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Expanding horizons: Range extension of three gastropod species to the northeast coast of India

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Short Communication

Abstract

This study presents new distribution records of three gastropod mollusc species from the northeast coast of India. The species include the naticid *Polinices flemingianus* (Récluz,1844), the pyramidellid *Pyramidella dolabrata* (Linnaeus,1758), and the pseudomelatomid *Ptychobela griffithii* (Gray,1833), hitherto unrecorded from the waters of Odisha. Additionally, *P. griffithii* was also recorded for the first time in the coastal waters of Andhra Pradesh. The occurrence of these species in previously unreported habitats indicates a range expansion along the northeastern coast of the Bay of Bengal. Morphological characterisation and notes on their environmental preferences contribute to a refined understanding of molluscan biodiversity in the region. These new records highlight the importance of continued benthic surveys and taxonomic documentation for coastal biodiversity assessment.

Keywords: *Coastal biodiversity, marine gastropods, range expansion, Polinices flemingianus, Pyramidella dolabrata, Ptychobela griffithii, Odisha coast*

Introduction

In recent decades, the Indian subcontinent has been experiencing extreme weather events. Reportedly, rising sea temperatures have led to frequent cyclonic storms, mostly impacting the east coast of India. The documented maximum mortality in Odisha and Andhra Pradesh (Ray *et al.*, 2021) and significant damage to coastal biodiversity are of concern (Bakshi and Panigrahi, 2022). Furthermore, several fast-paced anthropogenic interventions (port establishment, oil drilling platforms, industrialization, urbanization, and aquaculture) for economic development also detrimentally impact the coastal environment, especially sediment-associated organisms such as macrobenthos (Nayak *et al.*, 2022; Dash *et al.*, 2021; Nayak *et al.*, 2018). Continuing benthic explorations for the region are important in the context mentioned above.

During such benthic investigations (2008 to 2022) undertaken in coastal Andhra Pradesh (17° 30′ 500″ N and 83° 02′ 300″ E to 16° 26′ 32.4″ N and 82° 05′ 54.4″ E) and the intertidal region of Chandipur, Odisha (21° 27′ 17″ N, 87° 2′ 43″ E) (2023 to 2024), new distribution records of three gastropod mollusc species were discovered (Fig. 1). While a naticid *Polinices flemingianus* (Récluz,1844), the pyramidellid *Pyramidella dolabrata* (Linnaeus, 1758), and the pseudomelatomid *Ptychobela griffithii* (Gray, 1833), hitherto unknown from the waters of Odisha were recorded, *P. griffithii* previously undocumented from Andhra Pradesh, was obtained from several shallow locations along the coast. The ecological predilections of the species obtained in the study are tabulated (Table 1).

A perusal of published works on macrobenthos has no mention of *P. griffithii* from Andhra Pradesh (Dash *et al.*, 2021; Monolisha and Edward, 2015; Ramakrishna *et al.*, 2007; Subba Rao, 2003). Likewise, studies from Odisha (Nayak *et al.*, 2022; Sarkar *et al.*, 2021; Gurumayum, 2019; Ghosh *et al.*, 2018; Sarkar *et al.*, 2013; Subba Rao, 2003) have not documented the species mentioned above until this study. The three species now

