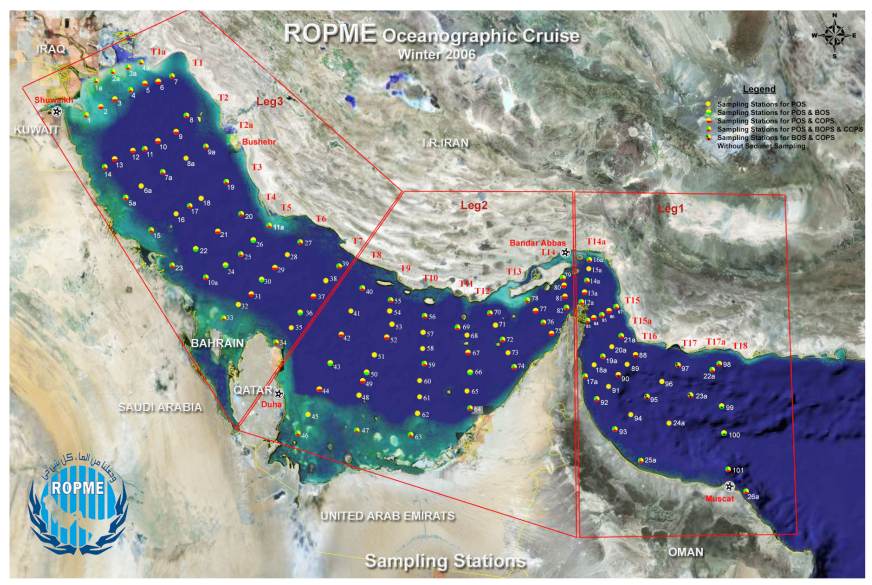


ROPME Oceanographic Cruise - Winter 2006



Technical Report Series

Technical Report : No. 9

Tintinnids in the ROPME Sea Area

July 2012

Regional Organization for the Protection of the Marine Environment

ROPME Oceanographic Cruise - Winter 2006

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Tintinnids in the RSA

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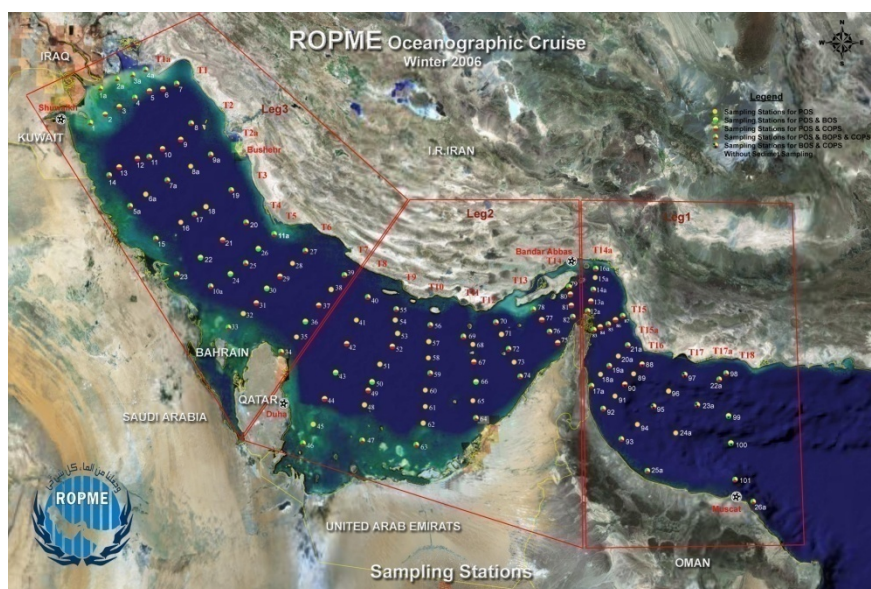
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Regional Organization for the Protection of the Marine Environment

ROPME Oceanographic Cruise - Winter 2006



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Technical Report Series:

1. Physical Oceanography
2. Contaminants in Marine Sediments
3. Nutrients
4. Chlorophyll-*a*
5. Phytoplankton
6. Zooplankton
7. Decapod Larvae
8. Ichthyoplankton
9. Tintinnids
10. Meiobenthos
11. Macrobenthos

Disclaimer

This Report has been prepared by Kuwait Institute for Scientific Research, as the Principal Investigator on 'Tintinnids' under a contract with ROPME. The Report is being separately subjected to peer review and linking with other relevant data and information, in order to develop an integrated understanding of the ROPME Sea Area. Meanwhile, in order to bestow the benefit of viewing the results in their preliminary form and promote a general level of understanding of the marine environment of the Region, notwithstanding the possible delay by peer review, this document is being brought out as part of a special Technical Report Series in the very form in which it was submitted by the Principal Investigator. Owing to this reason, ROPME shall not accept responsibility on the accuracy of data or interpretations contained in this Report. ROPME does not also subscribe to the inappropriate terms used to denote parts or full of the ROPME Sea Area inadvertently used by the Principal Investigator or provided in the published references and citations.

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Preface

In recognition of the importance of the oceanographic Cruises in the ROPME Sea Area to understand the state of the marine environment, ROPME Council has assigned high priority to the ROPME scientific Cruises. In pursuance of the Council Decision CM12/7, ROPME was mandated to coordinate a comprehensive oceanographic Cruise in Winter 2006. The Cruise was planned in such a way that the results and reports of the studies can find their way into the synthesis of ROPME State of the Marine Environment Report.

As a result of sustained efforts, cooperation of Member States, guidance of the designated scientific committee for the Cruise, encouragements from the Executive Committee of ROPME and the generous provisions made by the Council, the historic Winter Cruise was carried out successfully on board of M/V Ghods of I. R. Iran during 1st February and 11th March 2006.

Totally, 115 stations covering the RSA have been surveyed and 97 experts from ROPME Member States participated in the Cruise. The survey covered most of the main oceanographic disciplines.

The collected samples during the Cruise were distributed on a competitive basis to the competent laboratories in the Region and elsewhere for detailed analyses while sub-sample sets were kept in ROPME Marine Sample Bank to enable repetitive analyses in future, when required.

To enhance benefits from the reproduced results of the Cruise among Regional scientific community towards a better understanding of the marine environment in the RSA and to enable furtherance of marine researches, ROPME Secretariat decided on the publication of the results in a series of Technical Reports as follows:

1. Physical Oceanography
2. Contaminants in Marine Sediments
3. Nutrients
4. Chlorophyll-*a*
5. Phytoplankton
6. Zooplankton
7. Decapod Larvae
8. Ichthyoplankton
9. Tintinnids
10. Meiobenthos
11. Macrobenthos

The present Technical Report is devoted to the taxonomy and spatial occurrence of tintinnids in the RSA. The analyses of tintinnids samples and reporting have been conducted by a team of scientists led by Dr. Faiza Al-Yamani at Kuwait Institute for Scientific Research (KISR) under a contract with ROPME.

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Executive Summary

The ciliates of Order Tintinnida were 36.9% of total microzooplankton abundance in ROPME Sea Area (RSA) during February-March 2006. Average value of abundance of tintinnids was 8.7×10^3 organisms/m³ (rate 0.3×10^3 – 22.0×10^3 organisms/m³). Highest concentration of tintinnids was registered in northwestern area of the inner RSA, lowest abundance was observed in waters north to Qatar, near the Iranian coast; eastwards the abundance of tintinnids was increased. Three zones of high diversity of tintinnids marked were: northwestern part of the inner RSA; central zone of the inner RSA north to Qatar and the eastern region of the inner RSA near the Strait of Hormuz.

A total of 43 species of tintinnids were identified by KISR, of which, 16 species were observed in the inner RSA for the first time. The dominated tintinnids were belonging to the families of Tintinnidae (genera *Amphorides* and *Eutintinnus*), Codonellopsidae (genus *Codonellopsis*), Petalotrichidae (genus *Ascampbeliella*), Xystonellidae (genus *Parundella*) and Rhabdonellidae (genus *Protorhabdonella*). Descriptions and geographical distribution of each species are presented in this Report.

1. General Details

1.1 Introduction

At all stations in studied area representatives of protozoan microzooplankton of the Order *Tintinnida* dominated in the samples from plankton net. Tintinnids play a considerable role in functioning of the pelagic community. They feed on bacteria and small phytoplankton and are in turn food of fish larvae. Tintinnids consume from 4% to 80% of primary production (Pitta *et al.*, 2001). Taxonomic composition of this group of protozoans was poorly studied in the ROPME Sea Area. The only comprehensive guide of tintinnids was for Kuwait waters, by Al-Yamani and Skryabin (2006). In this ROPME's studies, a total of 43 species were identified in the studied samples, including 16 species newly observed in the ROPME Sea Area.

Tintinnids belong to the Kingdom *Alveolata*. They are ciliated protozoa, from the Phylum *Ciliophora*, Class *Spirotrichea*, Subclass *Choreotrichia*, Order *Tintinnida* according to Lynn and Small (2000).

1.2 Materials and Methods

Microzooplankton samples were collected at 42 sampling stations in the ROPME Sea Area including Strait of Hormuz using a 20- μ m mesh net, by vertical tows. Sampling started on 8 February 2006 and lasted until 9 March 2006. Depths in the studied area varied from 13 to 95 m. Locations of sampled stations are displayed in Fig. 1. Distribution of stations on transects is shown in Table 1. Volumes of samples varied from 344 to 1504 ml. Samples were fixed with unacidified Lugol preservative. In total 42 net microzooplankton samples were collected and processed.

Microzooplankton was examined under a stereomicroscope using a Bogorov's counting chambers and samples were enumerated for each identified species. If the sample was rich in microzooplankton, one 4 ml subsample was examined. If number of organisms was low, three to five subsamples of 4 ml each were taken. Organisms were picked up by a micropipette from the Petri dish or counting chamber by the use of a micropipette. Disposable glass micropipettes were made from a piece of glass or plastic tube. For proper identification, measurement and photography of microzooplankton, the specimen was placed on a glass slide and was examined under the compound microscope with magnification of 100–1000x. Microzooplankton in the whole chamber was counted. The first 20 (and up to 100)

specimens from each species were measured. For recalculation of number of specimens per cubic meter, the following equations were used:

- 1) Volume Filtered (V in cubic metres) = $3.14 \times (\text{net diameter in square metres}) \times \text{distance in meters}/4$;
- 2) Distance in meters = $\text{Difference in counts} \times \text{Rotor constant} / 9999$;
While Rotor Constant = 0.3;
Difference in counts* = Flowmeter End – Flowmeter Start;
- 3) Density of organisms = $\text{Number of individuals in subsample} \times \text{number of fraction} / \text{filtered volume}$.

For about 68% of stations the calculated tow distance was less than tow depth. It shows that the flowmeter counts undoubtedly were wrong. For some stations, it was possible to restore the approximate tow distance using the formula:

$$\text{Distance in meters} = \text{Tow depth} / \text{Cosine of Tow Angle (in radians)}$$

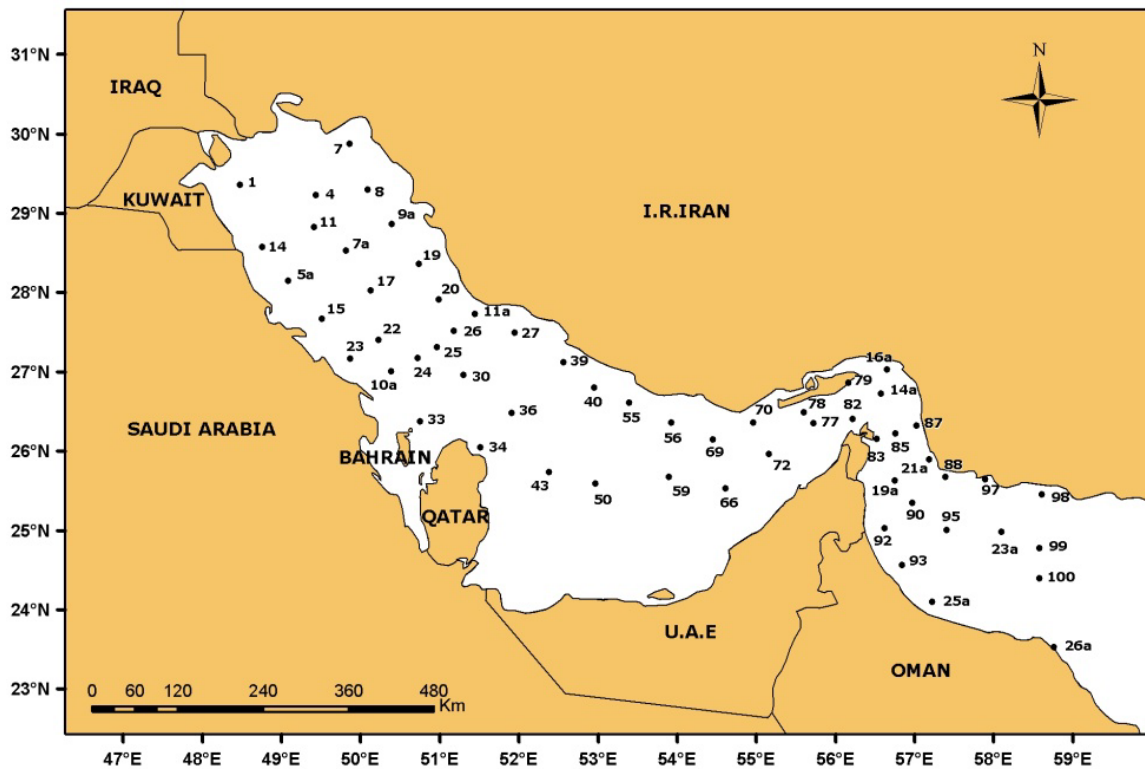


Fig. 1. Map showing the locations of the sampled stations in the RSA during Winter 2006.

Table 1. Summary of Sampled Stations along Transects in the RSA

Tr. #	S. #	Date D/M/Y	Position		Tr. #	S. #	Date D/M/Y	Position	
			Lat (°N)	Long (°E)				Lat (°N)	Long (°E)
T18	26a	3/2/06	23°31.000'	58°46.100'	T9	55	22/2/06	26°36.057'	53°24.057'
T18	100	3/2/06	24°23.404'	58°35.244'	T8	40	23/2/06	26°47.800'	52°57.400'
T18	99	3/2/06	24°46.136'	58°35.100'	T8	43	23/2/06	25°43.513'	52°23.170'
T18	98	3/2/06	25°26.801'	58°36.914'	T7	34	28/2/06	26°02.500'	51°31.200'
T17a	23a	4/2/06	24°58.210'	58°06.300'	T7	36	28/2/06	26°28.190'	51°54.900'
T17a	25a	4/2/06	24°05.505'	57°13.813'	T7	39	1/3/06	27°07.000'	52°34.100'
T17	93	5/2/06	24°33.147'	56°50.739'	T6	27	1/3/06	27°29.200'	51°57.000'
T17	95	5/8/06	24°59.595'	57°24.758'	T6	30	1/3/06	26°57.100'	51°18.500'
T17	97	5/2/06	25°38.200'	57°54.000'	T6	33	2/3/06	26°21.800'	50°45.500'
T16	88	5/2/06	25°40.043'	57°24.048'	T5	10a	2/3/06	26°59.800'	50°23.700'
T16	90	6/2/06	25°20.310'	56°58.530'	T5	24	3/3/06	27°10.100'	50°43.500'
T16	92	6/8/06	25°01.340'	56°37.800'	T5	25	3/3/06	27°18.290'	50°58.400'
T15a	19a	6/2/06	25°37.386'	56°45.487'	T5	26	3/3/06	27°30.497'	51°11.060'
T15a	21a	6/2/06	25°53.400'	57°11.300'	T5	11a	3/3/06	27°43.179'	51°27.088'
T15	87	7/2/06	26°18.900'	57°01.800'	T4	20	3/3/06	27°54.410'	50°59.518'
T15	85	8/2/06	26°13.000'	56°46.000'	T4	22	4/3/06	27°23.887'	50°13.952'
T15	83	8/2/06	26°08.763'	56°31.767'	T4	23	4/3/06	27°09.561'	49°52.363'
T14a	14a	9/2/06	26°43.200'	56°34.590'	T3	15	5/3/06	27°39.842'	49°30.928'
T14a	16a	9/2/06	27°01.400'	56°39.300'	T3	17	5/3/06	28°01.115'	50°07.896'
T14	79	13/2/06	26°51.046'	56°10.378'	T3	19	5/3/06	28°21.033'	50°44.312'
T14	82	13/2/06	26°23.771'	56°13.583'	T2a	09a	6/3/06	28°51.200'	50°24.200'
T13	77	14/2/06	26°20.671'	55°43.561'	T2a	07a	6/3/06	28°31.145'	49°49.321'
T13	78	14/2/06	26°28.769'	55°36.474'	T2a	05a	6/3/06	28°08.501'	49°05.508'
T12	70	14/2/06	26°32.104'	54°57.957'	T2	14	7/3/06	28°33.885'	48°45.702'
T12	72	15/2/06	25°57.254'	55°10.080'	T2	11	7/3/06	28°49.120'	49°25.120'
T11	66	15/2/06	25°31.090'	54°37.156'	T2	8	8/3/06	29°17.580'	50°05.490'
T11	69	16/2/06	26°08.382'	54°27.506'	T1	7	8/3/06	29°52.106'	49°52.049'
T10	56	21/2/06	26°20.905'	53°55.864'	T1	4	9/3/06	29°13.245'	49°26.487'
T10	59	21/2/06	25°39.885'	53°53.944'	T1	1	9/3/06	29°21.000'	48°29.000'
T9	50	22/2/06	25°35.092'	52°58.225'					

Tr - # = Transect number

S - # = Station number

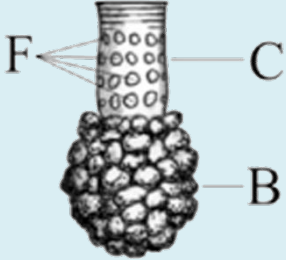
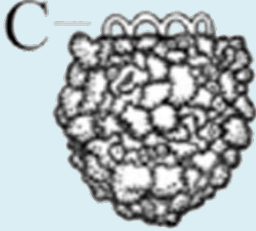
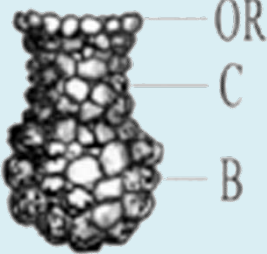
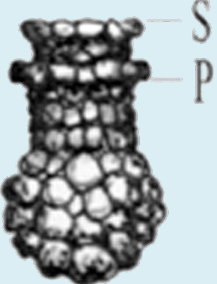
However, the tow angle was measured only at 43% of stations. Thus, we had the opportunity to calculate the distance of tows and, respectively, the volume of filtered water for 22 stations only (52% of samples). The rest of the samples were excluded from the quantitative analyses.

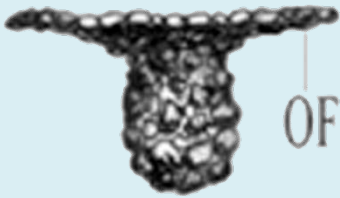
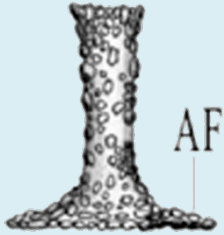
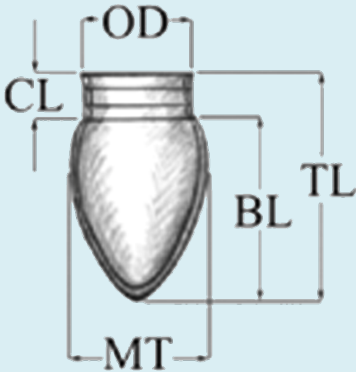
All data of analysis were transferred to agreed electronic format (Microsoft EXCEL spreadsheets).

A thorough literature search was conducted for the different identified genera of tintinnids that were encountered in the ROPME Sea Area. In addition, a general reference book chapter on ciliated protozoa by Lynn and Small (2000) was used, as well as references of Kofoid and Campbell (1929), Hada (1932, 1937), Marshall (1969), Paulmier (1997), Fernandes (2004), Al-Yamani, Skryabin (2006). A very useful site “The World of Protozoa, Rotifera, Nematoda and Oligochaeta” of Dr. Y. Inamori (2004) was also utilized [<http://web2.nies.go.jp/chiiki1/protoz/>].

1.3 General Identification Characteristics

	Ciliates of order Tintinnida produce lorica which is a hard or soft case for protection. It can be transparent or covered with foreign particles. Ciliates fasten to lorica with an offshoot of the cell called pedicel. Tintinnids move in the water using membranelles, each of them is formed with some connected cilia. Tintinnids can leave lorica and later build a new one, which usually differs from the primary lorica. L - hyaline lorica of family Xystonellidae; OE - oral end of lorica; AE - aboral end of lorica; M - membranelles; Ma – macronucleus; Mi – micronucleus; P - pedicel; AH - aboral horn.
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	Lorica of tintinnids of family Codonellopsidae have transparent hyaline collar, often with spiral structures and opaque agglomerated bowl. C – collar; B – bowl; F – fenestrae.
	Tintinnids of genus <i>Luminella</i> (family Dictyocystidae) have short hyaline collar with squarish or semi-circular windows.
	Tintinnids of genus <i>Eutintinnus</i> (family Tintinnidae) have transparent hyaline lorica with open aboral end. OE - oral end of lorica; AE - aboral end of lorica.
	Tintinnids of genus <i>Tintinnopsis</i> (family Codonellidae) have agglomerated loricas of various shapes. OR- oral rim; C - collar; B - bowl.
	Some tintinnids during their life time add to lorica one or more secondary oral rims. P - primary oral rim; S - secondary oral rim.

	Some tintinnids have wide oral expansion called oral flare (e.g. <i>Tintinnopsis mortensenii</i>). OF - oral flare.
	All tintinnids of genus <i>Leprotintinnus</i> (family Tintinnidiidae) have open aboral end, often with aboral flare. AF - aboral flare.
	Basic measurements of lorica (family Metacyclidae): OD - oral diameter; MT - maximum transdiameter; CL - length of collar; BL - length of bowl; TL - total length of lorica.

2. Specific Details

2.1 Classification

Kingdom Alveolata

Phylum CILIOPHORA Doflein, 1901

Subphylum Intramacronucleata Lynn 1996

Class SPIROTRICHEA Bütschli, 1889

Subclass Choretrichia Small and Lynn, 1985

Order Tintinnida Kofoid and Campbell, 1929

Kingdom Alveolata (groupings of organisms that share many characteristics): Alveolates are protists with sub-surface cavities (alveoli) and complex internal structures. They include both free-living and parasitic forms. Three major subgroups are recognized: the ciliates,

distinguished by the presence of two nuclei and cilia; the dinoflagellates, mostly unicellular with nuclei and with two flagella; and the apicomplexans, a group of parasites; they get from one host to another as swimming forms.

Phylum Ciliophora: Cell body covered with cilia, nuclei differentiate to macro- and micronuclei, cilia also differentiate to unique structures (cirri, membranelles, etc), consist of many species.

Subphylum Intramacronucleata: Microtubules associated with the division of the macronucleus, and are located within the macronucleus.

Class Spirotrichea: Intramacronucleate ciliates, may have somatic dikinetids usually with the anterior or both kinetosomes ciliated or somatic polykinetids; generally, with conspicuous right and left oral and/or preoral ciliature, with left serial oral polykinetids leading (usually clockwise) into the oral cavity, either around a broad anterior end or along anterior and left margins of the body; polykinetids (undulating membranes) may also be present along the right side of the oral region; the cytostome is deep in some groups and shallow in others; the body is ciliated in some groups, but nearly devoid of cilia in others; some are loricate, others are not; the lorica may be attached to substrate or not.

Subclass Choreotrichia: Spirotrich ciliates, body generally conical or bell-shaped; body cilia poorly developed; serial oral polykinetids form closed, outer circle around broader anterior end; the inner ends of some of these outer polykinetids may extend into the oral cavity where they may accompany a smaller number of oral polykinetids restricted to the inner oral cavity; most are planktonic.

Order Tintinnida: Choreotrich ciliates, with lorica, attached by aboral process to inner wall of lorica.

2.2 List of Species of Order Tintinnida Encountered in the ROPME Sea Area during February-March 2006

Family	Genus	Species
Tintinnidiidae	<i>Leprotintinnus</i>	<i>Leprotintinnus bubiyanicus</i> *
		<i>Leprotintinnus elongatus</i> *
		<i>Leprotintinnus nordqvisti</i>
Epiplocyidae	<i>Epiplocyloides</i>	<i>Epiplocyloides brandti</i>

Family	Genus	Species
Codonellidae	<i>Tintinnopsiss</i>	<i>Tintinnopsis beroidea</i>
		<i>Tintinnopsis directa</i>
		<i>Tintinnopsis gracilis</i>
		<i>Tintinnopsis karajacensis</i>
		<i>Tintinnopsis mortensenii</i>
		<i>Tintinnopsis nana</i>
		<i>Tintinnopsis parva</i>
		<i>Tintinnopsis parvula</i>
		<i>Tintinnopsis radix</i>
		<i>Tintinnopsis</i> spp.
Codonellopsidae	<i>Stenosemella</i>	<i>Stenosemella</i> sp.
	<i>Codonellopsis</i>	<i>Codonellopsis americana</i>
		<i>Codonellopsis morchella</i>
		<i>Codonellopsis orthoceras</i>
		<i>Codonellopsis ostenfeldii</i>
Dictyocystidae	<i>Dyctiocysta</i>	<i>Dyctiocysta duplex</i> *
	<i>Luminella</i>	<i>Luminella kuwaitensis</i> *
Ascampbelliellidae	<i>Ascampbelliella</i>	<i>Ascampbelliella obscura</i> *
Petalotrichidae	<i>Petalotricha</i>	<i>Petalotricha ampulla</i> *
Metacylididae	<i>Metacylis</i>	<i>Metacylis jorgenseni</i>
		<i>Metacylis pithos</i> *
Rhabdonellidae	<i>Protorhabdonella</i>	<i>Protorhabdonella curta</i> *
		<i>Protorhabdonella simplex</i> *
Xystonellidae	<i>Rhabdonella</i>	<i>Rhabdonella</i> sp. *
	<i>Parundella</i>	<i>Parundella lohmanni</i> *
	<i>Xystonella</i>	<i>Xystonella treforti</i> *
	<i>Xystonellopsis</i>	<i>Xystonellopsis gaussi</i> *
	<i>Favella</i>	<i>Favella azoric</i>
		<i>Favella panamensis</i>
Undellidae	<i>Parafavella</i>	<i>Parafavella gigantea</i>
	<i>Undella</i>	<i>Undella dilatata</i> *
Tintinnidae	<i>Amphorides</i>	<i>Amphorides amphora</i>
		<i>Amphorides quadrilineata</i> *
	<i>Amphorellopsis</i>	<i>Amphorellopsis acuta</i>

Family	Genus	Species
	<i>Dadayiella</i>	<i>Dadayiella ganymedes</i> * <i>Dadayiella cuspis</i>
	<i>Eutintinnus</i>	<i>Eutintinnus apertus</i> * <i>Eutintinnus lusus-undae</i> <i>Eutintinnus macilentus</i> <i>Eutintinnus tenue</i> <i>Eutintinnus turgescens</i>
	<i>Salpingella</i>	<i>Salpingella attenuata</i> * <i>Salpingella rotundata</i> *
	<i>Salpingacantha</i>	<i>Salpingacantha unguiculata</i> *

* - Tintinnid species, observed in the ROPME Sea Area for the first time

Family: TINTINNIDIIDAE Kofoid and Campbell, 1929.

Reference: Lynn and Small, 2000.

Ciliates with agglomerate on soft, tubular lorica; lorica may be attached to the substrate; no collar; most are marine, some freshwater; two genera.

Genus: *Leprotintinnus* Jörgensen, 1899.

References: Kofoid and Campbell, 1929; Hada, 1937.

Tintinnidiidae with lorica elongated, tube-like, open at both ends; frequently, but not always with spiral structures as in *Coxiella* either for the whole or part of the length of the lorica; no collar; surface viscous, freely agglomerating foreign bodies; wall soft and coarsely alveolar. Differs from *Tintinnidium* in the widely open aboral end.

Leprotintinnus bubianicus Skryabin and Al-Yamani, 2007.

References: Al-Yamani and Skryabin, 2006; Skryabin and Al-Yamani, 2007 (Fig. 2 a-f).

Description: Lorica soft and fragile, cylindrical, never with flaring oral and aboral ends, sometimes slightly narrowing toward the aboral end, up to 3° (Fig. 2 a, b, c). Wall often shows a weak spiral structure, more pronounced at aboral half of lorica, it usually depends both on the shape of the wall and of the distribution of particles (Fig. 2 d); agglomeration usually is relatively poor and even at the oral part of lorica and more dense at the aboral part.

Measurements: Total length 471.7 μm (350.2-834.3 μm). Average oral diameter 72.8 μm (72.1-82.4 μm). Average aboral diameter 70.7 μm (61.8-72.1 μm). Approximate ratio L/oral diameter 4.9-10.1. Thus, it is the longest species of all known tintinnids. Lorica of *L. bubianicus*, as well as lorica of *L. elongatus*, is very fragile, especially in the aboral part, so we cannot identify exactly the minimum size of this tintinnid. Usually there are many fragments of loricas in the samples (loricas could be broken during sampling or transportation), which made it difficult to determine the real size of loricas.

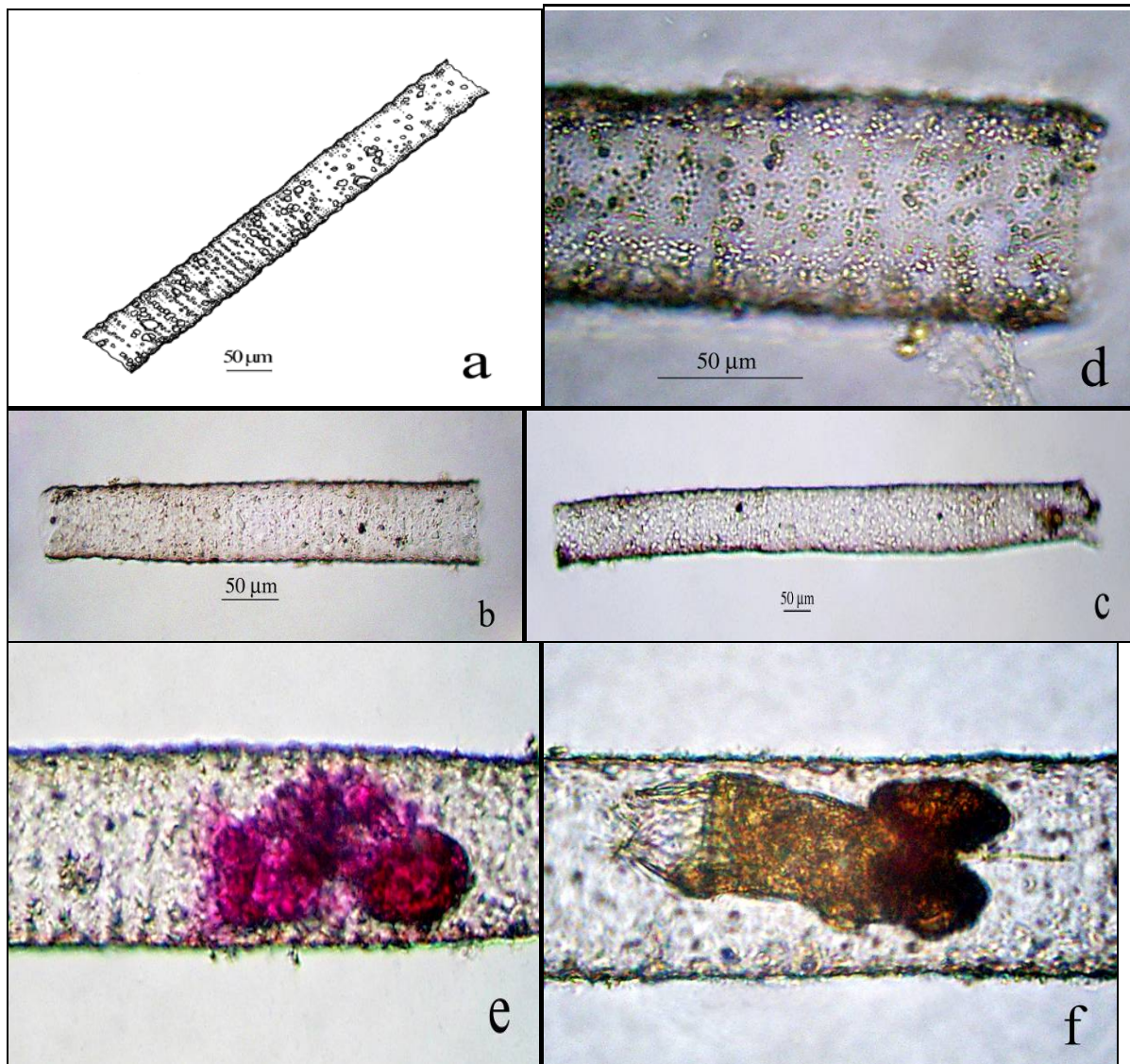


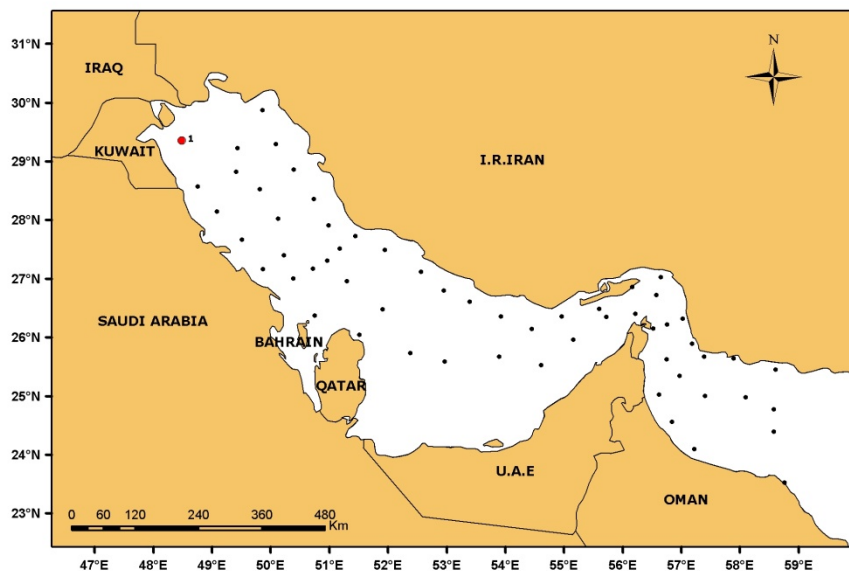
Fig. 2. Variations of lorica shape of *Leptotintinnus bubianicus* (Scale – 50 μm)

a-b. loricas of different length and shape; c. the longest of observed tintinnids, the length of this specimen is 834.3 μm ; d. structure of lorica; e. *L. bubianicus* with one cyst; f. *L. bubianicus* with two cysts.

Comments: *L. bubiyanicus* differs from *L. nordqvisti* in the absence of the aboral funnel and longer lorica, from *L. bottnicus* and *L. pellucidus* in absence of sharp narrowing of the aboral end, from *L. simplex* in larger size, from *L. elongatus* in absence of oral rim and from *L. neriticus* in smaller width, larger length and spiral structure formed not only by distribution of particles, but also by the shape of the wall.

Geographical Distribution: Northwestern ROPME Sea Area.

Sites of Occurrence in RSA: *L. bubiyanicus* is abundant in northern area of Kuwait waters and around Bubiyan Island only in winter and early spring; its abundance reached 150×10^3 organisms/m³ in February 2004 (Skryabin and Al-Yamani, 2007a). In spring this tintinnid produces one (Fig. 2 e) or two (Fig. 2 f) cysts and survives warm period as a resting stage. In Winter 2006 Cruise, this species was observed in Kuwait waters near Failaka Island (St. 1).



Site of occurrence of *Leprotintinnus bubiyanicus* in RSA

Leprotintinnus elongatus Skryabin and Al-Yamani, 2007.

References: Al-Yamani and Skryabin, 2006; Skryabin and Al-Yamani, 2007 (Fig. 3 a-d).

Description: Lorica almost cylindrical, with slightly flaring oral and aboral ends (Figs. 3 a, b), long specimen usually slightly narrowing toward the aboral end (up to 4°). Long specimens often have one (Fig. 3 c) or two (Figs. 3 d) secondary oral rims. Wall showing a

faint spiral structure, lorica agglomerated more thickly in the aboral end. Most of the long specimens in the samples have damaged aboral end without rim.

Measurements: Total length 245.9 μm (212.5-332.5 μm). Average oral diameter 37.0 μm (32.5-42.5 μm). Approximate ratio of L/oral diameter 5.3-9.5. Lorica of this tintinnid is very fragile, especially in the aboral part; most of tintinnids in the samples are more or less damaged, so it is impossible to identify exactly the minimum size of the unbroken tintinnid.

Comments: *L. elongatus* differs from *L. nordqvisti* in the absence of the aboral funnel, from *L. bottnicus*, and *L. pellucidus* in absence of sharp narrowing of the aboral end, from *L. simplex* in flaring oral end and spiral structure of the wall and from *L. neriticus* (380-470 μm) by its smaller size (212.5-332.5 μm).

