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Food Habits and Diet Composition of Demersal Marine Fishes from Gulf of Mannar, Southeast Coast of India

[1]*T. Mohanraj* and [2]*K. Prabhu*

[1]Tuticorin Research Centre of Central Marine Fisheries Research Institute, South Beach Road, Tuticorin
[2]CAS in Marine Biology, Annamalai University, Parangipettai, India

Abstract: Commercially important demersal fish specimens were collected from the fish landing centre of Tuticorin fishing harbour, India from June 2009 to December 2009. The samples were selected randomly and stored in boxes containing ice. *Arius thalassinus, Lutjanus fulviflammus. Lutjanus rivulatus. Lethrinus nebulosus, Lethrinus miniatus* and *Sphyraena jello* were the selected species for this study. All fishes were resulted as carnivorous. The catfish stomach showed variety of food particles which holds crabs as a main food item. Lethrinidae samples revealed that it took different food items as their feed with major composition of echinoderms and crustaceans. Other species were mainly feed on fishes. The lutjanidae fishes presents fish as its major diet 62.4% and 55.6% for *Lutjanus rivulatus*. And *Sphyraena jello* constitutes 88.6% of fish in their food habit.

Key words: Demersal Fishes · Gulf of Mannar · Lethrinidae · Lutjanidae · Echinoderms

INTRODUCTION

Being caught in a variety of gears such as trawlers, drift gill net, purse seine and hooks and line, these fishes are exploited from different levels of the water column during both day and night. Information on the diet of fishes is important to understand the basic functioning of fish assemblages and is widely used for ecological work and modeling and is becoming an increasingly important component in ecologically based management. Information about the food habits of fishes is useful in defining predator-prey relationships. A compilation of different food items consumed by a fish species may eventually result in identification of stable food preferences and in a preliminary estimate of trophic level [1]. Data on diet composition are useful in the creation of trophic models as a tool to understand complex coastal ecosystems. In a more recent paper, Alvarez-Leon *et al*. [2] stomach content studies on fish fauna are almost nonexistent and deal mainly with qualitative information. Other resources such as space and time have also been important for community ecology and the ecological theory predicts that resource partitioning at spatial, temporal and trophic level may increase tolerance of niche overlap reducing competition pressure between co-occurring species. Ross [3] identified that in aquatic environments food is the main factor and that its partition defines functional groups within the community, which get together in guilds according to trophic similarity. Food consumption usually provides information about the niche a species occupies in its habitat. It is also helpful in deciphering some of the higher level tropic relationships in ecosystems. The prey taken by a predator constitutes an essential parameter in connection with niche breadth and it complements studies that refer to competition and spatial overlap [4]. The knowledge of the feeding ecology of non commercial as well as commercial species is necessary for implementing a multispecies approach to fisheries management. Traditionally, information on the quality and quantity of food consumed by fish, which can be derived from feeding studies, is made operational for fisheries research through incorporation into appropriate fisheries models.

In addition, diet composition data also play an important role for the research on some ecological issues such as resource partitioning and within and between species competition [5], prey selection [6], predator-prey size relationships [7], distribution of feeding types with latitude, ontogenetic diet shifts [8], habitat selection [9], testing predictions from foraging behavior and optimal

Corresponding Author: T. Mohanraj, Tuticorin Research Centre of CMFRI, South Beach Road, Tuticorin-628 001, Tamil Nadu, India. Tel: +91-9965371050.

foraging theory models [10] and species invasions [11]. The estuaries and coastal regions are characterized by high productivity levels and that many fish species utilize those regions as nursery and feeding grounds [12]. Marine fish communities of temperate and coastal regions are characterized by considerable division of food resources among predators [13]. With fish growth, the proportion of planktonic organisms decreased, while that of fish increased. Feeding intensity varied throughout the year. The lowest feeding intensity was recorded in spring and the highest feeding intensity was recorded in summer [14]. Fish diet is highly linked to fish size as demonstrated by numerous studies which show that it acts on prey preference, prey diversity, feeding behavior or feeding rate. Feeding habits in fish may vary within wide bounds on temporal and spatial scales. Better understanding of the feeding patterns (diet composition, sources of variability, trophic interactions) of the major fish predators is crucial for determining their roles in a particular marine ecosystem. It is of interest to identify those environmental factors which, along with ontogenetic mechanisms, largely determine diets of fish and to obtain an overview of how diets vary with the environment [15]. Fish size, maturity and condition, season, bottom depth, latitude, longitude and habitat type are among potential factors influencing fish diets. They reflect or relate to ontogenetic changes, the physiological status of predators, seasonal variation in temperature and prey abundance and spatial distribution of prey in the environment [16]. Recent studies confirm the relationship between fish size and number of prey items. Several authors found that this relationship was not linear but first increased, then as the fish got to their maximum size, the diversity of theirprey tended to decrease, thus showing a specialization with size or age. It is generally difficult to envisage the full implications of ecosystem management, mainly because the interactions involved at the ecosystem level are complex and poorly understood [17]. The present study was conducted for commercial demersal fishes from the Tuticorin waters, the east coast of India in order to determine their dietary compositions and food habits.

