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Snake mackerel fishery of the Tuticorin coast of Gulf of Mannar with emphasis on population characteristics of the sackfish, *Neoepinnula orientalis* (Gilchrist & von Bonde 1924)

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ABSTRACT

Snake mackerels form by-catch in deep sea trawls and gillnets with an annual average production of 106 t during 2004 - 2006 in Tuticorin area. Fishery occurred almost round the year with peak during November - March. Fishery and biology of the dominant species, *Neoepinnula orientalis* was monitored during 2004 - 2005. Peak spawning and recruitment of the species was during December - March period. Growth parameters, L_∞ and K are estimated as 31.6 cm and 0.68/year respectively. K value indicates that fish growth is relatively slow. Natural mortality estimate (M) is 1.38, total mortality (Z) 1.59 and fishing mortality (F) 0.21. The exploitation ratio (E) is low being 0.132. These estimates indicate that the stock is at its early stage of exploitation and have large scope for future commercial exploitation. As a preliminary step in this direction, the extent of stock abundance, biomass and distribution of the stock needs to be assessed. Being a slow growing species in cold habitat, considerably long time is required for stock multiplication. These factors have to be taken into consideration while planning for exploitation of snake mackerels in future.

Keywords: Exploitation rate, Growth, Mortality, *Neoepinnula orientalis*, Sackfish, Snake mackerel

Introduction

Gulf of Mannar is well known for its biodiversity richness. In the recent past, with the dwindling production and increasing competition for resources in coastal waters, several fishers extended fishing activities to deeper waters by deploying mechanized boats as well as motorized vallams and exploited wide range of fish varieties previously less known. Incidentally, many deep sea fishes, which were documented earlier for their occurrence and distribution, have formed a diversified fishery now. Among them, members of the family Gempylidae became part of regular fish landings by deep sea trawls and large meshed gillnets as a prominent bycatch.

Snake mackerels are bathypelagic fishes, reported to be distributed along the tropical and subtropical parts of Atlantic and Pacific Oceans, South African coasts and Laccadives in the Indian Ocean. Occurrences of snake mackerel in deeper waters along the west coast of Indian EEZ was reported by Venu and Kurup (2006). Balasubramanian and Abdussamad (2007) reported six species of Gempylids in the fishery from south-east coast of India. However, biological information of the member species are limited, except a report on some aspects on the biology of *Neoepinnula orientalis* from west coast of India (Venu and Kurup, 2006) and some information on their food and feeding habits (Sommer *et al.,* 1996). In order to gather additional scientific information on the resource, fishery of snake mackerel as well as biological characteristics of the dominant species, *N. orientalis* were studied.

Materials and methods

Data on effort, catch and species composition of snake mackerels were collected from conventional trawls and gillnets operating off the coast of Tuticorin at weekly intervals during 2004-2005. Biology, length and weight composition of the common species, *N. orientalis* in the landings were also studied. Reproductive and feeding biology of 624 specimens within the size range of 14.0-29.2 cm were recorded. Food and feeding was studied following the method proposed by Natarajan and Jhingran (1961).

Length frequency data for the period were pooled and used for the estimation of von Bertalanffy growth parameters L_∞ and K following Ford-Walford plot (Ford, 1933; Walford, 1946) and by ICLARM's FiSAT software (Gayanilo *et al*., 1997). Age at zero length (t_0) was estimated

as in Bertalanffy (1934) and size at first capture (Lc) as in Pauly (1984). Natural mortality (M) was estimated using Pauly's empirical formula (Pauly, 1980), by using 8 °C as the mean seawater temperature at their habitat depth. Total mortality (Z) and exploitation ratio (E) were estimated from the catch curve as per Pauly (1983) and exploitation rate (U) from the relation; $U = F/Z * (1-e^{-Z})$; where, F is the fishing mortality. Optimum age of exploitation was estimated following Krishnankutty and Qasim (1968).

Results and discussion

Fishery and resource utilization

Snake mackerels formed a regular fishery along the Tuticorin coast since late nineties. They were exploited by deep sea trawls and large meshed gillnets operating beyond 200 m depth zone. Annually 106 t were landed by these gears during the study period (Table 1 and 2). About 91.4% of the catch was contributed by trawls and the rest by gillnets. Fishery occurred round the year with peak during November to March in trawls and June to January in gillnets.

Table 1. Estimated landings of snake mackerels (kg) by trawls and large meshed gillnets at Tuticorin during 2004-2006

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2004	1506	47238	9460	-	-	10342	1121	1738	678	3342	3584	2124	81133
2005	13938	3584	7492	-	-	1265	2545	5562	2902	1300	1528	6954	47070
2006	2687	6080	12387	-	-	8165	1487	4316	986	642	10881	1142290	189927
Average	6044	18967	9780	0	0	6591	1718	3872	1522	1761	5331	50458	106043

Fishery was supported by seven species; *Lepidocybium flavobrunneum, Ruvettus pretiosus*, *Gempylus serpens*, *Neoepinnula orientalis*, *Rexea prometheoides, Thyrsitoides marleyi* and *Thyrsites atun*. Trawls land all seven species, whereas, gillnets land only large species *viz*., *L. flavobrunneum* and *R. pretiosus*. In trawls, the catch was dominated by *N. orientalis* (74.5%) followed by *R. prometheoides* (12.3%), *L. flavobrunneum* (5.7%) and *R. pretiossus*. These species formed regular fishery along the region.

