Critical revision of the Myxomycetes collection of Young Naturalists Club of Zoological Museum of Moscow State University

Vladimir I. Gmoshinskiy*, Andrey V. Matveev, Evgeny S. Gubanov, Fedor M. Bortnikov & Evgeny A. Dunayev

ABSTRACT

In the present paper, we report the results of a critical revision of the Myxomycetes collection of Young Naturalists Club of Zoological Museum of Moscow State University. The collection consists of 1715 specimens from 142 species in 35 genera, 11 families, and 6 orders. Comprehensive material from Moscow and Moscov Region (1112 specimens), Tver Region (191), and Tyumen Region (112) is presented in the collection. There are also numerous specimens from Irkutsk, Murmansk, Ryazan Regions, and Primorye Territory, and fragmentary collections from Astrakhan, Kaluga, Pskov, Vladimir, Yaroslavl Regions, Altai, Krasnodar, Khabarovsk Territories, Altai and Karelia Republics, as well as Crimean Peninsula and Kingdom of Cambodia (Southeast Asia). During revision we discovered two new species for Russia: Stemonitis uvifera T. Macbr. and Fuligo intermedia T. Macbr.

Keywords: Amoebozoa, biodiversity, slime moulds, herbarium, Russia

The myxomycetes (Amoebozoa, Myxogastrea) are a relatively small group of amoeboid fungus-like protists which are widely spread across all continents (Schnittler et al. 2017). According to the online nomenclatural information system of Eumycetoza (Lado 2005–2020), this group consists of approximately 1050 morphospecies. Some of them apparently occur more often in certain terrestrial ecoregions (Novozhilov et al. 2009). It is important to note that myxomycetes are a very convenient object for herbarium storage. The specimens of fruit bodies (sporophores) on substrate pieces are relatively small (mostly in the range of 10–100 mm) and take up little space in herbarium. Unlike macrofungi fungi, it is not significant on which substrate myxomycete specimens were found. Almost all essential information to identify myxomycete species can be obtained from morphological characters of sporophores.

Despite the research intensification over the last 40 years, the territory of Russia remains extremely unevenly studied. The most well-studied areas are Astrakhan, Volgograd, Leningrad, Moscow, Novosibirsk, Sverdlovsk, and Tver Regions, Altai and Krasnoyarsk Territories, and Republic of Karelia. A total of 454 myxomycete species from 56 genera and 6 orders are found in Russia, which is approximately 42% of the total number of known species (Matveev et al. 2016–2020). However, studies of species diversity have never been conducted in most areas of Russia. Therefore, critical revisions of the available collections may provide additional information on the distribution of certain species throughout the country.

The Club of Young Naturalists of Zoological Museum of Moscow State University (CYN) was founded by Evgeny A. Dunayev in 1991. Since then, more than 512 students have been trained in this club and many of them have subsequently chosen biology as their main area of professional activity. During the years of the CYN existence, more than 135 field courses have been conducted in Russia and other countries.
(Dunayev 2017). The Myxomycetes collection of CYN was created in 1992 by E.A. Dunayev, who is still maintaining it. Specimens collected during field courses represent the basis of the deposited material (Dunayev & Barsukova 2002). In addition, part of the specimens was provided by the staff of the Department of Mycology and Algology (Biological Faculty, Lomonosov Moscow State University).

MATERIAL AND METHODS

Before the revision, all specimens in the collection were kept in matchboxes provided with finishing labels. A catalog containing the following information about the specimens was attached to the collection: taxon name and its authors; location description; date of collection; names of the collector and the person who identified the specimen. Sporophores of the same species collected on the same day and in the same habitat were often consolidated into one herbarium specimen, which was noted in the catalog.

During revision, all specimens were re-identified using widely accepted monographs (Martin & Alexopoulos 1969, Novozhilov 1993, Poulain et al. 2011a). Taxa names and authors correspond to the online nomenclatural information system of Eumycetozoa (Lado 2005–2020). We used the classification of Lado & Eliasson (2017). The level of preservation on a five-point scale was indicated for each specimen (according to dela Cruz et al. 2009, with modifications) (Table 1, see also Fig. 1). During identification, we attached them to the bottom of a U-shaped paper tray (according to Stephenson & Stempen 2000). Labels with specimen unique number, species name, collection location and date, collector’s and determination person’s names were affixed to box tops.

Based on the analysis of the verbal description of collection sites, we assigned georeferences and location uncertainties in meters to all specimens.

All information about the specimens in the collection was modified according to the Darwin Core standard (Wieczorek et al. 2012) and presented as a dataset on gbif.org (Gmoshinskiy et al. 2018).

List of collection sites

Altai Republic
1. 51.762990°N 85.732476°E (±1 km), 06.08.2007.

Altai Territory
2. 52.569319°N 78.928442°E (±1 km), 05.08.2007.

Astrakhan Region
3. 46.904181°N 47.913736°E (±5 km), a. 06.08.1999, b. 08.2005.

