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RHIZARIA: RADIOZOA CAVALIER-SMITH, 1987

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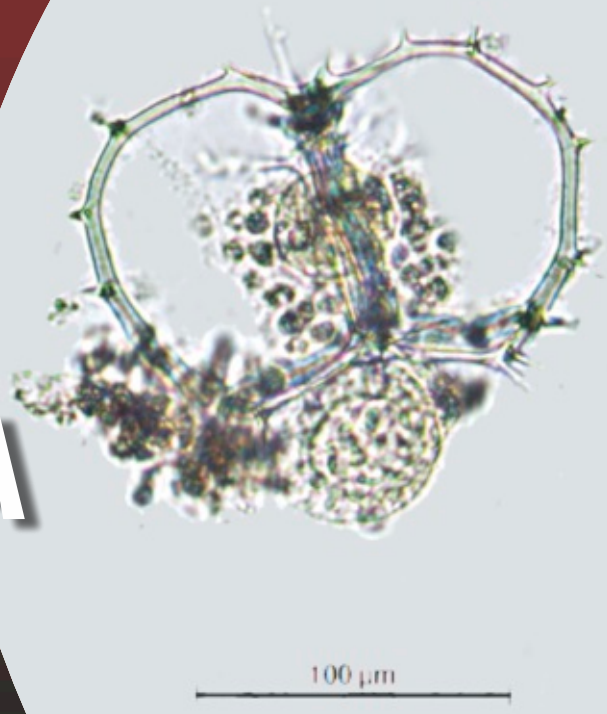

FAUNA OF INDIA CHECKLIST

PHYLUM RADIOZOA Cavalier-Smith, 1987

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Introduction : While the scientific definition has undergone changes over time, and in particular during the last two decades, phylum Radiozoa Cavalier-Smith, 1987 (Radiolaria Muller, 1858) can be described as a group of diverse protists characterised by their delicate and elaborate mineral skeletons with sizes ranging from 40 µm to 400 µm. They are marine holoplanktonic forms, present in all major oceans but absent from some marginal seas. While most radiozoans are solitary, some colonial forms exist (Suzuki and Aita, 2011; Stern et al., 2017; Biard, 2022). They possess axopodia, which are retractable cytoplasmic processes that radiate out from the cell and are used to capture prey. Their characteristic hard skeleton varies in composition among different radiozoan subgroups- Polycystine and taxopodid radiozoans (class Polycystina Ehrenberg, 1838 and class Sticholonchea) have a mineral skeleton consisting of opaline silica; on the other hand, Acantharian radiozoans (class Acantharia Haeckel,1881) have a skeleton made of spicules that cross the cell body and are made up of strontium sulphate. This is the only known example of a protist that biomineralizes this particular element, but it quickly dissolves when the organism dies and is exposed to fixatives (Decelle and Not, 2015). One of the most notable attributes of radiozoans is their intricate relationships with photosymbionts. Many species of radiozoans can harbour ten to hundreds of symbionts within their cell bodies, wherein the radiozoan host obtains carbon-rich products from the photosynthetic activity of the symbionts, and the symbiont benefits from a protected micro-environment (Biard, 2022). While radiozoans (except Acantharia) have been extensively studied as fossils by paleontologists, biologists have tended to overlook them until recent times.

Global diversity: Radiozoa can be found in a variety of marine environments worldwide. These environments include tropical, subtropical, and polar waters (Suzuki and Aita, 2011). In the marine waters of the world, 467 extant species of radiozoa are found, belonging to three classes, nine orders and 37 families (Guiry, M.D. & Guiry, G.M., 2023).

Diversity in India : In the Indian marine waters, 114 species belonging to two classes, five orders and 20 families have been reported so far.

