

Morphometric Characteristics of the Shell and Distribution along the Crimean Coast (Black Sea) of *Petricola lithophaga* (Retzius, 1788) (Mollusca: Veneridae)

Margarita Kovalyova

Institute of Marine Biological Research RAS, Nakhimov Avenue 2, Sevastopol 299011, Russia; E-mail: kovalmargarita@mail.ru

Abstract: A little-known rock-borer mollusc *Petricola lithophaga* (Retzius, 1788) was studied using specimens collected from the sublittoral zone of the Crimea (Black Sea). Taxonomic characteristics, metrical parameters of the shell, abundance, biomass and distribution of the mollusc along the Crimean coast are discussed.

Keywords: molluscs, rock-borer, *Petricola lithophaga*, Black Sea, Crimea

Introduction

The genus *Petricola* Lamarck, 1801, includes 24 species of bivalve molluscs, distributed mainly in subtropical and tropical littoral zones (20 species) (BOUCHET, GOFAS 2014). The distribution of some species is poorly studied, i.e. of *Petricola aequistriata* Sowerby, 1874; *P. habei* Huber, 2010; *P. insignis* (Deshayes, 1854); *P. quadrasi* (Hidalgo, 1886). *Petricola* species are boring bivalves that burrow in soft sediment, rocks (SAVAZZI 1994), hard clay, mud, peat, wood or limestone (MILASHEVICH 1916). Their life strategies and the lack of commercial interest explain the scarcity of information on *Petricola* species.

In the Black Sea, this genus is represented only by *P. lithophaga* (Retzius, 1788). It was first described from a coastal area of Livorno, Italy (RETZIUS 1788). This rock-borer is distributed in the Boreo-Atlantic littoral zone: the Atlantic coasts of Europe and North Africa, from Great Britain in the north to Morocco in the south, as well as in the Mediterranean, Aegean, Marmara and Black seas (GOLIKOV, STAROBOGATOV 1972).

Petricola lithophaga is classified usually as benthic (ZERNOV 1913, SHARONOV 1952, KANEVA-ABADJEVA 1960 a, b, KANEVA-ABADJEVA, MARINOV 1960, BĂCESCU *et al.* 1963, APPUKUTTAN 1972, 1973, KOTAPALLI, SUNDARAM 1972, LEBEDEV 1972, SINEGUB 2004, SMIRNOVA *et al.* 2004, ZENETOS *et al.* 2005, SEN *et al.* 2010). In the above publications, records of this species are given without illustrations or description of the diagnostic characters or, when descriptions of

P. lithophaga are given, they disagree with some of the key parameters used in the species identification and do not include detailed pictures (MILASHEVICH 1916, NEVESSKAYA 1965, GOLIKOV, STAROBOGATOV 1972). Probably, this is due to the insufficient number of studied specimens. For example, the description given by NEVESSKAYA (1965) has been based only on ten specimens.

The aim of the present study is to obtain reliable morphometric parameters of the shell and new data on the distribution, abundance and biomass of *P. lithophaga* from the Crimean upper sublittoral zone (Black Sea).

Material and Methods

We studied small stone substrates, collected from depths ranging from 0 to 3 m. Stones and pieces of rocks, presumably inhabited by rock-borers, were picked up from the sea bed and placed into a bag. The number and biomass of *P. lithophaga* in the substrate were evaluated through measuring and studying the surface colonised by the benthic organisms. Then the stones were fragmented into small pieces and all molluscs were removed and fixed in 70% ethanol. Altogether, 277 bivalves were collected. Shells were measured using a vernier caliper (precision 0.1 mm) and an ocular micrometer. Density of the substrate was determined using Moose scale (SHEVCHUK *et al.* 2005). Shells were photographed using an Olympus Camedia E-520 camera attached to an Olympus SZX16 ster-

eomicroscope at the Zoological Museum, University of Turku. The materials were deposited in the collection of the Department of Benthic Ecology, Institute of Biology of the Southern Seas, Sevastopol, Crimea.

Results and Discussion

Petricola lithophaga (Retzius, 1788)

Figs. 2-12

Venus lithophaga Retzius, 1788: 13, f. 1-2.

