On the structure, ecology and distribution of the species of Mitrula s.lat. (Ascomycetes, Geoglossaceae)

Esteri Kankainen

The Subarctic Research Station of the University of Turku, Turku. Finland

Introduction

The matter under consideration is a part of my research including the larger fungi in arctic and subarctic regions. For eight years I have also collected Mitrula material, and some notes are published in Kallio & Kankainen (1964, 1966). I have had the opportunity to participate on the excursions of Kevo, the Subarctic Research Station of the University of Turku under the leadership of Prof. Paavo Kallio. Our Mitrula collections from these trips to Spitsbergen in 1966 and northeastern Canada in 1967 are taken into consideration in the present paper. The specimens studied are preserved in the following herbariums:

- H Botanical Museum of the University of Helsinki
- HFR Finnish Forest Research Institute, Helsinki
- HPP Department of Phytopathology, University of Helsinki
- KEVO Collections of the Subarctic Research Station of the University of Turku, Utsjoki
- OULU Botanical Museum of the University of Oulu
- S Botanical Museum of Stockholm
- TROMS Department of Botany, Tromsø Museum
- TUR Botanical Museum of the University of Turku

Only unpublished finds are included in the enclosed lists of the studied specimens, but the notes of Kallio & Kankainen (1964, 1966) are also plotted on the maps (Figs. 1, 3).

I express my best thanks for direction and advice of great value to my teacher Prof. Paavo Kallio, for valuable notes and discussion to Phil. lic. Tauno Ulvinen, for determination of the mosses in question to Phil. mag. Unto Laine, and for the linguistic revision to Mrs. Linna Müller-Wille. I have received financial support from Suomen Kulttuurirahasto.

Mitrula Fr., Syst. Myc. 1, p. 491. 1821. (sensu strict.)

Imai (1941) and Maas Geesteranus (1964) have unravelled the history of the genus Mitrula, and we only ascertain the large variation in its content from one extreme to the other, from the wide opinion of Karsten (1871) and Massee (1897) to the narrow one of Imai (1941, 1956) and Maas Geesteranus (1964). Imai (1956), divided Geoglossaceae into new subfamilies and tribes. Consequently the tribe Mitruleae includes only one monotypic genus Mitrula on the basis of that the ascocarp of M. paludosa is hemiangular. In the tribe Gymnomitruleae is included one genus Gymnomitrula with two species G. abietis and G. gracilis on the basis of that the ascocarp of M. pusilla is gymnocarpic. According to Maas Geesteranus (1964) the genus Mitrula is also monotypic. He has renewed the old genus Heyderia which is in his opinion monotypic, because the place of M. gracilis is indistinct.
In the present paper we have taken the genus *Mitrula* in a larger sense than the last two authors, but sensu stricto compared with the opinion of e.g. Fries (1821), Nannfeldt (1942) and Eckblad (1963).


   *Clavaria phalloides* Bull., Champ. France, p. 214, Tab. 469, Fig. 3. 1791—1798.

   *Clavaria epiphila* Dickens., Plant. Crypt. 3, p. 22, Tab. 9, Fig. 10. 1798.

   *Leotia ludwigii*, dickeni, bullardi Pers., Syn. Fung., pp. 611, 612, Tab. 3, Fig. 13. 1801.


   *Leotia uliginosa* var. aurantiaca Pers., Ibid., p. 201. 1822.

   *Mitrula phalloides* Chev., Fl. Paris, p. 114, Fig. 183. 1826—1827.


**External morphology.** The size and form of the studied ascocarps of *Mitrula paludosa* are quite variable. The stipe is 2—5 centimetres high, smooth, transparent, whitish when fresh, orange yellow when dry. The base of the stem is generally thickened when grown in soft habitat, for instance in mud, forming a large white ball of hyphae. When growing on only a little decayed leaves the base of the stem is not at all thickened or very slightly.