Diversity in States :

Sl. No.	State / Union Territory	No. of Species
1	Andhra Pradesh	0
2	Arunachal Pradesh	0
3	Assam	0
4	Bihar	0
5	Chhattisgarh	0
6	Gujarat	0
7	Goa	0
8	Haryana	0
9	Himachal Pradesh	0
10	Jharkhand	0
11	Karnataka	0
12	Kerala	0
13	Madhya Pradesh	0
14	Maharashtra	0
15	Manipur	0
16	Meghalaya	0
17	Mizoram	0
18	Nagaland	0
19	Odisha	1
20	Punjab	0
21	Rajasthan	0
22	Sikkim	0
23	Tamil Nadu	1
24	Telangana	0
25	Tripura	0
26	Uttar Pradesh	0
27	Uttarakhand	0
28	West Bengal	0
29	Andaman & Nicobar	50
30	Chandigarh	0
31	Dadra Nagar Haveli, Daman & Diu	0
32	Delhi	0
33	Jammu & Kashmir	0
34	Ladakh	0
35	Lakshadweep	0
36	Puducherry	0
37	State Unknown	88
	INDIA TOTAL	**114**

Endemism: Although some endemism is observed in certain Arctic polycystine radiolarians, none have been recorded that are endemic to Indian waters.

Habitat: Radiozoa predominantly dwell in marine environments, specifically in tropical, subtropical, and arctic waters around the world, occupying different depths in the water column
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Ecological Significance: Radiozoa are primarily recognized by their fossil records, and their modern-day ecological behaviour is not extensively understood. They have a broad distribution and can be found in various depths of the ocean. Little is known about their genetic diversity and biogeographic patterns in modern-day oceans. They play a significant role in marine ecosystems as part of the plankton community, serving as a food source for many marine organisms such as fish and zooplankton, and in biogeochemical cycles, especially in the deep ocean. Recent evidence based on both molecular and in situ imaging technologies suggests that the abundance and diversity of radiozoan species in the environment may be significant, although they are still likely to be under-represented.

Human Significance (Economic importance, human and veterinary importance): Radiozoa do not have any direct economic importance to humans.

Threatened species as per IUCN (Numbers under different categories) : No species are included under IUCN as Threatened species.

Protected Species as per WPA (2022) (Number of species in different schedules) : No species are included under any schedule as per the WPA (2022)

Species under CITES (Number of species) : Indian radiozoan species are not listed under any appendices of CITES.

Invasive alien species (Number of species) : No species are known to be invasive.

Gap areas (Discuss taxonomic and geographic gap areas): Radiozoans are poorly documented from most of the coastal states (except single records from Odisha, Tamil Nadu) and Union Territories (except from Andaman and Nicobar Islands). Moreover, acantharians all across the Indian Exclusive Economic Zone are poorly documented in terms of their distribution, ecology, biogeography.

Systematic List:

Sl. No.	Species
	Phylum RADIOZOA Cavalier-Smith 1987
	Class ACANTHARIA Haeckel, 1881
	Order ARTHRACANTHIDA Schewiakoff, 1926
	Family ACANTHOMETRIDAE Haeckel, 1887
	Genus ***Acanthometra*** J. Müller, 1856
1	*Acanthometra bulbosa* Haeckel, 1860
2	*Acanthometra pellucida* Müller, 1858
	Genus ***Acanthometron*** Haeckel, 1887
3	*Acanthometron sp.*
	Genus ***Amphilonche*** Haeckel, 1860
4	*Amphilonche elongata* (Müller, 1858)
	Family DORATASPIDAE Haeckel, 1887
	Genus ***Hystrichaspis*** Haeckel 1887
5	*Hystrichaspis dorsata* Haeckel, 1887
	Family PHYLLOSTAURIDAE Schewiakoff, 1926

