

Three new species of Myxosporea (Bivalvulida), parasites of the gallbladder of scombrid fish, from the Bay of Bengal (Indian Ocean), West Bengal, India

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Summary

We describe three new myxosporean species (Myxozoa: Myxosporea: Bivalvulida) *Zschokkella scomberosis* sp. n. and *Thelohanelloides lomae* sp. n. from the gallbladder of *Scomberoides commersonianus* (Scombridae), and *Pseudalataspora misrae* sp. n. from the gallbladder of *Rastrelliger kanagurta* (Scombridae), from West Bengal coast of the Bay of Bengal (Indian Ocean), India.

Key words: Myxosporea, Scombridae, *Zschokkella*, *Pseudalataspora*, *Thelohanelloides*, *Scomberoides*, *Rastrelliger*, the Bay of Bengal (Indian Ocean)

Introduction

The myxosporean species are coelozoic or histozoic (Lom and Dykova, 1992) infecting marine and freshwater fish, amphibians and reptiles (Lom and Dykova, 2006) throughout the world. Their life cycle requires an oligochaete intermediate host to complete development, although direct development or fish-to-fish transmission also occur (Diamant, 1997). Presently about more than 2200 myxosporean species are known (Fiala 2006; Lom and Dykova, 2006). In India, however, only about 200 species of myxosporea have been described (Tripathi, 1951; Lalithakumari, 1969; Narasinhmurti et al., 1990; Padma Dorothi et al., 1998; Sarkar, 2010; Singh and Kaur, 2012). While studying the diversity of myxosporea in fish inhabiting the Bay of Bengal (Indian Ocean), many species have been identified. The present investigation describes three new

species of genera *Zschokkella* (Auerbach, 1910), *Pseudalataspora* (Kovaleva and Gaevskaya, 1983), and *Thelohanelloides* (Sarkar, 2009).

Material and methods

Fishes were collected during 2008–20011 in the Bay of Bengal coast of West Bengal (87.32°N, 21.36°E) at Kakdwip of South 24-parganas district and at Digha of Midnapur district. Fish samples were preserved in ice chests until examination in the laboratory. Autopsies were taken from frozen fish and examined under the microscope for myxosporean infections. Squash preparations of the infected gallbladder and other organs were prepared. The spores and plasmodia were studied under the microscope with 100× oil objective, with a drop of Lugol's iodine. All measurements were performed as

suggested by Lom and Arthur (1989). The minimum and maximum spore measurements are provided in micrometers (μm), followed by arithmetic mean and standard deviation in parentheses. Giemsa (Emark) was used for staining dry smears of tissues prefixed in absolute methanol. The figures were drawn with the aid of camera lucida and CorelDRAW 12. The micrographs were taken with Viviter equipment.

Results

ZSCHOKKELLA SCOMBEROSIS SP. N. (FIGS 1-3)

Vegetative and sporogonial stages: not observed.

Spores: mature spores were broadly ellipsoidal with round ends in valvular view and ellipsoidal in sutural view with acuminate ends; suture distinct, thick and elongated S-shaped, slightly sinuous; shell valves with many end-to-end fine striations; two polar capsules almost ovoid in sutural and spherical in valvular views, the polar filament in the capsule was indiscernible; but when extruded it was thick and measured about $36\mu\text{m}$ in length. Inter-capsular spore cavity was filled with the uninucleate sporoplasm. Frozen spores measured 17.8 ± 1.42 ($16.5-19.5$) \times 10.4 ± 1.43 ($9-12$) μm ; polar capsules 4.4 ± 0.54 ($3.7-5.0$) μm in diameter, or 4.9 ± 0.87 ($3.7-5.25$) \times 4.2 ± 0.59 ($3-4.5$) μm , polar filaments 35.7 ± 5.43 ($28.5-39.0$) μm in length, total number of frozen spores – 20.

Host: *Scomberoides commersonianus* (Scombridae).

Site of infection: gallbladder.

Incidence: 2/53 (3.77%).

Locality: Kakdwip, 24 Parganas (South), Bay of Bengal coast of West Bengal, India.

Material: syntypes on slide No. MyxZk. 23, deposited to the Zoological Survey of India, Kolkata.