MATERIALS AND METHODS

From time immemorial Tuticorin has been an important fishing centre in India. Apart from the production of quality marine fish it is famous for the valuable pearl and molluscan fisheries and rays. Demersal fish specimens (Table 1) were collected from the fish landing centre of Tuticorin fishing harbour, India from June 2009 to December 2009. The samples were selected randomly and then stored in boxes containing ice to slow bacterial digestion process in the fish stomachs and make it easier to identify the prey. The fish samples were taken to laboratory for further analysis. The total length and fresh weight of the individual specimens were measured. Then the fish guts were removed and cut open. All food items in the stomachs were identified. The total number, wet weight and occurrence of each prey item in the stomach of the fishes were recorded. The dietary components for each species studied were expressed as a percentage of species composition.

RESULTS AND DISCUSSION

Arius Thalassinus: A total number of 30 specimens in the size range 33-42 cm were examined. *A. thalassinus* is carnivorous and the food comprises mostly organisms of the benthic epifauna and infauna along with fishes. This fish occurs in coastal waters from near shore to the continental shelf margin. The diet of this fish is mainly opportunistic and carnivorous such as crustaceans, squid, fishes, detritus, echinoderms, amphipods, sand and mud. The analyzed stomach contents included a higher percentage of crabs (38%) and a significant quantity of prawns (*Metapenaeus affinis, Acetes indicus),* polychaetes, bivalves, gastropods and cephalopods (3.8%) (Fig. 1). According to Chacko [18] this fish is omnivorous, feeding at the surface and also browsing at the bottom.

Table 1: List of the selected marine demersal fishes for dietary composition studies from Tuticorin waters, Gulf of Mannar

S.No.	Scientific name	Common name	Length (cm)	Weight (Kg)
1.	*Arius thalassinus*	Giant sea catfish	33 - 42	0.25 - 4.75
2.	*Lutjanus fulviflammus*	Blackspot snapper	18 - 30	0.35 - 5.0
3.	*Lutjanus rivulatus*	Blubber lip snapper	28 - 65	1.5 - 5.5
4.	*Lethrinus nebulosus*	Spangled emperor	10 - 32	1.8 - 5.45
5.	*Lethrinus miniatus*	Sweetlip emperor	14 - 38	1.2 - 6.1
6.	*Sphyraena jello*	Pickhandle barracuda	45 - 70	1.2 - 4.0