Crimean Peninsula
4. 44.508184°N 34.236980°E (±10 m), 03.02.1999.
5. 44.508199°N 34.241218°E (±30 m), 30.04.2013.

Table 1. Criteria adopted to establish the level of preservation of Myxomycetes collection of CYN

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>No traces of sporophores</td>
</tr>
<tr>
<td>II</td>
<td>Sporophores are heavily damaged. Only stalks and hypothallus of the sporophores are preserved. Precise identification is impossible</td>
</tr>
<tr>
<td>III</td>
<td>Sporophores are heavily damaged, but it is possible to identify species by using a set of diagnostic features. There are ≥ 10 complete sporophores in collection</td>
</tr>
<tr>
<td>IV</td>
<td>Sporophores in good condition, but many of them are slightly damaged (in particular, broken peridium, whole colonies are pressed as a result of incorrect storage, etc.)</td>
</tr>
<tr>
<td>V</td>
<td>Sporophores in excellent condition</td>
</tr>
</tbody>
</table>

Figure 1 Specimens of Trichia decipiens (Pers.) T. Macbr. with levels of preservation from I to V. Scale bar: 1 mm
Exact collection locality and collection date are unknown.
RESULTS

The species list is annotated with boldface numeric codes of collection locations, alphabetic indices of collection dates (see the list of collecting sites) and herbarium numbers in the Myxomycetes collection of CYN in parentheses. Myxomycete nomenclature follows Lado (2005–2020), except for some varieties and subspecies, which are not accepted in this information system, and Stemomitus lignicola Nann.-Bremek., which we consider as a separate species.

**Amaurochaete atra** (Allb. et Schwein.) Rostaf. – 168j (662).

New for Tver Region.

**Arcyodes incarnata** (Allb. et Schwein.) O.F. Cook – 20 (1388-1); 94f (189); 110e (1479-1).

New for Khabarovsk Territory.

**Arcyria affinis** Rostaf. – 5 (1571); 7 (491); 23 (762); 27 (355); 29b (231); 35c (35); 78b (330-1); 78g (282-1); 78i (417); 78g (353); 78n (516); 78o (715); 78g (1229); 78i (28, 255); 83a (760); 89h (1263, 1589); 94i (851); 96a (450); 105b (503, 306, 507); 105e (376); 109f (375); 109m (388, 389); 110e (1329); 110b (835-1); 110k (1430); 110m (1543); 110n (1467); 111s (1219); 132 (804); 135 (421); 136a (382, 393); 166b (673); 168i (442); 174a (936, 937-1, 985).

New for Tyumen and Murmansk Regions.

**Arcyria cinerea** (Bull.) Pers. – 16c (1086, 1092, 1107-1); 43 (306); 69a (314, 327); 133b (724-1); 155c (475); 155d (1078); 174b (1464).

New for Tyumen Region and Tyumen Regions.

**Arcyria dudennata** (L.) Westr. – 27 (357); 67c (148); 69a (1557); 78b (1218); 89h (626); 94d (108); 110e (617); 110m (1545); 137b (1007); 149 (557); 160c (1078); 174b (1464).

New for Tyumen Region.

**Arcyria ferruginea** G. Lister, in Lister – 16c (1145); 78g (266); 86 (850-1); 89d (734); 109 (406); 110e (1422); 168g (202); 168j (469); 168k (537); 168l (689); 168m (631); 168n (775-1); 169c (1053).

New for Tyumen Region.

**Ceratiomyxa fruticulosa var. flexuosa** (Lister) G. Lister, in Lister – 16c (1145); 78g (266); 86 (850-1); 89d (734); 109 (406); 110e (1422); 168g (202); 168j (469); 168k (537); 168l (689); 168m (631); 168n (775-1); 169c (1053).

New for Tyumen Region.

**Ceratiomyxa fruticulosa var. poroides** (Allb. et Schwein.) G. Lister, in Lister – 29b (221, 222), 78g (302), 78q (1185); 88 (1252).

**Cladostroma debaryanum** (Bull.) Pers. – 16c (1145); 78g (266); 86 (850-1); 89d (734); 109 (406); 110e (1422); 168g (202); 168j (469); 168k (537); 168l (689); 168m (631); 168n (775-1); 169c (1053).

New for Tyumen Region.

**Ceratodon purpureus** (L.) Schröt., in Cohn – 29b (221, 222), 78g (302), 78q (1185); 88 (1252).

**Collaria arcyriophylloides** (Rostaf.) Nann.-Bremek. ex Lado – 29b (220); 40 (340, 343); 44 (366); 78g (275, 315, 322); 89c (848); 110e (1143-1); 113b (445); 117 (1417); 125 (478); 163 (580); 168i (444); 168m (635); 169c (1066); 174a (951, 953, 960, 963, 969); 174b (1041, 1236).

New for Tyumen Region.