P. lithophaga: MILASHEVICH 1916: 253, f. tab. VII 5-6.

P. lithophaga: SKARLATO and STAROBOGATOV 1972: 249, f. tab. V 7A-7B.

P. lithophaga: NEVESSKAYA 1965: 248, f. tab. XIII 34-38.

Material. Crimea: Tarkhankut Peninsula: 28 specimens, near Kipchak Bay, 45°28'42.2"N 32°34'54.7"E, 07.2011, 07.2012; 20 specimens, Maryino Village, 45°20'08.2"N 32°41'27.5"E, 07.2011, 07.2012; 27 specimens, near Okunyovka Village, 45°20'24.3"N 32°42'04.8"E, 45°21'57.7"N 32°46'02.3"E, 45°21'59.5"N 32°46'10.3"E, 45°21'58.6"N 32°46'32.8"E, 07.2011, 08.2012; Bays of Sevastopol: 170 specimens, 44°37'38.1"N 33°31'33.3"E, 44°36'55.9"N 33°30'10.7"E, 44°36'18.3"N 33°26'50.9"E, 44°36'07.1"N 33°26'32.3"E, 44°34'59.2"N 33°24'08.6"E, 05-09.2011-2013; Karadag Nature Reserve: 32 specimens, 44°54'41.1"N 35°12'08.6"E, 07.2013; Dvuyakornaya Bay: three specimens, 44°59'34.9"N 35°21'48.1"E 10.08.2013. All the material was col-

lected by the author. The distribution of *P. lithophaga* based on the studied specimens is shown in Fig. 1.

Faunistic records: The seawater areas of Tarkhankut Peninsula (KOVALYOVA 2012, present study); Sevastopol bays (ZERNOV 1913, KOVALYOVA 2012, 2013, KOVALYOVA *et al.* 2012, present study); the marine area of Karadag nature reserve (BECKMAN 1940, SHARONOV 1952, SINEGUB 2004, GRINTSOV *et al.* 2005, present study); Dvuyakornaya Bay (present study).

Description: Shell structure of *P. lithophaga* was described based on the examination of 277 specimens. Shell rounded (min length/height ratio = 0.96) or elongated-oval (max length/height ratio = 2); thin valves, inequilateral and posteriorly gaped, and with c. 60 radial ridges on surface (Figs. 7-8, 10-11).

Pallial sinus wide, ca. 2/3 (0.61-0.76) of the shell. Pallial line 0.5 mm wide. Muscle scars usually distinct. Borderline between anterior adductor and anterior pedal retractor weakly marked; muscle scars crescent. Borderline between posterior adductor and posterior pedal retractor distinct. Posterior adductor rounded whereas posterior pedal retractor oblong to filiform (Fig. 2).

Right valve with two (often parallel to one another) cardinal teeth; their thickness varies depending on the individual; back tooth always larger (Figs. 4, 6, 12). As a rule, back tooth partly or fully divided by a groove into two equal or, infrequently, unequal parts (1 : 1 or 1 : 2, respectively). Left valve with two distinct cardinal teeth, one anterior and the other posterior (Figs. 3, 5, 9), which is consistent with the ob-

