

# Taxonomy and biodiversity of hysteriaceous ascomycetes in fynbos

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Received 17 March 2003, accepted in revised form 3 June 2003

Six hysteriaceous ascomycetes, *Gloniopsis praelonga*, *Glonium chambianum*, *G. compactum*, *G. lineare*, *G. pusillum*, and *Hysterium angustatum*, were commonly collected during a survey of saprobic microfungi occurring on leaf and twig litters of Proteaceae, or dead culms

of Restionaceae in the Fynbos of the Cape Floral Kingdom. Several new hosts are reported for these taxa, while additional data are presented as to their morphological variation, distribution and ecology.

## Introduction

The fynbos biome, which comprises 80% of the Cape Floral Kingdom in the south-western and southern Cape of South Africa, includes three vegetation types of which shrubs, the so-called 'Fynbos', are the most dominant. The biome is defined by moderate to high amounts of winter rain, a predominance of low to medium-height shrubs, nutrient poor soils and frequent fires (Cowling and Richardson 1995). The study on saprobic microfungi in Fynbos was initiated in 2000 and two families, monocotyledonous Restionaceae (restio) and dicotyledonous Proteaceae (protea), were chosen as host plants because of their high endemic ratios in the area, 94% and 96% respectively, accessibility, and tissue types favoured by saprobic fungi. During the course of this study several species of three genera of hysteriaceous fungi, *Gloniopsis* De Not., *Glonium* Muhl., and *Hysterium* Pers., were commonly encountered. The majority of these represent new records for South Africa, and are also reported on new host plants. Their morphological characteristics are described, and discussed in relation to their distribution patterns and ecology.

Hysteriaceous ascomycetes represent fungi having lirelliform ascomata, so-called hysterothecia, which are ellipsoid to elongate-shaped and open by means of longitudinal slits. The family Hysteriaceae accommodates some hysteriaceous fungi having ascomata that open by means of a longitudinal slit with two depressed flaps or lips. *Gloniopsis* and *Glonium* have hyaline dictyosporous and didymosporous ascospores respectively, whereas *Hysterium* has brown phragmosporous ascospores. Presently, approximately 524 names have been recorded in these three genera (<http://www.speciesfungorum.org/>). This large number of names, mostly generated during the 19<sup>th</sup> century, was the result of various workers trying to identify these fungi by means of macroscopic features of their ascomata, and sup-

posed host specificity. The chaotic status that ensued was settled when Zogg (1962) monographed these genera, and this still remains the only treatment of this family. He emphasised the colour, number of septa and size of ascospores as the main criteria for separating species and genera. In so doing he recognised seven genera in the Hysteriaceae: *Farlowiella*, *Gloniella*, *Gloniopsis*, *Glonium*, *Hysterium*, *Hysterocharina*, and *Hysterographium*. Luttrell (1973) followed Zogg's treatment in the subfamily Hysteroideae. Barr (1987) accepted five genera and concluded that the presence of hysterothecial ascomata was not a prerequisite of the Hysteriaceae, but rather the consistency of a three-layered peridium composed of small pseudoparenchymatous cells. In a later treatment Kirk *et al.* (2001) acknowledged 13 genera in the Hysteriaceae, while Eriksson (2001) recognised seven, considering a further three as doubtful. Since Zogg's monograph, several new species have been added to this complex, resulting in five species of *Gloniopsis* (Amano 1983, Lorenzo and Messuti 1998), 19 species of *Glonium* (Amano 1983, Sivanesan and Sutton 1985, Speer 1986, Lorenzo and Messuti 1998), and 20 of *Hysterium* (Tilak 1963, Tilak and Rao 1965, 1966, Farr 1973, Messuti and Lorenzo 1997). Although several species of Hysteriaceae have been reported from woody substrates in South Africa by Van der Linde (1992), we were curious to know if the taxa occurring on endemic Proteaceae and Restionaceae would represent common species, or be unique to Fynbos, and whether there was any indication of host and tissue specificity among them.

## Materials and Methods

Nature reserves and undisturbed areas of the Fynbos in the Western Cape province of South Africa were visited over a

3-year period (2000–2002). Dead leaves, twigs, and old flowerheads of proteas or dead culms of restios were collected from the beds or from the standing plants. The samples were inspected immediately for fungal structures, and air-dried for later study. Air-dried samples were incubated in moisture chambers for 2–3 days before examination. Single spore colonies were established on 5% malt extract agar (MEA; Biolab, Midrand, Johannesburg), supplemented with 0.04g l<sup>-1</sup> streptomycin sulphate. Cultural characteristics were rated for each isolate in triplicate from MEA plates after 15–30d of incubation at 25°C in the dark, and colours determined according to Rayner (1970). Microscopic observations, measurements and photography of characteristic structures were made from structures mounted in lactophenol. The 95% confidence intervals were derived from 30 observations wherever possible to determine the range of variation in size of structures, with the extremes given in parentheses. Sections of ascomata were made on a Leica CM1100 Cryostat microtome, mounted with Jung tissue freezing medium™ (Leica Instruments, Germany). Photographic images were captured with a Nikon Digital Camera DXM 1200 on a Nikon Eclipse E600 light microscope or a Nikon SMZ800 dissecting microscope. Herbarium specimens are lodged at PREM (National Collection of Fungi, Pretoria) and reference cultures are maintained in the culture collection of the Centraalbureau voor Schimmelcultures (CBS) in the Netherlands.

