

Glimpses of Marine Biodiversity at Lakshadweep

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Introduction

Marine environment is the most spectacular and diverse systems of the planet and coral reefs are getting much importance, as it plays a major role in coast line protection and also providing livelihood to millions of people. Complex and productive reefs boast thousands of species, many of which are un-described by science. Corals have been the underlying reason for the structure of reef ecosystems for at-least 200 million years; they have built the primary structure of entire reefs, islands and such massive oceanic barriers of the world oceans. Coral reefs protect the coast from storm damage, erosion and flooding by reducing wave action across tropical coastlines. The fortification offered by coral reefs also enables the formation of associated ecosystems (seagrass beds and mangroves), which allow the formation of essential habitats, fisheries and livelihoods. Over the last three decades there has been a change worldwide from traditional, usually sustainable, exploitation of coral reef resources to a heavy increase in demands largely as a result of demographic changes. At the same time coral reefs in a wide range of geographic locations have suffered degradation as a result of both natural (tropical cyclones, volcanic activity, catastrophic low tides, El Nino-Southern Oscillation events) and anthropogenic disturbances (coral mining, dredging, sewage, dynamite fishing, chemical pollution, oil spills, ship groundings and sediment, fertilizer and pesticide run-off as a result of changing land-use).

Coral reefs in India have been under stress for quite some time. The major reef formations in India are restricted with Gulf of Mannar, Gulf of Kachchh, Andaman & Nicobar and Lakshadweep Islands. Scattered coral growth has also been reported along certain inter-tidal belts and submerged banks both on the east and west coasts of the country. Reefs at present are important to the local community only to the extent of sustenance fishing. Tourism is being developed at some places though local communities do not benefit much from the revenue generated. The reef condition is

generally poor and declining in near shore waters and areas of high population density. Sedimentation, dredging and coral mining are damaging near shore reefs, while the use of explosives and bottom nets in fishing are damaging off shore reefs in specific regions. The bleaching event of 1998 has been reported to have increased dead coral cover to about 70% in the Gulf of Kachchh, 40-60% in the Gulf of Mannar, 60-80% in Lakshadweep and about 80% (subsequent studies do not confirm this report) in Andaman and Nicobar Islands. Quantitative data and studies on monitoring health of coral reefs are inadequate.

Geography

The union territory of Lakshadweep (Laccadive Archipelago) is located on the Laccadive-Chagos ridge, supposed to be the continuation of the Aravali mountains and considered as the largest atoll system in the world. It consists of inhabited and uninhabited islands, which are well known for their floral and faunal diversity. They lie scattered in the Arabian Sea between 225 to 445 km from Kerala coast and lies between the latitudes 08°00' N and 12°30'N and longitudes 71°00'E and 74°00'E. This is the smallest union territory of India, measuring 32 km² with 36 islands, 12 submerged banks and 5 atolls. Though the land area is small, it has a lagoon area of 4200 km², exclusive economic zone (EEZ) of 400,000 km² and territorial waters of 20,000 km² (Apte, 2012). The islands are fringed by coral sands and marked by huge, shallow and calm lagoon on the west coast, bordered by massive coral boulders and live corals, which protects the island from the incoming swells of the outer sea.

Biodiversity

Marine biodiversity of Lakshadweep Islands is very rich with corals (148 species) and their associated fauna viz. 603 species of finfish (Jones and Kumaran, 1980), 93 species of marine algae, 406 species of mollusks, 58 species of echinoderms, 86 species of annelids, 2



species of amphibians, 18 species of reptiles and 95 species of birds (Apte and Dutta, 2010). Reef fishes and corals are the most heavily collected and traded group of organisms in the marine ornamental industry, which represents the major source of income. However, increasing demand for other groups of ornamental invertebrates is also exploited by the professional collectors and thereby enters into the marine aquarium trade.

Marine ornamental fishes

Fishes of Lakshadweep Islands, especially those of commercial value are very abundant. Of the 603 species of marine fish of 126 families reported from these islands, at least 300 species belonging to over 40 families are **ornamental fishes** (Jones and Kumaran, 1980). However, there is no detailed information on the relative abundance or areas in profusion of different species of ornamental fishes at various islands.

