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Diversity of marine molluscs in the bycatch from lobster nets, Erwadi, Gulf of Mannar

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The current study was carried out to document molluscs that are caught in lobster nets (Singhi valai), an indigenous gear operated by fishers in the Gulf of Mannar to harvest lobsters, crabs and fishes. This net is operated in depths up to 15 m from the traditional country craft, '*Vallam*'. A total of 73 species of marine molluscs from class Bivalvia (32 species belonging to 4 families) and Gastropoda (41 species belonging to 27 families) have been documented. *Vulsella vulsella* was dominant (12.35%) among bivalves whereas *Lambis lambis* was dominant (14.7%) among the gastropods. The family Veneridae in bivalves (29%) and the family Strombidae in gastropods (17%) contributed the highest among the documented molluscs.

[**Keywords:** Gastropods, Bivalves, Biosphere Reserve, Marine National Park, reef, fishing, conservation]

Introduction

The Gulf of Mannar located in the southeast coast of Tamil Nadu is one of the four coral reef regions in India comprising of Gulf of Mannar Marine National Park (GoMMNP) and Biosphere Reserve (GoMBR). There are 47 fishing villages along the GoM which essentially depend on the resources of this region. The common fishing gears in use among the fishers are gill nets, seines, drift nets hooks & lines and trawl nets. Major fishes caught by the fishers of this region comprise of pelagic fishes such as sardines, anchovies, mackerels, carangids, tunas and seerfishes and demersal fishes such as silverbellies, perches, goat fishes, croakers, barracudas and rays[1].

Bycatch or the incidental catch occur when fishing gear catches unwanted species whose retention is either not economical or prohibited by law[2]. Traditional fishers in the Gulf of Mannar region deploy Lobster net (*Singhi valai* in Tamil), an indigenous net to harvest lobsters, crabs and fishes. Molluscs constitute the major bycatch while operating the lobster net. In the current study, a comprehensive checklist of molluscs discarded as bycatch from lobster nets has been documented and the paper discusses on significance of these molluscs in the ecosystem and strategies for their conservation.

Materials and Methods

The study was conducted in the Erwadi region of Gulf of Mannar during July 2014 (Fig.1). Lobster nets are usually operated in the fishing banks, traditionally called '*Paars*' located close to the reefs of the islands, 3-15 nautical miles from the shore.

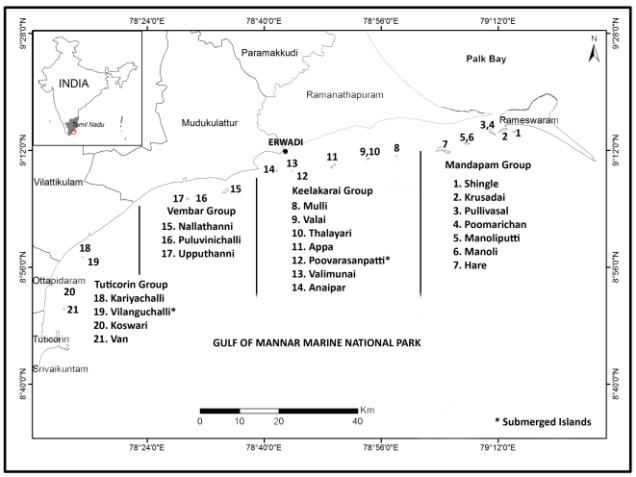


Fig.1 – Map showing the study area

The Lobster net (***Singhi valai*** in Tamil; Fig. 2a) is an indigenous bottom-set gear operated in depths up to 5-15 m in the Gulf of Mannar. A typical lobster net is about 200 m long and 2 m wide. Each mesh measures 40 mm (Fig. 2b) without any floats in the head rope and about 200 lead sinkers in the foot rope spaced in a gap of 11-13 cm (4-5 inches). Absence of floats results in the net almost lying flat on the seabed. Moreover, the water currents tend to push the net in the direction it moves but the presence of sinkers aid in settling down of these nets after deployment.

