Iberus

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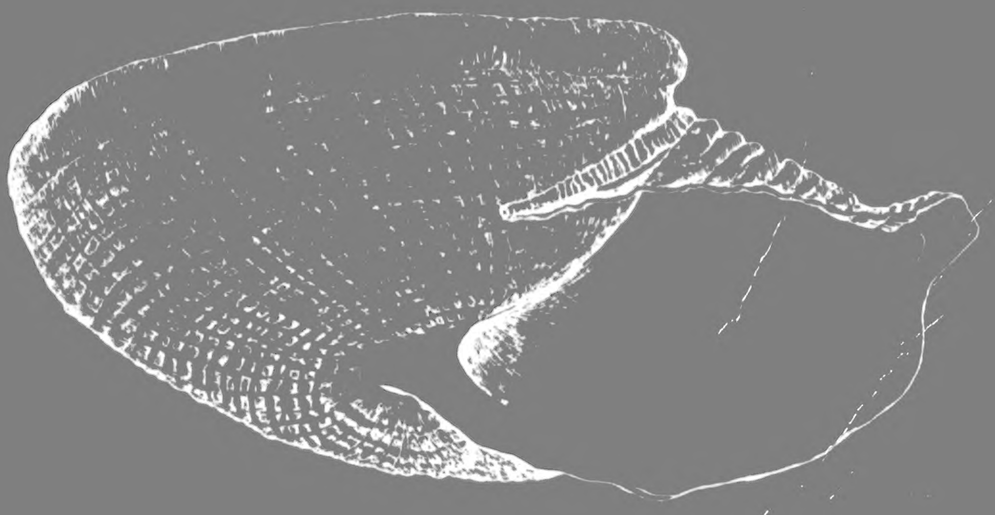

Oviedo, junio 2000

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Revista de la

SOCIEDAD ESPAÑOLA DE MALACOLOGÍA

PORTADA DE *Iberus*

Iberus gualterianus (Linnaeus, 1758), una especie emblemática de la península Ibérica, que da nombre a la revista. Dibujo realizado por José Luis González Rebollar "Toza".

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Contribución al conocimiento de los Moluscos Opistobranquios de la costa de Granada (sureste de la Península Ibérica)

Contribution to the knowledge of the Opisthobranch Molluscs from the coast of Granada (southeastern Spain)

Luis SÁNCHEZ-TOCINO*, Amelia OCAÑA*, Francisco J. GARCÍA**

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RESUMEN

En un estudio realizado en el litoral granadino durante los años 1994-1999 se identificaron 84 especies de opistobranquios, siendo la distribución de especies por órdenes la siguiente: *Cephalaspidea*, 4; *Thecosomata*, 1; *Anaspidea*, 3; *Sacoglossa*, 5; *Notaspidea*, 6 y *Nudibranchia*, 65. En el presente artículo se aportan datos sobre abundancia de las especies, rangos de variación en la profundidad, distribución temporal y características del substrato donde fueron observadas cada una de ellas. Del total de especies encontradas, 55 son nuevas citas para la costa granadina. *Polycera faeroensis* y *Pruvotfolia pselliotes* son nuevas citas para el Mar Mediterráneo, *Geitodoris planata* para el Mediterráneo ibérico y *Hermaea paucicirra* lo es para el litoral Mediterráneo andaluz. La especie *Tambja marbellensis* es citada por primera vez desde su descripción.

ABSTRACT

In a study conducted on the coast of Granada (S. Spain) from 1994 to 1999, 84 opisthobranchs species were identified. The distribution of the species by orders was: *Cephalaspidea*, 4; *Thecosomata*, 1; *Anaspidea*, 3; *Sacoglossa*, 5; *Notaspidea*, 6 and *Nudibranchia*, 65. Data are presented for species abundance, depth-variation ranges, temporal distribution, and characteristics of the substrate were each species was found. Of the species found, 55 are new citations for the Granada coast. *Polycera faeroensis* and *Pruvotfolia pselliotes* are new citations for the Mediterranean Sea, *Geitodoris planata* for the Iberian Mediterranean and *Hermaea paucicirra* for Andalusian Mediterranean. The species *Tambja marbellensis* is collected for the first time since its description.

PALABRAS CLAVE: Mollusca, Opisthobranchia, Mediterráneo, Costa de Granada.
KEY WORDS: Mollusca, Opisthobranchia, Mediterranean, Coast of Granada

INTRODUCCIÓN

Pocos son los estudios malacológicos realizados hasta la fecha en la costa de Granada. LUQUE (1983, 1986) estudió los gasterópodos de las costas de Málaga y

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Tabla I. Coordenadas geográficas (GTM), de las distintas estaciones de muestreo.
Table I. Geographical coordinates (GTM) for the different sampling stations.

Estaciones de muestreo	Coordenadas GTM
1. La Rábita	36° 45,4' N; 03° 10,5' O
2.Peñón de San Patricio	36° 45,5' N; 03° 15,1' O
3. Castell de Ferro	36° 44,2' N; 03° 20,5' O
4. La Rijana	36° 42,5' N; 03° 23,5' O
5. Calahonda	36° 41,5' N; 03° 25,1' O
6. Peñón de Salobreña	36° 44,1' N; 03° 35,6' O
7. Barranco del Cambrón	36° 44,5' N; 03° 37,4' O
8. Bahía de Velilla	36° 44,8' N; 03° 39,1' O - 36° 44,5' N; 03° 39,9' O
9. Peñones de Almuñecar	36° 43,6' N; 03° 41.5' O
10. Punta de San José	36° 43,9' N; 03° 42,6' O
11. Punta de la Mona	36° 43,5' N; 03° 43,7' O - 36° 43,6' N; 03° 44,4' O
12. Cerro Gordo	36° 44,3' N; 03° 45,7' O- 36° 44,7' N; 03° 46, 6' O

Granada, centrándose principalmente en la primera de las dos provincias, ya que sólo una de las 15 estaciones de muestreo establecidas, la de La Herradura, pertenece al litoral granadino. Del mismo modo, TEMPLADO, LUQUE Y MORENO (1988) eligieron La Herradura como única estación de muestreo en la costa de Granada. Posteriormente, como consecuencia de la la campaña oceanográfica "Fauna I", TEMPLADO, GUERRA, BEDOYA, MORENO, REMÓN, MALDONADO Y RAMOS (1993) encontraron varias especies de opistobranquios en el circalitoral frente a las costas granadinas. MORENO Y TEMPLADO (1998) completan los estudios anteriores en las provincias de Almería y Granada, seleccionando, en esta última, sólo 4 puntos, de los 23 muestreados.

Con el presente estudio se pretende ampliar el inventario de la fauna de opistobranquios del litoral de la provincia de Granada. Además, se aportan datos sobre el número de ejemplares, periodo de avistamiento a lo largo de los años de muestreo, profundidad y tipo de substrato donde se encontraron cada una de las especies, así como las citas de otros autores que han encontrado las especies relacionadas en el presente trabajo, en las distintas provincias del litoral andaluz.

MATERIAL Y MÉTODOS

Se han seleccionado en total trece estaciones de muestreo, doce en el litoral granadino y una treceava que corresponde a las muestras recolectadas en barcos de arrastre. La selección de dichas estaciones queda justificada por la variabilidad de substratos y por tanto de hábitats diferentes que se encuentran en ellas, ya que es frecuente la combinación, en varias de las mismas, de fondos de cascajo, arena, fango, praderas de fanerógamas o rocosos que en algunas ocasiones, como es el caso de la Punta de la Mona, alcanzan grandes profundidades.

El área de estudio comprende una linea litoral de unos 60 Km, desde el límite con la provincia de Málaga por el Oeste, hasta La Rábita por el Este. El nombre de cada una de las doce estaciones de muestreo aparecen en la Tabla I acompañadas de las correspondientes coordenadas geográficas, G. T. M. Las estaciones 1, 2, 3, 4, 5, 6, 7, 9 y 10 son puntuales, mientras que las 8, 11 y 12 quedan definidas por la línea de costa comprendida entre las dos coordenadas geográficas que se citan en la Tabla I. De la estacion 13 se recogen muestras mediante barcos de arrastre que faenan frente a la costa de Motril a profundida-

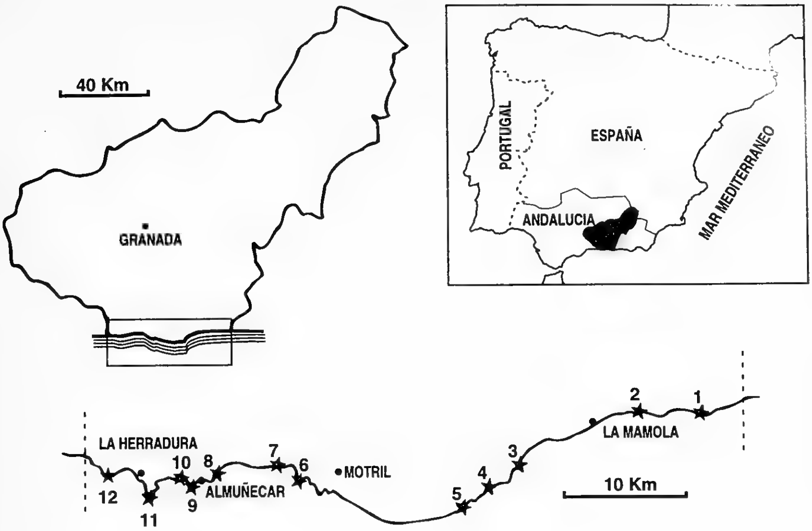


Figura 1. Mapa ilustrando las situación geográfica de las diferentes zonas de muestreo.
Figure 1. Illustrated map showing the geographic situation of the different sampling localities.

des comprendidas entre 50 y 150 m. En la Figura 1 se muestra la ubicación de las distintas estaciones de muestreo.

Se realizaron una serie de muestreos preliminares desde Enero de 1994 hasta Diciembre de 1995, que han servido para seleccionar aquellas estaciones con una mayor diversidad de opistobránquios, que correspondieron con la 8, 11 y 12, y en las que se centraron los muestreos durante los años 1996, 1997, 1998 y hasta Marzo de 1999.

El material examinado, a excepción del recogido mediante arrastres, fué obtenido en inmersiones con escafandra autónoma, entre la zona mediolitoral y 40 m. de profundidad.

Para la recogida de datos se realizaron en cada estación de muestreo transectos de longitud variable. En la estación 8, se utilizó también un segundo método que consistió en colgar de una boya, a 3 m de profundidad, una tela mosquitera enrollada de 1,5 m de longitud. El crecimiento de algas e hidroideos fue bastante rápido, por lo que al cabo de unos dos meses se pudieron recolectar opistobranquios.

Los opistobranquios que ofrecían alguna duda para su identificación fueron colectados, fotografiados y grabados en vídeo. Posteriormente los ejemplares capturados se anestesiaron mediante congelación en agua de mar o añadiendo lentamente alcohol. Se fijaron con formol al 4% y se conservaron en alcohol al 70%.

RESULTADOS

En la Tabla II se aportan, para cada una de las especies identificadas, los siguientes datos: número que define la zona de muestreo, mes/es de observación, año/s, abundancia, longitud (en milímetros), tipo de substrato y profundidad (en metros). La abundancia es referida con el siguiente criterio: E, especie escasa de la que sólo se han observado, en todo el periodo de estudio, entre 1 y 10 ejemplares; PA, especie poco abundante de la que se han observado entre 10 y 50 individuos; A, especie abundante de la que se han observado entre 50 y 100 ejemplares;

Tabla II. Especies observadas en la provincia de Granada acompañadas del número que define la estación de muestreo donde aparecen cada una de ellas, mes/es de avistamiento, año/s, abundancia relativa (E: entre 1 y 10 ejemplares; PA: entre 10 y 50 ejemplares; A: entre 50 y 100 individuos; MA: más de 100 individuos observados en toda la campaña de muestreo), longitud (mm), tipo de sustrato (A: algas; B: fondos blandos; BP: bajo piedra; BR: briozoos; C: cuevas, CA: cascajo; E: esponjas; G: gorgonáceos; H: hidroideos; R: rocoso; S: flotando en superficie) y profundidad (m).
Table II. Species observed in the province of Granada, accompanied by the number that identifies the sampling station where each specimen was observed, together with month/s, year/s, relative abundance (E: between 1 and 10 specimens; PA: between 10 and 50 specimens; A: between 50 and 100 specimens; MA: more than 100 specimens observed over the entire sampling campaign), length (mm), type of substrate (A: algas; soft sediments; BP: low rock; BR: briozoa; C: caves; CA: gravel; E: sponges; G: gorgonacea; H: hydroids; R: rock; S: floating on surface) and depth (m).

	Estación	Mes	Año	Abun.	Long.	Subs.	Prof.
Orden CEPHALASPIDEA P. Fischer, 1883							
Familia Bullidae Lamarck, 1801.							
Bulla striata Bruguiére, 1792	8	10	95	E	15	B	5
Familia Aglajidae Pilsbry, 1895							
Aglaja tricolorata Renier, 1804	6	7, 8	97	E	10-12	B	5-8
Philinopsis depicta (Renier, 1807)	8	8	95	E	25	B	5
Familia Cylichnidae Adams H.&A., 1854							
Scaphander lignarius (Linnaeus, 1758)	13	6	97	E	40	B	50-150
Orden THECOSOMATA Blainville, 1824							
Familia Cymbuliidae Gray, 1840							
Cymbulia peronii Lamarck, 1819	8	4, 9	94	E	30	S	0
Orden ANASPIDEA P. Fischer, 1883							
Aplysia fasciata Poiret, 1789	8, 11, 12	7, 10, 12	94, 96	MA	200- 300	B, R	5-12
Aplysia parvula Guilding in Mörch, 1863	8, 11	4, 8	95, 97	E	10-15	A, BP	3-5
Aplysia punctata (Cuvier, 1803)	8, 11	9-10	94, 96	E	60-80	B, BP	3-5
Orden NOTASPIDEA P. Fischer, 1883							
Familia Umbraculidae Dall, 1889							
Umbraculum umbraculum (Lighfoot, 1786)	12	1	97, 98	E	120-150	C, R	5-9
Familia Pleurobranchidae Férussac, 1822							
Pleurobranchus testudinarius Cantraine, 1835	11	4, 10, 11	97	E	130-150	CA	5-20
Berthella ocellata (Delle-Chiaje, 1828)	12	2, 7	96	E	30-35	C	10-13
Berthella plumula (Montagu, 1803)	5, 11, 12	1, 3, 5, 9-11	94, 95,97- 99	E	15-25	BP	5-12
Berthella stellata (Risso, 1826)	3, 5, 12	1, 11	96, 99	E	15	BP	3-7
Pleurobranchaea meckelii Blainville, 1825	8, 11, 12	2-5, 8, 10	95, 96	MA	10-100	B, BP	3-9
Orden SACOGLOSSA Von Ihering, 1876							
Familia Placobranchidae Rang, 1829							
Thuridilla hopei (Vérany, 1853)	5, 11, 12	1, 3, 5-11	95-99	PA	10-20	A, R	5-15
Elysia viridis (Montagu, 1804)	12	11, 12	98	PA	2-3	A	3-5
Familia Hermaeidae H. Adams y A. Adams, 1854							
Hermaea paucicirra Pruvot-Fol, 1953	1	1	99	E	1-2	A	5
Familia Polybranchiidae O´Donoghue, 1929							
Caliphylla mediterranea A. Costa, 1867	5	1	99	E	5-7	A	3
Familia Limapontiidae Gray, 1847							
Placida verticillata Ortea, 1981	11, 12	2, 7, 11	98, 99	A	1-3	A	5-10
Orden NUDIBRANCHIA Blainville, 1814							
Suborden DORIDACEA Odhner, 1934							
Familia Aegiretidae P. Fischer, 1883							
Aegires leuckarti Vérany, 1853	11	1	99	E	3	R	10
Familia Goniodorididae Adams H.y A., 1854							
Trapania hispalensis Cervera y García-Gómez, 1989	2, 4, 11, 12	1-7, 9-11	95-99	PA	8-15	E	7-15
Trapania lineata Haefelfinger, 1960	1, 12	1, 6-8, 10, 11	97, 98	E	8-15	BP, E	6-8
Trapania maculata Haefelfinger, 1960	11, 12	1, 3, 5-7, 9-12	95-98	PA	8-20	E, R	6-15

Tabla II. Continuación.
Table II. Continuation

	Estación	Mes	Año	Abun.	Long.	Subs.	Prof.
Familia Onchidorididae Alder y Hancock, 1845							
Diaphorodoris luteocincta (Sars M., 1870)	11, 12	1, 2, 4, 8	96, 97-99	PA	10-20	R	10-15
Diaphorodoris papillata Portmann y Sandmeier, 1960	11, 12	1-5, 8, 9-11	96-99	PA	5-10	BP, E, R	3-15
Familia Triophidae Odhner in Franc, 1968							
Crimora papillata Alder y Hancock, 1862	5, 11, 12	1, 3, 4	97-99	E	10-15	BP, R	6-20
Familia Aldisidae Odhner, 1933							
Aldisa banyulensis Pruvot-Fol, 1951	8, 11, 12	8, 10	96, 97, 98	E	15-20	BP, R	5-9
Familia Chromodorididae Bergh,1891							
Chromodoris britoi Ortea y Perez, 1983	2, 11, 12	1, 2, 7, 8,11, 12	96, 98, 99	PA	5-15	BP, R	8-10
Chromodoris krohni (Vérany, 1846)	10, 11, 12	1-12	95-99	A	3-30	BP, R	5-20
Chromodoris luteorosea (Rapp, 1827)	11, 12	2, 4, 9,11, 12	96-98	E	10-25	R	7-20
Chromodoris purpurea (Risso in Guérin, 1831)	11, 12	1-3, 5-7, 9-12	95-99	A	3-30	BP, R	5-20
Cadlina pellucida (Risso, 1826)	11, 12	6, 11, 12	95-98	E	8-12	BP	3-6
Hypselodoris bilineata (Pruvot-fol, 1953)	11, 12	1-5, 7, 8, 10, 12	95-99	A	9-30	BP, E, R	6-15
Hypselodoris cantabrica Bouchet y Ortea, 1980	11	3	98	E	15-30	R	5-9
Hypselodoris fontandraui (Pruvot-Fol, 1951)	11, 12	1, 3-6,11,12	96-99	A	10-35	R	6-25
Hypselodoris picta (Schultz in Philippi, 1836)	1,4,5,7,8,9, 11, 12	1-12	95-99	MA	30-150	R, E	6-28
Hypselodoris midatlantica Gosliner, 1990	4, 11, 12	1-8,10, 11	95-99	MA	8-30	BP, E, R	5-20
Hypselodoris villafranca (Risso, 1818)	4, 5, 7, 11, 12	1-5, 8, 10-12	95- 99	PA	6-20	BP, E, R	5-12
Familia Discodorididae Bergh, 1891							
Discodoris atromaculata (Bergh, 1880)	4, 11, 12	1, 3- 8, 11	94, 96- 99	PA	30-80	BP, C, E, R	7-28
Discodoris fragilis (Alder y Hancock, 1864)	12	8	97	E	50	BP	10
Discodoris rosi Ortea, 1979	11, 12	3, 10	96, 97	E	15-25	BP, E	7-10
Geitodoris portmanni (Schmekel, 1972)	9, 11	8, 9	96, 97	E	5-10	BP	5-9
Geitodoris planata (Alder y Hancock, 1846b)	12	11	97	E	25	BP, E	7
Familia Kentrodorididae Bergh, 1892							
Jorunna onubensis Cervera, García-Gómez y García, 1986	12	12	96	E	30	R	6
Familia Platydorididae Bergh, 1891							
Platydoris argo (Linneo, 1767)	11, 12	1-8,10 , 11	95-99	PA	30-90	BP, E, R	5-20
Familia Rostangidae Pruvot-Fol, 1951							
Rostanga rubra (Risso, 1818)	11	11	97	E	25	E	7
Familia Polyceridae Alder y Hancock, 1845							
Polycera aurantiomarginata García-Gómez y Bobo, 1984	12	1-3, 11, 12	96-99	MA	2-5	BP	3-7
Polycera faeroensis Lemche, 1929	11	5, 8	95, 97	E	10-25	R	25-30
Polycera quadrilineata (O.F. Müller, 1776)	8, 11, 12	1, 3, 6, 7, 12	96-98	PA	10-20	R, H	1-10
Limacia clavigera (O.F. Müller, 1776)	10, 11, 12	1-4, 10-12	96, 99	PA	3-20	BP, E, R	4-10
Roboastra europea García-Gómez, 1985	11	1, 7	95, 97	E	30-50	R	5-36
Tambja ceutae García-Gómez y Ortea, 1988	12	10, 11	96	E	5-20	BP, BR, R	7-8
Tambja marbellensis Schick y Cervera, 1998	12	1-4	98	PA	3-10	BP, BR	5-7
Familia Dendrodorididae O'Donoghue, 1924							
Dendrodoris limbata (Cuvier, 1804)	11, 12	3-5, 7-11	95-97	PA	10-65	BP,CA, R	6-15
Doriopsilla areolata Bergh, 1880	2, 8, 11, 12	2-6, 8, 10, 12	94, 95, 97-99	PA	10-30	BP, E, R	3-25
Suborden DENDRONOTACEA Odhner, 1934							
Familia Dotoidae Gray, 1853							
Doto koenneckeri Lemche, 1976	2, 11, 12	1, 2, 10	99	PA	5-8	H	7-15
Familia Hancockiidae Pruvot-Fol, 1954							
Hancockia uncinata (Hesse, 1872)	8	8, 10	96, 97	PA	8-10	H	1-3
Familia Tethyidae Alder y Hancock, 1855							
Tethys fimbria Linné, 1767	13	5, 6	96, 97	E	130, 150	B	50-150
Familia Tritoniidae Lamarck, 1809							
Tritonia manicata Deshayes, 1853	11	3, 5	97, 98	E	10	H	6-14
Tritonia nilsodhneri Marcus Ev., 1983	10, 11, 12	2, 3, 5, 7	95, 97-99	E	10-15	G	5-8
Tritonia striata Haefelfinger, 1963	11	1, 3, 6-8, 10	96-99	PA	8-10	BP	5-6

Tabla II. Continuación.
Table II. Continuation

	Estación	Mes	Año	Abun.	Long.	Subs.	Prof.
Mariona blainvillea (Risso, 1818)	10, 11, 12	1-3, 5, 10,11	95-99	PA	10-40	BP, G, R	5-10
Suborden ARMINACEA Odhner, 1934							
Familia Arminidae Pruvot-Fol, 1927							
Armina maculata Rafinesque, 1814	13	5, 6	96, 97	PA	70-90	B	50-150
Familia Zephyrinidae Iredale y O´Donoghue, 1923							
Janolus cristatus (Delle Chiaje, 1841)	1, 3, 4, 11, 12	1, 4, 7, 12	95, 97-99	E	20-55	R	6-7
Suborden AEOLIDACEA Odhner, 1934							
Familia Aeolidiidae d'Orbigny, 1834							
Aeolidiella soemmeringi (Leuckart, 1828)	4, 11	2, 4, 9-12	94-96, 99	E	15-20	BP	4-12
Berghia coerulescens Laurillard, 1830	11	2-8, 10, 11	95, 97-99	PA	20-30	BP	5-15
Berghia verrucicornis (A. Costa, 1867)	8	9, 10	95, 97	E	20-25	H	1-3
Spurilla neapolitana (Delle-Chiaje, 1841)	3, 8, 11	1, 2, 6-11	97-98	PA	3-25	H, BP	1-5
Familia Eubranchidae Odhner, 1934							
Eubranchus farrani (Alder y Hancock, 1844)	6, 8, 11, 12	1, 2 , 5, 9,10,12	96-99	PA	8-10	A, H, BP	1-3
Familia Facelinidae Bergh in Carus, 1889							
Facelina annulicornis(Chamisso y Heysenhardt,1821)	8, 11	1-3, 6, 9,10, 12	96-98	A	10-20	H, BP	1-6
Facelina coronata (Forbes y Goodsir, 1839)	8, 11	1-4, 6-8, 10, 12	96-98	A	10-25	H, CA	1-9
Facelina rubrovitatta (A. Costa, 1866)	11	4, 9, 10	97, 98	PA	10-15	H	7-10
Caloria elegans (Alder y Hancock, 1845)	4, 5, 11, 12	1 -12	95-99	A	5-15	BP, H, R	5-15
Cratena peregrina (Gmelin, 1791)	4, 11, 12	1-11	95-99	MA	10-30	H	7-20
Pruvotfolia pselliotes (Labbé, 1923)	2	2	99	E	15	BP	4
Dicata odhneri Schmekel, 1967	11	4	98	E	3	CA, H	9
Dondice banyulensis Portmann y Sandmeier,1960	4, 11, 12	2-5, 7, 9-11	95-99	PA	15-35	R, H	15-20
Familia Flabellinidae Bergh, 1889							
Flabellina affinis (Gmelin, 1791)	4,5,7, 8, 9,10,11, 12	1-12	95-99	MA	5-30	H, R	2-25
Flabellina ischitana Hirano y Thompson, 1990	11, 12	1, 2, 5, 8, 12	94-99	A	10-20	H, R	5-25
Flabellina babai Schmekel, 1972	11	3, 4, 8, 10	94, 97, 98	PA	10-60	CA, R	9-16
Flabellina pedata (Montagu, 1815)	2, 4, 11, 12	1, 2, 4-11	95-99	MA	5-25	H	6-15
Calmella cavolini (Vérany, 1846)	11, 12	1, 2, 9-11	98, 99	PA	8-15	H	7-10
Familia Piseinotecidae Edmunds, 1970							
Piseinotecus gabinieri (Vicente, 1975)	11, 12	2-10	95-99	A	15-30	H, R	9-15
Familia Tergipedidae Bergh, 1889							
Cuthona genovae (O´Donoghue, 1929)	8	5	98	E	6	H	1

MA, especie muy abundante de la que se han observado más de 100 individuos durante todo el estudio. Los tipos de substratos vienen indicados con las abreviaturas: A (algas), B (fondos blandos), BP (bajo piedra), BR (briozoos), C (cuevas), CA (cascajo), E (esponjas), G (gorgonáceos), H (hidroideos), R (rocoso, cubierto fundamentalmente de algas fotófilas e hidroideos) y S (especie encontrada flotando en superficie).

En el litoral granadino se han identificado 84 especies de opistobranquios distribuidas, en órdenes y subórdenes, de la siguiente manera: *Cephalaspidea*, 4; *Thecosomata*, 1; *Anaspidea*, 3; *Notaspidea*, 6; *Sacoglossa*, 5 y *Nudibranchia*, 65, repartidos en *Doridacea*, 36; *Dendronotacea*, 7; *Arminacea*, 2 y *Aeolidacea*, 20.

Como se desprende de la Tabla II, existen una serie de especies que han aparecido en tres o más estaciones de muestreo, prácticamente a lo largo de todo el año y a lo largo de toda la campaña de muestreo, aunque en ocasiones de forma escasa o poco frecuente. Éstas son: *Berthella plumula, Chromodoris britoi, C. krohni, Hypselodoris picta, H. villafranca, Doriopsilla areolata, Mariona* *blainvillea, Eubranchus farrani, Caloria elegans, Dondice banyulensis, Flabellina affinis y F. pedata.* Dichas especies las podemos considerar como las más constantes del litoral granadino.

Por el contrario otras especies destacan por haber aparecido en una sola estación de muestreo y únicamente en una o dos ocasiones, siendo éste el caso de: *Umbraculum umbraculum, Berthella ocellata, Elysia viridis, Hermaea pucicirra, Caliphylla mediterranea, Aegires leuckarti, Hypselodoris cantabrica, Discodoris fragilis, Geitodoris planata, Jorunna onubenis, Rostanga rubra, Polycera faeroensis, Roboastra europea, Tambja ceutae, Hancockia uncinata, Tritonia manicata, Berghia verrucicornis, Pruvotfolia pselliotes, Dicata odhneri y Cuthona genovae.* Dichas especies pueden considerarse raras o de presencia accidental en nuestras costas. No hemos tenido en cuenta, en este caso, los Cefalaspideos pues de las cuatro estaciones en las que se intensificaron los muestreos una sóla correspondía a fondos blandos, por lo que el número de inmersiones ha sido menor en este tipo de fondos, que es donde preferentemente se encuentran las especies de dicho grupo. Tampoco hemos tenido en cuenta las especies procedentes de arrastreros.

Es igualmente destacable que las tres especies de *Trapania: T. hispalensis, T. lineata y T. maculata* se han encontrado durante los mismos meses del año, en las mismas estaciones de muestreo y sobre el mismo tipo de substrato. Este hecho justificaría un estudio taxonómico y ecológico de las especies del género en el Mediterráneo.

La mayor abundancia de opistobranquios se ha observado en la zona comprendida entre 5 y 15 m de profundidad, durante los meses de octubre, noviembre, enero, febrero y marzo, que corresponden con otoño e invierno.

En la estación de muestreo 11 es donde aparecen un mayor número de especies, dado que en ella se alcanza una mayor profundidad, por lo que la variedad de substratos y por tanto de habitats diferentes es mayor. Sin embargo las especies *Tambja ceutae, T. marbellensis y Polycera aurantiomarginata,* se recolectaron exclusivamente como juveniles en la cercana estación 12 y debajo de piedras, sobre el briozoo *Sessibugula barrosoi,* del que hemos comprobado se alimentan, al menos durante la etapa juvenil. Sólo el ejemplar de *T. ceutae* de mayor tamaño, unos 20 mm de longitud, fué encontrado directamente sobre una pared a plomo, en un substrato diferente, suponiendo que en una fase juvenil más avanzada dicha especie cambia de habitos alimenticios. En general la mayor parte de las especies fueron observadas sobre epibiontes de substratos rocosos y como infralapidícolas.

Respecto a la distribución de las especies que se han encontrado en la costa granadina y en base a la Tabla III, de las especies citadas, 53 son nuevas citas para las costas de Granada. *Polycera faeroensis* y *Pruvotfolia pselliotes* son primeras citas para el Mediterráneo. *Geitodoris planata* es nueva cita para el Mediterráneo ibérico y *Hermaea paucicirra* lo es para el Mediterráneo andaluz.

Polycera faeroensis ha sido citada antes de ahora en el litoral gallego por ORTEA Y URGORRI (1981) y URGORRI Y BESTEIRO (1983) y en el Estrecho de Gibraltar por GARCÍA- GÓMEZ (1983; 1984).

Por su parte *Pruvotfolia pselliotes* ha sido citada con anterioridad en el litoral atlántico de la Península Ibérica desde Galicia hasta el Estrecho de Gibraltar y en las Islas Canarias (CERVERA, TEMPLADO, GARCÍA-GÓMEZ, BALLESTEROS, ORTEA, GARCÍA, ROS Y LUQUE, 1988).

Debido a la confusión que ha habido entre las especies *Geitodoris planata y Discodoris stellifera* (CERVERA, GARCÍA-GÓMEZ Y GARCÍA., 1985; CERVERA *ET AL.*, 1988) resulta dificil establecer las áreas de distribución de ambas, siendo necesario, como señalan estos últimos la revisión de las diferentes citas de las dos especies. Aunque *G. planata* no ha sido citada en las costas mediterráneas ibéricas, desde hace una década, es relativamente frecuente en diferentes localidades de la costa catalana (Ballesteros, com. pers.). Los ejemplares observados en las costas catalanas junto con los observados en la

Tabla III. Artículos donde se citan, en cada una de las provincias andaluzas, la presencia de las diferentes especies observadas en la costa de Granada. Simbolos empleados: * especie citada por primera vez en la provincia de Granada; - especie citada por primera vez en el litoral mediterráneo andaluz; = especie citada por primera vez en el litoral mediterráneo ibérico, + especie citada por primera vez en el Mediterráneo. Abreviaturas y números: C: Cervera; HU: Huelva; CA: Cádiz; MA: Málaga; GR: Granada; AL: Almería; 1: Aartsen, Menkhorst y Gittenberger (1984); 2: Ballesteros (1980); 3: Ballesteros, Barrajón, Luque, Moreno, Talavera y Templado (1986); 4: Ballesteros y Templado (1987); 5: Bobo (1998); 6: Cervera (1988); 7: Cervera y García-Gómez (1986); 8: Cervera y García-Gómez (1988); 9: Cervera, García-Gómez y García (1985); 10: García-Gómez y Cervera (1985); 11: Cervera, García-Gómez y García (1986); 12: Cervera, García-Gómez y Ortea (1988); 13: Cervera, López González y García-Gómez (1998); 14: Cervera, Medina y García (1986); 15: Cervera *et al.* (1988); 16: García, García-Gómez y Cervera (1986); 17: García-Gómez (1982); 18: García-Gómez (1983); 19: García-Gómez (1984); 20: García-Gómez (1985); 21: García-Gómez (1986); 22: García-Gómez (1987); 23: García-Gómez y Bobo (1984); 24: García-Gómez y Ortea (1988); 25: García Raso, Luque, Templado, Salas, Hergueta, Moreno y Calvo (1992); 26: Hergueta (1985); 27: Hergueta y Salas (1987); 28: Hidalgo (1916); 29: Hidalgo (1917); 30: Luque (1983); 31: Luque (1986); 32: García-Gómez y García (1984); 33: Martínez *et al.* (1993); 34: Moreno y Templado (1998); 35: Nobre (1932); 40: Rampal (1968); 41: Ros (1975); 42: Salas y Hergueta (1986); 43: Salas y Luque (1986); 44: Schick y Cervera (1998); 45: Sierra, García y Lloris (1978); 46: Templado, Luque y Moreno (1988); 47: Templado *et al.* (1993); 49: Vayssiere (1913); 50: Vives, Santamaría y Trepart (1975).

*Table III. Articles citing, for each Andalusian province, the presence of the different species observed on the coast of the province of Granada. Symbols used: * species cited for the first time in the province of Granada; - species cited for the first time on the Mediterranean coast of Andalusia; = species cited for the first time on the Mediterranean coast of the Iberian Peninsula; + species cited for the first time in the Mediterranean sea. Abbreviations and numbers: C: Cervera; HU: Huelva; CA: Cádiz; MA: Málaga; GR: Granada; AL: Almería; 1: Aartsen, Menkhorst and Gittenberger (1984); 2: Ballesteros (1980); 3: Ballesteros, Barrajón, Luque, Moreno, Talavera y Templado (1986); 4: Ballesteros and Templado (1987); 5: Bobo (1998); 6: Cervera (1988); 7: Cervera and García-Gómez (1986); 8: Cervera and García-Gómez (1988); 9: Cervera, García-Gómez and García (1985); 10: García-Gómez and Cervera (1985); 11: Cervera, García-Gómez and García (1986); 12: Cervera, García-Gómez and Ortea (1988); 13: Cervera, López González and García-Gómez (1998); 14: Cervera, Medina and García (1986); 15: Cervera* et al. *(1988); 16: García, García-Gómez and Cervera (1986); 17: García-Gómez (1982); 18: García-Gómez (1983); 19: García-Gómez (1984); 20: García-Gómez (1985); 21: García-Gómez (1986); 22: García-Gómez (1987); 23: García-Gómez and Bobo (1984); 24: García-Gómez and Ortea (1988); 25: García Raso, Luque, Templado, Salas, Hergueta, Moreno y Calvo (1992); 26: Hergueta (1985); 27: Hergueta and Salas (1987); 28: Hidalgo (1916); 29: Hidalgo (1917); 30: Luque (1983); 31: Luque (1986); 32: García-Gómez and García (1984); 33: Martínez* et al. *(1993); 34: Moreno and Templado (1998); 35: Nobre (1932); 40: Rampal (1968); 41: Ros (1975); 42: Salas and Hergueta (1986); 43: Salas and Luque (1986); 44: Schick and Cervera (1998); 45: Sierra, García and Lloris (1978); 46: Templado, Luque and Moreno (1988); 47: Templado* et al. *(1993); 49: Vayssiere (1913); 50: Vives, Santamaría and Trepart (1975).*

ESPECIE	HU	CA	MA	GR	AL	1º Cita
Bulla striata	29,17	29,17,1	29,30,31		3,45	*
Aglaja tricolorata	33	33		34	34	
Philinopsis depicta		47			34	*
Scaphander lignarius	29	29,1,47	29			*
Cymbulia peronii			40,50		25	*
Aplysia fasciata	C(obs. pers.)	17	30,31		3,25	*
Aplysia parvula		47	4		25	*
Aplysia punctata	7	17,47	30,31,3,43		3,25	*
Umbraculum umbraculum	29	29	29,30,31		29	*

Tabla III. Continuación.
Table III. Continuation

ESPECIE	HU	CA	MA	GR	AL	1º Cita
Pleurobranchus testudinarius		47		34	34	
Berthella ocellata		22,47				*
Berthella plumula	14	7			3,25	*
Berthella stellata	14	7,11,22			3,25	
Pleurobranchaea meckelii	8,5	47	30,31,47	47,34	34	
Thuridilla hopei		17,19,7	30,31	30,31	3,25	
Elysia viridis	6	17,19	3		3	*
Hermaea paucicirra	7,12					—
Caliphylla mediterranea			30,31			*
Placida verticillata		19,22				*
Aegires leuckarti					3	
Trapania hispalensis		8			25	*
Trapania lineata					3,25	*
Trapania maculata	19	19,8			3,25	*
Diaphorodoris luteocincta		18,19	30,31	30,31	3,25	
Diaphorodoris papillata		18,19	30,31		46,25	*
Crimora papillata	5	18,19		46	25	
Aldisa banyulensis		17,19,16				*
Chromodoris britoi	5	22		31	3,25	
Chromodoris krohni		17,19,7	26,31,42	31	3,25	
Chromodoris luteorosea	5	18,19,7			25	*
Chromodoris purpurea	5	18,19,7	30,31	46	3,25	
Cadlina pellucida					34	*
Hypselodoris bilineata	5	18,19,7		30,31		
Hypselodoris cantabrica	5	18,19	30,31	30,31		
Hypselodoris fontandraui		18,19	30,31	30,31		
Hypselodoris picta	5	17,18,19	41,30,31	30,31	3	
Hypselodoris midatlantica		18,19		31	3	
Hypselodoris villafranca	5	19,7	30,31		25	*
Discodoris atromaculata		18,19		31	3	
Discodoris fragilis						*
Discodoris rosi		18,19	31			*
Geitodoris portmanni						*
Geitodoris planata	9					=
Jorunna onubensis	11,5	7		46		
Platydoris argo		41,18,19,47	30,31	30,31	3,25	
Rostanga rubra	6,5	17,19,21			46,25	*
Polycera aurantiomarginata	25,19,5	7			46	*
Polycera faeroensis	5	18,19				+
Polycera quadrilineata	17,19,5	19	30,31		46,25	*
Limacia clavigera		18,19				*
Roboastra europea		19,20		34		
Tambja ceutae		24			34	*
Tambja marbellensis		44				*
Dendrodoris limbata	17,19	17,19,7	30,31		3,25	*
Doriopsilla areolata	19,5	17,19,7,47	30,31,47,42	31	25	
Doto koenneckeri					46,25	*
Hancockia uncinata					34	*
Tethys fimbria		47	30,31,47	47		
Tritonia manicata		18,19,7	30,31	46	46	
Tritonia nilsodhneri		18,19				*
Tritonia striata					46	*
Marionia blainvillea	49,28,35	17,19	47	47	3	

Tabla III. Continuación.
Table III. Continuation

ESPECIE	HU	CA	MA	GR	AL	1ª Cita
Armina maculata		17	30,31			*
Janolus cristatus	19	18,19,7	30,31		46,25	*
Aeolidiella soemmeringi	19	17,19,7				*
Berghia coerulescens		18,19	26,42,27	34		
Berghia verrucicornis	19	18,19,7			3,25	*
Spurilla neapolitana	19,10,5	18,19,10,7	30,31		3,25	*
Eubranchus farrani		7		46	46,25	
Facelina annulicornis		18		46		
Facelina coronata		18,7		46	25	
Facelina rubrovitatta		7	30,31		3	*
Caloria elegans		18,19			3,25	*
Cratena peregrina	19	19,7			3,25	*
Pruvotfolia pselliotes		19,7,22				+
Dicata odhneri		19			34	*
Dondice banyulensis		17,32,47		30,31	46,25	
Flabellina affinis	19	17,18,19,21,7	30,31	30,31	3,25	
Flabellina ischitana	5	13			25	*
Flabellina babai		19,21	31		25	*
Flabellina pedata	19	17,19,7	30,31	46	3	
Calmella cavolini					3,25	*
Piseinotecus gabinieri				46		
Cuthona genovae		18,19,7			3,25	*

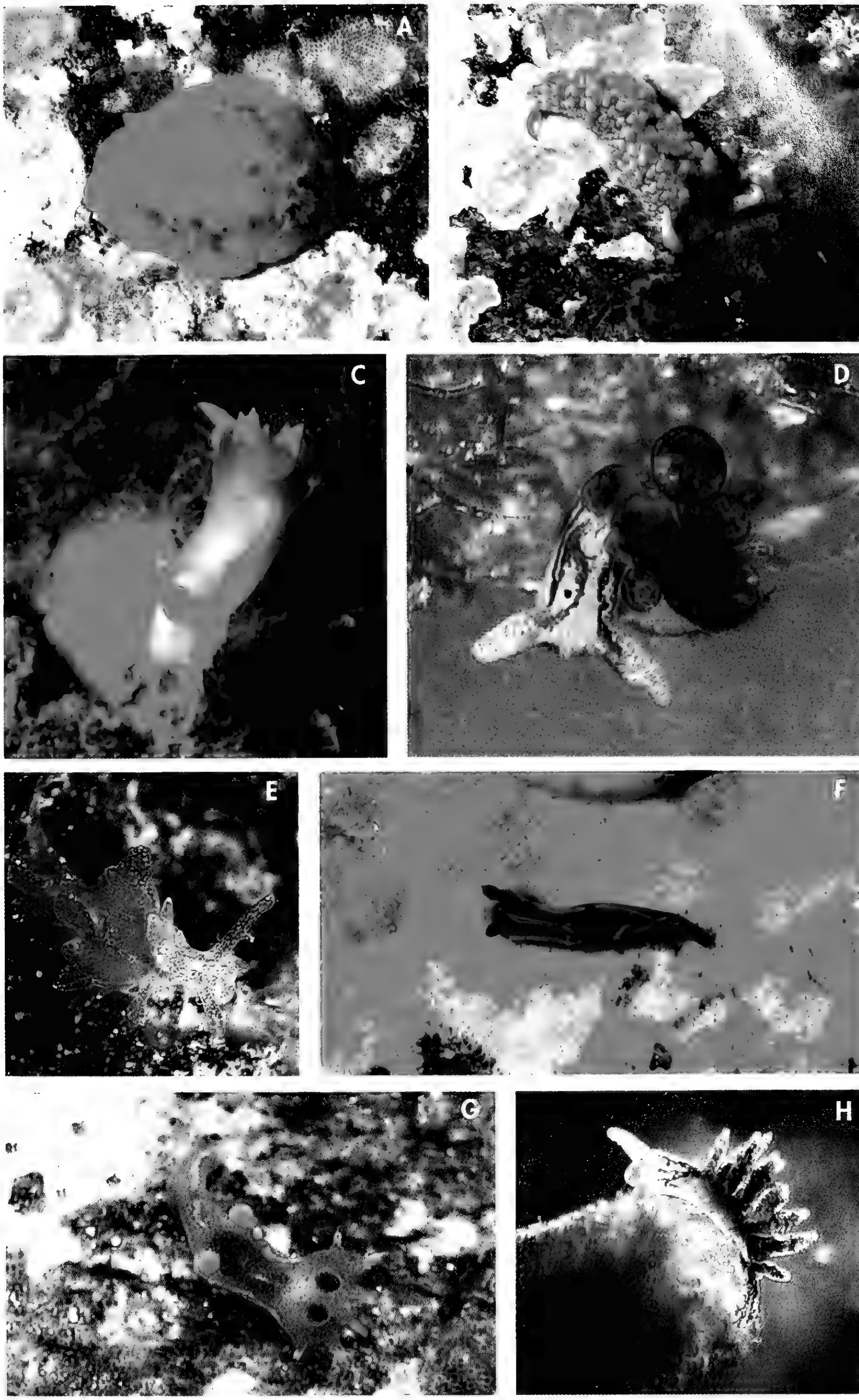
costa granadina constituyen la primera cita para el Mediterráneo.

Hermaea paucicirra ha sido encontrada con anterioridad en el litoral asturiano (Ortea, 1977a, b), en el litoral gallego (Urgorri y Besteiro, 1983), en las costas de Alicante y Murcia (Marín y Ros, 1988), en el litoral catalan (Ballesteros, 1980) así como, en las costas de Cádiz (Cervera y García-Gómez, 1986; Cervera, García-Gómez y Ortea, 1988). Por tanto el hallazgo de esta especie en la costa de Granada supone su primera cita para el litoral mediterráneo andaluz.

Resulta de interes el haber observado en una franja costera tan reducida los dos tipos de coloraciones que se dan en el Mediterráneo español, para *Hypselodoris villafranca*, según Ortea, Valdés y García-Gómez (1996): la que se da en las costas catalanas y la propia del sur de la Península, siendo más frecuente ésta última.

Por otro lado, el género *Tambja* es el que ha proporcionado los resultados taxonómicos más interesantes, al encontrarse en la costa granadina todas las especies del género citadas por ahora en las costas europeas. *Tambja marbellensis* se

(Página derecha) Figura 2. A: *Geitodoris planata*, ejemplar de 25 mm; B: *Pruvotfolia pselliotes*, ejemplar de 15 mm; C: *Polycera faeroensis*, ejemplar de 25 mm; D: *Hermaea paucicirra*, ejemplar de 2 mm; E: *Caliphylla mediterranea*, ejemplar de 5 mm; F: *Tambja marbellensis*, ejemplar de 12 mm; G: *Polycera aurantiomarginata*, ejemplar de 3 mm: H: *Placida verticillata*, ejemplar de 2 mm.
(Right page) Figure 2. A: Geitodoris planata, *specimen of 25 mm; B:* Pruvotfolia pselliotes, *specime of 15 mm; C:* Polycera faeroensis, *specimen of 25 mm; D:* Hermaea paucicirra, *specimen of 2 mm: E:* Caliphylla mediterranea, *specimen of 5 mm: F:* Tambja marbellensis, *specimen of 12 mm*; G*:* Polycera aurantiomarginata, *specimen of 3 mm; H:* Placida verticillata, *specimen of 2 mm.*


A
C
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F
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H

cita por primera vez tras su descripción original por SCHICK Y CERVERA (1998)

Respecto a las veces que han sido citadas las especies contempladas en el presente trabajo, en las distintas provincias del litoral andaluz (ver Tabla III) resulta resaltable, en primer lugar, que éstas no han sido homogéneas, lo que está motivado por la peculiaridad de la orografía del litoral de cada una de ellas y por la profusión de los muestreos, más intensa en unas que en otras. En cualquier caso es destacable que en las provincias andaluzas más estudiadas (Cádiz y Almería) determinadas especies son repetidamente citadas por más de un autor. Así, en la costa gaditana, *Bulla striata, Scaphander lignarius, Berthella stellata, Thuridilla hopei, Aldisa banyulensis, Chromodoris krohni, C. luteorosea, C. purpurea, Hypselodoris bilineata, H. picta, Platidoris argo, Rostanga rubra, Dendrodoris limbata, Doriopsilla areolata, Tritonia manicata, Janolus cristatus, Aeolidiella soemmeringi, Bergia verrucicornis, Spurilla neapolitana, Pruvotfolia pselliotes, Dondice banyulensis, Flabellina affinis, Flabellina pedata, y Cuthona genovae*, son las especies más frecuentes. De la misma forma, en la costa almeriense, *Aplysia fasciata, Aplysia punctata, Berthella plumula, B. stellata, Thuridilla hopei, Trapania lineata, T. maculata, Diaphorodoris luteocincta, D. papillata, Chromodoris britoi, C. krohni, C. purpurea, Platydoris argo, Rostanga rubra, Polycera quadrilineata, Dendrodoris limbata, Doto koenneckeri, Janolus cristatus, Berghia verrucicornis, Spurilla neapolitana, Eubranchus farrani, Caloria elegans, Cratena peregrina, Dondice banyulensis, Flabellina affinis, Calmella cavolini y Cuthona genovae*, presentan una mayor frecuencia. Teniendo en cuenta los datos de todas las provincias, las especies: *Bulla striata, Aglaja tricolorata, Aplysia fasciata, A. punctata, Umbraculum umbraculum, Pleurobranchaea meckelii, Elysia viridis, Chromodoris purpurea, Hypselodoris picta, H. villafranca, Polycera quadrilineata, Dendrodoris limbata, Doriopsilla areolata, Mariona blainvillea, Janolus cristatus, Spurilla neapolitana, Flabellina affinis y F. pedata* han sido citadas en todo el litoral andaluz.

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BIBLIOGRAFÍA

AARTSEN, J. J., MENKHORST, H. P. M. G. Y GITTENBERGER, E., 1984. The marine mollusca of the Bay of Algeciras, Spain, with general notes on *Mitrella*, Marginellidae and Turridae. *Basteria*, Suppl. 2: 1-135.

BALLESTEROS, M., 1980. La presencia en las costas catalanas de *Hermaea paucicirra* y *Hermaea cremoniana* (Opisthobranchia: Sacoglossa). *Publicaciones del Departamento de Zoología de Barcelona*, 5: 19-23.

BALLESTEROS, M., BARRAJÓN, A., LUQUE, A. A., MORENO, D., TALAVERA, P. Y TEMPLADO, J., 1986. Contribución al conocimiento de los gasterópodos marinos de Almería. *Iberus*, 6: 39-55.

BALLESTEROS, M. Y TEMPLADO, J., 1987. *Aplysia parvula* Guilding in Morch, 1863 en las costas de la Península Ibérica. *Publicaciones del Departamento de Zoología de Barcelona*, 13: 55-62.

BOBO, A., 1998. *Huelva desde el Oceano*. Ed. Rueda. Madrid. 160 pp.

CERVERA, J. L., 1988. *Notaspideos, Ascoglosos y Nudibranquios (Mollusca: Opistobranchia) de Andalucía occidental con algunas referencias al Estrecho de Gibraltar. Estudio faunístico y Sistemático*. Tesis doctoral. Universidad de Sevilla. 312 pp.

CERVERA, J. L. Y GARCÍA-GÓMEZ, J. C., 1986. Moluscos Opistobranquios del litoral occidental Andaluz: Nuevas aportaciones faunisticas. *Iberus*, 6 (2): 201-207.

CERVERA, J. L. Y GARCÍA-GÓMEZ, J. C., 1988. Dos nuevas especies de *Trapania* Pruvot-fol, 1931 (Gastropoda: Nudibranchia) del sur de España. *Bollettino Malacologico*, 24, (9-12): 189-204.

CERVERA, J. L., GARCÍA-GÓMEZ, J. C. Y GARCÍA, F. J., 1985. Redescription of *Geitodoris planata* (Alder and Hancock, 1846) (Gastropoda. Nudibranchia). *Journal of Molluscan Studies*, 51: 198- 204.

CERVERA, J. L., GARCÍA-GÓMEZ, J. C. Y GARCÍA, F. J., 1986. Il Genere *Jorunna* Bergh, 1876 (Mollusca: Gastropoda: Nudibranchia) nel litorale Iberico. Estratto da: *Atti del I Congresso Societa Italiana di Malacologia. Lavori della Società Italiana di Malacologia*, 22: 111-132.

CERVERA, J. L., GARCÍA-GÓMEZ, J. C. Y ORTEA, J., 1988. Una nueva especie del género *Hermaea* (Gastropoda: Opistobranchia: Sacoglossa) y redescripción de dos raros sacoglosos de la Malacofauna europea. *Iberus*, 8 (22): 215-224.

CERVERA, J. L., LÓPEZ GONZÁLEZ, P. J. Y GARCÍA-GÓMEZ, J. C., 1998. Redescription of the Aeolid Nudibranch *Flabellina ischitana* Hirano & Thompson, 1990 (Gastropoda: Opistobranchia). *The Veliger*, 41 (3): 289. 293.

CERVERA, J. L., MEDINA, A. Y GARCÍA, J. C., 1986. Comparative study of *Berthella stellata* and *B. plumula* (Gasteropoda: Notaspidea), with notes on the histology of the mantle. *Abstract IX International Malacology Congress*. Edinburgh (U. K.).

CERVERA, J. L., TEMPLADO, J., GARCÍA-GÓMEZ, J. C., BALLESTEROS, M., ORTEA, J. A., GARCÍA, F. J., ROS, J. Y LUQUE, A. A., 1988. Catálogo actualizado y comentado de los Opistobranquios (Mollusca, Gastropoda) de la Península Ibérica, Baleares y Canarias, con algunas referencias a Ceuta y la Isla de Alborán. *Iberus*, Supl. 1: 84 pp.

GARCÍA, F. J., GARCÍA-GÓMEZ, J. C. Y CERVERA, J. L., 1986. Ridescrizione di *Aldisa banyulensis* (Pruvot-Fol, 1951). *Lavori della Società Italiana di Malacologia*, 22: 97-110.

GARCÍA-GÓMEZ, J. C., 1982. Contribución al conocimiento de los Opistobranquios del litoral andaluz. *Actas II Simposio Ibeico de Estudios del Bentos Marino*, III: 235-241.

GARCÍA-GÓMEZ, J. C., 1983. Moluscos Opistobranquios del Estrecho de Gibraltar y Bahía de Algeciras. *Iberus*, 3: 41-46.

GARCÍA-GÓMEZ, J. C., 1984. *Bulomorfos, Ascoglosos y Nudibranquios (Mollusca: Opisthobranchia) del Estrecho de Gibraltar, con algunas referencias al litoral onubense.* Tesis Doctoral Universidad de Sevilla. 343 pp.

GARCÍA-GÓMEZ, J. C., 1985. A new species of *Roboastra* (Gastropoda: Nudibranchia), from The Gibraltar Strait (Southern Spain). *Journal of Molluscan Studies*, 51: 169-176.

GARCÍA-GÓMEZ, J. C., 1986. El género *Flabellina* (Voight, 1834), Gastropoda: Nudibranchia, en el litoral Ibérico. *Bollettino Malacologico*, 22 (1-4): 37-48.

GARCÍA-GÓMEZ, J. C., 1987. Adiciones a la fauna de Opistobranquios del Estrecho de Gibraltar (Sur de España). I. *Iberus*, 7 (2): 197-209.

GARCÍA-GÓMEZ, J. C. Y BOBO, A., 1984. Una nueva especie de *Polycera* Cuvier (Mollusca: Nudibranchia) del litoral ibérico. *Extrait des Cahiers de Biologie Marine*, 25: 361-373.

GARCÍA-GÓMEZ, J. C. Y CERVERA, J. L., 1985. Revisión de Spurilla neapolitana Delle Chiaje, 1823 (Mollusca: Nudibranchiata). *Journal of Molluscan Studies*, 51: 138-156.

GARCÍA-GÓMEZ, J. C. Y GARCÍA, F. J., 1984. Estudio anatómico y algunas reseñas ecológicas de Godiva banyulensis (Portmann y Sandmeier) (Gastropoda: Nudibranchia). *Cahiers de Biologie Marine*, 25: 49-65.

GARCÍA-GÓMEZ, J. C. Y ORTEA, J., 1988. Una nueva especie de *Tambja* Burn, 1962 (Mollusca: Nudibranchia). *Bulletin du Muséum National d'Historie Naturelle*, Paris, 4 (10); sect. A, nº 2: 301-307.

GARCÍA RASO, J. E., LUQUE, A. A., TEMPLADO, J., SALAS, C., HERGUETA, E., MORENO, D. Y CALVO, M., 1992. *Fauna y flora marinas del Parque Natural de Cabo de Gata-Nijar*. Madrid, 288 pp.

HERGUETA, E., 1985. *Malacofauna asociada a* Mesophyllum lichenoides *(Ellis) Lemoine (Corallinaceae, Rodophyta).* Tesis de Licenciatura. Universidad de Málaga.

HERGUETA, E. Y SALAS, C., 1987. Estudio de los Moluscos asociados a concentraciones de *Mesophyllum lichenoides* (Ellis) Lemoine del mar de Alborán. *Iberus*, 7 (1): 85-97.

HIDALGO, J. C., 1916. Datos para la fauna española (Moluscos y Braquiopodos). *Boletin de la Real Sociedad Española de Historia Natural*, 16: 235-246.

HIDALGO, J. C., 1917. *Fauna malacológica de España, Portugal y las Baleares. Moluscos testáceos marinos.* Trabajos del Museo Nacional de Ciencias Naturales, serie Zoológica, nº 30, Madrid. 752 pp.

LUQUE, A., 1983. Contribución al conocimiento de los Gasterópodos de las Costas de Málaga y Granada. 1. Opistobranquios (1). *Iberus* 3: 51-74.

LUQUE, A., 1986. *Contribución al conocimiento de los Moluscos gasterópodos de las costas de Málaga y Granada.* Editorial de la Universidad Complutense. Madrid. 695 pp.

MARÍN, A. Y ROS, J., 1988. Los Sacoglosos (Mollusca, Opisthobranchia) del Sudeste ibérico. Catálogo de especies y presencia de cloroplastos algales en las mismas. *Iberus*, 8 (1): 25-49.

MARTÍNEZ, E., BALLESTEROS, M., ÁVILA, C., DANTART, L. Y CIMINO, G., 1993. La familia Aglajidae (Opistobranchia: Cephalaspidea) en la Península Ibérica. *Iberus*, 11 (1): 15-29.

Moreno, D. y Templado, J., 1998. Nuevas aportaciones al conocimiento de los opistobranquios del sureste español. II. *Iberus*, 16 (2): 39-58.

Nobre, A., 1932. *Moluscos marinhos de Portugal*. Porto, 2. 378 pp.

Ortea, J., 1977a. *Moluscos marinos gasterópodos y bivalvos del litoral asturiano entre Ribadesella y Ribadeo, con especial atención a la subclase de los opistobranquios*. Tesis Doctoral. Universidad de Oviedo.

Ortea, J., 1977b. Contribución a la actualización de la fauna de opistobranquios ibéricos. Sacoglosos. *Boletin de la Estación Central de Ecología*, 6 (11): 75-91.

Ortea, J. y Urgorri, V., 1981. Opistobranquios nuevos para el litoral ibérico colectados en Galicia, I. *Boletín del Instituto Español de Oceanografía*, 6: 49-60.

Ortea, J., Valdés, A. García-Gómez, J. C., 1996. Revisión de las especies atlánticas de la familia Chromoddorididae (Mollusca: Nudibranchia) del grupo cromático azul. *Avicennia* (1): 165 pp.

Rampal, J., 1968. *Les Ptéropodes Thécosomes en Mediterranée*. Comm. Int. Explor. Sci. Mer. Médi., Comité de Plancton. Monaco. 142 pp.

Ros, J., 1975. Opistobranquios (Gastropoda: Euthyneura) del litoral ibérico. *Investigación Pesquera*, 39 (2): 269-372.

Salas, C. y Hergueta, E., 1986. La fauna de moluscos de las concreciones calcáreas de *Mesophyllum lichenoides* (Ellis) Lemoine. Estudio de la diversidad de un ciclo anual. *Iberus*, 6 (1): 57-65.

Salas, C. y Luque, A. A., 1986. Contribución al conocimiento de los gasterópodos marinos de la Isla de Alborán. *Iberus*, 6 (1): 29-37.

Schick, K. L. y Cervera, J. L., 1998. Description of a new species in the genus *Tambja* Burn, 1962 (Gastropoda: Nudibranchia: Polyceratidae) from Southern Spain. *The Veliger*, 4 (4): 344- 350.

Sierra, A., García, L. y Lloris, D., 1978. Trofismo y competencia alimentaria en asteroideos de la Bahía de Almería. *Investigación Pesquera*, 42 (2): 485-499.

Templado, J, Luque, A. y Moreno, D., 1988. Nuevas aportaciones al conocimiento de los Opistobranquios (Gastropoda, Opisthobranchia) del sureste español. *Iberus*, 8 (1): 15-23.

Templado, J., Guerra, A., Bedoya, J., Moreno, D., Remón, J. M., Maldonado, M. y Ramos, M. A., 1993. *Fauna marina circalitoral del sur de la Península Iberica. Resultados de la campaña oceanográfica "Fauna I"*. Museo Nacional de Ciencias Naturales. Madrid. 135 pp.

Urgorri, V. y Besteiro, C., 1983. Inventario de los Moluscos Opistobranquios de Galicia. *Investigación Pesquera*, 47 (1): 3-28

Vayssiere, A., 1913. *Mollusques de la France et des regions voisines I*. Encyclopedie Scientifiue. G. Doim et Cie Edit. Paris. 257 pp.

Vives, F., Santamaría, G. y Trepart, J., 1975. El zooplancton de los alrededores del Estrecho de Gibraltar. *Resultados de la Expedición Científica del B. O. Cornide*, 4: 7-100.

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Onoba oliverioi n. sp. (Prosobranchia, Rissoidae), a new gastropod from the Mediterranean

Onoba oliverioi n. sp. (Prosobranchia, Rissoidae), un nuevo gasterópodo para el Mediterráneo

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ABSTRACT

Onoba oliverioi n. sp. (Prosobranchia, Rissoidae) is here described from material collected on muddy bathyal bottoms surrounding a deep-sea coral bank located off-shore Latium (Central Tyrrhenian Sea). The new species is known from shells only and it has been placed in the genus *Onoba* H. and A. Adams, 1852. *Onoba oliverioi* n. sp. is compared to *Onoba gianninii* (Nordsieck, 1974) (deep-shelf), *Onoba dimassai* Amati and Nofroni, 1991 (shallow water) and *Alvania wareni* (Templado and Rolan, 1986) (deep-shelf), which it resembles. A list of mollusc species found associated with the new taxon is also given.

RESUMEN

En el presente trabajo se describe, en base exclusivamente a caracteres de la concha, una nueva especie de *Onoba*, a partir de material recogido en un fondo batial de arena y fango, en las proximidades de una comunidad de corales blancos, localizada a lo largo de las costas del Lazio. El nuevo taxon, denominado *Onoba oliverioi* n. sp., se compara con las especies similares del género *Onoba*, *O. gianninii* y *O. dimassai* Amati y Nofroni, 1991, y *Alvania wareni* (Templado y Rolan, 1986). Se incluye la lista de las especies que se han encontrado en el mismo muestreo.

KEY WORDS: *Onoba*, new species, Mediterranean Sea.
PALABRAS CLAVE: *Onoba*, nueva especie, Mediterráneo.

INTRODUCTION

The genus *Onoba* H. and A. Adams, 1852 includes small size cylindrical species which share certain shell features with members of *Alvania* Risso, 1826 *s. l.* and *Crisilla* Monterosato, 1917 *s. l.*, regarded as a genus, according to BOUCHET AND WARÉN (1993). Anatomical differences have been found between some representative taxa of the two genera *Onoba* and *Rissoa*, leading to the idea that is an interesting case of shell morphological convergence (PONDER, 1985; OLIVERIO, 1988; BOUCHET AND WARÉN, 1993). The Mediterranean species of *Onoba*, well illustrated by GIANNUZZI- SAVELLI, PUSATERI, PALMERI

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AND EBREO (1996), consist of mainly shallow-water shells. In fact, the only deep-water taxon is *Onoba gianninii* (Nordsieck F., 1974), figured by SEM photographs by AMATI AND NOFRONI (1991), who also designate the lectotype, and BOUCHET AND WARÉN (1993). In this paper we describe, on the base of shell morphology, a new species of *Onoba* from material dredged on some muddy bathyal bottoms surrounding a deep-sea coral bank located off Latium coast and currently under investigation (SMRIGLIO AND MARIOTTINI, 1999). The new species is compared to the similar *O. gianninii* and *Onoba dimassai* Amati and Nofroni, 1991. A list of mollusc species found in the same material is also given.

Abbreviations:

MZB: Museo di Zoologia dell'Università di Bologna, Italy.
MZR: Reparto Malacologico del Museo Civico di Zoologia di Roma, Italy.
CS: C. Smriglio private collection.
MO: M. Oliverio private collection.
PM: P. Mariottini private collection.

RESULTS

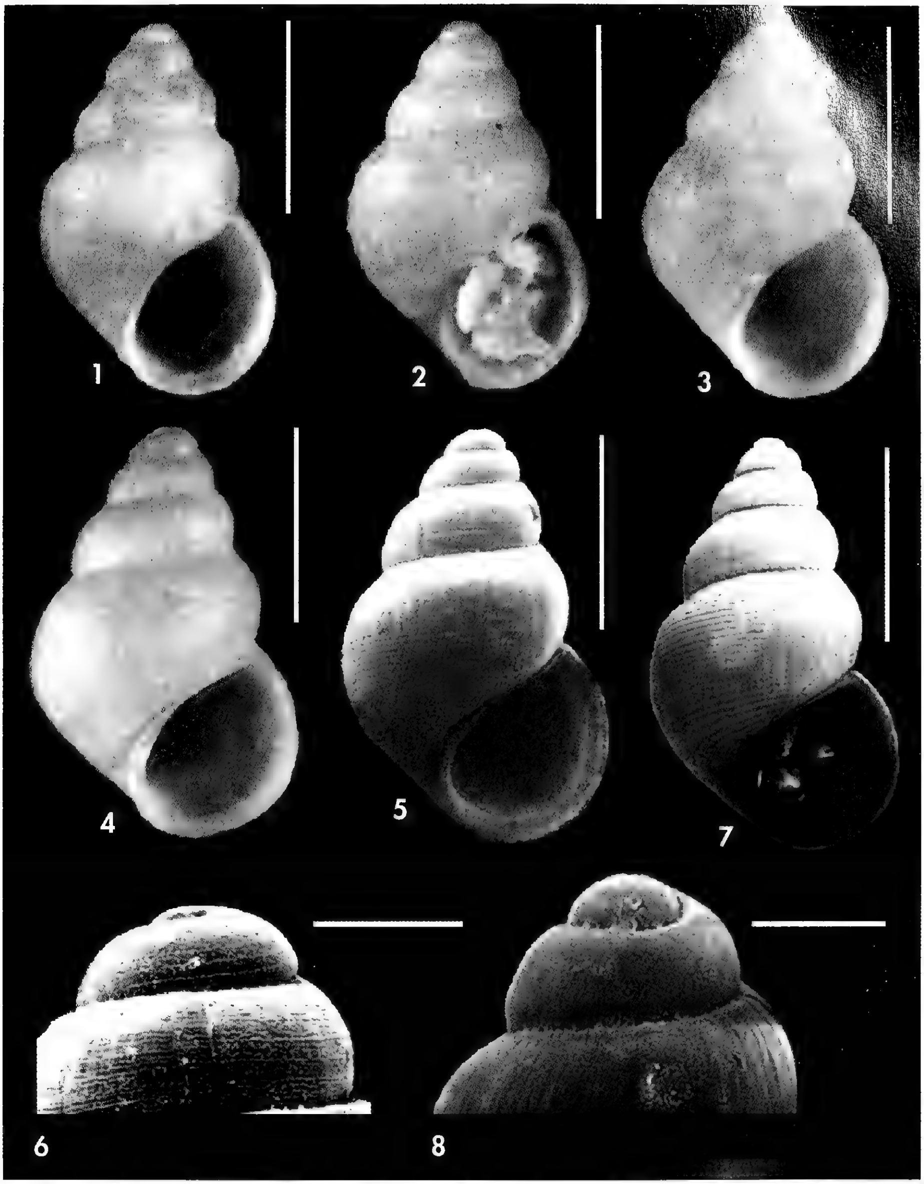
Family RISSOIDAE Gray J. E., 1847
Genus *Onoba* H. and A. Adams, 1852

Onoba oliverioi n. sp. (Figs. 1-6)

Type material: Holotype (MZB 14000), 1 sh., dredged, june 1987. Paratype D (MZR), 1 sh., type locality, june 1987. Paratypes A, B, C, E, F, G, H, I and L (CS), 9 sh., type locality, june 1987. Paratype M (MO), 1 sh., type locality, may 1990. Paratype N (PM), 1 sh., type locality, may 1990.
Type locality: Central Tyrrhenian Sea (41° 51′ N, 11° 28′ E), off coast of Latium, on muddy bottom in a deep-sea coral biocoenosis, [biocoenosis VB and CB *sensu* PÉRÈS AND PICARD (1964)], at a depth of 350-600 m.
Material examined: *O. oliverioi* n. sp., type locality, 32 sh. (CS).
Derivatio nominis: This species is named in honour of Dr Marco Oliveiro, expert malacologist and good friend of the authors, who has contributed a great deal to the knowledge of the Mediterranean malacofauna.

Description: Shell small (from 1.61 to 2.32 mm in height), conical-ovate, with a large aperture, blunt apex. Protoconch dome-shaped consisting of about 1.5 whorls, with a diameter of 400-440 μm, sculptured with 6-8 fine and irregular spiral cordlets. Among them, several other interrupted fine furrows create a sort of micro-tuberculated sculpture. Teleoconch of about 3.0 rounded convex whorls, the last one is about $^2/_3$ of the entire length, average ratio H/W = 1.55, average ratio H/Ha = 1.99. Suture pronounced and shallowly channelled, axial growing lines evident, spiral sculpture consisting of about 27 evenly spaced ribs, with about 2-3 much smaller furrows in the inter-spaces. Aperture ovoid, umbilical crevice slightly visible. Colour milky-white or yellowish translucent. Operculum and animal unknown.

Remarks: *O. oliverioi* (Figs. 1-6) is conchologically very similar to *O. gianninii* (Figs. 7, 8), resulting in the new taxon having been already recorded in the past by BOUCHET AND WARÉN (1993: fig. 1520, p. 663), but misidentified as *O. gianninii*. M. Oliverio already mentioned the possibility to face a complex of species when dealing with *O. gianninii*: *"Studying the specimens usually classified as gianninii it resulted that more than one species could be involved"* OLIVERIO (1988). Indeed, *O. oliverioi* can be separated from the last species on the ground of some protoconch and teleoconch features. In particular, the protoconchs differ in the two species, being the one of *O. oliverioi* much flatter, more sculptured and slightly smaller. The teleoconch outline of *O. oliverioi* differs from the one of *O. gianninii* being less slender



Figures 1-6. *Onoba oliverioi*. 1: holotype. 2.0 x 1.3 mm, (MZB 14000); 2: paratype D, 1.8 x 1.2 mm, (MZR); 3: paratype C, 1.8 x 1.2 mm, (CS); 4: paratype E, 2.2 x 1.3 mm, (CS); 5: paratype A; 6: protoconch, paratype A, 2.2 x 1.4 mm, (CS). Figures 7, 8. *O. gianninii*. 7: lectotype; 8: protoconch,lectotype, 2.2 x 1.2 mm, (MZR). Strait of Bonifacio, off Capo Comino (200-220 m). Lectotype figure after AMATI AND NOFRONI (1991). Scale bars, shells: 1 mm; protoconchs: 200 mm.

Figuras 1-6. Onoba oliverioi. *1: holotipo. 2,0 x 1,3 mm, (MZB 14000); 2: paratipo D, 1,8 x 1,2 mm, (MZR); 3: paratipo C, 1,8 x 1,2 mm, (CS); 4: paratipo E, 2,2 x 1,3 mm, (CS); 5: paratipo A; 6: protoconcha, paratipo A, 2,2 x 1,4 mm, (CS). Figuras 7, 8.* O. gianninii. *7: lectotipo; 8: protoconcha del lectotipo, 2,2 x 1,2 mm, (MZR), Estrecho de Bonifacio, Capo Comino (200-220 m). Lectotipo figura original de AMATI Y NOFRONI (1991). Escalas, conchas: 1 mm; protoconchas: 200 mm.*

(H/W = 1.55 versus H/W = 1.75, respectively), having a smaller average number of whorls (about 2.5-3 versus 3.5-4, respectively) and a bigger aperture (H/Ha = 1.99 versus H/Ha = 2.40, respectively). On the contrary, the sculpture of the teleoconch in the two species results very similar, consisting in rounded spiral ribs of equal breadth and number (26-31). *O. oliverioi* also differs from *Alvania wareni* (Templado and Rolan, 1986), a species closely related to *O. gianninii*, as stressed by BOUCHET AND WARÉN (1993: 663): *"They may prove to be conspecific, when material becomes known from the intermediate area"*. The differences outlined between the new species and *O. gianninii*, hold when comparing the new species to *A. wareni* as well. Furthermore, the shell of *A. wareni* has an additional and diagnostic sculpture feature at the protoconch-teleoconch demarcation (BOUCHET AND WARÉN, 1993: 646; fig. 1462); in fact, the last part of the protoconch whorl shows about 20 fine cordlets irregularly interrupted, which are not present in *O. oliverioi* nor in *O. gianninii*. The new taxon is distinguishable from *O. dimassai* too, a shallow water species which has a similar shell shape. *O. dimassai* has a smooth protoconch with no evident microsculpture, of about 1.20-1.25 whorls and a diameter of about 300-380 μm. Its teleoconch sculpture shows 24-30 major spiral ribs which present 4-5 fine furrows, together with the 3-4 furrows at the interspaces, the shell surface appears to be more tightly covered by these spiral ribs; furthermore, the last whorl does not show any umbilical crevice (AMATI AND NOFRONI, 1991). These shell features pointed out allow an easy separation of *O. dimassai* from *O. oliverioi*.

DISCUSSION

The shell features observed in the specimens of *O. oliverioi* from the Central Tyrrhenian Sea, summarised in Table I, are clearly visible in the individual figured by BOUCHET AND WARÉN (1993), which is from the Strait of Bonifacio (off Capo Comino, 200-300 m). So, it seems that the morphological characters shown by *O. oliverioi* are very constant regardless the collecting spot. Since shells of both *O. gianninii* and *O. oliverioi* have been collected together in that area (BOUCHET AND WARÉN, 1993), the two species could be sympatric in the Strait of Bonifacio, corroborating the idea that are indeed two different taxa and not just two extreme forms of the same species. The shells of *O. oliverioi* from the Central Tyrrhenian Sea were dredged on a bathyal bottom, at a depth of 350-600 m, resulting in a deeper record than the ones of the specimen from Capo Comino and of *O. gianninii* (AMATI AND NOFRONI, 1991). The new taxon probably belongs to the biocoenosis VB *sensu* PÉRÈS AND PICARD (1964), the other mollusc species found in the same dredged material seem to support this assumption. The identified species occurring with *O. oliverioi* are: *Propilidium exiguum* Thompson, 1843, *Lepetella* cf. *laterocompressa* (De Rayneval and Ponzi, 1854), *Emarginula tenera* Locard, 1892, *Clelandella miliaris* (Brocchi, 1814), *Danilia otaviana* (Cantraine, 1835), *Putzeysia wiseri* (Calcara, 1842), *Alvania cimicoides* (Forbes, 1844), *Alvania subsoluta* (Aradas, 1847), *Orbitestella dariae* (Liuzzi and Stolfa Zucchi, 1979), *Trophon muricatus* var. *barvicensis* (Johnston, 1825), *Nassarius lima* (Dillwin, 1817), *Amphissa acuteocostata* (Philippi, 1844), *Granulina gofasi* Smriglio and Mariottini, 1996, *Gymnobela abyssorum* (Locard, 1897), *Microdrillia loprestiana* (Calcara, 1841), *Pleurotomella demosia* (Dautzenberg and Fischer P., 1896), *Pleurotomella gibbera* Bouchet and Warén, 1980 ex Jeffreys ms., *Teretia teres* (Reeve, 1844), *Conopleura aliena* Smriglio, Mariottini and Calascibetta, 1999, *Heliacus alleryi* (Seguenza G., 1876), *Mathilda cochlaeformis* Brugnone, 1873, *Japonacteon pusillus* (McGillivray, 1843), *Asperarca nodulosa* (Müller, 1776), *Chlamys bruei* (Payraudeau, 1826) and *Cadulus subfusiformis* (Sars M., 1865). At the present time, the distribution of *O. oliverioi* is limited to the Tyrrhenian Sea: off Latium and Sardinia (Strait of Bonifacio) coasts.

Table I. Shell morphological measurements of *Onoba oliverioi* type material. Abbreviations. H: height in mm; W: width in mm; Ha: height aperture in mm; Pd: protoconch diameter in µm; Sr: spiral ribs of the last whorl; ND: not determined.
Tabla I. Medidas morfológicas de la concha del material tipo de Onoba oliverioi. *Abreviaciones. H: altura en mm; W: ancho en mm; Ha: altura de la boca en mm; Pd: diámetro de la protoconcha en µm; Sr: estrias espirales en la ultima vuelta; ND: no determinado.*

Specimen	**H**	**W**	**Ha**	**H/W**	**H/Ha**	**Pd**	**Sr**
Holotype	1.85	1.20	0.97	1.54	1.91	440	26
Paratype A	2.17	1.38	1.08	1.57	2.00	400	31
Paratype B	2.26	1.47	1.08	1.53	2.09	420	27
Paratype C	2.05	1.26	0.94	1.62	2.18	440	28
Paratype D	1.79	1.17	0.88	1.53	2.03	400	28
Paratype E	2.23	1.35	1.05	1.65	2.12	440	26
Paratype F	1.91	1.29	1.00	1.48	1.91	440	26
Paratype G	1.79	1.20	0.94	1.49	1.90	440	26
Paratype H	1.79	1.20	0.94	1.49	1.90	440	28
Paratype I	2.17	1.41	1.11	1.54	1.95	400	ND
Paratype L	1.73	1.20	0.94	1.44	1.84	420	26
Paratype M	1.61	1.08	0.85	1.49	1.89	400	23
Paratype N	2.32	1.47	1.11	1.57	2.09	400	29

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BIBLIOGRAPHY

AMATI, B. AND NOFRONI, I., 1991. Designazione del lectotipo di *"Setia" gianninii* F. Nordiesck, 1974 e descrizione di *Onoba dimassai* nuova specie (Prosobranchia: Rissoidae). *Notiziario C.I.S.M.A.*, 13: 30-37.

BOUCHET, P. AND WARÉN, A., 1993. Revision of the Northeast Atlantic Bathyal and Abyssal Mesogastropoda. *Bollettino Malacologico*, suppl. 3: 579-849.

GIANNUZZI-SAVELLI, R., PUSATERI, F., PALMERI, A. AND EBREO, C., 1996. *Atlante delle Conchiglie Marine del Mediterraneo. Vol. 2.* "La Conchiglia", Roma, 258 pp.

OLIVERIO, M., 1988. On the systematics of *"Setia" gianninii* (Gastropoda: Prosobranchia). *Bollettino Malacologico*, 24 (5-8): 112-114.

PÉRÈS, J. M. AND PICARD, J., 1964. Nouveau Manuel de Bionomie Benthique de la Mer Méditerranée. *Recuil des Travaux de la Station Marine d'Endoume*, 31 (47): 1-137.

PONDER, W. F., 1985. A review of the genera of the Rissoidae (Mollusca: Mesogastropoda: Rissoacea). *Records of the Australian Museum*, suppl. 4: 1-221.

SMRIGLIO, C. AND MARIOTTINI, P., 1999. Molluschi del Mar Tirreno Centrale. Contributo XII. Segnalazione di due rari Epitoniidae batiali per le coste laziali (Gastropoda, Ptenoglossa). *Bollettino Malacologico*, 39 (9-12): 137-140.

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The subfamily Rissoininae (Mollusca: Gastropoda: Rissoidae) in the Cape Verde Archipelago (West Africa)

La subfamilia Rissoininae (Mollusca: Gastropoda: Rissoidae) en el archipiélago de Cabo Verde (África Occidental)

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ABSTRACT

The subfamily Rissoininae (Gastropoda, Rissoidae) is studied in the Cape Verde Archipelago. Twenty-nine species belonging to three genera have been found: *Rissoina (Rissoina) punctostriata* (Talavera, 1975), a species with planktotrophic development widely distributed along West Africa, and currently confused with the also planktotrophic Caribbean species *Rissoina (Rissoina) decussata* (Montagu, 1803); one new species of *Rissoina (Ailinzebina)*; 26 new species of *Schwartziella (Schwartziella)*, and one new species of *Zebina (Zebina)*. The paucispiral protoconch of all the new species indicates a non-planktotrophic development and strongly suggest all them are endemic of the Cape Verde Archipelago. The new species are compared among them and with other related West African species. The high level of endemism, the geographical distribution of all the species in the Archipelago and the possible relationships of the Cape Verde Rissoininae are also commented.

RESUMEN

Se estudia la subfamilia Rissoininae en el Archipiélago de Cabo Verde. Se han encontrado 29 especies pertenecientes a tres géneros: *Rissoina (Rissoina) punctostriata* (Talavera, 1975), una especie con desarrollo larvario planctotrófico ampliamente distribuida a lo largo de la costa occidental africana y hasta ahora confundida con la especie caribeña *Rissoina (Rissoina) decussata* (Montagu, 1803), también de desarrollo planctotrófico; una nueva especie de *Rissoina (Ailinzebina)*; 26 especies nuevas de *Schwartziella (Schwartziella)*, y una especie nueva de *Zebina (Zebina)*. La protoconcha paucispiral de todas las especies nuevas indica un desarrollo larvario no planctotrófico y sugiere que todas ellas son endémicas del archipiélago. Se comparan las nuevas especies descritas con otras del África occidental con las que están relacionadas, y entre sí. Se comentan el alto grado de endemismo, la distribución geográfica de todas las especies en el archipiélago y las posibles relaciones de los Rissoininae de Cabo Verde.

KEY WORDS: Rissoininae, *Rissoina, Zebina, Schwartziella*, new species, Cape Verde Islands, West Africa.
PALABRAS CLAVE: Rissoininae, *Rissoina, Zebina, Schwartziella*, nuevas especies, Islas de Cabo Verde, África Occidental.

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INTRODUCTION

Though many papers dealing with the marine gastropods of the Cape Verde Archipelago have been published during the last years (see BURNAY AND COSEL, 1987; FERNANDES AND ROLÁN, 1991, and ROLÁN AND RUBIO, 1999 for a list), several groups are still awaiting study. One of them is the subfamily Rissoininae (Rissoidae), revised at the generic level by PONDER (1985) and studied in other parts of the world (LEAL AND MOORE, 1989; SLEURS, 1989, 1991, 1993, 1994, 1996; FABER, 1990; SLEURS AND PREECE, 1994; ROLÁN, 1998). However, there are only a few papers dealing with Rissoininae from West Africa and neighbouring islands. WATSON (1873) described *Eulima paivensis* from the Selvagens Islands, which turned out to be the common species recorded from the Canary Islands as *Zebina browniana* (d'Orbigny, 1842) or *Z. vitrea* (C. B. Adams, 1850) by ODHNER (1932), NORDSIECK (1972) and GARCÍA-TALAVERA (1983) (see GOFAS, 1999). SMITH (1890) described five new species from St. Helena and erroneously recorded *Rissoina bryerea* (Montagu, 1803), a Caribbean species. DAUTZENBERG (1913) and TALAVERA (1975), described two new species: *Rissoina africana* from Senegal, and *Zebina punctostriata* from Mauritania, respectively. GOFAS (1999) studied *Rissoina punctostriata*, *Schwartziella africana* and described a new species of *Zebina*. ROLÁN AND RYALL (1999) recorded *Rissoina punctostriata* (Talavera, 1975) from Angola. A few probably erroneous records are sparse in different papers: *Rissoina elegantula* (Angas, 1880) from São Tomé (TOMLIN AND SHACKLEFORD, 1914), *Rissoina calia* Bartsch, 1915, from Senegal (NICKLÈS, 1947), *Zebina vitrea* (A. Adams, 1854) from Sahara, Mauritania (ALTIMIRA, 1978) and the Canary Islands (ALTIMIRA, 1978; NORDSIECK, 1982). FERNANDES AND ROLÁN (1994) recorded six amphiatlantic species of Rissoininae which actually have not been accepted.

The first record of a Rissoininae from the Cape Verde Islands is that of DAUTZENBERG AND FISCHER (1906) (*Rissoina decussata* (Montagu, 1803), see below under remarks of *R. punctostriata*). MARCHE-MARCHAD (1958) and SAUNDERS (1977) recorded *Rissoina africana* (Dautzenberg, 1913). GARCÍA-TALAVERA AND BACALLADO (1978) recorded *Rissoina bryerea* (Montagu, 1803), but this is a misidentification of a Caribbean species. COSEL (1982a, b, c) recorded *R. decussata* (Montagu, 1803), *R. africana* Dautzenberg, 1913, *Zebina* cf. *punctostriata* (Talavera, 1975) and other 2-3 probably undescribed species of *Rissoina*.

A preliminary revision of the subfamily Rissoininae from the Cape Verde Archipelago was presented by MORÁN, ROLÁN AND LUQUE (1989) to the 5th Symposium Fauna and Flora of the Cape Verde Islands (Leiden), and an updated checklist of the marine gastropods by ROLÁN, FERNANDES, LUQUE, ORTEA AND TEMPLADO (1993) to the First Symposium Fauna and Flora of the Atlantic Islands (Madeira). In both abstracts was referred the existence of seven or more undescribed species of Rissoininae. During recent years, a thorough revision of the material from different expeditions to the Cape Verde Islands has shown that the number of Rissoininae species in this archipelago has been greatly underestimated. A total of 29 species of three genera, 28 of which are new for the science, are described in the present paper.

MATERIAL AND METHODS

About 2300 shells and specimens have been studied from almost all the Cape Verde Archipelago (Fig. 157). A part of this material was collected by the "I Expedición Científica Ibérica al Archipiélago de Cabo Verde" (1985), as well as in several trips of Spanish and Portuguese malacologists between 1978 and 1988, most of them with the participation of the first author. A small part of the material was collected by dredging down to 100 m of depth, or by SCUBA diving down to 30 m, but most of the material was collected by skin diving down to 15 m. Additional material collected by the CANCAP Expeditions of the National Museum of Natural History of Leiden has been included in the present study, so as some new material collected in 1997 by the first author during the expedition "Macaronesia 2" of Las Palmas University. Some types housed in The Natural History Museum of London and the Muséum National d'Histoire Naturelle of Paris have been also studied.

Specimens are illustrated using SEM micrographs; the views of microsculpture were made at the middle part of the body whorl.

Abbreviations:

AMNH: American Museum of Natural History, New York.
BMNH: The Natural History Museum, London.
DBUA: Departamento de Biología, Universidad Autónoma, Madrid.
MNCN: Museo Nacional de Ciencias Naturales, Madrid.
MNHN: Muséum National d'Histoire Naturelle, Paris.
NNM: Nationaal Natuurhistorisch Museum, Leiden.
CER: Collection of E. Rolán, Vigo.
The material with no indication of collection is from CER.
sp: live collected specimen.
s: empty shell.
j: juvenile shell.
f: fragment of shell.

RESULTS

Family RISSOIDAE J. E. Gray, 1847
Subfamily RISSOININAE Stimpson, 1865
Genus *Rissoina* d'Orbigny, 1840
Subgenus *Rissoina* s. s.

Type species: *Rissoina inca* d'Orbigny, 1840, by original designation.
Diagnosis: PONDER (1985, p. 78) and SLEURS (1993, p. 74).

Rissoina (Rissoina) punctostriata (Talavera, 1975) (Figs. 1-3, 6-8)

Zebina punctostriata Talavera, 1975. *Bol. Inst. Esp. Oceanog.*, 192: 3, pl. 1, fig. 1, pl. 4, fig. 7. [Type locality: SAHMAS-1, st. EO-8, Mauritania].

Material studied: Cape Verde Archipelago: Sal: 2 s, Palmeira; 2 sp, 8 s, Regona,1-3 m; 1 sp, 5 s, Rabo de Junco, 3 m; 1 s, 3 f, Mordeira, 5 m; 3 f, off Palmeira, CANCAP Sta. 7.109, 16° 45′ N, 22° 59′ W, 31 m (31-VIII-86) (NNM); 2 j, 1 f, Santa Maria Bay, CANCAP Sta. 7.093, 16° 34′ N, 22° 54′ W, 42 m (29-VIII-1986) (NNM); 3 j, 1 f, Santa Maria Bay, CANCAP Sta. 7.094, 16° 34′ N, 22° 54′ W, 24 m (NNM). Brava: 8 f, 8 s, Furna, 8 m. Boa Vista: 15 s, 3 f, Sal Rei, 3-7 m; 2 s, Baia Teodora, 5 m; 4 s, Rife de Chaves, 12 m; 10 j, CANCAP Sta. 6.056, 15° 59′ N, 22° 47′ W, 25 m (12-VI-1982) (NNM); 6 s, 6 f, CANCAP Sta. 6.064, 15° 58′ N, 22° 47′ W, 29-32 m (12-VI-82) (NNM); 12 s, 1 j, Ilhéu Calheta do Velho, CANCAP Sta. 7.064, 16° 11′ N, 22° 58′ W, 25 m (NNM); 2 j, Ilhéu Calheta do Velho, CANCAP Sta. 7.068, 16° 11′ N, 22° 59′ W, (27-VIII-1986) (NNM); 1 s, 5 j, 2 f, CANCAP Sta. 7.075, 16° 08′ N, 22° 58′ W, 33 m (NNM); 1 j, 5 f, CANCAP Sta. 7.079, Ilhéu de Sal Rei, 16° 10′ N, 23° 00′ W, 60 m (28-VIII-1986) (NNM). Maio: 1 j, CANCAP Sta. 7.042, Ponta Inglez/Ponta Preta, 15° 07′ N, 23° 14′ W, 76 m (25-VIII-1986) (NNM). Santiago: 1 s, Praia Baixa, 5 m; 1 s, Cidade Velha, 4 m; 1 s, CANCAP Sta. 6.005, 14° 54′ N, 23° 30′ W, 75-68 m (5-VI-1982) (NNM); 1 s, 2 j, CANCAP Sta. 6.007, 14° 54′ N, 23° 30′ W, 70-88 m (5-VI-1982) (NNM); 2 j, CANCAP Sta. 6.015, 14° 53′ N, 23° 30′ W, 150 m (5-VI-1982) (NNM); 1 j, CANCAP Sta. 6.024, 15° 00′ N, 23° 44′ W, 540 m (7-VI-1982) (NNM); 1 s, CANCAP Sta. 6.054, 14° 54′ N, 23° 30′ W, 29-33 m (11-VI-1982) (NNM); 1 s, 1 j, CANCAP Sta. 7.120, 16° 36′ N, 24° 37′ W, 208 m (1-IX-1986) (NNM). São Vicente: 2 sp, Calhau, 3 m; 1 sp, 2 s, Matiota, 5-7 m; 1 s, Porto Mindelo, 12 m; 1 j, CANCAP Sta. 6.162, 16° 54′ N, 25° 01′ W, 38-45 m (21-VI-1982) (NNM). Santa Luzia: 1 s, Praia Francisca, 2 m. Ilhéu Razo: 1 s, 1 j, CANCAP Sta. 7.116, 16° 36′ N, 24° 36′ W, 75 m (1-IX-1986) (NNM). São Nicolau: 2 j, CANCAP Sta. 6086, 16° 34′ N, 24° 22′ W, 35 m (15-VI-1982) (NNM). Santo Antão: 1 s, W of Tarrafal, CANCAP Sta. 6.108, 16° 58′ N, 25° 20′ W, 10 m (6-VI-1982) (NNM). Mauritania: 3 s, Baie de l'Etoile, Nouadhibou, 3 m; 1 s, off Bank d'Arguin, 20° 01′ N, 17° 32′ W, 53 m (14-VI-1988) (NNM). Ghana: 7 s, 6 f, 3 j, Mianmia, 25-35 m; 2 s, Busua, 6 m; 3 s, 4 f, Takoradi, 1-4 m. Senegal: 4 s, Almadies, 30 m; 2 s, N'Gor, Dakar, 5 m; 2 s, Madeleines, Dakar. São Tomé and Principe: 1 s, Esprainha, 3 m; 1 s, Lagoa Azul, 4 m; 7 s, Praia Mutamba, 5 m; 2 s, 3 f, São Tomé city, 4 m. Angola: 4 sp, 18 s, Corimba, Luanda, 20 m; 2 s, Cacuaco, 7 m; 5 s, 10 f, off Luanda, 50 m; 5 s, 4 j, 4 f, Palmeirinhas, 30 m; 1 sp, 2 s, 3 j, Buraco, near Palmeirinhas, prov. Bengo; 3 s, Santa Maria, 15 m.

Description: See TALAVERA (1975). Shell (Figs. 1, 2) length 5-10 mm, width 2.5-3.5 mm, not solid, elongate-conical.

Protoconch (Fig. 3) of three spiral smooth whorls and about 400 μm of diameter of last whorl, of planktotrophic type. A spiral cord in the middle of the last quarter of the last whorl reaches the lower margin of the deep sinusigera notch.

Teleoconch of 6-7 whorls; adapical 3-4 spire whorls angulated; subsequent whorls gradually convex; last whorls convex. Suture shallow, with a subsutural depression gradually better marked which gives a slightly undulated profile to the last whorls. Colour white.

Axial sculpture of adapical whorls consisting of somewhat prominent, rounded, narrow, closely spaced, slightly curved, opisthocline ribs, becoming gradually less prominent and more numerous (up to 30 weakly prominent ribs on the last whorl) (Figs. 1, 2). Spiral sculpture of about 8-10 prominent spiral cords on adapical whorls, up to more than 60 on the last whorl, those of the base more prominent; interspaces a little wider or of similar width. Microsculpture (Fig. 8) of fine spiral threads, with interspaces of the same width or wider. Aperture D-shaped, large; inner lip thin, slightly concave; anterior channel short, shallow; outer lip with thin external varix, slightly opisthocline in profile.

Operculum (Fig. 7) yellowish, thick, pyriform, with a prominent and long inner peg.

Radula (Fig. 6): central tooth with two pairs of basal denticles, and a prominent central cusp with 3-4 small cusps at each edge; lateral teeth with 6-7 cusps on the inner and outer edge; inner marginal teeth with cusps on about distal one third of the outer edge; outer marginal teeth with cusps on about distal one third of the inner and outer edge.

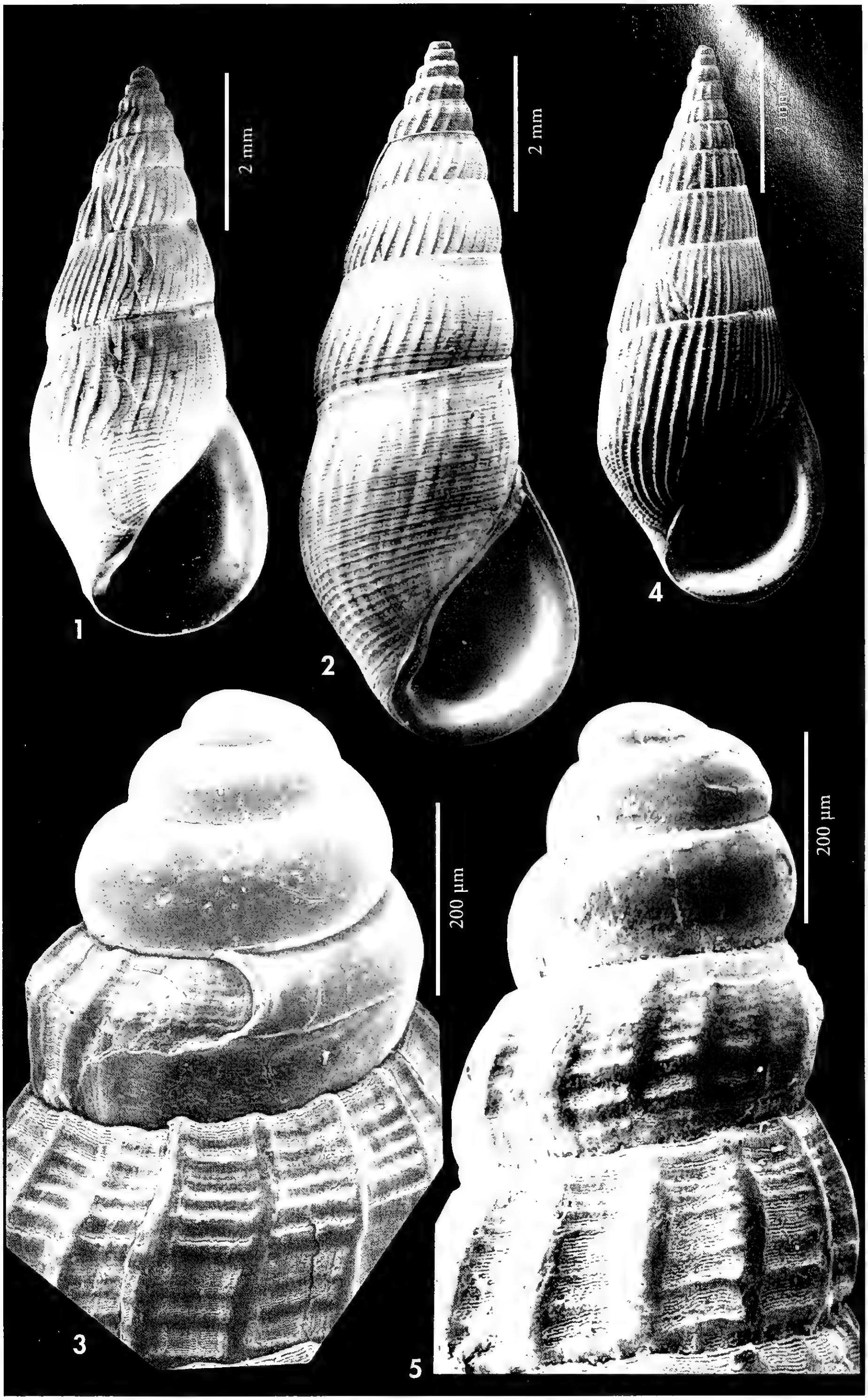
Habitat: Living specimens were collected at the base of rocks on sandy bottom.

Distribution: *R. punctostriata* is known from Mauritania (TALAVERA, 1975), Senegal, Ivory Coast, São Tomé, Gabon, Cameroun (GOFAS, 1999), Angola (GOFAS, 1999; ROLÁN AND RYALL, 1999), and Ghana and the Cape Verde Archipelago (pers. obs.).

Remarks: GARCÍA-TALAVERA (1983) considered this species a junior synonym

(Right page) Figures 1-3. *Rissoina (Rissoina) punctostriata* (Talavera, 1975). 1: shell from Corimba, Luanda, Angola; 2: shell from Sal Rei, Boa Vista, Cape Verde Archipelago; 3: protoconch of a shell from Regona, Sal. Figures 4-5: *Rissoina decussata* (Montagu, 1803), 4: shell from Los Canarreos Archipelago, Cuba; 5: protoconch of the same shell.

(Página derecha) Figuras 1-3. Rissoina punctostriata *(Talavera, 1975). 1: concha de Corimba, Luanda, Angola; 2: concha de Sal Rei, Boa Vista, Archipiélago de Cabo Verde; 3: protoconcha de una concha de Regona, Sal. Figuras 4-5:* Rissoina decussata *(Montagu, 1803), 4: concha del Archipiélago de Los Canarreos, Cuba; 5: protoconcha de la misma concha.*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of *Rissoina decussata* (Montagu, 1803) from the Caribbean, probably due to the shell similarity and the protoconch of planktotrophic type. But the comparative study of the shells and protoconchs (Figs. 1-5 and 8-9) of *R. decussata* from Cuba and *R. punctostriata* has showed enough differences to consider both them different species (Table I, see page 86). So, *R. decussata* is not an amphiatlantic species, and all the previous West African records of this species (Senegal, Gabon, Ivory Coast, São Tomé, Cameroun and Angola) should be attributed to *R. punctostriata*. The record of *Rissoina elegantula* (Angas, 1880), a similar species described from S Australia, from São Tomé (TOMLIN AND SHACKLEFORD, 1914), must be also referred to *R. punctostriata*.

COSEL (1982a, c) recorded this species (as *Zebina* cf. *punctostriata*) from the Cape Verde Islands. The previous records of *Rissoina decussata* from Santa Luzia and Boa Vista (DAUTZENBERG AND FISCHER, 1906), and the more recent of COSEL (1982b), who cited the previous authors, should be attributed to *R. punctostriata*.

The study of the best preserved of two syntypes of each *R. decussata* (BMNH, no. 4239) and *R. striatocostata* (d'Orbigny, 1842) (BMNH 1854.10.4.209) has proved that the last name is a junior synonym of *R. decussata*.

Subgenus *Ailinzebina* Ladd, 1966

Type species: *Zebina* (*Ailinzebina*) *abrardi* Ladd, 1966, by original designation.
Diagnosis: SLEURS (1993, p. 112).

Rissoina (Ailinzebina) onobiformis n. sp. (Figs. 10-14, 158)

Type material: Holotype (Fig. 11) 1 s of 3.1 x 1.2 mm and 2 paratypes, 2 s, from Rabo de Junco, Sal Island, Cape Verde Archipelago, 6 m (MNCN 15.05/31713). Other paratypes: 4 s (Fig. 10, broken during the study), 3 f, from the type locality, 2 m (CER); 1 s, Derrubado, Boa Vista, 3 m (CER); 1 s, Pedrinha, Brava, 6 m (CER); 2 s, 2 f, 1 j, Furna, Brava, 20-30 m (CER); 1 s, Furna, Brava, 30 m (AMNH); 1 s, Sal Rei, Boa Vista, 6 m (NNM 58020); 1 s, South of Santiago, CANCAP Sta. 6.015, 14° 53′ N, 23° 30′ W, 50 m (5-VI-1982) (NNM 59417); 1 s, 5 m, Derrubado, Boa Vista (MNHN); 1 s, Cidade Velha, Santiago, 5 m (DBUA).
Other material studied: Boa Vista: 2 s, Morro de Areia, 1 m; 1 f, Baijos de João Valente, 20 m; 3 j, Baia Teodora, 4 m. Santiago: 1 f, Cidade Velha, 4 m; 1 f, South of Santiago, CANCAP Sta. 6.015, 14° 53′ N, 23° 30′ W, 50 m (5-VI-1982) (NNM). Brava: 2 s, Furna, 30 m; 6 s, Porto do Ancião, 6 m.
Etymology: The specific name alludes to the resemblance of the shell with that of the genus *Onoba*.

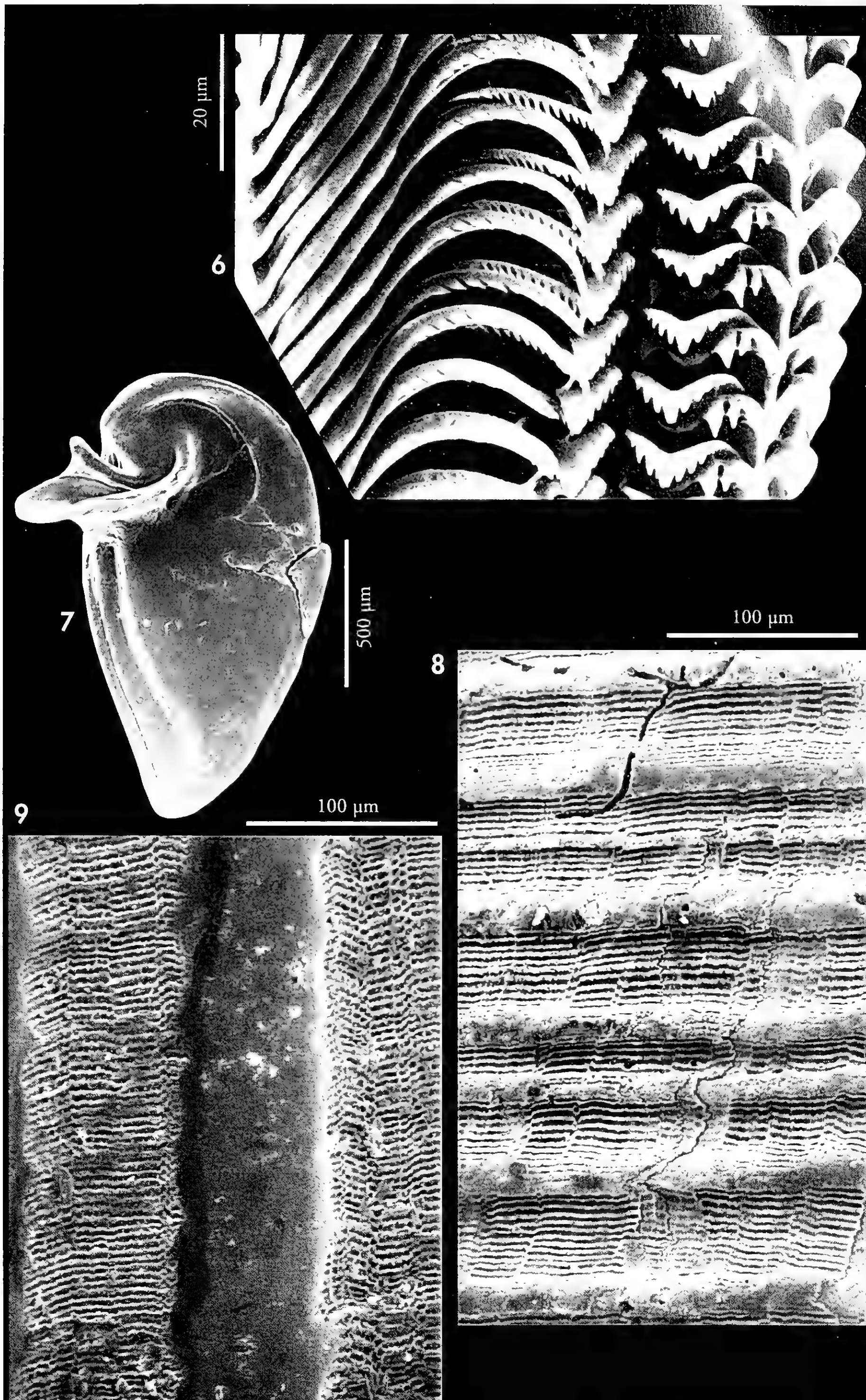
Description: Shell (Figs. 10, 11) length up to 3.5 mm, maximum width 1.4 mm, not solid, elongate, subcylindrical, with pupoid apex.

Protoconch (Figs. 12, 13) of a little more than one whorl and 360 μm of maximum diameter, of non-planktotrophic type; transition to teleoconch abrupt; surface smooth with some rather elevated marks like an Arabic writing.

Teleoconch of 4 $^1/_2$ whorls in holotype, but usually 4, weakly convex, not

(Right page) Figures 6-8. *Rissoina punctostriata* (Talavera, 1975). 6: radula of a specimen of Mordeira, Sal, Cape Verde Archipelago; 7: operculum of the same specimen; 8: teleoconch microsculpture of the shell of Figure 2. Figure 9. *Rissoina decussata* (Montagu, 1803), teleoconch microsculpture of the shell of Figure 4.

(Página derecha) Figuras 6-8. Rissoina punctostriata *(Talavera, 1975). 6: rádula de un ejemplar de Mordeira, Sal, Archipiélago de Cabo Verde; 7: opérculo del mismo ejemplar; 8: microescultura de la teloconcha del ejemplar de la Figura 2. Figura 9.* Rissoina decussata *(Montagu, 1803), microescultura de la teloconcha del ejemplar de la Figura 4.*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angulated below suture, but with a small angulation near the base; last whorl weakly convex; suture shallow. Colour cream-whitish.

Axial sculpture consisting of very weak, narrow, slightly opisthocline, distantly spaced axial ribs, gradually more closely spaced, 30-37 in the last whorl, a little prominent on the suture. Spiral sculpture very fine, appreciable at low magnification. Microsculpture (Fig. 14) formed by bands of 6-10 very fine threads between two irregular fine spiral cords.

Aperture D-shaped, relatively large, with an acute angulation on its upper part; inner lip thick; columellar side weakly concave; anterior channel almost absent; outer lip with a weak external varix; peristome wide and flat when well developed, with an internal and an external sharp rims; inner part with two small depressions, one on the anterior channel and other on the part corresponding to the anal sinus.

Habitat: Shells from sand sediments between 2 and 50 m.

Distribution: Sal, Boa Vista, Santiago, Brava (Fig. 158). This species probably will be found in all the islands of the Cape Verde Archipelago.

Remarks: PONDER (1985) considered *Ailinzebina* a synonym of *Rissoina* s. s., but SLEURS (1993) considered the radular and head-foot characters of *Rissoina (Ailinzebina) elegantissima* enough different from those of *Rissoina* s. s. to warrant a subgeneric status for *Ailinzebina*. SLEURS (1993) included in this subgenus four Pacific species and *Rissoina (Ailinzebina) elegantissima* d'Orbigny, 1842, from the Caribbean. Considering the distinctive shell features (and also the known anatomical ones, see SLEURS, 1993) of the species of this subgenus and its wide distribution, we think that *Ailinzebina* may be elevated to the generic level, but we prefer to do not any taxonomical change waiting for further anatomical information.

Rissoina (Ailinzebina) elegantissima is the only other known Atlantic species of this subgenus and it differs from *R. (A.) onobiformis* n. sp. by the planktotrophic type of protoconch (see LEAL AND MOORE, 1989, fig. 9, and SLEURS, 1993, fig. 41), the rather solid shell with strongly convex whorls, the more prominent and opisthocline axial ribs and the more densely spaced spiral cords. Moreover, the sculpture of the protoconch of *R. onobiformis* is different from any other known species of *Rissoina*.

Genus *Schwartziella* Nevill, 1881
Subgenus *Schwartziella* s. s.

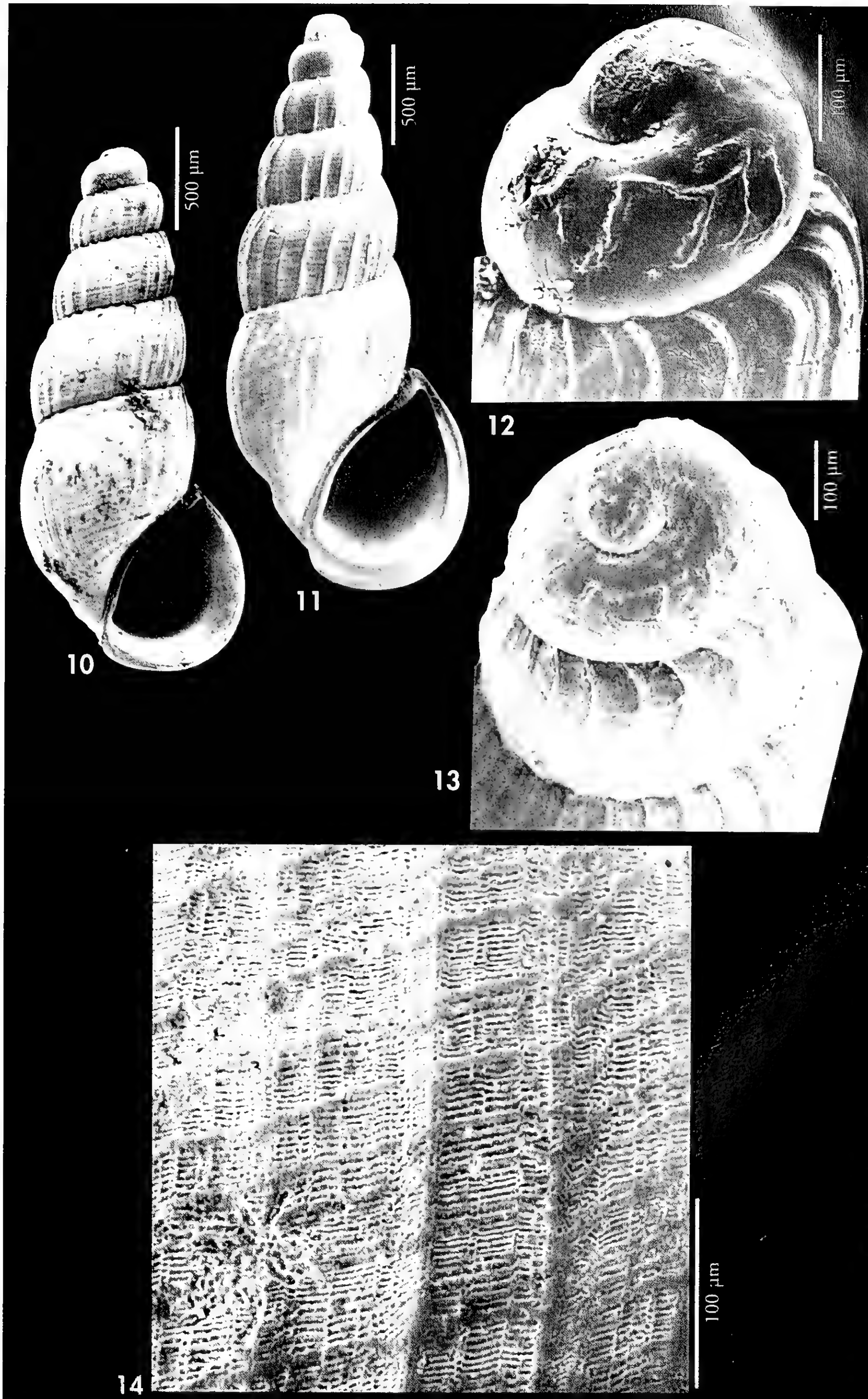
Type species: *Rissoina orientalis* Nevill, 1881 (= *Rissoina triticea* Pease, 1861), by original designation. Diagnosis: PONDER (1985, p. 98-99).

Schwartziella (Schwartziella) robusta n. sp. (Figs. 15-19, 144, 148, 159)

Type material: Holotype (Fig. 15) 1 s of 3.7 x 1.9 mm, and 1 paratype, 1 s, Fiura, Sal Island, Cape Verde Archipelago (MNCN 15.05/31718). Other paratypes: 3 s, Regona, 10 m, and 3 s, Punta Preta

(Right page) Figures 10-14: *Rissoina (Ailinzebina) onobiformis* n. sp. 10: paratype (broken during study), Rabo de Junco, Sal (CER); 11: holotype, Rabo de Junco, Sal (MNCN 15.05/31713); 12-13: protoconchs of paratypes, Rabo de Junco, Sal (CER); 14: teleoconch microsculpture of a paratype, Furna, Brava (CER).

(Página derecha) Figuras 10-14: Rissoina (Ailinzebina) onobiformis *spec. nov. 10: paratipo (roto durante su estudio), Rabo de Junco, Sal (CER); 11: holotipo, Rabo de Junco, Sal (MNCN 15.05/31713); 12-13: protoconchas de paratipos, Rabo de Junco, Sal (CER); 14: microescultura de la teloconcha de un paratipo, Furna, Brava (CER).*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(DBUA); 1 s, Rabo do Junco, 4 m (AMNH); 1 s, Rabo do Junco, 3 m (NNM 58028); 4 s, Regona, 2-3 m, and 6 s, 1 f, Mordeira Bay, 5 m (CER); 1 s, Regona, 2 m (MNHN). All the type material from Sal.
Other material studied: Sal: 2 sp, Mordeira Bay, 4 m (broken for radular study); 2 s, Regona. Boa Vista: 3 s, Sal Rei, 8 m; 8 s, Porto da Cruz, 4 m.
Etymology: The specific name alludes to the very solid shell.

Description: Shell (Figs. 15, 16) length up to 4.3 mm, maximum width 2.0 mm, very solid, elongate-conic.

Protoconch (Fig. 17) of 1 whorl and 400 μm of maximum diameter, of non-planktotrophic type, with a spiral cord and a slight angulation below; transition to teleoconch abrupt. Microsculpture (Fig. 18) formed by numerous small pits.

Teleoconch of 5 whorls; two adapical spire whorls convex below sutures, subsequent spire whorls becoming gradually angulate only in subsutural part; suture evident; last whorl strongly convex. Colour whitish.

Axial sculpture consisting of prominent, strongly convex, rounded, almost orthocline, widely spaced axial ribs, slightly shouldered in their subsutural part, between 10-12 in the last whorl. Spiral sculpture inconspicuous. Microsculpture (Fig. 19) formed by very numerous fine spiral threads, with a wider one between each 5-13 fine threads, sometimes more evident in the subsutural region.

Aperture D-shaped, relatively small; inner lip thick; columellar side weakly concave; anterior channel shallow; outer lip opisthocline, with strong varix with several concentric lines towards the inner part of the aperture.

Operculum (Fig. 148) translucent, thin, paucispiral, with a very eccentric nucleus, and without any peg on inner side; the insertion area is elongate and close to the edge.

Radula (Fig. 144): central tooth with 1 pair of basal denticles, and a prominent central cusp with 3-4 small cusps at each side; inner marginal teeth finely denticulate; outer marginal teeth without any denticles on the external margin.

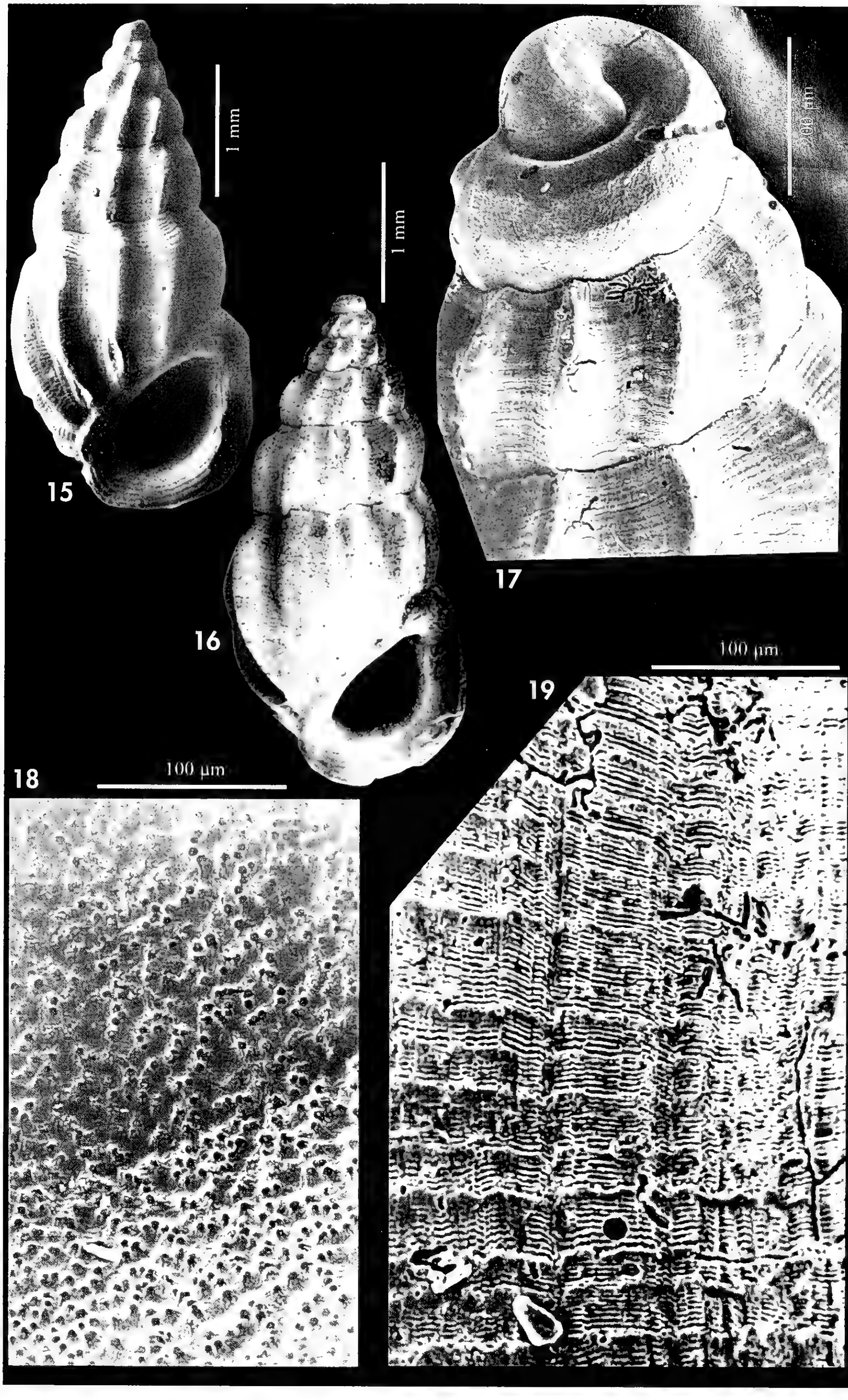
Habitat: Sandy sediments in shallow water.

Distribution: Only known from Sal and Boa Vista Islands (Fig. 159).

Remarks: The holotype of *Schwartziella africana* (Dautzenberg, 1913) (MNHN) from "Pointe de Bel-Air (baie de Hann)", Dakar (Senegal) lacks protoconch, but it is smaller (2.9x1.2 mm) than *S. robusta* n. sp., the whorls are not angulate, the axial ribs are 4-5 times narrower than interspaces and there are fine growth lines more evident at the subsutural region and very fine spiral threads more evident at the middle of the whorls. The sole specimen of *Rissoina africana* var. *crassior* (Dautzenberg, 1913), from the same locality (MNHN), is very different of the holotype in having an undulate suture between the penultimate and the last whorls (almost straight in the holotype), axial ribs only a little narrower than interspaces, and apparently no microsculpture. The protoconch is paucispiral (one whorl) and apparently smooth. It is also smaller (2.9x1.4 mm) than *S. robusta* n. sp.

The specimens described and illustrated by GOFAS (1999) under the name of *Schwartziella africana* from Senegal are also different from *S. robusta* n. sp.: they

(Right page) Figures 15-19: *Schwartziella (Schwartziella) robusta* n. sp. 15: holotype, Fiura, Sal (MNCN 15.05/31718); 16: paratype, Fiura, Sal (MNCN 15.05/31718); 17: protoconch of a paratype, Regona, Sal (CER); 18: protoconch microsculpture of the same paratype; 19: teleoconch microsculpture of the same paratype.
(Página derecha) Figuras 15-19: Schwartziella (Schwartziella) robusta *spec. nov. 15: holotipo, Fiura, Sal (MNCN 15.05/31718); 16: paratipo, Fiura, Sal (MNCN 15.05/31718); 17: protoconcha de un paratipo, Regona, Sal (CER); 18: microescultura de la protoconcha del mismo paratipo; 19: microescultura de la teloconcha del mismo paratipo.*


15
1 mm
16
1 mm
17
18
100 µm
19
100 µm

are larger (up to 5.25x2.15 mm), with the whorls not angulate but convex, and the protoconch has no spiral cords but rounded spots. According to GOFAS (1999), *S. africana* is only known with certainty from a small stretch of coastline around Dakar, Senegal. The only shell recorded from Maio island (Cape Verde Archipelago) must be regarded as an erroneous record, since no specimens of this species were found in the large material examined in this paper.

The differences of *S. robusta* with the other new species of *Schwartziella* described below are given in the remarks of each species.

Schwartziella (Schwartziella) obesa n. sp. (Figs. 20-24, 160)

Type material: Holotype (Fig. 20) 1 s of 5.5 x 2.4 mm from Furna Bay, Brava Island, Cape Verde Archipelago, 15-20 m (MNCN 15.05/31712). Paratypes: 3 s (DBUA); 2 s (CER); 1 s (AMNH); 1 s (NNM 58019); 1 s (MNHN), all from the type locality.

Other material studied: Brava: 2 f, Furna, 30 m; 2 s, Pedrinha, 4 m; 1 s, Porto do Ancião, 30 m. Santiago: 1 s, Praia, 5 m; 1 sp, 5 s (Fig. 16), 4 f, Tarrafal, 3 m; 2 s, Cidade Velha, 5 m; 2 f, CANCAP Sta. 6.015, S of Santiago, 14° 53′ N, 23° 30′ W, 150 m (5-VI-1982) (NNM); 2 j, 1 f, CANCAP Sta. 6.024, 15° 00′ N, 23° 44′ W, 540 m (7-VI-1982) (NNM); 2 j, CANCAP Sta. 6.054, 14° 54′ N, 23° 30′ W, 29-33 m (11-VI-1982) (NNM); 1 j, CANCAP Sta. 7.008, 14° 54′ N, 23° 38′ W, 320 m (20-VIII-1986) (NNM). Fogo: 1 j, CANCAP Sta. 6.052, 14° 53′ N, 24° 31′ W, 85 m (10-VI-1982) (NNM). São Vicente: 1 s, Calhau, 4 m. Maio: 2 f, CANCAP Sta. 7.050, 15° 06′ N, 23° 14′ W, 380 m (25-VIII-1986) (NNM).

Etymology: The specific name alludes to the wide shell.

Description: Shell (Figs. 20, 21) length up to 7.0 mm, maximum width 2.8 mm, solid, elongate-conic, strongly scalariform.

Protoconch (Fig. 22) of 1 whorl and about 300 µm of maximum diameter, of non-planktotrophic type, with a spiral cord in its upper part; transition to teleoconch abrupt. Microsculpture formed by very small pits.

Teleoconch of 5-6 whorls; spire strongly scalariform, whorls with a prominent subsutural shoulder and rapidly enlarging; suture shallow but clearly visible. Colour whitish.

Axial sculpture consisting of prominent, sharp, narrow and widely spaced axial ribs, which are aligned across several whorls, slightly opisthocline on the first whorls and almost orthocline in the body whorl, on where there are about 14-15 ribs, clearly arched to the base. Spiral sculpture formed by very fine cords. Microsculpture (Figs. 23, 24): all the surface of the shell is covered by very fine threads, both on the spiral cords and the interspaces.

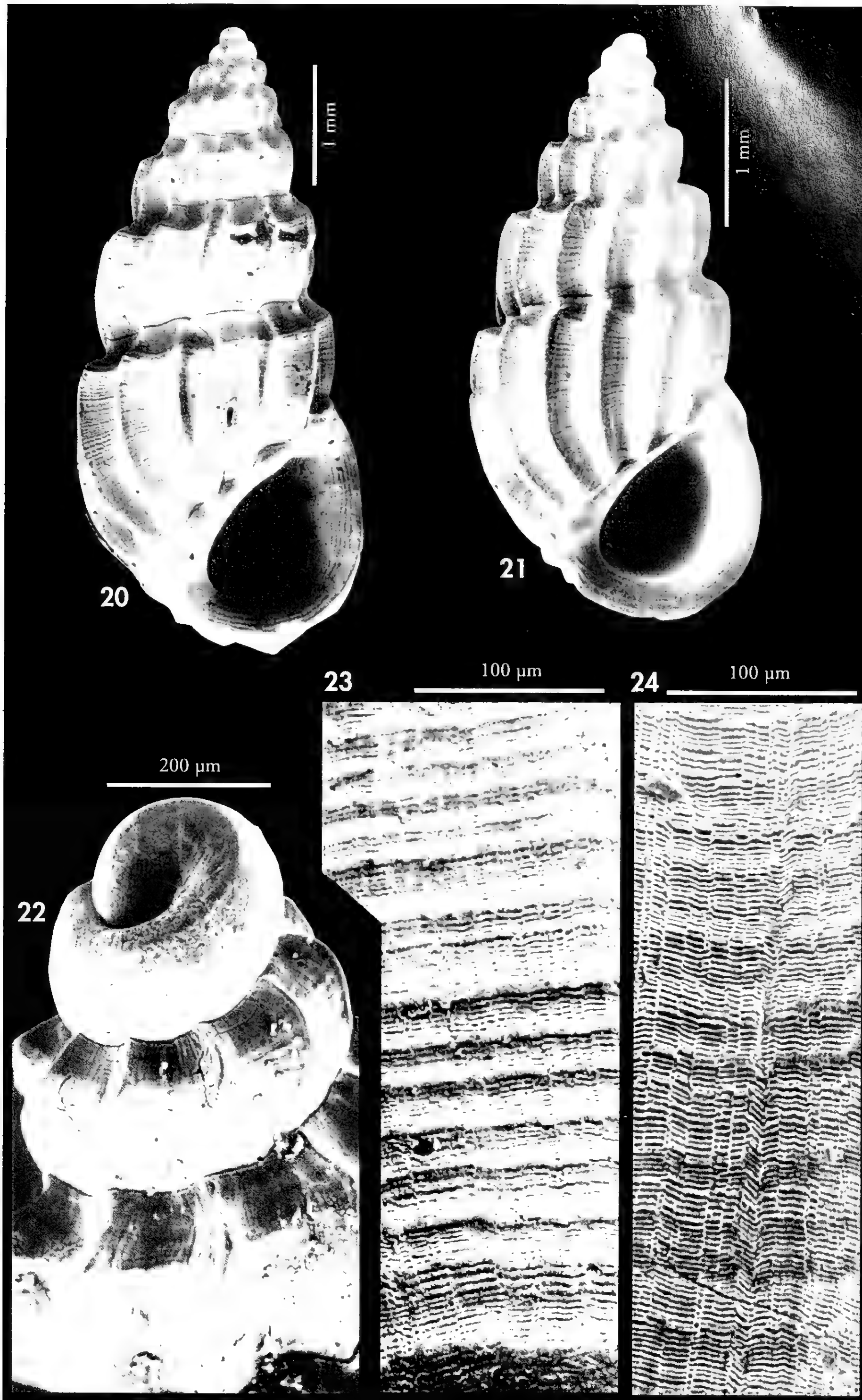
Aperture D-shaped, small; inner lip thick; columellar side strong, weakly concave; anterior channel shallow; outer lip opisthocline, with thick external varix, with about eight parallel lines towards the inner part of the aperture.

Habitat: Sandy sediments from 3 to 600 m.

Distribution: Known from the group of Brava-Santiago-Fogo Islands, but some fragments from Maio and one shell from São Vicente seem to be this species (Fig. 160).

(Right page) Figures 20-24: *Schwartziella (Schwartziella) obesa* n. sp. 20: holotype, Furna, Brava (MNCN 15.05/31712); 21: shell from Tarrafal, Santiago (CER); 22: protoconch of a shell from Tarrafal, Santiago (CER); 23: teleoconch microsculpture of the holotype; 24: teleoconch microsculpture of a shell from Tarrafal (CER).

(Página derecha) Figuras 20-24: Schwartziella (Schwartziella) obesa *spec. nov. 20: holotipo, Furna, Brava (MNCN 15.05/31712); 21: concha de Tarrafal, Santiago (CER); 22: protoconcha de una concha de Tarrafal, Santiago (CER); 23: microescultura de la teloconcha del holotipo; 24: microescultura de la teloconcha de una concha de Tarrafal (CER).*


1 mm
1 mm
20
21
23
100 µm
24
100 µm
200 µm
22

Remarks: The shells of *Schwartziella obesa* n. sp. from Brava seem to be a little different from those of Santiago and São Vicente: the latter are a little smaller, the axial ribs are a little closer, the subsutural angle is slightly more elevate and the spiral threads are more depressed (see Figs. 18, 19). All these differences seem to be not relevant in order to consider both populations to be not conspecific, and probably they are the expression of a difficult genetic flow between populations of different islands, but only more detailed studies on living specimens will clarify this matter.

S. robusta n. sp. also has a thick shell, but it lacks the subsutural angulation and the scalariform profile of *S. obesa*, the axial ribs are less numerous, sharper and more arched in its subsutural part and to the base. The spiral threads of the subsutural part are more evident in *S. robusta*, whereas in *S. obesa* are more attenuated.

S. africana (Dautzenberg, 1913) and *S. africana* var. *crassior* (Dautzenberg, 1913) are smaller, their whorls are not angulate, and the axial ribs and the spiral sculpture and microsculpture are different. The protoconch of *S. africana* var. *crassior* is apparently smooth, without any spiral cord (see under remarks of *S. robusta*). The specimens of *Schwartziella africana* described and illustrated by GOFAS (1999) from Senegal are also different: they are smaller, the whorls are not angulate, have a lower number of ribs on the body whorl (ca. 12), the protoconch has no spiral cords and its microsculpture consists of rounded spots.

Schwartziella (Schwartziella) corrugata n. sp. (Figs. 25-29, 161)

Type material: Holotype (Fig. 25) 1 s of 5.6 x 2.1 mm from Furna, Brava Island, Cape Verde Archipelago, 30 m (MNCN 15.05/31703). Paratypes: 1 s (MNHN) and 3 s (CER) (Fig. 26), all from the type locality.

Other material studied: Brava: 2 s, 1 f, 2 j (1 broken), Pedrinha, 10 m; 1 s, 2 f, Porto do Ancião, 3 m; 1 s, Ilhéus do Rombo, 3 m.

Etymology: The specific name alludes to the sutural undulation formed by the axial ribs of the shell.

Description: Shell (Fig. 25) length up to 5.6 mm, maximum width 2.1 mm, very solid, elongate-conic.

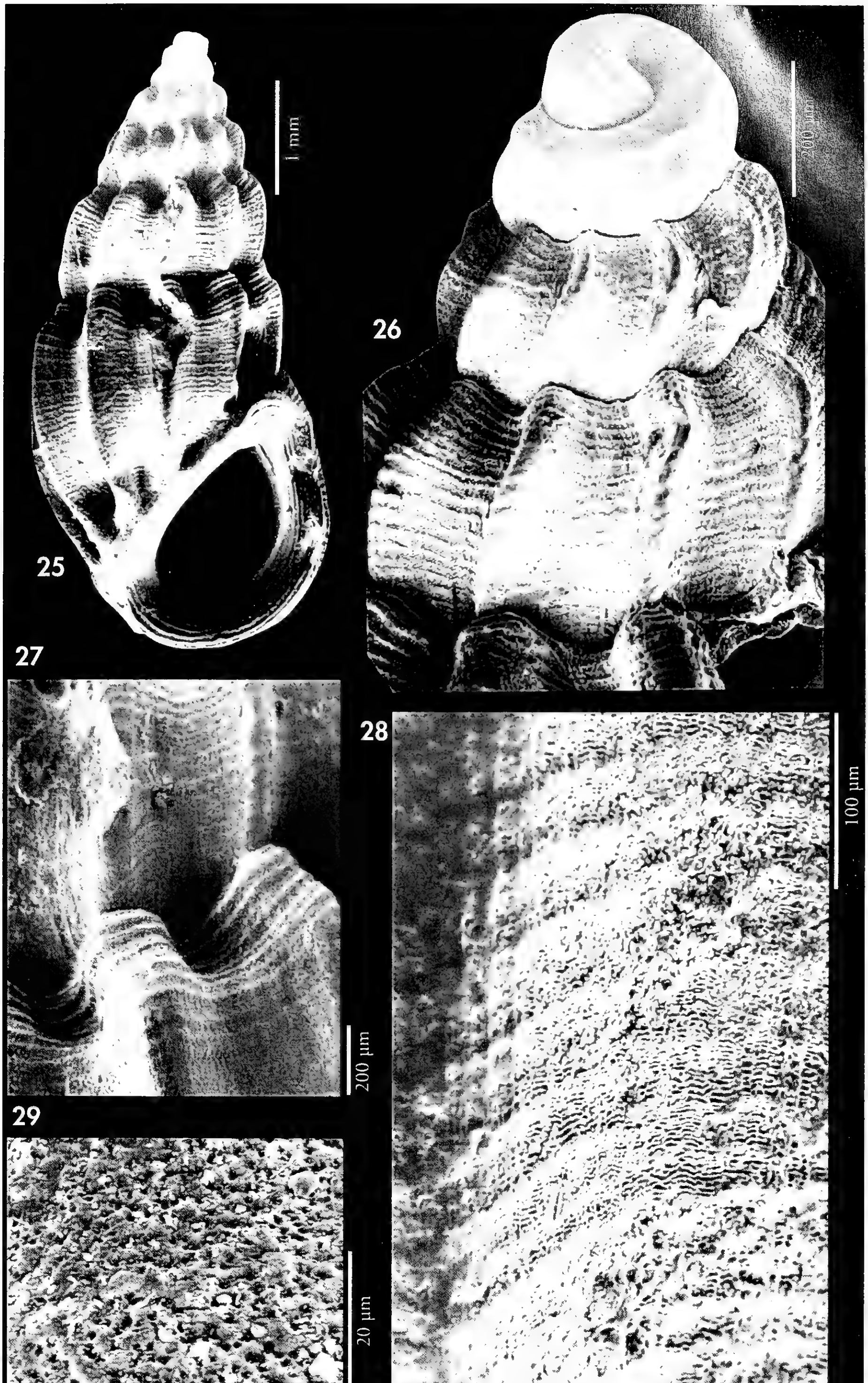
Protoconch (Fig. 26) of 1 whorl and 360 μm of maximum diameter, of non-planktotrophic type, with one spiral cord in its upper part and an angulation below; transition to teleoconch abrupt. Microsculpture (Fig. 29) formed by very small pits.

Teleoconch of 5 whorls, weakly convex, slightly angulated below sutures; last whorl weakly convex; suture (Figs. 26, 27) well marked and undulous due to the axial ribs. Colour whitish.

Axial sculpture consisting of prominent, rounded, spaced axial ribs, which are almost orthocline in the body whorl and opisthocline in previous whorls, curved subsuturally, and about 12 in last whorl. Near the base, the interspace between ribs is deep. Spiral sculpture formed by fine cords, visible at low magnification, and more evident in the

(Right page) Figures 25-29: *Schwartziella (Schwartziella) corrugata* n. sp. 25: holotype, Furna, Brava (MNCN 15.05/31703); 26: protoconch of a paratype, Furna, Brava (CER); 27: detail of the suture of a paratype, Furna, Brava (CER); 28: teleoconch microsculpture of a paratype, Furna, Brava (CER); 29: protoconch microsculpture of a paratype, Furna, Brava (CER).

(Página derecha) Figuras 25-29: Schwartziella (Schwartziella) corrugata *spec. nov. 25: holotipo, Furna, Brava (MNCN 15.05/31703); 26: protoconcha de un paratipo, Furna, Brava (CER); 27: detalle de la sutura de un paratipo, Furna, Brava (CER); 28: microescultura de la teloconcha de un paratipo, Furna, Brava (CER); 29: microescultura de la protoconcha de un paratipo, Furna, Brava (CER).*


25
26
27
28
29
1 mm
200 µm
200 µm
100 µm
20 µm

subsutural zone. Microsculpture (Fig. 28) formed by many irregular threads between and on the spiral cords.

Aperture D-shaped, relatively small; inner lip thick; columellar side weakly concave; anterior channel shallow; outer lip thick with external varix with about seven parallel lines towards the inner part of the aperture.

Habitat: The material studied was obtained from sand sediments between a few meters and 30 m deep.

Distribution: S. corrugata n. sp. is only known from Brava Island and Ilhéus do Rombo (Fig. 161).

Remarks: S. corrugata n. sp. has a shell as solid as the precedent ones (*S. robusta* and *S. obesa*), but it can be differentiated by its very undulous sutural line due to the stronger and elevated axial ribs and it lacks of the subsutural depression. *S. corrugata* and *S. robusta* have similar protoconch and teleoconch microsculpture, and the allopatric distribution of both species point out to be different morphs (or subspecies) of an unique species distributed in different islands. Nevertheless, no intermediate forms between the marked undulous suture of *S. corrugata* and the linear suture of *S. robusta* were found in other islands, so we consider them as different species. *S. corrugata* is sympatric with *S. obesa* in Brava.

Schwartziella africana (Dautzenberg, 1913) is smaller, the whorls are not angulate, and the suture, axial and spiral sculpture and microsculpture are also different (see under remarks of *S. robusta*).

S. africana var. *crassior* (Dautzenberg, 1913) has an undulate suture, but it is also smaller, its axial ribs are wider, and apparently has no microsculpture both in protoconch and teleoconch.

Schwartziella (Schwartziella) sanmartini n. sp. (Figs. 30-34, 146, 149-151, 156, 162)

Type material: Holotype (Fig. 30) 1 s of 4.8 x 2.0 mm, and paratypes, 2 s, from Mordeira Bay, Sal Island, Cape Verde Archipelago, 4 m (MNCN 15.05/31719). Paratypes: Paratypes: 3 s, Mordeira Bay, Sal, 5 m (CER); 4 sp, 6 s, Rabo de Junco, Sal, 4 m (CER); 2 sp, 1 s, Mordeira, Sal (DBUA); 2 s, Regona, Sal, 4 m (MNHN); 1 s, Mordeira, Sal, 4 m (AMNH); 1 s, Mordeira, Sal, 4 m (NNM 58029).
Other material studied: Sal: 1 s, 6 j, Palmeira, 6 m; 6 s, 1 f, Mordeira, 5 m; 1 s, Rabo de Junco, 2 m; 1 s, Algodoeiro, 4 m. Boa Vista: 5 s, Sal Rei, 4 m; 2 sp, 2 s, Ilhéu de Sal Rei, 5 m; 1 s, Porto Ferreira, 5 m; 3 s, Porto da Cruz, 4 m; 2 s, 4 j, Baia Teodora, 5 m; 3 s, Derrubado, 5 m. Maio: 1 s, Navio Quebrado, 3 m.
Etymology: The specific name is dedicated to the zoologist Guillermo San Martín, companion of some research trips.

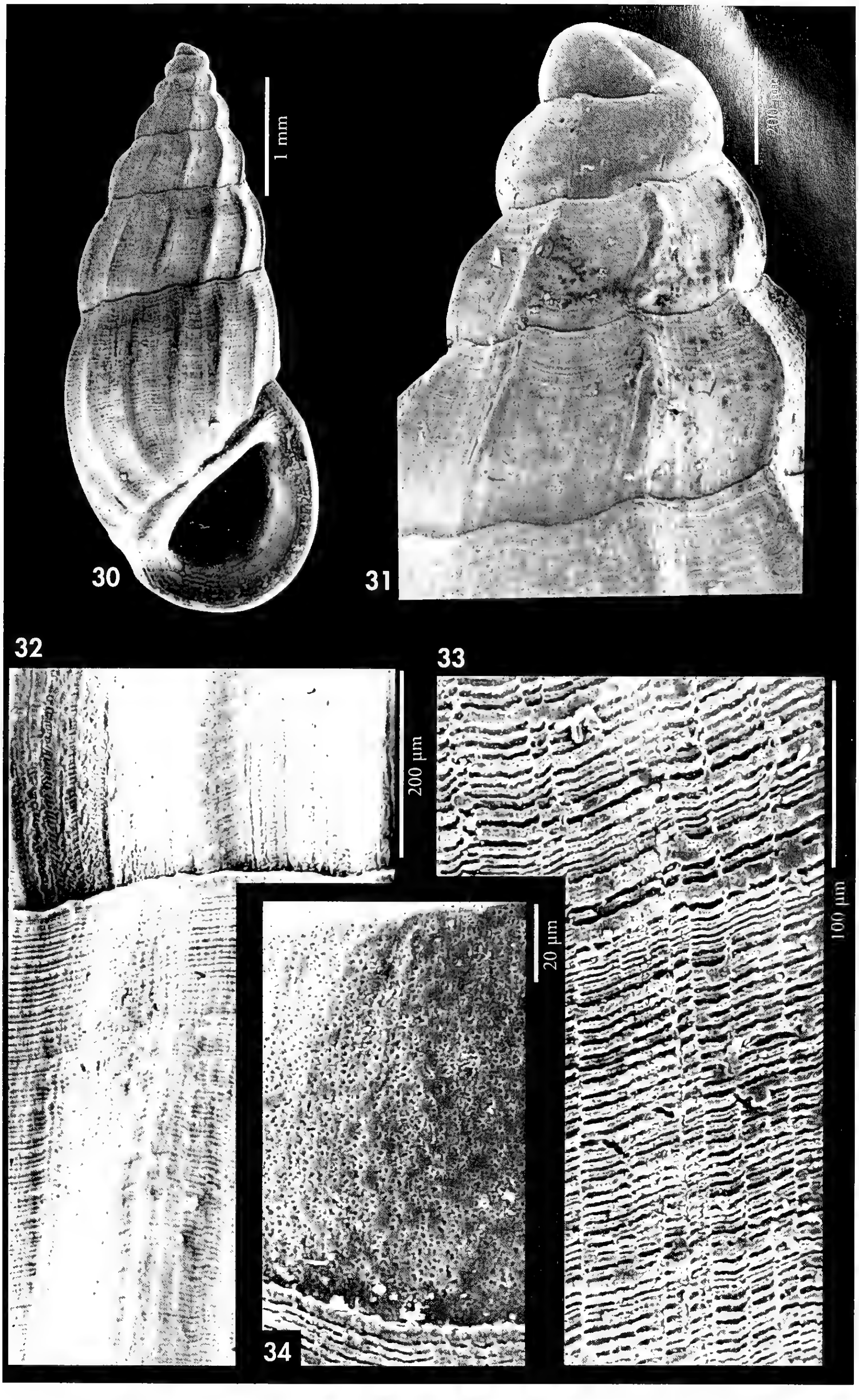
Description: Shell (Fig. 30) length up to 5.0 mm, maximum width 2.1 mm, relatively solid, elongate-conic.

Protoconch (Fig. 31) of 1 whorl and 360 μm of maximum diameter, of non-planktotrophic type, no spiral sculpture except by a very slight angulation in its upper part. Microsculpture (Fig. 34) formed by very small pits.

Teleoconch of about 5 whorls weakly convex, slightly angulated below sutures; last whorl large, weakly convex, repre-

(Right page) Figures 30-34: *Schwartziella (Schwartziella) sanmartini* n. sp. 30: holotype, Mordeira, Sal (MNCN 15.05/31719); 31: protoconch of the holotype; 32: detail of the suture of a paratype, Mordeira (CER); 33: teleoconch microsculpture of the same paratype; 34: protoconch microsculpture of the same paratype.

(Página derecha) Figuras 30-34: Schwartziella (Schwartziella) sanmartini *spec. nov. 25: holotipo, Mordeira, Sal (MNCN 15.05/31719); 26: protoconcha del holotipo; 27: detalle de la sutura de un paratipo, Mordeira (CER); 28: microescultura de la teloconcha del mismo paratipo; 34: microescultura de la protoconcha del mismo paratipo..*


1 mm
200 µm
30
31
32
33
200 µm
20 µm
100 µm
34

senting more than a half of the shell; suture shallow, slightly undulate due to the axial sculpture. Colour whitish.

Axial sculpture consisting of depressed, rounded, narrow, almost orthocline in last whorl and opisthocline in previous whorls, distantly spaced axial ribs, about 14 in last whorl. Spiral sculpture almost not appreciable at low magnification. Microsculpture (Figs. 32, 33) formed by very fine threads axially interrupted and modified by growth lines.

Aperture D-shaped, small; inner lip thick; columellar side weakly concave; anterior channel almost absent; outer lip with ample external varix with several parallel lines towards the inner of the aperture.

Operculum (Figs. 149-151) translucent, thin, paucispiral with the nucleus very eccentric and without any prominent peg on inner side.

Radula (Fig. 146): central tooth with one pair of basal denticles, a slightly prominent central cusp, and 3-4 smaller cusps at each side, the more basal ones very small; lateral teeth with 6-8 cusps on the inner edge and 4-5 on the outer edge; inner marginal teeth with many small denticles on both edges (serrated); outer marginal teeth without any denticle on the outer edge.

The animal (Fig. 156) examined in alcohol is apparently white. The penis has a cylindrical base; in the middle part it is curved ahead, and flattened and enlarged at its distal end; the margin of both sides of this terminal widening are denticulate and also two denticulate fringes appear close to the tip, with a short and sharp appendix towards the right part.

Habitat: The material studied was obtained in sand sediments between 3-6 m.

Distribution: Only known from Sal, Boa Vista and Maio (Fig. 162).

Remarks: Schwartziella sanmartini n. sp. has a thinner shell than *S. robusta, S. obesa* and *S. corrugata,* and its axial ribs are more depressed and rounded and less elevate. Also it differs from *S. robusta* n. sp. by having more axial ribs, from *S. obesa* n. sp. by lacking of any subsutural angulation, and from *S. corrugata* by the slightly undulate suture.

S. africana y *S. africana* var. *crassior* are smaller; the first species has narrower ribs, fine growth lines more evident at the subsutural region and very fine spiral threads more evident at the middle of the whorls. *S. africana* var. *crassior* has an undulate suture, axial ribs only a little narrower than interspaces, and apparently no microsculpture.

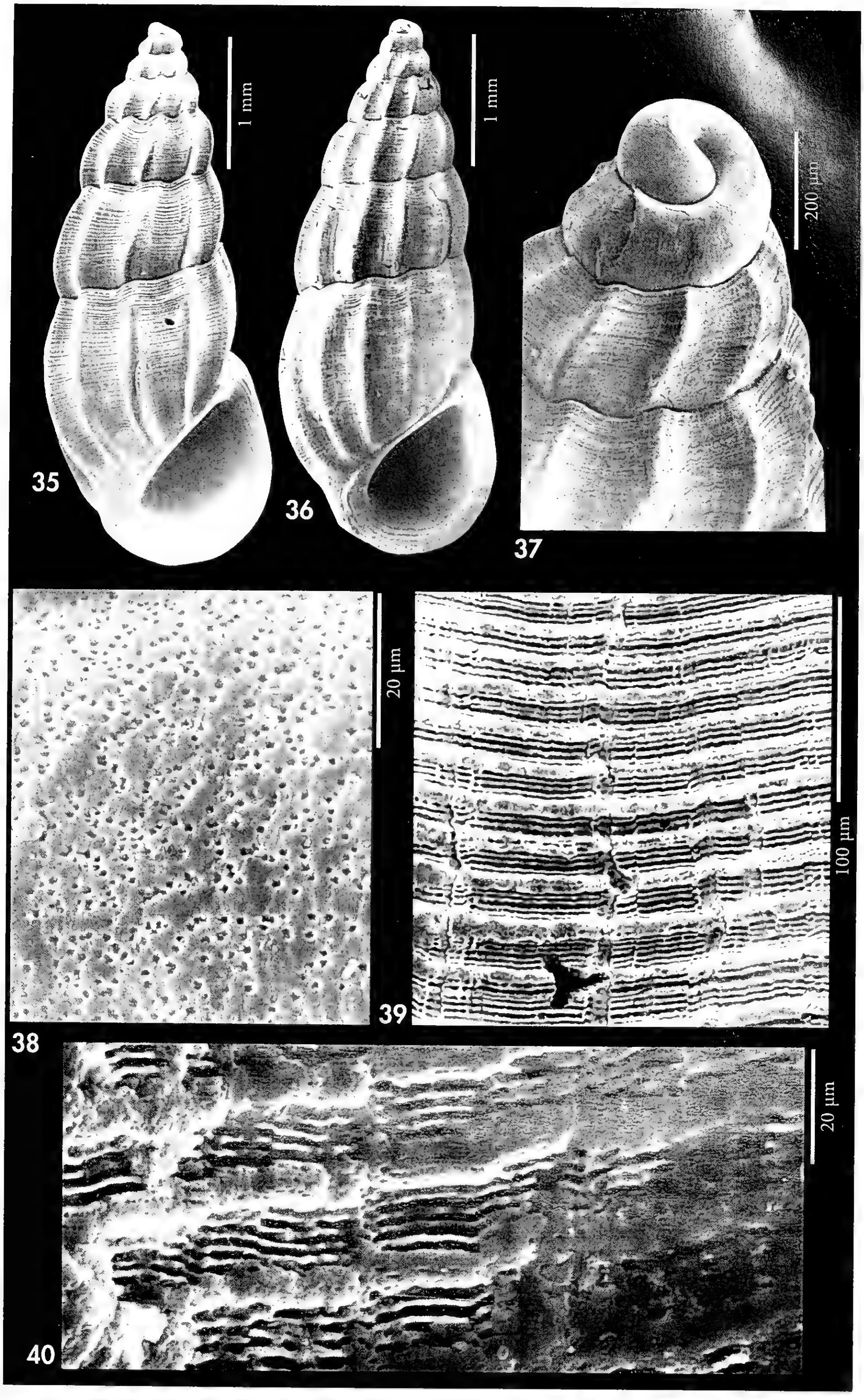
Schwartziella (Schwartziella) similiter n. sp. (Figs. 35-40, 147, 152, 163)

Type material: Holotype (Fig. 35) 1 s of 5.6 x 2.1 mm and 5 paratypes, 5 s, Furna, Brava Island, Cape Verde Archipelago, 8-20 m (MNCN 15.05/31721). Other paratypes: 2 s from the type locality in each of MNHN, AMNH, DBUA, NNM (58031), and 42 s in CER.

Other material studied: Brava: 3 sp, 115 s, 41 f, 2 j, Furna, 8-20 m; 5 s, 8 j, Pedrinha, 4 m; 3 sp, 23 s, 14 j, 3 f, Porto do Ancião, 3 m; 6 s, 4 j, Ilhéus do Rombo, 3-5 m. Santiago: 31 s, 5 j, 6 f, Praia, Ilhéu de Santa Maria, 6 m; 8 s, 5 j, 1 f, Prainha, 5 m; 4 s, Cidade Velha, 4 m; 29 s, 2 j, Tarrafal, 4 m; 1 s, 1 j, 1 f, CANCAP Sta. 6024, 15° 00′ N, 23° 44′ W, 540 m (7-VI-1982) (NNM). São Vicente: 13 s, Calhau, 3 m; 1 s, Porto Mindelo, 15 m; 4 s, Salamança. Santa Luzia: 2 sp, 1 s, Praia Francisca, 3 m.

(Right page) Figures 35-40: *Schwartziella (Schwartziella) similiter* n. sp. 35: holotype, Furna, Brava (MNCN 15.05/31721); 36: shell from Tarrafal, Santiago (CER); 37: protoconch of a paratype, Furna (CER); 38: protoconch microsculpture of the same paratype; 39-40: teleoconch microsculpture of a shell from Furna.

(Página derecha) Figuras 35-40: Schwartziella (Schwartziella) similiter *spec. nov. 35: holotipo, Furna, Brava (MNCN 15.05/31721); 36: concha de Tarrafal, Santiago (CER); 37: protoconcha de un paratipo, Furna (CER); 38: microescultura de la protoconcha del mismo paratipo; 39-40: microescultura de la teloconcha de un ejemplar de Furna.*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100 µm
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39
20 µm
40

Etymology: The specific name alludes to the similarity of the shell of this species with other species of Cape Verde *Schwartziella*.

Description: Shell (Figs. 35, 36) length up to 6.0 mm, maximum width 2.1 mm, relatively solid, elongate conic.

Protoconch (Fig. 37) of 1 whorl and about 300 μm of maximum diameter, of non-planktotrophic type, with a spiral cord running along a keel on its upper part; transition to teleoconch abrupt. Microsculpture (Fig. 38) formed by very small pits.

Teleoconch of 5 whorls, regularly convex, not angulated below sutures, last whorl weakly convex; suture shallow, slightly undulate. Colour whitish.

Axial sculpture consisting of slightly prominent, rounded, narrow, almost orthocline in the last whorl and opisthocline in previous, distantly spaced axial ribs not regularly continued from whorl to whorl. Spiral sculpture appreciable with difficulty at small magnification. Microsculpture (Figs. 39, 40) consisting in very close relatively thick spiral threads interrupted by axial growth lines, with 2-5 thinner threads between each two of them which are interrupted in some places.

Aperture D-shaped, small; inner lip thick; columellar side weakly concave; anterior channel almost absent; outer lip with a thick varix; with about 5 parallel lines.

Operculum (Fig. 152) translucent, thin, paucispiral, with a very eccentric nucleus and without any prominent peg on the inner side.

Radula (Fig. 147): central tooth with one pair of basal denticles, a few prominent central cusp and 3-4 small cusps at each side, those of the extremes very small; lateral teeth with 7-8 cusps on the inner edge and 4-5 on the outer edge inner marginal teeth with many small denticles; outer marginal teeth without denticles on the external edge.

Habitat: The material studied was obtained in sand sediments from 4 to 20 m. One sample was collected at 540 m.

Distribution: Santiago, Brava, São Vicente and Santa Luzia (Fig. 163).

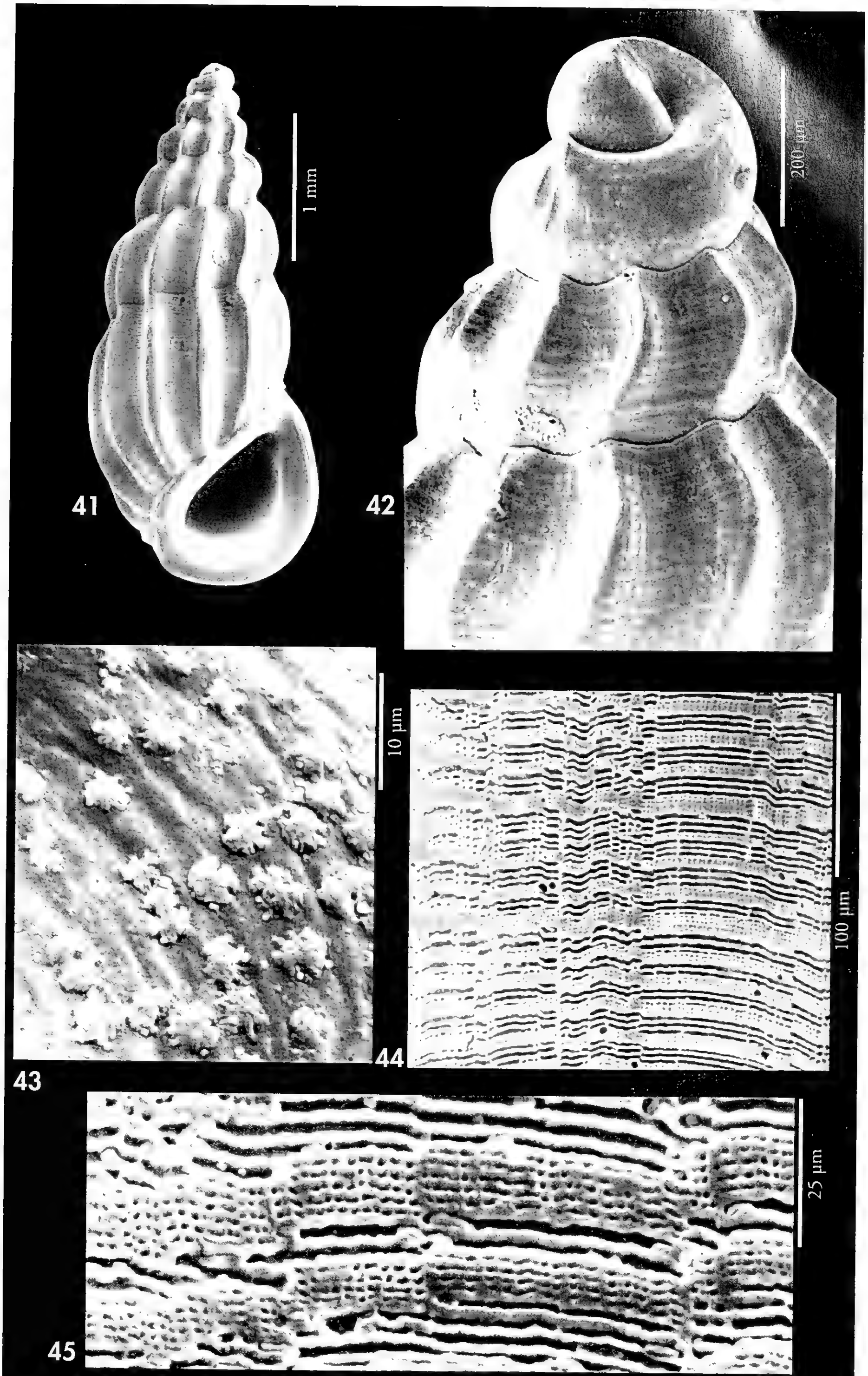
Remarks: The shells from the northern (Santa Luzia and São Vicente) and the southern (Brava and Santiago) islands are very similar, with only small differences in size, and we consider them conspecific though both groups of islands are quite far for this species with non-planktotrophic development.

S. similiter n. sp. is similar to *S. sanmartini* n. sp., and the differences with other species mentioned in its remarks are not repeated here. *S. sanmartini* n. sp. is wider than *S. similiter* n. sp., has more axial ribs and these are more depressed; also, it has different microsculpture, with less marked and interrupted spiral threads, and a slightly smaller protoconch.

Schwartziella (Schwartziella) typica n. sp. (Figs. 41-45, 142, 143, 145, 164)

Type material: Holotype (Fig. 41) 1 s of 3.8 x 1.6 mm and one paratype, 1 s, Palmeira, Sal Island, Cape Verde Archipelago, 6 m (MNCN 15.05/31705). Paratypes: 1 s from Monte Leste, Sal, in each of MNHN, AMNH, DBUA, NNM (58006), and 1 s, from Guincho do Ninho, 4 m; 2 s, from Palmeira, 6 m; 1 s, from Punta Preta, 3 m; 16 s, from Rabo de Junco, 6 m, and 4 s, from Regona, 10 m, all in CER.
Other material studied: Sal: 5 s, Palhona, 1 m; 1 sp (broken for radular study), 3 s, 6 f, Monte Leste, 1 m; 4 s, Algodoeiro, 4 m; 4 s, Palmeira, 8 m; 4 s, Regona, 3 m; 3 s, 1 j, Mordeira, 5 m; 7 s, 3 j, 3 f,

(Right page) Figures 41-45: *Schwartziella (Schwartziella) typica* n. sp. 41: holotype, Palmeira, Sal (MNCN 15.05/31705); 42: protoconch of a paratype, Palmeira (CER); 43: protoconch microsculpture of the same paratype; 44-45: teleoconch microsculpture of the same paratype.
(Página derecha) Figuras 41-45: Schwartziella (Schwartziella) typica *spec. nov. 41: holotipo, Palmeira, Sal (MNCN 15.05/31705); 42: protoconcha de un paratipo, Palmeira (CER); 43: microescultura de la protoconcha del mismo paratipo; 44-45: microescultura de la teloconcha del mismo paratipo.*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CANCAP Sta. 7.100, off Palmeira, 16° 45′ N, 23° 01′ W, 354 m (30-VIII-1986) (NNM); 2 j, off Palmeira, CANCAP Sta. 7.109, 16° 45′ N, 22° 59′ W, 31 m (31-VIII-1986) (NNM). Boa Vista: 6 s, 2 j, Sal Rei. São Nicolau: 17 s, 6 j, 6 f, São Jorge Bay, CANCAP Sta. 7.129, 16° 33′ N, 24° 16′ W, 405 m (2-IX-1986) (NNM); 13 s, 8 f, CANCAP Sta. 7.128, 16° 33′ N, 24° 17′ W, 400 m (2-IX-1986) (NNM).
Etymology: The specific name alludes to the typical aspect of the shell for the genus.

Description: Shell (Fig. 41) length up to 4.5 mm, maximum width 1.8 mm, solid, elongate-conic.

Protoconch (Fig. 42) of 1 whorl and about 290 μm of maximum diameter, of non-planktotrophic type, with a depressed spiral cord running along a keel in its upper part; transition to teleoconch abrupt. Microsculpture (Fig. 43) formed by flat prominences with irregular edges on an undulated surface.

Teleoconch of about 5 whorls, strongly convex, not angulated below sutures; last whorl convex; suture shallow, but evident. Colour white.

Axial sculpture consisting of prominent, relatively rounded, narrow, almost orthocline in last whorl and opisthocline in previous ones, distantly spaced axial ribs; the ribs are slightly curved in most of spire, but less in the last whorl. Spiral sculpture not appreciable at low magnification. Microsculpture (Figs. 44, 45) formed by bands of 4-6 closely packed, very fine spiral threads with minute pits between each two of them and 1-3 fine threads between each two of these bands.

Aperture D-shaped, small; inner lip thick; columellar side weakly concave; anterior channel almost absent; outer lip with thick and ample varix, almost orthocline; with 5-6 lines towards the inner part of the aperture.

Operculum translucent, with very eccentric nucleus and without any prominent peg on the inner side.

Radula (Fig. 145): central tooth with one pair of basal denticles, a slightly prominent central cusp, and 3-4 cusps at each side, those of extremes very small; lateral teeth with 6-8 cusps on the inner edge and 4-6 on the outer edge; inner marginal teeth with many small denticles on both edges, outer marginal teeth without denticles on external edge.

Habitat: The material studied was obtained in sand sediments from 1 to 400 m.

Distribution: Sal, Boa Vista and São Nicolau Islands (Fig. 164).

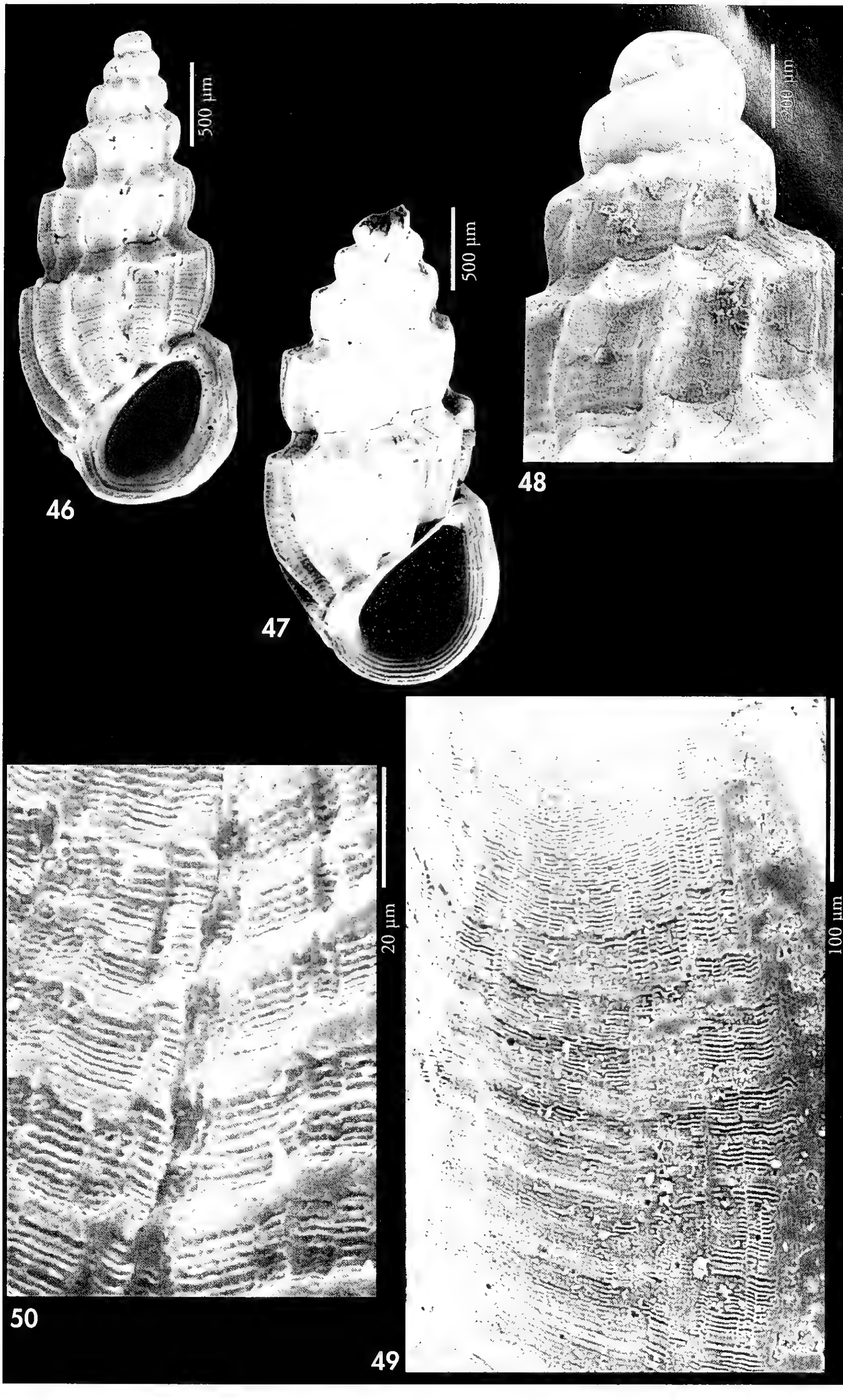
Remarks: S. typica n. sp. is similar to *S. sanmartini* n. sp. and *S. similiter* n. sp., but it is smaller than *S. sanmartini* and *S. similiter*, has more elevated axial ribs, less evident spiral sculpture and different teleoconch and protoconch microsculpture. *S. africana* has a similar protoconch microsculpture (GOFAS, 1999), but differs by its oblique axial ribs.

One shell (Figs. 142, 143) found in Calhau, São Vicente, is similar to this species and has the same microsculpture, but has a more evident spiral sculpture; we provisionally consider it conspecific awaiting for further material.

Schwartziella (Schwartziella) angularis n. sp. (Figs. 46-50, 159)

Type material: Holotype (Fig. 46) 1 s of 2.9 x 1.3 mm from Rabo de Junco, Sal Island, Cape Verde Archipelago, 4 m (MNCN 15.05/31701). Paratypes: 1 s from the type locality in each of MNHN,

(Right page) Figures 46-50: *Schwartziella (Schwartziella) angularis* n. sp. 46: holotype, Rabo de Junco, Sal (MNCN 15.05/31701); 47: paratype, Rabo de Junco, Sal (CER); 48: protoconch of a paratype, Rabo de Junco (CER); 49-50: teleoconch microsculpture of the same paratype.
(Página derecha) Figuras 46-50: Schwartziella (Schwartziella) angularis *spec. nov. 46: holotipo, Rabo de Junco, Sal (MNCN 15.05/31701); 47: paratipo, Rabo de Junco, Sal (CER); 48: protoconcha de un paratipo, Rabo de Junco (CER); 49-50: microescultura de la teloconcha del mismo paratipo.*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AMNH, DBUA, NNM (58000); further paratypes in CER: 3 s, Rabo de Junco, 4 m; 2 s, Pesqueiro do Aire, 1 m, and 2 s, Regona, 2 m.
Other material studied: Sal: 1 s, Rabo de Junco, 4 m; 2 f, CANCAP Sta. 7.110, 16° 46′ N, 23° 02′ W, 85 m (31-VIII-1986) (NNM). Boa Vista: 1 f, Sal Rei, 3 m.
Etymology: The specific name alludes the angulated subsutural shoulder of the shell.

Description: Shell (Figs. 46, 47) length up to 3.0 mm, maximum width 1.5 mm, relatively solid, elongate-conic, strongly scalariform.

Protoconch (Fig. 48) of 1 whorl and about 400 μm of maximum diameter, of non-planktotrophic type, with only a faint spiral angulation on its upper part; transition to teleoconch abrupt.

Teleoconch of about 5 whorls, which are strongly scalaroid, with a prominent subsutural shoulder and rapid development. Suture shallow, but evident. Colour whitish.

Axial sculpture consisting of prominent, straight, sharp, narrow and spaced axial ribs, regularly continued from whorl to whorl, orthocline or slightly opisthocline in first whorls, and about 12 orthocline ribs in the last whorl. Spiral sculpture formed by very fine cords. Microsculpture (Figs. 49, 50) formed by thick spiral threads with sparse very small pits, with 5-10 very thin threads between each two thick ones. The microsculpture almost disappears on the ribs.

Aperture D-shaped, small; inner lip thick; columellar side weakly concave; anterior channel very shallow; outer lip thick, strongly opisthocline, with wide external varix, with 5-6 parallel lines on the inner part.

Habitat: The material studied was obtained in sand sediments from 1 to 85 m of depth.

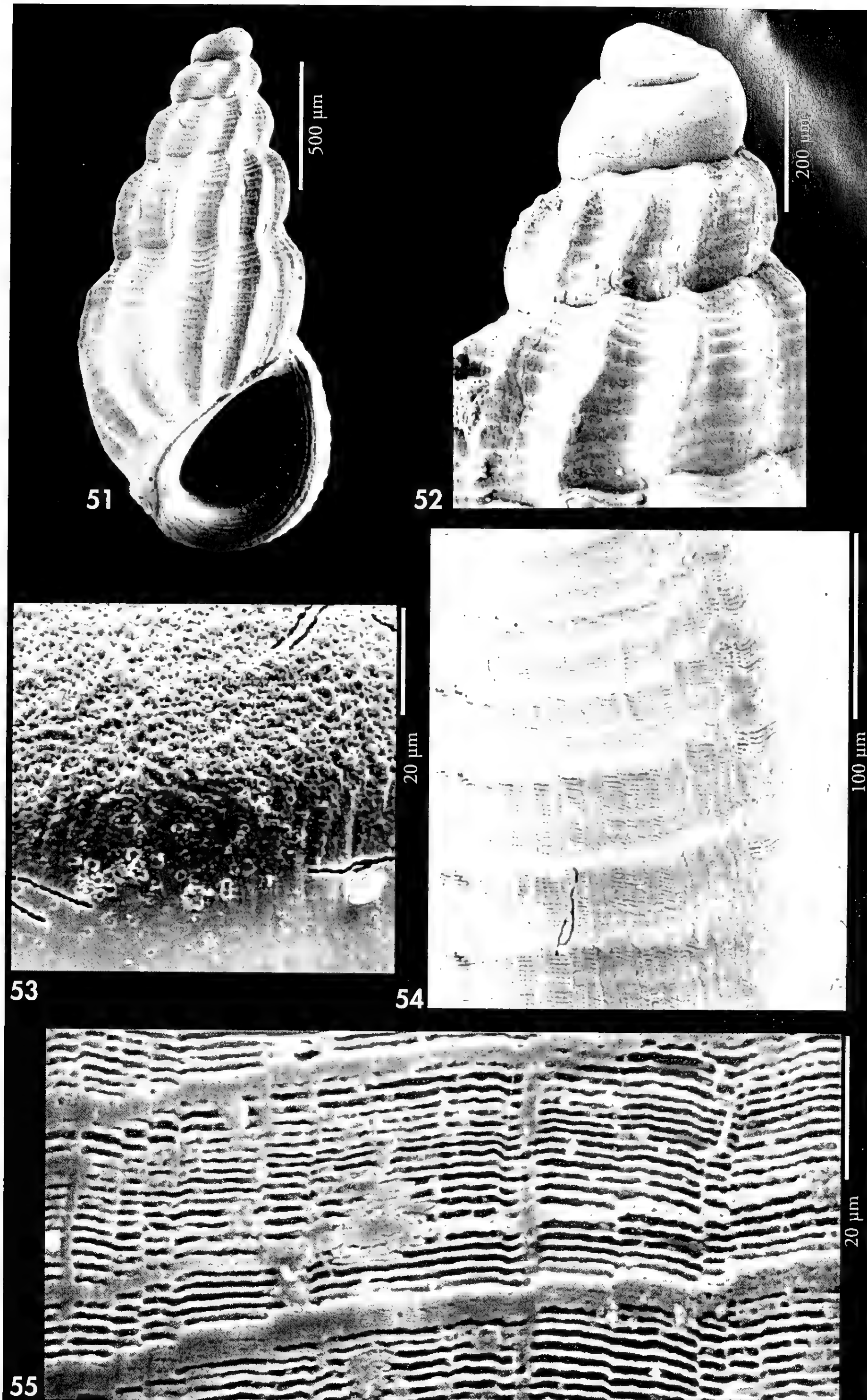
Distribution: Only known from Sal and Boa Vista Islands (Fig. 159).

Remarks: S. angularis n. sp. has a scalariform profile like *S. obesa* n. sp. and *S. gradata* n. sp. (see below), but *S. obesa* is larger, wider and more solid, and *S. gradata* is more slender and has a different protoconch sculpture.

Schwartziella (Schwartziella) luisi n. sp. (Figs. 51-55, 153-155, 159)

Type material: Holotype (Fig. 51) 1 s of 2.0 x 1.0 mm and 2 paratypes, 2 s, from Derrubado, Boa Vista Island, Cape Verde Archipelago, 2-4 m (MNCN 15.05/31722). Paratypes: 1 s in each of MNHN, AMNH, DBUA, NNM (58032), and 29 s in CER, all from the type locality.
Other material studied: Sal: 1 s, Praia do Cascalho, 1 m; 1 s, 3 j, Palmeira, 8 m; 3 s, Mordeira, 4 m; 1 j, CANCAP Sta. 7.100, off Palmeira, 16° 45′ N, 23° 01 W, 354 m (30-VIII-1986) (NNM); 1 sp, 12 s, 2 f, Rabo do Junco, 2-5 m; 1 sp, 34 s, Regona, 2-10 m; 1 s, Palhona, 1 m; 1 sp, 8 s, 3 j, Mordeira, 4 m. Boa Vista: 18 s, 35 j, 16 f, Derrubado, 4 m; 2 sp, 4 s, Baia Teodora, 6 m; 1 sp, 7 s, Ilhéu de Sal Rei, 5 m; 52 s, 18 j, 8 f, Porto da Cruz, 6 m; 35 s, 7 f, 1 j, Sal Rei, 8 m; 9 s, Porto Ferreira, 6 m; 3 s, 2 j, Rife de Chaves, 6 m; 34 s, 2 j, 2 f, Morro de Areia, 4 m; 5 s, 1 j, Baijos de João Valente, 23 m.
Etymology: The specific name is dedicated to Luis Murillo, malacologist and Secretary of the Sociedad Española de Malacología, by his contribution to the development of Malacology in Spain.

(Right page) Figures 51-55: *Schwartziella (Schwartziella) luisi* n. sp. 51: holotype, Derrubado, Boa Vista (MNCN 15.05/31722); 52: protoconch of a paratype, Derrubado (CER); 53: protoconch microsculpture of the same paratype; 54-55: teleoconch microsculpture of the same paratype.
(Página derecha) Figuras 51-55: Schwartziella (Schwartziella) luisi *spec. nov. 51: holotipo, Derrubado, Boa Vista (MNCN 15.05/31722); 52: protoconcha de un paratipo, Derrubado (CER); 53: microescultura de la protoconcha del mismo paratipo; 54-55: microescultura de la teloconcha del mismo paratipo.*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Description: Shell (Fig. 51) length up to 3.0 mm, maximum width 1.3 mm, not very solid, elongate-conic.

Protoconch (Fig. 52) of a little more than 1 whorl and about 280 µm of maximum diameter, of non-planktotrophic type, with two spiral angulations, one on the upper part and other a little below; transition to teleoconch abrupt. Microsculpture (Fig. 53) formed by very small and irregular pits.

Teleoconch of 4 strongly convex whorls, not angulated below sutures; last whorl strongly convex; suture shallow but evident. Colour whitish.

Axial sculpture consisting of prominent, sharp, narrow, slightly curved, weakly opisthocline spaced axial ribs, which are continued from whorl to whorl. Spiral sculpture formed by prominent, widely spaced, very fine cords, visible under low magnification. Microsculpture (Figs. 54, 55) formed by small pits on the spiral cords, and 15-20 very fine threads between two cords.

Aperture D-shaped, medium sized; inner lip thick; columellar side weakly concave; anterior channel almost absent; outer lip opisthocline, with thick external varix; with several parallel lines towards the inner part of the aperture.

Operculum (Figs. 153-155) translucent, thin, paucispiral with the nucleus very eccentric and without any prominent peg on the inner side.

Habitat: The material studied was obtained in sand sediments between 2-10 m and at 354 m depth.

Distribution: Only known from Sal and Boa Vista Islands (Fig. 159).

Remarks: S. luisi n. sp. is smaller than any of the previously described species. Among the smallest of those, *S. angularis* n. sp. differs by having a subsutural angulation, and *S. typica* n. sp. has a different protoconch and teleoconch microsculpture. The differences with the other small species are discussed below.

Schwartziella (Schwartziella) minima n. sp. (Figs. 56-60, 139, 159)

Type material: Holotype (Fig. 56) 1 s of 2.2 x 1.0 mm and 1 paratype, 1 s, from Regona, Sal Island, Cape Verde Archipelago, 2-4 m (MNCN 15.05/31711). Paratypes: 1 s in each of MNHN, AMNH, DBUA, NNM (58018), and 30 s in CER, all them from the type locality.

Other material studied: Sal: 5 s, 1 f, Palhona, 1 m; 1 s, Punta do Cascalho, 2 m; 2 sp, 2 s, Rabo de Junco, 5 m; 8 s, Palmeira, 5 m; 4 s, Pesqueiro do Aire, 1 m; 3 s, 2 f, Mordeira, 4 m; 3 s, CANCAP Sta. 7.100, off Palmeira, 16° 45′ N, 23° 01′ W, 354 m (30-VIII-1986) (NNM); 1 s, CANCAP Sta. 7.109, off Palmeira, 16° 46′ N, 22° 59′ W, 31 m (31-VIII-1986) (NNM). Boa Vista: 1 s, Ilhéu de Sal Rei; 2 f, Derrubado, 4 m.

Etymology: The specific name alludes to the small size of the shell.

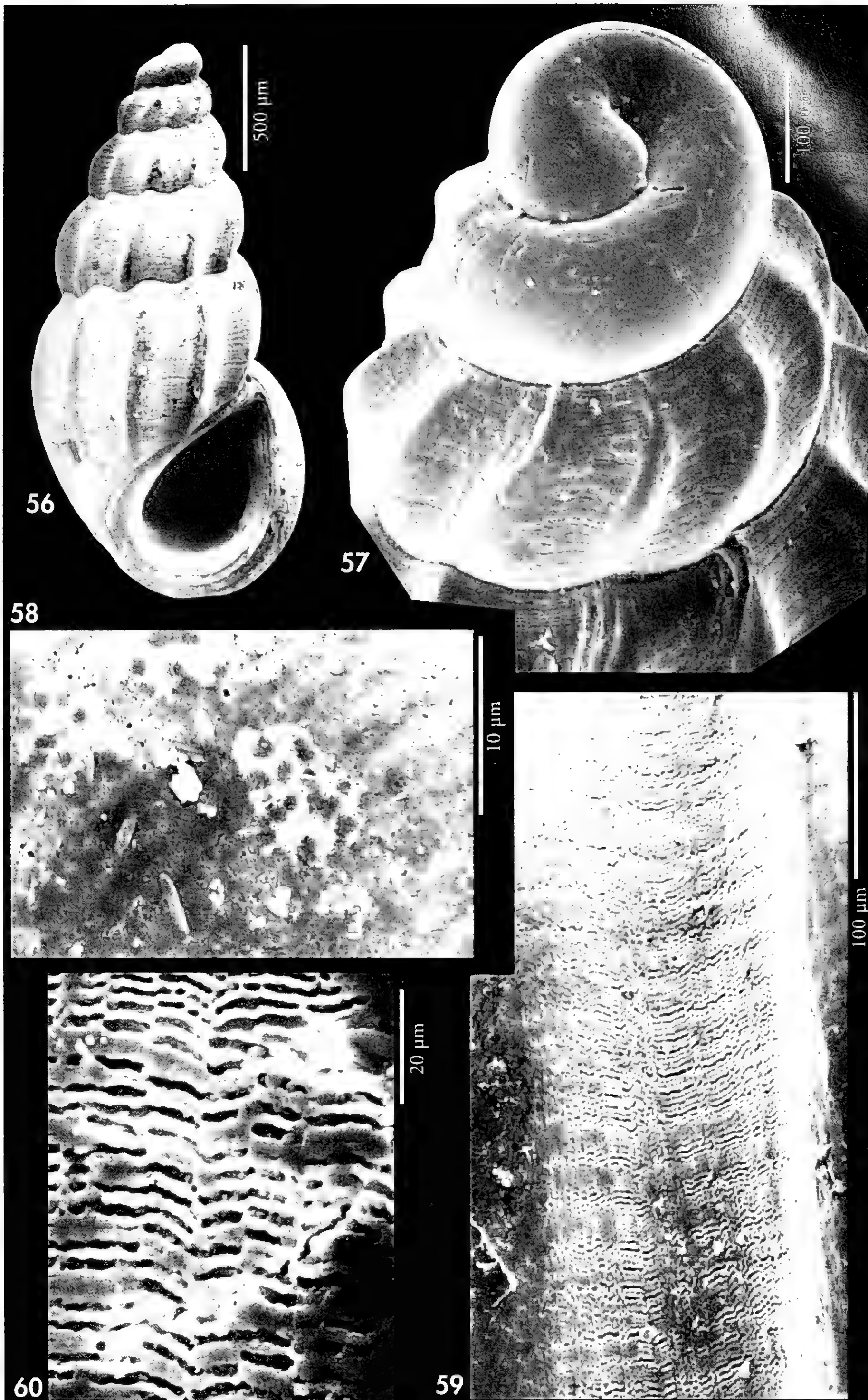
Description: Shell (Fig. 56) length up to 2.8 mm, maximum width 1.3 mm, relatively solid, elongate-conic.

Protoconch (Fig. 57) of 1 whorl and 320 µm of maximum diameter, of non-planktotrophic type, without spiral sculpture. Microsculpture (Fig. 58) formed by irregular flat prominences with some circular pits on an undulate surface.

Teleoconch of about 4 strongly convex whorls, not angulated below sutures,

(Right page) Figures 56-60: *Schwartziella (Schwartziella) minima* n. sp. 56: holotype, Regona, Sal (MNCN 15.05/31711); 57: protoconch of a shell from Regona, Sal; 58: protoconch microsculpture of a paratype, Regona (CER); 59-60: teleoconch microsculpture of the same paratype.

(Página derecha) Figuras 56-60: Schwartziella (Schwartziella) minima *spec. nov. 56: holotipo, Regona, Sal (MNCN 15.05/31711); 57: protoconcha de una concha de Regona, Sal; 58: microescultura de la protoconcha de un paratipo, Regona (CER); 59-60: microescultura de la teloconcha del mismo paratipo.*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last whorl convex; suture shallow, but evident. Colour whitish.

Axial sculpture consisting of prominent, rounded, narrow, distantly spaced axial ribs, almost orthocline in last whorl and opisthocline in previous ones. Spiral sculpture formed by very fine cords. Microsculpture (Figs. 59, 60) formed by very fine and irregular spiral threads.

Aperture D-shaped, medium sized, inner lip thick; columellar side weakly concave; anterior channel almost absent; outer lip strongly opisthocline with thick varix; with about five parallel lines towards the inner part of the aperture.

Habitat: The material studied was obtained in sand sediments between 1 and 354 m.

Distribution: Only known from Sal and Boa Vista Islands (Fig. 159).

Remarks: S. minima n. sp. is smaller than any of the previously described species. Among the small species, *S. typica* n. sp. has a larger shell, different spiral microsculpture, and the irregular flat prominences which form the microsculpture of the protoconch of smaller size and without pits; *S. angularis* n. sp. has a subsutural angulation; *S. luisi* n. sp. has a different teleoconch and protoconch microsculpture.

One shell (Fig. 139) found in Calhau, São Vicente, is similar in size to this species, but it has more curved axial ribs, a slightly different teleoconch microsculpture and spiral sculpture in the protoconch. We prefer not to describe it as new awaiting further material.

Schwartziella (Schwartziella) fulgida n. sp. (Figs. 61-65, 165)

Type material: Holotype (Fig. 61) 1 s of 2.4 x 1.1 mm, from Furna, Brava Island, Cape Verde Archipelago, 30 m (MNCN 15.05/31706). Paratypes: 1 s in each of MNHN, AMNH, DBUA, NNM (58007), and 6 s in CER, all from the type locality.

Other material studied: Brava: 4 f, Furna, 30 m; 2 s, 1 j, 1 f, Pedrinha, 6 m; 5 s, Ilhéus do Rombo, 6 m; 18 c, 1 f, Porto do Ancião, 3 m. Santiago; 1 s, 6 j, 5 f, Prainha, 5 m; 7 s, 1 f, Tarrafal, 4 m; 2 f, CANCAP Sta. 6.004, 14° 54′ N, 23° 30′ W, 58-63 m (5-VI-1982) (NNM); 4 s, CANCAP Sta. 6.010, 14° 52′ N, 23° 30′ W, 310 m (5-VI-1982) (NNM); 4 s, 1 f, CANCAP Sta. 6.015, S of the island, 14° 53′ N, 23° 30′ W, 150 m (5-VI-1982) (NNM); 1 s, CANCAP Sta. 6.024, 15° 00′ N, 23° 44′ W, 540 m (7-VI-1982) (NNM); 2 s, 3 f, CANCAP Sta. 7.008, Ponta Grande da Cidade, 14° 54′ N, 23° 38′ W, 700 m (20-VIII-1986) (NNM); 1 s, 2 j, 3 f, Cidade Velha, 6 m. Fogo: 2 s, CANCAP Sta. 6.040, 14° 55′ N, 24° 31′ W, 38-55 m (9-VI-1982) (NNM); 1 s, CANCAP Sta. 6.041. W of the island, 14° 55′ N, 24° 31′ W, 60 m (9-VI-82) (NNM).

Etymology: The specific name alludes to the apparently smooth shell, which gives it a shining appearance.

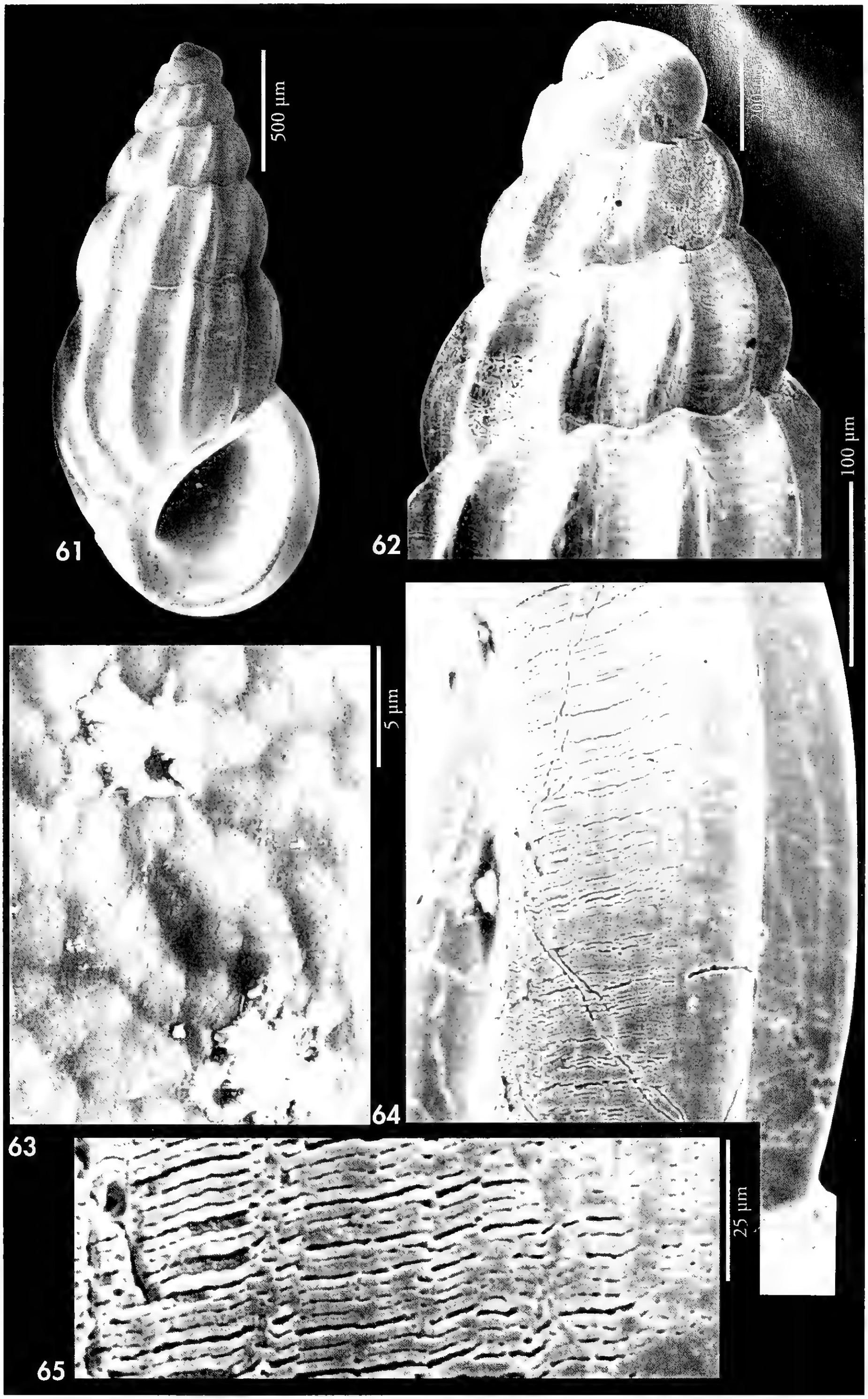
Description: Shell (Fig. 61) length up to 2.8 mm, maximum width 1.3 mm, solid, elongate-conic, shining.

Protoconch (Fig. 62) of 1 whorl and 300 μm of maximum diameter, of non-planktotrophic type, with only a very slight angulation at the upper part; transition to teleoconch abrupt. Microsculpture (Fig. 63) shows irregular flat prominences with some circular pits on an undulate surface, but the studied protoconchs were poorly preserved.

Teleoconch of about 4 whorls, regularly convex, not angulated below

(Right page) Figures 61-65: *Schwartziella (Schwartziella) fulgida* n. sp. 61: holotype, Furna, Brava (MNCN 15.05/31706); 62: protoconch of the holotype; 63: protoconch microsculpture of the holotype; 64-65: teleoconch microsculpture of the holotype.

(Página derecha) Figuras 61-65: Schwartziella (Schwartziella) fulgida *spec. nov. 61: holotipo, Furna, Brava (MNCN 15.05/31706); 62: protoconcha del holotipo; 63: microescultura de la protoconcha del holotipo; 64-65: microescultura de la teloconcha del holotipo.*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sutures; sutures shallow but evident. Colour whitish.

Axial sculpture consisting of prominent, rounded, wide, spaced axial ribs, slightly opisthocline in last whorl and a little more on previous ones; about 14 in last whorl. At low magnification, apparently there is no spiral sculpture, but there is a fine microsculpture (Figs. 64, 65) of very fine threads on the interspaces between ribs, which disappears on the ribs.

Aperture D-shaped, medium sized; inner lip thick; columellar side weakly concave; anterior channel almost absent; outer lip opisthocline with a thick external varix. Peristome prominent in large specimens, with several parallel lines towards the inner part of the aperture.

Habitat: Sand sediments between 4 and 700 m.

Distribution: Only known from Fogo, Brava and Santiago (Fig. 165).

Remarks: S. fulgida n. sp. differs from the other small species of *Schwartziella* previously described: *S. minima* n. sp. is smaller, with smaller and less numerous axial ribs and it has more evident spiral sculpture; *S. luisi* n. sp. also has a more evident spiral sculpture and the protoconch microsculpture formed by very small pits; *S. angularis* n. sp. has a subsutural angulation; *S. typica* n. sp. has a larger shell, and a fairly evident and different spiral microsculpture, uniform in *S. fulgida* and with two different alternate zones in *S. typica.*

Schwartziella (Schwartziella) depressa n. sp. (Figs. 66-70, 164)

Type material: Holotype (Fig. 66) 1 s of 3.6 x 1.5 mm and 2 paratypes, 2 s, from Mordeira Bay, Sal Island, Cape Verde Archipelago, 4 m (MNCN 15.05/31704). Paratypes: 1 s in each of MNHN, AMNH, DBUA, NNM (58003), and 15 s, 2 f in CER, all from the type locality.

Other material studied: Sal: 1 s, Mordeira, 4 m; 24 s, 4 f, Palmeira, 8 m; 12 s, Regona, 1-3 m; 1 s, Algodoeiro, 4 m; 10 s, Rabo do Junco, 2 m; Boa Vista: 1 sp, 14 s, 3 f, Sal Rei, 5 m; 2 s, 1 f, Ilhéu de Sal Rei, 3 m; 10 s, 7 f, Porto da Cruz, 6 m; 9 s, 3 j, 9 f, Derrubado, 4 m; 5 s, Rife de Chaves, 8 m; 1 s, Baijos de João Valente, 23 m. São Nicolau: 13 s, 7 f, CANCAP Sta. 7.128, 16° 33′ N, 24° 17′ W, 400 m (2-IX-1986) (NNM); 21 s, 11 f, São Jorge Bay, CANCAP Sta. 7.129, 16° 33′ N, 24° 16′ W, 405 m (2-IX-1986) (NNM).

Etymology: The specific name alludes to the unusual subsutural depression of the shell.

Description: Shell (Fig. 66) length up to 4.0 mm, maximum width 1.6 mm, relatively solid, elongate-conic.

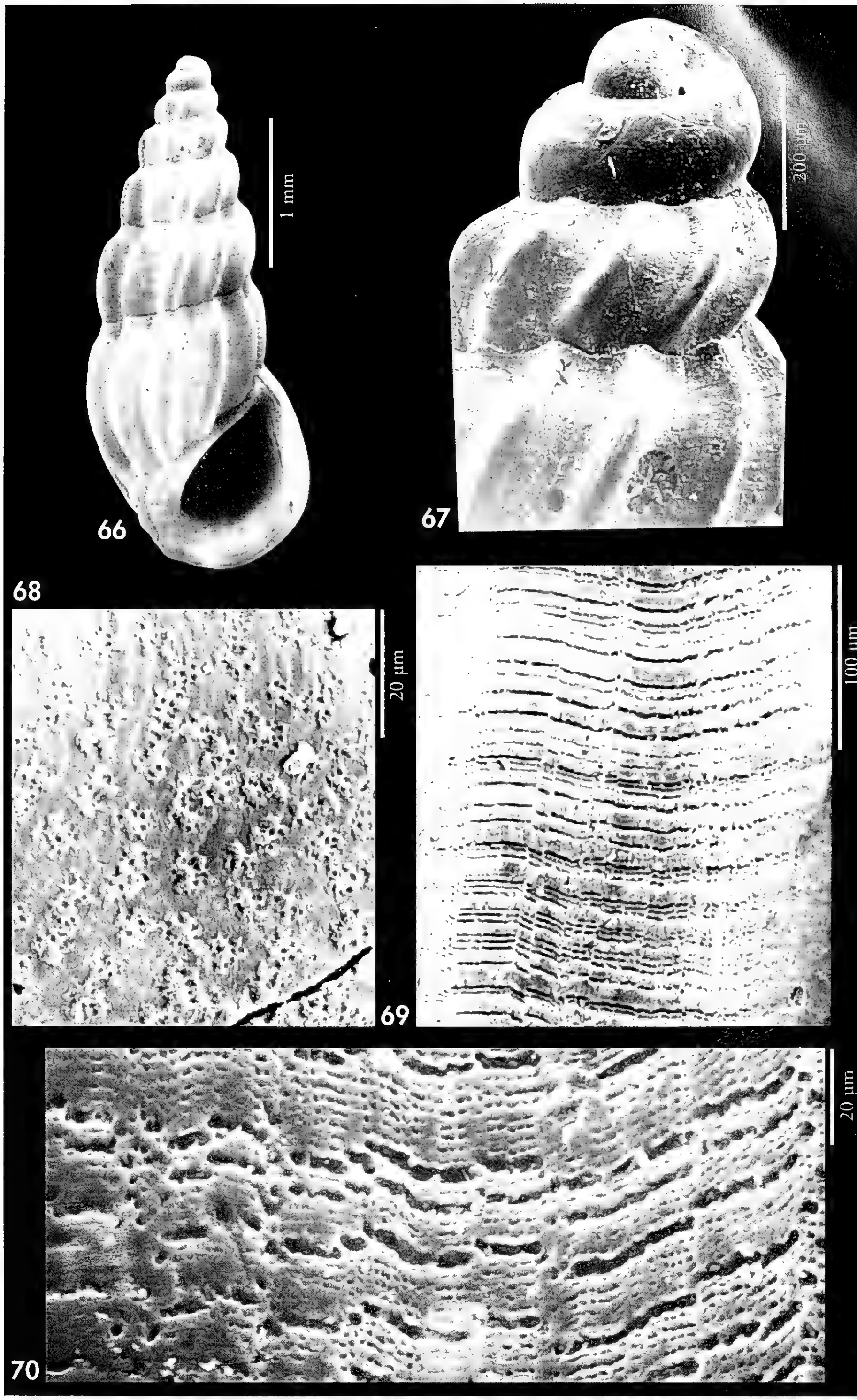
Protoconch (Fig. 67) of 1 whorl and about 300 μm of maximum diameter, of non-planktotrophic type, with a prominent spiral cord on its upper part; transition to teleoconch abrupt. Microsculpture (Fig. 68) formed by irregular flat prominences with small pits on an undulous surface.

Teleoconch of 5 whorls, strongly convex, last whorl weakly convex; suture shallow, with a slight subsutural depression. Colour whitish.

Axial sculpture consisting of prominent, rounded, wide, slightly opisthocline axial ribs, with interspaces of similar size, a little reduced in the subsutural depression specially in the last two whorls; about ten axial ribs in last whorl. At low magnification, appa-

(Right page) Figures 66-70: *Schwartziella (Schwartziella) depressa* n. sp. 66: holotype, Mordeira, Sal (MNCN 15.05/31704); 67: protoconch of the holotype; 68: protoconch microsculpture of the holotype; 69: teleoconch microsculpture of the holotype; 70: teleoconch microsculpture of a shell from Mordeira, Sal.

(Página derecha) Figuras 66-67: Schwartziella (Schwartziella) depressa *spec. nov. 66: holotipo, Mordeira, Sal (MNCN 15.05/31704); 67: protoconcha del holotipo; 68: microescultura de la protoconcha del holotipo; 69: microescultura de la teloconcha del holotipo; 70: microescultura de la teloconcha de una concha de Mordeira, Sal.*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rently there is no spiral sculpture, but there is a fine microsculpture of bands with small pits and 1-3 fine and irregular threads between each two bands on the interspaces between ribs, which disappear on the ribs (Figs. 69, 70).

Aperture D-shaped, relatively small; inner lip thick; columellar side weakly concave; anterior channel shallow; outer lip with thick external varix; with about 6 lines towards the inner part of the aperture.

Habitat: The material studied was obtained from sand sediments between 1-8 and to 400-405 m.

Distribution: Only known from Sal, Boa Vista and São Nicolau Islands (Fig. 164).

Remarks: The shells from deep water off São Nicolau are similar in size and sculpture to those from shallow waters of Sal and Boa Vista, but the subsutural depression is less evident.

S. depressa n. sp. differs from *S. similiter* n. sp. by its smaller shell, less marked spiral sculpture, narrower interspaces between axial ribs, and different microsculpture of the protoconch and teleoconch. *S. typica* n. sp. has a wider shell, lacking subsutural depression. *S. angularis* and *S. luisi* have more evident spiral sculpture. *S. minima* and *S. fulgida* n. sp. have smaller shells without subsutural depression; *S. minima* also has a more evident spiral sculpture and lacks spiral sculpture on the protoconch.

Schwartziella (Schwartziella) gradata n. sp. (Figs. 71-75, 161)

Type material: Holotype (Fig. 71) 1 s of 3.1 x 1.3 mm and 1 paratype, 1 s, Furna, Brava Island, Cape Verde Archipelago, 30 m (MNCN 15.05/31708); 1 paratype in NNM (58010) from the type locality.
Other material studied: Brava: 2 s, 3 j, Pedrinha, 5 m.
Etymology: The specific name alludes to the scalariform profile of the shell.

Description: Shell (Figs. 71, 72) length up to 3.1 mm, maximum width 1.3 mm, slightly solid, elongate-conic and relatively narrow.

Protoconch (Fig. 73, 74) of 1 whorl and 270 μm of maximum diameter, of non-planktotrophic type, with an apical spiral cord and two narrower cords at both sides, and small and irregular axial threads on the interspaces between cords; transition to teleoconch abrupt. The rest of the surface of the protoconch have irregular flat prominences with small pits on a smooth surface.

Teleoconch of about 5 whorls weakly convex, with a strong subsutural angulation. Colour whitish.

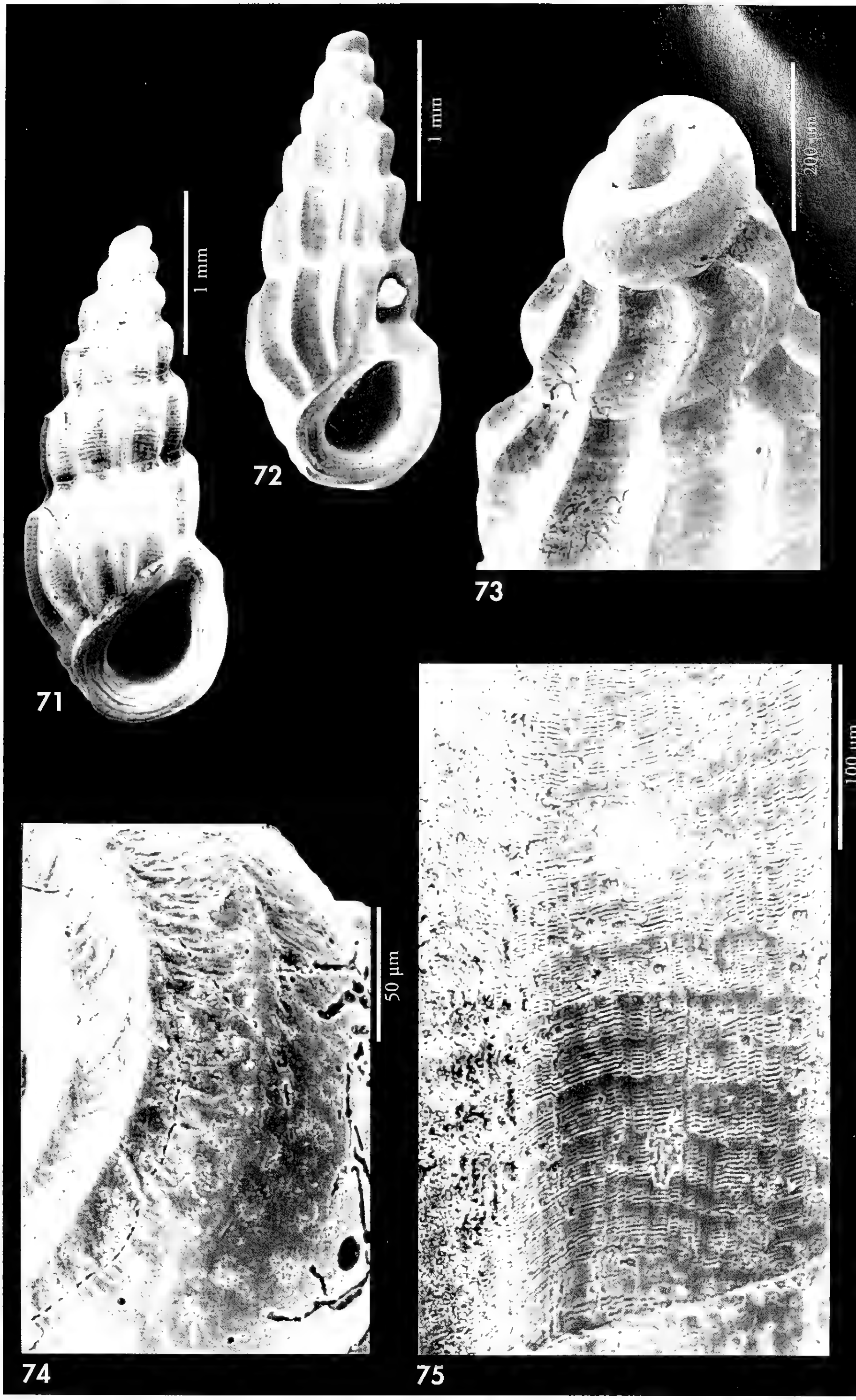
Axial sculpture consisting of prominent, sharp, narrow, slightly opisthocline, distantly spaced axial ribs, about 12 in last whorl. Spiral sculpture formed by very fine cords. Microsculpture (Fig. 75) formed by very numerous spiral threads, which disappear on the cords and continue on the ribs.

Aperture D-shaped, small; inner lip thick; columellar side weakly concave; anterior channel absent, with a depression in the zone; outer lip opisthocline with thick external varix, with 5-6 parallel lines towards the inner part of the aperture.

Habitat: The material studied was obtained from sand sediments between 5 and 30 m.

(Right page) Figures 71-75: *Schwartziella (Schwartziella) gradata* n. sp. 71: holotype, Furna, Brava (MNCN 15.05/31708); 72: paratype, Furna, Brava (NNM 58010); 73: protoconch of a paratype, Furna (CER); 74: detail of the protoconch of the same paratype: 75: teleoconch microsculpture of the same paratype.

(Página derecha) Figuras 71-75: Schwartziella (Schwartziella) gradata *spec. nov. 71: holotipo, Furna, Brava (MNCN* 15.05/31708*); 72: paratipo, Furna, Brava (NNM 58010); 73: protoconcha de un paratipo, Furna (CER); 74: detalle de la protoconcha del mismo paratipo: 75: microescultura de la teloconcha del mismo paratipo.*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Distribution: Only known from Brava Island (Fig. 161).

Remarks: S. gradata n. sp. differs from any other species of *Schwartziella* of the Cape Verde Islands by the protoconch sculpture. From other species with subsutural angulation, the sympatric *S. obesa* n. sp. is larger, and *S. angularis* is smaller and relatively wider (length / width ratio 2.12-2.23, and 2,32-2,44 in *S. gradata*), with only a spiral angulation in the upper part of the protoconch, instead of three spiral cords and irregular axial threads in *S. gradata.*

Schwartziella (Schwartziella) pavita n. sp. (Figs. 76-79, 162)

Type material: Holotype (Fig. 76) 1 s of 3.3 x 1.3 mm and 1 paratype, 1 s, from Sal Rei, Boa Vista Island, Cape Verde Archipelago, 5 m (MNCN 15.05/31714). Other paratypes: 1 s (NNM 58022), 1 s (MNHN) and 1 s (CER), all from the type locality; 11 s from Porto da Cruz, north of Sal Rei (CER).
Other material studied: (in poor condition) Boa Vista: 2 s, 1 f, Ilhéu de Sal Rei, 6 m; 1 s, Sal Rei, 6 m; 1 s, Baia Teodora, 4 m; 1 s, Derrubado, 4 m. Sal: 1 s, Mordeira, 4 m. Maio: 1 s, Pau Seco, 5 m.
Etymology: The specific name derives from the Latin verb *pavio* which means "to level" by the depressed axial ribs of the shell.

Description: Shell (Fig. 76) length up to 3.3 mm, maximum width 1.3 mm, relatively solid, elongate-conic.

Protoconch (Fig. 77) of 1 whorl, about 300 μm of maximum diameter, in poor condition in all the material studied, of non-planktotrophic type, apparently without spiral sculpture.

Teleoconch of about 5 whorls, almost flat-sided; last whorl weakly convex; suture shallow. Colour whitish.

Axial sculpture consisting of rounded, not prominent, wide, slightly opisthocline, distantly spaced axial ribs, about 12 in last whorl. Spiral sculpture of fine spiral cords densely spaced. Microsculpture (Figs. 78, 79) formed by one or two very fine irregular spiral threads between each cord.

