

AN ASSESSMENT OF LEGALLY PROTECTED MARINE FAUNA IN CURIO TRADE – A MARKET STUDY FROM TAMIL NADU, INDIA.

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Abstract

In an endeavor to prioritize the conservation of marine environment, species that are threatened were given protection under various Schedules of the Indian Wildlife (Protection) Act, 1972. Though the protection is sturdy on paper, marine fauna, such as sea shells, corals and sea horses are often illegally collected from their natural environment and are traded as marine curiosities. To assess those protected marine species in the curio trade in the state of Tamil Nadu, South India, certain major tourist and pilgrimage hot spots were surveyed during 2007. Among surveyed curio markets, Kanyakumari was found to have an alarming number of protected species being traded through huge number of marine curio shops. 15 species of legally protected mollusks, 10 species of corals and one sea horse species were found, along with other non-protected marine taxa in curio trade. Species protected through Schedule I were often highly priced than those under Schedule IV. The present survey suggests that protected marine species are an integral part in the growing marine curio business. High market demand, coupled with a lack of awareness and an inadequate enforcement were found to be major driving forces for the illegal marine curio trade. Awareness campaigns, along with a promotion of viable and alternate sources of income for seashell / coral collectors and strengthening of law enforcement may curtail the illegal marine curio trade.

Keywords: Marine curios; protected species; illegal trade; conservation; South India; mollusks; corals.

Introduction

Wildlife trade is a financially viable activity taking place across the globe at both national and international levels and is one of the primary reasons for the loss of biodiversity, threatening millions of plants and animals. It is not easy to survey the international wildlife trade, due to a wide variety of reasons and the existing trade records are extremely unreliable [1, 2]. The global wildlife trade is frequently carried out through informal paths, mostly hidden from government agencies and the domestic wildlife trade is hardly ever recorded.

The trade of marine ornamental mollusks and corals, along with other hard bodied marine vertebrates and invertebrates as curios, is becoming a major source of income for many of the coastal communities. Humans have been using these marine mollusks, corals and other fauna for a wide variety of purposes since prehistoric times [3]. The meat of marine mollusks

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and crustaceans is considered to be a major cheap protein source for the coastal fishermen [4]. Seashells have been used as currency, ornaments, tools, for games, medicine and as talismans and amulets [5]. Certain species have been thought to have mysterious, sacred or medicinal properties [6, 7], such as the sacred chank (*Turbinella pyrum*) which have been revered for centuries [8]. The current exploitation of these species as marine curios can threaten a range of mollusks, invertebrates and some fish species to extinction. However, there is a lack of official information on most of the species involved in trade [9].

To trim down the exploitation and to protect the overexploited marine fauna from the unrestricted curio trade, during the year 2000, the Government of India (GoI) included 24 species of marine mollusks, along with all reef-building hard and soft corals under various Schedules (Schedule I, II, III and IV) of the Indian Wildlife (Protection) Act, 1972 (IWPA), depending on their conservation importance [10]. Even though the law provides protection for those marine species, their illegal trade provides large-scale profits to traders, intermediaries and an income opportunity for the rural coastal communities.

In India, a detailed documentation of the protected marine fauna in the illegal curio trade has not been attempted. The existing economic evaluation of the marine species is mainly restricted to the commercially important species. Only a few studies have been conducted so far to quantify the trade of less commercially important marine species. Patterson & Ayyakkannu [11] studied the shell trade and the marketing of *Chicoreus ramosus* along the Gulf of Mannar. Patterson *et al.* [12] studied the meat trade of *Chicoreus ramosus* and *Pleuroploca trapezium* in the Gulf of Mannar and Palk Bay. Salin *et al.* [13] evaluated the catch and trade of sea horses in southern India. Asha & Diwakar [14] quantified the exploitation of the *Protoreaster lincki* starfish for the marine curio trade in Tuticorin, Tamil Nadu.

The initial reconnaissance conducted during the middle of 2006 revealed that the legally protected marine species were traded as curios in alarming amounts. The current study aims to assess the status of those protected marine species in curio trade and their exploitation in the southern coastal state of Tamil Nadu.

The Study Area

Tamil Nadu, the south eastern maritime state of India (Fig. 1), with its rich cultural heritage, attracts an enormous number of tourists from across the country and across the world. There was a 28.83% increase in the number of tourists who visited Tamil Nadu between 1993 and 2005 [15], which included domestic and foreign tourists. Tamil Nadu alone caters to about 12% of the total tourists arriving to India. Apart from being culturally rich, Tamil Nadu is also admired for its rich biodiversity, especially with respect to the marine life. The Gulf of Mannar Marine Biosphere Reserve and National Park, along the southern coast of the state, harbors a huge diversity of marine fauna and flora and it is also one of the four coral reef ecosystems of the country. Tamil Nadu has a coastline of about 1076 Km, across which a total of 591 marine fishing villages are spread.

Those were our reasons to select Tamil Nadu for this study. The entire coast of Tamil Nadu was surveyed for its marine curio trade. Major tourist and pilgrimage destinations, such as Kanyakumari (KK), Tiruchendur (TCR), Rameswaram (RAM), Velankanni (VGN), Poompuhar (PHR), Chidambaram (CDM), Pondicherry (PDY), Mahabalipuram (MPM) and Chennai (CHN) were given major priority, based on their tourist and pilgrim influx.

