

Dietary preference of three species of *Periophthalmus* from the mangrove swamp of South Andaman

Anisha Ani Benadict, G. Padmavati* and Limaangnen Pongener

Department of Ocean Studies and Marine Biology, Pondicherry University off Campus,
Brookshabad, Port Blair – 744112, Andaman and Nicobar Islands

*Email: padma190@rediffmail.com

Abstract

The dietary preference of three major *Periophthalmus* sp., found along the mangrove swamps of South Andaman coast were studied for gut content analysis by using Point and Frequency of occurrence methods. The analysis of gut content for all the three species of mudskippers revealed that the main food preference were either diatoms or algae, hence linking the relationship of mudskippers as primary consumers feeding directly on the primary producers in the food chain and also their carnivorous mode of feeding on the crustaceans and other polychaetes as a secondary consumers. The interaction of *Periophthalmus* sp., with crabs further streamlines on the ecological niche of mudskipper in the mangrove ecosystem.

Keywords: *Periophthalmus*, Dietary Preference, Mangrove Swamp, South Andaman.

Introduction

Mudskippers are benthic fishes belonging to the family Gobiidae (Order Perciformes). They thrive in the tropical and subtropical waters of wide salinity range inhabiting tidal mudflats, estuaries and mangrove swamps. Mudskipper possess frog-like protruding eyes, torpedo-shaped body, muscular pectoral fins. These special pectoral fins generally help them not only to skip or jump in the muddy swamps of the intertidal zones but also help them to climb upon the mangrove trees for an extent (Clayton, 1993). They are detritus feeders, mainly feeding on insects, benthic diatoms, algae, crustaceans, polychaetes and other small fishes. Unlike other fishes it is an amphibious fish which can survive on terrestrial habitat, as well as in the water. Since it lives in the muddy substratum, the oxygen content and the water percolation is less. It breathes by using gills, mucous membrane in the mouth and throat and through the dense network of blood capillaries in the skin, which holds moisture to survive in such a harsh condition. They usually make burrows of 'J', 'U' and 'V' shapes to lay eggs and escape from predators (Lee et al., 2005; Kim et al., 2011).

Diet of a fish represent an interaction among many ecological components depending on the behavior, habitat, energy flow, food chains and inter/ intra-specific

interactions (Chesson, 1983). The study on food habit of the mudskipper also provides valuable information regarding its food preference, the nutrition and relative importance of each food items selected by the fish. The literature review suggested that the study of eco-biology of mudskippers from this area is meager.

Material and Methods

Andaman and Nicobar group of islands located about 1,200 km away from mainland India situated at 6°45' N to 13°45' N and 92°10'E to 94°15' E covers a coastline of 1,962 km and the exclusive economic zone (EEZ) comprising of 0.6 million km², which is 30% of the Indian EEZ (Anon, 2008).

Sampling Stations

Station 1 - Carbyns Cove

Carbyns Cove is located at 11° 38.482' N and 092° 44.528' E. This area is muddy and flourished with mangroves. Mudskippers abundance is high in this region and mostly found on the underside of the resting boats.

Station 2 - Burmanallah

Burmanallah is located at 11° 33.569' N and 092° 43.781' E. It is basically a rocky beach lined with abundant

mangroves where small streams of fresh water join the sea. The abundance of *Rhizophora* sp. in the present sampling site showed high occurrence of mudskippers that were found resting on the network of prop roots.

Station 3 - North Bay

North Bay is located at 11° 43.112' N and 092° 44.626' E, covering a large patch of coral reefs along with rocky intertidal zone lined by vast area of mangrove vegetation in the muddy base.

Sampling Method

Sampling was carried out in January and February, 2017. Scoop nets (net mouth: 30cm x 30cm; mesh size: 200µm) were operated during low tide. At St. 1 and St. 2, the quiescent mudskippers that were attached on the resting surface were disturbed from the front allowing the fish to somersault backwards into the scoop net that were kept underneath. At St. 3, scoop nets were kept on both sides of tide pools. The tide pools were disturbed, upon which the mobilized fishes were scooped from the tide pool. Cast net (mesh size 1cm) by the fisherman was mainly operated during high tide in all the stations. Due to the mesh size, it captured only the adults and sub adults. Thus, an approximate of 30 adult mudskippers of each species was collected from all the three stations.