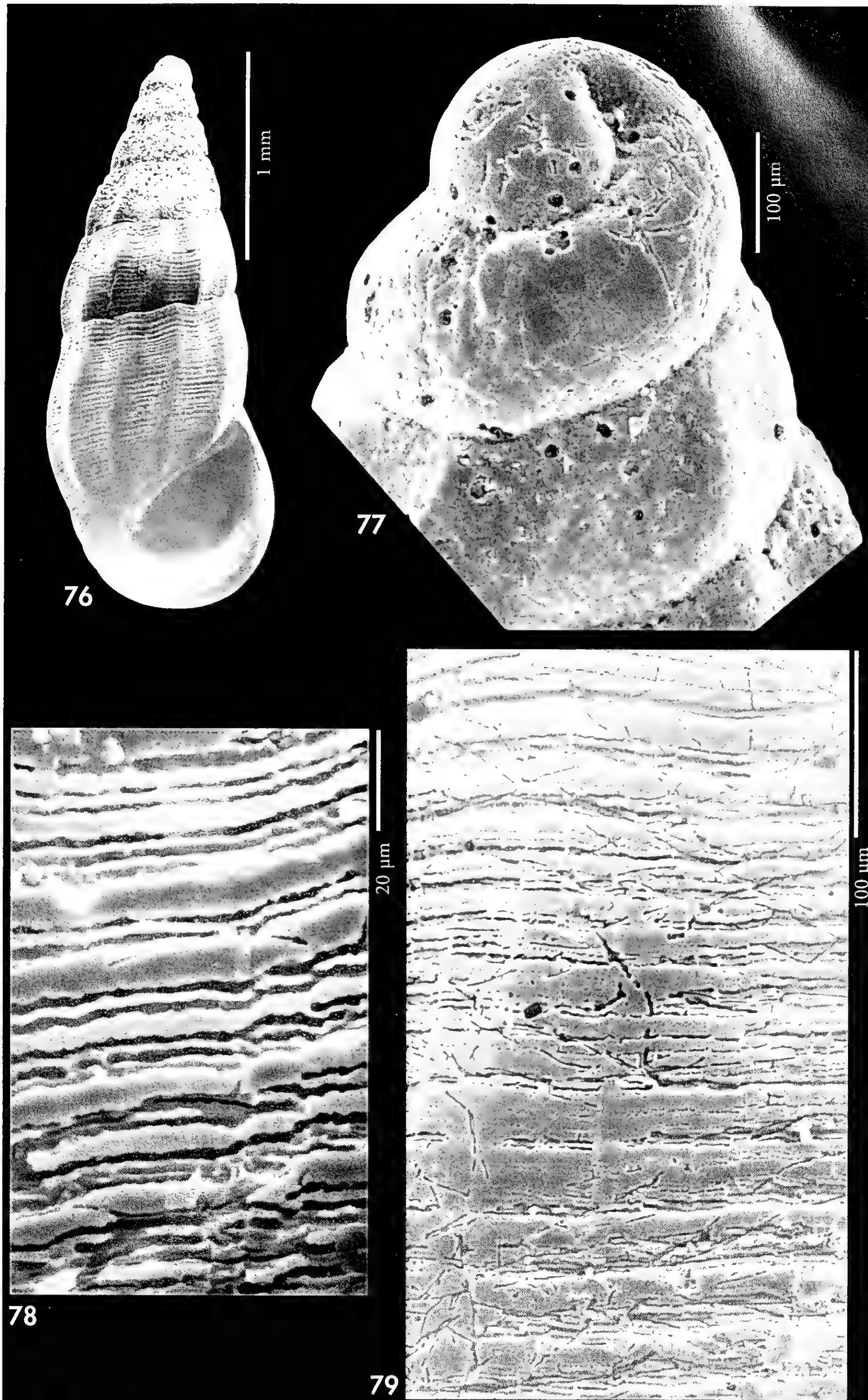
Aperture D-shaped, small, inner lip thick; columellar side weakly concave; anterior channel almost absent; outer lip opisthocline with thick external varix, with about 3-4 parallel lines.

Habitat: The material studied was obtained from sand sediments between 4 and 6 m.

Distribution: Only known from Sal, Boa Vista and Maio Islands (Fig. 162).

Remarks: S. pavita n. sp. differs from other Cape Verde species of *Schwartziella* by the very depressed axial ribs and the microsculpture with densely spaced spiral cords and only one-two threads between cords. The sympatric *S. sanmartini* n. sp. also has non-prominent axial ribs, but it has a larger and wider shell, with a teleoconch microsculpture formed only by very fine threads. *S. similiter* n. sp. and *S. typica* n. sp. have the axial ribs more prominent and a different teleoconch microsculpture. *S. minima* n. sp. and *S. fulgida* n. sp. are smaller and both have more prominent axial ribs and microsculpture formed almost exclusively by very fine threads.

(Right page) Figures 76-79: *Schwartziella (Schwartziella) pavita* n. sp. 76: holotype, Sal Rei, Boa Vista (MNCN 15.05/31714); 77: protoconch of a shell from Sal Rei, Boavista; 78: teleoconch microsculpture of a shell from Sal Rei, Boavista; 79: teleoconch microsculpture of the holotype.
(Página derecha) Figuras 76-79: Schwartziella (Schwartziella) pavita *spec. nov. 76: holotipo, Sal Rei, Boa Vista (MNCN 15.05/31714); 77: protoconcha de una concha de Sal Rei, Boavista; 78, microescultura de la teloconcha de una concha de Sal Rei, Boavista; 79: microescultura de la teloconcha del holotipo.*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Schwartziella (Schwartziella) cancapae n. sp. (Figs. 80-84, 165)

Type material: Holotype (Fig. 80) 1 s of 3.8 x 1.5 mm (NNM 58001) and 6 paratypes (5 f), CANCAP Sta. 6.009, S of Santiago, Cape Verde Archipelago, 14° 54′ N, 23° 30′ W, 175 m (5-VI-1982) (NNM 58002). Other paratypes: 1 s (MNCN 15.05/31702) and 1 s (CER), Praia, Santiago, 10 m; 9 s, CANCAP Sta. 6.006, S of Santiago, 14° 54′ N, 23° 30′ W, 150 m (5-VI-1982) (NNM 59409).
Other material studied: Santiago: 1 s, 1 f, CANCAP Sta. 6.005, S of the island, 14° 54′ N, 23° 30′ W, 175 m (5-VI-1982) (NNM); 3 f, CANCAP Sta. 6.010, 14° 52′ N, 23° 30′ W, 310 m (5-VI-1982) (NNM); 2 s, 18 f, CANCAP Sta. 6.015, S of the island, 14° 53′ N, 23° 30′ W, 150 m (5-VI-1982) (NNM); 1 s, 3 j, CANCAP Sta. 6.024, 15° 00′ N, 23° 44′ W, 540 m (7-VI-1982) (NNM); 1 s, 4 f, CANCAP Sta. 7.004, 14° 54′ N, 23° 38′ W, 320 m (21-VIII-1986) (NNM); 1 s, CANCAP Sta. 7.005, 14° 54′ N, 23° 38′ W, 235 m (21-VIII-1986) (NNM); 3 s, 5 f, CANCAP Sta. 7.007, 14° 54′ N, 23° 38′ W, 420 m (20-VI-1986) (NNM); 1 s, 7 j, CANCAP Sta. 7.008, 14° 54′ N, 23° 38′ W, 700 m (20-VIII-1986) (NNM); 1 s, 7 j, CANCAP Sta. 7.014, Ponta Grande da Cidade, 14° 54′ N, 23° 38′ W, 450-600 m (21-VIII-1986) (NNM). Fogo: 1 j, São Felipe, 20 m. Brava: 2 s, 1 f, Furna, 30 m.
Etymology: The specific name alludes to the CANCAP expeditions in which has been collected most of the material of this species and part of the material studied in this paper.

Description: Shell (Fig. 80) length up to 4.0 mm, maximum width 1.6 mm, not solid, elongate-conic.

Protoconch (Fig. 81) of 1 whorl and 400 μm of maximum diameter, of non-planktotrophic type, without spiral sculpture; transition to teleoconch abrupt. Microsculpture (Fig. 82) formed by a rough surface with many small pits.

Teleoconch of about 5 whorls, weakly convex; last whorl weakly convex; suture shallow but evident. Colour whitish.

Axial sculpture consisting of prominent, rounded, narrow, slightly opisthocline, distantly spaced axial ribs, 13 in last whorl; the ribs are continued from whorl to whorl, except in first whorls. Spiral sculpture appreciable with difficulty at low magnification. Microsculpture (Figs. 83, 84) of threads with a few parallel lines of minute pits, and more separated, sometimes paired irregularly interrupted striae.

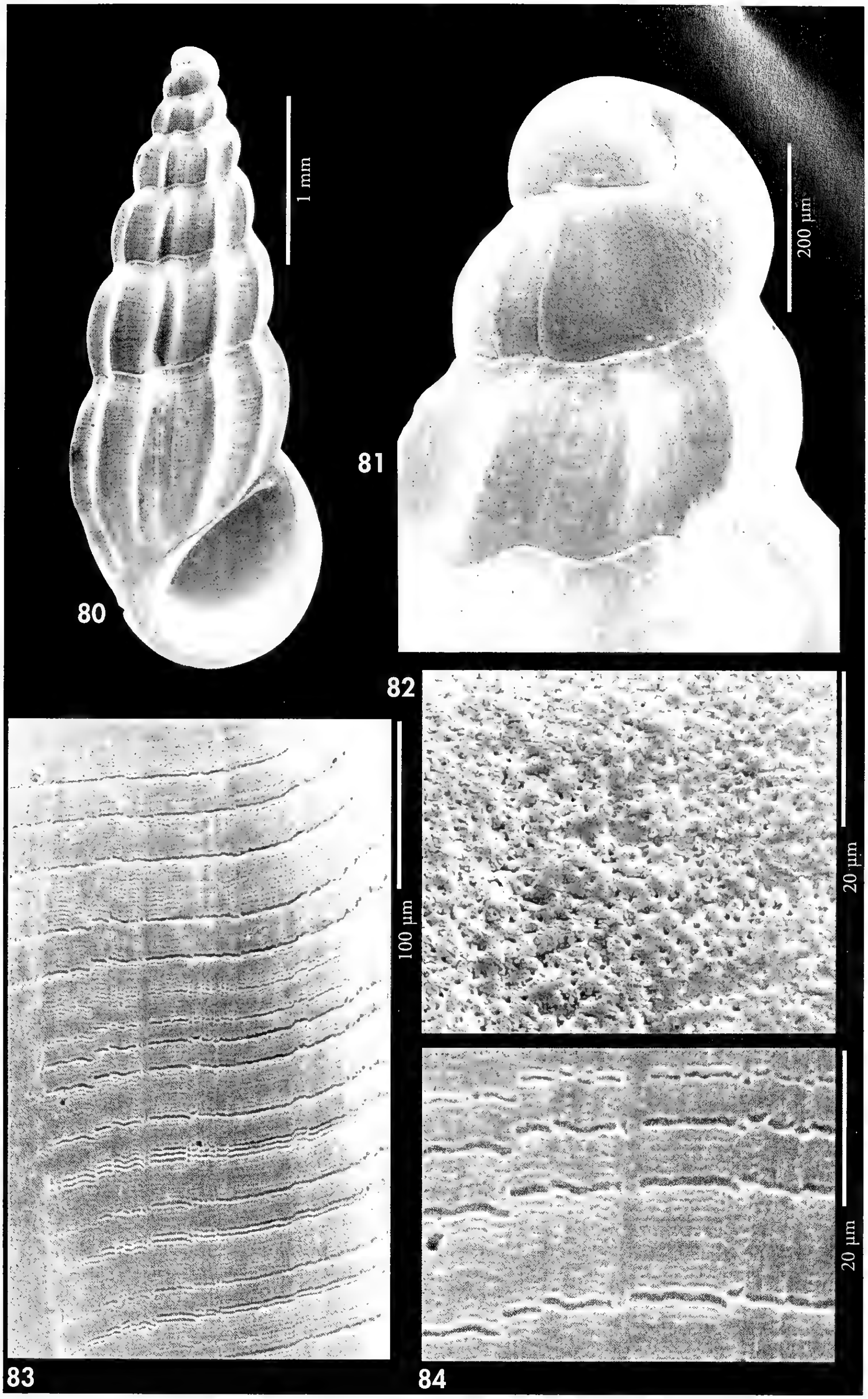
Aperture D-shaped, medium-small, inner lip thick; columellar side weakly concave; anterior channel almost absent; outer lip opisthocline with thick external varix, peristome narrow with a few parallel lines.

Habitat: Some shells of this species were collected in relatively shallow water (20-30 m), but most of material comes from 60-200 m in depth in sand and shell gravel bottom.

Distribution: Only known from Santiago, Fogo and Brava (Fig. 165).

Remarks: S. cancapae n. sp. differs from most of the species described before by its protoconch lacking spiral sculpture and larger than most of Cape Verde *Schwartziella* species. The more similar species are: *S. depressa* n. sp., with a more evident subsutural depression, and an evident spiral cord and different microsculpture in the protoconch; *S. fulgida* n. sp. is smaller, almost smooth, with different microsculpture in the teleoconch and protoconch; *S. typica* n. sp. is smaller and has different protoconch microsculpture, and *S. similiter* n. sp. is larger, wider, and with more evident spiral sculpture. *S. cancapae* is quite similar to *S. africana*, but the latter species has strongly opisthocline axial

(Right page) Figures 80-84: *Schwartziella (Schwartziella) cancapae* n. sp. 80: holotype, Santiago (NNM 58001); 81: protoconch of the holotype; 82: protoconch microsculpture of the holotype; 83-84: teleoconch microsculpture of the holotype.
(Página derecha) Figuras 80-84: Schwartziella (Schwartziella) cancapae *spec. nov. 80: holotipo, Santiago (NNM 58001); 81: protoconcha del holotipo; 82: microescultura de la protoconcha del holotipo; 83-84: microescultura de la teloconcha del holotipo.*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ribs, different protoconch and teleoconch microsculpture (see GOFAS, 1999). Previous records or *S. africana* from the Cape Verde Islands (MARCHE-MARCHAD, 1958; SAUNDERS, 1977) could be referred to this species.

Schwartziella (Schwartziella) puncticulata n. sp. (Figs. 85-87, 140-141, 166)

Type material: Holotype (Fig. 85, NNM 58023) 1 s of 4.0 x 1.6 mm and 2 paratypes (NNM 58024), 2 f, CANCAP Sta. 7.119, S of Ilhéu Razo, 16° 36′ N, 24° 36′ W, Cape Verde Archipelago, 140-160 m (1-IX-1986). Paratypes: 1 s (MNCN 15.05/31715) and 1 s (CER), both from the type locality; 7 s, 11 f, CANCAP Sta. 7.028, Ilhéu de Cima, 14° 57′ N, 24° 39′ W, 225 m (23-VIII-1986) (NNM 59414).
Other material studied: Sal: 6 f, CANCAP Sta. 7.100, off Palmeira, 16° 45′ N, 23° 01′ W, 354 m (30-VIII-1986) (NNM). Maio: 6 f, CANCAP Sta. 7.050, 15° 06′ N, 23° 14′ W, 380 m (25-VIII-1986) (NNM). Santiago: 1 s, 12 j, Cidade Velha, 6 m; 10 j, Prainha, 5 m; 6 s, 3 f, CANCAP Sta. 6.095, 16° 35′ N, 24° 37′ W, 930 m (15-VI-1982) (NNM). Fogo: 9 s, 6 f, CANCAP Sta. 6.041, W of the island, 14° 55′ N, 24° 31′ W, 60 m (9-VI-82) (NNM). Brava: 12 j, Pedrinha, 6 m; 7 j, Furna, 30 m. Ilhéu de Cima: 2 s, 5 f, CANCAP Sta. 7.037, 14° 57′ N, 24° 38′ W, 350-385 m (24-VIII-1986) (NNM); 1 s, 2j, CANCAP Sta. 7.038, 14° 57′ N, 24° 38′ W, 410-460 m (24-VIII-1986) (NNM); 1 s, 6 j, CANCAP Sta. 7.031, 14° 57′ N, 24° 38′ W, 75 m (23-VIII-1986) (NNM); 2 s, CANCAP Sta. 7.037, 14° 57′ N, 24° 38′ W, 385-350 m (24-VIII-1986) (NNM). São Vicente: 1 s, CANCAP Sta. 6.147, 16° 48′ N, 25° 06′ W, 99 m (20-VI-1982) (NNM); 4 s, 1 j, 4 f, CANCAP Sta. 6.149, 16° 47′ N, 25° 06′ W, 293 m (20-VI-1982) (NNM). Ilhéu Razo: 1 s, 5 j, CANCAP Sta. 6.093, 16° 36′ N, 24° 37′ W, 400-430 m (15-VI-1982) (NNM); 3 s, 10 j, 9 f, CANCAP Sta. 7.119, S of Ilhéu Razo, 16° 36′ N, 24° 36′ W; 140-160 m (1-IX-1986); 7 s, 21 f, CANCAP Sta. 7.121, 16° 36′ N, 24° 37′ W, 200-230 m (1-IX-1986) (NNM). Santa Luzia: 9 f, CANCAP Sta. 6.103, 16° 43′ N, 24° 46′ W, 102 m (16-VI-1982) (NNM); 1 s, 6 f, CANCAP Sta. 6.105, SSW of the island, 16° 43′ N, 24° 47′ W, 204 m (16-VI-1982) (NNM). São Nicolau: 1 s, 3 j, CANCAP Sta. 6.085, 16° 34′ N, 24° 22′ W, 100 m (14-VI-1982) (NNM).
Etymology: The specific name alludes to the microsculpture of this species, formed by undulated rows of small pits.

Description: Shell (Fig. 85) length up to 4.5 mm, maximum width 1.7 mm, relatively solid, elongate-conic.

Protoconch (Fig. 86) of 1 whorl and 360 μm of maximum diameter, of non- planktotrophic type; no spiral sculpture; transition to teleoconch abrupt. Microsculpture formed by irregular flat prominences on a smooth surface, with some pits.

Teleoconch of 4-5 whorls, strongly convex, and more convex in the subsutural part of the ribs; last whorl regularly convex; suture a little deep. Colour whitish.

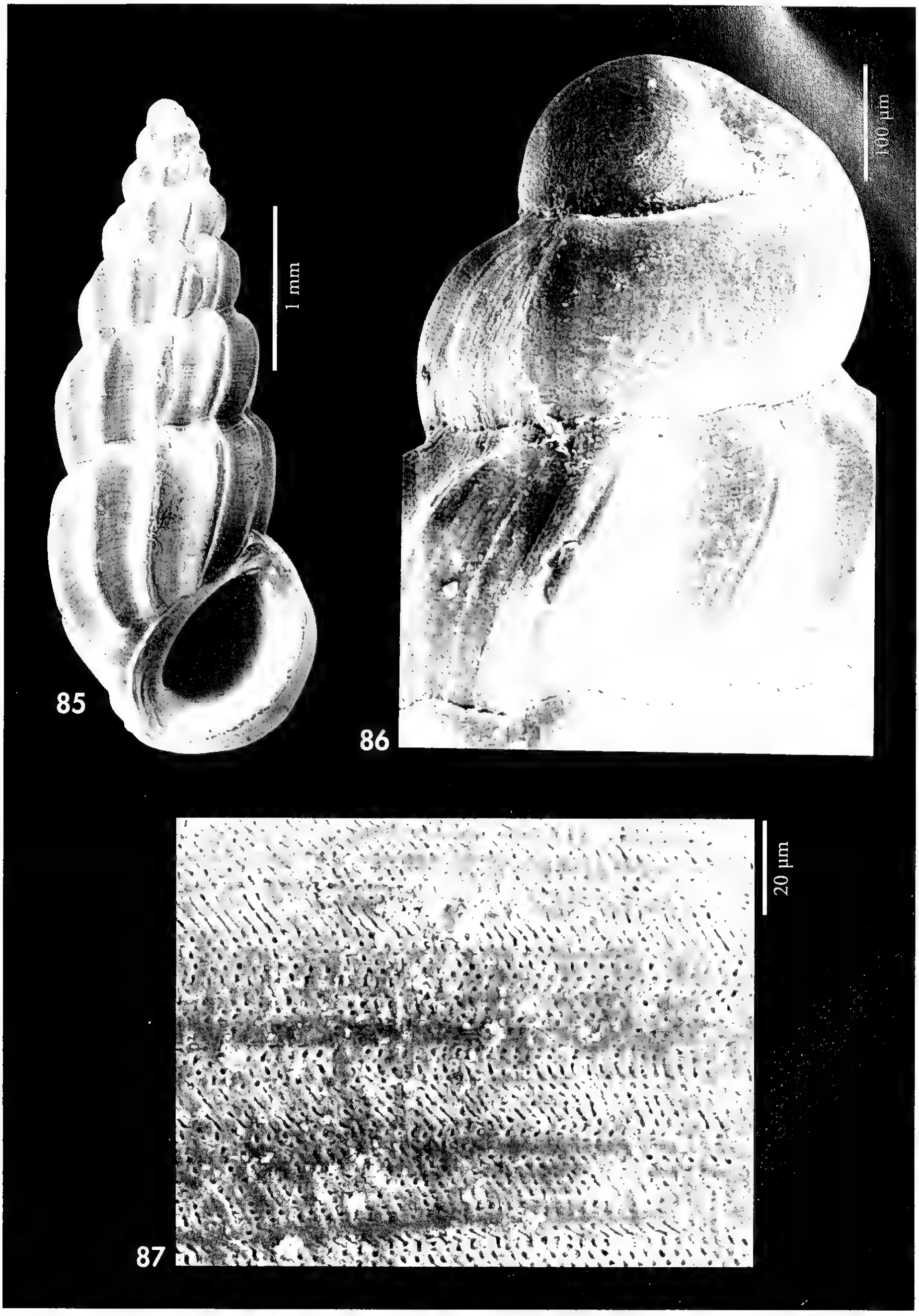
Axial sculpture consisting of prominent, rounded, narrow, a little opisthocline distantly spaced axial ribs, which are continued from whorl to whorl. Spiral sculpture not visible at low magnification. Microsculpture (Fig. 87) formed by very fine, densely packed undulated threads with intermediate rows of small pits.

Aperture D-shaped, small; inner lip thick; columellar side weakly concave; anterior channel shallow; outer lip strongly opisthocline with a very thick external varix, peristome with a prominent edge and some parallel lines towards the inner part.

Habitat: Sand sediments, between 6 and 930 m.

Distribution: Sal, Maio, Santiago, Fogo, Brava, Ilhéu de Cima, São Vicente, Santa Luzia, Ilhéu Razo and São Nicolau (Fig. 166). Probably this species is present in all the archipelago, but it is frequent in some islands and uncommon in others.

Remarks: S. puncticulata n. sp. differs from the following similar species: *S. similiter* n. sp. has no subsutural shoulder and a different protoconch and teleoconch microsculpture; *S. typica* n. sp. is smaller, less elongate, uniformly convex and with different teleoconch microsculpture; *S. fulgida* n. sp. is also smaller, with the whorls less convex, and the teleoconch microsculpture more lineal; *S. depressa* n. sp. is smaller, with a



Figures 85-87: *Schwartziella (Schwartziella) puncticulata* n. sp. 85: holotype, Ilhéu Razo (NNM 58023); 86: protoconch of a paratype, Ilhéu Razo (NNM 58024); 87: teleoconch microsculpture of the holotype.

Figuras 85-87: Schwartziella (Schwartziella) puncticulata *spec. nov. 85: holotipo, Ilhéu Razo (NNM 58023); 86: protoconcha de un paratipo, Ilhéu Razo (NNM 58024); 87: microescultura de la teloconcha del holotipo.*

spiral cord on the protoconch and a subsutural depression on the teleoconch; *S. cancapae* n. sp. has a more regular curvature of the whorls, a larger protoconch, and a different protoconch and teleoconch microsculpture.

One shell (Figs. 140, 141) found in São Vicente, CANCAP Sta. 6.145, 16° 48′ N, 25° 06′ W) is smaller, stouter and the axial ribs are less convex, but we provisionally consider it conspecific since it has identical microsculpture.

Schwartziella (Schwartziella) hoenselaari n. sp. (Figs. 88-92, 167)

Type material: Holotype (Fig. 88) 1 s of 2.3 x 1.1 mm (NNM 58011) and 26 paratypes (NNM 58012), 26 s, S of Santiago, CANCAP Sta. 6.001, 14° 54′ N, 23° 30′ W, 15-20 m (4-VI-1982). Other paratypes: 13 s, CANCAP Sta. 6.014, 14° 54′ N, 23° 29′ W, 18 m (5-VI-1982) (NNM 59415); 1 s (MNCN 15.05/31709) and 1 s (CER), both from the type locality; 1 s, Prainha, 5 m (CER).
Other material studied: Santiago: 16 s, 2 j, Tarrafal, 4 m; 4 s, CANCAP Sta. 6.003, 14° 54′ N, 23° 30′ W, 15-21 m (5-VI-1982) (NNM); 3 s, CANCAP Sta. 6.004, 14° 54′ N, 23° 30′ W, 58-63 m (5-VI-1982) (NNM); 2 f, CANCAP Sta. 6.006, S of the island, 14° 54′ N, 23° 30′ W, 150 m (5-VI-1982) (NNM); 3 s, 2 j CANCAP Sta. 6.007, 14° 54′ N, 23° 30′ W, 70-88 m (5-VI-1982) (NNM); 1 s, CANCAP Sta. 6.008, 14° 54′ N, 23° 30′ W, 120 m (5-VI-1982) (NNM); 6 s, 1 f, CANCAP Sta. 6.010, 14° 52′ N, 23° 30′ W, 310 m (5-VI-1982) (NNM); 6 s, 3j, CANCAP Sta. 6.015, S of the island, 14° 53′ N, 23° 30′ W, 150 m (5-VI-1982) (NNM); 4 s, 1 f, CANCAP Sta. 6.024, 15° 00′ N, 23° 44′ W, 540 m (7-VI-1982) (NNM); 1 s, 1 j, CANCAP Sta. 6.025, 15° 00′ N, 23° 45′ W, 728 m (7-VI-1982) (NNM); 2 s, CANCAP Sta. 7.005, 14° 54′ N, 23° 38′ W, 235 m (21-VIII-1986) (NNM); 2 f, CANCAP Sta. 7.007, 14° 54′ N, 23° 38′ W, 420 m (20-VI-1986) (NNM); 3 s, 2 f, Ponta Grande da Cidade, CANCAP Sta. 7.015, 14° 54′ N, 23° 38′ W, 450-600 m (21-VIII-1986) (NNM); 2 f, CANCAP Sta. 7.020, 14° 45′ N, 23° 29 W, 0-2200 m (21-22-VIII-1986). Fogo: 2 s, 1 f, in front of São Felipe, 20 m; 6 s, 3 j, CANCAP Sta. 6.040, 14° 55′ N, 24° 31′ W, 38-55 m (9-VI-1982) (NNM). Ilhéu de Cima: 2 s, CANCAP Sta. 7.028, 14° 57′ N, 24° 39′ W, 225 m (23-VIII-1986) (NNM); 1 s, CANCAP Sta. 7.037, 14° 57′ N, 24° 38′ W, 350-385 m (24-VIII-1986) (NNM). Santa Luzia: 1 s, 1 f, CANCAP Sta. 6.103, 16° 43′ N, 24° 46′ W, 102 m (16-VI-1982) (NNM); 2 s, CANCAP Sta. 6.107, 16° 44′ N, 24° 46′ W, 50 m (16-VI-1982) (NNM). Ilhéu Razo: 1 s, CANCAP Sta. 7.120, 16° 36′ N, 24° 37′ W, 208 m (1-IX-1986); 1 s, CANCAP Sta. 7.121, 16° 36′ N, 24° 37′ W, 200-230 (1-IX-1986) (NNM). São Nicolau: 2 s, 6 f, CANCAP Sta. 7.128, São Jorge Bay, 16° 33′ N, 24° 17′ W, 400 m (2-IX-1986) (NNM); 6 s, 3 f, São Jorge Bay, CANCAP Sta. 7.129, 16° 33′ N, 24° 16′ W, 405 m (2-IX-1986) (NNM). Sal: 2 s, Palhona, 2 m.
Etymology: The specific name is dedicated to Hink J. Hoenselaar, Dutch malacologist who begun the study of the Rissoininae material from the CANCAP Expeditions.

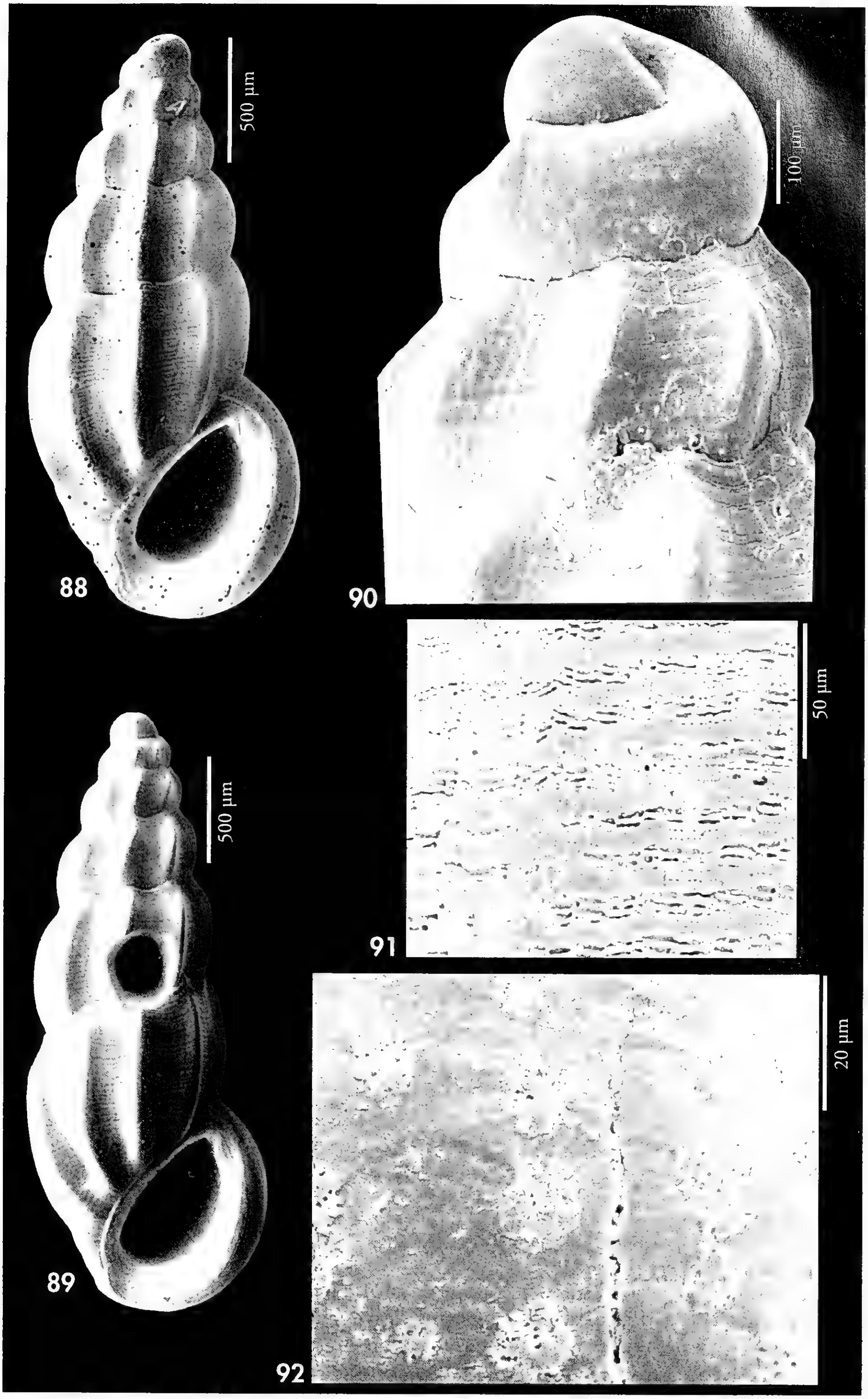
Description: Shell (Figs. 88, 89) length up to 3.0 mm, maximum width 1.4 mm, relatively solid, elongate-conic.

Protoconch (Fig. 90) of 1 whorl and about 300 μm of maximum diameter, of non-planktotrophic type, with no spiral sculpture; transition to teleoconch abrupt. Microsculpture (Fig. 92) formed by irregular flat prominences with some pits on an undulate surface.

Teleoconch of 4-5 whorls, clearly convex, not angulated below suture; last whorl convex; suture shallow, but evident. Colour whitish.

Axial sculpture consisting of prominent, rounded, narrow, almost orthocline

(Right page) Figures 88-92: *Schwartziella (Schwartziella) hoenselaari* n. sp. 88: holotype, Santiago (NNM 58011); 89: paratype, Santiago (NNM 58012); 90: protoconch of a paratype, Santiago (NNM 58012); 91: teleoconch microsculpture of a paratype, Santiago (NNM 58012); 92: protoconch microsculpture of a paratype, Santiago (NNM 58012).
(Página derecha) Figuras 88-92: Schwartziella (Schwartziella) hoenselaari spec. nov. 88: holotipo, Santiago (NNM 58011); 89: paratipo, Santiago (NNM 58012); 90: protoconcha del paratipo, Santiago (NNM 58012); 91: microescultura de la teloconcha del paratipo, Santiago (NNM 58012); 92: microescultura de la protoconcha del paratipo, Santiago (NNM 58012).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(slightly opisthocline on first whorls), very distantly spaced axial ribs; being 9-11 in the last whorl. Spiral sculpture almost unappreciable at low magnification. Microsculpture (Fig. 91) with zones with 2-3 fine threads irregularly distributed, alternating with wider threads with spiral rows of small pits.

Aperture D-shaped, small-medium sized; inner lip thick; columellar side weakly concave; anterior channel absent; outer lip strongly opisthocline with a very thick external varix; peristome narrow with about 5 parallel lines towards the inner part of the aperture.

Habitat: The material studied was collected from 2 to 728 m of depth.

Distribution: Sal, Santiago, Fogo, Ilhéu de Cima, Santa Luzia, Ilhéu Razo, São Nicolau (Fig. 167).

Remarks: Schwartziella hoenselaari n. sp. differs from most of the Cape Verde species of the genus by having less axial ribs. It differs from the following species with similar shape and protoconch lacking spiral sculpture: *S. puncticulata* n. sp. has a larger protoconch, a subsutural curvature of the whorls, and the teleoconch microsculpture lacks continuous threads; *S. cancapae* n. sp. has a smaller protoconch, a more pointed shell, with different protoconch and teleoconch microsculpture; *S. depressa* n. sp. and *S. typica* n. sp. have a similar shape, but the protoconch of both species has spiral sculpture and the microsculpture of the teleoconch is different. Differences with the similar *S. paucicostata* n. sp. are discussed under remarks of this species.

Schwartziella (Schwartziella) paucicostata n. sp. (Figs. 93-96, 168)

Type material: Holotype (Fig. 93) 1s of 3.1 x 1.3 mm (NNM 58004), and 2 paratypes, 2 s (NNM 58005), CANCAP Sta. 7.105, off Palmeira, 16° 45′ N, 23° 01′ W, 123-142 m. Other paratypes: 1 f, CANCAP Sta. 7.093, Ilhéu Razo, 16° 34′ N, 33° 54′ W, 42 m (29-VIII-1986) (NNM 59410); 1 s, 1 j, CANCAP Sta. 7.095, Ilhéu Razo, 16° 34′ N, 22° 53′ W, 30-50 m (29-VIII-1986) (NNM 59411); 1s, 1 j (MNCN 15.05/34277), 3 s, 1 j (CER) Pau Seco, Maio, 30 m.

Other material studied: Sal: 1 s, CANCAP Sta. 7.088, Ponta do Leme Velho, 16° 34′ N, 22° 54′ W, 59 m (29-VIII-1986) (NNM). Maio: 2 s, 1 f, CANCAP Sta. 7.050, 15° 06′ N, 23° 14′ W, 380 m (25-VIII-1986) (NNM). Santiago: 1 s, CANCAP Sta. 6.017, 14° 53′ N, 23° 30′ W, 380 m (5-VI-1982).

Etymology: The specific name alludes to the low number of axial ribs of the shell.

Description: Shell (Fig. 93) length up to 3.3 mm, maximum width 1.4 mm, relatively solid, elongate-conic.

Protoconch (Fig. 94) of 1 whorl and 270 μm of maximum diameter, of non-planktotrophic type, without spiral sculpture, smooth.

Teleoconch of about 5 whorls, strongly convex; last whorl a little less convex; suture shallow. Colour whitish.

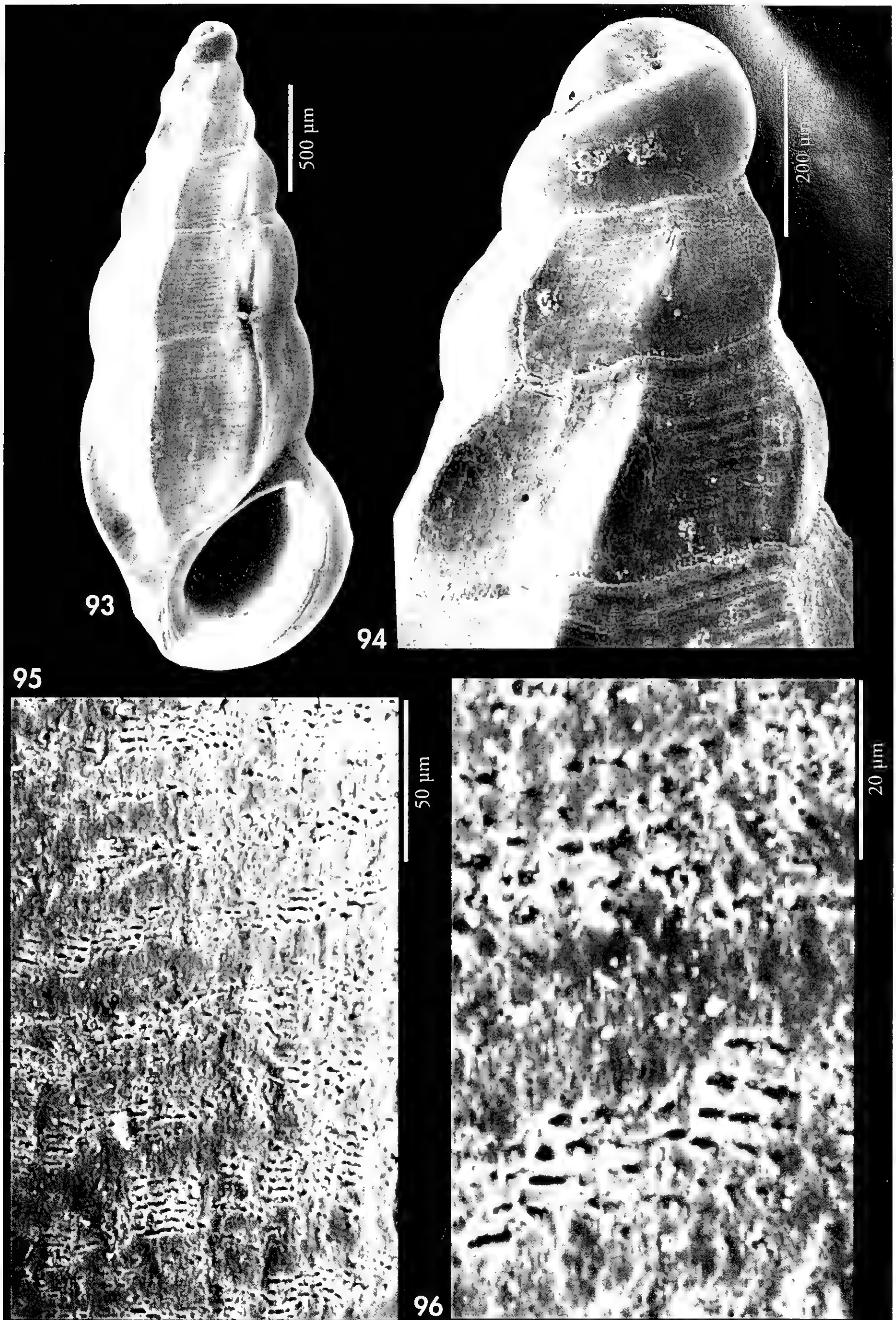
Axial sculpture consisting of prominent, sharp, very distantly spaced (4 times narrower than the interspaces) axial ribs, almost orthocline in last whorl and opisthocline in previous whorls; only 6-7 axial ribs in last whorl. Spiral sculpture almost unappreciable at low magnification. Microsculpture (Figs. 95, 96) formed by bands of interrupted and irregularly disposed fine spiral threads and wider threads without sculpture.

Aperture D-shaped, small; inner lip thick; columellar side weakly concave; anterior channel almost absent; outer lip with thick external varix; peristome narrow with several parallel lines towards the inner part of the aperture.

Habitat: The material studied was collected in sand bottom between 30 and 380 m.

Distribution: Sal, Maio, Santiago and Ilhéu Razo (Fig. 168).

Remarks: *S. paucicostata* n. sp. differs from any other of the previously described species of Cape Verde *Schwartziella* by its smooth protoconch and the few and distant axial ribs. The similar *S. hoenselaari* n. sp. has a wider protoconch with microsculpture, and more numerous axial ribs.



Figures 93-96: *Schwartziella (Schwartziella) paucicostata* n. sp. 93: holotype, Sal (NNM 58004); 94: protoconch of the holotype; 95-96: teleoconch microsculpture of the holotype.
Figuras 93-96: Schwartziella (Schwartziella) paucicostata *spec. nov. 93: holotipo, Sal (NNM 58004); 94: protoconcha del holotipo; 95-96: microescultura de la teloconcha del holotipo.*

Schwartziella (Schwartziella) sulcostriata n. sp. (Figs. 97-101, 169)

Type material: Holotype (Fig. 91) 1 s of 3.1 x 1.2 mm (NNM 58033), and 3 paratypes, 3 s (NNM 58034), CANCAP Sta. 7.100, off Palmeira, 16° 45′ N, 23° 01′ W, 354 m (30-VIII-1986). Other paratypes: 1 s, CANCAP Sta. 7.101, off Palmeira, Sal, 16° 45′ N, 23° 01′ W, 262-280 m (30-VIII-1986) (NNM 59421); 2 s, 2 f, CANCAP Sta. 7.120, 16° 36′ N, 24° 37′ W, Ilhéu Razo, 208 m (1-IX-1986) (NNM 59422).
Other material studied: Sal: 2 f, CANCAP Sta. 7.110, 16° 46′ N, 23° 02′ W, 85 m (31-VIII-1986) (NNM). São Nicolau: 2 s, São Jorge Bay, CANCAP Sta. 7.129, 16° 33′ N, 24° 16′ W, 405 m (2-IX-1986) (NNM); 1 s, CANCAP Sta. 7.128, São Jorge Bay, 16° 33′ N, 24°17′ W, 400 m (2-IX-1986) (NNM).
Etymology: The specific name alludes to the microsculpture of the teleoconch.

Description: Shell (Fig. 97) length up to 3.1 mm, maximum width 1.2 mm, not very solid, strongly elongate-conic.

Protoconch (Fig. 98) of 1 whorl and 340 μm of maximum diameter, of non-planktotrophic type, no spiral sculpture; transition to teleoconch not very abrupt. Microsculpture (Fig. 101) formed by irregular flat prominences with some pits on a smooth surface.

Teleoconch of 5 whorls, weakly convex, not angulated below suture but a little on suture; suture shallow, slightly undulate. Colour whitish.

Axial sculpture consisting of not prominent, rounded, narrow, slightly opisthocline, distantly spaced axial ribs, not always coincident from whorl to whorl. Spiral sculpture appreciable with difficulty at low magnification. Microsculpture (Figs. 99, 100) only observable among the spiral ribs and formed by smooth spiral bands separated by furrows with 2-3 spiral striae.

Aperture D-shaped, small; inner lip thick; columellar side weakly concave; anterior channel almost absent; outer lip with thick external varix, peristoma narrow and with a few parallel lines towards the inner part of the aperture.

Habitat: Collected in sand sediments between 85 and 405 m.

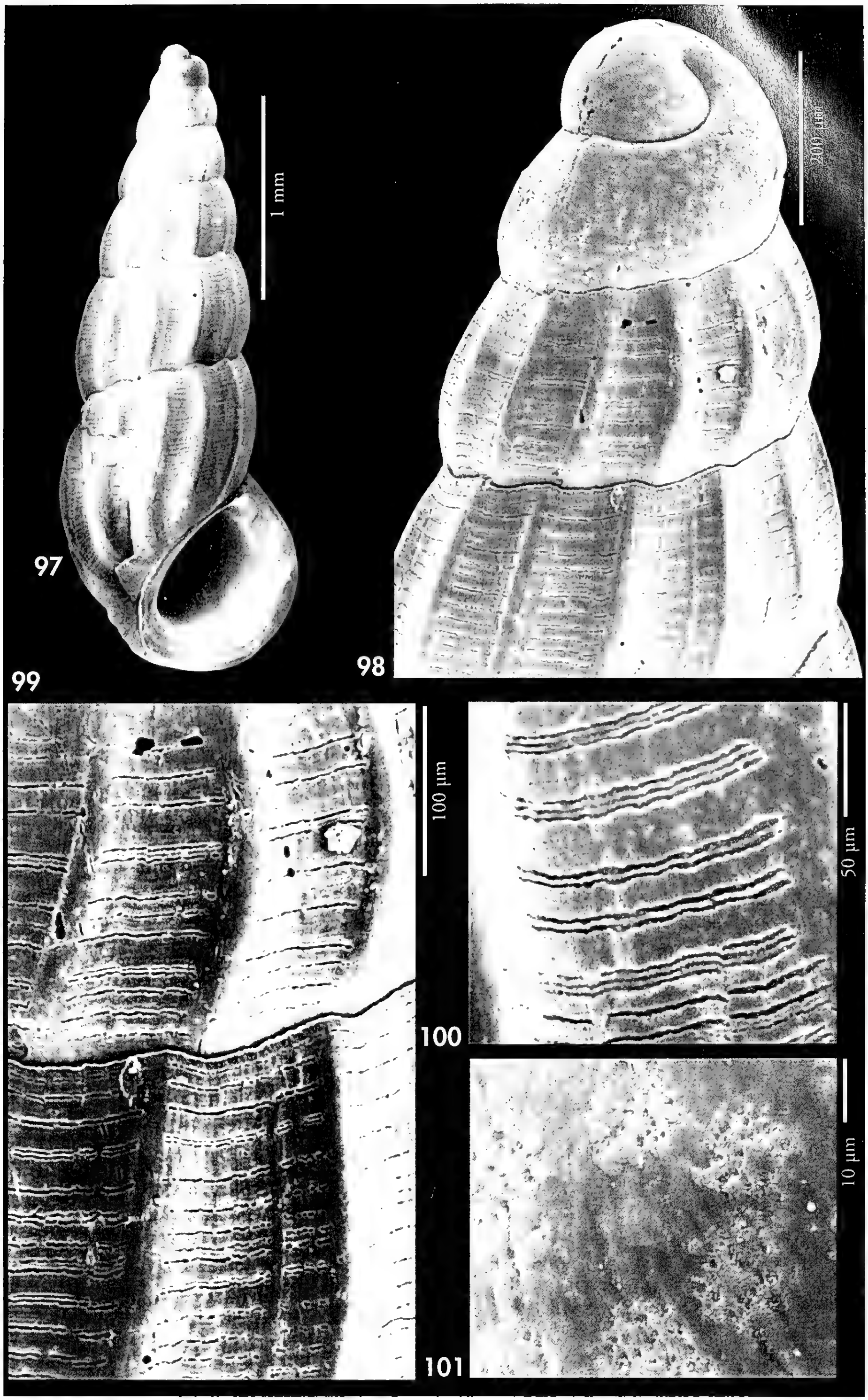
Distribution: Known from Sal, Ilhéu Razo and São Nicolau (Fig. 169). Probably it is present in all the islands of the northern group.

Remarks: S. sulcostriata n. sp. is more elongated than most of the previously described species and it also differs from any other by the spiral sculpture of the teleoconch, formed by alternate smooth bands and striated furrows. *S. similiter* n. sp. has a spiral cord on the top of the protoconch, rectilinear profile and a different microsculpture of the protoconch. *S. pavita* n. sp. has more depressed axial ribs. *S. depressa* n. sp. has a spiral cord on the top of the protoconch and a subsutural depression; *S. cancapae* n. sp. has stronger axial ribs and a wider protoconch with different microsculpture.

Schwartziella (Schwartziella) gibbera n. sp. (Figs. 102-106, 170)

Type material: Holotype (Fig. 102) 1 s of 3.7 x 1.3 mm (NNM 58008), and 3 paratypes, 3 s (NNM 58009), CANCAP Sta. 7.079, W of Ilhéu de Sal Rei, Boa Vista, Cape Verde Archipelago, 16° 10′ N, 23° 00′ W, 60 m (28-VIII-1986). Other paratypes: 5 j, Ilhéu de Sal Rei, CANCAP Sta. 7.080, 16° 10′ N, 23° 01′ W, 74 m (28-VIII-1986) (NNM 59412); 2 s (Fig. 103), 4 j, off Palmeira, Sal, CANCAP Sta.

(Right page) Figures 97-101: *Schwartziella (Schwartziella) sulcostriata* n. sp. 97: holotype, Palmeira, Sal (NNM 58033); 98: protoconch of the holotype; 99: detail of the spire of the holotype; 100: teleoconch microsculpture of the holotype; 101: protoconch microsculpture of the holotype.
(Página derecha) Figuras 97-101: Schwartziella (Schwartziella) sulcostriata *spec. nov. 97: holotipo, Palmeira, Sal (NNM 58033); 98: protoconcha del holotipo; 99: detalle de la espira del holotipo; 100: microescultura de la teloconcha del holotipo; 101: microescultura de la protoconcha del holotipo.*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7.101, 16° 45′ N, 23° 01W, 262-280 m (30-VIII-1986) (NNM 59413); 1 j, (MNCN 15.05/31707) and 1 j, both from Boa Vista (CER).

Other material studied: Boa Vista: 43 j, 25 f, CANCAP Sta. 6.066, 15° 53′ N, 23° 00′ W, 53 m (13-VI-1982) (NNM). Sal: 2 j, off Palmeira, 16°46′ N, 23° 01′ W, 165 m (30-VIII-1986) (NNM). Santiago: 1 f, 4 m, Tarrafal; 1 s, 5 f, CANCAP Sta. 6.008, 14° 54′ N, 23° 30′ W, 120 m (5-VI-1982) (NNM); 11 s, 6 f, CANCAP Sta. 6.010, 14° 52′ N, 23° 30′ W, 310 m (5-VI-1982) (NNM).

Etymology: The specific name alludes to the subsutural hump on the axial ribs of the shell.

Description: Shell (Figs. 102, 103) length up to 3.7 mm, maximum width 1.3 mm, relatively solid, strongly elongate-conic.

Protoconch (Fig. 104) of 1 whorl and about 325 µm of maximum diameter, of non-planktotrophic type, without spiral sculpture. Microsculpture formed by irregular flat prominences with some pits on a smooth surface.

Teleoconch of about 6 strongly convex whorls; there is a short depressed space below suture, followed by an evident shoulder on the axial ribs; last whorl strongly convex; suture shallow, but evident. Colour whitish.

Axial sculpture consisting of prominent, sharp, narrow, scarcely opisthocline, distantly spaced axial ribs, about 12 in last whorl. Spiral sculpture almost unappreciable at low magnification. Microsculpture (Figs. 105, 106) shows groups of 6-9 threads, interrupted by the growth lines, alternating with bands with only pits.

Aperture D-shaped, relatively small; inner lip thick; columellar side weakly concave; anterior channel almost absent; outer lip opisthocline with thick external varix; peristome with 4-5 parallel lines towards the inner part of the aperture.

Habitat: In sandy and muddy bottom, between 53 and 310 m.

Distribution: Known from Sal, Boa Vista and Santiago Islands (Fig. 170).

Remarks: Schwartziella gibbera n. sp. differs from the previously described species by its elongate shell and subsutural hump. *S. puncticulata* n. sp. also has a subsutural shoulder, but it has a smaller and not so elongate shell and different teleoconch microsculpture. *S. sulcostriata* n. sp. is also elongate, but it lacks subsutural hump and has a different teleoconch microsculpture.

Schwartziella (Schwartziella) irregularis n. sp. (Figs. 107-109, 171)

Type material: Holotype (Fig. 107) 1 s of 3.8 (1.4 mm, CANCAP Sta. 7.042, Ponta Inglez/Ponta Preta, SW of Maio, 15° 07′ N, 23° 14′ W, 76 m (25-VIII-1986) (NNM 58014). Paratypes: 1 s, CANCAP Sta. 7.050, SW of Maio, 15° 06′ N, 23° 14′ W, 380 m (25-VIII-1986) (NNM 58015); 1 s, CANCAP Sta. 7.101, off Palmeira, Sal, 16° 45′ N, 23° 01′ W, 262-280 m (30-VIII-1986) (NNM 59416).

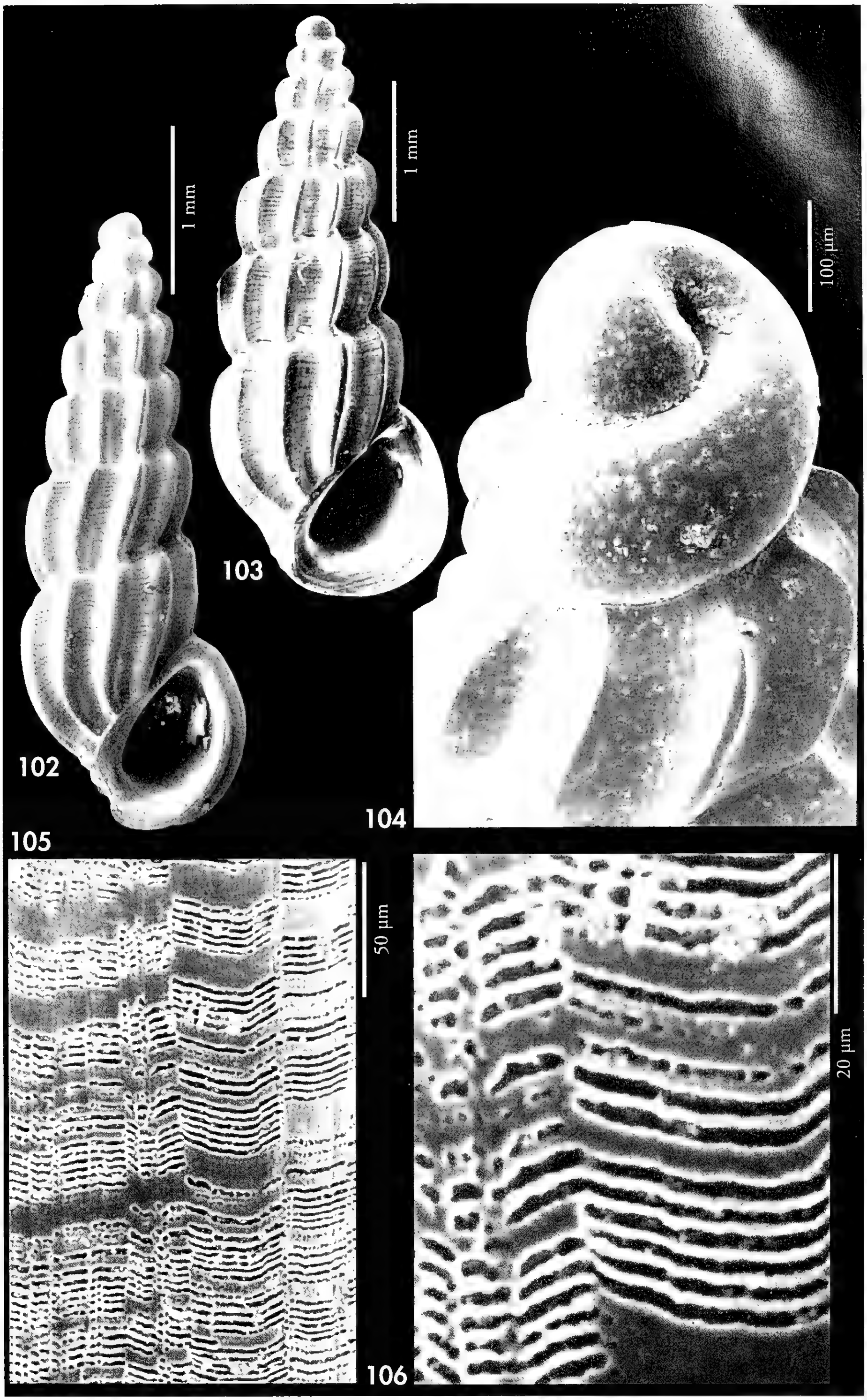
Etymology: The specific name alludes to the irregular distribution of the axial ribs on the shell.

Description: Shell (Fig. 107) length up to 3.8 mm, maximum width 1.4 mm, not solid, narrowly elongate-conic.

Protoconch (Fig. 108) of 1 whorl and about 175 µm of maximum diameter, of non-planktotrophic type, smooth.

(Right page) Figures 102-106: *Schwartziella (Schwartziella) gibbera* n. sp. 102: holotype, Ilhéu de Sal Rei, Boa Vista (NNM 58008); 103: paratype, off Palmeira, Sal (NNM 59413); 104: protoconch of a paratype, Sal Rei, Boavista (NNM 58009); 105-106: teleoconch microsculpture of the holotype.

(Página derecha) Figuras 102-106: Schwartziella (Schwartziella) gibbera *spec. nov. 102: holotipo, Ilhéu de Sal Rei, Boa Vista (NNM 58008); 103: paratipo, Palmeira, Sal (NNM 59413); 104: protoconcha de un paratipo, Sal Rei, Boavista (NNM 58009); 105-106: microescultura de la teloconcha del holotipo.*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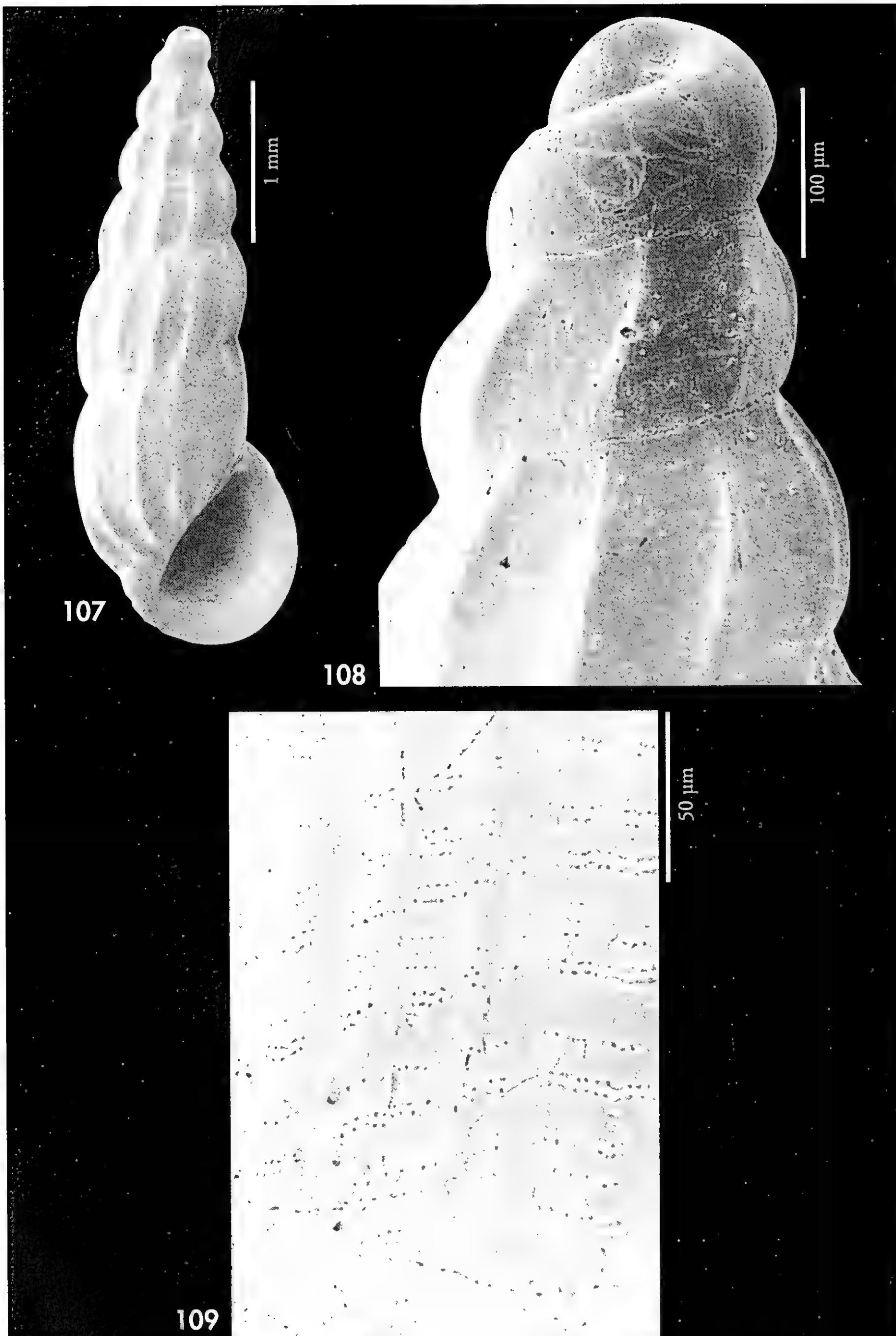
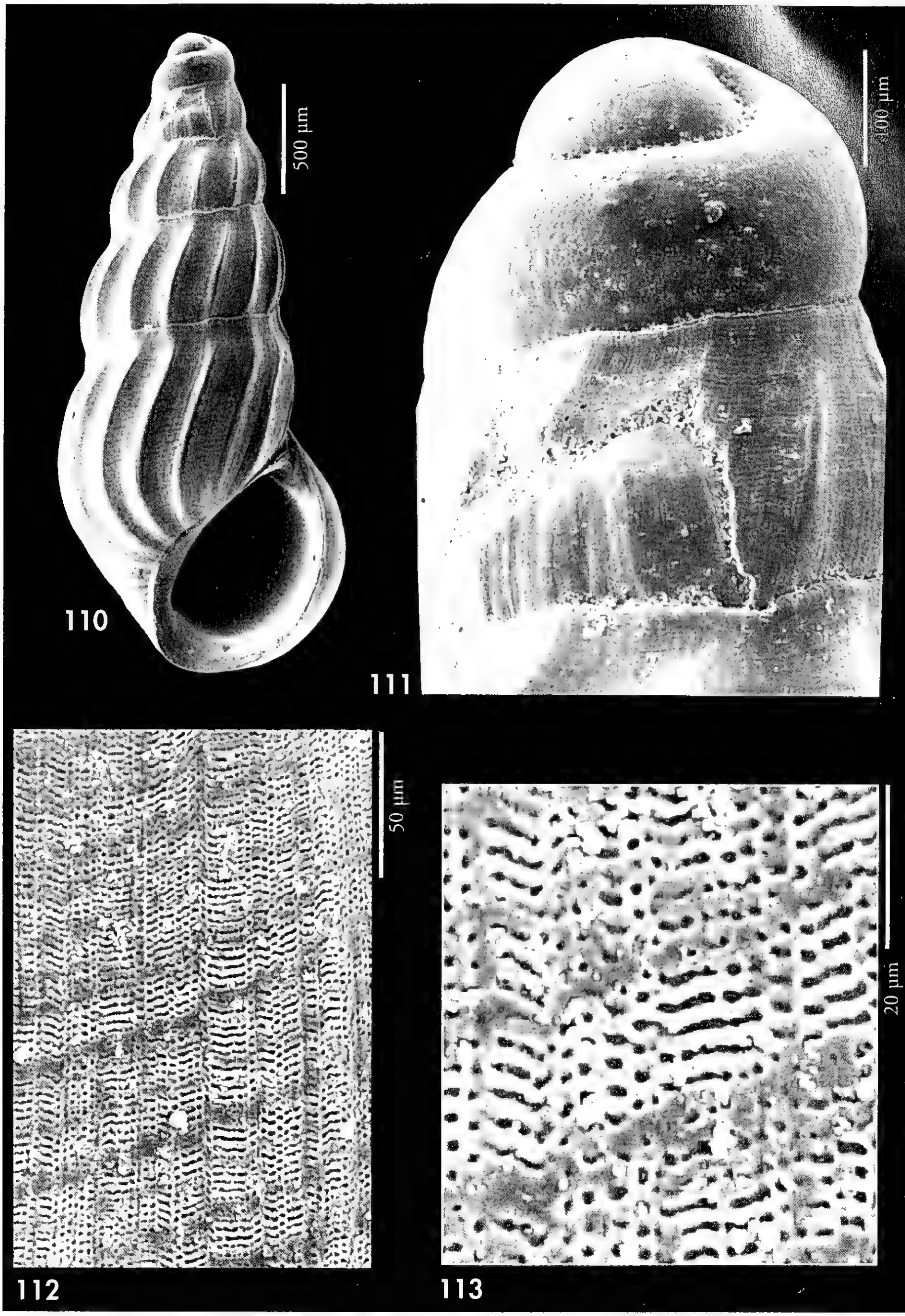
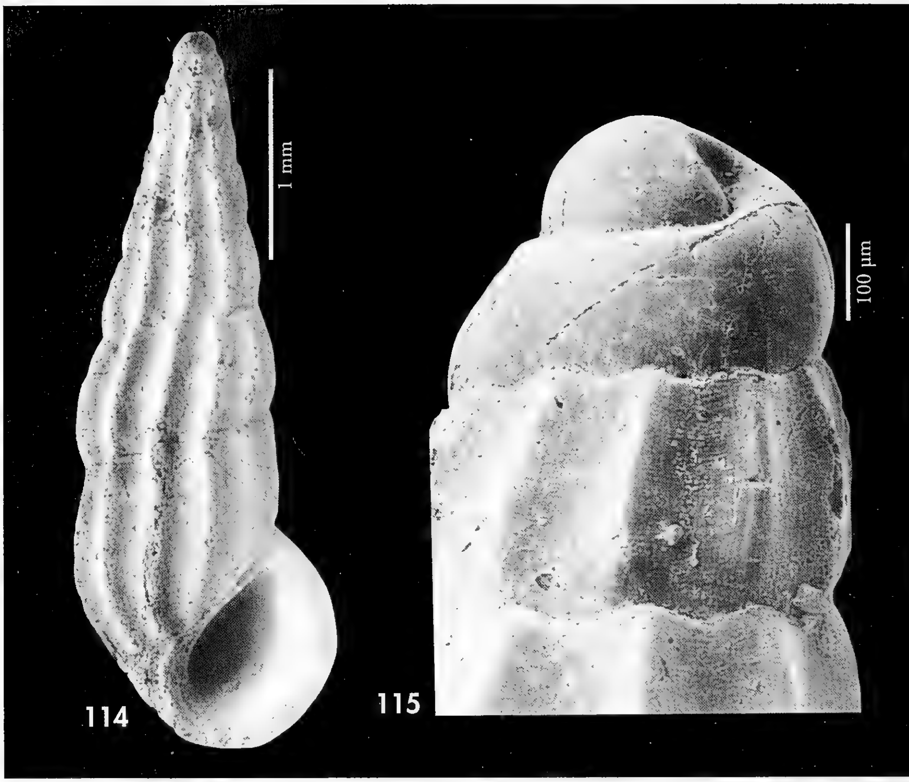


Figures 107-109: *Schwartziella (Schwartziella) irregularis* n. sp. 107: holotype, Ponta Inglez/Ponta Preta, Maio (NNM 58014); 108: protoconch of the holotype; 109: teleoconch microsculpture of the holotype.
Figuras 107-109: Schwartziella (Schwartziella) irregularis *spec. nov. 107: holotipo, Ponta Inglez/Ponta Preta, Maio (NNM 58014); 108: protoconcha del holotipo; 109: microescultura de la teloconcha del holotipo.*



Figures 110-113: *Schwartziella (Schwartziella) abundata* n. sp. 110: holotype, off Palmeira, Sal (NNM 57998); 111: protoconch of the holotype; 112-113: teleoconch microsculpture of the holotype.

Figuras 110-113: Schwartziella (Schwartziella) abundata *spec. nov. 110: holotipo, Palmeira, Sal (NNM 57998); 111: protoconcha del holotipo; 112-113: microescultura de la teloconcha del holotipo.*



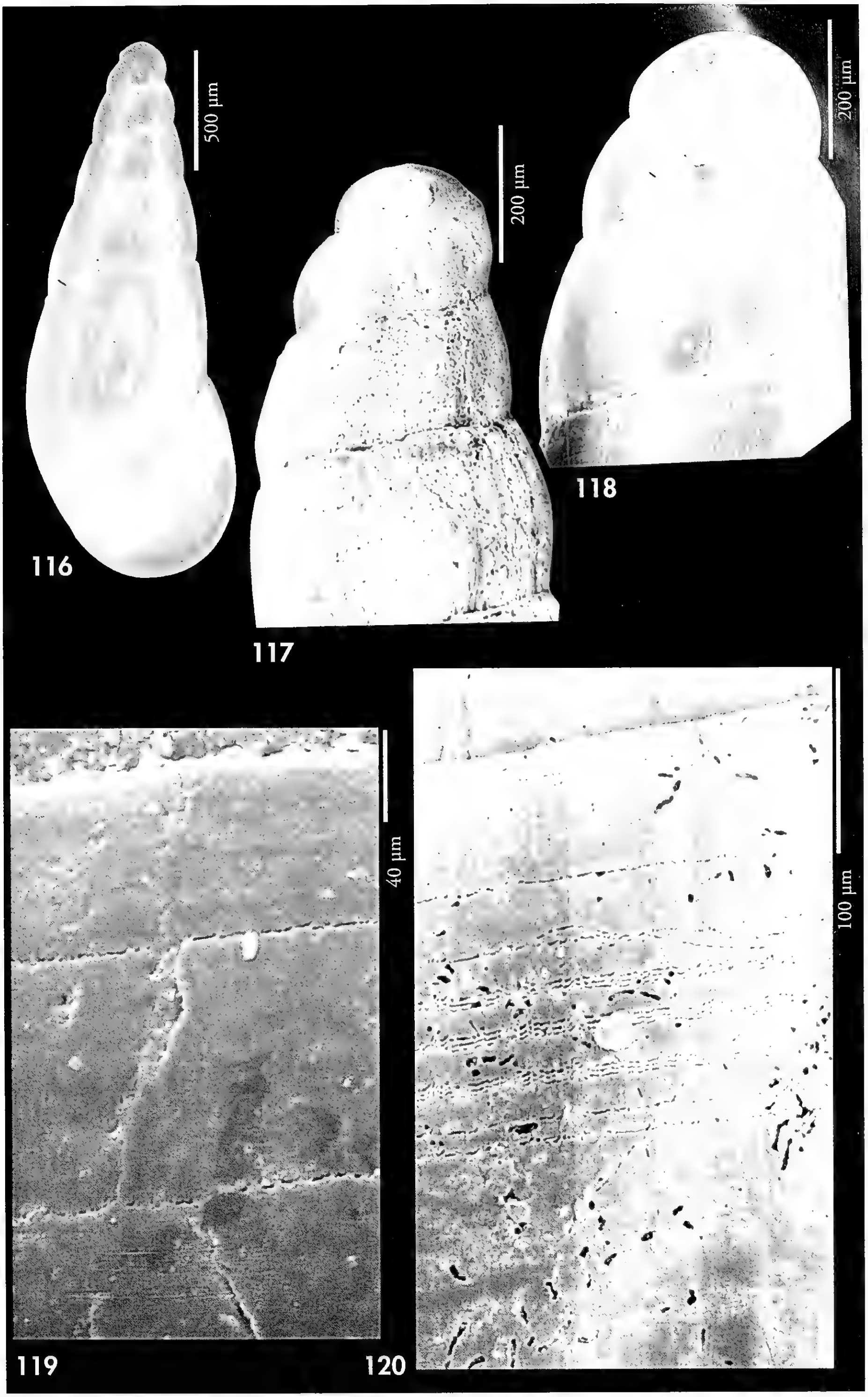
Figures 114-115: *Schwartziella (Schwartziella) rectilinea* n. sp. 114: holotype, Ilhéu Razo (NNM 58026); 115: protoconch of a paratype from type locality (NNM 58027).
Figuras 114-115: Schwartziella (Schwartziella) rectilinea *spec. nov. 114: holotipo, Ilhéu Razo (NNM 58026); 115: protoconcha de un paratipo de la localidad tipo (NNM 58027).*

Teleoconch of 5 whorls, weakly convex, not angulated below sutures, last whorl weakly convex; suture shallow. Colour whitish.

Axial sculpture consisting of few prominent, sharp, narrow, slightly opisthocline, distantly spaced axial ribs, 10 in last whorl, which have not a regular correspondence from whorl to whorl. Spiral sculpture not visible at low magnification. Microsculpture (Fig. 109) only formed by irregular spiral rows of small pits.

Aperture D-shaped, small sized; inner lip thin; columellar side weakly concave; anterior channel almost absent; outer lip opisthocline with thick external varix; peristoma simple with a second elevation in the inner part.

(Right page) Figures 116-120: *Schwartziella (Schwartziella) rarilineata* n. sp. 116: holotype, Rabo de Junco, Sal (MNCN 15.05/31716); 117: protoconch of a paratype; 118: protoconch of the holotype; 119-120: teleoconch microsculpture of a paratype, Rabo de Junco (CER).
(Página derecha) Figuras 116-120: Schwartziella (Schwartziella) rarilineata *spec. nov. 116: holotipo, Rabo de Junco, Sal (MNCN 15.05/31716); 117: protoconcha del paratipo; 118: protoconcha del holotipo; 119-120: microescultura de la teloconcha de un paratipo, Rabo de Junco (CER).*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Habitat: Collected in sandy sediments between 76 and 380 m.

Distribution: Only known from Sal and Maio (Fig. 171).

Remarks: S. irregularis n. sp. differs from the previously described species of *Schwartziella* by the narrow and elongated shell, small protoconch, axial ribs irregularly disposed and the very faint microsculpture with only small perforations. By its elongate shape it is similar to *S. gibbera* n. sp., but this species has a larger protoconch, a subsutural hump, axial ribs continued over adjacent whorls and a more marked microsculpture. *S. sulcostriata* n. sp. also has a larger protoconch and different protoconch and teleoconch microsculpture.

Schwartziella (Schwartziella) abundata n. sp. (Figs. 110-113, 171)

Type material: Holotype (Fig. 110) 1 s of 2.9 x 1.4 mm (NNM 57998) and 2 paratypes, 2 s (NNM 57999), CANCAP Sta. 7.100, off Palmeira, Sal, 16° 45′ N, 23° 01′ W, 262-280 m (30-VIII-1986).
Other material studied: Maio: 4 j, 1 f, CANCAP Sta. 7.050, 15° 06′ N, 23° 14′ W, 380 m (25-VIII-1986) (NNM).
Etymology: The specific name is derived of the Latin *abundo* (to surpass), alluding to the numerous axial ribs of this species, more than in any other Cape Verde *Schwartziella*.

Description: Shell (Fig. 110) length up to 2.9 mm, maximum width 1.4 mm, not solid, elongate-conical.

Protoconch (Fig. 111) of 1 whorl and 420 μm of maximum diameter, of non-planktotrophic type, without spiral sculpture; transition to teleoconch abrupt. Microsculpture formed by irregular flat prominences with some perforations on a smooth surface.

Teleoconch of 4 strongly convex whorls, not angulated below suture; last whorl strongly convex; suture shallow. Colour whitish.

Axial sculpture consisting of scarcely prominent, narrow, opisthocline, distantly spaced axial ribs, absent just below the suture; about very curved 15-16 ribs on the last whorl. Spiral sculpture not visible at low magnification. Microsculpture (Figs. 112, 113) formed by fine threads separated by rows of small pits.

Aperture D-shaped, relatively large; inner lip thick; columellar side weakly concave; anterior channel shallow; outer lip opisthocline with thick external varix; peristome sharp.

Habitat: Muddy bottom between 260 and 380 m.

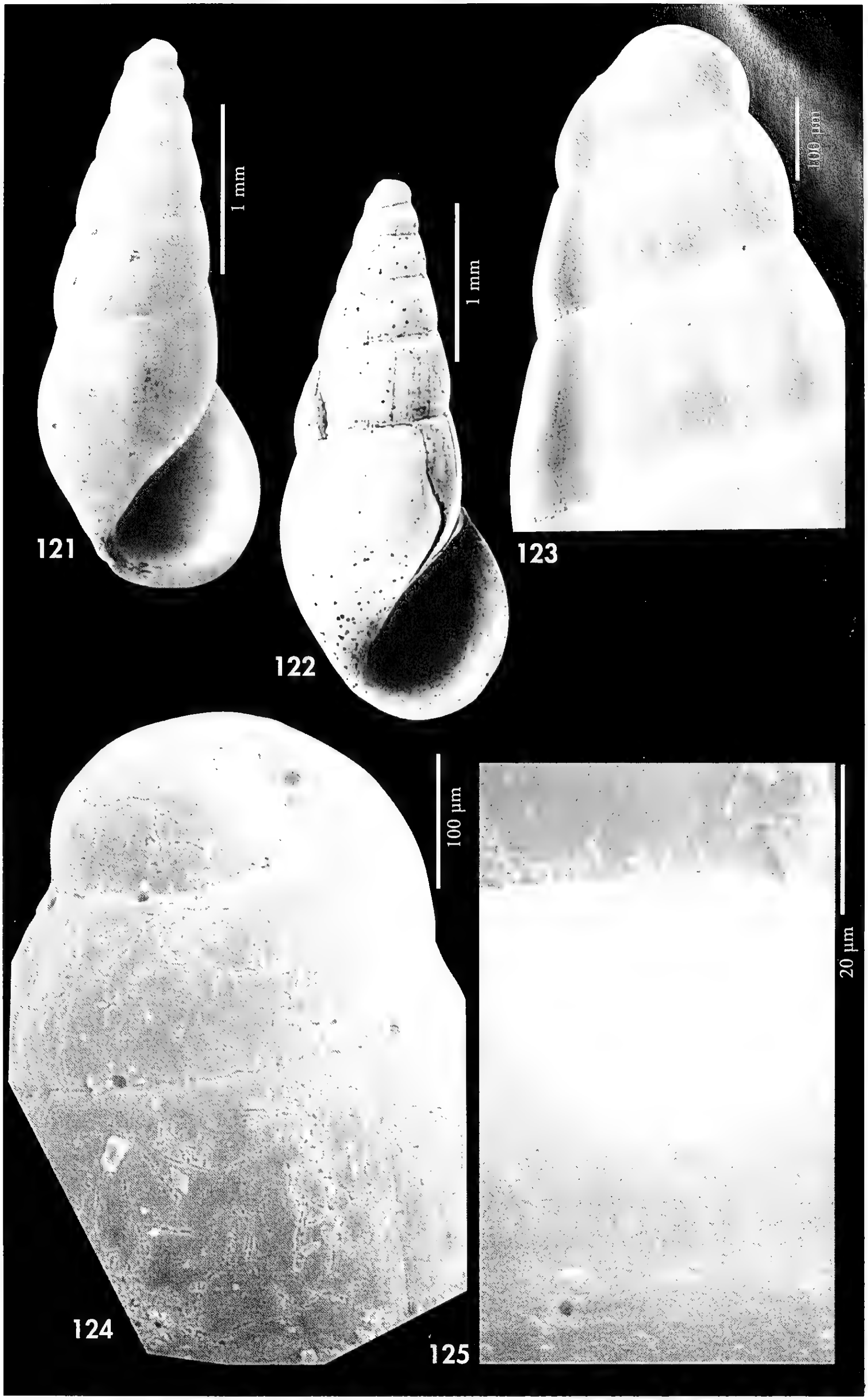
Distribution: Only known from Sal and Maio (Fig. 171).

Remarks: S. abundata n. sp. has a larger protoconch than any other of the Cape Verde species of *Schwartziella*, and also more numerous and curved axial ribs, and a subsutural area without axial sculpture.

Schwartziella (Schwartziella) rectilinea n. sp. (Figs. 114, 115, 172)

Type material: Holotype (Fig. 114) 1 s of 3.8 x 1.4 mm (NNM 58026), and 16 paratypes, 16 j (NNM 58027), CANCAP Sta. 7.121, Ilhéu Razo, 16° 36′ N, 24° 37′ W, 200-230 m (1-IX-1986). Other paraty-

(Right page) Figures 121-125: *Schwartziella (Schwartziella) inscripta* n. sp. 121: holotype, Palmeira, Sal (MNCN 15.05/31710); 122: shell from Maio (broken during the study); 123, protoconch of a paratype, Rabo de Junco, Sal (CER); 124: protoconch of a shell from Palmeira, Sal; 125: detail of the suture in last whorl of the same shell.
(Página derecha) Figuras 121-125: Schwartziella (Schwartziella) inscripta *spec. nov. 121: holotipo, Palmeira, Sal (MNCN 15.05/31710); 122: concha de Maio (rota durante su estudio); 123, protoconch of a paratype, Rabo de Junco, Sal; 124: protoconcha de una concha de Palmeira, Sal; 125: detalle de la sutura en la última vuelta de la misma concha.*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pes: 1 j (MNCN 15.05/31717) and 1 s (CER), both from the type locality; 19 j, CANCAP Sta. 7.119, S of Ilhéu Razo, 16° 36′ N, 24° 36′ W, 140-160 m (1-IX-1986) (NNM 59418); 1 s, CANCAP Sta. 6.095, S of Ilhéu Razo, 16° 35′ N, 24° 37′ W, 930 m (15-VI-1982) (NNM 59419); 1 s, CANCAP Sta. 7.120, S of Ilhéu Razo, 16° 36′ N, 24° 36′ W, 208 m (1-IX-1986) (NNM 59420).
Other material studied: São Nicolau: 25 j, 1 f, São Jorge Bay, CANCAP Sta. 7.129, 16° 33′ N, 24° 16′ W, 405 m (2-IX-1986) (NNM).
Etymology: The specific name alludes to the right profile of the whorls of the shell.

Description: Shell (Fig. 114) length up to 3.8 mm, maximum width 1.4 mm, relatively solid, elongate-conical.

Protoconch (Fig. 115) of 1 whorl and 380 μm of maximum diameter, of non-planktotrophic type, without spiral sculpture, transition to teleoconch attenuated.

Teleoconch of 7 whorls, almost flat-sided, specially the first ones; last whorl weakly convex; suture shallow. Colour cream-whitish.

Axial sculpture consisting of prominent, narrow, scarcely opisthocline, distantly spaced axial ribs; the ribs are continued from whorl to whorl. Spiral sculpture unappreciable at low magnification. Microsculpture formed by spiral rows of very small pits on the first whorls. Due to poor condition of the adult shells no microsculpture could be observed on the last whorl except for growth lines.

Aperture D-shaped, relatively small; inner lip thick; columellar side weakly concave; anterior channel absent; outer lip opisthocline with thick external varix.

Habitat: Found in muddy and calcareous sand between 140 and 930 m.

Distribution: Ilhéu Razo and São Nicolau (Fig. 172).

Remarks: S. rectilinea n. sp. is very elongate, and it differs from the following similar species with elongate shell: *S. irregularis* n. sp. has more convex spire whorls and smaller protoconch; *S. gibbera* n. sp. has very prominent axial ribs and a subsutural hump; *S. sulcostriata* n. sp. has a smaller protoconch, a more curved profile of the spiral whorls, and a more marked teleoconch microsculpture.

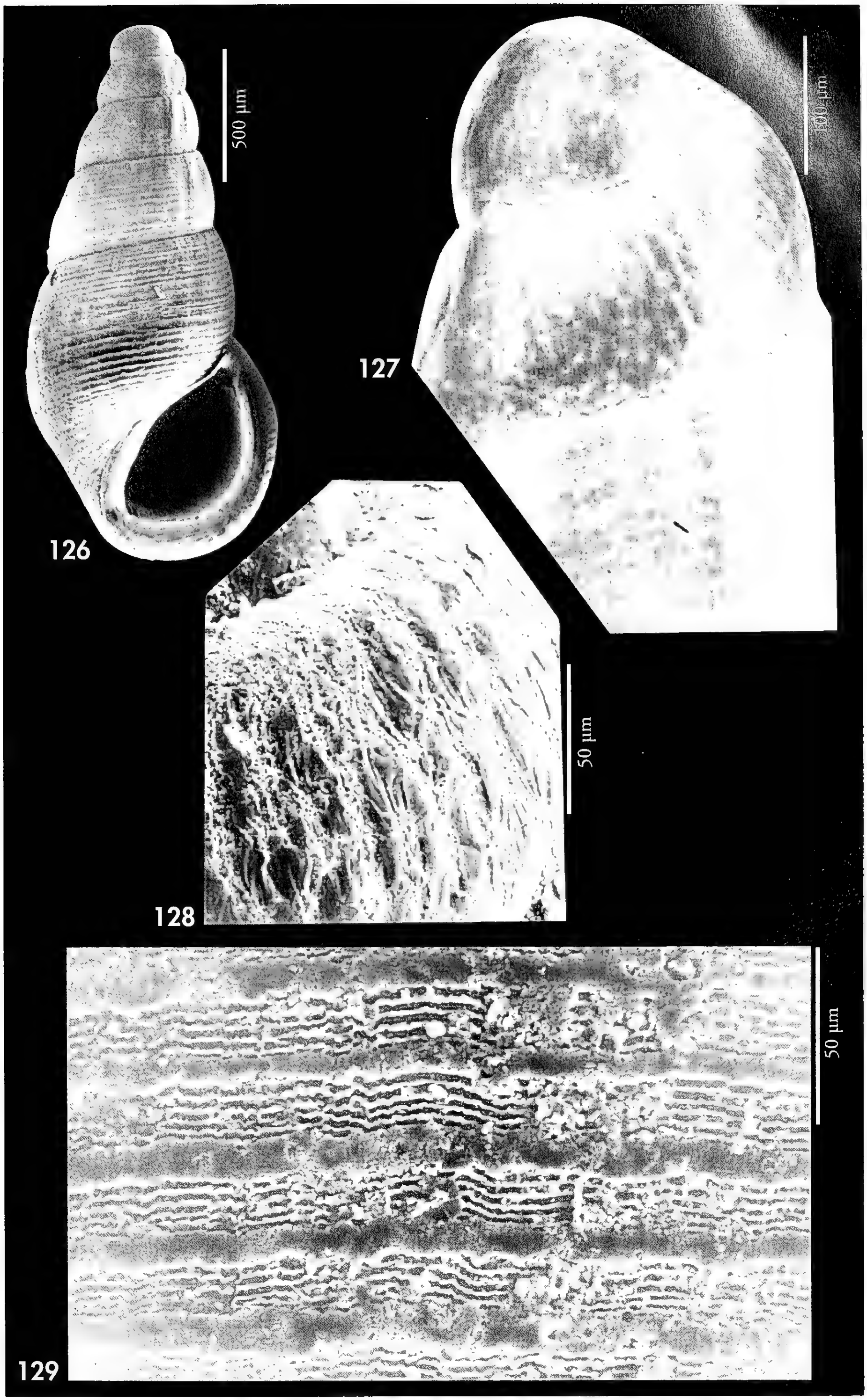
Schwartziella (Schwartziella) rarilineata n. sp. (Figs. 116-120, 173)

Type material: Holotype (Fig. 116) 1 s of 2.3 (1.0 mm, Rabo de Junco, Sal, Cape Verde Archipelago, 6 m (MNCN 15.05/31716). Paratypes: 1 s, Palmeira, Sal, 8 m (MNHN); 1 s, Regona, Sal, 2 m (NNM 58025); 1 s, São Vicente, CANCAP Sta. 7.161, 16° 54′ N, 24° 54′ W, 95 m (NNM 59428); 2 s, 2 f, Rabo de Junco, Sal, 6 m (CER); 1 j, Baia Teodora, Boa Vista, 4 m (CER); 1 s, Sal Rei, Boa Vista, 4 m (AMNH).
Other material studied: Sal: 2 s, 1 j, 1 f, Palmeira, 8 m; 4 s, Regona, 10 m; 2 s (eroded), 1 j, Rabo de Junco, 4 m. São Nicolau: 1 s (eroded), São Jorge Bay, CANCAP Sta. 7.129, 16° 33′ N, 24° 16′ W, 405 m (2-IX-1986) (NNM).
Etymology: The specific name alludes to the teleoconch microsculpture formed by a few lines.

Description: Shell (Fig. 116) length up to 2.5 mm, maximum width 1.1 mm, shining, relatively solid, elongate-conic.

Protoconch (Figs. 117, 118) of 1 whorl and about 320 μm of maximum diameter, of non-planktotrophic type, smooth, transition to teleoconch not abrupt.

(Right page) Figures 126-129: *Schwartziella (Schwartziella) sculpturata* n. sp. 126: holotype, Palmeira, Sal (MNCN 15.05/31720); 127-128: protoconchs of two paratypes, Rabo de Junco, Sal (CER); 129: teleoconch microsculpture of the holotype.
(Página derecha) Figuras 126-129: Schwartziella (Schwartziella) sculpturata *spec. nov. 126: holotipo, Palmeira, Sal (MNCN 15.05/31720); 127-128: protoconchas de dos paratipos, Rabo de Junco, Sal (CER); 129: microescultura de la teloconcha del holotipo.*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Teleoconch of 4 whorls, almost flat-sided, last whorl weakly convex; suture shallow. Colour translucent white.

No axial sculpture. Spiral sculpture (Fig. 116, 119) formed only by few spiral bands, composed by groups of 2-3 very fine threads with intermediate striae on subsutural areas (Fig. 120).

Aperture D-shaped, relatively large; inner lip thin; columellar side weakly concave; anterior channel almost absent; outer lip slightly opisthocline with thin external varix; peristome narrow, rounded.

Habitat: Sand sediments, in shallow water (2-6 m), except for two shells dredged from 95 and 405 m, respectively.

Distribution: Sal, Boa Vista, São Nicolau and São Vicente (Fig. 173).

Remarks: Schwartziella rarilineata n. sp. differs from any of the previously known Eastern Atlantic species of the genus by its teleoconch without axial ribs, almost smooth and shining, like a *Zebina*. Nevertheless, we include it in the genus *Schwartziella* because it lacks of tubercles inside of the outer lip, unlike other Atlantic species of *Zebina* (*Z. paivensis*, *Z. browniana*, *Z. robustior*, see GOFAS, 1999, and below under *Zebina villenai*).

Schwartziella (Schwartziella) inscripta n. sp. (Figs. 121-125, 174)

Type material: Holotype (Fig. 121) 1 s of 3.4 x 1.4 mm, Palmeira Bay, Sal Island, Cape Verde Archipelago, 6 m (MNCN 15.05/31710). Paratypes: 1 s, Matiota, São Vicente, 4 m (NNM 58013); 1 s, Pau Seco, Maio (AMNH); 1 s, Rabo de Junco, Sal (MNHN); 1 s, Rabo de Junco, Sal (CER); 1 s, 2 f, Ilhéu de Sal Rei, Boa Vista (CER); 1 s, 1 f, Porto da Cruz, Boa Vista, 4 m (CER).

Other material studied: Sal: 2 s (1 destroyed during study), 2 j, 1 f, Palmeira, 8 m; Boa Vista: 1 f, Sal Rei, 5 m; Maio: 1 s (Fig. 121, destroyed during study), Pau Seco; São Vicente: 1 f, Porto Mindelo, 15 m.

Etymology: The specific name alludes the presence of striae on the first whorl of the shell.

Description: Shell (Figs. 121, 122) length up to 3.5 mm, maximum width 1.5 mm, relatively solid, shining, elongate-conic.

Protoconch (Figs. 123, 124) of 1 whorl and about 310 μm of maximum diameter, of non-planktotrophic type, smooth; transition to teleoconch not conspicuous.

Teleoconch of 5 whorls, weakly convex; suture very shallow. Colour translucent whitish. Axial sculpture absent. Spiral sculpture only present on the first whorl of the teleoconch (Fig. 123), formed by 4-5 spiral striae, which disappear immediately (Fig. 125).

Aperture D-shaped, relatively large; inner lip thin; columellar side weakly concave; anterior channel almost absent; outer lip opisthocline, with thick external varix; peristome simple, rounded.

Habitat: Sand sediments from shallow water (4-15 m).

Distribution: Sal, Boa Vista, Maio, São Vicente (Fig. 174).

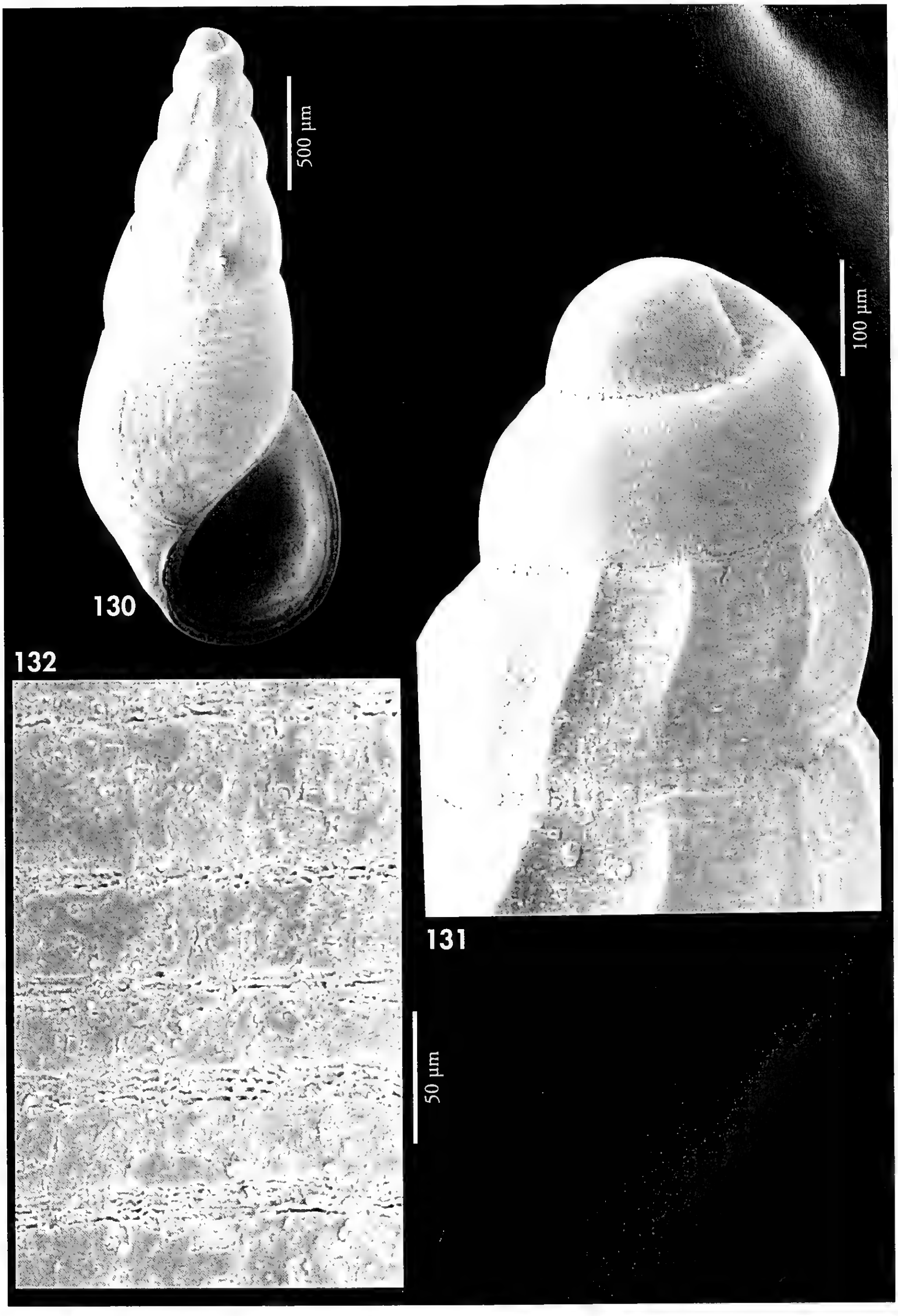
Remarks: S. inscripta n. sp. has a larger shell than *S. rarilineata* n. sp., and the spiral striae only appear on the first whorl.

Schwartziella (Schwartziella) sculpturata n. sp. (Figs. 126-129, 175)

Type material: Holotype (Fig. 126) 1 s of 2.1 x 1.0 mm, Palmeiras, Sal Island, Cape Verde Archipelago, 10 m (MNCN 15.05/31720). Paratypes: 1 s (NNM 58030), 1 s (MNHN), 3 s (CER), all from the type locality; 2 s, 2 f, Sal Rei, Boa Vista (CER); 3 s, Rabo de Junco, Sal, 4 m (CER).

Other material studied: Sal: 2 s (1 broken during the study), 2 f, Rabo de Junco, 4 m; 2 s, Palmeira, 10 m; 6 s, 1 f, Regona, 10 m. Santiago: 1 s, Cidade Velha, 4 m; 1 s, Praia, 5 m. Brava: 1 s, Furna, 30 m; 1 s, Porto do Ancião, 3 m. São Vicente: 1 s, Porto Mindelo, 15 m.

Etymology: The specific name alludes to the presence of axial and spiral sculpture.



Figures 130-132: *Schwartziella (Schwartziella) paradoxa* n. sp. 130: holotype, São Vicente (NNM 58021); 131: protoconch of the holotype; 132: teleoconch microsculpture of the holotype.
Figuras 130-132: Schwartziella (Schwartziella) paradoxa *spec. nov. 130: holotipo, São Vicente (NNM 58021); 131: protoconcha del holotipo; 132: microescultura de la teloconcha del holotipo.*

Description: Shell (Fig. 126) length up to 2.1 mm, maximum width 1.0 mm, not solid, elongate-conic.

Protoconch (Figs. 127, 128) of 1 whorl and 270 μm of maximum diameter, of non-planktotrophic type, without spiral sculpture; transition to teleoconch abrupt. Microsculpture (Fig. 128) shows a rough surface formed by small depressions with many irregular threads.

Teleoconch of 4 whorls, weakly convex; suture shallow. Colour cream-whitish.

Axial sculpture consisting of weakly prominent, narrow, almost orthocline, distantly spaced axial ribs, only on the first 2-3 whorls of teleoconch, disappearing on the last whorl. Spiral sculpture very regular, formed by fine spiral cords, about 15 on penultimate and 35 on last whorl. Microsculpture (Fig. 129) formed by spiral bands of 4-5 threads alternating with furrows.

Aperture D-shaped, medium sized; inner lip thin; columellar side weakly concave; anterior channel absent; outer lip opisthocline with a thin external varix; peristome simple with a pair of parallel lines towards the inner part of the aperture.

Habitat: Sandy sediments from shallow water (3-30 m).

Distribution: Known from Sal, Boa Vista, Santiago, Brava, São Vicente (fig. 175). Probably it can be found in the entire archipelago.

Remarks: S. sculpturata n. sp. differs from *S. rarilineata* n. sp. and *S. inscripta* n. sp. by its evident teleoconch and protoconch sculpture.

Schwartziella (Schwartziella) paradoxa n. sp. (Figs. 130-132, 137, 138, 176)

Type material: Holotype (Fig. 130) 1 s of 2.7 x 1.1 mm, Baia das Gatas, São Vicente, CANCAP Sta. 7.161, 16° 54′ N, 24° 54′ W, 95 m (NNM 58021).

Etymology: The specific name alludes to the shell characters intermediate between *Schwartziella* and *Zebina.*

Description: Shell (Fig. 130) length 2.7 mm, width 1.1 mm, not solid, elongate-conic.

Protoconch (Fig. 131) of 1 whorl and 320 μm of maximum diameter, of non-planktotrophic type, without spiral sculpture and smooth; transition to teleoconch not abrupt.

Teleoconch of 4 whorls, weakly convex; suture shallow. Colour whitish.

Axial sculpture of adapical spire whorls consisting of few prominent, sharp, narrow, opisthocline, slightly undulate and distantly spaced axial ribs, which begin on the suture and disappear a little below the middle of the whorl; axial ribs absent on the last whorl. Spiral sculpture visible at low magnification in all the whorls, except on the inferior part of the last whorl. Microsculpture (Fig. 132) formed by groups of few spiral threads separated by wider rough spaces.

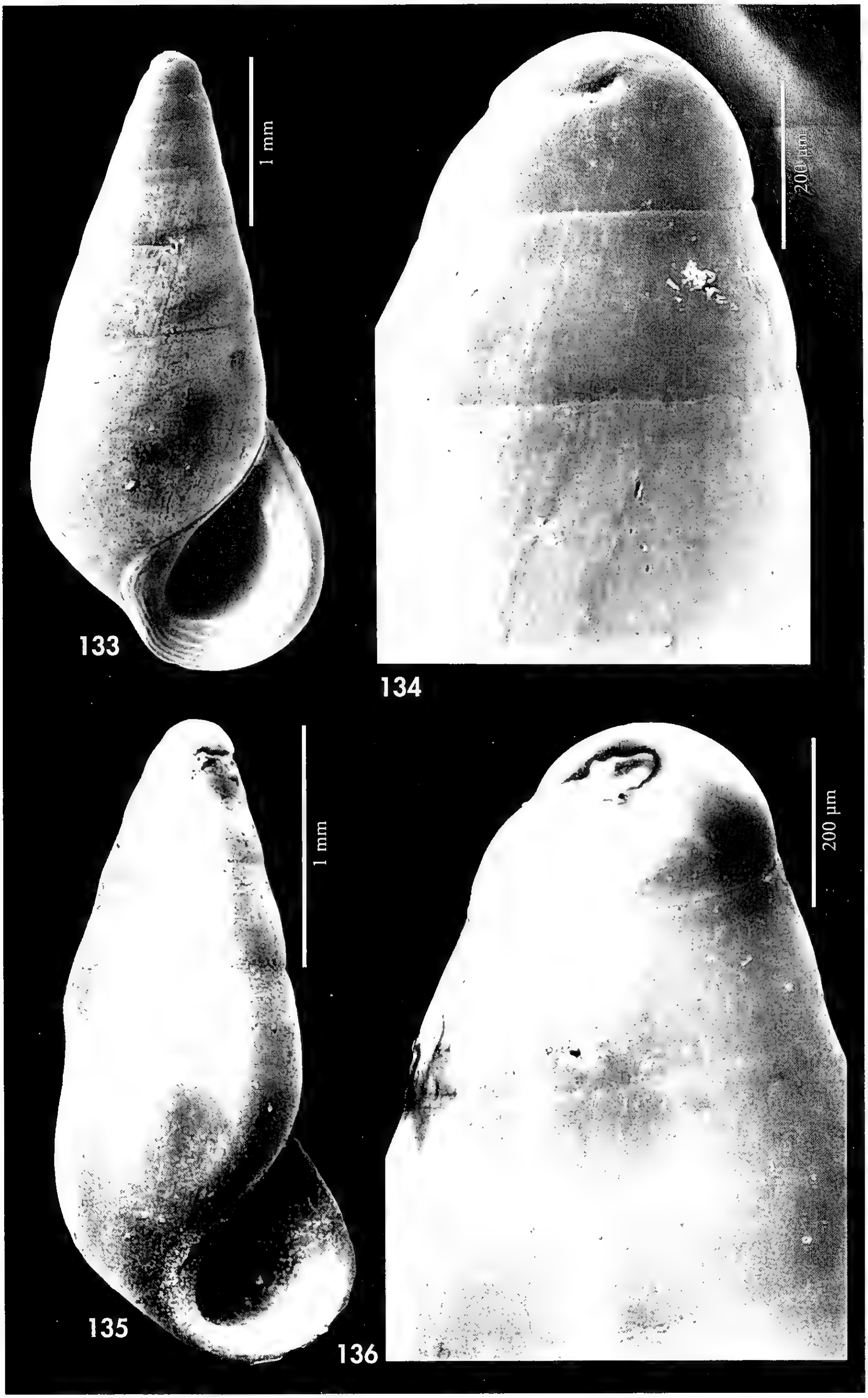
Aperture D-shaped, relatively large; inner lip thin; columellar side weakly concave; anterior channel absent; outer lip opisthocline with a not too thick external varix; peristome simple with some parallel lines towards the inner part of the aperture.

Habitat: Muddy bottom, at 95 m.

Distribution: Only known from the type locality (Fig. 176).

(Right page) Figures 133-136: *Zebina (Zebina) villenai* n. sp. 133: holotype, S of Ilhéu Razo (NNM 58016); 134: protoconch of the holotype; 135: shell of smaller size, S of Ilhéu Razo (NNM 58017); 136: protoconch of the same shell.

(Página derecha) Figuras 133-136: Zebina (Zebina) villenai *spec. nov. 133: holotipo, Sur de Ilhéu Razo (NNM 58016); 134: protoconcha del holotipo; 135: concha de pequeño tamaño, Sur de Ilhéu Razo (NNM 58017); 136: protoconcha de la misma concha.*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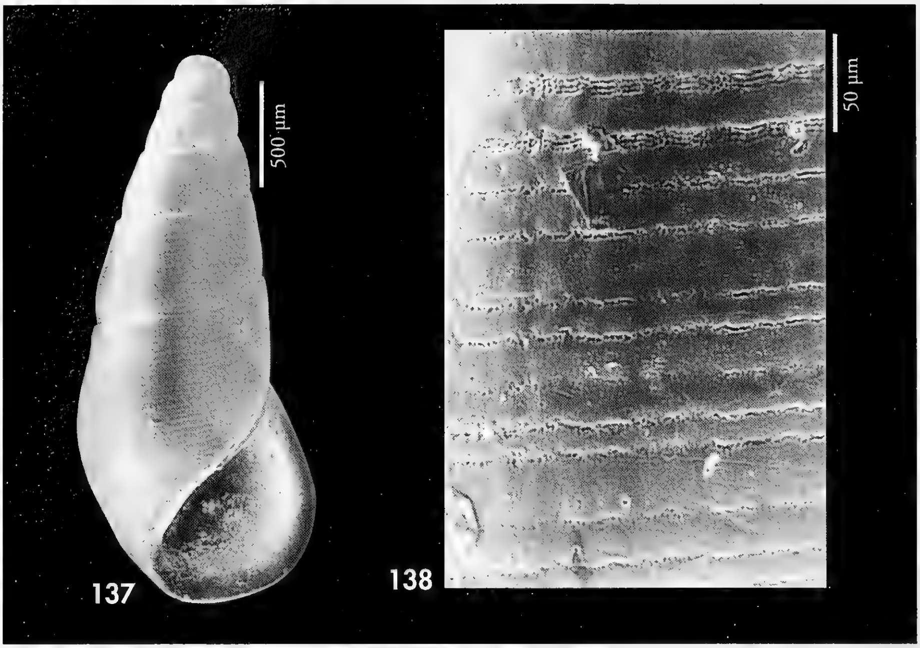


Figures 137, 138: *Schwartziella (Schwartziella) cf. paradoxa*. 137: shell from Rabo de Junco, Sal (CER); 138: teleoconch microsculpture.
Figures 137, 138: Schwartziella (Schwartziella) cf. *paradoxa. 1. 137: concha de Rabo de Junco, Sal (CER); 138: microescultura de la teloconcha.*

Remarks: Schwartziella paradoxa n. sp. differs from any other species of Cape Verde *Schwartziella* by having prominent axial ribs on first whorls of teleoconch, which are absent on last whorl. *S. sculpturata* n. sp., which also has weak axial ribs on the first 2-3 whorls, is less elongate, has more evident spiral sculpture and a different protoconch microsculpture.

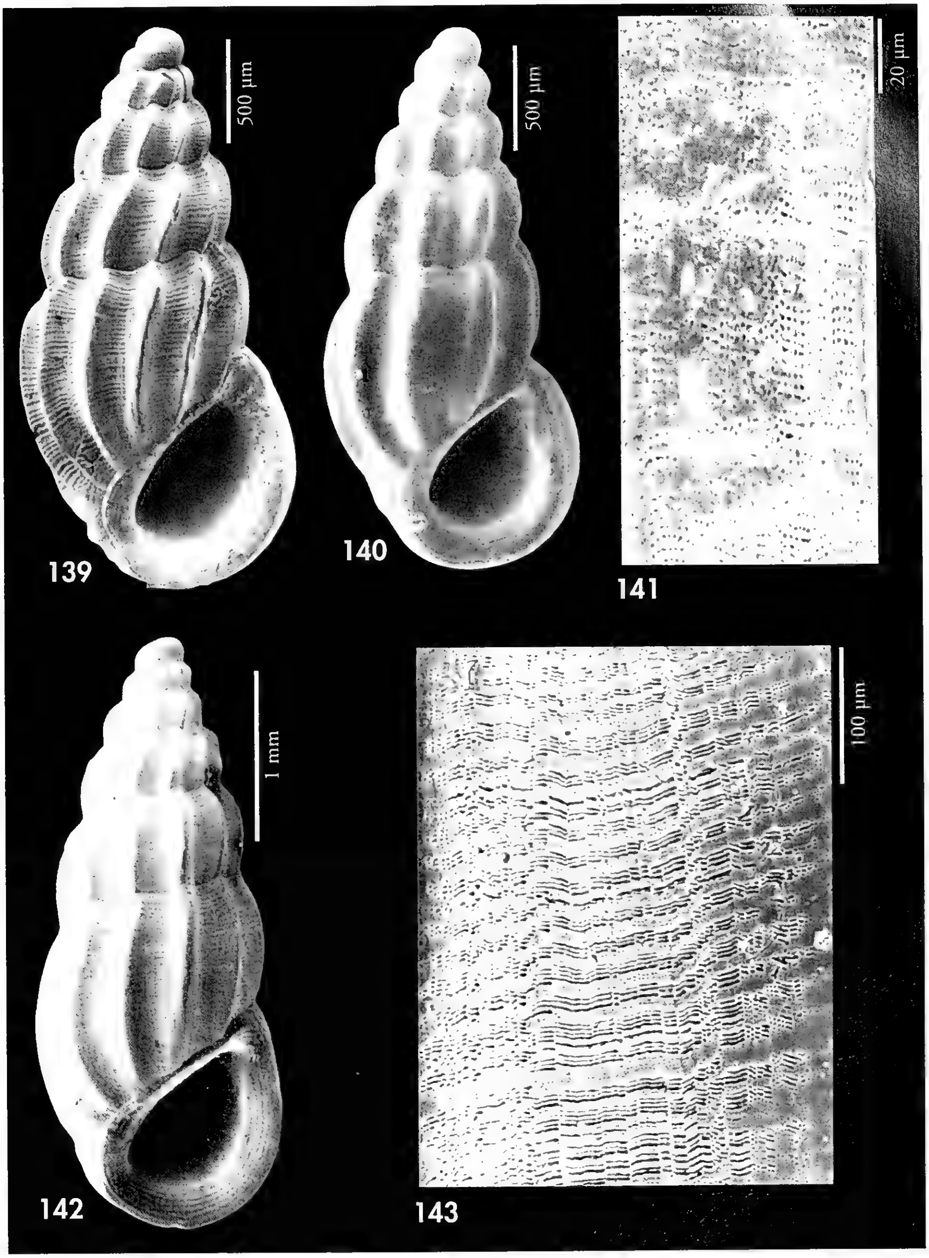
One shell (Figs. 137, 138) of 3.0 x 1.0 mm, found in Rabo de Junco, Sal, is similar to that of *Schwartziella paradoxa* n. sp. but it lacks totally of axial ribs and has more spiral sculpture in the last whorl. We think that it is probably a different species, but we prefer do not describe it awaiting for further material.

Genus *Zebina* H. and A. Adams, 1854
Subgenus *Zebina* s. s.

Type species: *Rissoina semiglabrata* A. Adams, 1854, by subsequent designation (Rehder, 1980).
Diagnosis: Ponder (1985, p. 85).

Zebina (Zebina) villenai n. sp. (Figs. 133-136, 172)

Type material: Holotype (Fig. 133) 1 s of 4.2 (1.8 mm (NNM 58016) and 1 paratype, 1 s (NNM 58017), CANCAP Sta. 7.119, S of Ilhéu Razo, 16° 36′ N, 24° 36′ W, 140-160 m (1-IX-1986). Other paratypes: 1 s, CANCAP Sta. 7.122, S of Ilhéu Razo, 16° 36′ N, 24° 35′ W, 100 m (1-IX-1986) (NNM 59423); 1 s, CANCAP Sta. 6.093, SW of Ilhéu Razo, 16° 36′ N, 24° 37′ W, 400-430 m (15-VI-1982)



Figures 139-143: Shells of dubious species of *Schwartziella (Schwartziella)* from the Cape Verde Islands. 139: *Schwartziella (Schwartziella)* cf. *minima*, Calhau, São Vicente. 140, 141: *S. (S.)* cf. *puncticulata*. 140: shell, CANCAP Sta. 6145, São Vicente; 141: microsculpture of the same shell. 142, 143: *S. (S.)* cf. *typica*; 142: shell from Calhau, São Vicente; 143: microsculpture of the same shell.
Figuras 139-143: Conchas de especies dudosas de Schwartziella (Schwartziella) *de Cabo Verde. 139:* Schwartziella (Schwartziella) *cf.* minima, *Calhau, São Vicente. 140, 141:* S. (S.) *cf.* puncticulata. *140: concha, CANCAP Sta. 6145, São Vicente; 141: microescultura de la misma concha; 142, 143:* S. (S.) *cf.* typica; *142: concha de Calhau, São Vicente; 143: microescultura de la misma concha.*

(NNM 59424); 1 s, 1 j, CANCAP Sta. 7.128, São Jorge Bay, São Nicolau, 16° 33′ N, 24° 17′ W, 400 m (2-IX-1986) (NNM 59425).

Other material studied: Ilhéu Razo: 2 s (Fig. 134), CANCAP Sta. 7.116, S of Ilhéu Razo, 16° 36′ N, 24° 36′ W, 75 m (1-IX-1986) (NNM).

Etymology: The specific name is dedicated to Miguel Villena, who manages the type collection of molluscs at the MNCN, for his kind cooperation.

Description: Shell (Figs. 133, 135) length up to 4.2 mm, maximum width 1.8 mm, very solid, elongate-conic.

Protoconch (Figs. 134, 136) of 1 whorl and about 430 μm of maximum diameter, of non-planktotrophic type, without spiral sculpture; transition to teleoconch appreciable with difficulty.

Teleoconch of about 5 flat-sided whorls; last whorl strongly convex at the lower part; suture shallow. Colour whitish. Axial and spiral sculpture lacking. Surface smooth and shining.

Aperture D-shaped, relatively small; inner lip thin; columellar side weakly concave; anterior channel almost absent; peristome simple, with some parallel lines towards the inner part of the aperture; two tubercles not always evident on an interior elevation of the aperture.

Habitat: Coarse calcareous sand, gravel and stones, between 75 and 430 m.

Distribution: Ilhéu Razo and São Nicolau (Fig. 172).

Remarks: Zebina villenai n. sp. is similar to *Z. paivensis* (Watson, 1873) from the Canary and Selvagens Islands, a species confused with the Caribbean species *Z. browniana* (d'Orbigny, 1842) or *Z. vitrea* (C. B. Adams, 1850) by authors (ODHNER, 1932; NORDSIECK, 1972; GARCÍA-TALAVERA, 1983; see GOFAS, 1999), but *Z. paivensis* has a smaller protoconch (340 μm) and more convex whorls. *Z. browniana* and *Z. vitrea* have protoconchs of planktotrophic type. *Z. robustior* Gofas, 1999, from Southern Morocco to Senegal is larger than *Z. villenai* (up to 5.3 mm) and its protoconch is smaller (about 350 μm, measurements from figure 80 of GOFAS, 1999).

A few shells from Ilhéu Razo are of small size (Fig. 135), but the protoconch (Fig. 136) shows no differences.

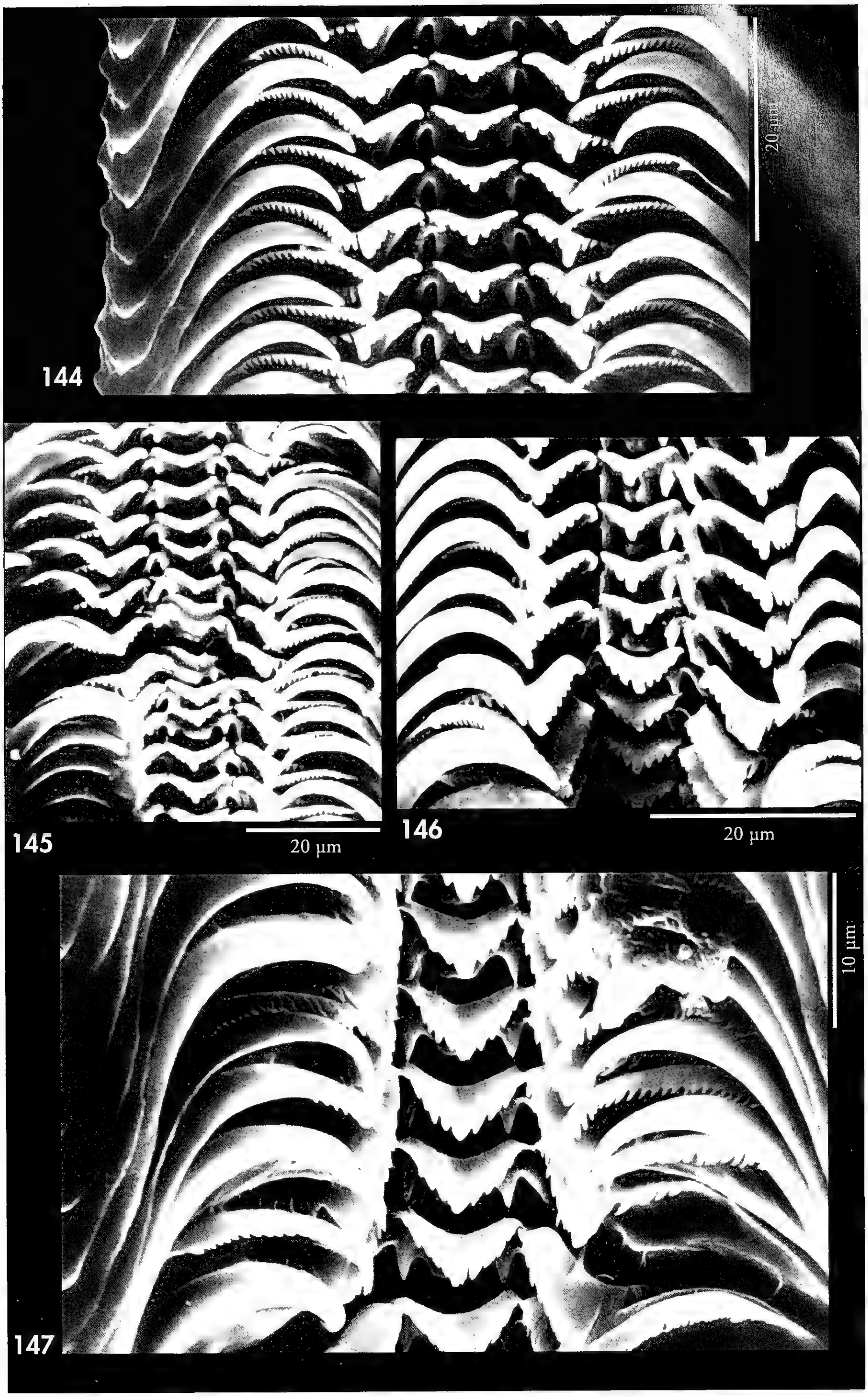
CONCLUSIONS

Twenty-nine species of the subfamily Rissoininae belonging to three genera and four subgenera have been found in the Cape Verde Archipelago. Only one of them, the sole species with a protoconch of planktotrophic type (*Rissoina (Rissoina) punctostriata*) has a wide distribution along the West African coast, whereas the other 28 species, 1 belonging to the genus *Rissoina (Ailinzebina)*, 26 to *Schwartziella (Schwartziella)*, and 1 to *Zebina (Zebina)* should be considered endemic of the archipelago on the basis of their non-planktotrophic type of protoconch and the absence of records from the neighbouring continental coasts (Senegal).

The high percentage of endemism of the Cape Verde Rissoininae (96,5%) is comparable to that of other Cape Verde

(Right page) Figures 144-147: Radulae of *Schwartziella (Schwartziella)* from the Cape Verde Islands. 144: radula of *Schwartziella (Schwartziella) robusta* n. sp., Sal; 145: radula of *S. (S.) typica* n. sp., Sal; 146: radula of *S. (S.) sanmartini* n. sp., Boa Vista; 147: radula of *S. (S.) similiter* n. sp., Brava.

(Página derecha) Figures 144-147: Rádulas de Schwartziella (Schwartziella) *de las islas de Cabo Verde. 144: rádula de* Schwartziella (Schwartziella) robusta *spec. nov., Sal; 145: rádula de* S. (S.) typica *spec. nov., Sal; 146: rádula de* S. (S.) sanmartini *spec. nov., Boa Vista; 147: rádula de* S. (S.) similiter *spec. nov., Brava.*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20 µm
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rissoideans, like *Alvania* (16 endemic species from a total of 19, viz. 84,2%; MOOLENBEEK AND ROLÁN, 1988, HOENSELAAR AND GOUD, 1998), *Manzonia* (7 of 7, 100%; ROLÁN, 1987a), *Crisilla* (6 of 6, 100%; TEMPLADO AND ROLÁN, 1994), *Barleeia* (3, 100%; GOFAS, 1995). Similar high percentages of endemic rissoids were found in other Macaronesian Islands: *Alvania* (Canary Islands, 14 of 20, 70%; Madeira, 10 of 14, 71,4%; HOENSELAAR AND GOUD, 1998), and *Manzonia* (Canary Islands, 9 of 10, 90%; Madeira, 6 of 7, 85,7%; MOOLENBEEK AND FABER, 1987a, b, c). Other gastropod genera also show high percentages of endemic species in the Cape Verde Islands, like *Eatonina* (2, 100%, MOOLENBEEK, 1985-86; ROLÁN AND TEMPLADO, 1993), *Ammonicera* (7 species, 100%, ROLÁN, 1992), *Euthria* (7, 100%; COSEL, 1982d; COSEL AND BURNAY, 1983; ROLÁN, 1985, 1987b), *Conus* (45 of 48, 93,7%) (ROLÁN, 1990, 1991) and *Volvarina* (9 of 9, 100%) (MORENO AND BURNAY, 1999). From our own preliminary data, which will be discussed in a forthcoming paper, the number of endemic species of Cape Verde marine gastropods reachs 193, from a total of 588 identified species, i. e., a general percentage of 32,8% of endemism. This high percentage of endemic species is comparable with other even more isolated oceanic islands (Galapagos, Easter Is., Hawaii), and requires special research and conservation efforts. Considering only data referring to Rissoininae, Pitcairn Islands, which are 390 km from the nearest islands, have 12 species, with a maximum of three endemic ones, all them with non-planktotrophic protoconch (SLEURS AND PREECE, 1994). Only four species of Rissoininae are reported from the Galapagos Islands, which are 1000 km off the nearest continental mainland, two of which are probably endemic; the Galapagos Rissoininae fauna is very impoverished compared to the rather rich tropical eastern Pacific (SLEURS, 1989). In contrast, there are four species, three of them endemic in Guadalupe Island which is only 260 km off the coast of northern Baja California (SLEURS, 1989).

The occurrence of the studied species in each one of the islands of the archipelago is showed in Figures 158-176 and Table II. The currently available information is insufficient to know the actual geographical patterns of distribution of all the species in the archipelago. We have studied only a few samples from deep water from Santo Antão and Ilhéus do Rombo, and from shallow water from Fogo, Ilhéu Branco, Ilhéu Razo, Santa Luzia and São Nicolau. Moreover, it is also possible that the original distribution of the species could have been altered by the accidental introduction of species in some islands due to the human activities. Anyway, we can be sure that some species are not uniformly distributed along the archipelago but they are only present in some islands, because we commonly found them in one or two islands and not at all in the rest. Nothing can be said in species in which little material has been studied, like *Schwartziella paradoxa*. In these cases, we are not sure of its presence in other islands. Sal and Boa Vista are the islands with a higher number of species (20 and 14, respectively), and this

Figures 148-155: Opercula of *Schwartziella (Schwartziella)* from the Cape Verde Islands. 148: *S. (S.) robusta*, Sal, inner part; 149: *S. (S.) sanmartini*, Sal, inner part; 150: *S. (S.) sanmartini*, Boa Vista, outer part; 151: *S. (S.) sanmartini*, Sal, inner part; 152: *S. (S.) similiter*, Brava, inner part; 153: *S. (S.) luisi*, Palhona, Sal, inner part; 154: *S. (S.) luisi*, Palhona, Sal, outer part; 155: *S. (S.)* cf. *luisi*, Calhau, São Vicente.

Figures 148-155: Opérculos de Schwartziella (Schwartziella) *de las islas de Cabo Verde. 148:* S. (S.) robusta, *Sal, parte interna; 149:* S. (S.) sanmartini, *Sal, parte interna; 150:* S. (S.) sanmartini, *Boa Vista, parte externa; 151:* S. (S.) sanmartini, *Sal, parte interna; 152:* S. (S.) similiter, *Brava, parte interna; 153:* S. (S.) luisi, *Palhona, Sal, parte interna; 154:* S. (S.) luisi, *Palhona, Sal, parte externa; 155:* S. (S.) cf. luisi, *Calhau, São Vicente.*

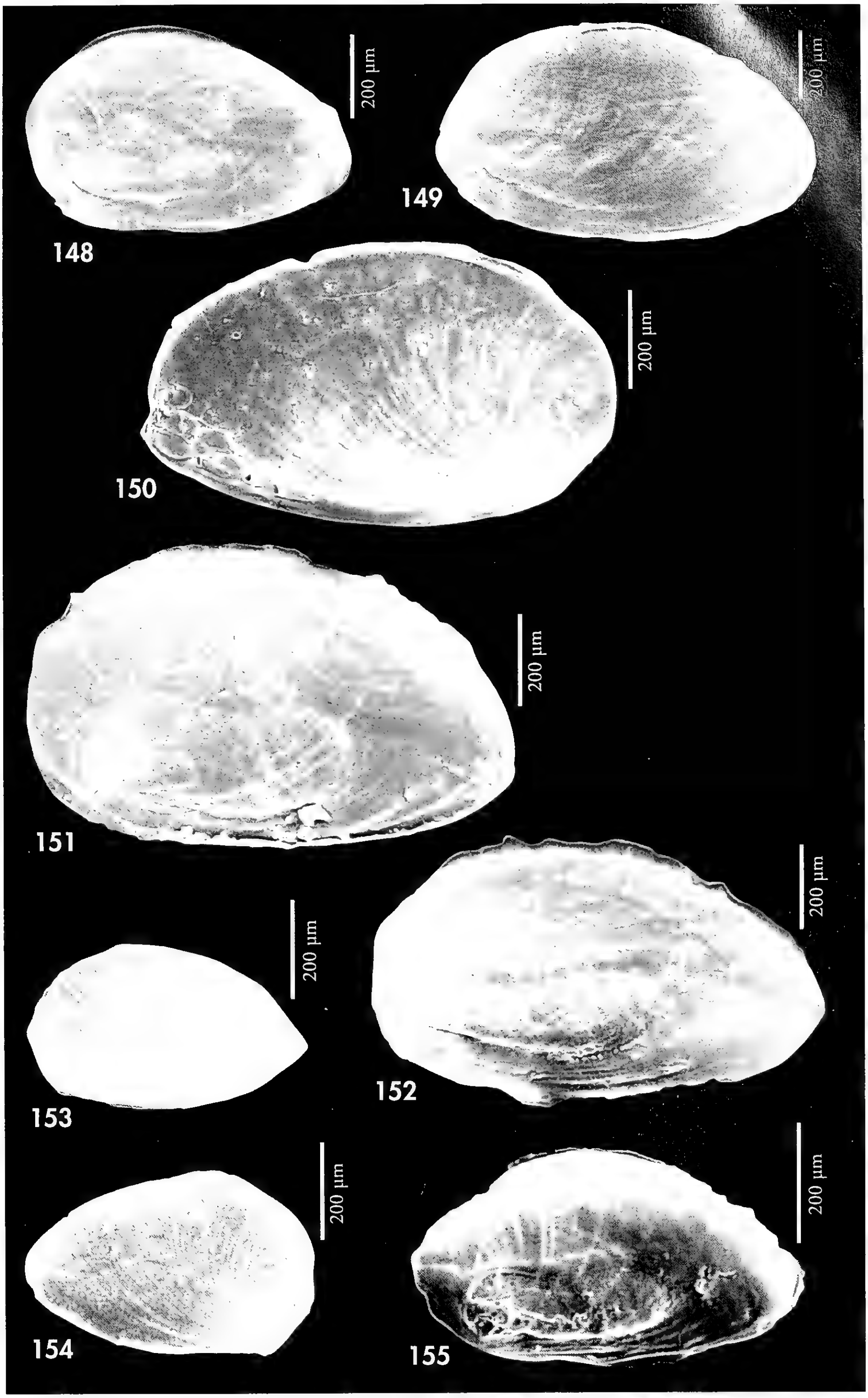
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Table I. Differences between *Rissoina (Rissoina) punctostriata* and *R. (R.) decussata*.
Tabla I. Diferencias entre Rissoina (Rissoina) punctostriata *y* R. (R.) decussata.

	Rissoina punctostriata	*Rissoina decussata*
size	up to 10 mm	usually up to 7 mm
profile	slightly undulated in the last whorls by the subsutural depression	almost rectilineal
adapical whorls of teleoconch	angulated	not angulated
axial ribs	opisthocline and slightly curved; weakly prominent on the last whorl	almost orthocline; rectilineal; prominent on the last whorl
subsutural part of last whorls	depressed; axial ribs almost disappear	not depressed; axial ribs well marked
protoconch	3 whorls, diameter increases rapidly	2 $^{1}/_{2}$ whorls, diameter increases slowly
sinusigera notch	deep	absent

could be related with its older origin as ROLÁN (1991) pointed for the species of the genus *Conus*, but also with the fact that these islands were the most sampled, as well as Santiago (11 species), São Vicente (8) and Brava (9). Some species have been found in several close islands of a group and not in the rest. Probably these species are restricted to this group of islands, which is compatible with their non-planktotrophic development and the isolation of islands, as was mentioned by ROLÁN (1991) in the Cape Verde species of *Conus* with non-planktotrophic development. More than a half of *Schwartziella* species (15) apparently have a wide bathymetric distribution, since they were found between shallow water and bathyal depths. Nevertheless, only shells were collected of most of species or were found at deep water, and they are probably transported from shallow to deeper bottoms along the abrupt shelf of the islands. Only *S. cancapae* are mainly represented by shells collected below 60 m, and *S. irregularis*, *S. abundata*, *S. rectili-*

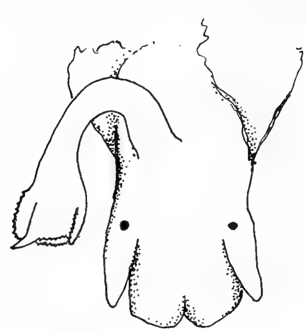


Figure 156: Drawing of the anterior part of a male of *Schwartziella (Schwartziella) sanmartini*, showing the penis.
Figura 156: Esquema de la parte anterior de un macho de Schwartziella (Schwartziella) sanmartini, *mostrando el pene.*

Table II. Distribution of the species in the archipelago. Abbreviations: S, Sal; BV, Boavista; M, Maio; ST, Santiago; F, Fogo; B, Brava; IR, Ilhéus do Rombo ou Secos; C, Ilhéu de Cima; SA, Santo Antão; SV, São Vicente; SL, Santa Luzia; R, Ilhéu Razo; SN, São Nicolau.
Tabla II. Distribución de las especies en el archipiélago. Abreviaturas: S, Sal; BV, Boavista; M, Maio; ST, Santiago; F, Fogo; B, Brava; IR, Ilhéus do Rombo ou Secos; C, Ilhéu de Cima; SA, Santo Antão; SV, São Vicente; SL, Santa Luzia; R, Ilhéu Razo; SN, São Nicolau.

	S	BV	M	ST	F	B	IR	C	SA	SV	SL	R	SN
R. punctostriata	+	+	+	+	+	+	+	+	+	+	+	+	+
R. onobiformis	+	+		+		+							
S. robusta	+	+											
S. obesa			+	+	+	+	+			+			
S. corrugata						+							
S. sanmartini	+	+	+										
S. similiter				+		+				+	+		
S. typica	+	+											+
S. angularis	+	+											
S. luisi	+	+											
S. minima	+	+											
S. fulgida				+	+	+							
S. depressa	+	+											+
S. gradata						+							
S. pavita	+	+	+										
S. cancapae				+	+	+							
S. puncticulata	+		+	+	+	+		+		+	+	+	+
S. hoenselaari	+			+	+			+			+	+	+
S. paucicostata	+		+	+								+	
S. sulcostriata	+											+	+
S. gibbera	+	+		+									
S. irregularis	+		+										
S. abundata	+		+										
S. rectilinea												+	+
S. rarilineata	+	+								+			+
S. inscripta	+	+	+							+			
S. sculpturata	+	+		+		+				+			
S. paradoxa										+			
Z. villenai												+	+

nea, S. paradoxa and *Zebina villenai* are exclusively represented by shells collected below 75 m of depth. Since only a small part of the studied material was collected alive and the sampling effort was quite different on different islands and depths, a lot of work remains to be done for knowing the basic ecological information of almost all the species (actual habitat, relative abundance, etc.)

The sole species with planktotrophic type of protoconch (*Rissoina punctostriata*) was found in all the islands. Eight species of *Schwartziella* were only known from the North-east group of islands: two of them from Sal, Boa Vista and Maio (*S. sanmartini* and *S. pavita*, Fig. 162), four only from Sal and Boavista (*S. robusta, S. angularis, S. luisi* and *S. minima*, Fig. 159), and two other only from Sal and Maio (*S. irregularis* and *S. abundata*, Fig. 169). Three species were known only from the North-west group: two from São Nicolau, Ilhéu Razo and Ilhéu de Cima (*S. rectilinea* and *Zebina villenai*, Fig. 172), and one only from São Vicente (*S. paradoxa*,

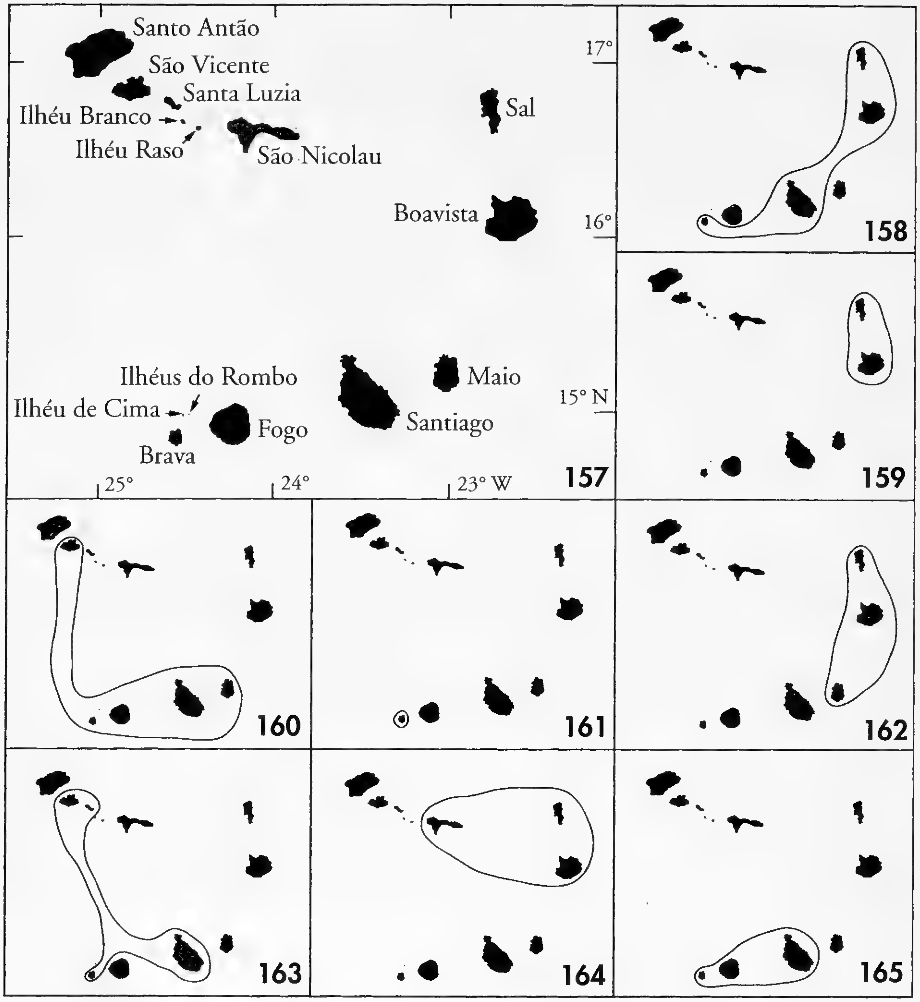
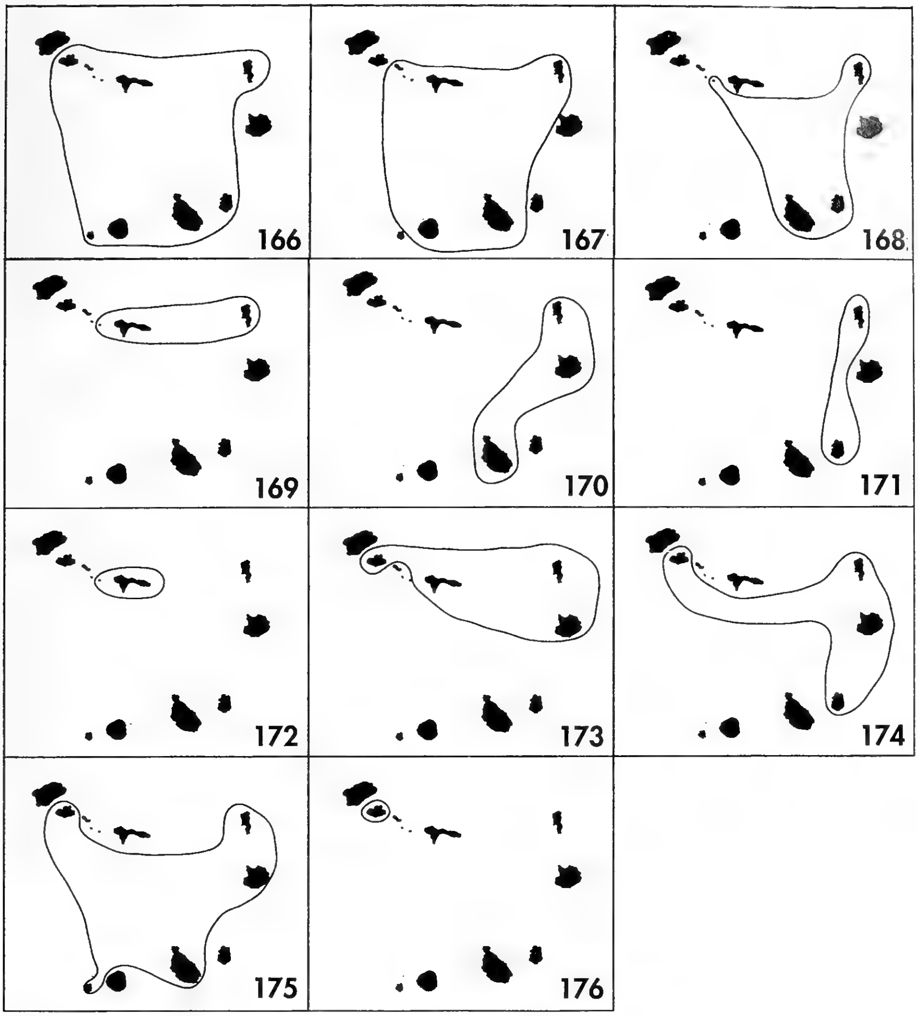


Figure 157. Map of the Cape Verde Archipelago. Figures 158-165: Distribution areas. 158: *Rissoina (Ailinzebina) onobiformis*; 159: *Schwartziella (Schwartziella) robusta, S. (S.) angularis, S. (S.) luisi* and *S. (S.) minima*; 160: *S. (S.) obesa*; 161: *S. (S.) corrugata* and *S. (S.) gradata* (only Brava); 162: *S. (S.) sanmartini* and *S. (S.) pavita*; 163: *S. (S.) similiter*; 164: *S. (S.) typica* and *S. (S.) depressa*; 165: *S. (S.) fulgida* and *S. (S.) cancapae*.
Figura 157. Mapa del Archipiélago de Cabo Verde. Figuras 158-165. Áreas de distribución. 158: Rissoina (Ailinzebina) onobiformis*; 159:* Schwartziella (Schwartziella) robusta, S. (S.) angularis, S. (S.) luisi *y* S. (S.) minima*; 160:* S. (S.) obesa*; 161:* S. (S.) corrugata *y* S. (S.) gradata *(sólo Brava); 162:* S. (S.) sanmartini *y* S. (S.) pavita*; 163:* S. (S.) similiter*; 164:* S. (S.) typica *y* S. (S.) depressa*; 165:* S. (S.) fulgida *y* S. (S.) cancapae.

Fig. 176). Four species were known only from the South-west group of islands: two (*S. fulgida* and *S. cancapae*, Fig. 165) from Santiago, Fogo and Brava, and two (*S. corrugata* and *S. gradata*, Fig. 161) only from Brava. Finally, five species (*Schwart-*



Figures 166-176. Distribution areas. 166: *S. (S.) puncticulata*; 167: *S. (S.) hoenselaari*; 168: *S. (S.) paucicostata*; 169: *Schwartziella (Schwartziella) sulcostriata*; 170: *S. (S.) gibbera*; 171: *S. (S.) irregularis* and *S. (S.) abundata*; 172: *S. (S.) rectilinea* and *Zebina (Zebina) villenai*; 173: *S. (S.) rarilineata*; 174: *S. (S.) inscripta*; 175: *S. (S.) sculpturata*; 176: *S. (S.) paradoxa*.

Figuras 166-176. Áreas de distribución. 166: S. (S.) puncticulata*; 167:* S. (S.) hoenselaari*; 168:* S. (S.) paucicostata; *169:* Schwartziella (Schwartziella) sulcostriata*; 170:* S. (S.) gibbera*; 171:* S. (S.) irregularis *y* S. (S.) abundata*; 172:* S. (S.) rectilinea *y* Zebina (Zebina) villenai*; 173:* S. (S.) rarilineata*; 174:* S. (S.) inscripta*; 175:* S. (S.) sculpturata*; 176:* S. (S.) paradoxa.

ziella obesa, S. puncticulata, S. hoenselaari, S. paucicostata and *S. sculpturata*) were found in the three groups of islands, other five in the NE and NW groups (*S. typica, S. depressa, S. sulcostriata, S. rarilineata* and *S. inscripta*), and three other in the NW and SW groups (*S. similiter, S. gibbera* and *Rissoina (Ailinzebina) onobiformis*).

Since Rissoininae species do not differ markedly in anatomical features, except for the morphology of the penis, species identification is usually based on shell characters only (PONDER, 1985; SLEURS, 1993, 1994). However, shell characters seem to be strongly subject to parallelism, and this makes identification of the apomorphic conditions extremely difficult (SLEURS, 1994). Only a thorough revision of the genera of Rissoininae, including teleoconch microsculpture, protoconch morphology, anatomy (and especially the penial characters) and the fossil record, may give us an accurate idea of the phylogenetic relationships of the species. Nevertheless, in the absence of sufficient systematic and distributional data, we point out in the following lines some considerations about the Cape Verde species of Rissoininae that will need further research.

Rissoina punctostriata seems to form with *R. decussata* from the Caribbean and *R. elegantula* (Angas, 1880) from South Australia a group of closely related species. The holotype of *R. elegantula* (BMNH 1881.4.29.4, Aldinga Bay) has similar shell size (6.6 x 2.8 mm), shape and sculpture to the two Atlantic species, and it also has a protoconch of planktotrophic type with sinusigerous discontinuity. As we will say below, this is not the only group of species with an apparently disjunct Atlantic-Pacific distribution.

The subgenus *Rissoina (Ailinzebina)* comprises at least five Recent species, of which four are apparently distributed only in the Western Pacific, and one (*R. (A.) elegantissima*) has a tropical western Atlantic distribution (SLEURS, 1993). The second Atlantic species described here, *Rissoina (Ailinzebina) onobiformis* n. sp., seems to be more closely related by its size, subcylindrical and thin shell, axial and spiral sculpture and non-planktotrophic type or protoconch to the western Pacific species *R. (A.) abrardi* (Ladd, 1966). The shell of the western Atlantic *R. (A.) elegantissima* is also similar in size, shape and sculpture, but it is rather solid and the protoconch is of planktotrophic larval type. The remaining three Pacific species of this subgenus clearly differ from the precedent "group" of species in shell shape or size and sculpture (see SLEURS, 1993). It should be considered a vicariant origin of the two non-planktotrophic species of this "group" from a widely distributed Tethyan planktotrophic ancestor (may be *R. (A.) elegantissima*?), a hypothesis proposed by LEAL AND MOORE (1989) for two other related species of *Rissoina* (*Rissoina indiscreta* Leal and Moore, 1989, from Brazil, and *R. turricula* Pease, 1861, from the Indo-Pacific). Nevertheless, species of the subgenus *Ailinzebina* are rather uncommon, and therefore more biogeographical and anatomical information is needed to establish reliable relationships. The oldest known fossils of this subgenus date from the Early Tertiary of France and the Lower Miocene of Bikini (SLEURS, 1993), and this supports such hypothesis. These matter deserves further detailed research, since similar groups of closely related species distributed in one (or both) sides of the Atlantic and the Indo-Pacific were recorded in several families, viz. the genus *Luria* (Cypraeidae), with a pair of related species (*Luria lurida* from the Eastern Atlantic and *L. pulchra* from the Red Sea, Gulf of Oman and Persian Gulf) (ALVARADO AND ÁLVAREZ, 1964), the *Conus venulatus* group from the Cape Verde Islands and *Conus suturatus* from Central Indo-West Pacific and Australia (ROLÁN, 1991), and the genus *Volvarina* (Marginellidae), with Western and Eastern Atlantic and Red Sea related species (MORENO AND BURNAY, 1999).

The high number of species of Cape Verde *Schwartziella* is surprising, since only one species of this genus (*S. africana*) has been recorded from the neighbouring West African coast, and as far as we know, there are no endemic species of this genus in the islands of São Tomé and Principe and the Canary Islands. The five species of *Schwartziella* from St. Helena Island described by SMITH (1890) also have paucispiral protoconch and seem to be endemic. The loss of a planktotrophic larval stage and the isolation of Cape Verde islands seem to be the main factors of speciation, but there is yet much work to do on the isolation mechanisms within the archipelago that has led to such a high speciation. The present knowledge does not allow to stablish if such a radiation is dued to one or more colonizations of the archipelago, followed by isolation and speciation. The scarce information on Atlantic *Schwartziella*, especially regarding protoconch characters, teleoconch microsculpture and penial anatomy, makes very difficult to establish relationships based solely on the available data. It is possible that the non-planktotrophic Atlantic *Schwartziella* derived from a widespread Atlantic species with planktotrophic development, but only a revision of the Atlantic recent and fossil species could give solid cues about the speciation of the genus.

On the basis of the shell characters used in the descriptions we present a key for the Cape Verde species of *Schwartziella*.

1. - Shell with axial sculpture on all whorls 2
   - Shell without axial sculpture or with weak axial sculpture not present on all whorls 23

2. - Shell with a strong subsutural angulation 3
   - Shell lacking strong subsutural angulation 5

3. - Shell longer than 3 mm . . . . *S. obesa*
   - Shell length up to 3 mm 4

4. - Shell relatively wide (l/w ratio 2.12-2.20); protoconch with only a spiral angulation in its upper part . . . . *S. angularis*
   - Shell relatively narrow (l/w ratio 2.32-2.44); protoconch with three spiral cords and irregular axial threads . . . . *S. gradata*

5. - Suture markedly undulous due to the axial ribs . . . . *S. corrugata*
   - Suture rectilinear or slightly undulous 6

6. - Shell very solid and strong . . . . *S. robusta*
   - Shell not so solid 7

7. - Shell showing aperture with 8 axial ribs visible in last whorl 8
   - Shell showing aperture with less than 8 axial ribs visible in last whorl 9

8. - Adult shells longer than 3 mm; protoconch diameter about 360 μm . *S. sanmartini*
   - Adult shells length up to 3 mm; protoconch diameter about 420 μm . *S. abundata*

9. - Shell showing aperture with less than 6 axial ribs visible in last whorl 10
   - Shell showing aperture with 6 or more axial ribs visible in last whorl 11

10. - Shell showing aperture with 5 axial ribs visible in last whorl; protoconch with sculpture, of about 300 μm of diameter . . . . *S. hoenselaari*
    - Shell showing aperture with 4 axial ribs visible in last whorl; protoconch smooth, of about 270 μm of diameter . . . . *S. paucicostata*

11. - Axial ribs more convex in the subsutural part 12
    - Axial ribs not more convex in subsutural part 13

12. - Teleoconch microsculpture formed by undulated rows of punctae . *S. puncticulata*
    - Teleoconch microsculpture formed by groups of 6-9 spiral threads interrupted by the growth lines, alternating with bands with only pits . . . . *S. gibbera*

13. - Spiral sculpture of the teleoconch visible at low magnification 14
    - Spiral sculpture of the teleoconch not visible at low magnification 19

14. - Shell length up to 3 mm 15
    - Shell longer than 3 mm 16

15. - Shell with evident and separate spiral threads . . . . *S. luisi*
    - Shell with finer and closer spiral threads . . . . *S. minima*

16. - Shell with not prominent axial ribs . . . . *S. pavita*
    - Shell with prominent axial ribs 17

17. - Protoconch with a spiral cord . . . . *S. similiter*
    - Protoconch lacking spiral sculpture 18

18. - Axial ribs not very prominent; protoconch diameter about 400 µm . *S. sulcostriata*
    - Axial ribs prominent; protoconch diameter about 340 µm . . . . *S. cancapae*

19. - Shell with rectilinear profile, specially in first whorls . . . . *S. rectilinea*
    - Shell with convex whorls 20

20. - Axial ribs not regularly disposed; protoconch diameter < 200 µm . . *S. irregularis*
    - Shell with regular ribs; protoconch diameter > 200 µm 21

21. - Shell shining . . . . *S. fulgida*
    - Shell not shining 22

22. - Shell with a slight subsutural depression . . . . *S. depressa*
    - Shell lacking subsutural depression . . . . *S. typica*

23. - Shell with spiral sculpture only 24
    - Shell with spiral and axial sculpture 25

24. - Shell with spiral striae on first whorl only . . . . *S. inscripta*
    - Shell with spiral sculpture on all whorls . . . . *S. rarilineata*

25. - Shell with uniform spiral sculpture in all the shell . . . . *S. sculpturata*
    - Shell without spiral sculpture at the base . . . . *S. paradoxa*

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BIBLIOGRAPHY

ALTIMIRA, C., 1978. Moluscos marinos de las costas del NW de África (Expedición "Atlor VII"). *Resultados de las Expediciones Científicas del B/O Cornide*, 7: 173-193.

ALVARADO, R. AND ÁLVAREZ, J., 1964. Resultados de la expedición Peris-Álvarez a la isla de Annobón. VIII. Algunos invertebrados marinos. *Boletín de la Real Sociedad Española de Historia Natural (Biología)*, 62: 265-282.

BURNAY, L. P. AND COSEL, R. VON., 1987. History of the investigations of the marine Mollusca of the Cape Verde Islands. *Courier Forschungsinstitut Senckenberg*, 95: 5-11.

COSEL, R. VON, 1982a. Ergebnisse deutsch-portugiesischer Sammelreisen auf den Kapverdischen Inseln (Republica de Cabo Verde). Vorläufige Liste der marinen Mollusken. *Courier Forschungsinstitut Senckenberg*, 52: 15-25.

COSEL, R. VON, 1982b. Marine Mollusken von Sta. Luzia, Branco und Razo (Kapverdische Inseln). *Courier Forschungsinstitut Senckenberg*, 52: 27-33.

COSEL, R. VON, 1982c. Marine Mollusken der Kapverdischen Inseln. Übersicht mit zoogeographischen Anmerkungen. *Courier Forschungsinstitut Senckenberg*, 52: 35-76.

COSEL, R. VON, 1982d. Zwei neue Euthria-Arten von den Kapverdischen Inseln (Prosobranchia: Buccinidae). *Archiv für Molluskenkunde*, 112 (1/6): 157-163, 1 pl.

COSEL, R. VON AND BURNAY, L. P., 1983. A new *Euthria* from deeper shelf of the Cape Verde Islands. *Archiv für Molluskenkunde*, 113 (1-6): 151-157.

DAUTZENBERG, P., 1913 (1912). Mission Gruvel sur la côte occidentale d'Afrique (1909-1910): Mollusques marins. *Annales de l'Institut Océanographique*, 5 (3): 1-111, pls. 1-3.

DAUTZENBERG, P. AND FISCHER, H., 1906. Mollusques provenant des dragages effectués a l'Ouest de l'Afrique pendant les campagnes scientifiques de S. A. S. le Prince de Monaco. *Résultats des Campagnes Scientifiques accomplies sur son yacht par Albert 1er Prince Souverain de Monaco*, 32: 1-125, pls. 1-5.

FABER, M. J., 1990. Studies on West Indian marine molluscs 19. On the identity of *Turbo bryereus* Montagu, 1803, with the description of a new species of *Rissoina* (Gastropoda Prosobranchia: Rissoidae). *Basteria*, 54 (1-3): 115-120.

FERNANDES, F. AND ROLÁN, E., 1991. Bibliografía malacológica de la costa occidental de África. *Reseñas Malacológicas*, 6: 1-64.

FERNANDES, F. AND ROLÁN, E., 1994. Check-list of the amphiatlantic Mollusca based on a revision of the literature. *Reseñas Malacológicas*, 8: 1-36.

GARCÍA-TALAVERA, F., 1983. *Los Moluscos Gasterópodos anfiatlánticos (estudio paleo y biogeográfico de las especies bentónicas litorales)*. Universidad de La Laguna, Colección Monográfica n° 10: 1-352, 7 pls.

GARCÍA-TALAVERA, F. AND BACALLADO, J. J., 1978. Nuevas aportaciones a la fauna de gasterópodos marinos (Mollusca, Gastropoda) de las islas de Cabo Verde. *Boletín del Instituto Español de Oceanografía*, 6 (328): 202-208.

GOFAS, S., 1995. A remarkable species richness of the Barleiidae (Gastropoda: Rissoacea) in the Eastern Atlantic. *The Nautilus*, 109 (1): 14-37.

GOFAS, S., 1999. The West African Rissoidae (Gastropoda: Rissooidea) and their relationships to some European species. *The Nautilus*, 113 (3): 78-101.

HOENSELAAR, H. J. AND GOUD, J., 1998. The Rissoidae of the CANCAP expeditions, I. The genus *Alvania* Risso, 1826 (Gastropoda Prosobranchia). *Basteria*, 62: 69-115.

LEAL, J. H. AND MOORE, D. R., 1989. *Rissoina indiscreta*, a new rissoid species from the tropical Southwestern Atlantic with Indo-West Pacific affinities (Mollusca, Gastropoda, Rissooidea). *Bulletin of Marine Science*, 45 (1): 139-147.

MARCHE-MARCHAD, I., 1958. Nouveau catalogue de la collection de Mollusques testacés de l'I. F.A. N. *Catalogues de l'I. F. A. N.*, 14, 66 pp.

MOOLENBEEK, R. G., 1985-86. A new species of *Eatonina* from the Cape Verde Islands. *Notiziario C. I. S. M. A.*, 7-8 (8-9): 67-69.

MOOLENBEEK, R. G. AND ROLÁN, E., 1988. New species of Rissoidae from the Cape Verde Islands (Mollusca: Gastropoda) Part 1. *Bulletin Zoölogisch Museum*, 11 (14): 121-126.

MORÁN, R., ROLÁN, E. AND LUQUE, A. A., 1989. Contribution to the knowledge of the prosobranchs (Mollusca, Gastropoda, Prosobranchia) of the Cape Verde Archipelago. V. Rissoininae (Rissoidae). *Abstracts of papers and posters of the 5th symposium Fauna and Flora of the Cape Verde Islands*, Leiden, p. 20.

MORENO, D. AND BURNAY, L. P., 1999. The genus *Volvarina* (Gastropoda: Marginellidae) in the Cape Verde Islands. *Journal of Conchology*, 36 (5): 83-124.

NICKLÈS, M., 1947. *La collection de Mollusques testacés marins de l'IFAN*. Catalogues, I, IFAN, 23 pp.

NORDSIECK, F., 1972. *Die europäischen Meeresschnecken*. Gustav Fischer Verlag, Stuttgart, 327 pp.

NORDSIECK, F., 1982. *Die europäischen Meeres-Gehäuseschnecken (Prosobranchia) Vom Eismeer bis Kapverden, Mittelmeer und Schwarzes Meer. 2. Auflage*. Gustav Fischer Verlag, Stuttgart, 539 pp.

ODHNER, N. H., 1932. Beiträge zur Malakozoologie der Kanarischen Inseln. Lamellibranchen, Cephalopoden, Gastropoden. *Arkiv för Zoologi*, 23A (14): 1-116, 2 pls.

PONDER, W. F., 1985. A Review of the Genera of the Rissoidae (Mollusca: Mesogastropoda: Rissoacea). *Records of the Australian Museum*, suppl. 4, 221 pp.

ROLÁN, E., 1985. A new *Euthria* of the Cape Verde Islands. *La Conchiglia*, 17 (190-191): 6-7.

ROLÁN, E., 1987a. El género *Manzonia* Brusina, 1870 en el Archipiélago de Cabo Verde. *Publicaçoes Ocassionaes Sociedade Portuguesa de Malacologia*, (9): 27-36.

ROLÁN, E., 1987b. The species in the genus *Euthria*. (Mollusca: Gastropoda). *Argonauta*, 3 (5-6): 291-308.

ROLÁN, E., 1990. Descripción de nuevas especies y subespecies del género *Conus* (Mollusca, Neogastropoda) para el Archipiélago de Cabo Verde. *Iberus*, supl. 2: 1-63, 9 pls.

ROLÁN, E., 1991. *La familia Conidae (Mollusca, Gastropoda) en el Archipiélago de Cabo Verde (Africa Occidental)*. Tesis Doctoral, Universidad de Santiago de Compostela, 653 pp.

ROLÁN, E., 1992. La familia Omalogyridae G. O. Sars, 1878 (Mollusca, Gastropoda) en el Archipiélago de Cabo Verde. *Graellsia*, 47: 105-116.

ROLÁN, E., 1998. A new species of *Zebina* (Gastropoda: Rissoidae: Rissoininae) from Yucatán (Mexico). *Apex*, 13 (4): 177-179.

ROLÁN, E., FERNANDES, F., LUQUE, A. A., ORTEA, J. AND TEMPLADO, J., 1993. Marine gastropods of the Cape Verde Islands: an updated and annotated checklist. *Abstracts First Symposium "Fauna and Flora of the Atlantic Islands"*, Funchal, Madeira.

ROLÁN, E. AND RUBIO, F., 1999. New information on the malacological fauna (Mollusca, Gastropoda) of the Cape Verde Archipelago, with the description of five new species. *Apex*, 14 (1): 1-10.

ROLÁN, E. AND RYALL, P., 1999. Checklist of the Angolan marine molluscs. *Reseñas Malacológicas*, 10: 1-132.

ROLÁN, E. AND TEMPLADO, J., 1993. The family Cingulopsidae (Prosobranchia: Rissoidea) in the Cape Verde Islands, with the description of one new species. *Basteria*, 57: 193-198.

SAUNDERS, G. D., 1977. Some notes on shelling in the Cape Verde Islands. *La Conchiglia*, 9 (97-98): 3-21.

SLEURS, W. J. M., 1989. A zoogeographical analysis of the Rissoinine fauna of the eastern Pacific with special reference to a comparison with the Caribbean fauna and with a checklist of the Eastern Pacific Rissoininae Stimpson, 1865 (Mollusca: Gastropoda). *Annales de la Societé royale zoologique de Belgique*, 119 (2): 155-164.

SLEURS, W. J. M., 1991. Mollusca Gastropoda: Four new rissoinine species (Rissoininae) from deep water in the New Caledonian region. In: A. Crosnier and P. Bouchet (eds), Résultats des Campagnes MUSORSTOM, volume 7. *Mémoires du Muséum national d'Histoire naturelle*, (A), 150: 163-178.

SLEURS, W. J. M., 1993. A revision of the Recent species of *Rissoina (Moerchiella), R. (Apataxia), R. (Ailinzebina)* and *R. (Pachyrissoina)* (Gastropoda: Rissoidae). *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Biologie*, 63: 71-135.

SLEURS, W. J. M., 1994. Two new *Rissoina* (s. s.) sister species from the Western Pacific. *Molluscan Research*, 15: 13-19.

SLEURS, W. J. M., 1996. A revision of the recent species of the genus *Stosicia* (Gastropoda: Rissoidae). *Mededelingen van de Koninklijke Academie voor Wetenschappen, Letteren en Schone Kunsten va België*, 1: 117-158, 19 pls.

SLEURS, W. J. M. AND PREECE, R. C., 1994. The Rissoininae (Gastropoda: Rissoidae) of the Pitcairn Islands, with the description of two new species. *Journal of Conchology*, London, 35: 67-82.

SMITH, E. A., 1890. Report on the Marine Molluscan Fauna of the Island of St. Helena. *Proceedings of the Zoological Society of London*, 1890: 247-317, pls. 21-24.

TALAVERA, F. G., 1975. Moluscos de sedimentos de la plataforma continental de Mauritania. *Boletín del Instituto Español de Oceanografía*, 192: 1-18.

TEMPLADO, J. AND ROLÁN, E., 1994. Las especies del género *Crisilla* y afines (Gastropoda: Prosobranchia: Rissoidae) en el archipiélago de Cabo Verde. *Iberus*, 11 (2): 1-25.

TOMLIN, J. R. LE B. AND SHACKLEFORD, L. J., 1914. The marine mollusca of São Thomé, I. *Journal of Conchology*, 14 (9): 239-256.

WATSON, R. B., 1873. On some marine molluscs from Madeira. *Proceedings of the Zoological Society London*, 1873: 361-391.

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A molluscan community from coastal bioclastic bottoms in the Strait of Gibraltar area

La comunidad de moluscos de un fondo bioclástico costero del Estrecho de Gibraltar

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ABSTRACT

The molluscan community of a soft bottom of bioclastic gravels and sand has been studied monthly over two years in four stations of the bay of Barbate, SW Spain at the Atlantic entrance of the Strait of Gibraltar, between 18 and 29 m depth. Species richness, dominance and frequency over the two years are recorded. Micromolluscs, less than 1 mm in size, were also recorded from the sample of April 1994.

Over the two years, 203 species of macromolluscs were found, of which 174 species (115.104 individuals) were collected alive and quantified. A total of 25 species of micromolluscs were determined, some of which usually considered as rare species. Most species richness values range between 20 to 40 species per sample, which is comparable with, or higher than, the values reported in other studies from soft bottom communities of molluscs.

The qualitative analysis based on Jaccard's and Baroni-Urbani and Buser's indices show that three stations are significantly similar ($p < 0.01$), whereas the lowest similarity was found between the station close to the harbour of Barbate and the other ones. The quantitative analysis based on the Bray and Curtis index is biased by the high number of individuals of *Chamelea striatula* but consistent with the qualitative indices when this species is not taken into account.

The main community is similar to "Biocénose des fonds meubles instables (MI)" and "Biocénose des fonds detritique du large (DL)" of PÉRÈS AND PICARD (1964), but occurs shallower than in the Mediterranean. The concurrence of species from the Lusitanian, Mediterranean and Mauritanian regions results in an increment of the total number of species.

RESUMEN

Se ha estudiado la comunidad de Moluscos de fondos de grava bioclástica y arena durante dos años en la bahía de Barbate, SW de España cerca del Estrecho de Gibraltar. Se han elegido cuatro estaciones entre 18 y 29 metros de profundidad. Se ha determinado la riqueza especifica, la dominancia y la frecuencia a lo largo de los dos años. Los micromoluscos, de menos de 1 mm de talla, se han estudiado sólo para la muestra de Abril de 1994.

Se han colectado un total de 203 especies de macromoluscos a lo largo de los dos años, de las cuales 174 especies (115.104 individuos) se cogieron vivos y se cuantificaron. Se han determinado también 25 especies de micromoluscos, algunas de las cuales conside-

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radas habitualmente como especies raras. La mayoría de los valores de la riqueza específica oscilan entre 20 y 40 especies por muestra, lo que es comparable o incluso mayor que los valores reseñados en otros estudios para comunidades de moluscos de fondos blandos.
Los análisis cualitativos de afinidad basados en los índices de Jaccard y de Baroni-Urbani y Buser muestran que tres estaciones son significativamente similares ($p < 0,01$), mientras que la menor afinidad se encontró entre la estación próxima al puerto de Barbate y las otras. El análisis cuantitativo de afinidad basado en el índice de Bray y Curtis esta sesgado por el gran número de individuos de *Chamelea striatula*, pero si no consideramos dicha especie los resultados son similares a los obtenidos por índices cualitativos.
La comunidad es similar a la "Biocénose des fonds meubles instables (MI)" y "Biocénose des fonds detritique du large (DL)" de Pérès y Picard (1964), pero aparece a menor profundidad que en el Mediterráneo. La comunidad de la estación próxima al puerto presenta caracteres intermedios con la "Biocénose des sables fins bien calibrés (SFBC)" de Pérès y Picard (1964). La coexistencia de especies procedentes de las tres regiones Lusitánica, Mediterránea y Mauritánica supone un incremento de la riqueza específica.

KEY WORDS: Molluscan communities, Strait of Gibraltar, Species richness,
PALABRAS CLAVE: Comunidades de moluscos, Estrecho de Gibraltar, riqueza específica.

INTRODUCTION

The Strait of Gibraltar is an interesting area for the study of the marine fauna, including molluscs, due to the confluence of Atlantic and Mediterranean waters. According to Ekman (1953), it is the meeting point of three biogeographic regions: Lusitanian, Mauritanian and Mediterranean. As a result of this, the species richness in this area is possibly the highest of the European coasts. In addition, there is a clear presence of North African fauna in this zone, and there also occur some endemic mollusc species (Gofas, 1999).

Some XIX century expeditions, such as "Lightning" and "Porcupine", "Challenger" "Travailleur" and "Talisman" reported on the marine molluscs from the Ibero-Moroccan Gulf (see review in Salas, 1996) but were mostly concerned with the bathyal fauna. Recently a French expedition "Balgim" (1984) and a Spanish survey "Fauna 1" (1989) added more information about the malacofauna, particularly bivalves (Salas, 1996).

There are relatively few studies regarding the fauna from the Strait of Gibraltar. Some of them reported only faunistic lists (Fischer-Piette, 1959; Thorson, 1965; García-Gomez, 1983a; van Aartsen, Menkhorst and Gittenberger, 1984; Cervera, Templado, García-Gómez, Ballesteros, Ortea, García, Ros and Luque, 1988) and others added information about molluscan communities (García-Gómez, 1983b; Templado, Guerra, Bedoya, Moreno, Remon, Maldonado and Ramos, 1993, Gofas, 1999) or other invertebrate groups (Carballo, Naranjo and García-Gómez, 1997; López de la Cuadra and García-Gomez, 1993; Medel-Soteras, García and García-Gómez, 1991). Some general studies have been carried out in the inner Bay of Cádiz (Arias, 1976; López de la Rosa, 1997; Drake, Arias and Conradi, 1997), but these were not directed to molluscan communities. A review of the decapods from expeditions carried out off the southern Iberian peninsula and the northern coast of Morocco is given by García Raso (1996), and new records were added by López de la Rosa, García Raso and Rodriguez Martín (1998). The decapod crustacean community from Barbate

Table I. Physical characteristics of the sampling stations in bay of Barbate.
Tabla I. Características físicas de las estaciones de muestreo en la bahía de Barbate.

	Retín 12	Retín 16	Barra 16	Barra 10
Depth	21-22 m	28-29 m	28-29 m	18 m
Type of sediment	coarse sand with bioclasts	coarse sand with bioclasts	medium sand with bioclasts	fine sand with bioclasts
Organic matter content	0.35 – 0.40 %	0.40 – 0.60 %	0.70 – 0.80 %	0.80 – 1.10 %

was studied by MANJÓN-CABEZA AND GARCÍA RASO (1998a), and the population structure and growth of the hermit crab *Diogenes pugilator* from the same area by MANJÓN-CABEZA AND GARCÍA RASO (1998b). None of these previous studies contained data on molluscan communities from infralittoral bottoms and their changes through the year.

The present paper was aimed to a better knowledge of molluscan communities from bioclastic infralittoral bottoms in the Strait of Gibraltar, and of the influence they receive from the different water masses. The results have been obtained from monthly samples over two years of survey. These molluscan communities are poorly documented in the Spanish coasts, although some information from other European stations is available in the literature (CABIOCH, 1968; PÉRÈS AND PICARD, 1964; GLÉMAREC, 1969; TEMPLADO *ET AL.*, 1993).

AREA OF STUDY

Samples were collected in the bay of Barbate (36° 8′ N- 5° 56′ W), on the Atlantic side of the Strait of Gibraltar (Fig. 1). Four sample stations were selected and sampled monthly throughout two years. Sample stations were placed on two transects, R (Retín) and B (Barra), at different distances from the estuary and harbour of Barbate. The main characteristics of sampling stations are listed in Table I.

The station B10 is the nearest to the harbour and the estuary of Barbate river, with high level of sedimentation (fine particles) and a higher value of percentage of organic matter in the sediment than in the other stations. Hard bottoms are present in the bay as flagstones between the station R12 and the beach (Fig. 1).

The Bay of Barbate is mainly influenced by water masses from the Atlantic Ocean. Most of the flow comes from South Portugal, but due to the proximity of North Africa there are also currents of Southern origin (REY, 1983). Atlantic water currents flow in this bay in direction to the Mediterranean Sea, while Mediterranean water currents flow below 200-250 meters deep in the opposite direction (VIVES, SANTAMARIA AND TREPAT, 1975) and do not affect the bay. Tidal currents can change the direction of the dominant currents, producing local gyres. Water temperature varies from 21° C (Summer months) to 14° C (Winter months). Water salinity values (around 34 ‰) can change due to the influence of the river Barbate and some other fresh water reservoirs (ESTABLIER AND MARGALEF, 1964; SEOANE-CAMBA, 1965).

The mixed sediment (shell fragments and sand) is a habitat for some benthic algae, which were reported on by FLORES-MOYA, SOTO, SÁNCHEZ, ALTAMIRANO AND CONDE (1995a, b) and by CONDE, FLORES-MOYA, SOTO, ALTAMIRANO AND SÁNCHEZ (1996).

MATERIAL AND METHODS

Samples were collected from October 1993 to September 1995 with a small fishing boat, by towing a rectan-

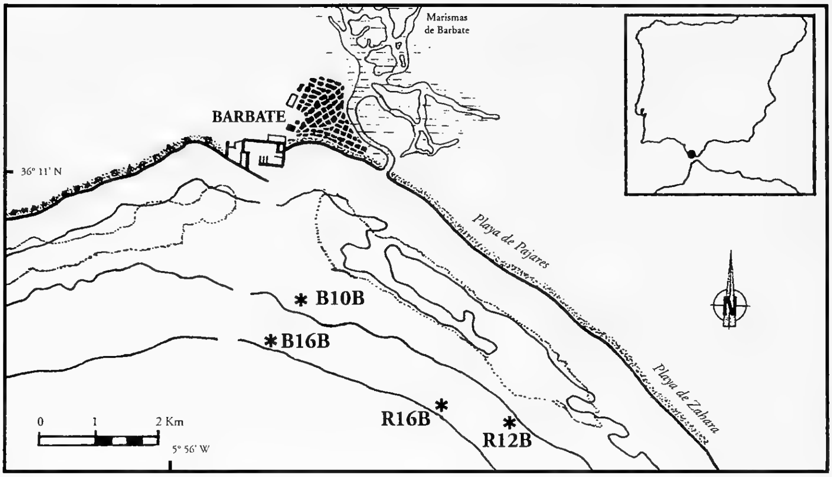

Figure 1. Location of the sampling points in Bay of Barbate. The dashed line represents rocky bottoms.

Figura 1. Localización de los puntos de muestreo dentro de los fondos de la bahía. La linea discontinua indica la presencia de lajas de roca.

gular dredge (42 cm width x 22 cm height), with a 0.5 mm mesh inner holding bag, for 15 minutes at a speed of 1 knot. The dredged area for each sample was approximately 150 m^2.

Biological samples were sieved on different mesh sizes (10, 5, 3, and 1 mm) in order to split into different size fractions and sort them. The smaller fractions were sorted under a stereomicroscope. Molluscs were separated from the rest of macrobenthos and fixed in formaldehyde 10 % and subsequently preserved in neutralized alcohol 70%.

The fraction above 1 mm shell size, representing the macrofauna, was sorted quantitatively for every sample over the two years. Both living and dead specimens were identified, although only living specimens were quantified. The taxonomical ordination is according to SABELLI, GIANNUZZI-SAVELLI AND BEDULLI (1990) and current CLEMAM catalogue (www.mnhn.fr/base/malaco.html).

Species richness and dominance (percentage of individuals to the total, for a particular species) were calculated in order to describe the community. We also calculated the frequency or percentage of the samples in which the species is present over the two years. Three indices of affinity were calculated to classify the molluscan composition from the four stations, in order to check the different communities present in our study area. Two of them are qualitative (JACCARD, 1908; BARONI-URBANI AND BUSER, 1976), the other one quantitative (BRAY AND CURTIS, 1957). The quantitative dissimilarity index (I) of BRAY AND CURTIS (1957) was transformed as (1-I) so as to use it as a quantitative similarity index. The qualitative indices were chosen in view of the possibility to test the significance, following REAL AND VARGAS (1996) for the Jaccard index and Baroni-Urbani and Buser tables (BARONI-URBANI AND BUSER, 1976) for their own index. The affinity between stations was represented for each index by a dendrogram, using the UPGMA algorithm.

Micromolluscs, mostly species which have a shell size smaller than the bulk of the sediment grain, need special processing to be recovered efficiently and this was done mainly on the sample of April 1994. The fraction not retained by the 1 mm sieve was sieved on the 0.5 and 0.3 mm sieves. Then, each of these fractions was winnowed in sea water, so that the water movement will carry away the lighter fraction including molluscs. The water outflow was collected on the 0.3 mm sieve, examined for living micromolluscs, and dried. The micromolluscs were sorted in this dry residue under the stereomicroscope, using a Strattman micropaleontological tray and a fine wet brush to manipulate them. Micromollusc data were studied apart due to an incomplete cuantification, only in the sample of April 1994.

Sediment samples were collected and analysed for granulometry and percentage of organic matter (% OM). The grain size distribution of the sediment was determined by sieving. The mud fraction was separated by wet sieving in a 80μm sieve, and finally the dried sand fraction was sieved over a stacked set of grade sieves. Granulometric parameters were calculated according to the method of BUCHANAN (1984). Sediment for determination of % OM was stored in formaldehyde 10% just after collection. A fraction was dried at 100° C for 24 hours and weighted for obtaining dry weight. Later on it was burnt to ashes for 2 h at 525° C and finally weighted again. Difference of dry weight and dry weight after ignition determined %OM in the sediment.

RESULTS

Analysis of the taxocoenosis of molluscs

A: Macromolluscs composition and species richness: Over the two years, a total of 203 species of macromolluscs were found. Of these, 174 species (115. 104 individuals) were collected alive (Tables II, III). Some individuals were only identified to genus level, either because diagnostic characters are seen only on living animals and could not be observed (e. g. Triphoridae, many Opisthobranchs), or because they belong to groups where taxonomic problems are not solved (see remarks below).

Number and percentage of species by class collected were similar in R12, R16 and B16. In B10, the number of species by class was lower, although the percentages of abundance were similar to those in the other stations (Table III). The families Trochidae (12 sp., Fig. 2), Nassariidae (9 sp., Fig. 3) and Muricidae (7 sp.) were the best represented among the gastropods; the Veneridae (13 sp.) and Cardiidae (10 sp.) among the bivalves.

Mean values for species richness per month were lower in B10 (between 12 to 36) than in the other sampling points: R12 (17-45 species); R16 (20-49 species); B16 (21-51 species).

The number of species of gastropods and their abundance were higher in R16 and B16, where the sediments were characterised by a mixture of bioclasts and of coarse and medium sand, respectively. Total abundances of bivalves were high in R16 and B10 due to a strong settlement of the bivalve *Chamelea striatula*, but richness for bivalves was higher in the stations with mixed sediments (gravels and fine sand) than in the most homogeneous one (B10). In global terms, bivalves were more abundant than gastropods mainly due to their gregarious occurrence in soft bottoms. The dredge was not adequate for the collection of cephalopods so that a low number of them were registered and always small individuals (2-3 cm).

The base of the ascidian *Phallusia mammillata* (Cuvier, 1815) clusters shells and small stones which provide a microhabitat for some species of molluscs such as *Chauvetia procerula* and *Ocinebrina edwardsii* which were abundant inside the holes and crevices from these structures. We also noted the presence of small individuals of the bivalves *Chlamys varia* and *Striarca lactea* both attached by byssal thread.

Some associations of molluscs with others organisms were found. The bivalve *Digitaria digitaria* usually supported colonies of the hydrozoan *Monobrachium parasitum* Meresckowsky, 1877 located on the posterior part of the umbo. Colonies of another non determined hy-

Table II. Species of macromolluscs collected in the survey. Ab: Abundance, Fr: Frequency, ††: Dead specimen, #: Non quantitative data."Total" is (Retín 12 + Retín 16 + Barra 16), excluding Barra 10.
Tabla II Especies de macromoluscos recolectadas en los muestreos. Ab: Abundancia, Fr: Frecuencia, ††: Individuo muerto, #: Datos no cuantitativos. "Total" es (Retín 12 + Retín 16 + Barra 16), excluyendo Barra 10.

	Retín 12		Retín 16		Barra 16		Barra 10		Total	
	Ab	Fr	Ab	Fr	Ab	Fr	Ab	Fr	Ab	Fr
CLASSIS **POLYPLACOPHORA** Gray J. E., 1821										
Family **LEPTOCHITONIDAE** Dall, 1889										
Leptochiton cimicoides (Monterosato, 1879)	36	20.83	86	20.83	78	54.17			200	66.67
Family **ISCHNOCHITONIDAE** Dall, 1889										
Lepidochitona cinerea (Linné, 1767)	1	4.17					1	4.35	1	4.17
Lepidochitona corrugata (Reeve, 1848)	2	4.17							2	4.17
Family **ACANTHOCHITONIDAE** Pilsbry, 1893										
Acanthochitona fascicularis (Linné, 1767)	8	16.66	5	16.66	65	58.33			78	75.00
Acanthochitona sp.							1	4.35		
CLASSIS **GASTROPODA** Cuvier, 1797										
Family **ACMAEIDAE** Carpenter, 1857										
Acmaea virginea (Müller O. F., 1776)	1	4.17	5	8.33	3	8.33			9	20.83
Family **FISSURELLIDAE** Fleming, 1822										
Diodora gibberula (Lamarck, 1822)					1	4.17			1	4.17
Diodora graeca (Linné, 1758)			2	8.33	1	4.17			3	8.33
Family **SCISSURELLIDAE** Gray J. E., 1847										
Scissurella costata D'Orbigny, 1824					2	8.33			2	8.33
Family **TROCHIDAE** Rafinesque, 1815										
Calliostoma zizyphinum (Linné, 1758)					8	12.50			8	12.50
Calliostoma sp. 1	28	45.83	48	66.67	120	95.83	7	21.74	196	95.83
Calliostoma sp. 2	1	4.17			3	12.50			4	16.67
Gibbula magus (Linné, 1758)	39	41.67	279	70.83	264	79.17	16	30.43	582	87.50
Gibbula fanulum (Gmelin, 1791)	3	12.50	1	4.17	4	8.33			8	25.00
Gibbula guttadauri (Philippi, 1836)	167	70.83	14	25.00	11	20.83	13	21.74	192	75.00
Gibbula cineraria (Linné, 1758)	1	4.17	1	4.17					2	8.33
Jujubinus dispar Curini-Galletti, 1982					40	58.33	3	8.70	40	58.33
Jujubinus exasperatus (Pennant, 1777)	2	8.33							2	8.33
Jujubinus montagui (Wood W., 1828)	12	20.83	55	50.00	68	58.33			135	79.17
Jujubinus striatus (Linné, 1758)	1	4.17	1	4.17					2	8.33
Clanculus cruciatus (Linné, 1758) ††	#	—								
Family **TRICOLIIDAE** Robertson, 1985										
Tricolia pullus (Linné, 1758)	1	4.17							1	4.17
Family **TURBINIDAE** Rafinesque, 1815										
Bolma rugosa (Linné, 1767)			5	12.50					5	12.50
Family **CERITHIIDAE** Férussac, 1819										
Bittium reticulatum (Da Costa, 1778)			1	4.17					1	4.17
Bittium submamillatum (De Rayneval a Ponzi, 1854)	619	62.50	134	20.83	73	37.50			826	75.00
Bittium simplex (Jeffreys, 1867) ††	1	—								
Cerithium vulgatum Bruguière, 1792 ††			1	—						
Family **TURRITELLIDAE** Lovén, 1847										
Mesalia varia (Kiener, 1887)	149	79.17	201	91.67	495	100	113	86.96	845	100
Turritella communis Risso, 1826	246	50.00	993	95.83	525	75.00	45	26.09	1764	95.83
Turritella turbona Monterosato, 1877	250	50.00	403	41.67	61	29.17			714	75.00
Family **RISSOIDAE** Gray J. E., 1847										
Rissoa guerinii Récluz, 1843			2	8.33	1	4.17			3	12.50
Rissoa inconspicua (Alder, 1844)	1	4.17	1	4.17					2	8.33

Table II. Continuation.
Tabla II Continuación.

	Retín 12		Retín 16		Barra 16		Barra 10		Total	
	Ab	Fr	Ab	Fr	Ab	Fr	Ab	Fr	Ab	Fr
Alvania cimex (Linné, 1758) ††					1	—				
Alvania discors (Allan, 1818) ††	#	—								
Family **APORRHAIIDAE** Gray J. E., 1850										
Aporrhais pespelecani (Linné, 1758)	104	79.17	113	58.33	61	50.00			278	83.33
Family **CALYPTRAEIDAE** Lamarck, 1809										
Calyptraea chinensis (Linné, 1758)	450	70.83	1297	91.67	645	87.50	104	56.52	2392	95.83
Family **LAMELLARIIDAE** D'Orbigny, 1841										
Lamellaria sp.	1	4.17	1	4.17					1	4.17
Family **TRIVIIDAE** Troschel, 1863										
Trivia arctica (Pulteney, 1789)					1	4.17			1	4.17
Family **NATICIDAE** Forbes, 1838										
Natica hebraea (Martyn, 1784)	2	8.33					22	52.17	2	8.33
Polinices alderi (Forbes, 1838)	8	20.83	9	16.67	13	37.50			30	62.50
Polinices guillemini (Payraudeau, 1826)	6	20.83			11	25.00	3	13.04	17	33.33
Polinices macilenta (Philippi, 1844)	11	29.17	5	12.50	10	20.83	19	56.52	26	54.17
Family **CASSIDAE** Latreille, 1825										
Phalium saburon (Bruguière, 1792) ††			#	—	#	—				
Phalium undulatum (Gmelin, 1791) ††					#	—				
Family **RANELLIDAE** Gray J. E., 1854										
Cymatium corrugatum (Lamarck, 1816)			1	4.17	2	8.33			3	12.50
Ranella olearia (Linné, 1758) ††			#	—	#	—				
Charonia lampas (Linné, 1758) ††			#	—	#	—				
Family **TRIPHORIDAE** Gray J. E., 1847										
Not determined	1	4.17	3	12.50					4	12.50
Family **CERITHIOPSIDAE** Adams H. & A., 1853										
Cerithiopsis scalaris Locard, 1892			2	8.33	1	4.17			3	12.50
Cerithiopsis tubercularis (Montagu, 1803)			1	4.17					1	4.17
Family **EPITONIIDAE** Berry S. S., 1910										
Epitonium commune (Lamarck, 1822)	3	12.50	9	20.83	1	4.17			13	33.33
Epitonium pulchellum (Bivona Ant., 1832)			2	8.33					2	8.33
Epitonium jolyi (Monterosato, 1878)			1	4.17					1	4.17
Cirsotrema cochlea (Sowerby G. B. II, 1844)							1	4.35		
Family **EULIMIDAE** Adams H. & A., 1853										
Eulima glabra (Da Costa, 1778)					1	4.17	1	4.35	1	4.17
Melanella alba (Da Costa, 1778)			1	4.17			1	4.35	1	4.17
Melanella sp.			1	4.17					1	4.17
Family **MURICIDAE** Rafinesque, 1815										
Bolinus brandaris (Linné, 1758)	61	75.00	88	79.17	78	70.83	38	65.22	227	95.83
Hexaplex trunculus (Linné, 1758)	19	37.50			4	12.50	4	17.39	23	37.50
Muricopsis cristata (Brocchi, 1814)	1	4.17							1	4.17
Ocenebra erinaceus (Linné, 1758)	2	8.33	23	58.33	72	87.50			97	95.83
Ocinebrina aciculata (Lamarck, 1822)			2	8.33	1	4.17			3	12.50
Ocinebrina edwardsii (Payraudeau, 1826)	48	58.33	32	58.33	154	79.17			234	91.67
Trophon muricatus (Montagu, 1803)	17	33.33	44	62.50	49	54.17			110	87.50
Buccinulum corneum (Linné, 1758)	1	4.17							1	4.17
Chauvetia procerula Monterosato, 1889			27	37.50	62	45.83			89	58.33
Chauvetia brunnea (Montagu, 1803) ††	#	—								
Chauvetia sp. ††			#	—						
Fusinus pulchellus (Philippi, 1844)	9	12.50	14	29.17	46	75.00			69	79.17
Fusinus rostratus (Olivi, 1792)			2	8.33	1	4.17			3	12.50

Table II. Continuation.
Tabla II Continuación.

	Retín 12		Retín 16		Barra 16		Barra 10		Total	
	Ab	Fr	Ab	Fr	Ab	Fr	Ab	Fr	Ab	Fr
Nassarius elatus (Gould, 1845)					13	25.00	202	100	13	25.00
Nassarius heynemanni (Von Maltzan, 1884)	9	12.50	1	4.17					10	16.67
Nassarius vaucheri (Pallary, 1906)	3	4.17					17	39.13	3	4.17
Nassarius incrassatus (Ström, 1768)	3	12.50			5	16.67	1	4.35	8	29.17
Nassarius pygmaeus (Lamarck, 1822)	51	50.00	69	79.17	86	62.50	59	65.22	206	95.83
Nassarius reticulatus (Linné, 1758)	8	16.67			13	33.33	276	100	21	41.67
Nassarius mutabilis (Linné, 1758)					7	8.33	243	100	7	8.33
Nassarius granum (Lamarck, 1822) ††							#	—		
Cyclope donovania Risso, 1826 ††							1	—		
Family **COLUMBELLIDAE** Swainson, 1840										
Mitrella minor (Scacchi, 1836)			3	12.50	10	29.17			13	33.33
Mitrella bruggeni van Aartsen, Menkh. & Gittenb., 1984 ††	#	—								
Columbella rustica (Linné, 1758) ††					#	—				
Family **COSTELLARIIDAE** Mc Donald, 1860										
Vexillum tricolor (Gmelin, 1791) ††	#	—								
Family **CYSTISCIDAE** Stimpson, 1865										
Gibberula epigrus (Reeve, 1865)	29	45.83			13	16.67	44	65.22	42	58.33
Gibberula miliaria (Linné, 1758)							1	4.35		
Family **VOLUTIDAE** Rafinesque, 1815										
Cymbium olla (Linné, 1758) ††			#	—	#	—				
Family **CANCELLARIDAE** Gray J. E., 1853										
Cancellaria cancellata (Linné, 1758) ††							#	—		
Family **CONIDAE** Rafinesque, 1815										
Conus mediterraneus Hwass in Bruguière, 1792 ††	#	—								
Family **TURRIDAE** Swainson, 1840										
Bela laevigata (Philippi, 1836)	81	54.17	143	83.33	111	70.83	118	65.22	335	95.83
Bela striolata (Risso, 1826)	9	12.50	16	33.33	16	33.33	9	21.74	41	50.00
Bela sp. 1	3	12.50					2	8.70	3	12.50
Bela sp. 2	2	8.33	1	4.17					3	12.50
Mangelia attenuata (Montagu, 1803)	33	45.83	19	45.83	14	41.67	13	34.78	66	79.17
Haedropleura septangularis (Montagu, 1803)					1	4.17	1	4.35	1	4.17
Crassopleura maravignae (Bivona, 1838)	2	8.33			1	4.17			3	12.50
Raphitoma aequalis (Jeffreys, 1867)			2	8.33					2	8.33
Comarmondia gracilis (Montagu, 1803)	4	16.67	10	33.33	13	29.17	1	4.35	27	58.33
Family **PYRAMIDELLIDAE** Gray J. E., 1840										
Chrysallida terebellum (Phillippi, 1844)			2	4.17					2	4.17
Eulimella acicula (Phillippi, 1836)					2	8.33			2	8.33
Eulimella scillae (Scacchi, 1835)					1	4.17			1	4.17
Odostomia acuta Jeffreys, 1848			1	4.17					1	4.17
Odostomia conoidea (Brocchi, 1814)			1	4.17					1	4.17
Brachystomia eulimoides (Hanley, 1844)	1	4.17							1	4.17
Turbonilla fulvocincta (Thompson, 1840)	25	45.83	14	20.83	17	37.50	9	26.09	56	70.83
Turbonilla rufa (Phillippi, 1836)			19	37.50	20	37.50			39	62.50
Turbonilla rufescens (Forbes,)	1	4.17					7	13.04	1	4.17
Turbonilla striatula (Linné, 1758) ††	#	—								
Family **ACTEONIDAE** D'Orbigny, 1835										
Acteon tornatilis (Linné, 1758)	1	4.17	2	8.33			1	4.34	3	8.33
Family **RETUSIDAE** Thiele, 1931										
Retusa truncatula (Bruguière, 1792)	2	4.17							2	4.17
Retusa mamillata (Philippi, 1836)	3	8.33	2	8.33					5	16.67

Table II. Continuation.
Tabla II Continuación.

	Retín 12		Retín 16		Barra 16		Barra 10		Total	
	Ab	Fr	Ab	Fr	Ab	Fr	Ab	Fr	Ab	Fr
Family **RINGICULIDAE** Philippi, 1853										
Ringicula auriculata (Menard, 1811)	17	20.83	20	41.67	19	37.50	27	43.48	56	70.83
Family **BULLIDAE** Lamarck, 1801										
Bulla striata Bruguière, 1792 ††							#	—		
Family **HAMINOEIDAE** Pilsbry, 1895										
Haminoea sp.					1	4.17			1	4.17
Family **PHILINIDAE** Gray J. E., 1850										
Philine aperta (Linné, 1767)	22	8.33					4	4.35	22	8.33
Philine sp.	2	8.33							2	8.33
Family **CYLICHNIDAE** Adams H. & A., 1854										
Scaphander lignarius (Linné, 1758)			1	4.17					1	4.17
Family **PLEUROBRANCHIDAE** Férussac, 1822										
Berthella sp.			1	4.17					1	4.17
Family **APLYSIIDAE** Lamarck, 1809										
Aplysia fasciata Poiret, 1789			12	8.33					12	8.33
Family **ARCHIDORIDIDAE** Bergh, 1892										
Archidoris tuberculata (Cuvier, 1804)	1	4.17							1	4.17
Archidoris sp.	2	4.17	1	4.17					3	8.33
Family **DENDRODORIDIDAE** O'Donoghue, 1924										
Doriopsilla sp.					3	8.33			3	8.33
CLASSIS **SCAPHOPODA** Bronn, 1862										
Family **DENTALIIDAE** Linné, 1758										
Dentalium inaequicostatum Dautzenberg, 1891	12	12.50	16	33.33	21	29.17	35	56.52	49	70.83
Dentalium vulgare Da Costa, 1778	4	8.33			6	16.67	1	4.35	10	20.83
CLASSIS **BIVALVIA** Linné, 1758										
Family **NUCULIDAE** Gray J. E., 1824										
Nucula hanleyi (Winckworth, 1931)	52	70.83	41	33.33	9	20.83			102	87.50
Family **NUCULANIDAE** Adams H. & A., 1858										
Nuculana pella (Linné, 1767)	147	91.67	314	95.83	219	95.83	387	100	680	100
Family **ARCIDAE** Lamarck, 1818										
Arca noae Linné, 1758			1	4.17					1	4.17
Anadara polii (Mayer, 1868)			10	29.17	9	25.00			19	54.17
Family **NOETIDAE** Stewart, 1930										
Striarca lactea (Linné, 1758)	2	8.33	2	8.33					4	12.50
Family **GLYCYMERIDIDAE** Newton, 1922										
Glycymeris glycymeris (Linné, 1758)	8	29.17	5	16.67	2	8.33			15	45.83
Family **MYTILIDAE** Rafinesque, 1815										
Modiolarca subpicta (Cantraine, 1835)	2	8.33	6	16.67	1	4.17			9	25.00
Modiolus barbatus (Linné, 1758)					4	8.33			4	8.33
Modiolus adriaticus (Lamarck, 1819)	326	62.50	289	75.00	154	66.67	107	47.83	769	91.67
Amygdalum agglutinans (Cantraine, 1835)			16	37.50	12	33.33			28	66.67
Family **PINNIDAE** Leach, 1819										
Atrina fragilis (Pennant, 1777)					1	4.17			1	4.17
Family **PTERIIDAE** Gray J. E., 1847										
Pteria hirundo (Linné, 1758)			1	4.17					1	4.17
Family **PECTINIDAE** Rafinesque, 1815										
Pecten maximus (Linné, 1758)	11	12.50	8	25.00	9	25.00	7	17.39	28	41.67

Table II. Continuation.
Tabla II Continuación.

	Retín 12		Retín 16		Barra 16		Barra 10		Total	
	Ab	Fr	Ab	Fr	Ab	Fr	Ab	Fr	Ab	Fr
Aequipecten opercularis (Linné, 1758)			5	16.67	5	16.67			10	29.17
Aequipecten commutatus (Monterosato, 1815)			7	12.50					7	12.50
Chlamys varia (Linné, 1758)	20	29.17	63	66.67	34	54.17			117	87.50
Flexopecten flexuosus (Poli, 1795)	73	58.33	133	62.50	51	58.33	19	21.74	259	87.50
Family **ANOMIIDAE** Rafinesque, 1815										
Anomia ephippium Linné, 1758	39	37.50	162	66.67	140	62.50	15	13.04	341	87.50
Family **LIMIDAE** Rafinesque, 1815										
Limatula subauriculata (Montagu, 1808)	11	12.50							11	12.50
Lima lima (Linné, 1758) ††					#	—				
Family **LUCINIDAE** Fleming, 1828										
Ctena decussata (Costa O. G., 1829) ††			#	—						
Family **UNGULINIDAE** Adams H. & A., 1857										
Diplodonta rotundata (Montagu, 1803)					1	4.17			1	4.17
Family **KELLIIDAE** Forbes & Hanley, 1848										
Kellia suborbicularis (Montagu, 1803)	1	4.17	1	4.17	1	4.17			3	12.50
Family **ASTARTIDAE** D'Orbigny, 1844										
Digitaria digitaria (Linné, 1758)	597	91.67	1188	100	1067	95.83	1272	91.30	2852	100
Goodallia triangularis (Montagu, 1803)							2	8.70		
Family **CARDIIDAE** Lamarck, 1819										
Acanthocardia aculeata (Linné, 1758)	4	12.50	2	8.33	2	8.33	1	4.35	8	20.83
Acanthocardia echinata (Linné,1758)					2	8.33			2	8.33
Acanthocardia mucronata (Poli, 1795)	2	8.33							2	8.33
Acanthocardia tuberculata (Linné, 1758)	40	41.67	2	4.17	4	12.50	280	100	46	41.67
Acanthocardia spinosa (Solander, 1786) ††					#	—				
Parvicardium scabrum (Philippi, 1844)	72	58.33	57	62.50	20	25.00	3	13.04	149	87.50
Plagiocardium papillosum (Poli, 1795)	4	12.50	21	50.00	8	25.00			33	62.50
Laevicardium crassum (Gmelin, 1791)	404	100	90	58.33	115	79.17	255	78.26	609	100
Laevicardium oblongum (Gmelin, 1791)					1	4.17			1	4.17
Cerastoderma glaucum (Poiret, 1789) ††							#	—		
Family **MACTRIDAE** Lamarck, 1809										
Mactra stultorum (Linné, 1758)	29	29.17			5	4.17	3	13.04	34	29.17
Spisula subtruncata (Da Costa, 1778)	388	79.17	241	75.00	182	91.67	1013	100	811	100
Spisula elliptica (Locard, 1890)	12	8.33	2	4.17					14	12.50
Lutraria angustior Philippi, 1844 ††			#	—	#	—				
Family **PHARIDAE** Adams H. & A., 1858										
Ensis ensis (Linné, 1758)	4	16.67					10	17.39	4	16.67
Ensis sp.	1	4.17							1	4.17
Phaxas pellucidus (Pennant, 1777)			1	4.17			1	4.35	1	4.17
Family **TELLINIDAE** Blainville, 1814										
Arcopagia balaustina Linné, 1758							1	4.35		
Tellina incarnata (Linné, 1758)							2	8.70		
Tellina distorta (Poli, 1791)					1	4.17			1	4.17
Tellina pygmaea Lovén, 1846	1	4.17							1	4.17
Tellina donacina Linné, 1758 ††	#	—								
Family **DONACIDAE** Fleming, 1828										
Donax venustus Poli, 1795	6	20.83					124	73.91	6	20.83
Capsella variegata (Gray J. E., 1851)	30	54.17			2	4.17			32	54.17
Family **PSAMMOBIIDAE** Fleming, 1828										
Gari fervensis (Gmelin, 1791)			3	12.50	2	8.33			5	16.67

Table II. Continuation.
Tabla II Continuación.

	Retín 12		Retín 16		Barra 16		Barra 10		Total	
	Ab	Fr	Ab	Fr	Ab	Fr	Ab	Fr	Ab	Fr
Gari depressa (Pennant, 1777)	1	4.17					4	8.70	1	4.17
Gari costulata Turton, 1822			1	4.17					1	4.17
Gari pseudoweinkauffi Cosel, 1990	51	62.50	12	16.67	5	8.33	6	4.35	68	66.67
Family **SCROBICULARIIDAE** Adams H. & A., 1856										
Scrobicularia plana (Da Costa, 1778) ††							#	—		
Family **SEMELIDAE** Stoliczka, 1870										
Ervilia castanea (Montagu, 1803)	10	20.83							10	20.83
Family **SOLECURTIDAE** D'Orbigny, 1846										
Solecurtus scopula (Turton, 1822) ††			#	—	#	—				
Azorinus chamasolen (Da Costa, 1778) ††					#	—				
Family **VENERIDAE** Rafinesque, 1815										
Venus verrucosa Linné, 1758			2	4.17	3	8.33			5	16.67
Venus casina Linné, 1758	1	4.17							1	4.17
Globivenus effossa (Philippi ex Bivona ms., 1836) ††					#	—				
Chamelea gallina (Linné, 1758)							9	17.39		
Chamelea striatula (Da Costa, 1778)	12582	75.00	26169	79.17	7028	91.67	26052	73.91	45779	100
Clausinella fasciata (Da Costa, 1778)	152	91.67	55	70.83	85	66.67	15	26.09	292	100
Timoclea ovata (Pennant, 1777)	1	4.17	9	33.33	2	8.33			12	37.50
Gouldia minima (Montagu, 1803)	1074	87.50	1941	100	1142	83.33	299	56.52	4157	100
Dosinia lupinus (Linné, 1758)	4	12.50	1	4.17					5	16.67
Pitar rudis (Poli, 1795)	12	20.83	55	66.67	42	75.00			109	87.50
Callista chione (Linné, 1758)	72	87.50	19	41.67	55	62.50	64	69.57	146	100
Tapes rhomboides (Pennant, 1777)	81	50.00	704	75.00	195	75.00	31	21.74	980	91.67
Tapes decussatus (Linné, 1758) ††							#	—		
Family **CORBULIDAE** Lamarck, 1818										
Corbula gibba (Olivi, 1792)	4715	87.50	3886	100	4076	100	1115	78.26	12677	100
Family **GASTROCHAENOIDEA** Gray J. E., 1840										
Gastrochaena dubia (Pennant, 1777)			3	8.33	1	4.17			4	8.33
Family **HIATELLIDAE** Gray J. E., 1824										
Hiatella arctica (Linné, 1767)	1	4.17	19	25.00	8	25.00			28	50.00
Panopea glycymeris (Von Born, 1778) ††			#	—	#	—				
Family **THRACIIDAE** Stoliczka, 1870										
Thracia sp. ††							#	—		
Family **PANDORIDAE** Rafinesque, 1815										
Pandora inaequivalvis (Linné, 1758)	140	45.83	132	62.50	107	58.33	322	69.57	379	91.67
Pandora pinna (Montagu, 1803)	17	29.17	116	62.50	83	50.00	8	17.39	216	79.17
Family **LYONSIIDAE** Fischer P., 1887										
Lyonsia norwegica (Gmelin, 1791)	5	20.83	11	33.33	10	33.33	7	26.09	26	62.50
CLASSIS **CEPHALOPODA** Cuvier, 1798										
Family **SEPIIDAE** Leach, 1817										
Sepia officinalis Linneo, 1758	1	4.17							1	4.17
Family **SEPIOLIDAE** Leach, 1817										
Sepietta oweniana (D'Orbigny, 1840)							1	4.17		
Family **OCTOPODIDAE** D'Orbigny, 1840										
Octopus vulgaris Cuvier, 1798	1	4.17	1	4.17	3	12.50			5	20.83

Table III. Species richness and abundance (in brackets) per sampling station, and percentages of each molluscan class.
Tabla III. Riqueza específica y abundancia (entre paréntesis) para cada estación de muestreo y porcentages por clase de moluscos.

CLASS	RETÍN 12	RETÍN 16	BARRA 10	BARRA 16	TOTAL	%
POLYPLACOPHORA	4 (47)	2 (91)	2 (2)	2 (143)	5 (283)	*2,87 (0,24)*
GASTROPODA	58 (2.580)	60 (4.165)	35 (1.423)	58 (3.261)	99 (11.429)	*56,89 (9,92)*
BIVALVIA	44 (21.205)	44 (35.806)	30 (31.434)	44 (14.905)	65 (103.350)	*37,35 (89,74)*
SCAPHOPODA	2 (16)	1 (16)	2 (36)	2 (27)	2 (95)	*1,14 (0.082)*
CEPHALOPODA	2 (2)	1 (1)	1 (1)	1 (3)	3 (7)	*1,72 (0.006)*
TOTAL	110 (23.850)	108 (40.079)	70 (32.896)	107 (18.339)	174 (115.164)	*100 (100)*

drozoan were found in some individuals of *Corbula gibba* and were mainly located on the posterior part of the shell.

The high abundance and frequency of the shells of *Panopea glycymeris, Solecurtus scopula* and *Lutraria angustior* indicates their possible presence in these communities. These species live deeply buried in the sediment (25-40 cm), making difficult their collection with the dredge. The large valves are a substrate for *Calyptraea chinensis*, and a shelter for many other species.

Some other species such as *Cerastoderma glaucum* and *Scrobicularia plana* were transported from the estuary of Barbate which is close to B10 where they were found.

B: Micromolluscs list: A total of 25 species of micromolluscs (Table IV) were determined in the sample from April 1994. A few species (e. g. *Gibbula magus, Chamelea striatula, Tapes rhomboides*) are the juveniles of species otherwise listed in the macrofauna, but most of them are species of which the adult size is small, and which would be totally missed in the 1 mm sieve.

A few species, some of which are illustrated on Figure 4, are very abundant, and these belong to species which are usually deemed to be rare because they are found preferently on this kind of bottom, where micromolluscs are not easy to collect. The best represented families of microgastropods were Pyramidellidae (5 sp.), Skeneidae (3 sp) and Caecidae (3 sp.). The best represented family of microbivalves was Montacutidae (3 sp.). As for the number of individuals, the larger numbers correspond to the supposedly rare chiton *Leptochiton cimicoides*, the gastropods *Dikoleps nitens, Pusillina inconspicua* and *Retusa mamillata*, and to the bivalve *Limatula subauriculata*. The small cerithiid *Bittium submamillatum*, also found in the fraction over 1 mm, was quite abundant.

In addition to these species which are dominant in their size class, we found several species which are notoriously rare elsewhere and could be recovered here in moderate numbers, hence are not so rare on this kind of substrate. The gastropod *Retrotortina fuscata* was found alive for the first time in our study and reported on by GOFAS AND WARÉN (1998). The recently described bivalve *Notolimea clandestina*, described from a few specimens only, is well represented in our samples and could be observed with brooded juveniles inside.

The highest overall abundance and species richness of micromolluscs was registered in the samples from R12, with the lowest percentage of organic mater, and the lowest in B10, with the greatest percentage of organic matter (Table I).

Analysis of the Community

A: Dominance and Frequency: In spite of the high number of collected species, the molluscan taxocoenosis is dominated by few species. The main dominant species were quite similar among the 4

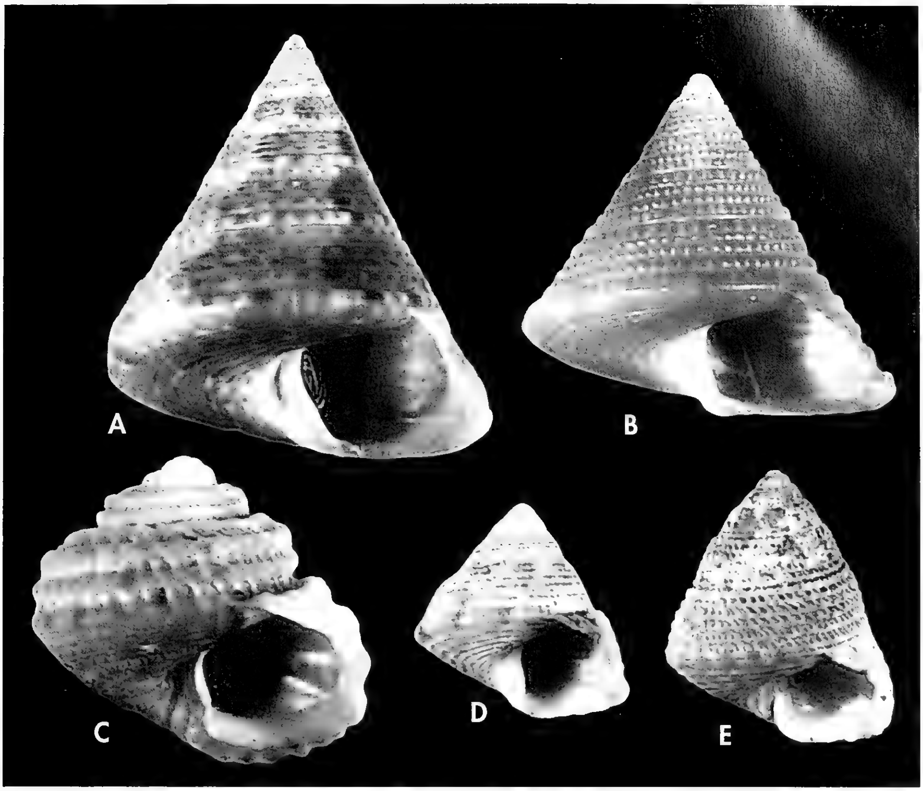

Figure 2. Species of the family Trochidae from Bay of Barbate. A: *Calliostoma* sp. 1, 8.5 mm; B: *Calliostoma* sp. 2., 7.0 mm; C: *Gibbula guttadauri*, 5.5 mm; D: *Jujubinus dispar*, 3.8 mm; E: *Jujubinus dispar*, 6.3 mm. Dimensions are for shell height.

Figura 2. Especies de la familia Trochidae presentes en la bahía de Barbate. A: Calliostoma *sp. 1, 8,5 mm; B:* Calliostoma *sp. 2., 7,0 mm; C:* Gibbula guttadauri*, 5,5 mm; D:* Jujubinus dispar*, 3,8 mm; E:* Jujubinus dispar*, 6,3 mm. Las medidas indicadas corresponden a la altura.*

sampled stations. There were 8 to 13 species with dominance values higher than 1 % in R12, R16 and B16, but only 5 species had dominance values higher than 1 % in the station B10 (Table V). *Chamelea striatula* was the most dominant species in all sample stations: in some months it reached abundance of 5000 to 13000 individuals per sample. The strong settlement of juveniles of this species occurred during Spring months of the first year of survey (1994), then it persisted as a dominant species for a limited time in R16, and until the end of the studied period in B10. The higher amount of mud and percentage of the organic matter in the sediment from this latter station could have favoured the development of this species.

