Notes on some nivicolous myxomycetes from Australia and New Zealand including the description of a new species of *Lamproderma*

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Abstract: Eight species of nivicolous myxomycetes collected in New Zealand and Australia are reported. Three of these are new records for both Australia and the entire Southern Hemisphere, another is a new record for New Zealand, and one is a species new to science. This new species (*Lamproderma australiensis*) is described herein. Descriptions and scanning electron micrographs of the most important morphological characters are provided for each species.

Zusammenfassung: Acht Arten in Neuseeland und Australien gesammelter nivicoler Myxomyceten werden vorgestellt. Drei Arten werden erstmals sowohl von Australien, als auch von der gesamten südlichen Halbkugel berichtet, und eine Art wurde erstmals in Neuseeland angetroffen. Außerdem wird eine neue Art, *Lamproderma australiensis*, beschrieben. Beschreibungen und rasterelektronenmikroskopische Aufnahmen der wichtigsten Merkmale werden für alle beschriebenen Arten gegeben.

One group of myxomycetes (plasmodial slime moulds or myxogastrids) is restricted largely to alpine areas of mountains, where its members are found fruiting along the margins of melting snowbanks in late spring and early summer. The species that occupy this rather special and very limited habitat are usually referred to as "nivicolous" or "snowbank" myxomycetes. They constitute a distinct ecological group, since they generally produce fruiting bodies only during the relatively brief period of time when the special microenvironmental conditions associated with the margins of snowbanks and apparently required for their growth and fruiting exist. The majority of nivicolous myxomycetes are members of such genera as *Comatricha*, *Diacheopsis*, *Diderma*, *Didymium*, *Lamproderma*, *Lepidoderma* and *Physarum*. Although recorded from a number of areas in temperate regions of the Northern Hemisphere (MARTIN & ALEXOPOULOS 1969, STEPHENSON & STEMPEN 1994, LADO 2004), a few high-elevation areas of the tropics (FARR 1976), and more recently from several areas in the

Southern Hemisphere (STEPHENSON & JOHNSTON 2003, STEPHENSON & al. 2007), investigations of the ecological aspects of nivicolous myxomycetes are few. SCHINNER (1982), who carried out an ecological study of the myxomycetes he collected in alpine, subalpine and mountainous zones of the Hohe Tauern Mountains in the Austrian Alps, commented on the possible influence of factors such as temperature, frost, heat, dryness, moisture and water content of the substrate on spore germination and formation of fruiting bodies of nivicolous species. LADO (2004) suggested that the snow layer works as insulation, providing on the one hand excellent protection against low temperatures from the "outside" of the snowbank and on the other hand permitting – if the snow layer is thin enough – the penetration of infrared radiation to the "inside" while also retaining the heat produced by absorption of this radiation by the black humus of the soil below the snow layer. Presumably, water released due to the melting of the snow close to the ground produces a natural moist chamber providing ideal microenvironmental conditions for the development of nivicolous myxomycetes. However, STEPHENSON & al. (2007) collected several species of nivicolous myxomycetes from non-snowbank habitats on subantarctic Macquarie Island, which indicates that these organisms can occur in the total absence of snowbanks.

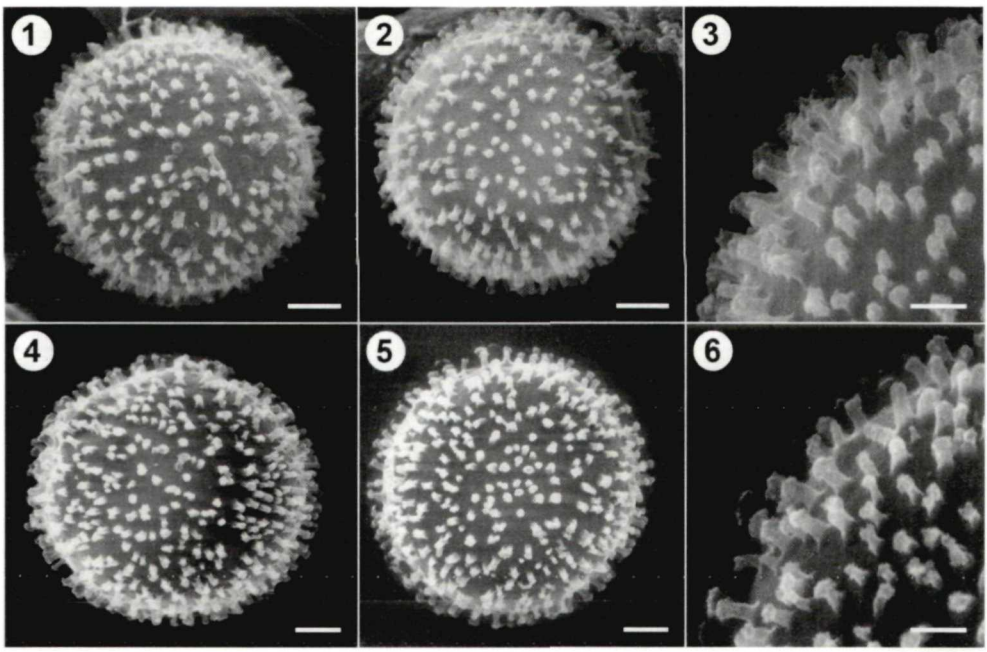
MARTIN & ALEXOPOULOS (1969) suggested that the harsh microenvironmental conditions associated with snowbank habitats could cause certain irregularities in the fruiting bodies produced by nivicolous species. For example, fruiting bodies that were normally stalked could be sessile or possess excessively long stalks, species typically forming sporangia could produce plasmodiocarps (or vice versa), fruiting bodies with lime usually present could be totally limeless, and spores could be atypically large. Moreover, as a general observation, the fruiting bodies of nivicolous species tend to be more robust and their spores larger than is the case for closely related taxa that occur only in lowland situations (STEPHENSON & STEMPEN 1994). It seems possible that more robust fruiting bodies might better protect the spores from the severe microenvironmental conditions of snowbank habitats, and larger spores (presumably with additional food reserves) might have a greater chance of remaining viable under these conditions. The fact that most taxa of nivicolous myxomycetes are characterized by dark spores, with the pigment theoretically providing some degree of protection from the high levels of ultraviolet radiation present at higher elevations, would seem to lend some support for such a hypothesis.

