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DISTRIBUTION PATTERN OF BARNACLES (CRUSTACEA : CIRRIPEDIA) IN ESTUARINE SYSTEMS OF INDIA

A. DANIEL

Zoological Survey of India

Marine Biological Station, Madras

ABSTRACT

The distribution pattern of the thoracic cirripedes in some major estuarine systems namely, Hooghly-Matla, Hukitola, Chilka Lake, Godavary, Krishna, Pulicat Lake, Ennore Backwaters, Adyar River, Vellar of the east coast and Cochin Backwaters in Kerala of the southwest coast of India is presented in the paper. The factors influencing the distribution of the various species of barnacles in the estuarine systems are also dealt with.

INTRODUCTION

The thoracic cirripedes are a diverse group of marine crustaceans, with only a few species occurring in the estuarine environment, and no species known to complete its life-cycle in freshwater or terrestrial conditions although some species spend as much as ten months per year in fresh water, and others spend sufficient time in air during the changes in tide to be included among the semi-terrestrial Crustacea (*vide* Newman, 1967). Due to their relative abundance, sessile mode of existence and conspicuousness, the distribution and ecology of intertidal and estuarine barnacles in the temperate waters of America, Europe and Britain have been studied extensively (Bousfield, 1955 ; Hedgepeth, 1957 ; Moore, 1958 ; Newman, 1967). In the tropics, the distribution of barnacles and their larvae in the estuarine area of Jakarta, Indonesia have been studied recently (Kasijan Romimohtarto and Okto Haryanto Arinardi, 1977). In the Indian region, their distribution in the marine environment are known to some extent (Annandale, 1909 ; Stubbings, 1936 ; Nilsson Cantell 1938 ; Daniel, 1955, 1967, 1972). However, very little published information is available on the species occurring in the estuarine environment (Annandale, 1907, 1915 ; Daniel, 1962 ; Balasubramanyam and Menon, 1963 ; Balakrishnan Nair, 1967). The study of barnacle fouling in estuarine areas has gained importance in recent years, since in coastal areas close to estuaries electric power generators/ thermal stations have been established and the flow of water in their cooling system is impeded by heavy harnacle settlement and growth.

In the present paper, the distribution pattern of the thoracic cirripedes in some major estuarine systems of the east and southwest coasts of India is presented, based on

extensive survey, collections, test-panel and test-pole studies made by the author, collections available in the Zoological Survey of India and all published records.

Observations

Hooghly-Matla Estuary : The distribution pattern of the cirripedes occurring in the Hooghly-Matla estuarine system is presented in Fig. 1. At the mouths of the rivers Hooghly and Matla at 'Sandheads' and nearby regions, 15 species and subspecies of barnacles occur. These are, *Lepas anserifera* Linné, *Conchoderma virgatum hunteri* (Owen), *Octolasmis warwickii* Gray, *Octolasmis cor* (Aurivillius), *Octolasmis orthogonia* (Darwin), *Chthamalus malayensis* Pilsbry, *Europlia withersi* (Pilsbry), *Balanus patellaris* (Spengler), *Megabalanus tintinnabulum tintinnabulum* (Linné), *Balanus amphitrite amphitrite* Darwin, *Balanus variegatus* Darwin, *Balanus variegatus cirratus* Darwin, *Chirona amaryllis euamaryllis* (Broch), *Chirona amaryllis nivea* (Gruvel) and *Chelonibia testudinaria* (Linne). The first really sharp faunal break appears to occur in this region. Beyond this region, only five species extend into the estuarine system. These are, *Octolasmis cor*, *Chthamalus malayensis*, *Europlia withersi*, *Balanus patellaris* and *Balanus amphitrite amphitrite*. In the river Hooghly, these five species extend up to Palta, and in the river Matla, up to Port Canning. In this area of the estuarine system, the second faunal break occurs (Fig. 1).

