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New records of Conidae (Mollusca, Gastropoda) from Andhra Pradesh, east coast of India

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A benthic investigation from the coastal corridor of Andhra Pradesh revealed 17 species of cone snails. Of these, seven species, namely *Conasprella aculeiformis* Reeve, *C. coromandelica* (E. A. Smith), *Conus amadis* (Gmelin), *C. caracteristicus* (Fischer von Waldheim), *C. coronatus* (Gmelin), *C. monile* Hwass in Bruguiere, and *C. sulcatus* Hwass in Bruguière are recorded for the first time from the coastal waters of Andhra Pradesh. The present findings of *Conus* from Andhra Pradesh coast are indicative of the species extended distribution to the northeast coast along the Bay of Bengal. Additionally, the live specimens collected could be of resource value for species description and historical analyses.

[**Keywords**: Bay of Bengal, *Conus*, India, Macrofauna, Molluscs]

Introduction

A re-examination of benthic samples collected at several (~ 500) inshore and offshore locations of east Peninsular India (11 – 21° N latitude), Bay of Bengal, from 1987 – 2017 (30 years) revealed as many as 10,574 individuals of macrobenthos represented by 152 species of gastropods. Amongst these, there were 17 species of *Conus*, of which seven species are reported here for the first time from the coastal waters of Andhra Pradesh. Commonly referred to as cone snails, these predatory gastropods of the tropical and subtropical coasts[1] are in the spotlight of drug discovery[2] ascribable to their venom. Compounds present in their toxins are widely used to treat Alzheimer's and Parkinson's diseases, besides depression and epilepsy[3]. The family comprises of taxa recognized for their rapid diversification and species richness[4], with more than 800 species existing worldwide[5].

Furthermore, the Indo-Pacific region is the most diverse with the maximum number of documented species[6]. In India, 93 species are known[7], with the majority (79 species) from the Gulf of Mannar[8] and Tamil Nadu (60 species); regions well studied for the diversity and distribution of Conidae[9]. In recent times, investigations from the islands of Lakshadweep revealed 78 species[5], while the reef ecosystem of Andaman and Nicobar Islands remains understudied with reports of only 55 species[10,11]. Merely, 17 species of cones were recorded from the waters of Andhra Pradesh[12,7] (*Conus zeylanicus* Gmelin, 1791 from Nagapattinam, Tamil Nadu)[12]. In this context, the present study off coastal Andhra Pradesh adds seven additional species of cone snails, increasing the total number of species to 24.

Material and Methods

Within the coastal corridor of Andhra Pradesh between Durgarajupatnam (13°59'59.28" N, 80°11'35.94" E) and Jagathi/Baruva (18°59'30.54" N, 84°42'56.04" E) (Figs. 1 & 2) as many as ~ 2050 benthic samples were collected from the nearshore waters (depth 1 – 200 m) using a Naturalist's dredge (20×50 cm; mesh size ~ 0.6 cm^2) which yielded diverse macrofaunal taxa. The dredge was towed behind a fishing trawler and operated for 15 – 20 minutes at each location at three nautical miles. After retrieval, the material was washed onboard with running seawater, sorted, live specimens were vigilantly picked and narcotized using a few menthol crystals. The material was carefully preserved in 4 % formaldehyde for further work in the laboratory. All morphometric measurements were recorded using a dial caliper. Species identification was based on key