The diameter of the ascigerous portion varies from 0.5 to over one centimetre. Mostly the cap is uneven, folded, but also even, almost spherical caps exist. Sometimes the caps resemble *Spathularia*. The colour of the cap is yellow — orange yellow when fresh becoming far darker when dried. The form with even, cylindrical-spherical cap is pure yellow in colour (cf. *var. cylindrica* of Velenovsky 1934).

The ascigerous portion is connected to the stem without a sterile margin as seen in *Mitrula gracilis* and Heyderia abietis. The cap-stem relation varies very much depending on the habitat. In very rotten, soft places the specimens have thick, short, caespitose stems and small caps (cf. *var. pachyceps* of Karsten 1883); on a more solid substrate the stems grow slender and long, the height of them depending on the depth of the substrate in the water. The caps are generally large and variable in form.

**Anatomy.** The width of the hyphae in the central part of the stipe widens up to 15 μ, in the periphery of the stipe about 6 μ. The surface of the stem is smooth.

The size of the asci averages 75—110 × 5—6 μ (measured in five specimens). The paraphyses are straight, not at all or very slightly enlarged above. The spores are hyaline, not punctate, nonseptate, cylindrical to clavate-cylindrical, in average larger than those in *M. gracilis*. The size of the spores in the following specimens is: Masku 4.6.1959 15.3 × 3.5 μ (50 measurement); Lohja 12.6.1961 12.2 × 2.5 μ (50 meas.); Kiirninki 25.6.1966 13.7 × 2.6 μ (50 meas.); Inari 15.7.1968 11.1 × 2.6 μ (30 meas.).

The morphological and anatomical features of the specimens studied correspond well with those recorded in the literature (Fries 1821, Karsten 1871, 1883, Rehm 1896, Massie 1897, Durand 1908, Lloyd 1916, Velenovsky 1934, Mainz 1955, Benedix 1962, Eckblad 1963, Maas Geestanus 1964). Specimens belonging to *var. pachyceps* Karst., and possibly to *var. sphaerocephala* Boud. and *var. cylindrica* Vel. are included in the list of the studied specimens. *Var. castanea* Vel. is unknown to us as is *f. pallens* Eisfelder & Benedix. Mainz (1955, p. 873) has found three types of ascospores occurring in the *Mitrula paludosa* collections. We have found, however, spores of very variable form and size in the same specimen. The uniseptate spores are very rare in our collections (cf. Mainz 1897, Mainz 1941, Mainz 1955).

**Habitat.** *Mitrula paludosa* grows in Finland preferably on decaying leaves of birch, but it is also found on leaves of *Alnus*, on needles and twigs of *Pinus silvestris* and *Picea*...
abies, and among more rotten rests of plants (in mud and slime). Almost without exception the species is found along springs and spring brooks, and in bogs. Often its habitat is a puddle, but always a place where the water changes but does not flow. In such places the oxygen conditions are good. The habitat of our specimen collected in Canada was very similar to those in Lapland.

The habitats of the studied specimens agree with the notes presented in the literature (Fries 1821, Karsten 1871, 1883, Cooke 1871, Reim 1896, Massee 1897, Durand 1908, Lloyd 1916, Velenovsky 1934, Imai 1941, Nannfeldt 1942, Mains 1955, Benedix 1962). Var. pachyceps of Karsten (1883) is grown «Supra acus Pini sylvestris putrescentes». It is not yet understood, whether the caespitose form is caused by the quality of the substrate and/or only by the softness of it. Benedix (1962, p. 402) presents four «Varietäten» sphaerocephala Boud., pachyceps Karst., castanea Vel. and cylindrica Vel. only as habitat forms.

Phenology. Mitrula paludosa is earlier than M. gracilis, occurring from spring to early autumn. The studied unpublished collections are listed in order of occurrence in the following list (abbrev. K). For comparison the other columns are made according to observations of Ulvines (abbrev. U) presented later on, and to collections mentioned by Kallio & Kankainen 1964 and 1966 (abbrev. K & K; all specimens are from Lapland) and Nannfeldt 1942 (abbrev. N).