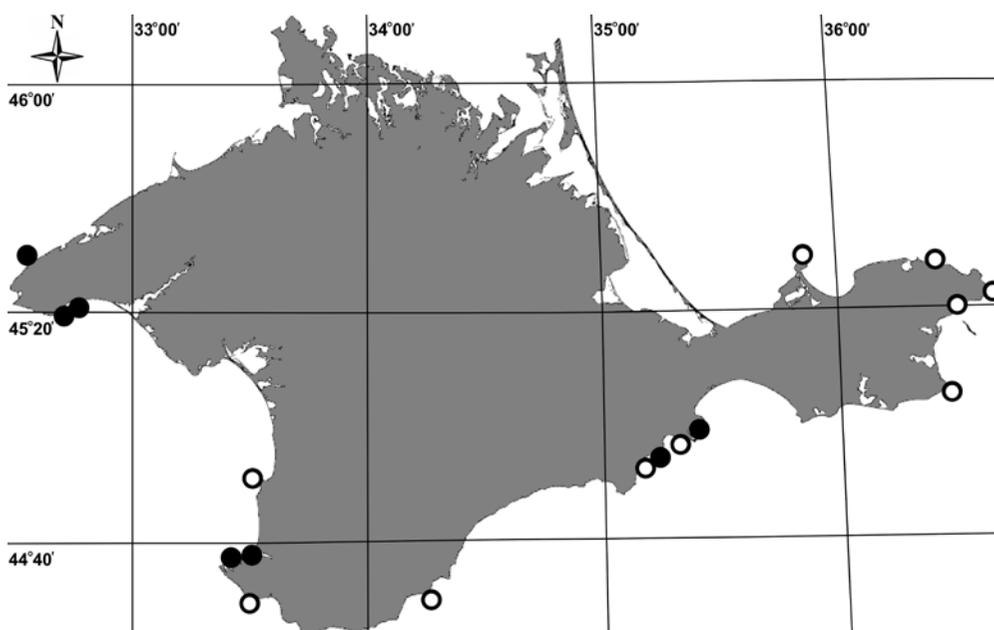


Fig. 1. The distribution of *P. lithophaga* based on the studied specimens (full circles – species is found, empty circles – isn't found)

servations of RETZIUS (1788) and MILASHEVICH (1916). According to GOLIKOV and STAROBOGATOV (1972) and NEVESSKAYA (1965), left valve with three teeth of which the anterior and posterior reduced. We have not found information about the number, age and integrity of the shells examined by these authors. Possibly, *P. lithophaga*, similarly to some other members of this genus, can have the third tooth as a character typical of juveniles which is lost during its ontogeny. However, none of 277 molluscs examined in our investigation had a third tooth. Anterior tooth on the left valve often apically forked; posterior tooth usually positioned at an angle of 45° to the central tooth. This angle can be greater; in 5% of the molluscs, the arrangement was parallel. Rarely, both teeth fine and mutually parallel, joined with a fine bridge or accrete (2, 1 and 1%, respectively). Hinge area absent. On average, external ligament 1/7 (0.10-0.16) of shell length (Table 1).

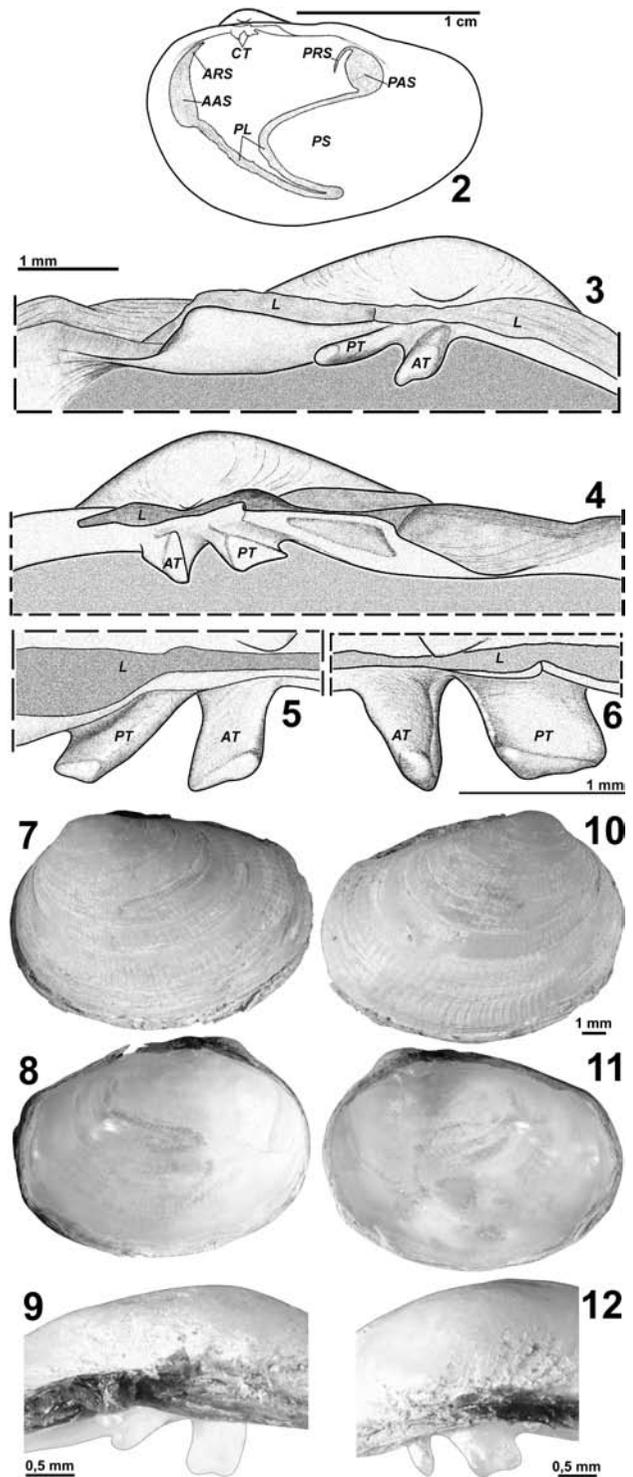
Length to width ratio is a good descriptor of shell shape which elongates as the mollusc grows. Ratio of height to width of shell and length of sinus shell do not depend on the length of shell. Largest estimates of ligament/shell lengths ratio registered for youngest *P. lithophaga*.

