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Studies on ecological status, nutritive values and exploitation of *Peronia verruculata*, Cuvier, 1830 (Gastropoda: Onchidiidae) from Gulf of Khambhat, India

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Abstract

Molluscs were exploited as a food since middle Palaeolithic time. Slugs are the brilliant indicator of climate change and also a good source of protein. The present investigation attempts to evaluate the population status, nutritive values and threats to the marine pulmonate *Peronia verruculata* from five stations of Gulf of Khambhat. It was found to consume by the local people especially from June to October when it shows great populations in upper intertidal area. Proximate analyses revealed that slug meat contains good amount of protein (59.42±1.82%), carbohydrate (10.52±1.0%) and lipid (5.73±0.98%). *P. verruculata* over exploited by the local people of selected coasts while pollution and coastal development could be the significant threats to this slug.

Keyword: *Peronia verruculata*, ecology, nutritive values, exploitation, Gulf of Khambhat

1. Introduction

Peronia verruculata, despite being a cosmopolitan species, it remains understudied [1, 2]. Moreover, researchers focused on Onchidiums as a whole rather than focusing on a single slug. *P. verruculata* is a shell-less [3], an air-breathing sea slug. It inhabits in marine waters, commonly found grazing on intertidal algae-covered rocks [4] and mud in mangroves or mangrove tree roots during low tides [5, 2], but during high tide, they burrow into sand or mud, trapping an air bubble for breathing from.

These slugs are close relatives of land snails in terms of air-breathing habits. They possess modified gills, a division of the mantle cavity which is modified as a lung to breath directly from air while it different from other members of Pulmonata because they breathe underwater through gills. *P. verruculata* get to die if left in sea water for a long time. McFarlane, 1979 [6] has discussed ecological aspects of *P. verruculata*. This slug generally has a preferred feeding area, meaning that this slug often returned to the same area to feed every time. This behavior indicates an ability to remember their grazing sites. They produce feeding trails while grazing [7, 8].

The species is common in the Indo-Pacific region, extending from the Red Sea to East Africa all the way to Australia, Japan, and even Hawaii [4, 1, 5, 9, 3, 10]. According to Dayrat, 2009 [1] the phylogenetic relationships within members of family Onchidiidae are still confusing. The genus *Peronia* more closely related to *Paraoncidium* and *Onchidella*. *P. verruculata* is oval shaped and dosroventrally flattened, attains length about 6 cm. The dorsal surface of its olive to brown in color, and bears leathery appearance because of numerous papillae or wart-like nodules presence which helps to reduce water loss. Some of these nodules carry additional structures like dorsal eyes and brachial gills. They have a broad foot and tiny eyes at the anterior end a pair of long fleshy stalks, which can be protruded inside the body at any disturbance so these slugs blend perfectly with the rocks in both texture and color. The sand particles and sediments that settle on their skin adds to the camouflage. It feeds on algae and lichen that grows on rocks, mud, and sand by a pair of oral flaps nearby the mouth [1]. *P. verruculata* is a hermaphrodite snail, despite having both reproductive organs, there are no records of self-fertilization [11, 12], The Egg capsules are laid shortly after mating, it hatches after 16 days and developed into free-swimming larvae [12, 13]. The Asian countries like China, Onch slug populations are fast declining because of their over-exploitation as a highly nutritious source of food, though the sternness of the over-exploitation remains mainly unknown [14]. Present study reveals the ecological status, a nutrient content and exploitation and threats to the *P. verruculata* from five different coasts of Gulf of Khambhat, Gujarat, India.

2. Materials and methods

2.1 Sampling Station

P. verruculata is the common gastropod distributed throughout the west coast of India. The ecological studies on this gastropod have carried out from five different stations of Gulf of Khambhat. The study sites namely Ghogha, Lakhanka, Alang, Zanzmer and Unchakotda, small shoreline towns of Bhavnagar district coastline (Fig.1. Table.1).

