24

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Cerastes cerastes (Linnaeus, 1758) - Sahara Desert, Tunisia

***Cerastes cerastes* (Linnaeus, 1758) (Reptilia Serpentes).** The desert horned viper *Cerastes cerastes* - a venomous snake native of the desert of North Africa - is present in Algeria, Chad, Egypt, Libya, Mali, Mauritania, Niger, Sudan, Tunisia, South Morocco, SW Arabian Peninsula and SW Israel. The average total length ranges from 30 to 60 cm (tail included). The females are larger than males, but males have heads and eyes larger than the females. The body is robust, cylindrical and depressed, narrow neck, thick midsection, tapering tail. One of the most distinctive characteristic of this species is the presence of supraorbital horns; however, these may be reduced in size or absent. The colour pattern consists of a yellowish, pale grey, pinkish, reddish, or pale brown ground colour that almost always matches the substrate colour where the animal is found. Dorsally, a series of dark, semi-rectangular blotches runs the length of the body. These blotches may or may not be fused into crossbars. The belly is usually white, and the tail, which may have a black tip, is usually thin. The desert horned viper prefers dry, sandy areas with sparse rock outcroppings and doesn't like coarse sand. Occasionally, it is found around oases and up to an altitude of 1.500 m. Cooler temperatures, with annual averages of 20 °C or less, are preferred. *Cerastes cerastes*, like all snakes, is a meat eater; it preys primarily on lizard but also on mammals and birds that inhabit its arid environment. It often lies in ambush, just beneath the sand with only its horns and eyes exposed, ready to escape from its cover and strike its victim with stunning swiftness (photos by Mauro Grano).

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New record of *Macrobrachium gua* (Chong, 1989) (Crustacea Palaemonidae) from Sintang, West Kalimantan, Indonesia

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ABSTRACT

A new record of freshwater prawn of the genus *Macrobrachium* Bate, 1868 (Crustacea Palaemonidae) was founded in West Kalimantan, Sintang District, Kelam Permai Subdistrict, Indonesia. One ovigerous female specimen was collected in Lebak creeks, Ransi Pendek village on July 2015. *Macrobrachium gua* (Chong, 1989) from Sintang can be distinguished from others by morphological character, including egg size, teeth of ventral margin, length of carpus, length of merus, length of finger and palm as a chela part. *Macrobrachium gua* was found under rocks in a surface river with black-tea-colour waters and dense vegetation.

KEY WORDS Creek; egg size; *Macrobrachium*; morphological character; Sintang.

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INTRODUCTION

Suborder Caridea occur in all aquatic habitats, they exist in marine to freshwater ecosystems (Grave et al., 2008). There are three families of Caridea freshwater species: Palaemonidae, Atydae and Alphidae. Genus *Macrobrachium* Bate, 1868 (Palaemonidae) is extremely important for food market and is widely cultivated around the world (Wowor et al., 2004). *Macrobrachium* shows a relatively high species richness, from fresh to brackish envinroments (Guo & He, 2008). Based on available literature, in Brunai Darussalam near Kalimantan, *Macrobrachium* includes only three species (Choy, 1991); howeer, in a subsequent study this number has been updated to fourteen (Wowor & Choy, 2001). In East Kalimantan, two new species have been reported (Wowor & Short, 2007): *Macrobrachium urayang* Wowor and Short, 2007 and *M. kelianense* Wowor and Short, 2007; in West Kalimatan, there are only a few reports about *Macrobrachium* species. *Macrobrachium* or river shrimps, freshwater prawn (see Rashid et al., 2013) and river prawn (see Kingdom & Erondu, 2013) have complex live histories, some species being amphidromous (Bowles et al., 2000).

Sintang is a city plenty of rivers, the largest of which are Kapuas and Melawi. Most species of *Macrobrachium* are considered to be found at freshwater habitats (Dimmock, 2004) as Kapuas and Melawi or creeks formed from both rivers. The occurrence of *Macrobrachium* in West Kalimantan has been poorly reported. This paper reports the new record of *Macrobrachium gua* (Chong, 1989) from Sintang, West Kalimantan, Indonesia.

MATERIAL AND METHODS

Study area, West Kalimantan, Sintang District, Indonesia, was selected based on information provided from local fishermen or community (Oliveira, 2011). Specimens were collected from creeks, captured using local tools, "bubu" and "kemansai" (i.e. traps made of plaited bamboo). Beside that, hand net was used in the stream area. The species of collected specimens were identified by observing and measuring the rostrum, telson and carapace shape using key identification by Wowor et al. (2004). Images of collected specimens were taken using a Sony dsc-wx350 digital camera. The specimens were preserved in 70% alcohol, then replaced by 96% alcohol, in laboratory.

RESULTS

Macrobrachium gua (Chong, 1989)

EXAMINED MATERIAL. West Kalimantan, Sintang District: Kelam Permai Subdistrict. Ransi Pendek Village. About 2 km from Kelam Hill. One ovigerous female. coll. Fani Irwan, Novese Tantri, 27.VII.2015.

TYPE OF MATERIAL. West Kalimantan, Sintang: 1 female, coll. Fani Irwan, 27.VII.2015.

DIAGNOSIS. Ventral of carapace has 1 to 3 teeth (observed specimen has 2 teeth), carapace has hepatic spine, chela of second pereiopod not similar in shape and size, finger was covered by soft and dense pubescence, carpus was shorter than merus, all of the body, from carapace to telson, showed spot-and-line pattern, influenced by the environment around the creek.

DISTRIBUTION. Indo-west pacific. East Malaysia, Sabah. Gumantong cave (Chong, 1989).

REMARKS. A total of 18 specimens belonging to five species were collected. *M. gua* was represented by one female (Fig. 5). Fresh specimens of *M. gua* have a blade-like rostrumand the carpus shorter than merus in the second pereiopods. There are six abdominal somites, as in another Caridean, in *M. gua* the second abdominal segment covers the first and third segment. Normally, ventral margin rostrum of *M. gua* has 1 to 3 teeth, but the specimen found in Lebak creek has 2.

The following measurements of specimens presented in figures 2–5 were obtained: length of rostrum 0.26 mm (Fig. 4), length of body 39 mm, length of telson 0.22 mm, length of egg 1.27 mm (Fig. 2), length of chela 7.35 mm, length of finger 2.93 mm and length of palm 3.81 mm (Fig. 3). Cornea of the eye was black and standed out, the rostrum was short, chela was normal or slender, major second pereiopod has a finger as long as palm.

DISCUSSION

Macrobrachium gua was firstly reported in Sabah, Malaysia. The name of "*gua*" is adopted from the Malay name for cave, in allusion to habitat where the specimens were collected (Chong, 1989). In Indonesia, we found *M. gua* (Chong, 1989) in small creek near Bukit Kelam Sintang area. The existence of the *M. gua* was reported on the river outside cave (in Indonesia) and in river inside cave (in Gumantong) East Malaysia which indicates that *M. gua* includes troglophilus specimens.

Several discoveries of new species of freshwater prawn in Indonesia, such as *M. keliaense* and *M. urayang* (Wowor & Short, 2007) in East Kalimantan and the new record of *M. gua* in West Kalimantan, increase the list of freshwater prawns diversity in Indonesian waters.

Macrobrachium gua has a high commercial potential and can be cultivated in freshwater throughout the world. As a fishery target of freshwater

Figure 1. Map of Sintang District. Province of Kalimantan. Red circle indicates the location where the specimen was collected, near from Kelam Hill.

Figures 2–5. *Macrobrachium gua*. Figure 2: egg; Figure 3: chela, the finger as long as palm; Figure 4: carapace and rostrum; Figure 5: fresh specimens of *M. gua*, female ovigerous. Scale bar: 1 mm.

prawn aquaculture, biological information of this species is needed for its sustainable management. Exploration in biological aspects of *M. gua* is open for future studies.

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Diversity of Ground Beetles (Coleoptera Carabidae) in the Ramsar wetland: Dayet El Ferd, Tlemcen, Algeria

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ABSTRACT A study on diversity of ground beetle communities (Coleoptera Carabidae) was conducted between March 2011 and February 2012 in the temporary pond: Dayet El Ferd (listed as a Ramsar site in 2004) located in a steppe area on the northwest of Algeria. The samples were collected bimonthly at 6 sampling plots and the gathered Carabidae were identified and counted. A total of 55 species belonging to 32 genera of 7 subfamilies were identified from 2893 collected ground beetles. The most species rich subfamilies were Harpalinae (35 species, 64%) and Trechinae (14 species, 25.45%), others represented by one or two species. According to the total individual numbers, Cicindelinae was the most abundant subfamily comprising 38.81% of the whole beetles, followed by 998 Harpalinae (34.49%), and 735 Trechinae (25.4%), respectively. The dominant species was *Calomera lunulata* (Fabricius, 1781) (1087 individuals, 37.57%) and the subdominant species was *Pogonus chalceus viridanus* (Dejean, 1828) (576 individuals, 19.91%).

KEY WORDS Algeria; Carabidae; Diversity; Ramsar wetland “Dayet El Ferd”.

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INTRODUCTION

Mediterranean temporary ponds (MTP) are priority habitats according to the Natura 2000 network of the European Union and are located in various Mediterranean countries. Priority habitats are those habitat-types or elements with a unique or important significance to a diverse group of species (Zacharias & Zamparas, 2010).

In Mediterranean regions, and more particularly in North Africa, wetlands contain a very rich, but declining biodiversity (Bouldjedri et al., 2011). The temporary ponds appear as real laboratories of survey of the living world but are poorly known as regards to vegetation and especially fauna, in particular arthropods. This is especially regrettable than they became very rare and are threatened of disappearance. The industrialization, the change of the hydrologic performance, the irrational use of their resources and the development of the tourism on the Mediterranean periphery are as many menacing factors (Hanene et al., 2008). In Algeria, wetlands are very rarely protected from anthropogenic disturbances, even if they are recognised as conservation priorities, for instance through the ‘Ramsar site’ status. In North West Africa, the term “Daya” is generally applied to define temporary ponds. The wide range of climatic and altitudinal conditions across Algeria prevent making further generalization except that a "Daya" is, usually, a temporary wetland (Cherkaoui et al., 2003). Many of these wetlands, located along the North of Algeria, are important stop-overs for wildfowl on the migratory route that connects Africa and Europe (Boix, 2000). Temporary ponds provide forage, refuge, and a place for overwintering or estivation for many species, including soil macrofauna and microfauna, insects, and birds (Kato, 2001; Thomas et al., 2004; Katoh et al., 2009; Paik et al., 2009).

Among the organism groups inhabiting wetlands, ground beetles are especially useful as environmental indicators because they strongly respond to changes in microhabitat conditions, such as moisture content, light intensity, temperature regime, vegetation density and substrate composition (Rainio & Niemelä, 2003; Lambeets et al., 2008, 2009). Coleoptera are important in terms of ecological research because of their large number of species, cosmopolitan distribution, and ease of capture (Barney & Pass, 1986; Floate et al., 1990; Kromp, 1999). Ground beetles are well known organisms, their habitat choice is very specific and for this reason they are often used to categorize habitats (Lövei & Sunderland, 1996) and can be used as bioindicators (Thiele, 1977). Ground-beetles (Coleoptera: Carabidae) offer strong potential as local scale indicators of disturbance effects (Thiele, 1977; Kimberling et al., 2001; Pearce & Venier, 2006; Gaucherel et al., 2007). Among these, ground beetles except Harpalinae and Zabrinae, are predaceous and feed on small sized invertebrates including earthworms, aphids, moths and snails which play a very important role in the ecosystem (Lövei & Sunderland, 1996; Holland, 2002), especially in mountainous and steppe areas (Kromp, 1999; Holland, 2002).

They are well adapted to dynamic flood prone areas and have a strong flight capacity and, therefore, a high dispersal ability (Desender, 2000), which makes them fast colonizers of emerging or restored habitats (Lambeets et al., 2008).

More specifically, in wet habitats such as temporary pools, wet grasslands, river sides, and lowlands with different vegetation, lower soil pH, and higher soil moisture than surrounding areas, ground beetles can be characterized by species composition, food preference, and habitat selection (Hengeveld, 1987; Luff et al., 1989; Eyre et al., 1990; Do & Moon, 2002; Do et al., 2007).

The study was performed to make specific inventories of ground beetles in the Ramsar wetland (Dayet El Ferd) and to provide fundamental information on diversity and community structure of these beetles.

MATERIAL AND METHODS

Study area and collecting method

The northwest of Algeria comprises a varied set of environments differing in climate, substrate, topography and vegetation (Brague-Bouragba et al., 2007). The study was conducted in the Ramsar wetland "Dayet El Ferd", located right in the heart of the steppe zone, 50 km south of Tlemcen (34°28′N and 1°15′W). It's a permanent endorheic depression with brackish water, surrounded by pastures and cereal fields and situated between two mountain chains. The study area is characterized by a typical vegetation dominated by *Tamarix gallica* L. (Boumezber, 2004). Catching of adult ground-beetles were obtained with interception traps on the ground "Barber traps", on six study plots regularly distributed over each elevation stratum for one year between March 2011 and February 2012.

A total of 6 plots were chosen and each plot was subdivided into two sub-plots from the pond periphery along two linear transects, in each sub-plot three pitfall traps were placed for standardized trapping, resulting in a total of 36 traps. The distance between the sub-plots amounted to at least 1 km, and at each sub-plot, traps were set out in a triangular pattern.

Carabid fauna was collected using pitfall traps, which is an adapted trapping method for this family (Lövei & Sunderland, 1996). Ground beetles mainly live on the surface of ground, and pitfall traps are installed considering these features (unbaited so as to capture the Arthropoda at random without having an effect on their behaviour). Pitfall traps were constructed from round plastic containers with 10 cm height, 7 cm diameter and 200 ml volume fitted with a clear plastic funnel. The traps were covered with plastic lids to keep debris and rain out of the traps. The number of beetles in pitfall traps is a function of both individual activity and population density (Tretzel, 1955; Heydemann, 1957; Chiverton, 1984).

Plots were sampled twice a month and sampling was replicated for 12 months (March 2011 to February 2012). All insects collected were preserved in 70% ethyl alcohol and brought to the laboratory for being dried, mounted, and identified to the species level under a stereo-microscope (Nikon SMZ-745T). Identification to species of the Carabidae was made using the key of Bedel (1895-1914), Du-Chatenet (2005). Nomenclature follows Löbl & Smetana (2003). All specimens once identified were stored in insect storage boxes.

Community Structure Analysis

Diversity was expressed using the Shannon- Weiner index (H') (Magurran, 2004), McNaughton's dominance index (DI, McNaughton, 1967), Margalef's species richness index (RI, Margalef, 1958), Pielou's species evenness index (EI, Pielou, 1975) and Jaccard's similarity index (SJ, Jaccard, 1908). The formulas are as follows:

$H' = -\sum (P_i \times \log_2 P_i)$, when P_i: Relative frequency of species i ($P_i = n_i/N$)

n_i means number of individuals at i-th species and N means total number of individuals (Pielou, 1969).

DI (Dominance index) = $(n_1 + n_2)/N$

n_1 means number of dominant species individuals, n_2 means number of subdominant species individuals, N means total number of individuals (McNaughton, 1967).

RI (Species richness index) = $(S-1)/\ln N$

S means total number of species and N means total number of individuals (Margalef, 1958).

EI (Evenness index) = $H'/\log_2 S$

H' means species diversity index and S means total number of species (Pielou, 1975).

Alternatively, the Jaccard index may be calculated using the following equation:

$CJ = a/(a + b + c)$

where a: the number of species found in both sites; b: the total number of species in sample 1; and c: the total number of species in sample 2.

The results of calculated similarity are shown as dendrograms obtained by the Minitab 16 software.

RESULTS

A total of 55 species belonging to seven subfamilies were identified from 2893 collected ground beetles in temporary wetland (Dayet El Ferd) located in a natural steppe area (Table 1). Thirty five species of Harpalinae recorded the highest number of subfamily species, followed by 14 Trechinae, 2 Cicindelinae, 2 Scaritinae, and the others subfamilies Carabinae, Siagoninae, Apotominae with 1 species each (Fig. 1). The subfamily Cicindelinae had the maximum number of individuals comprising 38.81% of the total, followed by 998 Harpalinae (34.49%), 735 Trechinae (25.4%), 32 Scaritinae (1.1%), 2 Carabinae (0.07%), 2 Siagoninae (0.07%), and 1 Apotominae (0.03%), respectively (Fig. 2).

At the genus level, 6 species of *Bembidion* Latreille, 1802, 5 species of *Harpalus* Latreille, 1802, 3 species of *Amara* Bonelli, 1810, *Microlestes* Schmidt-Goebel, 1846, *Poecilus* Bonelli, 1810, 2 species of *Acinopus* Dejean, 1821, *Acupalpus* Latreille, 1829, *Calathus* Bonelli, 1810, *Chlaenius* Bonelli, 1810, *Cymindis* Latreille, 1806, *Ditomus* Bonelli, 1810, *Emphanes* Motschulsky, 1850 and *Pogonus* Dejean, 1821, were collected. The other 19 genera were all represented by single species. 1087 individuals of *Calomera* Moutschulsky, 1862 and 593 individuals of *Pogonus* were collected, followed by *Harpalus* and *Poecilus* with 370 and 190, respectively. The number of individuals of each species was pooled per plots. The number of ground beetle species in each surveyed plot varies from 20 (Plot 6), to 33 (Plot 1) (Fig. 3).

The dominant species was *Calomera lunulata* (1087 individuals, 37.57%) and the subdominant species was *Pogonus chalceus* (576 individuals, 19.91%), these two species represented 57.48% of the total catch. Eight of the 55 species occurred in all 6 plots namely; *Bembidion varium*, *Pogonus chalceus*, *Harpalus tenebrosus*, *Harpalus lethierryi*, *Harpalus oblitus*, *Laemostenus algerinus*, *Syntomus fuscomaculatus*, and *Poecilus* sp. On the other hand, more than 70% of the species were recorded in less than five plots, including 15 species recorded in only one plot.

The Dominance index (DI) for each site varied between 0.48 and 0.74, and the average dominance index was in the order of Pt.6 > Pt.4 > Pt.5 > Pt.1 > Pt.3 > Pt.2, respectively.

The species diversity index (H') for each site ranged from 1.56 to 2.53, and the average species diversity index was in the order of Pt.2 > Pt.1 > Pt.3 > Pt.5 > Pt.4 > Pt.6, respectively.

Subfamily	Species	indivi-duals	Pt 1	Pt 2	Pt 3	Pt 4	Pt 5	Pt 6
Cicindelinae	*Calomera lunulata* (Fabricius, 1781)	1087		4	240	447	180	216
	Lophyra flexuosa flexuosa (Fabricius, 1787)	36			24	11	1	
Carabinae	*Calosoma inquisitor* (Linnaeus, 1758)	2		2				
Siagoninae	*Siagona europaea europaea* (Dejean, 1826)	2		2				
Scaritinae	*Dyschirius chalybeus chalybeus* (Putzeys, 1846)	14	3		1	2	6	2
	Distichus planus (Bonelli, 1813)	18		1	6	5	4	2
Apotominae	*Apotomus rufithorax* (Pecchioli, 1837)	1					1	
Trechinae	*Amara* (*Acorius*) *metallescens* (Dejean, 1831)	5	1		3	1		
	Amara (*Paracelia*) *simplex* (Dejean, 1828)	5		2	1	2		
	Amara sp.	10		1	4	4	1	
	Zabrus (*Aulacozabrus*) *distinctus* (Lucas, 1842)	7	2		4		1	
	Bembidion (*Peryphus*) *andreae* (Fabricius, 1787)	2	1					1
	Bembidion (*Nega*) *ambiguum* (Dejean, 1831)	14	11		1		1	1
	Bembidion (*Emphanes*) *latiplaga mateui* (Antoine, 1953)	3	3					
	Bembidion (*Emphanes*) *minimum* (Fabricius, 1792)	15			1	10	4	
	Bembidion (*Notaphemphanes*) *ephippium* (Marsham, 1802)	9				5		4
	Bembidion (*Notaphus*) *varium* (Olivier, 1795)	70	3	1	1	35	8	22
	Emphanes sp.1	1						1
	Emphanes sp.2	1					1	
	Pogonus chalceus viridanus (Dejean, 1828)	576	6	55	86	164	190	75
	Pogonus luridipennis (Germar, 1823)	17		1		3	5	8
Harpalinae	*Acinopus* (*Oedematicus*) *megacephalus* (P. Rossi, 1794)	2	1	1				
	Acinopus sp.	1	1					
	Daptus vittatus (Fischer von Waldheim, 1823)	9	1		4	4		
	Harpalus (*Cryptophonus*) *tenebrosus* (Dejean, 1829)	42	9	10	11	6	3	3
	Harpalus lethierryi (Reiche, 1860)	96	7	12	41	16	18	2
	Harpalus microthorax (Motschulsky, 1849)	2	2					

Table 1/1. List of ground beetles collected in Dayet El Ferd, Algeria.

Subfamily	Species	indivi-duals	Pt 1	Pt 2	Pt 3	Pt 4	Pt 5	Pt 6
Harpalinae	*Harpalus oblitus patruelis* (Dejean, 1829)	184	14	40	44	60	21	5
	Harpalus sp.	19	3	7	3	4	2	
	Acupalpus (*stenolophus*) *elegans* (Dejean, 1829)	1				1		
	Acupalpus maculatus (Schaum, 1860)	2	1				1	
	Amblystomus metallescens (Dejean, 1829)	1			1			
	Anisodactylus (*Hexatrichus*) *virens winthemi* (Dejean, 1831)	11	1	1	5	4		
	Ditomus sp.	2		2				
	Ditomus sphaerocephalus (Olivier, 1795)	2		1	1			
	Calathus fuscipes algericus (Gautier des cottes, 1866)	110	69	4	36		1	
	Calathus (*Neocalathus*) *mollis atticus* (Gautier des Cottes, 1867)	15	1	14				
	Laemostenus (*Pristonychus*) *algerinus algerinus* (Gory, 1833)	22	1	1	6		11	3
	Agonum marginatum (Linnaeus, 1758)	7	1	2		2	2	
	Chlaenius (*Trichochlaenius*) *chrysocephalus* (P. Rossi, 1790)	10	1		8	1		
	Chlaenius velutinus (Duftschmid, 1812)	85		1	16	16	21	31
	Cymindis suturalis pseudosuturalis (Bedel, 1906)	3	1		1			1
	Cymindis setifeensis brevitarsis (Normand, 1933)	7	7					
	Lebia (*Lebia*) *trimaculata* (Villers, 1789)	2	1	1				
	Microlestes corticalis (L. Dufour, 1820)	35		3	6	12	12	2
	Microlestes sp.1	32	11	6	7	8		
	Microlestes sp.2	1	1					
	Philorhizus sp.	2	2					
	Syntomus fuscomaculatus (Motschulsky, 1844)	87	53	9	8	3	11	3
	Graphipterus exclamationis exclamationis (Fabricius, 1792)	1	1					
	Orthomus sp.	10	1	6		3		
	Poecilus (*Carenostylus*) *purpurascens* purpurascens (Dejean, 1828)	103		2	18	22	60	1
	Poecilus sp.	80	2	2	12	21	35	8
	Poecilus (*Ancholeus*) *nitidus* (Dejean, 1828)	7					7	
	Zuphium olens olens (P. Rossi, 1790)	5		2	3			

Table 1/2. List of ground beetles collected in Dayet El Ferd, Algeria.

The species richness index (R') for each site ranged between 3.18 and 5.91, and the average species richness index was in the order of Pt.1 > Pt.2 > Pt.3 > Pt.5 > Pt.4 > Pt.6, respectively.

The species evenness index (E') for each site was calculated between 0.36 to 0.51, and the average species evenness index was in the order of Pt. 2 > Pt.1 > Pt.3 > Pt.5 > Pt.4 > Pt.6, respectively (Table 2).

Between most plots, species similarity (Jaccard index) does not exceed 50% (Table 3). According to the results of cluster analysis, the Carabid faunas between plot 3 and plot 4 and between plot 5 and plot 6 are quite similar and separated from those of the plots 1 and 2 (Fig. 4).

DISCUSSION

There are few published references on the diversity of terrestrial beetles specific to temporary ponds (Lott, 2001). However, recent work in the salt marsh of Rechgoun, Algeria, has revealed some interesting patterns. Wetlands, temporary submersions, are particularly attractive to terrestrial beetles. Thus, Soldati (2000) lists 32 species in the marshes of Romelaëre (Pas-de-Calais, France), dominated mainly by Carabidae and Staphylinidae. The Carabidae family is best known taxonomically and ecologically, and includes usually good bio-indicators (Lövei & Sunderland, 1996). Jacquemin (2002) cites 19 species in salt marshes of Lorraine (France). 60 species were identified in the marsh of Frocourt (France) during the months of June and July 2005 by Borges & Meriguet (2005) against 157 species identified in the mouth of the Moulouya in Morocco at numerous fragmentary studies by Chavanon and Mahboub (1998).

Boukli-Hacene & Hassaine (2009) report 20 terrestrial taxa of Carabidae and only two water beetles in a salt marsh Sebkha of Oran (Algeria) during a preliminary study conducted between January and June 2004. A study of Coleopteran communities was conducted between October 2009 and September 2010 in the salt marsh at the mouth of the Tafna River (Northwest of Algeria), and 3833 specimens belonging to 140 species were inventoried with 40 species of Carabidae. It was noted that

plot	DI	H'	R'	E'
Pt. 1	0.54	2.4	5.91	0.47
Pt. 2	0.48	2.53	5.49	0.51
Pt. 3	0.54	2.27	4.68	0.45
Pt. 4	0.7	1.82	3.98	0.37
Pt. 5	0.6	2.08	4.05	0.43
Pt. 6	0.74	1.56	3.18	0.36

Table 2. Various diversity indices calculated for each surveyed plot. DI: Dominance index, H': Diversity index, R': Species richness index, E': Evenness index.

	P1	P2	P3	P4	P5	P6
P1	1.000					
P2	0.3695	1.000				
P3	0.4318	0.525	1.000			
P4	0.3555	0.5263	0.6388	1.000		
P5	0.3333	0.4615	0.5675	0.5277	1.000	
P6	0.2926	0.3888	0.4571	0.4545	0.5161	1.000

Table 3. Similarity matrix at plot-scale (Jaccard Index; black: > 50%; striped: 40-49%; grey: < 40%).

the large majority of species is represented by a small number of individuals; this same observations were made by Menet (1996), Soldati (2000), Boukli-Hacene et al. (2012), and on inventories of terrestrial beetles. The result of this research indicated that there is a diverse fauna of Carabidae in the wetland of Dayet El Ferd.

Carabid beetles are increasingly used as taxonomic study group in biodiversity and as bio-indicators in monitoring or site assessment studies for nature conservation purposes (Luff et al., 1989, 1992; Luff, 1990; Erwin, 1991; Desender et al., 1991, 1992; Loreau, 1994; Heijerman & Turin, 1995). The very high number of species, estimated some ten years ago at about 40000 described species (Atamehr, 2013), as well as the well-studied pronounced habitat or even microhabitat preference of many of these (Thiele, 1977) are important reasons for the increasing interest they get. Furthermore, the majority of carabid beetles (at least in steppe areas) are relatively easily collected in a more or less standardized way by means of pitfall trapping. Nevertheless, much discussion remains on the necessary methodologies in sampling (details of techniques, intensity and duration of trapping) as well as in diversity assessment (Southwood, 1978). One problem related to the study of carabid diversity is to assess which part of the species caught at a certain site actually belongs to the local fauna and has reproducing populations (Finch, 2005). Related to this problem is the question of observed turnover in species richness from year to year on a given site.

A short review of the literature shows that most authors either deny the problem (i.e. assume that all species caught on a site belong to the local fauna and/or that species caught in low numbers have a small local population) or use a more or less arbitrary limit between so-called local species and accidentally caught species. Surprisingly, there have been few attempts to discriminate between the two by means of long term population studies or by investigating additional aspects of the biology (dispersal power and reproductive characteristics) and ecology (occurrence in surrounding or nearby other habitats) (Niemels & Spence, 1994; Konjev & Desender, 1996). Several species were frequent, thus they can be regarded as regular inhabitants of steppe areas. It has been hypothesised that heterogeneous landscapes have a higher regional diversity, because meta-community dynamics lead to a faster recolonisation of vacant niches (Duelli, 1997). Apart from the density of temporary wetlands, the studied landscape features did not have an impact on regional diversity, which contradicts the mosaic concept. However, communities of wetland are distinct from those of other habitats, primarily because the sites are flooded. The diversity of wetland and habitat-specific species was strongly dependent on the mean duration of flooding. There might be two

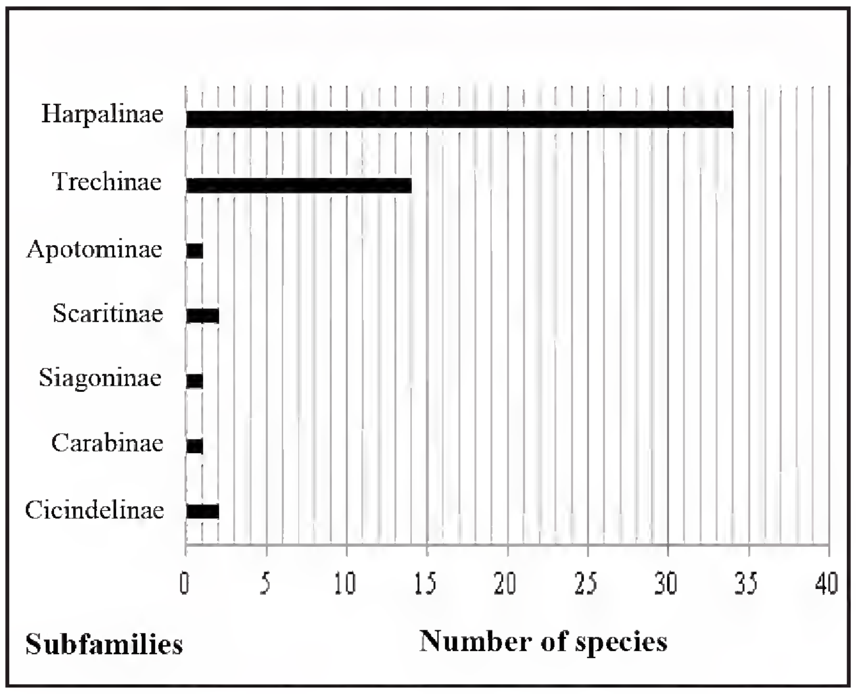

Figure 1. Distribution of the species numbers with respect to subfamilies.

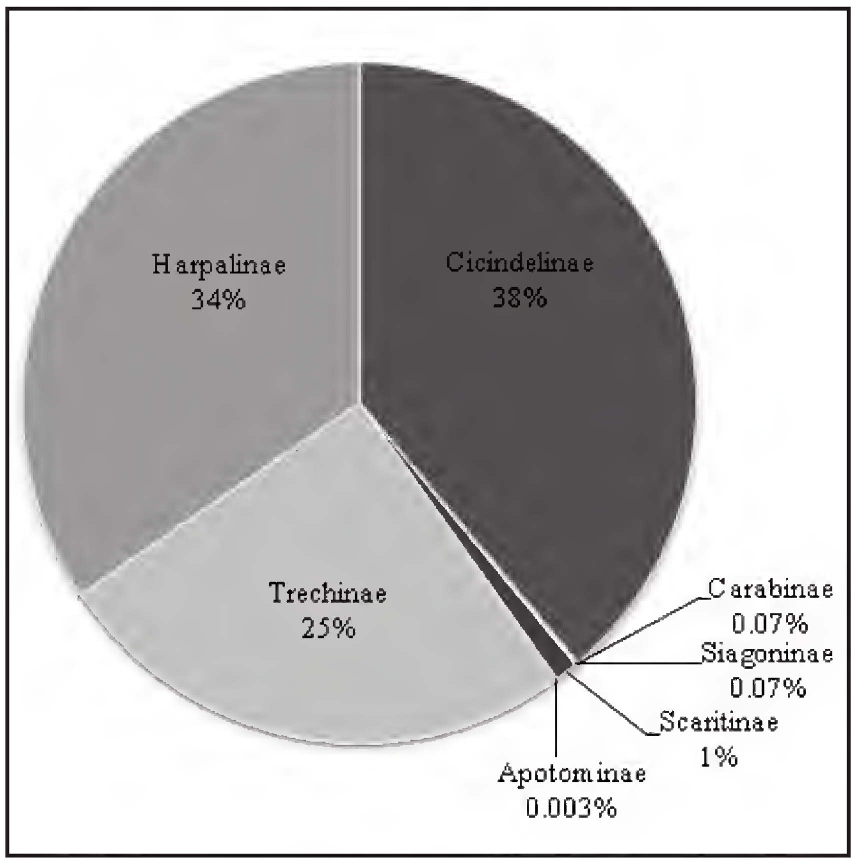

Figure 2. Percentage of the inviduals for each subfamily.