## Results

A total of six hysteriaceous species were recovered from Fynbos: *Gloniopsis praelonga*, comprising 34 collections from 12 plant genera; *Glonium*, with 21 collections representing four species (*G. chambianum*, *G. compactum*, *G. lineare*, *G. pusillum*) on 11 host genera, and *Hysterium angustatum*, comprising eight collections on six host genera. All species represent new records for South Africa, except *G. praelonga*. Furthermore, new host plants are also documented for each fungal species. The morphological variation occurring in each taxon is described below.

*Gloniopsis praelonga* (Schwein.) H. Zogg., Beitr. Kryptogamenflora Schweiz 11: 50 1962.

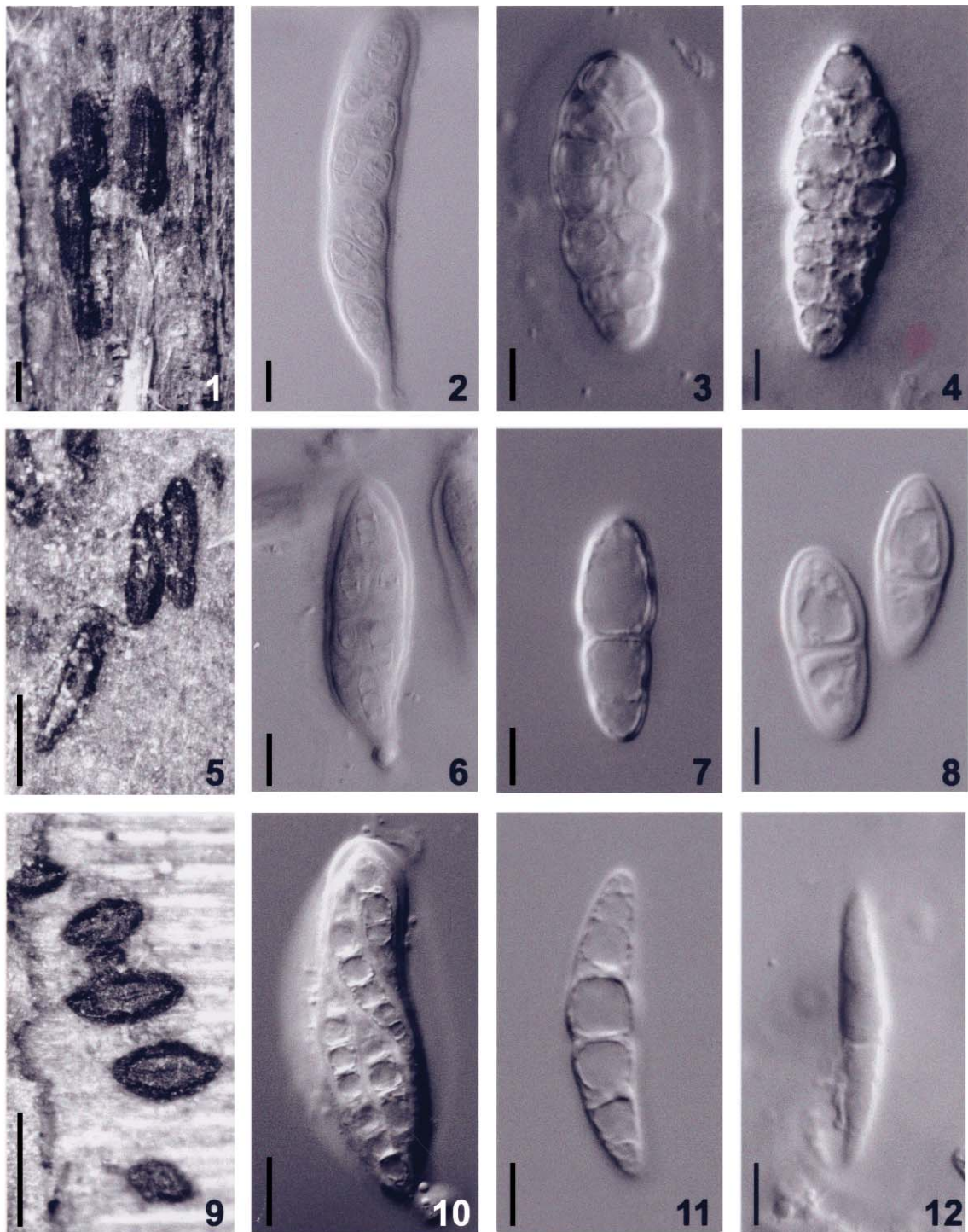
Figures 1–4, 25.

Ascomata hysterothecoid, globose to subglobose in vertical section, solitary to gregarious, erumpent to superficial with base immersed, straight to flexuous, simple to rarely branched, ellipsoid or elongated with blunt to pointed extremes, opening by a depressed longitudinal slit, 0.1–0.9mm long, 0.3–0.4mm wide, 0.1–0.2mm high (Figures 1, 25). Peridium consisting of three layers, up to 70µm in diameter, pseudoparenchymatous, outer layer dark, carbonaceous, inner layer hyaline, compressed, middle layer consisting of 1–2 rows of thick-walled, brown cells between outer and inner layers (Figure 25). Pseudoparaphyses cellular, hyaline, septate, flexuous, branched, numerous, 0.5–1.5µm wide. Asci bitunicate, cylindrical to clavate, stipitate, octosporous, 95–113 x 15–20µm (Figure 2). Ascospores (23–)25–26(–30) x (9–)10–11(–13)µm (Mean 25.5 x 10.7µm), ellipsoid, hyaline to yellowish, with 5–7

transverse septa and 1–2 longitudinal septa, slightly constricted at the transverse septa, with a gelatinous sheath (Figure 3). The description is based on PREM57535.