If we take into account the 20 first dominant species, it is possible to find some differences between stations. The most different composition of dominant species occurs in B10, where 5 species (*Acanthocardia tuberculata, Nassarius reticulatus, Nassarius mutabilis, Nassarius elatus* and *Donax venustus*) are typical of shallow sand bottom communities. Their dominant presence in comparison with the other stations indicates similarity with communities of well sorted fine sand (PÉRÈS AND PICARD, 1964; GLÉMAREC, 1969; GARCÍA RASO, LUQUE, TEMPLADO, SALAS, HERGUETA, MORENO AND CALVO, 1992). This is further supported by the constant occurrence of high numbers of *Ophiura texturata* Lamarck, 1816 and of some individuals of *Echinocardium cordatum* (Pennant, 1777). In R12 some species with affinities for coarse sand bottoms are listed in the first 20 dominant species: *Bittium submamillatum, Laevicardium crassum* (with the highest abundance in the 4 stations), *Turritella turbona, Gibbula guttadauri*. Some other animals collected frequently in this station, such as *Branchiostoma lanceolatum* (Pallas, 1766) and *Echinocyamus pusillus* (Müller, 1776), are common in coarse sand bottom communities (FORD, 1923; CABIOCH, 1968; GLÉMAREC, 1969).

The species occurring in a high frequency throughout the 2 years in B10 were different from those of the other three stations (Table VI), and were mainly the species with affinity for fine and shallow sandy bottoms listed with the dominance data. Species of nassarids (*Nassarius reticulatus, N. mutabilis* and *N. elatus*) and some bivalves such as *Spisula subtruncata, Nuculana pella* and *Acanthocardia tuberculata* were recorded in all monthly samples during two years. Nevertheless, other species recorded with a high frequency in the other stations, such as *Mesalia varia, Corbula gibba, Digitaria digitaria* and *Laevicardium crassum,* were also important for the community structure of B10.

Aplysia fasciata Poiret, 1789 was recorded in spring and summer months from the first year and not in samples from the second year, probably due to a decrease on the production of algae in the bay.

B: Faunal affinity between sampling points: The values of qualitative and quantitative similarity indices between sampling stations are shown in Table VII and Figure 5. A single dendrogram was found for each index with the UPGMA reconstructions. From the qualitative viewpoint, according to Jaccard's as well as to Baroni-Urbani and Buser's indices, the points Retín 12, Retín 16 and Barra 16 are significantly similar ($p < 0.01$). The lowest similarity in qualitative terms was found between the station B10 and the other stations, whereas a higher similarity is found between the two deeper stations R16 and B16. The quantitative analysis according to BRAY AND CURTIS (1957) also showed high similarity between R16 and B16, where a high number of individuals of *Chamelea striatula* were collected. Assuming the invasive character of the settlement of this species in this kind of communities, the same index was computed also without the data for this species. The influence of the flood of *Chamelea* brings a bias so as to increase the similarity between Barra 10 and other stations (Fig. 5C), whereas the quantitative data without *Chamelea* are consistent with the qualitative indices (Fig. 5D).

DISCUSSION

Taxonomic remarks: The species of the genus *Calliostoma* (Fig. 2) are problematic in the area of transition between

(Right page) Figure 3. Species of the family Nassariidae from Bay of Barbate. A: *Nassarius pygmaeus*, 11 mm; B: *Nassarius vaucheri*, 13 mm; C: *Nassarius reticulatus*, juvenile, 13 mm; D: *Nassarius incrassatus*, 11 mm; E: *Nassarius tingitanus*, 9 mm (specimen collected in Tarifa); F: *Nassarius heynemanni*, 13 mm; G: *Nassarius mutabilis*, 12 mm; H: *Nassarius elatus*, 14 mm. Dimensions are for shell height.
(Página derecha) Figura 3. Especies de la familia Nassaridae presentes en la bahía de Barbate. A: Nassarius pygmaeus, *11 mm; B:* Nassarius vaucheri, *13 mm; C:* Nassarius reticulatus, *juvenil, 13 mm; D:* Nassarius incrassatus, *11 mm; E:* Nassarius tingitanus, *9 mm (ejemplar recolectado en Tarifa); F:* Nassarius heynemanni, *13 mm; G:* Nassarius mutabilis, *12 mm; H:* Nassarius elatus, *14 mm. Las medidas corresponden a la altura.*

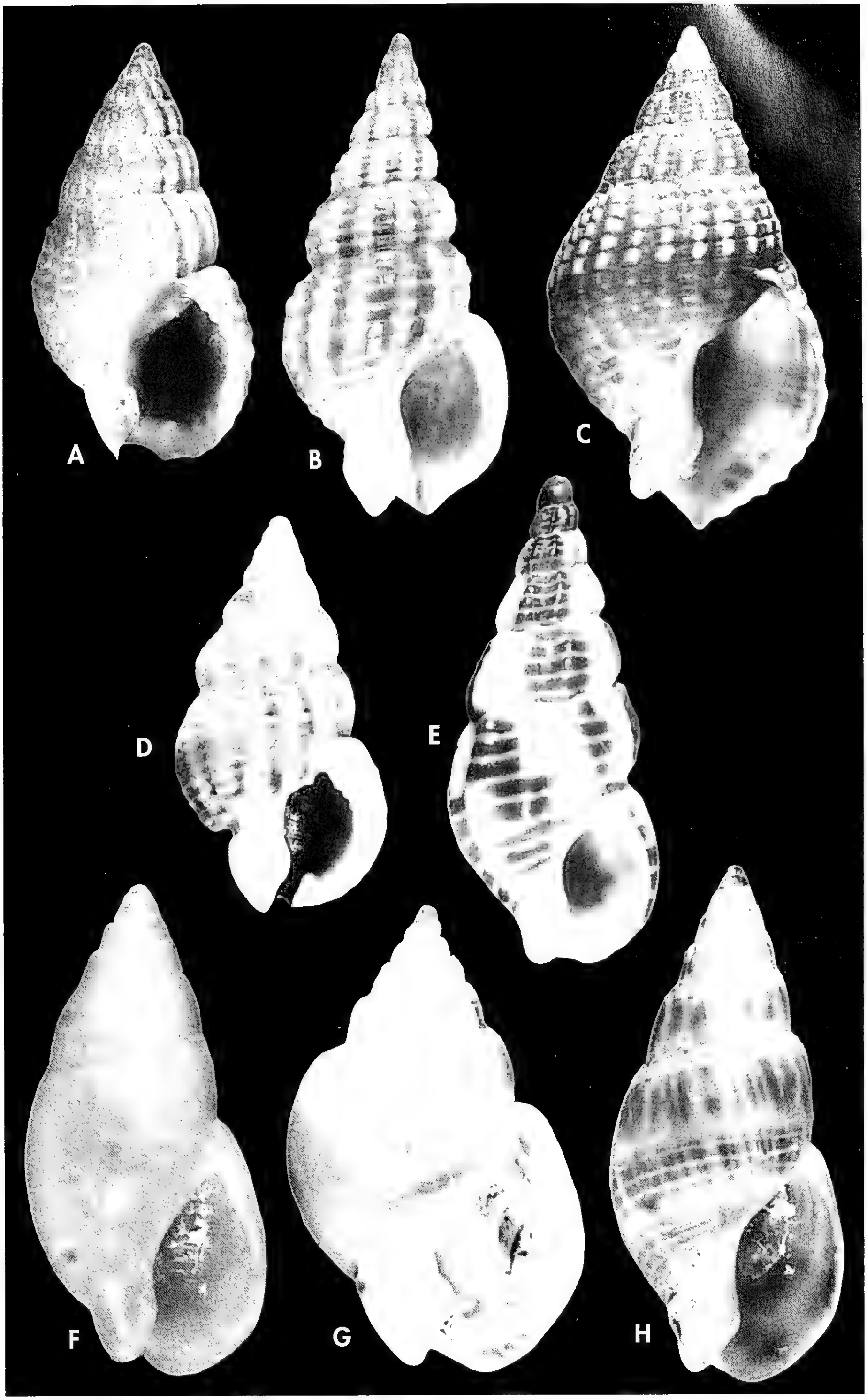
A
B
C
D
E
F
G
H

Table IV. Species of micromolluscs collected in the survey, mainly in the samples of april 1994. Numbers in brackets denote specimens collected only in thanatocenosis, >100 denotes abundant species with more than 100 live-collected specimens in the sample.
Tabla IV. Especies de micromoluscos recolectadas en los muestreos, principalmente en abril de 1994. Los numeros entre parentesis denotan ejemplares encontrados sólo en tanatocenosis, >100 indica especies abundantes con más de 100 ejemplares colectados en las muestras.

	Retín 12	**Retín 16**	**Barra 10**	**Barra 16**
POLYPLACOPHORA				
Leptochitonidae				
Leptochiton cimicoides (Monterosato, 1879).	>100	3	-	1
GASTROPODA				
Scissurellidae				
Scissurella costata d'Orbigny, 1824	-	-	-	3
Skeneidae				
Skenea serpuloides (Montagu, 1808)	10	-	-	
Dikoleps nitens (Philippi, 1844)	>100	-	-	
Dikoleps pruinosa (Chaster, 1896)	53	-	-	
Trochidae				
Gibbula magus (Linné, 1758)	12	-	-	
Rissoidae				
Pusillina inconspicua (Alder, 1844)	>100	-	-	
Obtusella intersecta (Wood, 1857)	(1)	-	-	
Caecidae				
Caecum trachea (Montagu, 1808)	12	-	-	
Caecum cuspidatum Chaster, 1896	2	-	-	
Caecum clarkii Carpenter, 1858	1	-	-	
Vanikoridae				
Macromphalina disciformis (Granata Grillo, 1877)	-	-	-	4
Cerithiidae				
Bittium pusillum (de Rayneval & Ponzi, 1854)	80	-	-	
Turritellidae				
Turritella turbona Monterosato, 1877	(2)	-	-	
Turritella communis Risso, 1826	-	(2)	-	
Mesalia varia (Kiener, 1887)	-	(2)	-	
Eulimidae				
Vitreolina sp.	3	-	-	2
Fasciolariidae				
Fusinus pulchellus (Philippi, 1844)	-	1	-	
Pyramidellidae				
Evalea divisa (J. Adams, 1797)	(5)	-	-	
Odostomia conspicua Alder, 1850	(2)	-	-	
Odostomia unidentata (Montagu, 1803)	-	-	-	1
Brachystomia eulimoides (Hanley, 1844)	12	1	-	4
Brachystomia sp.	2	-	-	
Omalogyridae				
Retrotortina fuscata Chaster, 1896	20	-	-	
Ebalidae				
Ebala pointeli (de Folin, 1868)	3+(10)	1	-	

Table IV. Continuación.
Tabla IV. Continuation.

	Retín 12	Retín 16	Barra 10	Barra 16
Retusidae				
Retusa mamillata (Philippi, 1836)	>100	-	-	
Cylichnidae				
Cylichna crossei B.D.D., 1886	(2)	-	(1)	4
Oxynoidae				
Lobiger sp.	(1)	-	-	
BIVALVIA				
Nuculidae				
Nucula recondita Gofas & Salas, 1996	(1)	-	-	
Glycymeridae				
Glycymeris glycymeris (Linné, 1758)	(2)	(1)	-	
Pectinidae				
Chlamys sp.	9	-	-	
Anomiidae				
Anomia ephippium (Linné, 1758)	5	-	-	2
Limidae				
Limatula subauriculata (Montagu, 1808)	>100	-	-	
Notolimea clandestina Salas, 1994	25	-	-	
Leptonidae				
Hemilepton nitidum (Turton, 1822)	1	-	(1)	
Kelliidaee				
Kellia suborbicularis (Montagu, 1803)	-	-	-	3
Montacutidae				
Mysella bidentata (Montagu, 1803)	5+(4)	-	-	1
Tellimya ferruginosa (Montagu, 1808)	(1)	-	5	
Montacuta goudi van Aartsen, 1996	(1)	(1)	-	
Astartidae				
Goodalia triangularis (Montagu, 1803)	2+(3)	-	-	
Digitaria digitaria (Linné, 1758)	47	3	1	2
Cardiidae				
Parvicardium scabrum (Philippi, 1844)	4	-	-	
Matridae				
Spisula subtruncata (da Costa, 1778)	-	-	6	
Tellinidae				
Tellina pusilla Lovén, 1846	2	-	-	
Semelidae				
Ervilia castanea (Montagu, 1803)	70	-	-	
Veneridae				
Tapes rhomboides (Pennant, 1777)	>100	-	-	>100
Gouldia minima (Montagu, 1803)	28	-	-	2
Chamelea striatula (da Costa, 1778)	>100	38	4	9
Corbulidae				
Corbula gibba (Olivi, 1792)	4	22	-	2
Thraciidae				
Thracia sp.	5 (+ v.)	1	2	

Mediterranean Sea and Atlantic Ocean. Atlantic forms usually have a heavier sculpture of spiral cords than Mediterranean ones, and this variation in sculpture obscures the delimitation of the species. *Calliostoma zizyphinum* was easily recognized by its broader and less conical shape, although some variability occurs between individuals. *Calliostoma* sp. 1 is close to the Mediterranean species *Calliostoma conulus* (Linné, 1758), from which it differs by the presence of heavier ribs. *Calliostoma* sp. 2 resembles *Calliostoma laugieri* (Payraudeau, 1826), but a detailed comparison of protoconchs shows a higher number of granulated whorls in *Calliostoma* sp. 2.

The genus *Chauvetia* is well represented in the area nearby Strait of Gibraltar with 10 to 15 species, and its taxonomy is difficult. *Chauvetia* sp. from our study has a white band in the shell and resembles *Chauvetia crassior* Odhner, 1923. However, the latter was described from the Canary Islands and has direct development, so that it is doubtful whether the same species is present in the Strait of Gibraltar. Other species like *Chauvetia decorata* Monterosato, 1889, described from Morocco, also show white bands, and this character may even not be constant within a single species.

Some other taxonomical or nomenclatural problems are related with the *Bela* species, which are in need of revision. In our samples some of them were named as *Bela* sp. 1 and sp. 2. Nomenclatural problems were found for the species known in the literature as *Bela striolata* Risso, 1826, a usage which is not correct considering that the type specimen belongs to the genus *Rissoina* d'Orbigny, 1840. The next available name could be *Bela smithi* Forbes, 1844, but the description is not clear and the type material is lost. We have followed the incorrect usage, as revising this question is beyond the scope of. the paper.

According to OLIVER AND COSEL (1993), *Anadara polii* (Mayer, 1868) is not the same species than the Miocene *Arca diluvii* Lamarck, 1805: the Recent species has a lower number of ribs (24-28) and a less median umbo. All individuals of *Aequipecten opercularis* were smaller and more elongate than the usual Atlantic form, and can be grouped in the form *audouinii*. Although *A. audouinii* (Payraudeau, 1826) is currently regarded as a a synonym of *A. opercularis*, a reevaluation of their relationships is needed in order to clarify if this form is a different species. *Chamelea striatula* (more Atlantic) and *C. gallina* (more Mediterranean) are two closely related species which live sympatrically in the Southern part of Iberian peninsula. BACKELJAU, BOUCHET, GOFAS AND DE BRUYN (1994) justified the separation of the two species using allozyme electrophoresis. *C. gallina* is common in shallow and sandy bottoms in our latitudes, but *C. striatula* prefers muddy and deeper

(Right page) Figure 4. Micromolluscs from the soft bottom in Bay of Barbate. A: *Bittium submamillatum*, height 3.8 mm; B: detail of the microsculpture of *Bittium submamillatum*; C: protoconch of *Bittium submamillatum*; D: *Pusillina inconspicua*, height 1.6 mm; E: *Caecum cuspidatum*, length 2.15 mm; F: detail of the microsculpture of *Caecum cuspidatum*; G: *Retusa mamillata*, height 1.85 mm; H: *Leptochiton cimicoides*, dorsal view, length 2.0 mm; I: *Leptochiton cimicoides*, lateral view, length 1.65 mm; J: detail of the girdle of *Leptochiton cimicoides*, showing the two types of spicules. Scale bars 100 µm.

(Página derecha) Figura 4. Micromoluscos de los substratos blandos de la bahía de Barbate. A: Bittium submamillatum, *altura 3,8 mm; B: detalle de la microescultura de* Bittium submamillatum*; C: protoconcha de* Bittium submamillatum*; D:* Pusillina inconspicua, *altura 1,6 mm; E:* Caecum cuspidatum, *longitud 2,15 mm; F: detalle de la microescultura de* Caecum cuspidatum*; G:* Retusa mamillata, *altura 1,85 mm; H:* Leptochiton cimicoides, *vista dorsal, longitud 2,0 mm; I:* Leptochiton cimicoides, *vista lateral, longitud 1,65 mm; J: detalle del cinturón de* Leptochiton cimicoides *mostrando los dos tipos de espículas. Escalas 100 µm.*

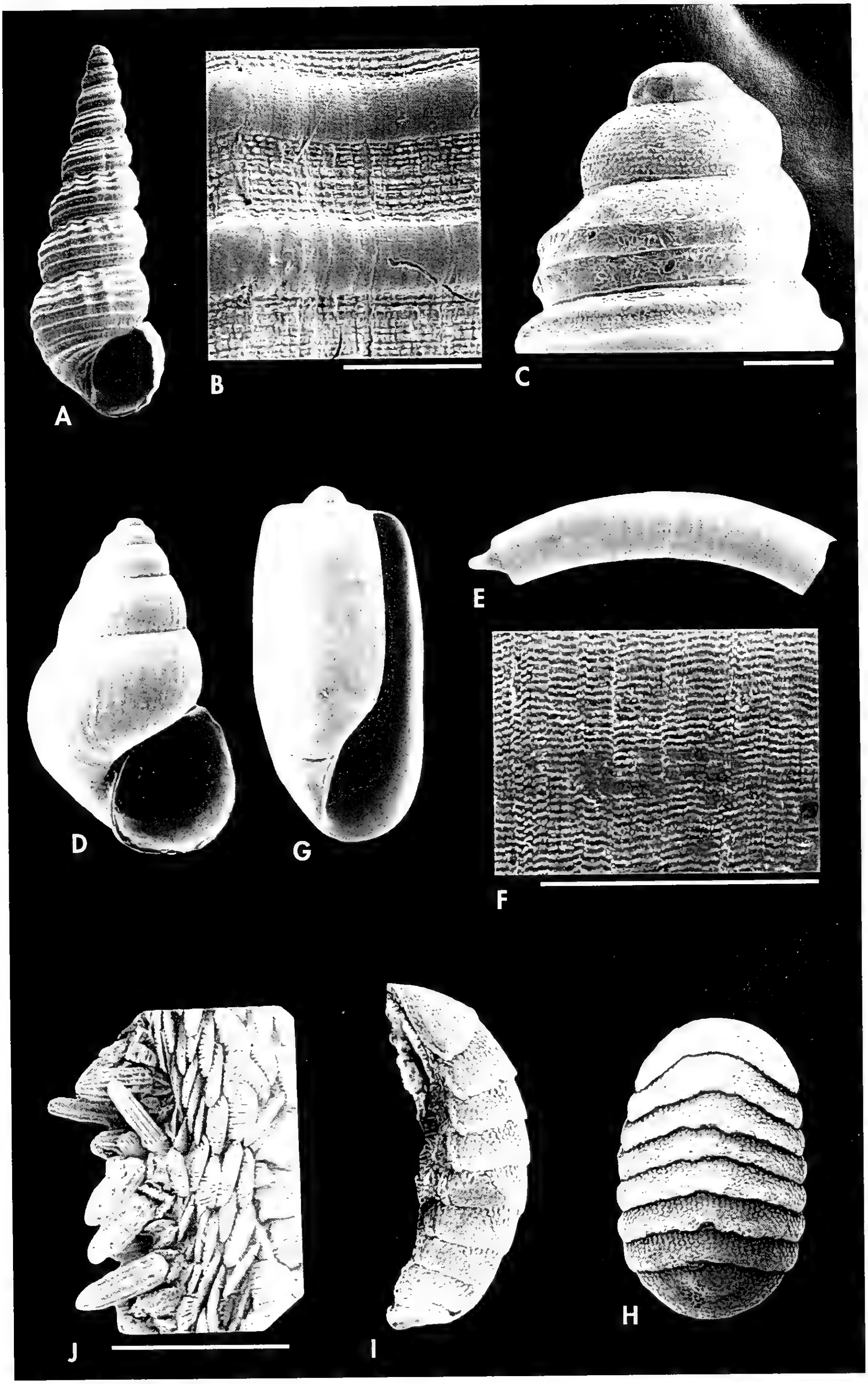
A
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Table V. The 20 most dominant species in each of the sampled stations.
Tabla V. Las 20 especies con mayor índice de dominancia en cada estación.

Retín 12	%	Retín 16	%	Barra 16	%	Barra 10	%
Chamelea striatula	52.47	*Chamelea striatula*	65.29	*Chamelea striatula*	47.14	*Chamelea striatula*	79.19
Corbula gibba	19.77	*Corbula gibba*	9.69	*Corbula gibba*	27.34	*Digitaria digitaria*	3.86
Gouldia minima	4.50	*Gouldia minima*	4.84	*Gouldia minima*	7.66	*Corbula gibba*	3.38
Bittium submamillatum	2.59	*Calyptraea chinensis*	3.23	*Digitaria digitaria*	7.15	*Spisula subtruncata*	3.07
Digitaria digitaria	2.50	*Digitaria digitaria*	2.96	*Calyptraea chinensis*	4.33	*Nuculana pella*	1.17
Calyptraea chinensis	1.88	*Turritella communis*	2.47	*Turritella communis*	3.52	*Pandora inaequivalvis*	0.98
Laevicardium crassum	1.69	*Tapes rhomboides*	1.76	*Mesalia varia*	1.77	*Gouldia minima*	0.91
Spisula subtruncata	1.62	*Turritella turbona*	1.00	*Gibbula magus*	1.47	*Acanthocardia tuberculata*	0.85
Modiolus adriaticus	1.36	*Nuculana pella*	0.78	*Nuculana pella*	1.31	*Nassarius reticulatus*	0.84
Turritella turbona	1.05	*Modiolus adriaticus*	0.72	*Tapes rhomboides*	1.31	*Laevicardium crassum*	0.77
Turritella communis	1.03	*Gibbula magus*	0.69	*Spisula subtruncata*	1.22	*Nassarius mutabilis*	0.74
Gibbula guttadauri	0.70	*Spisula subtruncata*	0.60	*Modiolus adriaticus*	1.03	*Nassarius elatus*	0.61
Clausinella fasciata	0.63	*Mesalia varia*	0.50	*Ocinebrina edwardsi*	1.03	*Donax venustus*	0.38
Mesalia varia	0.62	*Anomia ephippium*	0.40	*Anomia ephippium*	0.94	*Bela laevigata*	0.36
Nuculana pella	0.61	*Bela laevigata*	0.36	*Calliostoma sp.1*	0.80	*Mesalia varia*	0.34
Pandora inaequivalvis	0.59	*flexopecten flexuosus*	0.34	*Laevicardium crassum*	0.77	*Modiolus adriaticus*	0.32
Aporrhais pespelicani	0.44	*Bittium submamillatum*	0.33	*Bela laevigata*	0.74	*Calyptraea chinensis*	0.31
Tapes rhomboides	0.34	*Pandora inaequivalvis*	0.33	*Pandora inaequivalvis*	0.72	*Callista chione*	0.19
Bela laevigata	0.34	*Pandora pinna*	0.29	*Nassarius pygmaeus*	0.58	*Nassarius pygmaeus*	0.18
Flexopecten flexuosus	0.31	*Aporrhais pespelicani*	0.28	*Pandora pinna*	0.56	*Turritella communis*	0.14

Table VI. Species with a frequency of more than 75% in each of the sampled stations.
Tabla VI. Especies con frecuencia superior a los 75% en cada una de las estaciones.

Retín 12	%	Retín 16	%	Barra 16	%	Barra 10	%
Laevicardium crassum	100%	*Corbula gibba*	100%	*Corbula gibba*	100%	*Spisula subtruncata*	100%
Digitaria digitaria	>90%	*Gouldia minima*	100%	*Mesalia varia*	100%	*Nuculana pella*	100%
Clausinella fasciata	>90%	*Digitaria digitaria*	100%	*Digitaria digitaria*	>95%	*Acanthocardia tuberculata*	100%
Nuculana pella	>90%	*Turritella communis*	>95%	*Nuculana pella*	>95%	*Nassarius reticulatus*	100%
Corbula gibba	>85%	*Nuculana pella*	>95%	*Calliostoma sp 1*	>95%	*Nasarius mutabilis*	100%
Gouldia minima	>85%	*Calyptraea chinensis*	>90%	*Chamelea striatula*	>90%	*Nassarius elatus*	100%
Callista chione	>85%	*Mesalia varia*	>90%	*Spisula subtruncata*	>90%	*Digitaria digitaria*	>90%
Aporrhais pespelecani	>75%	*Bela laevigata*	>80%	*Calyptraea chinensis*	>85%	*Mesalia varia*	>85%
Spisula subtruncata	>75%	*Chamelea striatula*	>75%	*Ocenebra erinacea*	>85%	*Corbula gibba*	>75%
Mesalia varia	>75%	*Bolinus brandaris*	>75%	*Gouldia minima*	>80%	*Laevicardium crassum*	>75%
Chamelea striatula	>75%	*Tapes rhomboides*	>75%	*Gibbula magus*	>75%		
Bolinus brandaris	>75%	*Nodiolus adriaticus*	>75%	*Ocinebrina edwardsi*	>75%		
		Spisula subtruncata	>75%	*Laevicardium crassum*	>75%		
				Turritella communis	>75%		
				Tapes rhomboides	>75%		
				Pitar rudis	>75%		
				Fusinus pulchellus	>75%		

Table VII. Values of affinity indexes between sampling stations, qualitative (Jaccard and Baroni-Urbani and Buser) and quantitative (Bray and Curtis, with and without *Chamelea striatula*).
Tabla VII. Valores de los índices de de afinidad entre estaciones de muestreos, cualitativos (Jaccard y Baroni-Urbani y Buser) y cuantitativo (Bray y Curtis, con o sin los datos para Chamelea striatula*).*

Jaccard	**R12**	**R16**	**B10**	**B16**
R12	1.000	0.496	0.432	0.510
R16		1.000	0.296	0.536
B10			1.000	0.393
B16				1.000
Baroni-Urbani and Buser	**R12**	**R16**	**B10**	**B16**
R12	1.000	0.617	0.595	0.629
R16		1.000	0.447	0.659
B10			1.000	0.557
B16				1.000
Bray and Curtis	**R12**	**R16**	**B10**	**B16**
R12	1.000	0.667	0.579	0.742
R16		1.000	0.839	0.593
B10			1.000	0.433
B16				1.000
Bray and Curtis (Sin C.s.)	**R12**	**R16**	**B10**	**B16**
R12	1.000	0.701	0.434	0.760
R16		1.000	0.414	0.823
B10			1.000	0.449
B16				1.000

bottoms with a higher amount of organic matter.

Species richness: Values of species richness in the Bay of Barbate are comparable with those obtained in other studies from soft bottom communities of molluscs, although sometimes higher. No information about species richness per month from detritical bottoms communities of molluscs have been found in the literature, but some information for communities for other soft bottoms is available. Species richness of Molluscs in soft bottoms from the North Sea is low (10 to 15 sp.) (ELEFTHERIOU AND BASFORD, 1989; KÜNITZER, 1990), but there is an increase in the English Channel (CABIOCH, GENTIL GLAÇON AND RETIÈRE, 1977). In Northern Spain, species richness values from 15 to 25 have been recorded in soft bottom communities of molluscs (SÁNCHEZ MATA, MORA, GARMENDIA, AND LASTRA, 1993; GARMENDIA, SÁNCHEZ MATA AND MORA, 1996). In Mediterranean coasts Salas (1984) registered values for species richness of molluscs from 20 to 30 in different kinds of soft bottoms of Málaga bay (Alboran Sea). The highest values of species richness were recorded (around 40 species per sample) in fine sand bottoms with low percentage organic matter. APARICI SEGUER AND GARCÍA-CARRASCOSA (1996) recorded values of species richness between 4 to 11 per sample in the soft bottoms of Chafarines islands (close to the Mediterranean area of Morocco), but such low values probably reflect incomplete sampling. APARICI SEGUER, ROWLAND, TAYLOR AND GARCÍA CARRASCOSA (1996) found 10-20 species per sample in the soft bottoms (fine sand) from the gulf of Valencia at depths of 15 meters. Values of species richness per month comparable to those found in this study have been registered in communities from hard bottoms (Troncoso, Urgorri and Olabarría, 1996), from sea grass beds (Hergueta, 1996; Ledoyer, 1966 a, b) or the calcareous algae *Mesophyllum lichenoides* (Lemoine) (Hergueta, 1996).

Characterisation of the community: The species living sympatrically in the Bay of Barbate form communities with more components than in other areas. In the Mediterranean Sea similar communities were referred to as "Biocénose des fonds meubles instables (MI) " and "Biocénose des fonds detritique du large (DL) " (Pérès and Picard, 1964). These have a similar faunistic compositions, although species richness is higher in Barbate bay. In our study these communities occurred in the infralittoral level (25 m), whereas in the Mediterranean they occur in the circalittoral, deeper than in the Atlantic.

The community from B10 is also similar to the "Biocénose des sables fins bien calibrés (SFBC) " (Pérès and Picard, 1964), but there is a high influence of faunistic components from the previously mentioned communities. In R12 some similarities with the "Biocénose des sables grossiers et des fins graviers (SGFG) " (Pérès and Picard, 1964) are found, although the instability of the bottoms due to strong currents changes the composition of the community through the year.

Cabioch (1968) found similar and comparable communities in the English channel, named as "Peuplements des sédiments fins a *Abra alba* et *Corbula gibba*" and "Biocoenose du Maerl". In these communities a mixture of in- and epifauna occurred over a heterogeneous sediment. The depth in which these communities occurred was similar to those from Barbate, within the infralitoral. However, the biogeographical differences result in that some species have been replaced in the Strait of Gibraltar. We could not trace in the literature any reference to communities in the Mauritanian region, so that a comparison was not possible.

Structure of the community. Dominance and Frequency: High values of dominance were more common among bivalves than among gastropod species. This reflects their high abundance in soft bottoms, conforming large populations. Gastropods are less numerous than bivalves in soft bottoms samples. In order to correct this bias, we also took into account the frequency of the species in the samples. It is important to take into account both figures, because some species with a marked seasonality may show high abundance during a short period of time, and thus have a low frequency although they are important elements of the community.

The highest dominance was for the species *Chamelea striatula*, although it showed lower percentages of presence than other species. This was caused by a massive and successful recruitment of this species in these bottoms in the first sampling year, although no recruitment occurred in the second year. Such strong settlement has been registered for the same species along the Scottish coasts by Ansell (1961). At the beginning of this study *Chamelea striatula* was found in some samples with low abundance. After spring 1994 this species was dominant in the four sample stations, although the population decreased in some stations during 1995. At the end of the sampled period, large population of *Chamelea striatula* was only present in B10 which is close to the harbour and the estuary. This species is common in fine sand bottoms from shallow coasts (3-20 m) in the North Sea (Muus, 1973; Duineveld and Belgers, 1994). In the Strait of Gibraltar area, *Chamelea striatula* is found living sympatrically with *Chamelea gallina* which is very common in fine sand bottoms from shallow shores (2-15 m) in the Mediterranean Sea. C *striatula* is usually found in mud bottoms with high percentages of organic matter in southern Spanish

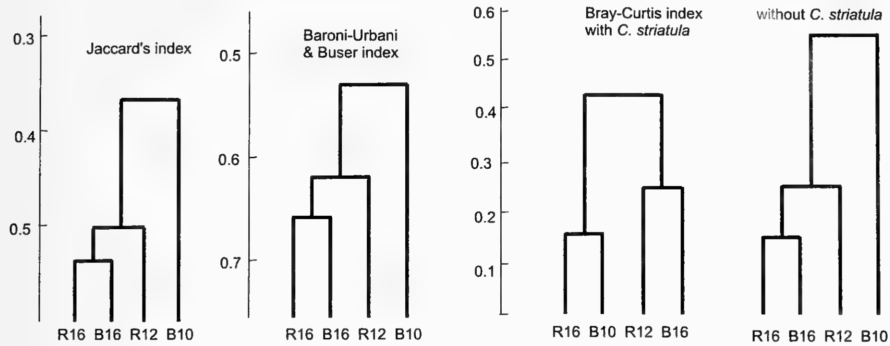

Figure 5. Dendrograms representing affinity of sampling points, according to the qualitative indices (above) and quantitative (below). Algorithm is UPGMA.
Figura 5. - Dendrogramas de afinidad de los puntos muestreados en base a los valores de los índices cualitativos (Superior) y cuantitativos (Inferior). Algoritmo de aglomeración UPGMA.

coasts and never reaches high dominance in near-shore sandy bottoms. The persistence of this species may have been favoured by the cleaning and dredging of the channel in the harbour of Barbate during our sampling period, which turned more muddy the sediments nearby.

Other molluscs of these detritic bottom communities showed high frequencies and dominance. Large populations of *Corbula gibba* were collected, but this is a rather ubiquitous species, commonly found together with *Turritella* communities on fine sandy bottoms with large pieces of graves and pebbles (HRS-BRENKO, 1981).

Digitaria digitaria is a typical species of coastal detritic bottoms from North Spanish coasts (ORTEA, 1977; BESTEIRO, TRONCOSO, PARAPAR, SALVINI-PLAWEN AND URGORRI, 1990). Among the gastropods, some of the most typical species for detritic bottoms are turritellids. In this location *Mesalia varia* is an important component of the community from Barbate and also one of the West African representatives.

In station B10, a mixed community occurs. Species from detritic bottom communities (*Digitaria digitaria, Mesalia varia, Corbula gibba*) have a high frequency and dominance but some species from communities of well sorted fine sand (*Nassarius* species, *Acanthocardia tuberculata, Spisula subtruncata*) showed also high dominances and the highest frequencies. The community from this latter sample station seems to be a transition between both. Communities of well sorted fine sands are known in other points from European coasts: in the North Sea (FORD, 1923; CABIOCH, 1968), in the Mediterranean Sea (SPADA, SABELLI AND MORANDI, 1973; SALAS, 1984; GARCÍA RASO *ET AL.*, 1992). In Barbate bay this community shows a higher species richness than other communities from European coasts. Three species of Nassariidae (*Nassarius reticulatus, Nassarius mutabilis* and *Nassarius elatus*) were found in B10 with high frequency, while *Nassarius pygmaeus* and *Nassarius vaucheri* occurred with low frequency. This kind of community in the Mediterranean Sea holds usually only two species of Nassariids (*N. mutabilis* and *N. reticulatus*) and in the North Sea *N. reticulatus* and *N. pygmaeus*. Other species like *Mactra stultorum* and *Chamelea gallina* were not found as main components in this sample point but they show high abundance in similar communities from the Mediterranean Sea (SPADA *ET AL.*, 1973; SALAS, 1984; GARCÍA RASO *ET AL.*, 1992).

Zoogeographical notes: The area of the Strait of Gibraltar has been said to act as a barrier for many marine species including molluscs (EKMAN, 1953). For some Mediterranean species (*Gibbula guttadauri, Nassarius mutabilis, Naticarius hebraeus*) there is a barrier which makes them less common or absent in the Atlantic waters even nearby the Strait of Gibraltar. Conversely, a few common species of the North Atlantic waters such as *Spisula elliptica* are not found, or rarely found, in Mediterranean waters.

On the other hand, the area of the Strait can also be regarded as one where species of quite different zoogeographical affinity will concur (PALLARY, 1907; SPADA AND MALDONADO, 1974; RUEDA AND SALAS, 1998). The fauna from tropical and temperate West African areas is represented in Barbate by *Mesalia varia, Epitonium jolyi, Nassarius elatus, Nassarius heynemanni, Nassarius vaucheri* and *Gari pseudoweinkauffi*, among others. These species share a northern limit along the coasts of South Portugal (to the North) and in the Alboran Sea (in the Mediterranean). Most Mediterranean species do occur in the Ibero-Moroccan gulf, at least to Cape St. Vincent and sometimes further north. This results in an increase of the number of species from the different biogeographical regions, and Barbate is a locality where their distribution ranges overlap. This trend is well illustrated by the distribution patterns of the seven species of Nassariids (Fig. 6) which were collected sympatrically in this bay.

The fauna of molluscs found in this study includes mostly species which are widespread in the Northeast Atlantic and Mediterranean. Among 27 species with a distribution restricted to one of EKMAN's (1953) three regions, there is a high percentage of similarity (48%) with typical Mediterranean fauna as found along the Italian coast. Nine species are shared with the so-called Mauritanian region (mostly Morocco), according to the information of PASTEUR-HUMBERT (1962 a, b) and of NICKLÈS (1950, 1955) This represents a high similarity (33%). This percentage of similarity could be higher if the information available about molluscs from North-West Africa were more complete. Five species with a mainly North Atlantic distribution are present in Barbate bay, which represents 18%. This percentage resulted as a comparison with the British fauna (TEBBLE, 1966; GRAHAM, 1988) and indicates less affinity than the other two regions.

It is important from a biogeographic viewpoint to point out the presence of endemic molluscan species in the Strait of Gibraltar area. Recently, several species of endemic gastropods have been described from this area and the data have been summarized by GOFAS (1999). Nevertheless, most of the endemic component are linked to rocky shore in intertidal of very shallow environments. It is interesting to note the presence of *Nassarius tingitanus* (Pallary, 1901) on hard bottoms very near the sampling area, but closer to the shore. This species (Fig. 3) shows a typical endemic distribution restricted to the Strait of Gibraltar.

In our samples, we found large numbers of the endemic gastropod *Jujubinus dispar*, which occurs in a restricted area from Tangier to Ceuta (North Africa) and was only cited in European coasts by VAN AARTSEN *ET AL.* (1984) in Algeciras Bay (South Spain). Another rather well documented endemic component is the skeneid *Dikoleps pruinosa*, originally described from Tangier, where it is now very rare due to the extension of the harbour.

Other species which occur in the Barbate samples have once been thought to be endemic of the Gibraltar area but are now known to occur on other subtidal current-swept gravel bottoms. The small bivalve *Notolimea clandestina* Salas, 1994 (SALAS, 1994), which is common on the bottoms of Barbate is also known to occur near Lampedusa, in Sicily Channel (Italy). The same pattern is found for the rare skeneid *Parviturbo fenestratus*, originally described from Tangiers, and now reported from Adventure Bank, Sicily Channel (WARÉN, 1992).

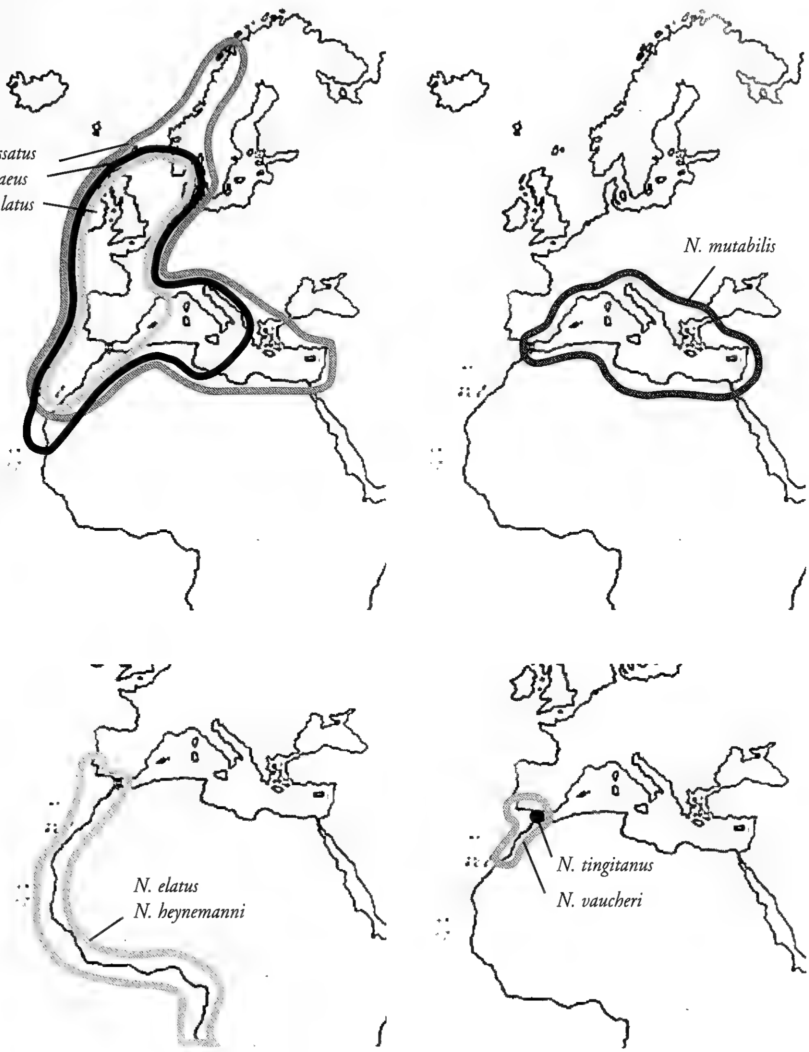

Figure 6. Range of the different species of Nassariidae found in Bay of Barbate.
Figura 6. - Distribución geográfica de las diferentes especies de Nasáridos presentes en la bahía de Barbate.

To summarize, the results of this study show that the bay of Barbate supports a rich soft bottom fauna of molluscs, which is basically the same in three of the sampled stations. The high species richness recorded in these bottoms may be influenced by three kinds of factors:

(1) *Environmental factors.* The bottom contains a mixture of hard and soft components in the sediments. The deeper stations (25 m) have more large bioclastic material (fragments of shells) deposited over a fine sand bottom. This heterogeneity of the substrates induces a diversification of the micro-habitats

(Frontier and Pichod-Viale, 1991; Dewarumez, Davoult, Sanvicente Anorve and Frontier 1992), and consequently a diversification of the fauna. The occurrence of large-size particles favours the settling and development of sessile epifaunal molluscs such as *Anomia ephippium, Modiolus adriaticus, Calyptraea chinensis,* and some mobile pectinids as *Flexopecten flexuosus, Chlamys varia* and *Aequipecten* species. In B10 with a lower amount of bioclastic material there was a decrease in the abundance of these species but an increase of others. The mixture of these with fine sand favours well established populations of infaunal molluscs, mainly bivalves as *Gouldia minima, Digitaria digitaria* or *Spisula subtruncata.*

(2) *The sampling method.* The survey spanned a longer period of time than in other reviewed researchs. This allowed to record changes in the composition of the community such as occurred with *C. striatula,* and to collect species with occasional patterns of occurrence (*Aplysia fasciata* and *Philine* species), or locally rare (*Cymatium corrugatum, Atrina fragilis, Pteria hirundo, Spisula elliptica*), as well as juveniles in the recruitment season.

(3) *The macrogeographic pattern.* The confluence of species from different biogeographical areas has been discussed above, and accounts for much of the species richness in the area.

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BIBLIOGRAPHY

Ansell, A., 1961. Reproduction, growth and mortality of *Venus striatula* (Da Costa) in Kames Bay, Millport. *Journal of the Marine Biological Association of the United Kingdom*, 41: 191-215.

Aparici Seguer, V. and García Carrascosa, A. M., 1996. Moluscos de los fondos de sustratos blandos de las Islas Chafarinas (Mar de Alborán, Mediterráneo). Datos preliminares. *Iberus*, 14: 85-91.

Aparici Seguer, V., Rowland, R. A., Taylor, S. and García Carrascosa, A. M., 1996. Moluscos infralitorales de la playa de Pinedo-El Saler (Valencia, Mediterráneo Occidental). *Iberus*, 14: 93-100.

Arias, A., 1976. Contribución al conocimiento de la fauna bentónica de la Bahía de Cádiz. *Investigación Pesquera*, 40: 335-386.

Backeljau, T., Bouchet, P., Gofas, S. and De Bruyn, L., 1994. Genetic variation, systematics and distribution of the venerid clam *Chamelea gallina*. *Journal of the Marine Biological Association of the United Kingdom*, 74: 211-223.

Baroni-Urbani, C. and Buser, M. W., 1976. Similarity of binary data. *Systematic Zoology*, 25: 251-259.

Besteiro, C., Troncoso, J. S., Parapar, J., Salvini-Plawen, L. von and Urgorri, V., 1990. Hallazgos de *Monobrachium parasitum* (Cnidaria, Hydrozoa) en asociación con *Digitaria digitaria* (Mollusca, Bivalvia). *Iberus*, 9: 91-96.

Bray, R. J. and Curtis, J. T., 1957. An ordination of the upland forest communities of southern Wisconsin. *Ecological monographs*, 27: 325-347.

Buchanan, J. B., 1984. Sediment analysis. In: N. A. Holme and A. D. McIntyre. *Methods for the study of marine benthos*. Blackwell, Oxford: 41-65.

Cabioch, L., 1968. Contribution a la connaissance des peuplements benthiques de la Manche Occidentale. *Cahiers de Biologie Marine*, 9: 493-720.

Cabioch, L., Gentil, F., Glaçon, R. and Retière, C., 1977. Le macrobenthos des fonds meubles de la Manche. *Biology of Benthic organisms*: 115-128.

Carballo, J. L., Naranjo, S. and García-Gómez, J. C., 1997. Where does the Mediterranean Sea begin? Zoogeographical affinities of the littoral sponges of the Straits of Gibraltar. *Journal of Biogeography*, 24: 223-232.

CERVERA, J. L., TEMPLADO, J., GARCÍA-GÓMEZ, J. C., BALLESTEROS, M., ORTEA, J., GARCÍA, F. J., ROS, J. AND LUQUE, A. A., 1988. Catálogo actualizado y comentado de los opistobranquios (Mollusca, Gastropoda) de la Península Ibérica, Baleares y Canarias, con algunas referencias a Ceuta y la Isla de Alborán. *Iberus*, suppl. 1, 84 pp., 4 pl.

CONDE, F., FLORES-MOYA, A., SOTO, J., ALTAMIRANO, M. AND SÁNCHEZ, A., 1996. Checklist of Andalusia (S. Spain) Seaweeds. III. Rhodophyceae. *Acta Botanica Malacitana*, 21: 7-33.

DEWARUMEZ, J. M., DAVOULT, D., SANVICENTE ANORVE L. E. AND FRONTIER, S., 1992. Is the "muddy heterogeneous sediment assemblage" an ecotone between the pebbles community and the *Abra alba* community in the Southern Bight of the North Sea?. *Netherlands Journal of Sea Research*, 30: 229-238.

DRAKE, P., ARIAS, A. M., AND CONRADI, M., 1997. Aportación al conocimiento de la macrofauna supra y epibentónica de los caños mareales de la bahía de Cádiz (España). *Publicaciones Especiales del Instituto Español de Oceanografía*, 23: 133-141.

DUINEVELD, G. C. A. AND BELGERS, J. J. M., 1994. The macrobenthic fauna in the Dutch sector of the North Sea in 1993 and a comparison with previous data. *NIOZ-Rapport*, 12. 103 pp.

EKMAN, S., 1953. *Zoogeography of the sea*. Sidgwick and Jackson, London, XIV. 417 pp.

ELEFTHERIOU, A. AND BASFORD, D. J., 1989. The macrobenthic infauna of the offshore Northern North Sea. *Journal of the Marine Biological Association of the United Kingdom*, 69: 123-143.

ESTABLIER, R. AND MARGALEF, R., 1964. Fitoplancton e hidrografía de las costas de Cádiz (Barbate), de Junio de 1961 a Agosto de 1962. *Investigación Pesquera*, 25: 5-31.

FISCHER-PIETTE, E., 1959. Contribution à l'écologie intercotidale du Détroit de Gibraltar. *Bulletin de l'Institut Océanographique*, nº 1. 145.

FLORES-MOYA, A., SOTO, J., SÁNCHEZ, A., ALTAMIRANO M. AND CONDE, F., 1995 a. Checklist of Andalusia (S. Spain) seaweeds, I. Phaeophyceae. *Acta Botanica Malacitana*, 20: 5-18

FLORES-MOYA, A., SOTO, J., SÁNCHEZ, A., ALTAMIRANO M. AND CONDE, F., 1995 b. Checklist of Andalusia (S. Spain) seaweeds, II. Chlorophyceae. *Acta Botanica Malacitana*, 20: 19-26

FORD, E., 1923. Animal communities of the level sea bottom in the waters adjacent to Plymouth. *Journal of the Marine Biological Association of the United Kingdom*, 13: 164-224.

FRONTIER, S. AND PICHOD-VIALE, D., 1991. *Ecosystèmes: structure, fonctionnement, évolution*. Masson, Paris: 1-392.

GARCÍA GÓMEZ, J. C., 1983a. Estudio comparado de las tanatocenosis y biocenosis malacológicas del Estrecho de Gibraltar y áreas próximas. *Iberus*, 3: 75-90

GARCÍA GÓMEZ, J. C., 1983b. Moluscos opistobranquios del Estrecho de Gibraltar y bahía de Algeciras. *Iberus*, 3: 41-46

GARCÍA RASO, J. E., 1996. Crutacea Decapoda (excl. Sergestidae) from Ibero-Moroccan waters. Results of Balgim-84 Expedition. *Bulletin of Marine Science*, 58: 730-752.

GARCÍA RASO, J. E., LUQUE, A. A., TEMPLADO, J., SALAS, C., HERGUETA, E., MORENO D. AND CALVO, M., 1992. *Fauna y flora marinas del Parque Natural de Cabo de Gata-Nijar*. Junta de Andalucia-AMA. 288 pp.

GARMENDIA, J. M., SÁNCHEZ MATA A. AND MORA, J. 1996. Estudio ecológico estacional de los moluscos de la Ría de Ares y Betanzos (Galicia, NO España). *Iberus*, 14: 115-123.

GLÉMAREC, M., 1969. Les peuplements benthiques du plateau continental Nord-Gascogne. *Thèse Doctorat d'Etat*. Paris, 167 pp.

GOFAS, S., 1999. Marine molluscs with a very small range in the Strait of Gibraltar. *Diversity and Distributions*, 4: 255-266.

GOFAS, S. AND WARÉN, A., 1998. Europe's smallest gastropod: habitat, distribution and relationships of *Retrotortina fuscata* (Omalogyridae). *Cahiers de Biologie Marine*, 39: 9-14.

GRAHAM, A., 1988. *Molluscs: Prosobranch and Pyramidellid Gastropods*. Synopses of the British Fauna. 662 pp.

HERGUETA, E., 1996. Estudio de las taxocenosis malacológicas asociadas a concreccionamientos de *Mesophyllum lichenoides* (Ellis) Lemoine y a una pradera de *Posidonia oceanica* (Linnaeus) Delile del litoral almeriense. *Tesis doctoral. Universidad de Málaga*. 860 pp.

HRS-BRENKO, M., 1981. Population studies of *Corbula gibba* (Olivi), Bivalvia, Corbulidae, in the Northern Adriatic Sea. *Journal of Molluscan Studies*, 47: 17-24.

JACCARD, P. 1908. Nouvelles recherches sur la distribution florale. *Bulletin de la Société Vaudoise de Sciences Naturelles*, 44: 223-270.

KÜNITZER, A., 1990. A comparison of the *Amphiura filiformis*-associations North-East of the Dogger Bank and of the German Bight. *Netherland Journal of Sea Research*, 25: 199-208.

LEDOYER, M., 1966 a. Ecologie de la faune vagile des biotopes méditerranéens accessibles en scaphandre autonome. I. Introduction. Données analytiques sur les biotopes de substrat dur. *Recueil des Travaux de la Station Marine d'Endoume*, 40: 103-149.

LEDOYER, M., 1966 b. Ecologie de la faune vagile des biotopes méditerranéens accessibles en scaphandre autonome. II. Données analytiques sur les herbiers de phanerogames. *Recueil des Travaux de la Station Marine d'Endoume*, 41: 135-164.

LÓPEZ DE LA ROSA, I., 1997. Crustáceos Decápodos capturados durante las campañas del IEO ARSA 0393 y ARSA 1093 en el Golfo de Cádiz: distribución batimétrica. *Publicación Especial del Instituto Español de Oceanografía*, 23: 199-206.

LÓPEZ DE LA ROSA, I., GARCÍA RASO, J. E. AND RODRIGUEZ MARTÍN, A., 1998. First record of *Gourretia denticulata* (Lutze, 1937) (Crustacea, Decapoda, Thalassinidae) from the Atlantic coast of Spain. *Scientia Marina*, 62: 393-395.

LÓPEZ DE LA CUADRA, C. M. AND GARCÍA-GÓMEZ, J. C., 1993. Zoogeographical study of the Cheilostomatida from the Straits of Gibraltar. In Ryland J. S., Taylor, P. D. and Hayward P. J. (Eds.): *Biology and Paleobiology of Bryozoans*, Olsen and Olsen, Fredensborg: 107-112.

MANJÓN-CABEZA, M. E. AND GARCÍA RASO, J. E., 1998a. Structure and evolution of a decapod crustacean community from the coastal detritic bottoms of Barbate (Cádiz, Southern Spain). *Journal of Natural History*, 32: 1619-1630.

MANJÓN-CABEZA, M. E. AND GARCÍA RASO, J. E., 1998b. Population structure and growth of the hermit crab *Diogenes pugilator* (Decapoda: Anomura: Diogenidae) from the Northeastern Atlantic. *Journal of Crustacean Biology*, 18: 753-762.

MEDEL-SOTERAS, M. D., GARCÍA, F. J. AND GARCÍA-GÓMEZ, J. C., 1991. La familia Sertulariidae (Cnidaria: Hydrozoa) en el estrecho de Gibraltar y la Península Ibérica: Aspectos taxonómicos y zoogeográficos. *Cahiers de Biologie Marine*, 32: 503-543.

MUUS, K., 1973. Settling, growth and mortality of young bivalves in the Øresund. *Ophelia*, 12: 79-116.

NICKLÈS, M., 1950. *Mollusques testacés marins de la côte occidentale d'Afrique*. Lechevalier, París. 269 pp.

NICKLÈS, M., 1955. Scaphopodes et Lamellibranches récoltés dans l'Ouest Africain. *Atlantide report*, 3: 93-230.

OLIVER, P. G. AND COSEL, R. VON, 1993. Taxonomy of tropical West African Bivalves: IV Arcidae. *Bulletin du Muséum National d'Histoire Naturelle* (4e sér) 14, section A (2): 293-381.

ORTEA, J., 1977. Moluscos marinos Gasterópodos y Bivalvos del litoral asturiano entre Ribadesella y Ribadeo, con especial atención a la subclase de los Opistobranquios. *Tesis Doctoral, Universidad de Oviedo*, 581 pp.

PALLARY, P., 1907. Sur l'extension de la faune equatoriale du nord-ouest de l'Afrique et reflexions sur la faune conchyliologique de la Mediterranée. *Bulletin Scientifique de la France et de la Belgique*, 16: 421-425.

PASTEUR-HUMBERT, C., 1962 a. Les mollusques marins testacés du Maroc. Les Gastéropodes. *Travaux de l'Institut Scientifique Chérifien*, série Zoologie nº 23. 245 pp.

PASTEUR-HUMBERT, C., 1962 b. Les mollusques marins testacés du Maroc. Les Lamellibranches et les Scaphopodes. *Travaux de l'Institut Scientifique Chérifien*, série Zoologie nº 28. 184 pp.

PÉRÈS, J. M. AND PICARD, J., 1964. Nouveau manuel de Bionomie benthique de la Mer Méditerranée. *Recueil des Travaux de la Station Marine d'Endoume*, 31: 1-137.

REAL, R. AND VARGAS, J. M., 1996. The Probabilistic Basis of Jaccard's Index of Similarity. *Systematic Biology*, 45 (3): 380-385.

REY, J. C., 1983. El paso del atún rojo, *Thunnus thynnus* (Linnaeus, 1758), a traves del Estrecho de Gibraltar y su relación con la hidrología. Esquemas de migración. *Boletín del Instituto Español de Oceanografía*, 1: 85-94.

RUEDA, J. AND SALAS, C., 1998. *Modiolus lulat* (Dautzenberg, 1891): A Tropical West African bivalve recorded from South European coasts. *Journal of Conchology*, 36: 80.

SABELLI, B., GIANNUZZI-SAVELLI, R. AND BEDULLI, D., 1990. *Catalogo annotato dei Molluschi Marini del Mediterraneo*. Edizioni Libreria Naturalistica Bolognese. Vol. 1. 781 pp.

SALAS, C., 1984. Contribución al conocimiento de los moluscos macrobentónicos infralitorales (en especial bivalvos) de la bahía de Málaga. *Tesis Doctoral. Universidad de Málaga*. 526 pp.

SALAS, C., 1994. *Notolimea clandestina* a new species of neotenous bivalve (Bivalvia: Limidae) endemic to the Strait of Gibraltar. *Journal of Molluscan Studies*, 60: 249-254.

SALAS, C., 1996. Marine bivalves from off the Southern Iberian Peninsula collected by the Balgim and Fauna 1 expeditions. *Haliotis*, 25: 33-100.

SÁNCHEZ MATA, A., MORA, J., GARMENDIA, J. M. AND LASTRA, M., 1993. Estructura trófica del macrozoobenthos submareal de la ría de Ares y Betanzos. I: Composición y distribución. *Publicación Especial del Instituto Español de Oceanografía*, 11: 33-40.

SEOANE-CAMBA, J., 1965. Estudios sobre las algas bentónicas en la costa sur de la Península Ibérica (litoral de Cádiz). *Investigación Pesquera*, 29: 3-216.

SPADA, G. AND MALDONADO, A., 1974. Nota preliminare sulle specie di molluschi a diffusione prevalentemente Atlantica e presenti anche in Mediterraneo nel Mare di Alboran. *Quaderni della Civica Stazione Idrobiologica di Milano*, 5: 51-69.

SPADA, G., SABELLI, B. AND MORANDI, V., 1973. Contributo alla conoscenza della malacofauna marina dell'isola di Lampedusa. *Conchiglie*, 9: 29-67.

TEBBLE, N., 1966. *British Bivalve Seashells.* Royal Scottish Museum-BMNH. 212 pp.

TEMPLADO, J., GUERRA, A., BEDOYA, J., MORENO, D., REMON, J. M., MALDONADO, M. AND RAMOS, M. A. 1993. *Fauna marina circalitoral del sur de la Península Ibérica.* Resultados de la campaña oceanográfica "Fauna I". MNCN-CSIC. 160 pp.

THORSON, G., 1965. The distribution of benthic marine mollusca along the NE shelf from Gibraltar to Murmansk. *Proceedings of the first European Malacological congress* (1962): 5 - 23.

TRONCOSO, J. S., URGORRI, V. AND OLABARRÍA, C., 1996. Estructura trófica de los moluscos de sustratos duros infralitorales de la Ría de Ares y Betanzos (Galicia, NO España). *Iberus,* 14: 131-141.

VAN AARTSEN, J., MENKHORST, H. P. M. G. AND GITTENBERGER, E. 1984. The marine Mollusca of the bay of Algeciras, Spain, with general notes on *Mitrella, Marginellidae* and *Turridae. Basteria,* suppl. 2: 1-135

VIVES, F., SANTAMARIA, G. AND TREPAT, J., 1975. El zooplancton de los alrededores del Estrecho de Gibraltar en Junio-Julio de 1972. *Resultados de las expediciones cientificas del. B/O Cornide,* 4: 7-100.

WARÉN, A., 1992. New and little known "Skeneimorph" gastropods from the Mediterranean Sea and the adjacent Atlantic Ocean. *Bollettino Malacologico,* 27: 149-247.

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Rhopalomenia aglaopheniae (Kowalevsky y Marion, 1887) (Mollusca, Solenogastres, Rhopalomeniidae), presente en la costa norte de la Península Ibérica [1]

Rhopalomenia aglaopheniae (Kowalevsky and Marion, 1887) (Mollusca, Solenogastres, Rhopalomeniidae), present in the north coast of Iberian Peninsula

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RESUMEN

En la actualidad, dentro del proyecto FAUNA IBERICA, se está realizando el estudio de los solenogastros de las costas ibéricas. En este trabajo se describe una especie casi desconocida para las aguas ibéricas, *Rhopalomenia aglaopheniae* (Kowalevsky y Marion, 1887), que solo había sido mencionada para aguas peninsulares en el Cap de Creus por Pruvot en 1891.

ABSTRACT

A study on the solenogastres of the Iberian coast is currently underway within the project FAUNA IBERICA. This paper offers a description of a species which is practically unknown in Iberian waters, *Rhopalomenia aglaopheniae* (Kowalevsky and Marion, 1887), and which has only been cited in the waters of the Iberian Peninsula on the Cap de Creus by Pruvot in 1891.

PALABRAS CLAVE: *Rhopalomenia algaopheniae*, Mollusca, Solenogastres, Península Ibérica.
KEY WORDS: *Rhopalomenia algaopheniae*, Mollusca, Solenogastres, Iberian Peninsula.

INTRODUCCIÓN

Aunque los Moluscos Solenogastros no constituyen un grupo zoológico raro, ya que su presencia se extiende por todos los fondos marinos, desde la costa hasta las grandes profundidades, sí son una clase poco conocida. Las informaciones sobre su biología son escasas y los datos sobre su diversidad y biogeografía son aún pobres y sobre todo desiguales. Esto se pone de manifiesto en las aguas europeas, donde las costas de la Península Ibérica muestran un vacío muy notable en el conocimiento de esta fauna (SALVINI-PLAWEN, 1997).

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Figura 1. Localización de la estación de recolección.
Figure 1. Map showing the location of the sampling station.

Fruto de las investigaciones, que, dentro del proyecto FAUNA IBÉRICA, se vienen realizando en el Atlántico y Mediterráneo peninsulares, se recogió en las costas cantábricas españolas el solenogastro *Rhopalomenia aglaopheniae* (Kowalevsky y Marion, 1887). Esta es una especie ampliamente distribuida tanto en el Mediterráneo, donde se conoce del Sur de Grecia, Golfo de Nápoles y Golfo de León (KOWALEVSKY Y MARION, 1887; MALUQUER, 1917; NIERSTRASZ Y STORK, 1940; PRUVOT, 1891; SALVINI-PLAWEN, 1972, 1997), como en el Atlántico, donde existen varias citas en las costas británica e irlandesa, así como de Roscoff (GARSTANG, 1896; JONES, 1956; JONES Y BAXTER, 1987; SALVINI-PLAWEN, 1997; SEAWARD, 1992). En cambio, a excepción de la única cita de PRUVOT (1891) en Cap de Creus, la Península Ibérica es una laguna de conocimiento en cuanto a la distribución europea de esta especie.

Por todo ello, nos parece de interés acompañar esta nueva localización de *Rhopalomenia aglaopheniae*, con una descripción de los principales caracteres anatómicos de la especie, a los que se acompaña la reconstrucción de su organización interna anterior y posterior, así como de fotografías y dibujos del animal, de algunos cortes y de sus tipos espiculares.

MATERIAL Y MÉTODOS

El ejemplar estudiado procede de la Estación 165-A de la campaña de muestreo FAUNA II, realizada en junio de 1991, a profundidades entre 30 y 1000 m., en las costas del N y NW de la Península Ibérica, desde la zona oriental de Guipúzcoa hasta las Islas Cíes, incluyendo el Banco de Galicia. La Estación 165-A se localiza al oeste del Cabo Peñas, norte de España (Fig. 1) (43° 43′ 18″ N - 43° 43′ 46″ N; 05° 55′ 51″ O - 05° 56′ 37″ O) en un fondo de roca y piedras a una profundidad de 122-124 m. El ejemplar tenía unas dimensiones de 12,2 mm de largo por 1,1 mm de ancho y se conserva seccionado en cortes seriados.

El ejemplar fue fijado y conservado en alcohol al 70%. Se separaron pequeños trozos de cutícula de la parte media del cuerpo y del surco ventral, para obtener una representación de los dis-

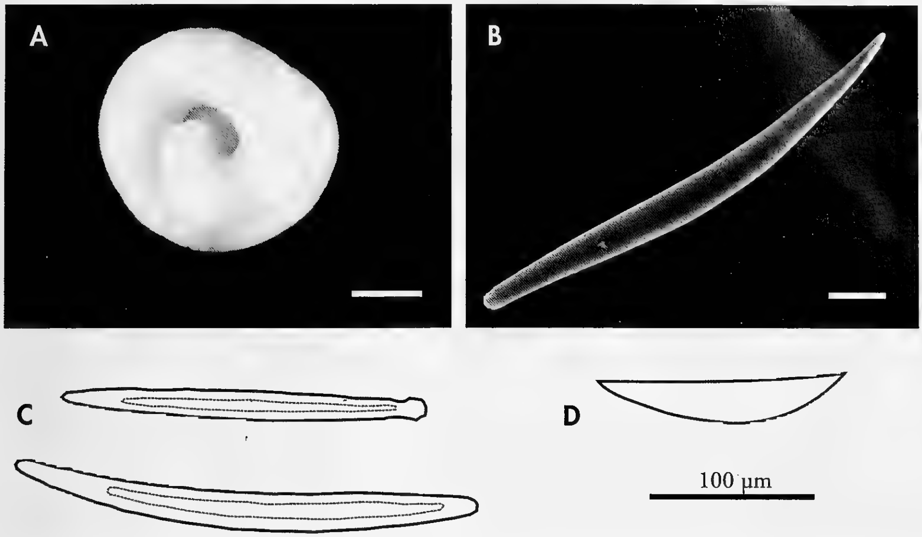

Figura 2. A: fotografía de *Rhopalomenia aglaopheniae* (Kowalevsky y Marion, 1887); B: microfotografía de una espícula acicular; C: espículas aciculares; D: espícula del surco pedio.
Figure 2. A: photograph of Rhopalomenia aglaopheniae *(Kowalevsky and Marion, 1887); B: microphotograph of acicular spicules; C: acicular spicules; D: spicules alongside the pedal groove.*

tintos tipos espiculares. Estas piezas se trataron con hipoclorito sódico al 5% durante 12 horas para el aislamiento de las espículas; posteriormente se lavaron en agua destilada, se secaron en una estufa a 40 °C y se montaron con resina sintética. Para el estudio anatómico, los ejemplares fueron descalcificados en una solución de EDTA durante 12 horas, se cortaron en parafina en series transversales de 10 μm de sección. Se tiñó en Azan de Heidenhain y se realizó la reconstrucción anatómica a partir de los cortes seriados.

RESULTADOS

Orden CAVIBELONIA Salvini-Plawen, 1978
Familia RHOPALOMENIIDAE Salvini-Plawen, 1978
Género *Rhopalomenia* Simroth, 1893

Rhopalomenia aglaopheniae (Kowalevsky y Marion, 1887)

Proneomenia aglaopheniae Kowalevsky y Marion, 1887 (denominación original), *Rhopalomenia eisigi* Thiele, 1894.

Descripción

Habitus: Animal muy enrollado sobre sí mismo, con el cuerpo liso, sin abultamientos (Fig. 2 A). Surco ventral bien visible. Color en alcohol amarillo.

Manto: Cutícula de 100 a 140 μm de grosor, con papilas pedunculadas y con el extremo distal grueso. Las espículas se disponen en varias capas estrechamente entrelazadas. Son huecas, de

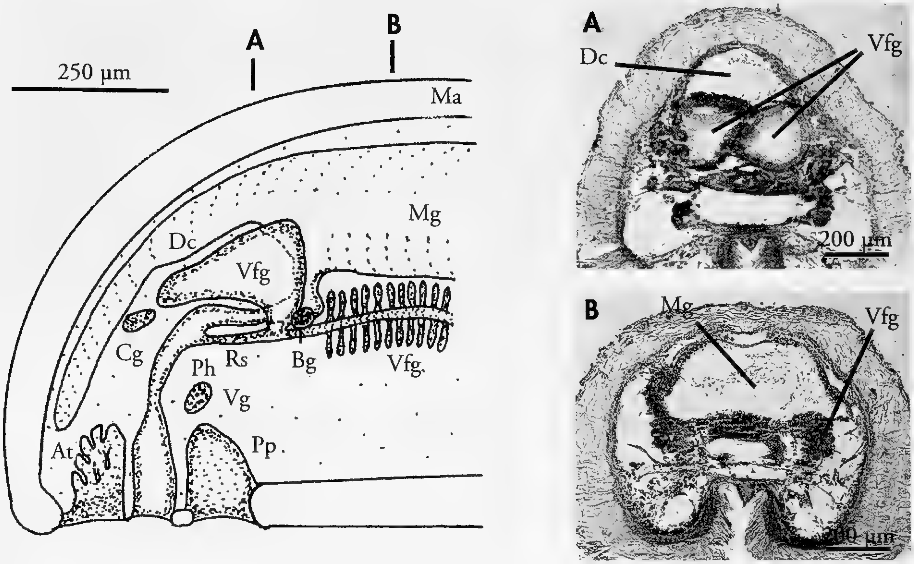

Figura 3. Organización esquemática de la parte anterior del cuerpo de *Rhopalomenia aglaopheniae* (Kowalevsky y Marion, 1887). At: órgano sensitivo atrial; Bg: ganglio bucal; Cg: ganglio cerebral; Dc: ciego dorsal; Ma: manto; Mg: intestino; Ph: faringe; Pp: foseta pedia; Rs: saco radular; Vfg: órgano glandular ventral de la faringe; Vg: ganglio ventral; A, B: cortes en sección correspondientes a las líneas A, B.

Figure 3. Schematic organizaltion of the anterior body of Rhopalomenia aglaopheniae *(Kowalevsky and Marion, 1887). At: atrial sense organ; Bg: buccal ganglion; Cg: cerebral ganglion; Dc: dorsal caecum; Ma: mantle; Mg: midgut; Ph: pharynx; Pp: pedal pit; Rs: radular sac; Vfg: ventral foregut glandular organ; Vg: ventral ganglion; A, B: cross-section corresponding to lines A, B.*

forma acicular, de hasta 150 μm de longitud, levemente arqueadas, más anchas en su parte central y con los extremos romos (Fig. 2B, C). En el surco ventral se sitúan escamas con forma de hoja de cuchillo de hasta 75 μm de longitud (Fig. 2D).

Surco pedio: Comienza en una foseta ciliada (Fig. 3), situada debajo de la faringe, que se comunica con el exterior por una estrecha abertura. En el surco pedio se encuentra un pliegue ciliado que entra en la cavidad paleal.

Cavidad paleal: La cavidad paleal es pequeña, no tiene pliegues respiratorios y se comunica con el exterior por una pequeña abertura ventro-terminal. El conducto de desove desemboca, a través de un orificio genital impar, en la parte rostro-central de la cavidad paleal. Dorsalmente al mismo se sitúa el ano. No presenta ni espículas abdominales, ni espículas copulatrices (Fig. 4).

Organos de los sentidos: El atrio presenta en sus paredes frontal y laterales numerosas papilas pequeñas e individualizadas (Fig. 3). Dorsalmente tiene dos pliegues ciliados que continúan hasta la parte posterior del atrio. Posee un solo órgano dorsoterminal, situado en posición terminal, en el extremo posterior del cuerpo (Fig. 4).

Aparato digestivo: La cavidad bucal está separada del atrio por un pliegue, continuándose en una faringe estrecha y larga, que presenta ventralmente un saco radular. No tiene rádula. En el saco radular (Fig. 3) desemboca lateralmente el par de órganos glandulares de la faringe. Estos órganos glandulares, en

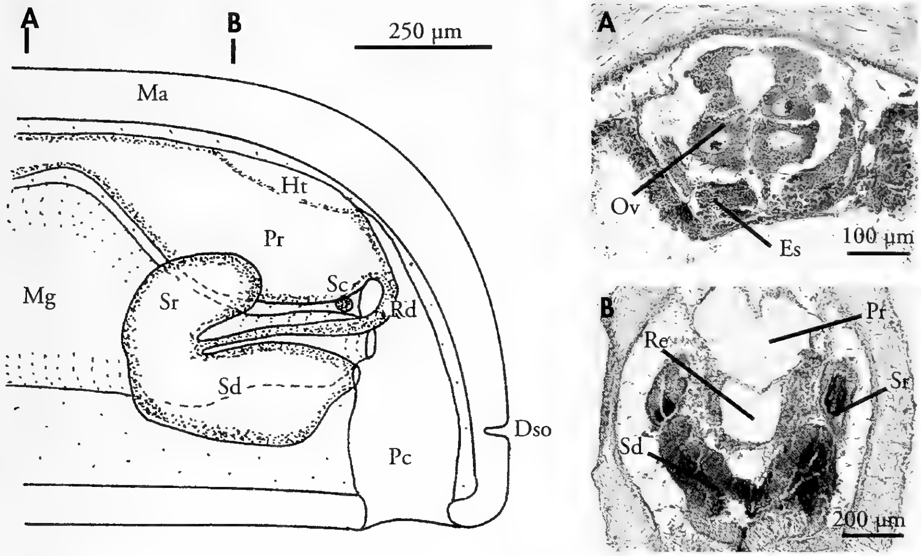

Figura 4. Organización esquemática de la parte posterior del cuerpo de *Rhopalomenia aglaopheniae* (Kowalevsky y Marion, 1887). Dso: órgano sensitivo dorsoterminal; Es: espermatozoides; Ht: corazón; ; Ma: manto; Mg: intestino; Ov: óvulos; Pc: cavidad paleal; Pd: pericardioducto; Pr: pericardio; Re: recto; Sc: comisura suprarrectal; Sd: conducto de desove; Sr: receptáculo seminal; A, B: cortes en sección correspondientes a las líneas A, B.

Figure 4. Schematic organization of the posterior body of Rhopalomenia aglaopheniae *(Kowalevsky and Marion, 1887). Dso: dorsoterminal sense organ; Es: sperm; Ht: heart; Ma: mantle; Mg: midgut; Ov: eggs; Pc: pallial cavity; Pd: pericardioduct; Pr: pericardium; Re: rectum; Sc: supra-rectal commissure; Sd: spawning duct; Sr: seminal receptacle; A, B: cross-section corresponding to lines A, B.*

su parte posterior, pertenecen al tipo A (SALVINI-PLAWEN, 1978), ya que están formados por un conducto muy largo en el que se abren los folículos glandulares subepiteliales, discurriendo ventralmente al intestino medio hasta la mitad del cuerpo (Fig. 3, 3B); mientras que en la parte anterior, cada órgano glandular de la faringe, es del tipo C (SALVINI-PLAWEN, 1978) con forma de una burbuja de gran tamaño (Fig. 3, 3A). Este par de burbujas se sitúan ventralmente al ciego rostral del intestino medio y latero-dorsalmente a la faringe. La faringe continúa durante un trecho hasta desembocar por su parte dorsal en el intestino medio. En esta misma zona del intestino medio, parte rostralmente un ciego dorsal, que llega hasta la parte anterior del cuerpo (Fig. 3, 3A). El intestino medio presenta en toda su longitud numerosos constricciones seriadas en sus paredes laterales y ventral. El recto discurre bajo el pericardio (Fig. 4B) y se abre en el ano, que desemboca dorsalmente en la parte rostral de la cavidad paleal (Fig. 4).

Sistema nervioso: El ganglio cerebral es aplanado dorso-ventralmente, estando situado ventralmente al ciego rostral del intestino medio y dorsalmente a la cavidad bucal (Fig. 3). El par de ganglios ventrales se encuentran dorsalmente a la foseta pedia, y a ambos lados del saco radular están el par de ganglios bucales (Fig. 3). En la parte terminal del cuerpo, cerca del ano, está la comisura suprarrectal (150 μm de longitud) (Fig. 4).

Aparato circulatorio: El corazón, situado en la pared dorsal del pericardio, tiene forma tubular (Fig. 3). Las células sanguíneas son de dos tipos: granulocitos redondeados con un diámetro de 7,5 μm, y eritrocitos alargados y sin gránulos de hasta 20 μm de longitud.

Aparato reproductor: El par de gónadas se extienden sobre el intestino medio. El ejemplar examinado las presentaba llenas de óvulos y espermatozoides (Fig. 4A). Las gónadas se unen con el pericardio a través de un par de gonopericardioductos. El pericardio es voluminoso (Fig. 4B), posteriormente se continúa en dos pericardioductos, que se curvan y se dirigen anteriormente hasta unirse con los conductos de desove (Fig. 4). Posee un par de receptáculos seminales situados dorsalmente a los conductos de desove (Fig. 4, 4B), que se encontraban llenos de espermatozoides. Estos receptáculos no parecen ser órganos particulares, sinó que cada uno es solamente una parte encorvada del conducto de desove (SALVINI-PLAWEN, 1972). Los dos conductos de desove tienen las paredes glandulares (Fig. 4B) y se fusionan en un único conducto, que desemboca impar, ventralmente en la pared rostral de la cavidad paleal (Fig. 4).

Distribución: Sur del Peloponeso (fuera del cabo Matapan/Tainaron) (Grecia) (SALVINI-PLAWEN, 1972, 1997); Golfo de Nápoles (Italia), asociada al hidroideo *Lytocarpia myriophyllum*, a 50-60 m de profundidad (NIERSTRASZ Y STORK, 1940); Marsella (Francia), en fondos rocosos, asociada al hidroideo *Lytocarpia myriophyllum*, a 50-60 m de profundidad (KOWALEVSKY Y MARION, 1887); Banyuls (Francia), en fondos limosos, asociada al hidroideo *Lytocarpia myriophyllum*, a 60-80 m de profundidad (PRUVOT, 1891); costa del Rosellón (Francia), sobre *Lytocarpia myriophyllum*, a 60-80 m de profundidad (MALUQUER, 1917); Isla Portaló (Cap de Creus, España), sobre *Lytocarpia myriophyllum*, a 80 m de profundidad (PRUVOT, 1891); Roscoff (Francia) (SALVINI-PLAWEN, 1997); Plymouth (Gran Bretaña), asociada al hidroideo *Lytocarpia myriophyllum*, a 47-57 m de profundidad (GARSTANG, 1896); Isla de Man (Gran Bretaña), en fondos de arena fangosa, a 58-71 m de profundidad (JONES, 1956); costas este y oeste de Gran Bretaña, asociada al hidroideo *Lytocarpia (Theocarpus) myriophyllum*, a 50 m o más de profundidad (JONES Y BAXTER, 1987); costas este y oeste de Gran Bretaña, Mar de Irlanda y costas norte y sur de Irlanda (SEAWARD, 1992); Liberia (Africa), a 70 m de profundidad (THIELE, 1906), aunque es una cita que necesita un nuevo examen y confirmación (SALVINI-PLAWEN, 1997).

DISCUSIÓN

El ejemplar estudiado pertenece al orden Cavibelonia por sus espículas aciculares huecas, dispuestas en varias capas dentro de una cutícula gruesa con papilas epidérmicas. Se clasifica dentro de la familia Rhopalomeniidae, por sus órganos glandulares ventrales de la faringe subepiteliales de tipo A, ausencia de rádula y de pliegues respiratorios en la cavidad paleal. Las características genéricas que lo sitúan dentro de *Rhopalomenia* están bien definidas en este ejemplar: la cavidad bucal está separada del atrio, la desembocadura del conducto de desove es impar, presenta un órgano sensitivo dorsoterminal y carece de espículas copulatrices (SALVINI-PLAWEN, 1967, 1978).

Esta especie, además de su descripción original de KOWALEVSKY Y MARION (1887), fue redescrita por NIERSTRASZ Y STORK (1940) y posteriormente SALVINI-PLAWEN (1978) ofrece, en una tabla comparativa con las especies antárticas del género, el conjunto de caracteres específicos más significativos. En nuestro ejemplar se pueden observar todos los rasgos que lo identifican como *Rhopalomenia aglaopheniae* (Kowalevsky y Marion, 1887), únicamente no hemos encontrado el botón sensitivo anterior descrito por KOWALEVSKY Y MARION (1887).

Rhopalomenia aglaopheniae (Kowalevsky y Marion, 1887), presenta una distribución, que va desde el Mediterráneo oriental hasta las costas atlánticas europeas, asociada al hidroideo *Lytocarpia myriophyllum,* a una profundidad de 47-137 m (SALVINI-PLAWEN, 1990, 1997). El ejemplar aquí estudiado fue recogido al oeste del Cabo Peñas (Golfo de Vizcaya, norte de España) a una profundidad de 122-124 m. Esta especie sólo había sido señalada anteriormente en aguas de la Península Ibérica en las costas españolas mediterráneas en el Cap de Creus (PRUVOT, 1891), por lo que esta cita representa la primera en las costas atlánticas ibéricas.

Del género *Rhopalomenia* Simroth, 1893, además de *Rhopalomenia aglaopheniae,* se conocen en la actualidad otras 6 especies. Cinco de ellas son antárticas y con un conjunto de caracteres específicos bien diferenciados de *Rhopalomenia aglaopheniae* (Tabla 4, pág. 159 en SALVINI-PLAWEN, 1978). La única especie del género, próxima al entorno biogeográfico de *Rhopalomenia aglopheniae,* es *Rhopalomenia atlantica* (Leloup, 1948). Fue recogida en aguas de Tenerife (Islas Canarias), a una profundidad de 540 m, asociada a hidroideos de la Familia Lafoeidae. Se diferencia de *Rhopalomenia aglaopheniae* fundamentalmente porque tiene los órganos glandulares de la faringe muy cortos y sólo de tipo A, no presenta saco radular y la faringe es muy corta (LELOUP, 1948; SALVINI-PLAWEN, 1972, 1978).

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BIBLIOGRAFÍA

GARSTANG, W., 1896. On the Aplacophorous Amphineura of the British Isles. *Proc. Malacol. Soc. London,* 2: 123-125.

KOWALEVSKY, A. Y MARION, A., 1887. Contributions à l'histoire des solénogastres ou aplacophores. *Ann. Mus. Hist. nat. Marseille, Zool.,* 3 (1): 1-77.

JONES, N.S., 1956. The fauna and biomass of muddy sand deposit off port Erin, Isle of Man. *J. Anim. Ecol.,* 25: 217-252.

JONES, A.M. Y BAXTER, J.M., 1987. *Mollusca: Caudofoveata, Solenogastros, Polyplacophora and Scaphopoda.* Synopses of the British Fauna, 37: 1-37

LELOUP, E., 1948. Un nouveau solénogastre pronéoméniidae, *Entonomenia atlantica* g. nov., sp. nov. *Bull. Mus. Roy. Hist. Natur. Belgique,* 24 (37): 1-11.

MALUQUER, J., 1917. Notes para l'estudi dels Solenogastros (Mollusca anfineures) de Catalunya. *Treballs Inst. catal. Hist. nat. (Barcelona),* 3: 9-53.

NIERSTRASZ, H.F. Y STORK, H.A., 1940. Monographie der Solenogastren des Golfes von Neapel. *Zoologica (Stuttgart),* 99: 1-92.

PRUVOT, G., 1891. Sur l'organisation de quelques néomeniens des côtes de France. *Arch. Zool. Exptl. Gén., sr. 2,* 9: 699-810.

SALVINI-PLAWEN, L.V., 1967. Kritische Bemerkungen zum System der Solenogastres (Mollusca, Aculifera). *Zeitschr. zool. Syst. Evolut.-forsch.,* 5 (4): 398-444.

SALVINI-PLAWEN, L.V., 1972. Revision der monegassischen Solenosgastres (Mollusca, Aculifera). *Zeitschr. zool. Syst. Evolut.-forsch.,* 10 (3): 215-250.

SALVINI-PLAWEN, L.V., 1978. Antarktische und subantarktische Solenogastres. Eine Monographie: 1898-1974. *Zoologica (Stuttgart),* 128: 1-315.

SALVINI-PLAWEN, L.V., 1990. The status of the Caudofoveata and the Solenogastres in the Mediterranean Sea. *Lavori S.I.M. Napoli,* 23: 5-30.

SALVINI-PLAWEN, L.V., 1997. Fragmented knowledge on West-European and Iberian Caudofoveata and Solenogastros. *Iberus,* 15 (2): 35-50.

SEAWARD, D.R., 1992. *Distribution of the marine molluscs of north west Europe.* Nature Conservancy Council, Peterborough, 1- 105.

THIELE, J., 1906. *Archaeomenia prisca* n. g. n. sp. *Wissensch Ergebnisse Dtsch. Tiefsee Exped. Valdivia, 1898/99,* 9: 317-324.

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***Dendrodoris limbata* (Cuvier, 1804)**
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Doris nigricans Otto, 1823, *Nov. Act. Ac. Caes. Leop. Car.*, 10: 275.

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Ponder, W. F., 1988. The Truncatelloidean (= Rissoacean) radiation - a preliminary phylogeny. En Ponder, W. F. (Ed.): Prosobranch Phylogeny, *Malacological Review*, suppl. 4: 129-166.

Ros, J., 1976. Catálogo provisional de los Opistobranquios (Gastropoda: Euthyneura) de las costas ibéricas. *Miscelánea Zoolgica*, 3 (5): 21-51.

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Synonyms
Doris limbata Cuvier, 1804, *Ann. Mus. H. N. Paris*, 4 (24): 468-469 [Type locality: Marseille].
Doris nigricans Otto, 1823, *Nov. Act. Ac. Caes. Leop. Car.*, 10: 275.

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PORTADA DE *Iberus*

Iberus gualterianus (Linnaeus, 1758), una especie emblemática de la península Ibérica, que da nombre a la revista. Dibujo realizado por José Luis González Rebollar "Toza".

Iberus

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Nuevos datos anatómicos y taxonómicos del género *Chiton* Linnaeus, 1758 (Mollusca, Polyplacophora) en la Península Ibérica

New anatomical and taxonomical data on the Genus *Chiton* Linnaeus, 1758 (Mollusca, Polyplacophora) from the Iberian Peninsula

Pilar CARMONA ZALVIDE*, Francisco J. GARCÍA* y Victoriano URGORRI **

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RESUMEN

Se presentan aspectos relacionados con la morfología y taxonomía de las especies del género *Chiton* Linnaeus, 1758 en la Península Ibérica. Para cada una de las especies estudiadas, *Ch. olivaceus* Spengler, 1797, *Ch. corallinus* (Risso, 1826) y *Ch. phaseolinus* Monterosato, 1879, se aportan datos sobre la concha, perinoto y rádula. Finalmente se realiza una discusión sobre la sistemática de este género y otros relacionados con él, y se acepta que *Rhyssoplax* Thiele, 1893 constituye un subgénero de *Chiton*.

ABSTRACT

Aspects related to the morphology and taxonomy of the species belonging to the genus *Chiton* Linnaeus, 1758 in Iberian Peninsula are presented. Anatomical data of the shell, perinotum and radula of *Ch. olivaceus* Spengler, 1797, *Ch. corallinus* (Risso, 1826) and *Ch. phaseolinus* Monterosato, 1879 are included. A systematic discussion on the genus *Chiton* and other related genera is included. *Rhyssoplax* Thiele, 1893 is proposed as a subgenus of *Chiton*.

PALABRAS CLAVES: Mollusca, Polyplacophora, Taxonomía, Anatomía, *Chiton (Rhyssoplax) olivaceus, Chiton (Rhyssoplax) corallinus, Chiton (Rhyssoplax) phaseolinus.*

KEY WORDS: Mollusca, Polyplacophora, Taxonomy, Anatomy, *Chiton (Rhyssoplax) olivaceus, Chiton (Rhyssoplax) corallinus, Chiton (Rhyssoplax) phaseolinus*

INTRODUCCIÓN

El género *Chiton* Linnaeus, 1758 ha ocasionado controversias taxonómicas debido a que ciertos autores no aceptan las posiciones subgenéricas y las admiten como géneros. No obstante desde su descripción, se han establecido

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diferentes subgéneros en éste. PILSBRY (1892) consideró en el género *Chiton* las secciones *Chiton s. s.*, *Radsia* Gray, 1847 y *Sclerochiton* Carpenter 1873.

THIELE (1893), asimismo, describe nuevos subgéneros y secciones para *Chiton*: *Amaurochiton, Chondroplax, Sypharochiton, Triloplax,* y *Anthochiton*. IREDALE Y HULL (1926) no admiten los subgéneros para *Chiton* y consideran que las diferencias que presentan los distintos grupos justificarían su posición como géneros independientes e incluso aportan los siguientes géneros nuevos: *Delicatoplax, Tegulaplax, Mucroquasma,* a la vez que mantienen a los géneros *Rhyssoplax* Thiele, 1893, *Clavarizona* Hull, 1923, *Amaurochiton, Sypharochiton, Liolophura* Pilsbry, 1892, *Amphitomura* Pilsbry, 1892, *Acantopleura* Guilding, 1829, *Onithochiton* Gray, 1847, *Lucilina* Dall, 1882 y *Schizochiton* Gray, 1847.

Posteriormente, THIELE (1929) desarrolla una nueva clasificación, en la que admite subgéneros y secciones, de manera que en el género *Chiton* establece los subgéneros: *Chiton* y *Rhyssoplax*. En el primero incluye las secciones: *Chiton s. s., Amaurochiton, Diochiton, Chondroplax, Radsia* y *Sypharochiton;* y en *Rhyssoplax* las secciones: *Anthochiton, Delicatoplax, Tegulaplax, Rhyssoplax s. s.* y *Mucroquasma*.

En el presente trabajo se ha realizado un estudio anatómico de las especies de *Chiton (Rhyssoplax)* que se distribuyen en la Península Ibérica, *Chiton (Rhyssoplax) olivaceus* Spengler, 1797, *Chiton (Rhyssoplax) corallinus* (Risso, 1826) y *Chiton (Rhyssoplax) phaseolinus* Monterosato, 1879. Así mismo, se ha discutido la categoría taxonómica de *Rhyssoplax*.

MATERIAL Y MÉTODOS

Los ejemplares estudiados se han recolectado desde Lisboa (Portugal) hasta Punta Europa (Gibraltar) y, a su vez, se han estudiado los ejemplares del Museo Nacional de Ciencias Naturales de Madrid (MNCN). En el apartado de material estudiado, se especifica la localidad, número de ejemplares, tamaño máximo de éstos, la fecha de la recolección y la profundidad.

El material se ha capturado de forma directa tanto en la zona mediolitoral como infralitoral, utilizándose en esta última equipos de inmersión autónomos. Los ejemplares se relajaron con cristales de mentol y se fijaron entre dos portas con etanol absoluto, conservándose posteriormente en alcohol 70%.

Para el estudio de las partes duras se introdujeron los ejemplares en KOH 10%, separándose las placas, escamas y espículas del perinoto y la rádula. La estructura de las diferentes partes se observó mediante microscopía electrónica de barrido (Philips XL-20).

RESULTADOS

Chiton (Rhyssoplax) olivaceus Spengler, 1797

Chiton olivaceus Spengler, 1797, *Skrivt. Naturh. Selsk.*, 4: 73, pl 6 f 8a-c. [Localidad tipo: Mar Mediterráneo].
Chiton squamosus Poli 1791 no Linneo 1764, *Test. Utr. Sicil.*, 1: 8, pl 3 figs. 21, 22 [Localidad tipo: Sicilia]
Chiton sulcatus Risso 1826, *Hist. Nat, Eur. Mérd.*, 4: 268 [Localidad tipo: Niza]
Chiton siculus Gray 1828, Spicil. Zool., 1: 5 [Localidad tipo: Mar Mediterráneo]
Chiton polii Deshayes 1833, *Exp. Sci. Morée*, 3 Moll.: 132 [Localidad tipo: Peloponeso]
Chiton subdivisus Renier en Monterosato 1879, G. Sci. nat. Econ. Palermo, 14: 7
Chiton striatus Chierghini MS, en Nardo, 1847, *Ipsa Chieregh. Conch.*: 44 [Localidad tipo: Laguna de Venecia]
Chiton estuarii Chiereghini MS, en Nardo, 1847, *Ipsa Chieregh. Conch.*: 44 [Localidad tipo: Venecia]
Chiton squammulosus Dollfus 1883, *Feuille. Jeun. Nat.*: 3. [Localidad tipo: Palavas, Hérault, Francia]

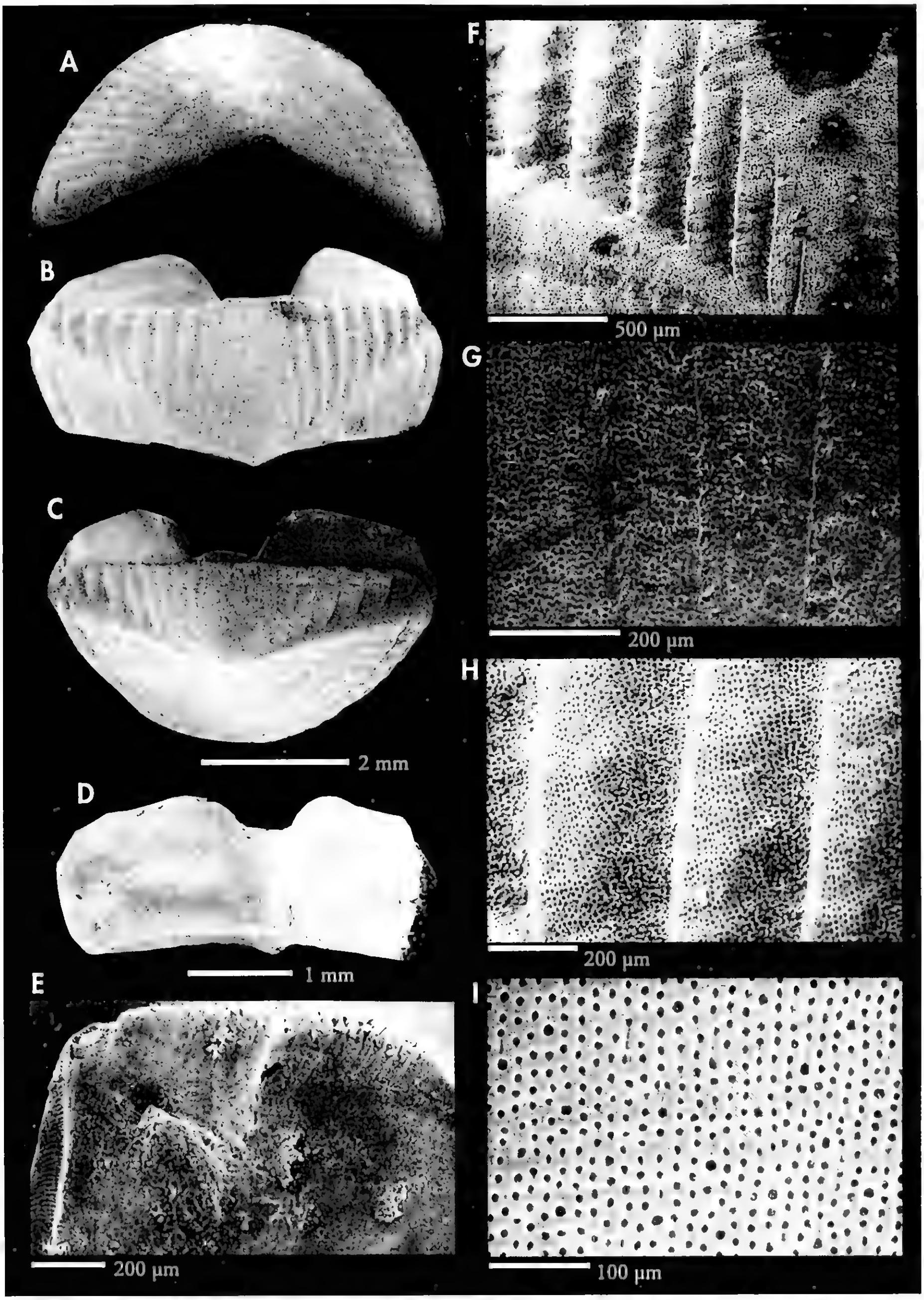

Figura 1. *Chiton (R.) olivaceus.* A: valva I; B: valva IV; C: valva VIII; D: articulamento de valva intermedia; E: dientes pectinados del articulamento; F: ornamentación del tegmento; G: costillas de la zona jugal; H: costillas de la zona pleural; I: disposición de las megaloestetas y microestetas.
Figure 1. Chiton (R.) olivaceus. *A: valve I; B: valve IV; C: valve VIII; D: articulamentum of an intermediate valve; E: pectinated teeth from articulamentum; F: ornamentation of tegmentum; G: jugal area; H: pleural area; I: disposition of megalaesthetes and micraesthetes.*

Material estudiado: El total de ejemplares estudiados ha sido de 275. Portinho de Arrabida, Portugal: 1 ej., 24 x 12 mm, IX/95 (10 m). Porto Covo, Portugal: 1 ej., 14 x 8 mm, VIII/94 (8 m). Praia do Lagos, Portugal: 2 ej., 14,5 x 6,8 mm, VIII/93 (17 m). Praia da Marinha, Portugal: 6 ej., 22,4 x 11,2 mm, VIII/88 (Intermareal). Almaçao de Pera, Portugal: 2 ej., 16, 2 x 9 mm, VIII/93 (22 m). El Arrecifillo, Conil, Cádiz: 2 ej., 17 x 10 mm, VII/92 (12 m). Isla del Tajo, Cádiz: 1 ej., 19 x 11 mm, VII/92 (8 m). Playa del Chorro, Cádiz: 5 ej., 28, 5 x 15 mm, VII/92 (Intermareal). Isla de Tarifa, Cádiz: 7 ej., 16 x 8 mm, III/91; 2 ej., 27 x 11 mm, VII/91 (Intermareal). Isla de las Palomas, Cádiz: 1 ej., 18 x 11 mm, VII/91; 1 ej., 21 x 12 mm, VIII/91; 5 ej., 25,5 x 16 mm, IX/92 (3-12m). Punta Carnero, Cádiz: 1 ej., 30 x 17 mm, V/91; 3 ej., 18 x 11 mm, VIII/91 (Intermareal). La Ballenera, Cádiz: 10 ej., 21 x 13 mm, IV/91; 1 ej., 14 x 7 mm, VII/91; 1 ej., 16,5 x 10,5 mm, VII/91; 5 ej., 19 x 10 mm, VIII/91; 8 ej., 12 x 8,2 mm, IV/92 (12 m). Punta de San García, Cádiz: 1 ej., 16 x 9 mm, VII/90; 1 ej., 10,5 x 6 mm, VII/91; 2 ej., 8 x 5 mm, VII/91; 3 ej., 16 x 8,5 mm, IX/92; 12 ej., 21 x 13 mm, IX/92 (12 m). Ensenada de Cucareo, Cádiz: 11 ej., 28,5 x 15 mm, IX/92; 10 ej., 18 x 9, 5 mm, I/93). Puerto de Algeciras, Cádiz: 2 ej., 18 x 11 mm, VII/91; 3 ej., 24 x 12 mm, VII/91; 21 ej., 18 x 11 mm, VIII/91; 2 ej., 16 x 9 mm, VII/92 (10 m). Punta de Paredones, Cádiz: 3 ej., 8 x 6 mm, VII/90; 12 ej., 22 x 13 mm, VII/91; 1 ej., 8 x 4 mm, VIII/91 (16 m). El Rinconcillo, Cádiz: 1 ej., 15 x 9 mm, VII/90; 3 ej., 12,5 x 8 mm, VII/91 (25 m). Punta del Gallo del Mirador, Cádiz: 5 ej., 9 x 4,5 mm, I/93 (3-6 m). Campamento, Cádiz: 1 ej., 17 x 10 mm, VII/90; 8 ej., 17 x 9 mm, III/91 (Intermareal). Crinavis, Cádiz: 1 ej., 15 x 9 mm, VII/90; 1 ej., 19 x 11 mm, III/91; 1 ej., 18 x 11 mm, VI/91; 5 ej., 19 x 11 mm, VII/91; 3 ej., 22 x 11 mm, VIII/91; 1 ej., 24 x 14 mm, II/92; 53 ej., 21 x 12 mm, IX/93 (33 m). San Felipe, Cádiz: 3 ej., 25 x 12 mm, VII/91; 11 ej., 17 x 11 mm, VIII/91; 1 ej., 10 6 mm, X/91 (17 m). Punta Europa, Gibraltar: 2 ej., 22 x 10 mm, VII/92 (20-25 m). MNCN: Nº 1503/138: 1 ej., 11 x 5. 5 mm, (Cabrera, Baleares) (Colección: Hidalgo). 1503/230: 1 ej., 24 x 12 mm, 12/08/84 (La Herradura, Granada) (A. Luque). 1503/356: 1 ej., 21 x 11 mm, (Cádiz) (Colección: Hidalgo). 1503/364: 3 ej., 26 x 13 mm, (Valencia) (Colección: Hidalgo). 1503/424: 5 ej., 35 x 18 mm, (Mahón, Menorca) (Colección: Hidalgo). 1503/425: 1 ej., 22 x 11 mm, (Palma) (Colección: Hidalgo). 1503/433: 2 ej., 22 x 15 mm, (Pto. Pollensa, Mallorca). 1503/434: 5 ej., 27 x 10 mm, (Mahón, Menorca) (Colección: Azpeitia, 1408). 1503/435: 5 ej., 37 x 20 mm, (Tarifa, Cádiz) (Colección: Azpeitia, 1408). 1503/436: 2 ej., 24 x 13 mm, (Valencia) (Colección: Azpeitia, 1408).

Descripción: (Figs. 1 y 2). El tamaño de los ejemplares ha variado entre 3 x 2 y 28,5 x 15 mm. El animal es ovalado, carenado y con las valvas gruesas y consistentes. Las valvas terminales y áreas laterales ofrecen una estriación radial. En la zona pleural presentan una serie de costillas longitudinales muy marcadas que disminuyen en longitud hacia la zona jugal. El tegmento de las placas está finamente granulado debido a la presencia de pequeños tubérculos, donde se sitúan las estetas. Éstas se disponen en líneas longitudinales en el área central de las placas intermedias, aunque algo distorsionadas en la zona pleural debido a la presencia de las costillas. En el área lateral y valvas terminales, las líneas se disponen radialmente. Las megaloestetas, se puede considerar que se ordenan en quincunce entre las microestetas, aunque se encuentran insertas en las mismas líneas. El diámetro medio de luz de las megaloestetas y microestetas es de 9,92 mm (σ: 1,2) y 7,08 mm (σ: 1,2) respectivamente. En una misma fila se encuentran con una separación media de 10 mm (σ: 0,84) y entre filas de 11, 8 mm (σ: 1,81).

Los aleros del articulamento ofrecen un aspecto sólido, aunque son algo esponjosos. Los robustos dientes se encuentran pectinados en el margen. Sobre el ápice se distingue el reborde del tegmento. El seno jugal es pectinado. Las láminas suturales son lisas, su aspecto varía desde triangular en las valvas II a IV, rectangular en las valvas V a VII y trapezoidal, aunque con los bordes redondeados, en la valva VIII. La fórmula de las ranuras de las líneas de inserción oscila entre 8-10/1-2/10-11. La situación más frecuente es la presencia de una sola hendidura en cada lado de las placas intermedias, aunque se han encontrado ejemplares que presentan dos, pero sólo en un lado.

El perinoto es ancho y está constituido por escamas que ofrecen un aspecto de piel de serpiente. Las escamas presentan a su vez finas y leves estriaciones en el borde anterior. El tamaño de las

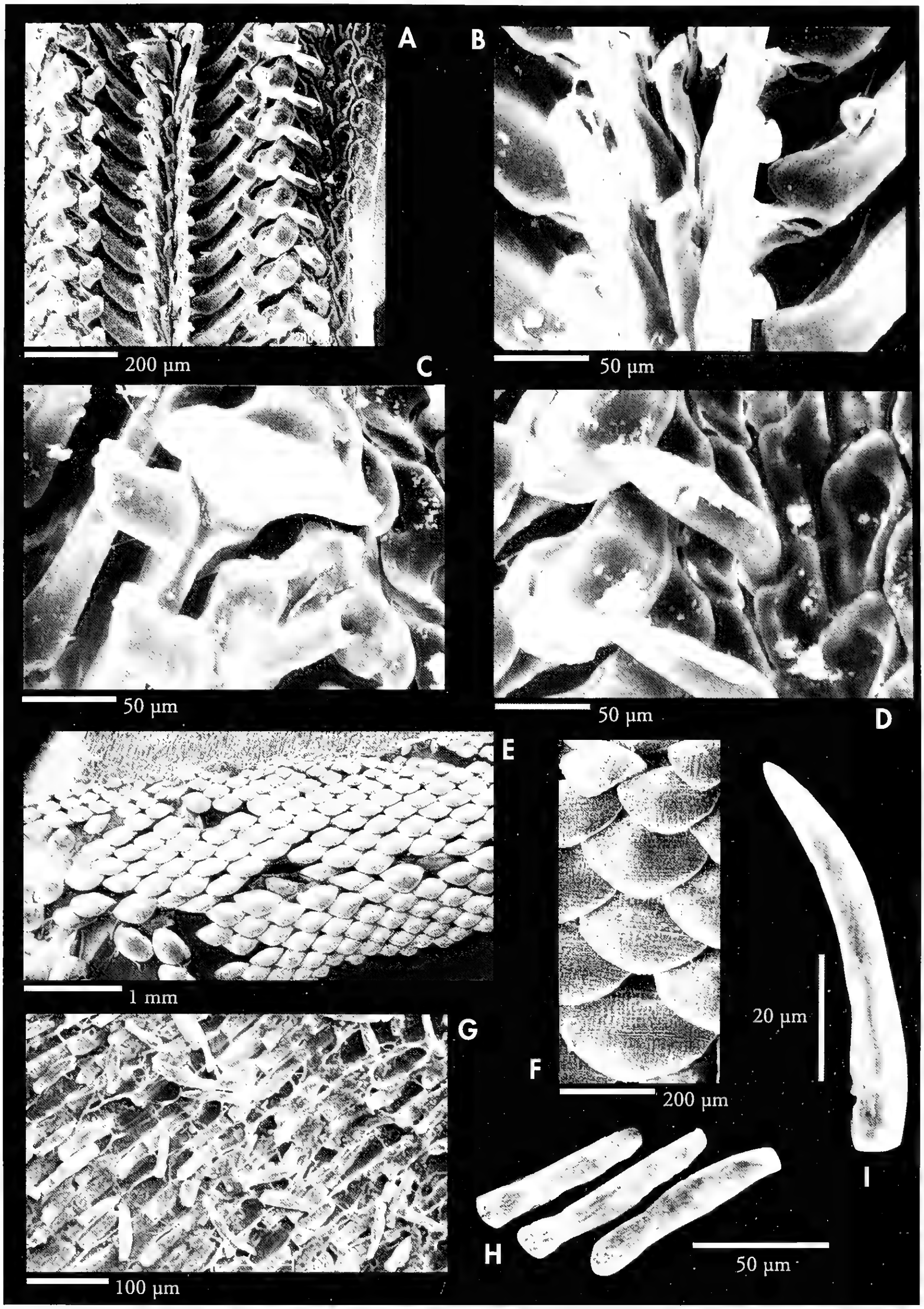

Figura 2. *Chiton (R.) olivaceus.* A: rádula; B: dientes raquídeo y primer lateral; C: placa uncinada del diente mayor lateral; D: diente espatulado; E: perinoto; F: disposición de las escamas dorsales; G: disposición de las escamas ventrales; H: escamas dorsales; I: espícula marginal.
Figure 2. Chiton (R.) olivaceus. *A: radula; B: rachidian and first lateral teeth; C: uncinal plate of the major lateral tooth; D: spatulate tooth; E: perinotum; F: disposition of dorsal scales; G: ventral scales; H: dorsal scales; I: marginal spicules.*

Tabla I. Caracteres taxonómicos de las especies de *Chiton* de la Península Ibérica
Table I. Taxonomical features of Chiton *species in the Iberian Peninsula*

	Ch. olivaceus	***Ch. corallinus***	***Ch. phaseolinus***
Tamaño máximo (mm)	28,5 x 15	16 x 10,2	7,3 x 4,1
Color	Variable	Variable	Rosados, Verdosos
Diámetro medio Megaloesteta (σ)	9,92 µm (1,2)	8, 17 µm (0,51)	7,7 µm (0,89)
Diámetro medio microestetas (σ)	7,08 µm (1,2)	8, 17 µm (0,51)	7,7 µm (0,89)
Fórmula de líneas de inserción	8-10/1-2/10-11	8-10/1-2/10-12	8-10/1/9-12
Longitud máxima de escamas dorsales	475 µm	280 µm	210 µm
Longitud máxima de escamas ventrales	120 µm	80 µm	57,5 µm
Longitud máxima de espículas marginales	125 µm	112,5 µm	70 µm
Nº de Costillas en el área pleural	4-11	3-8	2-3

escamas es variable según la región del perinoto. Próximas a las placas se localizan las de tamaño medio, aumentan hacia la zona media del perinoto, y próximas a la zona marginal se encuentran las más pequeñas. En un mismo ejemplar (de 14 mm), varía desde la zona dorsal, media y próxima a la marginal entre 105, 433 y 210 μm respectivamente. El tamaño máximo de escama encontrado entre los ejemplares estudiados, ha sido de 475 μm de ancho y 230 μm de altura. Las escamas ventrales son más pequeñas que las dorsales, generalmente presentan forma rectangular, aunque existen variaciones, de modo que pueden aparecer algo curvadas, con un extremo más estrecho, con bordes muy redondeados, etc. El tamaño oscila entre 63 x 20 y 120 x 25 μm en los distintos individuos observados. En un mismo ejemplar el rango de variación es menor, aproximadamente entre 10 y 15 μm. En la zona marginal presenta espículas cónicas curvadas. El tamaño oscila en los distintos individuos entre 65 x 25 μm y 125 x 30 μm. En un mismo ejemplar la máxima diferencia de tamaño que se ha encontrado ha sido de 20 μm.

El diente central de la rádula es alargado y bastante estrecho con el borde flexible muy marcado, de manera que ofrece forma de "bastón". El primer lateral, algo más ancho y largo que el central, presenta una prominencia redondeada en la parte terminal del diente. El diente mayor marginal, exhibe una protuberancia con forma de aleta en la base de la placa uncinada. Ésta se caracteriza, por no presentar cúspide.

En la Tabla I se especifican las características de la especie.

Chiton (Rhyssoplax) corallinus (Risso, 1826)

Lepidopleurus corallinus Risso, 1826, *Hist. Nat. Eur. Mérid.*, 4: 268. [Localidad tipo: Nizza]
Chiton rubicundus Costa 1829, *Cat. Sist. Test. Sicil.*: i, iii, pl 1 f. 3 [Localidad tipo: Sicilia]
Chiton pulchellus Philippi 1844 no Gray 1828, *Enum. Moll. Sicil.* 2: 83, pl 19 f. 14 [Localidad tipo: Nápoles]
? *Chiton scytodesma* Scacchi 1836, *Cat. Conch. Icon. R. Neapol.*: 9 [Localidad tipo: Nápoles]
? *Chiton freelandi* Forbes 1844, *Rep. Br. Ass. Advmt Sci.*: 188 [Localidad tipo: Mar Egeo]
Chiton philippi Issel 1870, *Bull. Malac. Ital.* 3: 5 [Localidad tipo: Génova]
Chiton rubellus Carpenter MS in Pilsbry, 1893, no Nardo, 1847, *Man. Conch.* 14: 182.

Material estudiado: Se han estudiado 90 ejemplares. Isla de Tarifa, Cádiz: 1 ej., 6 x 3 mm, III/91; 2 ej., 13,5 x 8 mm, IV/92 (Intermareal). Isla de las Palomas, Cádiz: 1 ej., 6 x 3, 5 mm, VIII/91; 3 ej., 16 x 10,2 mm, IX/92 (3-12 m); 2 ej., 13,2 x 8,7 mm, XI/93 (9 m). La Ballenera, Cádiz: 3 ej., 13 x 9 mm,

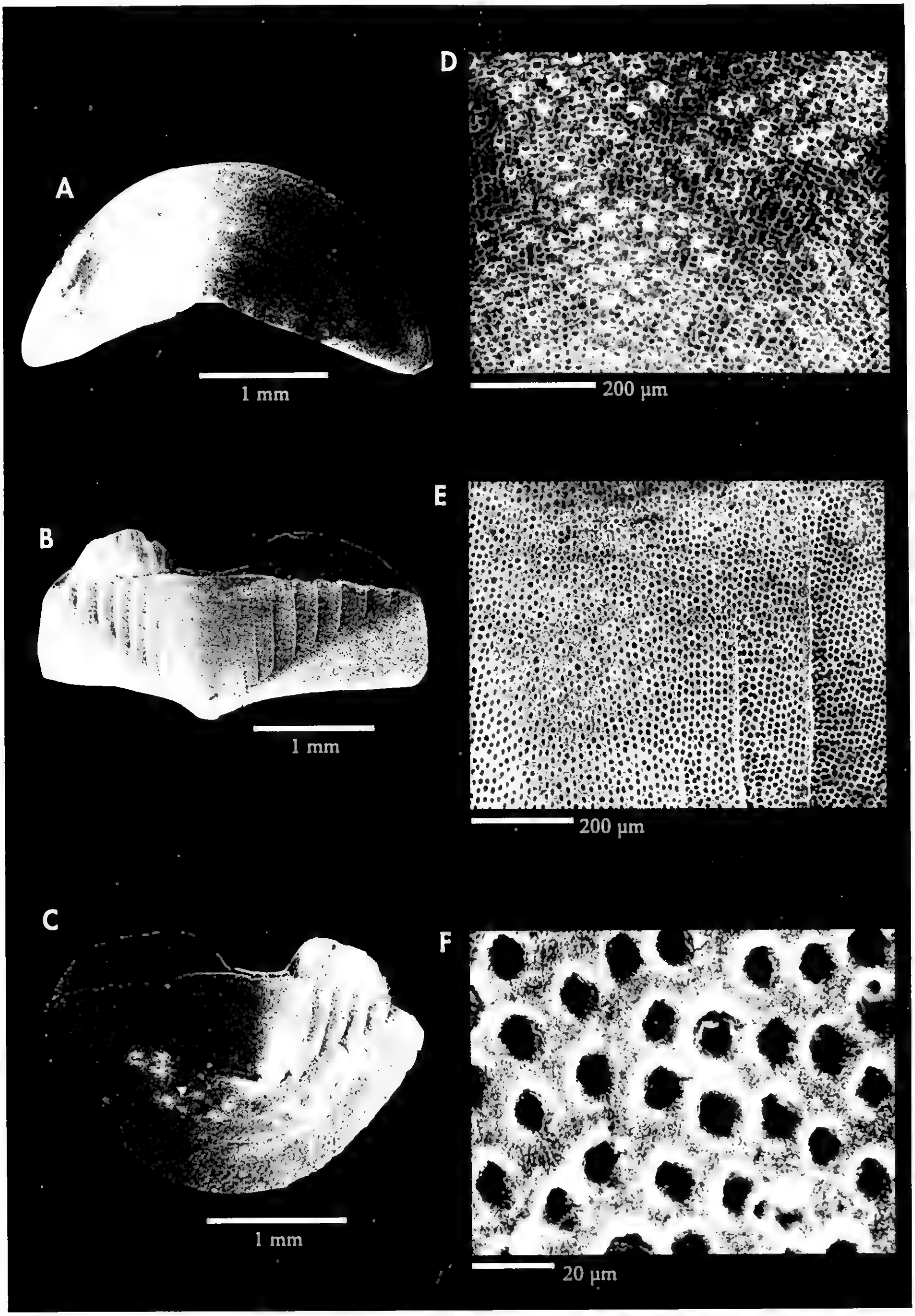

Figura 3. *Chiton (R.) corallinus*. A: valva I; B: valva IV; C: valva VIII; D: ornamentación del tegmento de la valva I; E: ornamentación del tegmento del área central; F: disposición de las megaloestetas y microestetas.

Figure 3. Chiton (R.) corallinus. *A: valve I; B: valve IV; C: valve VIII; D: tegmentum of valve I; E: tegmentum of central area; F: disposition of megalaesthetes and micraesthetes.*

IV/92 (12 m). Punta de San García, Cádiz: 1 ej., 8 x 4,5 mm, VII/91; 1 ej., 7,5 x 5 mm, IX/92; 3 ej., 10,5 x 5 mm, IX/92; 1 ej., 5x 3 mm, III/93; 1 ej., 10 x 5, 5 mm, VI/93; 2 ej., 16 x 10 mm, VII/93; 1 ej., 15,2 x 9,2 mm, VIII/93; 4 ej., 15 x 9 mm, IX/93 (12 m); 5 ej., 16 x 9 mm, XII/93 (8 m); 1 ej., 12,5 x 7 mm, I/94 (5 m); 4 ej., 12,3 x 6,2 mm, II/94 (5 m). Ensenada de Cucareo, Cádiz: 2 ej., 10,5 x 7,5 mm, I/93 (12 m); 1 ej., 12,5 x 7 mm, XI/93 (5 m); 2 ej., 16 x 13 mm, XII/93 (6 m); 2 ej., 14 x 8 mm, I/94 (5 m); 1 ej., 12 x 6,5 mm, II/94 (5 m). Puerto de Algeciras, Cádiz: 4 ej., 7 x 4 mm, VIII/91; 1 ej., 6 x 3,5 mm, IX/91 (10 m). Punta de Paredones, Cádiz: 3 ej., 8,5 x 5 mm, VII/91; 1 ej., 3 x 2 mm, VIII/91 (16 m). Punta del Gallo del Mirador, Cádiz: 3 ej., 6 x 4 mm, VIII/91 (3-6 m). Campamento, Cádiz: 6 ej., 10 x 5,5 mm, III/91 (Intermareal). Crinavis, Cádiz: 2 ej., 8,5 x 5,5 mm, VII/90 (33 m); 1 ej., 7 x 3,5 mm, V/93 (9 m); 4 ej., 7 x 3 mm, VII/93 (9 m); 1 ej., 7 x 5 mm, IX/93 (10 m); 1 ej., 6,5 x 3,8 mm, II/94 (8 m). San Felipe, Cádiz: 2 ej., 5 x 3 mm, VI/91; 4 ej., 7,5 x 4 mm, VIII/91; 1 ej., 14,5 x 9 mm, V/93; 5 ej., 6 x 3,5 mm, VII/93; 1 ej., 11 x 5,8 mm, X/93 (17 m). Punta Europa, Gibraltar: 1 ej., 6 x 3 mm, VII/93 (14 m). MCNM: 1503/72: 1 ej., 14 x 8 mm, (Canarias) (Colección: Hidalgo). 1503/234: 1 ej., 10,5 x 6 mm, (Aguilas, Murcia) (Colección: Azpeitia, 3227). 1503/401: 1 ej., 16 x 8,5 mm, (España) (hidalgo). 1503/402: 1 ej., 8,5 x 4,5 mm, (Mahón, Menorca) (Colección: Hidalgo). 1503/403: 2 ej., 10 x 6 mm, (Aguilas, Murcia) (Colección: Hidalgo). Sin numerar: 5 ej., 11 x 7 mm, (Cabo Menorca) (Colección: Hidalgo).

Descripción: (Figs. 3 y 4). El tamaño de los ejemplares recolectados ha variado entre 3,3 x 2,1 mm y 16 x 10,2 mm. El aspecto es ovalado, aunque algo más estrecho en la parte caudal, con conchas consistentes. Se encuentran ornamentados con costillas longitudinales en el área central. En el tegmento se detecta una granulación fina ocasionada por las estetas, que se disponen en líneas. No se puede distinguir entre megalo y microestetas, ya que todas ofrecen un diámetro similar con una media de luz de 8,17 μm (σ: 0,51). Las filas que tienden a formar varían, de manera que en la placa oral, áreas laterales y zona postmucral se disponen radialmente, mientras que en el área central y zona anteromucral son de forma longitudinal, aunque pueden estar algo distorsionadas por la presencia de las costillas. La distancia media entre dos estetas en una misma fila y la paralela es de 12,6 μm (σ: 5,91) y 10,05 μm (σ: 5,36) respectivamente.

El borde de las láminas de inserción del articulamento se encuentra pectinado en todas las valvas, al igual que los dientes de las placas terminales. Las apófisis son lisas y están separadas por el seno jugal. En éste se aprecia la presencia de 4 a 6 láminas ligeramente dentadas en el margen. La forma de las apófisis varía de rectangular, en las valvas II y III, a trapezoidal, de la IV a VIII, aunque en todas los márgenes aparecen redondeados. La fórmula de hendiduras de las láminas de inserción es 8-10/1-2/10-12. Las valvas intermedias exhiben, generalmente, una sola hendidura; en el caso de que presente dos, es sólo en uno de los lados.

El perinoto está constituido por escamas romboides imbricadas, que ofrecen un aspecto de piel de serpiente. Las escamas se encuentran ornamentadas por unas finas y leves estriaciones. El tamaño varía en un mismo ejemplar, encontrándose las mayores en la zona media del perinoto. Las dimensiones varían desde 60 x 25 μm a 250 x 100 μm de anchura y altura en el mismo ejemplar. El tamaño máximo encontrado ha sido de 280 μm de ancho por 130 μm de alto. Las escamas ventrales son rectangular, aunque pueden tener ligeras variaciones. El tamaño ha oscilado en los diferentes ejemplares entre 60 x 13 μm y 80 x 15 μm, con variación máxima de 5 μm en la longitud de las escamas en un mismo individuo. Las espículas marginales, de forma cilíndrica con el extremo terminal apuntado, tienen estrías longitudinales. El tamaño varía, en distintos ejemplares, entre 62,5 x 21 μm y 112,5 x 22,5 μm.

El diente central de la rádula es alargado y bastante estrecho, con una longitud máxima de 59,8 μm. El primer lateral es ligeramente más ancho, sobrepasa o iguala al central, a pesar de ser más largo. La placa uncinada del diente mayor lateral no presenta cúspides.

En la Tabla I se especifican las característica de la especie.

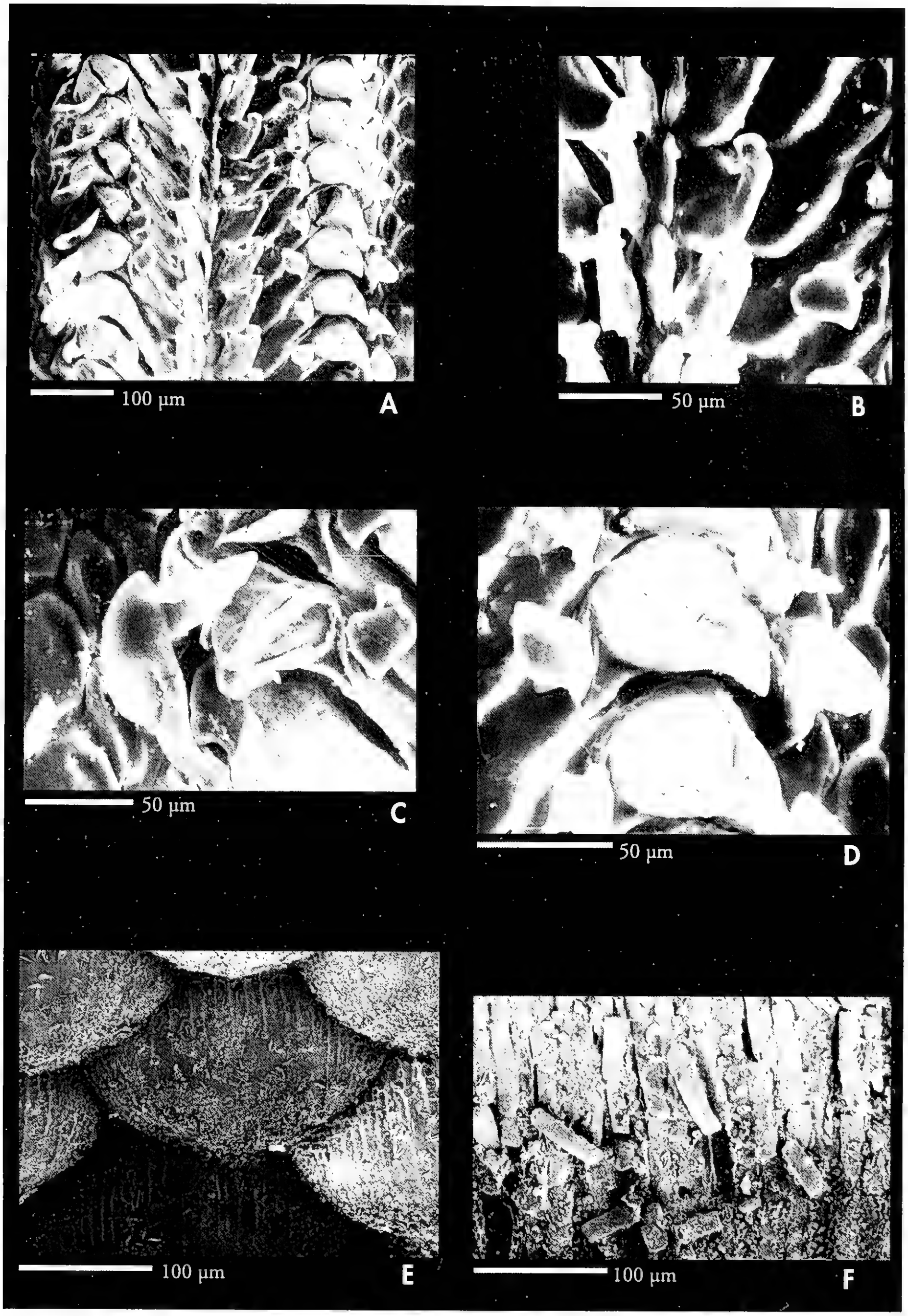

Figura 4. *Chiton (R.) corallinus.* A: rádula, B: dientes raquídeo y primer lateral; C, D: placa uncinada del diente mayor lateral y diente plumoso; E: cintura; F: disposición de las escamas dorsales.
Figure 4. Chiton (R.) corallinus. *A: radule; B: rachidian and first lateral teeth; C, D: uncinal plate of major lateral tooth and spatulate tooth; E: perinotum, F: disposition of dorsal scales.*

Chiton (Rhyssoplax) phaseolinus Di Monterosato, 1879

Chiton (Rhyssoplax) phaseolinus Di Monterosato, 1879, *G. Sci. Nat. Econ. Palermo*, 14: 8. [Localidad tipo: Nápoles, Palermo].

Material estudiado: El total de ejemplares estudiados ha sido de 59. Isla de Tarifa, Cádiz: 2 ej., 5 x 3 mm, VII/90; 1 ej., 5 x 2, 5 mm, II/91; 1 ej., 5 x 3 mm, VII/91 (Intermareal). Punta Carnero, Cádiz: 1 ej., 7 x 4 mm, V/91; 2 ej., 6 x 3 mm, VIII/91 (Intermareal). La Ballenera, Cádiz: 1 ej., 3 x 2 mm, VIII/91 (12 m). Punta de San García, Cádiz: 3 ej., 6,5 x 3 mm, VII/91; 1 ej., 5 x 3 mm, IX/92; 3 ej., 7 x 3 mm, VI/93; 1 ej., 8 x 3,5 mm, VII/93 (10 m); 6 ej., 6, 5 x 4 mm, VIII/93; 1 ej., 5, 5 x 3,2 mm, X/93 (12 m); 1 ej., 6 x 3 mm, II/94 (5 m). Ensenada de Cucareo, Cádiz: 2 ej., 3 x 1,5 mm, XI/91 (5 m); 2 ej., 5 x 2,5 mm, I/93; 1 ej., 7 x 4 mm, IX/93 (12 m); 2 ej., 7,5 x 4 mm, X/93 (5 m); 2 ej., 9 x 3,2 mm, XI/93 (5 m); 1 ej., 9 x 4 mm, XII/93 (5 m). Puerto de Algeciras, Cádiz: 19 ej., 7 x 3 mm, VII/93; 2 ej., 3,2 x 2 mm, X/93 (10 m). Punta de Paredones, Cádiz: 1 ej., 5 x 3 mm, VIII/91 (16 m). MCNM: 1503/426: 2 ej., 12 x 6,5 mm, (Tarifa, Cádiz) (H. L. Strack). Sin numeración: 1 ej., 10, 2 x 6,5 mm, (Tánger) (Colección: Azpeitia, 5362).

Descripción: Los ejemplares son de tamaño medio, varían entre 3,1 x 2,2 m y 7,3 x 4,1 mm. El animal es ovalado, no carenado, redondeado, con conchas no muy consistentes. Presenta un aspecto granulado fino, con 2-3 costillas no muy marcadas en las áreas pleurales. El tegmento ofrece un aspecto granuloso derivado de las estetas. El diámetro medio de éstas es de 7,7 μm (σ: 0,89). Las estetas se sitúan de manera que forman líneas, que varían de disposición, en la valva cefálica, áreas laterales de las intermedias y zona postmucral, donde constituyen líneas radiales, mientras que el área central y anteromucral tienden a constituir líneas longitudinales, aunque se encuentran algo perturbadas en la zona pleural, donde aparecen las costillas. La distancia media de las estetas en una misma fila es de 5,6 μm (σ: 1,81) y de 7,9 μm (σ: 2,6) entre las filas paralelas.

Los aleros del articulamento son esponjosos. Los dientes de la valvas caudales y el borde de las láminas de inserción se encuentran dentados. En el seno jugal también se aprecian láminas algo pectinadas, aunque no tan finamente como en las láminas laterales de inserción. Por el contrario, las apófisis son lisas, con una forma triangular en las valvas II, III y IV, que varían a trapezoidal en las placas siguientes hasta la caudal. La fórmula de ranuras de las líneas de inserción es 8-10/1/9-12.

El perinoto está constituido por espículas romboidales imbricadas. Pueden presentar leves estriaciones longitudinales, aunque no se encuentran en todas las escamas. En la zona basal presentan una perforación, lugar por donde probablemente se insertan en el perinoto. En un mismo ejemplar aparecen de diferentes tamaños y la variación puede ser desde 63 μm de ancho y 20 μm de alto, las más pequeñas, a 200 x 40 μm las mayores. El tamaño máximo observado ha sido de 210 μm de anchura por 53 μm de altura. Las escamas ventrales son blancas y rectangulares, se disponen en filas longitudinales. El tamaño es menor que el de las dorsales, y éste varió de 40 a 57,5 μm de longitud y de 9 a 14,4 μm de ancho en los distintos ejemplares estudiados. En la zona marginal aparecen espículas de forma cónica, aplastadas, ligeramente cóncavas y con el borde terminal redondeado y más estrecho que el basal. Estas espículas se encuentran adornadas con estrías por la cara dorsal, que surgen en la mitad de ella, dispuestas paralelamente e inclinadas con respecto al eje longitudinal. El tamaño varía en los distintos ejemplares entre 52,5 x 17,5 μm y 70 x 20 μm de longitud y base.

El diente raquídeo de la rádula es muy estrecho y alargado, con una pequeña protuberancia redondeada en la zona terminal. El primer diente lateral es más ancho y sobrepasa al central. El diente mayor lateral presenta una apófisis en la zona basal de la placa con

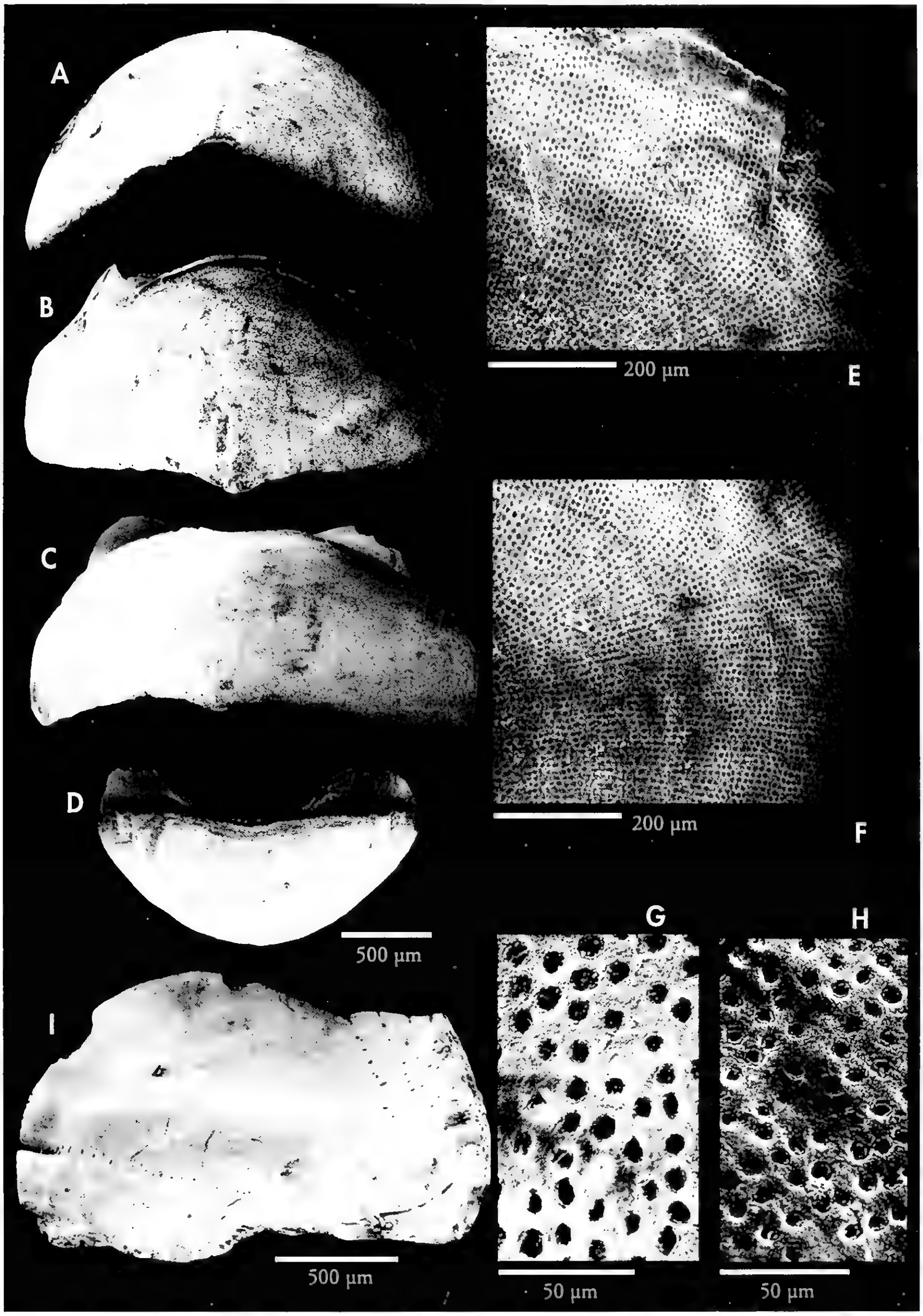

Figura 5. *Chiton (R.) phaseolinus.* A: valva I; B: valva II; C: valva IV; D: valva VIII; E: ornamentación del área central; F: ornamentación del área lateral; G, H: disposición de las megaloestetas y microestetas; I: articulamento.

Figure 5. Chiton (R.) phaseolinus. *A: valve I; B: valve II; C: valve IV; D: valve VIII; E: ornamentation of central area. Figure 6: ornamentation of lateral area. Figures 7 and 8: disposition of megalaesthetes and micraesthetes. Figure 9: articulamentum.*

aspecto de cilindro hueco, con un reborde, en forma de lengüeta, en la parte superior, que está dirigido hacia atrás.

En la Tabla I se especifican los caracteres taxonómicos de las especies de *Chiton (Rhyssoplax)* de la Península Ibérica.

DISCUSIÓN

DALL (1879) incluyó en el género *Chiton* la sección *Radsia* Gray (1847). PILSBRY (1892) a su vez consideró en el género *Chiton* las secciones *Chiton s. s.* (especie tipo: *Ch. tuberculatus* Linneo, 1758), *Radsia* (especie tipo: *Ch. barnesii* Gray, 1847) y *Sclerochiton* Carpenter, 1873 (sin mencionar especie tipo dicho autor). KAAS Y VAN BELLE (1980) consideran a *Sclerochiton* sinónimo del género *Squamopleura* Nierstrasz (1906), clasificado en la subfamilia Acanthopleurinae.

THIELE (1893) describe nuevos subgéneros y secciones para *Chiton*: *Amaurochiton* (especie tipo: *Ch. magnificus* Deshayes, 1827 = *Ch. striatus* Barnes, 1824), *Chondroplax* (especie tipo: *Ch. granosus* Frembly, 1827), *Diochiton* (especie tipo: *Ch. albolineatus* Broderip y Sowerby, 1829), *Poeciloplax* (especie tipo: *Ch. quoyi* Deshayes, 1836 = *Ch. glaucus* Gray, 1828), *Sypharochiton* (especie tipo: *Ch. pellisserpentis* Quoy y Gaimard, 1835), *Triloplax* (especie tipo: *Ch. scabriculus* Quoy y Gaimard, 1832 = Ch. *pellisserpentis* Quoy y Gaimard, 1835), *Georgus* (especie tipo: *Ch. mauritianus* Quoy y Gaimard, 1835), *Rhyssoplax* (especie tipo: *Ch. affinis* Issel, 1869), *Clathropleura* (especie tipo: *Ch. siculus* Gray, 1828 = *Ch. olivaceus* Spengler) y *Anthochiton* (especie tipo: *Ch. tulipa* Quoy y Gaimard, 1835).

No obstante, actualmente sólo se consideran válidos a *Chiton* y *Rhyssoplax* ya que tal como señalaron KAAS Y VAN BELLE (1980) se consideran simples sinónimos de *Chiton* a *Amaurochiton, Chondroplax, Diochiton, Poeciloplax, Sypharochiton, Triloplax, Georgus* y *Anthochiton,* y de *Rhyssoplax* a *Clathropleura*.

NIERSTRASZ (1906), que sigue la clasificación de PILSBRY (1892), incluye en el género *Chiton* los taxones subgenéricos *Chiton s. s., Radsia* y *Sclerochiton* y propone un nuevo género, *Squamopleura,* considerado actualmente por KAAS Y VAN BELLE (1980) como válido en vez de *Sclerochiton*.

Posteriormente, THIELE (1909) admite únicamente dos géneros: *Chiton* y *Sclerochiton*. En el primero encuadra la sección *Radsia* y el subgénero *Clathropleura,* y obvia al resto de los géneros que había descrito anteriormente (THIELE, 1893).

BERGENHAYN (1914) sigue los criterios de PILSBRY (1892), de manera que acepta los subgéneros. Sin embargo, IREDALE Y HULL (1926) no los admiten y consideran que las diferencias que presentan los distintos grupos justifican su separación como géneros independientes e incluso consideran los siguientes nuevos: *Delicatoplax, Tegulaplax, Mucroquasma,* a la vez que mantienen *Rhyssoplax, Clavarizona* Hull (1923), *Amaurochiton, Sypharochiton, Squamopleura, Liolophura* Pilsbry (1892), *Amphitomura* Pilsbry (1892), *Acantopleura* Guilding (1829), *Onithochiton* Gray (1847), *Lucilina* Dall (1882) y *Schizochiton* Gray (1847). KAAS Y VAN BELLE (1980), de los géneros nuevos propuestos por tales autores, admiten como válidos a *Tegulaplax* y *Mucroquasma,* consideran a *Delicatoplax* sinónimo de *Chiton,* y aceptan a *Squamopleura, Liolophura, Acantopleura* y *Clavarizona* como géneros y subgéneros de la subfamilia Acantopleurinae, y a *Onithochiton* y *Lucilina* de Toniciinae. El resto se encuentran sinonimizados, como hemos comentado anteriormente.

THIELE (1929) desarrolla una nueva clasificación, en la que admite subgéneros y secciones, de manera que en la subfamilia Chitoninae incluye los subgéneros: *Chiton* y *Rhyssoplax*. En el primero considera las secciones: *Chiton s. s., Amaurochiton, Diochiton, Chondroplax, Radsia* y *Sypharochiton*; y en *Rhyssoplax* las secciones: *Anthochiton, Delicato-*

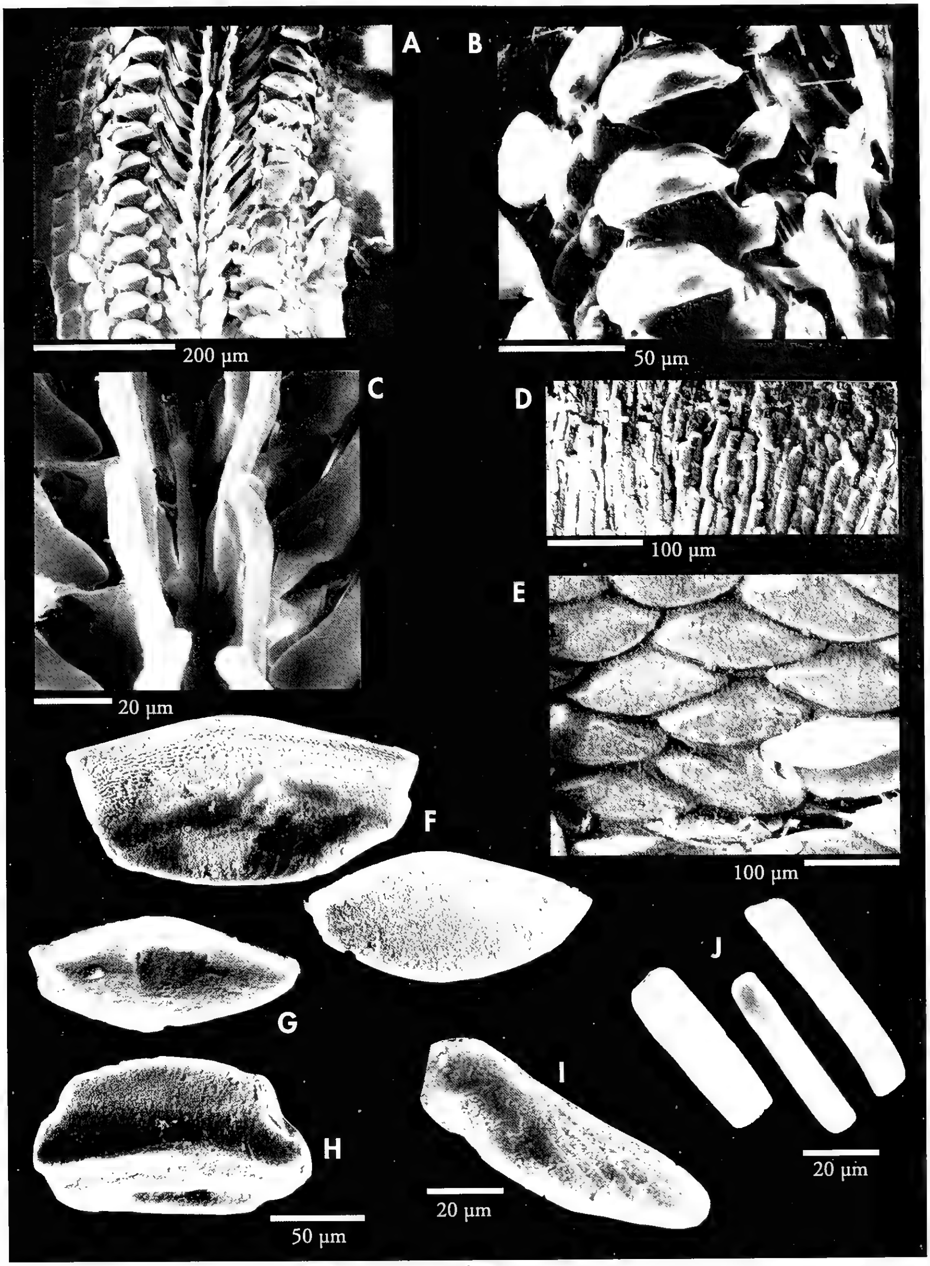

Figura 6. *Chiton (R.) phaseolinus*. A: rádula; B: placa uncinada del diente mayor lateral y diente plumoso; C: dientes raquídeo y primer lateral; D: disposición de las escamas ventrales; E: disposición de las escamas dorsales; F: escamas ventrales, vista dorsal; G: escama dorsal, vista ventral; H: escama dorsal, vista lateral; I: espícula marginal; J: escamas ventrales.

Figure 6. Chiton (R.) phaseolinus. *A: radula; B: uncinal plate of major lateral tooth and spatulate tooth; C: rachidian and first lateral tooth; D: disposition of ventral scales; E: disposition of dorsal scales; F: dorsal view of ventral scales; G: ventral view of dorsal scales; H: lateral view of dorsal scales; I: marginal spicules; J: ventral scales.*

plax, Tegulaplax, Rhyssoplax s. s. y *Mucroquasma*.

Como se ha visto hasta ahora, puede decirse que se han desarrollado dos líneas en la clasificación de todos estos taxones, en una se admiten los subgéneros de *Chiton*, y en la otra se consideran con valor genérico propio. La primera opción es seguida, entre otros, por ASHBY (1931), que admite el subgénero *Sypharochiton* (considerado sinónimo de *Chiton* por KAAS Y VAN BELLE, 1980); FISCHER-PIETTE Y FRANC (en GRASSÉ, 1960), que citan como subgénero a *Amaurochiton;* SMITH Y FERREIRA (1977), que admiten a *Radsia* como subgénero de *Chiton;* VAN BELLE (1978), que considera como subgéneros de *Chiton* a *Chiton s. s., Radsia, Rhyssoplax* y *Mucrosquama;* KAAS Y VAN BELLE (1980) añaden al listado de VAN BELLE (1978) el subgénero *Tegulaplax*, aunque VAN BELLE (1983) lo considera como sinónimo de *Chiton*. Por último, SABELLI *et al* (1990) y DELL' ANGELO *et al* (1990) admiten a *Rhyssoplax* como subgénero.

BULLOCK (1988) también sigue esta línea, pero admite como subgéneros de *Chiton* a *Amaurochiton, Diochiton, Chondroplax* y *Chiton s. s.* Por otro lado, separa del género *Chiton* a *Radsia, Sypharochiton* y *Rhyssoplax*, considerados con el mismo rango taxonómico, y en el último incluye como subgéneros a *Delicatoplax* y *Mucrosquama*. Por último, a *Typhlolochiton* lo sinonimiza con *Chaetopleura*.

En la otra línea, podemos a su vez, considerar dos tendencias. En la primera, los autores incluyen todas las especies en el género *Chiton* (BERGENHAYN, 1931, LELOUP Y VOLZ, 1938; SABELLI, 1974; LAGHI, 1977; BARASH Y DANIN, 1977; BALUK, 1984; MIFSUD *et al*., 1990; SABELLI *et al*., 1990), y en la segunda denominan a la especie con el género que otros han considerado como subgéneros (TAKI, 1962; FERREIRA, 1983; ZEILER Y GOWLET, 1985; SCOTT *et al*., 1990).

En el presente trabajo se admite a *Rhyssoplax* como subgénero de *Chiton* al igual que lo hacen VAN BELLE (1978; 1983), KAAS Y VAN BELLE (1980), SABELLI *et al.* (1990), pues desde que se realizaron las primeras clasificaciones se encuadraba en este género, a pesar de que ciertos autores no utilizan la categoría de subgénero para denominar a las especies que se encuentran en la Península Ibérica (BERGENHAYN, 1931; LELOUP Y VOLZ, 1938; SABELLI, 1974; LAGHI, 1977; BARASH Y DANIN, 1977; BALUK, 1984; MIFSUD *et al*., 1990; SABELLI *et al*., 1990).

VAN BELLE (1983) indica la siguiente diagnosis para el subgénero *Rhyssoplax:* El tamaño varía de pequeño a grande, forma de oval a oval alargado. Valvas carenadas, áreas distinguibles; la pleural siempre provista de costillas más o menos marcadas, la escultura del área lateral y de las valvas terminales varía de microgranular a radialmente estriada. Fórmula de líneas de inserción: 8-9/1/10-12. Perinoto tapizado de escamas. Las tres especies estudiadas presentan estos caracteres, por lo que se les ha denominado *Ch. (R.) olivaceus, Ch. (R.) corallinus* y *Ch. (R.) phaseolinus.*

BIBLIOGRAFÍA

ASHBY, E., 1931. Monograph of the South African Polyplacophora (chitons). *Annals South Africa Museum*, 30 (1): 1-59.

BALUK, W., 1984. Additional data on Chitons and cuttlefish from the Korytnica Clays (Middle Miocene; Holy Cross Mountains, Central Poland). *Acta Geológica Polónica*, 34 (3-4): 281-297.

BARASH, A. Y DANIN, Z., 1977. Polyplacophora (Mollusca) from the Eastern Mediterranean. *Journal de Conchyliologie*, 64 (1-2): 3- 27.

BERGENHAYN, J. R. M., 1914. Die Loricaten Von Prof. Dr. Sixten Bocks expedition Nac Japan und den Bonin-Inseln 1914. *Kungl. Svenska Vetenskapsakademiens Handlingar*, 12 (1- 4): 4-57.

BERGENHAYN, J. R. M., 1930. Die Loricaten Von Prof. Dr. Sixten Bocks Pazifik Expedition 1917-1918, mit spezieller Berhcksichtigung der Perinotumbildungen und der chalenstruktur. *K. Svenska Vetensk*, 9 (3): 1-54.

BERGENHAYN, J. R. M., 1931- Beitruge zur Malakozoologie der Kanarischen Inseln. *Arkiv for zoologl.* 23 (13): 1-28.

BULLOCK, R. C. 1988., The genus *Chiton* in the New World (Polyplacophora: Chitonidae). *Veliger*, 31 (3-4): 141-191.

DALL, W. H., 1882. On the genus *Chiton*. *Proceedings of United States National Museum*. 279-291.

DELL'ANGELO, B., S. HONG Y VAN BELLE, R. A., 1990. The chiton fauna (Mollusca: Polyplacophora) of Korea Part I: Suborder. *Korean Journal systematic Zoology*, 6 (I): 29-56.

FERREIRA, A. J., 1983. Researches on the coast of Somalia. The Chiton fauna (Mollusca Polyplacophora). *Monitore Zoologico Italiano*, suppl 18 (9): 249-297.

FISCHER-PIETTE, E. Y FRANC, A., 1960. Classe des Polyplacophores. *In:* P. Grassé, (Ed.) *Traité de Zoologie*. Paris. 1701-1728.

IREDALE, T. Y HULL, A. F. B., 1926. A monograph of the Australian Loricates, I-VIII. *Australia Zoology*, 339-359.

KAAS, P. y VAN BELLE, R. A., 1980. *Cataloge of living chitons (Mollusca: Polyplacophora)*. Dr. W. Publisher. Rotterdam. 144 pp.

LAGHI, G. F., 1977. Polyplacophora (Mollusca) neogenici dell'Appennino Settentrionale. *Bolletino della Paleontologica Italiana*, 16 (1): 87-115.

LELOUP, E. Y VOLZ, P., 1938. Die Chitonen (Polyplacophoren) der Adria. *Thalassia*. 2 (10): 1-63.

MIFSUD, C., CACHIA, C. Y SAMMUT, P. M., 1990. Note sui Poliplacofori delle isole Maltesi. *La Conchiglia*, 256: 52-61.

NIERSTRASZ, H. F. 1906. Remarks on the Chitonidae. *Tijdschrift der nederlandsche. Dierkunde Vereeiging*, (2) 10: 141-172.

PILSBRY, H. A., 1892-1894. Monograph of the Polyplacophora. En: *Tryon*, G. W.: *Manual of Conchology*. Academy of Natural Sciences, Philadelphia. 331 pp.

SABELLI, B. A., 1974. Origine e distribuzione dei Poliplacophora viventi in Mediterraneo. - *Quaderni civico Staz. Idrobiologi Milano*, 5: 71-78.

SABELLI. B., GIANNNUZZI-SAVELLI. R. Y BEDULLI, D., 1990. *Catalogo annotato dei Molluschi marini del Mediterraneo*. Ed. Librería Naturalistica Bolognese, Boloña, vol. 1, 348 pp.

SCOTT, P. H., F. G. HOCHBERG Y ROTH, B., 1990. Cataloge of recent and fossil molluscan types in the Santa Barbara Museum of Natural History. I. Caudofoveata, Polyplacophora, Bivalvia, Scaphopoda and Cephalopoda. *Veliger* 33, Suppl. 1: 1-27.

SMITH, A. G., y Ferreira, A. J. 1977., Chiton fauna of the Galapagos Islands. *Veliger* 20 (2): 82-97.

TAKI, I., 1962. A List of the Polyplacophora from Japanese Islands and Vicinity. *Japan Journal Malacology*, 22 (1): 29-53.

THIELE, J., 1893. *Poliplacophora, Lepidoglossa, Schupenzüngler*. En: Troschel, F. H.: Das gegebiss der Schnnecken, 2: 325-336.

THIELE, J., 1909-1910. *Revision des Systems der Chitonen*. Zoologica Stuttg. 22: 1-132.

THIELE, J., 1929. *Handbuch der systematischen Weichtierkunde*. Classis Loricata. Smithsonian Institution Libraries and The National Science Foundation. Washington. 1992. 1-22.

VAN BELLE, R. A., 1975-1978. Sur la classification des Polyplacophora. I-VII. *Informations de la Société belge de Malacologia*, 4 (5): 121-131. 4 (6): 135-145. 5 (2): 15-42. 6 (1): 3-28. 6 (2): 35-44. 6 (3): 65-82.

VAN BELLE, R. A., 1983. The systematic classification of the chitons (Mollusca: Polyplacophora). *Informations de la Société belge de Malacologia*. 11 (1-3): 1-178.

ZEIDLER, W. Y GOWLETT, K. L., 1985. Mollusc Type-Specimens in the South Australian Museum. 3. Polyplacophora. *Australia Museum*, 19 (8): 97-115.

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El género *Lepidochitona* Gray, 1921 (Mollusca, Polyplacophora) en el litoral Atlántico de la Península Ibérica

The genus *Lepidochitona* Gray, 1921 (Mollusca, Polyplacophora) in the Atlantic littoral of Iberian Peninsula

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RESUMEN

En el presente trabajo se citan las especies del Género *Lepidochitona* Gray, 1921 (Polyplacophora) del litoral atlántico de la Península Ibérica con indicación de la distribución de cada especie. Se describen además dos especies nuevas de dicho género.

ABSTRACT

The species of *Lepidochitona* Gray, 1921 (Polyplacophora) from the Atlantic littoral of Iberian Peninsula are cited. For each species the geographical distribution in this area is included. Two new species are described.

PALABRAS CLAVES: Mollusca, Polyplacohora, Taxonomía, Anatomía, *Lepidochitona cinerea, L. corrugata, L. canariensis, L. simrothi, L. monterosatoi, L. iberica, L. kaasi* sp. nov. y *L. severianoi* sp. nov., Península Ibérica.
KEY WORDS: Mollusca, Polyplacohora, Taxonomy, Anatomy, *Lepidochitona cinerea, L. corrugata, L. canariensis, L. simrothi, L. monterosatoi, L. iberica, L. kaasi* sp. nov., *L. severianoi* sp nov., Iberian Peninsula.

INTRODUCCIÓN

El género *Lepidochitona* Gray, 1821 ha sido ampliamente discutido desde el punto de vista taxonómico. La controversia mantenida ha estado motivada por la clasificación de las especies en diferentes géneros y familias. Amplios estudios de diferentes autores han sinonimizado con *Lepidochitona* a los siguientes taxones: *Trachydermon* Carpenter, 1864 (BERRY, 1918; WINCKWORTH, 1932; KAAS Y VAN BELLE 1981; 1985; FERREIRA, 1982), *Craspedochilus* Sars, 1878 (PILSBRY, 1892; IREDALE, 1914; THIELE, 1929; KAAS Y VAN BELLE, 1981), *Middendoffia* Dall, 1882 (ex Carpenter MS) (KAAS Y VAN BELLE, 1981; FERREIRA, 1982), *Cyanoplax* Pilsbry, 1892 (THIELE, 1929; VAN BELLE, 1977; KAAS Y VAN BELLE, 1981; 1985; FERREIRA, 1982), *Adriella* Thiele, 1893 (THIELE, 1929), *Mopaliopsis* Thiele, 1893 (THIELE, 1929; KAAS Y VAN BELLE, 1981; FERREIRA, 1982), *Mopaliella* Thiele, 1909 (KAAS Y VAN BELLE, 1981; FERREIRA, 1982), *Basiliochiton* Berry, 1918 (FERREIRA, 1982), *Plotochiton* Berry, 1926 (VAN BELLE, 1977; FERREIRA, 1982).

En el presente trabajo se enumeran un total de 8 especies: *Lepidochitona cinerea* (Linneo, 1767), *L. corrugata* (Reeve, 1848), *L. simrothi* (Thiele, 1902), *L.*

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canariensis (Thiele, 1909), *L. monterosatoi* Kaas y Van Belle, 1981, *L. iberica* Kaas y Van Belle, 1981, *L. kaasi* sp. nov y *L. severianoi* sp nov., todas ellas pertenecientes al dominio litoral del Atlántico Ibérico.

Se describen como especies nuevas para la ciencia a *Lepidochitona kaasi* y *Lepidochitona severianoi.*

MATERIAL Y MÉTODOS

Se han estudiado los ejemplares de las colecciones del Departamento de Bioloxía Animal de la Universidade de Santiago de Compostela, del Departamento de Biología Animal de la Universidad de Sevilla y del Museo Nacional de Ciencias Naturales de Madrid (MNCN de Madrid).

Determinados ejemplares de *L. kaasi* y *L. severianoi* se trataron con KOH 20% al objeto de separar las valvas, elementos del perinoto y la rádula. El estudio de las partes duras se ha realizado mediante el uso de microscopía electrónica de barrido (Philips XL-20).

RESULTADOS

Lepidochitona cinerea (Linneo, 1767)

Chiton cinereus Linneo, 1767, *Syst. Nat.*, ed. 12: 1107.
Chiton marginatus Pennant, 1777, *Brit. Zool.* 4: 71. [Localidad tipo: England].
Chiton cimex Gmelin, 1791, *Syst. Nat.*, ed. 13: 3206. [Localidad tipo: Norway]
Chiton cimicinus Spengler, 1797, *Skkrivt. Naturh. Selsk.* 4: 79. [Localidad tipo: Norway].
Chiton quinquivalvis Brown, 1823, *Brit. Ennc.* (Edinb.) 6 th ed., 6 (2): 402. [Localidad tipo: Wales].
Chiton fuscatus Brown, 1827, III. *Conch. Gr. Brit. Irel.* Pl 35 f 17.
Chiton variegatus Philippi, 1836, *Enum. Moll. Sicil.* 1: 107 [Localidad tipo: Sicilia]
Lepidopleurus carinatus Leach, 1852, *Syn. Moll. Gr. Brit.*: 228 [Localidad tipo: Ireland]
(Non: Fleming, 1828; Brown, 1823; 1827; Sowerby, 1841 = *Chiton asellus* Gmelin, 1791).

Material estudiado: Se ha estudiado un total de 1. 087 ejemplares. Praia de Altar, Benquerencia: 3 ej., 6 x 5,2 mm IX/83 (intermareal). Praia da Area Longa, Foz: 16 ej., 6, 3 x 4, 1 mm II/84 (intermareal). Area de San Román, Ría de Viveiro: 4 ej., 10 x 6 mm VIII/83 (intermareal). Vicedo, Ría do Barqueiro: 22 ej., 10 x 6 mm IV/76 (intermareal). San Isidro, Ría de Cedeira: 6 ej., 8,2 x 6,1 mm IV/76 (intermareal). Canal da ría, Ría de Ferrol: 2 ej., 2,5 x 1,5 mm V/87 (10-25 m). Enseada de Laxe, Ría de Ferrol: 1 ej., 9,5 x 4,8 mm V/76; 3 ej., 6 x 4,4 mm VII/87 (16 m). Enseada de Leuseda, Ría de Ferrol: 1 ej. 5,7 x 4,7 mm VI/87 (12 m). Faro da Palma, Ría de Ferrol: 2 ej., 4,4 x 4,5 mm VIII/91 (14 m). Punta da Redonda, Ría de Ferrol: 1 ej., 3,2 x 2,1 mm IX/87; 20 ej., 6,8 x 4,3 mm XII/90; 1 ej., 7,9 x 5,7 mm VII/91; 1 ej., 4,7 x 3,5 mm VII/91; 10 ej., 9,8 x 5,7 mm VIII/91 (20 m). Punta Piteira, Ría de Ferrol: 1 ej., 6,5 x 4,7 mm VII/91 (16 m). Enseada da Malata, Ría de Ferrol: 10 ej., 11,5 x 7,5 mm I/75); 24 ej., 17 x 12,4 mm IX/76; 11 ej., 13 x 8 mm V/84; 1 ej., 7,9 x 6 mm III/85; 1 ej., 7 x 4,3 mm II/87 (intermareal-5 m). Enseada da Barca, Ría de Ferrol: 2 ej., 4,6 x 3,5 mm VII/87 intermareal). O Seixo, Ría de Ferrol: 5 ej., 6, 6 x 6 mm X/87 (intermareal). Maniños, Ría de Ferrol: 4 ej., 8,2 x 5,9 mm X/87 (intermareal). O Montón, Ría de Ferrol: 1 ej., 3,8 x 3,3 mm III/87 (5 m). As Pías, Ría de Ferrol: 12 ej., 5,9 x 3,8 mm III/87; 1 ej., 6,3 x 4,1 mm III/87 (5 m). A Faísca, Ría de Ferrol: 5 ej., 4,6 x 4,7 mm VIII/87 (intermareal). O Couto, Ría de Ferrol: 105 ej., 10 x 5,1 mm VIII/87; 1 ej., 5,9 x 4,1 mm X/87 (intermareal). O Puntal, Ría de Ferrol: 1 ej., 3,5 x 4,3 mm III/87 (intermareal). Illas Mirandas, Ría de Ares: 1 ej., 5 x 3 mm IV/87 (13-16 m). Enseada de Ares, Ría de Ares: 1 ej., 8 x 5 mm II/86; 4 ej., 8 x 5 mm VIII/86; 9 ej., 10 x 6 mm I/87; 2 ej., 10 x 6,5 mm IV/87 (8 m). Seno de Pontedeume, Ría de Ares: 6 ej., 15 x 9 mm IV/76; 2 ej., 8 x 5 mm III/87 (5 m). Punta de San Pedro, Ría de Ares: 1 ej., seco IV/83; 5 ej., 11 x 7 mm II/87 (intermareal). Punta dos Curbeiros de Miño, Ría de Ares: 3 ej., 7,3 x 6,2 mm IV/83; 2 ej., 9 x 5, 5 mm I/87 (intermareal). Sada, Ría de Ares: 8 ej., 7,5 x 4,9 mm III/76; 13 ej., 6,5 x 5,7 mm III/78; 11 ej., 5,6 x 6,1 mm IV/83; 1 ej., 4,8 x 3,2 mm IV/87 (intermareal). Carnoedo, Ría de Ares: 18 ej., 17,4 x 8,5 mm II/76; 1 ej., 10 x 5 mm IV/87 (intermareal). Lorbé, Ría de Ares: 3 ej., 6,5 x 3,9 mm XI/85 (intermareal). Santa Cruz, Ría da Coruña: 5 ej., 10,6 x 6,1 mm II/76. Punta do Cabo, Suevos: 1 ej., 3,1 x 2,8 mm IV/78 (intermareal). Praia das Cunchas, Ría de Corme e Laxe: 9 ej., 7,9 x 5,8 mm VIII/80 (intermareal). Baixo do Placer do Cabezo de Laxe: 1 ej., 6,7 x 5,7 mm VIII/80 (42 m). Punta Cabo da Area, Ría de Corme e Laxe: 1 ej., 8,3 x 4,9 mm VIII/80 (intermareal). Fraga de Abaixo, Ría de Camariñas: 14 ej., 8,7 x 5,4 mm III/76 (intermareal). Punta dos Corvos, Ría de Camariñas: 1 ej., 3,3 x 3,5 mm XII/83 (intermareal). Estorde, Ría de Corcubión: 4 ej., 9 x 6,8 mm II/76 (intermareal). Punta da Ameixenda, Ría de Corcubión: 2 ej., 11 x 7,1 mm II/76 (intermareal). O Pindo, Ría de Corcubión: 12 ej., 7,5 x 6,2 mm VII/84 (intermareal). Punta das Pedras, Ría de Muros e Noia: 7 ej., 8 x 5,7 mm I/84 (intermareal). Punta Aguieira, Ría de Muros e Noia: 5 ej., 12 x 7 mm III/76 (intermareal). Punta Cabeiro, Ría de Muros e Noia: 63 ej., 11, 4 x 7 mm V/76 (intermareal). Punta Sagrada, Porto do Son, Ría de Muros e Noia: 13 ej., 9,8 x 5,6 mm III/76 (intermareal). Punta do Castro, Baroña, Ría de Muros e Noia: 3 ej., 7,7 x 8,9 mm III/76; 14 ej., 11,4 x 6,8 mm III/76; 4 ej., 3,8 x 2,5 mm III/84. Aguiño, Ría de Arousa: 9 ej., 9,5 x 6,4 mm III/76; 1 ej., 1,6 x 1,5 mm IV/76; 4 ej., 10, 5 x 7 mm VI/81; 1 ej., 7 x 3,4 mm VII/82; 3 ej., 4,2 x 3,5 mm III/92 (intermareal); 29 ej., 8,6 x 5,2 mm. VI/94 (intermareal). As Insuas, Ribeiriña, Ría de Arousa: 2 ej., 13 x 7,6 mm V/76; 28 ej., 11 x 7,3 mm VI/76 (intermareal). Vilagarcia, Ría de Arousa: 5 ej., 8,2 x 5,5 mm V/76 (intermareal). Cambelo da Area, Ría de Arousa: 8 ej., 5,7 x 5,3 mm II/82 (10-15 m). Cambados, Ría de Arousa: 18 ej., 11, 7 x 8,6 mm VI/76 (intermareal). Marisma da Revolta, Ría de Arousa: 2 ej., 8,7 x 6,6 mm II/76 (intermareal). Punta de A Lanzada, O Grove: 2 ej., 8,5 x 3,7 mm VIII/76 (22 m). Praia de Bascuas, Ría de Pontevedra: 2 ej., 7,8 x 4,7 mm VIII/76 (intermareal). Portonovo, Ría de Pontevedra: 13 ej., 10,5 x 7 mm VIII/76 (intermareal). Sanxenxo, Ría de Pontevedra: 3 ej., 8,3 x 5,5 mm VIII/76 (intermareal). Punta de Campelo, Ría de Pontevedra: 17 ej., 15 x 11 mm IV/76 (intermareal). Illa de San Clemente, Ría de Pontevedra: 4 ej., 9 x 5,8 mm IV/76; 2 ej., 3,7 x 2,2 mm III/78; 1 ej., 3,7 x 2,4 mm. Praia Ancora, Portugal: 4 ej., 6,2 x 3 mm. IX/93 (intermareal). Praia S. Bartolomeu do Mar, Portugal: 5 ej., 4,5 x 2,5 mm IX/93 (intermareal). sposende, Portugal: 3 ej., 3,9 x 2,8 mm. IX/93 (intermareal). Vila do Conde, Portugal: 5 ej., 4,2 x 2 mm. IX/93 (intermareal). Aveiro, Portugal: 3 ej., 5,5 x 3,2 mm IX/93 (intermareal). Portinho de Arrabida, Portugal: 5 ej., 5,5 x 3,9 mm. X/96 (intermareal). Troia, Portugal: 1 ej., 9 x 5,5 mm V/88 (intermareal). Porto Covo, Portugal: 1 ej., 7 x 4 mm. VIII/93 (8 m) Arrifana, Portugal: 1 ej., 4 x 2,6 mm (VII/94 (5 m). Praia Mareta, Portugal: 10 ej., 5,5 x 3,6 mm. VII/94 (8 m). Praia do Burgao, Portugal: 6 ej., 12 x 7, 8 mm. VIII/93 (7 m). Praia do Lagos, Portuga): 1 ej., 3,1 x 2 mm. VIII/93 (17 m). Praia da Marinha, Portugal: 1 ej., 5,8 x 3,2 mm. IV/88 (intermareal); 4 ej., 8,3 x 4,7 mm. VIII/88 (intermareal). Praia do Hollos, Portugal: 10 ej., 6,2 x 3 mm. VIII/93 (intermareal). Mirador, Río Piedras: 1 ej., 3 x 2 mm. V/88 (intermareal). Aguas del Pino, Río Piedras: 1 ej., 6,3 x 3,8 mm VII/87 (intermareal); 4 ej., 10 x 5,5 mm. V/92 (intermareal); 6 ej., 12 x 7 mm. III/93 (intermareal). El Portil, Río Piedras: 3 ej., 13 x 8 mm. IV/91 (intermareal). Bahía de Cádiz: 1 ej., 6,5 x 4 mm. XI/90 (intermareal). 1 ej., 7 x 5 mm. VI/92 (intermareal). Cabo de Trafalgar, Cádiz: 1 ej., 8,2 x 3,3 mm. IX/95 (intermareal). Caños de Meca, Cádiz: 1 ej., 9 x 6 mm IV/94 (intermareal). Isla del Tajo, Cádiz: 2 ej., 5 x 4 mm. VII/92 (5 - 6 m). Playa del Chorro, Cádiz: 26 ej., 11 x 6 mm. VII/92 (intermareal). Isla de Tarifa, Cádiz: 1 ej., 3 x 2 mm. II/91 (3 m); 2 ej., 7,5 x 5 mm. I/93 (intermareal). La Ballenera, Cádiz: 4 ej., 15 x 9 mm. V/91 (intermareal). Campamento, Cádiz: 5 ej., 8 x 4 mm. III/91 (intermareal); 9 ej., 9 x 6 mm. VIII/91 (intermareal). MNCN: N° 1503/223: 10 ej., 19 x 10,5 mm. (La Coruña) (Colección: Azpeitia, 3184). N° 1503/225: 2 ej., 12 x 8 mm. (Tarifa, Cádiz) (Colección: Azpeitia, 3184). N° 1503/236: 4 ej., 12 x 7,5 mm. (Sangenjo, Pontevedra) (Colección: Azpeitia, 3184). N° 1503/287: 2 ej., 11 x 7 mm. (Cádiz) (Colección: Hidalgo). N° 1503/290: 5 ej., 13,5 x 7,5 mm. (Cascaes, Portugal) (Colección: Hidalgo). N° 1503/291: 3 ej., 9 x 5 mm. (Foz, Lugo) (Colección: Hidalgo). N° 1503/295: 4 ej., 13,5 x 7 mm. (Murgados, Coruña) (Colección: Hidalgo). N° 1503/298: 2 ej., 11 x 6 mm. (Setúbal, Portugal) (Colección: Hidalgo). N° 1503/299: 1 ej., 9 x 5 mm. (Vigo) (Colección: Hidalgo). N° 1503/301: 1 ej., 10 x 7,5 mm. (Bayona, Pontevedra) (Colección: Hidalgo). N° 1503/408: 1 ej., 11 x 7,5 mm. (Cascaes, Portugal) (Colección: Hidalgo). Sin N°: 3 ej.,. 19 x 11 mm. (España) (Colección: Hidalgo). Sin N°: 2 ej., 13,5 x 8 mm. (Inglaterra) (Colección: Azpeitia, 3184). Sin N°: 19 ej., 12 x 8 mm. (Isla la Toja, Pontevedra) (Colección: Azpeitia, 3184).

Referencias bibliográficas: Vigo, Coruña, sur de Portugal (MAC ANDREW, 1849; 1850); Vigo, (PILSBRY, 1892); Portugal (FORBES Y HANLEY, 1853; BUCQUOY, DAUTZENBERG Y DOLFUS, 1882; NOBRE Y BRAGA, 1942; PIANI, 1980); Algeciras

(CAPELLINI, 1859); Baiona (HIDALGO, 1867); Vigo, Portugal (JEFFREYS, 1865; 1880; 1882); Gibraltar y Algeciras (MONTEROSATO, 1888); Vigo (PILSBRY, 1892; MALUQUER, 1915); Algorta, Baiona, Coruña, Mugardos, San Sebastián, Santander, Santurce, Vigo, Zumaya, Cascais, Foz, Lisboa, Leça, Setúbal, Algarve, Cádiz y Algeciras (HIDALGO, 1917); Berlengas, Cascais, Balieira, Ría de Faro, y Olhao, (NOBRE, 1932; 1938-1940); costas Atlánticas de la Península Ibérica (MALATESTA, 1962; SABELLI, 1974); Costas Asturianas (ANADÓN, 1979); Galicia, Minho, Baixo Alentejo y Algarve (KAAS Y VAN BELLE, 1981); costa vasca (BORJA, 1983); Algarve (REIS Y MONTEIRO, 1984); Algeciras (AARTSEN *et al*, 1984); Galicia, Portugal y Andalucía (KAAS Y VAN BELLE, 1985b); Berlenga (PISANI, 1986); Illas Sisargas (OTERO Y TRIGO, 1986); Ría de Arousa (OTERO Y TRIGO, 1987); Illas Cíes, (ROLÁN *ET AL*, 1985); Ría de Pontevedra, Islas de Ons (TRIGO Y OTERO, 1987); Ría de Muros (OTERO Y TRIGO, 1989); Lourizán, Ría de Pontevedra (PLANAS Y MORA, 1989); Ría de Vigo (ROLÁN *ET AL.*, 1989); Ría de Ares y Betanzos (TRONCOSO y URRGORRI, 1991); Río Piedras (ESTACIO *ET AL.*, 1992); Enseado do Baño (OLABARRÍA *ET AL.*, 1997).

Lepidochitona corrugata (Reeve, 1847)

Chiton corrugatus Reeve, 1847, *Conch. Icon.* 4. [Localidad tipo: Mediterráneo].
Chiton cinereus Poli, 1791, *Test. Utr. Sicil.* 1: 4. [Localidad tipo: Sicilia].
Lophyrus melphinctensis Poli, 1791, *Test. Utr. Sicil.* 1: 4. [Localidad tipo: Sicilia].
Chiton crenulatus Risso, 1826, *Hist. Nat. Eur. Mérid.* 4: 267. [Localidad tipo: Nizza].
Chiton caprearum Scacchi, 1836 (fide Monterosato, 1879), *Cat. Conch. Regn. Napoli.*, 9. [Localidad tipo: Napoli].
Chiton polii Philippi, 1836, Enum. Moll. Sicil., 1: 106. [Localidad tipo: Sicilia].
Chiton decipiens Tiberi, 1877, Boll. Malac. Ital., 3: 14
Nuttallina (Middendorffia) cinerea var. *pseudorissoi* Carpenter (en Pilsbry, 1893), *Man. Conch.* 14: 285. [Localidad tipo: Malta].
Chiton (Nuttallina) (sic!) caprearum, Scacchi, 1836 var. *major* Pallary, 1900, *J. Conch. Paris*, 48: 366
Non: *Chiton cinereus* Linneo, 1767 = *Lepidochitona (L.) cinerea* (Linneo, 1767)
Non: *Chiton polii* Deshayes, 1833=*Chiton (Rhyssoplax) olivaceus* Spengler 1797

Material estudiado: El total de ejemplares recolectados ha sido de 69. Bahía de Cádiz: 10 ej., 14 x 9 mm VI/92 (intermareal); 8 ej., 14 x 9 mm, III/94 (intermareal). Isla de Tarifa, Cádiz: 2 ej., 3 x 1, 5mm, V/91 (intermareal); 1 ej., 3 x 1, 5 mm VI/91 (intermareal). Punta Carnero, Cádiz: 8 ej., 4 x 2, 5 mm. V/91 (intermareal). La Ballenera, Cádiz: 1 ej., 6 x 3, 7 mm. V/91 (intermareal). Puerto de Algeciras, Cádiz: 4 ej., 5, 5 x 4 mm, VIII/91 (6 m). Campamento, Cádiz: 1 ej., 10 x 7 mm. VIII/91 (intermareal). Crinavis, Cádiz: 2 ej., 8 x 4, 5 mm, VI/93 (10 m); 1 ej., 10, 5 x 6, 2 mm, VII/93 (10 m). MNCN: N° 1503/94: 1 ej., 18, 2 x 12 mm. (Mahón, Menorca, Baleares) (Colección: Hidalgo). N° 1503/227: 5 ej., 16 x 11 mm. (Alicante) (Colección: Azpeitia). N° 1503/228: 5 ej., 15. 5 x 9 mm. (Cartagena, Murcia) (Colección: Azpeitia, 413). N° 1503/464: 2 ej., 14 x 10 mm. (B. Columbreta) (Colección: Hidalgo). N° 1503/465: 4 ej., 14. 5 x 8. 5 mm. (Cartagena, Murcia) (Colección: Hidalgo). N° 1503/466: 4 ej., 13 x 8. 5 mm. (Valencia) (Colección: Hidalgo). N° 1503/467: 2 ej., 11 x 8 mm. (Barcelona) (Colección: Hidalgo). Sin N°: 4 ej., 13 x 8, 2 mm. (Valencia) (Colección: Azpeitia, 413). Sin N°: 4 ej., 11 x 7 mm. (Málaga) (Colección: Hidalgo).

Referencias bibliográficas: Portugal, (CAPELLINI, 1858; BUCQOUY, DAUTZENBERG Y DOLFUS, 1882; LOCARD, 1886); Lagos, Ría de Faro y Olhao, Cádiz (PILSBRY, 1892); Cádiz (MALUQUER, 1915); Océano Atlántico Ibérico (THIELE, 1929); Lagos, Ría de Faro, Olhao (NOBRE, 1938 - 1940); costas suratlánticas de la Península Ibérica, (MALATESTA, 1962); Costas meridionales Atlánticas españolas, (SABELLI, 1974); Algarve y Golfo de Cádiz, (KAAS Y VAN BELLE, 1981; 1985b); Algarve (REIS Y MONTEIRO, 1984); Algeciras (AARTSEN *ET AL.* 1984); Berlenga (PISANI, 1986).

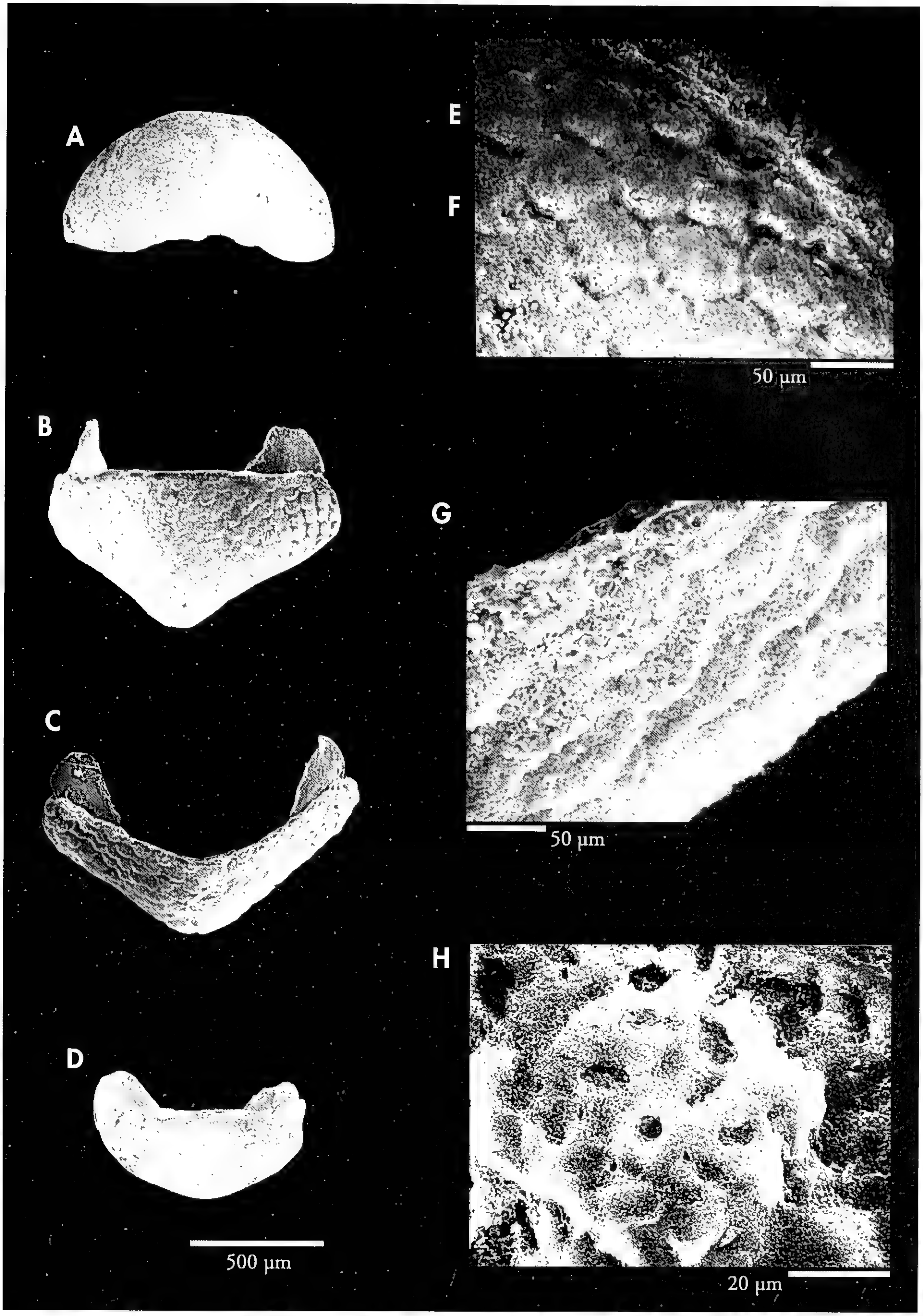

Figura 1. *Lepidochitona kaasi.* A: valva I; B: valva II; C: valva IV; D: valva VIII; E: disposición de los tubérculos en la valva I; F: disposición de las estetas en los tubérculos en la valva I; G: disposición de los tubérculos en la zona pleural; H: disposición de las megaloestetas y microestetas.
Figure 1. Lepidochitona kaasi. *A: valve I; B: valve II; C: valve IV; D: valve VIII; E: arrangement of the tubercles on valve I; F: arrangement of aesthetes on valve I; G: arrangement of tubercles on pleural area; H: arrangement of megaloaesthetes and microaesthetes.*

Lepidochitona simrothi (Thiele, 1902)

Nutallina (Middendorffia) simrothi Thiele, 1902, *Z. Wiss. Zool.* 72: 287. [Localidad tipo: Azores].

Material estudiado: Se ha estudiado un total de 6 ejemplares. Praia da Marinha (Portugal): 6 ej., 9, 8 x 7, 7 mm, IV/88 (intermareal).

Lepidochitona canariensis (Thiele, 1909)

Trachydermon canariensis Thiele, 1909, *Zoologica Stuttg.* 22: 15. [Localidad tipo: Tenerife].

Material estudiado: Se ha estudiado un total de 21 ejemplares. Arrifana, Portugal: 1 ej., 3, 7 x 2, 2 mm, VII/94 (intermareal). Praia Mareta (Sagres, Portugal): 6 ej., 4, 2 x 2, 9 mm, VII/94 (8 m). Isla Tarifa, Cádiz: 4 ej., 4, 8x3, 2 mm, VI/91 (intermareal). La Ballenera, Cádiz: 2 ej., 6, 5x4 mm, V/91 (intermareal); 1 ej., 7, 2 x 4 mm, IX/91 (12 m). Puerto de Algeciras, Cádiz: 1 ej., 3, 8 x 2, 2 mm, VIII/91 (6 m). Crinavis, Cádiz: 3 ej., 6, 1 x 4, 1 mm, III/93 (10 m); 1 ej., 4, 5 x 3 mm, V/93 (10 m); 1 ej., 4 x 2, 5 mm, VI/93 (10 m); 1 ej., 4 x 2 mm, IX/93 (10 m).

Lepidochitona monterosatoi Kaas y Van Belle, 1981

Lepidochitona (Mopaliella) sp. Van Belle, 1977, *Inf. Soc. belg. Malac.* 5 (2): 15-42.

Material estudiado: Se han estudiado un total de 50 ejemplares: Praia da Area Longa, Foz: 4 ej., 4, 2x2, 5 mm, II/84 (intermareal). Portocelo, Viveiro: 2 ej., 3, 5x2, 7 mm, VIII/83 (intermareal). Santa Cruz, Ría da Coruña: 1 ej., 4, 6x3, 4 mm, I/84 (intermareal). Punta do Cabo, Suevos: 1 ej., 4x2 mm, IV/78 (intermareal). Punta Chan, Malpica: 2 ej., 4, 5x3 mm, XI/83 (intermareal). Praia das Cunchas, Ría de Corme e Laxe: 1 ej., 4, 2x2, 8 mm, VIII/80 (intermareal). Punta dos Corvos, Ría de Camariñas: 1 ej., 4x2, 5 mm, II/83 (intermareal). Illa da Creba, Ría de Muros e Noia: 4 ej., 4, 4x2, 7 mm, XI/74 (1-4 m). Punta Aguieira, Ría de Muros e Noia: 1 ej., 3, 7x2, 1 mm, XII/74 (intermareal). Punta Sagrada, Ría de Muros e Noia: 6 ej., 5x3 mm, III/76 (intermareal). Aguiño, Ría de Arousa: 1 ej., 6x4 mm, III/92 (intermareal); 1ej., 2, 8x1, 5 mm, XII/83 (intermareal); 4 ej., 4, 5x2, 3 mm, VI/94 (intermareal). Marisma da Revolta, Ría de Arousa: 1 ej., 4x2, 5 mm, III/76 (intermareal). Praia Mexiloeira, Ría de Arousa: 2 ej., 3, 5x2, 5 mm, X/76 (2 m). Illa de San Clemente, Ría de Pontevedra: 1 ej., 4, 2x2, 6 mm, IV/76 (intermareal). Monteagudo, Illas Cíes: 1 ej., 4, 5x3, 4 mm, III/83 (intermareal). Enseada do Lago, Illas Cíes: 4 ej., 5x3 mm, III/83 (intermareal). Faro, Illas Cíes: 1 ej., 7x5 mm V/84 (intermareal). Canido, Ría de Vigo: 1 ej., 1, 7x1, 1 mm, XII/74; (intermareal); 3 ej., 7, 5x5, 5 mm, IX/76 (intermareal); 1 ej., 5x3 mm, IV/84 (intermareal). Praia Mareta, Portugal: 1 ej., 3, 8x2 mm, VII/94 (5 m). Isla Tarifa, Cádiz: 1 ej., 4, 8x3 mm, VI/91 (intermareal). La Ballenera, Cádiz: 2 ej., 5, 5x4 mm, V/91 (intermareal). Puerto de Algeciras, Cádiz: 3 ej., 7x5 mm, VIII/90 (6 m). El Rinconcillo, Cádiz: 1 ej., 3, 5x2 mm, VII/90 (3m). Crinavis, Cádiz: 1 ej., 6x3, 5 mm, IV/93 (11 m).

Lepidochitona iberica Kaas y Van Belle, 1981

Material estudiado: Se han estudiado dos ejemplares. SW da Illa da Arousa, Ría de Arousa: 1 ej., 2 x 1,5 mm, III/82 (8-28 m). Museum Leiden-Mollusca (paratipo) N1 5538512 (Ría de Arousa, VII/1962, 2,5 x 1 mm; 15 m).

Referencias bibliográficas: Ría de Arousa (Kaas y Van Belle, 1981); Galicia (Rolán, 1989; Otero y Trigo, 1989).

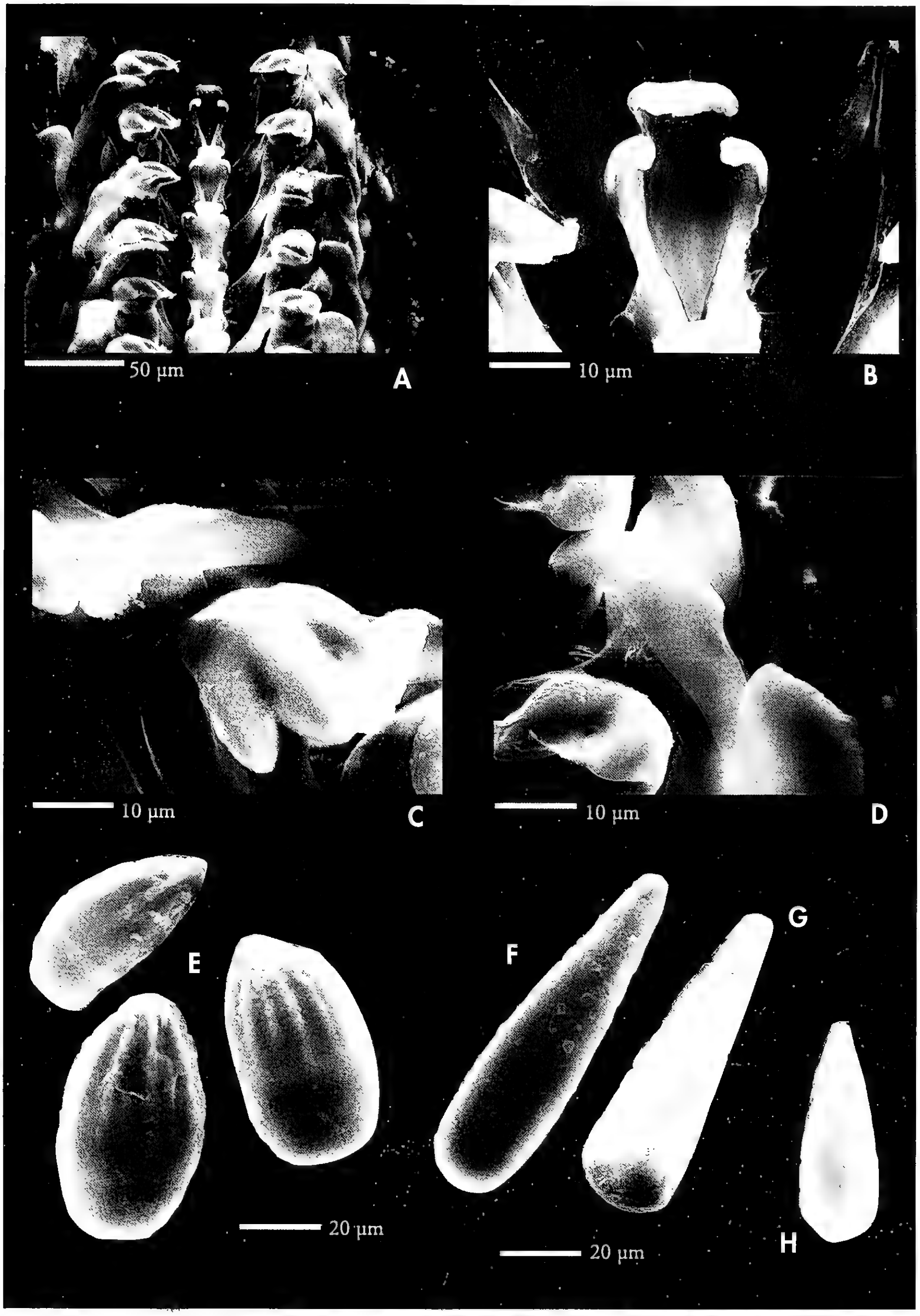

Figure 2. *Lepidochitona kaasi.* A: rádula; B: dientes raquídeo y primer lateral; C: placa uncinada del diente mayor lateral; D: diente plumoso; E: corpúsculos dorsales; F: espícula marginal, vista ventral; G: espícula marginal, vista dorsal; H: escama ventral.

Figure 2. Lepidochitona kaasi. *A: radula; B: rachidian and first lateral teeth; C: uncinal plate of the major lateral tooth; D: spatulate tooth; E: dorsal corpuscles; F: ventral view of the marginal spicules; G: dorsal view of the marginal spicules; H: ventral scales.*

Lepidochitona kaasi spec. nov.

Material estudiado: Se ha estudiado un total de 25 ejemplares: Isla Tarifa, Cádiz: 22 ej., 3,5 x 2 mm, VI/91 (intermareal); 3 ej., 2,9 x 1,7 mm, VII/95 (intermareal).
Se ha designado como holotipo el ejemplar de 3,0 x 1,5 mm, procedente de la Isla las Palomas de Tarifa (localidad tipo, 36° 01′ 8″ N; 05° 36′ 22″ O), que ha sido depositado en el Museo Nacional de Ciencias Naturales de Madrid con número de registro MNCN 15.03/486 y los restantes constituyen la serie paratípica, que se encuentra en la colección de del Departamento de Fisiología y Biología Animal de la Universidad de Sevilla.
Derivatio nominis: La especie ha sido denominada como *Lepidochitona kaasi,* dedicada al Doctor Piet Kaas, recientemente fallecido, y que dedicó la mayor parte de su vida al estudio de los poliplacóforos de todo el mundo.

Diagnosis: Ejemplares de hasta 3,5 x 2 mm. La coloración es parda, a veces con manchas blancas. El aspecto es ovalado, las valvas son redondeadas y no carenadas con el ápice muy marcado. La ornamentación está constituida por gránulos toscos redondeados. El perinoto es estrecho, con bandas alternas claras y oscuras.

Descripción (Figs. 1, 2): La valva cefálica muestra el borde anterior semicircular y el posterior triangular, con un ángulo muy obtuso (Fig. 1A). La pendiente de la valva tiende a ser convexa. El tegmento ofrece leves surcos radiales que recorren la valva hasta el margen. Las valvas intermedias son triangulares, en forma de V, con el borde anterior cóncavo (Fig. 1C) a excepción de la valva II (Fig. 1B) que tiende a ser recto, los laterales son ligeramente redondeados, y los márgenes posteriores concurren de forma casi recta en el ápice. Las áreas laterales sobresalen ligeramente de la central. La valva caudal (Fig. 1D) es de menor tamaño que la cefálica, el margen anterior tiende a ser recto y el posterior semicircular. El mucro, poco marcado, se encuentra en disposición central con una pendiente ligeramente convexa. Todas las valvas se caracterizan por presentar un reborde muy marcado del tegmento en la zona posterior de la cara ventral.

El tegmento ofrece una ornamentación constituida por toscos gránulos dispuestos en quincunce, con alguna variación en las distintas áreas de las valvas. En la valva cefálica, zona postmucral de la caudal y áreas laterales de las intermedias tienden a formar cadenas semicirculares concéntricas (Figs. 1E, F), mientras que en las áreas centrales y anteromucral se disponen en líneas que forman V concéntricas (Fig. 1 G). En los gránulos se dispone una megaloesteta central de 5 μm (σ: 0,38) de diámetro y en círculo concéntrico las microestetas de 1,3 μm (σ: 0,23) de diámetro (Fig. 1H). Entre los gránulos también se disponen de forma azarosa estas microestetas.

El articulamento es blanco aunque puede variar a pardo en la zona jugal. Los aleros son muy esponjosos y los dientes algo ondulados. Las apófisis son lisas, de forma triangular con los bordes algo redondeados en las valvas intermedias. Presenta entre 8 y 10 líneas de inserción en la valva cefálica, una en las intermedias y ninguna en la caudal, ofreciendo 8 ó 9 dientes dirigidos hacia delante.

El perinoto se caracteriza por la alternancia de bandas blancas y pardas. Está constituido por corpúsculos no imbricados, cilindrocónicos curvados, con una serie de costillas en ambas caras, que se disponen desde la mitad del corpúsculo hasta el borde apical. Su número varía entre 4 y 6 (Fig. 2E). El tamaño oscila entre 52 y 65 μm de altura y 20 y 30 μm de base. Las escamas ventrales ofrecen una forma cónica de 28 mm de altura y 10 mm de diámetro (Fig. 2H). El fleco marginal está formado por espículas cilíndricas con el borde terminal afilado, de un tamaño de 105 μm de longitud y 25 μm de diámetro. Se caracterizan por presentar estrías longitudinales en la cara dorsal (Fig. 2G) de la espícula y lisa por los laterales y la cara ventral (Fig. 2H).

Las branquias se clasifican como holobranquia abanales. Se han contabilizado hasta 14 branquias.

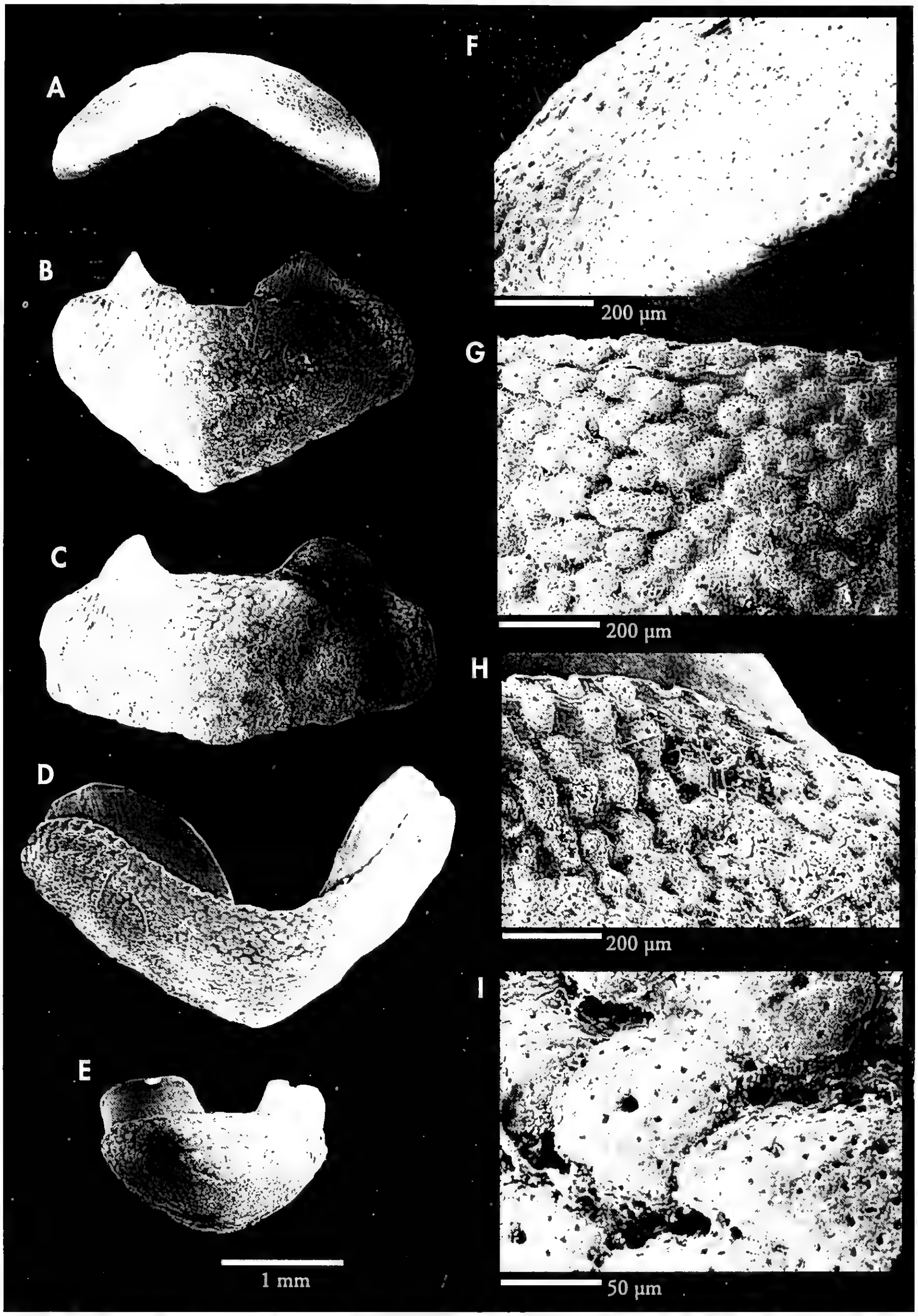

Figure 3. *Lepidochitona severianoi.* A: valva B; 2 valva II; C: valva IV; D: valva V; E: valva VIII; F: disposición de los tubérculos en la valva I; G: disposición de los tubérculos en la zona jugal; H: disposición de los tubérculos en la zona pleural; I: disposición de las megaestetas y microestetas.
Figure 3. Lepidochitona severianoi. *A: valve I; B: valve II; C: valve IV; D: valve V; E: valve VIII; F: arrangement of the tubercles on valve I; G: arrangement of the tubercles on the jugal area; H: arrangement of the tubercles on the pleural area; I: arrangement of megaesthetes and microesthetes.*

El diente radular raquídeo es alargado, con un borde terminal flexible. El primer lateral es más estrecho y de una longitud similar al central, aunque no lo sobrepasa por encontrarse insertado a un nivel más bajo (Figs. 2A, B). El diente mayor lateral presenta tres puntas de tamaños prácticamente iguales, aunque sobresale ligeramente la central (Fig. 2C). El diente plumoso que sobrepasa al diente mayor lateral, presenta el borde pectinado (Fig. 2D).

Biología: Solamente se han recolectado ejemplares en pozas de roquedos de la zona intermareal de la Isla de Tarifa.

Lepidochitona severianoi spec. nov.

Material estudiado: Se ha estudiado un total de 8 ejemplares: Caños de Meca, Cádiz: 1 ej. 9 x 5,2 mm, IX/93 (Intermareal). Islas de las Palomas, Cádiz: 1 ej., 8 x 5 mm, IX/92 (12 m). Punta Carnero, Cádiz: 1 ej. 4 x 2, 4 mm, V/91 (Intermareal). La Ballenera, Cádiz: 1 ej., 4 x 2,5 mm, V/91 (Intermareal). 1 ej., 7, 8 x 4 mm, IX/91 (12 m). Crinavis, Cádiz: 1 ej., 8 x 5 mm, V/93 (10 m); 1 ej. 4,6 x 2,5 mm, VI/93 (10 m); 1 ej. 5,5 x 3,5, X/93 (10 m).

Se ha designado como holotipo al ejemplar de 7,8 x 4 mm recolectado en la bahía de Algeciras (localidad tipo) que ha sido depositado en el Museo de Ciencias Naturales de Madrid con número de registro MNCN 15.03/487 y los restantes constituyen la serie paratípica que se encuentra en la colección de del Departamento de Biología Animal de la Universidad de Sevilla.

Derivatio nominis: La especie ha sido denominada como *Lepidochitona severianoi* dedicada a D. Severiano Carmona Cuñales.

Diagnosis: Ejemplares de talla media, de hasta 9 mm de longitud y 5,2 mm de anchura. La coloración es rosada con matices anaranjados muy pálidos y manchas pardas en la zona central de las valvas. La forma es ovalada, con las valvas redondeadas y las áreas laterales son patentes y elevadas, aunque normalmente se encuentran muy erosionadas. La ornamentación la forman gránulos redondeados de aspecto tosco, dispuestos en quincunce. Puede ofrecer de 3 a 4 costillas longitudinales en las áreas pleurales. Presenta 8 ó 9 surcos radiales en la valva cefálica y hasta 3 en las áreas laterales. La valva caudal es de menor tamaño. El aspecto del perinoto es granulado, constituido por corpúsculos no imbricados y lisos, entre los cuales sobresalen espículas aisladas o en penachos de dos o tres. El fleco marginal es poco patente.

Descripción (Figs. 3, 4): La valva cefálica ofrece el borde anterior en forma de un tercio de círculo (Fig. 3A). El margen posterior es triangular. La pendiente originada es fuertemente convexa. Se observan de 8 a 9 surcos radiales muy marcados, dispuestos desde el ápice hasta el margen anterior. La valva segunda es triangular (Fig. 3B). El resto de las valvas intermedias son rectangular, con el margen anterior ligeramente convexo, los laterales curvados y el posterior tiende a ser recto pues el ápice generalmente está erosionado (Figs. 3C, D). Las áreas laterales están fuertemente elevadas con respecto al área central y presentan surcos radiales obsoletos, en número de 2 a 3. En las áreas pleurales, pueden presentar hasta 4 costillas longitudinales patentes, aunque no en todas las valvas. La valva caudal, de menor tamaño que la cefálica, presenta el borde anterior algo convexo y el posterior semicircular (Fig. 3E). El mucro se posiciona de forma anterocentral y es poco prominente. La pendiente que origina el mucro es convexa.

La ornamentación de las valvas está constituida por toscos tubérculos redondeados dispuestos en quincunce en la zona jugal (Fig. 3G) y con tendencia a formar cadenas convergentes hacia el margen anterior en la zona pleural (Fig. 3H), perdiendo de esta forma la identidad de tubérculo redondeado. En las áreas laterales y valvas terminales se observa una tendencia a constituir cadenas concéntricas (Fig. 3F).

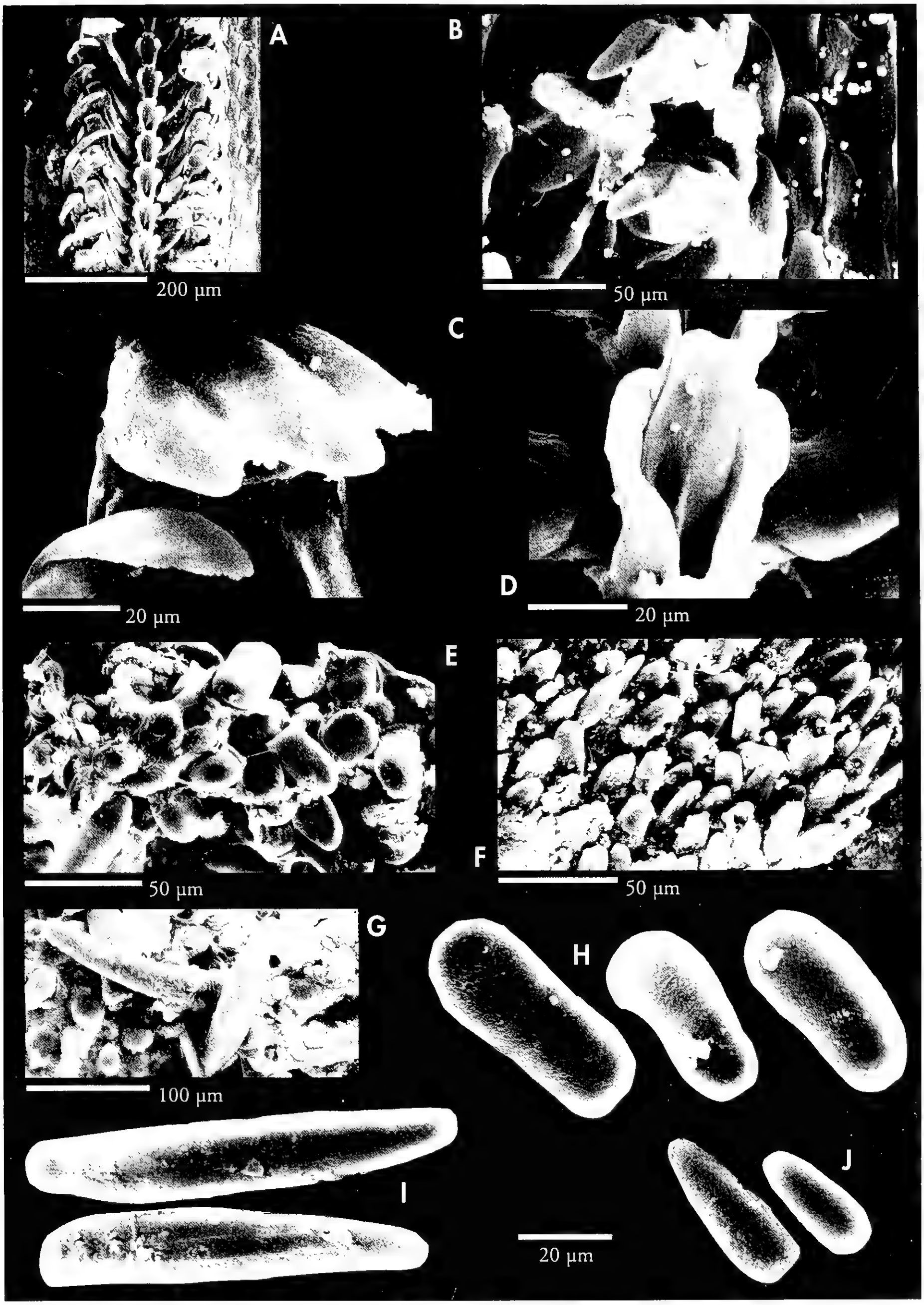

Figura 4. *Lepidochitona severianoi.* A, B: rádula; C: placa uncinada del diente mayor lateral y diente plumoso; D: dientes raquídeo y primer lateral; E: disposición de los corpúsculos dorsales; F: disposición de las escamas ventrales; G: espículas dorsales; H: corpúsculos dorsales; I: espículas marginales; J: escama ventral.

Figure 4. Lepidochitona severianoi. A, B: radula; C: uncinal plate of major lateral tooth and spatulate tooth; D: rachidian and first lateral teeth; E: arrangement of dorsal corpuscles; F: arrangement of ventral spicules; G: dorsal spicules; H: dorsal corpuscles; I: marginal spicules; J: ventral scales.

El diámetro de los gránulos es de 86,99 μm (σ: 5,92). En el centro se sitúa una megaloesteta de 9,3 μm (σ: 0,5) de diámetro. Las microestetas se disponen en círculos concéntricos alrededor de la megaloesteta, con un diámetro medio de 3,4 μm (σ: 0,83) (Fig. 3I).

El articulamento es de color blanco. Los aleros son esponjosos y los dientes fuertes y ligeramente ondulados, dirigidos hacia el centro en la valva caudal. En las valvas intermedias y cefálica se observa el reborde del tegmento de la zona del ápice sobre la articulamento. La forma de las apófisis varía desde triangulares en las valvas más anteriores a trapezoidal en las posteriores. Las líneas de inserción son patentes en todas las valvas, la fórmula es 8/1/9.

El perinoto ofrece bandas alternas de tonos claros y pardo anaranjado. Está constituido por corpúsculos lisos con forma de "almohadillas", con los bordes proximal y terminal redondeados y los laterales rectos, aunque pueden estar algo curvadas en posición convexa (Figs. 4E, H). El diámetro oscila entre 15 y 20 μm y la longitud de 25 a 50 μm. Entre ellas, se encuentran penachos de espículas dorsales curvadas y lisas, que pueden alcanzar tamaños de 200 μm (Fig. 4G). Las escamas ventrales son de aspecto triangular y lisas (Figs. 4F, J). Su tamaño varía entre 27 y 40 μm de altura y de 12 a 15 μm de ancho. El fleco marginal es poco patente, estando formado por espículas cilíndricas con el borde terminal agudo y estriadas dorsalmente por 5 costillas longitudinales. El rango de longitud es de 80 a 85 μm.

Las branquias se clasifican como merobranquia abanal. El numero de branquias en cada lado ha oscilado entre 10 y 14.

El diente radular raquídeo presenta forma rectangular, con una lengüeta flexible terminal estrecha (Figs. 4A, B). El primer lateral (Fig. 4D), a pesar de no sobrepasar al diente central, ofrece una mayor longitud, y es más estrecho que el diente raquídeo. El diente mayor lateral es tricúspide; la punta central sobresale en los dientes de nueva formación, mientras que en los más antiguos se encuentran al mismo nivel. El diente plumoso exhibe el borde terminal pectinado (Fig. 4C).

