MOIST CHAMBER AND FIELD COLLECTIONS OF MYXOMYCETES FROM THE NORTHERN SIMPSON DESERT, AUSTRALIA

E. M. Davison[1], P. J. N. Davison[2] and M. H. Brims[3]

[1]*Department of Environmental Biology, Curtin University of Technology, GPO Box U1987, Perth, WA 6845, Australia*
[2]*148, Bateman Road, Mt Pleasant, WA 6153, Australia*
[3]*Western Australian Herbarium, George Street, Kensington, WA 6157, Australia*

Abstract

This is the first species list of myxomycetes from the northern Simpson Desert, Northern Territory. Bark, dung and litter substrates from the Hay River region were used for moist chamber culture incubation for myxomycetes. Field collections, together with specimens obtained from the moist chamber cultures have resulted in 35 species from this region of Australia. Nine of these species (*Badhamia melanospora, Comatricha vineatilis, Didymium dubium, Echinostelium arboreum, E. coelocephalum, Licea* cf. *perexigua, Macbrideola oblonga, Physarum ovisporum* and *Stemonitis laxifila*) are recorded for the first time from Australia. An additional 13 species are first records for the Northern Territory.

Key words: Australia, Northern Territory, Simpson Desert, myxomycetes, new records.

E. M. Davison, P. J. N. Davison & M. H. Brims (2008). Moist chamber and field collections of myxomycetes from the northern Simpson Desert, Australia. *Australasian Mycologist* 27 (3): 129–135.

Introduction

Myxomycetes, or plasmodial slime moulds, are common and relatively cosmopolitan in their distribution. They have been widely studied in Europe and North America, but those from Australia are still poorly known. Mitchell (1995) collated the first recent check list, recording 147 species. Ing and Spooner (1994) added an additional 16 species from the Kimberley Region of Western Australia, and McHugh *et al.* (2003) added a further 28 species from the Australian mainland and Tasmania. Other authors have added to this inventory with new records from specific habitats or locations (Jordan *et al*. 2006, Rosing *et al.* 2007, Stephenson *et al.* 2007).

The Simpson Desert covers about 200 000 km^2 in the south east of the Northern Territory (NT), the south west of Queensland and the north east of South Australia. The desert is classed as a hot desert and lies in the driest part of Australia (Purdie 1984). The region is renowned for its extensive dunefields but includes other landforms such as gibber plains, sand plains, dissected residuals and floodplains. The central part of the desert has mean annual rainfall of less than 150 mm. This rainfall is very erratic, both in seasonal occurrence and between years. Surface water is ephemeral.

During the late nineteenth and early twentieth centuries, grazing licences and leases were taken out over much of the Simpson Desert, although the frequent fluctuations in these grazing lease boundaries indicate the uncertainty of the pastoral industry in this area. These leases and licences were mainly in the west, south and east of the Simpson Desert; the northern part was generally free of pastoral activity and has been only lightly grazed (Gibson & Cole 1988).

The Northern Simpson Desert, in the vicinity of the Hay River, is not well known scientifically. This region was visited by the Winneke Expedition in 1883 and the Madigan Expedition in 1939 (Madigan 1945). A biological survey of this area was conducted by Gibson and Cole (1988) to assess the biological resources of the region and to recommend its potential for conservation. A description of the vegetation, and a plant list were published from the

Madigan expedition (Crocker 1946, Eardley 1946) and additional plant lists were published by Purdie (1984) and Gibson and Cole (1988). These lists do not include any myxomycetes from this region. In July 2007 the Australian Geographic Society organized an expedition to the Hay River region. One of us (EMD) took part, with the aim of collecting substrates for myxomycetes, as well as making collections of other fungi. The results of the myxomycete collections are presented in this paper.