Laboratory analysis

All the collected fishes were separated into adults and sub adults in the laboratory. The total length and standard length of all the specimens were measured to the nearest millimeter by using a measuring board. Before the dissection of the specimen, photographs were taken so as to incur accurate pictorial reference for further study. Fish morphometric was analyzed and the specimens were identified up to species level by using identification keys (Murdy, 1989; Rao et al., 2000; Munro, 2000; Larson and Murdy, 2001). Specimens were selected for gut content analysis. Each specimen was weighed before dissection; the dissected stomachs were weighed and then placed in a petri dish and added 1 ml – 2 ml of fresh water for neutralize the formalin to make it working condition. Then, each stomach as slit open and contents were

removed by scraping the inner wall of the stomach and weighed. The content was transferred into petri dish along with some distilled water and spread by constant rotating. Analysis of the gut content was done by using a compound microscope (Magnus MLX) and number of dietary components was recorded from each sample.

Data analysis

Two standard qualitative methods was also used to study the gut content analysis of mudskippers, i.e., the Frequency of Occurrence Method (Hynes, 1950; Hyslop, 1980) and Point Method (Swynnerton and Worthinton, 1940). A combination of both these methods was used in this present study, so that one method could nullify the disadvantage of the other.

Results

A total of three species- *Periophthalmus argentilineatus*, *P. minutes* and *P. kalolo* of mudskippers were identified from study areas.

Systematics

Class	- Actinopterygii
Order	- Perciformes
Family	- Gobiidae
Genus	- <i>Periophthalmus</i>
Species	- <i>Periophthalmus minutes</i> Eggert, 1935
Common Name	- Minute mudskipper
Location:	- Carbyns Cove
Habitat:	Marine, brackish, demersal tropical and mangrove swamps and estuaries
Distribution:	Western Pacific, Andaman Islands, Thailand, Australia, Indonesia



Fig. 1. *Periophthalmus minutus*

Species description: Fin Formula: D. X- XII, 11-12; A. XI-XII; P. 10-12; Ls. 62-78. Standard length- 4.2 cm, Total length- 5 cm, dorsal spine 10-12, dorsal rays 11-12. Body moderately elongate, compressed; head slightly compressed, profile of snout steep, dermal cup like process each jaws, pelvic fins almost separated, fraenum absent, scales on head and body cycloid, no sensory canals and pores on the head, head and body dark brown, with dusky saddles; first dorsal fin reddish with numerous white spots and white distal margins, second dorsal fin reddish with brown stripes at the middle of fin (Fig.1).

Species - *Periophthalmus argentilineatus* Valenciennes, 1837

Common Name - Barred Mudskipper

Location - North Bay

Habitat: Marine, brackish, demersal tropical and mangrove swamps and estuaries

Distribution: Indo- Pacific, Southern Red sea to South Africa, East to the Marianas and Samoa, North to Ryukyu



Fig.2. *Periophthalmus argentilineatus*

Species description: Fin Formula: D. XII- XIV, 10-12; A. X, 12; P. 12-14. Standard length- 5.5 cm and Total length- 6cm. The ventral fin lack of fraenum, first dorsal fin margin convex, and both the dorsal fins separated. Body brownish, silvery and white ventrally, numerous white spots on the head and few on the trunk: trunk with narrow silvery bars, first dorsal fin with prominent black infra marginal bands and below white spots. Middle of the second dorsal fin with wide black spots; caudal fin with brownish red spot (Fig.2).

Species - *Periophthalmus kalolo* Lesson, 1831

Common Name - Common mudskipper

Location - Carbyns Cove, Burmanallah and North Bay

Habitat - Marine, brackish, demersal tropical and mangrove swamps and estuaries

Distribution - Indo- Pacific: East Africa to Samoa,



Fig. 3. *Periophthalmus kalolo*

Species description: Fin Formula: D.XI-XII, 12; A.I, 12; P.12-13; VI; Ls. 72-74. Standard length-6 cm and Total length- 6.5 cm Pelvic fraenum vestigial; First dorsal fin widely separated from second. Body grey; head with numerous white spots antero- ventrally; trunk with black flecks; faint brown saddles dorsally; margins of the dorsal spines white; prominent black stripe infra- marginally, fin with many grey spots all over (Fig.3).