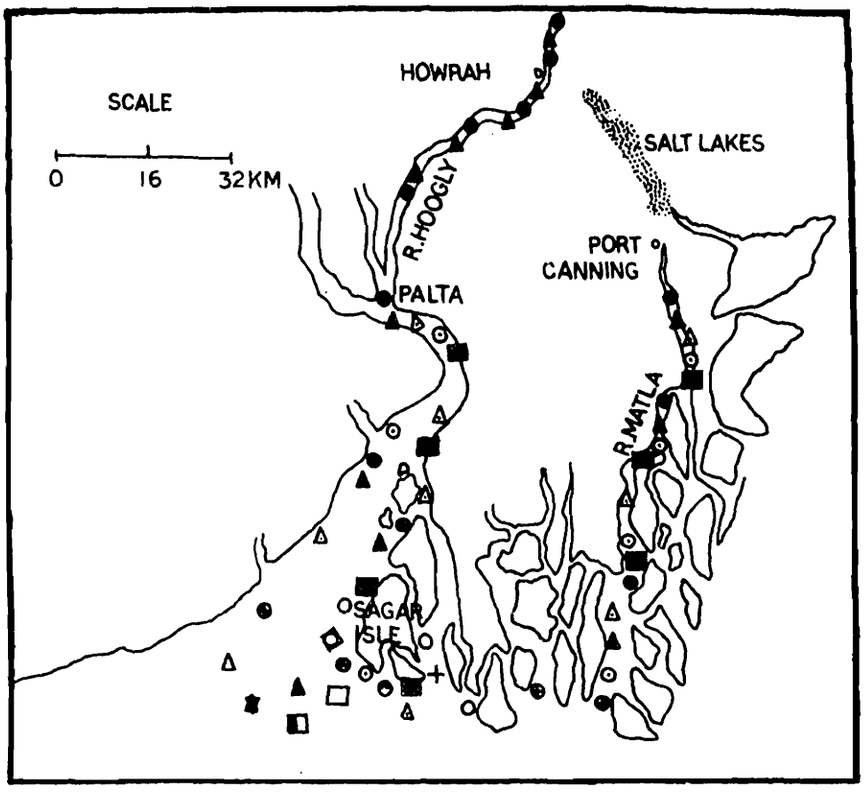
Balanus amphitrite amphitrite and *B. patellaris* extend further inside, from polyhaline conditions into waters of very low salinity and even fresh water.

B. amphitrite amphitrite and *B. patellaris* are found both subtidally and intertidally in the upper part of the estuary. As conditions become marine, they become restricted mainly to the intertidal zone. In the river Matla *B. patellaris* is the dominant species, whereas in the river Hooghly, *B. amphitrite amphitrite* is more abundant. In both species, successful settlement occurs throughout the year, although it is not known whether adults closest to the freshwater environment survive through the entire annual cycle.

Chthamalus malayensis and *Europlia withersi* are both intertidal outer coastal forms. In this estuarine system, both the species are inconspicuous and occur in the high intertidal region, nearer the marine environment *E. withersi*, however, progresses subtidally into the system, whereas, *C. malayensis* occurs only in the intertidal region even in the inner regions of the system.

Octolasmis cor, occurring on the branchiae primarily of the edible crab *Scylla serrata* (Förskal), is the only pedunculate cirripede, extending from marine conditions into the polyhaline waters of the estuary. In the marine environment, this species has also been found in the gill chambers of *Panulirus* sp. It does not occur on *Scylla serrata* obtained from very low salinity areas, although the larvae are able to hatch from eggs and live for some hours in fresh tap water, under laboratory conditions.