Biología: Se ha recolectado en zonas rocosas con abundancia de algas calcáreas. Algunos ejemplares se han encontrado cubiertos, casi en su totalidad, por este tipo de algas. Su distribución batimétrica se extiende desde la zona intermareal hasta 10 m de profundidad.

DISCUSIÓN

A las dos especies, *Lepidochitona kaasi* y *lepidochitona severianoi* se les ha clasifica dentro del género *Lepidochitona* por manifestar las características propias que definen Kaas y Van Belle (1981), distinguiéndose de *Dendrochiton* y *Spongioradsia* por no presentar los apéndices córneos ramificados en el perinoto.

Al comparar a *Lepidochitona kaasi* con otras especies de *Lepidochitona* del Atlántico Oeste, Sur Africa, Noroeste y Noreste del Pacífico, se comprueba que ninguna presenta las valvas intermedias en forma de V, característica marcada de los ejemplares de esta especie.

Con respecto a las especies del Atlántico Oriental, por su aspecto externo se puede confundir en un principio con *L. corrugata, L monterosatoi, L. simrothi* y *L. iberica*, descartándose de *L. cinerea, L. canariensis, L. furtiva, L. stromfelti* y *L. severianoi* porque éstas presentan las valvas intermedias claramente rectangulares. Al estudiar los corpúsculos calcáreos dorsales del perinoto, se determina que por la forma son diferentes a los de *L. piceola*. De igual manera, se puede distinguir de *L. simrothi*, ya que la especie en cuestión no presenta espículas calcáreas entre los corpúsculos del perinoto y el tamaño de las espículas marginales y escamas ventrales es menor.

Al desmontar las valvas, se observa que no presenta líneas de inserción en la valva VIII, lo que la diferencia de *L.*

iberica y *L. monterosatoi*. Comparándola con *L. corrugata*, a pesar de ser diferente la forma de las valvas intermedias, se distingue por el número de costillas de los corpúsculos dorsales del perinoto y el tamaño de éstos, por el nivel de inserción de las branquias y disposición y tamaños de los dientes raquídeos y primer lateral de la rádula.

Comparando *Lepidochitona severianoi* con las especies de *Lepidochitona* del Atlántico Oeste, Sur Africa y Noroeste y Noreste del Pacífico, se diferencia porque las que presentan costillas en la zona pleural también presentan estriados los corpúsculos del perinoto.

Con respecto a las especies del Atlántico Oriental, partimos de la base que ninguna de ellas presenta costillas en la zona pleural y los corpúsculos del perinoto son estriados en todas. No obstante por su aspecto externo tosco se puede confundir en un principio con *L. corrugata, L monterosatoi, L. piceola, L. simrothi, L. iberica* y *L. kaasi*, descartándose del resto de las especies que son de apariencia más finas. Sin embargo por la forma de las valvas, que la presentan en V, se excluye *L. piceola, L. simrothi, L. iberica* y *L. kaasi*.

En relación con el articulamento, *L. corrugata* no ofrece las líneas de inserción de la valva caudal, por lo que se diferencia de *L. severianoi*. Y con respecto a *L. monterosatoi* se distingue porque esta especie no presenta las áreas laterales tan elevadas, ni costillas en la zona pleural y los corpúsculos del perinoto se encuentran estriados en el tercio terminal.

Estas diferencias de *L. kaasi* y *L. severianoi* con el resto de las especies de este género, es lo que nos lleva a proponerlas como nuevas especies para la ciencia.

BIBLIOGRAFÍA

AARTSEN, J., MENKHORST H. Y GITTENBER, E., 1984. The Marine Mollusca of the Bay of Algeciras, Spain, with general notes on *Mitrella*, Marginellidae and Turridae. *Basteria*. 2: 1-135.

ANADON, N., 1979. Poliplacoforos de las costas Asturianas. I, Estudios taxonómicos. *Sup. Cien. Bol. Idea*. 24: 119-130.

BERRY, S. S., 1917. Notes on West American chitons. I. *Proceeding California Academy of Science*, 7 (10): 229-248.

BORJA, A., 1983. *Sistemática de los moluscos marinos de la costa vasca. Clave de moluscos de la zona intermareal.* Publicaciones de la Sociedad cultural INSUB, 2 San Sebastián.

BUCQUOY, M. M. E., DAUTZENBERG, P. H. Y DOLLFUS G., 1882: *Les Mollusques marins du Roussillon*. Vol I. Paris (Bailliere).

CAPELLINI, J., 1859. Catalogue des Oscabriones de la Mediterranée. *Journal de Conchologia de Paris*, 2 ser., 3: 320-328.

ESTACIO, F., CARBALLO, J. L., CARMONA, P. Y ZURITA, F., 1993. Preliminary study about the aquatic fauna from the Piedras river marshes (Huelva, SW Spain). *Arquivos do Museo de Bocage*, 2 (18): 337-343.

FERREIRA, A. J., 1982. The Family Lepidochitonidae Iredale, 1914 (Mollusca: Polyplacophora) in the Eastern Pacific. *Veliger*, 25 (2): 93-138.

FORBES, E. Y HANLEY, S., 1853-55. *History of British mollusca and their shells*. 4. Vols figs. London (John Van Voorst).

HIDALGO, J. G., 1867. Catalogue des coquilles marines des costes de l'Espagne et des Iles Baleares. *Journal de Conchologia*. 15: 416 pp.

HIDALGO, J. G., 1917. Fauna malacológica de España, Portugal y las Baleares: Moluscos Testáceos Marinos. *Trabajo del Museo Nacional de Ciencias Naturales, serie Zoológica, Madrid*, 30: 752 pp.

IREDALE, T., 1914. Some more notes on Polyplacophora. Part I. *Proceeding of the malacological Society of London*. 11: 123-131.

JEFFREYS, J., 1865. *British Conchology, or an account of the Mollusca which now inhabit the British Isles and the Surrounding Seas*. Vol. III. London. John Van Voorst, Paternoster Row. 211-229.

JEFFREYS, J., 1880. On a new Species of Chiton lately found on the British Coasts. *Annals and Magazine of Natural History*. Serie 5 (6). 33-35.

JEFFREYS, J., 1882. On the Mollusca procured during the "Lightning" and "Porcupine" Expeditions, 1868-70. *Proceedings of the Zoological Society of London*: 656-687.

KAAS, P. y VAN BELLE, R. A., 1981. The genus *Lepidochitona* Gray, 1821 (Mollusca: Polyplacophora) in the northeastern Atlantic Ocean, the mediterranean Sea and Black Sea. *Zoologische Verhandelingen*, 43 pp.

KAAS, P., y VAN BELLE, R. A., 1985. *Monograph of living chitons. 2, Suborder Ischnochitonina, Ischnochitonidae: Schizoplacinae, Callochitoninae y Lepidochitoninae.* E. J. Brill/W Backhuys, Leiden. 198 pp.

LOCARD, A., 1898. Mollusques Testaces. Expedition scientifique du "Travailleur" et du "Talisman" pendant les anées 1880-1883, 2: 1-515, pls 1-18 (París) Matthews, E. H. 1897. Exhibits. *Journal Conchology of London,* 8: 378 pp.

MAC ANDREW, R., 1849. On the Mollusca of Vigo Bay in the North-West of Spain. *Annals and Magazine of Natural History,* ser. 2 (3): 507-512.

MAC ANDREW, R., 1850. Notes on the Distribution and range in depth of Mollusca and other Marine animals observed on the coast of Spain, Portugal, Barbary, Malta, and Southern Italy in 1849. *Report British Association Advance Science,* 8: 264-304.

MALATESTA, A., 1962. Mediterranean Polyplacophora Cenozoic and Recent. *Geologia romana,* 1: 145-171.

MALUQUER, J., 1915. Amfineures de Catalunya. *Treballs de la Institució Catalana d' Historia natural,* 186-280.

MONTEROSATO, T. A. DI., 1888. Coquilles marines Marocaines. *Journal de Conchyologie,* 37 (1): 20-40.

NOBRE, A., 1932. Moluscos Marinhos de Portugal. *Instituto Zoologico de la Universidad de Porto*: 1-466.

NOBRE, A., 1938-40. *Fauna malacologica de Portugal. Moluscos Marinhos e das aguas salobras.* Companhia Editora do Minho, Porto.

NOBRE, A. Y BRAGA, J. M. 1942. Notas sobre a fauna das ilhas Berlengas e Farilhoes. *Memoria Est. do Museo Zoologico da Universidad do Coimbra,* N1 138: 1-66.

OLABARRIA, C., URGORRI, V. Y TRONCOSO, J. S., 1997. Distribución y autoecología de la malacofauna infralitoral de la Ensenda do Baño (Ría de Ferrol, NO de España). *Nova acta científica compostelana (Bioloxia),* 7: 177-192.

OTERO, J. J. Y TRIGO, J. E., 1986. Contribución al conocimiento de los Moluscos de las Islas Sisargas. *Iberus,* 6: 19-27.

OTERO, J. J. Y TRIGO, J. E., 1987. Adiciones a la fauna malacológica de la Ría de Arousa (No de España). *Iberus,* 7 (1): 129-135.

OTERO, J. J. Y TRIGO, J. E., 1989. Moluscos de la Ría de Muros. *Thalassas,* 7: 79-90.

PIANI, P., 1980. Catalogo dei molluschi conchiferi viventi nel Mediterraneo. *Bolletino malacologico Milano,* 16 (5-6): 113-224.

PILSBRY, H. A., 1892-1893. Monograph of the Polyplacophora. In: *Tryon,* G. W.: *Manual of Conchology,* 1. Academy of Natural Sciences, Philadelphia, 331 pp.

PISANI, L., 1986. Moluscos Testáceos Marinhos da Berlanga (Portugal). MPAT. Secretaria de Estado do Ambiente e dos Recursos Naturais. *Serviço Nacional de Parques, Reservas e Conservaçao da Natureza.* Lisboa.

REIS, C. A. Y MONTERO, A. J., 1984. Aspectos ecologicos dos polyplacophora (Mollusca) da costa portuguesa. *Actas do IV Simposio Iberico de Estudos do Benthos Marinhos.* I: 219-227.

ROLÁN, E., TRIGO, J., OTERO-SCHMITT, J. Y ROLÁN-ÁLVAREZ, E., 1985. Especies implantadas lejos de su área de distribución natural. *Thalassas.* 3: 29-36.

ROLÁN, E., OTERO, J. Y ROLÁN-ÁLVAREZ, E., 1989. Moluscos de la Ría de Vigo II. *Thalassas.* Anexo II. 276 pp.

SABELLI, B. A., 1974. Origine e distribuzione dei Poliplacophora viventi in Mediterraneo. *Quaderni civico Staz. Idrobiologi Milano,* 5: 71-78.

THIELE, J., 1929. *Handbuch der systematischen Weichtierkunde.* Classis Loricata. Smithsonian Institution Libraries and The National Science Foundation. Washington. 1992. 1-22.

TRIGO, J. E. Y OTERO, J. J., 1987. Contribución al conocimiento de los moluscos matrinos de la Ría de Pontevedra e Isla de Ons. *Iberus,* 7 (1): 121-128.

TRONCOSO, J. S. Y URGORRI, V., 1991. Los moluscos intermareales de la Ría de Betanzos (Galicia, España). *NACC (Bioloxia).* 2: 83-89.

VAN BELLE, R. A., 1977. Sur la clasification des Polyplacophora. *Informations de la Société belge de Malacologia.* 5 (2): 15-42.

WINCKWORTH, M. A., 1932. The Britisth marine Mollusca. *Journal of Conchology,* 19 (7): 211-252.

Descripción de *Trochoidea (Xerocrassa) roblesi* spec. nov. (Mollusca, Gastropoda, Hygromiidae) de la Comunidad Valenciana (España)

Description of *Trochoidea (Xerocrassa) roblesi* spec. nov. (Mollusca, Gastropoda, Hygromiidae) from "Comunidad Valenciana" (Spain)

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RESUMEN

Se describe una nueva especie de Hygromiidae, *Trochoidea (Xerocrassa) roblesi* spec. nov., endemismo valenciano que se ha recolectado en varias localidades de la Sierra Calderona, en la provincia de Valencia. Se caracteriza por su concha pequeña, parduzca con flamulaciones blanquecinas y abundante pilosidad. Genitalia con la porción masculina y el conducto de la bolsa copulatriz de gran longitud. Se compara con otras especies de la misma familia como *Trochoidea (Xerocrassa) penchinati* (Bourguignat, 1868), *T. (X.) ripacurcica* (Bofill, 1886), *T. (X.) salvanae* (Fagot, 1886) y *Microxeromagna armillata* (Lowe, 1852), con las que guarda alguna similitud conquiológica o de la genitalia.

ABSTRACT

A new species from Hygromiidae, *Trochoidea (Xerocrassa) roblesi* spec. nov., is described, a Valencian endemism which has been collected in various localities of the Sierra Calderona, in Valencia (Spain). It is characterised by its small, brown shell with white streaks and abundant hair. Genitalia with the masculine section and copulatrix bursa's duct in great length. The *Trochoidea (X.) roblesi* spec. nov. is compared to other species of the same family such as, *Trochoidea (X.) penchinati* (Bourguignat, 1868), *T. (X.) ripacurcica* (Bofill, 1886), *T. (X.) salvanae* (Fagot, 1886) and *Microxeromagna armillata* (Lowe, 1852), with those which have some conquiological or genitalial similarity.

PALABRAS CLAVE: Mollusca, Hygromiidae, *Trochoidea roblesi*, especie nueva, Comunidad Valenciana, España.
KEY WORDS: Molluscs, Hygromiidae, *Trochoidea roblesi*, new species, "Comunidad Valenciana", Spain.

INTRODUCCIÓN

Durante los últimos 10 años el autor ha realizado un intensivo muestreo por toda la Comunidad Valenciana, con el propósito de estudiar la malacofauna terrestre presente en esta región, situada en el este de la Península Ibérica. Uno de los resultados obtenidos destacables ha sido el hallazgo de una nueva especie, perteneciente al género *Trochoidea* Brown, 1827 (MARTÍNEZ-ORTÍ, 1999).

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Este género se caracteriza por presentar una variabilidad conquiológica tan acusada que no permite realizar una descripción a nivel genérico satisfactoria. En su genitalia destaca la presencia de un aparato estimulador constituido por dos sacos sin dardos, dispuestos a ambos lados de la vagina, con sus bases contiguas o alejadas, incluyendo todas las posiciones intermedias, y dos a cuatro glándulas mucosas simples o bifurcadas dispuestas alrededor de la vagina (PUENTE, 1994).

En la Comunidad Valenciana se han hallado 12 especies atribuidas al género *Trochoidea*, tres del subgénero *Trochoidea* s. str. y nueve de *Xerocrassa* Monterosato, 1892 (MARTÍNEZ-ORTÍ Y ROBLES, 1998) siguiendo los criterios de FORCART (1976). Así, el nuevo taxon se asigna a *Xerocrassa* por la ausencia de apéndice atrial.

Dado el número elevado de especies del subgénero *Xerocrassa* presentes en la Comunidad Valenciana, el nuevo taxon se ha comparado con las especies que presentan características conquiológicas o del aparato reproductor similares.

SISTEMÁTICA

Género *Trochoidea* Brown, 1827

Subgénero *Xerocrassa* Monterosato, 1892

Trochoidea (Xerocrassa) roblesi spec. nov.

Localidad tipo: Náquera: La Fonteta, (263V), 30SYJ2292, 260 m, 25 ejemplares y 19 conchas.

Material tipo: Holotipo depositado en el Museu Valencià d´Història Natural (MVHN) de València con N° 401-A; 36 paratipos depositados en el MVHN (20 ejemplares y 16 conchas), N° 401-B; 2 paratipos (ejemplares) en el Museo Nacional de Ciencias Naturales de Madrid con N° 15.05/32055; 3 paratipos (2 ejemplares y una concha) en el Nationaal Natuurhistorisch Museum de Leiden (Holanda) con N° 59157; 2 paratipos (conchas) en el Museo de Geología de la Universitat de València con N° 5751. Todos ellos proceden de la misma localidad que el holotipo.

Otras localidades: Olocau: Barranco de Olocau (258V), 30SYJ1197, 260 m, 1 concha; Náquera: Fuente del Salt (271V), 30SYJ2293, 280 m, 1 ejemplar y 2 conchas. Serra: Fuente del Berro (262V), 30SYJ1698, 4 conchas.

Etimología: Especie dedicada al Doctor Fernando Robles Cuenca por su larga trayectoria en el estudio de los moluscos valencianos y por sus consejos y ayuda para llevar a cabo mi proyecto de Tesis doctoral.

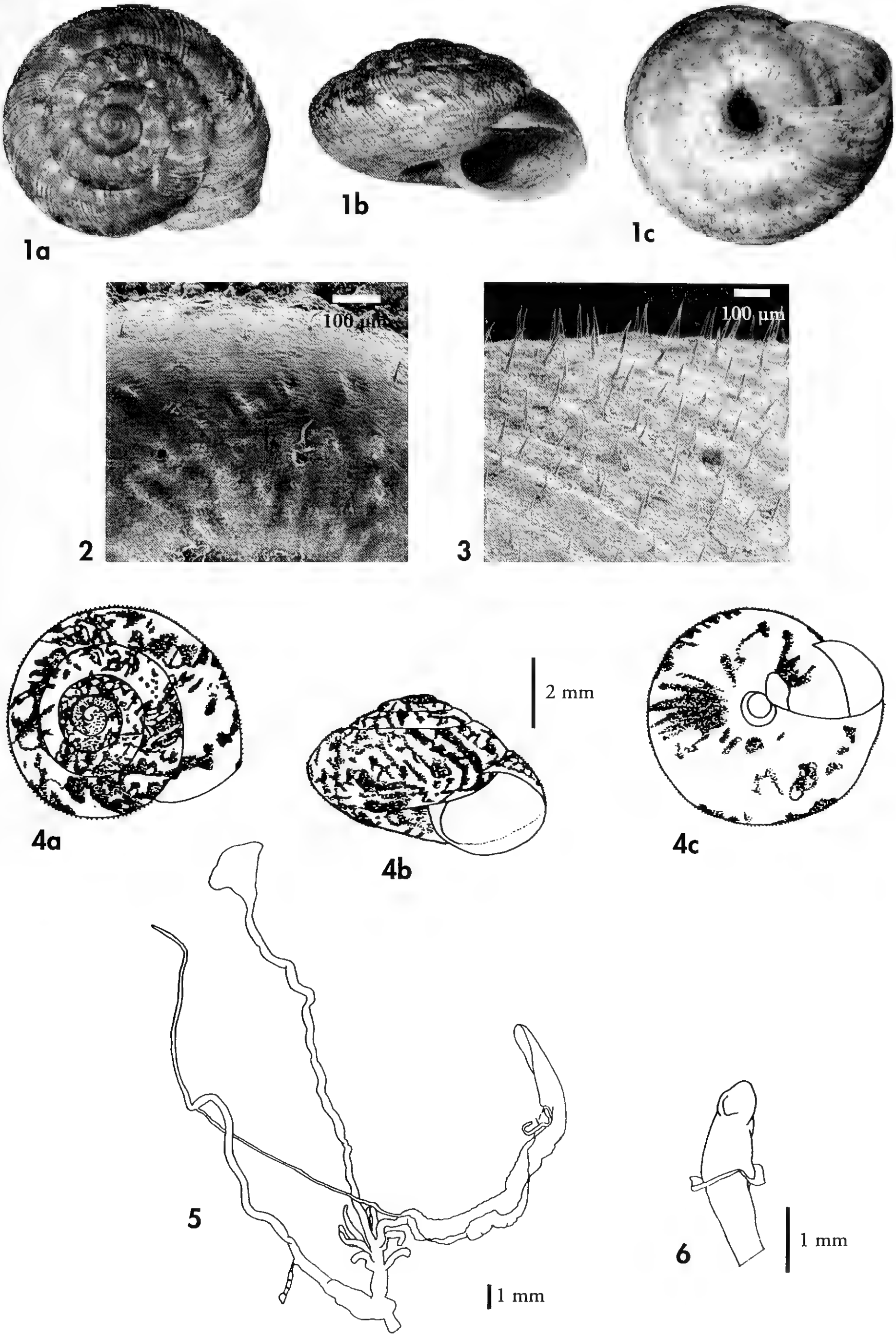
Diagnosis: Concha pequeña, de coloración parduzca con pequeñas flamulaciones blanquecinas y recubierta por una pilosidad diminuta y abundante. La genitalia está caracterizada por una gran longitud del conjunto pene, epifalo y flagelo, y del conducto de la bolsa copulatriz.

Descripción:

Concha (Figs. 1-4): dextrógira, subglobosa cónica de pequeño tamaño, con 4 a 5 vueltas de espira, de crecimiento regular, con una ligera quilla en la última vuelta. Protoconcha formada por 1 $^{1}/_{4}$ vueltas, con flamulaciones y presencia de una diminuta pilosidad menos abundante que en la teloconcha.

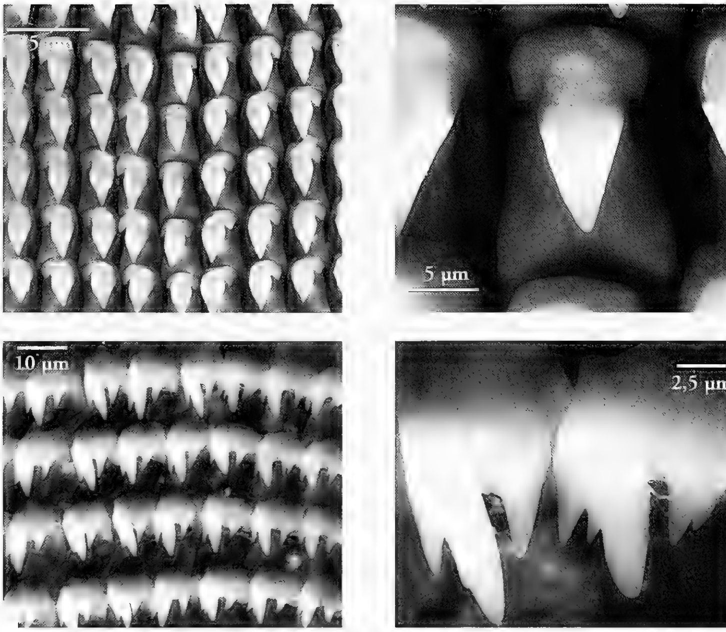
Abertura oval, con el peristoma interrumpido, simple, cortante y sin reborde interno. Ombligo pequeño, entre 1,20 y 1,50 mm de diámetro, parcialmente oculto por la reflexión del peristoma, que posee una anchura máxima de 1 mm, dejando ver el interior del ombligo.

La superficie de la teloconcha posee una ligera y fina costulación. Coloración parduzca con numerosas flamulaciones blanquecinas de pequeño tamaño, sobre todo en la zona más próxima al ápice y que forman bandas a lo largo de toda la concha en ambas caras, si bien en la umbilical se forma un reticulado. Presenta una abundante pilosidad constituida por pelos cortos, curvados en su



Figuras 1-6. Holotipo de *Trochoidea (Xerocrassa) roblesi* spec. nov. 1a-c: Concha (4,77 mm h; 7,52 mm Ø); 2: protoconcha; 3: teloconcha; 4a-c: dibujo de la concha; 5: aparato genital; 6: papila penial.
Figures 1-6. Holotype of Trochoidea (Xerocrassa) roblesi *spec. nov. 1a-c: Shell (4.77 mm h; 7.52 mm Ø); 2: protoconch; 3: teloconch; 4a-c: drawing of the shell; 5: genital system; 6: penial papilla.*

7 8 9 10



Figuras 7-10. Rádula del Holotipo de *Trochoidea (Xerocrassa) roblesi* spec. nov. (M.E.B.) 7: dientes central y laterales; 8: diente central; 9: dientes marginales; 10: diente marginal.
Figures 7-10. Holotype radula of Trochoidea (Xerocrassa) roblesi *spec. nov. (S.E.M). 7: central and lateral teeth; 8: central tooth; 9: marginal teeth; 10: marginal tooth.*

extremo más distal, que se presentan alineados siguiendo las estrías colabrales.

Las dimensiones oscilan entre 3,73 y 4,89 mm de altura y 6,66 y 7,84 mm de diámetro. Holotipo, 4,77 mm de altura y 7,52 mm de diámetro.

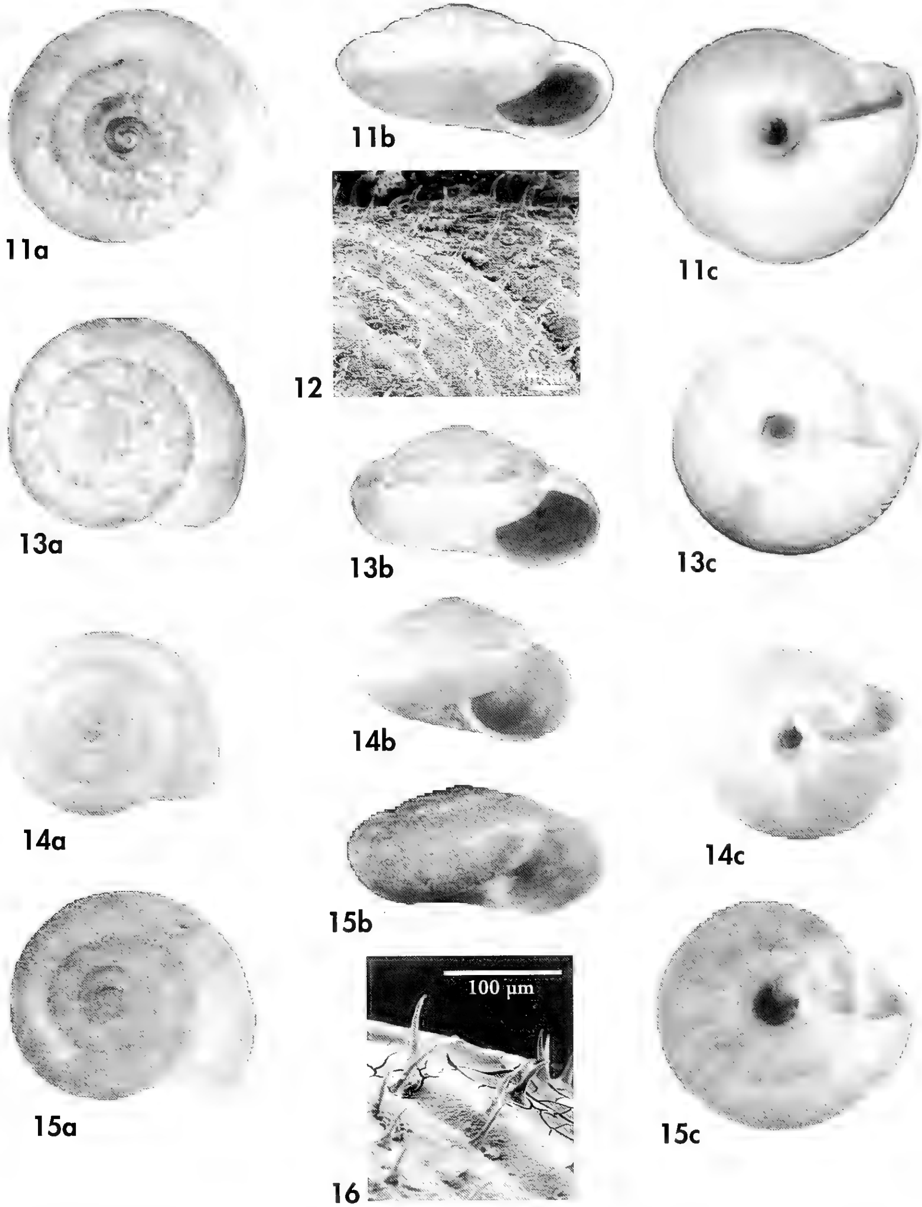
Aparato genital (Figs. 5, 6): El esquema general de la genitalia, cuyo estudio anatómico se ha realizado sobre siete ejemplares, es similar al de las restantes especies de *Trochoidea (Xerocrassa)* (Fig. 5).

En el atrio, corto, aparece un ensanchamiento de la pared en la zona enfrentada al pene, que se presenta en algunas otras especies del género *Trochoidea* y que posiblemente pueda estar relacionado con la eversión del pene, ya que únicamente se ha observado en ejemplares que ya han copulado.

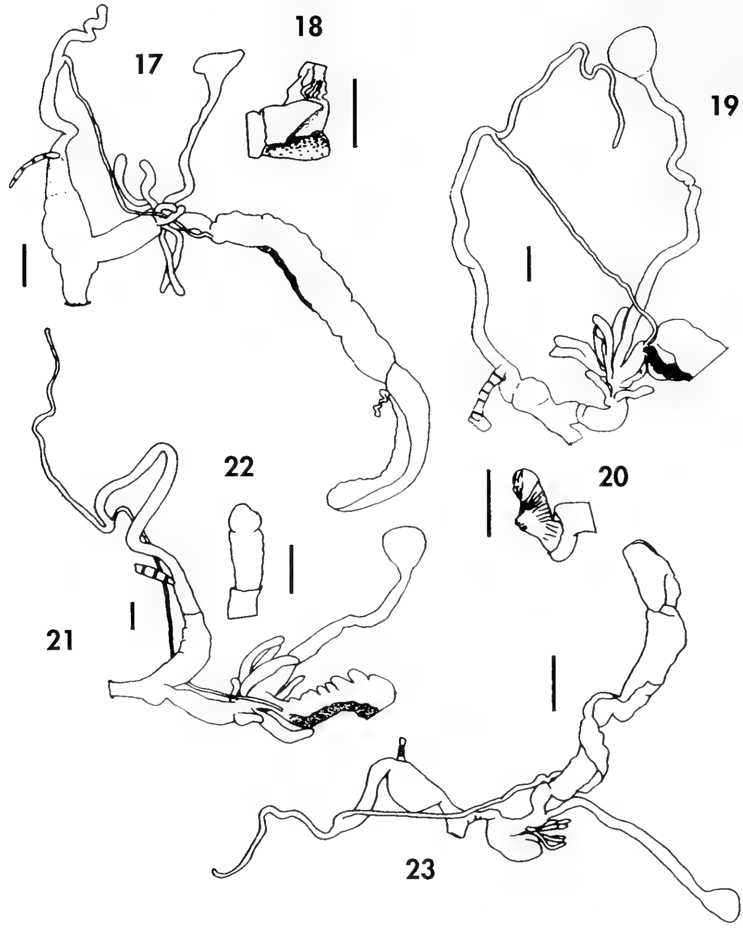
Vagina desde 2,2 hasta 3,05 mm de longitud, en cuya zona media o en la más próxima a la inserción con el conducto de la bolsa copulatriz se insertan los dos sacos del dardo, a ambos lados relativamente distanciados, curvados, rudimentarios, de 1,35 mm de longitud máxima, con un engrosamiento basal y carentes de dardo. El oviducto libre es corto, curvado, de 1 a 1,2 mm, formando un fuerte pliegue.

Las glándulas mucosas, que se presentan insertadas en la vagina, se reúnen en cuatro troncos independientes. Se han encontrado seis glándulas, dos de ellas bifurcadas y con una longitud máxima de 2,9 mm.

El conjunto pene, epifalo y flagelo tiene una longitud considerable. El pene proporcionalmente pequeño, tiene una longitud entre 2,65 y 3,55 mm. En su interior se presenta una papila penial corta, cónica, en ocasiones curvada, de 1,25 mm de longitud y con la abertura subapical (Fig. 6). El epifalo presenta una longitud comprendida entre 6,25 y 10,5 mm y el flagelo varía entre 5,5 y 10,05 mm. El conducto deferente presenta una longitud entre 7,60 y 10,75



Figuras 11-16. Conchas. 11a-c: *Trochoidea (Xerocrassa) penchinati* (3,09 mm h; 6,19 mm Ø), Tibi, Les Casetes, Nº 89A; 12: teloconcha de *T. (X.) penchinati* (M.E.B., Nº 89A); 13a-c: *T. (X.) ripacurcica* (5,7 mm h; 10,6 mm Ø*)*, Fredes, Barranco del Salt, Nº 205C; 14a-c: *T. (X.) salvanae* (4,54 mm h; 6,88 mm Ø), Utiel, ermita Virgen del Remedio, Nº 299V; 15a-c: *M. armillata* (2,7 mm h; 5,16 mm Ø), Ayora, Meca, Nº 169V; 16: teloconcha de *M. armillata* (M.E.B., Nº 169V), colección Martínez-Ortí.
Figures 11-16. Shells. 11a-c: Trochoidea (Xerocrassa) penchinati *(3.09 mm h; 6.19 mm Ø), Tibi, Les Casetes, Nº 89A; 12: teloconch of* T. (X.) penchinati *(S.E.M., Nº 89A); 13a-c:* T. (X.) ripacurcica *(5.7 mm h; 10.6 mm Ø), Fredes, Bco. del Salt, Nº 205C; 14a-c:* T. (X.) salvanae *(4.54 mm h; 6.88 mm Ø), Utiel, ermita Virgen del Remedio, Nº 299V; 15a-c:* M. armillata *(2.7 mm h; 5.16 mm Ø), Ayora, Meca, Nº 169V; 16: teloconch of* M. armillata *(S.E.M.), Martínez-Ortí collection.*

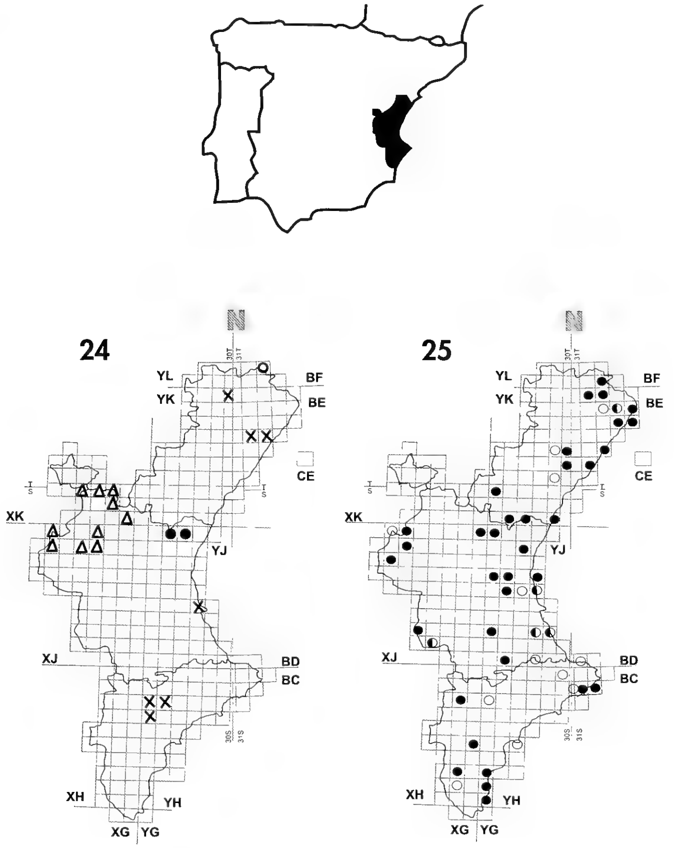


Figuras 17-23. Aparato genital de: 17. *Trochoidea (Xerocrassa) penchinati*. Tibi: Cabezo de la Alcocha, Nº 202. 18. Papila penial de *T. (X.) penchinati*, Nº 202. 19. *T. (X.) ripacurcica*. Fredes: Barranco del Salt, Nº 205C. 20. Papila penial de *T. (X.) ripacurcica*. 21. *T. (X.) salvanae*. Aras de Alpuente: ermita Santa Catalina, Nº 267V. 22. Papila penial de *T. (X.) salvanae*, Nº 267V. 23. *M. armillata*. La Loberuela: entrada, Nº 189V. (e= 1 mm).
Figures 17-23. Genital system of: 17. Trochoidea (Xerocrassa) penchinati. Tibi. Cabezo de la Alcocha, Nº 202. 18. Penial papilla of T. (X.) penchinati, Nº 202. 19. T. (X.) ripacurcica. Fredes: Barranco del Salt, Nº 205C. 20. Penial papilla of T. (X.) ripacurcica. 21. T. (X.) salvanae. Aras de Alpuente: ermita Santa Catalina, Nº 267V. 22. Penial papilla of T. (X.) salvanae, Nº 267V. 23. M. armillata. La Loberuela: entry, Nº 189V. (b= 1 mm).

mm. Músculo retractor del pene corto, inferior a 2 mm de longitud.

El conducto de la bolsa copulatriz presenta una gran longitud, llegando a alcanzar entre 11,4 y 15,25 mm. La bolsa copulatriz, sin espermatóforo en su interior, es de aspecto redondeado y presenta unas dimensiones de 1,60 mm de ancho por 2,05 mm de alto. Sin embargo, con espermatóforo presente ésta puede deformarse hasta alcanzar 2,35 mm de ancho y 2,50 mm de longitud.

Otros caracteres: El cuerpo es de color blanquecino sin pigmentación aparente.



Figuras 24, 25. Localización geográfica de 24: *Trochoidea (Xerocrassa) roblesi* spec. nov. (puntos), *T. (X.) ripacurcica* (circulo vacío), *T. (X.) penchinati* (aspas), *T. (X.) salvanae* (triángulos); 25: *M. armillata.* (círculos llenos: nuevas localidades; círculos vacíos: localidades citadas; círculos semivacíos: ambas). *Figures 24, 25. Geographic location in the "Comunidad Valenciana" of 24:* Trochoidea (Xerocrassa) roblesi *spec. nov. (points),* T. (X.) ripacurcica *(empty circle),* T. (X.) penchinati *(crosses),* T. (X.) salvanae *(triangles); 25:* M. armillata *(full circles: new localities; empty circles: cited localities; half-empty: both).*

Pie de tipo holópoda. Presenta el músculo retractor del ommatóforo derecho independiente del aparato genital.

La mandíbula del holotipo es de tipo odontognato, con 0,50 mm de anchura, arqueada y con once costillas.

La rádula del holotipo presenta 1,70 mm de longitud y 0,50 mm de anchura (Figs. 7-10) con la siguiente fórmula radular: 13M+12L+C+15L+16M. Como se puede observar la fórmula radular del holotipo es asimétrica. La hemirrádula derecha está constituida por 25 dientes de los cuales 12 corresponden a dientes laterales y 13 a marginales. La fila 15 presenta dientes de morfología anómala. La hemirrádula izquierda está constituida por 31 dientes de los cuales 15 corresponden a los laterales y 16 a los marginales. La fila 27 presenta dientes de morfología anómala.

Distribución geográfica y hábitat: *Trochoidea (Xerocrassa) roblesi* spec. nov. es un endemismo valenciano que vive en la Sierra Calderona, comarca de El Camp de Túria (provincia de Valencia), donde se ha recogido en varias localidades próximas entre sí (Fig. 24).

Vive en ambientes xerófilos, como pinadas y matorral mediterráneo, y en una ocasión se recogió una concha en un barranco con curso de agua, junto al municipio de Olocau, probablemente arrastrada. Los ejemplares vivos se capturaron semienterrados entre la pinocha (hojarasca) y debajo de pequeñas piedras, a altitudes desde los 260 hasta los 560 m. Se ha encontrado conviviendo con *Trochoidea (Xerocrassa) murcica* (Guirao *in* Rossmässler, 1854).

Ninguna de las especies con las que se podría confundir conquiológica o anatómicamente se ha recolectado junto a *T. (X.) roblesi* spec. nov., siendo *M. armillata* la especie más extendida por la región, mientras que las otras tres aparecen en áreas más concretas y reducidas (Martínez-Ortí, 1999) (Figs. 24-25).

Conservación: *Trochoidea (Xerocrassa) roblesi* spec. nov. es una especie poco común en la Comunidad Valenciana que se extiende por un área muy reducida de su territorio, la Sierra Calderona. Se conoce viva en pocas localidades, por lo que es recomendable realizar un mayor número de prospecciones para intentar encontrar nuevas poblaciones. Las principales amenazas para esta especie son el auge urbanístico en la zona, los incendios, vertederos, carreteras y canteras. Por todo ello, *T. (X.) roblesi* spec. nov. debe considerarse como especie vulnerable, según la IUCN-1994, y el autor pretende realizar las gestiones oportunas para incluirla en el catálogo de especies amenazadas de España.

Discusión: Desde el punto de vista conquiológico, las especies más parecidas a *T. (X.) roblesi* spec. nov. son *Trochoidea (Xerocrassa) penchinati* (Bourguignat, 1868) (Fig. 11) y *Microxeromagna armillata* (Lowe, 1852) (Fig. 15), ya que ambas presentan una pilosidad diminuta y abundante por toda la concha (Figs. 12 y 16), y unas dimensiones que entran en el rango de variabilidad de *T. (X.) roblesi* spec. nov. De ellas difiere principalmente por las numerosas flamulaciones blanquecinas que presenta por toda la concha, el menor aquillamiento de la última vuelta y el ombligo más reflejado. Las genitalias de estas dos especies, son claramente distintas de *T. (X.) roblesi* spec. nov.; *T. (X.) penchinati* presenta una menor longitud de los conductos de la parte masculina y del conducto de la bolsa copulatriz (Fig. 17) y una papila penial con morfología distinta (Fig. 18), mientras que *M. armillata* presenta un aparato estimulador constituido por un saco del dardo, con un dardo en su interior, y un saco accesorio a un lado de la vagina, y dos glándulas mucosas bifurcadas que se insertan en el mismo lado que los sacos (Manganelli y Giusti, 1988; Puente, 1994; Puente y Altonaga, 1995) (Fig. 23).

En cuanto al aparato genital, *Trochoidea (Xerocrassa) ripacurcica* (Bofill, 1886), *Trochoidea (Xerocrassa) salvanae* (Fagot, 1886) y *T. (X.) roblesi* spec. nov. presentan un esquema general similar (Figs. 5, 19, 21). Las principales diferencias halladas entre las tres especies se basan en las diferentes medidas obtenidas del pene, epifalo, flagelo y la bolsa copulatriz y su relación entre ellas. El flagelo es largo en todas ellas. El epifalo es de mayor longitud en *T. (X.) roblesi* spec. nov. y *T. (X.) ripacurcica* que en *T. (X.) salvanae*, mientras que el conducto de la bolsa copulatriz es de mayor longitud en *T. (X.) roblesi* spec. nov. que en las otras dos especies. Además, las papilas peniales de las tres especies presentan distinta morfología (Figs. 6, 20, 22). Por otra parte, las características morfológicas de la concha de estas especies permiten diferenciarlas claramente (Figs. 1-4, 13 y 14). Las dimensiones máximas de los ejemplares valencianos de *T. (X). ripacurcica* son 5,97 mm de altura y 10,08 mm diámetro, mayores que las de las otras dos especies. Las medidas obtenidas por Faci (1991) para esta especie en Aragón son 7,0 mm de altura y 12,25 mm de diámetro. Las dimensiones máximas encontradas para *T. (X.) salvanae* en la Comunidad Valenciana son de 6,0 mm de altura y 8,60 mm de diámetro, mientras que para *T. (X.) roblesi* spec. nov. son 4,89 mm de altura y 7,84 mm de diámetro. Además, la presencia de pilosidad en la concha y una coloración característica permiten que *T. (X.) roblesi* spec. nov. pueda ser fácilmente diferenciada de las otras dos especies.

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BIBLIOGRAFÍA

FACI, G., 1991. *Contribución al conocimiento de diversos moluscos terrestres y su distribución en la Comunidad Autónoma Aragonesa*. Tesis Doctoral (inédita). Universidad de Zaragoza. 787 pp.

FORCART, L., 1976. Die Cochlicellinae und Helicellinae von Palästina und Sinai. *Archiv für Molluskenkunde*, 106 (4-6): 123-189.

MANGANELLI, G. Y GIUSTI, F., 1988. A new Hygromiidae from the italian Apennines and notes on the genus *Cernuella* and related taxa (Pulmonata: Helicoidea). *Bolletino Malacologico*, 23 (11-12): 327-380.

MARTÍNEZ-ORTÍ, A., 1999. *Moluscos terrestres testáceos de la Comunidad Valenciana*. Tesis doctoral (inédita). Univ. València. 743 pp.

MARTÍNEZ-ORTÍ, A. Y ROBLES, F., 1998. El Subgénero *Xerocrassa* Monterossato, 1892 (Gastropoda, Pulmonata, Hygromiidae) en la Comunidad Valenciana. *XII Congreso Nacional de Malacología. Málaga. C. Salas Ed.*: págs. 24-25.

PUENTE, A. I., 1994. *Estudio taxonómico y biogeográfico de la superfamilia Helicoidea Rafinesque, 1815 (Gastropoda:Pulmonata:Stylommatophora) de la Península Ibérica e Islas Baleares*. Tesis Doctoral (inédita). Universidad del País Vasco. 1.037 pp.

PUENTE, A. I. Y ALTONAGA, K., 1995. Estudio morfológico y corológico de dos especies conquiológicamente similares, *Helicella conspurcata* (Draparnaud, 1801) y *Microxeromagna armillata* (Lowe, 1852), en la Península Ibérica e Islas Baleares (Pulmonata: Helicoidea: Hygromiidae). *Zoologica baetica*, 6: 121-148.

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Plaxiphora mercatoris Leloup, 1936 (Polyplacophora: Mopaliidae) de Isla de Pascua, Chile

Plaxiphora mercatoris Leloup, 1936 (Polyplacophora: Mopaliidae) from Easter Island, Chile

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RESUMEN

Se analizaron 588 ejemplares de *P. mercatoris* por tallas y sexos, entre 6 y 57 mm. de longitud total. *P. mercatoris* presenta sexos separados, sin diferencias sexuales externas. No se observaron hermafroditas. La proporción entre machos y hembras fue de 1,04: 0,89. Los machos se diferenciaron sexualmente a los 15,6 mm y las hembras a los 18,2 mm de longitud; las tallas máximas registradas para ambos sexos fueron de 53 y 57 mm respectivamente, *P. mercatoris* es una especie endémica y exclusiva de isla de Pascua, que se distribuye verticalmente en el intermareal medio al inferior de los sistemas rocosos de la isla. *P. mercatoris* se presenta con densidades entre 1 y 8 individuos/m^2. La flora acompañante de este quitón presentó una dominancia de las algas calcáreas *Mesophyllum siamense, Amphiroa yendoi* y otras Corallinaceae. La fauna acompañante está constituida por las especies *Chthamalus belyiaevi, Cypraea caputdraconis, Echinometra insularis, Nodilittorina pyramidalis pascua, Nerita morio*, Polychaeta, Cnidaria (Antozoa), Briozoa y otros.

ABSTRACT

A total 588 specimens of *Plaxiphora mercatoris* were analyzed, in terms of sizes and sex, registering sizes between 6 and 57 mm. *P. mercatoris* presents separate sexes, with no external sexual differences; no hermaphrodites were observed. The proportion of males versus females was 1.04: 0.89. Males differentiate sexually at 15.6 mm and females at 18.2 mm, and the maximum sizes registered were 53 mm and 57 mm respectively. *P mercatoris is* distributed only along the perimeter of the island. Its vertical distribution in the rocky system is from mid to low intertidal with densities between 1 and 8 individuals/m^2. The accompanying flora of this chiton presented some algae, calcareous algae being dominant: *Mesophyllum siamense, Amphiroa yendoi* and other Corallinaceae. The accompanying fauna is made by following species *Chtamalus belyiaevi, Cypraea caputdraconis, Echinometra insularis, Nodilittorina pyramidalis pascua* and *Nerita morio.*

PALABRAS CLAVES: *Plaxiphora mercatoris*, Polyplacophora, población, distribución, densidades, fauna y flora asociada, Isla de Pascua, Océano Pacífico.
KEY WORDS: *Plaxiphora mercatoris*, Polyplacophora, population, distribution, densities, fauna and flora associated Easter Island, Pacific Ocean.

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INTRODUCCIÓN

Los poliplacóforos constituyen un grupo de invertebrados marinos que habitan especialmente las zonas rocosas intermareales de gran parte de las costas del mundo (VAN BELLE, 1983). Por su abundancia y hábitos alimentarios, estas especies son estructuradoras y/o modificadoras de las comunidades de algas del sistema intermareal (PIERCY, 1987; GLYNN, 1970; OTAÍZA Y SANTELICES, 1985; PEÑA, ZUÑIGA Y RODRIGUEZ, 1987), forman parte de la dieta de peces, aves y estrellas de mar (OTWAY, 1994); y también han constituido históricamente un recurso alimenticio para el hombre. Existen antecedentes de su consumo por los habitantes en la Isla de Pascua, en la Polinesia, en Oriente, en las costas de Chile Continental y en Cape Banks, Australia (OSORIO, ATRIA Y MANN, 1979; OTWAY, 1994). Poca importancia se ha dado al conocimiento de la biología y ecología de este grupo pese a su relativa importancia en algunos ecosistemas.

El conocimiento científico de la única especie registrada para la Isla de Pascua (o Rapa Nui), *Plaxiphora mercatoris* Leloup, 1936 está limitado sólo su taxonomía. Se ha recolectado en las localidades de Hanga Piko, Haka Ea, Hotu Iti, Otuu, Hanga Pukura, Ovahe, y Anakena (REDHER, 1980).

Al igual que Isla de Pascua, en Samoa, Marquesas, Tahití y Mangareva, los poliplacóforos se conocen con el nombre común de "mama" cuyo significado en lengua pascuense es "bostezo" (Atan, com. pers). En Rapa Nui, los grupos de isleños más tradicionales creen que estos moluscos son un alimento muy nutritivo para los niños. Por otra parte, su extracción es parte de la transferencia de conocimientos entre padres e hijos. Esta actividad es una práctica común, donde participa la familia en la extracción de organismos marinos, para alimentarse y obtener materia prima para su artesanía, permitiendo además la enseñanza del medio marino. Los "mamas" son preferidos como alimento a otros moluscos, por ser grandes y más fáciles de comer que los caracoles *Nerita morio* (Sowerby, 1833) y *Nerita lirellata* Redher (1980). Se comen crudos o cocidos en agua. Los análisis químicos ratifican que son una buena fuente de proteína (14,3%) y de minerales (3,6%), con un bajo contenido graso (2,6%) una humedad de 77,1% y un 2,4% de extractivo no nitrogenado (hidratos de carbono y otros) (Masson com. pers).

Los escasos antecedentes biológicos sobre representantes del Género *Plaxiphora* en el mundo, se limitan a los trabajos de BRANDANI, FAEDO Y PENCHAZADEH (1974), quienes estudian la estructura por tallas y sexo, densidad específica y la epibiosis de *P. aurata* del intermareal de Mar del Plata, Argentina. En la ultima década sólo conocemos los trabajos de GALVEZ (1991) sobre la hipomería en *P. fernandezi*; de OTWAY (1994) quien describe la ecología poblacional de *Plaxiphora albida* (Blainville, 1825) en Australia y LÓPEZ Y TABLADO (1997) quiénes estudian aspectos del crecimiento y producción en *P. aurata* en Quequen, Argentina.

Las características especiales de aislamiento geográfico, de este único y endémico representante de la Clase Polyplacophora en Isla de Pascua, y el uso que los isleños hacen de ella, hicieron particularmente interesante este estudio, cuyos objetivos son caracterizar la especie basados en aspectos biológicos como la morfogravimetría, la estructura poblacional y la sexualidad, además de caracterizar su hábitat y distribución en el intermareal.

El conocimiento de la fauna de Isla de Pascua es muy escaso, debido principalmente a su lejanía y a la dificultad para trabajar en sus costas, por lo cual la información de este trabajo es valiosa y amerita ser conocida por la comunidad científica, datos que serán útiles en futuras investigaciones.

MATERIAL Y MÉTODOS

El estudio fue realizado en Isla de Pascua (27°10'S, 109°20'O). Las muestras proceden de diferentes localidades

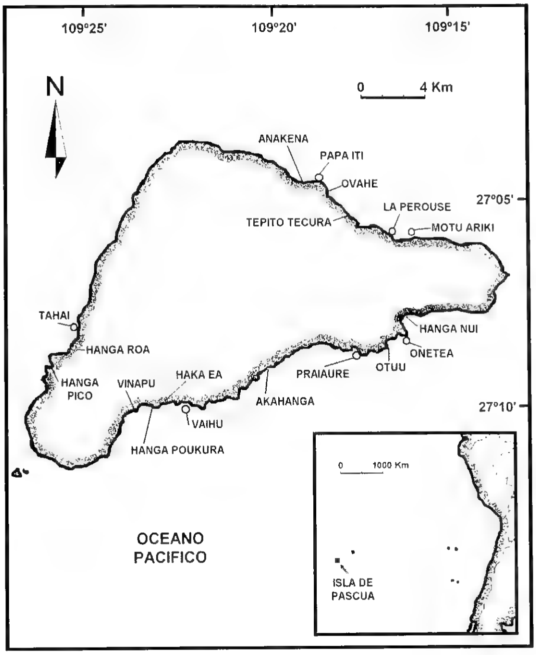


Figura 1. Mapa de Isla de Pascua y su localización en el océano Pacífico. Las localidades señaladas con un circulo corresponden a lugares de recolección de muestras de *Plaxiphora mercatoris*.
Figure 1. Eastern Island in the Pacific Ocean. Sampling stations of Plaxiphora mercatoris are indicated by an open circle.

del intermareal rocoso (Fig. 1), y fueron recolectadas durante los períodos de marea baja, en distintas fechas desde 1991 a 1994 (Tabla I). El muestreo consideró una muestra de un mínimo de 50 ejemplares, número que en algunas oportunidades no se alcanzó. Estos ejemplares se mantuvieron extendidos y congelados sobre una base de madera por algunas horas, finalmente fueron fijados en formol al 10% diluido en agua de mar y trasladados al laboratorio en Santiago para su análisis.

El análisis poblacional para determinar la estructura de talla y la sexualidad de la especie se hizo sobre un total de 588 ejemplares, que incluían los anteriores. La determinación de sexos se realizó después de la disección, basado en la observación de frotis gonádico y/o por observación del color de las gónadas, verde para hembras y rojo para machos.

En un total de 278 ejemplares, de los 588 recolectados, se midió a cada ejemplar la longitud y ancho máximos considerando el cinturón, con un calibre 0,01 mm precisión. También se registró el peso total de cada ejemplar con una balanza Sartorius de 0,02 g de precisión.

La cobertura de algas y la densidad de las especies, se cuantificó en terreno mediante dos transectos extendidos desde un punto máximo superior hasta el mínimo de marea, el día 20 de Septiembre de 1993. Se cuantificó la densidad y cobertura usando cuadrantes reticulados de 0,25 m^2 y de 0,50 m^2. La descripción del hábitat se hizo basándose en la identificación de muestras de la flora y fauna acompañante, recolectadas en los transectos indicados.

Para describir la morfometría de machos y hembras se usaron diagramas de dispersión y un análisis de regresión simple. En los cálculos se utilizó el programa Microsof Excel para Windows 95 para describir las relaciones longitud - ancho y longitud - peso. La selección del modelo

Tabla I. *Plaxiphora mercatoris* de Isla de Pascua. Localidad de recolección, fecha, número de individuos por sexo y tipo de análisis realizado. Q: químico; M: morfométrico; G: gravimétrico; Med*: medidos *in situ.*
Table I. Plaxiphora mercatoris *of Easter Island. Sampling station, date, number of individual, sex and type of analysis. Q: chemical; M: morphometric; G: gravimetric; Med.*: measured* in situ.

Localidad	Fecha	Número de individuos				Tipo análisis
		Total	Machos	Hembras	Indeterminados	
Prai Ahure	13.03.91	53	28	19	6	M, G
Prai Ahure	23.06.91	43	19	24		M, G
Prai Ahure	22.09.91	15	8	7		M, G
Prai Ahure	10.10.91	23	14	8	1	M, G
Motu Ariki	19.05.92	55	32	23		M, G
One Tea	21.11.92	35	23	12		M, G
Tahai	22.09.93	58	24	28	6	M, G
La Perouse	22.09.93	90				M, Q
Papa Iti	19.09.93	57				Med*
Vaihu	19.02.94	9	5	3	1	M, G
Vaihu	18.03.94	44	23	21		M, G
Vaihu	27.04.94	54	28	26		M, G
Vaihu	09.05.94	52	25	27		M, G
Total		588	229	198	14	

de regresión se basó en el coeficiente de determinación r^2 para los modelos lineal, exponencial y potencial (CANAVOS, 1996). Además se compararon las relaciones longitud - ancho y longitud - peso entre machos y hembras, a través de la prueba de Chow (GUJARATI, 1997).

Para describir la estructura de la población, se usó el método tradicional de Petersen del análisis de frecuencias de tallas (MIRANDA, 1967). Para describir la distribución por sexos se utilizaron frecuencias acumuladas expresadas en porcentajes de machos y hembra y proporción sexual (HERNÁNDEZ, FERNÁNDEZ Y BAPTISTA, 1996).

RESULTADOS

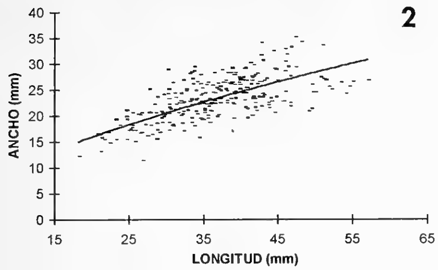
A. Parámetros Morfológicos: Las relaciones entre la longitud total (LT) con el ancho total (AT) y el peso total (PT) fueron estudiadas en 278 ejemplares (142 machos y 136 hembras).

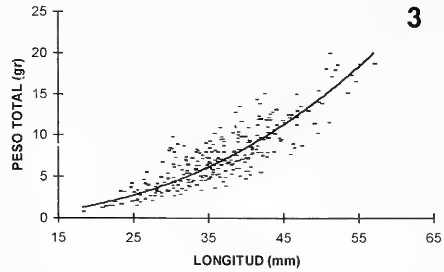
Dado que no se encontró diferencias significativas entre sexos (FAT v/s LT: 2,66; gl=2.274; p< 0,05 y F PT v/s LT: 0,52; gl=2.274; p< 0,05), machos y hembras fueron analizados conjuntamente para cada relación. La relación potencial en ambos casos fue la que mejor se ajusta a los datos (Figs. 2 y 3):

$AT = 2{,}426 * LT\ 0{,}6286$, r^2: 0,4861

$PT = 0{,}0013 * LT\ 2{,}3916$, r^2: 0,7582

B. Análisis de la población: *Plaxiphora mercatoris* presenta sexos separados, sin diferencias sexuales externas. De los 435 ejemplares analizados (Tabla I), 192 correspondieron a hembras (44,1%) y 229 fueron machos (52,6%) y en 14 ejemplares (3,2%) no se pudo determinar el sexo por presentar gónadas incoloras, pese a realizarse frotis. La proporción entre machos y hembras, fue 1,04: 0,89. La talla mínima a la cual se reconoció el sexo fue de 15,6 mm en machos y 18,2 mm en hembras. La talla máxima observada en machos fue de 53 mm, mientras que las hembras alcanzan tallas de hasta 57 mm. Los individuos indeterminados presentaron tallas entre 12 mm y 47 mm. De 11 muestreos, en ocho oportunidades





Figuras 2, 3. Relación longitud - ancho (2) y longitud total y peso total (3) en *Plaxiphora mercatoris* de Isla de Pascua.
Figures 2, 3. Length - width (2)and total length vs *total weight (3) relationship of* Plaxiphora mercatoris *from Easter Island.*

predominaron los machos, y en tres las hembras (Tabla I).

El rango de tallas estudiado osciló entre 13 y 57 mm a excepción de 3 individuos del área de Papa Iti (19/09/93) que registraron tallas inferiores a 13 mm. Aún cuando existe una gran diferencia en el número de individuos por muestra (9 a 90), el promedio de las tallas tiene poca variación, (Fig. 4). Los promedios de tallas variaron entre 30 y 44 mm y solo la muestra 3 (22/09/91) tiene un promedio bajo (23,35mm). Se observó una tendencia a la disminución de tallas en junio 1991 (muestra 2), septiembre 1991 (muestra 3) y septiembre de 1993 (muestra 9).

En las localidades de Prai Ahure (1991) y Vaihu (1994), se realizó un muestreo continuo de cuatro meses de duración, donde se observó una distribución normal de tallas de la población. En Prai Ahure (Fig 5A), el rango de tallas estuvo entre 11 y 57 mm de longitud total. En cada uno de los meses se encontró una moda principal y otras secundarias. La moda principal parece desplazarse hacia tallas menores al pasar el tiempo y sólo en el último mes aumenta con relación al anterior. En Vaihu (Fig. 5B), las tallas de la población estuvieron entre 15 y 55 mm de longitud total. Se encontró una moda principal en cada uno de los meses casi sin desplazamiento de moda, registrándose una talla media, de 35 mm entre febrero y mayo de 1994.

C. Descripción del hábitat: Los ejemplares de *P. mercatoris* se encontraron adheridos a grandes rocas en áreas semi expuestas con suaves a pronunciadas pendientes y en pozas del intermareal. Su distribución se observa desde el intermareal medio al intermareal inferior. Se adhieren por medio de su pie al sustrato, de superficies casi lisas o algo rugosas, en grietas o fisuras estrechas, ajustados a su talla; en paredes verticales, laterales u horizontales al oleaje.

La flora acompañante de este Poliplacóforo consistió principalmente en algas calcáreas como (*Mesophyllum siamense* (Foslie) Adey, *Amphiroa yendoi* Borgesen y otras Corallinaceae). También se encontraron otras algas como *Hypnea cenomyce* J. Ag., *Ulva* sp, *Enteromorpha* sp., *Lobophora variegata* (Lamour) Wom., *Hincksia mitchelliae* (Harv.) Silva, *Colpomenia sinuosa* (Roth) Derb. y Sol., *Hydroclathrus clathratus* (Bory) Howe y *Cladophora socialis* Kuetz., representadas escasamente en cobertura, cuya distribución vertical y abundancia en porcentaje se indican en la Tabla II.

La fauna acompañante a *P. mercatoris* está constituida preferentemente por un conjunto de organismos como *Chthamalus belyiaevi* Zevina y Kurshakova, 1973; *Cypraea caputdraconis* Melvill, 1888; *Echinometra insularis* Clark, 1972; *Nodilittorina pyramidalis pascua* Rosewater, 1970; *Nerita morio* (Sowerby,1833), Polychaeta, Cnidaria (Antozoa), Briozoa y otros.

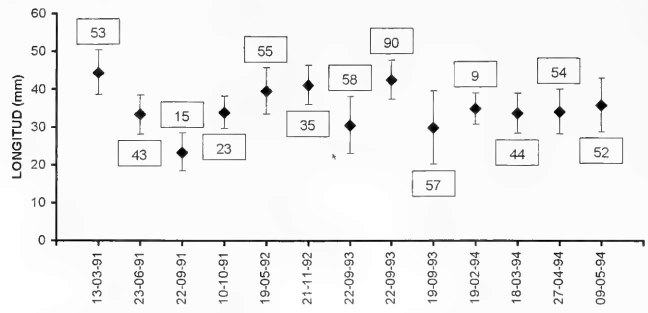


Figura 4. Promedio de tallas y desviación estándar por muestra en *Plaxiphora mercatoris*, Isla de Pascua. En el recuadro se indica el número de individuos controlados por muestra.
Figure 4. Mean length and standard deviation per sample in Plaxiphora mercatoris *of Easter Island. boxes: number of individuals in each sample.*

D. Distribución vertical y abundancia de *P. mercatoris*: En Tahai, en un frente semiexpuesto se ubicaron los transectos realizados (Fig. 1, Tabla II). En el muestreo, realizado el 20/09/93, se observó la presencia de *P. mercatoris* desde los 32 cm del máximo de altura de las mareas, hacia el intermareal inferior. Los ejemplares se encuentran por lo general aislados, con una densidad de 1 ind/m^2, ocasionalmente se observaron 3 o más ejemplares juntos. También tenemos constancia de la presencia de 4 ejemplares, de pequeña talla (<2 cm) en el interior de marmitas (orificios cancávos) marinas, bajo el erizo *Echinometra insularis* y junto a turbelarios. Como resultado de este análisis es posible reconocer que *Plaxiphora mercatoris* tiene densidades entre 1 ind/m^2 (20/09/93 Tahai) a 8 ind/m^2 (22/09/91 Prai Ahure).

E. Cobertura: Se midió la cobertura de los organismos dominantes en la localidad de Tahai (20/09/93), en una extensión de superficie de playa de 9,25 m2 y desde el punto de marea máxima, denominado Estación 0 (Tabla II). Entre las Estaciones 0 y 1, que equivalen a un desplazamiento de 3,75 m horizontales y 0,77 m de altura intermareal, las dos especies dominantes son *Nodilittorina pyramidalis pascua* (12%) y *Chthamalus belyiaevi* (22%).

Entre la Estación 1 y la Estación 2, que equivale a un desplazamiento de 3,0 m horizontales hacia el mar y 0,12 m de altura de marea, los organismos dominantes son *Chthamalus belyiaevi* (41% en el cuadrante 21), las algas *Ulva* sp (60% cuadrante 25) e *Hypnea cenomyce* (45% cuadrante 24). En las áreas inferiores, entre las Estaciones 2 a 3, aumenta la cobertura de otras algas como *Lobophora variegata* (40% cuadrante 33), *Hincksia mitchelliae* (58% cuadrante 35) y en el cuadrante 36, las algas *H. mitchelliae* (19%) y *Amphiroa yendoi* (14%).

DISCUSIÓN

La talla máxima registrada en *P. mercatoris* (57 mm de longitud) es semejante a lo indicado por REDHER (1980), quien da una longitud máxima de 60 mm, medida estimada para un ejemplar parcialmente doblado (USNM 756279), y superior a lo señalado por LELOUP (1936), quien dio una longitud máxima de 31 mm, basado en cuatro ejemplares.

La estructura de la población de *P. mercatoris* en Isla de Pascua mostró tres grupos modales, semejantes a lo registrado por LÓPEZ Y TABLADO (1997) en *Plaxiphora aurata* para las costas de Argentina. Similar observación realiza GLYNN (1970) para tres especies de poliplacóforos tropicales donde existirían

Tabla II. Distribución vertical de *Plaxiphora mercatoris* en el intermareal de Isla de Pascua. Cobertura de algas y presencia de fauna asociada en la localidad de Tahai (20/09/93, 10:50 a 15:30 h). Anp: *Anphiroa yendoni* Borgesen; Cla: *Cladophora socialis* Kutzing; Cirr: *Chthamalus belyiaevi* Zevina y Kurshakova, 1973; Col: *Colpomenia sinuosa*(Roth)Derb. y Sol.; Cor: Coralinaceae; Ech: *Echinometra insularis* Clarck, 1972; Ent: *Enteromorpha* sp.; Hin: *Hincksia mitchelliae* (Harv.) Silva; Hyd: *Hydroclathrus clathratus* (Bory) Howe; Hyp: *Hypnea cenomyce* Agardh; Lob: *Lobophora variegata* (Lamour) Wom.; Mes: *Mesophyllum siamense* (Foslie) Adey; Nod: *Nodilittorina pyramidalis pascua* Rosewater, 1970; Pla: *Plaxiphora mercatoris* Leloup,1936; Ulv: *Ulva* sp. X: presencia de *P. mercatoris* en áreas paralelas. Cuadrantes de 25 cm^2.

Table II. Vertical distribution of Plaxiphora mercatoris *on the rocky intertidal of Easter Island. Algal coverage and presence of associated fauna in Tahai, (20/09/93, 10:50 to 15:30 h). Anp:* Anphiroa yendoni *Borgesen; Cla:* Cladophora socialis *Kutzing; Cirr:* Chthamalus belyiaevi *Zevina and Kurshakova, 1973; Col:* Colpomenia sinuosa *(Roth) Derb. and Sol.; Cor: Coralinaceae; Ech:* Echinometra insularis *Clarck, 1972; Ent:* Enteromorpha *sp.; Hin:* Hincksia mitchelliae *(Harv.) Silva; Hyd:* Hydroclathrus clathratus *(Bory) Howe; Hyp:* Hypnea cenomyce *Agardh; Lob:* Lobophora variegata *(Lamour) Wom.; Mes:* Mesophyllum siamense *(Foslie) Adey; Nod:* Nodilittorina pyramidalis pascua *Rosewater, 1970; Pla:* Plaxiphora mercatoris *Leloup,1936; Ulv:* Ulva *sp. X: presence of* P. mercatoris *in adjacent areas. Squares has 25* cm^2.

Cuadrante Nº	Estación N°	ESPECIES Nod Nº	Cirr %	Hyp %	Cor %	Ulv %	Ent %	Pla Nº	Lob %	Mes %	Hin %	Col %	Anp %	Ech Nº	Hyd %	Cla %
1	0	1														
2		6														
3		3														
4		12														
5		0														
6		1														
7		0														
8		0														
9		2														
10		0														
11		0														
12		1	8													
13			3													
14			10													
15	1		22													
16		1	30													
17			10													
18			14	3	1											
19				3		16										
20						0	8									
21			41		21	4										
22			12			10	43	1								
23			12			33		x								
24			21	45		50		x								
25						60		x								
26			3	18		23		x	1							
27				17		8		x								
28	2			20		19		x		32						
29				3		3		x								
30								x								
31								x			24					
32				8		10		x	14		50	4	4			
33						5		x	40		7					
34						4		x	6		30				5	1
35	3					0		x			58	4	7			
36						1		x			19		14			

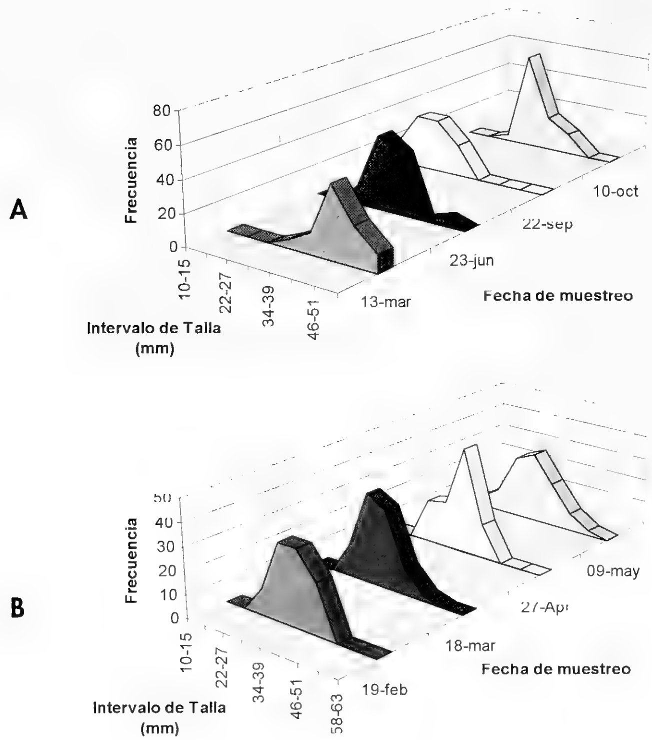


Figura 5. Distribución de tallas de la población de *Plaxiphora mercatoris* de Isla de Pascua, durante cuatro muestreos realizados en 1994 en dos localidades diferentes. A. Prai Ahure; B. Vaihu.
Figure 5. Size distribution of the Plaxiphora mercatoris *population found in two different sampling stations of Easter Island during a period of four month, 1994. A. Prai Ahure; B. Vaihu.*

tres grupos de edades, compuestos por animales jóvenes, o menores a 2 años, con un rápido reemplazo de los ejemplares, esto explicaría que las poblaciones se mantienen en el tiempo con tallas mas o menos constantes.

La población de chitones de Prai Ahure muestra un desplazamiento de las modas con reducción de sus tallas entre marzo, junio y septiembre. Esto indicaría reclutamiento a la población y ausencia de individuos de mayor tamaño. En octubre nuevamente desaparecen los juveniles y aumenta el número de ejemplares de tallas mayores (Fig. 5A).

El bajo número de ejemplares superiores a 40 mm en Isla de Pascua, (octubre, septiembre y junio 1991; septiembre 1993; marzo y abril de 1994), podría estar relacionado con la extracción de este recurso en tallas superiores a 40 mm, (Obs. per.; González, com. pers.).

En *Plaxiphora mercatoris* predominan los machos, lo que coincide con otras especies del grupo, GLYNN (1970) indica que la relación machos:hembras en *Chiton stokesi* Broderip, 1832, es de 1,46:1,0, en *Acanthozostera gemmata* (Blainville, 1825), es de 1,52:1,0 y en *Chiton marmoratus* Gmelin, 1791, es de 1,1:1,0. OTWAY (1994) encontró una relación de 2:1 para *Onithochiton quercinus* (Gould, 1846), mientras que en *Plaxiphora albida* el mismo autor encontró una proporción (1,0:0,99) entre ambos sexos que no difiere significativamente. Por otra parte BRANDANI *ET AL.* (1974) indican para *P. aurata*, un 48% de machos y un 52% de hembras.

Microscópicamente la diferenciación de sexos en *P. mercatoris* ocurre tempranamente en ambos sexos, a partir de los 15,6 mm de longitud en machos y a los 18,2 mm en hembras, en el primer año de vida. BRANDANI *ET AL.* (1974) indica para *P. aurata* una talla de 12 mm de longitud. También GLYNN (1970), encuentra que la madurez sexual se logra en el primer año, en las tres especies de poliplacóforos tropicales que ha estudiado.

Los estudios que describen el hábitat de otras especies de *Plaxiphora* son coincidentes con lo encontrado para *P. mercatoris*. SAITO Y OKUTANI (1991) mencionan que *Plaxiphora integra* (Taki, 1954) y *Plaxiphora kamehamehae* Ferreira y Bertsch, 1979, viven en áreas con gran cantidad de algas; LOPEZ Y TABLADO (1997) indican que *Plaxiphora aurata* vive en paredes verticales sombreadas del intermareal sin embargo mencionan que faltan completamente sobre sustratos horizontales.

La densidad de *P. mercatoris* (1 a 8 individuos/m^2), fue ligeramente inferior a los datos publicados para otros poliplacóforos. LOPEZ Y TABLADO (1997) indican para *Plaxiphora aurata*, densidades de 7,3 y 11,8 indiv/m^2 y un promedio de 9,5 indiv/m^2 en Quequen, Argentina. Para la misma especie, BRANDANI *ET AL.* (1974) registran valores entre 5 a 20 indiv/m^2, en Mar del Plata. GLYNN (1970) indica para *Achantopleura* sp. 1 a 8 indiv/m^2, y para *Chiton* sp. 1 a 22 indiv/m^2.

En contraste a lo que ocurre generalmente en los sistemas intermareales, *P. mercatoris* no es abundante en Isla de Pascua. Entre los factores que pueden causar esto, cabe destacar la acción antrópica ya que, continuamente son recolectados por los isleños (González, com. per.). Por otra parte, la acción de fenómenos naturales ocasionales, también colabora a disminuir la densidad de *P. mercatoris*. Por ejemplo semanas antes del muestreo de septiembre de 1993, ocurrieron mareas diurnas extremadamente bajas (Tabla de mareas de la Costa de Chile, 1993) que coincidieron con altas temperaturas, lo que ocasionó una elevada mortalidad en la especie; los "mamas" se desprendían fácilmente con una pequeña presión de los dedos, y durante los días posteriores al fenómeno se observaron muchos ejemplares muertos en las rocas (Pakarati, com. per.). El efecto de la deshidratación es probablemente importante; BOYLE (1970), describe que en *Sypharochiton pelliserpentis* Quoy y Gaimard, 1835, la deshidratación es un factor importante que afecta la densidad de la población. El autor determinó que la especie tolera pérdidas del 75% del contenido de agua, antes de ocurrir una mortalidad del 50% de la población. GLYNN (1970) observó mortalidades naturales como resultado de una prolongada exposición a bajas mareas diurnas, desprendimiento por impacto del oleaje, abrasión y probablemente depredación de aves y peces.

Así, *P. mercatoris* constituye actualmente un recurso explotado por los isleños, cuya población parece mantenerse sin llegar a estar sobre-explotada ya que no se registra una disminución en la talla media de la población. Aunque su densidad se mantiene baja, tanto por la mortalidad natural como por la antrópica, la población se mantendría estable gracias a un rápido recambio de individuos.

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BIBLIOGRAFÍA

BOYLE, P. R., 1970. Aspects of the ecology of a littoral chiton, *Sypharochiton pelliserpentis* (Mollusca, Polyplacophora). *New Zealand Journal of Marine and Freshwater Research*, 4 (4): 364-384.

BRANDANI, A., FAEDO, J. C. Y PENCHASZADEH, P.E., 1974. Aspectos de la ecología de los quitones del litoral de Mar del Plata (Mollusca Polyplacophora) con especial referencia a sus epibiosis. *Ecología*, 11: 19-33.

CANAVOS, G., 1996. *Probabilidad y Estadística, Aplicaciones y Métodos*. Editorial McGraw Interamericana, México, 651pp.

GÁLVEZ, H. O., 1991. Hipomería en *Plaxiphora fernandezi* Thiele, 1909, (Mollusca Polyplacophora Mopalidae). *Noticiario Mensual. Museo Nacional de Historia Natural*, 318: 3-5.

GLYNN, P. W., 1970. On the ecology of the Caribbean chitons *Achanthopleura granulata* Gmelin and *Chiton tuberculatus* Linne, density, mortality, feeding, reproduction and growth. *Smithsonian Contribution to Zoology*, 66: 21 pp.

GUJARATI, D., 1997. Econometría. Editorial McGraw, Interamericana, México, 824 p.

HERNÁNDEZ, R., FERNÁNDEZ, C. Y BAPTISTA, P., 1996. *Metodología de la Investigación*. McGraw, Interamericana, México 505 pp.

LELOUP, E., 1936. Chitons recoltés au cours de la croisière (1934-1935) du navire ecole belge Mercator. *Bulletin du Musée Royal d'Histoire naturelle de Belgique*, 12 (6): 1-6.

LÓPEZ, G. J. Y TABLADO, A., 1997. Growth and Production of an Intertidal Population of the Chiton *Plaxiphora aurata* (Spalowki, 1795). *The Veliger*, 40 (3): 263-270.

MIRANDA, O., 1967. Edad y grupos modales en *Thais chocolata*, una descripción de los métodos usados. *Apuntes Oceanológicos*, 3: 1-25.

OSORIO, C., ATRIA , J. Y MANN, S., 1979. Moluscos marinos de importancia económica en Chile. *Biología Pesquera*, 11:3-47.

OTAIZA, R. D. Y SANTELICES, B., 1985. Vertical Distribution of Chitons (Mollusca: Polyplacophora) in the rocky Intertidal Zone of Central Chile. *Journal of Experimental Marine Biology and Ecology*, 86:229-240.

OTWAY, N. M., 1994. Population ecology of the low-shore chitons *Onithochiton quercinus* and *Plaxiphora albida*. *Marine Biology*, 121: 105-116.

PEÑA, R., ZUÑIGA, O. Y RODRIGUEZ, L., 1987. Variación estacional del índice gonadosomático en *Acanthopleura echinata* (Barnes 1823) (Mollusca: Polyplacophora). *Estudios Oceanológicos*, 6: 59-65.

REDHER, H. A., 1980. The marine mollusks of Easter Island and Sala y Gómez. *Smithsonian Contribution to Zoology*, 289: 1-167.

SAITO, H. Y OKUTANI, T., 1991. Taxonomy of Japanese species of the Genera *Mopalia* and *Plaxiphora*. *The Veliger*, 34(2): 172-194.

TABLA DE MAREAS DE LA COSTA DE CHILE, 1993. Servicio Hidrográfico de la Armada. Valparaíso, Chile, 228 pp.

VAN BELLE, R. A., 1983. The systematic classification of the chitons (Mollusca: Polyplacophora). *Informations Societé Belge de Malacologie, Serie* 11 (1-3): 1-178, 13 pls.

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The shallow-water Rissoidae (Mollusca, Gastropoda) of the Azores and some aspects of their ecology

Los Rissoidae (Mollusca, Gastropoda) de las Azores y algunos aspectos de su ecología

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ABSTRACT

A critical review of the distribution of the Rissoidae on the islands of the Azorean Archipelago is made, on the basis of bibliographic data as well as newly-collected samples. Twenty three taxa of Rissoidae are given to the Azores: twelve endemic species, three restricted to the Azores and Madeira/Selvagens archipelago and two with wider distribution. Of the remaining taxa, one is an unidentified species of *Setia* and five are records not confirmed by this study. The assemblage of Rissoidae associated with heterogeneous algae on a rocky shore on the northern coast of São Miguel Island, Azores, is also described. Aspects of community structure (species composition, abundance and zonation) were studied and a multispecies analysis conducted using clustering techniques. Some comments are also made regarding the Rissoidae speciation that has occurred in the Azores and its relation to the main sea-surface circulation in this area of the Atlantic Ocean.

RESUMEN

Se realiza una revisión crítica de la distribución de los Rissoidae de las Azores, en base a datos bibliográficos y a muestras recientes. Se han encontrado 23 táxones de Rissoidae: 12 especies endémicas, 3 restringidas a las Azores y a Madeira/Salvajes y otras dos con una distribución mayor. De las especies restantes, una es una especie sin identificar de *Setia* y otras 5 son citas no confirmadas en el presente estudio. Se describe también la asociación de Rissoidae con algas en una costa rocosa del norte de São Miguel (Azores). Se incluyen datos sobre la estructura de la comunidad (composición específica, abundancia y zonación), así como un análisis multiespecífico empleando técnicas de cluster. Se comenta también la especiación que ha tenido lugar en las Azores con la famila Rissoidae y su relación con las principales corrientes superficiales en esta zona del Atlántico.

KEY WORDS: Rissoidae, Azores, taxonomy, ecology, geographic range.
PALABRAS CLAVE: Rissoidae, Azores, taxonomía, ecología, distribución geográfica.

INTRODUCTION

The marine Rissoidae of the Azores were studied by DROUËT (1858), DAUTZENBERG (1889) and NOBRE (1924; 1930), who provided annotated check-lists.

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During the scientific expeditions made by the Prince of Monaco to the Azores, 25 species of Rissoidae were described from deep-water samples, most of them *Alvania* (11 species) (DAUTZENBERG, 1889). Using SEM techniques, two new species were described by AARTSEN (1982a; 1982b; 1982c; 1982d) and Amati (1987), from material collected by the Prince of Monaco. With the same methodology (SEM photos of the protoconch and of the microsculpture of the body whorl), MOOLENBEEK AND FABER (1987) revised the genus *Manzonia* in the Macaronesian islands, identifying a single species from the Azorean archipelago (*Manzonia unifasciata* Dautzenberg, 1889).

As a result of the scientific expeditions organized by the Department of Biology of the University of the Azores to some of the islands (e.g.: "Graciosa/88", "Flores/89", "Santa Maria e Formigas 1990" and "Pico/1991") and also the scientific expedition "Açores 89", organized by the Department of Oceanography and Fisheries (DOP/UA) of the University of the Azores, several check-lists (some of them not yet published) have allowed preliminary reports on the geographical distribution of Rissoidae species on the islands of the Azores (AZEVEDO AND MARTINS, 1989; AZEVEDO, 1990; AZEVEDO AND GOFAS, 1990; ÁVILA AND AZEVEDO, 1996; ÁVILA AND AZEVEDO, 1997; ÁVILA, 1998; ÁVILA, AZEVEDO, GONÇALVES, FONTES AND CARDIGOS, 1998; ÁVILA, AZEVEDO, GONÇALVES, FONTES AND CARDIGOS, *in press*).

During the "I International Workshop of Malacology" held at Vila Franca do Campo (São Miguel island), GOFAS (1989; 1990) refers to 11 species of Rissoidae from the Azorean littoral (*Alvania angioyi* Van Aartsen, 1982, *A. cancellata* (Da Costa, 1778), *A. mediolittoralis* Gofas, 1989, *A. poucheti* Dautzenberg, 1889, *A. sleursi* (Amati, 1987), *Botryphallus ovummuscae* (Gofas, 1990), *Cingula trifasciata* (Adams, 1798), *Crisilla postrema* (Gofas, 1990), *Manzonia unifasciata* (Dautzenberg, 1889), *Rissoa guernei* Dautzenberg, 1889 and *Setia subvaricosa* Gofas, 1990) to which we must add *Alvania formicarum* Gofas 1989, a species endemic to Formigas and Santa Maria (GOFAS, 1989; 1990).

Samples taken by the author from several locations in the Azores revealed another species at São Miguel island that was formerly reported by Gofas (1990) to be restricted to the islands of the central and western groups *i.e.*, *Onoba moreleti* Dautzenberg, 1889. AZEVEDO AND GOFAS (1990) recorded a species of *Setia* from Flores. This species was later found by ÁVILA *ET AL*. (1998) at Pico and São Miguel. A new species of *Alvania*, described by Hoenselaar and Goud (1998) as *A. internodula*, was also collected from Formigas by Ávila and AZEVEDO (1997). The revision of the material of the CANCAP expeditions (1976-1986) has confirmed some species and described a few others to the Azores (Hoenselaar and Goud, 1998).

The Rissoidae is one of the best represented families of shallow-water marine molluscs in the Azores, with 8 genera and 18 confirmed taxa, of which 12 species are considered as endemic (MOOLENBEEK AND FABER, 1987; GOFAS, 1989; 1990; KNUDSEN, 1995; HOENSELAAR AND GOUD, 1998).

This study had three main objectives: to undertake a taxonomic revision of Rissoidae in the Azores, to identify any island to island endemisms, that is species restricted to some of the islands and to describe the zonation of the Rissoidae on the Azorean shores.

MATERIAL AND METHODS

A bibliographic analysis was made, in order to compile published information about the shallow-water Rissoidae of the Azores (intertidal to a depth of about 50m). The synonymy and the distribution of the species, by islands, was also annotated. A table with the distribution of the Rissoidae species, by islands, was constructed and multivariate analysis was performed on the data obtained (Bray-Curtis similarity index/UPGMA as well as MDS). The

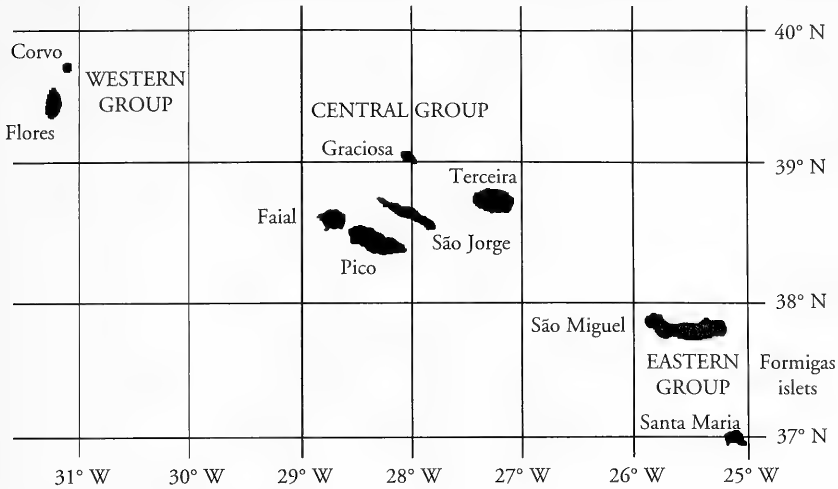


Figure 1. Map of the Azores Archipelago.
Figura 1. Mapa del archipiélago de las Azores.

gastropod classification follows PONDER AND LINDBERG (1997). CLEMAM (Check List of European Marine Mollusca) database classification was quite useful for synonymy.

Protoconchs of almost all the Azorean Rissoidae were photographed with a SEM, as well as other detailed structures of the shells (*e.g.* microsculpture of the last whorl and protoconch, shell aperture and the whole shell).

The zonation of the Rissoidae was examined for São Miguel, which is located in the eastern group of islands of the archipelago (Fig. 1). Several dives were performed in July 1996 at Porto da Baleia, a former whaling ramp boat, located at São Vicente (Capelas) on the north coast of São Miguel (Fig. 2). In the selected zone, a 400m long transect was done, from the intertidal zone to a depth of 30m (Fig. 3). Quadrates of 50x50 cm, placed on algae covering the rocky substratum were scrapped, and the material collected put into labeled cotton drawstring bags. Three replicates were obtained from eight chosen depths, *i.e.*, 3.5m, 5.1m, 8m, 12m, 13.6m, 16.3m, 22m and 26.8m. In the laboratory, each of the replicates was washed several times and the animals removed from the algae by pouring the washing water through a sieve tower with decreasing mesh sizes (1mm, 0.5mm and 0.25mm). Samples were then labeled and preserved in 70% ethanol. The molluscs from the 1mm mesh were sorted and the Rissoidae identified and counted.

Multispecies analysis between all the samples were conducted using ordination techniques. Prior to the multivariate analysis, the absolute values of the counts were transformed, in order to standardize the data and ensure that the multivariate ordination would not be determined by the most abundant species (CLARKE AND AINSWORTH, 1993). Absolute counts were transformed by double square root transformation, which weights the abundant species and is advisable when a Bray-Curtis measure is used as a similarity coefficient in further steps (FIELD, CLARKE AND WARWICK, 1982).

Triangular matrices of similarities between every pair of samples were then computed from transformed data of absolute counts, using the Bray-Curtis coefficient (FIELD *ET AL.*, 1982; CLARKE AND AINSWORTH, 1993). The similarity matrices were subjected to clustering by an hierarchical agglomera-

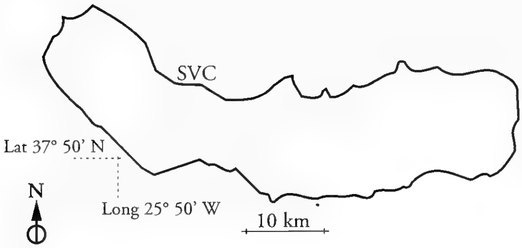


Figure 2. São Miguel island. SVC - São Vicente.
Figura 2. Isla de São Miguel. SVC - São Vicente.

tive method employing group-average linking (UPGMA).

Data analysis were undertaken using the PRIMER (Plymouth Routines in Multivariate Ecological Research) set of programs developed and tested by Plymouth Marine Laboratory.

All the material is deposited at the reference collection of the Department of Biology of the University of the Azores (DBUA), unless otherwise stated.

Abbreviations used in text:

DBUA: marine molluscs reference collection of the Department of Biology of the University of the Azores.
MCM(HN): Museu Carlos Machado / História Natural, Ponta Delgada, Azores.
MNHN: Muséum National d´Histoire Naturelle, Paris (Malacologie).
NNM: Nationaal Natuurhistorisch Museum, Leiden.

RESULTS

Phylum Mollusca
Class Gastropoda
Subclass Orthogastropoda
Superorder Caenogastropoda
Order Sorbeoconcha
Suborder Hypsogastropoda
Superfamily Rissooidea
Family Rissoidae
Alvania Risso, 1826

Alvania abstersa Van der Linden and Van Aartsen, 1994

References to the Azores:
Alvania obsoleta Van der Linden, 1993: 79-82.
Alvania abstersa Van der Linden and Van Aartsen, 1994: 2; Hoenselaar and Goud, 1998:71.

Occurrence: Pico(Lajes do Pico), Terceira (Porto Martins), São Jorge (Fajã da Caldeira), São Miguel (Lagoa and Mosteiros), Santa Maria (Van der Linden, 1993: 80). Azores (CANCAP expeditions) (Hoenselaar and Goud, 1998: 71).

DBUA 726.

Comments: although more common just below the intertidal, it may appear to a depth of 35m.

Dimensions: up to 3.3 mm long, 1.7mm wide.

Geographic distribution: endemic to the Azores.

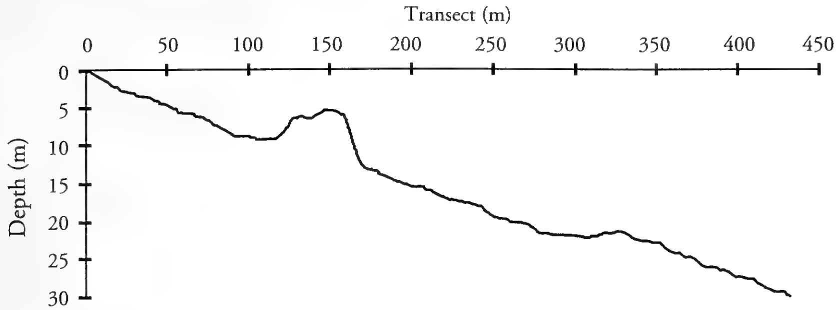


Figure 3. Transect performed at Porto da Baleia (São Vicente, Capelas), north coast of São Miguel island, Azores.
Figura 3. Transecto realizado en Porto da Baleia (São Vicente, Capelas), costa N de la isla de São Miguel, Azores.

Alvania angioyi Van Aartsen, 1982

References to the Azores:
Alvania (Alvinia) watsoni Schwartz, *in* Watson, 1873: Dautzenberg, 1889: 51.
Alvania watsoni (Schwartz MS) Watson, 1873: Bullock, Turner and Fralick, 1990: 45.
Alvania angioyi Van Aartsen, 1982: Azevedo and Martins, 1989: 69; Gofas, 1990: 112; Azevedo and Gofas, 1990: 85; Ávila, 1996: 27; Ávila and Azevedo, 1996: 106; Ávila and Azevedo, 1997: 326; Bullock, 1995: 16; Knudsen, 1995: 140; Hoenselaar and Goud, 1998: 72.
Alvania angioyi Van Aartsen, 1982d: Azevedo 1991b: 44.

Occurrence: São Miguel, Faial (Bay of Horta, -15 to -20 m, Stn. 103, "Hirondelle", 1887), Pico (-1287 m) (DAUTZENBERG, 1889: 51), Graciosa (AZEVEDO AND MARTINS, 1989: 69), Flores (Santa Cruz, -20m) (AZEVEDO AND GOFAS, 1990: 85), São Miguel (BULLOCK *ET AL.*, 1990: 45); São Miguel (Vila Franca (-24m) and Morro das Capelas ("Biaçores" 1971 expedition); Lagoa (-10 to -22m); Feteiras (-15 to -22m); Ponta da Galera (intertidal and -13 to -18m); Ponta Delgada; Capelas (intertidal); Ilhéu de Vila Franca; Ponta da Pirâmide (-13m)), Faial (Horta, -3m; -7m; Monte da Guia, -20m, "Biaçores" 1971), Terceira (Pedra Furada, Angra do Heroísmo; Praia da Vitória), Flores ("Pr. Alice" st. 703, 1896; Santa Cruz, -20m) and Formigas (west coast, -16m, "Biaçores" 1971) (GOFAS, 1990: 112), São Miguel (Caloura and Ribeirinha) (AZEVEDO, 1991a: 22), Santa Maria (Vila do Porto, Ponta do Marvão) (AZEVEDO, 1991b: 44), São Miguel (Ilhéu de Vila Franca) (BULLOCK, 1995: 16; KNUDSEN, 1995: 140), Pico (intertidal) (ÁVILA, 1996: 27), Pico (ÁVILA AND AZEVEDO, 1996: 106), Formigas islets (ÁVILA AND AZEVEDO, 1997: 326) and Azores (CANCAP expeditions) (HOENSELAAR AND GOUD, 1998: 72).

DBUA 119, 173, 188, 227, 274, 277, 281, 335, 340, 343, 350, 352, 353, 355, 372, 374, 379, 394, 398, 400, 407, 410, 412, 462, 493, 496, 499, 556, 560, 564, 568, 571, 574, 579, 666, 675, 715, 719.

MCM(HN) 7, 9.

Comments: this species is closely related to specimens from Madeira and is also similar to *Alvania oranica* (Pallary, 1900) from Ceuta (GOFAS, 1990). It occurs to a depth of 35m, but is commonest in the first 10m. Although Gofas raises the hypothesis of its existence at Madeira archipelago, its presence was not confirmed in the samples from the CANCAP expeditions (HOENSELAAR AND GOUD, 1998: 72).

Dimensions: 1.8mm long, 1.1 mm wide.

Geographic distribution: endemic to the Azores.

Alvania beani (Hanley in Thorpe, 1844)

References to the Azores:
Rissoa calathus Forbes and Hanley, 1858: Mac Andrew, 1856: 121.
Alvania (Turbona) reticulata (Montagu, 1803): Simroth, 1888.

Occurrence: Azores (-10 to -90m) (MAC ANDREW, 1856: 121). São Miguel (Ponta Delgada) (SIMROTH, 1888).

Comments: this record needs to be confirmed. Its occurrence in the Azores is possible and, if so, it lives predominantly at depths >50m and I have only a few samples collected by scuba diving at these depths. However, in the significant amount of samples collected at the Azores by the CANCAP expeditions, not a single specimen was found (HOENSELAAR AND GOUD, 1998).

Dimensions: 3.5mm long, 2.0mm wide (FRETTER AND GRAHAM, 1978).

Geographic distribution: Norway to the Mediterranean, Azores (?) and Canary Islands (FRETTER AND GRAHAM, 1978; ROLÁN, 1984).

Alvania cancellata (Da Costa, 1778)

References to the Azores:
Rissoa crenulata Michaud, 1832: Mac Andrew, 1856: 148.
Rissoa (Alvania) cancellata Da Costa: Watson, 1886: 592.
Alvania laxa Dautzenberg and Fischer, 1896: 62-63, pl. 19, figs. 10,11.
Alvania cancellata Da Costa: Dautzenberg, 1889: 49.
Alvania cancellata (Da Costa, 1778): Nobre, 1924: 80; 1930: 57; Morton, 1967: 36; Azevedo, 1990: 59; Gofas, 1990: 104; Azevedo and Gofas, 1990: 85; Azevedo, 1991a: 21; 1991b: 44; Ávila, 1996: 27; Ávila and Azevedo, 1997: 326; Hoenselaar and Goud, 1998: 73.

Occurrence: Azores (MAC ANDREW, 1856: 148); Faial (-823 to -914m) (WATSON, 1886: 592), Faial (Horta, -15 to -20m, Stn. 103, "Hirondelle", 1887), Pico (-1287m) and São Miguel (DAUTZENBERG, 1889: 49), Azores (NOBRE, 1924: 80; 1930: 57), São Jorge (Velas) (MORTON, 1967: 36), Pico (Baía de São Pedro, Lajes do Pico) (AZEVEDO, 1990: 59), Flores (Santa Cruz) (AZEVEDO AND GOFAS, 1990: 85), São Miguel (Ponta Delgada; Vila Franca do Campo, -10m, -24m; Morro das Capelas ("Biaçores" 1971 expedition); Feteiras, -15 to -22m; Ponta da Galera, -13 to -18m, -20m; Lagoa, -10 to -22m; Ponta da Pirâmide, -13m), Formigas (east coast, -16m), Terceira (Ponta de São Diogo, Pedra Furada - Angra do Heroísmo), Flores (Santa Cruz, -20m) and Pico (-1287m) (GOFAS, 1990: 104), São Miguel (infralittoral of Ribeirinha) (AZEVEDO, 1991a: 21), Santa Maria (Vila do Porto, Ilhéu da Vila) (AZEVEDO, 1991b: 44), São Miguel (Ilhéu de Vila Franca) (KNUDSEN, 1995: 141), Pico (subtidal) (ÁVILA, 1996: 27), Formigas islets (ÁVILA AND AZEVEDO, 1997: 326) and Azores (CANCAP expeditions) (HOENSELAAR AND GOUD, 1998: 73).

DBUA 127, 168, 173, 176, 197, 240, 274, 281, 341, 350, 379, 394, 395, 405, 408, 410, 411, 415, 421, 422, 438, 441, 446, 448, 459, 489, 493, 496, 499, 500, 555, 558, 561, 569, 570, 574, 579, 605, 608, 609, 614, 658, 659, 660, 661, 662, 665, 666, 667, 670, 672, 675, 677, 719.

Comments: it occurs from low tide level to a depth of 45m (SALDANHA, 1995), but its presence at low depths is rare (GRAHAM, 1988; GOFAS, 1990). It is detritivorous (GRAHAM, 1988). The populations in the Azores are conspecific with those on European mainland, their protoconchs matching exactly (KNUDSEN, 1995). GOFAS (1990) also states their conspecificity with the populations of Madeira and the Canary Islands, because of external similarities and the existence of a multispiral protoconch, denoting a planktotrophic development.

Dimensions: 3.7 mm long, 2.4 mm wide.

Geographic distribution: Atlantic, Azores, English Channel and North Sea (CAMPBELL, 1994), Madeira (NOBRE, 1889, 1937; GOFAS, 1990), British isles, Mediterranean, Canary islands and Cape Vert Islands (KNUDSEN, 1995). São Tomé island (FERNANDES AND ROLÁN, 1993).

Alvania cimex (Linnaeus, 1758)

References to the Azores:
Rissoa granulata Philippi, 1836: Mac Andrew, 1856: 121.

Occurrence: Azores from shores (dead) (MAC ANDREW, 1856: 121).

Comments: DAUTZENBERG (1889), raised doubts about the specific status of the specimen(s) identified by Mac Andrew. I agree with him and consider that this record needs to be confirmed.

Alvania formicarum Gofas, 1989

References to the Azores:
Alvania formicarum Gofas, 1989: 40-41; Hoenselaar and Goud, 1998: 72.

Occurrence: Formigas and Ilhéu de São Lourenço (Santa Maria) (GOFAS, 1989:40-41).

DBUA 332, 335, 338, 340, 341, 342, 343, 345, 348, 350, 352, 353, 355, 359.

Comments: the zonation of this species is not known. However, living specimens have been collected from 15 to 43m depth.

Dimensions: 2.4mm long, 1.4mm wide.

Geographic distribution: restricted to Formigas islets and Santa Maria island.

Alvania internodula Hoenselaar and Goud, 1998

References to the Azores:
Alvania sp.: Ávila and Azevedo, 1997: 326.
Alvania internodula Hoenselaar and Goud, 1998: 83.

Occurrence: Formigas (ÁVILA AND AZEVEDO, 1997: 326). Azores (CANCAP expeditions: Sta. 5033, 35m/1 specimen; Sta. 5039, 43m/2; Sta. 5040, 41-47m/25; Sta. 5091, 33m/7; Sta. 5098, 40m/1; Sta. 5113, 45m/12; Sta. AZO.022, at shore/1) (HOENSELAAR AND GOUD, 1998: 83).

DBUA 336, 338.

Comments: in their check-list of the shallow-water marine molluscs of Formigas, ÁVILA AND AZEVEDO (1997) indicated the presence of a new species of *Alvania* in 6 lots of the DBUA collection: DBUA 332, 335, 336, 338, 350, 355. Later work at the SEM level revealed the existence of a species already described as *A. internodula* Hoenselaar and Goud, 1998. Also, only the specimens in the DBUA 336 and 338 lots were correctly assigned to this new species, all other specimens being *Alvania angioyi* Van Aartsen, 1982d. The shells of the young specimens of *Alvania internodula* resemble *Alvania angioyi* Van Aartsen, 1982d, but the adults are quite different, with stronger knobs in the whorls and with deeper sutures.

Additional description: Protoconch sculptured with 5-6 marked spiral ribs, the interstices covered with numerous very small nodules, not aligned. In the second whorl of the teleoconch, the intermediate 3 ribs are more prominent than the others, the same happening in the body whorl. The crossings of spiral ribs and costae produce nodules, that are stronger in the intermediate 3 ribs. The ribs located in the anterior part of the body whorl are quite smooth. Inside the outer lip there are 8-9 faint denticles (Fig. 8: A-J).

Dimensions: 2.3 mm long, 1.3 mm wide.

Geographic distribution: restricted to the Formigas islets, Azores.

Alvania mediolittoralis Gofas, 1989

References to the Azores:

Alvania mariae (D'Orbigny): Dautzenberg, 1889: 49.

Rissoa (Alvania) reticulata Montagu var. *mariae* D'Orbigny: Nobre, 1924: 81.

Alvania (Turbona) reticulata (Montagu, 1803): Martins, 1980: 17 (misidentification, A.M.F. Martins, *pers. comm*).

Alvania mediolittoralis Gofas, 1989: Gofas, 1989: 39; Azevedo and Martins, 1989: 69; Azevedo, 1990: 59; Azevedo and Gofas 1990: 85; Gofas, 1990: 110-112; Azevedo, 1991a: 21; 1991b: 44; Ávila, 1996:27; Hoenselaar and Goud, 1998: 91.

Occurrence: São Miguel and Pico (-1287m) (Dautzenberg, 1889: 49), São Miguel (Ponta Delgada; Praia do Rosto do Cão), Terceira, Pico and Graciosa (Nobre, 1924: 81; 1930: 57), São Miguel (Atalhada, Lagoa) (Martins, 1980: 17), Graciosa (mediolittoral of Porto Afonso and Santa Cruz; infralittoral of Baía da Folga) (Azevedo and Martins, 1989: 69), Flores (Santa Cruz) (Azevedo and Gofas, 1990: 85), Pico (Baía de São Pedro, Lajes do Pico) (Azevedo, 1990: 59), São Miguel (Caloura, -4m; Vila Franca, -9m, -24m "Biaçores" 1971 expedition; Ponta da Galera, intertidal; Capelas, intertidal; Água d'Alto, intertidal; Calheta - Ponta Delgada, intertidal), Faial (Horta, -7m), Terceira (Praia da Vitória; Cais da Silveira; Pedra Furada - Angra do Heroísmo); Flores (Santa Cruz) (Gofas, 1989: 39; 1990: 110), São Miguel (mediolittoral of Caloura; infralittoral of Caloura and Ribeirinha) (Azevedo, 1991a: 21), Santa Maria (Vila do Porto, Ponta do Marvão) (Azevedo, 1991b: 44), Ilhéu de Vila Franca (Bullock, 1995: 16), Pico (mediolittoral) (Ávila, 1996: 27) and Azores (CANCAP expeditions) (Hoenselaar and Goud, 1998: 91).

DBUA 124, 188, 193, 197, 229, 240, 274, 442, 444, 445, 446, 448, 449, 450, 451, 452, 453, 455, 456, 457, 458, 459, 460, 461, 462, 471, 473, 474, 475, 476, 483, 486, 489, 490, 492, 493, 496, 499, 500, 551, 553, 558, 560, 561, 564, 565, 566, 568, 570, 571, 574, 579, 614, 632, 659, 661, 662, 663, 665, 666, 667, 715, 719.

Comments: common in sheltered places, especially under rocks. Sometimes present in large numbers in the intertidal zone, together with *Fossarus ambiguus* (Linnaeus, 1758) and *Cingula trifasciata* (Adams, 1798) (Gofas, 1990). It is similar to *Alvania manzonia* (Nordsieck, 1972) from the Canary Islands and Selvagens, and resembles also *Alvania leacocki* (Watson, 1873), from Madeira (Gofas, 1989).

Dimensions: up to 2.7 mm long, 1.5 mm wide.

Geographic distribution: Azores and Madeira archipelago (CANCAP expeditions, Sta. 1.D48, 0-22m/1 specimen; Sta.1.K14, at shore/1 and Sta. 1.K16, at shore/2) (Hoenselaar and Goud, 1998: 91).

Alvania poucheti Dautzenberg, 1889

References to the Azores:

Alvania poucheti Dautzenberg, 1889: 49-50; Bullock *et al.*, 1990: 45; Gofas, 1990: 108; Morton and Britton, 1995: 70; Knudsen, 1995: 141; Ávila, 1996: 27; Ávila and Azevedo, 1996: 106; Ávila and Azevedo, 1997: 326; Ávila *et al.*, 1998: 497; Hoenselaar and Goud, 1998: 99.

Alvania poucheti var. *cingulifera* Dautzenberg, 1889: 50.

Occurrence: São Miguel (DAUTZENBERG, 1889: 49-50), São Miguel (Ponta da Galera; Queimada, Água d'Alto; Mosteiros; Ilhéu de Vila Franca) (BULLOCK *ET AL.*, 1990: 45), São Miguel (Capelas, -24m ("Biaçores" 1971 expedition); Feteiras, -15 to -22m; Ponta Delgada, -10 to -20m; Lagoa; Ilhéu de Vila Franca, -1m; Ponta da Pirâmide, -13m; Calheta, Ponta Delgada; Ponta da Galera, -13 to -18m), Faial (Horta, -17 and -20m), Terceira (Praia da Vitória; Angra do Heroísmo, Pedra Furada) (GOFAS, 1990: 108), São Miguel (off Vila Franca do Campo) (MORTON AND BRITTON, 1995: 70), São Miguel (Ilhéu de Vila Franca) (KNUDSEN, 1995: 141), Pico (intertidal) (ÁVILA, 1996: 27), Pico (ÁVILA AND AZEVEDO, 1996: 106), Formigas islets (ÁVILA AND AZEVEDO, 1997: 326), Flores (ÁVILA *ET AL.*, 1998: 497) and Azores (CANCAP expeditions) (HOENSELAAR AND GOUD, 1998: 99).

DBUA 119, 173, 240, 350, 352, 353, 355, 447, 465, 493, 499, 500, 556, 563, 570, 631, 666.

MCM(HN) 3, 11, 107, 108.

Comments: usually associated with brown algae. It may occur at 20m depth, but is commonest in the first 10m.

Dimensions: up to 2.2mm long, 1.3mm wide.

Geographic distribution: endemic to the Azores.

Alvania sleursi (Amati, 1987)

References to the Azores:

(?) *Rissoa (Alvania) hispidula* Monterosato: Watson, 1886: 593 (misidentification).

Alvania hirta Monterosato: Dautzenberg and Fischer, 1896: 456 (misidentification).

Manzonia sleursi Amati, 1987: 25-30.

Alvania sleursi (Amati, 1987): Gofas, 1990: 107; Knudsen, 1995: 142; Ávila, 1996: 27; Ávila and Azevedo, 1996: 106; Ávila and Azevedo, 1997: 326.

Occurrence: Faial (-823 to -914 m) (WATSON, 1886: 593), Banco Princesa Alice (st. 46, -1385 m) (DAUTZENBERG AND FISCHER, 1896: 456), São Miguel (Ponta da Galera, -7 to -8m, -13 to -18m and -20m; Vila Franca, -24m; Morro das Capelas, -15 to -20m; Lagoa, -10 to -22m; Feteiras, -15 to -22m; Ponta da Pirâmide, -13m; Ilhéu de Vila Franca, -1m), Pico (-1287m), Terceira (Angra do Heroísmo, Pedra Furada; Praia da Vitória), Flores (Santa Cruz, -40m) (GOFAS, 1990: 107), Ilhéu de Vila Franca (KNUDSEN, 1995: 142), Pico (intertidal) (ÁVILA, 1996: 27), Pico (ÁVILA AND AZEVEDO, 1996: 106) and Formigas islets (ÁVILA AND AZEVEDO, 1997: 326).

DBUA 173, 335, 340, 341, 342, 343, 350, 352, 353, 355, 446, 448, 458, 459, 493, 496, 499, 500, 666, 667, 719.

MCM(HN) 40.

Comments: occurs from the intertidal to 45m depth, being more abundant on rocky shores, between -10 to -20m. HOENSELAAR AND GOUD (1998) reported this species to Selvagens archipelago (CANCAP expeditions, Sta. 3070, 645m depth / 8 specimens; Sta. 3072, 830m / 3; Sta. 3087, 322m / 8, with all specimens strongly eroded).

Dimensions: up to 2.5 mm long, 1.6 mm wide.

Geographic distribution: Azores and Selvagens archipelago (HOENSELAAR AND GOUD, 1998: 103).

Alvania tarsodes (Watson, 1886)

References to the Azores:

Rissoa (Alvania) tarsodes Watson, 1886: 595, pl. XLIV, fig. 2.

Alvania tarsodes (Watson, 1886): Bouchet and Warén, 1993: 642; Hoenselaar and Goud, 1998: 106.

Occurrence: Azores, from 35m depth to 620m (HOENSELAAR AND GOUD, 1998: 106).

Comments: although first reported to be a bathyal species (480-1385m depth,

BOUCHET AND WARÉN, 1993), HOENSELAAR AND GOUD (1998) have found specimens in some shallow samples of the CANCAP expeditions (Sta. 5033, 35m/3 specimens; Sta. 5039, 43m/8; Sta. 5040, 41-47m/8; Sta. 5050, 55m/3; Sta. 5096, 52m/4; Sta. 5100, 55m/1 and Sta. 5113, 45m/1).

Dimensions: 2.2mm long, 1.3mm wide (WATSON, 1886).

Geographic distribution: restricted to the Azores.

Botryphallus Ponder, 1990

Botryphallus ovummuscae (Gofas, 1990)

References to the Azores:
Peringiella nitida Brusina: Dautzenberg, 1889: 53.
Cingula (Peringiella) nitida (Brusina) Monterosato: Martins, 1980: 5.
"Peringiella" sp.: Azevedo and Gofas, 1990: 85.
"Peringiella" ovummuscae (Gofas, 1990): Gofas, 1990: 119-121, fig. 11.
Botryphallus ovummuscae (Gofas, 1990): Ávila, 1996: 27; 1998: 466; Ávila and Azevedo, 1996: 106.

Occurrence: Faial (-15 to -20m) and São Miguel (DAUTZENBERG, 1889, p. 53), Terceira (Poça dos Frades, Silveira; Caminho de Baixo, São Mateus) e São Miguel (Água d'Alto; Pópulo; Atalhada, Lagoa) (MARTINS, 1980, pp. 9-16), Flores (Santa Cruz, mediolittoral) (AZEVEDO AND GOFAS, 1990: 85), São Miguel (Ponta da Galera, intertidal; Calheta, Ponta Delgada), Terceira (Porto Martins), Flores (Santa Cruz, upper intertidal zone), (GOFAS, 1990, p. 120), Pico (intertidal) (ÁVILA, 1996: 27; 1998: 466) and Pico (ÁVILA AND AZEVEDO, 1996: 106).

DBUA 209, 493, 499, 500, 659, 661, 662, 665, 666, 715.

Comments: according to GOFAS (1990), there are related species in the Straits of Gibraltar (*Peringiella epidaurica* Brusina, 1886), at Madeira and also on the Canary Islands (in this last archipelago there are two species similar to the Azorean one).

Dimensions: up to 1.3 mm long, 0.7 mm wide.

Geographic distribution: endemic to the Azores.

Cingula Fleming, 1828

Cingula ordinaria Smith

References to the Azores:
Cingula ordinaria Smith: Chapman, 1955: 803.

Occurrence: Faial (Feteira, mid-tide) (CHAPMAN, 1955: 803).

Comments: this species was probably misidentified. Most probably, it represents *Cingula trifasciata* (J. Adams, 1800), the only representative of this genus that lives at the Azores Archipelago.

Cingula trifasciata (J. Adams, 1800)

References to the Azores:
Rissoa (Cingula) cingillus Montagu, 1803: Mac Andrew, 1856: 148.
Cingula cingillus Montagu, 1803: Dautzenberg, 1889: 52; Knudsen, 1995: 143.
Rissoa (Cingula) cingillus Montagu, 1803: Nobre, 1924: 80; 1930: 57.
Cingula (Cingula) cingillus (Montagu, 1803): Martins, 1980: 5; Lemos and Viegas, 1987: 65.
Cingula trifasciata (Adams, 1798): Azevedo and Gofas, 1990: 85.

Cingula trifasciata, (Adams, 1800): Gofas, 1990: 97-134; Bullock, 1995: 9-55; Ávila, 1996: 27 Ávila and Azevedo, 1997:326.

Occurrence: Azores, at shore (Mac Andrew, 1856: 122, 148), São Miguel (Dautzenberg, 1889: 52), São Miguel (Ponta Delgada), Faial (Horta), Terceira (Angra do Heroísmo), Graciosa, Pico and São Jorge (Calheta; Velas) (Nobre, 1924: 80; 1930: 57), São Jorge (Velas) (Morton, 1967: 36), Terceira (Poça dos Frades, Silveira; Fanal, São Pedro, Angra do Heroísmo; Caminho de Baixo, São Mateus) and São Miguel (Água d'Alto; Calheta, Ponta Delgada; Pópulo; Atalhada, Lagoa) (Martins, 1980: 9-17), São Miguel (Vila Franca do Campo: intertidal) (Lemos and Viegas, 1987: 65), Flores (mediolittoral of Santa Cruz) (Azevedo and Gofas, 1990: 85), São Miguel (Ponta da Galera, intertidal; Água d'Alto, intertidal) (Gofas, 1990: 119), São Miguel (Ilhéu de Vila Franca) (Bullock, 1995: 9-55), Pico (intertidal) (Ávila, 1996: 27) and Formigas islets (Ávila and Azevedo, 1997: 326).

DBUA 128, 205, 240, 352, 442, 445, 448, 449, 457, 460, 461, 470, 474, 475, 489, 490, 496, 499, 500, 659, 632, 660, 661, 662, 663, 665, 666, 667.

Comments: Nobre (1924; 1930) states that this species is common in littoral debris. It is extremely common in sheltered places, especially under rocks (Ávila and Azevedo, 1997). This species is detritivorous and usually occurs from the upper limit of barnacles (*Chthamalus stellatus*) to a few meter's depth (Graham, 1988). It has non-planktotrophic development (Knudsen, 1995) and because of this, Gofas (1990) has some doubts about its conspecificity with populations in Europe. The specimens collected by the author at Lajes do Pico, have a wide range of external color, from almost black to light-brown (pers. obs.).

Dimensions: 3.9 mm long, 2.1 mm wide.

Geographic distribution: Bay of Biscay to the West coast of Norway, the English Channel, Azores (Graham, 1988; Poppe and Goto, 1991; Hayward, Wigham and Yonow, 1995; Knudsen, 1995), Madeira (Nobre, 1937), Berlenga (Portugal) (Burnay, 1986).

Crisilla Monterosato, 1917

Crisilla postrema (Gofas, 1990)

References to the Azores:
Setia abjecta (Watson, 1873): Dautzenberg, 1889: 52.
Setia picta (Jeffreys, 1867): Dautzenberg, 1889: 53.
Alvania (Crisilla) sp.: Azevedo and Gofas, 1990: 85.
Alvania (Crisilla) postrema Gofas, 1990: 114.
Alvania postrema Gofas, 1990. Azevedo, 1991b: 44; Ávila and Azevedo, 1997: 326; Hoenselaar and Goud, 1998: 99.

Occurrence: Azores (colec. G. Dollfus), São Miguel and Faial (-15 to -20 m) (Dautzenberg, 1889: 53), Flores (Santa Cruz) (Azevedo and Gofas, 1990: 85), São Miguel (Capelas, -12m; Ilhéu dos Mosteiros, -3 to -5m; Morro das Capelas, intertidal and at -29m ("Biaçores" 1971 expedition); Ponta da Galera, intertidal and from -13 to -18m; Ponta Delgada, -10 to -20m, Ilhéu de Vila Franca; Ponta da Pirâmide, -13m; Calheta, Ponta Delgada), Faial (Horta, -3m, -7m and -17m), Terceira (Praia da Vitória; Angra do Heroísmo, Pedra Furada), Flores (Santa Cruz, intertidal pool), Formigas (-16m) (Gofas, 1990: 114-115), Caloura and Ribeirinha (Azevedo, 1991a: 22), Santa Maria (Vila do Porto, Ilhéu da Vila, Ponta do Marvão) (Azevedo, 1991b: 44), São Miguel (Ilhéu de Vila Franca) (Bullock, 1995: 16), Pico (intertidal) (Ávila, 1996: 27), Pico (Ávila and Azevedo, 1996: 106) and Formigas islets (Ávila and Azevedo, 1997: 326).

DBUA 121, 173, 188, 198, 274, 277, 340, 350, 351, 352, 353, 355, 359, 447, 462, 465, 470, 472, 492, 496, 499, 500, 545, 564, 632, 670.

Comments: this is an uncommon species. It occurs from the low-tide level to a depth of 20m. Two specimens were recently found at Madeira (CANCAP expeditions, Sta. 4.K27, at shore) (HOENSELAAR AND GOUD, 1998: 99).

Dimensions: 1.5mm long, 0.9mm wide.

Geographic distribution: Azores and Madeira (HOENSELAAR AND GOUD, 1998: 99).

Manzonia Brusina, 1870

Manzonia unifasciata Dautzenberg, 1889

References to the Azores:

Manzonia costata J. Adams, 1797 var. ex coloure: *unifasciata*: Dautzenberg, 1889: 51, pl. III, fig.10.
Manzonia costata J. Adams var. ex coloure: *bifasciata*: Dautzenberg, 1889: 51, pl. III, fig. 9.
Manzonia costata J. Adams var. ex coloure: *luteola*: Dautzenberg, 1889: 51.
Manzonia aurantiaca (Watson, 1873): Dautzenberg, 1889: 52.
Manzonia costata (Adams, 1797). Pico (Nobre, 1924: 80; 1930: 56).
Alvania (Manzonia) crassa (Kanmacher, 1798): Morton, 1967: 36.
Manzonia aurantiaca (Watson, 1873): Nordsieck, 1972: 176, pl. R VI, fig. 2.
Alvania (Manzonia) costata (Adams): Martins, 1980: 5, 16.
Manzonia unifasciata Dautzenberg, 1889: Moolenbeek and Faber,1987, p.26, fig. 42; Azevedo and Martins, 1989: 69; Azevedo, 1990: 59; Azevedo and Gofas, 1990: 85; Gofas, 1990: 116, figs. 9; 59-64; Azevedo, 1991a: 22; Ávila, 1996: 27; Ávila and Azevedo, 1997: 326.
Manzonia crassa (Kanmacher, 1798) (misidentification?): Bullock *et al.*, 1990: 45.
Manzonia unifasciata (Dautzenberg, 1889): Azevedo, 1991b: 44.
Alvania crassa (Kanmacher, 1798) (misidentification?). Knudsen, 1995: 141.

Occurrence: São Miguel (Ponta Delgada), Faial (Horta), Pico, Graciosa and Terceira (Angra do Heroísmo) (DAUTZENBERG, 1889: 51-52), São Miguel (Ponta Delgada), Faial (Horta), Pico, Graciosa and Terceira (Angra do Heroísmo) (NOBRE, 1924: 80; 1930: 56) São Jorge (Velas) (MORTON, 1967: 36), Pico (-1276m) and São Miguel (NORDSIECK, 1972: 176), São Miguel (Brejela, Atalhada, Lagoa) (MARTINS, 1980: 5, 16), Graciosa (mediolittoral of Fonte da Areia, Porto Afonso and Santa Cruz. Infralittoral of Baía da Folga and Carapacho) (AZEVEDO AND MARTINS, 1989: 69), Faial (Monte da Guia) (AZEVEDO, 1990: 59), Flores (Santa Cruz) (AZEVEDO AND GOFAS, 1990: 85), São Miguel (Ponta da Galera; Queimada, Água d'Alto; Mosteiros; Calheta, Ponta Delgada; Ilhéu de Vila Franca) (BULLOCK *ET AL.*, 1990: 43, 45), São Miguel (Caloura, -4m; Vila Franca do Campo, -24m; Ilhéu de Vila Franca do Campo; Morro das Capelas, -29m ("Biaçores" 1971 expedition); Capelas, intertidal; Lagoa, intertidal; Calheta, Ponta Delgada, 0 to -1m; Ponta da Galera, -13 to -18m), Faial (Horta, -3m, -20m), Terceira (Porto Martins; Praia da Vitória; Pedra Furada-Angra do Heroísmo); Flores (Santa Cruz, intertidal) (GOFAS, 1990: 116), São Miguel (mediolittoral of Caloura. Infralittoral of Caloura and Ribeirinha) (AZEVEDO, 1991a: 22), Santa Maria (Vila do Porto, Ilhéu da Vila, Ponta do Marvão) (AZEVEDO, 1991b: 44), São Miguel (Ilhéu de Vila Franca) (BULLOCK, 1995: 16; KNUDSEN, 1995: 142), Pico (intertidal) (ÁVILA, 1996: 27) and Formigas islets (ÁVILA AND AZEVEDO, 1997: 326).

DBUA 173, 188, 266, 273, 274, 281, 332, 338, 340, 341, 346, 350, 352, 353, 355442, 443, 445, 446, 449, 451, 452, 462, 470, 471, 475, 476, 486, 492, 493, 496, 499, 500, 556, 571, 574, 579, 657, 660,661, 662, 665, 666, 667, 670, 715, 719.

MCM(HN) 1, 75.

Comments: from low-tide level to -20m. This species has a quite variable color pattern (pers. obs.). The diameter of the protoconch (340 μm, KNUDSEN, 1995: 142, fig. 3B), seems to indicate that *M unifasciata* has non-planktotrophic development (KNUDSEN, 1995). *Manzonia crassa*, a species that exists on the Portuguese mainland (*e.g.*: Berlenga, see BURNAY, 1986: 27; BULLOCK *ET AL.*, 1990), *Rissoa costata*, reported from the Canary Islands (MAC ANDREW, 1852: 5) and *Alvania costata*, reported from Madeira by NOBRE (1937: 45) have also been reported from the Azores. I believe that all of them were misidentified with *Manzonia unifasciata*, which is endemic to the Azores and is the only representative of this genus in the Azorean Archipelago.

Dimensions: 2.5 mm long, 1.2 mm wide.

Geographic distribution: endemic to the Azores.

Onoba Adams H. and A., 1854

Onoba moreleti Dautzenberg, 1889

References to the Azores:
Onoba moreleti Dautzenberg, 1889: 52; Moolenbeek and Hoenselaar, 1987: 154; Ávila *et al.*, in press.

Occurrence: Pico, Faial and Flores (ÁVILA *ET AL.*, 1998: 498), Faial, Horta bay (Stn. 193) (-20m) (MOOLENBEEK AND HOENSELAAR, 1987: 154), São Miguel (ÁVILA *ET AL.*, *in press*).

DBUA 181, 410, 411, 500, 556, 666, 748.

Comments: this is a rare species of the Azorean littoral. AARTSEN, MENKHORST AND GITTENBERGER (1984) were surprised to find specimens of *Onoba moreleti* at the Bay of Algeciras (Southern Spain), but this species was later described as *Onoba josae* by MOOLENBEEK AND HOENSELAAR (1987). Its presence was also reported from Graciosa, Canary Islands (collection M. C. Fehr-de Wal) by AARTSEN *ET AL.* (1984) but, once again, it was a different species, described as *Onoba manzoniana* by ROLÁN (1987). According to MOOLENBEEK AND FABER (1987) this species is *Manzonia manzoniana* (Rolán, 1987). Formerly thought to be restricted to the western and central groups of islands of the Azores, recent sorting of material collected at São Miguel island (DBUA 748 - Capelas, north coast, 14m depth) has revealed that *O. moreleti* also occur in the eastern group.

Dimensions: 2.6mm long, 1.3mm wide.

Geographic distribution: endemic to the Azores.

Rissoa (Fréminville, ms.) Desmarest, 1814

Rissoa guerini Récluz, 1843

References to the Azores:
Cingula costulata Alder, 1844: Chapman, 1955: 803.

Occurrence: Faial (Feteira, mid tide) (CHAPMAN, 1955: 803).

Comments: a dubious record. This species has not since been cite from the Azores yet, although its distribution ranges from the British isles to the Canaries (FRETTER AND GRAHAM, 1978; POPPE AND GOTO, 1991). Probably, Chapman misidentified specimens of *Rissoa guernei* Dautzenberg, 1889 for his species *Cingula costulata*.

Dimensions: 6.0 mm long, 3.0 mm wide (FRETTER AND GRAHAM, 1978).

Geographic distribution: British isles to Portugal and the Canaries (FRETTER AND GRAHAM, 1978; POPPE AND GOTO, 1991).

Rissoa guernei Dautzenberg, 1889

References to the Azores:
Rissoa guernei Dautzenberg, 1889: 47-48, pl. 3, figs. 1a, b; Azevedo and Gofas, 1990: 85; Bullock *et al.*, 1990: 45; Gofas, 1990: 100; Azevedo, 1991a: 21; 1991b: 44; Bullock, 1995: 16; Knudsen, 1995: 140; Ávila, 1996: 27; Ávila and Azevedo, 1996: 106.
Rissoa obesula Dautzenberg, 1889: 48, pl. 3, figs. 2a, b.
Rissoa jousseaumei Dautzenberg and Fischer, 1896: 60-61, pl. 19, fig. 9 *fide* Gofas, 1990, p. 99.
Moniziella moniziana azorica Nordsieck, 1972: 173, pl. R V, fig. 28.

Occurrence: São Miguel and Faial (-15 to -20 m) (DAUTZENBERG, 1889: 47-48), Pico (-1287m) (DAUTZENBERG, 1889: 48, pl. 3, figs. 2a, b), São Miguel (-1385m) (DAUTZENBERG AND FISCHER, 1896: 60-61, pl. 19, fig. 9), São Miguel (Ponta Delgada) (NORDSIECK, 1972: 173, pl. R V, fig. 28), Graciosa (mediolittoral of Porto Afonso; infralittoral of Baía da Folga) (AZEVEDO AND MARTINS, 1989: 69), Pico (Lajes do Pico) (AZEVEDO, 1990: 59), Flores (Fajã Grande; Santa Cruz) (AZEVEDO AND GOFAS, 1990: 85), São Miguel (Ponta da Galera; Queimada, Água d'Alto; Mosteiros; Calheta, Ponta Delgada; Ilhéu de Vila Franca; Porto do Ilhéu, Vila Franca do Campo) (BULLOCK *ET AL.*,1990: 43, 45), Flores (infralittoral of Fajã Grande and Piscina of Ponta Delgada) (NETO AND AZEVEDO, 1990: 96, 98), São Miguel (Vila Franca ("Biaçores" 1971 expedition); Ponta Delgada; (-10 to -20m); Ponta da Galera (intertidal); Capelas (intertidal); Vila Franca (0 to -5 m); Ilhéu de Vila Franca (0 to -1 m); Calheta, Ponta Delgada (intertidal); Ponta da Pirâmide (-13m) (GOFAS, 1990: 100), São Miguel (mediolittoral of Caloura; infralittoral of Caloura and Ribeirinha) (AZEVEDO, 1991a: 21), Santa Maria (Vila do Porto, Ponta da Malbusca, Ilhéu da Vila, Ponta do Marvão) (AZEVEDO, 1991b: 44), São Miguel (Ilhéu de Vila Franca) (BULLOCK, 1995: 16; KNUDSEN, 1995: 140), Pico (intertidal) (ÁVILA, 1996: 27) and Pico (ÁVILA AND AZEVEDO, 1996: 106).

DBUA 188, 190, 193, 195, 220, 240, 274, 281, 442, 443, 448, 451, 452, 459, 460, 462, 468, 470, 471, 472, 473, 475, 492, 493, 496, 499, 500, 551, 554, 556, 565, 566, 568, 570, 571, 574, 579, 632, 661, 662, 666, 667, 719.

Comments: feeds on detritus and on epiphytics algae (GRAHAM, 1988). According to GOFAS (1990) this species is sexual dimorphic. It occurs from the low-tide level to -8m. PONDER (1985) states that the genus *Rissoa* has pelagic larvae, being restricted to the Mediterranean and north-eastern Atlantic. *Rissoa guernei* however, is a direct development species and one may hypothesize that the ancestral of this species probably lost its planktotrophic veliger larvae after colonizing the Azores.

Dimensions: up to 2.3 mm long, 1.3 mm wide.

Geographic distribution: endemic to the Azores, even though it is closely related to Macaronesian/European species (GOFAS, 1990).

Setia H and A. Adams, 1852

Setia sp.

References to the Azores:
Setia sp. Azevedo and Gofas, 1990: 85; Ávila *et al.*, 1998: 496.

Occurrence: Flores (Santa Cruz, -20m) (AZEVEDO AND GOFAS, 1990: 85), Pico and Flores (ÁVILA *ET AL.*, 1998: 496).

DBUA 274, 276, 277, 281, 446, 449, 478, 496, 499, 662.

Comments: the small dimensions of this species has probably led to its being overlook in samples. The sorting of samples with a mesh size of 0.5mm will help to clarify its zonation and its geographical distribution.

Dimensions: 1.0mm long, 0.8mm wide.

Geographic distribution: Flores, Pico and São Miguel.

Setia pulcherrima (Jeffreys, 1848)

References to the Azores:
Cingula pulcherrima (Jeffreys, 1848): Bullock *et al.*, 1990: 45; Knudsen, 1995: 143-144.

Occurrence: São Miguel (Ponta da Galera; Queimada, Água d'Alto; Mosteiros; Calheta, Ponta Delgada; Ilhéu de Vila Franca; Porto do Ilhéu, Vila Franca) (BULLOCK *ET AL.*, 1990: 45), São Miguel (Ilhéu de Vila Franca) (KNUDSEN, 1995: 143-144).

Comments: this record needs to be confirmed. This species is reported to live on rocky shores, among fine weeds at the low tide (FRETTER AND GRAHAM, 1978). However in all the samples collected from such places in the Azores, I have never found this species. It might be a misidentification for *Setia subvaricosa* Gofas, 1990.

Dimensions: 1.2 mm long, 0.8 mm wide (FRETTER AND GRAHAM, 1978).

Geographic distribution: Azores (?). North to the Channel islands (FRETTER AND GRAHAM, 1978).

Setia quisquiliarum Watson, 1886

References to the Azores:
Setia quisquiliarum Watson, 1886: Dautzenberg, 1889: 53.
"Rissoa" quisquiliarum Watson, 1886: Gofas, 1990: 103.

Occurrence: São Miguel (DAUTZENBERG, 1889: 53). Off Faial (38° 38′ N, 28° 28′ 30″ W, in 730-910 m), Terceira (GOFAS, 1990).

Comments: GOFAS (1990) states that this species is restricted to the central group of islands, but DAUTZENBERG (1889) quotes it from São Miguel, in the eastern group.

Dimensions: 1.4mm long, 0.9mm wide.

Geographic distribution: Faial, Terceira and São Miguel.

Setia subvaricosa Gofas, 1989

References to the Azores:
Setia abjecta Watson, 1873: Dautzenberg, 1889: 52.
Setia subvaricosa Gofas, 1989: Azevedo, 1990: 58; Gofas, 1990: 102-104; Ávila, 1996: 27; Ávila and Azevedo, 1996: 106; Ávila and Azevedo, 1997: 326; Ávila *et al.*, 1998: 496.

Occurrence: Faial (-15 a -20 m) (DAUTZENBERG, 1889: 52), Faial (Monte da Guia) (AZEVEDO, 1990: 58), São Miguel (Ilhéu de Vila Franca, intertidal; Capelas, intertidal; Feteiras, -15 m; Lagoa, -10 to -22 m; Ponta da Galera, intertidal; Ponta da Pirâmide, -13 m; Calheta, Ponta Delgada, intertidal), Terceira (Praia da Vitória, Pedra Furada - Angra do Heroísmo), Flores (Santa Cruz, -20 m) (GOFAS, 1990: 102-103), Pico (intertidal) (ÁVILA, 1996: 27), Pico (ÁVILA AND AZEVEDO, 1996: 106), Formigas islets (ÁVILA AND AZEVEDO, 1997: 326), Flores (ÁVILA *ET AL.*, 1998: 496).

DBUA 176, 188, 193, 195, 223, 274, 281, 332, 335, 336, 338, 343, 345, 350, 352, 355, 447, 451, 462, 465, 467, 471, 481, 496, 499, 500, 545, 557, 564, 571, 574, 660, 662, 666.

Comments: this is an uncommon species. The outer lip of the adult shell of *S. subvaricosa* is thicker than that in the other species of *Setia* from the Mediterranean and the Atlantic (GOFAS, 1990).

Dimensions: up to 1.4 mm long, 0.8 mm wide.

Geographic distribution: endemic to the Azores.

Table I. Distribution of the Rissoidae on the islands and islets of the Azorean Archipelago.
Tabla I. Distribución de los Rissoidae en las islas e islotes del archipiélago de las Azores.

	western group	central group					eastern group		
	Flores	Pico	São Jorge	Faial	Graciosa	Terceira	São Miguel	Santa Maria	Formigas
Alvania abstersa		1	1			1	1	1	
Alvania angioyi	1	1		1	1	1	1	1	1
Alvania cancellata	1	1	1	1	1	1	1	1	1
Alvania formicarum								1	1
Alvania internodula									1
Alvania mediolittoralis	1	1		1	1	1	1	1	
Alvania poucheti	1	1		1		1	1		1
Alvania sleursi	1	1		1		1	1		1
Botryphallus ovummuscae	1	1		1		1	1		
Cingula trifasciata	1	1	1	1	1	1	1		1
Crisilla postrema	1	1		1		1	1	1	1
Manzonia unifasciata	1	1	1	1	1	1	1	1	1
Onoba moreleti	1	1		1			1		
Rissoa guernei	1	1		1	1		1	1	
Setia quisquiliarum				1		1	1		
Setia subvaricosa	1	1		1		1	1		1
Setia sp.	1	1					1		
Total number of taxa	13	14	4	13	6	12	15	8	10

Table II. Morphometry of the Rissoidae of the Azores. #Wp: number of protoconch whorls; #Wt: number of teleoconch whorls; Di p: diameter of the protoconch; I protoconch 1; II: protoconch 2; L: total length of the shell; W: total breadth of the shell (based on own data; WATSON, 1886; GOFAS, 1990; KNUDSEN, 1995; HOENSELAAR AND GOUD, 1998).
Tabla II. Morfometría de los Rissoidae de las Azores. #Wp: número de vueltas de la protoconcha; #Wt: número de vueltas de la teleoconcha; Di p: diámetro de la protoconcha; I protoconcha 1; II: protoconcha 2; L: longitud total de la concha; W: anchura total de la concha (basado en datos propios; WATSON, 1886; GOFAS, 1990; KNUDSEN, 1995; HOENSELAAR AND GOUD, 1998).

RISSOIDAE	#Wp	#Wt	Di p (m)	L (mm)	W (mm)
Alvania abstersa Van der Linden and Van Aartsen, 1994	1.5	3.5	300-400	2.3 – 3.3	1.5 - 1.7
Alvania angioyi Van Aartsen, 1982	1.5	3.25 - 3.75	283.3 - 292.3	1.2 - 1.8	0.7 - 1.1
Alvania cancellata (Da Costa, 1778)	I: 1 II: 1.5	3.5	I: 120.0 – 175.0 II: 375.0 – 440.0	2.7 - 3.7	1.8 - 2.4
Alvania formicarum Gofas, 1989	1.25	3	366.7	2.4	1.4
Alvania internodula Hoenselaar and Goud, 1998	1.25	3.5	310.0-333.3	2.0 - 2.3	1.1 - 1.3
Alvania mediolittoralis Gofas, 1989	1.25	3.25 - 3.75	294.1 - 304.0	2.2 - 2.7	1.3 - 1.5
Alvania poucheti Dautzenberg, 1889	1.25	3.25	363.4 - 383.4	1.8 - 2.2	1.0 - 1.3
Alvania sleursi (Amati, 1987)	1.25	3.75 - 4	358.3 - 400.0	2.2 - 2.5	1.5 - 1.6
Alvania tarsodes (Watson, 1886)	?	?	?	2.2	1.3
Botryphallus ovummuscae (Gofas, 1990)	1.25	3	222.2	1.1 - 1.3	0.6 - 0.7
Cingula trifasciata (Adams, 1798)	2.0 - 2.5	4	500.0	3.2 - 3.9	1.8 - 2.1
Crisilla postrema (Gofas, 1990)	1.25	3	?	1.4 - 1.5	0.8 - 0.9
Manzonia unifasciata (Dautzenberg, 1889)	1.25	4	304.3 - 347.8	2.0 - 2.5	1.0 - 1.2
Onoba moreleti Dautzenberg, 1889	1.25	3	322.7 - 333.3	1.9 - 2.6	0.9 - 1.3
Rissoa guernei Dautzenberg, 1889	1.25	4	258.8 - 281.3	1.9 - 2.3	1.1 - 1.3
Setia sp.	0.6	2.0-2.5	200.0 - 213.0	0.8 - 1.0	0.6 - 0.8
Setia quisquiliarum Watson, 1886	?	3	?	1.4	0.
Setia subvaricosa Gofas, 1990	1.25	3	238.5	1.1 - 1.4	0.7 - 0.8

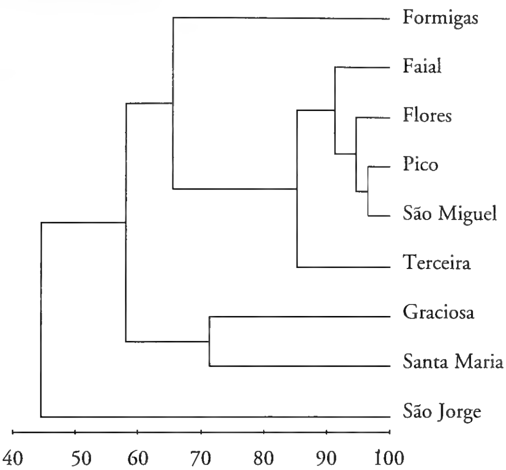


Figure 4. Bray-Curtis/non transformed presence/absence data / UPGMA for the Rissoidae of the Azores.
Figura 4. Análisis Bray-Curtis/no transformado de presencia/ausencia data / UPGMA de los Rissoidae de las Azores.

RESULTS

At the present status of our knowledge, 23 taxa of Rissoidae are given to the Azores: 12 are endemic species, three are restricted to the Azores and Madeira/Selvagens archipelago, two have a wider distribution, one is an unidentified species of *Setia* and there are five records that were not confirmed by this study. The presence/absence of Rissoidae species on the islands of the Azores, based on the literature and new data, is shown in Table I. Classification techniques used for this table, resulted in Figure 4. São Miguel, Pico and Flores, clustered at more than the 95% similarity level, form a consistent group, to which Faial (92%) and Terceira (85%) are also joined. Formigas, clustered at 65%, seems to be different from the first group of islands in terms of the Rissoidae species. São Jorge is the last island to cluster, at only the 44% similarity level.

Morphometry: The largest Rissoidae present on Azorean littoral are *Alvania cancellata* (3.7 x 2.4 mm) and *Cingula trifasciata* (3.9 x 2.1 mm), whereas the smallest are *Setia* sp. (1.0 x 0.8 mm), *Botryphallus ovummuscae* (1.3 x 0.7 mm) and *Setia subvaricosa* (1.4 x 0.8 mm). Almost all protoconchs have 1 $^{1}/_{4}$ whorls, *Alvania cancellata* being the exception with 2 $^{1}/_{2}$ whorls. The smallest protoconchs belong to *Setia* sp. and *S. subvaricosa* (200 to 238,5 μm). *Alvania cancellata,* with a multispiral protoconch, has the largest (protoconch I= 120 μm; protoconch II= 440 μm). The number of the teleoconch whorls range from 3 to 4 in all rissoids (Table II).

Zonation: Nine species of Rissoidae were found at São Vicente, Capelas, on the north coast of São Miguel, Azores. A total of 1,564 specimens were counted, on the 24 collected quadrates of 50 x 50 cm, *Manzonia unifasciata* Dautzenberg, 1889 being the most abundant with a total of 631 individuals, whilst *Setia* sp. and *S. subvaricosa* Gofas, 1990 uncommon species, (11 and 13 specimens, respectively) (Table III).

The zonation of the Rissoidae at São Vicente, Capelas, seems to indicate the

Table III. Rissoidae collected in July 1996 at São Vicente-Capelas, north coast of São Miguel (all specimens larger than 1mm).
Tabla III. Rissoidae recogidos en julio de 1996 en São Vicente-Capelas, costa norte de São Miguel (todos los especimenes mayores de 1mm).

Depth (m)	**3.5**	**3.5**	**3.5**	**5.1**	**5.1**	**5.1**	**8**	**8**	**8**	**12**	**12**	**12**
A. angioyi	6	6	27	27	24	4	6	15	16	0	1	9
A. cancellata	1	0	1	1	0	1	8	6	1	1	3	4
A. poucheti	2	4	3	3	2	0	0	2	3	0	1	1
A. sleursi	16	19	28	18	30	23	11	15	20	6	5	11
C. postrema	0	0	8	0	1	0	0	0	4	0	0	0
M. unifasciata	10	11	28	87	116	16	51	138	89	0	5	13
R. guernei	16	14	41	16	19	11	8	7	9	0	0	1
S. subvaricosa	1	0	2	2	3	0	0	2	0	0	0	2
Setia sp.	1	1	1	2	2	0	0	0	1	0	1	2
TOTAL	53	55	139	156	197	55	84	185	143	7	16	43

existence of common species at shallow depths (from low tide level to -10 m), such as *Rissoa guernei*, *Manzonia unifasciata* and *Alvania angioyi*, and species more abundant from 15 m down, such as *Alvania sleursi*, *A. cancellata* and *A. poucheti* (Figs. 5 and 6).

By clustering the stations, at the 60% similarity level, two groups appear. The first one, with the highest number of stations and with the exception of replicates 20 and 21 (22 m depth), contains stations in shallow/medium depths. The second group, with the exception of stations 10 (12 m depth) and 14 (13.6 m depth) are all medium/high depths (Fig. 7).

DISCUSSION

It seems evident that there is some island to island endemism, as suspected by Gofas (1990), *Alvania formicarum* and *A. internodula* being restricted to the eastern group of islands (São Miguel, Santa Maria and Formigas islets). Pico, Faial, Flores and São Miguel, the best studied islands, are almost identical in the composition of the Rissoidae, with the exceptions of *Setia quisquiliarum* (not found yet at Flores and Pico), *Alvania abstersa* (not found at Flores and Faial) and *Setia* sp. (not found at Faial). There is a clear distinction between the Rissoidae of Formigas islets and the remaining islands of the Azores. In fact, *A. internodula* is restricted to these islets and *A. mediolittoralis* and *Rissoa guernei*, common species in the other islands, do not occur at Formigas. The importance of the Formigas islets as a Nature Reserve is therefore reinforced by the results of this study.

Santa Maria, São Jorge and Graciosa must be considered as outsiders in this biogeographic puzzle, as long as the number of samples and the quality of them is not increased (Table I and Fig. 4). As for *Setia* sp., it may have been overlooked in some samples because of its small size.

The abundance of the Rissoidae in the littoral of the Azores seems to be variable. Azevedo (1991) found that *Crisilla postrema* (= *Alvania postrema*) (mediolittoral) and *Rissoa guernei* (infralittoral) were the most abundant species associated with macroalgae in two sites at São Miguel island (Caloura/south coast and Ribeirinha/north coast). At Lajes do Pico (rocky intertidal conditions), the most abundant species is *Cingula trifasciata*, which may reach densities of 32,500 specimens/m^2 (Ávila, 1998). In this study, *Manzonia unifasciata* and *Alvania sleursi* are revealed to be the most abundant species, both in the infralittoral. Only long term and seasonal studies will answer this apparent discrepancy between mine and Azevedo's data.

Table III. Continuación.
Tabla III. Continuation.

13.6	13.6	13.6	16.3	16.3	16.3	22	22	22	26.8	26.8	26.8	TOTAL
0	1	0	4	0	8	0	3	0	0	0	3	160
4	2	2	3	0	2	2	19	6	2	1	1	71
2	1	0	2	0	11	3	16	2	0	1	0	59
20	47	8	16	6	11	11	106	13	4	4	7	455
0	0	0	0	0	5	0	0	0	0	0	0	18
18	8	3	14	2	2	0	19	3	0	0	1	631
0	0	0	1	0	0	0	0	0	0	0	0	143
0	0	0	1	0	0	0	0	0	0	0	0	13
0	0	0	0	0	0	0	0	0	0	0	0	11
44	59	13	41	8	39	16	163	24	6	6	12	1,564

With the sole exception of *Alvania cancellata* none of the other species of Rissoidae in the Azores has a long planktotrophic larval development, because their protoconchs are bigger than about 200 μm (VERDUIN, 1982; 1985) (Table II). However, studies on other marine Prosobranchs (*e.g.* Turridae) have demonstrated that a paucispiral protoconch (as seen in the majority of the Azorean Rissoidae) must not be interpreted as evidence for lacking a planktonic phase (SHIMEK, 1986; BOUCHET, 1990). Nevertheless, if there is a planktonic phase, it must be of small duration, but of high importance to the dispersal of the species within the archipelago.

The similarity between the shells of *Alvania cancellata* and *A. sleursi* was pointed out by GOFAS (1990), who thought the latter species could have speciated from the former, by losing the planktotrophic phase. On the other hand, *Alvania abstersa, A. formicarum* and *A. mediolittoralis* are so similar in their protoconchs as well as in their teleoconchs, that we may hypothesize their relation with a common ancestor.

MAC ANDREW (1854: 49), stated that the marine molluscs of the Azores, Madeira and Canary Islands were «closely related to that of the old continent, notwithstanding that the prevailing set of currents is from America». The surface currents in the Northern Atlantic, especially the Gulf Stream, have been studied in detail during this century (ISELIN, 1936; GOULD, 1985; FIALHO AND BARROS, 1988; KLEINE AND SIEDLER, 1989; ALVES, 1990; 1992;). All studies indicate that the surface currents are mainly from West to the East, that is, from America to Europe.

The larvae of *Alvania formicarum* probably did not reach the islands of the central and western groups because of the main direction of surface currents in the Azores. The same may be true for *A. internodula,* but the scarcity of data on this last species, does not allow for a stronger conclusion. Additional samples must be taken at Formigas, in order to determine the zonation of *A. internodula*. If it becomes apparent that it usually occurs at depths of about 45 m (as is the case at Formigas islets), this species may be common on the other islands of the Azores, but not found yet, because no representative samples have been collected by me at depths greater than 30m. However, this species was not found in any of the CANCAP samples (ranging from 33 to 47 m depth), so we have some evidence that it may be restricted to Formigas.

A non-planktotrophic species may be distributed over a large area if there is another plausible means of transport. It is likely that those species of Rissoidae

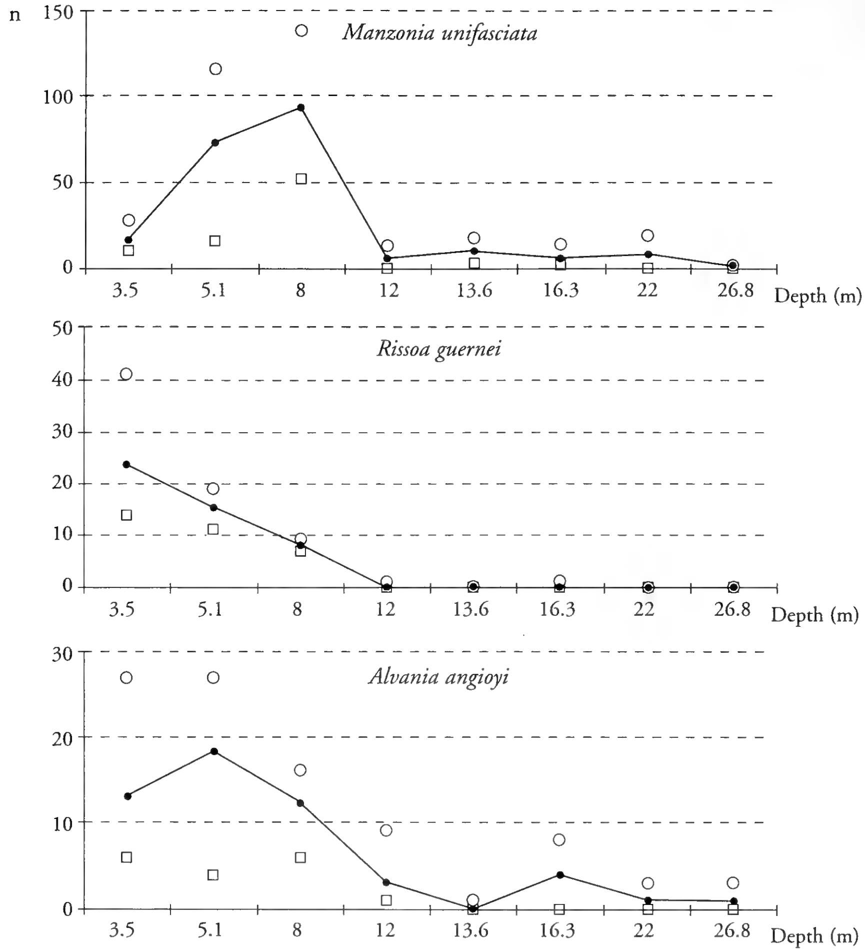


Figure 5. Common Rissoidae species collected at shallow depths (from low tide level to -10m) collected at São Vicente, Capelas, São Miguel, Azores (❍: maximum; ●: average; ❑: minimum values).

Figura 5. Especies de Rissoidae comunes en aguas someras (del nivel de bajamar hasta -10m) recogidas en São Vicente, Capelas, São Miguel, Azores (❍: máximo; ●: media; ❑: mínimo).

living in the first few meters of water (*e.g. Alvania angioyi, Manzonia unifasciata* and *Rissoa guernei*) may drift from island to island on "rafts" of algae provided by heavy seas breaking into the shore.

There are 231 confirmed species of shallow-water molluscs on the littoral of the Azores (ÁVILA, 2000). Only 16 species (6.9%) are amphi-Atlantic species, in contrast to the 181 species (78.4%) shared with the western Mediterranean, or the 147 species (63.6%) shared with Madeira (with the Desertas and Selvagens). Mainland Portugal and Canary Islands, share 144 (62,3%) and 137 species (59,3%), respectively, with the Azores, whereas Saint Helena (5,2%) and Ascension island (5,6%) share only a small number of species. A total of 112 species (48,5%) occurs simultaneously in the Azores, Madeira and the Canary Islands, and 53 species (22,9%) occur in all the Macaronesian Ar-

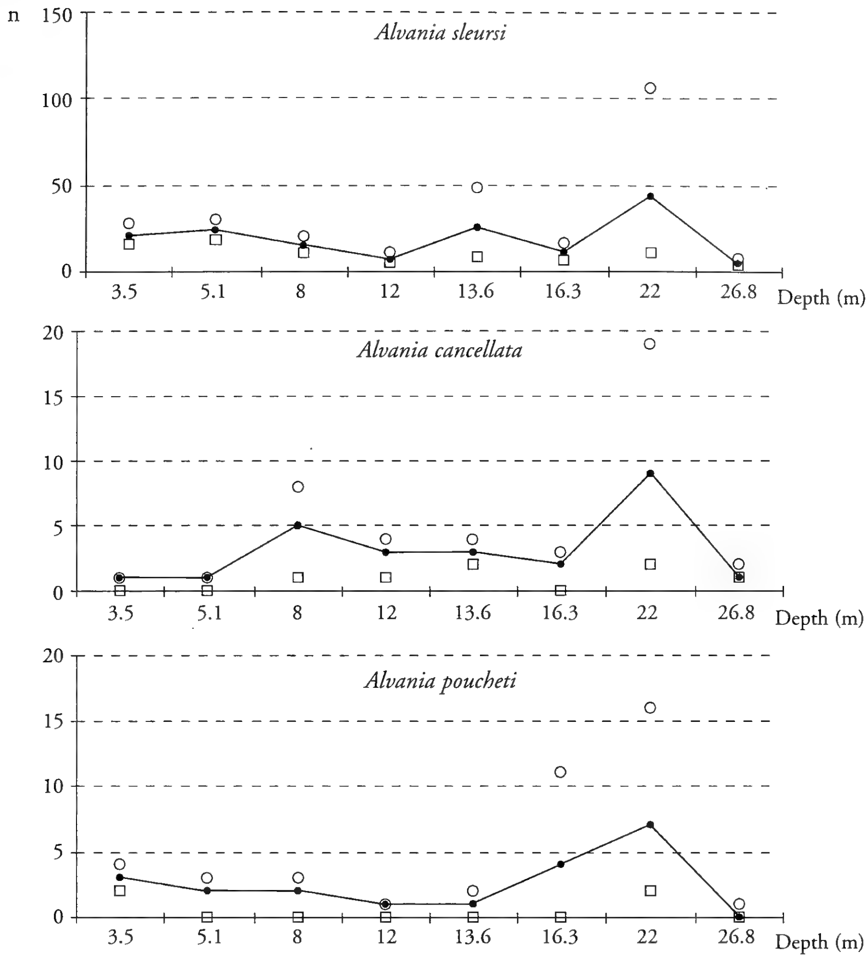
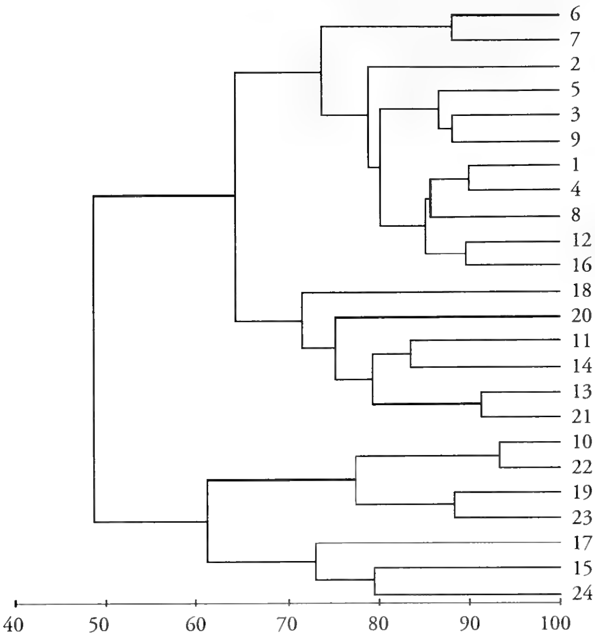


Figure 6. Common Rissoidae species collected at high depths (-15 to -30m) collected at São Vicente, Capelas, São Miguel, Azores (❍: maximum; ●: average; ❑: minimum values).
Figura 6. Especies de Rissoidae comunes en aguas profundas(-15 a -30 m) recogidas en São Vicente, Capelas, São Miguel, Azores (❍: máximo; ●: media; ❑: mínimo).

chipelagos (ÁVILA, 2000). Of the 231 reported species, 19 are endemic (8,2%) and of these, 13 (5,6%) are endemic Rissoidae (ÁVILA, 2000). The dominance of the Rissoidae in the littoral fauna of the Azores, is one piece of evidence that supports its higher similarity with that of Europe (GOFAS, 1990).

An understanding of the colonization and subsequent speciation that has occurred in the molluscan fauna of the Azores, with special emphasis on the Rissoidae, clearly merits further research. Samples of plankton should be taken in the three groups of islands, in order to evaluate the dispersal capabilities of the endemic Rissoidae, especially the most problematic species (*Alvania formicarum, A. internodula, Onoba moreleti* and the undescribed *Setia*). Deeper samples should also be collected in order to respond to the questions raised by the so far apparent restricted range of *Alvania internodula.*



Depth (m)	Quadrats
3.5	1-3
5.1	4-6
8.0	7-9
12.0	10-12
13.6	13-15
16.3	16-18
22.0	19-21
26.8	22-24

Figure 7. Rissoidae at São Vicente, Capelas, São Miguel, Azores. Double Square Root/Bray-Curtis/UPGMA.

Figura 7. Rissoidae de São Vicente, Capelas, São Miguel, Azores. Doble Raíz/Bray-Curtis/UPGMA.

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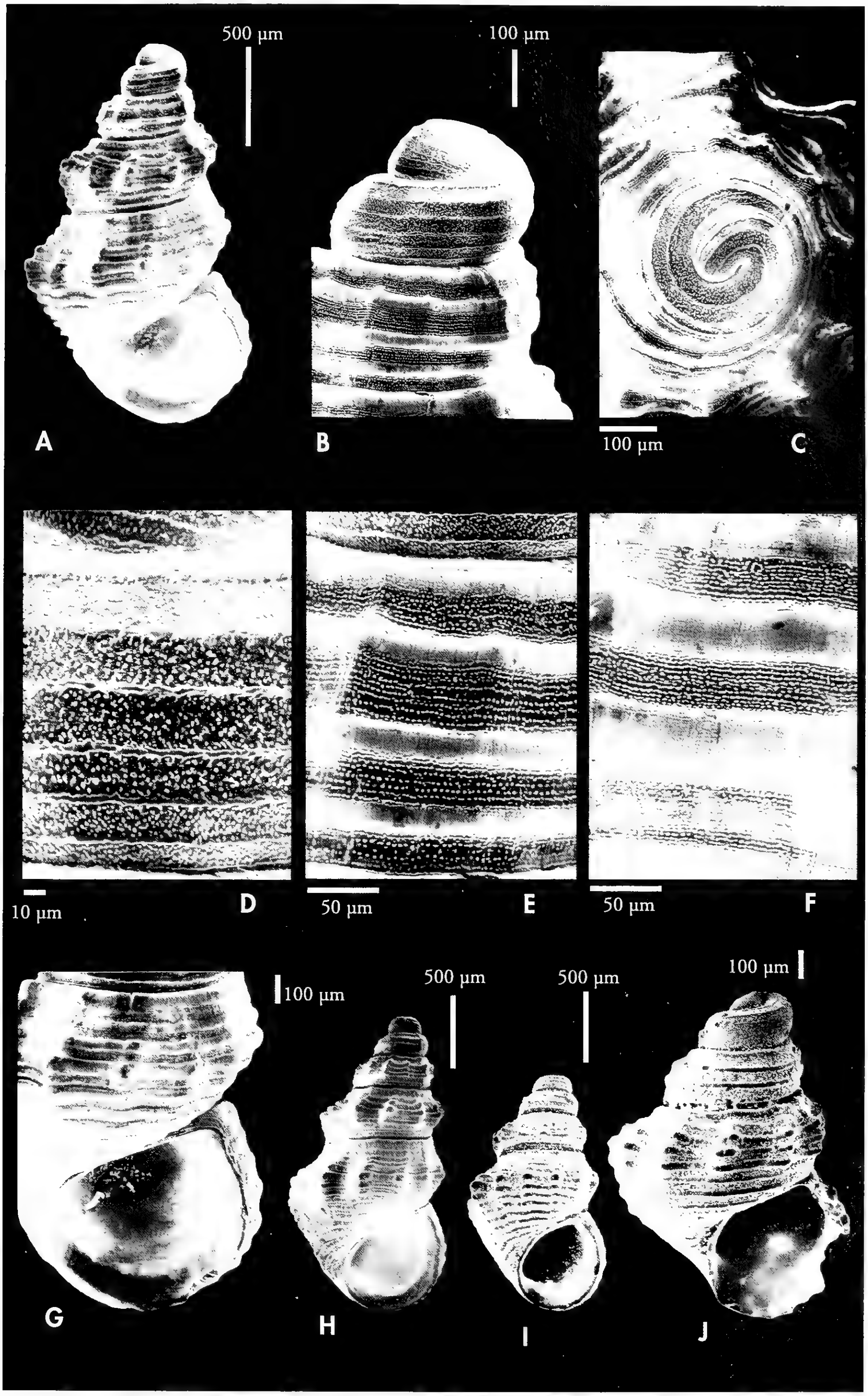
(Right page) Figure 8. *Alvania internodula* Hoenselaar and Goud, 1998. A: shell (DBUA 338/19-3) 2.3 x 1.3 mm; B, C: protoconch (lateral and frontal view); D: microsculpture of protoconch; E: microsculpture of 1st post-larval whorl; F: microsculpture of body whorl; G: aperture of the shell; H: shell (DBUA 338/19-4), 2.0 x 1.1 mm; I: shell (DBUA 338/31-4), 1.6 x 0.9mm; J: shell of juvenile (DBUA 338/31-2), 1.1 x 0.9 mm.

(Página derecha) Figura 8. Alvania internodula *Hoenselaar y Goud, 1998. A: concha (DBUA 338/19-3) 2,3 x 1,3 mm; B, C: protoconcha (vistas lateral y frontal); D: microescultura de la protoconcha; E: microescultura de la primera vuelta postlarvaria; F: microesculptura de la vuelta del cuerpo; G: apertura de la concha; H: shell (DBUA 338/19-4), 2,0 x 1,1mm; I: concha (DBUA 338/31-4), 1,6 x 0,9mm; J: concha de juvenil (DBUA 338/31-2), 1,1 x 0,9mm.*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BIBLIOGRAPHY

AARTSEN, J. J. VAN, 1982a. Synoptic tables of Mediterranean and European conchology (Gen. *Alvania*). *La Conchiglia*, 14 (158-159): 4-5.

AARTSEN, J. J. VAN, 1982b. Synoptic tables of Mediterranean and European conchology (Gen. *Alvania*). *La Conchiglia*, 14 (160-161): 16-17.

AARTSEN, J. J. VAN, 1982c. Synoptic tables of Mediterranean and European conchology. Gen. *Alvania* (Subgen. *Alvinia* and *Galeodina*). *La Conchiglia*, 14 (162-163): 8-9.

AARTSEN, J. J. VAN, 1982d. Synoptic tables of Mediterranean and European conchology. Gen. *Alvania* (Subgen. *Arsenia* and *Alvaniella*). *La Conchiglia*, 14 (164-165): 4-6.

AARTSEN, J. J. VAN, MENKHORST, H. P. M. G. AND GITTENBERGER, E., 1984. The marine Mollusca of the Bay of Algeciras, Spain, with general notes on Mitrella, Marginellidae and Turridae. *Basteria*, Supplement 2: 1-135.

ALVES, M., 1990. Enquadramento oceanográfico da região dos Açores. *10ª Semana das Pescas dos Açores*: 163-169.

ALVES, M., 1992. Condições Oceanográficas na região dos Açores. Sua influência nas pescas demersais e pelágicas. *12ª Semana das Pescas dos Açores*: 153-171.

AMATI, B., 1987. *Manzonia (Alvinia) sleursi* sp. n. (Gastropoda, Prosobranchia). *Notiziário CISMA* 10: 25-30.

ÁVILA, S. P., 1996. Malacological composition of the intertidal zone ot a rocky shore in Pico island, Azores. *Abstracts of the II Symposium "Fauna and Flora of the Atlantic Islands"*: 27.

ÁVILA, S. P., 1998. Zonação intertidal de uma comunidade malacológica numa lagoa costeira localizada na costa Sul da ilha do Pico, Açores. *Açoreana*, 8(4): 436-486.

ÁVILA, S. P., 2000. Shallow-water marine molluscs of the Azores: biogeographical relationships. *Arquipélago*. Life and Marine Sciences. Supplement 2 (Part A): 99-131.

ÁVILA, S. P. AND AZEVEDO, J. M. N., 1996. Checklist of the marine molluscs of the littoral of Pico island (Azores, Portugal). *Libro de Resúmenes XI Congreso Nacional de Malacología. Sociedad Española de Malacología*: 106-107.

ÁVILA, S. P. AND AZEVEDO, J. M. N., 1997. Shallow-water molluscs from the Formigas islets, Azores, collected during the "Santa Maria e Formigas 1990" scientific expedition. *Açoreana*, 8(3): 323-330.

ÁVILA, S. P., AZEVEDO, J. M. N., GONÇALVES, J., FONTES, J. M. AND CARDIGOS, F., 1998. Checklist of the shallow-water marine molluscs of the Azores: Pico, Faial, Flores and Corvo. *Açoreana*, 8 (4): 487-523.

ÁVILA, S. P., AZEVEDO, J. M. N., GONÇALVES, J., FONTES, J. M. AND CARDIGOS, F., (*in press*). Checklist of the shallow-water marine molluscs of the Azores: 2 - São Miguel island. *Açoreana*.

AZEVEDO, J. M. N., 1990. Microgastrópodes. *Expedição Açores 89. Ecologia e Taxonomia do Litoral Marinho. Relatório Preliminar*, 1: 54-59.

AZEVEDO, J. M. N., 1991a. *Estudo das comunidades malacológicas fitais do litoral em São Miguel, Açores*, IV+75pp.. Provas de A. P. C. C.. Universidade dos Açores, Ponta Delgada.

AZEVEDO, J. M. N., 1991b. Moluscos litorais da ilha de Santa Maria. Santa Maria e Formigas / 1990. *Relatórios e Comunicações do Departamento de Biologia*, 19: 43-46.

AZEVEDO, J. M. N. AND MARTINS, A. M. de F., 1989. Moluscos Marinhos do Litoral da Ilha Graciosa. *In*:: *Relatórios e Comunicações do Departamento de Biologia. Expedição Científica Graciosa/88*, 17: 67-72.

AZEVEDO, J. M. N. AND GOFAS, S., 1990. Moluscos marinhos litorais da ilha das Flores. *In*: *Relatórios e Comunicações do Departamento de Biologia. Expedição Científica Flores/89 (Relatório Preliminar)*, 18: 83-87.

BOUCHET, P., 1990. Turrid genera and mode of development: the use and abuse of protoconch morphology. *Malacologia*, 32(1): 69-77.

BOUCHET, P. AND WARÉN, A., 1993. Revision of the Northeast Atlantic bathyal and abyssal Mesogastropoda. *Bolletino Malacologico* Supplemento 3: 579-840.

BULLOCK, R. C., 1995. The distribution of the molluscan fauna associated with the intertidal coralline algal turf of a partially submerged volcanic crater, the Ilhéu de Vila Franca, São Miguel, Azores. In MARTINS, A. M. DE F. (Ed.): The marine fauna and flora of the Azores. Proceedings of the Second International Workshop of Malacology and Marine Biology, Vila Franca do Campo, São Miguel, Azores. *Açoreana*, Suplemento Maio de 1995: 9-55.

BULLOCK, R. C., TURNER, R. D. AND FRALICK, R. A., 1990. Species richness and diversity of algal - associated micromolluscan communities from São Miguel, Açores. In MARTINS, A. M. DE F. (Ed.): The marine fauna and flora of the Azores. Proceedings of the First International Workshop of Malacology São Miguel, Azores. *Açoreana*, Suplemento Outubro de 1990: 39-58.

BURNAY, L. P., 1986. *Moluscos testáceos marinhos da Berlenga*, 64 pp., 1 mapa. Serviço Nacional de Parques, Reservas e Conservação da Natureza, Lisboa.

CHAPMAN, G., 1955. Aspects of the fauna and flora of the Azores. VI. The density of animal life in the coralline alga zone. *Annals and Magazine of Natural History*, 12 (8): 801- 805.

CLARKE, J. AND AINSWORTH, M., 1993. A method of linking multivariate community structure to environmental variables. *Marine Ecology Progress Series*, 92: 205-219.

DAUTZENBERG, P., 1889. Contribution à la faune malacologique des Iles Açores. Résultats des dragages effectués par le yacht l'*Hirondelle* pendant sa campagne scientifique de 1887. Révision des mollusques marins des Açores. *Résultats des Campagnes Scientifiques Prince de Monaco*, 1: 112 pp., 4 pls..

DAUTZENBERG, P. AND FISCHER, P. H., 1896. Dragages effectués par l'Hirondelle et la Princesse Alice. *Mémoires de la Société Zoologique de France*, 9: 395-498, pls. 15-22.

DROUËT, H., 1858. Mollusques Marins des Iles Açores. *Mémoires de la Société Académique de l'Aube*, 22: 53 pp., 2 pls.. Paris.

FERNANDES, F. AND ROLÁN, R., 1993. Moluscos marinos de São Tomé. *Iberus*, 11(1): 31-47.

FIALHO, G. L. AND BARROS, V. P., 1988. Resultados das bóias oceanográficas lançadas nos Açores 1980-1983. Correntes de superfície. *8ª Semana das Pescas dos Açores*: 187-192.

FIELD, J. G., CLARKE, K. R. AND WARWICK, R. M., 1982. A practical strategy for analysing multispecies distribution patterns. *Marine Ecology Progress Series*, 8: 37-52.

FRETTER V. AND GRAHAM, A., 1978. The prosobranch molluscs of Britain and Denmark. Part 4 - Marine Rissoacea. *Journal of Molluscan Studies*, Suppl. 6: 153-241.

GHISELIN, M. T., 1966. Reproductive function and phylogeny of opistobranch gastropods. *Malacologia*, 3: 327-378.

GOFAS, S., 1989. Two new species of Alvania (Rissoidae) from the Azores. *Publicações Ocasionais da Sociedade Portuguesa de Malacologia*, 14: 39-42, 15 figs..

GOFAS, S., 1990, The littoral Rissoidae and Anabathridae of São Miguel, Azores. In MARTINS, A. M. de F. (Ed.): The marine fauna and flora of the Azores. Proceedings of the First International Workshop of Malacology São Miguel, Azores. *Açoreana*, Suplemento 1990: 97-134.

GOULD, W. J., 1985. Physical oceanography on the Azores front. *Progress in Oceanography*, 14 (1-4): 167-190.

GRAHAM, A., 1988. *Molluscs: Prosobranch and Pyramidellid Gastropods*, 2nd ed., VII+662 pp. Synopsis of the British Fauna (New Series), 2. E. J. Brill, Leiden.

HASZPRUNAR, G., 1988. On the origin and evolution of major gastropod groups, with special reference to the Streptoneura. *Journal of the Molluscan Studies*, 54: 367-441.

HAYWARD, P. J., WIGHAM, G. D. AND YONOW, N., 1995. Molluscs (Phylum Mollusca). In HAYWARD, P. J. AND J. S. RYLAND (Eds.): *Handbook of the Marine Fauna of North-West Europe*, XI+800 pp.. Oxford University Press, Oxford.

HOENSELAAR, H. J. AND GOUD, J., 1998. The Rissoidae of the CANCAP expeditions, I: the genus *Alvania* Risso, 1826 (Gastropoda Prosobranchia). *Basteria*, 62: 69-115.

ISELIN, C. O. D., 1936. A study of the circulation of the western North Atlantic. *Papers in Physics, Oceanography and Meteorology*, 4: 1-101.

KLEINE, B. AND SIEDLER, G., 1989. On the origin of the Azores current. *Journal of Geophysical Research*, 94(C5): 6159-6168.

KNUDSEN, J., 1995. Observations on reproductive strategy and zoogeography of some marine Prosobranch Gastropods (Mollusca) from the Azores. In MARTINS, A. M. de F. (Ed.): The marine fauna and flora of the Azores. Proceedings of the Second International Workshop of Malacology and Marine Biology. *Açoreana*, Suplemento 1995: 135-158.

DO LEMOS, M. L. F. C. C. AND VIEGAS, M. DO C., 1987. Contribuição para o estudo da zona intertidal (substrato rochoso) da ilha de São Miguel-Açores. Fácies de *Corallina elongata* Ellis and Solander. Resultados preliminares. *Cuad. Marisq. Publ. Téc.*, 11: 59-69.

LINDEN, J. VAN DER, 1993. *Alvania obsoleta* spec. nov. from the Azores (Gastropoda, Prosobranchia: Rissoidae). *Basteria*, 57(1-3): 79-82.

LINDEN, J. VAN DER AND AARTSEN, J. J. VAN, 1994. *Alvania abstersa* nom. nov., a new name for *A. obsoleta* Van der Linden, 1993, non *A. obsoleta* (S. V. Wood, 1848) (Gastropoda Prosobranchia: Rissoidae). *Basteria*, 58: 2.

MAC ANDREW, R., 1852. Note of the Mollusca observed during a short visit to the Canary and Madeira islands, in the months of April and May, 1852. *Annals and Magazine of Natural History*, 1852:1-8.

MAC ANDREW, R., 1854. *On the geographical distribution of testaceous Mollusca in the North Atlantic and neighbouring seas*, 51pp.. H. Greenwood, Liverpool.

MAC ANDREW, R., 1856. Report on the marine testaceous Mollusca of the North-East Atlantic and neighbouring Seas and the physical conditions affecting their development. *Report of the Brit. Assoc. for the Adv. of Sc.*, 158 pp.. London.

MARTINS, A. M. DE F., 1980. *Notes on the habitat of five halophile Ellobiidae in the Azores*, 24 pp., 6 figs., 2 pls.. Museu Carlos Machado, Ponta Delgada.

MARTINS, A. M. DE F. 1995. Anatomy and systematics of the western Atlantic Ellobiidae (Gastropoda, Pulmonata). *Malacologia*, 37(2): 163-332.

MOOLENBEEK, R. G. AND FABER, M. J., 1987. The Macaronesian species of the genus *Manzonia* (Gastropoda: Rissoidae), part II. *Kreukel*, 2-3: 23-31.

MOOLENBEEK, R. G. AND HOENSELAAR, H. J., 1987. On the identity of *Onoba moreleti* Dautzenberg, 1889 (Gastropoda: Rissoidae), with the description of *Onoba josae* n. sp.. *Basteria*, 51: 153-157.

MORTON, B., 1967. Malacological Report. *Chelsea College Azores Expedition, July - October 1965. Final Report* : 30-38.

MORTON, B. AND BRITTON, J. C., 1995. Partitioning of shell resources by *Aspydosiphon muelleri* (Sipuncula) and *Anapagurus laevis* (Crustacea) in the Azores. In MARTINS, A. M. DE F. (Ed.): The marine fauna and flora of the Azores. Proceedings of the Second International Workshop of Malacology and Marine Biology. *Açoreana*, Suplemento 1995: 65-77.

NOBRE, A. 1924. Contribuições para a fauna dos Açores. *An. Inst. Zool. Univ. Porto*, 1: 41-90.

NOBRE, A., 1930. *Materiais para o estudo da fauna dos Açores*, 108 pp.. Instituto de Zoologia da Universidade do Porto, Porto.

NOBRE, A., 1937. Moluscos testáceos marinhos do arquipélago da Madeira, 101 pp.. *Memórias e Estudos do Museu Zoológico da Universidade de Coimbra*, Série I, 98. Coimbra Editora, Coimbra.

NORDSIECK, F., 1972. *Die europäischen Meeresschnecken (Opisthobranchia mit Pyramidellidae; Rissoacea)*, 327 pp., 41 pls.. Gustav Fischer Verlag, Stuttgart.

OLIVERIO, M., 1996. Contrasting developmental strategies and speciation in N.E. Atlantic Prosobranchs: a preliminary analysis. *In: Origin and evolutionary radiation of the Mollusca* (ed. J. Taylor): 261-266. The Malacological Society of London, Oxford University Press.

PONDER, W. F., 1985. A Review of the Genera of the Rissoidae (Mollusca: Mesogastropoda: Rissoacea). *Records of the Australian Museum, Supplement* 4: 1-221.

PONDER, W. F. AND LINDBERG, D. R., 1997. Towards a phylogeny of gastropod molluscs – an analysis using morphological characters. *Zoological Journal of the Linnean Society*, 19(2): 83-265.

POPPE, G. T. AND GOTO, Y., 1991. *European Seashells*, vol. 1 (Polyplacophora, Caudofoveata, Solenogastra, Gastropoda), 352 pp. Verlag Christa Hemmen, Wiesbaden.

ROLÁN, E., 1984. *Moluscos de la Ria de Vigo I - Gasteropodos*, 383 pp.. Santiago de Compostela (Colegio Universitário de Vigo).

ROLÁN, E., 1987. Aportaciones al estudio de los Risoaceos de las Islas Canarias: I. Description de tres especies nuevas. *Publicações Ocasionais da Sociedade Portuguesa de Malacologia*, 8: 1-4.

SALDANHA, L., 1995. *Fauna Submarina Atlântica*, 364 pp.. Publicações Europa-América, Mem-Martins.

SHIMEK, R. L., 1986. The biology of the northwestern Pacific Turridae. V. Demersal development, synchronous settlement and other aspects of the larval biology of *Oenopota levidensis*. *International Journal of Invertebrate Reproduction and Development*, 10: 313-333.

VERDUIN, A., 1982. On the taxonomy and variability of Recent European and North African marine species of the subgenus *Rissostomia* Desmarest, 1814 (Mollusca, Gastropoda, Prosobranchia). *Basteria*, 45: 143-166.

VERDUIN, A., 1985. On the taxonomy and variability of Recent European and North African species of the subgenera *Apicularia* and *Goniostoma* of the genus *Rissoa* (Gastropoda, Prosobranchia). *Basteria*, 49(4-6): 105-132.

WARWICK, R., PLATT, H., CLARKE, K., AGARD, J. AND GOBIN, J., 1990. Analysis of macrobenthic and meiobenthic community structure in relation to pollution and disturbance in Hamilton harbour, Bermuda. *Journal of Experimental Marine Biology and Ecology*, 138: 119-142.

WATSON, R. B., 1886. Report on the Scaphopoda and Gasteropoda collected by H.M.S. "Challenger" during the years 1873-1876. *Reports on the Scientific Results of the "Challenger" Expedition 1873-76. Zoology*, Vol. XV, part XLII, 756 pp., LIII pls.

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A peculiar high-tidal molluscan assemblage from a Madeiran boulder beach

Una peculiar comunidad de moluscos del nivel superior de la marea en una playa de cantos rodados de Madeira

Emilio ROLÁN* and José TEMPLADO**

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ABSTRACT

The molluscs living at the higher intertidal level in a protected area of boulders in Madeira are described. Fourteen species of molluscs were found in this peculiar habitat, the gastropods *Littorina striata, Melaraphe neritoides, Assiminea cf. grayana, Paludinella littorina, Caecum armoricum, Caecum clarkii, Truncatella subcylindrica, Botryphallus epidauricus, Odostomia microeques* (parasitizing the former species), *Ovatella aequalis, Auriculinella bidentata, Pedipes pedipes, Pseudomelampus exiguus,* and the bivalve *Lasaea rubra*. Their abundance and distribution assemblages in this habitat are noted and they are compared with the molluscs found in similar habitats in other areas of the Northeastern Atlantic and Mediterranean.

RESUMEN

Se describen los moluscos hallados en el nivel superior de la marea en una zona de bloques y cantos rodados de la isla de Madeira. Se hallaron catorce especies de moluscos en este hábitat tan peculiar, los gasterópodos *Littorina striata, Melaraphe neritoides, Assiminea cf. grayana, Paludinella littorina, Caecum armoricum, Caecum clarkii, Truncatella subcylindrica, Botryphallus epidauricus, Odostomia microeques* (parasitando la especie anterior), *Ovatella aequalis, Auriculinella bidentata, Pedipes pedipes, Pseudomelampus exiguus* y el bivalvo *Lasaea rubra*. Se aportan datos sobre la abundancia de todas estas especies y su distribución dentro de este hábitat. Por último, se compara esta comunidad de moluscos con las halladas en hábitats similares en otras zonas del Atlántico nordeste y del Mediterráneo.

KEY WORDS: Madeira, boulder beach, high-tidal molluscan assemblage, Littorinidae, Assimineidae, Caecidae, Truncatellidae, Rissoidae, Pyramidellidae, Ellobiidae, Kelliidae.

PALABRAS CLAVE: Madeira, playa de cantos rodados, comunidad de moluscos supralitoral, Littorinidae, Assimineidae, Caecidae, Truncatellidae, Rossoidae, Pyramidellidae, Ellobiidae, Kelliidae.

INTRODUCTION

Faunas associated with boulder beachs were described by MORTON (1975) in New Zealand. He pointed out that the molluscs that lives at the high-tidal level in such places form a distinctive ecological grouping. These molluscan communities are characterised by species of both marine and terrestrial

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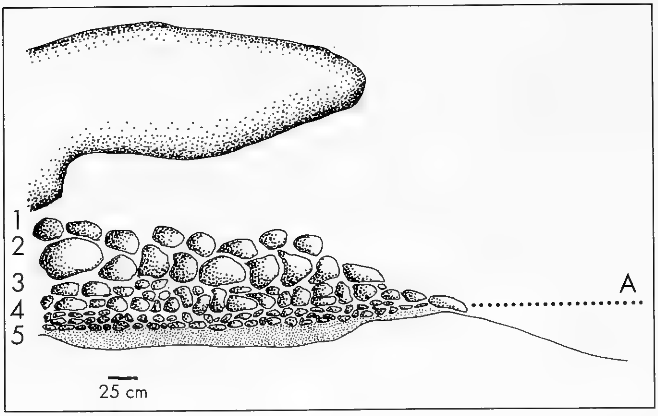


Figure 1. Schematic representation of the sampling site. 1: the upper level formed by cobbles of about 15-25 cm, occasionally receiving sunlight; 2: among and under them, there was another layer of scarcely smaller stones of about 9-15 cm, never exposed to sunlight; 3: other small stones without any contact with sand; 4: smaller ones mixed with some coarse sand formed a layer of about 6-8 cm thick; 5: bed of gravel and coarse sand mixed with very small stones; A: high tide level.
Figura 1. Esquema del lugar de muestreo. 1: nivel superior formado por cantos rodados de unos 15-25 cm, que reciben ocasionalmente la luz del sol; 2: entre ellos y por debajò hay otro nivel con piedras ligeramente más pequeñas (9-15 cm), que nunca están expuestas a la luz del sol; 3: otras piedras más pequeñas sin contacto alguno con arena; 4: otras piedras pequeñas mezcladas con arena compacta formando un estrato de unos 6-8 cm de espesor; 5: nivel de grava y arena compactada con pequeñas piedras; A: nivel de la marea alta.

groups, which form a mixed assemblage. According to this author especially common here are species of the caenogastropods families Assimineidae and Caecidae, and primitive pulmonates of the family Ellobiidae. PONDER (1990) studied a close related habitat in the Strait of Gibraltar, but in a somewhat lower level. He pointed out that "these habitats, long neglected by biologist, clearly deserve much closer attention".

During a short visit to Madeira Island in Octuber of 1993 we had the opportunity to find a surprisingly diverse molluscan assemblage, quite similar to that described by MORTON (1975), in such seemingly inhospitable habitat. These molluscs and their abundance and distribution within this habitat are here described.

The small molluscs of Madeira were firstly studied by MANZONI (1868a, 1968b), WATSON (1873, 1891, 1898), and in more recent times by NORDSIECK AND GARCÍA-TALAVERA (1979), VERDUIN (1984, 1988), MOOLENBEEK AND FABER (1987), PALAZZI (1988) and MOOLENBEEK AND HOENSELAAR (1989, 1998), among others. All these publications are mainly lists, inventories or description of new species, and most of them are based on dead material. In the other hand, the Ellobids from Madeira were studied firsly by WOLLASTON (1878) and in recent times by MARTINS (1995, 1996, 1999).

MATERIAL AND METHODS

The Madeiran coast is very steep, and exposed to an intense wave action. In most part of its coast only boulder beachs are found. In October of 1993 a small area of about 2 x 2 m was sampled in Funchal, near the Club Naval. The sampling site was located at the corner of a small bay, where wave-rounded boulders and large cobbles were over a

Table I. Species found in Madeira and their abundance and habitat where they predominated. 1: upper part of big boulders; 2: amongst and under boulders; 3: under cobbles without any contact with the sand layer. ; 4: amongst and under small stones in contact with the sand layer. ; 5: in the sand under cobbles; +: 1 - 10 specimens; ++: 11 - 50 specimens; +++: 51-150 specimens; ++++: more than 150 specimens.
Tabla I. Especies encontradas en Madeira, su abundancia y nivel en el que eran predominantes. 1: parte superior de bloques grandes; 2: entre y bajo bloques; 3: bajo guijarros sin ningún contacto con la capa de arena; 4: entre y bajo pequeñas piedras en contacto con la arena; 5: en la arena bajo guijarros; +: 1 - 10 especímenes; ++: 11 - 50 especímenes; +++: 51-150 especímenes; ++++: más de 150 especímenes.

Species	**1**	**2**	**3**	**4**	**5**
L. striata	+				
M. neritoides	+				
A. cf. grayana			+++	+	
P. littorina			+	+++	
C. clarkii					+
C. armoricum					++
T. subcylindrica				+	++
B. epidauricus				+	++++
O. microeques					++
O. aequalis		+	++++	+	
A. bidentata			+	++	
P. pedipes		+			
P. exiguus		+			
L. rubra				+	

coarse sand and gravel layer, among rocks (Fig. 1). It was a moderately stable, shady place, protected against the direct impact of the waves. The sea-water was received slowly braked by its filtration through the gravel. Thus, the main ecological factors of the small area sampled were the high humidity, and permanently low levels of light and temperature. Some decaying algal wrack and plant debris can be found under stones, which constitute the food for most of the animals inhabiting there. No macroscopic seaweeds were observed in this habitat.

Material was collected in the high tide spring level by direct observation with frontal lens. Also, some cobbles were cleaned in a box with sea-water, and samples of the coarse sand and gravel placed under boulders and stones were taken in order to be studied later under magnification.

The samples obtained cannot be treated as a valid quantitative estimates. Therefore, the number of specimens given might be interpreted as a general picture of abundance and distribution of each species.

In order to make comparisons, a very similar habitat and level was sampled in other localities, two located in the Atlantic coast of NW Spain (Cies Islands, Ría de Vigo, June, 1997, and Ribadeo, Lugo, June, 1998), and another in the Mediterranean (Los Escullos, Almería, SE Spain, September 1996). Some specimens from the Muséum Nationale d'Histoire Naturelle of Paris (MNHN) (loaned by Serge Gofas), coming from Ceuta, Azores and Canary Islands were used for comparison. Voucher material of all the species recorded has been deposited in the Museo Nacional de Ciencias Naturales of Madrid.

Table II. Species found in similar habitat in Madeira and in several localities of the Spanish coasts (Ribadeo, Cies Islands, in NW Spain, and Los Escullos, SE Spain).
Tabla II. Especies presentes en hábitats similares en Madeira y varias localidades del litoral español (Ribadeo, Islas Cíes, en el NO de España, y Los Escullos, SE de España).

Genera	Species in MADEIRA	Species in NW SPAIN	Species in SE SPAIN
Littorina	*L. striata*	*L. saxatilis*	
Melaraphe	*M. neritoides*		*M. neritoides*
Assiminea	*A. cf. grayana*		
Paludinella	*P. littorina*	*P. littorina*	*P. littorina*
Caecum	*C. armoricum* *C. clarkii*		*C. armoricum*
Cingula		*C. trifasciata*	
Truncatella	*T. subcylindrica*	*T. subcylindrica*	*T. subcylindrica*
Botryphalus	*B. epidauricus*		*B. epidauricus*
Odostomia	*O. microeques*		
Ovatella	*O. aequalis*		
Myosotella		*M. myosotis*	*M. myosotis*
Auriculinella	*A. bidentata*	*A. bidentata*	*A. bidentata*
Pedipes	*P. pedipes*		
Pseudomelampus	*P. exiguus*	*P. exiguus*	*P. exiguus*
Lasaea	*L. rubra*	*L. rubra*	

RESULTS

Description of the habitat: We considered the following levels in the sampling site (Fig. 1), with independence of the big stones which were around the place:

1- the upper level was formed by cobbles of about 15-25 cm, occasionally receiving sunlight;

2- among and under them, there was another layer of scarcely smaller stones of about 9-15 cm, never exposed to sunlight; some algal debris were deposited here;

3- under these, other small stones without any contact with sand;

4- amongst and under small stones, smaller ones mixed with some coarse sand formed a layer of about 6-8 cm thick.

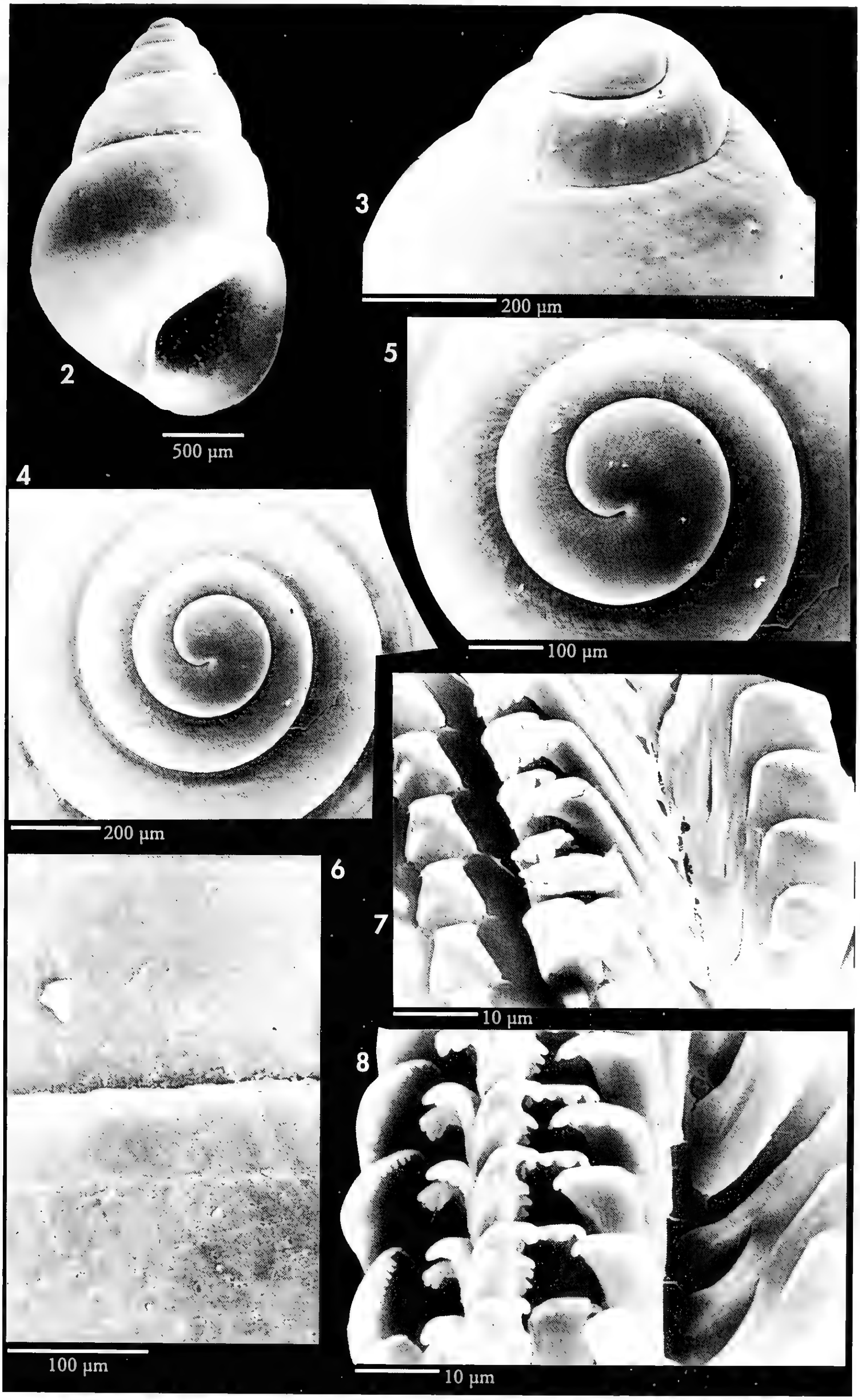
5- under this layer there was a bed of gravel and coarse sand mixed with very small stones.

All these levels were at the higher intertidal level. Probably, the sea-water could reach the upper cobbles when the sea was strong, but normally the waves arrived to this place very attenuated. The cobbles and stones under boulders were always humid and they were not hardly heated by the sun.

The molluscan species found in this habitat lived very close one to another but occupied different levels or niches. Most of them were found very close because there were only about 25 cm from the higher to the lower level.

Species found: The species found in Madeira and its relative abundance and location within this habitat are shown in Table I. The Table II shows the species found in similar habitat in Madeira, NW Spain, and SE Spain.

(Right page) Figures 2-8. *Assiminea cf. grayana*, Madeira. 2: shell; 3-5: protoconch; 6: detail of the suture; 7-8: radula.
(Página derecha) Figuras 2-8. Assiminea cf. grayana, *Madeira. 2: concha; 3-5: protoconcha; 6: detalle de la sutura; 7-8: rádula.*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7
10 µm
8
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Family LITTORINIDAE Gray, 1840

Littorina striata King and Broderip, 1832

Material studied: 8 specimens from Madeira.

Habitat: Found in the upper level amongst big boulders.

Remarks: This species is known from Azores, Madeira, Canarias, Cabo Verde and São Tomé islands. Our specimens were found in the upper part of the studied area, on the rocks. Most of them were not adults. Some of them had tubercles in the upper part of the first whorls, even in one specimen the tubercles reached the last whorl. This pattern is frequent in the same species in Cape Verde Islands. No other differences were appreciated between Madeiran and Canarian populations of this species. A detailed study on patterns of shell variation in this species along Macaronesia was done by DE WOLF *ET AL.* (1998).

Melaraphe neritoides (Linné, 1758)

Material studied: 7 specimens from Madeira, 20 specimens from Almería.

Habitat: Found in the upper level on the surface of big boulders.

Remarks: The species ranges from Scandinavia to the Mediterranean. The shells from Madeira had the same characteristics that the ones found in the European mainland coasts populations.

Family ASSIMINEIDAE H. and A. Adams, 1856

Assiminea cf. grayana Fleming, 1828 (Figs. 2-8, 30)

Material studied: 104 specimens from Madeira.

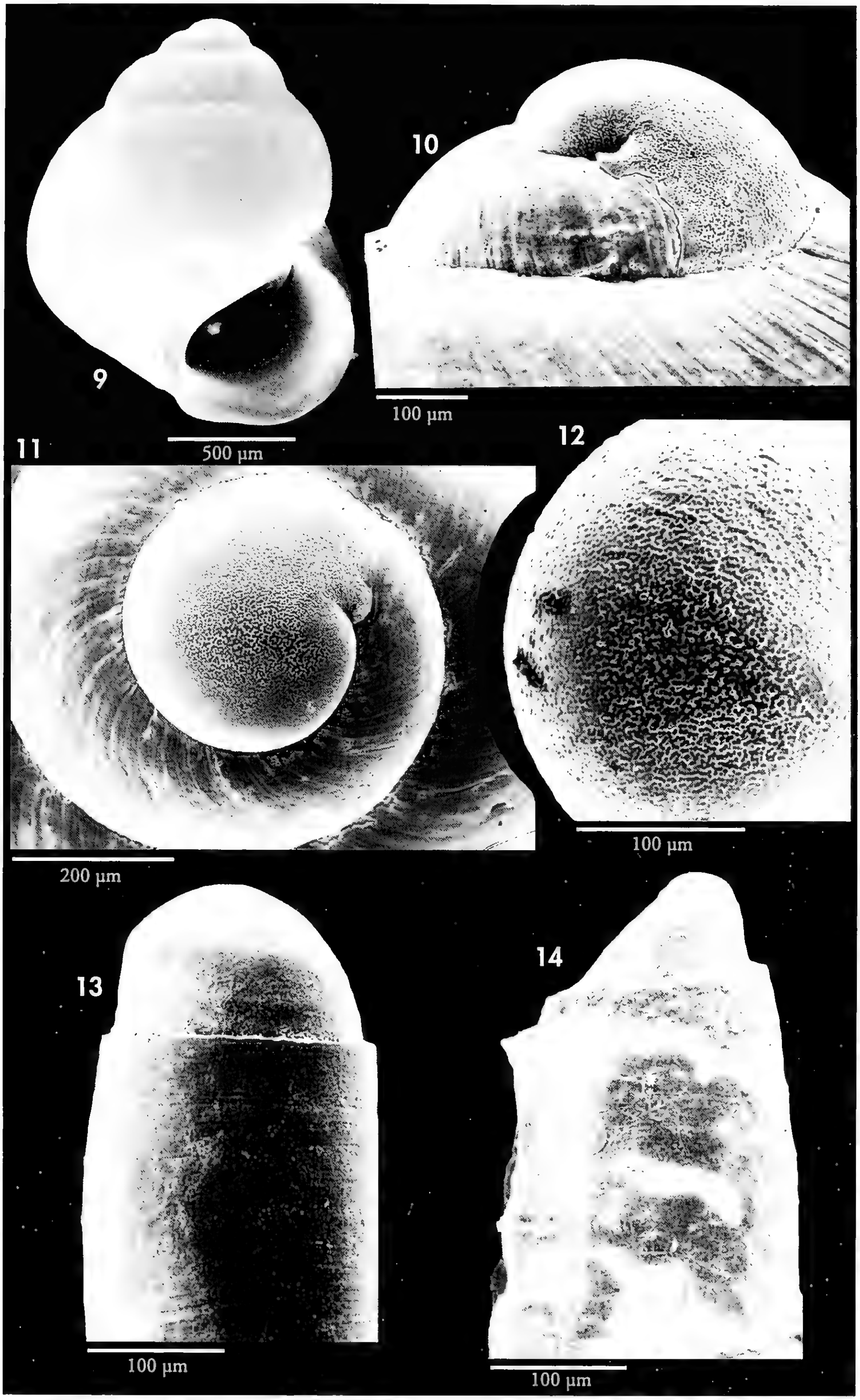
Description: Shell (Fig. 2) small, solid, globose-conical, with spire scarcely pointed. Surface smooth, only with growth lines and a subsutural spiral groove (Fig. 6), not clearly appreciated in first whorls. Suture slowly depressed. Protoconch (Figs. 3-5) smooth, with somewhat more than one spiral whorl. Its nucleus measured 130 μm in diameter

Animal white, with short and contractile cephalic tentacles, showing the eyes close to their tip. The anterior part of the foot is rounded and bilobulated (Fig. 30). Black pigmentation was very constant in the external apical part of the tentacles. A black or grey spots in the head, between the tentacles, can be also present. In some specimens a quite dark first whorls can be observed by transparence.

Radula (Figs. 7-8) with a narrow and elongate rachidian tooth, which presents a prominent central cusp, with one or two at each side. There are also three small cusps near its base at each side, being less prominent the more basal. The lateral teeth have a spoon-like form,

(Right page) Figures 9-12. *Paludinella littorina*, Madeira. 9: shell; 10-11: protoconch; 12: microsculpture of the protoconch. Figure 13. *Caecum armoricum*, apex (Madeira). Figure 14. *Caecum clarki*, apex (Madeira).

(Página derecha) Figuras 9-12. Paludinella littorina, *Madeira. 9: concha; 10-11: protoconcha; 12: microescultura de la protoconcha. Figura 13.* Caecum armoricum, *ápice (Madeira). Figura 14.* Caecum clarki, *ápice (Madeira).*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with some cusps at their margin. The marginal internal are very similar to the lateral, being also spoon-like, somewhat wider, with smaller and more numerous cusps.

Habitat: Found living under boulders in humid parts, without contact with the sand, but very near to this layer.

Remarks: In a first glance we identified this species as *A. grayana* Fleming, 1828. But after a most detailed study we had some doubts because FRETTER AND GRAHAM (1978) noted spiral lines in the protoconch of this taxon, which are not present in our shells. They referred also a protoconch of two whorls, but our shells have only somewhat more than one (using the method of VERDUIN, 1984). We have tried to examine the protoconch of specimens of populations of this species recorded in the Ría de Arosa by CADÉE (1968) and ROLÁN (1987), but all the shells had the protoconch eroded.

A. grayana ranges from the Atlantic coast of Europe to the Mediterranean Sea. Other forms of the genus *Assiminea* has been observed in some areas of West Africa down to Angola. ÁVILA (1998, 2000) used the name *Assiminea eliae* Paladilhe, 1875 for the specimens of the Azores. Until a detalied review of all these forms is done, we prefer to keep the specimens from Madeira under the current name *A. grayana*, following the nomenclature proposed by the CLEMAN checklist.

Paludinella littorina (delle Chiaje, 1828) (Figs. 9-12, 29)

Material studied: 62 specimens from Madeira; 30 from Almería; 35 from Cies Islands; 15 from Ribadeo.

Description: Shell (Fig. 9) small, globose, glossy, semitransparent. Protoconch (Figs. 10-12) with a huge nucleus and one whorl and little more; its surface is covered by a fine microsculpture of irregular granulations. There is a distinc boundary with the teleoconch. Animal milky-white, with cephalic tentacles very short, flat, semitriangular, with subapical eyes (Fig. 29). A pinkish area can be observed by transparence between the tentacles.

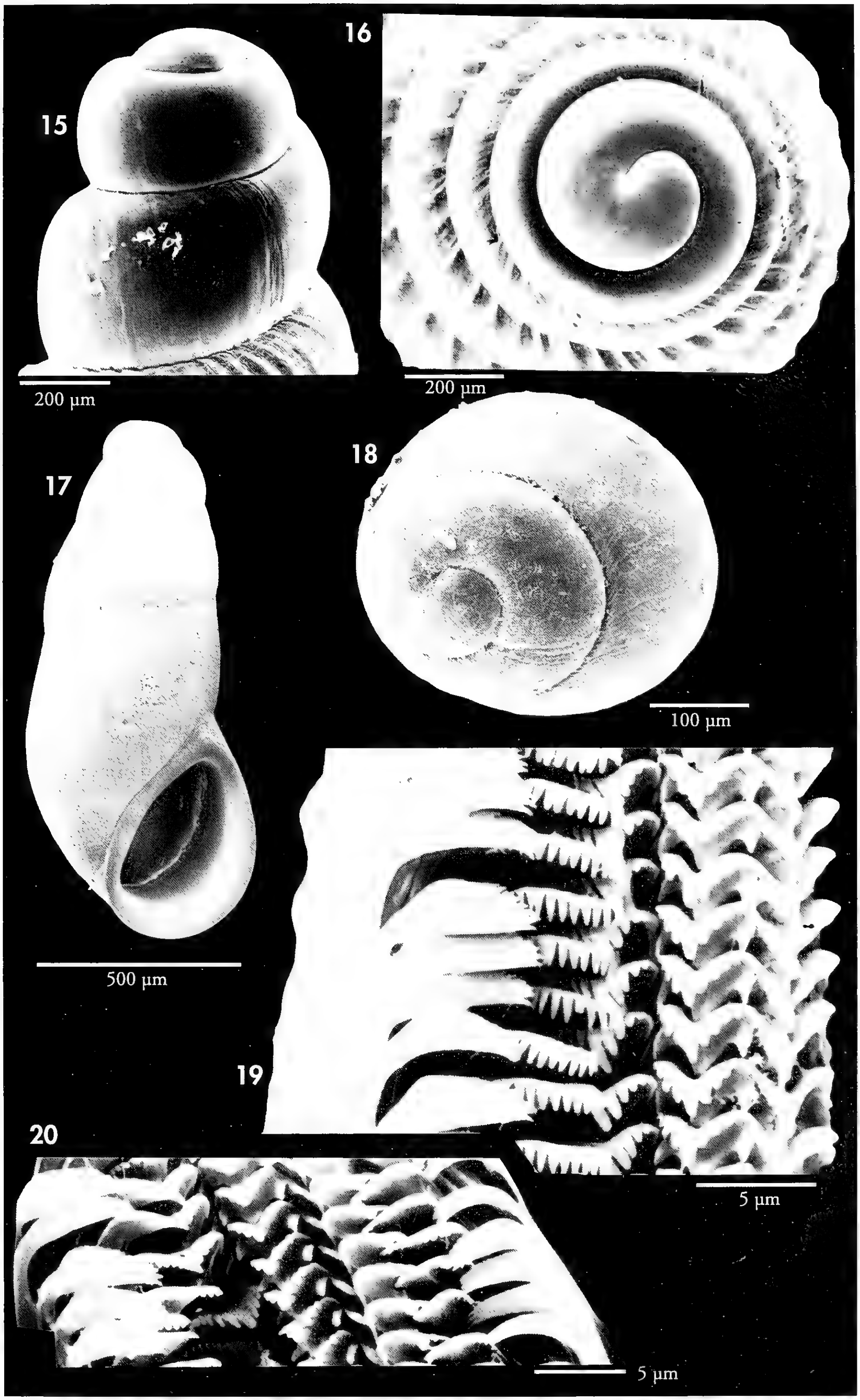
Habitat: *P. littorina* was living under boulders near or in contact with the sand layer.

Remarks: FRETTER AND GRAHAM (1978) noted that *P. littorina* has a protoconch of 1 3/4 smooth whorls. The photograph presented by them (FRETTER AND GRAHAM, 1978, fig. 130) show a protoconch that seems to have less than one whorl. In fact, in our material there is only a little more than 1/2 whorl after a wide nucleus (using the method of VERDUIN, 1984). The surface of the protoconch of our material is covered by irregular fine sculpture and was never smooth, as in the protoconch showed by FRETTER AND GRAHAM (1978, p. 149, fig. 130). Perhaps, the shells studied by these authors had eroded protoconchs or they were not studied at enough magnification. We have compared the Madeiran shells with those from SE Spain, and their microsculpture (Fig. 12) is similar in both populations. Thus we consider to be the same species both Madeiran and Mediterranean specimens.

This species occurs throughout the Mediterranean Sea and along the Eastern Atlantic coast, from Madeira to the southern coast of the British Isles.

(Right page) Figures 15-16. *Truncatella subcylindrica*, protoconch, Madeira. Figures 17-20. *Botryphallus epidauricus.*, Madeira. 17: shell; 18: protoconch; 19-20: radula.

(Página derecha) Figuras 15-16. Truncatella subcylindrica, *protoconcha, Madeira. Figuras 17-20.* Botryphallus epidauricus., *Madeira. 17: concha; 18: protoconcha; 19-20: rádula.*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Family CAECIDAE Gray, 1850

Caecum armoricum de Folin, 1869 (Fig. 13)

Caecum incomptum (Monterosato, 1884).

Material studied: 22 specimens from Madeira; 9 specimens from Almería.

Description: A complete description of the shell of this species can be seen in the papers of VAN AARTSEN AND HOENSELAAR (1984) and HOEKSEMA AND SEGERS (1993). The specimens studied did not differ from these descriptions. Animal white.

Habitat: Found buried in the sand, under boulders and stones.

Remarks: PONDER (1990) pointed out that this species (as C. *incomptum*) is very abundant in the intertidal gravel habitat in the Strait of Gibraltar. Our specimens are quite similar to those mentioned by this author. *Caecum armoricum* occurs throughout the Mediterranean Sea and along the Eastern Atlantic coast, from Canary Island to Azores and Northern France. Its distribution and systematic had been discused by AARTSEN AND HOENSELAAR (1984) and HOEKSEMA AND SEGERS (1993).

Caecum clarkii Carpenter, 1858 (Fig. 14)

Material studied: 1 living specimen from Madeira.

Habitat: Buried in sand under cobbles.

Remarks: *C. clarkii* was originally described from Canary Islands and widespread throughout the European Atlantic coasts and the Mediteranean Sea.

Family TRUNCATELLIDAE Gray, 1840

Truncatella subcylindrica (L., 1767) (Figs. 15-16, 28)

Material studied: 39 specimens from Madeira; 109 from Almería; 12 from Vigo; 45 from Ribadeo.

Description: Shells of Madeiran specimens were very similar to those from the Mediterranean populations, with numerous axial ribs, but some specimens were smooth. Protoconch smooth (Figs. 15-16). Animal white. Anterior end of the foot with two flat enlargements. Tentacles not very long, cylindrical with the eyes at their bases (Fig. 28).

Habitat: Amongst vegetal debris and cobbles.