Sl. No.	Species
	Genus ***Acanthostaurus*** Haeckel, 1862
6	*Acanthostaurus purpurascens* (Haeckel, 1860)
7	*Acanthostaurus* sp.
	Order HOLACANTHIDA Schewiakoff, 1926
	Family ACANTHOCHIASMIDAE Haeckel, 1862
	Genus ***Acanthochiasma*** Krohn, 1861
8	*Acanthochiasma fusiforme* Haeckel, 1861
9	*Acanthochiasma rubescens* Haeckel, 1862
	Order SYMPHYACANTHIDA Schewiakoff, 1926
	Family AMPHILITHIIDAE Haeckel, 1882, emend. Schewiakoff, 1926
	Genus ***Amphibelone*** *Haeckel,1862*
10	*Amphibelone* sp.
	Class POLYCYSTINA Ehrenberg, 1838
	Order NASSELLARIA Ehrenberg, 1875
	Family ARTOSTROBIIDAE Riedel, 1967 emend. Foreman, 1973
	Genus ***Botryostrobus*** Haeckel, 1887 emend. Nigrini, 1977
11	*Botryostrobus aquilonaris* (Bailey) Johnson, 1974
12	*Botryostrobus auritus-australis* Ehrenberg, 1844
	Genus ***Phormostichoartus*** Campbell, 1951 emend. Nigrini, 1977
13	*Phormostichoartus corbula* (Harting) Nigrini, 1977
	Genus ***Siphocampe*** Haeckel 1882
14	*Siphocampe arachnea* (Ehrenberg) Nigrini, 1977
15	*Siphocampe lineata* (Ehrenberg) Nigrini, 1977
	Genus ***Spirocyrtis*** Haeckel 1882
16	*Spirocyrtis scalaris* Haeckel, 1887
17	*Spirocyrtis subscalaris* Nigrini, 1977
	Family CANNOBOTRYIDAE Haeckel, 1881 emend. Riedel, 1967
	Genus ***Acrobotrys*** Haeckel 1881
18	*Acrobotrys sp.*
	Genus ***Botryocyrtis*** Ehrenberg, 1860
19	*Botryocyrtis scutum* (Harting) Nigrini, 1967
	Genus ***Centrobotrys*** Petrushevskaya 1965
20	*Centrobotrys thermophila* Petrushevskaya, 1965
	Family CARPOCANIIDAE Haeckel, 1881 emend. Riedel, 1967
	Genus ***Carpocanarium*** Haeckel, 1887
21	*Carpocanarium papillosum* (Ehrenberg, 1872)
22	*Carpocanarium* sp.
	Genus ***Carpocanistrum*** Haeckel, 1887
23	*Carpocanistrum* spp.
	Genus ***Carpocanopsis*** Riedel & Sanfilippo 1971
24	*Carpocanopsis favosa* (Haeckel) Kruglivkova, 1978

Sl. No.	Species
	Family COLLOZOIDAE Haeckel, 1862
	Genus ***Acrosphaera*** Haeckel 1882
25	*Acrosphaera lappacea* (Haeckel) Johnson & Nigrini, 1980
26	*Acrosphaera spinosa* Caulet, 1986
	Genus ***Buccinosphaera*** Haeckel, 1887
27	*Buccinosphaera invaginata* Haeckel, 1887
	Genus ***Collosphaera*** Müller, 1859
28	*Collosphaera huxleyi* Mueller, 1855
29	*Collosphaera macropora* Popofsky, 1917
30	*Collosphaera tuberosa* Haeckel, 1887
	Genus ***Disolenia*** Ehrenberg, 1861
31	*Disolenia quadrata* (Ehrenberg) Nigrini, 1967
	Genus ***Otosphaera*** Haeckel, 1887, emend. Nigrini, 1967
32	*Otosphaera auriculata* Haeckel, 1887
	Genus ***Siphonosphaera*** Muller, 1858
33	*Siphonosphaera polysiphonia* Haeckel, 1887
	Genus ***Solenosphaera*** Haeckel, 1887
34	*Solenosphaera zanguebarica* Brandt, 1905
	Genus ***Sphaerozoum*** Meyen 1834
35	*Sphaerozoum ovodimare* Haeckel 1860
	Family PLAGIACANTHIDAE Hertwig, 1879
	Genus ***Arachnocorys*** Haeckel 1861
36	*Arachnocorys circumtexta* Haeckel, 1860
	Genus ***Callimitra*** Haeckel 1882
37	*Callimitra solocicribrata* Takahashi 1991
	Genus ***Ceratocyrtis*** Bütschli 1882
38	*Ceratocyrtis histricosa (Joergensen)* Petrushevskaya, 1971
	Genus ***Lampromitra*** Haeckel 1882
39	*Lampromitra schultzei* (Haeckel) Takahashi, 1991
	Genus ***Lithomelissa*** Ehrenberg 1847
40	*Lithomelissa* spp.
	Genus ***Peridium*** Haeckel 1887
41	*Peridium* sp.
	Family PTEROCORYTHIDAE Haeckel, 1881
	Genus ***Anthocyrtidium*** Haeckel, 1881
42	*Anthocyrtidium ophirense* (Ehrenberg) Petrushevskaya, 1968
43	*Anthocyrtidium zanguebaricum* (Ehrenberg) Haeckel, 1887
	Genus ***Lamprocyclas*** Haeckel 1881
44	*Lamprocyclas hannai* (Campbell & Clark) Sanfilippo, Westberg-Smith & Riedel, 1985
45	*Lamprocyclas maritalis* Haeckel, 1887
	Genus ***Lamprocyrtis*** Kling, 1973