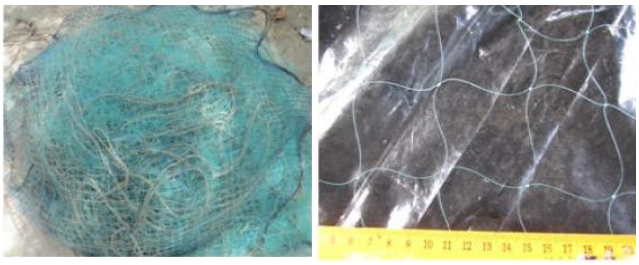


Fig.2 – A view of lobster net

Approximately 250-300 fishermen are dependent on lobster net fishery at Erwadi in the Gulf of Mannar. Currently 60 boats are actively fishing and each boat carries an average of 4-5 nets (some boats carry a maximum of up to 15 nets). Crew strength ranges from 4 to 5 fishermen. The net is deployed at the desired location early in the morning and retrieved on the following day or the day after. Fishers operate the gear 3-4 times in a week depending upon weather conditions, primarily the wind speed.

Samples of molluscs discarded from the lobster nets were collected by handpicking. Shells were transferred to the laboratory and were thoroughly washed in running tap water to remove debris. The fouling organisms like barnacles, tubiculous polychaetes, etc. Were removed using a scalpel. Shells like *Vulsella vulsella*, which are endosymbionts with sponges were carefully taken out with the help of a scalpel and forceps. Epizootic bivalves attached to dead gorgonians were removed after cutting the byssal threads. All collected shells were identified with the help of standard identification guides and checklists[3-13]. The validity and taxonomic status of the molluscs collected were verified with WoRMS database.

Details on the fishing craft and gear used, collection method, catch composition including the discards, fishing area, fishing season and frequency of fishing were obtained from the shell traders and fishers deploying lobster nets through personal interviews.

Results

The major catch from the net comprises of lobsters (*Panulirus homarus, P. polyphagus, P. versicolor* and *P. ornatus*), commercially important molluscan species (*Chicoreus ramosus, Turbinella pyrum* and *Lambis lambis*), crabs (*Portunus pelagicus, P. sanguinolentus* and *Charybdis natator*) and fishes (sweetlips, snappers, groupers etc.). Sponges, drifting algae, sea fans and corals are gathered when this gear is operated in reef areas, which however, are discarded. As per the information provided by fishermen and shell dealers, 70% of the catch typically comprises of shell fish and the rest finfish. Bycatch accounts for nearly 55% of the total catch comprising of smaller non-target molluscs, sea fans, coral pieces, macro algae and undervalued fishes. Molluscs account for about 75% of bycatch during non-windy season and while during the windy season, 90% of bycatch is composed of only drifting algae due to water currents.

A total of 73 marine molluscs were collected from the lobster nets operated by the fishers at Erwadi and identified. Of this, bivalves (Class: Bivalvia) were represented by 32 species belonging to 14 families and gastropods (Class: Gastropoda) were represented by 41 species belonging to 27 families. The samples did not contain any species from other Classes under the Phylum Mollusca, viz., Polyplacophora, Scaphapoda and Cephalopoda.

Among the bivalves, family Venereidae represented by 7 species, contributed to 29% of total bycatch. This was followed by Pteriidae (27%; 7 species), Malleidae (9%; 1 species), Arcidae (8%; 3 genus and 3 species) and Ostreidae (7%; 1 species) (Fig.3). Other families accounted for less than 5% of the bycatch. Among the bivalves, *Vulsella vulsella* belonging to family Pteriidae dominated (12.35%) the bycatch followed by *Gafrarium pectinatum* (9.41%), *Circe tumefacta* (8.23%) under family Veneridae and *Dendostrea folium* (7.05%) of family Ostreidae.