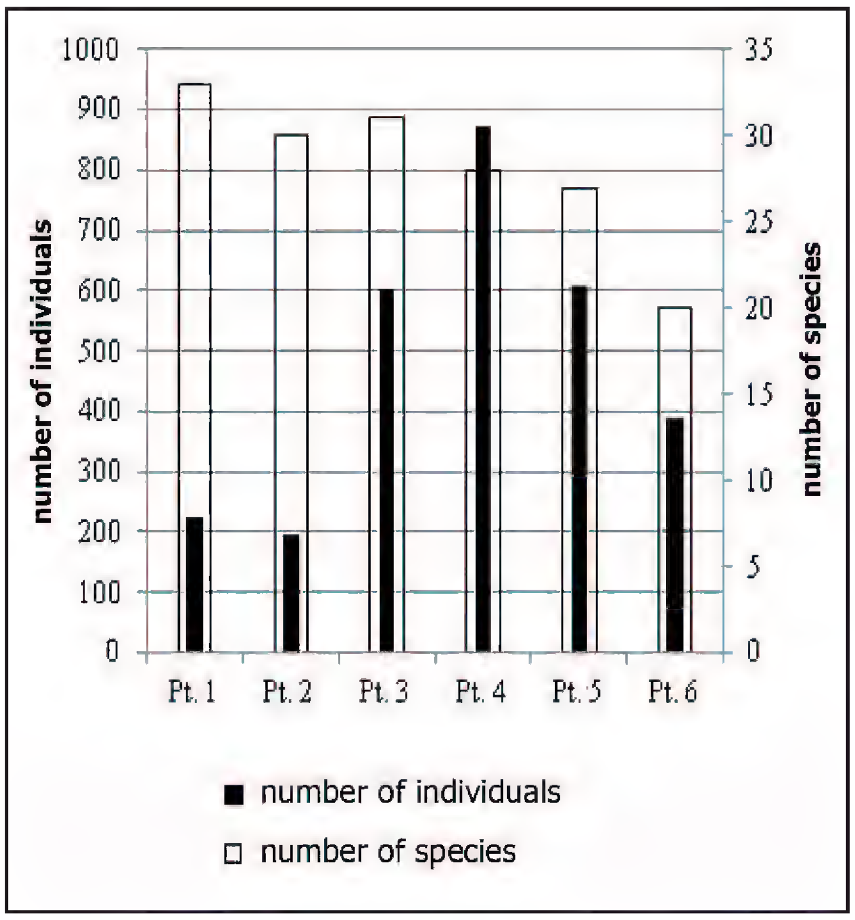

Figure 3. Number of species and individuals in each surveyed plot.

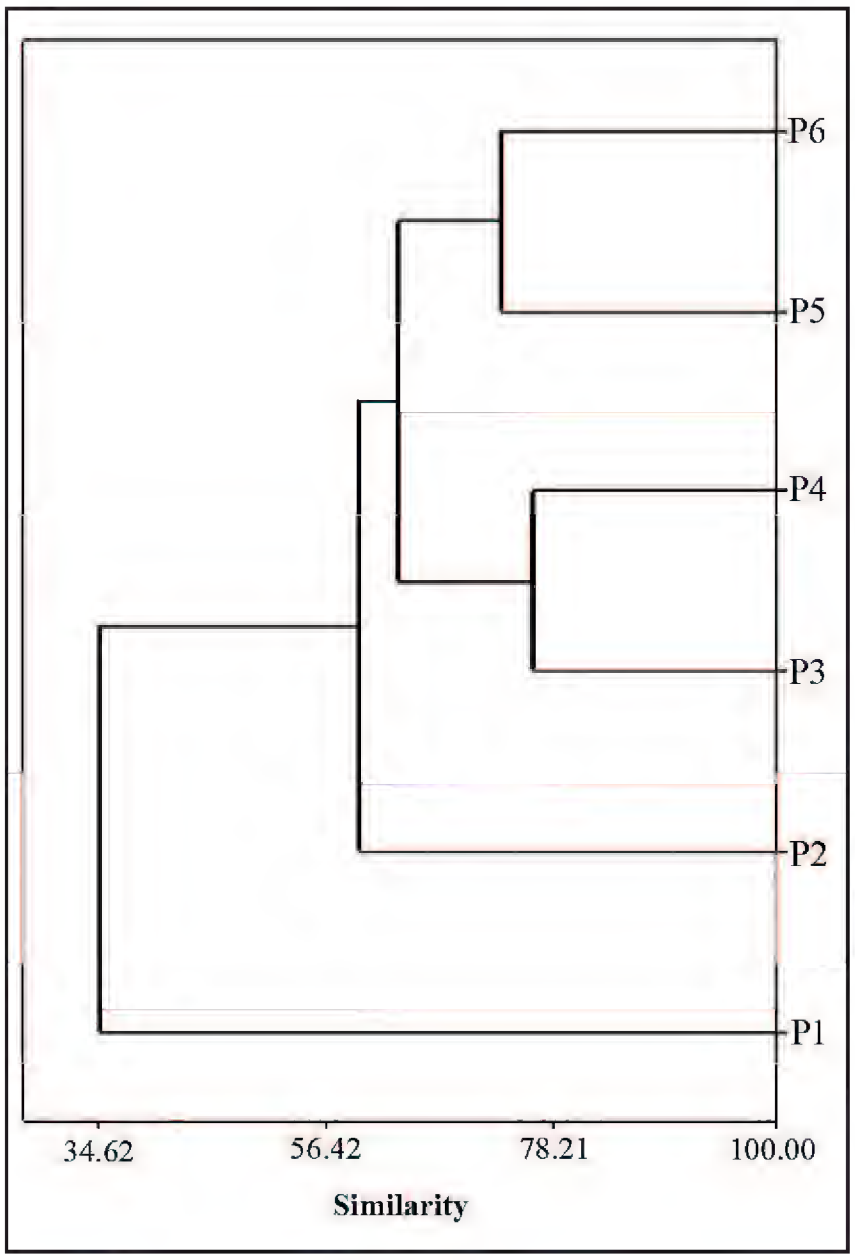

Figure 4. Cluster analysis of collected ground beetles in each surveyed plot.

reasons: (i) a high attractiveness of landscapes with a high mean duration of flooding for potential immigrants and (ii) a generally high number of available niches for hygrophilous species in these landscapes (Duelli, 1997).

Generally, the high diversity of ground-beetle community was found in plots 1 and 2, where the environment was well preserved and never flooded. These conditions created a great number of micro-habitats that were exploited by a higher number of species, in contrast, the plot 6 presented the lowest values of diversity. In accordance with the evenness values, Dominance index was lowest at plot 1 and 2, whereas in plot 6, it reached its highest value (0.74). In the latter, *Calomera lunulata* was definitively a dominant species and prevailed over the others.

In this wetland, although small, the ecological challenge is very important given its international importance (Ramsar wetland) but also because it ensures a hydrological function (sponge area ensuring regulation floods) and biological functions (e.g. high diversity of coleopteran fauna). The high biodiversity and remarkable presence of species are arguments in favor of protection of this area, highly endangered. Therefore, these protected areas are major sites for the development of the carabid fauna and deserve protection. The more effort must be made to get more information about the spatio-temporal distribution of carabid species in similar ecosystems to help to identify and locate endemic species, rare or endangered species for conservation.

Our perspective is to expand the research to an additional number of similar habitats in northern Algeria.

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Global climate change and its effects on biodiversity

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ABSTRACT Unprecedented rise in greenhouse gas due to undue anthropogenic activities has induced global warming. It has been speculated that about 1.4–5.8 °C temperature is likely to increase by 2100 for which every species and their habitat are at risk. Some species have already perished while others are on the face of decline. This review work discusses the threats of global warming and the response of diverse biota to the global climatic shift.

KEY WORDS Climate change; biodiversity; anthropogenic activities; global climate.

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INTRODUCTION

Summers were never so severe, erratic rains never disturbed us while cyclones and storms never frequented so often in this part of the continent. Unpredictable climatic conditions, unnatural disturbances are rampant throughout the globe. Global climate has become unpredictable and undergone drastic change that is inversely affecting every life form on this earth.

Global warming is the gradual increase in the average temperature of the Earth's atmosphere and its oceans that have induced a gradual change in the Earth's climatic pattern. Global temperature has already risen by 5 °C since the last ice age whereas mean temperatures of the earth have risen by about 0.6 °C since the last century. However, more than half of this increase has happened in the last 25 years. It has been speculated that 1.4–5.8 °C temperature is likely to increase by 2100 (Millennium Ecosystem Assessment, 2005).

Although global warming is a natural phenomenon induced by volcanic eruptions, shifts in the tectonic plates, striking of meteors on the earth's surface and altered solar outputs yet it can be mainly attributed to anthropogenic causes (Lovejoy & Hannah, 2005).

Urbanization, population growth, economic development, change in life style, fossil fuel consumption, depletion of forest and altered land use pattern have induced unpredictable change in the climatic pattern round the world.

Global warming and cooling are primarily controlled by cyclical variations in the sun's energy. The short wavelength solar radiation is readily transmitted by the atmosphere to heat the surface of the earth. However energy absorbed by the earth's surface is reflected back in the form of long wavelength infrared rays that are absorbed by clouds, aerosols and greenhouse gases which remain as a blanket over the earth's surface. These gases absorb and emit radiation within the thermal infrared range and trap heat the way glass does in a greenhouse , preventing it to radiate back into the space. As a result the energy that is unable to disperse, builds up in the atmosphere culminating to temperature rise (Maiti & Maiti, 2011).

The potential environmental implications of climate change are many. Temperature rise not only alters the climatic conditions but also intensely affects every single species and their habitat. Moreover, animal behavior, reproduction, population size, species richness and their distributions are also affected. However different ecosystems are impacted differently. Inhabitants of coastal, montane regions, high-latitude or polar zones and tropical belts are maximally at risk. About 43% of the world's endemic species, 25% of the biodiversity hotspots around the world, covering a total area of 1.4% of the earth's surface, nursing 44% plants, 35% vertebrates are seriously threatened (IUCN, 2000). It has disrupted ecosystem stability with unprecedented loss of biodiversity.

GREENHOUSE GASES

These are natural or anthropogenic gases that absorb or re-emit infra red radiation contributing to global warming.

Carbon Dioxide (CO_2) is a potent, natural greenhouse gas. Every year about 6.5 billion tones of carbondioxide are released in the atmosphere by anthropogenic sources such as burning of fossil fuels (oil, natural gas, and coal), solid waste, wood products, vehicular emissions and industrial release. Global Warming Potential (GWP) of carbondioxide is 1 and it has a variable atmospheric lifetime, contributing 9–26% to the global temperature rise. Human economy is run by carbon so progress in economic development releases more of carbondioxide and since 1980 carbondioxide in troposphere has been recorded to have increased to 380 ppm. It has been speculated that an average rise of 550 ppm of carbondioxide can increase the global temperature by 4.5 °C in the near future. With the advent of Industrial Revolution carbondioxide concentration has risen by 31% and will double within the next 50 to 100 years (Cunningham & Cunningham, 2007).

Methane (CH_4): Marsh gas contributes only 4–9% to the global temperature rise. It has an atmospheric lifetime of around 12 years with a lower GWP value. It degrades gradually in nature and is emitted from decay and bacterial fermentation of organic and municipal landfills, solid waste, livestock manure, paddy stubbles and sewage plants. Besides cattle belching or transport of coal, natural gas and oil also release considerable amount of gas. Bogs, fens of Polar Regions besides gas hydrates under the sea sediments and polar permafrost trap million tones of methane inside them (Maiti & Maiti, 2011).

Nitrous Oxide (N_2O) and Nitrogen dioxide is emitted from vehicular emission, agricultural and industrial activities, as well as during combustion of fossil fuels and decomposition of solid waste. The gas has an atmospheric lifetime of 114 years with a GWP of 289 over 20 years. Nitrogen dioxide is a common component of smog that induces respiratory ailment and acid rain. The latter has devastating effects on vegetations and human properties.

Chlorofluorocarbons (CFCs) or Freons are chlorine and bromine containing compounds that have led to the depletion of stratospheric ozone layer. These were commercially manufactured during the 1930s for use in refrigerants and other cooling systems. Depending on the chemical nature, the atmospheric lifetime of the gas is 23 to 270 years. In 1987 , the Montreal Protocol appealed to reduce the production of CFC gases. In 1990 an amendment was passed that totally banned the production of these chemicals.

Stratospheric ozone layer occurs naturally which blocks the harmful UV radiation from the sun. Atmospheric pollutants such as CFC gases, halon and even the activities of the supersonic air craft induce ozone holes, which is actually thinning of the stratospheric ozone layer. This allows uninhibited ultraviolet radiations from the sun on the earth's surface that induces DNA mutation and related disease such as skin cancer, burns, melanoma, leukemia, breast cancer, lung cancer, cataracts and photokeratitis. Further, it is injurious to plants as induce lesion and deplete chlorophyll reducing crop productivity (Cunningham & Cunningham, 2007).

Ground level ozone or troposheric ozone is formed through a series of complex reaction involving hydrocarbons and nitrogen oxides in the presence of sunlight. It is highly reactive and an active component of photochemical smog that contributes to 3–7% of global warming.

Fluorinated gases like perfluorocarbons, and sulfur hexafluoride are synthetically formed greenhouse gases, emitted mostly as an industrial byproduct. These potent greenhouse gases are recently used as substitutes for CFCs, HCFCs, and halons and are often referred as High Global Warming Potential gases.

Volatile organic compounds (VOC's) are ozone-destroying chemicals that form smog and are released when fuel is burned. Moreover, certain aerosols are also effective pollutants.

Interestingly, water vapour is one of the most potent greenhouse gas contributing to about 36–72% of the total global warming. It absorbs and traps enormous amount of radiant infrared rays reflected from earth's surface. Warm air holds more water vapor per unit volume so warming associated with increased level of the other greenhouse gases actually increase the concentration of water vapor that further add to temperature rise. Cirrus or high thin clouds increase surface temperature by trapping solar infrared rays but low thick clouds reflect incoming solar ray and reflect a cooling effect (Asthana & Asthana, 2009).

EFFECTS OF GLOBAL WARMING

The most drastic effect of global warming are the receding snowcaps of mountains and melting of polar ice besides rising of average summer temperatures, intense rain, overflooding of coastal zones and expansion of deserts in the interior of the continent. The third Assessment Report of the Intergovernment Panel on Climate Change on Biodiversity discussed the impact of climate change on biodiversity. This has a profound negative effect on crop fields, forests, coastal wetlands and various biodiversity rich ecosystems.

Effects on the Polar and Montane Environment

Following global warming polar ice caps and glaciers over mountains have started melting significantly. With retreating of Gomukh glacier that feeds the river Ganges significant drying up of the latter has been observed with profound change in the climatic conditions of the Indo Gangetic belt. Glaciers in Scandinavia, Central Europe, Africa, and South America have already retreated upwards. As a result watercourses depending on them are also in the face of challenge. Moreover, huge amounts of methane have been released from loss of Arctic and Antarctic permafrost and also from bogs and fens of sub arctic Siberia and Alaska that have further added to the agony of temperature rise (Sanyal, 2006).

With the disappearance of polar ice, many endemic species such as polar bears, arctic fox, seals and penguins, have lost their habitat and have no place to live and forage. Melting of sea ice in the Arctic has led to decline in the abundance of algae that thrive in nutrient-rich pockets of the ice. These have temperature optima above the ambient water temperatures at which they reside, and are therefore likely to respond to moderate increase in temperature. These algae are consumed by zooplanktons, which are in turn eaten by Arctic cod, an important food source for many marine mammals, including seals. Seals are food for polar bears. Hence, decline in algal population can contribute to the decline in the apex predators disrupting the entire food chain.

Increased warming has changed the composition of the biotic communities and shifted the vegetation zones more towards the poles or higher latitudes. With only 1°C rise in temperature a shift in 100–160 km towards the higher latitudes has been observed by more than 5 km per year. Alaska's boreal forests have been shifted northwards by 100 kilometers. Plant species native to the mountain region of Alps, have been also shifting upwards by one to four meters per decade. Biotic communities have also started shifting towards the higher latitudes or higher altitudes and if this continues then those in the higher range would finally disappear. Many species may perish with rising temperature, as they would retreat from their historic range, to face new competitors in the new habitat. Species sensitive to warmer climates such as butterflies, dragonflies, moths, beetles and other insects have started shifting to higher latitudes or altitudes especially in the northern hemisphere. This has induced increased territorial aggression and fight for natural resources. Thus climate optima will be observed which means that animals would withdraw from their unsuitable native localities and shift to relatively cooler region while those adapted to higher altitudes or polar zones would find nowhere to disperse. Red fox has been already observed to be heading northwards. Species with small population size inhabiting in restricted ranges, with limited ability of dispersal or migration are declining at a steady state (Dobson & Rubenstein, 1989).

Observations reveal that in the Antartican region, Emperor penguins, dependent on sea ice, have declined from 300 breeding pairs to 9 in the Western Antarctic Peninsula. Adelie penguins have declined by 70 percent on Anvers Island along the Antarctic Peninsula but are thriving at more southerly Ross Island. Rock hopper penguins have also suffered.

In the Himalayas, range adjustment has been observed in the Red Panda and Monal Pheasant. These have migrated to the higher altitudes within Singhalilla National Park, leaving their earlier territory at the lower reaches of Senchal Sanctuary, (Darjeeling). Similarly the snow leopards of alpine Himalayan ranges have migrated to the higher altitudes. However, amphibians are at greater risk as many species, including the tiny golden frog living in the misty Monteverde Cloud forest of Costa Rica and Emerald frogs, are on the edge of extinction due to increased dryness. There has been a large shift in the reproductive seasons of many species especially the egg laying ones and some are reproducing earlier. In the mountain forests of Central America, the Harlequin frogs are falling prey to global warming. About 67% of 110 endemic species have become extinct in just two decades. Similarly, lizards inhabiting the higher altitudes especially at the Western Ghats of India and the Himalayan range are decreasing in population for which the entire food chain is being threatened. As reptiles tolerate only narrow temperature range therefore fall prey to abrupt climatic fluctuations (Lovejoy & Hannah, 2005).

Besides, the picas of the highland areas of West USA are already extinct. It has been speculated that 15 to 37% fauna will be wiped out in the next 50 years if global temperature continues to increase. Global temperature has threatened Beater's Opossum of Victoria, Hairy-nosed wombat of South Australia and Koala of Queensland in Australia and many others.

Problem of Sea level rise

Melting of polar ice caps and glaciers would make the sea level rise by 4–35 inches at the end of this century culminating to extensive floods throughout the low lying coastal regions of the world. Hence, people in the coastal areas of Bangladesh, Southern Asia and Egypt will be highly affected. An UN Environmental Programme (UNEP, 2002) report suggests that 40% of the world's total populations that live in coastal zones are at higher risk. Besides, melting of ice adds significant amount of freshwater to the sea reducing its salinity that subsequently slows down the thermohaline circulation (Wood et al., 1999).

Sea level rise with consequent overflooding of the coastal zones can cause saline water to seep into the coastal aquifers, estuaries or freshwater bodies making freshwater and brackish water system unsuitable for both animals and human use. As a consequence, loss of plant productivity, depletion of biodiversity, destruction of wetlands, coral reefs or mangrove forests is foreseen. Coastal settlements, low-lying islands and coral islands that rely on underground fresh water have been also affected. In the estuarine areas, seawater intrusion is largely affecting the stenohaline animals.

In India, sea level rise has pushed the mangroves of the Sunderbans further north, with considerable shrinking of the ecosystem. The prevailing salinity of creek waters has increased, due to transgressions of sea which have affected population of Water Buffalo *Bubalus bubalis* (Linnaeus, 1758), Swamp deer *Rucervus duvaucelii duvaucelii* (G. Cuvier, 1823), Great One-Horned Rhino *Rhinoceros unicornis* (Linnaeus, 1758), Indian muntjak *Muntiacus muntjak* Zimmermann, 1780, Gharial *Gavialis gangeticus* (Gmelin, 1789), Finless porpoise *Neophocaena phocaeniodes* (Cuvier, 1829), Small Clawed Otter *Aonyx cinerea* Illiger, 1815, and the Fishing Cat *Prionailurus viverrinus* (Bennet, 1833). At the Gulf of Mannar, damage of the sea grass, Halodula or Dugong grass due to sea level rise has consequently affected the population of dugong (Sanya, 2006).

Temperature rise of sea water

This has induced negative impact on the migratory routes of birds and fishes. Species composition and dominance of a community seems to be changing while sensitive species are going extinct. Warmer seas could lead to some turtle species becoming entirely female, as water temperature strongly affects the sex ratio of hatchlings. Frequent floods and marine surges have destroyed the nesting sites for sea turtles and wading birds. Increased storminess has damaged the breeding colonies of albatross. Hundreds of thousands of seabirds have already failed to breed. The breeding grounds of Flamingo and Lesser Florican at the Rann of Kutch, Gujarat have been already destroyed. Decrease in precipitation has led to the extinction of Aldabra banded snails and rockfish crustaceans.

Corals reefs are showing signs of stress with water temperature rise. A rise of 2° to 3°C expels most of the symbiotic algae zooxanthelae leading to coral bleaching. Major bleaching event was observed between 1998 and 2002 at the Great Barrier Marine Parks, Australia. However, reef ecosystem is resilient to severe stress and can recover after major setback. Recently Fungia and Brain corals are observed to have been affected mostly in the Andaman and Nicobar islands. In the region of the Bering Sea disrupting climate change has reduced productivity and phytoplankton productions negatively affecting the survival of large mammals. Change in water temperature induces migration of lobsters to colder climates (Venkataraman et al., 2003).

Changes in the Terrestrial system

Temperature change is felt greater over land than over sea. With El Nino conditions developing, there have been large changes in the redistribution of heat and moisture that caused droughts and floods in the various parts of the world. Intense summer, low precipitation in the tropical regions and semi-arid low-latitude countries have increased the risk of forest fires and depletion of soil moisture. This is inducing crops and livestock to perish. With progressive clearance of evergreen forest, increased summer temperature and water stress have brought to periods of drought. There has been a trend towards desertification. Arid lands have started losing their fringe region resulting in expansion of deserts. The Sahara desert in Africa has also shifted northwards. Some parts of Europe, Central Asia, Africa, Australia New Zealand and Mediterranean regions, are receiving less rainfall. This has culminated into the crisis of safe drinking water besides loss of food crop production. Heat waves and drought interfering with plant growth have further reduced carbondioxide uptake. With intense summer heat, thousands of temperature sensitive fruit bats have also perished in 1998. Unpredictable droughts and floods, food crisis and heat stress have maximally affected the third world countries. Besides, the biota in this region is slowly moving towards a threshold limit of tolerance to this increased temperature (Maiti & Maiti, 2011).

According to climate models, some regions of high temperature range would experience prolonged heat waves, higher precipitation and consequently increased incidence of floods that will inflict greater damage to crops. Plants will suffer due to water logging and other heat related stress. Moreover, increased outbreaks of pests and pathogens will be observed as warm climate and wet soil would allow microbes to grow. Enhanced soil erosion, and contamination of groundwater from seepage of pollutants are among the other problems that would linger. Higher precipitation is also predicted for polar and sub polar region (Lovejoy & Hannah, 2005).

In places of higher precipitation associated with warm climatic conditions algae and weeds will dominate the water bodies leading to eutropication. Intense precipitation will increase flood, erosion and increased flow of surface water runoff dumping more pollutants and sediments in the water bodies. Isolated freshwater ecosystem supporting rare and endemic population will be also highly stressed due to ecosystem alteration, unexpected rise in temperature and change in precipitation pattern. Wetland inhabitants such as shorebirds, wading birds and waterfowls will be highly impacted for changes in hydrological cycles. Many species of plant and animals, highly vulnerable to climate change, will fail to adapt falling prey to the global warming. With loss of suitable habitat, cold water fish are also at risk while warm-water fish have been observed to expand their ranges (Lovejoy & Hannah, 2005).

There has been marked change in the breeding season of birds especially in the colder parts of the world, such as Europe, North America, Latin America and United Kingdom following shift in seasonal patterns. Shifts in migratory patterns of several species of birds have been observed and long distant migratory birds are at greater risk due to habitat alteration of their wintering grounds. Growing water scarcity in many regions has further destroyed the wetlands on which migrating waterfowls depend.

Observations reveal that bird's migratory route and timings have drastically changed. There has been an advanced spring time arrivals and birds are departing later in the autumn with subsequent change in the breeding activities by an average of 1.9 to 4.8 days per decade over a time frame of 30–60 years. This has resulted in increased territorial aggression. European and the western Palearctic birds have been shown to lay eggs earlier. Migration have also failed due to unforeseen weather consequences while some birds may have even starved to death.

Effects on Ocean diversity

Oceans are important carbon sink. The amount of carbon absorbed in ocean is determined by the solubility pump and the biological pump. The former is primarily a function of differential atmospheric CO_2 dissolving in sea water that induces thermohaline circulation. The biological pump on the hand consists of the phytoplanktons, shelled animals (mollusca, protozoas), calcifying organisms (coccolithophores, foraminiferans) and pteropods that absorb atmospheric carbondioxide to form carbonate shells. The biological pump thus transports organic and inorganic carbon from the euphotic zone to other parts of the ocean. With the death of these animals a part of this assimilated organic carbon remains buried in the seabed, that contribute to the forming of fossil fuels.

In the past two hundred years, acidity of sea water has increased by 1 unit and likely to rise further by 0.5 units in the future. Increased ocean acidification due to rise in atmospheric CO_2 would affect the biological pump negatively that would endanger corals, molluscs and others organisms. As these form calcium carbonate shells they would have difficulty in growing their exoskeleton. With decrease in their population the ability of the ocean water to absorb more carbondioxide will also decrease. The concerted effects of these factors will actually increase the global build up of this greenhouse gas (Jeffries, 1997).

Rise in ocean temperature and alteration of patterns in circulation of currents have also affected the nutrient delivery system. As cold waters are more productive than warm waters, warming of the oceans may disrupt marine food chain threatening the heat sensitive under water species.

The system of currents supplies the deeper parts of the water with oxygen and nutrients from the deep are transported to the surface that helps the phytoplankton to flourish. Rise in temperature of water disrupts the upwelling of cold, nutrient-rich waters leading to loss of planktonic populations. This in turn affects the population of krill which feeds on these planktons. Reducing the population of krills has largely threatened whales, larger fish and seabirds which feed on these creatures. Several species of whales such as beluga, narwhal, bowhead, right whales are threatened with changes in ocean currents and food shortage.

Consequently, decrease in phytoplanktons would reduce the uptake of carbon dioxide from the oceans. All these factors have affected the rich food web in the continental shelf areas on which global marine biodiversity thrives.

The '2005 Millennium Ecosystem Assessment' estimated that by the end of 21st century, climate change will be instrumental for most of the global biodiversity loss. Worldwide, 25% of all mammals and 12% of birds are already at significant risk. With prolonged summers in warmer parts of the world and the shortened winters in the colder regions, the overall shift in the global climate has profound effect on the world's biotic communities (Sanyal, 2006).

When temperature rises, it may drive some plants and animal species to go extinct as their range shrinks or are forced to compete with invasive species and pathogens moving into their territory. About 1250 Indian plant species are already extinct from the wild.

Effects on Human Health

Since there is an optimal temperature specified for each organism, climate shift has already led to low crop, dairy and meat production.

Small shifts in temperature can extend the range of mosquitos increasing the occurrence of malaria, yellow fever and other vector borne diseases. According to a study by WHO (2002), almost 150,000 people die every year from the ill effects of heat stress, malaria and malnutrition. The number could almost become double by 2020. Risk of damage to people and properties, decrease in food production, respiratory troubles, skin problems and spread of infectious tropical diseases and metabolic disorders are the other problems on the card. Moreover, decrease in agriculture, crisis of food and potable water would challenge the poorer sectors of the third world countries. This has resulted in increased cases of environmental refugees.

Reducing Global Warming

Global warming can be reduced either by lowering the release of greenhouse gases or by removal of greenhouse gas from the environment. This can be done by adoption of afforestation programs including social forestry and plantation outside the range of forested areas. Automobile or factory emissions, tilling soil, addition of fertilizers and construction of cemented structures release huge amount of carbondioxide. So minimizing soil disturbance, recovering degraded soil, besides restoring grasslands, water bodies and other natural habitats would help in the process of carbon sequestration. Reduction in the use of fossil fuels, burning of plant materials and adoption of energy efficient biofuels can effectively mitigate global warming. Greenhouse gases can be effectively removed from the atmosphere by various physical and chemical processes. Moreover, solar energy, biomass energy, wind, wave or tidal power and other renewable energy has to be harnessed as an alternative to fossil fuels. Reduction of power generation in the urban sectors, use of energy saving bulbs, change in lifestyle, alteration in the pattern of trade or communication, adoption of modern sail design in shipping and aviation can also brings positive results.

According to the Intergovernmental Panel on Climate Change "*a sustainable forest management strategy aims at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber, fiber or energy from the forest, and this will generate the largest sustained mitigation benefit*". Carbon offset programs have been implemented for planting millions of fast-growing trees per year to reforest tropical lands.

The blame of global warming goes on man's misdeed that limits the survival of other species. For his endeavor to conquer nature the air is over burdened with pollutants, natural system has been replaced by manmade structures with thousands of species losing their life and habitat. There has been a pervasive change in the global landscapes that have modified the ecological background on which species evolve. Most species are now suffering from the indirect and subtle changes of global climatic shift. Exploding rise in human populations along with the need and greed of man has impoverished the rich biodiversity on which his own existence is depended. So, global climatic shift might be a revenge on nature's part. If this is allowed to continue it is certain that man's existence will be at stake in the very near future.

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On some Pliocene Cancellaridae (Mollusca Gastropoda) from the Mediterranean Basin with description of a new species

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ABSTRACT During the study on Pliocene Mediterranean malacofauna the author found the presence of a new species of the genus *Sveltia* Jousseaume, 1887 called *S. confusa* n. sp. The new species is present both in Zanclean sediments of Southern Spain (Guadalquivir basin and Estepona), and in Pliocenic sediments of Southern Tuscany. This species had been previously discussed and figured by various authors as *Sveltia varicosa* (Brocchi, 1814). During the research were also found some specimens similar to *Ventrilia imbricata* (Hörnes, 1856), a taxon which was already described for the Austrian Miocene. In this study the taxonomic position of *V. imbricata*, along with its presence in Pliocenic sediments and its relashionships with *Scalptia etrusca* Brunetti, Della Bella, Forli et Vecchi, 2008, are clarified.

KEY WORDS Pliocene; Cancellariidae; new species.

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INTRODUCTION

During some research on Pliocene Mediterranean malacofauna it was found the presence of a new species of the genus *Sveltia* Jousseaume, 1887 type species *Voluta varicosa* Brocchi, 1814. This species was cited by various authors as *Sveltia varicosa* (Brocchi, 1814), a taxon frequently found in Italian Pliocene sediments. During the same research, were also found some specimens similar to *Ventrilia imbricata* (Hörnes, 1856) a species already described for the Austrian Miocene and, as confirmed in the present study, also present in the Iberian Zanclean.

MATERIAL AND METHODS

The examined material, collected during surface investigations, comes from various Pliocene deposits from Guadalquivir basin (see Gonzales Delgado, 1985, 1988, 1989, 1993; Landau et al., 2011), and Zanclean of Southern Tuscany (Brunetti, 2014). For the generic attributions used see Brunetti et al. (2008, 2011).

ABBREVIATIONS AND ACRONYMS: H = maximum height of the shell, as measured from the apex to the ends of the siphonal channel; coll. = collection; exx. = specimens; MGGC = Della Bella collection, Geological Museum "G. Capellini " in Bologna; NHMW = Naturhistorischen Museum Geologisch Paläontologische-Abteilung, Wien; CDB = Della Bella private collection; CMB = Mauro Brunetti collection.

SYSTEMATICS

Classis GASTROPODA Cuvier, 1797
Subclassis PROSOBRANCHIA Milne Edwards, 1848

Ordo STENOGLOSSA Bouvier, 1887
Superfamilia CANCELLARIOIDEA Forbes et Hanley, 1851
Familia CANCELLARIIDAE Forbes et Hanley, 1851
Subfamilia CANCELLARIINAE Forbes et Hanley, 1851
Genus *Sveltia* Jousseaume, 1887
Type species: *Voluta varicosa* Brocchi, 1814

Sveltia confusa n. sp. (Figs. 1–4, 7, 9)

Narona (*Sveltia*) *varicosa* (Brocchi, 1814) - Gonzales Delgado, 1993, tav. 1, figs. 13-14
Narona (*Sveltia*) *varicosa* (Brocchi, 1814) - Vera-Peláez et al., 1995, p. 148, fig. 3: A-B; fig. 5 C-D
Sveltia varicosa (Brocchi, 1814) - Landau et al., 2011, p. 32, tav. 16, fig. 6
Sveltia varicosa (Brocchi, 1814) - Brunetti, 2014, p. 62

EXAMINED MATERIAL. Holotype MGCC 24539, Lucena del Puerto (Huelva, Spagna), Lower Pliocene 37° 17'54.0"N, 6°43'49.7"W (see also Landau et al., 2011). Paratypes (MGGC 24540 and MGGC 24541): same data of holotype.

OTHER EXAMINED MATERIAL. *Sveltia confusa* n. sp.: Lucena del Puerto (Huelva, Spagna), Lower Pliocene , 22 exx. (CMB); Santa Catalina (Huelva, Spagna), Lower Pliocene, 20 exx. (CMB); Villarasa (Huelva, Spagna), Lower Pliocene, 2 exx. (CMB); Monte Antico (Grosseto, Italia), Lower Pliocene, 14 exx. (MGGC); Monte Antico (Grosseto, Italia), Lower Pliocene, 8 exx. (CMB).

Sveltia varicosa: Cedda (Siena), Zanclean-Piacenzian, 78 exx. (CMB-MGGC); Rio Carbonaro (Piacenza), Piacenzian, 53 exx. (CMB); Poggio alla Staffa (Siena), Zanclean, 34 exx. (CMB-MGGC); Spicchio (Firenze), Zanclean-Piacenzian, 12 exx. MGGC. Linari (Siena), Piacenzian, 12 exx. (CMB-MGGC); Monte Padova (Piacenza), Piacenzian, 10 exx. (CMB-MGGC); Ponte a Elsa (Pisa), Piacenzian, 14 exx. (CMB-MGGC); Lagune (Bologna), Zanclean, 13 exx. (MGGC); Torrente Stirone (Parma), Gelasian, 5 exx. (MGGC).

DESCRIPTION OF HOLOTYPE. Shell elongated, robust, medium sized (H = 30.1 mm). Protoconch multispiral, composed of three straight rounds, globular with shallow sutures. The transition to teleoconch is little evident and it is marked by the presence of three well-spaced ribs. Teleoconch of 6 laps scale-like with slightly convex profile. The sculpture consists of numerous spiral cords, the same thickness, ribbon-like; fifteen of them are on the penultimate whorl, forming small knots on 11 axial ribs which are slightly opistocline, angular, and forming, apically, several spines. The first whorl has 4 spirals cords, ribbon-like and equidistant, and ten slightly varicose coasts, apically angular. Subsequent whorls have similar ornamentation, with increasing number of spiral cords and axial coasts, more and more varicose and scale-like, giving rise to a very sutural ramp inclined and flat, apically. The last whorl is 2/3 of the total height, slightly convex, with spiral sculpture composed of fifty spirals cords of identical size; the tenth of which forms, intersecting with the axial ribs, small spines, delimiting the sutural ramp.

