ON *LITHOPHAGA (DIBERUS) BISULCATA* A MYTILID BORER CAUSING DAMAGE TO THE COMMERCIALLY IMPORTANT GASTROPOD SHELLS

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ABSTRACT

Lithophaga (Diberus) bisulcata d' Orbigny was found to bore into the gastropod shells, *Xancus pyrum* (Linne) and *Fasciolaria trapezium* (Linne), causing good amount of destruction to the shells. The taxonomy, shell structure and the details of the burrowing habit of this species are discussed in detail. The present report of this species from the southeast coast of India is the first record of this species from Indian Ocean and it is for the first time reported to bore into *Xancus* and *Fasciolaria*. Since this borer causes damage to commercially important gastropod shells, much attention is paid to understand the details of boring mechanism. It is assumed that they make burrow initially by chemical means and later by mechanical rotating movement of the shell within the burrow.

INTRODUCTION

The marine bivalves, capable of burrowing into corals, submerged rocks, concrete structures, sandstones and into molluscan shells, belong mainly to the genera *Botula, Lithophaga, Tridacna, Venurupis, Petricola, Aloides, Platyodon, Hiatella, Gastrochaena, Pholas, Barnea, Zirfaea, Pholadidea, Panitella, Parapholas, Diplothyra* and *Jouannetia*. Among these, *Lithophaga* is the most important genus from the point of view of destruction to corals and commercially important shells.

Turner and Boss (1962) pointed out that lithophages are a specialised group of marine bivalves belonging to the family Mytilidae and the method of boring is chemical. Most of the *Lithophaga* species bore into either dead or living corals, although the records of occurrence in firm mud or clays show that at times they invade unusual substrate. Those known to bore into molluscan shells are *L. nigra, L. aristata* and *L. bisulcata* (Turner and Boss 1962). The present study was taken up with a view to understanding the destruction caused by lithophages to *Xancus pyrum* and *Fasciolaria trapezium* collected from Kilakkarai on the southeast coast of India. The boring bivalve was identified as *Lithophaga bisulcata* and this is the first record of this species from

Indian region. Other species of lithophages recorded from Indian coasts are *L. nigra* (d'Orbigny), *L. gracilis* (Philippi), *L. teres* (Philippi), *L. stramineus* Dunker, *L. levigata* (Q & G) and *Lithophaga* sp.

Lithophaga (*Diberus*) *bisulcata* d'Orbigny 1842
(Fig. 1: 1, 3 & 4)

Lithodomus bisulcatus d'Orbigny 1842 (in) Sagra, Histoire Naturelle de l'Ille de Cuba, Mollusques 2: 233, pl. 28, fig. 14-16.

Modiola appendiculata Philippi 1846, Abbildungen und Beschreibungen Conchylien 2: 150, *Modiola*, pl. 1, fig. 4.

Lithophaga appendiculata Philippi. Morch 1853, Catalogus Conchyliorum Comes de Yoldi 2: 56.

Lithodomus biexcavatus Reeve 1857, Conchologia Iconica 10, *Lithodomus* pl. 4, figs 22 a-b.

Lithodomus (*Diberus*) *bisulcata* d'Orbigny, Dall 1898, Trans. Wagner Free Institute of Science, Philadelphia 3: 801.

Lithophaga (*Diberus*) *bisulcata* d'Orbigny. Turner and Boss 1962, Johnsonia 4 (41): 110-114, pl. 73-74.

Diagnosis

The species belonging to the subgenus *Diberus* Dall is characterised by having two radial sulci extending from the umbos to the posterior margin of the valves. The region in between the sulci is encrusted with calcareous deposit. In *bisulcata* the incrustation is slightly pitted or even smooth. The calcareous incrustation extends beyond the end of the valve and the posterior margin is smoothly rounded. The dorsal margin is with a slight alation in the posterior half of the shell and the anterior margin extending slightly beyond the umbo.