**Comatricha elae** Härk. – 110c (1487-2); 132 (807).

**Comatricha lassa** Rostaf. – 29b (213, 214).

**Comatricha nipona** (Pers. ex J.F. Gmel.) J. Schröt., in Cohn – 11 (656); 29a (224, 225); 29b (223), 53a (136); 60 (69); 67a (63); 87x (322); 85e (1029); 94c (60); 97 (68); 100d (593); 109 (420), 168a (64); 110e (1310-1); 110g (567); 110k (1427); 110m (1357-1); 110o (1457, 1461); 112a (368); 117b (1418, 1436); 168b (1450); 170 (1171); 174b (1248).

**Comatricha pulchella** (C. Bab.) Rostaf. – 111 (1501-1); 142b (724); 168a (663, 664); 174a (949).

**Comatricha cf. reticulosa** Ing et P.C. Holland – 110c (1300); 132 (810).

New for Moscow, Moscow and Murmansk Regions.

**Craterium aureum** (Schumach.) Rostaf. – 78-p (296).

**Craterium leucocephalum** (Pers. ex J.F. Gmel.) Dinar, in Sturm – 78g (278); 85a (112); 89d (740); 89g (1243-1, 1246, 1256); 89h (799, 921, 1264); 132 (865).

New for Murmansk Region.

**Craterium minutum** (Leers) Fr. – 78g (266, 316); 110e (1125, 1350); 174a (966); 174b (1235).

New for Moscow Region.

**Craterium obovatum** Peck – 16c (1094, 1108).

**Cribaria argillacea** (Pers. ex J.F. Gmel.) Pers. – 16c (1095; 29b (227); 44 (367); 78g (290, 304); 78q (1270); 89d (737), 738, 739-1); 89h (1299); 110o (1454); 152 (560); 162 (599); 174a (955, 981); 174b (1045).

New for Irkutsk, Ryzan, and Tyumen Regions.

**Cribaria aurantiaca** Schrad. – 29b (226); 78g (288); 174a (943-1).

Botanica Pacifica. A journal of plant science and conservation. 2020. 9(2)
Cribraria cancellata (Batsch) Nann.-Bremek. – 16c (1100, 1109); 29b (190); 39 (348); 78g (293); 78o (711); 78u (1162); 78t (254); 78v (1514-2); 86 (850-2); 89c (849); 89h (1267); 110b (1425); 110o (1462, 1463, 1473); 136c (1015); 137b (1012); 148a (396); 151 (64, 565); 168a (660); 168b (665); 168m (685); 168n (787); 176a (935); 174h (1047).

For new Ryazan Region.

Cribraria intrica Schrad. – 174a (978).

For new Tymen Region.

Cribraria languescens Rex – 100d (588).

For new Tymen Region.

Cribraria macaropa Schrad. – 89d (739-2); 174a (958).

For new Tymen Region.

Cribraria microcarpa (Schrad.) Pers. – 69a (1554, 1558); 110b (846); 151 (562); 169c (1084); 174b (1160).

For new Ryazan and Tymen Regions.

Cribraria oregana H.C. Gilbert, in Peck et Gilbert – 78y (461); 137b (1009); 174a (974).

For new Moscow, Moscow and Tymen Regions.

Cribraria piriformis Schrad. – 78y (430); 110o (1471); 168m (638); 168n (778).

For new Tymen Region.

Diderma purpurea (Schumach.) Rostaf., in Lister

Botanica Pacifica. A journal of plant science and conservation. 2020. 9(2)

Didymium nigripes (Link) Fr. – 78t (190), 140 (595); 29b (284); 78q (194).

For new Moscow and Moscow Region. This species is distinguished by an oval shape of sporangia with long, thin, reddish-brown stalk, large clavate columella that reaches the centre of sporangium (Fig. 3G), and evenly warted spores (Fig. 3I). It was previously reported only from Altay Republic (Novozhilov et al. 2005, Novozhilov et al. 2010). Like D. megalosporum, D. nigripes is very similar to D. radiatum var. nigripes (P. Nowotny et at. 2011a): “D. nigripes, which belongs to this group, is a poorly defined species with several interpretations”. Apparently, it is a group of similar morphospecies on long, lime-green, semi-transparent stalks.

Diederma radiatum (L.) Morgan – 78g (787); 174a (935).

For new Irkutsk Region.

D. effusum (Schumach.) Rostaf., in Lister

Botanica Pacifica. A journal of plant science and conservation. 2020. 9(2)

D. iridis, which belongs to this group, is a poorly defined species very similar to D. nigripes (Fig. 3E). It has a thin stalk, remains in the centre and form a loose pseudocolumella. Spores black in mass; light-brown in transmitted light, globose, 10–12 µm in diam., minutely warted (Fig. 3D). Plasmodium white by color, white flakes. However, sometimes it can be seen clearly in transmitted light. After aethalium is broken, capillitium consists of large angular lime nodules connected by hyaline threads and united into a net with few free ends (Fig. 3F). Occasionally, lime knots gathered into the centre and form a pseudocolumella. Spores black in mass, light-brown in transmitted light, globose, 10–12 µm in diameter, capillitium structure are the only reliable diagnostic features of this species.

