

A TAXONOMIC REVISION OF THE AUSTRALIAN SPECIES OF *HYPOLEPIS*

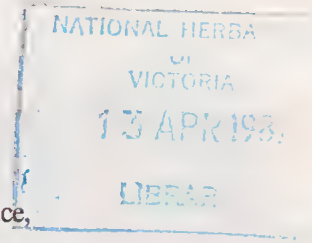
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Abstract

Eight species and two hybrid combinations within the fern genus *Hypolepis* Bernh. are recognised in Australia (including Norfolk Island and Lord Howe Island). The name *H. punctata* (Thunb.) Mett. ex Kuhn is shown to have been misapplied, and material previously referred to this species is described as *H. glandulifera*, sp. nov. Two species, *H. muelleri* and *H. rugosula*, are regarded as endemic. Three species, *H. dicksonioides*, *H. distans* and *H. amaurorachis*, are shared with New Zealand; *H. amaurorachis* is shown to be an earlier name for both *H. australis* and the recently described *H. subantarctica*. Two species, *H. elegans* and *H. glandulifera*, extend into the Pacific but not to New Zealand, and one, *H. tenuifolia*, has a wide distribution in the Indo-Malesian region. Chromosome numbers are newly reported for four species, including $n = 49$ in *H. muelleri*, a number not previously recorded in the genus.

Introduction

This paper forms part of an ongoing revision of *Hypolepis* in the Old World. Brownsey (1983) published some observations on the cytological evolution of the genus as a whole together with some ideas on the relationships of the dennstaedtioid ferns. This was followed by a taxonomic revision of the New Zealand species of *Hypolepis* (Brownsey & Chinnock, 1984). The present paper deals with species in Australia, and a subsequent paper will treat those of Malesia and the Pacific.

A review of the existing literature on *Hypolepis* and the treatment of the genus since it was first established by Bernhardt in 1805 have already been provided by Brownsey & Chinnock (1984). That publication also indicated the important taxonomic characters for distinguishing *Hypolepis* from related genera, and for delimiting individual species.

In Australia, just three species were recognised until the 1940s — *H. punctata*, *H. rugosula* and *H. tenuifolia* (Bentham, 1878; Bailey, 1902), of which only *H. rugosula* was actually described from this country (Labillardière, 1806 — as *Polypodium rugosulum*). However, the true diversity of *Hypolepis* in Australia became more apparent with the description of two new species, *H. muelleri* and *H. australis*, and the re-definition of *H. rugosula*, by Wakefield (1943, 1955, 1956). A sixth species was added when Chinnock (1976) reported the occurrence on King Island, Tasmania, of *H. distans*, a species previously thought to be endemic to New Zealand. Brownsey & Chinnock (1984) accepted *H. dicksonioides*, a taxon first described from Norfolk Island by Endlicher (1833) as *Cheilanthes dicksonioides*, but not generally recognised by subsequent authors. In the present paper, the validity of *H. elegans*, first described by Carruthers (in Seemann, 1873) from Fiji, New Hebrides and Lord Howe Island, is also accepted and plants previously referred to *H. punctata* are distinguished as a new species, *H. glandulifera*. *Hypolepis amaurorachis* is shown to be an earlier name for both *H. australis* and

the recently described *H. subantarctica* from New Zealand. In all, seven species are recognised from the eastern States of Australia, with one extending to Norfolk Island and another to Lord Howe Island; the eighth species is confined to Norfolk Island. Only *H. muelleri* and *H. rugosula* are thought to be endemic to the Australian region.

A summary of the critical characters for distinguishing the species is given in Table 1.

Materials and Methods

This revision of Australian species of *Hypolepis* is based on examination of over 1000 herbarium sheets together with field observations in several different parts of the country. Morphological measurements and distribution maps are based on material in AD, BRI, CANB, HO, MEL, NSW, PERTH and WELT. Only selected lists of material examined are given, but sheets in the above herbaria have been appropriately annotated. Selected material (mostly of type status) from B, BM, CHR, E, FI, K, and W has also been examined.

Measurements given here for all characters (except spores) indicate the full size range observed in the above material; figures in brackets indicate exceptional values found in odd specimens. The figures relating to spores are measurements of the exospore made from spores mounted in gum chloral. The approximate range of mean values to the nearest 1 μm (based on a sample of 20 spores) for a specified number of collections is given for each species, the figures in brackets indicating the extreme sizes of individual spores.

Meiotic chromosome preparations were obtained by fixing young sporangia and staining according to the method described by Manton (1950, pp. 295-296). Material which has been examined cytologically is listed immediately after the chromosome number. Voucher specimens are deposited in WELT.

Fronde shape has been illustrated by silhouettes made from dried specimens, and pinnules and hairs by *camera lucida* drawings of lightly pressed specimens. Photographs of spores were taken on an ETEC Autoscan Scanning Electron Microscope.

Herbarium abbreviations follow Holmgren et al. (1981); author abbreviations are those proposed by Kew (Halliday et al., 1980); serials are abbreviated according to Botanicum Periodicum Huntianum and monographs according to Stafleu & Cowan (1976-1985).

HYPOLEPIS

Hypolepis Bernh., Neues J. Bot. (1 (2): 34 (1805).

Type species: Hypolepis tenuifolia (Forst. f.) Bernh. ex C. Presl, Tent. Pterid. 162 (1836).

Diagnosis

Terrestrial ferns; rhizomes long-creeping, solenostelic; fronds often large, bipinnate or more compound; veins free; scales absent; hairs present on at least some part of lamina, rachis, stipe or rhizome, often abundant, glandular or non glandular, sometimes modified on stipe and rachis into recurved spines; sorus \pm round, ranging in position from marginal and terminal on a vein to submarginal and not quite terminating the vein; indusium a reflexed laminal flap, sometimes well-developed protecting the marginal sorus, more usually only partially reflexed, occasionally totally lacking in species with submarginal sori; spores monoletic; chromosome number $n = 28, 29, (39?), 49, 52, 98, 104$ (Brownsey 1983).

	<i>H. distans</i>	<i>H. amaurorachis</i>	<i>H. rugosula</i>	<i>H. muelleri</i>	<i>H. glandulifera</i>	<i>H. elegans</i>	<i>H. dicksonioides</i>	<i>H. tenuifolia</i>
Stipe diameter	0.7-1 mm	1-3.5 mm	2-5 mm	1.5-5 mm	3-10 mm	4-8 mm	(2) 5-15 mm	3.5-10 mm
Colour of stipe and rachis	Red-brown almost to apex	Mostly dark red-brown, becoming yellow-brown near apex	Mostly red-brown, becoming yellow-brown near apex	Red-brown at very base, but mostly yellow-brown	Chestnut-brown at base, but mostly yellow-brown	Dark chestnut-brown below, becoming yellow-brown or green near apex	Dark chestnut-brown below, becoming yellow-brown or green near apex	Dark chestnut-brown below, becoming yellow-brown or green at apex
Hairs on upper stipe and rachis	Almost glabrous, a few scattered pale brown hairs	Abundant, colourless and pale brown, glandular hairs (to 2 mm)	Abundant, colourless and red-brown, glandular and non-glandular hairs (to 2 mm)	Sparse colourless and red-brown, non-glandular hairs (to 1 mm)	Dense, fine, colourless and brown-tinged, glandular and non-glandular hairs (to 1 mm)	Abundant, colourless and brown-tinged, non-glandular hairs (to 1 mm)	Abundant, colourless, glandular and non-glandular hairs (to 5 mm)	Abundant, colourless, glandular and non-glandular hairs (to 5 mm)
Lamina	2-(3)-pinnate Narrowly elliptic to ovate (15)25-35 x 9-12 cm	2-3-pinnate Narrowly ovate to ovate 15-55 x 10-35 cm	2-3(4)-pinnate Ovate to broadly elliptic 35-115 x 20-60 cm	1-3-pinnate Rhombic to broadly ovate 20-100 x 15-70 cm	2-4-pinnate Broadly ovate or broader than long 45-180 x 40-150 cm	2-4(5)-pinnate Broadly ovate or broader than long 40-100 x 45-80 cm	2-4(5)-pinnate Broadly ovate to broadly elliptic (20)35-135 x (15) 35-110 cm	2-4(5)-pinnate Broadly ovate to broadly elliptic 25-200 x 28-140 cm
Hairs on underside of lamina	Virtually glabrous	Dense, colourless, glandular and non-glandular hairs on margins and all surfaces, 0.3-0.7(1) mm	Abundant, colourless and red-brown, glandular and non-glandular hairs on veins and midribs, 0.3-1 mm	Abundant, colourless, stiff, slightly curved, non-glandular hairs on veins and midribs, 0.3-0.8 mm	Dense, fine, colourless and brown-tinged, glandular and non-glandular hairs on all surfaces, 0.1-1 mm	Abundant, colourless and brown-tinged, stiff, curved, sharply pointed, non-glandular hairs on veins and midribs, to 1 mm	Abundant, colourless, glandular and non-glandular hairs on veins and midribs, 0.2-1(1.5) mm	Dense, fine, colourless, glandular and non-glandular hairs, 0.1-0.8(1) mm
Soral hairs	Absent	Absent	Absent	Present	Absent	Absent	Absent	Absent
Soral protection	Reflexed, incised membranous flap	Slightly reflexed, green laminal flap with a few short hairs	Unprotected, or with slightly reflexed, green laminal flap with a few short hairs	Unprotected	Unprotected, or with slightly reflexed, green laminal flap	Well-developed, reflexed, membranous flap	Well-developed, reflexed, incised, tapering, mostly green flap often bearing a few glandular hairs on margin	Well-developed, reflexed, incised, broad, membranous flap sometimes bearing a few glandular hairs on upper surface
Spore size	(34)37-38(43) x (21)24-25(27) μ m	(29)32-34(38) x (18)20-22(26) μ m	(34)37-40(42) x (21)24-27(29) μ m	(29)31-34(37) x (18)20-22(25) μ m	(31)33-35(37) x (20)21-26(29) μ m	(24)26-28(31) x (16)17-19(21) μ m	(36)38-40(44) x (20)24-26(28) μ m	(30)33-36(39) x (17)20-23(25) μ m
Chromosome number	n = 28 (in N.Z.)	n = 52 (in N.Z.)	n = c. 104	n = 49	n = 52	Unknown	n = 104 (in N.Z.)	n = 52

