BIODIVERSITY AND BIOLOGY OF MARINE ORNAMENTAL REEF FISHES OF GULF OF MANNAR – PARROTFISHES (FAMILY: SCARIDAE)

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ABSTRACT

Many highly priced ornamental reef fishes are available in the Gulf of Mannar Marine Biosphere Reserve. Among the 113 marine ornamental finfish species recorded, parrotfishes coming under the family Scaridae, show a very rich biodiversity and species richness. Studies made on the biodiversity of parrotfishes of Gulf of Mannar revealed the occurrence of 9 species of which Scarus gibbus formed a year round fishery in Gulf of Mannar (9.4 tonnes). A study made on biodiversity using different indices showed that in parrotfishes, diversity and evenness were higher at Thoothukudi coast than Mandapam coast. Examination of gut contents of all the recorded revealed that many species feed on living coral polyps and medusae. In addition to corals, algal matter and crustacean remains were also recorded in the gut contents. By virtue of their high biodiversity, the reefs of Gulf of Mannar serve as good breeding grounds for 4 species of parrotfishes.

INTRODUCTION

The world ornamental fish trade is about 4.5 billion US$ and India's export earning through ornamental fish is about 0.5 million US$. Among the ornamental fish species, the marine ornamental fish species constitute only about 10–15% of the market. About 95% of marine fish are collected from the wild, while 5% are bred fish. The figure for cultured marine fish is continually growing as advances are made in the breeding technology for new species. The price of an ornamental fish is considerably higher than the price of a fish destined for human consumption.

Like the freshwater ornamental fishes, the marine ornamental fishes show tremendous amount of variations in colour pattern. The aquarists and scientists are puzzled by the different colour patterns that may occur in the single species of reef fish. Due to drastic variation in colouration in different length groups, taxonomists working in marine ornamental fishes gave different names and this caused a great deal of confusion in subsequent literature. In addition to this, sexual dimorphism is also more common along with good camouflage.

Variations in pattern and the intensity of colours are influenced by a number of ecological factors including the depth, the type of substrate, turbidity and the time of day.

Colour intensity variation related to depth is common in many fishes, particularly among the parrotfishes, seahorses, butterflyfishes, pipefishes, surgeonfishes, wrasse, damselfishes, angelfishes, etc.

ORNAMENTAL FISHES IN THE REEFS OF GULF OF MANNAR

The Gulf of Mannar is the First Marine Biosphere Reserve not only in India but also in South and Southeast Asia. It falls within what is the Indo-Pacific realm - the world's richest region from a marine biodiversity perspective. This reserve was one of the six areas chosen on the basis of seriousness and diversity of threats on one hand and the richness of biological wealth on the other. This marine biosphere occupies an area of 10,500 sq. km. Considering the importance and conservation of diversified fishery resources, a Marine National park has been set up in this province.

Gulf of Mannar has unique ecological systems mainly contributed by coral reefs (as spawning and feeding grounds), seagrass beds (as nursery grounds) and mangroves (as shelter and feeding grounds) for many species of commercially important finfish and shellfish. There are 21 islands which extend between 8^{o} 47′ N Lat 78^{o}12′ E Long and 9^{o}15′ N Lat. –79^{o}14′ E Long from Pamban to Thoothukudi as an arc, i.e., these islands are arranged northeast from Thoothukudi. Excepting Krusadai island, Musal island and Nallathanni island, other islands are uninhabited. Most of the islands are small, i.e., less than 8 sq. km. These islands are generally formed of a calcareous framework of dense corals and coral reefs. The southern-most island, Pandyan island (also called Hare Island) is now connected with the main land following the construction of the major port.

The Gulf of Mannar with its islands provides a very interesting heterogeneous group of fauna and flora. Located within this biosphere reserve, Krusadi island exemplifies the biological significance of the area. This island has representatives of every animal phylum known except amphibians. About 3,600 species of fauna and flora have been identified from this region. An unique endemic species of Balanoglossus - *Ptychodera fluva*, a living fossil that links invertebrates and vertebrates has been recorded only from this island.