D. cinereum – 78g (787); 174a (935).

For new Irkutsk Region.

D. anellus (All. et Schwein.) Rabenh. – 78g (283).

For new Tymen Region.

D. ovoideum (Berk. et M.A. Curtis, in Berkeley

Notes. Fuligo intermedia is very similar to F. septica var. candida, but differs by large spores (10–12 µm vs. 7–9 µm respectively). F. candida differs by oval spores, smaller size of sporophore, and a poorly developed hypothallus. In addition, F. intermedia has a thin, compact fungal patch attached to a sporophore that never falls off as white flakes. However, sometimes F. intermedia has an underdeveloped cortex (see Poulin et al. 2011b, Fig. 179), but individual sporangia still preserve peridium. In this case, spore diameter and capillitium structure are the only reliable diagnostic features of this species.

Fuligo septica var. candida (Pers.) F. septica var. candida (Pers.) (Wigand) G. Lister, in Lister – 174a (961).

For new Irkutsk Region.

Fuligo septica (L.) H.E. Wigg. – 27 (354); 29b (228); 37 (349-2); 45c (179); 64b (870); 78g (300-2); 78j (518); 78k (464); 78q (1163, 1575); 78s (252); 85b (176); 92 (1519); 93 (31); 109 (401, 416); 126 (244); 130 (800); 141 (1435); 142b (720); 144 (553); 151 (466); 157 (603); 168b (1438-2); 174a (1432).

For new Ryazan Region.

Fuligo varia (Cand.) Pers. – 37 (349); 38 (352); 78q (274, 300-1); 78j (528); 85b (875); 109 (242); 109 (384); 110o (1433); 125 (477, 479, 480, 481); 153 (552); 160 (554); 168i (865); 174b (1234).

For new Irkutsk Region.

Fuligo varia septica (Cand.) Pers. – 37 (349); 38 (352); 78q (274, 300-1); 78j (528); 85b (875); 109 (242); 109 (384); 110o (1433); 125 (477, 479, 480, 481); 153 (552); 160 (554); 168i (865); 174b (1234).

For new Ryazan Region.

For new Moscow and Moscow Region.

Fuligo septicum (L.) H.E. Wigg. – 27 (354); 29b (228); 37 (349-2); 45c (179); 64b (870); 78g (300-2); 78j (518); 78k (464); 78q (1163, 1575); 78s (252); 85b (176); 92 (1519); 93 (31); 109 (401, 416); 126 (244); 130 (800); 141 (1435); 142b (720); 144 (553); 151 (466); 157 (603); 168b (1438-2); 174a (1432).

For new Ryazan Region.

For new Moscow and Moscow Region.

For new Moscow and Moscow Region.

F. candida differs by oval spores, smaller size of sporophore, and a poorly developed hypothallus. In addition, F. intermedia has a thin cortex firmly attached to a sporophore that never falls off as white flakes. However, sometimes F. intermedia has an underdeveloped cortex (see Poulin et al. 2011b, Fig. 179), but individual sporangia still preserve peridium. In this case, spore diameter and capillitium structure are the only reliable diagnostic features of this species.

Fuligo levigera H. Neubert, Nowotny et K. Baumann – 16c (1087); 53b (160); 67b (134); 76 (463); 78g (305); 81a (858); 85a (122); 89f (701); 94b (6); 94c (157); 94f (462); 96a (449); 100b (451); 101 (17); 102 (16); 110f (1638); 110g (913); 110h (834); 110m (1548); 110p (1626); 168c (18); 169c (1062); 170 (1170); 176a (767).

For new Irkutsk Region.

For new Moscow and Moscow Region.

For new Moscow and Moscow Region.

For new Moscow and Moscow Region.

For new Moscow and Moscow Region.

For new Moscow and Moscow Region.
Figure 3 Drawings. A–C – Didymium megasporum Berk. et M.A. Curtis (collection number 745), A – two sporophores with flat columella, B – spores as seen under oil immersion, C – capillitium, spores and stellate lime crystals; D–F – Fuligo intermedia T. Macbr. (1516), D – spores, E – capillitium and spores, F – aethalium; G–I – Didymium ovoidum Nann.-Bremek. (277), G – two sporophores with clavate columella, H – capillitium, spores and stellate lime crystals, I – spores; J–L – Physarum murinum Lister (576), J – capillitium and spores, K – sporophore, L – spores and lime nodule. Scale bars: A – 0.3 mm; B, E – 25 μm; C, D, L – 10 μm; F – 1 mm; G – 0.2 mm; H – 20 μm; I – 5 μm; J – 50 μm; K – 0.2 mm
Physarum album (Bull.) Chevall. – 20 (1388-2); 29b (234-253); 35d (104); 64a (859); 69a (1563); 77a (20); 78g (280-1); 78k (508); 78k (1166, 1182); 81a (866); 83a (758); 85e (874); 89d (741, 745-2); 89g (1245-2); 89h (156, 1536, 1950-2); 90 (1219); 100d (589); 105b (305); 107d (383); 109 (426); 110e (647-3); 110f (1209, 1291, 1314, 1317); 110l (1140); 110l (1140); 110l (828, 1346, 1374, 1401); 110l (1421); 110l (1588); 110o (1456, 1466, 1469); 110p (1625, 1627); 112b (370); 114 (358); 120 (978); 136a (404); 157b (1004); 157d (60); 157h (81); 26, 27, 65; 168a (775-2, 779, 786); 168b (1293, 1241); 171 (475); 174a (941-1, 946); 174b (1038, 1156, 1157, 1158, 1159); 175b (897).