Table 1. Summary of the most important characters for distinguishing Australian species of *Hypolepis*.

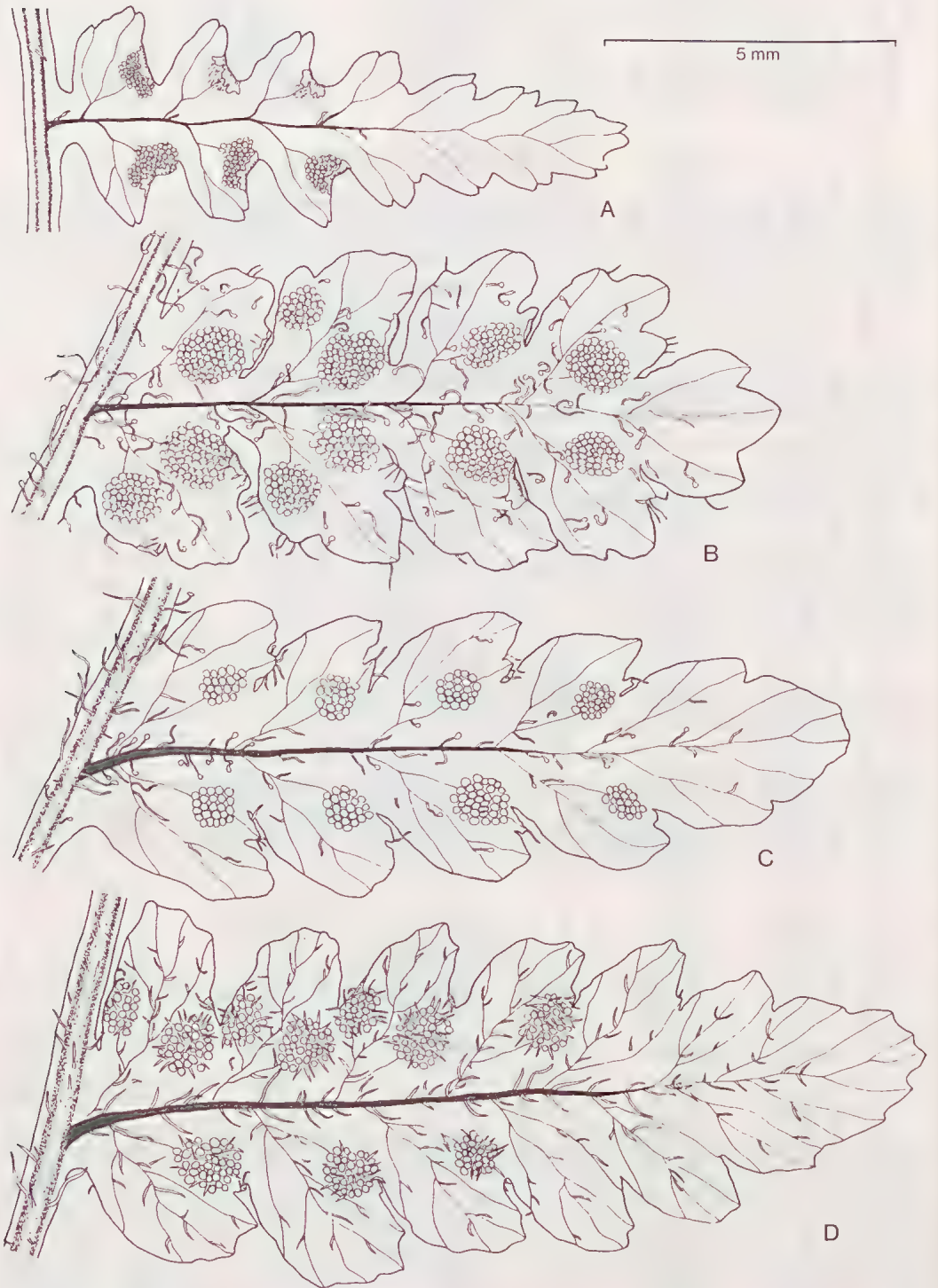


Fig. 1. *Camera lucida* drawings of pinnules. A, *Hypolepis distans*; B, *H. amaurorachis*; C, *H. rugosula*; D, *H. muelleri*.