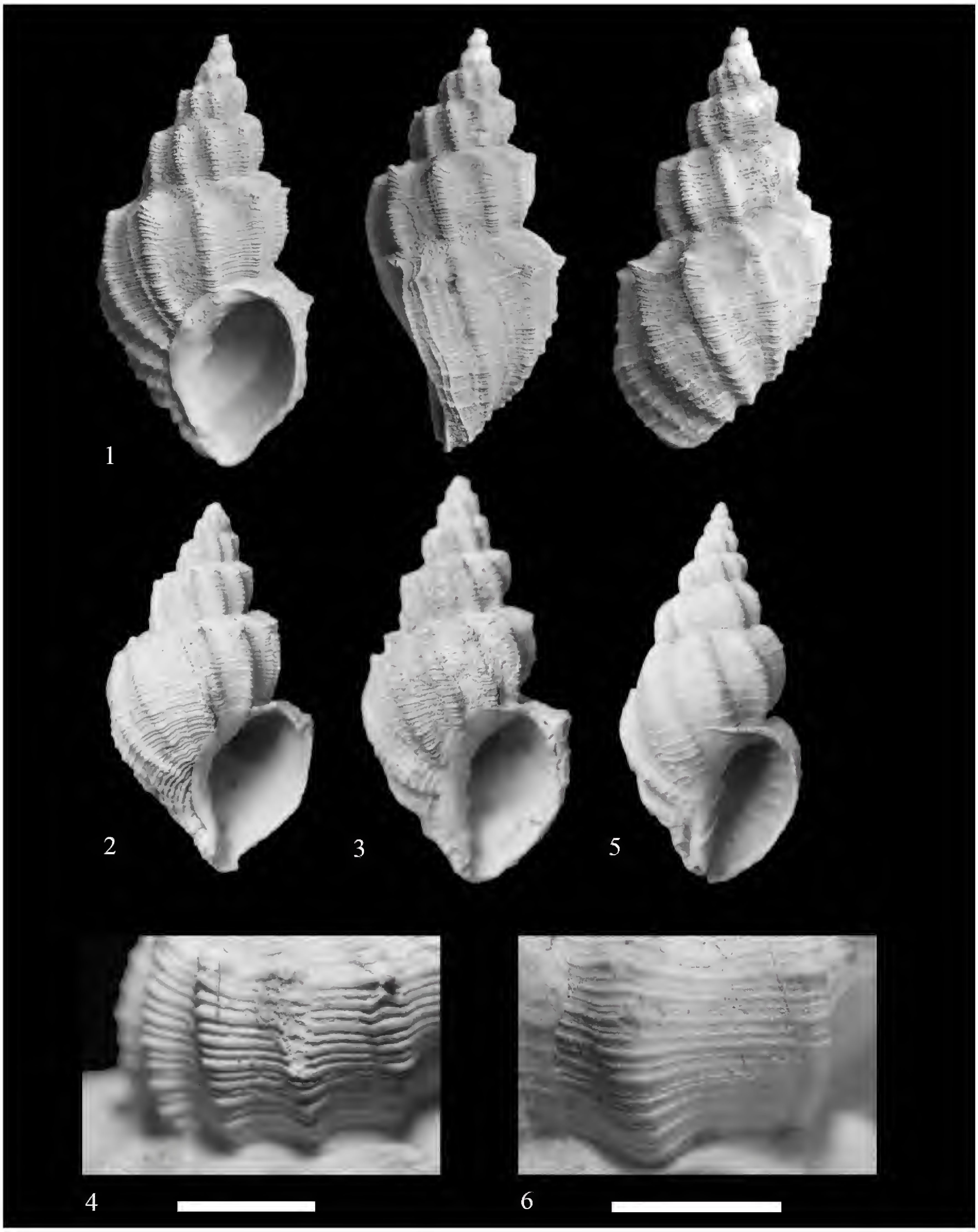
Aperture oval, elongated; outer lip internally provided with very thin lirature. Columellar board with little evident callus and two folds subparallel, almost equal in size; navel absent.

VARIABILITY. The paratypes do not show substantial morphological differences from the described holotype. Paratype MGCC 24540 with H = 21 mm; paratype MGGC 24541 with H = 25.2 mm.

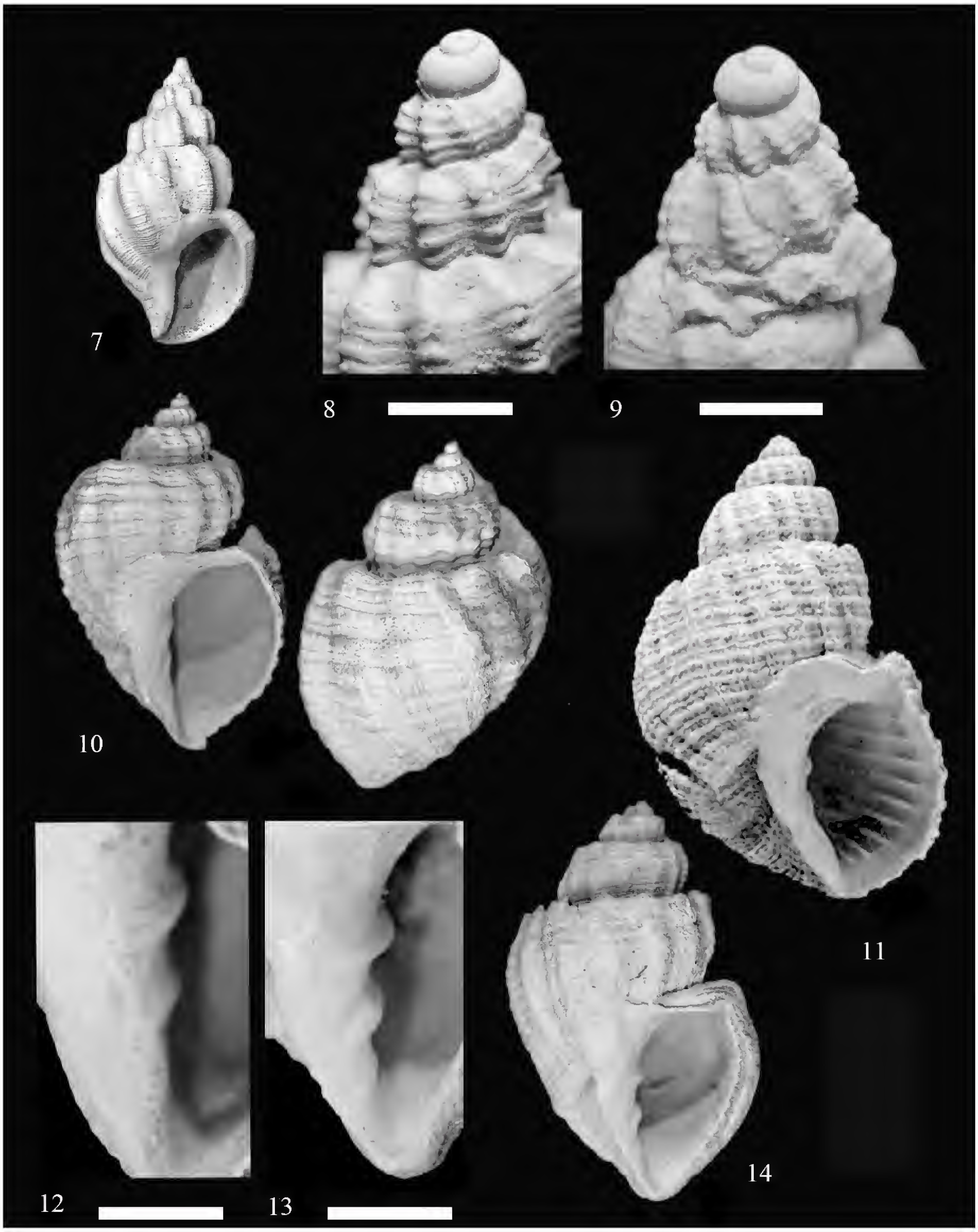
ETYMOLOGY. The specific epithet derives from the Latin *confusus -a -um* since the new species was confused with the similar *Sveltia varicosa*.

DISTRIBUTION. The new species at present is known from both Zanclean sediments of Southern Spain (Guadalquivir basin and Estepona), and from those related to the Pliocene of Southern Tuscany.

REMARKS. Compared to the very similar taxon, *S. varicosa*, the new species has spiral sculpture composed of ribbon-like strings of identical thickness (Fig. 4) while *S. varicosa* shows larger cords alternating with several others much thinner (Fig. 6), moreover, in *S. confusa* n. sp. the axial ribs are narrower and acute. Even the appearance of the loop is different: regularly convex in *S. varicosa*, with sutural ramp little evident, definitely ramp-like in *S. confusa* n. sp. with a suture ramp always inclined, well evident and spiny.



Figures1–4. *Sveltia confusa* n. sp. Fig. 1: holotype, Lucena del Puerto (Huelva, Spagna), Zanclean, H = 30.1 mm MGGC 24539. Fig. 2: paratype 1, Lucena del Puerto (Huelva, Spagna), Zanclean, H = 21 mm MGGC 24540. Fig. 3: paratype 2, Lucena del Puerto, (Huelva, Spagna), Zanclean, H = 25.2 mm MGGC 24541. Fig. 4: Santa Catalina, (Huelva, Spagna), Zanclean, penultimate whorl sculpture, CMB (scale bar = 5 mm). Figures 5, 6. *Sveltia varicosa*. Fig. 4: Lagune (Bologna), Zanclean H = 23.2 mm CDB. Fig. 6: Rio Carbonari (Piacenza), Piacenzian, penultimate whorl sculpture, CMB (scale bar = 5 mm).



Figures 7, 8. *Sveltia confusa* n. sp. Fig. 7: Monte Antico (Grosseto), Zanclean, H = 16.5 mm CMB. Fig. 8: Santa Catalina, (Huelva, Spagna), Zanclean, apical whorls, CMB (scale bar = 1 mm). Figure 9. *Sveltia varicosa*, Poggio alla Staffa (Siena), Zanclean, apical whorls, CMB (scale bar = 1 mm). Figure 10. *Ventrilia* cf. *imbricata*, Santa Catalina, (Huelva, Spagna), Zanclean, H = 24.2 mm CMB. Figure 11. *Ventrilia imbricata*, syntype, Enzesfeld (Austria), Miocene, NHMW 1846/0037/0287, H = 44.5 (from Harzhauser & Landau, 2012, p. 53, modified). Figure 12. *Ventrilia* cf. *imbricata*, Santa Catalina, (Huelva, Spagna), Zanclean, columellar plicae, CMB (scale bar = 5 mm). Figures 13, 14. *Scalptia etrusca*. G. Poggio alla Staffa (Siena), Zanclean, columellar plicae, CDB (scale bar = 5 mm). H. Poggio alla Staffa (Siena), Zanclean, H = 30.5 mm CDB.

Diagnostic character is certainly the peculiar spiral sculpture. *S. confusa* n. sp. was figurated as *S. varicosa* by various authors (Delgado Gonzales, 1993; Vera-Pelaez et al., 1995; Landau et al., 2011; Brunetti, 2014). It was examined a great amout of pliocenic material attributable to *S. varicosa*, and among these specimens no transition forms have been observed. Based on the locations, *S. confusa* n. sp. would seem to have a chronostratigraphic distribution exclusive to the basal Zanclean and a wide dissemination both in the Mediterranean (Estepona, Monte Antico) and Guadalquivir (Lucena del Puerto, Santa Catalina, Villarasa) Basins, while *S. varicosa* would be particularly abundant in the Piacenziano turning out to be present up to the Gelasian (Brunetti et al., 2011).

Along with the discovery of *S. confusa* n. sp. it is reported the discovery of some specimens related to *Ventrilia imbricata* (Hornes, 1856) (Figs. 10, 12). This species was described for the Austrian Miocene, noteworthy, few specimens found in the Pliocene of the Guadalquivir Basin deviate from the Austrian specimens illustrated by Harzhauser & Landau (2012) (Fig. 11). Herein are reported (agreed by the Author) the observations on these populations by Gonzales Delgado (1993): "*Las citas anteriores revisadas de esta especie (ver Davoli, 1982) la consideran miocénica, y presenta ademas un tamaño algo menor (en relación al numero de vueltas), la ornamentación axial cercana al labro más obsoleta, y pliegues lábrale internos. Probablemente, el ejemplar onubense constituiría la variedad pliocénica de la especie hornesiana*".

Ventrilia cf. *imbricata* was found in the gray sands of Santa Catalina (Huelva, Spain). The report of *V. imbricata* from the Pliocene of Estepona (Landau et al., 2006) consists of an incomplete specimen, but recognizable, by the loop shape, corresponding, beyond any doubt, to *Scalptia etrusca* Brunetti, Della Bella, Forli et Vecchi, 2008 (Brunetti et al., 2008) (Figs. 13, 14) as later confirmed by Landau et al. (2011) and Harzhauser & Landau (2012). In conclusion, not only *S. etrusca* is very different from *V. imbricata* by shell sculpture and the shape of the loop, but also it is rather a different Genus. In fact, *V. imbricata* shows only two columellar folds (Fig. 12), typical of the genus *Ventrilia* Jousseaume 1887, whereas *S. etrusca* has three folds, which is a diagnostic character of the genus *Scalptia* Jousseaume,1887 (Fig. 13).

It is thus confirmed the presence of specimens similar to *V. imbricata* in the Spanish Pliocene as also figured in Landau et al. (2011, p. 30, pl. 15, fig. 13) that could perhaps belong to a different taxon but, because of the small number of specimens examined, are, at present (at least), considered as related to the populations observed in the Austrian Miocene.

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An updated herpetofaunal inventory for some islets of South-Eastern Tunisia

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ABSTRACT The present paper provides the results of the herpetological investigations carried out on the satellite islets of Djerba and the Kneiss Archipelago, and an updated list of their herpetofauna. On the whole, the faunal assemblage of the eleven visited islets includes seven species of reptiles, whose richness seems to be related to the islet size. *Stenodactylus sthenodactylus* (Lichtenstein, 1823) and *Malpolon insignitus* (Geoffroy Saint-Hilaire, 1827) are new records, respectively, for the Djerba satellites and the Kneiss Archipelago, while new localities were recorded for the previously known species.

KEY WORDS Reptiles; faunal list; new records; Kneiss Archipelago; Djerba satellites; Tunisia.

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INTRODUCTION

The small coastal islands of Tunisia are largely uninhabited and have not undergone to a strong anthropization, therefore are generally characterized by a good level of preservation of their environmental characteristics and their biodiversity. However, their biological knowledge is often lacking (see Lo Cascio & Rivière, 2014).

During a scientific mission organized in 2015 April in the framework of the Mediterranean Small Islands Initiative PIM, an international program supported by the French Conservatoire du Littoral, dedicated to island conservation, we had the opportunity to carried out herpetological surveys on El Bessila, El Hajar, El Laboua, Gharbia North and Gharbia South, belonging to the Kneiss Archipelago, as well as on some satellites of Djerba, namely Dzira, El Gataïa el Bahria, El Gataïa el Gueblia, Jlij and two unnamed islets nearby to this latter that are hereafter indicated as Jlij 2 and Jlij 3.

Some of them have been previously investigated by Tlili (2003), Nouira (2004), and Gobbaa (2012). The aim of the present paper is to update the faunal knowledge on both islets' groups, providing further records that also concern some islets so far unexplored.

MATERIAL AND METHODS

Study area

Localization of the study area is shown in figure 1, while the main geographical data of the islets are given in Table 1. All these islets have continental origin, are characterized by a flat morphology, with an altitude ranging from 1 to a maximum of < 10 m a.s.l., and lie into the isopleth of -10 m, hence their definitive isolation is dated back to historical times (see Oueslati, 1995). Both Kneiss and Djerba's islets fall within the arid bioclimatic belt, with an annual precipitation of about 200 mm.

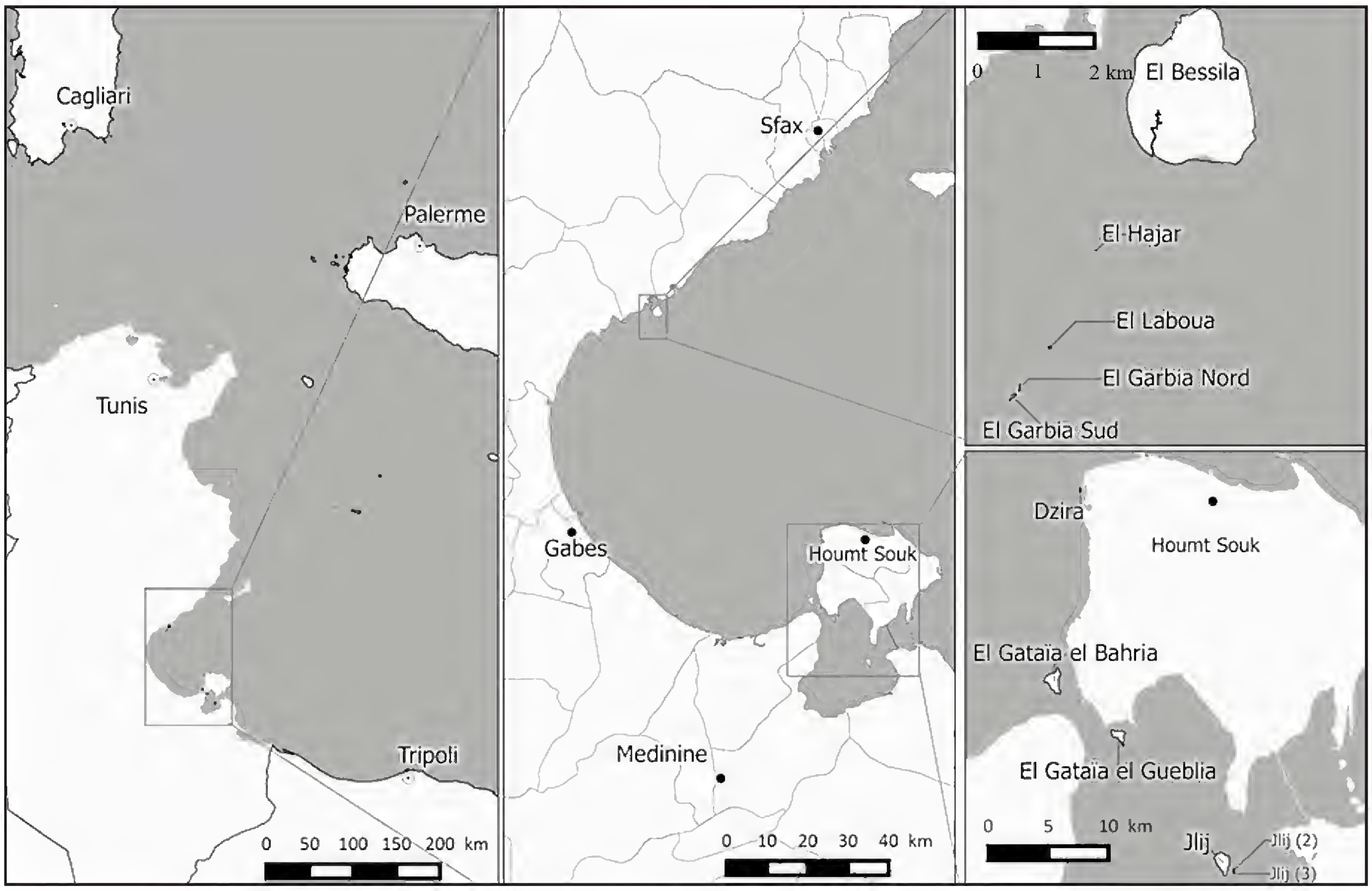

Figure 1. Geographical setting of the study area, South-Eastern Tunisia.

ISLAND	A	B	C	D
El Bessila	N 34.36639° E 10.31444°	436.24	3090	3
El Gharbia-North	N 34.32128° E 10.27646°	0.19	6480	1
El Gharbia-South	N 34.31999° E 10.27499°	0.53	6665	1
El Hajar	N 34.34277° E 10.29083°	0.01	4405	0
El Laboua	N 34.32749° E 10.28194°	0.22	5855	1
Dzira	N 33.87497° E 10.73973°	2.44	315	4
El Gataïa el Bahria	N 33.73222° E 10.71527°	153.21	1500	5
El Gataïa el Gueblia	N 33.69138° E 10.77388°	72.81	575	4
Jlij	N 33.59638° E 10.86722°	149.29	3090	4
Jlij 2	N 33.57909° E 10.86893°	1.43	5815	0
Jlij 3	N 33.57732° E 10.86966°	0.28	6055	0

Table 1. Geographical data of the study islands: A) geographical coordinates; B) surface (ha) (from initiative PIM Database); C) distance from main island/mainland (m); D) number of species.

The Kneiss Archipelago includes the tiny islets of El Hajar, El Laboua, Gharbia North and Gharbia South, and El Bessila which is the largest of the group. This latter is formed by sandy plains and dunes covered by sparse xeric grasslands of the *Lygeo-Stipetea*, and by a mosaic of sebkhas and chotts dominated by salt-marsh plant assemblages and intersected by tidal channel networks. The islet is still used for grazing and frequented by fishermen but without a permanent settlement. The other islets are mainly composed by sandstone and densely covered by halophile vegetation. Until recent times, El Laboua, Gharbia North and Gharbia South were forming a single island, where in 6th century A.D. was active a monastery (Trousset et al., 1992).

The satellites of Djerba, in alphabetical order, are Dzira, El Gataïa el Bahria, El Gataïa el Gueblia, Jlij, Jlij 2 and Jlij 3. All have a flat morphology and are formed by sandy and limestone outcrops, except for Jlij and the nearby islets which are exclusively sandy. The vegetation consists mostly in xero-thermophile and halophile steppe. The larger of the group, El Gataïa El Bahria, hosts an archaeological site with remains of tombs, while on El

Gataïa El Gueblia there are ruins of small fishing settlements and traces of a past agricultural exploitation.

Field work

Field work was done from 7 to 13 April 2015, spending from some hours to one day on each islet; El Bessila was also visited nocturnally. Visual encounter surveys have been carried out along linear transects or on the whole accessible surface of the smallest islets. Animals have also been actively searched by lifting stones and by checking their potential shelters. All the found specimens have been identified, photographed and successively released at the place of capture. Their identification was done using the keys given by Joger (1984), Szczerbak (1989), and Schleich et al. (1996).

Nomenclature and data analysis

The nomenclature follows Sindaco & Jeremčenko (2008) and Sindaco et al. (2013), except for the species formerly included in the genus *Mabuya* Fitzinger, 1826, that according to Bauer (2003) is here referred to *Trachylepis* Fitzinger, 1843. Faunal data analysis was assessed by using simple linear regression with 95% confidence limits and performed with the open source software PAST version 3.04.

RESULTS

Species list

PHYLLODACTYLIDAE

Tarentola cf. ***mauritanica*** (Linnaeus, 1758)

Previously recorded for El Gataïa El Bahria by Tlili (2003), although this locality has not been mentioned in the recent review of the Tunisian distribution of the genus *Tarentola* Gray, 1825 (Tlili et al., 2012a). The record for this islet was however confirmed by our observations, and the species was also found on El Gataïa El Gueblia and Dzira, where small populations occur usually in correspondence of vestiges, ruins and/or rocky outcrops. The lack of these microhabitats on Jlij, Jlii 2 and Jlii 3 could explain its apparent absence on these islets.

REMARKS. The taxonomy of the *Tarentola* specimens from Djerba (and virtually from its satellites) is uncertain, and molecular investigations are still in progress (W. Tlili, pers. comun.). Joger (2003) found that they are morphologically very close to *T. mauritanica*, but affine to *T. deserti* Boulenger, 1891 from the results of electrophoretic analysis. Tlili (pers. comun. in Lo Cascio & Rivière, 2014) has supposed also their belonging to *T. fascicularis* (Daudin, 1802), while no data were given in the further papers by Joger & Bshaenia (2010), Tlili et al. (2012a) and Farjallah et al. (2013). Waiting for a definitive clarification of its status, the populations of the islets of Djerba are here referred to *Tarentola* cf. *mauritanica*.

GEKKONIDAE

Stenodactylus sthenodactylus (Lichtenstein, 1823)

Previously recorded for El Gataïa El Bahria by Tlili (2003), although this locality has not been successively mentioned by Tlili et al. (2012b). The species (Fig. 2) has not been detected on the islet during our survey, but several habitats seem to be potentially suitable for this gecko, which is characterized by nocturnal activity and elusive behavior. One specimen was instead found in a diurnal shelter at El Bessila, despite the nocturnal survey we performed. This observation represents the first record of the species for the Kneiss Archipelago. On this islet *S. sthenodactylus* seems however rare

Figure 2. A specimen of *Stenodactylus sthenodactylus* from El Bessila (Kneiss Archipelago).

and localized, as suggested by the lacking of further observations during a nocturnal prospection.

SCINCIDAE

Chalcides ocellatus (Forsskål, 1775)

Previously recorded for El Gataïa El Bahria by Gobbaa (2012), it has been found also on El Gataïa El Gueblia, Dzira and Jlij, as well as for El Laboua, El Gharbia North and El Gharbia South. It was known for Djerba (Escherich, 1896; Mertens, 1946; Parent, 1981; Tlili, 2003), while it is a new record for the Kneiss Archipelago.

Trachylepis vittata (Olivier, 1804)

Nouira (2004) has recorded this species (sub *Mabuya vittata*) for El Bessila and emphasized that it was also the first finding for the Tunisian islands, but the descriptive sheet given in this paper shows a photo of a specimen belonging to *Mesalina olivieri* (Audouin, 1829) (see Nouira, 2004: 4). Its occurrence on El Bessila is however confirmed from our observations.

LACERTIDAE

Acanthodactylus boskianus (Daudin, 1802)

Previously recorded for El Gataïa El Bahria and El Gataïa El Gueblia by Tlili (2003) and for Jlij by Gobbaa (2012), it has been found also on Dzira. We can also confirm the record for El Bessila given by Nouira (2004).

Mesalina olivieri (Audouin, 1829)

Previously recorded for El Gataïa El Bahria by Tlili (2003), it has been found also on El Gataïa El Gueblia, Dzira and Jlij.

LAMPROPHIIDAE

Malpolon insignitus (Geoffroy Saint-Hilaire, 1827)

New record for Jlij. The species was previously known for Djerba (Parent, 1981; Tlili, 2003). We can confirm also the record for El Bessila given by Nouira (2004).

DISCUSSION

Two species, *Malpolon insignitus* and *Stenodactylus sthenodactylus*, are new records for the satellites of Djerba and the Kneiss Archipelago, respectively, while for other four species (*Tarentola* cf. *mauritanica*, *Chalcides ocellatus*, *Acanthodactylus boskianus* and *Mesalina olivieri*) new localities within the study area are given. Our observations also allow to confirm all the previous records given in literature, with the only exception of *S. sthenodactylus* for El Gataïa El Bahria, where however its occurrence cannot be excluded.

The Djerba satellites and the Kneiss Archipelago harbor respectively six and five species of reptiles, while no amphibians occur on both groups.

Comparing their faunal assemblages, *Mesalina olivieri* is a distinctive species of the Djerba satellites, but its absence fromthe Kneiss appears difficult to explain and is probably related to ecological constrains, considering that the Olivier's lizard is widely distributed and rather common both in continental and insular areas of Tunisia (Blanc, 1980).

Conversely, the largest islet of Kneiss, El Bessila, is inhabited by T*rachylepis vittata* that was not recorded for the Djerba satellites, as well as for the main island, although it occurs on other coastal islands (such as Kuriat and Kerkennah: see Lo Cascio & Rivière, 2014; Corti et al., 2015) and in several continental localities, including the southern Tunisia (Mayet, 1903; Kalboussi & Nouira, 2004).

On the basis of these updated information and those given in literature for Djerba and Kuriat (Tlili, 2003 and references therein; Lo Cascio & Rivière, 2014), the analysis of the herpetofauna by using a simple linear regression has shown an highly significant correlation between log N species and log area (r = 0.899, P = 0.0001) (Fig. 3). Species richness of the coastal Tunisian islets seems therefore mostly influenced by the island size, as also indirectly confirmed by the absence of herpetofauna on Jlij 2, Jlij 3 and El Hajar which are, respectively, the smaller of the Djerba and Kneiss groups. Among them, the relatively high number of species found on the tiny islet of Dzira could be justified by its closeness to the main island, as well as by its

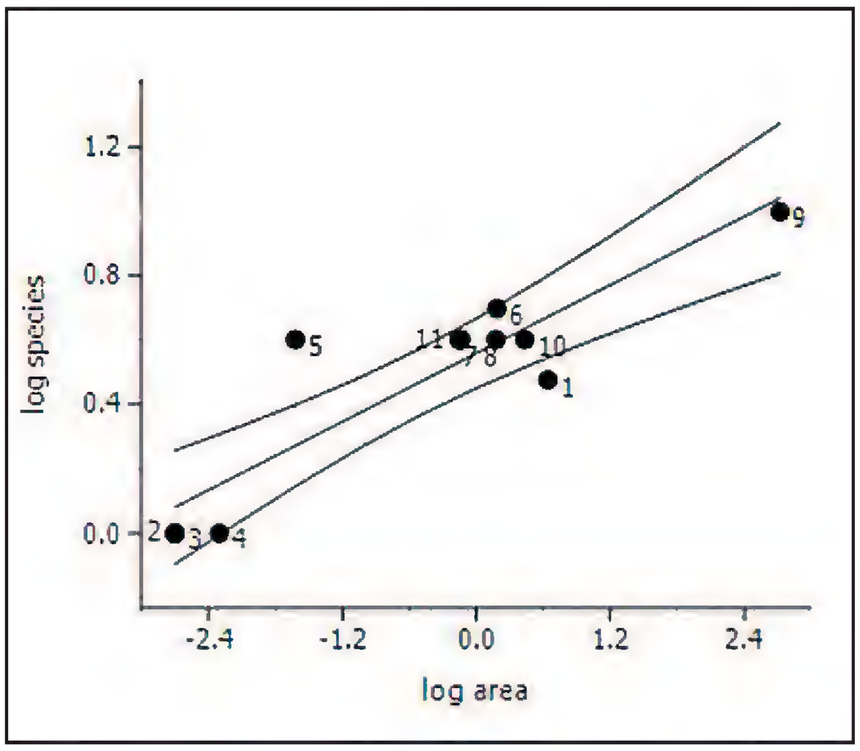

Figure 3. Species-area plot (log species - log area) of the herpetofauna of some Tunsian coastal islands. Numbers are as follows: 1) El Bessila, 2) El Laboua, 3) El Gharbia North, 4) El Gharbia South, 5) Dzira, 6) El Gataïa el Bahria, 7) El Gataïa el Gueblia, 8) Jlij, 9) Djerba, 10) Great Kuriat, 11) Small Kuriat.

environmental heterogeneity, determined by the occurrence of limestone and sandy areas together with some rocky outcrops.

None of the species occurring on both islet groups is listed among the threatened taxa of the Red List by IUCN (www.iucnredlist.org) or seems to be characterized by particular conservation problems at regional and local levels. However, it should be emphasized the importance of safeguarding and maintenance of the reptile populations that represent the most significant component of the terrestrial vertebrate fauna in these insular environments, and that could suffer any small disturbance or environmental alteration in these fragile ecosystems.

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Diversity and population status of waders (Aves) of Bakhira Tal, a natural wetland in District SantKabir Nagar, Uttar Pradesh, India

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ABSTRACT

Present study was conducted from April 2015 to March 2016 to assess diversity of waders (Aves) and its population status in Bakhira Tal. The study area was Bakhira Tal, located in District Sant Kabir Nagar U.P., India. Counting of waders was carried out during early morning from 6 am to 9 am with the help of binoculars and SLR cameras. Point count method was applied to count total number of individuals of each species of waders. Identification of birds was done with the help of key reference books. A total of 28 species of waders were recorded and identified. Bronze winged Jacana (178) outnumbered rest of the species and minimum number was shown by Wood Snipe (6). Maximum species diversity was recorded in winter season (H=3.13 and D=0.048) followed by minimum in summer (H=2.72 and D=0.073). The data collected were analysed using one way ANOVA. All the calculations were done with the help of Graph Pad Prism5. Result of analysed data was found to be significant ($p<0.05$) in case of winters. Seasonal mean values were compared by applying Tukey´s test. The outcome of this test clearly indicates similarity in diversity of waders between rain and winter.

KEY WORDS Bakhira Tal; diversity; point count; population; waders.

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INTRODUCTION

Waders are defined as a group of medium sized wading birds, which have a wide variety of bill structures and possess long legs and toes enabling them to live and feed in shallow water habitats. Waders are belonging to following families, viz. Ardeidae, Charadriidae, Recurvirostridae, Gruidae, Rallidae, Ciconidae, Jacanidae, Threskiornithidae and Burhinidae. Waders represent the greatest species diversity (Tak et al., 2003). Water birds and wetlands are inseparable elements (Grimmett & Inskipp, 2007). Wetlands are the main custodians of the water birds (Weller, 1999; Stewart, 2001). Wetlands attract a large number of migratory and resident bird species. Wetlands are defined as transitional zone between terrestrial and aquatic ecosystem where land is covered by shallow water (Mitsch & Gosselink, 1986). They are also known as biological supermarkets because they provide extensive food chain and rich in biodiversity. Waders have been seen wading through the shallow waters and occasionally probing along dry margins of the wetland. They prefer shallow muddy banks of the pond and close by small water spots. The migratory waders need adequate food supply and safety

(Bharat Lakshmi, 2006). Almost all of them leave the wetland by march-end or early April. Habitats used by waders are diverse ranging from aquatic habitat to dry upland meadows, pastures and crop fields. They usually inhabit in wet lands where they feed and breed even some species are migratory, breeding in northern latitudes and migrating to tropics and south of the equator (Howes & Bakewell, 1989). Most of waders migrate to India during autumn, mainly through the north and north-west (Balachandran, 2006). They are primarily gregarious in nature. Waders commonly feed on fish, aquatic and terrestrial invertebrates, amphibians and crustaceans. Most waders are opportunistic feeders, capturing food items using bills adapted to probe mud and animal burrows. Asian water bird census (Mohan & Gaur, 2008), collects data which is used as vital tool nationally and internationally for conservation and protection of wetlands as water bird habitat.