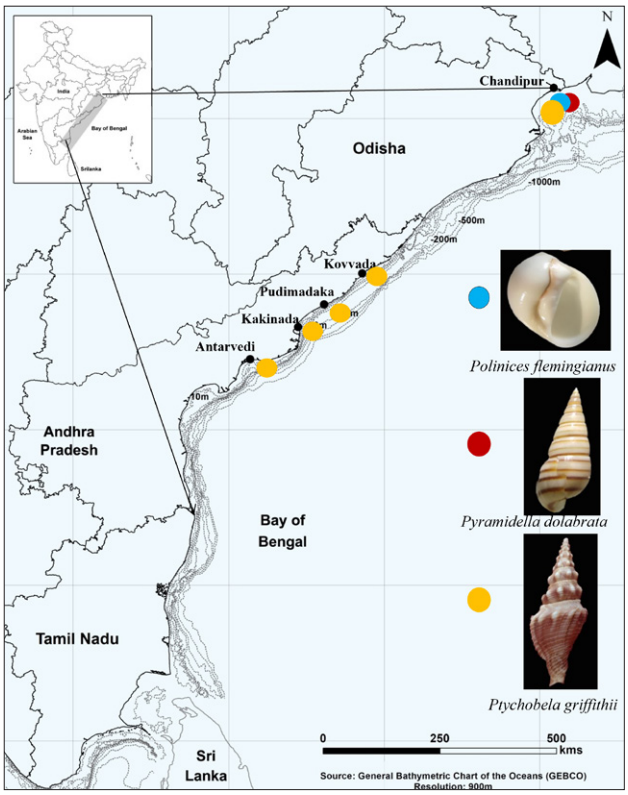

Fig. 1. Map showing the sites of collection in Odisha and Andhra Pradesh on the east coast of India. Source: General Bathymetric Chart of the Oceans (GEBCO)

recorded through our findings mark important additions to the region's marine biodiversity. The study's main objective was to recognise and understand the new distribution patterns of the three species of molluscs on the northeast coast of India in the context of environmental impacts.

Material and methods

A series of benthic explorations was designed for the coastal corridor of Andhra Pradesh and the intertidal region in Chandipur, Odisha (Eleftheriou and Moore, 2005) (Fig. 1). The coastal corridor of Andhra Pradesh predominantly features tidal flats, estuaries, and mangroves. The region is a hub of industries and other economic drivers. Besides special economic zones, aquaculture, seafood export/processing units, cement, granite, leather, textiles, petroleum, steel, and many other commercial ventures have been established along the coastal corridor.

The other explored region, Chandipur, is associated with the Budhabalanga estuary. The latter debouches into the Bay of Bengal, off the Balasore coast, Odisha. A narrow siliciclastic beach, a sandy barrier parallel to the coast, a back-barrier marsh, and wetlands (Saha *et al.*, 2024) characterise the shoreline of Chandipur. The area is known for its unique tidal patterns and is often called "Miracle Beach" or "Hide and Seek Beach." During high tides, as seawater advances and submerges the shore, it recedes up to approximately 5 km during the ebb tide, exposing a vast stretch of a mostly sandy and silty intertidal coastal expanse (Ramachandra *et al.*, 2023) teeming with sediment-associated fauna.

While benthic specimens were collected in replicates from 17 GPS-marked stations along the coastal waters between April 2016 and November 2017, using a naturalist's dredge (inlet area: 20 × 50 cm, mesh size: ~0.6 cm^2) operated parallel to the coast, specimens from the intertidal zones

Table 1. Location and ecological preferences of the species studied

Species Name		Location	Coordinates		Number of individuals (n)	Depth (m)	Salinity (PSU)	Sand (%)	Silt and Clay (%)	Organic matter (%)
		Pudimadaka	17°30′500″N	83°02′300″E	1	10	33.04	14.33	85.67	0.69
			17°30′500″N	83°04′400″E	1	20	33.67	16.23	83.77	0.78
		Kovvada	18°07′51″N	83°48′14″E	2	12	-	-	-	-
			17°02′41.4″N	82°22′28.2″E	2	14	23.82	58.4	41.6	0.77
Ptychobela griffithii	Andhra Pradesh	Kakinada	16°28′17.6″N	82°06′13.5″E	3	5.3	33.81	63.9	36.1	0.2
			16°28′02.0″N	82°06′24.2″E	3	6.5	33.3	59.4	40.6	0.3
			16°28′01.9″N	82°06′49.2″E	3	7	33.56	56.6	43.4	0.2
		Antarvedi	16°28′23.4″N	82°09′39.6″E	1	8.8	33.56	24.3	75.7	0.5
			16°26′32.4″N	82°05′54.4″E	1	9.3	33.43	16.2	83.8	1.7
Ptychobela griffithii					10					
Polinices flemingianus	Odisha	Chandipur	21°27′17″N	87°2′43″E	2	Intertidal	25	86.58	13.42	0.32
Pyramidella dolabrata					3					