There are relatively few records of nivicolous myxomycetes from Australasia, although it is interesting to note that the first myxomycetes reported from Australia (BERKELEY 1859) included one example (*Prototrichia metallica*) usually associated with snowbank habitats. STEPHENSON & JOHNSTON (2003) listed 12 species from New Zealand, and MITCHELL (1992) cited one additional record (*Lepidoderma chailletii*) from Australia. The specimens examined in the study reported herein were obtained as a result of surveys carried out on Macquarie Island during the period of late January to late April of 1995 (STEPHENSON & al. 2007), in the mountains of New Zealand during the period of mid-November to mid-December of 2000 (STEPHENSON & JOHNSTON 2003), and in the mountains of southeastern Australia in October of 2004 (STEPHENSON, unpubl. data).

Materials and methods

The methods used in carrying out the field surveys for myxomycetes were essentially those described by STEPHENSON (1988) and STEPHENSON & JOHNSTON (2003). Visits were made to various localities in each of the regions investigated and potential substrates were examined carefully for myxomycete fruiting bodies (sporocarps) that had developed in the field under natural conditions. Specimens were collected, returned to the laboratory, air-dried and glued in small boxes for permanent storage in the herbarium of the University of Arkansas (UARK). Collection numbers assigned to each specimen, including those mentioned later herein, are those of the first author (S. L. S.). Later, some of these specimens were sent to the laboratory of the second author, where individual sporocarps were removed, mounted in Hoyer's medium and studied with a Nikon microscope. Scanning electron micrographs (SEM) were obtained with the use of a Zeiss DSM-950. Spore measurements were made under the oil immersion objective of a light microscope (LM) and include surface structures such as spines or warts. Terminology used to describe spore ornamentation follows that of RAMMELOO (1974, 1975).

For ultramicroscopic studies, the material to be examined was rehydrated in concentrated ammonium hydroxide (28-30%) for 30 min, dehydrated in aqueous ethanol (70%) for 30 min, fixed for two hours in pure ethylene glycol dimethyl ether (= 1,2-dimethoxymethane) and finally immersed in pure acetone for at least two hours. This was followed by critical point drying and sputtering with gold-palladium.



Figs. 1-6. Nivicolous species of *Diderma*. – Figs. 1-3. *Diderma alpinum* (S. L. S. 19097). Figs. 1, 2. SEM micrographs of spores, bar: 2 µm. Fig. 3. More detailed views of the spore ornamentation, bar: 1 µm. – Figs. 4-6. *Diderma niveum* (S. L. S. 19148). Figs. 4, 5. SEM micrographs of spores, bar: 2 µm. Fig. 6. More detailed view of the spore ornamentation, bar: 1 µm.

List of taxa

***Diderma alpinum* (MEYL.) MEYL.**, Bull. Soc. Vaud. Sci. Nat **51**: 261. 1917 (Figs. 1-3)

Specimens examined: Australia: Victoria, ski area on summit ridge of Mt. Hotham (36°58'34" S, 147°07'55" E), alpine snowbank habitat, on living plant, 19. 10. 2004, S. L. S. 19097.

