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www.biodiversityjournal.com

ISSN 2039-0394 (Print Edition)
ISSN 2039-0408 (Online Edition)

Biodiversity Journal

MARCH 2011, 2 (1): 1-50

FOR NATURALISTIC RESEARCH
AND ENVIRONMENTAL STUDIES



Dactyloctenium bicolor bicolor Charpentier, 1843 - Mexico



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Cover: Adult male of *Dactylotum bicolor bicolor* on an *Agave* sp. leaf. Mexico, Hidalgo, Tecamatlán, 2205 m, 27 XII 2010. 1) Adult male of *Melanoplus solitarius*: Mexico, Queretaro, Sierra Gorda, carr. 120, km 131, 8 km S of Pinal de Amoles, 2624 m, 24.XI.2008. 2) Mating *Cephalotettix pilosus*: Mexico, Veracruz, Reserva Natural Barranca el Corazon (Fortin de las Flores) 810 m, 6.XII.2010, (photos by Paolo Fontana).

MEXICAN MELANOPLINAE. Mexico is an extraordinary country with unique history, culture and nature. In terms of natural history this country, which has an almost continental extension (1,972,550 km²), has a huge biodiversity. The fauna and flora of Mexico are made up of both Nearctic and Neotropical elements, with many endemic taxa. Nearctic taxa decrease southwards while, at the opposite, neotropical ones increase getting to central America. Mexican diversity is really huge in all organisms, from plants, to mammals but insects are so particularly abundant, diverse and peculiar. Orthoptera are very common insects in Mexico and they are represented by almost one thousand species. Orthoptera in Mexican culture are often considered as food, especially in some states like Oaxaca, where they are normally consumed. The species used as food are members of the genus *Sphenarium* (Pyrgomorphidae), the so called Chapulines. One of the most interesting and well distributed group is that of the Melanoplinae, a subfamily of grasshoppers (Caelifera), family Acrididae. The type genus *Melanoplus* contains many species common in North America toward central Mexico with one holarctic species, *Melanoplus frigidus frigidus* (Boheman, 1846). The subfamily Melanoplinae, called sometime “spur-throated grasshoppers”, is widespread, occurring for example almost anywhere in the holarctic region. Some Melanoplinae (especially within the genus *Melanoplus*), are considered pest, although they have not a really locust behavior. Mexican Melanoplinae are represented by many species of the genus *Melanoplus*: many are distributed from USA to Mexico but a great number are endemic. Most of the Mexican endemic *Melanoplus* are short-winged to brachypterous as well as other Mexican Melanoplinae, more or less brachypterous to apterous. *Dactylotum bicolor bicolor* Charpentier, 1843 (called the Painted Grasshopper) is a common but astonishing species living in dry habitats in northern Mexico. It is characterized by bright colors, constant within local populations but also quite variable in distinct population also from closed localities. The meaning of this bright colour is not yet known but commonly this species is not considered toxic. In this case its colour pattern could be considered a Batesian mimicry. Since 2004 I had the chance to organize many entomological expeditions all around Mexico, with Italian and Mexican colleagues. During these trips we collected, photographed and bioacoustically recorded many species. An aspect of Mexican entomofauna we soon understood is the abundance of undescribed taxa. In the last years many new species and even genera have been collected and described and many of them were Melanoplinae. Is the case of *Melanoplus solitarius* (Buzzetti, Barrientos-Lozano & Fontana, 2010), collected on Sierra Gorda (Queretaro) in 2007 or of the recently collected new species of the genus *Pedies*, from Puebla. Most of these new taxa have a distribution restricted to mountains, but also tropical forests are extremely rich in Melanoplinae, with many peculiar species like *Cephalotettix pilosus* (Stål, 1878), a quite rare but locally abundant species.

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Mollusca and environmental conservation in Santa Catarina State (SC, Southern Brazil): current situation

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ABSTRACT Available knowledge of malacofauna (mollusc species) conservation in the territory of Santa Catarina State, SC, central Southern Brazil region, is shortly analyzed and discussed herein. Present data originate from the author's active participation in three recent regional unpublished events dealing with biodiversity conservation in the State, carried out to cope the sensitive lack of population studies which is the main difficulty to face in order to provide accurate and detailed evaluations on biodiversity and its conservation status.

KEY WORDS Biodiversity, Conservation status, Mollusc fauna, Santa Catarina State, Southern Brazil region.

Received 08.01.2011; accepted 13.02.2011; printed 30.03.2011

INTRODUCTION

After fourteen years of pioneering systematic work spanning from 1996 to 2010, carried out in the territory of Santa Catarina State, SC, within the Brazilian Southern region, framed in the so-called Atlantic Slope of the Southern Cone of South America (Agudo-Padrón, 2008a), a basic list of continental (land and freshwater) and marine mollusc species was compiled. Besides constant interactions and consultations with numerous national and international specialists, such a list was mostly based on available literature and/or analyses of voucher specimens deposited in collections belonging to research centers or environmental education institutes.

To date (up to the first semester of 2010), this list comprises a total of 878 taxa (species and subspecies, including 695 marine and 183 continental forms), and these numbers are likely to increase as field surveys ensue.

In the present study, results obtained from the author's active participation in three recent regional field sampling expeditions dealing with marine and continental mollusc taxa, are reported.

I. Official State program for listing and control of invasive exotic species

Starting from November 2009, and for the first time in the history of Santa Catarina State, the presence of invasive allochthonous mollusc species in Santa Catarina State was studied and discussed through the organisation of seminars by the Official Foundation for the Environment of the State of Santa Catarina (Fundação do Meio Ambiente – FATMA) jointly with the Hórus Institute for Development and Environmental Conservation (Instituto Hórus de Desenvolvimento e Conservação Ambiental), with the main goal to compile the Official State List of Species. To date, the occurrence of a total of twenty allochthonous (exotic) forms of mollusc species has been confirmed, 14 Gastropoda and 6 Bivalvia [namely, 11 terrestrial gastropods, 5 freshwater taxa (3 gastropods and 2 bivalves) and 4 marine bivalves]. Taking into account the contributions of Agudo & Bleicker (2006a), Agudo-Padrón (2008b) and Agudo-Padrón & Lenhard (2010), the slug *Pallifera* sp. - the taxonomic determination of which is still in process (Thomé et al., 2006) - was included within such a list. Of these twenty

allochthonous species, 14 are invasive forms involving 10 Gastropoda (5 slugs and 5 snails, 1 of which is freshwater) and 4 Bivalvia (2 freshwater and 2 marine).

Notably, the Asian golden mussel, *Limnoperna fortunei* (Dunker, 1857), a highly invasive species, which up to now fortunately only shows a moderate presence in SC territory (Agudo-Padrón, 2007; 2008c; Agudo-Padrón & Lenhard, 2010), received particular attention in the course of the event. On the other hand, the marine cultivated mussel *Perna perna* (Linnaeus, 1758), interpreted as invasive exotic species (Junqueira et al., 2009; Agudo & Lenhard, 2010), was definitely deleted from the list based on extensive analyses and conclusive technical discussions that confirmed it to be a native species for Brazil and Santa Catarina State (Magalhães et al., 2007; Schaefer et al., 2009).

II. Construction of the official list of species threatened with extinction in Santa Catarina

Similarly, for the first time in the history of the State, the presence and the conservation status of the native molluscan fauna in SC State was examined and discussed. Sponsored, organized and driven by the Official Foundation for the Environment of the State of Santa Catarina (Fundação do Meio Ambiente – FATMA) jointly with the IGNIS – Planejamento e In-formação Ambiental (IGNIS – Planning and Environmental In-formation), works dealing with these regional invertebrate animals officially began in October 2009 (IGNIS online published informations are available via <http://www.ignis.org.br>). The event, denominated as “IV Forum IGNIS of Discussion”, was celebrated in March 2010, even if works were extended until April of the same year. In the mollusc specialist group, out of seven participant researchers, only two focus on continental (terrestrial and freshwater) species. This is in line with the fact that most scientists working in Santa Catarina have to date focused primarily on marine taxa, as clearly deducible from regional literature (e.g. Agudo, 2004; Agudo & Bleicker, 2005a, b; 2006a; Agudo-Padrón, 2008a, b; 2010; Agudo-Padrón et al., 2009).

A total of 675 marine and 82 continental molluscan forms were officially considered and recognized for area under review within the IGNIS database. In particular, 156 marine taxa (21 Cephalopoda, 89 Gastropoda and 46 Bivalvia) were included in the list, along with 17 new registrations of marine species (11 Cephalopoda and 6 Gastropoda) (Agudo-Padrón & Bleicker, 2011). Moreover, another three species of marine bivalves were incorporated to the malacological inventory, on the basis of the record in Caregnato et al. (2009).

As for continental taxa, taking into account available information (Agudo-Padrón, 2008b; 2009a, b; 2010) we strongly believe they have been under-appraised in this first census, probably due to the lack of information on their population structure and distribution. At the moment, out of 82 forms of continental molluscs, only 18 were included in the IGNIS list and just 14 (9 Bivalvia and 5 Gastropoda) were considered as valid species. Moreover, four freshwater bivalves (3 Mycetopodidae and 1 Hyriidae) were added to the list, based on the hypothesis of their “evident occurrence by zoogeographical reasons”. In fact, the presence of these taxa has not yet been confirmed by any official sources such as: (1) bibliographic references, (2) specimens collected in the field, (3) voucher material, coming from the State, deposited in naturalistic collections.

Class BIVALVIA Order UNIONOIDA

Family MYCETOPODIDAE

Anodontites trapezeus (Spix, 1827)
Anodontites trigonus (Spix, 1827)
Fossula fossiculifera (d’Orbigny, 1835)

Family HYRIIDAE

Castalia undosa Martens, 1885

On the other hand, three of the confirmed gastropod species underwent “interpretation conflicts” being considered, in the same way, as marine or continental forms due to their high ecological tolerance.

Class GASTROPODA
Subclass PROSOBRANCHIA
Order CAENOGASTROPODA

Family HYDROBIIDAE

Littoridina (= *Heleobia*) *australis* (d'Orbigny, 1835)

Within the continental forms, Simone (2006) recognized *Littoridina* (= *Heleobia*) *australis* (d'Orbigny, 1835) - already reported by Rios (2009) - and *Littoridina* (= *Heleobia*) *piscium* (d'Orbigny, 1835) - as two separate species, with the occurrence of these two species being definitely confirmed in the territory of Santa Catarina (Agudo & Bleicker, 2005a, c; Agudo-Padrón, 2008b; 2009a).

Subclass PULMONATA

Family ELLOBIIDAE

Melampus coffeus (Linnaeus, 1758)

Pedipes mirabilis (Muhlefeld, 1816)

These species – already reported for SC State (Agudo & Bleicker, 2005a, c; Agudo-Padrón, 2009a) - were included in the list of continental molluscs.

III. Malacological field research in the Itajaí-Açu river basin valley, SC State

In March 2010, the “Environmental Impact Study” (Estudo de Impacto Ambiental - EIA) was initiated by a private company in the medium valley of the Itajaí-Açu river basin [the largest Atlantic drainage-basin of the State (Siebert, 1997; Agudo-Padrón, 2008c)] (Figs. 1-3).

Emerging results (still unpublished) revealed a total of eight species of continental molluscs, 6 freshwater and 2 terrestrial. Notably, within these taxa, two freshwater forms, encountered inside bivalve shells deposits, are new records for the State:



Fig. 1



Fig. 2



Fig. 3

Figures 1, 2. Medium valley of the Itajaí-Açu river basin.

Figure 3. *Pomacea sordida* on the Itajaí-Açu river basin.

Class GASTROPODA
Subclass PROSOBRANCHIA
Order CAENOGASTROPODA

Family HELICINIDAE

Helicina angulata Sowerby, 1873

The occurrence of this tree snail was confirmed in the field survey.

Family AMPULLARIIDAE

Pomacea sordida Swainson, 1823 (Fig. 4)

Family THIARIDAE

Aylacostoma sp. (Fig. 5)

This freshwater gastropod (river snail) genus was a new record for the area under review (Agudo-Padrón & Bleicker, 2011).

Family HYDROBIIDAE

Potamolithus catharinae Pilsbry, 1911 (Fig. 6)

Subclass PULMONATA

Family CHILINIDAE

Chilina globosa Frauenfeld, 1881

Family AGRIOLIMACIDAE

Deroceras laeve (Müller, 1774)

Class BIVALVIA

Order UNIONOIDA

Family HYRIIDAE

Diplodon aethiops (Lea, 1860) (Fig. 7)

This species was considered by Simone (2006) as one of the synonymous forms of the still contentious species *Rhipidodonta charruana* (d'Orbigny, 1835) (Agudo-Padrón, 2008b; 2009a).



Figure 4. *Pomacea sordida* – Figure 5. *Aylacostoma* sp. – Figure 6. *Potamolithus catharinae* – Figure 7. *Diplodon aethiops* – Figure 8. *Corbicula largillierti*.

Order VENEROIDA

Family CORBICULIDAE

Corbicula largillierti (Philippi, 1844) (Fig. 8)

The whole malacological material presented herein has been deposited at the “Augusto Ruschi Zoobotanical Museum” (Museu Zoobotânico Augusto Ruschi – MUZAR), Passo Fundo University – UPF, Rio Grande do Sul State – RS, Southern Brazil region.

Present results, although still preliminary, constitute the first known effort at achieving a general knowledge on Mollusca distribution in the medium basin of the Itajaí-Açu river, since previous available data on this group, at regional level, is extremely scarce and fragmented (Agudo-Padrón, 2008b; 2009a).

As far as data on molluscan species in the region of Blumenau Municipal District and the Itajaí river valley are concerned, a few other previous studies have been conducted, including those by Morretes (1949; 1953), Prando & Bachia (1995), Silva & Veitenheimer-Mendes (2004), Agudo (2002), AA.VV. (2005), Agudo & Bleicker (2006a), Simone (2006), Molozzi et al. (2007) and Agudo-Padrón (2008b, c).

CONCLUSIONS

Generally speaking, molluscan fauna can be investigated from several perspectives, i.e. zoological diversity, biogeographical distribution, palaeontology, veterinary, agricultural plagues, invasive exotic species, conservation, as an alimentary resource (fishing and malacoculture), as bio-indicators of environmental quality and, last but not least, as a health hazard (as vectors or transmitters of human parasitic diseases) (Agudo 2004, 2007; Agudo & Bleicker, 2006b; Agudo-Padrón 2008a, 2010).

In the course of this study, it emerged that the lack of population studies is the main difficulty thwarting detailed evaluation of the conservation status of molluscan species already recorded in the State. In particular, for terrestrial taxa, the dearth of information is even more dire since the largest part of active limnologists in the area work on marine species. Hence, to overcome such a lack of information on mollusc fauna of

the State of Santa Catarina (Agudo & Bleicker, 2006b), a lot of work has still to be done, focusing exclusively on continental and allochthonous species.

ACKNOWLEDGEMENTS

This study is dedicated to all friends that during these last fourteen years helped in many ways and supported the construction and consolidation of this modest research project. Special thanks to Dra. Sílvia R. Sziller, executive director and researcher of the Instituto Hórus de Desenvolvimento e Conservação Ambiental (Florianópolis, SC), and Dra. Roberta Aguiar dos Santos, official researcher of the CEPESUL – ICMBio (Itajaí, SC), for suggestions, critical observations, bibliographic material, and for providing opportune help and information on (unpublished) regional marine molluscs.