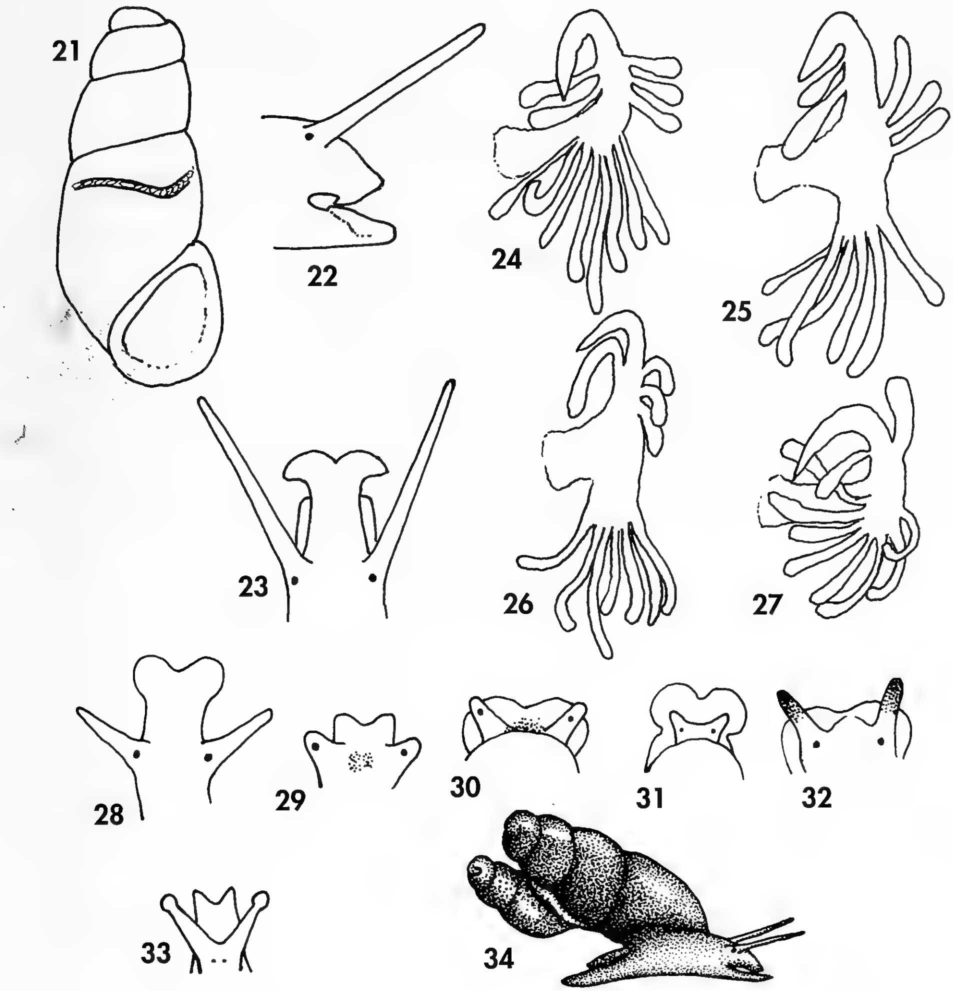
Remarks: The characteristics of the habitat and shells are quite similar to those of the European populations.

Family RISSOIDAE Gray, 1847

Botryphallus epidauricus (Brusina, 1866) (Figs. 17-27)

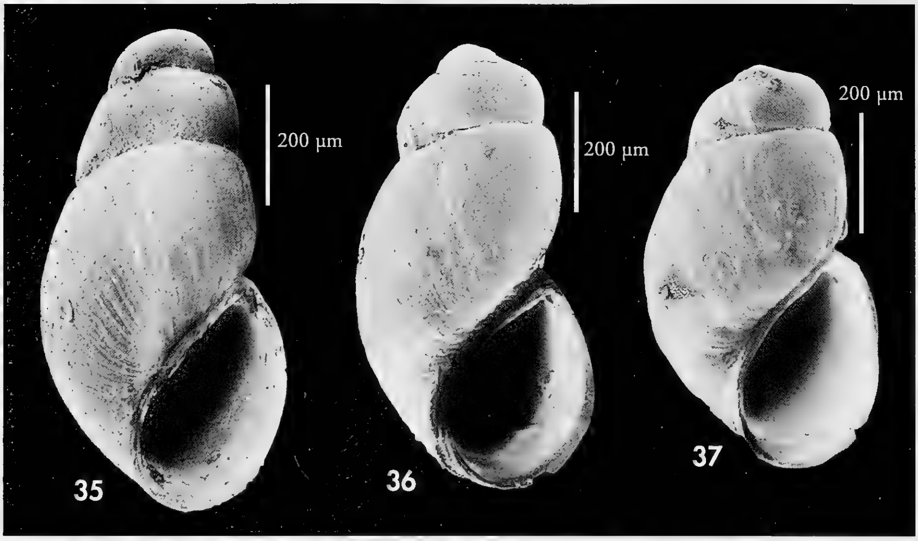
Material studied: 570 specimens from Madeira; 409 from Almería, more than 500 from Canary Islands (MNHN), and more than 500 from Ceuta (MNHN).

Description: Shell (Fig. 17) minute, tall-spired, almost cylindrical, smooth, whitish, with a dome-shaped apex. Aperture pyriform, slightly widening, peristome continuous and outer lip smooth. Protoconch (Fig. 18) with about 1 smooth whorl. Teleoconch with about 3 whorls.



Figures 21-27. *Botryphallus epidauricus*, Madeira. 21: sketch of one specimen showing by transparence part of the intestinal tract; 22, 23: details of the head-foot; 24-27: penis of several males. Figure 28. Sketch of the head-foot of *Truncatella subcylindrica*, Madeira. Figure 29. Sketch of the head-foot of *Paludinella littorina*, Madeira. Figure 30. Sketch of the head-foot of *Assiminea cf. grayana*, Madeira. Figure 31. Sketch of the head-foot of *Pseudomelampus exiguus*, Madeira. Figure 32. Sketch of the head-foot of *Pedipes pedipes*, Madeira. Figure 33. Sketch of the head-foot of *Odostomia microeques*, Madeira. Figure 34. Live position of *Odostomia microeques* on its host, *Botryphallus epidauricus*, Madeira.

Figuras 21-27. Botryphallus epidauricus, *Madeira. 21: esquema de un ejemplar mostrando por transparencia parte del tracto intestinal; 22, 23: detalles de la parte anterior del animal; 24-27: penes de algunos ejemplares. Figura 28. Esquema de la parte anterior del animal de* Truncatella subcylindrica, *Madeira. Figura 29. Esquema de la parte anterior del animal de* Paludinella littorina, *Madeira. Figura 30. Esquema de la parte anterior del animal de* Assiminea cf. grayana, *Madeira. Figura 31. Esquema de la parte anterior del animal de* Pseudomelampus exiguus, *Madeira. Figura 32. Esquema de la parte anterior del animal de* Pedipes pedipes, *Madeira. Figura 33. Esquema de la parte anterior del animal de* Odostomia microeques, *Madeira. Figura 34. Posición habitual de* Odostomia microeques *sobre su hospedador,* Botryphallus epidauricus, *Madeira.*



Figures 35-37. Shells of *Odostomia microeques*, Madeira. 35: Holotype (MNCN); 36-37: paratypes (CER and MNHN).
Figuras 35-37. Conchas de Odostomia microeques, *Madeira. 35: holotipo (MNCN); 36-37: paratipos (CER y MNHN).*

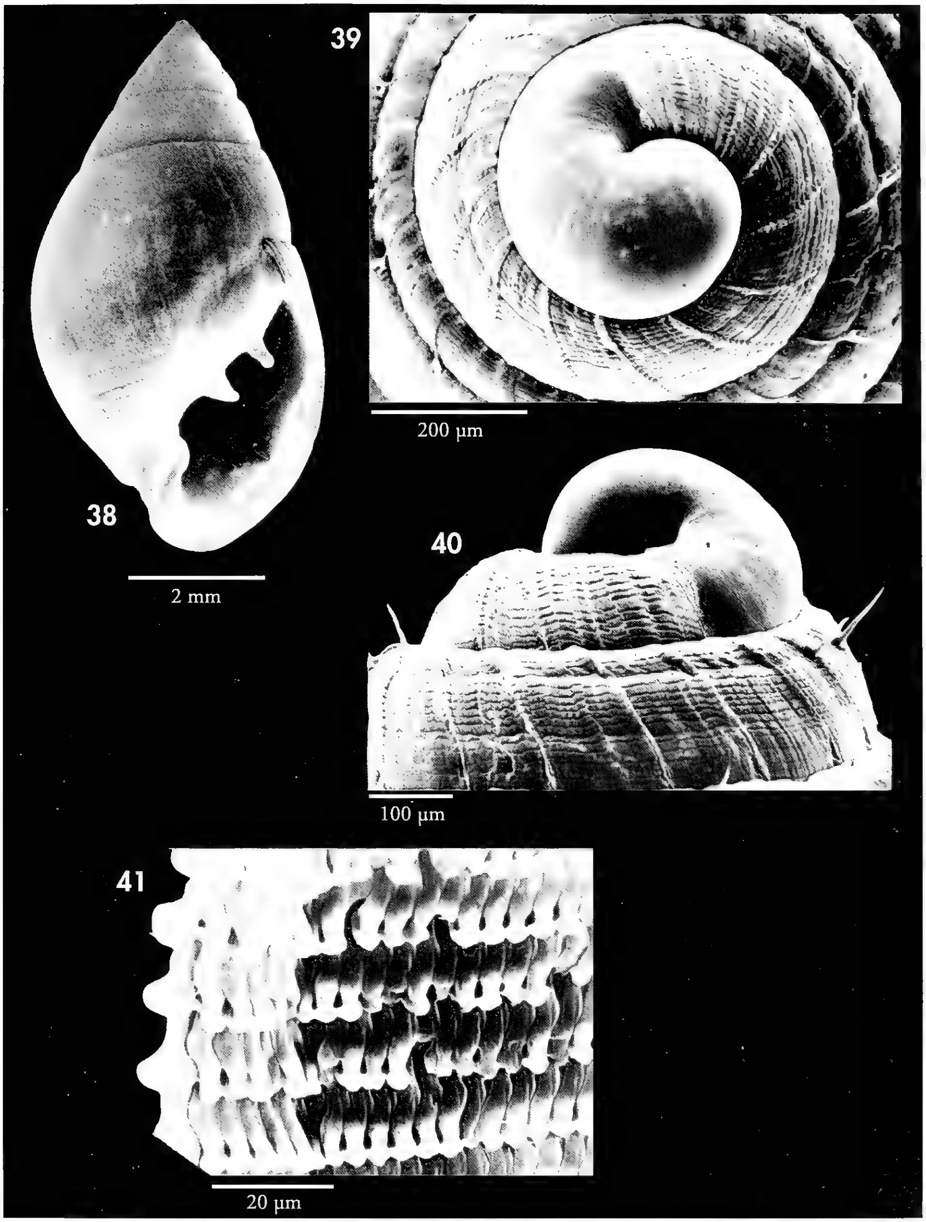
Animal (Figs. 22, 23) translucent white, with cephalic tentacles thin and elongated. The eyes lie at their bases. Propodium with a conspicuous, triangular, and opaque-white pedal gland. Snout with two pronounced distal lobes. Intestine visible by transparence throughout the last whorl of the shell, with a slight curvature (Fig. 21). Males with a large and flower-like penis (Figs. 24-27), also visible by transparence, bearing several (from 11 to 16) digitiform appendages (apocrine glands, *sensu* Ponder, 1990). Operculum thin, translucent, paucispiral with a eccentric nucleus.

Radula (Figs. 19-20) taenioglossan, with a raquidian tooth having the cutting edge with 9 cusps (the central more elongated and the others smaller towards the periphery). Lateral teeth with 9 cusps also, one of the central more prominent and the others decreasing in size at both sides. Marginal teeth with many small cusps of the same size in their distal edge.

Habitat: Some specimens were found under cobbles and stones that were permanently humid and in contact with the sand, but most of them were buried in the sand.

Remarks: At first we suspected that our specimens belonged to an undescribed species, due its short protoconch (meaning a direct development) and the long distance between Madeira and the Mediterranean Sea. Besides, the drawing of the penis of *B. epidauricus* showed by PONDER (1990, fig. 8C) upon material from the Strait of Gibraltar appeared to be rather different from our drawings. But later, we had the opportunity to study samples of a population of *B. epidauricus* from Los Escullos (Almería, SE Spain) and we found that the shell and the male genitalia in specimens of this population were identical to those from Madeira, and therefore belong to the same species. Perhaps the differences between our observations and the Ponder drawings are due to the fact that we have studied alcohol preserved material and he probably examined living specimens.

We have also studied two similar forms from the Canary Islands (MNHN)



Figures 38-41. *Ovatella aequalis*, Madeira. 38: shell; 39-40: protoconch; 41: radula.
Figuras 38-41. Ovatella aequalis, *Madeira. 38: concha; 39-40: protoconcha; 41: rádula.*

of different size, about 1. 5 mm hight the larger one, and about 1. 0 the smaller. The bigger form is almost identical with the Madeiran specimens and probably is the species named by MANZONI (1868a) *Rissoa balteata*, as VERDUIN (1988) and GOFAS (1990) suspected. The smaller form from the Canary Island, has a shell quite similar, but the males lack the characteristic penis of the genus *Botryp-*

hallus and it might be an undescribed species of the genus *Peringiella*.

Two similar species have been described in recent years: *B. ovummuscae* (Gofas, 1990) from Azores and *B. tuber* (Rolán, 1991) from Cape Verde islands, both described under the genus *Peringiella*. According to the results of this study, the type species of this genus, *B. epidauricus*, occurs along the Mediterranean Sea, Atlantic coast of Spain and Portugal, and Madeira and Canary Islands.

Family Pyramidellidae Gray, 1840

Odostomia microeques Rolán and Templado, 1999 (Figs. 33-37)

Material studied: 22 specimens from Madeira.

Description: Shell (Figs. 35-37) minute, oval-cylindrical, very fragile. Spire from 2 to 3 spiral whorls, slightly rounded, with suture impressed, and very evident prosoclines growth lines. Apex blunt, dome-shaped, with the protoconch of type C of 206 μm, emerging and showing less than one spiral whorl. Aperture oval and somewhat pyriform. Columela slightly curved. Peristoma continuous. Umbilicus absent. Columelar lip not showing any fold externaly, but a slight fold begin somewhat inner and continues internally well developed.

Animal translucent white, with short and divergent cephalic tentacles, slightly tapering distally but the distal end is expanded into a spheric tip (Fig. 33). Eyes small and placed very close behind the base of the tentacles. Operculum with a perpendicular line to the columela.

Habitat: Found just with its host, *Botryphallus epidauricus*, in the sand under stones.

Remarks: *O. microeques* is the smallest pyramidellid gastropod known. It was not observed during the first time in the collecting site due its very small size. Some samples of the sand taken under the cobbles was carried to the laboratory for examination under magnification. During this study the presence of some tiny shells, smaller than those of *Botryphallus epidauricus*, were observed, which was abundant in the sample. Curiously, it was observed that these specimens were placed on the shell of *B. epidauricus* (Fig. 34). Many times, we took off the specimens of *O. microeques* from the shells of *B. epidauricus*, but immediately, they looked for another specimen to go up it again. In oposition, they rejected the shells of other species that lived in the same habitat. This convinced us that *O. microeques* parasites *B. epidauricus*.

The closest species to *O. microeques* is *Odostomia megerlei* (Locard, 1886), but the latter is clearly bigger (see comments in Peñas and Rolán, 1999).

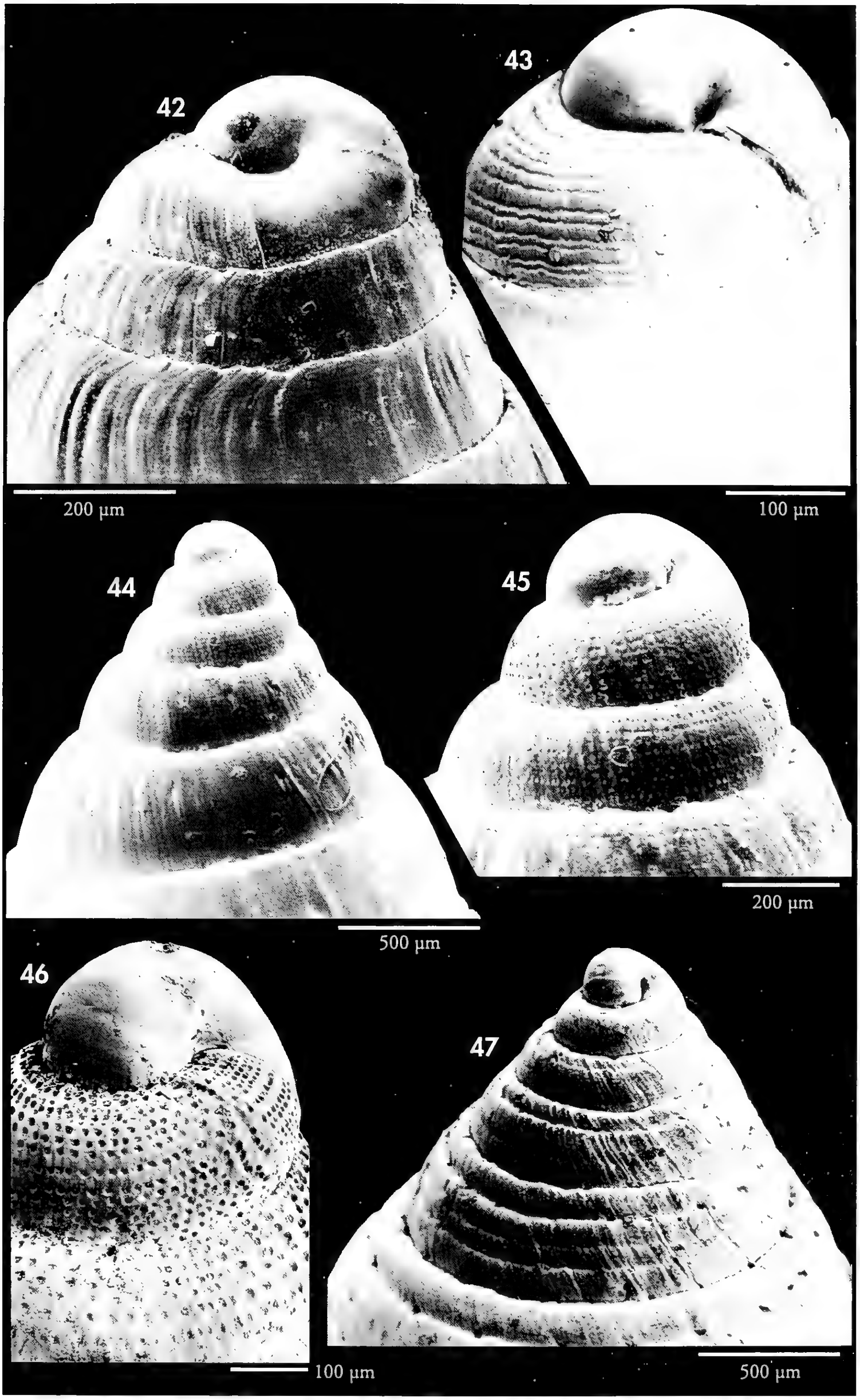
Family Ellobiidae Pfeiffer, 1854

Ovatella aequalis (Lowe, 1832) (Figs. 38-41)

Material studied: 260 specimens from Madeira.

(Right page) Figures 42-47. Protoconchs of some European species of Ellobiidae. 42: *Auriculinella bidentata*, Cies Islands; 43: *A. bidentata*, Almería; 44-45: *Myosotella myosotis*, Cies Islands; 46: *M. myosotis*, Almería; 47: *Ovatella firminii*, Cies Islands.

(Página derecha) Figuras 42-47. Protoconchas de algunas especies europeas de Ellobiidae. 42: Auriculinella bidentata, *Islas Cies; 43:* A. bidentata, *Almería; 44-45:* Myosotella myosotis, *Islas Cies; 46:* M. myosotis, *Almería; 47:* Ovatella firminii, *Islas Cies.*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Description: Shell (Fig. 38) oval-conic, elongated, somewhat solid, brown. Protoconch (Figs. 39-40) smooth, with about one whorl. Teleoconch of about 6 whorls. Body whorl about 70% of the total height. First whorls with fine spiral striation and narrow and spaced prosocline axial ribs. There is a deep subsutural furrow in which sharp periostracal hairs inserted at each axial rib. Suture not depressed. Aperture oval-elongated with two columelar folds and two prominent parietal teeth. Animal whitish to pale-yellowish. Radula (Fig. 41) with many teeth, all quite similar, disposed in rows.

Habitat: Below and under cobbles of middle size, in humid places, not close to the sand layer.

Remarks: MARTINS (1995, 1999) has compared the Açorean *O. vulcani* (Morelet, 1860) with the Mediterranean *O. firminii* (Payraudeau, 1826) and the Madeiran *O. aequalis*, concluding for the recognition all of them as valid species, often previously considered as synonyms. According to this author, the sculpture of the protoconch and the first whorls of the teloconch seems to be very important as specific characters in this group. To show the differences with other close European species we present the protoconchs of *Myosotella myosotis* (Draparnaud, 1801) (Figs. 44-46) from Cies Islands and Almería, and *Ovatella firminii* (Payraudeau, 1826) (Fig. 47) from the Cies islands.

Auriculinella bidentata (Montagu, 1808) (Figs. 42, 43, 48-50)

Material studied: 39 specimens from Madeira; 21 from Almería; 12 from Ribadeo; 15 from Cies Islands.

Description: Shell (Fig. 48) oval-conic elongated, smooth, withish, with blunt apex, very similar to the European populations studied. Protoconch (Figs. 42, 43, 49, 50) smooth with about half whorl. The teleoconch begins with axial prosocline striation which cross fine spiral threads. This sculpture almost desappears in subsequent whorls. Aperture oval, elongated with a prominent parietal tooth and a curved columelar fold below.

Animal white, sometimes with small dark areas at the tip of the cephalic tentacles.

Habitat: Found amongst and under cobbles of middle size, in humid places.

Remarks: The specimens from Madeira are almost identical to the European populations examined, showing the specimens from Almería the typical sculpture of the first whorl of the teleoconch (Figs. 49-50), and being less evident in the shells of the Cies Islands (Fig. 42). This species widespread from the British Isles to the Mediterrnean, Azores and Madeira.

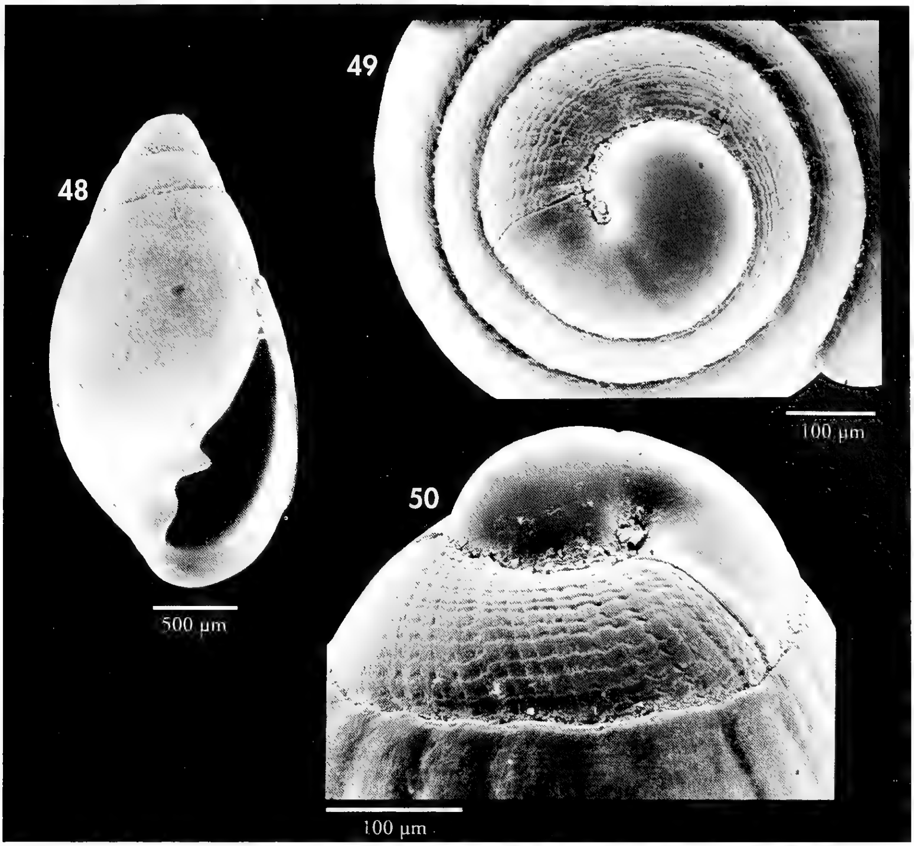
Pedipes pedipes (Bruguière, 1789) (Figs. 32, 51-54)

Pedipes afer (Gmelin, 1791)

Material studied: 5 specimens from Madeira.

Description: Shell (Fig. 51) globose, solid, brown, with low spire and very large body whorl, that averaging near the 90% of shell length. Protoconch (Figs. 52-54) very small, with less than one whorl. The teleoconch begins with spiral and prosocline axial sculpture, the later desappearing in the following whorls. Aperture ovate, widely rounded at base, about 70% of the length of body whorl. There are two strong columellar teeth, and one strongest parietal tooth very elongated.

Animal (Fig. 32) white with grey pigmentation towards the tip of the cephalic tentacles. Anterior part of the foot bilobulated by a central incision. Snout



Figures 48-50: *Auriculinella bidentata*, Madeira. 48: shell; 49-50: protoconch.
Figuras 48-50: Auriculinella bidentata, *Madeira. 48: concha; 49-50: protoconcha.*

short and cephalic tentacles contractile, somewhat elongated when extended.

Habitat: Found amongst boulders in the upper level of the collecting site.

Remarks: This species is known from Azores, Madeira, Canary, Cape Verde and São Tomé Islands (FERNANDES AND ROLÁN, 1993; ÁVILA, 2000).

Pseudomelampus exiguus (Lowe, 1832) (Figs. 31, 55-57)

Material studied: 2 specimens from Madeira; 12 from Almería; 20 from Ribadeo.

Description: Shell (Fig. 55) ovoid, solid, pinkish-brown, body whorl more than 90% of total shell hight. Protoconch (Fig. 56) smooth, heterostrophic, with its spiral axis perpendicular to the axis of the shell, and partly covered with first whorl of teleoconch. Microsculpture of irregular spiral striae (Fig. 57). Aperture elongate with one columellar tooth and two parietal theeth. Animal (Fig. 31) whitish, foot bilobulated anteriorly, cephalic tentacles short, somewhat flattened, with the eyes in the middle of their bases.

Habitat: Found amongst big stones in the upper part of the bottom.

Remarks: The lectotype of this species was figured by MARTINS (1996, fig. 180), being Madeira the type locality.

Family KELLIIDAE Forbes and Hanley, 1848

Lasaea rubra (Montagu, 1803)

Material studied: 2 specimens from Madeira; more than 200 specimens in Cies Islands.

Remarks: *L. rubra* is an extremely common species, frequently associated with some of the previously mentioned species in other areas, sometimes in high number. In the studied community its presence was scarce.

DISCUSSION

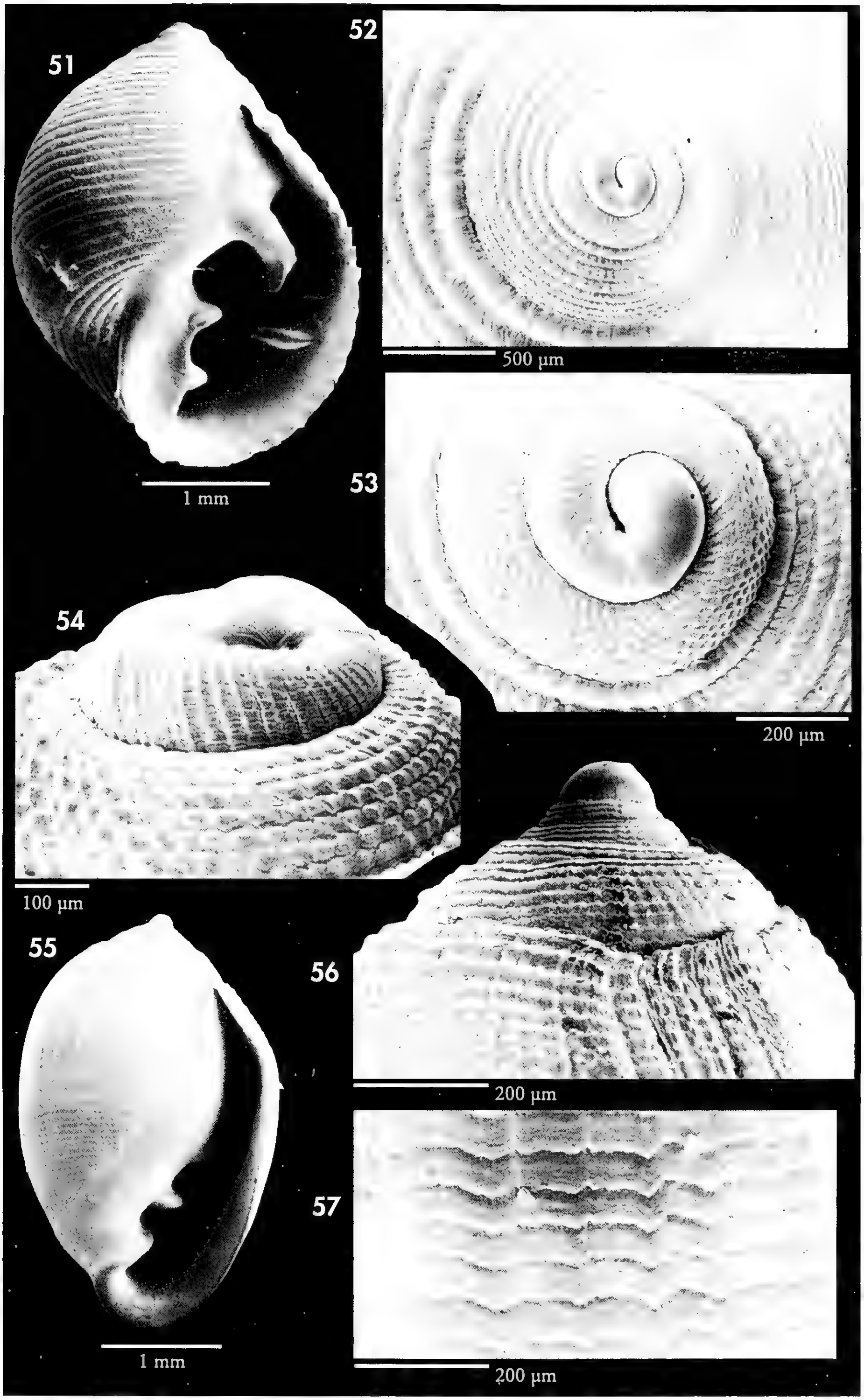
The under-boulder molluscs assemblage studied in a protected place of the upper level of the tide and its distribution in different levels in Madeira has some resemblance with that described by MORTON (1975) in New Zealand (dominated by species of Ellobiidae, Assimineidae and Caecidae). Four of the fourteen species we found clearly dominated in this habitat in Madeira. *Botryphallus epidauricus* in the lowest level, on the sand under rocks, *Paludinella littorina* in a somewhat higher layer, amongst small stones in contact with sand. *Ovatella aequalis* and *Assiminea cf. grayana* dominated in an upper level, under boulders without contact with sand. Other species frequent in this habitat were *Caecum armoricum, Truncatella subcylindrica* and *Odostomia microeques* in the same layer that *B. epidauricus,* and *Auriculinella bidentata,* living together with *Paludinella littorina.* The other species found were scarce. The ellobids *Pedipes pedipes* and *Pseudomelampus exiguus,* and the littorinids *Littorina striata* and *Melaraphe neritoides* are typical supralittoral species, which sometimes can be found in the highest level of the habitat studied. *Lasaea rubra* is very common in tufts of coralline algae and lichens (*Lichina* sp.) high in the intertidal zone and only isolated specimens can be found in boulder beach (BULLOCK *ET AL.*, 1990). Last, *Caecum clarkii* prefer lower shore (midlittoral or sublittoral) but is capable of penetrating the upper levels when conditions are favourable (PONDER, 1990).

Only two of the species found are apparently endemic of Madeira: *Ovatella aequalis* and *Odostomia microeques.* The latter might be present in other areas where its host occurs, but it might be over looked due its minute size (smaller than 1 mm). *Ovatella aequalis* is replaced by its related species *Myosotella myosotis* (Draparnaud, 1801) in the European coasts and by *O. vulcani* (Morelet, 1860) in Azores. All the other species, but *Littorina striata* and *Pedipes pedipes,* are also present in the European mainland, both in the Atlantic and Mediterranean coasts. Ten of the species found in Madeira occurs also in Azores and eight in Canary Islands.

The most abundant species, *Botryphallus epidauricus,* widespreads along the Atlantic and Mediterranean coasts of Europe and also in Canary Islands. It is replaced in Azores (northward) and in Cabo Verde Island (southward) by the related species *B. ovummuscae* and *B. tuber*, respectively.

PONDER (1990) studied a similar habitat in the Strait of Gibraltar, but in a somewhat lower level. He studied an intertidal gravel beach at Ceuta, and its upper level coincides with the lowest one studied by us. In both localities (Funchal

(Right page) Figures 51-54. *Pedipes pedipes*, Madeira. 51: shell; 52-54: protoconch. Figures 55-57: *Pseudomelampus exiguus*, Madeira. 55: shell; 56: protoconch; 57: microsculpture.
(Página derecha) Figuras 51-54. Pedipes pedipes, *Madeira. 51: concha; 52-54: protoconcha. Figuras 55-57:* Pseudomelampus exiguus, *Madeira. 55: concha; 56: protoconcha; 57: microescultura.*


51
52
500 µm
1 mm
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54
200 µm
100 µm
55
56
200 µm
57
1 mm
200 µm

in Madeira, and Ceuta in the Strait of Gibraltar) this level is dominated by the same species: *Botryphallus epidauricus*.

The small molluscs found in this peculiar habitat in Madeira seem to form a distinctive ecological grouping which have close parallels in European/North African mainland and in other Macaronesian Islands. Some species of this grouping are present in this habitat in all areas of the temperate NE Atlantic, and other are replaced by close related species according to the geographical area.

The species found in this habitat in Madeira and in some localities of the Spanish coasts (Ribadeo and Cies Islands, NW Spain, and Los Escullos, SE Spain) are included in Table II. Four species have been found in this habitat in all localities sampled: *P. littorina, T. subcylindrica, A. bidentata* and *P. exiguus*. In Madeira this molluscan assemblage is particularly diverse. Six of the species found here, including the two endemic of Madeira, were not found in the other localities sampled. Some of them are present in these localities, but they did not find in this habitat. The more remarkable peculiarity of this molluscan assemblage in Madeira is the presence of an parasitic pyramidellid gastropod (*O. microeques*). In contrast, only two of the species collected in this habitat in the Spanish coasts were not found in Madeira: *Littorina saxatilis* (Olivi, 1792) and *Cingula trifasciata* (J. Adams, 1800). The former is not typical of this habitat but it can be found sometimes in the upper part of big boulders in the Atlantic European mainland. *C. trifasciata* is quite common beneath large boulders in shaded, stable places in other areas (Ponder, 1990), including Azores Islands (Ávila, 1998), but it was not present in the samples taken in Madeira.

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BIBLIOGRAPHY

Aartsen, J. J. van and Hoenselaar, H. J., 1984. European marine Mollusca: notes on less well-known species. VIII. *Caecum armoricum* De Folin, 1869. *Basteria*, 48: 23-26.

Ávila, S. P., 1998. Zonação intertidal de uma comunidade malacológica na "Poça da Barra", uma lagoa localizada na plataforma costeira da Vila das Lajes do Pico, Açores. *Açoreana*, 8 (4): 457-485.

Ávila, S. P., 2000. Shallow-water marine molluscs of the Azores: biogeographical relationships. *Arquipélago*, Supplement 2 (Part A): 99-131.

Bollock, R. C., Turner, R. D. and Fralick, R. A. 1990. Species richness and diversity of algal-associated micromolluscan communities from São Miguel, Açores. *Açoreana*, suplemento 1990: 39-58.

Cadée, G. C., 1968. *Molluscan biocenoses and thanatocoenoses in the Ria de Arosa, Galicia, Spain*. J. Brill, Leiden, 121 pp, 6 pls.

CLEMAM. Unitas Malacologica Check List of European Marine Mollusca. Internet site [current URL http: //www. mnhn. fr/base/malaco. html, last searched june 2000].

Fernandes, F. and Rolán, E., 1993. Moluscos marinos de São Tomé y Príncipe: actualización bibliográfica y nuevas aportaciones. *Iberus*, 11 (1): 31-47.

Fretter, V. and Graham, A., 1978. The prosobranch molluscs of Britain and Denmark. Part 3- Neritacea, Viviparacea, Valvatacea, terrestrial and fresh water Littorinacea and Rissoacea. *The Journal of Molluscan Studies*, Suppl. 5: 101-153.

GOFAS, S., 1990. The littoral Rissoidae and Anabathridae of São Miguel, Açores. *Açoreana*, suplemento 1990: 97-134.

HOEKSEMA, D. F. AND HOENSELAAR, H. J., 1984. On the distribution of *Caecum clarkii*, Carpenter, 1858 (Prosobranchia, Caecidae) in the Channel. *Basteria*, 48: 27-30.

HOEKSEMA, D. F. AND SEGERS, W., 1993. On the systematics and distribution of the marine Gastropod *Caecum armoricum* de Folin, 1869 (Prosobranchia, Caecidae). *Gloria Maris*, 31 (6): 79-88.

MARTINS, A. M. de F., 1995. Anatomy and systematics of *Ovatella vulcani* (Morelet, 1860) (Pulmonata: Ellobiidae) from the Azores. *Açoreana*, supplement 1995: 231-248.

MARTINS, A. M. de F., 1996. Anatomy and systematics of the Western Atlantic Ellobiidae (Gastropoda: Pulmonata). *Malacologia*, 37 (2): 163-332.

MARTINS, A. M. de F., 1999. On the generic separation of *Ovatella* Bivona, 1832 and *Myosotella* Monterosato, 1906 (Pulmonata: Ellobiidae). *Iberus*, 17 (2): 59-75.

MANZONI, A., 1868a. Nouvelles especes de *Rissoa* recueillies aux Îles Canaries et a Madëre par Mac-Andrew en 1852. *Journal de Conchyliologie*, Paris, 16: 164-168.

MANZONI, A., 1968b. Sur les *Rissoa* des Îles Canaries et de Madëre par Mac-Andrew en 1852. *Journal de Conchyliologie*, Paris, 16: 236-256.

MOOLENBEEK, R. G. AND FABER, M. J., 1987. The Macaronesian species of the genus *Manzonia* (Gastropoda: Rissoidae). *De Kreukel*, 23 (1): 1-16, pl. 1; 23 (2-3): 23-31; 23 (10): 166-179, pl. 2-3.

MOOLENBEEK, R. G. AND HOENSELAAR, H. J., 1989. The genus *Alvania* on the Canary Islands and Madeira (Mollusca: Gastropoda), part 1. *Bulletin Zoölogisch Museum*, Universiteit van Amsterdam, 11 (27): 215-228.

MOOLENBEEK, R. G. AND HOENSELAAR, H. J., 1998. The genus *Alvania* on the Canary Islands and Madeira (Mollusca: Gastropoda), part 2. *Bulletin Zoölogisch Museum*, Universiteit van Amsterdam, 16 (8): 53-62.

MORTON, J., 1975. Form and habit in some small gastropods of New Zealand boulder beachs. *The Veliger*, 18 (1): 1-15.

NORDSIECK, F. AND GARCÍA-TALAVERA, F., 1979. *Moluscos marinos de Canarias y Madera (Gastropoda).* Aula de Cultura de Tenerife. 208 pp, 46 pls.

PALAZZI, S., 1988. Note sugli Omalogyridae mediterranei e maderensi. *Bollettino Malacologico*, 24 (5-8): 101-111.

PEÑAS, A. AND ROLÁN, E., 1999. La familia Pyramidelloidea Gray, 1840 (Mollusca, Gastropoda, Heterostropha) en África occidental. 4. Los géneros *Megastomia, Odostomia, Ondina, Noemiamea* y *Syrnola*. *Iberus*, suplemento 5: 1-150.

PONDER, W. F., 1990. A gravel beach shelled micro-gastropod assemblage from Ceuta, Strait of Gibraltar, with description of a new truncatelloidean genus. *Bulletin Muséum nationale d'Histoire naturelle,*, Paris, 4 sér., 12, section A (2): 291-311.

ROLÁN, E., 1987. Primera cita de *Assiminea grayana* Fleming, 1828 (Mollusca; Gastropoda) para la fauna ibérica. *Iberus*, 7 (2): 241-242.

ROLÁN, E., 1991. *Peringiella tuber*, new species for the Cape Verde fauna. *La Conchiglia*, 22 (258): 54-55.

VERDUIN, A., 1984. On the taxonomy of some recent European marine species of the genus *Cingula* s. l. (Gastropoda: Prosobranchia). *Basteria*, 48: 37-87.

VERDUIN, A., 1988. On the taxonomy of some Rissoacean species from Europe, Madeira and the Canary Islands (Gastropoda Prosobranchia). *Basteria*, 52: 9-35.

WATSON, R. B., 1873. On some marine mollusca from Madeira, including a new genus of the Muricidae, a new Eulima, and the whole of the Rissoidae of the Group of Islands. *Proceeding of the Zoological Society of London*, 1873: 361-391, pls. 34-36.

WATSON, R. B., 1891. The marine Mollusca of Madeira. *Journal of Conchology*, 4: 365-377.

WATSON, R. B. 1898. On the marine Mollusca of Madeira; with descriptions of thirty-five new species, and an Index-list of all the known sea-dwelling species of that island. *Journal of the Linnean Society of London*, 26: 233-329.

WOLF, H. DE, BACKELJAU, T., VAN DONGEN, S. AND VERHAGEN, R., 1998. Large-scale patterns of shell variation in *Littorina striata*, a planktonic developing periwinkle from Macaronesia (Mollusca, Prosobranchia). *Marine Biology*, 131: 309-317.

WOLLASTON, T. V., 1878. *Testacea Atlantica or the Land and Freshwater Shells of the Azores, Madeiras, Salvages, Canaries, Cape Verde and Saint Helena*. L. Reeve and Co. London, xi + 588 pp.

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***Dendrodoris limbata* (Cuvier, 1804)**
Sinonimias
Doris limbata Cuvier, 1804, *Ann. Mus. H. N. Paris*, 4 (24): 468-469 [Localidad tipo: Marsella].
Doris nigricans Otto, 1823, *Nov. Act. Ac. Caes. Leop. Car.*, 10: 275.

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Ros, J., 1976. Catálogo provisional de los Opistobranquios (Gastropoda: Euthyneura) de las costas ibéricas. *Miscelánea Zoolgica*, 3 (5): 21-51.

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Doris limbata Cuvier, 1804, *Ann. Mus. H. N. Paris*, 4 (24): 468-469 [Type locality: Marseille].
Doris nigricans Otto, 1823, *Nov. Act. Ac. Caes. Leop. Car.*, 10: 275.

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Ros, J., 1976. Catálogo provisional de los Opistobranquios (Gastropoda: Euthyneura) de las costas ibéricas. *Miscelánea Zoológica*, 3 (5): 21-51.

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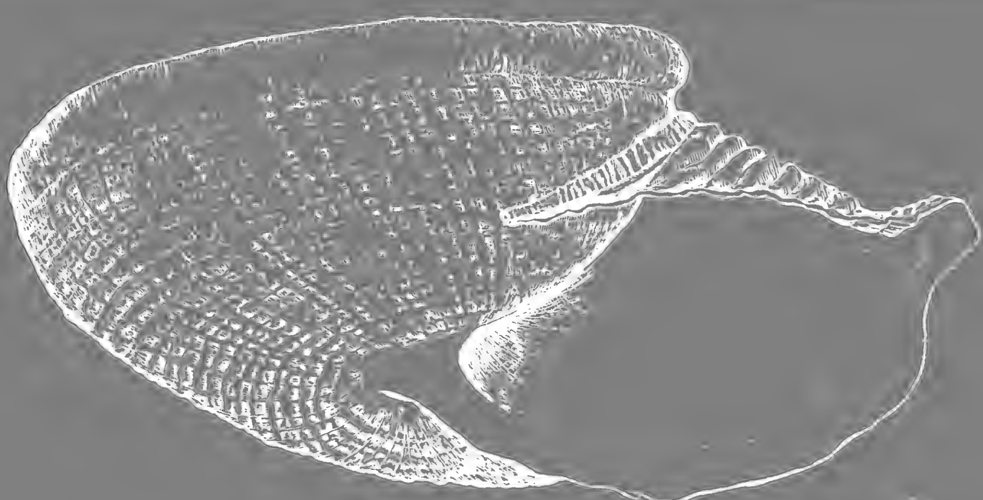

Oviedo, junio 2001

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Toxicity of Alphamethrin, Dimethoate and Carbaryl pesticides to the freshwater snails *Lymnaea acuminata* and *Indoplanorbis exustus*

Toxicidad de los pesticidas Alfametrín, Dimetoato y Carbaril sobre los caracoles dulceacuícolas *Lymnaea acuminata* y *Indoplanorbis exustus*

Vijay Kumas SRIVASTAVA* and Ajay SINGH*[1]

Recibido el 14-III-2000. Aceptado el 12-VI-2000

ABSTRACT

To use the snails as bio-indicator of pesticidal pollution, different doses of a pyrethroid (Alphamethrin), an organophosphate (OP) (Dimethoate) and a carbamate (Carbaryl) were administrated for 24 to 96 hours to the snails *Lymnaea acuminata* and *Indoplanorbis exustus*. Both species were susceptible to the three pesticides at concentrations in the range of 0.008 mg/l to 16.92 mg/l. The order of toxicity was pyrethroid > organophosphate (OP) > and carbamate. The toxicity of all the pesticides was both time and dose dependent as expected. Variation in water temperature influenced the toxicity of pyrethroid significantly, however, OP and carbamate were not influenced significantly. At low temperature pyrethroid became 3 to 4 times more toxic. Similar results are also reported in the case of fish. Thus, the susceptibility of snails may be directed in the field of pollution monitoring.

RESUMEN

Con el fin de usar caracoles como bioindicadores de la polución por pesticidas, se administraron distintas dosis de un piretroide (Alfametrín), un organofosfato (OP) (Dimetoato) y un carbamato (Carbaril), entre 24 y 96 horas a las especies *Lymnaea acuminata* y *Indoplanorbis exustus*. Ambas respondieron a los tres a concentraciones de 0,008 mg/l hasta 16,92 mg/l. El orden de toxicidad fue piretroide > organofosfato > carbamato. La toxicidad se comporto de acuerdo con lo esperado en cuanto a dosis y periodos de exposición. La variación en la temperatura del agua afecto significativamente a la toxicidad del piretroide, pero no a las de los otros. A baja temperatura el piretroide es de 3 a 4 veces más tóxico. Se obtuvieron resultados similares en el caso de peces. Así pues, se pueden usar estas especies en el estudio la polución.

KEY WORDS: Pesticides, *Lymnaea acuminata, Indoplanorbis exustus,* toxicity.
PALABRAS CLAVE: Pesticidas, *Lymnaea acuminata, Indoplanorbis exustus,* toxicidad.

INTRODUCTION

It has been reported that both snails are susceptible to most of the synthetic pesticides entering the freshwater bodies (SINGH AND AGARWAL, 1981; 1990; 1991). SINGH AND AGARWAL (1990) reported that the pyrethroids permethrin, cypermeth-

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Table I. Experimental conditions of tap water at different temperature, determined by methods of APHA/WPCF (1985).
Tabla I. Condiciones experimentales del agua del grifo a diferentes temperaturas, determinadas según los métodos de APHA/WPCF (1985).

Water temperature, °C	18	28
pH	6.70-7.05	7.20-7.40
Dissolved oxygen, mg/L	6.5-7.2	6.8-7.40
Free carbon dioxide, mg/L	4.5-6.5	4.3-6.2
Bicarbonate alkalinity, mg/L	105-109	106-109

rin and fenvalerate are highly toxic to snail *Lymnaea acuminata*. Fishes are also very sensitive to pyrethroids (COATS AND DONNELL-JEFFERY, 1979; HAYA, 1989).

Currently most of the works concerning these snails are in the direction of their control by using synthetic pesticides, as they are the intermediate host of *Fasciola* species, causing endemic fascioliasis in the cattle and livestocks. But, considering the fact if snails are sensitive to these pesticides, their population may not remain unaffected by pesticidal pollution. We are also interested to assess the effect of the water temperature, which varies with season, on the toxicity of pesticides.

MATERIALS AND METHODS

Snails *Lymnaea acuminata* (1.8 ± 0.1 cm in shell height) and *Indoplanorbis exustus* (0.8 ± 1.1 cm in shell height) were collected locally and used as test animals. Toxicity experiments were performed using the method of SINGH AND AGARWAL (1990). Commercial grade pesticides, Stop (Synthetic pyrethroid alphamethrin), Rogohit (Organophosphate, Dimethoate) and Sevin, (Carbaryl Carbamate) were purchased from local market. Adult animals were kept in glass aquaria, containing 3 L of dechlorinated tap water. The aquaria contained 20 snails. Test animals were exposed to five different concentrations of the three pesticides for 24, 48, 72 or 96 hours. Concentrations of alphamethrin, dimethoate and Sevin used for both snails were 0.001, 0.005, 0.009, 0.03 and 0.07 mg/l; 11, 14, 17, 20 and 23 mg/l; and 12, 15, 18, 21 and 24 mg/l, respectively. Pesticides doses were given as the final concentration (w/v) of active ingredient in the test aquaria. Control groups were kept in dechlorinated tap water without any treatment. Each set of experiments was replicated six times.

Mortality was recorded every 24 hours during the observation period of 96 hours. The LC50 values, lower (LCL) and upper (UCL) confidence limit, slope values, ‘t’ ratio and heterogeneity were calculated by the computer POLO programme (RUSSELL, ROBERTSON AND SAVIN, 1977). The product momentum correlation coefficient was determined between exposure time and different values of LC50 (SOKAL AND ROHLF, 1973).

Some toxicological experiments were performed first in the month of January (water temperature 18 °C) and then, in May (water temperature 28 °C) to assess the effects of water temperature on the toxicity of pesticides.

RESULTS

LC50 values of the three pesticides for periods ranging from 24h to 96h at 18 °C and 28 °C water temperature are shown in Tables II and III, respectively. The three pesticides had the following order of toxicity, Alphamethrin (pyrethroid) > Dimethoate (OP) > Sevin (carbamate). The toxicity was time dependent, as there was a significant negative correlation between LC50 and exposure times. Thus, with increase in exposure time, LC50 of alphamethrin for *Lymnaea acuminata* decreased from 0.008 mg/L (24h) to 0.002

Table II. Toxicity data (LC50; mg/l) for different exposure periods of the three different pesticides against the snails *Lymnaea acuminata* and *Indoplanorbis exustus* at 18°C water temperature. LCL: lower confidence limit; UCL: upper confidence limit; SF: slope function.
Tabla II. Datos de toxicidad (LC50; mg/l) de diferentes periodos de exposición a 3 pesticidas distintos de las especies Lymnaea acuminata y Indoplanorbis exustus *a 18 °C de temperatura del agua. LCL: límite inferior de confianza; UCL: límite superior de confianza; SF: función de ajuste.*

Pesticides		Exposure period							
		L. acuminata				*I. exustus*			
		24h	48h	72h	96h	24h	48h	72h	96h
	LC_{50}	0.008	0.006	0.003	0.002	0.005	0.004	0.002	0.001
Alphamethrin	LCL	0.005	0.004	0.001	0.001	0.003	0.002	0.000	0.000
(Pyrethroid)	UCL	0.018	0.010	0.008	0.004	0.012	0.009	0.005	0.004
	SF	1.48	1.39	1.37	1.32	1.73	1.49	1.45	1.24
	LC_{50}	14.31	12.69	11.78	11.24	13.09	11.65	11.57	10.03
Diamethoate	LCL	13.06	10.79	10.19	10.02	9.02	8.21	8.01	7.32
(OP)	UCL	16.07	13.88	12.71	12.01	17.42	15.91	14.81	14.06
	SF	4.35	4.15	5.46	4.72	3.78	3.21	4.59	4.78
	LC_{50}	16.92	14.74	13.68	12.99	15.42	13.90	11.57	10.02
Sevin	LCL	15.16	12.65	11.47	11.12	11.16	10.23	8.43	7.51
(Carbamate)	UCL	18.28	16.00	14.79	14.00	26.25	21.33	15.76	14.73
	SF	4.91	4.53	5.26	6.58	3.36	3.56	4.21	4.32

Table III. Toxicity data (LC50; mg/l) for different exposure periods of the three different pesticides against the snails *Lymnaea acuminata* and *Indoplanorbis exustus* at 28°C water temperature. LCL: lower confidence limit; UCL: upper confidence limit; SF: slope function.
Tabla III. Datos de toxicidad (LC50; mg/l) de diferentes periodos de exposición a 3 pesticidas distintos de las especies Lymnaea acuminata y Indoplanorbis exustus *a 28 °C de temperatura del agua. LCL: límite inferior de confianza; UCL: límite superior de confianza; SF: función de ajuste.*

Pesticides		Exposure period							
		L. acuminata				*I. exustus*			
		24h	48h	72h	96h	24h	48h	72h	96h
	LC_{50}	0.020	0.012	0.009	0.005	0.018	0.120	0.008	0.003
Alphamethrin	LCL	0.015	0.009	0.006	0.003	0.012	0.008	0.004	0.001
(Pyrethroid)	UCL	0.036	0.017	0.011	0.007	0.030	0.021	0.017	0.011
	SF	1.47	1.29	1.83	1.82	1.82	1.36	1.21	1.96
	LC_{50}	19.65	18.13	15.26	10.81	16.23	14.26	11.96	9.41
Diamethoate	LCL	17.50	15.73	13.75	7.43	13.14	11.29	9.43	6.43
(OP)	UCL	29.66	35.02	19.43	17.68	27.56	23.92	17.52	14.26
	SF	4.10	3.35	2.97	2.62	3.21	3.15	3.16	4.21
	LC_{50}	20.05	17.37	15.84	14.19	18.43	15.32	13.26	12.53
Sevin	LCL	18.51	16.38	14.69	12.18	14.42	11.46	9.65	8.12
(Carbamate)	UCL	24.50	19.07	17.08	15.30	27.51	21.51	18.39	17.91
	SF	6.57	6.56	5.61	5.11	6.21	6.26	5.41	4.53

mg/L (96h) at 18 °C and for *Indoplanorbis exustus* it decreased from 0.005 mg/L (24h) to 0.001 mg/L (96h). In case of Dimethoate, at 18 °C this decrease was 14.31 mg/L (24h) to 11.24 mg/L (96h) and 3.09 mg/L (24h) to 10.12 mg/L (96h) for *Lymnaea acuminata* and *Indoplanorbis exustus*, respectively. With Sevin, at 18 °C it decreased from 16.92 mg/L (24h) to 12.99 mg/L (96h) and 15.42 mg/L (24h) to 10.02 mg/L (96h) for *Lymnaea acuminata* and *Indoplanorbis exustus* respectively, (Table II). Same trend was also observed at 28 °C water temperature (Table III). The lower and upper limits were within 95% confidence limit and the slope values were steep (Tables II, III).

DISCUSSION

It is clear from the data given above that both the snails are highly sensitive to all the three tested pesticides. Of the three, alphamethrin (pyrethroid) was found to cause snail mortality at very low doses. The synthetic pyrethroids are mainly absorbed through the dermal, oral and respiratory routes. Their metabolic degradation occurs at numerous sites (MIYAMOTO, 1976). Due to their lipophylic nature, they undergo rapid absorption and are distributed in all the tissues of the body. Their concentrations vary according to the lipophilicity of the tissue. Higher concentrations have been reported in skin, fat, liver, kidney and brain tissue (RUZO, EUGEL AND CASIDA, 1979; RICHARD AND BRODIE, 1985). Pyrethroids are well known to change the Na+ and K+ permeability of nerve membrane resulting in repetitive discharges at the synapse and neuromuscular junction (SINGH AND AGARWAL, 1986; WILKINSON, 1976; NARAHASHI, 1983). SINGH AND AGARWAL (1986, 1991) reported that pyrethroids also cause inhibition of Acetylcholinesterase and reduction of Cytochrome oxidase and lactic dehydrogenase and increase ness in the Succinic dehydrogenase level. This multifarious mode of action rapid absorption of pyrethroid might explain its extreme toxicity to snails.

The LC50 of all the three pesticides showed a significant ($P< 0.05$) negative correlation with exposure times. It demonstrates that detoxification of pesticides in the snail body might be slow. This result also justifies the effectiveness of three pesticides up to at least 96 hours. Both the snails are very sensitive to pesticides. Thus, their mortality or decreasing population in water body result of pesticidal pollution. Finally, it may be concluded that the snails may be taken as bio indicator with bioassay spp. of water (pesticidal) pollution monitoring.

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BIBLIOGRAPHY

APHA/WPCF, 1985. *Standard method for the examination of water and waste water.* 16 ed. APHA,Washington. 1080 pp.

COATS. J. R. AND O'DONNELL-JEFFERY, N. L., 1979. Toxicity of four synthetic pyrethroid insecticides to Rainbow Trout. *Bulletin of Environmental Contamination and Toxicology*, 23: 250-255.

HAYA, K., 1989. Toxicity of pyrethroid insecticides to fish, *Environmental Toxicology and Chem.istry*, 8: 381-391.

MIYAMOTO, J., 1976. Degradation, metabolism and toxicity of synthetic pyrethroids. *Environmental Health Perspectives*, 14: 15-28.

NARAHASHI, T., 1983. *Neurophysiological study of pyrethroids: Molecular and Membrane Mechanism of Action.* (Edited by J. Miyamoto, P.C. Kearney). Pesticide Chemistry, Human Welfare and Environment, Oxford, Pergamon Press. 365 pp.

RICHARD, J. AND BRODIE, M. E., 1985. Correlation of blood and brain levels of the neurotoxic pyrethroid deltamethrin with the onset of symptoms in rats. *Pesticide Biochemistry and Physiology*, 23: 143-156.

RUSSELL, R. M., ROBERTSON, J. L. AND SAVIN, N. E., 1977. POLO: A new computer programme for probit analysis. *Bulletin of the Entomological Soc iety of America*, 23: 209-213.

RUZO, L. O., EUGEL, J. L. AND CASIDA, J. E., 1979. Cecamethrin metabolites from oxidative, hydrolytic and conjugative reactions in mice. *Journal of Agriculture and Food Chem.istry*, 27: 725-731.

SINGH, A AND AGARWAL, R. A. 1990. Molluscicidal properties of synthetic pyrethroids. *Journal of Med ical and Applied Malacology*, 2: 141-144.

SINGH, D. K. AND AGARWAL, R. A., 1986. Pipronyl butoxide synergism with two synthetic pyrethroids against *Lymnaea acuminata*. *Chemosphere*, 15: 493-498.

SINGH, D. K. AND AGARWAL, R. A., 1991. Action sites of cypermethrin, a synthetic pyrethroid in the *Lymnaea acuminata*. *Acta Hydrochemica et Hydrobiologica*, 4: 411-516.

SOKAL, R. R. AND ROHLF, F. J., 1973. *Introduction to biostatistic*. San Franciosco, W.H. Freeman. 386 pp.

WILKINSON, C. F., 1976. *Insecticide biochemistry and physiology*. Plenum Publcorp, NewYork. 768 pp.

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Eulimid gastropods (Caenogastropoda: Eulimidae) of the Canary Islands. Part I. Species parasiting sea urchins

Eulímidos (Caenogastropoda: Eulimidae) de las Islas Canarias. Parte I. Especies parásitas de erizos de mar

Myriam RODRÍGUEZ, Jacinto BARQUÍN and Gustavo PÉREZ-DIONIS*

Recibido el 11-VII-2000. Aceptado el 22-XI-2000

ABSTRACT

The present paper deals with 4 species of eulimid gastropods parasitic on sea urchins: *Echineulima leucophaes* parasite of *Diadema antillarum*; *Vitreolina philippi* parasite of *Arbacia lixula, Paracentrotus lividus* and *Sphaerechinus granularis;* and *Nanobalcis nana* and *Sabinella bonifaceae* both parasites of the sea urchin *Cidaris cidaris*. A complete description of shell and soft parts of these species along wiht data on lifestyle and infestation rates is provided.

RESUMEN

Este trabajo versa sobre 4 especies de eulímidos parásitos de erizos de mar: *Echineulima leucophaes* parásita de *Diadema antillarum*; *Vitreolina philippi* parásita de *Arbacia lixula, Paracentrotus lividus* y *Sphaerechinus granularis;* y *Nanobalcis nana* y *Sabinella bonifaceae* ambas parásitas del erizo *Cidaris cidaris*. Se incluyen descripciones de concha y partes blandas, así como datos sobre su ecología y tasas de infección.

KEY WORDS: Mollusca, Gastropoda, Eulimidae, *Echineulima leucophaes, Vitreolina philippi, Nanobalcis nana, Sabinella bonifaciae,* Tenerife, Canary Islands, NE Atlantic.
PALABRAS CLAVE: Mollusca, Gastropoda, Eulimidae, *Echineulima leucophaes, Vitreolina philippi, Nanobalcis nana, Sabinella bonifaciae,* Tenerife, Islas Canarias, Atlántico NE.

INTRODUCTION

The Eulimidae is a large family of parasitic gastropods. Almost all species are parasites on echinoderms and typically have small, glossy, white shells. Many are free-living, able to move from one host to another, but some are permanently attachet to their host, or have become endoparasites. There are probably thousand species worldwide, many of them undescribed. According to WARÉN (1984), there have been described about 850 living species, of which about 150 from North Atlantic, but few of them are known from their host. Nevertheless, the species of eulimids are almost impossible to place in genera if the host is unknown, and often difficult to determine. In many species there is a pronounced sexual dimorfism and to some extent the development of the shell depends on sex of the animal or on the presence or absence of additional individuals of the same species, which in some of them determine the sex of

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Figure 1. Sampling localities.
Figura 1. Localidades de muestreo.

newly settle larvae (WARÉN, 1984). This complicates specific classification. A complete review of the biology and systematic of the family can be seen in the above mentioned work (WARÉN, 1984).

The eulimids from the Canary Islands are poorly known. NORDSIECK AND GARCÍA-TALAVERA (1979) included eighteen species of Eulimidae in their book on marine molluscs of Madeira and Canary Islands, mainly based upon the work of WATSON (1897). The status of most of these nominal species must be questioned in light of recent work. BOUCHET AND WARÉN (1986) in their revision of the northeast Atlantic bathyal and abyssal molluscs described six new species of Eulimidae near the Canary Island, between 500 and 850 m in depth. In recent year ENGL (1997a, 1997b, 1998) has described three new species of eulimids in circalittoral bottoms of Puerto del Carmen, Lanzarote. All these descriptions were based upon dead shells. An additional paper was published by ENGL (1999) on *"Eulima" fuscozonata* Bouchet and Warén, 1986.

In recent years we have carried out an exhaustive searching for species of Eulimidae, mainly in Tenerife Island. In a former paper the first author (RODRÍGUEZ, 2000) described the new species *Melanella lutea,* which parasites the sea cucumber *Holothuria sanctori* Delle Chiaje. Here we deal with four species found parasiting sea urchins. In another paper in this volume we focus our attention on two species found parasiting the crinoids *Antedon bifida* (Pennant), and a next work will deal whith the species found in sediments.

MATERIAL AND METHODS

The specimens of eulimids studied in this paper come from samples of the more common littoral species of sea urchins in the Canary Islands: *Paracentrotus lividus* (Lamark), *Arbacia lixula* (L.), *Sphaerechinus granularis* (Lamark) and *Diadema antillarum* (Philippi). Twenty eight samples were taken by scuba diving in eighteen localities of Tenerife Island (see Figure 1) between 5 and 35 m in depth. Besides, some samples of the circalittoral sea urchin *Cidaris cidaris* (L.) coming from fishing nets were studied. These samples were caught from some localities of Tenerife, Gran Canaria and Fuerteventura (see Table VIII).

In the laboratory each specimen of sea urchin was carafully examined under a binocular microscope. The living specimens of eulimids found in each one were recorded and measured. Some specimens were photographied alive an others were selected to be observed at scanning electron microscopy.

Voucher material of all the species studied was deposited in the Department of Animal Biology, La Laguna University, Tenerife.

RESULTS

Family EULIMIDAE Philippi, 1853
Genus *Echineulima* Lützen and Nielsen, 1975

Echineulima leucophaes (Tomlin and Shackleford, 1913) (Figs. 2, 4-9)

Mucronalia leucophaës Tomlin, J. R, le B. and Shackleford, L. J. "Descriptions of new species of *Marginella* and *Mucronalia* from São Thomé. *The Journal of Conchology,24*: 1913-1915.

Type locality: São Thomé
Material estudied: The number of specimens studied and the localities where they were collected are specify in Table I and Figure 1.

Description: Shell solid, white, glossy, translucent, rather globular, sharpened apically and last whorl inflated occupying $^2/_3$ of the shell. Spire straight without curvature. Whorls clearly convex. Suture very evident because of the whorl convexity. Below the suture a narrow whitish band is appreciated which corresponds to the false suture.

Surface smooth with only growing scars, strongly marked in some shells.

Protoconch clearly differentiated, since the larval whorls have a very reduced diameter, meanwhile the teleoconch diameter increases rapidly. It consists of three whorls and lacks ornamentation or colour that differentiates from the rest of the shell. Male and female shells have been studied with scanning electron microscopy and no significant differences with respect to their morphology were observed (Fig. 2).

Protoconch smooth, increasing slightly its diameter between one whorl and the next. These larval whorls easily differentiate from those of the teleoconch, the diameter of the latter increase more rapidly, are clearly more convex and have fine grooves that cross the whorl perpendicularly with respect to the suture. These grooves appear on the shell of both sexes, although in males they are more marked. The growing scars are very clear.

Aperture rounded and large in males, and slightly more quadrangular in females. Outer lip fine, no terminal swelling. In profile almost straight, first third part projected faintly and withdraws ending at the base, further behind than the apical union with the suture. Inner lip slightly swelled forming a small columelar callosity.

Size: The specimens studied had a range of 4 to 9 whorls. The measurements were carried out separating previously the males from the females, because of the great difference in size. A male of a determinate number of whorls presents a much smaller size with respect to a female with the same number of whorls. Terefore, males have less whorls inflated and smaller diameter (Figs. 5, 6).

In the 54 specimens measured the ratio (width/length) ranged from 2.44/1.73 mm in a male of 4 whorls to 13.45/7.15 mm in a female of 9 whorls (Tables II and III).

Soft parts: Soft parts white and similar in both sexes. Neither spots nor coloured marks are normally appreciated in the head-foot or mantle. In some specimens small dark spots are seen by transparency in the suture zone and areas slightly yellowish that correspond to the internal organs.

Tentacles long, fine, sharpened at the tip, strong yellow in colour with some whitish spots on the surface. Tip and ventral zone white. Some animals with lighter coloured tentacles were observed, sometimes almost white.

Eyes small, black, located at the base of the tentacles, with a yellow border. Vision through the shell.

Once the animal is in the parasite position on the host the different parts of the foot are observed, partially covering the base of the shell. When it is

Table I. Material studied of *Diadema antillarum* and *Echineulima leucophaes*, and infestation rates.
Tabla I. Material estudiado de Diadema antillarum *y* Echineulima leucophaes, *y porcentajes de infección.*

Locality	Nº of specimens of *D. antillarum* studied	Nº of specimens of *D. antillarum* parasited	Infestation rates (%)	Nº of specimens of *E. leucophaes*
Abades	100	4	4.0	7
Agua Dulce	180	7	3.9	13
Alcalá	115	1	0.9	1
El Palm-mar	61	1	1.6	2
El Tablado	80	2	2.5	3
La Barranquera	100	0	0.0	0
Las Aguas	30	0	0.0	0
Las Caletillas	290	11	3.8	21
Las Eras	258	5	1.9	10
Playa Paraiso	200	4	2.0	11
Pta. Salema	125	2	1.6	2
Pta. La Rasca	166	2	1.2	4
Punta del Hidalgo	6	0	0.0	0
Tajao	200	2	1.0	3
Total	1.911	41	$\bar{X} = 2.1$	77

repeatedly disturbed it withdraws partly in the shell, unable to completely introduce itself, leaving part of the foot covering the base of the shell.

Snout elongated, thick, cylindrical, used to hold on to the host, slightly swelled at the centre, with an apical disk to adhere on to the host. The proboscis, used to suck food, penetrates this disk and outer tissue of the host, and it inserts itself inside (Fig. 7).

According to LÜTZEN AND NIELSEN (1975) the species of this genus present an operculum oval and transparent, not observed in our specimens.

Radula absent.

Data on life history: Echineulima leucophaes seems to be an exclusive parasite of the sea urchin *Diadema antillarum* (Philippi, 1845). It is a permanent parasite, once adhered to the host it is unable to free itself. The apical disk of the snout fuses with the host's tissue, wich in response creates a callosity or fibroid gall leaving the snail's snout firmly adhered (Fig. 4).

Proboscis very long, sometimes duplicating the length of the shell completely stretched out. Several specimens had the proboscis evaginated after the fixative procedure. A female presented a shell of 11.7 mm and a proboscis of 22.3 mm; another had a shell of 11.4 mm and a proboscis of 25.1 mm (Fig. 7). The snail, using this appendix, can reach any internal organ of the sea urchin to feed on. The proboscis has a slight swelling at the apical end where the suction pump is located. According to LÜTZEN and NIELSEN (1975), the gonadal tissues of the sea urchins are the food source of this species.

Inside the sea urchin fixation zone of the parasite is clearly appreciated as a necrotic spot, darker and black rimmed, surrounding the proboscis. In this zone, the shell of the sea urchin is soft and brakes easily. If several parasites are located next to each other the necrotic zone is shared by all, although the same number of spots as parasites are appreciated (Fig. 9).

The insertion zone of the parasite is variable. *E. leucophaes* was observed adhered to the oral side, to the sides or on the aboral zone of the sea urchin.

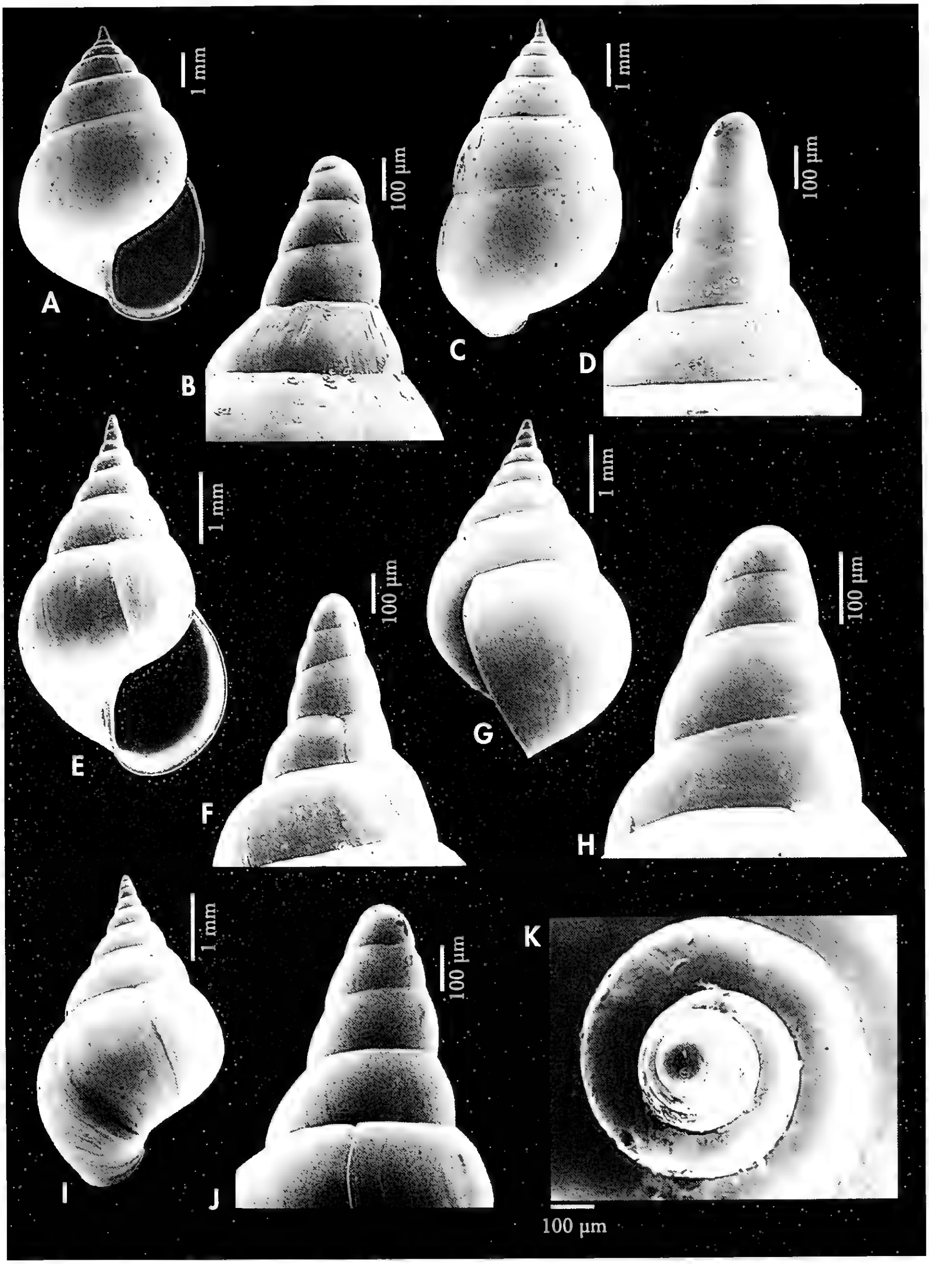


Figure 2. *Echineulima leucophaes*, female (A-D), male (E-K). A: ventral view of the shell; B: apex in ventral view; C: shell in dorsal position; D: apex in dorsal position; E: ventral view of the shell; F: apex in ventral view; G: shell in lateral view; H: apex in shell profile; I: shell in dorsal position; J: apex with shell in dorsal position; K: upper view of the protoconch.

Figure 2. Echineulima leucophaes, *hembra (A-D), macho (E-K). A: vistra ventral de la concha; B: ápice en vista ventral; C: concha en posición dorsal; D: ápice en posición dorsal; E: vista ventral de la concha; F: ápice en vista ventral; G: concha en vista lateral ; H: ápice en el perfil de la concha; I: concha en posición dorsal; J: ápice con la concha en posición doral; K: vista superior de la protoconcha.*

Table II. Number of whorls and mean size of the male specimens of *Echineulima leucophaes* studied.
Tabla II. Número de vueltas y talla media de los machos de Echineulima leucophaes.

Nº whorls	Nº of specimens	width/ length (mm)
7	4	6.06/3.47
6	17	4.98/3.08
5	10	3.41/2.24
4	1	2.44/1.73
TOTAL	32	$\bar{X}$ = 4.22/2.63

Table III. Number of whorls and mean size of the female specimens of *Echineulima leucophaes* studied.
Tabla III. Número de vueltas y talla media de las hembras de Echineulima leucophaes.

Nº whorls	Nº of specimens	width/ length (mm)
9	6	12.29/6.86
8	5	10.84/6.64
7	7	8.85/5.38
6	4	6.23/3.83
TOTAL	22	$\bar{X}$ = 9.55/5.67

Several specimens were also seen adhered to the same sea urchin, forming clearly differentiated groups. The groups can be made up of one or more specimens, and each group has a sole female and one or several males. The high grade of aggregation examined in the individuals of *E. leucophaes* assumes the existence of some type of chemical attraction among them.

Internally, the insertion area is also variable. Parasites were seen on the ambulacralia or interambulacralia plates. Occasionally some specimens were observed adhered to the peri-buccal soft area.

The experiments conducted to determine the ability of the species to free themselves from the host indicate that the fixation is definitive and irreversible. The parasites released artificially lost the locomotor capacity.

This species is protandric hermaphrodite with environmental sex determination (ESD). The first individual, once settled on the host, spends a short phase as a male and continues to grow as a female. The following specimens that settle next to her develop as males and remain like this until the female disappears, then one of them reverses and becomes a female. There also exists a marked sexual dimorphism, males are much smaller than the females, therefore very easy to differentiate. Frequently there is one or several groups of individuals on a same host, each with only one female along with one or more males (Fig. 8).

The infestation rate of *E. leucophaes* on *D. antillarum* is very low, never higher than 4.0% (see Table I).

Distribution: This species seems to be restricted to the tropical and subtropical Eastern Atlantic. It is only known from São Thomé Island, Guf of Guinea, and Canary Islands.

Remarks: This species was described for the first time as *Mucronalia leucophaes* in São Thomé Island by TOMLIN AND SHACKLEFORD (1913). This description did not provide any data on soft parts or host.

LÜTZEN AND NIELSEN (1975) described the new genus *Echineulima* to include some species parasitic on sea urchins of the families Diadematidae and Echinometridae. These authors synonymized *M. leucophaes* with the type species (by original designation) of *Echineulima, E. mittrei*, that is widespread throughout the tropical Indo-Pacific. They recorded it also from the Gulf of Guinea and Tenerife Island. WARÉN (1980) revised the genus *Echineulima* and considered *E. mittrei* and *E. leucophaes* as different species, being the former of Indo-Pacific distribution and the latter Atlantic. Although the shell appearance is quite similar in both species, we follow the opinion of Warén due the big gap in disribution between them from the Gulf of Guinea (West Africa) to Mozambique (East Africa). Nevertheless, the divergence of these species must be confirmed by mean of genetic or DNA studies.

According to WARÉN (1980) the species of this genus presents planktotrophic larval development, since the egg diameter ranges from 65 to 70 μm and the height of the protoconch is 300 μm or more, evidencing the presence of protoconch I and II.

Genus *Vitreolina* Monterosato, 1884.

Vitreolina philippi (Rayneval, Hecke and Ponzi, 1854) (Figs. 3, 10-12)

Eulima philippi Rayneval, Hecke and Ponzi, 1854. "Catalogue des fossiles du Monte Mario (prés Rome), recueillis par M. le Cte de Rayneval, Mgr Van den Hecke et M. le professeur Ponzi, 1854." *Versailles Beaujeune*: 20 + 6 pp.

Type locality: Monte Mario, Roma, fossil
Material studied: The number of specimens studied and the localities where they were collected are specify in Tables IV, V and VI, and Figure 1.

Description: Shell conical, slender, sharpened, slightly curved, generally towards the right, more clear in larger individuals (Fig. 10), glossy, completely transparent, without any colouration and fragile in appearance; ornamentation absent.

True suture hard to observe in live specimens, forming a fine and tenuous groove along the whorls causing a discontinuity in the shell's brilliance. False suture very evident, appreciated as a more opaque line. Both sutures are parallel, false under true. The space between them is quite narrow, approximately $^1/_5$ of the height of the whorls.

On the shell surface the sutures and growth scars are observed. Most shells have scars located dorsally on the right side, each one ahead of the one before, indicating that the animal has grown more than one whorl in each growth period. One scar per whorl is observed. The study of the shells with scanning electron microscopy confirms the absence of ornamentation or microsculpture on the shell's surface, only the sutures and growth scars are appreciated (Fig. 3). Whorls of teleoconch flat, and those of the protoconch slightly convex. On some areas of the surface deteriorated zones appeared, probably due to chemical disintegration by immersion in preservative fluids or by erosion caused by friction with the substratum when the animal was alive.

Protoconch of four whorl, with pointed apex, smooth, transparent and without sculpture or colour.

Aperture ovated, small, with apical zone faintly sharpened. Outer lip not swelled, withdrawn at the suture forming a sinus, very marked at the centre. Inner lip straight, swelled at the base forming a patent callus at the base of the columella.

Size: The sizes (length/ width) of the specimens studied ranged from 3.73/1.32 mm, in an specimen of 8 whorls, and 0.52/0.17 mm in the smallest specimens of 2 whorls. The average sizes obtained are shown in Table VII.

Table IV. Material studied of *Vitreolina philippi* parasiting *Arbacia lixula* and infestation rates.
Table IV. Material estudiado de Vitreolina philippi *parasitando* Arbacia lixula *y porcentajes de infección.*

Locality	**Nº of specimens of *A. lixula***	**Nº of sea urchins with parasites**	**Nº of specimens of *V. philippi***	**Max nº of specimens of *V. philippi* /sea urchin**	**Infestation rates**
Abades	5	1	1	1	20.0
Aguadulce	10	8	38	12	80.0
Alcalá	7	2	2	1	28.6
El Médano	3	0	0	0	0.0
El Palm-mar	2	1	5	5	50.0
Garachico	4	4	16	7	100.0
La Barranquera	25	7	16	6	28.0
Las Aguas	7	5	17	7	71.4
Las Caletillas	11	8	26	8	72.7
Las Eras	15	13	53	6	86.7
Las Teresitas	3	1	3	3	33.3
Playa Paraíso	10	5	6	2	50.0
Porís de Abona	24	19	118	27	79.2
Pta. Hidalgo	13	0	0	-	0.0
TOTAL	139	74	301	$\bar{X}$ = 6.5	$\bar{X}$ = 49.9

Table V. Material studied of *Vitreolina philippi* parasiting *Patacentrotus lividus* and infestation rates.
Table V. Material estudiado de Vitreolina philippi *parasitando* Patacentrotus lividus *y porcentajes de infección.*

Locality	**Nº of specimens of *P. lividus***	**Nº of sea urchins with parasites**	**Nº of specimens of *V. philippi***	**Max nº of specimens of *V. philippi* /sea urchin**	**Infestation rates**
Abades	31	8	12	3	25.8
Aguadulce	1	0	0	-	0.0
Alcalá	27	6	7	2	22.2
El Médano	25	4	5	2	16.0
El Palm-mar	2	1	29	29	50.0
Garachico	29	29	187	18	100.0
La Barranquera	15	4	10	4	26.7
Las Aguas	34	31	148	12	91.2
Las Caletillas	19	19	131	19	100.0
Las Eras	1	1	2	2	100.0
Las Teresitas	10	5	8	3	50.0
Playa Paraíso	0	0	0	-	-
Porís de Abona	9	8	90	30	88.9
Pta. Hidalgo	25	5	6	2	20.0
TOTAL	228	121	635	$\bar{X}$ = 10.5	$\bar{X}$ = 53.1

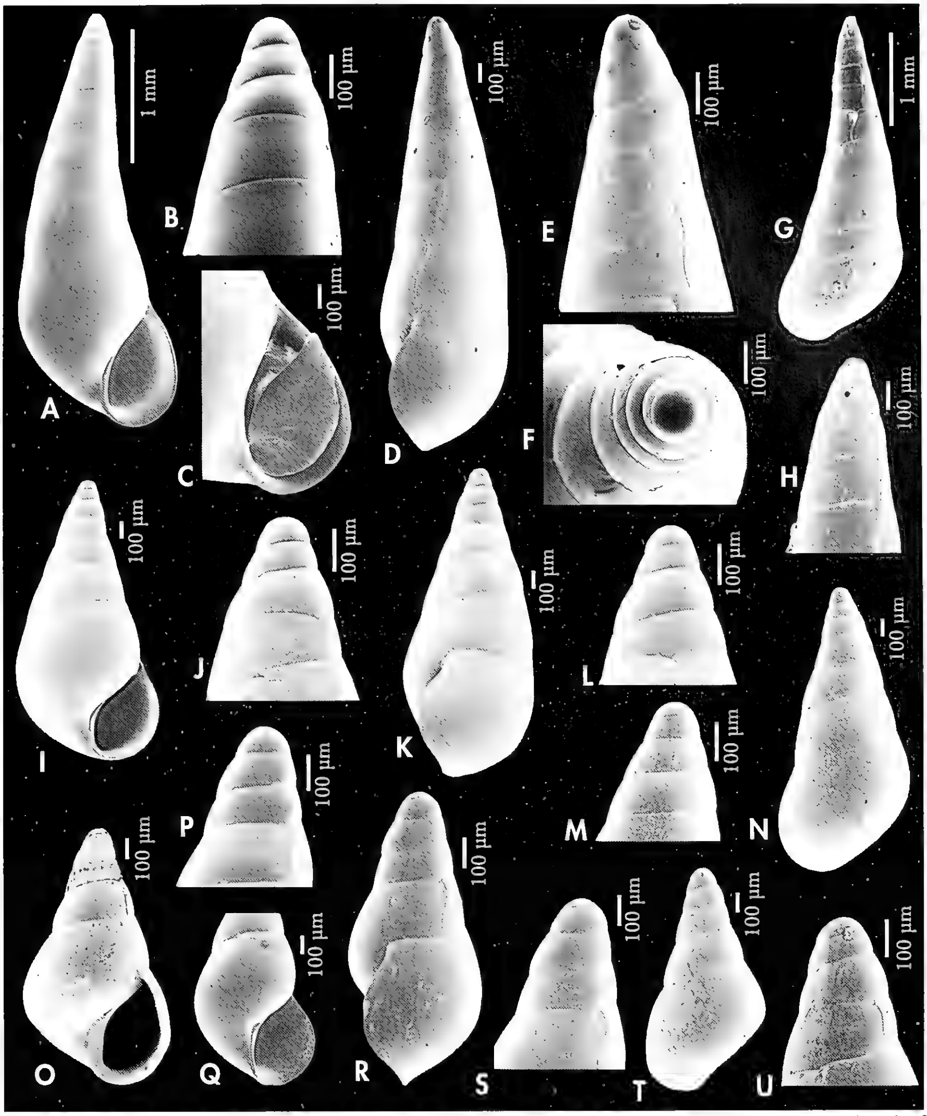


Figure 3. A-H: *Vitreolina philippii*, A: ventral view of the shell; B: apex in ventral view; C: detail of aperture and operculum; D: profile of shell; E: apex in lateral view; F: upper view of the protoconch; G: shell in dorsal position; H: apex in dorsal position. I-N: *Nanobalcis nana*, I: ventral view of the shell; J: apex in ventral view; K: profile of shell; L: apex in lateral view; M: apex in dorsal position; N: shell in dorsal position. O-U: *Sabinella bonifaciae*, O: ventral view of the shell; P: apex in ventral view; Q: detail of aperture and growth scar of the last whorl; R: profile of shell; S: apex in lateral view; T: shell in dorsal position; U: apex in dorsal position.

Figura 3. A-H: Vitreolina philippii, *A: vista ventral de la concha; B: ápice en vista ventral; C: detalle de la apertura y el opérculo; D: perfil de la concha; E: ápice en vista lateral; F: vista superior de la protochocha; G: concha en posisicón dorsal; H: ápice en posición dorsal. I-N:* Nanobalcis nana, *I: vista ventral de la concha ; J: ápice en vista ventra; K: perfil de la concha; L: ápice en vista lateral; M: ápice en posición dorsal; N: concha en posición dorsal. O-U:* Sabinella bonifaciae, *O: vista ventral de la concha; P: ápice en vista ventral; Q: detalle de la apertura y marca de crecimiento de la última vuelta; R: perfil de la concha; S: ápice en vista lateral; T: concha en posición dorsal; U: ápice en posición dorsal.*

Soft parts: The soft parts are perfectly observed by transparency. The first whorls are plain yellow and the last ones have a series of orange and yellow-whitish spots on the head and foot. The disposition of these spots is variable but there are two patterns that repeat frequently.

In the first pattern when observed from the side of the aperture, the first four whorls are yellowish, the fifth and sixth have orange dots arranged forming lines perpendicular to the sutures, the seventh whorl has disperse punctuation and the last one presents scattered orange and yellow-whitish dots. These orange dots are mainly disposed around the eyes and sides of the head and the most whitish areas are placed at the top of the head. In dorsal view the same colour pattern of the whorls is appreciated, but in the last one a series of orange dots aligned parallel to the suture are observed, along with orange and whitish dots dispersed around the head (Fig. 11). The two black eyes are very patent in this position with an orange dot under each one.

The second pattern differs from the previous in the third, fourth and fifth whorls, which have three reddish lines per whorl. These lines are wide in the upper suture and they get narrower until disappear at the lower one. The sixth whorl has a very patent red dot.

Cephalic tentacles long and slender, translucent, with a row of small bright yellow dots on its dorsal surface. At the base of each one a small orange dot is observed besides the large and black eyes, located in faint protuberances at the sides of the head. The vision is by transparency through the shell.

Foot dorsally yellow with bright orange and yellow scattered dots at its base.

Operculum paucispiral, transparent, slightly yellowish. Fine growth lines are observed that emerge from one point within the inner margin and head towards the outer one gradually fading before reaching the edge of the operculum (Fig. 3).

Radula absent.

After short fixative periods in preservative fluids, the pattern of coloration disappears and the colour becomes uniform from white to yellow-orange.

Data on life history: *Vitreolina philippi* was found parasiting the sea urchins *Arbacia lixula, Sphaerechinus granularis* and *Paracentrotus lividus*. It is a sporadic parasite, associates with sea urchins to feed, but capable of freeing himself and crawl around looking for another host. The adherence to the sea urchin is weak, freeing himself very easily once disturbed and therefore occasionally seen on rocks or substratum.

In the specimens of *A. lixula* studied in Tenerife, *V. philippi* was parasite always on the oral zone (Fig. 12). In *P. lividus* and *S. granularis* the position of this parasite is more difficult to specify, since these sea urchins adhere algae, stones or other objects on their surface, being very difficult locate the eulimids.

Most of the specimens of *V. philippi* freed themselves from the host during the trip to the laboratory, appearing free in the bags. The ones remaining on the host were adhered to the soft parts at the base of the ambulacralia feet in the peri-buccal zone.

A total of 502 sea urchins were studied, collected in 14 localities of the coast of Tenerife, in a depth range of 5-20 m (Tables IV, V and VI). *V. philippi* parasites preferably on *Sphaerechinus granularis*, and 80% of the specimens of this sea urchin had parasited. The infestation rate on *Arbacia lixula* and *Paracentrotus lividus* is quite similar and somewhat greater than 50%. The maximum number of specimens of *V. philippi* found on a single host (*P. lividus*) was 30.

Distribution: It is known from north to Norway to the Canary Islands, including the Mediterranean Sea.

Remarks: Despite the high specificity of host choice that characterises most of the genera of Eulimidae, the species of the genus *Vitreolina* present a wide variety of hosts, Ophiuroidea (WARÉN, 1984) and several genera of sea urchins (WARÉN, BURCH AND BURCH, 1984). FRETTER AND GRAHAM (1982) indicated that they have appeared also on holot-

Table VI. Material studied of *Vitreolina philippi* parasiting *Sphaerechinus granularis* and infestation rates.
Table VI. Material estudiado de Vitreolina philippi *parasitando* Sphaerechinus granularis *y porcentajes de infección.*

Locality	Nº of specimens of *S. granularis*	Nº of sea urchins with parasites	Nº of specimens of *V. philippi*	Max nº of specimens of *V. philippi* /sea urchin	Infestation rates
Abades	6	0	0	-	0.0
Aguadulce	16	16	125	20	100.0
Alcalá	7	5	21	11	71.4
El Médano	4	0	0	-	0.0
El Palm-mar	27	18	83	16	66.6
Garachico	0	0	0	-	-
La Barranquera	1	0	0	-	0.0
Las Aguas	0	0	0	-	-
Las Caletillas	6	5	31	21	83.3
Las Eras	25	22	113	14	88.0
Las Teresitas	12	11	64	12	91.7
Playa Paraíso	20	12	27	5	60.0
Porís de Abona	9	9	78	18	100.0
Pta. Hidalgo	2	1	1	1	50.0
TOTAL	135	99	543	$\bar{X}$ = 13.1	$\bar{X}$ = 59.2

Table VII. Number of whorls and mean size of 48 specimens of *Vitreolina philippi.*
Table VII. Número de vueltas y talla media de 48 ejemplares de Vitreolina philippi.

Nº whorls	Nº of specimens	width/ length (mm)
8	4	3.50 /1.26
7	6	2.87 /1.15
6	10	2.38 /0.95
5	7	1.90 /0.64
4	6	1.46 /0.47
3	9	1.13 /0.29
2	6	0.60 /0.19
TOTAL	48	$\bar{X}$ = 1.97 / 0.71

hurians and crinoids, if all available data are correct.

Several works record *V. philippi* in the Mediterranean. MIFSUD (1990a) point out that it is common on *P. lividus*, but very rare on *A. lixula* in Malta, but RINALDI (1994) found it very common on both species of sea urchins in Sardinia. OLIVERIO, BUZZURRO AND VILLA (1994) add *S. granularis, Centrostephanus longispinus* (Philippi) and *Psammechinus microtuberculatus* (Blainville) to their host list in the Eastern Mediterranean. FRETTER AND GRAHAM (1982) recorded *V. philippi* in the Atlantic coasts of Europe and lastly, NORDSIECK AND TALAVERA (1979) in Madeira and Tenerife.

Genus *Nanobalcis* Warén and Mifsud, 1990.

Nanobalcis nana (Monterosato, 1878) (Figs. 3, 13 -15)

Eulima nana Monterosato, 1878. "Note sur quelques coquilles draguées dans les eaux de Palerme, par le Marquis de Monterosato". *Journal de Conchyliologie*, 26: 143-160.

Type locality: Palermo, Sicily, 50-90 m deep.
Material studied: The number of specimens studied and the localities where they were collected are specify in Table VIII.

Description: Shell conical, almost straight in profile, small, completely transparent, without ornamentation or coloured zones (Fig. 13). The transparency fades with the fixation, although it is maintained in those preserved dried. In these, the sutures and growth scars are well observed.

Teleoconch whorls flat and slightly convex at the protoconch. Last whorl quite high, occupying almost half of the height of the shell.

In the dry specimens, the suture and false suture are clearly distinct. Both are parallel, the space between them quite narrow and more opaque in appearance than the rest of the shell.

The growth scars are not aligned, located at a different place in each whorl. There are growth periods in which the animal almost form a complete whorl, while in others only a half whorl is formed. The scars appearing irregularly. The SEM photographs show the surface of the shell totally smooth, without any kind of micro-sculpture, except the sutures and growth scars (Fig. 3). These scars are strongly marked and located irregularly in the different whorls.

Apex slightly sharpened. Protoconch with 2 whorls faintly convex, transparent, whitout ornamentation or colour that differentiates it from the teloconch. There is no mark indicating the existence of protoconch II, and therefore this species might lack a planktotrophic larval phase. No micro-sculpture is appreciated in the protoconch (Fig. 3).

Aperture wide, round and slightly sharpened at its upper margin. It is quite low and faintly surpasses the edge of the lower part of the shell. In lateral view, the inner lip presents the first section straight coinciding with the zone between the sutures; then projected forming a sinus, very marked at the centre. Inner lip with columelar callus very patent, located at the lower margin of the aperture, coinciding with the base of the columella.

Size: The size (length/width) of the specimens from Tenerife ranged from 0.45/0.31 mm in an specimen with one whorl to 1.85/0.79 mm in other of 6 whorls.

The average size of the specimens studied are shown in Table IX.

Soft parts: Soft parts orange-brown, clearly observed by shell transparency.

Several yellowish spots are observed in the gonad-visceral zone and other reddish stand out on an orange background. These spots do not seem to follow a constant colour pattern.

In the suture of the last whorl a reddish spot is appreciated, diffused and edges scarcely defined. At the sides of the head there are also small reddish zones.

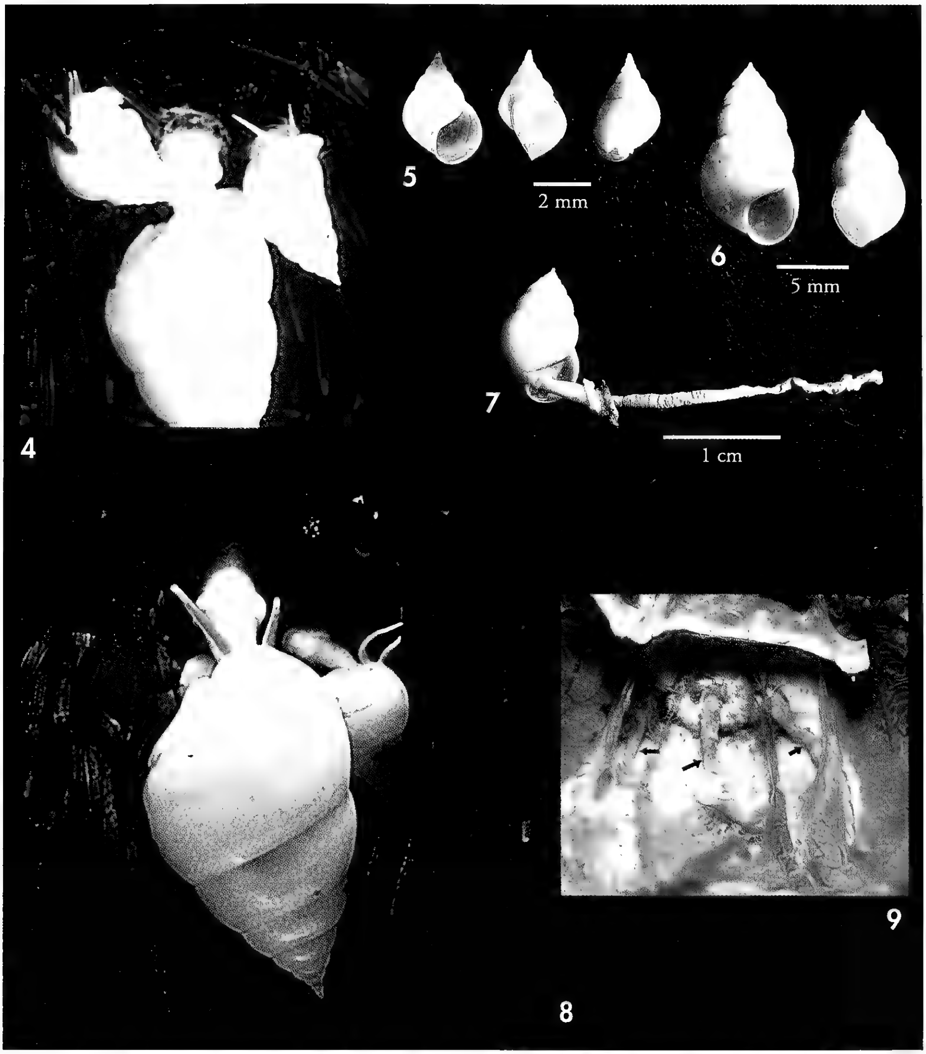
Cephalic tentacles very long, slender, sharpened and almost transparent, with faint yellow highlights on the surface, mainly on the apical zone.

Eyes black and large, placed quite close and slightly behind with respect to the tentacles. At the base of each eye a more intense orange spot is observed. Vision by transparency through the shell (Fig. 14). Foot also orange.

Operculum very thin, transparent, oval, with faint growth lines. Animal capable of complete retraction inside the shell.

Radula absent.

After fixation the soft parts loose their pigmentation becoming pale



Figures 4-9. *Echineulima leucophaes.* 4: group of one female and two males; 5: males; 6: females; 7: female with snout and proboscis evaginated; 8: male and female, in parasitic position on *Diadema antillarum*; 9: inner face of *Diadema antillarum* where three necrotic marks, the proboscis of a female (centre) and two males of *E. leucophaes* are observed.
Figuras 4-9. Echineulima leucophaes. *4: grupo de una hembra y dos machos; 5: machos; 6: hembras; 7: hembra con el morro y probóscide evaginados; 8: macho y hembra, parasitando un ejemplar de Diadema antillarum; 9: cara interna de* Diadema antillarum *con tres marcas necróticas correspondientes a la probóscide de una hembra (centro) y dos machos de* E. leucophaes.

yellow, almost white or even hyaline in smaller specimens. Some individuals, after fixation, present faint dark spots in the last whorl of the suture and on the cephalic zone.

Date on life history: *Nanobalcis nana* was found on the sea urchin *Cidaris cidaris* (L., 1758). It is an sporadic parasite, capable of freeing itself when disturbed. The insertion zone of the parasite on the host is at the base of the largest spines (MIFSUD, 1990b), although most of the specimens from Tenerife was found free in the transportation bag, crawling, floating or moving on the surface of the sea urchin (Fig. 15). Therefore the insertion zone was not determined.

The sea urchins were captured using fishing nets, suffering an intense manipulation to untangle and free them. It is possible that during this process some parasites freed themselves. The sea urchins were introduced together in a container with sea water, many parasites were liberated, making it difficult to determine the number of eulimid parasiting each sea urchin.

The localities studied and the number of hosts and parasites are shown in Table VIII.

Distribution: It was only known from Malta, Sicily and Gulf of Naples. We recorded it here for the first time in the Atlantic ocean. Engl (com. pers.) has found this species in sediments coming from the CANCAP expeditions, and Templado (com. pers.) has found a quite similar species (probably the same) in Cape Verde Islands parasiting the Cidarid *Eucidaris tribuloides*.

Remarks: MONTEROSATO (1875) named for the first time this species as *Eulima nana*, collected in Palermo at a depth of 90 m. There is not more data on the species in this work. Later MONTEROSATO (1878) presented the first formal description of the shell of this species. This description was based on specimens from sediment dredged and no data on soft parts of the animal or possible hosts were done.

MIFSUD (1990) found several specimens of this species (cited as *Eulima nana*) adhered to the largest spines of the sea urchin *Cidaris cidaris*. The same year, WARÉN AND MIFSUD (1990) erected the new genus *Nanobalcis* to embrace a group of small eulimids parasitic on cidaroid sea urchins, and designed *E. nana* as type species of this genus. They recorded this species from Malta and the Gulf of Naples. Until now this species has not been recorded outside of the Mediterranean Sea.

Genus *Sabinella* Monterosato, 1890

Sabinella bonifaciae Nordsieck, 1974 (Figs. 3, 16)

Eulima (Sabinella) bonifaciae Nordsieck, 1974. "Molluscs from the continental shelf bottom betwen Corsica and Sardinia (Bocche di Bonifacio, station K1)". *La Conchiglia*, 61: 11-14.

Type locality: off Capo Comino, between Sardinia and Corsica, 200-220 m deep.
Material studied: The number of specimens studied and the localities where they were collected are specify in Table VIII.

Description: Shell conical, small, quite translucent but not totally transparent, apex slightly sharpened and aperture very large. Ornamentation or colour absent (Fig. 16). Shells in preservative fluids become white and opaque. Profile straight, whorls convex, the last one very high, occupying $^{2}/_{3}$ of the shell height. Sutures clearly distinct by whorl convexity. The false suture is very evident as a fine opaque line located under the true suture. Both sutures are parallel and the space between them is very narrow. The growth scars are strongly marked. Normally there are two per whorl, located irregularly because the snail grows more than half a whorl each growth period. These scars are the only marks appreciated on the surface of the shell. The shells lack micro-sculpture in the teleoconch and protoconch (Fig. 3). Some shells present the first whorls deeply eroded, probably due to chemical attack of the preservative fluids, indicating a greater debility of the larval shell with respect to the teleoconch.

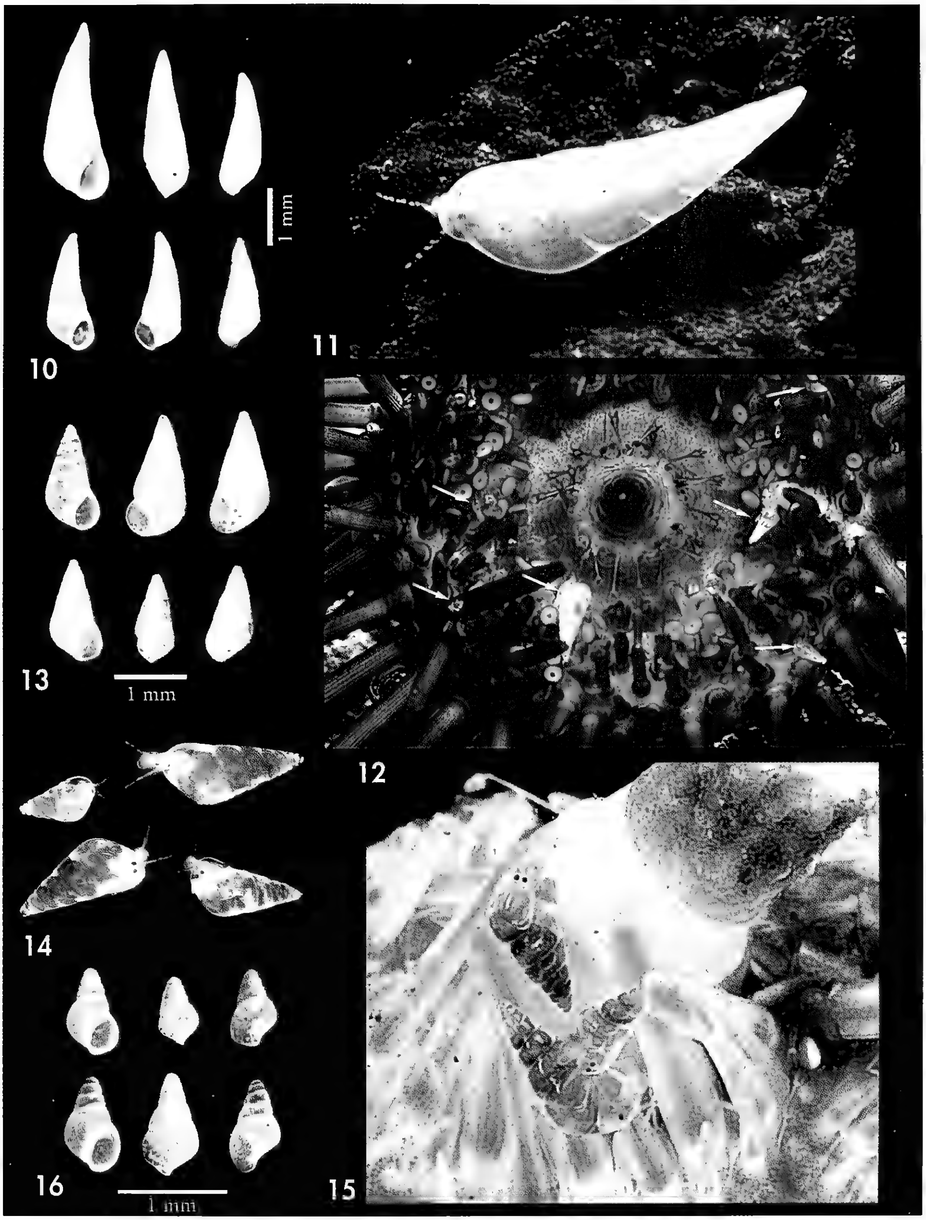


Figure 10. Some specimens of *Vitreolina philippi.* Figure 11. *Vitreolina philippi* crawling on the substratum after freeing himself from the host; the most common colour pattern of soft parts can be observed. Figure 12. Oral zone of *Arbacia Lixula* with 6 specimens of *Vitreolina philippi.* Figure 13. Some specimens of *Nanobalcis nana.* Figure 14. Common colour pattern of *Nanobalcis nana.* Figure 15. Three specimens of *Nanobalcis nana* on *Cidaris cidaris.* Figure 16. Some specimens of *Sabinella bonifaciae.*
Figura 10. Varios ejemplares de Vitreolina philippi. *Figura 11.* Vitreolina philippi *arrastrándose sobre el sustrato tras alimentarse del hospedador; se puede observar el patrón de color más común de las partes blandas. Figura 12. Zona oral de* Arbacia Lixula *con 6 ejemplares de* Vitreolina philippi. *Figura 13. Varios ejemplares de* Nanobalcis nana. *Figura 14. Patrón de color habitual de* Nanobalcis nana. *Figura 15. Tres ejemplares de* Nanobalcis nana *sobre* Cidaris cidaris. *Figura 16. Varios ejemplares de* Sabinella bonifaciae.

Table VIII. Material studied of *Cidaris cidaris* and its parasites *Nanobalcis nana* and *Sabinella bonifaciae.*
Table VIII. Material estuciado de Cidaris cidaris *y sus parásitos* Nanobalcis nana *y* Sabinella bonifaciae.

Locality	Island	Date	Depth (m)	Nº of specimens studied C. cidaris	N. nana	S. bonifaciae
Mogán	Gran Canaria	22-11-94	100	32	12	10
Ptito. de Güímar	Tenerife	13-11-96	-	1	28	0
28° 29,38 N, 16° 09,15 W	Tenerife	5-12-96	293	70	437	0
28° 22,80 N, 16° 20,23 W	Tenerife	6-12-96	253	2	13	1
Los Gigantes	Tenerife	4-12-97	135	2	2	0
28° 10,56 N, 14° 22,32 W	Fuerteventura	1-10-97	232	68	280	5
Pto. de la Cruz	Tenerife	28-2-98	198	1	3	0

Table IX. Number of whorl and mean size of 47 specimens of *Nanobalcis nana.*
Table IX. Número de vueltas y talla media de 47 ejemplares de Nanobalcis nana.

Nº whorls	Nº of specimens	width/ length (mm)
6	1	1.85 / 0.79
5	13	1.57 / 0.70
4	12	1.27 / 0.59
3	8	0.93 / 0.47
2	11	0.67 / 0.35
1	2	0.47 / 0.31
TOTAL	47	$\bar{X}$ = 1.13 / 0.53

Table X. Number of whorl and mean size of 9 specimens of *Sabinella bonifaciae.*
Table X. Número de vueltas y talla media de 9 ejemplares de Sabinella bonifaciae.

Nº whorls	Nº of specimens	width/ length (mm)
4	2	1.27 / 0.72
3	4	0.93 / 0.53
2	3	0.81 / 0.45
TOTAL	9	$\bar{X}$ = 1.00 / 0.56

Mucronate protoconch of 2.5 whorls, without coloration or ornamentation that differentiates it from the teloconch.

Aperture large, oval, slightly sharpened at it upper part and rounded at the base. Outer lip faintly swelled at the tip of the aperture, surpassing largely the edge of the shell. In profile, the lip in the sutural zone is withdrawn and then projected forming a very marked sinus. Inner lip swelled forming a notable columelar callus.

Size: The specimens obtained in the Canary Islands (Tenerife, Gran Canaria and Fuerteventura) had from 2 to 4 whorls. The average sizes are shown in Table X.

Soft parts: The study of *S. bonifaceae* was done with specimens kept in fixative fluids, therefore we have not photos of living animals nor description of colour patterns were obtained. The preserved animals presented a uniform whitish coloration in the cephalic zone, and only big black eyes stood out. The gonad-visceral zone presents the same colour as the cephalic area, although some individuals were reddish brown.

Operculum very thin, yellowish and transparent.

Date on life history: *Sabinella bonifaciae* was found living on the sea urchin *Cidaris cidaris* (L., 1758). The specimens observed in the Canary Islands were found crawling freely on the sea urchin, indicating that they are sporadic parasite, capable of freeing themselves from the host.

S. bonifaciae is parasite of *C. cidaris* jointly with the eulimid above mentioned, *Nanobalcis nana*. In specimens of *C. cidaris* from Tenerife the latter was much more abundant than the former.

The localities studied and the number of hosts and parasites are shown in Table VIII.

The intense manipulation suffered by the sea urchins using the fishing nets, as with *Nanobalcis nana*, could have made caused the parasites to free themselves from the host.

Distribution: It was known from the Western Mediterranean and Sicilian Chanel, and from Bay of Biscay to the Ibero-Moroccan Gulf. Here recorded for the first in the Canary Islands.

Remarks: MONTEROSATO (1875) described this species for the first time as *Eulima piriformis* Brugnone, in Palermo. Later, MONTEROSATO (1890) created the new genus *Sabinella*, were *S. piriformis* was included.

NORDSIECK (1975) described the new species *Eulima (Sabinella) bonifaciae*, for the area between Corsica and Sardinia. The description was obtanied from shells of sediments, therefore lacks data on possible hosts. VAN AARTSEN (1978) and GAGLINI (1990) considered *Sabinella bonifaciae* as synonum of *S. piriformis* Brugnone, 1873, but WARÉN (1984) and BOUCHET AND WARÉN (1986) discusses on the taxonomy of these taxa and considered the former as a valid species.

According to BOUCHET AND WARÉN (1986) the females of this species are larger than the males and are permanently adhered to the host, meanwhile the males may crawl freely. This species has tentacles smooth, wide and short, with eyes located at the base of each one. The foot is well developed and functional and, after comparing the shell's size of the veliger larva with the postlarval specimens, concluded that the size difference indicated a planktotrophic development.

WARÉN AND MIFSUD (1990) found some specimens of *S. bonifaciae* on *C. cidaris* in Malta and provided new additional data on sof parts and life-style. They noted that the insertion zone of this eulimid on its host is at the base of the primary spines, originating a distinc thickening. When the specimens had a size of 1-2 mm they attached permanently to the host with a mucous collar, covering the base of the proboscis, which remained in the sea urchin once the parasite was separated from the host. The small size of the specimens found in Canaries and the fact that they were observed free on *C. cidaris* may indicate that they were juveniles or males. Although the spines of this sea urchin were carefully examined, none specimen of *S. bonifaciae* was found attached to them.

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BIBLIOGRAPHY

AARTSEN, J. J. VAN, 1978. *Eulima (Sabinella) bonifaciae* Nordsieck, 1974 a synonym of *E. (Sab.) piriformis* Brugnone, 1873. *Conchiglie*, 14 (11-12): 219-220.

BOUCHET, P. AND WARÉN, A., 1986. Revision of the northeast Atlantic Bathyal and Abyssal Aclididae, Eulimidae, Epitoniidae (Mollusca, Gastropoda). *Bollettino Malacologico*, Supplemento 2: 300-576.

ENGL, W., 1997a. New species of the family Eulimidae from the Canary Islands. Part I: Description of *Sticteulima richteri* n. sp. *La Conchiglia*, 283: 44-47.

ENGL, W., 1997b. New species of the family Eulimidae from the Canary Islands. Part II: Description of *Sticteulima wareni* n. sp. *La Conchiglia*, 285: 43-45.

ENGL, W., 1998. New species of the family Eulimidae from the Canary Islands. Part 3: Description of *Fusceulima boscheineni* n. sp. *La Conchiglia*, 289: 11-14,60.

ENGL, W., 1999. New or pourly known species of the family Eulimidae from the Eastern Atlantic and Mediterranean. Part 4: *"Eulima" fuscozonata* Bouchet and Warén, 1986. *La Conchiglia*, 292: 45-46.

FRETTER, V. AND GRAHAM, A., 1982. The prosobranch Molluscs of Britain and Denmark. Part 7- "Heterogastropoda" (Cerithiopsacea, Triforacea, Epitoniacea, Eulimacea). *The Journal of Molluscan Studies*, Supplement 11. 360-435.

GAGLINI, A., 1990. Sulla valitá del taxon *Sabinella piriformis* Brugnone, 1873 (Eulimidae). *Notiziario CISMA*, 12: 29-31.

LE RENARD, J., 2000. CLEMAN (Check list of European Marine Mollusca). Muséum National d'Histoire Naturelle. www.mnhn.fr/base/malaco.html

LÜTZEN, J. AND NIELSEN, K., 1975. Contributions to the anatomy and biology of *Echineulima* n.g. (Prosobranchia: Eulimidae), parasitic on sea urchins. *Videnskablige Meddelelser Danske Naturhhistoriske Forening*, 138: 171-199.

MIFSUD, C., 1990a. *Vitreolina philippi* (Ponzi, De Rayneval and Van Den Heck, 1854) (Eulimidae) found living on the echinoid *Paracentrotus lividus* (Lamark) in infralittoral Maltese Waters. *Bollettino Malacologico*, 26 (10-12): 165-168.

MIFSUD, C., 1990b. Due specie di Eulimidi parassiti dell' echinoide *Cidaris cidaris* (L., 1758). *La Conchiglia*, 258: 30-31.

MONTEROSATO, M., 1875. Nuova rivista delle conchiglie Mediterranee. *Atti dell`Accademia di scienze, Lettere ed Arti, Palermo* Vol V, ser. 2: 1-50.

MONTEROSATO, M., 1878. Note sur quelques coquilles draguées dans les eaux de Palerme. *Journal de Conchyliologie*, Paris 26: 143-160.

MONTEROSATO, M., 1890. Conchiglie della profondità del mare di Palermo. *Il Naturalista Siciliano*, 9 (7): 157-66.

NORDSIECK, F., 1974. Molluscs from the continental shelf bottom between Corsica and Sardinia (Bocche di Bonifacio, station K1). *La Conchiglia*, 61:11-14.

NORDSIECK, F. AND GARCÍA-TALAVERA, F., 1979. *Moluscos marinos de Canarias y Madera (Gastropoda)*. Aula de Cultura de Tenerife, 208 pp.

OLIVERIO, M., BUZZURRO, G. AND VILLA, R., 1994. A new Eulimid Gastropod from the eastern Mediterranean sea (Caenogastropoda, Ptenoglossa). *Bollettino Malacologico*, 30 (5-9): 211-215.

RAYNEVAL, L. M. A. G. DE, HECKE, M. VAN DEN, AND PONZI, M,. 1854. *Catalogue des fossiles du Monte Mario (prés Rome), recueillis par M. le Cte de Rayneval, Mgr Van den Hecke et M. le professeur Ponzi*. Versailles Beaujeune: 20 + 6 pp.

RINALDI, A. C., 1994. Frecuenza e distribuzione di *Vitreolina Philippi* (De Rayneval and Ponzi, 1854) (Prosobranchia, Eulimidae) su due specie di Echinoidei regolari lungo le coste meridionali della Sardegna. *Bollettino Malacologico*, 30 (1-4): 29-32.

RODRÍGUEZ, M., 2000. Description of a new Eulimid (Mollusca: Gastropoda) off the Canary Islands. *Melanella lutea* n. sp. *La Conchiglia*, 294-295: 82- 86.

TOMLIN, B. AND SHACKLEFORD, L. J., 1913. Descriptions of new species of *Marginella* and *Mucronalia* from São Thomé. *The Journal of Conchology*, vol. XIV (1913-1915): 43- 44.

WARÉN, A., 1980. Revision of the genera *Thyca, Stilifer, Scalenostoma, Mucronalia* and *Echineulima* (Mollusca, Prosobranchia, Eulimidae). *Zoologica Scripta*, 9: 187-210.

WARÉN, A., 1984. A generic revision of the Family Eulimidae. *The Journal of Molluscan Studies*, supplement 13: 96 pp.

WARÉN, A., BURCH, B. L. AND BURCH, T. A., 1984. Description of five new species of Hawaiian Eulimidae. *The Veliger*, 26 (3): 170-178.

WARÉN, A. AND MIFSUD, C., 1990. *Nanobalcis* a new Eulimid genus (Prosobranchia) parasitic on Cidaroid sea urchins, with two new species, and comments on *Sabinella bonifaciae* (Nordsieck). *Bollettino Malacologico*, 26 (1-4): 37-46.

WATSON, R. B., 1897. Marine Mollusca of Madeira. *Journal of the Linnean Society of London*, 26: 233-239.

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Eulimid gastropods (Caenogastropoda: Eulimidae) of the Canary Islands. Part II. Species parasiting the crinoid *Antedon bifida*

Eulímidos (Caenogastropoda: Eulimidae) de las Islas Canarias. Parte II. Especies parásitas del crinoideo *Antedon bifida*

Myriam RODRÍGUEZ, Gustavo PEREZ-DIONIS and Jacinto BARQUÍN*

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ABSTRACT

The present work deals with two species of eulimids, *Curveulima dautzenbergi* and *Crinophtheiros collinsi*, found parasiting the crinoid *Antedon bifida* in Tenerife, Canary Islands. Data on shell, soft parts, lifestyle and infestation rates are provided.

RESUMEN

El presente trabajo versa sobre dos especies de eulímidos, *Curveulima dautzenbergi* y *Crinophtheiros collinsi*, que parasitan al crinoideo *Antedon bifida* en la Isla de Tenerife (Canarias). Se aportan datos sobre la concha, partes blandas, ecología y tasas de infección.

KEY WORDS: Mollusca, Gastropoda, Eulimidae, *Curveulima dautzenbergi, Crinophtheiros collinsi,* Crinoidea, *Antedon bifida,* Tenerife, Canary Islands.

PALABRAS CLAVE: Mollusca, Gastropoda, Eulimidae, *Curveulima dautzenbergi, Crinophtheiros collinsi,* Crinoidea, *Antedon bifida,* Tenerife, Islas Canarias.

INTRODUCTION

We follow the serie of works dealing with the eulimids gastropods of the Canary Islands. We dedicated a former paper in this same volume to the species parasiting sea urchins, and we deal here with those found on the crinoid *Antedon bifida* (Pennant), very common in littoral waters of this Archipielago. In a previous paper, RODRÍGUEZ (2000) described the new species *Melanella lutea,* which parasites the sea cucumber *Holothuria sanctori* Delle Chiaje. In the other hand, in recent year ENGL (1997a, 1997b, 1998) has described some new species of eulimids in circalittoral bottoms of Puerto del Carmen, Lanzarote, based upon dead shells.

MATERIAL AND METHODS

The material studied comes from samples of the crinoid *Antedon bifida* taken from the infralittoral zone of Tene-

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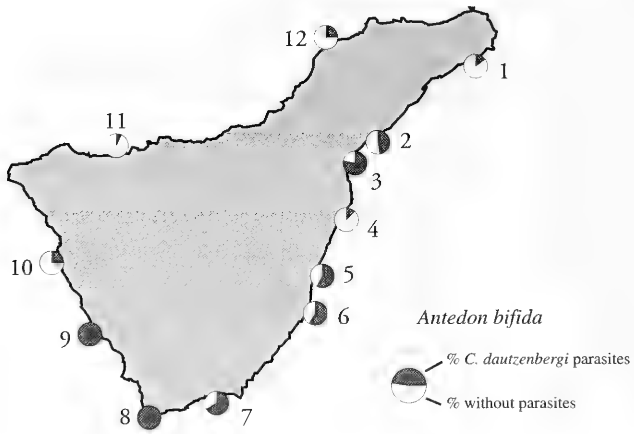


Figure 1. Sampling localities.
Figura 1. Localidades de muestreo.

rife in 16 dives, between 5 and 35 m in depth, in several localities throughout this island (see Table I and Figure 1). Some additional samples were taken in other islands (Fuerteventura, el Hierro y La Palma).

The crinoids captured (294 specimens) along with the eulimid parasites were preserved in ethanol 70% and voucher material was deposited at the Animal Biology Department of the University of La Laguna.

RESULTS

Family EULIMIDAE Philippi, 1853
Genus *Curveulima* Laseron, 1955

Curveulima dautzenbergi (Pallary, 1900) (Figs. 2, 4-10)

Eulima (Vitreolina) dautzenbergi Pallary, 1900 "Coquilles marines du littoral du département D'Oran." *Journal de Conchyliologie,* 48: 211-422.

Type locality: Roseville (Orán).
Material studied: The material studied in Tenerife Island is detailed in Table I and Figure 1, as well as the infestation rate for each locality (Table II). A total of 181 specimens of this eulimid were found in the 294 specimens of *Antedon bifida* collected. Additional specimens were obtained in most of the samples of *A. bifida* from Fuerteventura, El Hierro and La Palma islands.

Shell: Live specimens with transparent shell, smooth, glossy, clearly curved and delicate aspect (Figs. 4, 5). The curvature of the axis of the shell varies in the specimens studied and it is very obvious in the larger. In big specimens the shell is clearly curved towards the right. Sometimes a slight dorsal curvature of the apex with respect to the aperture is observed.

Whorls slightly convex. Suture slightly marked, like a thin line along the whorl. False suture very evident, parallel and below the true suture. The space between the sutures is approximately one third of the height of the whorls.

Surface of the shell without ornamentation. A fine line is observed marking the suture and the scars left by

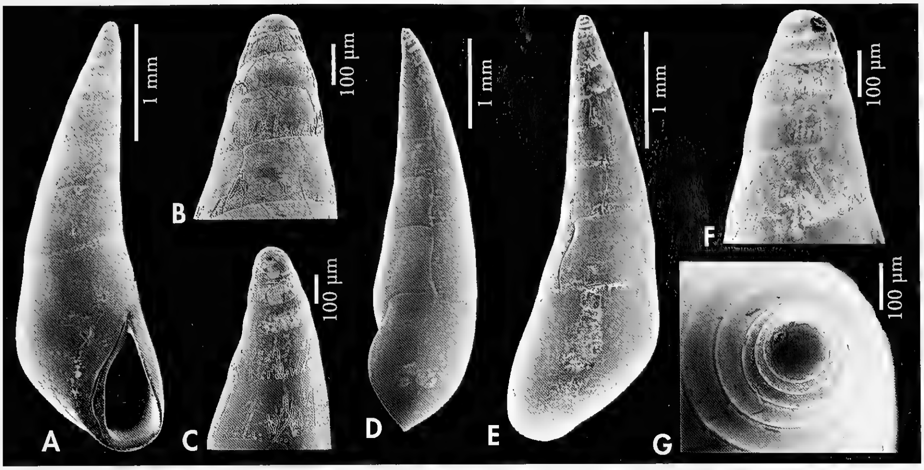


Figure 2. *Curveulima dautzenbergi.* A: ventral view of the shell; B: apex in ventral view; C: apex in lateral view; D: shell in lateral view; E: shell in dorsal position; F: apex in dorsal view; G: upper view of the protoconch.

Figura 2. Curveulima dautzenbergi. *A: vista ventral de la concha; B: ápice en vista ventral; C: ápice en vista lateral; D: concha en vista lateral; E: concha en posición dorsal; F: ápice en vista dorsal; G: vista superior de la protoconcha.*

the previous position of the inner lip during the periods when the animal growth stopped. These scars are mainly on the right margin, although the position varied in the specimens studied. There were shells with scars clearly lined up that presented a very marked curvature; others had a scar ahead or behind with respect to the previous one. The study of the shells with SEM confirms the absence of ornamentation or micro-sculpture on the surface of the shell, only the sutures and growth scars are appreciated. In spite of the live shells studied, a high degree of abrasion was observed (Fig. 2).

Protoconch smooth, transparent, without ornamentation or colour. The presence of individuals with one whorl adhered to the host seems to indicate the absence of a planktotrophic larval phase. This would be corroborated by the lack of marks on the shell that indicate the presence of protoconch II.

Aperture oval, drop-shaped, tall, quite sharp adapically and rounded at the base. The lower margin of the aperture exceeds the shell edge. Outer lip not swelled, projected at the centre forming a sinus. The internal margin of the aperture swelled. This callus is appreciable in younger specimens and very marked in larger shells.

Size: The number of whorls of the specimens studied ranged from one to nine. The average size was 4.90/1.56 mm (width/length) in specimens of nine whorls (Table III).

Soft parts: Can be perfectly observed by transparency in living specimens, held to the host or crawling once they are free (Fig. 6). Two zones are clearly differentiated:

1. Gonad-visceral zone yellow-orange in colour. Reddish tones may be present in larger specimens. Juveniles paler, almost hyaline in smaller individuals. A series of small reddish dots, located in all the whorls and without any pattern, are visible in this zone. In larger specimens the reddish dots are more numerous and intense.

Table I. Sampling localities in Tenerife Island.
Table I. Localidades de muestreo en Tenerife.

Nº	Nº samples	Latitude	Longitude	Locality
1	3	3153502	383734	Las Teresitas
2	2	3142338	369506	Radazul
3	1	3139345	366594	Las Caletillas
4	1	3130701	365361	Ptito. Güímar
5	1	3118638	359865	Las Eras
6	2	3116209	359468	Porís de Abona
7	1	3101415	344499	Agua Dulce
8	1	3098165	334277	Pta. La Rasca
9	1	3112015	325169	Playa Paraíso
10	1	3120183	320729	Alcalá
11	1	3139814	326886	Garachico
12	1	3155267	360932	La Barranquera

2. Cephalic zone orange with numerous reddish dots, whose position varies according with the size of the specimens:

a) In smaller specimens the dots had not an apparent pattern on the dorsal view and they are slightly aligned parallel to the suture on the ventral one. In some medium or large specimens this same pattern was observed.

b) In larger specimens the colour of the dots is much more intense, in some areas they join forming a red band, and the lines starting at the suture of the shell progress towards the centre of the last whorl where they fragment forming a transverse band with clearly defined dots. The red lines beginning at the suture alternates with orange zones and glassy yellow highlights are observed.

On the head, a dorsal zone, whitish with yellow highlights, is appreciated, flanked at both sides by small pale-orange dots (Fig. 7). Cephalic tentacles thin, long and blunt. The edge is hyaline and the mid-line yellow. An orange spot is observed at the base of the tentacles.

Eyes black, immediately behind the orange cephalic spot, very obvious and always inside the shell. The vision is through the shell whether the animal is crawling or adhered to the host.

Foot hyaline with small orange and yellow dots (Fig. 8).

Operculum slender, paucispiral, transparent, slightly yellowish with tenuous growth lines.

Radula absent.

Data on life history: *Curveulima dautzenbergi* parasites the crinoid *Antedon bifida* (Fig. 9). It is a sporadic parasite, which if disturbed looses itself from the host and crawl freely around the substratum without suffering any damage.

The position of the parasite on the host is variable. Specimens of *C. dautzenbergi* were observed adhered to the finials, arms or central disk in both dorsal and ventral sides of crinoids (Fig. 10). Those adhered to the central disk were always large specimens and juveniles were never seen in this zone. Parasites of different sizes were observed in arms and finials.

The maximum number of parasites per crinoid was 19, all small sized, on a specimen of *A. bifida*.

A total of 181 specimens of *C. dautzenbergi* were found in 294 specimens of *A. bifida*. The results obtained in the samples are detailed in Tables I, II and Figure 1, as well as the infestation rates for each locality and total.

In all the samples taken in the islands of Fuerteventura, El Hierro and La Palma this species was observed, which confirms that it is a common

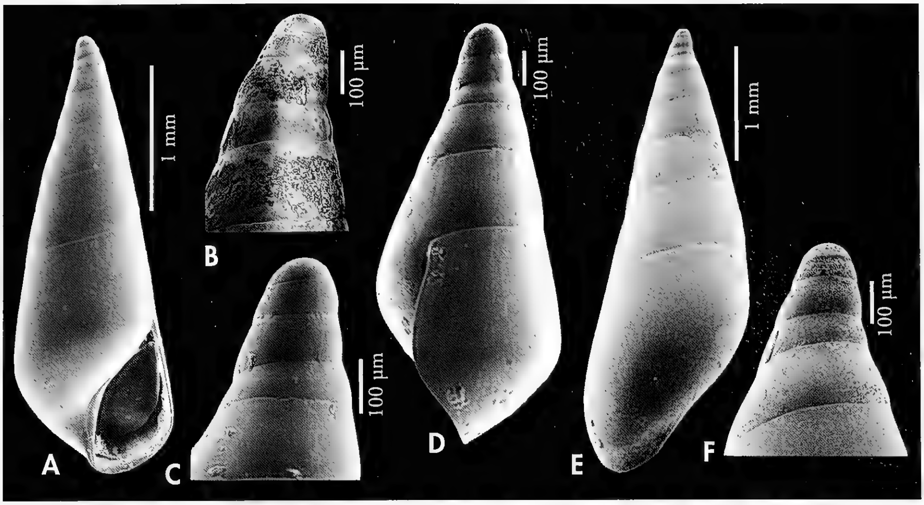


Figure 3. *Crinophtheiros collinsi.* A: ventral view of the shell; B: apex in ventral view; C: apex in lateral view; D: shell in lateral view; E: shell in dorsal position; F: apex in dorsal view.
Figura 3. Crinophtheiros collinsi. *A: vista ventral de la concha; B: ápice en vista ventral; C: ápice en vista lateral; D: concha en vista lateral; E: concha en posición dorsal; F: ápice en vista dorsal.*

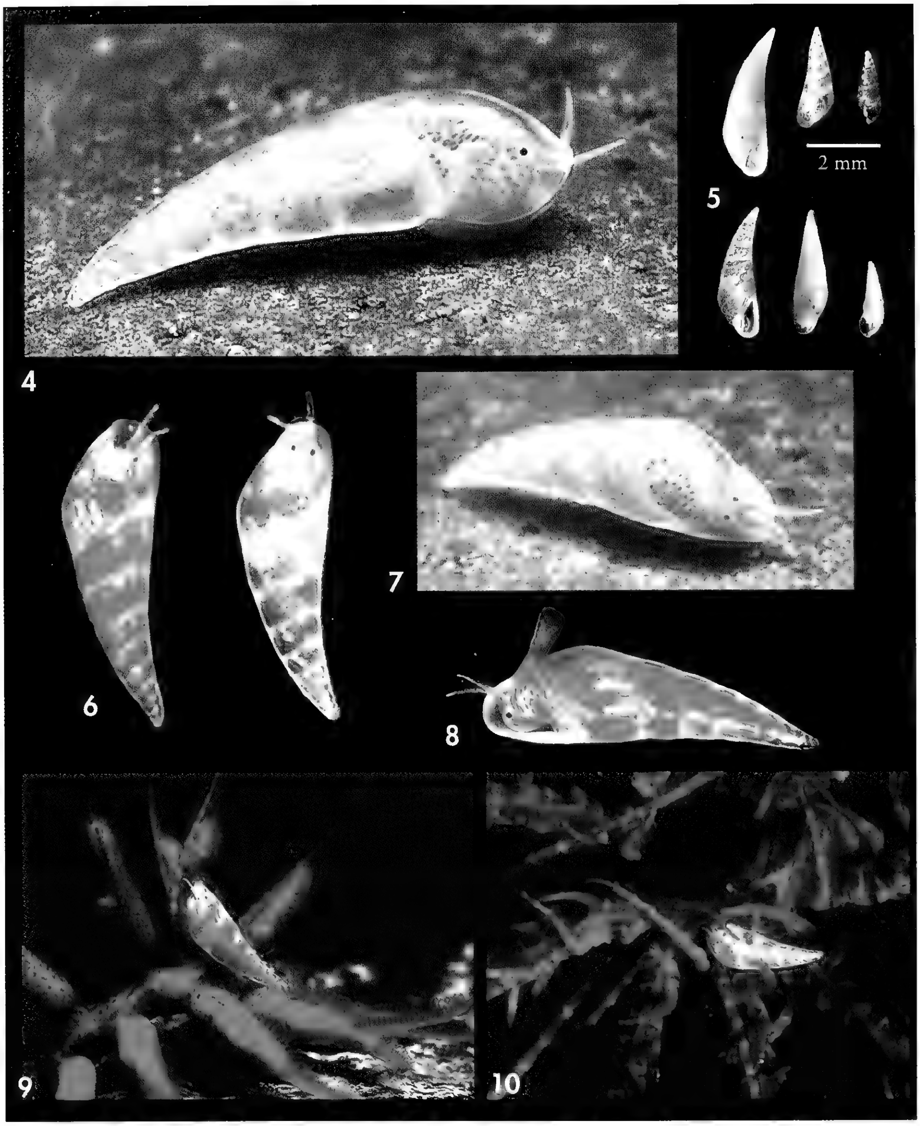
species all around the Canarian Archipelago.

Distribution: Until now it was only known from the western Mediterranean Sea. We extend here its geographical range of distribution to the Canary islands.

Remarks: The specimens studied has been identified as *C. dautzenbergi* by Dr. Warén (com. pers.). PALLARY (1900) des-

Table II. Number of specimens studied of *Antedon bifida, Curveulima dautzenbergi* and *Crinophtheiros collinsi* in each locality.
Table II. Número de ejemplares de Antedon bifida, Curveulima dautzenbergi *y* Crinophtheiros collinsi *estudiados en cada localidad.*

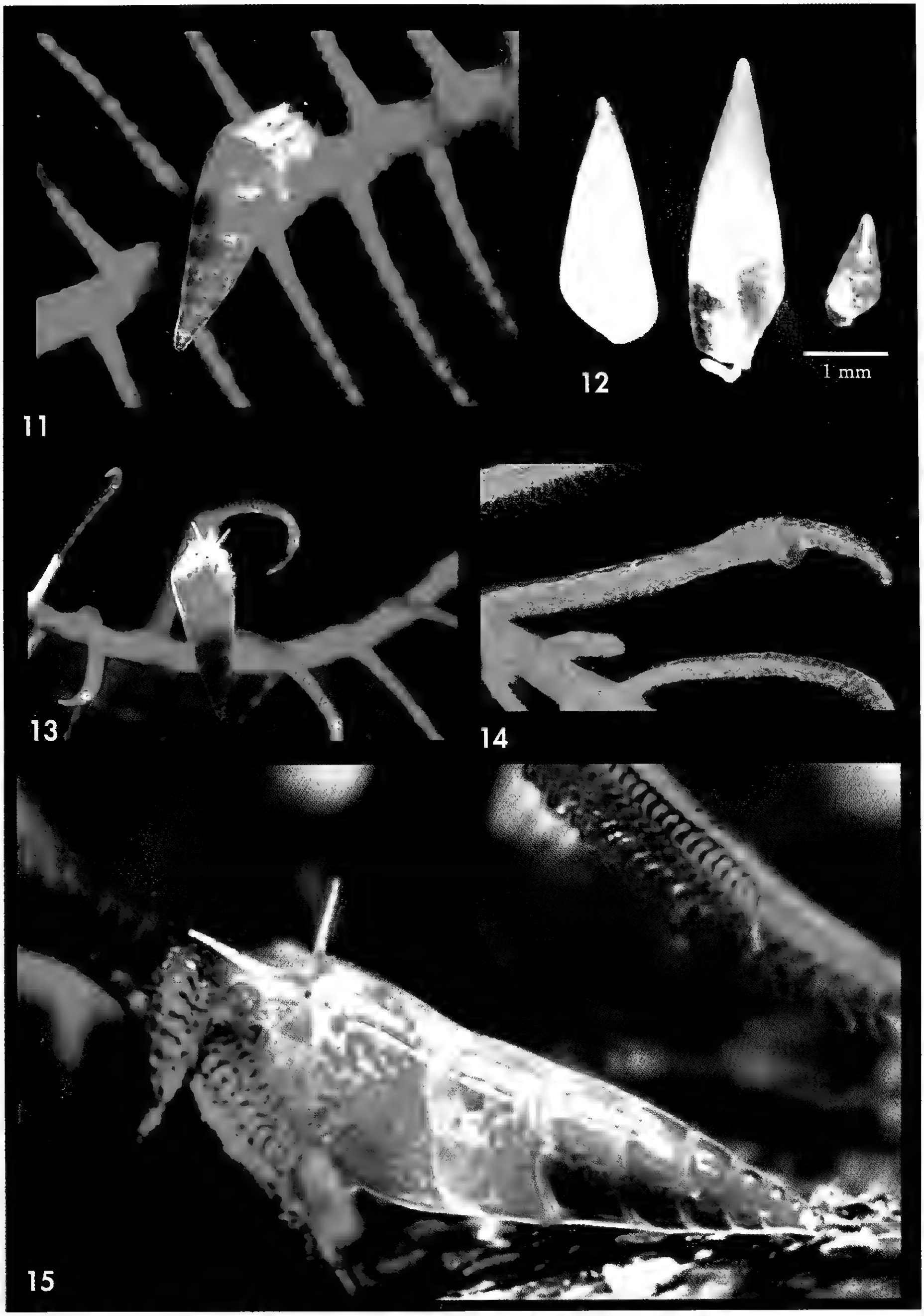
Locality	Nº of crinoids	Nº of *C. dautzenbergi*	% *C. dautzenbergi* parasited	Nº of *C. collinsi*	% *C. collinsi* parasited
1	93	14	15.1	3	3.2
2	36	17	42.2	2	5.5
3	46	36	78.3	5	10.9
4	24	3	12.5	2	8.3
5	19	11	57.9	3	15.8
6	39	23	59.0	1	2.5
7	6	4	66.6	1	16.6
8	1	5	100.0	0	0
9	4	64	100.0	3	75.0
10	8	2	25.0	0	0
11	14	1	7.1	0	0
12	4	1	25.0	0	0
TOTAL	294	181	$\bar{X} = 49.1$	20	$\bar{X} = 6.8$



Figures 4-10. *Curveulima dautzenbergi*. 4: living specimen; 5: several specimens; 6-8: common colour pattern; 9: an specimen adhered to the finial of *Antedon bifida*; 10: another specimen adhered to the central disk of *A. bifida*.
Figuras 4-10. Curveulima dautzenbergi. *4: ejemplar vivo; 5: conchas; 6-8: patrones de coloración; 9: ejemplar fijado a un brazo de* Antedon bifida*; 10: otro ejemplar fijado al disco central de* A. bifida.

cribed this species under the genus *Vitreolina*, due great similarity with others species of this genus. Later, LASERON (1955) erected the genus *Curveulima* to embrace a group of Australian and Antarctic species.

In the book of NORDSIECK AND TALAVERA (1979) on marine molluscs from Madeira and Canary Island, some species of eulimids with curved shell were included, but none fit well with *C. dautzenbergi*. Only the species cited by



Figures 11-15. *Crinophtheiros collinsi.* 11: living specimen; 12: several specimens; 13: common coloration; the proboscis of the parasite is observed adhered to the finial of the crinoid; 14: pinna scar of *Antedon bifida*; 15: an specimen parasiting *A. bifida*.
Figuras 11-15. Crinophtheiros collinsi. *11: ejemplar vivo; 12: conchas; 13: coloraciones; se ve la probóscide del parásito sujeta al brazo del crinoideo; 14: cicatriz en la pinna de* Antedon bifida*; 15: un ejemplar parasitando* A. bifida.

Table III. Number of whorls and mean sizes of 48 specimens of *Curveulima dautzenbergi*.
Table III. Número de vueltas y talla media de 48 especímenes de Curveulima dautzenbergi.

Nº whorls	**Nº of specimens**	**width/ length (mm)**
9	2	4.85 / 1.55
8	15	3.62 / 1.40
7	5	3.11 / 1.18
6	8	2.28 / 0.85
5	9	1.92 / 0.58
4	5	1.38 / 0.49
3	4	1.07 / 0.39
TOTAL	48	$\bar{X}$ = 2.61 / 0.92

these authors as *Eulima* (*vitreolina*) *cf. spiridioni* Dautzenberg and Fischer, 1896, could refer to *C. dautzenbergi,* although they described the shell as white in deep water of Azores, Porto Santo and Tenerife, without any mention to the depth or information concerning soft parts and lifestyle of the animal. The illustrations slightly resemble this species, although the aperture is clearly different.

WARÉN (1984), in his revision of the eulimids genera, included in *Curveulima* some species from Japan and Cuba, pointing out the similarities between *Curveulima* and *Vitreolina*. BOUCHET AND WARÉN (1986), in their revision of bathyal and abyssal eulimids of the northeastern Atlantic, included within the genus *Curveulima* two deep waters species found near the Canary Islands: *C. macrophtalmica* (Warén, 1972), and *C. eschara* described as new.

We record *C. dautzenbergi* for the first time in the Canary Islands, and no other species parasiting *Antedon bifida* has been previously mentioned in this area.

Genus *Crinophtheiros* Bouchet and Warén, 1986

Crinophtheiros collinsi (Sykes, 1903) (Figs. 3, 11-15)

Eulima collinsi Sykes, 1903. Notes on some British Eulimidae. *Proceedings of the Malacological Society of London*, 5: 348-353.

Type locality: Guernsey (British Islands), in 10 fathoms.
Material studied: The material studied in Tenerife Island is detailed in Table I and Figure 1, as well as the infestation rate for each locality (Table II). A total of 20 specimens of this eulimid were found in the 294 specimens of *Antedon bifida* collected. Additional specimens were obtained in samples of *A. bifida* from El Hierro and La Palma islands.

Shell: Shell completely transparent, glossy, thin, very delicate, extremely fragile and perfectly smooth, without any ornamentation or colour (Fig. 11). Teleoconch straight and protoconch generally slightly curved with respect to the shell axis, but some specimens may have a straight shell (Fig. 12). Last whorl very high.

Suture very faint, hardly noticeable under magnifying glass. False suture evident and clear, even if the animal is completely or halfway inside the shell. Faint scars on the surface of the previous position of the outer lip, irregularly arranged since the animal growths more than one whorl each growth period. The study of the shells with SEM confirms the absence of ornamentation or micro-sculpture on the surface of the shell, and only the sutures and growth scars are appreciated (Fig. 3). Some shells present an eroded surface, this may be caused by erosion or chemical attack due to preservative fluids. Teleoconch whorls smooth, those of the protoconch slightly convex and width not constant originating a faint curvature of the larval shell.

Apex round. Protoconch transparent, smooth, without ornamentation or colour. Distinguished from the teloconch by a slight curvature of the shell and by the convex whorls. According to FRETTER AND GRAHAM (1982) the protoconch has four whorls, but in the specimens studied by us only three larval whorls are visible. There is no trace in the protoconch indicating the presence of protoconch II, therefore this species probably lacks planktotrophic larval phase.

Aperture extremely fragile. Only five specimens collected in Tenerife presented the aperture entire. Parasites alive on the host had the aperture broken or broke it when released. It is tall, narrow and slightly rectangular in the central zone. Upper part sharpened. Outer lip thin, not swelled terminally and almost straight in the middle. Base rounded and surpassing the edge of the shell, making it elongated.

Size: The specimens collected in Tenerife presented a range of 3-7 whorls. The dimensions (length/width) of the shells with intact aperture were: 3.56/1.20 mm and 4.06 mm/1.33 mm in two specimens with 7 whorls; 2.91/1.04 mm in one specimen with 6 whorls; and 2.18/0.49 mm and 2.49/0.97 mm in two specimens with 5 whorls.

Soft parts: Perfectly visible by shell transparency. The gonad-visceral zone varies in colour from orange, red, brownish-gray-greenish to clearly greenish. In all cases intense red dots are observed in this area. These dots are clearly defined as small rounded spots with diffuse edges. In the last three whorls of some specimens small yellow spots are observed close each other and forming lines starting at the suture and almost reaching the next one (Fig. 13).

Last whorl with many red dots arranged without an apparent order. The centre of the spots has a more intense colour and the edges much more diffuse. In many specimens these spots are very close and look like an unique crimson red coloured area. Close to the suture the dots are arranged in order, forming wide lines alternating with bright yellow spotted areas.

Upper part of the head yellow. On the sides, red dots are observed from the red spot of the last whorl to the tentacles. Eyes big, black, rounded and very evident, located at the centre of this dotted line. The animal can see by shell transparency either when held to the host or crawling freely on the substratum.

Tentacles long, blunt, divergent, hyaline, with yellow highlights on the surface and red base. Foot whitish, with red dots at the posterior end and middle part, with hyaline margins.

Proboscis whitish, without coloured area, strongly fixed to the host. Once the eulimid is detached from its host a marked scar left (Fig. 14).

Operculum yellowish, paucispiral, very thin and transparent, hence two orange spots on the foot can be observed, one on the apex and another on the base of the aperture. The study of the operculum with SEM shows that it presents faint growth lines in the inner basal zone and the rest is completely smooth.

Radula absent.

Data on life history: *Crinophtheiros collinsi* lives parasite on the crinoid *Antedon bifida* (Fig. 15). It is sporadic parasite, able of releases from the host and crawls over substratum.

All the specimens collected in Tenerife remained adhered to the host during the study. In the laboratory they were only freed after persisten disturbation. This fact, along with the absence of specimens in the scraped stones, washed seaweeds or free in the sediment, presumes that in spite of the ability of freeing themselves from the host, this occurs infrequently in nature.

The insertion zone of the eulimid on the host is variable. Specimens have been found in the arms or finials of the crinoid, but never near the central disk. In all the cases one only specimen of *C.*

collinsi was found on the crinoid, although they frequently had simultaneously one specimen of *C. collinsi* and one or several of *Curveulima dautzenbergi*.

In the samplings conducted in Tenerife a total of 294 crinoids were studied, obtaining 20 specimens of *C. collinsi*. In all the cases there was only one parasite per host, and the infestation rate of *C. collinsi* was 6.8% (Table II).

Distribution: It was known from the northeastern Atlantic.

Remarks: SYKES (1903) described this species as *Eulima collinsi* in British waters, without providing any data regarding soft parts of the animal or lifestyle.

FRETTER (1955) make a detailed description of the anatomy and way of life of an eulimid gastropod (identified as *Balcis devians*) parasite of *Antedon bifida*. According to BOUCHET AND WARÉN (1986) and judging from the figure of FRETTER AND GRAHAM (1962, fig. 139), this species should probably be referred to *C. collinsi*. Subsequently, the same authors (FRETTER AND GRAHAM, 1982) included a complete description of *Vitreolina collinsi* within their serie on the prosobranch molluscs of Britain and Denmark. This description of *V. collinsi* fits well with the specimens found in Tenerife, except for some details regarding colour pattern, although this minor differences could be caused by the fixative process.

BOUCHET AND WARÉN (1986) erected the new genus *Crinophtheiros* to include some species of eulimids parasite of crinoids. Up to date this genus includes *C. comatulicola* (Graff, 1875), parasite of *Antedon mediterranea* (Lamark) and *C. giustii* Gaglini, 1991, probable parasite of *Leptopmetra phalangium* (Müller) (see GAGLINI, 1991), in the Mediterranean, and *C. collinsi*, parasite of *Antedon bifida* and *C. junii*, in the northeastern Atlantic, the last one only known from deep water of the Azores area (J. Templado com. per.).

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BIBLIOGRAPHY

BOUCHET, P. AND WARÉN, A., 1986. Revision of the northeast Atlantic Bathyal and Abyssal Aclididae, Eulimidae, Epitoniidae (Mollusca, Gastropoda). *Bollettino Malacologico, Supplemento 2*. 300-576.

ENGL, W., 1997a. New species of the family Eulimidae from the Canary Islands. Part I: Description of *Sticteulima richteri* n. sp. *La Conchiglia*, 283: 44-47.

ENGL, W., 1997b. New species of the family Eulimidae from the Canary Islands. Part II: Description of *Sticteulima wareni* n. sp. *La Conchiglia*, 285: 43-45.

ENGL, W., 1998. New species of the family Eulimidae from the Canary Islands. Part 3: Description of *Fusceulima boscheineni* n. sp. *La Conchiglia*, 289: 11-14,60.

FRETTER, V., 1955. Observations on *Balcis devians* (Monterosato) and *Balcis alba* (Da Costa). *Proceeding of the Malacological Society of London*, 31: 137-144.

FRETTER, V. AND GRAHAM, A., 1962. *British Prosobranch Molluscs*. Ray Society, London, 755 pp.

FRETTER, V. AND GRAHAM, A., 1982. The prosobranch Mollusc of Britain and Denmark. Part 7- "Heterogastropoda" (Cerithiopsacea, Triforacea, Epitoniacea, Eulimacea). *The Journal of Molluscan Studies, Supplement* 11: 360-435.

GAGLINI, A., 1991. Melanellide del Mediterraneo, III: Il genere *Crinophtheiros, C. comatulicola* Graff, 1875 e *C. giustii* n. sp. *Notiz. CISMA*, 13: 23-29.

LANSERON, C. F., 1955 . Revision of the New South Wales Eulimoid shells. *The Australian Zoologist*, 12, part 2: 83-107

NORDSIECK, F. AND GARCÍA-TALAVERA, F., 1979. *Moluscos marinos de Canarias y Madera (Gastropoda)*. Aula de Cultura de Tenerife, 208 pp.

PALLARY, P., 1900. Coquilles Marines du littoral du département d`Oran. *Journal de Conchyliologie*, 48: 211-422.

RODRÍGUEZ, M., 2000. Description of a new Eulimid (Mollusca: Gastropoda) off the Canary Islands. *Melanella lutea* n. sp. *La Conchiglia*, 294-295: 82- 86.

RODRÍGUEZ, M., BARQUÍN, J. AND PÉREZ-DIONIS, G., 2001. Eulimid gastropods (Caenogastropoda: Eulimidae) of the Canary Islands. Part I. Species parasiting sea urchins. *Iberus*, 19 (1): 7-24.

SYKES, E. R., 1903. Notes on some British Eulimidae. *Proceedings of the Malacological Society of London*, 5:348-353.

WARÉN, A., 1984. A generic revision of the Family Eulimidae. *The Journal of Molluscan Studies*, supplement 13: 96 pp.

Updated and annotated checklist of the opisthobranch molluscs (excluding Thecosomata and Gymnosomata) from the Azores archipelago (North Atlantic Ocean, Portugal)[1]

Lista comentada y actualizada de los moluscos opistobranquios (excepto los Thecosomata y Gymnosomata) del archipiélago de las Azores (Océano Atlántico Norte, Portugal)[1]

Manuel António Encarnação MALAQUIAS*

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ABSTRACT

The literature available on the opisthobranch molluscs of the Azores archipelago is reviewed in this study. A critical discussion is done on some of the most recent papers concerning this subject. A summary of the opisthobranch species from the Azores is presented. The opisthobranch fauna (excluding the planctonic Thecosomata and Gymnosomata) comprises 107 identified species distributed among six orders, Cephalaspidea *s.l.*: 50, Anaspidea: 5, Tylodinoidea: 2, Pleurobranchoidea: 6, Sacoglossa: 4 and Nudibranchia: 40.

RESUMEN

En el presente trabajo se ha hecho una revisión de la literatura existente sobre los moluscos opistobranquios del archipiélago de las Azores.Son discutidos los trabajos más recientes en relación con esta materia. Se incluye una sinopsis de las especies de opistobranquios de las Islas Azores . La fauna identificada (excluyendo las especies de los grupos plantónicos Thecosomata y Gymnosomata) comprende 107 especies que se distribuyen en seis órdenes, Cephalaspidea *s.l.*: 50, Anaspidea: 5, Tylodinoidea: 2, Pleurobranchoidea: 6, Sacoglossa: 4 and Nudibranchia: 40.

KEY WORDS: Mollusca, Opisthobranchia, Azores, Atlantic Ocean, Portugal
PALABRAS CLAVE: Mollusca, Opisthobranchia, Azores, Océano Atlántico, Portugal

INTRODUCTION

The first works concerning the Azorean opisthobranch molluscs are those by DROUËT (1858), WATSON (1883; 1886), SIMROTH (1888), DAUTZENBERG (1889), RUSH (1891), BERGH (1892), PILSBRY (1895), VAYSSIÈRE (1896), DAUTZENBERG AND FISCHER (1896), LOCARD (1897) and BERGH (1899), based particularly on material collected during some scientific expeditions carried out during the last century, 'Challenger', 'Princesse Alice', 'L'Hirondelle' and 'Talisman'.

[1] Contribution of the Instituto Português de Malacologia

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Besides the description of new species, based on specimens captured in Azores, those studies given an important contribution to testacean opisthobranch taxonomy (Cephalaspidea *s.l.*) as well as to that of non-testacean forms of the orders Pleurobranchoidea and Nudibranchia from the archipelago.

During the twentieth century, especially in the second half, many works have contributed considerably to the knowledge of opisthobranch molluscs from Azores (Sykes, 1904; Nobre, 1924; Odhner, 1931; Eales, 1957, 1960; Marcus, 1967, 1970; Nordsieck, 1972; Bouchet, 1975; 1977; Nordsieck and García-Talavera, 1979; García-Talavera, 1983; Gosliner, 1990; 1994; Azevedo and Gofas, 1990; Azevedo, 1991; Menezes, 1991; Wirtz, 1992; 1995; 1999; Wirtz and Martins, 1993; Linden, 1994; 1995; Ortea, Valdés and Espinosa, 1994; Picton and Morrow, 1994; Jensen, 1995; Moro, Ortea, Bacallado, Valdés and Pérez-Sánchez, 1995; Ortea, Valdés and García-Gómez, 1996a; Ortea, Bacallado, Pérez-Sánchez and Vallès, 1996b; Valdés and Ortea, 1996; Valdés, Ortea, Ávila and Ballesteros, 1996; Ávila and Azevedo, 1996; 1997; Ávila, Azevedo, Gonçalves, Fontes and Cardigos, 1998; Morton, Britton and Martins, 1998; Ortea and Moro, 1999 and Ávila, 2000).

Very recently, the opisthobranch molluscs of the Azores were the goal of Mikkelsen (1995) and Wirtz (1998). Mikkelsen (1995) given the account of cephalaspidean species of the archipelago and reported the occurrence of forty-six species. This author described shells and provided anatomical details for several species, possible synonymies and misidentifications, and also discussed zoogeographical affinities. Wirtz (1998) presented an updated summary of the opisthobranch gastropods (except the Cephalaspidea *s.l.*), with a record of sixteen new species.

The detailed analysis of these recent contributions shows that several species previously recorded from the Azores were not considered in Mikkelsen (1995) and Wirtz (1998). The list of opisthobranch molluscs occurring in the Azores archipelago is completed in the present study by means of a comprehensive literature review.

RESULTS

Based on the analysis of the known literature, it can be noted that two species, *Philine rugulosa* Dautzenberg and Fischer, 1896 and *Philine intricata* Monterosato, 1884 were excluded from Mikkelsen's inventory of the azorean cephalaspids and twenty-two species previously mentioned for the coasts of the Azores islands, were not included in Wirtz (1998): four Pleurobranchoidea, one Sacoglossa and seventeen Nudibranchia (see species with an asterisk in the appendix). Four species previously mentioned, were referred to by Wirtz as first references for the archipelago. A complete taxonomic list of the opisthobranch species from the Azores is presented in an appendix.

DISCUSSION

Previous studies (Bergh, 1892, 1899; Bouchet, 1977; Azevedo and Gofas, 1990; Azevedo, 1991; Linden, 1994; Ortea *et al.* 1996a; Valdés and Ortea, 1996; Ávila and Azevedo, 1997 and Morton *et al.* 1998), mentioned opisthobranch species for the Azores not included in Wirtz (1998) account. Even one genus (*Thorybopus*) and five species (*P. morosus*, *K. atlanticus*, *H. goslineri*, *P. stomascuta*, and *T. lophatus*) for which the Azores is the type-locality were not considered.

On the the contrary Wirtz (1998) claimed first records of species already mentioned in the literature. This was the case of *Fionna pinnata*, cited by Bergh (1892: 6) as *Fiona marina*, *Geitodoris planata*, recorded by Azevedo and Gofas (1990: 86), *Flabellina pedata*, cited by Gosliner (1994) and *Marionia blainvillea*, recorded by the author himself (Wirtz, 1995: 182).

Among the species of opisthobranchs recorded from the Azores, eight have not been identified at species level. GOSLINER (1990) mentioned the occurrence of *Runcina* sp. noting that, with the exception of the body coloration, the specimens are anatomically similar to the species *R. coronata,* which leads the author to the hypothesis that the studied specimens may be conspecific with this species. However, given the present lack of a revision of this group showing the intra-specific and inter-specific variation among different geographic regions, the author decided not to attribute the specimens to any particular species. Although the anterior situation has not yet been altered, ORTEA AND MORO (1999) describe the species *Runcina hidalgoensis* based on specimens which were collected in the Canaries and Azores, similar to those studied by GOSLINER (1990).

BOUCHET (1977) refered to an undetermined species of the genus *Platydoris* externally similar to *Platydoris stomascuta,* but with marked differences in the digestive and genital organs and also to other two specimens of the family Dorididae. After the anatomical study of these two dorids, the author concludes that identification is difficult considering the fact that these are the only specimens, collected at great depth (more than 1000 m) and that the external morphological characteristics may have suffered damage along the sampling procedures (BOUCHET 1977: 42-43 and 46-48).

WIRTZ (1998) based solely on the external morphology, distinguished four undetermined species from the Azores (one sacoglossan and three nudibranchs). However, the assumption that specimens with small external morphological differences belong to different species can lead to misconsiderations, once the biological species concept admits the existence of intra-specific variability. E.g. specimens of the genus *Tambja* were regarded as two different species: *Tambja* sp. (WIRTZ 1998: pl. 5, fig.6, p. 14) and *Tambja ceutae* (WIRTZ 1998: pl. 5, fig.5, pag.14). Despite the chromatic differences between specimens observed by WIRTZ (1998) a more detailed study of the morphology and coloration of the mantle tubercles and radula (Cervera and Malaquias, unpublished data), revealed the existence of two distinct chromatic forms for *Tambja ceutae* and not two different species as suggested by Wirtz.

The opisthobranch molluscs of the Azores (excluding the planctonic Thecosomata and Gymnosomata) comprise a total of 107 identified species distributed as follows: Cephalaspidea *s.l.*: 50, Anaspidea: 5, Tylodinoidea: 2, Pleurobranchoidea: 6, Sacoglossa: 4 and Nudibranchia: 40.

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BIBLIOGRAPHY

ÁVILA, S. P., 2000. Shallow-water marine molluscs of the Azores: biogeographical relationships. *Arquipélago. Life and Marine Sciences,* Supplement 2 (1): 99-130.

ÁVILA, S. AND AZEVEDO, J. M. N., 1996. Cheklist of the marine molluscs of the littoral of Pico Island (Azores, Portugal). *Libro de Résumenes XI Congresso Nacional de Malacología. Sociedad Española de Malacología*: 106-107.

ÁVILA, S. AND AZEVEDO, J. M. N., 1997. Shallow-water molluscs from the Formigas Islets. Azores, collected during the "Santa Maria e Formigas 1990" Scientific Expedition. *Açoreana,* 8 (3): 323-330.

ÁVILA, S., AZEVEDO, J. M. N., GONÇALVES, J. M., FONTES, J. AND CARDIGOS, F., 1998. Checklist of the shallow-water marine molluscs of the Azores: 1 – Pico, Faial, Flores and Corvo. *Açoreana,* 8 (4): 487-523.

AZEVEDO, J. M. N., 1991. Moluscos litorais da ilha de Santa Maria. Santa Maria e Formigas / 1990. *Relatórios e Comunicações Científicas do Departamento de Biologia*, 19: 43-46.

AZEVEDO, J. M. N. AND GOFAS, S., 1990. Moluscos marinhos litorais da ilha das Flores. Expedição Científica Flores / 89 (relatório preliminar). *Relatórios e Comunicações Científicas do Departamento de Biologia*, 18: 83-87.

BERGH, L. S. R., 1892. Opisthobranches provenant des campagnes du yacht l'Hirondelle. *Résultats des Campagnes Scientifiques accomplies sur son Yacht par Albert Ier Prince souverian de Monaco*. Fascicule IV: 1-35.

BERGH, L. S. R., 1899. Nudibranchs et Marsenia provenant des campagnes de la «Princesse Alice» (1891-1897). *Résultats des Campagnes Scientifiques accomplies sur son yacht par Albert Ier prince souveriain de Monaco*, Fascicule XIV: 1-45p.

BOUCHET, P., 1975. Opisthobranches de profondeur de l'océan Atlantique. I – Cephalaspidea. *Cahiers de Biologie Marine*, 16: 317-365.

BOUCHET, P., 1977. Opisthobranches de profondeur de l'océan Atlantique: II – Notaspidea et Nudibranchiata. *Journal of Molluscan Studies*, 43: 28-66.

CERVERA, J. L., GARCÍA-GÓMEZ, J. C. AND GARCÍA, F. J., 1991. The genus *Runcina* Forbes and Hanley, 1851 (Opisthobranchia: Cephalaspidea) in the Strait of Gibraltar, with the description of a new species from the Bay of Algeciras. *Journal of Molluscan Studies*, 57: 199-208.

DAUTZENBERG, P., 1889. Révision des mollusques marins des Açores. Contribution à la faune malacologique des Iles Açores. Résultats des dragages effectués par le yacht l'Hirondelle pendant sa campaigne scientifique de 1887. *Résultats des campagnes scientifiques, accomplies sur son yacht par Albert 1er Prince Souverain de Monaco*, I: 1-112, pls. I-IV.

DAUTZENBERG, P. AND FISCHER, H., 1896. Campagnes scientifiques de S. A. le Prince Albert Ier de Monaco. Dragages effectués par l'Hirondelle et par la Princesse-Alice, 1888-1895. *Mémoires de la Société Zoologique de France*, IX: 395-498, Pls. XV-XXII.

DAUTZENBERG, P. AND FISCHER, H., 1897. Campagnes scientifiques de S. A. le Prince Albert Ier de Monaco. Dragages effectués par l'Hirondelle et par la Princesse-Alice, 1888-1896. *Mémoires de la Société Zoologique de France*, X: 139-234, Pls. III-VII.

DROUËT, H., 1858. Molusques marins des îles Açores. *Mémoires de la Société d'Agriculture du Départment de l'Aube*, 22: 1-53.

EALES, N. B., 1957. Revision of the species of *Aplysia* of the Muséum National d'Histoire Naturelle (Malacologie), Paris. *Bulletin du Muséum*, 2ªsérie, t. XXIX, nº3: 246-255.

EALES, N. B., 1960. Revision of the world species of Aplysia (Gastropoda: Opisthobranchia). *Bulletin of the British Museum* (Natural History) (Zoology), 5 (10): 267-404.

GARCÍA-TALAVERA, C. F., 1983 (1981). *Los moluscos gasteropodos anfiatlanticos (estudio paleo y biogeografico de las especies bentonicas litorales)*. Universidad de la Laguna, Secretariado Publicaciones, Coleccion Monograficas, No.10, 352p.

GOSLINER, T. M., 1990. Opisthobranch mollusks from the Azores Islands. I. Runcinidae and Chromodorididae. *Açoreana*, Suplemento 1990: 135-166.

GOSLINER, T. M., 1994. New records of Flabellinidae (Opisthobranchia: Aeolidacea) from the Tropical Americas, with descriptions of two new species. *Proceedings of the California Academy of Sciences*, 48 (9): 171-183.

JENSEN, K. R., 1995. Anatomy and Biology of *Aplysiopsis formosa* Pruvot-Fol (Mollusca, Opisthobranchia, Sacoglossa) from the Azores. *Açoreana*, Suplemento 1995: 217-230.

LINDEN, J. VAN DER, 1994. *Philine intricata* Monterosato, 1884, an overlooked species from the North-East Atlantic and the Mediterranean Sea (Gastropoda, Opisthobranchia, Philinidae). *Basteria*, 58: 41-48.

LINDEN, J. VAN DER, 1995. Philinidae dredged by the CANCAP expeditions (Gastropoda, Opisthobranchia). *Basteria*, 59: 65-83.

LOCARD, A., 1897. *Expéditions scientifiques du «Travailleur» et du «Talisman», pendant les années 1880, 1881, 1882, 1883. Molusques testacés*. Masson et Cie, Paris, 512pp.

MARCUS, E. D. B.-R., 1967. Opisthobranchs from the southwestern Caribbean Sea. *Bulletin of Marine Science*, 17 (3): 597-628.

MARCUS, E. D. B.-R., 1970. Opisthobranchs from northern Brazil. *Bulletin of Marine Science*, 20 (4): 922-951.

MENEZES, G., 1991. *Umbraculum mediterraneum* (Lamarck, 1819) (Mollusca: Opisthobranchia: Umbraculomorpha), a new record for the littoral fauna of the Azores. *Arquipélago. Life and Marine Sciences*, 9: 101-102.

MILLEN, S.V. AND GOSLINER, T. M., 1985. Four new species of dorid nudibranchs belonging to the genus *Aldisa* (Mollusca, Opisthobranchia), with a revision of the genus. *Zoological Journal of the Linnean Society*, 84 (3): 195-233.

MIKKELSEN, P. M., 1995. Cephalaspid opisthobranchs of the Azores. *Açoreana*, Suplemento 1995: 193-215.

MORO, L., ORTEA, J., BACALLADO, J., VALDÉS, A. AND PÉREZ-SÁNCHEZ, J. M., 1995. Nuevos aeolidaceos (Gastropoda, Nudibranchia) para la fauna de Canarias. *Revista de la Academia Canaria de Ciencias*, 7 (2, 3 y 4): 63-75.

MORTON, B., BRITTON, J. C. AND MARTINS, A. M. F., 1998. *Ecologia Costeira dos Açores*, Sociedade Afonso Chaves, Associação de Estudos Açoreanos, 249pp.

NOBRE, A., 1924. Contribuições para a fauna dos Açores. *Annais do Instituto de Zoologia*, Universidade do Porto, 1: 41-90.

NORDSIECK, F., 1972. *Die europäischen Meeresschnecken (Opisthobranchia mit Pyramidellidae; Rissoacea) vom Eismeer bis Kapverden, Mittelmeer und Schwarzes Meer*, Gustav Fischer Verlag, Suttgart, 327pp.

NORDSIECK, F. AND GARCÍA-TALAVERA, F., 1979. *Moluscos marinos de Canarias y Madera (Gastropoda)*, Aula de Cultura de Tenerife, 208pp, 46pls.

ODHNER, N. H., 1931. Beiträge zur Malakozoologie der Kanarischen Inseln Lamelibranchen, Cephalopoden, Gastropoden. *Arkiv för Zoologi*, Stockholm, 23A: 1-116.

ORTEA, J., VALDÉS, Á. AND ESPINOSA, J., 1994. North Atlantic nudibranchs of the *Chromodoris clenchi* colour group (Opisthobranchia: Chromodorididae). *Journal of Molluscan Studies*, 60: 237-248.

ORTEA, J., VALDÉS, A. AND GARCÍA-GÓMEZ, J. C., 1996a. Review of the Atlantic species of the family Chromodorididae (Mollusca: Nudibranchia) of the blue chromatic group. *Avicennia*, Suplemento 1: 1-165.

ORTEA, J., MORO, L., BACALLADO, J. J., PÉREZ-SÁNCHEZ, J. M. AND VALLÈS, Y., 1996b. Nuevos datos sobre la fauna de dóridos fanerobranquios (Gastropoda, Nudibranchia) de las Islas Canarias. *Revista de la Academia Canaria de Ciencias*, 8 (2, 3 y 4): 125-138.

ORTEA, J., MORO, L., BACALLADO, J. J. AND ESPINOSA, J., 1998. Catálogo abreviado de las especies del orden Sacoglossa (=Ascoglossa, Mollusca: Opisthobranchia) de las islas Canarias y de Cabo Verde. *Revista de la Academia Canaria de las Ciencias*, 10 (número 4): 85-96.

ORTEA, J. AND MORO, L., 1999. Estudio de las especies del género *Runcina* Forbes y Hanley, 1853 (Opisthobranchia: Cephalaspidea) de coloración rojiza (grupo "ferruginea) en la Macaronesia, con la descripción de tres especies nuevas. *Revista de la Academia Canaria de las Ciencias*, 11 (Núms. 3-4): 63-74.

PICTON, B. E. AND MORROW, C. C., 1994. *A field guide to the nudibranchs of the British Isles*. Immel Publishing Limited, London, 143p

PILSBRY, H. A., 1895. Polyplacophora. Acanthochitonidae, Cryptoplacidae and appendix. Tectibranchiata. *Manual of Conchology* (1), 15 (60): 181-436.

RUSH, W. H., 1891. List of shells collected on Fayal Islands, Azores; and on Madeira Islands; with prefatory notes. *The Nautilus*, 5 (5): 49-52.

SIMROTH, H., 1888. Zur Kenntnis der Azorenfauna. *Arch. für Naturg.* Berlim, 54 (1): 179-234.

SYKES, E. R., 1904. Mollusca of the 'Porcupine' expeditions, 1869-70. Part I. *Proceedings of the Malacological Society of London*, 6 (1): 23-40.

VALDÉS, A. AND ORTEA, J., 1996. Review of the family Phyllidiidae in the Atlantic Ocean (Nudibranchia, Doridoidea). *American Malacological Bulletin*, 13 (1/2): 1-9.

VALDÉS, A., ORTEA, J., ÁVILA, C. AND BALLESTEROS, M., 1996. Review of the genus *Dendrodoris* Ehrenberg, 1831 (Gastropoda: Nudibranchia) in the Atlantic Ocean. *Journal of Molluscan Studies*, 62: 1-31

VAYSSIÈRE, A., 1896. Description des coquilles des quelques espèces nouvelles ou peu connues de Pleurobranchides. *Jornal de Conchyliologie*, 44: 113-137.

VAYSSIÈRE, A., 1902. Opistobranches, in *Expéditions scientifiques du «Travailleur» et du «Talisman», pendant les années 1880, 1881, 1882, 1883*. Masson et Cie Editeeurs, Paris, 221-270, Pls. IX-XI.

WATSON, R. B., 1883. Mollusca of H. M. S. Challenger, Pt. XIX. *Journal of the Linnean Society of London, Zoology*, 17 (101): 319-340; 17 (20): 341-346.

WATSON, R. B., 1886. Report on the Scaphopoda and Gasteropoda collected by H.M.S. Callenger during the years 1873-1876. *Report on the Scientific Results of the Voyage of H. M. S. Challenger during the years 1873-76*. Zoology. 17 (II), i-v+1-756, Pls. I-LIII.

WIRTZ, P., 1992. Pleurobranchier von der Azoren. *Die Aquarien und Terrarien Zeitschrift* (DATS), 1992 (1): 45-46.

WIRTZ, P., 1994. Three shrimps, five nudibranchs, and two tunicates new for the marine fauna of Madeira. *Boletim do Museu Municipal do Funchal*, 46 (257): 167-172.

WIRTZ, P., 1995. *Unterwasserführer Madeira Kanaren / Azoren, Niedere Tiere*, Delius Klasing, Edition Naglschmid, 247pp.

WIRTZ, P., 1998. Opisthobranch molluscs from the Azores. *Vita Marina*, 45 (1-2): 1-16.

WIRTZ, P., 1999. *Hydatina physis* (Mollusca: Gastropoda: Opisthobranchia) from the Azores. *Arquipélago*. Life and Marine Sciences, 17A: 97-99.

WIRTZ, P. AND MARTINS, H., 1993. Notes on some rare and little known marine invertebrates from the Azores, with a discussion on the zoogeography of the area. *Arquipélago*, Life and Marine Science, 11A, 55-63.

Appendix – Synopsis of the opisthobranch molluscs from the Azores
Apéndice – Sinopsis de los moluscos opistobranquios de las Azores

Order CEPHALASPIDEA *s.l.* Fischer, 1883

Family Ringiculidae Meeck, 1862

Ringicula blanchardi Dautzenberg and Fischer, 1896

DAUTZENBERG AND FISCHER (1896, 1897), MIKKELSEN (1995).

Ringicula semistriata Orbigny, 1853

NORDSIECK (1972), MIKKELSEN (1995).

Family Acteonidae D'Orbigny, 1835

Acteon incisus Dall, 1881

DAUTZENBERG AND FISHER (1896), MIKKELSEN (1995).

Acteon monterosatoi Dautzenberg, 1889

DAUTZENBERG (1889), DAUTZENBERG AND FISHER (1896, 1897), NORDSIECK [1972 as *Acteon* (*Metacteon*)], MIKKELSEN (1995).

Acteonina amabilis (Watson, 1883)

WATSON (1883, 1886 in both works as *Acteon*), DAUTZENBERG (1889 as *Acteon*), DAUTZENBERG AND FISHER (1897 as *Acteon*), NORDSIECK [1972 as *Callostracon* (*Ovacteonina*)], MIKKELSEN (1995).

Acteonina chariis (Watson, 1883)

WATSON (1883, 1886 in both works as *Acteon*), DAUTZENBERG (1889 as *Acteon*), DAUTZENBERG AND FISHER (1897 as *Acteon* (*Acteonina*)), NORDSIECK [1972 as *Callostracon* (*Ovacteonina*)], MIKKElsen (1995).

Crenilabium exilis (Jeffreys, 1870)

DAUTZENBERG (1889 as *Acteon*), DAUTZENBERG AND FISHER (1896, 1897 in both works as *Acteon* (*Lisacteon*)), WATSON (1886 as *Acteon*), NORDSIECK (1972 as *Crenilabrum*), MIKKELSEN (1995).

Inopinodon azoricus (Locard, 1897)

LOCARD (1897), BOUCHET (1975), MIKKELSEN (1995).

?*Japonacteon pusillus* (Forbes, 1843)

BOUCHET (1975), MIKKELSEN (1995).

Liocarenus ?globulinus (Forbes, 1843)

WATSON (1886 as *Acteon*). The identification made by Watson was based on a shell fragment collected at 1828 m, DAUTZENBERG (1889 as *Acteon*), NORDSIECK (1972), MIKKELSEN (1995).

Mysouffa turritus (Watson, 1886)

BOUCHET (1975), DAUTZENBERG AND FISHER (1896 as *Acteon grimaldii*), MIKKELSEN (1995).

Ovulactaeon meeki Dall, 1889

NORDSIECK (1972), MIKKELSEN (1995).

Family Hydatinidae Pilsbry, 1893

Hydatina physis (Gmelin, 1794)

WIRTZ (1999)

Micromelo undatus (Bruguière, 1792)

NORDSIECK (1972), GARCÍA-TALAVERA (1983), MIKKELSEN (1995).

Family Diaphanidae Odhner, 1914

Diaphana seguenzae (Watson, 1886)

WATSON (1886), DAUTZENBERG (1889 as *Amphisphyra*), NORDSIECK (1972 as *Toledonia seguenzae*), MIKKELSEN (1995).

Family Retusidae Thiele, 1926

Pyrunculus ovatus (Jeffreys, 1870)

BOUCHET (1975), MIKKELSEN (1995).

Relichna simplex (Locard, 1897)
BOUCHET (1975), MIKKELSEN (1995).
Retusa leuca (Watson, 1883)
WATSON (1883, 1886 in both works as *Utriculus leucus*), DAUTZENBERG (1889 as *Tornatina*), NORDSIECK (1972), MIKKELSEN (1995).
Retusa truncatula (Bruguière, 1792)
DAUTZENBERG (1889 as *Tornatina truncatula* and also as *Tornatina mariei* n.sp.), NORDSIECK [1972 as *Retusa (Coleophysis) mariei*], NORDSIECK AND GARCÍA-TALAVERA (1979 as *Retusa mariae*), MIKKELSEN (1995), MORTON *ET AL.* (1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).
Retusa multiquadrata Oberling, 1970
MIKKELSEN (1995), MORTON *ET AL.* (1998), ÁVILA *ET AL.* (1998).
Cylichnina umbilicata (Montagu, 1803)
ÁVILA AND AZEVEDO (1996), ÁVILA *ET AL.* (1998,), ÁVILA (2000).

Family Cylichnidae Rudman, 1978

Acteocina protracta (Dautzenberg, 1889)
DAUTZENBERG (1889 as *Tornatina*), DAUTZENBERG AND FISCHER (1896, 1897 both works as *Tornatina*), MIKKELSEN (1995).
"Bulla" semilaevis Seguenza, 1879
WATSON (1886 as *Bulla*), DAUTZENBERG (1889 as *Bulla guernei* and also as *Bulla semilaevis*), DAUTZENBERG AND FISCHER (1896, 1897 both works as *Bulla guernei*), NORDSIECK [1972 as *Bulla (Leucophysena)*], MIKKELSEN (1995).
Cylichna alba (Brown, 1827)
WATSON (1886), SYKES (1904), NORDSIECK (1972), MIKKELSEN (1995), ÁVILA *ET AL.* (1998).
Cylichna chevreuxi Dautenberg, 1889
DAUTZENBERG (1889), DAUTZENBERG AND FISCHER (1896, 1897), NORDSIECK (1972), MIKKELSEN (1995).
Cylichna cylindracea (Pennant, 1777)
PILSBRY (1895), SYKES (1904), NORDSIECK (1972), MIKKELSEN (1995), ÁVILA *ET AL.* (1998), ÁVILA (2000).
Cylichna oliviformis (Watson, 1883)
WATSON (1883, 1886 in both works as *Utriculus*), DAUTZENBERG (1889 as *Tornatina*), DAUTZENBERG AND FISCHER (1896, 1897 in both works as *Utriculus*), NORDSIECK (1972 as *Cylichnium*), MIKKELSEN (1995).
Cylichna ovata Jeffreys, 1871
WATSON (1886), DAUTZENBERG (1889), DAUTZENBERG AND FISCHER (1896, 1897), LOCARD (1897), MIKKELSEN (1995).
Cylichna piettei Dautzenberg and Fisher, 1896
DAUTZENBERG AND FISCHER (1896, 1897), MIKKELSEN (1995).
Mamillocylichna richardi Dautzenberg, 1889
DAUTZENBERG (1889 as *Cylichna richardi*), DAUTZENBERG AND FISCHER (1897 as *Cylichna*), NORDSIECK (1972), MIKKELSEN (1995).
Meloscaphander imperceptus Bouchet, 1975
BOUCHET (1975), MIKKELSEN (1995).
Roxania monterosatoi Dautzenberg and Fischer, 1896
DAUTZENBERG AND FISCHER (1896, 1897), MIKKELSEN (1995).
Scaphander gracilis Watson, 1883
WATSON (1883, 1886), DAUTZENBERG (1889), DAUTZENBERG AND FISCHER (1896, 1897), LOCARD (1897), NORDSIECK (1972), BOUCHET (1975), MIKKELSEN (1995).

Scaphander nobilis Verrill, 1884
BOUCHET (1975), MIKKELSEN (1995).
Scaphander punctostriatus (Mighels, 1841)
WATSON (1886), DAUTZENBERG (1889), DAUTZENBERG AND FISCHER (1896, 1897), LOCARD (1897), NORDSIECK (1972), BOUCHET (1975), MIKKELSEN (1995).

Family Philinidae Gray, 1850
Philine approximans Dautzenberg and Fischer, 1896
DAUTZENBERG AND FISCHER (1896, 1897), BOUCHET (1975), MIKKELSEN (1995).
Philine azorica Bouchet, 1975
BOUCHET (1975), MIKKELSEN (1995).
Philine ?lima Brown, 1827
DAUTZENBERG (1889), NORDSIECK (1972), MIKKELSEN (1995).
Philine monilifera Bouchet, 1975
BOUCHET (1975), MIKKELSEN (1995), LINDEN (1995 as *P.* cf. *monilifera*).
Philine quadrata (S. Wood, 1839)
WATSON (1886), DAUTZENBERG (1889), NORDSIECK [1972 as *Laona* (*Ossiania*)], MIKKELSEN (1995); LINDEN (1995), ÁVILA *ET AL.* (1998), ÁVILA (2000).
Philine rugulosa Dautzenberg and Fischer, 1896
DAUTZENBERG AND FISCHER (1896).
Philine intricata Monterosato, 1884
LINDEN (1994; 1995).
Philine calva Linden, 1995
LINDEN (1995)
Philine condensa Linden, 1995
LINDEN (1995)

Family Runcinidae H. and Adams, 1854
Runcina adriatica Thompson, 1980
GOSLINER (1990), MIKKELSEN (1995), ÁVILA (2000).
Runcina coronata (Quatrefages, 1844)
GOSLINER (1990), MIKKELSEN (1995), ÁVILA (2000). All this authors refer to this species as *R. aurata* García, Lopez, Luque and Cervera, 1986 that is a junior synonym of *R. coronata*. For a discussion of this subject see CERVERA *ET AL.* (1991: 200-201).
Runcina hidalgoensis Ortea and Moro, 1999
GOSLINER (1990), MIKKELSEN (1995), ÁVILA (2000) all this authors as *Runcina* sp.. ORTEA AND MORO (1999: 67), São Miguel, Azores.

Family Bullidae Lamarck, 1801
Bulla pinguicula Watson, 1886
WATSON (1886), DAUTZENBERG (1889), NORDSIECK (1972 as *Roxania*), MIKKELSEN (1995).
Bulla striata Bruguière, 1792
DROUËT (1858), DAUTZENBERG (1889), RUSH (1891), NORDSIECK (1972), GARCÍA-TALAVERA (1983), MIKKELSEN (1995), ÁVILA *ET AL.* (1998), ÁVILA (2000).

Family Haminoeidae Pilsbry, 1895
Atys macandrewii E. A. Smith, 1872
MARCUS (1970), NORDSIECK [1972 as *Atys* (*Limulatys*)], GARCÍA-TALAVERA (1983), MIKKELSEN (1995), ÁVILA (2000).
Haminoea hydatis (Linné, 1758)
GARCÍA-TALAVERA (1983), MIKKELSEN (1995), ÁVILA *ET AL.* (1998 as *H.* cf *hydatis*), ÁVILA (2000).

Haminoea orteai Talavera, Murillo and Templado, 1987
MIKKELSEN (1995), MORTON *ET AL.* (1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).
Order ANASPIDEA Fischer, 1883
Family Akeridae Pilsbry, 1893
Akera bullata Müller, 1776
NOBRE (1924), ÁVILA (2000).
Family Aplysiidae, Lamarck, 1809
Aplysia parvula Guilding in Mörch, 1863
EALES (1960), WIRTZ (1998), ÁVILA *ET AL.* (1998).
Aplysia depilans Gmelin, 1791
AZEVEDO AND GOFAS (1990 as *Aplysia* sp), WIRTZ (1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).
Aplysia fasciata Poiret, 1789
WIRTZ AND MARTINS (1993), ÁVILA AND AZEVEDO (1997), WIRTZ (1998), ÁVILA (2000).
Aplysia punctata Cuvier, 1803
SIMROTH (1888), ÁVILA AND AZEVEDO (1997), WIRTZ (1998), MORTON *ET AL.* (1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).
Order TYLODINOIDEA Gray, 1847
Family Tylodinidae Gray, 1847
Tylodina perversa (Gmelin, 1791)
DAUTZENBERG (1889 as *Tylodina citrina*), WIRTZ (1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).
Family Umbraculidae Dall, 1889
Umbraculum umbraculum (Lightfoot, 1876)
MENEZES (1991), ÁVILA *ET AL.* (1998), ÁVILA (2000).
Order PLEUROBRANCHOIDEA Férussac, 1822
Family Pleurobranchidae Férussac, 1822
Pleurobranchus testudinarius Cantraine, 1836
WIRTZ AND MARTINS (1993), WIRTZ (1992, 1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).
**Pleurobranchaea morosa* (Bergh, 1892)
BERGH (1892: 28 as *Pleurobranchillus morosus*). Type-locality channel Pico-Faial, 130 m depth.
**Pleurobranchaea meckelli* Blainville, 1825
BERGH (1899: 26). Near Terceira island, 599m depth.
**Berthella plumula* (Montagu, 1803)
BERGH (1892: 19, 1899: 27 as *Pleurobranchus plumula*). Channel Pico-Faial, 130 m depth.
**Berthella aurantiaca* (Risso, 1818)
BERGH (1892: 26 as *Pleurobranchus aurantiacus*). Channel Pico-Faial, 130 m depth.
Berthellina edwardsi (Vayssière, 1896)
VAYSSIÈRE (1896: 1902), AZEVEDO AND GOFAS (1990 AS *BERTHELLINA* SP.), WIRTZ (1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).
Order SACOGLOSSA Ihering, 1876
Family Plakobranchidae Gray, 1840
Elysia ornata (Swainson, 1840)
WIRTZ (1995, 1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).
**Elysia viridis* (Montagu, 1804)
AZEVEDO (1991: 27), ÁVILA (2000). Santa Maria island.

Family Hermaeidae H. and A. Adams, 1854

Aplysiopsis formosa Pruvot-Fol, 1953

JENSEN (1995), WIRTZ (1998); ORTEA, *ET AL.* (1998), ÁVILA (2000).

Family Limapontiidae Gray, 1847

Placida verticillata Ortea, 1981

ÁVILA (2000).

Placida sp.

(see WIRTZ, 1998: 3), ÁVILA *ET AL.* (1998).

Order NUDIBRANCHIA Blainville, 1814

Family Onchidorididae Alder and Hancock, 1845

Diaphorodoris luteocincta (M. Sars, 1870)

WIRTZ AND MARTINS (1993), WIRTZ (1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).

Family Triophidae Odhner, 1941

Kaloplocamus ramosus (Cantraine, 1835)

WIRTZ (1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).

**Kaloplocamus atlanticus* (Bergh, 1892)

BERGH (1892: 12, 1899: 19 as *Euplocamus atlanticus*), NORDSIECK (1972 as *Kaloplocamus ramosus* f. *atlanticus*). Type-locality channel Pico-Faial, 130 m depth.

Family Polyceridae Alder and Hancock, 1845

Tambja ceutae García-Gómez and Ortea, 1988

WIRTZ AND MARTINS (1993), ORTEA *ET AL.* (1996B), WIRTZ (1995 as *Tambja ceutae* and also as *Roboastra europea*), WIRTZ (1998 as *Tambja ceutae* and as *Tambja* sp.), ÁVILA *ET AL.* (1998) and ÁVILA (2000) as *Tambja ceutae* and as *Tambja* sp..

Limacia clavigera (Müller, 1776)

WIRTZ (1998), ORTEA *ET AL.* (1996B), ÁVILA *ET AL.* (1998), ÁVILA (2000).

Polycera elegans (Bergh, 1894)

WIRTZ AND MARTINS (1993), WIRTZ (1998), ORTEA *ET AL.* (1996B), ÁVILA *ET AL.* (1998), ÁVILA (2000).

Polycera quadrilineata (Müller, 1776)

WIRTZ (1998), ORTEA *ET AL.* (1996B), MORTON *ET AL.* (1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).

Polyceratidae indet.

(see WIRTZ, 1998: 13).

Family Chromodorididae Bergh, 1891

Chromodoris britoi Ortea and Pérez, 1983

(see GOSLINER, 1990 [as *C. clenchi*]: 148, ORTEA *ET AL.*, 1994 and WIRTZ, 1998: 8 for a discussion on this species), WIRTZ (1994; 1995), ÁVILA *ET AL.* (1998), ÁVILA (1999).

Chromodoris purpurea (Risso in Guérin, 1831)

GOSLINER (1990), WIRTZ (1994; 1995; 1998), MORTON *ET AL.* (1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).

Chromodoris krohni (Vérany, 1846)

ÁVILA *ET AL.* (1998), ÁVILA (2000).

**Chromodoris goslineri* Ortea and Valdés, 1996

ORTEA *ET AL.* (1996a: 143). Type-locality Santa Maria island.

Hypselodoris picta (Schultz in Philippi, 1836).

This species was recorded for the first time from Azores by BERGH (1899: 7) as *Chromodoris cantrainei*. GOSLINER (1990: 155) recorded to it as *H. webbi* and ORTEA *ET AL.* (1996a: 56 as *H. picta azorica*) and WIRTZ (1994 as *H. webbi*; 1998: 8 as *H. picta azorica*). ÁVILA *ET AL.* (1998), ÁVILA (2000).

Hypselodoris fontandraui (Pruvot-Fol, 1951)
WIRTZ (1995, 1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).
Hypselodoris midatlantica Gosliner, 1990
(see GOSLINER, 1990: 152), ORTEA *ET AL.*, 1996a: 32 and WIRTZ, 1998: 9 for a discussion on this species). ÁVILA *ET AL* (1998: 504), ÁVILA (2000). This species is usually mentioned under the name *H. tricolor*.
Glossodoris edmundsi Cervera, García-Gómez and Ortea, 1989
GOSLINER (1990), WIRTZ (1995, 1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).
Family Aldisidae Odhner, 1939
**Aldisa zetlandica* (Alder and Hancock, 1854)
BERGH (1899: 8), NORDSIECK (1972), PICTON AND MORROW (1994). Azores 38° 30′ 30″ N-38° 31′ N and 29° 09′ 30″ W-29° 10′ 30″ W, 845 m depth.
Aldisa smaragdina Ortea, Pérez and Llera, 1982
WIRTZ (1998), ÁVILA *ET AL.* (1998: 504), ÁVILA (2000). S. Ávila, cited this species as *A. binotata* according to the synonymy proposed by MILLEN AND GOSLINER (1985).
Family Dorididae Rafinesque, 1815
**Doris ocelligera* (Bergh, 1881)
AZEVEDO AND GOFAS (1990: 86), ÁVILA *ET AL.* (1998: 504), ÁVILA (2000). Azores, Flores island.
**Thorybopus lophatus* Bouchet, 1977
BOUCHET (1977: 43). Azores type-locality 37° 37′ N-25° 32′ W, 395-465 m depth.
*Dorididae sp.1
BOUCHET (1977). See BOUCHET (1977: 46) for a discussion on this species. Azores 37° 57′ N-25° 33′ W, 1070-1235 m depth.
*Dorididae sp.2
BOUCHET (1977). See BOUCHET (1977: 47) for a discussion on this species. Azores 37° 57′ N-25° 33′ W, 330 m depth.
Family Discodorididae Bergh, 1891
Discodoris atromaculata (Bergh, 1880)
WIRTZ AND MARTINS (1993), WIRTZ (1994; 1995, 1998), MORTON *ET AL* (1998 as *Peltodoris atromaculata*), ÁVILA *ET AL.* (1998), ÁVILA (2000).
**Discodoris tristis* Bergh, 1892
BERGH (1899: 11). Ponta Delgada, São Miguel island, 98 m depth.
**Discodoris* cf. *millegrana* (Alder and Hancock, 1854)
ÁVILA AND AZEVEDO (1997: 328), ÁVILA (2000: appendix), Azores, Formigas Islets. According to Ávila (personal communication) this was a misidentification with an unknown species.
Geitodoris planata (Alder and Hancock, 1846)
AZEVEDO AND GOFAS (1990 as *Geitodoris* cf. *planata*), WIRTZ (1998), ÁVILA *ET AL* (1998), ÁVILA (2000).
Family Kentrodorididae Bergh, 1892
**Jorunna tomentosa* (Cuvier, 1804)
MORTON *ET AL.* (1998: 151).
Family Platydorididae Bergh, 1891
Platydoris argo (Linné, 1767)
BERGH (1899), WIRTZ AND MARTINS (1993), WIRTZ (1994; 1998), ÁVILA *ET AL* (1998), ÁVILA (2000).
**Platydoris stomascuta* Bouchet, 1977
BOUCHET (1977: 35). Azores 37° 43′ N-29° 04′ W, 370-450 m depth.

**Platydoris* sp.

BOUCHET (1977). See BOUCHET (1977: 42) for a discussion on this species. Azores 37° 39′ N-25° 35′ W, 330 m depth.

Taringa sp.

(see WIRTZ, 1998: 12).

Family Phyllidiidae Rafinesque, 1815

**Phyllidiopsis berghi* Vayssière, 1902

BOUCHET [1977: 48 cited this species as *P. gynenopla* but according to VALDÉS AND ORTEA (1996: 3), it is a synonym of *P. berghi*], VALDÉS AND ORTEA (1996). Azores 38° 22′ -28° 48W, 525-600 m depth.

**Reticulidia gofasi* Valdés and Ortea, 1996

VALDÉS AND ORTEA (1996: 7). Azores 38° 30′ 00′ N-27° 14′ 05″ W, 75-106 m depth.

Family Dendrodorididae O'Donoghue, 1924

**Dendrodoris limbata* (Cuvier, 1804)

BERGH (1892: 16 as *Doriopsis limbata*). Channel Pico-Faial, 130 m depth.

Dendrodoris herytra Valdés and Ortea, 1996

ODHNER (1931 as *D. grandiflora*), VALDÉS *ET AL.* (1996), WIRTZ (1995 as *Dendrodoris* n.sp., 1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).

Family Tritoniidae Lamarck, 1809

**Tritonia (Tritonidoxa) griegi* Odhner, 1922

BOUCHET (1977: 53). Azores 47° 46′ N – 8° 04′ W, 820-940 m depth.

Marionia blainvillea (Risso, 1818)

WIRTZ (1995, 1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).

Family Scyllaeidae Fischer, 1883

Scyllaea pelagica Linné, 1758

SIMROTH (1888), MORTON *ET AL.* (1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).

Family Phylliroidae Férussac, 1821

Phylliroe cf. *atlantica* Bergh, 1871

WIRTZ (1998).

Family Dotoidae Gray, 1853

Doto floridicola Simroth, 1888

SIMROTH (1888), WIRTZ (1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).

Family Flabellinidae Bergh, 1889

Flabellina pedata (Montagu, 1815)

GOSLINER (1994), WIRTZ (1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).

Family Facelinidae Bergh, 1889

Caloria elegans (Alder and Hancock, 1845)

MORO *ET AL* (1995), WIRTZ (1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).

Family Aeolidiidae D'Orbigny, 1834

**Aeolidiella sanguinea* (Norman, 1877)

MORTON *ET AL.* (1998: 79), ÁVILA (2000).

Spurilla neapolitana Delle Chiaje, 1823

SIMROTH (1888) AND WIRTZ (1998). Cited by both authors as *S. sargassicola*.

Family Glaucidae Menke, 1828

Glaucus atlanticus Forster, 1777

SIMROTH (1888), BERGH (1899), WIRTZ (1998).

Family Fionidae Alder and Hancock, 1855

Fiona pinnata Eschscholtz, 1831

BERGH (1892 as *Fiona marina*), WIRTZ (1998), MORTON *ET AL.* (1998), ÁVILA *ET AL.* (1998), ÁVILA (2000).

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A new species of *Alvania* (Mollusca, Rissoidae) from Annobón (Gulf of Guinea, West Africa)

Una nueva especie de *Alvania* (Mollusca, Rissoidae) de Annobón (Golfo de Guinea, África occidental)

Emilio ROLÁN*

Recibido el 21-XII-2000. Aceptado el 8-II-2001

ABSTRACT

Alvania gascoignei spec. nov. from Annobón is described as new for science. It is compared with other species of this genus in eastern Atlantic.

RESUMEN

Se describe una especie nueva para la ciencia, *Alvania gascoignei* spec. nov., procedente de Annobón y se compara con otras del mismo género del Atlántico oriental.

KEY WORDS: *Alvania*, Rissoidae, new species, Annobón, Guinea Equatorial.
PALABRAS CLAVE: *Alvania*, Rissoidae, nueva especia, Annobón, Guinea Ecuatorial.

INTRODUCTION

The genus *Alvania* Risso, 1826 is one of most numerous in species within the Rissoidae of the Eastern Atlantic. So, descriptions of species of this genus are present in a high number of publications. GOFAS AND WARÉN (1982) showed the genus in the Iberian and Moroccan coast. In the Mediterranean, this genus has been mainly studied by Italian malacologist and a compendium of colour photographs of all of them can be seen in GIANUZZI-SAVELLI, PUSATERI, PALMERI AND EBREO (1996). A recent revision of the West African species of *Alvania* was included in GOFAS (1999). In the other hand, MOOLENBEEK AND HOENSELAAR (1989) and HOENSELAAR AND GOUD (1998) dealt the genus in the eastern Atlantic archipelagos, and BOUCHET AND WARÉN (1993) studied the bathyal and abyssal species of the northern Atlantic.

Annobón is the most southestern island in the Gulf of Guinea, about 200 kms at southwest of São Tomé. The marine molluscan fauna of São Tomé and Principe has been studied by FERNANDES AND ROLÁN (1993). Few information exists on the Annobón molluscan fauna (ALVARADO AND ALVAREZ, 1964).

An unknown species of this genus was found in sediment obtained during the Annobón 2000 Expedition and is described in the present work.

Abbreviations:

MNCN Museo Nacional de Ciencias Naturales, Madrid

MNHN Muséum National d'Histoire Naturelle, Paris

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RESULTS

Family RISSOIDAE Gray, 1847
Genus *Alvania* Risso, 1826

Alvania gascoignei spec. nov.

Type material: Holotype (Fig. 1) and 1 paratype in the MNCN; one paratype (Fig. 2) in MNHN; six more in CER. All from type locality.
Other material examined: 1 shell, 4 juveniles and 16 fragments.
Etymology: The specific name is after Angus Gascoigne, an English naturalist living in São Tomé, who participated and played an important role in the organization of the Annobón 2000 Expedition.
Type locality: San Antonio de Palé, Annobón, Guinea Equatorial. Obtained in sediment from 10-15 m depth.

Description: Shell (Figs. 1, 2) moderately solid, ovate-conical, dirty white in colour. Protoconch (Fig. 3) somewhat more that 1 convex whorl, sculptured by seven irregularly undulating fine spiral threads. Teleoconch of about 4 convex whorls, sculptured with axial ribs and narrower spiral cords and a well defined suture. Axial ribs almost ortocline, separated by wider interspaces, which are more evident subsuturally and almost disappear on the suture. Five spiral cords on the first whorl, 9-10 on the penultimate and about 18 on the last one, with approximately equal interspaces. Aperture ovoid with a continuous peristome lacking any internal tooth. The external border of the aperture is undulating due the end of the spiral cords. The microsculpture can be observed with high magnification (Figs. 4-5), showing a great quantity of small pits on the spiral cords and 4-7 spiral nodulous fillets in the interspaces. Umbilicus absent.

Dimensions: the holotype is 2.7 x 1.5 mm.

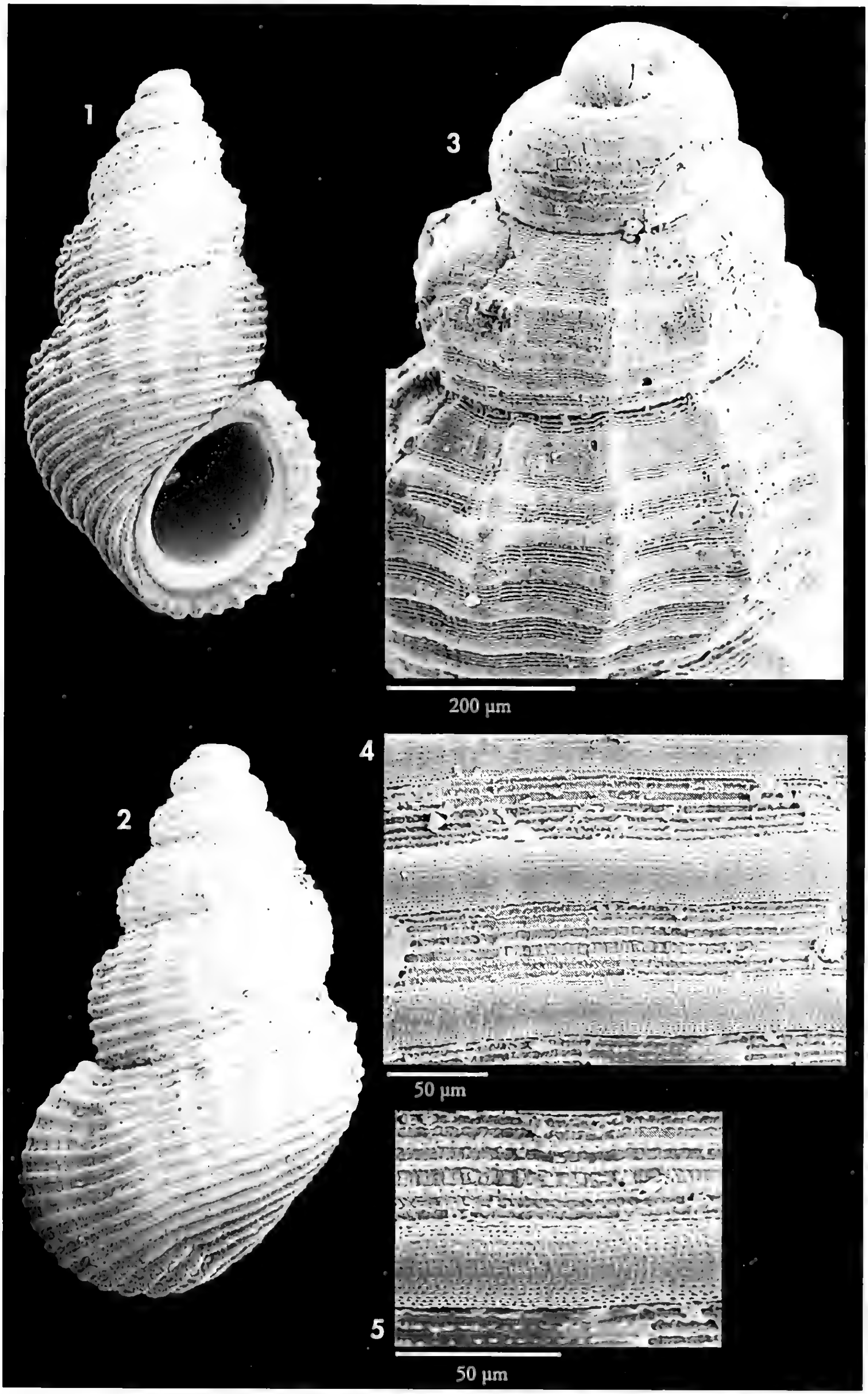
Distribution: Only known from the type locality.

Discussion: *Alvania gascoignei* spec. nov. is different from most of the European and West African species because of its numerous spiral cords. Related species with similar profile and a protoconch with a similar sculpture are, for example, *A. subsoluta* (Aradas, 1847), *A. parvula* (Jeffreys, 1884), *A. testae* (Aradas and Maggiore, 1844), *A. tomentosa* (Pallary in Monterosato, 1920) and *A. imperspicua* (Pallary in Monterosato, 1920) (in the Mediterranean) and *A. africana* Gofas, 1999, *A. coseli* Gofas, 1999, (in West Africa). Other species of the genus have a quite similar number of spiral cords, but are different in profile and protoconch, as *A. beanii* (Hanley in Thorpe, 1844), *A. lactea* (Michaud, 1832), *A. punctura* (Montagu, 1803), *A. regina* Gofas, 1999, or *A. zylensis* Gofas and Warén, 1982.

Due to its high number of spiral cords, *A. gascoignei* spec. nov. shows affinity to some species of the genus *Onoba* H. and A. Adams, 1852, but its sculpture is more prominent and the external enlargement of the aperture is different from that of most of the species of this genus. In the other hand, this species shows affinity with the genus *Manzonia* Brusina, 1870 in some characters (shape and microsculpture).

This species has not been found in the many samples made by several collectors on the island of São Tomé. Thus, it can provisionally be considered to be endemic to the island of Annobon.

(Right page) Figures 1-5. *Alvania gascoignei* spec. nov. 1: holotype, 2.7 mm, San Antonio de Palé, Annobon (MNCN); 2: paratype, 2.7 mm, Annobon (MNHN); 3: protoconch, paratype (MNCN); 4, 5: microsculpture of the holotype.
(Página derecha) Figuras 1-5. Alvania gascoignei *spec. nov. 1: holotipo, 2,7 mm, San Antonio de Palé, Annobon (MNCN); 2: paratipo, 2,7 mm, Annobon (MNHN); 3: protoconcha, paratipo (MNCN); 4, 5: microescultura del holotipo.*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3
200 µm
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4
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5
50 µm

ACKNOWLEDGEMENTS

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BIBLIOGRAPHY

ALVARADO, R. AND ALVAREZ, J., 1964. Resultados de la expedición Peris-Alvarez a la isla de Annobón. VIII. Algunos invertebrados marinos. *Boletín de la Real Sociedad Española de Historia Natural (Biología)*, 62: 265-282.

BOUCHET, P. AND WARÉN, A., 1993. Revision of the Northeast Atlantic bathyal and abyssal Mesogastropoda. *Bollettino Malacologico*, supl. 3: 579-840.

FERNANDES, F. AND ROLÁN, E., 1993. Moluscos marinos de São Tomé y Principe: actualización bibliográfica y nuevas aportaciones. *Iberus*, 11 (1): 31-47.

GIANNUZZI-SAVELLI, R., PUSATERI, F., PALMERI, A. AND EBREO, C., 1996. *Atlante delle conchiglie marine del Mediter*raneo. La Conchiglia, Roma. 259 pp.

GOFAS, S., 1999. The West African Rissoidae (Gastropoda: Rissooidea) and their similarities to some European species. *The Nautilus*, 113 (3): 78-101.

GOFAS, S. AND WARÉN, A., 1982. Taxonomie de quelques especes du genre *Alvania* (Mollusca, Gastropoda) des côtes ibèriques et marocaines. *Bollettino Malacologico*, 18 (1-4): 1-16.

HOENSELAAR, H. J. AND GOUD, J., 1998. The Rissoidae of the CANCAP expeditions,1: the genus *Alvania* Risso, 1826 (Gastropoda Prosobranchia). *Basteria*, 62 (1-2): 69-115.

MOOLENBEEK, R. G. AND HOENSELAAR, H. J., 1989. The genus *Alvania* on the Canary Islands and Madeira (Mollusca: Gastropoda). Part I. *Bulletin Zoologisk Museum, Amsterdam*, 11 (27): 215-230.

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La superfamilia Pyramidelloidea Gray, 1840 (Mollusca, Gastropoda, Heterostropha) en África Occidental. 8. Los géneros *Bacteridium* y *Anisocycla*

The superfamily Pyramidelloidea Gray, 1840 (Mollusca, Gastropoda, Heterostropha) in West Africa. 8. The genera *Bacteridium* and *Anisocycla*

Anselmo PEÑAS* y Emilio ROLÁN**

Recibido el 13-XI-2000. Aceptado el 16-II-2001

RESUMEN

Se revisan las especies de África Occidental de los géneros *Bacteridium* y *Anisocycla*. En total se estudian 1 taxon en *Bacteridium* y 5 en *Anisocycla*, de los que uno de ellos es descrito como nuevo para la ciencia.

ABSTRACT

The West Africa species of the genera *Bacteridium* and *Anisocycla* are studied. In total 1 taxon in *Bacteridium* and 5 in *Anisocycla* are in the study, one of the latter being described as new.

PALABRAS CLAVE: Pyramidelloidea, *Bacteridium, Anisocycla,* África Occidental, nuevas especies
KEY WORDS: Pyramidelloidea, *Bacteridium, Anisocycla,* West Africa, new species.

INTRODUCCIÓN

Las más pequeñas, frágiles y alargadas especies de piramidélidos, han sido objeto reciente de numerosas disquisiciones en cuanto a su posición taxonómica y ubicación genérica.

De los numerosos taxones que han sido utilizados a nivel genérico para estas pequeñas conchas, el más antiguo es *Ebala* Leach in Gray, 1847 que, según WENZ (1938) tiene como especie tipo a *Turbo nitidissimus* Montagu, 1803.

GOUGEROT Y FEKI (1980) hacen una revision del género *Anisocycla* y GOUGEROT (1991) completa la misma con las especies fósiles de este género. En esos trabajos se justifica el uso *Anisocycla* en vez de *Ebala*.

Sin embargo WARÉN (1994) no opina así y cree que el nombre a usar debería ser *Ebala*, explicando sus razones y creando la familia Ebalidae para incluir las especies de algunos géneros que poseen aparato masticador, como *Ebala* Gray, 1847, *Henrya* Bartsch, 1947 y *Murchisionella* Mörch, 1875. En la misma publicación AARTSEN (1994) presenta

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una opción diferente. En la actualidad, aparece como *Ebala* en la lista existente en Internet (CLEMAM: Gofas y Renard (eds.), http://www.mnhn.fr/base/malaco/html).