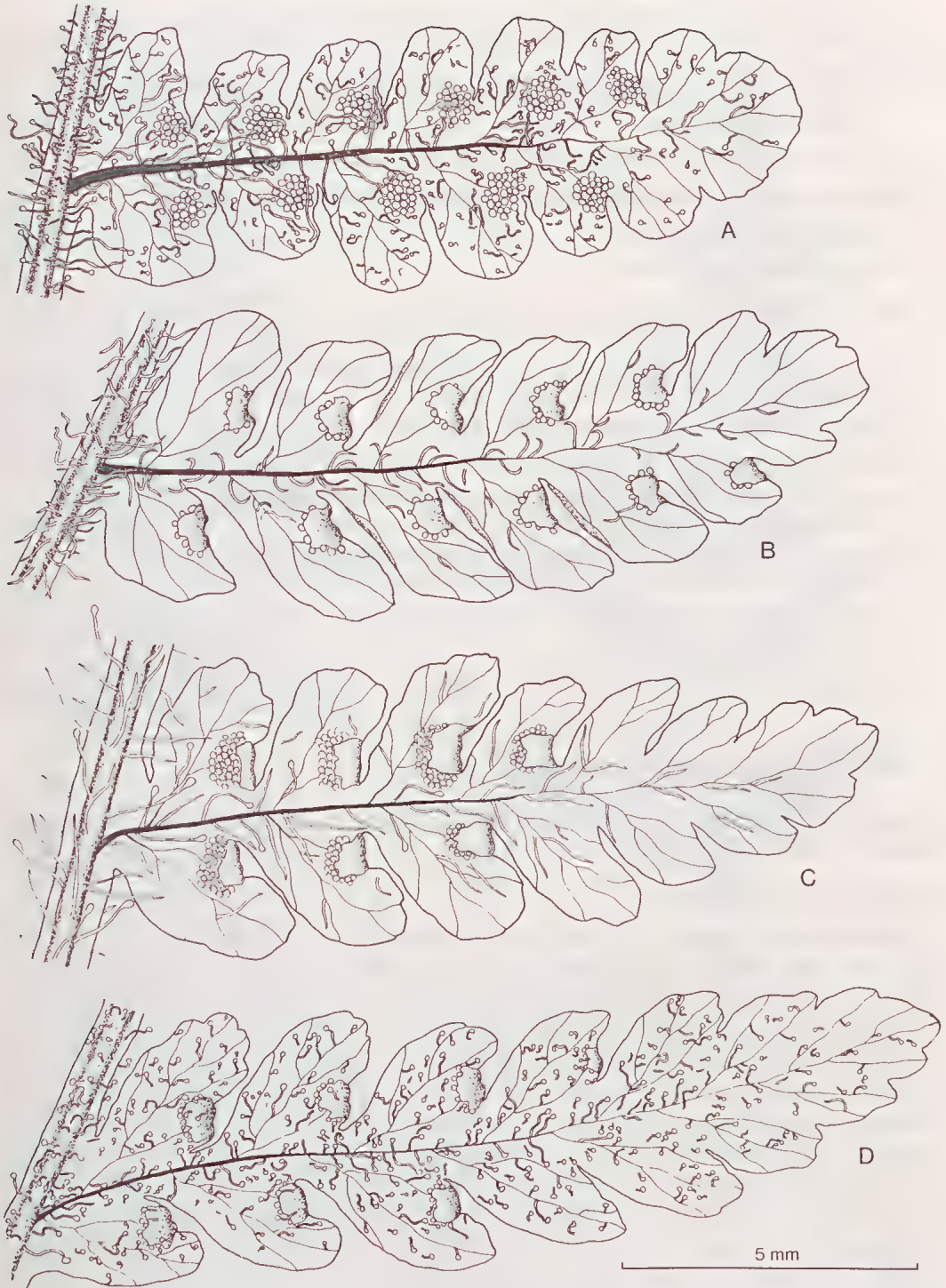


Fig. 2. Camera lucida drawings of pinnules. A, *Hypolepis glandulifera*; B, *H. elegans*; C, *H. dicksonioides*; D, *H. tenuifolia*.

Key to Australian species of *Hypolepis*

1. Veins of ultimate pinnules reaching margin at a small sinus (Fig. 1A); lowest pair of primary pinnae arising at c. 90° to rachis, bearing secondary pinnae of approximately equal length 1. *H. distans*
 Veins of ultimate pinnules never ending in a sinus (Figs 1B-D, 2A-D); lowest pair of primary pinnae arising at 20-80° to rachis, bearing secondary pinnae which decrease markedly in length along the primary pinnae 2
2. Sporangia protected by well-developed, reflexed, at least partially membranous indusium 3
 Sporangia unprotected, or protected only by a slightly reflexed, green segment of the lamina 5
3. Glandular hairs absent from frond 6. *H. elegans*
 Glandular hairs abundant on frond 4
4. Hairs on lamina undersurface fine, 0.1-1 mm long; indusial flap mostly membranous, broad, sometimes bearing glandular hairs on upper surface; spores 33-36 x 20-23 μm 8. *H. tenuifolia*
 Hairs on lamina undersurface stouter, 0.2-1.5 mm long; indusial flap mostly green, tapering, often bearing glandular hairs on margin; spores 38-40 x 24-26 μm 7. *H. dicksonioides*
5. Hairs present in sorus; glandular hairs always absent from frond 4. *H. muelleri*
 Hairs absent from sorus; glandular hairs usually present on frond 6
6. Stipes mostly yellow-brown, 3-10 mm diameter; laminae quadripinnate, 45-180 x 40-150 cm, densely covered in fine colourless hairs (Fig. 8) 5. *H. glandulifera*
 Stipes mostly red-brown, 1-5 mm diameter; laminae tripinnate (rarely quadripinnate), 15-115 x 10-60 cm, more sparsely covered in stout, colourless or red-brown hairs (Figs 3B, 5) 7
7. Laminae 15-55 x 10-35 cm, bearing mostly colourless hairs on underside; spores 32-34 x 20-22 μm 2. *H. amauro-rachis*
 Laminae 35-115 x 20-60 μm , bearing both colourless and red-brown hairs on underside; spores 37-40 x 24-27 μm 3. *H. rugosula*

1. *Hypolepis distans* Hook., Sp. Fil. 2: 70, t. 95c (1852).

Lectotype: *W. Colenso 1782*, [Hutt Valley, New Zealand], no date (K; chosen by Brownsey & Chinnock 1984).

Description (Figs 1A, 3A, 13A)

Rhizome long-creeping, 1-2.5 mm diameter, abundantly covered in dark red-brown hairs 2-3.5 mm long. *Stipes* 5-10 cm long, 0.7-1 mm diameter, dark red-brown, bearing a few scattered red-brown hairs at base. *Laminae* narrowly elliptic to elliptic or ovate, (15-) 25-35 x 9-12 cm, rather stiff and harsh to the touch, bipinnate at apex to almost tripinnate at base. Rachises dark red-brown, becoming paler only at the very apex, bearing scattered pale brown non-glandular hairs. *Primary pinnae* in 20-40 pairs, opposite or subopposite, arising at c. 90° to rachis, the longest at or below middle 5-7 x 1.7-2.5 cm, narrowly ovate or triangular, midrib narrowly winged throughout; lowest pair orientated at 90° to plane of frond in largest specimens. *Secondary pinnae* sessile or shortly stalked, ovate to narrowly ovate, the longest 0.8-1.3 x 0.4-0.5 cm, doubly serrate with 3-9 primary serrations on each side of longest secondary pinna; those on lower primary pinnae \pm equal in length, only decreasing in size towards the very apex of each pinna. *Veins* reaching margin at a sinus (emarginate). Hairs virtually absent on upper surface of frond, a few scattered pale-brown non-glandular hairs on underside of lamina veins and pinna midribs. *Sori* \pm ovate, marginal, protected by reflexed incised membranous flaps, lacking hairs amongst sporangia. *Spores* appearing dark brown under light microscope with reticulate perispores lacking obvious projections, (34-) 37-38 (-43) x (21-) 24-25 (-27) μm (1 population).



Fig. 3. Silhouettes of fronds of A, *Hypolepis distans* ($\times 1/4$) and B, *H. amaurorachis* ($\times 1/3$).

Chromosome number

No chromosome number has been obtained from Australian material, but Brownsey & Chinnock (1984) recorded $n = 28$ in 5 populations from New Zealand, the evolutionary significance of which is discussed fully by Brownsey (1983). The larger size of the spores in Australian as compared with New Zealand material ($37-38 \times 24-25 \mu\text{m}$ cf. $31-34 \times 19-21 \mu\text{m}$) suggests the possibility of a higher chromosome number which should be investigated.

Distribution (Fig. 4)

In Australia, this species is known only from scattered localities in the north-east of King Island, from where it was first recorded by Chinnock (1976). It occurs also in New Zealand and the Chatham Islands (Brownsey & Chinnock, 1984).

Specimen examined

TASMANIA: P.F. Barnett s.n., King Is., 4 km S of Penny's Lagoon, iv. 1973 (AD 97529194, MEL 77350, NSW P10101).

Ecology

On King Island, *H. distans* grows under *Melaleuca squarrosa*/*Leptospermum scoparium* scrubland bordering swampy ground, usually in organic material at the base of *Todea barbara* and *Restio tetraphyllus*. This habitat is comparable to that in New Zealand where it grows on humus or decomposing logs.

Notes

Hypolepis distans can be distinguished immediately from all other species by its relatively long, narrow frond, the pinnae arising in opposite or subopposite pairs at right angles to the rachis, the veins ending in emarginations (Fig. 1A), the thin, highly polished, rather brittle stipe and the dark brown spores with virtually no perispore projections (Fig. 13A).



Fig. 4. Australian distributions of A, *Hypolepis rugosula* ●; B, *H. amaurorachis* ○ and *H. distans* ■.

2. *Hypolepis amaurorachis* (Kunze) Hook., Sp. Fil. 2:62 (1852).