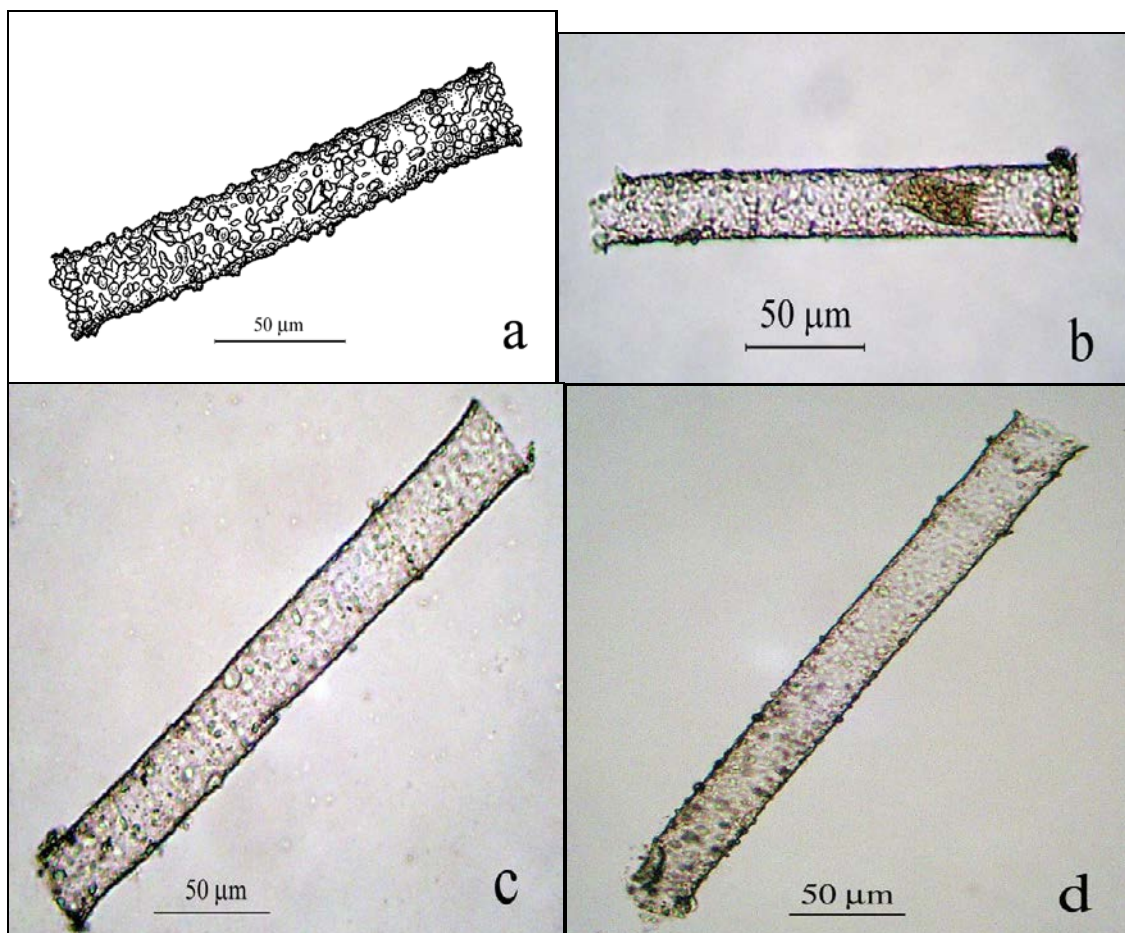
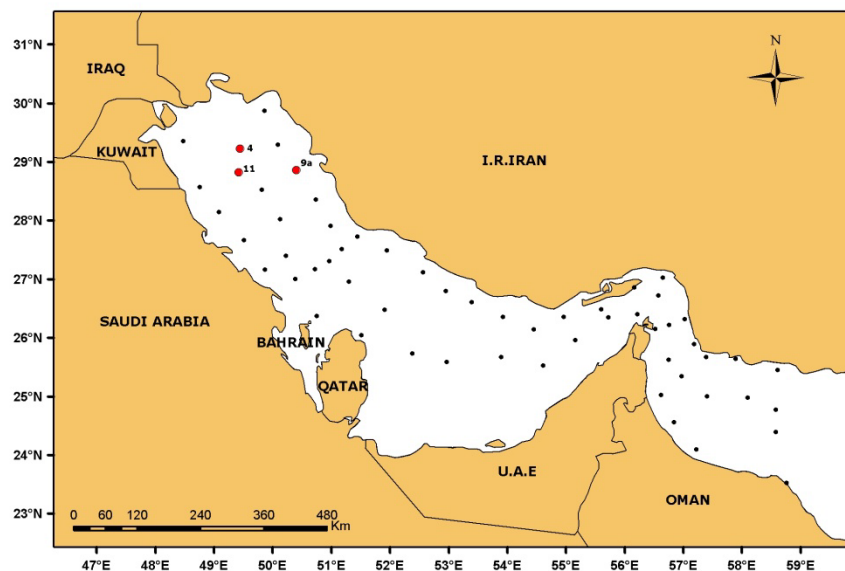


Fig. 3. Variations of lorica shape of *Leprotintinnus elongatus* (Scale – 50 μm)

a, b. loricas without secondary oral rim; c. lorica with one secondary oral rim; d. loricas with two secondary oral rims.

Geographical Distribution: Northwestern ROPME Sea Area.

Sites of Occurrence in RSA: *L. elongatus* is common neritic species in Kuwait waters (Skryabin and Al-Yamani, 2007). In Winter 2006 Cruise, *L. elongatus* was observed in the northern area of the ROPME Sea Area (St. 4, 11 and 9a).



Sites of occurrence of *Leptotintinnus elongatus* in RSA

Leptotintinnus nordqvisti (Brandt, 1906).

Synonym: *Tintinnopsis nordqvisti* Brandt, 19.

Reference: Kofoed and Campbell, 1929 (Fig. 4 a-f).

Description: Lorica consisting of a tubular shaft and an inverted funnel-shaped aboral flare, 4.3-10.5 oral diameters in length; oral rim irregular, usually slightly flaring (80-85°); shaft more or less tapering (15°), expanding near the posterior region to form a distinct aboral conical flare (50-110°); aboral aperture large, 1.2-2.3 oral diameters; aboral margin very ragged; wall showing a faint spiral structure, made of rather scarce particles aggregated more thickly on the surface of the aboral flare than on that of the shaft.

The species differs from the other species of *Leptotintinnus* in having a conspicuously large aboral flare.

Reported Measurements: Length 245 µm (150-352 µm); oral diameter 35 µm (30-38 µm); aboral diameter 61 µm (48-80 µm).

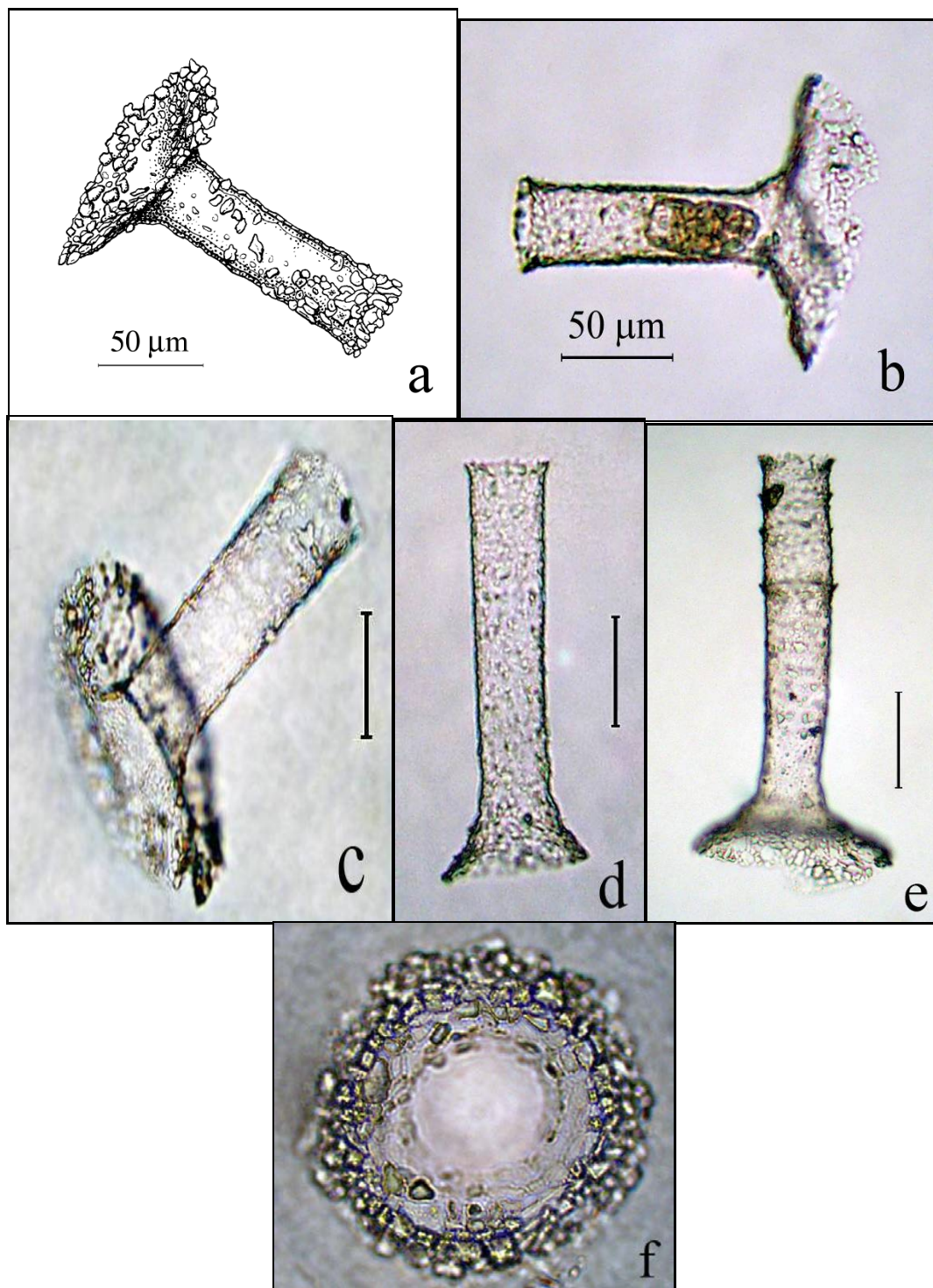


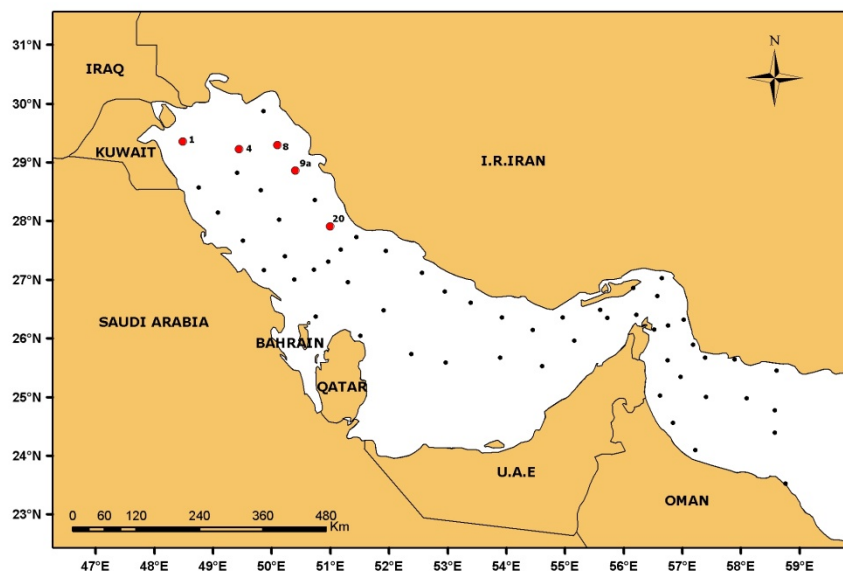
Fig. 4. Variations of lorica shape of *Leptotintinnus nordqvisti* (Scale – 50 µm)

a - c. shape of lorica of *L. nordqvisti* typical for Kuwait Water; d. shape of lorica more typical for another regions of the World Ocean; e. lorica with secondary oral rims; f. aboral flare.

Measurements of Specimens from the ROPME Sea Area: Most of the specimens of *L. nordqvisti* in Kuwait waters differ by size and, especially by proportions. They are shorter and wider, often with large aboral flare. Total length $159 \pm 3 \mu\text{m}$ (128-192 μm); oral diameter $43 \pm 1 \mu\text{m}$ (109-154 μm); aboral flare $129 \pm 1 \mu\text{m}$ (109-154 μm). Some specimens of *L. nordqvisti* have secondary oral rims (Fig. 4. e).

Geographical Distribution: Neritic and estuarine species in temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *L. nordqvisti* is common neritic species in Kuwait waters and around Bubiyan Island. Abundance of this species is higher in winter and early spring (Skryabin and Al-Yamani, 2007, 2007a). *L. nordqvisti* spread along Iranian coast to south-east up to 28°N and $51^\circ 30'\text{E}$ (St. 1, 4, 8, 9a and 20) and was not observed in central, eastern and southern regions of the inner ROPME Sea Area (Inner RSA).



Sites of occurrence of *Leprotintinnus nordqvisti* in RSA

FAMILY: CODONELLIDAE Kent, 1881

Reference: Lynn and Small, 2000.

With agglomerate on flask-, bowl- or chalice-shaped lorica; collar not clear, if present may or may not have nuchal constriction; 26 genera.

Genus: *Tintinnopsis* Stein, 1867

Reference: Kofoed and Campbell, 1929

Codonellidae with lorica usually bowl-shaped, never with a narrow oral aperture; distinct aboral end closed or rarely with an irregular (broken?) aperture; sometimes with a posterior horn but more usually not; wall thin and homogeneous, or with a fine primary structure, with freely agglomerated “foreign” matter as well as particles of detritus, scattered abundantly on outer surface; spiral structure rare.

Differs from *Codonella* in less regular pattern of the secondary structure of the wall and in the lack of a nuchal groove or an inner nuchal shelf.

This is a very complex genus of many species practically all of which are either neritic, or fresh-water inhabitants. The characterization of the species of this genus is very difficult and as yet the systematics of the group are not satisfactory, largely because of the great irregularities of the loricae due to agglomeration, which obscures the underlying structure apparent in most other genera.

Tintinnopsis directa Hada, 1932.

Reference: Hada, 1932 (Fig. 7 a-f).

Description: Lorica tall campanulate, 1.6-2.2 oral diameters in length; oral rim irregular, flaring (60-92°); suboral region somewhat tapering, conical (5-10°), laid up with about 6 spiral turns, narrowest at the basal portion of the subcylindrical part, its smallest transdiameter 0.68-0.82 of the oral diameter; posterior region subspherical, with a rounded aboral end, 0.80-0.95 oral diameters in transdiameter; wall rather coarse in the posterior part, about 0.035 diameters in thickness at the thickest portion of the aboral region.

Comments: The species differs from *T. everta* Kofoed and Campbell and *T. cyathus* Daday in having a distinct globose posterior region, from *T. everta* Kofoed and Campbell in having a distinct aboral enlargement, from *T. pallida* Brandt in the presence of the more differentiated aboral part, and from *T. turgida* Kofoed and Campbell in possession of a flare of the oral rim.

Reported Measurements: Total length 72-100 μm ; oral diameter 35-48 μm ; greatest transdiameter of the bowl 32-40 μm . Approximate ratio L/oral diameter 2.1-2.7. Some *T. directa* in Kuwait Water have slightly developed bowl (Fig. 7 c).

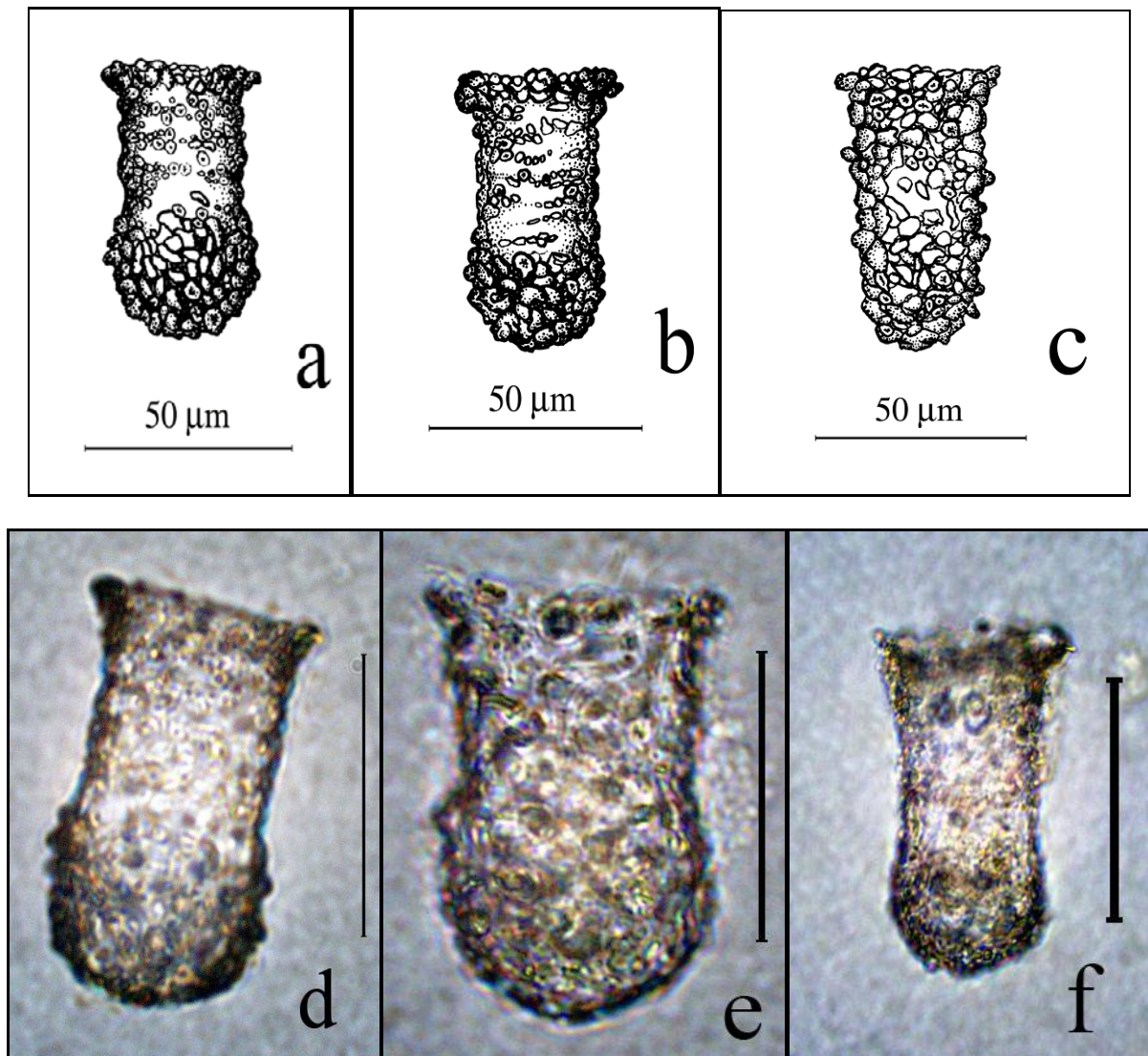
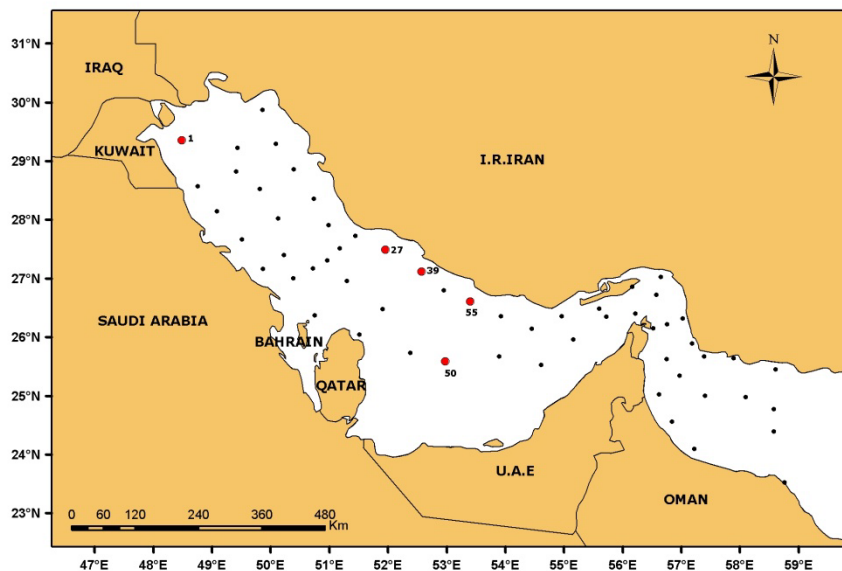


Fig. 5. a-f. Variations of lorica shape of *Tintinnopsis directa* (Scale – 50 μm)

Geographical Distribution: Neritic and estuarine species in temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *T. directa* is common and abundant in the northwestern ROPME Sea Area and in central region of the inner RSA, mainly along the Iranian coast (St. 1, 27, 39, 50 and 55).



Sites of occurrence of *Tintinnopsis directa* in RSA

Tintinnopsis gracilis Kofoid and Campbell, 1929.

Synonyms: *Tintinnopsis karajacensis* var.a Brandt, 1906; *Tintinnopsis parvula* Jörgensen, 1912.

References: Kofoid and Campbell, 1929, Marshall, 1969 (Fig. 8 a-d).

Description: Lorica finger-shaped, oral margin usually comparatively smooth; bowl tubular, sometimes slightly swollen in the posterior one-third of the bowl; aboral region convex conical (40-75°) with a blunt distal end; wall coarsely agglomerated without a spiral structure.

Comments: The species differs from *T. karajacensis* Brandt in the conical aboral region instead of the round.

Reported Measurements: Length 105-125 µm; oral diameter 28-34 µm; approximate ratio L/oral diameter 3.3-4.0.

Measurements of Specimens from the ROPME Sea Area: Length 109-130 µm; oral diameter 36-45 µm; greatest transdiameter 42-46 µm; approximate ratio L/oral diameter 2.8-3.2.

Geographical Distribution: Neritic and estuarine species in temperate and tropical waters of Atlantic, Indian and Pacific oceans.

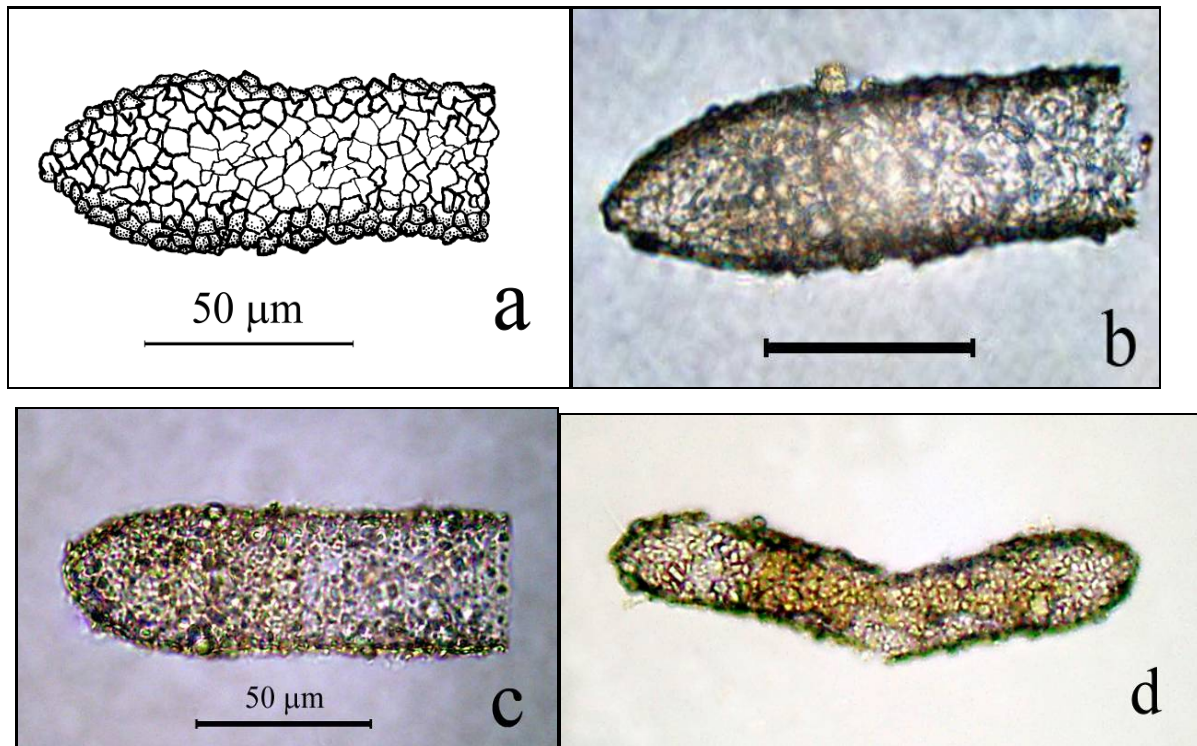
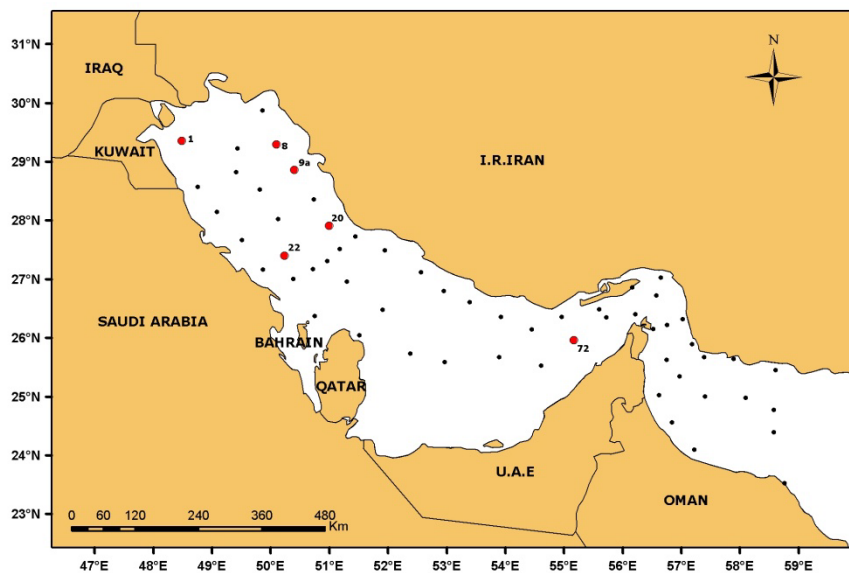


Fig. 6. a-d. Variations of lorica shape of *Tintinnopsis gracilis* (Scale – 50 µm)

Sites of Occurrence in RSA: *T. gracilis* is one of the most common and abundant species in the northwestern ROPME Sea Area (Al-Yamani and Skryabin, 2006; Skryabin and Al-Yamani, 2007a) and in central region of the inner RSA, mainly along the Iranian coast (St. 1, 8, 9a, 20, 22 and 72).



Sites of occurrence of *Tintinnopsis gracilis* in RSA

Tintinnopsis karajacensis Brandt, 1896.

References: Kofoid and Campbell, 1929, Marshall, 1969 (Fig. 9).

Description: Lorica capsular, bowl cylindrical in the margin part, oral rim ragged; aboral end rounded or disfigured as the result of irregularly agglomerated particles; wall coarse, having several slight spiral turns in the anterior half.

Comments: This species differs from *T. directa* Hada in the absence of the oral flare and the posterior inflation, from *T. cochleata* (Brandt) in less extensive spiral organization and in roughened agglomeration, from *T. lobiancoi* Daday in the shorter lorica, and from *T. rotundata* Jorgensen in more slender proportions and in the shape of the aboral end.

Reported Measurements: Length 60-172 μm ; oral diameter 30-64 μm ; approximate ratio L/oral diameter 2.0-2.7

Measurements of Specimens from the ROPME Sea Area: Length 107-115 μm ; oral diameter 35-38 μm ; approximate ratio L/oral diameter 3.0.

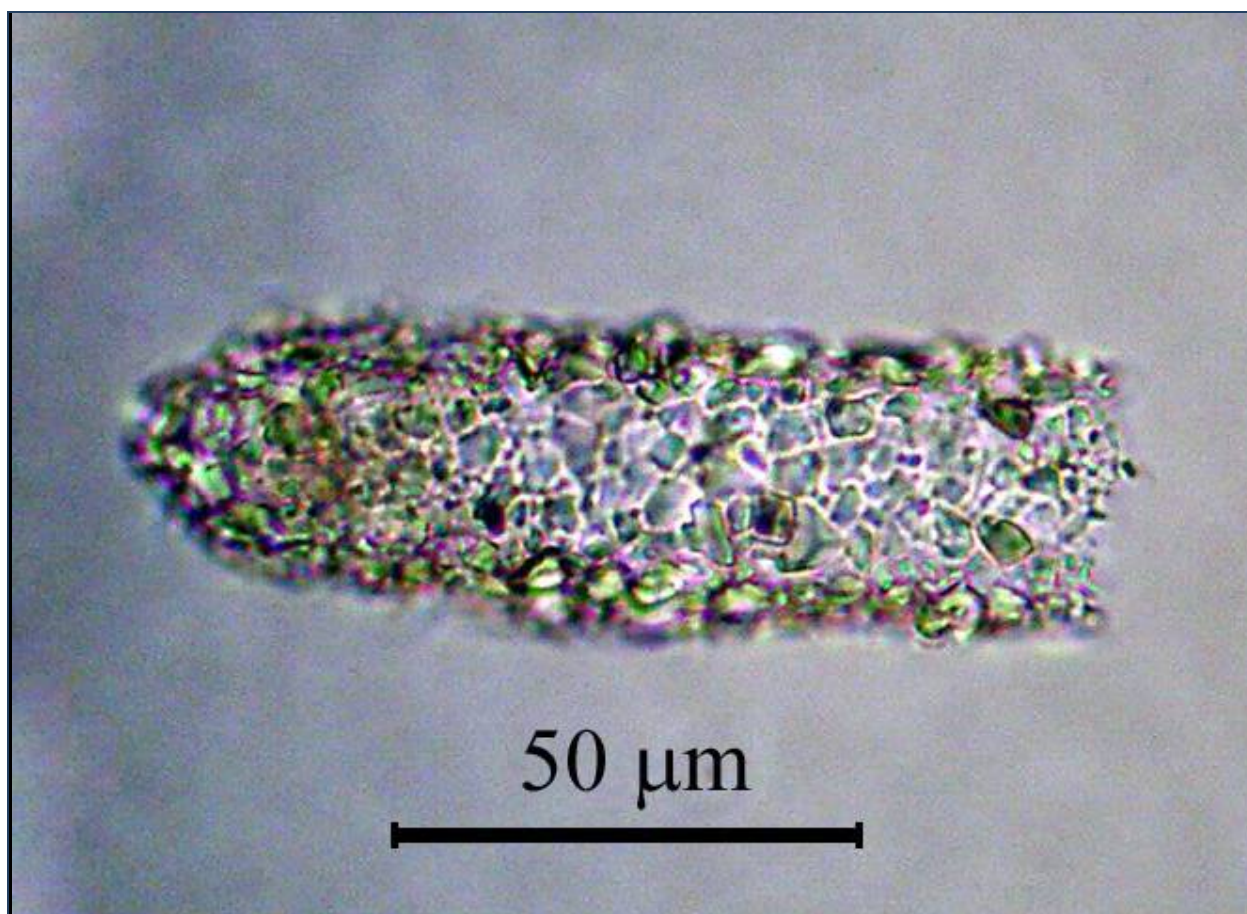
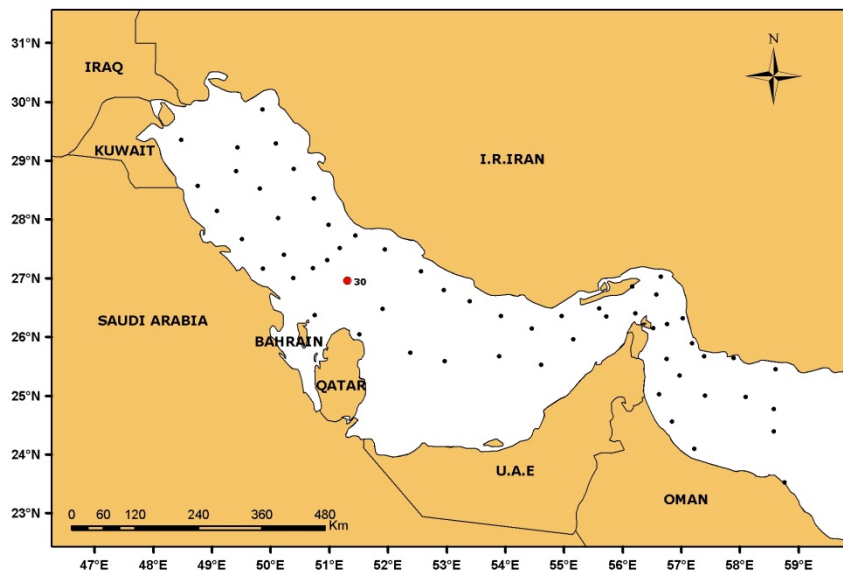


Fig. 7. Lorica shape of *Tintinnopsis karajacensis* (Scale – 50 μm)

Geographical Distribution: Neritic and estuarine species in temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *T. karajacensis* was registered in relatively low abundances in Kuwait waters (Al-Yamani and Skryabin, 2006; Skryabin and Al-Yamani, 2007a) and in central region of inner RSA (St. 30).



Site of occurrence of *Tintinnopsis karajacensis* in RSA

Tintinnopsis mortensenii Schmidt, 1901.

References: Kofoid and Campbell, 1929, Marshall, 1969 (Fig. 10 a-d).

Description: Lorica bell-shaped with slightly concave collar, very wide, horizontal oral funnel and rounded aboral end.

Reported Measurements: Length 90-110 μm ; oral diameter 87-100 μm ; approximate ratio L/oral diameter 1.0-1.1.

Measurements of Specimens from the ROPME Sea Area: Length 50-70 μm ; oral diameter 52-92 μm ; greatest transdiameter of bowl 33-45 μm ; minimum transdiameter of collar 26-35 μm ; approximate ratio L/oral diameter 0.9-1.5.

Geographical Distribution: Neritic and estuarine species in temperate and tropical waters of Atlantic, Indian and Pacific oceans.

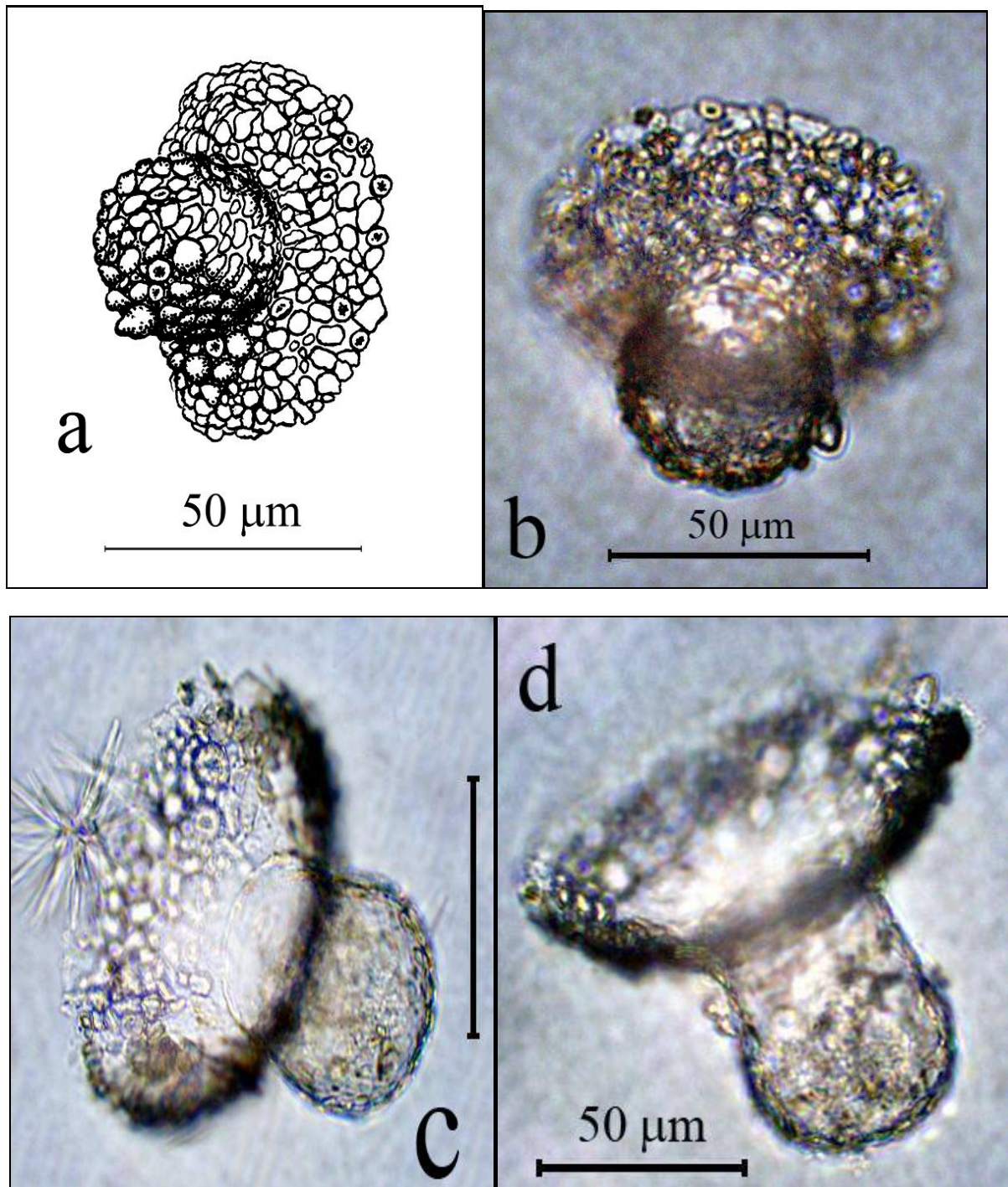
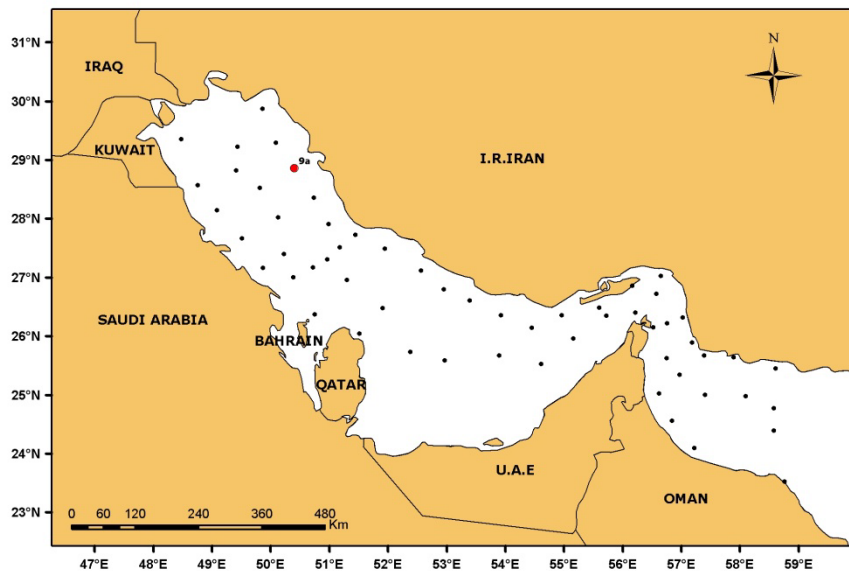


Fig. 8. a-d. Variations of lorica shape of *Tintinnopsis mortensenii* (Scale – 50 µm)

Sites of Occurrence in RSA: *T. mortensenii* is common in the northwestern ROPME Sea Area (Al-Yamani and Skryabin, 2006; Skryabin and Al-Yamani, 2007a) and near the Iranian coast (St. 9a) in the inner RSA.