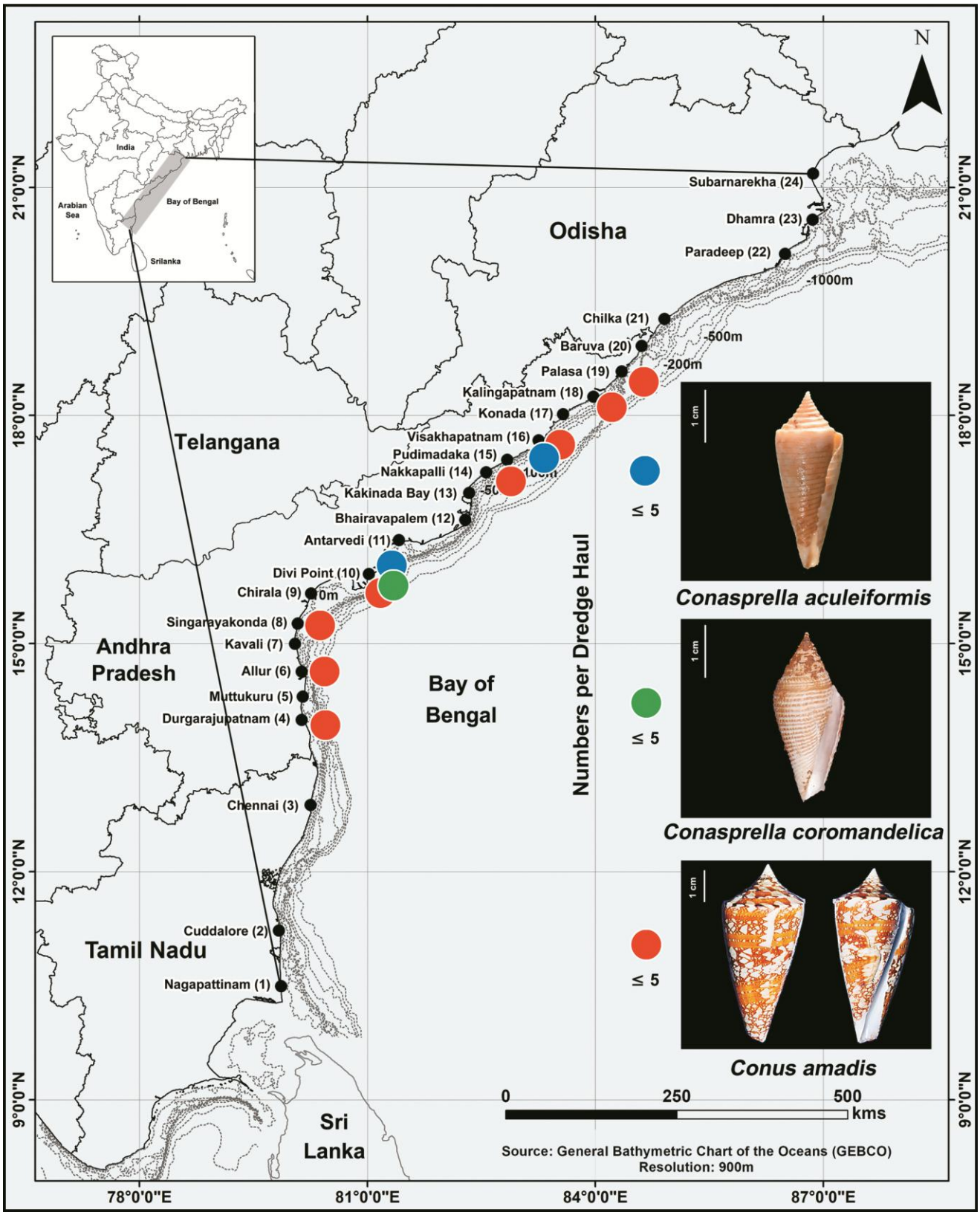

Fig. 1 — Distribution map of *Conasprella aculeiformis*, *C. coromandelica*, and *Conus amadis*

