

The First Record of *Leiosolenus simplex* (Iredale, 1939) (Bivalvia: Mytilidae) Boring into *Plesiastrea versipora* from Minamata Bay in Japan

Masato Owada

Department of Biological Sciences, Kanagawa University, 2946 Tsuchiya, Hiratsuka, Kanagawa, Japan;
pt125365@kanagawa-u.ac.jp

In the family Mytilidae, six genera are known to include rock-boring species: *Adula*, *Botula*, *Fungiacava*, *Gregariella*, *Leiosolenus* and *Lithophaga* (Kleemann, 1990). Species of all except *Fungiacava* are distributed in Japan: *Adula* spp. are found north of the Boso Peninsula, Honshu and northward and bore into mudstone; *Botula*, *Gregariella*, *Leiosolenus* and *Lithophaga* spp. are found south of the Boso Peninsula and bore into dead corals, limestone or calcareous sandstone (Habe, 1977; Higo & Goto, 1993; Kurozumi, 2000). It is known that all *Fungiacava* species and some *Leiosolenus* species bore into living corals (Kleemann, 1990). In Japan, however, the distributions and habitats of these species are not yet clear.

Leiosolenus simplex was collected from living *Plesiastrea versipora* (Anthozoa: Scleractinia) distributed in Minamata Bay, Kumamoto Prefecture, Kyushu, and is recorded for the first time in Japan. In this paper, the shell morphology and habitat of this species are described, and the classification of *Leiosolenus* is discussed.

Taxonomy

Family Mytilidae Rafinesque, 1815

Genus *Leiosolenus* Carpenter, 1856

Type species: *Leiosolenus spatiosus* Carpenter, 1856

Remarks: Wilson (1979) and Wilson & Tait (1984) suggested that the genus *Lithophaga* be classified into two groups on the basis of the presence of incrustations on the shell surface. Oliver (1992) classified the group with incrustations as the genus *Leiosolenus* and that without as *Lithophaga*. However, this classification has not been accepted widely, because the phylogenetic relationships between the two groups were not described sufficiently. On the basis of molecular phylogenetic analysis, Owada (2007)

concluded that *Leiosolenus* and *Lithophaga* are monophyletic genera and that the group of *Leiosolenus* plus *Lithophaga* is paraphyletic. Consequently, the classification proposed by Oliver (1992) is appropriate and has been adopted in this study.

Leiosolenus simplex (Iredale, 1939)

(Fig. 1)

Materials: Sixteen individuals were collected from Minamata Bay on 24 May 2007 (Fig. 2). The specimens were extracted from living *P. versipora* inhabiting the seafloor at a depth of 9–10 m using a hammer and chisel. These specimens and substrata were deposited at Kanagawa University.

Measurements: (Shell length \times height \times width in mm): #1, 19.8 \times 8.1 \times 7.1 (Fig. 1); #2, 19.8 \times 8.0 \times 7.0; #3, 16.3 \times 7.5 \times 6.5; #4, 16.0 \times 7.1 \times 6.2; #5, 15.3 \times 6.3 \times 5.4; #6, 15.1 \times 7.1 \times 5.8; #7, 14.9 \times 6.9 \times 6.3; #8, 14.4 \times 6.2 \times 5.6; #9, 14.3 \times 5.6 \times 5.1; #10, 14.0 \times 6.2 \times 5.4; #11, 13.2 \times 6.0 \times 5.3; #12, 13.0 \times 5.9 \times 5.4; #13, 12.9 \times 6.1 \times 5.3; #14, 12.4 \times 5.8 \times 4.9; #15, 11.9 \times 5.2 \times 4.6; #16, 10.5 \times 4.4 \times 3.7.

Description: Shell small for genus, rarely exceeding 20 mm in length and 7 mm in height, thin, cylindrical, slightly tapering posteriorly. Umbo near anterior end. Anterior and posterior margins rounded. Dorsal margin elevated. Ventral margin slightly convex. Hinge line straight. Periostracum pale yellowish, covered by thin, chalky calcareous incrustation. Siphon darkly pigmented.

Remarks: *L. simplex* can be distinguished from *Leiosolenus lessepsianus* (Vaillant, 1865) because it has an inflated shell form and darkly pigmented siphon. *L. simplex* also resembles the juvenile of *Leiosolenus curtus* (Lischke, 1874), but the incrustation does not protrude from the posterior margin, and the color of the periostracum is pale yellowish.