Poco después, AARTSEN (1995) muestra de nuevo una opinión contraria al uso de *Ebala* y repasa los comentarios sobre las publicaciones que WARÉN (1994) había hecho en su trabajo y, en relación a los trabajos en los que es utilizado por primera vez este nombre, afirma lo que sigue: "The «october»-paper gives *Ebala elegantissima* (Montagu) as a synonym of *Turritella* and both Warén and I do agree that the name *Ebala* Leach in Gray, Oct. 1847 has *Turbonilla elegantissima* (Montagu, 1803) as its type-species by monotypy". De esta forma, esta especie debería ser considerada la especie tipo ya que, aunque posteriormente Gray utiliza *Turbo nitidissimus* Montagu, 1803 "como especie tipo del género", esto no cambia la designación inicial. Este problema taxonómico, comentado y enfatizado por AARTSEN (1995) y no contestado por otros autores, parece nos debe hacer considerar por tanto que *Ebala* es un sinónimo de *Turbonilla* Risso, 1826.

Según AARTSEN (1995) el nombre a utilizar para estas especies sería *Anisocycla* Monterosato, 1880, nombre introducido para sustituir el previamente ocupado *Aciculina* Deshayes, 1861 *non* H. y A. Adams, 1853, cuya especie tipo, *Aciculina scalarina* Deshayes 1861, define este género. FABER (1995) señala, no obstante, que esta designación de especie tipo fue hecha por primera vez por DALL Y BARTSCH (1909).

Otros taxones posteriores, como *Careliopsis* Mörch, 1895, *Ebalina* Thiele, 1929, *Bermudaclis* Bartsch, 1947 y *Pandorella* Laseron, 1951 (non Conrad, 1863) han sido considerados sinónimos por otros autores (WARÉN, 1994).

Según AARTSEN (1995) el nombre de familia Ebalidae Warén, 1994, sería substituido por el de Anisocyclidae Aartsen, 1995.

El presente trabajo es el octavo de una serie dedicada al estudio de los Pyramidelloidea de las costas de África occidental. En los dos trabajos anteriores (PEÑAS Y ROLÁN, 1999b, 2000) se hace referencia a los diversos géneros previamente estudiados.

En este trabajo presentamos juntos los géneros *Bacteridium* Thiele, 1929 y *Anisocycla* Monterosato, 1880 por la similitud morfológica de sus conchas, con independencia de que ambos puedan estar situados en familias diferentes.

MATERIAL Y MÉTODOS

En este apartado remitimos al lector al trabajo de PEÑAS Y ROLÁN (1999a).

Las abreviaturas empleadas son las siguientes:

BMNH The Natural History Museum, Londres
MMF Museo Municipal de Funchal, Madeira.
MNCN Museo Nacional de Ciencias Naturales, Madrid.
CAP colección Anselmo Peñas, Vilanova i la Geltrú, Barcelona.
CCO colección Cristina Ortiz, Santa Cruz de Tenerife, Canarias.
CER colección Emilio Rolán, Vigo.
CFR colección Federico Rubio, Valencia.
CFS colección Frank Swinnen, Lommel, Bélgica.
CJP colección Jacques Pelorce, Le Grau du Roi, Francia.
CPD colección Gustavo Pérez-Dionis, Santa Cruz de Tenerife, Canarias.
CPS colección José Luis Pérez Sixto, Alcalá de Henares, Madrid.
CWE colección Winfried Engl, Düsseldorf, Alemania.
c concha
j juvenil
f fragmento
ex ejemplar con partes blandas

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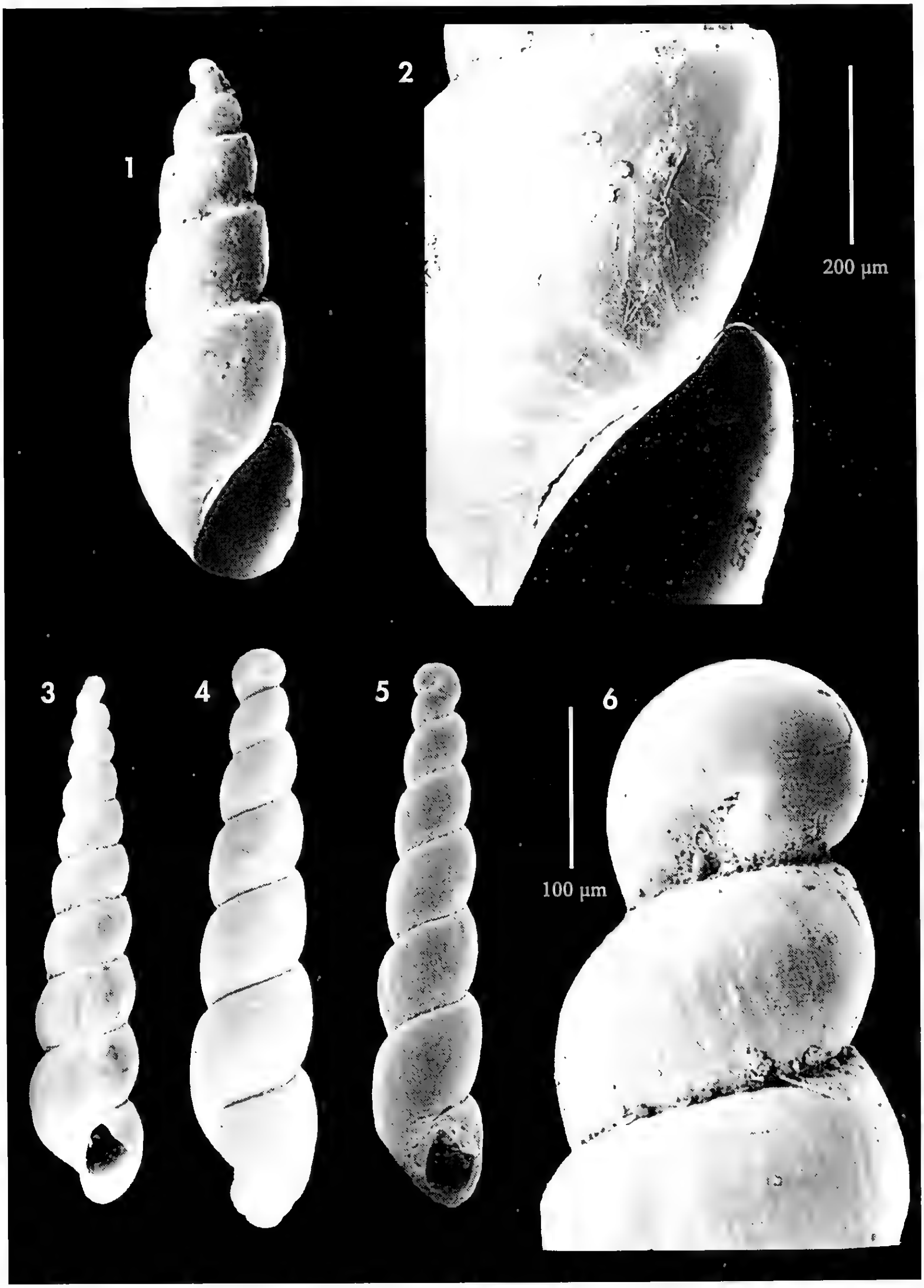


Figuras 1, 2. *Bacteridium carinatum*; 1: concha, 1,5 mm, Sahara (CFR); 2: detalle de la última vuelta. Figuras 3-6. *Anisocycla pointeli*; 3: concha, 2,9 mm, Banc d'Arguin, Mauritania; 4: concha, 1,8 mm, Baia de l'Etoile, Mauritania; 5: concha, 1,8 mm, Miamia, Ghana; 6: protoconcha, Banc d'Arguin.

Figures 1, 2. Bacteridium carinatum*; 1: shell, 1.5 mm, Sahara (CFR); 2: detail of the last whorl. Figures 3-6.* Anisocycla pointeli*; 3: shell, 2.9 mm, Banc d'Arguin, Mauritania; 4: shell, 1.8 mm, Baia de l'Etoile, Mauritania; 5: shell, 1.8 mm, Miamia, Ghana; 6: protoconch, Banc d'Arguin.*

PARTE SISTEMÁTICA

Familia Turbonillidae
Subfamilia Eulimellinae
Género *Bacteridium* Thiele, 1929

Especie tipo: *Eulimella praeclara* Thiele, 1925.

Concha pequeña, muy delgada, alargada, lisa o con fina microescultura. Sin diente ni pliegue columelar, ni ombligo. Protoconcha planispiral.

Las especies pertenecientes a este género apenas se diferencian de las del género *Anisocycla* por la morfología de la concha. Sin embargo, el animal tiene el estilete característico de los Pyramidellidae, mientras que las pertenecientes al género *Anisocycla* tienen un aparato masticador. Schander (1994) incluyen este género en la familia Turbonillidae (Eulimellinae).

Bacteridium carinatum (De Folin, 1870) (Figs 1, 2)

Eulimella carinata De Folin, 1870. *Les fonds de la Mer,* 1, pág. 209, lám. 28, fig. 8 [Localidad tipo: Cagnabac, Senegal].

Material tipo: no examinado.
Material examinado: Península Ibérica: Mediterráneo, ver Peñas *et al.* (1996). Sahara: 1 c, en *Solea sp.* (CFR). Senegal: 1 c, Sec de Thouriba, Cap Vert, 30 m (CJP). Ghana: 15 c, Miamia, 12-35 m. Angola: 1 c, Luanda, 50 m.

Descripción: Descripción en Peñas, Templado y Martínez (1996: 73-74, fig. 81). Ilustración en Schander (1994, figs. 1c, 9e, f) y en Aartsen, Gittenberger y Goud. (2000, fig. 20) como *Anisocycla* cf. *carinata*. Concha (Fig. 1) diminuta, delgada, subcilíndrica, lisa, blanquecina. Protoconcha planispiral, del tipo B. Vueltas escalonadas, con un claro hombro subsutural. Sutura muy marcada. Líneas de crecimiento flexuosas, opistoclinas bajo la sutura (Fig. 2). Abertura semicircular, sin pliegue columelar ni ombligo, peristoma continuo.

Distribución: Mediterráneo español, Túnez, Israel (Bogi y Bella, 1997). África Occidental hasta Angola. Infralitoral y circalitoral.

Comentarios: Schander (1994) incluye por primera vez esta especie en el género *Bacteridium*, basándose en que no posee aparato masticador.

Familia Anisocyclidae
Género *Anisocycla* Monterosato, 1880

Especie tipo: *Aciculina scalarina* Deshayes, 1861.

Concha pequeña, delgada, alargada, lisa o con microescultura, sin diente ni pliegue columelar, ni ombligo. Protoconcha planispiral, con la espira totalmente visible y un ángulo de su eje con el de la teleoconcha superior a 130° (tipo B de van Aartsen). El animal tiene un sistema mandibular complejo ("aparato masticador").

Este género fue revisado por Gougerot y Feki (1979, 1980) y posteriormente por Aartsen (1994). Warén (1994) crea la familia Ebalidae y defiende la validez del nombre *Ebala* Gray, 1847 frente a

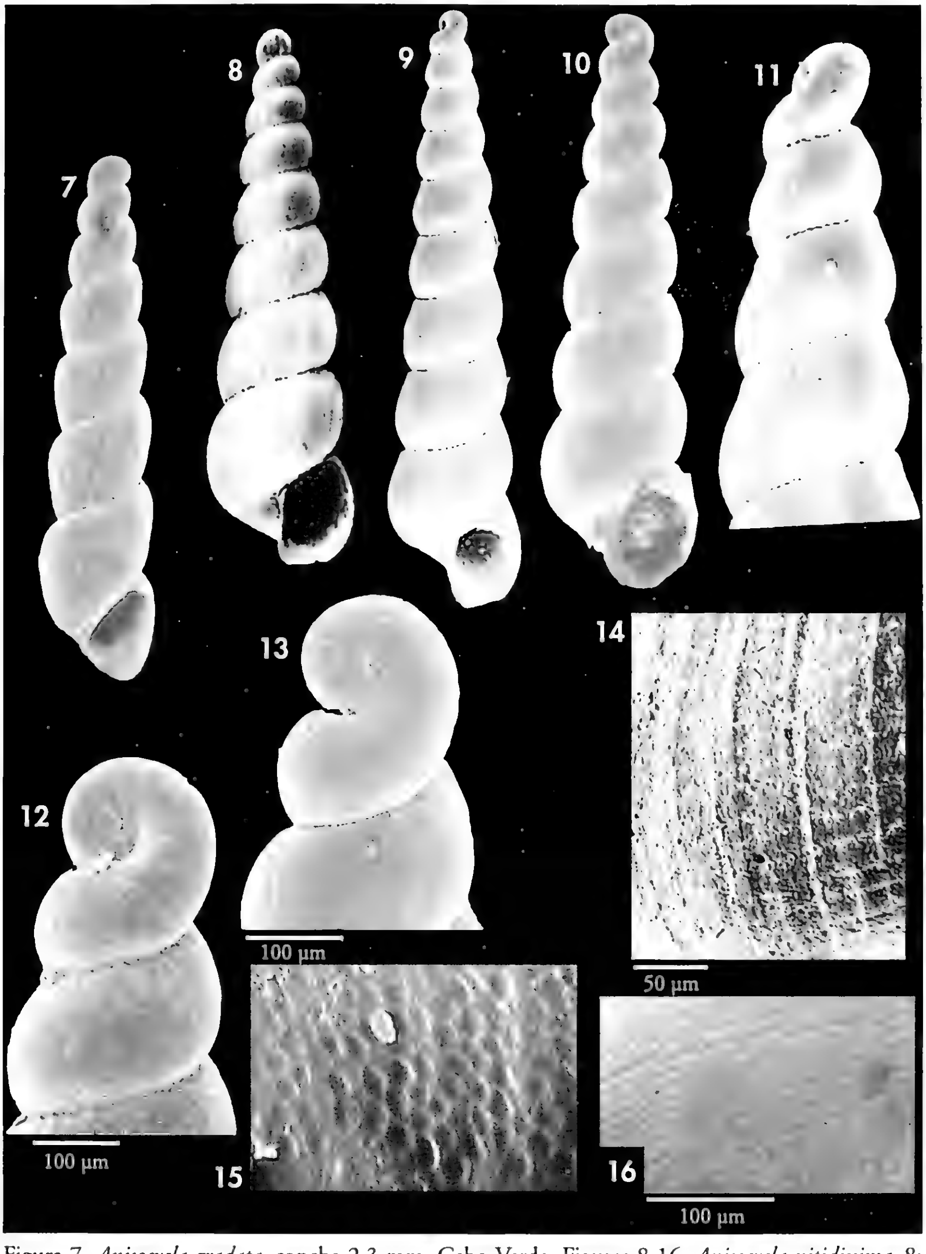


Figura 7. *Anisocycla gradata*, concha 2,3 mm, Cabo Verde. Figuras 8-16. *Anisocycla nitidissima*. 8: concha, 2,2 mm, Dakar, Senegal; 9: concha, 2,1 mm, Porto Mindelo, São Vicente, Cabo Verde; 10: concha, 2,2 mm, Luanda, Angola; 11: detalle de la espira, Cabo Verde; 12: protoconcha, Angola; 13: protoconcha, Vigo, España; 14: detalle de la microescultura, Senegal; 15: microescultura, España; 16: microescultura, Angola.

Figure 7. Anisocycla gradata, *shell 2.3 mm, Cape Verde. Figures 8-16.* Anisocycla nitidissima. *8: shell, 2.2 mm, Dakar, Senegal; 9: shell, 2.1 mm, Porto Mindelo, São Vicente, Cape Verde; 10: shell, 2.2 mm, Luanda, Angola; 11: detail of the spire, Cape Verde; 12: protoconch, Angola; 13: protoconch, Vigo, Spain; 14: detail of the microsculpture, Senegal; 15: microsculpture, Spain; 16: microsculpture, Angola.*

Anisocycla. AARTSEN (1995) sigue la discusión y defiende *Anisocycla*, concluyendo que *Ebala* es un sinónimo de *Turbonilla* Risso, 1826, tesis que comparten SCHANDER *ET AL*. (1999) y que nosotros aceptamos.

Anisocycla pointeli (De Folin, 1868) (Figs. 3-6)

Turbonilla pointeli De Folin, 1868. *Les fonds de la Mer*, 1, pág. 100, lám. 11, fig. 4. [Localidad tipo: isla de Syra, Grecia].

Material tipo: No encontrado.
Material examinado: Península Ibérica: Mediterráneo, ver PEÑAS *ET AL*. (1996). Atlántico: 1 c, Bahía de Cádiz, 30 m; 1 c, Lagos, Portugal. Islas Canarias: Tenerife: 40 c, 27 m (CPD); 35 c, 27 m, (CCO); 2 c, Fañabé, 25 m. Lanzarote: 6 c, Playa del Reducto (CFS); 3 c, Puerto del Carmen, 45-50 m (CWE). Gran Canaria: 1 c, Playa Sardina (CFS). Madeira: 3 c, Funchal, 50-75 m (CFS); 2 c, Funchal, 50-75 m (CWE); 1 c, Cabo Guirado, 75-100 m (CWE). Sahara: 9 c, Cabo Loven, 35-50 m (CFR). Mauritania: 10 c, Banc d'Arguin, litoral. Ghana: 8 c, Miamia, 35 m. Archipiélago de Cabo Verde : 1 c, Porto da Cruz, Boavista, litoral; 5 c, Tarrafal, Santiago, 15 m.

Descripción: En PEÑAS *ET AL*. (1996: 74, figs: 82-83, 85)). Concha (Figs. 3-5) pequeña, alargada, lisa, blanca vítrea, semitransparente. Protoconcha (Fig. 6) planispiral, típica del género. Espira muy elevada con las vueltas bien convexas, redondeadas; sutura profunda; líneas de crecimiento prosoclinas; abertura circular; sin diente ni pliegue columelar, ni ombligo.

Distribución: Mediterráneo y Atlántico europeo próximo. Atlántico africano desde el Sahara hasta Ghana; archipiélagos de Canarias, Madeira y Cabo Verde. Infralitoral y circalitoral.

Comentarios: Se trata de una especie muy polimorfa, que se diferencia de *E. nitidissima* en la ausencia de escultura espiral.

Anisocycla gradata Monterosato, 1878 (Fig. 7)

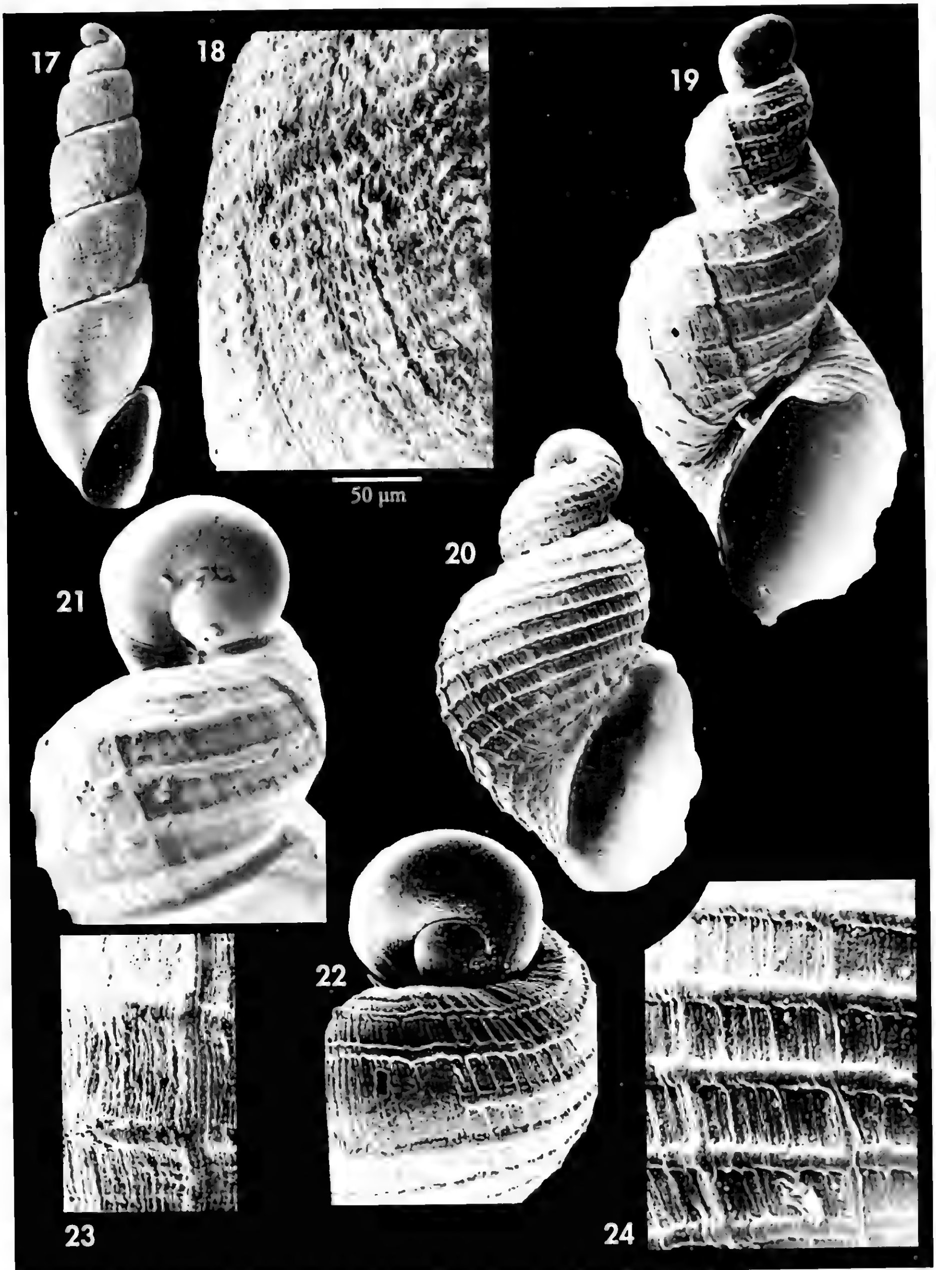
Odostomia pointeli var. *gradata* Monterosato, 1878. *Enum. e sinon. conch. med.*: 95.[Localidad tipo: Joly, Argel]. *Nomen nudum*.
Odostomia (Eulimella) pointeli Folin, var. *gradata* Monterosato, 1878. *Jour. Conchy*. 26: 458.
¿*Eulimella trigonostoma* De Folin, 1870. *Les fonds de la Mer*, 1, pág. 260, lám. 31, fig. 11. [Localidad tipo: Canal de Suez].

Material tipo: El tipo de *A. gradata*, supuestamente en el Museo Civico de Roma, no ha sido encontrado hasta el momento, debido a que se está realizando la organización de la colección, aunque su búsqueda continua.
Material examinado: Península Ibérica: Mediterráneo, ver PEÑAS *ET AL*. (1996); Atlántico: 1 c, Tarifa, litoral. Marruecos: 3 c, Agadir, litoral (CFS). Islas Canarias: Tenerife: 2 c, dragado a 10-27 m (CCO); 2 c, dragado a 10-27 m (CPD). Gran Canaria: 1 c, Las Canteras (CPS). La Palma: 1 c, Los Cancajos (CWE). Fuerteventura: 1 c, Puerto del Rosario (CWE). Madeira: 1 c, dragado 12-35 m (CFS); 1 c, Funchal (CFS). Archipiélago de Cabo Verde: 1 c, Pau Seco, Maio, 30 m.

Descripción: En PEÑAS *ET AL*. (1996: 75, fig. 86). Concha (Fig. 7) pequeña, alargada, delgada, lisa, blanca vítrea, semitransparente. Protoconcha planispiral típica del género; vueltas casi planas, escalonadas, con una repisa subsutural; sutura profunda, muy inclinada: líneas de crecimiento ortoclinas. Abertura semicircular, sin pliegue columelar ni ombligo.

Distribución: Mediterráneo y Atlántico europeo y marroquí. Archipiélagos de Canarias, Madeira y Cabo Verde. Infralitoral y circalitoral.

Comentarios: GOUGEROT Y FEKI (1980) constataron que en el tubo de los tipos



Figuras 17, 18. *Anisocycla striatula*; 17: concha, 1,8 mm, Banc d'Arguin, Mauritania. Figuras 19-24. *"Anisocycla" micalii* spec. nov. 19: holotipo, 1,6 mm, Banc d'Arguin (MNCN); 20: concha, 1,0 mm, Guinea Conakry (CFR); 21: protoconcha del holotipo; 22: protoconcha, Guinea Conakry; 23: microescultura del holotipo; 24: microescultura, Guinea Conakry.

Figures 17, 18. Anisocycla striatula*; 17: shell, 1.8 mm, Banc d'Arguin, Mauritania. Figures 19-24.* "Anisocycla" micalii *spec. nov. 19: holotype, 1.6 mm, Banc d'Arguin (MNCN); 20: shell, 1.0 mm, Guinea Conakry (CFR); 21: protoconch of the holotype; 22: protoconch, Guinea Conakry; 23: microsculpture or the holotype; 24: microsculpture, Guinea Conakry.*

de *A. trigonostoma* había dos conchas que no eran de esa familia, pero la tercera coincidía con la descripción de De Folin y por tanto, según estos autores, sería el holotipo, opinando que *A. pointeli* var. *gradata* de Nordsieck, 1972 era un sinónimo de *A. trigonostoma*. No obstante, siendo la localidad tipo de esta última especie el Canal de Suez y el ejemplar existente en el lote de los sintipos de muy pequeño tamaño, podría tratarse de una especie de origen Indo-Pacífico, por lo que preferimos utilizar el nombre de Monterosato y dejar en posición de dudas para un futuro estudio a la especie de De Folin.

Anisocycla nitidissima (Montagu, 1803) (Figs. 8-16)

Turbo nitidissimus Montagu, 1803. *Testacea Britannica*, pág. 299, lám. 12, fig. 1. [Localidad tipo: puerto de Falmouth, Islas Británicas].

Material tipo: No examinado.
Material examinado: Península Ibérica: Mediterráneo, ver PEÑAS ET AL. (1996). Atlántico: 6 c, Ría de Vigo, Pontevedra; 15 c, Panxon, Pontevedra; 5 c, Tarifa. Marruecos: 6 c, Agadir, litoral (CFS); 6 c, Agadir, litoral (CWE). Sahara: 2 c, Cabo Loven, 40-50 m (CFR). Islas Canarias: Lanzarote: 7 c, Puerto del Carmen (CWE). La Gomera: 1 c, Playa Santiago, 58 m. Tenerife: 41 c, (CCO). Gran Canaria: 1 c, Las Canteras (CPS). Madeira: 1 c, Santa Cruz (MMF); 5 c, dragado 27-100 m (CFS); 2 c, Cabo Guirado, 75-100 m (CFS). Archipiélago de Cabo Verde: 2 c, Pau Seco, Maio, 30 m; 3 c, Tarrafal, Santiago, 15 m. Mauritania: 103 c, Banc d'Arguin, litoral; 21 c, Bahía de la Estrella, 3 m. Senegal: 25 c, Sec de Thouriba, Cap Vert, 30-33 m. Angola: 4 c, Corimba, 20 m; 1 c, Luanda, 50 m.

Descripción: Ver PEÑAS ET AL. (1996: 74-75, figs. 87-88, 92). Concha (Figs. 8-10) pequeña, delgada, muy alargada, blanca amarillenta, semitransparente. Protoconcha (Figs. 11-13) planispiral, típica del género. Vueltas bien convexas, con la sutura profunda. Líneas de crecimiento flexuosas, opistoclinas bajo la sutura. Microescultura (Figs. 14-16) formada por estrías espirales; con gran aumento pueden verse microescavaciones. Abertural oval, sin pliegue columelar ni ombligo.

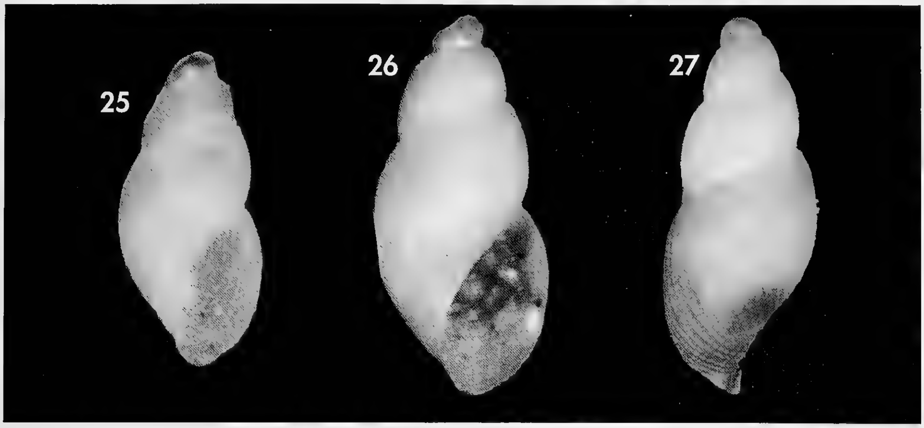
Distribución: Mediterráneo y Atlántico europeo. Atlántico africano hasta Angola y los archipiélagos de Canarias, Madeira y Cabo Verde. Infralitoral y circalitoral.

Anisocycla striatula (Jeffreys, 1856) (Figs. 17, 18)

Eulimella striatula Jeffreys, 1856. *Ann. Mag. Nat. Hist. Ser.* 2, 17: 186, lám. 2, figs. 14-15. [Localidad tipo: La Spezia, Italia, 10 brazas].
Eulimella folini P. Fischer in De Folin, 1869. *Les fonds de la Mer*, 1: 149-150, lám. 22, fig. 8. [Localidad tipo: Golfo de Gascogne].
Odostomia hyalina Jeffreys, 1870. *Ann. Mag. nat. Hist.* ser.4, 5: 79. Nuevo nombre para *Eulimella striatula* Jeffreys, 1856 non *Odostomia striatula* (L., 1758). Reemplazamiento innecesario.

Material tipo: De *E. striatula*: Originalmente en el BMNH, registrado 1856.2.18.9, desaparecido. Dos fragmentos de sintipos, reg. nº 196470, imposibles de determinar, pero en los que no hemos apreciado escultura espiral. De *E. folini*: no encontrado.
Material examinado: Península Ibérica: 2 c, L'Ampolla, Tarragona (CAP); 10 c, San Carlos de la Rápita, Tarragona, 4 m (CAP); 1 c, Tarifa, litoral. Mauritania: 4 c, Banc d'Arguin, litoral.

Descripción: En AARTSEN (1994: 95, fig. 14). Concha (Fig. 17) pequeña, delgada, alargada, blanca vítrea, semitrasparente. Protoconcha planispiral, típica del género. Vueltas ligeramente convexas, escalonadas, que crecen relativamente



Figuras 25-27. *Mathilda epicharis*, sintipos, 2-3 mm, Pointe de Pitre, Guadalupe, Caribe (MNHN).
Figures 25-27. Mathilda epicharis, *syntypes, 2-3 mm, Pointe de Pitre, Guadalupe, Caribbean (MNHN).*

deprisa, con una clara repisa subsutural; sutura profunda, inclinada; líneas de crecimiento algo flexuosas, opistoclinas bajo la sutura; numerosas estrías espirales (Fig. 18), las cuales en su cruce con las líneas de crecimiento forman una especie de retículo. Abertura estrecha, oval; sin pliegue columelar ni ombligo.

Distribución: Mediterráneo y Atlántico europeo. Mauritania. Infralitoral.

Comentarios: Los holotipos de *A. striatula* y *A. folini* no son utilizables para la diagnosis de la especie. Por tanto, nuestra determinación es tentativa, basada exclusivamente en la descripción de los autores.

"Anisocycla" micalii spec. nov. (Figs. 19-24)

Material tipo: Holotipo (Fig. 19) en el MNCN (15.05/43726), en sedimentos de la playa.
Otro material examinado: Mauritania: 1 c, Banc d'Arguin (CAP). Senegal: 1 c, Cap Vert, 15-34 m (CJP) (destruida durante el estudio). Guinea Conakry: 1 c, en el estómago del pez *Solea* sp. (CFR).
Localidad tipo: Banc d'Arguin, Mauritania.
Etimología: El nombre de la especie se dedica a Pasquale Micali, de Fano, Italia, por su constante ayuda en nuestros trabajos.

Descripción: Concha (Figs. 19, 20) diminuta, pupoide, blanca vítrea, semitransparente. Protoconcha (Figs. 21, 22) planispiral, del tipo B, con la espira visible, y con un diámetro de 170-190 μm. Teleoconcha de espira corta, con las vueltas bien convexas, las cuales crecen muy deprisa. Sutura inclinada y muy profunda, de forma que la última vuelta no queda soldada a la anterior, dando la impresión de que se trata de una concha umbilicada. Escultura espiral (Figs. 23, 24) formada por 5-7 cordoncillos, espaciados, casi equidistantes, bien conspicuos. Escultura axial formada por las líneas de crecimiento prosoclinas, muy marcadas, formando una especie de retículo con los cordones espirales. Abertura oval, grande, sin diente ni pliegue columelar. Peristoma continuo.

Dimensiones. El holotipo tiene una dimensión máxima de 1,6 mm; las otras conchas examinadas medían entre 1,0 y 1,2 mm.

Distribución: Solamente conocida entre Mauritania y Guinea Conakry.

Discusión: *"A." micalii* spec. nov. tiene un cierto parecido con la especie *Mat-*

hilda epicharis de Folin, 1870 (Figs. 25-27). Sin embargo, esta última especie tiene la espira con las vueltas más próximas, la protoconcha está menos separada de la primera vuelta de la teleoconcha y, finalmente, la escultura está formada por cordones espirales y costillas axiales, ambas de un tamaño similar y que forman un reticulado muy evidente.

Aunque, a primera vista, esta especie no se parece a ninguna de las *Anisocycla* conocidas en el área de estudio y próximas, hemos preferido su ubicación en este género como más próximo por el tipo de protoconcha, por la delgadez de la concha, por la ausencia de ombligo y por la ausencia de pliegue columelar.

Las conchas procedentes de Senegal y Guinea Conakry son proporcionalmente más anchas y con un crecimiento de las vueltas más lento que las de Mauritania, tienen más cordones espirales y una protoconcha con un diámetro algo menor. Sin embargo, la escasez de ejemplares en este estudio no nos ha permitido conocer su verdadera variabilidad, y por tanto preferimos considerarlas como conespecíficas.

COMENTARIO FINAL

Se estudian 6 especies que presentan una morfología bastante similar (excepto una de ellas) y que se consideran pertenecientes a los géneros *Bacteridium* y *Anisocycla*. *"Anisocycla" micalii* spec. nov. es incluidas tentativamente en uno de estos géneros, ya que no se conoce su anatomía.

Algunas de las especies estudiadas en este trabajo tienen un área de distribución relativamente amplia, como *Bacteridium carinatum* y *Anisocycla nitidissima*, presentes ambas en Europa en su límite septentrional, la primera en en Mediterráneo y la segunda en el Atlántico norte, extendiéndose por el sur hasta en un país tan distante como Angola. No obstante, existiendo una cierta variabilidad morfológica y con escasez del material en estudio, no puede excluirse que dentro de estos taxones pudiese existir más de una especie.

Anisocycla pointeli y *A. gradata* son conocidas desde el Mediterráneo hasta Ghana, incluyendo los archipiélagos de Canarias y Cabo Verde.

A. striatula se conoce desde el Mediterráneo hasta Mauritania. Finalmente, *"Anisocycla" micalii*, se ha encontrado desde Mauritania hasta Guinea Conakry, presentando por tanto un área de dispersión reducida, aunque es probable que, dada su pequeñez y lo difícil de su recolección, en el futuro se pueda encontrar en otras localidades.

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Los autores agradecen la cesión de material de las especies estudiadas a las siguientes personas: a Winfried Engl, de Düsseldorf, Alemania; a Cristina Ortiz y a Gustavo Pérez-Dionis, de Santa Cruz de Tenerife, Canarias; a Jacques Pelorce, de Le Grau du Roi, Francia; a José Luis Pérez Sixto, Alcalá de Henares, Madrid; a Federico Rubio, de Valencia; a Frank Swinnen, de Lommel, Bélgica. A Virgine Héros del MNHN por el préstamo de material tipo. Las fotografías al MEB fueron realizadas por Jesús Méndez, del CACTI de la Universidad de Vigo. También a los revisores P. Micali e I. Nofroni por sus correcciones.

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BIBLIOGRAFÍA

AARTSEN, J. J. VAN, 1994. European Pyramidellidae: IV. The genera *Eulimella, Anisocycla, Syrnola, Cingulina, Oscilla* and *Careliopsis*. *Bollettino Malacologico*, 30 (5-9): 85-110.

AARTSEN, J. J. VAN, 1995. *Anisocycla* Monterosato, 1880 or *Ebala* in Gray, 1847: that is the question. *Bollettino Malacologico*, 31 (1-4): 65-68.

AARTSEN, J. J. VAN, GITTENBERGER, E. Y GOUD, J., 2000. Pyramidellidae (Mollusca, Gastropoda, Heterobranchia) collected during the Dutch CANCAP and MAURITANIA expeditions in the south-eastern part of the North Atlantic Ocean (part 2). *Zoologische Med.* Leiden, 74.

BOGI, C. Y BELLA, G. S., 1997. Discoveries along the Israeli coast. *La Conchiglia,* 29 (284): 42-45.

DALL, W. H. Y BARTSCH, P., 1909. A monograph of west American pyramidellid Mollusks. *Bulletin U. S. N. M.*, 68: 1-258.

FABER, M. J., 1995. On the type species of the genus *Anisocycla* Monterosato, 1880. *De Kreukel,* 31 (5): 70-72.

GOUGEROT, L., 1991. Les espèces d'*Anisocycla* Monterosato du Paléocène et de l'Éocène français (Gastropoda, Pyramidellidae). *Cahiers des Naturalistes,* 47 (1): 1-25.

GOUGEROT, L. Y FEKI, M., 1979. Contribution a la revision du genre *Anisocycla* Monterosato (1884) (Gastropoda, Pyramidellidae). *Bulletin Societé de Sciences Naturelles, Tunisia,* 13: 87-96.

GOUGEROT, L. Y FEKI, M., 1980. Etude critique des especes d'*Anisocycla* Monterosato d'appartenance generique certain, subsistant actuellment. *Bulletin Societé de Sciences Naturelles, Tunisia,* 15: 25-50.

PEÑAS, A. Y ROLÁN, E., 1999a. La familia Pyramidellidae en Africa Occidental. 4. Los géneros *Megastomia, Odostomia, Ondina, Noemiamea* y *Syrnola. Iberus,* suplemento 5: 1-150.

PEÑAS, A. Y ROLÁN, E., 1999b. La familia Pyramidellidae Gray, 1840 (Mollusca, Gastropoda, Heterostropha) en África Occidental. 6. El género *Pseudoscilla* Boettger, 1901. *Iberus,* 17 (2): 11-22.

PEÑAS, A. Y ROLÁN, E., 2000. The family Pyramidellidae Gray, 1840 (Mollusca, Gastropoda, Heterostropha) in West Africa. 7. Addenda to the genera *Eulimella* and *Turbonilla,* with a list of the east Atlantic species and synonyms. *Argonauta,* 13 (2): 59-80.

PEÑAS, A., TEMPLADO, J. Y MARTÍNEZ, J. L., 1996. Contribución al conocimiento de los Pyramidelloidea (Gastropoda: Heterostropha) del Mediterráneo español. *Iberus,* 14 (1): 1-82.

SCHANDER, C., 1994 (1993). Twenty-eight new species of Pyramidellidae (Gastropoda, Heterobranchia) from West Africa. *Notiziario CISMA,* 15: 11-78.

SCHANDER, C., AARTSEN, J. J. VAN Y CORGAN, J. X., 1999. Famillies and genera of the Pyramidelloidea (Mollusca, Gastropoda). *Bollettino Malacologico,* 34 (9-12): 145-166.

WARÉN, A., 1994. Systematic position and validity of *Ebala* Gray, 1847 (Ebalidae Fam. N., Pyramidelloidea, Heterobranchia). *Bollettino Malacologico,* 30 (5-9): 203-210.

WENZ, W., 1938. *Handbuch der Paläozoologie* I. Borntraeger, Berlin, 948 pp.

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Environmentally safe molluscicides from two common euphorbiales

Molusquicidas no perjudiciales para el medioambiente obtenidos a partir de dos euforbiáceas

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Recibido el 15-V-2000. Aceptado el 14-III-2001

ABSTRACT

Aqueous extracts of latex and stem bark of *Codiaeum variegatum* and *Croton tiglium* (Euphorbiaceae) have a high molluscicidal activity. It was observed that the molluscicidal activity of extracts of both the plants against two harmful freshwater snails *Lymnaea acuminata* and *Indoplanorbis exustus* was time as well as dose dependent. There was a significant negative correlation between LC50 values and exposure periods thus increase in exposure time, the LC50 of *Croton tiglium* and *Codiaeum variegatum* latices were decreased from 0.060 mg DW/L (24h)> to 0.014 mg DW/L (96h) and 0.381 mg DW/L (24h)> to 0.159 mg DW/L (96h), respectively against *Lymnaea acuminata* and 0.034 mg DW/L (24h)> to 0.009 mg DW/L (96h) and 0.246 mg DW/L (24h)> to 0.030 mg DW/L (96h), respectively against *Indoplanorbis exustus*.

These plant part extracts at higher doses were also lethal to freshwater fish *Channa punctatus*, which shares the habitat with these snails, but the doses LC90, (24h) of snails are safe for fish.

RESUMEN

Los extractos acuosos de latex y corteza del tallo de Codiaeum variegatum y Croton tiglium (Euphorbiaceae) tienen una alta actividad molusquicida. Esta actividad, frente a dos caracoles de agua dulce dañinos, *Lymnaea acuminata* y *Indoplanorbis exustus* , depende tanto del tiempo como de la dosis. Hay una correlación negativa significativa entre los valores LC50 y los periodos de exposición según se aumentan éstos, el LC50 de los latex de *Croton tiglium* y *Codiaeum variegatum* fueron decrecientes 0.060 mg DW/L (24h)> hasta 0.014 mg DW/L (96h) y 0.381 mg DW/L (24h)> hasta 0.159 mg DW/L (96h), respectivamente contra *Lymnaea acuminata* y 0.034 mg DW/L (24h)> hasta 0.009 mg DW/L (96h) y 0.246 mg DW/L (24h)> desde 0.030 mg DW/L (96h), respectivamente contra *Indoplanorbis exustus*.

Estos extractos de partes de plantas a dosis mayores fueron también letales para el pez de agua dulce *Channa punctatus*, que comparte hábitat con estos dos caracoles, pero la dosis LC90, (24h) era inocua para los peces.

KEY WORDS: Molluscicide, *Codiaeum variegatum, Croton tiglium, Lymnaea acuminata, Indoplanorbis exustus,* Euphorbiaceae.

PALABRAS CLAVE: Molusquicida, *Codiaeum variegatum, Croton tiglium, Lymnaea acuminata, Indoplanorbis exustus,* Euphorbiaceae.

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INTRODUCTION

Recent studies have indicated that there are a number of medicinal plants which may be useful for control of snail population and hence control transmission of schistosomiasis and fascioliasis (Medina and Ritchi, 1980; Marston and Hostettman, 1987; Gopalsamy, Gueho, Julien, Owadally and Hostettman, 1990; Singh, Singh and Singh, 1996; Singh and Singh, 1997; Sukumaran, Prashar and Rao, 1994; Marston, Dudan, Gupta, Salis, Correa and Hostettman, 1996; Geerts, Alard, Belot and Sidhom, 1992; Amusan, Msothi and Makhuba, 1997 and Laurens, Fournean, Hoaqnemiller, Care, Bories and Loiseau, 1997).

Molluscicides derived from plants that can be grown in endemic areas of fascioliasis transmission may provide a relatively low cost means for controlling snail intermediate hosts, since expenses of synthesis, marketing and transportation are reduced or eliminated. But, the use of plant products as molluscicides would be justified only, if it can be demonstrated that the effect of the dose needed as molluscicide is non-toxic to other aquatic animals, especially fish.

The present study reports the molluscicidal effect of the two euphorbious plants i.e. *Codiaeum variegatum* and *Croton tiglium* (which is a commonly cultivated as an ornamental plant in gardens, and is usually called a Croton) against the harmful snails *Lymnaea acuminata* and *Indoplanorbis exustus*. These snails are vectors of liver fluke, *Fasciola hepatica* and *Fasciola gigantica*, which causes endemic fascioliasis in Eastern Uttar Pradesh (Singh and Agarwal, 1981). Toxicity experiments have also carried out on freshwater fish *Channa punctatus* (which shares the habitat with snails) for environmental toxicity, if any.

MATERIALS AND METHODS

Latex and stem bark of both the euphorbiales were collected from the Botanical garden of D.D.U. Gorakhpur University, Gorakhpur and identified by Prof. S.K. Singh (taxonomist), Botany Department, D.D.U. Gorakhpur University, Gorakhpur.

Preparation of aqueous extracts of Stem bark and Latex

Stem bark: The fresh stem bark (50mg/5ml) were minced with distilled water homogenized for 5 min and centrifuged at 1000 g for 10 min The supernatant was used as a water extract for the molluscicidal activity.

Latex: The white latex from these plants was drained in glass tubes by cutting their stem apices, this latex was lyophilized at - 40 °C and lyophilized powder was stored for further use. The freeze-dried powder was mixed with appropriate volume of distilled water to obtain the desired concentrations. The wet weight of volume of 1 ml latex of *Codiaeum variegatum* and *Croton tiglium* was 810 mg and 800 mg respectively and dry weight was 305 mg and 300 mg respectively.

Lymnaea acuminata (2.6±0.3 cm in shell height), *Indoplanorbis exustus* (0.87±0.035 cm in shell height) and *Channa punctatus* (10.5±0.9 cm in total length) were collected from Ramgarh Lake of Gorakhpur district, and used as test animals. Toxicity experiments were performed using the method of Singh and Agarwal (1988). Ten experimental animals were kept in glass aquaria, containing 3L of dechlorinated tap water for both the snails. The experimental animals were exposed continuously for 96h to four different concentrations. Control animals were kept under similar conditions without any treatment.

Toxic effect of aqueous extracts of latex and stem bark of both the plants was also studied in mixed populations of fish and snails. In these experiments, a group of 10 snails *Lymnaea acuminata* and 10 fish *Channa punctatus* were put together in 6L dechlorinated tap water. These mixed populations were exposed to previously determined LC90 (24h) of snails for 24h.

Table I. Toxicity (LC10, 50, 90) of aqueous freeze-dried latex extracts of *Croton tiglium* (Family Euphorbiaceae) against *Lymnaea acuminata* at different time intervals. Batches of ten snails were exposed to four different concentrations of aqueous extracts of latex of *Croton tiglium.* Concentrations (Dry weight of latex) given are the final concentrations W/V in aquarium water. Regression coefficient showed that there was significant ($P<0.05$) negative regression between exposure time and different LC values. LCL: lower confidence limit. UCL: upper confidence limit. There was no mortality in control groups.

Tabla I. Toxicidad de extractos acuosos liofilizados de latex (LC10, 50, 90) de Croton tiglium *(Familia Euphorbiaceae) frente a* Lymnaea acuminata *en diferentes intervalos de tiempo. Grupos de 10 caracoles fueron expuestos a 4 diferentes concentraciones de extractos acuosos de latex de* Croton tiglium. *Las concentraciones indicadas (peso seco de latex) son concentraciones finales P/V en el agua del acuario. Los coeficienes de regresión muestran que hay regresiones negativas significativas (P<0.05) entre el tiempo de exposición y diferentes valores de LC. LCL: límite inferior de confianza. UCL: límite superior de confianza. No hubo mortalidad en los grupos de control.*

Exposure periods	Effective dose (W/V) (mg DW/L)	Limit (mg DW/L) LCL	UCL	Slope value	't' ratio	'g' value	Heterogeneity
24h	LC10= 0.015	0.011	0.017				
	LC50=0.06	0.03	0.07	3.98±0.78	5.05	0.15	0.22
	LC90=0.19	0.14	0.42				
48h	LC10= 0.011	0.005	0.013				
	LC50=0.04	0.03	0.06	2.17±0.56	3.86	0.57	0.22
	LC90=0.15	0.07	0.31				
72h	LC10= 0.007	0.004	0.01				
	LC50=0.02	0.017	0.025	2.69±0.50	5.36	0.13	0.77
	LC90=0.061	0.043	0.13				
96h	LC10= 0.04	0.002	0.006				
	LC50=0.014	0.012	0.017	2.38±0.47	4.99	0.15	0.30
	LC90=0.05	0.036	0.106				

Mortality was recorded at 24h intervals up to 96h. Lethal concentrations (LC10, 50, 90) values, Upper and Lower confidence limits (UCL, LCL) and slope values were calculated by the Probit log method using POLO computer programme of Russell et al. (1977). The regression coefficient was determined between exposure time and different values of LC50 (SOKAL AND ROHLF, 1973).

RESULTS

Experimental conditions of water determined by the method of APHA/WPCF (1980). Atmospheric and water temperature was ranging from 30.5 – 31.5 °C and 27.0 – 28.0 °C, respectively. pH of water was 7.3 – 7.5, while dissolved oxygen, free carbon dioxide and bicarbonate alkalinity were ranging from 6.8 – 7.6, 4.4 – 6.5 and 105.0 – 109.0 mg/L, respectively for whole experiments.

(A) Effects on Behavioural changes and Poisoning Symptoms

Exposure to the aqueous extracts of latex and stem bark of *Codiaeum variegatum* and *Croton tiglium* caused significant behavioural changes in the freshwater snails *Lymnaea acuminata* and *Indoplanorbis exustus.* Behavioural changes appear with 5 to 10 min of exposure. The initial 30 – 45 min was a

Table II. Toxicity (LC10, 50, 90) of aqueous freeze-dried latex extracts of *Croton tiglium* (Family Euphorbiaceae) against *Indoplanorbis exustus* at different time intervals. Other details are as given in Table 1.
Tabla II. Toxicidad de extractos acuosos liofilizados de latex (LC10, 50, 90) de Croton tiglium *(Familia Euphorbiaceae) frente a* Indoplanorbis exustus *en diferentes intervalos de tiempo. Resto de detalles como en la Tabla I.*

Exposure periods	Effective dose (W/V) (mg DW/L)	Limit (mg DW/L) LCL	UCL	Slope value	't' ratio	'g' value	Heterogeneity
24h	LC10= 0.009	0.006	0.018				
	LC50=0.034	0.026	0.063	2.36±0.53	4.50	0.18	0.28
	LC90=0.117	0.063	0.549				
48h	LC10= 0.005	0.003	0.008				
	LC50=0.02	0.017	0.025	2.36±0.42	5.56	0.12	0.18
	LC90=0.068	0.044	0.161				
72h	LC10= 0.004	0.002	0.006				
	LC50=0.015	0.012	0.017	2.42±0.40	6.04	0.10	0.26
	LC90=0.050	0.035	0.095				
96h	LC10= 0.03	0.002	0.004				
	LC50=0.009	0.008	0.011	2.96±0.41	7.22	0.48	0.74
	LC90=0.026	0.021	0.037				

Table III. Toxicity (LC10, 50, 90) of aqueous freeze-dried latex extracts of *Codiaeum variegatum* (Family; Euphorbiaceae) against *Lymnaea acuminata* at different time intervals. Other details are as given in Table 1.
Tabla III. Toxicidad de extractos acuosos liofilizados de latex (LC10, 50, 90) de Codiaeum variegatum *(Familia Euphorbiaceae) frente a* Lymnaea acuminata *en diferentes intervalos de tiempo. Resto de detalles como en la Tabla I.*

Exposure periods	Effective dose (W/V) (mg DW/L)	Limit (mg DW/L) LCL	UCL	Slope value	't' ratio	'g' value	Heterogeneity
24h	LC10= 0.159	0.108	0.189				
	LC50=0.381	0.321	0.546	3.41±0.77	4.42	0.19	0.39
	LC90=0.906	0.600	2.589				
48h	LC10= 0.120	0.081	0.147				
	LC50=0.258	0.023	0.291	3.92±0.69	5.62	0.12	0.15
	LC90=0.546	0.432	0.870				
72h	LC10= 0.099	0.066	0.120				
	LC50=0.195	0.171	0.213	4.37±0.69	6.26	0.98	0.20
	LC90=0.381	0.330	0.501				
96h	LC10= 0.090	0.060	0.117				
	LC50=0.159	0.141	0.171	6.60±0.93	7.08	0.07	0.69
	LC90=0.246	0.228	0.279				

Table IV. Toxicity (LC10, 50, 90) of aqueous freeze-dried latex extracts of *Codiaeum variegatum* (Family Euphorbiaceae) against *Indoplanorbis exustus* at different time intervals. Other details are as given in Table 1.
Tabla IV. Toxicidad de extractos acuosos liofilizados de latex (LC10, 50, 90) de Codiaeum variegatum *(Familia Euphorbiaceae) frente a* Indoplanorbis exustus *en diferentes intervalos de tiempo. Resto de detalles como en la Tabla I.*

Exposure periods	Effective dose (W/V) (mg DW/L)	Limit (mg DW/L) LCL	UCL	Slope value	't' ratio	'g' value	Heterogeneity
24h	LC10= 0.045	0.024	0.063				
	LC50=0.246	0.183	0.417	1.78±0.3	5.11	0.1	0.27
	LC90=1.29	0.651	5.793				
48h	LC10= 0.018	0.006	0.027				
	LC50=0.093	0.075	0.117	1.82±0.28	6.42	0.09	0.28
	LC90=0.471	0.318	0.996				
72h	LC10= 0.009	0.003	0.018				
	LC50=0.048	0.036	0.060	1.98±0.28	6.42	0.09	0.92
	LC90=0.222	0.165	0.248				
96h	LC10= 0.006	0.003	0.012				
	LC50=0.030	0.018	0.039	2.16±0.32	6.60	0.08	0.98
	LC90=0.117	0.093	0.168				

period of hyperactivity during which slugish snails moved rapidly in the aquarium water. After some time they started crawling on each other. As the poison enters in the snail's body, a muscular twitching and the snails become spirally twisted, which resulted ataxia, convulsion, paralysis and finally death of snails. Prior to death, there was complete withdrawal of the body inside the shell that indicates nerve poisoning.

(B) Dose-mortality response

LC values (LC10, 50, 90) of aqueous extracts of latex and stem bark of *Croton tiglium* and *Codiaeum variegatum* for period ranging from 24h to 96h for the snails, *Lymnaea acuminata* and *Indoplanorbis exustus* have been given in (Tables I-IV and Figure 1). In case of both the snails toxicity was time as well as dose dependent. There was a significant negative correlation between LC50 values and exposure time (Tables I-IV and Figure 1). Thus increase in exposure time the LC50 of *Croton tiglium* latex decreased from 0.06 mg DW/L (24h);> 0.04 mg DW/L (48h);> 0.02 mg DW/L (72h);> to 0.014 mg DW/L (96h) and 0.034 mg DW/L (24h);> 0.02 mg DW/L (48h); 0.015 mg DW/L (72h);> to 0.009 mg DW/L (96h) in case of *Lymnaea acuminata* and *Indoplanorbis exustus*, respectively (Tables I, II). Same trend of toxicity was observed in case of stem bark extracts of *Croton tiglium* and *Codiaeum variegatum* against both the snails at all the exposure periods (Fig. 1).

Laboratory experiments also indicates that the latex and stem bark extracts of both the plants were more toxic against *Indoplanorbis exustus* than *Lymnaea acuminata* at all the exposure periods.

At higher dose, active moiety of plants, which were effective against the snails, would also cause death amongst the fish. Consequently, a mixed popula-

Table V. Per cent mortality (mean ±SE) of *Lymnaea acuminata* and *Channa punctatus* caused by aqueous extracts of latex and stem bark (i.e. 24h LC90 of snail) of *Codiaeum variegatum* and *Croton tiglium* after 24h exposure period. Each aquarium contained ten fish (*Channa punctatus*) and ten snails (*Lymnaea acuminata*) in 6L dechlorinated tap water. There was no mortality in case of control group.

Table V. Porcentaje de mortalidad (media ±SE) de Lymnaea acuminata *y* Channa punctatus *producida por extractos acuosos de latex y corteza de tallos (i.e. 24h LC90 de caracoles) de* Codiaeum variegatum *y* Croton tiglium *despues de 24 horas de exposición. Cada acuario contenía 10 peces (*Channa punctatus*) y 10 caracoles (*Lymnaea acuminata*) en 6 l de agua de grifo desclorada. No hubo mortalidad en el grupo de control.*

Plants	Plant Parts	Experimental animals	Concentration (mg DW/L) (w/v)	% Mortality
Codiaeum variegatum	Latex	*L. acuminata*	0.906 (LC90)	91.6±2.31
		C. punctatus	-	Zero
	Stem bark	*L. acuminata*	50.14 (LC90)	93.3±1.15
		C. punctatus	-	Zero
Croton tiglium	Latex	*L. acuminata*	0.19 (LC90)	100
		C. punctatus	-	Zero
	Stem bark	*L. acuminata*	35.52 (LC90)	95.0±2.45
		C. punctatus	-	Zero

tions of 10 snails (*Lymnaea acuminata*) and 10 fish (*Channa punctatus*) were treated with the 24h, LC90 of latex and stem bark of *Croton tiglium* and *Codiaeum variegatum*, up to the LC90 doses for snail *Lymnaea acuminata* there was no mortality amongst fish (Table V).

The slope values given in toxicity tables (I – IV) were steep and heterogeneity factor was less than 1.0 indicates the result found to be within the 95% confidence limits of LC values. The regression test ('t' ratio) was greater than 1.96 and the potency estimation test ('g' value) was less than 0.5 at all probability levels.

DISCUSSION

Data of present study shows that the extracts of both the plants caused significant behavioural changes in both the freshwater snails. The most obvious sign of distress in the treated snails were muscular twitching and spiral twisting of the body, followed by crawling on each other. The nature and rapid onset of these behavioural responses indicates that, the latex perhaps contains some neurotoxins, which amongst other think, might be active at the neuromuscular system of the exposed animals. Similar behavioural responses were also observed Singh and Agarwal (1990), in their study on acute toxicity of latices of *Euphorbia royleana, Euphorbia antisyphliatica* and *Jatropha gossypifolia* on snail *Lymnaea acuminata*. The behavioural changes are indeed reminiscent to the response of snails to organophosphorus and carbamate pesticides (Singh and Agarwal, 1981).

No such behavioural symptoms and death occurred in control groups indicating that no factor other than plant moieties was responsible for altered behaviour and mortality.

Mortality caused by the plant parts preparation showed a clear significant positive correlation between dose and mortality. For example, for latex of *Croton tiglium* present mortality of snail *Lymnaea acuminata* after 24h was 10% at 0.015 mg DW/L which increased up to 90% at 0.004 mg DW/L (Table I) which

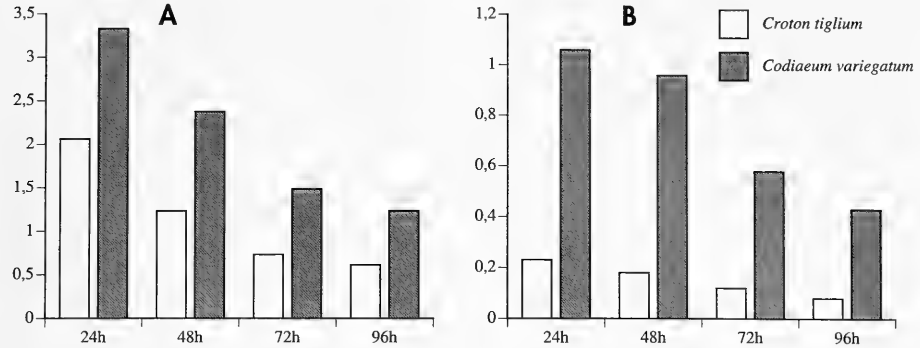

Figure 1. Bar diagram showing the toxicity (LC50; ml/l) of aqueous stem bark extract of *Croton tiglium* and *Codiaeum variegatum* against *Lymnaea acuminata* (A) and *Indoplanorbis exustus* (B) at different time intervals. Batches of 10 snails were exposed to four different dilutions of aqueous extract of bark of *C. tiglium* and *C. variegatum.* Doses are expressed as final concentration (V/V) of stem bark in aquarium. There was no mortality in control group.

Figura 1. Diagrama de barras que muestra la toxicidad (LC50) de extractos acuosos de corteza de tallos de Croton tiglium *y* Codiaeum variegatum *frente a* Lymnaea acuminata *(A) y* Indoplanorbis exustus *(B) a diferentes intervalos de tiempo. Se expusieron grupos de 10 caracoles a 4 concentraciones distintas de extractos de corteza de* C. tiglium *y* C. variegatum. *Las dosis se expresan como concentraciones finales (V/V) de corteza en el acuarion. No hubo mortalidad en el grupo de control.*

in case of *Codiaeum variegatum* mortality it increased from 10% to 90%, when doses increased from 0.159 mg DW/L to 0.090 mg DW/L (Table III). Same trend was also observed in case of stem bark of both the plants at all the exposure periods.

The positive correlation between dose and mortality in all cases was noted because increase concentration of pesticides in aquarium water resulted in more intake or entry of pesticides in the body of animals. This trend is also independent upon several factors such as, rate of penetration, nature of slope, variability and maximal effects of active moieties.

Aqueous preparation of all the plant parts showed a significant negative correlation between LC value and exposure periods e. g LC50 of latex extracts of *Croton tiglium* were decreased from 0.06 mg DW/L (24h); > 0.04 mg DW/L (48h); > 0.02 mg DW/L (72h); > 0.014 mg DW/L (96h) and 0.034 mg DW/L (24h); > 0.02 mg DW/L (48h); > 0.015 mg DW/L (72h); > to 0.009 mg DW/L (96h) in the case of *Lymnaea acuminata* and *Indoplanorbis exustus* respectively (Tables I, II).

Increased in mortality with increased in exposure periods could be affected by several factors, which may be acting separately or conjointly. For example, uptake of active moiety is time dependent, which leads progressive increase the entrance of the drug and its effects in the snail body (SINGH AND AGARWAL, 1988; 1993a; 1993b). Stability (life span) of active moiety of pesticides in environment and the rate of their detoxification in animal body also alter the mortality and exposure periods, relationships (MITRA, SUD AND MITRA, 1978; KOUNDINYA AND RAMAMMURTHY 1979; MATSUMURA, 1985). This possibility cannot be ruled out in case of plant origin pesticides also.

More important is the fact that the latex of these plants is much more toxic than synthetic pesticides. The present study demonstrates that the latex of *Croton tiglium* and *Codiaeum variegatum* have higher molluscicidal activity than any of the prevalent synthetic pyrethroids. Thus, the 24h LC50 of mexacarbamate (3.5 ppm), aldicarb (30.00 ppm), farmothion (27.00 ppm), Cypermethrin (2.5 ppm), permethrin (0.82 ppm) and fenavalerate (2.5 ppm) against the *Lymnaea acuminata* (SINGH AND AGARWAL 1981; SINGH AND AGARWAL 1986; 1987; 1988 and 1991; SAHAY, SINGH AND AGARWAL, 1991) is higher than that of the *Croton tiglium* (0.06 ppm) which is about 196 times stronger the standard molluscicides niclosamide (LC50 11.8 ppm) (SINGH AND AGARWAL, 1984).

Statistical analysis of the data on toxicity brings out several important points. The χ^2 test for goodness of fit (Heterogeneity) demonstrated that the mortality counts were not found to be significantly heterogeneous and other variables, e.g. resistance etc. do not significantly affect the LC50 values, as these were found to lie within the 95% confidence limits. The dose mortality graphs exhibit steep slope values. The steepness of the slope line indicates that there is a large increase in the mortality of snails with relatively small increase in the concentration of the toxicant. The slope is, thus an index of the susceptibility of the target animal to the pesticides used. A steep slope is also indicative of rapid absorption and onset of effects. Even though the slope alone is not a very reliable indicator of toxicological mechanism, yet it is a useful parameter (RAND AND PETROCELLI, 1988) for such a study. Since the LC50 of the latices of different euphorbiales lay within the 95% confidence limits, it is obvious that in replicate test of random samples, the concentration response lines would fall in the same range (RAND AND PETROCELLI, 1988).

The doses, that can be, used for killing the snails are safe for fish. This is supported by our observations on a mixed population of snails and fish.

In conclusion, it is believed that the extracts of above plants may be used as potent source of molluscicides, because plant products are less expensive, easily available, easily soluble in water and less hazardous to the non-target animals than the synthetic molluscicides.

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BIBLIOGRAPHY

AMUSAN, O. O. G., MSOTHI, J. D. AND MAKHUBA, L. P., 1997. Molluscicidal activity of *Urginia epigea*. *Fitoterapia*, 68: 185-186.

APHA/AWWA/WPCF, 1985. *Standard methods for the examination of water and wastes water*. 16th edition, American Public Health Association, New York, U.S.A. 1080 pp.

GEERTS, S., ALARD, F., BELOT, J. AND SIDHOM, M., 1992. The toxicity of *Ambrosia maritima* to snails and non-target organisms. In Symoens, J. J., Geerts, S. and Terriest, L. (Eds.): Vectors control of schistosomiasis using Native African plants. *Seminar Brussels Royal Academy of Overseas Sciences (Brussels)*: 89-100.

GOPALSAMY, N., GUEHO, J., JULIEN, H. R., OWADALLY, A. W. AND HOSTETTMAN, K., 1990. Molluscicidal saponins of *Polyscias dichroostachya*. *Phytochemistry*, 29: 793-795.

KOUNDINYA, R. P. AND RAMAMMURTHY, R., 1979. Effect of sumithion (Fentothion) on some selected enzymes system in the fish, *Tilapia mossambica* (Reters). *Indian Journal of Experimental Biology*, 16: 808-811.

LAURENS, A., FOURNEAN, C., HOAQNEMILLER, R., CARE, A., BORIES, C. AND LOISEAU, P.M., 1997. Antivectorial activities of casheunut shell extracts from *Anacardium occidentale*. L. *Phytotherapy Research*, 11: 145-146.

MARSTON, A. AND HOSTETTMAN, K., 1987. Antifungal molluscicidal and cytotoxic compounds from plants used in traditional medicine. In Hostettman, K. and Lea, P. J. (Eds.): *Biologically Active Natural Products*. Oxford Science Publications, Clarendon Press Oxford pp. 65-85.

MARSTON, A., DUDAN, G., GUPTA, M. P., SALIS, P. N., CORREA, M. D. AND HOSTETTMAN, K., 1996. Screening of Panamanian plants for molluscicidal activity. *International Journal of Pharmacognosy*, 34: 15-18.

MATSUMURA, F., 1985. *Toxicity of Insecticides*. 2nd ed, Plenum Press, New York. pp. 47, 74, 78-80, 163-165, 446.

MEDINA, F. R. AND RITCHI, L. S., 1980. Molluscicidal activity of the Pureto Rican weed *Solanum nodiflorum* against snail host of *Fasciola hepatica*. *Economic Botany*, 34: 368-375.

MITRA, P. K., SUD S. C. AND MITRA, H. C., 1978. Acute oral toxicity of metasystoxin in buffalo calves. *Indian Journal of Experimental Biology*, 16: 813-815.

RAND, G. M. AND PETROCELLI, S. R., 1988. *Fundamentals of aquatic toxicology*. Rand, G. M. and Petrocelli, S. R. (Eds.) Hemisphere Publishing Corporation, New York. 415 pp.

RUSSELL, R. M., ROBERTSON, J. L. AND SEVIN, N. E., 1977. POLO: A new computer programme for probit analysis. *Bulletin of the Entomolological Society of Am.erica*, 23: 209-213.

SAHAY, N., SINGH, D. K. AND AGARWAL, R. A., 1991. Synergistic effect of piperonyl butoxide the toxicity of synthetic pyrethroids in the snail *Lymnaea acuminata*. *Journal of Medical and Applied Malacology*, 3: 107-111.

SINGH, A. AND AGARWAL, R. A., 1988. Possibility of using latex of euphorbiales for snail control. *The Science of the total Environment*, 77: 231-267.

SINGH, A. AND AGARWAL, R. A., 1990. Molluscicidal properties of synthetic pyrethroids. *Jorunal of Medical and Applied Malacology*, 2: 141-144.

SINGH, A. AND AGARWAL, R. A., 1993a. Toxicity of the synthetic pyrethroid fenvalerate, on enzymes of the target snail *Lymnaea acuminata* and the non-target fish *Channa striatus*. *Journal of Medical and Applied Malacology*, 5: 87-91.

SINGH, A. AND AGARWAL, R. A., 1993b. Effect of Cypermethrin on lactate Succinic dehydrogenase and Cytochrome oxidases of snail and fish. *Bulletin of Environmental contamination and Toxicology*, 51: 445-452.

SINGH, K., SINGH, A. AND SINGH D. K., 1996. Molluscicidal activity of neem (*Azadirachta indica* A. Jus). *Journal of Ethnopharmacology*, 52: 35-40.

SINGH, D. K. AND AGARWAL, R. A., 1984. Correlation of the anticholinesterase and molluscicidal activity of the latex of *Euphorbia royleana* Bloss. on *Lymnaea acuminata*. *Journal of Natural Products*, 47: 702-705.

SINGH, D. K. AND AGARWAL, R. A., 1986. Toxicity of pesticides to fecundity, hatchability and survival of young snail *Lymnaea acuminata*. *Acta Hydrochimica et Hydrobiologica*, 14: 191-194.

SINGH, D. K. AND AGARWAL, R. A., 1987. Effect of the synthetic pyrethroids permethrin on the snail *Lymnaea acuminata*. *The Science of the total Environment*, 67: 263-267.

SINGH, D. K. AND AGARWAL, R. A., 1991. Action sites of Cypermethrin a synthetic pyrethroids in the snail *Lymnaea acuminata*. *Acta Hydrochimica et Hydrobiologica*, 19: 425-430.

SINGH, O. AND AGARWAL, R. A., 1981. Toxicity of certain pesticides to two economic species of snails in northern India. *Journal of Economic Entomology*, 74: 568-571.

SINGH, S., SINGH, V. K. AND SINGH D. K., 1997. Molluscicidal activity of some common spices plants. *Biological Agriculture and Horticulture*, 14: 237-249.

SOKAL, R. R. AND ROHLF F. J., 1973. *Introduction to Biostatics*. Fremon, W. H. San Francisco. 365 pp.

SUKUMARAN, D., PRASHAR, B. D. AND RAO, K. M., 1994. Molluscicidal properties of *Agave americana* and *Balaenities aegyptica*. *International Journal of Pharmacognosy*, 31: 232-238.

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The Opisthobranch Molluscs from Porto Santo Island (Madeira Archipelago, Northeastern Atlantic)[1]

Moluscos Opistobranquios de la Isla de Porto Santo (Archipiélago de Madeira, Atlántico Nordeste)[1]

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ABSTRACT

New data on the opisthobranch fauna from Porto Santo island (Madeira Archipelago) are presented. A list of the previously recorded sixteen species and their relatives references, together the first record of twelve additional species, is supplied.

RESUMEN

En este trabajo se presentan nuevos datos sobre la fauna de moluscos opistobranquios de la isla de Porto Santo (Archipiélago de Madeira). Se confecciona una lista de las dieciseis especies previamente citadas en esta isla, junto a sus correspondientes referencias, la cual se ve incrementada con otras doce especies adicionales citadas por primera vez en esta contribución.

KEY WORDS: Mollusca, Opisthobranchia, Porto Santo, Madeira, Portugal.
PALABRAS CLAVE: Mollusca, Opisthobranchia, Porto Santo, Madeira, Portugal.

INTRODUCTION

Among the islands of Madeira Archipelago, Porto Santo is one of the less known with respect to the opisthobranchs. Only seven papers are known to us referring the presence of 16 species of opisthobranchs in Porto Santo (WATSON, 1897; NOBRE, 1937; NORDSIECK, 1972; NORDSIECK AND GARCÍA-TALAVERA, 1979; WIRTZ, 1994; FONSECA, GUERREIRO AND GIL, 1995; WIRTZ, 1999).

Porto Santo is the second largest island of Madeira archipelago and is situated 21 miles on the Northeast of Madeira island. It lies between 33° 07′ N

[1] Contribution of the Instituto Português de Malacologia

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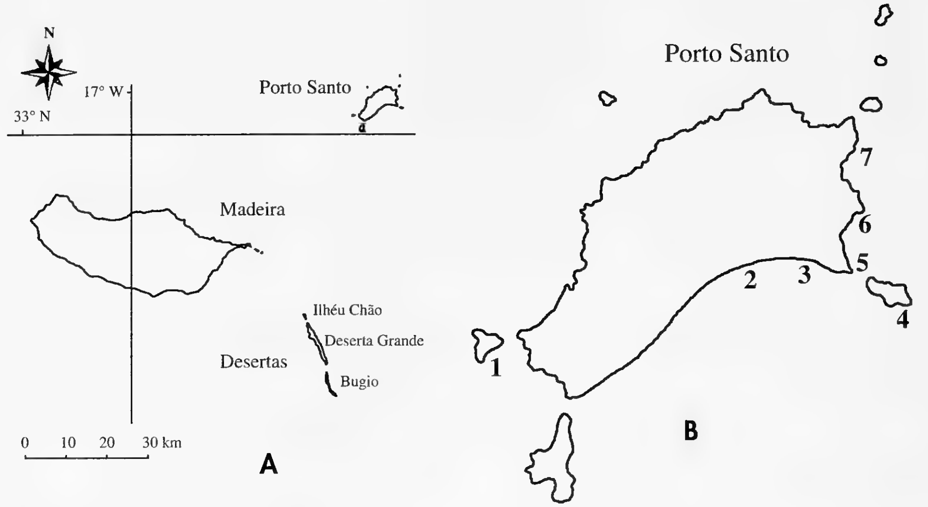


Figure 1. (A) Madeira archipelago and (B) Porto Santo Island with sampling localities. 1 Ilhéu de Ferro; 2: Porto de Abrigo; 3: Pedras Altas; 4: Ilhéu do Farol; 5: Ponta da Galé; 6: Porto dos Frades; 7: Pontinha.

Figura 1. (A) Archipiélago de Madeira y (B) Localidades de muestreo en la Isla de Porto Santo: 1: Ilhéu de Ferro; 2: Porto de Abrigo; 3: Pedras Altas; 4: Ilhéu do Farol; 5: Ponta da Galé; 6: Porto dos Frades; 7: Pontinha.

– 33° 00′ N and 16° 25′ W – 16° 17′ W and has an approximate area of 41 Km^2 with a coastal line of 38 Km. It is surrounded by seven islets, three of them with considerable dimensions. The littoral of Porto Santo is quite different from that of Madeira, mostly due to the presence of calcareous rocks and a large sandy beach. Whether these features are responsible or not for any particular faunistical composition of Porto Santo's littoral ecosystems is not yet known, by lacking of available ecological information.

As part of the research Programme OpisthoMadeira, launched in 1994 by the Museu Municipal do Funchal (História Natural), several field sampling were carried on Porto Santo island, which results are reported here together with a compilation of the previous bibliographical records.

MATERIAL AND METHODS

During the period of 18 to 23 September 2000, opisthobranch molluscs were collected in eight different localities in a total of ten sampling efforts, covering both the intertidal and the subtidal areas down to 20 meters depth. On the subtidal areas the specimens were collected by SCUBA diving, using a suction device and by manual collecting after direct observation. Substratum covered with seaweeds, sponges, bryozoans and hydrozoans colonies were particularly searched.

After sieving, the specimens were studied with stereomicroscopes, photographed, fixed in formalin 4% and preserved in ethanol 70%.

The specimens were kept in the collections of the Museu Municipal do Funchal (História Natural) (designated as MMF).

RESULTS

Fourteen species were collected and identified during the present Campaign (1 Cephalaspidea, 1 Anaspidea, 1 Sacoglossa, 2 Tylodinoidea, 1 Pleurobranchoidea, and 8 Nudibranchia) and

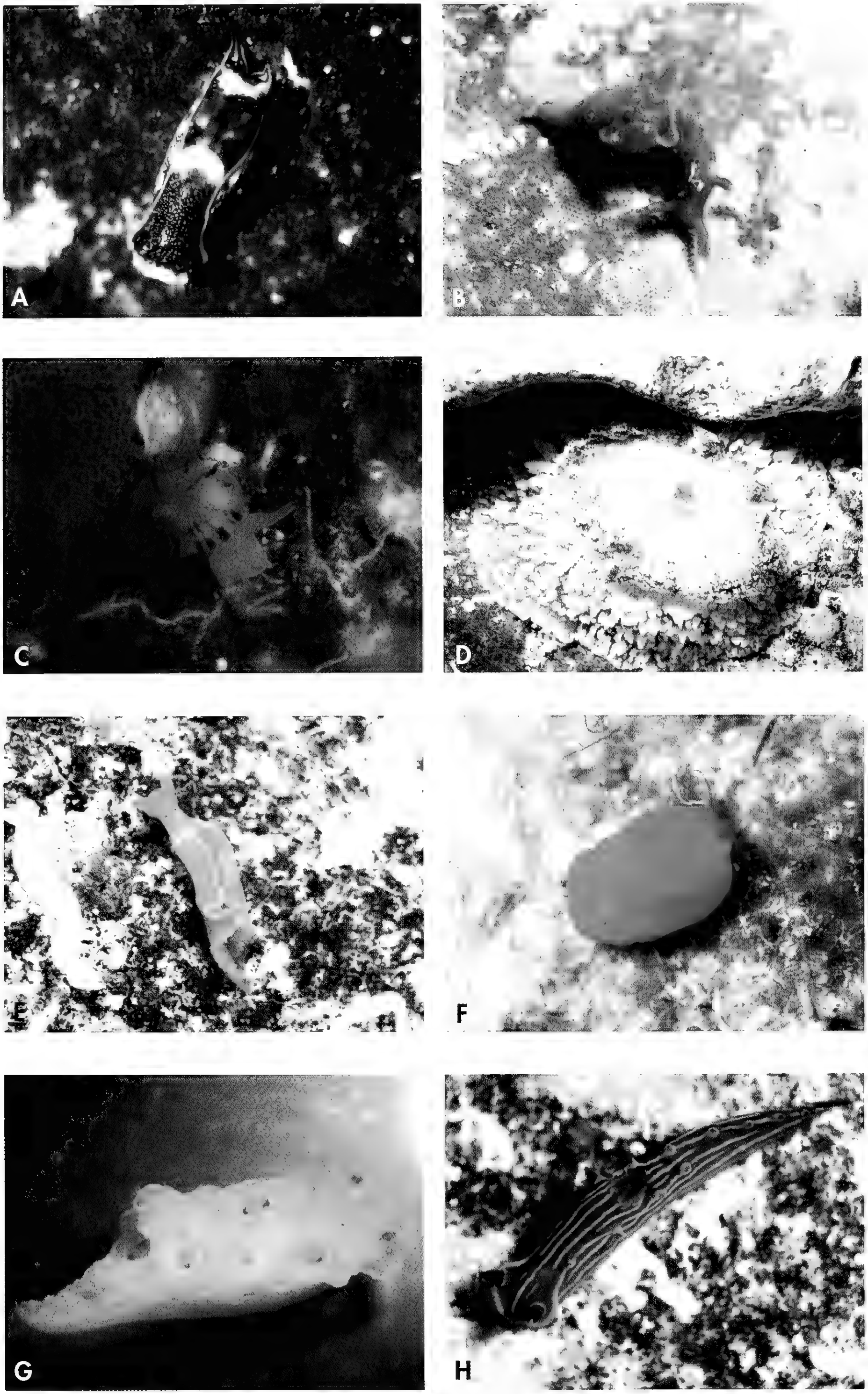
Table I. Opisthobranch molluscs from Porto Santo island.
Tabla I. Moluscos Opistobranquios de la Isla de Porto Santo.

Cephalaspidea Fischer, 1863 (*sensu* MIKKELSEN, 1996)	
Chelidonura africana Pruvot-Fol, 1953	Present account. Porto de Abrigo, 18th September 2000, one specimen with 3 mm in length. 22nd September 2000, one specimen (MMF31629) with 3mm in length, collected at night time under a floating jetty.
Cylichna cylindracea (Pennant, 1767)	NORDSIECK (1972: 15), NORDSIECK AND GARCÍA-TALAVERA (1979: 170)
Pyrunculus spretus (Watson, 1897)	WATSON (1897: 234), NOBRE (1937: 15)
Philine monterosatoi (Vayssière, 1885)	NORDSIECK (1972: 22 as *Philingwynia monterosati*), NORDSIECK AND GARCÍA-TALAVERA (1979: 171)
Philine desmotis Watson, 1897	WATSON (1897: 236), NOBRE (1937: 17) and NORDSIECK AND GARCÍA-TALAVERA (1979: 172)
Retusa truncatula (Bruguière, 1792)	WATSON (1997: 326 as *Utriculus truncatulus*), NORDSIECK (1972: 34 as *Retusa mariei*), NOBRE (1937: 14 as *Tornatina truncatula*)
Retusa mamillata (Brusina, 1865)	NORDSIECK AND GARCÍA-TALAVERA (1979: 177 as *Retusa (Mamilloretusa) mamillata*)
Retusa leptoleinema (Brusina, 1865)	NORDSIECK AND GARCÍA-TALAVERA (1979: 176 as *Retusa leptoleynema*)
Retusa tornata (Watson, 1883)	NORDSIECK (1972: 36 as *Semiretusa tornata*), NORDSIECK AND GARCÍA-TALAVERA (1979: 177 as *Semiretusa tornata*)
Scaphander (W.) diaphana Aradas and Maggiore, 1839	WATSON (1897: 315), NOBRE (1937: 14)
Anaspidea Fischer, 1883	
Aplysia parvula Guilding in Mörch, 1863	Present account. Porto de Abrigo, 20th September 2000, one specimen (MMF31626) with 20 mm in length. 22nd September, three specimens (MMF31631) with 2,5, 3 and 4 mm in length, collected during night time under a floating jetty.
Sacoglossa Ihering, 1876	
Ascobulla fragilis (Jeffreys, 1856)	WATSON (1897: 284) and NOBRE (1937: 16)
Elysia flava Verril, 1901	Present account. Pontinha, 22nd September 2000, one specimen (MMF31636) with 9 mm in length, collected under a stone at 10 m depth.
Pleurobranchoidea Ferussac, 1822	
Berthellina edwardsi (Vayssière, 1896)	Present account. Ilhéu de Ferro (Southeast shore), 19th September, one specimen (MMF31637) with 13 mm in length, collected under a stone at 10 m depth.
Tylodinoidea Gray, 1847	
Tylodina perversa (Gmelin in L., 1791)	WIRTZ (1999: 6), Present account. Ilhéu de Ferro (Southeast shore), 19th September 2000, one specimen with 4 mm of shell length, collected near the sponge *Aplysina aerophoba* at 10 m depth. Pedras Altas, 20th September 2000, two specimens with 5 mm of shell length, collected near the sponge *Aplysina aerophoba* at 3 m depth. Ilhéu do Farol (Southeast shore), 21st September 2000, one specimen with 7 mm in length.
Umbraculum umbraculum (Lightfoot, 1796)	Present account. Pontinha, 22nd September 2000, one specimen (MMF31634) with 50 mm of shell length, collected crawling on a wall at 10 m depth.

Table I. Continuation.
Tabla I. Continuación.

Nudibranchia Blainville, 1814	
Aegires sublaevis Odhner, 1931	Present account. Porto dos Frades, 21st September 2000, one specimen (MMF31624) with 3,5 mm in length, collected bellow algae between 0 and 1 m depth.
Aldisa smaragdina Ortea, Pérez and Llera, 1982	Present account. Ilhéu de Ferro (Southeast shore), 19th September 2000, five specimens (MMF31641) with 10, 12, 14, 16 and 20 mm in length, under stones covered by a red sponge at approximately 10 m depth. Pedras Altas, 20th September 2000, one specimen with 23 mm in length, collected at 3 m depth, under a stone with red sponges.
Chromodoris purpurea (Laurillard, 1831)	Present account. Porto de Abrigo, 20th September 2000, one specimen (MMF31632) with 7 mm in length, collected under a stone at 4 m depth. Porto de Abrigo (out part of the west harbour protection near the beach), 23rd September 2000, one specimen (MMF3164) with 10 mm in length, collected under a stone between 4 to 5 m depth.
Discodoris atromaculata (Bergh, 1884)	Wirtz (1994: 169; 1999: 7)
Discodoris confusa Ballesteros, Llera and Ortea, 1984	Wirtz (1999: 8), Present account. Ponta da Galé, 18th September 2000, one specimen with 40 mm in length, collected under a stone at 6 meters depth.
Hypselodoris bilineata (Pruvot-Fol, 1953)	Wirtz (1999: 7)
Hypselodoris picta (d'Orbigny, 1839)	Present account. Ilhéu de Ferro (Southeast shore), 19th September 2000, one specimen (MMF31623) with 50 mm in length, collected under a stone at 9 m depth
Tambja ceutae García-Gómez and Ortea, 1988	Present account. Porto de Abrigo, 22nd September 2000, five specimens (MMF31627) with 4, 16, 20, 26 and 27 mm in length, collected at night time under a floating jetty on colonies of the bryozoan *Bugula dentata*.
Taringa cf. *fanabensis* Ortea and Martínez, 1992	Wirtz (1999: 9)
Platydoris argo (Linné, 1767)	Present account. Ilhéu de Ferro (Southeast shore), 19th September 2000, two specimens (MMF31625) with 18 and 28 mm length, collected under stones at about 10 m depth. Pontinha, 22nd September 2000, two specimens (MMF31642) with 10 and 12 mm in length, collected under stones at about 10 m depth.
Plocamopherus maderae (Lowe, 1842)	Present account. Pontinha, 22nd September 2000, one specimen (MMF31622) with 20 mm in length, collected under a stone at 10 m depth.
Pseudovermis sp.	Fonseca *et al.* (1995: 243)

(Right page) Figure 2. A: *Chelidonura africana* (10 mm; specimen collected at Porto Santo, 24th June 1999); B: *Aplysia parvula* (20 mm); C: *Tylodina perversa* (7 mm); D: *Umbraculum umbraculum* (50 mm of shell length); E: *Elysia flava* (9 mm); F: *Berthellina edwardsi* (13 mm); G: *Aegires sublaevis* (7 mm; the illustrated specimen is from the southern coast of Madeira Island); H: *Tambja ceutae* (20 mm).
(Página derecha) Figura 2. A: Chelidonura africana *(10 mm; ejemplar capturado en Porto Santo el 24 Junio 1999); B:* Aplysia parvula *(20 mm); C:* Tylodina perversa *(7 mm); D:* Umbraculum umbraculum *(50 mm de longitud de la concha); E:* Elysia flava *(9 mm); F:* Berthellina edwardsi *(13 mm); G:* Aegires sublaevis *(7 mm; el ejemplar ilustrado proviene de la costa sur de la Isla de Madeira); H:* Tambja ceutae *(20 mm).*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twelve of them are new records for Porto Santo island. Table I shows this news records and all the explicit historical and recently references for opisthobranch molluscs on Porto Santo island.

DISCUSSION

Despite the new records for Porto Santo, it must be pointed out that all the species were already known for Madeira Island. Our record of *Elysia flava* is a confirmation of the hypothetical occurrence of this species in the archipelago since Ortea, Moro and Espinosa (1997) have quoted this sacoglossan species for Madeira without providing any information about the location of those specimens. However, the geographical distribution given by Ortea, Moro, Bacallado and Espinosa (1998) for this species does not include Madeira.

Four apparently undescribed species, two of them belonging to the cephalaspidean genus *Runcina* and the remaining to the nudibranch genera *Geitodoris* and *Cratena*, were also collected and are currently under study.

Taking in account the present results (excluding the unidentified species) and the bibliographical data, we can say that the known opisthobranch fauna in Porto Santo island comprises a total of 28 species, 10 belonging to the Cephalaspidea, 1 to the Anaspidea, 2 to the Sacoglossa, 2 to the Tylodinoidea, 1 to the Pleurobranchoidea and 12 to the Nudibranchia.

Some remarks can be commented taking into consideration the geographic distribution of the species collected in Porto Santo Island. Most of the species (65.2%) are considered NE Atlantic Mediterranean species. About half of these (34 % of the total) are restricted mainly to the Lusitanic + Mauritanic + Mediterranean area, being the temperate caracter (Mauritanic + Mediterranean) represented by the 17.4% of the total.

Those opisthobranch species only collected in the central Macaronesian archipelagos (Madeira islands and Canary islands) are here considered endemic of this area, and reach the 13% of the total (*Discodoris confusa, Pyrunculus spretus* and *Philine desmotis*).

The presence of widely distributed species (circuntropical, 8.7%; amphiatlantic, 4.4%), as well as, temperate or subtropical NE Atlantic species is not very significant (8.7%).

In conclusion, Porto Santo possesses an intermediate position between the European and African faunae. The South European and North African species are the most important components, being moderately low the participation of widely distributed species and central Macaronesian endemism. Additional data from future campaigns will surely improve our knowledge about the biogeographical relationships of the different Macaronesian archipelagos. Another interesting aspect is the evaluation of the importance of these islands as intermediate steps in the dispersion of temperate-subtropical species, as well as, the possible gradient of endemic species from Azores throughout Madeira and Canary up to Cape Verde, following the Eastern Gulf Stream branch and Canary current influence.

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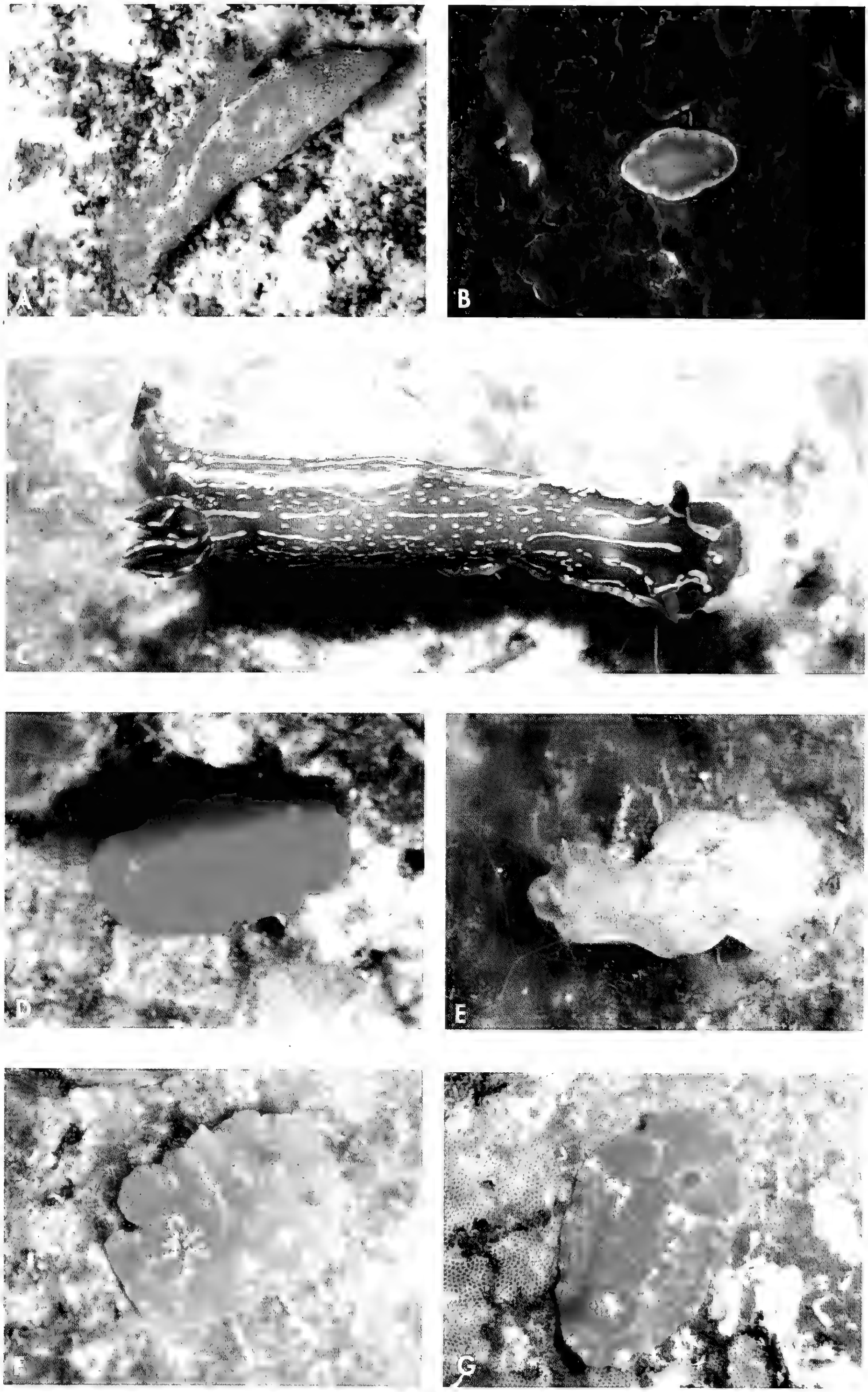
Thanks are due to the Clube Naval do Porto Santo, the Administração de Portos da Região Autónoma da Madeira, the crew of the vessel Fonte da Areia and to

(Right page) Figure 3. A: *Plocamopherus maderae* (20mm); B: *Chromodoris purpurea* (7mm); C: *Hypselodoris picta* (50mm); D: *Aldisa smaragdina* (12mm); E: *Discodoris confusa* (40mm); F: *Platydoris argo* (28mm); G: *Aldisa smaragdina* (23mm).

(Página derecha) Figura 3. A: Plocamopherus maderae *(20mm); B:* Chromodoris purpurea *(7mm); C:* Hypselodoris picta *(50mm); D:* Aldisa smaragdina *(12mm); E:* Discodoris confusa *(40mm); F:* Platydoris argo *(28mm); G:* Aldisa smaragdina *(23mm).*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BIBLIOGRAPHY

FONSECA, L. C., GUERREIRO, J. AND GIL, J., 1995. Note on the macrozoobenthos of the upper level sediments of Porto Santo Island (Madeira, Portugal). *Boletim do Museu Municipal do Funchal,* Suplemento 4: 233-252.

MIKKELSEN, P. M., 1996. The evolutionary relationships of Cephalaspidea s. l. (Gastropoda: Opisthobranchia): a phylogenetic analysis. *Malacologia,* 37 (2): 375-442.

NOBRE, A., 1937. Moluscos Testáceos Marinhos do Arquipélago da Madeira. *Memórias e Estudos do Museu Zoológico da Universidade de Coimbra,* 101p.

NORDSIECK, F., 1972. *Die europäischen Meeresschnecken (Opisthobranchia mit Pyramidellidae; Rissoacea) vom Eismeer bis Kap Verden, Mittelmeer und Schwarzes Meer.* Gustav Fischer Verlag, 327p.

NORDSIECK, F. AND GARCÍA-TALAVERA, F., 1979. *Moluscos marinos de Canarias y Madera (Gastropoda).* Aula de Cultura de Tenerife, 208p., pls. I-XLVI.

ORTEA, J., MORO, L., AND ESPINOSA, J., 1997. Nuevos datos sobre el género *Elysia* Risso, 1818 (Opisthobranchia: Sacoglossa) en el Atlántico. *Revista de la Academia Canaria de Ciencias,* 9 (número 2, 3 y 4): 141-155.

ORTEA, J., MORO, L., BACALLADO, J. J. AND ESPINOSA, J., 1998. Catálogo abreviado de las especies del orden Sacoglossa (=Ascoglossa, Mollusca: Opisthobranchia) de las islas Canarias y de Cabo Verde. *Revista de la Academia Canaria de Ciencias,* 10 (número 4): 85-96.

WATSON, R. B., 1897. On the Marine Mollusca from Madeira; with Descriptions of Thirty-five new Species, and an Index-List of all the know Sea-dwelling Species of that Island. *Linnean Society's Journal – Zoology,* 26: 18-320.

WIRTZ, P., 1994. Three shrimps, five nudibranchs, and two tunicates new for the marine fauna of Madeira. *Boletim do Museu Municipal do Funchal,* 46 (257): 167-172.

WIRTZ, P., 1999. Opisthobranch Molluscs from the archipelago of Madeira. *Vita Marina,* 46 (1-2): 1-18.

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Contribution to the marine molluscan fauna of Kerguelen Islands, South Indian Ocean

Contribución a la fauna de moluscos marinos de las Islas Kerguelen, Sur del Océano Índico

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ABSTRACT

The present work contributes to the knowledge of the mollusc fauna of the Kerguelen Is., on the basis of a collection of the Institut Royal des Sciences naturelles de Belgique. This collection include 32 species of gastropods and 12 of bivalves collected in shallow waters of the Morbihan Bay, among the gastropods *Margarites* cf. *porcellana* and *Perissodonta mirabilis* are the most abundant, whereas among the bivalves the commonest species are *Gaimardia trapesina* and *Laternula elliptica*. Most of the species in this collection have a wide distribution, although some species are endemics of Kerguelen Is. or of the Kerguelen–Heard platform and another species circumantartic.

RESUMEN

El presente trabajo es una contribución al conocimiento de la fauna de moluscos de las Islas Kerguelen, basada en una colección del Institut Royal des Sciences naturelles de Belgique. Esta colección incluye 32 especies de gasterópodos y 12 de bivalvos recolectadas en aguas someras de la Bahía de Morbihan, entre los gasterópodos *Margarites* cf. *porcellana* y *Perissodonta mirabilis* son las especies más abundantes, mientras que entre los bivalvos las especies más comunes son *Gaimardia trapesina* y *Laternula elliptica*. La mayoría de las especies de esta colección tienen una amplia distribución, aunque algunas de ellas son endémicas de las Islas Kerguelen o de la plataforma Kerguelen-Heard y otras son de distribución circumantartica.

KEY WORDS: Molluscs, Gastropods, Bivalves, Taxonomy, Kerguelen Is., Subantarctic region.
PALABRAS CLAVE: Moluscos, Gasterópodos, Bivalvos, Taxonomía, Islas Kerguelen, Región Subantartica.

INTRODUCTION

During the second half of the 19th century and during the 20th, there were many expeditions to the Southern Ocean, resulting in a great number of taxonomic and ecological studies on molluscs. The Kerguelen archipelago fauna is well known, due to the number of collections that have been made and reported since the original report of Smith (POWELL, 1957). The benthic fauna of the Kerguelen Is. was first studied by Studer in 1889 (ARNAUD,

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1974) and later a few works about Kerguelen were published, among them one may emphasise the works made by POWELL (1957), ARNAUD (1974) and CANTERA AND ARNAUD (1985). Following the work published by CANTERA and ARNAUD (1985), the Kerguelen and Crozet gastropods are well known, but our work provides taxonomic remarks to make's easy the identification of the Kerguelen fauna.

Kerguelen Is. are located at about 2000 km from the Antarctic continent, on the Kerguelen-Heard platform in the subantarctic waters and is composed of about 300 islands and islets (ARNAUD 1974). They are placed between the subtropical and the antarctic convergence and have a volcanic origin (CANTERA and ARNAUD, 1985). Most of the specimens were collected in the Morbihan Bay, in the oriental part of the archipelago. This work is a revision of the fauna collected by a Belgian expedition, giving taxonomic remarks of some species.

The present collection comprises 44 species of molluscs. A number of species are impossible to identify without access to the type material; for this reason these species are recorded with doubts. We follow the nomenclature of DELL (1990) and that of CANTERA and ARNAUD (1985) for the species absent from Dell's work.

MATERIAL AND METHODS

The present material was collected by C. De Broyer during January and February of 1982 during the mission Ker-82 of the Institut Royal des Sciences naturelles de Belgique (I.G. 26.482 I.R.Sc.N.B.-K.B.I.N.). Sample stations in the Morbihan Bay are represented in Figure 1 and stations situation and characteristics are included in Table I.

In the record of the material, "sp." denotes live collected material, "shell" refers to empty gastropod shells, and "valve" refers to dead bivalve shells.

Anatomical descriptions are based on preserved material and the radulae were removed by dissection and drawn with the aid of a camera lucida connected to an Olympus BX 40 microscope.

Photographs were obtained using a digital camera Olympus DP10 and processed using Microimage analysis software. Shells measurements were obtained with a electronic digital caliper, measuring the minor axis first. The major and minor specimens are separated by a dash.

SYSTEMATICS

Class GASTROPODA
Family FISSURELLIDAE Fleming, 1822
Genus *Puncturella* Lowe, 1827

Puncturella conica (Orbigny, 1841) (Fig. 2)

Rimula conica Orbigny, 1841.
Puncturella noachina (non Linn.) Watson, 1886: 42; Strebel, 1908: 79; Thiele, 1912: 234.
Puncturella conica: Powell, 1951: 86; Powell, 1957: 125; Powell, 1960:127; Arnaud, 1972: 113; Cantera and Arnaud, 1985: 32; Branch *et al.*, 1991: 55.

Material: 1 broken shell (7.5 x 3.5 x 3.6 mm), D9; 1 shell (8.13 x 5.60 x 4.05 mm), D37.

Remarks: Only two empty shells were collected agreeing in size and shell characteristics with *Puncturella conica*, which appears in BRANCH *ET AL.* (1991). ARNAUD (1972) records *P. spirigera* Thiele, 1912 as a synonym of *P. conica* Orbigny, 1841 and says that it only differs in the apex position, imputing it to small size of the type material of *spirigera*.

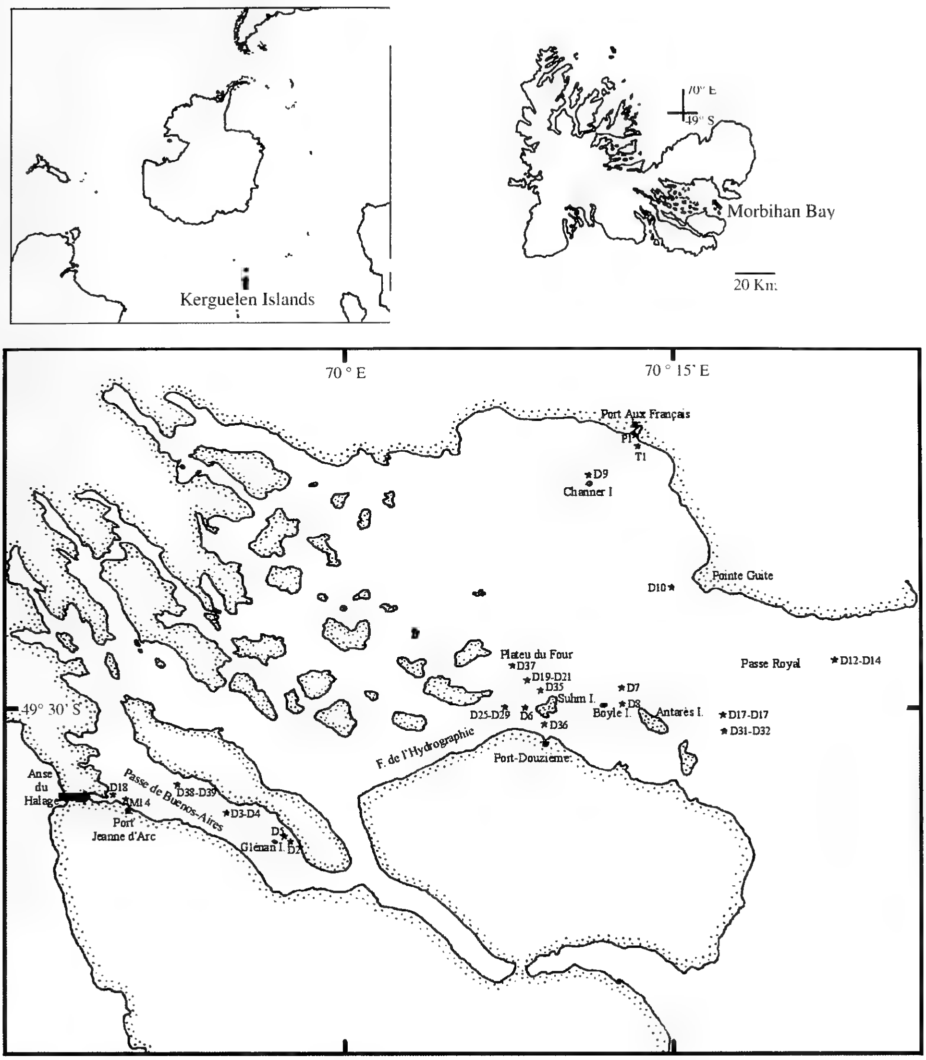


Figure 1. Sample stations in the Morbihan Bay, Kerguelen Is.
Figura 1. Estaciones de muestreo en Morbihan Bay, islas Kerguelen.

Distribution: Type localities of this species are Falkland Is. (*conica* and *falklandica*) and Kerguelen Is. (*P. analoga*). WATSON (1886 as *noachina*) finds this species at Marion, Prince Edward and Kerguelen Is. and in the Strait of Magellan. STREBEL (1908) records *P. noachina* in Berkeley Sound. POWELL (1951) records *conica* in South Georgia, Clarènce, South Shetlands and Falkland Is. Later he finds this species in open sea near Kerguelen Is. (POWELL, 1957). The distribution range given by POWELL (1960) includes Strait of Magellan, Falkland, South Georgia, South Shetland and Kerguelen Is. ARNAUD (1972) finds one specimen in Adelie Land and CANTERA AND ARNAUD (1985) records this species in Crozet and Kerguelen Is. BRANCH *ET AL.* (1991) record this species in Marion and Prince Edward Is., 5-355 m.

Family TROCHIDAE Rafinesque, 1815
Genus*Margarites* Gray, 1847

Margarites cf. *porcellana* Powell, 1951 (Figs. 3, 43)

Margarella porcellana Powell, 1951: 98, pl. 5, fig. 2; Branch *et al.*, 1991: 56.

Material: 1 shell (10.0 x 11.0 mm), D2; 1 sp. (4.98 x 5.21 mm), D3-D4; 1 sp. (7.69 x 9.05 mm), D5; 1 sp. (5.72 x 6.44 mm), D6; 21 shells (7.25 x 9.18 mm – 4.14 x 4.90 mm), D9; 8 sp. (9.42 x 10.88 mm – 5.94 x 6.68 mm), D10; 9 sp. (12.35 x 13.96 mm – 10.98 x 13.61 mm) and 10 broken shells, D18; 1 shell (9.37 x 10.01 mm), D19-21; 10 sp. (8.45 x 9.7 mm – 3.1 x 3.5 mm) and 1 shell (9.51 x 10.13 mm), D25-D29; 18 sp. (8.75 x 10.36 mm – 2.5 x 3.0 mm), D35.

Remarks: DEAMBROSI (1969 in DELL 1990) was the first author who separated the genus *Margarella* and *Margarites* on the basis of the first lateral tooth, including in *Margarella* the species with the first lateral tooth large. This author shows that the first lateral tooth of other species is rudimentary and takes this character to separate the genus *Margarites* and *Margarella*. Later, Dell (1990) remarks that *Margarella* Thiele, 1893 and *Margarites* Gray, 1847 must be considered synonyms, on the basis of the *expansa* radula, the type species of *Margarella*, which belongs to the first group, with a first lateral teeth large. Individuals of this species found in this collection have a radula with the first lateral tooth well developed (see fig. 43), belonging to this genus. On the basis of shell characters we think that these individuals belong to the species *M. porcellana*. These individuals have a uniformly white shell with a white columelar callus, four and half whorls and the suture adpressed, these characters agree with the description of the species given by POWELL (1951). On the other hand the shell measurements are larger in our individuals than in the type material. In this collection we found individuals that reach 12.35 mm x 13.96 mm while the individuals described by POWELL (1951) were 8.0 mm x 7.0 mm. Moreover the columelar callus of the Kerguelen individuals do not reach the outer lip as in the type material. These two differences make us record this species with doubts. Unfortunately the radula of *Margarella porcellana* is not known and because of that it is not possible to compare with our radula.

Distribution: The type locality is off Marion I. POWELL (1951) describes this species with material found in three stations off Marion I. in a bathymetric range of 97-113 m, BRANCH ET AL. (1991) record this species from Marion and Prince Edward Is. at depths of 10-151 m, as rare to abundant. A total of 48 individuals were found in mud ,sand and algae from depths of 10-50 m.

Margarites violacea (King and Broderip, 1831) (Figs. 4, 44)

Margarita violacea (King and Broderip, 1831)
Photinula (*Margarella*) *violacea*: Strebel, 1908: 72.
Margarella violacea: Powell, 1951: 96; Powell, 1957: 125; Powell, 1960: 131; Cantera and Arnaud, 1985: 37.

Material: 1 shell (9.20 x 9.94 mm), D5; 2 sp. (8.47 x 10.19 mm; 6.01 x 6.66), D6; 2 sp. (8.95 x 10.18 mm; 4.16 x 4.92 mm), D8; 1 sp. (10.55 x 11.40 mm), D12-D14; 1 shell (8.54 x 9.55 mm), D16-D17; 1 sp. (10.52 x 11.96 mm), D19-D21; 7 sp. (9.37 x 8.81 mm – 3.39 x 3.73 mm), D25-D29; 2 sp. (7.29 x 8.68 mm; 5.98 x 7.90 mm) and 1 deteriorated sp., D31-D32; 7 sp. (6.53 x 7.55 mm – 5.27 x 6.36 mm), D35.

Remarks: We follow Dell's nomenclature, which considers *Margarella* Thiele, 1893 and *Margarites* Gray, 1847 synonyms. DEAMBROSI (1969 in DELL, 1990) showed that the first lateral tooth of *violacea* was large, including this spe-

Table I. Place, date and characteristics of the sample stations.
Tabla I. Lugar, fecha y características de las estaciones de muestreo.

Station	Place	Date	Depth (m)	Bottom	Sample device
D2	Passe de Buenos-Aires, NW. Glénan I.	19/01/1982	23	Mud	Dredge
D3-D4	Passe de Buenos-aires.	19/01/1982	42	Mud, spicles and serpulids tubes	Dredge
D5	Passe de Buenos-Aires, NW. Glénan I.	19/01/1982	23	Mud, spicles and Macrocystis	Dredge
D6	S. Suhm I.	19/01/1982	40	Mud and spicles	Dredge
D7	NW. Boyle I.	19/01/1982	65	Mud	Dredge
D8	N. Boyle I.	19/01/1982	48	Mud	Dredge
D9	Port aux Français-Channer I.	28/01/1982	30	Mud	Dredge
D10	Pointe Guite	28/01/1982	30	Mud, sand and Macrocystis	Dredge
D12-D14	Passe Royale	28/01/1982	30	Mud, sand and Macrocystis	Dredge
D16-D17	N. Antarès I.	28/01/1982	50	-	Dredge
D18	Anse du Halage-Port Jeanne d'Arc	29/01/1982	10	Mud	Dredge
D19-D21	SW. Suhm I.	29/01/1982	40-50	-	Dredge
D25-D29	S. Suhm I.	10/02/1982	30-50	Mud and Rhodophyces	Dredge
D31-D32	N. Antarès I.	23/02/1982	50	Mud	Dredge
D35	SW. Suhm I.	23/02/1982	25	Macrocystis and Rhodophyces	Dredge
D36	Fosse de l'Hrographie. Between Suhm I. and Port Douzième	23/02/1982	90	Mud	Dredge
D37	Plateu du Four.	23/02/1982	25	Sand, Pebble and gravel	Dredge
D38-D39	Passe de Buenos-Aires.	1/03/1982	35	-	Dredge
M14	Anse du Halage-Port Jeanne d'Arc	10/02/1982	0,1-0,4	Sand	Hand net
P1	In front Biomar laboratory	18/01/1982	-	Over Macrocystis	Hand net diving
T1	Port aux Françaís, in the shore of Pointe des Cormorans	17/02/1982 18/02/1982	15	Stomachic contens	Baited trap

cies in the genus *Margarella* that later DELL (1990) considers synonym of *Margarites*. There are two species of *Margarella-Margarites* recorded in the Kerguelen Is.; *expansa* with a ligth olivaceus coloration and a maximum size of 20 mm and *violacea* that it is close to *expansa* but differs in a more elevated spire, honey colour and a minor size (max. 12 mm). DELL (1990) points out that *expansa*, the type species of *Margarella*, has the first lateral tooth rudimentary, whereas *violacea* has the first lateral tooth large. Our specimens is honey-coloured with a white callus and its radula have the first lateral tooth large (see fig. 44), for these reasons we have included them in *violacea*.

Distribution: The type locality is Strait of Magellan. STREBEL (1908) records this species in the magellanic region. POWELL (1951) found *violacea* in the magellanic region and Falkland Is. and later records this species with doubts in Kerguelen Is. (POWELL, 1957). CANTERA and ARNAUD (1985) found death shells of *M.violacea* in Crozet. In this collection there are 23 individuals found in mud, sand and algae from depths of 23-50 m.

Family PATELLIDAE Rafinesque, 1815
Genus *Nacella* Schumacher, 1817

Nacella cf. *mytilina* (Helbling, 1779) (Fig. 5)

Patella mytilina Helbling, 1779
Nacella mytilina Powell, 1951: 80; Powell, 1957: 126; Powell, 1960: 128.

Material: 1 sp. (12.50 x 8.99 x 4.0 mm), P1.

Remarks: Only one thin individual with brown ovate shell and anterior central apex has been found. It has fine concentric grown lines. POWELL (1951) restricted the genus to "the thin, ovate shells with anterior apex". Moreover this individual has the gill cordon continuous and the foot encircled by a scalloped epipodial ridge, exactly like the genus description made by POWELL (1951). Our material presents these shell characteristics, although we cannot access to the description and figures of this species.

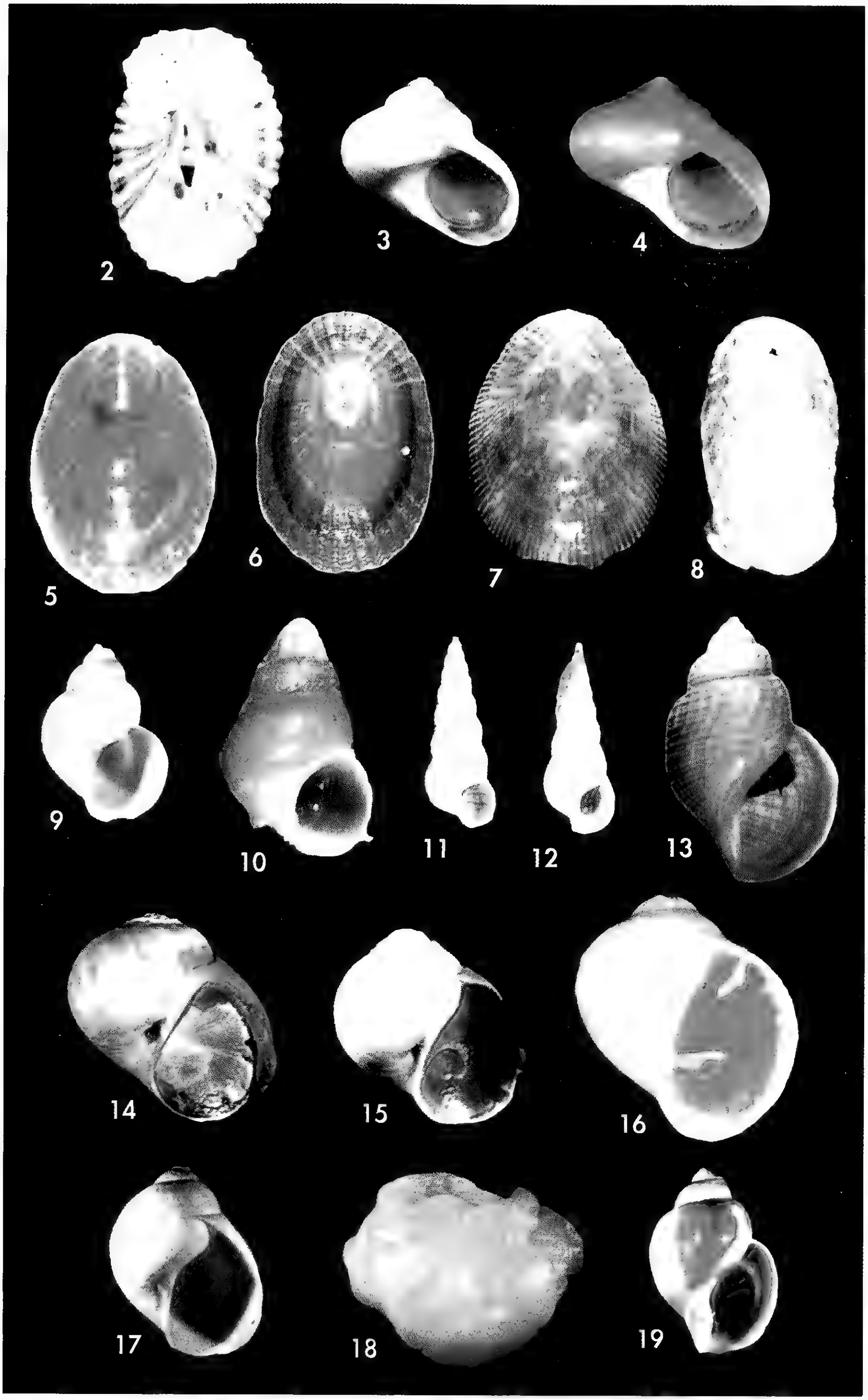
Distribution: The type locality is Strait of Magellan and its distribution includes Falkland and Kerguelen Is. POWELL (1951) points out that "*Nacella* seems to be restricted to the subantarctic from the Magellan region to the Kerguelen". THIELE (1912) records this species in Observatory Bay in Kerguelen. Our specimens was found in *Macrocystis* from Morbihan Bay in Kerguelen.

Nacella (*Patinigera*) *edgari* (Powell, 1957) (Fig. 6)

Patinigera (*Patinella*) *fuegiensis* Smith, 1877 (non Reeve, 1855), 180, pl. 19, figs. 14, 14a.
Nacella (*Patinigera*) *fuegiensis*: Thiele, 1912: 234.
Patinigera fuegiensis edgari Powell, 1957: 127, pl. 2, fig. 5 and text figs. B; Powell, 1960: 129.
Nacella (*Patinigera*) *edgari*: Cantera and Arnaud, 1985: 35.

(Right page) Figure 2: *Puncturella conica,* 8.1 x 5.6 mm. Figure 3: *Margarites* cf. *porcellana,* 8.9 x 10.8 mm. Figure 4: *Margarites expansa,* 6.1 x 7.1 mm. Figure 5: *Nacella* cf. *mytilina,* 12.50 x 8.99 x 4.0 mm. Figure 6: *Nacella* (*Patinigera*) *edgari,* 12.5 x 9.0 x 3.5 mm. Figure 7: *Nacella* (*Patinigera*) *delicatissima,* 12.90 x 9.15 x 3.6 mm. Figure 8: *Iothia* cf. *coppingeri,* 7.0 x 4.0 x 2.5 mm. Figure 9: *Pellilitorina setosa,* 10.2 x 6.8 mm. Figure 10: *Eatoniella k. kerguelenensis,* 2.8 x 1.7 mm. Figure 11: *Banzarecolpus austrina,* 11.5 x 4.1 mm. Figure 12: *Eumetula ornata,* 15.6 x 5.7 mm. Figure 13: *Perissodonta mirabilis,* 23.81 x 36.05 mm. Figure 14: *Kerguelenatica bioperculata,* 9.5 x 10.1 mm. Figure 15: *Falsilunatia* cf. *delicatula,* 13.6 x 15.2 mm. Figure 16: *Falsilunatia* cf. *xantha,* 11.79 x 12.86 mm. Figure 17: *Sinuber sculpta,* 20.0 x 17.0 mm. Figure 18: *Marseniopsis* cf. *pacifica,* 14.0 x 11.0 mm. Figure 19: *Neobuccinum eatoni,* 23.5 x 15.6 mm.

(Página derecha) Figura 2: Puncturella conica, *8,1 x 5,6 mm. Figura 3:* Margarites *cf.* porcellana, *8,9 x 10,8 mm. Figura 4:* Margarites expansa, *6,1 x 7,1 mm. Figura 5:* Nacella *cf.* mytilina, *12,50 x 8,99 x 4,0 mm. Figure 6:* Nacella (Patinigera) edgari, *12,5 x 9,0 x 3,5 mm. Figura 7:* Nacella (Patinigera) delicatissima, *12,90 x 9,15 x 3,6 mm. Figura 8:* Iothia *cf.* coppingeri, *7,0 x 4,0 x 2,5 mm. Figura 9:* Pellilitorina setosa, *10,2 x 6,8 mm. Figura 10:* Eatoniella k. kerguelenensis, *2,8 x 1,7 mm. Figura 11:* Banzarecolpus austrina, *11,5 x 4,1 mm. Figura 12:* Eumetula ornata, *15,6 x 5,7 mm. Figura 13:* Perissodonta mirabilis, *23,81 x 36,05 mm. Figura 14:* Kerguelenatica bioperculata, *9,5 x 10,1 mm. Figura 15:* Falsilunatia *cf.* delicatula, *13,6 x 15,2 mm. Figura 16:* Falsilunatia *cf.* xantha, *11,79 x 12,86 mm. Figura 17:* Sinuber sculpta, *20,0 x 17,0 mm. Figura 18:* Marseniopsis *cf.* pacifica, *14,0 x 11,0 mm. Figura 19:* Neobuccinum eatoni, *23,5 x 15,6 mm.*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Material examined: 2 broken shells, D5; 1 sp. (12.5 x 9.0 x 3.5 mm) and 2 broken shells, D7; 1sp. (30.08 x 21.20 x 9.5 mm) and 3 shells (38.58 x 29.01 x 8.8 mm – 11.93 x 9.13 x 5.0 mm), D9; 3 broken shells, D18; 8 sp. (43.28 x 32.45 x 13.1 mm – 19.90 x 13.82 x 4.91 mm) and 1 shell (29.5 x 21.6 x 7.0 mm), D25-D29; 3 sp. (42.50 x 31.8 x 17.9 mm – 13.2 x 8.9 x 4.2 mm), P1.

Remarks: Southern limpets are very difficult to identify, POWELL (1951) records *Patinigera* as a genus in which the species *fuegiensis edgari* is included. He points out that *Nacella* and *Patinigera* "have the gill cordon continuous and the foot encircled by a scalloped epipodial ridge" and characterized *Nacella* by the "thin, ovate shells with anterior apex", while the "shell in *Patinigera* has a subcentral apex and is of normal shape and solidity". However here, we follow the nomenclature of CANTERA and ARNAUD (1985) considering that *Patinigera* is only a subgenus of *Nacella*. Our individuals agree with description of *P. fuegiensis edgari* given by POWELL (1957), who revised a large series of Kerguelen specimens.

Distribution: The type locality is Royal Sound in Kerguelen Is. POWELL (1957) records this species in several BANZARE localities and also from Port Jeanne d`Arc, CANTERA and ARNAUD (1985) point out that this species is very abundant in the Morbihan Bay and find dead shells in Crozet Is. This species is known only from Kerguelen in a depth range of 8 to 67 m, although it is more abundant in 8 to 30 m (CANTERA and ARNAUD, 1985). In the present collection there are specimens collected in muddy bottoms and algae in Kerguelen from depths of 10-65 m.

Nacella (*Patinigera*) *delicatissima* (Strebel, 1907) (Fig. 7)

Patinella delicatissima Strebel, 1907; Strebel, 1908: 80, pl. 1, figs. 75-75a.
Patinigera delicatissima Powell, 1951: 82; Powell, 1960: 129.
Nacella (*Patinigera*) *delicatissima* Cantera and Arnaud, 1985: 34.

Material: 1 sp. (19.30 x 14.92 x 3.1 mm) and 1 shell (12.90 x 9.15 x 3.6 mm), D12-D14.

Remarks: This small species of *Nacella* has a bronze coloured shell with brown spots externally and a nacreous interior. It is a thin species with delicately squamose ribs (POWELL, 1951). Our specimens reach 19 mm of length and have a low profile (3.1 mm) as Powell remarks in his work (POWELL, 1951). CANTERA and ARNAUD (1985) give for this species a maximum length of 23 mm and record it in Morbihan Bay.

Distribution: The type locality is Strait of Magellan. Since Strebel's description, the same author records this species from Falkland Is. (STREBEL, 1908). Afterwards POWELL (1951) records it in many Falkland localities and CANTERA and ARNAUD (1985) find *delicatissima* in Kerguelen and Crozet Is., a new record for this species. Our material come from Morbihan Bay in Kerguelen and was dredged in mud and sand with *Macrocystis* from a depth of 30 m.

Family LEPETIDAE Dall, 1869
Genus *Iothia* Gray, 1857

Iothia cf. *coppingeri* (Smith, 1881) (Fig. 8)

Tectura (*Pilidium*) *coppingeri* Smith, 1881: 35, pl. 4, figs 12, 12a.
Pilidium coppingeri: Strebel, 1908: 83.
Lepeta coppingeri: Thiele, 1912: 183, 233, 257; Hedley, 1916: 41; Powell, 1951: 84; Powell, 1957: 128; Powell, 1960: 129; Arnaud, 1972: 114, fig. 1 (radula); Cantera and Arnaud, 1985: 35; Linse, 1997: 27.
Iothia coppingeri: Egorova, 1982: 12, figs. 73,74; Dell, 1990: 105, figs. 185, 186; Linse, 1998: 883.

Material: 1 deteriorated shell (7.0 x 4.0 x 2.5 mm), D5.

Remarks: Our specimen is refered to *I. coppingeri* according to its radial sculpture and shell profile, but its scales have disappeared, probably due to the erosion.

Distribution: The type locality is Sandy point, Patagonia. *I. coppingeri* is a widely distributed species, with circumantarctic distribution (DELL 1990). It is recorded from Falkland Is. (STREBEL, 1908; POWELL, 1951), Gauss Station (THIELE, 1912), Commonwealth Bay (HEDLEY, 1916), Ross Sea (POWELL, 1951; DELL, 1990; CATTANEO-VIETTI *ET AL.*, 2000), Kerguelen and Crozet Is. (POWELL, 1957; CANTERA and ARNAUD, 1985), Commonwealth Bay and Enderby Land (POWELL, 1958), Adelie Land (ARNAUD, 1972), Davis Sea (EGOROVA, 1982) and Beagle Channel (LINSE, 1997; LINSE and BRANDT, 1998). Our shell was dredged in mud with organogenic components (spicles and *Macrocystis*) from 23 m depth.

Family LITTORINIDAE Gray, 1840
Genus *Pellilitorina* Pfeffer, 1886

Pellilitorina setosa (Smith, 1875) (Fig. 9)

Littorina setosa Smith, 1875: 69.
Pellitorina setosa: Strebel, 1908: 50.
Pellilitorina setosa: Thiele, 1912: 235; Powell, 1951: 109; Powell, 1960: 135; Arnaud and Bandel, 1979: 218, fig. 5, pl. 2, figs. 4,6-8, pl. 3, figs. 7-10, pl. 4, figs. 6-10; Cantera and Arnaud, 1985: 41; Dell, 1990: 108, fig. 181.

Material: 16 shells (7.26 x 10.75 mm – 4.24 x 5.84 mm), D9; 1 shell (5.0 x 7.0 mm), D10; 2 sp. (4.5 x 5.5 mm; 2.5 x 3.2 mm), D35.

Remarks: The genus *Pellilitorina* has a typical radula, different of the others members of the family. POWELL (1951) described *Pellilitorina*`s radula "with a broad, shallow-based central tooth bearing five cusps, the middle one strongest, laterals with three strong cusps, marginal foliated and with several denticles". This radula corresponds with large, globose shells with only a narrow umbilical perforation and an epidermis covered with hair-like processes (POWELL 1951). Later ARNAUD and BANDEL (1978) point out that the Powell's definition differs from the original definition in that the outer marginal tooth of this genus shows three cusps and show that the greatest diference of the *Pellilitorina* radula is the central tooth without lateral wings. Our specimens have a radula with a central tooth with five cusps, two laterals teeth with three cusps and a lateral one foliated, and can be placed easily in the genus *Pellilitorina*. Two species of *Pellilitorina* were recorded in Kerguelen Is.; *P. setosa* and *P. pellita*. Shell and radular characteristics place our specimens in *Pellilitorina setosa* but since they are juvenile their shell characteristics are least reliable. ARNAUD and BLANDEL (1978) show a figure of a juvenile shell that agree with our specimens in shells characteristics.

Distribution: The type locality is Swain's Bay, Kerguelen Is. STREBEL (1908) records in Cumberland Bay and later THIELE (1912) records it in Observatory Bay. A study of the radula of the southern Littorinidae was made by POWELL (1951). This author showed the radula of *P. setosa* and records it in South Georgia and off Bouvet I. CANTERA and ARNAUD (1985) collect this species in Crozet and Kerguelen Is. and included within the distribution range Heard and South Orkneys. DELL (1990) points out that it is a common species in South Georgia, South Orkneys, Heard and

Kerguelen Is. and suggests that its restricted range around the continent is probably due to the lack of stable shallow-water habitats. We found this species in mud, sand and algae at Morbihan Bay, from depths of 25-30 m.

Family EATONIELLIDAE Ponder,1965
Genus *Eatoniella* Dall, 1876

Eatoniella kerguelenensis kerguelenensis (Smith, 1875) (Figs. 10, 43)

Eatonia kerguelenensis Smith, 1875: 70.
Eatoniella kerguelenensis: Thiele, 1912: 235, pl. 14, fig. 26, pl. 16, fig. 1 (radula); Hedley, 1916: 46; Powell, 1957: 129; Arnaud, 1972: 118, fig. 9, 12.
Eatoniella kerguelenensis kerguelenensis: Powell, 1960: 138; Ponder, 1983: 11, figs. 2a, 7 e-f; Cantera and Arnaud, 1985: 42.

Material: 24 sp. (1.98 x 3.2 mm – 0.5 x 0.5 mm), D35.

Remarks: PONDER (1983) points out the need for the presence of operculum and radula to assure the identification of this species. CANTERA and ARNAUD (1985) point out a maximum length of 4.5 mm in specimens found in Kerguelen and 4.0 mm in Crozet. Our specimens do not exceed 3.2 mm, have a pale yellowish operculum that it is very close to the figure 12 of ARNAUD (1972). The radula is the typical of genus, it has a central tooth with five small cusps, two lateral teeth, the first with five cusps and the second with two, and one marginal tooth with several denticles. These radular characteristics agree with the radula of *E. kerguelenensis kerguelenensis* as figured by other authors (THIELE, 1912; ARNAUD, 1972; PONDER, 1983).

Distribution: The type locality is Royal Sound, Kerguelen Is. There are four subspecies of *Eatoniella kerguelenensis*. *E. k. regularis* and *E. k. contusa* have a western Antarctic distribution, *E. k. chiltoni* from New Zealand and the New Zealand subantarctic Is., and *E. k. kerguelenensis* is confined to Kerguelen Is. (PONDER, 1983). *E. k. kerguelenensis* has been recorded from Observatory Bay (THIELE, 1912), Commonwealth Bay (HEDLEY, 1916), in BANZARE localities at Kerguelen Is. (POWELL, 1957) and Pointe Geologie archipelago (ARNAUD, 1972). All these authors recorded it as *E. kerguelenensis*. PONDER (1983) renames the species *E. kerguelenensis kerguelenensis* and CANTERA and ARNAUD (1985) found this species in some stations of Kerguelen and Crozet Is. Our specimens come from Morbihan Bay in Kerguelen and was collected in algae from 25 m depth.

Family TURRITELLIDAE Woodward, 1851
Genus *Banzarecolpus* Powell, 1957

Banzarecolpus austrina (Watson, 1881) (Fig. 11)

Turritella austrina Watson, 1881: 224; Watson, 1886: 470, pl. 29, fig. 2; Thiele, 1912: 240.
Banzarecolpus austrina: Powell, 1957: 131; Powell, 1960: 141; Cantera and Arnaud, 1985. 48; Branch *et al.*, 1991: 57.

Material: 1 shell (3.5 x 8.2 mm), D8; 5 sp. (4.47 x 11.61 mm – 2.98 x 8.22 mm) and 16 shells (5.2 x 13.5 mm - 2.5 x 7.1 mm), D9; 1 shell (5.0 x 15.0 mm), D10; 2 shells (4.07 x 10.35 mm; 2.56 x 6.86 mm), D16-D17; 3 shells (4.0 x 10.0 mm – 3.0 x 8.0 mm), D31-D32.

Remarks: Two species of *Banzarecolpus* are known in Kerguelen Is., *B. austrina* with a maximum length of 21 mm and *B. frigida* with a maximum length of 6.0 mm (CANTERA and ARNAUD, 1985). Our specimens have a typical *austrina* shell sculpture and round aperture, white colour and a length never shorter than 8.0 mm.

Distribution: Type locality is Kerguelen Is. WATSON (1886) finds this species off Marion I., Prince Edward I. and in the Royal Sound (Kerguelen). THIELE (1912) records it in Kerguelen and described a new species *Banzarecolpus frigida* from Kerguelen too. POWELL (1957) records *B. austrina* from a series of BANZARE localities in Kerguelen. CANTERA and ARNAUD (1985) record it in Crozet and Kerguelen Is. in depths of 2 to 1390 m. BRANCH *ET AL.* (1991) record this species in Marion and Prince Edward Is. between 85 and 228 m. In this collection the only live specimens are from Port aux Français and was collected in mud at 30 m.

Family CERITHIIDAE Fleming, 1822
Genus *Eumetula* Thiele, 1912

Eumetula ornata Thiele, 1912 (Fig. 12)

Eumeta ornata Thiele, 1912: 242, pl. 15, fig 14.
Eumetula ornata: Powell, 1957: 129; Powell, 1960: 140; Cantera and Arnaud, 1985: 53.

Material: 1 sp. (5.79 x 15.69 mm), D16-D17; 1 sp. (2.78 x 7.54 mm), D 35.

Remarks: This species was described by THIELE (1912) from specimens found in Observatory Bay. The original specimen have 4.25 mm of length and seven and half body whorls. Later CANTERA and ARNAUD (1985) record two species of *Eumetula* based on dead shells: one has 12.0 mm of length and a maximum length of 7.0 mm for *Eumetula ornata*. We have found a specimen of 16 mm of length and ten and half body whorls and other with 7.8 mm of length and eight and half body whorls. We consider these specimens found in the shallow waters of Kerguelen Is. as *Eumetula ornata* specimens.

Distribution: Type locality THIELE (1912) is Observatory Bay, Kerguelen Is. POWELL (1957) finds it in BANZARE localities in Kerguelen Is. and CANTERA and ARNAUD (1985) records it in Crozet and Kerguelen Is., in depths of 15 to 22 m in Kerguelen, where they found live specimens. Our specimens come from Morbihan Bay and was collected in algae from depths of 25-50 m.

Family STRUTHIOLARIIDAE Gabb, 1868
Genus *Perissodonta* Martens, 1878

Perissodonta mirabilis (Smith, 1875) (Fig. 13)

Struthiolaria mirabilis Smith, 1875.
Perissodonta mirabilis var. *georgiana* Strebel, 1908: 46, pl. 3, figs. 33a, b, c.
Perissodonta mirabilis georgiana: Powell, 1951: 129, pl. 8, figs. 40-42.
Perissodonta mirabilis: Powell, 1957: 131; Powell, 1960: 144; Cantera and Arnaud, 1985: 57.

Material: 2 sp. (25.89 x 41.98 mm; 24.44 x 41.18 mm) and 2 shells (28.22 x 43.38 mm – 20.02 x 35.13 mm), D6; 2 sp. (25.53 x 38.48 mm; 23.81 x 34.44 mm) and 2 broken shells, D7; 11 sp. (26.04 x 43.64 mm – 23.27 x 34.02 mm) and 1 broken shell, D9; 2 sp. (22.31 x 34.07 mm - 21.01 x 32.98 mm) and 2 broken shells, D10; 2 sp. (22.77 x 35.95 mm; 20.79 x 32.16 mm) and 2 shells (25.77 x 39.97 mm; 23.43

x 34.86 mm), D12-D14; 4 shells (24.51 x 35.87 mm – 23.81 x 36.05 mm), D16-D17; 7 sp. (26.78 x 41.97 mm– 21.99 x 32.50 mm) and 3 shell (27.55 x 39.88 mm - 18.62 x 31.52 mm), D19-21; 9 sp. (27.10 x 41.02 mm – 13.72 x 22.63 mm) and 2 shells (25.38 x 39.0 mm – 23.01 x 42.61 mm), D25-D29; 4 sp. (24.20 x 38.79 mm; 23.86 x 28.97 mm) and 1 shell (23.27 x 36.08 mm), D31-D32; 1 sp. (22.34 x 32.98 mm), D36.

Remarks: This family is restricted to southern waters and only one species of the genus is living in Antarctic waters; *Perissodonta mirabilis*. STREBEL (1908) records a variety or subspecies called *P. mirabilis georgiana* from material found in Seymour I. and POWELL (1951) maintains this variety based on the opercular variation. Later POWELL (1957) considers that differences between Kerguelen and Georgia populations were unsufficient for maintaining the validity of Strebel's variety.

Distribution: Type localities are Swain's Bay, Kerguelen (*P. m. mirabilis*) and Cumberland Bay, South Georgia (*P. m. georgiana*). STREBEL (1908 as *P. m. georgiana*) finds this species in Seymour I., POWELL (1951 as *P. m. georgiana*) records this species in South Georgia and later in different BANZARE localities in Kerguelen (POWELL 1957). CANTERA and ARNAUD (1985) record it in Kerguelen and Crozet Is. They find *P. mirabilis* specimens alive in depths of 15 to 3025 m in Kerguelen and point out that it is particularly abundant between 15 and 150 m. In this collection *P. mirabilis* is the most abundant gastropod and was found in muddy and sandy bottoms with *Macrocystis* from depths of 30 to 90 m.

Family NATICIDAE Forbes, 1838
Genus *Kerguelenatica* Powell, 1951

Kerguelenatica bioperculata Dell, 1990 (Fig. 14)

Natica grisea Martens, 1878; Watson, 1886: 432, pl. 28, fig. 5; Strebel 1908: 61.
Fraginatica grisea: Hedley, 1916: 52.
Amauropsis (*Kerguelenatica*) *grisea*: Powell, 1951: 118; Powell, 1957: 130; Powell, 1958: 190; Powell, 1960: 144; Arnaud, 1972: 125, fig. 16; Egorova, 1982: 29.
Kerguelenatica bioperculata, n. n. Dell, 1990: 145, figs. 252, 253, 264.

Material: 1 sp. (10.29 x 11.01 mm), D9; 1 sp. (8.51 x 9.23 mm), D19-D21; 1 sp. (8.34 x 8.43 mm), D25-D29; 2 sp. (9.75 x 9.81 mm - 7.65 x 8.34 mm), D31-D32; 3 shells (7.63 x 8.35 mm – 6.58 x 6.75 mm), D37.

Remarks: The first author to place this species in a different subgenus was POWELL (1951), who considered *Kerguelenatica* as a subgenus of *Amauropsis*. The same author points out that it is easily recognised by the composite nature of the operculum and points that it is possible that more that one species is represented here. Dell (1990) suggests that it is treated as a genus and renames the species as *Kerguelenatica bioperculata*. This species could be easily confused with a species of the genus *Falsilunatia*, DELL (1990) points out that some published records of *bioperculata* may have been based on *Falsilunatia delicatula*. Our specimens have a horny operculum with an outer calcareous covering, characteristics that included them in the genus *Kerguelenatica* (DELL 1990), it has a maximum length of 11.0 mm although usually the length is about 8.0 mm, it has a pale brown to yellowish epidermis and a chink shaped umbilicus. These characteristics fits the description of the shell gives by DELL (1990).

Distribution: The type locality is Kerguelen. WATSON (1886 as *Natica grisea*) finds this species in Kerguelen within "Challenger" material. STREBEL (1908 under *Natica grisea*) and Hedley (1916 under *Fraginatica grisea*) record it, the later one in Commonwealth Bay and Shackleton Ice-shelf. Later POWELL

(1951), ARNAUD (1972) and EGOROVA (1982) record this species as a subgenus of *Amauropsis* in South Shetlands, Bouvet I., Ross Sea and Adelie Land. Some records of *bioperculata* may be based on *delicatula* specimens. For this reason the distribution of *Kerguelenatica bioperculata* is still uncertain (DELL 1990), although this author points out that its distribution range is around the Antarctic continent from 49° E to 140° E and records a long series of places from the Ross Sea to South Georgia and Kerguelen (DELL 1990). Specimens of this collection was collected in mud, sand, pebble and gravel from depths of 25-50 m.

Family NATICIDAE Forbes, 1838
Genus *Falsilunatia* Powell, 1951

Falsilunatia cf. *delicatula* (Smith, 1902) (Figs. 15, 46)

Natica delicatula Smith, 1902; Thiele, 1912: 199, pl. 12, figs. 16, 17.
Falsilunatia delicatula: Dell, 1990: 148, figs. 237, 256, 257, 269.

Material: 1 sp. (13.65 x 15.21 mm), D19-D21; 1 shell (9.86 x 10.68 mm), D36.

Remarks: The shell characteristics of our single specimen are very close to *Kerguelenatica bioperculata*. The shell is thin, with a pale brown epidermis, open umbilicus and has a horny operculum without a outer calcareous covering. Its radula is of the *Falsilunatia* type, with a central tooth with a central cusp and a pair of peg-like basal cusps, lateral teeth with a single cusp and a small subsidiary cusp near the upper and marginal teeth simple. These radular characteristics included it in the genus *Falsilunatia*, and the characteristics of the shell operculum poin to *F. delicatula*. DELL (1990) gives a good description of *delicatula*, with shell measurements and figures, which fit our specimens.

Distribution: DELL (1990) remarks that it is impossible to analyse the range of *delicatula* adequately. This is due to the uncertainly of previous identifications and records it in the Ross Sea between 47–1890 m. Our specimen was collected in muddy bottoms from off Suhm I. in 45–50 m and a dead shell was found from Fosse de l`Hydrographie in a depth of 90 m.

Falsilunatia cf. *xantha* (Watson, 1881) (Figs. 16, 47)

Natica xantha Watson, 1881; Watson, 1886: 445, pl. 27, fig. 8.
Amauropsis xantha: Powell, 1958: 189; Powell, 1960: 144; Arnaud, 1972: 125; Cantera and Arnaud, 1985: 58; Cantera and Arnaud, 1985: 58.
Falsilunatia cf. *xantha*: Dell, 1990: 152, figs. 232, 272.

Material: 2 sp. (4.5 x 4.9 mm), D6; 1 sp. (6.5 x 7.3 mm) and 2 shells (7.0 x 7.0 mm), D10; 2 sp. (10.3 x 11.50 mm; 6.01 x 6.90 mm) and 2 shells (10.50 x 11.68 mm; 6.14 x 9.48 mm), D19-D21; 2 sp. (11.89 x 13.68 mm; 5.63 x 7.21 mm), D25-D29; 1 sp. (11.79 x 12.86 mm) and 1 shell (12.51 x 12.62 mm), D31-D32.

Remarks: A series of specimens found in this collection are very close to *xantha*. These Kerguelen specimens have a globose shell with a thin yellowish to pale brown epidermis and a white columellar callus, the umbilicus is a slight chink. They have a spiral sculpture of fine threads and a horny operculum. The radula is of the *Falsilunatia* type, and very close to *delicatula*'s radula, but the central tooth is wider. These characteristics agree with the description of Dell's specimens, which considered them referable to *Falsilunatia* cf. *xantha* (DELL 1990). He points out that the topotypic material of *xantha* must be examined to settle the generic placing (DELL 1990: 153). The specimens in our collection cannot be identified with certainty with *xantha* for the same reason.

Distribution: Type locality WATSON (1886) between Kerguelen and Heard Is. POWELL (1958) records it off Enderby Land, ARNAUD (1972) in Adelie Land, and CANTERA and ARNAUD (1985) record live specimens in Kerguelen in a depth of 17 to 650 m and death shells in Crozet. DELL (1990) remarks that due to the difficulties of identification the range of *xantha* cannot be stated and records it in the Ross Sea between 348 and 549 m. Specimens of this collection were found in mud, sand and algae in Kerguelen between 30 to 50 m.

Family NATICIDAE Forbes, 1838
Genus *Sinuber* Powell, 1951

Sinuber sculpta Martens, 1878 (Fig. 17)

Natica perscalpta Martens, 1878; Watson, 1886: 454, pl. 28, fig. 4.
Sinuber perscalpta: Powell, 1957: 130; Powell, 1960: 145;
Sinuber sculpta: Cantera and Arnaud, 1985: 60.

Material: 2 shells (17.02 x 20.01 mm; 16.15 x 19.98 mm), D18.

Remarks: These thin shells are of great size (about 20 mm), with an inconspicuous periostracum, sculpture of grooves and a chink-like umbilicus. It is easy to separate from *S. sculptum* by its great size and its chink-like umbilicus, almost closed by the columellar callus. The Watson's figure shows a thin globose shell with fine linear grooves (WATSON 1886). Our specimens are very close to it but the spires are more acute and the aperture is a little larger.

Distribution: The type locality is Royal Sound, Kerguelen Is. WATSON (1886) records this species in Kerguelen Is. and POWELL (1957) finds it in two BANZARE localities at Kerguelen. Later CANTERA and ARNAUD (1985) record it in Kerguelen and Crozet with a maximum size of 40 mm in Kerguelen and 8 mm in Crozet. Shells of this collection were found in muddy bottoms at 10 m.

Naticidae indet.

Material: 2 shells, D5; 2 broken shells and 2 shells, D8; 2 broken shells, D9; 1 broken shell and 1 shell, D12-D14; 4 broken shells, D19-21.

Remarks: Here we include badly preserved shells of the family found in different localities. All were impossible to identify.

Family LAMELLARIIDAE Orbigny, 1841
Genus *Marseniopsis* Bergh, 1886

Marseniopsis cf. *pacifica* Bergh, 1886 (Fig. 18)

Marseniopsis pacifica Bergh, 1886; Thiele, 1912: 200, pl. 12, fig. 18; Powell, 1951: 123; Marcus, 1959: 8, figs. 1-8; Powell, 1960: 146; Cantera and Arnaud, 1985: 62; Dell, 1990: 165; Cattaneo-Vietti *et al.*, 2000: 176.

Material: 1 sp. (11.0 x 14.0 mm), D38-D39.

Remarks: There are three species of *Marseniopsis* described from Antarctica, but only one is represented in Kerguelen Is., *M. pacifica*. The external aspect of our single specimen agrees with the Marcus's figure (MARCUS, 1959) and makes us suppose that it is a specimen of *M. pacifica*, but its anatomy and radular characteristics must be checked.

Distribution: The type locality is Kerguelen Is. POWELL (1951) records *pacifica* in South Georgia, South Orkneys and Palmer Archipelago. MARCUS (1959) records this species on the coast of Chile and CANTERA and ARNAUD (1985) find it in Kerguelen and Crozet Is. Dell (1990) gives the range of *Marseniopsis pacifica* as including Magellan strait and Antarctic Peninsula, and CATTANEO-VIETTI *ET AL.* (2000) record this species in Terra Nova Bay, Ross Sea.

Family BUCCINIDAE Rafinesque, 1815
Genus *Neobuccinum* Smith, 1877

Neobuccinum eatoni (Smith, 1875) (Fig. 19)

Buccinopsis eatoni Smith, 1875

Neobuccinum eatoni Watson, 1886: 216; Thiele, 1912, 211; Hedley, 1916:59 pl. 9, fig. 97; Powell, 1951: 143; Powell, 1957: 132; Powell, 1958: 193; Powell,1960: 150; Arnaud, 1972: 128; Egorova, 1982: 41, figs. 172-176; Cantera and Arnaud, 1985: 70; Dell, 1990: 165, figs. 280-282; Cattaneo-Vietti *et al.*, 2000: 175.

Neobuccinum praeclarum Strebel, 1908:31, pl. 3, fig. 38.

Material: 2 sp. (15.64 x 23.51 mm; 14.18 x 22.27 mm), T1.

Remarks: Our two specimens have a deciduous straw coloured epidermis produced in fine spiral lines and only persisting on the last whorl. The operculum is horny with a subterminal nucleus and fine grow lines, it agrees with the Egorova's figure (EGOROVA 1982). DELL (1990) points that the variation of the shell proportion with size and the variation in the shell outline may be the indication that more than one species could be represented.

Distribution: The type locality is Royal Sound, Kerguelen (*N. eatoni*) and Graham Land (*N. praeclarum*). Some authors consider this species with a circumantarctic distribution (POWELL 1958, 1960) or circumantarctic and subantarctic (ARNAUD 1972) and it is one of the most widely distributed molluscs in the Antarctic (POWELL 1957). This species does not appear to reach South Georgia and it is not represented in the Magellanic region (DELL, 1990). CATTANEO-VIETTI *ET AL.* (2000) record this species in Terra Nova Bay, Ross Sea and point out that it is the most common buccinid gastropod. Our specimens were collected in stomachic contens from Morbihan Bay in Kerguelen Is., which seems to be its northern limit (POWELL 1957).

Family BUCCINIDAE Rafinesque, 1815
Genus *Pareuthria* Strebel, 1905

Pareuthria chlorotica (Martens, 1878) (Fig. 20)

Euthria chlorotica Martens, 1878.

Fusus Euthria chloroticus: Watson, 1886: 209, pl. 18, fig. 8.

Pareuthria chlorotica: Thiele, 1912 (in faunal list); Powell, 1957: 132; Powell, 1960: 147; Cantera and Arnaud, 1985: 66.

Material: 4 sp. (10.15 x 16.34 mm – 6.97 x 10.81 mm) and 3 damaged shells (11.0 x 16.11 mm – 10.69 x 14.09 mm), D7; 1 sp. (10.89 x 19.25 mm) and 2 shells (8.4 x 12.8 mm), D8; 2 sp. (13.0 x 19.17 mm; 6.46 x 10.60 mm), D16-D17; 1 shell (11.38 x 17.66 mm), D19-21; 3 sp. (12.33 x 18.35 mm - 8.62 x 12.16 mm) and 1 damaged shell (5.9 x 9.09 mm), D31-D32; 2 sp. (9.75 x 15.75 mm; 7.88 x 13.13 mm) and 2 shells (11.91 x 18.0 mm; 12.12 x 17.71 mm), D36.

Remarks: Shell ovate, of moderate size (about 20 mm) with a pale brown deciduous epidermis in juvenile specimens, which is brown in dead and eroded shells. The surface is covered with a spiral sculpture of close-set threads and in the last whorl, near the canal, it has a sculpture of fine lines. The operculum is leaf-shaped with a subterminal nucleus and the aperture is semicircular, ending in a curved canal. Our specimens agree in shell features and measurements with the Watson`s figure (WATSON 1886).

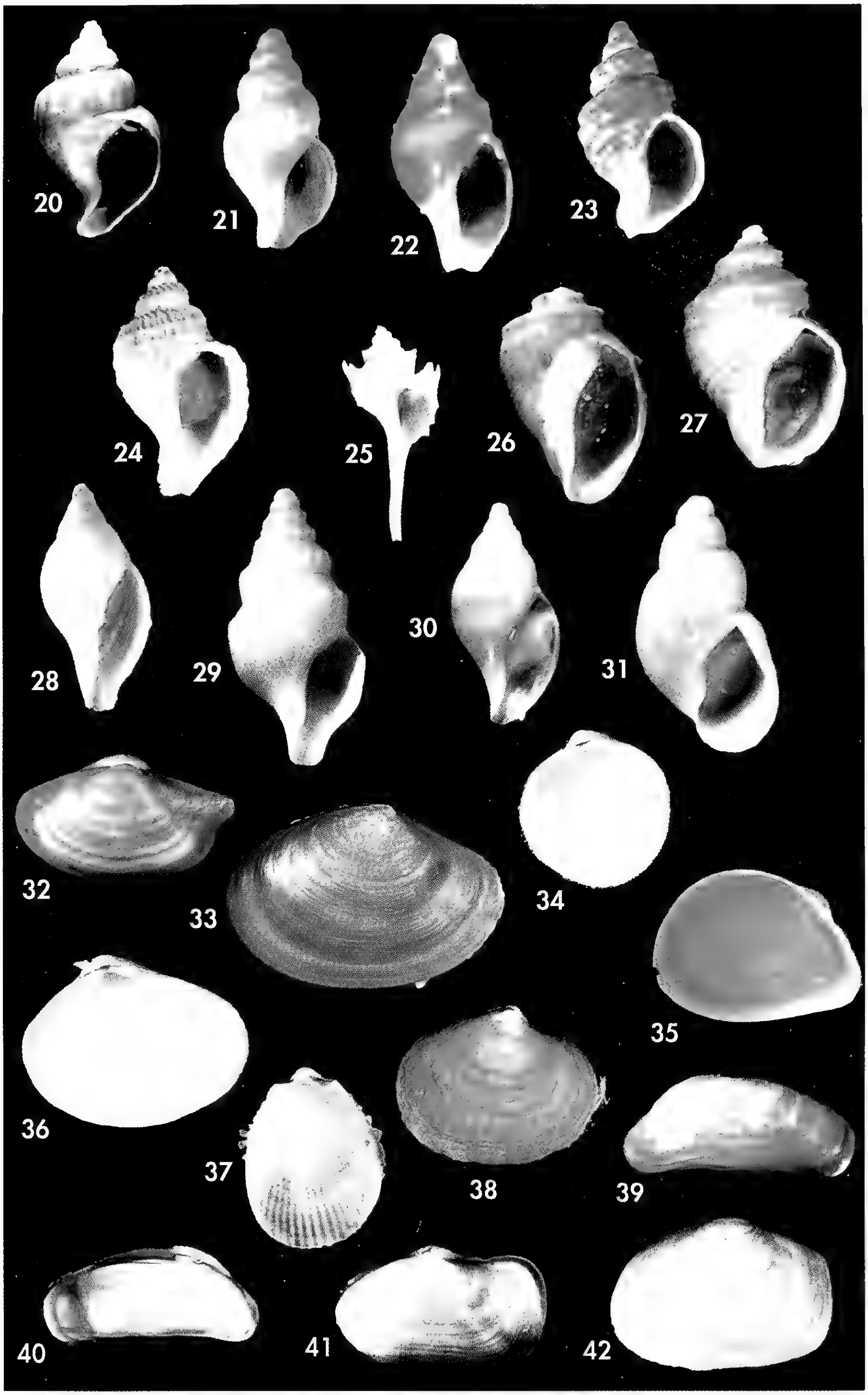
Distribution: The type locality is Kerguelen Is. WATSON (1886) records this species from Kerguelen Is. THIELE (1912) records in a faunal list and POWELL (1957) finds it in a BANZARE localities at Kerguelen. CANTERA and ARNAUD (1985) find *chlorotica* in Kerguelen and Crozet Is., being the later a new record. Our specimens were collected in muddy bottoms from depths of 48-90 m.

Pareuthria regulus (Watson, 1882) (Fig. 21)

Fusus (*Sipho*) *regulus* Watson, 1882.
Fusus (*Neptunea*) *regulus*: Watson, 1886: 204, pl. 12, fig. 7.
Pareuthria regulus: Powell, 1957: 132; Powell, 1960: 148; Cantera and Arnaud, 1985: 66; Branch *et al.*, 1991: 59.

Material: 1 sp. (3.0 x 6.5 mm), D6.

(Right page) Figure 20: *Pareuthria chlorotica*, 19.2 x 10.8 mm. Figure 21: *Pareuthria regulus*, 6.5 x 3.0 mm. Figure 22: *Falsimohnia albozonata*, 4.0 x 8.5 mm. Figure 23: *Prosipho propinquus*, 5.0 x 2.5 mm. Figure 24: *Trophon albolabratus*, 12.8 x 7.5 mm. Figure 25: *Trophon septus*, 22.5 x 10.1 mm. Figure 26: *Admete carinata*, 11.5 x 8.0 mm. Figure 27: *Admete specularis*, 10.4 x 6.7 mm. Figure 28: *Paradmete fragillima*, 12.1 x 6.1 mm. Figure 29: *Spirotropis studeriana*, 8.0 x 4.1 mm. Figure 30: *Typhlodaphne translucida*, 10.1 x 5.4 mm. Figure 31: *Toledonia elata*, 4.3 x 2.2 mm. Figure 32: *Yoldia* (*Aeqviyoldia*) *isonota*, 18.2 x 10.9 mm. Figure 33: *Yoldia* (*Aeqviyoldia*) *eightsi*, 19.0 x 12.9 mm. Figure 34: *Pseudokellya cardiformis*, 4.6 x 4.5 mm. Figure 35: *Gaimardia t. trapesina*, 16.6 x 12.2 mm. Figure 36: *Neolepton umbonatum*, 4.5 x 5.5 mm. Figure 37: *Limatula* (*Antarctolima*) *pygmaea*, 11.2 x 8.5 mm. Figure 38: *Cyclocardia astartoides*, 14.4 x 18.1 mm. Figures 39, 40: *Hiatella antarctica*, 19.0 x 8.2 mm. Figure 41: *Laternula elliptica*, 20.5 x 12.4 mm. Figure 42: *Thracia meridionalis*, 20.5 x 14.3 mm.
(Página derecha) Figura 20: Pareuthria chlorotica, *19,2 x 10,8 mm. Figura 21:* Pareuthria regulus, *6,5 x 3,0 mm. Figura 22:* Falsimohnia albozonata, *4,0 x 8,5 mm. Figura 23:* Prosipho propinquus, *5,0 x 2,5 mm. Figura 24:* Trophon albolabratus, *12,8 x 7,5 mm. Figura 25:* Trophon septus, *22,5 x 10,1 mm. Figura 26:* Admete carinata, *11,5 x 8,0 mm. Figura 27:* Admete specularis, *10,4 x 6,7 mm. Figura 28:* Paradmete fragillima, *12,1 x 6,1 mm. Figura 29:* Spirotropis studeriana, *8,0 x 4,1 mm. Figura 30:* Typhlodaphne translucida, *10,1 x 5,4 mm. Figura 31:* Toledonia elata, *4,3 x 2,2 mm. Figura 32:* Yoldia (Aeqviyoldia) isonota, *18,2 x 10,9 mm. Figura 33:* Yoldia (Aeqviyoldia) eightsi, *19,0 x 12,9 mm. Figura 34:* Pseudokellya cardiformis, *4,6 x 4,5 mm. Figura 35:* Gaimardia t. trapesina, *16,6 x 12,2 mm, Figura 36:* Neolepton umbonatum, *4,5 x 5,5 mm. Figura 37:* Limatula (Antarctolima) pygmaea, *11,2 x 8,5 mm. Figura 38:* Cyclocardia astartoides, *14,4 x 18,1 mm. Figuras 39, 40:* Hiatella antarctica, *19,0 x 8,2 mm. Figura 41:* Laternula elliptica, *20,5 x 12,4 mm. Figura 42:* Thracia meridionalis, *20,5 x 14,3 mm.*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Remarks: Our specimens have a fusiform shell with axial ribs present in the body whorl and an ovate operculum with a terminal nucleus. These features included this species in the subfamily Cominellinae and together with its small size, anterior canal and opercular characteristics locate it in the genus *Pareuthria*. CANTERA and ARNAUD (1985) include *Fusus* (*Sipho*) *edwardiensis* in the synomy of *P. regulus*, but *edwardiensis* have not axial ribs in the last whorl. For lack of type material to compare with, we think that our specimen is a *Pareuthria regulus*. BRANCH *ET AL.* (1991) recorded *P. regulus* but refered it to WATSON (1883). However Branch's figure agrees in shell features with our specimen.

Distribution: The type locality is Royal Sound, Kerguelen Is. WATSON (1886) records two species of *Fusus* (*Neptunea*): *regulus* from Kerguelen and *edwardiensis* from between Marion I. and Prince Edward I. POWELL (1957) records *Pareuthria regulus* in a BANZARE locality at Kerguelen, later in a summary records two species refereed to *F. regulus* in the Kerguelen. CANTERA and ARNAUD (1985) record *Pareuthria regulus* in Kerguelen and Crozet Is. and BRANCH *ET AL.* (1991) in Marion and Prince Edward Is. between 0 and 527 m. Specimen of this collection was collectec in mud with spicles at 40 m.

Family BUCCINIDAE Rafinesque, 1815
Genus *Falsimohnia* Powell, 1951

Falsimohnia albozonata (Watson, 1882) (Fig. 22)

Buccinum albozonatum Watson, 1882; Watson, 1886: 212, pl. 13, fig. 7.
Falsimohnia albozonata: Powell, 1951: 138; Powell, 1957: 133; Powell, 1960: 149; Cantera and Arnaud, 1985: 67.

Material: 3 sp. (4.0 x 8.5 mm – 3.0 x 6.0 mm), D6; 1 shell (2.5 x 4.5 mm), D35.

Remarks: The shell is easy to recognise by its brown colour with a white band in each whorl and in the pillar. It has a small and very thin shell with a tall spire and a spiral sculpture of fine threads. Our specimens reach 8.0 mm long but CANTERA and ARNAUD (1985) give a maximum size of 12.0 mm from specimens collected in Kerguelen.

Distribution: The type locality is Royal Sound, Kerguelen Is. Later Powell records *F. albozonata* from South Georgia (POWELL, 1951) and Kerguelen (POWELL, 1957). More recently CANTERA and ARNAUD (1985) find this species in Kerguelen and Crozet Is., being the second locality a new record for this species. Our specimens were collected in mud with spicles at 40 m.

Family BUCCINIDAE Rafinesque, 1815
Genus *Prosipho* Thiele, 1912

Prosipho propinquus Thiele, 1912 (Fig. 23)

Prosipho propinquus Thiele, 1912: 245, pl. 13, fig. 11; Powell, 1957: 133; Powell, 1960: 152; Cantera and Arnaud, 1985: 73.

Material: 1 sp. (2.5 x 5.0 mm), D35.

Remarks: This species has a small (4.8 x 2.5 mm) brown shell with radial ribs, 3 whorls and a protoconch of one and half whorls and a D-shaped aperture. The shell colour is white in the canal and external lip. In the first and second whorl it has two radial ribs and over six in the body whorl.

Distribution: The type locality is Observatory Bay, Kerguelen Is. It has been recorded in Kerguelen. POWELL (1957) record this species in Bras Bolinder but CANTERA and ARNAUD (1985) did not find it in their samples from Kerguelen. Our specimen was collected in algae collected in Morbihan Bay at depth of 25 m.

Family BUCCINIDAE Rafinesque, 1815
Genus *Bathydomus* Thiele, 1912

Bathydomus sp.

Material: 1 damaged shell, D7; 1 sp., D9; 1 sp. and 1 shell, D10; 1 sp., D12-D14; 1 sp. and 2 shells, D25-D29.

Remarks: Not assigned to any species.

Distribution: The specimens were found in Kerguelen Is.

Family MURICIDAE Rafinesque, 1815
Genus *Trophon* Montfort, 1810

Trophon albolabratus Smith, 1875 (Fig. 24)

Trophon albolabratus Smith, 1875; Strebel, 1908: 42; Powell, 1957: 134; Powell, 1960: 153; Cantera and Arnaud, 1985: 63.

Material: 1 broken shell (9.44 x 24.73 mm), D8; 1 shell (10.95 x 20.61 mm), D9; 1 sp. (4.43 x 8.24 mm) and 2 shells (11.40 x 20.71 mm; 8.66 x 16.59 mm), D10; 1 shell (8.79 x 17.55 mm), D12-D14; 1 shell (10.76 x 19.13 mm), D16-D17; 1 shell (16.2 x 22.8 mm) and 3 broken shells, D19-21; 3 sp. (14.92 x 26.87 mm - 7.56 x 13.22 mm) and 1 shell (8.7 x 16.1 mm), D25-D29; 2 sp. (7.29 x 13.18 mm; 7.25 x 12.61 mm), D35.

Remarks: This species is easy to recognise by the reticulation formed by axial lamellae and spiral cords. In Kerguelen specimens this reticulation produced usually interspaces higher than wide. POWELL (1957) points out that the Macquarie shells, recorded erroneously by HEDLEY (1916) produce interspaces two or three times wider than high and in *T. albolabratus* the reticulation have rectilinear interspaces.

Distribution: The type localities are Swain's Bay and Royal Sound, Kerguelen. This species has been recorded from Kerguelen by STREBEL (1908). POWELL (1957) finds this species in a series of BANZARE localities at Kerguelen and later extends its range to South Georgia and South Orkneys (Powell, 1960). A more complete distribution range was given by CANTERA and ARNAUD (1985), including Falkland Is. Our material comes from mud, sand and algae collected in Morbihan Bay, where CANTERA and ARNAUD (1985) recorded it as a common on a variety of bottoms.

Trophon septus Watson, 1882 (Fig. 25)

Trophon septus Watson, 1882; Watson, 1886: 170, pl. 10, fig. 11; Powell, 1957: 134; Powell, 1960: 154; Cantera and Arnaud, 1985: 65; Branch *et al.*, 1991: 59.

Material: 1 sp. (6.03 x 10.66 mm), D7; 2 sp. (10.29 x 22.75 mm; 10.36 x 22.62 mm), D8; 1 sp. (6.46 x 14.64 mm) and 1 shell (7.62 x 16.65 mm), D31-D32.

Remarks: This species is easy to recognise by the angulose shoulder, where are placed prominent tubercles and it has a long, narrow canal. The shell is porcelaneus white with 5 or 6 whorls, paucispiral protoconch and a horny, ovate operculum with a terminal nucleus. Our specimens agree in shell features with the Watson's figure (WATSON, 1886). However the specimen represented by BRANCH *ET AL*. (1991) has a more globose shell, the tubercles are less prominent than in Watson's figure and has a short canal.

Distribution: The type locality is Royal Sound, Kerguelen. Later POWELL (1957) finds this species in BANZARE localities from Kerguelen. CANTERA and ARNAUD (1985) record *T. septus* in Kerguelen and Crozet, pointing out that is a species living in a great variety of bottoms and with a bathymetric range of 30 to 620 m in the Kerguelen Is. BRANCH *ET AL*. (1991) record it from Marion and Prince Edward Is. in depths of 140 to 200m. Our specimens were collected in mud from depths of 48-65 m.

Family CANCELLARIIDAE Forbes and Hanley, 1853
Genus *Admete* Kroyer, 1842

Admete carinata (Watson, 1883) (Fig. 26)

Cancellaria (*Admete*) *carinata* Watson, 1883; Watson, 1886: 275, pl. 18, fig 9.
Admete carinata: Powell, 1960: 157; Cantera and Arnaud, 1985: 76.

Material: 1 sp. (8.02 x 11.53 mm), D7.

Remarks: The systematics of the antarctic forms of *Admete* present a number of problems. This genus contains a few species of southern latitudes and some species which have been placed here but actually belong to other groups (BOUCHET and WARÉN 1985). The shell is white with a yellowish epidermis and it has two collumelar teeth and it lacks of operculum. This species of *Admete* differs from *A. specularis* in the stronger shelter and the fine spiral threads below the shelter, besides *A. carinata* has 5 whorls and the spire is short while *A. specularis* has 5 1/2 whorls and its spire is larger. CANTERA and ARNAUD (1985) give a maximum size of 20 mm for *carinata* and 13 mm for *specularis*. Our specimen has 12.5 mm of length and agree in shell features with the Watson`s description and figure (WATSON 1886).

Distribution: The type locality is Royal Sound, Kerguelen Is. POWELL (1960) records this species in Falkland Is. and Tierra del Fuego. CANTERA and ARNAUD (1985) find it in Kerguelen between 71 and 195 m. Our single specimen was collected in mud at 65 m.

Admete specularis (Watson, 1882) (Fig. 27)

Cancellaria (*Admete*) *specularis* Watson, 1882; Watson, 1886: 274, pl. 18, fig. 9.
Admete specularis: Powell, 1957: 134; Powell, 1960: 158; Cantera and Arnaud, 1985: 76; Branch *et al*., 1991: 59.

Material: 2 sp. (6.71 x 10.16 mm – 4.92 x 7.47 mm) and 5 shells (6.42 x 9.70 mm – 5.62 x 8.6 mm), D9; 4 shells (6.0 x 10.0 mm – 6.0 x 9.5 mm), D10; 1 broken shell, D31-D32.

Remarks: This shell is white with a yellowish epidermis, below the shelter that is only marked by an angulation it has a sculpture of spiral lines on the whole shell surface and it has two collumelar teeth. This shell is shorter than *ca-*

rinata but its spire is longer because the body whorl of *specularis* is shorter than the body whorl of *carinata*. The mouth is semicircular and differs from *carinata* where the mouth is wide, angulated and reaches half the size of the shell.

Distribution: The type locality is near Royal Sound, Kerguelen Is. WATSON (1886) found it also off Heard Is. POWELL (1957) records it in the BANZARE material collected in Kerguelen, CANTERA and ARNAUD (1985) from Kerguelen and Crozet Is. and BRANCH ET AL. (1991) from Marion and Prince Edward Is. between 49 and 228 m. Specimens of this collection were collected in mud and sand with *Macrocystis* from depths of 30-50 m.

Family VOLUTOMITRIDAE Gray, 1845
Genus *Paradmete* Strebel, 1908

Paradmete fragillima (Watson, 1882) (Fig. 28)

Volutomitra fragillima Watson, 1882; Watson, 1886: 263, pl.14, fig. 7: Thiele, 1912: 264; Cantera and Arnaud, 1985: 75.
Paradmete fragillima: Powell, 1951: 165, Powell, 1957: 134; Powell, 1958: 198; Powell, 1960: 157; Egorova, 1982: 37, fig. 166; Dell, 1990: 222, fig. 390.
Paradmete typica Strebel, 1908: 22, pl. 3, figs. 35 a-f.

Material: 1 broken shell, D2; 1 sp. (6.02 x 12.2 mm) and 2 shells (7.22 x 14.11 mm; 6.59 x 13.8 mm), D9; 2 shells (7.58 x 15.1 mm; 6.92 x 13.97 mm), D16-D17; 1 sp. (6.62 x 12.44 mm), D31-D32; 2 shells (3.86 x 8.83 mm; 3.36 x 5.81 mm), D37.

Remarks: *P. fragillima* has white shell, smooth with four oblique teeth in the columella. Sculpture of fine longitudinal grown lines with a fine yellowish epidermis. It reaches a maximun size of 23 mm in Kerguelen and it is more abundant in the bays (CANTERA and ARNAUD 1985). Only two live specimens were collected in the Morbihan Bay between 30-50 m, reaching 14 mm of length and 6.4 mm of wid.

Distribution: The type localities are Royal Sound, Kerguelen Is. (*P. fragillima*), South Georgia (*P. typica*). POWELL (1951) collected it in South Georgia and Palmer archipelago and later the same author found it in BANZARE localities at Kerguelen Is. (POWELL, 1957) and in the Victoria – Ross Quadrant's (POWELL, 1958). CANTERA and ARNAUD (1985) collected this species in a many stations at Kerguelen and Crozet, between 37 and 315 m of depth. DELL (1990) gives a complete description of the range distribution of *P. fragillima* and the bathymetric range where this species was found. This species was collectec in a great variety of bottoms from depths of 23-50 m.

Family TURRIDAE Swainson, 1840
Genus *Spirotropis* G. O. Sars, 1878

Spirotropis studeriana (Martens, 1878) (Fig. 29)

Pleurotoma (Spirotropis) studeriana Martens, 1878; Watson, 1886: 322, pl. 25, fig. 7.
Spirotropis studeriana: Powell, 1957: 135; Powell, 1960: 160; Powell, 1966: 75; Cantera and Arnaud, 1985: 78; Branch *et al.*, 1991: 59.

Material: 2 sp. (5.99 x 14.47 mm; 5.03 x 11.51 mm) and 1 shell (4.71 x 11.12 mm), D7; 1 sp. (4.07 x 7.95 mm), D8; 5 sp. (6.02 x 13.61 mm – 3.61 x 7.63 mm) and 1 shell (5.61 x 12.89 mm), D31-D32.

Remarks: This shell is characterised by its tall spire, angulated whorls and a subsutural sinus. The aperture is pyriform, ending in a short and straight canal, it has a sculpture of wavy axial ribs and white colour. The protoconch is smooth, rounded and has 1 1/2 whorls, we could not see the operculum because the animal was retracted in all the specimens that we found, but the typical *Spirotropis* operculum is leaf- shaped with a terminal nucleus (POWELL 1966). Our specimens reach a maximum of 14 mm of length, but in adult specimens the maximum size is 26 mm (CANTERA and ARNAUD, 1985). BRANCH *ET AL*. (1991) give a size of 15 mm from specimens collected in Marion and Prince Edward Is.

Distribution: The type locality is Kerguelen Is. POWELL (1957) find it in the material collected in Kerguelen belonging to the BANZARE Expedition. CANTERA and ARNAUD (1985) find this species in Kerguelen and give a new record to Crozet. BRANCH *ET AL*. (1991) collect it in Marion and Prince Edward Is., between 140 and 204 m. Our specimens were collected in mud from depths of 48-65 m.

Family TURRIDAE Swainson, 1840
Genus *Typhlodaphne* Powell, 1951

Typhlodaphne translucida (Watson, 1881) (Fig. 30)

Pleurotoma (*Thesbia*) *translucida* Watson, 1881; Watson, 1886: 330, pl. 25, fig. 11.
Thesbia translucida: Thiele, 1912: 248, pl. 15, fig. 15.
Typhlodaphne translucida: Powell, 1951: 175; Powell, 1957: 136; Powell, 1958: 204; Powell, 1960: 160; Powell, 1966: 129; Cantera and Arnaud, 1985: 80; Dell, 1990: 239; Branch *et al*., 1991: 59.

Material: 2 sp. (5.46 x 10.08 mm; 4.5 x 8.5 mm) and 1 shell (6.52 x 12.49 mm), D25-D29; 1 shell (2.0 x 5.0 mm), D31-D32.

Remarks: The shell is oval, white in colour and smooth, it has not operculum and presents a sculpture of fine lines of growth. CANTERA and ARNAUD (1985) give a maximum size of 14 mm for Kerguelen specimens, our two specimens measured 11 mm in length.

Distribution: The type locality is halfway between Marion I. and Prince Edward I. *Typhlodaphne translucida* has been also recorded in material of a BANZARE expedition from Kerguelen (POWELL 1957) and Victoria – Ross Quadrant's (POWELL 1958). CANTERA and ARNAUD (1985) collect this species from Kerguelen and Crozet, being the later a new record. DELL (1990) gives a range distribution of *T. translucida* that included the antarctic continent between 49° E-53° E and BRANCH *ET AL*. (1991) collected it from Marion and Prince Edward Is. between 210 and 355 m. Our specimens were collected in mud with *Rhodophyces* from depths of 30-50 m.

Family DIAPHANIDAE Odhner, 1914
Genus *Toledonia* Dall, 1902

Toledonia elata Thiele, 1912 (Fig. 31)

Toledonia elata Thiele, 1912: 249, pl. 14, fig. 22; Powell, 1957: 137; Powell, 1958: 206; Powell, 1960: 161; Dell, 1990: 256, figs. 471, 472.

Material: 1 sp. (2.26 x 4.33 mm), D16-D17.

Remarks: Among the species of *Toledonia* endemic of Kerguelen Dell (1990) points out that *T. punctata* is distinguishable by "the sculpture of the protoconch, the strongly developed spiral sculpture and the relatively straight-sided whorl outlines", while *T. elata* have smooth protoconch and a polished shell surface. Our specimen has a smooth protoconch and a polished white shell surface with very fine spiral lines, this spiral sculpture is only noticable with a great magnification. Its measurements are 4.6 x 2.5 with a D/H ratio of 54. We think it is a *T elata* specimen relying on the smooth protoconch and the absence of a strongly spiral sculpture.

Distribution: The type locality is Observatory Bay, Kerguelen Is. Powell records this species in material from BANZARE expedition collected in Kerguelen (POWELL 1957) and in the Victoria – Ross Quadrant (POWELL 1958). POWELL (1960) points out that it has been also recorded from Enderby Land and DELL (1990) found *T. elata* in the Ross Sea between 238 and 351 m.

Family PHILINIDAE Gray, 1850
Genus *Philine* Ascanius, 1772
Philine cf. *amoena* Thiele, 1925

Material: 1 broken shell, D5; 1 shell (6.0 x 7.0 mm), D8; 2 sp. (4.1 x 7.5 mm; 4.1 x 8.0 mm), D25-D29.

Remarks: This species seems to be *amoena,* but without access to type material, we only suspect that it is this species. The shell characteristics agree with this species of *Philine,* although its identity may be confirmed.

Distribution: The type locality is Gazelle Bay, Kerguelen Is. This specie was recorded by POWELL (1957) from two stations of the BANZARE expedition at Kerguelen Is. of which the species is endemic.

Class BIVALVIA
Family SAREPTIDAE A. Adams, 1860
Genus*Yoldia* Möller, 1842
Subgenus *Aeqviyoldia* Scoot-Ryen, 1951
Yoldia (*Aeqviyoldia*) *isonota* Martens, 1881 (Fig. 32)

Yoldia isonota Smith, 1885: 242, pl. 20, figs. 5-5b.
Yoldia (*Aeqviyoldia*) *isonota* Powell, 1957: 115; Powell, 1960: 170.

Material: 3 valves (8.56 x 15.15 mm - 8.10 x 12.44 mm), D2; 11 valves (10.8 x 19.2 mm – 7.9 x 12.8 mm), D3-D4; 2 sp. (15.15 x 26.98 mm; 10.52 x 15.83 mm) and 6 valves (14.5 x 25.0 mm - 9.5 x 15.2 mm), D5; 1 sp. (11.36 x 18.94 mm) and 6 valves (12.42 x 20.23 mm - 9.20 x 14.50 mm), D7; 2 valves (8.83 x 16.58 mm), D16-D17; 2 sp. (10.98 x 18.19 mm; 8.56 x 14.44 mm), D31-D32; 1 sp. (8.59 x 14.01 mm), D36.

Remarks: This species was recorded by Smith (1885) in Kerguelen Is. He pointed out that it is not comparable with any other species.

Distribution: The type locality is Kerguelen Is., from where it was also recorded by the BANZARE expedition (POWELL, 1957). It appears to be endemic of Kerguelen, but ARNAUD (1979) records it at Kerguelen Is. and includes this species in a group with subantartic distribution. In this collection appear three individuals alive in muddy bottoms from 50-90 m, being the remaining material only empty valves.

Yoldia (*Aeqviyoldia*) *eightsi* (Couthouy, in Jay, 1839) (Fig. 33)

Nucula eightsii Couthouy, in Jay, 1839.
Yoldia (Aequiyoldia) eightsi: Dell, 1990: 10, figs. 2, 5; Cattaneo-Vietti *et al.* 2000: 176.
Yoldia subaequilateralis Smith, 1885: 243.
Yodia (*Aequiyoldia*) *subaequilateralis*: Powell, 1957: 114; Powell, 1960: 170.

Material: 1 sp. (19.27 x 32.11 mm) and 3 valves (17.65 x 25.91 mm – 16.22 x 26.59 mm), D5; 1 valve (18.24 x 28.17 mm), D8; 3 sp. (10.93 x 16.81 mm – 8.22 x 12.64 mm) and 5 valves (13.53 x 20.67 mm – 10.57 x 15.76 mm) D9; 1 sp. (14.71 x 22.18 mm) and 4 valves (15.2 x 22.3 mm – 13.2 x 19.5 mm), D10; 1sp. (9.16 x 13.85 mm) and 1 valve (13.59 x 20.81 mm), D12-D14; 1 sp. (15.32 x 22.43 mm) and 1 valve (13.42 x 20.26 mm), D19-21; 2 sp. (12.94 x 19.04 mm; 11.66 x 16.91 mm) and 1 valve (9.02 x 12.84 mm), D25-D29.

Remarks: This is one of the commonest bivalves in antarctic shallow waters (DELL, 1990; CATTANEO-VIETTI *ET AL.*, 2000). *Y. eightsi* was found in the Ross Sea with densities of 70-80 ind./m2 (CATTANEO-VIETTI *ET AL.*, 2000).

Distribution: The type locality is Swain's Bay, Kerguelen Is. This species with circumantarctic distribution (DELL, 1990) extends to the South Shetlands, South Orkneys, South Sandwich Is., South Georgia, Falkland Is., Tierra del Fuego, Southern Chile and to Kerguelen Is. Although its known range is 4-824 m, DELL (1990) remarks that this species is much commoner at depth shallower than at 100 metres. CATTANEO-VIETTI *ET AL.* (2000) find this species in Terra Nova Bay, Ross Sea with a maximum size of 30 mm and between depths of 36 and 380 m. ARNAUD (1979) found *Y. isonota* in Kerguelen Is. in coarse sand with a detritic and organogenic components. In the present collection *Y. eightsi* was found in muddy and sandy bottoms with an organogenic components (spicles) from 23 to 50 m.

Family MALLETIIDAE Adams and Adams, 1858
Genus *Malletia* Desmoulins, 1832

Malletia gigantea (Smith, 1875)

Solenella gigantea Smith, 1875.
Malletia gigantea: Thiele, 1912: 254; Powell, 1957: 115; Powell, 1960: 171.

Material: 1 sp. (24.63 x 44.06 mm) and 13 valves (31.0 x 57.2 mm – 25.0 x 47.0 mm), D18; 3 valves, D31-D32.

Remarks: It is the largest bivalve found in this collection and its measurements are 44.06 mm x 24.63 mm. Smith's type is the largest known with 62 mm x 32 mm (POWELL, 1957).

Distribution: The type locality is Royal Sound, Kerguelen Is. This species was also recorded in Kerguelen Is. by THIELE (1912) in Observatory Bay and by POWELL (1957) in a BANZARE localities between 4 and 150 m. ARNAUD (1979) records it from Kerguelen Is. and points out that is another species with subantarctic distribution. Shells and the individual of this collection come from muddy bottoms, agreeing with ARNAUD (1979), who found this species in muddy bottoms and included it in the deposit-feeders.

Family MYTILIDAE Rafinesque, 1815
Genus *Aulacomya* Moerch, 1853

Aulacomya ater regia Powell, 1957

Mytilus magellanicus Thiele, 1912: 253.
Aulacomya ater regia Powell, 1957: 120, pl. 2, figs. 1-2; Powell, 1960: 174.

Material: 2 sp. (49.0 x 98.0 mm; 8.0 x 18.0 mm), D10; 6 sp. (50.98 x 112.31 mm - 12.72 x 26.83 mm), D12-D14; 1 sp. (46.06 x 105.42 mm) and 1 valve (30.51 x 56.82 mm), D16-D17; 3 sp. (50.57 x 106.85 mm - 47.74 x 115.64 mm), D19-21; 1 sp. (41.63 x 85.51 mm), D29-25; 1 sp. (1.4 x 2.2 mm), D35.

Remarks: This species has the same shape as *Aulacomya ater ater*, but it is distinguishable by the number of ribs in the umbonal area (POWELL, 1957). In our Kerguelen individuals the number of ribs reaches a range of 9-14, while the range known for this subspecies is 10-13 (POWELL, 1957). This author described the Kerguelen population as a new subspecies upon the umbonal rib count (POWELL, 1957). The greater individual found in this work was 115.6 mm x 47.7 mm with 14 ribs in the umbonal area and golden brown coloration, features that agree with the subspecies described by Powell. ARNAUD (1974 and 1979) do not maintain this subespecies for Kerguelen populations.

Distribution: The type locality is Bras Bolinder, Kerguelen Is. THIELE (1912) records this species in Observatory Bay, Kerguelen Is. and POWELL (1957) in some BANZARE stations at Kerguelen.

Family KELLIIDAE Forbes and Hanley, 1958
Genus *Pseudokellia* Pelseneer, 1903

Pseudokellia cardiformis (Smith, 1885) (Fig. 34)

Kellia cardiformis Smith, 1885: 202, pl. 11, figs. 6-66.
Pseudokellia stillwelli Hedley, 1916: 31, pl. 3, figs. 38, 39; Powell, 1960: 178; Egorova: 1982: 72, figs. 326, 327.
Pseudokellia cardiformis: Powell, 1957: 122; Powell, 1960: 178; Dell, 1990: 40, figs 66, 67.

Material: 3 valves (4.5 x 4.6 mm), D8; 1 sp. (2.5 x 3.0 mm), D25-29.

Remarks: Only one young individual was found alive in this collection. It is a whitish, circular and very thin shell. In the empty shells we can see the hinge composed of two cardinal teeth in the left valve and only one in the right, ligament is internal and it is situated just below the umbo.

Distribution: The type locality is Royal Sound in Kerguelen Is. HEDLEY (1916) records *P. cardiformis* in Adelie Land and Davis Sea, POWELL (1957) found it in BANZARE localities and EGOROVA (1982) records this species in the Results of the Soviet Antartic Expedition. According to DELL (1990) this species has a probably circumantarctic distribution. Antarctic Peninsula, South Sethlands, South Sandwich Is., South Georgia, Shag Rocks, off the Falkland Is., Kerguelen Is. and Ross Sea. This author records *P. cardiformis* in the Ross Sea at 51-377 m. CATTANEO-VIETTI *ET AL*. (2000) record *P. cardiformis* in Terra Nova Bay, Ross Sea between 49 and 544 m. Our specimen was collected in muddy bottom with *Rhodophyces* from depths of 30-50 m.

Family GAIMARDIIDAE Hedley, 1916
Genus *Gaimardia* Gould, 1852

Gaimardia trapesina trapesina (Lamarck, 1819) (Fig. 35)

Gaimardia trapesina Hedley, 1916: 25, with the following synonyms: *Modiolarca crassa, cannellieri, lephayi, savatieri, fuegiensis* and *hahni*, all of Rochebrune and Mabille, 1889: 120-123; Powell, 1957: 122; Branch *et al.*, 1991: 47, 52, 61, 63.

Gaimardia trapesina trapesina: Powell, 1960: 179

Material: 79 sp. (15.56 x 22.39 mm – 5.5 x 8.8 mm), D5; 1 valve (0.6 x 0.8 mm), D9; 1 broken valve, D19-21; 54 sp. (16.52 x 22.56 mm – 96.54 x 10.39 mm), D25-D29.

Remarks: According to BRANCH *ET AL.* (1991) this species can reach up to 25 mm of length. The largest individual found by us in Kerguelen Is. was 23 mm length. *G. trapesina* has a fragile shell, with a coloration pale buff to brown and the typical rostrum of *trapesina,* we found most of the samples associated to the kelp. Samples found by POWELL (1957) in Kerguelen Is. are shorter than 10 mm, while the largest Macquarie I. samples that were found by Hedley are 19 mm (HEDLEY 1916). This author remarks that Lamarck´s type is 22 mm and BRANCH *ET AL.* (1991) point out that this species is usually attached to the blades of the kelp *Macrocystis pyrifera,* and records this bivalve in sand with depth range of 5-200 m.

Distribution: The type locality of *G. trapesina* appears to be unknown, probably Magellan province (POWELL 1960). HEDLEY (1916) records the *coccinea* variety in Macquarie I. This species has almost a subantarctic distribution following the *Macrocystis pyrifera* distribution (ARNAUD, 1979; HAREAU and ARNAUD, 1984). It has been recorded in the Magellanic province, including Falkland Is., Kerguelen Is. and Crozets (POWELL 1960). BRANCH *ET AL.* (1991) records this species from Marion and Prince Edward Is. between 5 and 200 m. Our samples come from Port aux Français, Channer I., Suhm I., Glénan Is. and Passe de Buenos Aires and were collected in muddy bottons whit spicles and *Marocystis* from depths of 23-50 m.

Family NEOLEPTONIDAE Thiele, 1934
Genus *Neolepton* Monterosato, 1875

Neolepton umbonatum (Smith, 1885) (Fig. 36)

Davila (?) *umbonata* Smith, 1885: 82, pl. 6, figs 1, 1b.
Notolepton umbonatum: Powell, 1955: 37; Powell, 1957: 123; Powell, 1960: 180.
Neolepton umbonatum: Branch *et al.*, 1991: 54; Linse, 1997: 57; Linse and Brandt, 1998: 884, 887.

Material: 2 valves (2.0 x 2.0 mm; 1.5 x 2.0 mm), D5; 1 sp. (3.5 x 5.0 mm), D6; 1 sp. (3.0 x 4.0 mm), D7; 5 valves (4.5 x 5.5 mm – 3.0 x 4.0 mm), D8.

Remarks: SMITH (1885) described this species from individuals found in Balfour Bay and Royal Sound in Kerguelen Is. and places it in the genus *Davila,* although he points out that it did not correspond in the hinge with the typical *Davila.* Later this species has been recorded under different genera. DELL (1964a in DELL 1990) places a specimen of *Lepton parasiticum* from Kerguelen in the genus *Neolepton* and considers this one as a synonymy of *Notolepton*. BRANCH *ET AL.* (1991) describe the shell of *N. umbonatum* as more longer than high, a little inflated and with a prominet umbo, these shell features agree with our individuals.

Distribution: The type localities of this species are Balfour Bay and Royal Sound in Kerguelen Is. POWELL (1955) records it in Auckland Is. and later records this species in BANZARE material POWELL (1957). BRANCH *ET AL.* (1991) records it in Marion and Prince Edward Is., 10 to 750 m. LINSE (1997) found this species in the Beagle Channel, 25 to 271 m. Our specimens were collected in muddy bottoms with an organogenic components (spicles) from depths of 23-65 m.

Family LIMIDAE Rafinesque, 1815
Genus *Limatula* Searles-Wood, 1839

Limatula cf. *pygmaea* (Philippi, 1845) (Fig. 37)

Lima pygmaea Philippi, 1945; Thiele, 1912: 251, pl. 17, figs. 6-8.
Limatula pygmaea: Powell, 1955: 27; Powell, 1957: 116; Powell, 1960: 176; Branch *et al.*, 1991: 50; Linse, 1997: 52; Linse and Brandt, 1998: 884.
Limatula cf. *pygmaea*: Arnaud, 1979: 222; Hareau and Arnaud, 1984: 466.
Limatula (*Antarctolima*) *pygmaea*: Dell, 1990: 55.

Material: 3 sp. (8.51 x 11.26 mm – 5.54 x 7.22 mm), D3-D4; 1 broken valve, D5; 1sp. (8.55 x 11.26 mm) and 11 valves (11.0 x 14.28 mm – 4.84 x 6.11 mm), D8; 1 valve (9.31 x 12.37 mm), D9; 12 valves (11.33 x 14.49 mm – 10.16 x 14.06 mm), D10; 2 sp. (11.30 x 14.85 mm; 7.39 x 9.59 mm), D19-21; 29 sp. (12.67 x 16.42 mm – 6.89 x 8.76 mm) and 2 valves (12.5 x 16.1 mm; 10.5 x 12.8 mm), D25-D29.

Remarks: The greatest specimen of this collection reaches 16.5 mm, is a white broadly oval shell with radial ridges and growth rings. POWELL (1957) points out that it is better to maintain the name *pygmaea* for the Kerguelen shells until comparative material can be examined. ARNAUD (1979) and HAREAU and ARNAUD (1984) point out that Stuardo (1968) concluded that the Kerguelen specimens of *L. pygmaea* defered of *L. pygmaea* (Philippi, 1845) but the new name could not be employed because remains unpublished. DELL (1990) explains that "the relationship of *L. pygmaea* and *L. ovalis* will be better understood when more material of eastern Antarctica can be critically compared with material of the full range of *L. pygmaea*". We consider that our specimens are very close to *L. pygmaea* (Philippi, 1845) in measurements and shell characteristics but we agree with Arnaud's nomenclature and consider this species as cf.

Distribution: It has a wide distribution range and has been recorded from Southern Chile and the Magellanic region to Kerguelen and Macquarie Is. in depths of 6 to 598 m (DELL 1990). BRANCH ET AL. records this species from Marion and Prince Edward I. between 38 and 240 m and recently it has been collected in the Beagle Channel by LINSE (1997) and LINSE AND BRANDT (1998), 5 to 665 m. HAREAU and ARNAUD (1984) included, in the distribution range of Stuardo's species, Crozet and Kerguelen Is. and pointed out that some of *L. pygmaea* (Philippi, 1845) records could be about Stuardo's species. We found this species in muddy and sandy bottoms from depths of 23-50 m.

Family CARDITIDAE Fleming, 1828
Genus *Cyclocardia* Conrad, 1867

Cyclocardia astartoides (Martens, 1878) (Fig. 38)

Cardita astartoides: Smith, 1885: 212, pl. 5, figs. 2-2a; Thiele, 1912: 230, pl. 18, fig. 10.
Venericardia astartoides: Hedley, 1916: 30, pl. 3, figs. 33, 34.
Cyclocardia astartoides: Powell, 1957: 121; Powell, 1958: 177; Powell, 1960: 177; Egorova, 1982: 72, figs. 328, 329; Dell, 1990: 59, figs. 98, 99; Cattaneo-Vietti *et al.*, 2000: 176.
Cyclocardia antarctica: Powell, 1960: 177.

Material: 4 sp. (23.93 x 30.04 mm – 8.0 x 9.5 mm) and 5 valves (34.2 x 43.5 mm – 8.8 x 11.5 mm), D3-D4; 1 sp. (4.5 x 5.2 mm) and 9 valves (14.44 x 18.15 mm – 6.42 x 6.74 mm), D5; 1 sp. (30.70 x 36.54 mm), D8; 1 valve (26.07 x 29.43 mm), D10; 52 valves (29.0 x 37.2 mm – 18.5 x 22.2 mm), D12-D14; 1 sp. (23.51 x 27.16 mm) and 2 valves (14.45 x 16.78 mm), D16-D17; 8 sp. (31.02 x 36.34 mm – 17.34 x 20.03 mm) and 12 valves (31.44 x 39.17 mm – 11.25 x 13.31 mm), D19-21; 5 sp. (23.0 x 27.7 mm - 9.42 x 10.61 mm) and 5 valves (27.21 x 32.19 mm – 8.28 x 9.95 mm), D25-D29.

Remarks: POWELL (1960) records three types of *Cyclocardia* in Antarctic waters: *antarctica, astartoides* and *intermedia* that later DELL (1964a in DELL, 1990) suggests as the variants of the widely distributed *C. astartoides*. Afterwards NICOL (1966 in DELL, 1990) reiterates the differences between the type *antarctica* and typical form *astartoides* and gives the ratio of length to height of this types. DELL (1990) revises the ratios and other characteristics of a series of specimens belonging to *astartoides* and concludes that until a better evidence is found, *antarctica* is based on a single aberrant specimen of *astartoides*.

Distribution: The type locality is Kerguelen Is. *C. Astartoides* has been recorded from Kerguelen and between Kerguelen and Heard Is. (SMITH, 1885; THIELE, 1912; POWELL, 1957), Davis Sea and Shackleton Ice-shelf (HEDLEY, 1916), Enderby Land and Adelie Land (POWELL 1958) and Terra Nova Bay, Ross Sea (CATTANEO-VIETTI *ET AL.*, 2000). Moreover it has been recorded from South Shetlands, South Orkneys, South Sandwich Is., South Georgia, Bouvet I., Ross Sea and Kerguelen (see DELL 1990). This author points out that it is a common species in the Ross Sea, 18-1674 m. In this collection it is one of the characteristic bivalves, appearing in muddy and sandy bottoms with organogenic components and algae from depths of 30-50 m.

Family HIATELLIDAE Gray, 1824
Genus *Hiatella* Daudin, 1801

Hiatella cf. *antarctica* (Philippi, 1845) (Figs. 39, 40)

Saxicava antarctica Hedley, 1916: 33.
Hiatella cf. *antarctica*: Powell, 1955: 44.
Hiatella antarctica: Powell, 1957: 124; Powell, 1960: 183.

Material: 1 sp. (19 mm x 8.2 mm), D3-D4.

Remarks: This species has a very variable shape and POWELL (1957) ascribes all irregular Subantarctic and Antarctic *Hiatella* to *antarctica*. HAREAU and ARNAUD (1984) point out that determination of South hemisphere *Hiatella* is uncertain and consider the similarity between this species and *H. arctica* (Linné, 1767). This collection have only one individual, found in Passe de Buenos Aires. It is elongate (19 mm x 8.2 mm), slightly gaping with concentric growth rings and two rows of little spines only visible in the anterior dorsal margin. This shell is white with pale brown deciduous periostracum, ligament external and one cardinal tooth in the right valve. We have not enougth data on which to base a judgement and for this reason we consider this species as cf.

Distribution: The distribution range can not be critically established with the specific discusions existing. In this collection there is one specimen collected in muddy bottoms with organogenic components from a depth of 42 m.

Family LATERNULIDAE Hedley, 1918
Genus *Laternula* Röding, 1798

Laternula elliptica (King and Broderip, 1831) (Fig. 41)

Anatina elliptica: Smith, 1885: 76; Thiele, 1912: 256.
Laternula elliptica: Hedley, 1916: 27; Powell, 1957: 120; Powell, 1960: 185; Egorova, 1982: 68, figs. 197-299; Dell, 1990: 62, fig. 106; Branch *et al.*, 1991: 51; Cattaneo-Vietti *et al.*, 2000: 176.

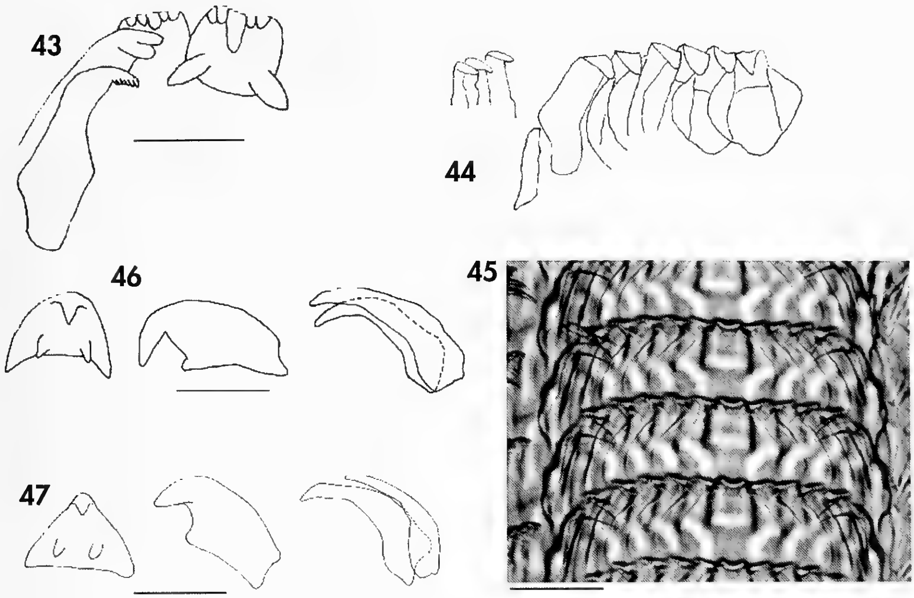

Figure 43: *Eatoniella k. kerguelenensis*, radula. Figure 44: *Margarites* cf. *porcellana*, radula. Figure 45: *Margarites violacea*, radula. Figure 46: *Falsilunatia* cf. *dalicatula*, radula. Figure 47: *Falsilunatia* cf. *xantha*, radula. Scale bars, 43: 25 µm, 44-47: 100 µm

Figura 43: Eatoniella k. kerguelenensis, *radula. Figura 44:* Margarites cf. porcellana, *radula. Figura 45:* Margarites violacea, *radula. Figura 46:* Falsilunatia cf. dalicatula, *radula. Figura 47:* Falsilunatia cf. xantha, *radula. Escalas, 43: 25 µm, 44-47: 100 µm.*

Material: 1 broken valve, D7; 1 sp. (12.42 x 22.07 mm), D9; 2 sp. (28.0 x 45.0 mm; 9.77 x 16.67 mm) and 1 valve (33.61 x 60.80 mm), D16-D17; 2 valves (28.27 x 50.05 mm; 21.82 x 37.91 mm), D18; 2 sp. (13.85 x 27.37 mm; 9.43 x 22.15 mm), D19-21; 5 sp. (21.88 x 37.86 mm – 8.5 x 17.5 mm), D25-D29; 3 sp. (12.41 x 20.53 mm - 10.8 x 17.5 mm), D31-D32; 1 valve (19.65 x 36.59 mm), M14.

Remarks: This species of bivalve is easy to recognize by its shell and the big siphon. *L. elliptica* is an abundant shallow waters species, DELL (1990) remarks this species as probably commoner in depths shallower than 20 m. CATTANEO-VIETTI *ET AL.* (2000) found in the Terra Nova Bay a specimen with a maximum size of 83 mm, whereas in this collection the maximum size is 60.8 mm.

Distribution: The type locality is South Shetlands. *L. elliptica* has been recorded from Betsy Cove and Royal Sound (SMITH, 1885), Observatory Bay (THIELE, 1912) and Commonwealth Bay (HEDLEY, 1916) all in Kerguelen. POWELL (1957) also records this species in a series of BANZARE localities at Kerguelen Is. *L. elliptica* has a completely circumantarctic distribution, being known from Antarctic Peninsula, South Shetlands, South Orkneys and South Sandwich Is., South Georgia and Kerguelen (DELL, 1990). BRANCH *ET AL.* (1991) find this species in Marion and Prince Edward Is. CATTANEO-VIETTI *ET AL.* (2000) record this specie in Terra Nova Bay, Ross Sea. Individuals of this collection have been collected in muddy and sandy bottoms with *Rhodophyces* from depths of 0,1-65 m.

Family THRACIIDAE Stoliczka, 1870
Genus *Thracia* Sowerby, 1823

Thracia meridionalis Smith, 1885 (Fig. 42)

Thracia meridionalis Smith, 1885: 68, pl. 6, figs. 4-4b; Hedley 1916: 29; Powell, 1958: 178; Powell, 1960: 184; Egorova, 1982: 69, figs. 304-306; Dell, 1990: 63, figs. 109, 110, 111; Branch *et al.*, 1991: 51; Linse, 1997: 61; Linse and Brandt, 1998: 884; Cattaneo-Vietti *et al.*, 2000: 176.
Mysella truncata Thiele, 1912: 230, pl. 18, fig. 18.
Mysella frigida Thiele, 1912: 231, pl. 18, fig. 19.

Material: 1 valve, D9; 3 valves (15.7 x 20.8 mm - 14.3 x 20.5 mm), D25-D29.

Remarks: This characteristic bivalve is easy to recognize, besides its shell features, by its pallial sinus and its muscle scars. Although this species is a common antarctic bivalve, in this collection *T. meridionalis* is only represented by empty valves. CATTANEO-VIETTI *ET AL.* (2000) found, in Terra Nova Bay, Ross Sea, a specimen with a length of 25 mm.

Distribution: The type locality is Royal Sound in Kerguelen Is. DELL (1990) points out that it is another species with probably circumantarctic distribution and records it in the Antarctic Peninsula, South Shetland, South Orkneys, South Sandwich Is., South Georgia, Magellanic region, Falkland Is., Kerguelen, Marion and Prince Edward Is. and in the Ross Sea with a bathymetric range of 5-752 m. This author remarks that it is more common in relatively shallow depths. BRANCH *ET AL.* (1991) collect this species from Marion and Prince Edward Is., 15-120 m. LINSE (1997) records this species in the Beagle Channel. CATTANEO-VIETTI *ET AL.* (2000) record *T. meridionalis* in Terra Nova Bay, Ross Sea, 30-123 m. In this collection there are two shells collected in mud with *Rhodophyces* from depths of 30-50 m.

CONCLUSIONS

A total of 843 individuals was identified belonging to 44 species of molluscs. Twelve of these species are bivalves with a total of 434 individuals and thirty-two species are gastropods with a total of 409 individuals. All the species are characteristics of shallow waters, being the samples collected in a maximum depth of 90 m.

Among the bivalves, the most abundant species are *Gaimardia t. trapesina* with 132 individuals and *Limatula* cf. *pygmaea* with 35 individuals and 27 valves. Whereas among the gastropods the most abundant species are *Margarites* cf. *porcellana* with 48 individuals and 34 shells and *Perissodonta mirabilis* with 40 individuals and 19 shells. Only one species of bivalve, *Thracia meridionalis*, is represented by empty valves whereas three species of gastropods, *Puncturella conica*, *Iothia coppingeri* and *Sinuber sculpta*, are represented by empty shells. The small size of most of the species of this collection must be emphasized. There are a few exceptions like the limpets *Nacella* (*Patinigera*) *edgari* and *N. delicatissima* or *Perissodonta mirabilis* and among the bivalves *Aulacomya ater regia* and *Laternula elliptica*.

In this collection, there are one species of bivalve and two of gastropods that are endemics of the Kerguelen Is., the bivalve *Aulacomya ater regia*, and the gastropods *Nacella* (*Patinigera*) *edgari* and *Prosipho propinquus*. This latter species have not been recorded after POWELL (1957) and CANTERA and ARNAUD (1985) included it in the faunal list. There are four species of bivalves that ARNAUD (1979) and HAREAU and ARNAUD (1984) pointed out that have a subantarctic distribution, these species are: *Yoldia* (*Aeqvi-*

yoldia) isonota, Malletia gigantea, Gaimardia t. trapesina and *Limatula* cf. *pygmaea.*

Most of the species formerly considered as endemic of Kerguelen Is., have been recorded from Crozet Is. by CANTERA and ARNAUD (1985): *Eatoniella k. kerguelenensis, Eumetula ornata, Pareuthria chlorotica, Spirotropis studeriana, Trophon septus* and *Admete specularis.* There are only one species of gastropod (*Iothia coppingeri*) with a circumantarctic distribution whereas there are four species of bivalves with this distribution: *Yoldia* (*Aeqviyoldia*) *eightsi, Laternula elliptica, Thracia meridionalis* and *Pseudokellya cardiformis.* The two latter species are recorded by DELL (1990) as with a probable's circumantarctic distribution.

If the specific identity of *Margarites* cf. *porcellana,* one of the most abundant gastropod is confirmed, it would be a new record for the Kerguelen Is., since its the type locality is off Marion I. and its recent records Marion and Prince Edward Is. (BRANCH *ET AL.*, 1991).

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BIBLIOGRAPHY

ARNAUD, P. M., 1972. Invertébrés marins des XIIème et XVème Expéditions Antarctiques Françaises en Terre Adélie. 8. Gastéropodes prosobranches. *Tethys,* Supplément 4: 105-134.

ARNAUD, P. M., 1974. Contribution à la bionomie marine benthique des régions antarctiques and subantarctiques. *Tethys,* 6: 465-656.

ARNAUD, P. M., 1979. Ecologie, biogéographie et caractères biologiques des pélécypodos macrobentiques du Plateau des îles Kerguelen (Sud Océan Indien). *Memoires Museum Histoire Naturelle,* 43: 221-233. París.

ARNAUD, P. M. AND BANDEL, K., 1978. Comment on six species of marine antarctic littorinacea (Mollusca, Gastropoda). *Tethys,* 8 (3): 213-230.

BRANCH, M. L.; ARNAUD, P. M.; CANTERA, J. AND GIANAKOURAS, D., 1991. The benthic Mollusca and Brachiopoda of subantarctic Marion and Prince Edward I.: 1) Illustrated keys to the species 2) Records of the 1982-1989 University of Cape town Surveys. *South African Journal of Antarctic Research,* 21, 1: 45-64.

BOUCHET, P. AND WARÉN, A., 1985. Revision of the Northeast Atlantic bathyal and abyssal Neogastropoda excluding Turridae (Mollusca, Gastropoda). *Bollettino Malacologico,* Supplemento 1: 121-296.

CANTERA, J. AND ARNAUD, P. M., 1985. Les gastéropodes prosobranches des Illes Kerguelen et Crozet (de l'Océan Indien) comparison écologique et particularités biologiques. *CNFRA (Comité National Français des Recherches Antarctiques),* 56: 1-169.

CATTANEO-VIETTI, R.; CHIANTORE, M.; SCHIAPARELLI, S. AND ALBERTELLI, G., 2000. Shallow- and deep-water mollusc distribution at Terra Nova Bay (Ross Sea, Antarctica). *Polar Biology,* 23: 173-182.

DELL, R. K., 1990. Antarctic Mollusca. *Bulletin of the Royal Society of New Zealand,* 27: 1-311.

EGOROVA, E. N., 1982. Biological results of the Soviet Antarctic expeditions, 7. Mollusca of the Davis Sea. *Explorations of the faunas of the Sea,* 26 (34): 1-142 [in Russian].

HAREAU, A. AND ARNAUD, P. M., 1984. Macropelecipodos de las IslasCrozet (Indico Sur). 1. Composición faunística y zoogeografía. *Revista de la Facultad de Humanidades y Ciencias, Serie Ciencias Biológicas,* Volumen 1, 28: 457-476.

HEDLEY, C., 1916. Mollusca. *Australasian Antarctic Expedition 1911-1914, Scientifics Reports, C- Zoology and Botany,* 4 (1): 1-80.

LINSE, K., 1997. Die Verbreitung epibenthischer Mollusken im chilenischen Beagle-Kanal. *Berichte zur Polarforschung*, 228, 1-131 [in German].

LINSE, K. AND BRANDT, A., 1998. Distribution of epibenthic mollusca on a transect through the Beagle channel (Southern Chile). *Journal of the Marine Biological Association of the United Kingdom* , 78, 875-889.

MARCUS, E., 1959. Reports of the Lund University Chile Expedition 1948-49. 36. Lamellariacea und Opisthobranchia. *Lunds Universitets Arsskrift*. N.F. (2), 55 (9): 1-137.

PONDER, W. F., 1983. Rissoaform gastropods from the Antarctic and Subantarctic. *British Antarctic Survey Scientific Reports*, 108: 1-96.

POWELL, A. W. B., 1951. Antarctic and Subantarctic Mollusca: Pelecypoda and Gastropoda. *Discovery Reports*, 26: 47-196.

POWELL, A. W. B., 1955. Mollusca of the Southern Islands of New Zealand. *Cape Expedition Series Bulletins*, 15: 1-151.

POWELL, A. W. B., 1957. Mollusca of the Kerguelen and Macquarie Islands. *B.A.N.Z. Antarctic Research Expedition 1929-1931 Reports B*, 6: 107-149.