Materials and Methods

Collection area

The collection area covered floodplains, dunefields and sand plains in the vicinity of the Hay River, between 23° 0′ S to 24° 17′ S and 136° 51′ E to 137° 28′ E. The vegetation types follow Purdie (1984). The vegetation of the flood plains on the Hay River consisted of fringing woodland of *Eucalyptus camaldulensis* Dehnh. in the river bed and along the bank, with occasional *Erythrina vespertilio* Benth.also present and with *Eucalyptus microtheca* F. Muell. low open woodland, with occasional *Corymbia opaca* (D.J.Carr & S.G.M.Carr) K.D.Hill & L.A.S.Johnson on the adjacent alluvial plain. The dunefields were characterized by low open woodland of *E. microtheca* with occasional *Hakea eyreana* (S.Moore) McGill*., H. lorea* (R.Br.) R.Br. and *Atalaya hemiglauca* (F.Muell.) Benth. in the swales, and *Grevillea stenobotrya* F.Muell. on the dunes. The sand plains in the north of the collection area, around the dissected residuals of the western part of the Adam Range, included open woodland of *Acacia cambagei* R.T.Baker*,* with occasional *C. papuana* (F.Muell.) K.D.Hill & L.A.S.Johnson and *E. pachyphylla* F. Muell. All collections were made between 2 and 13 July 2007.

The collecting area lies between the 300 mm and 200 mm isohyets on the Bureau of Meteorology mean rainfall chart; the estimated rainfall in this region in the previous 6 months was between 200 and 300 mm (Australian Bureau of Meteorology 2007).

Collections, moist chamber preparation and identifications

Substrates suitable for moist chamber incubation (see below) were collected from the outer bark of living and dead trees and shrubs, herbivore dung and leaves (aerial litter) washed into fringing shrubs along the Hay River following previous rain. Each collection is indicated by the prefix SD. Collections were from substrates separated by at least 200 m. The substrates were placed in new paper bags and returned to Perth. Field collections were opportunistic.

Moist chamber cultures were prepared as described by Stephenson and Stempen (1994). The chamber cultures were plastic containers with lids, 9.5 cm in diameter and 4 cm deep, lined with absorbent paper towel. At least three replicate chamber cultures were prepared from each bark sample; a single chamber was prepared from each dung or litter sample. The samples were placed on the paper towel and flooded with deionised water. After 24 hr. the water was drained off and either the pH measured with a pHTestr 20 pH meter (Eutech Instruments PTE Ltd, Singapore), or the water was discarded. Moist chamber cultures were maintained at room temperature (20–25°C) in diffuse light, and examined frequently with a stereo microscope.

Fruiting bodies and plasmodia were recorded whenever the chamber cultures were checked. Slides of sporocarps were mounted in either Hoyers gum chloral or polyvinyl alcohol. Herbarium specimens were made by removing the sporocarps together with a portion of the substrate and gluing the substrate onto a card. The myxomycetes were identified using standard European and North American keys (Whitney 1980, Nannenga-Bremekamp 1991, Ing 1999, Mitchell 2003). The colour descriptions are from the Flora of British Fungi (1969). The names used in this paper follow those in Index Fungorum (2008).

Representative samples have been deposited at DARWIN, others have been deposited in PERTH, and some samples have been retained in a private collection (PJN&EMD).

Results

Annotated list of species

The moist chamber cultures, together with field collections, resulted in 35 species of myxomycetes. Nine of these are new records for Australia and 13 are new records for the NT. Six taxa could not be assigned to a species, either because of the small numbers of sporocarps or possibly aberrant material. Where cf. is used it indicates that the specimen representing the source of the record could not be identified with certainty. One specimen appears to be similar to an

undescribed species of *Arcyria* reported by McHugh *et al.* (2003), whilst another specimen could not be assigned to a genus.

All species are from moist chamber cultures unless otherwise indicated.

