

Review

CULTIVABLE TROPICAL MARINE MOLLUSCS OF ANDAMAN AND NICOBAR ISLANDS, INDIA

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ABSTRACT

The topography of the Andaman and Nicobar Island groups is summarised with emphasis on the coastline and Exclusive Economic Zone (EEZ). Molluscs constitute an important marine resource because of their commercial value. The gastropods *Trochus* and *Turbo* are very important for ornamental trade while pearl oysters, edible oysters, mussels, giant clams, and abalones offer excellent scope for coastal aquaculture as a part of sea food export development. The history of molluscan research in the Andaman Islands is reviewed along with the information on the molluscan fishing zones and shell collection methods. The occurrence and distribution of pearl oysters, edible oysters, green mussels and giant clams are described and their culture potential is highlighted by presenting the results of the culture experiments conducted in South Andaman. The need for sea ranching of *Turbo* and *Trochus* to replenish the already depleted stocks in Andaman waters and the prospects of pearl production using blacklip pearl oysters have been emphasised. The research support for the overall development of molluscan fisheries of the Andamans is emphasised.

INTRODUCTION

The Andaman and Nicobar group of islands in the Bay of Bengal (between 6°45' and 13°14' N; and 92°12' and 93°57' E) consist of more than 500 islands and islets of which only 36 are inhabited. The total land area of the islands is 8,241 km² of which 6,400 km² are in the Andaman group of islands and 1,841 km² in the Nicobar group of Islands. Only one island, Great Nicobar in the Nicobar group of islands, has more than 1,000 km² in area.

The characteristic features of the island groups are low ranging hills and narrow valleys covered with tropical forests, exhibiting high degree of species diversity and endemism. High rainfall, humid climate, undulating terrain, deep inlets, and creeks are very conducive for rich faunal and floral species diversity. Some of the important ecosystems of the islands are evergreen forests, coastal mangroves and coral reefs.

The islands have tropical climate with an

average rainfall of about 3,000 mm per year received during the south west monsoon (May to October) and north east monsoon (November to January). Throughout the year, the temperature remains moderate with little variation between the maximum and minimum temperatures. The relative humidity exceeds 80 % on an average during June to November and above 70 % during the rest of the year.

The coastline of the islands is 1,912 km. The total continental shelf area is estimated to be 16,000 km² and the island groups encompass 600,000 km² of Exclusive Economic Zone (EEZ) which is about 30 % of India's total EEZ. Besides, there are several protected bays, inlets, brackish-water creeks and shallow inshore areas in the islands which are most suitable for development of coastal aquaculture.

The islands have rich fishery including molluscan resources. The estimated fishery

potential from the continental shelf area is 161,000 tons which comprises of 100,000 tons of tuna and tuna like fishes, 40,000 tons of demersal fishes and 20,000 tons of pelagic fishes. The present fish production is only about 26,000 tons per year.

The gastropods *Trochus* and *Turbo* are commercially important. The other groups which are of importance from an aquaculture point of view are pearl oysters, edible oysters, mussels, giant clams and abalones. Besides, several other ornamental molluscan forms are richly distributed in the islands.

HISTORY OF MOLLUSCAN RESEARCH IN THE ANDAMANS

Smith's (1878) work on molluscan shells of the Andamans is considered as the earliest publication. The two important shell fisheries, *viz.*, *Trochus* and *Turbo* were recognised by the Andaman and Nicobar Administration only in 1929 when it was known that these resources were being exploited illegally by the Japanese fishermen. As many as 21 Japanese fishing vessels were captured during 1929 by the Andaman authorities. To prevent poaching, a set of provisional rules for the issue of licence for shell fishing and collection of royalty were framed and implemented. Simultaneously, efforts were made to study the status of molluscan resources and relevant conservative measures were undertaken with the help of Zoological Survey of India. Several scientific studies were carried out between 1930 and 1935, which brought to light the status of molluscan fishery in general and biological and ecological aspects of two molluscan forms, *Turbo* and *Trochus* (Amirthalingam 1932; Setna 1933; Prasad & Rao 1934; Rao 1936 a & b, 1937; Panicker 1938). The Andaman and Nicobar Islands Fisheries Regulation (1938) and the Andaman and Nicobar Islands Shell Fishing Rules (1978) were framed to regulate the molluscan fisheries.