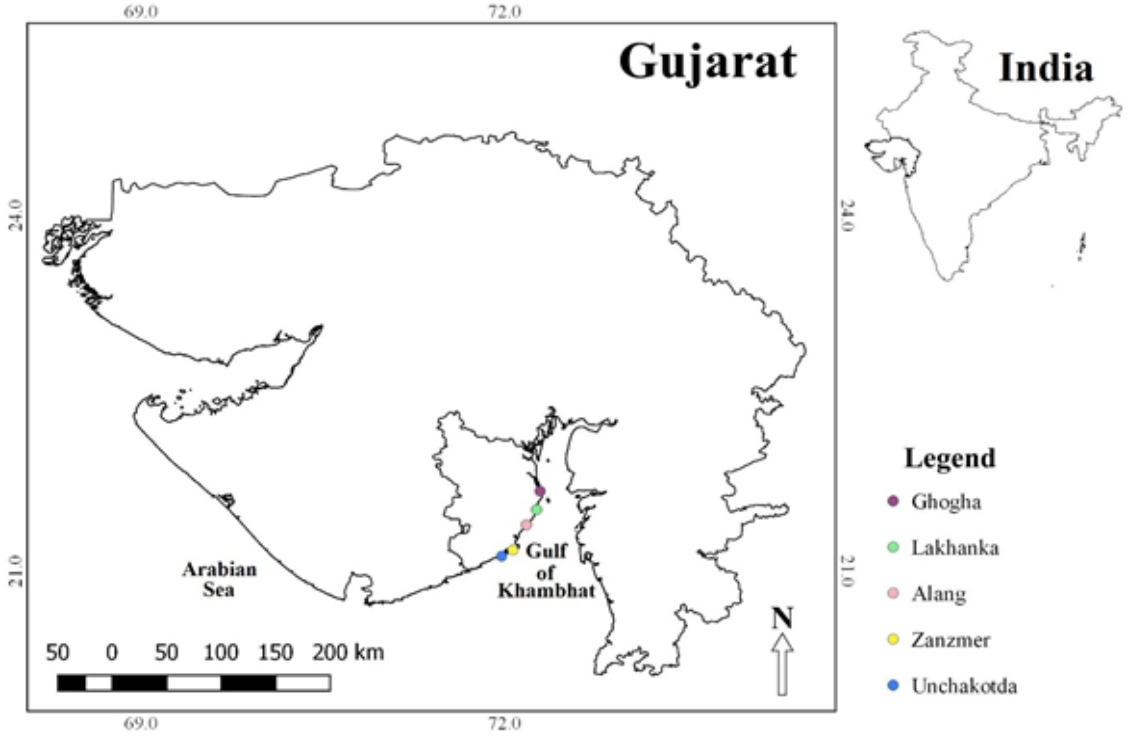


Fig 1: Sampling stations

Table 1: Geographic locations and Intertidal exposure of sampling**.**

Stations	Intertidal Exposures (m)	Latitude			Longitude	
		From	To		From	To
Ghogha	30-100	21°41'30" N	21°39'27" N		72°16'42" E	72°17'34" E
Lakhanka	20-120	21°31'55" N	21°30'22" N		72°15'56" E	72°15'23" E
Alang	20-100	21°22'33" N	21°22'25" N		72°10'0.8" E	72°9'51" E
Zanjmer	30-200	21°11'1" N	21°10'27" N		72°43'6" E	72°3'44" E
Unchakotda	30-200	21°7'25" N	21°7'20" N		71°58'8" E	71°57'4" E

*Intertidal exposures were approximate distance (Minimum-Maximum) from shore to lowest tidal area during low tides at particular coast.

2.2 Methodology

This research work has carried out during the period of two years from November 2015 to October 2016. *P. verruculata* was collected from the selected stations by hand picking method from upper intertidal zone during low tides. The population studies were carried out by using line transects and quadrate data. Physico-chemical parameters like pH, temperature, salinity and DO were measured by standard protocols and devices. For the estimation of nutritive contents, the slugs were dried in laboratory and protein, carbohydrate, and lipid content was measured by following standard biochemical methods like for the proteins Lawry et al. 1951 [15], for the carbohydrate Seifter et al. 1950 [16] while for the lipid estimation Folch et al. 1957 [17] have used. The nutrient content measured from the body of *P. verruculata*. Three replicas has performed for the measurement of all three biomolecules (Table.3).