Cheilanthes amaurorachis Kunze, *Linnaea* 23: 242, 306 (1850).

Lectotype: *G. Kunze s.n.*, Hort. Lips. ex Tasmania (B 74521, here chosen).

Hypolepis australis Wakef., *Victorian Naturalist* 72: 95 (1955).

Holotype: *N.A. Wakefield 107*, Arte R., Victoria, Australia, 23.iii. 1941 (MEL 1512588).

Hypolepis subantarctica Brownsey et Chinnock, *New Zealand J. Bot.* 22: 57 (1984).

Holotype: *D.R. Given s.n.*, Campbell Is., New Zealand, cultivated at CHR as G11407 (WELT P11518; isotypes AK, CHR).

Description (Figs 1B, 3B, 13B)

Rhizome long-creeping, 2-2.5 mm diameter, covered in red-brown hairs. *Stipes* 7-23 (-45) cm long, 1-3.5 mm diameter, dark red brown, bearing abundant colourless or pale brown glandular hairs up to 2 mm long. *Laminae* narrowly ovate to ovate, 15-55 x 10-35 cm, bipinnate at apex, tripinnate at base. *Rachises* dark red-brown at base becoming paler above and often green at apex, densely covered in colourless or pale-brown glandular hairs up to 1.5 mm long. *Primary pinnae* in 15-30 pairs + pinnatifid apex, opposite or alternate, the longest below the middle 5-20 x 2-9 cm; upper ones parallel-sided or narrowly ovate, lower ones ovate or narrowly ovate. *Secondary pinnae* ovate to \pm parallel-sided, the longest 0.5-4.5 x 1-2 cm, those on the lower primary pinnae decreasing markedly in length along the pinnae. *Tertiary pinnae* up to 0.6 x 1 cm, deeply incised on larger specimens, bearing 1-3 pairs of sori. *Veins* reaching margin at a tooth apex. *Hairs*: colourless glandular hairs (0.3-0.7 mm on laminae, up to 1 mm on midribs) interspersed with a few bristly colourless hairs densely covering both surfaces of lamina, lamina margins, and pinna midribs and costae. *Sori* round, originating away from margin, protected by partially reflexed lamina segments which often bear a few short hairs, lacking hairs amongst sporangia. *Spores* very pale under light microscope, perispores of inter-connecting flattened projections, (29-) 32-34 (-38) x (18-) 20-22 (-26) μm (7 populations).

Chromosome number

No chromosome number has been obtained from Australian material, but Brownsey & Chinnock (1984) recorded $n = 52$ from one population of this species (as *H. subantarctica*) from Campbell Island, New Zealand.

Distribution (Fig. 4)

Southern Victoria, Tasmania.

Outside Australia, this species occurs only in New Zealand in Fiordland, and on Auckland and Campbell Islands (Brownsey & Chinnock, 1984).

Representative specimens (18 specimens seen)

VICTORIA: *A.C. Beauglehole 41125*, Gable End, 4 km SW of Mt Wellington, 8.i.1973 (AD, MEL); *W. Forsyth s.n.*, Bonang, v.1908 (NSW P10051); *N.A. Wakefield 4865*, Reedy R., East Gippsland, 14.i.1959 (MEL); *N.A. Wakefield & J.H. Willis s.n.*, Upper Calder R., Otway Ranges, 19.xi.1955 (NSW P10099).

TASMANIA: *P.J. Brownsey s.n.*, Myrtle Forest Gully, Mt Wellington, 3.viii. 1981 (WELT P12245); *P.J. Brownsey s.n.*, Betts Falls Track, Mt Wellington, 3.viii.1981 (WELT P12246); *A.M. Gray s.n.*, Godkin Ridge, Cleveland Track, SE of Luina, 21.vii.1979 (HO 31126); *A.M. Gray s.n.*, L. King William, Guelph Bas.n, 19.vii.1975 (HO 27402); *J. Somerville s.n.*, Surprise V., nr Mt Arrowsmith, 14.i.1941 (HO 1151); *Stuart s.n.*, Mt d'Laperouse, 1.iii.1857 (MEL 1512585-6).

Ecology

Hypolepis amaurobachis is an uncommon species in Australia, as it also is in New Zealand, being confined to cool upland streambeds and wet forest situations in southern Victoria and Tasmania. It grows on damp ground, on rotten logs and occasionally in moist rock crevices, usually as scattered individual plants. It has been recorded at an altitude up to 750 m.

Notes

Hypolepis amaurobachis can be distinguished from most other species by its red-brown stipe and rachis, abundant glandular hairs and absence of both soral hairs and a well-developed indusium. However, it is very closely related to *H. rugosula* and distinguished only by its smaller frond (15-55 x 10-35 cm cf. 35-115 x 25-60 cm), more densely hairy laminae, mostly colourless hairs, more finely dissected pinnae and smaller spores (32-34 x 21-22 μm cf. 37-40 x 24-27 μm). The difference in spore size almost certainly reflects a difference in chromosome number, but this has yet to be determined conclusively in Australian material. New Zealand material of *H. amaurobachis* is tetraploid with $n = 52$, whilst Australian *H. rugosula* is octoploid with $n = c. 104$.

The two species have somewhat different habitats, *H. amaurobachis* being confined to cool, wet, forest situations, whereas *H. rugosula* is often found in more open places. Nevertheless, in parts of Tasmania and Victoria the two occur together in several localities where they probably hybridise, although this remains to be confirmed.

Hypolepis amaurobachis has until now been known in Australia as *H. australis*, a name first used by Wakefield (1955). However, the taxon was actually first described as *Cheilanthes amaurobachis* by Kunze (1850) from material in cultivation at Leipzig originally collected in Tasmania. Hooker (1858) transferred the species to the genus *Hypolepis* but, since then, the name has been almost completely ignored by Australian botanists. The original description from cultivated material was not entirely adequate, and the destruction of Kunze's herbarium at LZ left little chance for modern botanists to trace the attribution of the name. However, very recently, an authentic specimen comprising two fronds has been located at B (photo WELT). The morphology and spore size indicate clearly that the two fronds belong to the species previously known as *H. australis*, and not to the more widespread *H. rugosula*, as might have been expected. Their Tasmanian origin is consistent with this finding. Since the name *H. amaurobachis* predates *H. australis* by almost a century it must take precedence. The recently described *H. subantarctica* from New Zealand (Brownsey & Chinnock, 1984) must also be reduced to synonymy, being in every way identical to the Australian plant.

3. *Hypolepis rugosula* (Labill.) J. Smith, Comp. Bot. Mag. New Ser. 2: 8 (1846) as "rugulosa". — *Polypodium rugosulum* Labill., Nov. Holl. Pl. 2: 92, t. 241 (1807). — *Phegopteris rugosula* (Labill.) Fée, Gen. Fil. 243 (1852). — *Polypodium punctatum* var. *rugosulum* (Labill.) Hook. et Baker, Syn. Fil. 312 (1868) as "rugulosum". — *Dryopteris punctata* subsp. *rugosula* (Labill.) C. Chr., Ind. Fil. 287 (1905). — *Dryopteris punctata* var. *rugosula* (Labill.) Domin, Biblioth. Bot. 85: 41 (1913).

Lectotype: J.J. Labillardière s.n., [van Diemen's Land], no date (FI, here chosen).

