

The genus *Cyrtomium* (Pteridophyta: Dryopteridaceae) in Africa and Madagascar

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Suggested running head: *Cyrtomium* in Africa and Madagascar

Abstract

The fern genus *Cyrtomium* (Dryopteridaceae) in Africa and Madagascar is reviewed. Until now a single *Cyrtomium* species ascribed to either *C. caryotideum* or *C. micropterum* (the latter often considered a variety of the former) was recognised for the region. This study shows that three *Cyrtomium* species occur in the region. One species, *C. falcatum*, is not native to the African or Madagascan region, but it has become naturalised in various parts of South Africa and Réunion. Two species formerly considered as a single taxon and confused with *C. caryotideum* and Indian forms thereof, are described as new – *C. luctuosum* from Madagascar, East-, West- and South Africa and *C. pseudocaryotideum* from South Africa.

ADDITIONAL KEY WORDS: morphology – new species

INTRODUCTION

There is little consensus as to the number of species in the genus *Cyrtomium* C.Presl, with as few as nine (Christensen, 1930) or as many as 60 (Shing, 1965) taxa having been recognised, depending on species concepts. Presl (1836) based *Cyrtomium* on *Polypodium falcatum* L.f. [*Cyrtomium falcatum* (L.f.) C.Presl] and included only one further species – *C. caryotideum* (Wall. ex Hook. & Grev.) C.Presl – in the genus. The defining features of the genus are 1-pinnate laminae where the terminal pinna nearly conforms to the

lateral pinnae, reticulate venation with included veinlets in the larger areolae, circular sori with peltate indusia, and ellipsoidal, monolete spores with the perispore folded to form large inflated tubercles.

As with species concepts, there are also differences of opinion as to the recognition of *Cyrtomium* as a distinct genus. John Smith (1875) and Tryon and Tryon (1982) recognised *Cyrtomium*, but they incorporated the neotropic genus *Phanerophlebia* C.Presl (incl. *Amblia* C.Presl) in it. Contrary to this, Copeland (1947), Tardieu-Blot (1953, 1958, 1964) and Lovis (1977) treated *Cyrtomium* as a synonym of *Phanerophlebia*. Smith (1875) remarked on the obvious close affinity of these genera with *Polystichum* Roth and Diels (1899), Christensen (1905), and Kramer (1990) incorporated *Cyrtomium* and *Phanerophlebia* into *Polystichum*. Supported by molecular evidence, *Cyrtomium*, *Phanerophlebia* and *Polystichum* are currently accepted as distinct genera (Smith *et al.*, 2006; Christenhusz *et al.*, 2011).

Yatskievych *et al.* (1988) suggested that *Cyrtomium* and *Phanerophlebia* originated from different progenitor groups in *Polystichum*, and that *Cyrtomium* is genetically more similar to temperate New World *Polystichum* than to *Phanerophlebia*. Lu *et al.* (2005), however, demonstrated that *Cyrtomium* is monophyletic only when species ascribed to subseries *Balansana* Ching & Shing (*C. balansae* (Christ) C.Chr., *C. uniseriale* Ching and *C. hookerianum* (C.Presl) C.Chr.) are excluded from the genus. These species all have pinnatifid lamina apices and one or two rows of sori (Shing, 1965) while the remaining *Cyrtomium* species all have 1-pinnate laminae with a subconform lamina apex, and several rows of sori. Lu *et al.* (2005) suggest that these taxa be included in *Cyrtogonellum* Ching rather than *Cyrtomium*.

The centre of distribution for *Cyrtomium* is chiefly East Asia: species are known from Hawai'i, Japan and Taiwan to South-western China, the Sino-Himalayan region as far west as Nepal, southern India, Madagascar, and east and southern Africa, with an outlying location in Cameroon.

Cyrtomium is now widely accepted as a distinct genus and its affinity to the polystichoid ferns within Dryopteridaceae is well supported (Little & Barrington 2003; Liu *et al.* 2007). A large number of new *Cyrtomium* species, especially from central Asia, was described during the latter part of the 20th century

and concerns have been raised as to how many of these are synonymous. There is, however, no critical review of *Cyrtomium* and its segregate genera of the polystichoid assemblage, nor are there any studies demonstrating an acceptable generic and/or species phylogeny.

Aware of the morphological diversity within *Cyrtomium* and the biogeographic links between Africa and Asia, I studied accessible herbarium collections and undertook broad literature studies to establish the identity of the taxa discussed here. Following Christensen (1930), authors have all viewed native African and Madagascan *Cyrtomium* as a single taxon and as a variety of *C. caryotideum*, a taxon occurring from Japan to India. This study demonstrates the existence of two native and one naturalised *Cyrtomium* species in this region. The native species are not considered to be *C. caryotideum* or variations thereof. Since no names are available for the native taxa they are here described anew.

MATERIAL AND METHODS

This review is based on herbarium collections, field observations and bibliographic information. Collections of the following herbaria were studied: BOL, GRA, K, NBG, NU, PRE and SAM (acronyms follow Holmgren, Holmgren & Barnett, 1990). Where possible, a small number of structures were removed from selected specimens. These were cleaned and cleared in diluted household bleach, rinsed in clean water, and semi-permanently mounted in glycerine on microscope slides for detailed studies. Cover slips were sealed with Entellan. Measurements and drawings were prepared using an Olympus CH-2 light-microscope fitted with a drawing tube. Where possible, a minimum of 20 measurements per specimen were recorded for stoma and spore size. Counts and measurements for frond, stipe and lamina dimensions were more variable than the number of stomata and spores measured as this was determined by the number and the quality of specimens available for study. Counts and measurements are presented as the minima, maxima (in brackets) and means. Studies in the reticulation pattern of the veins were conducted using the same clearing technique as described above. Complete pinnae were photographed using an Olympus SZ61 compound microscope fitted with an Olympus SC30 digital camera. The terminology adopted for morphological descriptions follows the standard practice for ferns and used by most authors in recent revisions and floras. Distribution and habitat data were taken from the

herbarium specimens and from the literature. Distribution maps for species were prepared and plotted using ArcGIS 9.2. Coordinates were obtained using several electronic gazetteers.

MORPHOLOGY

RHIZOME.

The rhizome anatomy of some *Cyrtomium* species has been studied by Chandra & Nayar (1982) and Gibson *et al.* (1984). The rhizome is erect to ascending, unbranched, and 7–8 mm in diameter in the native species. In the naturalised *C. falcatum* it can be up to 12 mm in diameter. In *C. luctuosum* sp. nov. the rhizomes are up to 110 mm long and in *C. pseudocaryotideum* sp. nov. up to 80 mm. Rhizomes are generally well-seated in the substrate and are often covered by a detritus layer. The closely spaced, radially arranged layer of persistent stipe bases and roots make the rhizomes appear thicker than they actually are. The rhizome apex is covered by a dense layer of scales, these being narrower than the stipe base scales.

FRONDS

Live fronds in *Cyrtomium* are crowded at the rhizome apex. *Cyrtomium luctuosum* generally has the least number of live fronds – as many as nine, but generally fewer. Fronds in this species are held upright (erect). *Cyrtomium pseudocaryotideum* may have up to 14 live fronds and *C. falcatum* as many as 20. The fronds in these species generally arch, but in *C. falcatum* exposed plants may have suberect fronds. Mature fronds in *C. luctuosum* are shortest, to 520 mm long, whilst those in *C. falcatum* are longest and may reach up to 1.3 m. Fronds in *C. pseudocaryotideum* can reach a length of up to 760 mm.

Stipes in native *Cyrtomium* species are shortest and thinnest in *C. luctuosum* reaching a length of up to 210 mm and a basal diameter of 3 mm whilst that in *C. pseudocaryotideum* can reach up to 320 mm in length and 5 mm in diameter. In these species four to five meristemes are arranged in a U-shaped arch with the dorsal meristemes at each end slightly larger than those between. In *C. falcatum* as many as eight meristemes occur in the arch with the two dorsal ones significantly larger than those between. Stipes are firm and shallowly sulcate adaxially. In *C. falcatum*, however, they tend to be slightly convex towards the

base. A narrow continuous aerophore line extends dorso-laterally along the stipe length, extending to the rachis. In *C. falcatum* it is shallowly sunken. This species and *C. luctuosum* generally bear scale scars of various shapes and sizes along the stipe, extending to the rachis. Scales occur on the stipes of all the species, but their density and size diminishes towards the lamina base.

Laminae are monomorphic and 1-pinnate with sub-opposite to alternate pinnae. Within a single frond, however, the pinna arrangement along the rachis may vary. Rachises are adaxially shallowly sulcate, the sulcus being an extension of that in the stipe. The sulcus becomes more pronounced towards the lamina apex in *C. falcatum*. The sulcus is not open to the very shallow and somewhat inconspicuous sulci of the pinna petioles. The laminae have discrete terminal pinnae which are quite variable in size and outline. In fronds with an uneven pinna number the terminal pinna may have a distinct auricle or pinna-like extension at its base. This auricle forms on that side of the lamina with the least number of pinnae which suggests that a lateral pinna failed to separate from the terminal pinna. In some cases auricles, mostly of different sizes, occur on both sides of the terminal pinna.

Pinnae are petiolate, but the petiole length diminishes towards the lamina apex. They are shallowly sulcate adaxially, but the sulcus is not confluent with that of the rachis. Costal sulci are not well developed. The native *Cyrtomium* species have herbaceous pinnae whilst those of *C. falcatum* are firmly herbaceous to coriaceous. Pinnae range significantly in shape from inaequilaterally ovate-caudate to oblong-acuminate, or lanceolate and are often falcate in *C. falcatum* and *C. pseudocaryotideum*. They are mostly acroscopically developed (the pinna lamina on the acroscopic side of the costa is larger than that on the basiscopic side) and often acroscopically auriculate. The margins range from crenate in *C. falcatum* to irregularly dentate in *C. luctuosum* to irregularly serrate in *C. pseudocaryotideum*. All the species have thickened pinna margins.