The spider conch, *Lambis lambis* was found to be the dominant gastropod (14.7%) in the bycatch, followed by *Harpulina lapponica* (10.8%) and *Pleuroploca trapezium* (5%). In terms of representation from families, Strombidae accounted for the maximum bycatch (17%; 2 species), followed by Volutidae (11%; one species), Phasianellidae (9%; 1 species), Muricidae (8%; 2 species), Fasciolaridae (7%; 2 species) and 7% (Potamididae; 1 species) (Fig.4).

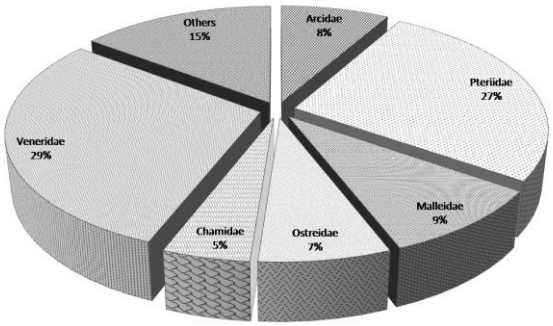
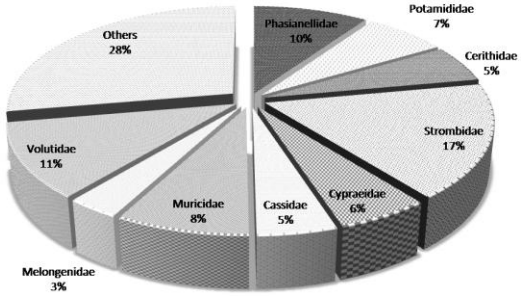


Fig.3 – Percentage contribution of bivalve families *(Others include families Cardiidae, Carditidae, Donacidae, Cucullaeidae, Spondylidae and Pectinade with ≤ 3%*



representation)

Fig.4 – Percentage contribution of gastropod families *(Others include families Trochidae, Chilodontidae, Neritidae, Phenacolepapidae, Turritellidae, Siliquaridae, Hipponicidae, Naticidae, Ranellidae, Tonnidae and Columbellidae with ≤ 3% representation)*

The entire checklist of bivalves and gastropods collected from lobster net discards are given in Table 1.

