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Annotated list of species of the Microsporidia described in the Former Soviet Union and Russia in 20th century (1967–2000)

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Summary

The annotated list contains 118 species of microsporidia (phylum Microsporidia Balbiani 1982) described in Russia and other States of the Former Soviet Union (FSU) during the last decades of the 20th century (1967–2000). These species are distributed among 46 genera, 20 of which were new for science at the time of description. The described microsporidia parasitize about 100 hosts belonging to major groups of freshwater and terrestrial invertebrates and fish. The goal of this publication is to draw the attention of the international community to microsporidia taxa described in Russia and FSU during the era of the "iron curtain". Many of the taxa comprising the list, are poorly known because the descriptions would be published in Russian, often in hardly available editions. The list reflects the abundance of microsporidia and breadth of their distribution among various hosts and biocenoses. We hope that publication of the list stimulates the interest of young microsporidiologists working on the territory of FSU, to the species described by their predecessors. Validation of these taxa that had been described basing on morphology, by molecular tools is badly warranted and will certainly contribute to creation of a better system of the phylum Microsporidia.

Key words: microsporidia, taxonomy, systematics, parasitology

Introduction

Extensive study of microsporidia and microsporidioses in Russia was initiated by the senior author of this paper, Irma V. Issi, in late 1960-s. This time was marked by growing worldwide interest to microsporidia, particularly as potential candidates for biological control agents against agricultural pests. In 1967 the International Society of Invertebrate Pathology (SIP) was established and its first official division was the Microsporidia one (Lange, Sokolova, 2017). In Former Soviet Union (FSU) parasites infecting agricultural pests, were in the focus as well, and investigating the opportunities of their application as biological pesticides and/ or regulators of population dynamics served the

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rationale for the research on entomopathogenic fungi and microsporidia conducted in Leningrad All-Union-Institute for Plant Protection (VIZR). I.V. Issi initiated exploration of Microsporidia diversity on vast territories of the Former Soviet Union (FSU). Her graduate students and associates from different former Soviet Republics (now Independent States) of the FSU enthusiastically carried on this research. During the period from 1967 to 2000 highlighted in this paper, a plethora of new species and genera of microsporidia were described in the FSU, mostly in Russian language in local editions hardly available to international scholars. Since 2000, Russian microsporidiology has integrated into international science, and most descriptions published since then are easily accessible. This justifies the period chosen for the presented revision: the years 1967–2000.

A poor practice of description of new genera and species of microsporidia in hardly local editions, collective monographs and dissertations[1], was common in the FSU partly due to political reasons, partly due to limited access to publication in foreign journals. Thus, many of those taxa have been remaining either unknown for the international research community, or the genera and species described by "Russians", and occasionally mentioned by them in literature, considered invalid, since the source of original descriptions could not be identified. With a few exceptions, the species described before 2000 in Russia and other FSU states, were not molecularly characterized. The phylogenetic SSU rDNA-based analyses that has become recently a mandatory part of a species description, was introduced later. This analysis indicated, first, a strong correlation of microsporidia divergence and speciation with host groups and habitat, and, second, a perception that inference of relationships basing on certain morphological and developmental characters was often misleading (Vossbrinck, Debruner-Vossbrinck 2005; Vossbrinck et al., 2014). From the height of our current knowledge, we know that the placement of some species mentioned in this review, into previously established genera basing exclusively on structural resemblance, was probably erroneous. The examples of such flaws would be likely attribution of the tabanid microsporidium to the genus *Ameson* representatives of which infect exclusively marine decapods, the Cereal beetle microsporidium - to the genus *Unikaryon* described from cestods, and insect "pleistophoras" - to a fish genus *Pleistophora*. Publishing this list of species is not only informative; it also helps to identify potential erroneous attributions that have to be amended in future. We hope, publication of this list stimulates interest of young microsporidiologists working on the territory of the FSU, to the species described by their predecessors. Validation of these taxa described basing on morphological characters, by molecular tools is badly warranted and will certainly contribute to creation of a better system of the phylum Microsporidia, the ultimate goal of taxonomy.

Beneath we provide a list of valid species and genera with references to original descriptions and, when possible, also to the subsequent publications refining characterization of the described taxa. Overall, the list contains 118 species. These species are distributed among 46 genera, 20 of which were new for science at the time of description, and parasitize about 100 host species (see Addendum: Distribution of microsporidia species among the hosts). For all genera, the type species and type host are mentioned in square brackets as they are provided in the latest "Checklist of Available Generic Names for Microsporidia" (Becnel et al., 2014). For the genera described in FSU in 1967–2000, in addition, the reference to the relevant publication is provided. Each species name is accompanied by the reference to the relevant publication, and when possible to the figures displaying images of the described species. For most species, the following information is provided in brief: whether the species was studied by light (LM), electron (EM) microscopy, or characterized by molecular phylogeny (Mph); key characters of developmental stages and spores; type host and tissue tropism, and locality. We omit this information for a few species that were re-described in worldwide renowned editions; in this case, the references are provided.

Abbreviations

DK, diplokaryon; EM, electron microscopy; LM, Light microscopy; PF, polar filament; PP, polaroplast; PF, polar filament; PV, posterior vacuole; SV, sporophorous vesicles.

1. *Aedispora* Kilochitskiy 1997 [*Aedispora dorsalis* ex *Aedes caspius dorsalis* (Diptera, Culicidae) (Kilochitskiy, 1997, P.16)].

[1] Dissertations are not considered a publication and species name given therein are not valid being typical "nomine nude" (Anonimus, ICZN 1999, Articles 8, 13).

A. dorsalis Kilochitskiy 1997 (Kilochitskiy, 1997, P. 16; Fig. 1, 2, 5). LM, EM. Sporogonial plasmodium with 8 large nuclei; 8 spores with subpersistent SV membrane. Spores pyriform, 10.0–14.4 × 3.5–4.4 µm (live), with thin envelopes; exospore 40–60 nm + endospore 170–210 nm. PF anisofilar, 5-7+6-8 coils, large nucleus at the posterior end. In fat body of ***Aedes caspius dorsalis*** larvae. Type locality: valley of the river Bahmut, Donezk region[1], open temporal water reservoir, Ukraine.

Aedispora sp. Kilochitskiy 1997 (Kilochitskiy, 1997, P.18). LM.Sporogonial plasmodium with 8 large nuclei; 8, rarely 2 or 4 broadly oval or pyriform spores in a SV. Spores variable in size: 6.3–16.3 × 3.7–7.5 µm; in fat body of *Aedes caspius* larvae. Type locality: suburbs of the town Golaya Pristan, Hersonsk region, open temporal water reservoir.

2. *Agglomerata* Larsson et Yan 1988 [*Agglomerata sidae* ex *Holopedium gibberum* (Cladocera, Holopediidae)].

A.* (*Duboscqia*) *sidae (Jirovec, 1942) Larsson, Yan 1988. (Voronin, 1986, P. 147, Voronin, 1999, P. 364–368). LM, EM[2]. Merogony and sporogony with isolated nuclei. Sporogonial plasmodium with 16 (rarely 12 or 8) nuclei divide by rosette-type budding; sporoblasts and spores uninucleate. SV envelope persistent, episporontal space with prominent tubular inclusions. Pyriform spores, 3,6 × 1,6 µm, with slightly anisofilar (heterofilar) PT coiled in 7 coils, tripartite PP, and 5-layered exospore. In fat body of *Sida cristallina* and *Diaphanosoma brachyurum* (Cladocera, Daphniidae). Type locality: Lake Vrevo, Leningrad region.

A.* (*Thelohania*) *simocephali (Voronin 1986) Voronin 1999 (Voronin, 1986, P. 147, Voronin, 1999, P. 370-372). LM, EM[2]. Merogony and sporogony with iso-lated nuclei. Sporogonial plasmodium with 8 (rarely 12 or 16) nuclei divide by rosette-type budding; sporoblasts and spores uninucleate. SV envelope thin, episporontal space with thin fibrous inclusions. Pyriform spores, 5,0 × 2,8 µm, with slightly anisofilar (heterofilar) PT coiled in 9 coils, bipartite PP, and 2-layered exospore. In the hypoderma of *Simocephalus vetulus* (Cladocera, Daphniidae). Type locality: Lake Vrevo, Leningrad region and other lakes of North-West part of Russia.

A.* (*Thelohania*) *cladocera (Jirovec 1936) Voronin 1999 (Voronin, 1986, P. 147, Voronin, 1999, P. 368-370). LM, EM[2]. Merogony and sporogony with isolated nuclei. Sporogonial plasmodium with 8 (rarely 12 or 16) nuclei divide by rosette-type budding; sporoblasts and spores uninucleate. SVs envelope thin. Pyriform spores, 2,8 × 1,45 µm, with slightly anisofilar (heterofilar) PT coiled in 6–7 coils, bipartite PP, and 2-layered exospore with thin filamentous coat. In the hypoderma of *Simocephalus vetulus* (Cladocera, Daphniidae). Type locality: Lake Vrevo, Leningrad region; other lakes of North-West part of Russia.

3. *Alfvenia* Larsson 1983 [*Alfvenia nud*a ex *Acantocyclops vernalis* (Copepoda, Cyclopidae)].

A. ceriodaphniae Vidtmann, Sokolova 1995 (Vidtmann, Sokolova, 1995, P. 217). LM, EM. Diplokaryotic meronts, sporogonial plasmodia divide by rosette-type budding; sporoblasts and spores uninucleate, reside individually, without SVs. Egg-shaped spores, 4,5 × 3,3 µm, with isofilar PF in 8-9 coils, bipartite PP, and 3-layered exospore. Spores are enclosed in additional undulating envelope of the episporal origin. In the hypoderm of *Ceriodapnia reticulata* (Cladocera). Type locality: Lake Dringis, Ignalina region, Lituania.

4. *Amblyospora* Hazard and Oldacre 1975 [*Amblyospora californica* ex *Culex tarsalis* (Diptera, Culicidae), type definitive host, and *Mesocyclops leukarti* (Copepoda, Cyclopidae, type intermediate host)].

A.* (*Hyalinocysta*[3]) *aestiva Kilochitskiy 1996 (Kilochitskiy, 1996, P.91, Fig.5). LM, EM. The earliest stage: chains of elongated meronts with DKs. Roundish sporonts with 1–8 nuclei and several “metabolic granules”; sporogony results in formation of 8-spore SVs, 8–10 µm in diameter. Spores oval, 3.8–4.3 × 2.4–3.1 (4.02 ± 0.38 × 2.91 ± 0.28) µm; megaspores, 6.3 × 3.8 µm (live). SV lumens are filled with finely dispersed material of moderate density. Spore envelopes consist of rough undulating exospore, 130–250 nm thick, and relatively thin endospore (7–140 nm). Spores contain lamellar PP, anisofilar PF arranged in 4–6 coils, and large irregularly shaped nucleus. In fat body of 4-instar larvae and imago of *Aedes dorsalis*

[1] Hereafter we use the term “region” in the meaning of “oblast”, a federal subject of Russia.

[2] Ultrastructural details are taken from: Voronin V.N. 1999. Microsporidia of freshwater invertebrates and fish in Russia (fauna, systematics, biology). Dr.Sci Dissertation. Zoological Institure Rusian Academy of Sciences.

[3] The author places this species in the subgenus Hyalinocysta (Hazard et Oldacre, 1975) Kilochitzkyj 1996.

(type host) and *A. caspius*. Type locality: village Siberezh, Chernigovsk region, Ukraine, small open water basins.

A. alajense (Khodzhaeva 1988[1]) Khodzhaeva 1990 (Issi et al., 1990, P.84, Fig. 22). LM. 2 sporogonies occure simultaneously. Meronts and sporonts with DK. In first sporogony, DK divides 3 times, sporoblasts segregate by rosette-type budding to produce 8 pyriform or 16 (rarely) spores, 3.7–5.0 × 1.8–2.5 µm (fixed). SVs with numerous granules stained bright blue with Azur-Eosin. Second sporogony results in forming large binucleate spores, 5.6–6.2 × 3.7–4.3 µm (fixed). These spores are grouped in pairs with a large granule located between spores. In fat body of *Tetisimulium alajense* larvae. Uzbekistan.

A. caspius Pankova, Issi, Simakova 2000 (Pankova et al., 2000, P. 421. Fig.1–3). LM, EM. Late meronts with large DK; sporonts with 1 to 8 nuclei. Sporoblasts segregate by rosette-type budding, within SVs with persistent envelopes. SV lumens with vacuoles arranged in comb-like structures. Spores broadly egg-shaped, measure c.4.8 × 3.6 µm (live). PF anisofilar, of 14 coils (5 + 9), in one row. Bi-partite polaroplast with lamellar and fibrillary regions. Envelope consists of 2-layered 110 nm-thick exo- and 40 nm-thick endospore. PV large, collapses upon fixation. In fat body of *Aedes caspius* larvae, in temporal ponds created by thawed snow in May, University Grove, Tomsk, Siberia, Russia.

A. (***Amblyospora***[2]) ***cantansi*** Kilochitskiy1995 (Kilochitskiy, 1995 , P. 4; Fig. 4). LM, EM. Oval DK meronts, round 8-nucleate sporont, divide by rosette-type budding. SV with granular secrete, SV envelopes sub persistent. Egg-shaped spores 6.0–6.3 × 3.8–4.8 µm submerged in thick mucus capsule. Occasional macrospores 9–10 × 5–6 µm. PT length up to 125 µm. Spores with thick (300 nm) endospore, waving exospore, 2-partite lamellar polaroplast. Anisofilar PT of 10–12 (3–5) + 2 + (5–6) coils in one row. In a fat body and oenocytes of IV instar larvae *Aedes cantans* (type host), *A. flavescens, A. euedes*. Type locality: Kiev and Chernigovsk regions, Ukraine.

A. (***A.***) ***cataphyllus*** Kilochitskiy 1992 (Kilochitskiy,1992, P. 255, Fig. 1.2). LM, EM. Oval gamonts, 5.0 × 3.6 µm with a "nipple" at one of the poles; transient DK stage 10.0–10.5 × 6.0–10.0 µm (live). Sporonts with 1 to 8 nuclei. Nucleus of 1-nucleate (1N) stage fills the volume of the whole cell. 8N sporonts up to 18.7 µm in diameter with nuclei arranged in one group. Egg-shaped spores 6.0–6.3 × 3.8–4.8 µm submerged in thick mucus layer. Occasional macrospores 9–10 × 5–6 µm. Spores 6.0–7.3 × 3.8–5.0 µm (live). Spore size depends on the host. Spores with 60–170 nm-thick endospore; waving smooth or wrinkled exospore, 200–250 (up to310) nm-thick, 3-partite lamellar PP, anisofilar PT 80–120 µm long arranged in 17–20 coils, (3–5) + (15–17), a large nucleus of irregular size, and half-moon-shaped PV with posterosome. In fat body and oenocytes of larvae of *Aedes cataphylla* (type host), *A. cantans, A. c. cinereus*, Collected in Kiev region, Ukraine.