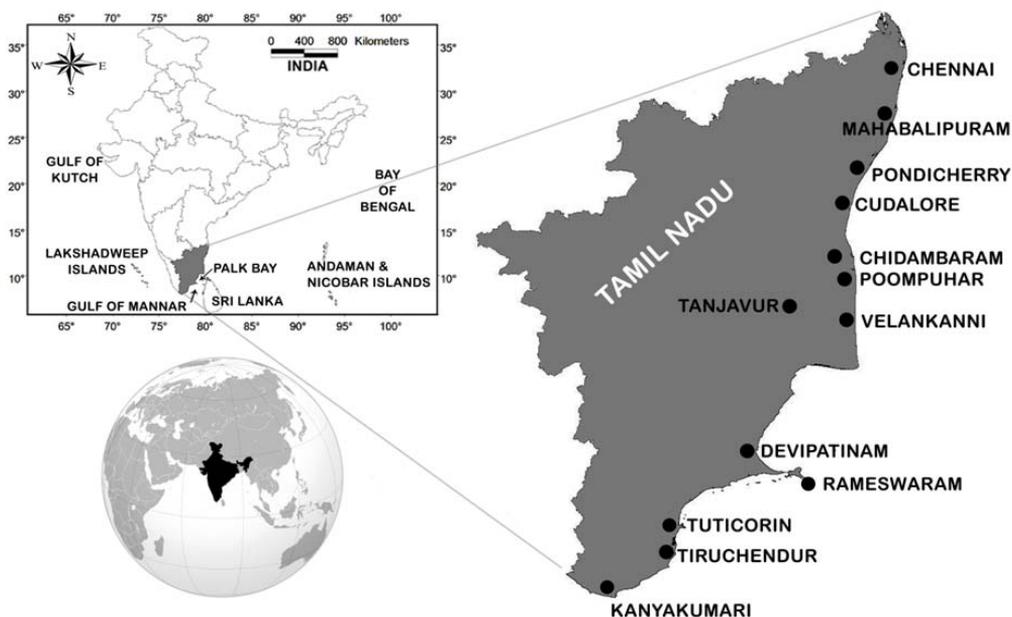


Fig. 1. Map of India showing Tamil Nadu and surveyed marine curio markets

Methods

The survey was carried from January to December, 2007. 13 major coastal tourist / pilgrim centers were identified and surveyed for their curio trade. The primary objective of the survey was to quantify and document the protected marine mollusks (gastropods, bivalves and cephalopods), scleractinian corals (hard corals) and any other IWPA listed species (sea horse, sea turtle shell, shark products etc.) on sale in the marine curio trade, as souvenirs. Even though non-protected mollusks, crustaceans and echinoderms were traded as curios, our attention was limited mainly to the IWPA listed marine fauna. The required information was collected from the retail vendors ($n=180$) by informal interviews. As a vast majority of the retail vendors we interviewed ($<78\%$) showed a high degree of awareness towards the IWPA and its legal consequences, the rationale of the study was disclosed as “a survey on seashells in the curio trade” in general. The word “Protected” was omitted on purpose, as it could raise concerns in the interviewee and thus hide genuine facts. Efforts were made to convince the vendors that the interviewers were neither tourists nor working for the government. As the retail prices fluctuated very much with the customer / tourist, and due to our apprehension towards government norms, it was essential to ensure that neither the retail prices, nor the information about the source of species were exaggerated or concealed.

The interviews were mainly conducted during two time-intervals: one between 0900 hrs and 1200 hrs and the other from 1500 hrs to 1600 hrs (IST) avoiding the peak trade hours (0700 hrs to 0900 hrs and from 1600 hrs to 1900 hrs IST). This strategy was adopted so as to minimize the interference with tourists / customers, which could distract the vendor during our interview.

Rather than taking notes during the interviews, we recorded the responses of the vendors immediately after each interview, in order to make the process less formal. Information such as the number of “legally protected” species traded, their average price (same species will have different price tags, depending on the size and perfection, so the lowest and the highest price was recorded), average quantity (in number) sold annually and the major sources of collection

of certain species (whether collected locally, from other coastal states or from other countries) were recorded.

Visual observations, such as species in trade, their quantity in each shop, total number of vendors and those who are involved in trading legally protected species were made and recorded. Photographs of species (mainly for corals) were also taken for further reference.

Morphometrics of protected mollusks, mainly shell average length (the length of the smallest shell and the length of the largest shell of the same species) were also recorded by using a ruler [16], in order to know the prevailing size class on the market and the data was compared to the common wild size, so as to know the exploitation level.

For easy documentation, corals were divided into three major groups: branching, boulder and foliose. According to Yap *et al.* [17] the corals growing at shallow depths tend to grow faster than corals found in deeper waters. As different environmental conditions such as light, temperature and depth can have a tremendous impact on the growth rate of corals [18], the morphometric examination of corals was avoided. Moreover, the branching corals and some massive forms displayed for sale were mostly not intact.

Results and Discussions

Marine curio markets

Thirteen important tourist and pilgrimages from Kanyakumari in the south to Chennai in the north along a stretch of 1076 km coastline of Tamil Nadu was surveyed. Among them, 11 coastal tourist / pilgrimage centers were identified as having marine curio trade and nine of those 11 had legally protected marine fauna on sale as curios. Among the nine identified curio markets, six were of religious importance and three were of tourist importance. Being in the vicinity of the coast, all identified sites were equally attracting tourists all around the year. Kanyakumari, Rameswaram, Poompuhar, Chidambaram, Tiruchendur and Velankanni are the famous religiously important sites that attract pilgrims throughout the year. Kanyakumari, Rameswaram, Mahabalipuram, Pondicherry and Chennai are major tourist hot spots of the state. Chennai is the state's capital (Fig. 2).

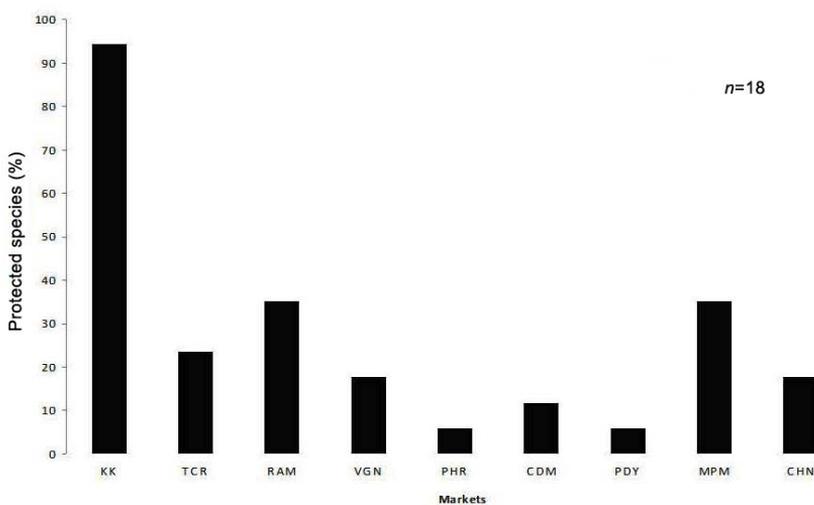


Fig. 2. Percentage of the protected marine species available in the curio markets: Kanyakumari (KK), Tiruchendur (TCR), Rameswaram (RAM), Velankanni (VGN), Poompuhar (PHR), Chidambaram (CDM), Pondicherry (PDY), Mahabalipuram (MPM) and Chennai (CHN)

As seashells play a major role in Hindu religious rituals [19], curio trade is often intense around the Hindu pilgrimage centers and to attract tourists, curio trade is flourishing in the vicinity of coastal tourist hubs.