Pillai (1996) provided a comprehensive account of the coral fauna of this region. There are about 94 species of corals belonging to 37 genera in the Gulf of Mannar. The most commonly occurring genera of corals are *Acropora, Montipora, Porites*, *Astreopora* and *Pocillopora* sp.

In Gulf of Mannar, a total of 113 marine ornamental finfish species, have been recorded and their biodiversity and standing stock biomass were also assessed (Venkataramani, 2004). The recorded species have exclusive ornamental value and are not considered as food fishes unlike other coral loving species, such as nemipterids,

lutjanids, serranids, carangids, etc. The recorded 113 marine ornamental fishes come under 24 families, of which the family Acanthuridae, Balistidae, Chaetodontidae, Haemulidae, Labridae, Pomacanthidae, Pomacentridae, Scaridae and Syngnathidae have a very rich biodiversity perspective in Gulf of Mannar. The biodiversity and biology of these families have been studied in detail in the Gulf of Mannar Province. (Venkataramani, *et al*., 2005).

The parrotfishes coming under the family Scaridae are one of the most conspicuous elements of the coral reef community. The parrotfishes are very closely related to wrasses in their colour pattern. The parrotfish gets its name because of teeth, which are fused into a solid horny plate, which resembles the bill of a parrot. However, few species have separate teeth.

These species have molariform teeth with powerful jaw muscles, highly adapted for browsing coral polyps, medusae and associated zooxanthellae, a special type of algae found in the tissues of living corals. While grazing on reefs, these fishes break pieces of corals. The polyps and medusae of corals are chewed into fine sand and passed through the digestive tract. It is reported by Harold *et al.* (1984) that by eating coral and coralline red algae, a single parrotfish may produce upto 90 kg of sand/year. Thus, these parrotfishes ingest large amount of calcareous materials along with live coral polyps and this is ground into a fine powder with the help of powerful pharyngeal teeth and passed out as faeces. Thus, parrotfishes contribute substantially to the formation of bottom sediments.

DISTRIBUTION

Parrotfishes are distributed in tropical and subtropical seas. They occur mainly in reefs and algal beds. Eighty species were identified in this family (Nelson, 1989). In Indian Ocean, about 50 species are reported to occur and in India, about 20 species are reported. The occurrence and diversity are high in Gulf of Kachchh, Palk Bay and Gulf of Mannar, Andaman and Nicobar islands and Lakshadweep islands. By an intensive study made along the entire stretch of Gulf of Mannar on the biodiversity of scarid fishes, nine species of parrotfishes were recorded in the family Scaridae. These species are caught in specialized bamboo traps (one, two and three holes) operated in the reef islands of Gulf of Mannar at a depth of 20 m (Fig. 1).

BIODIVERSITY OF PARROTFISHES

To study the biodiversity of scarid fishes in Gulf of Mannar, three biodiversity indices, namely, Simpson diversity, Shannon diversity and Brillouin diversity, Simpson evenness, Evenness and Brillouin evenness were tested at two major landing centres of Gulf of Mannar namely, Mandapam and Thoothukudi coasts. The diversity and evenness

were high in Thoothukudi coast because of more species diversity and species richness compared to Mandapam coast of Gulf of Mannar (Table 1). At Thoothukudi coast, 9 species were recorded, among which *Scarus gibbus* formed a good fishery (9.4 tonnes) in the year 2003 – 2004.

Table: 1 Biodiversity Indices of Parrotfishes of Gulf of Mannar

Sl. No	Indices	Thoothukudi coast	Mandapam coast
1.	Simpson Diversity	0.484	0.263
2.	Shannon Diversity	0.529	0.313
3.	Brillouin Diversity	0.681	0.367
4.	Simpson Evenness	0.518	0.342
5.	Evenness	0.682	0.436
6.	Brillouin Evenness	0.321	0.286

BIOLOGY OF PARROTFISHES

An intensive study was made on the food habits and reproduction of scarid fishes of Gulf of Mannar. The above parameters were analysed by collecting specimens from 6 reef islands of Gulf of Mannar by SCUBA diving and using underwater video camera, the spawning grounds were also identified. Biological studies were also made on examining specimens from the Thoothukudi and Mandapam fish landing centres of Gulf of Mannar. Biological investigations have been made on the following species of Gulf of Mannar.