3. Result and Discussion

P. verruculata was studied from five different stations of Gulf of Khambhat during the year 2015-16. This slug distributed in all three zone of the intertidal area but the greater numbers were recorded from the upper intertidal zone of rocky coasts

like Zanzmer and Unchakotda. The other selected stations like Ghogha and Lakhanka were the mangrove coasts where it showed moderate densities during monsoon while the lowest numbers reported at Alang coast. These slugs are diurnal, reported more active during daytime. The highest number of individuals 0.6 per m² area was reported during summer or pre-monsoon to monsoon season while less 0.2 per m² number was recorded during post-monsoon to winter season at all the sampling stations (Fig.3). The Physico-chemical parameters salinity, pH, and dissolved oxygen showed merely stable at sampling sites. The temperature from Lakhanka and Alang bit higher than other sites therefore very low density recorded during study (Table.2). *P. verruculata* is an edible gastropod and uptake by the local people exclusively, especially on holidays 5-6 members of the same family were noticed to collecting this slugs by hand picking from the intertidal area of rocky shores. Locally this slug is known as 'Falva 'or 'Doshi'. They like to have this Onch slug, because of its small size they collect it in massive quantities. The estimated protein, carbohydrates and lipid amount was respectively 59.42±1.82, 10.52±1.01 and 5.73±0.98 from the slug (Table.3). There was great exploitation seen from June to October 2016 (Fig.4). *P. verruculata* is currently not listed as threatened species by IUCN like other intertidal species but it facing threats like coastal development which leads to the habitat loss and pollution.

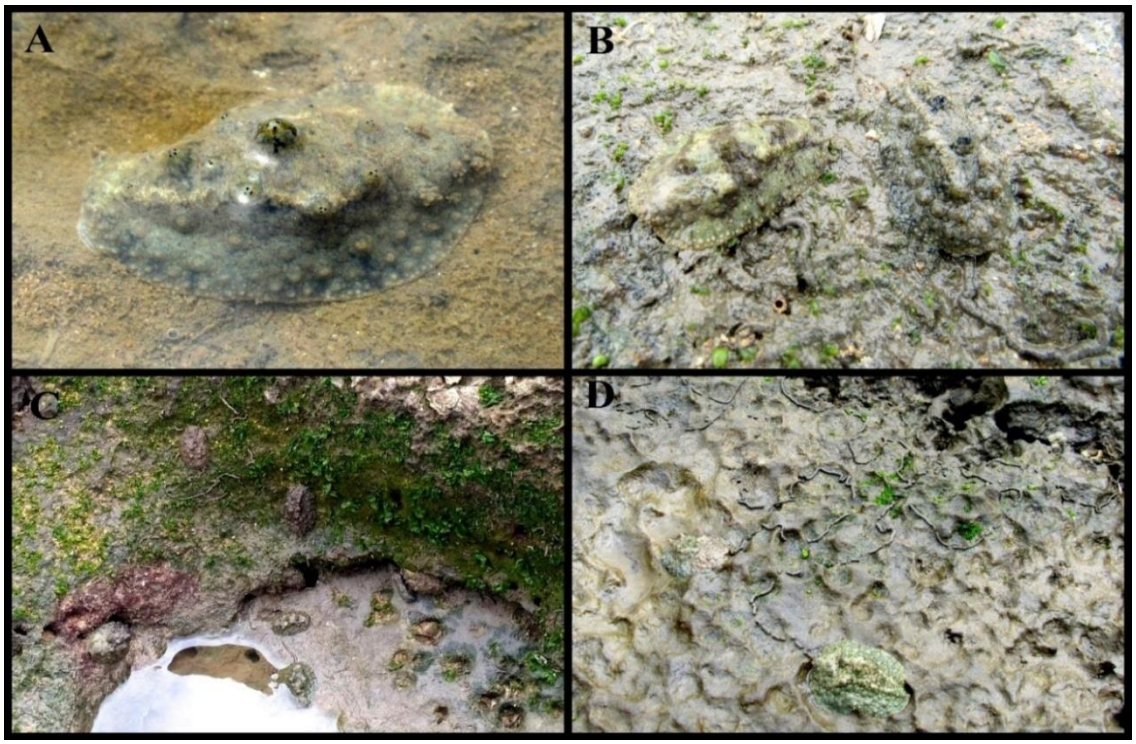
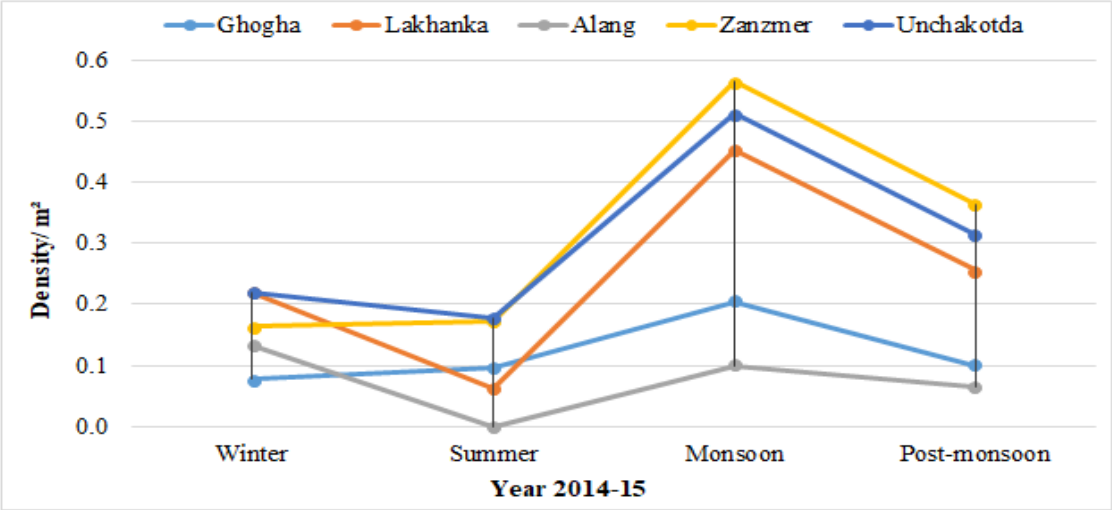


Fig 2: (A) *P. verruculata* in water pool during low tide. **(B)** Phenomenon of camouflage. **(C)** Grazing on benthic algae. **(D)** Forming feeding trails.



*****Densities of *P. verruculata* were calculated as seasonal mean from selected sampling stations.

Fig 3: Density of *P. verruculata* from the intertidal zone of sampling stations.

Fig 4: Collection of *P. verruculata* by local people at Zanzmer coast.

Table 2: Mean and standard deviation of physicochemical parameters recorded station-wise during (November 2015 to October 2016).

Station	Salinity (ppt)	Temp. (°C)	pH	DO (mg/l)
Ghogha	33.47 ± 0.65	32.13 ± 4.85	7.91 ± 0.47	5.08 ± 1.50
Lakhanka	33.98 ± 0.74	33.80 ± 5.21	7.76 ± 0.53	4.38 ± 1.48
Alang	33.55 ± 0.83	32.85 ± 5.79	7.84 ± 0.34	5.12 ± 1.64
Zanjmer	33.77 ± 0.72	32.90 ± 5.64	7.95 ± 0.52	4.54 ± 1.68
Unchakotda	33.64 ± 0.74	33.08 ± 5.21	7.75 ± 0.53	4.00 ± 1.29

*Temp. = Temperature: DO = dissolved oxygen

Table 3: Nutritive e values in *P. verruculata*.

Carbohydrate (%)	Lipid (%)	Protein (%)
9.37	4.98	57.89
10.92	5.37	58.93
11.27	6.84	61.44

4. Conclusions

P. verruculata is one of the common and abundant intertidal gastropod fauna of Gulf of Khambhat. This species over-exploited for the food from the studied area. Although the average nutritive values, it might be exploited because of its availability. The local people preferred to have mudskippers, crabs, and prawns but the pre-monsoon is the breeding time of mudskippers hence

only small sized Gobi fishes available at coast it might one of the possible reason behind their great exploitation during this particular time period. The parameters like temperature and pH have shown significant impact on a marine slug.

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