Differential diagnosis (Table 1). The salient features of the present species, such as coelozoic localization, ellipsoid or broadly ellipsoid spores, S-shaped elongate suture, round polar capsule, and marine host, were similar to the features of *Zschokkella* Auerbach, 1910 (Lom and Dykova, 2006). So, the current species is placed in the genus *Zschokkella* Auerbach, 1910. The type species of the genus is *Zschokkella hildae* Auerbach, 1910 (Kudo, 1919). The morphometry, phylogeny and location of the type species have been extensively studied by Holzer et al. (2010). Among the known 68 *Zschokkella* spp. about seven species are relatively similar to the current *Zschokkella* sp. in the shape of

the spores and the polar capsules, and striations on shell valves. They are: *Z. ilishae* ($12.36 \times 6.18 \mu\text{m}$, Pc. $4.26 \mu\text{m}$) reported from *Hilsa ilisha* from the Bay of Bengal (Chakravarty, 1943), *Z. platistomusi* ($10.5-12.75 \times 6.5-7.35 \mu\text{m}$, Pc. $2.8-3.5 \mu\text{m}$, Pf. $84 \mu\text{m}$ long) reported from *Tachysurus platystomus* from the Bay of Bengal (Sarkar, 1987), *Z. ganapatii* ($11.18-15.48 \times 7.74-10.32 \mu\text{m}$, Pc. $2.58-4.3 \mu\text{m}$, Pf. $28-40 \mu\text{m}$ long) reported from *Liza macrolepis* of the Bay of Bengal (Padma Dorothi and Kalavati, 1992), *Z. cascasiensis* ($8.0-10.5 \times 6.5-8.0 \mu\text{m}$, Pc. $3-4 \mu\text{m}$) reported from *Sicamugil cascasia* from the Bay of Bengal (Sarkar, 1995), *Z. leptatherinae* ($13.0-17.0 \times 9.5-14.0 \mu\text{m}$, Pc. $3.5-5.0 \mu\text{m}$, Pf. $18.0-34.0 \mu\text{m}$ long) reported from *Leptotherina presbyteroides* from Tasmania (Su and White, 1995), *Z. pseudosciaena* ($9.5-13.0 \times 5.0-7.0 \mu\text{m}$, Pc. $3.5-4.5 \mu\text{m}$) reported from kidney tubules and ureter of *Pseudosciaena coibor* from the Bay of Bengal (Sarkar, 1996), *Z. egyptica* ($12.5-15.0 \times 9.5-11.0 \mu\text{m}$, Pc. $4.2-5.2 \mu\text{m}$) reported from *Plotosus lineatus*, *Upeneus tragula* from Red Sea (Ali et al., 2007), and *Z. helmlii* ($10.0-11.0 \times 7.0-8.0 \mu\text{m}$, Pc. $2.0-3.0 \mu\text{m}$) reported from *Siganus rivulatus* from Red Sea (Abdel-Gaffar et al., 2008). All the above mentioned *Zschokkella* spp. are dissimilar in size of spores and therefore distinctly different from the novel *Zschokkella* sp. having also slightly sinuous suture. Thus, the species under study was assigned to a new species and named *Zschokkella scomberosis* sp. n. The epithetic name is given after the host name.

PSEUDALATASPORA MISRAE SP. N. (FIGS 4-8)