Observations: This is the first record of *Diderma alpinum* from mainland Australia. The species was reported previously from subantarctic Macquarie Island (STEPHENSON & al. 2007), which is politically part of Australia, and is also known from New Zealand (STEPHENSON & JOHNSTON 2003). *Diderma alpinum* is morphologically very similar to *D. niveum* (ROSTAF.) T. MACBR., and the two species were examined in detail by MORENO & al. (2002) in the context of their studies of what has been referred to as the *D. niveum* complex. The latter consists of those nivicolous species of *Diderma* in which the sporocarps are sessile and have white, coriaceous peridia. In their typical expressions, *D. alpinum* can be distinguished from *D. niveum* on the basis of the type of sporocarp produced, plasmodiocarps for *D. alpinum* and sporangia for *D. niveum* (MEYLAN 1913, NEUBERT & al. 1995). However, this is neither a stable nor a reliable character, since plasmodiocarps can be produced in both species. Features that can be used to separate *D. alpinum* and *D. niveum* have to be looked for on the microscopic level and can be found in the morphology of the capillitium, which is flexuous, hyaline to somewhat dark, and about 1 µm in diam. for *D. alpinum* and rigid, rough, dark and 1-3 µm in diam. for *D. niveum*. Both species show the same type of spore ornamentation, baculae when observed by SEM (Figs. 1-6) and spines under the LM.

It should be noted that our interpretation of the features used to separate these two species is in accordance with the concepts of MEYLAN (1924) and KOWALSKI (1975) as well as those of such current authorities as M. MEYER and W. NOWOTNY (pers. comm.).

***Diderma niveum* (ROSTAF.) T. MACBR.**, N. Amer. Slime-Moulds: 100. 1899 (Figs. 4-6)

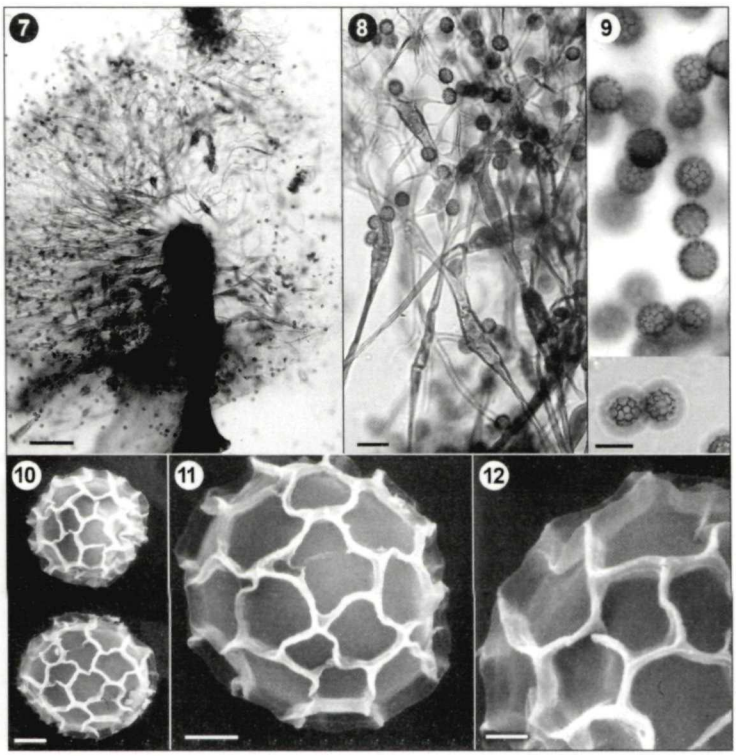
Specimens examined: New Zealand: South Island, Old Man Ridge (45°18'50" S, 169°11'44'' E), alpine snowbank habitat, on living plant, 8. 12. 2000, S. L. S. 14172; - South Island, Mt. Dodson ski area (43°56'33" S, 170°39'53" E), alpine snowbank habitat, on litter, 9. 12. 2000, S. L. S. 14127; - South Island, Ohau ski area (44°13'19" S, 169°46'47" E), alpine snowbank habitat, on litter, 9. 12. 2000, S. L. S. 14145; - South Island, Mt. Dodson ski area (43°56'33" S, 170°39'53" E), alpine snowbank habitat, on litter, 9. 12. 2000, S. L. S. 14160.

Australia: New South Wales, Charlotte Pass area of Kosciuszko National Park (36°24'07" S, 148°24'50'' E), alpine snowbank habitat, on woody twigs, 23. 10. 2004, S. L. S. 19148.

Observations: *Diderma niveum* was reported previously from New Zealand by STEPHENSON & JOHNSTON (2003), but this is the first record of the species from Australia. Macroscopically, *D. niveum* is a very variable species with respect to overall morphology and the size of the sporocarps, presence or absence of a columella and presence or absence of a hypothallus. The differences between *D. niveum* and *D. alpinum* were noted above. The morphological variability of *D. niveum* and the presence of the same type of spore ornamentation in both species suggest that they may be two varieties of the same taxon, which apparently led LADO & al. (2005) to combine

the two species and to consider them as *D. niveum* sensu lato. However, at the moment we maintain the two species as separate entities, distinguishing them primarily on the basis of differences in the morphology of the capillitium. Presumably, this taxonomic situation will be resolved once the appropriate molecular studies can be carried out.