Site of occurrence of *Tintinnopsis mortensenii* in RSA

Tintinnopsis nana Lohmann, 1908.

Synonym: *Tintinnopsis fistularis* Meunier, 1919.

References: Kofoid and Campbell, 1929, Marshall, 1969 (Fig. 11 a-d).

Description: Lorica very small, cylinder with slightly pointed aboral end. Oral rim often ragged. Wall thin, with poor agglomeration.

Comments: The species differs from *T. beroidea* Stein in the smaller size and the shape of the aboral region, differs from *T. minuta* only in shape of aboral end and ratio of length to oral diameter, both rather variable characters.

Reported Measurements: Length 30-47 μm ; oral diameter 12-19 μm ; approximate ratio L/oral diameter 1.7-3.5.

Measurements of Specimens from the ROPME Sea Area: Length 29-39 μm ; oral diameter 21-29 μm ; approximate ratio L/oral diameter 1.3-1.6. In our samples *T. nana* had wider lorica, often with expanded oral end (Fig. 11 c).

Geographical Distribution: Neritic and estuarine species in temperate and tropical waters of Atlantic, Indian and Pacific oceans.

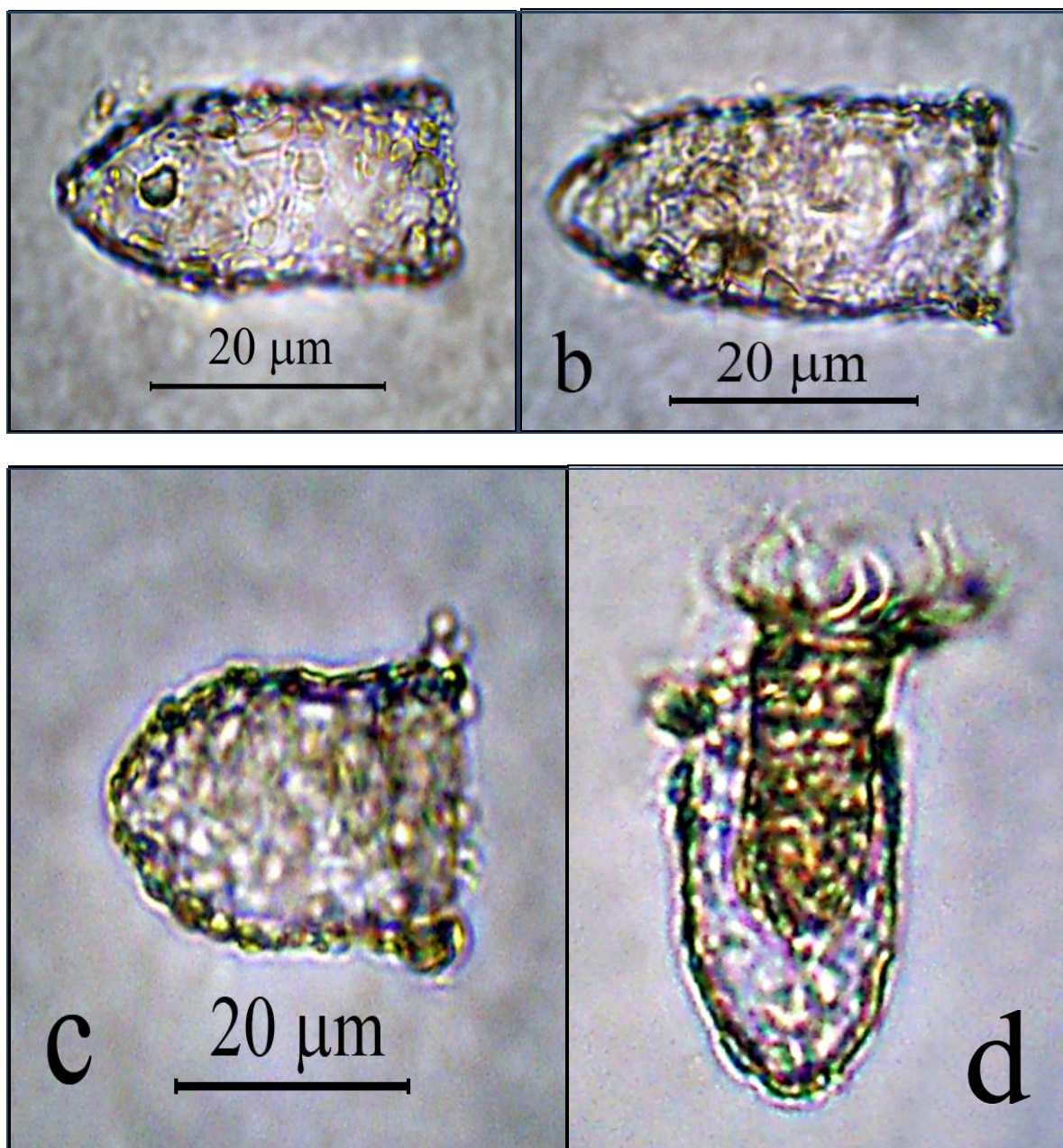
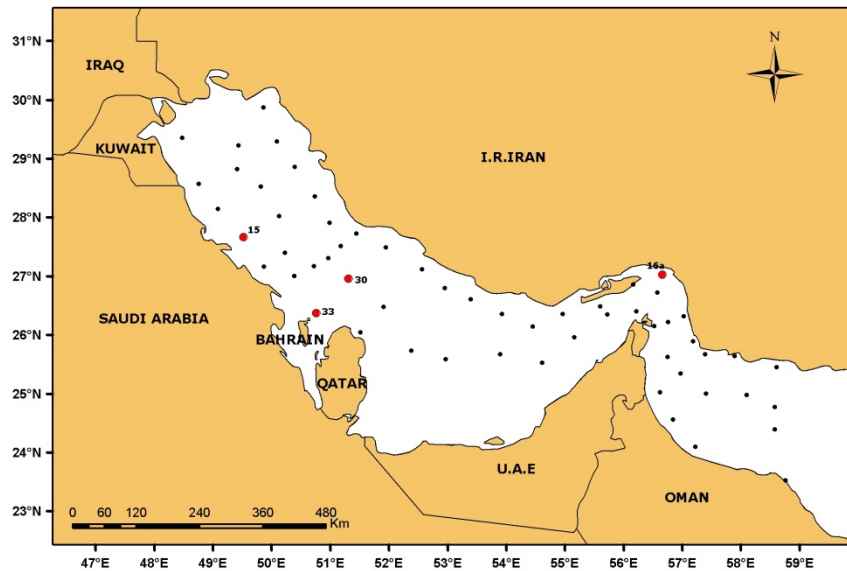


Fig. 9. a-d. Variations of lorica shape of *Tintinnopsis nana* (Scale – 20 µm)

Sites of Occurrence in RSA: *T. nana* is common in the northwestern ROPME Sea Area (Al-Yamani and Skryabin, 2006; Skryabin and Al-Yamani, 2007a), in central region of the inner RSA and in the Strait of Hormuz (St. 15, 30, 33 and 16a).



Sites of occurrence of *Tintinnopsis nana* in RSA

Tintinnopsis parva Merkle, 1909.

Synonyms: *Tintinnopsis glans* Meunier 1919; *Tintinnopsis turbinata* Balech, 1948.

References: Kofoid and Campbell, 1929, Marshall, 1969 (Fig. 12 a-c).

Description: Lorica small, widest in middle, narrowing slightly to mouth, more sharply to pointed aboral end.

Reported Measurements: Length 30-49 μm ; oral diameter 20-23 μm ; greatest transdiameter of the bowl 15-31 μm ; approximate ratio L/oral diameter 1.2-2.5.

Measurements of Specimens from the ROPME Sea Area: Length 50-65 μm ; oral diameter 25-30 μm ; greatest transdiameter 43-46 μm ; approximate ratio L/oral diameter 1.2-1.5.

Geographical Distribution: Neritic and estuarine species in temperate and tropical waters of Atlantic, Indian and Pacific oceans.

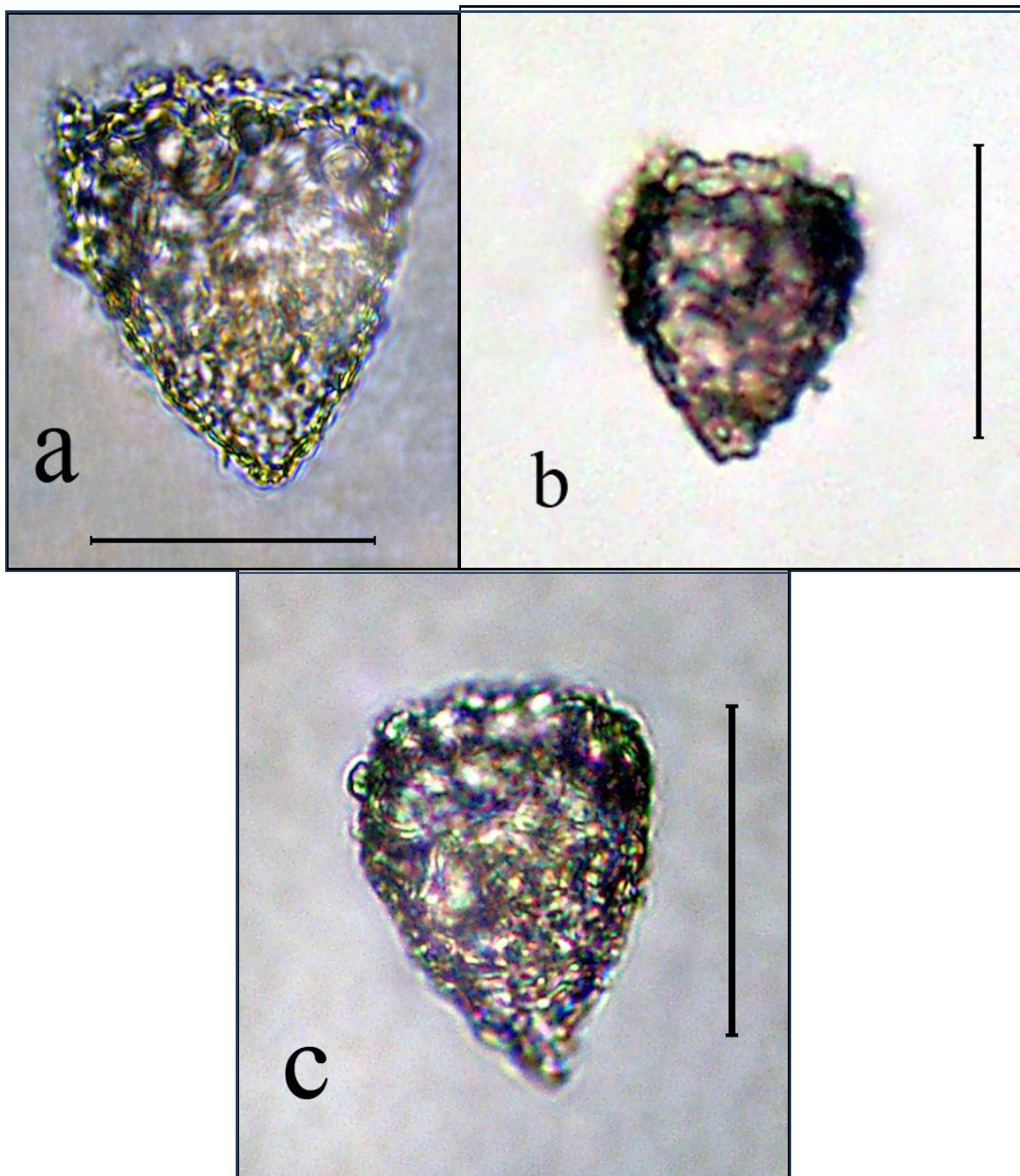
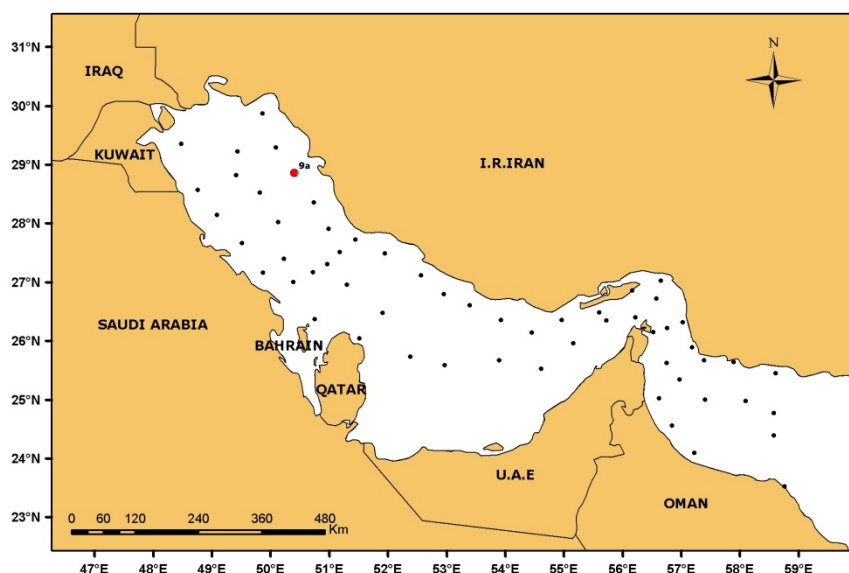


Fig. 10. a-c. Variations of lorica shape of *Tintinnopsis parva* (Scale – 50 μ m)

Sites of Occurrence in RSA: *T. parva* is relatively common in the northwestern ROPME Sea Area (Al-Yamani and Skryabin, 2006; Skryabin and Al-Yamani, 2007a). In Winter 2006 Cruise, *T. parva* was observed near the Iranian coast (St. 9a).



Site of occurrence of *Tintinnopsis parva* in RSA

Tintinnopsis parvula Jörgensen, 1912.

Synonyms: *Tintinnopsis beroidea* Brandt, 1896; *Tintinnopsis karajacensis* var. a Brandt, 1906; *Tintinnopsis fusus* Meunier, 1910; *Tintinnopsis gracilis* Kofoid and Campbell, 1929.

Reference: Marshall, 1969 (Fig. 13 a-d).

Description: Lorica small, slightly expanded below a cylindrical anterior region, pointed aborally.

Comments: Lorica more pointed aborally than *T. nucula* and more expanded than *T. beroidea*.

Reported Measurements: Length 51-70 μm ; oral diameter 20-37 μm ; approximate ratio L/oral diameter 1.8-3.4.

Measurements of Specimens from the ROPME Sea Area: Length 62-85 μm ; oral diameter 27-35 μm ; greatest transdiameter 32-42 μm ; approximate ratio L/oral diameter 2.0-2.5.

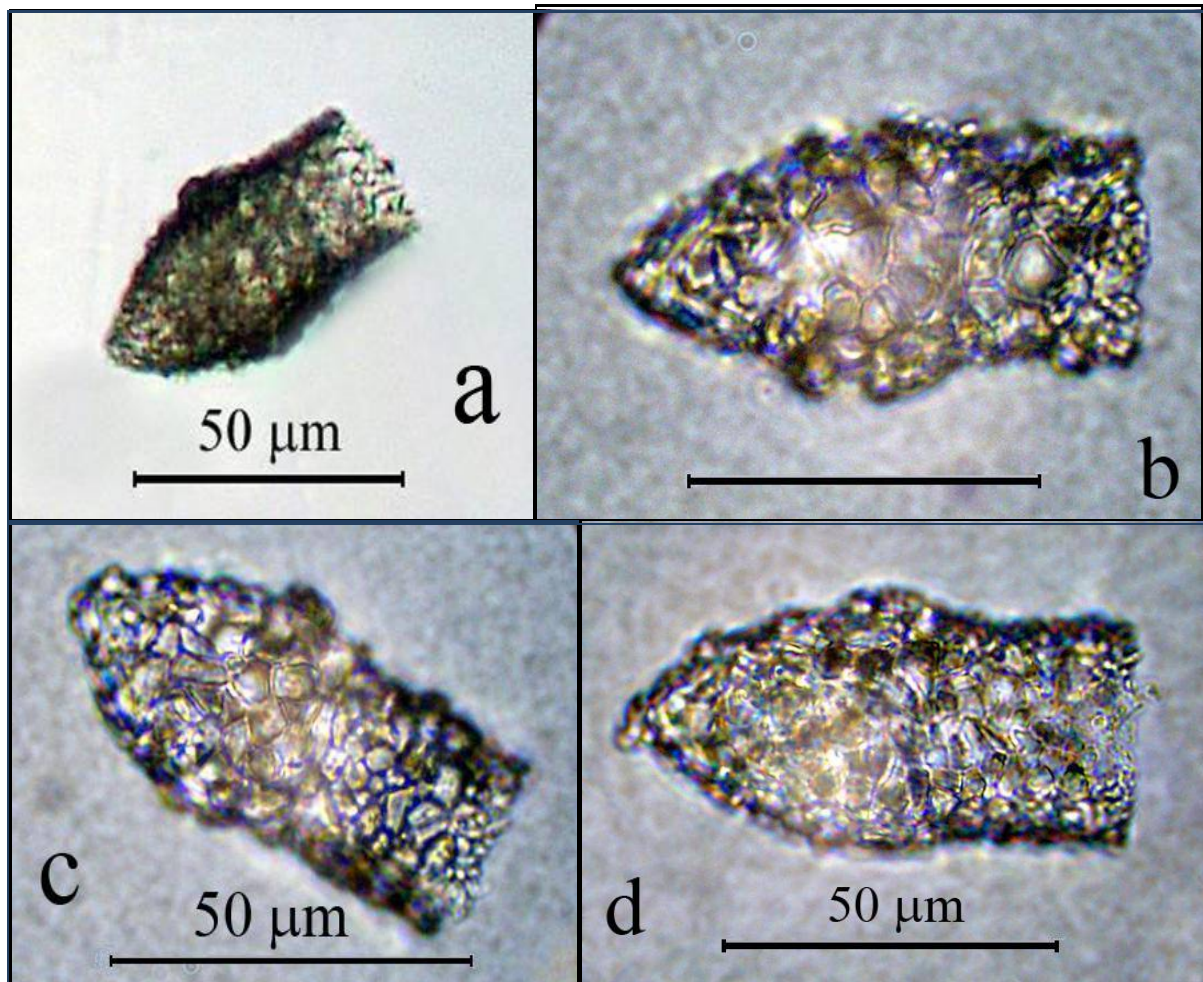
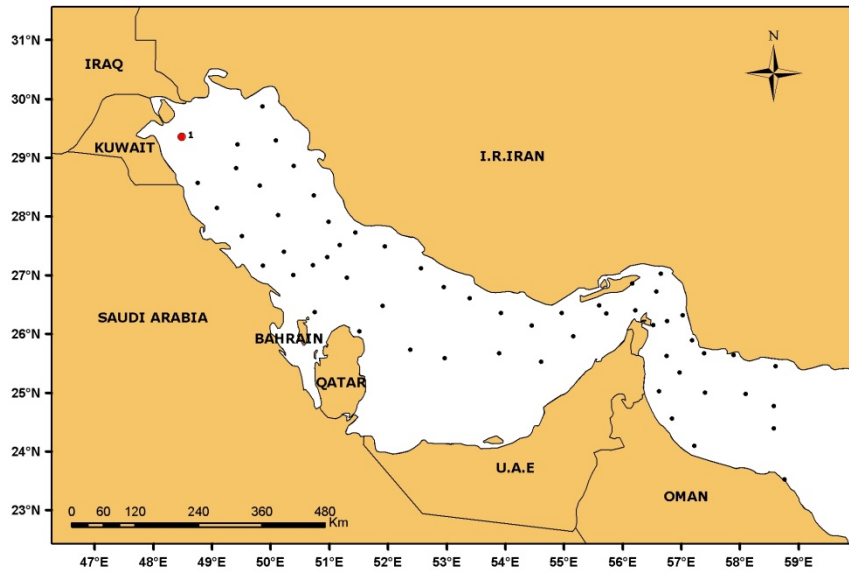


Fig. 11. a-d. Variations of lorica shape of *Tintinnopsis parvula* (Scale – 50 µm)

Geographical Distribution: Neritic and estuarine species in temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *T. parvula* is common and abundant in the northwestern inner RSA and in waters surrounding Bubiyan Island (Al-Yamani and Skryabin, 2006; Skryabin and Al-Yamani, 2007a). In Winter 2006 Cruise, *T. parvula* was observed near Failaka Island (St. 1).



Site of occurrence of *Tintinnopsis parvula* in RSA

Tintinnopsis radix (Imhof, 1886).

Synonyms: *Codonellaradix* Imhof, 1886; *Tintinnopsis davidoffii* Daday, 1887; *Tintinnopsis curvicauda* Daday, 1887; *Tintinnopsis cylindrica* Daday, 1887; *Tintinnopsis fracta* Brandt, 1906; *Cyttarocylis subulatus* Entz, 1904.

References: Kofoid and Campbell, 1929, Marshall, 1969 (Fig. 14 a-f).

Description: Lorica elongate, slender, tubular, oral rim generally entire (smooth and round) or sometimes irregular; bowl long, cylindrical; aboral region tapering gradually into an aboral horn, inverted conical (41-21°); aboral horn usually more or less curved, with an irregularly formed aboral opening typically set laterally as gouged, leaving its tip or cutting off it; wall thin and fragile, 0.03 of the oral diameter in thickness, with a variable spiral structure.

Comments: The species differs from *T. kofoidi* Hada in the fragile construction of the lorica, in less contraction at the aboral region, and in the shape of the lateral opening in the aboral horn, and from *T. cylindrica* in open aboral end and spiral structure of lorica.

Reported Measurements: Total length 140-524 μm . Oral diameter 32-75 μm . Approximate ratio L/oral diameter 6.0-9.5.

Measurements of Specimens from the ROPME Sea Area: Size of *Tintinnopsis radix* is very variable. Length 195-500 μm ; oral diameter 45-95 μm ; approximate ratio L/oral diameter 4.3-7.0.

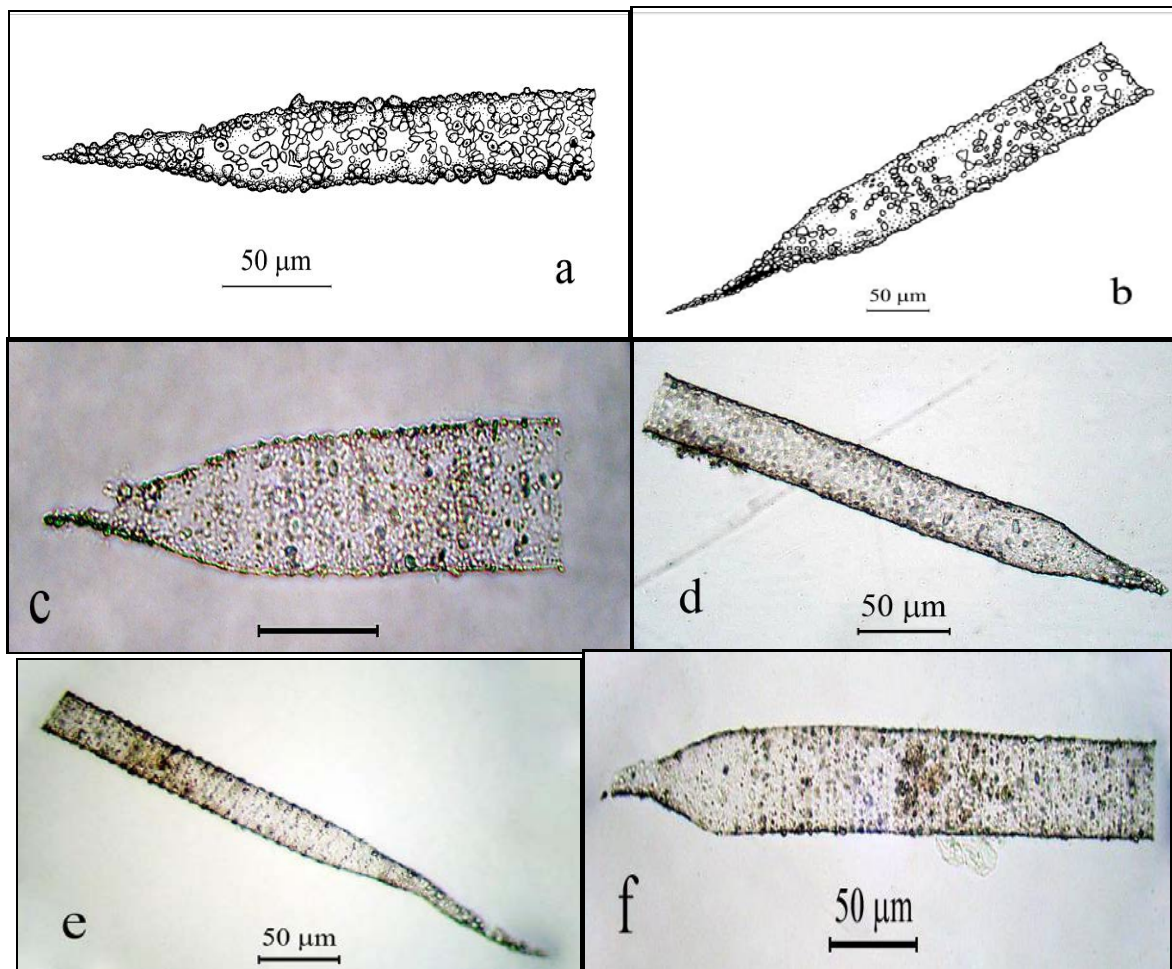
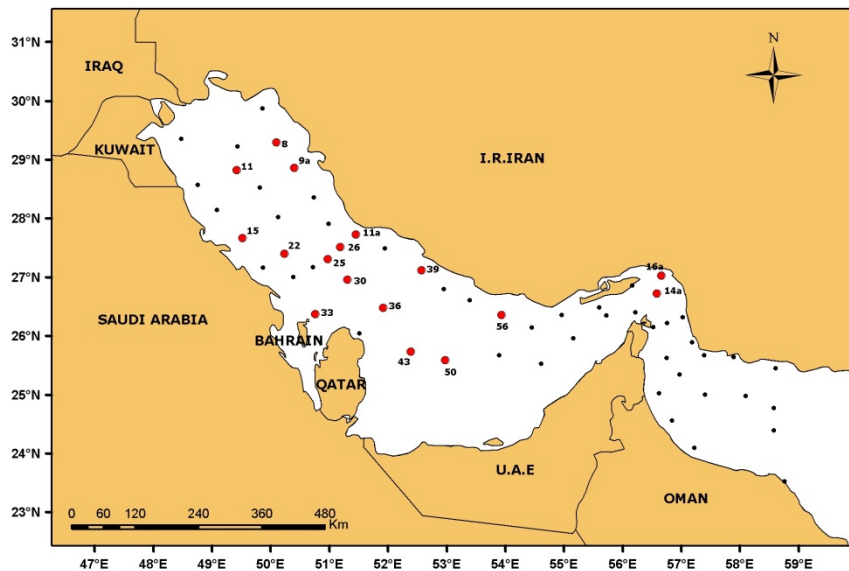


Fig. 12. a-f. Variations of lorica shape of *Tintinnopsis radix* (Scale – 50 μm)

Geographical Distribution: Neritic and estuarine species in temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *T. radix* is common and abundant at all studied area of the ROPME Sea Area, from Bubiyan Island (Al-Yamani and Skryabin, 2006; Skryabin and Al-Yamani, 2007a) in the northern inner RSA to the Strait of Hormuz (St. 11, 8, 9a, 15, 22, 25, 26, 11a, 30, 33, 36, 39, 43, 50, 56, 14a and 16a).



Sites of occurrence of *Tintinnopsis radix* in RSA

FAMILY: CODONELLOPSIDAE Kofoid and Campbell, 1929.

Reference: Lynn and Small, 2000.

Lorica top-shaped, thick walled; agglomerate of mineral particles; 12 genera.

Genus: *Codonellopsis* Jörgensen, 1924

Reference: Kofoid and Campbell, 1929

Codonellopsidae with lorica divided into an annular collar and a bowl; collar set off distinctly in structure from bowl, often narrower than the bowl, hyaline with spiral structure, or at least with one or two coiled bands, and even these sometimes obscured; bowl oval to spheroidal, with or without hollow antapical horn closed off from the bowl by a basal membrane; wall of bowl with primary, secondary and tertiary structure, sometimes with “fenestrae”; agglomerating material often on wall, as *Tintinnopsis* structure.

Differs from *Stenosemella* in the higher collar and from *Laackmaniella* in the closed instead of open aboral end.

Codonellopsis morchella (Cleve, 1900).

Synonyms: *Codonella morchella* Cleve, 1900; *Codonella ecaudata* Brandt, 1906; *Codonellopsis ecaudata* Kofoid and Campbell, 1929; *Codonellopsis turgescens* Kofoid and Campbell, 1929; *Codonellopsis obconica* Kofoid and Campbell, 1929; *Codonellopsis schabi* Kofoid and Campbell, 1929; *Codonellopsis erythräensis* Kofoid and Campbell, 1929; *Codonellopsis globosa* Kofoid and Campbell, 1929; *Codonellopsis americana* Kofoid and Campbell, 1929; *Codonellopsis indica* Kofoid and Campbell, 1939.

Reference: Hada, 1938 (Fig. 16 a-d).

Description: Lorica 2.2-3.2 oral diameters in length; collar with a somewhat flaring rim, slightly bulging near its middle, usually lower than the bowl, its height 0.22-0.34 of the total length, composed of 4-11 spiral turns with a few elliptical fenestrae; bowl generally ovate, 1.5-1.7 oral diameters in greatest diameter; aboral region convex conical; aboral end usually round or rarely bluntly pointed; wall of the bowl thick, coarsely agglomerated.

Comments: The species differs from *C. americana* in its shorter lorica and ovate bowl instead of an ellipsoid one and from *C. schabi* in its low bowl.

Reported Measurements: Length 65-95; oral diameter 29-32; length of the collar 14-32; greatest diameter of the bowl 43-65 μm . Approximate ratio L/oral diameter 2.2-3.2.

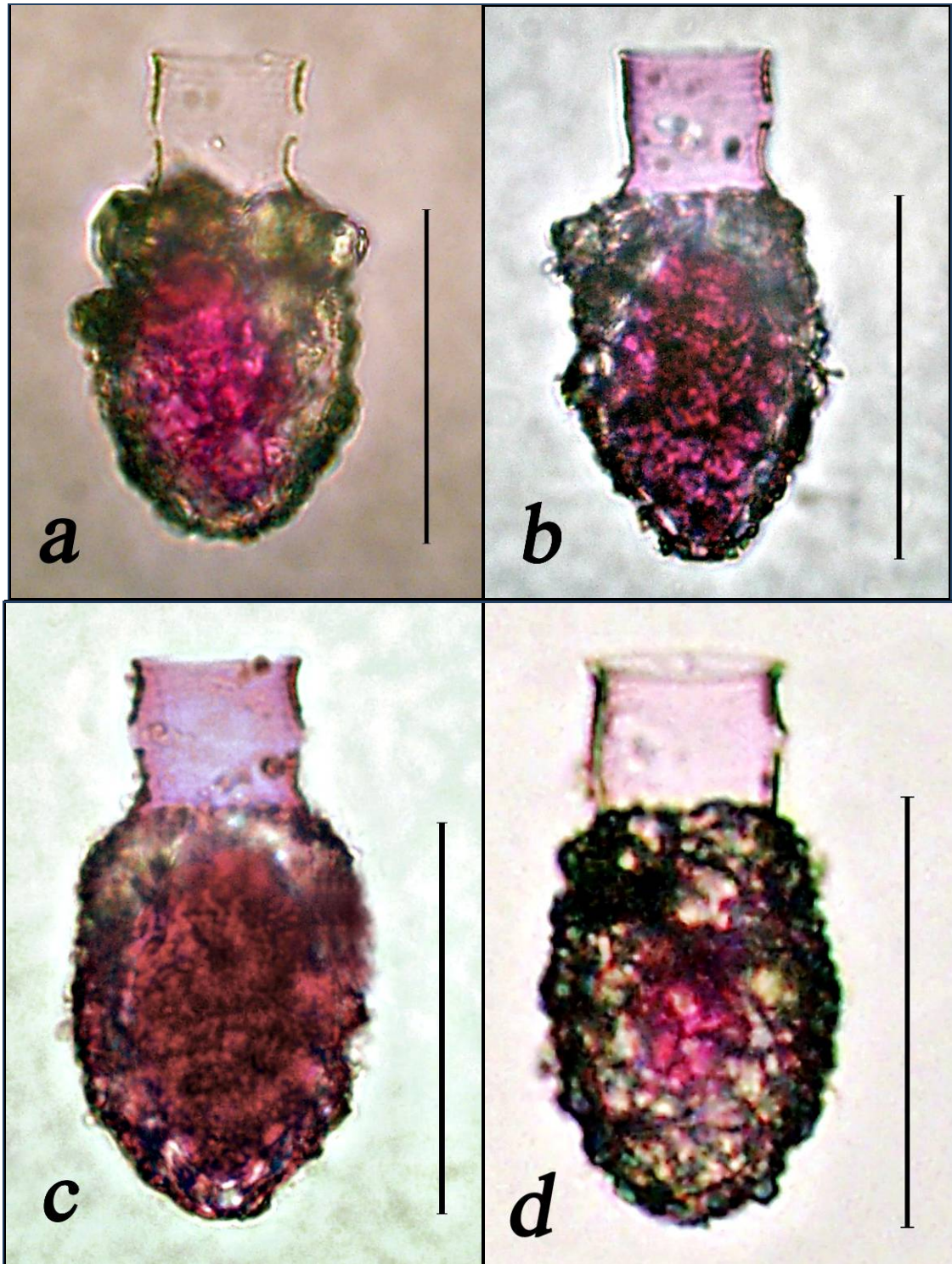
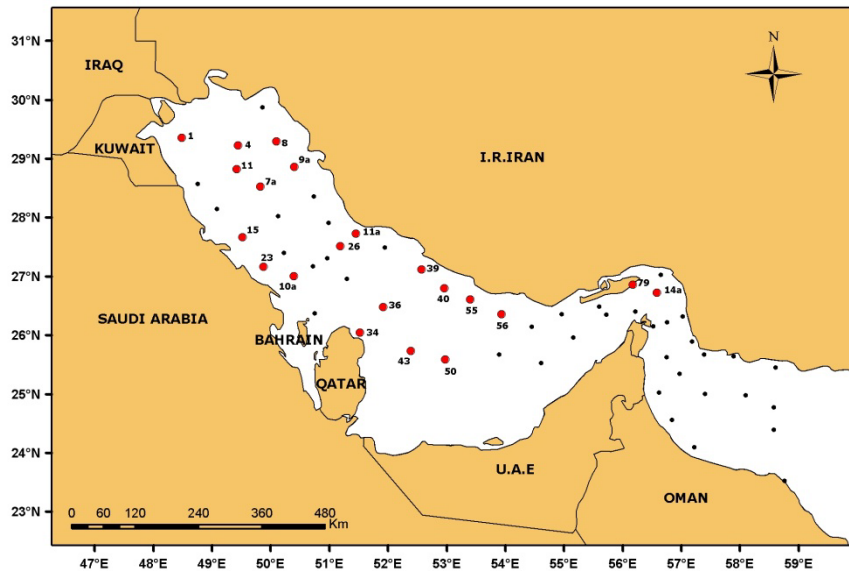


Fig. 13. a-d. Variations of lorica shape of *Codonellopsis morchella* (Scale – 50 μm, stained with Rose Bengal)

Geographical Distribution: Neritic species in temperate and tropical waters of Indian and West Pacific oceans.