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Current knowledge on population studies on five continental molluscs (Mollusca, Gastropoda et Bivalvia) of Santa Catarina State (SC, Central Southern Brazil region)

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ABSTRACT Although still very scarce, available knowledge on population studies on continental (land and freshwater) molluscs in the territory of Santa Catarina State is shortly analyzed and discussed. Based on the IUCN "Restricted Distribution" criterion, a total of 54 nominal species, including 31 terrestrial gastropods, 15 freshwater gastropods and 8 limnic bivalves, were considered strong candidates as threatened taxa. Out of all these endangered species, only 5 limnic forms (2 gastropods and 3 bivalves) were previously analysed, in some way, at population level.

KEY WORDS Biodiversity, Conservation status, Continental mollusc populations, Santa Catarina State, Southern Brazil region.

Received 08.01.2011; accepted 13.02.2011; printed 30.03.2011

INTRODUCTION

As already reported in Moraes (2006), all Brazilian autochthonous continental mollusc species are seriously threatened with extinction. Moreover, there are presumably a high number of taxa still awaiting discovery and numerous others that, as a first step for their conservation, need to be investigated and inventoried with alacrity. Considering the rapid rate of current anthropic environmental degradation, several species will surely become extinct before the scientific community gets to know them all (Simone, 2006).

Besides the environmental degradation (including deforestation for agricultural aims or forest exploitation, mining, pollution of the river basins with dejections and several pollutants, indiscriminate use of agricultural poisons and chemical fertilizers, proliferation of the construction of hydroelectric mills, invasions of natural spaces by town planning enterprises), the Brazilian species face considerable competition with invading forms that, among others, are also

responsible for serious sanitary and agronomic problems (Agudo & Bleicker, 2006a; Agudo-Padrón, 2008; Agudo-Padrón & Lenhard, 2010). Introduced willfully or accidentally, allochthonous invading species are novel to local ecosystems and, for this reason, lack any natural predators, thus achieving an uncontrolled growth of populations with, consequently, extinction of native species and an indiscriminate occupation of native (often under-exploited) niches.

Taking into account that molluscs found in rivers and lakes show extinction rates ranging from four to six times higher than their counterparts in marine or terrestrial habitats, these species are the most threatened globally due to the widespread collapse of such fluvial ecosystems. In particular, freshwater bivalves are very sensitive to trampling, organic and chemical pollution and other different types of environment degradation. Moreover, they show a relatively slow growth rate and don't usually re-settle in previously abandoned/discarded areas. There a few endemic species for each basin and many of them inhabit restricted and seriously

threatened areas suffering from countless environment alterations recently elicited by human activities. This scenario worsened still by the absence of these species from “red lists” provided by ecology centers or units. Nearly nobody wants to preserve a natural area just because of a snail; unfortunately, molluscs, although being fundamental for ecological balance (Moraes, 2006), have a very smaller appeal when compared to any vertebrate species and are considered as non-charismatic species.

In the present work, current knowledge on native continental molluscs of Santa Catarina State is reported by publishing information available from past population studies. As far as available data on autochthonous malacofauna in Santa Catarina State is concerned, reference should be made to Agudo-Padrón (2011). As already underlined in the above mentioned paper, continental forms are currently sub-appraised due to a sensitive lack of population studies coupled with a traditional and historical chronic lack, in the State, of specialists working on continental forms.

In this paper, 54 continental native species - 46 Gastropoda (31 land and 15 freshwater taxa) and 8 limnic Bivalvia (Agudo-Padrón, 2010), along with two recent new registrations for the Extreme Western area of the State, *Macrodonates thielei* Pilsbry, 1930 (Odontostomidae) and *Streptaxis pfeifferi* (Pilsbry, 1930) (Streptaxidae) (Agudo-Padrón & Bleicker, 2011), were considered for inclusion in IUCN categories of specific status of threat and conservation, based on the specific Restricted Distribution Criterion. Out of these taxa only the following five species have been studied, somehow, at population level in Santa Catarina State:

Class GASTROPODA

Prosobranchia/Caenogastropoda

Family AMPULLARIIDAE Gray, 1824

Genus *Pomacea* Perry, 1811

Pomacea lineata (Spix, 1827)

Available preliminary population studies were reported a few years ago (Santos et al., 2005; Quadros et al., 2007). This taxon was included in the specific IUCN category ENDANGERED (EN).

Pomacea lineata (Spix, 1827), also known as apple snail, is a native taxon the rank of which is

still contentious. In fact, it was considered by several authors an essential element of the *canaliculata* complex, but, on the other hand, recognized as a valid species by local specialists (Thiengo, 1987; Cowie & Thiengo, 2003; Simone, 2006). In our opinion, this is a sterile discussion, since, whatever its taxonomic rank might be, we really need to evaluate the conservation status of this taxon in the State, since it inhabits a restricted area (Salto do Rio Caveiras, Santa Catarina plateau) under strong regional threat from hydroelectric development (Santos et al., 2005; Agudo-Padrón, 2008, 2010).

Family HYDROBIIDAE Stimpson, 1865

Genus *Potamolithus* Pilsbry, 1896

Potamolithus kusteri (Ihering, 1893)

For preliminary population studies see Santos et al. (2005) and Quadros et al. (2007). This taxon was included in the specific IUCN category VULNERABLE (VU).

It occurs in a restricted area (Salto do Rio Caveiras, Santa Catarina plateau) under strong regional threat from hydroelectric development (Santos et al., 2005; Agudo-Padrón, 2008, 2010).

Class BIVALVIA

UNIONOIDA (freshwater mussels/naiads)

Family HYRIIDAE Swainson, 1840

Genus *Diplodon*, Spix, 1827

Diplodon parallelipipedon (Lea, 1834)

Preliminary population studies were previously reported (Santos et al., 2005; Quadros et al., 2007). This taxon was included in the specific IUCN category ENDANGERED (EN). It occurs in a restricted area (Salto do Rio Caveiras, Santa Catarina plateau) under strong regional threat from hydroelectric development (Santos et al., 2005; Agudo-Padrón, 2008, 2010).

VENEROIDA (freshwater clams)

Family SPHAERIIDAE Deshayes, 1854

Genus *Pisidium* Pfeiffer, 1821

Pisidium pipoense (Ituarte, 2000)

Preliminary population studies were carried out by Perizzolo (2003) and Agudo-Padrón (2008, 2010). This taxon was included in the

specific IUCN category ENDANGERED (EN). It occurs in a restricted area (Lageado São José, Chapecó municipal district, Uruguay River valley) under severe human influence (water reservoir).

Pisidium taraguayense (Ituarte, 2000)

Preliminary population studies were carried out by Perizzolo (2003) and Agudo-Padrón (2008, 2010). This taxon was included in the specific IUCN category ENDANGERED (EN).

It occurs in a restricted area (Lageado São José, Chapecó municipal district, Uruguay River valley) under severe human influence (water reservoir).

DISCUSSION AND CONCLUSIONS

Out of 54 continental species, only 5 limnic forms (2 gastropods and 3 bivalves) have been preliminarily studied at population level, with none of these studies ever being formally published. Hence, at present, in spite of burgeoning scientific and technological progress, we still have a lot of difficulty in evaluating threats menacing continental mollusc species within the territory of Santa Catarina State, SC, the smallest portion of the Southern Brazil mosaic (Agudo & Bleicker, 2006b; Agudo, 2007). The main reasons for this are, among others, the lack of concrete population data and the extremely small amount of taxonomic specialists on these species living and working in the State.

Personally, during 14 years of work in the field, the author has witnessed the decrease and even the extirpation of certain species from several places and specific areas of the SC State. One example is the native giant snail *Megalobulimus gummatus* (Hidalgo, 1870), a magnificent representative of the family Megalobulimidae in the valley of the Uruguay river basin which was abundant until a few years ago; currently this species is difficult to locate in such an area, probably due to the consequences of the increase of regional agricultural activities (use of pesticides, mainly). Meanwhile, invading exotic species proliferate and colonize larger areas.

Endemic species, such as the small aquatic snail *Potamolithus catharinae* Pilsbry, 1911, representative of the family Hydrobiidae, and the tiny freshwater limpets *Burnupia ingae* Lanzer, 1991 and *Ferrissia gentilis* Lanzer, 1991, family Ancyliidae (Agudo-Padrón, 2008), are particularly vulnerable since their fragile natural habitat is easily altered by a multitude of human activities.

In general, for Brazilian fluvial habitats there is a regrettable lack of basic conservation and management information, particularly dealing with the spatio-temporal dynamics of populations and communities, as well as with the impact of several human activities. Hence, for this reason, it is extremely important to pay great attention to the conservation status of continental molluscs, including those occurring in Santa Catarina State.

ACKNOWLEDGEMENTS

Very thanks to Dra. Roberta Aguiar dos Santos, Official researcher of the CEPSUL – ICMBio (Itajaí, SC), for critical observations, suggestions and useful information.

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New corological and biological data of the Red Gum Lerp Psyllid, *Glycaspis brimblecombei* Moore, 1964 in Italy (Hemiptera, Psyllidae)

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ABSTRACT *Glycaspis brimblecombei* Moore, 1964 is a psyllid (Hemiptera: Psyllidae) pest of *Eucalyptus*, native to Australia and first recorded in Europe: Spain in 2008 and more recently (2010) in Italy. The present paper deals with recent research, carried out in central Italy, with new data on the distribution and biology of this species.

KEY WORDS Hemiptera, Psyllidae, new records, Italy.

Received 02.03.2011; accepted 03.03.2011; printed 30.03.2011

INTRODUCTION

The red gum lerp psyllid, *Glycaspis brimblecombei* Moore, 1964, is a sap-sucking insect of Australian origin (Moore, 1964) which currently shows a widespread distribution outside its native range due to frequent introductions. It was detected in California, U.S.A. in 1998 (Brennan et al., 1999), in Mexico in 2000 (Castillo, 2003), in the Hawaiian Islands in 2001 (Nagamine & Heu, 2001), in Chile in 2002 (Sandoval & Rothmann, 2003), in Brazil (Santana et al., 2003) and Mauritius (Sookar et al., 2003) in 2003, in Madagascar in 2004 (Hollis, 2004), in Argentina in 2005 (Bouvet et al., 2005), in Ecuador in 2007 (Onore & Gara, 2007), in Venezuela (Rosales et al., 2008), Peru (Burckhardt et al., 2008) and Iberian Peninsula (Hurtado & Reina, 2008; Valente & Hoodkinson, 2009; Prieto-Lillo et al., 2009) in 2008, and finally in Italy in 2010 (Laudonia & Garonna, 2010). Within Spain, it was only recorded at first in the provinces of Cáceres,

Cádiz, Huelva and Seville, but has subsequently also been recorded along the Mediterranean coast and in central regions (Peris-Felipo et al., 2009). *G. brimblecombei* is associated with a variety of species of *Eucalyptus* (Dahlsten & Rowney, 2000; Diodato & Venturini, 2007), but in the Mediterranean basin it associates mainly with red eucalyptus (*E. camaldulensis*), frequently used in urban and rural forestry programmes (Peris-Felipo et al., 2009). This psyllid can be distinguished from other species thanks to the length of the cephalic projections below the eyes, indicated as genal processes (Fig. 1) (Laudonia & Garonna, 2010). The adults of this species show a degree of sexual dimorphism based mainly on body size, with females slightly larger than males (size varying between 2.5 and 3.1 mm). The body colour is light green, sometimes with yellow spots. During oviposition, females lay eggs, ovoid in shape and yellow in colour, individually or in groups and without any protection (Fig. 2). Nymphs are yellowish orange with grey wing



1



2



3



4

Figures 1-4. *Glycaspis brimblecombei*: 1, adult; 2, eggs; 3, nymphs; 4, shields.

rudiments (Fig. 3). Nymphs secrete honeydew, which builds a white cover for protection until the adult stage is reached. This cover, also called a shield, is conic in shape and is built by several layers linked to each other. The nymph and the protective shield, which reaches a maximum size of 3.0×2.0 mm (Ide et al., 2006) (Fig. 4), grow at the same rate. After oviposition, which takes place on leaves, in the event of adverse weather, eggs enter a period of quiescence until conditions become favourable. After hatching, nymphs rapidly develop into pupal instars, producing the protective shield and readying the insect for final development into adulthood (Laudonia &

Garonna, 2010). Once the adult stage is reached reproductive activity swiftly takes place, fertilized females oviposit and nymphs hatch a few days later, starting another cycle. *G. brimblecombei* may undergo a multivoltine cycle, but variations of the life cycle have been observed in different geographical contexts. For instance, in Australia and California there are two to four generations per year, while in Chile the life cycle is postponed for about one month during the spring-summer period (Hidalgo, 2005). The present paper deals with new chorological and biological data on this species, based on recent research carried out in central Italy (Latium).

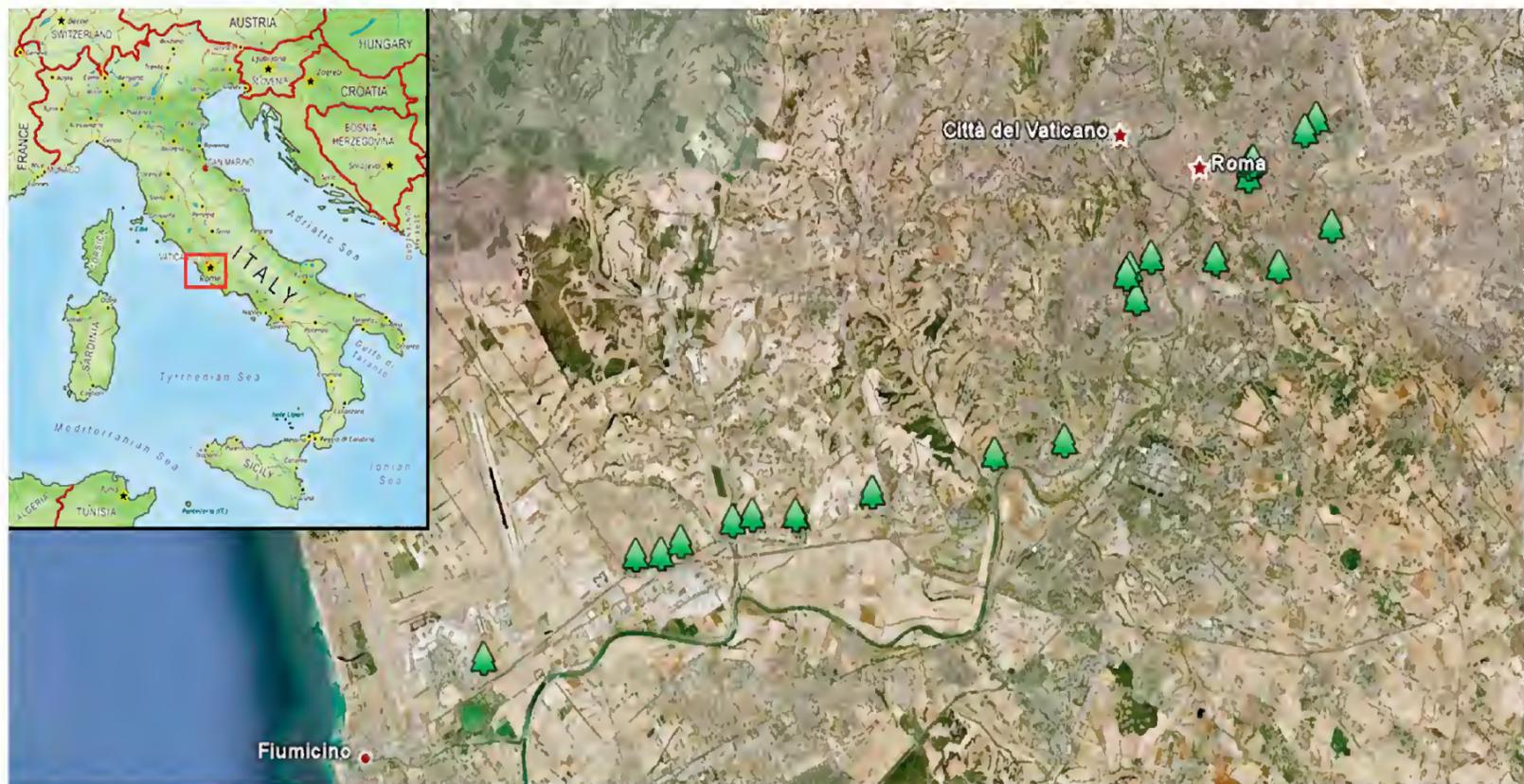


Figure 5. Distribution of *Glycaspis brimblecombei* in Italy.