ECHINOSTELIALES

Echinostelium apitectum K.D. Whitney (= *E. vanderpoelii* Nann.-Bremek., D.W. Mitch., T.N. Lakh. & R.K. Chopra)

Bark from living *G. stenobotrya* (pH 5.3) PJN&EMD 528 (SD 21). Bark from living *H. eyreana* (pH 5.9) PJN&EMD 511 (SD 27). Bark from living *C. opaca* (pH 4.5, 4.8) PJN&EMD 535, 537 (SD 28). Bark from living *E. vespertilio* (pH 7.0) PJN&EMD 480 (SD 75). Bark from dead *A. cambagei* (pH 5.8, 6.1) PJN&EMD 485, 486 (SD 94).

First reported as *E. vanderpoelii* from Australia by Mitchell (1995) but not previously recorded from the NT.

Echinostelium arboreum H.W. Keller & T.E. Brooks

Bark from living *E. microtheca* (pH 6.4, 6.7) PJN&EMD 520, 522 (SD 10). Bark from living *E. microtheca* (pH 6.7) PJN&EMD 542 (SD 54).

Not previously recorded from Australia.

Echinostelium coelocephalum T.E. Brooks & H.W. Keller

Bark from dead fallen unidentified shrub (pH 5.4) PJN&EMD 524 (SD 12). Bark from living *G. stenobotrya* (pH 5.3) PJN&EMD 528 (SD 21). Bark from living *G. stenobotrya* (pH 5.6) PJN&EMD 530 (SD 22).

Not previously recorded from Australia.

Echinostelium fragile Nann.-Bremek.

Bark from living *H. eyreana* (pH 5.5) PJN&EMD 512 (SD 27).

Previously reported from the NT by McHugh *et al.* (2003).

Echinostelium minutum de Bary

Bark from living *H. lorea* (pH 6.2) PJN&EMD 539 (SD 30). Bark from dead *A. cambagei* (pH 5.8) PJN&EMD 486-D (SD 94).

Reported in Mitchell (1995). Not previously recorded from the NT.

LICEALES

Licea biforis Morgan

Bark from dead fallen *A. hemiglauca* (pH 6.4) PJN&EMD 515-A (SD 2). Bark from living *E. microtheca* (pH 6.7) PJN&EMD 521 (SD 10). Bark from living *G. stenobotrya* (pH 5.8) PJN&EMD 531 (SD 22). Bark from living *E. microtheca* (pH 6.4, 6.7) PJN&EMD 541, 542, 543 (SD 54).

Previously reported from the NT by McHugh *et al.* (2003).

Licea denudescens H.W. Keller & T.E. Brooks

Bark from living *E. microtheca* (pH 6.4, 6.7) PJN&EMD 520, 521, 522 (SD 10). Bark from living *E. microtheca* (pH 6.1, 6.3) PJN&EMD 533, 534 (SD 26). Bark from living *E. microtheca* (pH 6.7) PJN&EMD 542 (SD 54).

These specimens have larger spores (11.2–14.0 µm) than the published description (Keller & Brooks 1977).

Reported from Australia by McHugh *et al.* (2003), but not previously recorded from the NT.

Licea kleistobolus G.W. Martin

Bark from dead fallen shrub (pH 4.8, 5.4) PJN&EMD 523, 524 (SD 12). Bark from living *G. stenobotrya* (pH 5.4) PJN&EMD 528 (SD 21). Bark from living *G. stenobotrya* (pH 5 6, 5.8) PJN&EMD 529, 530 (SD 22). Bark from living *C. opaca* (pH 5.5, 5.6) PJN&EMD 495-A, 496-A (SD 56). Bark from living *A. cambagei* (pH 6.4) PJN&EMD 493 (SD 76). Bark from dead *A. cambagei* (pH 5.8, 6.1) PJN&EMD 485-B, 486-A, MHB (SD 94).

Previously reported from the NT by McHugh *et al.* (2003).

Licea* cf. *perexigua T.E. Brooks & H.W. Keller

Bark from dead *A. cambagei* (pH 5.8, 6.1) PJN&EMD 485-E, 486-C (SD 94).