Sites of Occurrence in RSA: *C. morchella* is common in the northwestern and central regions of the inner RSA and in the Strait of Hormuz and Sea of Oman, with high abundance in the central regions of the ROPME Sea Area (Stations 1, 4, 8, 11, 7a, 9a, 15, 23, 10a, 11a, 26, 34, 36, 39, 43, 40, 50, 55, 56, 79 and 14a).



Sites of occurrence of *Codonellopsis morchella* in RSA

Codonellopsis ostenfeldii (Schmidt, 1901).

Synonym: *Codonella ostenfeldi* Brandt, 1906.

References: Kofoid and Campbell, 1929, Marshall, 1969 (Fig. 18 a-d).

Description: Lorica flask-shaped, 2.7-3.0 oral diameters in length; oral margin entire (smooth and round), slightly flaring; collar subcylindrical, 0.40-0.43 of the total length in height, with 2-4 spiral turns in its anterior end and 5-6 (in the ROPME Sea Area often 12-15) annular rows of elliptical fenestrae lying transversely on the lower part (Fig.18 d); bowl globose, its greatest transdiameter 1.6 oral diameters; aboral end broadly rounded; wall agglomerated with coarse foreign particles.

Comments: The species differs from the other species of *Codonellopsis* in having spiral rows of numerous fenestrae on the collar.

Reported Measurements: Length 95-112 μm ; oral diameter 35-38 μm ; length of the collar 38-50 μm ; greatest transdiameter of the bowl 55-62 μm .

Measurements of Specimens from the ROPME Sea Area: Length of this species reaches to 227 μm (bowl up to 87 μm , collar up to 140 μm) in the ROPME Sea Area.

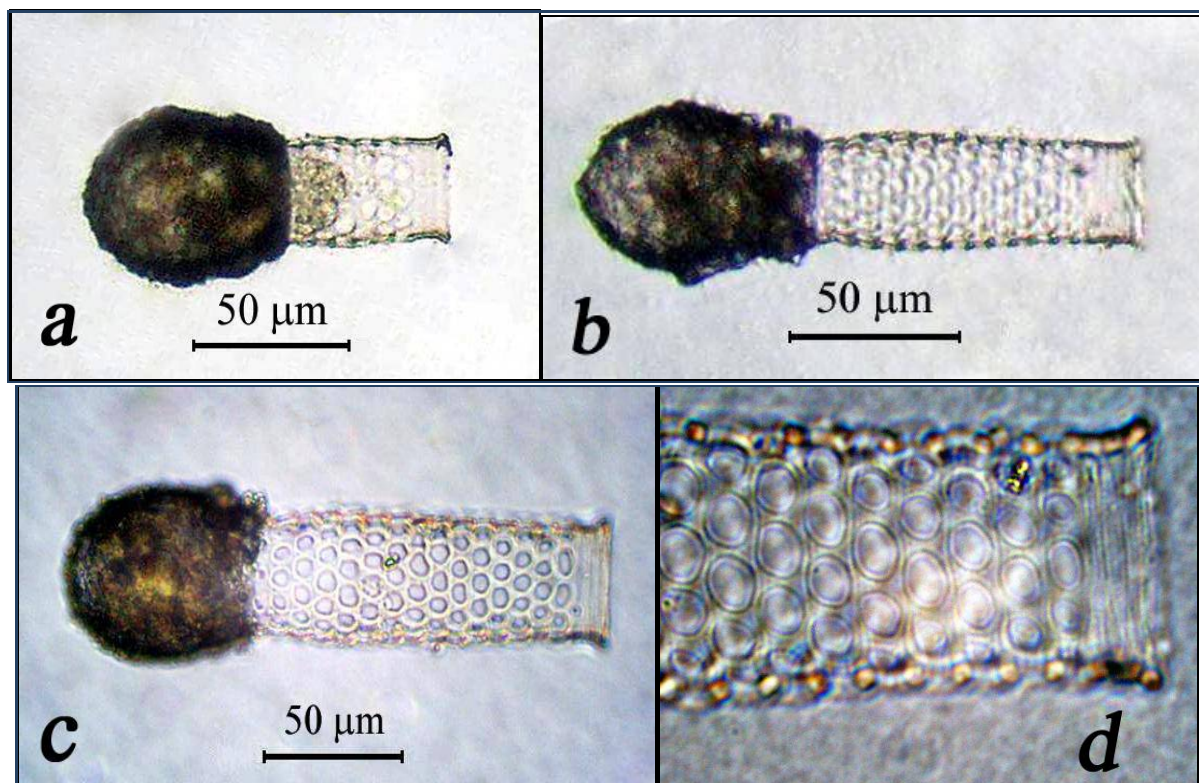
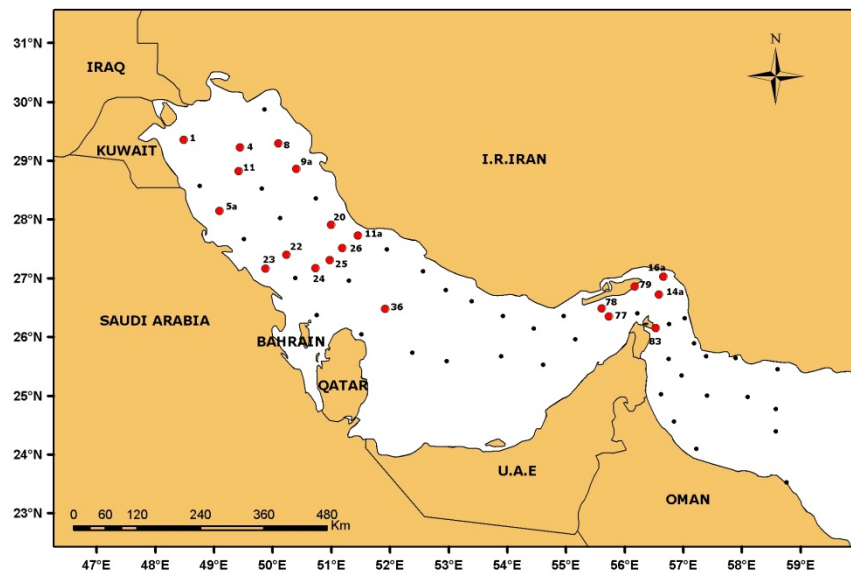


Fig. 14. a-c. Variations of lorica shape of *Codonellopsis ostenfeldii*; d. structure of collar (Scale – 50 µm)

Geographical Distribution: Neritic species in temperate and tropical waters of Indian and West Pacific oceans.

Sites of Occurrence in RSA: *C. ostenfeldii* is common and abundant in the northwestern (Al-Yamani and Skryabin, 2006; Skryabin and Al-Yamani, 2007a) and central regions of the inner RSA and in the Strait of Hormuz and Sea of Oman (St. 1, 4, 8, 11, 5a, 9a, 20, 22, 23, 24, 25, 26, 11a, 36, 77, 78, 79, 14a, 16a and 83).



Sites of occurrence of *Codonellopsis ostenfeldii* in RSA

FAMILY: DICTYOCYSTIDAE Haeckel, 1873

Reference: Lynn and Small, 2000.

Lorica collar with one or two rows of quadrangular fenestrae; coccoliths or mineral particles as foreign material; all marine; two genera.

Genus: *Dictyocysta* Ehrenberg, 1854

Reference: Kofoed and Campbell, 1929

Dictyocystidae with lorica with a tall cylindrical collar with beams surrounding large windows in one to several rows; bowl rounded, inflated; wall with coarse and fine reticulations and often with included coccoliths.

Dictyocysta duplex Brandt, 1906.

Synonym: *Dictyocysta templum* var. d Brandt, 1906.

References: Kofoid and Campbell, 1929; Marshall, 1969 (Fig. 19 a-b).

Description: Lorica with oral margin undulating; collar 0.3 – 0.5 total length in length, with a single row of 7-9 tall rectangular windows whose length is 1.2 of their width; beams sometimes bowed outwards. Bowl subglobular, or rarely wider (0.8 length of bowl) than long, set off by distinct shoulder from the bowl; aboral region subhemispherical. Wall of bowl with large, subuniform, coarse, rounded and overlapping meshes and with smaller ones intermingled, formed by included coccoliths. Fenestrae sometimes present, variable in pattern (Fig. 19 b).

Comments: The species differs from the other species of *Dictyocysta* in the extensive coccolith inclusions and duplex nature of the wall structure.

Reported Measurements: Length 53-75 μm ; oral diameter 32-42 μm ; approximate ratio L/oral diameter 1.6-2.3.

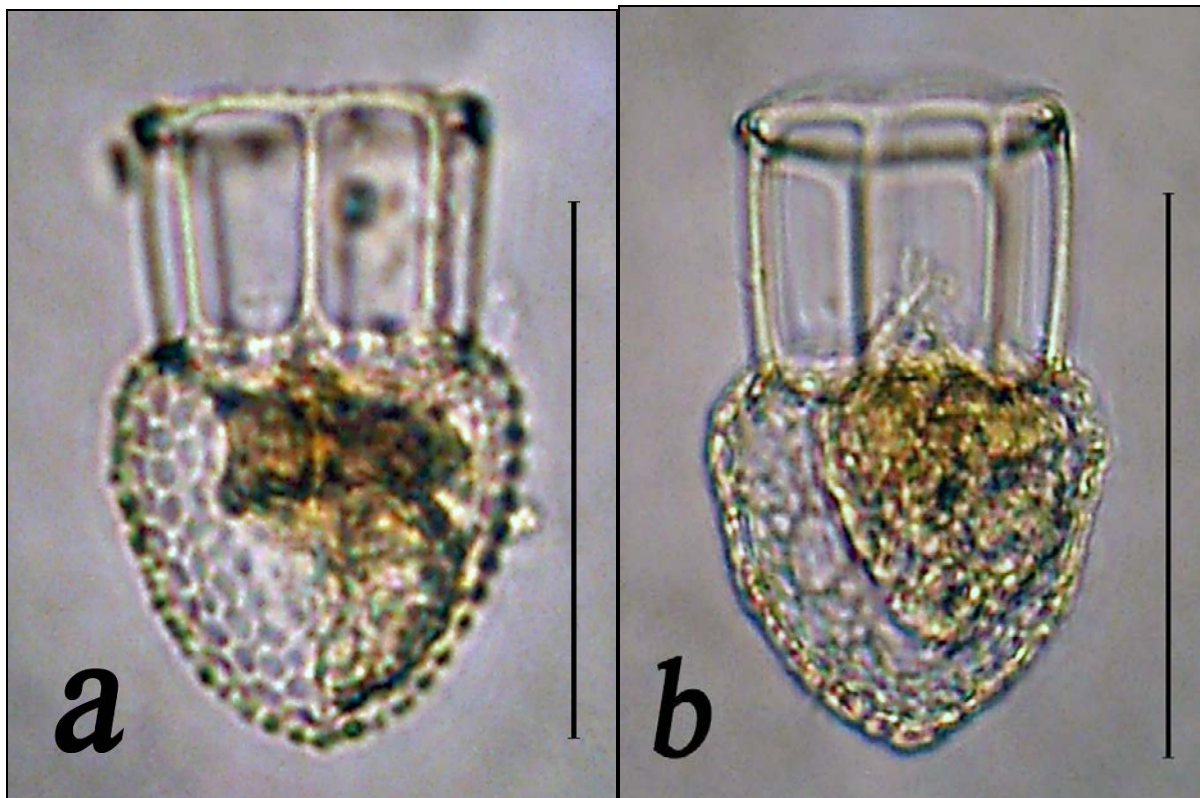
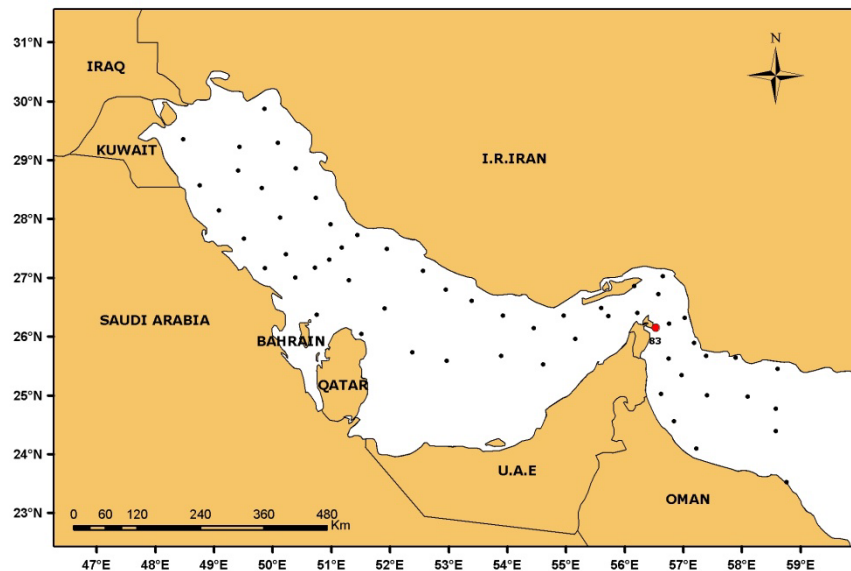


Fig. 15. a-b. Variations of lorica shape of *Dictyocysta duplex* (Scale – 50 μm)

Geographical Distribution: Temperate and tropical waters of Indian and Pacific oceans.

Sites of Occurrence in RSA: *D. duplex* was abundant in the northern region of the Sea of Oman, close to Strait of Hormuz (St. 83).



Site of occurrence of *Dityocysta duplex* in RSA

Genus: *Luminella* Kofoid and Campbell, 1939.

References: Kofoid and Campbell, 1939; Marshall, 1969; Al-Yamani and Skryabin, 2006; Skryabin and Al-Yamani, 2007.

Collar very short, hyaline, with beams, or with small semi-circular windows at base. Bowl globose or cup-shaped, bluntly pointed or hemispherical aborally. Surface covered with particles.

Luminella kuwaitensis Skryabin and Al-Yamani, 2007.

References: Al-Yamani and Skryabin, 2006; Skryabin and Al-Yamani, 2007 (Fig. 20 a-f).

Description: Collar short, approximately 1/10 of total length, hyaline, consists of 8-10 thin connected arcs enclosing big squarish fenestrations. Bowl cup-shaped, heart-shaped, or globose, bluntly pointed or hemispherical aborally, usually forms pronounced shoulder below collar. Surface densely covered with big agglomerated particles. Bowl without any visible concentric structures.

Comments: *L. kuwaitensis* differs from *L. parvicollis* in its smaller size of lorica, collar formed with 8-10 arcs, not cylindrical with 12 small windows and absence of concentric striae on the bowl.

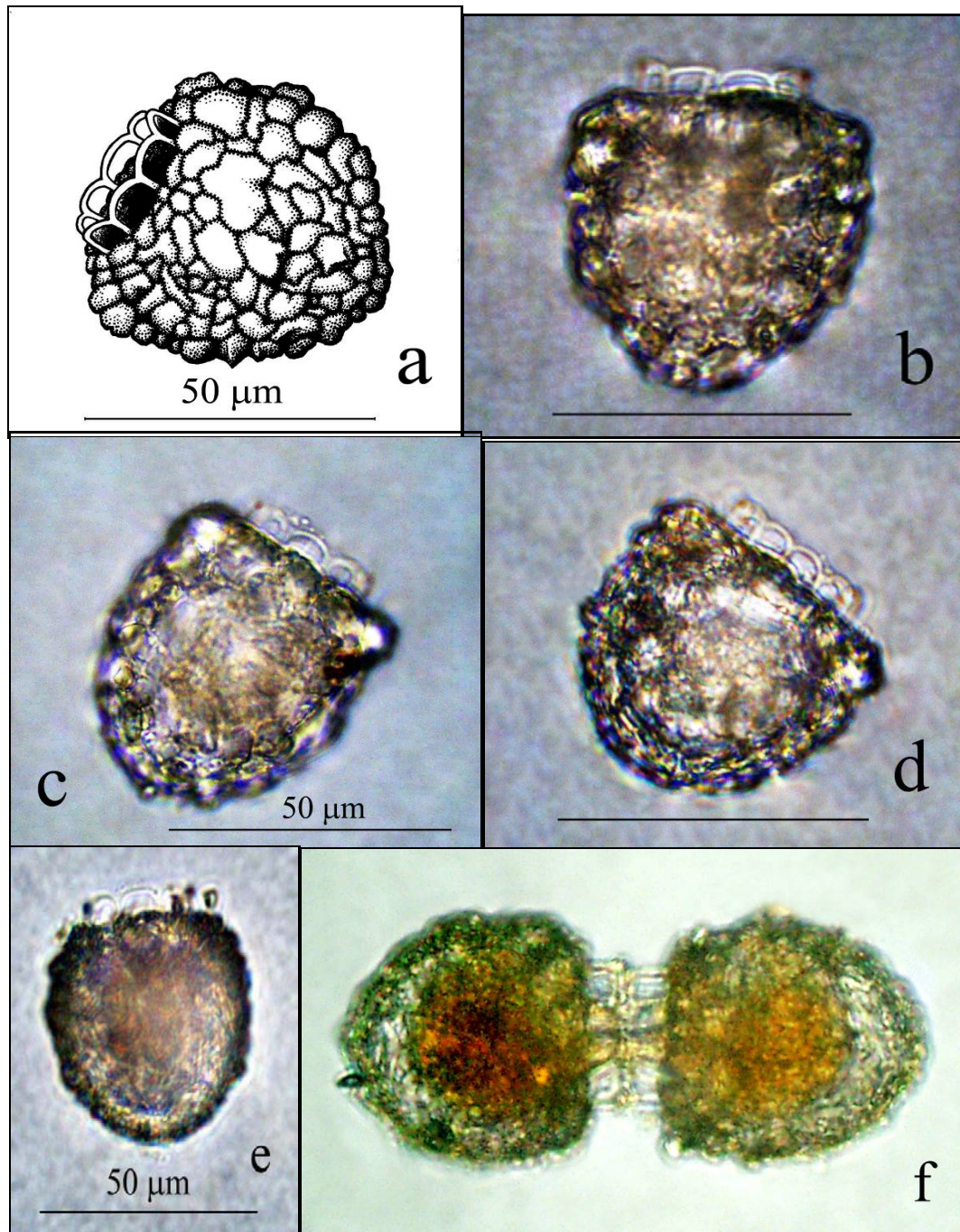
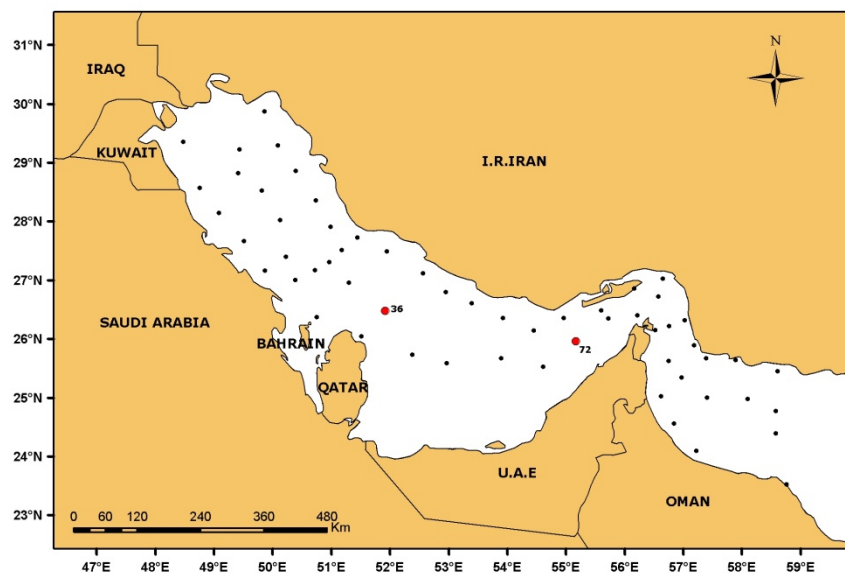


Fig. 16. a-e. Variations of lorica shape of *Luminella kuwaitensis*; f. conjugation of *L. kuwaitensis* (Scale – 50 μm)

Measurements: Total length 52.1 μm (47.5-58.8 μm). Length of bowl 47.0 μm (42.5-50.0 μm). Maximum width of bowl 47.2 μm (42.5-52.5 μm). Diameter of oral aperture 26.8 μm (22.0-32.5 μm). Length of collar 5.1 μm (5.0-7.5 μm). Width of separate arch 8.6 μm (8.0-10.0 μm).

Geographical Distribution: ROPME Sea Area.

Sites of Occurrence in RSA: *L. kuwaitensis* is one of the most abundant species in Kuwait waters and the northwestern part of the inner RSA. Abundance of this species reaches 6.7 million organisms/ m^3 , with 70% percentage composition of total number of tintinnids in October 2003 (average percentage composition for Kuwait waters in August-October 2003 is 56% of total tintinnid abundance). In Kuwait Bay in December 2007, when water temperature fall below 18°C, total conjugation of *L. kuwaitensis* was observed (Fig. 20f). This species changed the asexual type of propagation into sexual reproduction, produce the resting stages, and in January 2008 almost completely disappeared at studied area until the beginning of warm period. In Winter 2006 Cruise, *L. kuwaitensis* was registered in central and eastern regions of the inner RSA (St. 36 and 72).



Sites of occurrence of *Luminella kuwaitensis* in RSA

FAMILY: ASCAMPBELLIELLIDAE Corliss, 1960

References: Marshall, 1969; Lynn and Small, 2000.

Very small forms, cup or tube shaped with rounded or pointed aboral end. Circumoral region differentiated into inner collar and outer collar or flaring lip with gutter or slope between. Wall trilaminate with intermediate layer hyaline or weakly alveolar. Five genera.

Genus: *Ascampbelliella* Corliss, 1960.

Reference: Marshall, 1969.

Ascampbelliellidae with very small tubular or cup-shaped bowls. Circumoral region always with two rims: an inner collar and flaring lip. Outer rim sometimes repeated. No teeth.

Ascampbelliella obscura (Brandt, 1906).

Synonyms: *Cyttarocyliis obscura* Brandt, 1906; *Craterella obscura* Kofoid and Campbell, 1929.

Reference: Marshall, 1969 (Fig. 21 a-c).

Description: Lorica cone-shaped, narrowing more abruptly in aboral $\frac{1}{4}$ to a sharp point. Inner collar erect, outer slightly flaring, with gutter between. Well marked alveolar structure in wall.

Reported Measurements: Total length 70-90 μm ; oral diameter 42-53 μm ; approximate ratio L/oral diameter 1.6-1.7.

Geographical Distribution: Neritic species in temperate and tropical waters of Atlantic, Indian and Pacific oceans.

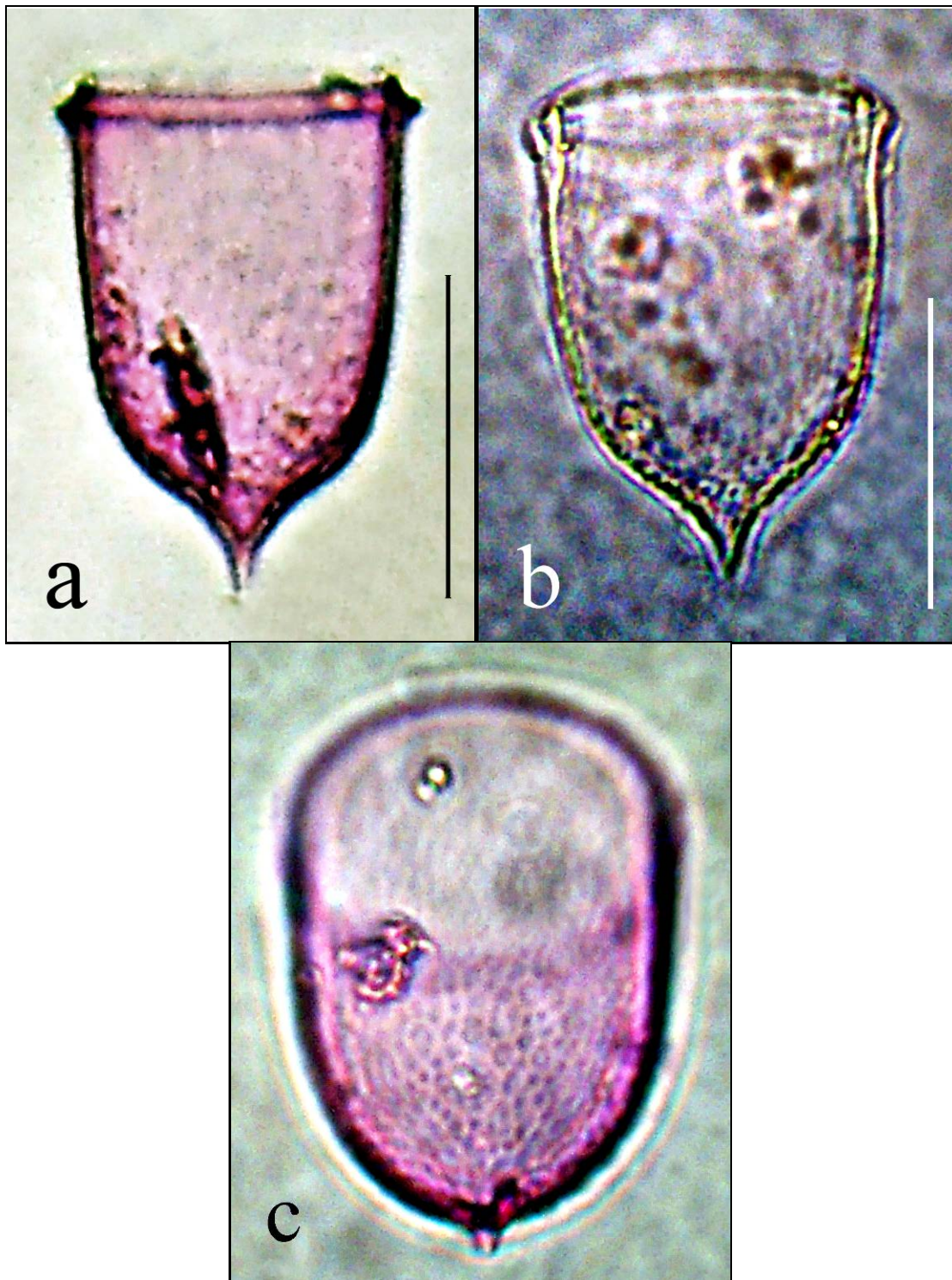
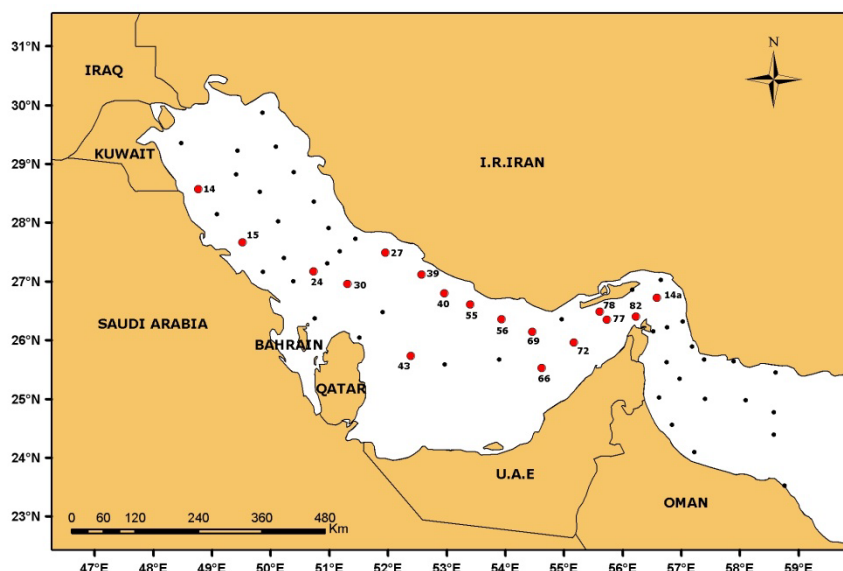


Fig. 17. a-c. Variations of lorica shape and structure of lorica of *Ascampbelliella obscura* (Scale – 50 μm , stained with Rose Bengal)

Sites of Occurrence in RSA: *A. obscura* was observed at all studied area of the ROPME Sea Area with highest abundance in the western part of the Strait of Hormuz (St. 14, 15, 24, 27, 30, 39, 40, 43, 55, 56, 66, 69, 72, 77, 78, 82 and 14a).



Sites of occurrence of *Ascampbelliella obscura* in RSA

FAMILY: PETALOTRICHIDAE Kofoid and Campbell, 1929.

Reference: Marshall, 1969; Lynn and Small, 2000.

Lorica bowl-shaped with round or pointed aboral end and collar in two parts, suboral cone and flaring lip. Nuchal constriction usually present. Small, suboral and subnuchal fenestrae on lip and bowl. Two genera.

Genus: *Petalotricha* Kent, 1881.

Reference: Kofoid and Campbell, 1929.

Petalotrichidae with bowl-shaped or conical lorica, oral shelf spreading; low oral ridge, flaring conical collar; slight or deep nuchal constriction, prominent internal nuchal ledge; globular, sack-like, or subconical bowl; aboral end hemispherical, flattened, minutely pointed or bluntly pointed; wall with inner and outer laminae enclosing 1-3 layers of minute, faint or thick-walled, rounded, uneven prisms; suboral fenestrae in one row with horizontal axis, subnuchal fenestrae circular or elliptical in a more or less restricted zone, with long axis oblique or vertical.

Petalotricha ampulla (Fol, 1881).

Synonyms: *Tintinnus ampulla* Fol, 1881; *Petalotricha serrata* Kofoid and Campbell, 1929; *Petalotricha major* Kofoid and Campbell, 1929; *Petalotricha pacifica* Kofoid and Campbell, 1939.

Reference: Marshall, 1969 (Fig. 22 a-b).

Description: Bowl globose or ovoid, with rounded or pointed aboral end. Suboral cone nearly cylindrical, lip flaring. Edge of lip often irregularly denticulate. Ring of small oval fenestrae at top of cone and a double row on shoulder of bowl.

Reported Measurements: Total length 116-165 μm ; oral diameter 100-135 μm ; approximate ratio L/oral diameter 1.1-1.6.

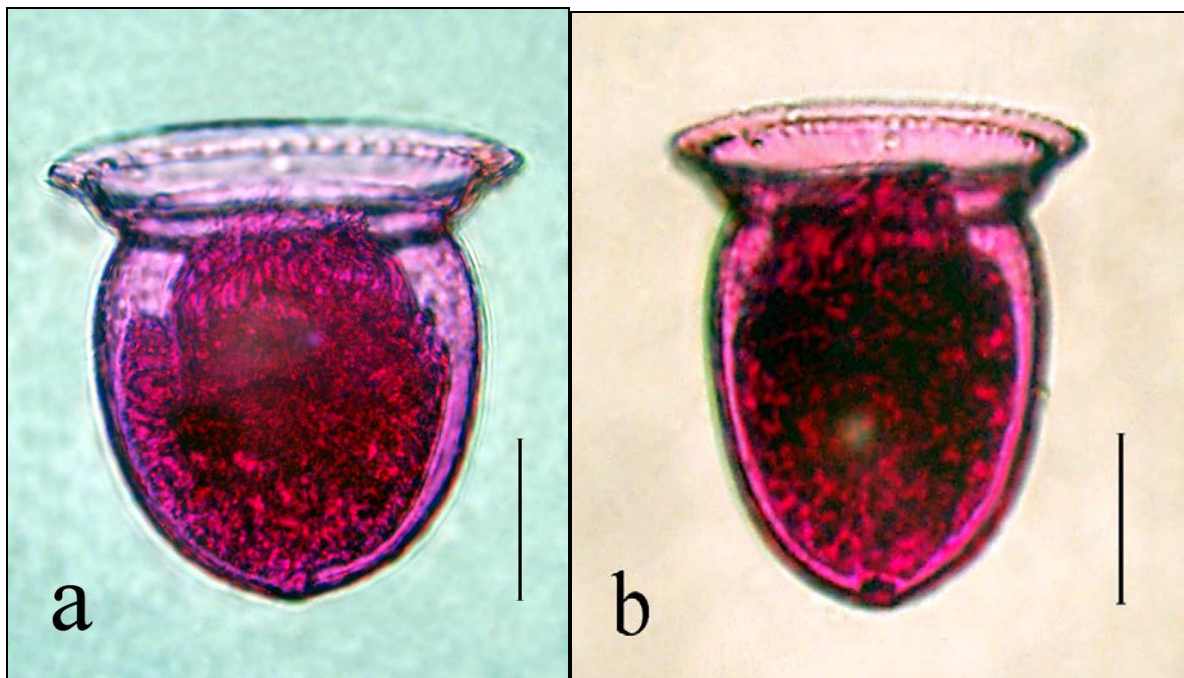
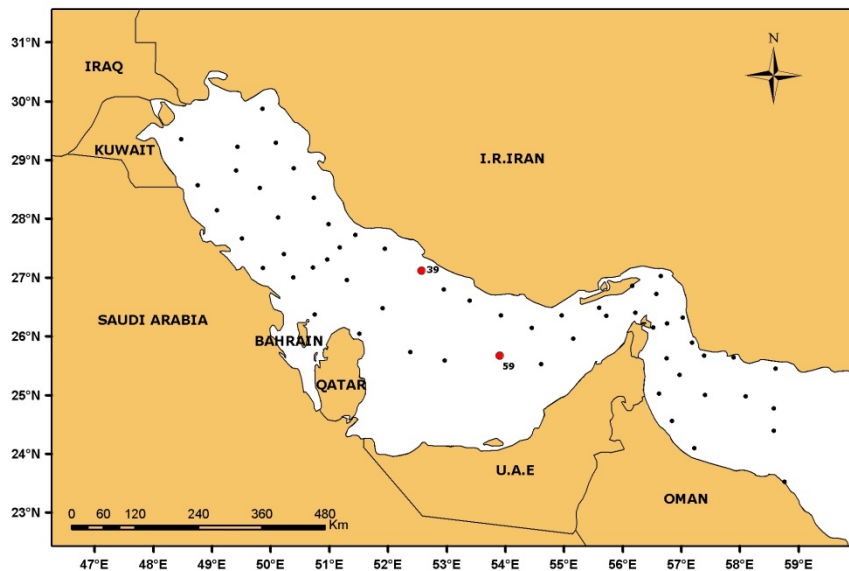


Fig. 18. a, b. Variations of lorica shape of *Petalotricha ampulla* (Scale – 50 μm , stained with Rose Bengal)

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: In Winter 2006 Cruise, *P. ampulla* was registered in central and eastern regions of the inner RSA (St. 39 and 59).



Sites of occurrence of *Petalotricha ampulla* in RSA

FAMILY: METACYLIDIDAE

Reference: Lynn and Small, 2000.

Lorica tubular or goblet-shaped, with rings or spiral band on all or part, wall 3-layered, usually with distinct alveoli; 10 genera.

Genus: *Metacylis* Jörgensen, 1924.

Reference: Kofoed and Campbell, 1929.

Metacylididae with lorica usually short and wide, oval, in some species elongate capsular; usually with a wide mouth and a short wide collar with a few, low spiral turns or annuli; bowl wide; aboral end rounded or pointed, flattened, or with a spinule; wall bilaminate, simple with indistinct structure, or with simple prismatic structure, or hyaline.

Metacylis jorgensenii (Cleve, 1902).

Synonyms: *Codonella Jörgensenii* Cleve, 1902a; *Tintinnus urceolatus* Brandt, 1906; *Metacylis jorgensenii* Kofoed and Campbell, 1929.

References: Kofoed and Campbell, 1929; Marshall, 1969 (Fig. 23 a-d).

Description: Lorica short, ovoid, with slightly or sharply pointed aboral end. Collar short, with 2-5 spiral turns, cylindrical or slightly flaring, narrower than bowl.

Reported Measurements: Total length 50-61 μm ; oral diameter 44-50 μm ; approximate ratio L/oral diameter 1.3-1.9.

Measurements of Specimens from the ROPME Sea Area: Total length 61-67 μm ; oral diameter 55-56 μm ; greatest transdiameter 63-64 μm ; approximate ratio L/oral diameter 1.1-1.2.

