

New record of *Rhizosolenia cochlea* (Brun, 1891) and *Rhizosolenia bergonii* (Peragallo, 1892) from the Palk Bay, southeast coast, India

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Rhizosolenia cochlea Brun 1891 and *Rhizosolenia bergonii* Peragallo 1892 are identified for the first time from Palk Bay, south east coast of India. The cell of *R. cochlea* is stout and tubular or cylindrical in shape ending with curve processes. Otaria is small and extending along the basal part of the process. *R. bergonii* is also cylindrical, straight and valve terminating in a short spine. Basal part of the process has no otaria and tip appears like cleft. Cell wall is thick and usually heavily silicified. Length of perivalvar axis, cell diameter and cell volume of *R. cochlea* varied from 445.54 – 784.93 μm , 50.83 – 73.60 μm , 2.4×10^6 to $7.5 \times 10^6 \mu\text{m}^3$ respectively and of *R. bergonii* the same varied from 366.30 – 535.03 μm , 20.22 – 34.82 μm and 1.8×10^6 to $6.7 \times 10^6 \mu\text{m}^3$. These cells are large enough to be visible clearly and identified with light microscope. Even though, 11 species of the genera, *Rhizosolenia* have been reported by several authors since 1956 to 2013, from this region, *R. cochlea* and *R. bergonii* are remained unidentified. These species might have migrated from offshore due to global warming and climate change, which lead frequent occurrence of cyclone in this region and /or due to anthropological activities such as offshore fishing and large scale macro algal cultivation, which might have established their population. The identifying characteristics, frequency and seasonal occurrences of both the species will be described in the present study.

[Key words: New record, Palk Bay, Phytoplankton, *Rhizosolenia bergonii*, *Rhizosolenia cochlea*.]

Introduction

Biodiversity of living organism in this changing world is an important topic to study more minutely and more elaborately. World oceans cover 70% of the earth surface and phytoplankton is the most dominant primary producer as the plants in terrestrial vegetation¹ but the knowledge of diversity patterns of marine phytoplankton is limited than the terrestrial plants. The diversity of marine microbes are huge and it is reported that worldwide more than 50,000 (approx.) diatoms species are available². More than 2000 extant dinoflagellates are present in the sea along with few thousands of cyanobacteria and other microalgae³. Further, a decade before, it is reported that more than 200 nos. of diatom species as well as more than 90 nos. of

dinoflagellates are present along the Indian waters itself⁴.

Several authors⁵⁻¹⁰ already reported many phytoplankton species from the Palk bay region, south-east coast of India. In the year 2006, only 45 phytoplankton species were reported from Kattumavadi region of the Palk Bay⁵, whereas more elaborate study revealed 88 more species and in total 133 species were reported along coral reef as well as sea grass environment of the Palk Bay region⁶.

The present study, will describe the identifying characteristics of *R. cochlea* as well as *R. bergonii*, which are remains unidentified from the Palk Bay region and are being reported for the first time from the Palk Bay region of Tamil Nadu, south-east of India.

Material and Methods

Samples were collected from 10 different locations in the Palk Bay region (Lat. N 09°17.418' Long. E 079°09.054') during May, 2013 to February, 2014. There were two transects and each transect was consisting five stations. Transect 1 (stations 1 to 5) and transect 2 (station 6 to 10) were situated 0.5 as well as 3.0 km far from the shoreline respectively (Fig. 1). Samples were collected by using phytoplankton net (mesh size 20 μm) and were preserved in 4% formaldehyde solution. The preserved samples were then examined under light microscope (AxioScope A1 with attached AxioCamHRC camera, Carl Zeiss, Jena, Germany). Samples

highly productive oceanic regions¹³. The genus *Rhizosolenia*, was first time recognized by Ehrenberg in the year 1843 with the species *Rhizosolenia americana* as stated by Yun and Lee (2010)¹⁴ and thereafter this genus is reviewed by several authors^{13, 15-16}. This marine planktonic genus belongs under the family, Rhizosoleniaceae¹⁵ was also included two genera namely *Pseudosolenia* and *Proboscia*¹³.