Sl. No.	Species
46	*Lamprocyrtis nigriniae* (Caulet) Kling, 1973
	Genus ***Pterocorys*** Haeckel, 1881
47	*Pterocorys hertwigii* (Haeckel) Petrushevskaya, 1971
48	*Pterocorys zancleus (Mueller)* Nigrini & Moore, 1979
49	*Pterocorys* sp.
	Genus ***Theocorythium*** Haeckel, 1887
50	*Theocorythium trachelium* (Ehrenberg) Nigrini, 1967
	Family THEOPERIDAE Haeckel, 1881 emend. Riedel, 1967
	Genus ***Cornutella*** Ehrenberg, 1838
51	*Cornutella profunda* Ehrenberg, 1856
	Genus ***Dictyophimus*** Ehrenberg, 1847 emend. Nigrini, 1968
52	*Dictyophimus crisiae* Ehrenberg, 1854
	Genus ***Eucecryphalus*** *Haeckel 1861*
53	*Eucecryphalus sp.*
	Genus ***Eucyrtidium*** Ehrenberg, 1847 emend. Nigrini, 1967
54	*Eucyrtidium acuminatum* (Ehrenberg) Ehrenberg, 1847
55	*Eucyrtidium hexagonatum* Haeckel, 1887
	Genus ***Lithopera*** Ehrenberg 1846
56	*Lithopera bacca* Ehrenberg, 1872
	Genus ***Pterocanium*** Ehrenberg, 1847
57	*Pterocanium charybdeum* (Müller, 1858)
58	*Pterocanium praetextum* (Ehrenberg) Haeckel, 1887
	Genus ***Theocorys*** Haeckel 1882
59	*Theocorys* sp.
	Family TRISSOCYCLIDAE Haeckel, 1881, emend. Goll, 1968
	Genus ***Acanthodesmia*** Müller 1857
60	*Acanthodesmia vinculata* Mueller, 1858
	Genus ***Amphispyris*** Haeckel 1882
61	*Amphispyris reticulata* (Ehrenberg, 1872)
	Genus ***Lophospyris*** Haeckel, 1881 emend. Goll, 1977
62	*Lophospyris pentagona* (Ehrenberg) Petrushevskaya, 1971
	Genus ***Nephrospyris*** Haeckel, 1887
63	*Nephrospyris* spp.
	Genus ***Phormospyris*** Haeckel, 1881 emend. Goll, 1977
64	*Phormospyris stabilis* Goll, 1976
	Genus ***Tholospyris*** Haeckel 1882
65	*Tholospyris anthophora* (Haeckel, 1887)
	Order SPUMELLARIA Ehrenberg, 1875
	Family ACTINOMMIDAE Haeckel, 1862, emend. Riedel, 1967
	Genus ***Actinomma*** Haeckel, 1860, emend. Nigrini, 1967
66	*Actinomma arcadophorum* (Haeckel, 1887)