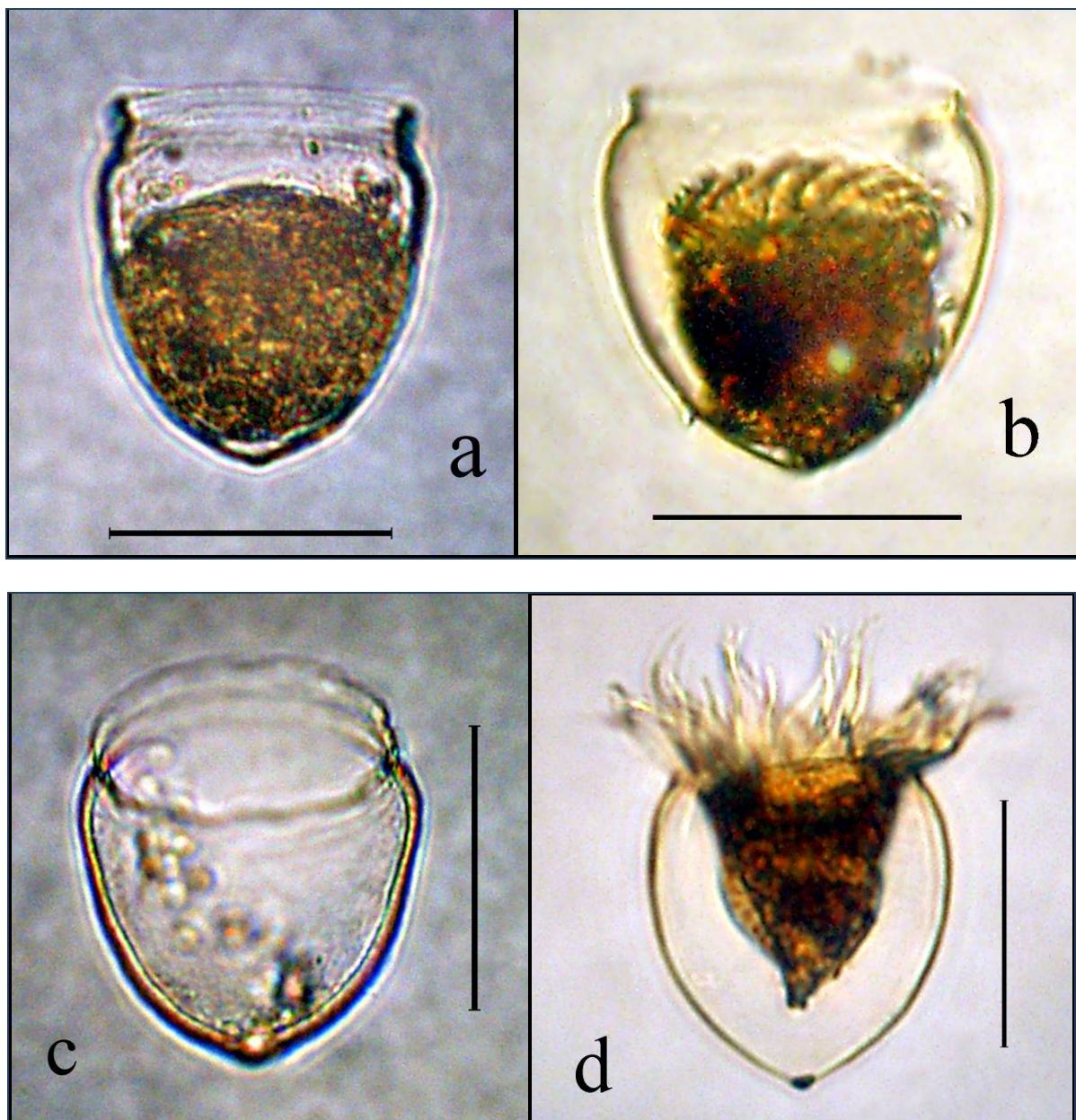
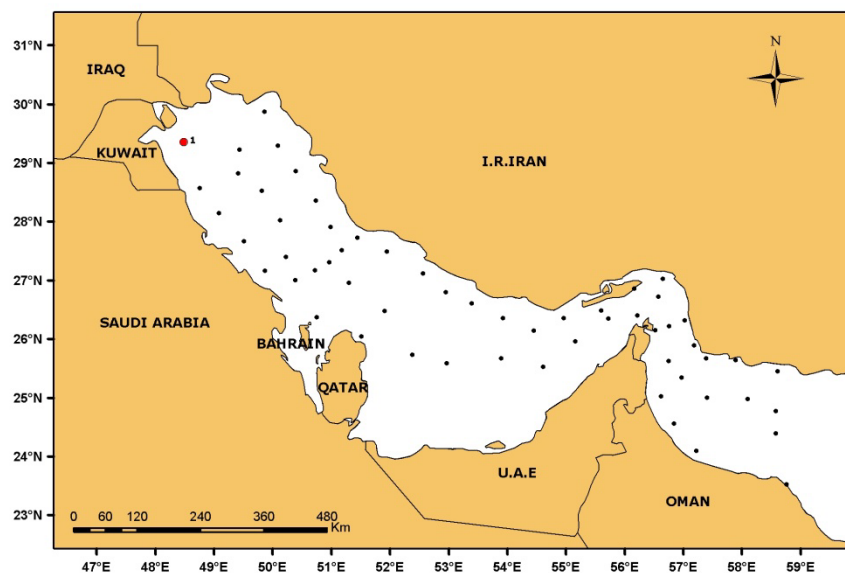


Fig. 19. a-d. Variations of lorica shape of *Metacylis jorgensenii* (Scale – 50 μm)

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *M. jorgensenii* usually is relatively rare in Kuwait waters and is observed mainly in the end of warm season, in August-September (Al-Yamani and Skryabin, 2006; Skryabin and Al-Yamani, 2007a). In Winter 2006 Cruise, *M. jorgensenii* was registered in the northwestern inner RSA near Failaka Island (St. 1).



Site of occurrence of *Metacylis jorgensenii* in RSA

Metacylis pithos Skryabin, Al-Yamani, 2006.

References: Skryabin and Al-Yamani, 2006; Al-Yamani and Skryabin, 2006 (Fig. 24 a-f).

Description: Lorica small, hyaline, pot-shaped, shape of aboral end varies from bluntly to sharply pointed. Collar cylindrical, relatively short (0.14-0.23 total length), with 1-6 spiral turns. Diameter of collar varies from 80 to 97% of maximum diameter of bowl.

Comments: *M. pithos* differs from *M. pontica* in cylindrical collar, from *M. jorgensenii* and *M. mereschkovskii* in proportions, from *M. rossica* in smaller size and in *M. corbula* in pointed aboral end.

Measurements: Total length 38-57 μm ; maximum transdiameter 32-35 μm ; oral diameter 28-31 μm , length of collar 8-10 μm , approximate ratio L/oral diameter 1.5-2.0.

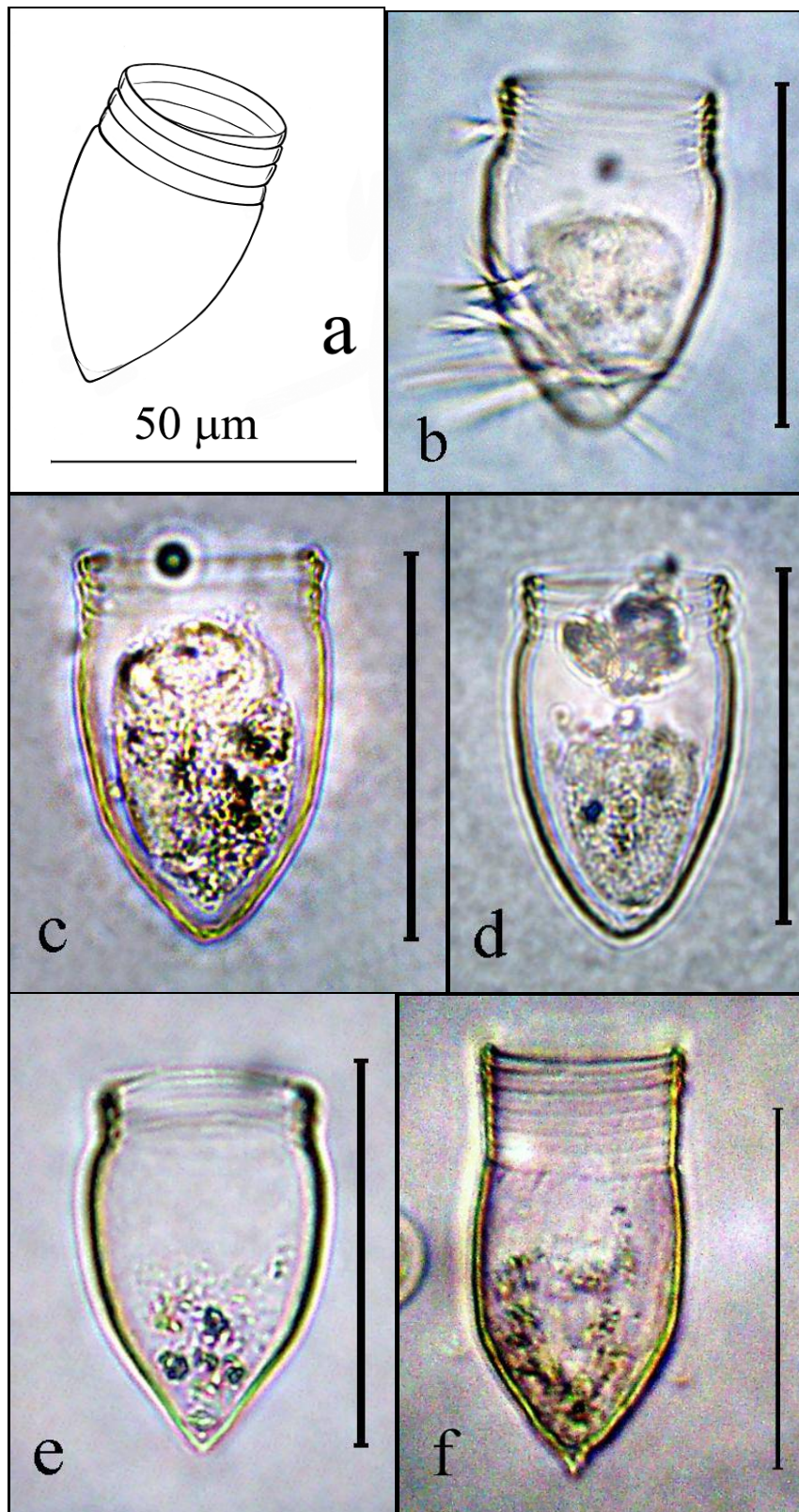
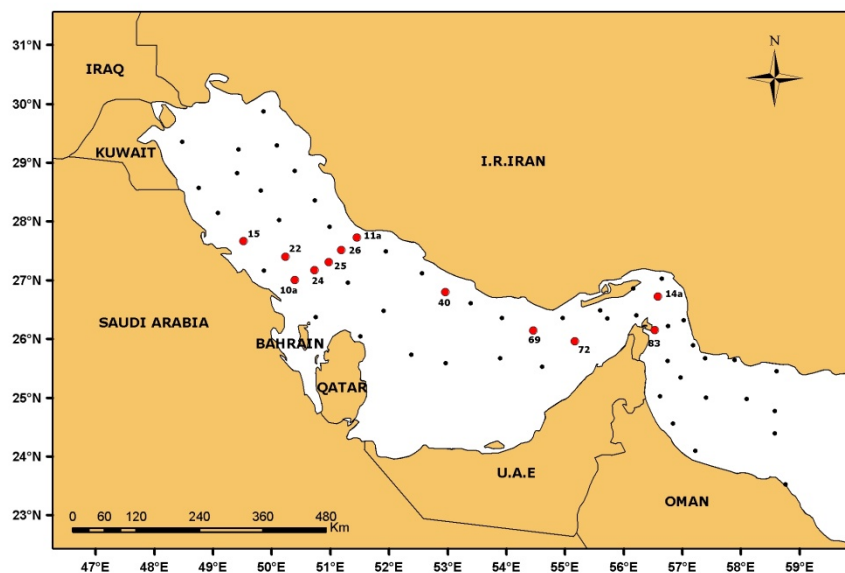


Fig. 20. a-f. Variations of lorica shape of *Metacylis pithos* (Scale – 50 μm)

Geographical Distribution: ROPME Sea Area.

Sites of Occurrence in RSA: *M. phitos* is common at all studied areas of the ROPME Sea Area, from Bubiyan Island (Al-Yamani and Skryabin, 2006; Skryabin and Al-Yamani, 2006, 2007a) to the Strait of Hormuz and Sea of Oman with high abundance in the northwestern region (St. 15, 22, 10a, 24, 25, 26, 11a, 40, 69, 72, 14a and 83).



Sites of occurrence of *Metacyclis pithos* in RSA

FAMILY: RHABDONELLIDAE

Reference: Lynn and Small, 2000.

Lorica acorn- or chalice-shaped with longitudinal, low ridges that may be simple, branch or anastomose; four genera.

Genus: *Protorhabdonella* Jorgensen, 1924

Reference: Kofoed and Campbell, 1929

Rhabdonellidae with lorica short and stout; oral aperture never with teeth; always simple; bowl more or less conical; with few or many vertical or subvertical ribs; rarely with an aboral horn; wall single, usually hyaline or with primary prisms only.

Differs from *Rhabdonella* in the absence of the oral gutter and *Rhabdonellopsis* in the absence of pedicel and knob.

Protorhabdonella curta (Cleve, 1901).

Synonyms: *Cyttarocylis striata*, forma *curta* Cleve 1901; *Cyttarocylis amor* var. *curta* Brandt, 1906.

References: Kofoid and Campbell, 1929; Marshall, 1969 (Fig. 25 a-b).

Description: Lorica with more or less conical bowl, slightly dilated above middle. Aboral end pointed, closed. Oral rim simple, with only one slight thickening of wall below. Ribs 18-24, vertical or slightly spiral; no branching. No fenestrae. Wall thin hyaline.

Comments: *P. curta* differs from *P. simplex* in more numerous ribs and smaller size and from *P. mira* and *P. striatura* in absence of pedicel.

Measurements: Total length 39-52 μm ; oral diameter 22-29 μm , approximate ratio L/oral diameter 1.4-1.8.

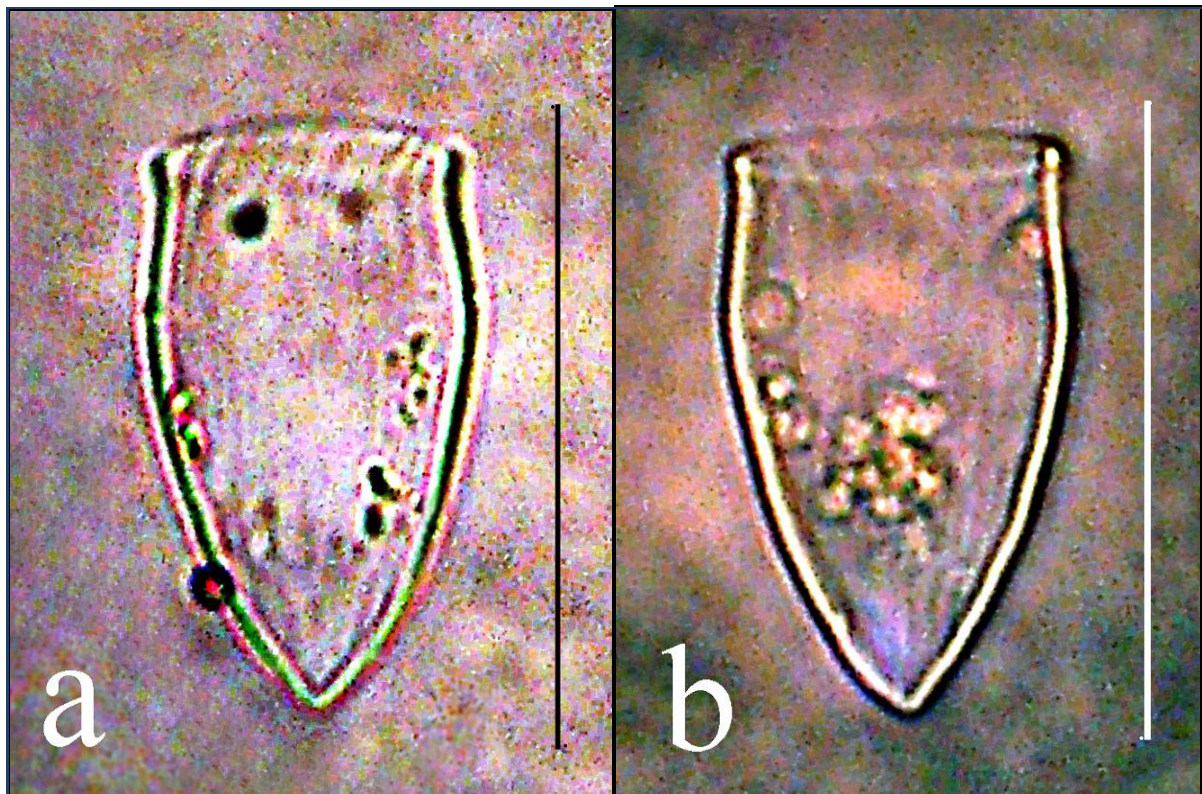
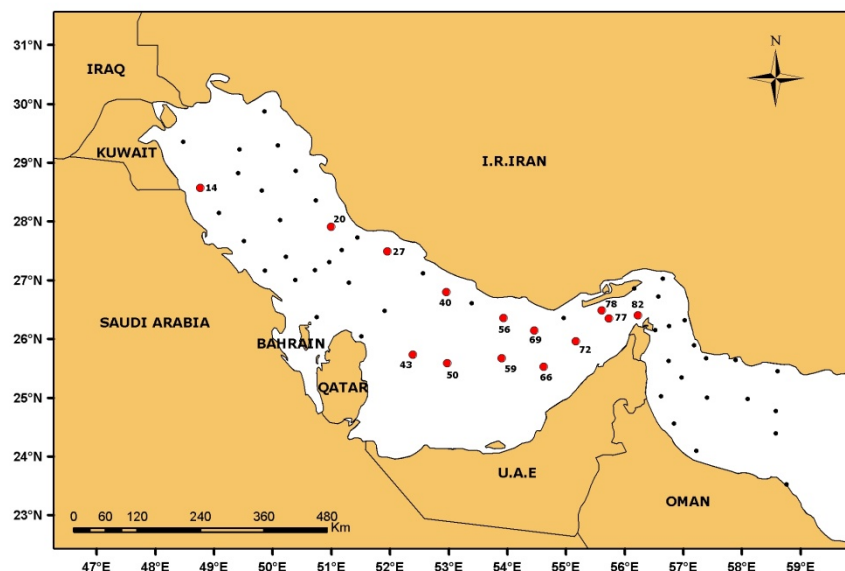


Fig. 21. a-b. Variations of lorica shape of *Protorhabdonella curta* (Scale – 50 μm , stained with Rose Bengal)

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *P. curta* was registered in central and eastern regions of the inner RSA.



Sites of occurrence of *Protorhabdonella curta* in RSA

Protorhabdonella simplex (Cleve, 1900).

Synonyms: *Cyttarocyclus simplex* Cleve, 1900; *Rhabdonella amor* var. *simplex* Brandt, 1906.

References: Kofoed and Campbell, 1929; Marshall, 1969 (Fig. 26 a-c).

Description: Lorica short, convex-conical, with low collar and pointed aboral end. Ribs 6-10.vertical, no branching. Wall thick just below collar.

Comments: *P. simplex* differs from *P. curta* in less ribs and bigger size and from *P. mira* and *P. striatura* in absence of pedicel.

Measurements: Total length 47-98 µm; oral diameter 26-39 µm, approximate ratio L/oral diameter 1.5-2.2.

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

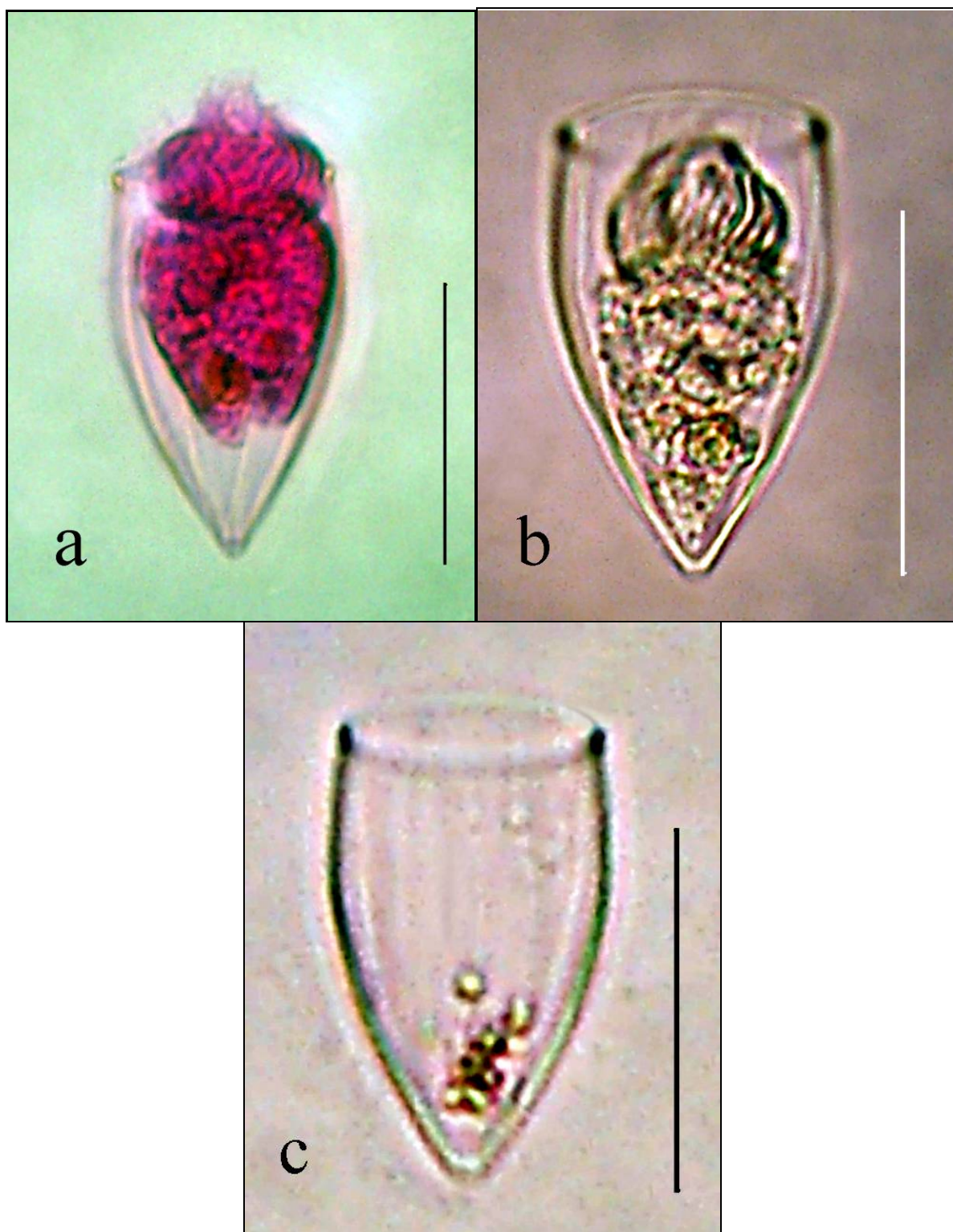
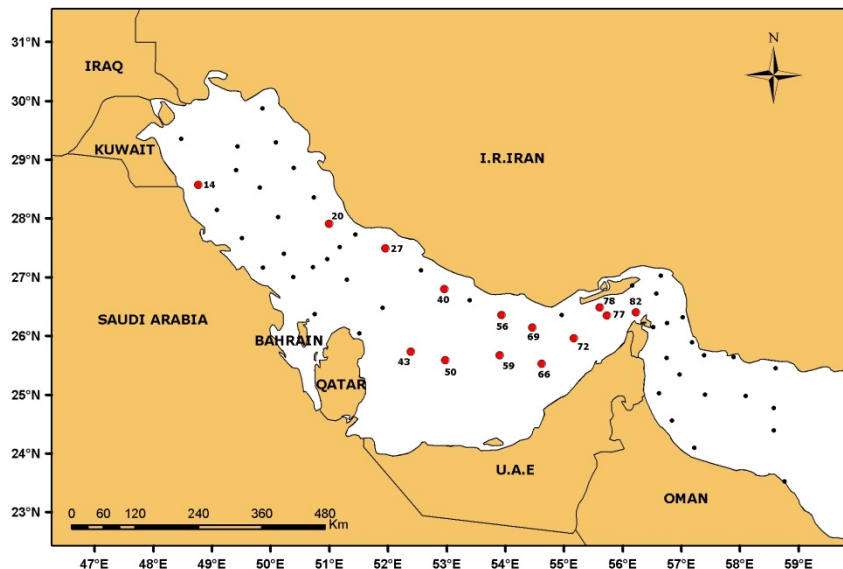


Fig. 22.a-c. Variations of lorica shape of *Protorhabdonella simplex* (Scale – 50 μm, stained with Rose Bengal)

Sites of Occurrence in RSA: *P. simplex* was registered in central and eastern regions of the inner RSA. In Winter 2006 Cruise, two species of genus *Protorhabdonella*: *P. curta* and *P. simplex*, were observed at stations 14, 20, 27, 43, 40, 50, 59, 56, 66, 69, 72, 77, 78 and 82.



Sites of occurrence of *Protorhabdonella simplex* in RSA

Genus: *Rhabdonella* Brandt, 1906.

Reference: Kofoid and Campbell, 1929.

Rhabdonellidae usually with elongated chalice-shaped lorica; oral rim never with teeth, but usually with a gutter between the inner and outer laminae; pedicel slender, more or less protracted, never with apophyses; ribs more or less vertical, simple or branched and sometimes with anastomoses, with few, to many or no fenestrae between the ribs, usually in the suboral region; laminae well developed, especially toward the mouth, generally with one layer of primary prisms and usually a coarse *Cyttarocylis* structure.

Differs from *Protorhabdonella* and *Rhabdonellopsis* in the presence of pedicel and knob.

***Rhabdonella* sp.**

(Fig. 27 a-b).

Description: Lorica almost cylindrical above and conical (7° - 9°) below. Oral rim flaring, relatively wide, no higher than lip. Pedicel very short, 0.2 total length, with small roundish knob or swelling on the tip. Ribs almost vertical on oral half, curving slightly right to near aboral end. Fenestrae numerous.

Comments: The species differs from the other species of *Rhabdonella* in wide flaring oral rim and short pedicel with swelling on tip.

Measurements: Total length 155-185 μm . Oral diameter 45-50 μm . Approximate ratio L/oral diameter 3.6-3.7.

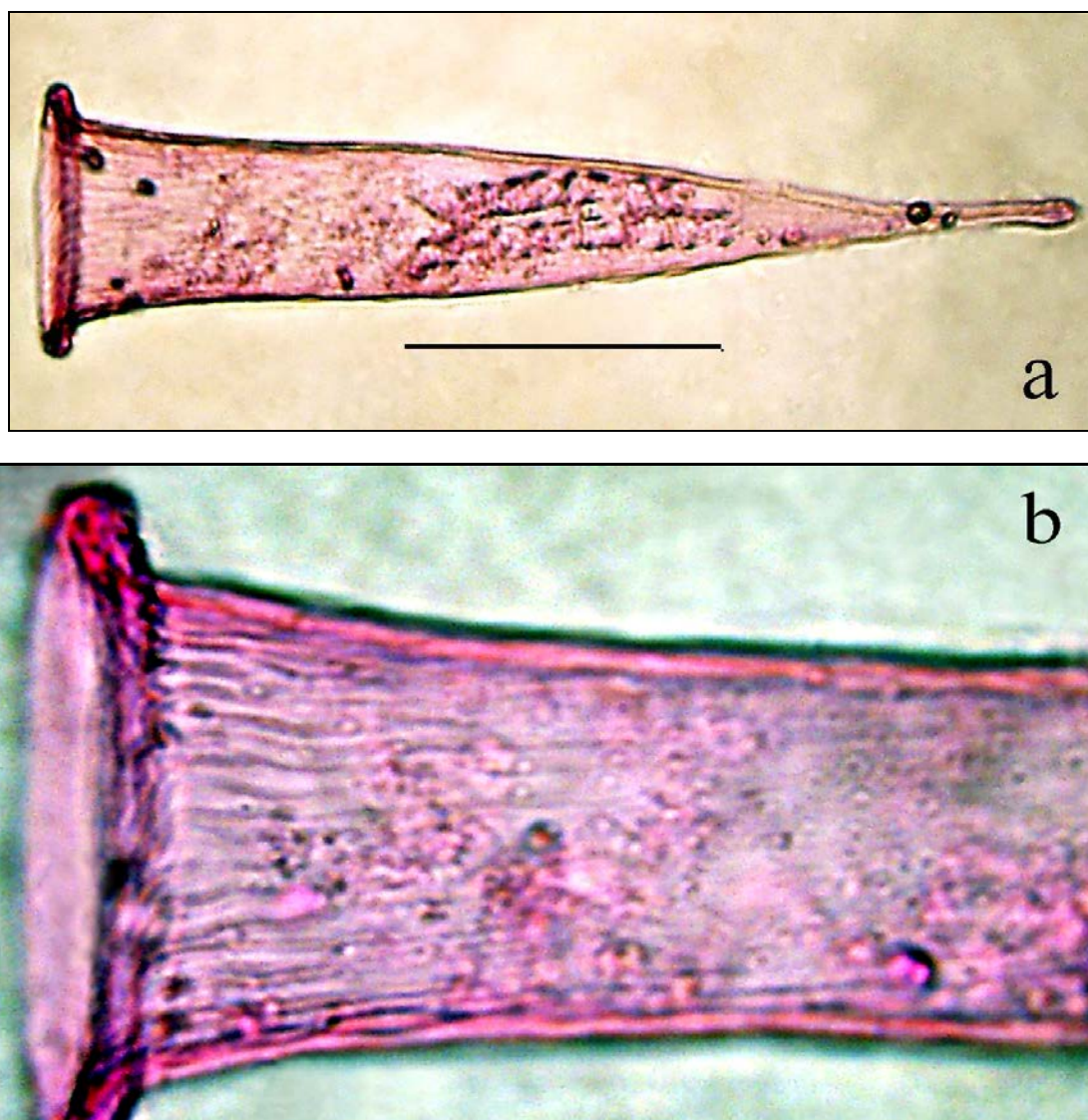
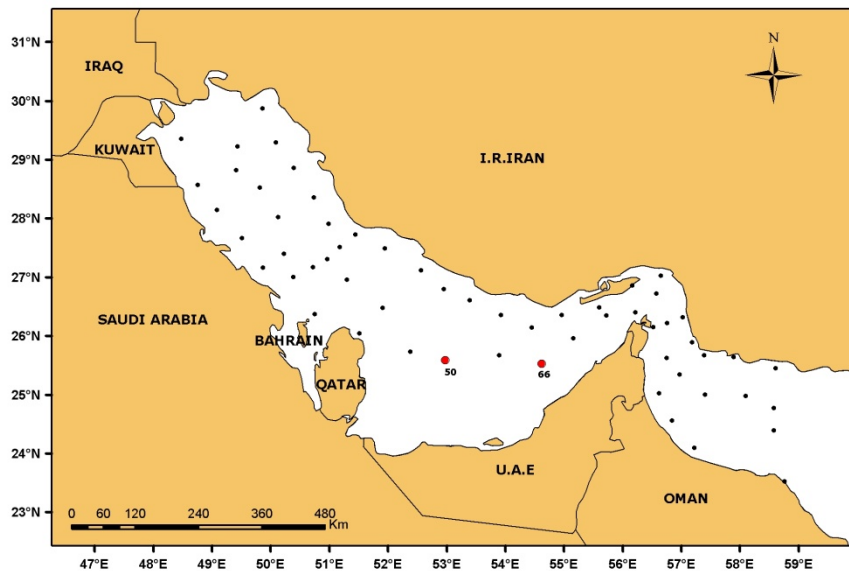


Fig. 23. Lorica shape of *Rhabdonella* sp. (Scale – 50 μm , stained with Rose Bengal)

a. shape of lorica; b. structure of lorica.

Geographical Distribution: ROPME Sea Area.

Sites of Occurrence in RSA: *Rhabdonella* sp. was registered in southeastern region of the inner RSA (St. 50 and 66).



Sites of occurrence of *Rhabdonella* sp. in RSA

FAMILY: XYSTONELLIDAE

Reference: Lynn and Small, 2000.

Lorica chalice-shaped; irregular and conspicuous meshwork between wall layers with inconspicuous, thin wall material separating polygons; six genera.

Genus: *Parundella* Jörgensen, 1924

Reference: Kofoid and Campbell, 1929

Xystonellidae with elongated lorica with an upper cylinder and a lower cone prolonged usually as a simple caudal lance; wall with a simple primary structure, or hyaline, its laminae separated but approximate, except at the aboral end where they fuse.

Differs from *Xystonella* in the absence of the channeled oral rim and from *Xystonellopsis* the thin, not flaring oral rim.

Parundella lohmanni Jörgensen, 1924.

References: Kofoed and Campbell, 1929; Marshall, 1969 (Fig. 28 a-b).

Description: Lorica more or less cylindrical, but dilated just below mouth, contracted in middle of bowl, and expanding again slightly before thick pedicel. Wall thick, lamellae well separated except where they fuse in tip of pedicel.

Reported Measurements: Total length 151-183 μm . Oral diameter 38-43 μm . Approximate ratio L/oral diameter 3.9-4.3.

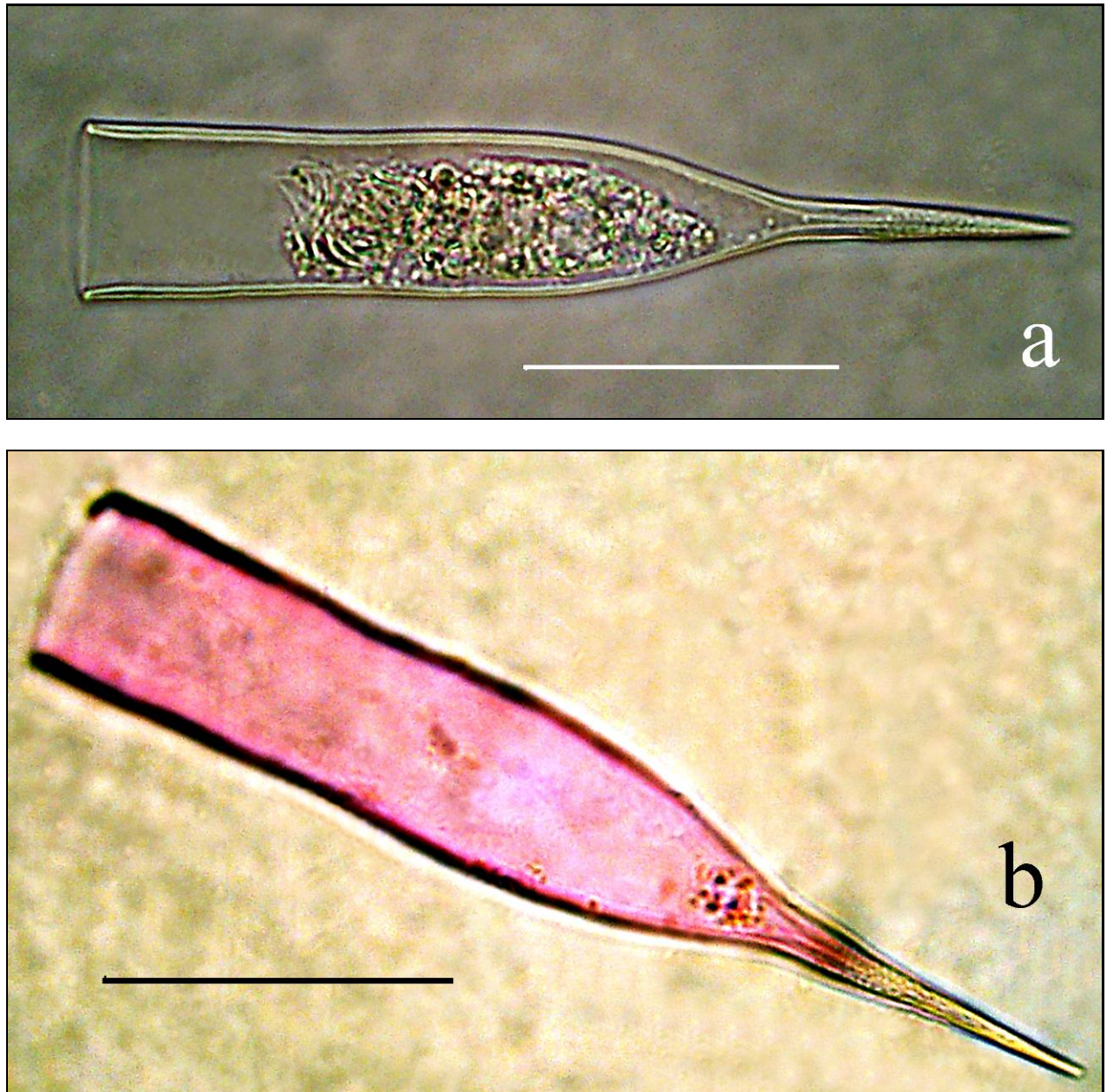
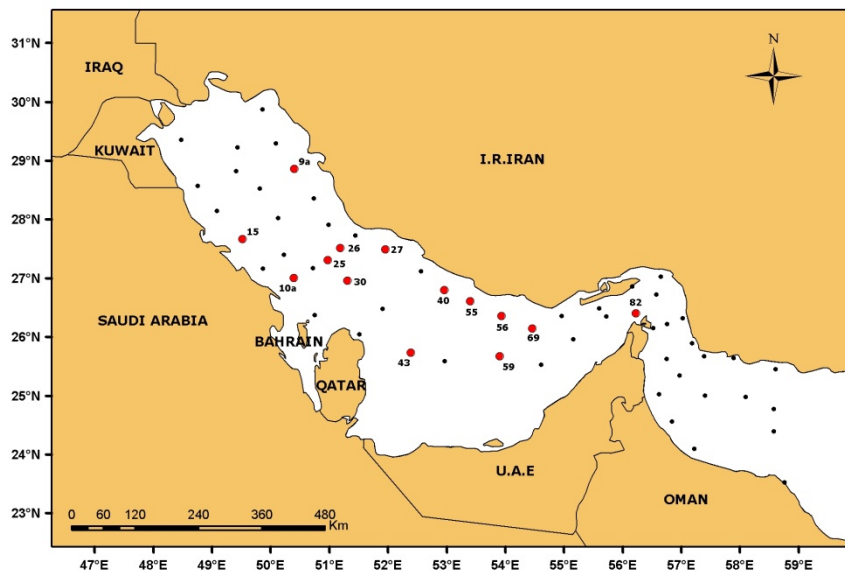


Fig. 24.a-b. Variations of lorica shape of *Parundella lohmanni* (Scale – 50 μm , stained with Rose Bengal)

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *P. lohmanni* is common in the central and eastern parts of the inner RSA with highest abundance in the eastern regions (St. 9a, 15, 10a, 25, 26, 27, 30, 40, 43, 55, 56, 59, 69 and 82).