Specimens examined: SOUTH AFRICA, Western Cape province: Albertyne, dead twigs of *Protea susanne*, 3 Feb. 2001, S. Lee SL498 (PREM57526); Betty's Bay, dead twigs of *Leucospermum* sp., 26 Jun. 2000, S. Lee SL621 (PREM57527); dead leaves of *Protea magnifica*, 11 Jul. 2000, S. Lee SL321 (PREM57528); dead twigs of *Protea speciosa*, 11 Jul. 2000, S. Lee SL298 (PREM57529); Cape Point National Park, dead culms of *Elegia vaginulata*, 4 Dec. 2001, S. Lee SL962 (PREM57530); dead culms of *Hypodiscus* sp., 4 Dec. 2001, S. Lee SL1178 (PREM57531); De Hoop Nature Reserve, dead culms of *Restio quadratus*, 28 Feb. 2002, A. Wood SL1091 (PREM57532, CBS112417); Gordon's Bay, dead twigs of *Leucadendron laeolium*, 26 Jun. 2000, S. Lee SL576 (PREM57533); dead twigs of *Protea nerifolia*, 26 Jun. 2000, S. Lee SL174 (PREM57534); Helderberg Nature Reserve, dead twigs of *Leucadendron* sp., 14 Aug. 2000, S. Lee SL176 (PREM57535); dead twigs of *Protea cynaroides*, 14 Aug. 2000, S. Lee SL207 (PREM57536); dead twigs of *Protea laurifolia*, 14 Aug. 2000, S. Lee SL238 (PREM57537); dead flowerheads and twigs of *Protea repens*, 14 Aug. 2000, S. Lee SL191 (PREM57538); Jonkershoek Nature Reserve, dead flowerheads of *Leucadendron rubrum*, 6 Jun. 2000, S. Lee SL131 (PREM57539); dead twig of *Leucadendron salignum*, 6 Jun. 2000, S. Lee SL105 (PREM57540, CBS112418); dead twig of *Protea repens*, 14 Aug. 2000, S. Lee SL244 (PREM57541); dead twigs of *Protea nitida*, 14 Aug. 2000, S. Lee SL270 (PREM57542); dead culms of *Ischyrolepis subverticella*, 5 Apr. 2001, S. Lee SL673 (PREM57543); dead culms of unknown restio, 15 Jun. 2001, S. Lee SL826 (PREM57544); dead culms of *Ischyrolepis* cf. *gaudichaudiana*, 31 Jul. 2001, S. Lee SL859 (PREM57545); Kirstenbosch National Botanical Garden, dead culm of *Ischyrolepis subverticellata*, 3 Dec. 2001, S. Lee SL999 (PREM57546); dead culms of *Restio dispar*, 3 Dec. 2001, S. Lee SL972 (PREM57547, CBS112416); dead culms of *Thamnochortus spicigerus*, 3 Dec. 2001, S. Lee SL909 (PREM57548); dead culms of *Rhodocoma capensis*, 3 Dec. 2001, S. Lee SL1063 (PREM57549); Kleinmond, dead twigs of *Protea compacta*, 11 Jul. 2000, S. Lee SL305 (PREM57550); Kogelberg Nature Reserve, dead twigs of *Brabejum stellatifolium*, 3 Nov. 2000, S. Lee SL343 (PREM57551); dead flowerheads of *Leucadendron* sp., 3 Nov. 2000, S. Lee SL442 (PREM57552); dead twigs and flowerheads of *Leucadendron xanthoconus*, 3 Nov. 2000, S. Lee SL405 (PREM57553); dead flowerheads of *Protea lepidocarpodendron*, 3 Nov. 2000, S. Lee SL369 (PREM57554); dead culms of *Restio egregious*, 11 May 2001, S. Lee SL694 (PREM57555); dead culms of *Restio triticeus*, 11 May 2001, S. Lee SL722 (PREM57556); dead culms of unknown restio, 11 May 2001, S. Lee SL643 (PREM57557); dead culms of *Staberoha distachyos*, 11 May 2001, S. Lee SL699 (PREM57558, CBS112415); University of Stellenbosch Botanical Garden, dead culms of *Elegia capensis*, 4 Jun. 2002, S. Lee SL1191 (PREM57559).

Cultural characteristics: Colonies sterile, 22mm in diameter on MEA after 15d at 25°C in the dark, circular with an



**Figures 1–12:** (1–3) *Gloniopsis praelonga* (PREM57535). (4) *Gloniopsis praelonga* (PREM57557). (5–7) *Glonium chambianum* (PREM57562). (8) *Glonium chambianum* (PREM57560). (9–12) *Glonium compactum* (PREM57570). 1, 5, 9 Hysterothecia on the host surface. 2, 6, 10 Asci. 3 Ascospore with a gelatinous sheath. 4 Ascospore without a sheath. 7, 8, 11, 12 Ascospores. Scale bars: 1, 5, 9 = 0.5mm; 2, 6, 10 = 10µm; 3, 4, 7, 8, 11, 12 = 5µm



entire margin, raised, pale olivaceous grey (21''''d) above, reverse smoke grey (21''''f), velvety. Aerial mycelium dense.

Notes: Although not on Proteaceae, *Gloniopsis praelonga* has previously been recorded from South Africa (Van der Linde 1992), namely on wood of *Acacia* spp. The morphology of this species appears to be relatively uniform between different collections. Observations made from various isolates revealed, however, that the gelatinous sheaths of ascospores varied between different collections. Ascospores of some collections were clothed with a gelatinous sheath (PREM57535, PREM57536, PREM57537, PREM57528), whereas the majority of collections lacked gelatinous sheaths (Figure 4, PREM57557). Ascospore dimensions of the various collections varied from narrower (20–24 x 8–10µm in PREM57530) to wider (25–38 x 8–13µm in PREM57534), but all fell into the range (16–34 x 6–15µm) of Zogg's description for the species (Zogg 1962). The presence of three distinct layered peridium emphasised by Barr (1987) for recognition of members of Hysteriaceae was not commonly observed. However, a middle layer of 1–2 cells thick was found between the outer and inner layers.