INDUMENTUM

Indumentum in *Cyrtomium* includes scales, paleasters, and hairs. Scales (paleae) are dermal appendages occurring on the rhizome and lamina axes and show significant variation. Scales have never

been thoroughly studied in the genus. In *C. luctuosum* pluricellular hairs occur on the laminae or faces of the larger stipe scales as well as along their margins, a feature not observed in *C. falcatum* or *C. pseudocaryotideum*. A similar feature has been reported for rhizome scales in *Polystichum luctuosum* (Kunze) T.Moore (Roux 2000).

Paleasters were observed in *C. luctuosum* and *C. pseudocaryotideum*, but not in *C. falcatum*. Paleasters are structures intermediate between scales and hairs. They usually have a basally and terminally uniseriate series of cells whilst part or parts of them (mostly towards the base) consist of two or more cells occurring alongside (Fig. 2D–I). Paleasters occur among the hairs on the abaxial pinna surfaces.

Hairs in *Cyrtomium* are uniseriate, pluricellular structures (mostly) confined to the abaxial pinna surfaces. Whereas a single hair type differing slightly in length occurs in *C. luctuosum* and *C. pseudocaryotideum*, two distinct types were observed in *C. falcatum* (Fig. 2A–C). These hair types are defined in the species description.

VENATION

Cyrtomium is characterised by a reticulate venation pattern. The central pinna vein or midrib in this study is referred to as the costa and veins that branch from the costa are referred to as primary veins. Arching vein connectives extend between the near-parallel primary veins resulting in the formation of dome- to lunate-shaped areolae. As a result of the successive formation of connectives between the primary veins, areolae between adjacent primary vein pairs become stacked or storied. Areole stories between adjacent primary veins may be up to four deep with the upper story (the one closest to the pinna margin) areolae becoming more irregular. In both *C. falcatum* and *C. pseudocaryotideum* the first storey areolae (the row adjoining the costa) contain a single excurrent veinlet that branches acroscopically from the primary vein. In *C. luctuosum* areola formation is more irregular and several, often branched excurrent veinlets are formed (Fig. 1B). In the second and higher storied areolae the excurrent veinlets arise from the connectives. Recurrent veinlets were observed in *C. luctuosum* only (Fig. 1B).

SORI

In the relevant *Cyrtomium* species veinlets bear a single inframedial sorus. Less frequently, however, a sorus may also occur near the veinlet apex. Sori appear to be randomly dispersed on the pinnae. One or two sori may occur within each areole, but not all areolae have sori.

The sori are circular and covered by an indusium that is more or less persistent. Indusia are peltate, circular in outline, and have repand, erose, or lacinate margins. When mature they are pale brown to ferruginous. Indusia are smallest in *C. luctuosum* (to 1 mm in diameter) and largest in *C. pseudocaryotideum* where they can be up to 1.8 mm in diameter. Indusium cell walls in *C. falcatum* are conspicuously thickened (Fig. 3A) and densely impregnated with secondary compounds, a feature not seen in the other taxa. Indusia are more or less flat when immature, but their form changes when mature and dry. In *C. falcatum* and *C. pseudocaryotideum* they regularly evert forming a cup-shaped structure. In *C. luctuosum*, however, mature indusia are wrinkled (rugose) forming an infundibuliform structure and are often obscured by sporangia.

TAXONOMY

Key to the native and naturalised *Cyrtomium* species in Africa and Madagascar

- 1 Pinna margins repand to irregularly crenate, never serrate nor dentate 1. **C. falcatum**
- 1' Pinna margins generally serrate or dentate, not crenate 2
- 2 Lamina oblong-acute; areole stories irregular, areolae with excurrent and recurrent veins; marginal free vein branches regularly fertile; indusium rugose at maturity, the margins lacinate ... 2. **C. luctuosum**
- 2' Lamina lanceolate; areole stories regular; areolae with excurrent veins only; marginal free vein branches always sterile; indusium regularly everted at maturity, the margins erose
..... 3. **C. pseudocaryotideum**

1. *CYRTOMIUM FALCATUM* (L.F.) C.PRESL

Tentamen pteridographiae: 86 (Oct. 1836); *Polypodium falcatum* L.f., *Supplementum plantarum*: 446 (Apr. 1782); *Aspidium falcatum* (L.f.) Sw. in *Journal für die Botanik* (H.A. Schrader, ed.) 1800,2: 31 (1801); *Dryopteris falcata* (L.f.) Kuntze, *Revisio generum plantarum* 2: 812 (5 Nov. 1891); *Polystichum falcatum* (L.f.) Diels in *Die natürlichen Pflanzenfamilien* 1,4: 194 (Aug. 1899); *Phanerophlebia falcata* (L.f.) Copel., *Genera filicum*: 111 (1947). Type: Japan, C.P. Thunberg s.n. (UPS, holo.).

Japanese holly fern; Asian net-veined holly fern

Description: PLANTS terrestrial or epilithic. RHIZOME simple, erect to ascending, to 60 mm long, to 12 mm in diameter, closely set with roots, crowded, spirally arranged persistent stipe bases, live fronds towards the apex, and scales, the scales similar to, but smaller than those at the stipe bases. FRONDS to 20 per plant, caespitose, suberect to arching, to 1.3 m long; STIPES dark brown at the base, green higher up, firm, proximally convex adaxially, higher up shallowly sulcate adaxially and along the aerophore line, to 470 mm long, to 7 mm in diameter, variously set with deeper coloured scale scars of variable sizes and shape along the stipe and rachis length, with a conspicuous thin green aerophore line dorso-laterally, drying reddish-brown, proximally densely scaled, sparsely scaled higher up, the scales ferruginous to castaneous, the basal and marginal regions of the scales generally paler than the central distal region, chartaceous, the smaller scales pale brown, thinly chartaceous, sessile, narrowly elliptic-caudate to narrowly triangular-caudate, cordate to broadly cuneate, the margins closely set with long, twisted, pluricellular, filiform outgrowths, the scale apex flagelliform, twisted, terminating in a long uniseriate series of cells, the larger scales broadly attached, ovate to narrowly ovate, to 25 mm long, to 6 mm wide, the margins closely set with twisted filiform outgrowths, the outgrowths long and simple, pluricellular, the apical cell oblong to clavate, the scale apex flagelliform, terminating in a uniseriate series of filiform cells; LAMINAE oblong-lanceolate, to 690 mm long, to 210 mm wide, 1-pinnate, with up to 13 near alternate pinna pairs, the pinnae often somewhat overlapping, increasingly more remote towards the base; RACHIS green, drying reddish-brown, somewhat flattened to shallowly sulcate adaxially, initially densely scaled, subglabrous later, the scales similar to the smaller stipe scales; PINNAE petiolate towards the lamina base,

the petiole to 6 mm long, sessile higher up, closely set with scales similar to those on the rachis, glossy and bright green adaxially, firmly herbaceous to coriaceous, inaequilaterally ovate-caudate to lanceolate, often somewhat falcate, acroscopically enlarged and often auriculate, to 135 mm long, to 57 mm wide, the auricle acute, the basiscopic and acroscopic margins cordate to broadly cuneate, the apical pinna as large or larger than the lateral pinnae, obliquely ovate-caudate to lanceolate-caudate, often auriculate on one side, narrowly to broadly cuneate, the pinna margins irregularly crenate, thickened, glabrous adaxially, abaxially without paleasters but sparsely to moderately set with hairs of two types; 1) the shorter nearly straight, with 6–10 short cells 0.2–0.4 mm long, 2) the longer twisted, with 8–14 cells of unequal length, 0.8–1.2 mm long; COSTAE sulcate adaxially, prominent abaxially, flexuose towards the pinna apex, abaxially proximally sparsely set with pale brown, simple and twisted, pluricellular hairs and narrow scales with long and twisted filiform outgrowths arising from near the scale base; VENATION evident adaxially and abaxially, anadromous, reticulate, primary veins on basal pinnae conspicuous, but less so towards the distal pinnae to 3 mm apart, set at 80°–30° to the costa, the angle decreasing towards the pinna apex, areolae storied, regular, the 1st order areolae variable, transversely narrowly rhomboid, with a single, simple or branched, free and excurrent or anastomosing vein branch, the 2nd order areolae obliquely lunate, with 1 to 3 simple or branched excurrent veinlets, the veinlets free or anastomosing, the higher order areolae variable, polygonal, with 1 or 2 excurrent or rarely recurrent vein branches, the vein branches free or anastomosing, the ultimate vein branches arising from the areole connectives, free or anastomosing, ending near the margin; STOMATA hypostomatic, guard cells (40–)45(–50) µm long. SORI more commonly confined to the distal parts of the lamina and pinnae, scattered, inframedial, supramedial, or terminal on free or anastomosing veins, circular, to 1.2 mm in diameter at maturity; INDUSIUM peltate, pale brown, chartaceous, circular, to 1.2 mm in diameter, often everted when dry, the margins repand to erose, the cells variously impregnated with secondary compounds, the walls much thickened; RECEPTACLE nude, not noticeably raised; SPORANGIA stalks long, simple, 3-seriate below the capsule, capsule elliptic to obovate in lateral view, with 3(–4) epistomial cells, with 3(–5) hypostomial cells, with (16–)18(–20) indurated annulus cells; SPORES 32 per sporangium, brown, ellipsoidal to spheroidal, monolete, laesura to $\frac{3}{4}$ the spore length, perispore with broad, inflated tubercles and short folds, the

exospore smooth, endospore (38–)45(–56) µm long. CHROMOSOME NUMBER: $n = 41$ (Löve *et al.*, 1977), sexual (in eastern Asia), or apogamous, $n=123$, $2n=123$ (Manton, 1950: 303). Figures 1A, 2A–C, 3A & 4.

Etymology: falcatum – sickle-shaped, alluding to the sometimes curved shape of the pinnae.

