CHAPTER 1

INTRODUCTION

India has a vast coastline of about 6100 Km out of which two million hectares (Bal and Rao, 1990) is suitable for farming fishes, crustaceans, molluscs and other marine organisms. As marine capture fisheries have almost reached the optimal levels of exploitation intensive farming of selected species is an urgent need to meet the demand both of our local as well as export market. A prerequisite for this is a thorough knowledge of the various aspects such as the biology, food, feeding behaviour, spawning cycle, breeding season, size at first maturity, fecundity, sex ratio, induced maturation, growth etc.

Holothurians among echinoderms are a promising group for culturing in coastal waters in order to meet the export demand and augment our foreign exchange as they are still not very popular in the domestic market. Beche-de-mer or Trepang, a product obtained from sea cucumber is an important seafood item having great demand in the international market notably in Hongkong, Singapore and Malaysia.

Holothurians are exclusively marine and generally sluggish, benthic animals found on muddy or sandy substratum and also attached to rocks. They are collected mainly by skin diving.
They have the power to eviscerate and regenerate the lost parts in due course and this unique ability makes the animal to escape from predators.

Holothurians though distributed throughout the Indian coast are found more on the southeast coast of India comprised by the Gulf of Mannar, Palk Bay and the Andaman and Nicobar Islands and also at the Lakshadweep Islands. They occur in large numbers wherever reefs are present.

More than 650 species of holothurians are known from all over the world, about 200 species of holothurians are known in the seas surrounding India, of which about 75 species are from the shallow waters within 20 m depth (James, 1989a). About a dozen species are of commercial value used for the beche-de-mer industry.

The processing of beche-de-mer along the Gulf of Mannar and Palk Bay is carried out for two species Holothuria (M.) scabra and H. spinifera and at the same time there is an indication of over exploitation of these species especially H. (M.) scabra at certain areas as reported by James (1989a). Moreover, due to over exploitation, the Government of India imposed a ban on export of beche-de-mer below 3 inches size (75 mm) with effect from August 1982. To diversify over fishing of H. (M.) scabra from the
southeast coast, beche-de-mer resources for other species can also be exploited.

In order to culture animals away from the natural habitat, a clear picture of the natural food ingested by them, feeding behaviour, and the preferred particle size of food should be obtained to assure better survival. The food and feeding habits of holothurians have been investigated by a few workers. Sloan and Von Bodungen (1980) gave an account on the distribution and feeding of the sea cucumber, *Isostichopus badionotus* of the Bermuda Platform in relation to shelter and sediment criteria. Mosher (1980), Sibuet (1984), Massin and Doumen (1986) recorded the distribution of holothurians with reference to habitat, behaviour and feeding activity. Kinosita and Tanaka (1939), Yamanouchi (1942), Tanaka (1950a), Ferguson (1973), Hauksson (1979) and Massin (1982) reported on the diet of different species of holothurians. Fankboner (1981) re-examined the mucus feeding behaviour of the sea cucumber, *Leptopentacta elongata*. Sambrano et al. (1990) have also described the feeding of holothurians.

Massin and Jangoux (1976), Roberts and Bryce (1982), Smith (1983) and Cameron and Fankboner (1984) explained the tentacle structure and feeding behaviour of different species of

Hammond (1979) observed the feeding ecology and substrate relations of sediment ingesting holothurians from a shallow reef lagoon, Discovery Bay, Jamaica. The patterns of feeding and its activity in deposit feeding holothurians was studied (Hammond, 1982b). Yingst (1982) described the factors influencing rates of sediment ingestion in *Parastichopus parvimensis*, a deposit feeding holothurian. The particle size selection and sediment of deposit feeding holothurians have been analysed by Powell (1977), Taghon et al. (1978), Levin (1979), Hammond (1981, 1982a) and Taghon (1982).

A few investigators attempted the biochemical analysis of the gut contents of holothurians. Tokuhisa (1915) commented that holothurians extract organic matter out of sand or mud taken together. Hunt (1925) stated that holothurians ingest the plankton and organic deposits contained in sand or mud. Clark (1954) noted that holothurians and other bottom dwelling animals generally extract organic matter out of sand or mud which pass through their intestine. Newell (1965) suggested that bacteria provide the main food source for organisms ingesting particulate
detritus material. Hargrave (1970) examined the ability of a deposit feeding holothurian to utilize different fractions of organic matter available in bottom sediments.

Lawrence (1972) analysed the carbohydrate and lipid levels in the intestine of Holothuria atra. The role of dissolved compounds in the nutrition of benthic invertebrates, uptake in relation to organic content of the habitat was examined by Southward and Southward (1972). Bakus (1973) reported that tropical holothuroids occur maximum in coral reef environments and grow to a large size, while subsisting mainly on sediments which contain only low concentration of organic carbon. Marshall et al. (1975) observed the particulate and dissolved organic matter in coral reef areas. Yingst (1976) investigated the utilization of organic matter and constituent food items in shallow marine sediments of Parastichopus parvimensis, an epibenthic deposit feeding holothurian. The sediment ingested by Holothuria tubulosa was examined (Massin, 1979).

estimated the composition of organic matter in the intestinal contents of the bottom detritus feeding holothurians. The role of dissolved organic matter in the nutrition of deep sea benthos was attempted by Southward and Southward (1982). Hammond (1983) investigated the ingestion and assimilation of various forms of organic carbon by the aspidochirote holothuroids Isostichopus badionotus, Holothuria mexicana and H. arenicola, in the shallow back-reef lagoon on the Western side of Discovery Bay, Jamaica. Coates et al. (1984) noted the effects of grazing by deposit feeders on biogenic hydrocarbons in coral reef surface sediments. Moriarty et al. (1985) recorded the productivity of bacteria and microalgae and the effect of grazing by holothurians in sediments on a coral reef flat.