This specimen is similar to *L. perexigua* with respect to its size and form, spore size and lack of spore ornamentation; however the sporotheca is not iridescent.

Not previously recorded from Australia.

Licea species 1

Bark from living *G. stenobotrya* (pH 5.6) PJN&EMD 530 (SD 22).

This could not be assigned to a species. Sporocarp sessile, pulvinate, solitary, black, 150 µm diameter, peridium indehiscent, gelatinous, spores black in the mass, purplish black in transmitted light, 12.8 µm diameter, uniformly warty.

Licea species 2

Bark from living *E. microtheca* (pH 6.7) PJN&EMD 520 (SD 10).

This could not be assigned to a species. Sporocarp sessile, elongated, iridescent, 200 x 400 µm, peridium persistent, single, membranous, hyaline, papillose on the inner surface, spores cinnamon in the mass, yellowish in transmitted light, 11.5 µm diameter, densely verrucose.

TRICHIALES

Arcyria cinerea (Bull.) Pers.

On fallen bark from living *E. microtheca* MHB (SD 124).

Reported in Mitchell (1995). Not previously recorded from the NT.

Arcyria sp.

Bark from living *C. opaca* (pH 5.5) PJN&EMD 496 (SD 56).

This could not be assigned to a species. A group of six, short stalked, ovate, olivaceous buff sporothecae; capillitium firmly attached to the calyculus, capillitium brown, about 5 µm wide (excluding ornamentation) and decorated with rings; calyculus pleated and coarsely reticulate; spores slightly brownish in transmitted light, 9.9–10.2 µm. This is similar to *Arcyria* sp. DWM6506 in McHugh *et al*. (2003), which was obtained in moist chamber culture from *C. opaca* bark from the NT.

Perichaena corticalis (Batsch) Rostaf.

Bark from dead fallen *A. hemiglauca* MHB (SD2). Bark from base of living *E. microtheca* MHB (SD 10). Aerial litter washed down by past floods MHB (SD17). Bark from living *E. microtheca* (pH 6.7) PJN&EMD 424 (SD 54).

Reported in Mitchell (1995). Not previously recorded from the NT.

Perichaena vermicularis (Schwein.) Rostaf.

Bark from dead fallen *A. hemiglauca* MHB (SD2).

Reported in Mitchell (1995). Not previously recorded from the NT.

PHYSARALES

Badhamia melanospora Speg.

Euro (*Macropus robustus* Gould) dung MHB SD 128.

Not previously recorded from Australia. Known from New Zealand (Stephenson 2003).

Badhamia sp.

Bark from dead *A. cambagei* (pH 5.8) PJN&EMD 486-E (SD 94).

This could not be assigned to a species. Sporocarps were stipitate, gregarious, about 600 µm diameter, iridescent, with a short, flaccid chestnut stalk, capillitium a coarse three dimensional network of white lime tubules, spores very dark brown in the mass, purplish brown in transmitted light, 11.6 µm diameter, uniformly covered with short spines.

Didymium difforme (Pers.) Gray

Bark from living *E. microtheca* (pH 6.4, 6.7) PJN&EMD 520, 521, 522 (SD 10).

Reported in Mitchell (1995). Not previously recorded in the NT.

Didymium dubium Rostaf.

Bark from dead fallen *Atalaya hemiglauca* (pH 5.9) PJN&EMD 513 (SD 2). Field collection, on fallen bark *E. microtheca* PJN&EMD 545 (SD 66).

Not previously recorded from Australia. Known from New Zealand (Stephenson 2003).

Didymium squamulosum Fuckel

Field collection, on bark from fallen dead tree PJN&EMD 546 (SD 116).

Reported in Mitchell (1995). Not previously recorded from the NT.

Didymium sp.

Camel (*Camelus dromedarius* Linnaeus) dung MHB (SD 13).