Distribution and habitat: Cyrtomium falcatum is native to mainland China, Hainan, South Korea, Japan, and Taiwan. This widely cultivated garden ornamental has become naturalised in many parts of the world, including Hawai'i, North America, Australia, W and S Europe and SW England, Réunion and South Africa. In South Africa it chiefly occurs near water courses, on moist cliffs or rocky outcrops, and stone walls in gardens in coastal regions. It has also been collected from inland forests at higher elevations. Three cytotypes have been reported for the species – sexual diploids and tetraploids, and apogamous triploids (Nakato *et al.*, 1995). The South African collection studied all showed 32 spores per sporangium, suggesting the plants to be triploid apomicts.

The first known record of *Cyrtomium falcatum* from southern Africa is a collection made by Mrs Anna Dieterlen (no. 826) at Teyateyaneng (Tejatejaneng) in Lesotho between April 1909 and Oct. 1911. Her collecting register housed at NBG does not give an exact collecting date. During recent searches for this species in that area no plants could be located.

It is apparent that more recently several new populations of this species became established, especially in coastal regions of South Africa. The fact that the known populations all proved to be apogamous may explain its successful establishment and spread.

Specimens examined: LESOTHO. —2927 (Maseru): Teyateyaneng (-BB), 5–6 000 ft, *Dieterlen, A. 826* (SAM0009470-0).

SOUTH AFRICA. —3030 (Port Shepstone): Umbogintweni AECI effluent site (-BB), dam 3/4, 4/04/2007, *Brink, E. 5514* (GRA); South Coast, Munster, Dolphin Bay (-CD), soil between boulders, 3–4 m, 26/12/1990, *Ward, C.J. 11119* (K, NU, PRE).

—3129 (Port St Johns): Port St Johns, Mt Sullivan, Nenga River (-DA), rare in forest, 26/10/2005, *Cloete, E. 6355* (GRA).

—3322 (Oudtshoorn): Wilderness. Waterside and Freesia road crossing (-DC), seasonal stream in forest, 25/01/2011, *Roux, J.P. 5208* (NBG); Wilderness, Hillside Road, among rocks and at base of stone wall along road, *Roux, J.P. 5209* (NBG); Wilderness, Sands Road, frequent along road in stone wall, 25/01/2011, *Roux, J.P. 5213* (NBG); Wilderness, railway line just past 1st tunnel to Kaaimans River, small stands on banks above railway line, 26/01/2011, *Roux, J.P. 5222* (NBG); Wilderness, along railway line towards Kaaimans River, near beach, c 10 m, 26/01/2011, *Roux, J.P. 5224* (NBG).

—3325 (Port Elizabeth): Port Elizabeth, Settler's Park (-DA), at foot of cliff, 16/04/1979, *Roux, J.P. 501* (NBG0223860-0).

—3419 (Caledon): Hermanus, Voëlklip, Langbaai (-AD), seasonal streambed in coastal scrub, 5 m, 2/11/2010, *Roux, J.P. 4897* (NBG0261938); Hermanus, Voëlklip, Grotto Beach, cliff face in coastal forest, 5 m, 2/11/2010, *Roux, J.P. 4901* (NBG0261942); Hermanus, Langbaai, on edge of stream, 3 m, 16/06/1987, *Williams, S.L. 1202* (NBG0223860-0).

SINE LOCO: *Holland, B.H. s.n.* (NBG0223860-0); Op die Pêrel in Worcester, 09/1942, *Jooste, E. s.n.* (NBG0223762-0); Northern Transvaal, 21/04/1933, *Repton, J.E. 14B* (PRE); Worcester, 08/1942, *Zuidmeer, M. s.n.* (NBG0223765-0).

2. *CYRTOMIUM LUCTUOSUM* J.P.ROUX, SP. NOV.

Typus: South Africa, KwaZulu-Natal, Cathkin Peak area, Ndema Forest, in deep shade in moist montane forest, c. 1 450 m, 2 February 2010, *J.P. Roux 4648* (NBG0241021-2, holo.; NBG0241021-1, iso.).

A *Cyrtomio caryotideo* pilis pluricellulosis in laminis squamarum stipitis [maioris] praesentibus; laminis oblongo-acutis pinnarum paribus pluribus (usque ad 12); pinnis olivaceis, herbaceis, ovato-acuminatis vel oblongo-acuminatis, usque ad 75 x 35 mm, plerumque auriculam inconspicuam obtusam acroscopicam ferentibus, marginibus irregulariter dentatis; nervatura reticulata, areolas irregulares formanti; indusiis stellatis, ad 1.2 mm diametro rugosis et infundibuliformescentibus ubi maturis; sporis 64 per sporangium, differt.

Cyrtomium falcatum sensu Pappe & Rawson, *Synopsis filicum Africae australis*: 15 (1858), p.p., non (L.f.) C.Presl (1836).

Aspidium anomophyllum sensu Kuhn, *Filices africanae*: 125 (1868), p.p., non Zenker (1835).

Cyrtomium caryotideum (L.f.) C.Presl var. *micropterum*, as '*micropteris*', p.p., sensu Christensen in *American Fern Journal* 20,2: 52 (1930), non Kunze (1851), p.p.

Cyrtomium micropterum sensu Ching, *Icones filicum sinicarum* 3: pl. 127 (1935), p.p., non Kunze (1851).

Phanerophlebia caryotideia (Wall. ex Hook. & Grev.) Copel. var. *micropteris* sensu Tardieu-Blot in *Mémoires de l'Institut Français d'Afrique Noire* 28: 152, 153 (1953), non Kunze (1851).

Icones: Tardieu-Blot, pl. 38, figs 4, 5 (1964); Schäffer-Fehre, fig. 9, t. 1–9 (2007).

Description: PLANTS terrestrial. RHIZOME simple, ascending to erect, stout, to 110 mm long, to 8 mm in diameter, set with roots, crowded, spirally arranged persistent stipe bases, live fronds, and scales, the scales ferruginous to castaneous, firmly chartaceous to thinly crustaceous, broadly attached or cordate, narrowly triangular, to 12 mm long, to 1.2 mm wide, the margins variously set with short and/or long twisted, simple, pluricellular, uniseriate outgrowths, the scale apex flagelliform, terminating in a uniseriate series of elongated cells. FRONDS to 14 per plant, caespitose, erect, to 520 mm long; STIPES proximally dark brown, green higher up, firm, to 210 mm long, to 3 mm in diameter, sulcate adaxially, variously set with dark brown to reddish-brown scale scars of variable sizes and shapes along the stipe and rachis length, proximally densely set with scales, moderately scaled higher up, the larger scales centrally atrocastaneous towards the point of attachment and scale apex, the margins brown to ferruginous, firmly chartaceous to thinly crustaceous, broadly attached to cordate, broadly ovate-caudate to lanceolate-caudate, to 16 mm long, to 7 mm wide, often somewhat bullate, the margins variously set with short angular outgrowths and long, twisted, distally uniseriate, pluricellular outgrowths, the scale apex terminating in a short or long uniseriate series of filiform cells, also with scattered pluricellular, uniseriate hairs on the scale laminae or surfaces, smaller scales twisted, ferruginous, thinly chartaceous, sessile, cuneate to cordate, narrowly triangular, to 4 mm long, to 1.5 mm wide, the margins variously set with twisted, pluricellular, uniseriate outgrowths as well as short angular or curved outgrowths, the scale apex

flagelliform, terminating in a uniseriate series of elongated cells, the terminal cell oblong and deeper in colour; LAMINAE oblong-acute, to 350 mm long, to 130 mm wide, 1-pinnate, with (4–)7(–12) sub-opposite to alternate pinna pairs that are more widely spaced towards the base, the basal 2 or 3 pinna pairs slightly reduced or not, often somewhat deflexed, the distal pinnae often slightly overlapping; RACHIS sulcate and olive-green adaxially, pale green abaxially, the sulcus not confluent with that of the costae, variously scaled, the scales stramineous to ferruginous, chartaceous, cordate, filiform to narrowly triangular or narrowly lanceolate-caudate, to 6 mm long, to 1.5 mm wide, the margins variously set with outgrowths similar to those on the smaller stipe scales; PINNAE petiolate at the lamina base, sessile at the apex, the petiole to 3 mm long, closely set with scales similar to but smaller than those on the rachis, the pinnae not or gradually reduced in size towards the lamina apex, herbaceous, olive-green adaxially, paler abaxially, inaequilateral, ovate-acuminate to oblong-acuminate, to 75 mm long, to 34 mm wide, often somewhat falcate, acroscopically enlarged, mostly with a low obtuse, often inconspicuous auricle acroscopically, the basisopic margin narrowly to broadly cuneate, the acroscopic margin truncate to broadly cuneate, the margins irregularly dentate, thickened, the terminal pinna as large or larger than the lateral pinnae directly below, mostly with an auricle developed on one side, rarely on both sides, the auricles variously developed, the base oblique, narrowly to broadly cuneate, glabrous adaxially, abaxially moderately set with conspicuous, pluricellular, uniseriate hairs to 0.1 mm long, and paleasters to 0.3 mm long; COSTAE shallowly sulcate adaxially, prominent abaxially, the sulcus not confluent with that of the rachis, proximally closely set with scales similar to those on the petiole; VENATION evident or obscure, reticulate, primary veins obscure, areolae irregularly storied, the 1st order areolae transversely narrowly rhomboid to oblong on outline, with 1 to 3, simple or branched, apically directed excurrent free vein branches, the 2nd order areolae variable, with 1 or 2 simple, excurrent or recurrent free vein branches, higher order areolae present or not, if present then polygonal, mostly with a single, simple, excurrent vein branch, ultimate vein branches simple or branched, ending near the pinna margin; STOMATA hypostomatic, guard cells (54–)59(–62) μm long. SORI more commonly confined to the distal parts of the lamina and pinnae, scattered, medial or inframedial on the free vein branches in areolae as well as the free vein branches near the margin, circular, 1.0 to 1.2 mm in diameter at maturity; INDUSIA persistent, peltate, ferruginous, firmly chartaceous, circular, the margins lacinate, to 1 mm in diameter, rugose and

infundibuliform at maturity; RECEPTACLE nude, raised; SPORANGIA stalks long, simple, 3-seriate below the capsule, capsule broadly elliptic in lateral view, with (13–)15(–17) indurated annulus cells, epistomium (3–)4(–5)-celled, hypostomium (3–)4-celled; SPORES 32 or 64 per sporangium, brown, ellipsoidal, monoete, laesura to $\frac{3}{4}$ the spore length, perispore with large inflated tubercles, the exospore surfaces smooth, endospore (28–)32(–34) μm long. CHROMOSOME NUMBER: $n=123$, $2n=123$, apogamous (Manton, 1950: 303). Figures 1B, 2D–F, 3B, 5 & 6.

Etymology: *luctuosum* – mourning, alluding to the dark appearance of the plants.

Note: Based on a study of material from Uganda, Manton (1950: 303) found that the species is a triploid apomict with a chromosome number of $n=123$. A chromosome count of material from South Africa is not available and the plants showed to have 64 spores per sporangium which suggest it is sexual. This aspect requires further study.

Distribution and habitat: *Cyrtomium luctuosum* has a disjunct distribution in Africa: it occurs chiefly along the eastern mountain ranges, but has an outlying population in Cameroon. In Africa it ranges from the southwestern parts of the Ethiopian highlands to the mountains in western Uganda. From here it extends to the Kenyan highlands, southwards to the Usambara and Uluguru Mountains in Tanzania and central Malawi. Further south it is only known from South Africa. *Cyrtomium luctuosum* also occurs in Madagascar. The species is confined to seasonally moist evergreen forest at elevations ranging from 360 m in Madagascar to 2 100 m on Mt Kilimanjaro, Tanzania. In South Africa the species occurs in Northern Afromontane Forests, Southern- and Northern Mistbelt Forests, and Scarp Forests (Mucina & Geldenhuys, 2006). The plants generally grow in deep shade near water, but they also grow on drier ravine slopes. In South Africa *Cyrtomium luctuosum* has a sympatric distribution with *C. pseudocaryotideum*, and they regularly grow together.

Specimens examined: CAMEROON. —Lac Negueu, près Bafoussam, *Nicklès* 53 (P).

ETHIOPIA. —Kaffa Prov., Badda Buna Forest, 10 km NE of Jimma, at foot of rock ledge in forest, 1 800 m, 21/12/1961, *Meyer, F.G.* 7764 (K).

KENYA. —Kakamega Distr., Forest along Isiukhu River, S to SSW of Wibakake on Kambiri-Vihiga road, lowland wet evergreen forest, 1 680 m, 27/12/1969, *Faden, R.B. & Rathbun, G.* 67/2105 (BOL); Nyanza Prov., Sotik, on forest floor above Sisi River, 05/1960, *Balley, P.R.O.* 12255 (K); Karura forest near Nairobi, 08/1942, *McLoughlin, A.G.* 709 (BOL).

MADAGASCAR. —Haut Bemarivo, dans la foret d'Analamahitso, 900 m, 08/1907, *Perrier de la Bathie* 7455 (P); Madagascar, montagnes au nord de Mangindrano (haute Maevarano) jusqu'aux sommets d'Ambohimirahavavy (partage des eaux Mahavavy-Androranga: Centre Nord), Vallon d'Ambatohafo, foret ombrophile, 1 200–1 400 m, 19/01–12/02/1951, *Humbert, H. & Capuron, R.* 25339 (K); Foret du Valoala, 6/01/1945, *Cours, M.G.* 2195 (K); Près de Manakambahiny-Est, 850 m, 27/09/1940, *Cours, M.G.* 1527 (K, 2 sheets); Madagascar, vallee de la Manambolo, rive droite (bassin du Mandrare) aux environs d'Isomon (confluent de la Sakamalio). Mont Morahariva (Mahamena), foret sclerophylle des pentes occidentalis, 1 000–1 400 m, 12/1933, *Humbert, H.* 13229 (K); Madagascar, provenant de la foret de Maryakanadian, 21/05/1919, *Waterlot, M. s.n.* (K).

MALAWI. —Central Region, Dzalanyama Forest Reserve, submontane *Olea capensis* forest on the plateau, on forest floor near a stream, 470 m, 17/03/1984, *Dowsett-Lemaire, F.* 1118 (K).

SOUTH AFRICA. —2430 (Pilgrim's Rest): Mpumalanga, Blyde Forest Reserve on steep S-facing boulder strewn slope in deep shade, N of Driekoppen (-DB), in *Podocarpus* forest, 1 360 m, 17/05/1972, *Jacobsen, W.* 4367 (K).

—2531 (Komatipoort): Mpumalanga, Barberton, Lomati Valley (-CC), 2/1906, *Thorncroft, G.* 105 (PRE).

—2729 (Volksrust): Newcastle Distr., Buffelshoek (-DD), forest along scarp, 21/06/1989, *Smith, R.* 1221 (PRE).

—2829 (Harrismith): Van Reenen's Pass (-AD), 1 875-1 880 m, *Rehmann, A.* 7211 (K).

—2929 (Underberg): Cathkin Park, Ndema Forest (-AB), occasional on forest floor, 1 275 m, 13/12/1961, *Edwards, D.* 2684 (NU); Cathkin Park, Fern Forest, 21/02/1946, *Howlett, B & C.* 51 (NU, PRE); Cathkin Park, Ndema Forest, montane forest, 22/01/2008, *Roux, J.P.* 4452 (NBG); Cathkin area, Ndema Forest,

frequent in deeply shaded forest, 2/02/2010, *Roux, J.P. 4648* (NBG); Balgowan Distr. (-AC), in damp forest, 1 370 m, 05/1944, *Edwards, E.M. 125* (NU); Fort Nottingham commonage (-BD), in deep shade in forest in very damp conditions, 1 675 m, 15/03/1977, *Cowan, L. 22* (NU); Lion's Bush, in bush, 1 675 m, 06/1914, *Thode, J. s.n.* (NBG); Bulwer (-DA), 06/1943, *Henkel, J.S. s.n.* (NU); Bulwer, Mahwaqa Mountain, farm The Shelter, frequent in montane forest, 28/01/2010, *Roux, J.P. 4492A* (NBG); Impendhle (-DB), in forest near streams, 1 580 m, 1/1947, *Shuter, R.L. 84* (NU).

—2930 (Pietermaritzburg): Balgowan (-AC), in shady forest near rocks, 1 065 m, 05/1945, *Bursele, E. 118* (NU); Balgowan, in bush, 1 065 m, 04/1946, *Crookes, H.B. 104* (NU); Balgowan, 'Boschfontein', frequent in shade near water, 1 220 m, 31/05/1944, *Fisher, B.S. 649* (NU); Balgowan, on forest floor, 1 220 m, 05/1945, *Lindahl, R.E. 104* (NU); Balgowan, 05/1946, *McElligott, M. 57* (NU); Balgowan, common near stream in natural forest, 1 300 m, 06/1947, *Ripley, S.H. 80* (NU); near Balgowan, near Hurst's farm, in shade in midlands forest, 1 220 m, 15/08/1942, *Schelpe, E.A.C.L.E. p.8*, in part (NU); Howick, in shade, 12/05/1946, *Thomas, J. 61* (NU); Pietermaritzburg, Ferncliff Nature Reserve (-CB), dry forest floor, 1 000 m, 7/06/1992, *Crouch, N. 585* (NU); Pietermaritzburg, Town Bush Valley, 26/06/1911, *Doidge, E.M. s.n.* (PRE); Pietermaritzburg, Town Bush, abundant in undergrowth, c. 685 m, 2/05/1948, *Dosi, C.G. 79* (NU); Pietermaritzburg, Town Bush (-CB), steep side of ravine, shaded, 915 m, 24/05/1947, *Neidner, H. 101*, in part (NU); Pietermaritzburg, Town Bush Valley, in moist furrow, 912 m, 2/05/1948, *Nieuwoudt, B.J. 61* (NU).

—3029 (Kokstad): In umbr. pr. fl. Umzimkulu (-BD), 1 216 m, 7/02/1895, *Schlechter, R. 6636* (K).

—3127 (Lady Frere): Eastern Cape, Engcobo (-DB), *McLoughlin, A.G. s.n.* (PRE).

—3128 (Umtata): Tsolo, Ncabukeni Forest (-BC), near dry riverbed, 23/08/1983, *Cawe, S. 727* (BOL); between Ugie and Tsolo, Chenkwe Mtn., 1 216 m, 1896, *Flanagan, H.G. 2648* (SAM).

—3226 (Fort Beaufort): Katberg forests (-BC), in more open areas of forest, c. 912 m, 8/02/1945, *Adams, B.Z.M. 162* (NU).

TANZANIA. —Kilimanjaro, mill behind Kilimanjaro Timbers, virgin forest, c. 2 100 m, 17/07/1993, *Grimshaw, J.M. 93419* (K); Kibosho, 1 300 m, 10/08/1909, *Mucke, M. 160* (PRE); Deutsch Ost-Afrika: Landschaft Usambara W. Mts., 03/1916, *Peter, A. 15735* (K, PRE); Lushoto Distr., Mkussu Forest Reserve, on steep bank by road side, 1 500 m, 18/01/1967, *Richards, M. 22027* (K); Morogoro Distr., W

slopes of Nguru Mts above Maskati, montane *Albizzia-Podocarpus* forest, 1 650 m, 17/03/1988, *Bidgood, S., Mwasumbi, L., Pocs, T. & Vollesen, K. 541* (K); Ukwira montane forest, N-facing slopes dominated by *Prunus africana*, *Bridelia micrantha* and *Nuxia congesta*, locally frequent, 1 750 m, 5/08/2001, *Mwangoka, M.A. & Amani, A. 2279* (K); Udzungwa Mountain National Park, montane forest, 2 060 m, 2/06/2002, *Luke, P.A. et al. 8648* (K).

UGANDA. —Bunyaruguru, Ankole, crater forest, 1 460 m, 07/1939, *Purseglove, J.W. 859* (K).

SINE LOCO: *Barkly s.n.* (SAM0024526-2); *MacOwan s.n.*, A only (SAM0024525-0).

3. *CYRTOMIUM PSEUDOCARYOTIDEUM* J.P.ROUX, SP. NOV.

Typus: South Africa, KwaZulu-Natal, Cathkin Peak area, Fern Forest, 3 February 2010, *J.P. Roux 4674* (NBG0241020-3, holo.; NBG0241020-2, K, iso.).

A *Cyrtomio luctuoso* frondibus longioribus (usque ad 760 mm), lamina lanceolata (non oblongo-acuta), pinnis obscure viridibus, firme herbaceis, saepe lanceolato-falcatis, ad apicem laminae gradatim deminutis, variabiliter acroscopice auriculatis, ad margines irregulariter serratis (non dentatis); nervatura reticulata, areolas regulares (non irregulars) formanti; areolis nervas tantum excurrentes (non etiam recurrentes) ferentibus; indusiis pallide brunneis, firme chartaceis, circularibus, ad 1.8 mm diametro, marginibus erosis (non laciniatis); sporis 32 (non 32–64) per sporangium, differt.

Cyrtomium falcatum sensu Pappe & Rawson, *Synopsis filicum Africae australis*: 15 (1858), p.p., non (L.f.) C.Presl (1836).

Aspidium anomophyllum sensu Kuhn, *Filices africanae*: 125 (1868), p.p., non Zenker (1835).

Aspidium anomophyllum Zenker f. *micropterum* sensu Christensen in *American Fern Journal* 20,2: 52 (1930), p.p., non Kunze (1851).

Cyrtomium micropterum sensu Ching, *Icones filicum sinicarum* 3: pl. 127 (1935), p.p., non Kunze (1851).

Description: PLANTS terrestrial. RHIZOME simple, ascending to erect, stout, to 80 mm long, to 7 mm in diameter, set with roots, crowded, spirally arranged persistent stipe bases, live fronds, and scales, the scales broadly attached, ferruginous, often castaneous and glossy centrally, chartaceous, narrowly triangular to oblong-acuminate, to 10 mm long, to 1.5 mm wide, the margins variously set with short,

angular and/or curved outgrowths and long, pluricellular, uniseriate outgrowths, the scale apex often flagelliform, terminating in a uniseriate series of filiform cells. FRONDS up to 9 per plant, caespitose, arching, to 760 mm long; STIPES proximally dark brown, paler higher up, firm, to 320 mm long, to 5 mm in diameter, sulcate adaxially, proximally densely scaled, moderately scaled higher up, the scales ferruginous, frequently with a castaneous central region near the point of attachment or near the scale apex, or castaneous throughout, chartaceous, broadly attached to cordate, oblong-acuminate to broadly ovate, to 11 mm long, to 6 mm wide, the margins irregularly set with short angular and curved outgrowths as well as long, pluricellular, uniseriate outgrowths, the scale apex terminating in a uniseriate series of filiform cells; LAMINAE lanceolate, to 450 mm long, to 130 mm wide, 1-pinnate, with (6–)7(–11) sub-opposite to alternate pinna pairs reduced in size towards the lamina apex, the pinna pairs more widely spaced towards the base, not reduced, the distal pinnae never overlapping; RACHIS sulcate adaxially, the sulcus not confluent with that of the costae, variously scaled, the scales ferruginous, the larger often centrally castaneous, chartaceous, cordate, filiform to narrowly triangular, to 3 mm long, to 0.2 mm wide, the margins variously set with long and twisted, pluricellular, uniseriate, filiform outgrowths, the scale apex flagelliform, terminating in a uniseriate series of filiform cells; PINNAE petiolate at the lamina base, sessile at the apex, the petiole to 3 mm long, closely set with scales similar to but smaller than those on the rachis, the pinnae herbaceous, green adaxially, marginally paler abaxially, inaequilateral, lanceolate, to 135 mm long, to 48 mm wide, falcate, the basal 1 to 3 pinna pairs mostly acroscopically auriculate, the auricle variously developed, acute to obtuse, the basiscopic margin narrowly to broadly cuneate, the acroscopic margin truncate to broadly cuneate, the margins irregularly serrate, thickened, the terminal pinna oblique, mostly with an auricle developed on one side, frequently on both, the auricles poorly to strongly developed, adaxially with ferruginous, chartaceous, linear to filiform scales similar to, but smaller than those on the rachis along the petioles and costae, and with scattered, appressed, uniseriate hairs to 0.25 mm long on the laminae, abaxially with scales along the pinna petioles and costae, the scales twisted, ferruginous to stramineous, thinly chartaceous, filiform, to 2.5 mm long, and with scattered ferruginous to stramineous, uniseriate hairs to 0.1 mm long, and paleasters to 0.25 mm long; COSTAE shallowly sulcate adaxially, pronounced abaxially, proximally closely set with scales similar to that on the pinna stalk; VENATION evident or obscure, reticulate, primary veins obscure, often conspicuous

abaxially when dry, areolae regularly storied, the 1st order areolae more or less transversely broadly rhomboid in outline, with a single, simple, excurrent free vein branch arising from the primary vein, the 2nd order areolae obliquely broadly lunate, with 1 or 2 simple, excurrent, free vein branches arising from the 1st order connectives, the higher order areolae polygonal, with or without a single, simple, free vein branch, ultimate vein branches free, ending near the pinna margin; STOMATA hypostomatic, guard cells (52–)58(–64) μm long. SORI more commonly confined to the distal parts of the lamina and pinnae, scattered, medial or inframedial on the free vein branches in areolae, circular, to 1.5 mm in diameter at maturity; INDUSIA persistent or deciduous, peltate, pale brown at maturity, firmly chartaceous, circular, the margins shallowly repand, 1.6 to 1.8 mm in diameter, often everted; RECEPTACLE nude, raised; SPORANGIA stalks long, simple, 3-seriate below the capsule, capsule broadly elliptic in lateral view, with 13(–15) indurated annulus cells, epistomium (3–)4-celled, hypostomium (3–)4(–5)-celled; SPORES apogamous, 32 per sporangium, brown, ellipsoidal, monolete, perispore with large inflated tubercles, the surfaces smooth, endospore (30.0–)34.8(–42.0) μm long. CHROMOSOME NUMBER: unknown. Figures 1C, 2G–I, 3C, 7 & 8.

Etymology: *pseudo-*, false, and *caryotideum*, alluding to the *Cyrtomium caryotideum*-like appearance of the species.

Distribution and habitat: *Cyrtomium pseudocaryotideum* is confined to the higher rainfall eastern regions of South Africa. Here the species is confined to seasonally moist Northern Afromontane Forests, Southern- and Northern Mistbelt Forests, and Scarp Forests (Mucina & Geldenhuys, 2006). The plants generally form small groups, mostly near water, at elevations ranging from 670 to 1 825 m. In South Africa the distribution of *C. pseudocaryotideum* and *C. luctuosum* is sympatric.

Specimens examined: SOUTH AFRICA. —2430 (Pilgrim's Rest): Mpumalanga, Graskop, Blyde Forest Reserve (-DD), S-facing slope, in deep shade, 1 360 m, 17/05/1972, *Jacobsen, W.* 4367 (PRE); Mpumalanga, Transvaal, MacMac, in forest, *McLea, J.H.* 6 (BOL); Mpumalanga, Graskop, 07/1919, *Rogers, F.A. s.n.* (BOL).

—2530 (Lydenburg): Mpumalanga, Sudwala Caves (-BC), rainforest, on dolomite cliff, in shade of forest, 4/09/1983, *Burrows, J.E. 3196* (BOL); Sudwala Caves, in forest, c. 2 km N of caves, at foot of cliffs, 1 500 m, 18/11/1981, *Kluge, J. 2464* (K, NBG).

—2531 (Komatipoort): Mpumalanga, Barberton, Pedlar's Bush Forest, Shiyalongobu road (-CC), on earth banks in deeply shaded ravine in evergreen montane forest, 1 300 m, 8/07/2002, *Burrows, J.E. & Burrows, S.M. 7741* (PRE).

—2730 (Vryheid): Inyati (-DB), occasional fern in forest undergrowth, usually along stream banks, 7/04/1950, *Johnstone, D. 421* (NU).

—2830 (Dundee): Uitval, near Dundee (-AC), in shady bush, 1 215 m, 08/1912, *Thode, J. s.n.* (NBG).

—2929 (Underberg): Cathkin, Ndema Forest (-AB), 1 340 m, 5/07/1945, *Hillary, C.M. 99* (NU); Cathkin area, Ndema Forest, moist slope in forest, 2/02/2010, *Roux, J.P. 4544* (NBG); Cathkin area, Ndema Forest, damp soil in forest, 2/02/2010, *Roux, J.P. 4546* (NBG); Cathkin area, Fern Forest, on moist steep S-facing slope in forest, 3/02/2010, *Roux, J.P. 4574* (NBG); Fort Nottingham, Garlick's farm (-BD), common on moist forest floor, in damp areas only, 11/1988, *Edwards, T. 347* (NU); Lion's Bush forest, in moist shaded forest, 1 520 m, 18/05/1964, *Moll, E.J. 831* (BOL, NU); Bulwer, Nkelabantwana Forest (-DA), common on forest floor, 600–910 m, 03/2000, *Edwards, T. 2133* (NU); On farm 'Clairmont', 6.7 mls from Bulwer on road to Impendhle (-DD), rare in forest, 1 825 m, 11/11/1953, *Killick & Marais 2102* (NU, PRE); Hlabeni Forest (-DC), frequent in deep shade in moist evergreen forest, 5/03/2002, *Roux, J.P. 3367* (NBG).

—2930 (Pietermaritzburg): Dargle, Lion's River (-AC), streamside in forest, 22/07/1954, *Esterhuysen, E. 23045* (BOL); Balgowan Distr., bush, 10/05/1945, *Graham, D.S. 102* (NU); Balgowan Distr., in damp stream bed near forest, 910 m, 16/10/1949, *Molesley, C. & Thomas, P. 6* (NU); Nottingham Road Distr., damp shady positions in forest, 1 640 m, 01/1944, *Smith, D.L. 80* (NU); Dargle, 'Kilgobbin', on moist bank along road near stream, 4/05/1974, *Smook, L. 567* (NU); Balgowan Distr., in forest on river bank, 1 370 m, 05/1944, *Thievel 107* (NU); Balgowan, in moist well-shaded soil in forest, 1 300 m, 6/1947, *Ward, C.J. 107* (NU); Karkloof, farm Shawswood (-AD), in deep shade in evergreen forest, 15/01/1987, *Roux, J.P. 1913* (NBG, PRE); Karkloof, Lions River, Bracco, rare in forest, 1 210 m, 19/01/1955, *Schelppe, E. A.C.L.E. 5109* (BOL); Dargle Forest (-CA), in dense shaded part, 1 220 m, 02/1948, *Harding, A.H. 17*

(NU); Pietermaritzburg, Town Hill (-CB), 820 m, *Carnegie, F.G. 674*, in part (NU); Pietermaritzburg, Town Bush, steep side of shaded ravine, 910 m, 24/05/1947, *Heidner, H. 101*, in part (NU); Pietermaritzburg, near Botanical Gardens, rare in bush on hillside near stream, 670 m, 05/1953, *Most, B.M. 93* (NU); Enon Forest near Byrne, near farmhouse 'Forest Cliff' (-CC), common in drier areas of forest, 18/06/1989, *Wirringhaus, J.O. 912* (NU); Bulwer, Mahuaqa Mountain (-DA), 1 900 m, 20/02/1992, *Feltham, N. 270* (NU).

—2931 (Stanger): In sylvis Natalensibus, Mapumulo (-AA), 910–1215 m, *Wood, J.M. s.n.* (SAM00024527-0).

—3029 (Kokstad): Kokstad, Mt Currie (-AD), *McLoughlin, A.G. 756* (BOL).

—3030 (Port Shepstone): Ixopo, farm 'Eersteling'(-AA), *Hancock, F.D. s.n.* (NU).

3127 (Lady Frere): Cofimvaloa, Tsojana Forest (-DC), moist stream bank, 4/07/1984, *Cawe, S. 900* (BOL).

—3225 (Somerset East): Somerset East (-BC), moist, shade kloofs, 01/1862, *Guthrie, F. s.n.* (BOL).

—3226 (Fort Beaufort): Stockenstroom, Katberg Forest (-BC), 1866, *Holland, B.H. s.n.* (NBG); Adelaide (-CB), in mountainous area, shaded rocky area, 07/1942, *Myburgh, D.C. s.n.* (NBG); Hogsback (-DB), occasional in shade on forest floor, 1 125 m, 8/07/1960, *Schelpe, E. A.C.L.E. 6560* (BOL, K, PRE).

—3227 (Stutterheim): Toise River (-AD), 30/09/1905, *Galpin, E.E. 4680* (PRE).

SINE LOCO: Drakensberg, Natal, 01/1952, *Grout 99* (NU); South Africa, KwaZulu-Natal, 610 m, *Wood, M. s.n.* (NU).

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FIGURES

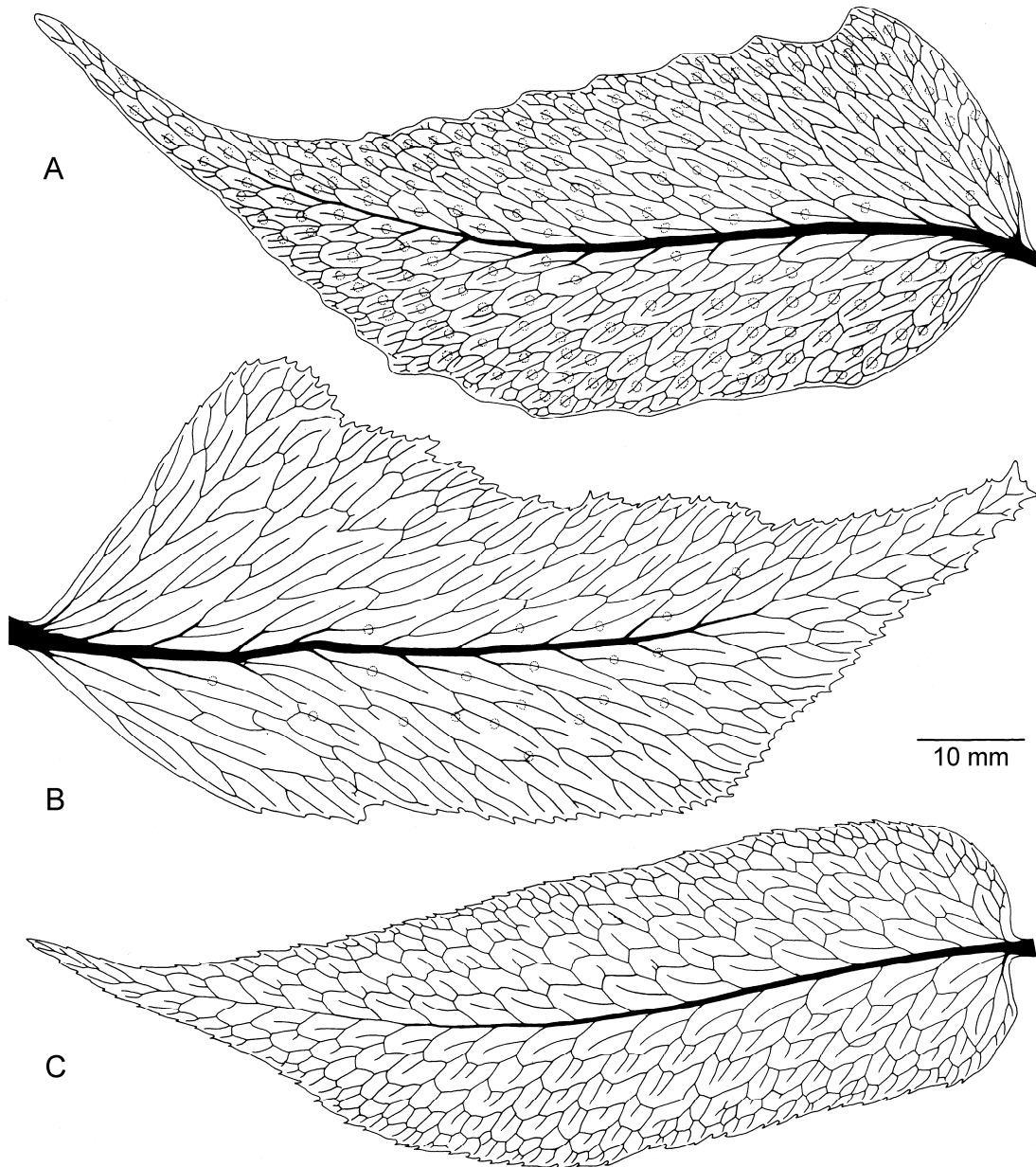


Figure 1. Pinnae of *Cyrtomium* species showing the venation patterns. A, *C. falcatum*, from Roux 501 (NBG); B, *C. luctuosum* from Roux 4648 (NBG), and C, *C. pseudocaryotideum* from Roux 4646 (NBG).

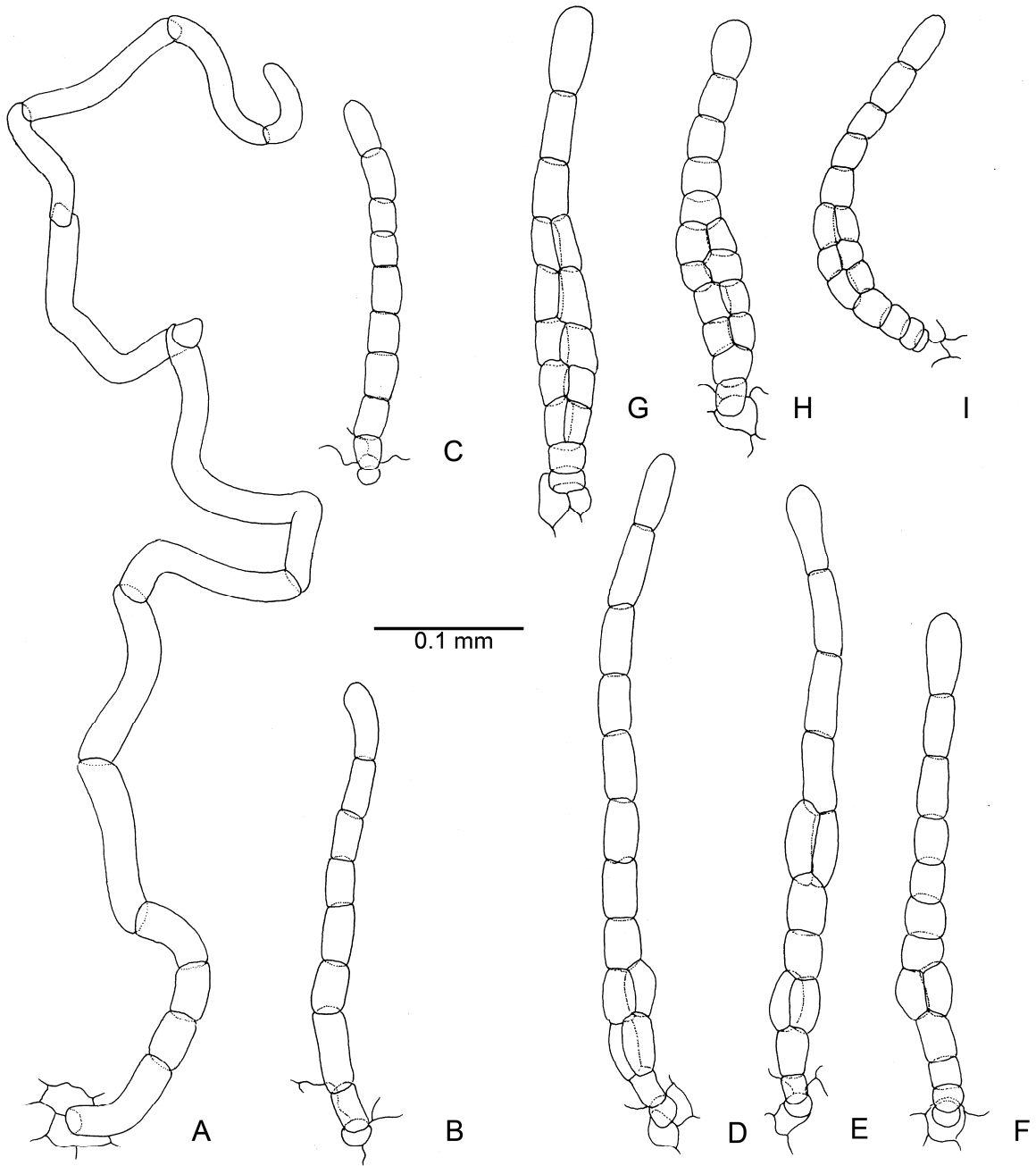


Figure 2. Hairs and paleasters from the abaxial pinna surfaces in *Cyrtomium*. A–C, *C. falcatum*, from Roux 4901 (NBG); D–F, *C. luctuosum*, from Roux 4648 (NBG); G–I, *C. pseudocaryotideum*, from Roux 4544 (NBG).