Table 1 – Diversity of marine molluscs from lobster net discards

Groups	Family	No	Species name	Author name
Bivalves	Arcidae	1	*Arca navicularis*	Bruguiere, 1789
		2	*Arca mutabilis*	(G.B.Sowerby I, 1833)
		3	*Anadara (Mosambicara) erythraeonensis*	(Jonas in Philippi, 1851)
		4	*Barbatia amygdalumtostum*	(Roding, 1798)
	Cucullaeidae	5	*Cucullaea labiata*	(Lightfoot, 1786)
	Pteriidae	6	*Vulsella vulsella*	(Linnaeus, 1758)
		7	*Pteria avicular*	(Holten, 1802)
		8	*Pteria tortirostris*	(Dunker, 1849)
		9	*Pteria heteroptera*	(Lamarck, 1819)
		10	*Pinctada imbricata fucata*	(Gould, 1850)
		11	*Isognomon bicolor*	(C.B.Adams, 1845)
		12	*Isognomon isognomum*	(Linnaeus, 1758)
	Malleidae	13	*Malleus malleus*	(Linnaeus, 1758)
	Pinnidae	14	*Pinna bicolor*	Gmelin, 1791
	Pectinidae	15	*Mimachlamys sanguinea*	Linnaeus, 1758
	Spondylidae	16	*Spondylus layardi*	Reeve, 1856
	Placunidae	17	*Placuna placenta*	(Linnaeus, 1758)
	Ostreidae	18	*Dendostrea folium*	Linnaeus, 1758
	Carditidae	19	*Cardites antiquatus*	(Linnaeus, 1758)
		20	*Cardita calyculata*	(Linnaeus, 1758)
	Chamidae	21	*Chama spinosa*	Lamarck, 1819
	Cardiidae	22	*Maoricardium setosum*	(Redfield, 1846)
		23	*Acrosterigma oxygonum*	(G. B. Sowerby II, 1834)
		24	*Acrosterigma impolitum*	(G. B. Sowerby II, 1841)
	Veneridae	25	*Placamen foliaceum*	(Philippi, 1846)
		26	*Circe tumefacta*	G.B. Sowerby II, 1851
		27	*Circe scripta*	(Linnaeus, 1758)
		28	*Gafrarium pectinatum*	(Gmelin, 1791)
		29	*Gafrarium divaricatum*	(Gmelin, 1791)
		30	*Gafrarium dispar*	(Holten, 1802)
		31	*Paphia amabilis*	(Philippi, 1847)
	Donacidae	32	*Donax faba*	Gmelin, 1791
Gastropods	Trochidae	33	*Trochus cariniferus*	Reeve, 1842
	Chilodontidae	34	*Euchelus asper*	Gmelin, 1791
	Phasianellidae	35	*Phasianella solida*	(Born, 1778)
	Neritidae	36	*Nerita albicilla*	Linnaeus, 1758
	Phenacolepadidae	37	*Phenacolepas asperulata*	A. Adams, 1858
	Turritellidae	38	*Turritella columnaris*	Kiener, 1843
		39	*Turritella cochlea*	Reeve, 1849
		40	*Zaria duplicata*	(Linnaeus, 1758)
	Siliquaridae	41	*Tenagodus cumingii*	Morch, 1861
	Potamididae	42	*Cerithideopsilla cingulata*	(Gmelin, 1791)
	Cerithidae	43	*Rhinoclavis articulata*	(A. Adams & Reeve, 1850)
		44	*Cerithium traiili*	G.B. Sowerby II, 1855
		45	*Clypeomorus bifasciata*	(G.B. Sowerby II, 1855)
	Hipponicidae	46	*Cheilea equestris*	(Linnaeus, 1758)
	Strombidae	47	*Lambis lambis*	(Linnaeus, 1758)
		48	*Lambis truncata***	([Lightfoot], 1786)
	Naticidae	49	*Neverita didyma*	(Roding, 1798)
		50	*Natica vitellus*	(Linnaeus, 1758)
		51	*Sinum haliotoideum*	(Linnaeus, 1758)
	Cypraeidae	52	*Monetaria caputserpentis*	(Linnaeus, 1758)
		53	*Monetaria moneta*	(Linnaeus, 1758)
		54	*Erosaria ocellata*	(Linnaeus, 1758)

Groups	Family	No	Species name	Author name
		55	*Leporicypraea mappa*	(Linnaeus, 1758)
	Ranellidae	56	*Ranularia oboesa*	(Perry, 1811)
	Cassidae	57	*Phalium glaucum*	(Linnaeus, 1758)
	Tonnidae	58	*Tonna tessellata*	(Lamarck, 1816)
	Muricidae	59	*Haustellum haustellum*	(Linnaeus, 1758)
		60	*Drupella margariticola*	(Broderip, 1833)
	Columbellidae	61	*Euplica scripta*	(Lamarck, 1822)
	Buccinidae	62	*Babylonia spirata*	(Linnaeus, 1758)
	Fasciolaridae	63	*Fusinus nicobaricus*	(Roding, 1798)
		64	*Pleuroploca trapezium***	(Linnaeus, 1758)
	Melongenidae	65	*Volegalea cochlidium*	(Linnaeus, 1758)
	Olividae	66	*Ancilla cinnamomema*	Lamarck, 1801
		67	*Ancilla scaphella*	(Sowerby, 1859)
		68	*Agaronia nebulosa*	Lamarck, 1811
	Turbinellidae	69	*Turbinella pyrum*	(Linnaeus, 1767)
	Volutidae	70	*Harpulina lapponica*	(Linnaeus, 1767)
	Marginellidae	71	*Volvarina angustata*	(Sowerby, 1846)
	Conidae	72	*Conus araneosus*	(Solander in Lightfoot, 1786)
	Bullidae	73	*Bulla ampulla*	Linnaeus, 1758