MATERIAL AND METHODS

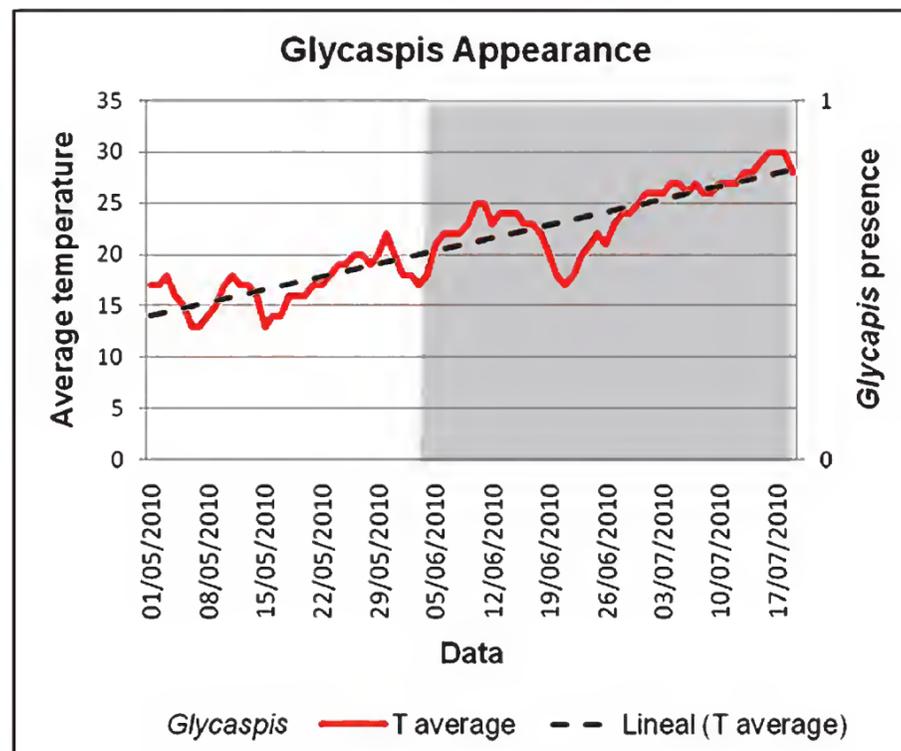
During investigations carried out between May and July 2010 in the city of Rome and its surroundings for the identification of possible pests in *E. camaldulensis*, most specimens were found to be infested with *G. brimblecombei*. The trees were checked weekly to ascertain the presence of the psyllid. Eucalyptus-trees showing positive presence were sampled, and leaves and insects collected. The samples were either hand-picked or collected with entomological nets. Leaves were taken to the laboratory for observation under light stereomicroscope. Additionally, local climatic data, specifically maximum-minimum temperatures, was also recorded for correlation with the life cycle of *G. brimblecombei*.

RESULTS AND DISCUSSION

The new record of *G. brimblecombei* increases our knowledge of its distribution in Italy confirming that this psyllid species is well established in Rome and its environs (Fig. 5; Table 1). Despite reported

damage caused by the species on eucalyptuses around the world, our observations have not revealed any negative effects so far, though it should be noted that further research is required. Although our research has not identified any significant effect on the trees' health-status, the attack of this sucking insect can indeed leave large quantities of honeydew on leaves, facilitating subsequent attacks by fungi resulting in fumagina syndromes. Moreover, when trees support high population levels, some discoloration of leaves or, at least, the adoption of a yellowish green colour has been detected. In fact, as time progresses, these fungi attacks produce leaf discoloration, falling, stunted growth and general abatement of plant vigour. This general deterioration could facilitate further attacks by other insect pests or the death of branches or even whole trees, as shown by some published examples (Bouvert et al., 2005; Ide et al., 2006; Hurtado & Reina, 2008). The maximum and minimum temperatures recorded in Rome during the sampling period have permitted us to ascertain the values at which *G. brimblecombei* starts its activity. In May, specifically at the end of the month, with

Locality	UTM coordinates	Altitude (m)
Fiumicino	33T 272804, 4629886	3
Magliana	33T 282693, 4633479	14
Magliana	33T 285797, 4634282	22
Magliana	33T 287568, 4634537	17
Parco Leonardo	33T 276695, 4632179	6
Parco Leonardo	33T 277329, 4632195	2
Ponte Galeria	33T 277836, 4632459	4
Ponte Galeria	33T 279158, 4632909	8
Ponte Galeria	33T 279658, 4633035	13
Ponte Galeria	33T 280747, 4633003	41
Rome	33T 289229, 4638359	22
Rome	33T 289317, 4638487	26
Rome	33T 289467, 4637794	16
Rome	33T 289859, 4638735	19
Rome	33T 291485, 4638662	28
Rome	33T 292361, 4640575	30
Rome	33T 292400, 4640830	49
Rome	33T 292489, 4640895	53
Rome	33T 293071, 4638438	23
Rome	33T 293813, 4641575	49
Rome	33T 294106, 4641852	39
Rome	33T 294425, 4639343	37

Table 1. Localities, UTM and altitude of *Glycaspis brimblecombei* findings in Italy.Figure 6. Temperatures and time of onset of *Glycaspis brimblecombei*.

temperatures above 20 °C (favourable conditions), eggs leave the quiescent state and a new cycle takes place. Shields were first detected in early June and from that time *Glycaspis* populations increased significantly (Fig. 6).

The rapid colonization of Mediterranean countries by *G. brimblecombei* demands the conduction of organic studies aimed at obtaining a better knowledge of its distribution, population characteristics, possible impact and potential natural enemies. Once these aspects are clarified, appropriate control measures should be adopted to prevent significant damage on trees and economic loss.

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On the increasing occurrence of the Bluespotted Cornetfish *Fistularia commersonii* (Rüppel, 1838) in the Central Mediterranean (Osteichthyes, Fistulariidae)

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ABSTRACT The increasing occurrence of the blue-spotted cornet fish *Fistularia commersonii*, a highly successful Lessepsian migrant, within coastal waters of Sicily and of the Maltese Islands is hereby recorded. Reports of recent sightings of the species within such a marine area are documented and these suggest the establishment of viable populations for the species within the same marine area.

KEY WORDS *Fistularia commersonii*, Sicily, Maltese Islands, Lessepsian migrant.

Received 10.02.2011; accepted 05.03.2011; printed 30.03.2011

INTRODUCTION

The ongoing dispersal of exotic species and the general rearrangement of species' geographical distribution are an increasing worldwide phenomenon and currently the most striking biological outcome of global changes (Vitousek et al., 1996). Recent changes in distribution of indigenous fish species as a putative result of climate change have been well documented (Beare et al., 2004; UNEP-MAP-RAC/SPA 2008; CIESM 2008). Ever since the opening of the Suez Canal in 1869, a continuous influx of Lessepsian species, mostly of Erythrean and Indo-Pacific affinity, into the Mediterranean has been observed. CIESM (International Commission for the Scientific Exploration of the Mediterranean Sea) has published regular census results for such species within a series of *ad hoc* atlases (www.ciesm.org/atlas/), with the most recent for Lessepsian fish species being published in 2007 (Golani et al., 2007). According to such a census, of the 108 known allochthonous fish species in the Mediterranean, 65 are thought to be Lessepsian in nature.

In addition to the Lessepsianism phenomenon, meridionalisation, involving the westward and northward shift of indigenous Mediterranean marine species (Andarolo & Rinaldi, 1998; Grau & Riera, 2001), and the influx of Atlantic species through the Straits of Gibraltar, is further disrupting the biotic composition of different biogeographical provinces. An example is given by recent increases in populations of fish species previously almost exclusively restricted to the eastern Mediterranean, such as *Lobotes surinamensis* and *Thalassoma pavo* in central (Deidun et al., 2010) and northern (Dulčić, 2004) areas of the Mediterranean.

The high dispersal potential, ecological differentiation, general non-resilience, temperature sensitivity, large size and ease of identification make fishes ideal candidates for the study of the effects of climate variability (Wood & Mc Donald, 1997). The cornet fish *Fistularia commersonii* (Figs. 1-5) is a benthopelagic species with a circum-tropical distribution, being associated with reefs or with



1



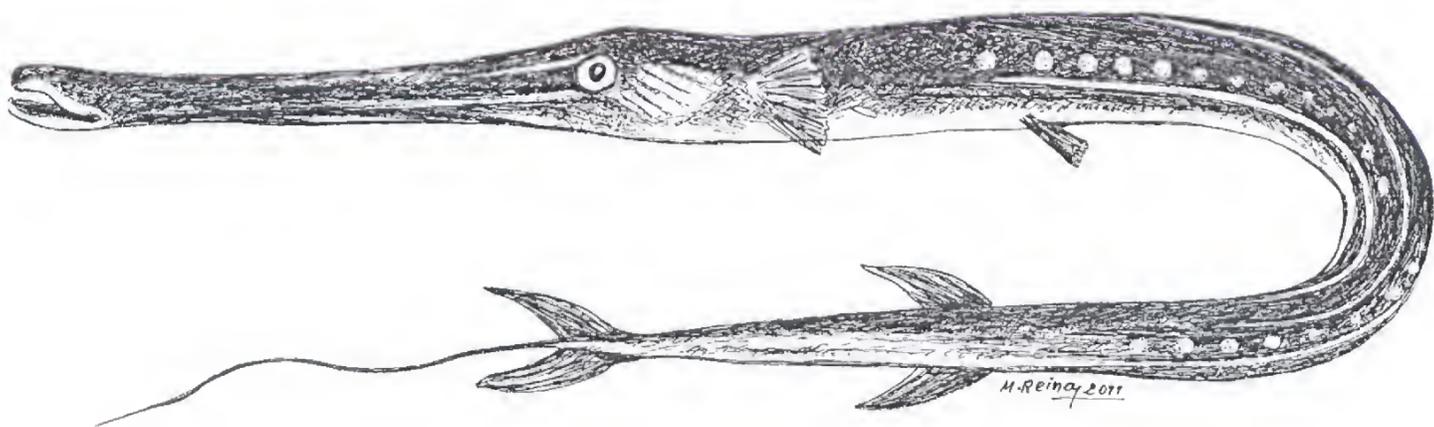
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Figures 1-4. *F. commersonii* individuals photographed in the wild in Maltese coastal waters.
Figure 5. An artistic impression of an adult *F. commersonii* individual.



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Figures 6-11. Various aspects of the *F. commersonii* caught at Marzamemi (SR), Sicily.

sandy bottoms at depths extending down to 132 m (Froese & Pauly, 2010), whose ease of identification makes it seamless to track. The species is ventrally flattened and has a long, whip-like tail filament, being green dorsally and grading to silvery white ventrally, with two blue stripes or rows of blue spots on the back. It reaches a maximum length of 160 cm and maximum weight of 4 kg, with the most frequent length being that of 100 cm. The body is extremely elongated, the head (consisting of a long, tubular snout) constitutes more than one-third of the total body length, ending in small mouth. Dorsal and anal fins are posterior in position, opposite to each other. The caudal fin is forked, with two very elongated and filamented middle rays. The skin is smooth, without bony plates along the midline of the back.

MATERIALS AND METHODS

In December 2010, a specimen of *F. commersonii* (Figs. 6-11) was caught in Marzamemi (36°44'17"N, 15°07'02"E) in the south-eastern extremity of the island of Sicily, in a trammel net deployed over a depth of 20-30 m. The specimen was frozen and successively identified, whilst anecdotal counts of sightings or captures of the species from the coastal waters of the whole of Sicily and the Maltese Islands were collated. These reports were submitted to the authors by fishermen and SCUBA divers and were also gleaned from the grey literature (primarily, newspaper reports).

RESULTS AND CONCLUSIONS

Fistularia commersonii has been recently sighted or caught on numerous occasions within Sicilian and Maltese coastal waters. In Sicily, the species has been sighted or caught in 2010 specifically at Pozzallo (36°43'31"N, 14°50'47"E - Castaldo, 2010), at Avola (36°54'24"N, 15°09'00"E - Tiralongo, 2010), within the Ragusa province, at Messina (38°11'32"N,

15°33'44"E - Ventimiglia, 2010), Mazara del Vallo (37°38'59"N, 12°35'21"E), Selinunte (37°34'51"N, 12°48'21"E) and along coastal areas within close proximity of Palermo, such as Addaura (38°11'28"N, 13°20'53"E), Aspra (38°06'28"N, 13°30'07"E), Cefalù (38°02'20"N, 14°01'19"E), and Isola delle Femmine (38°12'30"N, 13°14'16"E).

Table 1 gives the details for the various (21) sightings and collections of *F. commersonii* individuals made in Maltese coastal waters and arranged in chronological order.

The cornet fish individual captured at Marzamemi in December 2010 had a length of 102 cm and a weight of 450 g. The dorsal and anal fins had a combined total of 14 rays. The colouration of the body, which lacked dorsal bony scales, ranged from grey mottled with grey along dorsal areas to a silver sheen along the sides.

An analysis of the data reported in this study suggests that the abundance of *F. commersonii* in the Malta-Sicily shelf area has increased greatly recently, with numerous reports of sightings being made in just a few months. The *F. commersonii* individuals sighted within the same marine area range from 30 cm to 110 cm in length, dimensions which are consistent with a wide spectrum of age classes for the species, including juveniles. This further confirms that the species has established viable populations within the region and this is consistent with the view expressed by Golani et al. (2007) that *F. commersonii* is well established in the Mediterranean with the presence of both juvenile and adult individuals. In addition, most of the sightings for the species reported in this study refer to small shoals rather than to single individuals, with most sightings being made in shallow water (<5 m) characterized by a seagrass-dominated rocky seabed, although the species was recorded from other infralittoral bioceonoses as well. The species was mostly recorded at popular diving sites (e.g. Zurrieq in Malta) or at important fishing (e.g. Mazara del Vallo in Sicily) or touristic (e.g. Cefalù in Sicily) locations.

