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SOME PATHOLOGICAL ASPECTS AKIN TO SPONGE BORING IN MOLLUSCAN SHELLS

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ABSTRACT

Boring sponges are considered to be a menace to the oyster beds and coral reefs in many parts of the world. In India too, where the molluscan population exists in fishable magnitude, the boring sponges pose a serious threat to their fishery.

The main target of the boring sponge is the calcareous shell of the host and the techniques adopted by the sponge to gain entry into the hard parts of the host are the same for all the species of boring sponges. But the shells of the different species react differently to the intruder, namely the sponge. These reactions often produce a wide variety of pathological symptoms in the host. Several live shells infested by boring sponges have been collected during the years 1964-1978 from both natural and artificial beds and the pathological aspects have been investigated, the results of which are presented in this paper.

INTRODUCTION

MANY species of sponges are known to bore into submerged calcareous objects like coral rocks, molluscan shells, calcareous algae, etc. A detailed survey made by the present author (Thomas, 1972, 1975) revealed the presence of 32 species of boring sponges in Indian waters and it was concluded that this is an area which harbours the maximum number of boring sponges in the world. Besides, one species (*Cliona vastifica* Hancock) which is rather common in the marine environment is unique in its distribution since it has succeeded in colonising the estuarine areas posing a serious threat to the gregarious molluscs found in the estuaries (Thomas, 1975).

Boring sponges are not considered as parasites since they obtain their food from extraneous sources (Old, 1941). The calcareous object, whether shell or coral, provides only a shelter and the ramification made by the sponge inside a living shell is liable to produce considerable physical and physiological strain on the host. Some of the common diseases found in the mollusc are reported herein.

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MATERIAL AND METHODS

Bored shells collected from the natural beds and also those found discarded in the various chank godowns were mainly utilised in the present study. Pearl oyster shells cultured both

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at Tuticorin and Vizhinjam were also used in evaluating the incidence and magnitude of damage caused by boring sponges on culture rafts. Spicules of sponges were prepared following standard methods and the various species were identified.

Pathological Aspects

Porosis: The primary system of sponge infection is the formation of minute chambers and interconnecting canals within the shell. French fishermen noted this disease as early as 1823 and called it 'spice bread disease'. The chambers formed inside the shell may in one or several rows according to the thickness of the shell and are formed in the following manner. The free swimming larva, soon after settling on the shell spreads out on the surface and start etching out minute particles from the shell liberally (size, 0.020-0.050 mm) and form an initial chamber (Fig. 1 a). The mechanism of boring, according to Rutzler and Rieger (1973) is by a combination of chemical and enzymatic action and the filopodial basket produced by the archaeocytes at the vicinity of etching play an important role in the cutting as well as removal of these minute particles. Such particles are continuously expelled through the excurrent stream of water in a living sponge (Fig. 1 c, e). The initial chamber, thus formed, may have a