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In Lapland the peak of occurrence of the species is July-August in normal years, in southern Finland June-July.

Most authors record the species to occur in spring and early summer (e.g. Lloyd 1916, Velenovsky 1934, Mains 1955, Eckblad 1963). Benedix (1962) says that in the lowland the species occurs in May-June, in the highland in September.

Distribution. The specimens studied by the writer are mostly from Finland (see Fig. 1). The species has never been found in the alpine regions of Lapland, thus above the Betula tortuosa tree limit. In other parts of Finland it seems to be common. Many collections and observations have been made along the Salpausselkä ridges. The species is common on this area because of the occurrence of springs at the foot of the ridges.

Mitrula paludosa occurs in all of Europe (Saccardo 1889, Imai 1941, Benedix 1962), in Greenland (Lange 1957), North America (Durand 1908, Mains 1955), Japan (Imai 1941), that is to say only in the northern hemisphere. Eckblad (1963, p. 153) has also noticed that this species does not occur above the tree limit. He says that «In southern Norway it shows a slight tendency to coastal distribution». Maybe the greater elevation of the inner parts of Norway leads to the aforesaid distribution.

List of the specimens studied (marked with dots on the enclosed map, Fig. 1):

FINLAND
A. Eckerö Storby 17. 6. 1956 L. E. Kari (TUR); Lemland Slåttskär 7. 6. 1946 Uno Vidlund (H).
Ab. Bromarv Kärböle 27. 6. 1945 Gunnar Marklund (H), Rilax 17. 8. 1945 H. Buch (H), Sandö 9. 8. 1936 Nicken Malmström (H); Karjalohja Karkali 30. 6. 1944 L. E. Kari (TUR) and 15. 6. 1962 Timo Koponen 4193 (H); Kustavi in 1863 E. Bonsdorff (H), Isokari (Enskär) 26. 6. 1967 Unto Laine (TUR); Lohja mik Linnaniemi 27. 6. 1944 and 5. 7. 1944 L. E. Kari (TUR), Vaanila 12. 6. 1961 Harri T. Toppari (H); Masku Kareva 1. 6. 1943 A. V. Auer (TUR) and 4. 6. 1959 Paavo Kallio (TUR); Merimasku 23. 6. 1860 P. A. Karsten (H); Mietoainen Aarlahti 28. 6. 1967 Vesa Oittinen (H); Pikkio HarVALuo 14. 6. 1967 Vesa Oittinen (H); Pöytä Pujo 13. 8. 1962 Paula Siltanen (TUR).
N. Eligamiaki Mustila 30. 5. 1909 C. G. Tigerstedt (H); Espoo Bodom 4. 6. 1950 Viljo Kuja 521 (HFR); Kirkkonummi Bergsta, in 1905 F. W. Klingstedt (H); Pernaja Kildö, July, 1922 W. Nyberg (H); Pornainen Kirveskoski 26. 10. 1916 Tauno Putkonen (HPP); Porvo 25. 6. 1860 P. A. Karsten (type material of Mitrula paludosa var. pachyceps Karst.; H) and 25. 6. 1860 W. Nyberg (H), Vesaö 25. 6. 1938 W. Nyberg (H); Tammsaari mik Tvärminne 15. 6. 1934 Nicken Malmström (H) and 30. 6. 1937 E. Häyrén (H); Tuusula Nummenkylä 16. 6. 1946 E. Häyrén (H), Ruotsinkylä 12. 7. 1941 E. Häyrén (H), 8. 7. 1957 Ann-Marie Malmström (H) and 4. 7. 1962 Veikko Hinnikka (HFR). St. Kankaannä Venejakivi 5. 6. 1934 Matti Laurila (TUR, HPP) and 16. 6. 1935 Matti Laurila (HPP); Laatila Leinä 26. 6. 1949 Holger Sälthin (H) Määntaka 21. 7. 1955 Holger
Fig. 1. The studied collections and observations of *Mitrula paludosa* Fr.