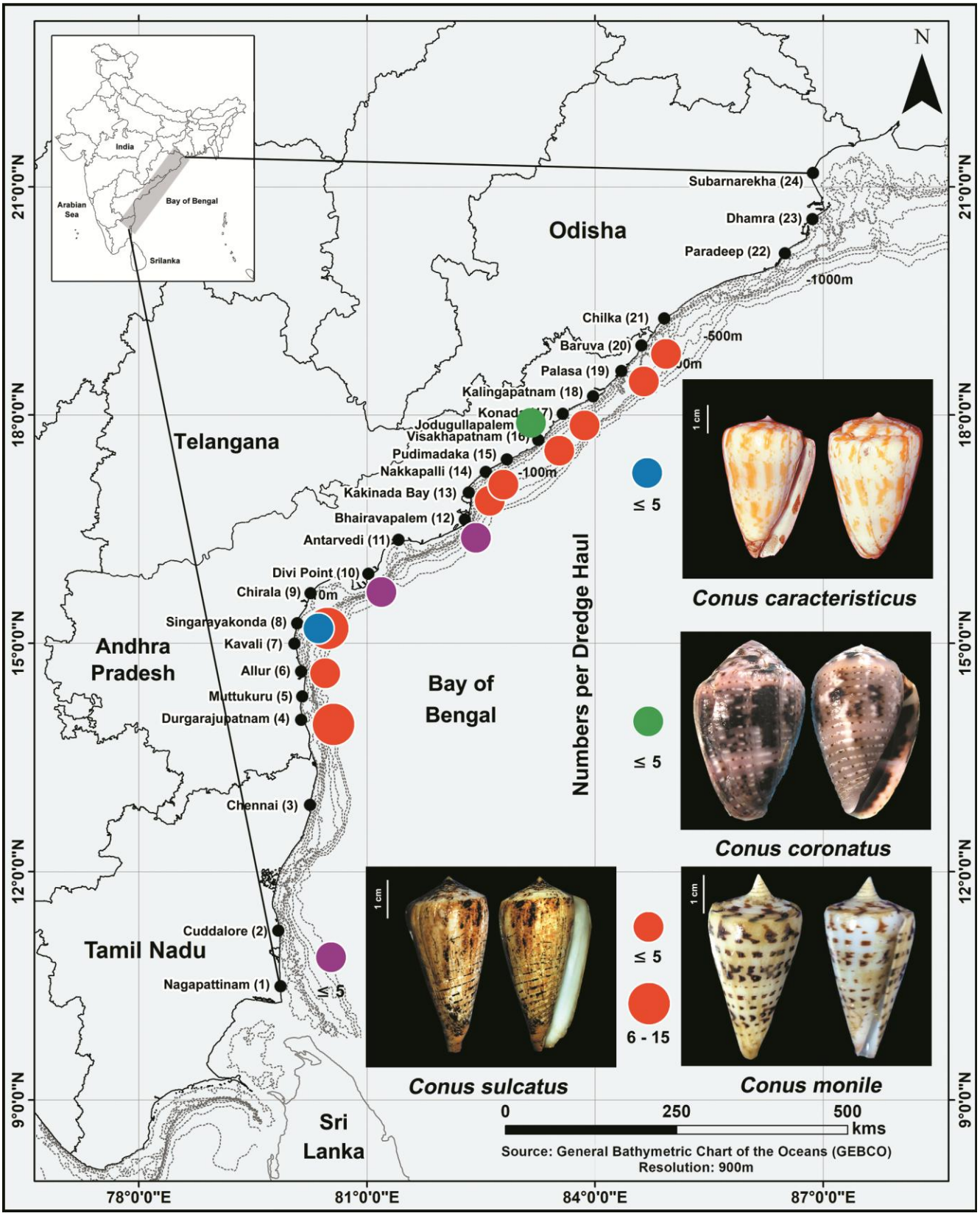

Fig. 2 — Distribution map of *C. caracteristicus*, *C. coronatus*, *C. monile* and *C. sulcatus*

taxonomic features with appropriate literature[13]. The specimens were photographed (digital camera, Nikon D5600), vouchered, and deposited in the collections of the Marine Biology Laboratory, Department of Zoology, Andhra University, Visakhapatnam, India.

Abbreviations

AMNH – American Museum of Natural History, New York, USA; BMNH – The Natural History Museum, London, UK; MBLDZAU – Marine Biology Laboratory, Department of Zoology, Andhra University; MGM – Madras Government Museum, India; ZMUC – Zoologisk Museum, Copenhagen, Denmark; SL – Shell Length; SW – Shell Width; LC – Least Concern; DD – Data Deficient.

Results

Fifteen species of cone snails are reported here, of which seven species are new to the coast of Andhra Pradesh (Table 1). Morphometric measurements and location details are tabulated in Table 2.

Systematic account

Order: Neogastropoda Wenz, 1938
Superfamily: Conoidea J. Fleming
Family: Conidae J. Fleming

Discussion

The diversity of cone snails in Indian coastal waters is fairly well documented[14]. From the coast of Andhra Pradesh, merely 17 species of cone snails were reported earlier[12,7]. In the present study, all the cones examined were obtained from shallow subtidal waters, except *Conus coronatus* Gmelin, 1791 (Plate 1g & h) collected from a rocky intertidal region; the latter is reported for the first time from Andhra Pradesh. This species was documented from the Gulf of Mannar *viz.* Krusadai Island[15], Shingle Island[16], Krusadai Island, Mandapam Camp[14], and Keelakarai[9] along the East coast of India. From the west coast, specimens were collected from Okha, Gujarat, Purnagath, Ratnagiri (at AMNH), and Tuticorin (at BMNH)[14].