Description (Figs 1C, 5, 13C)

Rhizome long-creeping, 2-3 mm diameter, densely covered in red-brown hairs up to 2 mm long. Stipes 10-95 cm long, 2-5 mm diameter, red brown at base, chestnut-brown above, covered at base in red-brown hairs similar to those of rhizome, sparsely hairy above, slightly rough. Laminae ovate, broadly ovate or broadly elliptic, 35-115 x 20-60 cm, bipinnate at apex, tri- or quadripinnate at base. Rachises chestnut-brown at base, yellow-brown at apex, covered in colourless and red-brown non-glandular and usually also glandular hairs up to 1.5 mm long,



Fig. 5. Silhouette of a frond of *Hypolepis rugosula*.

densely so on upper surface. *Primary pinnae* in 20-30 pairs, opposite or subopposite, the longest at or near the base 13-55 x 5-25 cm, upper ones narrowly triangular or narrowly ovate, basal ones ovate. *Secondary pinnae* narrowly ovate or ovate, the longest 3-15 x 1.2-5 cm, those on the lower primary pinnae decreasing markedly in length along the midribs, the midribs narrowly winged. *Tertiary pinnae* \pm parallel-sided, obtuse or acute, the longest 0.7-4 x 0.3-1.5 cm, divided on larger fronds almost to the midrib into quaternary pinnae up to 0.9 x 0.4 cm. *Veins* reaching margin at tooth apices. *Hairs*: colourless and red-brown non-glandular and usually also glandular hairs on underside of lamina veins and pinna midribs, 0.3-1 mm long, the red-brown hairs generally slightly longer than the colourless ones and more common on the midribs; similar but denser hairs on the upper surfaces; short non-glandular hairs sometimes present on the lamina margins adjacent to sori, but otherwise usually absent. *Sori* round, originating away from margin, unprotected or protected only by partially reflexed lamina segments, lacking hairs amongst sporangia. *Spores* very pale under light microscope, perispores of flattened inter-connecting projections, (34-) 37-40 (-42) x (21-) 24-27 (-29) μm (7 populations).

Chromosome number

$n = c.104$ (Fig. 14D)

P.J. Brownsey s.n., Aire R., Otway Range, Victoria, 5.x.1985 (WELT P13649).

Distribution (Fig. 4)

Western Australia, South Australia, southern Queensland, New South Wales, Victoria and Tasmania.

Endemic; possibly introduced to Western Australia from the eastern States.

New Zealand plants referred to *H. rugosula* by Allan (1961) belong to one of three species, *H. rufobarbata* (Col.) Wakef., *H. lactea* Brownsey & Chinnock and *H. amaurorachis*, or to the hybrid *H. ambigua* \times *rufobarbata* (Brownsey & Chinnock 1984, p. 72).

Representative specimens (131 specimens seen)

WESTERN AUSTRALIA: *A.R. Annel s.n.*, Parwill Well, W of Manjimup, viii. 1982 (PERTH).

SOUTH AUSTRALIA: *R. Bates 2650*, 3 km NE of Marshes Swamp, Glencoe, 6.iii. 1977 (AD); *P.J. Brownsey s.n.*, nr Mt Compass, S of Adelaide, 30.vii.1981 (WELT P12242); *R. Schodde 528*, Kangaroo Is., 8 km E of Cape Borda, 29.xii.1957 (CANB, AD); *I.B. Wilson 1002*, Mt Edward, 5.ix.1969 (AD).

QUEENSLAND: *P. Grimshaw s.n.*, South Bald Rock, Girraween Nat. Park, 28.v.1978 (BRI 339960-1); *J. Shirley s.n.*, Roberts Plateau (BRI 114678); *C.T. White s.n.*, MacPherson Range, xii.1918 (BRI 114683, NSW P4234).

NEW SOUTH WALES: *E.F. Constable s.n.*, Mt Tambo Limb, 12.xii.1948 (NSW P5608); *E.F. Constable s.n.*, Mt Spirabo, 20 km SSE of Tenterfield, 7.v.1961; *R. Coveny 9190* & *S.K. Roy*, below Govett's Leap, Blackheath, 15.iii.1977 (NSW); *M. Gray 5459*, Two Sticks Rd, Blue Range, 21.v.1964 (CANB); *N.A. Wakefield 179*, Wonboyn Rd, 11.i.1942 (MEL); *E. Yauba s.n.*, Devils Creek, 13.i.1950 (MEL 77351).

VICTORIA: *A.C. Beaglehole 38232*, Rosedale Shire, 5 miles SW of Gormandale, 16.iii.1972 (MEL); *A.C. Beaglehole 41430*, East Gippsland, Nunniong Plateau, Diggers Hole Track, 10.ii.1973 (MEL); *R.J. Chinnock P812*, Otway Range, Turtin's Track, 5km W of Hains Junction, 31.xii.1973 (MEL); *J.H. Willis s.n.*, Mt Buffalo Nat. Park, track to Monolith, 21.ii.1963 (MEL 47078, 50286); *J.H. Willis s.n.*, Smythesdale Forest, 20 km SW of Ballarat, 7.i.1974 (MEL 504735).

TASMANIA: *P.J. Brownsey s.n.*, Myrtle Forest Gully, Collinsvale, 3.viii.1981 (WELT P12243); *P.J. Brownsey s.n.*, Serpentine Dam, Gordon R. road, 6.viii.1981 (WELT P12244); *I.D. Cameron s.n.*, Tarra Ck, King Is., 6.iii.1966 (HO 27125-6); *R.J. Chinnock P984*, Mackintosh R., 1.4 km N of Tullah, 30.i.1974 (AD, HO); *D.I. Morris 7845*, Flowery Gully, Tamar, 30.xi.1978 (HO).

Ecology

Hypolepis rugosula is found most frequently in streambeds, damp gullies, along drainage ditches and in swampy ground, usually in clearings, forest margins or open situations, on soil or

sometimes on rock. On disturbed soils or swampy ground it can form extensive colonies, but it is usually restricted to small patches. It grows at higher altitudes and produces fronds of smaller dimensions in the northern part of its range, and has been recorded up to 1400 m altitude.

Notes

Hypolepis rugosula can be distinguished from most other species by its red-brown stipe and rachis, absence of soral hairs and absence of a well-developed indusium. Normally it has colourless and red-brown glandular hairs on the underside of the laminae and costae, but sometimes these are very sparse or even replaced altogether by non-glandular hairs. In Australia, it can only be confused with *H. amaurorachis* whose characteristics are given above (p. 10). Its close relationship to the New Zealand *H. ambigua* has been discussed elsewhere (Brownsey & Chinnock, 1984, p. 72).

4. *Hypolepis muelleri* Wakef., Victorian Naturalist 60: 42, t. 2 (1943).

Holotype: N.A. Wakefield 114, Mt Drummer, East Gippsland, Victoria, Australia (MEL 1511490-1).

Description (Figs 1D, 6, 13D)

Rhizome subterranean, long-creeping, 1.5-5 mm diameter, sparsely covered in red-brown hairs up to 1 mm long. *Stipes* 12-80 (-100) cm long, 1.5-5 mm diameter, red-brown at very base, yellow-brown above, covered in red-brown hairs similar to those of rhizome at base, \pm glabrous above, smooth, often producing roots at base. *Laminae* rhombic, ovate or broadly ovate, 20-100 (-150) x 15-70 cm, pinnate at apex, tripinnate to almost quadripinnate below, generally rather coriaceous. *Rachises* yellow-brown throughout, sparsely covered in colourless or red-brown non-glandular hairs up to 1 mm long. *Primary pinnae* in 15-30 pairs, opposite or subopposite, the longest at or near the base 13-45 x 6.5-28 cm, upper ones narrowly triangular, basal ones triangular to broadly triangular. *Secondary pinnae* narrowly ovate or \pm parallel-sided, often with midribs narrowly winged, the longest 3.5-15 x 1.2-5 cm, those on the lower primary pinnae decreasing markedly in length along the midribs. *Tertiary pinnae* ovate or \pm parallel-sided, obtuse to acute, the longest 0.6-2.5 x 0.3-1 cm. *Veins* reaching margin at tooth apices. *Hairs*: glistening, colourless, or sometimes brown-tinged, non-glandular, stiff, often slightly curved, on underside of lamina veins and pinna midribs, 0.3-0.8 mm long; similar, but generally slightly shorter hairs also on upper surfaces; occasional very short hairs present on lamina margins, but usually absent. *Sori* round, often absent from lower 2 pairs of pinnae, originating away from margin, unprotected, short hairs (0.2-0.5 mm long) intermixed with sporangia. *Spores* very pale under light microscope, perispores of inter-connecting flattened projections, (29-) 31-34 (-37) x (18-) 20-23 (-25) μ m (6 populations).

Chromosome number

n = 49 (Fig. 14A)

R.J. Chinnock 5851 & P.J. Brownsey, nr Pomona, 1 km E of Bruce Highway, Queensland, 19.x.1982 (WELT P11639, AD 98304275).