Sälthin (TUR); Oripää Myllylähe 13.7.1956
L. E. Kari (TUR), 30.6.1968 Martti Kemilä (OULU); Pomerkk Uusikylä 19.6.1939
Matti Laurila (HPP).

Ta. Asikkala 15.6.1863 J. P. Norrin (H);
Janakkala Koljala Suurisuo 5.7.1968 Pertti
Uotila (H); Jokiönen 22.6.1910 S. Salmen-
linna (H); Jämsä Jämssäniemi Myllyjärvi 26.
7.1964 Raikko Ruotsalo (H); Kurominen
Puukkoistenkoski 22.6.1965 Yrjö Mäkinen (TUR);
Lammievo 24.6.1965 Harri T. Toppari (H),
Porraaskoski 19.8.1952 Otto v. Schulmann (H);
Tamme Mustiala 30.7.1866, 23.7.1869, 24.7.1869 P. A. Karsten (H) and 27.6.1867 A.
L. Borenius (H); Vanaja Isojärvi 8.7.1965
Harri T. Toppari (H).

Tb. Laukaa Seppälä 14.6.1915 Anne-Marie
Häyrén (H), Växkola 18.9.1949 E. J. Valovirta
(H).

v. Schulmann (HFR).

Ka. Sippola Enäjärvi 6.7.1948 Viljo Ku-
List of the observations of Tauno Ulvinen (marked with rings on the enclosed map, Fig. 1):


St. Kankaanpää Kuninkaanhde 18.6. 1957.


Observations of Lauri Teivainen in HFR (marked with rings on the enclosed map, Fig. 1):

Ob. Rovaniempi Pissavaara (two finds), in 1946-47.

All observations of Lauri Teivainen are from wet cope fen. We must, however, be critical with the observations in Ob and Lkem, because there is a possibility of confusing Mitrula paludosa and M. gracilis.


Mitrula rehmmii Bres., Fung. Trid. 2, p. 41, Tab. 147, Fig. 2. 1892.


External morphology. Mitrula gracilis is a rather inconsistent species in so far as it does not grow in abundance. It differs from M. paludosa and Heyderia abietis chiefly in
colour, in size of asci and spores, and in habitat.

The height of the studied ascocarps varies from 0.7 to five centimetres. The stipe is yellowish or ochraceous in fresh material, but in some specimens it is whitish because of the presence of white, partly hyaline scales and hyaline hairs. The scales are poorly seen in dry material. The base of the stem is rugged, somewhat thickened, and divided into many fibres crossing the rhizoids of the host moss. The form of the ascigerous portion and its connexion with the stipe varies between that of Mitrula paludosa and Heyderia abietis. The head and stipe are, however, almost the same colour when fresh.

Two extreme morphological forms can be distinguished in Mitrula gracilis material. In some specimens the fertile, capitata, more or less folded head continues to the stipe without a distinct sterile zone. In very young ascocarps of this type, however, a free margin, filled with mucilaginous matter and hanging over the apex, can be seen (Tauno Ulvinnen, by letter).

The specimens of the other type have a pileata, unfolded head with a sharp overhanging margin. The surface of the broad sterile area is somewhat reticulated. These kinds of specimens are as a rule smaller and paler, and the stipe is more scaly than in the former type. They have features, even when adult, similar to the juvenile stage of M. gracilis.

Though the extreme specimens among the studied material differ very conspicuously from each other it is not necessary to attach great importance to them as separate species, or even as variations, because mediator specimens exist in this material. For instance most specimens from Canada indicate an infraspecific series. Some of these are also from Lapland, although it is very difficult to distinguish this group. Most material from northern Fennoscandia is of the capitata form. Some specimens from the northernmost Fennoscandian research area and all material from Spitsbergen are of the extreme pileata form.