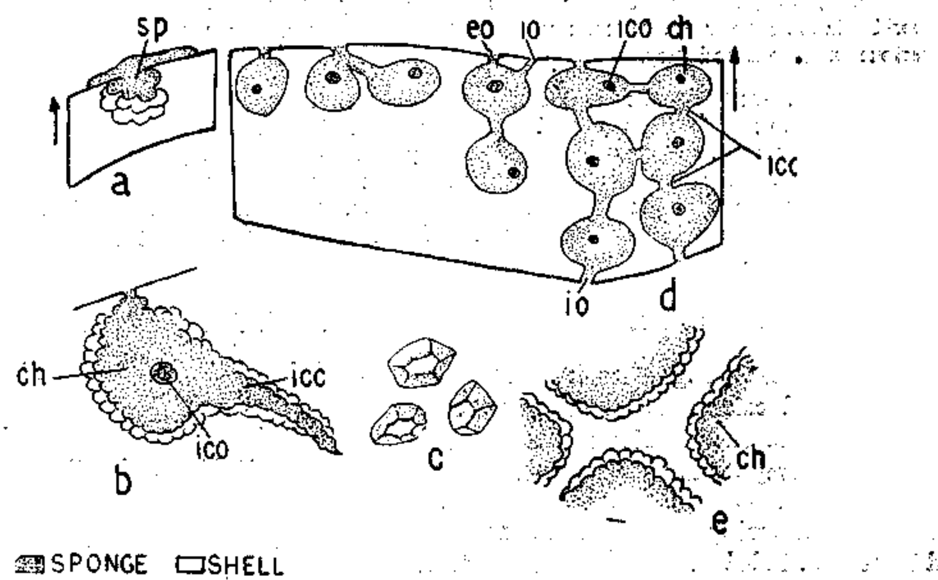

Fig. 1. a. Just attached Clionid larva gains entry into the shell (Sp : Sponge larva), b. An initial chamber (ch) is formed. Inter-chamberal connective (icc) is formed by etching out minute particles from the shell. Inter-chamberal connective opens to the adjacent chamber through inter-chamberal opening (ico), c. Particles etched out from the shell, d. Section of shell showing the arrangement of chambers inside. As growth advances more chambers are formed in different layers. The innermost chambers open to the mantle cavity through incurrent and excurrent papillae. Shell becomes porous on both surfaces and e. Chambers enlarged to show the etched out interior.

diameter of about 1.5 mm. Further growth inside the shell is effected through branches formed from the initial chamber. The branches are formed in the same manner as the initial chamber and each branch after a short distance form a new chamber and thus the spreading of the sponge inside the shell is effected. Each chamber communicates with the outside through two different types of papillae, the incurrent and excurrent. Both these papillae, at this stage, are directed towards the outer part of the shell and the water drawn in through the former is circulated through the canals inside the sponge and then expelled through the latter.

Monofacial and bifacial porosis: Normally when the shell is in its actively growing phase, both the incurrent and excurrent papillae open out at the outer part of the shell (monofacial, Fig. 2 a, ; Pl. I A, B). This is because every attempt by the sponge to pierce the inner surface of the shell is foiled by the mantle of the mollusc by secreting enough shell material in between. As suggested by de Laubenfels (1947) this results in a heavy drain of the oysters energy. But when the mollusc becomes physiologically weak or old, the sponge succeeds in piercing through the inner surface of the shell. At this stage the shell becomes porous on both surfaces (bifacial, Fig. 2 b, Pl. I F, G, I).

Hinge imbalance: The hinge mechanism of bivalves play an important role in the welfare of the organism. Hence, any cavity formed on the teeth or any outgrowth produced due to any repair, can considerably affect its smooth functioning. Defects of this type are rather common.

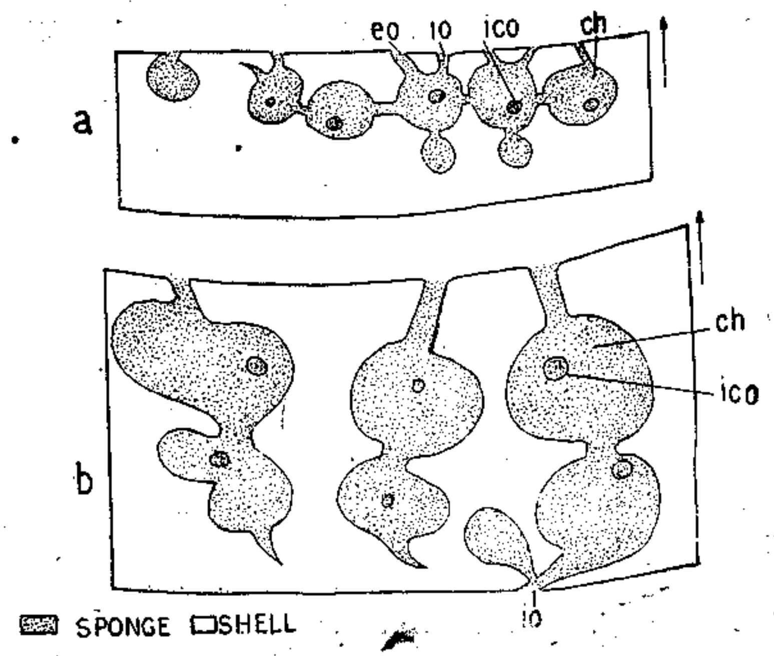

Fig. 2. a. Monofacial porosis. Both incurrent (io) and excurrent (eo) openings open towards the outer surface of the shell and b. Bifacial porosis. The inner surface of the shell becomes porous as the papillae formed from the innermost chambers pierce the inner wall.

Insertion scar imbalance: When the inroads of sponge become extensive at or near the adductor attachment zone, slightest pressure exerted by this muscle may cause complete breakdown of this area. Such a shell, which cannot open and close at will, may fall prey to other animals or may eventually die off (Pl. I G, H.). Rock oysters found in plenty along the estuaries are generally prone to this disease.