Gut Content Analysis

Frequency of occurrence of all the three species in a single plate depicting that *P. kalolo* gut has highest diatom content (100%) followed by *P.minutus* (84%), but in case of algal fragments *P. minutes* showed the highest (92%) followed by *P. argentilineatus* (80%) [Fig. 4].

Gut content (frequency of occurrence method)

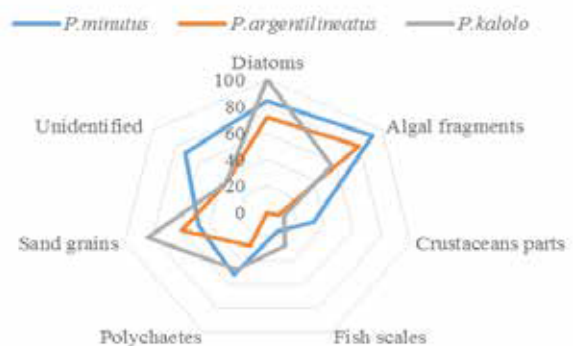


Fig. 4. Gut content of all the three species using Occurrence method

Points gained (using point method) of all the three species in a single plate depicting that *P. minutes* has highest diatom content (69%) followed by *P. kalolo* (23.76%) and *P. argenteolineatus* (16.48%) and in case of algal fragments *P. minutes* also showed the highest (81.72%) followed by *P. argenteolineatus* (29.8%) and *P. kalolo* (16.04%) [Fig. 5]

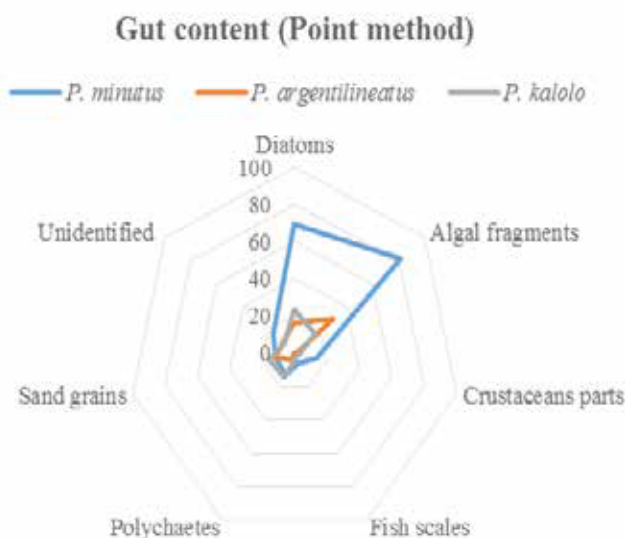


Fig.5. Gut content of all the three species using Point method

Animal association of mudskippers

The rock crab, *Grapsus albolineatus*, when seen resting on the rocky patches or tide pools covered with macro algal mats, the mudskipper were always found to be in the nearby vicinity. The crab upon feeding, tears the thallus into small pieces and feeds on it. On one occasion, while the crab moved away from the feeding site, the mudskipper started to feed on the spilled algal fragments. This type of commensal behavior was observed in St.1 and St.2 during the study period.

The *Uca tetragonon*, which is very common in the mangroves of South Andaman was also observed to have an interesting association with the mudskipper. *Uca* feeds on the humus deposits in the mangrove areas. Once this thick deposit of humus is ploughed and made into

small fragments by the slitting activity of the *Uca*, the mudskipper thereby feed upon the detritus.