Hukitola Estuary : The distribution pattern of the cirripedes in this estuary is presented in Fig. 2. *Octolasmis cor* occurs on the gills of *Scylla serrata* collected from the mouth of the river Mahanadi, whereas, *B. amphitrite amphitrite* appears to have progressed further, from polyhaline waters into waters of lower salinity. Specimens from this locality are rather small, never exceeding 9 mm in diameter, although sexually mature. It appears



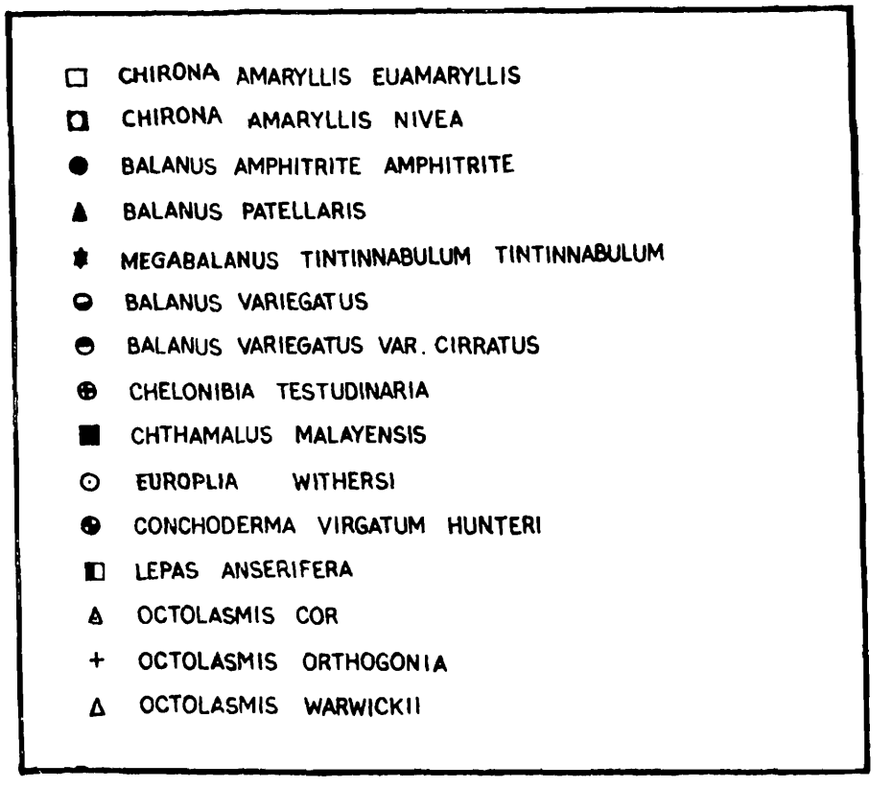


Fig. 1. Map of the Hooghly-Matla estuarine system showing the distribution of the thoracic cirripedes.

to occur predominantly in the subtidal region, and very rarely intertidally, at the mouth region. In the open coast in the Bay of Bengal, this species is very commn in the intertidal region.

Chilka Lake : *Octolasmis cor* is found commonly attached to the branchiae of *Scylla serrata* collected from the outer channel (see Fig. 2) but has never been found on individuals from the main area of the lake. *Balanus amphitrite amphitrite* is abundant on oyster shells, fish traps, and wooden posts in the outer channel of the lake, where it grows to a diameter of 15-16 mm (see also Annandale, 1915). This species also occurs singly or in small numbers on the shells of *Potamides*, other gastropods and lamellibranchs. In the main area of the lake a few solitary individuals of small size (5-6 mm) occur on rocks subtidally, mostly at the end of the dry season. The species rarely occurs in Rhamba bay in low salinity condition (Fig. 2).

Godavary and Krishna Estuaries : *Lepas anserifera* has been reported to occur in these estuaries. However, the specimens were taken in a dead or moribund condition from floating sticks and therefore can hardly be included in the fauna of these estuaries. *O. cor* occurs in the estuarine regions in the vicinity of the sea ; *B. amphitrite amphitrite* alone extends subtidally further inside, into waters of low salinity.

Pulicat Lake, Ennore Backwaters and Adyar River : In the Pulicat Lake, Ennore Backwaters and Adyar River *O. cor* and *B. amphitrite amphitrite* occur in situations similar to those of the Godavary and Krishna estuaries. However, *Chelonibia patula* (Ranzani) occurs on the carapace of *Scylla serrata* in the Pulicat lake in inconspicuous numbers.