The cultured pearl oysters at Vizhinjam, exhibit another type of insertion scar damage. In these, blisters are formed at the adductor attachment zone which weaken the efficiency of adductor muscle (Pl. I E).

Fragility: Although the production of more openings on the surface of the shell is an indication of increased activity of sponge inside, merely by superficial examination alone the extent of damage caused to the shell cannot be assessed. As the inroads of sponge become extensive, more calcareous particles are expelled in the form of chips through the excurrent stream of water and this results in a gradual loss of weight on the part of the host. Chambers and interconnections lie more concentrated in the middle layers of the shell and as their number increases due to growth, the middle layers of the shell become hollow. Certain 'pillar like' structures which are the remnants of the middle layers of the shell, may be seen connecting the inner and outer layers of the shell (Fig. 3 a, b). Such shells, though externally firm and intact, may crumble at the slightest pressure.

Loss of thickness: Certain species of sponge (usually *Spirastrella* sp.) when they infect a shell, the infection may remain localised without spreading much inside the substratum. The other parts of the shell may grow in thickness, but the part infected by sponge will never increase in thickness. Bivalves with thick shells usually exhibit this symptom.

Undulosis: Undulating lines or ridges generally occur in the inner side of the shell when the infection is rather heavy. Polychaetes, mainly of the genus *Polydora*, are capable of producing such thickened ridges inside the shell. But this could be differentiated from sponge infection by its varicose nature and uniformly tubular cavity which it encloses (Pl. I C).

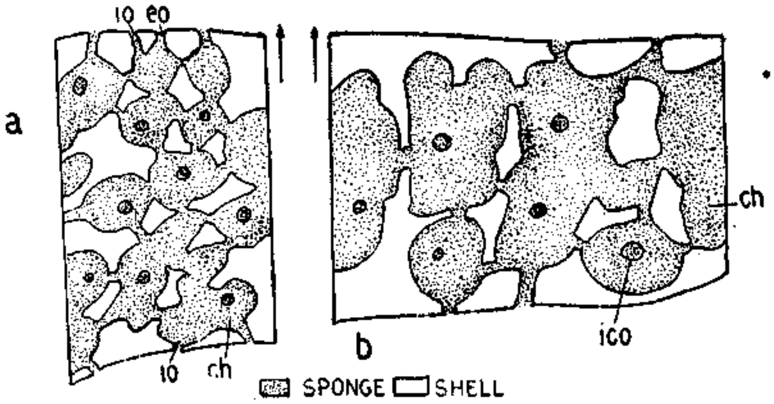

Fig. 3. Advanced stage of sponge infection in: a. Pearl oyster and b. *Xancus pyrum*. Chambers become large in the middle layers of the shell, but the outer and inner surfaces appear rather intact. Such shells get crumbled when pressure is exerted.

Atrophy: Shells possessing lateral projections or spines exhibit different grades of atrophy. Spines and lateral processes, when infected directly at their base, may even show stunted growth.

Blister formation: Blister formation is a closely associated phenomenon of sponge boring only in the case of shells possessing pearly layer. Blisters are formed inside for two purposes *viz.*, (1) to prevent the chamber formed inside the shell (by sponges) from