Particularly in dry material from Canada, but also in the pileatae specimens rests of a veil between the stem and the head can be seen. When dried or preserved in alcohol the colours of M. gracilis, like M. paludosa become far darker, and the stipe and the head are no longer uniformly coloured the stipe being (lemon) yellow, and the head reddish brown.

Fig. 2. A circular population of Mitrula gracilis Karst. on the Calliergon sarmentosum mat. Spitsbergen, Kongressdalen, in 1966.
Anatomy. The anatomy does not vary like the external morphology of the species in question. The hyphae in the axis of the stipe are up to 8 \( \mu \) wide, in the periphery 4—5 \( \mu \) wide. The hairs are hyaline, one- and two-celled, up to 30 \( \mu \) long. The scales extend upward, and they turn dark blue with cotton blue.

The asci average 65—85 × 6—7 \( \mu \) (measured in five specimens). The tips of the asci turn blue with iodine. The paraphyses are numerous and slightly thickened above. The spores are hyaline, somewhat punctate (best seen with oil immersion), often uniseptate, more or less straight, fusiform. The size of the spores in the following collections is: Ranua 22.7.1943 9.2 × 2.4 \( \mu \) (50 measurements); Kuusamo 6.8.1948 9.8 × 2.0 \( \mu \) (50 meas.); Kiirninki 21.7.1966 11.2 × 2.8 \( \mu \) (30 meas.); Utsjoki 14.8.1963 12.5 × 2.7 \( \mu \) (30 meas.); Spitsbergen Kongressdalen 16.8. 1966 11.1 × 2.6 \( \mu \) (50 meas.); Canada: Beam Lake 6.8.1963 11.6 × 2.6 \( \mu \) (25 meas.), Attikamagen Lake 5.8.1967 11.7 × 2.6 \( \mu \) (30 meas.), Highfall Creek 2.8.1967 11.2 × 2.5 \( \mu \) (25 meas.). The specimens from Ranua, Kuusamo and Kiiminki are of the capitate form, the specimens from Utsjoki and Spitsbergen of the pileate form.

Many different observations and opinions have been presented on *Mitrula gracilis* and the related species. The notes on the anatomical features do not vary greatly, but the morphology has caused much confusion.

Karsten (1883) considers this species to be between *M. elegans* and *M. paludosa*. Durand (1908) however, has combined the mentioned two species as one species *M. phaloides*. Massé (1897) says that *M. rehmii* in many points resembles *M. muscicola* — which subsequently is enclosed with *M. gracilis* — but has a «somewhat longer stem and more uneven hymenium» (p. 280). Rehm (1896) assumes *M. gracilis* and *M. rehmii* to be variants of same species. Durand (1908) has studied the type of Karsten, and he writes that the American specimens agree well with the type. He has found that «*M. gracilis* agrees with *M. muscicola* and *M. rehmii* in habitat and differs from them principally in the smaller size and more even hymenium» (p. 404). Seaver (1911) observed the large variability of the asccarps of *M. gracilis*.

The morphology and anatomy of our material correspond to those of *M. rehmii* of Bresadola (1892, p. 41). Heim & Remy (1932, p. 68) widen *M. rehmii* and describe the «forme alpine», which according to Nannfeldt (1942, p. 50) is *M. gracilis*, while the «forme sylvatique subalpine» — Bresadola’s original type — should perhaps be different. According to Heim & Remy both forms have much larger asci and spores than the type described by Bresadola. The spores are also very irregular in form.

Nannfeldt (1928) has studied herbarium material of *M. rehmii*, and he says that it is a good deal larger than *M. gracilis*. The author has seen a specimen of the exsiccate material of Lundell & Nannfeldt, and it corresponds well with the capitate type described above.