In India 243 species of water birds and 67 species of wetland dependent and associated birds have been reported (Kumar et al., 2005). They form vital prey base for many living organism in the food webs of wetlands and are important component of wetland ecosystem. Waders are also important component of nutrient cycle. Bakhira Tal is a natural wetland which has been converted into Bird Sanctuary in 1990. It is the largest natural flood plain in U.P. (Uttar Pradesh). It is vast stretch of water body expanding over an area of 29 km^2. Due to high nutritional value and productivity; it provides a long stretch of feeding and breeding ground for the huge number of migratory and resident wader's species. But among the various habitats, wetlands are considered as one of the most threatened one in the world (Prasad et al., 2015). During the last century the world has lost over 50% of wetlands due to various anthropogenic activities (Ma et al., 2010). Wetland habitat is being lost owing to constant spreading of villages, expansion of crop fields, discharging of domestic sewage, discharging of industrial effluent, dumping of solid waste, and over exploitation of their natural resources and conversion of wetlands into barren lands. This results in to the loss of biodiversity and disturbance of wetland services (Ramachdran, 2006). Moreover, shortage of wetlands during the dry season forces water birds to gather in dense concentrations, which are probably highly vulnerable to drought, hunting or other threats. In Bakhira Tal Sarus crane are forced to feed in the fields, causing major economic losses and antagonism between farmers and birds. The loss of wetland reduces the number of stop over sites for migrating birds as well as nesting species (Prasad et al., 2004). The present study was carried out to prepare a checklist as well as current population status of waders in study area.

MATERIAL AND METHODS

Study area

Present study was carried out in Bakhira Tal, which was declared a bird sanctuary in 1990 (Forest and Wild Life Department, Government of Uttar Pradesh, India). It is the largest natural flood plain in U.P. (Uttar Pradesh). It is a vast water body expanding over an area of 29 km^2. The landscape and terrain of the wetland is almost flat having an average height of 100 meter representing a typical terai landscape. The central coordinates of Bakhira Tal are N 26° 34' 0" - E 83° 0' 00". Bakhira Tal provides a wintering and staging ground for a number of migratory waterfowls and breeding ground for resident birds.

Identification

Bird survey was done by using binoculars at 5-6 day intervals. Entire study was carried out from April 2015 to March 2016. Waders were counted by 4 main observers to avoid double counting. They were identified by '*Birds of the Indian subcontinent*' (Inskipp et al., 2011) a field guide to the birds of India. Moreover, identification of birds with the help of key reference books (Grewal et al., 2002, Ali, 2002 and Grimmett & Inskipp, 2007) was done successfully.

Census

Bird counting was carried out during early morning from 6 am to 9 am with the help of binoculars and SLR cameras. Point count method was used while total number of bird from each wader species was recorded. Block count method was adapted for estimating waders present in flocks either in flight or on ground.

S.N.	Common Name	Species Name	Spring	Summer	Rain	Winter	Annual	Mean±Sd
1	Wood Snipe	*Gallinago nemoricola* (Hodgson, 1836)	00	00	00	06	6	1.5±3
2	Bronze winged Jacana	*Metopidus indicus* (Latham,1790)	38	40	45	55	178	44.5±7.59
3	Pheasant tailed Jacana	*Hydrophasians chirurgus* (Scopoli, 1786)	36	43	47	38	164	41±4.96
4	Spotted Redshank	*Tringa erythrops* (Pallas, 1764)	00	00	00	20	20	5± 10
5	Common Redshank	*Tringa totanus* Linnaeus, 1758)	00	00	00	25	25	6.25±12.5
6	Yellow wattled Lapwing	*Vanellus malabaricus* (Boddaert,1783)	12	23	28	23	86	21.5±6.757
7	River Lapwing	*Vanellus duvaucelii* (Lesson, 1826)	15	29	28	25	97	24.25±6.39
8	Red wattled Lapwing	*Vanellus indicus* (Boddaert, 1783)	25	36	34	38	133	33.25±5.73
9	Darter	*Anhinga melanogaster* (Pennant, 1769)	20	22	35	30	107	26.75±6.99
10	Long toed Stint	*Calidris subminuta* (Middenorff , 1853)	00	00	00	14	14	3.5±7
11	Little Stint	*Calidris minuta* (Lesisler , 1812)	00	00	00	36	36	9± 18
12	Common Tern	*Sterna hirundo* (Linnaeus, 1758)	25	30	40	45	140	35±9.12
13	Common Sand piper	*Actitis hypoleucos* (Linnaeus, 1758)	08	00	24	28	60	15±13.21
14	Asian Open bill Stork	*Anastomas oscitans* (Boddaert,1783)	32	25	50	40	147	36.75±10.75
15	Painted Stork	*Mycteria leucocephala* (Pennat,1769)	28	21	24	38	111	27.75±7.41
16	European White stork	*Ciconia ciconia* (Linnaeus,1758)	00	00	00	12	12	3±6
17	White necked Stork	*Ciconia episcopus* (Boddaert,1783)	05	03	02	09	19	4.75±3.095
18	Water Rail	*Rallus aquaticus* (Linnaeus, 1758)	04	04	09	13	30	7.5±4.35
19	Common Moorhen	*Gallinula chloropus* (Linnaeus, 1758)	18	24	30	21	93	23.25±5.12
20	Purple Moorhen	*Porphyria porphyria* (Linnaeus,1758)	21	21	46	37	125	31.25±12.39
21	Grey Heron	*Ardea cinerea* (Linnaeus, 1758)	00	00	00	34	34	8.5±17
22	Cattle Egret	*Bubulcus ibis* (Linnaeus, 1766)	24	35	38	35	132	33±6.16
23	Little Egret	*Egretta garzetta* (Linnaeus, 1766)	18	33	35	20	106	26.5±8.736
24	Intermediate Egret	*Mesophoyx intermedia* (Wagler, 1827)	22	31	33	26	112	28±4.96
25	Cinnamon Bittern	*Ixobrychus cinnamomeus* (Gmelin, 1789)	08	06	14	11	39	9.75±3.5
26	Yellow Bittern	*Ixobrychus sinensis* (Gmelin, 1789)	06	04	06	08	24	6±1.63
27	Black Bittern	*Ixobrychus flavicollis* (Latham, 1790)	14	10	12	18	54	13.5±3.41
28	Black Crowned night Heron	*Nycticorax nyctiorax* (Linnaeus, 1758)	04	12	15	10	41	10.25±4.64
	Total		**383**	**452**	**595**	**715**	**2145**	**536.25 ±148.30**

Table 1. Seasonal variation in the number of waders, Bakhira Tal (District Sant Kabir Nagar U.P., India).

Statistical analysis

Mean and Standard deviation was calculated by using Microsoft excel. Simpson's diversity index (1-D) was used to estimate the biodiversity using the equations: $D = \sum ni (ni-1)/ N (N-1)$, Where D = Simpson's Index of Dominance, ni = total number of individuals of a particular species, N = the total number of individuals of all species (Simpson, 1949). Similarly Shannon diversity index was determined by $H' = - \sum(Pi) (\ln Pi)$, in which Pi = Proportion of total species belonging to ith species.

Biodiversity indices	Spring	Summer	Rain	Winter	Annual
Simpson's index(D)	0.062	0.064	0.059	0.044	0.051
Simpson's index of diversity(1-D)	0.937	0.935	0.941	0.955	0.948
Shannon diversity index (H)	2.88	2.82	2.90	3.21	3.08

Table 2. Diversity indices of waders in different season.

S.No.	Season	Mean and Standard deviation
1	Spring	13.68±12.01
2	Summer	16.14±14.76
3	Rain	21.25±17.48
4	Winter	25.54±12.74
5	Annual	76.61±52.57

Table 3. Seasonal Mean, standard deviation of waders.

ANOVA Table	SS	df	MS	F-Value	P-Value
Treatment (between columns)	22202	3	734.1	3.663	0.0147
Treatment (within columns)	21640	108	200.4		
Total	23850	111			

Table 4. Statistical description of parameters obtained by non-parametric test One way ANOVA.

Tukey's Multiple ComparisonTest	Mean Diff.	q	Significant (p<0.05)	Summary	95% Cl of diff.
Group A vs Group B	-2.464	0.921	No	Ns	-12.35 to 7.422
Group A vs Group C	-5.464	2.042	No	Ns	-15.35 to 4.422
Group A vs Group D	-11.86	4.432	Yes	*	-21.7 to -1.971
Group B vs Group C	-3.000	1.121	No	Ns	-12.89 to 6.886
Group B vs Group D	-9393	3.511	No	Ns	-19.28 to 0.4936
Group C vs Group D	-6.393	2.390	No	Ns	-16.28 to 3.494

Table 5. Tukey's Multiple Comparison Test among all groups. Group A-Spring, Group B-Summer, Group C-Rain &Group D-Winter. Value * is significant less than 0.05, **less than 0.01 and *** less than 0.001.

The data collected were analyzed using one way ANOVA followed by Tukey's test. All the calculations were done with the help of Graph Pad Prism5.

RESULTS

In the present study a total of 28 species of waders were recorded and identified listed in Table 1 and represented in figure 3. Maximum species diversity was recorded in winters while least in summers. Bronzed winged Jacana outnumbered rest of the species with total count of 178 individuals while minimum annual count was 6 in case of Wood Snipe. Bird count was high during and just after breeding season in case of resident birds and during winters in case of migratory birds. Diversity indices are reported in Table 2 and represented in figure 5. It is apparent from the study that species diversity was high during the winter season due to plenty of water and food availability. A gradual rise was noticed in Simpson's index of diversity (1-D) from spring (0.937) to winters (0.955). Similarly, Shannon diversity index was maximum in winter (3.21) followed by minimum in summer (2.82). Seasonal mean and standard deviation of total species of waders are listed in Table 3. However, a detail of mean and standard deviation of individuals of each species of waders was also mentioned in Table 1. Outcome of one way ANOVA reveals significant value ($p>0.05$) for winter season. Analyzed data is reported in Table 4. Turkey's test shows comparison among mean values of different season, listed in Table 5. Similar finding were reported by (Sharma & Saini Minakshi, 2014).

DISCUSSION

This was a premier and scientific study of waders of this Sanctuary. Waders are considered as a good bio indicators and useful models of the wetlands for studying the various environmental problems (Mistry & Mukherjee, 2015). The study shows that Bakhira Tal is an important site for wintering waders. During the study period a total of 28 species of waders were recorded and identified in study area. Out of which 8 were recorded as winter visitor as reported in figure 4. Among these, Little Stint is most common migrant which breeds en-

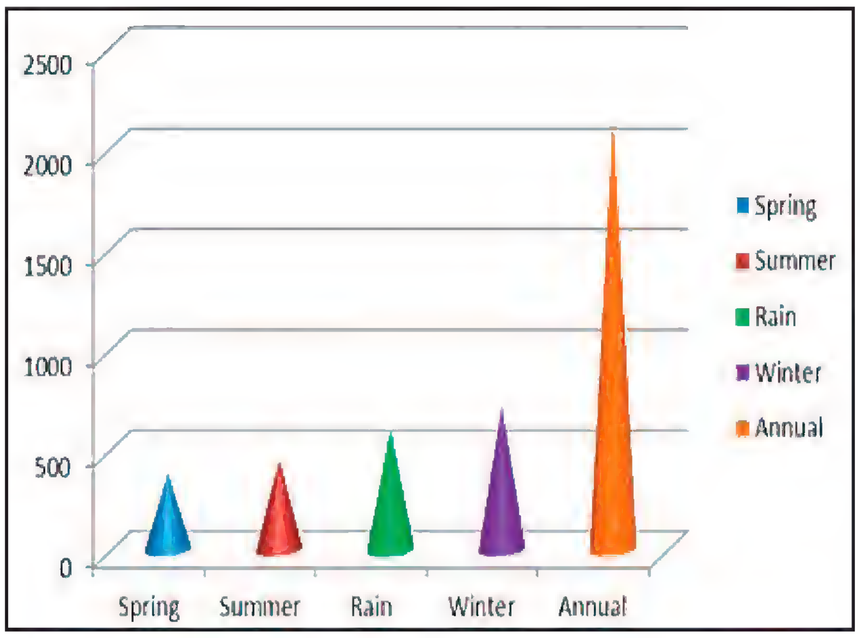

Figure 3. Total number of waders in different seasons.

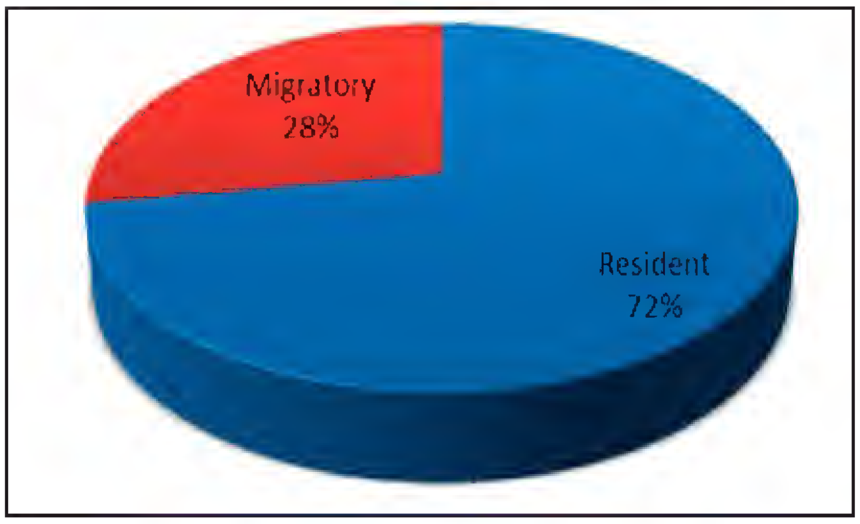

Figure 4. Status of waders of Bakhira Tal.

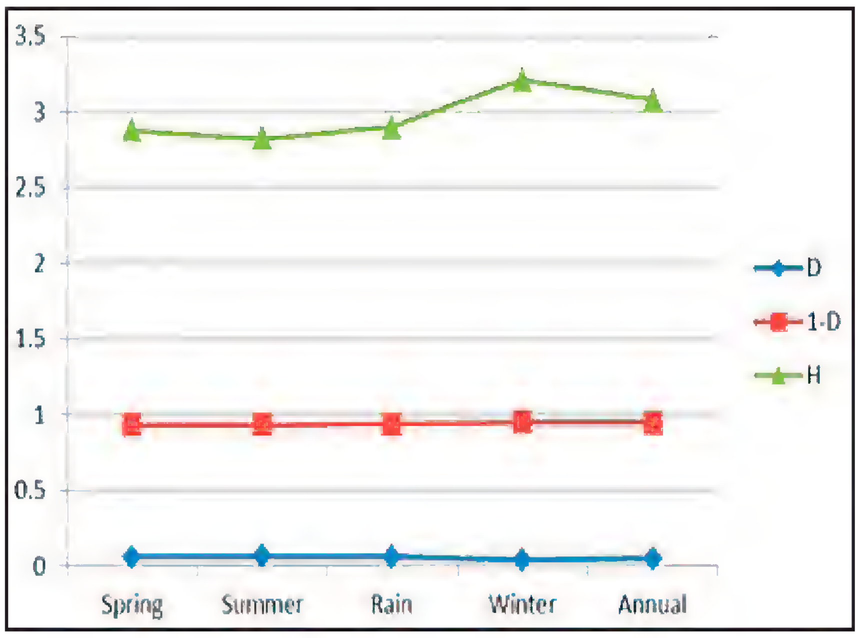

Figure 5. Diversity indices of waders in different seasons.

tirely in the Arctic (Zockler et al., 2005) while some wintering populations of the medium distance migrants, such as Redshank, Spotted Red shank might also originate partly from arctic breeding grounds. Maximum of waders were recorded in winter season (Total No. 715) followed by minimum in spring (Total No. 351).

High abundance of waders in a particular wetland usually depends on availability of food, nesting sites and predation risk (Halse et al., 1993). Bakhira wetland is an important natural wetland of eastern U.P., rich in wader fauna because it provides ample of food items, sufficient water supply throughout the year, breeding and nesting grounds for large number of migratory and resident waders. Present study reports that Purple Moorhen is one of the most beautiful common water birds found in this wetland. This is the most common breeding resident of Bakhira Tal, also known as 'Kaima'.

Grey heron, Common Red shank, Spotted Red shank, Long toed Stint, Little Stint, European White Stork and common Sand Piper were recognized as Wintering waders in Bakhira Tal, were highly susceptible to continuous anthropogenic pressures in the form of washing of cloths, cattle bathing, cattle grazing, and entry of domestic sewage, hunting, fishing, and expansion of crop lands. Since crop lands are being destroyed by waders to some extent, Man &Wild conflict was also observed among the local people of study area and waders. Consequently, villagers started scaring campaigns by exploding crackers near the waders to make them fly from the wetland.

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Study of the effect of a fungicide "the tachigazole" on some indicators of soil biological activity

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ABSTRACT

This study tests the impact of a pesticide molecule (hymexazole) on, on the one hand, the physio-biochemistry of hard wheat *Triticum durum* Desf. (Poales Poaceae) and on the other hand, the indicators of soil biological activity. To do this, the analysis has focused on total proteins, proline, the total carbohydrates and total chlorophyll of wheat leaves. Total carbon and soil organic matter have been also determined. Results reveal that the levels of total chlorophyll are practically identical in the presence of different doses of the fungicide in comparison with those of the control dose. The contents of other parameters (total proteins, carbohydrates and proline) are slightly different from those obtained for witnesses doses. Finally, the analyzed soil samples show that the values of the total carbon are higher and exceed the standards in the samples treated with fungicide.

KEY WORDS fungicide; hymexazole; organic matter; physio-biochemical; soil.

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INTRODUCTION

The intensive use of chemical molecules to kill pests, weeds and fungi contributes significantly to the improvement of yields. However, this use leads parallel, negative consequences for the functioning of ecosystems. Pesticides cause severe damage to the environment due to the combined effects of their anarchical and abusive uses, their persistence and toxicity. In sum, pesticides have a large part in the degradation of natural resources. According to the method of application, they propagate into the atmosphere over large areas, and due to their persistence, they can persist in the environment for long periods. Thus, the components of the physical environment namely, water, soil and plants, are gravely polluted.

This alarming situation, generated due to the repeated use of a multitude of plant protection compounds, has show the interest of a reflection on approaches to improve the biological fertility and sustainable agricultural development.

It is in this context that this work has been done and that has the objective to verify the effect of multiple doses of a fungicide "the Tachigazole" on, on the one hand, the indicators of biological activity of treated soil, and on the other hand, some physiological and biochemical parameters of a hard wheat species *Triticum durum* Desf. (Poales Poaceae) developed in situ.

For this, an experiment has been done to try to verify the consequences resulting from the use of three different doses of the fungicide hymexazole and a control dose, on the soil and on the cultivated plant in situ in pots.

MATERIAL AND METHODS

The soil samples are selected at random to a depth of 0–20 cm in the forest of Edough (Algeria), considered unpolluted area. Geographic coordinates are 36°55' North and 07°40' East. The fungicide used is "Tachigazole", which hymexazole is the active substance of a systemic fungicide seed from Golden Agrochemical Union. It belongs to the chemical family of Triazines, whose chemical structure is shown in figure1.

The considered plant material is hard wheat Cirta variety of the grass family of the genus *Triticum* and the species *Triticum durum.*

Methods

The solutions of fungicide are prepared in a mixture of sterile distilled water and methanol at a rate of 20 parts/80 parts. Three different doses are chosen:

- a dose to the field divided by 5 (D_1) is 9µl/cm²
- a dose to the field (D_2) is 45µl/cm²
- a dose field multiplied by 10 (D_3) or 450 µl/cm²
- a control dose (D_0) containing only sterile water without fungicide or methanol.

The solutions of different doses are pulverized directly on the soil before sowing.

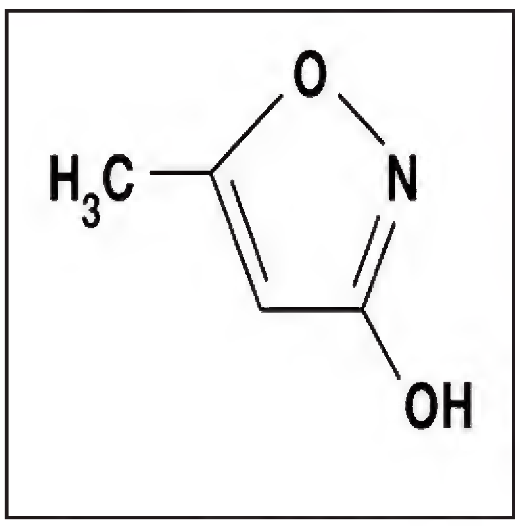

Figure 1. Hymexazole chemical structure

After 30 days, a hard wheat sowing is carried out at a depth of 2 cm, in previously prepared pots, with 10 grains of wheat per pot.

The experiment was performed on a total of 24 pots with repetition 6 pots per dose.

Data collection

The physio-biochemical parameters are measured and quantified from the leaves collected in the tillering of the plant.

The total chlorophyll is expressed in mg/g of fresh matter (F.M). It is extracted by the method of Mackiney (1941) improved by Holden (1975), by Hiscox & Israelsiam (1978) and this by means of a spectrophotometer.

The determination of total carbohydrates expressed in mg/g of fresh matter (F.M) is released by the method of Shields & Burnett (1960).

The extraction of total protein µg/g of fresh material (M. F.) is done according to the Bradford (1976) technique.

The dosage of proline expressed as µg/g of fresh matter (F.M) is effected by the method of Monneveux & Nemmar (1986).

The four parameters were obtained by using calibration curves.

The physico-chemical soil parameters are organic matter (O.M), which is obtained by the method Anne (Dabin, 1966). It is expressed in g/kg of dry matter (D.M). The total carbon that is deducted from the O.M expressed as g/kg of D.M.

Statistical analysis methods of data

The description of different studied characteristics of the plant and soil is made by calculating the average (m), standard deviation (s) and the minimal values (Xmin) and maximal (Xmax) for each dose of fungicide.

The analysis of variance (ANOVA) of the general linear model (GLM) of Minitab software for data statistical analysis (Minitab Inc., 2014) is used to compare averages, between them, of the four doses of the fungicide and this for each characteristic of interest (Dagnelie, 2009). We consider that there are significant differences between the means of four doses when the probability value (p) is less than or equal to the risk $\alpha = 0.05$ ($p \leq \alpha = 0.05$); highly significant differences when $p \leq \alpha = 0.01$ and very highly significant differences when $p \leq \alpha = 0.001$ (Dagnelie, 2009).

The test TUKEY (Dagnelie, 2009) was used to determine the doses of homogeneous groups characteristic of the plant or the soil (Minitab Inc., 2014).

Dunnett's test (Dagnelie, 2009) was used to compare the average of the control dose with each average of other doses for each parameter of the plant and soil (Minitab Inc., 2014).

RESULTS

The following Table 1 presents statistical parameter values obtained by characteristic and per dose of the fungicide to the plant and the soil. Average values and standard deviations are plotted as histograms in the various figures 2–7; which follow.

The results of the analysis of variance (ANOVA) are given in Table 2. Examination of the results of analysis of variance (Table 2) shows that there are only significant differences between the averages of 4 doses fungicide total chlorophyll of the plant and for the O.M and the total carbon in the soil; then, we notice highly significant differences for total protein and very highly significant differences for contents of the proline and the total carbohydrates.

The TUKEY's test used, after the rejection of the hypothesis of equality of averages, by the ANOVA shows that there exist two homogeneous dose groups, respectively, total chlorophyll, proline, organic matter and carbon total, and 3 homogeneous groups to total protein and carbohydrates. Alphabetic letters a, b, c in graphics from figures 2 to 7 designate these groups. The alphabetical letter indicates that the doses in question give consistent results on average.

Nature of samples	Variable	Doses	n	m	s	x min — x max
SOIL	ORGANIC MATTER	D_0	6	1.283	0.498	0.528 — 1.869
		D_1	6	3.693	1.093	1.477 — 4.257
		D_2	6	3.047	1.878	0.583 — 4.404
		D_3	6	2.032	1.223	0.495 — 4.180
	CARBONE TOTAL	D_0	6	0.745	0.289	0.306 — 1.082
		D_1	6	2.147	0.636	0.858 — 2.475
		D_2	6	1.779	1.097	0.340 — 2.560
		D_3	6	1.257	0.739	0.289 — 2.431
	CHLOROPHYLL	D_0	6	52.500	21.900	30.600 — 74.400
		D_1	6	37.600	5.710	31.890 — 43.310
		D_2	6	44.000	32.900	11.100 — 76.900
		D_3	6	109.430	14.010	95.420 — 123.440
PLANT	PROTEINS	D_0	6	2.769	0.298	2.476 — 3.071
		D_1	6	2.172	0.178	2.000 — 2.357
		D_2	6	2.988	0.357	2.571 — 3.285
		D_3	6	1.817	0.274	1.547 — 2.095
	PROLINE	D_0	6	0.073	0.056	0.009 — 0.106
		D_1	6	0.684	0.036	0.644 — 0.713
		D_2	6	0.046	0.007	0.038 — 0.530
		D_3	6	0.009	0.001	0.008 — 0.010
	CARBOHYDRATES	D_0	6	4.165	0.242	3.920 — 4.404
		D_1	6	2.479	0.039	2.447 — 2.522
		D_2	6	3.610	0.251	3.329 — 3.812
		D_3	6	3.307	0.191	3.092 — 3.458

Table 1. The values of basic statistical parameters based on soil samples and samples of the wheat plant: the number of samples (n), the mean (m), standard deviation (s), minimum values (X_{min}) and maximum (X_{max}).

Table 3 presents the results of the Dunnett's test calculated on the different characteristics of the plant and soil. From this Table 3 it can be seen that there is, each time, two fungicide doses, which give on average the results identical to those of the control dose, and this for, respectively, the total chlorophyll, proteins, proline, organic matter and the total carbon. Moreover, for contents of the carbohydrates, all doses of the fungicide on average give lower results compared to controls.

- Figure 2 relative to the total chlorophyll (a + b) shows that the D_3 dose of the fungicide provides the higher level with an average of 109.43 µg/g F.M. This result is, moreover, confirmed by the test TUKEY which classifies that this dose D_3 separately and the other doses D_0, D_1 and D_2; in a single homogeneous group.

- For protein contents represented by figure 3, the TUKEY test shows an overlapping 3 homogeneous groups of doses. The first group consists of doses D_0 and D_2, the second group consists of doses D_0 and D_1 and the third group D_1 and D_3. We notice that the dose D_0 is similar to D_1 and D_2 but different from dose D_3, and the dose D_1 is also identical to D_0 and D_3, doses but different from the dose D_2. The dose D_2 fungicidally induced a stimulation of the synthesis of proteins with the highest average 2.98 µg/g M.F.

- The total carbohydrates are given in figure 4. The TUKEY test shows 3 groups of distinct doses. D_0 dose is the first group with an average rate equal to the highest 4.16 µg/g F.M. D_1 dose alone represents a second group with the lowest rate (2.48 µg/g F.M), and D_2 and D_3 doses form a third homogenous group with no significant difference between their average. We note that the rates obtained from the leaves treated with all three doses are lower than those obtained from the reference dose.

- The levels of proline represented by figure 5 show two dose groups obtained by the TUKEY test. The first group consists of doses D_0, D_2 and D_3 with very low values and, particulary, almost zero for the D_3 dose (0.009 mg/g F.M). The second group consists only of the D_2 dose that gives the higher average (0.684 mg/g F.M).

- Figure 6 is related to organic matter content (O.M). In this figure, we noticed that two dose groups overlap. The first group consists of doses D_0, D_2 and D_3 and the second group consists of doses D_1, D_2 and D_3. This shows that the doses D_0 and D_1 are identical, each at doses D_2 and D_3, but are different from each other. D_0 control dose gives, on average, the lowest value (1.283 g/kg) O.M and the dose D_1 gives the higher value (3.693 g/kg).

- Finally, in Figure 7 related to the total carbon 2 dose groups. The doses D_0, D_2 and D_3 form the first group and, D_1 and D_2 doses form the second group. However, we note that the dose D_2 is common to both groups. The dose witness D_0 has given the lowest value (0.745 g/kg) of total carbon; while D_1 dose has given the higher value (2.147 g/kg).

DISCUSSION

In the present study, we tried to compare indicators of biological activity in soil submitted to the effect of a fungicide "the Tachigazole" and untreated control soil to establish a relationship between the repeated use of the fungicide, environmental parameters and soil fertility. The parameters analysed show variability in the results. The treated soils contain more total carbon but with slight variations between concentrations. The contents recorded in control samples are the lowest.

The organic material influences the distribution of the biomass. This latter is of great benefit for the microorganisms constituting the source of carbon and energy, which are transformed into new bodies and products of metabolism, and also play a role in the solubility of the pesticide (Bordjiba, 2003). The adsorption of the fungicide on the organic material increases its solubility and stability in the soil profile (Chiou et al., 1986).

The organic matter in the soil greatly influences the adsorption of pesticides in causing a decrease in the adsorption coefficient (Kd) and increased absorption coefficient (Koc) (Graber et al., 2010).

We note that treated plants with high doses of the fungicide registered a significantly lower effect on chlorophyll a and b. The letter accords perfectly with the results obtained by Hammou (2001) and Boutamine & Lahmar (2016), showing that very few fungicides affect the vital functions of the plant and in particular on the development of chlorophyll. We find that there is a close correlation between the rate of carbohydrate and chlorophyll content. Carbohydrate levels are lower in treated plants versus the control. During photosynthesis, electron

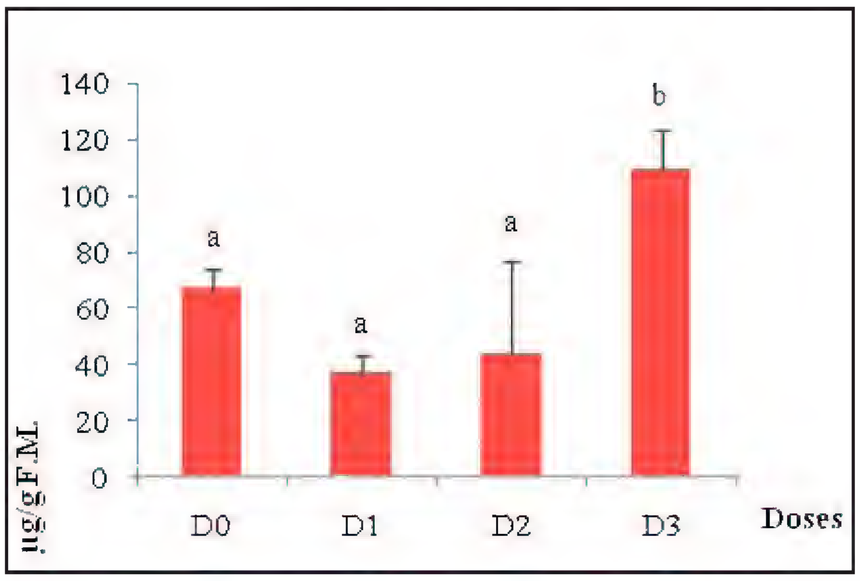

Figure 2. Total chlorophyll content in the presence of the four doses of the fungicide (hymexazole). The doses that have the same alphabetical letter constitute a homogeneous group according to the test TUKEY.

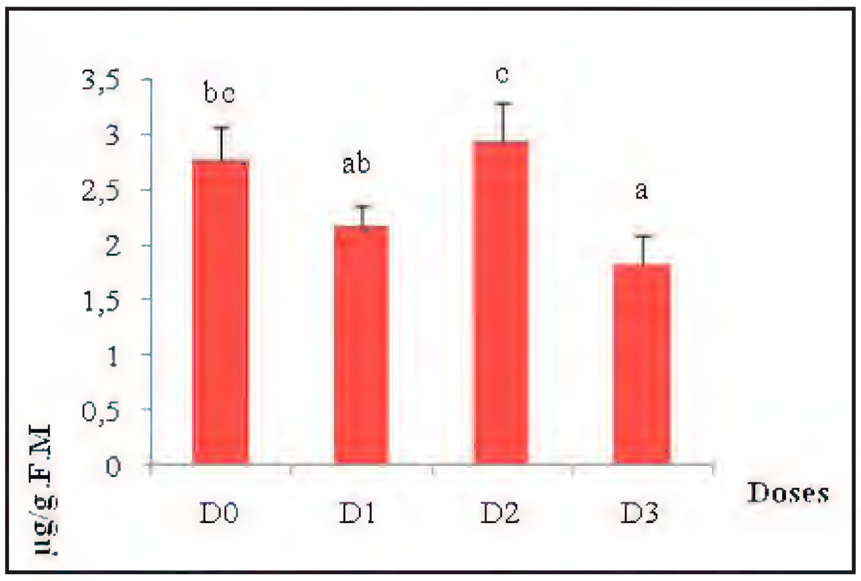

Figure 3. Content of proteins in the presence of four fungicide doses (hymexazole). The doses that have the same alphabetical letter constitute a homogeneous group according to the test TUKEY.