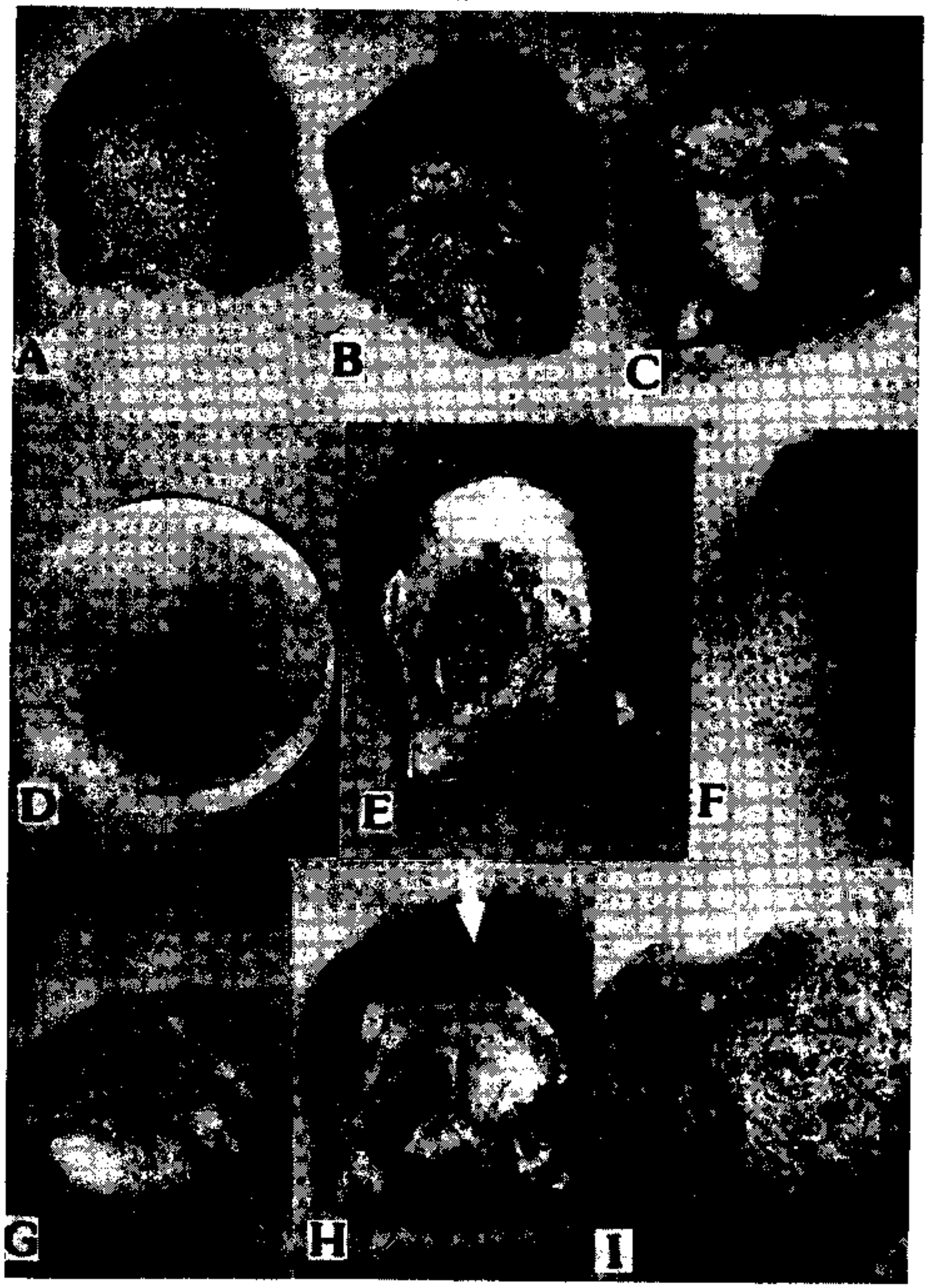

PLATE I. Pearl oyster shell infected by: A. *Cliona margaritifera.* The inroads of the sponge is seen upto the edge of the shell, B. *C. lobata*, C. Varicose nature of *Polydora* infection, D. Linear and reticulate pattern of boring noted in the Window pane oyster from Goa (Zuari Estuary). Sponge is *C. vastifica*, E. Blister formation at the adductor attachment zone (shown with an arrow). Smaller blisters seen around adductor attachment zone are those made by the repair of chambers, F. Shell of *Xancus pyrum* bored by *C. celata.* Both surfaces are uniformly bored (bifacial porosis). Larger openings are those made by *Lithophaga* sp., G. Pearl oyster shell infested by *C. margaritifera.* Inner surface is minutely pierced by sponge, H. Pearl oyster shell infested by *C. margaritifera.* The inroads of the sponge may be seen upto the edge of the shell (marked with an arrow) and I. *Crassostrea* sp. from the Zuari Estuary, Goa. Both surfaces are damaged to the maximum. Larger openings are made by boring mollusc (*Lithophaga* sp.).

contacting the soft parts of the mollusc and (2) to prevent the papillae, formed from the innermost layer of chambers, opening into the inner part of the shell. The etching and removal of calcium carbonate matter, though practically effected all along the zone of contact of sponge with the shell, is more pronounced at or near the actively growing tips only. The papillae, which are directed towards the inner side of the shell, are prevented from opening to the inside by constant secretion of nacreous layer by the mantle. But when conditions become unfavourable the process of repair becomes rather slow and the sponge again penetrates through the shell. When favourable conditions set in, some of the openings thus formed — probably the smaller ones — are again repaired and the others are left permanently open. The constant secretion of shell matter around a specified point of disturbance, thus, result in the formation of blister. Blisters may be classified into simple or compound based on the shape of the apical region (Fig. 4).