Table 2 – Status of protected species caught as bycatch from lobster net (NA-Not Assessed)

No	Species Protected	Protection status	IUCN status	Yolk size (mm)
1	Gorgonia (Sea fans)	Part IV A, WPA (1972)	NA	*Pteria avicular*, *P. heteroptera* and *P. tortirostris*
2	Porifera (sponges)	Only Class Calcarea protected under Part I WPA (1972)	NA	*Vulsella vulsella*
3	*Lambis truncata* (Mollusca)	Part IV, WPA (1972)	NA	Epiphytes occasionally
4	*Pleuroploca trapezium* (Mollusca)	Part IV, WPA (1972)	NA	--
5	*Placuna placenta* (Mollusca)	Part IV, WPA (1972)	NA	--

Discussion

Gears used in small scale fishery also contribute to overexploitation of target species, increased bycatch levels and cause severe damage to the benthic substrata. Though there exists diverse definitions to small scale fisheries[14], it is applied to vessels less than 15 m long, mechanized or manual fishing gears and relatively low catch from fishing[15]. Lobster net operated in Gulf of Mannar in traditional country crafts thus falls within this category. It is a type of set gill net targeting bottom dwelling crustaceans, molluscs, fishes and lobsters. Unselective fishing leads to capture of non target organisms (bycatch) which is the most significant global, nature conservation issue on resource management[16-17]. Though bycatch estimates on economic loss have been attempted for bottom trawling in India, bycatch estimation in the traditional fishing sector still remains without clarity. About 2,250,000 tonnes were landed from trawlers as bycatch representing 56.3% of estimated marine catch[18]. Since studies on bycatch from bottom set gill nets is sparse, we undertook this study to assess molluscan diversity from bycatch in order to highlight the deleterious impacts caused by this gear near reef ecosystems.

The lobster net is predominantly a bottom set gill net operated in the Gulf of Mannar region. These nets are made of monofilament material (like other bottom set gill nets), targeting lobsters and other fishes. Peak season for operation of this gear is from October to January. Besides lobsters, other regular catch includes sweetlips, groupers, rays and molluscs. The net is set at depths up to 15 m, close to the reef areas near the islands or in the traditional fishing grounds called 'Paars'. Though lobster nets are reported to be operated in Periyapattinam and Rameswarm[19], it is evident from the field observations that fishermen in the northern part of Gulf of Mannar, very specifically those from Kilakarai and Vembar group of islands operated the gear year round (except for windy seasons/ days).

From the study a list of 73 species were documented out of which 32 were bivalves. Harpulina lapponica a volute, locally called as '*Kuruvi Chanku*' is endemic to the Gulf of Mannar region and this species is the second highest in the bycatch number contributing to 10.8%, apparently depicting the alarming level of exploitation. Alongside, species like P. trapezium and L. truncata are protected under Schedule IV of the Wildlife Protection Act of India (1972). Theses shells are usually thrown back in water or brought ashore as discards and are usually found to be heaped in landing centres (Fig. 5a). Lambis lambis (Iviral chanku in Tamil) lands in large quantities mainly because of their structure and their abundance in this region. Since these shells are larger and possess strong spine-like digits, they are easily entangled in the lobster nets. Occurrence of Lambis spp. in bycatch of lobster nets in the Gulf of Mannar coast has been reported[20]. Pteria spp. is a sessile commensal

bivalve, found to be associated with gorgonians and its symbiotic nature is well explained in the case of Pteria brevialata on sea fan, Hicksonella principles[21]. Likewise, Pteria avicular, P. heteroptera and P. tortirostris are known to be associated with sea fans[22]. Sea fans (Gorgonians) are easily uprooted from their substrates because of lobster nets, which would deprive the above endangered organisms of their habitat. Pair trawls are known to cause damage to molluscan habitats like sponges, alcyonarians and gorgonians. The study corroborates that any bottom-set gear would affect these sensitive organisms, albeit in different scale.