Vellar Estuary : In this estuary 14 species and subspecies of thoracic cirripedes (see Fig. 2) occur at the mouth of the River Vellar. These are *Octolasmis warwickii*, *Octolasmis cor*, *Megabalanus tintinnabulum tintinnabulum* and *Balanus amphitrite amphitrite* which also occur at the mouth of the River Hooghly ; and *Lepas anatifera indica* Annandale, *Trilasmis minuta* (Gruvel), *Trilasmis amygdalum* (Aurivillius), *Octolasmis tridens* (Aurivillius). *Octolasmis grayii* (Darwin), *Octolasmis lowei* (Darwin), *Octolasmis angulata* (Aurivillius), *Semibalanus sinnurensis* Daniel, *Balanus hoekianus* Pilsbry and *Membranobalanus longirostrum* which have not so far been recorded at the mouth of the River Hooghly.

In this estuary a faunal break appears to occur at the mouth, as at the mouth of the Rivers Hooghly and Matla.

Balanus amphitrite amphitrite and *Octolasmis cor* extend further into the estuary ; the former occurring dominantly and penetrating to a greater extent. *Semibalanus sinnurensis* also extends riverward, but is rather inconspicuous and cannot be definitely termed as a member of the estuarine faunal complex.

Cochin Backwaters in Kerala : In the Cochin Backwaters near Ernakulam in Kerala, on the South-west coast of India, *Balanus amphitrite amphitrite* occurs abundantly throughout the major part of the year (see also Balasubramanyan and Menon, 1963 and Balakrishnan Nair, 1967). *Octolasmis cor* is also an important constituent of the barnacle fauna, whereas *B. amphitrite cochinensis* Nilsson-Cantell, is rare and inconspicuous.

Remarks

A detailed analysis of the barnacle fauna of the estuarine system of India reveals that