Date	Location	Geographical coordinates	Estimated abundance	Estimated range of individual fish lengths	Evidence in hand	Other details
15.01.08	Munxar Point	35°50'58"N 14°34'18"E	4-6		None – anecdotal (skin diver account)	3-15 m depth, rocky seabed
10.03.08	Marsascalea	35°51'41"N 14°34'33"E	5	110 cm	Photos	3 m depth; <i>Posidonia</i> on bedrock
15.12.09	Xrobb l-Ghagin	35°50'03"N 14°33'50"E	3 shoals of 3 individuals each		None – anecdotal (skin diver account)	10-20 m depth; rocky seabed with <i>P. oceanica</i>
August 2010	Munxar Point	35°50'58"N 14°34'18"E	3-4		None – anecdotal (skin diver account)	10-15 m
21.09.10	Santa Marija Bay, Comino	36°01'05"N 14°20'14"E	1		None – anecdotal (skin diver account)	15 m; sandy seabed
05.12.10	Rās il-Hobz, Gozo	36°00'59"N 14°16'46"E	4-6		Photos	12-14 m depth; rocky seabed
20.12.10	St. Thomas Bay	35°51'14"N 14°33'49"E	3		None – anecdotal (diver account)	5 m; <i>Posidonia oceanica</i> meadow
05.02.11	Zurrieq	35°49'17"N 14°27'28"E	5-8	50-80 cm	None – anecdotal (diver account)	12-14 m depth; rocky seabed
07.02.11	Birzebbuga	35°49'13"N 14°31'51"E	3		None – anecdotal (diver account)	4-10 m; sandy seabed
10.02.11	Zurrieq	35°49'17"N 14°27'28"E	5		Photos	14-18 m depth, rocky bottom
12.02.11	Qawra	35°57'54"N 14°25'28"E	4		None – anecdotal (diver account)	10 m, <i>Posidonia oceanica</i> meadow
14.02.11	Xwejini Bay	36°04'43"N 14°14'54"E	2	30-40 cm	video	2 m depth; bare sand with coarse sediment
14.02.11	Cirkewwa	35°59'11"N 14°19'41"E	2	40-50 cm	None – anecdotal (SCUBA diver account)	
19.02.11	Qawra	35°57'54"N 14°25'28"E	1		None – anecdotal (diver account)	6 m, <i>Posidonia oceanica</i> meadow
21.02.11	Zurrieq	35°49'17"N 14°27'28"E	3	40-50 cm	video	5-10 m depth; rocky bottom with photophilic assemblages
21.02.11	Qajjenza	35°49'56"N 14°32'38"E	3	30 cm	Photos	2-3 m, <i>Posidonia</i>
23.02.11	Manoel Island	35°54'17"N 14°29'53"E	1		None – anecdotal (diver account)	6 m, muddy seabed with anthropogenic debris and within yacht marina
27.02.11	Zurrieq	35°49'17"N 14°27'28"E	3-4	50 cm	Photo	15 m, rocky seabed
08.03.11	Zurrieq	35°49'17"N 14°27'28"E	4-5	50-70 cm	Photos	6-8 m depth, rocky seabed

Table 1. Recent reports of *Fistularia commersonii* from Malta.

The recent westward range expansion of Lessepsian species within the Mediterranean Sea is a well documented phenomenon. For instance, since the first published record of *F. commersonii* from the Mediterranean in 2000 (Golani, 2000), the species has been subsequently recorded from the south of Italy in 2004 (Azzurro et al., 2004), from Tunisia (Souissi et al., 2004) and from the Adriatic Sea and Ligurian Sea in 2008 (Dulčić et al., 2008; Garibaldi & Orsi Relini, 2008), making it one of the most successful Lessepsian migrants in the Mediterranean. In fact, no other Lessepsian species has spread so far in the Mediterranean (Golani et al., 2007). The number of published reports for the species within the Mediterranean has surged greatly in recent years and covers a vast geographical area, being recorded from Turkey (Bilecenoglu et al., 2002), Rhodes (Corsini et al., 2002), north Aegean (Karachle et al., 2004), Montenegro (Joksimovic et al., 2008), Malta (Cini, 2006), Sardinia (Pais et al., 2007), central Tyrrhenian (Psomadakis et al., 2009) and from Libya (Elbaraasi & Elsalini, 2009). Golani et al. (2007) report a reduced level of genetic differentiation within *F. commersonii* populations in the Mediterranean, with only two mitochondrial haplotypes being recorded for the species. According to the same authors, this has not hampered in any way the successful proliferation of the species within the Basin.

Several other instances of Lessepsian fish expansion have been documented. For instance, For the Tetraodontidae constitute a striking example of the tropicalization of the Mediterranean fish fauna, with the number of pufferfish species recorded for the Mediterranean waters rising from three (*Ephippion guttiferum*, *Lagocephalus lagocephalus* and *Lagocephalus spadiceus*) to 10 species, with seven novel tetraodontids of Lessepsian or tropical-Atlantic origin (Vacchi et al., 2007).

Fistularia commersonii is listed, along with nine other species, as an alien fish species for Italian waters (Occhipinti-Ambrogi et al., 2010). The species is also listed as one of the six alien species recorded from Maltese waters reputed to have an invasive nature (Sciberras & Schembri, 2007), with the latter authors also listing two additional records of the species, observed on both occasions in shoals of about 20 individuals, from Maltese waters in 2007. On the 27th February 2011, the species was sold commercially within the Marsaxlokk fish market (Reno Tonna, personal communication), a novelty for the Maltese Islands.

Some authors, including Psomadakis et al. (2009) have already speculated that the proliferation of the species within the Mediterranean could be indicative of an imminent colonization of the Basin by the same species. The arrival of Red Sea macroherbivores in the eastern Mediterranean, such as the rabbitfishes *Siganus luridus* and *S. rivulatus*, has been shown to disrupt native ecosystems (Lejeune et al., 2010). Despite its success in spreading throughout the Mediterranean, the occurrence of *Fistularia commersonii*, a Red Sea predator, has not been attributed, to date, such consequences.

ACKNOWLEDGEMENTS

The authors would like to thank Italian police commanders Giuseppe Campisi e Antonio Giaccotto from Marzamemi, Danilo Scuderi from Catania, Michele Reina from Palermo for the cornet fish illustration included in this manuscript, and Reno Tonna, Rio Sammut, Edward Scicluna, Edward Vella, Matthew Montebello, Roland Vella, Mark Dove, Anthony Sant, Sharklab, Drifa Diving & Marine Services Ltd, Atlam and Calypso Diving Clubs from the Maltese Islands for making their cornet fish specimens and sightings available.

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New records of *Testacella scutulum* Sowerby, 1821 (Gastropoda, Pulmonata, Testacellidae) from Southern Italy and Sicily

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ABSTRACT In the present paper we report on *Testacella scutulum* recently recorded for a few regions of Southern Italy and Sicily. An updated distribution map, anatomical remarks and feeding behaviours of collected specimens are related in order to extend and improve general knowledge on these terrestrial molluscs.

KEY WORDS terrestrial molluscs, semi-slugs, *Testacella scutulum*, Southern Italy, Sicily.

Received 08.02.2011; accepted 10.03.2011; printed 30.03.2011

INTRODUCTION

The family Testacellidae Cuvier, 1800 comprises the only genus *Testacella* Cuvier, 1800 with Euro-mediterranean distribution extending up to Macaronesia (Giusti et al., 1995; Schileyko, 2000; Rinaldi, 2003a; Bank, 2011). *Testacella* spp. specimens are carnivorous and mostly feed on earthworms actively hunted in the subsoil and, sometimes, on molluscs (Benoit, 1857; Paulucci, 1879; Webb, 1893; Quick, 1960). Such a particular mode of life is likely to be the main reason of the relative difficulty in sampling these organisms.

In Italy three *Testacella* species, distinguishable only by anatomical inspection, have been reported, *T. haliotidea* Draparnaud 1801, confirmed by anatomical data, from a single station in the northwestern Italy (Piedmont, Collina di Torino); *T. gestroi* Issel 1873, endemic of Sardinia and southern Corsica; and *T. scutulum* Sowerby, 1821 reported for some areas of the peninsula and Sicily (Manganelli et al., 1995). In North-central Italy the presence of *T. scutulum* was documented (by anatomical data) only for Liguria and Tuscany (Pollonera, 1889; Wagner, 1915; Colosi, 1919; Giusti 1968, 1970,

1976; Giusti & Mazzini, 1970); recently it was reported also for Abruzzo (Rinaldi, 2003a, b).

In Southern Italy, the genus *Testacella* was recorded (although without any anatomical analyses) only in three localities. In particular it was reported in Campania on the island of Capri (Costa, 1840; Bellini, 1915; Petraccioli et al., 2005) where Bourguignat (1861), based on morphological shell characters, described *T. drymonia*; such a taxon was successively accepted as valid by Pilsbry (1885) and Bellini (1915) whereas, a few decades later, Alzona (1971) suggested it to be a synonym of *T. haliotidea trigona* Gassies & Fischer, 1856. In the end, Petraccioli et al. (2005) attributed this population to *T. scutulum*. In Basilicata, Degner (1927) recorded *Testacella* sp. for Lagonegro (locality Mala Mogliera) and Paulucci (1878, 1879) indicated the occurrence of *Testacella* sp. in Calabria, Scilla (locality Grotte di Tremusa).

In Sicily, the genus *Testacella* has been recorded for the island of Ustica and surroundings of Palermo. In particular, Pirajno di Mandralisca (1842) reported that the malacologist A. Bivona collected a few specimens of *T. haliotidea* in Ustica (Palermo, Sicily), whereas Testa (1842) and Calcara (1842, 1845) and, some years later, Benoit

(1857) reported the same taxon for Monte Cuccio (Palermo) and Palermo surroundings. Alzona (1971) agreed in attributing the populations from Sicily and Ustica to *T. haliotidea*; on the contrary, Manganeli et al. (1995) considered the sicilian populations as *T. scutulium*.

In the present paper we report on 28 extant specimens of *T. scutulium* collected in Campania, Calabria and Sicily (Fig. 1), the reproductive systems of which are described and illustrated in details for the first time. Moreover a few notes on feeding behavior are added including an illustrative video (http://www.biodiversityjournal.com/video/BJ_video1.avi).

MATERIALS AND METHODS

All *Testacella* specimens were collected by sight on the soil or under the rocks. Observations on ecology of these organisms and their feeding behavior were made both directly in the field and in captivity by keeping the animals inside a terrarium.

In order to study and illustrate genital organs, highly informative at the specific level, individuals were drowned and fixed in 75% ethanol.

Reproductive apparatus was extracted by means of scalpel, scissors and needles. Photographs were taken with a digital camera. Height and maximum diameter of the shell along with some parts of genitalia were measured (in millimeters) by a digital gauge. Illustrations of genitalia were sketched using a camera lucida. Voucher specimens were stored in collections indicated below. Toponyms (place-names) are reported following the Portale Cartografico Nazionale (PCN, <http://www.pcn.minambiente.it/PCN/>), Map IGM 1:25,000. Each locality and/or collection site is named in the original language (Italian).

Studied material, except from when indicated in a different way, has been collected by the owner of the collection where it is stored.

Examined material:

Abbreviations: Collection F. Liberto, Cefalù (CL); Collection W. Renda, Amantea (CR); Collection I. Sparacio, Palermo (CS).

Campania: Benevento, Monte Taburno, 800 m, 30.X.1993, one specimen (CS).

Calabria: Melia, nearby Grotte di Tremusa, 550 m, legit W. Renda, 24.XI.2007, one specimen (genitalia in 75% Ethanol, CL), (shell, CR).

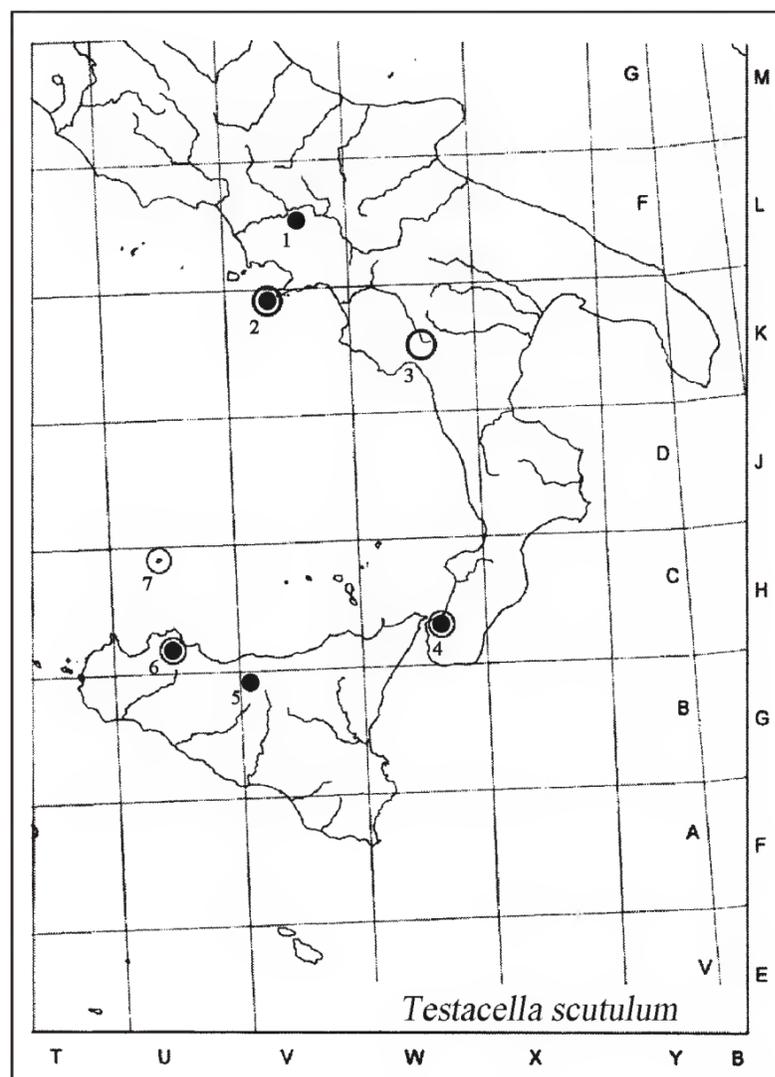
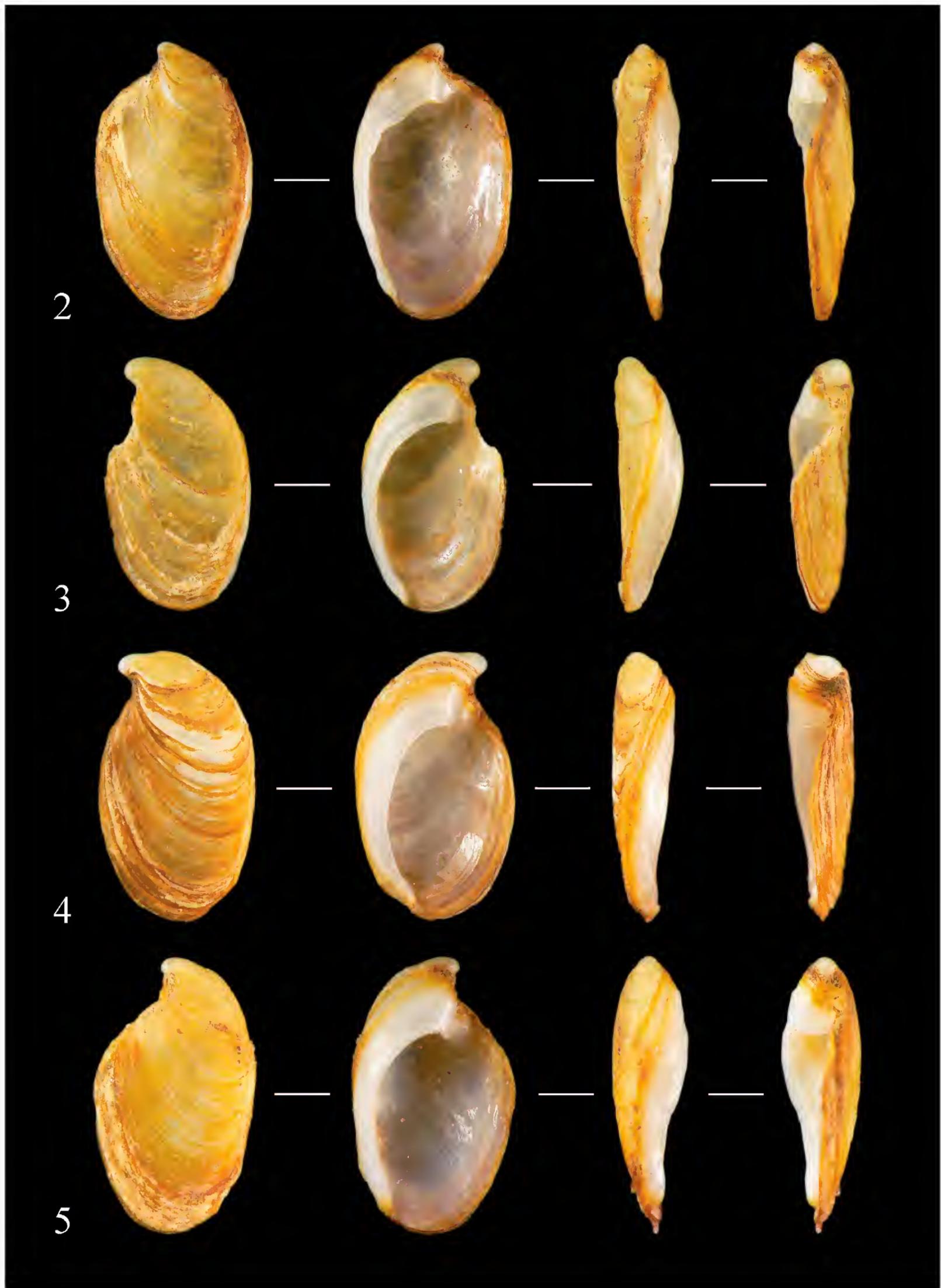


Figure 1. Distribution map showing the location of past and recent records of *Testacella scutulium* in Southern Italy and Sicily; blank circle, past records (before 1950), black dot, recent records (after 1950), circle with dot inside, past records confirmed by recent data. Localities: Benevento, Monte Taburno (1); island of Capri (2); Lagonegro, Mala Mogliera (3); Scilla, Grotte di Tremusa (4); Isnello, Vallone Madonie (5); Palermo, Ponte delle Grazie and Molarà (6); island of Ustica (7).