Distribution and habitat: *L. simplex* bores only

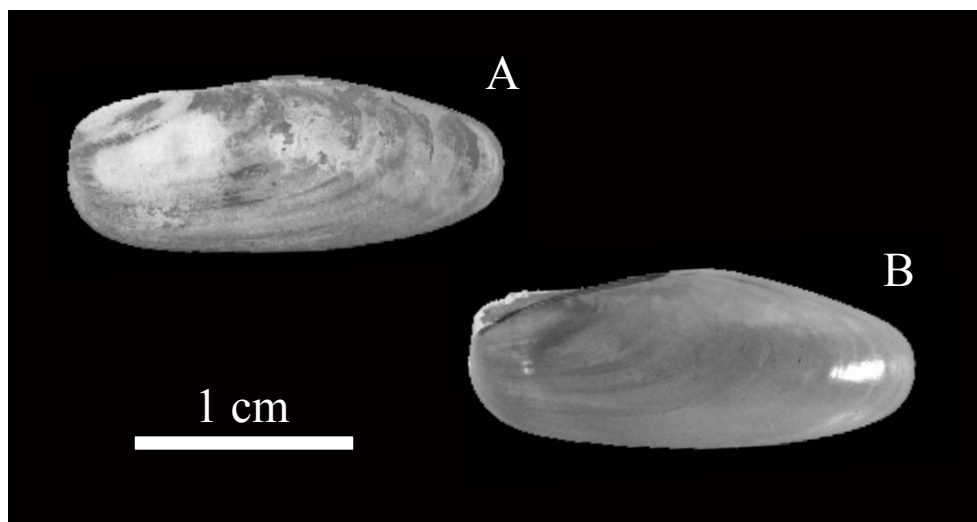


Fig. 1. *Leiosolenus simplex*. A. outer surface of right valve. B. inner surface of left valve.

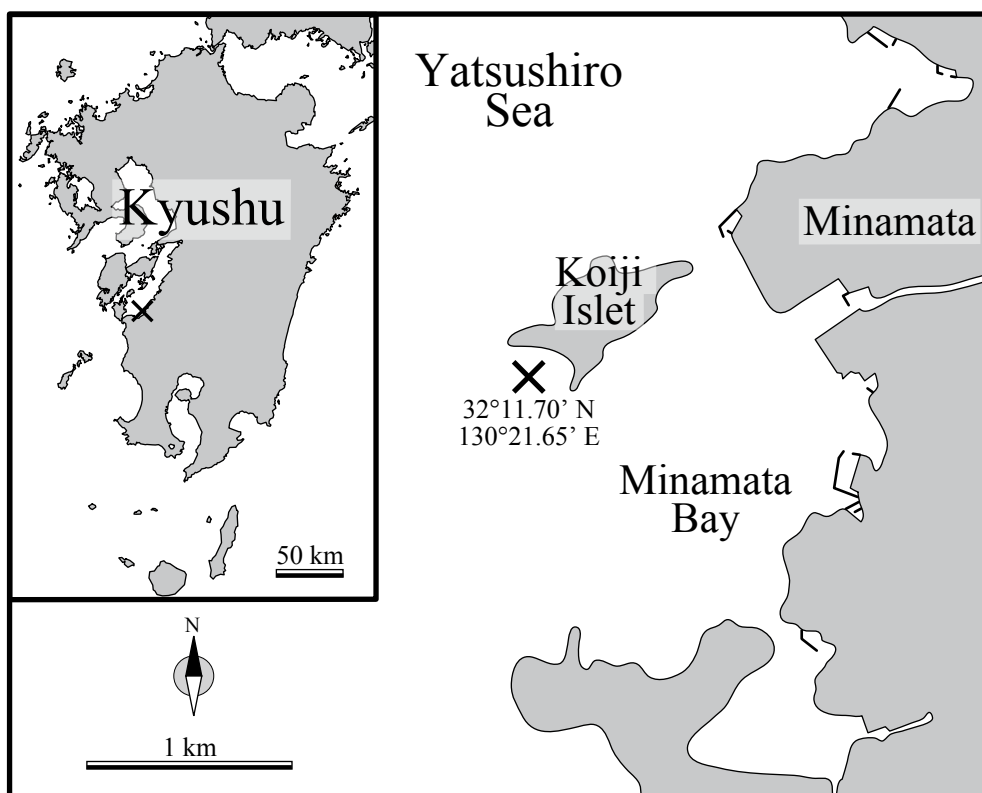


Fig. 2. Location of the sampling point. The specimens were collected from the place marked as “X”