Around 50 species, those belongs to the genus *Rhizosolenia* are reported from various part of the world (WoRMS, 2014), where as only 14 species of the genus *Rhizosolenia* were reported from the coast of Tamil Nadu, India (http://tnenvis.nic.in/tnenvis_old/images/Algal_D

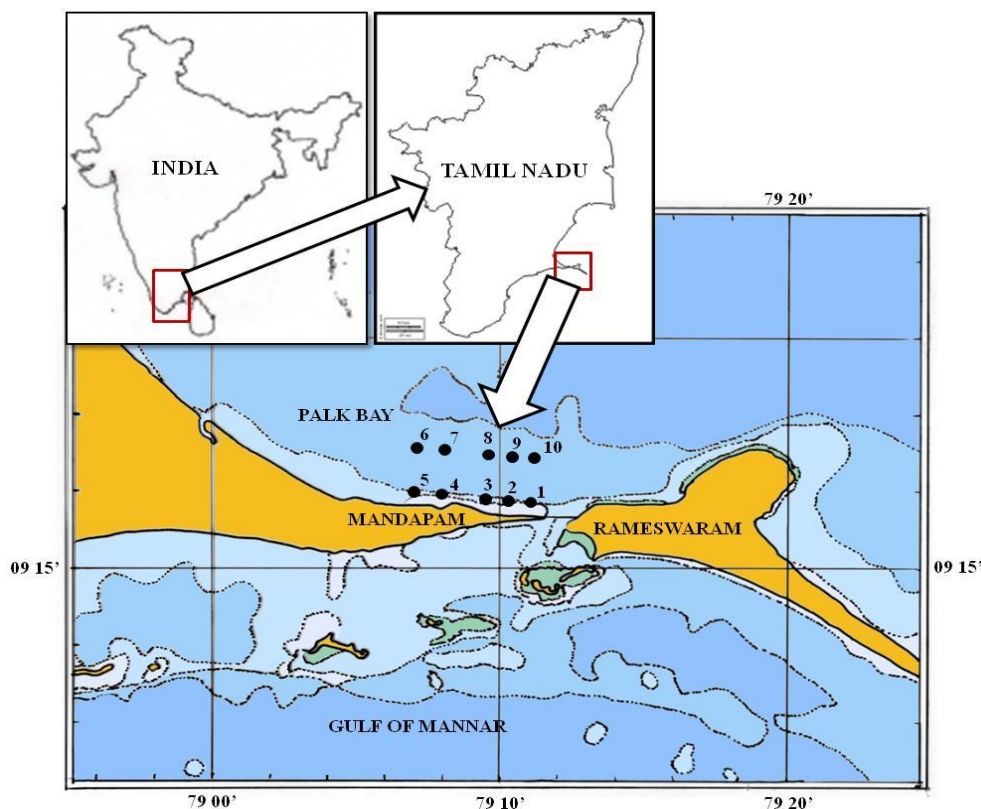


Fig 1. Map showing the study locations along Palk Bay region

were identified by using standard literature, “Identifying Marine Phytoplankton”², “Marine Plankton Diatoms of the west coast of North America”¹¹, “Marine Phytoplankton Atlas of Kuwait’s Waters”¹².

Result and Discussion

The genus *Rhizosolenia* Brightwell (1858) is one of the most important centric diatom genera in the ocean, and rarely found as dominated among the phytoplankton biomass in

atabase.pdf visited on 18 November 2014). While, 11 species of the genera *Rhizosolenia* were reported from the Palk Bay region, south east coast of India only (Table 1). Neither, *R. cochlea* nor *R. bergonii* was reported from the Palk Bay region till the date, this present study was carried out. The newly found species have been identified as *Rhizosolenia cochlea* Brun 1891 and *Rhizosolenia bergonii* H. Pérageallo 1892 and their systematic positions have been described following two different literatures^{2, 12}.