Curio traders

Certain gathering spots around the tourist and pilgrimage centers were found to be the main location of curio shops. Kanyakumari is a key tourist and pilgrimage spot, with large masses of tourists and pilgrims visiting throughout the year most of the curio shops selling protected species were here (number of shops 90; 45.2% of curio shops in TN). It was followed by Rameswaram (n=42; 21.1%) and Mahabalipuram (n=39; 19.6%), with a moderate tourist / pilgrim influx. Other sites, Poompuhar (n=9; 4.5%), Tiruchendur and Pondicherry (n=6; 3%), Velankanni (n=5; 2.5%), Chidambaram and Chennai (n=1; 0.5%) had comparatively less curio shops (Fig. 3). During the peak tourist seasons (December-February and April-May) other small scale mobile vendors were also added to our survey. There is no proper licensing system for those curio shops and the resources are endlessly tapped from the sea, without keeping any record of the annual turnover.

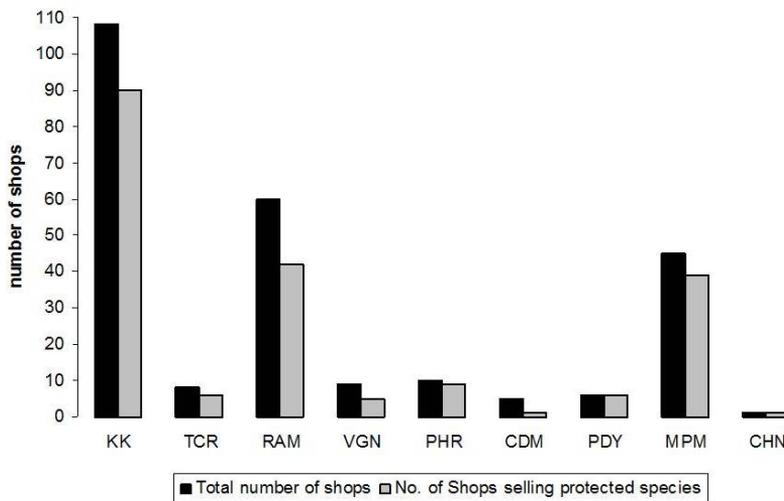


Fig. 3. Number of marine curio trading shops across Tamil Nadu: Kanyakumari (KK), Tiruchendur (TCR), Rameswaram (RAM), Velankanni (VGN), Poompuhar (PHR), Chidambaram (CDM), Pondicherry (PDY), Mahabalipuram (MPM) and Chennai (CHN)

Species in curio trade

The curio stalls offered 15 protected mollusk species, 10 coral genera and one species of sea horse. Protected mollusks were mainly gastropods (11 species), followed by bivalves (3 species) and cephalopods (1 species). Not all curio traders offered the same species. The most common species of mollusks available were *Pleuroploca trapezium* (195 shops), *Cassia cornuta* (113 shops), *Cypraeassis rufa* (91 shops), *Trochus niloticus* (64 shops), *Lambis chiragra* (47 shops), *Nautilus pompilius* (43 shops), *Lambis crocata* and *Lambis truncata* (30 shops). Among corals, *Acropora* spp. (49 shops), *Pocillopora* spp. (36 shops), *Turbinaria crater* (43 shops) and *Platygyra* spp. (22 shops) were dominant. All the corals sold were either in full structure or part of other curio artifacts. Generally, massive corals, such as *Favia*, *Platygyra* and branching forms, such as *Acropora* and *Pocillopora*, were traded as a whole, to decorate the aquariums / fish tanks. Broken pieces of branching forms were fixed on mollusk shells, to create fancy artifacts.

Among gastropods, *Pleuroploca trapezium* (98% markets) was present in almost all retail markets, followed by *Cassis cornuta* (67% markets), *Cypraecassis rufa* (44% markets), *Trochus niloticus*, *Lambis truncata* and *Lambis chiragra* (22% markets). Protected bivalves *Tridacna squamosa*, *Hippopus hippopus* and *Placenta placenta* were found only in one curio market. Their high market price was assumed to be the reason for their limited distribution in curio markets. *Nautilus pompilius*, the only protected cephalopod, was available in two curio markets. Sea horses were also traded as curios. Three shops from Kanyakumari were selling dried sea horses *Hippocampus kuda*. Among corals, the branching forms (*Acropora* and *Pocillopora* spp.) were dominating the curio market, then the foliose (*Turbinaria crater* and *Montipora* spp) and the boulder (*Porites* spp, *Platygyra* spp., *Favia* spp, *Favites abdita*, *Goniopora minor* and *Goniastrea retiformis*) forms (Fig 4).