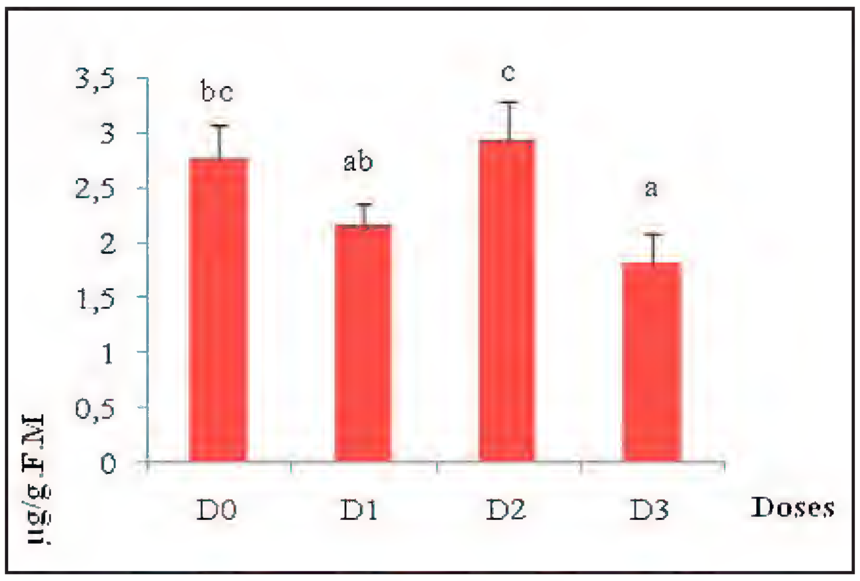

Figure 4. Content of proteins in the presence of four fungicide doses (hymexazole). The doses that have the same alphabetical letter constitute a homogeneous group according to the test TUKEY.

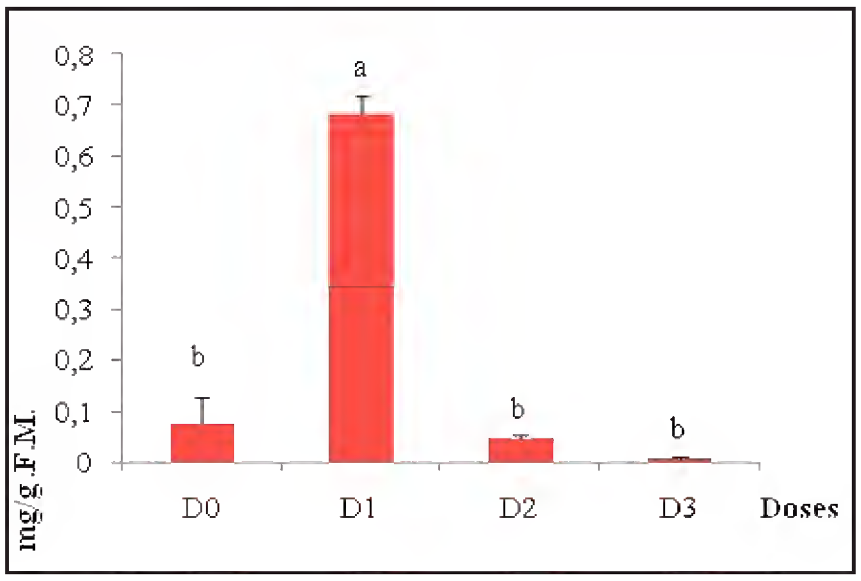

Figure 5. Content of proline in the presence of four fungicide doses (hymexazole). The doses that have the same alphabetical letter constitute a homogeneous group according to the test TUKEY.

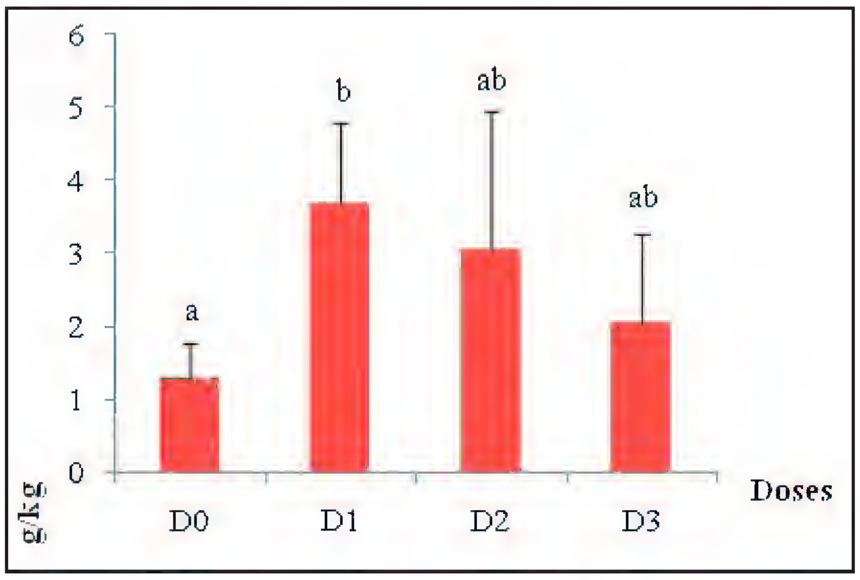

Figure 6. The organic matter in the presence of four fungicide doses (hymexazol). The doses that have the same alphabetical letter constitute a homogeneous group according to the test TUKEY.

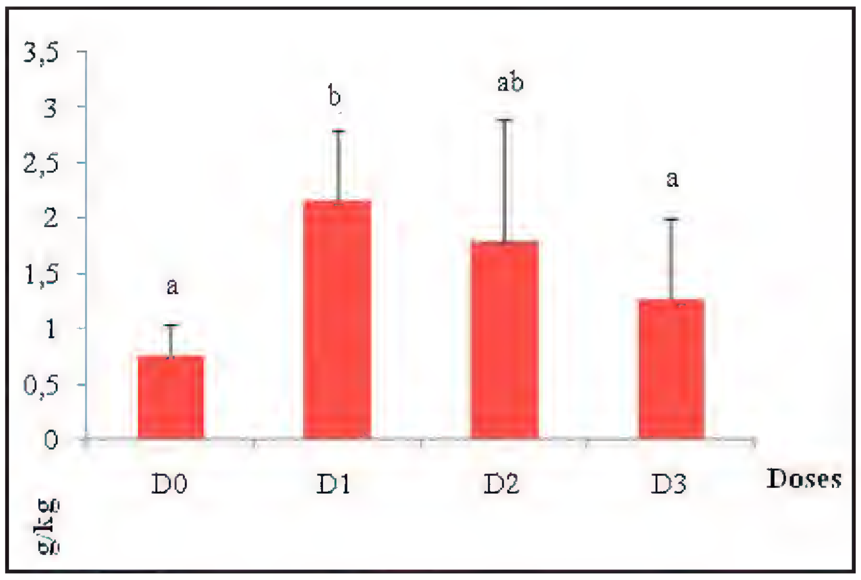

Figure 7. The total carbon levels in the presence of four fungicide doses (hymexazole). The doses that have the same alphabetical letter constitute a homogeneous group according to the test TUKEY.

Nature of samples	Variable	Source de variation	DF	Seq SS	MS	F	p
SOIL	ORGANIC MATTER	Doses	3	20.535	6.845	4.230	0.018*
	TOTAL CARBONE	Doses	3	6.746	2.249	4.020	0.022*
	CHLOROPHYLL	Doses	3	9760.50	3253.5	7.270	0.011 *
PLANT	PROTEINS	Doses	3	2.415	0.805	9.970	0.004 **
	PROLINE	Doses	3	0.932	0.310	279.58	0.000 ***
	CARBOHYDRATES	Doses	3	4.489	1.486	37.220	0.000 ***

Table 2. Results of the analysis of variance (ANOVA) to criteria for the soil and the plant. The number of degree of freedom (DF), the sum of squared differences (Seq SS), the middle square (MS), the observed value of the variable F Fisher (F) and the probability (p). *: Significant differences. **: Highly significant differences. ***: Very highly significant differences.

NATURE OF SAMPLE	VARIABLES	DOSES AND MEANS			
SOIL	ORGANIC MATTER	D_0 1.283	D_3 2.032	D_2 3.047	D_1 3.693
	CARBONE	D_0 0.745	D_3 1.257	D_2 1.779	D_1 2.147
	CHLOROPHYLL	D_0 37.600	D_3 44.000	D_2 52.500	D_1 109.430
PLANT	PROTEINS	D_3 1.817	D_1 2.172	D_0 2.769	D_2 2.988
	PROLINE	D_3 0.009	D_2 0.046	D_0 0.073	D_1 0.684
	CARBOHYDRATES	D_1 2.479	D_3 3.307	D_2 3.610	D_0 4.165

Table 3. Results of DUNNETT's test. Averages doses at once underlined bold are identical to the average of the control dose (D_0) for the soil and the plant.

transport along the photosynthetic chain is ensured by chlorophyll a and b. From there, the electrons are transferred to different carriers in the chain to the levels of photosystems I and II till the reduction of NADP to $NADPH_2$ necessary to the transformation of CO_2 into organic molecules, such as carbohydrates (Berkaloff et al., 1997).

Finally, the amounts of total protein are almost similar in samples treated with all doses of fungicide and are not very far from those of controls. The same was reported by Kloskowski (1992) and Dec & Bollog (1997), who claim that moderate concentrations of pesticides do not greatly affect the level of proteins.

CONCLUSIONS

The development of agriculture is accompanied by the use of plant protection products worldwide. This use has shown particular advantages in increasing production yields by eliminating or reducing crop predators. However, behind its misdeeds can hide insidious effects on the different components of the environment or human health. The study, we conducted, was to target soil fertility under conditions of considerable pollution by different doses of a pesticide molecule. This fertility was assessed using several indicators of biological activity, such as total carbon and organic matter.

We have tried to show the influence of a molecule of hymexazole with different concentrations on the physio-biochemistry durum wheat *Triticum durum* and some indicators of soil biological activity.

Due to the quasi-homogeneity and non-variability of the results recorded in the different samples treated and control samples, we believe that the assessment of the chemical fertility of soils polluted by pesticides seems difficult because of multiple interactions between the nature of the pollutant, the physio-chemical soil characteristics and environmental factors.

In addition, the lack of data on soils and norms of quality of biochemical and organic chemical and biological quality fertile soils makes assessment of soil quality and fertility difficult and not obvious.

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An unusual urban refuge for the crested porcupine, *Hystrix cristata* (Linnaeus, 1758) (Mammalia Rodentia): the ancient Catacombs of Priscilla in Rome (Italy)

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ABSTRACT In this note the author reports the unusual use of ancient catacombs as a daytime refuge for some specimens of crested porcupine *Hystrix cristata* (Linnaeus, 1758) (Mammalia Rodentia) belonging to the population of the Villa Ada urban park in Rome.

KEY WORDS Crested porcupine; *Hystrix cristata*; Rome; Urban Park; Villa Ada.

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INTRODUCTION

The crested porcupine *Hystrix cristata* (Linnaeus, 1758) (Mammalia Rodentia) is a species of rodent belonging to the family Hystricidae. The adult *H. cristata* has a body length of about 60 to 83 cm, excluding the tail, and a weight from 13 to 27 Kg. This rodent occurs in Italy, North Africa and Sub-Saharan Africa. It is sometimes asserted that the porcupine was introduced in Italy by the Romans, but fossil and sub-fossil remains suggest that it was probably present in Europe in the Upper Pleistocene. Recently the Italian distribution area has had a considerable expansion (Amori & Capizzi, 2002). At the end of 2010, *H. cristata* is recorded throughout the Italian region with exclusion of Friuli Venezia Giulia and Val d'Aosta (Mori & Sforzi, 2012). In the province of Rome the crested porcupine is widely spread and in some places is rather abundant (Angelici, 2009). The crested porcupine are active during the night (Corsini et al., 1995; Angelici, 2009) and spend most of the daylight hours in their dens located in natural or artificial caves or in underground tunnels (Monetti et al., 2005). They are particularly widespread in the agroforestry systems of the Mediterranean region. Occasionally can also be found in the green areas located within big cities, provided adjacent to a service area with abundant vegetation (Amori & Capizzi, 2002). Banks of streams and hedges are important wildlife corridors and are used as ways of expansion (Amori & Capizzi, 2002). Another hallway that allows crested porcupine easy expansion is consisting of railway lines (Gippoliti com. pers.).

STUDY AREA

Villa Ada, an urban park in Rome (Central Italy) with a surface of 450 acres (1, 8 km²), it is the second largest park in the city after Villa Doria Pamphili. It is located along Via Salaria, in the northeastern part of the city. Its highest relief is Monte Antenne with a height of 67 m above sea level (Fig. 1). The Catacombs of Priscilla are located in Via Salaria just in front of Villa Ada. These Catacombs are mentioned in all of the most ancient documents regarding Christian topography and liturgy in Rome; due to the great number of martyrs buried therein, were called

"*Regina catacumbarum - The Queen of the Catacombs*". The galleries dug into the tuff, a soft volcanic rock used to make bricks and lime, have a total length of about thirteen kilometers, at various depths.

RESULTS AND CONCLUSIONS

The presence of the crested porcupine in Villa Ada has been known since the 80s (Angelici, pers. com.) and well documented (Zapparoli, 2009). However, what was not known is the habit of this rodent to use the long underground passages of the Catacombs of Priscilla as daytime refuge. In recent years, religious custodians of the Catacombs, have repeatedly requested the intervention of the Wildlife Rescue Centre Lipu of Rome to try to remove some specimens of crested porcupine which had chosen as a refuge the long series of tunnels that form the underground part of the Catacombs of Priscilla (Manzia, pers. com.). Three of the six entrances of Villa Ada are located along the Via Salaria, just opposite to the above mentioned Catacombs.

The crested porcupines spend the daylight hours in their dens located in natural or artificial caves or underground tunnels (Monetti et al., 2005). The long tunnels (about thirteen kilometers) are rarely visited, the small distance and the ease of achieving, have made it possible the use of Catacombs of Priscilla as daytime refuge for the population of *H. cristata* of Villa Ada.

Figure 1. Study area: Northeastern part of Rome (Latium, Italy).

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Updated distribution of *Hydromantes italicus* Dunn, 1923 (Caudata Plethodontidae): a review with new records and the first report for Latium (Italy)

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ABSTRACT The Italian cave salamander *Hydromantes italicus* Dunn, 1923 (Caudata Plethodontidae) is an eutroglophilic amphibian found along the Appennines from Emilia-Romagna to Abruzzo, however the available bibliography shows inconsistencies in distribution data. Herein we provide an updated distribution of the species, with new records and the first detection for Latium in the Gran Sasso and Monti della Laga National Park in the Province of Rieti.

KEY WORDS Italian cave salamander, *Hydromantes*; distribution data; Monti della Laga; Latium.

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INTRODUCTION

Hydromantes italicus Dunn, 1923 (Caudata Plethodontidae) is an eutroglophilic salamander species found both in natural and artificial environments, such as underground cavities (caves, mines, etc.) and surface habitats (rock outcrops, dry-stone walls, etc.).

Like the other plethodontids, *H. italicus* has no lungs and breathing occurs through the skin and the buccal mucosa, for this reason this amphibian can live only in humid and fresh conditions; in fact *H. italicus* spends most of its life into the ground, coming to the surface at night or concomitantly with wet weather (Lanza et al., 2005).

Hydromantes italicus is one of the three species of the genus *Hydromantes* found along the Italian Peninsula. The known range of the species goes from the northern limit of Onfiano, province of Reggio Emilia (Gigante, 2009) to the the southern limit of Pescosansonesco, province of Pescara (Lanza et al., 2006). According to Lanza et al. (2005), *H. italicus* is present in the regions of Emilia-Romagna (Provinces of Reggio Emilia, Modena, Bologna, Ravenna and Forlì-Cesena), Tuscany (Provinces of Lucca, Pistoia, Prato, Firenze and Arezzo), Umbria (Province of Perugia), Marche (Provinces of Pesaro-Urbino, Ancona, Macerata, Fermo and Ascoli Piceno) and Abruzzo (Provinces of Teramo and Pescara). Despite the proximity of certain reports, the species had never been found in Latium (Bologna et al., 2000; Lanza et al., 2006). *Hydromantes italicus* is also present in the Republic of San Marino.

Outside of its natural range *H. italicus* has been introduced in a cave in the Province of Siena (Cimmaruta et al., 2013), in the "Gessi di Brisighella" area (Bassi & Fabbri, 2006) and in Germany in the "Weser Uplands" in Lower Saxony (e.g. www.fieldherping.eu/Forum/).

The altitudinal range varies from 80 m (Garfagnana, province of Lucca) up to 1598 m above sea level (Apuan Alps, province of Lucca) (Lanza et al., 1995). Despite the presence of suitable environment, *H. italicus* is absent from high altitudes on Apennines (Lanza et al., 1995). To explain this trend, Lanza et al. (2005) have speculated that the highest mountains still haven't been re-colonised since the Quaternary glaciations, or that *H. italicus* isn't an euryzonal species and is effectively incapable to occupy habitats above 1600 m asl.

On the Apuan Alps there is a hybrid zone in which the genome of *H.italicus* populations is, to varying degrees, introgressed with genes of *H. ambrosii bianchii* Cimmaruta, Lanza, Forti, Bullini et Nascetti, 2005. Ruggi (2007) has shown that *H. italicus* with introgressed alleles occurs at least up to the provinces of Florence, Bologna and Modena; instead pure populations are present from Umbria to Abruzzo and also in the northern limit in the province of Reggio Emilia.

Consulting the distributional data reported in the available bibliography, we have noticed inconsistencies and lacks of occurrences in some areas. In this paper we provide a review of the known distribution with new reports and the first data for Latium.

MATERIAL AND METHODS

To establish the known distribution of *H. italicus*, we consulted and compared the distributional data provided in CKmap (Checklist and Distribution of the Italian Fauna - version 5.3.8), in national and regional atlas and in conference papers.

In particular, we referred to the Atlas of Amphibians and Reptiles of Italy (Razzetti et al., 2006), Atlas of Amphibians and Reptiles of Tuscany (Vanni & Nistri, 2006), Amphibians and Reptiles of Umbria (Ragni et al., 2006), Atlas of Amphibians and Reptiles of Emilia-Romagna (Mazzotti et al., 1999), Atlas of Amphibians of Abruzzo (Ferri & Soccini, 2007) and Atlas of Amphibians and Reptiles of Sibillini Mountains National Park (Fiacchini, 2013).

Some data for Marche, Umbria and Abruzzo have been obtained from the following conference papers: Fiacchini (2008), Spilinga et al. (2008), Ferri et al. (2008), Cameli et al. (2016) and from the monography on European cave salamanders edited by Lanza et al. (2005).

Moreover, some documented sightings in new UTM 10x10 km squares were derived from the maps available on Ornitho.it database (www.ornitho.it) and from nature enthusiasts.

In addition to searching for new localities in our back data, we conducted a field research during the season 2015-2016, looking for *H. italicus* in some UTM 10x10 km squares in which the species is reported as absent and in particular in the Province of Rieti (North-East Latium). We actively searched the species in surface mainly in rainy nights via flashlight or during the daytime inspecting the rock crevices or the stonewalls. We also evaluated the presence of suitable habitats via Google Street View (http://maps.google.com). We used a digital camera for documenting the sightings and a GPS to register the exact location.

On the updated distributional map (Fig. 1), the presence sites are shown on the centroid of the respective UTM square 10x10 Km, sample sites of Rieti Province (Fig. 2) are shown in WGS 84 Longitude - Latitude coordinates. Maps were drawn by Quantum GIS - Valmiera 2.2.0 version.

RESULTS

Layering data reported in the various publications, we noticed some discrepancies that were unrelated to the publiction dates.

During field surveys, we found *H. italicus* in 11 localities in 9 new UTM 10x10 km squares (Table 1).

We detected the presence of *H. italicus* in only one locality in the Province of Rieti, Latium (Table 3). We found 3 adult individuals along the watercourse "Fosso di Valle in Sù" that flowing down from the area of lakes "Lago Secco" and "Lago della Selva", not far from the locality Poggio d'Api, on a sandstones and marls outcrop in the lower bound of the beech forest (Figs. 3, 4).

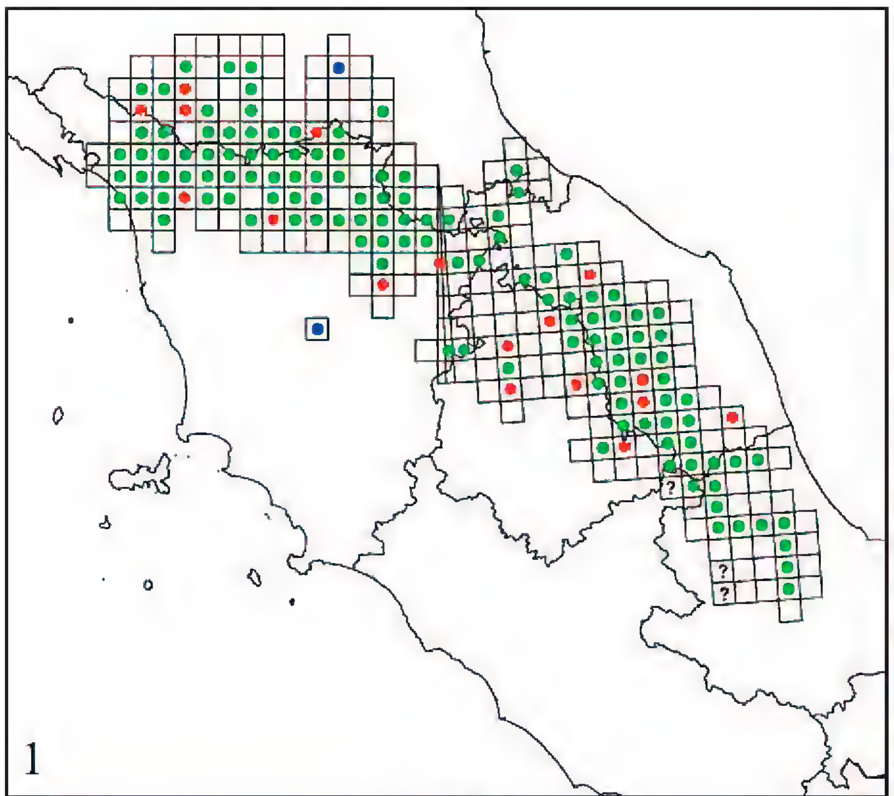
One of the Authors (D.F.) received on August 2015 a documented sighting of *H. italicus* from a small unregistered cave on the eastern slope of Monte Utero, in the Municipality of Accumoli, virtually in the new UTM square 33T UH52. Nevertheless, we have investigated neighbouring areas without being able to corroborate the data.

Excluding two UTM squares where the Italian cave salamander has been introduced artificially, the UTM squares occupied by the species according to published data are 125.

Our new sightings and unpublished data show that *H. italicus* is present in at least 142 UTM squares (Fig. 1).

DISCUSSION

Knowing the distribution of a species is essential for its conservation and to better understand its ecology and biogeography. The UTM squares reported in the Atlas of Amphibians and Reptiles of Italy where *H. italicus* naturally occurs are 105 (Lanza et al., 2006). Nevertheless, by adding up pre-existing and subsequent published data, unpublished data and new sightings, we demonstrate the presence of *H. italicus* in a total of 142 UTM squares. The report by Ruggi (2007) for Capo d'Acqua, in



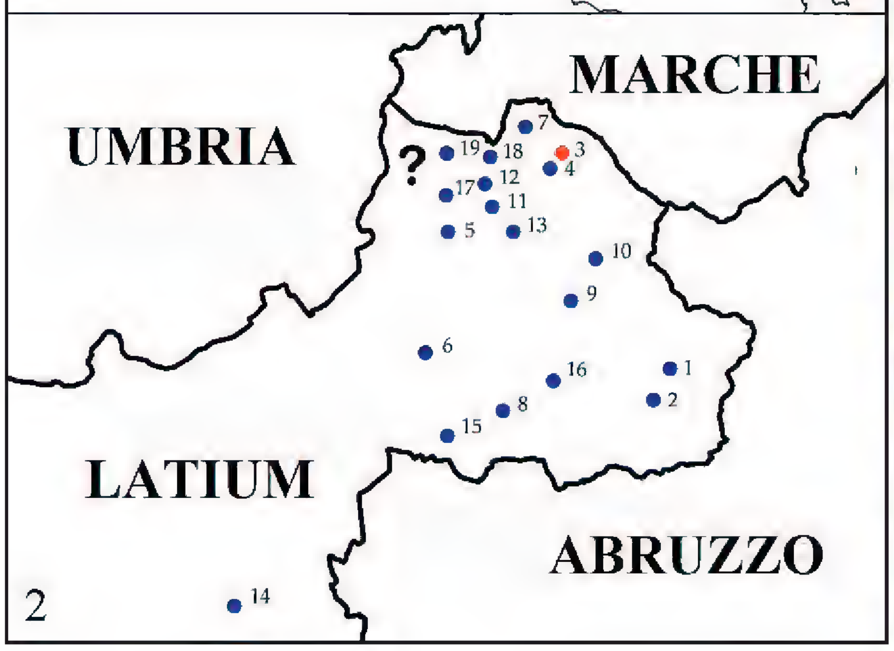


Figure 1. *Hydromantes italicus* updated national distribution. Green dots represent sites in UTM previously published. Red dots represent new occurences in UTM not yet published: from this study and second-hand data. Blu dots represent the two known introduced populations. Question marks represent UTM doubtful and not yet confirmed. Figure 2. Sample sites of the field reserch in Province of Rieti (Latium): 1 Sacro Cuore di Capricchia; 2 Preta; 3 Poggio d'Api (1); 4 Poggio d'Api (2); 5 Villanova; 6 Pasciano; 7 Grisciano; 8 Cornelle; 9 Sant'Angelo; 10 unnamed road to Macchie piane; 11 between Tino and Accumoli; 12 rx tributary "F.so di Valle Castello"; 13 Libertino; 14 Posta; 15 Scai; 16 Collemagrone; 17 "F.te Crocetta"; 18 Tino; 19 "F.te i Trocchi". Question mark represent the "M. Utero" area, not confirmed in our study. Figures 3, 4. *Hydromantes italicus* habitat in Poggio d'Api locality (Fig. 3), one of the three adult individuals observed in the same site (Fig. 4).

Date	Locality	UTM square	Elevation (m)	Environment
27/01/16	Bruceto, Carmignano (PO)	32T PP65	240	Epigeal
2003	Monte Ingino, Gubbio (PG)	33T UJ00	645	Hypogeal
11/01/08	Monte Acuto, Umbertide (PG)	33T TH89	878	Hypogeal
1998	Piano di Nese, Umbertide (PG)	33T TH89	400	Hypogeal
15/05/04	Santa Sabina, Corciano (PG)	33T TH87	226	Hypogeal
09/04/16	Monte Subasio, Assisi (PG)	33T UH17	633	Epigeal
10/08/06	Balza Tagliata, Cerr. di Spoleto (PG)	33T UH34	424	Hypogeal
06/10/06	Bagni di Triponzo, Cerr. di Spoleto (PG)	33T UH34	700	Hypogeal
07/06/15	Valdiea di Camerino, Camerino (MC)	33T UH47	390	Epigeal
12/10/14	Alfi, Fiordimonte (MC)	33T UH46	630	Hypogeal
16/04/16	Vallotica, Sassoferrato (AN)	33T UJ22	460	Epigeal

Table 1. New localities collected during field survey and not yet published.

Locality	UTM square	References
Ligonchio, Ventasso (RE)	32T PQ00	Sara Lefosse & Alessandro Riga Pers. Comm.
"F.so di Carpineti", Palagano (MO)	32T PQ20	Massimo Gigante Pers. Comm.
Cà Falchetti, San Benedetto Val di Sambro (BO)	32T PP89	Francesco Nigro Pers. comm.
Ponte alla Piera, Anghiari (AR)	32T QP43	Elia Serafini Pers. Comm.
Monte Ascensione, Ascoli Piceno (AP)	33T UH85	Amedeo Capriotti & Giorgio Marini Pers. Comm.
Faeto, Loro Ciuffena (AR)	32T QP12	Nicola Baccetti - Ornitho.it
Anchiano, Borgo a Mozzano (LU)	32T PP26	Enrico Lunghi & Domenico Verducchi - Ornitho.it
Corneto, Toano (RE)	32T PQ21	Massimo Gigante - Ornitho.it

Table 2. New localities collected from second-hand data.

Date	Locality	UTM square	Amphibian species
8/10/15	Sacro Cuore di Capricchia, Amatrice	33T UH62	
8/10/15	Preta, Amatrice	33T UH61	
9/10/15	Poggio d'Api, Accumoli (1)	33T UH63	*Hydromantes italicus*
10/10/15	Poggio d'Api, Accumoli (2)	33T UH63	*Rana temporaria*
10/10/15	Villanova, Accumoli	33T UH52	*Rana italica*
10/10/15	Pasciano, Amatrice	33T UH52	*Rana italica*
8/4/16	Grisciano, Accumoli	33T UH53	
8/4/16	Cornelle, Amatrice	33T UH51	*Triturus carnifex*
8/4/16	Sant'Angelo, Amatrice	33T UH62	*Rana temporaria*, *Pelophylax* sp., *Hyla intermedia*
8/4/16	Unnamed road to Macchie Piane, Amatrice	33T UH62	*Rana italica*, *Bufo bufo*
9/4/16	Poggio d'Api, Accumoli	33T UH63	*Rana italica*
9/4/16	Between Tino and Accumoli, Accumoli	33T UH52	*Hyla intermedia*, *Bufo bufo*
9/4/16	Right tributary "F.so di Valle Castello", Accumoli	33T UH52	*Salamandrina perspicillata*, *Rana italica*
9/4/16	Libertino, Accumoli	33T UH52	*Triturus carnifex*, *Rana dalmatina*
15/5/15	Posta	33T UH40	
15/5/15	Scai, Amatrice	33T UH51	
15/5/15	Collemagrone, Amatrice	33T UH51	*Rana dalmatina*
15/5/15	Cornelle, Amatrice	33T UH51	*Rana italica*
16/5/15	"F.te Crocetta", Accumoli	33T UH53	
27/6/16	Tino, Accumoli	33T UH53	*Rana italica*, *Pelophylax* sp.
27/6/16	"F.te i Trocchi", Accumoli	33T UH53	*Pelophylax* sp.

Table 3. Localities investigated in the Province of Rieti (Latium, Italy).

UTM square 33T VG08, is particularly relevant since represents the first data for the Province of L'Aquila. Our sighting in the locality of Poggio d'Api in the Province of Rieti, despite laying in the UTM UH63 formerly known for the species, constitutes the first report for the Latium Region. Our field survey in other zones of the Province of Rieti, lead us to assume that the species has colonized this area relatively recently, probably moving up the right side of the Tronto river's valley. Furthermore, it seems plausible that in future the species could possibly spreads in the area, given the absence of natural obstacles and the presence of environmental characteristics compatible with its ecological requirements. On the other hand, the documented sighting of Italian cave salamander for Monte Utero, if correct, combined with our negative result in the search of the species on the left side of the Tronto's valley, that anyway could have been caused by research limits, opens the door to a different way of colonization for this part of the Province of Rieti. On the basis of genetic findings, Ruggi (2007) considers reasonable that *H. italicus* has had a recent expansion from the Tosco-Emiliano Apennine south to Abruzzo. This scenario would explain the partial rarity of the species in the southern portion of its range, where it could be considered really threatened (Lanza et al., 2006). In fact already in the southern part of the Monti Sibillini, the species is reported in few localities despite the abundance of limestone substrates that provides suitable microhabitats (Fiacchini, 2013). The occurrence in the Monti della Laga area, at the boundary between Latium, Abruzzo and Marche regions, needs to be investigated more carefully in order to work out the availability and suitability of habitats, and to evaluate both natural and human threats.

Considering the rarity of *H. italicus* in the area of Monti della Laga, protection measures of the only locality where the species is present will be strongly required. In fact, it is well-known that an excessive frequentation of ravines, talwegs, caves and artificial cavities by the public, together with the alteration of the natural environment (e.g. wood cutting) could have a highly negative impact on salamanders both for microclimate variation in the refuge surrounding and for habitat damage (Fiacchini, 2008; Spilinga et al., 2008). Even though *H. italicus* has never been reported in Latium before this study, the species is listed as protected in the Regional Law No. 18/1988, and this makes conservation measures easier to apply.

Many of our recent new records refer to individuals found in epigean environment, where the detectability of the species is strictly influenced by meteorological conditions and quite lower than the one in caves. In order to improve the results during the investigations of *H. italicus* in new areas, we therefore underline the importance of focusing the research on the surface habitats during favourable weather conditions (e.g. wet nights or rainy days).

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The survey of macrophytes diversity in wetland zone of Boujagh National Park, Guilan, Iran

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ABSTRACT

The aim of this study was to identify the ecological species groups and investigate the diversity among them. The research area comprises a wetland system of Boujagh National Park, in Northern of Guilan Province, Iran. Vegetation sampling was carried out by 44 sample plots placed within the different zones in a stratified random manner. In each sampled plot, the cover percentage value of each species was estimated using Bran-Blanquet scales. Vegetation was classified using Two-Way Indicator Species Analysis (TWINSPAN). Classification of plots showed four vegetation groups: "*Ceratophyllum demersum-Nelumbo nucifera*, *Juncus acutus-Rubus sanctus*, *Mentha aquatica-Phragmites australis*, *Hydrocotyle vulgaris-Phragmites australis*". Plant diversity in these vegetation groups has been evaluated.The comparison of diversity indices among groups was performed with ANOVA test. Results of analysis of variance in species diversity indices showed significant differences among the groups in terms of some biodiversity indices. The survey of variation in the groups showed that group 3 had the highest value and group1 had the lowest in Fisher's diversity indices and Menhinink's and Margalef's richness indices, respectively. In Sheldon's evenness index group1 had the highest and group 2 had the lowest measure. Finally, the overall survey of indices showed that despite the high richness and diversity in groups 3 and 2, evenness of these groups was less than group 1 showing the lowest richness and diversity.

KEY WORDS Boujagh National Park; macrophytes; Caspian Sea; Iran.

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INTRODUCTION

Wetland macrophytes are defined as aquatic emergent, submergent or floating plants growing in or near water (USEPA, 1998). There are however some noted shortcomings of using macrophytes as biological indicators. These include the potential delay in response time for perennial vegetation, difficulty in identifying taxa to the species level in certain seasons and for some genera, different herbivory patterns and varied pest-management practices (Cronk & Fennessy, 2001). Despite these limitations, macrophytes have provided strong signals of anthropogenic influence (USEPA, 2003). Know-ledge of the plant communities enables us to forecast the likely changes in floristic composition after changes of site factors (Grevilliot & Muller, 2002). Description of patterns in species assemblages and diversity is an essential step before generating hypotheses in functional ecology (Jonsson & Moen, 1998).