Ramachandra (2002) published a document about 165 species belonging 20 families of marine ornamental fishes from the selected nine islands. Among them, Labridae (wrasses, 32 species) has the largest number of species, followed Pomacentridae (damsel fishes, 26 species), Serranidae (groupers, 9 species), Acanthuridae (surgeon fish, 17 species), Chaetodontidae (butterfly fish, 14 species), Scaridae (parrot fish, 12 species), Mullidae (goat fish, 10 species), Balistidae (trigger fish, 06 species), Holocentridae (squirrel fish, 11 species), Apogonidae (cardinal, 9 species) Siganidae (rabbit fish, 3 species), Scorpaenidae (lion fish, 3 species), Canthigasteridae (puffer fish, 2 species), Pomacanthidae (angel fish, 2 species), Tetraodontidae (puffer/ porcupine fish, 2 species) Synodontidae (lizard fish, 1 species), Ostraciontidae (boxfish, 1 species) and Zanclidae (moorish idol, 1 species). Recent survey conducted by Ajith Kumar *et al.* (2012 a,b) reported 177 species of ornamental fishes belongs 30 families from Agatti,



Under water view of ornamental fishes (clowns and damsels) at Lakshadweep

Bangaram, Kalpatti, Amini and Kadamat islands and also found that the Labridae is dominant followed by Pomacentridae, Acanthuridae, Scaridae and Chaetodontidae.

Marine invertebrates

Over 700 marine invertebrate species are currently traded in the marine aquarium industry (Wabnitz *et al.* 2003) and almost most of them found here. Corals, both soft and stony species are the popular and expensive group of marine ornamental invertebrates in the trade. Nonetheless, several groups of marine invertebrates are also heavily collected, such as other cnidarians (mostly sea anemones), mollusks (tridacnid clams and snails), decapods crustaceans (shrimp, crabs and hermit crabs) and live rock (although not scientifically a marine invertebrate, it is commonly traded under the designation of Scleractinia, along with stony corals; Wabnitz *et al.* 2003). Some other groups of ornamental invertebrates that are also collected for marine aquariums, although in lower amounts are polychaetes (tube dwelling species commonly known as feather dusters) and echinoderms (such as brittle stars, sea stars, sea cucumbers and sea urchins).

Corals

Corals have been propagated asexually for several years, either by public institutions, private enterprises or enthusiastic hobbyists. The fragmentation and growth of corals in re-circulating systems located inland has been widely practiced both by private aquarium reef

keepers, public aquariums and commercial enterprises.

Corals are of great importance to these islands and both hermatypic and ahermatypic corals occur in the sea around these islands. The commonest corals are *Acropora* sp., *Porites* sp., *Diploastrea* sp., *Goniastrea* sp. and *Lobophyllia* sp. The genus *Porites* is found in plenty at both lagoon and on reef flats. *Acropora formosa*, *A. palmata* and *A. pharaonis* are also commonly available (Anonymous, 2014). The massive coral bleaching event happened in 1998, caused the disappearance of selected ornamental fishes and the National Institute of Oceanography (NIO) has initiated the project on coral transplantation to repopulate the damaged coral reefs of Lakshadweep areas with the help of local participation. Some of the coral species transplanted in Kavaratti lagoon include *Acropora* sp. and *Pocillopora* sp. During the last few years, these techniques has been tested and found suitable and it is now being transferred to a community based exercise in all the islands, so that the reef restoration is enhanced, which will help in enhancing the fish catch near transplantation site (Suman Gad, 2008).

Sea anemones

Anemones have always been one the most popular marine invertebrates traded for marine aquariums and many scientific studies. The main reason for this popularity is certainly the symbiotic relationship displayed by anemones and clownfishes (*Amphiprion clarkii* and *A. nigripes*), as well as several other



Underwater view of corals at Lakshadweep





Sea anemones of Lakshadweep: a. Bubble tip anemone *Entacmaea quadricolor*; b. Tentacle anemone *Heteractis magnifica* with its resident Maldive clown *Amphiprion nigripes*

invertebrates (shrimps and porcelain crabs). However, the most popular anemone species of Lakshadweep waters includes *Heteractis magnifica*, *H. aurora* and *Entacmaea quadricolor*, which may be highly susceptible to over harvesting due to their long life span, slow growth rates and low reproductive rates. An additional aspect of concern is that the intensive harvest of clownfish, as well as symbiotic shrimp may also negatively affect the survival of host anemones in Lakshadweep waters.