New for Ryazan Region.

Physarum auriscalpum Cooke (Fig. 4A) – 159b (574).

New for Ryazan Region.

Physarum bivalve Pers. (Fig. 4B, C) – 75a (496); 78g (307); 78h (698); 89 (1262).

Physarum cinereum (Batsch) Pers. – 57 (1208); 59 (1201-1); 78d (151); 78g (318); 78h (705); 78s (1180); 78w (246); 88 (1279); 100d (590); 110o (1484); 168n (928); 171 (790, 791).

Physarum conformum T. Machr. – 171 (796).

New for Tver Region.

Physarum contextum (Pers.) Pers. – 110 (1373).

Physarum diderma Rostaf. – 84 (435); 101 (23).

Physarum diermoides (Pers.) Rostaf. – 81a (868).

Physarum flavicomum Berk. – 29b (237, 238).

Physarum globiferum Pers. – 154 (558); 168n (785); 174a (948, 979).

New for Tyumen Region.

Physarum leucoplema Fr. et Palmquist – 16b (1382); 20 (1585-2); 45a (25); 75a (495); 76 (693, 694); 110o (427); 85c (1030, 1031); 89g (1242); 94d (110); 94i (854); 95 (374); 110o (649); 110c (1289-2, 1331, 1345); 110f (1119); 110g (906); 110o (1479-2); 110o (653); 119 (799); 121 (818); 169c (1056, 1065, 1070, 1081); 175b (891).

New for Irkutsk and Tyumen Region.

Physarum mellem (Berk. et Broome) Massee – 21 (1192).

Physarum marinum (Lister) (Fig. 3J–L) – 153 (576).

New for Ryazan Region. This species is distinguished by globose sporocarps on long stalks (Fig. 3K), dense capitellum with numerous junctions with small, round, brown nodes connected by thin translucent tubes (Fig. 3L). Capillitium remains in the form of sporangium after spore dispersal. This species is closely related to Physarum globiferum, but differs by pale brown, not white, pigmented nodules. This is the first record of Physarum marinum in Russia confirmed by a herbarium specimen. Previously it was described only for Moscow region (Sizova & Titova 1985, Bar- sukova & Dumayt 1919, Novozhilov 2005), but there were no specimens to confirm identification.

Physarum mutable (Rostaf.) G. Lister, in Lister – 78g (324).

Physarum nitens (Lister) Ing. (Fig. 5D–F) – 109 (400).

New for Moscow and Moskovsk Region. This species is distinguished by long plasmodiocytes, slightly curved, with irregular shape, sometimes heaped (Fig. 5D, yellow), with large nodes of capitellum and small light spores (7-9 µm in diam.) uniformly covered with small warts. It was previously described as P. verrucosum var. nitens Lister. Typical form of P. verrucosum differs by pseudo-sclerotia composed of hard, dark sporocarps, which aggregate in a compact structure. P. nitens is distinguished from P. nitens by light-yellow lime on top of sporangia and bigger spores (8.5–11 µm). In addition, P. nitens is characterized by clustered but not heaped sporangia. In Russia, it was reported only for Altai by N.N. Lavrov (1929).

Physarum notabile T. Machr. – 20 (1391); 45c (19); 53b (12); 170a (80); 174a (973).

New for Khabarovsk Territory and Tyumen Region.

Physarum penetrare Rex (Fig. 5G) – 168d (22).

This unusual species is characterized by thin, membranous, slightly silvery iridescent penduncular, long, thin stalks and long colomela that penetrates the whole sporangium (Fig. 5G), solid colomela network formed by thin hyaline tubes with compact...
Figure 4 SEM photographs. A – Physarum auriscalpium Cooke (574), spore; B–C – Physarum bivalve Pers. (37); B – spore, C – fragment of capillitium with large, rounded nodules and spores; D–E – Physarum flavicomum Berk. (237): D – fragment of capillitium and spores, E – spores; F – Stemonaria irregularis (Res) Nann.-Bremek., R. Sharma et Y. Yamam. (1612), spores; G–H – Stemonitis uvifera T. Mách. (462); G – two clusters of spores, H – fragment of spore cluster, spores warted on the outer surface, nearly smooth elsewhere. Scale bars: A, E = 2 µm; B – 1 µm; C, D = 20 µm; F–H = 3 µm
lime nodes, which holds its shape after spore dispersal. In Russia, it was found only in Krasnoyarsk Territory (Kosheleva 2007, Kosheleva et al. 2008), Vladimir Region (Mishulin 2018), and in the Far East (F.M. Bortnikov, Yu.K. Novozhilov, personal data).

Physarum psittacinum Ditmar, in Sturm – 27 (356); 64f (1297); 78q (1187); 78r (1184); 78t (29); 78y (459); 110o (1472); 168d (81).

Physarum pusillum (Berk. et M.A. Curtis) G. Lister, in Lister – 29b (232).

Physarum serpula Morgan – 63 (1251); 74 (1203).

Physarum spectabile Nann.-Bremek., Lado et G. Moreno – 35d (95); 110c (1330); 110f (1315); 175b (894).

New for Moscow, Moscow and Tyumen Regions. This species is very similar to P. cinereum, but differs by dark-brown spores with light lines of dehiscence and well-developed warts. For the first time P. spectabile was recorded in the Central Forest Natural State Reserve (Nelidovo District, Tver Region) (Gmoshinskii et al. 2017). This species is probably widely distributed in Russia.

Physarum vernum Sommerf., in Fries – 110e (1292).

Physarum virensens Ditmar, in Sturm – 78g (319); 78t (257); 78y (458).

Physarum viride (Bull.) Pers. – 29b (233, 236); 69a (1565); 78g (280-2); 89h (917); 136a (439); 159a (559); 160 (575); 166b (678); 174a (945-2, 947-2, 986).

Physarum viride var. auranthum (Bull.) Lister – 78g (309); 110k (1426); 174a (947-1).

Reticularia intermedia Nann.-Breemek. – 16a (824); 110g (912); 110m (1586-1); 124 (338).

New for Irkutsk and Murmansk Region.

Reticularia lycoperdon Bull. – 8 (610); 11 (608, 613); 15 (1594); 31 (761); 56 (204); 64c (860); 73b (876); 78w (260); 110e (1150); 110f (1618); 118 (5); 122 (487); 125 (476); 172 (171).

New for Irkutsk Region.

Reticularia splendens Morgan – 20 (1583); 110f (1133); 132 (812); 142b (728).

New for Khabarovsk Territory and Republic of Karelia.

Stemonaria irregularis (Rex) Nann.-Breemek., R. Sharma et Y. Yaman., in Nannenga-Bremekamp, Yamamoto et Sharma (Fig. 4f) – 16b (1383); 29e (1612); 94d (111); 136b (1033); 168m (636).

New for Irkutsk and Tver Regions.

Figure 5 Drawings. A–C – Stemonitis uvifera T. Machr. (462), A – sporophores, B – fragment of columella and capillitium, C – fragment of surface network and clustered spores; D–F – Physarum nitens (Lister) Ing (400), D – two plasmodiocarps, E – fragment of capillitium and spores, F – spores; G – Physarum penetrale Rex (22), two sporophores. Scale bars: A – 2 mm; B, E – 25 µm; C – 20 µm; D – 0.4 mm; F – 5 µm; G – 0.2 mm.
Stemonitis axifera (Bull.) T. Machr. – 7 (490, 493); 16d (932); 20 (1584); 23 (764); 26 (358); 29b (215, 215); 53b (163); 78f (321); 78g (313, 317); 78j (514, 524, 529); 78s (713); 78t (248, 259); 79j (423); 85d (866); 88 (1224, 1250, 1577); 89h (880, 92); 1276, 1591); 89l (1254-1); 100a (184); 100d (319); 101 (483); 109k (1172, 1174); 111b (1332); 114b (1016); 114j (1018); 117 (1108-1); 142b (1425); 114j (1140); 110m (1546); 110o (1455, 1458, 1473, 1477, 1480); 110p (1624); 111 (1505-1); 113b (361); 116 (397); 117 (1416, 1528, 1529); 125 (472, 484); 131 (245); 133 (322); 142a (178); 142b (721, 722); 150 (546); 168n (161); 168q (541); 168r (542); 166b (679); 168i (399); 168j (586); 168k (536); 168l (684); 168m (632, 633-1); 168n (780, 783); 168p (1439, 1448, 1449); 168q (61); 168s (443); 169b (1355); 169c (1055, 1059, 1060, 1068, 1074, 1076, 1078, 1079); 176 (796); 176a (607); 176b (670); 179 (1285).

New for Khabarovsky Territory and Irkutsk Region.

Stemonitis axifera var. smithii (T. Machr.) Hagelst. – 109 (381); 158 (539); 168m (637); 169c (1077, 1148); 174a (975).

Stemonitis flavogena E. Jahn – 151 (540, 545); 155 (543); 168k (471).

New for Ryazan Region.

Stemonitis fusca Roth – 53b (162); 78g (279); 78y (410); 85g (770); 89j (1254-2); 94g (429); 109b (402); 110j (1018-2); 121 (884); 124 (1313-15); 168b (470); 168f (679); 168m (632-3); 168p (1452); 169b (1338); 170 (1321); 174a (976).