The morphological variability that occurs in *Diderma niveum* is evident in the specimens from New Zealand. For example, S. L. S. 14160 shows a typical dark capillitium but is rather plasmodiocarpous. S. L. S. 14172 seems to consist of poorly developed sporocarps that are characterized by a badhamioid-like capillitium, and S. L. S. 14145 has a less dark and more hyaline capillitium. However, the capillitium of all these specimens is always more than 1 µm in diam.



Figs. 7-12. *Lamproderma australiensis* (S. L. S. 19211, Holotype). Fig. 7. Sporocarp, bar: 0.1 mm. Fig. 8. Detail of capillitium, bar: 20 µm. Fig. 9. Spores, bar: 10 µm. Fig. 10. SEM micrograph of spores, bar: 2.5 µm. Fig. 11. SEM micrograph of spore, bar: 2 µm. Fig. 12. More detailed view of the spore ornamentation, bar: 1 µm.

Lamproderma australiensis **S. L. Stephenson, G. Moreno & H. Singer,** spec. nova (Figs. 7-12)

Specimens examined: Australia: Eagle's Nest above Thredbo, New South Wales (36°24'07" S, 148°24'50'' E), alpine snowbank habitat, on litter, 24. 10. 2004, S. L. S. 19211, holotype; - same locality and date, S. L. S. 19212.

Latin diagnosis: Sporocarpia gregaria vel dispersa, stipite brevi praedita. Sporotheca globosa, 0,7-1,3 mm lata. Peridium varium, coeruleum, persistens sed fragile. Capillitium centro flavidum, cetera pallidius, 2-4 µm latum, abundis excrescentibus fusiformibus flavis, plerumque 30-100 × 10-20 µm latis, praeditum. Sporae in cumulo obscure nigrae, sub microscopio violaceae, 10-12 µm latae, reticulatae, cum 4-7 maculis reticuli pro hemisphaerio, parietes maculae reticuli usque ad 1 µm altae. Plasmodium incognitum.

Description: Sporocarps gregarious to scattered, with a short stalk. Sporotheca globose, 0.7-1.3 mm in diam. (Fig. 7). Peridium iridescent with bluish colours, persistent but fragile. Capillitium golden in the centre, becoming pale toward the periphery when observed with a magnifying glass. Under LM, it is composed of reticulate, very clear, pale yellowish threads 2-4 µm in diam., with abundant fusiform nodules, concolorous with the capillitium, 30-100 × 10-20 µm, occurring more frequently from the centre of the capillitium towards the columella (Fig. 8). Spores dark in mass, dark violaceous by LM, 10-12 µm in diam., covered by a complete reticulum with 4-7 meshes per hemisphere, meshes 1 µm wide (Figs. 9-12). Plasmodium unknown.

Observations: The two collections of this new species consist of abundant (>100) sporocarps. *Lamproderma australiensis* is characterized by the broad threads of the capillitium, 2-4 µm in diam. and with yellowish to golden tones and abundant concolorous nodes and the reticulate spores 10-12 µm in diam. Other species of *Lamproderma* with reticulate spores are *L. cribrarioides* var. *cribrarioides* (FR.) R.E. FR. (SINGER & al. 2003), *L. meyerianum* (Y. YAMAM.) G. MORENO, H. SINGER & ILLANA (MORENO & al. 2005), and *L. retirugisporum* G. MORENO, H. SINGER, ILLANA & A. SÁNCHEZ (SINGER & al. 2003). *Lamproderma cribrarioides* var. *cribrarioides* is very different due to the dark capillitium with Y- or funnel-shaped free ends that are attached to the peridium, a peridium that persists on the sporotheca in the form of small patches, and large spores (14-16 µm in diam.). *Lamproderma meyerianum*, a species currently known only from Japan, can be distinguished by its distinctly stalked sporocarps, hyaline (not golden) capillitium, and spores that when viewed under LM are crested to subreticulate or reticulate with small, very tight meshes of variable size. There are more than 14 meshes per hemisphere, and these are only about 0.5 µm wide.