Figures 2-5. Shells of *Testacella scutulum* from Campania, Benevento, Monte Taburno, h 7 mm, D 4.1 mm (Fig. 2), Calabria, Scilla, Grotte di Tremusa, h 4.7 mm, D 2.8 mm (Fig. 3), Sicily, Isnello. Vallone Madonie, h 6 mm, D 3.5 mm (Fig. 4), Sicily, Palermo, Ponte delle Grazie, h 5.7 mm, D 3.4 mm (Fig. 5).

Sicilia: Palermo, by the Oreto river bank, at Ponte delle Grazie, 77 m, 8-15.XI.1993, six specimens (in 75% Ethanol, CS); same place X/XI.1995, twelve shells (CS), three specimens and two shells, legit I. Sparacio (CL). Palermo, Molarà, 140 m, 7.III.2011, one specimen, legit B. Massa (CS). Isnello, Vallone Madonie, 1130 m, 1.XI.2009, one specimen (CL); same place 14.XI.2010, one specimen (CL).

RESULTS AND DISCUSSION

Based on results of the analysis of reproductive apparatus, *Testacella* specimens investigated in the present study were attributed to *T. scutulium*. Such a species is characterized by a cylindrical penis, without flagellum and dilatations, with the retractor muscle originating from the apex of the penis, side by side with the point at which the vas deferens ends (Colosi, 1919; Quick, 1960; Giusti, 1968, 1976; Giusti & Mazzini, 1970; Giusti et al., 1995).

T. haliotidea differs from *T. scutulium* for the presence of a long penial flagellum and a short penial diverticulum situated level with where vas deferens ends (Giusti et al., 1995; De Mattia, 2006); whereas *T. gestroi* is characterized by both an appendix near the apex of the penis and a bifid retractor muscle, one branch of which is inserted on the penial apex and the other one on the appendix (Wagner, 1915; Giusti, 1970).

Shells of specimens examined in the present study were quite variable both in size and morphological characters (Figs. 2-5).

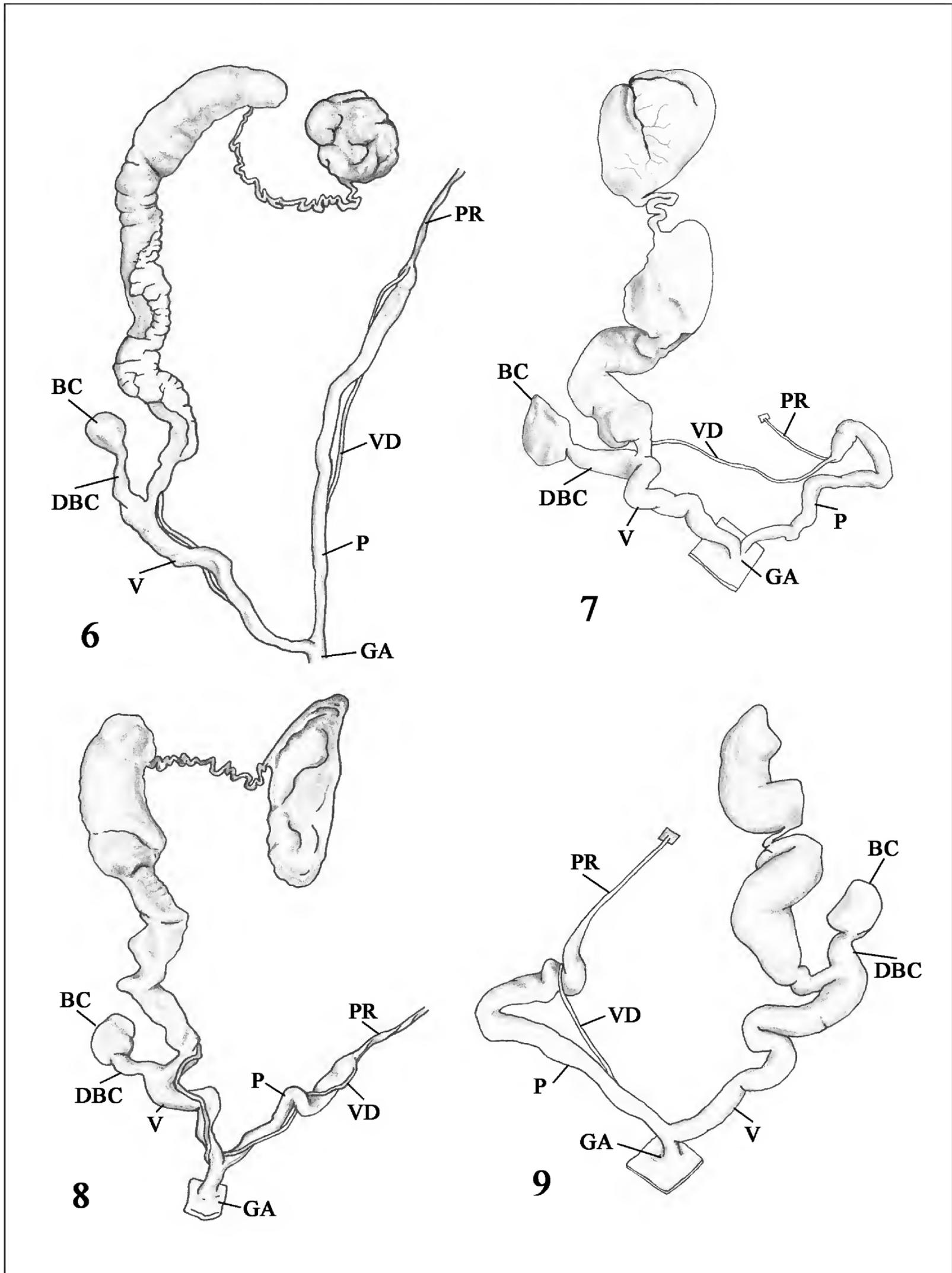
The specimen from Monte Taburno (Benevento) and those from Calabria and Sicily show the same structure of genitalia as that described for *T. scutulium*, with a more or less evident constriction of the proximal end of the penis, probably due to a contraction of the penis itself, and a retractor muscle sometimes very wide and more spanned on the penis apex (Giusti, 1970) (Figs. 6-9). Among all investigated animals, genitalia of the specimen from Monte Taburno were the most developed, while those of Sicilian samples were undersized with respect to the others.

From the ecological point of view, the specimen from Monte Taburno was collected under a rock in a natural environment comprising a meadow richly interspersed with shrubs at the edge of a group of

oaks (*Quercus pubescens* Willd.); the specimen from Calabria, found in the same place as that reported by Paulucci (1878, 1879), was collected in the day-time on a rock covered with a rich vegetation. *Testacella* caught at Ponte delle Grazie (Palermo) were found in activity on the fields, in the night-time. They were observed either in natural environments by the Oreto river banks with typical riparian vegetation or in the neighboring citrus plantations. *T. scutulium* (one specimen) picked up in Palermo (locality Molarà) was recovered under the soil during ploughing time (B. Massa, *in verbis*) within a field bordered by citrus plantations and gardens. The two specimens from Isnello (Vallone Madonie) were found in the day-time under large stones not far from a stream. The environment was characterized by reforestation with alder-trees, *Alnus cordata* (Loisel.) Desf., a native species from southern Apennines in association with *Ulmus*, *Fraxinus*, *Salix* and *Populus* (Schicchi, 1998).

From the biological point of view, *Testacella* are molluscs particularly specialized in being predators and carnivours. The buccal mass is very developed and endowed with powerful muscles and a radula with hooked teeth. The shell, reduced in size, is located at the posterior region of the body. The body, which at rest is wider in the posterior region, during locomotion appears worm-like (Fig. 10). Such a features facilitate *Testacella* specimens in pursuing, capturing and swallowing preys in the subsoil cracks. Several authors (Lacaze-Dutiers, 1887; Webb, 1893; Barnes, 1950; Quick, 1960) supplied information on biology of these mollusks and, moreover, a very detailed analysis of the anatomy and method of functioning of the buccal mass of *T. maugei* Férussac, 1819, was provided by Crampton (1975), with particular attention to prey capture and feeding process. The sequence of events during feeding seems to include two major phases, the first of these is the seizure of a worm and the drawing of the first part of the body through the mouth; the second is the ingestion of the remainder of the worm.

In the first phase *Testacella* protract the odontophore far outside the mouth, so that the radular teeth are erect. The worm is caught by the hooked teeth on the leading edge of the odontophore and contraction of the radular retractor follows rapidly. The body of the worm is pulled into the odontophoral concavity and,



Figures 6-9. Genitalia of *Testacella scutulum* from Campania, Benevento, Monte Taburno (Fig. 6), P 28 mm, V 15.8 mm, CBC 5.4 mm, CBC+BC 8.3 mm; Calabria, Scilla, Grotte di Tremusa (Fig. 7), P 17 mm, V 9 mm, CBC 4.8 mm, CBC+BC 6 mm; Sicily, Isnello, Vallone Madonie (Fig. 8), P 12.5 mm, V 8 mm, CBC 3.2 mm, CBC+BC 5.5 mm; Sicily, Palermo, Ponte delle Grazie (Fig. 9), P 12.4 mm, V 12 mm, CBC 2.9 mm, CBC+BC 3.8 mm. Abbreviations: GA, genital atrium; BC, bursa copulatrix; DBC, duct of the bursa copulatrix; P, penis; PR, penial retractor muscle; V, vagina; VD, vas deferens.



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Figures 10-15. Living specimens. *Testacella scutulum* (Fig. 10). Sequence of events in the feeding process (Figs. 11-14). Phase of regurgitation of the worm (Fig. 15).

because the sides of the radula now collapse inwards, the worm is gripped on three sides by radular teeth. The buccal sphincter also contracts so that the worm is held firmly within the buccal vestibule and the buccal cavity.

The second phase is carried out without further protraction of the odontophore outside the mouth. Swallowing occurs by a combination of suction and odontophoral movements. Contraction of the buccal sphincter increases pressure within the buccal cavity and, as the oesophagus is opened the worm is partially sucked into this. Swallowing also necessitates active participation by the radula to release the prey. As the worm is held by the teeth, a forward movement of these effectively releases it to the oesophagus. Relaxation of the buccal sphincter muscle occurs at this point and now the radula underlies a more anterior portion of the worm and is rapidly retracted by the radular retractor muscles, drawing more of the worm in through the mouth. Interactions between odontophore, buccal sphincter and walls of the buccal cavity continue with a ratchet-like mechanism until the whole worm has been ingested. Usually, the worm is caught at one or other extremity or, alternatively, laterally (http://www.biodiversityjournal.com/video/BJ_video1.avi). In the last case, since the worm is ingested after having been folded, *Testacella* remarkably widens its mouth (Figs. 11, 12). It has also been observed that *Testacella* may swallow only a portion of the worm and then cut, without eating, the remaining part (Figs. 13-14). Generally capturing and feeding may take up to one hour. Ingested worm is digested by gastric juices (=digestive fluids) without being broken into pieces; this hypothesis is corroborated by the observation that in case of regurgitation the worm only shows superficial lacerations (Webb, 1893; present work, Fig. 15).

CONCLUSIONS

Records reported and discussed in the present paper result from researches on the field carried out for about twenty years in Sicily and Southern Italy. Description and illustration of genitalia of these population are given herein for the first time. These studies led us either to ascertain the occurrence of *T. scutulium* including a few localities never being reported up to now for this species, i.e. Benevento (Monte Taburno) and

Isnello (Vallone Madonie), or to confirm the persistence of the populations of Scilla (Grotte di Tremusa) and Palermo (Ponte delle Grazie). From the ecological point of view, collection sites resulted quite variegated, being natural (Monte Taburno, Grotte di Tremusa, Ponte delle Grazie); semi-natural and partially anthropized (surroundings of Ponte delle Grazie, Molaro), or still characterized by reforestation within highly natural environments (Vallone Madonie). Because of their subterranean mode of life, *Testacella* are really useful in biogeographic studies (Giusti et al., 1995), and, for this reason, either deeper analyses by molecular genetic techniques in order to evaluate the real taxonomic status of some *T. scutulium* populations living in apparent isolation, or additional field investigations to ascertain the real distribution of the species are therefore desirable. Examples of anthropic passive transport of *Testacella* are, however, known for several geographic areas; New Zealand (Barker, 1999), South Africa (Quick, 1960), Australia (Smith & Kershaw, 1979; Smith, 1992), U.S.A. (Hanna, 1966; Branson, 1976; Thomas et al., 2010) hence, for some of the herein examined populations, a possible allochthonous origin cannot definitely be ruled out.

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New ecological and taxonomical data on some Ptenoglossa (Mollusca, Caenogastropoda) from the Gulf of Catania (Ionian Sea)

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ABSTRACT Ptenoglossans, well known as parasites of marine invertebrates, are one of the less common and less studied groups of caenogastropods. Most of the α -taxonomy of their Mediterranean representatives is still source of debate and very few data are known on their ecology. A considerable amount of fresh and living material of several ptenoglossan from the Gulf of Catania was available for study. Based on this material we here provide information on the distribution and ecology (e.g. habitat and host preference) of some relevant ptenoglossan species. In particular the distribution of *Similiphora similior* (Bouchet & Guillemot, 1978), *Pogonodon pseudocanarica* (Bouchet, 1985), *Cerithiopsis ladae* Prkic & Buzzurro, 2007, *Epitonium pseudonanum* Bouchet & Warén, 1986, *Melanella lubrica* Monterosato, 1890, and *Pelseneeria minor* Koehler & Vaney, 1908 were extended to the Ionian Sea and the host is reported for: two triphorids, one cerithiopsid, one epitoniid, three *Melanella* Bowdich, 1822 and other two eulimids. The particularly good conditions of the material studied also allowed some novel and important observations on the morphology to be made and provided the opportunity to discuss the taxonomy of some groups. Descriptions of the head-foot colour pattern were provided for one triphorid, three species of *Cerithiopsis* Forbes & Hanley, 1851, one epitoniid and three eulimids.

KEY WORDS Ptenoglossa, Mollusca Gastropoda, Gulf of Catania, host-parasite relationships.