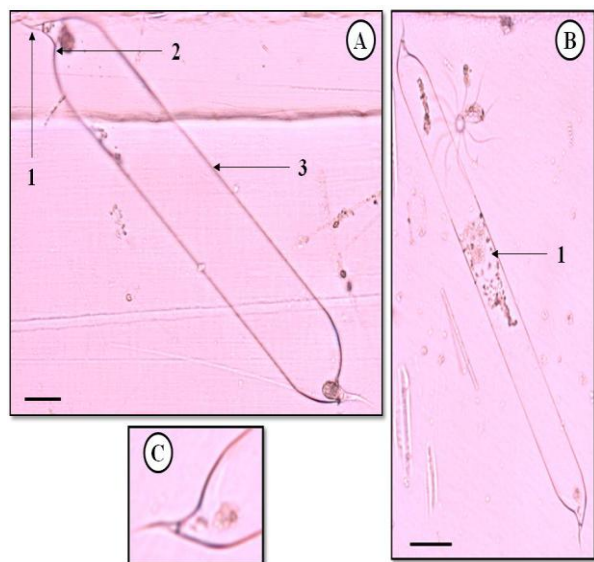


Fig 2. Morphology of *Rhizolenia cochlea*. (A) Light micrograph image showing different parts 1. sigma shaped curved Processes; 2. round-shaped valve; 3. Stout, tubular and cylindrical shape of *R. cochlea* cell; (B) 1. showing numerous cytoplasmic material at the centre, (C) Enlarged image of small, curved and sigma shaped processes. (Scale bar: 50 µm)

To the best of the knowledge of both the author's, both these species are recorded and reported for the first time from the Palk Bay region, south-east coast of India. The systematic positions are as follows.

Order: Rhizosoleniales Silva 1962

Family: Rhizosoleniaceae Petit 1888

Genus: *Rhizolenia* Brightwell 1858

Species 1: *Rhizolenia cochlea* Brun 1891

Species 2: *Rhizolenia bergonii* H. Péréal

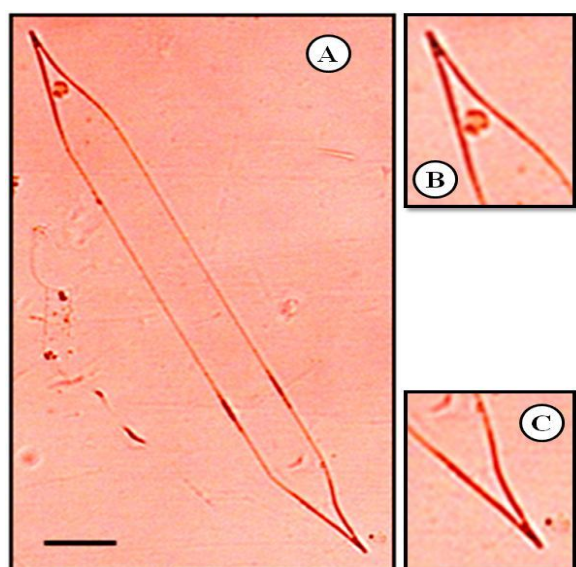


Fig. 3. Morphology of *Rhizolenia bergonii*. (A) Cylindrical and straight *R. bergonii* cells, (B) Light micrograph image showing valve is terminating in a short spine like process; (C) deeply conical valve. (Scale bar: 50 µm).

1892

The cell of *R. cochlea* was stout with tubular or cylindrical in shape. The cell valve is round in shape ending with needle-like processes. Processes are sigma shaped and directed almost parallel to pervalver axis of cell. Otaria is very small and extending along the basal part of the process (Fig. 2). Pervalver axis length and diameter of *R. cochlea* varied between 445.54 – 784.93 µm and 50.83 – 73.60 µm respectively. Diameter of *R. cochlea* was reported widely varied in size i.e., 58 – 63 µm¹⁷, 80 – 130 µm¹⁸, and 50 – 75 µm (Desikachary report) and 50 – 100 µm¹², whereas pervalver axis length of this species was 135 – 495 µm¹². So the present observations confirmed that the observed pervalver axis length of cell was longer and diameter was similar that of with Desikachary report.

R. cochlea was rare in Indian Ocean¹⁸ and was restricted to areas viz., Siam, Hong-Kong and Japan in the year of 1968. In the year 1970, *R. cochlea* was also reported from the Mozambique Channel Karsten¹⁹. Thereafter, *R. cochlea* was reported from different parts of the world, e.g. Indonesian waters²⁰, Kuwait's waters¹² and the western part of Pacific Ocean²¹. *R. cochlea* was also reported from Arabian Gulf²² and at Gulf of Mexico²³. They also commented that this species was rare in coastal waters. In this present study, both these species were found in coastal region only.

Table 1: *Rhizolenia* sp. is already reported from the Indian continent including the Islands of Andaman & Nicobar.