Description

The shell almost cylindrical with slight alation in the posterodorsal margin. Anterior portion of the shell higher than the posterior margin; anterior margin of the shell extends beyond the umbo. The shell valves are thin and fragile and are covered with a thick periostracum. The shell is also covered with a thick calcareous coating cemented to the shell valves, thickened more towards the posterior end and to the ventral side. This calcareous incrustation extends beyond the posterior margin of the shell valves as a beak-like structure which is smooth and rounded. Two oblique sulci are present over the shell, one beginning from the umbo to the dorsal margin of the posterior end of the shell dividing the posterior slope into two areas. The second sulcus extends from the umbo to the ventral margin of the posterior end of the shell; in between the sulci the calcareous incrustation is wedge-shaped and slightly pitted. The pitted appearance is more prominent towards the posterior margin of the shell

valves. In younger specimens the area between the two sulci is smooth and the feather-like appearance is not noticed. The pitted area is highly variable in this species (Fig. 1: 6). The area above and below the sulci is encrusted by smooth

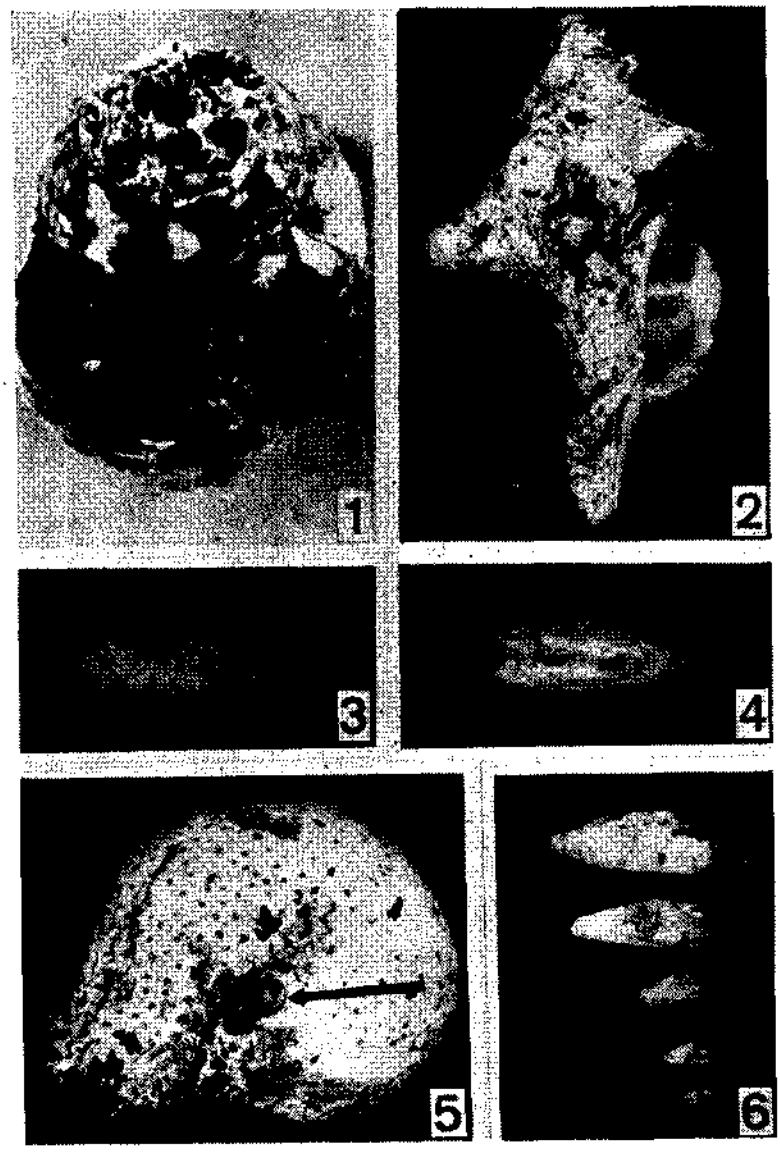

FIG. 1. The boring mollusc *Lithophaga bisulcata*. (1) Burrows made by the borer on the spire of *Xancus pyrum*; (2) The heavily infested knobs and umbilical part of *Fasciolaria trapezium*; (3) Dorsal valve of the borer; (4) Ventral valve of the borer; (5) *Xancus pyrum* with the borer *in situ* (arrow indicates the burrow); (6) *L. bisulcata* of various sizes.