Vegetation studies on Water and surrounding area in wetland habitats along the southern Caspian shore have been done by Asri & Aftekhari (2002), Riazi (1996), Ghahreman & Attar (2003), Shokri et al. (2004), Asri & Moradi (2006), Jalili et al. (2009), Zahed et al. (2013) and Naqinezhad & Hosseinzadeh (2014).

Boujagh National Park (BNP) is the first founded land-marine National Park and one of nineteen National Parks in Iran located in Caspian coastline (Naqinezhad et al., 2006). BNP is a very important ecosystem complex because of the fact that this area serves as a very valuable resting, nesting and wintering place for a wide variety of waterfowls particularly Siberian Crane, an endangered migratory bird (Naqinezhad, 2012). Some studies were conducted on the Flora and identification of species groups of this national park. The floristic study of this unique ecosystem was investigated for the first time by Naqinezhad et al. (2006). They identified 248 vascular plants and 10 bryophytes out of which six taxa are endemic for the flora of Iran. Naqinezhad (2012) recognized nine vegetation types in the area based with physiognomic-ecologic approach. This study was carried out to identify ecological species groups of the wetland zone of Boujagh National Park by phytosociological analysis of existing vegetation and inventory plant species diversity in this part of BNP.

MATERIAL AND METHODS

Study area

Boujagh National Park is located on the coast of Caspian Sea. This national park is located in Guilan Province, about 2 km away from north of Kiashahr city, and 35 km from northwest of Rasht city. It is 21 m below sea level and has an area of 3177 ha. Its geographical coordinates are 49°51′40″-49°59′50″E and 37°25′00″- 37°28′50″N. Boujagh and Kiashahr Lagoons are located within this national park (Reihanian et al., 2012; Naqinezhad, 2012).

Sampling methods

Vegetation surveys were conducted within the period 2013–2014. A total of 44 sample plots (2 m x 2 m) were placed within the different zones in a stratified random manner. In each sampled plot, the cover percentage value of each species was estimated using Braun-Blanquet scale (Braun-Blaunquet, 1964; Mueller-Dombois & Ellenberg, 1974).

Data analysis

Vegetation analysis method

The phytosociological data were collected during 2014–2015 using the cover-abundance scales. A divisive classification of 44 items was carried out, using the modified TWINSPAN embedded in a JUICE program (Tichý, 2002). Pseudospecies cut levels were set to seven and the values of cut levels to 1, 2, 3, 4, 5, 6, 7. Five items were selected as a minimum group size for division. The fidelity of species to clusters and diagnostic species for particular vegetation units were calculated with the help of presence/absence data using the phi-coefficient. Threshold value of phi = 0.25 was selected (Tichý & Chytrý, 2006).

Measuring plant diversity

To quantify the diversity of the plant species, The Shannon-Wiener diversity index (H'), Simpson diversity index (1-D), Fisher's alpha-a diversity index(a), Menhinink richness index (DMn), Margalef richness index (DMg) and Sheldon eveness index (Buzas & Gibson eveness index) (E3) were used (Kent & Cocker, 1992; Harper, 1999). The formulas are shown in Table 1.

Comparison of plant diversity

Normality of the data distribution was checked by Kolmogorov Smirnov test, and Levene's test was used to examine the equality of the variances. One-way analysis (ANOVA) of variance was used to compare groups with normal distribution data. Duncan test was used to test for significant differences in the species richness, diversity and evenness indices among the groups. This analysis was conducted using SPSS 16.0.

RESULTS

Modified TWINSPAN analysis was based on

44 plots from coastal area of Boujagh National Park. Four distinct groups of species were identified (Fig. 1).

Details of each group are as follows:

Group I (*Ceratophyllum demersum-Nelumbo nucifera*). This plant group shows13 plots situated in the middle of Boujagh and Kiashahr Lagoons, in the deepest areas. *Ceratophyllum demersum* L. and *Nelumbo nucifera* Gaertn. are dominant species. This group was seen in Boujagh Lagoon with *Nelumbo nucifera* Gaertn. but this species was not seen in Kiashahr Lagoon. Most important indicator species include *Myriophyllum spicatum* L., *Potamogeton crispus* L., *Potamogeton pectinatus*, *Potamogeton pusillus* L., *Stuckenia pectinata* (L.) Böerner, and *Zannichellia palustris* L.

Group II (*Juncus acutus-Rubus sanctus*). This group with 8 plots grows in wet marginal area of the lagoons where soil consists of sand and clay. This group includes a narrow strip on the eastern and western parts of Kiashahr Lagoon and northern and southern parts of Boujagh Lagoon. *Juncus acutus* L., *Rubus sanctus* Schreb., *Equisetum ramosissimum* Desf. and *Geraniumn molle* L. are diagnostic species.

Group III (*Mentha aquatica-Phragmites australis*). This group shows 6 plots situated in the marginal area of lagoons where soil is wet and swampy. *Phragmites australis* (Cav.) Trin. ex Steud. can be found in a narrow strip around the lagoons. It is an invasive-helophyte species and reduces frequency of hydrophyte in open water. Also *Mentha aquatica* L. is an indicator species that can be seen in the most wet area particularly East of Kiashahr Lagoon and South of Boujagh Lagoon.

Diversity index	Richness index	Eveness index
$H' = -\sum_{i=1}^{s} Pi \ln Pi = -\sum_{i=1}^{s} (Pi)(\log pi)$ $1 - D = \sum_{i=1}^{s} P_i^2 \quad Pi = \frac{ni}{N}$ $S = a^* \ln(1 + {}^{n}/_{a})$	$D_{Mg} = \frac{S-1}{LnN}$ $D_{Mn} = \frac{S}{\sqrt{n}}$	$E_3 = \frac{e^H}{S}$

Table 1. Richness, diversity and evenness indices used in this study. Pi = relative frequency of ith species, S = number of species(taxa), n is number of individuals, N = Total individual of species

Group IV (*Hydrocotyle vulgaris-Phragmites australis*). This group including 17 plots is situated in the wet marginal (northeastern and eastern) area of Kiashahr lagoon. This group makes a border between marginal and open water. *Hydrocotyle vulgaris* L., *Phragmites australis*, *Poa annua* L., and *Sambucus ebulus L.* are diagnostic species.

Species diversity among groups

First of all, based on Kolmogorov-Smirnov test it was confirmed that data were normally distributed. For analyzing the diversity among the groups, one-way Analysis of variance (ANOVA) was used. ANOVA results of diversity indices among groups and mean and standard error of diversity indices are listed in Table 2. ANOVA showed that there were significant differences among groups in terms of Sheldon's evenness index and Menhinink 's richness index ($P<0.05$).

Duncan's test of groups is showed in figures 2-5. Figure 2 shows the changes of Fisher diversity indices; group 3 and group 1 show the maximum and minimum values, respectively. No significant difference was observed between groups 2 and 4.

Figures 3 and 4 show the changes of Menhinink and Margalef's richness indices among ecological groups. Group 1 had the lowest value, whereas the highest value was showed by Group 3. These measurements indicated that there is not significant difference between groups 2 and 3 for both Menhinink and Margalef indexes.

Figure 5 shows the changes of sheldon's evenness index among ecological groups. The highest value of sheldon's evenness index was in group 1. While group 2 had the lowest value. Fort his index there was not significant difference between groups 3 and 4. Finally, the overall survey of indices showed that, despite the high richness and diversity in groups 3 and 2, evenness of these groups was lower than in group 1, which had the lowest richness and diversity.

DISCUSSION

This study, for the first time, introduced ecological species groups in wetland zone of Boujagh

Diversity index		F	P	Mean square	df	Mean and standard error
Diversity index	Shanon diversity index	0.828	0.48	0.188	3	1.440 ±0.071
	Simpson diversity index	0.210	0.88	0.006	3	0.677 ±0.024
	Fisher's diversity index	2.227	010	3.867	3	2.022 ±0.209
Richness index	Menhinink 's richness index	2.730	0.05*	0.265	3	0.644 ±0.049
	Margalef richness index	7.2.617	0.06	1.800	3	1.485 ±0.131
Evenness index	Sheldon's evenness index	3.856	0.01*	0.087	3	0.563 ±0.024

Table 2. ANOVA results of diversity indices among groups and mean and standard error of diversity indices.

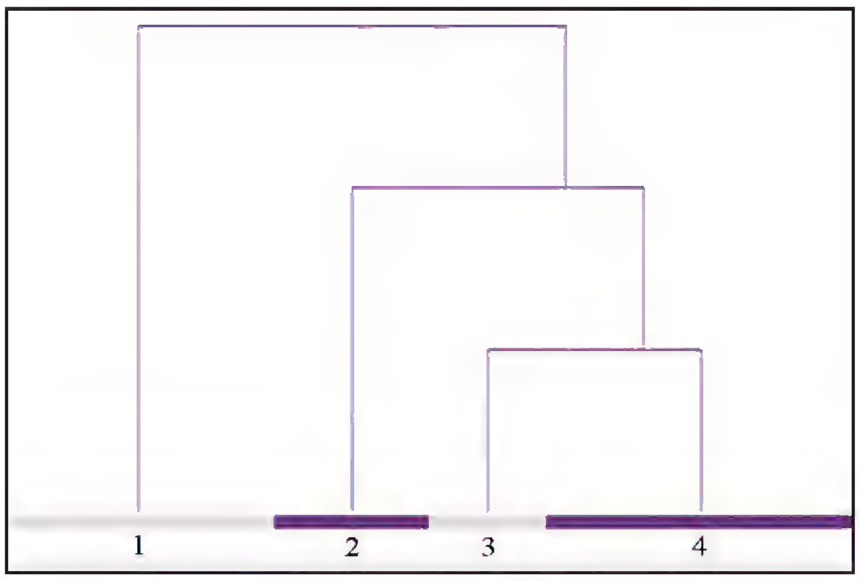

Figure 1. The cluster analysis to classify samples by Modified TWINSPANS.

National Park (BNP) assessed by floristic method and multivariate analysis. Modified TWINSPAN analysis identified four species groups.

The vegetation groups in the Caspian Sea coastal wetlands were analyzed by different methods such as physiognomic, Braun-Blanquet and multivariate methods which led to the identification of the following groups, communities and types: *Juncus*, *Rubus*, Sand dune, Halophyte, Hydrophyte (Shokri et al., 2004); *Juncus acutus* L., *Ruppia maritima* L., *Typha latifolia-Phragmites australis*, *Schoenoplectus litoralis* (Schrad.) Palla, *Nelumbium caspicum* Fisch. ex DC., *Ceratophyllum demersum-Myriophyllum spicatum* (Naqinezhad, 2012), *Potamogeton pectinatus*, *Ceratophylletum demersum-Azolla filiculoides*, *Nymphaea alba*, *Nelumbo nucifera* Gaertn., *Phragmites australis*, *Hydrocotyle ranunculoides* L.f., *Typha latifolia* L., *Cladium mariscus* (L.) Pohl., *Sparganium neglectum* Beeby, *Cyperus transitorius* Kük., *Paspalum distichum* L., *Cerastium dichotomum* L. (Asri & Moradi, 2006); *Lemno minoris-Azolletum filiculoidis*, *Lemno minoris-Spirodeletum polyrrhizae*, *Lemnetum minori-trisulcae*, *Salvinietum natantis*, *Hydrocharitetum morsus-ranae*, *Utricularietum australis*, *Trapo-Potametum crispi*, *Trapo-Potametum pectinati*, *Potametum pectinati*, *Ceratophylletum demersi*, *Hydrilletum verticillatae*, *Myriophylletum verticillati*, *Nelumbietum nucifei*, *Batrachietum trichophylli*, *Marsileo-Callirichetum brutiae*, *Potametum nodosi*, *Phragmitetum australis*, *Schoenoplectetum lacustris*, *Hydrocotyletum ranunculoidis*, *Iridetum pseudacori*, *Typhetum latifoliae*, *Sparganietum neglecti*, *Nasturietum officinalis*, *Paspaletum distichi*, *Rorippetum islandicae*, *Cyperetum serotini*, *Alismo-Sagittarietum sagittifoliae*, *Caricetum ripariae*, *Juncetum effusi*, *Cyperetum longi*, *Bidentetum cernuae*, *Bidento tripartitae-Polygonetum hydropiperis* (Asri & Eftekhari, 2002).

Comparing our research to other studies showed that groups of *Mentha aquatica-Phragmites australis* and *Hydrocotyle vulgaris-Phragmites australis* are new groups in wetland of southern Caspian Sea.

Naqinezhad et al. (2013) in survay of biomass in Babol wetlands (cosatal wetlands of southern Caspian Sea) mentioned that *Ceratophyllum demersum* and *Nelumbium nuciferum* can be rarely obseved together, mainly because they grow at different depths. The co-existence of the two species in the Boujagh wetland conflicts with the above results. In this case, the overlap of depth ranges of the two groups of floating (10–140 cm) and submerged plants (40–160 cm) (Jalili et al., 2009) justifies their co-existence in the same group.

ANOVA results indicated that group1 (*Ceratophyllum demersum-Nelumbo nucifera*) showed less diversity and richness but more evenness than others groups. The survey of geographical location of these groups showed group 1is located in a deep area, whereas other groups are on the sidelines or shallow area. Low diversity and richness of this group, compared to other groups, could be due to the reduction of the area of the deep section and the increase of the other areas (sidelines and shallow area); also euhydrophytic plants have less diversity than terrestrial and marginal ones because of more uniformity in aquatic ecosystems. In fact, as already reported (Seabloom et al., 1998), depth gradients can show floristic differences in wetlands.

Groups 2 and 3 had more diversity and richness than group 4. Evaluation of functional types of species in each of these groups showed groups 2 and 3 consist of emergent indicator species while groups 4 included emergent and floating species. In particular, marginal groups, i.e. those settled at lower depth, with low humidity and faraway from the center of the lagoon, showedmore richness and diversity.

Boujagh National Park is the first land-marine national park and one of 19 National Parks in Iran as well as the first one in Guilan Province. Habitat variation in the study area makes it possible to provide diversity of plant taxa as well as the development of ecologically specialized plant communities (Naqinezhad et al., 2006). On the other hand, this unique ecosystem does not show suitable environmental conditions. The main reasons for the destruction of this wetland ecosystem include: pollution of agricultural land, urban and rural settlements, agricultural land and industries, implementation of development projects and infrastructure such as roads, power transmission lines, port development of fisheries to Commercial port, creating fish ponds, illegal hunting, waste accumulation on the eastern part of the wetland, presence of non-native *Azolla* species, harvesting of wetland

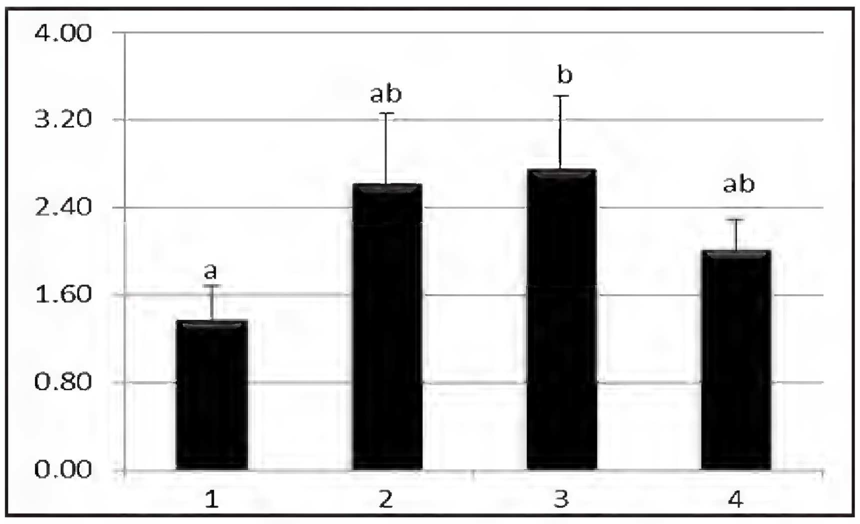

Figure 2. Changes in Fisher's diversity index among ecological groups.

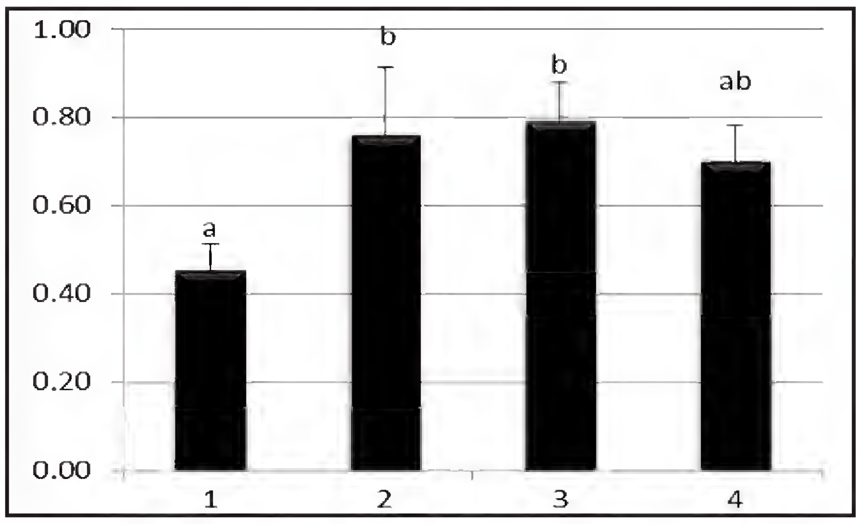

Figure 4. Changes in Margalef 's richness index among ecological groups.

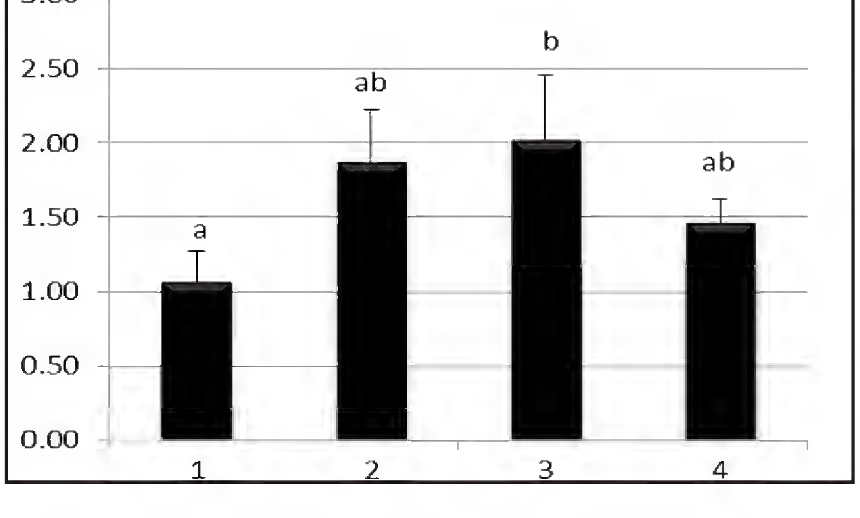

Figure 3. Changes in Menhinink 's richness index among ecological groups.

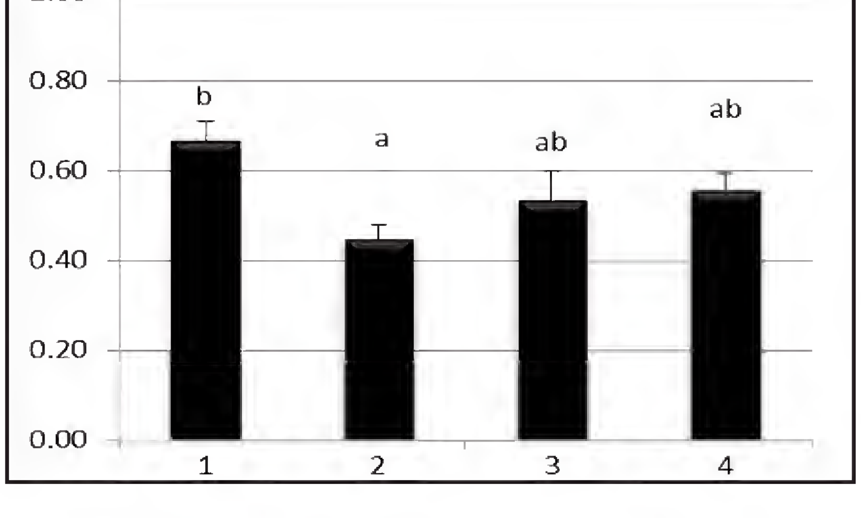

Figure 5. Changes in in sheldon's evennes index among ecological groups.

margins and widespread and uncontrolled presence of tourists. Comprehensive management plans within the framework of the ecosystem can be of some help inconservation and protection of species diversity in this park.

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Notes on the Avifauna in and around Devkhop lake of Palghar, India

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ABSTRACT In the present paper, the Authors show the results of their research carried out on birds of a peculiar and interesting natural habitat. The Devkhop Lake is located at the Palghar-Manor highway about 5 km away from Palghar city (India). It is a perennial lake and it is a very good site for the water birds including the migratory ones. It also provides a rich diet to birds. We have surveyed the avian fauna of this area from May 2015 to February 2016 and we recorded total 31 species of birds belonging to 8 orders and 20 families. Passeriformes and Ciconiiformes are the dominating orders in our observations which constituted 60% of total birds observed in this period. The families Corvidae, Anatidae, Ardeidae were found dominant with four, four and three species, respectively. In this paper qualitative enumeration of avifauna is discussed and a comparison is made with other studies on birds found in similar habitats.

KEY WORDS Avifaunal Diversity; Conservation; Devkhop Lake.

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INTRODUCTION

The Devkhop Lake is located at the Palghar-Manor highway about 5 km away from Palghar city. It is surrounded by deciduous forest and hillocks of Vaghoba tourist place. Vaghoba hill is the highest peak in this area. In the neighborhood there are two Adivashi padas namely Dasturi pada and Kathe Pada located at the northern and western side of the lake respectively. It is a good catchment area of rain water flowing from surrounding hillocks and the same is being utilized for irrigation, household things and fishing by local inhabitants. It is a perennial lake as government has constructed dam towards the downwards slope in the northern part of the lake which is helpful to keep water throughout the year.

Since water is available through the year and the lake is isolated from the thickly human population of Palghar city, it is a good adobe for residential and migratory birds (Fig. 1). Anon (2000) reported that the freshwater biodiversity is the most threatened of all types of diversity and wetlands are found to be the richest sites by holding major share of the existing avifauna. It is being suggested that the avifauna are important for the ecosystem as they play various roles as scavengers, pollinators and predators of insect pests (Padmavati et al., 2010). Surana et al. (2007) studied the birds of Chimdi lake of Nepal; Singh & Roy (1990) studied the ecology of birds of Kawar lake in Bihar.

During the last few decades considerable studies on avifauna diversity from different freshwater bodies of India have been carried out by researchers like, Osmatston (1922), Ali (1932), Kannon (1980), Mujumdar (1984), Davidar (1985), Newton et al. (1986), Jhingram (1988), Ghosal (1995), Rathore & Sharma (1999), Yardi et al. (2004), Kulkarni et al. (2005), Kumar (2006).

The primary purpose of this paper is to integrate the principles of ecology with the social and environment problems of society. Society still fails to understand her true position in the planet and knowledge of ecology has not yet taken hold to produce the kind of wisdom needed for our own survival. Therefore, there is need of hours for ecological knowledge to be greater than ever in this modern technological advance period. The present study is carried out to find out the avian diversity and to create the awareness for their conservation.

MATERIAL AND METHODS

Study area

This study was conducted in Palghar city of Maharashtra state which is situated between Geographic coordinates of Latitude: 19°41′48″ N Longitude: 72°45′55″ E. Elevation above sea level: 17 m = 55 ft. It is a town and a Municipal Council located about 87 kilometers north of Mumbai. Palghar lies on the Western Line of the Mumbai Suburban Railway on the busy Mumbai-Ahmadabad rail corridor. In addition to this, Tembhode Lake, Ganesh kund and other water bodies are also in the close proximity of the study area. Agriculture and fishing in this area are mainly dependent on monsoon rain. It is the administrative capital of the newly formed Palghar District.

Figure 1. The Devkhop Lake of Palghar, India.

Methods

The entire observations were conducted by rigorous field surveys all around the lake. Observations were recorded by using Nikon Action 10x50 binocular and relevant photographs were taken by Canon 700 D.

Birds were identified with the help of noting, standard methods given by Ali & Ripley (1969, 1995), Ali (1996, 2002), Grimmett et al. (1999).

RESULTS AND DISCUSSION

Birds are considered as useful biological indicators because they are ecologically versatile and live in all kinds of habitats as herbivores or carnivorous. They are susceptible to the change in wetlands or other ecosystems. Some birds are migratory, which are responsible for fluctuation in the population of birds that occurs during different seasons of the year, which may help to know whether an area is normal or getting polluted, as total absence of birds may be considered as pollution indicator (Borale et al.,1994). A total of 31 birds belonging to 8 orders and 20 families were recorded between May 2015 and February 2016 from Devkhop lake and its surrounding area (Table 1). This is the first record of avian biodiversity of Devkhop Lake in Palghar district of Maharashtra state in which the Lake exhibits qualitative variation in avifauna.

Order Passeriformes (14 species) was the most represented followed by Ciconiiformes (7), Anseriformes (4), Coraciformes (2), Charadriniiformes (2), Columbiformes (1), Apodiformes (1), and Gruiforme (1) (Fig. 2).

The families Anatidae and Ardeidae were found dominant with four and three species, respectively indicating the wetlands moderately support shorebirds. The other families were as follows: Muscicapidae (2), Motacillidae (2), Pycnonotidae (2)

ORDER	FAMILY	SCIENTIFIC NAME	COMMON NAME
PASSERIFORMES	MUSCICAPIDAE	*Saxicolodies fulicata* (Linnaeus, 1766)	Indian Robin
		Copsychus saularis (Linnaeus, 1758)	Magpie Robin
	MOTACILLIDAE	*Motacilla cinere cinere* (Tunstall, 1771)	Grey wagtail
		Motacilla flava (Swinhoe, 1863)	Yellow wagtail
	STURNIDAE	*Acridotheres tristis* (Linnaeus, 1766)	Common myna
	NECTARINIIDAE	*Nectarinia minima* (Sykes, 1832)	Smallsun bird
	HIRUNDINIDAE	*Hirundo daurica daurica* (Linnaeus, 1771)	Redrumped swallows
	PYCNONOTIDAE	*Pycnonotus cafer* (Linnaeus, 1766)	Red vented Bulbul
		Pycnonotus jocosus (Linnaeus, 1758)	Redwhiskered bulbul
	LANIIDAE	*Lanius excubitor* (Sykes, 1832)	Great grey shrike
	DICRURIDAE	*Dicrurus adsimilis* (Vieillot, 1817)	Black drongo
	CORVIDAE	*Corvus splendens* (Vieillot, 1817)	House crow
		Corvus macrorhynchos (Sykes, 1832)	Jungle crow
	PLOCEIDAE	*Passer domesticus indicus* (Jardine et Selby, 1835)	House sparrow
ANSERIFORMES	ANATIDAE	*Anas poecilorhyncha* (J.R. Forster, 1781)	Spot bill duck
		Anas crecca (Linnaeus ,1758)	Common teal
		Nettapus coromandelianus (Gmelin, 1789)	Cotton teal
		Anas clypeata (Linnaeus, 1758)	Shoveller
CICONIIFORMES	ARDEIDAE	*Ardeola grayii* (Skyes, 1832)	Pond heron
		Egretta garzetta (Linnaeus, 1766)	Little Egrets
		Bubulcus ibis (Boddaret, 1783)	Cattle Egrets
	PHALACROCORACIDAE	*Phalacrocorax niger* (Vieillot, 1817)	Little cormorant
		Phalacrocorax fuscicollis (Stephens, 1826)	Indian shag
	CICONIIDAE	*Anastomus oscitans* (Boddert, 1780)	Asian open bill stork
	THRESKIORNITHIDAE	*Pseudibis papillos* (Temminack, 1824)	Black ibis
CORACIFORMES	ALCEDINIDAE	*Halcyon smyrnensis* (Oberholser, 1915)	Whitebreasted Kingfisher
COLUMBIFORMES	COLUMBIDAE	*Streptopelia chinensis* (Gmelin, 1789)	Spotted dove
CHARADRINIIFORMES	JACANIDAE	*Hydrophasianus chirurgus* (Scopoli 1786)	Pheasant-tailed jacana
		Metopidius indicus (Latham, 1790)	Bronzewinged jacana
APODIFORMES	APODIDAE	*Cypsiurus parvus* (J.G.Gray,1829)	Palm swift
GRUIFORMES	RALLIDAE	*Fulica atra atra* (Linnaeus, 1758)	Common Coot

Table 1. Check list of birds which were observed in Devkhop Lake
from May 2015 to February 2016

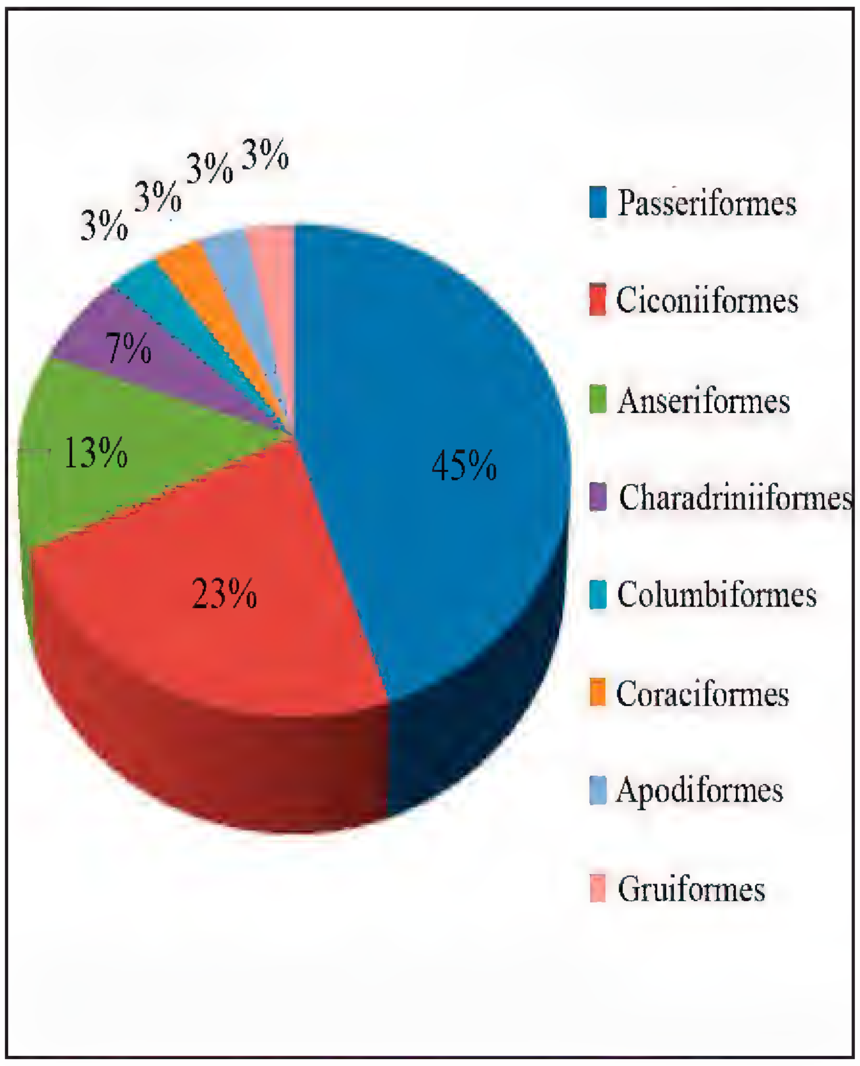

Figure 2. The Order wise distribution of avian fauna at Devkhop Lake of Palghar, India.

Corvidae (2), Phalacrocoracidae (2), Jacanidae (2), Sturnidae (1), Nectariniidae (1), Hirundinidae (1), Laniidae (1), Dicruridae (1), Ploceidae (1), Ciconiidae (1), Threskiornithidae (1), Alcedinidae (1), Columbidae (1), Apodidae (1), and Rallidae (1) (Fig. 3).

As far as the Authors know, a similar type of study was carried out by Vikas (2015), where 99 birds' species were recorded in Vansda National Park, Gujarat. Kurhade (1991) recorded 51 bird species in Ahmednagar district. Vyawahare (1991) listed 245 bird species in Dhule district of Maharashtra. Prashant et al. (1994) in their study of coastal area of Nellore district recorded 78 species of birds. Terdalkar et al. (2005) listed 45 species of birds belonging to 18 families around Bhatye estuary, Ratnagiri.