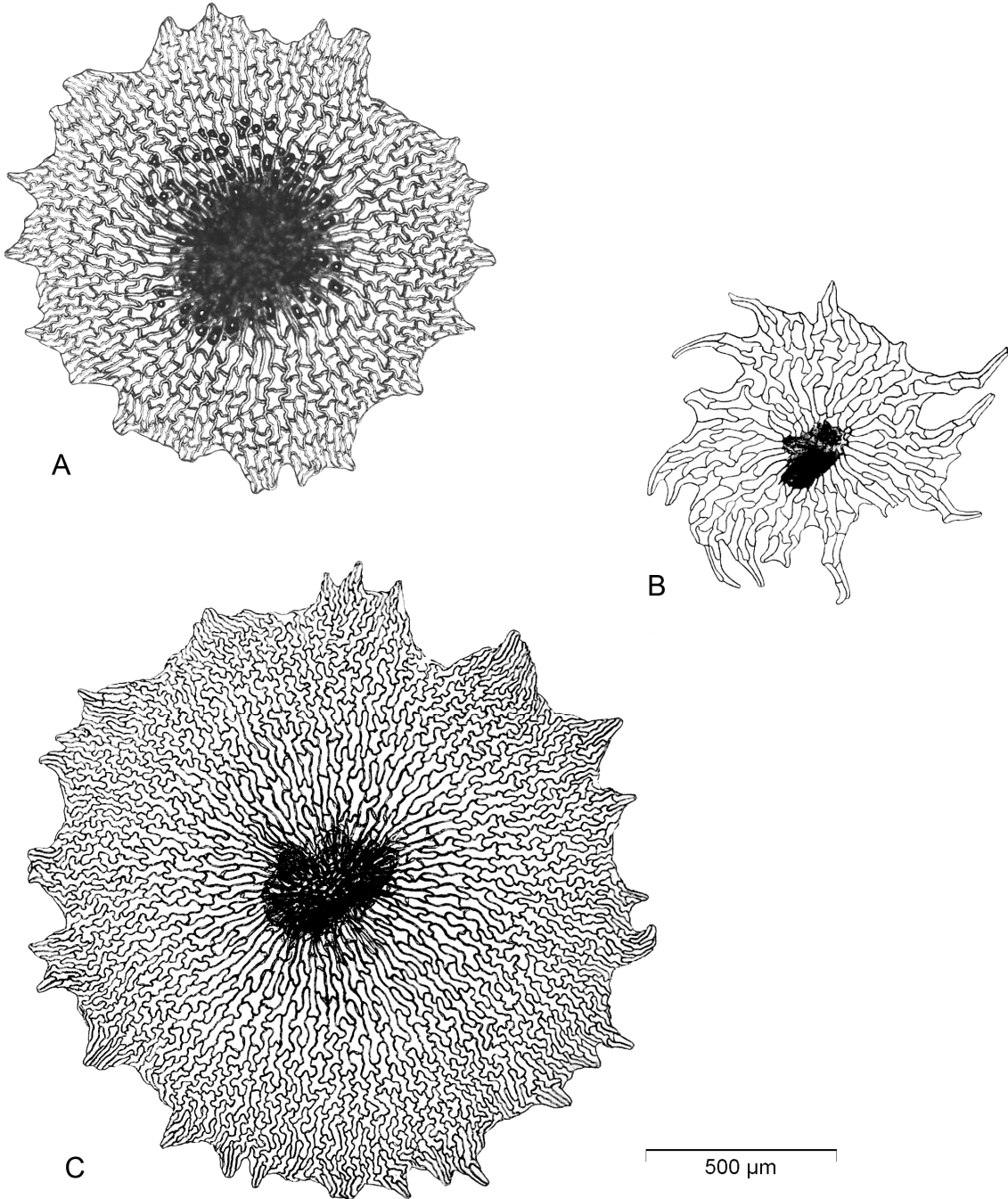


Figure 3. Indusia of *Cyrtomium* species. A, *C. falcatum*, from Roux 501 (NBG); B, *C. luctuosum*, from Meyer 7764 (K); C, *C. pseudocaryotideum*. from Roux 4674 (NBG).

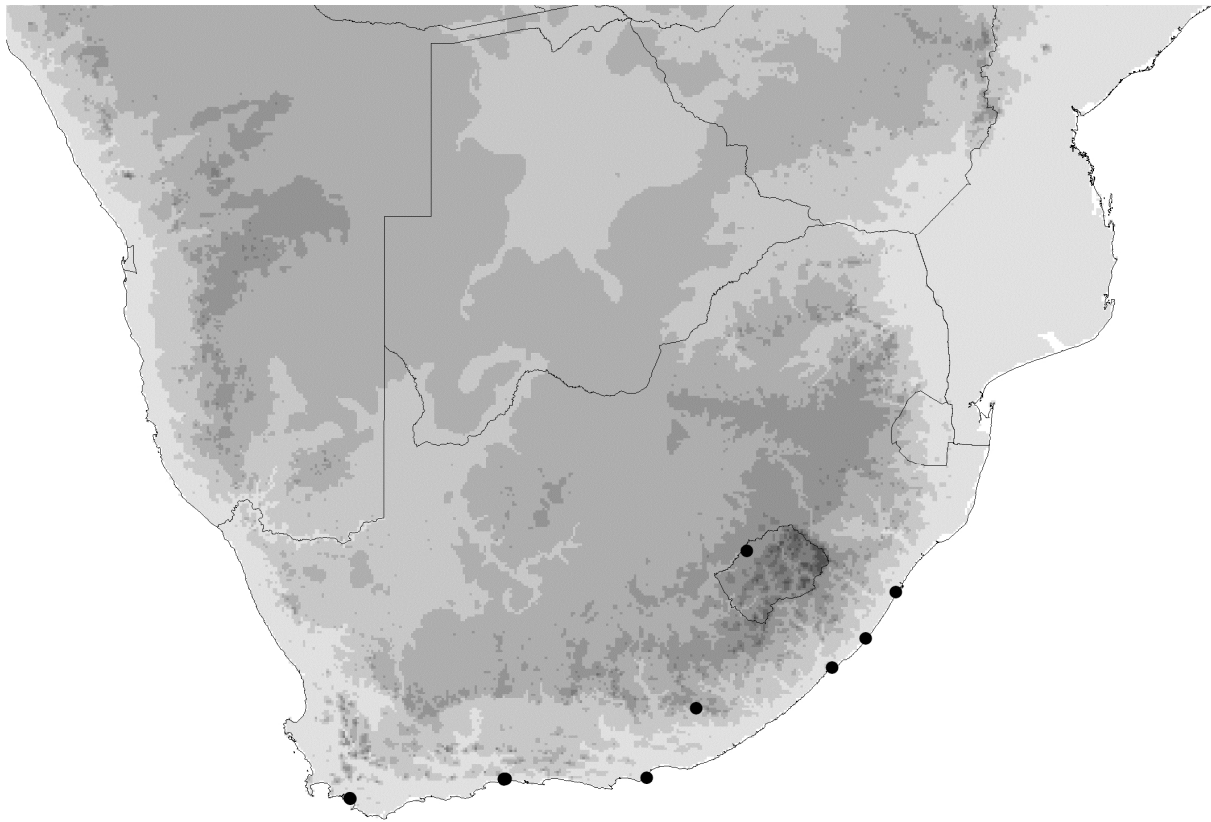


Figure 4. Distribution of *Cyrtomium falcatum* in South Africa and Lesotho.