into living corals. In the Great Barrier Reef, it bores into *Favia amicum*, *F. favosa*, *F. pallida*, *Goniastrea retiformis*, *Lobophyllia corymbosa*, *L. costata* and *Symphyllia nobilis*, and in the Red Sea, it bores into *Goniastrea pectinata* and *G. retiformis* (Kleemann, 1980). In Japan, *L. simplex* bores into *P. versipora*. It is also found in Hong Kong, but details of the coral into which it bores into are unknown (Scott, 2003).

Discussion

L. simplex has hitherto been known to be distributed in the Great Barrier Reef and the Red Sea and to bore into several species of living corals. *P. versipora* is not rare in coral reefs in the tropical Indo-West Pacific; however, *L. simplex* is reported to bore into this species for the first time in this paper. In Minamata Bay, *P. versipora* has been known since at least 1950; *L. simplex* has been found to occur here only since 1996 (Yamamori & Ise, personal communication). These facts may suggest that the environmental conditions of Minamata Bay have changed such that a suitable habitat has been created for *L. simplex*, which has undergone adaptation in the past couple of years to bore into *P. versipora*.

Apart from *L. simplex*, which bores into *P. versipora*, boring mytilid bivalves have been found in the living corals *Galaxea fascicularis*, *Montipora digitata*, *Platygyra ryukyuensis* and *Stylophora pistillata* from Sesoko Islet, Okinawa Prefecture, Ryukyu Islands; all were identified as *Leiosolenus malaccanus* (Reeve, 1858) (Moretzsohn & Tsuchiya, 1992). However, this identification is doubtful, because *L. malaccanus* bores only into dead corals (Wilson, 1979; Kleemann, 1984).

Species diversity and biomass of rock-boring mytilids are high in tropical and subtropical areas. In a coral reef they play an important role, especially in ecology. For example, Highsmith (1980) and Scott & Risk (1988) indicated that the destruction of hermatypic corals by rock-boring mytilids promotes the regeneration of the coral reef, and Kleemann (1996) and Nishihira (1996) suggested that the boreholes of rock-boring bivalves supply cryptic habitats for various animals. Furthermore, coevolution between mytilids boring into living corals and the host corals has been suggested (Brickner *et al.*, 1993; Mokady *et al.*, 1993; Mokady *et al.*, 1994).

Coral reefs in Japan are suitable for these studies, because the species diversity of corals and bivalves in these ecosystems is relatively high. In the initial stages, sufficient information should be gathered on bivalves boring into living corals.

Acknowledgements: I deeply thank Messrs. Hideo Yamamori and Yasuyuki Ise (Kumamoto Asahi Broadcasting Corporation) for providing the specimens. I am grateful to Prof. Satoshi Nojima (Kyushu University) for collection of the specimens and identification of the host corals. I appreciate Prof. Ken'ich Kanazawa (Kanagawa University) for helpful discussions. I also thank two anonymous reviewers for their valuable comments to improve the manuscript.

References

- Brickner, I., Kramarsky-Winter, E., Mokady, O. & Loya, Y. 1993. Speciation in the coral-boring bivalve *Lithophaga purpurea*: evidence from ecological, biochemical and SEM analysis. *Marine Ecology Progress Series* 101: 139–145.
- Habe, T. 1977. *Systematics of Mollusca in Japan. Bivalvia and Scaphopoda*. 372 pp. Hokuryukan, Tokyo. (in Japanese)
- Highsmith, R. C. 1980. Burrowing by the bivalve mollusc *Lithophaga curta* in the living reef coral *Montipora berryi* and a hypothesis of reciprocal larval recruitment. *Marine Biology* 56: 155–162.
- Higo, S. & Goto, Y. 1993. *A Systematic list of Molluscan Shells from the Japanese Is. and the Adjacent Area*. 693 pp. Elle Scientific Publications, Osaka. (in Japanese)
- Iredale, T. 1939. Mollusca 1. *Scientific Reports of the Great Barrier Reef Expedition* 5: 209.
- Kleemann, K. 1980. Boring bivalves and their host corals from the Great Barrier Reef. *Journal of Molluscan Studies* 46: 13–54.
- Kleemann, K. 1984. *Lithophaga* (Bivalvia) from dead coral from the Great Barrier Reef, Australia. *Journal of Molluscan Studies* 50: 192–230.
- Kleemann, K. 1990. Evolution of chemically-boring Mytilidae (Bivalvia). In: Morton, B. (ed.), *The Bivalvia – proceedings of a memorial symposium in honour of Sir Charles Maurice Yonge, Edinburgh, 1986*, pp. 111–124. Hong Kong University Press, Hong Kong.
- Kleemann, K. 1996. Biocorrosion by bivalves. *Marine Ecology* 17: 145–158.
- Kurozumi, T. 2000. Mytilidae. In: Okutani, T. (ed.), *Marine Mollusks in Japan*, pp.