Polychaetes

Sabellid polychaetes, popularly known as **feather dusters** are among the important ornamental invertebrates (Wabnitz *et al.* 2003). These organisms deserve their popularity in the hobby due to their delicate appearance, stunning coloration of their tentacle crown and their relatively large size. These tube worms, such as *Sabellastarte* sp. commonly inhabit the cracks and crevices of coral reefs at Lakshadweep, which makes their collection a challenging task. To harvest these organisms, collectors commonly employ destructive techniques (such as the use of crowbars) that damage delicate corals and other organisms surrounding the tube worm.

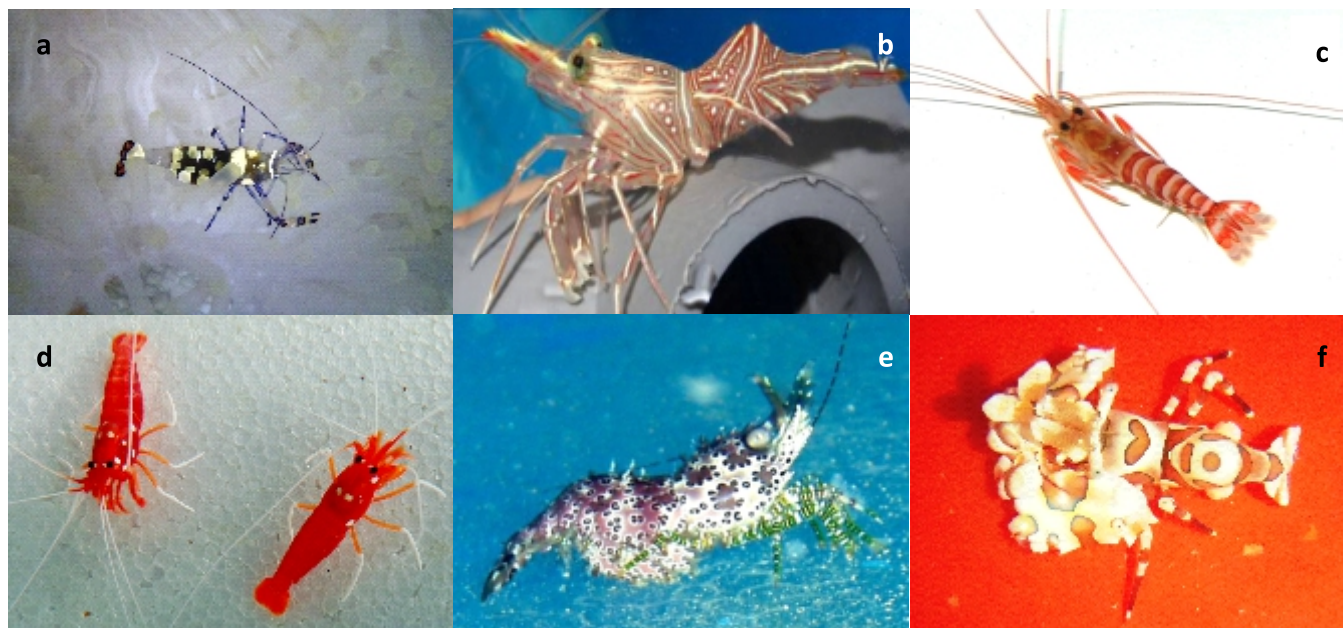
Mollusks

While describing the fauna of Lakshadweep, the importance of molluskan forms cannot be overlooked, since they are magnificent in their appearance and important from the economic point of the islanders.

The Cypraeds have great commercial value and the cowrie (*Cypraea monita*) is abundant in the shallow waters of the lagoons and on the reef. *C. tigris* and *C. caputser-pentis* are usually picked up from the reef area at low tide mainly by the women during their spare time and is largely sold in the mainland for decorative purposes. Other colorful varieties belonging to Cypraeds are *C. talpa* and *C. maculifera*. Cone shells are quite common and some of the species observed are *Conus betulinus*, *C. ebraeus*, *C. coronatus*, *C. abscurus*, *C. frigidus*, *C. piperatus* and *C. pinnaceus*.