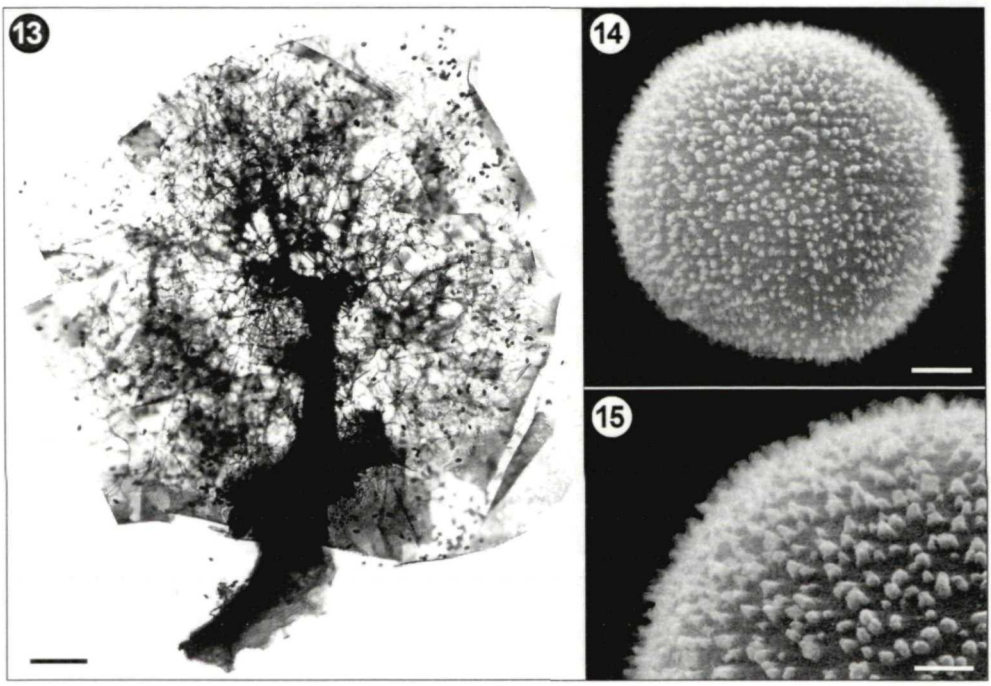
Lamproderma australiensis has a spore ornamentation similar to that of *L. retirugisporum* but clearly differs from specimens of the latter species collected in Austria, France and Spain as described by MORENO & al. (2005). The European specimens have a longer stalk, a darker, violaceous brown (not golden) capillitium and larger spores, 13-15 µm in diam. These differences are enough to indicate that the material from Australia represents a species new to science.

***Lamproderma maculatum* KOWALSKI,** Mycologia **62 (4)**: 654. 1970 (Figs. 13-15)

Specimens examined: Australia: New South Wales, Charlotte Pass near Jindabyne (36°58'32" S, 147°07'55" E), alpine snowbank habitat, on litter, 23. 10. 2004, S. L. S. 19154.

Observations: There are no previous records of this species from Australia or any other region of the Southern Hemisphere. The specimen we examined is characterized by sessile or short-stalked sporocarps with a globose to slightly elongated sporotheca,

a persistent peridium that bears dark spots (Fig. 13) and acicular lime crystals, and spores 13-15 µm in diam., and small baculae of more or less regular distribution under SEM (Figs. 14-15). While the sessile or subsessile growth habit is typical of *Lamproderma maculatum* var. *macrosporum* MAR. MEY. & POULAIN, the spore diameters conform to those described for *L. maculatum* var. *maculatum*. As such, the Australian specimen appears to represent an intermediate form that falls between the varieties. This situation demonstrates that in nivicolous myxomycetes a spore size larger than considered typical for a particular species can occur, but this condition does not warrant the recognition of different varieties. Instead, the larger spores should be considered as falling within the morphological variability of the species in question. We would refer the specimen from Australia to *L. maculatum* var. *maculatum*, giving priority to the small spore diameters.

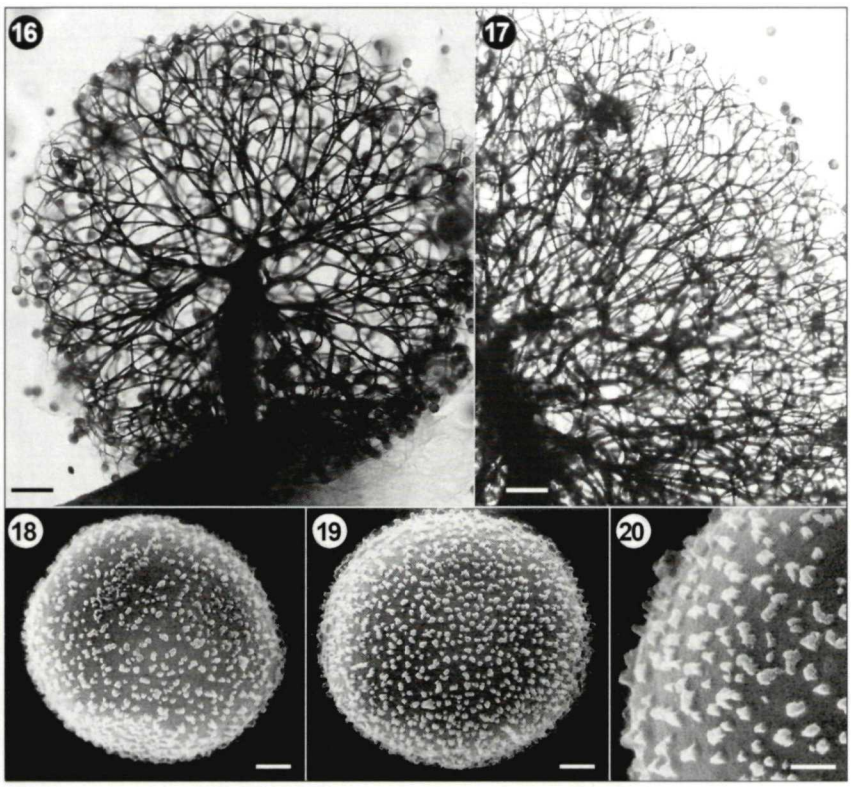


Figs. 13-15. *Lamproderma maculatum* (S. L. S. 19154). Fig. 13. Sporocarp, bar: 0.1 mm. Fig. 14. SEM micrograph of spore, bar: 2 µm. Fig. 15. More detailed view of the spore ornamentation, bar: 1 µm.