Table 2. Trawl effort and catch of *Neoepinnula orientalis* landed at Tuticorin

Year	Effort (units)	Catch (kg)	CPUE (kg)	Catch (kg)	%
2004	127646	76050	0.48	61657	81.1
2005	358914	39126	0.10	34478	88.1
2006	333836	175615	0.36	120504	68.6
Average	273465	96930	0.26	72213	74.5

Earlier, there were no buyers for the resource except the fish meal industry. Almost all the members of this family tend to yield high amount of oil and also delicious flesh, good for human consumption. This awareness changed the scenario with an increased demand from domestic traders. There is every possibility that demand for the present day non-conventional resources like snake mackerel may go up further with the stagnating/dwindling production of the conventional resources from coastal waters. This may lead to the development of targeted fishery for such resources in the immediate future

Population characteristics

Size composition in the catch

Catch was supported by fishes in the length range of 14.0 - 29.2 cm (TL) with 22.3 cm as mean size. Smaller fishes were totally absent in the catch during the study period. Size frequency distribution was raised to monthly catch and growth, mortality and exploitation parameters were estimated.

Growth and age

Estimates of growth parameters, L_{∞}, and K by Ford-Walford plot was 30.27 cm and 0.71/yr and that by FiSAT was 32.93 cm and 0.65/yr respectively. The average values of 31.6 cm and 0.68/year was used for further analysis. Age of the species at zero length (t_o) was estimated as -0.28 years. The estimate of K is relatively small indicating that the growth of the species is slow. They are estimated to attain 18.4, 24.9, 28.2 and 29.9 cm respectively by the end of 1st, 2nd, 3rd and 4th years. It will take more than 3.5 years to reach the L_{max} (29.2 cm).

Fishes inhabiting cold temperate waters generally have slow growth rate. This holds true for the fishes in the deep cold oceanic waters also. The average habitat water temperature of snake mackerels being very low at around 8 °C, the present growth estimates appear to be realistic. Lorenzo and Pajuelo (1999) reported small values of K for *Promethichthys prometheus,* another member of the

family Gempylidae, indicating slow growth for the species. However, Griffiths (2002) reported relatively much fast linear growth during the first year (33-44 cm) for the South African snoek, *Thyrsites atun.*

Size at first capture (L_c) of *N. orientalis* in trawl was estimated as 19.8 cm and optimum size of exploitation (L_{opt}) as 18.6 cm. Age corresponding to size at first capture estimated is 13+ months and age at optimum exploitation is one year.

Sexual maturity and spawning

Catch was dominated by adults (86.4 %) the rest being sub-adults. The exploited population during December-March was dominated by fishes with mature and spent gonads (nearly 46.2% to 84.7% of the catch) . During other seasons, fishes with mature and spent ovary in the population varied between 0 and 4.3%, indicating that the species spawn mainly during December-March along the Gulf of Mannar region.

Mature specimens of the species could be observed from 15.5 cm size onwards. But size at first maturity at 50% level on probability curve is 17.9 and 18.2 cm for males and females respectively. Age of the fish at this size is 11-12 months, indicating that they attain sexual maturity and spawn by the end of first year. Estimate of the size at maturity was smaller than the size at first capture and optimum size of exploitation, but since the values are lying very close to each other, there is need for close monitoring to avoid recruitment overfishing. Information on the reproductive biology of the species of snake mackerels are limited, except for the species *Thyrsites atun* (Griffiths, 2002). This specis attain sexual maturity at 73.0 cm FL.

Fecundity

Relative fecundity (fecundity/g body weight) of the fish determined by examining 11 gravid gonads (stage IV and V) ranged between 612 and 918 with a mean relative fecundity of 794. Though the fish appears to have relatively high fecundity, survival of young ones in deep cold water zone depends on several factors of the spawning ground such as prevailing water temperature and current patterns. Renwick *et al.* (1998) reported considerable inter-annual fluctuation in the recruitment of young southern gemfish (*Rexea solandri*) according to sea surface temperature and flow patterns.

Food and feeding

Gut observation indicated that sackfishes are carnivorous in feeding habit. Food was constituted mainly by myctophids, small mesopelagic fishes, deep sea prawns, small crabs and cephalopods. Nearly 56.7% of the food was constituted by myctophids and mesopelagic fishes, followed by cephalopods (22.6%), prawns and crabs (13.8%) and other small organisms (6.9%).