Fig.5(a-i) – Molluscs collected from lobster net bycatch
5a. Piled up *Pleurploca trapezium*; 5b&c. Dorsal and ventral view of *Circe scripta*; 5d&e. Dorsal and ventral view of *Pteria avicular*; 5f&g. Dorsal and ventral view of *Gafrarium dispar*; 5h&i. Dorsal and ventral view of *Vulsella vulsella*.

The endosymbiotic bivalve *Vulsella vulsella* is host-specific to sponges and cannot survive in any other substrate. This species contributed to 12.35% in numbers among bivalves because, sponges were hauled in the net. These shells act as typical bio-indicator for sponges being depleted as a result of discriminate fishing. Because of the bulky nature, size and fragility of the sponges, uprooting with lobster nets at the time of deployment or hauling is inevitable. Species like Chicoreus ramosus was not recorded in the bycatch, because the shells were immediately bought by shell dealers due to its high demand in the shell industry.

Most of the species documented were found in seagrass beds, seaweeds and coral reef habitats surrounding the islands or fishing grounds of Gulf of Mannar. An updated species checklist of Molluscs from the Gulf of Mannar reports 856 species[23]. More than 75% of the recorded species of molluscs were caught in the gear because of their attachment or when involved in foraging activity in the substrata. Given that the lobster net is operated as a bottom-set gill net, at the time of hauling, sponges, gorgonians, seagrass beds, reefs that provide a habitat for molluscs and other marine life is totally destroyed. This reveals the destructive nature of lobster nets operated in the Gulf of Mannar. Despite the fact that all bottom set gill nets are destructive, operation of lobster nets in and around the reef areas pose a major threat along with fish traps in this region[24]. In Baja, California, set gill nets have significantly higher bycatch and cause more damage to corals and kelp plants[15]. The biogenic habitat structures in the reef area with its ecological components like molluscs are important in shaping the community structure. Poorly set gill nets or a bad choice of mesh size have the risk of bringing ashore elevated levels of bycatch as in the case of lobster nets that are operated in the Gulf of Mannar.

From the bycatch, molluscs like Pleuroploca trapezium and Lambis truncata fall within Schedule IV of Wildlife Protection Act (1972) of India and all corals are protected under Schedule I of the Act (Table. 2). The fisher folk of this region have been traditionally fishing in this part for generations using diverse fishing gears. Replacement of the traditional fishing gears with bottom set gill netting has caused significant damage to the sensitive ecosystem like coral reefs. The fishers are interested to collect larger shells because of the attractive prices they offer. Larger molluscs get caught in the lobster net easily while the smaller molluscs, because of their attachment to their habitats like seaweeds, corals, seagrass etc. are found to be caught along with their substrates.

The challenge now is taking up conservation message to lobster net fishers in the Gulf of Mannar. People who work at sea often cling tenaciously to their main lifestyle as an expression of their personality[25] and they are proud to be a part of their culture – a fisherman. Since the intensity of lobster net fishing has increased in the last decade, convincing the fisher folk of the ill effects caused by this fishing is of prime importance. While some alternative livelihood programmes have been successful, complimentary livelihood programmes is well received in the community[16]. Strengthened alternative livelihood and complimentary livelihood programmes provide enhanced livelihood sources to minimize the dependency on the ecosystem. This is one way of minimizing fishing pressure caused due to

lobster net by decreasing the frequency of operation. Another parallel option is to encourage the fishers to operate the lobster nets outside the reef areas to avoid depletion of marine living resources. The study highlights the need for sensitizing the fisherfolk on the impacts of destructive nets and the need of conserving sensitive ecosystems besides documenting the diversity of molluscs.

Acknowledgement

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