POWELL, A. W. B., 1958. Mollusca from the Victoria-Ross quadrants of Antarctica. *B.A.N.Z. Antarctic Research Expedition 1929-1931 Reports B*, 6: 165-215.

POWELL, A. W. B., 1960. Antarctic and Subantarctic Mollusca. *Records of the Auckland Institute and Museum*, 5: 117-193.

POWELL, A. W. B., 1966. The molluscan families Speightiidae and Turridae. *Bulletin of the Auckland Institute and Museum*, 5: 1-184.

SMITH, E. A., 1885. Report on the Lamellibranchiata collected by H.M.S. Challenger during the years 1873-766. *Report on the Scientific Results of the Voyage of H.M.S. Challenger. Zoology*, 13: 1-341.

STREBEL, H., 1908. Die Gastropoden. *Wissenschaftliche Ergebnisse der schwedischen Südpolar Expedition. 1901-1903*, 6 (1): 1-112.

THIELE, J., 1912. Die Antarktischen und Schnecken und Muscheln. *Deutsche Südpolar-Expedition 1901-1903*, 13: 183-285.

WATSON, R.B., 1886. Report on the Scaphopoda and Gastropoda collected by H.M.S. *Challenger* during the years 1873-1876. *Report on the Scientific Results of the Voyage of H.M.S. Challenger. Zoology*, 15: 1-756.

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The genus *Mitrolumna* (Gastropoda, Turridae) in West Africa

El género *Mitrolumna* (Gastropoda, Turridae) en África Occidental

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ABSTRACT

Five species of *Mitrolumna* Bucquoy, Dautzenberg and Dollfus, 1883, are identified from West Africa, mostly from recent unpublished findings. Three species from Senegal, already known, are revised: *M. monodi* (Knudsen, 1956), *M.* cf *crenipicta* Dautzenberg, 1889 and *M. smithi* (Dautzenberg and Fischer, 1896). Two species are described as new for science: *Mitrolumna senegalensis* spec. nov. from Senegal and *Mitrolumna saotomensis* spec. nov. from São Tomé, Príncipe and Annobón.

RESUMEN

Cinco especies del género *Mitrolumna* Bucquoy, Dautzenberg y Dollfus, 1883, han sido encontradas en África occidental, la mayoría de ellas de hallazgos recientes no publicados. Tres especies ya conocidas de Senegal: *M. monodi* (Knudsen, 1956), *M.* cf *crenipicta* Dautzenberg, 1889 and *M. smithi* (Dautzenberg and Fischer, 1896). Dos especies más se describen como nuevas para la ciencia: *Mitrolumna senegalensis* spec. nov. de Senegal y *Mitrolumna saotomensis* spec. nov. de São Tomé, Príncipe y Annobón.

KEY WORDS: *Mitrolumna*, Lusitanian Province, West Africa, variability, distribution, new species.
PALABRAS CLAVE: *Mitrolumna*, Provincia Lusitanica, África Occidental, variabilidad, distribución, especies nuevas.

INTRODUCTION

The genus *Mitrolumna* was described by Bucquoy, Dautzenberg and Dollfus (1883), and several species are known in the Lusitanian Province.

M. olivoidea (Cantraine, 1835), type species of the genus, is known as a common and somewhat variable species, ranging at infralittoral and circalittoral levels throughout the western basin of the Mediterranean and the neighbouring Atlantic. *M. crenipicta* Dautzenberg, 1889, described from one beached shell collected in the Açores Islands, has been recognized by several authors as ranging throughout the southwest Mediterranean, the adjacent Atlantic and the Canarian Archipelago.

Two more species have been described in the last century from deep levels off the Açores Islands: *M. dalli* (Dautzenberg and Fischer, 1896) and *M. smithi* (Dautzenberg and Fischer, 1896). More recently, two other species have been described: *M. wilheminae* van Aartsen, Menkhorst and Gittenberger, 1984, from a subtidal level in the Strait of Gibraltar,

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and *M. melitensis* Mifsud, 1993 from circalittoral levels off Malta.

Many published taxa (*clandestina, columbellaria, columbellaris, granulosa, greci, leontocroma, major, oliviformis, striarella,* etc.) are presently considered synonyms or forms of these species. However, all the taxa of *Mitrolumna* from the Lusitanian Province deserve a complete revision, including the study of intraspecific variability, the range of geographic and bathymetric distribution of the species, and the possible description of new taxa based on phenae recently discovered off the Açores Islands, Canary Islands (Figs. 22, 49) and Western Sahara (Figs. 9-11). Such a revision is under study by C. Mifsud (pers. com.)

Little is known about *Mitrolumna* in West African waters. Records of only two species ascribable to *Mitrolumna* are to be found in the literature: one species described on the basis of four shells by KNUDSEN (1956) from Gorée Islands (Dakar, Senegal) as *Mitra monodi,* and another species designated in the same paper as *Mitromorpha olivoidea* (Cantraine) from a single shell collected at a bathyal level off the Cap Vert Peninsula, Dakar, Senegal.

The area of West Africa included in our study is that extending from Capo Blanco, North of Mauritania to the northern border of Namibia.

Investigations by both authors demonstrated the occurrence of several different phenae in Senegal waters, and also some others from the islands off the Guinean Gulf. These phenae are presented in this work and they are provisionally ascribed to appropriate taxa.

Abbreviations

MNHN Muséum National d'Histoire Naturelle, Paris
MNCN Museo Nacional de Ciencias Naturales, Madrid
MOM Museo Oceanographique, Monaco
CAP collection A. Peñas, Vilanova i la Geltrú
CER collection E. Rolán, Vigo
CFB collection F. Boyer, Sevran
CJP collection J. Pelorce, Le Grau du Roi
sp, live collected specimen
s, empty shell
f, fragment
j, juvenile

RESULTS

Family TURRIDAE Swainson, 1840
Subfamily Mitromorphinae Casey, 1904
Genus *Mitrolumna* Bucquoy, Dautzenberg and Dollfus, 1883

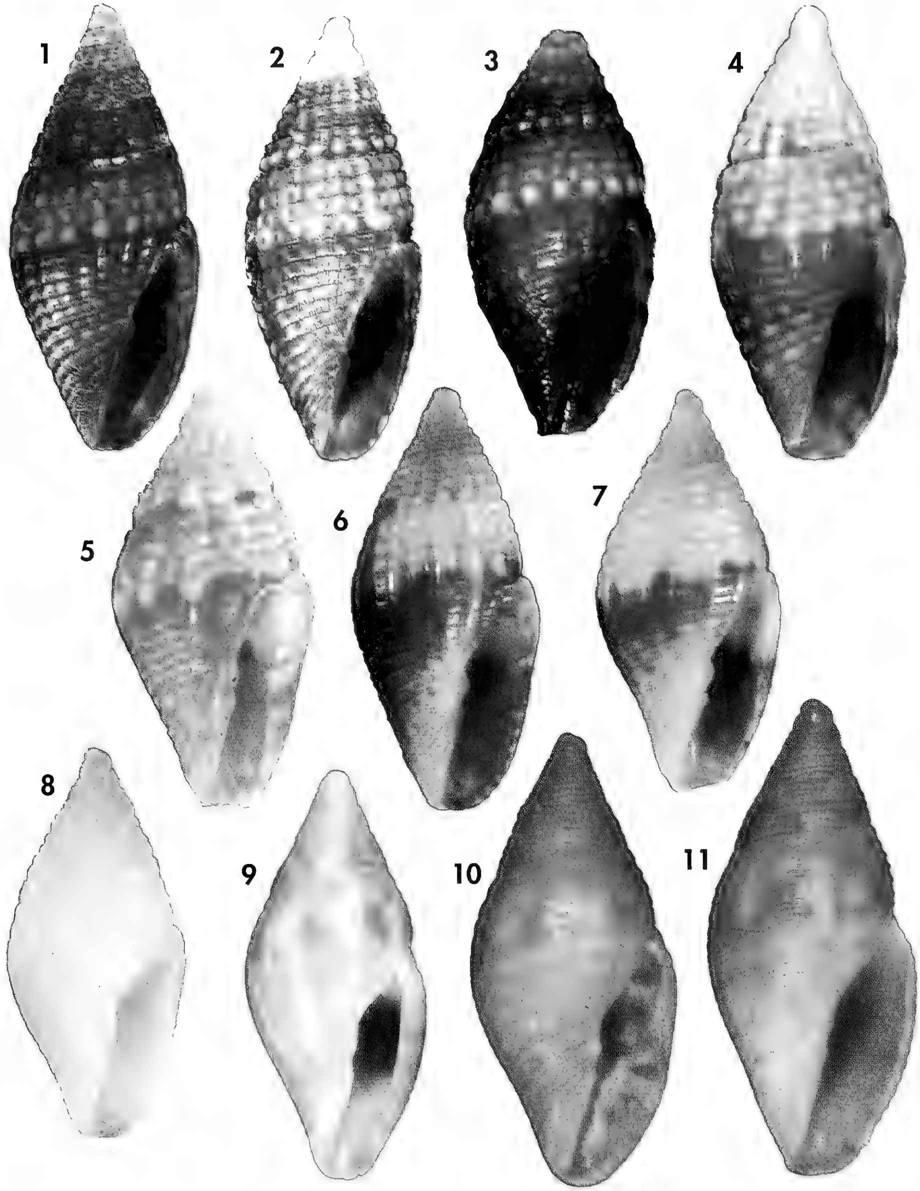
Type species by original designation, *Mitra olivoidea* Cantraine, 1835

Mitrolumna monodi (Knudsen, 1956) (Figs. 1-8)

Mitra monodi Knudsen, 1956: 519, pl. 1, fig. 1. [Type locality: Baie de Gorée, Dakar, 15 m].

Type material: Holotype in MNHN (5.9 x 2.8 mm).
Other material studied: Senegal: 1 sp, 2 s, diving, 1-2 m, Cap Vert Peninsula (CJP); 22 s, 13-15 m, Tacoma, Gorée (CJP); 2 s, 3 j, 25 m Groupe Teni Mbot (CJP); 7 sp, 40 m, Grand Thiouriba (CJP); 10 s, 3 j, 0-1 m, Anse Bernard, Dakar (CFB); 1 sp, 1 s, 32 m, Epopal (CFB); 29 s, beached, Almadies (CFB); 4 sp, Petite Corniche, Dakar (CER); 6 sp, 13 m, Tacoma (CFB); 1 sp, Cap Vert Peninsule (CJP); 3 s, Petit Thiouriba, 30 m, Dakar (CER); 1 s, 250 m, Mboro (CFB).

Description: See KNUDSEN (1956). Knudsen gave an accurate drawing of a subadult biconical shell with a granular sculpture. The upper part is whitish, the lower part is dark. The species was founded on a lot of 4 shells. The outline



Figures 1-8. *Mitrolumna monodi*. 1: 4.4 mm, Peninsule of Cap Vert (CJP); 2: 7.0 mm, Anse Bernard (CFB); 3: 5.0 mm, Petit Thouriba, Dakar, Senegal (CFB); 4: 5.1 mm, Tacoma, Gorée I., Dakar (CFB); 5: 4.2 mm, Tacoma (CJP); 6: 3.8 mm, Epopal (CFB); 7: 4.0 mm, Tacoma (CJP); 8: 3.8 mm, Tacoma (CJP). Figures 9-11. *Mitrolumna* sp. 9: 5.3 mm, Dahkla, Western Sahara (CER); 10, 11: 5.7 mm, 5.3 mm, Dahkla, Western Sahara (CFB).

Figuras 1-8. Mitrolumna monodi. *1: 4,4 mm, península de Cap Vert (CJP); 2: 7,0 mm, Anse Bernard (CFB); 3: 5,0 mm, Petit Thouriba, Dakar, Senegal (CFB); 4: 5,1 mm, Tacoma, Gorée I., Dakar (CFB); 5: 4,2 mm, Tacoma (CJP); 6: 3,8 mm, Epopal (CFB); 7: 4,0 mm, Tacoma (CJP); 8: 3,8 mm, Tacoma (CJP). Figuras 9-11.* Mitrolumna *sp. 9: 5,3 mm, Dahkla, Sáhara occidental (CER); 10, 11: 5,7 mm, 5,3 mm, Dahkla, Sáhara occidental (CFB).*

and the decoration of the holotype matches the shell pictured in Figure 5. The protoconch is totally white.

The adult shell has a length of 4.2 to 7.2 mm.

The animal is uniformly white, with no operculum.

Radula (Fig. 46): The radula is toxoglossan with marginal teeth only. Their number is about 134. The position of the teeth seems similar to that of *Conus* with the greater part aligned in a radular sac and a small group in a different direction in a radular caecum. Each tooth has a wider and more compact base and a ligament connected to it. There is a slight enlargement in the upper third of the radular tooth. For a shell of 4.2 mm, the size of the radular tooth was 0.08 mm.

Habitat: *M. monodi* has been collected on hard bottoms, in short algae, from low tide level to 40 m. Numerous samplings on soft bottoms made in Baie de Gorée (5-20 m) and on Petite Côte (Pointe Sarène, 3-8 m) have not yielded any specimen of the species, which seems to indicate that it is restricted to hard bottoms.

Distribution: *M. monodi* is distributed in small colonies around the Peninsula of Cap Vert. The species is apparently the best represented of the micro-turrids from hard bottoms at infralittoral levels in the area.

The shell trawled at Mboro (North Senegal, 250 m) may have been transported, due to the steep slopes and strong currents at this locality. However, its good state of preservation suggests that transport had been recent and that the species may also occupy bottoms from the lowest circalittoral levels and range at least along the whole North Senegal coast.

Discussion: KNUDSEN (1956) described the present species in the genus *Mitra*, deceived by the immature condition of the anterior part of the shell. Nevertheless, its belonging to the Mitromorphinae is well testified by the presence of the two faint columellar plaits.

The adult shell of *M. monodi* is very variable (Figs. 1-8). Outline suboval (Figs. 1-4) to sharp biconical (Fig. 5). Extreme colourations are from dark brown (Figs. 1-3) to pure white (Fig. 8). The general pattern is bicoloured, with a medium tendency to a whitish upper part and honey brown lower part.

The shell may have a sculpture of coarse nodules on strong spiral cords (Fig. 3) or dominant axial ribs (Fig. 4). Some shells are almost smooth. The external lip can be regularly arched (Fig. 7) or deeply inflexed (Fig. 5).

Such differences in shell features could suggest the occurrence of sibling species. In fact, all morphological and chromatic intergrades were observed in shells of live collected material, and the occurrence of a single variable species is corroborated by constant features of the animal, the protoconch and of the habitat.

Large, slender suboval and dark shells seem to be restricted to shallow water on the southern side of the Cap Vert Peninsula (Anse Bernard, 0-1 m, and Tacoma wreck, 7-13 m).

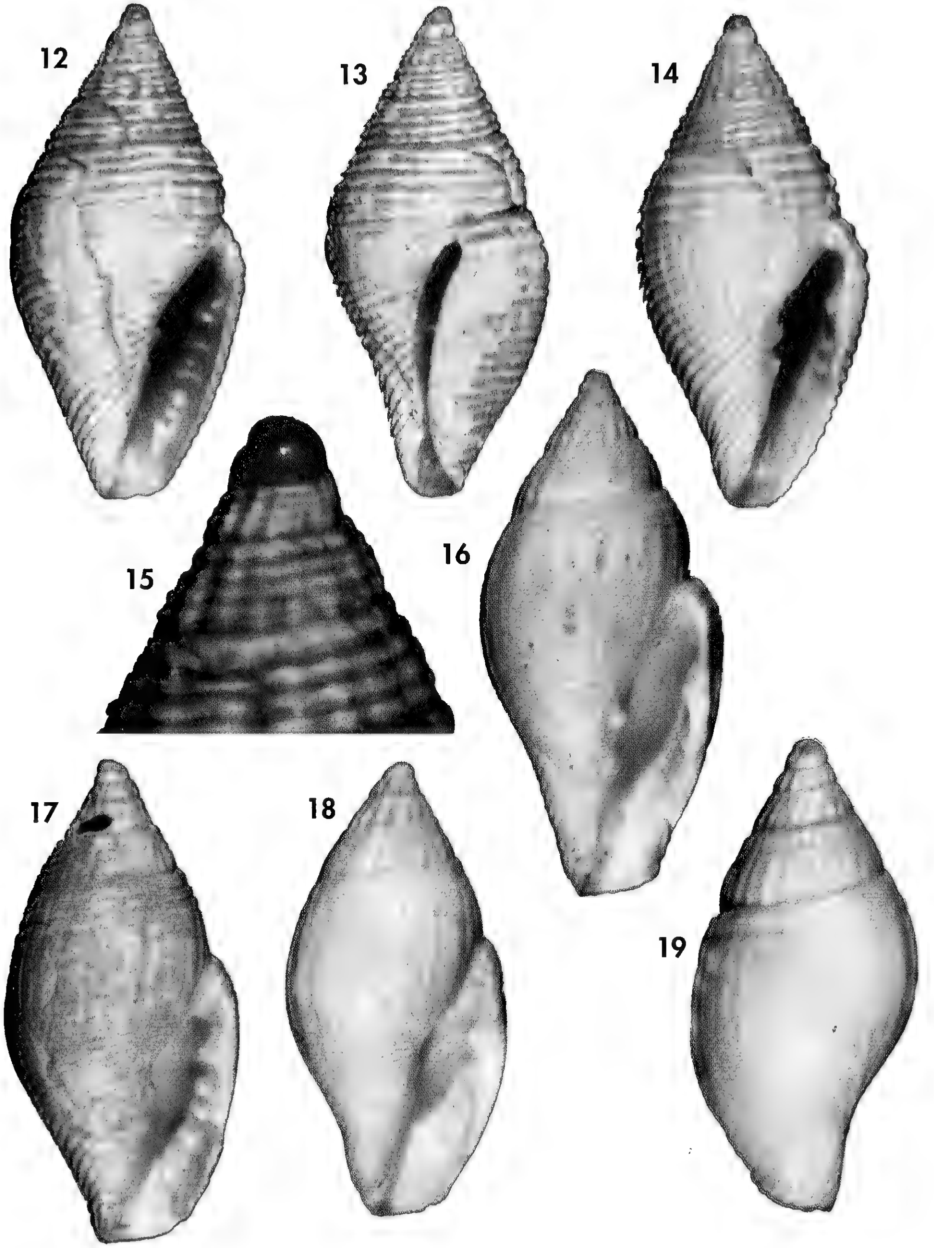
The dark forms of *M. monodi* may be differentiated from *M. olivoidea* by their subsutural light colour and the white protoconch. The shells with white and brown colour can be differentiated from *M. wilhelminae* (Fig. 23), which is wider, with more numerous spiral cords, no axial sculpture in the last whorls and, frequently, with spiral darker bands.

Mitrolumna cf *crenipicta* Dautzenberg, 1889

Mitrolumna olivoidea Cantraine var. *crenipicta* nov. var. Dautzenberg, 1889: 31, pl. 2, figs. 6a-6c. [Type locality: San Miguel, Açores, on the beach].

Mitromorpha olivoidea (Cantraine) Knudsen, 1956: 525, pl. 2, fig. 12.

Type material: Holotype of *M. crenipicta* in MOM (5 mm), figured in VAN AARTSEN ET AL. (1984, fig. 205a).



Figures 12-15. *Mitrolumna senegalensis* spec. nov., off Lompoul, Senegal. 12, 13: Holotype, 7.95 mm, (MNHN); 14: paratype (MNCN); 15: protoconch of the holotype. Figures 16-19. *Mitrolunma smithi*, off St. Louis, Senegal. 16: adult, 8.5 mm (CFB); 17: adult, 7.4 mm (CER); 18: juvenile, 6.7 mm (CER); 19: juvenile, 5.9 mm (CFB).

Figuras 12-15. Mitrolumna senegalensis *spec. nov., frente a Lompoul, Senegal. 12, 13: holotipo, 7,95 mm, (MNHN); 14: paratipo (MNCN); 15: protoconcha del holotipo. Figuras 16-19.* Mitrolunma smithi, *frente a St. Louis, Senegal. 16: adulto, 8,5 mm (CFB); 17: adulto, 7,4 mm (CER); 18: juvenil, 6,7 mm (CER); 19: juvenil, 5,9 mm (CFB).*

Description: See DAUTZENBERG (1889). A shell collected at 200-600 m off Cap Vert Peninsula, Dakar, Senegal, is figured by KNUDSEN (1956, pl. 1, fig. 12) as *Mitromorpha olivoidea* (Cantraine). A shell from the Mediterranean (Alboran Island) is pictured in MIFSUD (1993: 16). The protoconch of the holotype of *M. crenipicta* is in poor condition and not adequate for a diagnosis.

The size of the shell from Senegal is not given by Knudsen.

Habitat: Unknown.

Distribution: Açores, shallow water. Some specimens recorded from shallow or deep waters in the Mediterranean and the Canary Islands are referred to this species. The figure of KNUDSEN (1956) appears to extend the range of this species up to Senegal.

Discussion: The shell pictured by KNUDSEN (1956, fig. 12) as *M. olivoidea* closely resembles the original figure of *M. crenipicta*, both in the general outline of the shell and the pattern of the decoration. The shape of the holotype, as figured in VAN AARTSEN *ET AL*. (1984), is however somewhat different.

It might fall within the general range of variability of *M. monodi*, but it also corresponds to the range of the outline of the original figure of *M. crenipicta* from the Açores. When *M. monodi* shows a bicoloured pattern, the lighter part is always the upper one, and the dark part is the lower one; but the pattern presented by the shell of Knudsen is inverted.

M. wilheminae Aartsen, Menkhorst and Gittenberger, 1984 (Fig. 23) presents similarity to the shell of Knudsen. The geographic range of *M. wilheminae* needs checked, because the species does not seem to be restricted to the Strait of Gibraltar. We have examined shells from Alborán (CAP) and from Algeria (CER) that appear to be this species.

Mitrolumna senegalensis spec. nov. (Figs. 12-15)

Type material: Holotype (Figs. 12, 13), 7.95 x 3.7 mm, in MNHN. Paratype 1 (Fig. 14), 8.85 x 4.0 mm, in MNCN (15.05/43738); paratype 2, 8.15 x 4.0, in CER; paratypes 3-9, 7.5 x 3.9, 8.9 x 4.15, 9.0 x 4.2, 8.25 x 4.0, 8.25 x 3.8, 7.25 x 4.0 and 7.6 x 3.5 mm, in CFB, all from the type locality, trawled by Research Vessel, Marcel Pin, March 1991.

Etymology: From the type locality, situated off the northern coast of Senegal.

Type locality: Off Lompoul (Northern coast of Senegal, 150 m).

Description: Shell (Figs. 12-14) small, solid and fusiform, almost biconical. Protoconch smooth and shining, 1.5 whorls, somewhat produced, chesnut colored (Fig. 15). Teleoconch usually with 4-5 whorls, bearing a coarse sculpture of raised spiral cords, 4-5 per whorl on spire, the body whorl with 26-28 cords. Intervals between the cords on the body whorl decrease towards the base. Faint axial ribs are visible on the early whorls of the teleoconch, but absent on the two last whorls. Aperture somewhat narrow, representing 45-50 % of the total length. Outer lip straight. The columella bears 2 strong plaits; 6 to 8 wide spiral pleats inside the labrum, somewhat distant from the edge. The second upper pleat is the largest one and forms a small denticle. Colour whitish to tan.

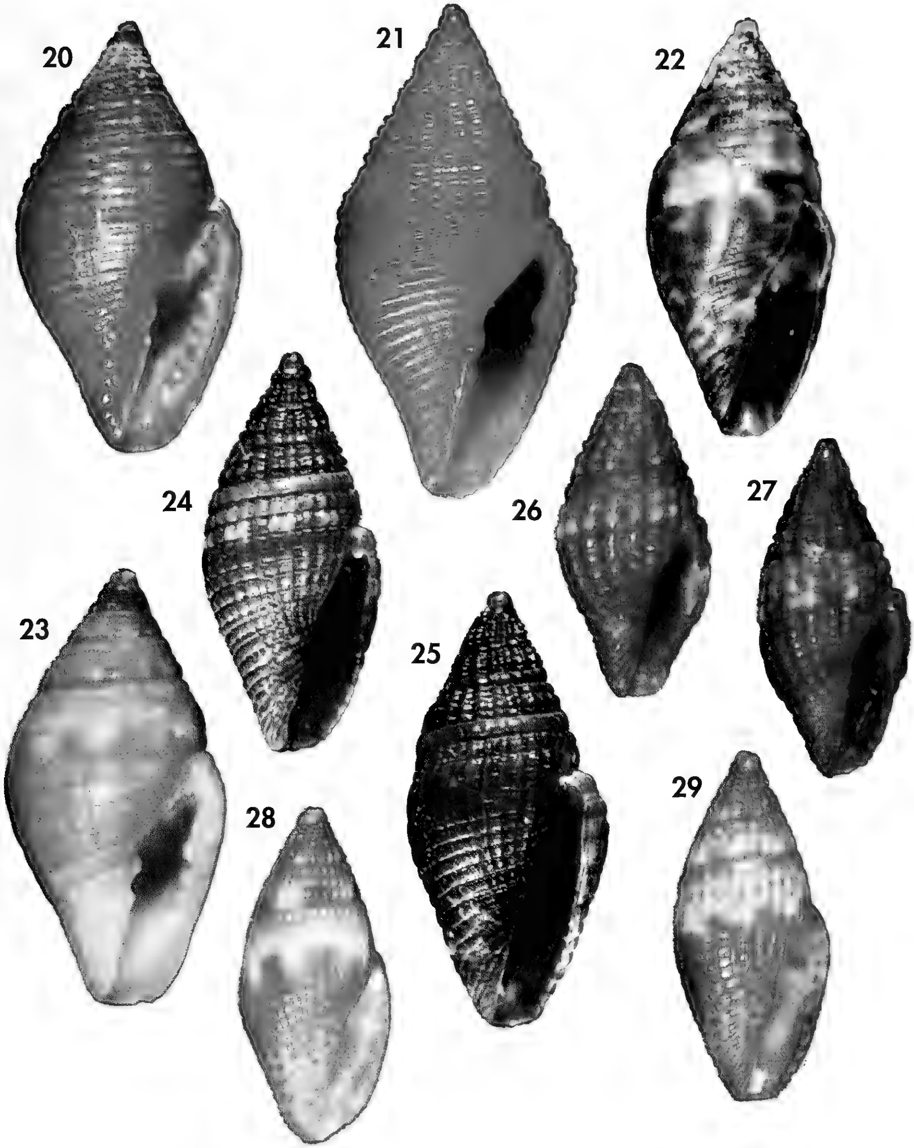
Adult shells length, 7.5 to 9.0 mm, width 3.8 to 4.15 mm.

The animal and radula are unknown.

Habitat: Unknown.

Distribution: Only known from the type locality.

Discussion: The new species presents very distinctive features compared with other species known from the eastern Atlantic. The most comparable species is *Mitrolumna dalli* (Dautzenberg and Fischer, 1896), known from a single shell dredged at bathyal depths (1300 m) off the Açores Islands. The description and the figure of this holotype (see DAUTZENBERG AND FISCHER, 1896: 431-432, pl. 15, fig. 18 and BOUCHET AND WARÉN, 1980: 77, fig. 160) show a shell large for the genus (14 x 6 mm), with a slender suboval outline. The whorls are somewhat convex and bear



Figures 20, 21. *Mitrolumna olivoidea.* 20: shell, 5.9 mm, Getares, Algeciras (CFB); 21: shell, 8.3 mm, Vilassar del Mar (CAP). Figure 22. *Mitrolumna* sp., 6.4 mm, Arguineguin, Gran Canary (CFB). Figure 23. *Mitrolumna wilhelminae*, shell, 6.7 mm, Alborán (CAP). Figures 24, 25. *Mitrolumna saotomensis* spec. nov. 24: holotype, 5.0 mm (MNCN); 25: paratype, 5.3 mm (MNHN), Esprainha, São Tomé. Figures 26, 27. *Mitrolumna saotomensis* morpho 1, 4.2 mm, 4.4 mm, Tortuga I., Annobón. Figures 28, 29. *Mitrolumna saotomensis* morpho 2, 4.0 mm, 4.6 mm, Tortuga I., Annobón.
Figuras 20, 21. Mitrolumna olivoidea. *20: concha, 5,9 mm, Getares, Algeciras (CFB); 21: concha, 8.3 mm, Vilassar del Mar (CAP). Figura 22.* Mitrolumna *sp., 6,4 mm, Arguineguin, Gran Canaria (CFB). Figura 23. Mitrolumna wilhelminae, concha, 6,7 mm, Alborán (CAP). Figures 24, 25.* Mitrolumna saotomensis *spec. nov. 24: holotipo, 5,0 mm (MNCN); 25: paratipo, 5,3 mm (MNHN), Esprainha, São Tomé. Figuras 26, 27.* Mitrolumna saotomensis *morpho 1, 4,2 mm, 4,4 mm, Tortuga I., Annobón. Figures 28, 29.* Mitrolumna saotomensis *morpho 2, 4,0 mm, 4,6 mm, Tortuga I., Annobón.*

thick wavy cords (about 5 on teleoconch whorls and 20 on the body whorl) crossed by well spaced strong axial ribs. Intervals between the cords on the body whorl widen towards the anterior end. Because of these differences, the conjecture relationship between these species is probably not very close.

Mitrolumna smithi (Dautzenberg and Fischer, 1896) (Figs. 16-19)

Mitromorpha smithi Dautzenberg and Fischer, 1896: 432-433, pl. 15, fig. 19. [Type locality: Açores Islands, 800 m, Hirondelle Vessel, Stn. 34].

Type material: Holotype in MOM (6 x 3 mm).
Other material examined: Senegal: off Saint-Louis, 500 m, Research Vessel, M. Pin, 31 March 1987: 5 s, 1 j (CFB), 1 s, 1 j (CER).

Description: See DAUTZENBERG AND FISCHER (1896). The description is based on a single shell. Another shell was collected during Campaign Biacores off Açores Islands (390-620 m) and is recorded by BOUCHET AND WARÉN (1980: 78). However, no comment nor figure is given of this shell, and the variability of *M. smithi* in its type locality remains unknown. The holotype was described as having a decoration of spiral dull yellow bands on a white glossy background, correctly illustrated in the type figure. This decoration is now completely faded and the shell is whitish, faintly shining, as illustrated by an enlarged picture in BOUCHET AND WARÉN (1980, fig. 161). The material studied is white.

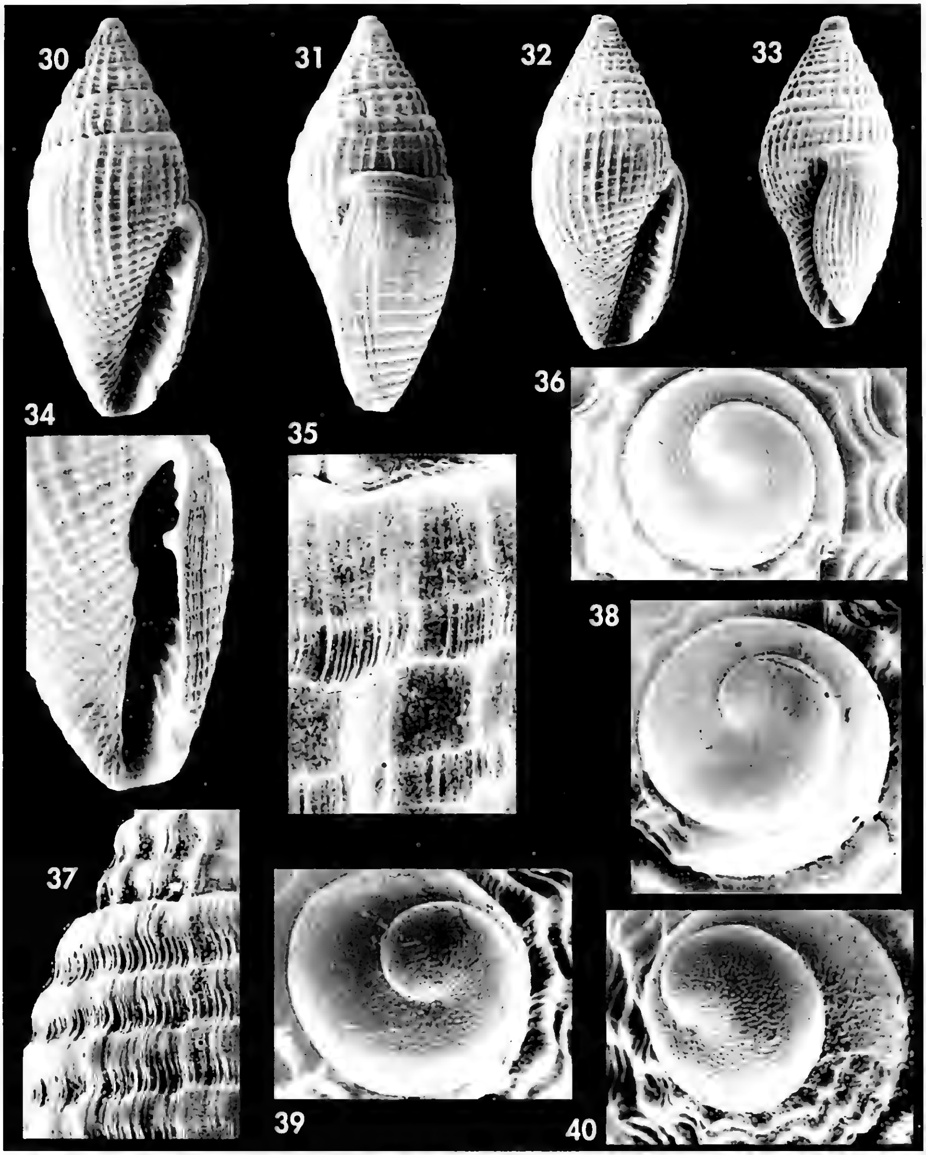
Animal and radula unknown (collected material consist only of empty shells).

Habitat: Unknown.

Distribution: The species was known only from the type locality. The discovery of a population from Senegal, proposed here as conspecific, allow us to extend the distribution of the species to northern Senegal. It can be observed that the bathymetric range is rather homogeneous (Açores: 800 and 390-620 m; Senegal: 500 m). On the basis of these data, it is assumed that the species is distributed in the medium-bathyal zone, possibly off most of northwest Africa. This last point remains however to be verified by further sampling, as a discontinuous distribution is also possible.

Discussion: The shells discovered in northern Senegal (Figs. 16-19) show very similar features to *M. smithi* as in the original description and figure. The similarity is well-correlated for shell size (6.9 to 8.5 mm in Senegal versus 6 mm for the holotype), proportions and outline; pattern of spiral levelled cords and the tendency to a smooth central body whorl; shape of the aperture and labrum; 5 to 6 pleats inside the labrum, the upper one forming a strong denticle; slightly sigmoid columella bearing 2 medium sized plaits. The protoconch is similar in the holotype (with a maximum diameter of 0.5 mm) and in the shells from Senegal (average width of 0.48 mm).

The sole differences may lie in details of the sculpture, principally in the fact that the spiral cords seem to be wider and less numerous in the holotype than in the shells from Senegal. However, it is observed that in shells from Senegal, the axial ribs and spiral cords are respectively more or less dominant on the teleoconch and on the last whorl, the smooth central zone of the body whorl and the smooth lower zone of the penultimate whorl are more or less wide, and width and number of spiral cords are somewhat variable depending on the individual. The holotype of *M. smithi* can be considered to belong to the same range of variability as the shells from Senegal. Our single reservation concerns the fact that there is no record of such a phena in the interval between the Açores Islands and Senegal.



Figures 30-33. *Mitrolumna saotomensis.* 30, 31: paratypes, 5.3 mm and 5.4 mm, Esprainha, São Tomé (CER); 32, 33: shells, 4.2 mm and 3.8 mm, Baia das Agulhas, Príncipe I. (CER); 34: detail of the aperture of a paratype (CER); 35: detail of the subsutural cord, Esprainha (CER); 36: protoconch of paratype (CER). Figure 37. *Mitrolumna olivoidea,* detail of the subsutural cord, La Herradura (CAP). Figure 38. Protoconch of *M. melitensis,* Murcia (CVG). Figures 39, 40. Protoconchs of *M. olivoidea,* La Herradura, Málaga (CAP).

Figuras 30-33. Mitrolumna saotomensis. *30, 31: paratipos, 5,3 mm y 5,4 mm, Esprainha, São Tomé (CER); 32, 33: conchas, 4.2 mm y 3.8 mm, Baia das Agulhas, Príncipe I. (CER); 34: detalle de la abertura de un paratipo (CER); 35: detalle de la cuerda subsutural, Esprainha (CER); 36: protoconcha de un paratipo (CER). Figura 37.* Mitrolumna olivoidea, *detalle de la cuerda subsutura, La Herradura (CAP). Figura 38. Protoconcha de* M. melitensis, *Murcia (CVG). Figures 39, 40. Protoconchas de* M. olivoidea, *La Herradura, Málaga (CAP).*

Mitrolumna saotomensis. spec. nov. (Figs. 24-36, 41-45)

Type material: Holotype (Fig. 24), 5.0 x 2.2 mm, in MNCN (15.05/43739). Paratype 1 (Fig. 25): 5.3 x 2.6 mm, in MNHN; paratypes 2-4: 5.5 x 2.3 mm, 4.7 x 2.1 mm, 4.4 x 2.0 mm, in CFB, and 22 paratypes more in CER. All from type locality.

Other material examined: São Tomé: 4 sp, 6 s, 3-4 m, Lagoa Azul (CER); 6 j, 8 m, Sant'Ana (CER); 10 s, 3 j, 1 f, 2-6 m, Praia Mutamba (CER); 13 s, 6 j, 4 m, São Tomé city (CER); 2 sp (destroyed for radular studies), 2 s, 7 j, 8 f, 4-9 m, Esprainha (CER). Príncipe: 3 sp, 8 m, Baia das Agulhas (CER). Annobón: morph 1: 15 s, 9 f, 8 m, Isla Tortuga (CER); 2 s, 10 m, Santo Antonio (CER); morph 2: 49 s, 20 f, 8 m, Isla Tortuga (CER); 4 s, 10 m, Santo Antonio (CER).

Etymology: The specific name refers to the island where the species was first collected.

Type locality: Esprainha, São Tomé, Republica de São Tomé and Príncipe.

Description: Shell (Figs. 24-25, 30-33) small, fusiform and solid. Protoconch (Fig. 36) with 1 and $^1/_4$ whorls, and about 450 μm maximum diameter; its surface is covered with fine granulations and is uniformly brown. Teleoconch of about 5 whorls with axial ribs crossed by spiral cords forming small nodules. The spiral cords number 3-4 on the spire whorls; on the last whorl there are a total of 17-20 cords, with 4-5 to the periphery. The subsutural cord (Fig. 35) is wider than the rest. The axial ribs are narrower than the interspaces. Last whorl is nearly $^2/_3$ the total length of the shell. In the latter middle part of the last whorl the ribs and cords are attenuated. The aperture (Fig. 34) is elongate and narrow. The outer lip has an anal notch at its upper part. There is an enlargement on the external lip but a little previous to the edge. The columella is oblique and presents 2 folds placed deeply near its middle part. The inner part of the outer lip has a large denticle at its upper third, 3 smaller above it and 5-8 below, all forming folds. The colour of the shell is brown, usually with a lighter subsutural band of varying width.

Dimensions: Larger specimens reach 6 mm. Shells from Príncipe (Figs. 32-33) are smaller, usually 4.5 mm in maximum size.

Animal: In specimens from São Tomé, the animal is whitish with numerous milky-white spots.

Radula (Fig. 47): The radular teeth are similar to that described for *M. monodi* being slightly wider. They number are about 130. For a shell of 4.0 mm, the size of the radular tooth is 0.08 mm and for a shell of 3.7 mm the tooth is 0.075 mm.

Habitat: Collected under rocks bearing short algae in 3-8 m.

Distribution: The new species has been recorded from São Tomé as *M. olivoidea* (Cantraine, 1835) by TOMLIN AND SHACKLEFORD, 1914; this record was cited later by KNUDSEN (1956) and FERNANDES and ROLÁN (1993). The original range of *M. olivoidea* is the Mediterranean Sea and it is extended to Casablanca (PASTEUR-HUMBERT, 1962). *M. saotomensis* is known from São Tomé, Príncipe and Annobón.

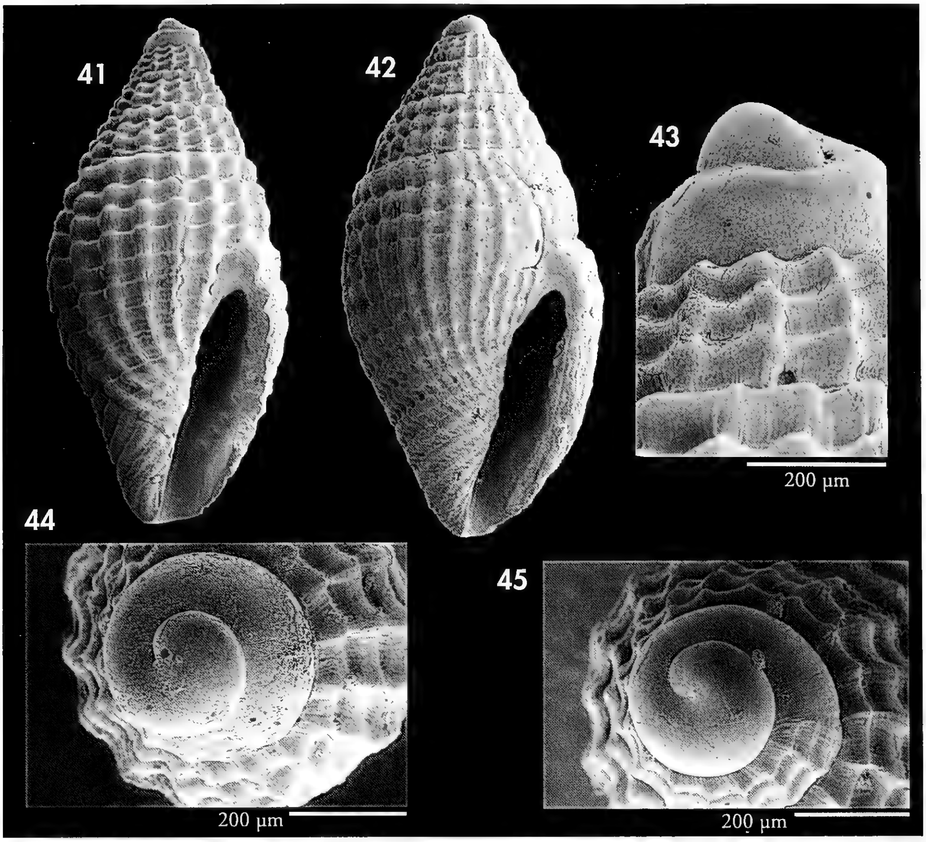
Discussion: Specific variability: we are including in the taxon *M. saotomensis*, shells from São Tomé, Príncipe and two morphs from Annobón.

The shells from Príncipe Island agree with those from São Tomé and are conspecific, being smaller in size.

The shells from Annobón Island (situated 200 Kms South of São Tomé) show sculptural differences, as follows, but appear to be conspecific. Two morphs of *Mitrolumna* are found here in the same samples. One of these morphs (Figs. 26-27) presents a very coarsely sculptured shell with a reduced number of axial ribs and thick, produced nodules, whereas the other morph (Figs. 28-29) has a finer sculpture with numerous axial ribs and small nodules. The ground colour is also different, the first being dark brownish orange, whereas the second is lighter.

In fact, these morphs could be extreme variations of *M. saotomensis*. The issue is about three points:

- the variability observed in the population from São Tomé and Príncipe



Figures 41-45. *Mitrolumna saotomensis.* 41: morpho 1, Tortuga I., Annobón (CER); 42: morph 2., Tortuga I., Annobón (CER); 43, 44: protoconch of morph 1, Tortuga I. (CER); 45: protoconch of morph 2, Tortuga I.

Figuras 41-45. Mitrolumna saotomensis. *41: morfo 1, Tortuga I., Annobón (CER); 42: morfo 2., Tortuga I., Annobón (CER); 43-44: protoconcha de morfo 1, Tortuga I. (CER); 45: protoconcha de morfo 2, Tortuga I.*

is far less than the variability observed in Annobón.

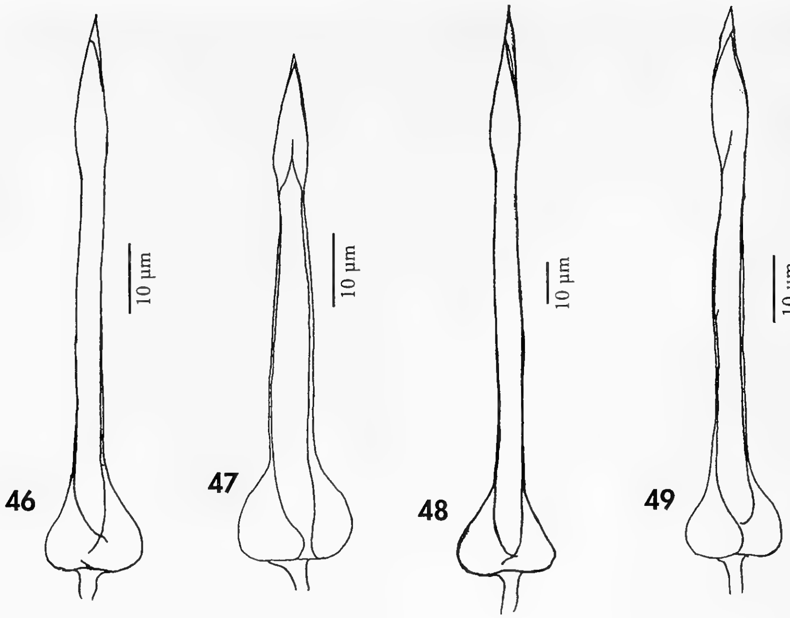
- we have not found clearly intergrading specimens between the two morphs in our material from Annobón, the most median form being represented by one single shell, as Fig. 42.

- one of the variant characters observed in the morphs from Annobón (the number of axial ribs) could be of specific value. We note that, in the other species studied, the number of axial ribs, as well as the number of spiral cords, is not very variable (cf. the variability displayed in *M. monodi*, Figs. 1-8)

Although the variations could be of specific value it is more likely that they represent geographic or ecological variants. The axial and spiral structural variations are of degree only rather than kind. It is probable that further intergrades will be discovered with more material.

Comparison with other species: The new species shows affinity with *M. olivoidea* for shell features that species usually being larger, wider, more uniform in colour, with more spiral cords, and less evident axial sculpture on the last whorl.

As noted by VAN AARTSEN *ET AL.* (1984) there are some doubts about the true iden-



Figures 46-49. Radular teeth of *Mitrolumna* species. 46: *M. monodi*, specimen of 4.2 mm, Petite Corniche, Dakar; 47: *M. saotomensis*, specimen of 4.0 mm, Esprainha, São Tomé; 48: *M. olivoidea*, specimen of 6.1 mm, Getares, South Spain; 49: *Mitrolumna* sp., specimen of 6.8 mm, Arguineguin, Canary.

Figuras 46-49. Dientes radulares de las especies de Mitrolumna. *46:* M. monodi, *ejemplar de 4,2 mm, Petite Corniche, Dakar; 47:* M. saotomensis, *ejemplar de 4,0 mm, Esprainha, São Tomé; 48:* M. olivoidea, *ejemplar de 6,1 mm, Getares, South Spain; 49:* Mitrolumna *sp., ejemplar de 6,8 mm, Arguineguin, Canarias.*

tity of the taxon *M. olivoidea*. The original description of this species by CANTRAINE (1835) is superficial and the lectotype illustrated by CERNOHORSKY (1975, figs. 55-56) does not resolve by itself the questions created by the great variability of the forms attributed to *M. olivoidea* in the Mediterranean. The bathyal range of *M. olivoidea* is recorded from intertidal down to 70-90 m, at Marbella by F. Gubbioli (pers. com.) and 90 m at Elba Island in ARDOVINI AND COSSIGNANI (1999). A complete revision of this species, including its morphologic variability, will allow us to fully determine the specific status of *M. olivoidea* and to verify the possible occurrence of sibling species in the Mediterranean and adjacent Atlantic.

Except for the dubious mention from Senegal by KNUDSEN (1956), there are no records of *M. olivoidea* south of Casablanca (Morocco). Intensive collecting at infralittoral levels around the Peninsula of Cape Vert during the last fifty years on hard and soft bottoms (Marche-Marchad, Pin, Pelorce and Boyer, the two last collectors specializing in microgastropods during the last decade) leads us to conclude that *M. olivoidea* is absent in this area. The same can be said of Ghana, extensely sampled in recent years by Peter Ryall (pers. com.). The populations found in São Tomé, Príncipe and Annobón Islands must be considered as geographically separated from *M. olivoidea* by wide gaps.

The animal of *M. saotomensis* spec. nov. is white spotted on a whitish ground, whereas that of *M. olivoidea* (specimens from Getares, Algeciras) is uniformly light sulphur yellow. This point is of importance for determination at the specific level, as the chromatism of the soft parts is very constant within each species of *Mitrolumna* examined for this character: *M. olivoidea* in Algeciras; *M.* sp, Gran Canaria (Fig. 22); *M. monodi*, in Dakar, Senegal.

The protoconchs of both species are similar (Figs. 36, 39-40) but are slightly larger in *M. olivoidea* (about 520-540 μm, whereas *M. saotomensis* is about 450 μm).

The radular teeth are similar, the teeth of *M. olivoidea* being more slender (Fig. 48) and with a higher number (184 teeth) in the specimen studied.

Another species with brown ground colour and with spiral sculpture is *M. melitensis* Mifsud, 1993; this can be distinguished by its more uniform ground colour, and by its larger size (usually reaching 9 mm). Furthermore, the 2-3 subsutural cords are separated by deeper interspaces, the last whorl may have up to 30 spiral cords (about 16-21 in *M. saotomensis* spec. nov.) and the penultimate whorl has 6-9 (instead of 3-4 of *M. saotomensis*). *M. melitensis* also lacks the axial sculpture on the last whorl. Its protoconch (Fig. 38) is similar to that of *M. olivoidea,* presenting also fine granulations (usually absent in adult shells) but being wider (usually about 550 μm) and having a further $^1/_4$ whorl.

M. saotomensis can be differentiated from the dark forms of *M. monodi* by several shell features: the first species has a dark protoconch instead of a whitish one, axial ribs extending all along the shell instead of disappearing towards the base, uniform brown ground colour on spire whorls lacking lighter nodules, and an enlargement on the external lip instead of an simple one.

CONCLUSIONS

Five species of the genus *Mitrolumna* from West Africa have been studied: three of them were previously known (*M. monodi, M. smithi* and *M.* cf *crenipicta*) and two are described as new (*M. senegalensis* and *M. saotomensis*).

The new species seem to have a restrict geographic range: *M. senegalensis* was only collected north of Senegal and *M. saotomensis* in the islands south of the Gulf of Guinea. *M. monodi* is also only known from Senegal. The other two species reported here are attributed to known taxa described from the Açores Islands, an oceanic archipelago situated at a much further distance on the northwest border of the Lusitanian Province.

Some of the studied species (*M. smithi, M. senegalensis* and *M.* cf *crenipicta*) appear to have low variability of shell morphology. The other two species (*M. monodi* and *M. saotomensis*) are variable in colour, shape and sculpture.

The radular teeth are very similar providing few useful characters for comparison althought those of M. saotomensis are broader. The protoconch is very similar in most of the species, however, this was not studied with SEM in some of them because erosion made this impractical.

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ADDENDUM

While the present paper was in press, Mifsud (April, 2001) published a work entitled "The genus *Mitromorpha* Carpenter, 1865 (Neogastropoda: Turridae) and its subgenera with notes on the European species". In this paper, the author employs *Mitromorpha* Bucquoy, Dautzenberg and Dollfus, 1883 as a subgenus for the European species. Obviously, the shells of the types of *Mitromorpha* (*M. filosa* Carpentier, 1864) and *Mitrolumna* (*Mitra olivoidea* Cantraine, 1835) have some similarities in shell and radula, but also differences, firstly in the columellar pleats and, probably, in the internal thickening of the outern lip. At present, we have not enough information on the anatomy of the soft parts, for which a comparison has not been made. For this reason, we prefer to keep the name *Mitrolumna* as a genus-name for the West African species in this paper.

BIBLIOGRAPHY

AARTSEN, J. J. VAN, MENKHORST, H. P. M. G. AND GITTENBERGER, E., 1984. The marine Mollusca of the Bay of Algeciras, Spain, with notes on *Mitrella*, Marginellidae and Turridae. *Basteria*, suppl. 2: 1-135.

ARDOVINI, R. AND COSSIGNANI, T., 1999. *Atlante delle conchiglie di profundità del Mediterraneo*. L'Informatiore Piceno, Ancona. 111 pp.

BUCQUOY, E., DAUTZENBERG, P. AND DOLLFUS, G., 1883. *Les Mollusques Marins du Roussillon*. Baillière et Fils, Paris, 570 pp, 66 pls.

BOUCHET, P. AND WARÉN, A., 1980. Revision of the Northeast Atlantic bathyal and abyssal Turridae (Mollusca, Gastropoda). *Journal of Molluscan Studies*, suppl. 8: 1-119.

CANTRAINE, F., 1835. Diagnosis ou descriptions succinctes de quelques espèces de mollusques. *Bulletin Academie Royal Sciences*, Bruxelles, 11: 1-31.

CERNOHORSKY, W. O., 1975. The taxonomy of some Indo-Pacific Mollusca. Part. 3. *Records of Auckland Institute and Museum*, 12: 213-234.

DAUTZENBERG, P., 1889. Contribution à la faune malacologique des Îles Açores. *Résume des Campagnes Scientifiques du Prince Albert I*, 1: 1-112.

DAUTZENBERG, P. AND FISCHER, H., 1896. Dragages effectués par L'Hirondelle et par la Princesse-Alice. *Mémories Societé Zoologie de France*, 9: 1-104, 8 pls.

FERNANDES, F. AND ROLÁN, E., 1993. Moluscos marinos de Sao Tomé y Príncipe: actualización bibliográfica y nuevas aportaciones. *Iberus*, 11 (1): 31-47.

KNUDSEN, J., 1956. Remarks on a collection of marine prosobranchs from Senegal. *Bulletin de l'I.F.A.N.*, ser. A (2): 514-529, 2 pls.

MIFSUD, C., 1993. Two new gastropod species from Malta. *La Conchiglia*, 15 (266): 14-17, 28.

PASTEUR-HUMBERT, C., 1962. Les mollusques marins testacés du Maroc. *Travaux de l'Institut Scientifique Chérifien. I. Serie Zoologie*, 23: 1-245.

TOMLIN, J. R. LE B. AND SHACKLEFORD, L. J., 1914. The marine Mollusca of São Thomé. *Journal of Conchology*, 14 (9): 239-276.

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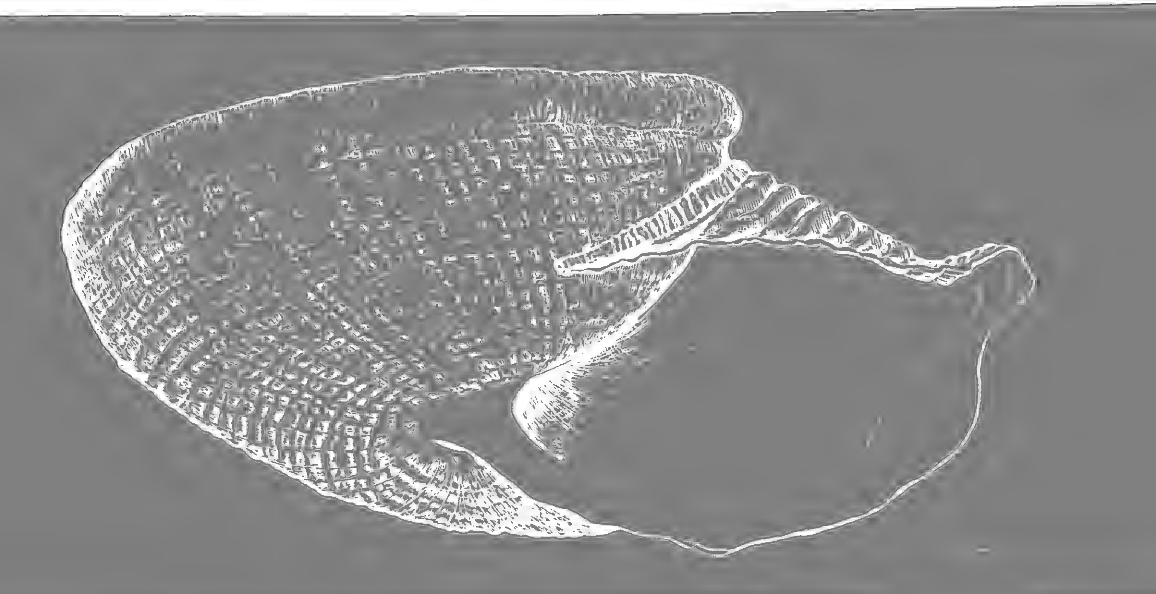

Oviedo, diciembre 2001

Iberus

Revista de la

SOCIEDAD ESPAÑOLA DE MALACOLOGÍA

PORTADA DE *Iberus*

Iberus gualterianus (Linnaeus, 1758), una especie emblemática de la península Ibérica, que da nombre a la revista. Dibujo realizado por José Luis González Rebollar "Toza".

Iberus

REVISTA DE LA SOCIEDAD ESPAÑOLA DE MALACOLOGÍA

Vol. 19 (2) **Oviedo, diciembre 2001**

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Ischnochiton (Stenosemus) gallaecus spec. nov. (Mollusca, Polyplacophora), an Atlantic species from the Iberian Peninsula

Ischnochiton (Stenosemus) gallaecus spec. nov. (Mollusca, Polyplacophora), nueva especie para el atlántico ibérico

Pilar CARMONA-ZALVIDE*, Victoriano URGORRI** and Francisco Javier GARCÍA*

Recibido el 26-VII-2000. Aceptado el 20-XII-2000

ABSTRACT

A new species of the genus *Ischnochiton,* subgenus *Stenosemus* (Mollusca, Polyplacophora) from the Eastern Atlantic is described. The species has been named *Ischnochiton (S.) gallaecus* in honour of Galicia, a region located in the Northwest of the Iberian Peninsula. It was collected in A Quiniela (Galicia) (43° 17′ 22″ - 52″N; 9° 36′ 38″ - 45″W).

RESUMEN

Se describe una especie nueva del género *Ischnochiton* y subgénero *Stenosemus* (Mollusca Polyplacophora), del Atlántico Ibérico, denominada, *Ischnochiton (Stenosemus) gallaecus.* La especie está dedicada a Galicia, situada geográficamente en el Noroeste de la Península Ibérica. La localidad tipo es A Quiniela (Galicia) (43° 17′ 22″ - 52 ″N; 09° 36′ 38″ - 45″ O).

KEY WORDS: Polyplacophora, *Ischnochiton (Stenosemus) gallaecus,* new species, description, taxonomy, Iberian Peninsula.
PALABRAS CLAVE: Polyplacophora, *Ischnochiton (Stenosemus) gallaecus,* especie nueva, descripción, taxonomía, Península Ibérica.

INTRODUCTION

The specimen was collected during the "Cangrexo I" campaign in A Quiniela (Galicia, NW Spain) at depths ranging from 753 to 880 m. The expedition was organised by the Animal Biology Department at the University of Santiago de Compostela. The specimen was found on bottoms having ferromanganesic nodules with calcareous plaques, coal slag and small stones.

After reviewing the monographic studies by KAAS AND VAN BELLE (1985; 1987; 1990; 1994), who have compiled all the species described belonging to the genus *Ischnochiton* Gray, 1847, it was found that the specimen collected pre-

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sented taxonomical features that are very different from the species described in previous papers. Therefore, in this article we describe what we consider to be a new species, *Ischnochiton (Stenosemus) gallaecus*.

This work has been partially supported by the project "FAUNA IBERICA IV" DGICYT/ PB95-0235).

MATERIAL AND METHODS

The specimen was collected in A Quiniela (43° 17′ 22″-52″ N; 09° 36′ 38″-45″W) (VII/1991) at 753 m depth during the Cangrexo I campaign. Samples were caught with traps used for the royal crab (*Chaceon affinis*). The specimen was separated using sieves of 5, 2, and 0.5 mm mesh.

The material collected was preserved in 70% alcohol. The structure of this species was studied by placing it in 10% KOH, which allowed for the separation of the shell valves, corpuscles scales and spicules of the girdle and the radula. The structures of the different parts were examined under the scanning electronic microscope (Philips XL-20).

RESULTS

Class POLYPLACOPHORA Gray, 1821
Order NEOLORICATA Bergenhayn, 1955
Suborder ISCHNOCHITONINA Bergenhayn, 1930
Family ISCHNOCHITONIDAE Dall, 1889

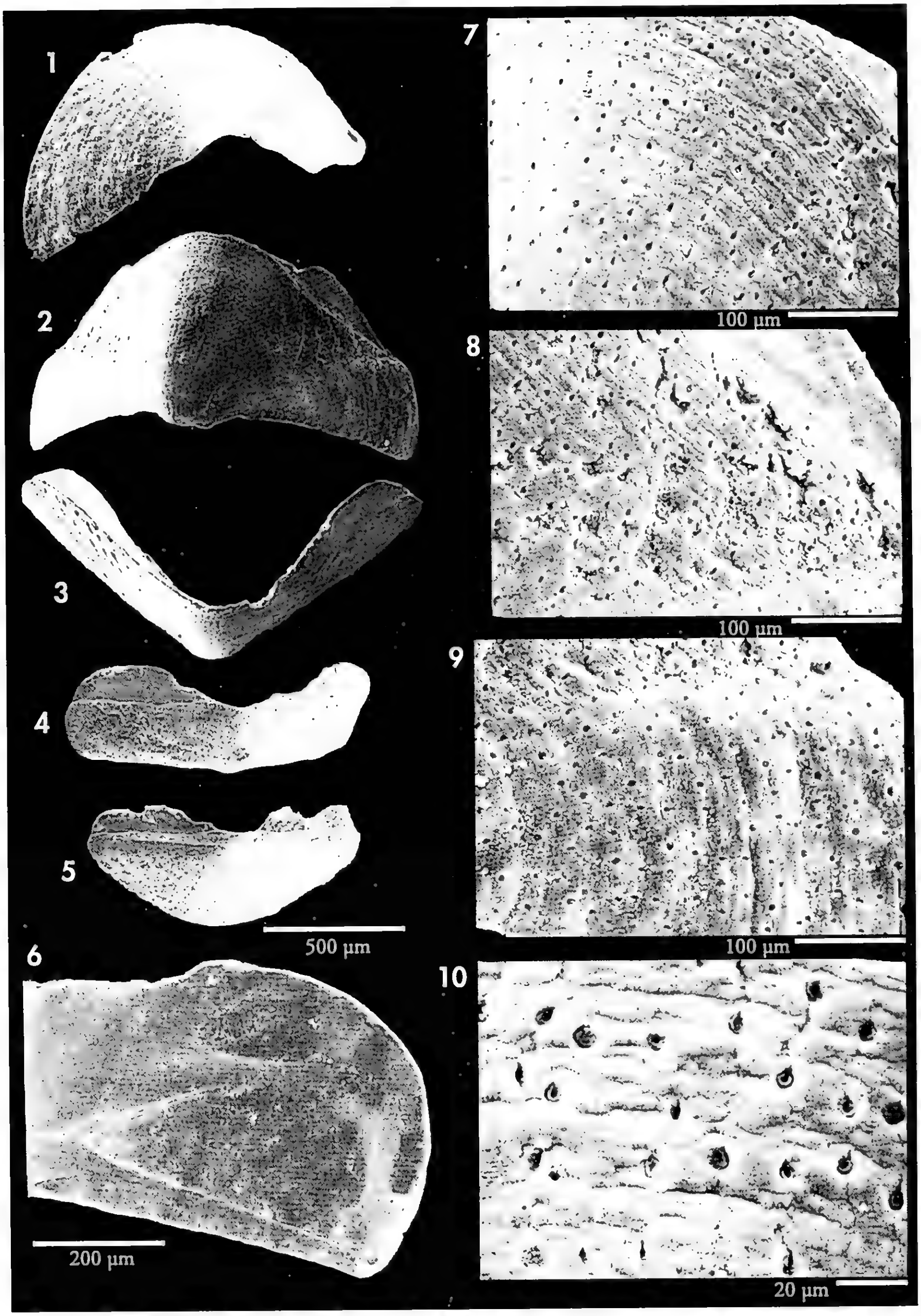
Ischnochiton (Stenosemus) gallaecus spec. nov.

Type material: The only specimen collected is the holotype. Four valves and the radula were metallized as required by the methodology used to examine it with a scanning electronic microscope, and the rest of the specimen has been preserved in 70% alcohol. It is stored at the Museo de Ciencias Naturales de Madrid with code number MNCN 15.03/485. The type locality is A Quiniela (Galicia) (43° 17′ 22″-52″ N; 09° 36′ 38″-45″ W).

Derivatio nominis: This species is dedicated to Galicia, a region located in the Northwest of the Iberian Peninsula.

Diagnosis: The specimen is 2.5 mm long and 1.8 mm wide. It is oval-shaped with the cephalic area being flatter than the caudal area. The shell is strongly carinated at valves II, III and IV with well marked apices on the same valves. The ornamentation consists of rounded granules, which are more noticeable on the sides. These areas are slightly higher than the central area. The perinotum is made up of oval-shaped, imbricated scales with stems, having a smooth appearance, although they are slightly striated. The marginal fringe is not highly visible; among its spicules, we can clearly see several cylindrical spicules with stems. The uncinal plate of the major lateral tooth of the radula is tricuspid, with the central cusp being much longer than the lateral ones, although there are three cusps, similar in size in the older area of the radula.

Description: Tegmentum. The specimen under study is white. The head valve is larger in size than the tail valve and has a semicircular anterior border and a triangular posterior border, with a considerably sharp apex (Fig. 1). The strong slope that originates at the valve tends to be convex. The intermediate valves decrease in size from the second to the seventh (Figs. 2-5). Despite being strongly carinated, they are rectangular shaped, with the exception of valve II. This valve has a convex anterior border, rounded sides, and at the apex the posterior borders converge forming a concave shape. The remaining intermediate plates have an almost straight anterior border, with a certain tendency



Figures 1-10. *Ischnochiton (Stenosemus) gallaecus* spec. nov. 1: valve I; 2: valve II; 3: valve IV; 4: valve V; 5: valve VIII; 6: articulamentum of valve VII; 7: ornamentation of the jugal zone; 8: ornamentation of the pleural zone; 9: ornamentation of the lateral area; 10: arrangement of aesthetes.
Figuras 1-10. Ischnochiton (Stenosemus) gallaecus spec. nov. 1: valva I; 2: valva II; 3: valva IV; 4: valva V; 5: valva VIII; 6: articulamentum de la valva VII; 7: ornamentación de la zona jugal; 8: ornamentación de la zona pleural; 9: ornamentación del área lateral; 10: disposición de las estetas.

to be concave at the jugal sinus. The lateral borders are rounded and the posterior is straight with an apex that is not well-defined. The lateral areas protrude from the central area. The anterior border of the tail valve tends to be straight, although we can see that it has a slight tendency to become convex. One third of the posterior border is semicircular. The mucro is located in an anterocentral position and is not highly prominent, so that the slope that it creates is moderate and straight (Fig. 5).

The ornamentation is comprised of granules arranged quincuncially on the head valve, lateral areas of the intermediate valves (Fig. 9), and the postmucronal zone of the tail valve. The arrangement varies in the middle area, and they are less pronounced in the jugal area, although it is possible to see a tendency to form longitudinal chains without the granules actually touching each other (Fig. 7). In the pleural zone, however, where the granules are more visible, they are seen to overlap and the chains tend to come together (Fig. 8).

The aesthetes are arranged over the entire tegmentum and have a tendency to form straight lines, which vary in layout from longitudinal in the jugal zone of the central area to radial in the head valve, lateral areas, pleural zone and postmucronal zone. The mean diameter of the aesthetes is 4.96 μm (σ: 0.97), mean length between aesthetes in the same row is 21.21 μm (σ: 2,5) and the average separation between aesthetes in parallel rows is 14.96 μm (σ: 4,30) (Fig. 10).

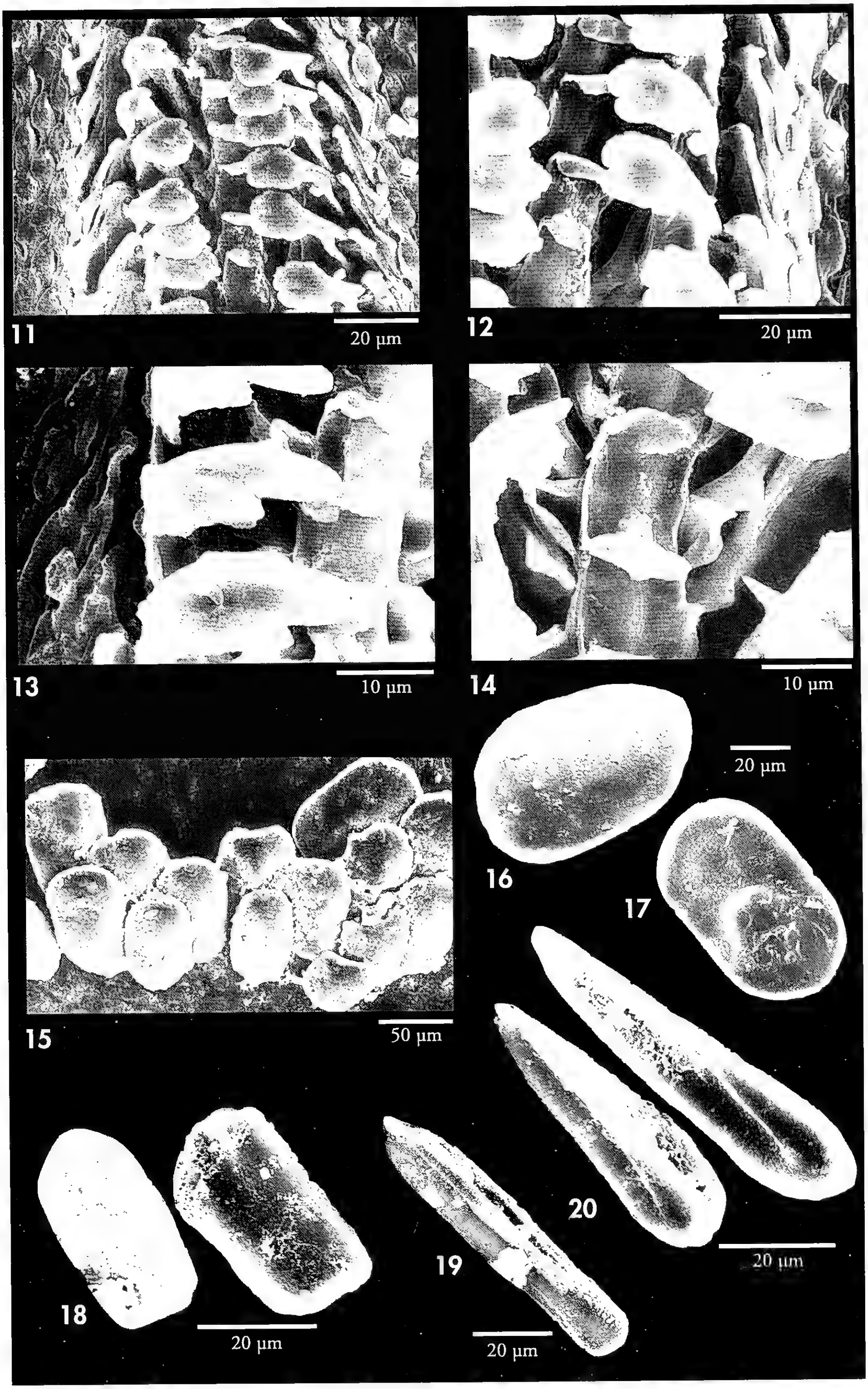
Articulamentum (Fig. 6). White in color with a weak consistency. The teeth, which are slightly uneven, tend to protrude from the tail valve. The apophyses of valve II to IV tend to be triangular, while valve V to VII become trapezoidal in shape. The insertion line formula is 11/1/11.

Girdle. The perinotum is similar in color to the tegmentum. It consists of imbricated, oval-shaped scales that have a small stem in the basal area, with 4 orifices (Figs. 15-17). In the dorsal area of the corpuscle, there are three slight striations (Fig. 16). They range in size from 50 to 90 μm on the largest axis. The mean stem diameter is 23.33 μm (σ : 1.36). If we observe the corpuscle sideways, it appears to have the shape of a boot, as the stem is located at one end. The ventral scales are arranged in overlapping lines. They are rectangular-shaped and feature two protuberances in the apical area of the scale (Fig. 18). They range between 30 and 40 μm in length and between 20 and 25 μm at the base. The marginal fringe is made up of cylindrical spicules with ribs that start at the base and come together at the sharp end of the spicule (Figs. 19, 20). Length is between 51 and 72 μm. Among these spicules, we observed another type of spicules, which are smaller in number and larger in size. They are arranged on a narrow and elongated appendix, which makes them protrude even farther out from the marginal fringe. The spicules are lanceolate with three ribs that run parallel over the spicule. Length varies from 80 to 100 μm.

Gills. They are classified as merobranchial adanal with interspace. They start at the level of valves VI-VII and extend to the anus. They gradually increase in size and decrease at the last two valves. The number of gills on each side is 8.

(Right page) Figures 11-20. *Ischnochiton (Stenosemus) gallaecus* n. sp. 11, 2: radula; 13: uncinal plate of the major lateral tooth; 14: central tooth of the radula and first lateral tooth; 15: arrangement of the dorsal corpuscles on the perinotum; 16: dorsal corpuscles, dorsal view; 17: dorsal corpuscle, ventral view; 18: ventral scales, dorsal view; 19, 20: marginal spicules.

(Página derecha) Figuras 11-20. Ischnochiton (Stenosemus) gallaecus *n. sp. 11, 2: rádula; 13: placa uncinada del diente lateral mayor; 14: dientes central y primer lateral; 15: disposición de los corpúsculos dorsales del perinoto; 16: corpúsculos dorsales, vista dorsal; 17: corpúsculo dorsal, vista ventral; 18: escamas ventrales, vista dorsal; 19, 20: espículas marginales.*


11
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Radula (Fig. 11). The central tooth of the radula is rectangular-shaped with a pronounced flexible border (Fig. 12, 13). The maximum length observed was 25 μm. The first lateral tooth, is longer, reaching up to 30 μm in length. The uncinal plate of the major lateral tooth is tricuspid, with the central cusp much longer than in the lateral teeth, although in the most utilized zone of the radula, the three cusps are similar in size (Fig. 13). The plumose tooth is small and does not reach the uncinal plate of the major lateral tooth, The two small intermediate teeth, internal and external, as well as the last three, have the typical scale form (Fig. 11).

Biology: The only specimen of *Ischnochiton (Stenosemus) gallaecus* was collected at a depth of 752 m in strong currents. The animal was attached to a stone on bottoms with ferromanganesic nodules, calcareous plaques and coal slag.

DISCUSSION

The specimen has been classified in the Family Ischnochitonidae given that the terminal valves have multiple fissures, the intermediate valves have a notch on both sides and it does not present pectinated insertion teeth. The "eyes" are not pigmentary; the apophyses are separated, and the perinotum is made up of scales.

It has been classified in the genus *Ischnochiton* because its tegmentum is sculpted by granules, it is twice as wide as it is long and on its jugal sinus there are no types of notches; nor does it have lines connecting the apophyses. It belongs to the subgenus *Stenosemus* since the perinotum scales do not have stems.

After reviewing the species that are classified in *Ischnochiton (Stenosemus)*, we found no other species presenting similar traits. The specimen may be distinguished primarily because of the morphology of its body, which is wider in the cephalic area than in the caudal area and because valves II to IV are strongly carinated, while valves V to VII are subcarinated. As far as ornamentation is concerned, it is easily distinguishable from the species of *Ischnochiton (Stenosemus)* which have a clearly visible sculpture such as *I. (S.) exaratus* (G.O. Sars, 1878), *I. (S.) stearnsii* Dall, 1902, *I. (S.) vanbellei* Kaas, 1985 and *I (S.) robustus* Kaas, 1991, since in *I. (S.) gallaecus* the granules are not very pronounced; they are quincuncially arranged and tend to form chains in the pleural zone. These characteristics also serve to differentiate it from species having a microgranulated tegmentum which do not tend to form chains such a: *I.(S.) albus* (Linneo, 1767), *I.(S.) chiversi* (Ferreira, 1981) and *I.(S.) vitreolus* Kaas, 1985. Our species differs from *I.(S.) substriatus* Kaas and Van Belle, 1990 as it has chains in both the jugal and pleural areas. It does not show clear striations in the corpuscles of the perinotum, which happens with *I. (S) substriatus*. Besides, in this species, the uncinal plate of the major lateral tooth of the radula is bicuspid, with sharp apexes, whereas that of *I. (S.) gallaecus* is tricuspid and its denticles are blunt. It differs from *I. (S.) delicatus* Kaas, 1991 because it has well-defined radial ribs in the lateral areas of the intermediate valves and head valve. It is also different from *I. (S.) perforatus* Kaas, 1990 due to the perforations found in the pleural zone of this species.

In comparasion to the species collected in the same habitat, such as *Leptochiton (Leptochiton) gascognensis* Kaas and Van Belle, 1985, *L. (L.) compostellanum* Carmona and Urgorri, 1999, *Hanleya hanleyi* (Bean in Thorpe, 1844), *I. (S.) exaratus* (G. O. Sars, 1878) and *Connexochiton platynomenus* Kaas, 1979, it differs from the species belonging to the families Leptochitonidae and Hanleyidae and the species *I. (S.) exaratus*. To start with, it can be identified with a small specimen of *C. platynomenus*. However, this species shows an ornamentation formed by corpuscles quincuncially arranged, while those of *I. (S.) gallaecus* are not so marked and tend to form chains. The arrangement of aesthetes changes, as in *C. platy-*

nomenus they are located in the corpuscles and not lined up as in *I. (S.) gallaecus*. At the same time, the apophyses of *C. platynomenus* are interconnected. The central radular tooth is notably sharp and convexly curved, features not present in *I. (S.) gallaecus*.

Based on the comparisons made between *I.(S.) gallaecus* and the other species of the subgenus *Stenosemus* and *C. platynomenus*, and not having found any other that presented the same characteristics as the species described, we consider this to be a new species.

BIBLIOGRAPHY

KAAS, P., AND VAN BELLE, R. A., 1985. *Monograph of living chitons. 2, Suborder Ischnochitonina, Ischnochitonidae: Schizoplacinae, Callochitoninae and Lepidochitoninae*. E.J. Brill, Leiden). 198 pp.

KAAS, P., AND VAN BELLE, R. A., 1987. *Monograph of living chitons. 3, Ischnochitonidae: Chaetopleurinae, Ischnochitoninae. Aditions to vols 1 and 2*. (E.J. Brill/ W. Backhuys, Leiden). 302 pp.

KAAS, P., AND VAN BELLE, R. A., 1990. *Monograph of living chitons. 4, Suborder Ischnochitonina: Ischnochitonidae: Ischnochitoninae (continued) Additions to vols 1,2 and 3*. E. J. Brill/W. Backhuys, Leiden. 298 pp.

KAAS, P., AND VAN BELLE, R. A., 1994. *Monograph of living chitons. 5 Suborder Ischnochitonina: Ischnochitonidae: Ischnochitoninae (conclued). Callistoplacinae; Mopalidae. Additions to vols 1-4*. E. J. Brill/W. Backhuys, Leiden. 403 pp.

Seasonal infection dynamic of tetraphyllidean cestodes in the ommastrephid squids from Galician waters

Dinámica estacional de la infección por cestodos tetrafilídeos en los omastréfidos de aguas de Galicia

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ABSTRACT

The seasonal dynamic of cestode tetraphyllidean infection by the genus *Phyllobothrium* on the short-finned squids *Illex coindetii* and *Todaropsis eblanae* from fishing grounds off Galicia is described. Seasonal changes in parasite infrapopulation counts were evident in northern and southern fishing areas but varying depending on host source. In any case highest infection values were found in late winter at the time of large mature squids, whereas lowest (and even no parasite recruitment to the host populations) infection values were found in the summertime. This corresponding with abundant hatchings and paralarvae supported by peaks in upwelling and blooms in available food related to the upwelled Eastern North-Atlantic Central Water (ENACW).

RESUMEN

Este trabajo describe la dinámica estacional de las infecciones por cestodos tetrafilídeos del género *Phyllobothrium* en las potas *Illex coindetii* y *Todaropsis eblanae* capturadas en las áreas de pesca de Galicia. Se evidenciaron cambios estacionales en el número de las infrapoblaciones parásitas en las áreas de pesca del norte y del sur, aunque éstos variaron en función de la especie hospedadora. En cualquier caso, los niveles más altos de infección se produjeron al final del invierno coincidiendo con las potas grandes y maduras. Mientras, los valores más bajos de infección (incluso sin reclutamiento de los parásitos en las poblaciones hospedadoras), se encontraron en el verano, coincidiendo con el periodo de puesta y abundancia de paralarvas, relacionada con los picos de afloramiento y disponibilidad de alimento en la masa de Agua Central NorAtlántica (ACNA).

KEY WORDS: cestode, tetraphyllidean, *Phyllobothrium*, *Illex coindetii*, *Todaropsis eblanae*.
PALABRAS CLAVE: cestodo, tetrafilídeo, *Phyllobothrium*, *Illex coindetii*, *Todaropsis eblanae*.

INTRODUCTION

Despite symbiotic relationships between adult tetraphyllidean cestodes and their elasmobranch final hosts have been largely studied, little work has been done on the larval procercoid and plerocercoid stages. This lack of information is especially evident with regard to the cephalopod hosts, in spite of the fact that tetraphyllidean larvae have been recovered and taxonomically iden-

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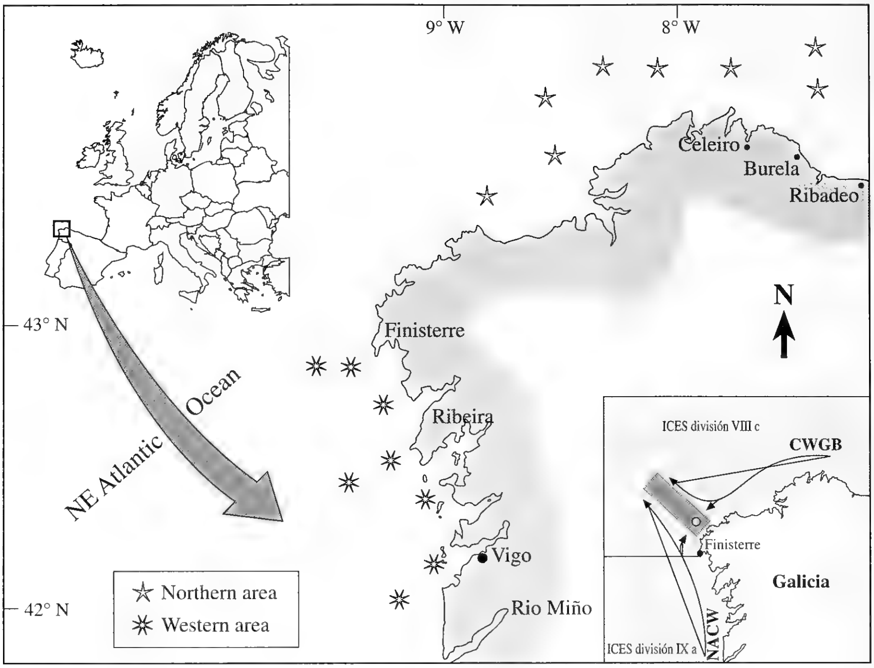

Figure 1. The location of sampling zones off Galician waters (NW Spain).
Figura 1. Localización de las zonas de muestreo en las costas gallegas (NO España).

tified from a wide diversity of coastal, neritic and/or oceanic squid, cuttlefish and octopus species worldwide (see review by HOCHBERG, 1990). Among this, only a few studies by Canadian, Russian and Spanish researchers (e.g., BROWN AND THRELFALL, 1968; BOWER, MARGOLIS AND YANG, 1990; NIGMATULLIN AND SHUKHGALTER, 1990; PASCUAL, GONZÁLEZ, ARIAS AND GUERRA, 1995a; PASCUAL, RASERO, ARIAS AND GUERRA, 1995b) have dealt with the demographic infection values and/or host-parasite relationships, but neither study provided a detailed account of the seasonal population dynamics of the infection in the wild, though this may be essential for a better understanding of the parasite recruitment and their ecological impact on wildlife cephalopod populations (PASCUAL, 1996).

In temperate waters off the NE Atlantic, relatively large ommastrephid samples were routinely available for study in commercial fisheries (GONZÁLEZ, RASERO AND GUERRA, 1996), thus providing an opportunity to describe the seasonal infrapopulation behavior of the plerocercoid tetraphyllideans in commercially-important ommastrephid squid populations.

MATERIAL AND METHODS

At monthly intervals between 1992-1993, 1200 post-recruit of lesser flying squids *Illex coindetii* (Vérany, 1839) and broadtailed short-finned squids *Todaropsis eblanae* (Ball, 1841) (600 each) were collected by fishermen from local fishing grounds off Galicia (42° 5′ to 45° 15′ N, 7° to 9° 20′ W) (Fig. 1). Samples comprising 25 individuals per host species and sampling area were obtained from commercial landings in several ports within two hydrographically well-differentiated areas (FRAGA, MOURIÑO AND MANRÍQUEZ, 1982). The northern group consisted of all squids

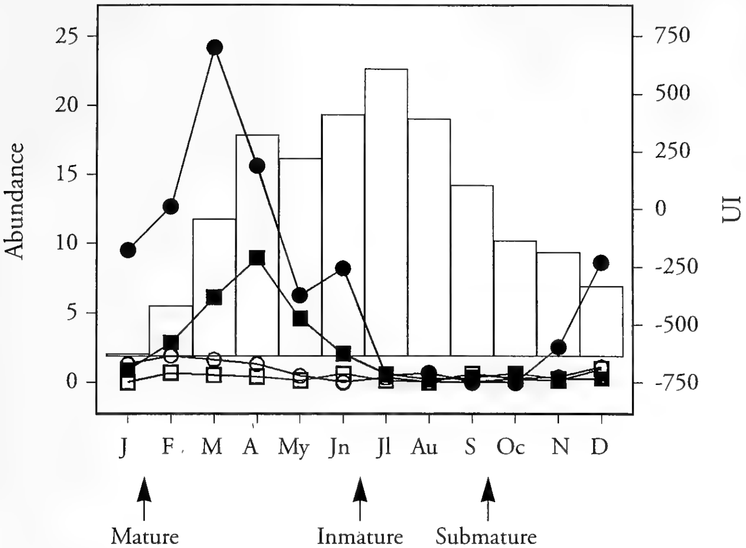

Figure 2. Monthly values in abundance of infection by *Phyllobothrium* spp. in squid at both sampling areas. (● ICN, *Illex coindetii* from the northern area; ❍ ICS, *I. coindetii* from the southern area; ■ TEN, *Todaropsis eblanae* from the northern area; ❑ TES, *T. eblanae* from the southern area). Mature, immature and submature squids (i.e., condition of the gonad) was assessed using an universal maturity scale (LIPINSKY, 1979). The histogram represents the upwelling index (UI, expressed as m3s-1Km-1).

Figura 2. Valores medios de infección por Phyllobothrium spp. en calamares de ambas áreas de muestreo. (● ICN, Illex coindetii *del área norte ; ❍ ICS,* I. coindetii *del área sur;* ■ *TEN,* Todaropsis eblanae *del área norte;* ❑ *TES,* T. eblanae *del área sur). La condición de la gónada de los calamares (maduro, inmaduro y submaduro) se ajusto usando una escala universal de madurez (LIPINSKY, 1979). El histograma representa el índice de afloramiento (UI, expressed as m3s-1Km-1).*

collected from Burela to Finisterre (ICES division VIIIc) and the southern group consisted of squids caught from Finisterre to Miño river (ICES division IXa). Each month, the viscera was removed from fresh dead squid and examined for larval tetraphyllidean cestodes. Seasonal differences among log-transformed parasite infrapopulation counts were compared using one-way ANOVA. To this end, data were analyzed on a quarterly basis: winter (January-March), spring (April-June), summer (July-September) and autumn (October-December). The abundance of infection (defined as the number of individuals of a parasite species in a host species regardless of whether or not the host is infected) was calculated each month for both host species and fishing areas as the most appropriate demographic infection value due to its population significance (BUSH, LAFFERTY, LOTZ AND SHOSTAK, 1997).

RESULTS

In the northern area, a clear seasonal pattern of plerocercoid infection by *Phyllobothrium* van Beneden, 1850 larvae in both squid populations ($F= 23.56$; $p< 0.001$ for *I. coindetii*) ($F= 4.885$; $p< 0.05$ for *T. eblanae*) was observed (Fig. 2). Abundance of infection increased throughout the winter, reaching a maximum in late winter and early spring at the time of spawning. The highest infection values were found in the largest mature squids but declining towards the summer, when immature individuals are abundant. In the southern area, a significant seasonal variation was only found in the short-finned squid *I. coindetii* ($F= 5.89$; $p<0.05$). By the contrast, no seasonal variation in infection values ($F= 0.289$; $p=0.602$) was evident in *T. eblanae*. Nevertheless, the general pattern of seasonal parasite dynamic clearly suggests that infection is higher during colder months than during warmer months which is inversely correlated with the upwelling index, regardless of host source or sampling area.

DISCUSSION

According with HOCHBERG (1990), plerocercoids of *Phyllobothrium* spp. in teuthoid cephalopods exhibit a marked ecological-specificity, i.e., they are more dependent on trophic levels occupied by the host species than on host phylogeny *per se*. The highest values of cestode infrapopulation counts during squid spawningtime herein reported, suggest that many species of selachians feed on the fast-moving squids mainly during the massive die-offs that occur following spawning. This clearly represents a synchronization of parasite and squid life-history strategies, in which the parasite utilizes the optimal stage of ontogenesis (i.e., trophic level) of the host to insure the maximum probability of entry into the final host. This pattern was also suggested by NIGMATULLIN AND SHUKHGALTER (1990) in the Patagonian squid *Illex argentinus* from 45-47°S but they observed no seasonal fluctuations among intraspecific groupings of similar size and maturity. In this way, the bimodal pattern of seasonal infection (highest during winter to springtime and lowest during summertime) herein reported, may be due to variations in squid size, age and/or maturity and ultimately to host feeding habits (PASCUAL, GONZÁLEZ, ARIAS AND GUERRA, 1996). In fact, the abundance of infection clearly increased with increasing host maturity over the entire life cycle, a characteristic common to many ommastrephid squids (BROWN AND THRELFALL, 1968; THRELFALL 1970; GAEVSKAYA AND NIGMATULLIN 1981; NIGMATULLIN AND SHUKHGALTER 1990; PASCUAL *ET AL.*, 1995a, b). Nevertheless, the abundance of infection did not increase with host maturity in the squids from the southern group which may be due to a lower overdispersion pattern of parasite infrapopulations than it accounted in the northern group. The effect of accumulation factor resulting from feeding patterns has been previously described in other trophically-transmitted cephalopod parasites by PASCUAL, GONZÁLEZ, ARIAS AND GUERRA (1999).

Otherwise, it is important to note that seasonal behavior of infection herein reported reflect variation in hydrographically-distinct sampling local areas of a single host species. In fact, regional variations (north-south) in the composition of the helminth fauna of both squid species has been also previously noted by PASCUAL *ET AL.* (1996). Despite the short distance between both sampling areas, these regions exhibit differences in oceanography, biological productivity, fauna composition, and diversity which may explain differences in infections values to the northern and southern mature squids. This clearly indicates that long-term sampling surveys should be carried out when comparing infection patterns in cephalopod populations, even at a microgeographic scale. Results also suggests that despite the influence of abiotic factors which could affect the infective free-living parasitic stages and thus their seasonal behavior, recruitment of worms to squid populations does not appear to be continuous. Infections were thus less abundant during late spring and summer, which coincided with the periodicity of host spawning for both squid species (GONZÁLEZ AND GUERRA, 1996) where hatchings and paralarvae are supported by peaks in upwelling and blooms in available food related to the upwelled Eastern North-Atlantic Central Water (ENACW) (ROCHA, GUERA, PREGO AND PIATKOWSKI, 1999). This type of periodicity appear similar to that described r-strategist organisms which have well-defined seasonal cycles in temperate waters of the world. Therefore, an ecological specificity based on host-related biotic factors rather than an oceanographic or host specificity is likely to be the caused of seasonal infection dynamic of tetraphyllidean cestodes of *Phyllobothrium* in the short-finned squids from Galician waters. Additionally, a wide distribution of both host and parasite clearly show the potential cosmopolitan character of the infection and the important role played by large, mature ommastrephids as second intermediate hosts for *Phyllobothrium* in temperate waters off the NE Atlantic.

BIBLIOGRAPHY

BOWER, S. M., MARGOLIS, L. AND YANG, D. T. C., 1990. A preliminary investigation of the helminth parasites of flying squid, *Ommastrephes bartrami*, in northeastern Pacific waters and comparison with other parasite surveys of Ommastrephidae. *Canadian Technican Report of Fisheries and Aquatic Science*, No. 1750.

BROWN, E. L. AND THRELFALL, W., 1968. A quantitative study of the helminth parasites of the Newfoundland short-finned squid, *Illex illecebrosus illecebrosus* (LeSueur) (Cephalopoda: Decapoda). *Canadian Journal of Zoology*, 46: 1087-1093.

BUSH, A. O., LAFFERTY, K. D., LOTZ, J. M. AND SHOSTAK, A. W., 1997. Parasitology meets ecology on its own terms: Margolis *et al.* revisited. *Journal of Parasitology*, 83 (4): 575-583.

FRAGA, F.; MOURIÑO, C. AND MANRÍQUEZ, M., 1982. Las masas de agua en las costas de Galicia: junio-octubre. *Resultados de Expediciones Científicas*, 10: 51-77.

GAEVSKAYA, A. V. AND NIGMATULLIN, CH. M., 1981. Several ecological aspects of the parasitic relationships of the flying squid (*Sthenoteuthis pteropus*) (Steenstrup, 1855). (En Ruso). *Biologicheskii Nauki*, Moscow, 1: 52-57.

GONZÁLEZ, A. F. AND GUERRA, A., 1996. Reproductive biology of the short-finned squid *Illex coindetii* (Cephalopoda, Ommastrephidae) of the Northeastern Atlantic. *Sarsia*, 81: 107-118.

GONZÁLEZ, A. F., RASERO, M. AND GUERRA, A., 1996. La explotación de los omastréfidos *Illex coindetii* y *Todaropsis eblanae* (Mollusca: Cephalopoda) en aguas de Galicia. *Nova Acta Científica Compostelana (Bioloxía)*, 6: 191-203.

HOCHBERG, F. G., 1990. Diseases of Mollusca: Cephalopoda. In: Kinne, O. (Ed.) *Diseases of marine animals*.Vol. III., Cephalopoda to Urochordata Biologisches Anstalt Helgoland, Hamburg: 47-227.

LIPINSKY, M. R., 1979. Universal maturity scale for the commercially-squids (Cephalopoda: Teuthoidea). The results of maturity classification of *Illex illecebrosus* (LeSueur, 1821) populations for the years 1973-1977. *ICNAF Research Documents*, 79/II/38.

NIGMATULLIN, CH. M. AND SHUKHGALTER, O. A., 1990. Helmintofauna y aspectos ecológicos de las relaciones parasitarias del calamar (*Illex argentinus*) en el Atlántico Sudoccidental. *Frente Marítimo*, Vol. 7, Sec. A: 57-68.

PASCUAL, S., GONZÁLEZ, A., ARIAS, C. AND GUERRA, A., 1995 a. Helminth infection in the short-finned squid *Illex coindetii* (Cephalopoda, Ommastrephidae) off NW Spain. *Diseases of Aquatic Organisms*, 23: 71-75.

PASCUAL, S., RASERO, M., ARIAS, C. AND GUERRA, A., 1995 b. Helminthfauna of the short-finned squid *Todaropsis eblanae* (Ball, 1841) (Cephalopoda: Ommastrephidae) off NW Spain. *Research and Reviews in Parasitology*, 55 (2):113-116.

PASCUAL, S., 1996. Los sistemas hospedador-parásito en la pesquería de omastréfidos de Galicia. Tesis doctoral. Universidad de Vigo. 167 pp.

PASCUAL, S., GONZÁLEZ, A., ARIAS, C. AND GUERRA, A., 1996. Biotic relationships of *Illex coindetii* and *Todaropsis eblanae* (Cephalopoda, Ommastrephidae) in the Northeast Atlantic: evidence from parasites. *Sarsia*, 81: 265-274.

PASCUAL, S., GONZÁLEZ, A., ARIAS, C. AND GUERRA, A., 1999. Larval *Anisakis simplex* B (Nematoda: Ascaridoidea) of short-finned squid (Cephalopoda: Ommastrephidae) in northwest Spain. *Journal of the Marine Biological Association of the United Kingdom*, 79: 65-72.

ROCHA, F., GUERRA, A., PREGO, R. AND PIATKOWSKI, U., 1999. Cephalopod paralarvae and upwelling conditions off Galician waters. *Journal of Plankton Research*, 21 (1): 21-33.

THRELFALL, W., 1970. Some helminth parasites from *Illex argentinus* (de Castellanos, 1960) (Cephalopoda: Ommastrephidae). *Canadian Journal of Zoology*, 48: 195-198.

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Two new species of *Mitrella* Risso, 1826 (Gastropoda, Columbellidae) from west Atlantic

Dos nuevas especies de Mitrella Risso, 1826 (Gastropoda, Columbellidae) del Atlántico oeste

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ABSTRACT

Two new species of *Mitrella* Risso, 1826 are described from the west Atlantic Ocean. *Mitrella cabofrioensis* sp.nov. is known only from the southeastern coast of Brazil. This species is diagnosed by its pattern of white flamules over a reddish brown background, and a dome-like, paucispiral protoconch, with 2 whorls. *Mitrella antares* sp. nov. is know from the Bahamas, Cozumel island, and Brazilian coast. This species is diagnosed by its large, globose, multispiral protoconch, with 3 whorls, and by two strong denticles on the columella.

RESUMEN

Se describen dos nuevas especies de Mitrella Risso, 1826 del Atlántico Oeste. Mitrella cabofrioensis sp. nov. se conoce sólo de la costa sudeste de Brasil. La especie se distingue por su patrón de manchas blancas sobre fondo pardo rojizo y por su protoconcha paucispiral, con foma de cúpula y dos vueltas. Mitrella antares sp. nov. se conoce de las Bahamas, isla Cozumel y costa de Brasil. Se distingue por su protoconcha grande, globosa, multispiral, con 3 vueltas, y por los dos fuertes dentículos en la columela.

KEY WORDS: Mollusca, Gastropoda, Columbellidae, *Mitrella*, West Atlantic, Brazil.
PALABRAS CLAVE: Mollusca, Gastropoda, Columbellidae, *Mitrella*, Atlántico oeste, Brasil.

INTRODUCTION

The inventory of Brazilian molluscan diversity is still far from complete. Examination of specimens deposited in collections as well as originating from diverse sources such as oceanographic vessels, trawling boats, and scuba divers often yield new taxa. Herein we describe two species of *Mitrella* from the west Atlantic.

Mitrella Risso, 1826 is comprised of small columbellids (4–20 mm). It has a circum-tropical distribution and its species are found from intertidal to bathyal depths (BOUCHET AND WARÉN, 1985). The genus still needs a thorough diagnosis. This causes much confusion and the species assigned to this genus vary greatly (ABBOT, 1974; LEAL, 1991; RADWIN, 1978; RIOS, 1994). Herein we consider the following west Atlantic species as belonging to *Mitrella*: *M. ocellata* (Gmelin, 1791); *M. dichroa*

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(Sowerby, 1844), *M. lunata* (Say, 1826); *M. profundi* (Dall, 1889); and *M. nitidulina* (Locard, 1897).

MATERIAL AND METHODS

Shells were photographed under a stereomicroscope Zeiss SV11. The scanning electron microscope (SEM) photographs were made at Centro de Pesquisas da Petrobrás, Rio de Janeiro.

Specimens of *M. cabofrioensis* were collected by trawling off Cabo Frio, Rio de Janeiro state, southeastern Brazil (see Figure 1) and specimens of *Mitrella antares* sp. nov. were collected by SCUBA diving, and oceanographic vessels between Bahamas and Marataízes, Espirito Santo state, southeastern Brazil (Fig. 1).

Abbreviations used:

ANSP Academy of Natural Sciences, Philadephia, U.S.A.
BMNH The Natural History Museum, London, U.K.
IBUFRJ Instituto de Biologia da Universidade Federal do Rio de Janeiro, Brazil
MCZ Museum of Comparative Zoology, Harvard, U.S.A.
MNHN Muséum National d'Histoire Naturelle, Paris, France
MNRJ Museu Nacional - Universidade Federal do Rio de Janeiro, Brazil
MORG Museu Oceanográfico Professor Eliézer de Carvalho Rios, Rio Grande, Brazil
MZSP Museu de Zoologia da Universidade de São Paulo, Brazil
USNM United States National Museum, Washington D.C., U.S.A.

SYSTEMATICS

Family COLUMBELLIDAE Swainson, 1840
Subfamily PYRENINAE Suter, 1913

Genus *Mitrella* Risso, 1826

Mitrella Risso, 1826: 246 - 247. Type species by SD, *Mitrella flaminea* Risso, 1826 [= *Mitrella scripta* (Linnaeus, 1758)], Mörch, 1859: 257-258. Holotype Muséum National d'Histoire Naturelle, Paris.
Mitsella Mörch, 1859: 257 - 258 (*error pro Mitrella*).

Diagnosis: Shell surface generally smooth, except for spiral grooves on anterior part of sheel. Rarely, first whorls of teleoconch, with thin spiral striae. Spire high, acute. Inner surface of external lip denticulated

Mitrella cabofrioensis sp. nov. (Figs. 2-4, 9-11)

Holotype MORG 39010 (length 9.5 mm, width 4.0 mm).
Paratypes: MNRJ 7162 (length 10 mm, width 4.0 mm); IBUFRJ 6930 (length 9.8 mm, width 4.0 mm); USNM 880111 (length 9.6 mm, width 3.8 mm); MNHN (length 9.6 mm, width 3.9 mm); BMNH 1995189 (length 9.2 mm, width 3.8 mm): off Cabo Frio, Rio de Janeiro, Brazil, 23° 18′ 00″ S, 42°00′ 00″ W, 23/IV/1993, trawler boat "Muriaé III", 140m, on calcareous conglomerate; MZUSP 28194 (length 6.6 mm, width 3.0 mm, juvenile), off Cabo Frio, Rio de Janeiro, Brazil, N. Oc. W. Besnrad.
Type locality: off Cabo Frio, Rio de Janeiro, Brazil, 23° 18′ 00″ S, 42° 00′ 00″ W, depth 140m.
Etymology: The specific epithet *cabofrioensis* refers to the type locality.

Diagnosis: Shell large (~ 9.5 mm) slightly inflated; protoconch dome-like, large with 2 whorls; pattern composed of irregular sigmoidal white flamules over a reddish brown background; siphonal canal distinct.

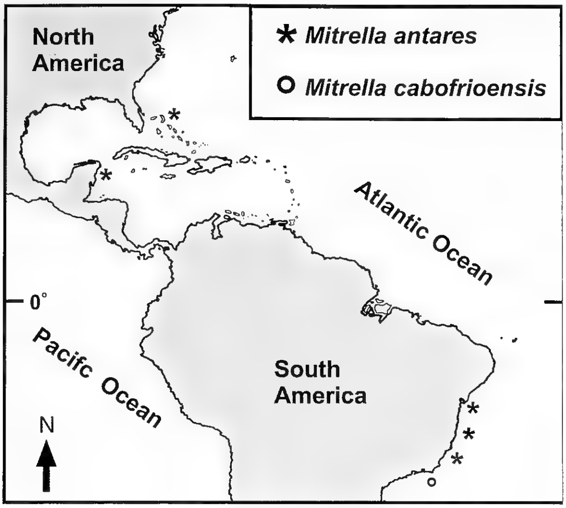


Figure 1. Geographic distribution of *Mitrella cabofrioensis* sp. nov. and *Mitrella antares* sp. nov.
Figura 1. Distribución geográfica de Mitrella cabofrioensis *sp. nov. y* Mitrella antares *sp. nov.*

Description: Shell (Figs. 2-4) large (length 9-10 mm), fusiform, acute, slightly inflated. Surface glossy, marked with very tenuous growth lines; anterior part of the body whorl with numerous (about 20) spiral groves, broadening towards the tip of the siphonal canal. pattern consisting of a series of irregular sigmoidal white flamules over a reddish brown background. Spire moderately high, comprising slightly more than half of total shell length. Protoconch (Fig. 9) dome-like, very large, smooth, vitreous, paucispiral with 2 whorls. Teleoconch with 3.25 slightly convex whorls, imparting a inflated aspect to the shell. Aperture moderately broad, internally with purplish white ation; inner margin of external lip with 6 denticles; columella slightly concave, with keel, on anterior end, reaching siphonal canal. Siphonal canal distinctive, short, slightly bent upwards. Operculum oval, corneous, with yellow coloration, nucleus terminal.

Radulae (Figs. 10, 11) rachiglossate, central tooth rectangular, about four times wider than long. Anterior edge straight or slightly convex, posterior edge is slightly concave. Lateral tooth approximately 1.55 longer than wide, slender, falcate with three cusps: basal cusp short, blunt; middle cusp sharp, short, thin, moderately curved; external cusp long, sharp, almost straight at its terminal part; distance between cusps subequal; base measuring 28.0 μm, from its anterior margin to the edge of basal cusp, length 43.5 μm between base and tip of distal cusps.

Habitat: Calcareous conglomerate, at approximately 140 m.

Range: Known only from off Cabo Frio, Rio de Janeiro State, Brazil (Fig. 1).

Remarks: *Mitrella cabofrioensis* has a very distinctive colour pattern, different from all other *Mitrella*. It differs from *M. dichroa* (Sowerby, 1844) by being slightly larger, more inflated, having more convex whorls, and protoconch shape. It is different from *M. lunata* in its much larger size, and protoconch shape. *M. ocellata* has a similar radula and paucispiral protoconch, but *M. cabofrioensis* differs by being slightly smaller, more inflated, having thinner shell, and larger siphonal canal. *M. profundi* Dall, 1889 differs from *M. cabofrioensis* by having a lighter coloration, smaller, more inflated shell, a conical, multispiral protoconch, and a columellar plication. *M. nitidulina* Locard, 1897, differs from *M. cabofrioensis* in its uniform cream white color, and in the multispiral, sculptured protoconch.

Mitrella antares sp. nov. (Figs. 5-8, 12-14)

Holotype MORG 33314 (length 3.6 mm, width 1.9 mm).
Paratypes: ANSP 367004, Indian Cay, Grand Bahama Island, Bahamas, J. Worsfold, 1980, 14 specimens; MNRJ 7257, Itapuã, Salvador, Bahia State, Brazil, 1 specimen; MORG 21241, Abrolhos Archipelago, Bahia State, Brazil, 8 specimens; MNRJ 7185 (length 3.5 mm, width 1.8 mm); IBUFRJ 8465 (length 3.4 mm, width 1.9 mm); USNM 880119 (length 3.6 mm, width 1.8 mm); MNHN (length 3.5 mm, width 2.0 mm); BMNH 1996073 (length 3.2 mm, width 1.7 mm); MZUSP 28244 (length 3.55 mm, width 1.8 mm); IBUFRJ 8.466 (length 3.2 mm, width 1.7 mm); MORG 33315 (length 3.6 mm, width 1.8 mm); ANSP 399368; off Marataízes, Espírito Santo state, 20° 10′ S, 40° 37′ W, Brazil, collected by diver, 30 m depth, 04/1995.
Type locality: off Guarapari - Espírito Santo state, Brazil, 20° 41′ S, 40° 22′ W, depth 25 m.
Etymology: The specific epithet *antares* refers to the red giant star in the Scorpio constellation.

Diagnosis: Shell small (~ 3.5 mm) inflated, protoconch large, convex whorled with 3 $^1/_2$ whorls, columella 2 strong denticles in parietal wall.

Description: Shell (Figs. 5-7) small (length 3.2 – 3.6 mm) fusiform, inflated, translucent. Surface glossy, sculptured with very thin sigmoidal growth lines, anterior part of shell sculptured with 9 spiral grooves. Colour pattern composed of brown subsutural blotches, extending anteriorly, forming sigmoidal flames. Spire high, about $^1/_3$ of total shell length. Protoconch (Fig. 12) globose, high, multispiral with 3.00 to 3.50 convex whorls, suture of the first nuclear whorl marked with dark brown coloration. Teleoconch with 3.5 distinctively convex whorls. Aperture trapezoidal, outer lip thickened forming a varix, inner margin of outer lip with five lirate teeth, decreasing in size anteriorly. Parietal wall smooth. Columella (Fig. 8) with two strong, colsely set denticles on its anterior half. Siphonal canal short. Operculum corneous, oval with terminal nucleus.

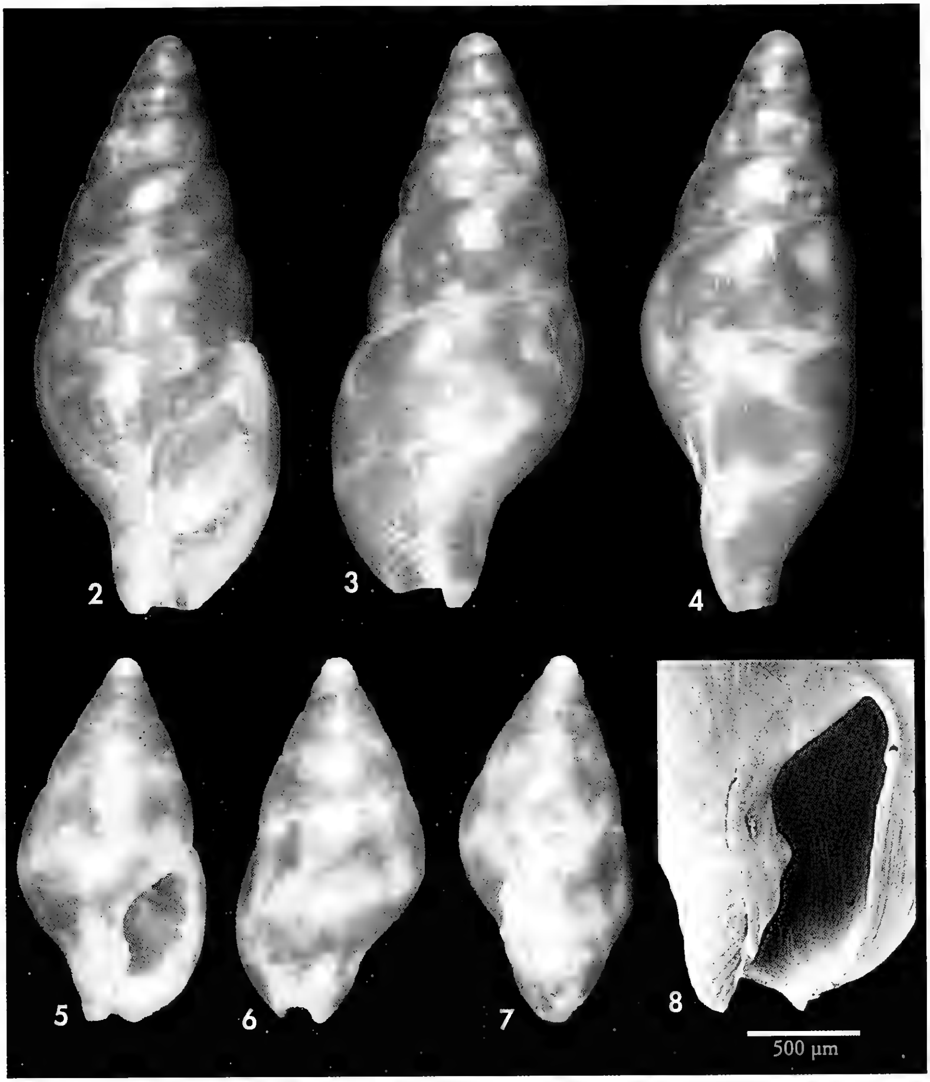
Radulae (Figs. 13, 14) rachiglossate, central tooth rectangular, about four times wider than long, anterior edge straight or slightly convex, posterior edge slightly concave. The lateral tooth approximately 1.65 longer than wide, falcate, stout with three cusps: basal cusp triangular, sharp, straight; middle cusp sharp, short, slightly shorter than basal cusp, moderately curved; external cusp long, sharp, almost straight at its terminal part; distance between basal and middle cusps about half of distance between middle and external cusps, base measuring 14.0 μm, from its anterior margin to edge of basal cusp, length 23.0 μm, between base and tip distal cusp.

Habitat: Calcareous algae and coraline bottoms between 10 and 90 m depth.

Range: Known from Abaco, Bahamas; Cozumel island, Mexico; and in Brazil between Abrolhos Archipelago, Bahia state and Off Marataízes, Espírito Santo state, 20° 10′ S, 40° 37′ W (Fig. 1).

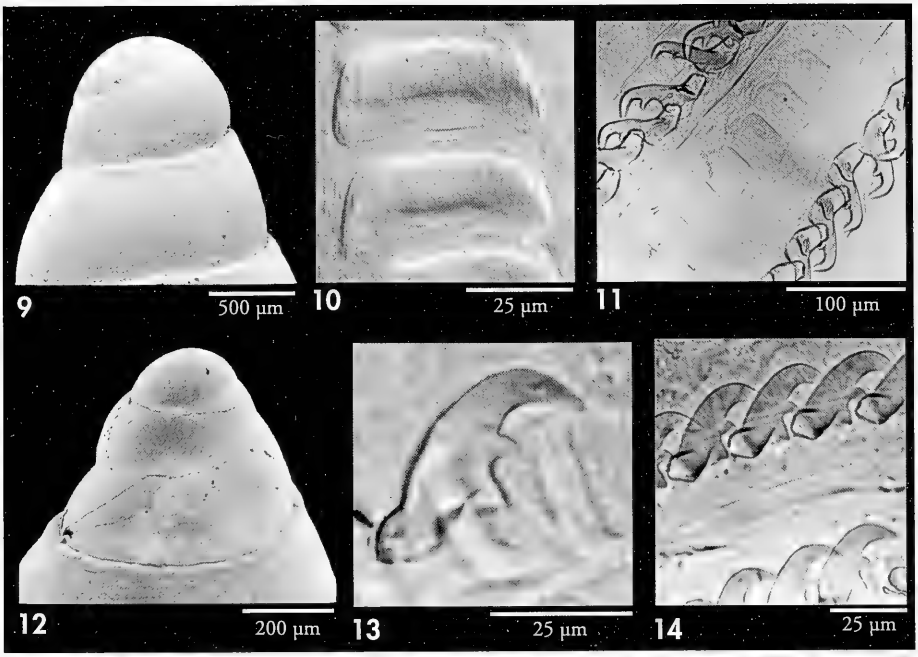
Remarks: *Mitrella antares* is most similar to *M. lunata* due to similar size (3.5 mm) and color pattern. *M. antares* is more inflated, has a globose protoconch, wider aperture, and denticles present on the columella. These species have been confused with each other in museum collections and we have found lots of *M. antares* identified as *M. lunata* (ANSP 367.004, MORG 21.241). *M. antares* differs from *M. dichroa* by being much larger, more inflated, having more convex whorls, and protoconch shape. *M. antares* differs from *M. ocellata* by being much smaller, more inflated, and its pattern. *M. profundi* also has a similar color pattern to *M. antares*, only somewhat lighter it also differs from *M. antares* in being larger, and having a conical, multispiral protoconch. *M. nitidulina* a deep water species, differs from *M. antares* by being larger, more elongate, with a uniform cream coloration, and multispiral sculptured protoconch.

The multispiral protoconch (with 3.00 to 3.50 whorls), suggests a planktotrophic development pattern of *M. antares*, that might help explain its wide geographic range. Other columbellids with multispi-



Figures 2-4. *Mitrella cabofrioensis* sp. nov. holotype (MORG 39010), shell length 9.5 mm. Figures 5-8. *Mitrella antares* sp. nov. 5-7: holotype (MORG 33314), shell length 3.6 mm; 8: detail of aperture showing denticles on columella (paratype: ANSP 367004).
Figuras 2-4. Mitrella cabofrioensis *sp. nov. holotipo (MORG 39010), longitud de la concha 9,5 mm. Figuras 5-8.* Mitrella antares *sp. nov. 5-7: holotipo (MORG 33314), longitud de la concha; 8: detalle de la apertura mostrando los dentículos de la columela (paratipo: ANSP 367004).*

ral protoconchs [e.g. *Anachis obesa* (Adams, 1845) e *M. dichroa* (Sowerby, 1844)] also present similar ranges, in the Caribbean islands., and along the west Atlantic coast, between Florida, EUA, and south east Brazil. However, there is no register of these species, either in meso-Atlantic islands, nor in the east coast of the Atlantic. See Table I for a comparison among all the cited species.



Figures 9-11. *Mitrella cabofrioensis* sp. nov. 9: protoconch; 10: radula, central teeth; 11: lateral teeth. Figures 12-14. *Mitrella antares* sp. nov. 12: detail of protoconch; 13, 14: radula, lateral teeth.
Figuras 9-11. Mitrella cabofrioensis *sp. nov. 9: protoconcha; 10: rádula, dientes centrales; 11: dientes laterales. Figuras 12-14.* Mitrella antares *sp. nov. 12: detalle de la protoconcha; 13, 14: rádula, dientes laterales.*

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Table I. Comparison among different species of *Mitrella* from the studied area.
Tabla I. Comparativa entre varias especies de Mitrella *presentes en el área estudiada.*

	Length mm	Width mm	Teleoconch whorls	Protoconch whorls	External lip teeth	Columellar plicae	Depth range m
M. ocellata	11.0	5.0	4-5	1.75-2.0	6-8	no	Intertidal
M. dichroa	7.5	3.2	5-5.5	2.75-3.0	6-8	no	0-30
M. cabofrioensis	9.5	4.0	4	2.0	6	no	135
M. profundi	87.7	3.7	6	3.25	9	yes	196-1400
M. nitidulina	11.5	5.2	6	3.5-4	*	no	1200-2900
M. lunata	3.2	1.5	4-4.5	3.25-4	5-7	no	0-30
M. antares	3.6	1,9	3.5	3.0	5	no **	15-35

* no fully adult specimens were examined
** in fully adult specimens there are two closely set teeth on the columella

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BIBLIOGRAPHY

ABBOTT, R. T., 1974. *American Seashells* 2nd ed. 663 pp. Van Nostrand Reinhold Co., New York.

BOUCHET, P. AND WARÉN, A., 1985. Revision of the northeast Atlantic bathyaland abyssal Neogastropoda excluding the Turridae (Mollusca, Gastropoda). *Bollettino Malacologico*, Supplemento 1: 121-296.

LANGE DE MORRETES, F., 1949. Ensaio de catálogo dos Moluscos do Brazil. *Arquivos do Museu Paranaense* 7: 3-216.

LEAL, J. H., 1991. *Marine prosobranch gastropods from oceanic islands off Brazil: Species composition and biogeography*. x + 419 pp. Backhuys / U.B.S., Oegstgeest.

MÖRCH, O. A. L., 1859. Note sur les Dents Linguales du Genre *Columbella*. *Journal de Conchyliologie* 7: 254 – 262.

RADWIN, G. E., 1978. The Family Collumbellidae in the Western Atlantic, Part IIb. - The Pyreninae (Continued). *The Veliger* 20 (4): 328 - 344.

RIOS, E. C., 1994. *Seashells of Brazil*. 368 pp., pl.113. Editora FURG, Rio Grande.

RISSO, J. A., 1826. *Histoire Naturelle des Principales Productions de l'Europe Méridionale et Particuliérement de Celles des Environs de Nice et des Alpes Maritimes*. 4: i-vii + 1-439; pl. 1-12.

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The presence of *Simrothiella borealis* (Odhner, 1921) (Mollusca, Solenogastres: Simrothiellidae) in waters off the Iberian Peninsula

Presencia de *Simrothiella borealis* (Odhner, 1921) (Mollusca, Solenogastres: Simrothiellidae) en aguas de la Península Ibérica

Óscar GARCÍA-ÁLVAREZ*, Luitfried v. SALVINI-PLAWEN** and Victoriano URGORRI*

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ABSTRACT

This paper offers a description of a species hitherto unknown in Iberian waters, *Simrothiella borealis* (Odhner, 1921), and which has only been cited off the Norwegian coast. The genera of the family Simrothiellidae are discussed and the species of the genus *Simrothiella* are compared.

RESUMEN

En este trabajo se estudia una especie desconocida para las aguas ibéricas, *Simrothiella borealis* (Odhner, 1921), que solamente estaba mencionada en las costas noruegas. Se discuten los géneros de la familia Simrothiellidae y se comparan las especies del género *Simrothiella*.

KEY WORDS: *Simrothiella borealis*, Mollusca, Solenogastres, Galicia, Iberian Peninsula.
PALABRAS CLAVE: *Simrothiella borealis*, Moluscos, Solenogastros, Galicia, Península Ibérica.

INTRODUCTION

Simrothiella borealis (Odhner, 1921) is a species hitherto known only off the Norwegian coasts (ODHNER, 1921), its presence in Galician waters (NW Spain) extends its known distribution considerably. At present, four species of the genus *Simrothiella* Pilsbry, 1898 are known, all of them have a geographical distribution restricted to clearly defined areas and depths between 75 and 5931 m. *Simrothiella margaritacea* (Koren and Danielssen, 1877) has been cited from Norwegian waters (ODHNER, 1921); *Simrothiella minima* (Nierstrasz, 1903) is known from the Gulf of Naples (NIERSTRASZ AND STORK, 1940); and *Simrothiella schizoradulata* Salvini-Plawen, 1978 and *Simrothiella (?) rhynchota* Salvini-Plawen, 1978 have been located in Antartic and Subantartic zones (SALVINI-PLAWEN, 1978). The family Simrothiellidae Salvini-Plawen, 1978, characterised by: hollow or solid acicular spicules; a biserial radula; a partially paired radular sac; type C epithelial ventral foregut glandular organs (GARCÍA-ÁLVAREZ, SALVINI-PLAWEN AND

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URGORRI, 2001), is at present formed by six genera (Table I) with regard to which there are, as in the cases of *Helicoradomenia* y *Birasoherpia*, serious doubts about their appropriate classification.

MATERIAL AND METHODS

The specimen studied, of 4.2 mm in length and 1.5 mm in width at the anterior part and 1 mm at the posterior part (sectioned in seriated cuts), comes from the fishing bank A Quiniela, situated to the West of the Galician coast (NW Spain), station M-5 (43° 15′ 90″ N; 09° 36′ 36″ W) of the CANGREXO I campaign for the study of the brachyuran decapod *Chaeceon affinis* (A. Milne Edwards and Bouvier, 1894) ("cangrexo real"), carried out in June 1991, on bottoms with ferro-manganesic nodules, calcareous plates and coal slag stones of terrigenous origin, at a depth of 835 m. The specimen was fixed and preserved in 70% alcohol. The spicules were studied by separation of small pieces of cuticle from the central dorsal area of the body and from the ventral groove. These pieces were treated with 5% sodium hypochlorite for 12 hours in order to isolate the spicules; they were them rinsed with distilled water, dried under a heater at 40°C and mounted using synthetic resin. For the anatomical study, the specimen were decalcified in an ethylenediaminetetracetic acid (EDTA) solution 12 hours, embedded in paraffin and a series of 10 μm cross sections cut. which were stained with Azan of Heidenhain. The anatomy was reconstructed from the serial sections.

RESULTS

Order CAVIBELONIA Salvini-Plawen, 1978
Family SIMROTHIELLIDAE Salvini-Plawen, 1978
Genus *Simrothiella* Pilsbry, 1898

Simrothiella borealis (Odhner, 1921)

Description of the specimen studied. *Habitus*: This animal has a thick body, which is somewhat flat dorso-ventrally, no lumps and no keel (Fig. 1A). The spicules project radially from the cuticle, those located right at the back are longer and project backwards. It has a clearly visible pedal groove. In alcohol, its colour is yellowish white.

Mantle: The cuticle is up to 40 μm thick, below it is the epidermis with papillae. The spicules are arrayed in several layers within the cuticle and many of them project radially from it. The spicules are hollow and acicular in form (Fig. 1B), some of them are curved and up to 390 μm in length and others are slightly sigmoidal and up to 230 μm in length. On the pedal groove there are blade shaped scales of up to 100 μm in length (Fig. 1C).

Pedal groove: The pedal groove begins in a ciliated pedal pit situated below the pharynx (Fig. 2A), which is connected to the outside by a narrow opening. The pedal groove has a ciliated fold, which begins in the pit and enters the pallial cavity.

Pallial cavity: The pallial cavity (Fig. 3A) is connected to the outside by a narrow ventro-terminal opening. It has 10-12 longitudinal respiratory folds, which are long, thin and radially arrayed (Figs. 3A, C). It possesses a couple of strong copulatory spicules, which are situated ventro-laterally to the spawning duct. At the distal end, each copulatory spicule has two smaller lateral spicules, which very closely follow the path of the central copulatory spicule. Besides, each copulatory spicule is accompanied by a voluminous mid-dorsal diverticle, which emerges from the front of the pallial cavity (Figs. 3A, B). The spawning duct open unpaired in the centre of the frontal wall of the

Table I. A comparative table of the generic traits of the genera belonging to the family Simrothiellidae.
Tabla I. Tabla comparativa de las características de los géneros pertenecientes a la familia Simrothiellidae.

	Simrothiella	***Cyclomenia***	***Biserramenia***	***Birasoherpia***	***Helicoradomenia***	***Spiomenia***
Cuticle	Thick	Thick	Thin	Thick	Thin	Thick
Spicules	Hollow acicular	Hollow acicular	Hollow acicular Hollow knife-like	Hollow acicular	Massive acicular	Hollow acicular Hollow harpoon-like at the end
Mouth	In the atrium	Not in the atrium	Not in the atrium	In the atrium	In the atrium	In the atrium
Radula	Biserial. Plates with small lateral denticles	Biserial. Plates with small lateral denticles	Biserial. Plates with small lateral denticles	Biserial. Plates with 1 large distal denticle and small lateral denticles	Biserial. Plates a with few large lateral denticles	Biserial. Plates with larges and small lateral denticles
Postbuccal glandular organs	No	No	No	Yes	No	No
Ventral foregut glandular organs	Tipo C Globular	Tipo C Globular	Tipo C Short Globular	No	Tipo C Short tubular	Tipo C Large tubular
Dorsoterminal sense organ	Yes	Yes	No	Yes	Yes	Yes
Copulatory spicules	Yes	Yes	No	Yes	Yes	Yes
Respiratory folds	Yes	Yes	No	Yes	Yes	Yes

pallial cavity, and the anus is located dorsally to the genital pore (Fig. 3A).

Sense organs and nervous system: On its dorsal and lateral walls, the atrium has numerous, long, narrow papillae, which may be individual or form groups of two or four (Fig. 2A). The only atrio-buccal space is connected to the outside ventro-anteriorly via a narrow longitudinal opening. It has just one dorsoterminal sense organ, situated above the middle part of the pallial cavity (Figs. 3A, C). The only part of the nervous system that it was possible to see was a short cerebral ganglion (40-50 μm), situated above the pharynx (Fig. 2A).

Digestive tract: The mouth opens from the posterior area of the atrium (Fig. 2A). It continues in a pharynx which has longitudinal folds on its walls. The back of the pharynx is surrounded by musculature and has pharyngeal glands (Fig. 2A). The radula is located in a ventral groove of the pharynx, it has strong ventral musculature with massive cells situated longitudinally along both sides of the radular groove (Figs. 2A, B). The radula is biserial and each row is formed by pairs of pectinated plates, of about 50 μm in length with 60 small denticles (Fig. 1D). A short narrow radular sac (30-40 μm in length) is situated ventrally to the oesophagus (Figs. 2A, C). The short ventral foregut glandular organs are epithelial (type C) (SALVINI-PLAWEN, 1978), and opens laterally in the pharynx on both sides of the beginning of the radula (Figs. 2A, B). The structure of these organs is tubular at the front near the opening, whilst at the rear it has a globular aspect which continues below the oesophagus. The pharynx continues into a short oesophagus which opens through a sphincter in the

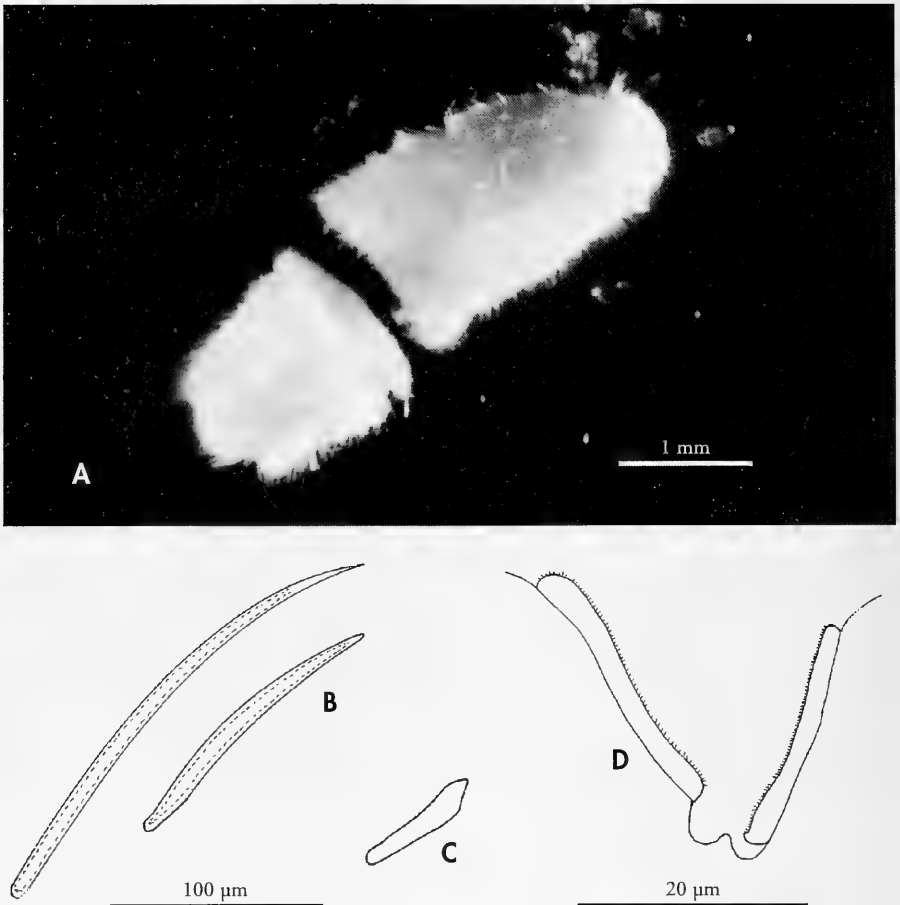

Figure 1. *Simrothiella borealis* (Odhner, 1921). A: habitus; B: acicular spicules; C: spicules along the edges of the pedal groove; D: radula plates.
Figura 1. Simrothiella borealis (Odhner, 1921). A: habitus; B: espículas huecas aciculares; C: escamas de los bordes del surco pedio; D: placas radulares.

centre of the midgut (Figs. 2A, C). The midgut has a short dorso-rostral caecum (Fig. 2A), and has seriated lateral constrictions due to the dorso-ventral musculature. The digestive tract opens into the pallial cavity through the anus, situated dorsally to the genital pore (Fig. 3A).

Reproductive system: The gonads were full of spermatozoa and ovules. The pericardium is voluminous, it contains the heart, which is free and is only linked at the anterior and posterior ends to the dorsal wall of the pericardium (Fig. 3A). The pericardioducts (Fig. 3A) begin at the back of the pericardium, and curve forwards until they join the anterior part of the spawning duct. The two spawning ducts have a lobular frontal wall, which serves as a seminal vesicle (Fig. 3A). These ducts then join to become a single spawning duct, which open into an unpaired genital pore in the centre of the frontal wall of the pallial cavity. It has two voluminous seminal receptacles, situated laterally to the point where the

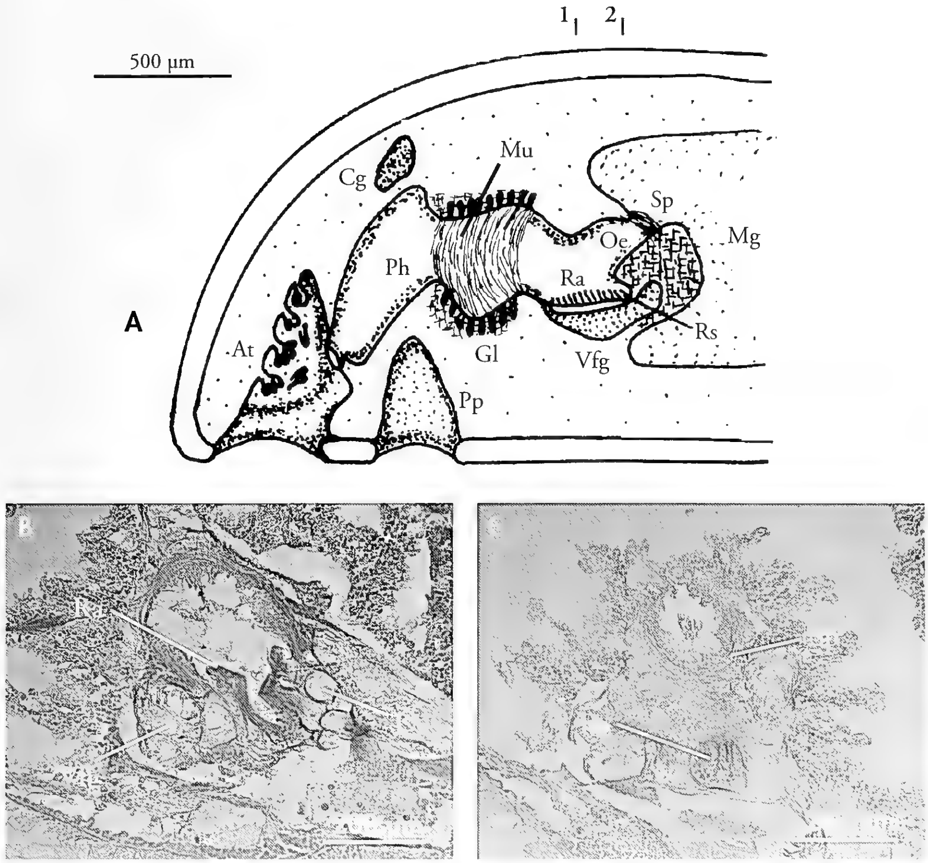

Figure 2. *Simrothiella borealis* (Odhner, 1921). A: schematic organisation of the anterior body; B: cross-section corresponding to line 1; C: cross-section corresponding to line 2.
Abbreviations, At: atrial sense organ; Cc: massive cells; Cg: cerebral ganglion; Gl: pharyngeal glands; Ma: mantle; Mg: midgut; Mu: musculature; Oe: oesophagus Ph: pharynx; Pp: pedal pit; Ra: radula; Rs: radular sac; Sp sphincter; Vfg: ventral foregut glandular organ.
Figura 2. Simrothiella borealis *(Odhner, 1921). A: organización esquemática de la parte anterior del cuerpo; B: corte en sección correspondiente a la línea 1; C: corte en sección correspondiente a la línea 2. Abreviaturas, At: órgano sensitivo atrial; Cc: células masivas; Cg: ganglio cerebral; Gl: glándulas faríngeas; Ma: manto; Mg: intestino; Mu: musculatura; Oe: esófago; Ph: faringe; Pp: foseta pedia; Ra: rádula; Rs: saco radular; Sp: esfínter; Vfg: órgano glandular ventral de la faringe.*

two ducts become one. These receptacles join the single spawning duct dorso-laterally (Figs. 3A, B).

Remarks: *Simrothiella borealis* belongs to the order Cavibelonia, since it possesses several layers of hollow acicular spicules in the cuticle and included within the family Simrothiellidae because of its biserial radula and its type C epithelial ventral foregut glandular organs (SALVINI-PLAWEN, 1978; GARCÍA-ÁLVAREZ *ET AL.*, 2001). The specimen studied has well defined generic characteristics: the buccal opening is in the atrium; the ventral foregut glandular organs are blister-like in shape; the radula is biserial; the midgut has seriated sacs; it has a dorsoterminal sense organ, an unpaired genital orifice, copulatory spicules and respiratory folds (SALVINI-

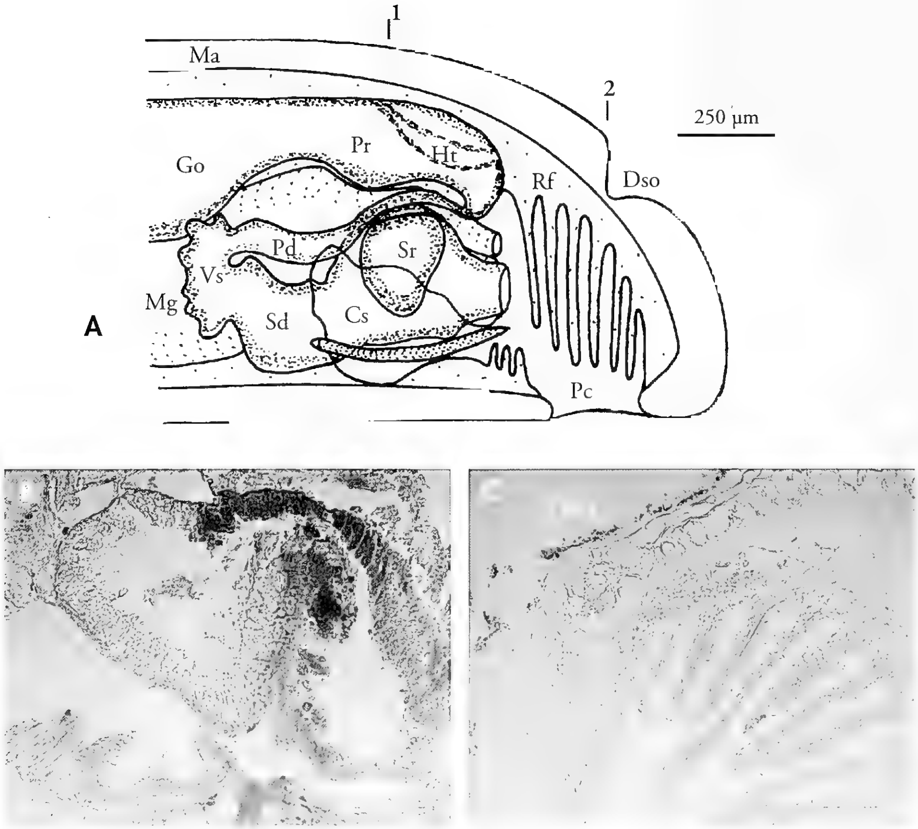

Figure 3. *Simrothiella borealis* (Odhner, 1921). A: schematic organsation of the posterior body; B: cross-section corresponding to line 1; C: cross-section corresponding to line 2.
Abbreviations, Cs: copulatory spicules; Dso: dorsoterminal sense organ; Go: gonad; Ht: heart; ; Ma: mantle; Mg- midgut; Pc: pallial cavity; Pd: pericardioduct; Pr: pericardium; Rf: respiratory folds; Sd: spawning duct; Sr: seminal receptacle; Vs: seminal vesicle
Figura 3.- Simrothiella borealis (Odhner, 1921). A: organización esquemática de la parte posterior del cuerpo; B: corte en sección correspondiente a la línea 1; C: corte en sección correspondiente a la línea 2. Abreviaturas, Cs: espícula copulatriz; Dso: órgano sensitivo dorsoterminal; Go: gónada; Ht: corazón; Ma: manto; Mg: intestino; Pc: cavidad paleal; Pd: pericardioducto; Pr: pericardio; Rf: pliegues respiratorios; Sd: conducto de desove; Sr: receptáculo seminal; Vs: vesícula seminal.

PLAWEN, 1967; SALVINI-PLAWEN, 1978). The characteristics which identify it as *Simrothiella borealis* are clearly defined: it is a small animal with a body with no lumps and no keel; the pedal groove has a fold which enters the pallial cavity; the biserial radula is formed by pairs of pectinated plates; it has a short narrow radular sac; it has a midgut with a small dorsal caecum and seriated constrictions; it has a pair of lobular seminal vesicles and two voluminous seminal receptacles located at the bifurcation of the spawning ducts, a pair of copulatory spicules, accompanied at the distal end by smaller spicules and 10-12 respiratory folds (ODHNER, 1921).

The specimen studied was collected off West Galicia (NW Spain) at a depth of 835 m. Until now *Simrothiella borealis* was only known from the coast of Norway (Sunde, Hardangerfjorrd, Bukennfjord) at depths between 110 and 350 m (Odhner, 1921). Therefore this record, besides being the first for the coasts of the Iberian Peninsula, considerably extends the geographical and the bathymetric distribution of this species.

DISCUSSION

The composition of the family Simrothiellidae has recently been modified, since two of the genera belonging to it, *Uncimenia* Nierstrasz, 1903 and *Sialoherpia* Salvini-Plawen, 1978 characterized by having circumpharyngeal glands, have been included, together with the new genus *Unciherpia*, in the family Pararrhopalidae, within the subfamily Unciherpiinae (García-Álvarez et al., 2001). For this reason the family Simrothiellidae is at present composed by six genera: *Simrothiella* Pilsbry, 1898, of which 5 species have been described; *Cyclomenia* Nierstrasz, 1902, monotypical; *Biserramenia* Salvini-Plawen, 1967, monotypical; *Birasoherpia* Salvini-Plawen, 1978, monotypical; *Helicoradomenia* Scheltema and Kuzirian, 1991, of which 3 species have been described; and *Spiomenia* Arnofsky, 2000, monotypical (Nierstrasz, 1902; Salvini-Plawen, 1968, 1978; Scheltema and Kuzirian, 1991; Arnofsky, 2000; Scheltema, 2000). Some of these genera have significant morphological differences (see Table I), and for this reason their origin does not appear to be monophyletic. The genera *Simrothiella, Biserramenia, Cyclomenia* and *Spiomenia* possess all the synapomorphic characters which define the family, such as: a biserial radula formed by pairs of plates which have small denticles, type C epithelial ventral foregut glandular organs and hollow spicules on the mantle. However, in both *Birasoherpia* and *Helicoradomenia* there are notable morphological differences, which cast doubt on whether they are classified correctly as belonging to the family Simrothiellidae. In the genus *Birasoherpia* there are no ventral foregut glandular organs, but it does possess three ventral postbuccal organs which do not exist in the other genera of the family Simrothiellidae and whose phylogenetic interpretation is not clear. On the one hand, due the similar position they occupy (Salvini-Plawen, 1978), they are reminiscent of the circumpharyngeal follicular glands, which justify the inclusion of the genera *Uncimenia* and *Sialoherpia* together with *Uniciherpia* in the subfamily Unciherpiinae (part of the family Pararrhopaliidae) after considering these a synapomorphic characters (García-Álvarez *et al.*, 2001). But on the other hand, such postbuccal glandular organs, could be an autapomorphy of the genus *Birasoherpia* within the family Simrothiellidae. The genus *Helicoradomenia* only has sturdy spicules on the mantle and the radula, although it is biserial, it is formed by morphologically different plates, due it has only a few large denticles .

Only four species of the genera *Simrothiella* are currently known, besides *Simrothiella borealis* (Nierstraz, 1905; Odhner, 1921; Nierstraz and Stork, 1940; Salvini-Plawen, 1978). *Simrothiella margaritacea* (Koren and Danielssen, 1877) is a species known only in Norwegian waters, it was collected in Stavanger at 75-115 m, Kopervik at 75-95 m and in the N of Norway at 1400 m. It is differentiated from *Simrothiella borealis* because it has some large radular plates, most of them with numerous denticles, and the anterior plates with only a few strong denticles; the radular sac large and paired; the ventral foregut glandular organs tubular, short and arrayed dorsally to the radular sac; the two seminal receptacles in front of the spawning ducts; and it has 20 respiratory folds. *Simrothiella minima* (Nierstrasz, 1903), is only known from the Mediterranean Sea, collected in the Gulf of Naples between 250 and 1100 m. The descriptions and illustrations presented by Nierstrasz (1905) and Nierstrasz and

STORK (1940) for *Simrothiella minima*, have certain similarities with the specimen of *Simrothiella borealis* studied by us, but there are also some clear differences. In the drawings of the radular plates of *Simrothiella minima* there are 30 denticles, whilst *Simrothiella borealis* has about 60; the dorsoterminal sense organ in *Simrothiella minima* occupies a terminal position, whilst in *Simrothiella borealis* it is located dorsally in the middle part of the pallial cavity; the seminal receptacle in *Simrothiella minima* is placed in front of the spawning ducts and not dorso-laterally to them as in the case of *Simrothiella borealis*; and the organisation of the diverticles of the copulatory spicules in *Simrothiella minima* includes glandular cells and does not have small spicules for the purpose of substitution. *Simrothiella schizoradulata* Salvini-Plawen, 1978 is an Antartic and Subantartic species found at great depths, it was collected in the Strait of Drake, near the South Shetland Islands at 4780 m and in the Atacama Deep (N. of Perú) at depths between 5821 and 5931 m. It may be distinguished from *Simrothiella borealis* by its very small atrium; the absence papillae on the epidermis; its pallial cavity with paired terminal sacs, a suprapallial gland and 8 respiratory folds; a pair of very characteristic ventral radular sacs; its midgut does not have a dorsal caecum and it has a pair of seminal receptacles in the form of a sac placed in front of the spawning ducts. *Simrothiella (?) rhynchota* Salvini-Plawen, 1978, is a South Pacific species collected at a depth of 3694 m. Little is known of the organisation of the posterior part of the anatomy of this species. The main differences between this species and *Simrothiella borealis* are the radular plates with 20-25 denticles and the pallial cavity with 4 respiratory folds.

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BIBLIOGRAPHY

ARNOFSKY, P., 2000. *Spiomenia spiculata* gen. et sp. nov. (Aplacophora: Neomeniomorpha) collected from the deep waters of the west European basin. *The Veliger*, 43 (2): 110-117.

GARCÍA-ÁLVAREZ, O., SALVINI-PLAWEN, L. V. AND URGORRI, V., 2001. *Unciherpia hirsuta* a new genus and species (Mollusca Solenogastres: Paratrrhopaliidae) from Galicia, northwest of Spain. *Journal of Molluscan Studies*, 67 (1): 113-119.

NIERSTRASZ, H., 1902. The Solenogastres of the Sibóga-Expedition. *Siboga-Expeditie Monographie*, 47: 1-46

NIERSTRASZ, H. F., 1905. *Kruppomenia minima* und die Radula der Solenogastren. *Zoologischen Jahrbüchern Abteilung für Anatomie und Ontogenie der Thiere*, 21: 665-702.

NIERSTRASZ, H. F. AND STORK, H. A., 1940. Monographie der Solenogastren des Golfes von Neapel. *Zoologica (Stuttgart)*, 99: 1-92.

ODHNER, N., 1921. Norwegian Solenogastres. *Bergens Museums Aarbok for 1918-1919 Naturvidenskabelig Raekke*, 3: 1-86.

SALVINI-PLAWEN, L. V., 1967. Kritische Bemerkungen zum System der Solenogastres (Mollusca, Aculifera). *Zeitschrift für zoologische Systematik und Evolutionsforschung*, 5 (4): 398-444.

SALVINI-PLAWEN, L. V., 1968. Neue Formen im marinen Mesopsammon: Kamptozoa und Aculifera. *Annalen des Naturhistorischen Museums in Wien*, 72: 231-272.

SALVINI-PLAWEN, L. V., 1978. Antarktische und subantarktische Solenogastres. Eine Monographie: 1898-1974. *Zoologica (Stuttgart)*, 128: 1-315.

SCHELTEMA, A. H., 2000. Two new hydrothermal vent species, *Helicoradomenia bisquama* and *Helicoradomenia acredema*, from the Eastern Pacific Ocean (Mollusca, Aplacophora). *Argonauta*, 14 (2): 15-25.

SCHELTEMA, A. H. AND KUZIRIAN, A.,M., 1991. *Helicoradomenia juani* gen. et sp. nov. a Pacific Hydrothermal Vent Aplacophora (Mollusca: Neomeniomorpha). *The Veliger*, 34 (2):195-203.

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Two new species of the genus *Monophorus* (Gastropoda, Triphoridae) in the east Atlantic and Mediterranean Sea

Dos nuevas especies del género *Monophorus* (Gastropoda, Triphoridae) en el Atlántico oriental y el Mediterráneo

Emilio ROLÁN* and Anselmo PEÑAS**

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ABSTRACT

The species of the genus *Monophorus* Grillo, 1877, (Gastropoda, Triphoridae) in the east Atlantic are studied. Two new species are described, together with a form that possibly represents *M. thiriotae*. The new species are compared with those previously known and distribution are plotted.

RESUMEN

Se revisan las especies del género *Monophorus* Grillo, 1877, (Gastropoda, Triphoridae) existentes en el Atlántico oriental, describiendo dos especies nuevas y mostrando un morfo que podría corresponderse con la especie *M. thiriotae*, pero cuya relación específica no está todavía bien determinada. Las especies nuevas se comparan con las previamente conocidas y se aporta un esquema de las áreas de distribución del género *Monophorus* en el Atlántico oriental.

KEY WORDS: *Monophorus*, Triphoridae, West Africa, Canary islands, Alboran Sea, new species, distribution range.

PALABRAS CLAVE: *Monophorus*, Triphoridae, Africa Occidental, Islas Canarias, Mar de Alborán, nuevas especies, área de distribución.

INTRODUCTION

In recent years several works on the eastern Atlantic Triphoridae have been published. These studies provide important information on the colour of the soft parts, on radula and protoconch, as correct method of the study of this family. In contrast with those of the older authors who considered shell characters alone, MARSHALL (1983) treated shell and radulas, being the first author who provided unique and original interpretations of the family in the Australian species. BOUCHET AND GUILLEMOT (1978) and BOUCHET (1984) made a revision on the Mediterranean and the close Atlantic species. FERNANDES AND ROLÁN (1988, 1993) studied the family in the Cape Verde archipelago. BOUCHET (1996) added new observations on the family and reported a list of the known species for European and closer Atlantic.

Some Triphoridae from Canary Islands (like *Triphora decorata canarica* Nordsieck and García-Talavera, 1979) have been studied by BOUCHET (1984) showing it is a valid species in the genus

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Cosmotriphora more extended in the West African coast. Further more, other species described by NORDSIECK AND GARCÍA-TALAVERA (1979) present additional taxonomic problems, as a shell described with the name *Triphora pseudobesula* n. sp. in the plates and as *Triphora grimaldi macaronesica* n. spp. in the text.

New observations on material recently collected belonging to the genus *Monophorus* Grillo, 1877, are the object of the present work. Some other species belonging in this genus have been previously studied in BOUCHET (1984) and FERNANDES AND ROLÁN (1988), and we have nothing to add on them: they will be mentioned only with the references to the previous studies.

Since much of the West African coast has not been adequately sampled, the fauna is poorly known, and precise distributions of few species are known.

Abbreviations:

MNCN Museo Nacional de Ciencias Naturales, Madrid
MNHN Muséum National d'Histoire Naturelle, Paris
CAP collection of A. Peñas, Vilanova i la Geltrú
CDM collection of D. Moreno, Cabo de Gata
CER collection of E. Rolán, Vigo
CFA collection of F. Azpilicueta, San Sebastián
CWE collection of W. Engl, Düsseldorf
sp shells with soft parts
s empty shell
f fragment

RESULTS

Genus *Monophorus* Grillo, 1877

Type species: *Trochus perversus* Linné, 1758

Description: Following BOUCHET (1984, p. 20) the generic characters are: animal with red blotches; protoconch embrionic shell with cruciform tubercles; radular formula (8-13)-1-C-1-(8-13), marginal teeth with 4-5 cusps, somewhat different from the lateral and central ones.

Monophorus perversus (Linné, 1758)

Material examined: That mentioned in BOUCHET (1984) in the MNHN. Some additional shells from several Mediterranean localities.

Description: See BOUCHET (1984).

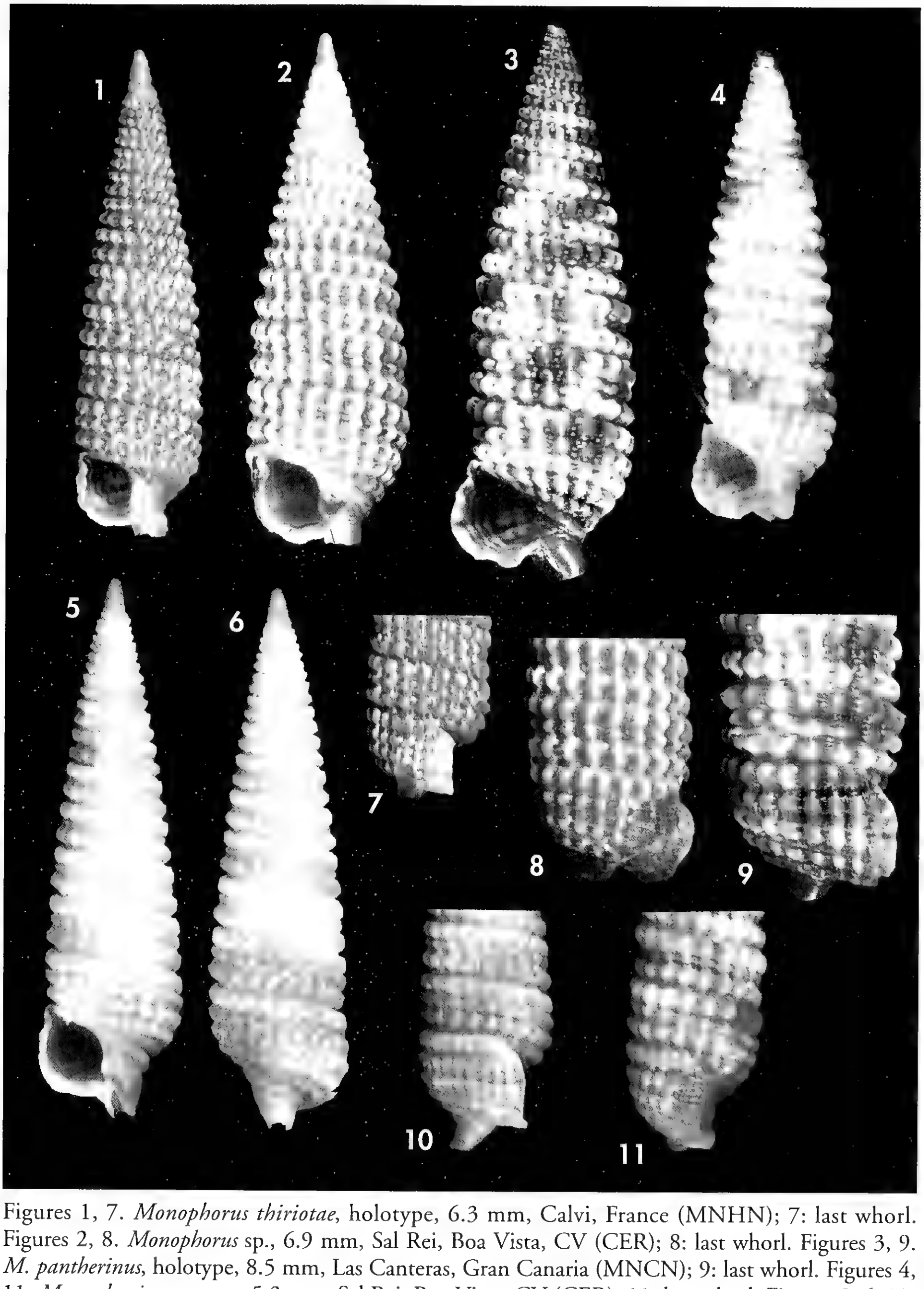
Distribution: Mediterranean Sea, Canary Islands, Senegal, Ivory Coast and Angola (BOUCHET, 1984). ROLÁN's (1983) record from Galizian coasts (NW Spain) is of uncertain identity being based on a single shell from ship sediments transporte from elsewhere by fishermen.

Monophorus erythrosoma (Bouchet and Guillemot, 1978)

Material examined: That mentioned in BOUCHET (1984) in the MNHN. Six specimens more from Cape Verde Islands.

Description: See BOUCHET AND GUILLEMOT (1978) and BOUCHET (1984). The animal colour has been always black in head and foot.

Distribution: Mediterranean and the Gulf of Gascoigne (BOUCHET, 1984). Cape Verde Islands (FERNANDES AND ROLÁN, 1988).



Figures 1, 7. *Monophorus thiriotae*, holotype, 6.3 mm, Calvi, France (MNHN); 7: last whorl. Figures 2, 8. *Monophorus* sp., 6.9 mm, Sal Rei, Boa Vista, CV (CER); 8: last whorl. Figures 3, 9. *M. pantherinus*, holotype, 8.5 mm, Las Canteras, Gran Canaria (MNCN); 9: last whorl. Figures 4, 11. *M. verdensis*, paratype, 5.3 mm, Sal Rei, Boa Vista, CV (CER); 11: last whorl. Figures 5, 6, 10. *M. alboranensis*, holotype, 7.6 mm, Alborán Sea (MNCN); 10: last whorl.

Figuras 1, 7. Monophorus thiriotae, *holotipo, 6,3 mm, Calvi, Francia (MNHN); 7: última vuelta. Figuras 2, 8.* Monophorus *sp., 6,9 mm, Sal Rei, Boa Vista, CV (CER); 8: última vuelta. Figuras 3, 9.* M. pantherinus, *holotipo, 8,5 mm, Las Canteras, Gran Canaria (MNCN); 9: última vuelta. Figuras 4, 11.* M. verdensis, *paratipo, 5.3 mm, Sal Rei, Boa Vista, CV (CER); 11: última vuelta. Figuras 5, 6, 10.* M. alboranensis, *holotipo, 7.6 mm, Mar de Alborán (MNCN); 10: última vuelta.*

Monophorus verdensis Fernandes and Rolán, 1988 (Figs. 4, 11)

Material examined: All the type material and about 40 additional shells more from several localities in the Cape Verde Archipelago.

Description: See FERNANDES AND ROLÁN (1988).

Distribution: Cape Verde archipelago.

Remarks: We represent photographs of one paratype of this species for comparison with the new species to be described (see below), which are somewhat similar.

Monophorus thiriotae (Bouchet, 1984) (Figs. 1, 7, 21A)

Material examined: Holotype (Fig. 1) and the material recorded from Calvi (France) and Açores by BOUCHET (1984) (MNHN). Açores: 1 sp, Agua d'Alto, São Miguel, infralittoral rocks (MNHN); 1 sp, Feteiras, São Miguel, infralittoral rocks (MNHN); 1 sp, Ponta Galera, São Miguel, infralitoral rocks (MNHN). Spain: 8 s, 4 f, San Sebastián, intertidal sediments (CFA); 1 sp, St. Jean de Luz, Costa Vasca, infralitoral rocks (MNHN); 1 sp, Candás, Ermita de San Pedro, Oviedo, (MNHN), infralittoral rocks. Canary: 10 s, 7 f, Puerto del Carmen, Lanzarote, 30-50 m (CWE).

Description: See BOUCHET (1984).

Distribution: Atlantic European and the Açores (BOUCHET, 1984). Species here recorded from Canary islands are probably this species, but soft parts and radula are not available for checking.

Monophorus sp. (Figs. 2, 8, 21B)

Material studied: Canary: 44 s, Puerto del Carmen, Lanzarote, 30-50 m (CWE); 1 s, Mala, Lanzarote, 40 m (CWE). Cape Verde Islands: the material mentioned in FERNANDES AND ROLÁN (1993) as *M. thiriotae;* 1 s, Furna, Brava, 30 m (CER); 1 s, Palmeira, Sal, 30 m (CER). Senegal: 3 s, Madeleines, 30 m (CER). Angola: 1 s, Luanda, 20 m (CER).

Description: Shell (Fig. 2) conic elongate, moderately wide for the genus, solid, sinistral. Protoconch of about 3 whorls; first whorl with a diameter of about 170 μm wide, sculptured with cruciform tubercles that interconnet to form a net; subsequent whorls with 2 spiral cords and numerous axial ribs. Teleoconch of 9-11 whorls, flat, with axial ribs crossed by spiral cords, forming nodules at intersections; nodules rounded, only shouldered on the adapical part of the cord 3. Spiral cords 1 and 3 appearing at the beginning, cord 2 appears on the 7th whorl, remains smaller than others. On base there are 4 additional cords numbers, 4 and 5 with nodules similar to those on 2 and 3 and smaller than those on cord 1; cord 6 irregularly nodulous, the 7th smooth. Aperture ovoid, siphonal canal short and almost closed by a reflection of the external lip.

First 2-3 whorls of teleoconch white, the rest cream in background with dark brown in interspaces between nodules, not extended around them.

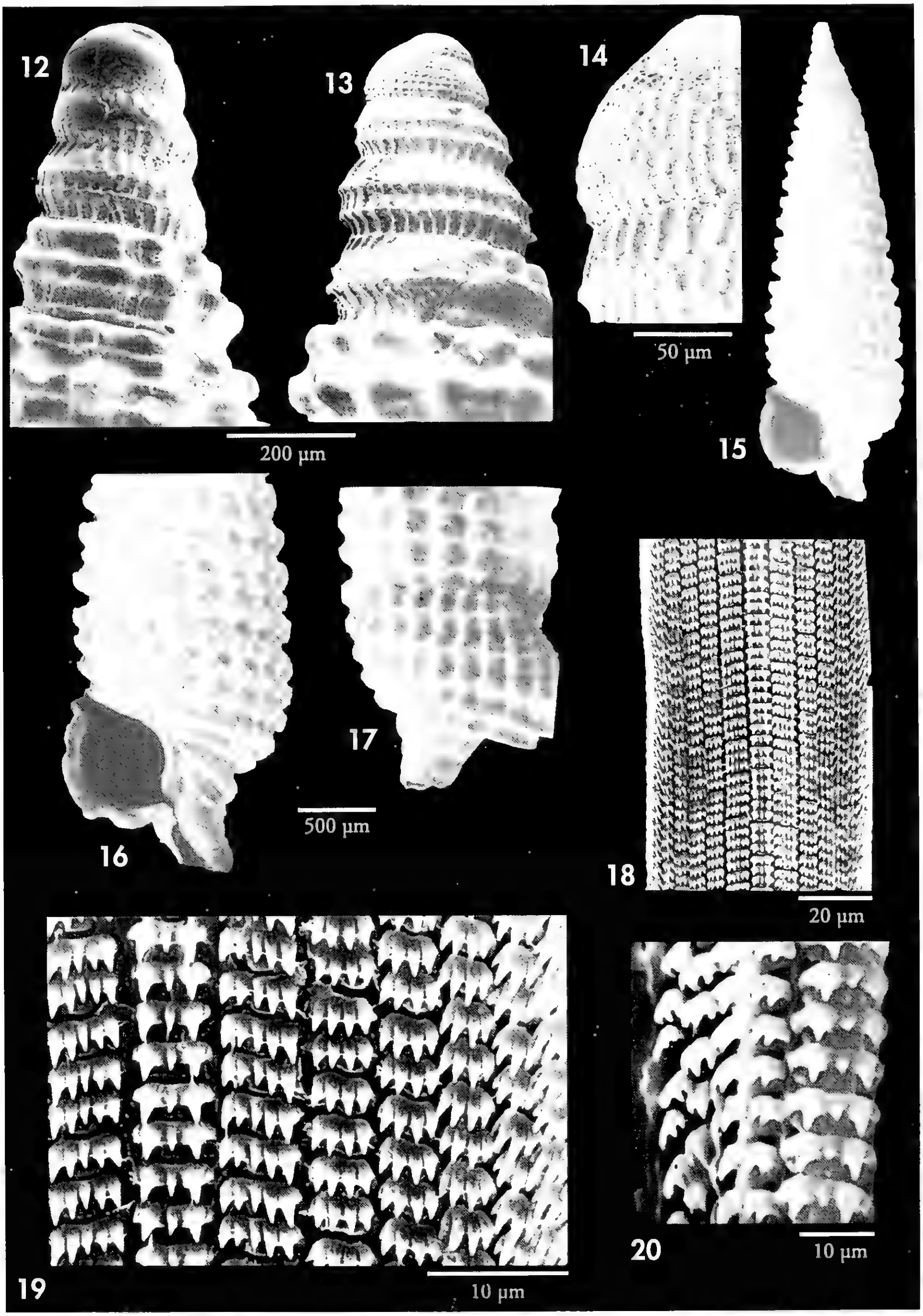
Dimensions: Up to 9 mm high, but smaller shells (5-6 mm) may be adult. The diameter up to 3 mm.

Animal cream and white with reddish blotches.

Radula (Figs. 20, 21B): Formula n-1-C-1-n, central tooth with 7 cusps, medial cusp small, adjacent cusp larger, outer 4 cusp smalest. Lateral teeth each with 6 cusps of different size: counting outwardly, the largest are cusps 2 and 5, the smallest being 1 and 4. The marginal teeth each have 4 cusps, large innermost and outermost small, median 2 large.

Distribution: Canary Islands, Cape Verde Islands, Senegal and Angola.

Remarks: The present morph was recorded in FERNANDES AND ROLÁN (1993) as *M. thiriotae*. All the shells included in this morph had a very similar morphology. We thought that these



Figures 12, 18, 19. *Monophorus pantherinus.* 12: protoconch; 18, 19: radula. Figures 13-17. *M. alboranensis.* 13: protoconch; 14: detail of the protoconch; 15: paratype; 16, 17: paratypes, detail of the last whorl. Figure 20. *Monophorus* sp., radula.

Figuras 12, 18, 19. Monophorus pantherinus. *12: protoconcha; 18, 19: rádula. Figuras 13-17.* M. alboranensis. *13: protoconcha; 14: detalle de la protoconcha; 15: paratipo; 16, 17: paratipos, detalle de la última vuelta. Figura 20.* Monophorus *sp., rádula.*

shells could be really assigned to the taxon *M. thiriotae*, but, in comparison with the holotype and the shells of *M. thiriotae* from Europe and the Açores, we have some doubts for the following reasons:

• the shells can be larger reaching 9 mm (while the holotype of *M. thiriotae* is 6.1 mm and most of the shells of similar size);

• the shells are typically wider, with a length/width ratio of 2.9 (in *M. thiriotae* is 3.5);

• the background of the shell is lighter, cream or almost white (brown in *M. thiriotae*);

• the first whorls of the teleoconch are white (brown in *M. thiriotae*);

• the nodules are larger than in *M. thiriotae* and most of them are not shouldered adapically;

• there are some radular differences: *Monophorus* sp (Fig. 21B) has a the central tooth with two external cusps more than in *M. thiriotae*; in the lateral teeth, *Monophorus* sp has the cusps more irregular (while *M. thiriotae* has four small cusps and one larger).

The problem with this comparison is that it was made from a small number of samples, and the value of these differences remais to be established.

We have found some shells with the typical morph of *M. thiriotae* from the Canary Islands (see material studied). This would seem to be a case of sympatry without intergradation, but the problem could not be resolved because of the lack of intact protoconchs and soft parts. Accordingly, we are doubtful about whether or not they belong to the taxon *M. thiriotae*.

Monophorus pantherinus spec. nov. (Figs. 3, 9, 12, 18, 19, 21B)

Type material: Holotype (Fig. 3) and 1 paratype in MNCN (15.05/44158). Paratypes: 1 in MNHN and 1 in CER. All alive collected at the type locality.

Other material examined: Canary Islands: Gran Canaria: 1 sp, intertidal, Las Canteras, Las Palmas, (dissolved for the radular study). Lanzarote: 2 s, 1 j, El Reducto, Arrecife, 5 m (CWE); 1 s, Puerto del Carmen, 5 m (CWE); 3 f, Tamara, intertidal (CAP). La Palma: 2 s, 3 f, Los Cancajos, Santa Cruz de la Palma, 20-40 m (CWE). Gomera: 1 s, San Sebastián de la Gomera, 12 m (CWE).

Type locality: Las Canteras Beach, Las Palmas de Gran Canaria, Canary Islands.

Etymology: The specific name alludes to the blotched pattern of the shell.

Description: Shell (Fig. 3) conic elongate, moderately wide for the genus, solid, sinistral. Protoconch (Fig. 12) of about 3 whorls, the first whorl 180 μm wide, with a microsculpture of cruciform tubercles that interconnect to form a net; subsequent whorls with 2 spiral cords and numerous axial ribs. Teleoconch of about 9-12 whorls, flat-sided, with axial ribs crossed by spiral cords forming nodules at intersections; nodules relatively large and rounded, only shouldered on the last whorl on the adapical side of cord 3. Spiral cords 1 and 3 commencing immediatly, cord 2 commencing on about 9th whorl, smaller up to the last whorl, where all are similar. Base with 4 additional cords, the 4 and 5 with nodules similar to those of 2 and 3 and smaller than those on cord 1; cord 6 irregularly nodulous, 7 smooth. Aperture ovoid with a small sinus adapically. Siphonal canal short and a gently curved towards the dorsum, borders of siphonal aperture on its upper part are in contact.

First 2-3 whorls of teleoconch darker brown than rest of shell; later whorls cream with numerous dark brown blotches, the latter more evident in subsutural area; interspaces between nodules brown, limited to the cord except in the area with brown blotches.

Dimensions: the holotype is the largest specimen, reaching 8.5 mm x 2.5 mm.

Animal with head brown between eyes, the eyes rounded by a white area. Tentacles transparent with yellow dots. Foot with irregular black and brown

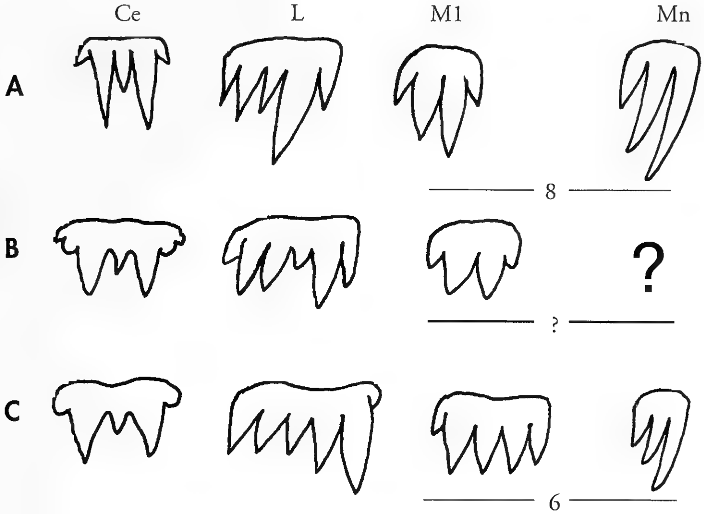


Figure 21. A: *Monophorus thiriotae*, drawing made from BOUCHET (1984, fig. 9); B: drawing of the radula of *Monophorus* sp., Sal Rei, Boa Vista; C: drawing of the radula of *Monophorus pantherinus*, Las Canteras, Gran Canaria. (Ce: central tooth; L: lateral tooth; M1: marginal tooth number 1; Mn: most external marginal tooth).

Figura 21. A: Monophorus thiriotae, *dibujo tomado de BOUCHET (1984, fig. 9); B: rádula de* Monophorus *sp., Sal Rei, Boa Vista; C: rádula de* Monophorus pantherinus, *Las Canteras, Gran Canaria. (Ce: diente central; L: diente lateral; M1: primer diente marginal; Mn: diente marginal más externo).*

blotches in middle, with some irregular yellow parts. Both sides of frontal and caudal part of foot reddish.

Operculum rounded, paucispiral, nucleus central.

Radula (Figs. 18-19, 21C). Formula n-1-C-1-n; central tooth with 5 cusps, median smaller, adjacent cusps larger, outermost cusp very small; lateral tooth with 6 cusps of different size: from the internal side, 4 are similar, the following larger, and outer very small. Marginal teeth with 5 cusps, the innermost smallest. Outermost marginal teeth with only three cusps.

Distribution: Canary Islands.

Remarks: The differences with the most similar species of the genus are the following (see also Table I):

• *M. perversus* usually forms more whorls, the shell is narrower, and more elongate, the colour is darker brown with fewer white blotches, and the protoconch has weaker sculpture with smooth parts.

• *M. thiriotae* has a more uniformly dark shell, and more darkly pigmented brownish background colour, without darker blotches, and the darker colour in the interspaces between the nodules is more extended. The nodules are smaller, and all are clearly shouldered adapically. The distribution of the colour of the soft parts as given in the original description is quite different.

• *M. erythrosoma* has a monochrome brown-red shell, with up to 15 teleoconch whorls, it is not darker in the interspaces between nodules, and spiral cord 2 appears on about the 10^{th} or 11^{th} whorl. The colour of the soft parts as described by BOUCHET (1984) is quite different.

• *M. verdensis* has a small and narrower shell, and it is cream-whitish in background colour with only isolates subsutural brown blotches.

• *M.* sp. (also present in Canary Islands) has a shell more uniform in pattern colour without dark blotches, the first whorls of the teleoconch being white.

• Some other triphorids present in Canary Islands belonging to different genera can be confused with these *Monophorus* species: *Cosmotriphora canarica* (Nordsieck and Talavera, 1979) has smaller nodules, three cords on most of the teleoconch, and lacks of dark colour between tubercles. *Cosmotriphora pseudocanarica* Bouchet, 1984 has a smaller shell, with only one cord on the first two whorls of the protoconch, brown axial lines continued along the shell and no dark brown colour in the internodular spaces.

Monophorus alboranensis spec. nov. (Figs. 5, 6, 10, 13-17)

Type material: Holotype (Figs. 5, 6, 10) in MNCN (15.05/44159). Paratypes: 1 in MNHN, 2 in CER, 4 in CAP, all from type locality ex-CAP.

Other material examined: 2 s, 2 j, 3 f, Alborán Sea, 200 m (CAP); 1 s, Piedras del Charco, Almería Bay, 50 m (CDM).

Type locality: Alborán Sea, Mediterranean, 100-200 m.

Etymology: The specific names alludes to the area where the species was collected.

Description: Shell (Figs. 5, 6, 15) conic elongate, solid, sinistral. Protoconch (Figs. 13, 14) of almost 4 whorls, the first one with a diameter of about 200 μm, and a microsculpture formed by cruciform tubercles which form a net; subsequent whorls with 2 spiral cords crossed by numerous axial ribs. Teleoconch of about 11 whorls, flat-sided, with axial ribs crossed by spiral cords forming nodules at intersections; nodules rounded and not shouldered except on last adult whorl, adapically on cord 3. Spiral cords 1-3 appearing immediatly, cord 2 commencing on 6th whorl, smaller before adult penultimate whorl, where equal to the 3 primaries. Base, with 4 additional cords, 4 and 5 with nodules similar to those on 2 and 3, smaller than those on cord 1; cord 6 irregularly nodulous; cord 7 very small, smooth and adherent to the siphon. Spiral cords without additional duplications at end of last whorl. Aperture ovoid with small sinus on its upper part. Siphonal canal larger than other species, reaching almost diameter of the aperture.

Colour cream, with some variations, of light brown. First 2-3 whorls of teleoconch same colour as rest of shell; some whorls with cream white or light brown colour, more evident sometimes on the 2 lower spiral cords includind nodules; colour in interspaces between nodules same colour as nodules.

Dimensions: Holotype 7.6 mm long, being the largest shell studied.

Animal unknown. Operculum (found into a shell from which animal had decayed) rounded and paucispiral.

Radula unknown.

Distribution: Only known from the Alborán Sea and the Almería Bay, Spain.

Remarks: The shell of *M. alboranensis* has a typical pattern different from most of the species of the area.

- *M. perversus* usually has more teleoconch whorls, is more elongate, is darker in colour with a pattern of blotches of white and brown, with a protoconch that typically has weaker sculpture with smooth parts.

- *M. thiriotae* has a darker shell, has brownish background colour, lacks blotches, is darker in the interspaces between the nodules, and has smaller nadules, that are well shouldered apically.

- *M. erythrosoma* has a monochrome brown-red shell, with up to 15 teleoconch whorls, spiral cord 2 appearing about on the 10th or 11th whorl.

- *M. verdensis* has a shorter and narrower shell, is cream-whitish in background colour with only isolated small brown blotches limited to the subsutural cord. Spiral cord 2 appears only on the last adult whorl. Finally, the siphonal canal is shorter.

Table I. Differences between *Monophorus thiriotae, M.* sp. and *M. pantherinus.*
Tabla I. Diferencias entre Monophorus thiriotae, M. *sp. y* M. pantherinus.

	M. thiriotae	***M. sp***	***M. pantherinus***
Form	elongate-narrow	moderately wide	wider
Ratio length/wigth	3.5	2.9	2.7
General impression of colour	brown	light brown	spotted cream with dark brown blotches
Background colour	brown	cream or whitish	spotty
Pattern colour	nodules light brown; dark brown in interspaces	nodules cream; dark brown in interspaces	nodules anternating 2-3 cream with other light brown; dark brown in interspaces
Brown colour of internodules	extended a little around the nodules	extended below but not around the nodules	except in the brown blotches limited only to cord between nodules
Colour of suture	darker	same colour	alternating parts cream and other darker
Colour of first 3 whorls of teleconch	same as rest of shell	lighter than rest of shell	darker than rest of shell
Medium spiral cord	at 8th whorl	at 7th whorl	at 9th whorl
Nodules	small	medium size	large
Nodules	clearly shouldered adapically	weakly shouldered adapically on cord 3	weakly shouldered adapically on cord 3 on last whorl only
Whorls of protoconch	3.75	3	3

- *M.* sp. from Canary and Cape Verde (see above) has a wider shell and a very uniform colour pattern without differences in other parts of the shell, the first whorls of the teleoconch are white and the spaces between nodules are dark brown.

- *M. pantherina* has a larger and wider shell, with more dark brown blotches, the 2nd spiral cord appears about the 7th whorl.

Table II. Distribution range of the species of the genus *Monophorus* in East Atlantic. EM: East Mediterranean; WM: West Mediterranean; EA: European Atlantic; AÇ: Açores; C: Canary; CV: Cape Verde Islands; S: Senegal and close areas; AN: Angola.
Tabla II. Distribución de las especies del género Monophorus *en el Atlántico este. EM: Mediterráneo este; WM: Mediterráneo oeste; EA: Atlántico europeo; AÇ: Azores; C: Islas Canarias; CV: Cabo Verde; S: Senegal y áreas cercanas; AN: Angola.*

	EM	**WM**	**EA**	**AÇ**	**C**	**CV**	**S**	**AN**
M. perversus	•	•	•	•	•		•	•
M. erythrosoma		•	•			•		
M. verdensis						•		
M. thiriotae			•	•	•			
M. sp					•	•	•	•
M. pantherina					•			
M. alboranensis		•						

DISCUSION

At present we have scarce information on the West coast of Africa but we have tried to represent in Table II the known distribution range of the species of the genus *Monophorus* in East Atlantic.

ACKNOWLEDGEMENTS

We thank the following institutions and persons: PARSYST project and MNHN for access to material and literature for the present work; to Winfried Engl and Diego Moreno for the loan of material from Canary islands and Almería Bay; to Philippe Bouchet for his opinions about the group; to Jesús S. Troncoso by the optical photographs made in the Department of Ecology, University of Vigo, and to Jesús Méndez of the CACTI for the SEM photographs, University of Vigo; to Bruce A. Marshall for a critic revision of the manuscript.

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BIBLIOGRAPHY

BOUCHET, P., 1984. Les Triphoridae de Mediterranée et du proche Atlantique (Mollusca, Gastropoda). *Lavori S.I.M.*, 21: 5-58.

BOUCHET, P., 1996. Nouvelles observations sur la systematique des Triphoridae de Mediterranée et du proche Atlantique. *Bollettino Malacologico*, 31 (9-12): 205-220.

BOUCHET, P. AND GUILLEMOT, H., 1978. The *Triphora perversa*-complex in Western Europe. Journal of Molluscan Studies, 44: 344-356.

FERNANDES, F. AND ROLÁN, E., 1988. A familia Triphoridae (Mollusca: Gastropoda) no arquipélago de Cabo Verde. *Publicações Ocasionais da Socidade Portuguesa de Malacologia*, (11): 17-32.

FERNANDES, F. AND ROLÁN, E., 1993. Nuevas aportaciones a la familia Triphoridae (Mollusca, Gastropoda) para el Archipiélago de Cabo Verde. *Iberus*, 10 (1): 143-148.

MARSHALL, B. A., 1983. A revision of the Recent Triphoridae of Southern Australia. *Records of the Australian Museum*, supl. 2: 1-119.

NORDSIECK, F. AND GARCÍA-TALAVERA, F., 1979. *Moluscos marinos de Canarias y Madera (Gastropoda)*. Aula de Cultura de Tenerife, Madrid. 208 pp, 46 pls.

ROLÁN, E., 1983. Moluscos de la Ria de Vigo. I. Gasterópodos. *Thalassas*, 1, supl. 1: 1-383.

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New species of Trochidae (Mollusca, Gastropoda) from the Cape Verde archipelago

Nuevas especies de Trochidae (Mollusca, Gastropoda) del archipiélago de Cabo Verde

Emilio ROLÁN* and José TEMPLADO **

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ABSTRACT

Few species of trochids have been found in the Cape Verde Archipelago. Two of them (*Osilinus atratus* and *Gibbula senegalensis*) are wide-spread along the West African coast, as well as being common in shallow waters of this Archipelago. Another (*Gibbula corallioides*) is a circalittoral species that appears to be endemic to the Cape Verde islands. In addition, four species (three of the genus *Gibbula* and one of *Jujubinus*) are considered undescribed and the present work is focused on their description. Two of these species are common in shallow waters of most islands. Two reddish forms of *Jujubinus* from deeper water are also found, but they remain undescribed, due the scarcity of material studied.

RESUMEN

Son pocas las especies de la familia Trochidae encontradas en el litoral del archipiélago de Cabo Verde. Dos de ellas (*Osilinus atratus* y *Gibbula senegalensis*) están ampliamente distribuidas por las costas del oeste de África y son también comunes en las aguas someras de este archipiélago. Otra (*Gibbula corallioides*) es una especie circalitoral que parece ser endémica de estas islas. Además, se han encontrado cuatro especies consideradas como nuevas para la ciencia (tres del género *Gibbula* y una de *Jujubinus*), en cuya descripción se centra el presente trabajo. Asimismo, se mencionan dos formas rojizas de *Jujubinus* que permanecen sin describir, debido al poco material de las mismas estudiado.

Key words: Trochidae, *Gibbula*, *Jujubinus*, *Osilinus*, new species, Cape Verde Islands, West Africa.
Palabras clave: Trochidae, *Gibbula*, *Jujubinus*, *Osilinus*, nuevas especies, islas de Cabo Verde, África occidental.

INTRODUCTION

Since the publication of the book by Burnay and Monteiro (1977) and the catalogue by Cosel (1982) on the marine molluscs of the Cape Verde Archipelago, the marine gastropods from these islands have been the subject of a considerable number of papers, in which many groups have been revised (see Burnay and Cosel, 1987, Rolán and Rubio, 1999 and Rolán and Luque,

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2000 for a list). As a consequence of this work, about 200 new species have been described. However, the family Trochidae has not received any attention, and no trochid species have been described from these islands since the 19th century. It is therefore not surprising that some common trochids are currently undescribed.

As CURINI-GALLETTI (1985) pointed out, Atlantic archipelagos harbour fewer trochid species than southern Europe and continental West Africa. Twelve species of this family are included in the catalogue of COSEL (1982): three of the genus *Solariella*; three of *Gibbula*, *G. corallioides* (Locard, 1898), *G. senegalensis* Menke, 1853 and *G. gorgonarum* P. Fischer, 1883; one of *Monodonta*, *M. punctulata* (Lamark, 1822); one of *Calliostoma*, *C. conulus* (Linné, 1758) (with doubts); three of *Jujubinus*, *J. exasperatus* (Pennant, 1777), *J. striatus* (Linné, 1758) and *J. gravinae* (Monterosato, 1884); and finally, *Clelandella miliaris* (Brocchi, 1814). Of these species, *G. gorgonarum*, *Clelandella miliaris* and the three *Solariella* species are deep-water species. After this catalogue the only mention of Cape Verde trochids was in GUERREIRO AND REINER (2000). This book included only three species: *Gibbula magus* form *corallinoides* (sic), *Gibbula senegalensis* Menke, 1853, and *Monodonta atrata* Wood, 1828.

Several trochid species have been collected during many trips to the Cape Verde archipelago (from 1978 to 2001). Regarding the littoral species, our observations verify the presence of *Osilinus atratus* Wood, 1828) (usually recorded as *M. punctulata* in most of the works on these islands), *Gibbula senegalensis*, and *Gibbula corallioides*. The former two species are widely distributed along the west African coast, and they are also very common in the Cape Verde Archipelago. On the other hand, *Gibbula corallioides* is a less common circalittoral species, recorded by DAUTZENBERG AND FISCHER (1906), MARCHE-MARCHAD (1958) and SAUNDERS (1977). In addition, some forms of *Jujubinus* to which European names have been applied are also common. However, we consider them to be clearly different species. Finally, we have found three species of *Gibbula* previously undescribed, despite the fact that one of them is apparently a common littoral species in all the islands. The present work focused on these littoral Trochidae considered by us to be new species: three of the genus *Gibbula* and one of *Jujubinus*.

MATERIAL AND METHODS

The present work is based on the material and data obtained by the first author from eleven trips to the Cape Verde archipelago during the last 25 years, including the "I Expedición Científica Ibérica al Archipiélago de Cabo Verde" (1985) (IEIACV), in which the two authors participated. Most of the material was collected by skin diving to a depth of 10 m, and some additional material was obtained by dredging down to 100 m. Trochids from different areas of Europe and West Africa in MNCN and CER have been used for comparison.

The type material has been deposited in the institutions mentioned in the tex; the material coming from the IEIACV is deposited at DBUA, and the rest in the collection of the first author (not specify in the text) .

Abbreviations:

MNCN Museo Nacional de Ciencias Naturales, Madrid
MNHN Muséum National d'Histoire Naturelle, Paris
AMNH American Museum of Natural History, New York
DBUA Departamento de Biología, Univerisdad Autónoma, Madrid
CER collection of Emilio Rolán, Vigo
H height of he shell
d diameter of the shell
j juvenile shells
s empty shells
sp specimens collected alive

RESULTS

Family Trochidae Rafinesque, 1815
Genus *Gibbula* Risso, 1826

Among the material studied by us, we recognize five species belonging to the genus *Gibbula*. Two of them are the two species previously recorded in the Cape Verde Islands, *G. senegalensis* and *G. corallioides*. The former is a common shallow water species, found in sheltered areas of most islands. It is clearly distinguished from the other species by its pattern of black-orange-white bands with irregular white blocks in the shell (Figs. 3-4). *G. corallioides* has been collected mainly by dredging deeper than 20 m. This species is similar to the European *G. magus* (L., 1758) and it has often been considered as a synonym of this last one (e.g. in Guerreiro and Reiner, 2000). We consider it as valid species due its smaller size and the constant differences in the colour pattern of the shell (Figs. 1, 2) and soft parts. It seems to be an endemic species from Cape Verde islands.

The other three species found by us are considered undescribed species. One of them is very common in exposed rocky areas in shallow waters and its elevated profile resembles a species of *Jujubinus*. The other two species are less common, restricted to one or two islands, and vaguely resemble to the European *G. tumida-G. racketti*. Below we describe these three species as new.

Gibbula verdensis n. sp. (Figs. 5-10, 36-41, 53-57)

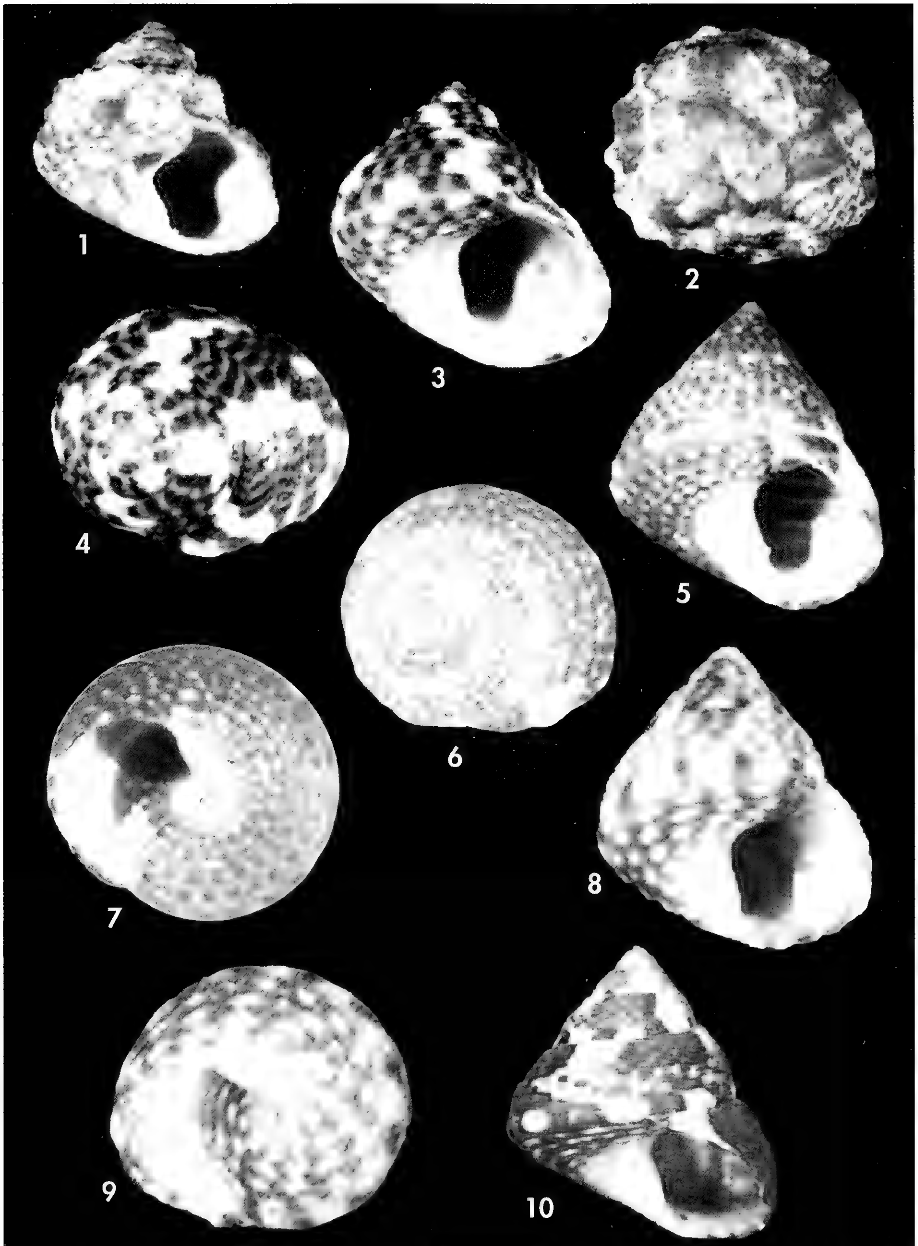
Type material: Holotype (Figs. 5-7) and 2 paratypes in MNCN (catalog number 15.05/44458). Other paratypes in the following collections: MNHN (2); AMNH (2); CER (127), all from the type locality.

Other material studied: Sal: 25 sp, 15 s, 45 j, Regona, 1-3 m; 5 sp, Regona (DBUA); 22 sp, Santa Maria, 1-2 m; 77 sp, 25 s, 28 j, Rabo de Junco, 0-1 m; 1 sp, 5 j, Mordeira, 1-2 m; 6 sp, Mordeira (DBUA); 4 sp, 2 j, Serra Negra, 1-3 m; 3 s, 20 j, Palmeira, 6-8 m; 10 sp, Fontona, 1-2 m; 1 sp, 2 j, Fontona (DBUA); 2 sp, 15 j, Parda, 0-1 m; 3 sp, Palhona, 1 m; 1 sp, Monte Leste, 1 m; 1 sp, Pesqueiro do Air, 1 m; 2 sp, Santa Maria (DBUA), 2 sp, Fiura (DBUA); 1 sp, Guincho do Ninho (DBUA). Boa Vista: 1 sp, Sal Rei (DBUA); 28 sp, 14 s, 16 j, Sal Rei, 1-3 m; 1 sp, 2 s, 30 j, 3 f, Ilheu Sal Rei, 2-5 m; 7 j, Baia Teodora, 1 m; 4 j, Rife de Chaves, 6 m; 16 sp, Baia da Gata, 2-4 m; 4 sp, 2 s, Derrubado, 1-3 m. Maio: 5 s, 2 j, Navio Quebrado, 4 m; 5 sp, Galeão, 2 m; 1 s, 7 j, Baijos de João Valente, 4 m; 3 s, Pau Seco, 1-4 m. Santiago: 3 sp, Calheta de San Miguel, 4 m; 4 sp, 5 s, 18 j, 3 f, Tarrafal, 3-5 m; 1 sp, Punta Geneanes, 2-5 m. Brava: 3 s, 20 j, Pedrinha, 1-4 m; 12 s, 46 j, Furna, 2-8 m; 6 sp, 36 j, Porto do Ancião, 4 m. Fogo: 1 j, San Felipe, 30 m. São Vicente: 19 j, Porto Mindelo, 15 m; 1 sp, Saragaça (DBUA). Santa Luzia: 1 sp, Agua Doce (DBUA). Ilheu Branco: 2 sp (DBUA).

Type locality: Sal Rei, Boa Vista Island, Cape Verde Archipelago.

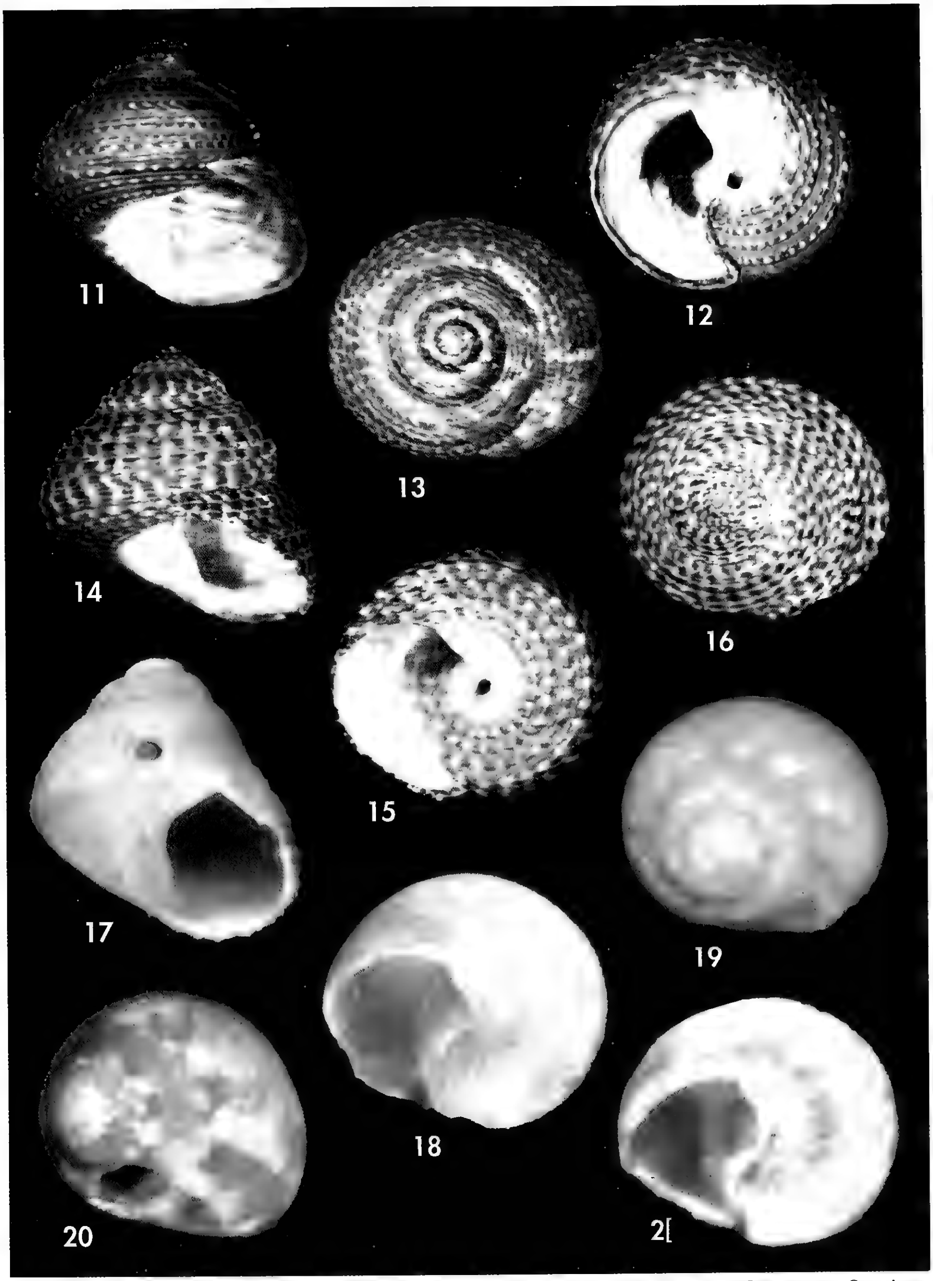
Etymology: The specific name refers to the archipelago where it is a common species in shallow waters.

Description: Shell (Figs. 5-10) solid, elevate-conical, with high spire that provides a general aspect and profile similar to a *Jujubinus*. Protoconch (Figs. 36-41) with less than one whorl, surface rough with three fine threads obliquely disposed; usually lighter in colour. Teleoconch of about 3-4 whorls, which have 2-4 spiral cords in first whorl, about 5 on the last whorl, and 4-5 at the base, below the peripherical angulation. This angulation is very evident in juveniles but is more attenuated in larger specimens. The lower spiral cord in each whorl is stronger and wider than the others. Columella slightly prosocline; columellar area white, with a small prominence below the middle. Aperture rounded, greenish, nacreous at the interior. Umbilical area white with a very



Figures 1,2. *Gibbula corallioides* (12.1 mm), Guincho do Ninho, Sal Island. Figures 3, 4. *Gibbula senegalensis* (6.5 mm), Mordeira, Sal Island. Figures 5-10. *Gibbula verdensis* n. sp. 5-7: holotype (4.5 mm), Sal Rei, Boa Vista Island; 8, 9: shell from Derrubado, Boa Vista Island; 10: paratype, Sal Rei, Boa Vista Island.

Figuras 1, 2. Gibbula corallioides *(12,1 mm), Guincho do Ninho, isla de Sal. Figuras 3, 4.* Gibbula senegalensis *(6,5 mm), Mordeira, isla de Sal. Figuras 5-10.* Gibbula verdensis *n. sp. 5-7: holotipo (4,5 mm), Sal Rei, isla de Boa Vista; 8, 9: concha de Derrubado, isla de Boa Vista; 10: paratipo, Sal Rei, isla de Boa Vista.*



Figures 11-16. *Gibbula sementis* n. sp. 11, 12: holotype (5.0 mm), Punta Geneanes, Santiago Island; 13: paratype, Punta Geneanes, Santiago Island; 14-16: shell from Furna, Brava Island. Figures 17-21. *Gibbula clandestina* n. sp. 17-19: holotype (1.9 mm), Palmeira, Sal Island; 20, 21: paratype, Palmeira, Sal Island.

Figuras 11-16. Gibbula sementis *n. sp. 11, 12: holotipo (5,0 mm), Punta Geneanes, isla de Santiago; 13: paratipo, Punta Geneanes, isla de Santiago; 14-16: concha de Furna, isla de Brava. Figuras 17-21.* Gibbula clandestina *n. sp. 17-19: holotipo (1,9 mm), Palmeira, isla de Sal; 20, 21: paratipo, Palmeira, isla de Sal.*

narrow umbilicus, sometimes as a small furrow. The shell colour is variable. Most of the darker shells appear grey-greenish, but with magnification it is clear that this colour is not uniform, and grey or greenish rectangles alternating with yellow ones on the spiral cords. In lighter shells, the rectangles of the cords are alternating red, and cream or white. They are sometimes larger than those in the darker shells and there is light green in the interspaces. Some specimens are almost cream or white, or white with grey blotches. There are intergradations between the different colour patterns. This variability can be observed within the same population, but no remarkable differences have been observed among samples from different islands.

Size: up to 7 mm. Mean values: H= 5.75 mm, d= 5.09, H/d= 1.13 (n= 20 adult shells). The holotype measures 4.7 x 4.6 mm.

Soft parts: Head and lateral parts of the foot blackish, sometimes with some white blotches; sole of the foot cream. Cephalic tentacles finely micropapillated, blackish with a darker line mid-dorsally. Eye stalks relatively short and thick, with terminal eyes. In adult specimens a white circle with a digitiform and short postoptic tentacle has been observed immediately behind the right eye stalk. Snout short and broad. Cephalic lappets small and simple. Neck lobes lighter in colour, being dark greenish at their base, with some silvered blotches on the dorsum. Anterior margin of the right neck lobe partially fused with the basal portion of the right eye stalk and with the right cephalic lappet. Margin of the right neck lobe almost smooth, while the left one is somewhat fringed. There are three pairs of blackish epipodial tentacles, with two white, rounded epipodial sense organs at their base. Another conspicuous rounded and white epipodial sense organ is located under the right neck lobe.

Operculum (Figs. 54-55) multispiral and almost transparent.

Radula (Figs. 56-57) as in other species of the genus, with the rachidian tooth with a narrow shaft and reduced cusp.

Habitat: Usually found under rocks in shallow water of exposed areas. In the same habitat but in sheltered areas it is replaced by *G. senegalensis*.

Distribution: Known from most of the islands of the Cape Verde Archipelago.

Discussion: The profile of the shell of this species is similar to *Jujubinus* species and differentiates it from most species of *Gibbula* from Europe and West Africa. The only species of this genus with a similar high spire is *G. cineraria* (Linné, 1758), from the Atlantic coast of Europe, but this species is notably larger. The other common, sympatric species of *Gibbula*, *G. senegalensis* (Figs. 3-4) is clearly different, with a more depressed spire, larger last whorl, very small umbilicus, and with black, orange and white rectangles on the spiral cords of the base. In the other hand, *G. verdensis* can be differentiated from all species of *Jujubinus* by its small but always evident umbilicus, and by the partial fusion of the right neck lobe with the right eye stalk. In addition, *G. verdensis* lives on rocky surfaces, while species of *Jujubinus* live among seaweeds and sea grasses (HICKMAN AND MCLEAN, 1990).

Gibbula sementis n. sp. (Figs. 11-16, 42-45)

Type material: Holotype (Figs. 11-12) and 2 paratypes in MNCN (catalog number 15.05/44459). Paratypes in the following collections: MNHN (2); AMNH(2); CER (19), all from the type locality.
Other material studied: Brava: 11 s, Furna, 15-30 m; 5 f, 6 j, Porto do Ancião, 8 m.
Type locality: Ponta Geneanes, Santiago Island, Cape Verde Archipelago.
Etymology: The specific name alludes to the similarity of the shell with a seed.

Description: Shell (Figs. 11-16) small, solid, roundly top-shaped. Protoconch (Figs. 42-45) with less than one whorl, usually dark in colour; surface rough with three narrow threads which are not in spiral arrangement, but oblique. Teleoconch of about 3 convex whorls, without remarkable angulation; suture impressed. Spirally sculptured with 3-4 fine spiral cords in first whorls and between 12-15 in the last one. There is not a more prominent peripherical cord. Columella orthocline; columellar area white, without any prominence. Aperture rounded, bluish iridescent in the interior. Umbilical area white, sometimes bordered with light green, with an evident deep umbilicus. The shell colour is a rather uniform olive-green, with small whitish spots on the spiral ribs in most of the species.

The shells from Brava Island (Figs. 14-16) are somewhat different, with stronger spiral threads, more angulated whorls and with reddish-brown and yellowish spots alternating on the spiral cords. We consider these differences as intraspecific variability between populations of different islands.

Size: up to 6.1 mm the larger specimen. Mean values: H= 4.12 mm, d= 4.6, H/d= 0.89 (n= 20 adult shells). The holotype measures 5.0 x 4.7 mm.

Soft parts: Not observed.

Habitat: On rocks with small seaweeds in shallow water.

Distribution: Only known from Santiago and Brava Islands.

Discussion: The species is clearly different from all others in this genus from Europe and West Africa. It slightly resembles *G. candei* (D'Orbigny, 1838), from the Canary Islands, but the latter species is notably larger, with shouldered whorls and different colour pattern, often with pinkish tints. *G. sementis* can be distinguished from *G. verdensis* (described above) because the latter has a higher spire, flattened profile of the whorls, smaller umbilicus and suture not impressed. Both species are sympatric in Santiago. *G. senegalensis* is more depressed, lacks a clear umbilicus and the colour of the spiral cords is white, orange and black.

Gibbula clandestina n. sp. (Figs. 17-21, 46-47)

Type material: Holotype (Figs. 17-19) in MNCN (catalog number 15.05/44460). Paratypes in the following collections: MNHN (1) (Figs. 20-21); AMNH (1); CER (10), all from the type locality.
Type locality: Palmeira, Sal Island, Cape Verde Archipelago.
Etymology: The specific name refers to the fact that this species may be confused at first sight with juveniles of other congeneric, and because it is very uncommon.

Description: Shell (Figs. 17-21) minute, solid, roundly top-shaped, somewhat depressed. Protoconch (Figs. 46-47) with less than one whorl, usually dark with rough surface and with three fine threads which are not spiral, but oblique. Teleoconch of about 4 whorls, somewhat convex subsuturally. Sculpture consisting of 3 very fine spiral cords in the first whorl, 8 in the second, and about 19 in the body whorl, one of them more prominent and making a slight angulation in the periphery. Aperture rounded, shiny in the interior. Columella curved, almost orthocline at its lower part, where a small prominence is present. Umbilical area cream-white with a narrow umbilicus. Shell colour cream with irregular light brown and whitish blotches axially. The subsutural area and the more prominent spiral cord of the periphery are whitish with light brown spots. The light brown pigmentation becomes pinkish in some shells.

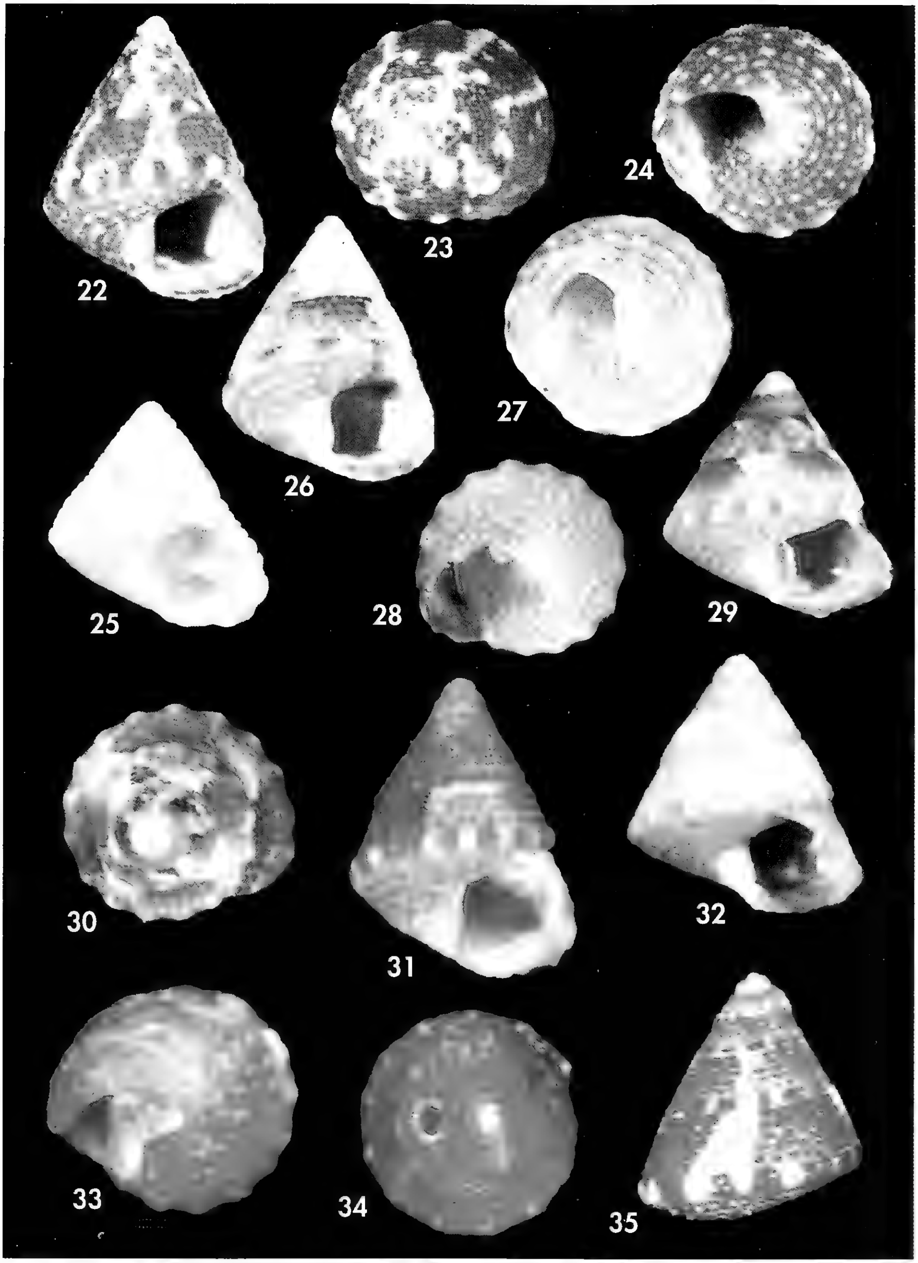
Size: up to 2.4 mm. Mean values: H= 1.95 mm, d= 1.90, H/d= 1.02 (n= 10 adult shells). The holotype measures 1.9 x 2.0 mm.