Sites of occurrence of *Parundella lohmanni* in RSA

Genus: *Xystonella* Brandt, 1907.

Reference: Kofoid and Campbell, 1929.

Xystonellidae with lorica subconical, very long and narrow; oral margin thickened and channeled between the two lamellae, the outer more or less flaring, and an inner usually forming an erect collar; bowl elongate, vase-like or conical; prolonged aborally in a spine or in pedicel with knob or apophyses; with or without terminal lance; wall with a single middle prismatic layer.

Differs from *Xystonellopsis* and *Parundella* in having the oral rim channeled.

Xystonella treforti (Daday, 1887).

Synonyms: *Cyttarocylis Treforti* Daday, 1887; *Cyttarocylis (Xystonella) treforti* Brandt, 1906; *Cyttarocylis (Coxliella) fasciata* var. *procera* Brandt, 1906; *Cyttarocylis fasciata* Kofoid, 1905; *Coxliella fasciata* Kofoid and Campbell, 1929.

References: Marshall, 1969 (Fig. 29 a-c).

Description: Lorica long, cylindrical to vase shaped, with pedicel ending in skirt, which has 6-8 folds and points. Slender lance, varying in width. Inner collar low, lip slightly flaring and may be denticulate.

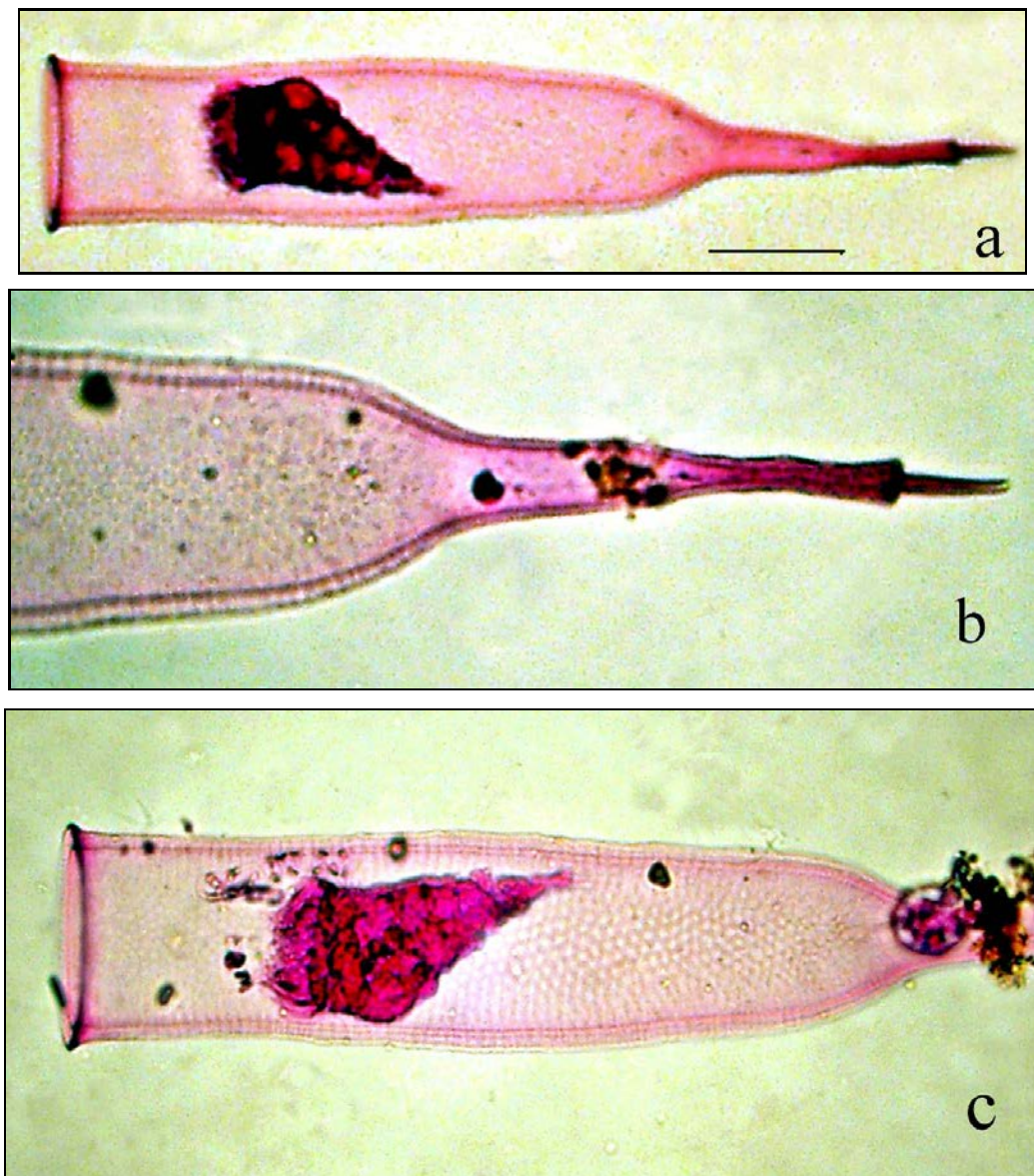
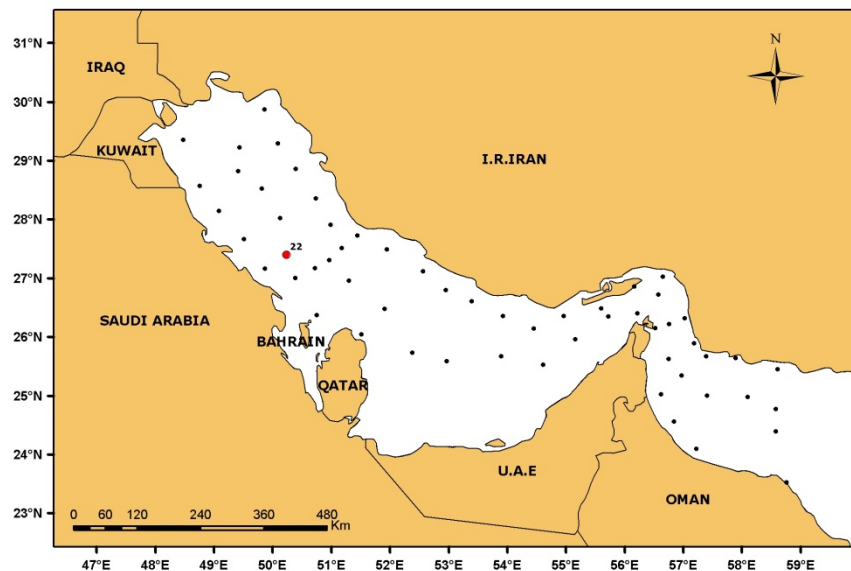


Fig. 25. Lorica shape and structure of *Xystonella treforti* (Scale – 50 μ m, stained with Rose Bengal)
a. shape of lorica; b. shape of aboral end and skirt; c. structure of bowl.

Reported Measurements: Total length 275-500 μm . Oral diameter 40-96 μm . Approximate ratio L/oral diameter 4.4-9.1.

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *X. treforti* was registered in low abundance in the central part of the inner RSA (St. 22).



Site of occurrence of *Xystonella treforti* in RSA

Genus: *Xystonellopsis* Jörgensen, 1924.

Reference: Kofoid and Campbell, 1929.

Xystonellidae with lorica elongated and usually narrow, chalice-shaped; oral rim thinning to sharp edge without a gutter; bowl vase-shaped or conical; pedicel very elongated, often with skirt; terminal lance usually present; wall with three well developed lamellae, the middle one of numerous small prismatic alveoli.

Differs from *Xystonella* in the absence of the channel in the oral rim and from *Parundellain* having an abruptly flared oral margin.

Xystonellopsis gaussi (Laackmann, 1909).

References: Kofoid and Campbell, 1929; Marshall, 1969 (Fig. 30).

Description: Lorica relatively short and stout, no suboral ring; bowl 0.75 total length in length, inverted subconical (3°) anteriorly; aboral cone contracting more rapidly (20° - 22°), 1.0 oral diameter in length; pedicel 0.6-1.0 oral diameter in length; terminating in a squarely truncate skirt without expansion; with 6-8 dextrotropic lists on pedicel and lower part of cone; lance slender, conical (15°), 0.4-0.5 oral diameter in length.

Comments: Differs from *X. dahli* in having a skirt.

Reported Measurements: Total length 371-470 μm . Oral diameter 60-70 μm . Approximate ratio L/oral diameter 5.6-6.6.

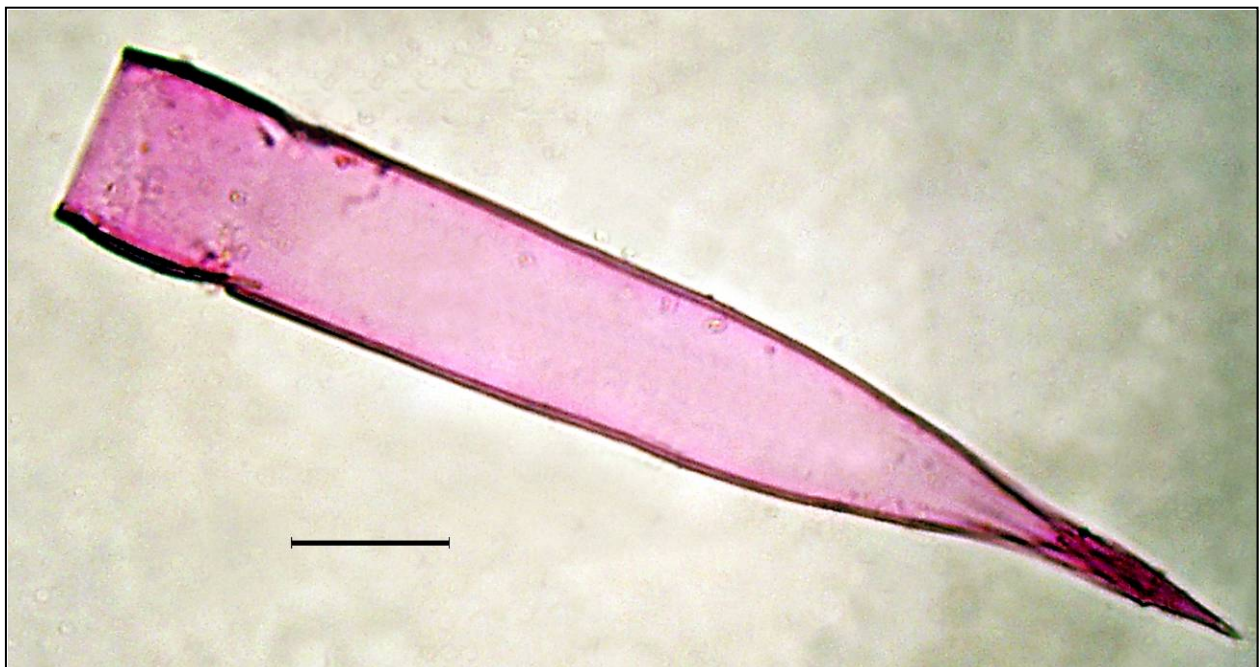
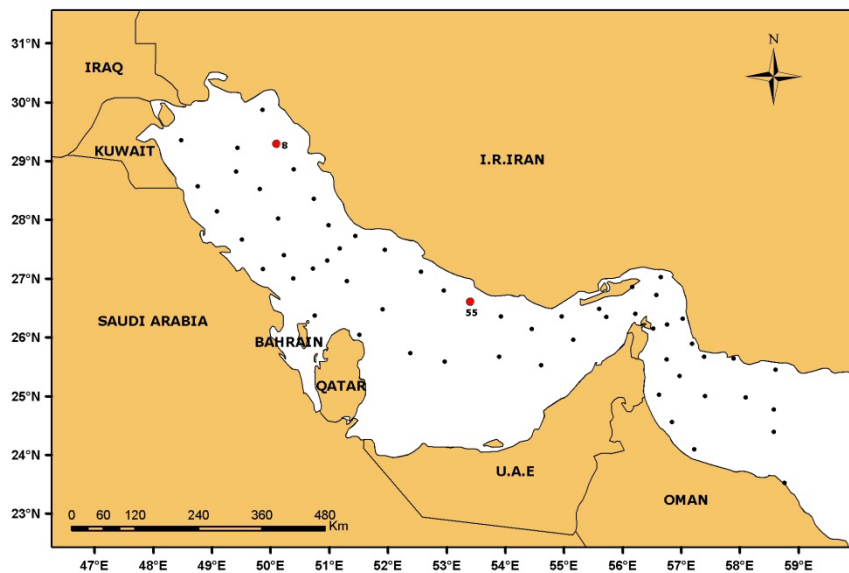


Fig. 26. Lorica shape of *Xystonellopsis gaussi* (Scale – 50 μm , stained with Rose Bengal)

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *X. gaussi* was registered in low abundances in northwestern and central parts of the inner RSA, along the Iranian coast (St. 8 and 55).



Sites of occurrence of *Xystonellopsis gaussi* in RSA

Genus: *Favella* Jörgensen, 1924.

Reference: Kofoed and Campbell, 1929.

Xystonellidae with lorica generally campanulate or subconical; oral rim entire or with small skirt, or with denticles, with or without a suboral constriction and ridge; never with a collar separated with a band from the bowl proper, but sometimes with one or more annuli; bowl campanulate to conical, contracting aborally; aboral horn present, generally thick-walled; wall bilamellate, usually with coarse, intermediate prismatic secondary alveoli and a very fine, primary structure, newer with regular polygonal structure. Only marine species.

Differs from *Protocymatocyliis* and *Cymatocyliis* in the absence of striae; from *Poroecus* in better developed more distinctly prismatic wall and more suboral development; and from *Parafavella* in much less regular, less distinct, and smaller prisms in the wall.

Favella panamensis Kofoed and Campbell, 1929.

References: Kofoed and Campbell, 1929; Marshall, 1969 (Fig. 32 a-f).

Description: Lorica cylindrical, stout, oral rim entire, with 1, rarely 2-4 rings, slightly lipped below the ring; bowl without nuchal constriction, subcylindrical for 0.60-0.75 its length; aboral region contracting abruptly; aboral horn 0.3-0.8 oral diameter in length, conical (20°), with oblique wings, tip pointed.

Comments: Differs from *F. ehrenbergi* in having a more cylindrical bowl and fuller aboral region.

Reported Measurements: Total length 136-232 μm . Oral diameter 37-38 μm . Approximate ratio L/oral diameter 2.0-2.9.

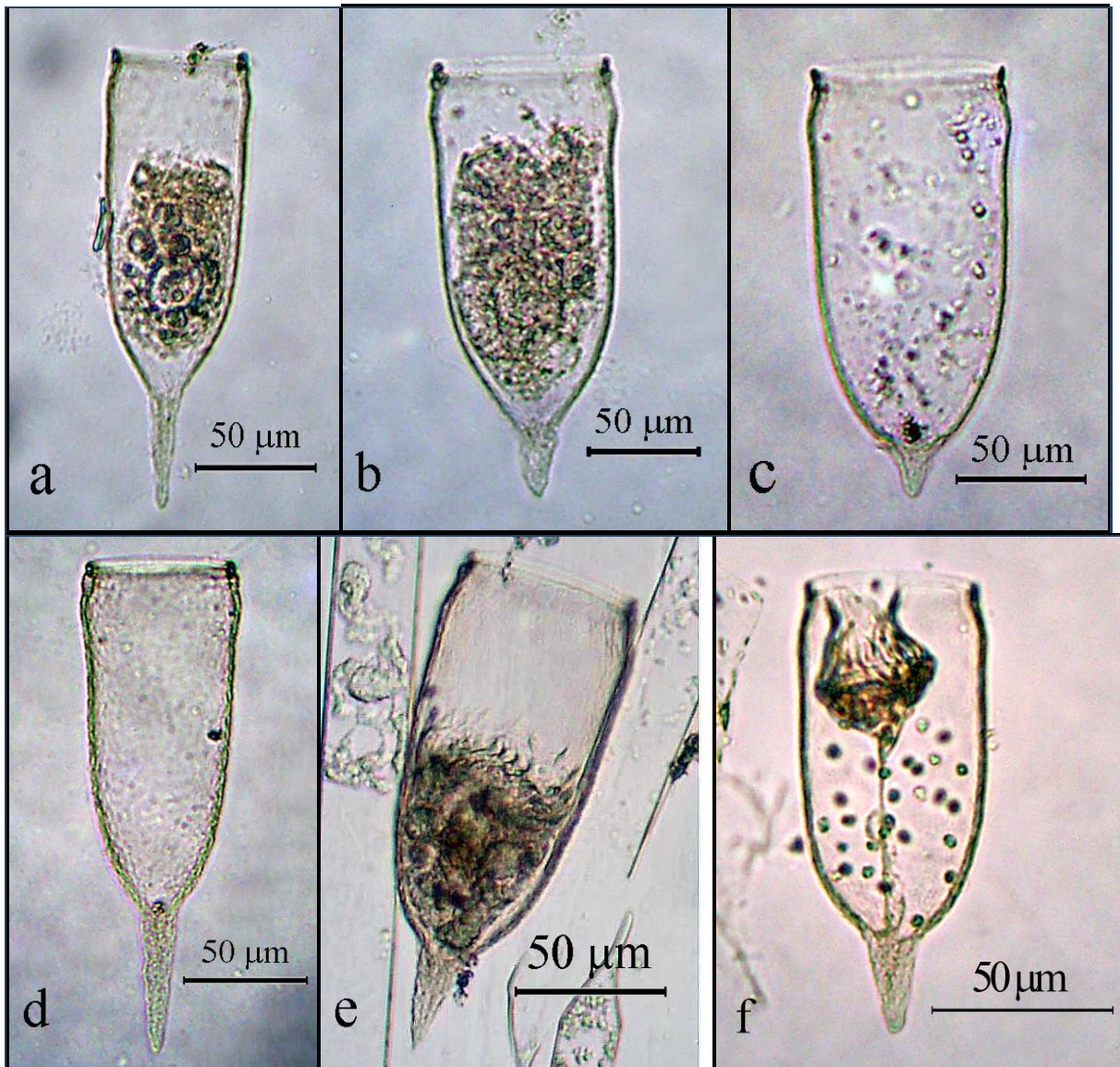
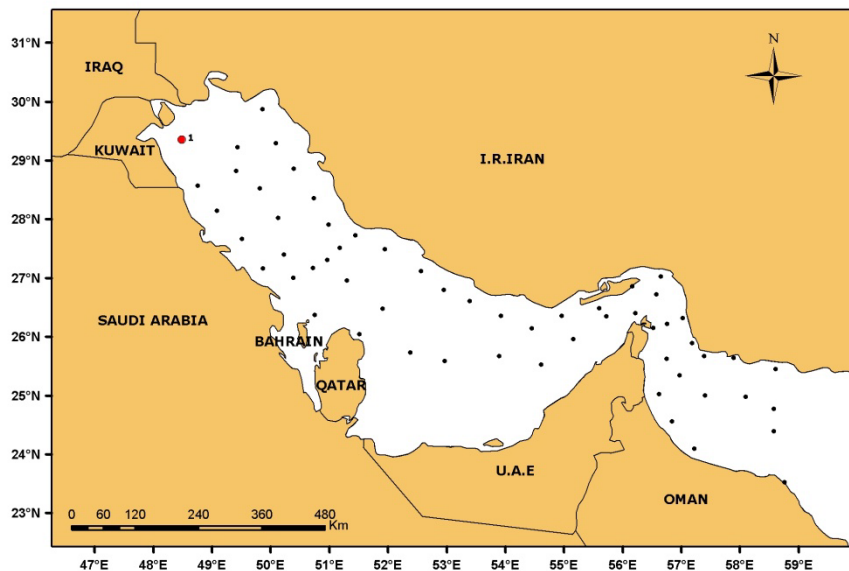


Fig. 27. a-f. Variations of lorica shape of *Favella panamensis* (Scale – 50 μm)

Geographical Distribution: Neritic and estuarine species in temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *F. panamensis* is common and abundant in the northwestern inner RSA during cool period (Al-Yamani and Skryabin, 2006; Skryabin and Al-Yamani, 2007a). In Winter 2006 Cruise, this species was registered near Failaka Island (St. 1).



Site of occurrence of *Favella panamensis* in RSA

FAMILY: UNDELLIDAE

Reference: Lynn and Small, 2000.

Lorica goblet-shaped; clear wall; inner and outer layers of wall, conspicuously thick; eight genera.

Genus: *Undella* Daday, 1887

Reference: Kofoed and Campbell, 1929

Undellidae with lorica with the suboral region tapering in section to a thin oral margin; without suboral ledge or inner collar; bowl cylindrical or nearly so anteriorly, never greatly or abruptly expanded aborally, without rings; aboral end rounded, angled, pointed or flattened; wall bilaminate, without reticulations and without prismatic structure.

Differs from *Undellopsis* in the absence of the suboral ledge, from *Cricundella* and *Amplectella* in the absence of rings, from *Proplectella* in the absence of the inner collar, and from *Amplectellopsis* in the absence of the bowl.

Undella dilatata Kofoed and Campbell, 1929.

References: Kofoed and Campbell, 1929; Marshall, 1969 (Fig. 34 a-d).

Description: Lorica subcylindrical, expanding posteriorly to slightly inflated, faintly angular aboral region; suboral region not expanded beyond the diameter of the bowl, narrowing in a sigmoid curve on the outer face for 0.1-0.2 oral diameter below the rounded oral rim; cylinder with constant diameter for 0.6-0.7 total length, then bulging to 1.1-1.4 oral diameters at about 0.7-0.8 total length, the upper slope of the bulge varying in length and convexity but not distinctly angular; aboral end subconical (125°-150°), broadly to acutely pointed; wall subuniform in thickness (0.1 oral diameter) in the cylinder, thickest in lower part of the bulge (0.15) and thinnest (0.05) in the aboral point.

Comments: The species differs from the other species of *U. hyalina* group in the dilated aboral region and from *U. dohrnii* in the lack of anterior contraction of the bowl.

Reported Measurements: Length 130-160 µm; oral diameter 48-52 µm. Approximate ratio L/oral diameter 2.5-3.3.

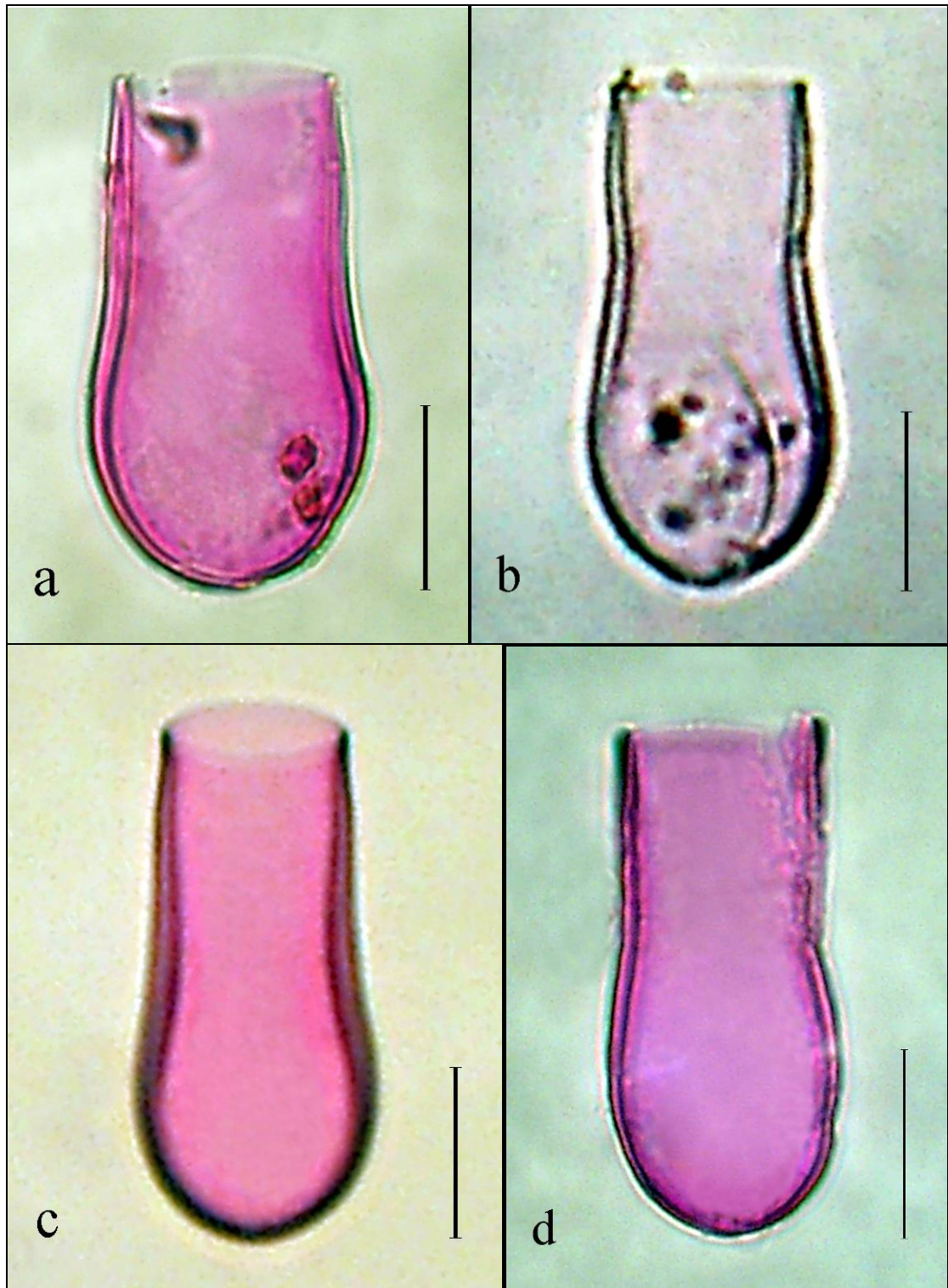
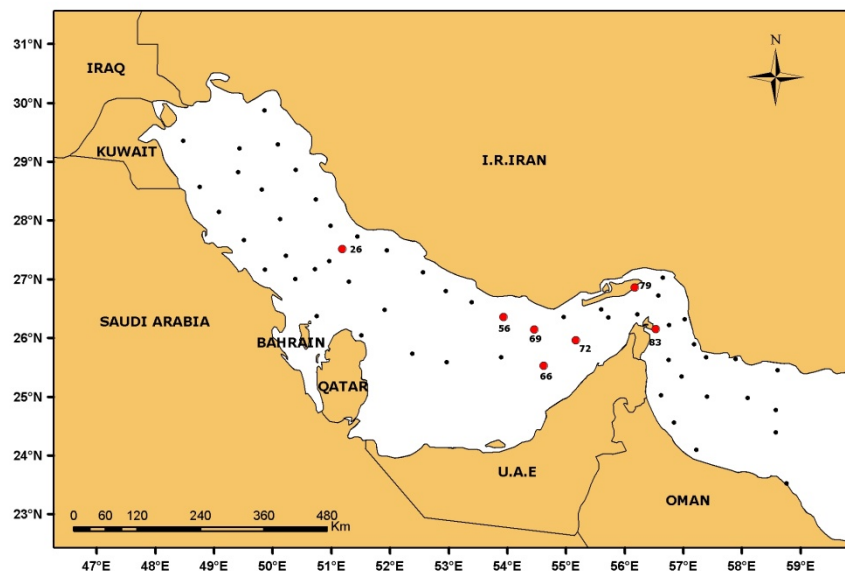


Fig. 28.a-d. Variations of lorica shape of *Undella dilatata* (Scale – 50 μ m, stained with Rose Bengal)

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *U. dilatata* was registered in low abundances from central part of the inner RSA to the Strait of Hormuz and Sea of Oman (St. 26, 56, 66, 69, 72, 79 and 83).



Sites of occurrence of *Undella dilatata* in RSA

FAMILY: TINTINNIDAE

Reference: Lynn and Small, 2000.

Lorica long, oral end flared; wall 2-layered, homogeneous, clear: inner and outer layers of wall not thick; 23 genera.

Genus: *Amphorides* Strand, 1926.

Reference: Hada, 1938.

Lorica tubular or vase-shaped, usually with flaring collar. Oral rim entire (or toothed), aboral end closed, often truncated. Bowl with 3, 4, or 8 longitudinal ridges or fins. Wall hyaline, structureless.

Amphorides amphora (Claparede and Lachmann, 1858)

Synonyms: *Tintinnus amphora* Claparède and Lachmann, 1858; *Amphorella quadrilineata* var. *brandti* Jörgensen, 1924; *Amphorella amphora* Kofoed and Campbell, 1929; *Amphorella brandti* Kofoed and Campbell, 1929.

Reference: Marshall, 1969 (Fig. 35 a-e).

Description: Lorica with flaring collar; oral aperture circular; usually with flaring collar. Greatest width in lower part of bowl, with truncated aboral end. Three low vertical fins. Wall thickened at neck.

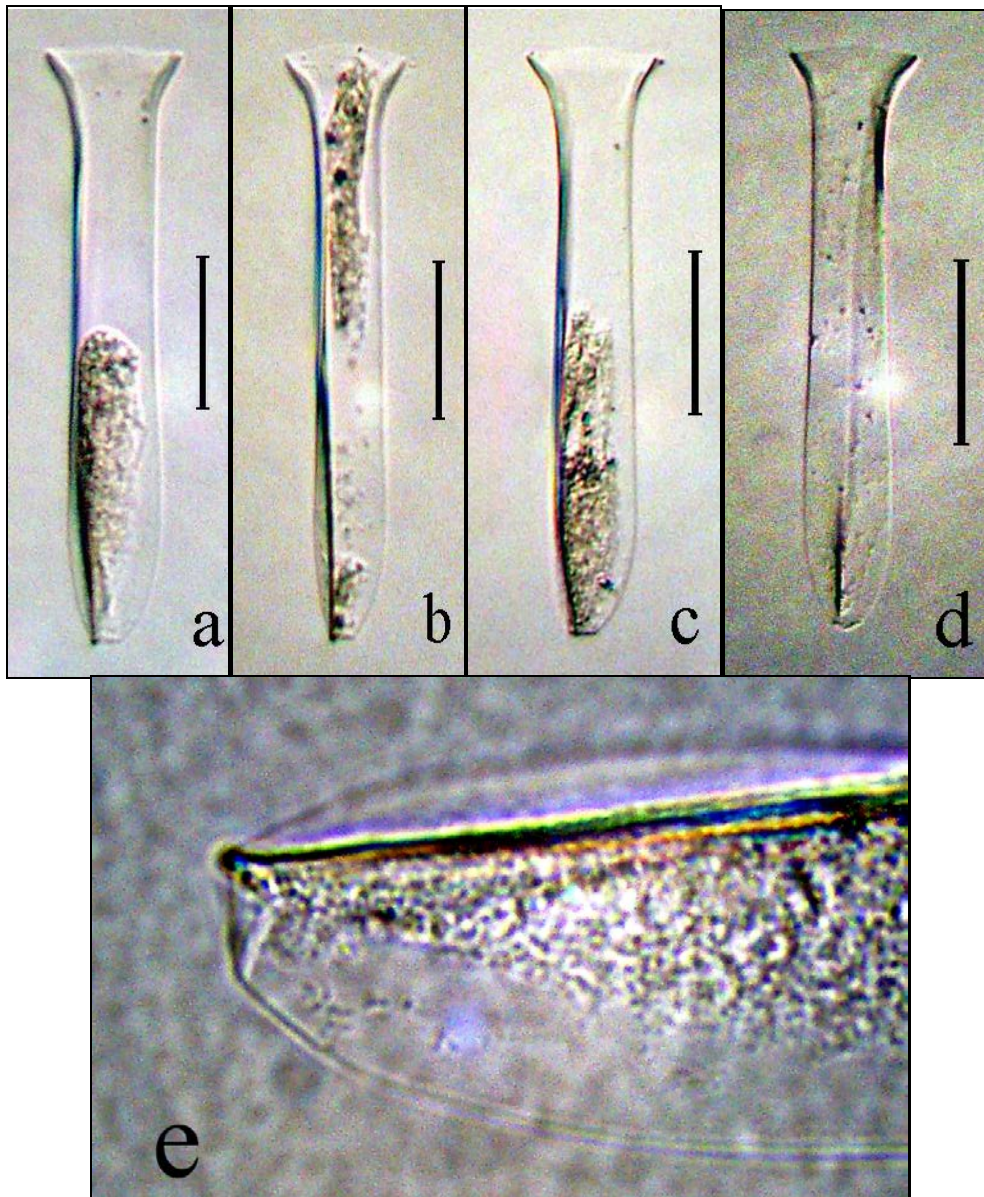


Fig. 29. Variations of lorica shape of *Amphorides amphora* (Scale – 50 μ m)

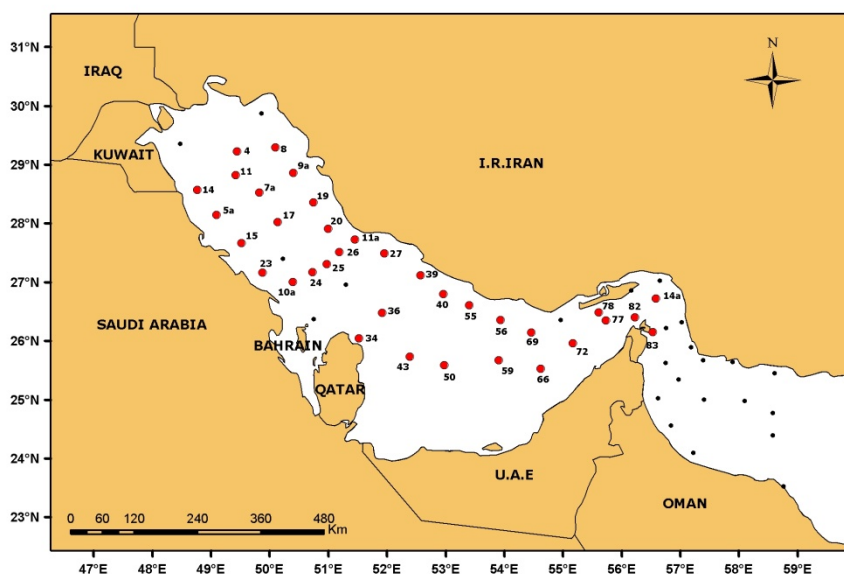
a-d. variations of lorica shape; e. structure of aboral end.

Reported Measurements: Length 100-220 μm ; oral diameter 55 μm , approximate ratio L/oral diameter 2.5-4.0.

Measurements of Specimens from the ROPME Sea Area: Length 100-244 μm ; oral diameter 45-65 μm ; approximate ratio L/oral diameter 3.4-4.5.

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *A. amphora* is common in Kuwait waters (Al-Yamani and Skryabin, 2006; Skryabin and Al-Yamani, 2007a). In Winter 2006 Cruise, this species was registered at all studied areas of the ROPME Sea Area, from its northwestern region to the Strait of Hormuz and Sea of Oman (St. 4, 14, 11, 8, 5a, 7a, 9a, 15, 17, 19, 23, 20, 10a, 24, 25, 26, 11a, 27, 34, 36, 39, 43, 40, 50, 55, 59, 56, 66, 69, 72, 77, 78, 82, 14a and 83).



Sites of occurrence of *Amphorides amphora* in RSA

Amphorides quadrilineata Jorgensen, 1924.

References: Kofoid and Campbell, 1929; Marshall, 1969 (Fig. 36 a-c).

Synonyms: *Tintinnus quadrilineatus* Claparède and Lachmann, 1858; *Amphorella quadrilineata* Jörgensen, 1924; *Amphorides laackmanni* Sassi and Melo, 1986; *Tintinnus amphora* var. *brasiliensis* Laackmann, 1910.

Description: Lorica tall urn-shaped; collar low funnel-shaped, its basal diameter 0.68-0.78 oral diameters; bowl circular in cross section in the anterior part, but gradually triangular in the posterior on account of development of three conspicuous fins extended through the entire bowl; aboral end truncate, more or less concave in its center. Variable in form, greatest width above or below middle of bowl.

Comments: Because the lower part of the lorica is triangular, frontal and side views of a specimen are different. The species differs from *A. brandti* in having a stouter form and from *A. infundibulum* in the structure of the collar and fins.

Reported Measurements: Length 92-182 μm ; oral diameter 38-66 μm ; approximate ratio L/oral diameter 2.4-3.6.