calcareous incrustation. The anterior and posterior margins of the shell are rounded. The anterodorsal margin is greater than the posterodorsal margin and the latter descends rapidly to the posterior end of the shell. Ventral margin almost straight, but slightly inclined towards the posterior end. Internally the shell is lightly purplish or iridescent. Muscle-scar impressions present as long anterior adductor scar, small anterior retractor scar just beneath the umbo. The posterior adductor scars elliptical and located on the dorsal ridge of the sulcus close to the posterior end of the shell.

Material

All the specimens were seen buried in the shells collected from south-east coast of India. Eight specimens were collected from *Xancus pyrum* and three from *Fasciolaria trapezium*. The shell length ranged from 2.0 to 15.4 mm. The length and height of the specimens are given below. The specimens have been deposited in the Reference Collection Museum of Central Marine Fisheries Research Institute at Mandapam Camp (Reg. No. CMFRI|M.340).

Sl. No.	Shell length (in mm)	Shell height (in mm)
1.	15.4	6.6
2.	14.5	5.5
3.	13.5	5.0
4.	7.0	4.0
5.	8.0	4.1
6.	5.7	2.8
7.	3.8	2.0
8.	4.9	2.6
9.	7.5	3.0
10.	7.4	3.0
11.	2.0	1.7

Distribution

The genus *Lithophaga* is world-wide in distribution, although occurring mainly in tropical and subtropical waters (Turner and Boss 1962). The subgenus *Diberus* Dall has been recorded from the Lower Miocene in Tampa, Florida (Dall 1898, 'Oligocene') and the recent species occur in the warm and tropical seas on the east and west coasts of America, Red Sea, east to the Philippines and Australia. The present record of *L. bisulcata* extends the distribution of this genus to Indian Ocean.

Remarks

The subgenus *Diberus* Dall 1898 is characterised by the plume-like incrustation in the upper and posterior part of the valves and the division of

the valves by the radial sulci extending posteriorly from the umbos. Iredale (1939) has named two sections from Australia, viz., *Exodiberus* and *Salebrolabis* which seems to be identical with or close to *Diberus* (Soot-Ryen 1955). Turner and Boss (1962) observed that Iredale's subgenera were based upon the differences in sculpturing of the incrustations which can be found within the range of variation of sculpturing found in *bisulcata* alone. *Lithophaga bisulcata* is closely related to the type species *L. plumula* Hanley, a well-known West American species. *L. bisulcata* differs from the type species in having less elaborate feather-like incrustation at the posterior end of the shell and the posterodorsal margin almost equal to the anterodorsal margin of the shell. In the type species the feather-like structure is typically elaborate and the anterodorsal margin is significantly greater than the posterodorsal margin. Other known species of subgenus *Diberus* are *L. canalifera* (Hanley) and *L. subula* (Reeve) (Soot-Ryen 1955). In the first species the incrustation over the shell is strong and radiating without a feather-like pattern whereas in the latter feather-like pattern is present over the shell.

Boring Habit

Turner and Boss (1962) observed *Lithophaga bisulcata* boring into living shells such as *Strombus* as well as into dead corals and calcareous rocks. In the present observations this species was found to occur in *Xancus pyrum* and *Fasciolaria trapezium*. The aperture of the burrow is circular in outline in most of the specimens (Fig. 1: 5). In some cases the opening protrudes slightly beyond the surface of the shells to which they have bored. The burrows made by the borer are seen close together mostly in a perpendicular position, sometimes slightly inclined, and may sometimes approach each other thus breaking the separating wall. In *Xancus pyrum* the borers were found to concentrate in the spire and apex region of the shell (Fig. 1: 1). In the body whorl of the shell very few specimens were found. In *Fasciolaria trapezium* the borers mainly attack the stout knobs found on the body whorl and occasionally on the base of body whorl (Fig. 1: 2). The burrow of the young specimens is as long as the shell while in bigger specimens it is a little bigger than the shell inside. Anteriorly the burrow is almost circular while in posterior region it becomes more oval in transverse section. The burrow is lined internally by a somewhat thick, undetachable calcareous lining, which is found to be thicker towards the posterior region of the burrow. In smaller specimens this internal lining is not complete sometimes leaving the anterior part exposed. In bigger specimens the internal calcareous lining is complete.