A chromosome number of n = 49 has not previously been reported in *Hypolepis*, but is not totally unexpected since n = 98 has been consistently recorded for Japanese material of *H. punctata* (Kurita, 1967, 1972; Mitui, 1975, 1976). Kurita (1972) also reported n = 98 in an unknown species cultivated in the Koishikawa Botanical Garden, reputedly of Australian origin. The occurrence of n = 49 and n = 98 is evidence of another aneuploid line within *Hypolepis*, this one presumably being derived from species with n = 52. Brownsey (1983) has

already demonstrated one aneuploid line linking American *H. nigrescens* ($n = 29$) and Australasian *H. distans* ($n = 28$) to a probable base number of $n = 26$ in the genus.



Fig. 6. Silhouette of a frond of *Hypolepis muelleri*.

It is evident from Figure 14A that some bivalents in *H. muelleri* are considerably bigger than the others, suggesting that reduction in chromosome number may have resulted from chromosomal fusion.

Distribution (Fig. 7)

Queensland, New South Wales, Victoria and north-western Tasmania.

Endemic.

Representative specimens (124 specimens seen)

QUEENSLAND: *M.S. Clemens s.n.*, Mt Coolum, Moreton District, iii.1945 (K); *D.A. Goy & L.S. Smith 632*, Stony Creek, nr Bundaberg, 2.i.1939 (BRI); *D.A. Goy & L.S. Smith 497*, Mt Glorious, Moreton District, 19.vi.1938 (BRI); *L.S. Smith 352*, Sunnybank, Moreton District, 15.ii.1938 (BRI); *N.A. Wakefield 408*, MacPhersons Ck, 26.vi.1942 (MEL).

NEW SOUTH WALES: *M.P. Austin 180*, Kioloa State Forest, c. 9 km NNE of Darras, 23.vii.1973 (CANB); *P.J. Brownsey & R.J. Chinnock s.n.*, Nerrigundah, W of Bodalla, 15.viii.1981 (WELT P12240); *P.J. Brownsey & R.J. Chinnock s.n.*, E. Kangaloon, nr Robertson, junction of Tourist Rd & Moresby Hill Rd, 16.viii.1981 (WELT P12239); *E.F. Constable s.n.*, Upper Cordeaux Dam, 2.v.1957 (NSW P7629); *M. Gray 5658*, Lane Cove Road, Lane Cove Nat. Park, 31.ii.1964 (CANB); *E. Yauba s.n.*, Devil's Creek, 13.i.1950 (NSW P10112).

VICTORIA: *P.J. Brownsey & R.J. Chinnock s.n.*, East Gippsland, Colquhoun State Forest, Torloo Arm Bridge, nr Nowa Nowa, 12.viii.1981 (WELT P12241); *F. Mueller s.n.*, banks of Latrobe, v.1853 (MEL 47058); *F. Mueller s.n.*, forests of Dandenong, ii.1875 (MEL 47063); *N.A. Wakefield 112*, Thurra R., 9.iii.1941 (MEL); *J.H. Willis s.n.*, East Gippsland, Wingan Inlet, nr Ram Head, 30.xii.1951 (MEL 47050).

TASMANIA: *P. Barnett s.n.*, King Is., NE of Mt Counsel, 4.v.1969 (MEL 77352); *M. Cameron s.n.*, Dinosaur Park, Launceston, 10.iii.1981 (HO 39669); *M. Garnett s.n.*, Tin Hut Creek, Fraser Road, WSW of Anson's Bay, 18.vi.1983 (HO 90018).

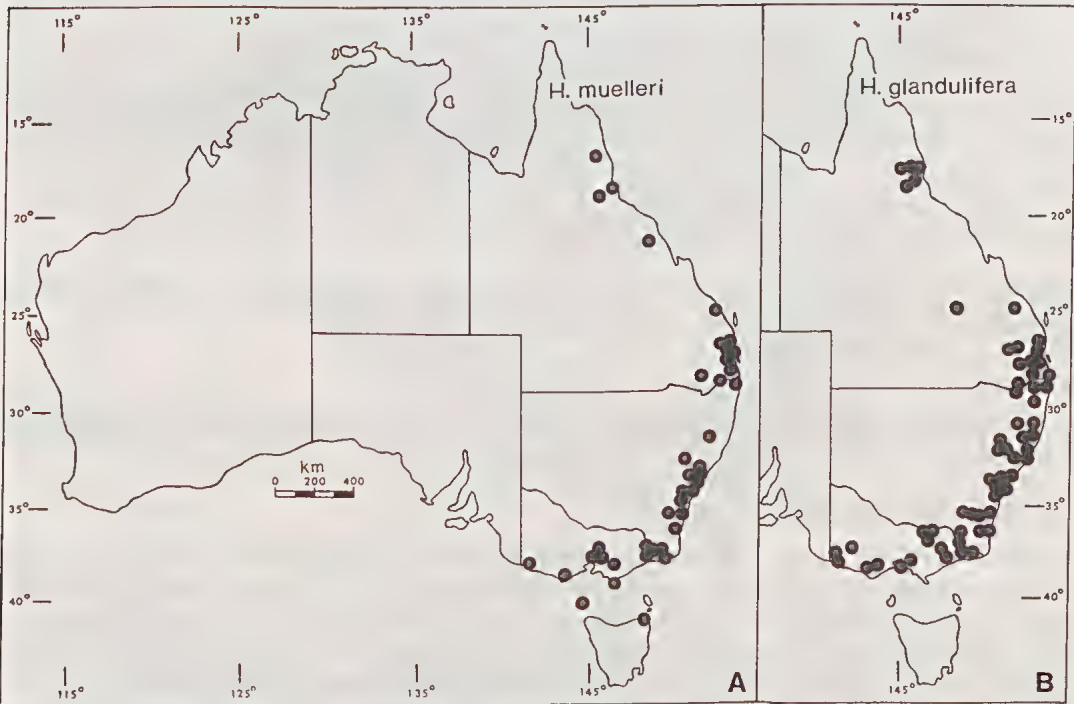


Fig. 7. Australian distributions of A, *Hypolepis muelleri* and B, *H. glandulifera*.

Ecology

Hypolepis muelleri frequently grows along creek banks and drainage channels on damp ground in otherwise rather dry, shaded sclerophyll forest. It also occurs on swampy ground in more open country, and often forms dense clumps or colonies in disturbed areas by virtue of its spreading habit. It has been recorded from sea-level to 850m.

Notes

Hypolepis muelleri is a very distinctive species with rather firm, harsh fronds, short, sharp, slightly curved, non-glandular hairs on the lamina under-surface, no indusium and, unlike any other Australian species, short non-glandular hairs amongst the sporangia in the sorus. This characteristic morphology is combined with the unusual chromosome number of $n = 49$ and may, in part, be the result of aneuploid evolution from the main *Hypolepis* line with $n = 52$. The relationship of *H. muelleri* to Japanese material of *H. punctata* with $n = 98$ obviously warrants further investigation.

5. *Hypolepis glandulifera* Brownsey et Chinnock, sp. nov.

Polypodium punctatum auctt. non Thunb. (1784): Benth., Fl. Austral. 7: 764 (1878); F.M. Bail., Queensland Fl. 1982 (1902).

Dryopteris punctata auct. non C. Chr. (1905): Domin, Biblioth. Bot. 85: 40 (1913).

Hypolepis punctata auctt. non Mett. ex Kuhn (1868): Wakef., Pap. Proc. Roy. Soc. Tasmania 91: 160 (1957); Willis, Handbk. Pl. Victoria 21 (1962, 1970); Tindale in Beadle et al., Fl. Sydney Region 64 (1972); Wakef., Ferns Victoria & Tasmania 27 (1975); Jones & Clemesha, Austral. Ferns & Fern Allies 198 (1976); *ibid* edn 2: 150 (1981).