were handpicked in September 2024. The collected samples were treated with buffered formaldehyde (10%) and packed in labelled bottles for further analysis. Shell morphometrics were recorded using a dial calliper (Safeseed, China; resolution: 0.01 mm, accuracy ±0.2 mm), and key characteristics were identified using a stereo microscope (Leica, E24W, Germany). Relevant literature (Subba Rao, 2003; Laust, 1998; Kilburn, 1989) was used for identification. To further strengthen validity, comparative reference images were consulted for morphological cross-checking from the National Zoological Collection at the Zoological Survey of India for *Polinices flemingianus* (Regd. No ZSI M26182/5) and *Ptychobela griffithii* (Regd. No ZSI M3232). The image of *Pyramidella dolabrata* was examined concurrently (Subba Rao, 2003; Plate 92; Fig. 1-2), and the taxonomic status of the species was confirmed through the World Register of Marine Species (WoRMS, 2024). The specimens were photographed using a Nikon Z30 digital camera with a MC 50mm/2.8f lens. All the specimens were vouchered and deposited in the Environmental Science Laboratory, Department of Zoology, Ravenshaw University, Cuttack, along with one specimen of each species deposited in the Zoological Survey of India, Estuarine Biology Regional Centre, Gopalpur, Odisha, with registration numbers: *Polinices flemingianus* (ZSI/EBRC/M19068); *Ptychobela griffithii* (ZSI/EBRC/M19069); *Pyramidella dolabrata* (ZSI/EBRC/M19070).

Results

Systematics

Phylum Mollusca
Class Gastropoda
Subclass Caenogastropoda
Order Littorinimorpha
Family Naticidae
Genus *Polinices*

***Polinices flemingianus* (Récluz, 1844):** The shell is globose and elongated. Six whorls, including the body whorl. Spire short with a yellow tinge, apex distended to some extent. Body glossy, nacreous white. Feeble growth lines are dispersed over the body compared to those on the outer lips. Umbilicus creamy white with an unobtrusive funicle. A distinct blackish-orange streak from the umbilical groove to the spire in one of the specimens. The umbilical groove is narrow and deep. Collumela with thick callus. Elongated semi-oval aperture (Fig. 2).

Morphometrics: SL-15.4-16.7 mm, SW-11.8-13.1 mm, ST-9.8-11.8 mm, AL-11.3-13.5 mm, AW-6.7-7.8 mm.

Distribution: Andaman Islands (Subba Rao and Dey, 2000), Lakshadweep (Susan *et al.* 2012), and Andhra Pradesh (Ramakrishna *et al.*, 2007). Now, *P. flemingianus* is recorded for the first time from Andhra Pradesh and Odisha coasts (RZEVCMG-1a) (Fig. 2; 2a-2c), marking its first documentation from the coast.

Remarks: The specimen is very similar to *P. mammila* in every way except for its oblong body shape and a deep umbilical groove not seen in *P. mammila.* A comparison to *P. peselephanti* reported from Odisha (Tudu *et al.*, 2018) shows a very deep umbilicus with a well-developed flat umbilical funicle, a feature not observed in *P. flemingianus*. While *P. mammila* has been documented from various regions of the east coast (Ramakrishna *et al.*, 2007; Ramakrishna *et al.*, 2003; Hylleberg and Kilburn, 2002; Subba Rao *et al.*, 1991), the other species *P. peselephanti* was reported from Odisha and Tamil Nadu (Tudu *et al.*, 2018; Hylleberg and Kilburn, 2002).