***Lamproderma ovoideum* MEYL.**, Bull. Soc. Vaud. Sci. Nat. **57**: 370. 1932 (Figs. 16-20)

Specimens examined: Australia: New South Wales, Eagle's Nest above Thredbo (36°29'38" S, 148°17'13" E), alpine snowbank habitat, on litter, 14. 10. 2004, S. L. S. 18980; - same locality and date, S. L. S. 18971; - same locality, 21. 10. 2004, S. L. S. 19139; - same locality, 24. 10. 2004, S. L. S. 19222; - same locality and date, S. L. S. 19189; - same locality, 25. 10. 2004, S. L. S. 19215; - New South Wales, Charlotte Pass near Jindabyne (36°23'56" S, 148°25'15" E), alpine snowbank habitat, living plant, 20. 10. 2004, S. L. S. 19126; - same locality and date, S. L. S. 19130; - same locality, 22.

10. 2004, S. L. S. 19172; - same locality, 23. 10. 2004, S. L. S. 19173; - New South Wales, Perisher Blue Ski Resort near Jindabyne (36°24'39" S, 148°24'02" E), alpine snowbank habitat, on litter, 27. 10. 2004, S. L. S. 19248; - same locality and date, S. L. S. 19267; - same locality and date, S. L. S. 19272; - same locality and date, on a living plant, S. L. S. 19321.

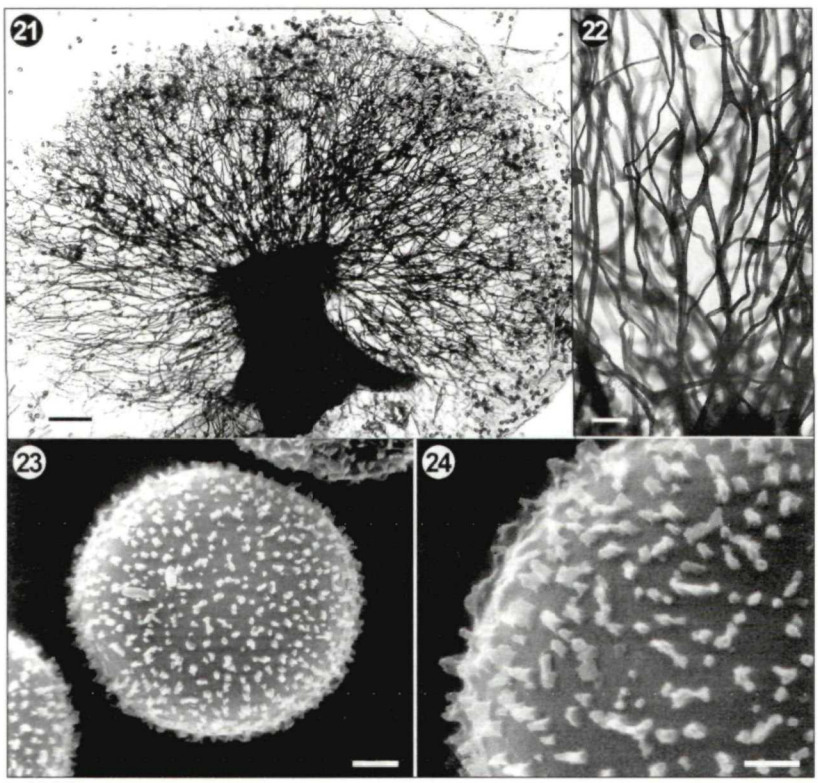


Figs. 16-20. *Lamproderma ovoideum* (16, 17. S. L. S. 19222; 18-20. S. L. S. 18971). Fig. 16. Sporocarp, bar: 0.1 mm. Fig. 17. Detail of capillitium, bar: 0.1 mm. Figs. 18, 19. SEM micrographs of spores, bar: 2 µm. Fig. 20. More detailed view of the spore ornamentation, bar: 1 µm.