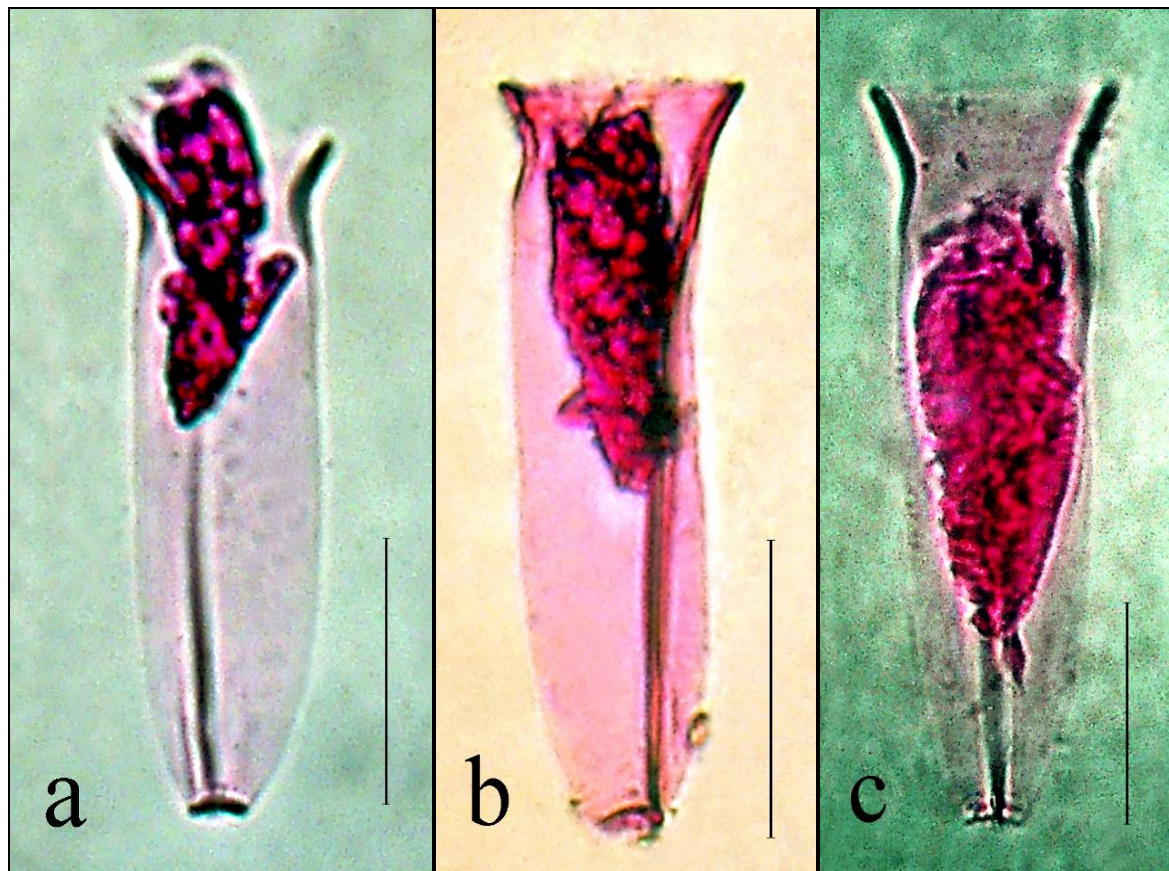
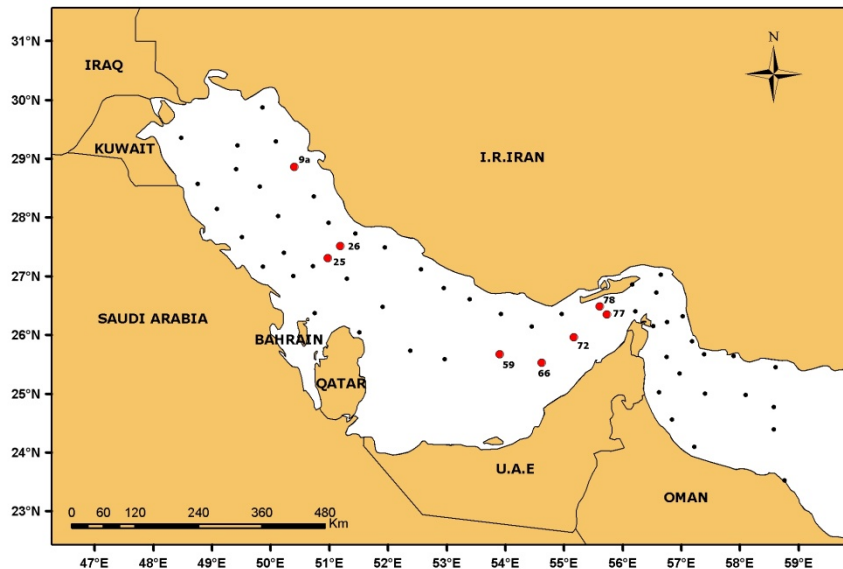


Fig. 30. a-c. Variations of lorica shape of *Amphorides quadrilineata* (Scale – 50 μm , stained with Rose Bengal)

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *A. quadrilineata* was observed in the northern, central and eastern areas of the inner RSA (St. 9a, 25, 26, 59, 66, 72, 77 and 78).



Sites of occurrence of *Amphorides quadrilineata* in RSA

Genus: *Amphorellopsis* Kofoid and Campbell, 1929.

Reference: Hada, 1938.

Lorica usually elongate, consisting of a low funnel-shaped collar and a subcylindrical or fusiform bowl with pointed end; oral margin usually entire; aboral region tapering to an aboral end, from which a number of vertical fins or ridges sometimes extend to the collar; wall single-layered except an anterior flaring part of the lorica. (Hada, 1938)

Amphorellopsis acuta (Schmidt) Kofoid and Campbell, 1929.

References: Kofoid and Campbell, 1929; Marshall, 1969 (Fig. 37 a-d).

Description: Lorica fusiform, oral aperture circular; collar low-funnel-shaped (70-85°), its nuchal smallest diameter 0.54-0.60 of an oral diameter; bowl circular in cross section below the collar, then gradually becoming triangular, posteriorly with three ridges in the aboral 0.6 of the total length; aboral end acute; wall composed of separated laminae in the anterior 0.2 of the lorica.

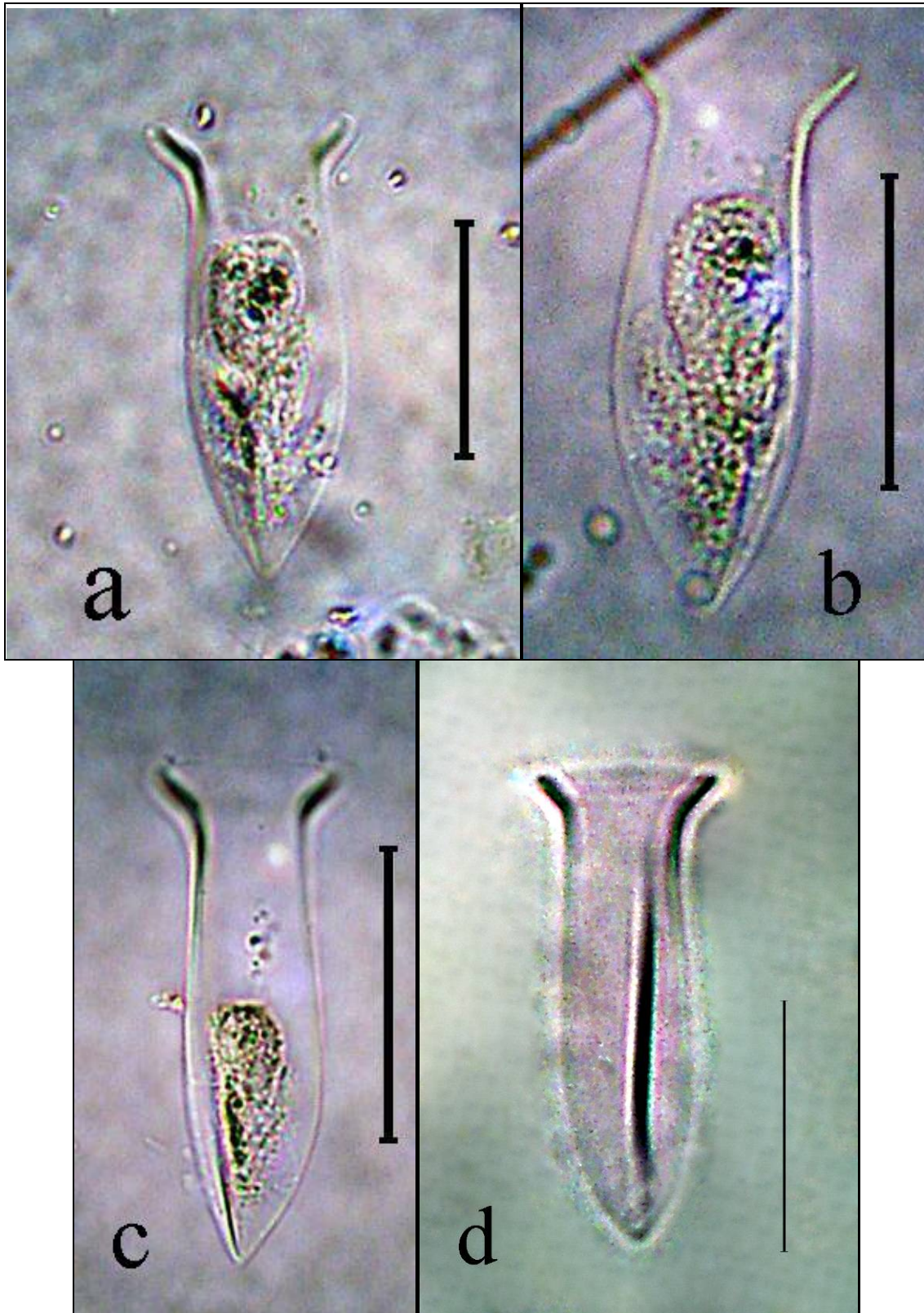


Fig. 31. a-d. Variations of lorica shape of *Amphorellopsis acuta* (Scale – 50 μm)

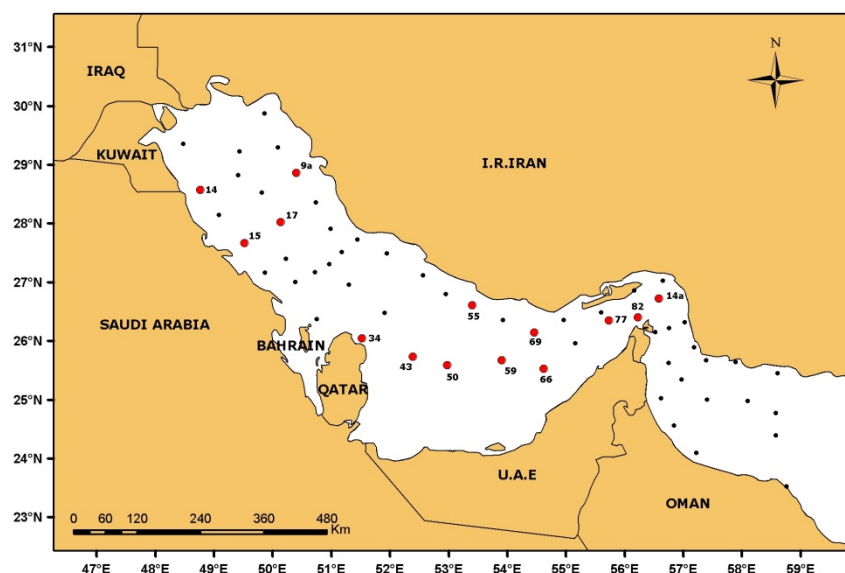
Comments: The species differs from the other species of *Amphorellopsis* in having three ridges.

Reported Measurements: Length 85-108 μm ; oral diameter 31-45 μm . Approximate ratio L/oral diameter 2.3-3.9.

Measurements of Specimens from the ROPME Sea Area: Length 92-102 μm ; oral diameter 36-49 μm ; approximate ratio L/oral diameter 2.1-2.7.

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *A. acuta* is common in Kuwait waters (Al-Yamani and Skryabin, 2006). In Winter 2006 Cruise, this species was registered from the northwestern region of the ROPME Sea Area to the Strait of Hormuz (St. 14, 9a, 15, 17, 34, 43, 50, 55, 59, 66, 69, 77, 82 and 14a).



Sites of occurrence of *Amphorellopsis acuta* in RSA

Genus: *Dadayiella* Kofoid and Campbell, 1929.

Reference: Kofoid and Campbell, 1929.

Tintinnidae with an elongated goblet-shaped lorica, 2.6-5.8 oral diameters in length; oral rim crenulated or entire; collar with 9-18 oblong facets; bowl campanulate, usually contracting

posteriorly to an elongated conical or cylindrical pedicel with or without an aboral knob; and with or without a pointed aboral tip.

Dadayiella cuspis Kofoid and Campbell, 1929.

References: Kofoid and Campbell, 1929; Marshall, 1969 (Fig. 38 a-b).

Description: Lorica small, elongated; collar flaring 12° , oral facets 11-13 on both collar and bowl extending to the pedicel; bowl subcylindrical conical posteriorly; pedicel short, 0.1-0.2 total length.

Reported Measurements: Total length (L) 67-93 μm ; oral diameter 22-31 μm . Approximate ratio L/oral diameter 2.9-3.1.

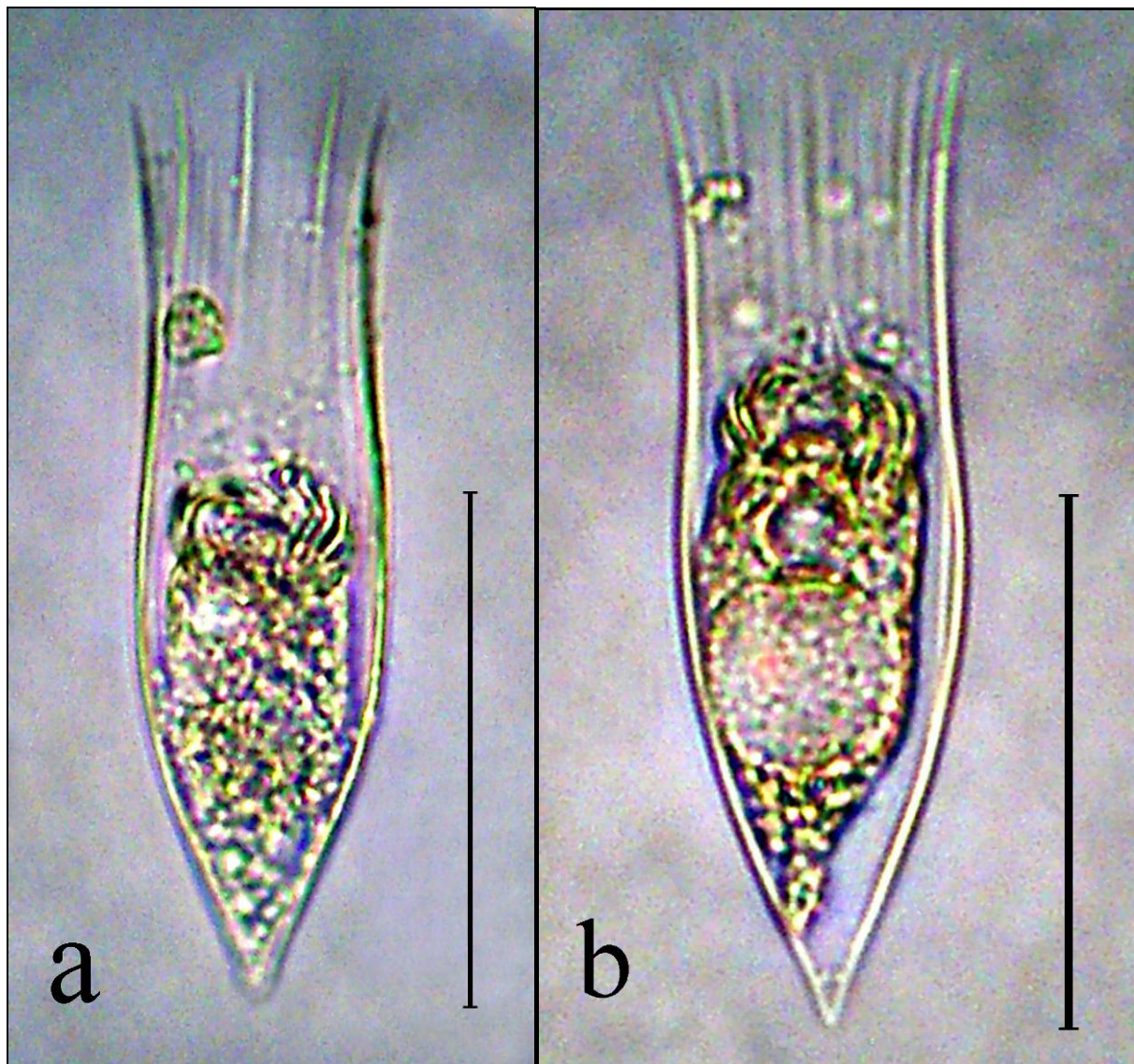
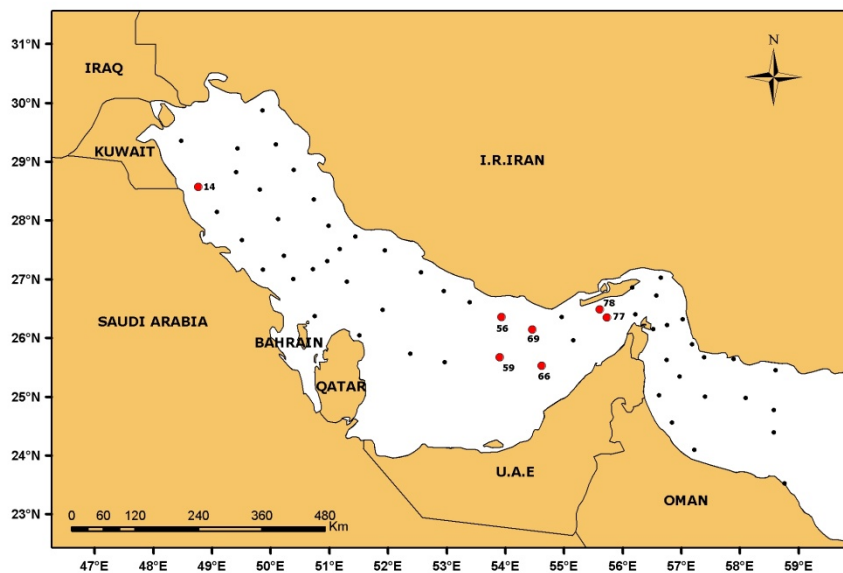


Fig. 32. a-b. Variations of lorica shape of *Dadayiella cuspis* (Scale – 50 μm)

Measurements of Specimens from the ROPME Sea Area: The oral facetes of lorica of all specimens from Kuwait waters sticking above the oral rim and form long spines, about 0.1-0.2 length of lorica. Total length 92-102 μm ; oral diameter 30-31 μm ; approximate ratio L/oral diameter 3.1-3.3.

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *D. cuspis* common in Kuwait waters (Al-Yamani and Skryabin, 2006). In Winter 2006 Cruise, this species was registered in the northwestern and in the eastern regions of the ROPME Sea Area (St. 14, 56, 59, 66, 69, 77 and 78).



Sites of occurrence of *Dadayiella cuspis* in RSA

Dadayiella ganymedes (Entz, 1884).

References: Kofoid and Campbell, 1929; Marshall, 1969 (Fig. 39 a-b).

Description: Lorica elongate, almost tubular or with a slightly flaring oral region, tapering from about $\frac{1}{2}$ total length to slender pedicel, about $\frac{1}{4}$ total length, pointed or obtuse at aboral tip. Pedicel often has 9-12 low longitudinal fins throughout its length. Oral region faceted with 9-18 ribs, sometime sticking up above oral rim. Nine secondary ribs sometimes appear between nine stronger primary ribs.

Comments: Y. Hada (1937) also includes in this species *D. acutiformes*, *D. bulbosa* and *D. jorgenseni*.

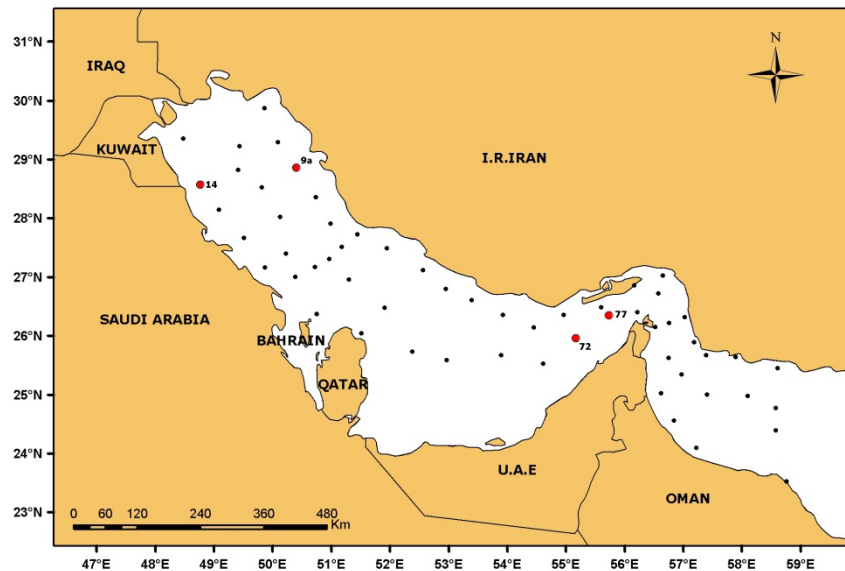


Fig. 33. a-b. Variations of lorica shape of *Dadayiella ganymedes* (Scale – 50 μ m, stained with Rose Bengal)

Reported Measurements: Total length 75-120 μm ; oral diameter 25-30 μm ; Approximate ratio L/oral diameter 3.0-4.2.

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *D. ganymedes* was registered in northwestern and in eastern regions of the inner RSA (St. 14, 9a, 72 and 77).



Sites of occurrence of *Dadayiella ganymedes* in RSA

Genus: *Eutintinnus* Kofoid and Campbell, 1939.

Reference: Kofoid and Campbell, 1939.

Tintinnidae with lorica in the form of a truncated cone or cylinder open at both ends; wall homogeneous, hyaline, rarely externally wrinkled, never with spiral structure.

Differs from all other genera of Tintinnidae in the lack of all structural differentiations in the oral and aboral ends, except those produced by eversion, by the thickening of the margins into a brim, and by the presence of teeth.

Eutintinnus apertus (Kofoid and Campbell, 1929).

Synonyms: *Tintinnus apertus* Kofoid and Campbell, 1929; *Tintinnus lusus-undae* var. *tubulosa* Brandt, 1906.

References: Kofoid and Campbell, 1929; Marshall, 1969 (Fig. 40 a-c).

Description: Lorica chalice-shaped; oral region slightly if at all flaring; bowl subconical (15° - 20°) anteriorly, slightly concave laterally; aboral region contracting abruptly to 0.3-0.6 oral diameter; aboral end truncated, open. Often with laterally attached pelagic diatoms, especially *Chaetoceros*.

Comments: This species differs from *E. angustatus* in wider aboral region.

Tintinnids *E. apertus* from the ROPME Sea Area often have an asymmetrical lorica. Aboral aperture of these specimens is shifted sideways relatively to the central axis of the lorica (Fig. 40 c).

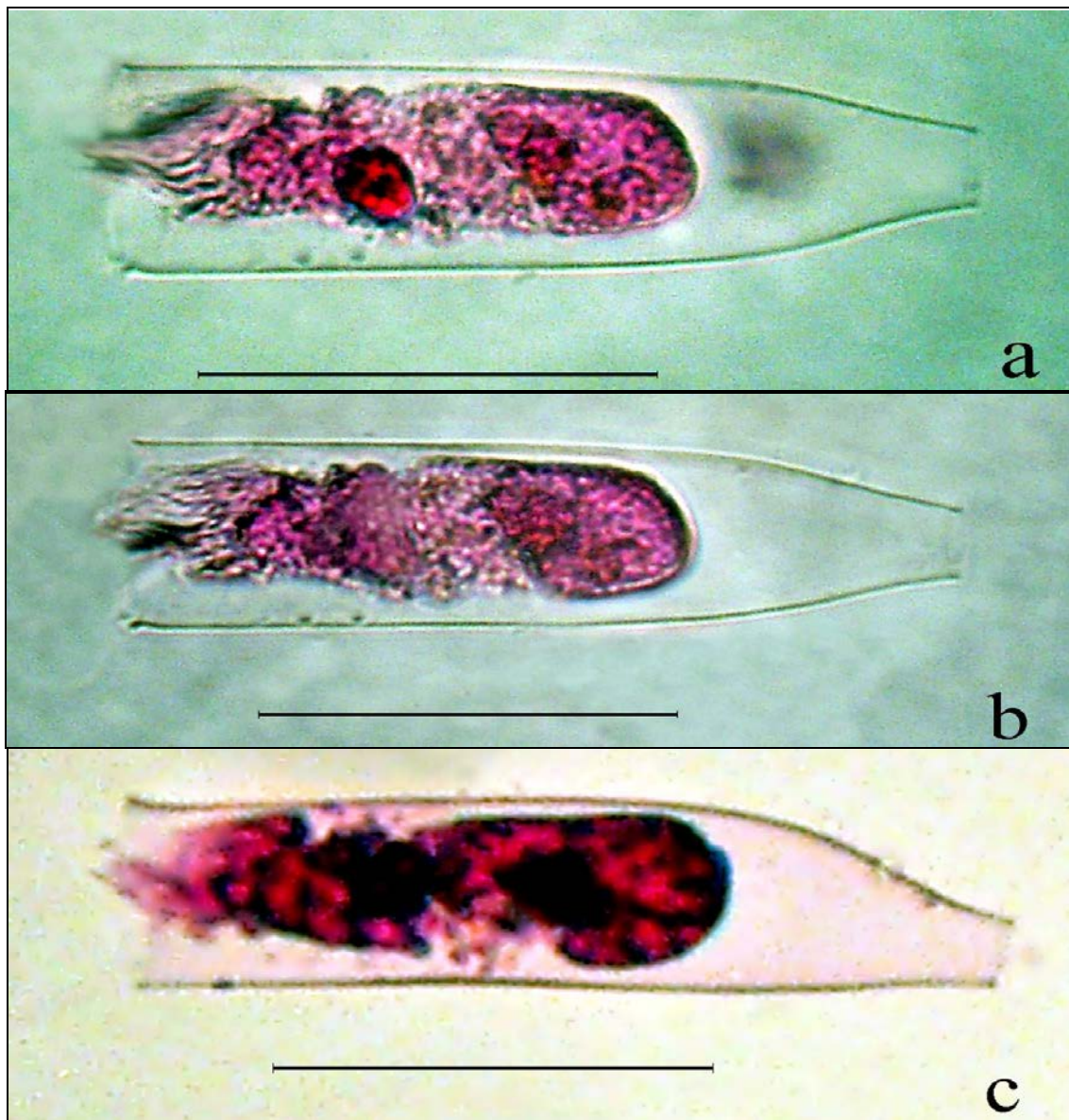
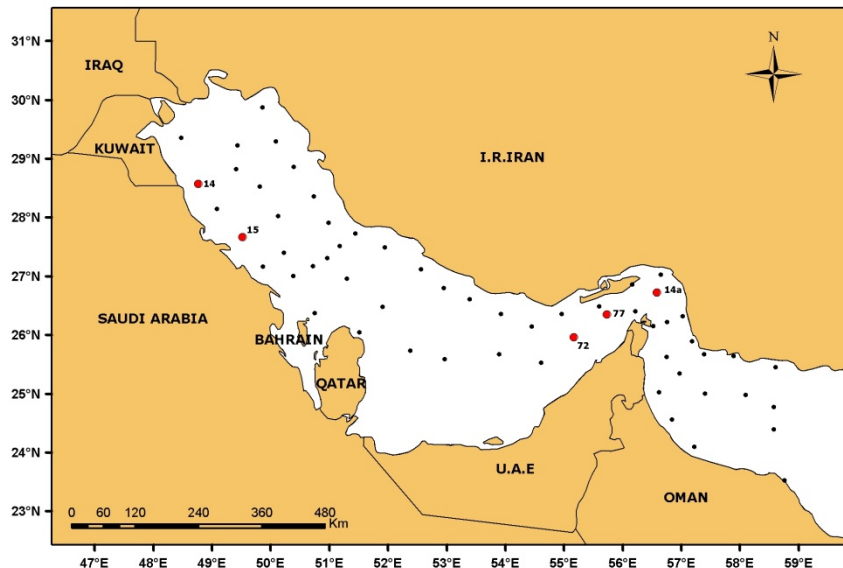


Fig. 34.a-c. Variations of lorica shape of *Eutintinnus apertus* (Scale – 50 μ m, stained with Rose Bengal)

Reported Measurements: Length 85-112 μm ; oral diameter 28-39 μm , approximate ratio L/oral diameter 2.2-3.2.

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *E. apertus* was registered in the northwestern and in the eastern regions of the ROPME Sea Area (St. 14, 15, 72, 77 and 14a).



Sites of occurrence of *Eutimninus apertus* in RSA

Eutimninus lusus-undae (Entz, 1885).

Synonym: *Tintinnus lusus undae* Entz, 1885.

References: Kofoid and Campbell, 1929; Marshall, 1969 (Fig. 41 a-d).

Description: Lorica almost cylindrical with slightly flaring oral end and low brim. No flare or brim aborally. Aboral diameter little more than 1/2 oral. Wall sometimes with prisms, sometimes with attached *Chaetoceros*.

Reported Measurements: Total length 169-290 μm . Oral diameter 38-54 μm . Approximate ratio L/oral diameter 3.2-4.9.

Measurements of Specimens from the ROPME Sea Area: Length 255-265 μm ; oral diameter 50-55 μm ; aboral diameter 25-26 μm ; approximate ratio L/oral diameter 5.0.

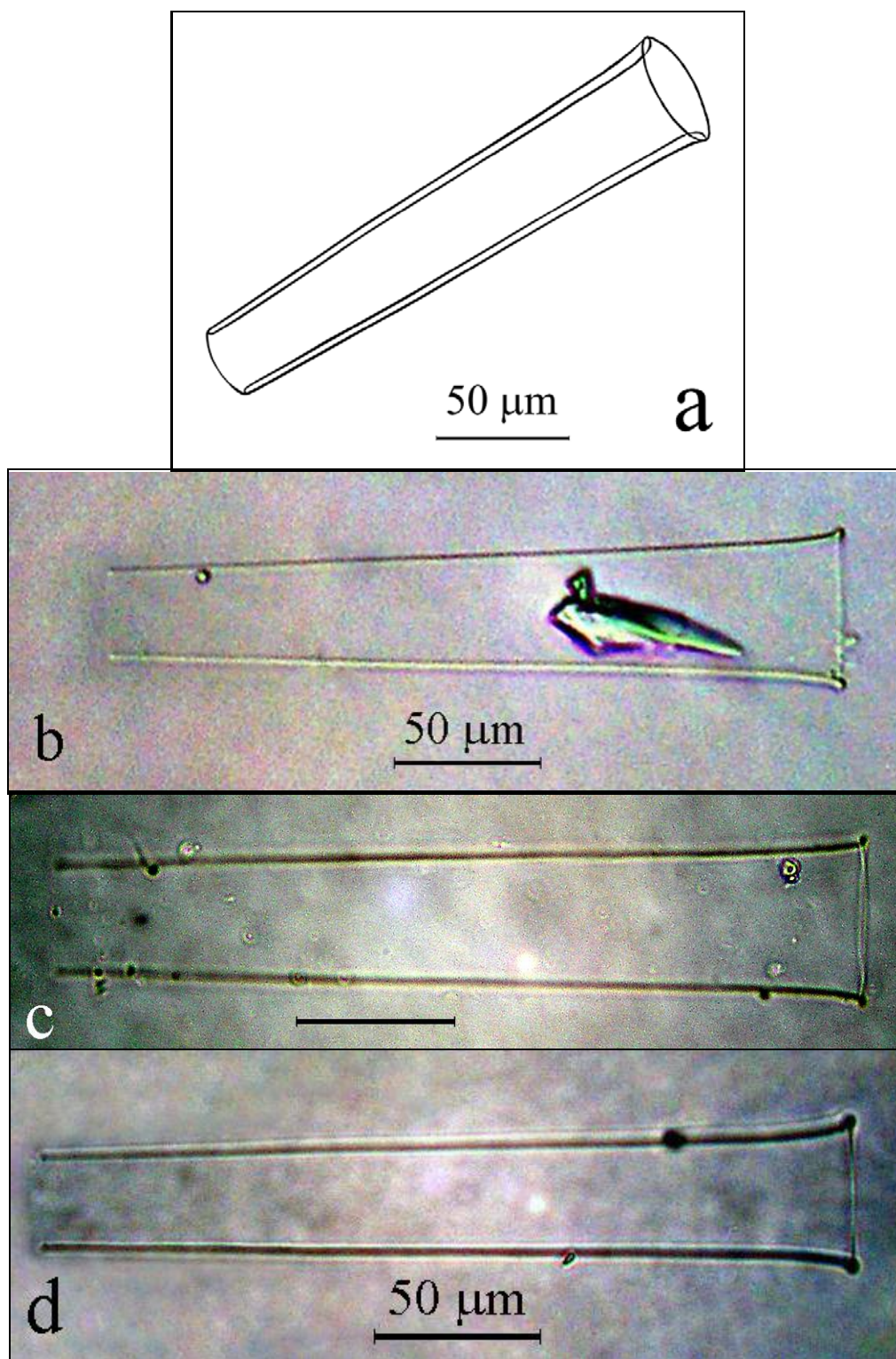
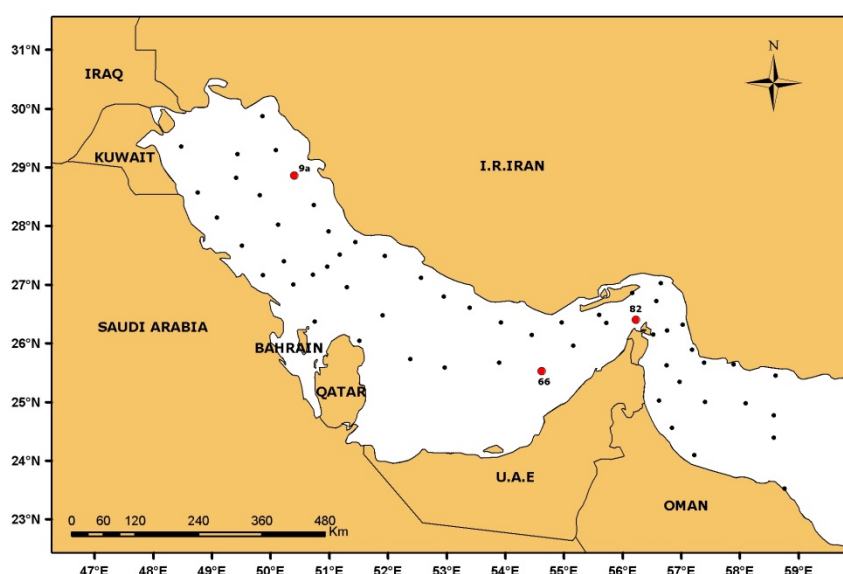


Fig. 35. a-d. Variations of lorica shape of *Eutintinnus lusus-undae* (Scale – 50 µm)

Geographical Distribution: Neritic and estuarine species in temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *E. lusus-undae* is common in Kuwait waters (Al-Yamani and Skryabin, 2006). In Winter 2006 Cruise, this species was registered in the northwestern and in the eastern regions of the inner RSA (St. 9a, 66 and 82).



Sites of occurrence of *Eutimninus lusus-undae* in RSA

Eutimninus macilentus (Jørgensen, 1924).

Synonym: *Tintinnus macilentus* Kofoid and Campbell, 1929.

References: Kofoid and Campbell, 1929; Marshall, 1969 (Fig. 42 a-c).

Description: Lorica a short truncated cone (6-9°); oral margin with a bearm; shaft flaring (18-29°) anteriorly, contracting as a cone (3-5°) toward the aboral end to a least diameter, 0.5 oral diameter, at a level 1.0 oral diameter from the aboral end; flaring aborally (30°).

Reported Measurements: Length 136-290 µm; oral diameter 37-58 µm, approximate ratio L/oral diameter 4.5-7.5.

Measurements of Specimens from the ROPME Sea Area: Length 214-227 µm; oral diameter 31-40 µm; aboral diameter 16-23 µm; approximate ratio L/oral diameter 3.6-5.0.