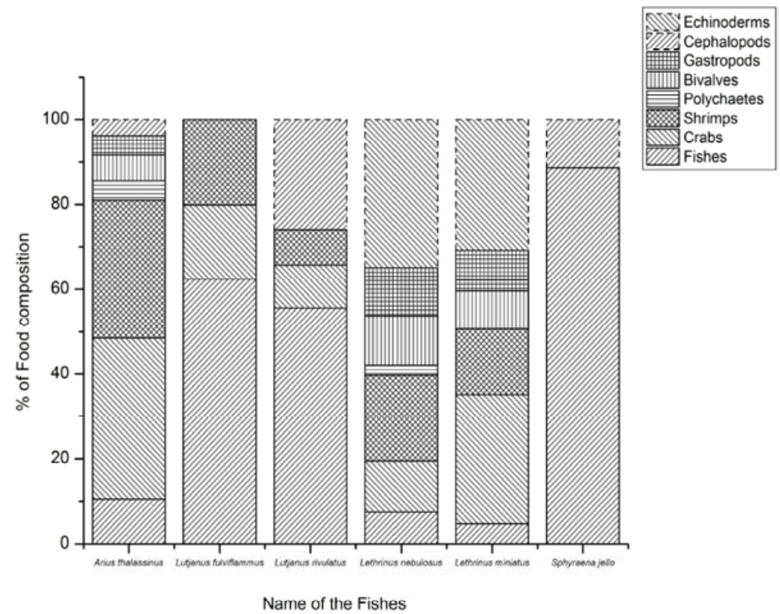

Fig. 1: Variations of the proportion of food items of selected demersal fishes

Lutjanus Fulviflammus: This is one of the commonest species that occurs among snappers and notable in the trawl catches. A total of 30 specimens of size range 18-30 cm were examined. It inhabits coral reefs at depths between 3 and 35 m. Juveniles sometimes found in brackish water or mangrove estuaries or in the lower reaches of freshwater streams. It feeds mainly on fishes, shrimps, crabs and other crustaceans. This species caught mainly with handlines, traps and gill nets [19]. The fish is an active carnivore, fishes (62.4%) and prawns forming the main constituent of the diet. Other organisms like crabs (17.5%) were also found in the stomach (Fig. 1).

Lutjanus Rivulatus: A total of 30 specimens of size range 28-65 cm were examined. This fish is occasionally encountered on coral reefs or shallow inshore flats. However this snapper occurs in deeper water to at least 100 m. Found solitarily or in small groups of up to 15 to 20 fish. It feeds on fishes, cephalopods and benthic crustaceans. This snapper caught with handlines, traps and gill nets, occasionally trawled [19]. The stomach content comprises of fishes (55.6%) and cephalopods at higher percentage. The crustacean such as crabs and shrimps (8.2%) shares the lower level (Fig. 1).

Lethrinus Nebulosus: Gut content analysis of Lethrinus *nebulosus* ranging in size from 10-32 cm in total length. This fish founds on near shore and offshore coral reefs, coralline lagoons, seagrass beds, mangrove swamps and coastal sand and rock areas, to depths of 75 m. It feeds mostly on echinoderms, mollusks, crustaceans and to a lesser extent on polychaetes and fishes. This emperor fish is taken by handline, traps, trawls, seines and gill nets [19]. The stomach content reveals echinoderms (26.9%) as higher composition following by shrimps, crabs, mollusks, fishes and polycheates (3.4%) (Fig. 1).

Lethrinus Miniatus: Sweetlip emperors are carnivorous predators in the reef. A total of 30 specimens of size range 14-38 cm were examined. It lives in the depths between 5 and 30 m. It feeds mostly on crustaceans, echinoderms, mollusks and fishes, with crabs and sea urchins predominating. This fish caught primarily by handline [19]. The stomach contents showed a high percentage of echinoderms (30.8%) and crabs along with shrimps, bivalves, gastropods and fishes (4.7%) (Fig. 1).

Sphyraena Jello: The pickhandle barracuda found in coastal areas of continental and island shelves. The gut content observed sizes ranged from 45-70 cm. It feeds mainly on small fishes, squids and shrimps. It caught mainly with handlines, bottom trawls, gill nets and encircling nets [19]. The fish is an active carnivore, fishes (88.6%) and cephalopods (11.4%) (Fig. 1) forming the main constituent of the diet.

The present study on stomach contents elaborates feeding composition of commercially important demersal fishes of this region. The *Arius thalassinus* is mainly feeds on benthic composition of animals. This results major constituent of feed is crustaceans. Although in some articles it has been indicated as scavenger due to the presence of big teleost vertebrae bone [20]. *L. fulviflammus* and *L. rivulatus* majorly feeds on fishes. These fishes constitute very important roles in snapper fishery at Tuticorin. The Lethrinidae fishes are the echinoderm tasters following with crustaceans. The above snapper's gut contents were some time disturbed by baits of fishermen. *Sphyraena jello* is a bigger fish that encountered in this study. The majority of food preference is fishes and cephalopods. The most frequently eaten prey items (fish, crustaceans, mollusks, worms and echinoderms) are the same than in all other studies on the diet of tropical carnivorous coastal fishes. The frequency of these items is probably not necessarily proportional to their abundance in the environment. Fish diet is highly linked to fish size as demonstrated by numerous studies which show that it acts on prey preference, prey diversity, feeding behavior or feeding rate. Nakamura *et al*. [21] indicates that there may be important changes of diet with size, many species switching from smaller, easier to access prey, to larger prey or to prey more difficult to catch or extract but of higher nutritive value. It is difficult to assess the consequence of such shifts in terms of energy flow as well as in terms of impact on the environment [22]. These changes in diet with size go often together with a change in biotope. Nekton was an increasingly important diet item as fish size increased, with more species eating this item as size increased. Nekton probably offers the best nutritional input for carnivorous fish and is therefore favored when possible [23]. Crustaceans decrease in importance in the diet of most fishes as size increases. This has been observed in other ecosystems, carnivorous fishes switching from crustacean to nekton as they grow [24]. Reef urchins were not a preferred food and it was a prey item only for the largest Lethrinidae. Worms never represented a high volume in the diet of the fish examined, probably due to the fact that this prey type is small, difficult to find and maybe of low nutritional value compared to other prey types. Eating mollusks requires powerful jaws and this may not be reached before a given size; thus explaining the low contribution of this prey type to the diet of small fishes. The absence of mollusks in the largest fishes could be due to a low nutritional value compared to the energy needed to consume large enough quantities. However, it is important to recognize the actual complexity of the situation because species may feed at different levels in the food chain at different stages of their life cycle. Landry [25] found that fully adult codfish are predators on herring, but when they are small (<50 cm long) they feed on copepods and other planktonic crustaceans. The food preference of predatory fishes is very complex and is influenced by many factors such as prey accessibility and mobility, prey abundance, prey energy content, prey size selection and seasoal changes [26].