An earlier description of *Conasprella aculeiformis* Reeve, 1844 from Andhra Pradesh[12] is a misidentification. However, careful examination of the two specimens obtained in the present study (Plate 1a) confirms the taxonomic identity as *C. aculeiformis*, indicative of its first report from the state's coastal waters.

The occurrence of another single live cone specimen of *C. coromandelica* (E. A. Smith, 1894)

Table 1 — Checklist of *Conus* species from Andhra Pradesh. * indicates species new to the state

Sl. No.	Species list	References
1	**Conasprella aculeiformis* Reeve, 1844	Present collection; Ramakrishna *et al.*[12] (misidentification)
2	*C. elegans* (G. B. Sowerby III, 1895)	Venkitesan *et al.*[7]
3	*C. lentiginosa* (Reeve, 1844)	Present collection; Ramakrishna *et al.*[12]; Venkitesan *et al.*[7]
4	**C. coromandelica* (E. A. Smith, 1894)	Present collection
5	*C. viminea* (Reeve, 1849)	Venkitesan *et al.*[7]
6	*Conus acutangulus* (Lamarck, 1810)	Present collection; Venkitesan *et al.*[7]
7	**C. amadis* (Gmelin, 1791)	Present collection
8	*C. balteatus* G. B. Sowerby I, 1833	Venkitesan *et al.*[7]
9	*C. betulinus* (Linnaeus, 1758)	Present collection; Ramakrishna *et al.*[12]; Venkitesan *et al.*[7]
10	*C. biliosus* (Röding, 1798)	Ramakrishna *et al.*[12]; Venkitesan *et al.*[7]
11	*C. buxeus loroisii* Kiener, 1846	Present collection; Venkitesan *et al.*[7]
12	**C. caracteristicus* Fischer von Waldheim, 1807	Present collection; Ramakrishna *et al.*[12] (without locality details)
13	**C. coronatus* Gmelin, 1791	Present collection
14	*C. eburneus* Hwass in Bruguière, 1792	Ramakrishna *et al.*[12]; Venkitesan *et al.*[7]
15	*C. eximius* Reeve, 1849	Venkitesan *et al.*[7]
16	*C. figulinus* (Linnaeus, 1758)	Present collection; Ramakrishna *et al.*[12]; Venkitesan *et al.*[7]
17	*C. hyaena* Hwass in Bruguiere, 1792	Present collection; Ramakrishna *et al.*[12]; Venkitesan *et al.*[7]
18	*C. inscriptus* Reeve, 1845	Present collection; Ramakrishna *et al.*[12]; Venkitesan *et al.*[7]
19	*C. madagascariensis* G. B. Sowerby II, 1858	Venkitesan *et al.*[7]
20	**C. monile* Hwass in Bruguiere, 1792	Present collection
21	*C. malacanus* Hwass in Bruguiere, 1792	Present collection; Venkitesan *et al.*[7]
22	**C. sulcatus* Hwass in Bruguiere, 1792	Present collection
23	*C. textile* Linnaeus, 1758	Venkitesan *et al.*[7]
24	*Conus zonatus* Hwass in Bruguière, 1792	Venkitesan *et al.*[7]

Table 2 — Morphometric measurements and locality details of newly recorded *Conus* species from Andhra Pradesh coast

Sl. No.	Species	SL × SW (mm)	Regd No.	No. of specimens	Locality	Year	Depth (m)	IUCN Status
1	*Conasprella aculeiformis* Reeve, 1844	33.5 × 14.0	MBLDZAU–137	2	Divi point, Visakhapatnam	1987-89, 2004-06	6.5-50	LC
2	*C. coromandelica* (E.A.Smith, 1894)	31.28 × 13.9	MBLDZAU–139	1	Divi point	2000	100	DD
3	*Conus amadis* Gmelin, 1791	51.41 × 23.42	MBLDZAU–141	12	Durgarajupatnam, Allur, Singarayakonda, Divi point, Pudimadaka, Visakhapatnam, Kalingapatnam, Palasa	2008-09, 2014, 2017	10-50	LC
4	*C. caracteristicus* Fischer von Waldheim, 1807	48.32 × 31.18	MBLDZAU–144	1	Singarayakonda	2017	20	LC
5	*C. coronatus* Gmelin, 1791	28 × 17	MBLDZAU–145	2	Jodugulla Palem	2004	Intertidal	LC
6	*C. monile* Hwass in Bruguiere, 1792	42.70-66.64 × 19.9-59.91	MBLDZAU–152	84	Visakhapatnam, Kakinada, Durgarajupatnam, Allur, Singarayakonda, Nakkapalli, Konada, Palasa, Baruva	2003, 2005, 2007, 2013, 2014, 2017	2-30	LC
7	*C. sulcatus* Hwass in Bruguière, 1792	43.36-58 × 22.72–27.42	MBLDZAU–154	5	Divi point, Bhairavpalem	2017	20-30	LC