*Glonium chambianum* A. L. Guyot, Ann. Serv. Bot. et Agr. Tunisie 28: 90 1955.

Figures 5–8, 27.

Ascomata hysterothecoid, subglobose to globose in vertical section, solitary to gregarious, erumpent to superficial with base immersed, straight to flexuous, simple to rarely branched, ellipsoid with blunt extremes, opening by a depressed longitudinal slit, 0.4–0.6mm long, 0.1–0.2mm wide, 0.1–0.2mm high (Figures 5, 27). Peridium consisting of two layers, up to 40µm in diameter, carbonaceous, outer layer dark, inner layer hyaline, compressed (Figure 27). Pseudoparaphyses cellular, hyaline, septate, flexuous, branched, 0.5–1.5µm wide. Asci bitunicate, cylindrical to clavate, stipitate, octosporous, biseriolate, 73–88 x 13–18µm (Figure 6). Ascospores (18–)20–21(–23) x (4–)5–6(–7)µm (Mean 20.4 x 5.5µm), ellipsoid to oblong, with upper cell often broader, hyaline, with one transverse septum, slightly constricted at the septum (Figures 7, 8). The description is based on PREM57562.

Specimens examined: SOUTH AFRICA, Western Cape province: Albertyne, dead flowerheads of *Protea susanne*, 3 Feb. 2001, S. Lee SL496 (PREM57560); Cape Point National Park, dead twig of *Leucospermum praecox*, 23 Feb. 2001, S. Lee SL508 (PREM57561); Kogelberg Nature Reserve, dead culms of unknown restio, 11 May 2001, S. Lee SL647 (PREM57562, CBS112414).

Cultural characteristics: Colonies sterile, 10mm in diameter on MEA after 30d at 25°C in dark, circular with entire margin, raised, above pale olivaceous grey (21''''d), reverse iron grey (23''''k), velvety. Aerial mycelium dense.

Notes: The first record of this species was from northern Africa on dead twigs of *Lonicera implexa* Soland (Caprifoliaceae, dicotyledon). The spore dimensions of *Lonicera* specimen (14–21 x 6–10µm) are slightly larger than those of PREM57560 (15–20 x 5–7µm), and almost identical to those of PREM57561 (15–23 x 6–9µm) (Zogg 1962). The species is similar to *G. lineare* but the ascospores of *G. chambianum* are bigger than those of *G. lineare* (10–18 x 4–8µm).

*Glonium compactum* H. Kern, Ber. Schweiz. Bot. Ges. 69: 277 1959.

Figures 9–12, 28.

Ascomata hysterothecoid, subglobose to globose in vertical section, solitary to gregarious, immersed, straight to flexuous, rarely branched, ellipsoidal with pointed extremes, opening by a depressed longitudinal slit, 0.3–0.6mm long, 0.2–0.3mm wide, 0.1–0.2mm high (Figures 9, 28). Peridium consisting of two layers, up to 50µm in diameter, pseudoparenchymatous, carbonaceous, outer layer dark, inner layer hyaline, compressed (Figure 28). Pseudoparaphyses cellular, hyaline, septate, flexuous, branched, 0.5–1.5µm wide. Asci bitunicate, clavate, stipitate, octosporous, 65–69 x 12–15µm (Figure 10). Ascospores (24–)26–27 (–30) x (4–)5–6(–7)µm (Mean 26.5 x 5.5µm), fusiform, often curved, hyaline, with one transverse septum, slightly constricted at the septum (Figures 11, 12). The description is based on PREM57570.

Specimens examined: SOUTH AFRICA, Western Cape province: Cape Point National Park, dead culms of *Thamnochortus erectus*, 4 Dec. 2001, S. Lee SL1029 (PREM57563); Helderberg Nature Reserve, dead culms of *Elegia capensis*, 13 Apr. 2002, S. Lee SL1128 (PREM57564); J. S. Marais Nature Reserve, dead culms of *Thamnochortus* cf. *insignis*, 31 Jul. 2002, S. Lee SL1218 (PREM57565); Jonkershoek Nature Reserve, dead culms of *Cannomois virgata*, 15 Jun. 2001, S. Lee SL735 (PREM57566); Kirstenbosch National Botanical Garden, dead culms of *Elegia equisetacea*, 3 Dec. 2001, S. Lee SL930 (PREM57567); dead culms of *Restio dispar*, 3 Dec. 2001, S. Lee SL974 (PREM57568); dead culms of *Ischyrolepis subverticellata*, 3 Dec. 2001, S. Lee SL1001 (PREM57569); dead culms of *Rhodocoma capensis*, 3 Dec. 2001, S. Lee SL1063 (PREM57570, CBS112412); University of Stellenbosch Botanical Garden, dead culms of *Chondropetalum tectorum*, 4 Jun. 2002, S. Lee SL1209 (PREM57571, CBS112413); dead culms of *Ischyrolepis subverticellata*, 4 Jun. 2002, S. Lee SL1143 (PREM57572).

Cultural characteristics: Colonies sterile, 14.2mm in diameter on MEA after 30d at 25°C in the dark, circular with an entire margin, raised, olivaceous grey (21''''i) above, reverse iron grey (23''''k), velvety. Aerial mycelium dense.