The periostracum of some specimens was found to be eroded at the anterior region. In younger specimens the calcareous coating over the periostracum is thick towards the posterior part while in the anterior region it is thin or even absent. In almost all the bigger specimens the calcareous lining over the periostracum was complete. The pitted appearance of the posterior

part of the shell is more prominent in bigger specimens. In smaller specimens it is either smooth or slightly pitted. In some big specimens the pitted area was found abraded and thus smooth in appearance.

In the younger forms the anterior part of the burrow has no calcareous lining. This suggests that during younger stage the animal secretes an acid to dissolve the anterior part of the burrow thus deepening the burrow, whereas in bigger specimens the calcareous coating is thick and the pitted area in the posterior part of the shell is prominent thus equipping the shell for mechanical boring. The abrasion of the pitted area of certain specimens is also an evidence of the mechanical movement of the shell valves. The circular or oval opening of the burrow is an indication of rotating movement of the shell inside the burrow. Further it was noticed that there were no dorsal or ventral ridges inside the burrow, which is also an evidence of rotating movement of the shells. Gohar and Soliman (1963) noticed a rocking mechanical movement in *Lithophaga cumingiana* boring into the corals of Red Sea. The above observations reveal that in *Lithophaga bisulcata* boring mechanism is by initial chemical boring and later by mechanical movement of the shell inside the burrow.

Most workers agree that lithophages employ both chemical and mechanical means for burrowing into rocks and coral blocks (Otter 1937, Yonge 1955, Hodgkin 1962, Gohar and Soliman 1963 and Appukuttan 1972). Yonge (1963) observed that in *Lithophaga,* confined to calcareous rocks, the means of mechanical boring are reduced, with accompanying modifications of preexisting mantle glands to supply the means of chemical softening of the rock. Gohar and Soliman (1963) stated that boring is mostly by rocking movement of the shell. A chemical component of a limited extent cannot be excluded.

A close examination of the 'wormed' *Xancus pyrum* collected from the godowns of a shell merchant at Kilakarai showed that lithophages occur mostly in shells ranging from 100 to 150mm size. The shells collected from 10 to 15 metres of depth in the Gulf of Mannar, and brought to the shell merchants by the fishermen, were all alive with periostracum intact. Out of the 352 'wormed' and discarded chanks examined, 306 specimens (87%) were found to be damaged by *Cliona* sp. and 196 (53%) were bored by lithophages. It is understood that an average 15% of the shells are discarded as 'wormed' shells since they are damaged either by sponges or by bivalve borers. In one 'wormed' *Xancus* shell of 123mm size 3cm^2 area in the apex portion alone has 35 to 40 small burrows of lithophages. *Cliona* sp. is found to attack *Xancus* shells of 65 to 180mm size and their burrows were found in the spire, apex and, most frequently, in the body whorl of the shell. From the above observations it could be inferred that lithophages rank second to *Cliona* sp. in the destruction of *Xancus* shells and they attack mainly the thicker parts of the shells.

It is reported that 1,500,000 chanks are fished annually from Indian waters. These chanks are used mainly for making bangles and a variety of curio articles, for use in worship and for blowing (Nayar and Mahadevan 1974). The present account reveals that a number of chanks are destroyed either by boring sponges or by lithophages. Mahadevan and Nayar (1974) observed that the thick periostracum present in chanks protect it to a great extent from the insidious attack of boring sponge *Cliona* sp. and its congeners. In the present study it was found that the thicker parts of live chanks afford an excellent substratum for *L. bisulcata*.

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