Among bivalves, the giant clam *Tridacna* sp. is seen among the crevices of the coral boulders exhibiting its brilliantly colored mantle camouflaging itself from the surroundings (Anonymous, 2014). Giant clams are endangered species in Indian waters and are protected under Wildlife Protection Act (1972). With a highly specialized life cycle, giant clams are indicators of healthy coral reefs. To understand the conservation needs of the species, work has been undertaken in the Lakshadweep islands under “Project Giant Clam” (Apte, 2012).

The dazzling coloration of sea slugs makes them highly appealing for the marine aquarium trade and few species are being used for scientific (bioactive compounds) also. However, the strict feeding habits of the most appealing specimens (*Chromodoris* sp.) make them a poor choice, even for the most skilled hobbyists, as they will slowly starve to death in captivity. Recent



Ornamental shrimps: a. Anemone shrimp *Periclimenes brevicarpalis*; b. Camel shrimp *Rhynchocinetes durbanensis*; c. Cleaner shrimp *Lysmata wurdemanni*; d. Fire shrimp *L. debelius*; e. Marbled shrimp *Saron marmoratus*; f. Harlequin shrimp *Hymenocera picta*

studies on the **Ophisthobranch fauna** of Lakshadweep reported 60 species from 25 families.

Decapod crustaceans

Information on crustacean resources of Lakshadweep is limited with only a few reports on crabs, lobsters and prawns. A total of 132 species of brachyuran crabs, 6 species of lobsters, 5 species of penaeid prawns and 7 stomatopod species have been reported (Sudhakar Rao *et al.*, 1989). These islands are very rich in ornamental decapods crustaceans especially, Caridean shrimps. Preliminary survey on the marine ornamental shrimps of Lakshadweep waters were initiated in Agatti island and documented nearly 15 species and the survey is still continuing on other islands as well (Prakash *et al.*, 2012). As the culture of marine ornamental decapods has experienced significant advances in the last decade, the development of commercial-scale culture protocols for some ornamental shrimp and crab species are much needed (Calado 2008).

The ornamental shrimps *Hymenocera picta* and *Stenopus hispidus* are extremely colorful, the bright patterns and adaptability make it a popular aquarium species. *S. hispidus* is common in almost all the islands, available in good numbers and can be caught from shallow areas using simple methods. Sudhakar Rao *et al.*

(1989) suggested that the colorful hermit crabs available here could also be used as aquarium animals. The widely available species of ornamental hermit crabs are *Dardanus megistos* and *D. deformis* (anemone hermit crab) are also found here.

Echinoderms

Nagabushanam and Rao (1972) reported 49 species of echinoderms from the Minicoy Atoll of Lakshadweep. James (1989) has reviewed the same and mentioned 78 species, but the total number of species available in the Lakshadweep waters is still not clearly known and no recent information is available for the same. With the exception of the dazzling coloration, echinoderms available in the marine aquarium industry are commonly traded as members of “clean-up crews.” Sea urchins, serpent stars (brittle stars) and small sea cucumbers are collected in significantly larger numbers than any other echinoderms and are commonly employed by hobbyists to control unwanted algae, scavenge on uneaten food and/or stir up sand beds employed in modern reef aquariums.

Ornamental fish breeding programmes

To start the programme on breeding and cultivating the marine ornamentals, brood stocks have to be carefully chosen because high-quality breeders are essential for successful larval rearing. **The main**



Hatchery produced Clown fish, *Amphiprion nigripes* at Lakshadweep



bottlenecks impairing the commercial culture of marine ornamental species are their long larval development, poor survival rate and suitable live feed availability. The ecological impacts of harvesting ornamental species under captivity are still poorly studied. So, cooperation between researchers working on larval biology, population dynamics, ecology, aquaculture and fisheries is essential to properly manage these activities (Calado *et al.*, 2009; Olivotto *et al.*, 2011).