The variations of the different food items generally depend upon their availability or any preference shown by the fish, as also the intensity of feeding which is influenced by the growth and maturation in many fishes. The analysis of the food of different species of trawl fishes has shown that most of them are predators on actively moving benthic invertebrates and teleost fishes [20]. Although Powell [27] and Cassie [28] note that snapper feed more extensively on pelagic food such as salps during spawning time (November-February). Identification of stomach content of fishes is not easy since the food items are usually completely digested or unidentifiable. In addition, most of the fish samples have empty stomachs. A greater physical structure creates more micro-habitat types which allow competitors coexistence as well as predator and prey persistency [29]. It also generates more complex trophic relations in terms of guilds number and functional groups as a result of the breadth of resource utilization [30]. On the other hand, Yanez-Arancibia and Sanchez-Gil [31] proposed that tropical estuarine ecosystems have great habitat heterogeneity, which allows high prey availability and so, greater breadth trophic spectrum. The variations in food preference during the young and adult stage in carangids may be considered as an adaptation, since fish in an advanced size group by feeding on easily available fish food tends to save energy which may be spared for growth and reproduction [32]. Traditionally, information on the quality and quantity of food consumed by fish, which can be derived from feeding studies, is made operational for fisheries research through incorporation into appropriate fisheries models (e.g., multispecies virtual population analysis) and, after scaling up to the total biomass of predators and prey, provides estimates of the total biomass consumed by predators [17]. This study might helps to sustainable fisheries research to establish a prey-predator relationship as well as for all aspects of better fisheries management of these Gulf of Mannar regions.