Plate 1 — a) *Conasprella aculeiformis* Reeve, 1844; b) *C. coromandelica* (E. A. Smith, 1894); c & d) *Conus amadis* Gmelin, 1791; e & f) *C. caracteristicus* Fischer von Waldheim, 1807; g & h) *C. coronatus* Gmelin, 1791; i & j) *C. monile* Hwass in Bruguiere, 1792; and k & l) *C. sulcatus* Hwass in Bruguière, 1792

from Divi Point as documented through this study (Plate 1b) at a depth of 100 m is suggestive of its extended distribution to the Northeast coast of India. The species was first recorded off Coromandel coast (14°18'15.00" N, 80°18'30.00" E and 15°14'6.00" N, 80°25'6.00" E, depth 234 m)[17] without a clear indication of the type locality. The holotype (Zoological Survey of India, Reg. No. 5359) is from the Bay of Bengal (14°18.25' N; 80°30' E. Sta. 154: off Coromandel coast, 80 – 110 fms). A specimen considered from a depth of 311 m, off the Coromandel coast, was considered the paratype (BMNH)[18]. A specimen from Nagapattinam, Tamil Nadu (BMNH), is possibly the only recent collection after its original discovery. Notably, subsequent collections were empty shells collected from Minicoy beach, Arabian Sea[5], and Gopalpur, Bay of Bengal[19].

Conus amadis Gmelin, 1791 (Plate 1c & d) observed at several locations of the study area is recorded for the first time off Andhra Pradesh waters. It was documented originally from Rameswaram[20]. Subsequent reports were from Pamban[21,16], Krusadai Island as '*C. acuminatus*'[15], Mandapam[22], erstwhile Madras[23,24,25,26,16], Porto Novo[14], Tuticorin (BMNH), Tranquebar (ZMUC) (Kohn, 1978)[14] and Tamil Nadu[9].

The cone, *C. caracteristicus* Fischer von Waldheim, 1807 (Plate 1e & f), was listed from Andhra Pradesh[12] without citing reference information on the material examined. In the existing collections of this study, a single species was obtained from Singarayakonda. Until now, the species has been recorded from Tamil Nadu, Puducherry, and Andaman Islands[7]. Present documentation of a live species from Singarayakonda constitutes the second report from Andhra Pradesh.

The occurrence and further abundance of *C. monile* Hwass in Bruguiere, 1792 (Plate 1i & j) from several stations across the area investigated is significant as the species is the first report from the Andhra Pradesh coast. It was documented from Madras[26], a reference later[27] without precise locality details, subsequently from Mumbai coast[28], off Porto Novo, Madras (MGM) and Tuticorin (BMNH)[14].

Further, *C. sulcatus* Hwass in Bruguière, 1792 (Plate 1k & l) is collected for the first time from Andhra Pradesh, the second report from India. It was first recorded from coastal Tamil Nadu[14].

Conclusion

Compared to the other cones, *C. monile* was most abundant (84 individuals from dredge hauls across most stations). Species, for example, *C. aculeiformis*, *C. amadis*, *C. monile*, and *C. sulcatus* were distributed at more than one location across the area investigated, with the maximum number of species recorded from Divi point (Table 2; Figs. 1 & 2). In all, the seven species of cones discovered from the waters off Andhra Pradesh are new additions to the molluscan biodiversity database of the state and an indication of range extension to the northeast coast.

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Conflict of Interest

The authors declare that they have no competing or conflict of interests.

Author Contributions

Taxonomic analysis: NVS, KVS & SSR; Funding acquisition and investigation: Late AVR; Writing: SSR, BD & DR; and Review & editing: NVS & DR.

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