A. (***A.***) *conopsa* Kilochitskiy 1992 (Kilochitskiy, 1992, P. 5). LM, EM. Two types of meronts: multinucleate ribbon-like plasmodia and 1-4 nucleate roundish cells. Sporogony results in SVs with 8-spores and sub persistent envelope. SV lumen is filled with 4-5 µm granules of secret that disappears upon spore maturation. Mature spores are egg-shaped with large PV; 6.2 (5.5–6.8) × 3.8 (3.6–4.0) µm (live). Smooth exospore, 100-250 nm; endospore, 100–180 nm. PF anisofilar with 11 coils (3.5+7.5). Nucleus is large, of irregular shape. In a fat body of larvae of *Aedes sticticus* (type host) and *A. flavescens*. Collected in Kiev region, Ukraine.

A. burlaki Pankova, Issi, Simakova 2000. (Pankova et al., 2000, P. 425. Fig. 4, 5). LM, EM. 2–4 nucleate sporonts in persistent SVs. SV lumens with large secretory granules. Egg-shaped spores, 4.8 × 3.5 µm, with blunt anterior poles, anisofilar PF of 9 coils (3+6), thick (350 nm) envelope composed of multi (6–7)-layered slightly undulating 260-nm thick exospore and relatively thin endospore. In a fat body of larvae of *Culex pipiens*. Type locality: environments of Tomsk, floodplain pools of the River Tom, Siberia, Russia.

A. (***Lanicysta***[3]) ***certa*** Kilochitskiy 1996 (Kilochitskiy, 1996, P. 89–90, Fig.4). LM, EM. Roundish sporonts with 1–8 nuclei; sporogony results in formation of 8-spore SVs, 11.5 µm in diameter, with relatively stable membrane. SVs contain 4–5

[1] The species was first described in: Khodzhaeva 1988. "Microsporidia of bloodsucking dipterans of the families Simuliidae and Culicidae of Uzbekistan (species composition, epizootology, ecology). PhD Dissertation. Tashkent". Valid description is provided in Issi et al.,1990.

[2] The author places this species in the subgenus *Amblyospora* (Hazard et Oldacre, 1975) Kilochitzkyj 1996.

[3] The author places this species in the subgenus *Lanicysta* Kilochitzkyj 1996.

metabolic granules that transform into fibrous secretion upon spore maturation. Spores are egg-shaped, 4.8—5.8 × 2.5—2.6 (4.5 ± 0.14 × 2.5 ±0.06) µm (live), with thin envelopes composed of wrinkled exospore, 90 nm, and a thicker (110 nm) endospore, lamellar PP, anisofilar PF arranged in 6 coils, and a large nucleus located above PV. In fat body of 4-instar larvae of *Aedes cinereus*. Type locality: village Vita Pochtovaya, Kiev region; village Siberezh, Chernigovsk region, Ukraine, small open semitemporal ponds.

A.* (*A.*) *dissimilis Kilochitskiy 1995 (Kilochitskiy, 1995, P. 12, Fig. 3, 4).LM, EM. Merogonial plasmodia are composed of chains of DK cells. SVs with 8-spores and sub persistent envelopes. Mature spores are egg-shaped and large, 6.0—7.0 × 3.8— 5.3 µm (live). Spore envelope is composed of the exospore, 250—400 nm-thick and endospore, 80—200 nm- thick. PF anisofilar, 60—70 µm long, arranged in 7—8 coils. In a fat body and oenocytes of larvae of *Aedes cantans* (type host), *A. cyprius, A. behningi, A. excrucians, A. vexans, Culiseta annulata, Culex territans*. Type locality: Chernigovsk region, Ukraine.

A.* (*A.*) *firma Kilochitskiy 1996 (Kilochitskiy, 1996, P. 87). LM, EM. Meront with DKs. 8-spore SVs, 8.6—8.9 µm in diameter. Egg-shaped spores 7.3—7.5 × 4.8—5.0 µm with large PV. Occasional macrospores 10.0 × 7.5 µm. Spores on thin sections 4.9—5.3 × 3.3—3.8 µm, with 400—600-thick envelope (exsospore, 250—420-nm thick, endospore 130—170 nm), deformed posterior edge, bipartite lamellar PP, anisofilar PF arranged in 12—13 coils (2—3) + (1—2) + (8—9), and one large nucleus. In fat bofy of *Aedes punctor* males. Type locality: Chernigovsk region, Ukraine.

A.* (*A.*) *media Kilochitskiy 1996 (Kilochitskiy, 1992, P. 92). LM, EM. Only mature spores were found on smears. Egg-shaped spores 6.3—6.9 × 4.4 —4.8 µm (live), with large PV and mucus capsule. Occasional macrospores 8.8—10.0 × 5.8—6.3 µm. On thin sections spores measured 6—4.2 × 2.8—4.2 µm, with 320—440 nm-thick endospore, in which the exospore was 2-3 times thicker than the endopore, lamellar PP, anisofilar PF arranged in 13—14 coils (3—4) +(1—2) + (8—9), and one large nucleus located in the center. In fat body of larvae *Aedes caspius dorsalis* (type host). Type locality: Kiev region, Ukraine.

A. nuratae (Khodzhaeva 1988) Khodzhaeva, 1990 (Issi et al., 1990, P.87, Fig.22). LM. 2 sporogonies. Oval octospores 2.5—4.3 × 1.8—3.7µm (fixed) with long PF (up to 100 µm); reside in spherical SVs, 8.7 µm in diameter. Secretory granules within SVs are larger than in the case of A. bracteata. Binucleate spores, 4.3—5.0 × 2.5—3.7 µm with thin envelopes. In fat body of *Tetisimulium alajense*. Type locality: Southern slopes of the Nuratau Ridge, Uzbekistan.

A.* (*H.*[1]) *pilosa Kilochitskiy 1995. (Kilochitskiy,1995, P. 7, Fig. 2, 4). LM, EM. Merogony and sporogony as in A. cantansi. Asynchronous division of sporont mother cell leads to formations of 1—8 N sporonts, filled with conspicuous metabolic granules at 1—3 N stage, and with fibrillary material at 4—8 N stage. SVs with 4—8 spores and persistent envelopes, SVs are filled with filamentous (or fibrillary) material. Mature spores are egg-shaped with large PVs. Live spores: 6.49 ± 0.19 × 4.57 ± 0.17 (3.8—5.0) µm. Endospore (70—180 nm) is equal or no more than twice as thick as the exospore (70—120 nm). Exospore with bush-like filamentous extensions. PF anisofilar, 90 µm long, arranged in 11—12 coils. In fat body of IV instar larvae of *Aedes cantans* (type host) and *A. annulipes*. Type locality: Kiev region, Ukraine.

A.* (*L.*) *rustica Kilochitskiy 1996. (Kilochitskiy, 1996, P. 89, Fig. 3). LM, EM. The earliest stage: DK meront. Roundish sporonts with 1—8 nuclei. Sporogony results in formation of 8-spore SVs, 11.3 —12.5 µm in diameter, with conspicuous fibrous secretion inside. Spores egg-shaped, variable in size: 6.3—6.9 × 3.8—4.4 (6.6 ± 0.22 × 4.9 ± 0.11) µm; macrospores ,8.8—10 × 6.3—7.5 µm (live). Spores with thick envelopes composed of exospore, 130—150 nm, and endospore, 150—210 nm, contain lamellar bipartite PP, anisofilar PF arranged in 8—10 coils, and a large nucleus located above PV. In fat body of 4-instar larvae of *Aedes dorsalis* (type host) and *A. caspius*. Type locality: Chernigovsk region, village Siberezh, Ukraine, small open water basins.

A.* (*A.*) *theophanica Kilochitskiy 1998 (Kilochitskiy, 1998, P. 35, Fig. 3,6). LM, EM. Meronts with DK. Sporonts and SVs with metabolic granules, tubular-like and fibrous secretion. The latter remains in SV s after spore maturation. Live spores egg-shaped with large PVs. Pairs of spores are occasionally enclosed in transparent membranous envelopes. Spores measure 6.3 (6.0—6.8) × 4.8 (4.4 —5.0) µm (live). Spore envelopes are composed of

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an undulating exospore (80–100 nm) and endospore (170–190 nm). Spores contain lamellar bipartite PP, anisofilar PF arranged in 7.5–8 coils, and a large horse shoe-shaped nucleus that embraces the distal part of PP above PV. In fat body of 4-instar larvae of *Aedes annulipes.* Type locality: in vicinity of the village Theophania, Kiev region, Ukraine, small shadowy semi-temporal ponds.

A. tetisimulii (Khodzhaeva 1988) Khodzhaeva 1990 (Issi et al.,1990, P. 87, Fig. 22). LM. 2 sporogonies. Round SVs with 8 (common), 4, 12, or 16 (rare) spores. Egg-shaped spores of variable size, 5.0–6.8 × 3.7–5.0 µm (live), with thick envelope and large nucleus at the posterior end. In fat body of *Tetisimulium alajense* larvae. Type locality: Uzbekistan, South slopes of Nuratinskiy Ridge, Uzbekistan.

A. (***Thelohania***) ***macrococcus*** (Voronin 1979) Voronin, 1991 (Voronin, 1979, P. 593; Voronin, 1991b, P. 67). LM, EM[1]. Meronts or young sporonts with DK. Octosporous sporogonial plasmodium divides by rosette-type budding; sporoblats and spores uninucleate. Stages of sporogony are limited by thin envelope of SVs. Round-oval spores, 6,3 × 4.8 µm, with thick multi-layered exospore and lamellar bipartite PP. Anisofilar PF consists of 3 anterior wider coils and 4–5 posterior narrower coils. In fat body of *Corynoneura* sp. larvae (Diptera, Chironomidae). Type locality: Lake Vrevo, Leningrad region, Russia.

A. (***A.***) ***ukrainica*** Kilochitskiy 1996 (Kilochitskiy, 1996, P. 93, Fig. 7). LM, EM. Sporonts with 1–8 nuclei; sporogony results in formation of 8-spore SVs, 10.0–13.3 µm in diameter. Live spores egg-shaped with small PVs, 6.0–6.5 × 3.5–4.4 (6.3 ± 0.11 × 3.8 ± 0.15) µm (live). Spores with multilayered thick (160–350 nm) exospore and relatively thin (120–180 nm) endospore. Spores contain lamellar bipartite PP, anisofilar PF arranged in 10 coils, and a large nucleus located above PV. In fat body of 4-instar larvae of *Aedes caspius.* Type locality: village Yurovka, Kiev region, Ukraine, small open temporal ponds.

A. (***A.***) ***verna*** Kilochitskiy 1996 (Kilochitskiy, 1996, P. 84, Fig. 1). LM, EM. The earliest stage: DK cells, 11 × 8 µm. Sporonts with 1-8 nuclei and 10-15 metabolic granules. Sporogony results in formation of 8-spore SVs, 12.5 -14 µm in diameter (live). Spores broadly oval, of variable length: regular, 6.3–7.0 × 4.8–5.0 (6.56 ± 0.29 × 4.93 ± 0.28) µm; macrospores, 8.1–11 × 6.3–8 µm; teratospores 12.5 × 8.8–9.8 µm (live). Of note: ovaries of mosquitoes that emerged from pupae in the lab, contained another type of spores: individual pyriform spores,7.5–9.8 × 2.5–3.1 µm, with large PVs. Spore envelopes were 340–350 nm thick (exospore, 190–350 nm; endospore,130–180 nm). Spores contained lamellar bipartite PP and anisofilar PF of 14–17 coils with 2-3 anterior coils of larger diameter. In fat body of 4-instar larvae and in ovaries of female imagoes of *Aedes communis.* Kiev region, village Puscha Vodica (type locality); Karelia, Petrozavodsk, in small temporal and semi-temporal water basins.

A. ussovae (Pushkar 1984[2]) Pushkar, 1990 (Issi et al.,1990, P. 87, Fig. 22, Table 18). South-Easten Ukraine. LM. 2 sporogonies. Meronts and early sporonts with DK. Sporogonial plasmodium with 8 nuclei. Round or slightly oval SVs with 8 sporoblasts and numerous small secretory granules. Oval octospores 4.8–4.9 × 3.6–3.8 µm (live), with pointed anterior end, round posterior end, and thick envelopes. Binucleate free spores, 5.5–7.7 × 4.4–5.5 µm. In fat body of larvae of *Eusimulium aureum* (type host), *Chelocnetha angustitarse, Cnetha latigoinu*m. Type locality: Donetsk region, South-Easten Ukraine.

5. *Ameson* Sprague 1977 [(*A. michaeils* ex *Callinectes sapidus* (Decapoda, Portunidae)].

A. hybomitrae Bykova, Krylova, Sokolova, Issi 1989 (Bykova et al., 1989, P. 37–38). LM, EM. All stages develop in direct contact with host cytoplasm. Meronts with DK, 6–8-nucleate sporonts are arranged in beads-shaped chains. Sporogony results in production of 2 types of spores: egg-shaped spores 2.35 × 2.34 µm with 4-5 PF coils, and pyriform spores 3.68 × 2.50 µm with 9 PF coils. Exospore with extension, similar to those observe in Ameson spp. In larvae of horseflies *Hybomitra arpadi* and *H. bimaculata* (Diptera, Tabanidae). Collected in North-Western Russia, Kareliya, Waterfall Kivach. May-June 1984–1986.

6. *Anncaliia* Issi, Krylova, Nikolaeva 1993 [(*Anncaliia meligethi* ex *Meligethes aeneus* Cole-

[1] Ultrastructural details are taken from: Voronin V.N. 1999. Microsporidia of freshwater invertebrates and fish in Russia (fauna, systematics, biology). Dr.Sci Dissertation. Zoological Institure, Rusian Academy of Sciences.

[2] The species was first described in: Pushkar E.N. 1984. Microsporidia of midges in Ukraine (species composition, biology, economical importance). PhD Dissertation. Baku, Azerbaidzhan. Valid description is provided in Issi et al.,1990.

optera, Nitidulidae)] (Issi et al., 1993, P.131)].