Rhizoma subterraneum, repens, 4-8 mm diametro, pilis multis rufescentibus usque ad 0.5 mm longos. *Stipes* 40-120 cm longus, 3-10 mm diametro, basi castaneus, apice fulvus, basi pilis multis rufescentibus, apice pilis sparsis, leviter asper, saepe basi radicibus. *Lamina* late ovata vel latior quam longior, 45-180 x 40-150 cm, apice bipinnata, basi quadripinnata. *Rhachis* fulva, pilis multis tenuibus hyalinis vel ferrugineis glanduliferis setosisque usque ad 1 mm longos. *Pinnae primariae* 20-30- jugatae, oppositae vel suboppositae, longissimae prope basin repertae 24-65 x 10-48 cm, superiores anguste ovatae vel anguste triangulatae, infimae ovatae. *Pinnae secundariae* ± lineares, anguste ovatae vel anguste triangulatae, longissimae 6-25 x 2-11 cm. *Pinnae tertiariae* ± lineares, 1-6 x 0.4-2 cm. *Pinnae quaternariae* obtusae vel acutae, 0.1-1 cm longae, interdum profunde incisae. *Venae* marginem in apicibus dentium attingentes. *Paginae* inferiores venaeque laminarum pilis multis 0.1-1 mm longis tenuibus hyalinis glanduliferis, pilis sparsis setosis interspersis, dense vestitae; costae pinnarum pilis similaribus hyalinis ferrugineisque dense vestitae; paginae superiores praeter costas pilis similaribus sparsis vestitae; margines laminarum pilis rarissimis. *Sori* rotundi, in pinnulis ultimis, procul a margine exorientes, sine pilis, non obtecti vel reflexis pinnularum marginibus partim obtecti. *Sporae* pallidae, perisporae projecturis complanatis interconnexis, (31-) 33-35 (-37) x (20-) 21-26 (-29) μm.

Holotype: R.J. Chinnock 5646 & P.J. Brownsey, Millaa Millaa Falls, NE of Millaa Millaa, Queensland, 10.x.1982 (WELT P11585; isotypes AD, CBG, NT).

Etymology

The specific epithet refers to the dense covering of fine, sticky, glandular hairs on the fronds of this plant.

Description (Figs 2A, 8, 13E)

Rhizome subterranean, long-creeping, 4-8 mm diameter, densely covered in a felt of soft red-brown hairs up to 0.5 mm long. *Stipes* 40-120 cm long, 3-10 mm diameter, chestnut-brown at base, yellow-brown above, densely covered in hairs similar to those of rhizome at base, sparsely hairy above, slightly rough, often producing roots at the very base. *Laminae* broadly ovate or slightly broader than long, 45-180 x 40-150 cm, bipinnate at apex, quadripinnate at base. *Rachises* yellow-brown throughout, densely covered in fine colourless or brown-tinged glandular and non-glandular hairs up to 1 mm long. *Primary pinnae* in 20-30



Fig. 8. Silhouette of a frond of *Hypolepis glandulifera*.

pairs, opposite or subopposite, the longest at or near the base 24-65 x 10-48 cm, upper ones narrowly ovate or narrowly triangular, the lower ones ovate. *Secondary pinnae* ± parallel-sided to narrowly ovate or narrowly triangular, the longest 6-25 x 2-11 cm. *Tertiary pinnae* ± parallel-sided, 1-6 x 0.4-2 cm. *Quaternary pinnae* obtuse to acute, 0.1-1 cm long, themselves deeply divided on largest fronds. *Veins* reaching margin at tooth apices. *Hairs*: fine colourless glandular hairs, interspersed with a few non-glandular hairs, densely covering underside of laminae, lamina veins and pinna midribs, with some similar brown-tinged hairs mostly on the midribs, 0.1-1 mm long; similar hairs on upper surfaces but less dense except on the midribs; hairs very rare on the lamina margins. *Sori* round, originating away from margin, unprotected, or protected only by partially reflexed lamina segments, lacking hairs amongst sporangia. *Spores* very pale under light microscope, perispores of inter-connecting flattened projections, (31-) 33-35 (-37) x (20-) 21-26 (-29) μm (6 populations).

Chromosome number

n = 52 (Fig. 14C)

R.J. Chinnock 5646 & P.J. Brownsey, Millaa Millaa Falls, NE of Millaa Millaa, Queensland, 10.x.1982 (AD 98303163, WELT P11585).

Distribution (Fig. 7)

Queensland, New South Wales, Victoria.

Outside Australia this species ranges from southern India and Sri Lanka, through Indonesia to Papua New Guinea and New Caledonia.

Representative specimens (125 specimens seen)

QUEENSLAND: S.T. Blake 21408, Mt Roberts, Lamington Nat. Park, 5.xi.1960 (BRI); R.J. Chinnock 5666 & P.J. Brownsey, Lamin's Hill, 3 km S of Butcher's Ck School, nr Malanda, 11.x.1982 (AD, BRI, WELT); R.J. Chinnock 5770 & P.J. Brownsey, summit Mt Bellenden Ker, 14.x.1982 (AD, WELT); A.W. Dockrill 246, The Crater, Atherton, 26.viii.1971 (BRI); T. Pentzcke s.n., Daintree R., 1882 (MEL 47093).

NEW SOUTH WALES: P.J. Brownsey & R.J. Chinnock s.n., S slope Mt Dromedary, nr Narooma, 14.viii.1981 (WELT P12247); P.J. Brownsey & R.J. Chinnock s.n., E. Kangaloon, nr Robertson, junction of Tourist Rd & Moresby Hill Rd, 16.viii.1981 (WELT P12248); E.F. Constable s.n., St Helena, 4 miles S of Springwood, 29.xi.1960 (NSW P8396); M. Gray 5305, Fitzroy Falls, 28.xi.1962 (CANB); R. Schodde 1170, Hurdle Ck, Mt Tidbinbilla, 5.vi.1960 (CANB); N.A. Wakefield 111, Dorrigo, 3.i.1941 (MEL).

VICTORIA: W.R. Archer s.n., Mornington Peninsula, off Main Ck, Baldry's Crossing, 23.vi.1979 (MEL 558302); A.C. Beauglehole 43713 & D.G. Cameron, Upper Edi Rd, 27 km SW of Myrtleford, 3.xii.1973 (MEL); A.C. Beauglehole 41792, Tea Kettle Ck, trib. of Stokes R., 8 miles SW of Digby, 28.iii.1953 (MEL); P.J. Brownsey & R.J. Chinnock s.n., 13 km up Glen Arte Rd off Prince's Highway, 13.viii.1981 (WELT P12249); N.A. Wakefield 108, Gipsy Pt, 19.xii.1941 (MEL).

Ecology

In Australia, *H. glandulifera* characteristically grows in extensive colonies that shade out other vegetation. It is best developed in humid, shaded forest situations growing on disturbed soils along creek banks, swamps and roadsides, but it occurs also in clearings, on forest margins, and on cleared hillsides where the fronds are generally shorter, harsher and less sticky. It has been recorded at an altitude up to 1600 m.

Notes

Hypolepis glandulifera is distinguished by its large, quadripinnate fronds, yellow-brown stipes, abundant fine glandular hairs on the laminae and the absence of both soral hairs and a well-developed indusium. It has been known previously in Australia as *H. punctata* (Thunb.) Mett. ex Kuhn. However, the type specimen of *H. punctata* is from Japan and, although fragmentary and over-mature (see Brownsey & Chinnock, 1984, fig. 21), relates to a species or

species-aggregate extending from Korea in the north to Sumatra in the south, westwards into China and the Himalayas. Compared with Australian *H. glandulifera*, Asian material of *H. punctata* has a smaller frond, is only tripinnate at the base, has a generally sparser covering of hairs on the lamina undersurface, and often has some hairs on the lamina margins. Japanese material is also known to be chromosomally distinct with $n = 98$ compared with $n = 52$ in *H. glandulifera*.

Plants morphologically similar to the Australian species, and with the same habit of growing in extensive colonies, are found from southern India and Sri Lanka, through Indonesia and Papua New Guinea to New Caledonia, where it is apparently rare. Sri Lankan material has the same chromosome number, reported as $n = 51-53$ by Manton & Sledge (1954). It seems that these plants have never been recognised as a distinct species before, having always been included within *H. punctata*. It is just possible that the name *Cheilanthes resistens* Kunze used for southern Indian material applies to this species, but, despite an exhaustive search, no type specimen has been located. Without authentic material the correct application of this name is impossible to determine.

Plants in New Zealand previously referred to *H. punctata* belong to other species, as described by Brownsey & Chinnock (1984, p. 72).

6. *Hypolepis elegans* Carruth. in Seemann, Fl. Vitiensis 347 (1873).