This could not be assigned to a species. There were only three sessile sporocarps, about 400 µm diameter, 150 µm high, covered in white granular lime, no capillitium seen, spores 12.2 µm in diameter, purplish brown in transmitted light, uniformly spinose, no germ pore seen.

Physarum cinereum (Batsch) Pers.

Field collection, on fallen bark from living *E. papuana* PJN&EMD 544 (SD 37).

Reported in Mitchell (1995). Not previously recorded from the NT.

Physarum decipiens M.A. Curtis

Bark from living *E. microtheca* (pH 6.7) PJN&EMD 520, 521 (SD 10). Bark from living *A. cambagei* (pH 6.4, 6.7) PJN&EMD 492, 493-B (SD 76). Bark from dead *A. cambagei* (pH 6.1) PJN&EMD 485-A, MHB (SD 94).

Reported in Mitchell (1995) although the location is not specified.

Physarum ovisporum G. Lister

Bark from living *E. vespertilio* (pH 7.0) PJN&EMD 480-B, MHB (SD 75). Bark from living *A. cambagei* (pH 6.4, 6.7) PJN&EMD 491-A, 492-B, 493-A (SD 76).

Not previously recorded from Australia.

'Plasmodiocarps'

Bark from living *E. microtheca* MHB (SD 26). Bark from living *E. microtheca* (pH 6.7) PJN&EMD 542, 543 (SD 54).

These could not be assigned to a genus. Sessile sporangia or short plasmodiocarps up to 5 mm long, covered with large plates of crystalline lime or areas of white granular lime, both were present on large sporocarps giving them a piebald appearance, no capillitium seen, spores straw coloured in mass, hyaline in transmitted light, smooth.

STEMONITALES

Colloderma robustum Meyl.

Bark from dead *A. cambagei* (pH 6.3) PJN&EMD 487 (SD 94).

Reported in Mitchell (1995). Not previously recorded from the NT.

Comatricha elegans (Racib.) Lister

Bark from dead fallen shrub (pH 4.8) PJN&EMD 523 (SD 12). Bark from living *G. stenobotrya* (pH 5.3) PJN&EMD 528 (SD 21). Bark from living *G. stenobotrya* (pH 5.8) PJN&EMD 529 (SD 22). Bark from living *C. opaca* (pH 4.8, 4.9) PJN&EMD 535, 536 (SD 28). Bark from living *E. microtheca* (pH 5.2, 5.3) PJN&EMD 502, 503 (SD 35). Bark from living *C. opaca* (pH 4.6, 5.5) PJN&EMD 494, 496-B (SD 56).

Previously reported from the NT by McHugh *et al.* (2003).

Comatricha laxa Rostaf.

Bark from living *E. camaldulensis* (pH 5.8) PJN&EMD 507 (SD 8). Bark from living *E. microtheca* (pH 6.4) PJN&EMD 522 (SD 10). Bark from dead, fallen unidentified shrub (pH 5.4) PJN&EMD 525 (SD 12). Bark from living *G. stenobotrya* (pH 5.6) PJN&EMD 526 (SD 21). Bark from living *H. eyreana* (pH 5.5, 5.8) PJN&EMD 510, 512-A, (SD 27). Bark from living *H. lorea* (pH 6.2) PJN&EMD 538 MHB (SD 30). Fallen bark from living *E. pachyphylla* (pH 5.1) PJN&EMD 505 (SD 40). Bark from living *A. cambagei* (pH 6.4) PJN&EMD 491 (SD 76). Bark from dead *A. cambagei* (pH 5.8, 6.3) PJN&EMD 486-H, 487-A (SD 94).

Previously reported from the NT by McHugh *et al.* (2003).

Comatricha vineatilis Nann.-Bremek.

Bark from living *C. opaca* (pH 4.5, 4.8) PJN&EMD 535, 537 (SD 28).

Not previously recorded from Australia. Known from New Zealand (Stephenson 2003).

Comatricha sp.