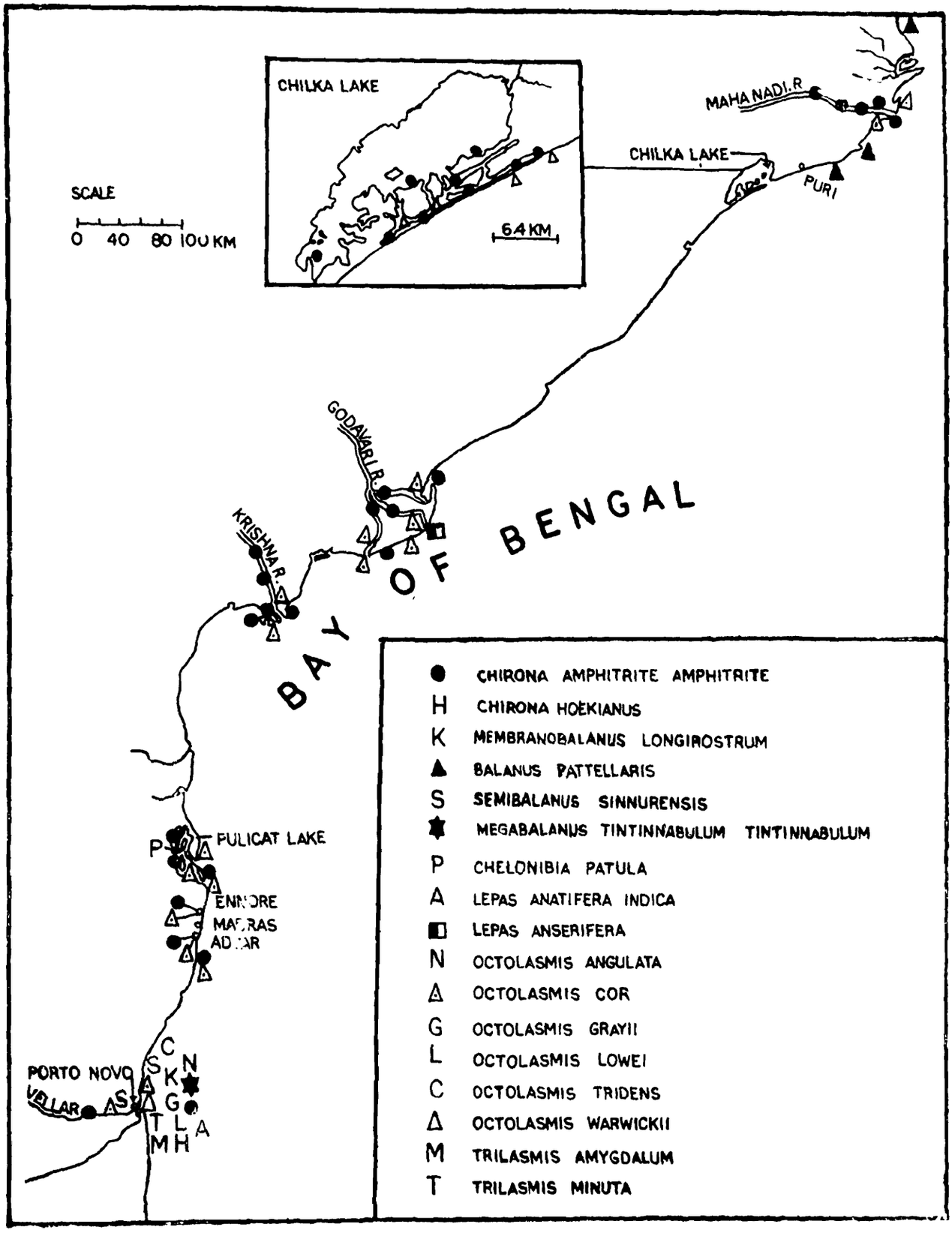


Fig. 2. Map showing distribution of the thoracic cirripedes in the estuarine systems of the east coast of India.

as one progresses from the marine environment into polyhaline waters of an estuary, the number of species diminishes rapidly, and when conditions become predominantly mesohaline, none are found. There are no truly fresh water forms, and those found in the estuaries are not confined to the estuarine environment as they also occur on the outer coast, and therefore, should be considered as marine invaders which tolerate estuarine conditions.

In all the estuaries of the Indian region studied, the pedunculate barnacle *Octolasmis cor* and the operculate barnacle *Balanus amphitrite amphitrite* are common but vary in the degree of penetration within the system. The occurrence of *O. cor* in the estuarine system is noteworthy, since no other pedunculate barnacle is known to tolerate estuarine conditions. *B. patellaris*, a predominant species in the Matla River, is confined to the Hooghly-Matla estuarine system, although in the marine zone it extends southwards up to Puri Beach in the Orissa coast. *C. malayensis* and *E. withersi* occurring inconspicuously in the Hooghly-Matla estuarine system are not known to penetrate into the other estuarine systems, although these occur in the marine environments in these areas.

Further, it is seen that *B. a. amphitrite*, *B. patellaris* and *E. withersi* which are predominantly intertidal forms in the marine environment, occur in the subtidal zone in the Hooghly-Matla estuarine system. Similarly, in the Hukitola Estuary also, *B. a. amphitrite* occurs predominantly in the subtidal zone. These suggest that stratification patterns of the watermasses in these estuaries may have played an important role in influencing the vertical distribution pattern of these species. Similarly, the subtidal predators and/or competitors may also be influenced by the stratification patterns of the watermasses.

The distribution of the adult barnacles in the various estuarine systems of India suggests that degree of penetration and vertical range is a reflection of the degree to which larvae are retained and distributed by currents and stratification patterns within the system, and the ability of the respective adults to tolerate dilution.

Further work is necessary on the physiology, behaviour, breeding and the reactions of the larvae of barnacles at the time of settlement in estuarine environments in India.

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