Imai (1941) on the basis of Dittrich’s (1898) and Corner’s (1930) investigations separated *M. gracilis* and *M. cucullata* to his own genus Gymnomitrula instead of Heyderia, which according to Imai is already occupied. Thus also *M. gracilis* should be gymnocarpic like *M. pusilla*. But the developmental phases of *M. gracilis* have not yet been clarified, and the possibility that *M. gracilis* might be angiocarpic is not excluded. That is why we for the present place the species in *Mitrula*. For instance rests of a veil in our specimens may resemble those seen in *M. paludosa* (Durand 1908, p. 389, Nannfeldt 1932, p. 317).

In 1949 Favre has united *M. rehmii* in *M. gracilis* and *M. muscicola*. In 1960 Favre recorded Gymnomitrula rehmii as synonym of Gymnomitrula gracilis. Mains (1955, p. 871) has observed some variation in *M. gracilis* in America. He writes that «In some asccarps the stipe gradually widens above, forming a sterile area on the lower portion of the head». Lange (1957) assumes that *M. gracilis* is possibly confused with *M. multiformis*.

Skirgiello (1961) has studied material collected from Spitsbergen, and she reports those specimens to have an overhanging margin. Eckblad (1963, p. 151), however, writes that Skirgiello’s illustration «seems to indicate another plant». In our opinion the material described by Skirgiello agrees entirely with our specimens from Spitsbergen, in other words with the pileate form described above. Similarly the finds from Jan Mayen (Larsen 1924) may be of this type.
Benedix (1962) and Svrček (1962) record from the Tatra Mitrula material the place of which in their opinion is uncertain as regards M. rehmii and M. gracilis. According to Benedix (p. 404) M. gracilis has a shorter stipe than M. rehmii. About his own Tatra material Benedix says that those specimens have no sharp overhanging margin, but they have the uneven head typical of M. rehmii. We assume that M. rehmii and M. gracilis sensu Benedix perhaps correspond in some degree to the variation described above. Benedix does not exclude the standpoint of Rehm (1896) who considers M. gracilis and M. rehmii variants of the same species. Benedix, however, placed M. rehmii together with M. paludosa and M. omphalostoma in the subgenus Physomitrula and M. gracilis together with M. abietis in the subgenus Heyderia.

Eckblad (1963) and Maas Geesternus (1964) have studied the anatomy of the stipe of Mitrula species. Maas Geesternus (p. 89) says that "the very different structure of the stipe in itself is sufficient proof that Mitrula gracilis is not a Heyderia. I am not sure, however, as to its relation to Mitrula." The anatomy of the stipe in our specimens nearly corresponds to that presented by Eckblad (1963) and Maas Geesternus (1964) except that neither author has observed any hairs or scales on the stem. Ulvinen (by letter) has seen scales in his M. gracilis material from Enontekio. Though the existence of such special structures brings M. gracilis in some way closer to Heyderia (sensu Maas Geesternus), it is not justifiable to place it in Heyderia. In our opinion it is thus reasonable to keep M. gracilis in Mitrula, but the study of the juvenile development is necessary.

Habitat. Mitrula gracilis grows on wet mossy places between hummocks in bogs. The studied specimens have been found on many different moss species. It is surprising that the extreme morphological forms presented above have no notable preference concerning to the mosses on which they live. Both forms are found on Aulacomnium palustre, Drepanoclados revolvens, and on Paludella squarrosa. In Lapland Paludella seems to be the most common host moss for the larger, capitate form. In addition it has been found connected with Bryum pseudotriquetrum, Calliergon stramineum, Campylium stellatum, Helodium blandowii, H. lanatum, and with Philonotis tomentella. The gracile, pileate form in our collections is connected also with Calliergon sarmentosum, Oncophorus wahlenbergii, and with Tomentypnum nitens.

Very often brown dead patches on moss mats around M. gracilis populations have been found. The phenomenon is most obvious when a bright green moss species (for instance Paludella squarrosa or Calliergon sarmentosum) forms a more or less pure growing unit, and when the fungus grows in abundance. The most regular growing units we have seen in Spitsbergen (Fig. 3) where such brown rings are very conspicuous in some bogs (Kankainen & Karlström & Heikkilä 1967). The fungus widens its growth area centrifugally while in the centre of the dead ring new, vigorous, bright green moss begins its growth.

In the literature M. gracilis is recorded growing on Aulacomnium palustre, Bryum pseudotriquetrum, Calliergon sarmentosum, C. stramineum, Dicranum majus (!), Drepanoclados badius, Dr. exannulatus, Helodium lanatum, Hylocomium splendens, Paludella squarrosa, Philonotis fontana, Ph. tomentella, Rhacomitrium canescens, Rh. fasciculare, Tomentypnum nitens, and on Weberia nutans (Henning 1885 concerning M. muscicola, Bresadola 1892 concerning M. rehmii, Durand 1908, Heim & Remy 1932 concerning M. rehmii, Nannfeldt 1942, Mains 1955, Benedix 1962 concerning M. rehmii and M. gracilis, Eckblad 1963, Kallio & Kankainen 1964).

Some authors have reported that the moss underneath the fungus is dead (Karsten 1883, Eckblad 1963, Kallio & Kankainen 1964). Some authors assume that the fungus is a parasite (Bresadola 1892, Durand 1908, Imai 1941, Mains 1955). Nannfeldt (1942) had seen only healthy moss below the fungus. Eckblad (1963) writes that he and Mr. S. Sivertsen have observed almost circular brown patches on the moss mats. Ulvinen (by letter) has found M. gracilis (the pileate form from Enontekio) killing Aulacomnium palustre.

Eckblad (1963, p. 152) says that "If such (intraspecific) taxa exist they will probably exhibit some specialization as regards the substratum, in the way that different taxa occur on different mosses. This does not mean
that we should expect a usual host — parasite relation. Further on Eckblad reports he has not seen any fungal hyphae within the cells of the moss. Neither have we observed fungal hyphae penetrating the moss cells. We are of the opinion that the fungus gets nutrients diffused from the exuding liquid of the moss. The toxic effect of the fungus is an axiom but it can be a secondary handicap effect which does not necessarily have to do with the nutrition of the fungus (cf., too, Eckblad 1963, p. 152). On the other hand the toxic effect may be also a primary effect increasing the permeability of the cell membranes in the host moss.

As seen above there is very large variation which does not seem to depend noteworthy on the moss substrate. The variation does not
obviously correspond to the "biologic variations" of *Mitrula abietis* (Velevensky 1934, Ulvïnen 1966) because the nutrition is different in *M. gracilis* and *M. abietis*. It is necessary to know more about the nutrition in *M. gracilis* and about the influence of e.g. the temperature on the morphogenesis of this species before the problem of variation is solved.

**Phenology.** *Mitrula gracilis* is a species between *M. paludosa* and *Heyderia abietis* as regards the period of growth, for it is a species of summer and autumn. The capitate specimens in the studied material seem to be earlier than the pileate types. The former is found to occur from the middle of July to August 21, the latter from August 6 to September 12. The specimens from Canada are collected between July 31 and August 6. The climate fluctuates very much between from year to year. For instance the summer and autumn in Finland in 1967 was warmer than average. In 1968 the summer was exceptional cold in Lapland.

In Fennoscandia the peak of occurrence of *M. gracilis* is clearly in August, as seen in the following table, which presents the number of collections reported by KANKAINEN in this article (abbrev. K), by KALLIO & KANKAINEN 1964, 1966 (K & K), NANNFELDT 1942 (N) and ECKBLAD 1963 (E).