Bark from living *H. lorea* (pH 6.3) PJN&EMD 540 (SD 30).

Only a single ellipsoidal sporocarp, total height 750 µm, stalk 60 % of the total height, peridium fugacious, columella extending almost to the top of the sporotheca, capillitium forming an internal net, small branches nodulose, no surface net, free ends numerous, pale, spores 10.5 µm diameter, purplish brown

in transmitted light, covered with coarse warts, no germ pore seen.

Macbrideola cornea (G. Lister & Cran) Alexop.

Bark from living *E. microtheca* (pH 6.7) PJN&EMD 520, 521 (SD 10).

Spores 7.5–7.6 µm diameter, slightly smaller than in published descriptions (Nannenga-Bremekamp 1991, Neubert, Nowotny & Baumann 2000).

Reported in Mitchell (1995). Not previously recorded from the NT.

Macbrideola oblonga Pando & Ladó

Bark from living *C. opaca* (pH 5.6) PJN&EMD 495 (SD 56). Bark from living *A. cambagei* (pH 6.4) PJN&EMD 491-B, 492-A (SD 76). Bark from dead *A. cambagei* (pH 5.8, 6.1, 6.3) PJN&EMD 485-D, 486-G, 487-C MHB (SD 94).

Not previously recorded from Australia.

Paradiacheopsis fimbriata (G. Lister & Cran) Hertel

Bark from dead fallen shrub (pH 4.8, 5.2) PJN&EMD 523, 525 (SD 12).

Reported in Mitchell (1995). Not previously recorded from the NT.

Stemonitis laxifila Nann.-Bremek. & Y. Yamam.

Bark from living *E. microtheca* (pH 5.2) PJN&EMD 501 (SD 35).

Not previously recorded from Australia.

Stemonitopsis amoena (Nann.-Bremek.) Nann.-Bremek.

Bark from living *E. microtheca* (pH 5.8) PJN&EMD 517 (SD 5). Bark from living *G. stenobotrya* (pH 5.5) PJN&EMD 527 (SD 21).

Reported in Jordan *et al*. (2006). Not previously recorded from the NT.

Discussion

The Hay River region of the northern Simpson Desert is one of the driest areas of Australia, yet our work has shown that it supports a diverse and abundant myxomycete flora, given the appropriate conditions that allow these organisms to develop. The most common species, in terms of numbers of SD collections, were *Comatricha laxa, Licea kleistobolus* and *C. elegans,* followed by *Echinostelium apitectum* and *Macbrideola oblonga*. The latter is a species that is considered rare, but was commonly found in moist chamber cultures of bark from the desert of Western Kazakhstan by Schnittler and Novozhilov (2000). They suggest that deserts have a limited, but distinctive myxomycete flora. Of the 27 species that they recorded, 41 % are common to both Western Kazakhstan and the northern Simpson Desert.

Stephenson (1989) drew attention to the importance of pH in determining the distribution patterns of myxomycetes. Our study yielded only a small number of common species that allow comparisons, but it does show that *Comatricha elegans* occurs on bark of significantly ($P<0.005$) lower pH (pH 5.1) than that on which *C. laxa* occurs (pH 5.8).

Our new records increase the number published records of corticolous myxomycetes known from Australia to at least 70. As the myxomycete flora of Australia is poorly known, it is likely that this number will increase as further surveys are undertaken.

Acknowledgements

These collections were made under collecting Permit Number 26800 issued by the Parks and Wildlife Commission of the Northern Territory. The senior author thanks Lindsay Bookie, the traditional owner of the land, for permission to collect on his land and the Australian Geographic Society for the opportunity to be part of the 9th Australian Geographic Society's Scientific Expedition to the Hay River region of the Northern Simpson Desert. We thank D. Albrecht and A. Duguid for identifying the plants. S. L. Stephenson is thanked for reviewing the manuscript.