Discussion

The frequency of occurrence method used in this study revealed that *P. minutes* is an omnivorous fish feeding mainly on algal fragments (92%) conspicuously, followed by diatoms (84%), indicating their primary diet preference relying more over plant materials. The very small percentage of fish scale are found in traces in the gut content indicated its feeding on other small fishes as well. Frequency of occurrence method for *P. argenteolineatus* revealed that the preference of algae (80%) and benthic diatoms (72%) as its main food items. Subsequently to the plant components, sand grains were found more in percentage (60%) which might have been consumed while feeding on the detritus. The very interesting fact with this species was that, there were no trace of fish flesh or scales in all of the specimens dissected, indicating that this species might not be feeding upon other fishes. The appendages of crustaceans were only 8% which showed that it can be an alternative or accessory food item as observed in this study has been reported for this species (Clayton, 1993).

P.kalolo diet content was quite different from the other two species. Both the occurrence and point methods of the gut content analysis in this study showed that the main food item of this species was benthic diatoms (100%), followed by sand grains (84%) as accidental food item, revealing that this species of mudskipper is more of a benthic feeder. Algal fragments (56%) was found in the gut content, indicating that *P. kalolo* may come to surface and feed on the algae when the main food source is not available as witnessed in this study has been reported (Polgar and Crosa, 2009).

The association between *Uca tetragonon* and the mudskipper showed that they are commensal. The association between the mudskipper and rock crab was mostly observed during the morning hours (low tide), especially in the tide pools. *Periophthalmus kalolo* was found to have this kind of interaction which was collected at St.3.

Conclusion

Analyzing results channeled to the conclusion that, the mudskippers are omnivores which feeds upon mainly plants components like diatoms and algae, without compromising its carnivorous nature, where small crustaceans and polychaetes were also incorporated as part of their diet. The sand grains and other detritus found in its diet indicate its bottom feeding nature. This study highlights the omnivorous feeding of mudskipper rather than carnivorous as reported earlier elsewhere.

Acknowledgments

We thank Pondicherry University for providing all the necessary facilities to carry out this research work.

References

- Chesson, J. (1983). The estimation and analysis of preference and its relationship to foraging model. *Ecology* 64: 1297-1304.
- Clayton, D. A. (1993). Mudskippers. *Oceanography and Marine Biology: An Annual Review* 31, 507-577.
- Glanluca, P. & Gioseppe, C. (2009). Multivariate characterization of the habitats of seven species of Malayan Mudskipper (Gobiidae: Oxudercinae). *Marine Biology* 156:1475-1486.
- Hynes, H.B.N. (1950). The food of fresh-water sticklebacks (*Gasterosteus aculeatus* and *Pygosteus pungitius*) with a review of point method used in studies of the food of fishes. *Journal of Animal ecology* 19: 36-58.
- Hyslop, E.J. (1980). Stomach content analysis- a review of methods and their application. *Journal of fishery biology* 17: 411-429.
- Koo, K.J., Baek, H.J., Kim, J.W., Chang, D.S. & Kim, J. (2011). Sexual Maturity and early life History of the mudskipper *Scartelaos gigas* (Pisces: Gobiidae): Implications for conservation. *Fish Aquatic Science* 14(4): 403-410.
- Larson, H.K. & Murdy, E.O. (2001). Gobiidae, Gobies. 3578-3603 p. In: FAO species identification guide for fishery purposes. The living marine resource of the western central pacific. Bony fishes Part 4 (Labridae to Latimeridae) FAO, 6.
- Lee, H.J., Martinez, C.A., Hertzberg, K.J., Hamilton, A.L. & Graham, J.B. (2005). Burrow air phase maintenance and respiration by the mudskipper *Scarletoshisto phorus* (Gobiidae: Oxudercinae). *The Journal of Experimental Biology* 208:169-177.
- Munro Ian, S.R. (2000). The marine and fresh water fishes of Ceylon. Biotech Books, New Delhi.
- Murdy, E.O. (1989). A Taxonomic Revision and Cladistic Analysis of the Oxudercine Gobies (Gobiidae: Oxudercinae). *Records of the Australian Museum Suppl. U*: 1-93.
- Rao, D.V., Devi, K. & Ranjan, P.T. (2000). Records of the Zoological Survey of India. An account of Ichthyofauna of Andaman and NBicobar Islands, Bay of Bengal. *Zoological Survey of India, Occasional Paper* 178: 434.
- Swynnerton, G.H. & Worthington, E.B. (1940). Note on the food of fish. *Journal of Animal Ecology* 9:183-187.