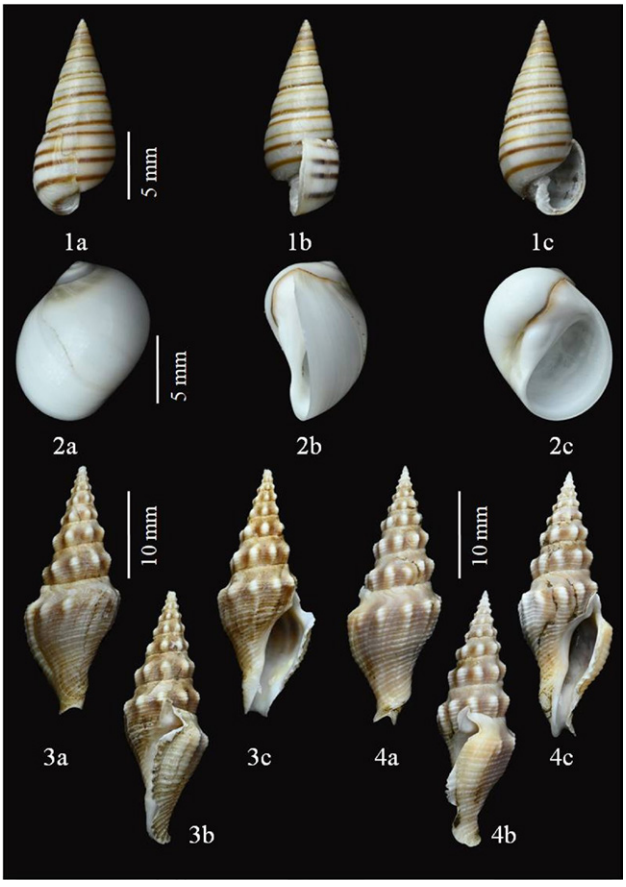

Fig. 2. 1a-1c: *Pyramidella dolabrata* (RZEVCMG- 2a) 1a. Dorsal view 1b. Lateral view 1c. Ventral view; 2a-2c: *Polinices flemingianus* (RZEVCMG-1a) 2a. Dorsal view 2b. Lateral view 2c. Ventral view; 3a-4c: *Ptychobela griffithii*; 3a-3c: (RZEVCMG-3a) 3a. Dorsal view 3b. Lateral view 3c. Ventral view; 4a-4c: (MBLDZAU-156) 4a. Dorsal view 4b. Lateral view 4c. Ventral view

Phylum Mollusca
Class Gastropoda
Subclass Heterobranchia
Super Order Pylopulmonata
Family Pyramidellidae
Genus *Pyramidella*

***Pyramidella dolabrata* (Linnaeus, 1758):** Shell thin, shape pyramidal, smooth, and glossy. The body has nine whorls with obsolete grooved sutures. Cream-coloured with three brown bands in each whorl. Dark brown and thick band at the supra-sutural region, while the other two bands are light brown and comparatively thin. The outer lip is thin and smooth. Aperture ovate, three brown streaks visible through it. Columella with three folds–upper fold prominent, while the lower two are comparatively small and closely placed. Umbilical groove deep (Fig. 2).

Morphometrics: SL-15.4-16.1mm, SW-4.8-5.4 mm, ST- 4.8-5.4, AL- 5.2-6.0 mm, AW- 2.3-2.8 mm.

Distribution: Goa (David, 2013), Digha (Subba Rao *et al*., 1992), Lakshadweep (Smith, 1903) and the Andaman Islands (Subba Rao, 2003).

Remarks: While there have been reports of two species of *Pyramidella*, *P. corrugata* and *P. dolabrata,* from Lakshadweep, the other regions, as mentioned above, have recorded only *P. dolabrata*. The presence of this species is new to the coast of Odisha (RZEVCMG- 2a) (Fig. 2; 1a-1c). It indicates the species' range expansion to the Northeast coast of India from its known geographic distribution and habitats.

Phylum Mollusca
Class Gastropoda
Subclass Caenogastropoda
Order Neogastropoda
Family Pseudomelatomidae
Genus *Ptychobela*

***Ptychobela griffithii* (Gray, 1833):** Shell small and fusiform; eleven whorls, including body whorl. Spire length is half of the total shell height. The distance between sutures is minimal. No subsutural cord found. Elongated axial nodes are present in all whorls. Body sculptured with fine spiral lines. Slightly concave wide aperture. Margin of aperture white, inner region brown. Outer lip thick and crenulated. Columella is almost straight, slightly folded towards the anterior side. A very thin callus plate on the inner lip extends to the posterior canal. The anterior canal is slightly long, and the posterior canal is deep and U-shaped (Fig. 2).

Morphometrics: SL- 30.1- 38.6 mm, SpL- 14.9-19.5 mm, SW- 9.5-12.8 mm, ST- 9.1-11.6 mm, AL-15.3-19.2 mm, AW- 4.8-4.9 mm.