References

Australian Bureau of Meteorology (2007). http://www.bom.gov.au/

Crocker, R.L. (1946). The Simpson Desert Expedition, 1939 - scientific reports: No. 8 – The soils and vegetation of the Simpson Desert and its borders. *Transactions of the Royal Society of South Australia* **70**, 235–258.

Eardley, C.M. (1946). The Simpson Desert Expedition, 1939 - scientific reports No. 7,

botany - Part 1: catalogue of plants. *Transactions of the Royal Society of South Australia* **70**, 145–175.

Flora of British Fungi (1969). Her Majesty's Stationery Office, Edinburgh.

Gibson, D.B. & Cole, J.R. (1988). A Biological Survey of the Northern Simpson Desert. Conservation Commission of the Northern Territory Technical Report no. 10, Alice Springs, Australia.

Index Fungorum (2008) http://www.indexfungorum.org/Names/Names.asp

Ing, B. (1999). *The Myxomycetes of Britain and Ireland*. The Richmond Publishing Company, Slough, UK.

Ing, B. & Spooner B.M. (1994). Myxomycetes from the Kimberley Region, Western Australia. *Botanical Journal of the Linnean Society* **116**, 71–76.

Jordan, C.C., Brims, M.H., Speijers, E.J. & Davison, E.M. (2006). Myxomycetes on the bark of *Banksia attenuata* and *B. menziesii* (Proteaceae). *Australian Journal of Botany* **54**, 357–365.

Keller, H.W. & Brooks, T.E. (1977). Corticolous myxomycetes VII: Contributions toward a monograph of *Licea*, five new species. *Mycologia* **69**, 667–684.

Madigan, C.T. (1945). The Simpson Desert Expedition, 1939 – Scientific reports. Introduction, narrative, physiography and meteorology. *Transactions of the Royal Society of South Australia* **69**, 118–139.

McHugh, R., Stephenson, S.L., Mitchell, D.W. & Brims, M.H. (2003). New records of Australian Myxomycota. *New Zealand Journal of Botany* **41**, 487–500.

Mitchell, D.W. (1995). The Myxomycota of Australia. *Nova Hedwigia* **60**, 269–295.

Mitchell, D.W. (2003). Myxomycete keys. CD-ROM privately published by the author.

Nannenga-Bremekamp, N.E. (1991) *A Guide to Temperate Myxomycetes*. Biopress Limited, Bristol, England.

Neubert, H., Nowotny, W. & Baumann, K. (2000) *Die Myxomyceten. Band 3 Stemonitales*. Karlheinz Baumann Verlag, Gomaringen.

Purdie, R. (1984). Land systems of the Simpson Desert region. Natural Resources Series No. 2, Division of Water and Land Resources, Institute of Biological Resources, CSIRO Australia.

Rosing, W.C., Mitchell, D.W. & Stephenson, S.L. (2007). Corticolous myxomycetes from Victoria. *Australasian Mycologist* **26**, 9–15.

Schnittler, M. & Novozhilov Y.K. (2000). Myxomycetes of the winter-cold desert in Western Kazakhstan. *Mycotaxon* **74**, 267–285.

Stephenson, S.L. (1989). Distribution and ecology of myxomycetes in temperate forests. II Patterns of occurrence on bark surface of living trees, leaf litter and dung. *Mycologia* **81**, 608–621.

Stephenson, S.L. (2003). *Myxomycetes of New Zealand*. Fungal Diversity Press, Hong Kong.

Stephenson, S.L., Moreno, G. & Singer, H. (2007). Notes on some nivicolous myxomycetes from Australia and New Zealand including the description of a new species of *Lamproderma*. *Österreichische Zeitschrift für Pilzkunde* **16**, 11–23.

Stephenson, S.L. & Stempen, H. (1994). *Myxomycetes: A Handbook of Slime Molds*. Timber Press, Portland, Oregon.

Whitney, K.D. (1980). The myxomycete genus *Echinostelium. Mycologia* **72**, 950–987.