The present work is an attempt to establish the richness of the Devkhop Lake in respect of avian fauna as birds are excellent indicators of ecological health. From the above results it could be made out that the availability of water, safe habitat and food sources for both common and mi-

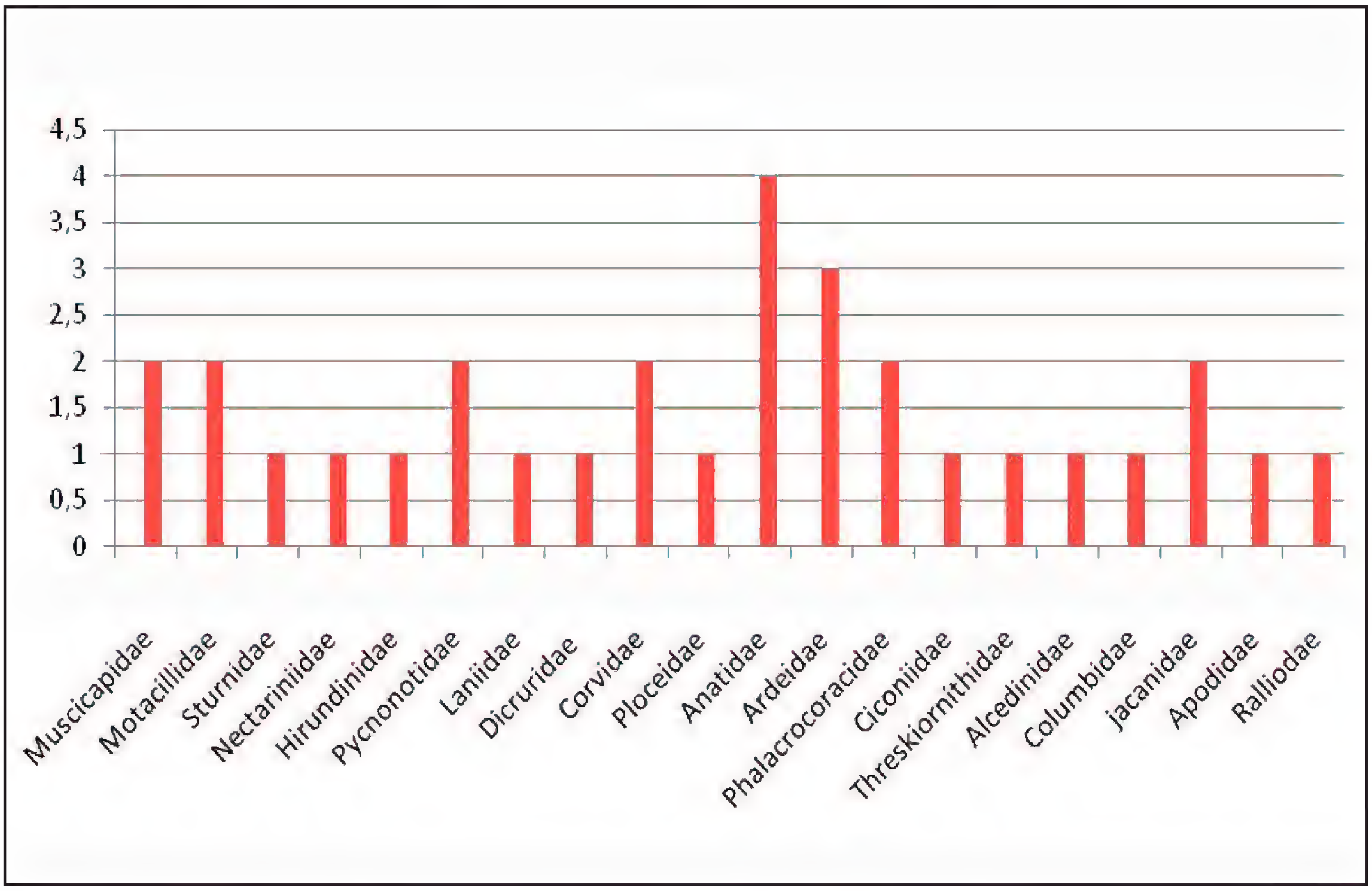

Figure 3. The family wise distribution of avian fauna at Devkhop Lake of Palghar, India.

gratory birds around the water bodies are important for the occurrence and abundance of avian population.

CONCLUSIONS

Around 31 species of birds belonging to 8 orders and 20 families were recorded in the study area. The proper and regular maintenance of district water bodies would further increase the avian diversity / population along with the incessant bird lovers' interest for this region.

During our study we also found that local inhabitants were collecting the eggs from the lake which is the cause of great concern for the richness of this ecosystem and in turn its conservation. Further intensive study of Devkhop lake is required to develop this place for avian conservation and tourists' pleasure.

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Two new Clausiliidae (Gastropoda Pulmonata) of Sicily (Italy)

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ABSTRACT In the present paper the Authors describe two new Clausiliidae (Gastropoda Pulmonata) of Sicily (Italy): *Muticaria cyclopica* n. sp. from SE-Sicily and *Siciliaria calcarae orlandoi* n. ssp. from W-Sicily. The two new species are described by virtue of their distinctive conchological and anatomical features. Additional biological and taxonomic notes are provided.

KEY WORDS Door snails; Clausiliidae; *Muticaria*; *Siciliaria*; new taxa; taxonomy; Sicily.

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INTRODUCTION

Muticaria Lindholm, 1925 and *Siciliaria* Vest, 1867 s. str. are xeroresistant and calcicolous mollusks, widespread, the first, in CE and SE-Sicily and Maltese Islands, the second in W-Sicily and Egadi Islands (Alzona, 1971; Beckmann, 1990, 1992; Cossignani & Cossignani, 1995; Giusti et al., 1995; Manganelli et al., 1995; Nordsieck, 2007, 2013; Liberto et al., 2010, 2015; Bank, 2011; Colomba et al., 2012. The strict connection between the geological nature (calcareous) of the soil they live in and the extremely scarce vagility of specimens results in island-like distributional patterns and contributes to high levels of endemism. Nordsieck (2007) listed 6 taxa of specific and subspecific ranks for *Muticaria* and 16 taxa for *Siciliaria* s. str. Recently, Colomba et al. (2012) described a new species of *Muticaria*.

The researches carried out in the last years on the Sicilian freshwater and land mollusks allow us to describe two new Clausiliidae (Gastropoda Pulmonata), *Muticaria cyclopica* n. sp. from SE-Sicily and *Siciliaria* (*Siciliaria*) *calcarae orlandoi* n. ssp. from W-Sicily.

ABBREVIATIONS AND ACRONYMS. AUPP = anterior upper palatal plica; BC = bursa copulatrix; BCD = diverticulum of bursa copulatrix; CD = copulatory duct; CL = columellar lamella; D = shell width; DBC = duct of the bursa copulatrix; DE = distal epiphallus; FO = free oviduct; G = penial papilla; GA = genital atrium; H = shell height; L = lunella; LPP = lower palatal plica (basal plica); P = penis; PD = diverticulum of penis; PE = proximal epiphallus; PL = parietal lamella; PLL = parallel lamella; PP = principal plica; PR = penial retractor muscle; PUPP = posterior upper palatal plica; SCL = subcolumellar lamella; SL = spiral lamella; SUL = sulcalis plica; SP = sutural plica; V = vagina; VD = vas deferens; ex/x = specimen/s, s.l. = sensu lato; s. str. = sensu stricto.

The materials used for this study are deposited in the following Museums and private collections:

A. Brancato collection, Syracuse, Italy (CB); S. Giglio collection, Cefalù, Italy (CG); Laboratory of Cytogenetics and Molecular Biology, University of Urbino, Italy (LCMBU); F. Liberto collection, Cefalù, Italy (CL); Museo Naturalistico F. Minà Palumbo, Castelbuono, Italy (MNMP); Museo Civico di Storia Naturale di Comiso (MSNC); Museo Civico di Storia Naturale di Genova "G. Doria", Italy (MSNG); Museo Regionale di Terrasini (MRT); A. Reitano collection, Tremestieri Etneo, Italy (CR); I. Sparacio collection, Palermo, Italy (CS); R. Viviano collection, Palermo, Italy (CV).

MATERIAL AND METHODS

All specimens were collected by sight on the soil and under the rocks. Observations on ecology of these organisms were made directly in the field. Dry shells have been studied as regard size, colour, morphology, sculpture, aperture, plicae and lamellae, lunella and clausilium. In order to study and illustrate genital organs, the specimens were drowned in water 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. Voucher specimens were stored in collections listed above. Toponyms (place-names) are reported following the Portale Cartografico Nazionale (PCN, http://www.pcn.minambiente.it /PCN/), Map IGM 1:25000. Each locality and/or collection site is in the original language (Italian).

All the specimens were studied by a Leica MZ 7.5 steromicroscope. The taxonomic order and nomenclatural arrangement follow Nordsieck (2007, 2013) and Bank (2011).

RESULTS

SYSTEMATICS

Phylum MOLLUSCA Cuvier, 1795
Classis GASTROPODA Cuvier, 1795
Ordo PULMONATA Cuvier in Blainville, 1814
Subordo STYLOMMATOPHORA A. Schmidt, 1855
Familia CLAUSILIIDAE J.E. Gray, 1855
Subfamilia ALOPIINAE A.J. Wagner, 1913
Tribus MEDORINII H. Nordsieck, 1997

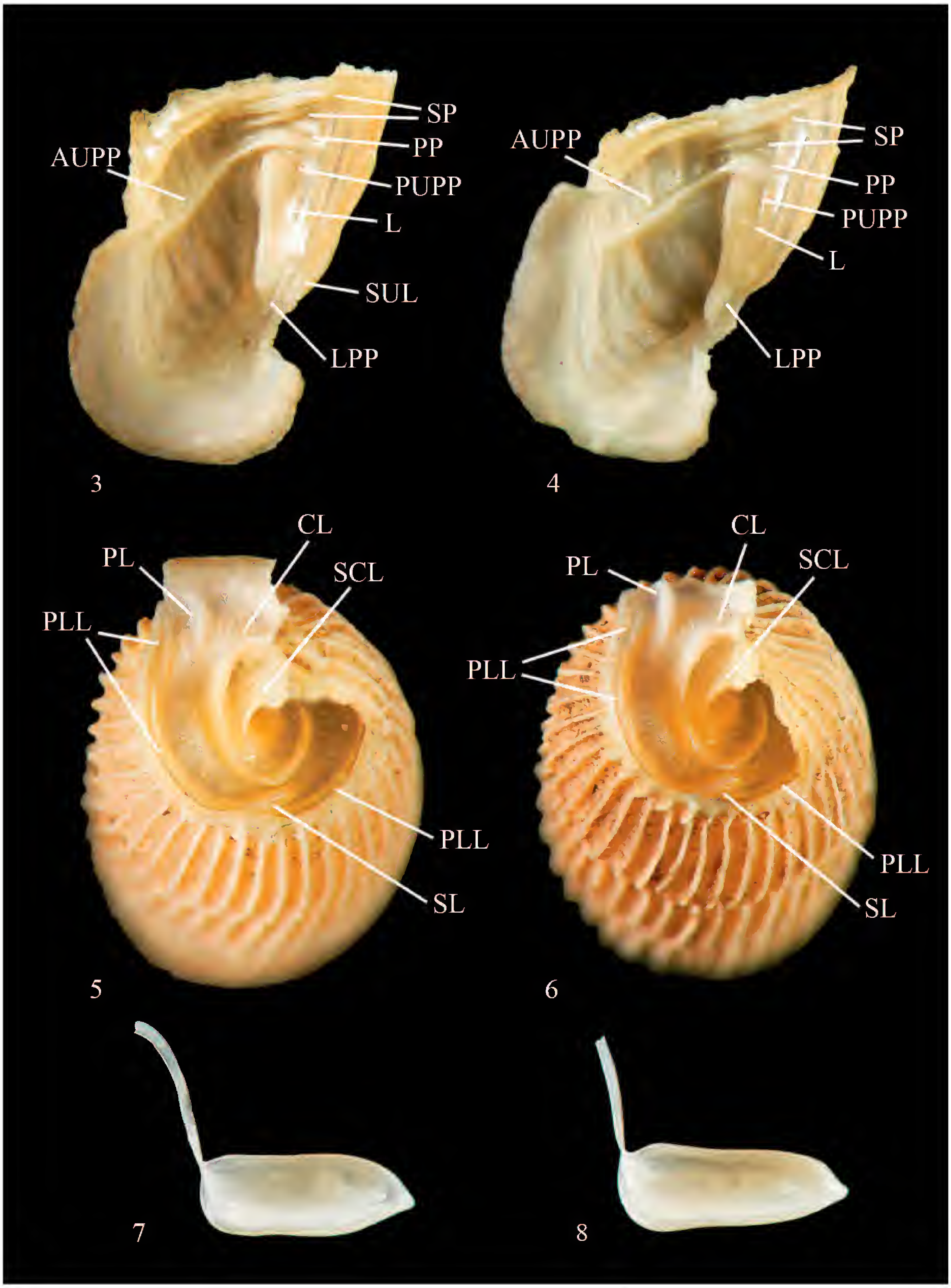
Genus *Muticaria* Lindholm, 1925
Type species: *Clausilia scalaris* L. Pfeiffer, 1850

Muticaria cyclopica n. sp. (Figs. 1–13)

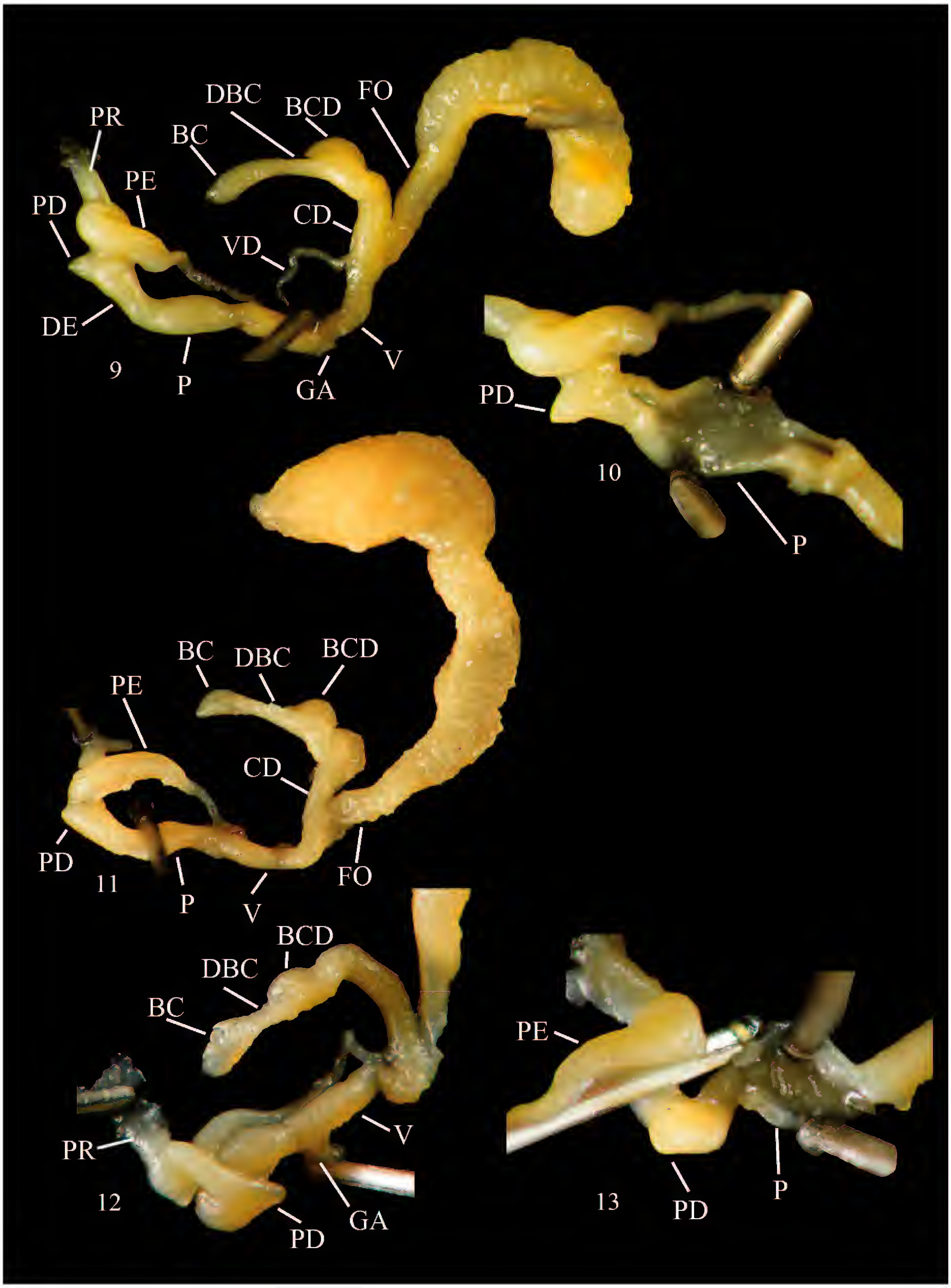
EXAMINED MATERIAL. Holotype: Italy, Sicily, Siracusa, Epipoli, 37°05'20"N, 15°13'49"E, 122 m, legit A. Reitano, 5.V.2015 (MSNC n. 4537). Paratypes: Siracusa, Epipoli, Castello di Eurialo, 37°05'20"N, 15°13'48"E, 112 m, legit A. Reitano and A. Brancato, 8.XI.2012, 5 exx (LCMBU); idem, 3 shells (MSNC n. 4537); idem, 49 shells (CL n. 16514–16562); idem, 8.XI.2012, legit A. Reitano, 38 exx (CR); idem, 2 exx (MSNG), idem, 2 exx (MNMP); idem, 37°05'20"N, 15°13'49"E, 122 m, legit A. Reitano, 5.V.2015, 6 exx, 13 shell (CL n. 16771–16789); idem, legit A. Reitano, 6.IV.2016, 8 exx (CL n. 16798-16805); idem, legit A. Reitano, 6.IV.2016, 28 exx (CS); idem, 37°05'20"N, 15°13'48"E, 112 m, legit A. Reitano, 6.IV.2016, 3 exx (MSNC n. 4538, 4539, 4540); idem, 8.VI.2016, 15 shells (CL n. 17293–177307).

DESCRIPTION OF HOLOTYPE. Shell sinistral, dimensions: height: 13.58 mm, maximum diameter: 4.2 mm, cylindrical-fusiform, decollate, rather robust, light yellowish-grey in colour; external surface with minute, raised, close ribs, 40 ribs on penultimate whorl; last whorl with robust and spaced ribs; spire slowly and regularly growing, with 4 whorls; last whorl tapering downwards, with elevated and curved cervical keel and lower basal keel; suture moderately deep; umbilicus closed; square aperture, with 5 lamellae (on parietum and columellar side) and lunella and 5 plicae (on palatum); on parietum, starting from suture, there are: very long parallel lamella, emerging in its anterior portion and well prolonged inside the shell in its posterior portion; short spiral lamella, deviating from centre of parietum to adhere to parallel lamella; (upper) parietal tooth-like lamella; on columellar side there are a low columellar lamella and an internal subcolumellar lamella; on palatum (Fig. 3) there is an evident and raised lunella and, starting from suture: two sutural plicae, the principal plica is robust in its posterior portion, whereas its anterior portion, fused to anterior upper palatal

Figure 1. Shell of *Muticaria cyclopica* n. sp., Italy, Sicily, Siracusa, Epipoli, H: 11.35 mm - D: 3.90 mm (MSNC n. 4537).
Figure 2. Idem, H: 13.95 mm - D: 4.40 mm (CL n. 16527).



Figures 3–8. *Muticaria cyclopica* n. sp., Siracusa, Epipoli: palatum, parietum, clausilium. Figure 3. Palatum of holotype (MSNC n. 4537). Figure 4. Palatum (CL n. 16514). Figures 5–6. Parietum of two specimens (CL n. 16522, 16523). Figures 7–8. Clausilium of two specimens (CL).



Figures 9–13. Genitalia of *Muticaria cyclopica* n. sp., Siracusa, Epipoli. Figure 9. Genitalia of holotype (MSNC n. 4537). Figure 10. Internal structure of penis, with penial papilla (same specimen of figure 9). Figure 11. Genitalia (CL n. 16772). Figure 12. Genitalia (CL n. 16798). Figure 13. Internal structure of penis, with penial papilla (same specimen of figure 12).

plica, is thinner and raised; rudimental posterior upper palatal plica fused to lunella apex; short basal plica fused to the base of lunella, small and curved sulcal plica; clausilium slender; plough-like basal plate, apically pointed, with subparallel columellar and palatal edges, and rounded sutural angle; peristome continuous, reflected, distinct from the wall of the last whorl.

Genitalia (Figs. 9, 10) are characterized by: short vagina (1.47 mm), very short free oviduct (0.4 mm), well developed ovispermiduct and a short copulatory duct (0.9 mm) ending in a branched bursa copulatrix complex: one branch consisting of a short and wide diverticulum of the bursa copulatrix (0.78 mm) and the other branch with very short bursa copulatrix duct and oval and elongated (1.52 mm) bursa copulatrix. Penial complex consisting of flagellum, epiphallus, penial diverticulum and penis; epiphallus (2 mm) divided, by point insertion of robust penial retractor muscle, into proximal and distal portions, the latter very short; very short and pointed penial diverticulum (0.55 mm) arising on border between distal epiphallus and penis; penis short (1.22 mm). Internal walls of penis without pleat.

VARIABILITY. Shell (10 specimens examined) (Figs. 1, 2, 4–8): dimensions in decollate specimens (4–5 whorls): height: 15.19–12.55 mm (on average: 13.59 mm); maximum diameter: 4.43–3.90 mm (on average: 4.21 mm). The number of ribs on 2 mm of the penultimate whorl ranges from 9 to 7 (on average, 7.7); parallel lamella from emerging to scarcely visible in frontal view of the aperture; spiral lamella adherent or fused to parallel lamella. Genitalia (5 specimens examined) (Figs. 11, 13): short to moderately long vagina (1.20–1.65 mm) and copulatory duct (0.9–1.65 mm); pointed to round penial diverticulum.

ETYMOLOGY. The specific epithet is derived from the English word cyclopic referring to the characteristic ancient Greek cyclopic walls of the type locality.

BIOLOGY AND DISTRIBUTION. Like the other *Muticaria* species, *M. cyclopica* n. sp. is xeroresistant and calcicolous and lives on limestone blocks of the ancient Greek walls of the type locality and under stones in stony soils.

The genus *Muticaria* is represented by about 7 taxa, most of which having a strictly limited distribution in C-E and S-E Sicily (Fig. 14) and Maltese Islands. *M. syracusana* (Philippi, 1836) is confined to a few coastal locality of Syracuse province (locus typicus Syracuse: Philippi, 1836), *M. neuteboomi* Beckmann, 1990 (locus typicus Cava d'Ispica, Modica, Raguse province: Beckmann, 1990) occurs throughout the greater part of the S-E Sicily, *M. brancatoi* Colomba, Gregorini, Liberto, Reitano, Giglio et Sparacio, 2012 has a restricted distribution to South of Syracuse, and *M. cyclopica* n. sp., at moment, is known only for the description locality: Epipoli, a hill about 150 m high, very close to the modern city of Syracuse (20–60 m). *Muticaria macrostoma* (Cantraine, 1835) is endemic to the Maltese Islands where it occurs with four subspecies: *M. macrostoma macrostoma*, *M. macrostoma scalaris* (L. Pfeiffer, 1850), *M. macrostoma oscitans* (Charpentier, 1852) and *M. macrostoma mamotica* (Gulia, 1861).

COMPARATIVE NOTES. *Muticaria cyclopica* n. sp. is morphologically closer to *M. brancatoi* n. sp. than other *Muticaria* species (see Colomba et al., 2012); for the morphology of other *Muticaria* species see Giusti et al. (1995) and Colomba et al. (2010).

However, *M. cyclopica* n. sp. has a rudimental posterior upper palatal plica (absent in *M. brancatoi*), a more raised anterior portion of principal plica (fused to anterior upper palatal plica), a longer and often emerging parallel lamella; the genitalia have a smaller penial diverticulum and the internal walls of penis without pleats (present in *M. brancatoi*).

Muticaria cyclopica n. sp. is similar to *M. syracusana* in morphology of shell but it is distinct for the longer and often emerging parallel lamella, the thinner anterior portion of principal plica (fused to anterior upper palatal plica), the rudimental posterior upper palatal plica (more developed in *M. syracusana*); genitalia have a smaller penial diverticulum and shorter copulatory duct.

Muticaria cyclopica n. sp. is well distinct also from *M. neuteboomi* and *M. macrostoma macrostoma* for the anterior portion of principal plica fused to anterior upper palatal plica (indipendent in *M. neuteboomi* and *M. macrostoma* spp.) and for longer parallel lamella which adheres to spiral lamella (indipendent in *M. neuteboomi*, *M. macrostoma macrostoma*, *M. macrostoma oscitans* and *M. macrostoma scalaris*).

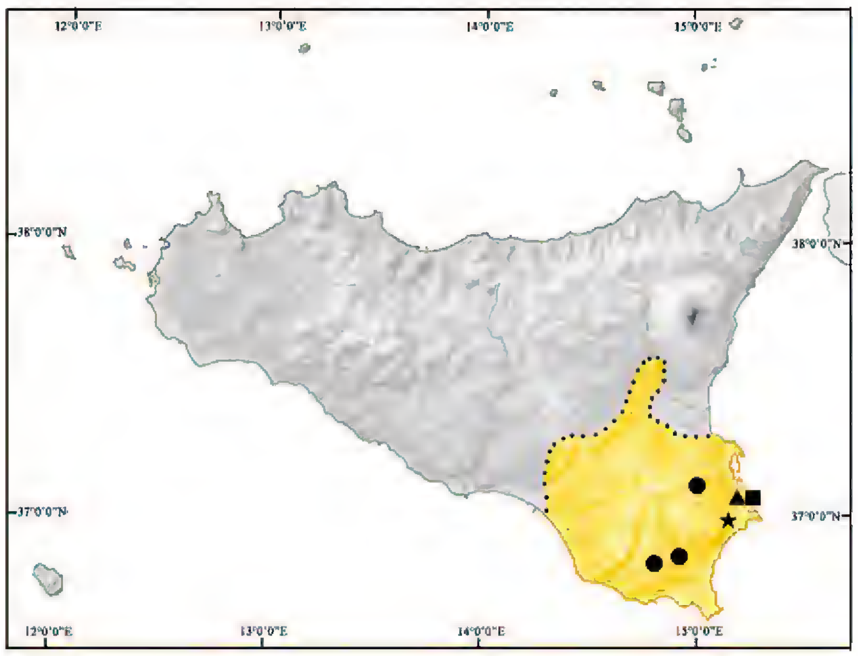


Figure 14. Geographic distribution of genus *Muticaria* in CE and SE Sicily (in yellow) with *M. cyclopica* n. sp. (triangle), *M. brancatoi* (star), *M. syracusana* (square) and *M. neuteboomi* (dots).

Genitalia with very short penial diverticulum, longer in *M. neuteboomi* and *M. macrostoma macrostoma*, *M. macrostoma scalaris* and *M. macrostoma oscitans*. Only *M. macrostoma mamotica* has a penial diverticulm similar to that of *M. cyclopica* n. sp.; however, *M. macrostoma mamotica* has genitalia with a pleat on the internal wall of the penis (not present in *M. cyclopica* n. sp.) and a ventricose shell (fusiform in *M. cyclopica* n. sp.) with shorter parallel lamella and anterior portion of principal plica distinct from anterior palatal plica (fused in *M. cyclopica* n. sp.).

Preliminary molecular studies (Gregorini et al., 2008; Colomba et al., 2010; 2012) showed the existence of significant genetic differences between populations attributed either to *M. syracusana*, *M. neuteboomi* or *M. brancatoi*, including the topotypic ones. Moreover, further and more complete molecular data (personal unpublished data), confirmed these preliminary results; furthermore, by comparing cytochrome oxydase I (COI) partial sequences, specimens of *M. cyclopica* n. sp. turn out to be genetically distant from all other Sicilian and Maltese *Muticaria* populations.

Tribus Delimini R. Brandt, 1956
Genus *Siciliaria* Vest, 1867
Subgenus *Siciliaria* Vest, 1867
Type species: *Clausilia grohmanniana* Rössmassler, 1836

Siciliaria (Siciliaria) calcarae orlandoi n. ssp. (Figs. 15–30)

EXAMINED MATERIAL. Holotype: Italy, Sicily, Corleone, Rocca Busambra, Ficuzza, 27.IX.1981, legit V.E. Orlando (MRT, n. 31040 Orlando collection, written in the box and in the register: *Siciliaria calcarai* n. subsp., det. H. Nordsieck); Paratypes: same data of holotype, 4 exx (MRT, n. 31041/4 Orlando collection); Corleone, Bosco Ficuzza, 25.IV.1971, legit V.E. Orlando, 2 exx (MRT, n. 4903/4 Orlando collection); Monreale, Ficuzza, Val di Conti, 23.III.1981, 2 exx (CS); idem, legit I. Sparacio, 8 exx (CL n. 17276–17283); Monreale, Diga Scanzano, 31.XII.1989, 5 exx (CS); Monreale, Bosco del Cappelliere, 2.I.1991, 21 exx (CS); idem, 28.XI.1993, 8 exx (CS); Godrano, Rocca Busambra, Alpe Cucco, 21.II.2010, 5 exx (CS); Monreale, Bosco Ficuzza, Ponte Arcera, 37°55'42" N; 13°23'01" E; 27.IX.2009; 9 exx, (CL n. 5508–5516); Monreale, Bosco del Cappelliere, Cozzo San Leopoldo, 37°54'53"N, 13°22'57"E, 616 m, 2.IV.2016, 4 shells (CV); idem, 3 exx, legit R. Viviano (CL n. 16446–16448).

OTHER EXAMINED MATERIAL. *Siciliaria calcarae calcarae* (Philippi, 1844). Italy, Sicily, Palermo, San Ciro, 31.X.1986, 7 exx (CS); idem, 38°05'11"N, 13°23'07"E, 190 m, legit Sparacio I., 28.XI.2015, 2 exx (CL n. 16807–16829); Bagheria, Monte Catalfano, 30.VI.2006, 28 exx (CS); Palermo, base Monte Grifone, Cimitero Santa Maria di Gesù, 24.VIII.2014, 11 ex (CS); Favignana Island, Grotta delle Uccerie, 37°57'04"N, 12°18'18"E; 30 m, 11.IX.2010, 17 exx, 14 shells, (CL n. 8414–8444); Calatafimi, Le Rocche, 37°54'14"N, 12°48'14"E, 493 m, 20.XI.2011, 6 exx, 15 shells (CL n. 10763–10783); Scopello, Torre Bennistra, 07.XII.2016, 3 exx (CR); Erice, Monte Castellazzo, 20.VI.2002, 26 exx (CR); Castellammare del Golfo, Monte Inici, VI.1996, 5 exx (CR).

Siciliaria (*S.*) *calcarae belliemi* (Brandt, 1961). Italy, Sicily, Partinico, Monte Belliemi, 1.III.2015, 28 exx (CS); idem, 8.V.2016, 34 exx (CS); idem 9 shells (CL n. 17284–17292).

Siciliaria (*S.*) *ferrox* (Brandt, 1961). Italy, Sicily, Trabia, Torre Sant'Onofrio, 143 m, 25.VIII.2007, 30 shell (CL n. 2331–2360); Altavilla Milicia, Grotta Mazzamuto, 15.X.2015, 25 exx (CS).

DESCRIPTION OF HOLOTYPE. Dimensions: height 19 mm; maximum diameter 4.8 mm. Shell elongated, fusiform, sinistral, not decollate, obtuse apex, robust, brown in colour (Figs. 15, 16); external surface with very minute and just raised ribs equally arranged in all whorl sof teleoconch; 92 ribs on penultimate whorl. Spire slowly and regularly growing, with 11 whorls little convex; basal and cervical keels little distinct; umbilicus closed; suture shallow with papillae scattered and slightly evident (more numerous from third to seventh whorl); aperture about ¼ of shell height, subovoidal, with 4 lamellae on parietum and columellar side, lunella, and 4 plicae on palatum. On palatum there is an evident lateral lunella, starting from suture there are a long and raised principal plica not fused to lunella apex and slightly wider in its posterior portion, a short posterior portion of upper palatal plica fused to lunella apex and an obsolete upper palatal plica represented only by a short, large callosity little in relief, a medium long basal plica, the internal first part of which is joined to the base of lunella; a short sulcalis. On parietum and columellar side there are: non emergent and well raised spiral lamella in centre of parietum; tooth-like (upper) parietal lamella, moderately high (inferior) columellar lamella, non emergent subcolumellar lamella. Peristome continous, slightly thickened, reflected, superiorly attached to the wall of last whorl.

VARIABILITY. Dimensions of paratypes (not decollate) (Fig. 17): height: 18–22 mm; maximum diameter: 4.2–4.8 mm; ribs on the penultimate whorl of the shell ranges from 88 to 95 mm, but some ribs are incomplete or obsolete; sometimes a very little sutural plica is present; the upper palatal plica can be very small or absent (Figs. 18, 19). Parietum as in figure 20. Clausilium (Figs. 21–22) with elongate plough-like basal plate, sutural angle slightly bent up, palatal and columellar edges of plate nearly parallel; outer corner more or less pointed.

Genitalia (5 specimens examined) (Figs. 23–28) are characterized by: slender and thin free oviduct, well developed ovispermiduct; bursa copulatrix complex consist of slender copulatory (3.45–2.8 mm) duct ending in two branches: one branch consisting of a long diverticulum of the bursa copulatrix (5.2 mm), second branch consisting of very short bursa copulatrix duct with cylindrical bursa copulatrix; vagina short (1.8–2.5 mm) and uniform in diameter; vas deferent long and slender, entering the epiphallus; epiphallus (2.6–3.2 mm) divided by point insertion of robust penial retractor muscle into cylindrical-conic proximal portion and shorter distal portion slightly enlarged before entering in the penis. Penis short (1.6–2.2 mm), wider than epiphallus; internal walls of penis show two weak longitudinal furrows; conic penial papilla, with slightly pointed apex and a restriction to the base.

Body. Animal long, narrow, posteriorly pointed, blackish with a dorsal, narrow and whitish band; skin tubercle ovale-elongated; upper tentacles rather short, cylindro-conical, whitish, apically widened with small black eyes; pneumostome and genital opening on left side; foot long, narrow, with sole paler than body.