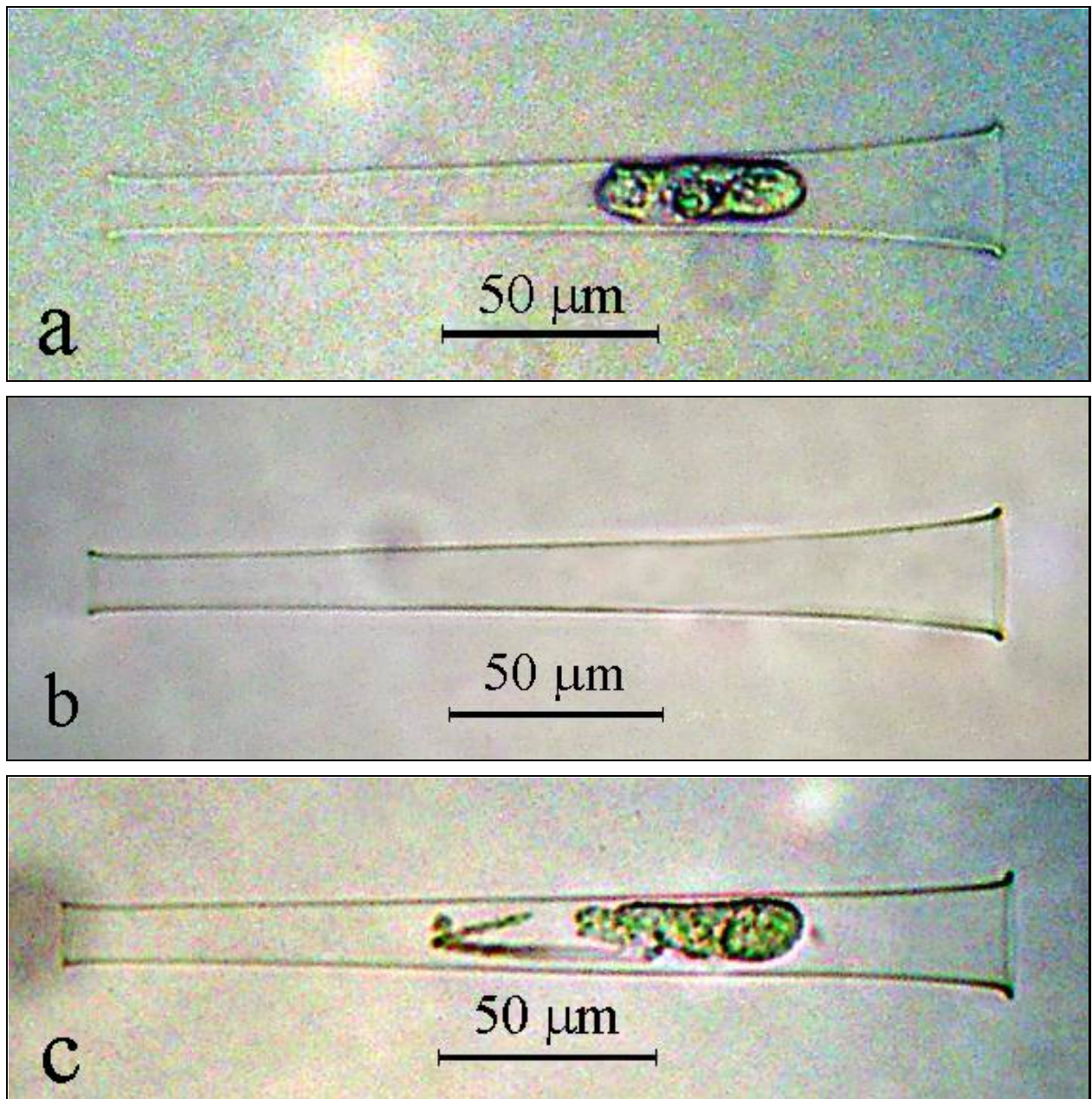
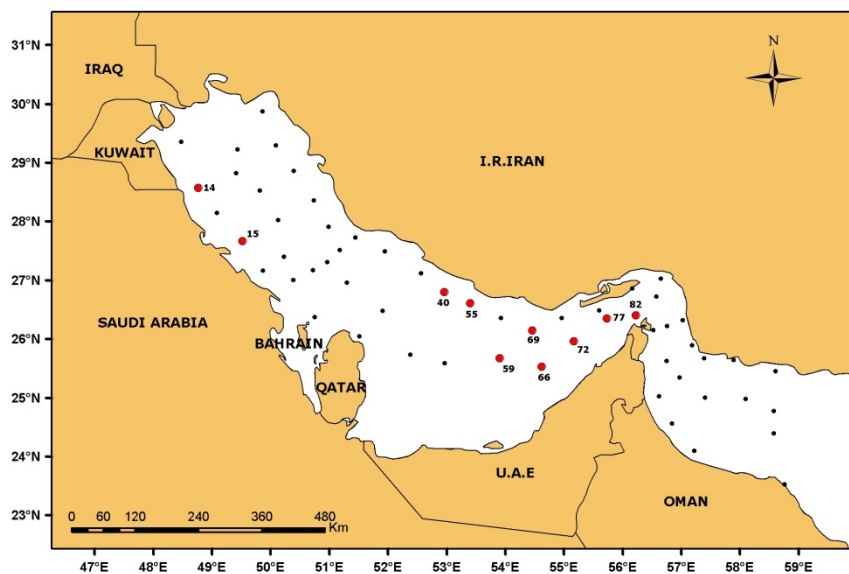


Fig. 36. a-c. Variations of lorica shape of *Eutintinnus macilentus* (Scale – 50 µm)

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *E. macilentus* is common in Kuwait waters (Al-Yamani and Skryabin, 2006). In Winter 2006 Cruise, this species was registered in the northwestern and the eastern areas of the inner RSA (St. 14, 15, 40, 55, 59, 66, 69, 72, 77 and 82).



Sites of occurrence of *Eutintinnus macilentus* in RSA

Eutintinnus tenue Kofoid and Campbell, 1929.

Synonym: *Tintinnus tenue* Kofoid and Campbell, 1929.

References: Kofoid and Campbell, 1929; Marshall, 1969 (Fig. 43 a-c).

Description: Lorica almost cylindrical; with tapering shaft of 2-6°; oral end abruptly flaring 20-35° into a horizontal brim; aboral end without flare.

Reported Measurements: Length 290 μm (179-238 μm); oral diameter 38-54 μm , approximate ratio L/oral diameter 4.3-6.1.

Measurements of Specimens from the ROPME Sea Area: Length 255-265 μm ; oral diameter 50-55 μm ; aboral diameter 25-26 μm ; approximate ratio L/oral diameter 5.0.

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

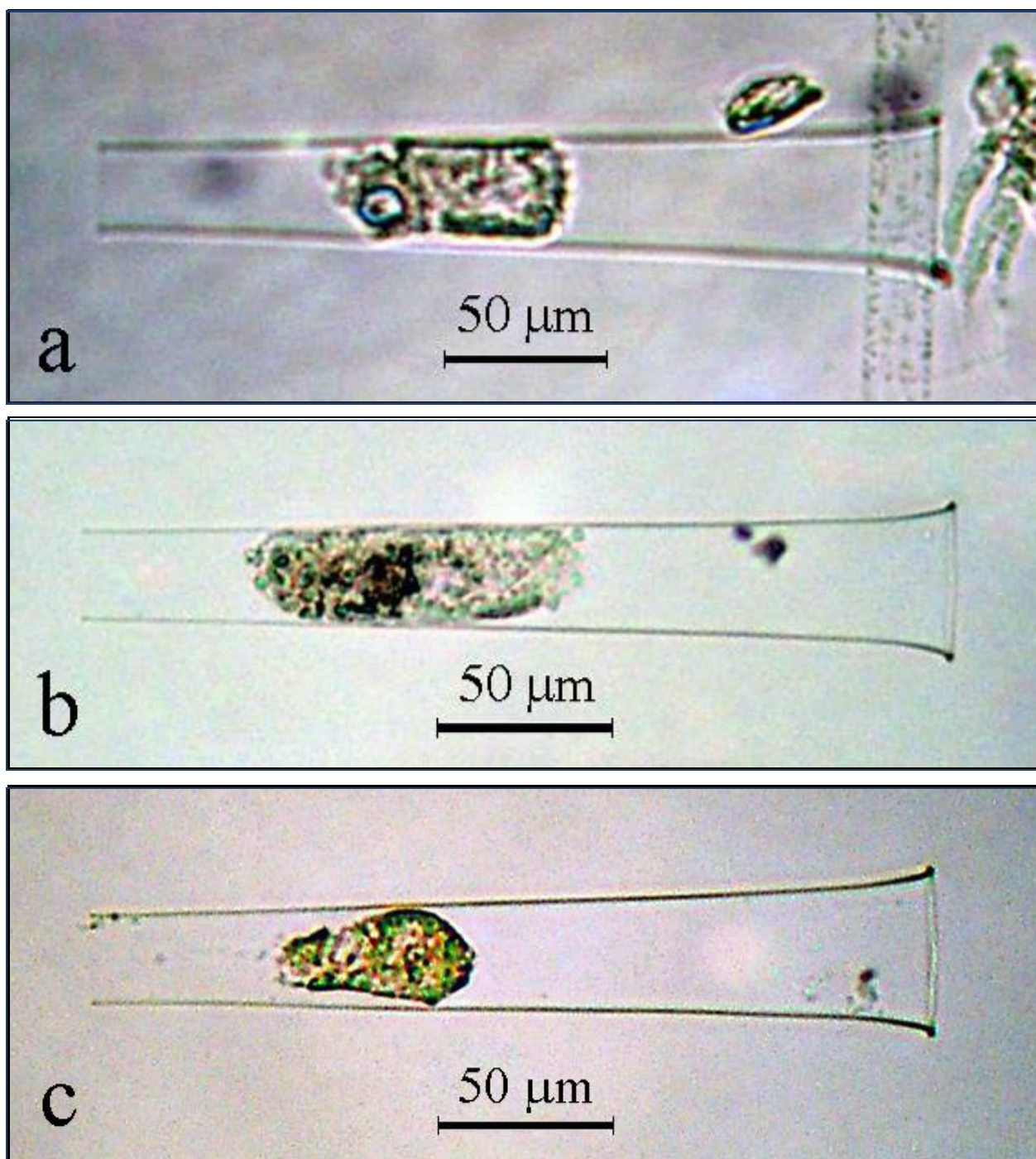
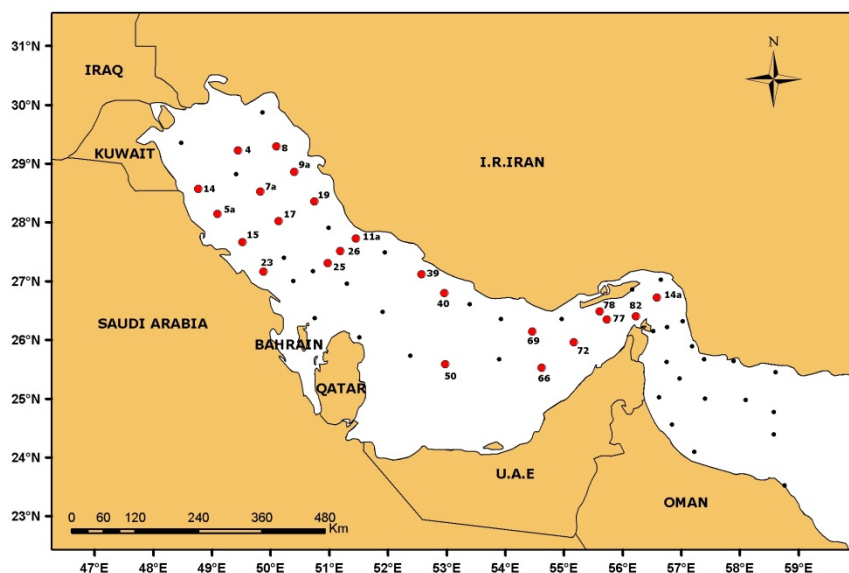


Fig. 37. a-c. Variations of lorica shape of *Eutintinnus tenue* (Scale – 50 μm)

Sites of Occurrence in RSA: *E. tenue* is common in Kuwait waters (Al-Yamani and Skryabin, 2006). In Winter 2006 Cruise, this species was registered at all studied areas of the ROPME Sea Area, from the northwestern region to the Strait of Hormuz and Sea of Oman (St. 4, 14, 8, 5a, 7a, 9a, 15, 17, 19, 23, 25, 26, 11a, 39, 40, 50, 66, 69, 72, 77, 78, 82 and 14a).



Sites of occurrence of *Eutintinnus tenue* in RSA

Eutintinnus turgescens (Kofoid and Campbell, 1929).

Synonym: *Tintinnus turgescens* Kofoid and Campbell, 1929.

References: Kofoid and Campbell, 1929; Marshall, 1969 (Fig. 44 a-d).

Description: Lorica almost cylindrical, 3.2-4.4 oral diameters in length; with subconical shaft of 5-8°, with submedian expansion and strait aboral end from 1/2-2/3 diameter of oral. Oral end gradually flaring 20-35° to a slightly emergent brim. This species is similar to *E. lusus-undae* apart the median expansion.

Reported Measurements: Length 155-193 µm; oral diameter 39-48 µm, approximate ratio L/oral diameter 3.2-4.4.

Measurements of Specimens from the ROPME Sea Area: Length 244 µm; oral diameter 42 µm; aboral diameter 26 µm; approximate ratio L/oral diameter 5.8.

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

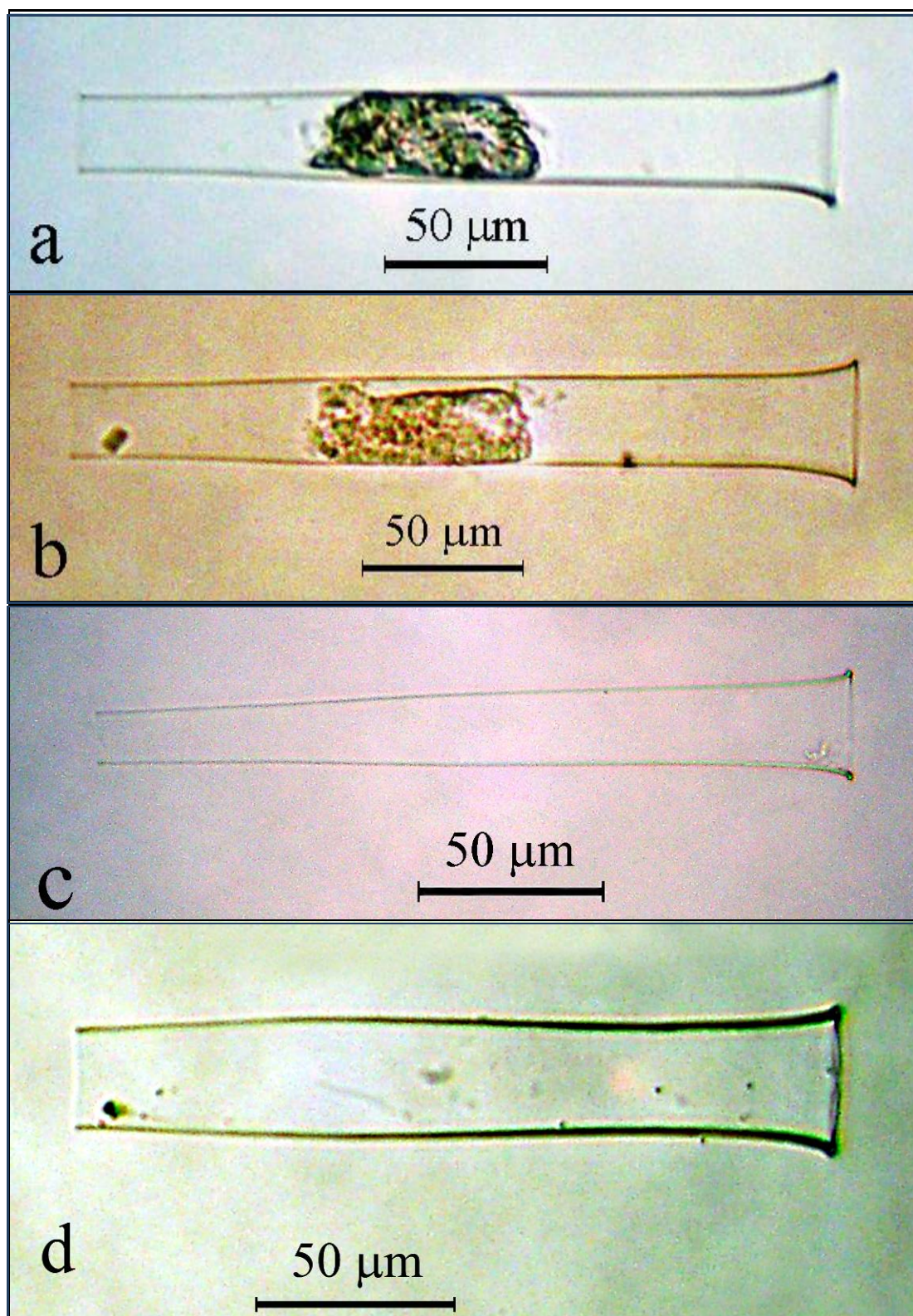
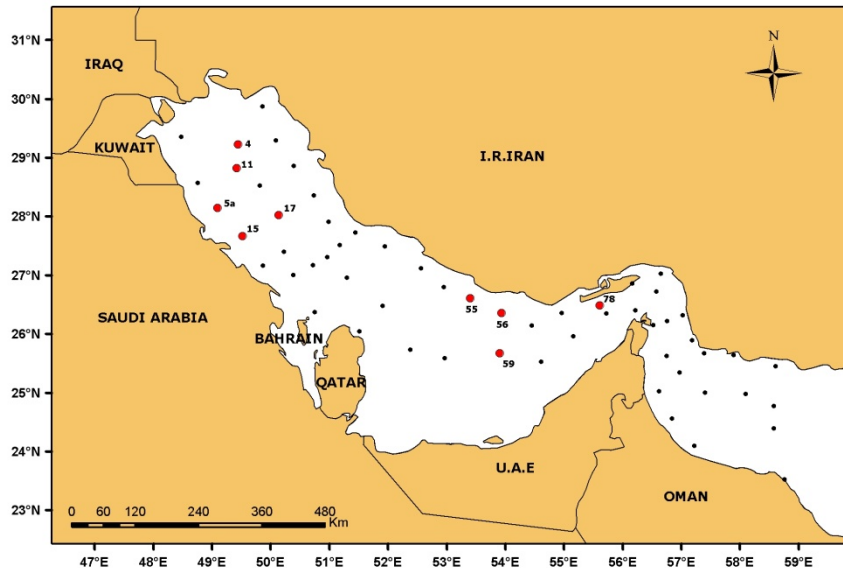


Fig. 38. a-d. Variations of lorica shape of *Eutintinnus turgescens* (Scale – 50 µm)

Sites of Occurrence in RSA: *E. turgescens* is common in Kuwait waters (Al-Yamani and Skryabin, 2006). In Winter 2006 Cruise, this species was registered in the northwestern and eastern areas of the inner RSA (St. 4, 5a, 11, 15, 17, 55, 56, 59 and 78).



Sites of occurrence of *Eutintinnus turgescens* in RSA

Genus: *Salpingella* Jorgensen, 1924.

Reference: Kofoed and Campbell, 1939.

Tintinnidae with lorica usually elongated, generally slender, trumpet-shaped, with a short collar provided with a circular or polygonal oral rim; bowl forming a tubular shaft in the anterior main part which becomes gradually tapering posteriorly, having a number of raised spiral fins in the lower region; aboral end typically opening; wall hyaline, composed of a single layer.

Differs from *Eutintinnus* in having the aboral end contracted, usually to a small terminal cylinder and in having aboral striae; from *Salpingacantha* in the absence of teeth in the oral margin; from *Daturella* in the rigidity of the lorica and greater aboral taper and contraction; and from *Epicranella* in the absence of suboral arches.

Salpingella attenuata Jorgensen, 1924.

References: Kofoed and Campbell, 1939; Marshall, 1969 (Fig. 45 a-c).

Description: Lorica very much elongated, collar is a funnel of 55°-60°, 0.6 oral diameter in length; bowl cylindrical in the anterior 0.8-0.9 total length, posteriorly a cone (6°-10°) with unevenly contracted sides; no aboral cylinder; fins 5-7, low blades, 0.2-0.4 total length in length, usually subvertical or dextrotropic (5°), sometimes giving appearance of aboral expansion.

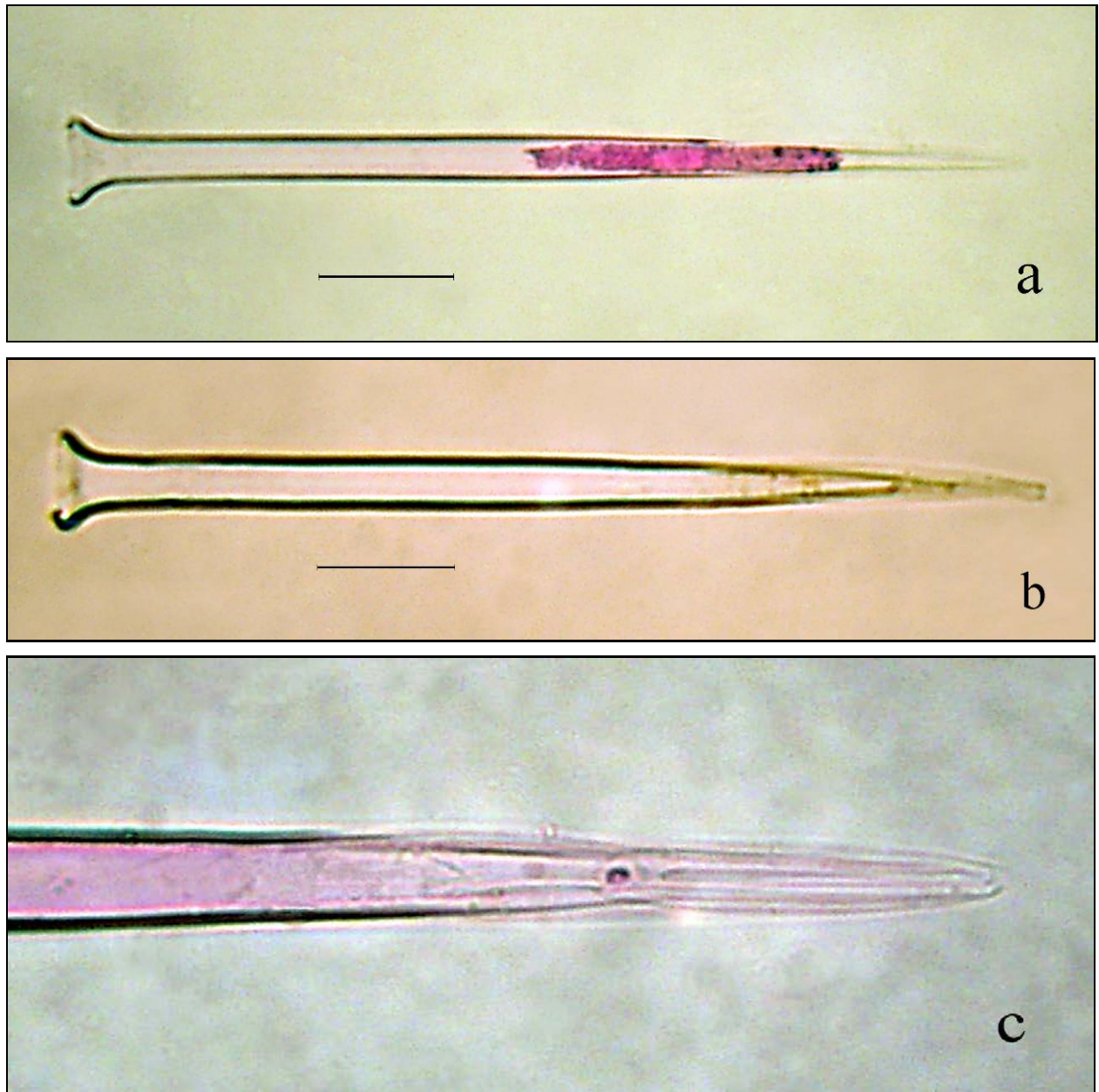


Fig. 39. Variations of lorica shape of *Salpingella attenuata* (Scale – 50 μ m, stained with Rose Bengal)

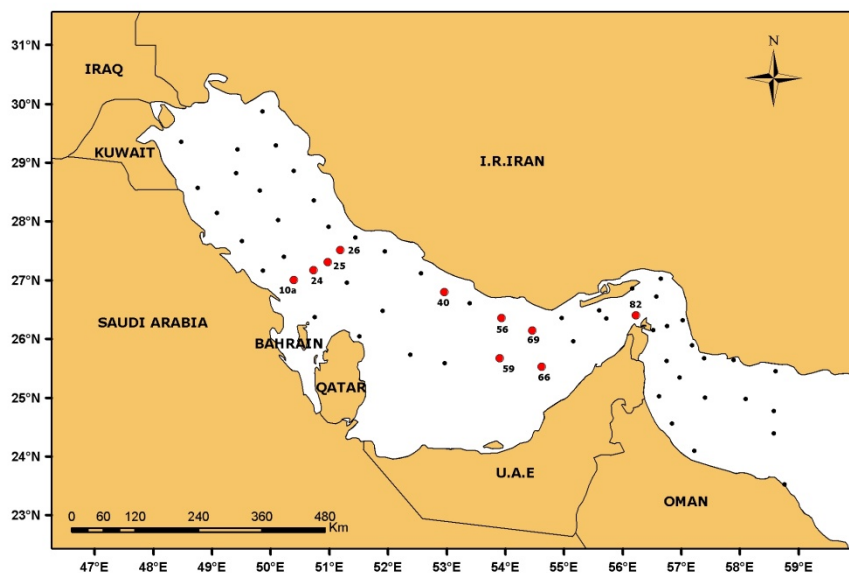
a, b. shape of lorica; c. aboral end.

Comments: This species differs from *S. faurei* in lack of expanded bowl, larger size and fewer fins, from *S. gracilis* in size and in having fewer fins, and from *S. ricta* in more slender proportions and in lack of the surface rugose.

Reported Measurements: Length 248-433 μm ; oral diameter 32-43 μm , transdiameter of the bowl 16 μm , approximate ratio L/oral diameter 7.4-15.3.

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *S. attenuata* was registered in the central and eastern regions of the inner RSA (St. 10a, 24, 25, 26, 40, 56, 59, 66, 69 and 82).



Sites of occurrence of *Salpingella attenuata* in RSA

Salpingella rotundata Jorgensen, 1924.

References: Kofoed and Campbell, 1929; Marshall, 1969 (Fig. 46 a-c).

Description: Lorica small, test-tube-like, inflated posteriorly; bowl cylindrical, with 6-7 low, ridge-like fins on the posterior 1/3 of the total length; aboral cylinder present.

Comments: This species differs from *S. curta* in proportions and heavier fins.

Reported Measurements: Length 92-160 μm ; oral diameter 13-19 μm , approximate ratio L/oral diameter 7.0-10.0.

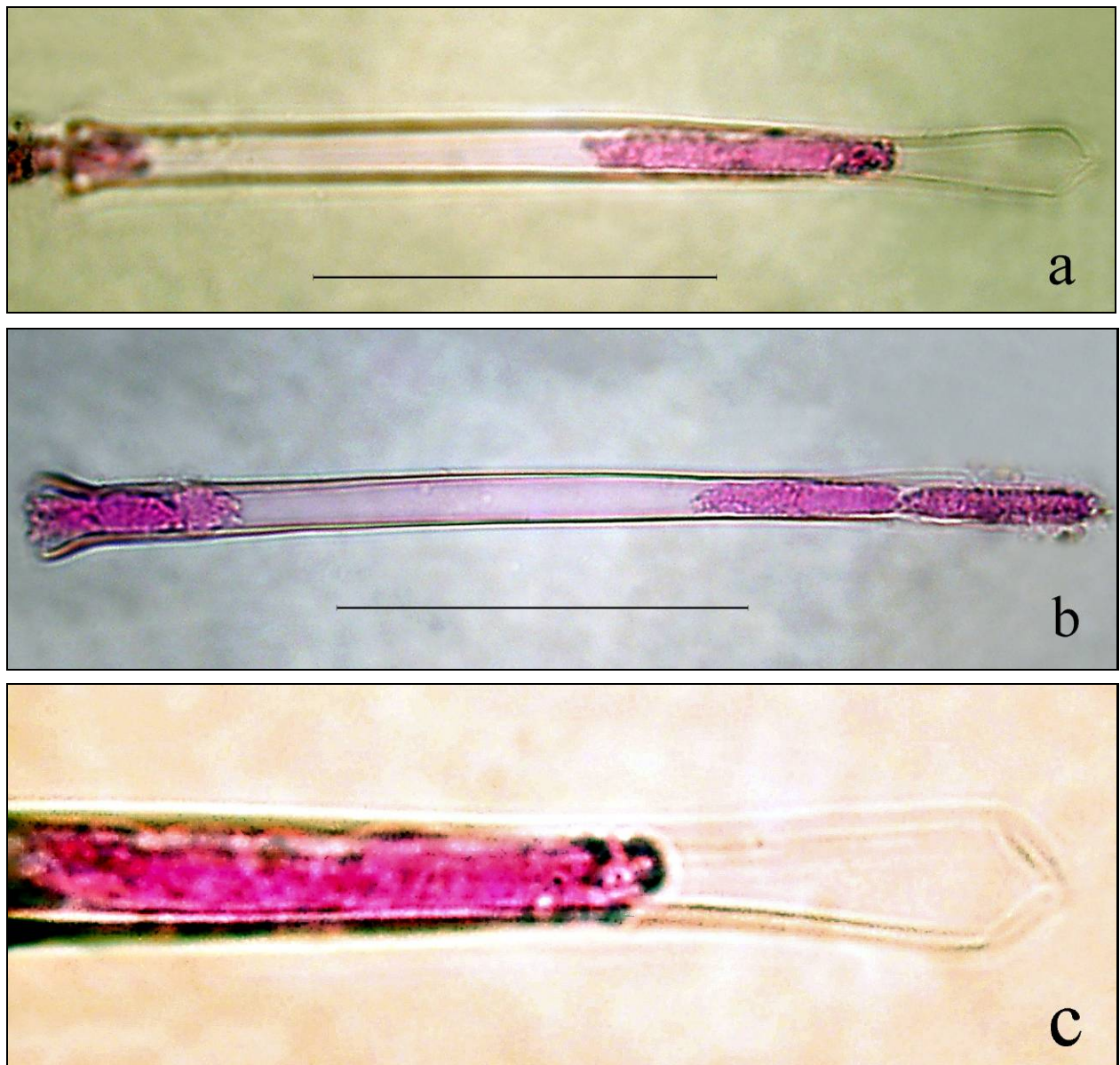
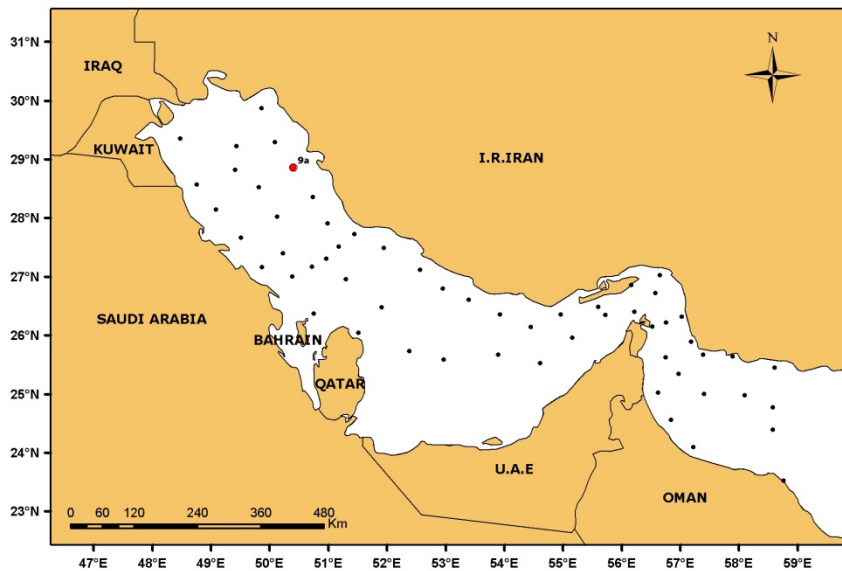


Fig. 40. Variations of lorica shape of *Salpingella rotundata* (Scale – 50 μm , stained with Rose Bengal)

a, b. shape of lorica; b. aboral end.

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *S. rotundata* was registered in low abundance in the northern part of the inner RSA, near Iranian coast (St. 9a).



Site of occurrence of *Salpingella rotundata* in RSA

Genus: *Salpingacantha* Kofoid and Campbell, 1929.

Synonym: *Tintinnus undatus* var. *unguiculata* Brandt, 1906.

Reference: Kofoid and Campbell, 1929.

Tintinnidae with lorica usually elongated, attenuated posteriorly, generally a nail-shaped, posteriorly truncated, tapering tube; oral margin with blunt or sharp, triangular, flaring, erect or incurved teeth; collar usually funnel-like or formed only by the swollen base of the teeth; bowl elongated cylindrical or slightly tapering, usually uniform, sometimes swollen in the middle, posteriorly a narrow, truncated cone; with 5-8 decurrent, low, blade-like fins; antapex with or without a distinct terminal cylinder.

Differs from all other genera of Tintinnidae in the presence of teeth in the oral margin.

Salpingacantha unguiculata Brandt, 1906

References: Kofoid and Campbell, 1929; Marshall, 1969 (Fig. 47 a-c)

Description: Slender tapering tube, oral region bowl-shaped, but little expanded. Oral margin with 5-8 strong incurved teeth, margin between flattened and rolled inwards. Shaft sometimes

slightly dilated in middle, contracting to narrow aboral end, with or without aboral cylinder.
7-8 low fins posteriorly.

Reported Measurements: Length 130-290 μm ; oral diameter 11-20 μm , approximate ratio
L/oral diameter 10.4-14.5.

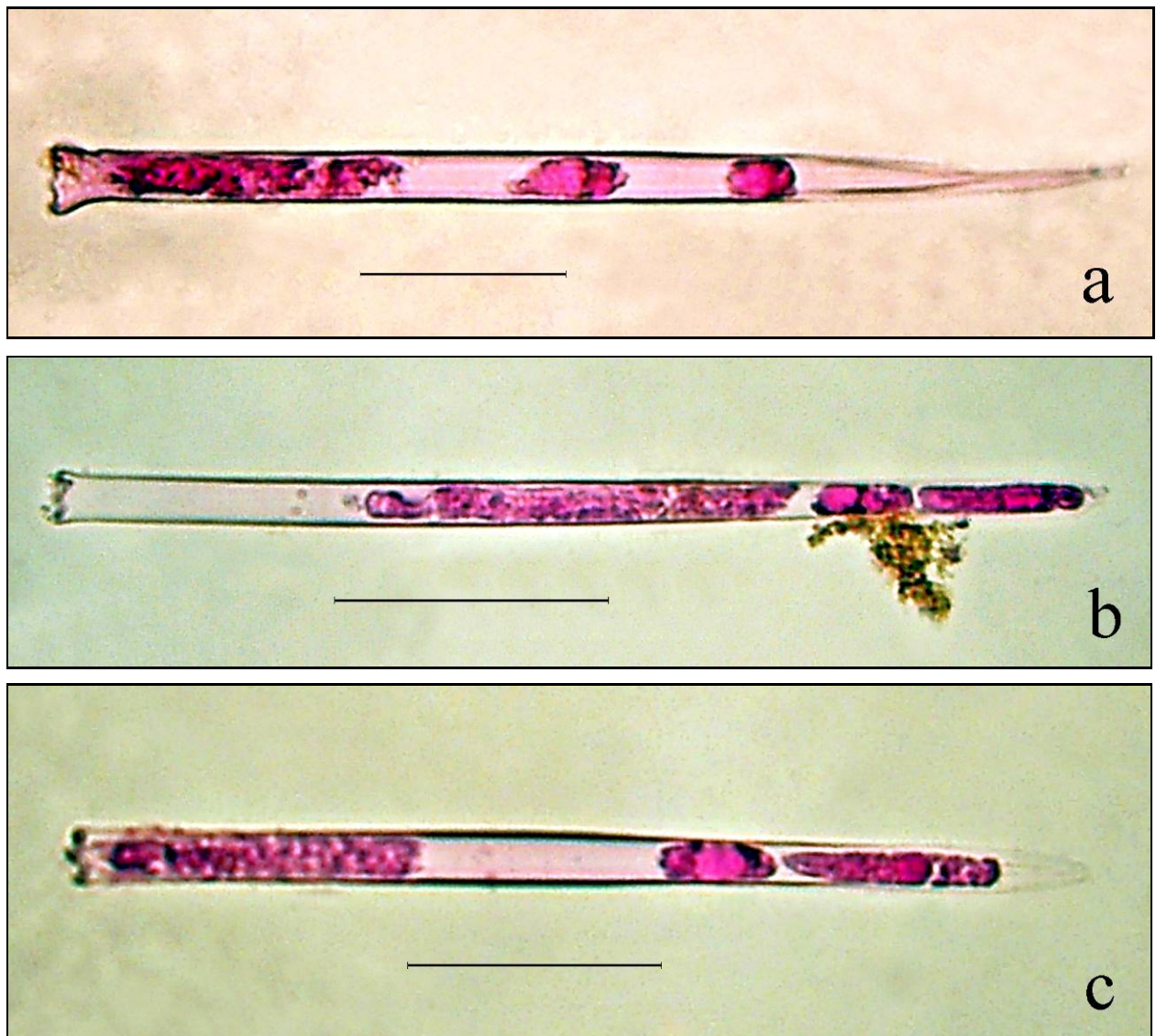
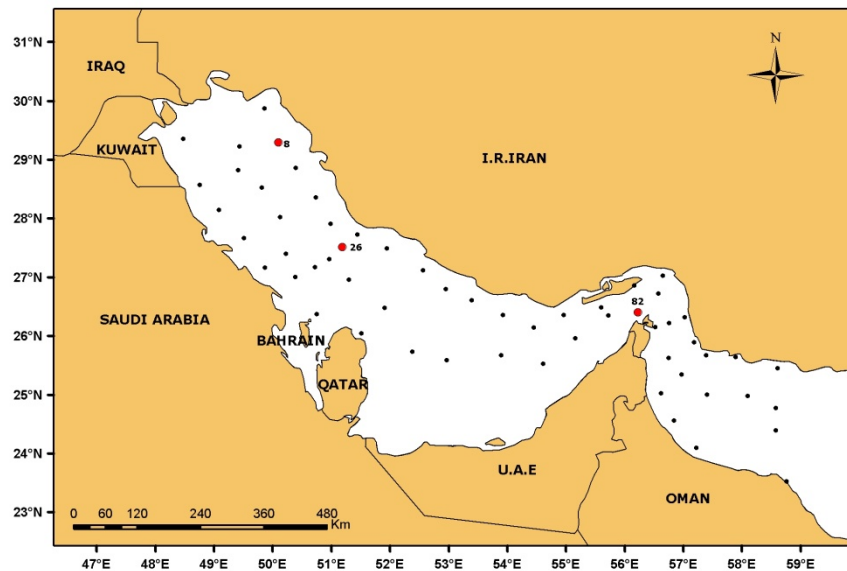


Fig. 41. a-c. Variations of lorica shape of *Salpingacantha unguiculata* (Scale – 50 μm , stained with Rose Bengal)

Geographical Distribution: Temperate and tropical waters of Atlantic, Indian and Pacific oceans.

Sites of Occurrence in RSA: *S. unguiculata* was registered in low abundances in the northwestern and central regions of the inner RSA and in Strait of Hormuz (St. 8, 26 and 82).



Sites of occurrence of *Salpingacatha unguiculata* in RSA

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