Bolbometopon muricatum, (Valenciennes, 1840) - Green humphead parrotfish (Fig. 2)

This species is confused with other humphead parrotfishes and humphead wrasses. Unlike wrasse, this species has a vertical head profile and unlike other parrotfishes this species is uniformly coloured for the leading edge of head, light green to pink, with a nodular outer surface to its beak.

The beautifully coloured green humphead parrotfish, which is a new record to Indian coast, was collected for the first time at Gulf of Mannar. This species was collected at Villangu Shuli island at a depth of 20 m. The collected specimen was a juvenile measuring 32 cm. It is reported that this species lives for 35 years and its first

maturity, however, was reported to be around 10 years. Since its flesh is not tasty, it is not generally consumed. Examination of the gut content revealed that this species generally feeds on benthic algae, live coral polyps and coral stones. It is also reported that this species consume about one cubic metre of coral skeleton per year, which is excreted as fine silt. With the help of their humphead, they ram their heads into the coral and break pieces off to facilitate feeding. This species grazes on corals and sleeps at coral crevices during night. It is a rare species in Gulf of Mannar.

Scarus ferrugineus, Forsskal, 1775 - Rusty parrotfish (Fig. 3)

This species was recorded in lesser numbers in Musal, Nallathanni and Krusadai islands of Gulf of Mannar at a depth range of 2 – 20 m. This species was also caught in gill nets, at a depth of 40 m. The maximum length recorded for this species in Gulf of Mannar region was 29 cm. This species is an omnivore and feeds on seaweeds such as *Sargassum, Ulva and Gracillaria.* In addition, a few coral bits were also recorded in the gut contents. The life span reported for this species is 7 years and attain maturity at 2 years of age. Length at minimum maturity was 25 cm. Specimens with mature testis and ovary were also collected and they were measuring 24 – 26 cm. Fecundity was estimated and the number of mature ova ranged from 61,280 to 1,14,250 at a length range of 23 – 27 cm. This species is not consumed fresh but are sundried. It is also a rare species in Gulf of Mannar.

Scarus ghobban Forsskal, 1775 - Yellowscale parrotfish (Fig. 4)

This species was collected in Kuswari, Villangu Shuli, Nallathanni, Musal and Krusadai islands of Gulf of Mannar at a depth range of 2 – 20 m. Also collected in gill nets and trawl nets at a depth of 40 m. This species lives in the inner and outer edges of *Acropora, Montipora* and *Pocillopora* corals. Small specimens (10 – 15cm) were collected in seaweed beds. Maximum length collected for this species in this region was 55 cm. Big specimens measuring 42 cm were collected in trawl nets and gill nets. Gut content analysis of this species showed that it is an omnivore, feeding on *Sargassum, Ulva, Gracillaria* and unidentified seaweeds. In addition to seaweeds, bits of corals were also recorded in the stomach in large quantities. The life span reported for this species is 13 years and attain maturity at 40 cm. This species is consumed in fresh condition. The contribution of this species to the fishery was 0.5 tonne per year at Tuticorin coast.

Scarus gibbus Ruppell, 1829 – Heavybeak parrotfish (Fig. 5.1 and 5.2)

This species forms a good fishery in the Gulf of Mannar region. This species contributes 9.4 tonnes per year at Tuticorin coast of Gulf of Mannar. This species is

caught in traps, gill nets and also in trawl nets. This species occurs in large groups in Kuswari, Villangu Shuli, Nallathanni and Krusadai islands of Gulf of Mannar at a depth range of 2 – 20m. They are frequently seen near *Acropora, Montipora* and *Pocillopora* corals. This species is an omnivore and the gut contents revealed the presence of coral polyps, algae, bits of seagrass and debris. The maximum length recorded for this species at Gulf of Mannar region was 80 cm.