Techniques for the culture of selective marine ornamental fishes have been perfected by the Central Marine Fisheries Research Institute (CMFRI) and Annamalai University. The latter has established a marine ornamental fish hatchery at Agatti Island, Lakshadweep and transferred the hatchery production technologies to local islanders through hands on trainings for the sustainable livelihood development

with the financial support of the Centre for Marine Living Resources and Ecology (Ministry of Earth Sciences), Government of India.

Threats to the reefs and biodiversity

The coral reef decline seems to be related mostly to anthropogenic impacts like over exploitation of resources, destructive fishing, increased sedimentation and nutrient overloading. Reef bleaching is a generalized stress response and evidence indicates that elevated sea surface temperature causes mass bleaching of corals leading to a rapid loss of pigmentation of coral and whitening of the colony. An increase in the frequency of bleaching events could have drastic consequences with irreparable loss of biodiversity and livelihood also. A recent mass coral bleaching event at Lakshadweep during May-June 2010 was recorded at Agatti, where the bleaching phenomenon was



conspicuous and perceived throughout the lagoon at the rate of around 70 to 80%, similar to that which occurred in 1998. It was also observed that the reef associated organisms like giant clams and sea anemones were affected nearly 83 to 92%, while the daily mean sea surface temperature (SST) reaching a maximum of 34°C. Another study during the same period, observed a decrease in population of reef-associated fishes such as coral groupers butterfly and parrot fishes, etc (Vinoth, 2012).

People of Lakshadweep have noticed a drop in fish catch within the reef lagoons, which could be due to the loss of live corals due to bleaching or increased harvesting due to population increase on the islands (Koya *et al.* 2000). Methods of catching live bait for the tuna fishery also cause damage to the reefs and the reduction of live bait for the tuna fishery has an adverse impact on the local economy, since the tuna fishery is the mainstay of the local people.

Other than bleaching, the main causes for the loss of reef biodiversity are coral mining, dredging of navigational channels, unsustainable fishing practices, coastal development activities, souvenir collection and other population associated pressures. In the atolls of Lakshadweep, coral rock is extracted from shallow reef-flat areas for use in the construction of buildings and houses. Degradation of these reef-flats by coral mining leads to loss of live coral cover and topographic diversity and to loss of reef-associated fishes (Shepherd *et al.*, 1992). The blasting of corals to create navigational channels has been stopped; the construction of breakwaters on some of the islands is a cause for concern about coastal erosion related problems (Koya *et al.* 2000).

In addition, fishing activities are reportedly generating nearly 2000 tonnes of waste, posing a health hazard for the islanders as well. The use of chemical detergents (cleaning and washing) and the application of artificial fertilizers and chemicals cause leaching of excessive nutrients into the lagoon resulting in eutrophication and smothering of corals. Plastic dumping is another hazard of increasing magnitude which kill sea turtles, crabs, shrimps and other crustaceans (Sampath, 2012).

Recommendations

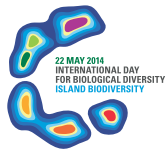
Lakshadweep islands are rich in biodiversity, but

increasing human population, demand for ornamental organisms, natural and anthropogenic effects may leads to species depletion in the near future. Hence, the following recommendations have been suggested for the sustainable management of biodiversity at Lakshadweep.

- Requires thorough knowledge of resident fauna, their systematic documentation and cataloging in all the islands
- Monitoring programmes for both biodiversity conservation and environmental changes will be strengthened and also new initiatives will be implemented
- An effort will be taken to declare the coral reefs of Lakshadweep under protected areas, needs to be given major attention
- Implementation of policies for sustainable harvest of resources from the reefs not by legislation, but by providing alternate options like culturing of bait fishes and ornamental organisms for the livelihood development of islanders
- Carrying capacity of each island in terms of living standards, population pressures and tourism have to be evaluated and should not be allowed to exceed
- Coral dredging should be reduced to avoid the physical damage to the reefs
- Education and awareness programmes for the island communities in a holistic way to know the importance of coral reef ecosystems and its associated resources
- To develop protocols for the sustainable harvest of ornamentals from the reef regions
- Establishment of marine ornamental aqua-park
- Create separate facilities to transport the live marine organisms to mainland for the sustainable aquarium trade in India and International scenario.

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