New for Tyumen Region.

Stemonitis fusca var. nigrescens (Rex) Torrend – 88 (1206-1).

Stemonitis liguicola Nann.-Bremek. – 29b (239); 110c (1339); 121 (821); 134-7447; 142b (729); 145 (538); 166b (682); 168d (59, 60); 168e (143); 168f (58); 168g (440); 169c (1073, 1075, 1080).

New for Tyumen Region.

Stemonitis Mặcica Rostaf. – 3b (1578); 134 (398); 136a (391, 426); 157b (1011); 138 (901); 174b (1214).

New for Tyumen Region.

Stemonitis ulicina T. Machr. (Fig. 4G–H, 5A–C) – 136 (1016).

New for Russia (Primorye Territory).

Description. Sporophores stalked sporangia, clustered in large groups, long, cylindrical, erect or slightly drooping (Fig. 5A), rich rusty-brown, become dark-brown or black, semi-transparent after spore dispersal, 7–9 mm high; often join and form a structure resembling a pseudochaetum. Peridium evanescent. Hypothallus well developed, continuous under a colony, membranous, shining, violet-brown. Stalk black, blackish, shining, from 1/4 to 1/2 of the total height, tapering upward, expanded toward the top. Columnella black, long, almost reaches the top of sporangium, in upper part curved and gradually transferred into a capitillum network. Capillitium forms a dark-brown to almost black matrix, with colorless network. Inner network is very lax, arising from the columnella by relatively few branches, often flattened, with membranous expansions in the axis. Surface net large, 3-4 mm high (the mesh diameter about 8–10 times the spore diameter), irregular, with many free ends (Fig. 5B–C). Spores dark-brown in mass; smoky-brown in transmitted light; united in clusters of 4–12 or more (Fig. 4G–H, 5C). Spores angular from pressure, often united in clusters of 4–12 or more (Fig. 4G–H, 5C).

Distribution. This is a very rare species. It is reported from USA, Canada, Germany (GBIF Secretariat 2019), India, Japan, Africa (Poulan et al. 2011a), and Spain (Lado 1994).

Notes. This is the only species from the genus Stemonitis with sporophores adhered in clusters. S. ulicina is closely related to species from the genus Symphytocarpus because of sporophores adhered in dense groups and spores joined into clusters (S. fusiformis Nann.-Bremek., S. nigrescens E. Jahn, and S.该怎么写 (Yamash.) Y. Yamam.). All the latter species, however, differ by more heaped sporophores taking the almost aethaloid form. Moreover, S. fusiformis also differs with its black, expanded ends, S. nigrescens with the radulae. "Nigrescens" from G. Lister (G. Lister & Gran Hertl ex Nann.-Bremek. (Nannenga-Bremek & Härkönen 1979). S. ulicina differs by rounded fragments of sporophores attached to the ends of capitillum, larger spores (12–13 mm vs. 7–8 mm in ulicina) and short stipes of spores (899).
Current state of the Myxomycetes collection

The Myxomycetes collection of the CYN includes 1715 specimens of sporophores belonging to 142 species of myxomycetes from 35 genera, 11 families, and 6 orders. Two species, *Stemonitis aspera* and *Fuligo intermedia*, were recorded in perfect condition were obtained in the early period of the collection. Hence, it can be assumed that during storage the material did not depend on the storage time in the herbarium. The greatest contribution to the collection establishment was made by O.M. Germant (641 deposited specimens), E.A. Dunayev (267), N.N. Kotelenets (248), T.N. Barsukova (117), V.I. Gmoshinskii (64), A.N. Bragin (63). During the whole period of the collection existence, only O.M. Germant and E.A. Dunayev were regularly depositing new material into it, while the contribution from other collectors was irregular.

Almost all specimens in the Myxomycetes collection of the CYN were collected in Russia. Many findings presented in the collection are new for the regions (Table 3).

Despite the fact that the specimens in the collection were not fixed on paper tray in matchboxes before the revision and that the age of some of them exceeded 20 years, most of the material (1331 specimens) was kept in satisfactory, good, or excellent condition (levels III to V according to Table 1). Thus, a fact of these species record could be confirmed by morphological features. Only 384 specimens were poorly preserved or were completely without sporophores (levels I and II), which accounted for 22.4% of the whole collection. It is interesting to note that the level of preservation of the material did not depend on the storage time in the herbarium (Fig. 6). On the contrary, the largest number of specimens in perfect condition were obtained in the early period of collection. Hence, it can be assumed that during storage the

---

**Table 2. Taxonomic structure of Myxomycetes collection of the CYN. Numbers in parentheses show number of species in taxon**