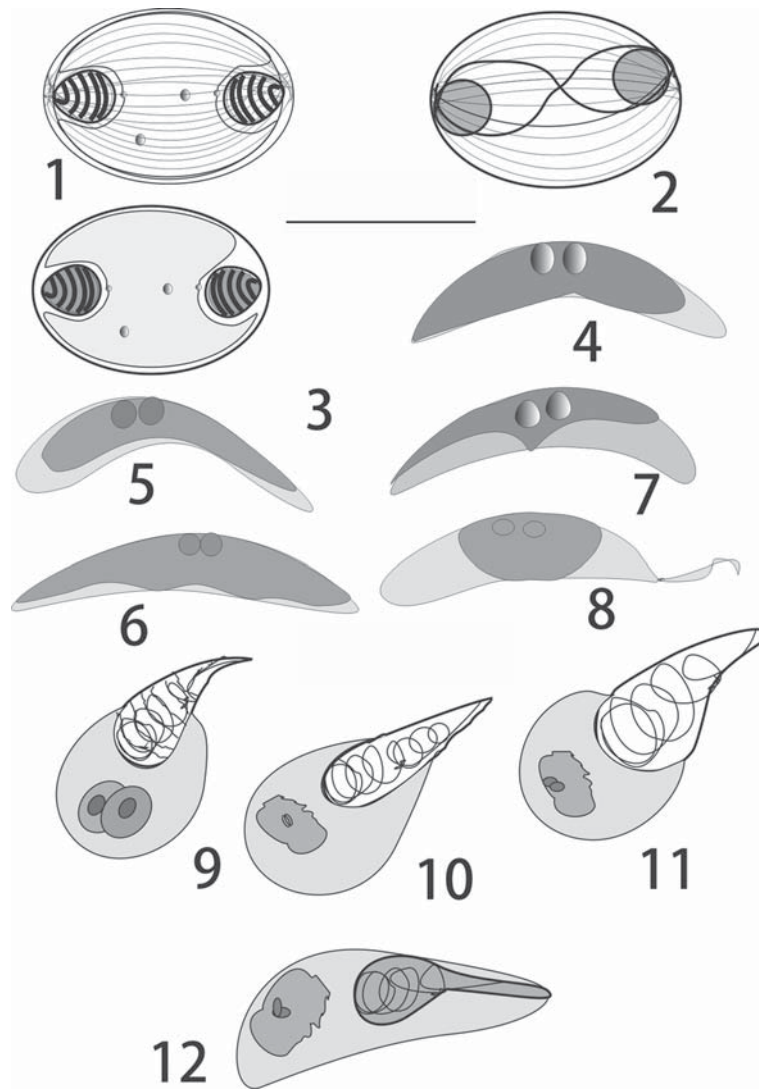
Plasmodia: disporic.

Spores: asymmetrical, laterally elongated, with one end broadly round, another – gradually pointed and often terminally twisted, with parachute-like lateral projection on each shell valve; these projections dissimilar, one pointed and occasionally folded, while another broad and round; obliterated suture vertical; thin-walled polar capsules usually equal, ovoid, rarely round; binucleated sporoplasm indiscernible. Frozen unfixed spores and polar capsules measure 24.5 ± 1.41 ($22.5-25.5$) \times 9.2 ± 0.71 ($8.2-9.7$) μm and 4.2 ± 0.38 ($3.7-4.5$) \times 4.0 ± 0.71 ($3.0-4.5$) μm . Fixed and stained spores and polar capsules measure 20.7 ± 1.41 ($18.7-21.7$) \times 8.2 ± 1.08 ($6.7-9.0$) and 4.2 ± 0.38 ($3.0-4.5$) \times 3.8 ± 0.56 ($3.0-4.2$) μm , total number of frozen spores – 20.

Host: *Rastrelliger kanagurta* (Scombridae).

Site of infection: gallbladder.

Incidence: 2/53 (3.8%).



Figs 1–12. New species of Myxosporaea (Bivalvulida), parasites of the gallbladder of scombrid fish. 1-3 – Spores of *Zschokkella scomberosis* sp. n.: 1 – stained spore in valvular view showing striations, Giemsa staining, 2 – stained spore in sutural view with striations, Giemsa staining, 3 – frozen spore in valvular view, Lugol’s iodine; 4-8 – stained spores of *Pseudalataspora misrae* sp. n. in various views, Giemsa staining; 9-11 – frozen spores of *P. misrae* in valvular views, Lugol’s iodine; 12 – stained spore of *Thelohanelloides lomae* sp. n. in side view, Giemsa staining. Scale bar: 10 μ m.

Locality: Digha, Midnapur, Bay of Bengal coast of West Bengal, India.

Material: syntypes on slide no. MyxZk. 23, deposited to the Zoological Survey of India, Kolkata.