Colour of the shell grey to white. Minimal shell length measured 4 mm. Maximum shell length 24 mm, maximum shell height 15.5 mm and maximum shell width 11 mm.

Ecology: *Petricola lithophaga* is found along the Crimean shoreline in the locations with limestone exposure. Owing to its chemical composition and density (3 by Moos scale) limestone is probably the optimal habitat for rock-borers. *Petricola lithophaga* specimens dwell in small burrows they make in the limestone, which probably perforate by acid, like the related *P. lapicida* (Gmelin, 1791) (MORTON, SCOTT 1988). In the surveyed coastal areas, the population density and biomass of *P. lithophaga* varied considerably, ranging from 60 to 185 ind./m² and from 44.84 to 144.7 g/m², respectively (KOVALYOVA 2012, KOVALYOVA *et al.* 2012). *Petricola lithophaga* are relatively small molluscs residing in the shallow burrows. Unlike many other rock-borers in the World Ocean, this species does not perforate deeply the substrate and it remains nearly undamaged, even when the population densi-

Table 1. Parameter ratios for *P. lithophaga* shells. Legend: L is length, H – height, D – width, Lig – ligament length, and S – sinus length; the average values were used

L, mm	L/H	H/D	Lig/L	S/L	Number of ridges
4-10	1.1	1.4	0.4	0.67	~ 60
11-15	1.4	1.4	0.12	0.68	~ 60
16-24	1.5	1.4	0.1	0.69	~ 60



Figs. 2-12. Left (3, 5, 7-9) and right (2, 4, 6, 10-12) valves of the shell of *P. lithophaga*: internal (2, 8, 11) and external (7, 10) sides; cardo, lateral (3-4); cardinal teeth, dorso-lateral (5-6, 9, 12). Abbreviations: AAS – anterior adductor muscle scar; ARS – anterior retractor muscle scar; PAS – posterior adductor muscle scar; PRS – posterior retractor muscle scar; AT – anterior tooth; CT – cardinal teeth; PT – posterior tooth; PL – pallial line; PS – pallial sinus; L – ligament

ty is extremely high. As our observations showed, *P. lithophaga* inhabits very small portion of the substrate – from 0.01 to 1.15% of the integral volume of the rock, and $0.5 \pm 0.16\%$ on average (KOVALYOVA 2013).

Conclusions

Compared with previous studies on *P. lithophaga* from the Crimean coastal zone, our investigation

showed differences in the hinge apparatus. Therefore, we have contributed towards the description of the shell by adding more information about the structure of teeth in the hinge apparatus. Also, abundance, biomass and new findings of *P. lithophaga* are presented for the first time along the Crimean coast.

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