- 429-436. Tokai University Press, Tokyo.
- Mokady, O., Bonar, D. B., Arazi, G. & Loya, Y. 1993. Spawning and development of three coral-associated *Lithophaga* species in the Red Sea. *Marine Biology* 155: 245-252.
- Mokady, O., Rozenblatt, S., Graur, D. & Loya, Y. 1994. Coral-host specificity of Red Sea *Lithophaga* bivalves: interspecific and intraspecific variation in 12S mitochondrial ribosomal RNA. *Molecular Marine Biology and Biotechnology* 3: 158-164.
- Moretzsohn, F. & Tsuchiya, M. 1992. Preliminary survey of the coral-boring bivalvia fauna of Okinawa, Southern Japan. *Proceedings of the Seventh International Coral Reef Symposium, Guam, 1992*, vol. 1: 404-412.
- Nishihira, M. 1996. *Ecology of Symbiosis*, vol. 8, *Ecology of footholds*. 267 pp. Heibon-sya, Tokyo. (in Japanese)
- Oliver, P. G. 1992. *Bivalved seashells of the Red Sea*. 330 pp. Natural Museum of Wales, U. K.
- Owada, M. 2007. Functional morphology and phylogeny of the rock-boring bivalves *Leiosolenus* and *Lithophaga* (Bivalvia: Mytilidae): a third functional clade. *Marine Biology* 150: 853-860.
- Scott, P. J. B. & Risk, M. J. 1988. The effect of *Lithophaga* (Bivalvia: Mytilidae) boreholes on the strength of the coral *Porites lobata*. *Coral Reefs* 7: 145-151.
- Scott, P. V. 2003. A taxonomic, distributional and bibliographic checklist of Hong Kong marine bivalve molluscs and research published on them from 1971-2000. In: Morton, B. (ed.), *Perspectives on Marine Environment Change in Hong Kong and Southern China, 1977-2001, Proceedings of an International Workshop Reunion Conference, Hong Kong, 21-26 October 2001*, pp. 260-310. Hong Kong University Press, Hong Kong.
- Wilson, B. R. 1979. A revision of Queensland lithophagine mussels (Bivalvia, Mytilidae, Lithophaginae). *Records of The Australian Museum* 32: 435-489.
- Wilson, B. R. & Tait, R. 1984. Systematics, anatomy and boring mechanisms of the rock-boring mytilid bivalve *Botula*. *Proceedings of the Royal Society of Victoria* 96: 113-125.

(Accepted June 13, 2008)

水俣湾のコマルキクメイシから採集されたイガイ科穿孔性貝類の1種

大和田正人

熊本県水俣湾に生息するコマルキクメイシ *Plesiastraea versipora* から日本初記録のイガイ科穿孔性貝類である *Leiosolenus simplex* (Iredale, 1939) (マメイシマテ・和名新称) が採集された。本種は生きたサンゴにのみ穿孔し、殻長 20 mm, 殻幅 7 mm を超える個体は少ない。殻形は円筒形であり、殻表の沈着物 (二次殻) はチョーク状で薄く、後縁から突出しない。

本種がコマルキクメイシに穿孔することは本稿で初めて報告された。コマルキクメイシは 1950 年以前から水俣湾に生息しているが、本種が穿孔するようになったのは 1996 年以降である。これらのことから、現在の水俣湾の環境が本種の生息に適していること、この 12 年間で本種がコマルキクメイシに穿孔できるように適応した可能性が示唆される。

シギノハシガイ属 *Lithophaga* は二次殻の有無に基づいて 2 つのグループに区別され、それぞれのグループは異なる系統を持つことが知られている。本稿では二次殻を持つグループをイシマテガイ属 *Leiosolenus* として記載した。