<table>
<thead>
<tr>
<th>Order</th>
<th>Family</th>
<th>Genus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ceratiomyxales (1)</strong></td>
<td>Ceratiomyxaceae (1)</td>
<td><strong>Ceratiomyxa</strong> (1)</td>
</tr>
<tr>
<td><strong>Echinosteliales (1)</strong></td>
<td>Echinostelariae (1)</td>
<td><strong>Echinostelium</strong> (1)</td>
</tr>
<tr>
<td><strong>Cribrariales (25)</strong></td>
<td><strong>Cribrariaceae (15)</strong></td>
<td><strong>Ceravis</strong> (1)</td>
</tr>
<tr>
<td><strong>Physarales (59)</strong></td>
<td><strong>Physaraceae (41)</strong></td>
<td><strong>Mucilago</strong> (1)</td>
</tr>
<tr>
<td><strong>Stemonitales (26)</strong></td>
<td><strong>Stemonitaceae (26)</strong></td>
<td><strong>Stemonita</strong> (1)</td>
</tr>
<tr>
<td><strong>Trichiales (30)</strong></td>
<td><strong>Trichariaceae (16)</strong></td>
<td><strong>Trichia</strong> (8)</td>
</tr>
</tbody>
</table>

---

Botanica Pacifica. A journal of plant science and conservation. 2020. 9(2)

13
morphological features of sporophores were slightly changed, if changed at all. Moreover, we do not have information about the condition in which specimens were initially obtained. A significant part of them was most likely far from being perfectly preserved at the time of gathering in the field. It should be noted that despite the lack of the collection processing by any special chemicals (such as mercuric chloride) or pre-freezing, only a few specimens had traces of insect damage. Representatives of the genera *Badhamia* and *Reticulata* were affected by insects the most.

The specimen preservation in different genera was also similar. The largest proportion of heavily damaged sporophores was related to the Physarales. Representatives of the genera *Badhamia* and *Physarum*, which have relatively small and very fragile sporophores, suffered the most from mechanical damage (Fig. 7). Also the specimens belonging to the genus *Comatricha* were hardly-damaged due to non-fixed storage of such fragile sporophores. Specimens from the genus *Tubifera* were also damaged, including the sporophore tops, which are very important for identification. A slightly smaller part of heavily damaged sporangia was noted in the Cribariales, Stemoni-tidales, and Ceratiomyxales. Specimens from the Trichiales (*Trichia, Hemitrichia,* *Arcyria*) were preserved the best due to the fact that the majority of their representatives have a sufficiently elastic peridium, which damages less by mechanical impact. Colonies of the genus *Didymium*, as a rule, are light color immediately after maturation because of lime on the sporophore surface, which makes them clearly visible on leaf litter. However, under the influence of precipitation, lime might wash off, so sporangia turn black and almost invisible on the substrate. As a result, they are often skipped during field collection. At the same time, sporophores are initially strong in dry condition and relatively serious impact is required to damage them. Thus, when species of this genus are collected in good condition, they are almost not damaged during storage, and it can explain a high proportion of well preserved specimens of *Didymium* species.

We can conclude that critical revisions of old collections can provide valuable information on the myxomycete distribution.

**ACKNOWLEDGEMENTS**

We are grateful to members of the Interdepartmental Electron Microscopy Laboratory (Faculty of Biology, Lomonosov MSU) for their technical support and N.I. Kireeva for drawings of specimens. Field work was supported by Russian Foundation for Basic Research (project 18-04-01232 A). Identification of the material was performed within the framework of the State task of MSU, part 2 (topic number AAAA-A16-11602160084-1). Work of the first author was supported by Moscow State University Grant for Leading Scientific Schools “Depository of the Living Systems” within frame of the MSU Development Program.

**Table 3. Distribution of species and specimens by regions in the Myxomycetes collection of CYN**

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of deposited species</th>
<th>Number of new species for the region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moscow and Moscow Region</td>
<td>122</td>
<td>11</td>
</tr>
<tr>
<td>Tver Region</td>
<td>55</td>
<td>3</td>
</tr>
<tr>
<td>Tyumen Region</td>
<td>49</td>
<td>27</td>
</tr>
<tr>
<td>Yaroslavl Region</td>
<td>30</td>
<td>12</td>
</tr>
<tr>
<td>Irkutsk Region</td>
<td>25</td>
<td>24</td>
</tr>
<tr>
<td>Murmansk Region</td>
<td>29</td>
<td>7</td>
</tr>
<tr>
<td>Primorye Territory</td>
<td>27</td>
<td>1</td>
</tr>
<tr>
<td>Crimean Peninsula</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>Republic of Karelia</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Khabarovsk Territory</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>Krasnodar Territory</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Pskov Region</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Kaluga Region</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Altai Territory</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Astrakhan Region</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Yaroslavl Region</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Altai Republic</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Vladimir Region</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Kingdom of Cambodia</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>No georeference</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Figure 6** Preservation level of specimens collected in different years and deposited in the CYN collection. Description of preservation levels see in Table 1

**Figure 7** Preservation level of most abundant genera (with number of specimens more than 30) on a five-point scale (see Table 1) in the Myxomycetes collection of CYN

Gmoshinsky et al.