Soft parts: Unknown.

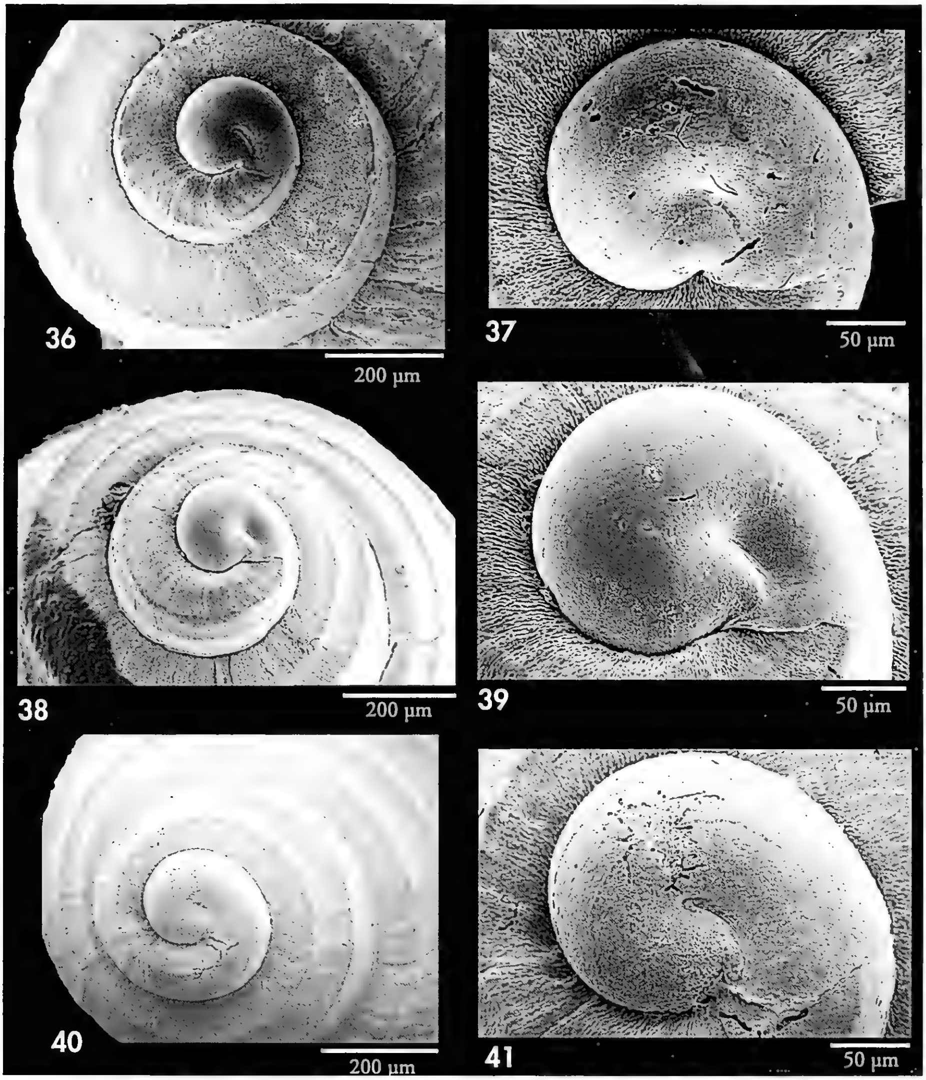
Habitat: Unknown. Empty shells were collected in sediments from 15 to 50 m in depth.

Distribution: Known only from Sal Island.

Discussion: The most similar species are the European *Gibbula tumida* (Montagu, 1803) and *G. racketti* (Pay-



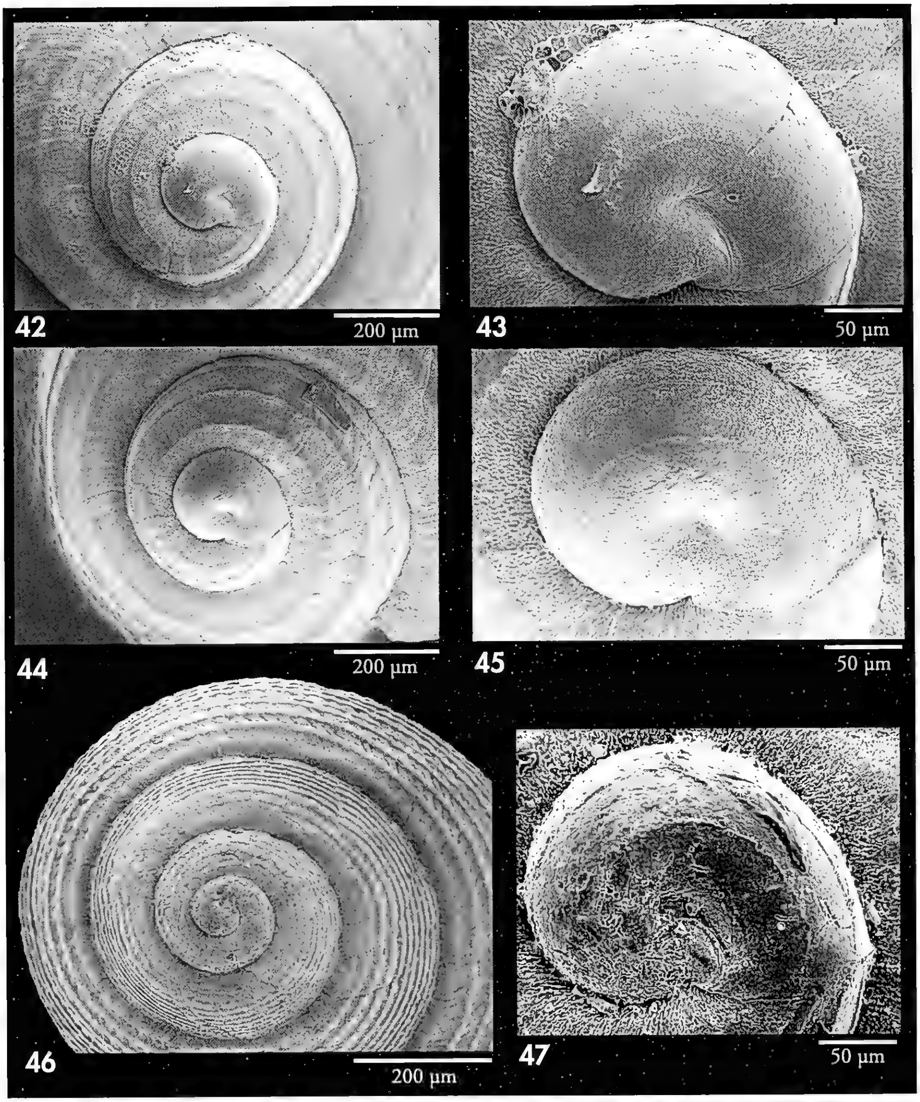
Figures 22-27. *Jujubinus rubioi* n. sp. 22-24: holotype (4.9 mm), Mordeira, Sal Island; 25-27: paratypes of the same locality. Figures 28-31. *Jujubinus* sp. 1. 28-30: shell (3.7 mm) from Palmeira, Sal Island, 50 m; 31: shell (3.2 mm) from Ilheu Branco, 50 m. Figures 32-35: *Jujubinus* sp. 2. 32: shell (2.8 mm), Ilheu Branco, 50 m; 33: shell (3.5 mm), Pau Seco, 30 m; 34, 35: shell (2.4 mm), Fogo, 30 m.
Figuras 22-27. Jujubinus rubioi *n. sp. 22-24: holotipo (4,9 mm), Mordeira, isla de Sal; 25-27: paratipos de la misma localidad. Figuras 28-31.* Jujubinus *sp. 1. 28-30: concha (3,7 mm) de Palmeira, isla de Sal, 50 m; 31: concha (3,2 mm) de Ilheu Branco, 50 m. Figures 32-35:* Jujubinus *sp. 2. 32: concha (2,8 mm), Ilheu Branco, 50 m; 33: concha (3,5 mm), Pau Seco, 30 m; 34, 35: concha (2,4 mm), Fogo, 30 m.*



Figures 36-41. *Gibbula verdensis*, protoconchs. 36, 37: Sal Rei, Boa Vista; 38, 39: Rabo de Junto, Sal; 40, 41: Furna, Brava.
Figuras 36-41. Gibbula verdensis, *protoconchas. 36, 37: Sal Rei, Boa Vista; 38, 39: Rabo de Junto, Sal; 40, 41: Furna, Brava.*

raudeau, 1927), but they are larger, with stronger and more irregular spiral cords. The umbilicus is wider in *G. racketti*. Furthermore, *G. tumida* has a smooth protoconch (see RODRÍGUEZ BABIO AND THIRIOT-QUIÉVREUX, 1975, plate 2, fig I).

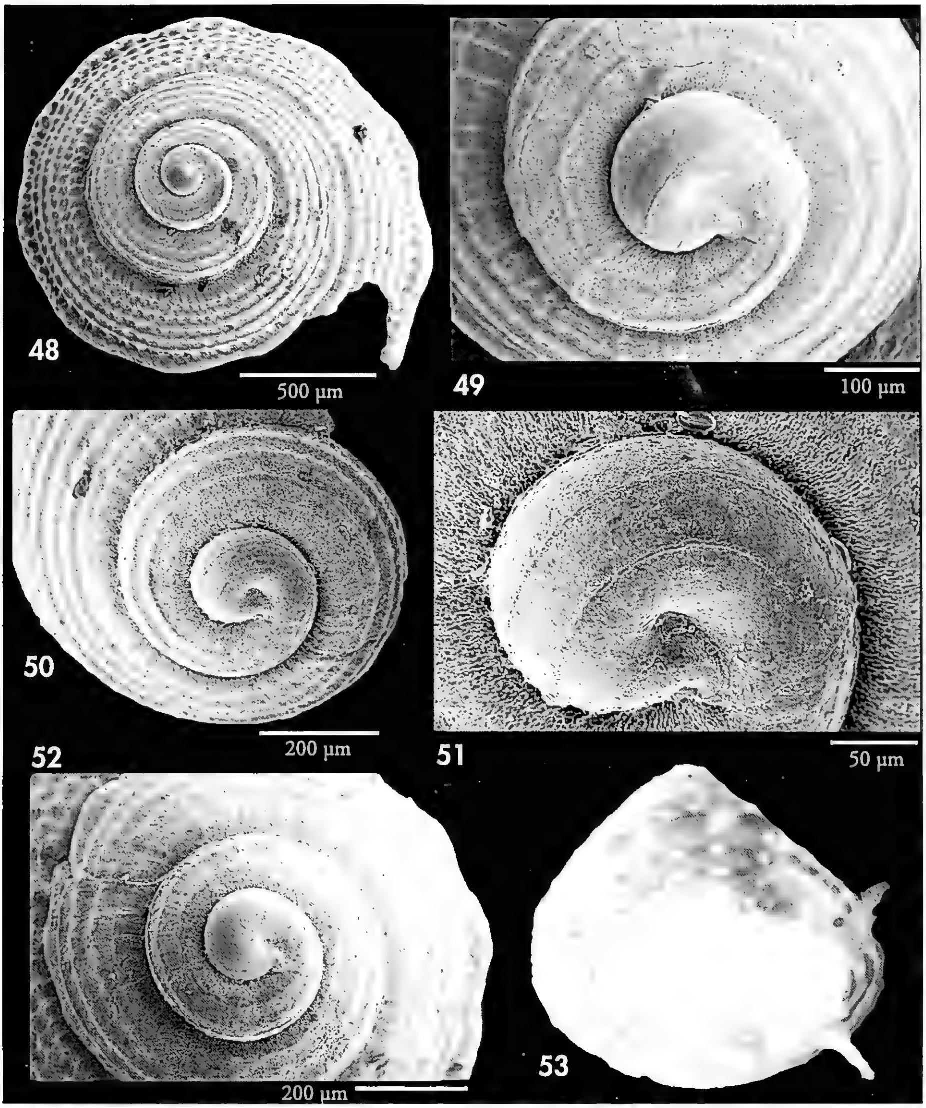
The West African species *G. joubini* Dautzenberg, 1910 is similar in colour but larger, with a lower number of spiral cords, which are more prominent. The angulation on the body whorl is more evident and the umbilicus wider in this last species.



Figures 42-45. *Gibbula sementis*, protoconchs. 42, 43: Punta Geneanes, Santiago; 44, 45: Furna, Brava. Figures 46, 47. *Gibbula clandestina*, protoconch, Palmeira, Sal, 30 m.
Figuras 42-45. Gibbula sementis, *protoconchas. 42, 43: Punta Geneanes, Santiago; 44, 45: Furna, Brava. Figuras 46, 47.* Gibbula clandestina, *protoconcha, Palmeira, Sal, 30 m.*

Genus *Jujubinus* Monterosato, 1884

This genus is widespread along the coasts of Europe and West Africa, from Norway to Angola. According to CURINI-GALLETTI (1985), a number of highly variable and phenotypically scarcely distinguishable species are found within this large area. Along the European coast the species of *Jujubinus* have



Figures 48, 49. *Jujubinus rubioi,* protoconchs. 48: Palmeira, Sal; 49: Sal Rei, Boa Vista. Figures 50, 51. *Jujubinus* sp. 1, São Felipe, Fogo. Figure 52. *Jujubinus* sp. 2, Palmeira, Sal, 30 m. Figure 53. *Gibbula verdensis,* Mordeira, Sal, soft parts.

Figuras 48, 49. Jujubinus rubioi, *protoconchas. 48: Palmeira, Sal; 49: Sal Rei, Boa Vista. Figuras 50, 51.* Jujubinus *sp. 1, São Felipe, Fogo. Figura 52.* Jujubinus *sp. 2, Palmeira, Sal, 30 m. Figura 53.* Gibbula verdensis, *Mordeira, Sal, partes blandas.*

been relatively well studied (see the complete review of Cretella, 1992-1993), meanwhile they are poorly known in West Africa. A new species of this genus (*J. fulgor*) has been described from Angola by Gofas (1991), but no other paper has been devoted to *Jujubinus* from the West African mainland. Curini-Galletti (1985) pointed out that the northeastern Atlantic archipelagoes

(Macaronesia) have in general a high level of endemicity of *Jujubinus* species. At present one species is known to be endemic to the Azores (*J. pseudogravinae* Nordsieck, 1973), one to Madeira (*J. vexationis* Curini-Galletti, 1990), two to the Canaries (*J. guanchus* Curini-Galletti, 1985 and *J. poppei* Curini-Galletti, 1985), and none are known from the Cape Verde Islands.

As we commented before, three of the most common and widespread European species have been recorded from the Cape Verde Islands. In fact, we have found three probable different species of *Jujubinus* in these islands. One of them is very common in shallow waters and wide-spread within the whole archipelago. It resembles *J. gravinae*, but it is clearly a different species (described below). The other two reddish species are much more scarce, and are found in deeper water. One of them, *Jujubinus* sp. 1 (Figs. 28-31, 50-51), may be a deeper-water form of the former species, and the other, *Jujubinus* sp. 2 (Figs. 32-35, 52), belongs to a different group of species (*J. exasperatus* species-group), to which *J. fulgor*, from Angola, also belongs. To reach a definitive conclusion about the taxonomic status of these two reddish forms of *Jujubinus* a complete revision of similar species from West Africa and Macaronesia would be necessary. It is also necessary to take into account the polytypic trends of most species in the genus. This is not within the scope of the present work.

Jujubinus rubioi n. sp. (Figs. 22-27, 48-49)

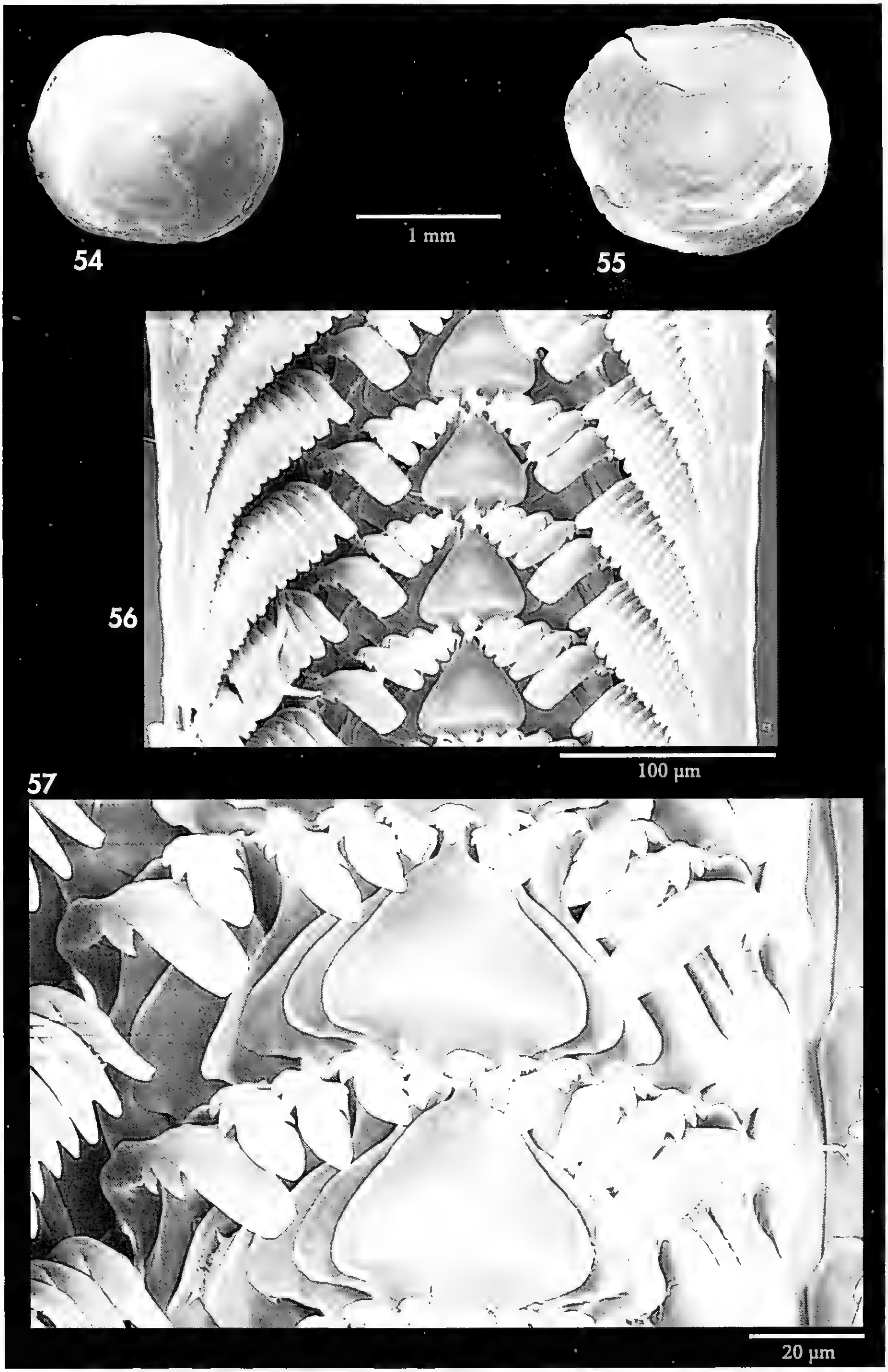
Type material: Holotype (Figs. 22-24) and 1 paratype (Figs. 26, 27) in MNCN (catalog number 15.05/44459). Paratypes in the following collections: MNHN (2); AMNH (2); CER (19), all from the type locality.

Other material studied: Sal: 1 sp, 1 j, Calheta Fonda, Sal, 4 m; 25 c, 16 j, Palmeira, 10-15 m; 11 sp, Palmeira (DBUA); 6 s, 6 j, Regona, 2-6 m; 10 j, Rabo de Junco, 2-6 m; 1 sp, 1 s, Monte Leste, 1 m. Boa Vista: 13 s, 13 j, 5 f, Sal Rei, 1-8 m; 2 s, 4 j, Ilheu Sal Rei, 8 m; 2 s, Santa Maria, 30 m. Santiago: 1 sp, 3 s, Praia, 10m; 2 s, 12 j, 1 f, Tarrafal, 4 m; 10 j, Tarrafal, 30 m; 3 s, 16 j, Cidade Velha, 4-6 m; 5 j, Pedra Badejo, 4 m. São Vicente: 12 j, Porto Mindelo, 15 m; 1 s, 6 j, Salamança, 3 m. São Nicolau: 6 s, 3 j, Tarrafal, 6 m. Fogo: 1 s, 7 j, San Felipe, 20-30 m. Brava: 5 s, 4 j, Furna, 8-15 m; 1 sp, 6 s, 2 j, Furna, 25-30 m; 5 j, Pedrinha, 6 m.

Type locality: Mordeira Bay, Sal Island, Cape Verde Archipelago.

Etymology: The species is named after a good friend, Federico Rubio, for his important contribution to the knowledge to the Trochoidea of West Africa.

Description: Shell (Figs. 22-27) conical, solid, thick, remarkably shiny, with flattened or only slightly convex whorls and convex basis. Protoconch (Figs. 48-49) usually white in colour, with less than one whorl, surface rough with three fine threads not arranged spirally, but obliquely. Teleoconch of about 5-6 whorls, the two uppermost with 3-4 flattened and smooth spiral cords and 6 in the penultimate. Basal threads well developed, wider than the others, being formed by a group of several small cords; markedly crenulated, resulting in a waved peripheral ridge. Furrows narrower than the threads and crossed by numerous growth lines strongly prosocline, raised almost as true lamellae. About 6-7 coloured basal concentric ridges, narrower than the furrows, with another thinner colourless ridge between them. Aperture almost rectangular with a vertical columella and a small elevation on its lower part. Umbilicus absent. Inner part of the aperture very nacreous. Shell vividly coloured. Most specimens with a cream to light green background colour, with some irregular white axial blotches and greenish-brown or light olive-green flammules. Spiral cords dotted with burgundy or greenish-brown and white. The crenulations of the lower cord and the undulations of the peripherical ridge are



Figures 54-57. *Gibbula verdensis*, Mordeira, Sal. 54, 55: operculum; 56, 57: radula.
Figuras 54-57. Gibbula verdensis*, Mordeira, Sal. 54, 55: operculum; 56, 57: rádula.*

highlighted, being whitish on a darker background. Almost white, pinkish, or greyish specimens can be found.

Size: Larger shells reach up to 6 mm. Mean values: H= 5.12 mm, d= 4.20, H/d= 1.16 (n= 20 adult shells). The holotype measures 4.9 x 3.9 mm.

Soft parts: Head-foot brightly pigmented with light violet, pinkish, green or intense yellow irregular spots over a yellowish or cream background body colour. Foot broad, truncated anteriorly, and tapered posteriorly. Sole of the foot whitish. Long cephalic tentacles, micropapillated, semi-transparent with bluish shades. Epipodium well developed. Three pairs of long and extensible epipodial tentacles, very active when the animal is crawling. They are micropapillated and semitransparent with some whitish pigmentation. Two white epipodial sense organs are present one above and the other below the base of each tentacle. Neck lobes semitransparent with some irregular white pigmentation, not fused with the eye stalks. The margin of the right neck lobe is smooth, but the left one is irregular. An epipodial sense organ is present under each neck lobe. Cephalic lappets small and pointed, almost white.

Operculum multispiral, very thin and almost transparent.

Radula (not figured) as in other species of the genus.

Habitat: Among small seaweeds under or over the rocks, from the intertidal level to about 10 m in depth.

Distribution: Known in most of the Cape Verde Islands. Probably it is endemic to this archipelago.

Discussion: This new species shows most of the characters described for the *J. gravinae* species-group (see CURINI-GALLETTI,1990 and CRETELLA, 1992), into which three species are recognized to date: the nominal species, *J. gravinae* (Dautzenberg, 1881), is widespread in Lusitanian and Mauretanian regions including the Canary Islands, *J. karpathoensis* Nordsieck, 1973, is restricted to the southeastern Aegean Sea, and *J. vexationis* Curini-Galletti, 1990, is endemic to Madeira

J. rubioi can be differentiated from *J. gravinae*, because the latter has a protoconch with a single fine thread (CRETELLA *ET AL.*, 1990, p. 60, fig. 10) (three in *J. rubioi*), higher H/d ratio, wider basal concentric ridges subequal to the furrows (thin and clearly narrower than the furrows in *J. rubioi*), somewhat different colour pattern of shell and soft parts, oak-leaf-shaped cephalic lappets (small and pointed in *J. rubioi*), and left neck lobe with finely scalloped margin (somewhat irregular in *J. rubioi*) (CRETELLA *ET AL.*, 1990, and own observations).

J. vexationis, from Madeira, has a similar H/d ratio to *J. rubioi*, but according to its original description (CURINI-GALLETTI,1990), it has a higher number of spiral threads, which are narrower than in *J. rubioi*, a thinner basal thread, and a more convex basis.

CURINI-GALLETTI (1990) postulated that the widespread species *J. gravinae* gave rise to a distinct species in the Madeira Archipelago, while the Canary specimens are phenotypically linked to Western Mediterranean populations. He noted that this is probably due to the differences in distance from the mainland. The Canaries (closer to the continent) are "in general comparatively easier to colonize, and consequently less liable to promote speciation" (CURINI-GALLETTI,1990). In the same way, *J. rubioi* may come from a common ancestor of species in the *J. vexationis* group, which once colonized the Cape Verde Islands, and subsequently became a distinct species by progressive speciation, due the great distance from the West African mainland (about 450 km).

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BIBLIOGRAPHY

BURNAY, L. P. AND COSEL, R. VON, 1987. History of the investigations of the marine Mollusca of the Cape Verde Islands. *Courier Forschungs-Institut Senckenberg*, 95: 5-11.

BURNAY, L. P. AND MONTEIRO, A. A., 1977. *Seashells from Cape Verde Islands*. Lisboa, 88 pp.

COSEL, R. VON, 1982. Marine Mollusken der Kapverdischen Inseln. *Courier Forschungs-Institut Senckenberg*, 52: 35-76.

CURINI-GALLETTI, M. C., 1985. Taxonomic notes on Trochidae (Mollusca, Prosobranchia): two new species of *Jujubinus* from the Canary Islands. *Basteria*, 49: 133-144.

CURINI-GALLETTI, M. C., 1990. Revision of the genus *Jujubinus* Monterosato, 1884: the *J. gravinae* (Dautzenberg, 1881) species-group. *Lavori della Società Italiana di Malacologia*, 23: 37-50.

CRETELLA, M., 1992-1993. Rassegna delle specie viventi del genere *Jujubinus* Monterosato, 1884 (Gastropoda: Trochidae) (Parts I-IV). *La Conchiglia*, 264 (1992): 14-23, 265 (1992): 16-20, 266 (1993): 45-50, 266 (1993): 40-46.

CRETELLA, M., SCILLITANI, G. AND PICARIELLO, O., 1990. The systematic position of *"Trochus" miliaris* Brocchi, 1814 (Gastropoda: Trochidae); morphological and biochemical evidences. *Lavori della Società Italiana di Malacologia*, 23: 51-81.

DAUTZENBERG, P. AND FISCHER, H., 1906. Mollusques provenant des dragages effectués a l'Ouest de l'Afrique pendant les campagnes scientifiques de S. A. S. le prince de Monaco. *Résultats des Campagnes Scientifiques Acomplies sur son yatch par Albert 1er Prince de Monaco*, 32: 1-125, pls. 1-5.

GOFAS, S., 1991. Un nouveau *Jujubinus* (Gastropodas: Trochidae) d'Angola. *Apex*, 6(1): 21-24.

GUERREIRO, A. AND REINER, F., 2000. *Moluscos marinhos da ilha de S. Vicente (Archipélago de Cabo Verde)*. Câmara Municipal de Oeiras, Europress, Póvoa de Santo Adrião, 279 pp.

HICKMAN. C. S. AND MCLEAN, J. H. 1990. *Systematic revision and suprageneric classification of the trochacean gastropods. Natural History Museum of Los Angeles County, Science Series*, 35: 1-169.

MARCHE-MARCHAD, I., 1958. Nouveau catalogue de la collection de Mollusques testacés de l'I.F.A.N. *Catalogues de l'I.F.A.N.*, 14: 66 pp.

RODRÍGUEZ BABIO, C. AND THIRIOT-QUIÉVREUX, C. 1975. Trochidae, Skeneidae et Skeneopsidae (Mollusca, Prosobranchia) de la région de Roscoff. Observations au microscope électronique à balayage. *Cahiers de Biologie Marine*, 16: 521-530.

ROLÁN, E. and LUQUE, A. A., 2000. The subfamily Rissoininae (Mollusca: Gastropoda: Rissoidae) in the Cape Verde Archipelago (West Africa). *Iberus*, 18(1): 21-94.

ROLÁN, E. AND RUBIO, F., 1999. New information on the malacological fauna (Mollusca, Gastropoda) of the Cape Verde Archipelago, with the description of five new species. *Apex*, 14(1): 1-10.

SAUNDERS, G. D.,1977. Some notes on shelling in the Cape Verde Islands. *La Conchiglia*, 9(97-98): 3-21.

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The endemic species of *Conus* from Angola. 2. Description of three new species

Los *Conus* endémicos de Angola. 2. Descripción de tres nuevas especies

Emilio ROLÁN* and Dieter RÖCKEL**

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ABSTRACT

Three new species of the genus *Conus* from Angola are described. The morphological characters of the shell and radula are shown, making comparisons with other similar species from the studied area.

RESUMEN

Se describen tres nuevas especies del género *Conus* procedentes de Angola. Se muestran las características morfológicas de la concha y diente radular comparándolas con otras especies similares del área de estudio.

KEY WORDS: Conidae, *Conus*, new species, Angola.
PALABRAS CLAVE: Conidae, *Conus*, especies nuevas, Angola.

INTRODUCTION

The Angolan *Conus* have been revised recently by ROLÁN AND RÖCKEL (2000). In this work all the previous studies on this group were mentioned and listed in the introduction and the references were included.

Some other populations were being studied at the same time as those published in 2000 but were unable to be finished at that time due to the sudden death of Francisco Fernandes. Francisco was the person who knew most about this group and had collected many samples in most locations on the Angola coast. Now we have had the time and more information to conclude that there are three populations, presented herein, that we consider to be new taxa.

Abbreviations:

AMNH American Museum of Natural History, New York
BMNH The Natural History Museum, London
MNCN Museo Nacional de Ciencias Naturales, Madrid
MNHN Muséum National d'Histoire Naturelle, Paris
SMNS Staatliches Museum für Naturkunde, Stuttgart
USNM The National History Museum, Washington
CDR collection Dieter Röckel, Eberbach, Neckar
CER collection Emilio Rolán, Vigo
CFF collection Francisco Fernandes, Cacelas

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CGR collection Gabriella Raybaudi Massilia, Roma
CMF collection Michael Filmer, Chobham
CPR collection Peter Ryall, Takoradi
D Number of denticles in serration
DR/PA Total length of the radula tooth/apical portion
F Blade of radula tooth
L Shell length
LC/DR Length of the shell/length of the radula tooth
ND Number of teeth in the radula
%PA Extension of the apical portion covered by the blade of radula tooth (F) (100*F/PA)
PMD Position of maximum diameter of last whorl = height of maximum diameter/aperture height.
RD Relative diameter of last whorl = maximum diameter/aperture height
RSH Relative spire height, as proportion of shell length = height of maximum diameter/aperture height.
RW Relative weight of the shell = absolute weight/L
S Serration
j juvenile
s shells
sp specimen(s) with soft parts

RESULTS

Conus tenuilineatus n. sp. (Figs. 1-6, 21)

Conus sp. Röckel, 1988. *Club Conchylia*, 1988: 4-5, pl. 2 fig. 14.
Conus sp. Röckel and Fernandes, 1982. *La Conchiglia*, 14 (164-165): 18, fig. 34.

Type material: Holotype (Figs. 1-2) in MNCN (15.05/44374) 26.7 x 14.5 mm. Paratypes (sp) in the following collections: MNHN (1), SMNS (1), CDR (2), CER (3), CGR (1), CMF (1) and CPR (1), all from type locality.
Other material studied: Angola: 2 s, Baía do Binga (CER); 1 s, Baía do Canoco (SMNS); 3 sp, Baía de Santa Maria (SMNS); 2 sp, Caota (Benguela) (CER); 9 sp, Caota (Benguela), 1-3 m (CER); dubious material: 13 sp, Piambo (CER).
Type locality: Baía do Binga, Angola.
Etymology: The name is derived from the shell-pattern.

Shell description: Small to moderately small, moderately solid. Last whorl ventricosely conical. Outline convex at adapical third, almost straight below. Aperture slightly wider at base than near shoulder. Shoulder subangulate. Spire of low to moderate height, outline usually slightly convex. Teleoconch sutural ramps convex, with numerous spiral striae. Last whorl smooth and dull, with some broad and weak spiral grooves at base.

Ground colour of shell white or light brown tinted with numerous wavy or straight, brown, close-set (10/cm up to 40/cm) hair-lines from spire to base, flowing together at shoulder and base, occasionally punctated and forming traces of a spiral-band at the central area. Base dark brown, aperture white. Specimens from Santa Maria and Canoco may have light bluish-white ground colour and a light violet aperture with two white bands at centre and shoulder.

Periostracum: Brown, transparent.

Shell morphometry:
L 18-29 mm
RD 0.54-0.61
RSH 0.09-0.14
PMD 0.76-0.82
RW 0.09-0.14 g/mm

Description of the animal: Animal not available for study although the radula was obtained from dry soft parts.

Radula: In radula sac 48-58 teeth. Tooth of a vermivorous type, relatively wide (Fig. 21). PA scarcely larger than half DR; S narrow, with only a single row of D, which are about 20 in number, being free of them on its upper part. F is covering near 80%.

Radula morphometry: (n=4)
D 19-21
ABS 30-40°
LC/DR 38-43
DR/PA 1.93-1.98

Distribution: Baía do Binga, Baía de Canoco, Baía de Santa Maria, Benguela, and Caota. The affiliation of the specimens from Piambo to *C. tenuilineatus* is questionable.

Habitat: 1-3 m, buried in sand under stones. *C. tenuilineatus* lives sympatrically with *C. bulbus*, *C. neoguttatus*, *C. variegatus*, *C. carnalis*, *C. zebroides*, *C. nobrei*, *C. musivus*, *C. naranjus*, *C. albuquerquei*, *C. micropunctatus*, and *C. trovaoi*.

Discussion: The specimens of *C. tenuilineatus* from Canoco and Santa Maria differ from the typical specimens in their slightly violet ground colour as well as in the violet colored inside of the aperture. Those from Caota may have the axial lines less evident. We consider all them local variants of the same species. The specimens from Piambo show certain similarities in shell pattern, but their taxonomical status remains doubtful, considering their living space is far from the typical specimens; we cannot exclude the possibility that they belong to an other species.

C. tenuilineatus is similar to the sympatric living *C. zebroides* in its colour-pattern. The latter species has a larger size (28-51 mm vs. 18-29 mm) and a broader last whorl (0.64-0.70 vs. 0.54-0.61). The axial pattern of *C. zebroides* is composed of distant instead of close-set uninterrupted axial streaks instead of hairlines. The tooth of *C. zebroides* (see ROLÁN AND RÖCKEL, 2000, fig. 124) is more elongate, relativelly smaller (LC/DR 51-97 vs. 38-53), narrower and its DR/PA higher (2.0-3.6 vs. 1.93-1.98) (see Figure 26).

Other similar species are *C. naranjus* and *C. cepasi*. *C. naranjus* can be distinguished by its different shape (RD 0.62-0.69 vs. 0.54-0.61, PMD 0.68-0.76 vs. 0.76-0.82), the orange colour and the pattern, consisting of punctated axial lines. *C. cepasi* has – like *C. naranjus* - a broader RD (0.64-0.70 vs. 0.54-0.61) and a smaller PMD (0.68-0.77 vs. 0.76-0.82), has a larger size (up to 50 mm), and an orange colour. *C. naranjus* and *C. cepasi* additionally differ in the shape of radula tooth (see ROLÁN AND RÖCKEL, 2000, figs. 128 and 132-133): *C. cepasi* and *C. naranjus* have radular teeth more primitive and smaller in size. In *C. tenuilineatus* the apical portion is covered by the blade of radula tooth at 77.2%, in *C. naranjus* and *C. cepasi* the apical portion is completely uncovered (%PA = 0). Also the radular teeth are different in other characters, particularly in LC/DR proportion: *C. tenuilineatus*: 40 vs. *C. cepasi*:94 and *vs. C. naranjus*: 73 (see the graphic comparison of some characters of the radular teeth in Figure 27).

Somewhat closer but still different is the radula tooth of *C. micropunctatus* (see ROLÁN AND RÖCKEL, 2000, fig. 139). But the latter, living sympatrically in Canoco, differs conspicuously in shell morphometry and shell pattern and cannot be confused with *C. tenuilineatus*.

Conus anabelae n. sp. (Figs. 7-12, 22, 25)

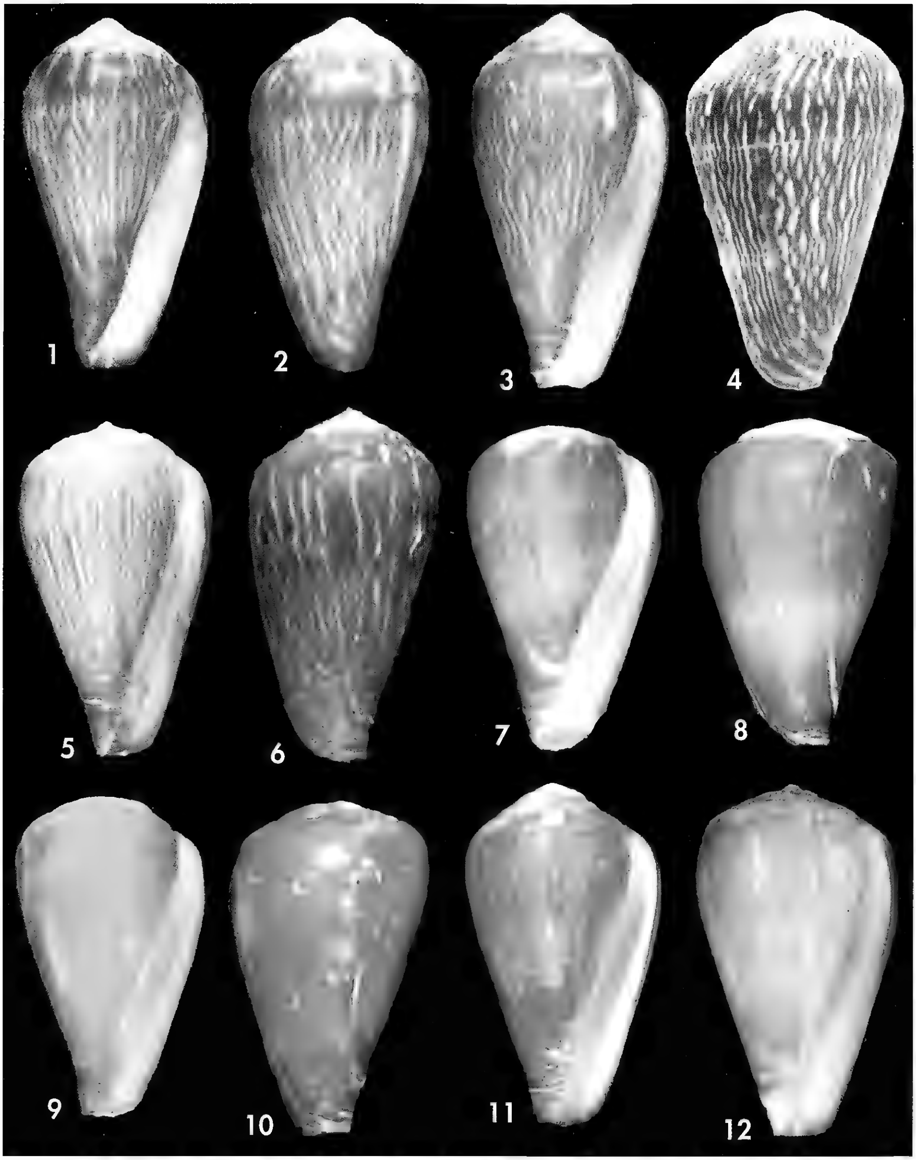
Conus sp. Röckel, 1988. *Club Conchylia Informationen*, 1988 (4-5): pl. 2, fig. 16.

Type material: Holotype (Figs. 7-8) in MNCN (15.05/44375) 23.3 x 15.1 mm. Paratypes in MNHN (1), AMNH (1), BMNH (1), SMNS (1), CDR (2), CGR (1), CER (17), CMF (1) and CPR (1), all from the type locality.

Other material studied: Angola: 36 sp, Praia Amelia, 3-6 m (CFF); 47 sp, 17 j, Praia Amelia 3-6 m (CER); 8 sp, Praia Amelia, 15-20 m (CER); 5 sp, Ponta de Noronha, Baía de Moçamedes (CER); 12 sp, Ponta de Noronha (SMNS); 14 sp, Praia Amelia, Baía de Moçamedes (SMNS); 3 sp, Praia das Conchas, Baía de Moçamedes (SMNS).

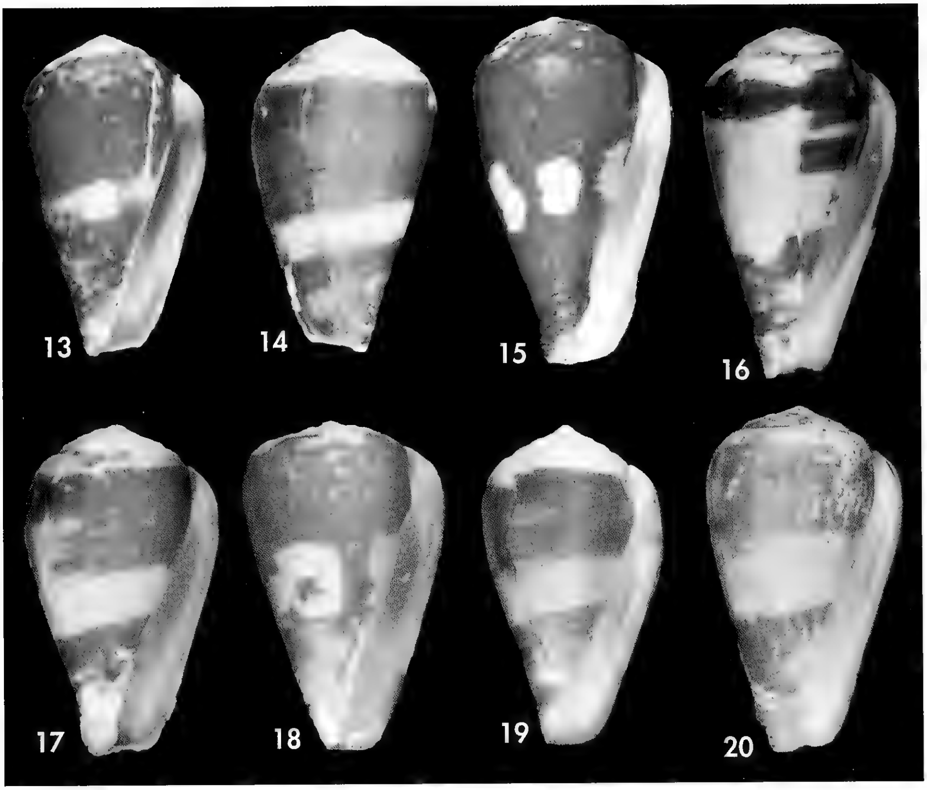
Type locality: Praia Amelia, in the Baía de Moçamedes.

Etymology: Named in honour of Anabela, daughter of Francisco Fernandes. Both, Anabela and Francisco, collected the material here described.



Figures 1-6. *Conus tenuilineatus*. 1, 2: holotype, 26.7 mm, Baía do Binga (MNCN); 3: paratype, 25.5 mm, Baía do Binga (MNHN); 4: shell, 21.0 mm, Baía do Canoco (CER); 5: paratype, 20.6 mm, Baía do Binga (CER); 6: paratype, 21.1 mm, Baía do Binga (CPR). Figures 7-12. *Conus anabelae*. 7, 8: holotype, 23.3 mm, Praia Amelia (MNCN); 9: paratype, 31.6 mm, Praia Amelia (MNHN); 10: paratype, 25.0 mm, Praia Amelia (AMNH); 11: paratype, 27.8 mm, Praia Amelia (CPR); 12: paratype, 26.2 mm, Praia Amelia (BMNH).

Figuras 1-6. Conus tenuilineatus. *1, 2: holotipo, 26,7 mm, Baía do Binga (MNCN); 3: paratipo, 25,5 mm, Baía do Binga (MNHN); 4: concha, 21,0 mm, Baía do Canoco (CER); 5: paratipo, 20,6 mm, Baía do Binga (CER); 6: paratipo, 21,1 mm, Baía do Binga (CPR). Figuras 7-12.* Conus anabelae. *7, 8: holotipo, 23,3 mm, Praia Amelia (MNCN); 9: paratipo, 31,6 mm, Praia Amelia (MNHN); 10: paratipo, 25,0 mm, Praia Amelia (AMNH); 11: paratipo, 27,8 mm, Praia Amelia (CPR); 12: paratipo, 26,2 mm, Praia Amelia (BMNH).*



Figures 13-20. *Conus babaensis.* 13-14: holotype, 25.8 mm, Baía do Baba (MNCN); 15: paratype, 34.1 mm, Baía do Baba (CER); 16: paratype, 34.5 mm, Baía do Baba (CER); 17: paratype, 28.0 mm, Baía do Baba (AMNH); 18: paratype, 29.3 mm, Baía do Baba (MNHN); 19: paratype, 21.9 mm, Baía do Baba (CER); 20: paratype, 35.1 mm, Baía do Baba (CER).

Figures 13-20. Conus babaensis. *13-14: holotipo, 25,8 mm, Baía do Baba (MNCN); 15: paratipo, 34,1 mm, Baía do Baba (CER); 16: paratipo, 34,5 mm, Baía do Baba (CER); 17: paratipo, 28,0 mm, Baía do Baba (AMNH); 18: paratipo, 29,3 mm, Baía do Baba (MNHN); 19: paratipo, 21,9 mm, Baía do Baba (CER); 20: paratipo, 35,1 mm, Baía do Baba (CER).*

Shell description: Small to moderately small, moderately light to moderately solid. Last whorl ventricosely conical. Outline convex at adapical third, slightly concave below. Aperture wider at base than near shoulder. Shoulder subangulate to rounded. Spire low, outline straight or slightly convex. Teleoconch sutural ramps convex,, with numerous spiral striae. Last whorl smooth and dull, with some broad and weak spiral grooves at base.

Ground colour light brown, changing to darker and lighter zones, spiral bands or spiral lines. Usually darker brown near base and often with a lighter brown broad spiral-band at centre or above centre. Lighter zones with very close-set axial brown lines. Aperture white.

Periostacum: Brown, transparent.

Shell morphometry:

L 18-29 mm

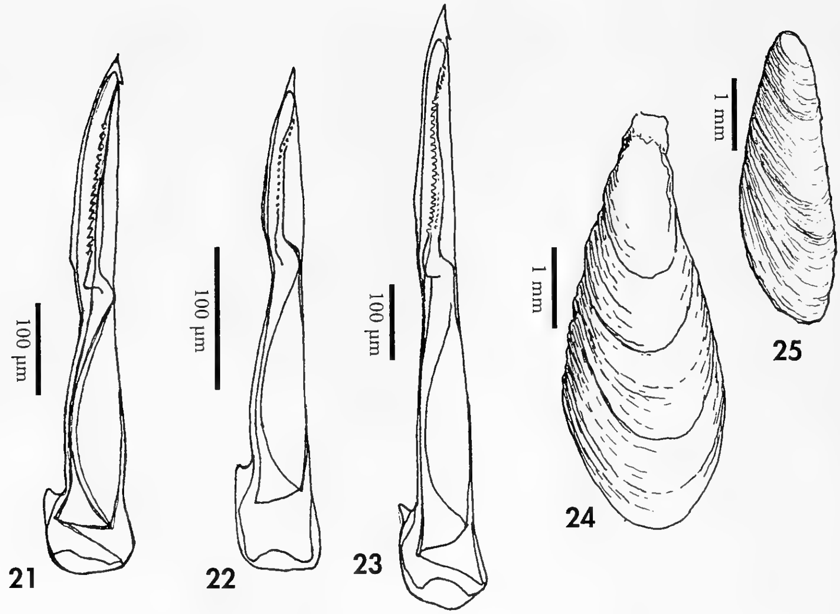
RD 0.66-0.73 (specimens of Praia das Conchas: 0.75-0.78)

RSH 0.07-0.14

PMD 0.76-0.80

RW 0.09-0.21

Description of the animal: Animal not available for study although the radula was obtained from dry soft parts.



Figures 21-23: Radular teeth. 21: *Conus tenuilineatus*, sp of 25.4 mm, Baía Binga; 22: *C. anabelae*, sp of 20.2 mm, Ponta de Noronha; 23: *C. babaensis*, sp of 35.4 mm, Baía da Baba. Figures 24, 25. Operculum. 24: *C. babaensis*, sp of 22.1 mm; 25: *C. anabelae*, sp of 22.2 mm.
Figuras 21-23: Dientes radulares. 21: Conus tenuilineatus, *sp de 25,4 mm, Baía Binga; 22:* C. anabelae, *sp de 20,2 mm, Ponta de Noronha; 23:* C. babaensis, *sp de 35,4 mm, Baía da Baba. Figuras 24, 25. Opérculos. 24:* C. babaensis, *sp de 22,1 mm; 25:* C. anabelae, *sp de 22,2 mm.*

Radula: In radula sac 70-100 teeth. Tooth of vermivorous type, relatively primitive (Fig. 22). PA shorter than half of DR; S narrow, with about 15 D in a single row, being present on its upper part; F covering near 80% of PA.

Radula morphometry: (n = 9)

D 13-20
ABS 45°
LC/DR 52-60
DR/PA 2.09-2.25
%PA 70-76

Habitat: Shallow water, under rocks, buried in sand. *C. anabelae* is sympatric with *C. filmeri* and *C. fuscolineatus*.

Distribution: Found in several localities around Baía de Moçamedes (Praia Amelia, Ponta de Noronha, Praia das Conchas).

Discussion: Specimens from Praia das Conchas differ from the typical specimens conspicuously by their larger relative diameter (0.75-0.78 vs. 0.66-0.73). As all other characters are identical, we consider the population of Praia das Conchas to be a geographical variant of *C. anabelae*.

C. anabelae is most similar to *C. babaensis* (see below) in shell characters, but can be distinguished by its brown instead of white ground colour. While the pattern of *C. anabelae* merges from lighter to darker brown, in *C. babaensis* brown and white bands and flecks are clearly separated. The tooth of *C. anabelae* is rather different from the tooth of *C. babaensis* (see Figs. 22 and 23-25), firstly in the ratio DR/PA (2.09-2.25 vs. 1.71-2.09) which conspecificy excludes. In addition, *C. anabelae* has about 50% more teeth in the radula (70-100 vs. 48-62) and more D in S (29 vs. 15) (see Figure 28). Most similar - although not identical - in radula shape is the sympatrically living *C. filmeri*, but the latter can easily be distinguished by its different shell characters (shell shape and

Table I. Distribution of the known species of endemic *Conus* in Angola. 1: Luanda area (Praia Santiago, Cacuaco, Corimba, Farol das Lagostas, Baía de Mussulo, Barra de Cuanza).; 2: Lobito; 3: Benguela (Sombreiro, Caotinha, Caota, Baía Azul, Baía Farta); 4: Cuio, Baía de Equimina, Ponta Campeona, Baía dos Elefantes, Piambo; 5: Baía dos Limagens; 6: Baía do Binga; 7: Meva, Baía do Canoco, Baía de Santa Maria; 8: Bonfim, Baía da Bissonga, Baía da Lucira, Baía do Cesar, Doca, Capato, Calonga.; 9: São Nicolau, Bentiaba; 10: Baía das Salinas; 11: Chapeu Armado; 12: Calungo; 13: Piambo; 14: Baía do Baba; 15: Baía do Mocuio; 16: Baía das Pipas; 17: Charungo, Praia das Conchas; 18: Baía do Saco Mar (do Saco), Baía de Moçamedes, Ponta de Noronha, Praia Amelia,; 19: Ensenada dos Tres Irmãos; 20: Pinda, Porto Alexandre, Ponta Albina; 21: Baía dos Tigres.

Tabla I. Distribución de las especies de Conus *endémicos de Angola. 1: Luanda area (Praia Santiago, Cacuaco, Corimba, Farol das Lagostas, Baía de Mussulo, Barra de Cuanza).; 2: Lobito; 3: Benguela (Sombreiro, Caotinha, Caota, Baía Azul, Baía Farta); 4: Cuio, Baía de Equimina, Ponta Campeona, Baía dos Elefantes, Piambo; 5: Baía dos Limagens; 6: Baía do Binga; 7: Meva, Baía do Canoco, Baía de Santa Maria; 8: Bonfim, Baía da Bissonga, Baía da Lucira, Baía do Cesar, Doca, Capato, Calonga.; 9: São Nicolau, Bentiaba; 10: Baía das Salinas; 11: Chapeu Armado; 12: Calungo; 13: Piambo; 14: Baía do Baba; 15: Baía do Mocuio; 16: Baía das Pipas; 17: Charungo, Praia das Conchas; 18: Baía do Saco Mar (do Saco), Baía de Moçamedes, Ponta de Noronha, Praia Amelia,; 19: Ensenada dos Tres Irmãos; 20: Pinda, Porto Alexandre, Ponta Albina; 21: Baía dos Tigres.*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
C. aemulus	•																				
C. africanus									•												
C. albuquerquei							•														
C. anabelae																		•			
C. babaensis														•		•					
C. bocagei		•																			
C. bulbus			•			•	•														
C. carnalis					•		•	•													
C. cepasi									•		•										
C. chytreus				•	•			•		•											
C. filmeri																		•			
C. flavusalbus																•					
C. franciscoi									•		•										
C. fuscolineatus									•		•			•	•	•		•	•		
C. gabrielae									•		•										
C. micropunctatus			•	•		•	•														
C. musivus					•		•														
C. naranjus			•				•	•													
C. neoguttatus					•		•														
C. nobrei							•	•													
C. tenuilineatus			•			•	•														
C. trovaoi					•			•													
C. variegatus					•		•	•													
C. xicoi	•																				
C. zebroides			•	•	•	•	•	•	•		•										

white colour pattern). Both species appear very similar when the periostracum is not removed.

The radula tooth is also different from other species of superficial similarity: *C. flavusalbus*, *C. africanus* and *C. naranjus* (see Figures 29, 30). On the other hand, *C. bulbus* has obvious different shell characters, while the radular characters are similar, except the number of teeth in radula sac (*C. anabelae* 70-100 vs. 58-63).

Conus babaensis n. sp. (Figs. 13-20, 23, 24)

Type material: Holotype (Figs. 13-14) in MNCN (15.05/44376) 25.8 x 15.7 mm; paratypes in AMNH (1), BMNH (1), MNHN (1), SMNS (1), USNM (1), CDR (2), CGR (1), CER (20), CMF (1) and CPR (1), all from the type locality.

Other material examined: Angola: 36 sp, Baía do Baba, 1-3 m (CFF); 20 sp, Baía do Baba, 1-3 m (CER)

Type locality: Baía do Baba, Province of Namibe, Angola.

Etymology: The name derives from the type locality.

Shell description: Small to moderately small, moderately solid. Last whorl ventricosely conical to broadly ovate. Outline convex at adapical third, almost straight below. Left side concave near base. Aperture slightly wider at base than near shoulder. Shoulder rounded. Spire of low to moderate height, outline convex, slightly sigmoid near apex. Teleoconch sutural ramps slightly convex, with fine spiral striae. Last whorl smooth but not glossy, with some weak spiral ribs near base.

Ground colour white. Last whorl with two light brown, broad spiral bands, leaving a white spiral band of varying extent below centre and a white base. The brown areas often show irregular darker brown spiral lines. Spire usually white with brown lines along suture, occasionally with irregular brown flecks. Aperture white.

Periostracum: Light brown, somewhat transparent.

Shell morphometry:

L 17-32 mm
RD 0.67-0.71
RSH 0.09-0.14
PMD 0.70-0.78
RW 0.09-0.19 g/mm

Description of the animal: Animal not available for study although the radula was obtained from dry soft parts.

Radula: In radula sac 48-78 teeth. Tooth of a vermivorous type, narrow and elongate (Fig. 23). PA larger than half DR, except in very juvenile specimens; S narrow, with about 33 in a single row of D, being present on its upper part. F covering near 80%.

Radula morphometry: (n = 12)

D 27-38
ABS 45-50°
LC/DR 40-55
DR/PA 1.71-2.09
%PA 51-74

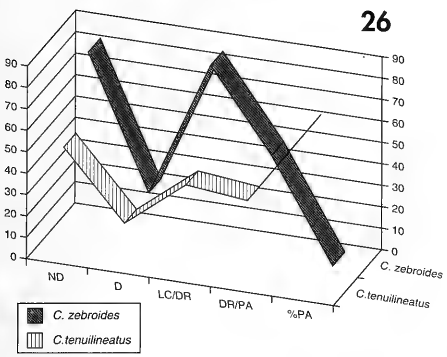
Habitat: Shallow water under rocks buried in sand. *C. babaensis* lives sympatrically with *C. flavusalbus*, and *C. fuscolineatus*.

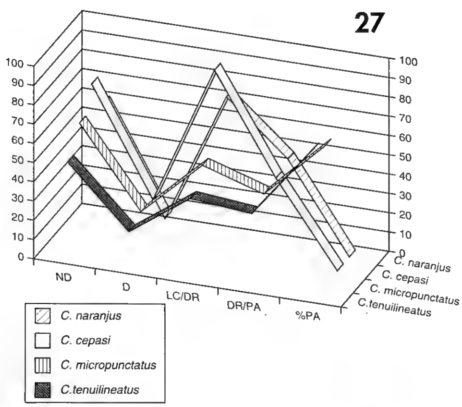
Distribution: Found in Baía do Baba and Baía das Pipas, Province of Namibe, Angola.

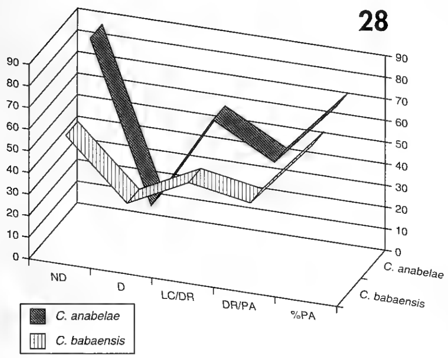
Discussion: *Conus babaensis* is a typical member of the endemic cones of Angola (being small sized, with rounded shoulders and a smooth and dull surface), but can be distinguished from all others by its colour-pattern.

Most similar in size and shell shape are *C. anabelae* - living in the adjoining area of Moçamedes – and *Conus chytreus* Melvill. *C. anabelae* can be distinguised by its colour pattern, in particular by the very different characters of its radular tooth. For comparison, see the Discussion of the latter species and the Figure 28.

C. chytreus and *C. bulbus* have a similar radula morphometry. However, *C. chytreus* differs in the number of D in S (*C. chytreus* 17-26 vs. 27-38) and in its







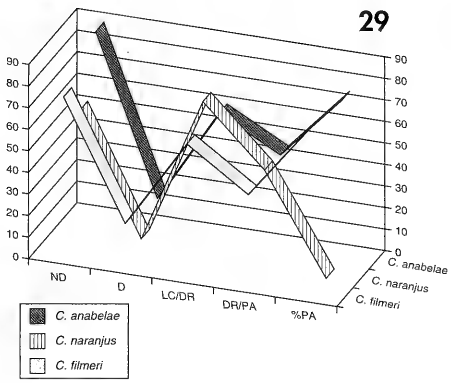


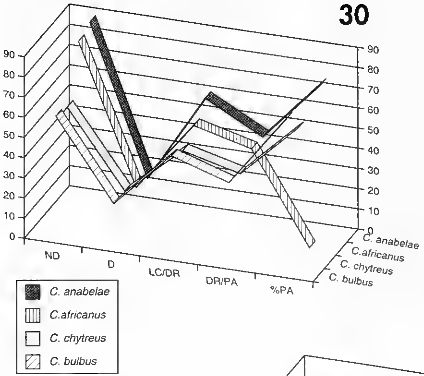
Figure 26. Comparison of some radula teeth characters of *Conus zebroides* and *C. tenuilineatus.* Figure 27. Comparison of some radula teeth characters of *Conus naranjus, C. cepasi, C. micropunctatus* and *C. tenuilineatus.* Figure 28. Comparison of some radula teeth characters of *Conus anabelae* and *C. babaensis.* Figure 29. Comparison of some radula teeth characters of *Conus anabelae, C. naranjus* and *C. filmeri.*

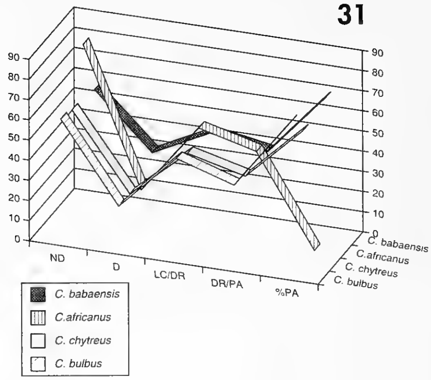
Figure 26. Comparación entre algunos caracteres radulares de Conus zebroides *y* C. tenuilineatus. *Figura 27. Comparación entre algunos caracteres radulares de* Conus naranjus, C. cepasi, C. micropunctatus *y* C. tenuilineatus. *Figura 28. Comparación entre algunos caracteres radulares de* Conus anabelae *y* C. babaensis. *Figura 29. Comparación entre algunos caracteres radulares de* Conus anabelae, C. naranjus *y* C. filmeri.

shell characters: its dark reddish brown colour of pattern, composed of spiral lines, the lack of a white central band, and the dark brown coloured spire. *C. bulbus* has – apart from small differences in morphometry - an obviously different colour pattern (compare Figures 2-6 in ROLÁN AND RÖCKEL, 2000). *C. bulbus* lives far from *C. babaensis*. For the radula teeth characters see Figure 31.

C. filmeri Rolán and Röckel, 2000, may have apparently the most similar radular tooth (different in DR/PA of 2.1-2.3 vs. 1.71-2.09), but differs clearly in shell morphometry and colour-pattern (pure white), so conspecificy cannot be assumed.

The tooth of *C. babaensis* is very different from those of *C. flavusalbus, C. naranjus,* and *C. africanus.* The latter two species are from the north of the Cuanzo River, while *C. babaensis* occurs in the distant places of Baía do Baba and Baía das Pipas (Figures 31, 32).





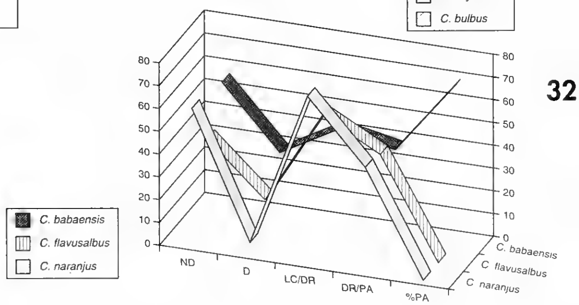


Figure 30. Comparison of some radula teeth characters of *Conus anabelae* with those of *C. africanus, C. chytreus* and *C. bulbus.* Figure 31. Comparison of some radula teeth characters of *Conus babaensis* with those of *C. africanus, C. chytreus* and *C. bulbus.* Figure 32. Comparison of some radula teeth characters of *Conus babaensis* with those of *C. flavusalbus* and *C. naranjus.*
Figura 30. Comparación entre algunos caracteres radulares de Conus anabelae *con los de* C. africanus, C. chytreus *y* C. bulbus. *Figura 31. Comparación entre algunos caracteres radulares de* Conus babaensis *con los de* C. africanus, C. chytreus *y* C. bulbus. *Figura 32. Comparación entre algunos caracteres radulares de* Conus babaensis *con los de* C. flavusalbus *y* C. naranjus.

FINAL COMMENTS

We present the list of the species of *Conus* and the distribution area of all the species described from Angola, which was published in the previous work (Rolán and Röckel, 2000) with the addition of the species here described.

ACKNOWLEDGEMENTS

The authors thank Anabela Fernandes, daughter of the late Francisco Fernandes, for her help in sending material for study, M. Filmer for critical revision of the manuscript. Also Jesús S. Troncoso of the Departamento de Biología y Ecología of the University of Vigo, is thanked for the use of the digital camera of this department for the colour photographs.

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BIBLIOGRAPHY

Rolán, E. and Röckel, D., 2000. The endemic *Conus* of Angola. *Argonauta*, 13(2): 5-44.

Actualización del catálogo de los moluscos marinos de la costa vasca, en campañas realizadas por AZTI

Update of the checklist of marine molluscs from the Basque Coast, from surveys conducted by AZTI

Ángel BORJA e Iñigo MUXIKA*

Recibido el 25-XI-2000. Aceptado el 15-VIII-2001

RESUMEN

Se han recopilado las especies de moluscos marinos identificadas en los últimos 22 años en la Costa Vasca por el personal del Departamento de Oceanografía y Medio Ambiente Marino de AZTI. Con los datos obtenidos se ha actualizado el catálogo publicado en 1987 introduciendo los cambios necesarios y añadiendo las nuevas citas. Ha aparecido 1 nueva cita de especies de Poliplacóforos, 27 de Gasterópodos (no se incluyen Opistobranquios sin concha) y 14 de Bivalvos, totalizando 42 nuevas citas. Además se ha confirmado la presencia de 16 especies que se citaban en trabajos antiguos. En total, se incluyen 7 Poliplacóforos, 208 Gasterópodos, 3 Escafópodos, 150 Bivalvos y 17 Cefalópodos, que suman 385 especies.
Además se añaden otras especies citadas en la Costa Vasca hasta totalizar 410.

ABSTRACT

The species of marine molluscs identified along the last 22 years in the Basque Coast by the staff of the Department of Oceanography and Marine Environment of AZTI have been compiled. The obtained data have been used to update the checklist published in 1987 inserting necessary changes and adding new records. One new records of species of Chitons, 27 new records of Gastropods (Opistobranch without shell are not included) and 14 new records of Bivalves have been identified, totalizing 42 new records. Besides, it has been confirmed the presence of 16 species cited in old works. In all, 7 Chitons, 208 Gastropods, 3 Scaphopods, 150 Bivalves and 17 Cephalopods are included, adding up 385 species.
Moreover other species cited in the Basque Coast were added, totalizing 410.

PALABRAS CLAVE: catálogo, moluscos marinos, Costa Vasca
KEY WORDS: checklist, marine molluscs, Basque Coast

INTRODUCCIÓN

A finales de los ochenta se publicó un primer catálogo de los moluscos marinos de la Costa Vasca (BORJA, 1987), aprovechando los datos obtenidos en muestreos que se realizaron para distintos trabajos. Se trataba de recopilar todas las especies que se habían citado en nuestras costas para poder llenar el

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hueco que el País Vasco representaba en las obras de recopilación realizadas en el resto de las costas peninsulares (BONNIN Y RODRÍGUEZ, 1990; GIRIBET Y PEÑAS, 1997, entre otros).

A partir de 1990, desde el Departamento de Oceanografía y Medio Ambiente Marino de la Fundación AZTI (Instituto Tecnológico Pesquero y Alimentario, entidad sin ánimo de lucro dedicada a la investigación y los servicios en el medio marino), se han realizado multitud de nuevos proyectos y ha aumentado el número de estaciones en las que se han realizado muestreos de bentos, tanto de sustrato duro como de blando. De este modo, se ha cubierto ya la práctica totalidad de la Costa Vasca, sobre todo la de las provincias españolas. Por esta razón, se ha pensado que ha llegado el momento de actualizar dicho listado y ampliarlo añadiendo las nuevas especies aparecidas en los últimos años e incluyendo citas en nuevas localidades de las especies que ya habían aparecido antes.

Sin embargo, este trabajo no pretende ser definitivo, ya que futuros estudios pueden confirmar la presencia de especies antes citadas pero que no se han localizado en los últimos años o pueden enriquecer el listado incluyendo nuevas especies, sobre todo en la costa de Lapurdi (País Vasco francés) que es la que menos se ha cubierto.

MATERIAL Y MÉTODOS

Tal y como se hizo en el anterior trabajo (BORJA, 1987), en éste el material también ha sido recogido por diferentes métodos. Se ha utilizado el raspado de superficies, la búsqueda directa de ejemplares, la inmersión con escafandra autónoma, la extracción con dragas y testigos, la recogida en aparejos de pesca, etc., proviniendo una pequeña parte de campañas oceanográficas no específicamente malacológicas, terceras personas y material conchífero depositado en las playas.

La identificación se llevó a cabo con claves, tablas, libros y separatas entre los que se pueden citar, como más importantes: LELOUP Y VOLZ (1938), MATTHEWS (1953), ANADÓN (1979), y KAAS (1979, 1981) para Poliplacóforos y TEBLE (1966), NORDSIECK (1968, 1969, 1972, 1977, 1982), GHISOTTI Y MELONE (1969, 1970, 1971, 1972, 1975), PARENZAN (1970, 1974, 1976), FRETTER Y GRAHAM (1976, 1977, 1978 A Y B, 1980, 1981, 1982), SABELLI Y SPADA (1977, 1978, 1979, 1980, 1981, 1982), ROLÁN MOSQUERA (1983) y FRETTER, GRAHAM Y ANDREWS (1986) para el resto de los grupos, excepto Opistobranquios sin concha que no se incluyen. Para algunas especies o grupos determinados, se han tenido en cuenta revisiones como las de BOUCHET (1984, 1997), BOUCHET Y GUILLEMOT (1978), BOUCHET Y WARÉN (1980, 1985, 1986, 1993), GIANNUZZI-SAVELLI, PUSATERI, PALMERI Y EBREO (1994, 1997, 1999), GOFAS Y WARÉN (1991), KAAS (1985), MARIOTTINI, SMRIGLIO Y OLIVERIO (2000), PONDER (1989), REID (1996), ROLÁN, DANTART Y FERNANDES (1997), RUBIO Y RODRÍGUEZ BABÍO (1996), SABELLI, GIANUZZI-SAVELLI Y BEDULLI (1990-1992) y VERDUIN (1988).

Para citar una especie se ha tenido en cuenta que ésta se haya recogido por el personal del Departamento de Oceanografía de AZTI en los últimos 22 años, pero otras especies citadas anteriormente y no encontradas en este último periodo se han incluido en la Tabla III.

En la presente recopilación se han tenido en cuenta los nombres más actuales propuestos por SABELLI *ET AL.* (1990-1992); POPPE Y GOTO (1991); ROLÁN MOSQUERA, OTERO SCHMITT Y ROLÁN ÁLVAREZ (1989) para poliplacóforos, bivalvos, escafópodos y cefalópodos; y los propuestos por GUERRA (1992) para los cefalópodos. También se ha usado la recopilación de taxones publicados en Iberus (1981-1997) (MURILLO, 1998). Posteriormente, y teniendo en cuenta que algunas guías eran antiguas, se han revisado y actualizado las denominaciones de todas las especies siguiendo la nomenclatura de la CLEMAN (http://www.mnhn.fr/base/malaco.html) y del *European Register of Marine Species* (http://erms.biol.soton.ac.uk/).

Tabla I. Claves de abreviatura.
Table I. Abbreviations key.

Distribución (Localidades)		RO=	Ría del Oria
A=	Arminza	ROn=	Ría de Ondarroa
Ab=	Abra	RP=	Ría de Pasajes
AI=	Abra Interior	RPl=	Ría de Plentzia
Al=	Algorri	RUr=	Ría del Urumea
An=	Punta Ansora	RZu=	Ría de Zumaia
Ar=	Arrigunaga	S=	Sopelana
Ba=	Bakio	SJ=	San Juan de Luz
Be=	Bermeo	SS=	San Sebastián
Bi=	Biarritz	St=	Santurtze
CG=	Costa Gipuzkoa	TC=	Toda la Costa Vasca
CL=	Costa Lapurdi	Tx=	Txatxarramendi
CM=	Cala Murgita	Z=	Zarautz
CV=	Costa Bizkaia	Zu=	Zumaia
D=	Deba		
Ea=	Ea	*Abundancia*	
F=	Fuenterrabia	1=	Muy raro
G=	Getaria	2=	Raro, escaso
Ga=	Gaztelugatxe	3=	Abunda localmente
Go=	Gorliz	4=	Común
Gy=	Guethary	5=	Muy común
H=	Higer		
He=	Hendaya	*Batimetría*	
I=	Igeldo	B=	Batial
J=	Jaizkibel	C=	Circalitoral
L=	Lekeitio	I=	Infralitoral
LA=	La Arena	M=	Mediolitoral
M=	Monpas		Mi= Ml. inferior
Ma=	Matxitxako		Mm= Ml. medio
Me=	Meñacoz		Ms= Ml. superior
Mo=	Motriko	S=	Supralitoral
Mu=	Mundaka		
O=	Orio	*Biotopo*	
On=	Ondarroa	B=	Bentónico
P=	Pasajes	D=	Demersal
PE1=	Playa de Eskote	E=	Estuario
PE2=	Playa de Eskote	PD=	Pelágico-Demersal
PG=	Plataf. continental de Gipuzkoa	SA=	Sustrato animal
RB=	Ría del Barbadún	SB=	Sustrato blando
RBi=	Ría del Bidasoa		a= arena
RD=	Ría del Deba		f= fango
RG=	Ría de Gernika	SD=	Sustrato duro
RN=	Ría del Nervión	SV=	Sustrato vegetal

Para cada especie se da la localidad donde se encontró, la abundancia (tanto por el número de individuos como por las veces o muestras en las que se ha localizado), batimetría (tanto en los diferentes niveles del intermareal, como en la plataforma continental y, ocasionalmente, en fondos hasta 800 metros) y biotopo que ocupaba al ser recolectada (claves de abreviatura en Tabla I). En el

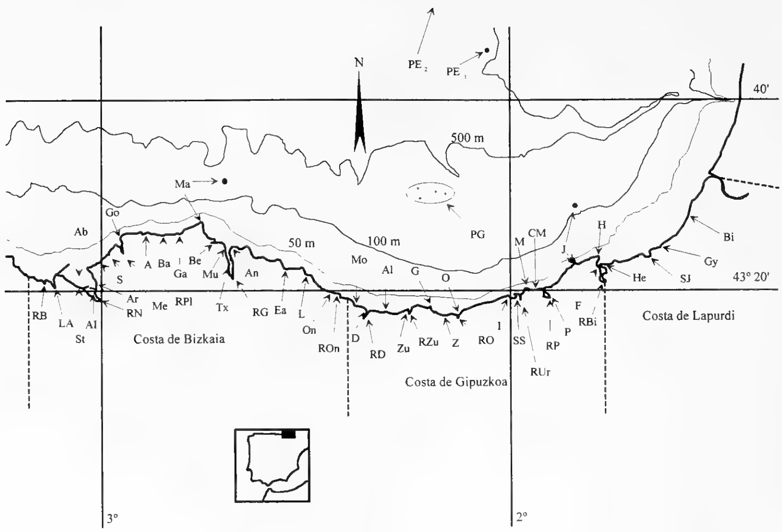

Figura 1. Mapa de la Costa Vasca con las localidades citadas (para abreviaturas ver Tabla I).
Figure 1. Basque coast map showing cited locations (abbreviations key in Table I).

caso de la localidad, cuando la especie ha aparecido en cuatro o más lugares de una misma provincia se da como Costas de Gipuzkoa, Bizkaia o Lapurdi (País Vasco francés), respectivamente, y cuando se ha localizado en más de siete localidades entre las tres provincias se da como TC, es decir, que se distribuye por toda la costa del País Vasco (Figura 1).

En cuanto a la batimetría, cuando la especie es circalitoral o batial se da también la profundidad aproximada a la que se encontró, o los valores extremos cuando se ha encontrado varias veces.

RESULTADOS Y DISCUSIÓN

Se han identificado 7 (1,8 %) Poliplacóforos, 208 (54 %) Gasterópodos (no se incluyen Opistobranquios sin concha), 3 (0,8 %) Escafópodos, 150 (39 %) Bivalvos y 17 (4,4 %) Cefalópodos, que suman un total de 385 especies (Tabla II, ver también Tabla III). De todas estas, constituyen nuevas citas 1 especie de Poliplacóforo, 27 Gasterópodos y 14 Bivalvos, totalizando 42 (10,9 %). De entre las especies citadas en la bibliografía antigua, siguen sin haber sido encontradas por nosotros 25 especies: 18 Gasterópodos, 6 Bivalvos y 1 Cefalópodo. Sin embargo, cabe señalar que *Plagyostila asturiana* fue citada por GOFAS Y PONDER (1991) en la costa vasca (San Juan de Luz y Hendaya). Sin duda, lo peculiar de su hábitat, bajo grandes bloques rocosos semienterrados, dificulta la localización de ejemplares de esta especie.

Sin tener en cuenta estas últimas especies, el número de ellas presentes al menos en un punto por provincia es de 142 (36,9%), siendo 104 (27%) las que se encuentran distribuidas por toda la costa, es decir en más de 7 localidades entre las tres provincias. En Bizkaia se localizan 320 (83,1%) especies, en Gipuzkoa se identificaron 252 (65,5%) y 196 (50,9%) en Lapurdi. Sin duda, esto tiene que ver con el esfuerzo de muestreo, ya que en Bizkaia hay 25 estaciones y en Gipuzkoa 21, por lo que el número de especies encontrado por estación es muy similar (12,8 en el primer caso y 12 en el segundo). Sin embargo, en Lapurdi, con 6 estaciones, se llega a un número de 32,7 especies por estación. Probablemente, si se aumentara el número de estaciones, el valor obtenido

Tabla II. Listado de las especies localizadas en la costa vasca durante los últimos 22 años; la especie se nombre en primer lugar, a continuación se dan los posibles nombres con los que se ha mencionado también en la costa vasca. En el circalitoral o batial se da la profundidad de localización, o su rango, en metros. 1: primera cita de la especie en la costa vasca; 2: especie localizada cuando el anterior trabajo se encontraba en prensa; 3: especie citada en trabajos antiguos, pero no localizada para el anterior trabajo. Para abreviaturas, ver Tabla I.

Table II. List of species found in the Basque coast for the last 22 years: the species is named first, possible names used to cite the species in the Basque coast are also included. In the circalitoral and batial areas, depth is given. 1: first record in the Basque coast; 2: species found when a previous paper was in press; 3: species cited in ancient papers, but not recorded in the already mentioned previous paper. Abbreviations shown in Table I.

	Especie	Distribución	Abundancia	Batimetría	Biotopo
	POLYPLACOPHORA				
1	*Lepidopleurus cajetanus* (Poli, 1791)	TC	2	I	SD
2	*Leptochiton asellus* (Gmelin, 1791)	Ma, H	2	C: 100	SD
3	*Leptochiton cancellatus* (Sowerby G. B. II, 1840)	TC	1	Mm, Mi, I, C: 100	SD
4	*Lepidochitona cinerea* (Linné, 1767)	TC	2	Mm, Mi, I, C: 5-25	SD
5	*Callochiton septemvalvis* (Montagu, 1803)	Me, Al, Zu, H, He	1	Mi, C: 20-25	SD
	Callochiton laevis Montagu, 1803				
6	*Acanthochitona crinita* (Pennant, 1777)	TC	4	S, Mm, Mi, I, C: 5-25	SD, SB: a
	Acanthochitona fascicularis (Linné, 1767)				
	Acanthochitona communis Risso, 1826				
7	1 *Acanthochiton discrepans* (Brown, 1827)	H	1	Mi	SD
	GASTROPODA				
8	*Tectura virginea* (Müller O. F., 1776)	TC	1	Mi, I, C: 25	SV, SD
9	1 *Tectura testudinalis* (Müller O. F., 1776)	Zu, CM, He	2	Mm, Mi, C: 5-15	SD
	Collisella tessulata (Müller O. F., 1776)				
10	*Patella vulgata* Linné, 1758	TC	5	S, M	SD, SB: a
11	*Patella ulyssiponensis* Gmelin, 1791	TC	5	Mm, Mi, I	SD
	Patella aspera Lamarck, 1822				
12	*Patella rustica* Linné, 1758	TC	4	S, M	SD
	Patella lusitanica Gmelin, 1791				
13	*Patella intermedia* Murray, 1857	TC	5	S, M, I	SD, SB: a
	Patella depressa Pennant, 1777 (n. dubium)				
14	*Iothia fulva* (Müller, 1776)	Ma	1	C: 100	SB
	Pilidium fulvum Forbes & Hanley, 1849				
15	1 *Propilidium exiguum* (Thompson, 1844)	Al	2	C: 5	SD
16	*Ansates pellucida* (Linné, 1758)	TC	3	I, C: 15	SV, SD
	Patina pellucida (Linné, 1758)				
	Helcion pellucidum Linné, 1758				
	Helcion pellucidus laevis (Pennant)				
17	*Scissurella costata* (d'Orbigny, 1824)	Ma	1	C: 100	SD
18	*Anatoma crispata* (Fleming, 1828)	Ma	1	C: 100	SD
	Scissurella crispata (Fleming, 1828)				
19	*Haliotis tuberculata* Linné, 1758	TC	2	Mi, I, C: 5	SD
	Haliotis tuberculata lamellosa Lamarck, 1822				
20	*Emarginula fissura* (Linné, 1758)				
	Emarginula reticulata (da Costa, 1778)	Ma, J, CL	2	C: 100	SB: a
	Emarginula reticulata Sowerby, 1813				
21	*Puncturella noachina* (Linné, 1771)	A, Ga	1	I, C: 9,8	SD
22	*Diodora graeca* (Linné, 1758)				
	Diodora apertura Montagu, 1803	Ga, Ma, CG	2	Mm, Mi, I, C: 5-100	SD
	Diodora reticulata (Montagu)				

Tabla II. Continuación.
Table II. Continuation.

	Especie	Distribución	Abundancia	Batimetría	Biotopo
23	*Diodora gibberula* (Lamarck, 1822)	Ga, Ma, CL	1	C: 10,6-100	SD
24	*Danilia otaviana* (Cantraine, 1835)	Ma	2	C: 100	SB
	Danilia tinei (Calcara, 1839)				
25	*Osilinus lineatus* (da Costa, 1778)	TC	2	S, M, I	SD
	Monodonta lineata (da Costa, 1778)				
26	*Jujubinus exasperatus* (Pennant, 1777)	Ma, Mo, H, CL	1	C: 15-100	SD
27	*Clelandella miliaris* (Brocchi, 1814)	Ma	1	C: 100	SD
28	*Gibbula magus* (Linné, 1758)	A, SJ, Gy	1	M	SD
29	*Gibbula cineraria* (Linné, 1758)	TC	4	M, I	SD
30	*Gibbula pennanti* (Philippi, 1846)	TC	3	M	SD
31	*Gibbula umbilicalis* (da Costa, 1778)	TC	3	M	SD, SB: a
32	*Calliostoma zizyphinum* (Linné, 1758)	TC	2	M, I, C: 5-35	SD, SB: a
33	*Calliostoma granulatum* (Von Born, 1778)	Ma	1	C: 100	SD
34	2 *Callumbonella suturalis* (Philippi, 1836)	PE2	2	C: 500	SB
35	*Bolma rugosa* (Linné, 1767)	TC	2	M, I, C: 15	SD
	Astraea rugosa (Linné, 1767)				
36	*Homalopoma peloritanum* (Cantraine, 1835)	Ma	2	C: 100	SB: a
	(citada erróneamente como *H. sanguineum*)				
37	*Tricolia pullus* (Linné, 1758)	TC	4	M, I, C: 5-70	SV, SD, SB: a
38	*Tricolia speciosa* (Von Mühlfeldt, 1824)	A, Ga	1	M, I	SV, SD
39	1 *Skenea serpuloides* (Montagu, 1808)	Ab	1	C: 15-30	SB: a
40	*Dikoleps cutleriana* (Clark W., 1848)	Ma	1	C: 100	SB
	Tubiola cutleriana (Clark W., 1850)				
41	1 *Lacuna vincta* Montagu, 1803	Al, Zu, H, He	2	Mm, Mi	SD
42	*Littorina littorea* (Linné, 1758)	TC	2	Mi, I	SD
43	*Littorina obtusata* (Linné, 1758)	S, A, Gy	3	Ms	SV, SD
44	*Littorina rudis* (Maton, 1797)	A, Mu, Gy	2	Mm	SD
45	*Littorina saxatilis* (Olivi, 1792)	CV	1	Mm, I	SD, SB
46	*Melarhaphe neritoides* (Linné, 1758)	TC	5	S, M, I	SD, SB: a
47	1 *Littorina neglecta* Bean, 1844	Al, H	1	Mm	SD
48	1 *Littorina compressa* Jeffreys, 1865	Al	1	Mi	SD
	Littorina nigrolineata Gray, 1839				
49	*Potamopyrgus antipodarum* (Gray, 1840)	RG, RUr	1	Mm, I	E, SB: a
	Hydrobia jenkinsi Smith, 1889				
	Potamopyrgus jenkinsi (Smith, 1889)				
50	1 *Hydrobia neglecta* Muus, 1963	RUr	1	Mm	SB: a
51	Hydrobia ulvae (Pennant, 1777)	TC	4	Mm, Mi, I, C: 1-30	E, SD, SB
	Peringia ulvae (Pennant, 1777)				
52	*Tornus subcarinatus* (Montagu, 1803)	Ma, D	1	Mm, C: 100	SD, SB: a
53	*Circulus striatus* (Philippi, 1836)	CV, SJ	1	M, C: 15-30	SD, SB
54	*Skeneopsis planorbis* (Fabricius, 1780)	TC	3	Mm, Mi, I	SD, SB
55	*Eatonina fulgida* (Adams J., 1797)	TC	3	Mi, I	SV, SD
	Microsetia fulgida (Adams J., 1797)				
56	*Barleeia unifasciata* (Montagu, 1803)	TC	2	M, I, C: 5-53	SV, SD, SB: a
	Barleeia rubra (A. Adams, 1975)				
57	*Obtusella intersecta* (Wood S., 1857)	Ma	2	C: 100	SD, SB: a
	Putilla alderi (Jeffreys, 1858)				
58	*Cingula cingillus* (Montagu, 1803)	S, Me, Mu, D, SJ	1	Mm, Mi	SD, SB: a
59	*Ceratia proxima* (Forbes & Hanley, 1850)	H	3	C: 100	SD
60	*Hyala vitrea* (Montagu, 1803)	Ab	1	C: 15-30	SB: f

Tabla II. Continuación.
Table II. Continuation.

	Especie	Distribución	Abundancia	Batimetría	Biotopo
61	*Onoba striata* (Montagu, 1803)	TC	3	M, I	SD
	Onoba semicostata (Montagu, 1803)				
62	*Crisilla semistriata* (Montagu, 1808)	TC	2	Mm, Mi, I, C: 15-30	SV, SD, SB: a
	Setia semistriata (Montagu, 1808)				
	Alvania semistriata (Montagu, 1808)				
63	*Rissoa parva* (da Costa, 1778)	TC	3	M, I, C: 5-35	SV, SD, SB: a
	Turboella parva da Costa, 1778				
	Turboella interrupta Adams J., 1798				
64	*Pusillina radiata* (Philippi, 1836)	LA, S, Al	2	Mi, I	SD
	Turboella radiata (Philippi, 1836)				
	Turboella pulchella (Philippi, 1836)				
65	*Pusillina sarsii* (Lovén, 1846)	Me, D	2	M, I	SV, SD, SB: a
	Rissoa albella Lovén, 1846				
	Risoella diaphana Alder, 1848				
66	*Rissoa decorata* Philippi, 1846	Ma, CM, H	2	I, C: 5-25	SD
	Apicularia decorata (Philippi, 1846)				
67	*Rissoa guerinii* Recluz, 1843	TC	2	Mm, I, C: 5-32	SV, SD, SB
	Apicularia guerinii (Recluz, 1843)				
68	1 *Pusillina inconspicua* (Alder,1844)	H	1	C: 25	SD
	Turboella inconspicua (Alder, 1844)				
69	1 *Rissoa membranacea* (Adams J., 1800)	Al	1	Mi	SD
	Rissoa labiosa (Montagu, 1803)				
70	*Pusillina lineolata* (Michaud, 1832)	Ma	1	I	SD
	Rissoa lineolata Michaud, 1832				
71	*Rissoa lilacina* Récluz, 1843	TC	2	Mm, Mi, C: 5	SV, SD
	Rissoa rufilabrum Alder, 1844				
	(citada erróneamente como *R. violacea*)				
72	Manzonia crassa (Kanmacher, 1798)	TC	2	Mi, I, C: 15-70	SV, SD, SB
	Folinia crassa Kanmacher, 1798				
	Alvania crassa (Kanmacher, 1798)				
73	*Alvania beani* (Hanley in Thorpe, 1844)	Ab, Ma, J, H	4	Mm, I, C: 100	SD, SB: a
	Turbona reticulata (Montagu, 1803)				
	Turbona calathus (Forbes & Hanley, 1853)				
74	*Alvania cancellata* (da Costa, 1778)	Ab, Ma, Zu, J, SJ	1	I, C: 20-100	SD, SB: a
	Acinopsis cancellata (da Costa, 1778)				
75	*Alvania subcrenulata* (Bucquoy, Dautzenberg & Dollfus, 1884)	Ga, Ma	1	I, C: 10,6-100	SD, SB: a
	Acinopsis subcrenulata (Schwartz, 1869)				
76	*Alvania jeffreysi* (Waller, 1864)	Ma	1	C: 100	SD, SB: a
	Alvinia jeffreysi (Waller, 1864)				
77	*Alvania punctura* (Montagu, 1803)	Ma, SJ, Bi	1	C: 100	SD, SB: a
	Arsenia punctura (Montagu, 1832)				
78	*Alvania carinata* (da Costa, 1778)	Ma, SJ, Gy	1	C: 100	SD, SB: a
	Galeodina carinata (da Costa, 1778)				
79	*Alvania lactea* (Michaud, 1832)	Ab, Ma, CL	4	Mi	SD
80	*Alvania zetlandica* (Montagu, 1815)	Ab, Ma	1	I, C: 100	SD
	Taramellia zetlandica (Montagu, 1811)				
81	*Alvania hispidula* (Monterosato, 1884)	Ma	1	C: 100	SD, SB: a
	Turbona hispidula (Monterosato, 1884)				
82	*Alvania cimicoides* Forbes, 1844	Ma	1	C: 100	SD, SB: a
	Turbona cimicoides (Forbes, 1844)				

Tabla II. Continuación.
Table II. Continuation.

	Especie	Distribución	Abundancia	Batimetría	Biotopo
83	*Alvania cimex* (Linné, 1758)	Mu	3	M, I	SD
	Turbona cimex (Linné, 1758)				
84	*Turritella communis* Risso, 1826	TC	1	I, C: 15-100	SB
85	*Turritella turbona* Monterosato, 1877	Ab, Ma, J	1	C: 20-100	SB
	Turritella triplicata Brocchi, 1855				
86	*Vermetus semisurrectus* Bivona Ant., 1832	Ma	1	C: 100	SD
87	*Caecum trachea* (Montagu, 1803)	Ma, I, SJ	1	C: 70-100	SB: a
88	*Caecum glabrum* (Montagu, 1803)	Ga, An, SJ	2	I	SB
89	*Caecum vitreum* Carpenter, 1858	Ga, Ma	2	I, C: 100	SB
90	*Bittium reticulatum* (da Costa, 1778)	TC	5	M, I, C: 1-70	SD, SB
	(hay citadas subespecies: *B. r. reticulatum* y *B. r. exiguum*)				
91	*Bittium latreillii* (Payraudeau, 1826)	A, Ga, Al, Zu, H, He	1	Mi, C: 25-45	SD, SB: a
92	*Bittium lacteum* (Philippi, 1836)	A, Ga	2	Mi	SD, SB: a
93	*Cerithium vulgatum* (Bruguière, 1792)	CG	2	Mi	SD
94	*Capulus ungaricus* (Linné, 1758)	A, Ga, Ma, Zu, SJ	1	I, C: 20-100	SD, SB
	Capulus hungaricus Linné, 1758				
95	*Aporrhais pespelicani* (Linné, 1758)	TC	1	I, C: 15-180	SB
96	*Aporrhais pespelecani* (Linné, 1758)	Ma	1	C: 100	SB: a
97	*Aporrhais serresianus* (Michaud, 1828)	Ma, G	1	I	SB: a
98	*Lamellaria perspicua* (Linné, 1758)	Mu	2	M	SB
99	*Erato voluta* (Montagu, 1803)	SS, H, SJ	1	I, C: 25	SD, SB
100	*Trivia arctica* (Pulteney, 1799)	TC	2	I	SD
101	*Trivia monacha* (da Costa, 1778)	TC	1	Mi, I, C: 15-35	SD, SB
102	*Pseudosimnia carnea* (Poiret, 1789)	Ma	1	C: 100	SB
103	*Neosimnia spelta* (Linné, 1758)	H	2	I	SD
104	*Euspira catena* (da Costa, 1758)	TC	1	I, C: 15-45	SD, SB
	Lunatia catena (da Costa, 1778)				
105	*Euspira fusca* (de Blainville, 1825)	H	2	C: 100	SB
	Natica fusca de Blainville, 1825				
106	*Euspira pulchella* (Risso, 1826)	TC	2	C: 9-100	SB
	Lunatia pulchella Risso, 1826				
	Lunatia alderi Forbes, 1838				
107	*Galeodea rugosa* (Lnné, 1771)	TC	2	C	SD, SB
	Galeodea tyrrhena Chemnitz, 1789				
	Cassidaria tyrrhena (Bruguière, 1789)				
	(a veces equivocado con *G. echinophora*)				
108	2 *Phalium saburon* (Bruguière, 1792)	PG	1	C: 150	SB
109	*Ranella olearium* (Linné, 1758)	L	2	C: 100-200	SB: f
	Ranella gigantea Lamarck, 1816				
	Argobuccinum olearium (Linné, 1758)				
110	*Cabestana cutacea* (Linné, 1767)	TC	1	C: 30	SD, SB
	Cymatium cutaceum (Linné, 1767)				
111	*Cymatium corrugatum* (Lamarck, 1822)	Mu	2	M, I	SB
112	*Charonia lampas* (Linné, 1758)	TC	4	I, C	SD, SB: a
	Charonia rubicunda (Pery, 1811)				
113	*Cerithiopsis tubercularis* (Montagu, 1803)	TC	1	I, C: 12	SD, SB
114	1 *Cerithiopsis fayalensis* Watson, 1886	Al	1	C: 70	SD
115	*Cerithiopsis minima* (Brusina, 1864)	S, A, SJ, Gy	2	M	SD
116	3 *Metaxia metaxae* (delle Chiaje, 1828)	Zu, He, SJ	1	C: 45	SD
	Cerithiopsis metaxa (delle Chiaje, 1828)				

Tabla II. Continuación.
Table II. Continuation.

	Especie	Distribución	Abundancia	Batimetría	Biotopo
117	1 *Cerithiopsis jeffreysi* Watson, 1885	Zu	1	C: 45	SD
	Cerithiopsis pulchella Jeffreys, 1858				
118	*Dizoniopsis coppolae* (Aradas, 1870)	Me	2	M	SD
	Dizoniopsis clarki Forbes & Hanley, 1858				
119	1 *Marshallora adversa* (Montagu, 1803)	CG	2	M, C: 5-25	SD, SB: a
	Triphora adversa (Linné, 1758)				
120	1 *Strobiligera brychia* (Bouchet & Guillemot, 1978)	RB, Ab, Ga, J	1	I, C: 15-35	SD, SB
	Triphora brychia Bouchet & Guillemot, 1978				
	Triphora aspera (Jeffreys, 1885)				
121	*Monophorus erytrhosoma* (Bouchet & Guillemot, 1978)	Al	1	Mi	SD
	Triphora erythrosoma Bouchet & Guillemot, 1978				
122	*Monophorus perversus* (Linné, 1758)	TC	1	Mi, I, C: 5-70	SD, SB
	Triphora perversa (Linné, 1758)				
123	*Epitonium commune* (Lamarck, 1822)	Ab, Al, Ma, CG	1	Mi, I, C: 9,5-39	SD, SB
	Epitonium clathrus (Linné, 1758)				
124	*Epitonium clathratulum* (J. Adams, 1798)	Ma, SJ	1	C: 100	SB: a
125	*Gyroscala lamellosa* (Lamarck, 1822)	Me, An	2	Mi, I	SB
	Epitonium lamellosum (Lamarck, 1822)				
126	*Epitonium turtonis* (Turton, 1819)	Ma	1	C: 100	SB: a
	Scalaria tenuicostata Michaud, 1829				
127	1 *Epitonium pulchellum* (A. Bivona, 1832)	Al	1	C: 70	SD
128	*Opalia (Dentiscala) crenata* (Linné, 1758)	Mu, CL	2	Mi	SB
129	*Janthina janthina* (Linné, 1758)	SS, SJ, Gy	1		PD
130	1 *Aclis gulsonae* (Clark, 1850)	Ab, Al	1	C: 15-30	SB
131	*Eulima (Strombiformis) bilineata* (Alder, 1848)	Ma, J	2	C: 100	SB: a
132	3 *Vitreolina incurva* (Bucquoy, Dautzenberg & Dollfus, 1883)	Ab, H, SJ, Gy	1	C: 25	SD
	Balcis incurvata (Renier, 1807)				
	Eulima incurva (Bucquoy, Dautzenberg & Dollfus, 1883)				
133	*Balcis devians* (Monterosato, 1884)	TC	4	I, C: 100	SB: a
134	1 *Muricopsis cristata* (Brocchi, 1814)	Ma	1	Mi, C: 10,6-15	SD
135	*Trophon muricatus* (Montagu, 1803)	Ab, Ma, Al	1	Mi, I, C: 13,8-30	SD, SB
	Trophonopsis muricata (Montagu, 1803)				
136	*Ocenebra erinaceus* (Linné, 1758)	TC	5	Mi, I, C: 5-45	SD, SB
137	*Ocinebrina aciculata* (Lamarck, 1822)	Ma, CG, He, SJ	2	M, I, C: 15-25	SD
138	*Ocinebrina edwardsi* (Payraudeau, 1826)	An, CL	2	M	SD
139	*Stramonita haemastoma* (Linné, 1766	TC	2	Mi, I	SD)
	Thais haemastoma (Linné, 1766)				
140	*Nucella lapillus* (Linné, 1758)	LA, Gy	1	Mi, I	SD
141	1 *Urosalpinx cinerea* (Say, 1822)	CG	3	Mm, Mi, I, C: 25	SD, SB: a
142	*Orania fusulus* (Brocchi, 1814)	Ma	1	C: 100	SD, SB: a
	Urosalpinx fusulus (Brocchi, 1814)				
143	*Coralliophila alucoides* (de Blainville, 1826)	Ma	1	C: 100	SD
	Coralliophila lamellosa (Cristofori & Jan, 1832)				
144	*Neptunea antiqua* (Linné, 1758)	TC	1	C: 370	SB
145	*Neptunea contraria* (Linné, 1771)	Ma	1	C: 100	SB
146	*Buccinum undatum* Linné, 1758	Zu	2	C: 165	SB
147	*Buccinum humpreysianum* Bennet, 1825	O	2	C: 160	SB
148	1 *Pollia dorbignyi* (Payraudeau, 1826)	Ma	1	C: 10,6	SD
	Cantharus dorbignyi (Payraudeau, 1826)				
149	*Chauvetia brunnea* (Donovan, 1804)	Ab, Ga, Mu, Al, SS, H, SJ	2	Mi, I, C: 15-30	SD, SB
	Chauvetia minima (Montagu, 1803)				

Tabla II. Continuación.
Table II. Continuation.

	Especie	Distribución	Abundancia	Batimetría	Biotopo
150	*Colus gracilis* (da Costa, 1778)	TC	2	C, B: 620	SB
151	*Colus jeffreysianus* (Fischer, 1868)	TC	2	C, B: 450	SB
152	*Nassarius cuvierii* (Payraudeau, 1826)	TC	1	I, C: 30	SD, SB
	Nassarius costulata (Renier, 1804)				
153	*Nassarius corniculum* (Olivi, 1792)	Be, SJ, Gy	3	M	SD
	Amyclina corniculum (Olivi, 1792)				
154	*Cyclope neritea* (Linné, 1758)	Ma, An, RP	2	M, I, C: 8-12	SB
155	*Nassarius reticulatus* (Linné, 1758)	TC	5	Mm, Mi, I, C: 1-53	SD, SB
	Hinia reticulata (Linné, 1758)				
156	*Nassarius incrassatus* (Ström, 1768)	TC	4	Mm, Mi, I, C: 5-45	SD, SB
	Hinia incrassata (Ström, 1768)				
157	*Nassarius pygmaeus* (Lamarck, 1822)	Ab, RN, S, O, CM, RP, SJ	2	Mm, I, C: 5-32	SD, SB
	Hinia pygmaea (Linné, 1758)				
158	*Kryptos elegans* (Jeffreys, 1896)	Ma	2	C: 100	SD, SB: a
	Fusinus elegans (Jeffreys, 1896)				
159	*Fusinus pulchellus* (Philippi, 1844)	Ma	1	C: 100	SD, SB: a
160	*Mitra cornea* Lamarck, 1811	Ab, An	1	I	SD, SB
	Mitra nigra Gmelin in Linné, 1791				
	Mitra fusca AA. non Swainson, 1829				
161	*Crassopleura (Clavus) maravignae* (Bivona, 1838)	Ma	1	C: 100	SD, SB: a
162	*Mangelia attenuata* (Montagu, 1803)	Ab, Al, Ma, Al, RP, H, SJ	2	C: 8-100	SD, SB
163	*Mangelia coarctata* (Forbes, 1840)	Mu, An, CM, H	1	C: 5-100	SD, SB: a
	Cythara coarctata (Forbes, 1843)				
164	*Mangelia costata* (Donovan, 1804)	TC	1	C: 15-100	SD, SB
165	?*Mangelia smithi* (Forbes, 1840)	Ea, D, Zu	1	C: 32-45	SD, SB: a
166	*Mangelia wareni* Piani, 1980	Ma	1	C: 100	SD, SB: a
167	*Bela nebula* (Montagu, 1803)	CV, D, RP	1	C: 9,8-100	SD, SB
168	*Bela ornata* (Locard, 1897)	Ma	1	C: 100	SD, SB
169	*Bela septemvillei* (Monterosato in Dautzenberg, 1913)	Ma	1	C: 100	SD, SB
170	?*Bela powisiana* (Recluz, 1846)	SS	1	C: 25	SD
171	*Clathromangelia quadrillum* (Dujardin, 1837)	LA	2	M, I	SD
	Clathromangelia granum (Philippi, 1844)				
172	*Mangiliella bertrandi* (Payraudeau, 1826)	LA	2	M, I	SD
173	*Raphitoma echinata* (Brocchi, 1814)	Ma, J	1	I, C: 28,5-100	SD, SB
	Raphitoma reticulata (Renier, 1804)				
174	?*Raphitoma leufroyi* (Michaud, 1828)	Ab, Ma, G	1	C: 28,5	SD
175	*Raphitoma concinna* (Scacchi, 1836)	Ma, Al, Zu, H	1	C: 20-100	SD
176	*Raphitoma linearis* (Montagu, 1803)	Ma, CG, SJ	1	Mi, C: 5-100	SD
177	*Raphitoma purpurea* (Montagu, 1803)	TC	1	I, C: 5-30	SD, SB
	Clathurella purpurea (Montagu, 1803)				
178	*Raphitoma philberti* (Michaud, 1829)	H, SJ	1	C: 100	SD
179	*Comarmondia gracilis* (Montagu, 1803)	Ma	2	C: 100	SD, SB: a
180	*Omalogyra atomus* (Philippi, 1841)	Ma	1	C: 100	SD
181	*Ammonicera rota* (Forbes & Hanley, 1853)	Ma, Mu, An	2	I	SD
182	*Rissoella diaphana* (Alder, 1848)	CV, He	2	Mm, Mi	SD, SB
	Rissoella glabra (Brown, 1827)				
183	*Rissoella globularis* (Forbes & Hanley, 1853)	LA, S, Ma	2	I	SD, SB
	Jeffreysia globularis Forbes & Hanley, 1853				
184	*Rissoella opalina* (Jeffreys, 1848)	LA, S, Al, Ma, He	2	Mm, Mi, I	SD, SB
	Rissoella cylindrica (Jeffreys, 1856)				

Tabla II. Continuación.
Table II. Continuation.

	Especie	Distribución	Abundancia	Batimetría	Biotopo
185	*Chrysallida excavata* (Philippi, 1836)	Ab, Ma, SJ	1	C: 100	SB: a
186	*Chrysallida indistincta* (Montagu, 1808)	Ma, SJ	1	C: 100	SB: a
187	*Clathrella clathrata* (Philippi, 1844)	Ma, SJ	1	C: 100	SB: a
	Phasianema clathratulum (Philippi, 1844)				
	Phasianema costata (Brocchi, 1814)				
	Fossarus costatus (Brocchi, 1814)				
188	*Eulimella acicula* (Philippi, 1836)	Ab, Ma, I	1	C: 20-100	SB: a
189	*Odostomia plicata* (Montagu, 1803)	Ma, SJ	2	C: 100	SB: a
190	*Odostomia striolata* Alder in Forbes & Hanley, 1853	Ma	2	C: 100	SB: a
191	*Odostomia umbilicaris* (Malm, 1858)	Ma	2	C: 100	SB: a
192	*Odostomia acuta* Jeffreys, 1848	Ma, P	1	C: 13-100	SB
193	*Turbonilla lactea* (Linné, 1758)	Ab, Ma, M, J, SJ	1	C: 15-100	SB
	Turbonilla elegantissima (Montagu, 1803)				
194	*Turbonilla pusilla* (Philippi, 1844)	Ma	1	C: 100	SB: a
195	*Turbonilla delicata* Monterosato, 1874	Ma	1	C: 100	SB: a
196	3 *Turbonilla rufa* (Philippi, 1836)	Mu, D, M	1	C: 31-43	SB: a
197	1 *Turbonilla acuta* (Donovan, 1804)	Ab	1	C: 15-30	SB
198	*Chrysallida fenestrata* (Jeffreys, 1848)	Ma	1	C: 100	SB: a
	Tragula fenestrata (Jeffreys, 1848)				
199	*Acteon tornatilis* (Linné, 1758)	CV	3	I, C: 100	SB
200	*Retusa truncatula* (Bruguière, 1792)	CV, I, SS	2	I, C: 15-100	SB
	Retusa truncatella Locard, 1883				
201	*Cylichnina umbilicata* (Montagu, 1803)	CV, J, SJ	1	C: 15-100	SB
	Bulla umbilicata Montagu, 1803				
	Cylichnina subcylindrica (Brown, 1844)				
	Cylichnina nitidula (Loven, 1846)				
202	*Retusa mammillata* (Philippi, 1836)	Ma	3	I, C: 100	SB: a
	Mamilloretusa mammillata (Philippi, 1836)				
203	*Volvulella acuminata* (Bruguière, 1792)	Ea, P, H, SJ	1	C: 13-100	SB
204	3 *Ringicula auriculata* (Menard, 1811)	Ab, RN	1	C: 14	SB: f
	Marginella auriculata Menard, 1811				
205	*Ringicula conformis* Monterosato, 1875	Ab, Ma, SJ	1	C: 20-100	SB: a
206	*Philine aperta* (Linné, 1767)	Ab, Al, RN, P, H	2	I, C: 15-100	SB
	Philine quadripartita Ascanius, 1772				
207	3 *Philine catena* (Montagu, 1803)	CM, SJ	1	C: 15-25	SD
208	1 *Philine punctata* (Adams J., 1800)	Mo	1	C: 15	SD
209	1 *Philine scabra* (Müller, 1784)	Ab	1	C: 15-30	SB
	Philine loveni Malm, 1855				
210	*Scaphander lignarius* (Linné, 1758)	TC	1	I, C: 34-640	SB
211	*Scaphander punctostriatus* (Mighels & Adams, 1842)	Ma	1	C: 100	SB: a
212	3 *Cylichna cylindracea* (Pennant, 1777)	CV, D, M, SJ	1	C: 14-58	SB
213	1 *Aplysia punctata* (Cuvier, 1803)	Ga, CG, He	2	Mm, Mi, I, C: 5-15	SD
214	1 *Myosotella myosotis* (Draparnaud, 1801)	ROn	1	Mi	SB: a
	Ovatella myosotis (Draparnaud, 1801)				
215	1 *Onchidella celtica* (Cuvier, 1817)	CM, H	1	Mm, I	SD
	SCAPHOPODA				
216	2 *Dentalium dentalis* Linné, 1758	PG, I, M, PE2	2	C:70-500	SB
217	3 *Dentalium novemcostatum* Lamarck, 1818	P, J, SJ	1	C: 13-73	SB
218	*Dentalium vulgare* da Costa, 1768	Ba, Ma, He	1	C: 45-100	SD, SB: a

Tabla II. Continuación.
Table II. Continuation.

	Especie	Distribución	Abundancia	Batimetría	Biotopo
	BIVALVIA				
219	*Nucula nucleus* (Linné, 1758)	Ma, CG, SJ	2	I, C: 15-100	SD, SB
220	*Nucula hanleyi* Winckworth, 1931	Ma	2	C: 100	SB: a
221	*Nucula sulcata* Bronn, 1831	TC	2	I, C: 14-100	SD, SB
222	*Nucula tenuis* (Montagu, 1808)	Ma, I	1	C: 70-100	SB: a
223	*Nucula nitidosa* Winckworth, 1930	TC	3	C: 15-100	SB
	Nucula turgida Leckenby & Marshall, 1875				
	Nucula nitida Sowerby, 1833				
224	*Nuculana commutata* (Philippi, 1844)	Ma, J	3	C: 100	SB: f
	Arca fragilis Chemnitz, 1784				
225	1 *Nuculana pernula* Müller O. F., 1779	Al	1	C: 45	SD
226	*Pristigloma lenticula philippiana* (Nyst, 1843)	Ma	2	C: 100	SB
227	*Arca noae* Linné, 1758	Ga, Al	1	I, C: 15	SD, SB
228	*Arca (Tetrarca) tetragona* Poli, 1795	Ga, Ma, Al, Zu, H, SJ	1	I, C: 5-100	SD, SB
229	*Barbatia barbata* (Linné, 1758)	Ma	2	C: 100	SD
230	*Striarca lactea* (Linné, 1758)	TC	1	Mi, I, C: 5-30	SD, SB
231	*Glycymeris glycymeris* (Linné, 1758)	TC	2	I, C: 100	SB
232	*Glycymeris violacescens* (Lamarck, 1819)	Ma	2	C: 100	SB
	Arca insubrica Brocchi, 1814				
233	*Mytilus edulis* Linné, 1758	TC	5	S, M, I, C: 4-45	SD, SB
234	*Mytilus galloprovincialis* Lamarck, 1819	O, CL	3	Mi, I	SD
235	*Mytilaster minimus* (Poli, 1795)	TC	5	M, I, C: 5-25	SD, SB: a
236	*Crenella decussata* (Montagu, 1808)	Ma	1	C: 100	SD
237	1 *Crenella prideauxi* (Leach, 1815)	Mo	1	C: 15	SD
238	*Gregariella barbatella* (Cantraine, 1835)	TC	2	Mm, Mi, I, C: 5-40	SD
	Gregariella opifex Say, 1825				
	Gregariella petagnae Scacchi, 1832 (*nomen nudum*)				
239	*Gregariella semigranata* (Reeve, 1858)	Ga, SJ	1	Mi	SD
	Modiola subclavata Libassi, 1859				
240	1 *Musculus costulatus* (Risso, 1826)	Ga, Ma, CG, He	4	Mm, Mi, I, C: 5-40	SD
241	*Musculus discors* (Linné, 1767)	TC	4	S, M, I, C: 5-45	SD, SB: a
242	*Musculus subpictus* (Cantraine, 1835)	Ga, CG, SJ	1	Mi, C: 5-25	SD
	Musculus marmoratus Forbes, 1838				
243	1 *Adula simpsoni* (Marshall, 1900)	Al	1	I	SD
244	*Myoforceps aristata* (Dillwyn, 1817)	TC	5	S, M, I, C: 5-25	SD
	Myoforceps caudigera Lamarck, 1819				
245	*Modiolus barbatus* (Linné, 1758)	TC	3	M, I, C: 5-45	SD, SB
246	*Modiolus adriaticus* (Lamarck, 1819)	S, Ma, Bi	4	I, C: 100	SD
247	*Modiolus modiolus* (Linné, 1758)	CV, Al	1	Mm, Mi, C: 1-30	SD, SB
248	*Modiolula phaseolina* (Philippi, 1844)	TC	4	Mm, Mi, I, C: 5-42	SD, SB: a
249	2 *Pinna nobilis* Linné, 1758	PG	1	C: 150	SB
250	*Pteria hirundo* (Linné, 1758)	Ma, CG	2	I, C: 25-100	SA, SD
251	*Pecten maximus* (Linné, 1758)	Ma, P	1	C: 100	SB: a
252	*Chlamys multistriata* (Poli, 1795)	Ma	1	I, C: 100	SB: a
253	*Chlamys varia* (Linné, 1758)	Ma, H, SJ	1	I, C: 25-100	SD
254	*Chlamys furtiva* (Lovén)	Ma	1	C: 100	SB: a
255	*Chlamys sulcata* (Müller, 1776)	Ma	1	C: 100	SB: a
256	*Hinnites distorta* (da Costa, 1778)	Ma, SJ, Gy	1	C: 100	SB: a
257	*Hyalopecten similis* (Laskey, 1811)	Ma	2	C: 100	SB
258	*Palliolum incomparabile* (Risso, 1826)	Ma	1	C: 100	SD
	(citada también como *P. hyalinum*)				

Tabla II. Continuación.
Table II. Continuation.

	Especie	Distribución	Abundancia	Batimetría	Biotopo
259	*Pseudamussium septemradiatum* (Müller, 1776)	Ma	1	C: 100	SD
260	*Aequipecten opercularis* (Linné, 1758)	Ma	1	I, C: 100	SB
261	*Camptonectes striatus* (Müller, 1776)	Ma	1	C: 100	SB: a
262	*Peplum clavatum* (Poli, 1795)	Ma	1	I, C: 100	SB
263	*Anomia ephippium* Linné, 1758	TC	2	M, I, C: 5-45	SD, SB: a
264	1 *Pododesmus patelliformis* (Linné, 1761)	RO, CM	1	Mm, C: 4-15	SD, SB: f
265	1 *Pododesmus squama* (Gmelin, 1791)	Mo, Al	1	C: 15	SD
266	*Limaria hians* (Gmelin, 1791)	Ga, Zu, CL	1	Mi, I, C: 15	SD, SB
267	*Limatula subauriculata* (Montagu, 1808)	Ma	2	I, C: 100	SB: a
268	*Limea loscombii* (Sowerby G. B. I, 1820)	Ma	1	C: 100	SB
269	*Ostrea edulis* Linné, 1758	Me, Ga, CM, RP, H, He	2	M, I, C: 8	SD, SB: f
270	*Crassostrea gigas* (Thunberg, 1793)	TC	3	S, M, I	SD, SB
	Crassostrea angulata (Lamarck, 1819)				
271	*Neopycnodonte cochlear* (Poli, 1795)	TC	3	C: 100	SD
272	*Ctena decussata* (Costa O. G., 1829)	A, G	1	I	SD
	Ctena reticulata Poli, 1795				
273	*Loripes lacteus* (Linné, 1758)	SS, M	1	Mi, I	SD, SB: a
274	3 *Lucinella divaricata* (Linné, 1758)	Go, Ea, CG, SJ	1	Mm, C: 8-70	SB
275	*Myrtea spinifera* (Montagu, 1803)	Ab, Ma, J	1	C: 15-100	SB
276	*Lucinoma borealis* (Linné, 1767)	Ab, Ma, SJ	1	C: 15-100	SB
277	*Thyasira flexuosa* (Montagu, 1803)	CV, CG	4	I, C: 8-100	SD, SB
278	*Axinulus croulinensis* (Jeffreys, 1847)	Ma	1	I, C: 100	SB: f
279	*Lasaea rubra* (Montagu, 1803)	TC	2	S, M, I	SD, SB: a
280	*Galeomma turtoni* (G. B. Sowerby I, 1825)	RN, Zu, CL	1	I, C: 15-30	SD, SB
281	*Kellia suborbicularis* (Montagu, 1803)	TC	1	Mi, I, C: 12-45	SD, SB
282	*Montacuta goudi* van Aartsen, 1996d	Ma	1	C: 100	SD
	Montacuta cylindracea Smith E. A., 1885				
283	*Mysella bidentata* (Montagu, 1803)	TC	3	Mi, C: 1-100	SB
284	*Tellimya ferruginosa* (Montagu, 1808)	TC	3	C: 1-100	SB
285	*Epilepton clarkiae* (W. Clark, 1852)	CV, SS	1	Mi, I, C: 15-100	SD, SB
286	*Turtonia minuta* (Fabricius O., 1780)	Al, Ma, SS, H, He	1	Mm, Mi, C: 5-30	SD, SB
287	*Astarte sulcata* (da Costa, 1778)	Ma, RP	1	C: 22-100	SB
288	*Digitaria digitaria* (Linné, 1758)	Ab, Ma, On, Zu, He, SJ	1	C: 15-100	SD, SB
289	*Goodallia triangularis* (Montagu, 1803)	CV, SJ	1	I, C: 15-51	SD, SB
290	*Acanthocardia aculeata* (Linné, 1758)	Ab, Al, G, SJ	1	I, C: 15-30	SB
291	*Acanthocardia echinata* (Linné, 1758)	Ab, RN, G	1	I, C: 15-30	SB
292	*Acanthocardia tuberculata* (Linné, 1758)	TC	2	Mi, I, C: 12,5-30	SB
293	1 *Parvicardium exiguum* (Gmelin, 1791)	RP	1	C: 13,6	SB: f
	Parvicardium parvum Philippi, 1844				
	Parvicardium commutatum B. D. D., 1892				
	Parvicardium scriptum (B. D. D., 1892)				
294	*Parvicardium minimum* (Philippi, 1836)	RB, RN, Ma	2	I, C: 1-100	SB
295	*Parvicardium fasciatum* Montagu, 1803	CV, CG	2	Mm, I, C: 1-73	SD, SB
	Parvicardium ovale (G. B. Sowerby II, 1844)				
296	*Parvicardium scabrum* (Philippi, 1844)	RB, RN, Ma	2	I, C: 15-100	SB
	Parvicardium nodosum Turton, 1819				
297	3 *Plagiocardium papillosum* (Poli, 1795)	Mu, Al, Zu, H, SJ	1	C: 20-40	SD, SB: a
298	*Cerastoderma edule* (Linné, 1758)	TC	2	Mm, Mi, I, C: 1-30	E, SB
299	1 *Cerastoderma glaucum* (Poiret, 1789)	RBi	1	Mm	SB: a
	Cerastoderma lamarcki Reeve, 1844				

Tabla II. Continuación.
Table II. Continuation.

	Especie	Distribución	Abundancia	Batimetría	Biotopo
300	*Mactra stultorum* (Linné, 1758)	TC	2	I, C: 1-100	SB
	Mactra corallina Linné, 1758				
301	*Mactra glauca* (Von Born, 1778)	SS	2	I	SB: a
302	2*Mactra cinerea atlantica* Bucquoi, Dautzenberg & Dollfus, 1889	PG	2	C: 200	SB
303	3*Spisula solida* (Linné, 1758)	Ab, He	1	C: 15-30	SB
304	*Spisula elliptica* (Brown, 1827)	RB, Ab, Ma, O, SS, Bi	1	I, C: 1-100	SB
305	*Spisula subtruncata* (da Costa, 1778)	TC	2	I, C: 13-53	SB
306	3*Lutraria angustior* (Philippi, 1844)	Mu	1	C: 31	SB
307	3*Lutraria lutraria* (Linné, 1758)	Ab, G, SS	1	C: 21,5	SB
	Lutraria elliptica Lamarck, 1801				
308	*Pharus legumen* (Linné, 1758)	Ab, RG, SJ	1	Mi, C: 15-30	SB
309	*Solen marginatus* Pennant, 1777	TC	1	I, C: 4-30	SB
310	*Ensis ensis* (Linné, 1758)	RG, G, SS	3	I	SB: a
311	*Ensis minor* (Chenu, 1884)	RG, RBi	1	Mi	SB
	Ensis siliqua (Linné, 1758)				
312	1*Phaxas pellucidus* (Pennant, 1777)	Ab, Mu, Ea, M	1	C: 15-58	SB
313	*Tellina tenuis* da Costa, 1778	TC	2	I, C: 1-70	SD, SB
314	*Tellina crassa* Pennant, 1777	Ma	2	C: 100	SB
315	3*Tellina fabula* Gronovious, 1781	TC	2	C: 1-73	SD, SB
316	*Tellina incarnata* Linné, 1758	G, SS, RBi	1	I	SB
317	*Tellina donacina* Linné, 1758	TC	1	Mi, C: 6-100	SB: a
318	*Tellina pygmaea* Lovén, 1846	CV, SS, RBi, SJ	1	Mi, I, C: 34-70	SD, SB: a
	Tellina pusilla Philippi, 1836				
319	1*Tellina compressa* Brocchi, 1814	Al, M, RP, He	2	C: 9,5-70	SD, SB
320	1*Tellina serrata* Brocchi, 1814	M	1	C: 58	SB: a
321	*Donax vittatus* (da Costa, 1778)	TC	4	I	SB: a
322	*Donax (Capsella) variegatus* Gmelin, 1791	TC	2	I	SB: a
323	*Donax trunculus* Linné, 1758	TC	4	I	SB: a
324	*Gari depressa* (Pennant, 1777)	TC	3	I	SB: a
325	*Gari costulata* (Turton, 1822)	Ab, Ma, Mu	1	C: 15-100	SB
	Psammobia costulata Turton, 1822				
326	*Gari tellinella* (Lamarck, 1818)	Ma	1	C	SB: a
	Psammobia tellinella Lamarck, 1818				
327	3*Gari fervensis* (Gmelin, 1791)	Ab, RN, G, SS, SJ	1	C: 15-30	SB
	Psammobia fervensis (Gmelin in Linné, 1791)				
	Psammobia faeroensis Chemnitz, 1782 inv. I. C. Z. N. op. 144/1944				
328	*Scrobicularia plana* (da Costa, 1778)	TC	4	Mm, Mi, I, C: 1-30	SB
	Scrobicularia piperata Poiret, 1789				
329	1*Abra tenuis* (Montagu, 1803)	RB, RN	2	I, C: 1-30	SB
330	*Abra nitida* (Müller, 1789)	CV, J, RBi, Bi	2	I, C: 1-73	SB
331	*Abra prismatica* (Montagu, 1808)	CV, M, RP	2	I, C: 8-45	SB
332	*Abra alba* (W. Wood, 1802)	TC	4	Mm, C: 1-100	SD, SB
333	*Glossus humanus* (Linné, 1758)	O	1	C: 100	SB: f
334	*Venus verrucosa* Linné, 1758	TC	1	I, C: 9,8	SB
335	*Venus casina* Linné, 1758	CV, M	1	C: 15-100	SB
336	*Chamelea gallina* (Linné, 1758)	TC	2	I, C: 12-53	SB
	Chamelea gallina gallina (Linné, 1758)				
	Chamelea gallina striatula (da Costa, 1778)				
	Venus striatula (da Costa, 1778)				
337	*Clausinella (Venus) fasciata* (da Costa, 1778)	CV, M	1	C: 14-100	SB
338	*Timoclea ovata* (Pennant, 1777)	CV, CG	2	C: 1-100	SD, SB
339	*Gouldia minima* (Montagu, 1803)	TC	2	C: 13-73	SD, SB

Tabla II. Continuación.
Table II. Continuation.

	Especie	Distribución	Abundancia	Batimetría	Biotopo
340	*Dosinia lupinus* (Linné, 1758)	TC	2	Mm, Mi, I, C: 5-70	SB
	Dosinia lincta Pulteney, 1813				
341	*Dosinia exoleta* (Linné, 1758)	TC	4	I	SB: a
342	*Pitar rudis* (Poli, 1795)	Ma	1	C: 100	SB
343	*Callista chione* (Linné, 1758)	TC	5	I, C	SB
344	*Tapes decussatus* (Linné, 1758)	TC	2	Mm, Mi, I, C: 1-30	SB
345	*Irus irus* (Linné, 1758)	TC	2	M, I, C: 5-40	SD, SB
346	*Venerupis aurea* (Gmelin, 1791)	Ma, P	1	C: 100	SB
347	3*Venerupis rhomboides* (Pennant, 1777)	Al, RN, He, SJ	1	Mi, C; 15-30	SD, SB
348	*Venerupis senegalensis* (Gmelin, 1791)	TC	1	Mm, Mi, I, C: 15-30	SD, SB
	Venerupis geographica Chemnitz, 1784				
	Venerupis pullastra Montagu, 1803				
349	1*Venerupis saxatilis* (Fleuriau de Bellevue, 1802)	He	2	Mm, Mi	SD
350	*Petricola lithophaga* (Philippson, 1788)	TC	3	M, I, C: 25	SD, SB: a
351	3*Mysia undata* (Pennant, 1777)	Ab, SJ	1	C: 15-30	SB: f
352	*Sphenia binghami* Turton, 1822	Go, Ma, H, SJ	1	Mi, I, C: 25-34	SD, SB: a
353	*Corbula gibba* (Olivi, 1792)	TC	4	I, C: 8-100	SB
354	*Gastrochaena dubia* (Pennant, 1777)	TC	2	Mi, I, C: 5-25	SD
355	*Hiatella arctica* (Linné, 1767)	TC	4	S, M, I, C: 5-45	SD, SB
356	*Hiatella rugosa* (Pennant, 1777)	TC	1	Mi, C: 40	SD
357	*Pholas dactylus* Linné, 1758	Ar, A, SS, SJ	4	M, I	SD
	Pholas callosa Cuvier, 1817				
358	*Barnea (Anchomasa) parva* (Pennant, 1777)	Zu, G, SJ	1	Mi	SD
359	*Pholadidea loscombiana* Goodall in Turton, 1819	Ma	2	C: 100	SD
360	*Xylophaga dorsalis* (Turton, 1819)	Zu	2	M, I	SD
361	*Teredo navalis* Linné, 1758	Zu	2	M, I	SD
362	*Psiloteredo megotara* (Hanley, 1848)	SS	1	Mi	SD
363	*Thracia papyracea* (Poli, 1791)	G, SS, SJ	1	I	SB
364	1*Thracia villosiuscula* (Mac Gillivray, 1827)	F	1	C: 33	SB: a
365	*Pandora inaequivalvis* (Linné, 1758)	Ab, Mu, SS, SJ	2	Mi, C: 20-31	SD, SB: a
366	2*Cuspidaria rostrata* (Spengler, 1793)	PG	1	C: 200	SB
367	*Cardiomya costellata* (Deshayes, 1833)	Ma	1	C: 100	SB
368	*Mya arenaria* Linné, 1758	TC	4	I	SD
	CEPHALOPODA				
369	*Sepia officinalis* Linné, 1758	TC	5	I, C	D
370	2*Sepia elegans* de Blainville, 1827	PG	2	C: 150-200	PD
371	*Sepia orbignyana* Férussac, 1826	Ma	3	C: 100	D
372	*Sepietta oweniana* (Orbigny, 1840)	PG	3	C: 150-200	PD
373	*Rossia macrosoma* (Delle Chiaje, 1830)	A, Ea, On	3	C: 290-370	D
374	2*Neorossia caroli* (Joubin, 1902)	PE2	1	C: 500	PD
375	*Illex coindetti* (Vérany, 1839)	Ea, On	5	C: 100-330	PD
376	*Todaropsis eblanae* (Ball, 1841)	Ea, SS, PE	4	C: 100-640	PD
377	*Loligo vulgaris* Lamarck, 1798	TC	5	C	PD
378	*Loligo forbesi* Steenstrup, 1856	Ea, PE1	4	C: 100-450	PD
379	*Alloteuthis media* (Linné, 1758)	Zu, H	4	C: 92-155	PD
380	*Alloteuthis subulata* (Lamarck, 1798)	Zu	3	C: 92	PD
381	*Opisthoteuthis agassizii* Verrill, 1883	PE1	3	C: 650	D
382	*Octopus macropus* Risso, 1826	Ea, Zu	3	C: 165-333	B
383	*Octopus vulgaris* Cuvier, 1798	TC	5	I, C	SD
384	2*Eledone cirrosa* (Lamarck, 1798)	PG, PE2	2	C: 150-500	PD
385	*Bathypolipus sponsalis* (Fischer & Fischer, 1892)	PE1	4	C: 450-630	B

Tabla III. Lista de especies citadas en la Costa Vasca que no han sido localizadas en los últimos 22 años por AZTI; la especie se nombre en primer lugar, a continuación se dan los posibles nombres con los que se ha mencionado también en la costa vasca. Para abreviaturas, ver Tabla I.
Table III. List of species cited in the Basque coast not found in the last 22 years by AZTI; the species is named first, possible names used to cite the species in the Basque coast are also included. Abbreviations shown in Table I.

	Especie	Distribución
	GASTROPODA	
1	*Emarginula sicula* Gray J. E., 1825	
	Emarginula rosea Bellini, 1829	SJ
2	*Osilinus sauciatus* (Koch, 1845)	
	Monodonta colubrina (Gould, 1852)	
	Monodonta sauciata (Koch, 1845)	
	Monodonta sagittifera Hidalgo non Lamark	St, CG
3	*Jujubinus striatus* (Linné, 1758)	G
4	*Truncatella subcylindrica* (Linné, 1767)	SJ
5	*Plagyostila asturiana* Fischer P. in de Folin, 1872	SJ
6	*Pusillina philippi* (Aradas & Maggiore, 1844)	
	Turboella dolium (Nyst, 1843)	Bi, SJ
7	*Parastrophia asturiana* Folin, 1870	SJ
8	*Dizoniopsis bilineata* (Hörnes, 1848)	SJ, Gy
9	*Melanella jeffreysi* (Tryon, 1886)	
	Eulima jeffreysi (Tryon, 1886)	CV
10	*Fossarus ambiguus* (Linné, 1758)	SJ, Gy
11	*Haedropleura septangularis* (Montagu, 1803)	
	Bellaspira septangularis (Montagu, 1803)	SJ
12	*Bela laevigata* (Philippi, 1836)	
	Mangelia nebula var. *Laevigata* (Philippi, 1836)	SJ
13	*Ringicula gianninii* Nordsieck, 1974	
	Ringicula nitida Verrill A. E., 1872	Ab
14	*Haminoea navicula* (da Costa, 1778)	
	Haminoea cornea (Lamarck, 1822)	SJ
15	*Odostomia scalaris* McGillivray, 1843	
	Odostomia rissoides Hanley, 1844	SJ
16	*Odostomia interstincta* Philippi, 1844	SJ
17	*Chrysallida pellucida* (Dillwyn, 1817)	
	Partulida spiralis (Montagu, 1803)	SJ
18	*Cylichna semisulcata*	SJ
	BIVALVIA	
19	*Pseudopythina macandrewi* (P. Fischer, 1867)	
	Pseudopythina setosa autoc. Non Dunker, 1864	CG
20	*Laevicardium crassum* (Gmelin in Linné, 1791)	Bi
21	*Gastrana fragilis* (Linné, 1758)	SS
22	*Coralliophaga lithophagella* (Lamarck, 1819)	G
23	*Barnea candida* (Linné, 1758)	Zu, G
24	*Lyrodus pedicellatus* (Quatrefages, 1849)	P
	CEPHALOPODA	
25	*Spirula spirula* (Linné, 1758)	SS

se aproximaría bastante a los de las otras dos provincias, ya que las especies más abundantes ya han sido identificadas.

Según la Clase, se encuentran:

- en las tres provincias (al menos una estación por provincia): 5 Poliplacóforos (3,5%), 67 Gasterópodos (47,2%), 66 Bivalvos (46,5%) y 4 Cefalópodos (2,8%).
- en Bizkaia: 6 Poliplacóforos (1,9%), 178 Gasterópodos (55,6%), 1 Escafópodo (0,3%), 126 Bivalvos (39,4%) y 9 Cefalópodos (2,8%).
- en Gipuzkoa: 7 Poliplacóforos (2,8%), 123 Gasterópodos (48,8%), 2 Escafópodos (0,8%), 110 Bivalvos (43,7%) y 10 Cefalópodos (4%).
- en Lapurdi: 5 Poliplacóforos (2,6%), 98 Gasterópodos (50%), 3 Escafópodos (1,5%), 81 Bivalvos (41,3%) y 9 Cefalópodos (4,6%).
- por toda la Costa Vasca (al menos 7 estaciones en total): 4 Poliplacóforos (3,8%), 50 Gasterópodos (48,1%), 47 Bivalvos (45,2%) y 3 Cefalópodos (2,9%).

Por otro lado, cabe destacar la gran abundancia de especies que aparece en el Cabo de Matxitxako, en Bizkaia, con 243 (75,9% de las especies encontradas en Bizkaia).

Si se tuviese que destacar alguna estación en Gipuzkoa, habría que tener en cuenta la del Cabo de Higer, donde se encuentran 149 especies (59,1%), y la rasa de Algorri con 140 (55,6%).

La mayoría de las especies (300; 77,9%) son circalitorales, aunque sólo 164 (42,6%) no aparecen en zonas intermareales o supralitorales. Además, más de la mitad (258; 67%) viven en sustrato blando; pero sólo 145 (37,7%) se han encontrado exclusivamente en este tipo de biotopo, mientras que el resto se han localizado también en sustrato rocoso.

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BIBLIOGRAFÍA

ANADÓN, N., 1979. Poliplacóforos de las costas asturianas I: Estudios taxonómicos. *Suplemento Ciencias Boletín IDEA* 24: 119-130

BONNIN, J. Y RODRÍGUEZ, C., 1990. Catálogo provisional de los moluscos bivalvos marinos de la plataforma continental de las costas mediterráneas de la Península Ibérica y de las Islas Baleares. *Iberus*, 9 (1-2): 97-110.

BORJA, A., 1987. Catálogo de los moluscos marinos de la costa vasca. *Iberus*, 7 (2): 211-223

BOUCHET, P., 1984. Les Triphoridae de Mediterranée et du proche Atlantique (Mollusca, Gastropoda). *Lavori SIM*, 21: 5-58.

BOUCHET, P., 1997. Nouvelles observations sur la systematique des Triphoridae de Mediterranée et du Proche Atlantique. *Bolletino Malacologico*, 31 (9-12): 205-220.

BOUCHET, P. Y GUILLEMOT, H., 1978. The *Triphora perversa*-complex in Western Europe. *Journal of Molluscan Studies*, 44: 344-356.

BOUCHET, P. Y WARÉN, A., 1980. Revision of the North-East Atlantic bathyal and abyssal Turridae (Mollusca, Gastropoda). *Journal of Molluscan Studies*, supplement 8: 1-119.

Bouchet, P. y Warén, A., 1985. Revision of the North-East Atlantic bathyal and abyssal Neogastropoda excluding Turridae (Mollusca, Gastropoda). *Bolletino Malacologico*, supplemento 1: 8: 120-296.

Bouchet, P. y Warén, A., 1986. Revision of the North-East Atlantic bathyal and abyssal Aclididae, Eulimidae, Epitoniidae (Mollusca, Gastropoda). *Bolletino Malacologico*, supplemento 2: 297-576.

Bouchet, P. y Warén, A., 1993. Revision of the North-East Atlantic bathyal and abyssal Mesogastropoda. *Bolletino Malacologico*, supplemento 3: 577-840.

CLEMAM. Unitas Malacologica Check List of European Marine Mollusca. Internet site (current URL http://www.mnhn.fr/base/malaco.html).

Fretter, V. y Graham, A., 1976. The Prosobranch molluscs of Britain and Denmark Part 1. Pleurotomariacea, Fissurellacea and Patellacea. *Journal of Molluscan Studies*, supplement 1: 21-37.

Fretter, V. y Graham, A., 1977. The Prosobranch molluscs of Britain and Denmark Part 2: Trochacea. *Journal of Molluscan Studies*, supplement 3: 38-100.

Fretter, V. y Graham, A., 1978a. The Prosobranch molluscs of Britain and Denmark Part 3: Neritacea, Viviparacea, terrestrial and freshwater Littorinacea and Rissoacea. *Journal of Molluscan Studies*, supplement 5: 101-152.

Fretter, V. y Graham, A., 1978b. The Prosobranch molluscs of Britain and Denmark Part 4: Marine Rissoacea. *Journal of Molluscan Studies*, supplement 6: 153-241.

Fretter, V. y Graham, A., 1980. The Prosobranch molluscs of Britain and Denmark Part 5: Marine Littorinacea. *Journal of Molluscan Studies*, supplement 7: 242-284.

Fretter, V. y Graham, A., 1981. The Prosobranch molluscs of Britain and Denmark Part 6: Cerithiacea, Strombacea, Hipponicacea, Calyptraecea, Lamellariacea, Cypreacea, Naticacea, Tonnacea, Heteropoda. *Journal of Molluscan Studies*, supplement 9: 285-363.

Fretter, V. y Graham, A., 1982. The Prosobranch molluscs of Britain and Denmark Part 7: Heterogastropoda (Cerithiopsacea, Triforacea, Epitoniacea, Eulimacea). *Journal of Molluscan Studies*, supplement 11: 364-434.

Fretter, V. y Graham, A., 1985. The Prosobranch molluscs of Britain and Denmark Part 8: Neogastropoda. *Journal of Molluscan Studies*, supplement 15: 438-556.

Fretter, V., Graham, A. y Andrews, E. B., 1986. The Prosobranch molluscs of Britain and Denmark Part 9, Pyramidellacea. *Journal of Molluscan Studies*, supplement.16: 557-649.

Ghisotti, F. y Melone, G. C., 1969. Catalogo illustrato delle conchiglie marine del Mediterraneo. *Conchiglie*, 5 (11-12).

Ghisotti, F. y Melone, G. C., 1970. Catalogo illustrato delle conchiglie marine del Mediterraneo. *Conchiglie*, 6 (3-4).

Ghisotti, F. y Melone, G. C., 1971. Catalogo illustrato delle conchiglie marine del Mediterraneo. *Conchiglie*, 7 (1-2).

Ghisotti, F. y Melone, G. C., 1972. Catalogo illustrato delle conchiglie marine del Mediterraneo. *Conchiglie*, 8 (11-12).

Ghisotti, F. y Melone, G. C., 1975. Catalogo illustrato delle conchiglie marine del Mediterraneo. *Conchiglie*, 11 (11-12).

Giannuzzi-Savelli, R., Pusateri, F., Palmeri, A. y Ebreo, C., 1994. *Atlante delle conchigglie marine del mediterranea / Atlas of the Mediterranean seashells*. Vol. 1 (*Archaeogastropoda*). Edizione de "La Conchiglia", Roma, 112 pp.

Giannuzzi-Savelli, R., Pusateri, F., Palmeri, A. y Ebreo, C., 1997. *Atlante delle conchigglie marine del mediterranea / Atlas of the Mediterranean seashells*. Vol. 2 (*Caenogastropoda* parte 1: *Discopoda-Heteropoda*). Edizione de "La Conchiglia", Roma, 258 pp.

Giannuzzi-Savelli, R., Pusateri, F., Palmeri, A. y Ebreo, C., 1999. *Atlante delle conchigglie marine del mediterranea / Atlas of the Mediterranean seashells*. Vol. 3 (*Caenogastropoda* parte 2: *Ptenoglossa*). Edizione de "La Conchiglia", Roma, 127 pp.

Giribet, G. y Peñas, A., 1997. Fauna malacológica del litoral del Garraf (NE de la Península Ibérica). *Iberus*, 15 (1): 41-93.

Gofas, S. y Ponder, W.F., 1991. The habitat and relationships of *Plagyostila asturiana* (Gastropoda, Rissoidae). *Bulletin Muséum nationale d'Histoire naturelle*, Paris, 4 sér., section A (1-2): 39-47.

Guerra, A., 1992. *Fauna Ibérica, Vol. 1: Mollusca, Cephalopoda*. Museo Nacional de Ciencias Naturales, Consejo Superior de Investigaciones Científicas, Madrid, 227 pp. + 12 láms.

Kaas, P., 1979. On a collection of Polyplacophora (Mollusca, Amphineura) from the Bay of Biscay. *Bulletin du Mussée National d'Histoire Natural de Paris* 4 (1), A (1): 13-31.

Kaas, P., 1981. Scandinavian species of *Leptochiton* Gray 1847 (Mollusca, Polyplacophora). *Sarsia* 66: 217-229.

Kaas, P., 1985. The genus *Acanthochitona* Gray, 1821 (Mollusca, Polyplacophora) in the northeastern Atlantic Ocean and in the Mediterranean Sea, with designation of neotypes of *A. fascicularis* (L., 1767) and of *A. crinita* (Pennant, 1777).. *Bulletin du Mussée National d'-Historie Natural de Paris* 7 (3), A (4): 579-609.

Leloup, E. y Volz, P., 1938. Die Chitonen (Polyplacophoren) der Adria. *Thalassia* 2 (10): 3-64.

MARIOTTINI, P., SMRIGLIO, C. Y OLIVERIO, M., 2000. The *Ringicula leptocheila* complex, with the description of a new species (Opistobranchia: Ringiculidae). *Bolletino Malacologico*, 36 (5-8): 71-82.

MATTHEWS, G., 1953. A key for use in the identification of British Chitons. *Proceedings of the Malacological Society of London*, 29: 241-248.

MURILLO, L., 1998. Taxones publicados en Iberus (1981-1997). *Iberus*, 155 p.

NORDSIECK, F., 1968. *Die Europäischen Meeres-*Gehäuseschnecken (Prosobranchia) Gustav Fischer Verlag, Stuttgart, 273 pp.

NORDSIECK, F., 1969. *Die Europäischen Meeresmuscheln (Bivalvia)*. Gustav Fischer Verlag, Stuttgart, 256 pp.

NORDSIECK, F., 1972. *Die Europäischen Meeresschnecken (Opisthobranchia mit Pyramidellidae, Rissoacea)*. Gustav Fischer Verlag, Stuttgart, 326 pp.

NORDSIECK, F., 1977. *The Turridae of the European Seas*. Ed. La Piramide, Roma, 131 pp.

NORDSIECK, F., 1982. *Die Europäischen Meeres-Gehäuseschnecken*. 2 Auflage. Gustav Fischer Verlag, Stuttgart, 359 pp.

PARENZAN, P., 1970. *Carta d'identità delle conchiglie del Mediterraneo. Vol. 1. Gasteropodi.* Ed. Bios Taras, Taranto, 238 pp.

PARENZAN, P., 1974. *Carta d'identità delle conchiglie del Mediterraneo. Vol. 2 (1). Bivalvi.* Ed. Bios Taras, Taranto, 277 pp.

PARENZAN, P., 1976 *Carta d'identità delle conchiglie del Mediterraneo. Vol. 2 (2). Bivalvi.* Ed. Bios Taras, Taranto, 277-546 pp.

PONDER, W. F., 1989. Mediterranean Cingulopsidae, a relect eastern Tethyan fauna (Gastropoda: Cingulopsoidea). *Bolletino Malacologico*, 25: 85-90.

POPPE, G. T. Y GOTO, Y., 1991. *European Seashells Vol I (Polyplacophora, Caudofoveata, Solenogastra, Gastropoda)*. Verlag Christa Hemmen, Wiesbaden, 352 pp.

POPPE, G. T. Y GOTO, Y., 1993. *European Seashells Vol II (Scaphopoda, Bivalvia, Cephalopoda)*. Verlag Christa Hemmen, Wiesbaden, 221 pp.

REID, D. G., 1996. *Systematics and evolution of Littorina*. The Ray Society, London, 463 pp.

ROLÁN MOSQUERA, E., 1983. *Moluscos de la Ría de Vigo I: Gasterópodos*. Velograf, Santiago de Compostela, 383 pp.

ROLÁN MOSQUERA, E., OTERO, J. Y ROLÁN ÁLVAREZ, E., 1989. *Moluscos de la Ría de Vigo II: Poliplacóforos, Bivalvos, Escafópodos y Cefalópodos.* Revista de ciencias del mar Thalassas, Anexo 2, 276 pp.

ROLÁN, E., DANTART, L. Y FERNANDES, F., 1997. On some dark species of *Mitra* from the Mediterranean and the Atlantic. *La Conchiglia*, 285: 11-23.

RUBIO, F. Y RODRÍGUEZ BABÍO, C., (1995) 1996. La familia Cingulopsidae (Gastropoda: Prosobrnachia: Cingulopsidae) en las costas españolas, con la descripción de una especie nueva. *Iberus*, 13 (2): 23-33.

SABELLI, B., GIANUZZI-SAVELLI, R. Y BEDULLI, D., 1990-1992. *Catalogo annotato dei molluschi marini del Mediterraneo*. Vol. 1 (1990), Vol. 2 (1992), Vol. 3 (1992). Libreria Naturalistica Bolognese, Boloña, 781 pp.

SABELLI, B. Y SPADA, G., 1977. Guida illustrata all'identificazione delle conchiglie del Mediterraneo. *Conchiglie*, 13(3-4), 13(7-8), 13(9-10), 13(11-12).

SABELLI, B. Y SPADA, G., 1978. Guida illustrata all'identificazione delle conchiglie del Mediterraneo. *Conchiglie*, 14(3-6), 14(9-10), 14(11-12).

SABELLI, B. Y SPADA, G., 1979. Guida illustrata all'identificazione delle conchiglie del Mediterraneo. *Bolletino Malacologico*, 15(3-4), 15(7-8).

SABELLI, B. Y SPADA, G., 1980. Guida illustrata all'identificazione delle conchiglie del Mediterraneo. *Bolletino Malacologico*, 16(1-2), 16(7-8).

SABELLI, B. Y SPADA, G., 1981. Guida illustrata all'identificazione delle conchiglie del Mediterraneo. *Bolletino Malacologico*, 17(3-4), 17(11-12).

SABELLI, B. Y SPADA, G., 1982. Guida illustrata all'identificazione delle conchiglie del Mediterraneo. *Bolletino Malacologico*, 18(5-6).

TEBBLE, N., 1966. *British Bivalve Seashells*. Royal Scotish Museum, Edinburgh, 212 pp.

VERDUIN, A., 1988. On the taxonomy of some Rissoacean species from Europe, Madeira and Canary Islands (Gastropoda: Prosobranchia). *Basteria*, 52: 9-35.

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Vexing question on fisheries research: the study of cephalopods and their parasites

Un asunto embarazoso en investigación pesquera: el estudio de los cefalópodos y sus parásitos

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ABSTRACT

For the beginning of this century it is evident that support for research will be increasingly dependent upon the results of that research having relevance to society's needs and public benefits. Within this web and coupled with the transfer of scientific knowledge is the opportunity to more effectively explain the society the benefits it receives for its investments in research. This viewpoint paper enlighten the general public on the scientific, industrial and commercial relevance of the research on cephalopods and their parasites. In a comparative analysis with other commercially-important taxa, a historical negligible financial support for research on diseases in this important animal group was noted. Because of that policy-makers on Fisheries Research should balance this public debt in the future.

RESUMEN

En el comienzo de este siglo es evidente que el apoyo a la investigación se incrementará en función de la relevancia que para las necesidades de la sociedad y de los beneficios públicos se obtenga de los resultados de dicha investigación. En este contexto y paralelamente a la transferencia de conocimientos científicos, surge la oportunidad de explicar más eficazmente a la sociedad los beneficios que recibe de su inversión en investigación. El punto de vista de este artículo ilustra al público en general sobre la relevancia científica, industrial y comercial de la investigación de los cefalópodos y sus parásitos, así como de la histórica e insignificante financiación destinada a la investigación de las enfermedades en este importante grupo animal. Un análisis comparativo con otros taxones comercialmente importantes, sugiere que los gestores de la política de Investigación Pesquera deberían equilibrar esta deuda pública en el futuro.

KEY WORDS: cephalopod, parasite, fisheries research.
PALABRAS CLAVE: cefalópodo, parásito, investigación pesquera.

INTRODUCTION

Cephalopods are fast-growing carnivorous molluscs that play an important role in the trophic webs of marine ecosystems (CLARKE, 1996). Moreover, cephalopod stocks are of great international importance in commercial fishe-

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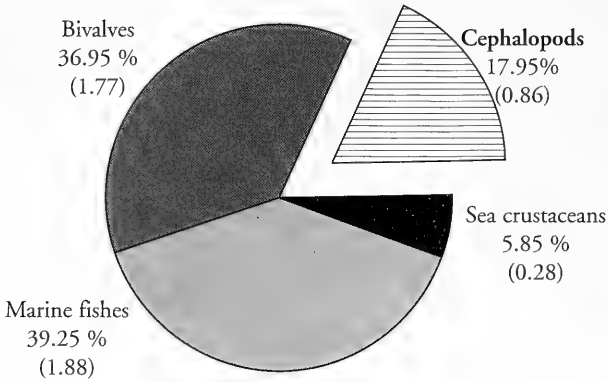

Figure 1. Percentage values and ratios (in parentheses, ¥10-6) which represent the relative scientific effort by nominal catch unit for each group of species. Ratios are calculated as the total number of publications that address parasitology and associated-pathology (mean for the period 1992-98: source of information in Biological Abstracts) and the nominal catch per group of species (mean number for the period 1992-98: source of information in F.A.O., 2000).
Figura 1. Porcentajes y ratios (en paréntesis ¥10-6) que representan el esfuerzo científico relativo por unidad de captura nominal para cada grupo de especies. Los ratios se han calculado como número total de publicaciones sobre parasitología y patología asociada (media del periodo 1992-98; fuente: Biological Abstracts) y la captura nominal para cada grupo de especies (media para el periodo 1992-98; fuente: F.A.O., 2000).

ries (BOYLE, 1990; GUERRA, 1992; JOSUPEIT, 1995). World catch statistics record a total catch of 3.5 million metric tons in 1999 (JOSUPEIT, 2000), with a rate of increase significantly greater than that for finfish species for the period 1970-1992 (BOYLE, 1990; CADDY, 1995). For the combined marine catch, all categories, between 1970-1992 there was an increase rate of 2%per year. In contrast, for cephalopods, the rate of increase over the same period averaged 8% per year. Because of their importance as a human food resource (PIERCE AND GUERRA, 1994) and because cephalopods have proved to be valuable as experimental animals for biomedical and behavioural research (GILBERT, ADELMAN AND ARNOLD, 1990; ABBOT, WILLIAMSON AND MADDICK, 1995; HANLON AND MESSENGER, 1996), scientists have spent considerable time and money studying cephalopods in the last two decades: how many species are there, how long do they live, how fast do they grow, how do they respond to changes in fishing intensity and environmental conditions, how do they find food, escape from enemies, migrate, signal to one another and reproduce, how does their nervous system function and what is their fishery potential in terms of biomass. By comparison, in the last decade marine scientists have devoted very little time and money to the study of cephalopod parasites and parasite-induced pathology in wild and cultivated populations.

SCIENTIFIC PRODUCTIVITY

Among 700,000 scientific papers a year published around the world (see Scientific Citation Index), almost nothing is written on cephalopod diseases (Fig. 1). Based on current trends there also appears to be an overall decline in the number of recent papers that treat taxonomy and basic research on parasites of other, non-commercial marine invertebrates. This may be due in part to the loss of parasite workers (specially taxonomists) through lack of funding support or redirection of research efforts to the study of human pathogens or ecological studies. Nevertheless, despite the obvious scarcity of scientific effort, recent world literature has stressed the important role of squids, cuttlefishes and octopuses as reservoirs for all taxa of marine eukariotic parasites at both macro- and micro-geographic sampling levels (HOCHBERG, 1990; PASCUAL, GESTAL, ESTEVEZ, RODRIGUEZ, SOTO, ABOLLO AND ARIAS, 1996). Most large free-living, mature cephalopods carry some microscopic (viruses, bacteria, fungi, protists) and macroscopic parasites (metazoans) in almost all their tissues and organs (HOCHBERG, 1990). This author, in an extensive survey of the literature, record a total of 225 parasite species in cephalopods world-wide. Since the HANLON AND FORSYTHE (1990) review on diseases caused by microorganisms and the HOCHBERG (1990) contribution on diseases caused by protistans and metazoans, only 32 scientific papers have dealt with cephalopod pathology. Of these, only 16 papers have been published in international scientific journals, 4 of these being chapter reviews within a zoological and/or fisheries biology context. Despite the fact that cephalopod landings have increased over the period 1992-1998, the number of people involved in this field and the number of papers on cephalopod pathology is still remarkably low. In fact, the scientific effort dealing with cephalopod parasites and associated pathology related to relative nominal catch by group of species account less than 54% of that on parasitic diseases of other commercially-important invertebrates (bivalve molluscs) and marine fish (Fig. 1). Why is this so?

Diversity of hosts *versus* number of researchers is a key factor. Thus, there are approximately 700 species of cephalopods and very few researchers compared with about 100,000 species of fishes and numerous researchers. Nevertheless, the scientific productivity with regard to papers on cephalopod parasites actually is not too bad considering how few researchers there are in the field.

THE SPANISH POLICY

In this context, we may look at the Spanish situation which is comparable with other fish-catching countries in Europe. Spain is the fifth largest cephalopod consuming country in the world, the first in Europe. In Spain cephalopods represent an important component of the diet (4 Kg./inhabitant/per year), yet no financing has been directed at research on cephalopod parasitic diseases. Although over 4 million US $ per year is assigned by Plan Nacional de Investigación y Desarrollo (Comisión Interministerial de Ciencia y Tecnología) to Research and Development (hereafter RandD) to finance research activities and projects on Marine Science and Technology, nothing was assigned to the investigation of cephalopod diseases in the last decade. In this context, it is relevant that cephalopod landings in Spain (averaging 110,000 metric tons per year for that period) contributed 308,000,000 US $ per year to our domestic economy. It seems quite remarkable that at least a small portion of the money derived from the fishery and manufacture processes profits should be returned to support research on diseases of wild and cultured cephalopods. The absence of support for a technology transfer mechanism clearly indicates that the responsibilities of the Spanish research funding agencies does not closely follow current fishing trends to support both established and emerging activities as the management of the ecological impact of parasitism in wildlife and cultured populations are (GRENFELL AND GULLAND, 1995). In other words, this indicates that in this field the Science-Technology-Industry Spanish System (STISS) still has an imbalance between the scientific and productive spheres. As regards STISS (involving parasitologists), it appears to be particularly stimulated by the production of scientific publications and thus, the most important yardstick to promote researches is the number of publications within the Scientific Citation Index (SCI). STISS lacks, however, of sufficient support to employ young trained scientists in research activities and seems to be insufficiently motivated by the food technological and sanitary aspects that imply a suitable development of the research on parasitic-caused cephalopod pathologies. In the case of Food technology, STISS have an important drawback which is the low level of interest of many private companies to deal with the necessary innovation of its products or processes. Consequently, financial and human resources being assigned by public policy and the private sector to develop research activities aimed at a scientific assessment of the impact of infectious processes in cephalopod stocks are patently insufficient. This situation is made worse when public organizations or businessmen have to solve serious problems related to the treatment and control of cephalopod diseases at present day in industrial processes. And the situation will be still worse if, following the successful results in experimental rearing of planktonic common octopus from hatching to settlement (Villanueva, 1995) and on growing of this species in floating cages (Hebberecht, 1996; Moral-Rama, 1996; Guerra, unp. data), the industrial culture of the octopuses become a business that rent good profits. In this regard, a recent study by the Industrial Research and Development Advisory Committee of the European Commission (1994) warns of the obvious danger of economic stagnation, unless there is a greater coordination between the productive system (extraction or production, processing and marketing of the resource) and the much-needed scientific environment (comprising the RandD groups).

FUTURE RESEARCH DIRECTIONS

In this article we should not forget some of the general trends emerging from the study of cephalopod parasitic diseases in the 1990's. Such a brief synopsis is urgently required in the light of the many advances which have been made utilizing new techniques.

Although older reports of infectious diseases emphasized description and systematic classification of cephalopod parasites, considerable confusion exists. The identifications of the parasites and sometimes even the hosts are often in doubt, with high synonymy rates (close to 70%) for numerous parasitic nominal species identified by light microscopy (Pascual, Arias and Guerra, 1995; Mattiucci, Nascetti, Cianchi, Paggi, Arduino, Margolis, Brattey, Webb, Dámelio, Orecchia and Bullini, 1997). Researchers trained in modern techniques, new trends in systematic, and improved technologies for detecting and defining species have allowed us to elucidate and re-evaluate the taxonomic status and the host-parasite relationships of many already described species. For example, recent papers dealing with scanning and transmission electron microscopy (SEM and TEM) and atomic force microscopy (AFM) studies have showed how much a combination of increased depth of field, resolution and magnification is needed in the identification and examination of the morphology, microtopography, topometry and cell biology of cephalopod parasites and the host-parasite interface (Gestal, Pascual, Corral and Azevedo, 1999).

Additionally, our understanding of the epizootiology (which involves investigations on the demographic infection values, patterns of transmission, and disease control) of many parasitic species in cephalopods is severely hampered by morphological characters of difficult interpretation The existence of morphologically identical cryptic species and parasitic races or morphotypes which can reflect selection pressure rather than taxonomic affiliation are problems faced by all taxonomists, but present particular difficulties because of the plasticity of body structures in endoparasites. Moreover, when histological, isolation and purification processes and parasitic dissection techniques are all needed to reveal diagnostic characters of some protozoan and metazoan ectoparasites, respectively, a high degree of skill (and training) is required. A number of molecular techniques should be developed to overcome these problems and should be applied worldwide as useful taxonomic tools for parasite detection and their species identification in cephalopods.

Diseases and pathology caused by microparasites on wild and cultured cephalopods have been reported in a few cases (HANLON AND FORSYTHE, 1990; POYNTON, REIMSCHUESSEL AND STOSKOFF, 1992; GESTAL, 2000). However, it should be noted that in Spain, during the massive culture of paralarvae and juveniles in system crowding, high mortalities rates have been assigned to several environmental factors including diseases by bioagressors (GESTAL, ABOLLO AND PASCUAL, 1998). Furthermore, despite cephalopod macroparasites typically have been considered symbionts (HOCHBERG, 1990), histopathological analysis on heavily parasitized cephalopods revealed the destruction of vital organs and potential loss of their functionality (PASCUAL, 1996; ABOLLO, GESTAL, LOPEZ, GONZALEZ, GUERRA AND PASCUAL, 1998). Unfortunately, in the past although attention has been paid to the presence of parasitic diseases in wild cephalopods, most of the early studies can be classified as single or short-time observations. Seasonal and continuous long-term parasite studies are missing, resulting in the current absence of reliable data to be used in comparative analysis. These data will improve our knowledge about whether present disease prevalence in wild exploited cephalopod stocks exceed natural prevalence, change with abiotic parameters and/or are influenced by host exploitation rates and discarding practices. These studies will be also very useful for mapping the existence of hot-spot areas by using the grid systems of International Fishery Organisations. To obtain base-line data, cephalopod disease recording in standard stock-assessment surveys is potentially useful since it agrees with demographic parameters observed during special cephalopod disease surveys in the same area (PASCUAL, 1996).

Although an extensive literature dealing with diseases and defence mechanisms is available for other commercially-important molluscs, little emphasis has been placed on the defence mechanisms of cephalopods. Despite humoral and cellular defence associated responses having been described for cephalopods maintained in closed sea-water systems for biomedical studies or fattening against potential bacterial pathogens (HANLON AND FORSYTHE, 1990; FORD, 1992), the effects of other microscopic and macroscopic parasites on phagocyte capabilities, inflammation, wound healing and functional morphology of cephalopod haemocytes has not been investigated in depth. The study of inmunobiology of cephalopods is just starting (MALHAM, 1996; MALHAM , DUNHAM AND SECOMBES, 1997). A better understanding of host defence reactions in cephalopods would also help to avoid or control outbreaks of parasitic diseases in commercial mariculture conditions where animal densities, intensive husbandry and stress may increase occurrence of parasitic disease. Because cephalopods are a food source in many regions of the world, the effects of parasitic infections on the biochemical composition and physiological characteristics including condition, growth rate, nutrient assimilation and protein/energy ratio of cephalopods in nature and culture systems should also be evaluated.

Most wildlife parasitic diseases have been investigated via pathological post-mortem examinations, or by producing lists of parasites identified in small samples of hosts. There have been few attempts to assess the impact of a disease at the population rather than individual level, or to describe the distribution of the disease agent in a manner sufficient to understand its epidemiology. PASCUAL, GESTAL AND ABOLLO (1997) considered the statistical distribution of parasites throughout the host species population, and confirmed the negative effect of gill macroparasites on the condition of exploited ommastrephid stocks. That study clearly suggests the existence of causal relationships, expressed in negative modifications of ecological potential, between parasitic infection and cephalopod stock productivity. Finally, an economic loss is present (PASCUAL, GONZALEZ AND GUERRA, 1998). Although further biochemical data on infected and parasite-free cephalopod tissues should be recorded to ascertain the physiological interactions between cephalopods and parasitic infections, parasites may have a considerable effect on infected stocks or individuals, as has been recently noted by GESTAL (2000). Less obvious to most fisheries scientists is the important role of parasites in regulating the general "well-being or fitness" of the host population (i.e. in regulating host abundance or fecundity). To this end, we should attempt to blend mathematical models for host-parasite relationships with those used by fisheries biologists to determine how parasites can affect the dynamics of exploited cephalopod populations, following the seminal articles of CROFTON (1971), ANDERSON AND MAY (1978, 1979), SINDERMANN (1987), DOBSON AND MAY (1987) and GRENFELL AND GULLAND (1995). The complications introduced by the presence of parasitic disease will in general further increase the levels of uncertainty that cephalopod fisheries managers have to contend with (BEDDINGTON, 1984), this mostly in relation to cephalopod condition and its potential fecundity (i.e., its recruitment dynamics).

Roughly 10% of the known species of living cephalopods (i.e. over 80 of the 700 known species) have been either maintained, reared or cultured in captivity (BOLETZSKY AND HANLON, 1983). The vast majority of these 82 species (representing 30 genera) have mainly been maintained or reared, while 12 species (7 genera) have been cultured through their entire life cycle (HANLON, 1987). No signs of diseases were ever observed during small-scale production, but when large-scale culture in high density groups was initiated, fatal infectious diseases occurred (HANLON, FORSYTHE, COOPER, DINUZZO, FOLSE AND KELLY, 1984; GESTAL *ET AL*., 1998). In Spain, where cephalopod mariculture is changing from experimental to industrial sphere, implementation of procedures for detection and monitoring the pathology and parasitic diseases on a wide scale in the ongrowing cephalopod industry should be common, together with other yet established diseases assessment policy (e.g. on cultured fishes and bivalve molluscs).

Furthermore, parasitoses in cephalopods appears not only as an important problem in the management of infected stocks, but also a zoonotic problem during food-processing. Larval stages of macroparasites are found in many species of squids, cutlefishes and octopuses, which are of commercial importance. The appearance of parasites makes cephalopods unsightly and unappealing to consumers. Moreover, although several species of anisakid nematodes and trypanorhynch cestodes, at the larval stage, can be pathogenic if consumed in raw or improperly cooked cephalopod dishes, few cases of illness by helminths in man have been reported in Spain (ABOLLO *ET AL*., 1998).

Cephalopod ecologists may also benefit by applying new ideas such as the study of the host-parasite systems. PASCUAL AND HOCHBERG (1996) revised the use of parasites as non-intrusive natural tags of cephalopod hosts in fisheries science. Protozoan and metazoan parasites have been used to assess the status of current stocks of several commercially-exploited cephalopod species. Few examples of the trophic status of cephalopods within food webs and their parasite community structure are available from the literature. The quantification of genetic variation obtained from allozyme frequencies among or within populations of larval anisakid nematodes (i.e., the parasite most frequently employed as tags for marine organisms and the most commonly encountered macroparasite in cephalopods) can provide valuable data on trophic relationships and stock identity of most wild cephalopod stocks.

Through workshops and symposia CIAC (Cephalopod International Advisory Council) aims to present current research and to stimulate and promote future research. Among the almost 40 symposia and workshops on cephalopods held by fisheries biologists from 1973, the 1996 workshop on cephalopod parasites developed on behalf of Commission Internationale pour l'Exploration Scientifique de la Mer Méditerranée (CIESM) by Boletzsky and Hochberg (Laboratory Arago, Banuyls-sur-mer, France) was the first attempt to provide on the parasite diseases processes of wild and reared cephalopods. The contents of this workshop established itself as the main introductory handbook of working techniques on cephalopod parasitology.

Today is well-established that support for research is increasingly dependent upon the results of that research having relevance to society's needs and public benefits. Coupled with the transfer of knowledge is the opportunity to more effectively explain to fisheries managers and companies the benefits they receive for their investments in research (MURRELL, 1996). Bearing in mind all the comments above, we feel that few cephalopod parasitologists have succeeded well in communicating many aspects of scientific and technical knowledge, but they have been less effective in enlightening the general public and private partnerships on the societal value and economic relevance of their research contributions. To overcome this it is imperative to encourage public and private managers, fisheries scientists and parasitologists to contact each other to go one step further in the 2[1th] century.

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BIBLIOGRAPHY

ABOLLO, E., GESTAL, C., LÓPEZ, A., GONZÁLEZ, A. F., GUERRA, A AND PASCUAL, S., 1998. Squids as trophic bridges for parasite flow within marine ecosystems: the case of *Anisakis simplex* or when the wrong way can be right. *South African Journal of Marine Science*, 20: 223-232.

ABBOT, N. J., WILLIAMSON, L. AND MADDICK, L., 1995. *Cephalopod neurobiology. Neuroscience studies in squid, octopus and cuttlefish.* Oxford University Press, Oxford, 542 pp.

ANDERSON, R. M. AND MAY, R. M., 1978. Regulation and stability of host-parasite population interactions. I. Regulation processes. *Journal of Animal Ecology*, 47: 219-247.

ANDERSON, R. M. AND MAY, R. M., 1979. Population biology of infectious diseases: Part I. *Nature*, 280: 361-367.

BEDDINGTON, J. R., 1984. Management under uncertainty. In May, R. M. (Ed.): *Exploitation of Marine Communities.* Dahlem Workshop 32, Springer Verlag, Berlin, pp 227-244.

BOLETZSKY, S.V. AND HANLON, R. T., 1983. A review of the laboratory maintenance, rearing and culture of cephalopod molluscs. *Memoirs of the National Museum of Victoria*, 44: 147-187.

BOYLE, P.R., 1990. Cephalopod biology in the fisheries context. *Fisheries Research*, 8: 303-321.

CADDY, J. F., 1995. Cephalopod and demersal finfish stocks: some statistical trends and biological interactions. *Squid'94 Venice International Cephalopod Trade Conference Proceedings.* Agra Europe London Ltd, 25 pp.

CLARKE, M. R., 1996. Role of cephalopods in the world's oceans. *Philosophical Transactions of the Royal Society of London* B, 351 (1343): 977-1112.

CROFTON, M. D., 1971. A model of host-parasite relationships. *Parasitology*, 63: 343-364.

DOBSON, A. P. AND MAY, R. M., 1987. The effects of parasites on fish populations- theoretical aspects. *International Journal for Parasitology*, 17: 363-370.

F.A.O., 2000. Yearbook-Fishery Statistics-Capture production. Vol. 86/1. Food and Agriculture Organisation of the United Nations, Rome 2000: 713 pp.

FORD, L. A., 1992. Host defence mechanisms of cephalopods. *Annual Review of Fish Diseases*, pp. 25-41.

GESTAL, C., 2000. *Epidemiología y patología de las coccidiosis en cefalópodos*. Ph.D. Thesis. Universidad de Vigo, Vigo. España.

GESTAL, C., ABOLLO, E. AND PASCUAL, S., 1998. Rickettsiales-like organisms in the gills of reared *Octopus vulgaris* (Mollusca, Cephalopoda). *Bulletin of the European Association of Fish Pathologists*, 18 (1): 13-14.

GESTAL, C., PASCUAL, S., CORRAL, L. AND AZEVEDO, C., 1999. Ultrastructural aspects of the sporogony of *Aggregata octopiana* (Apicomplexa, Aggregatidae), a coccidian parasite of *Octopus vulgaris* (Mollusca, Cephalopoda) from NE Atlantic coast. *European Journal of Protistology*, 35: 417-425.

GILBERT, D. L., ADELMAN, W. J. AND ARNOLD, J. M., 1990. *Squid as Experimental Animals*. Plenum Press, New York and London, 516 pp.

GRENFELL, B. T. AND GULLAND, F. M. D., 1995. Introduction: ecological impact of parasitism on wildlife host populations. *Parasitology*, 111 (Suppl), S3-S14.

GUERRA, A., 1992. Cephalopod resources of the world: a present day view. *Squid'91 Madrid International Cephalopod Trade Conference Proceedings*. Agra Europe London Ltd, 1-15.

HANLON, R. T., 1987. Mariculture. In Boyle, P. R. (Ed.): *Cephalopod life cycles. Vol. II*. Academic Press London, 291-305.

HANLON, R. T. AND FORSYTHE, J. W., 1990. Diseases of Mollusca: Cephalopoda. Diseases caused by microorganisms. In Kinne, O (Ed.): *Diseases of Marine Animals*. Biologisches Anstalt Helgoland, Hamburg. Vol. III, 23-46.

HANLON R. T. AND MESSENGER, J. B., 1996. *Cephalopod Behaviour*. Cambridge University Press, 232 pp.

HANLON, R. T., FORSYTHE, J. W., COOPER, K. M., DINUZZO, A. R., FOLSE, D. S. AND KELLY, M. T., 1984. Fatal penetrating skin ulcers in laboratory reared octopuses. *Journal of Invertebrate Pathology*, 44: 67-83.

HEBBERECHT, C., 1996. *Experiencia de cultivo intensivo de pulpo (Octopus vulgaris) en su fase de engorde en artefacto flotante*. Memoria. Consellería de Pesca, Marisqueo e Acuicultura. Xunta de Galicia. Santiago de Compostela. Spain, 5 pp.

HOCHBERG, F. G., 1990. Diseases of Mollusca: Cephalopoda. *Diseases caused by protistans and metazoans*. In Kinne, O (Ed.): *Diseases of Marine Animals*. Biologisches Anstalt Helgoland, Hamburg. Vol. III, 47-227.

IRDAC (Industrial Research and Development Advisory Committee of the European Commission), 1994. *Quality and Relevance: the challenger to European Education*. Unlocking Europe's Human Potential. E.C. March: 156 pp.

JOSUPEIT, H., 1995. World supply and markets. In: *Squid 94 Venice. The 3rd International Cephalopod Trade Conference*. Agra-Europe (London). Ltd: 13 pp.

JOSUPEIT, H., 2000. Los mercados mundiales de cefalópodos. *Productos del Mar*, Noviembre-Diciembre: 43-48.

MALHAM, S. K., 1996. *Inmunobiology of Eledone cirrhosa* (Lamarck) Ph. D. Thesis, University of Wales, Bangor, U.K.

MALHAM, S. K., DUNHAM, N. W., SECOMBES, C. J. 1997. Phagocytosis by haemocytes from the lesser octopus *Eledone cirrhosa*. *Iberus*, 15(2): 1-11.

MATTIUCCI, S., NASCETTI, G., CIANCHI, R., PAGGI, L., ARDUINO, P., MARGOLIS, L, BRATTEY, J., WEBB, S., D'AMELIO, S., ORECCHIA, P. AND BULLINI, L., 1997. Genetic and ecological data on the *Anisakis simplex* complex, with evidence for a new species (Nematoda, Ascaridoidea, Anisakidae). *Journal of Parasitology*, 83 (3): 401-416.

MORAL-RAMA, A., 1996. *Estudios bioquímicos e histológicos de cefalópodos relacionados con la aplicación de tecnologías convencionales y nuevas y con el control de calidad*. Informe final del proyecto TS3 CT93-0109.

MURRELL, K., 1996. Communications: technology transfer in the developed world. *Veterinary Parasitology*, 64: 107-120.

PASCUAL, S., 1996. *Los sistemas hospedador-parásito en la pesquería de ommastréfidos de Galicia*. Ph.D. Thesis, Universidad de Vigo, Vigo, España.

PASCUAL, S. AND HOCHBERG, F. G., 1996. Marine parasites as biological tags of cephalopod hosts. *Parasitology Today*, 12 (8): 324-327.

PASCUAL, S., ARIAS, C. AND GUERRA, A., 1995. Electrophoretic identification of L3 larvae of *Anisakis simplex* (Ascaridida: Anisakidae), parasites of squids in NE Atlantic. *Research and Reviews in Parasitology*, 55(4): 239-241.

PASCUAL, S., GESTAL, C. AND ABOLLO, E., 1997. Effect of *Pennella* sp. (Copepoda, Pennellidae) on the condition of *Illex coindetii* and *Todaropsis eblanae* (Cephalopoda, Ommastrephidae). *Bulletin of the European Association of Fish Pathologists*, 17 (3/4): 91-95..

PASCUAL, S., GONZÁLEZ, A. F. AND GUERRA, A. 1998. Effect of parasitism on the productivity of the ommastrephid stocks in Galician waters (NW Spain): economic loss. *Iberus*, 16 (2): 95-98.

PASCUAL, S., GESTAL, C., ESTÉVEZ, J., RODRÍGUEZ, H., SOTO, M., ABOLLO, E. AND ARIAS, C., 1996. Parasites in commercially-exploited cephalopods (Mollusca, Cephalopoda) in Spain: an updated perspective. *Aquaculture*, 142: 1-10.

PIERCE, G. AND GUERRA, A., 1994. Stock assessment methods used for cephalopod fisheries. *Fisheries Research*, 21: 255-285.

POYNTON, S. L., REIMSCHUESSEL, R. AND STOSKOFF, M. K., 1992. *Aggregata dobelli* n.sp. and *Aggregata millerorum* n. sp. (Apicomplexa: Aggregatidae) from two species of *Octopus* (Mollusca: Octopodidae) from the Eastern North Pacific Ocean. *Journal of Protozoology*, 39 (1): 248-256.

SINDERMANN, C. J., 1987. Effects of parasites on fish populations: practical considerations. *International Journal for Parasitology*, 17: 371-382.

VILLANUEVA, R., 1995. Experimental rearing and growth of planktonic *Octopus vulgaris* from hatching to settlement. *Canadian Journal of Fisheries and Aquatic Sciences*, 52: 2639-2650.

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Fusinus malhaensis sp. nov., a new species from Saya de Malha, Indian Ocean (Gastropoda: Fasciolariidae)

Fusinus malhaensis spec. nov., una nueva especies de Saya de Malha, Océano Índico (Gastropoda: Fasciolariidae)

Roland HADORN*, Koen FRAUSSEN** and Igor BONDAREV***

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ABSTRACT

Fusinus malhaensis sp. nov. is described from Saya de Malha Bank in the western Indian Ocean and compared to *F. colus* (Linnaeus, 1758), *F. longissimus* (Gmelin, 1791), *F. forceps* (Perry, 1811), *F. salisburyi* Fulton, 1930 and *F. multicarinatus* (Lamarck, 1822).

RESUMEN

Se describe *Fusinus malhaensis* spec. nov. de Saya de Malha Bank en el oeste del Océano Índico y se compara con *F. colus* (Linnaeus, 1758), *F. longissimus* (Gmelin, 1791), *F. forceps* (Perry, 1811), *F. salisburyi* Fulton, 1930 y *F. multicarinatus* (Lamarck, 1822).

KEY WORDS: Gastropoda, Fasciolariidae, *Fusinus*, new taxon, Saya de Malha, Indian Ocean.
PALABRAS CLAVE: Gastropoda, Fasciolariidae, *Fusinus*, nuevo taxon, Saya de Malha, Oceano Índico.

INTRODUCTION

F. malhaensis is one of the numerous new sea shell species collected by scientists and fishermen of the former USSR on the Saya de Malha Bank, a seamount which is part of the Mascarene Ridge in the Western Indian Ocean (8° 02′ S - 12° 00′S, 59° 30 ′E - 62° 30′ E). Five specimens are studied justifying the following description.

SYSTEMATICS

Family FASCIOLARIIDAE Gray, 1853
Genus *Fusinus* Rafinesque, 1815

Type species *Murex colus* Linnaeus, 1758 (by monotypy)

Fusinus malhaensis sp. nov. (Figs. 1-9)

Type material: Holotype : Muséum national d'Histoire naturelle (MNHN), Paris (149.8 x 42.3 mm), southwestern part of Saya de Malha Bank, collected by an Ukrainian fishing boat in 1992, 200-300

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m deep, dead collected, spire tip and tip of siphonal canal broken. (Figs. 1, 2). Paratype 1: Coll. Bondarev (141.0 mm), same data. Paratype 2: Coll. Hadorn (141.7 x 36.2 mm), same data, dead collected, spire tip broken. (Figs. 3, 4). Paratype 3: Coll. Fraussen (174.3 x 41.1 mm), same data, subadult, dead collected, spire tip broken. (Figs. 5, 6)

Material examined: The type material, and one dead collected specimen with same data (91.0 x 36.0 mm, coll. Hadorn), most probably a dwarf form (Figs. 7, 8).

Etymology: Named after the type locality Saya de Malha, derived from "Malha".

Type locality: 11° 46′ S, 59° 33′ E, southwestern part of Saya de Malha Bank, Mascarene Ridge, Indian Ocean, 200-300 m deep, on sandy silt.

Description: Shell large (91-175 mm), elongate, fusiform, conspicuously thin, light in weight, spire high, siphonal canal long, straight. Protoconch and spire tip broken in all available specimens, leaving 9 remaining whorls. Original number of teleoconch whorls 11 or 12 by estimation.

Upper whorls rounded, middle whorls with peripheral keel, lower whorls with small pointed knobs. Suture deeply incised, shoulder slope straight or convex.

Upper whorls with 7 or 8 narrow, rounded axial ribs extending from suture to suture. Interspaces weakly impressed, about as broad as ribs. On following whorls 7-10 axial ribs, withdrawing from both sutures and gradually transforming in small pointed knobs. 7-11 knobs on penultimate and 8-12 on body whorl.

Spiral sculpture consisting of conspicuously fine spiral cords and fine intercalated threads. 5 or 6 primary cords on uppermost remaining whorls. On following whorls, a secondary thread appears between primary cords, becoming as strong as primary ones on next whorls. On following whorls, fine intercalated tertiary threads between primary and secondary ones. Their number increasing by intercalation to up to 6 on latter whorls. Primary and secondary cords becoming weaker and tertiary threads becoming slightly stronger, sometimes from penultimate whorl on. Finally, all spirals have about the same strength on body whorl. Primary cord at periphery forming the strongest cord of carinated whorls. Spiral sculpture crossed by fine growth lines, giving the surface a uniform, minutely granulated appearance.

Aperture ovate, white. Outer lip simple, slightly crenulated with numerous rather strong, close-set internal lirae. Parietal callus strongly developed, outer edge free and detached from lower part of body whorl, surface of callus smooth or with some weak irregular folds. Columellar folds absent.

Siphonal canal conspicuously long, slender, straight. Outer side ornamented with weak spirals on upper half of siphonal canal, lower half almost smooth.

Uniformly white, one specimen (dwarf form) with brown coloured axial knobs. Periostracum, operculum and radula unknown.

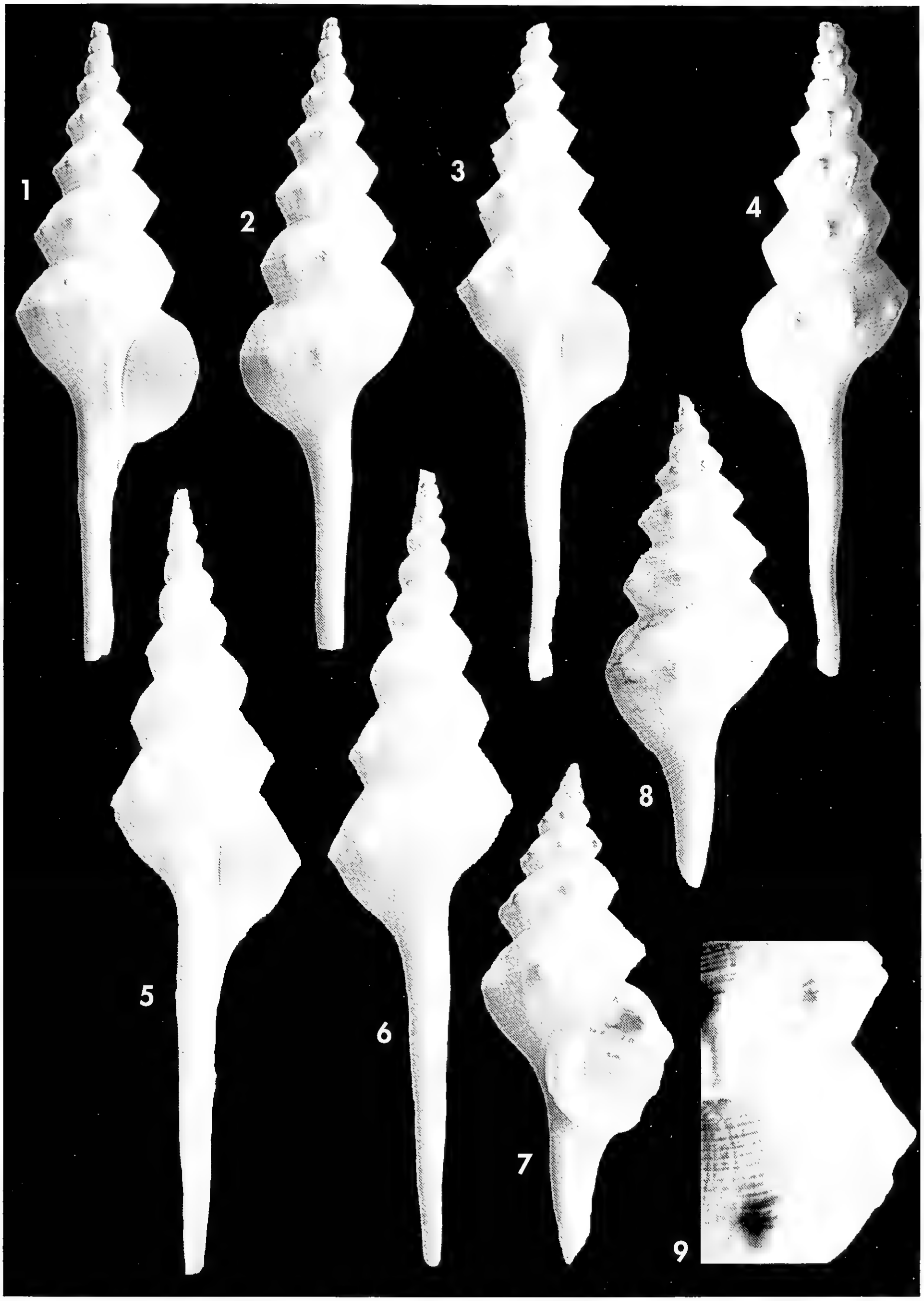
Range and habitat: Only known from the type locality, 200-300 m deep on sandy silt. Probably endemic.

Discussion: Little is known about this striking species because only five dead collected specimens without protoconch, periostracum and animal have been collected. However, the shell of *F. malhaensis* is conchologically characteristic for *Fusinus* s.s. and similar to the type species *F. colus* (Linnaeus, 1758).

F. malhaensis is easily recognizable and characterized by the conspicuously fine spiral sculpture, the large, elongate and light-weight shell, by the straight or clearly convex shoulder slope, and by the unicarinated lower whorls.

F. colus differs in having a stronger spiral sculpture with a smaller number of spirals, a less constricted suture, usually a smaller adult size, a thicker shell, white axial ribs with brown-coloured interspaces at least on upper whorls, and often a red-brown tinged spire and siphonal canal.

F. longissimus (Gmelin, 1791) can be distinguished by the stronger spiral sculpture, the smaller number of spiral



Figures 1-9. *Fusinus malhaensis* sp. nov., Saya de Malha Bank, 200-300 m deep. 1, 2: holotype MNHN, 149.8 mm; 3, 4: paratype 2, coll. Hadorn, 141.7 mm; 5, 6: paratype 3, coll. Fraussen, 174.3 mm; 7, 8: coll. Hadorn, 91 mm, dwarf form; 9: detail of shell sculpture on penultimate whorl.
Figuras 1-9. Fusinus malhaensis *sp. nov., Saya de Malha Bank, 200-300 m de profundidad. 1, 2: holotipo MNHN, 149,8 mm; 3, 4: paratipo 2, coll. Hadorn, 141,7 mm; 5, 6: paratipo 3, coll. Fraussen, 174,3 mm; 7, 8: coll. Hadorn, 91 mm, forma enana; 9: detalle de la escultura de la concha en la penúltima vuelta.*

cords, the less constricted suture, the clearly heavier and thicker shell, the usually straight or concave shoulder slope and by the darker coloured interspaces between the axial ribs on upper whorls.

F. forceps (Perry, 1811) and *F. salisburyi* Fulton, 1930 have both a conspicuously strong spiral sculpture, a clearly smaller number of spiral cords, a slightly channeled suture, a broader spire angle, a stronger and broader siphonal canal, and finally a thicker and heavier shell. Moreover, *F. forceps* has unkeeled whorls.

F. multicarinatus (Lamarck, 1822) from Somalia has a broader spire angle, ventricose whorls, a heavier and thicker shell, a stronger spiral sculpture, less numerous spirals, a less constricted suture, and a broader and shorter siphonal canal.

BIBLIOGRAPHY

FULTON, H. C., 1930. Descriptions of new species of *Fusinus, Biplex, Trochus,* and *Bushia. Proceedings of the Malacological Society*, 19: 16, pl. 2, fig.1.

GMELIN, J. F., 1791. *Caroli a Linné Systema naturae per regna tria naturae, Vermes*: 3021-3910. Leipzig/Germany.

GRAY, J. E., 1853. On the division of ctenobranchous gasteropodus Mollusca into larger groups and families. *Proceedings of the Zoological Society of London*, 21: 32-44, figs. 1-26.

LAMARCK, J. B. P. A. DE M. DE, 1822. *Histoire naturelle des Animaux sans vertèbres*, 7. Paris.

LINNAEUS, C. VON., 1758. *Systema naturae per regna tria naturae*. Editio decima, reformata. Vol. 1, Regnum animale. Stockholm, 824 pp.

PERRY, G., 1811. *Conchology, or the natural history of shells*. London, pp. 1-4, pls. 1-61 and expl.

RAFINESQUE, C. S., 1815. *Analyse de la nature ou tableau de l'univers et des corps organizes*. Palerme, 224 pp. [Included in: The complete writings of Constantine Smalz Rafinesque on Recent & fossil conchology edited by W.G. Binney and G.W. Tryon. New York: Bailliere Brothers. 1864. Reprinted 1984.]

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The superfamily Pyramidelloidea Gray, 1840 (Mollusca, Gastropoda, Heterostropha) in West Africa. 9. The genus *Clathrella*

La superfamilia Pyramidelloidea Gray, 1840 (Mollusca, Gastropoda, Heterostropha) en África Occidental. 9. El género *Clathrella*

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ABSTRACT

Clathrella volumen n. sp., the only West Africa species of the genus *Clathrella* is described here. Comparison of the new species with *C. clathrata* and *C. sulcosa* demonstrates they can be distinguished on the basis of shell characters.

RESUMEN

Se revisa la única especie del género *Clathrella* encontrada en África Occidental que se describe como nueva para la ciencia. La nueva especie es comparada con otros taxones próximos como *C. clathrata* y *C. sulcosa* diferenciándola en base a los caracteres de la concha.

KEY WORDS: Pyramidelloidea, *Clathrella*, West Africa, new species.
PALABRAS CLAVE: Pyramidelloidea, *Clathrella*, África Occidental, nuevas especies

INTRODUCTION

BROCCHI (1814: 298, pl. 1, figs. 3a,b) described *Nerita sulcosa*, a fossil species, from the Pliocene outcrops near Piacenza (North Italy). This material appears to be more properly assigned to the pyramidellid genus *Clathrella*.

Most of the older works on the African molluscan fauna, mentions a species that appears to belong to the taxon of Brocchi, but which is frequently placed in the Vanikoridae. NICKLÉS (1950) recorded *Fossarus sulcosus*, present in the european Miocene and Pliocene, and live collected material from Mauritania. ROLÁN AND FERNANDES (1993) recorded similar material under the same name, from São Tomé in a checklist of the species of the archipelago. ROLÁN AND RYALL (1999) referred this material to *Clathrella sulcosa*, in the Pyramidellidae.

In our studies we have reached the conclusion that the recent African species is different from the fossil *N. sulcosa* of Brocchi and therefore it is described as new in the present work.

Abbreviations:

MHNM Museo Civico di Storia Naturale, Milano
MNHN Muséum National d'Histoire Naturelle, Paris

* Carrer Olérdola, 39, 5º C, 08800 Vilanova i la Geltrú, (Barcelona).
** Cánovas del Castillo, 22, 36202 Vigo (Pontevedra).

MNCN Museo Nacional de Ciencias Naturales, Madrid
CAP collection A. Peñas, Vilanova i la Geltrú
CER collection E. Rolán, Vigo
CJP collection J. Pelorce, Le Grau du Roi
sp specimen with soft parts
s empty shell
j juvenile

RESULTS

Order HETEROSTROPHA
Superfamily PYRAMIDELLOIDEA
Familia AMATHINIDAE Ponder, 1987

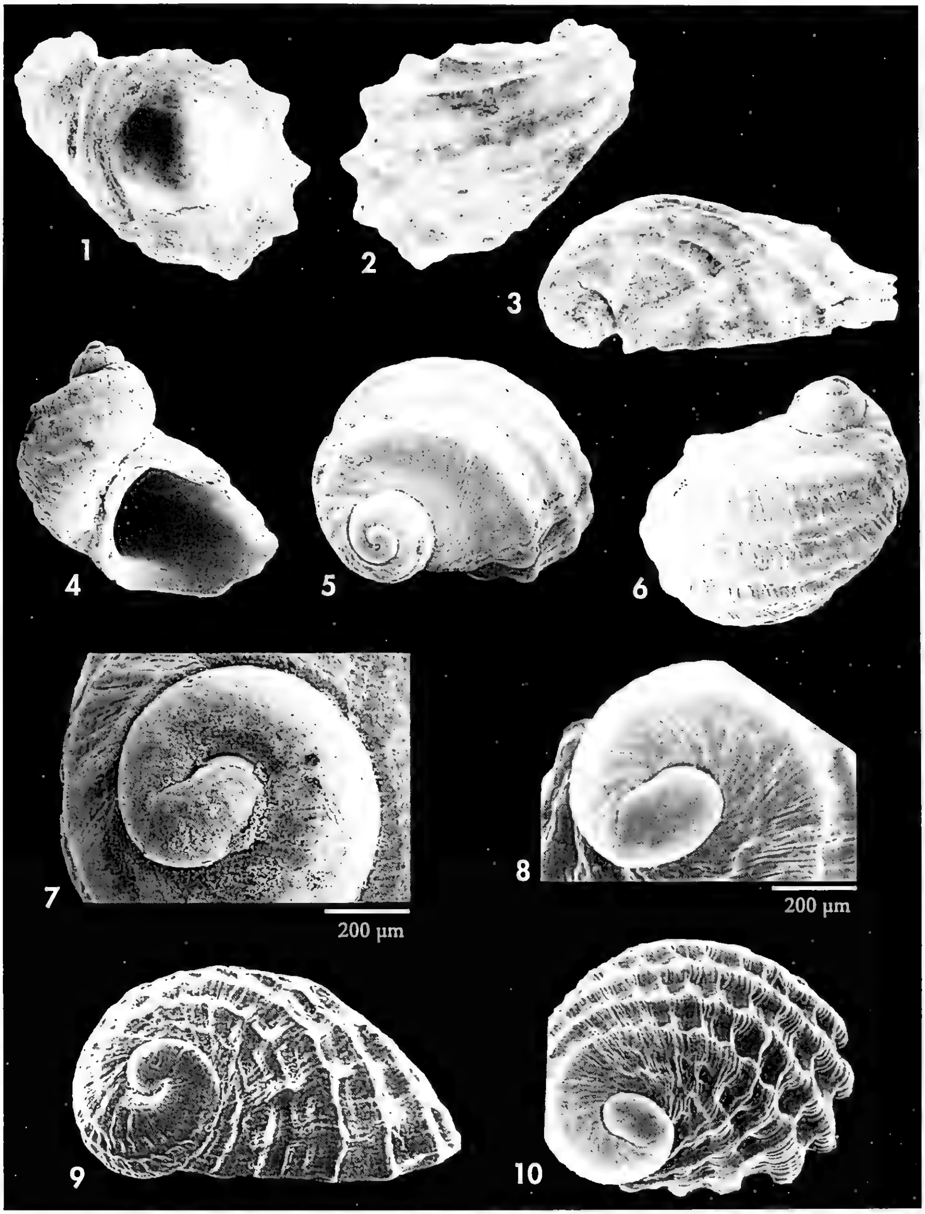
Genus *Clathrella* Rëcluz, 1864

Type species: *Nerita costata* Brocchi, 1814, by original designation.

Clathrella volumen spec. nov. (Figs. 8-16)

Type material: Holotype (Figs. 11-13) in the MNHN; paratypes in MNCN (1), CAP (1), CER (1), from the type locality; 61 paratypes in MNHN from Guinea Conakry: Expeditions "Sedigui" and "Chalgui 7": 1 s, W of the Ile de Los/Conakry, stn. B11DW, 9° 30'N 15° 09.6'W, 45 m (MNHN); 10 s, W of the Ile de Los/Conakry, stn. 261, 9° 30'N 14° 02'W, 25 m (MNHN); 7 s, W of the frontier of Sierra Leona, stn. 71, 9° 05.9'N 13° 35'W, 23 m (MNHN); 1 s, W of the frontier of Sierra Leona, stn. 72, 9° 06'N 13° 32'W, 16 m (MNHN); 1 s, W of the frontier of Sierra Leona, stn. 69, 9° 06' N 13° 41' W, 23 m (MNHN); 3 s, W of the frontier of Sierra Leona, stn. B27DW, 9° 06.6' N 14° 04' W, 45-47 m (MNHN); 1 s, W of Kaporo, stn. 276, 9° 36' N 14° 06' W, 18 m (MNHN); 2 s, W of Kaporo, stn. 277, 9° 36' N 14° 09' W, 23 m (MNHN); 1 s, W of Kaporo, stn. 302, 9° 36' N 15° 24' W, 36 m (MNHN); 1 s, W of the Morébaya River, stn. 174, 9° 24' N 13° 57' W, 21 m (MNHN); 2 s, W of Ouendi, stn. B7DW, 9° 55.5' N 14° 27' W, 23 m (MNHN); 1 j, W of Ile Tannah, stn. 13D, 9° 09' N 13° 37' W, 18-20 m (MNHN); 4 s, W of Ile Tannah, stn. 80, 9° 12.3' N 13° 37' W, 16 m (MNHN); 1 s, W of Ile Tannah, stn. 81, 9° 12' N 13° 40.5' W, 20 m (MNHN); 6 s W Ile Tannah, stn. 82, 9° 12' N 13° 43.5' W, 24 m (MNHN); 2 s, W of Ile Tannah, stn. 83, 9° 12' N 13° 46.8' W, 28 m (MNHN); 1 s, W of Ile Tannah, stn. 84, 9° 12' N, 13° 49.5' W, 33 m (MNHN); 1 s, W of Baie de Sangarea, stn. 338, 9° 42' N 15° 39.5' W, 38 m (MNHN); 1 s, W of Koumba River, stn. B6CH, 10° 21.5' N 14° 48.5' W, 20 m (MNHN); 5 s, W of Ile Kabak, stn. 153, 9° 18' N 14° 03' W, 26 m (MNHN); 1 j, W of Ile Kabak, stn. 155, 9° 18' N 13° 57' W, 21 m (MNHN); 1 s, W of Pointe Goro, stn. 534, 10° 06' N 16° 21' W, 50 m (MNHN); 5 s, W of Pointe Goro, stn. 544, 10° 06' N 15° 50' W, 41 m (MNHN); 2 s, W of Cap Verga, stn. 593, 10° 12' N 14° 50.5' W, 34 m (MNHN).
Other material examined: Mauritania: 6 s, Bank d'Arguin, beached (CER); 1 s, Bahía de l'Etoile, 3 m (CER). Senegal: 5 s, M'Bao, Cap Vert, 8 m, (CJP); 3 j, Gorée, Dakar (CJP). Guinea Bissau: Expedition "Chalbis II": 3 j, S of Ilha do Mel, stn. 8, 10° 41'N 15° 44.5'W, 25 m (MNHN). Ghana: 20 s, 13 j, Miamia, 8-25 m (Fig. 14)(CER); 2 s, Miamia, 8-25 m (CAP). São Tomé and Príncipe: 4 s, Baía das Agulhas, Príncipe I., 8 m (CER). Angola: 1 s, Matuco, 120 m (CER); 4 s, Palmeirinhas, 15-20 m (Figs. 15-16)(CER); 10 s, 2 sp, Buraco, 3 m (CER); 3 s, Buraco, 3 m (CAP); 2 s, Mussulo, litoral (CER); 1 s, Cacuaco, 20 m (CER).
Type locality: Guinea Conakry, W of the frontier of Sierra Leona, Stn. 71, 9° 05.9' N 13° 35' W, 23 m.
Etymology: The specific name derives of the latin word "volumen" meaning "coiled".

Description: Shell (Figs. 11-16) capuliform, solid, white, with a short spire scarcely prominent only when the shell has less than $1^1/_2$ whorls. Protoconch (Figs. 8-10) emergent and very short, about 273 μm. Teleoconch with between 1-2 spiral whorls and a fast expansion. At the beginning there are only 2-3 spiral cords, but more new ribs appear near the suture. In the last whorl there are between 12 and 16 prominent cords. Over the entire shell, these cords are crossed by sligthly proso-



Figures 1-3. *Nerita sulcosa*, holotype, 11.4 mm, (MHNM) from Pliocene of Piacenza (North Italy). Figures 4-7. *Clathrella* sp., from Ferriere-Larçon "Placete (La)", Indre and Loire, Langhien de Touraine (MNHN, coll. Lozouet and Maestrati) Middle Miocene. 4-6: shells of 3.1, 3.8 and 3.8 mm; 7: protoconch. Figures 8-10. *Clathrella volumen* spec. nov. 8: protoconch; 9, 10: juvenile shells, 1.6 and 1.2 mm.

Figuras 1-3. Nerita sulcosa, *holotipo, 11,4 mm, (MHNM) del Plioceno de Piacenza (norte de Italia). Figuras 4-7.* Clathrella *sp., de Ferriere-Larçon "Placete (La)", Indre y Loire, Langhien de Touraine (MNHN, col. Lozouet y Maestrati) Mioceno medio. 4-6: conchas de 3,1, 3,8 y 3,8 mm; 7: protoconcha. Figuras 8-10.* Clathrella volumen *spec. nov. 8: protoconcha; 9, 10: conchas juveniles, 1,6 y 1,2 mm.*

cline axial ribs, narrower than the cords and visible in the interspaces. These ribs are a little irregular and with growth lines between, more separated in the last whorl and sometimes causing elevation on the spiral cords. Aperture rounded, a little ovoid, the border serrated due to the end of the cords.

Animal: The only information recorded is that it is white in colour. We have disolved two dry animals from Angolan material in order to observe radula or jaws, but they were not found.

Dimensions: The holotype is 12.5 mm in maximum dimension. The largest shell examined is 14.7 mm.

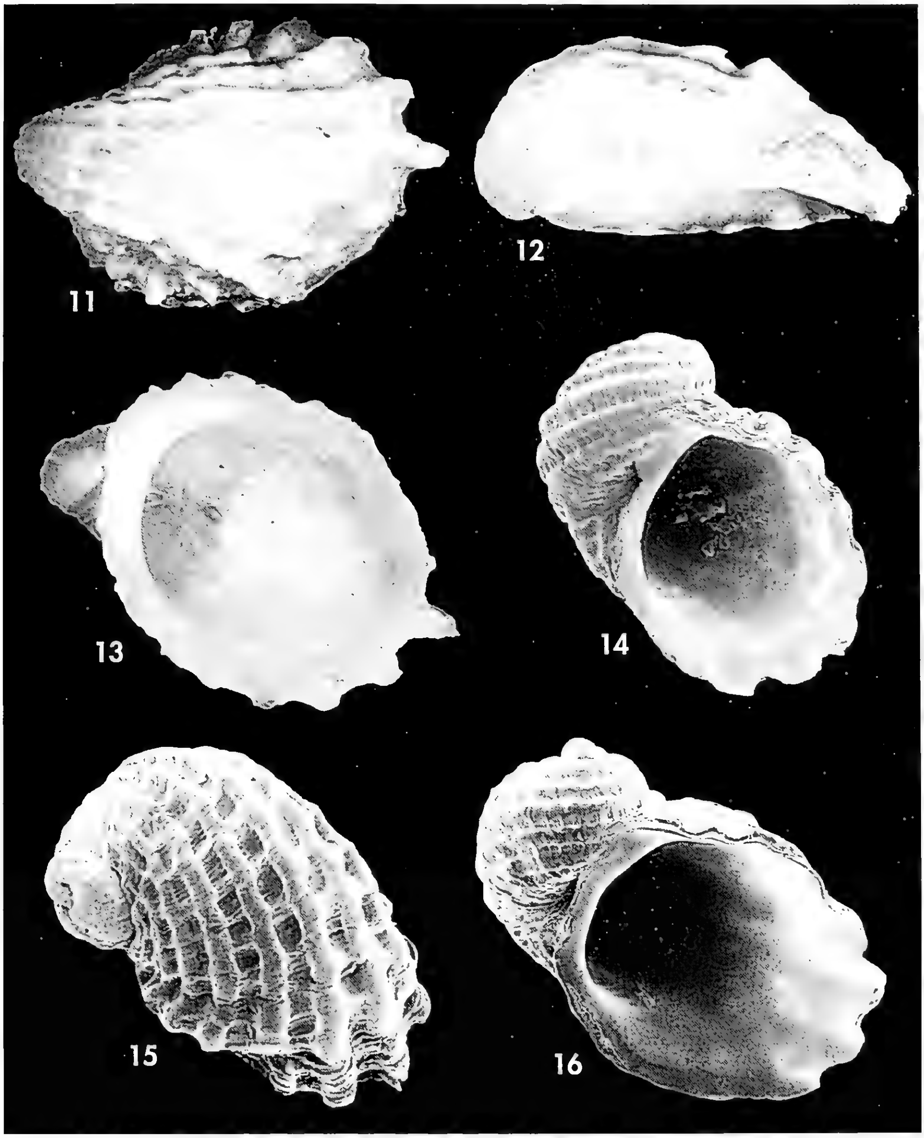
Habitat: *C. volumen* is found attached to stones or shells at variable depths.

Distribution: It is known from Mauritania to Angola, and is present in São Tomé island, but not in the Cape Verde archipelago.

Discussion: AARTSEN, MENHORST AND GITTENBERGER (1984) placed *Nerita costata* Brocchi, 1814 in the genus *Clathrella* Recluz, 1864 and considered that this genus is more appropriated than *Phasianema* S. Wood, 1872 where this species is often placed. The type species of the genus *Clathrella* is *Nerita costata* Brocchi, 1814 (=*Fossarus clathratus* Philippi, 1844). *Nerita sulcosa* Brocchi, 1814 has also been placed in the genus *Clathrella* (as in ROLÁN AND RYALL (1999))due to its similarity to *C. costata*. LOZOUET, LESPORT AND RENARD (2001) use the genus *Carinorbis* Conrad, 1862 for the species *Turbo burdigalus* (d'Orbigny, 1852), which has a shell morphology similar to *Nerita costata*. SCHANDER, VAN AARTSEN AND CORGAN (1999) consider that the genus *Carinorbis* is valid and synonymized it with the genus *Clathrella*, with reservations. PONDER (1987) employs the genus *Amathinoides* Sacco, 1896 for the species *Nerita sulcosa* but he also mentions that this genus is probably best considered a synonym of *Clathrella*. This synonymy is also accepted by LOZOUET, LESPORT AND RENARD (2001). We have placed our new species which is very similar to *Clathrella sulcosa* in this genus, because *Carinorbis* may be different as it designates smaller and more globose shells with a more prominent spire.

Clathrella volumen spec. nov. can be differentiated from *Clathrella clathrata* (Philippi, 1844) from European seas and Canary Islands because the latter species is smaller in size (usually reaching 3-4 mm), the spire is always clearly prominent and the development of the spire is smaller. In contrast, the protoconch of *C. volumen*, is only scarcely prominent in the smallest shells, and not at all in larger ones. Furthermore, in *C. clathrata* the emergent part of the protoconch is larger and almost as long as it is wide, while in *C. volumen* it is more elongate. The whorl expansion in *C. clathrata* is slow and uniform, while it is faster in *C. volumen*. So, the apertural size is smaller in relation to the height of the shell in *C. clathrata* than in *C. volumen*.

Because *C. volumen* was called *Clathrella sulcosa* (Brocchi, 1814) in some previous works on African shells, a comparison with this taxon is necessary. We have examined photographs of the holotype of *C. sulcosa* (Figs. 1-3) in the MHNM and the shell of 11.4 mm appears to be different from *C. volumen* in the following characters: the spire of *Clathrella sulcosa* is slightly prominent, the aperture is almost circular (somewhat ovoid in *C. volumen*); the spiral sculpture is reduced to 8 strong cords (in *C. volumen* there are 16 cords in larger shells and 12-14 in smaller); the upper part of the teleoconch is almost smooth (Fig. 3) up to the first spiral cord (while in *C. volumen* new cords appear subsequently (see Figs. 9, 10, 12, 14, 15 and 16). Also, axial ribs are not present in *C. sulcosa*, while in *C. volumen* they are well marked throughout the shell, being smaller and more distant on the last whorl. As the protoconch of the holotype of *N. sulcosa* is not in good condition, we have examined material from other shells which are from Ferriere-Larçon (France) (see Figs. 4-7). In these shells, probably the same species, the protoconch appears very similar to that



Figures 11-16. *Clathrella volumen* spec. nov. 11-13: holotype, from Guinea Conakry, 12.5 mm (MNHN); 14: shell, 1.7 mm, Miamia, Ghana, (CER); 15, 16: shells, 2.4 and 2.5 mm, Palmeirinhas, Angola (CER).

Figuras 11-16. Clathrella volumen *spec. nov. 11-13: holotipo, de Guinea Conakry, 12,5 mm (MNHN); 14: concha, 1,7 mm, Miamia, Ghana, (CER); 15, 16: conchas, 2,4 y 2,5 mm, Palmeirinhas, Angola (CER).*

of *C. volumen*, but 338 µm in diameter (in *C. volumen* it is 273 µm). The other shell characters of *C. sulcosa* are: a more prominent spire, fewer spiral cords, axial sculpture slightly marked, and the upper part of the whorls below the suture is smooth, without new spiral cords.

ACKNOWLEDGMENTS

We thank the PARSYST project and the MNHN which allowed us to examine the material of this species; to Alessandro Garassino (MHNM) for the photographs of the holotype of *Nerita sulcosa*; Pierre Lozouet for his help and the loan of fossil material employed in comparison; J. Pelorce for the loan of material; to Jesús Méndez (CACTI of the University of Vigo) for the SEM photographs; Jesús S. Troncoso (Department of Ecología y Biología Marina of the University of Vigo) for the photos with the digital camera.

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BIBLIOGRAPHY

Aartsen, J. J. van, Menkhorst, H. P. M. G. and Gittenberger, E. 1984. The marine Mollusca of the Bay of Algeciras, Spain, with general notes on *Mitrella*, Marginellidae and Turridae. *Basteria*. Suppl. 2: 1-135.

Brocchii, G., 1814. *Conchiologia fossile subapennina con osservazioni geologiche sugli Appennini e sul suolo adiacente.* Stamperia Reale, Milano, vol II, pp 241-712.

Lozouet, P., Lesport, J. F. and Renard, P., 2001. Révision des Gastropoda (Mollusca) du Stratotype de l'Aquitanien (Miocène inf.) site de Saucats "Lariey", Gironde, France. *Cossmanniana*, H. série 3: 1-189.

Nicklés, M., 1950. *Mollusques testacés marins de la côte occidentale d'Afrique.* Lechevalier, Paris, 269 pp.

Ponder, W. F., 1987. The anatomy and relationships of the Pyramidellacean limpet *Amathina tricarinata* (Mollusca: Gastropoda). *Asian Marine Biology*, 4: 1-34.

Rolán, E. and Fernandes, F., 1993. Moluscos marinos de São Tomé y Príncipe: actualización bibliográfica y nuevas aportaciones. *Iberus*, 11(1): 31-47.

Rolán, E. and Ryall, P., 1999. Checklist of the Angolan marine molluscs. *Reseñas Malacológicas*, 10: 1- 132.

Schander, C., Aartsen, J. J. van and Corgan, J. X., 1999. Families and genera of the Pyramidelloidea (Mollusca: Gastropoda). *Bollettino Malacologico*, 34 (9-12): 145-146.

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Ros, J., 1976. Catálogo provisional de los Opistobranquios (Gastropoda: Euthyneura) de las costas ibéricas. *Miscelánea Zoolgica*, 3 (5): 21-51.

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Doris limbata Cuvier, 1804, *Ann. Mus. H. N. Paris*, 4 (24): 468-469 [Type locality: Marseille].
Doris nigricans Otto, 1823, *Nov. Act. Ac. Caes. Leop. Car.*, 10: 275.

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