Observations: *Lamproderma ovoideum* was reported previously from Macquarie Island by STEPHENSON & al. (1992) and from New Zealand by STEPHENSON & JOHNSTON (2003), but there are no previous records from mainland Australia. However, the number of specimens collected in 2004 suggests that it is one of the more common nivicolous species to be found in the mountains of the southeastern portion of the country (STEPHENSON, unpubl. data). *Lamproderma ovoideum* is characterized by sporocarps grouped in large colonies, with the individual sporocarps sessile or short-stalked, and 0.8-2 × 0.8-1.5 mm in diam. The shape of the sporotheca varies considerably, ranging from globose to broadly ellipsoid (Fig. 18). The peridium, which tends to persist as a basal cup that frequently attains half the height of the sporotheca, displays iridescent colours, from grey to blue to silver. The columella generally extends to one third to half the height of the sporotheca and is dark brown. The capillitium is dense,

dark brown by LM, and composed of dark filaments 2-3 µm in diam., with these forming an intricate net (Fig. 17), with frequent spiny, rigid, generally clearer to hyaline free ends. Spores are 13-16 µm in diam., dark violaceous but with a clearer lateral zone, and bear dense and prominent spinules when seen with LM and small baculae of more or less regular distribution under SEM (Figs. 18-20).

Lamproderma ovoideum is a species with a very variable morphology and was considered by NEUBERT & al. (2000) to be a member of the *L. carestiae-ovoideum* complex. This complex was examined by the French myxomycetologists M. MEYER, M. POULAIN and J. BOZONNET, who have described several new species, including *Lamproderma aeneum* MAR. MEY. & POULAIN, *L. ovoideoechinulatum* MAR. MEY. & POULAIN, *L. ovoideoechinulatum* var. *microsporum* MAR. MEY. & POULAIN and *L. zonatum* MAR. MEY. & POULAIN (BOZONNET & AL. 1995). While some of their newly described species can be recognized easily, others appear to represent intermediate forms that are not easily distinguished from one another. Because of this, these species are currently being studied with scanning electron microscopy in order to carry out a detailed study of the spore ornamentation of the type specimens.



Figs. 21-24. *Lamproderma zonatum* (S. L. S. 19214). Fig. 21. Sporocarp, bar: 0.1 mm. Fig. 22. Detail of capillitium, bar: 20 µm. Fig. 23. SEM micrograph of spore, bar: 2 µm. Fig. 24. More detailed view of the spore ornamentation, bar: 1 µm.

The specimens examined in this study are generally sessile or (more seldom) short-stalked, and the majority have a globose sporotheca, in contrast to the typical situation in *Lamproderma ovoideum*. After studying hundreds of specimens of *L. ovoideum* (unpublished data), the second author has come to the conclusion that this species is highly variable in the shape of the sporotheca and length of the stalk. The Australian specimens agree in spore dimensions and ornamentation. Thus, we place the specimens studied in *L. ovoideum.*

***Lamproderma zonatum* MAR. MEY. & POULAIN,** Bull. Soc. Mycol. France **119 (3-4)**: 277, 2004 ("2003") (Figs. 21-24)
= ***L. carestiae*** ss. MEYLAN 1932, POULAIN & al. 2002, non *Stemonitis carestiae* CES. & DE NOT., Erb. Critt. Ital. Series II, FASC. 18, n° 888. 1879.

Specimens examined: Australia: New South Wales, Beyond Eagle's Nest above Thredbo, Kosciuszko National Park, living plant, alpine snowbank, 4536 degrees 29.463 S, 148 degrees 17.249 E, 25. 10. 2004, S. L. S. 19214.

Observations: This collection consists of numerous fruiting bodies that are sessile or have short stalks, a globose to ovoid sporotheca (Fig. 21) with a persistent, violaceous iridescent peridium, abundant capillitium, dark, somewhat clearer towards the periphery and spores 11-12 µm in diam., violaceous dark, warty, with an ornamentation formed by baculae (Fig. 23) that fuse forming small crests under SEM (Fig. 24). *Lamproderma zonatum* is a species recently proposed by MEYER & POULAIN in POULAIN & al. (2004), as a result of the study of the type material of *L. carestiae* CES. & DE NOT., and the observation that its interpretation has been wrong. *Lamproderma carestiae* is in reality a prioritary epithet of *L. atrosporum* MEYL. which has to be considered a synonym of it. What is interpreted today as *L. carestiae* by different authors and is well illustrated in the book of NEUBERT & al. (2000) corresponds to *L. zonatum.*

***Lepidoderma chailletii* ROSTAF.,** Sluzowce Monogr.: 189. 1874 (Figs. 25-27)

Specimens examined: New Zealand: South Island, Old Man Ridge (45°18'50" S, 169°11'44" E), alpine snowbank habitat, living plant, 8. 12. 2000, S. L. S. 14187.