Received 15.03.2011; accepted 26.03.2011; printed 30.03.2011

INTRODUCTION

The term Ptenoglossa has been traditionally used to indicate a group of mainly marine molluscs possessing a “comb-like” (ptenoglossate) radula (Gray, 1853). The taxonomical rank of Ptenoglossa has changed throughout the past decades and so has the number of families included (for an historical account see Warén, 1999; Giannuzzi-Savelli et al., 1999). Today no evidence support a ptenoglossan clade and data coming from both morphology (see Ponder & Lindberg, 1997 and references therein) and DNA sequences (e.g. Colgan et al., 2007; Ponder et al., 2008) reveal the parphyly or polyphyly of the group.

According to the currently accepted classification (Bouchet et al., 2005), Ptenoglossa are an informal group within the Caenogastropoda composed by eight families. Among ptenoglossan families,

only six (Epitoniidae, Janthinidae, Eulimidae, Aclididae, Triphoridae, Cerithiopsidae) have Mediterranean representatives.

In Europe there are 329 species of Ptenoglossa divided into 85 genera of 7 families (data from CLEMAM, Check List of European Marine Mollusca Database, <http://www.somali.asso.fr/clemam/index.clemam.html> searched on March 2011): Aclididae (10 species, 3 genera), Cerithiopsidae (44 species, 11 genera), Epitoniidae (73 species, 19 genera), Eulimidae (169 species, 40 genera), Janthinidae (4 species, 1 genus), Triforidae (10 species, 1 genus), Triphoridae (19 species, 10 genera). Ptenoglossan are present in Italian waters with 112 species divided into 40 genera of 6 families: Aclididae (8 species, 3 genera), Cerithiopsidae (18 species, 4 genera), Epitoniidae (24 species, 10 genera), Eulimidae (38 species, 16 genera), Janthinidae (3 species, 1 genus), Triphoridae (11 species, 8

genera) (Oliverio, 2008). It should be noted here that the supra-familiar classifications adopted by the above mentioned checklists have not been updated according to the current taxonomy of Gastropoda (Bouchet et al., 2005)

Some ptenoglossan families have been studied in some detail and a few revisions are available based almost exclusively on shell characters. (e.g. Fretter & Graham, 1982; Warén, 1983, 1988; Bouchet, 1984; Bouchet & Warén, 1986, 1993). Studies on other morphological characters are scarce and detailed anatomical accounts to date are lacking (for a discussion see Ponder & Lindberg, 1997).

Ptenoglossan families are particularly rich in species and their shells characters often show a high degree of convergence. For these reasons, their identification is very difficult and their α -taxonomy has often been source of great debate. Due to their beautiful shells, epitoniid species are probably best known and easier to identify. Eulimid shells have often very small dimensions and unreliable sculptural features. Similar reasons have led some authors to hypothesize a species complex status for some cerithiopsid and triphorid taxa, although these views are not universally accepted (Warén, 1999).

Based on some field observations and the gross anatomy of their alimentary systems, ptenoglossans are commonly considered as parasites (Fretter & Graham, 1962). Epitoniids feed mainly on Anthozoa (but also Zoantharia, Scleractinia, and Ceriantharia (Den Hartog, 1987), cerithiopsids and triphoriids are usually associated with sponges. The host-parasite relationship is best studied in eulimids whose genera seem to have a strict preference for individual classes of echinoderms (Warén, 1983).

Fresh specimens of several Mediterranean ptenoglossans species are hard to find and there are only few field observations for most taxa. For these reasons, the data presently available on the biology and ecology of Mediterranean ptenoglossans are based on observations of only a few common species.

In the present study we had access to a considerable amount of fresh and living specimens of Ptenoglossa, collected in several localities and from various biocenoses and substrates along the Gulf of Catania (Mediterranean, Ionian Sea).

Based on this material we here provide relevant information on the biology and the ecology of some species of Ptenoglossa, which contribute to the general understanding of this enigmatic group of caenogastropods in Mediterranean.

Thanks to the particular good conditions of our material, we were also able to perform several important observations on shell and external soft parts of some ptenoglossan species and their implications with respect to the taxonomical status of these species are here discussed.

MATERIALS AND METHODS

The source of the material here under study is twofold, being mostly obtained during an extensive sampling campaign (Scuderi et al., 2005) and partly collected in separate occasions by one of the authors (D.S.).

The area of the sampling campaign was the whole Gulf of Catania (Ionian Sea), extending from Capo Mulini southwards to Capo Campolato. Samples were performed, along 21 transects orthogonal to the coastline (Fig. 1), on five stations each transect (at depths of 3, 10, 20, 30, 50 m), totalling 105 stations.

Hard substrates were sampled by SCUBA diving with the technique of scraping (Bellan-Santini, 1969). A 1 mm mesh net was used to prevent the loss of microbenthic fraction. Sampling on soft substrates was performed by a 15 l Van Veen grab (Castelli et al., 2003) and sieved on a 1 mm mesh sieve to remove the finest substrate fraction.

Among the collected samples, a fraction composed by material larger than 1 mm (containing most of the ptenoglossans collected) plus several macroinvertebrates (e.g. echinoderms) were kept alive and the rest immediately fixed and preserved in 4% formaldehyde in seawater. All material was transferred to the laboratory, where under a stereomicroscope, fresh specimens of benthic fauna were isolated from the rest of the samples and sorted into major taxonomical groups. Ptenoglossan specimens were separated and identified at species level. Number of specimens (abundance) and species (diversity) was recorded for each ptenoglossan family.

Each sample was assigned to its original biocenosis (according to Pérès & Picard, 1964), which was inferred based on observation of the substrate and benthic fauna collected.

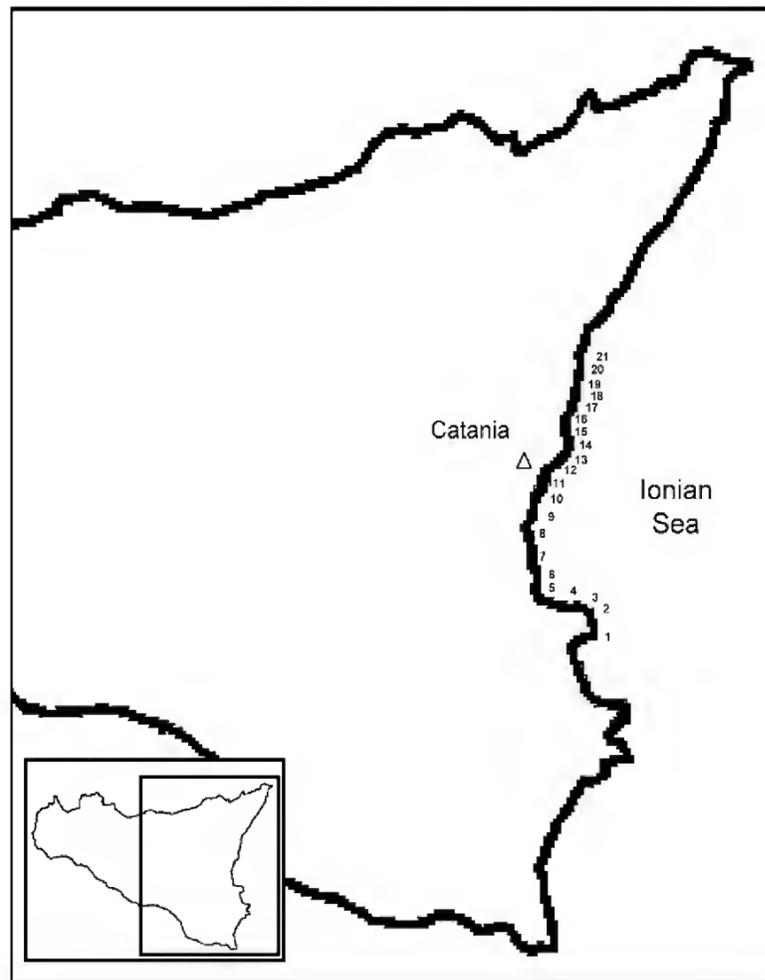


Figure 1. Map of the sampled area and of the BCGC transects. 1: Capo Santa Croce, 2: Capo Campolato, 3: Brucoli, 4: Punta Castelluccio, 5: Agnone, 6: San Leonardo, 7: Simeto, 8: Simeto Nord, 9: Catania Sud "Plaja", 10: Catania, 11: Ognina, 12: Aci Castello, 13: Acitrezza, 14: Capo Molini, 15: Santa Caterina, 16: Santa Maria La Scala, 17: Santa Tecla, 18: Pozzillo, 19: Praiola, 20: Torre Archirafi, 21: Riposto.

Details on the specimens collected separately by D.S. are given case by case in the discussion section below.

Observations on the distribution and ecology of ptenoglossan species (such as habitat preference, host-parasite relationship) were performed based on collected material. Teleoconch and protoconch features were observed under a stereomicroscope and protoconch microsculpture was revealed by treating the specimens with 70% Silver Proteinate. Observations were also performed on external soft parts morphology and colour pattern in live-collected material. Colour drawings of the head-foot were also produced, being published elsewhere (Scuderi, in press). Description of external soft-body parts and redescription of relevant shell features were provided for some species. The implication of these with the taxonomical status of the latter ones was also discussed.

The following abbreviations are used in the text: AP – photophilic algae biocenosis; BCGC – Study for the Biocenotic Characterization of the Gulf of Catania; C – coralligenous biocenosis; Di.S.Te.B.A - Dipartimento di Scienze e Tecnologie Biologiche ed Ambientali, Università del Salento, Italy; DC –

coastal detritic biocenosis; BMNH: British Museum of Natural History; SFBC - biocenosis of fine well-sorted sands; SGCF – biocenosis of coarse sands and fine gravels under bottom currents; VTC – terrigenous muds biocenosis.

Transitional environments between two biocenoses (ecotones) are indicated by two biocenosis abbreviations separated by a forward slash (/).

RESULTS

• BCGC campaign

On a total of 493 mollusc species and over 42000 specimens sampled, *Ptenoglossa* accounted for 36 species and 228 individuals.

Collected samples were assigned to 6 biocenoses and 9 ecotones. Among them, only samples from 4 biocenoses (AP, SFBC, DC and VTC) and 6 ecotones (AP/C, SFBC/DC, SFBC/VTC, SFBC/SGCF, DC/SGCF and DC/VTC) contained ptenoglossan taxa.

The highest abundance of ptenoglossans (Fig. 2) was recorded in AP while the lowest in VTC and in AP/C and SFBC/VTC. The highest diversity (Fig. 2) was found in DC/SGCF, and the lowest in AP/C, SFBC/DC, SFBC/VTC, and VTC.

The five ptenoglossan families here collected never occurred together. However, if Aclididae are excluded, all families were found in AP, SFBC/SCGF, DC, DC/VTC and DC/SGCF. Triphorids only occurred in AP/C and epitoniids only in SFBC/DC, SFBC/VTC and VTC. Epitoniids were the most widespread, occurring in every sample containing ptenoglossans, excluding those from AP/C and SFBC, whereas acclidids were exclusively present in those from SFBC.

AP biocenosis accounted for the highest number of specimens of all ptenoglossan families,

with the exclusion of epitoniids whose highest abundance was found in DC/VTC. This family showed also there the highest diversity, whereas triphorid species were more abundant in AP and those of eulimids and cerithiopsids in DC/SCGF.

Table 1 and Table 2 list the ptenoglossan families and species collected and summarize the data obtained on their abundance, diversity and habitat preference.

Figure 2 shows the occurrence of families relative to individual biocenoses and illustrate their relative abundance and diversity.

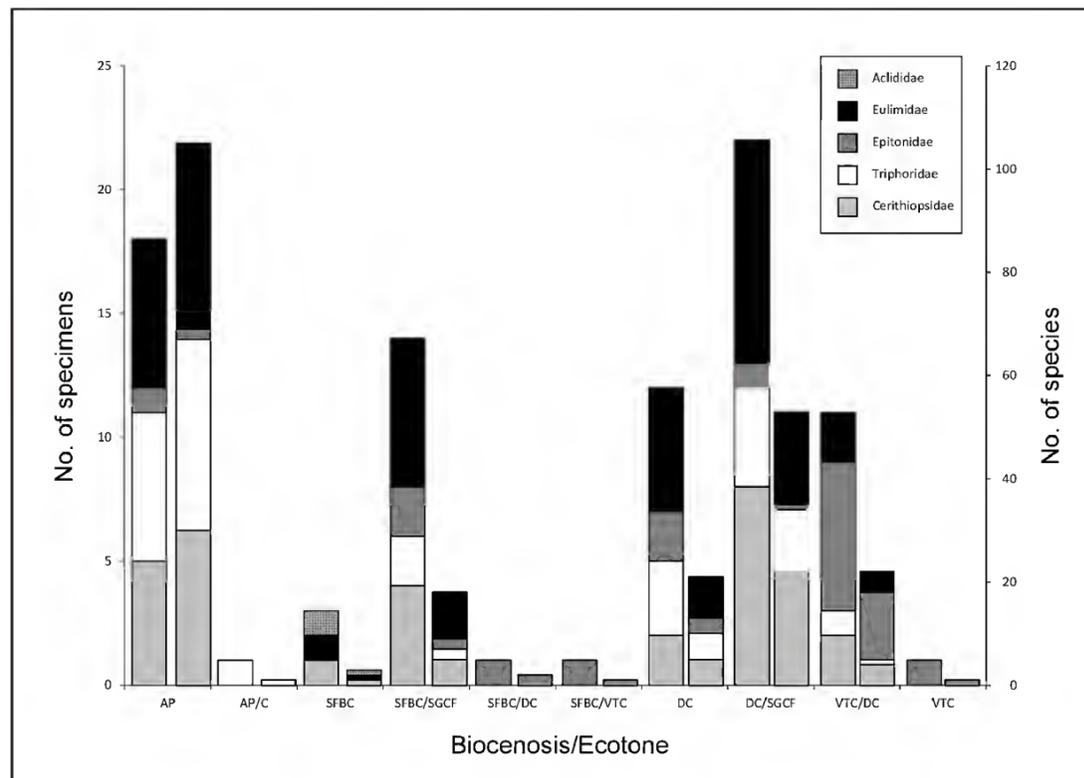


Figure 2. Diversity (left bar) and abundance (right bar) of Ptenoglossa and their families collected in the BCGC sample campaign. Data are shown relative to the original biocenosis of sampling.

	AP	AP/C	SFBC	SFBC/ SGCF	SFBC/ DC	SFBC/ VTC	DC	DC/ SGCF	VTC/ DC	VTC	Total
Abundance											
Cerithiopsidae	30	-	1	5	-	-	5	22	4	-	67
Triphoridae	37	1	-	2	-	-	5	12	1	-	58
Epitonidae	2	-	-	2	2	1	3	1	13	1	25
Eulimidae	36	-	1	9	-	-	8	18	4	-	76
Aclididae	1	-	1	-	-	-	-	-	-	-	2
Total abundance	106	1	3	18	2	1	21	53	22	1	228
Diversity											
Cerithiopsidae	5	-	1	4	-	-	2	8	2	-	10
Triphoridae	6	1	-	2	-	-	3	4	1	-	7
Epitonidae	1	-	-	2	1	1	2	1	6	1	6
Eulimidae	6	-	1	6	-	-	5	9	2	-	12
Aclididae	1	-	1	-	-	-	-	-	-	-	1
Total diversity	19	1	3	14	1	1	12	22	11	1	36

Table 1. Abundance, diversity and distribution in the samples of collected ptenoglossan families

	AP	AP/ C	SFBC	SFBC/ SGCF	SFBC/ DC	SFBC/ VTC	DC	DC/ SGCF	DC/ VTC	VTC	Total
Cerithiopsidae											
<i>Cerithiopsis diadema</i> Monterosato, 1874 ex Watson ms.	-	-	-	-	-	-	2	-	-	-	2
<i>Cerithiopsis fayalensis</i> Watson, 1886	-	-	-	-	-	-	-	1	-	-	1
<i>Cerithiopsis jeffreysi</i> Watson, 1885	-	-	-	1	-	-	-	1	-	-	2
<i>Cerithiopsis minima</i> (Brusina, 1865)	1	-	-	1	-	-	-	3	-	-	5
<i>Cerithiopsis nana</i> Jeffreys, 1867	14	-	-	2	-	-	-	3	-	-	19
<i>Cerithiopsis tubercularis</i> (Montagu, 1803)	12	-	1	1	-	-	3	5	2	-	24
<i>Krachia cylindrata</i> (Jeffreys, 1885)	-	-	-	-	-	-	-	2	2	-	4
<i>Dizoniopsis coppolae</i> (Aradas, 1870)	2	-	-	-	-	-	-	6	-	-	8
<i>Dizoniopsis micalii</i> Cecalupo & Villari, 1997	1	-	-	-	-	-	-	-	-	-	1
<i>Seila trilineata</i> (Philippi, 1836)	-	-	-	-	-	-	-	1	-	-	1
Triphoridae											
<i>Cheirodonta pallescens</i> (Jeffreys, 1867)	2	-	-	-	-	-	1	-	-	-	3
<i>Monophorus erythrosoma</i> (Bouchet & Guillemot, 1978)	1	-	-	-	-	-	-	-	-	-	1
<i>Monophorus perversus</i> (Linné, 1758)	-	-	-	-	-	-	2	1	-	-	3
<i>Monophorus thiriotae</i> Bouchet, 1984	11	-	-	1	-	-	-	-	-	-	12
<i>Marshallora adversa</i> (Montagu, 1803)	16	1	-	1	-	-	-	6	-	-	24
<i>Similiphora similior</i> (Bouchet & Guillemot, 1978)	4	-	-	-	-	-	-	2	-	-	6
<i>Metaxia metaxa</i> (Delle Chiaje, 1828)	3	-	-	-	-	-	2	3	1	-	9
Epitoniidae											
<i>Epitonium aculeatum</i> (Allan, 1818)	-	-	-	-	-	1	1	-	2	-	4
<i>Epitonium algerianum</i> (Weinkauff, 1866)	-	-	-	-	-	-	-	-	1	-	1
<i>Epitonium clathratulum</i> (Kanmacher, 1798)	-	-	-	1	-	-	-	-	3	-	4
<i>Epitonium commune</i> (Lamarek, 1822)	2	-	-	1	-	-	-	-	4	1	8
<i>Epitonium tiberii</i> (De Boury, 1890)	-	-	-	-	2	-	2	-	2	-	6
<i>Opalia (Nodiscala) hellenica</i> (Forbes, 1844)	-	-	-	-	-	-	-	1	1	-	2
Eulimidae											
<i>Melanella alba</i> (Da Costa, 1778)	-	-	-	-	-	-	4	-	-	-	4
<i>Melanella boscii</i> (Payraudeau, 1827)	1	-	-	1	-	-	-	2	-	-	4
<i>Melanella frielei</i> (Jordan, 1895)	-	-	-	-	-	-	1	1	-	-	2
<i>Melanella cf. monterosatoi</i> (Mtrs., 1890 ex De Boury ms.)	-	-	-	-	-	-	-	1	-	-	1
<i>Melanella petitiiana</i> (Brusina, 1869)	6	-	-	3	-	-	1	7	-	-	17
<i>Melanella polita</i> (Linné, 1758)	-	-	1	1	-	-	-	1	2	-	5
<i>Melanella cf. praecurta</i> (Pallary, 1904)	-	-	-	-	-	-	-	1	-	-	1
<i>Parvioris ibizenca</i> (Nordsieck, 1968)	5	-	-	2	-	-	1	1	-	-	9
<i>Vitreolina eurva</i> (Monterosato, 1874 ex Jeffreys ms.)	1	-	-	-	-	-	1	2	-	-	4
<i>Vitreolina philippi</i> (Rayneval & Ponzi, 1854)	17	-	-	1	-	-	-	-	-	-	18
<i>Vitreolina perminima</i> (Jeffreys, 1883)	6	-	-	-	-	-	-	2	2	-	10
<i>Crinophtheiros comatulicula</i> (Graff, 1875)	-	-	-	1	-	-	-	-	-	-	1
Aclididae											
<i>Aclis ascaris</i> (Turton, 1819)	-	-	1	-	-	-	-	-	-	-	1
Total specimens	105	1	3	18	2	1	21	53	22	1	227
Total species	18	1	3	14	1	1	12	22	11	1	36

Table 2. List of ptenoglossan species collected and their distribution in samples

DISCUSSION

• Ecology

The distribution of ptenoglossan families with respect to biocenoses reflected the predictable distribution of their hosts. In other words, these molluscs occurred in environments where their hosts were more likely to occur. Their diversity and abundance was also consistent with this rule.

Triphoridae

Our data revealed a marked preference of triphorids for shallow rocky bottoms where these spongivorous snails presumably are able to find higher abundance of their host.

Along with the BCGC specimens of *Similiphora similior* (Bouchet & Guillemot, 1978), several others were also hand-collected by D.S. at S. Giovanni Li Cuti, by SCUBA diving in

shady environments on shallow rocky bottoms, with the presence of the red sponge *Spirastrella cunctatrix* Schmidt, 1868.

Two living specimens of *Metaxia metaxa* (Delle Chiaje, 1828) were collected in the same occasion.

Cerithiopsidae

Some species of Cerithiopsidae revealed marked preferences for certain biocenoses: *Cerithiopsis ladae* Prkic & Buzzurro, 2007 (Figs. 7, 7a), for example, was only found under the same conditions reported in the original description: it is probably linked to a specific, currently unknown host. Other species were, however, more ubiquitous and showed higher flexibility at colonizing different environments and probably are less specifically connected to a specific host.

In additions to those collected during the BCGC campaign (Table 2), some living specimens of *Cerithiopsis minima* (Brusina, 1865) were hand-collected by D.S. by SCUBA diving at S. Giovanni Li Cuti, in shady environments on shallow rocky bottoms, with the presence of the red sponge *S. cunctatrix*. It is not unlikely that in the area of study, this sponge is a suitable host for a considerable number of cerithiopsid and triphorid species (see above).

Epitoniidae

One living specimen of *Epitonium dendrophylliae* Bouchet & Warén, 1986 (Figs. 21-21a) was found by D.S. in Acitrezza. The snail was attached to a large colony of *Dendrophyllia ramea* (Linnaeus, 1758) accidentally collected by fishing nets. This rare epitoniid is known as an ectoparasite of species of the genera of scleractinian corals *Dendrophyllia* (Linnaeus, 1758) and *Balanophyllia* Wood, 1844 (Bouchet & Warén, 1986), the former usually occurring at considerable depth. Richter & Luque (2004) reported the species also for the shallow waters of Punta de la Mona (Granada province, SE Spain) in association with a different species of scleractinian, *Astroides calycularis* (Pallas, 1766), and provided a redescription of the taxon (with details of head-foot and the radula) along with a detailed iconography.

One specimen of *Epitonium pulchellum* Bivona Ant., 1832 (Fig. 22) was hand-collected

by D.S. by SCUBA diving in Acitrezza at depths of 35-38 m, in DC, where it was associated to the actinian *Condilactys aurantiaca* (Delle Chiaje, 1825). As a common condition of this latter species, the column was buried in the sediment and the snail was hiding between the base of the actinian tentacles (probably attached by the proboscis) and the sediment surface, sharing this cryptic environment with some decapods of the genus *Periclimenes* Costa, 1844. Examination of the gut content of *E. pulchellum* revealed the presence of several nematocysts, (some of which unexploded) referable to *C. aurantiaca* (S. Piraino, Di.S.Te.B.A., pers. comm.).

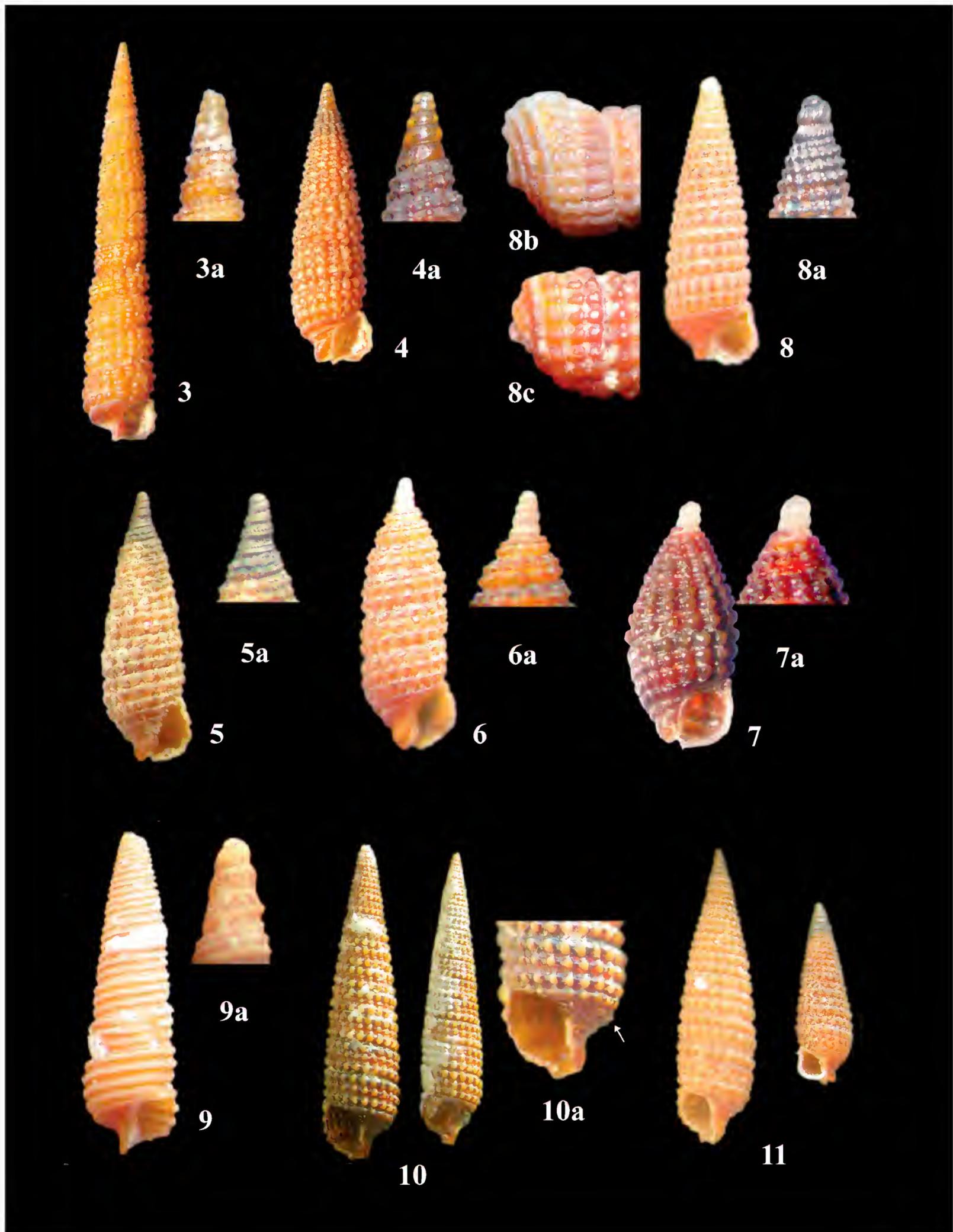
Eulimidae

The host preference of some eulimid genera for classes (or lower taxa) of echinoderms are known in some detail (Warén, 1983). The species of *Parvioris* Warén, 1981 are exclusively associated to Asteroidea, while the species of *Melanella* Bowdich, 1822 parasitize Holothuroidea only. *Vitreolina* Monterosato, 1884 species, however, shows larger flexibility, ranging from Echinoidea to Ophiuroidea and Oloturoidea.

Our BCGC data on eulimid genera and their biocenoses of occurrence seem to agree with the host preferences above outlined. While some species, such as *Vitreolina philippi* (de Rayneval & Ponzi, 1854) (Figs. 19, 19a) and *V. perminima* (Jeffreys, 1883), known to feed on echinoids (Warén & Mifsud, 1990), were more abundant in rocky bottom biocenoses (where most of their hosts thrive), species of *Melanella* were more commonly found on soft bottoms, where their holoturian hosts occurred in great numbers.

Cabioch et al., 1978 report the holoturian *Neopentadactyla mixta* (Östergren, 1848) as the host of *Melanella alba* (da Costa, 1778) in the Atlantic. At that time, however, the taxonomy of *Melanella* was far from being solved and it is not unlikely that the eulimids were misidentified.

Our observation on *M. alba* (Figs. 13, 13a, 13b) are based on four specimens of the BCGC campaign and further 75 specimens (found by D.S. in bycatch material collected by fishing nets in Aci Castello probably on DC at a depth of 80 m). In both occasions hundreds of specimens of the holoturian *Pseudothyone raphanus* (Duben & Koren, 1845) were present, some with living specimens of *M. alba* still attached (Fig. 13b).



Figures 3, 3a. *C. denticulata*, S. Giovanni Li Cuti, 10.5 mm; Fig. 3a, protoconch. - Figures 4, 4a. *C. buzzurroi*, S. Giovanni Li Cuti, 4.2 mm; Fig. 4a, protoconch. - Figures 5, 5a. *C. pulchraesculpta*, Acitrezza, 2.9 mm; Fig. 5a, protoconch. - Figures 6, 6a. *C. micalii*, Capo Molini, 2.6 mm; Fig. 6a, protoconch. - Figures 7, 7a. *C. ladae*, S. Giovanni Li Cuti, 1.8 mm; Fig. 7a, protoconch. - Figures 8, 8a, 8b. *D. coppolae*, Acitrezza, 4.5 mm; Fig. 8a: protoconch; Fig. 8b: detail of sculpture of the last whorl. - Figure. 8c. *D. concatenata*, Catania "Cajto", at depths of 27 m, detail of sculpture of the last whorl. - Figures 9, 9a. *S. trilineata*, Acitrezza, 7.7 mm; Fig. 9a, protoconch. - Figures 10, 10a. *Monophorus thiriota*, S.ta Tecla, 12 and 11 mm; Fig. 10a: detail of sculpture of the last whorl. - Figure 11: *Monophorus erythrosoma*, Is. Linosa (near Agrigento, Sicily), 6.7 and 4.6 mm.

This suggests that *P. raphanus* is the host of *M. alba* in the Mediterranean Sea.

Forty-two specimens of *Melanella lubrica* Monterosato, 1890 (Figs. 12, 12a) were also found by D.S. amongst the above mentioned material where the close similar *M. alba* also occurred. It is likely that in the original environment the two eulimids shared the same host. Unfortunately no pictures of this species were taken.

We were able to divide specimens of both species into two morphological categories, based on their shell morphology. This phenomenon was explained as expression of a marked sexual dimorphism, with males having typical shells (Fig. 12) and females having thinner shells with more rounded whorls (Fig. 12a). Both *Melanella* species occurred in the sample with specimens at different stages of growth.

One living specimen of *Melanella boscii* (Payraudeau, 1826) was hand-collected by D.S. at S. Giovanni Li Cuti (Catania), by SCUBA diving in AP, where it was crawling on the ascidian *Microcosmus sulcatus* (Coquebert, 1797). The host of *M. boscii* is known to be an undescribed holoturian species (Warén, 1999) and we have no evidence that the snail we collected was actually feeding on the ascidian. Although *Melanella* species are able to reattach if experimentally removed from their hosts (Warén, 1983), there is no evidence that they separate spontaneously from their host in order to conduct a free-crawling existence for prolonged periods. Furthermore, some exceptions to the rule of eulimids as strict parasites of echinoderms were reported (Warén, 1983) and we would not be surprised if further data reveal *M. boscii* to be able to parasitize ascidians.