SR. NO.	SPECIES NAME	REFERANCE
1.	<i>Rhizolenia alata</i> f. <i>gracillima</i> *	5, 6, 38, 39, 40 and Present study
2.	<i>R. bergonii</i> *	Present study only
3.	<i>R. calcar avis</i> *	38 and Present study
4.	<i>R. castracanei</i>	38
5.	<i>R. cochlea</i> *	Present study only
6.	<i>R. crassispina</i>	5
7.	<i>R. cylindrus</i>	5 and 40
8.	<i>R. hebetata</i>	38 and 41
9.	<i>R. imbricata</i> *	38, 39, 40, 41 and Present study
10.	<i>R. robusta</i>	38, 39, 40 and 41
11.	<i>R. setigera</i> *	40, 41 and Present study
12.	<i>R. stolterfothii</i>	38 and 41
13.	<i>R. styliformis</i>	6, 38, 39, and 41
14.	<i>Rhizolenia</i> Sp.*	7, 8 and 42

(*: indicates species observed in present study)

The *R. bergonii* cells are cylindrical, straight, and usually solitary. Valve is terminating in a short spine like processes which has a long and truncated apex. The valve at both the ends is deeply conical. Tip of process was appearing like cleft and processes always centrally located to the cell and straight. Cell wall was thick and usually heavily silicified and also absence of Otaria (Fig. 3). The pervalver axis length and diameter of *R. bergonii* varied from 366.30 – 535.03 μm and 20.22 – 34.82 μm and the same was 530 μm long, whereas, the diameter was varied between 22 - 70 μm^{11} . Similarly, it was reported by several authors with variable length and diameter, for example, 342 – 440 μm long with diameter 20 to 52 μm^{27} , whereas 500 μm long with the diameter was 100 μm , which seems too wide in shape¹², on the other hand the same species was reported as 211.7 – 313.3 μm long with very narrow or lean diameter 7.5 – 18.6 μm^{14} . However there were also some species, which were reported in normal range of length 203 – 406 μm and diameter 20 – 29 μm^{28} . So the above described literature shows that the species found in Palk Bay region shows similarity in diameter with the species reported at tropical Mexican Pacific and Buenos Aires coastal waters of Argentina. The pervalver axis shows quite similar length^{11, 12}.

R. bergonii is a warm water species^{13, 29, 30}. This species is reported along off Lower California and in Gulf of California¹¹, in Kuwait's waters¹², in Korean coastal waters¹⁴, at Buenos Aires coastal waters of Port Blair²⁴, Andaman & Nicobar islands²⁵, Orissa coast²⁶, Argentina²⁷, from the tropical Mexican Pacific²⁸, in the English Channel³¹, along Arabian Gulf³², at South China Sea³³, in the Gulf of Thailand³⁴, from the tropical central Pacific and the offshore Peru-Chile³⁵, etc. The *R. bergonii* also was reported from the coastal waters of south Andaman Sea²². While, in Indian Ocean it is reported along tropical southeastern Indian Ocean at Java coast³⁶, in neritic waters of Pakistan³⁷ etc. Presence of two species, *R. bergonii* and *R. cochlea* are quite different (Table 2). The period when, *R. cochlea* is dominant, *R. bergonii* appears in low concentration or vis a vis.

Conclusion

Rhizosolenia bergonii and *R. cochlea*, are reported here for the first time. Dispersal of phytoplankton from offshore to coastal seawater might be happen due to natural calamity, cyclone, and/or anthropogenic activities like macro algae cultivation etc. may be responsible to bring changes into shallow coastal ecosystem.

Table 2: Frequency of *R. cochlea* and *R. bergonii* within total phytoplankton community and within the genus *Rhizosolenia* during the study period from May 2013 to February 2014

Sr. No.	Months	Total phytoplankton cell count (No./L)	Cell count (cells/L.)				% of <i>R. cochlea</i>		% of <i>R. bergonii</i>	
			<i>R. cochlea</i>	<i>R. bergonii</i>	In total phytoplankton count	In <i>Rhizosolenia</i> count	In total phytoplankton count	In <i>Rhizosolenia a</i> count		
1	May-13	2676	-	92.67	-	-	3.46	12.90		
2	Jun-13	39461	60.00	1288.33	0.15	0.22	3.26	4.79		
3	Jul-13	19851	1192.00	99.93	6.00	15.72	0.50	1.32		
4	Aug-13	27798	-	749.64	-	-	2.70	5.96		
5	Nov-13	13644	3.00	159.35	0.02	0.06	1.17	3.18		
6	Dec-13	77168	17.00	416.44	0.02	0.21	0.54	5.23		
7	Feb-14	67145	2194.00	82.13	3.27	35.00	0.12	1.31		

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