Sl. No.	Species
67	*Actinomma leptodermum (Jorgensen)* Nigrini & Moore, 1979
68	*Actinomma medianum* Nigrini, 1967
	Genus ***Anomalacantha*** Loeblich & Tappan, 1961
69	*Anomalacantha dentata* Mast, 1910
	Genus *Arachnosphaera*
70	*Arachnosphaera* sp.
	Genus ***Carposphaera*** Haeckel 1882
71	*Carposphaera acanthophora* (Popofsky) Benson, 1966
	Genus ***Centrocubus*** Haeckel 1887
72	*Centrocubus cladostylus* Haeckel, 1887
	Genus ***Cladococcus*** Mueller, 1856
73	*Cladococcus* spp.
	Genus ***Cromyomma*** Haeckel 1862
74	*Cromyomma circumtextum* Haeckel, 1887
	Genus ***Druppatractus*** Haeckel 1887
75	*Druppatractus irregularis* Popofsky, 1912
	Genus ***Drymosphaera*** Haeckel 1882
76	*Drymosphaera polygonalis* Haeckel, 1887
	Genus ***Hexacontium*** Haeckel, 1881
77	*Hexacontium* sp.
	Genus ***Hexalonche*** Haeckel 1882
78	*Hexalonche sp.*
	Genus ***Hexastylus*** Haeckel 1882
79	*Hexastylus dimensivus* Haeckel, 1887
	Genus ***Saturnalis*** Haeckel 1882
80	*Saturnalis circularis* Haeckel, 1887
	Genus ***Spongosphaera*** Ehrenberg, 1847
81	*Spongosphaera streptacantha* Haeckel, 1860
	Genus ***Stylatractus*** Haeckel 1887
82	*Stylatractus* spp.
	Genus ***Styptosphaera*** Haeckel, 1887
83	*Styptosphaera* spp.
	Family COCCODISCIDAE Haeckel, 1862
	Genus ***Didymocyrtis*** Haeckel 1861
84	*Didymocyrtis tetrathalamus* (Haeckel) Sanfilippo & Riedel, 1980
	Family HELIODISCIDAE Haeckel 1881
	Genus ***Heliodiscus*** Haeckel, 1862 emend. Nigrini, 1967
85	*Heliodiscus asteriscus* Haeckel, 1887
86	*Heliodiscus echiniscus* Haeckel, 1887
	Family LITHELIIDAE Haeckel, 1862
	Genus ***Larcopyle*** Dreyer,1889

Sl. No.	Species
87	*Larcopyle buetschlii* Dreyer, 1889
88	*Larcopyle* spp.
	Genus ***Lithelius*** Haeckel, 1862
89	*Lithelius minor* Joergensen, 1900
90	*Lithelius nautiloides* Popofsky, 1908
	Genus ***Larcospira*** Haeckel, 1887
91	*Larcospira quadrangula* Haeckel, 1887
	Family PYLONIIDAE Haeckel, 1881
	Genus ***Circodiscus*** Kozlova 1972
92	*Circodiscus microporus* (Stoehr) Petrushevskaya & Kozlova, 1972
	Genus ***Hexapyle*** Haeckel 1881
93	*Hexapyle dodecantha* Haeckel, 1887
	Genus ***Phorticium*** Haeckel 1882
94	*Phorticium pylonium* Haeckel, 1887
	Genus ***Octopyle*** Haeckel 1881
95	*Octopyle stenozona* Haeckel, 1887
	Genus ***Tetrapyle*** Muller, 1858
96	*Tetrapyle octacantha* Mueller, 1858
	Family SPONGODISCIDAE Haeckel, 1862 emend. Riedel, 1967
	Genus ***Amphirhopalum*** Haeckel, 1881 emend. Nigrini, 1967
97	*Amphirhopalum ypsilon* Haeckel, 1887
	Genus ***Dictyocoryne*** Ehrenberg, 1860
98	*Dictyocoryne euclidis* Haeckel 1887
99	*Dictyocoryne profunda* (Ehrenberg, 1872)
100	*Dictyocoryne truncatum* (Ehrenberg) Nigrini & Moore, 1979
	Genus ***Euchitonia*** Ehrenberg 1861
101	*Euchitonia elegans-furcata group* (Ehrenberg, 1860) Boltovskoy, 1998
	Genus ***Hymeniastrum*** Ehrenberg 1846
102	*Hymeniastrum spp.*
	Genus ***Porodiscus*** *Haeckel 1882*
103	*Porodiscus sp.*
	Genus ***Spongaster*** Ehrenberg, 1860
104	*Spongaster tetras* Ehrenberg, 1860
	Genus ***Spongodiscus*** Ehrenberg, 1884
105	*Spongodiscus* spp.
	Genus ***Spongopyle*** Dreyer, 1889
106	*Spongopyle osculosa* Dreyer, 1889
	Genus ***Spongotrochus*** Haeckel, 1860
107	*Spongotrochus glacialis* Popofsky, 1908
	Genus ***Spongurus*** Haeckel, 1860
108	*Spongurus cylindricus* Haeckel, 1860