There is little information on the relationship existing between the length-weight in holothurians which along with other parameters is of vital importance in establishing the yield. (Conand, 1981, 1988, 1990; Choe, 1963; Lawrence, 1979 and Tyler et al. 1987) Similarly, the reproductive cycle plays a major role in understanding the life history and the annual regeneration of stocks.

Very little information is available on the reproductive biology of the holothurians in India. Krishnaswamy and Krishnan (1967), Krishnan (1967, 1968) studied on reproductive cycle
Jayasree and Bhavanarayana (1989) have studied the reproductive and biochemical constituents of *H. leucospilota*. Colwin (1948) studied the spawning of the holothurian *Thyone briareus*. Hyman (1955) briefly explained the reproduction of different species of holothurians. Tanaka (1958b) made a detailed study on the seasonal changes occurring in the gonad of *Stichopus japonicus* and its biology was studied by Choe (1963).

Pearse (1968) briefly explained the patterns of reproductive periodicities in four species of Indo-Pacific echinoderms. Summers et al. (1971) described the fine structure of the acrosomal region in spermatozoa of two echinoderms *Ctenodiscus* (starfish) and *Thyone* (Holothurian). Moore and Lopez (1972) reported the factors controlling the seasonal variation in spawning pattern of *Lytechinus variegatus*. Rutherford (1973) studied the reproduction, growth and mortality of the holothurian *Cucumaria pseudocurata*. Bakus (1973) reviewed the biology and ecology of tropical holothurians. The spermatogonia, spermatocytes and spermatids of *Cucumaria lubrica* were described by Atwood and Chia (1974). Fontaine and Lampert (1976) explained the fine structure of the sperm of a holothurian. Green (1978) and Costello (1985) made an account on the annual reproductive cycle of holothurians.

californicus, reproductive periodicity, spawning behaviour, development, recruitment and juvenile life stages.

Induced breeding is a widely adopted technique to make animals breed in captivity so as to increase their numbers and this helps in studying the early developmental stages. The most popular form in which holothurians are used for human consumption is beche-de-mer has great scope for industrialization as it fetches good foreign exchange. Beche-de-mer processing has been taken up by many industries along the coastline where there is a predominance of holothurian population but it is suffering a severe setback on account of the already stated dwindling resources of the few commercially important holothurian species as well as the poor knowledge of proper processing of beche-de-mer lowers its value in the International market.

*Holothuria (Metriotyta) scabra* (Jaeger, 1833)

Identifying characters of *H. (M.) scabra* are: Twenty tentacles; pedicels irregularly arranged on the flattened ventral 'sole'. Papillae usually quite large and conical and irregularly arranged dorsally, a lateral flange of papillae sometimes evident, a 'collar' of papillae around the base of the tentacles often present; anal papillae variously developed; body wall usually quite thin about 2mm (1-5 mm) thick, and gritty to touch;
body usually flattened ventrally, arched dorsally; size small to moderate, upto 400 mm long; calcareous ring quite well developed with radial plates upto three times as long as the interradials; spicules consisting of well developed tables with smooth disc and spire either of moderate height or high; terminating in a few to many small spires, tables rarely absent; buttons simple, with moderate sized irregularly arranged knobs and three to ten pairs of relatively large holes, according to Rowe (1969).

From the above information, it is evident that no detailed studies on the biology, food, feeding habits, length and weight relationship, size at first maturity, maturity stages, spawning season, fecundity, sex ratio, burrowing behaviour and locomotion, fishery etc., of Holothuria (H.) scabra particularly from Indian waters have been made (Plate I). In view of this, a detailed study on the biology, ecology and fishery of the sea cucumber Holothuria (Metriotyla) scabra (Jaeger) from south east coast of India, has been undertaken to provide first hand information on its biology, ecology and fishery.

The main objectives of the present study on H. (H.) scabra are:

1. To survey the distribution of the candidate species along the southeast coast of India.
Plate I. *Holothuria (Hetriatyta) scabra*– Entire
2. To investigate the food and feeding habits, and to find out the relationship between the length of the animal to that of the digestive tract.

3. To estimate the biochemical constituents *viz.* organic carbon, organic matter, carbohydrate, nitrogen and protein from different regions of the digestive tract and from the sediments.

4. To evaluate the length and weight relationship using the equation \( W = aL^b \).

5. To study the reproductive biology of the above species, dealing with maturity stages, spawning season, size at first maturity, gonad index, and its relationship with temperature and salinity. Relationship between total length, total weight, gutted weight, gonad weight and maturity stages, fecundity, sex ratio.

6. To find out the age and growth using modal progression analysis.

7. To observe the burrowing behaviour and locomotion in the laboratory.

8. To gather information on the fishery of this species.