REFERENCES

1. Sa-a P., M.L.D. Palomares and D. Pauly, 1997. The food items table. In Fish Base. 1997. CD-ROM. ICLARM, Manila.

2. Alvarez Leon, R., V. Rodriguez Mahecha and R.H. Orozco-Rey, 1999. Advances in the catalog of fishes of Colombia, present in freshwater, estuarine and marine, p. 8. In Colombian Symposium V Abstracts of Ichthyology. Com. Hundred Reg. and Technol. Amazon, Leticia.
3. Ross, S.T., 1986. Resource Partitioning in Fish Assemblages: A Review of Field Studies. Copeia, 2: 352-388.
4. Horn, H.S., 1966. Measurement of overlap in comparative ecological studies. The American Naturalist., 100: 419-424.
5. Harmelin Vivien, M.L., R.A. Kaim Malka, M. Ledoyer and S.S. Jacob Abraham, 1989. Food partitioning among scorpaenid fishes in Mediterranean seagrass beds. J. Fish Biol., 34: 715-734.
6. Stergiou K.I. and H. Fourtouni, 1991. Food habits, ontogenetic diet shift and selectivity in *Zeus faber* Linnaeus, 1758. J. Fish Biol., 39: 589-603.
7. Scharf, F.S., F. Juanes and R.A. Rountree, 2000. Predator size-prey size relationships of marine fish predators: Interspecific variation and effects of ontogeny and body size on trophic niche breadth. Mar. Ecol. Progr. Ser., 208: 229-248.
8. Labropoulou, M. and A. Eleftheriou, 1997. The foraging ecology of two pairs of congeneric demersal fish species: Importance of morphological characteristics in prey selection. J. Fish Biol., 50: 324-340.
9. Labropoulou, M. and K.N. Papadopoulou Smith, 1999. Foraging behavior patterns of four sympatric demersal fishes. Estuar. Coast. Shelf Sci., 49: 99-108.
10. Hughes, R.N, 1997. Diet selection. In: Godin, J.G.J. (ed.), Behavioral Ecology of Teleost Fishes. Oxford University Press, Oxford, pp: 134-162.
11. Golani, D. and B. Galil, 1991. Trophic relationships of colonizing and indigenous goatfishes (Mullidae) in the eastern Mediterranean with special emphasis on decapod crustaceans. Hydrobiologia, 218: 27-33.
12. Allen, L., 1982. Seasonal abundance, composition and productivity of the littoral fish assemblage in upper Newport Bay, California. Fishery Bulletin US 80: 769-790.
13. Tyler, A.V., 1972. Food resources divisions among northern marine demersal fishes. J. Fish. Res. Bd. Can. 29: 997-1003.
14. Hristova Yankova, M., V. Stoyanov Raykov and P. Bogomilova Frateva, 2008. Diet Composition of Horse Mackerel, *Trachurus mediterraneus ponticus* Aleev (Osteichthyes: Carangidae) in the Bulgarian Black Sea Waters. Turk. J. Fish. Aqu. Sci., 8: 321-327.
15. Hovde, S.C., O.T. Albert and E.M. Nilssen, 2002. Spatial, seasonal and ontogenetic variation in the diet of Northeast Arctic Greenland halibut (*Reinhardtius hippoglossoides*). ICES Journal of Marine Science, 59: 421-437.
16. Jaworski, A. and S.A. Ragnarsson, 2006. Feeding habits of demersal fish in Icelandic waters: a multivariate approach. ICES Journal of Marine Science, 63: 1682-1694.
17. Jennings, S., M.J. Kaiser and J.D. Reynolds, 2001. Marine Fisheries Ecology. Oxford: Blackwell Science, pp: 417.
18. Chacko, P.I., 1949. Food and feeding habits of the fishes of the Gulf of Mannar. Proc. Indian Acad. Sci., 29: 83-97.
19. Carpenter, K.E. and V.H. Niem, (eds), 1999. FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Volume 4. Bony fishes part 2 (Mugilidae to Carangidae). Rome, FAO, pp: 2069-2790.
20. Suseelan, C.and V. Somasekharan Nair, 1969. Food and feeding habits of the demersal fishes off Bombay. Ind. J. Fisheries, 16(1&2): 56-74.
21. Nakamura, Y., M. Horimonchi, T. Nakai and M. Sano, 2003. Food habits of fishes in a seagrass bed on a fringing reef at Iriomote Island, Southern Japan. Ichthyol. Res., 50: 15-22.
22. Jones, G.P., D.J. Ferrell and P.F. Sale, 1991. Fish predation and its impact on the invertebrates of coral reefs and adjacent sediments. In: Sale P. (Ed.) The ecology of fishes on coral reefs. Academic Press, pp: 156-179.
23. Domenci, P. and R.W. Blake, 1997. Review: the kinetics and performance of fish fast-start swimming. J. Exp. Biol., 200: 1165-1178.
24. Hanson, J.M and G.A. Chouinard, 2002. Diet of Atlantic cod in the southern Gulf of St. Lawrence as an index of ecosystem change, J. Fish Biol., 60: 902-992.
25. Landry, M.R., 1977. A review of important concepts in the trophic organization of pelagic ecosystems. Helgolander wiss. Meeresunters, 30: 8-17.
26. Nieland, H., 1980. Experiments on whether schooling by their prey affects the hunting behaviour of cephalopods and fish predators. J. Zool., 174(4): 149-167.
27. Powell, A.W.B., 1937. Animal communities of the sea-bottom in Auckland and Manukau Harbours. Trans. Proc. R. Soc. N.Z, 66(4): 354-401.

28. Cassie, R.M., 1956. Spawning of the snapper, *Chrysophrys auratus* Forster in Hauraki Gulf. Trans. R. Soc. N.Z, 84(2): 309-28.
29. Crowder, L. and W. Cooper, 1982. Habitat structural complexity and the interaction between bluegills and their prey. Ecology, 63(6): 1802-1813.
30. Angel, A. and F. Ojeda, 2001. Structure and trophic organization of subtidal fish assemblage on the northern Chilean Coast: the effect of habitat complexity. Marine Ecology Progress Series, 217: 81-91.
31. Yanez Arancibia, A. and P. Sanchez Gil, 1988. Ecología de recursos demersales marinos: fundamentos en costas tropicales, México D.F. A.G.T. Editor. pp: 228.
32. Sivakami, S., 1996. On the food habits of the fishes of the family Carangidae-a review. J. mar. biol. Ass. India., 38(1 & 2): 118-123.