Distribution: It is a common species documented in deep waters (300 m-400 m) in Tamil Nadu, India (Hylleberg and Kilburn, 2002). The species' distribution now extends from the southeast coast farther north to several shallow locations in the coastal corridor of Andhra Pradesh (MBLDZAU-156) (Fig. 2; 4a-4c) (Live specimen) and the intertidal region of Chandipur, Odisha (RZEVCMG-3a) (Fig. 2; 3a-3c), on the east coast of India.

Remarks: Three species of the genus *Ptychobela*: *P. nodulosa, P. suturalis,* and *P. griffithii* have been reported from India (Ramakrishna *et al*., 2007; Hylleberg and Kilburn, 2002; Subba Rao *et al*., 1992; Subba Rao *et al*., 1991). All three species are very similar in almost all aspects, but *P. griffithii* stands out due to the absence of a subsutural band and a broad aperture. Notably, it has a spire length of exactly half the total body height. This species is often confused with *Turricula javana* of the family Clavatullidae. However, the latter has an elongated siphonal canal, subsutural band, and small axial nodules on each whorl.

Discussion

The present study provides a detailed analysis of the morphometrics and key diagnostic features of three gastropod species: the naticid *Polinices flemingianus* (Récluz, 1844), the pyramidellid *Pyramidella dolabrata* (Linnaeus, 1758), and the pseudomelatomid *Ptychobela griffithii* (Gray, 1833), which align with the holotype descriptions (Récluz, 1843; Linnaeus, 1758; Griffith and Pidgeon, 1835). The identification challenges arising from near similarities among these species highlight the importance of detailed taxonomic studies that emphasise the unique features of each species. The results highlight distinct morphological variations among these species, contributing valuable data for accurate identification and further taxonomic studies. The study's findings revealed range extensions for these species along the northeast coast of India, providing novel distributional data. It also provides detailed morphometric measurements, images, and ecological and habitat descriptions, which have been underrepresented in previous literature. Ecological observations show that *Ptychobela griffithii*, previously considered a deep-sea species, can inhabit shallower waters between 7 and 20 meters. This ability to occupy sandy silt substrates suggests that *P. griffithii* has a broader ecological niche than previously understood.

In contrast, *Polinices flemingianus* and *Pyramidella dolabrata* were observed in the intertidal zone, particularly in silty sand with brackish salinity, demonstrating the varied ecological

preferences among marine benthic invertebrates. Notably, all three species have extended their ranges along the east coast of India, marking a change from previously documented distributions. This range expansion may result from larval dispersal mechanisms such as those mediated by ocean currents and ship ballast water, which help establish populations in new locations (Cowen and Sponaugle, 2009; López *et al*., 2025). Additionally, shifts in geographic ranges are often linked to climate change and other environmental stressors (Weiskopf *et al*., 2020; Lawlor *et al*., 2024), prompting organisms to relocate to higher latitudes, deeper subtidal zones, or higher intertidal areas, depending on their physiological tolerances (He and Silliman, 2019). Therefore, detailed documentation of faunal distributions is essential to identify the drivers of such range shifts, as understanding these dynamics is critical for managing species distributions in response to natural and human-driven environmental changes along the coastal regions of Andhra Pradesh and Odisha.

Conclusion

This study presents the first confirmed records of three gastropod species *Ptychobela griffithii, Polinices flemingianus,* and *Pyramidella dolabrata,* from the Odisha coast, and *P. griffithii* from Andhra Pradesh. These findings extend the known ranges of these marine gastropods and highlight the need for continuous faunal monitoring and environmental assessment along the Bay of Bengal coast. This discovery adds valuable information to the region's repository of marine malacofauna.

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Author contributions

Conceptualisation: DR, NVS; Methodology: DR; Data Collection: BD, AM, SD; Data Analysis: AM, SD, BD, RB; Writing Original Draft: SD, AM; Writing Review and Editing: NVS, DR; Supervision: DR

Data availability

The data is available and can be requested from the corresponding author.

Conflict of interest

The authors declare that they have no conflict of financial or non-financial interests that could have influenced the outcome or interpretation of the results.

Ethical statement

No ethical approval is required as the study does not include activities that require ethical approval or involve protected organisms/ human subjects/ the collection of sensitive samples/ protected environments.

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