During the seventies and eighties several research studies were undertaken to inves-

tigate and document the molluscan faunal wealth of the Andamans and these resulted in an authentic database on distribution, biology, capture, culture, and fishery of several molluscan forms (Subha Rao 1970; Daniel & Rajagopal 1974; Menon 1976; Chatterji 1976; Rajagopal & Subba Rao 1977; Nagappan Nayar & Appukuttan 1983; Ramadoss 1983; Alagarswami 1983; Mahadevan 1983; Dorairaj & Soundararajan 1985; Soundararajan & Dorairaj 1987; Soundararajan *et. al.* 1988).

MOLLUSCAN FISHING ZONES

For the purpose of commercial shell collection from the coastal areas, the entire Andaman and Nicobar coastal waters have been demarcated into 9 fishing zones; 7 zones in Andaman group of Islands and 2 zones in Nicobar group of islands. As per Andaman and Nicobar Islands Shell Fishing Rules (1978), the shells are to be exploited by licensing. The 'fishing season' commences from first day of October and expires and the thirtieth day of April every year. Shell fishing is prohibited during the rest of the period in the year. After two consecutive fishing seasons in a zone, the subsequent two years are completely closed for shell fishing to allow regeneration of stock. During 'closed years' shell fishing is completely prohibited in all the fishing zones. The following points are also stipulated in the rules: quantity of shell collections from each zone in one season should not exceed 15 tons in weight. At the end of each collection trip, the licensee should return to authorised port of call and should apply for inspection and measurement of collected shells by the authorised officer. *Trochus* shells that pass through a 9 cm ring are treated as undersized and are to be returned to fishing ground in live condition. *Turbo* specimens less than 6.35 cm in diameter at operculum are considered as undersized. The licences are liable for cancellation if undersized shells are more than 10 % of total catch.

SHELL COLLECTION METHODS

Rao (1938) described in detail the Japanese fishing method for collection of *Trochus* and *Turbo* shells. A more or less similar method is still being followed in the Andaman for collection of shells. Each licensee has been permitted to have one power driven boat and four smaller dinghies or canoes and engage not more than 20 registered divers. The smaller dinghies called 'Sampan' are towed by a power boat up to the fishing area, and each sampan with 3-4 divers onboard will be left at different areas about half a km from each other. The divers will dive to the sea bottom to collect the shells. Imported or locally made goggles or glass masks are the only gadgets used by divers for shell fishing which is usually done in the forenoon.

Shells are collected from depths ranging from 10 to 25 meters. Each diver will fish for 3 to 4 hours in a day. Beside *Trochus* and *Turbo* other marine gastropod shells such as *Strombus*, *Lambis*, *Oliva*, *Xancus*, *Cypraea*, *Murex*, and *Conus* are also collected.

CULTIVABLE MOLLUSCS

Pearl oysters

Four species of pearl oysters are known to occur in Andaman and Nicobar waters. They are *Pinctada margaritifera*, *P. fucata*, *P. anomioides* and *Pteria penguin*. The blacklip pearl oyster (*P. margaritifera*) is the most abundant species in the islands. It produces black pearls of high quality.

Central Agricultural Research Institute (CARI), Port Blair, has conducted experiments with *P. margaritifera* to produce pearls. Success was achieved in producing half pearls. Single and multiple implantations of 3 to 6 mm diameter shell nuclei were carried out and the oysters were reared in metal cages in the subtidal area. About 1 mm thick pearly layer was formed over the nuclei in about one year (Dorairaj & Soundararajan 1994).

The winged pearl oyster *P. penguin* is an

other important species which is known to produce brilliant pinkish half pearl. There is good opportunity for developing pearl culture in these islands under ideal conditions as unpolluted sea water exist around them.

Edible oysters

Crassostrea madrasensis and *Saccostrea cucullata* are distributed in fair densities in intertidal areas around several islands. The edible oyster population is more abundant in the Andaman Islands as compared to Nicobar Islands. In the Andamans the density of *Saccostrea cucullata* was between 15 and 70 m⁻² and that of *Crassostrea madrasensis* was between 5 and 35 m⁻² and in Nicobar the distribution was 10 to 30 and 5 to 8 m⁻² for the respective species in the intertidal region (Ramadoss 1983), *S. cucullata* was more dominant in all regions. The oyster meat is relished by 'Karens', Bengali settlers and Nicobarese. Presently, the edible oysters are not being cultivated. However, there is potential for establishing oyster culture in sheltered bays adopting rack method or longline method.