Anncaliia* (*Nosema*) *meligethi (Issi, Radischeva 1979) Issi, Nikolaeva, Krylova 1993. (Issi, Radischeva, 1979, P. 20; Issi et al., 1993, P. 128–130). LM, EM, MPh. All stages diplokaryotic. Disporoblastic sporogony. Oval spores, 4–5 × 2–3 µm, endospore 120 nm, exospore – 60 nm thick. Tubular ornamentation is well expressed at the poles. Bipartire lamellar-tubular PP. 2 nuclei of different shape. PF slightly anisofilar, 13–15 + 3–4 coils in one row. In fat body and muscle cells of imagoes of rape beetles *Brassicogethes* (*Meligethes*) *aeneus* (Coleoptera) (type host); in gut epithelium and fat body of cabbage wites *Pieris brassicae* (Lepidoptera) (experimental infection). Leningrad region (type locality), other regions of North-Western Russia, Finland, Baltic States and Ukraine. Detailed description in: Issi et al., 1993; Cali et al., 1998; Franzen et al., 2006.

7. *Berwaldia* Larsson, 1981 [*Berwaldia singularis* ex *Daphnia pulex* (Cladocera, Daphniidae)].

Berwaldia* (*Tuzetia*) *tscherníschovae (Voronin, 1986) Voronin 1999 (Voronin, 1986, P. 146; Voronin, 1999, P. 379). LM, EM[1]. Merogony and sporogony with isolated nuclei. Sporogony is disporoblastic. SVs with 2-layered envelope, which contacts the exospore in a few places. Elongated-oval spores 4,2 × 2.0 µm. Bipartite lamellar PP. PF heterofilar, (11–13) + 2 + 3 coils in one row. In fat body of *Daphnia cucullata* (Cladocera, Daphniidae). Type locality: Lake Vrevo, Leningrad region.

8. *Campanulospora* Issi, Radischcheva et Dolzhenko 1983 [*Campanulospora denticulata* ex *Delia floralis* (Diptera, Antomiidae) (Dolzhenko et al. 1982; Issi et al., 1983, P. 4)].

C. denticulata Issi, Radischcheva et Dolzhenko 1983 (Issi et al., 1983, P. 4–5). L M. Diplokaryotic through the life cycle. Disporoblastic sporogony. Egg-shaped spores 4.8 × 2.8 µm. Thick envelopes are surrounded by additional layer that thickens at the posterior end making spores look like a bell-shaped from the side, and a cog-wheel from the bottom. Spores are produced in pupae and imagoes of *Delia floralis* (summer cabbage fly) or *D. brassicae* (cabbage root fly) (Diptera, Anthomyiidae); cabbage farm fields in Leningrad region (type locality) and Kazakhstan.

9. *Caudospora* Weiser 1946 (*C. simulii* ex *Simulium latipes*).

C. simulii* forma *nordica Pushkar 1984 (Issi et al.,1990). LM. Fat body of larvae of *Simulium latipes*. 2N spores, twice as big as the ones of the type species, 5.5–6.0 × 3.6–4.8 µm, with well-developed appendages; width of the lateral "fins" 4 µm, of the "tail" up to 18 µm. North-West Russia, Leningrad region (Petergof and Pushkin districts), Karelian Isthmus.

10. *Cougourdella* Hesse 1935 [(*Cougourdella magna* ex *Megacyclops viridis* (Copepoda, Cyclopidae)].

C.* (*Tuzetia*) *coryniformis (Voronin 1986) Voro-nin 1993 (Voronin, 1986, P. 149, Fig. 2; Voronin, 1993a, P. 36). LM, EM. Monokaryotic through the life cycle. Elongated pyriform spores 7.8 × 2.8µm, surrounded by mucus coat. Sporonts divide by rosette-type budding within thick-walled SVs. 4–8 sporoblasts/spores in a SV. Spores with 3-partite lamellar PP, heterofilar PF with 15–17 coils arranged in 2 rows, one large nucleus, small PV; thick (up to 240 nm) endospore, double-layered exospore and undulating epispore. Fine granular secrete covers the spore envelope. In fat body of *Macrocyclops albidus* (Copepoda, Cyclopidae). Type locality: Lake Vrevo, Leningrad region.

11. *Cristulospora* Khodzhaeva et Issi 1989. [*Cristulospora sherbani* ex *Culex modestus* (Diptera, Cilicidae) (Khodzhaeva, Issi, 1989, P. 144)].

C. aedis Khodzhaeva, Issi 1989 (Khodzhaeva, Issi, 1989, P. 143). LM. Two types of spores are produced. In larvae, 4–8-nucleate sporogonial plasmodia give rise to sporoblasts by rosette-type budding. 1N spores are broadly oval, 6.2–7.5 × 3.0–5.6 µm, with characteristic appendages on the poles. In females, larger (8.7–11.8 × 3.7–5.0 µm) broadly cylindrical or C-shaped spores with 2 nuclei and thin envelopes are produced. In fat body of larvae and imago, and in gonads of females of *Aedes caspius caspius* (Diptera, Culicidae). Type locality: Syr-Darja valley and Bukharskiy Oasis, Uzbekistan.

C. cadyrovi Khodzhaeva, Issi 1989 (Khodzhaeva, Issi, 1989, P. 142). LM. Only final sporogony stages were studied. 8-nucleate sporont gives rise to 8 1N spores enclosed in a SV membrane. Egg-shaped spores, 5.6–6.8 × 3.7–5.0 µm. Both poles with large

[1] Ultrastructural details are taken from: Voronin V.N. 1999. Microsporidia of freshwater invertebrates and fish in Russia (fauna, systematics, biology). Dr.Sci Dissertation. Zoological Institure Rusian Academy of Sciences.

appendages. In fat body of IV instar larvae of *Culex pipiens* (Diptera, Culicidae). Type locality: Syr-Darja Valley, Uzbekistan.

C. sherbani Khodzhaeva, Issi 1989 (Khodzhaeva, Issi, 1989, P. 141). LM. Two developmental sequences. In larvae, 8-nucleate sporont gives rise to 8 1N spores in SVs. Oval octospores, 5.0–8.1 × 4.3–8.6 µm. Both poles with large appendages. Sporonts and sporoblasts with 1 - 2 DKs. In females, 2N thin-walled spores, 6.2–8.7 × 2.5–3.7 µm, are produced in the walls of ovarioles. In fat body of larvae and gonads of females of *Culex modestus* (Diptera, Culicidae). Type locality: Syr-Darja valley in 1983 and and Buharskiy Oasis in 1983.

12. *Cylindrospora* Issi, Voronin 1986 [*Cylindrospora chironomi* ex *Chironomus plumosus* (Diptera, Chironomidae) (Issi, 1986, P. 81)].

C. chironomi Issi, Voronin 1986 (Issi, 1986, P. 81, Fig. 33). LM, EM. Uninucleate meronts, DK sporonts, 8 uninucleate sporoblasts are produced as a result of meiosis within thin-walled SV envelopes; SVs lumen with electron dense granules. Elongated cylindrical spores 7.5 × 1.1 µm, with thin endospore and bilayered exospores. Straight and short (2/3 of the spore length) PF of unequal thickness, spongy-like PP, no PV. In fat body of larvae of *Chironomus plumosus*. Type locality: Water basins in Noth-Western Russia.

13. *Evlachovaia* Voronin, Issi 1986 [(*Evlachovaia chironomi* ex *Chironomas plumosus* (Diptera, Chironomidae) (Issi, 1986, P. 102. Molecular data suggest the synonymy with *Neoperezia* (unpublished data of Issi)].

E. chironomi Voronin et Issi 1986 (Issi, 1986; P. 102, Fig. 46). LM. Spores of 2 types: (i) individual large broadly egg-shaped spores, 8.8 (8.2–10.0) × 4.7 (4.2–5.3) µm, with tapered anterior end 2 nuclei, and (ii) smaller egg-shaped spores with blunt anterior pole, nearly round, 5.0 (4.5–5.3) × 4.0 (3.8–4.2) µm, arranged in pairs within a SV. In fat body of *Chironomus plumosus* larvae. Type locality: In a small lake in Leningrad region.

E. wilhelmiae (Khodzhaeva 1988[1]) Khodzhaeva 1990 (Issi et. al.,1990, P. 92; Fig. 23). LM. Spores of 2 types: large binucleate spores, 7.7–9.3 × 3.5–5.0 µm and uninucleate spores, 6.2–5.0 × 5.0 arranged in pairs within SVs. In fat body of larvae of *Obuchivia popowae* (type species), Wilhelmia mediterranea, W. salopiensis. Type locality: South-Western slope of Chatcal Mnt Range, Tian-Shan; Bukcharskiy oasis, Uzbekistan.

14. *Flabelliforma* Canning, Killick-Kendrick et Killick-Kendrick 1991.[*Flabelliforma montana* ex *Phlebotomus ariasi* (Diptera, Psychodidae)].

F.* (*Stempellia*) *diaptomi (Voronin 1977) Voronin 1996 (Voronin, 1977. P. 510; Voronin, 1996a, P. 59.) LM, EM. Monokaryotic. Ribbon-like multinucleate merogonial plasmodia. Multinucleate sporonts in SVs filled with electron-dense secret; divide by rosette-type budding in 6–16 (usually 8–12) sporoblasts. SV membrane not persistent. Uninucleate spores are pyriform, slightly elongated and bent, 3.7 × 1.9 µm in mucous capsules, with bipartite PP, heterofilar PF with 7–8 (1+1+5-6) coils in one row, with thick endospore and bilayered exospore. In fat body of *Diaptomus gracialis* (Copepoda, Calanoidae). Type locality: Lake Vrevo, Leningrad region.

15. *Glugea* Thelohan 1981 [*Glugea anomala* ex *Gasterosteus aculeatus* (Gasterosteiformes, Gasterosteidae)].

G. bychowskyi Gasimagomedov, Issi 1970 (Gasimagomedov, Issi, 1970, P. 1122) Described also in: Voronin, Issi, 1984. LM. Pyriform spores, 3.6 × 1.8 µm, arranged in pairs in testes of herring *Alosa kessleri volgensis* (Berg). Type locality: Tuleniy Island, Caspian Sea.

G. dogieli Gasimagomedov, Issi 1970 (Gasimagomedov, Issi, 1970, P. 1121) (syn. *Glugea luciopercae* Dogiel et Bychowsky 1939). LM. 2–6 oval cysts 200–250 µm in diameter are grouped together. Conspicious chromatine globules are located in the center of a cyst. Cyst envelope up to 10 µm. Elongated oval spores 3.6–4.8 × 2.4–2.7 µm. In the gut of *Sander* (=*Lucioperca*) *lucioperca*. Type locality: Caspian Sea near Samur-Kayakent, Aral Sea.

G. gasterostei Voronin 1974. (Voronin, 1974a, P. 213; Voronin et al., 1997, P. 261). LM, EM. Merogonial multinucleate plasmodia split in 1N sporonts. Sporogonial plasmodia produce uninucleated sporoblasts and spores in SVs. Oval xenomas up to 5 mm in diameter are enclosed in capsules formed by host connective tissue. Elongated oval spores 5.6 × 2.6 µm; with PV occupying half of the spore volume, eccentrically located

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[1] The species was first described in: Khodzhaeva 1988. “Microsporidia of bloodsucking dipterans of the families Simuliidae and Culicidae of Uzbekistan (species composition, epizootology, ecology). PhD Dissertation. Tashkent”. Valid description is provided in Issi et al.,1990.

anchoring disc, bi-partite PP, isofilar PF with 15-17 coils (180 µm long), large nucleus and PV. In connective tissue of internal organs of three- and nine-spined sticklebacks *Gasterosteus aculeatus* and occasionally *Pungitius pungitius* (Gasterosteiformes, Gasterosteidae). Type locality: Finland Gulf in vicinity of St.-Petersburg, Leningrad region.

G. shulmani Gasimagomedov, Issi 1970 (Gasimagomedov, Issi, 1970, P. 1122). Described also in: Voronin, Issi, 1984. LM. Small (18–80 µm) cysts each derived from a single cell. Cyst wall 2.5–5.0 µm thick. Egg-shaped or pyriform spore, 2.2–2.4 × 1.2–1.6 µm. In intestine walls of Caspian Goby *Neogobius caspius* (type host), *N. fluviatilis pallasi* and *N. melanostomus affinis*. Type locality: South Caspian Sea, near Bekdash mountain.

16. *Gurleya* Doflein 1898 [*Gurleya tetraspora* ex *Daphnia maxima* (Cladocera, Daphniidae)].

G. corynoneurae Voronin 1979 (Voronin, 1979, P. 592; Voronin, 1999, P. 335). LM, EM[1]. All stages with large monokaryotic nuclei. SVs with numerous small granules and large electron-dense bodies. Oval SVs with 4 egg-shaped spores in persistent envelopes. Egg-shaped spores 5.4 × 4.1 µm, with thick amorphous exospore, bipartite PP, long (100–150 µm) anisofilar PF of 9–10 + 5–6 coils arranged in 2–3 rows. Large oval nucleus, and small distinct PV. In fat body of *Corynoneura* sp. (Diptera, Chironomidae) larvae. Lakes in Leningrad and Pskov regions, and in Karelia.

G. lopukhinae Voronin 1986 (Voronin, 1986, P. 149, Fig 2; Voronin, 1999, P. 337). LM, EM[2]. Monokaryotic through the life cycle. Pyriform spores 3.2 × 1.9 µm with thin endospore and bi-layered exospore, bipartite PP, heterofilar PF of at max. 8 (2–4) + (1–2) + (2–4) coils, and small PV. Spores within SVs are connected by thin electron-dense fibrils. SV membrane sub persistent. In body cavity of *Eucyclops serrulatus* (Copepoda, Cyclopidae). Type locality: Lake Vrevo, Leningrad region.

G. macrocyclopis Voronin 1986 (Voronin, 1986, P. 149, Fig. 2, Fig. 3; Voronin, 1996b, P. 105). LM, EM. Monokaryotic through the life cycle. Ribbon-shaped meronts. SVs with spherical electron-dense secretory granules. Egg-shaped spores 4.0 × 2.7µm, are connected with each other in groups of 4. Spores with thick endo- and exospores, bipartite PP, anisofilar PT with 12 (8+4) coils in one row, and small posterior vacuole. In fat body of *Macrocyclops albidus* (Copepoda, Cyclopidae). Type locality: Lakes Vrevo and Kavgolovskoye, Leningrad region.

G. sokolovi Issi, Lipa 1968 (Issi, Lipa, 1968, P. 167). LM. Meronts and sporonts with DK. Sporogony results in formation of 4 piriform spores and 4 spherical bodies (reduced sporonts). Live spores 6.9–7.5 × 3.5–4.4 µm. Also found in metacercaria of plagioporinae trematodes (Opecoelidae: Plagioporinae) parasitizing the same mite. In hemocytes, fat body and nervous ganglia of the water mite L*imnochares aquatica* L. (Acarina, Hydrachnella). Type locality: Ponds of Old Petergof, Leningrad region. Detailed description in Issi, Lipa, 1968.