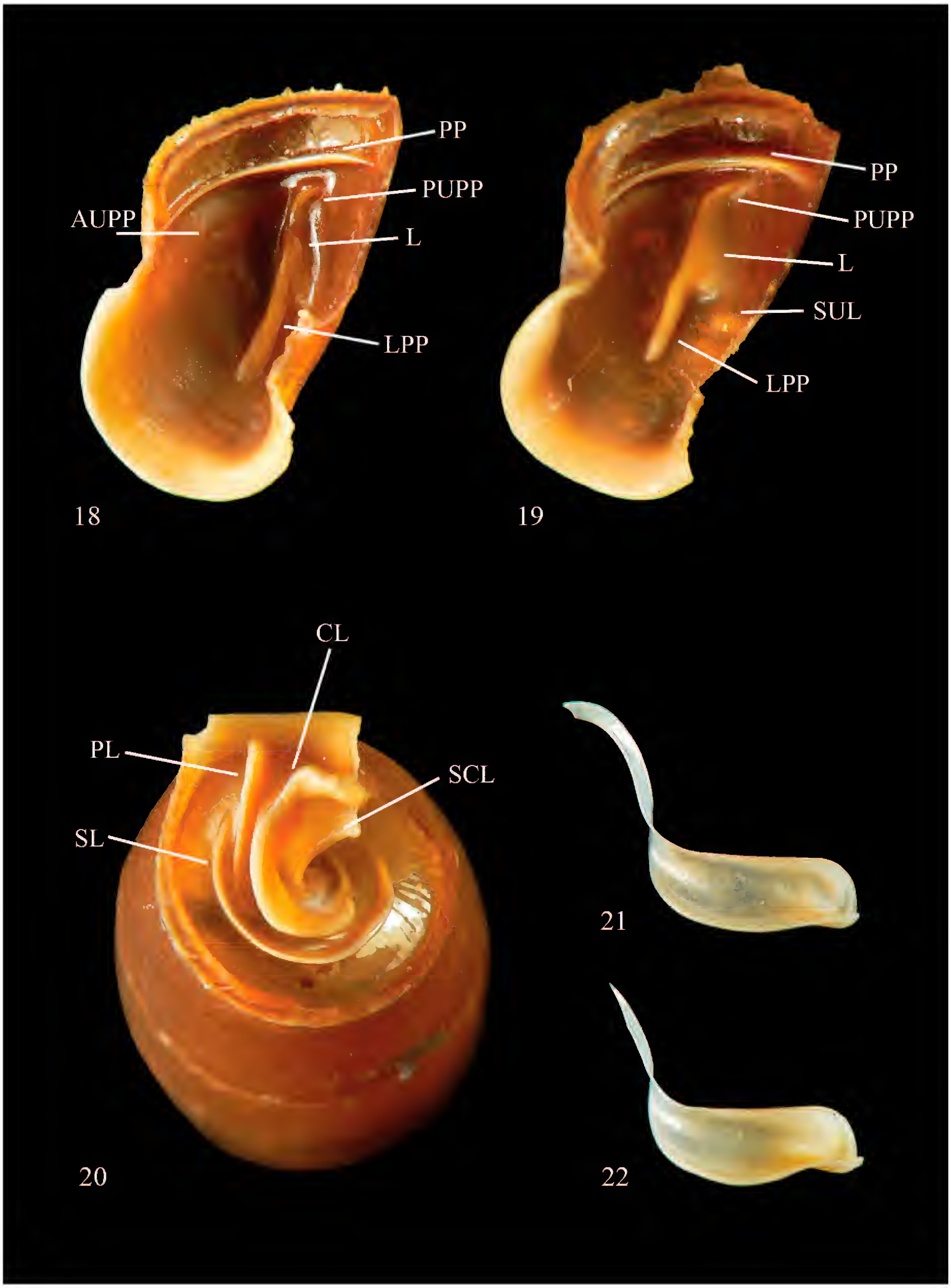
BIOLOGY AND DISTRIBUTION. *Siciliaria calcarae orlandoi* n. ssp. lives under the bark of dead trees and in the leaf litter of woods vegetating both in sandstone (Bosco del Cappelliere, Diga Scanzano) and calcareous (Alpe Cucco, Rocca Busambra) soils (Figs. 29, 30); in these two last localities *S. calcarae orlandoi* n. ssp. is found also on calcareous rocks into the woods. This new subspecies is known for the "Nature Reserve Bosco della Ficuzza, Rocca della Busambra, Bosco del Cappelliere e Gorgo del Drago" an area wich is included in the Sicani Mountains Regional Natural Park since 2013.

Siciliaria calcarae s.l. lives on calcareous rocks, in cavities and under stones on calcareous soils. It is described from Palermo and is widespread in Western Sicily and the Egadi Islands (see Beckmann, 2004) (Figs. 31, 32, 56).

ETYMOLOGY. The new subspecies is dedicated to Vittorio Emanuele Orlando (1928–2014, Terrasini, Italy), who identified this taxon, to his passion for molluscan studies and his museum activity in Sicily.

COMPARATIVE NOTES. *Siciliaria calcarae orlandoi* n. ssp. is distinct from *S. calcarae calcarae* (Figs. 31, 35, 37–41, 45–55) for the reduced anterior upper palatal plica (longer and raised in *S. calcarae calcarae* who as, rarely, also a small second upper palatal plica), reduced or absent sutural plica (present in *S. calcarae calcarae*), moderately high columellar lamella (low in *S. calcarae calcarae*), the clausilium with sutural angle slightly bent up, thus palatal and columellar edges of plate are nearly parallel (sutural angle much bent up in *S. calcarae calcarae*).

Figure 15. Holotype of *Siciliaria* (*S.*) *calcarae orlandoi* n. ssp., Italy, Sicily, Corleone, Bosco Ficuzza, h: 19 mm, D: 4.8 mm (V.E. Orlando coll., MRT). Figure 16. Label of holotype of *S. calcarae orlandoi* n. ssp. (V.E. Orlando coll., MRT). Figure17. Shell of *S. calcarae orlandoi* n. ssp., Monreale, Bosco Ficuzza, Ponte Arciera, H: 18.65 mm, D: 4.5 mm (CL n. 5512).



Figures 18–22. *Siciliaria* (*S.*) *calcarae orlandoi* n. ssp., palatum, parietum and clausilium. Figures 18, 19. Palatum: Monreale, Bosco Ficuzza, Ponte Arciera (CL n. 5509–5511). Figure 20. Parietum: Corleone, Val di Conti (CL n. 17276). Figures 21, 22. Clausilium: Monreale, Bosco Ficuzza, Ponte Arciera (CL).

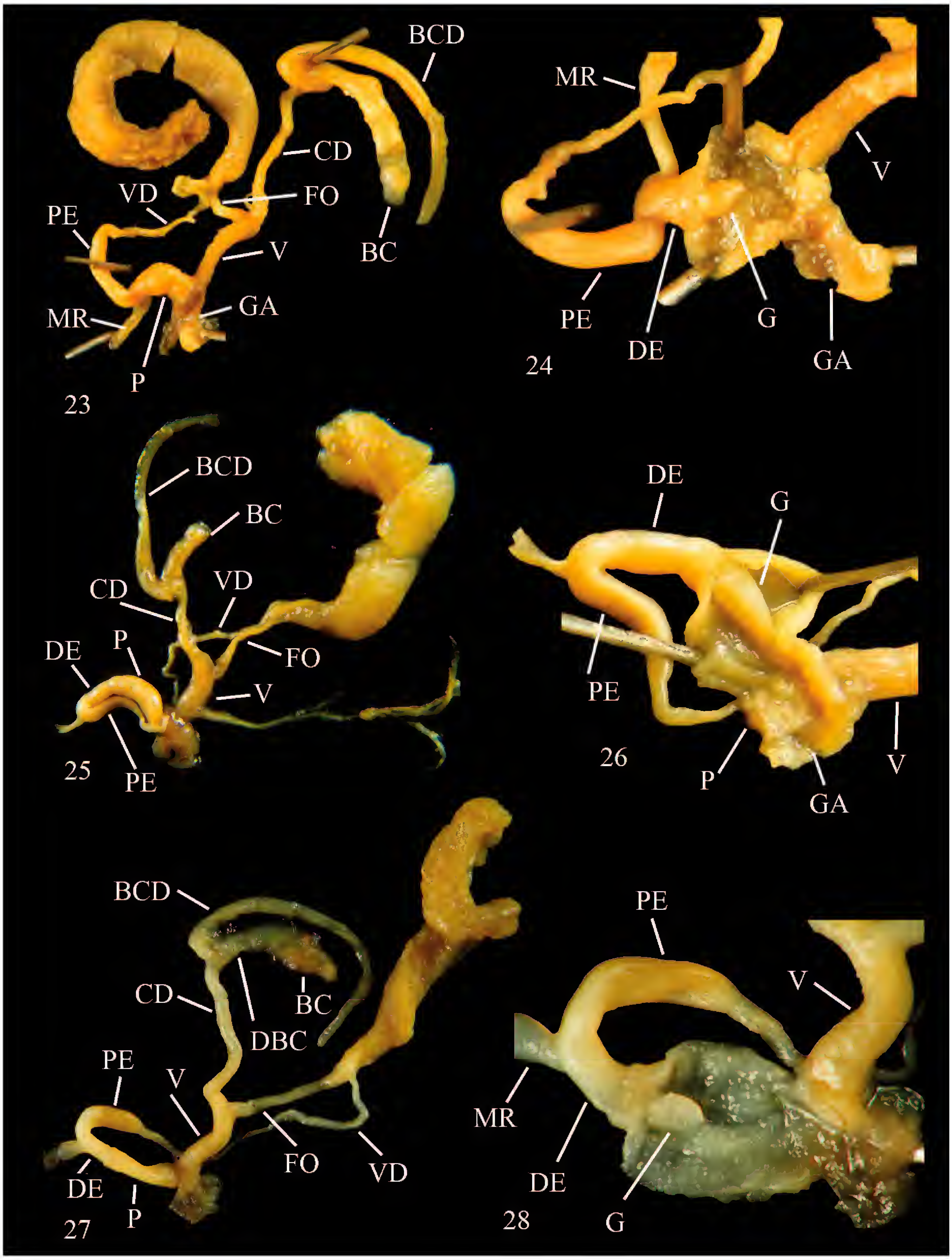


Figure 23–28. Genitalia of *Siciliaria* (*S.*) *calcarae orlandoi* n. ssp. Figure 23. Monreale, Bosco Ficuzza, Ponte Arciera (CL n. 5511). Figure 24. Idem, internal structure of penis, with penial papilla. Figure 25. Monreale, Bosco Ficuzza, Ponte Arciera (CL n. 5508). Figure 26. Idem, internal structure of penis, with penial papilla. Figure 27. Monreale, Bosco del Cappelliere, Cozzo San Leopoldo (CL n. 16448). Figure 28. Idem, internal structure of penis, with penial papilla.

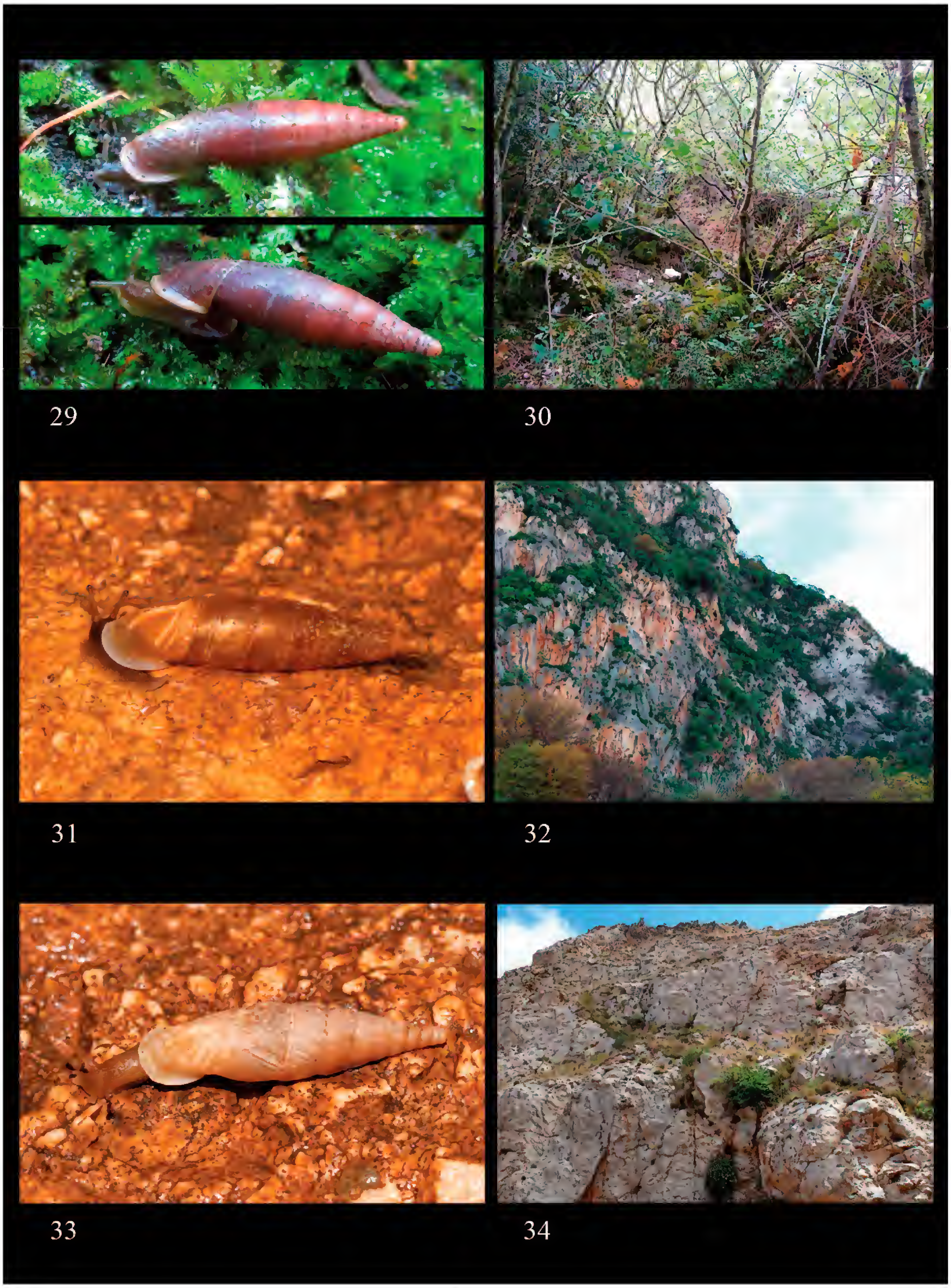


Figure 29. *Siciliaria* (*S.*) *calcarae orlandoi* n. ssp. in natural habitat. Figure 30. Landscape of Bosco Ficuzza, Monreale. Figure 31. *Siciliaria* (*S.*) *calcarae calcarae* in natural habitat. Figure 32. Landscape of San Ciro, Monte Grifone, Palermo. Figure 33. *Siciliaria* (*S.*) *calcarae belliemi* in natural habitat. Figure 34. Landscape of Monte Belliemi, Partinico.

Figure 35. *Siciliaria* (*S.*) *calcarae calcarae*, San Ciro, Monte Grifone, Palermo, H: 19.9 mm, D: 4.7 mm (CL n. 16816).
Figure 36. *Siciliaria* (*S.*) *calcarae belliemi*, Monte Belliemi, Partinico, H: 17.35 mm, D: 4.15 mm (CL n. 17284).

Figure 37. *Siciliaria* (*S.*) *calcarae calcarae*, Le Rocche, Calatafimi H: 20.5 mm, D: 4.65 mm (CL n. 10769).
Figure 38. *Siciliaria* (*S.*) *calcarae calcarae*, Grotta dell'Uccerie, Favignana, H: 18.5 mm, D: 4.1 mm (CL n.8431).

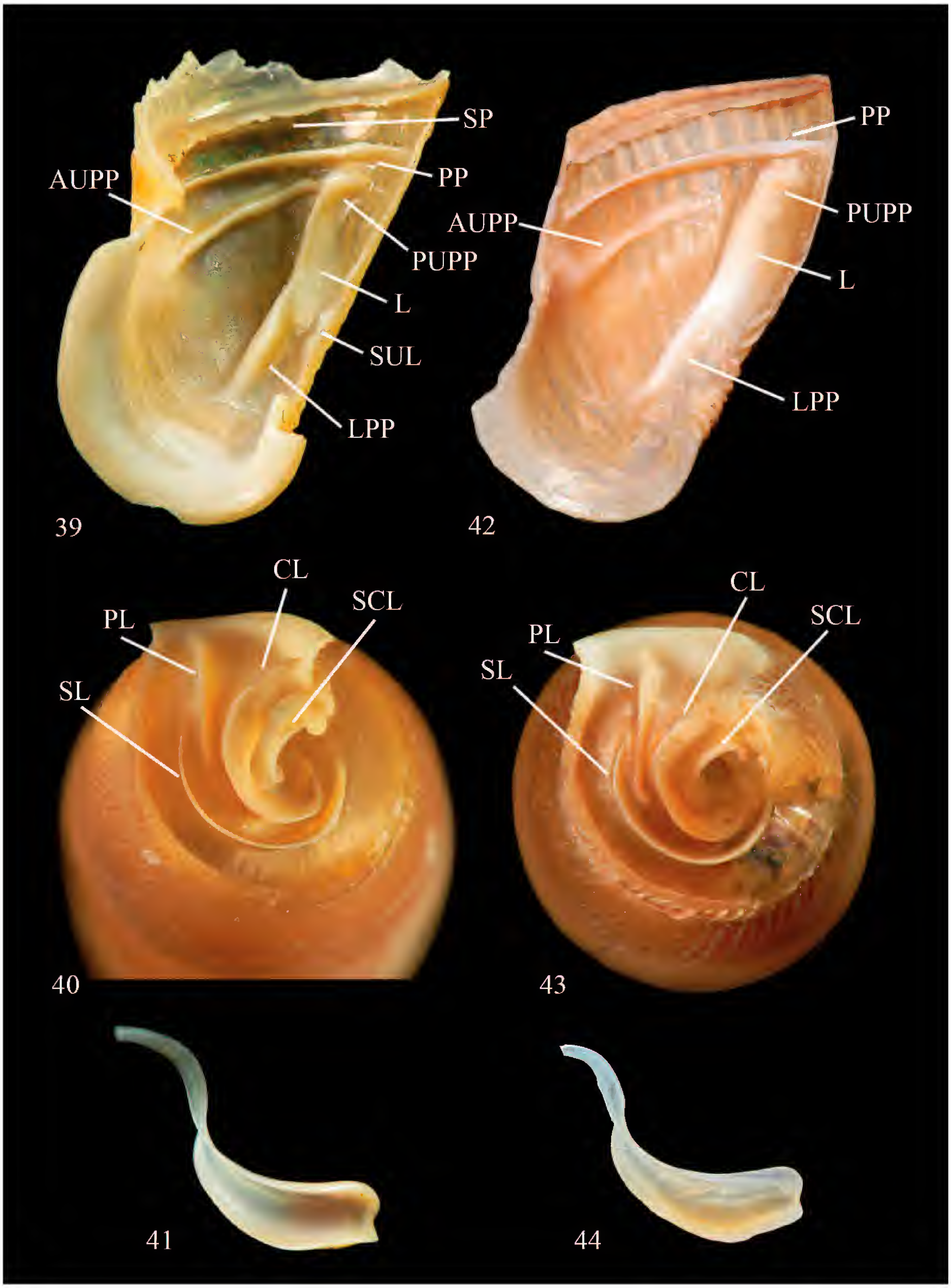


Figure 39. *Siciliaria* (*S.*) *calcarae calcarae*, San Ciro, Monte Grifone, Palermo: palatum (CL n. 16819). Figure 40. Idem, parietum (CL n. 16820). Figure 41. Idem, clausilium (CL). Figure 42. *Siciliaria* (*S.*) *calcarae belliemi*, Monte Belliemi, Partinico: palatum (CS). Figure 43. Idem, parietum (CL n. 17286). Figure 44. Idem, clausilium (CL).

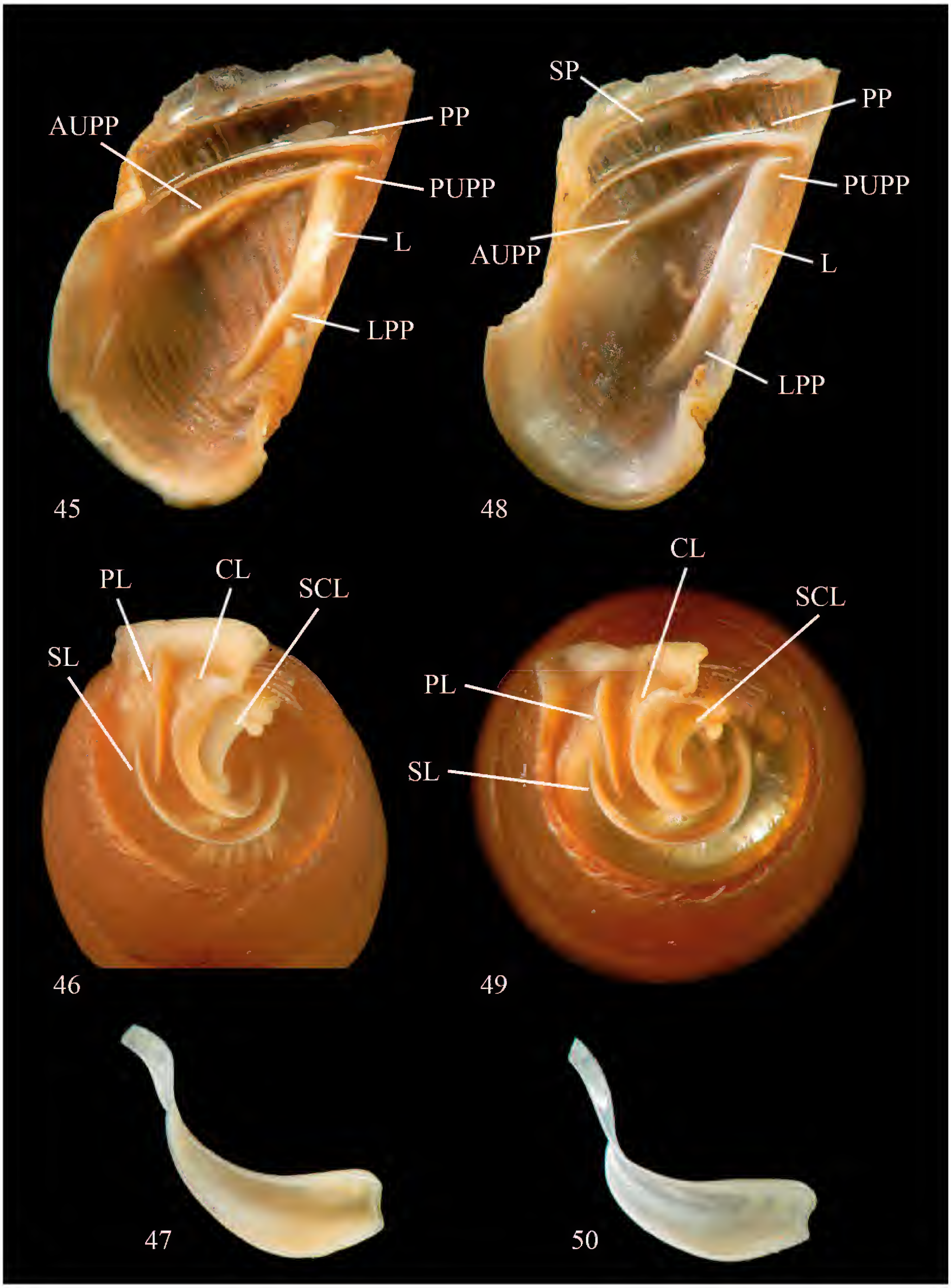
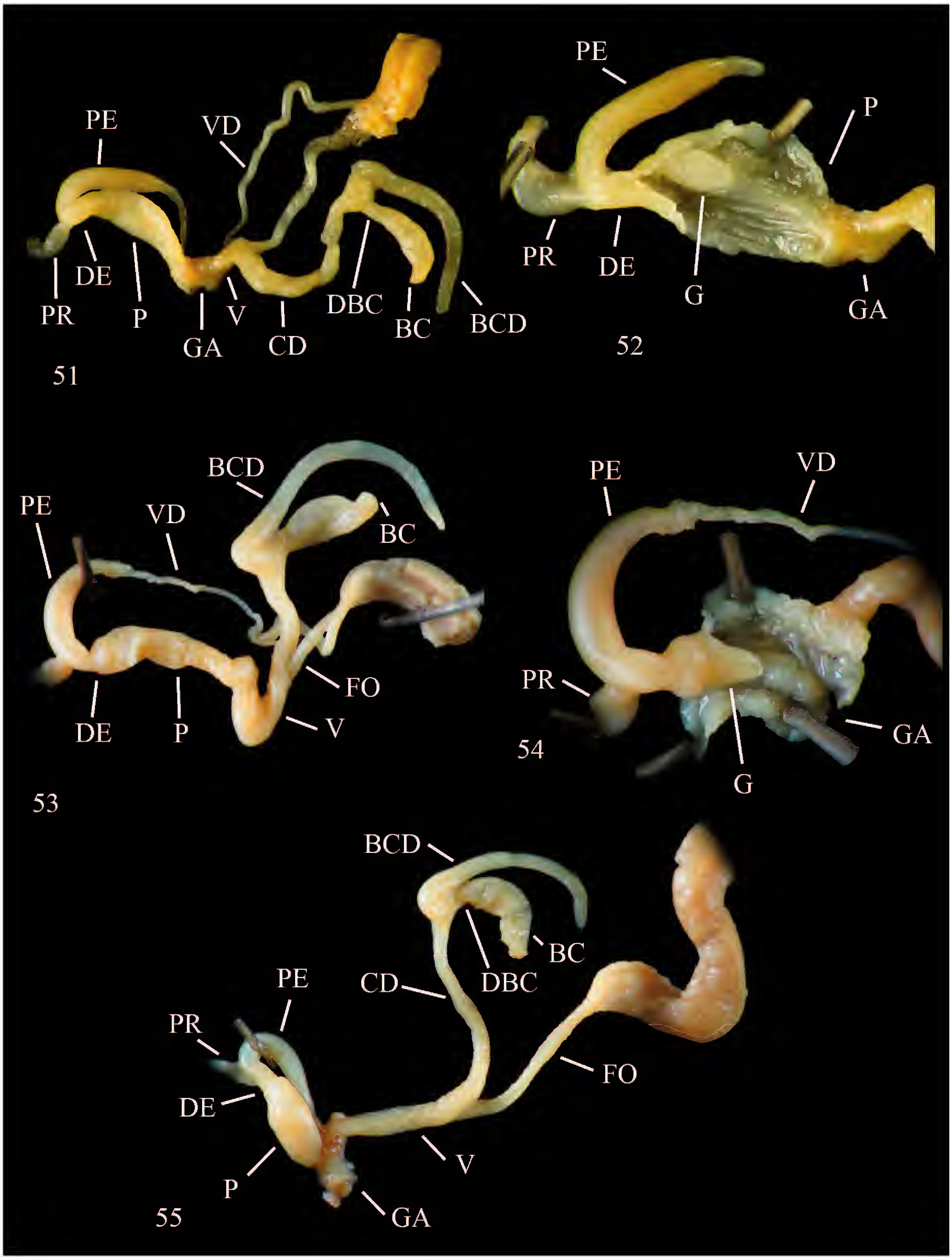


Figure 45. *Siciliaria* (*S.*) *calcarae calcarae*, Le Rocche, Calatafimi, palatum (CL n. 10770). Figure 46. Idem, parietum (CL n. 10771). Figure 47. Idem, clausilium (CL). Figure 48. *Siciliaria* (*S.*) *calcarae calcarae*, Grotta dell'Uccerie, Favignana, palatum (CL n. 8432). Figure 49. Idem, parietum (CL n. 8433). Figure 50. Idem, clausilium (CL).



Figures 51–55. Genitalia of *Siciliaria* (*S.*) *calcarae calcarae*. Figure 51. San Ciro, Monte Grifone, Palermo (CL n. 16807). Figure 52. Idem, internal structure of penis, with penial papilla. Figure 53. Le Rocche, Calatafimi (CL n. 10764). Figure 54. Idem, internal structure of penis, with penial papilla. Figure 55. Grotta dell'Uccerie, Favignana (CL n. 8424).

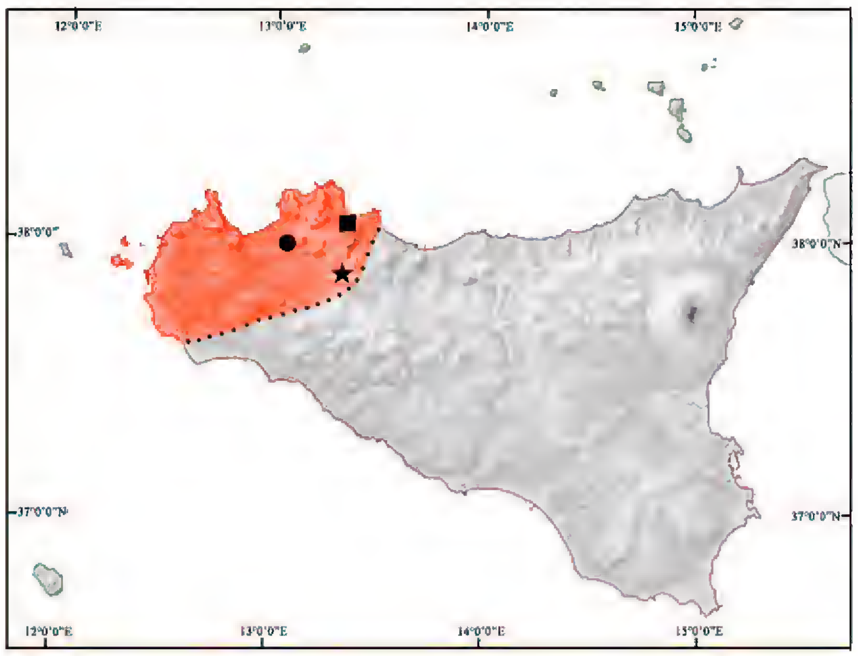


Figure 56. Geographic distribution of *Siciliaria* (*S.*) *calcarae* s.l. in W-Sicily (in red) with type locality of *S.* (*S.*) *calcarae orlandoi* n. ssp. (star), type locality of *S.* (*S.*) *calcarae calcarae* (square), and type locality of *S.* (*S.*) *calcarae belliemi*.

Siciliaria calcarae belliemi Brandt, 1961 (Figs. 36, 42–44), from Monte Belliemi, near Partinico, is characterized for ribbed whorls (rib-striated in *S. calcarae calcarae* and *S. calcarae orlandoi* n. ssp.); the anterior upper palatal plica is longer and raised same as in *S. calcarae calcarae*. Nordsieck (2002) considers *S. calcarae belliemi* a "*transitional form between neighboring species which may have originated by hybridation (*c. calcarae/tiberii*)" (see also Beckman, 2004).

REMARKS. *Siciliaria calcarae* s.l. is the more widespread species of the genus *Siciliaria* s. str. It lives from Bagheria in the East to Favignana Island and Levanzo Island in the West, up to Castelvetrano in the South.

It is reported in Quaternary deposits of Palermo (De Gregorio, 1927 sub *Clausilia adelina*, Palermo, Pietrazzi) and in in Quaternary deposit Wied tal-Bahrija in the Island of Malta (Giusti et al., 1995 sub *Siciliaria* cfr. *septemplicata*).

Siciliaria calcarae calcarae is morphologically little variable, nevertheless some taxa were described in the past for this mollusk, and nowadays they are considered synonyms.

Küster (1847–1862) described *Clausilia adelina* on specimens received by the Sicilian naturalist Luigi Benoit, with type locality "*Inseln Sicilien*". The accurate Küster's description and illustration (Küster, 1847: Pl. 34, figs. 4–6) show that *S. adelina* is a *S. calcarae* with a well developed anterior upper palatal plica and a low columellar lamella. These characters are typical of *S. calcarae calcarae* and exclude any reference to *S. calcarae orlandoi* n. ssp. Benoit (1875, 1882) specifies as distribution localities for *C. adelina*: "*Favignana e Bonagia presso Calatafimi*".

Pini (1884) described *Clausilia* (*Siciliaria*) *brugnonea* for Palermo. Also Pini's description and illustrations of *C. brugnonea* allow to refer this name to the typical *S. calcarae calcarae* for the presence of a developed upper palatal plica (Pini, 1884: Pl. 2, fig. 16a) and low sinuous columellar lamella (Pini, 1884: Pl. 2 fig. 16b).

Monterosato (1892) described *Clausilia* (*Siciliaria*) *adelina* var. *subsolida* for the Aegadian islands by these few words "*più solida e più fortemente striata*" [more solid and more strongly striated]. This description and the examen of topotypic specimens (Figs. 38, 48–50, 55) allowed us to consider the taxon *subsolida* clearly distinguished from *S. calcarae orlandoi* n. ssp.

Westerlund (1892) described *Clausilia* (*Siciliaria*) *calcarae* var. *nodosa* from Palermo, with these words: "*Testa non decollata, tenue regulariter costulato-striata, plica palatalis infera perbrevis, peristoma expansum, incrassatum, margine externo sub sinulum nodoso, plica palatalis supera secunda tenuis, brevis. Hab. Sicilien, bei Palermo (A. de Monterosato comm.)*". Monterosato (1892) specifies that the type series of *nodosa* came from Bagheria (East of Palermo). The diagnostic characters of *S. nodosa* Westerlund, 1892 are the presence of a small secon upper palatal plica and a small callus on the upper outer edge of the peristome. A similar species is *S.* (*S.*) *ferrox* Brandt, 1961 which is widespread along the coast from Termini Imerese in the East to Altavilla Milicia in the West, very close to Bagheria (Reitano et al., 2007). In fact, *S. ferrox* has the shell similar to *S. calcarae* s.l. but with a second upper palatal plica, therefore as in *S. nodosa*. Nevertheless, *S. calcarae calcarae* occasionally have a little second upper palatal plica; anyway this is absent in *S. calcarae orlandoi* n. sp.; nowdays *C.* (*S.*) *nodosa* Westerlund, 1892 is considered a synonym of a nominotypical subspecies of *S. calcarae* (Bank, 2011; Nordsieck, 2013).

Finally, De Gregorio (1894) described *Clausilia proxima levanzensis* from Levanzo Island (Aegadian Island, Western Sicily) but, however, for this little island, only *S. calcarae* is known (Fiorentino et al., 2004).

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We dedicate this work to the memory of our thear friend Giuseppe Pocaterra (San Pietro in Casale, Bologna, Italy).

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