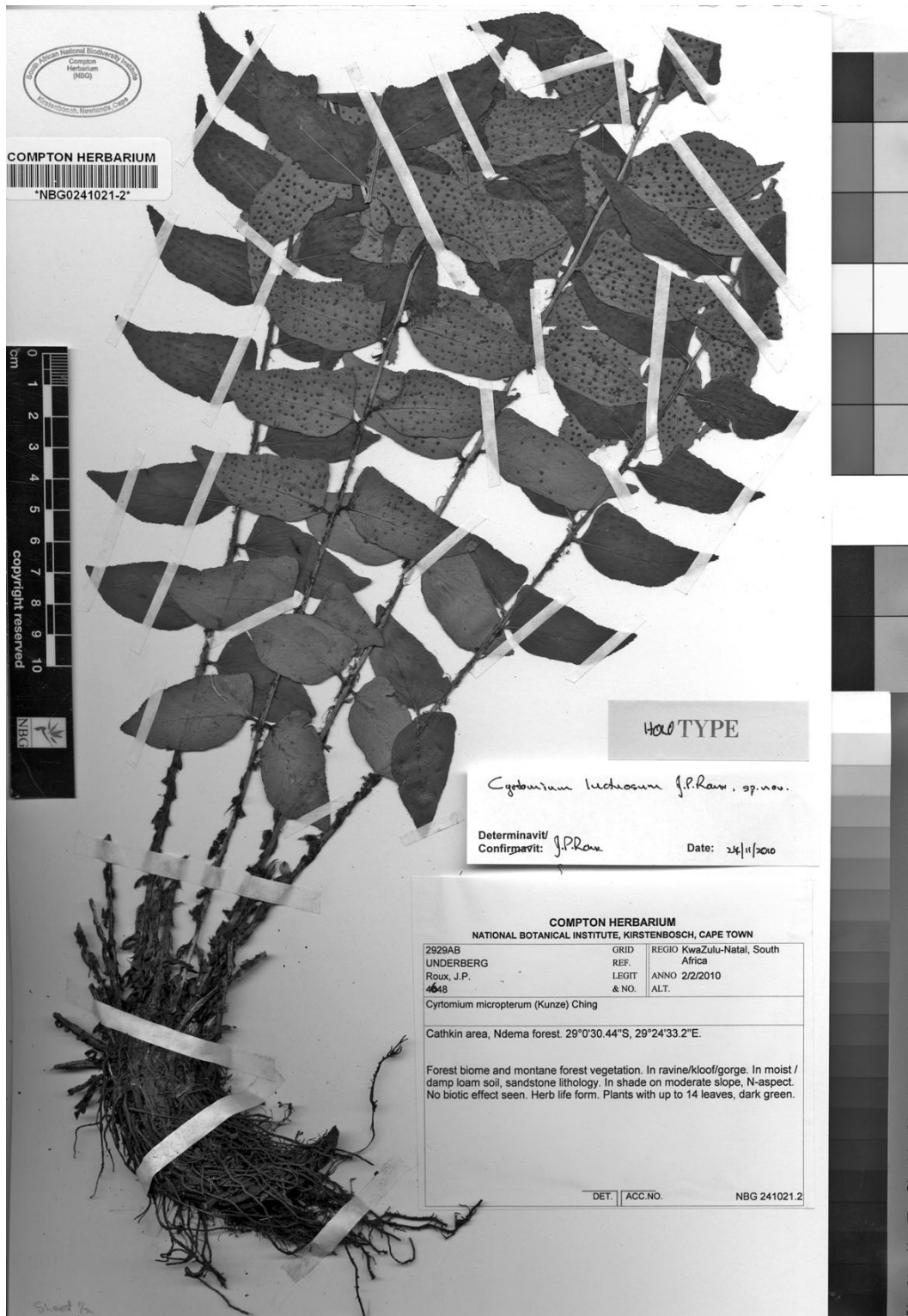


Figure 5. Holotype of *Cyrtomium luctuosum*, Roux 4648 (NBG).

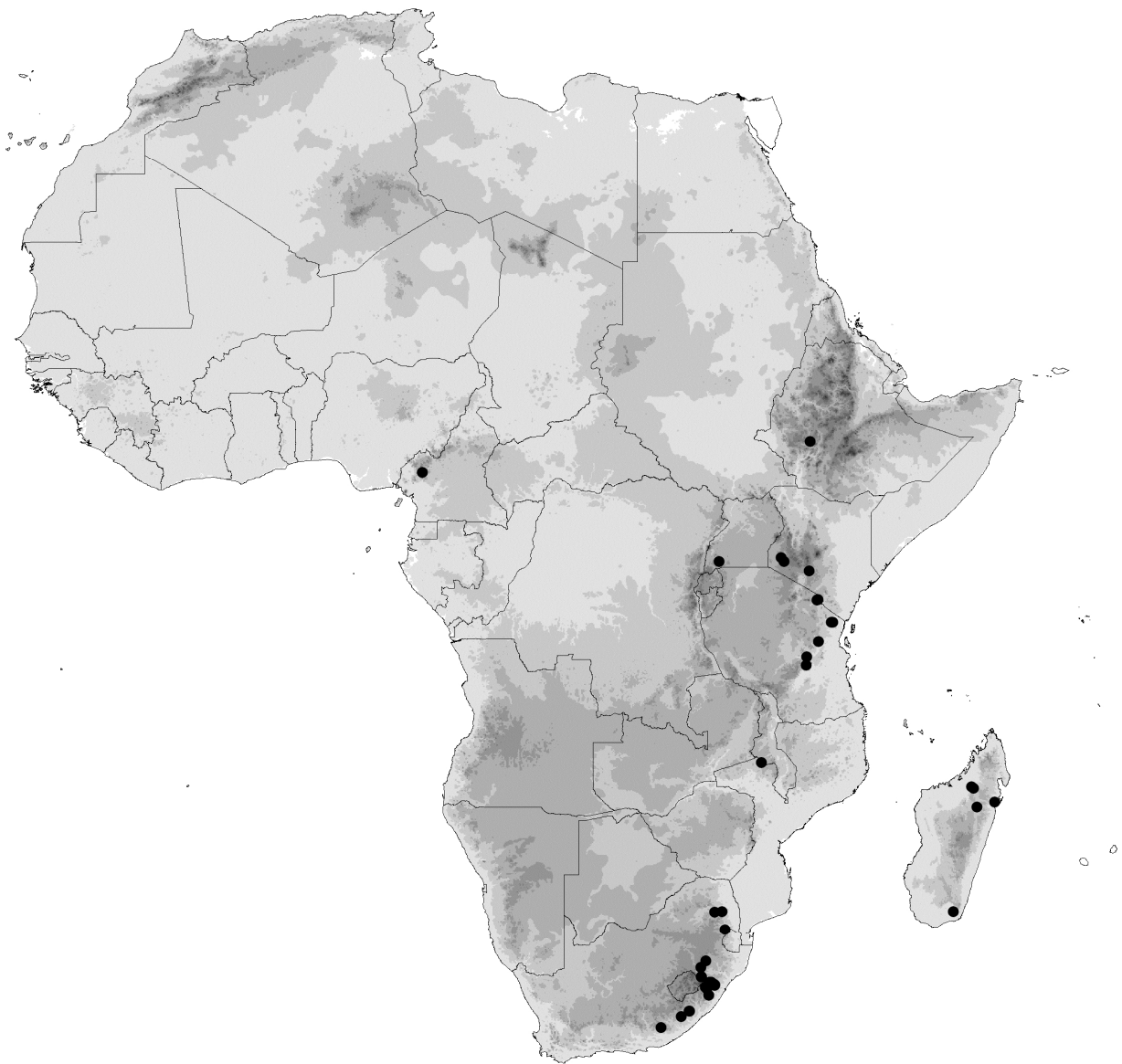


Figure 6. Distribution of *Cyrtomium luctuosum* in Africa and Madagascar.



Figure 7. Holotype of *Cyrtomium pseudocaryotideum*, Roux 4674 (NBG).

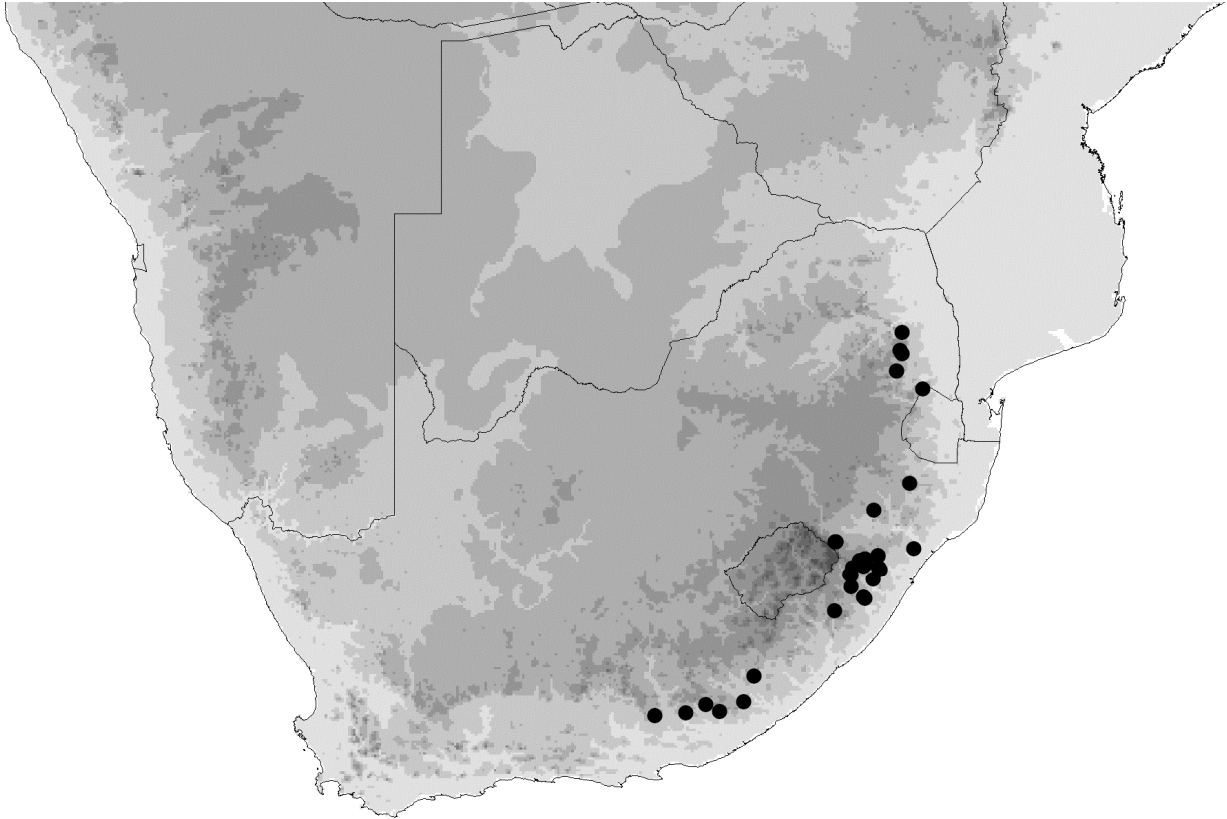


Figure 8. Distribution of *Cyrtomium pseudocaryotideum* in South Africa.