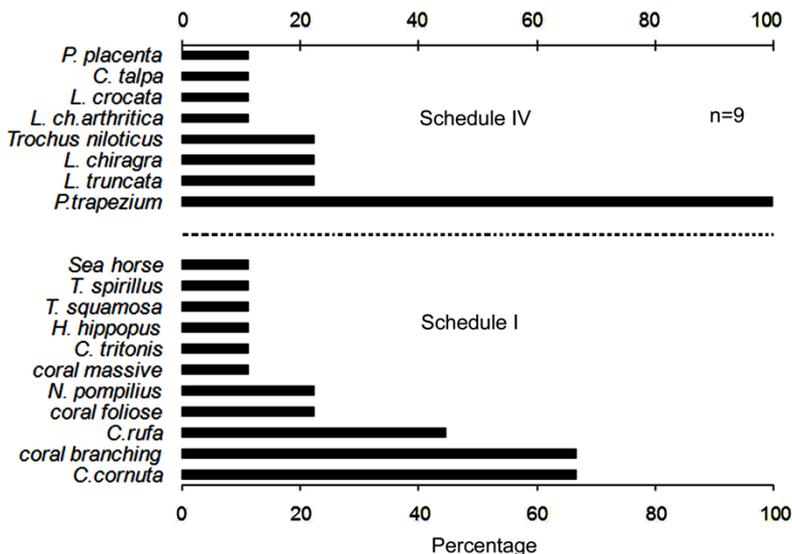


Fig. 4. Protected marine species dominating in the curio markets of Tamil Nadu coast

During the survey period, approximately 1300 protected marine mollusks and nearly 500 pieces of hard corals were available in the retail domestic curio markets across Tamil Nadu. Interviews with the vendors revealed that annually each vendor sold approximately 15% to 25% of the stock. Assuming there was an annual sale of 15% of the stock, during 2007, more than 200 protected mollusks and nearly 70 corals could have been sold.

From a turnover perspective, assuming a 15% annual sale, the most important protected species sold were *Cassis cornuta* (turnover: INR 6825; share of total: 19.38%), *Cypraecassis rufa* (INR 4600; 13.06%), *Lambis chiragra* (INR 2520; 7.16%), *Nautilus pompilius* (INR 2475; 7.03%), *Pleuroploca trapezium* (INR 2250; 6.39%) and *Trochus niloticus* (INR 1960; 5.57%). Together, those six protected mollusks accounted for nearly 60% of the turnover generated by the protected species in the curio trade in Tamil Nadu (Table 1).

Market availability of marine curios may be attributed to their unrestricted availability in the wild and in certain other places from where they are imported. Marine curios had different prices at different market places. Size, perfection and rarity were identified as the main price-determining factors. Large seashells sell for a better price than the smaller ones. Shells with defects, such as broken edges, cracks, or those having bore holes had low price tags. Among corals, the massive forms were more expensive than the foliose and the branching forms (Fig. 5). Rarity can be of two types: rare in the market and rare in the wild. In both the cases the retail price was high. Nevertheless, rare seashells need not be protected. Some rare, protected species

recorded were *Charonia tritonis*, (less than 12% in the market) with the highest recorded market (average) price of 600.00 INR, followed by *Tridacna squamosa* (~300.00 INR).

Table 1. Annual turnover of protected species in the curio trade from Tamil Nadu.

No.	Protected mollusks and coral	Schedule	Quantity sold/ annum (#)	Total income/ annum (INR)	Turnover/ annum
1	<i>Cassis cornuta</i>	I	39	6825	19.38
2	<i>Cypraeacassis rufa</i>	I	23	4600	13.06
3	<i>Lambis chiragra</i>	IV	14	2520	7.16
4	<i>Nautilus pompilius</i>	I	9	2475	7.03
5	<i>Fasciolaria trapezium</i>	IV	75	2250	6.39
6	<i>Trochus niloticus</i>	IV	14	1960	5.57
7	<i>Turbinaria crater</i>	I	6	1800	5.11
8	<i>Porites</i> sps.	I	10	1750	4.97
9	<i>Acropora</i> sps.	I	20	1700	4.83
10	<i>Platygyra</i> sps.	I	5	1500	4.26
11	<i>Favia</i> sps.	I	8	1400	3.98
12	<i>Pocillopora</i> sps.	I	16	1360	3.86
13	<i>Lambis truncata</i>	IV	5	1250	3.55
14	<i>Lambis crocata</i>	IV	22	1100	3.12
15	<i>Montipora</i> sps.	I	5	875	2.48
16	<i>Charonia tritonis</i>	I	1	600	1.70
17	<i>Favites abdita</i>	I	1	300	0.85
18	<i>Hippopus hippopus</i>	I	1	275	0.78
19	<i>hippocampus kuda</i>	I	1	250	0.71
20	<i>Goniopora minor</i>	I	1	175	0.50
21	<i>Lambis chi. arthritica</i>	IV	1	170	0.48
22	<i>Cypraea talpa</i>	IV	1	80	0.23
23	<i>Tridacna squamosa</i>	I	0	0	0.00
23	<i>Tudicla spirillus</i>	I	0	0	0.00
25	<i>Goniastrea retiformis</i>	I	0	0	0.00
1 USD = 41.20 INR during 2007 (52.57 INR - July 2012)				35215	100

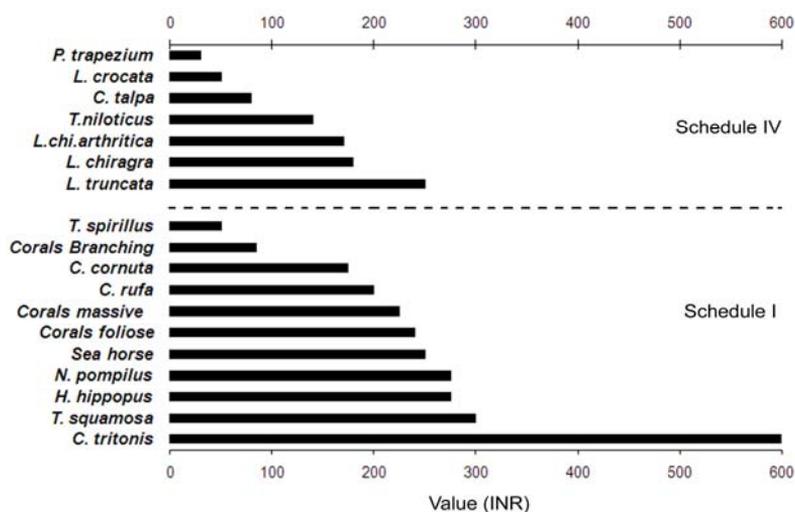


Fig. 5. Market value of the protected marine species in curio trade along Tamil Nadu coast. (1 USD=41.20 INR during 2007; 1 USD=52.57 INR during 2012)

The common wild size of the protected seashells mentioned by Dance [16], Apte [20] and Carpenter and Niem [21, 22] was larger than the common market size (Fig. 6). Only a few species, too few in numbers, as recorded on the market reached the common wild size. While it is evident that larger shells fetch a better price, presence of more under sized shells in the market seems to be a trade strategy of the vendors to meet a higher customer (pilgrims / tourist or both) demand.

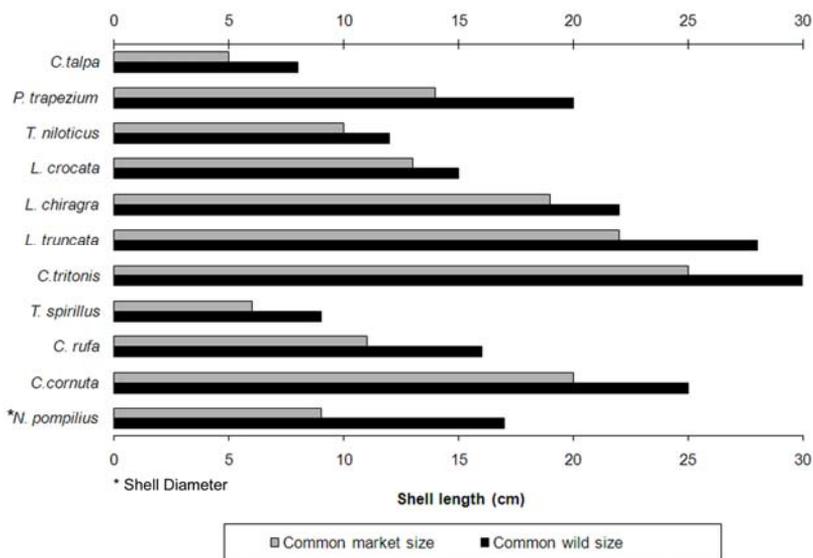


Fig. 6. Comparison of average wild size and average market size of some selected protected marine mollusks recorded from the study area

Sources of the species

The Gulf of Mannar (GoM) and Palk bay in Tamil Nadu, island territories of Andaman and Lakshadweep are rich in coral reefs and reef associated vertebrates and invertebrates. Those coral-rich waters are the major sources for those protected species in India. Local fishermen are involved in the collection of those seashells and corals, by using country canoes and skin-diving. Protected mollusks were also sometimes landed as by-catch in the mechanized fishing sector [23].

87.5% of the interviewed curio traders revealed that 65% of all identified protected mollusks and corals in the curio markets of Tamil Nadu were collected form Rameswaram (GoM and Palk bay), followed by Andaman (17%), Lakshadweep (10%) and Kerala (3%). Other curio traders (12.5%) had similar opinions, but with a varying degree of percentage in the composition of protected species from different sources. GoM and Palk bay, being in the state of Tamil Nadu and the proximity of seashell processing industries is assumed to be a major reason for this occurrence. Apart from local procurement, seashells were also imported from Sri Lanka, Mexico, China and Tanzania [11, 19 & 24]. Our interviews with curio traders revealed that 5% of the protected mollusks were imported to India from foreign countries. Unfortunately, there was no import data available with governmental / non-governmental agencies in regard to the quantity and the species of IWPA listed marine mollusks.

The result indicates that protected marine mollusk and corals are traded as curios along with other non-protected seashells and echinoderms along the Tamil Nadu coast. 15 out of the 24 mollusks listed under various schedules of IWPA were recorded in the marine curio trade, centered around costal tourist and pilgrimage centers. The growing coastal tourism has its own positive and negative effects. Better market for locally produced goods, better customers for

goods that could not be exported due to insufficient export capability [25] are positive effects. But it also increased the market for souvenirs / curios, resulting in pressure on the marine resources [26, 27].

In Tamil Nadu, we found that Kanyakumari dominated the retail domestic marine curio market both in terms of number of legally protected species being traded and the number of retail outlets trading them. This can be due to the geographical positioning of Kanyakumari being the southernmost tip of the peninsular India, making it a pilgrim and coastal tourist hot spot round the year. Tuticorin, Devipattanam, Tanjavur (Tanjore) and Cudallore were the surveyed areas that did not record any protected species in curio trade. Even though Tuticorin is a major collection and processing hub for corals and seashells, retail market is absent here. Devipattanam and Cudallore are attracted by more local (in and around Tamil Nadu) tourists and pilgrims; this can be a reason for non-flourishment of marine curio trade here. Even though Tanjavur is a cultural and heritage site attracting tourists all around the globe, it is far from the coast, and this distance can be a limiting factor for marine species in curio trade here.

It is obvious that large quantities of ecologically important protected and non-protected marine mollusks and corals are removed from their habitat annually for curio trade. Mollusks and corals are ecologically important marine taxa sharing the same or different ecological niche and performing key role in the environment which they endure. Gastropods are either grazers, predators of invertebrates or scavengers. They control the excessive algal growth by grazing the rock surfaces and check the outbreaks of nuisance invertebrates. The gastropod, giant triton (*Charonia tritonis*) is one of the species that feeds on the crown-of-thorns starfish (*Acanthaster planci*), which can cause massive destruction to the coral reefs [28]. Even though *C. tritonis* is a potential *A. planci* predator, its effect of predation on populations of *A. planci* has been questioned [29]. Top shells (*Trochus* spp) are mainly herbivorous, feeding on fleshy algae and algal films [30] that typically develop on live rock; they are also known to forage on organic detritus [31]. Helmet shells (*Cassis cornuta* and *Cypraea cassis rufa*) checks the outburst of sea urchins that graze on the soft lime stone rocks and corals when feeding on algae [32]. Marine mollusks such as Bivalves are important filter feeders of marine ecosystem and they convert large quantities of organic matter into protein [33]. While coral reefs are considered to be amongst the most biologically rich and productive ecosystems on Earth often described as the “underwater rain forest” [34, 35] nurturing and protecting over 4,000 species of fish and nearly 800 species of reef-building corals [36] along with other invertebrates, they also play a key role in stabilizing and protecting the coastlines from waves and surges [37].