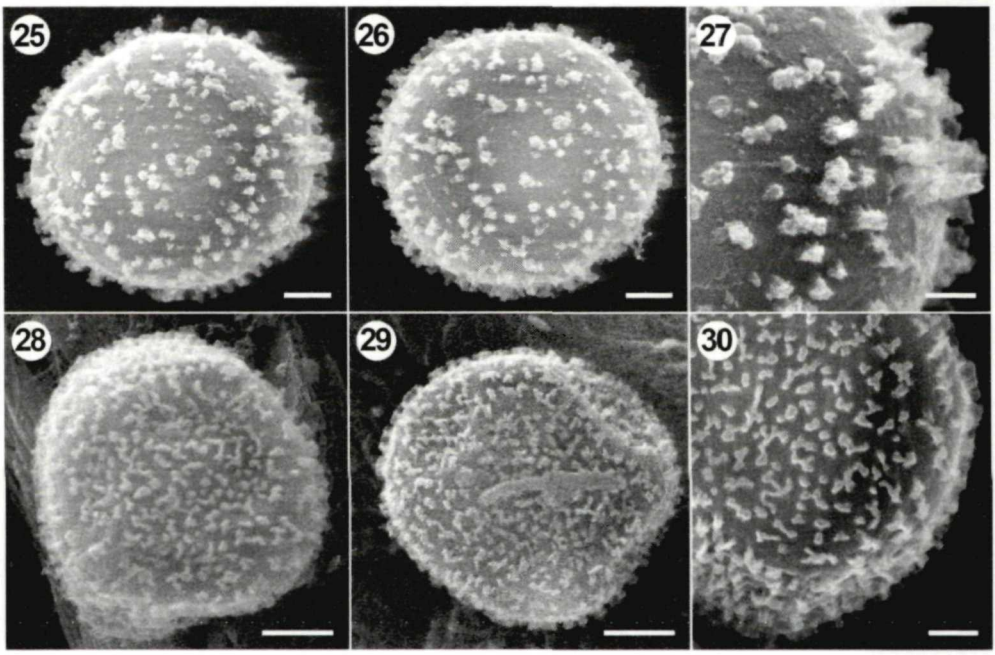
Observations: *Lepidoderma chailletii* is characterized by its aggregated, hemispherical to pulvinate, always sessile fruiting bodies, the presence of a columella and its spiny spores (Figs. 25, 26), 12-15 in diam., that show large baculae with more or less coralloid apices by SEM (Fig. 27). A closely related species is *L. crustaceum* KOWALSKI, whose differences with *L. chailletii* are discussed below.

The New Zealand specimen has spores with very variable spore diameters, 12-15 (-20) µm in diam., and some spores bear a very lax and warty to crested ornamentation, apparently indicating an irregular development.

***Lepidoderma crustaceum* KOWALSKI,** Mycologia **59**: 167. 1967 (Figs. 28-30)

Specimens examined: Australia: Macquarie Island, Finch Creek Valley (54°33'47" S, 158°54'36" E), subantarctic herbfield, on bryophyte mat, 7. 4. 1995, S. L. S. 7053; - Macquarie Island, Hasselborough Bay (54°30'04" S, 158°54'29" E), subantarctic herbfield, on root mat and bryophytes, 5. 4. 1995, S. L. S. 19960.

Observations: This species was reported previously from Macquarie Island by STEPHENSON & al. (2007) and also is known from New Zealand (STEPHENSON & JOHNSTON 2003). *Lepidoderma crustaceum* is characterized by its sporangiate, cream ivory to straw white, didermoid fruiting bodies, with distinct small and very aggregated calcareous scales, the absence of a columella, its scarce, dark brown, sinuous capillitium and spores 12-14(15) µm in diam., with baculae by SEM (MORENO & al. 2004) (Figs. 28-30). *Lepidoderma chailletii* is a closely related species that differs from *L. crustaceum* primarily by its aggregated fruiting bodies, the presence of a columella and its spiny spores that show large baculae with more or less coralloid apices by SEM.



Figs. 25-30. Nivicolous species of *Lepidoderma*. – Figs. 25-27. *Lepidoderma chailletii* (S. L. S. 14187). Figs. 25, 26. SEM micrographs of spores, bar: 2 µm. Fig. 27. More detailed view of the spore ornamentation, bar: 1 µm. – Figs. 28-30. *Lepidoderma crustaceum* (S. L. S. 7053). Figs. 28, 29. SEM micrographs of spores, bar: 2 µm. Fig. 30. More detailed view of the spore ornamentation, bar: 1 µm.

Another similar species is *Lepidoderma carestianum* (RABENH.) ROSTAF. This species has been confused with *L. chailletii* (KOWALSKI 1971, NEUBERT & al. 1995, SÁNCHEZ & al. 2002). However, POULAIN & al. (2002) studied for the first time the type material of *Reticularia carestiana* RABENH. and pointed out the differences between the two species. Later, MORENO & al. (2004) re-examined the type of *R. cares-*

tiana and agreed with the taxonomic treatment proposed by POULAIN & al. (2002). Apart from the plasmodiocarpic growth habit of *L. crustaceum*, a feature pointed out by POULAIN & al. (2002), the species can be distinguished on the basis of having spores that bear dense spines under LM and large bending spines when observed under SEM.

There are records of *Lepidoderma crustaceum* from California and Washington in the United States (KOWALSKI 1967, 1971) and in Europe from Greece (SCHNITTLER & NOVOZHILOV 1999), Italy (LADO 1994, BERSAN 1995) and Switzerland (KOWALSKI 1971).

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