Green mussel

Perna viridis occur in restricted populations in tidal areas near Bimbleton, Sippighat, Kalapathar, and on the rocks of the intertidal regions at Junglighat and Mitakhari, all in the Andamans. Green Mussel has been successfully cultured on ropes suspended from cross poles planted in the tidal creek (Soundararajan *et al.* 1988).

Seed of green mussels are available in restricted quantity only in the above mentioned areas. In the culture trial, the seed size ranged from 47 to 81 mm in shell length and 16-37 g in weight. Small sized seed are very rare. The mussels had a growth rate of 5.7 to 14.8 mm month⁻¹. The total net increase in weight ranged from 13 to 23 kg per meter length of rope in 5 months (Soundararajan *et al.* 1988). The predation on mussel, and slipping of seed from the rope, were negligible. The size range of cultured

mussels was 50-100 mm. Mussels contained 36.3 % meat by body weight. Raft culture of green mussels in offshore open sea also has great potential for development in the Andaman and Nicobar Islands.

Giant clam

Data exists on three species of giant clam in the Andamans: *Tridacna crocea*, *T. maxima*, *T. squamosa*. Giant clams occur singly and mostly colonise the sheltered waters, firmly buried in corals or attached to other substrata. *T. crocea* is abundant in Andaman waters rather than in Nicobar waters. *T. maxima* is the next important species with the same pattern of distribution. In the Great Nicobar, *T. crocea* and *T. maxima* were found in abundance in the inshore regions on coral reefs. Giant clam was experimentally cultured by CARI, Port Blair. Preliminary studies on the culture of *T. crocea*, *T. maxima* and *T. squamosa* indicated an average shell growth of 2.5 mm month⁻¹ up to 10 g in weight in smaller individuals. No feeding was required and they survived well in sea water kept under open sunlight. Application of lime and nutrients in water enhanced the growth process. The growth of giant clam has been found to be comparatively faster when it is reared in cages in the intertidal areas than those reared in land based outdoor tanks.

Farming of giant clam is on the verge of becoming a highly prospective economic enterprise in the tropical Indo Pacific region. It has been recognised that giant clams are large because they grow very fast and not because they are hundreds of years old. The largest species *T. gigas* which has also the highest growth rate can grow approximately 10 cm per year in the early years.

Mariculture of giant clam can be divided into five phases, viz., spawning, hatchery, nursery, ocean nursery and grow-out. Computations based on growth rate for *T. gigas* suggest that annual harvest exceeding 40 tons of marketable flesh ha⁻¹ is achievable. Adductor muscle is a highly preferred delicacy in Southeast Asia.

ORNAMENTAL MOLLUSCS

Trochus, *Turbo*, *Xancus*, *Cassia*, *Lambis*, *Conus*, *Nautilus*, *Cypraea*, *Tonna*, *Oliva*, *Murex*, *Thais*, *Pinna*, *Atrina* etc. are other important molluscs collected from the Andaman and Nicobar Islands mainly for ornamental and curio purposes. Apart from decorative purposes they are manufactured into table lamps, lockets, button, cufflinks, bangles, rings, ash trays, studs, hairpins, necklace, and inlaying works. There are more than 30 shell craft units in the Andaman and Nicobar Islands.

GENERAL REMARKS

It is now well established that the coastal waters of the Andaman and Nicobar Islands are very rich in molluscan resources. However, some species have been over exploited during the past years, which have resulted in depletion of stocks, especially *Turbo* and to some extent *Trochus*. These are important molluscan resources of the islands. Very strict enforcement of shell fishing regulation is required. There is a need for consideration of totally prohibiting the fishing of *Turbo* as it is becoming virtually extinct in these islands.