Notes: The first record of the species from Africa was on *Strychnos aculeata* Solered. (Loganiaceae, a dicotyledon), a host on which it was rarely encountered (Zogg 1962). This species differs from most *Glonium* species, which have erumpent to almost superficial ascomata with immersed bases, by having ascomata that are deeply imbedded in the host substratum (Figure 28). The present species was the most common *Glonium* species encountered during the survey of Fynbos, and was collected from monocotyledonous restios only. *Restio* species have larger ascospore dimensions than those of the *Strychnos* species (24–28 x 5–6µm), but smaller asci than those of the *Strychnos* species (90–130 x 8–13µm).

*Glonium lineare* (Fr.) De Not., Giorn. Bot. Ital. 2: 27 1847.

Figures 13–16, 26.

Ascomata hysterothecoid, solitary to gregarious, almost rectangular in vertical section, erumpent to superficial, straight to flexuous, ellipsoidal with blunt to pointed

extremes, opening by a depressed longitudinal slit, 0.2–0.4mm long, 0.1–0.2mm wide, up to 0.1mm high (Figures 13, 26). Peridium consisting of three layers, up to 12.5µm in diameter, pseudoparenchymatous, carbonaceous, outer layer dark, present only in sides and top, inner layer hyaline, compressed, middle layer consisting of 1–2 rows of thick-walled, brown cells between outer and inner layers at sides and 3–4 rows at the bottom (Figure 26). Pseudoparaphyses cellular, hyaline, septate, flexuous, branched, 1.5–2.5µm wide. Asci bitunicate, cylindric to clavate, stipitate, octosporous, 43–55 x 9–13µm (Figure 14). Ascospores (12–)13–14(–15) x (4–)5µm (Mean 13.5 x 4.7µm), ellipsoid with upper cell often broader, hyaline, with 1 transverse septum (Figures 15, 16).

Specimens examined: SOUTH AFRICA, Western Cape province: J. S. Marais Nature Reserve, dead leaves of *Protea magnifica*, 26 Jun. 2000, S. Lee SL151 (PREM57573).

Notes: This species is known worldwide from various dicotyledonous plants (Zogg 1962). Ascumata were so small that the typical hysterothecoid character was not easily recognised, while this was not the case for the other hysterothecoid fungi reported on in this study (Figure 26). The carbonaceous, dark outer layer was absent at the bottom of the ascumatal peridium. This resulted in the middle layer expanding, consisting of up to 3–4 thick-walled cells. *G. lineare* represents one of a few species collected from dead leaves of proteas.

*Glonium pusillum* H. Zogg, Beitr. Kryptogamenflora Schweiz 11: 62 1962.

Figures 17–20, 29.

Ascumata hysterothecoid, subglobose to globose in vertical section, solitary to gregarious, erumpent to superficial with base immersed, straight to flexuous, ellipsoidal with pointed extremes, opening by a depressed longitudinal slit, 0.2–0.3mm long, 0.1–0.2mm wide, up to 0.1mm high (Figures 17, 29). Peridium consisting of three layers, up to 17.5µm in diameter, pseudoparenchymatous, carbonaceous, outer layer dark, inner layer hyaline, compressed, middle layer consisting of 1–2 rows of thick-walled, brown cells (Figure 29). Pseudoparaphyses cellular, hyaline, septate, flexuous, branched, 1.5–2µm wide. Asci bitunicate, cylindric to claviform, stipitate, octosporous, 33–48 x 8–11µm (Figure 18). Ascospores (9–)11–12(–13) x 4–5µm (Mean 11.3 x 4.6µm), ellipsoid, with upper cell often larger, hyaline, with 1 transverse septum (Figures 19, 20). The description is based on PREM57574.

Specimens examined: SOUTH AFRICA, Western Cape province: Betty's Bay, dead leaves and twigs of *Protea magnifica*, 11 Jul. 2000, S. Lee SL323 (PREM57574); Jonkershoek Nature Reserve, dead twig of *Leucadendron salignum*, 6 Jun. 2000, S. Lee SL164 (PREM57575); dead culms of *Ischyrolepis* cf. *gaudichaudiana*, 15 Jun. 2001, S. Lee SL831 (PREM57576); dead culms of *Restio* cf. *confusus*, 15 Jun. 2001, S. Lee SL797 (PREM57577); dead culm of unknown restio, 15 Apr. 2001, S. Lee SL687 (PREM57578); Kleinmond Nature Reserve, dead leaves of *Mimetes cuculatos*, 11 Jul. 2000, S. Lee SL550 (PREM57579); Kogelberg Nature Reserve, dead flower-

heads of *Leucadendron xanthoconus*, 3 Nov. 2000, S. Lee SL409 (PREM57580).

Notes: Zogg (1962) first described this species from juniper and pine collected in Europe. An additional record was made from Taiwan by Sivanesan and Hsieh (1989). The asci in the original description (26–35 x 10–12µm) are smaller than in our collections, but the ascospore dimensions (9–13 x 4–6µm) are similar. This species is similar to *G. lineare* in ascospore shape and its small ascumata, but differs in ascospore dimensions (10–18 x 4–8µm).

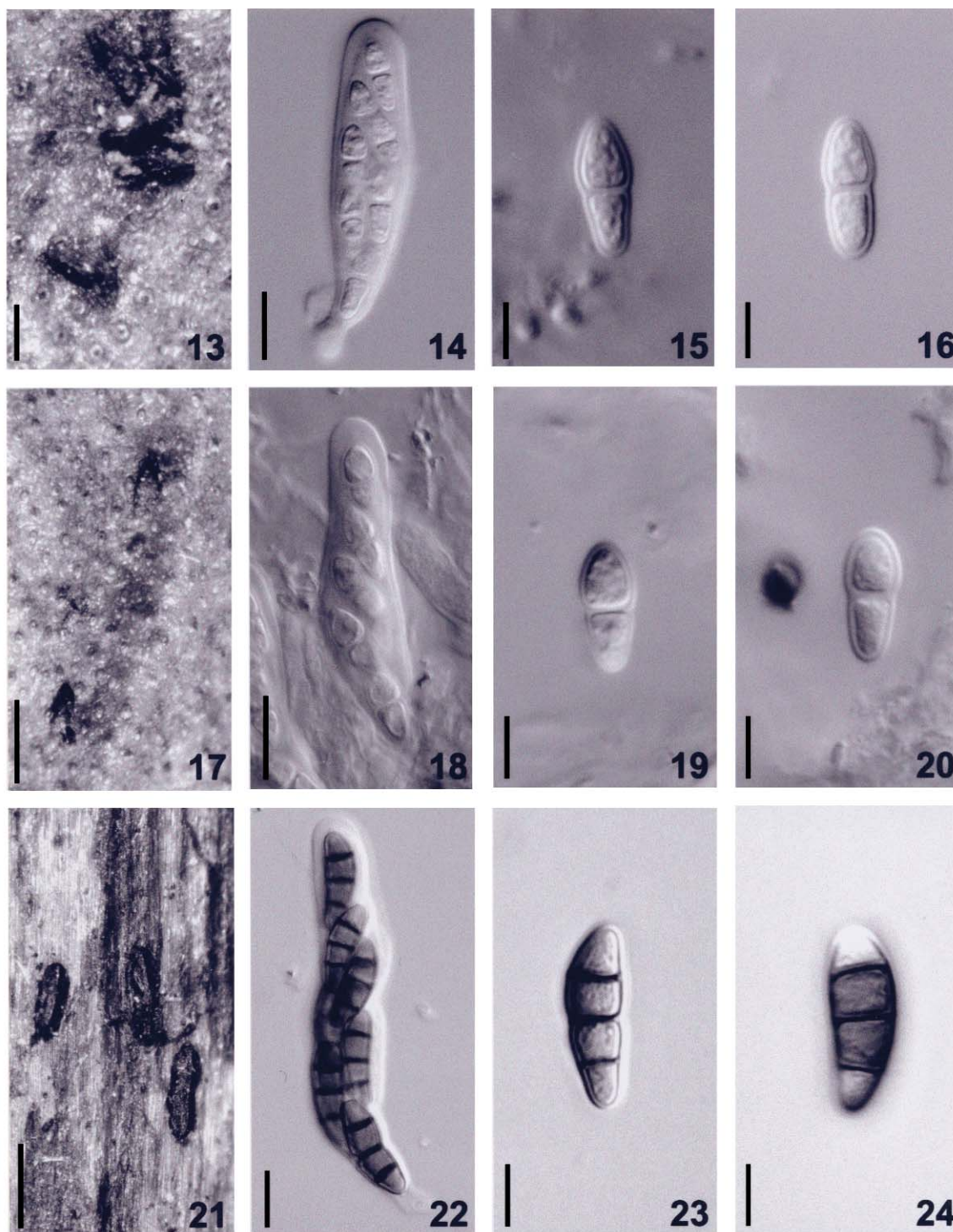
*Hysterium angustatum* Alb. & Schwein., Consp. fung. lusat.: 55 1805.

Figures 21–24, 30.

Ascumata hysterothecoid, subglobose to globose in vertical section, solitary to gregarious, erumpent to superficial with base immersed, straight to flexuous, ellipsoid or elongated with pointed extremes, opening by a depressed longitudinal slit, 0.4–0.6mm long, 0.1–0.2mm wide, 0.1–0.2mm high (Figures 21, 30). Peridium consisting of three layers, up to 25µm in diameter, carbonaceous, outer layer dark, inner layer hyaline, compressed, middle layer consisting of 1–2 rows of thick-walled, brown cells (Figure 30). Pseudoparaphyses cellular, hyaline, septate, flexuous, branched, 1–2µm wide. Asci bitunicate, cylindric to claviform, stipitate, octosporous, biseriata, 63–87 x 8–10µm (Figure 22). Ascospores (14–)16(–18) x (4–)5(–6)µm (Mean 16 x 5µm), ellipsoid, slightly curved, light brown, the end cells are rarely paler than the centre cells, biseriata, with 3 transverse septa, often slightly constricted at medium septum (Figures 23, 24). The description is based on the isolate PREM57585.

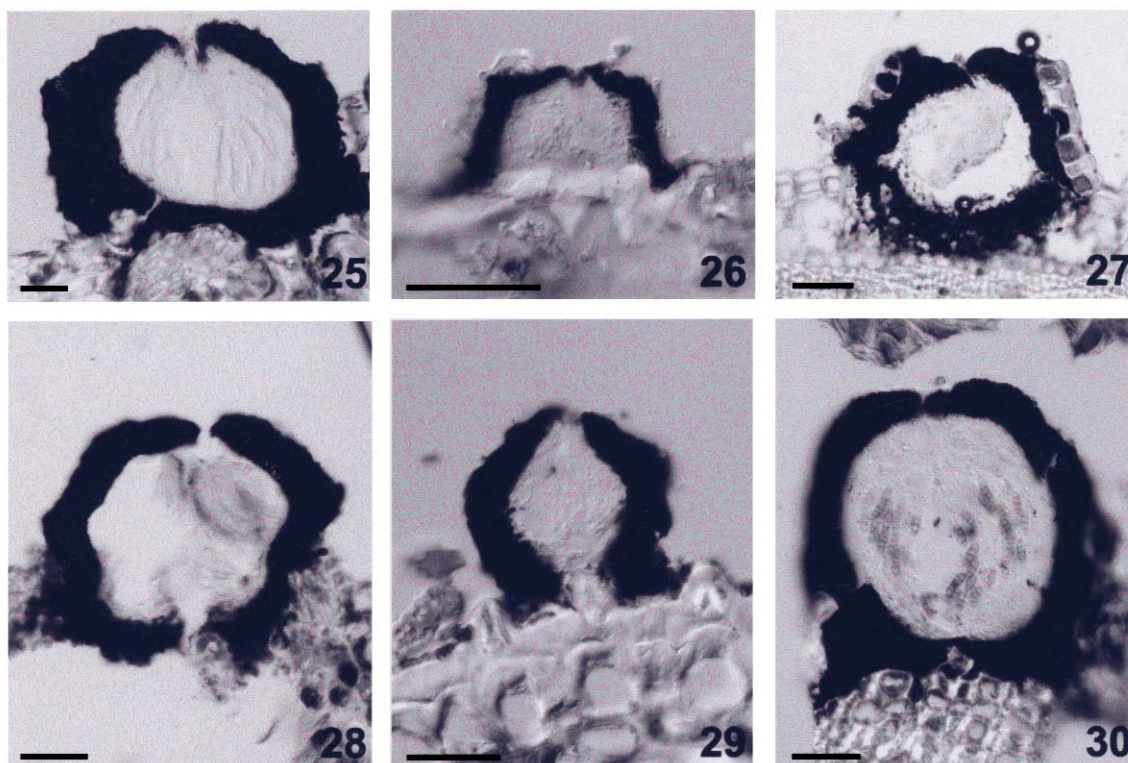
Specimens examined: SOUTH AFRICA, Western Cape province: Albertyne, dead flowerheads of *Protea susanne*, 3 Feb. 2001, S. Lee SL499 (PREM57581); Betty's Bay, dead twigs of *Leucadendron laureolum*, 26 Jun. 2000, S. Lee SL626 (PREM57582); dead twig of *Protea magnifica*, 11 Jul. 2000, S. Lee SL320 (PREM57583); Cape Point National Park, dead twigs of *Leucospermum praecox*, 23 Feb. 2001, S. Lee SL510 (PREM57584); Kleinmond, dead twigs of *Protea cynaroides*, 11 Jul. 2000, S. Lee SL299 (PREM57585); Kogelberg Nature Reserve, dead twigs of *Brabejum stellatifolium*, 3 Nov. 2000, S. Lee SL343 (PREM57586); dead culms of unknown restio, 11 May 2001, S. Lee SL642 (PREM57587); University of Stellenbosch Botanical Garden, dead culms of *Chondropetalum tectorum*, 4 Jun. 2002, S. Lee SL1195 (PREM57588).

Notes: This species has a worldwide distribution, and is known from numerous host plants (Zogg 1962). The chief generic feature of *Hysterium* species is their pigmented phragmospores. Approximately 20 species have thus far been described. Specific differentiation of *Hysterium* is mainly based on ascospore morphology, size and the number of septa. Since septal numbers vary within a species, averages and extremes are taken into consideration. Approximately half of the *Hysterium* species produce 4-celled ascospores. All of them have concolorous ascospores, except for *H. pullicare*, which has versicolorous ascospores with darker median cells and pale end cells. Observations of the present collections, however, revealed a mixture of concolorous and



**Figures 13–24:** (13–16) *Glonium lineare* (PREM57573). (17–20) *Glonium pusillum* (PREM57574). (21–24) *Hysterium angustatum* (PREM57585). 13, 17, 21. Hysterothecia on the host surface. 14, 18, 22. Asci. 15, 16, 19, 20, 23, 24. Ascospores. Scale bars: 3, 17, 21 = 0.5mm; 14, 18, 22 = 10µm; 15, 16, 19, 20, 23, 24 = 5µm





**Figures 25–30:** (25) *Gloniopsis praelonga* (PREM57535). (26) *Glonium lineare* (PREM57573). (27) *Glonium chambianum* (PREM57562). (28) *Glonium compactum* (PREM57570). (29) *Glonium pusillum* (PREM57574). (30) *Hysterium angustatum* (PREM57585). 25–30 Sections of ascomata. Scale bars: 50µm

versicolorous ascospores. The majority of ascospores were concolorous, with less than 5% being versicolorous in a single ascoma (Figure 24).