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Also the notes of the other authors nearly conform to that reported above as regards the period of growth in *M. gracilis* (Karsten 1883, Imai 1941, Mains 1955). Durand’s note (1908, p. 403) "March (?) — September" is really doubtful. In the Alps and in the Tatra the species is found in September (Heim & Remy 1932 concerning *M. rehmii*, Benedix 1962).

**Distribution.** (Fig. 3) The distribution of the different forms of *M. gracilis* is already treated above. The capitate form is found to occur from 65°20' to 70° n.lat. and the pileate form from 68° to 78° n.lat. The collections in Canada are made in the latitudes of 54° and 58° n.lat. *Mitrula gracilis* is a subarctic-arctic-alpine fungus. It is recorded from the Kola Peninsula (Karsten 1883), from northern Fennoscandia (Henning 1885: M. muscicola, Rostrup 1904, Nannfeldt 1928, 1942, Imai 1940, Eckblad 1963, Kallio & Kankainen 1964, 1966), from Spitsbergen (Skrgiello 1961, Kankainen & Karlstrom & Heikila 1967), Jan Mayen (Larsen 1924), Iceland (Larsen 1932), Greenland (Rostrup 1891, 1894, Lange 1957), from North America (Durand 1908, Mains 1955), Japan (Imai 1941), from the Alps (Bresadola 1892; M. rehmii, Heim & Remy 1932; M. rehmii, Favre 1949, 1955, 1960, Skrgiello 1961, Eisfelder 1962), and from the Tatra (Benedix 1962, Svrcek 1962).

List of the specimens studied (marked with dots on the map, Fig. 3, together with the collections reported by Kallio & Kankainen 1964, 1966):

**FINLAND**

Ob. K. iiminki rich fen between old Kuusamo road and Jolosjoki river (on Aulacornium palustre, Bryum pseudotriquetrum, Drepano cladus revolvens etc.) 21.7.1966 Tauno Ulvinen (OULU), and 2.8.1966 Tauno Ulvinen (OULU, TUR), (on Bryum pseudotriquetrum) 5.9.1968 M. Ohenoja & T. Ulvinen (OULU), south west of the central swamp of Murtoinsaaret 8.9.1968/XXXV Martti Ohenoja (OULU); R. nua Isopalo (on Helodium blandowii, Paludella squarrosa) 22.7.1943 A. V. Auer (TUR).


**NORWAY**

Troms. Lyngsiedet Rattenvikfjellet (on Helodium lanatum, Paludella squarrosa) 25.7.1968 Reino Alava & Kalevi Alho (TUR).


SWEDEN Torne Lappmark. Jukkasjärvi Abisko (on Paludella, Drepanocladus?) 5. 8. 1943 Pål Sontesson (S), Kopparilsen (on Paludella, Drepano­

USSR Kpoc. Paatene (on Philonotis tomentella) 15. 7. 1863 J. Sahlberg (TUR).

FINLAND St. Lappl Lapinkylä 20. 10. 1957 Holger Såtlin (TUR), Simasalo 8. 11. 1954 Holger Såtlin (TUR).

Heyderia abietis is a species of the autumn. It can be found even during November. It is recorded to occur except in the northern hemisphere also in Australia (IMA 1941). List of the specimens studied:

Heyderia abietis var. pusilla

SUMMARY

Mitrula paludosa Fr. is a species of spring and early summer. It is common in Finland up to the birch forest limit.

Mitrula gracilis Karst. is a subarctic-arctic-alpine species. Its external morphology varies very much. Except the extreme capitately and pileate forms also infraspecific forms exist. The basis of the variation is not yet solved.

Heyderia abietis (Fr.) Weinm. grows on pine and spruce needles, but the separation of var. abietis and var. pusilla is not fully founded. The species is found in Finland up to the limits of the pine and spruce forest.
REFERENCES


Henning, E., 1885: Bidrag till svampfloran i Norges sydligare fjelltrakter. - Bd. 1, 178 - 235.