G. pontica Ovcharenko 1984 (Ovcharenko, 1984, P. 405). LM. Chains composed of 3 mononuclear cells, are produce during merogony. 4-nuclear sporonts transform into CVs 4.0–5.0 µm in diameter. Spores are ovoid, 3.5–3.7 × 2.3–2.5 µm, thick-walled. Polaroplast occupies more than a half of the spore length, posterior vacuole -1/5-th, nucleus is located in the posterior third of the spore. In cross-striated musculature of shrimp *Palaemon elegans* (Decapoda, Palaemonidae). Type locality: Dnieper estuary, Ukraine.

17. *Gurleyides* Voronin 1986 [*Gurleyides biformis* ex *Ceriodaphnia reticulata* (Cladocera, Daphniidae) (Voronin, 1986, p.146, 152, Fig.5)].

G. biformis Voronin 1986 (Voronin, 1986, P. 146 Fig. 5; Voronin, 1999, P. 345). LM, EM[3]. Monokaryotic through the life cycle, dimorphic: with 2 sporogonies and 2 spore types. In the 1st sporogony sporont divides by binary fission to produce 2 sporoblasts that transform into free piriform spores, 4.2 × 2.4µm. In the 2nd sporogony, SVs with 2 pairs of elongated pyriform spores, 4–5.2 × 1.5–1.8µm, are produced. Meronts with one or two nuclei. In the 1st sporogony, 2N sporonts are enclosed in additional envelope that divide alongside with the cell. As a result, each of two spores got enclosed in an individual SV filled with thin threads of secrete material. In the 2nd sporogony, spores are

[1,2] Ultrastructural details are taken from: Voronin V.N. 1999. Microsporidia of freshwater invertebrates and fish in Russia (fauna, systematics, biology). Dr.Sci Dissertation. Zoological Institure Rusian Academy of Sciences.

[3] Ultrastructural details are taken from: Voronin V.N. 1999. Microsporidia of freshwater invertebrates and fish in Russia (fauna, systematics, biology). Dr.Sci Dissertation. Zoological Institure Rusian Academy of Sciences.

connected in pairs by amorphous electron-dense material. SV membrane is sub persistent, SV lumens lack secretory granules. Spores with bipartite PP, heterofilar PF of 3 + 2 + 3 coils arranged in one row, endospore of 150 nm-thick, and exospore of up to 30-45 nm-thick. In fat body and ovaries of *Ceriodaphnia reticulata* and *C. affinis* (Cladocera, Daphniidae). Type locality: Lakes Vrevo and Dolgoye, Leningrad region; Konchozero, Karelia.

18. *Helmichia* Larsson 1982 [*Helmichia aggregata* ex *Endochironomus* sp. (Diptera, Chironomidae)].

H. tetrasticta Kilochitskiy, Cholan 1993 (Kilochitskiy, Cholan, 1993, P.69). LM, EM. Sporogony in SVs. SV membrane sub persistent and disappears upon spore maturation. Oval spores, 2.6 ± 0.10 (2.50–2.75) × 1.27 ± 0.05 (1.25–1.38) μm. Rod-shaped spores, 3.0–3.7 × 1.0–1.3 μm.The short polar filament reached the posterior pole and had semi-coil with small PV and mucus capsules. Spores with smooth exospore, 17–30 nm-thick; endospore 12–30 nm-thick. Sponge-like PP with a few lamellae, occupies half of the spore volume. PT isofilar, makes 0.5 turns; 107–120 nm in diameter. In fat body of larvae of *Ablabesmyia tetrasticta* (Diptera, Chironomidae). Type locality: 12 km southwards from Kiev, Ukraine.

H. lacustris Voronin 1998 (Voronin, 1998, P. 327). LM, EM. DK meronts, DK sporonts undergo meiosis to produce 8 sporoblasts and spores with single nuclei. SV membrane sub persistent and disappears upon spore maturation. Rod-shaped spores, 3.0–3.7 × 1.0–1.3 μm. Short polar filament reaches posterior pole and makes semi-coil. PP consists of lamellar and sponge-like parts. Exospore thin, 2-layered. In fat body of larvae of *Chironomus plumosus* (Diptera, Chironomidae). Type locality: Lake Uchenoe, Pskov region.

19. *Holobispora* [*Holobispora thermocyclopis* ex *Thermocyclops oithonoides* (Copepoda, Cyclopidae)] (Voronin, 1986, P. 150, 152, Fig. 3).

H. thermocyclopis Voronin 1986 (=*Nosema* sp. Voronin 1977). (Voronin, 1977, P. 508; Voronin 1986, P. 150, Fig.3; Voronin, 1999, P. 382). LM, EM . Monokaryotic through the life cycle. Roundish meronts with one nucleus. Sporonts with 2 nuclei. Disporoblastic sporogony. Sporoblasts and spores are connected in pairs. No SV membrane visible. Egg-shaped spores, variable in size from 4.7 × 2.8 to 5.4 × 3.0 μm, with large nucleus, bipartite PP, heterofilar PF (60 μm long) with 9-14 coils (4-6) + (5–8), and small PV. In ovaries of *Thermocyclops oithonoides, T. leuckarti* (Copepoda, Cyclopidae). Type locality: Lake Vrevo, Leningrad region.

20. *Issia* Weiser 1977 [*Issia trichopterae* (Weiser 1946) ex *Plectocnemia geniculata* (Trichoptera, Polycentropodidae)].

I. globulifera Issi, Pankova 1983 (Issi, Pankova, 1983 P. 189–194; Simakova et al., 2005). LM. All stages with DK. Disporoblastic sporogony. During sporogenesis, a spherical protein structure measured 3.6 × 2.4 μm develops. The posterior ends of two or (rarely) four spores, are submerged into this "globule" keeping spores together in pairs or quartets. Spores and a globule are covered by a pansporoblastic membrane. In the intestinal epithelium of larvae and pupae of *Anopheles maculipennis*. Type locality: River Chulym, Tomsk region, Western Siberia.

Based on ultrastructural and molecular study of *Issia globulifera*, a new genus *Senoma* was described (Simakova et al., 2005).

21. ***Janacekia*** Larsson 1983 [*Janacekia debaisieuxi* ex. *Simulium maculatum* (Diptera, Simuliidae)].

J. costata (Khodzhaeva 1988) Khodzhaeva 1990 (Issi et. al., 1990,P. 68; Fig. 20, Table 15). LM. Early sporonts with DK. Multinucleate sporogonial plasmodia divide in 4, 8 or 16 sporoblasts. Oval spores 5.0–6.8 × 3.7–5.0 μm with one horseshoe-shaped nucleus. Each spore is enclosed in an individual SV. Fat body and later all tissues of larvae of *Odagnia ferganica* and *Tetisimulium desertorum*. Uzbekistan.

J. cristula (Khodzhaeva 1988[1]) Khodzhayeva 1990 (Issi et. al., 1990, P. 68; Fig. 20). LM. Meronts with DK. Spores are arranged in pairs. Broadly-oval spores 5.6–7.5 × 4.3–5.6 μm, with a hemispherical nucleus. PF up to 50 μm. Each spore is enclosed in an individual SV with a widening at the posterior end filled with secretory granules. In fat body and Malpighian tubules of larvae of *Wilhelmia mediterranea* and *W. salopiensis*. Type locality: Bukharskiy Oasis, Uzbekistan.

J. wilhelmiae (Khodzhaeva 19881) Khodzhaeva, Krylova, Issi 1990 (Issi et. al.,1990, p. 70; Fig. 20,

[1] The species was first described in: Khodzhaeva 1988. Microsporidia of bloodsucking dipterans of the families Simuliidae and Culicidae of Uzbekistan (species composition, epizootology, ecology). PhD Dissertation. Tashkent. Valid description is provided in Issi et al.,1990.

Table 5, 16). LM, EM Merogonial plasmodium with multiple DKs, split in individual DK meronts that give rise to sporont growing into sporogonial plasmodia. The latter produce 4–16 sporoblasts via rosette-like budding. SV membrane follows outlines of the plasmodium. Additional 2-layered envelope embracing SV, derives from thick walls of a young sporonts Egg-shaped, uninucleate, thin-walled spores, 3.7–5.0 × 2.5–3.7 µm, with isofilar PF of 8 coils in one row. Each spore is surrounded by undulating "membranes". In fat body and intestine of *Wilhelmiae mediterranea, W. salopiensis*. Type locality: Bukharskiy Oasis, Uzbekistan.

22. ***Krishtalia*** Kilochitskiy 1997 [*Krishtalia pipiens* ex *Culex pipiens pipiens* (Diptera, Culicidae) (Kilochitskiy, 1997, P.19)].

Krishtalia pipiens Kiloczycki 1997 (Kilochitskiy, 1997, P. 19; Fig. 3, 4, 6). LM, EM. Two types of sporogony resulted in production of uninucleate (1N) and binucleate (2N) spores. 1N sporogony occurred by internal budding and lead to formation of eight 2N sporonts. Each of those devided two 1N sporoblasts. Live 1N spores measured 4.0–6.3 × 1.2–2.5 (median, 5.5 × 2.3) µm; macrospores - 6.5–8.7 × 2.2–2.8 µm. Thick spore envelopes increased the width from anterior (60 nm) to posterior (325 nm) ends. 1N spores contained isofilar PF of 9-10 coils, (30–45 µm long), lamellar PP. 2N sporogony resulted in formation of eight 2N sporoblasts via rosette budding. 2N spores were thick-walled and remained connected with each other by mucoid extensions derived from processors located at the distal end of the spore. Live 2N spores measured 4.4–6.5 × 2.3–2.5 (median, 6.3 × 2.5) µm. Spores displayed 3 longitudinal ridges (thickenings of the exospore). The waving exospore was 80–110 nm-thick (400–700 nm thick along the ridges); endospore - 90–300 nm-thick. Anisofilar PF was arranged in 10 coils (3–5 + 7–5). Spores contained two oval nuclei at the posterior part, and lamellar PP. In fat body of larvae, and body cavity of imagoes. In *Culex pipiens pipiens* (type host), River Siberezh, Chernigovsk region, Ukraine; in *C. theileri*, Crimea; in anthropogenic, temporal and semi temporal polysaprobic water reservoirs.

23. ***Lanatospora*** Voronin, 1986. [*Lanatospora macrocyclopis* ex *Macrocyclops albidus* (Copepoda, Cyclopidae); Voronin, 1986, P. 149, 152, Fig. 4)].

Lanatospora (***Thelohania***) ***macrocyclopis*** (Voronin 1977) Voronin 1986 (Voronin, 1977, P. 509; Voronon, 1986, P. 149, Fig. 4; Voronin, 1989, P. 358). LM, EM. Monokaryotic through the life cycle. Ribbon-like meronts with 1–4 nuclei, divide by binary fission. Sporonts with 8, 12 or 16 nuclei. SVs are covered with electron-dense secret. Sporont divide by rosette-type budding. Egg-shaped spores, 3.2 × 2.0 µm, with a heterofilar PF of about 45 µm long arranged in 3–4 + 2–3 coils, bipartite lamellar PP, roundish nucleus and small posterior vacuole. In fat body and ovaries of *Macrocyclops albidus* (Copepoda, Cyclopidae). Type locality: Lake Vrevo, Leningrad region.

L. bosminae Voronin 1986 (Voronin, 1986, P. 146, Fig. 1; Voronin, 1999, P. 372). LM, EM[1]. Monokaryotic through the life cycle. Ribbon-like meronts with 1–4 nuclei. Sporonts with 8, 12 or 16 nuclei. Sporont divide by rosette-type budding. Pyriform spores, 2.9–3.6 ×1.7–2.0 µm (with mucus capsule visible on Indian ink-stained smears), with a slightly anisofilar (heterofilar) PF arranged in 1+1+3 coils, bipartite lamellar PP. Spores are covered with a coat composed of threads, Connective tissue of ovaries in B*osmina obtusirostris, B. longirostris, B. coregoni*. Type locality: Lake Vrevo, Leningrad region.

24. ***Larssonia*** Vidtman, Sokolova 1994 [*Larssonia obtusa* ex *Daphnia pulex* (Cladocera, Daphniidae (Vidtman, Sokolova, 1994. P. 211)].

Larssonia (***Pleistophora***) ***obtusa*** (Moniez 1887; Labbe 1899) Vidtmann, Sokolova 1994 (Vidtmann, Sokolova, 1994. P. 211). LM, EM. Monoxenous, monomorphic. Elongated merogonial plasmodia with 2–4 individual nuclei. Intermediate meront-sporont stage with DK. Sporogony by rosette-type budding, in SVs, produces 4–32 sporoblasts. Bi-layered exospore of sporoblasts and spores with thread-like projections. Elongated uninucleate pyriform spores, 4.3–4,6 × 2.6–3.0 µm, with lamellar bipartite PP; isofilar PF (35-50 µm long) arranged in 6–8 coils in one row, without PV. On smears, spores are arranged individually, or in groups of 8, 12 or 16. In fat body of *Daphnia pulex* (Cladocera, Daphniidae). Ponds in vicinity of Vilnus, Lituania (type location); in St. Petersburg, Russia.

25. ***Neoperezia*** Issi, Voronin 1979 [*Neoperezia chironomi* ex *Chironomus plumosus* (Diptera, Chironomidae) (Issi, Voronin, 1979, P. 150)].

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[1] Ultrastructural details are taken from: Voronin V.N. 1999. Microsporidia of freshwater invertebrates and fish in Russia (fauna, systematics, biology). Dr.Sci Dissertation. Zoological Institure Rusian Academy of Sciences.

N. chironomi Issi, Voronin 1979 (Issi, Voronin, 1979, P. 150; Issi, Voronin, 1985, P. 142; Issi, 1986, Fig. 41; redescribed in: Issi et al., 2011). LM, EM, MPh. Disporoblastic sporogony begins with dissociation of DK counterparts. Two types of egg-shaped 1N spores: (1) 6.1 × 3.4 µm, with long (up to 365 µm) PF, and (2) 5.7 × 3.3 µm with shorter PF (of about 300 µm). The latter spores are connected with each other by cementitious substance composed of fibrils and small granules. Pairs of spores are surrounded by external and internal (fibrous) SV envelopes.In fat body of *Chironomus plumosus* larvae. Type locality: Lake Pobednoye, Leningrad region.