Un-healthy fishing practices and un-controlled harvesting of these mollusks and corals can have adverse effect on the marine ecosystem. According McClanahan [38], intense coral removal can cause the replacement of a healthy, thriving coral dominated-system with a low-productivity algal mat. This in turn may trigger the decline of reef fish abundance, biomass and biodiversity [39]. The mining of corals for curio trade and for the aquarium is considered causing massive degradation and a major cause of concern globally [40]. The protected seashells and corals in curio trade are originating from coral rich areas of GoM and Palk bay, Andaman and Lakshadweep islands [41] by local fisher folks by skin diving and / hand picking of seashells during low tide. Moreover, seashells are imported from countries like Sri Lanka, Tanzania, Mexico and China. Even though, The Indian Export and Import (EXIM) policy forbids the trans-boundary trade of whole animal or animal derivatives listed in IWPA, the protected marine mollusks are imported along with other non-protected mollusks under the code “shells of Mollusks, Crustaceans / Echinoderms”. According to the Directorate General of Foreign Trade (DGFT), Govt. of India, during 2006-2007, the quantity of “shells of Mollusks, Crustaceans / Echinoderms” thus imported from Sri Lanka (330 t), Tanzania (281 t), Mexico (190 t), and China (138 t) was nearly 940 tonnes [24]. As species wise import records are not maintained, crucial information on the mollusks species listed in Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and IWPA and also their

quantities that is imported to India annually is seriously lacking. Easy availability of CITES Appendix II (Approximately 32,500 Appendix II species are permitted for trade, but each shipment must be accompanied by an export permit verifying that the shipment was legally obtained and that its harvest was not detrimental to the survival of the species [2]), non-native Queen Conch *Strombus gigas* in marine curio markets across Tamil Nadu is an example for this.

Conservation implications

Even though there is no evidence that commercial collection of marine mollusk and corals for curio trade has caused any extinction of species worldwide [8], but over exploitation has resulted in local scarcity and loss of mollusks and coral species [42], in countries such as Tonga [43], Colombia [44], Kiribati [45], Hawaii [46] and the Philippines [47-49].

As there is a lack of rational biological information and standing stock of the marine endangered species in India, a detailed resource status survey should be carried out to know the population estimates. Mollusks and corals are collected largely by traditional fishers by means of country canoe, diving and hand picking during low tides. But significant quantities of endangered marine fauna are landed incidentally in mechanized fishing sector [23, 50]. Endangered and protected species that are non-targeted but landed accidentally, which fetch more price constitute the high value by-catch (HBV). Thus landed protected mollusk species serve different purpose and discarded shells will end up as marine curios. For example Opercula of *Pleuroploca trapezium* (Schedule IV of IWPA) are used in cosmetics and medicines and empty shells are traded as curios. Sea horses (Schedule I of IWPA) and *Placenta placenta* (Schedule IV of IWPA) are mainly landed as by-catch [23]. Formulation of National level By-catch Reduction Polices (BRP's) in marine mechanized fishing sector and proper usage of By-catch Reduction Devices (BRD's) can reduce accidental landings of endangered species.

Countries find reporting problems such as mis-categorization and record management errors in trade monitoring systems [2]. Maintaining proper import / export records such as species, quantity, country of origin (both origin of the species and origin of the consignment) etc, will help in the proper documentation of the wildlife trade and can curtail the entry / exit of CITES and IWPA listed marine species in and out of a country.

The global coastal tourism is increasing year after year [51]. It is becoming evident that, marine curio trade is becoming an integral part of the growing coastal tourism in India. The trade of seashells as curios, other than the species listed in the IWPA, can be permitted provided, a proper licensing mechanism to check records is in place, but the exclusive collection of endangered and threatened sea shells and corals by diving and / or by other mechanical means should be dealt strongly. Promotion of traditional handicrafts and natural products by creating market at a national and international level as an alternative source of livelihood for traders, for sea shell and coral collectors; aquaculture of both fresh water and marine indigenous fish species (food fish and Ornamental fish) of commercial demand, pearl culture (*Pinctada fucata* and *Pinctada margaritifera*), culture of green mussel (*Perna viridis*) and edible Oyster (*Crassostrea madrasensis*) as sea food source, mud crab (*Scylla serrata* and *Scylla tranquebarica*) and lobster fattening, seaweed culture of native varieties, culture of marine micro algae as a source of single celled proteins (SCP) can be promoted. Awareness creation for fishers, traders and also to customers in form of seminars, campaigns, posters, hoardings and through media can make some difference. Public saltwater aquaria can provide a unique opportunity for the public to know more about the coral reefs and can create awareness and understanding about the hidden ecosystem [52]. Globally, overfishing is predominant and results in massive and possibly irreversible changes to marine ecosystems [53, 54]. So, a solution for this is to declare the marine biodiversity rich areas or a part of it as "No-take zones" with the involvement of community participation [55]. Experiences from Apo Island,

Philippines for more than two decades indicate that these “No take zones” can increase the fish stock displaying resource spillover [56]. Thus by facilitating spill over, the marine fauna can recolonize the over exploited waters.

Conclusions

The dependency on marine resources has gone beyond fulfilling the daily needs and crept into exploiting it beyond healthier fractions thereby endangering these resources critically affecting the marine ecosystem. The study reveals that legally protected marine species are exploited in alarming amounts and traded as curios across coastal tourist and pilgrim centers of Tamil Nadu. High market demand coupled with lack of awareness and inadequate enforcement is the major driving force for illegal marine curio trade. Necessary laws should be enforced by the wildlife/forest officials, along with educational and awareness programs and also promoting alternate resource of livelihood for seashell/coral collectors can curb the illegal marine curio trade.