Differential diagnosis (Table 2). The studied species has elongated spores, membranous projection or parachute-like shell valves, two round to ovoid polar capsules. It is coelozoic (gallbladder) and infects a marine host. All these features characterize representatives of the genus *Pseudalataspora* Kovaleva and Gaevskaya, 1983. Therefore we assign the novel species to this genus. The present species most closely

resembles *Pseudalataspora lophii* Afonso-Dias et al., 2007 (21.6–28.8 \times 7.2–10 μ m) reported from the gallbladder of *Lophius piscatorius* from Northwest Scotland, *P. beryxi* Kovaleva and Gaevskaya, 1988 (5.3–6.5 \times 14.6–19.95 μ m) of *Beryx splendens* from Atlantic Ocean (cited from Afonso-Dias et al., 2007), *P. meridionalis* Kovaleva, Rodjuk and Grudnev, 2002 (6.7–9.5 \times 14.6–19.95 μ m) of *Notothenia rossii* from Antarctic Ocean (cited from Afonso-Dias et al., 2007), *P. squamifrons* Kovaleva, Rodjuk and Grudnev, 2002 (5.3–6.7 \times 19.9–21.3 μ m) of *Lepidonotothen squamifrons* from Antarctic Ocean (cited from Afonso-Dias et al., 2007), *P.*

Table 1. Comparison of *Zschokkella scomberosis* sp. n. with other *Zschokkella* spp.*

Myxosporea (Host)	Tissue	Plasmodium	Spore	Polar capsule	Locality
<i>Zschokkella hildae</i> Auerbach, 1910 (<i>Phycis blennioides</i> , <i>Gadus</i> spp.)	Ub	Mono, Di or Polysporic	16–29×13–18.0	5.6–7.2	Norway Atlantic Ocean
<i>Z. ilishae</i> Chakravarty, 1943 (<i>Hilsa ilisha</i>)	Gb	Disporic	12.36×6.18	4.26	Indian Ocean
<i>Z. platistomusi</i> Sarkar, 1987 (<i>Tachysurus platystomus</i>)	Gb	Disporic	10.5–12.75×6.5–7.35	2.8–3.5	The Bay of Bengal
<i>Z. ganapatti</i> Padma Dorothi et Kalavati, 1992 (<i>Liza macrolepes</i>)	Gb	Disporic	11.18–15.48×7.74–10.32	2.58–4.3	The Bay of Bengal
<i>Z. cascasiensis</i> Sarkar, 1995 (<i>Sicamugil cascasia</i>)	Gb	Disporic	8–10.5×6.5–8	3–4	The Bay of Bengal
<i>Z. leptatherinae</i> Su et White, 1995 (<i>Leptotherina presbyteroides</i>)	Gb	Disporic	13–17×9.5–14	3.5–5	Tasmania
<i>Z. pseudosciaena</i> Sarkar, 1996 (<i>Pseudosciaena coibor</i>)	Kidney Ureter	Disporic	9.5–13×5–7	3.5–4.5	The Bay of Bengal
<i>Z. egyptica</i> Ali et al., 2006 (<i>Plotosus lineatus</i> , <i>Upeneus tragula</i>)	Gb	Disporic	12.5–15×9.5–11	4.2–5.2	Red Sea
<i>Z. helmlii</i> Abdel-Gaffar et al., 2007 (<i>Siganus rivulatus</i>)	Gb	Disporic	10–11×7–8	2–3	Red Sea
<i>Z. scomberosis</i> sp. n. (<i>Scomberoides commersonianus</i>)	Gb	Disporic	16.5–19.5×9–12	3–4.5	The Bay of Bengal West Bengal

* Measurements in μm ; abbreviations: Gb= Gall bladder, Ub= Urinary bladder.

pontica Kovaljova, Donec and Kolesnikova, 1939 (5.0–6.5 × 16.0–19.9 μm) of *Liza aurata* from Black Sea (cited from Afonso-Dias et al., 2007), *P. indecora* Kovalyova, Velev and Vladov, 1993 (3.3–4.7 × 13.4–20.0 μm) of *Dentex angolensis* from Atlantic Ocean, Africa (cited from Afonso-Dias et al., 2007) and *P. scomberomorusi* Sarkar, 2010 (6.0–7.8 × 16.5–21.5 μm) reported from the gallbladder of *Scomberomorus* sp. from the Bay of Bengal (Indian Ocean). However, the spores of all the *Pseudalataspora* spp. mentioned above, except *P. lophii*, are smaller, while spores of *P. lophii* are larger than those of the current species. The current species is therefore considered as a new species and designated as *Pseudalataspora misrae* sp. n. The epithetic name is given after Dr. Kamales Misra, a leading parasitologist in India.

THELOHANELLOIDES COMMERSONI SP. N. (FIGS 9–12)

Plasmodia and sporogonic stages: not observed.