N. semenovaiae (synonym *Semenovaia chironomi* Voronin 1986 (in Issi, 1986) Issi, Tokarev, Seliverstova, Voronin, 2012. LM, MPh. Two sporogonies. The first sporogony results in formation of free 2N spores; the second sporogony – in producing SVs with 16 uninucleate spores. The SSUrDNA sequence shares 96.7% homology with the orthologue from *N. chironomi*, the type species. Fat body of *Chironomus plumosus* larvae. Type locality: Lake Pobednoye, Leningrad region.

26. ***Nosema*** Naegeli 1857 [*Nosema bombycis* ex *Bombyx mori* (Lepidoptera, Bombycidae)].

N. grylli Sokolova, Selesniov, Dolgikh, Issi 1994 (Sokolova et al., 1994, P. 493). LM, EM, MPh. Microsporidium from fat body of laboratory population of *Gryllus bimaculatus* (Orthoptera, Gryllidae); later re-assigned to a newly erected genus *Paranosema* basing on molecular characterization and ultrastructure (Sokolova et al., 2003). Described in details in Sokolova et al., 2003.

N. hydraeciae Issi, Tkach 1975. (Issi, Tkach, P. 71). SM. Ovocylindrical spores 3.6–4.8 × 1.5–2.4 µm (fixed). PF up to 60 µm. In salivary glands and musculature underlying midgut, in all stages of Rosy Rustic Moth *Hydraecia micacea* (Lepidoptera, Noctuidae). Leningrad region.

N. loxostegi Issi, Simchuk, Radischeva 1980 (Issi et al., 1980, P. 4). LM. Ovo-cylindrical spores 3.6–6.0 × 1.1–2.4 µm. PF up to 80 µm, 45 µm in average. In *Loxostege sticticalis* (Lepidoptera, Pyralididae), primarily infects fat body, generalized infection. Moldova; Odessa region, Ukraine; Stavropolskiy Kray, Russia.

N. phalerae Issi, Lipa 1968. (Issi, Lipa, 1968, P. 285). LM. Diplokaryotic spores 2.2–4.5 × 1.3–2.0 µm. In fat body of *Phalera bucephala* larvae (Insecta, Lepidoptera). PF 40 µm. Type locality: Cernovcy, Karpathian region, Ukraine.

N. syntomidis Issi 1979 (Issi, 1979). LM. All sporogony stages are diplokaryotic; sporogony disporoblastic. Elongated oval spores, 3.6–4.8 × 1.8–2.4 µm (live). Generalized infection of larvae, pupae and imagoes of Nine-spotted moth *Amata* (*Syntomis*) *phegea* (Lepidoptera, Erebidae). Type locality: "Forest-on-Vorskla" Nature Reserve, Belgorod region, Russia.

N. xiphidiocercariae Voronin 1974 (Voronin, 1974b, P. 359).). LM. All sporogony stages are diplokaryotic; sporogony disporoblastic. Elongated oval spores, 4,5 (3.8–5.2) × 2,3 (1.9–2.4) µm (live). In sporocysts, cercariae and metacercariae of two species of trematodes (Plagiorchidae). Type locality: Lake Dolgoe, Leningrad region.

27. ***Octosporea*** Flu 1911. [*Octosporea muscaedomesticae* ex *Musca domestica* (Diptera, Muscidae)].

O. antiquae Issi, Radischcheva, Dolzhenko 1983. (Issi et al., 1983, P. 3–9). All stages with DK. Small cylindrical spores 3.5–3.7 × 0.6–0.8 µm, sporogony occurs in fat body of pupae and imagoes of *Delia antiqua* (onion fly) (Diptera, Anthomyiidae). Middle Ural (type locality), Povolzhye.

O. autumnalis Bykova, Issi 1991(=*Nosema tabani* Levchenko, Andreyeva 1982). (Bykova, Issi, 1991, P. 64, Fig. 23). LM. Binucleate curved sporoblasts, spores, 1.8–6.4 × 1.3–2.6 µm. PF up to 35 µm. In fat body, haemolymph, and Malpighian tubes of *Hybomytra* sp. larvae. Village Kitayevo, Kiev region; Town Vatutino, Cherkask region, Ukraine.

O. deliae Issi, Radischcheva, Dolzhenko 1983. (Issi et al., 1983, P. 3–9). All stages with DK. Cylindrical spores, 5.4–6.0 × 1.6–1.8 µm (live), in SVs with unstable envelopes. Spore formation occurs in pupae and imagoes of *Delia floralis* (summer cabbage fly) or *D. brassicae* (cabbage root fly) (Diptera, Anthomyiidae); cabbage farm fields in Leningrad region (type locality) and Kazakhstan.

O. tabani Levtchenko, Issi 1973. (Levtchenko, Issi, 1973, P. 43). LM. Sporogonial plasmodia with 4–8 nuclei. SVs with 8 spores. Cylindrical narrow spores, 3.8–5.5 × 1.2–1.6 µm, with thin envelopes and 2 nuclei. In ovaries, fat body and intestine of females of flies *Atylotus karybenthinus, Hybomitra pecularis*, and in larvae of *Hybomitra* sp. Type locality: River Turgen, Kazakhstan.

O. hybomitrae Bykova, Issi 1991 (Bykova, Issi 1991, P. 64–65, Fig. 23, 24). LM. Shortly cylindrical large spores, 9.4 × 3.9 µm, with rounded ends, thin envelopes and 2 small centrally located nuclei.On smears reside in sets of 8. In *Hybomitra arpadi* larvae.

Type locality: Wildlife Preserve Kivatch, Village Gomselga, Kondopozhskiy district, Karelia.

28. ***Octotetraspora*** Khodzhaeva, Pushkar, Krylova 1990 [*O. paradoxa* ex *Wilhelmia mediterranea* (Diptera, Simuliidae)] (Issi et. al.,1990, P. 57)].

O. paradoxa Khodzhaeva, Krylova, Issi 1990 (Issi et. al., 1990, P. 80, Fig. 21 (7–9), Table 8–10, 17). LM, EM. DK meronts. Sporogonial plasmodia with 4–6–16-nuclei evenly distributed throughout the cytoplasm. SV lumen is filled with tubules that connect sporont envelopes with SV membrane. Several SVs are linked by cytoplasmic bridges in bead-like structures. Dimorphic uninucleated spores: (i) small egg-shaped spores, 4.0–5.4 × 2.7–5.4 µm, with isofilar PF with 4 coils, and undulating exospore, and (ii) large oval spores, 5.0–6.2 × 3.7–5.0 µm, with elongated nucleus, isofilar PF of 4 coils, and smooth exospore. In fat body of larvae of *Wilhelmia mediterranea*. Type locality: Bukharskiy Oasis, Uzbekistan.

O. cincta Khodzhaeva, Krylova, Issi 1990 (Issi et al., 1990, P. 79, Fig. 21 (10v11), Table 6, 7, 17. LM, EM. DK sporont gives rise to either 4Nor 8N (rarely 16N) sporogonial plasmodium, that splits in 4 or 8 sporoblasts that transform either into egg-shaped tetraspores measured 5.0–5.6 × 3.7–4.3 µm, or oval octospores, 3.7–4.3 × 2.5–3.1 µm. SV lumens are filled with fibrillary and tubular secretory material. Tubular secretion is preserved in SVs with mature spores. Fibrillary secretion is transformed into small granules that eventually disappears. Octospores with large PV, small polar sac, isofilar PF of 3 coils. External layer of the exospores tends to detach and form additional envelope surrounding spores. Tetraspores with an isofilar PF of 5–6 coils in one row and small posterior vacuole. In fat body of larvae of *Wilhelmia mediterranea* (type species), *W. balcanica, W. lineata, W. salopiensis*, and *W. veltistshevi*. Uzbekistan.

29. ***Parapleistophora*** Issi, Khodzhaeva, Krylova 1990 [*Parapleistophora ectospora* ex *Tetisimulium desertorum* (Diptera, Simuliidae) (Issi et. al.,1990, P. 65)].

P. ectospora Khodzhaeva, Krylova, Issi 1990 (Issi et. al.,1990, P. 65–66, Fig. 20, Table 15). LM. Sporogony stages and spores in round SVs. 48, 64 and more spores in a SV. Spores are arranged in a row under the SV surface; SV lumens are filled with numerous small granules. SVs are connected with each other by 1–2 threads in groups of 2 or 3. Egg-shaped uninucleate thick-walled spores, 4.3–7.5 × 3.1–5.0 µm, with short (up to 30 µm) PF. In fat body of larvae of T*etisimulium desertorum*. Type locality: Uzbekistan, South-Western slopes of Chatkal Mnt Range, Tian-Shan.

30. ***Parastempellia*** (Khodzhaeva 1988) [Khodzhaeva 1990 (*Parastempelia odagmiae* ex *Odagmia ferganica* (Diptera, Simuliidae) (Issi et. al., 1990, P. 91)].

P. odagmiae (Khodzhaeva 1988[1]) Khodzhaeva 1990 (Issi et. al., 1990, P. 91, Fig. 22). LM. SVs round with 4, 8 or 16 spores. Two spore types: oval small 1N spores, 1.2–2.5 × 1.2–1.8 µm (fixed), and egg-shaped 2N spores, 3.1–3.7 × 1.2–2.5 µm, with slightly pointed anterior ends and thick envelops. In fat body, intestine, salivary glands of *Odagmia ferganica* (type species), *Simulium angustifilum, Montisimulium lithkense, M. quattuordecimfilum*. Type locality: Uzbekistan, South-Wesyern slopes of Chatkal Mnt Range, Tian-Shan.

31. ***Parathelohania*** Codreanu 1966 [*Parathelohania legeri* ex *Anopheles maculipennis* (Diptera, Culicidae)].

P. detinovae Kilochitskiy 1998 (Kilochitskiy, 1998, P. 31, Fig. 1, 4). LM, EM. Meronts with DK. Sporogony results in 8-spores SVs, 12.5–14.5 µm. Spores oval, 5.0–6.0 × 3.3–3.6 µm (live), with characteristic for *Parathelohania* spp. tongue-like protrusion of the posterior pole. Spore envelopes are composed of a smooth exospore (115–190 nm) and endospore (70–150 nm). Spores contain lamellar PP, anisofilar PF arranged in 6–8 coils, and a large horseshoe-shaped nucleus that embraces the distal part of PP above the PV. In fat body of 4-instar larvae of *Anopheles maculipennis.* Type locality: in vicinity of village Siberezh, Chernigov region, Ukraine.

P. illinoisensis* var. *messeae Pankova, Issi, Krylova 1991 (Pankova et al., 1991, P. 259, Fig. 1–4). LM, EM. Early sporonts with 1 or 2 DKs. 4-nucleate sporogonial plasmodia give rise to 4 individual sporonts, which divide forming 8 sporoblasts. Sporogony in persistent SVs with the lumens filled with irregularly shaped secretory granules up to 1.5 µm in size and tubular structures

[1] The taxon was first described in: Khodzhaeva 1988. Microsporidia of bloodsucking dipterans of the families Simuliidae and Culicidae of Uzbekistan (species composition, epizootology, ecology). PhD Dissertation. Tashkent. Valid description is provided in Issi et al., 1990.

of 80 nm in diameter. The tubules connect SV membrane with exospores of sporoblasts and spores. Secrete material disappears upon spore maturation. Exospore of sporoblasts and young spores is composed of tightly packed short microtubules arranged perpendicularly to the parasite surface. In mature spores bilayered exospore is about 25 nm thick; endospore – 30 nm. Spores broadly oval, 4.8 × 3.4 µm, display ultrastructure typical for *Parathelohania* spp. Spore envelopes form extensions on the anterior and posterior poles, PP tripartite, with granular posterior portion; anisofilar polar filament forms 6 coils (1.5–2 + 3.5–4). In fat body of III-IV instar larvae of *Anopheles messea*. Type locality: Tomsk region, flood plain pools of the rivers Om, Ob, Chulym, Russia.

P. issiae Kilochitskiy 1998 (Kilochitskiy, 1998, P. 34, Fig. 2,5). LM, EM. The earliest stage observed was 1–8 nucleate sporonts with large metabolic granules which number decreased in the course of sporogony. 8-spores SVs measured 8–9 µm. Some SVs were enclosed in multilayered capsules. Spores, 4.8–5.0 × 2.8–3.8 µm (live) or 4.4–5.0 × 2.2–3.8 µm (fixed), with characteristic for *Parathelohania* spp. tongue-like protrusion of the posterior pole. Spore envelopes composed of a smooth 170 nm-thick exospore and 150–170 nm-thick endospore. Spores contain lamellar PP, anisofilar PF arranged in 5–6 coils, and a nucleus that embraces the distal part of PP above the PV. In fat body of 4-instar larvae of *Anopheles claviger*. Of note, in ovaries of *A. claviger*, DK meronts of the presumably same microsporidium had been previously recorded. Type locality: in vicinity of village Kruglik, Kiev region, Ukraine, in permanent shadowy pond.

32. *Perezia* Leger, Duboscq 1909 [*Perezia lankesteria* ex *Lankesteria ascidiae* (Apicomplexa, Gregarinidae)].

P.* (*Octosporea*) *diaphanosomae (Voronin 1977) Voronin 1986 (Voronin, 1977, P. 511; Voronin, 1986, P. 146; Voronin, 1988, P. 770). LM, EM. DK sporonts. Ribbon-like sporonts with 6–8 monokaryotic nuclei. SV is absent. Oval or rod-shaped spores 3,5–6,8 × 1,1–2,8 µm with bipartite PP and thin exospore. PF is slightly anisofilar (heterofilar) with 4–6 coils. In the epithelian cells of intestine of *Diaphanosoma brachyurum* (Cladocera). Type locality: Lake Vrevo, Leningrad region, Russia.

33. *Pilosporella* Hazard and Oldacre 1975 [*Pilosporella fishi* ex *Wyeomyia vanduzee* (Diptera, Culicidae)].

P. simulii (Pushkar 1984[1]) Pushkar 1990 (Issi et. al.,1990, P. 92, Fig. 22, Table 18). LM. SVs with 8 round spores, 2.2–3.3 µm in diameter, with spherical or horseshoe-shaped nucleus. Oval binucleate spore, 3.6 × 2.4–3.0 µm. In fat body of *Odagmia ornata* larvae. Ukraine (type locality), Eastern Siberia, Russia.

34. *Pleistophora* Gurley 1983 [*Pleistophora typicalis* ex *Cottus scorpius* (Perciformes, Cottidae)].