Acknowledgments

This study was carried out from National Institute for Coastal and Marine Biodiversity (NICMB), the satellite centre of Wildlife Institute of India (WII) at Kanyakumari with WII's grant-in-aid funds. The encouragement of the Director, Dean and the research coordinator of WII are acknowledged. SJ and BMPK wish to thank K.R.Saravanan, S. Jeganathan, Divya Thankappan, Sumitro Sen, J.J.Wilson and A. Murugan for their comments and valuable suggestions and all NICMB staff for their help and support.

References

- [1] S. Broad, T. Mulliken, D. Roe, *The nature and extent of legal and illegal trade in wildlife, The Trade in Wildlife*, (Editor Sara Oldfield), Earth Scan Publication, London 2003, pp. 3-22.
- [2] A.G. Blundell, M.B. Mascia, *Discrepancies in reported levels of international wildlife trade*, **Conservation Biology**, **19**, 2005, pp. 2020-2025.
- [3] A.S. Gaur, Sundaresh, P. Vardhan, *Ancient shell industry at Bet Dwaraka Island*, **Current Science**, **89**, 2005, pp. 941-946.
- [4] A.K. Nishida, R.R.N Alves, N. Nordi, *Mollusk gathers of Northeast Brazil: gathering techniques and productivity*, **Human Ecology**, **341**, 2006, pp.133-145.
- [5] C. Claassen, **Shells**, Cambridge University Press, Cambridge, UK, 1998, pp. xiv+266.
- [6] L. Efrain, *Traditional healing with animal's zootherapy: Medieval to present-day Levantine practice*, **Journal of Ethno Pharmacology**, **85**, 2003, pp. 107-118.
- [7] M. Sara, *An aquatic pharmacy: The biomedical potential of the deep sea*, **The Journal of Marine Education**, **21**, 2005, pp. 31-32.
- [8] S.M. Wells, *International trade in ornamental corals and shells*, **Proceedings of fourth International Coral Reef Symposium**, 18th -22th May, 1981, vol. 1, pp. 323-330.
- [9] F. Tony, *Marine creature collection*, **MLSSA News Letter**, **294**, 2002.
<http://www.mlssa.asn.au/nletters/november2002.htm> (accessed on 26 July 2006)
- [10] * * *, **The Wildlife Protection Act, 1972**, Wildlife Trust of India, Natraj publishers, Dehradun, India, 2003, pp.149-163.
- [11] J.K. Patterson, K. Ayyakannu, *Shell trade and marketing with special reference to *Chicoreus ramosus* along the south east coast of India: Interviews with shell traders*, **Phuket Marine Biological Centre special publication**, **10**, 1992, pp. 33-34.

- [12] J.K. Patterson, A. Murugan, K. Ayyakannu, *Landing data and meat trade with *Chicoreus ramosus* and *Pleuroploca Trapezium* in the Gulf of Mannar and Palk Bay, Southeastern coast of India*, **Phuket Marine Biological Centre special publication**, **13**, 1994, pp. 37-42.
- [13] K.R. Salin, T.M. Yohannan, C. Mohanakumaran Nair, *Fisheries and trade of seahorses, *Hippocampus spp.*, in southern India*, **Fisheries Management and Ecology**, **12**, 2005, pp. 269–273.
- [14] P.S. Asha, K. Diwakar, *A note on the exploitation of starfish *Protoreaster lincki* (Echinodermata: Asteroidea) in Tuticorin*, **Marine Fisheries Information Service, Technical & Extension Series**, **187**, 2006, pp. 20-21.
- [15] * * *, **Tourism Policy Note**, Commissioner of Tourism, Tamil Nadu Tourism Development Corporation, Chennai, India, 2005, pp. 1-109.
- [16] P. Dance, **Shells**, Dorling Kindersley, Great Britain, London, 1992, pp. 256.
- [17] H.T. Yap, R.M. Alvarez, H.M. Custodio III, R.M. Dizon, *Physiological and ecological aspects of coral transplantation*, **Journal of Experimental Marine Biology and Ecology**, **229**(1), 1998, pp. 69-84.
- [18] R. Buddemeier, R. Kinzie, *Coral growth*, **Oceanography and Marine Biology Annual Reviews**, **14**, 1976, pp. 179-200.
- [19] K. Tanner, *Seashell trade of Tanzania: A Value chain analysis*, **Contour Journal**, Royal Geographical Society, 2006, pp. 51-61.
- [20] D. Apte, **The Book of Indian seashells**, BNHS, Oxford University press Publication, New Delhi, 1998, pp. 21-27.
- [21] K.E. Carpenter, V.H. Niem, (Editors), *FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific, Seaweeds, corals, bivalves and gastropods*, **1**, 1998, Rome, pp. 1-686.
- [22] K.E. Carpenter, V.H. Niem, (Editors), *FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific, Seaweeds, corals, bivalves and gastropods*, **2**, 1998, Rome, pp. 687-1396.
- [23] A. Murugan, R. Durgekar, *Beyond the Tsunami: Status of Fisheries in Tamil Nadu, India: A Snapshot of Present and Long-term Trends*. UNDP/UNTRS, Chennai and ATREE, Bangalore, India, 2008, pp. 75.
- [24] * * *, Directorate General of Foreign Trade, <http://dgft.delhi.nic.in/> (accessed on 27 March 2012)
- [25] T. Mihalic, *Tourism and Economic Development Issues*, **Tourism and Development: Concepts and Issues**, (eds. Sharpley R. and Telfer D.J.), Channel View Publications, Clevedon, 2002, pp. 81-111.
- [26] S. Gössling, T. Kunkel, K. Schumacher, M. Zilger, *Use of mollusks, fish and other taxa by tourism in Zanzibar, Tanzania*, **Biodiversity and Conservation**, **13**, 2004, pp. 2623–2639.
- [27] T.L.P. Dias, N.A. Leo Neto, R.R.N. Alves, *Mollusks in the marine curio and souvenir trade in NE Brazil: species composition and implications for their conservation and management*, **Biodiversity and Conservation**, **20**, 2011, pp. 2393–2405.
- [28] R. Endean, *Acanthaster planci infestations of reefs of the Great Barrier Reef*. **Proceedings of third International Coral Reef Symposium**, May 1977, Vol. 1, pp. 185-191.
- [29] P.J. Moran, *The Acanthaster phenomenon*, **Oceanography Marine Biology Annual Review**, **24**, 1986, pp. 379-48.
- [30] C. Wabnitz, M. Taylor, E. Green, T. Razak, **From Ocean to Aquarium**, UNEP-WCMC, Cambridge, UK, 2003, pp. 1-64.
- [31] T.M. Gosliner, D.W. Behrens, G.C. Williams, **Coral Reef Animals of the Indo-Pacific**, Monterey, USA, 1996, pp 314.
- [32] R.N. Hughes, H.P. Hughes, *Morphological and behavioural aspects of feeding in the *Cassidae* (Tonnacea, Mesogastropoda)*, **Malacologia**, **20**, 1981, pp. 385–402.