Parrotfishes are hermaphroditic and many species begin life as females (protogynous). However, some species of parrotfishes are males in the initial stages (protandrous) (Girolamo *et al.,* 1999). In the present study, *Scarus gibbus* and *S. ghobban* were found to be both males and females initially. It was also observed that most of the specimens at higher length groups (30 cm) are males. The terminal males are much larger showing bright colouration than the juveniles, initial males are females. It was also observed that there are transitional males (25 cm) which had testis and undeveloped ovary. This indicates that *S. gibbus* have testis in the initial stage and later develop into functional ovaries. However, reverse trend was also observed by Girolamo *et al.,* (1999), where the initial females transform into males with ovary and secondary testis. In the present study, it was observed that *S. gibbus* has an extended breeding season with peak in March to April and an other in December and has life span of 7 years, attains maturity at two years of age. Mature males and females were collected in large numbers in the Kuswari, Vilangu Shuli, Nallathanni and Krusadai islands of Gulf of Mannar at a depth range of 15 – 20 m. The length at first maturity recorded for this species was 35 cm. The mature males and females were in initial phase with bright red/green colouration. The number of mature ova was ranging from 58,200 to 1,15,000 in specimens measuring from 35 to 38 cm. The recruitment was also observed round the year. Since the life span of this species was 7 years, this species has an effect on the amount of bioerosion and sedimentation that can occur on the reef over the lifetime of the fish. Obviously, fish having a longer life span will have a greater amount of bioerosion in reefs than fish having a life span of five years (Choat *et al*., 1996).

The flesh of *S. gibbus* is very soft and hence eaten in fresh condition. The flesh of the parrotfishes in general, when eaten raw is considered as a great delicacy in Polynesia and also as “Royal Fish” in former times as it could only be eaten by the kings. (Girolamo *et al.,* 1999). Young ones of less than 10 cm having aquarium value are priced Rs. 200 per fish and are exported. The present level of exploitation of *S. gibbus* is 0.46. It could be further increased, as the optimum exploitation for this species is 0.5.

COCOON FORMATION

In the present study, it was observed that this species and *S. russelii* tend to sleep in night hours. This was noticed in Krusadai island at a depth of 15 – 20 metres by SCUBA divers. These species build a mucus envelope around themselves, at night hours. These envelopes protect the parrotfishes. The mucus produced by the fish gets a gelatinous but supple texture when contact with water. This envelope keeps fish scent from reaching predators. They sleep under crevices of *Acropora* and *Montipora* reefs. Scientists think that the mucus makes it harder for predators to find the parrotfish (Bouchet *et al.*, 1996).

Scarus globiceps Valenciennes, 1840 - "Globehead parrotfish" (Fig. 6)

This species was recorded in Nallathanni and Krusadai islands of Gulf of Mannar at a depth range of 3 – 20m. The maximum length recorded in this region was 25cm. This species is an omnivore, feeding algae and coral polyps. The life span reported for this species was 2 – 3 years, and attains maturity at first year of age. This species is rare in Gulf of Mannar.

Scarus niger Forsskal, 1775 - "Dusky parrotfish" (Fig. 7)

This species was recorded in lesser numbers in the Krusadai and Musal islands of Gulf of Mannar at a depth range of 2 – 20m. The maximum length recorded in this region was 21cm. This species feeds on algae and corals. Young ones (10 – 15 cm) hide in the crevices of coral reefs of *Acropora* and *Pocillopora*. This species is rare in Gulf of Mannar.

Scarus psittacus Forsskal, 1775 - "Common parrotfish" (Fig. 8)

This species was collected in Krusadai island of Gulf of Mannar at a depth range of 5 – 15 m. The maximum length recorded was 22cm. This species is an omnivore, as unidentified seaweed and coral bits were recorded in the gut contents. This species is rare in Gulf of Mannar.