P. aidarlovica Levtchenko, Issi 1973. (Levtchenko, Issi, 1973, P. 59; Fig. 10). LM. Large sporogonial plasmodia with up to 20–70 nuclei. Egg-shaped spores, 2.4–3.0 × 1.2–2.0 µm or, rarely, 3.2–4.8 × 2.4–3.0 (fixed). In haemolymph, salivary glands, fat body, intestine and ovaries of female of a tabanid *Atylotus karybenthinus* (Diptera, Tabanidae). Type locality: Valley of the Ili River, Panfilovskiy district, Kazakhstan.

P. carpocapsae Simchuk, Issi 1975 (Simcuk, Issi, 1975, P. 294). LM. Monokaryotic through the life cycle. Sporogonial plasmodia with up to 64 nuclei (most often 8–32). Oval spores, 1.6–3.1 × 0.7–1.4 µm. PF, 25–50 µm. In all tissues of larvae, pupae and imago *Laspeyresia pomonella* (Lepidoptera, Tortricidae). Type locality: Environments of Kishiniov, Moldova.

P. culicoidi Levtchenko, Issi 1973 (Levtchenko, Issi, 1973, P. 61. Fig. 12). LM. SVs with even number of spores (from 2 to 16). Fixed spores 1.8–2.0 × 0.9–1.2 µm. Fat body of *Culicoides* spp. (Diptera, Ceratopoganidae) larvae, valley of the Ili River, Kazakhstan.

P. hybomitrae Bykova, Issi 1991 (Bykova, Issi, 1991, P. 42, Fig. 12) LM. Multinucleate plasmodia with 12–160 nuclei. Broadly oval mononucleate spores, 4.5 × 2.9 in average, with slightly narrowed anterior ends, 56 nm-long PFs, thick envelopes, and oval 1N nuclei. Tracheal epithelium, hypoderm, fat body and striated muscles of *Hybomitra arpadi* larvae. (Diptera, Tabanidae). Type locality: Wildlife Preserve Kivatch, Village Gomselga, Kondopozhskiy district, Karelia, Russia.

P. ladogensis Voronin 1978 (Voronin, 1978, P. 455). LM. Monokaryotic through the life cycle. Sporogonial plasmodia with up to 128 nuclei (most

[1] The species was first described in: Pushkar E.N. 1984. Microsporidia of midges in Ukraine (species composition, biology, economical importance). PhD Dissertation. Baku, Azerbaidzhan. Valid description is provided in Issi et al.,1990.

often 32). Mature SVs 18–60 µm in diameter with thick solid envelope. Egg-shaped or pyriform spores, 5.4 × 2.9 µm. PF 100–180 µm, in cross-striated musculature. Type host: bulbot *Lota lota* (Actinopterygii, Gadidae); type locality: Lake Vrevo, Leningrad region. Also *Osmerus eperlanus* nation ladogensis (Actinopterygii, Osmeridae). Type locality: Lake Ladoga, Leningrad region, Russia.

P. siluri Gasimagomedov, Issi 1970 (Gasimagomedov, Issi 1970, P. 1118–1119, Fig.1). LM. Yellowish cysts of 380–410 µm in diameter along the entire length of the fish intestine. A cyst is composed of several thousand SVs. The center of the cyst is free of spores, SVs 11-28 µm in diameter, each contains >50 elongated/ovoid spores, 4.8–5.0 × 1.8–2.4 µm. Type host: Wels catfish *Silurus glanis* (Actinopterygii, Siluridae). Type locality: Agrakhan Bay, Caspian Sea, Azerbaijan.

P. tuberifera Gasimagomedov, Issi 1970 (Gasimagomedov, Issi, 1970, P.1119–1120, Fig. 2). LM. In subcutaneous muscules, induce bump-like tissue growths about 550 × 200 µm. Eventually all muscle tissue is replaced by spores. SVs of about 32 µm in diametrer. Number of spores within one SV vary from 50 to several hundreds. Spores are pyriform, 9.6 × 5.4 µm. Type host: Caspian big-head Goby, *Neogobius kessleri gorlap* (Actinopterygii, Gobiidae). Type locality: coastal waters in vicinity of Bekdash, Caspian Sea.

P. turgenica Levtchenko, Issi 1973 (Levtchenko, Issi, 1973, P. 55–57, Fig. 8) LM. Sporogonial plasmomia with up to 26 nuclei. The nuclei migrate to the periphery and form finger-shaped outgrowths that transform into sporoblasts. Each sporont contains an even number of sporoblasts (6–20). Young spores are irregularly pyriform with pointed apical ends. Mature spore measured 4.8 × 2.6 µm, with 2 small nuclei. Type host: *Odagmia* sp. (Diptera, Simuliidae). Type locality: Zailiyskiy Ala-Tau, the Turgen river, 1200–1300 m. above the sea level, Kazakhstan. Potentially a new genus (Issi, unpublished)

35. ***Pulicispora*** Vedmed, Krylova, Issi 1991 [*Pulicispora xenopsyllae* ex *Xenopsylla hirtipes* (Siphonaptera, Pulicidae) (Vedmed et al., 1991, P. 14)].

P. xenopsyllae Vedmed, Krylova, Issi 1991 (Vedmed et al., 1991, P. 14).

LM, EM. Sporogonial plasmodium with 4–32 nuclei. Typically, 8, 16 or 32 spores develop within round to oval SVs. Spores are oval cylindrical with slightly narrowed anterior end, with rod-shaped or horseshue-shaped nuclei. Live spores from *X. skrjabini*: 5.7 × 2.8 (3.6–7.3 × 2.4–3.2) µm; from *X. hirtipes*: 4.6 × 3.0 (3.6–6.1 × 2.4–4.8) µm. Young sporonts with DK give rise to sporogonial plasmodia that split in unicellular sporoblasts by rosette-type budding. Sporogony within 2-layered SV envelope. SV lumen is filled with granular material that disappears upon spore maturation. Spores are enclosed in 60–80 nm-thick envelopes with waving exospores ornamented in the medial part by "secretory tubules" 25–30 nm in diameter. Anisofilar polar filament of 10 coils (5–7 + 3–4) arranged in one row except for the last coil that stands apart. In fat body, hypodermis, muscles, and other tissues of pupae and imagoes of *Xenopsillae skrjabini* and *X. hirtipes* (type host). Type locality: Insectarium of the Zoology Department of Kiev State University, Ukraine.

36. ***Simuliospora*** Khodzhaeva, Krylova, Issi 1990 [*Simuliospora uzbekistanica* ex *Tetisimulium alajense* (Diptera, Simuliidae) (Issi et. al.,1990, P. 57)].

S. uzbekistanica Khodzhaeva, Krylova, Issi 1990 (Issi et. al., 1990, P. 57; Fig. 16, Table 3). LM, EM. Meronts with DK. 8-32 sporoblasts are produced by rosette-like budding of sporogonial plasmodia. Elongated pyriform 1N spores of two types: (i) more abundant elongated wedge-shaped spores 3.2–6.5 × 1.7 –1.9 µm, and (ii) shorter spores with blunt anterior edge, 2.6–3.9 × 1.7–1.9 µm. Polar tube is up to 30 µm, coiled in 2–3 turns with anterior coil of larger diameter. PP is composed of 3 regions: (i) broad chambers filled with granules, (ii) thin lamellas; and (iii) fibrils. PV is unusually large, often seen as a pared structure. Thin SV envelope is underlain by rows of tubules 70–80 nm in diameter arranged perpendicularly to the SV surface. Tubules disappear upon spore maturation. SVs of both spore types, are enclosed in mucous capsules. In fat body of larvae of *Tetisimulium alajense*. Type locality: South-Western slopes of Chatcal Mnt Range, Uzbekistan.

S. (***Pleistophora***) ***turgenica*** (Levtshenko, Issi 1973) Issi, Chodzhaeva, Krylova 1990 (Issi et. al., 1990, P. 58, Fig. 16). LM. Meronts with DK. 6–20 sporoblasts are produced by rosette-type budding of sporogonial plasmodia. Dimorphic spores: (i) more common thin-walled monokaryotic irregularly-pyriform spores with a laterally located nucleus, 4.8–6.0 × 1.8–2.4 µm, and (ii) rarer thick-walled binucleate spores with blunt anterior end, 4.8 × 2.6 µm. Some of the latter spores display short projection at the posterior end of the exospore. SVs without mucus capsules. In fat body of larvae of *Odagmia* sp. in South-Easten Kazahstan.

37. ***Stempellia*** Leger and Hesse 1910 [*Stempellia mutabilis* ex *Ephemera vulgate* (Ephemeroptera, Ephemeridae)].

S. angreni (Khodzhaeva 1988[1]) Khodzhaeva 1990 (Issi et al., 1990, P. 82, Fig. 21). LM. Spherical SVs with 8 and 16 spores in 1:1 ratio. Fixed spore nearly round, 4.3–5.0 × 4.3–5.0 µm, with 1 nucleus, thick envelope and long (up to 200 nm) PF. In all organs and tissues of larvae of *Tetisimulium alajense* (type host) and *Odagmia ornate*. Type locality: South-Western slopes of Chatcal Mnt Range, Uzbekistan.

S. captshagaica. Levtchenko, Issi 1973. (Levtchenko, Issi, 1973. P. 51–53. Fig. 6.) LM. Even (mostly 8) number of spores in SVs. Spore size decreases proportionally to a spore number increase: in 2-spore CVs spores measured 7.2–9.6 × 5.6–6.0 µm; in 8-spore CVs 3.0–3.6 × 2.4–3.0 µm. In 3–4 instar larvae of *Aedes caspius caspius*. Type locality: in a permanent pond, floodplain of the Ili River, Kazakhstan.

S. rubtsovi Issi 1968 (Issi, 1968, P. 346). LM. SVs with 2, 4, 8, and 16 spores. Variable spore size, 5.4–16.3 × 3.6–8.4 µm. Spores with thick envelopes, large PVs and smaller PPs. Sporoplasms either binucleate, or with one horseshue-like nucleus. In salivary glands of *Odagmia caucasica* larvae. Transcaucasus.

38. ***Striatospora*** Issi, Voronin 1986 [*Striatospora chironomi* ex *Chironomus plumosus* (Diptera, Chironomidae) (Issi, Voronin, 1986, P. 77)].

S. chironomi Issi, Voronin 1986 (Issi, Voronin, 1986, P. 78, Fig. 32). SM, EM. Uninucleate meronts. Early sporonts with DK. Sporogony starts within a parasitophorous vacuole. Sporogonal plasmodia with 8 nuclei divide by rosette-type budding. Sporoblas ts and spores uninucleate. One parasitophorous vacuole may contain several SVs. SV envelopes are thin and fragile. Rod-shaped spores, 6.0–8.0 × 0.8–1.0 µm, with straifgt and short PF (2/3 of spore length). PF is spongius, without lamellae. Endospore is thin, exospore with short-spined projections. In fat body of larvae of *Chironomus plumosus* (Diptera, Chironomidae). Type locality: Small lake in Leningrad region.

39. ***Tabanispora*** Bykova, Issi 1991 [*Tabanispora bacillifera* ex *Hybomitra arpadi* (Diptera, Tabanidae (Bykova, Issi, 1991, P.5 1) = *Tabanispora* Bykova, Sokolova, Issi 1987, *nomen nudum*].

T. bacilifera Bykova, Issi 1991 (=*Tabanispora bacillifera* Bykova, Sokolova, Issi 1987, *nomen nudum*) (Bykova, Issi, 1991, P. 52–58, Fig. 17). LM, EM. Meronts and sporonts with DK. 2 sporogonies.1st sporogony results in formation of 1 to 10 sporoblasts residing in a SV with large bacilliform secretory granules corresponding in number to the number of sporoblasts.1st sporogony gives rise to SVs with up to 10 oval spores, 3.5 × 2.3 µm (live), yet unstudied by EM due to high electron density. 2nd sporogony produces free binucleate *Nosema*-type spores, 5.3 × 3.2 µm (live), with multilayered anchoring disk, bipartite (lamellar + sponge-like) PP, PF of 18–21 coils, 175 nm-thick envelopes, and 25-nm thick exospore with episporal incrustation formed by radial thin tubules. Fat body, hypoderma, haemolymph of *Hybomitra arpadi* larvae. Type locality: Village Kutizhma, Priazhinskiy district, Karelia; Wildlife Preserve Kivatch, Kondopozhskiy district, Karelia, Russia.

T. hybomitrae Bykova, Issi 1991 (Bykova, Issi, 1991, P. 58, Fig. 21). LM, EM. Meronts and early sporonts with DK. SVs with 1 or 2 sporoblasts. SV lumen is filled with tubular secrete material. Upon spore maturation, secretory granules and SV envelope disappear. Spores within SVs are mononucleate with lamellar polaroplast and isofilar PF arranged in 4–6 coils. Endospore is thick, exospores is composed of electron-dense granules. Free spores, 5.0 × 2.9 µm, resemble *Nosema* spores, with PF arranged in 14–17 coils, two oval nuclei, bipartite PP (lamellar and spongious), thick (200–300 nm) spore wall composed of 250 nm-thick endospores and thin 10–15 nm-thick exospore. Episporal secrete con-sists of small granules of moderate electron density. In larvae and pupae of *Hybomitra lundbecki*. Type locality: Village Kutizhma, Priazhinskiy district, Karelia; Wildlife Preserve Kivatch, Village Gomselga, Kondopozhskiy district, Karelia, Russia.

[1] The taxon was first described in: Khodzhaeva 1988. Microsporidia of bloodsucking dipterans of the families Simuliidae and Culicidae of Uzbekistan (species composition, epizootology, ecology). PhD Dissertation. Tashkent. Valid description is provided in Issi et al.,1990.

40. ***Thelohania*** Henneguy 1892 [*Thelohania giardi* 1892 ex *Crangon vulgaris* (Decapoda, Cranganidae)].

Th. assovi Levtshenko 1977 (Levtshenko, 1977, P. 272). LM. Late meronts with DK. Sporonts with 1, 2, 4 or 8 nuclei. Oval sporoblasts segregate via internal budding. Pansporoblast membrane is not well distinguished, but spores are kept together in sets of 8. Mature spores are elongated oval or egg shaped with one, rearly 2 nuclei. Spores measure 4.4–7.0 × 2.5–3.8 µm (live) or 3.8–6.4 × 2.3–3.8 µm (fixed). In larvae of *Odagmia* sp. Type locality: Zaililiyskiy Alatau, River Assy (type locality) and other mountain rivers of South-Eastern Kazakhstan and Tien-Shan, at the elevation 800–2600 m above the sea level.

Th. argyresthiae Issi, Lipa 1968 (Issi, Lipa, 1968b, P. 282, Table 2). LM. 8 spores in SVs. Fixed spores, 3.0–6.0 × 2.0–3.1 µm. In fat body of larva of *Argyresthia conjugella* (Lepidoptera). Type locality: suburbs of Vilnus, Lituania.