Melanosis : When the opening made by sponge at the inner surface of the shell is repaired by the nacreous material, a black patch is often formed at the site of the original pore. Apical region of the blisters usually contain such pigmented patches (melanoid blister, Fig. 4)

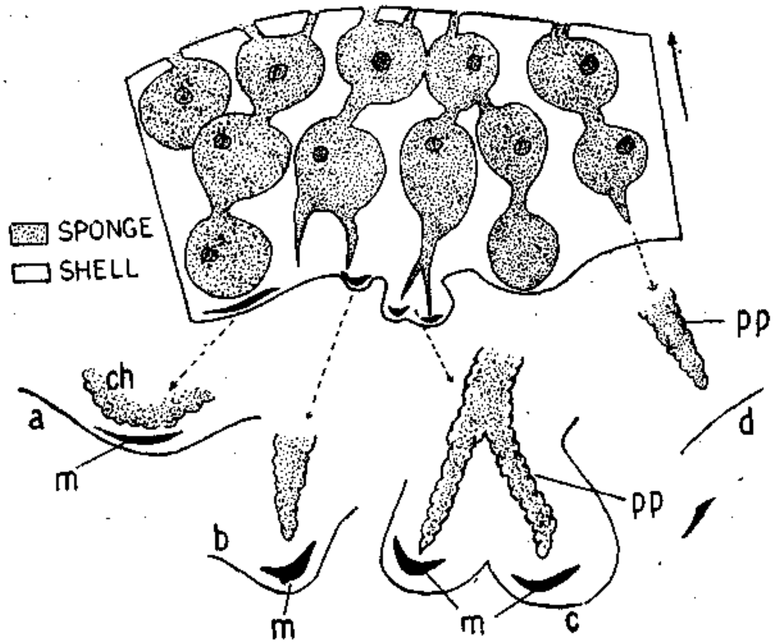

Fig. 4. Section of pearl oyster shell to show the different types of blisters : a. Blister formed by the opening of chamber, b. Blister formed by the papilla, c. Compound blister, d. A papillar projection which has not yet opened into the mantle cavity (m- black pigment ; pp- papillar projection).

Nacreerosis : Nacreous layer erosion in pearl oyster is a rare disease. Normally shells which are heavily infested by *Cliona margaritifera* and *M. lobata* exhibit this disease. As the first step, the nacreous layer becomes less lustrous followed by its erosion either partly or completely. The total damage if the nacre secreting cells on the mantle is the chief cause of this disease.

Lysis and Pustulosis : When sponge comes into contact with the soft parts of the mantle, certain reactions are noted along the area of contact. The first sign is that the mantle becomes flabby followed by the formation of dark pigmented pustules exactly opposite the holes on the shell. The tissue often gets detached from the shell and presents a diseased look (Hornell, 1904). Warburton (1958) could note such pustules in oyster and considered that these are blood cells.

Discussion

The above mentioned are some of the ailments found in the mollusc as a result of sponge infection. The shells dealt with herein have been collected mostly from natural beds and only a few were obtained from culture rafts. Hence the data available at present are rather insufficient to compare and contrast the various diseases occurring in these two environments, their frequency of occurrence, etc. But as far as the distribution of boring sponge is concerned, these two environments show marked difference ; the salient features of which may be summarised as follows :

1. The percentage of incidence of boring sponges is considerably more on the culture rafts when compared to that in the natural beds. An incidence of 8.5% was noted in the natural beds off Tuticorin (Thomas, 1979) while that in culture rafts at Tuticorin was 20.7% (Alagarswami and Chellam, 1976) and at Vizhinjam, 33.3% (Thomas, MS).
2. The number of boring sponge species occurring in the culture raft is always greater than that in natural beds. This is effected by harbouring certain species from natural beds, and is done in two ways, (a) by harbouring certain species which are dominant in other habitats like coral reefs or even other species of mollusec and (b) by harbouring some species which remain quiescent in nature.
3. Boring sponges inhabiting the culture rafts produce more larvae as against those in natural beds. This makes their dispersal easier in an environment rich in calcium carbonate in the form of shells.

The above facts show that culture rafts provide a condition quite congenial for the boring sponges. The ecological equilibrium found in nature is disturbed in this artificial environment. More stress to the ecological aspects should be given in the culture of marine molluscs which are prone to sponge boring.

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