In order to revive the *Turbo* and *Trochus* fishery earnest attempts should be made for producing hatchery seed, and transplanting the young ones to suitable and protected habitats. Such sea ranching programmes should be given high priority and necessary infrastructure to facilitate such conservation programmes is an urgent need. There are good prospects for establishing pearl oyster farms in the Andaman and Nicobar Islands since ideal environment with unpolluted sea water exists in several protected bays. Success has already been achieved in producing half pearls in blacklip pearl oysters. This programme needs to be strengthened with collaborative efforts from national and international institutions. Overall well designed projects for research and development for a sustainable use of marine resources in the Andaman and Nicobar Islands, with particular reference for pearl oysters, giant clams, *Turbo* and *Trochus* with adequate funding from Tropical Marine Molluscan Programme are worth consideration.

REFERENCES

- Alagaraswami, K. 1983. The black-lip Pearl Oyster resources and pearl culture potential. - Bulletin of the Central Marine Fisheries Research Institute **34**: 72-78.
- Amirthalingam, C. 1932. Breeding of *Trochus* and preservation of the beds in Andaman. - Current Science **1**(1): 31
- Chatterji, S. 1976. Andaman shell handicrafts. - Yojana **20**(13): 70-71.
- Daniel, A. & A.S. Rajagopal. 1974. Molluscs of economic values from Great Nicobar Islands. - Journal of the Bombay Natural History Society **70**(2): 394.
- Dorairaj, K. & K. Soundararajan. 1985. Exploited Marine Fisheries resources of Andaman and Nicobar Islands. - Journal of Andaman Science Association **1**(I): 49-58.
- Dorairaj, K. & K. Soundararajan 1994. On the success of half pearl production in black lip pearl oyster (*Pinctada margaritifera*) from Andaman. - Journal of Andaman Science Association (in press).
- Mahadevan, S. 1983. On the possibility of mussel culture. - Bulletin of the Central Marine Fisheries Research Institute **34**: 70-71.
- Menon, P.M.G. 1976. Fisheries in Andamans. - Yojana **20**(13): 65.
- Nagappan Nayar, K. & K.K. Appukuttan. 1983. *Trochus* and *Turbo* resources. - Bulletin of the Central Marine Fisheries Research Institute **34**: 81-84.
- Panicker, N.K. 1938. Recent researches on *Trochus*. - Current Science **6**: 552-553
- Prasad, B. & H.S. Rao. 1934. Notes on the bio-nomies of *Trochus niloticus* Linné. On two limpet-like gastropods from the Andaman waters. - Records of the Indian Museum **35**: 409-412.
- Rajagopal, A.S. & N.V. Subba Rao. 1977. On chitons from Andaman and Nicobar Islands. - Journal of the Marine Biological Association of India **16**(2): 398-411.
- Ramadoss, K. 1983. Edible oyster resources and culture potential. - Bulletin of the Central Marine Fisheries Research Institute **34**: 69.
- Rao, H.S. 1936 a. Observations on the rate of growth and longevity of *Trochus niloticus* Linné in Andaman. - Records of the Indian Museum **38**: 473-498.
- Rao, H.S. 1936 b. A Statistical Survey of the data growth in shell of *Trochus niloticus* Linné in Andaman. - Records of the Indian Museum **38**: 499-502.
- Rao, H.S. 1937. On the habitat and habits of *Trochus niloticus* Linné in the Andaman sea. - Records of the Indian Museum **39**: 47-82.
- Rao, H.S. 1938. Consolidated report on the shell fisheries in Andaman during the year 1930-35. - Zoological Survey of India, Calcutta 130 pp.
- Setna, S.B. 1933. The Andaman shell fishery. - Journal of the Bombay Natural History Society **26**(1): 94-100.
- Smith, E.A. 1878. On a collector of Marine shell from Andaman Islands. - Proceedings of the Zoological Society of India **10**: 804-821.
- Soundararajan, R. & K. Dorairaj. 1987. Coastal Aquaculture in Andaman prospects and problems in the proceedings of the symposia on management of coastal ecosystems and oceanic resources of Andamans, organised by Andaman Science Association. 71-79.
- Soundararajan, R., K. Dorairaj & I. Jagdish. 1988. Experimental culture of green mussel, *Perna viridis* (L.) in the Andamans. - Journal of Andaman Science Association **4**(1): 61-66.
- Subba Rao, N.V. 1970. On the collection of Strombidae (Mollusca: Gastropoda) from Bay of Bengal, Arabian sea and Western Indian ocean with some records.