Th. culisetae Levtchenko, Issi 1973 (Levtchenko, Issi, 1973, P. 50–51, Fig.5). LM. SVs with 8- oval spores, 6.0–8.4 × 3.6–5.1 µm (fixed). Spores enclosed in gelatinous capsules. In 3–4 instar larvae of mosquitoes *Culiseta alaskaensis* (Diptera, Culicidae). Type locality: Floodplain of the Ili Rive, Panfilovskiy district, Kazakhstan.

Th. dasychirae Issi, Lipa 1968 (Issi, Lipa, 1968b, P. 284, Table 3). LM. 8-spore SVs; spores, 3.2–5.8 × 2–3 µm. Infection was revealed in laboratory (Laboratoty of Entomology, Leningrad State University, Peterhof, St. Petersburg) in a larvae of *Dasychira pudibunda* (Lepidoptera) collected in Sukhumi, Caucasus.

Th. baueri Voronin 1974 (Voronin, 1974, P. 214). LM. Merogonial multinucleate plasmodia are ribbon-like. Round sporogonial plasmodia with 8, 12 or 16 nuclei produce uninucleated sporoblasts and spores in SVs. Pyriform spores 5.4 × 2.7 µm; with PV which occupied a half of the spore volume. Sometimes the microspores (4.8 × 1.6 µm) were observed. In the eggs of nine- and three-spined sticklebacks *Pungitius pungitius* and *Gasterosteus aculeatus* (Gasterosteiformes, Gasterosteidae). Type locality: Gulf of Finland, in vicinity of St.-Petersburg, Leningrad region.

Th. corynoneurae Voronin 1979 (Voronin, 1979, P. 592-593). LM. SVs with 8 elongated-oval spores, 5.3–6.4 × 3.1–3.7 µm (live). PF is 60–75 µm long. In fat body of *Corynoneura* sp. larvae. (Diptera. Chironomidae). Type locality: Lake Vrevo, Leningrad region; other lakes in North-West Russia.

Th. jungarica Levtshenko 1976 (Levtshenko, 1976, P. 422-427)). LM. SVs with 8 pear-shaped spores, 5.1–7.6 × 2.5–3.8 µm (live). PF is 80–90 µm long. In larvae of *Odagmia* sp. Type locality: mountain rivers of Tien-Shan in South-eastern Kazakhstan.

Th. volgensis Khaliulin 1977 (Khaliulin, 1977, P. 270–271). LM. SVs with 4 or 8 spores. SVs, 15.05–16.75 µm in diameter; spores, 6.4–8.3 × 5.5–6.2 µm (live). In larvae of *Aedes excrucians, A. beklemishevi, A. annulipes, A. canians*. Type locality: Middle Povolzhye: Tatarstan, Mariyskaya AO, Chuvashia, Russia.

41. ***Toxospora*** Voronin 1993 [*Toxospora volgae* ex *Corynoneura* sp. (Diptera. Chironomidae) Voronin, 1993b, P. 148].

T. volgae Voronin 1993 (Voronin, 1993b, P. 148). LM, EM. Meronts or young sporonts with DK. Stages of octosporous sporogony are limited by thin and fragile SV envelopes. C-shaped spores, 6–8 × 0.7–0.8 µm, with elongated nucleus, multilayered exospores and PF of unusual structure (Helmichia-like type, but longer). In fat body of *Corynoneura* sp. larvae. (Diptera. Chironomidae). Type locality: River Volga, near Kostroma, Russia.

42. ***Tuzetia*** Maurand, Fize, Vernick et Michel 1971 [*Tuzetia infirma* ex *Cyclops albidus* (Copepoda, Cyclopidae)].

T. ceriodaphniae Voronin 1986 (Voronin, 1986, P. 146, Fig. 1; Voronin, 1999, P. 385). LM, EM[1]. Merogony and sporogony with isolated nuclei. Sporogonial plasmodia divide by rosette-type budding. Uninucleate sporoblats and spores enclosed in individual SVs. Oval spores, 4,3 × 2,6 µm, with slightly anisofilar (heterofilar) PF of 9–11 coils, lamillar PP and one-layered exospore. In hypoderma of *Ceriodaphnia affinis* and *C. reticulata* (Cladocera, Daphniidae). Type locality: Lake Vrevo, Leningrad region, Russia.

T. diaphanosomae Voronin 1986 (Voronin, 1986, P. 146, Fig. 1; Voronin, 1999, P. 387). LM, EM[2]. Merogony and sporogony with isolated nuclei. 4–6-nucleate sporogonial plasmodia divide by rosette-type budding. Uninucleate sporoblats and spores in individual SVs. Elongated-oval spores, 4,3 × 2,6 µm, with slightly anisofilar (heterofilar)

[1,2] Ultrastructural details are taken from: Voronin V.N. 1999. Microsporidia of freshwater invertebrates and fish in Russia (fauna, systematics, biology). Dr.Sci Dissertation. Zoological Institute Russian Academy of Sciences.

PF of 8–10 coils, lamillar PP, thick endospore and one-layered exospore. In fat body of *Diaphanosoma brachyurum* (Cladocera, Daphniidae). Type locality: Lake Vrevo, Leningrad region, Russia.

43. ***Unikaryon*** Canning, Lai, Lie 1974 [*Unikaryon piriformis* ex *Echinostoma audyi* (Diginea, Echinostomatidae)].

U. oulemi Issi, Krylova, Morzhina, Sokolova 1998 (Issi et al, 1998, P. 67). EM. Short cylindrical spores, 2.7–2.9 × 1.2–1.4 µm (measured on thin sections), with isofilar PF of 11.5–12.5 coils arranged in one row, and one nucleus. Oval 1N spores with 7–8 PF coils can by seen occasionally as well. Mitgut epithelium of imago of *Oulema melanopus* (Coleoptera, Chrysomelidae). Type locality: On wheat crops in Krasnodarskiy Kray, Southern Russia.

U. vrevi (Voronin 1991) Voronin 1999 (Voronin, 1991a, P. 9; Voronin 1999, P. 295). LM, EM[1]. Ribbon-like merogonial and sporogonial plasmodia, with isolated nuclei. Sporoblasts and spores are uninucleate. No SVs or parasitophorous vacuoles. Short-cylindrical spores, 3,5–2,5 × 0,6–0,8 µm, with isofilar PF coiled in 6–7 coils. PP consists of an anterior narrow lamellar region and posterior wide lamellar part. Exospore with external electron-dence granular layer. In fat body of *Macrocyclops distinctus* (Copepoda, Cyclopidae). Type locality: Lake Vrevo, Leningrad region, Russia.

U. moniezi (Voronin 1977) Voronin 1999 (Voronin, 1977, P. 508; Voronin, 1999, P. 300). LM. Merogonial and sporogonial plasmodia with 2–4 isolated nuclei. Sporoblasts and spores uninucleate. SV and parasitophorous vacuole are absent. Ellipsoidal spores, 4,4 × 2,1 µm. PF is up to 75 µm long. In fat body of *Eucyclops macrurus* (Copepoda, Cyclopidae). Type locality: Lake Vrevo, Leningrad region, Russia.

U. pfeifferi (Voronin 1977) Voronin 1999 (Voronin, 1977, P. 506; Voronin, 1999, P. 293). LM, EM[2]. Merogonial and sporogonial plasmodia with 2–4 isolated nuclei. Sporoblasts and spores uninucleate. SVs and parasitophorous vacuoles are absent. Elongated-oval spores, 3,5 × 1,6 µm, with isofilar PF of 12 coils arranged in two rows. Lamellar bipartite PP. Exospore thin and granular. In fat body of *Acanthocyclops viridis* (Copepoda, Cyclopidae). Type locality: Lake Vrevo, Leningrad region, Russia.

44. ***Vairimorpha*** Pilley 1976 [*Vairimorpha necatrix* ex *Pseudaletia unipuncta* (Lepidoptera, Noctuidae)].

V. (***Nosema***) ***hybomitrae*** (Levtchenko, Issi 1973) Bykova, Issi 1984 (Levtchenko, Issi, 1973, P. 60–61. Fig. 1; Bykova, Issi, 1984, P. 248). LM. Two sporogonies. Disporoblastic sporogony produces *Nosema*-like broadly oval thick enveloped spores, 3.9–6.5 × 2.6–3.9 µm (live); 3.6–6.0 × 2.4–3.6 µm (fixed); octosporoblastic sporogony results in *Thelohania*-like spores, 2.0–2.4 × 1.5–1.8 µm in SVs, 8.4 × 7.8 µm. In fat body, muscles, hypoderm, haemolymph of larvae and pupae of *Hybomitra lundbecki, H. arpadi, H. bimaculata* (Diptera, Taba-nidae). Village Kutizhma, Priazhinskiy region, Karelia, Russia; Wildlife Preserve Kivatch, Kondozhskiy region, Karelia; Zailiyskiy Ala-Tau, the Turgen river, 1200–1300 m above the sea level, Kazakhstan.

45. ***Vavraia*** Weiser 1977 [*Vavraia culicis* ex *Culex pipiens* (Diptera, Culicidae)].

V. cyclocypris Voronin, Melnikova 1984 (Voronin, Melnikova, 1984, P. 484). LM, EM. Merogony and sporogony with isolated nuclei. Sporogonal plasmodia with numerous nuclei divide by rosette-type budding; sporoblasts and spores uninucleate. SV envelope thin, episporontal space with tubular inclusions. Elongated-oval spores, 3, 4 × 1,7 µm, with slightly anisofilar PF coiled in 6–9 (2–3+4–6) turns, lamellar PP, and 2-layered exospore. In adipose tissue of *Cyclocypris ovum* (Ostracoda). Type locality: Lake Vrevo, Leningrad region.

46. Species described in the collective group, the "genus" ***Microsporidium*** Balbiani 1984:

Microsporidium (***Bacillidium***) ***chironomi*** (Voronin 1975) Voronin 1999 (Voronin, 1975, P. 373; Voronin, 1999, P. 470). LM, EM. Meronts with DK. Multinicleate (up to 32 nuclei) sporonts in SVs. Thin walled rod-shaped spores,15.6 (11.8–19.0) × 0,7 (0.6–0.8) µm, with short PFs (up to a half of the spore length), and bipartite PP with a small lamellar part and large spongy-like one. In fat body of larvae of *Chironomus dorsalis* (Diptera, Chironomidae). Type locality: Water basins of North-Western Russia.877

Microsporidium fluviatilis Voronin 1994 (Voronin, 1994, P. 49). LM, EM. Club-shaped, assimetric spores, 16–18 × 2.8–3.0 µm with heterofilar PF of

[1,2] Ultrastructural details are taken from: Voronin V.N. 1999. Microsporidia of freshwater invertebrates and fish in Russia (fauna, systematics, biology). Dr.Sci Dissertation. Zoological Institure Rusian Academy of Sciences.

23–24 coils in one row and thread-like episporal structures. In adipose tissue of *Eucyclops serrulatus* (Copepoda, Cyclopidae). Type locality: The River Oredezh, Leningrad region.

Microsporidium* (*Nosema*) *jiroveci (Voronin 1977) Voronin 1986 (Voronin, 1977, P. 508, Fig. 27–35; Voronin, 1986, P. 150, Fig. 2). LM. Merogonial or sporogonial plasmodia with isolated nuclei. Disporoblastic sporogony produces monokariotic sporoblasts and spores. Pyriform spores with pointed anterior poles, 6.1 × 2,6 μm (live) with mucous coat. In adipose tissue of *Cyclops vicinus* (Copepoda, Cyclopidae). Lake Vrevo, Leningrad region.

Microsporidium* (*Pleistophora*) *hilobii Issi 1979 (Issi, 1979, P. 1597). LM. Sporophorous vesivles with 6–12 1N spores, and individual 2N spores, 4.2 –6.0 × 1.2–2.4 μm. In epithelial cells of imagoes of both sexes, in oenocytes, and in epithelial cells of copulation sacs of females of *Hylobius abietis* (Coleoptera, Curculionidae). Type locality: Gatchinskiy and Tihvinskiy districts, Leningrad region.

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Addendum

DISTRIBUTION OF MICROSPORIDIA SPECIES AMONG THE HOSTS

Phylum Plathelmintes, classTrematoda, subclass Digenea

Order Plagiorchida – family Plagiorchidae
Two unidentified species
Nosema xiphidiocercariae Voronin, 1974

Phylum Arthropoda, subphylum Chelicerata, class Arachnida, subclass Acari

Trombidiformes – Limnocharidae
Limnochares aquatica L.
Gurleya sokolovi Issi, Lipa 1968

Phylum Arthropoda, subphylum Crustacea, class Brachypoda, subclass Phyllopoda

Cladocera – Daphniidae
Ceriodaphnia reticulata (Jurine), *C. affinis* Lilljeborg
Gurleyides biformes Voronin 1986
Tuzetia ceriodaphniae Voronin 1986
Ceriodaphnia reticulata (Jurine)
Toxoglugea sp. Voronin 1977
Ceriodaphnia sp.
Tuzetia juntschisi Voronin 1986
Daphnia magna Straus, *Daphnia pulex* (De Geer)
Glugoides intestinalis Larsson, 1996
Daphnia longispina O.F. Muller
Norlevinea daphniae (Weiser, 1947) Vavra 1984
Daphnia pulex (De Geer)
Berwaldia singularis Larsson 1981
Gurleya daphniae Friedrich 1996
Larssonia obtusa (Moniez, 1887) Vidtman, Sokolova 1994
Agglomerata sp. Voronin 1999
Daphnia cucullata Sars
*Berwaldia tschernischovae (*Voronin, 1986) Voronin 1999
Simocephalus vetulus (O.F. Muller)
Agglomerata simocephali (Voronin 1986) Voronin 1999
Agglomerata cladocera (Jirovec 1936) Voronin 1999
Gurleya sp. Voronin 1999
Scapholeberis mucronata (O.F. Muller)
Systenostrema scapholeberi (Voronin 1986) Voronin 1999
Cladocera – Diaphanosomidae
Diaphanosoma brachyurum Fischer
Tuzetia diaphamosomae Voronin 1986
Perezia diaphamosomae Voronin 1986
Sida cristalina (O.F. Muller), *Diaphanosoma brachyurum* Fischer
Agglomerata sidae (Jirovec 1942) Larsson, Yan 1988

Cladocera – Bosminidae
Bosmina longirostris (O.F. Muller), *B. obtusirostris* Sars
Agglomerata bosminae (Voronin 1986) Voronin 1999
Bosmina obtusirostris Sars
Tuzetia sp. Voronin 1999

Cladocera – Polyphemidae
Polyphemus pediculus (Linne)
Unikaryon polyphemi (Voronin 1977) Voronin 1999

Phylum Arthropoda, subphylum Crustacea, class Maxillopoda, subclass Copepoda

Cyclopoida – Cyclopidae
Macrocyclops albidus (Jur.)
Lanatospora macrocyclopis (Voronin 1977) Voronin 1986
Gurleya macrocyclopis Voronin 1986
Cougourdella coryniformis (Voronin 1986) Voronin 1993
Pyrotheca cuneiformis (Maurand et al. 1972) Voronin 1999
Unikaryon sp.2 Voronin 1999
Macrocyclops distinctus (Rich.)
Unikaryon vrevi (Voronin 1991) Voronin 1999
Eucyclops macrurus (Sars)
Unikaryon moniezi (Voronin 1977) Voronin 1999
Eucyclops serrulatus (Fisch.)
Gurleya lopukhinae Voronin 1986
Unikaryon sp.3 Voronin 1999
Microsporidium fluviatilis Voronin 1994
Eucyclops serrulatus (Fisch.), *E. macruroides* Lill.
Microsporidium eucyclopis Voronin 1986
Eucyclops macrurus (Sars)
Microsporidium cardiformis Voronin 1986
Thermocyclops oithonoides (Sars), *Th. crassus* (Fisch.)
Holobispora thermocyclopis Voronin 1986
Thermocyclops oithonoides (Sars)
Thelohania sp.2 Voronin 1977
Thermocyclops oithonoides (Sars), *Cyclops vicinus* Uljan
Microsporidium jiroveci Voronin 1986
Megacyclops gigas Claus
Microsporidium mucilaginosis (Voronin 1986) Voronin 1999
Acanthocyclops viridis (Jur.)
Unikaryon pfeifferi (Voronin 1977) Voronin 1999

Mesocyclops leuckarti (Claus)
Pyrotheca virgula (Moniez 1887) Hesse 1935

Calanoida – Diaptomidae
Diaptomus gracialis Lill.
Flabelliforma diaptomi (Voronin 1977) Voronin 1996

Phylum Arthropoda, subphylum Crustacea, class Ostracoda

Podocopida – Cyprididae
Cyclocypris ovum Jur.
Vavraia cyclocypris Voronin, Melnikova 1984

Phylum Arthropoda, subphylum Crustacea, class Malacostraca, subclass Eumalacostraca

Decapoda – Palaemonidae
Palaemon elegans Rathke, 1837
Gurleya pontica Ovcharenko 1984

Phylum Arthropoda, subphylum Hexapoda, class Insecta

Orthoptera – Gryllidae
Gryllus bimaculatus De Geer
Paranosema (*Nosema*) *grylli* (Sokolova et. al. 1994) Sokolova et al. 2003

Coleoptera – Curculionidae
Hylobius abietis L.
Microsporidium (*Pleistophora*) *hilobii* Issi 1979

Coleoptera – Nitidulidae
Meligethes (*Brassicogethes*) *aeneus* Fabricius
Anncaliia (*Nosema*) *meligethi* (Issi, Radischeva 1979) Issi et al.1993

Coleoptera – Chrysomelidae
Oulema melanopus L.
Unikaryon oulemi Issi, Krylova, Morzhina, Sokolova 1998

Lepidoptera – Noctuidae
Hydraecia micacea Esper
Nosema hydraeciae Issi, Tkach. 1975
Lepidoptera – Erebidae
Amata (*Syntomis*) *phegea* L.
Nosema syntomidis Issi 1979

Lepidoptera – Pyralididae
Loxostege sticticalis L.
Nosema loxostegi Issi, Simchuk, Radischeva 1980

Lepidoptera – Notodontidae
Phalera bucephala L.
Nosema phalerae Issi, Lipa 1968

Lepidoptera – Tortricidae
Laspeyresia pomonella (L.)
Pleistophora carpocapsae Simchuk, Issi 1975

Lepidoptera – Yponomeutidae
Argyresthia conjugella Zeller
Thelohania argyresthiae Issi, Lipa 1968

Lepidoptera – Lymantriidae
Calliteara (*Dasychira*) *pudibunda* (L.)
Thelohania dasychirae Issi, Lipa, 1968

Diptera –Tabanidae
Atylotus karybenthinus Szilady
Octosporea tabani Levtchenko, Issi 1973
Pleistophora aidarlovica Levtchenko, Issi 1973
Hybomitra arpadi Szilady
Ameson hybomitrae Bykova,Krylova, Sokolova, Issi 1989
Octosporea hybomitrae Bykova, Issi 1991
Pleistophora hybomitrae Bykova, Issi 1991
Tabanispora bacilifera Bykova, Issi 1991
Hybomitra bimaculata Macquart
Ameson hybomitrae Bykova,Krylova, Sokolova, Issi 1989
Hybomitra pecularis Szilady
Octosporea tabani Levtchenko, Issi 1973
Hybomitra sp.
Octosporea tabani Levtchenko, Issi 1973
Octosporea autumnalis Bykova, Issi 1991
Hybomitra lundbecki Lyneborg
Tabanispora hybomitrae Bykova Issi 1991
Vairimorpha (*Nosema*) *hybomitrae* (Levtchenko, Issi 1973) Bykova, Issi 1984

Diptera – Ceratopogonidae
Culicoides spp.
Pleistophora culicoidi Levtchenko, Issi 1973

Diptera – Chironomidae
Corynoneura sp.
Amblyospora (*Thelohania*) *macrococcus* (Voronin, 1979) Voronin 1991
Gurleya corynoneurae Voronin 1979
Thelohania corynoneurae Voronin 1979
Toxospora volgae Voronin 1993
Toxoglugea corynoneurae Voronin 1979
Chironomus dorsalis (Meigen)
Microsporidium (*Bacillidium*) *chironomi* (Voronin 1975) Voronin 1999
Chironomus plumosus L.
Cylindrospora chironomi Issi, Voronin 1986
Evlachovaia chironomi Voronin et Issi 1986

Helmichia lacustris Voronin, 1998
Neoperezia chironomi Issi, Voronin 1979
Neoperezia semenovaiae (*Semenovaia chironomi*) Voronin, 1986
Striatospora chironomi Issi, Voronin, 1986
Ablabesmyia tetrasticta Kieffer
Helmichia tetrasticta Kilotchitskiy, Cholan 1993

Diptera – Anthomyiidae
Delia floralis (Fallen)
Octosporea deliae Issi, Radischcheva et Dolzhenko 1983
Campanulospora denticulata Issi, Radischcheva, Dolzhenko 1983
Delia brassicae (L.)
Octosporea deliae Issi, Radischcheva, Dolzhenko 1983
Campanulospora denticulata Issi, Radischcheva, Dolzhenko 1983

Diptera – Simuliidae
Chelocnetha angustitarse Lundstr.
Amblyospora ussovae (Pushkar 1984) Pushkar 1990
Cnetha sp.
Amblyospora ussovae (Pushkar 1984) Pushkar 1990
Eusimulium aureum (Fries)
Amblyospora ussovae (Pushkar 1984) Pushkar 1990
Odagmia caucasica Rubzov
Stempellia rubtsovi Issi, 1968
Odagmia ferganica Rubzov
Janacekia costata (Khodzhaeva 1988) Khodzhaeva 1990
Odagmia ornata (Meigen)
Pilosporella simulii (Pushkar 1984) Pushkar 1990
Odagmia (*Tetisimulium*) *alajense* (Rubzov)
Amblyospora alajense (Khodzhaeva 1988) Khodzhaeva 1990
Amblyospora nuratae (Khodzhaeva 1988) Khodzhaeva 1990
Amblyospora tetisimulii (Khodzhaeva 1988) Khodzhaeva 1990
Simuliospora uzbekistanica (Khodzhaeva Krylova, Issi 1990
Stempellia angreni (Khodzhaeva 1988) Khodzhaeva 1990
Odagmia (*Tetisimulium*) *desertorum* (Rubzov)
Janacekia costata (Khodzhaeva 1988) Khodzhaeva 1990
Parapleistophora ectospora Khodzhaeva, Krylova, Issi 1990
Odagmia sp.
Stempelia (*Pleistophora*) *turgenica* (Levtshenko, Issi 1973) Issi et al. 1990
Thelohania assovi Levtshenko 1977
Simulium latipes Meigen
Caudospora simulii forma *nordica* (Pushkar 1984) Issi et al.,1990
Simulium (s.g. *Obuchovia*) *popowae* Rubzov
Evlachovaia wilhelmiae (Khodzhaeva 1988) Khodzhaeva 1990
Simulium (s.g. *Wilhelmia*) *mediterranea* (Puri)
Evlachovaia wilhelmiae (Khodzhaeva 1988) Khodzhaeva 1990
Janacekia cristula (Khodzhaeva 1988) Khodzhayeva 1990
Janacekia wilhelmiae (Khodzhaeva 1988) Khodzhaeva, Krylova, Issi 1990
Octotetraspora paradoxa Khodzhaeva, Krylova, Issi 1990
Octotetraspora cincta Khodzhaeva, Krylova, Issi 1990
Simulium (s.g. *Wilhelmia*) *salopiensis* (Edwards)
Evlachovaia wilhelmiae (Khodzhaeva 1988) Khodzhaeva 1990
Janacekia cristula (Khodzhaeva 1988) Khodzhayeva 1990
Janacekia wilhelmiae (Khodzhaeva 1988) Khodzhaeva, Krylova, Issi 1990
Octotetraspora cincta Khodzhaeva, Krylova, Issi 1990
Simulium (s.g. *Wilhelmia*) *balcanica* Rubzov
Octotetraspora cincta Khodzhaeva, Krylova, Issi 1990
Simulium (s.g. *Wilhelmia*) *lineata* Meigen
Octotetraspora cincta Khodzhaeva, Krylova, Issi 1990
Simulium (s.g. *Wilhelmia*) *veltistshevi* Rubzov
Octotetraspora cincta Khodzhaeva, Krylova, Issi 1990

Diptera – Culicidae
Aedes annulipes (Meigen)
Amblyospora theophanica Kilochitskiy 1998
Thelohania volgensis Khaliulin 1977
Aedes behningi Martini
Amblyospora dissimilis Kilochitskiy 1995
Aedes beklemishevi Stegnii, Kabanova
Thelohania volgensis Khaliulin 1977
Aedes cantans (Meigen)
Amblyospora cantansi Kilochitskiy 1995
Amblyospora cataphyllus Kilochitskiy 1992
Amblyospora dissimilis Kilochitskiy 1995
Amblyospora pilosa Kilochitskiy 1995
Thelohania volgensis Khaliulin 1977
Aedes caspius (Pallas)
Aedispora dorsalis Kilochitskiy 1997
Aedispora sp. Kilochitskiy 1997
Amblyospora aestiva Kilochitskiy 1996

Amblyospora caspius Pankova, Issi, Simakova 2000
Amblyospora media Kilochitskiy 1996
Amblyospora ukrainica Kilochitskiy 1996
Amblyospora rustica Kilochitskiy 1996
Cristulospora aedis Khodzhaeva, Issi 1989
Stempellia captshagaica Levtchenko, Issi 1973
Aedes cataphylla (Dyar)
Amblyospora cataphyllus Kilochitskiy 1992
Aedes communis (DeGeer)
Amblyospora verna Kilochitskiy 1996
Aedes cinereus (Meigen)
Amblyospora certa Kilochitskiy 1996
Aedes cyprius Ludlow
Amblyospora dissimilis Kilochitskiy 1995
Aedes dorsalis (Meigen)
Amblyospora aestiva Kilochitskiy 1996
Aedes euedes Howard, Dyar, Knab
Amblyospora cantansi Kilochitskiy 1995
Aedes excrucians Walker
Amblyospora dissimilis Kilochitskiy 1995
Thelohania volgensis Khaliulin 1977
Aedes flavescens (Muller)
Amblyospora cantansi Kilochitskiy 1995
Amblyospora conopsa Kilochitskiy 1992
Aedes punctor Kirby
Amblyospora firma Kilochitskiy 1996
Aedes sticticus (Meigen)
Amblyospora conopsa Kilochitskiy 1992
Aedes vexans (Meigen)
Amblyospora dissimilis Kilochitskiy 1995
Anopheles claviger (Meigen)
Parathelohania issiae Kilochitskiy 1998
Anopheles maculipennis (Meigen)
Parathelohania detinovae Kilochitskiy 1998
Senoma (*Issia*) *globulifera* (Issi, Pankova 1983)
Anopheles messeae Falleroni
Parathelohania illinoisensis var. *messeae* Pankova et al. 1991
Culex modestus Ficalbi
Cristulospora sherbani Khodzhaeva, Issi 1989
Culex pipiens L.
Amblyospora burlaki Pankova et al. 2000
Cristulospora cadyrovi Khodzhaeva, Issi 1989
Krishtalia pipiens Kilochitskiy 1997
Culex theileri Theobald
Krishtalia pipiens Kilochitskiy 1997
Culex territans Walker
Amblyospora dissimilis Kilochitskiy1995
Culiseta alaskaensis (Ludl.)
Thelohania culisetae Levtchenko, Issi, 1973
Culiseta annulata (Schrank)
Amblyospora dissimilis Kilochitskiy 1995

Phylum Chordata, subphylum Craniata, class Actinopterigii, subclass Neopterigii

Clupeiformes – Clupeidae
Alosa kessleri volgensis (Berg)
Glugea bychowskyi Gasimagomedov, Issi 1970

Perciformes – Percidae
Sander (*Lucioperca, Stizostedion*) *lucioperca* (L.)
Glugea dogieli Gasimagomedov, Issi 1970

Perciformes – Gobiidae
Neogobius caspius (Eichwald), *N. fluviatilis palasi* (Berg), *N. melanostomus* (Eichward)
Glugea shulmani Gasimagomedov, Issi 1970
Neogobius caspius (Eichwald), *N. melanostomus* (Eichward), *N. kessleri gorlap* (Lljin)
Pleistophora tuberifera Gasimagomedov, Issi 1970

Perciformes – Odontobutidae
Percottus glehni Dyb.
Thelohania peponoides Schulman 1962

Siluriformes – Siluridae
Silurus glanis L.
Pleistophora siluri Gasimagomedov, Issi 1970

Gasterosteiformes – Gasterosteidae
Gasterosteus aculeatus (L.), *Pungitius pungitius* (L.)
Glugea gasterostei Voronin 1974
Thelohania baueri Voronin 1974

Gadiformes – Gadidae
Osmeriformes – Osmeridae
Lota lota L., *Osmerus eperlanus eperlanus nation ladogensis* Berg
Pleistophora ladogensis Voronin 1978

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