Spores: spherical to pyriform with sharply pointed and terminally bent polar capsule. Polar capsules have broad round base and sharply bent anterior end pointed terminally; coils of polar filament denser at the base and looser at the anterior end; number of coils of the polar filament not discernible; sporoplasm large and binucleated; no mucous envelope found around the spore.

Host: *Scomberoides commersonianus* (Scombridae).

Site of infection: gallbladder.

Incidence: 2/53 (3.7%).

Locality: Kakdwip, 24 Parganas (South), West Bengal, India.

Material: Syntypes on slide No. MyxT1, 23, deposited to the Zoological Survey of India, Kolkata.

Differential diagnosis. The only species of the genus *Thelohanelloides* Sarkar, 2009 recorded so far, is *T. bengalensis* from the gallbladder of *Arius sagor* from the Bay of Bengal (Indian Ocean). Its characteristic features are: *Thelohanellus*-like spores with anteriorly bent polar capsule, ovoid to round extra spore cavity, coelozoic localization and internal development. The present myxoporean species having similar features warrants its placement in the genus *Thelohanelloides* Sarkar, 2009. Besides spore measurements, the current species differs from *T. bengalensis* by its retort-like polar capsule (side view) and different host fish. Moreover, one shell valve is flat, while the other shell valve is strongly concave in the side view. The current species therefore, is considered a new species and named *Thelohanelloides lomae* sp. n. The epithetic name is given in honor of renowned protistologist Dr. Jiří Lom of Czech Republic.

Table 2. Comparison of *Pseudalataspora misrae* sp. n. with other *Pseudalataspora* spp.*

Myxosporea (Host)	Spore	Polar capsule	Locality
<i>Pseudalataspora beryxi</i> Koveleva et Gaevskaya, 1988 (<i>Beryx splendens</i>)	14.6–19.95×5.3–6.65	1.5×1.5	Atlantic Ocean
<i>P. indecora</i> Kovaleva, Velev et Vladev, 1993 (<i>Dentex angolensis</i>)	13.4–20×3.3–4.7	2×2	Atlantic Ocean
<i>P. insolita</i> Kovaleva, Velev et Vladev, 1993 (<i>Caranx rhonchus</i>)	14.6–17.3×5.3–6	2×2	Atlantic Ocean
<i>P. pontica</i> Kovaleva, Donets et Kolesnikova, 1989 (<i>Liza aurata</i>)	16–19.9×5.5–6.5	3×2.7	Black Sea
<i>P. scombri</i> Kovaleva et Gaevskaya, 1983 (<i>Scomber japonicus</i>)	7.92–10.64×4.65–5.98	1.3–1.5×1.3–1.5	Southeast Pacific Ocean
<i>P. atlantica</i> Kovaleva, Velev et Vladev, 1993 (<i>Chlorophthalmus agassizi</i>)	34.6–42.5×6.7–10	3.3–4×3.3–4	Atlantic Ocean
<i>P. originalis</i> Aseeva, 2003 (<i>Hippoglossoides dubius</i>)	27–36×10–12	3.5–4×2.8–3	Sea of Japan
<i>P. sebastei</i> Bakay et Grudnev, 1998 (<i>Sebastes marinus</i>)	22.64×13.3	4.65×4.65	North Atlantic
<i>P. squamifrons</i> Kovaleva, Rodjuk et Grudnev, 2002 (<i>Lepidonotothen squamifrons</i>)	19.9–21.3×5.3–6.7	2–2.3×1.3	Atlantic Ocean
<i>P. umbraculiformis</i> Gaevskaya et Kovaleva, 1984 (<i>Gaidropsarus mediterraneus</i>)	14.6–17.3×8–9.3	2.7×2.7	Celtic Sea
<i>P. lophii</i> Afonso-Dias, Kalavati, Mackenzie et Machenzie, 2007 (<i>Lophius piscatorius</i>)	21.6–28.8×7.2–10	3.8–5.4×3–4	Northwest Scotland
<i>P. misrae</i> sp. n. (<i>Rastrelliger kanagurta</i>)	22.5–25.5×9–12	3.7–4.5×3–4.5	The Bay of Bengal Indian Ocean

* Measurements in µm; all *Pseudalataspora* spp are reported from Gall bladder (cited from Afonso-Dias et al., 2007).

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