- [33] S.M. Wells, R.M. Pyle, N.M. Collins, **The IUCN Invertebrate Red Data Book**, Gland, IUCN, Switzerland, 1983, pp.xxxv+632.
- [34] D. McAllister, *Status of the world's ocean and its biodiversity*, **Sea Wind**, **9**(4), 2005, pp. 14.
- [35] M.D. Spalding, C. Ravilious, E.P. Green, **World Atlas of Coral Reefs**, UNEP World Conservation Monitoring Centre, University of California Press, Berkeley, USA, 2001, pp. viii+428.
- [36] D. Pauly, V. Christensen, S. Guenette, T. Pitcher, U.R. Sumaila, C. Walters, R. Watson, D. Zeller, *Towards un-sustainability in world fisheries*, **Nature**, **418**, 2002, pp. 689-695.
- [37] O. Hoegh-Guldberg, R.J. Jones, *Photoinhibition and photoprotection in symbiotic dinoflagellates from reef-building corals*, **Marine Ecology Progress Series**, **183**, 1999, pp. 73– 86.
- [38] T.R. McClanahan, *A coral reef ecosystem-fisheries model: impacts of fishing intensity and catch selection on reef structure and processes*, **Ecological Modelling**, **80**, 1995, pp. 1-19.
- [39] A. Dawson-Sheppard, *An analysis of fish community responses to coral mining in the Maldives*, **Environmental Biology of Fishes**, **33**, 1992, pp. 367-380.
- [40] A. Bruckner, *Tracking the trade in ornamental coral reef organisms: The importance of CITES and its limitations*, **Aquarium Sciences and Conservation**, **3**(1-3), 2001, pp. 79-94.
- [41] V. Menon, A. Kumar, **Wildlife crime: An enforcement guide**. Wildlife Protection Society of India, Natraj publishers, New Delhi, 1998, pp. 110.
- [42] W. Hodgson, *A global assessment of human effects on coral reefs*, **Marine Pollution Bulletin**, **385**, 1999, pp. 345-355.
- [43] R. H. Chesher, *Save the Kele'a*, **Matangi Tonga**, **4**, 1990, pp. 18.
- [44] S. Zea, J. Geister, Garzo'n-Ferreira, J.M. Di'az, *Biotic changes in the reef complex of San Andre's Island (southeastern Caribbean Sea, Colombia) occurring over nearly three decades*, **Atoll Research Bulletin**, **456**, 1998, pp. 1-30.
- [45] F.R. Thomas, *Mollusk habitats and fisheries in Kiribati: An assessment from the Gilbert Islands*, **Pacific Science**, **55**, 2001, pp. 77–97.
- [46] R.W. Grigg, *Fishery management of the precious coral in Hawaii*, **Proceedings of the third international Coral Reef Symposium**, May 1977, Vol. 1, pp.609-619.
- [47] B.J. Gonzales, *Trochus restocking as enhancement intervention*, Sagip Dagat, second quarter, Bureau of fisheries and aquatic resources, 2000, pp.11-13.
- [48] R. Adan, *The window pane oyster (Kapis shell) industry*, SEAFDEC Asian aquaculture department, **22**(4), 2000, pp.23-31.
- [49] M.A. Ross, *A quantitative study of the stony coral fishery in Cebu, Philippines*, **Marine Ecology**, **51**, 1984, pp. 75-91.
- [50] B.G. Giles, Truong Si Ky, Do Huu Hoang, C.J. Amanda Vincent, *The catch and trade of seahorses in Vietnam*, **Biodiversity and Conservation**, **15**, 2006, pp. 2497–2513.
- [51] N. Nasuchon, **Coastal management and community management in Malaysia, Vietnam, Cambodia and Thailand, with a case study of Thai fisheries management**, Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs, the United Nations, New York, 2009, pp. ix+81. (accessed on 4 July 2012)
http://www.un.org/depts/los/nippon/unnff_programme_home/fellows_pages/fellows_papers/nasuchon_0809_thailand.pdf
- [52] C. Andrews, *The ornamental fish trade and fish conservation*, **Journal of Fish Biology**, **37**, 1990, pp. 53–59.
- [53] G. Paulay, *Diversity and distribution of reef organisms*, **Life and Death of Coral Reefs**, (Editor C. Birkeland), Chapman and Hall, New York, 1997, pp 298-353.
- [54] J.B.C. Jackson, M.X. Kirby, W.H. Berger, K.A. Bjorndal, L.W. Botsford, B.J. Bourque, R.H. Bradbury, R. Cooke, J. Erlandson, J.A. Estes, P.T. Hughes, S. Kidwell, B.C. Lange, S.H. Lenihan, J.M. Pandolfi, C.H. Peterson, R.S. Steneck, M.J. Tegner, R.R. Warner,

- Historical overfishing and the recent collapse of coastal ecosystems*, **Science**, **293**, 2001, pp. 629-638.
- [55] A.C. Alcala, G.R. Russ, *No-take marine reserves and reef fisheries management in the Philippines: a new people power revolution*, **Ambio**, **35**, 2006, pp. 245–254.
- [56] G.R. Russ, A.C. Alcala, *Do marine reserves export adult fish biomass? Evidence from Apo Island, central Philippines*, **Marine Ecology Progress Series**, **132**, 1996, pp. 1-9.
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Received: March, 11, 2012

Accepted: July, 26, 2012