Melanella polita (Linné, 1758) (Fig. 14) was regularly found in BCGC samples from biocenosis of soft substrates as well as in beach detritus samples collected by D.S. at "Plaja" (Catania beach, Fig. 1). The presence in both samples of the spatangid *Brissus unicolor* (Leske 1778) may be the evidence for a strict host-parasite relationship with this eulimid.

Along with those collected during the BCGC campaign, further specimens of *V. philippi* (Figs. 19, 19a) were found by D.S. in several localities along the Gulf of Catania associated to *Paracentrotus lividus* (Lamarck, 1816). This association was first reported by Mifsud (1990).

Over ten years of observations (unpublished data) suggest that this eulimid seems to prefer populations of echinoids occurring in a range of 4-6 m depth, while it is not found on urchins living deeper. Most *V. philippi* specimens were found attached to the aboral zone or periproct of the host from where presumably they are able to reach less protected soft parts.

One living specimen of the rare *Pelseneeria minor* Koehler & Vaney, 1908 (Fig. 17) was found by D.S. in fishing net material collected in Acitrezza at depths of 80-100 m. This species is known to live on *Genocidaris maculata* A. Agassiz 1869 (Bouchet & Warén, 1986). The material here found was instead characterised by the massive presence of the pencil-spine urchin *Cidaris cidaris* (Linnaeus, 1758) that could be an alternative host of *P. minor*. A similar relationship could be hypothesized for the eulimid species *Sticteulima jeffreysiana* (Brusina, 1869), whose abundant living specimens were found among the same material. *Pelseneeria stylifera* (Turton, 1825) is currently distinct from *P. minor*; in the Atlantic it was found (Barel & Kramers, 1977) at different localities on several species of echinoids (*Echinus esculentus* Linnaeus, 1758, *Strongylocentrotus droebachiensis* (O.F. Müller, 1776), "*Echinus pictus*", *P. lividus*, *Psammechinus miliaris* (Gmelin, 1778), "*Echinus saxatilis*", "small sea urchin").

Few shells of *Ersilia mediterranea* (Monterosato 1869) (Fig. 18) were hand collected by D.S. at S. Giovanni Li Cuti associated to *Ophioderma longicauda* (Bruzellius, 1805), which lives under stones in shallow waters.

• Systematics

Triphoridae

The teleoconch of *Monophorus thiriota* Bouchet, 1984 (Fig. 10) resembles that of *Similiphora similior* (Bouchet & Guillemot, 1978) from which is distinguishable by the sculpture of the protoconch and the fourth beaded spiral cord of the teleoconch (Fig. 10a). The colour of the external soft parts of this latter species is described by Bouchet & Guillemot (1978).

Specimens of *Monophorus erythrosoma* (Bouchet & Guillemot, 1978) (Fig. 11) were found by D.S. in Acitrezza, among material collected by fishing nets at depths of 80-100 m.



Figures 12, 12a. *Melanella lubrica*, Aci Castello, 6.2 mm, male; Fig. 12a, 6 mm, female. - Figures 13, 13a, 13b. *Melanella alba* (da Costa, 1778), Aci Castello, 9.5 mm; Fig. 13a, detail of sculpture of the last whorl; Fig. 13b, living specimens on *Pseudothyone raphanus*. - Figure 14. *Melanella polita*, Catania "Plaja", 7.2 mm. - Figures 15, 15a. *M. petitiana*, Acitrezza, 3.8 and 3.5 mm. - Figure 16. *Melanella* sp., Aci Castello, 4 mm. Figure 17. *Pelseneeria minor*, Acitrezza, 2.3 mm. - Figure 18. *Ersilia mediterranea*, S. Giovanni Li Cuti, 1.5 mm. - Figures 19, 19a. *Vitreolina philippi*, S. Giovanni Li Cuti (CT, Sicily), 3 mm; Fig. 19a, detail of the last whorl seen from the base. - Figures 20, 20a. *Crinophtheiros comatulicola*, Acitrezza, 3 mm; Fig. 20a, detail of the last whorl seen from the base. - Figures 21, 21a. *Epitonium dendrophylliae*, 1986, Acitrezza, 7 mm; Fig. 21a, living specimen. - Figure 22. *Epitonium pulchellum*, Acitrezza, 11.3 mm.

The head-foot of *M. metaxa* was almost white, with marbled pale greyish areas on the opercular region and just behind the head; no microstructures were present on the cephalic tentacles.

The presence of *S. similior* and *Pogonodon pseudocanarica* (Bouchet, 1985) (collected by D.S. in Acitrezza, among residuals of fishing nets at depths of 80-100 m) in our samples represents the first record for these species in the Ionian Sea, and their distribution is thus extended to this area.

Cerithiopsidae

Species of *Cerithiopsis* Forbes & Hanley, 1850 share similar teleoconch features and can often be distinguished only by slight differences in protoconch size and microsculpture. This has been source of several taxonomical debates (van Aartsen et al., 1984; Palazzi & Villari, 2001; Bouchet et al., 2010). Cecalupo & Robba (2010) described two new genera including species formerly attributed to *Cerithiopsis* based exclusively on differences in protoconch microsculpture. According to them, species of *Prolixodens* Marshall, 1978 have multispiral cylindrical protoconchs with prosocline riblets, protoconchs of species of *Nanopsis* Cecalupo & Robba 2010 have subsutural axial riblets, whereas species of *Cerithiopsis* s.s. have smooth protoconchs. Many other species of *Cerithiopsis*, however, show different protoconchs from those of the genera listed by these authors (see for instance that of *C. ladae* Buzzurro & Prkic, 2007, *C. diadema* Monterosato, 1874 ex Watson ms., *C. atalaya* Watson, 1874, *C. pulchraesculpta* Cachia, Mifsud & Sammut, 2004, and the closely related *C. iudithae* Reitano & Buzzurro, 2006). If the approach of Cecalupo & Robba 2010 was extended to all *Cerithiopsis* species, several new genera should be described. In our opinion such a complex systematic problem would require a more modern approach and more characters (e.g. from the anatomy) should be examined in order to assess generic distinctions. We here prefer to maintain the former interpretation of *Cerithiopsis* until this issue will be more adequately studied.

Five shells of *C. buzzurroi* (Cecalupo & Robba, 2010) (Figs. 4, 4a) and 11 of *C. denticulata* (Cecalupo & Robba, 2010) (Figs. 3, 3a) were collected by D.S. both in shell grit at S.

Giovanni Li Cuti, at depths of 15-22 m at the base of rocks.

Along with the specimens collected during the BCGC campaign, several living specimens of *Cerithiopsis diadema* (Monterosato, 1874 ex Watson ms.) were found by D.S. in material collected by fishing nets at depths of 80-100 m at Ognina. Description of the external soft-body parts are lacking in the literature. The head-foot was whitish, with long, evident and opaque granular material, arranged in two longitudinal rows in the propodium; punctations were present behind the eyes; microstructures were present at the tips of the cephalic tentacles.

Two living specimens of *C. ladae* (Figs. 7, 7a) were hand-collected by D.S. at S. Giovanni Li Cuti, by SCUBA diving in a little and shallow semi-submerged cave at a depth of 2 m. The original description (Prkic & Buzzurro, 2007) contains no data on the colour pattern of the external soft body parts which we here provide. The body was white, translucent, with paler punctuations near the operculum; punctuations were also present behind the eyes; long, evident and opaque granular material, arranged in two longitudinal rows, was present on the propodium; no microstructures were visible on the tentacles. Our record is the first for the Ionian Sea, therefore the distribution of this species is extended to this area.

Part of the material examined for the institution of *Cerithiopsis micalii* (Cecalupo & Villari, 1997) (Figs. 6, 6a) was collected by D.S. and the data on these specimens are reported in Cecalupo & Villari (1997). We here report the collection of further three specimens at Capo Molini and Acitrezza in the same conditions. Based on the presence of a third granulated spiral cord, Bouchet et al. (2010) suggested the unsuitable position of this species in *Dizoniopsis*. We agree with their idea and provide details on the external soft-body parts: body almost white, with long, evident and opaque granular material, arranged in two longitudinal rows in the propodium; microstructures were present at the tips of the cephalic tentacles.

The general shell shape of *C. minima* recalled that of the other pupoid closely related species, from which *Cerithiopsis minima* is readily distinguished by its smooth and almost white protoconch. The head-foot was entirely white, with yellow lines under the suspensor of the

operculum; no microstructures were visible at the tips of the cephalic tentacles.

As shown by our data, *Cerithiopsis tubercularis* (Montagu, 1803) is particularly common and widespread in the studied area. Prkic & Mariottini (2009), based on observation of living specimens of *C. tubercularis* indistinguishable by shell characters, found three forms distinct by relevant differences in the head-foot colour pattern. These forms were given species rank viz. *C. tubercularis*, *C. oculisfictis* and *C. petanii*. Cecalupo & Robba (2010) did not see any ground for the separation of these two latter species from *C. tubercularis*. Their approach to the taxonomy of *C. tubercularis*, based on a neotype designation, provided better nomenclatural stability. Among our material, we observed not only the same three forms described by these authors but also intermediate forms connecting to each other. We consider the presence of these intermediates as the evidence of the expression of an intraspecific variability in the colour pattern of the head-foot of *C. tubercularis*.

Some specimens of *Cerithiopsis pulchresculpta* Cachia, Mifsud & Sammut, 2004 (Figs. 5, 5a) were collected by D.S. in Acitrezza, among material collected by fishing nets at depths of 80-100 m. Although previously reported for Italian waters (Reitano & Buzzurro, 2006), this species has not been included in the Italian checklist (Oliverio, 2008).

Some taxonomical controversies also characterize the genus *Dizoniopsis* Sacco, 1895, for which we refer to a recent review (Bouchet et al., 2010). We follow these last authors in considering inappropriate the recent designation of a lectotype of *D. concatenata* by Landau et al. (2006), being not based on type materials. Here, however, we want to make a taxonomical remark about the correct diagnosis of *D. concatenata* (Conti, 1864), of which species we collected fresh material. This issue (discussed in Bouchet et al., 2010) was previously solved by Palazzi & Villari (2001), who pointed out that the original description (Conti, 1864) was based on a shell with the apex positioned downwards this reflecting on the numbering order of the spiral chords.

Specimens of *Dizoniopsis coppolae* (Aradas, 1870) were found in BCGC samples (Figs. 8, 8a, 8b). The species was dedicated to the Sicilian musician Antonio Pietro Coppola (Fig. 23), who reached a worldwide notoriety.

Both *D. coppolae* and *D. concatenata* have a characteristic “bilineated” sculpture (visible on



Figure 23. Statue of Antonio Coppola, Villa Bellini (Catania).

the body whorl) that is the result of the fusion of two spiral rows. According to Bouchet et al. (2010) in *D. concatenata* the adapical row splits into two rows (Fig. 8c) and this is a feature distinguishing this species from the congeneric *D. coppolae*. We sometimes observed the same phenomenon also on shells of this latter species, with the exception that is the abapical row that splits (Fig. 8b).

The record of one specimen of *Seila trilineata* (Philippi, 1836) and the illustration here proposed (Figs. 9, 9a) are of remarkable importance due to the rarity of this species.

Epitoniidae

Shells of *Epitonium pseudonanum* Bouchet & Warén, 1986 were collected by D.S. in shell grit at Catania “Cajto” (at depths of 25-30 m). As this represents the first record of this species in the Ionian Sea its distribution is extended to this area.

No accounts have been published on the soft-body part colour pattern of *E. pulchellum*, which we here report to be entirely white. As for the other species live-collected in this study we confirm the consistency of our observations with those reported in the literature.

Eulimidae

Before the redescription and the illustration of the most representative species of *Melanella* (Warén, 1988), there was a considerable confusion in the taxonomy of this genus.

Warén (1988) identified two main groups of *Melanella* species: one, with a more slender shell shape, resembling *M. alba sensu* A.A., and another, with more inflated and solid shells, resembling *M. boscii* and including also *M. petitiana* (Brusina, 1869), *M. praecurta* (Pallary, 1904) *M. stalioidi* (Brusina, 1869) and *M. doederleini* (Brusina, 1886). *M. alba* (Figs. 13, 13a, 13b), is representative of the former group of species. The taxonomical interpretation of this species has been controversial until the designation of a neotype, the publication of a more detailed redescription and a new iconography (Warén, 1989). It is easily distinguishable from the closely related *Melanella lubrica* (Monterosato, 1890) (Figs. 12, 12a), here found sympatrically, by the larger shell, size and the more conical shape of the teleoconch. A microscopic net of spiral and axial lines (Fig. 13a) was also present on the shell surface of *M. alba*. This is not a true sculpture, but only a product of light refraction. This species shares with its congeneric ones the colour pattern of the external soft parts: head and foot were yellowish and the cephalic tentacles orange; orange and red stripes crossed spirally the animal at the base and just below the suture (Fig. 13b). Many eulimid species have red stains (Monterosato, 1890) whose pattern and shape seem to differ among species (Scuderi, *in press*).

Living specimens of *Crinophtheiros comatulicola* (Graff, 1875) (Figs. 20, 20a) were found on *Antedon mediterranea* Lamarck, 1816 in BCGC samples and by D.S. in Acitrezza among material collected by fishing nets at - 50/60 m, as the host association confirmed that reported in the description of the genus (Bouchet & Warén, 1986) and the species. The young specimens of *C. comatulicola* we collected were morphologically similar to *V. philippi* but the shell of the former ones (Fig. 20) were more slender and showed a more elongated mouth; the inner lip (Fig. 20a) was straight and more prominent than in the shells of the latter (Fig. 19a). The two species shared similar head-foot colour pattern: the body was yellow with red

spots limited to the cephalic tentacles in *C. comatulicola* and extend beyond the eyes and on the foot in *V. philippi*. They also differed in their host preference.

A single specimen of *Melanella* sp. (Fig. 16), belonging to the latter group of species of *Melanella*, was found in Aci Castello at a depth of 30 m in SGCF/DC. First morphological observations (Scuderi et al., 2005) suggested that this could be a morphological variation of *Melanella petitiana* (Brusina, 1869) (Figs. 15, 15a), which is relatively common on hard substrata along the shores of E Sicily. A detailed description of the shell is here reported: "shell glossy, very short, inflated; 5 ½ rounded teleoconch whorls of which the last is 0.62 of the total height of the shell. Basal outline very rounded, suture thin but clearly appreciable. Colour white, with a grayish subsutural area. Protoconch blunt, dagger-like, short, constituted by 3 ½ whorls, 0.4 mm high, 0.25 large. Size: 4 mm high, 1.7 large".

Compared to the sympatric typical *M. petitiana*, this morph is more solid, less slender, shorter and with whorls more rounded; with a higher shell body-whorl/total height ratio (0.55 in *petitiana*). While the suture is indistinguishable in *M. petitiana*, it is well-marked in *M. sp.* and this latter species has an additional protoconch whorl. In order to assess whether these differences are enough to justify a new species description or simply are the evidence of the intraspecific variability of *M. petitiana*, more material and observations on the external soft-body parts characters are required.

M. lubrica and *P. minor* are here reported for the first time for the Ionian Sea, and therefore their distribution is extended to this area.

ACKNOWLEDGMENTS

We would like to express gratitude to Stefano Palazzi (Modena, Italy) for having provided literature and for his precious advice.

We would also thank Prof. Grazia Cantone (University of Catania, Italy) for having given the chance to study BCGC material and data.

We are also grateful to anonymous referees for their comments and suggestions to the improvement of the text.

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