Scarus rubroviolaceus Bleeker, 1847 - "Ember parrotfish" (Fig. 9)

This species was collected in Kuswari, Villangu Shuli, Nallathanni, Musal and Krusadai islands of Gulf of Mannar at a depth range of 2 – 20m. It was collected in good numbers in trawl nets and gill nets at Tuticorin and Mandapam coasts of Gulf of Mannar at a depth of 40 m. The maximum length recorded for this species in this region was 39

cm. Studies on the food habits of this species revealed the presence of seaweeds and polyps of corals in the gut contents. Along with seaweed and corals, unidentified crustacean remains were also recorded in the gut contents of this species. This species has a life span of 5 years and attains age at first maturity in less than two years of age. The length at maturity recorded for this species at Gulf of Mannar was 28 cm. Mature females and males were collected in the said islands of Gulf of Mannar at a depth range of 15 – 20m. Both the mature sexes were bright orange red in colour. Fecundity was estimated in specimens ranging in length from 25 to 33 cm and the number of mature ova was ranging from 52,100 to 1,21,000. Unlike other scarids, flesh of this species is more harder and not consumed in fresh condition. Juveniles of this species (10 – 20 cm) are considered as good aquarium fish and are priced for Rs. 200 per fish in Gulf of Mannar. This species is recorded in lesser numbers in Gulf of Mannar.

Scarus russelii Valenciennes, 1840 - "Eclipse parrotfish" (Fig. 10)

This species was recorded in Kuswari, Villangu Shuli, Nallathanni and Musal islands of Gulf of Mannar at a depth range of 3 – 20m. It was also collected in small numbers in hook and lines and gill nets operated at Tuticorin coast at a depth of 30 m. The maximum length recorded for this species at Gulf of Mannar was 27 cm. This species is an omnivore. Seaweeds (*Gracillaria* and *Sargassum)* were recorded in the gut contents. In addition to seaweeds, corals polyps were recorded in the gut contents. The life span reported for this species is about 4 years and attains maturity at 2.5 years at a length of 25 cm. Few specimens (25 – 27cm in TL) with mature gonads were collected in the Nallathanni island of Gulf of Mannar at a depth range of 15 – 20 m. Flesh is very soft and consumed in fresh condition. It is a rare species in Gulf of Mannar.

CONCLUSION

In the present study, it is evident that parrotfish species are very common in all the reef islands of Gulf of Mannar. It was observed that biodiversity and species richness are more in Thoothukudi coast of Gulf of Mannar. These typical reef fishes exhibit three unique adaptations that make them very interesting subjects for scientific exploration. All the species have a set of pharyngeal teeth, which are used to browse on corals. This adaptation helps them reduce interspecies competition for food resources within the reef community. A second set of adaptation is, they show good amount of colouration and exhibit hermaphroditic life style. This lets them change sex in response to fluctuations in population density. The more interesting character of parrotfish *S. gibbus* is, they sleep at night by surrounding themselves in a mucus cocoon for protection. Though most of the species were recorded in lesser numbers in the reef islands, *S. gibbus*, occur in large numbers and could be exploited more for ornamental fish trade in Gulf of Mannar.

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Fig.1. Trap

Fig. 2. *Bolbometopon muricatum*

Fig. 3. *Scarus ferruginues*

Fig. 4. *Scarus ghobban*

Fig. 5.1 *Scarus gibbus* (Initial phase)

Fig. 5.2. *Scarus gibbus* (Terminal phase)

Fig. 6. *Scarus globiceps*

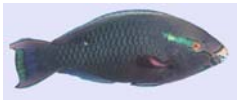

Fig. 7. *Scarus niger*

Fig. 8. *Scarus psittacus*

Fig. 9. *Scarus rubroviolaceous*

Fig. 10. *Scarus russelii*