Sl. No.	Species
109	*Spongurus elliptica* (Ehrenberg, 1872)
	Genus ***Stylochlamydium*** Haeckel 1887
110	*Stylochlamydium asteriscus* Haeckel, 1887
111	*Stylochlamydium venustum (Bailey)* Haeckel, 1887
	Genus ***Stylodictya*** Ehrenberg, 1847 emend. Kozlova, 1972
112	*Stylodictya aculeata* Joergensen, 1905
113	*Stylodictya validispina* Joergensen, 1905
	Family THOLONIIDAE Haeckel, 1887
	Genus ***Cubotholus*** Haeckel 1887
114	*Cubotholus* sp.

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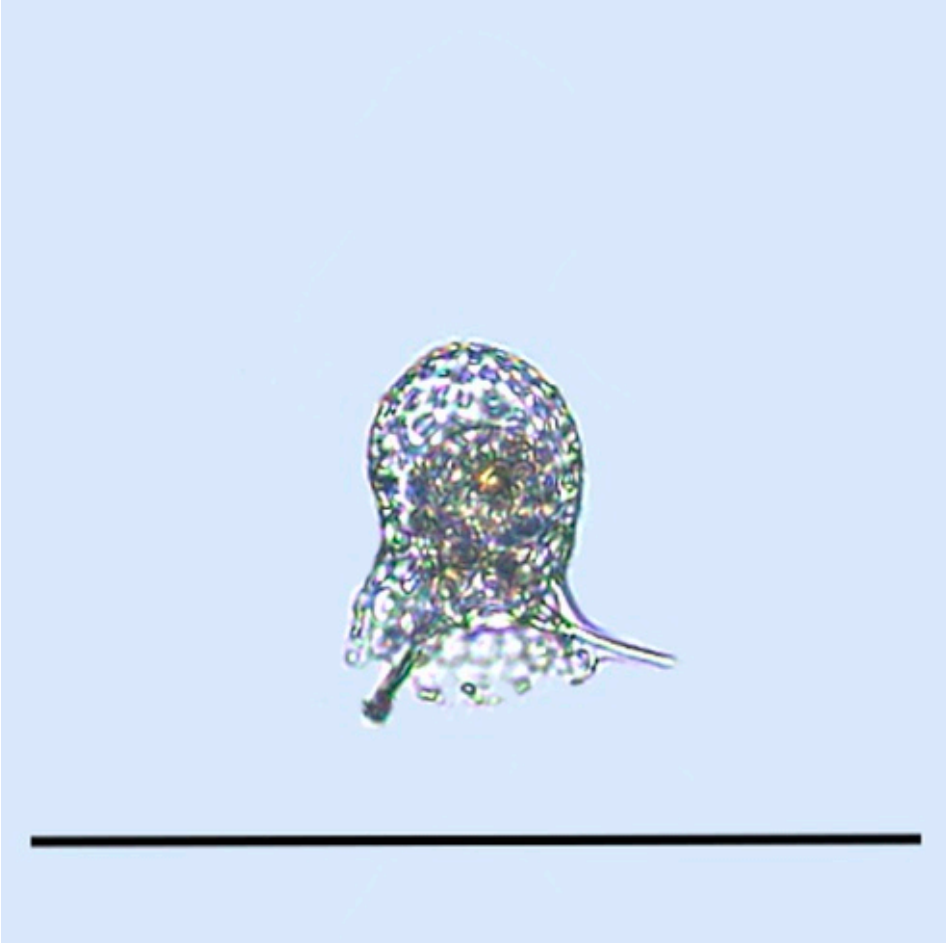

Lithomelissa sp., a polycystine Radiozoa of order Nassellaria.