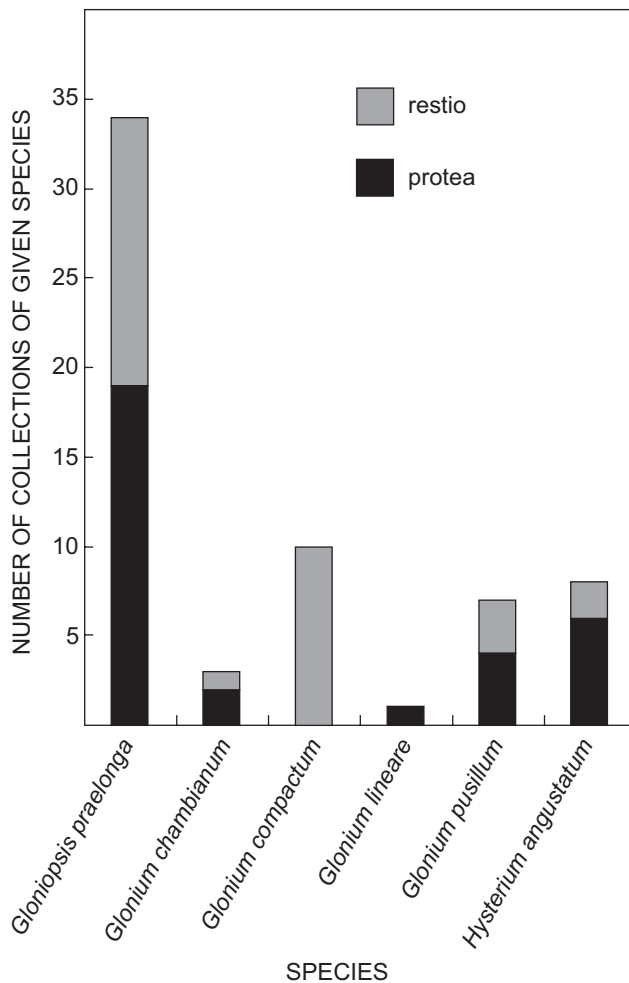
## Discussion

Until recently, the Hysteriaceae were only known to be represented in South Africa by 12 species from five different genera (Van der Linde 1992). Most of these collections were obtained from dead woody substrates, and are represented in the National Collection of Fungi (PREM) in Pretoria as *Gloniella bambusae*, *Gloniopsis praelonga*, *Glonium abbreviatum*, *Hysteroglyphium acaciae*, *H. flexuosum*, *H. fraxini*, *H. mori*, *H. spinicolum*, *H. subrugosum*, *Hysterium insidens*, *H. sinense* and *H. velloziae*.

A total of 63 hysteriaceous fungi was collected during the present survey, which is approximately 12.5% of the total number of ascomycetes collected. The Hysteriaceae was the most commonly collected family next to the Lophiostomataceae. Previous data generated from this survey revealed the presence of unique and novel fungal species occurring only in Fynbos (Lee and Crous 2003a, 2003b, 2003c, Lee *et al.* 2003). Although no new hysteriaceous ascomycetes were found on endemic Proteaceae and Restionaceae, the majority of the taxa collected proved to be new records for South Africa when compared to data by Van der Linde (1992).

Of all the members of the Hysteriaceae collected, *Gloniopsis praelonga* was the species most commonly encountered. This taxon occurred on twigs of Proteaceae and culms of Restionaceae in most areas sampled. The genus *Glonium* was the second most frequently collected, and showed the highest specific diversity (Figure 31). Three collections of *Glonium chambianum*, a species recorded as rare in northern Africa (Zogg 1962), were made from three localities set far apart from one another. Host-exclusivity, coined by Zhou and Hyde (2001), namely the unique occurrence of a saprobic fungus on a restricted range of related host plants, was observed for *Glonium compactum* from the collections made during the survey. Of the two host types investigated, this species was only ever found on restios, and then only in areas where some degree of disturbance was observed. *Glonium lineare*, considered to be a cosmopolitan species on various substrates (Zogg 1962), was found only once on dead leaves of *Protea*, whereas *G. pusillum*, considered rather a rare species by Zogg (1962), was more frequently collected from both proteas and restios.

Hysteriaceous fungi with darkly pigmented ascospores such as *Hysterium* and *Hysteroglyphium* were found less commonly in Fynbos. *Hysteroglyphium*, of which six species were reported from the eastern and south-eastern region of South Africa (Van der Linde 1992), was not found during this investigation, while *Hysterium*, represented by *H. angustatum*, was collected on nine separate occasions. The present



**Figure 31:** Hysteriaceae ascomycetes collected from proteas and restios

study was conducted on limited host plants in a restricted area, namely Fynbos, located in the southern and south-western Cape of South Africa. Taking into account that South Africa has seven plant biomes of different vegetation and climate, ranging from Fynbos to grassland, desert and forest, a more comprehensive collection on other host plants in Fynbos or a collection from different areas may produce a better understanding of the distribution patterns of hysteriaceae fungi throughout the country.

Fynbos burns at frequencies of between five years to 40 years, with an average fire-free interval of about 12 years to 15 years (Cowling and Richardson 1995). Fire is known to be a keystone factor in the long-term survival of Fynbos. Some woody plants like proteas survive fires, but reed-like restios are usually burnt to ashes. As fires affect the whole ecosystem at various levels in the community (Richardson and Van Wilgen 1992), fires may have a great influence on the distribution of saprobic fungi in the area. A study on post-fire soil populations of fungi and bacteria showed short-lived declines of microbial populations immediately after fires, but rapid subsequent recovery (Van Reenen *et al.* 1992). Unfortunately, no information is available of the ecology of

lignicolous or follicolous saprobic fungi in Fynbos after fire. The mycota may be renewed after each fire, in which situation inocula may be supplied from nearby. It is possible, however, that some of these fungi have managed to survive fires by specific adaptation to host plants or the ecosystem. Johnson (1992) stated the fire-prone Fynbos is unsuitable for obligate mutualisms, since the extinction of one species could mean the extinction of the other. However, this is not applicable to the majority of saprobic fungi, as they are predominantly assumed to be non-host specific. A study of the succession of saprobic fungi in burned areas is needed to bring more understanding of post-fire ecology of the Fynbos mycota. In areas in Fynbos where fires have recently occurred (Jonkershoek Nature Reserve), *Gloniopsis praelonga* was infrequently found on burnt twig litter of proteas. This was in contrast, however, to members of *Glonium* and *Hysterium*, which were found to be absent.

**Acknowledgements** — The authors are thankful to the Western Cape Nature Conservation Board for permission to collect indigenous plants. The officers at Kogelberg Nature Reserve, Jonkershoek Nature Reserve, Cape Point National Park, Kirstenbosch National Botanical Garden, and University of Stellenbosch Botanical Garden are also thanked for help during field trips.

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