Lectotype: *J. MacGillivray 108*, Aneiteum, New Hebrides, ii.1860 (BM, here chosen; isolectotype E).

Description (Figs 2B, 9, 13F)

Rhizome long-creeping, up to 5 mm diameter, covered with pale-brown hairs. *Stipes* 30-95 cm long, 4-8 mm diameter, dark chestnut-brown at base, lighter above, densely covered at base with fine colourless non-glandular hairs up to 0.5 mm long, sparsely hairy above, slightly rough. *Laminae* broadly ovate or broader than long, 40-100 x 45-80 cm, bipinnate at apex, 4-5-pinnate at base. *Rachises* chestnut-brown at base, yellow-brown or green at apex, covered in colourless or brown-tinged non-glandular hairs up to 1 mm long, densely so on upper surface. *Primary pinnae* in 20-25 pairs, opposite or subopposite, the longest at or near the base 28-70 x 20-50 cm, upper ones narrowly ovate or narrowly triangular, the lower broadly ovate. *Secondary pinnae* narrowly triangular or narrowly ovate to ovate, the longest 13-35 x 4-18 cm. *Tertiary pinnae* \pm parallel-sided to narrowly ovate or narrowly triangular, the longest 2.5-11 x 0.8-5 cm. *Quaternary pinnae* obtuse or acute, 0.4-3 x 0.2-1.2 cm, divided to midrib in largest specimens to form segments up to 0.7 cm long, the ultimate segments regardless of degree of dissection often sickle-shaped. *Veins* reaching margin at tooth apices. *Hairs*: colourless or brown-tinged, stiff, curved, sharply pointed, non-glandular, up to 1 mm long, on both surfaces of lamina veins and pinna midribs; absent from margins. *Sori* round or ovate, originating at margin, protected from earliest stages by obvious reflexed incised membranous flaps, lacking hairs amongst sporangia. *Spores* very pale under light microscope, perispores of inter-connecting flattened projections, (24-) 26-28 (-31) x (16-) 17-19 (-21) μm (3 populations).

Chromosome number

Unknown.

Distribution (Fig. 10)

In Australia, *H. elegans* is known only from Lord Howe Island and from three mainland collections: from the Atherton Tableland, Richmond River, and Wilsons Promontory. A few

early specimens (e.g. MEL 47074) suggest that it may once have occurred on Norfolk Island, but it has not been collected there in recent years, and the localities may have been confused.

Outside Australia, the species extends from New Ireland and the Solomon Islands through the New Hebrides and New Caledonia to Fiji, Samoa and Rapa.



Fig. 9. Silhouette of a frond of *Hypolepis elegans*.

Representative specimens (32 specimens seen)

QUEENSLAND: *L.S. Smith 10854*, Laurensens and Johnsons, near Lamond's Hill, 17 km S of Malanda, 9.ix.1959 (BRI).

NEW SOUTH WALES: *C. Fraser s.n.*, Richmond R. (NSW P5493, P6025).

LORD HOWE ISLAND: *R.E. Beever 78139*, track to Boat Harbour, 29 viii. 1981 (WELT); *R.E. Beever 78140-2*, Goat House Track, 31.viii.1981 (WELT); *R.J. Chinnock s.n.*, nr Mountain Inn, 5.xii.1968 (NSW P10094); *W.R.B. Oliver s.n.*, Mt Lidgbird, 5.xi.1913 (WELT P1493); *W.R.B. Oliver s.n.*, Transit Hill, 16.xi.1913 (WELT P12224); *W.R.B. Oliver s.n.*, Little Slope, 11.xi.1913 (WELT P12225); *A. Rodd 1713*, Malabar, 19.iii.1971 (NSW).

VICTORIA: *J.W. Audas & P.K.M. St John s.n.*, Wilson's Promontory, x.1909 (AD 97114319).

Ecology

On Lord Howe Island, *H. elegans* grows in damp forest situations in the undergrowth, in canopy gaps and along water courses. It has been recorded up to 300 m altitude. The single Queensland specimen was collected in "gallery rainforest".

Notes

Hypolepis elegans is easily recognised by its large fronds, thick stipes, conspicuously reflexed indusia and the slightly curved, non-glandular hairs on the laminae. In its general habit and proportions it is similar to both *H. dicksonioides* and *H. tenuifolia*, but lacks the glandular hairs of those species.

It is almost certainly the only species of *Hypolepis* occurring on Lord Howe Island today. Early accounts (e.g. Oliver, 1917) referred to it as *H. tenuifolia* but these were misidentifications.

Hypolepis elegans was first described by Carruthers in Seemann's *Flora Vitiensis* based on collections from Fiji, New Hebrides and Lord Howe Island. MacGillivray's specimen from Aneiteum in the New Hebrides is chosen here as the lectotype because it is more complete than any of the others.



Fig. 10. Distribution of *Hypolepis elegans* (●) in Australia (A) and on Lord Howe Island (B).

7. *Hypolepis dicksonioides* (Endl.) Hook., Sp. Fil. 2: 61 (1852).

Cheilanthes dicksonioides Endl., Prodr. Fl. Norfolk. 15 (1833).

Lectotype: *F. Bauer s.n.*, Norfolk Island, no date (W, on 4 sheets; chosen by Brownsey & Chinnock, 1984).

Hypolepis endlicheriana C. Presl, Tent. Pterid. 162 (1836), nom. nov. pro *Cheilanthes dicksonioides* Endl.

Cheilanthes pellucida Col., Tasm. J. Nat. Sci. 2:173 (1845).

Hypolepis tenuifolia var. *pellucida* (Col.) Hook., Sp. Fil. 2:60, t. 90a (1851).

Lectotype: *W. Colenso s.n.*, E. coast. New Zealand, no date (WELT P3224; chosen by Brownsey & Chinnock, 1984).

Description (Figs 2C, 11, 13G)

Rhizome long-creeping, (3-) 4-8 mm diameter, densely covered in pale brown hairs near growing apex, elsewhere more scattered hairs becoming red-brown. *Stipes* (9-) 20-100 cm long, (2-) 5-15 mm diameter, dark chestnut-brown at base, pale chestnut or yellow-brown above, bearing red-brown hairs at very base, replaced by colourless glandular and non-glandular hairs above (up to 5 mm long on uncoiling fronds); two dark, prominent, vertical bands on opposite sides of stipe. *Laminae* broadly ovate or broadly elliptic, (16-) 35-135 x (12-) 35-110 cm, bipinnate at apex, 4-5-pinnate at base. *Rachis* yellow-brown at base, green at apex, bearing colourless glandular and non-glandular hairs (up to 3 mm long). *Primary pinnae* in 15-30 pairs, opposite or subopposite, the longest at or near the base (11-) 20-70 x (7-) 14-45 cm; upper ones narrowly ovate, lower ones ovate. *Secondary pinnae* ovate, (4.5-) 7-30 x 3-15 cm, those on the lower pinnae decreasing markedly in length along the pinnae. *Tertiary pinnae* ovate, (1.6-) 2-8 x (0.7-) 1-3.5 cm, midrib winged. *Quaternary pinnae* narrowly ovate, 0.7-1.6 x 0.2-0.6 cm, shallowly incised on smaller specimens, divided into 4-5 pairs of ultimate segments on larger specimens. *Veins* reaching margin at a tooth apex, or sometimes ending just short of margin. *Hairs*: stout, colourless, glandular and non-glandular, on midribs and veins of both lamina surfaces but absent from margins, 0.2-1 mm long on lamina surfaces, up to 1.5 mm on midribs. *Sori* round or ovate, protected from earliest stages by reflexed, incised, tapering flaps that are green at base and membranous at apex, often bearing a few glandular hairs on margin, 0.3-0.8 mm wide; lacking hairs amongst sporangia. *Spores* very pale under light microscope, perispores of inter-connecting flattened projections, (36-) 38-40 (-44) x (20-) 24-26 (-28) μm (3 populations).

Chromosome number

No chromosome number has been obtained from Norfolk Island material, but Brownsey & Chinnock (1984) recorded $n = 104$ from three New Zealand populations of this species.

Distribution (Fig. 12)

This species is known with certainty only from Norfolk Island, the Kermadec Islands and parts of New Zealand (Brownsey & