



Taxonomic study of *Peronia peronii* (Cuvier, 1804) (Mollusca: Gastropoda: Onchidiidae) from the Karachi coast, northern Arabian Sea

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Research Article

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Abstract

Onchidiidae species are generally found in sandy, muddy, or rocky habitats within the middle and upper intertidal zones, respectively. The diversity of their species remains poorly understood, and their taxonomy has not been well investigated. Genus *Peronia* has nine presently accepted species. The current analysis is the first investigation on taxonomy of *Peronia peronii* on the Karachi coast.

Keywords: *Taxonomy, Peronia peronii, Gastropoda, Onchidiidae, Karachi coast, northern Arabian Sea.*

Introduction

Peronia peronii is a shelled, air-breathing mollusc of the family Onchidiidae. It is widely distributed and inhabits a wide range of habitats. The onchidiids comprise as a minimum 86 species belonging to 35 genera (MolluscaBase, 2024). Onchidiidae species are globally distributed and live in sandy, rocky, and muddy environments of the upper intertidal zone (Dayrat, 2009; Zhang et al., 2016, Goulding et al., 2022). There are a variety of habitats in which onchidiid slugs can survive, however,

their larvae are released in sea water, hence onchidiid slugs are truly marine slugs (Dayrat, 2009). As adults, slugs breathe air using their lungs, and submersion in water for extended periods can be fatal.

Until the 1930s, considerable effort was devoted to nomenclature of species, but thereafter, exploration of their diversity was largely neglected, and identification at both the genus and specific levels remained nearly impossible (Dayrat et al., 2016). Onchiidids generally share similar morphological characteristics with oval or stretched body shape, with a few differences in variety of examples and positions of diverse organs. Onchidiid slugs are also extremely difficult to distinguish at a traditional level (Dayrat et al., 2019).

Dorsal gills and eye spots are two peculiar characteristics that make identification possible at a generic level. Genus *Peronia* is recognized as a genus of onchiidids with dorsal gills and eye spots. Onchiidiidae family can also be identified based on the position of the male aperture. Onchiidiidae are characterized by having lungs that open at the posterior end of the body using a pneumostome (pulmonary opening) (Chaouti et al., 2017).

This study reported the taxonomic identification of *P. peronii* collected from the Karachi coast and compared it with a similar study.

Material and Methods

An investigation of the taxonomy of Onchidiid slugs collected from the Karachi coast of the northern Arabian Sea is reported in the present study (Figure 1). During low tide from November 2022 to October 2023, rocky intertidal areas of Buleji, Mubarak Village, and Cape Monze were selected for exploring and collecting Onchidiid slug samples.

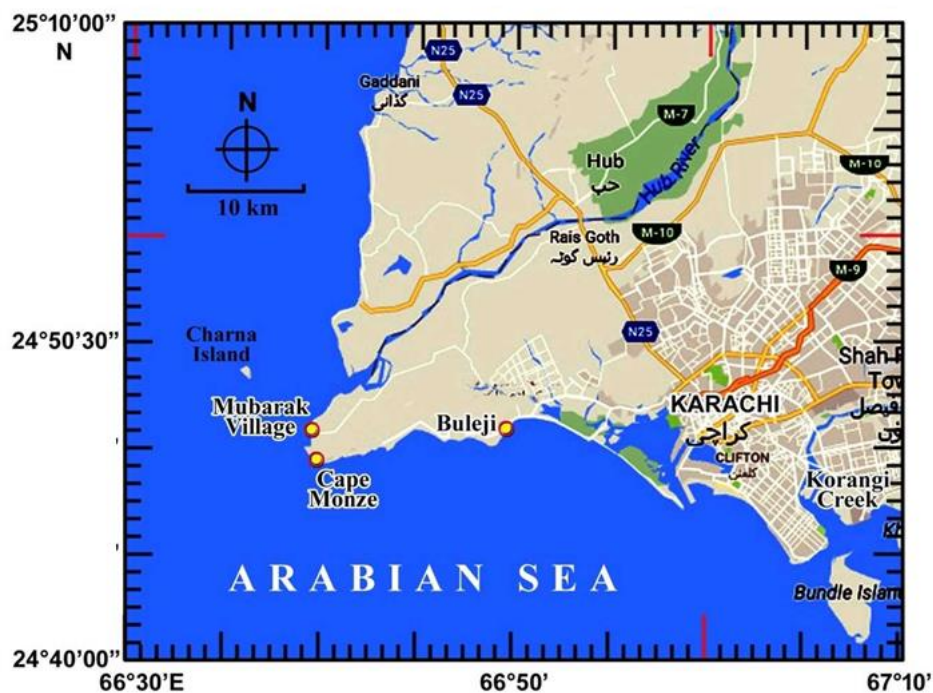


Figure 1. Map showing the sampling locations of *Peronia peronii*.

Random sampling was performed, and photographs were taken in the natural habitat of the samples. Only a few fully mature samples were collected by moving from low tide to high tide without using the fauna in each area. The samples were placed in the designated aquarium after one day of acclimatization. The coordinates of the study areas were documented using GPS (Table 1).

Table 1. Collection data of *P. peronii* from the Karachi coasts.

Date of collection	Locality	Coordinates	Size ranges of the specimens (mm)	Number of specimens
November 2022	Mubarak village	24° 50' 44"N, 66° 39' 35" E	95 – 115	5
November 2022	Cape Monze	24° 49' 30"N, 66° 40' 00" E	95 – 107	4
January 2023	Mubarak village	24° 50' 44"N, 66° 39' 35" E	93 – 110	2
January 2023	Buleji	24° 50' 12"N, 66° 49' 12" E	83 – 85	3
September 2023	Cape Monze	24° 49' 30"N, 66° 40' 00" E	90	1
October 2023	Buleji	24° 50' 12"N, 66° 49' 12" E	82 – 120	5

The physicochemical parameters were measured as follows: pH using a digital portable pH meter (model TI98 Pen), water and air temperature (°C) with a glass thermometer, and salinity (ppt) with a refract meter (ATC BRIX, China).

After acclimatizing for a day, *P. peronii* samples were placed in designated aquariums. Aquariums were maintained according to their collection sites based on physicochemical parameters including temperature (°C), salinity (ppt) and pH. A thorough cleaning of the aquarium and fresh seawater addition or replacement was conducted to maintain the water quality. A variety of narcotics were used for taxonomic analysis, including menthol crystals floated on top, Epsom salt pinches, alcohol drops, propylene phenoxitol one percent solution, magnesium chloride 70% solution. Live specimens were examined for morphological observation. Formalin was used for the initial preservation of the specimens, and then 70% alcohol was used to transfer them to the next stage.

Species identification was carried out for microscopic observations using available literature. The specimens collected alive from the field were dissected from the ones that remained viable. A Leica WILD M3C microscope was used to examine the internal anatomy. The radula was separated from the buccal mass by boiling in 5% KOH. The radula, male reproductive organs and digestive organs were cleaned separately for auxiliary anatomical examinations. Photographs were taken using Olympus BH2 microscope (1.25X4, 10, 20 and 40 magnifications) with Nomarski Differential Interference Contrast (D/C) camera lucida accessory and Leica WILD M3C microscope.

The total length (TL) of the specimen was determined from the anterior end to the posterior end. The measurements were recorded in millimeters (mm). The specimens collected from the field were deposited in the Marine Reference Collection and Resource Centre, University of Karachi. The dissected specimen was catalogued (Cat. No. MRC&RC-UOK-GAST-227).

Results

Morphological characters

The examination indicated that the specimen gathered from the hard tidal zones and sizable rocks on sandy beaches was round to oval in form and measured 115 mm in length (Figure 2A-D). There are numerous eye spots on the dorsal notum that range in color from olive green to reddish brown. In the central part of the dorsal notum, there are a greater number of papillae, whereas there are fewer on the entire notum. A total of 12-13 papillae has eye spots. Eye spots (2-3 in number) are present on nearly all the papillae, whereas a few lofty papillae have 7-9 eye spots (Figure 3A and B). When an animal is underwater and alive, its branchial gills are more obvious on its posterior half. Hyponotum is pale yellow. Foot broad and brown in color. Pair of eyes present at the tip of small ocular tentacles exceeding the buccal cavity anteriorly. Pneumostome is center now exceeding the anal opening on the posterior end of the ventral region. The male aperture is located beneath the right ocular tentacle, on its left side (Figure 4).

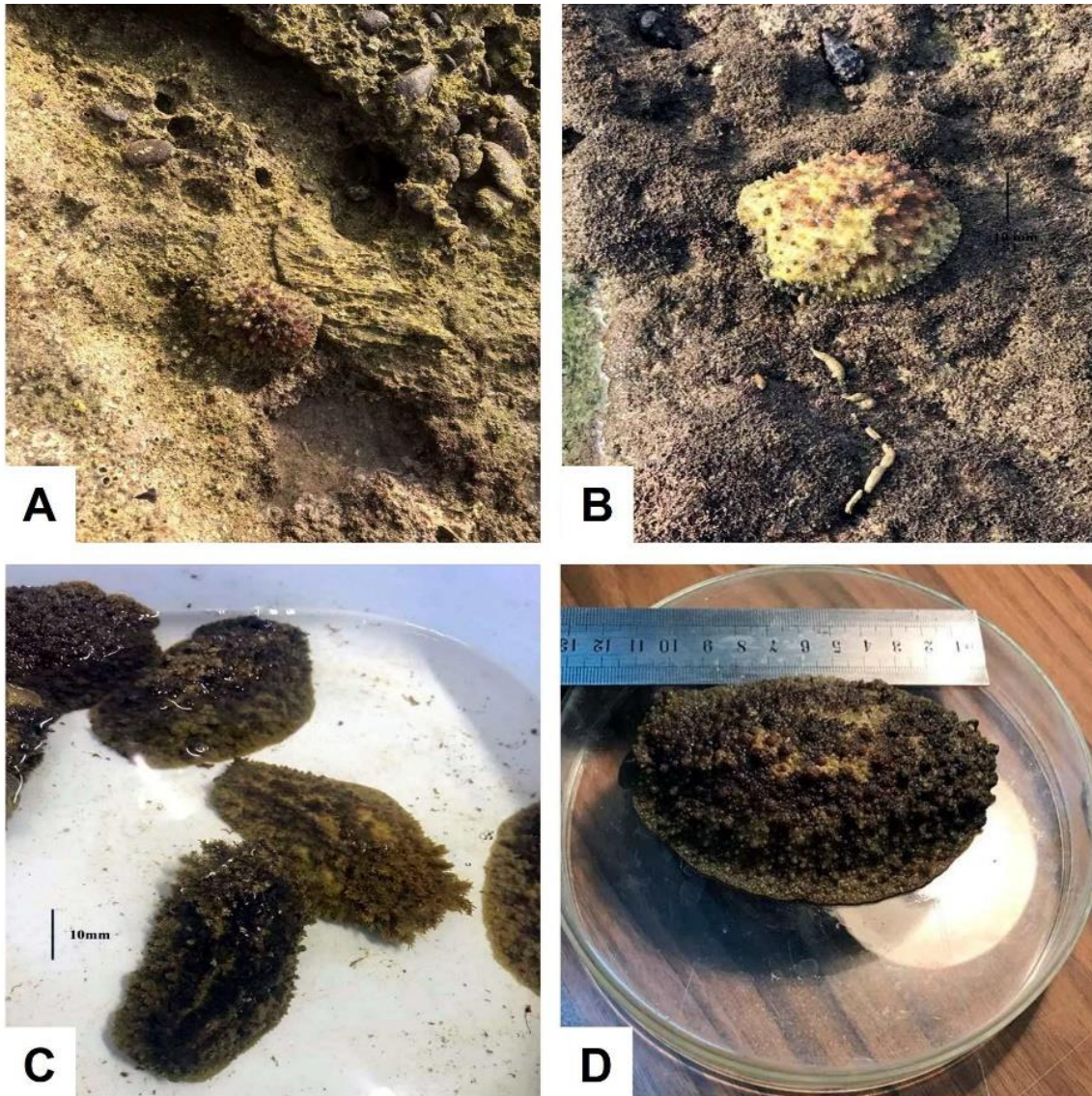


Figure 2. Natural (A and B), and laboratory (C and D) views of *P. peronii*.

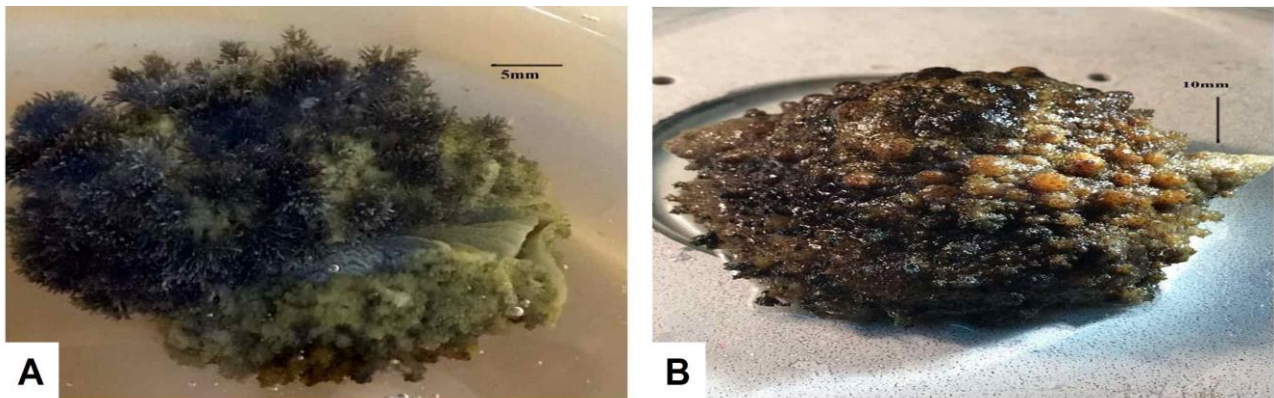


Figure 3. Dorsal view of *P. peronii*: A, showing gills; B, showing eye spots on dorsal papillae.



Figure 4. Right oral lobe, showing the male aperture of *P. peronii*.

Anatomical characters

The transitional pattern of the intestinal loop (Type I) is oriented at 1 o'clock (Figure 5). Each row of the radula is lined up with 1 median (racidian) tooth in the middle and 85 lateral teeth on each side, the base of the innermost lateral teeth consists of spines. The radial formula is 77 (85/1/85) (Figure 6A). Anteriorly comprises a vestibule, bifurcated into a frill pineal organ with a 25 mm long solid sac and a penial sheath. The needle spine of the frill pineal organ is 2.5 mm long, ruddy brown in variety on the base (breadth 300 μ m), and yellow on the tip (measurement 80 μ m) which is fairly twisted

framing a spew-out molded form (Figure 6B). The retractor muscle is little, implanting near the heart. The penis within the penial sheath has bent snares (snare length is $80\ \mu\text{m}$) (Figure 7).



Figure 5. The transitional pattern of the intestinal loop of *P. peronii*, Type I

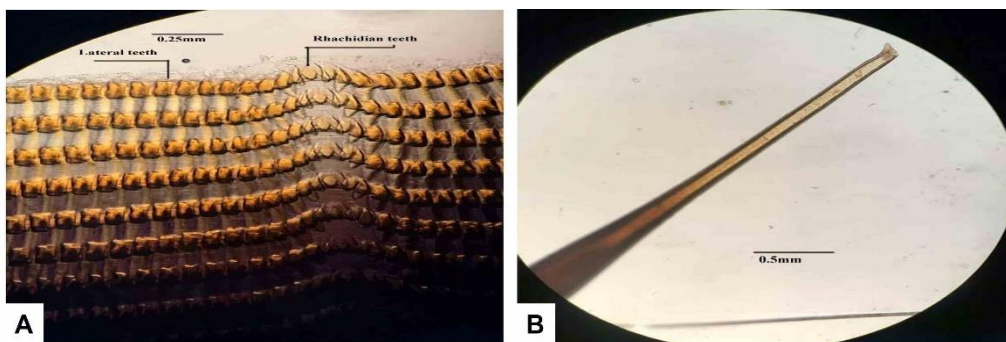


Figure 6. Radula (A) and needle spine (B) of *P. peronii*.

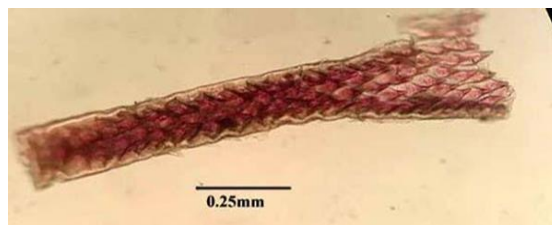


Figure 7. Penial hooks of *P. peronii*.

Discussion

The northern Middle Eastern Ocean is splendid with faunal variety of different species occupying various living spaces. An ordered investigation of Onchidiids has been a complicated errand for

precedent many years (Dayrat, 2009). The Onchidiids are obscure species since various species are start at the comparative territory and it's truly unpredictable to recognize them morphologically to determine this secret, a point-by-point physical assessment is fundamental to distinguish and recognize these pulmonated mollusks (Maniei et al., 2020). The genus *Peronia* involves the two basically inescapable onchidiid species, *P. verruculata* and *P. peronii* (Dayrat et al., 2020). Morphologically it is seen that a very huge estimated of people have a place with *P. peronii* (90–120mm). *P. peronii* has a large dorsal papilla and a small dorsal papilla. Both variations are present in different individuals. Our study has shown that *P. peronii* has its gills on the posterior half of its dorsal notum. The intestinal loop of *P. peronii* originates from Type I, but radial formulas may also vary among the various *Peronia* species. By examining the genitalia anatomy, it can be helpful for observing morphological dissimilarities among closely allied onchidiid species (Chang et al., 2018). The male copulatory organ alike to muscular sac of accessory pineal gland is seen capricious in size in various *Peronia* species. The form, color and size of needle spine as well contain difference in unlike *Peronia* species. The hook length of penis is recorded 150 μ m in our *P. peronii* specimens even though it is less than 50 μ m studied by Dayrat et al., (2020). The anatomical characters of *P. peronii* obtained from this study were compared with those previously described by Dayrat et al., (2020) in Table 2.

Table 2. Anatomical characters of *P. peronii* in the present study and comparison with similar data previously described. Measurements are given in millimeters (mm) and micrometers (μ m).

Characters	Present study	Dayrat et al., (2020)
Size	105 mm	140 mm
Papillae with dorsal eyes	12–13	15–20
Muscular sac length	24mm	30mm
Needle spine length	2.5mm	3.6mm
Type of intestinal loop	Type I (T loop at 1 o'clock)	Type I (T loop b/w 12-3 o'clock)
Needle spine base diameter	300 μ m	400–500 μ m
Needle spine tip diameter	80 μ m	160–200 μ m
Retractor muscle inclusion	incusing close to the heart	heart (exc. vestigial)
Length of the accessory penial gland spine	2.0–29 mm	3.0–5.0 mm
Base diameter of accessory penial glands	340–400 μ m	400–500 μ m
Needle spine tip diameter	150 μ m	160–200 μ m
Penis hooks length	150 μ m	<50 μ m

Conflict of Interest

The authors declare that they have no competing interests.

Author Contributions

A.N.K. performed all the experiments (Taxonomical procedures). F.S.G. supervised and drafted the main manuscript text. Both authors reviewed and approved the final version of the manuscript.

Ethical Approval Statements

Local Ethics Committee Approval was not obtained because experimental animals were not used in this study.

Data Availability Statement

The data used in the present study are available upon request from the corresponding author.

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