Predators

Observations on the gut of predatory fishes landed along the region were observed as part of ecological interaction studies. *N. orientalis* was observed in the guts of many oceanic predatory fishes like different shark species, perches, yellowfin tuna (*Thunnus albacares*) and ribbonfishes. The present observation is substantiated by the report of Dragorich (1971), who observed snake mackerels in the stomach of skipjack and yellowfin tuna

Mortality and exploitation rate

Estimate of total mortality in the population during the period was 1.59, natural mortality being 1.38 and fishing mortality 0.21. Exploitation ratio was very lowbeing 0.132 (Table 3). Small values for estimates of fishing mortality and exploitation rates indicate that removal from the stock by fishing was only nominal compared to natural mortality. Total loss from the population due to fishing is only 13% and that by natural causes is 87%. This indicates stock is almost at virgin state and remains grossly underexploited. Since the extent of distribution and abundance of the stock in the ecosystem remains to be ascertained, stock, biomass and sustainable yield could not be estimated.

Table 3. Estimated values of population parameters of *Neoepinnula orientalis* landed at Tuticorin

Year	Natural mortality (M)	Fishing mortality (F)	Total mortality (Z)	Exploitation rate (E)
2004	1.38	0.13	1.51	0.09
2005	1.38	0.2	1.58	0.13
2006	1.38	0.3	1.68	0.18
Mean	1.38	0.21	1.59	0.13

Mortality estimates (M-0.35, F-0.14, Z-0.49) of *P. prometheus* by Lorenzo and Pajuelo (1999), indicated that the resource is under nominal fishing pressure. Most of the non-conventional and non-target resources are under low fishing pressure and have small values for exploitation rates.

The database developed from the present study will serve as a basic information on the population characteristic of the species. However, detailed studies are required to arrive at conclusive estimates for stock as well as potential yield of the resource, which are essential for management of the resource. Exploitation strategies for this resource have to be based on such detailed database.

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References

Balasubramanian, T. S. and Abdussamad E. M. 2007. On the occurrence and fishery of fishes of the family: Gempylidae along the Tuticorin coast in Gulf of Mannar. *Mar. Fish. Inf. Serv., T&E Ser.,* 191: 21-22.

Bertalanffy, L. von 1934. Unter suchungen uberdie Gesetzlichkeiten des waswasdestums I. Allgemeine Grundlagen der Theorie. *Roux Arch. Entwicklungsmech. Org.,* 131: 613-653.

Dragorich 1971. The food of skipjack and yellowfin tunas in the Atlantic Ocean. *Fish. Bull. Natl. Atmos. Admini. Seattle*, 68 (3): 445-455.

Ford, E. 1933. An account of the herring investigations conducted at Plymouth during the years from 1924-1933. *J. Mar. Biol. Ass. U. K.,* 19: 305-384.

Gayanilo, Jr. F. C., Sparre, P. and Pauly, D. 1997. The FAO-ICLARM stock assessment tools (FiSAT) user's guide. *FAO computerised information series: fisheries*. FAO, Rome, Italy.

Griffiths, M. H. 2002. Life history of South Atlantic snoek, *Thyrsite atun* (Pisces: Gempylidae): a pelagic predator. *Fish Bull*., 100 (4): 690-710.

Krishnan Kutty, M. and Qasim S. Z. 1968. The estimation of optimum age of exploitation and potential yield in fish populations. *J. Cons. Perm. Int. Explor. Mer.,* 32(2): 249-255.

Lorenzo, J. M. and Pajuelo, J. G. 1999. Biology of a deep benthiopelagic fish, nudi escalator, *Promethichthys Prometheus* (Gempylidae) off the Canavy Islands. *Fish Bull*., 99 (1): 92-99.

Natarajan, A.V. and Jhingran, V. G. 1961. Index of preponderance-a method of grading the food element in the stomach analysis of fishes. *Indian J. Fish*., 8: 54-59.

Pauly, D. 1980. A selection of simple methods for the assessment of tropical fish stocks. *FAO. Fish. Circular,* No. 729, FIRM/ 129: 54 pp.

Pauly, D. 1983. Some simple methods for the assessment of tropical fish stocks. *FAO. Fish. Tech. Paper,* 234: 1-52.

Pauly, D. 1984. Length converted catch curves: A powerful tool for fisheries research in the tropics (Part II). *Fishbyte*, 2 (1): 17-19.

Renwick, J. A., Hurst R. J. and Kidson, J. W. 1998. Climatic influence on the survival of southern gemfish (*Rexea solandri*, Gempylidae) in New Zealand waters. *Int. J. Climatol,* 18 (15): 1655-1667.

Sommer, C., Schneider, W. and Poutiers, J. M. 1996. The living marine resources of Somalia. *FAO species identification field guide for fishery purposes.* FAO, Rome, 376 pp.

Venu, S. and Kurup, B. M. 2006. Distribution and biology of deep sea fishes *Neoepinnula orientalis* Gilchrist and von Bonde 1924 and *Psenes squamiceps* Lloyd, 1909 from west coast of Indian EEZ, *J. Mar. Biol. Ass. India*, 48 (1): 24-28.

Walford, L. A. 1946. A new graphic method of describing the growth of animals. *Biol. Bull. Mar. Biol. Lab. Woods Hole,* 90: 141-147.

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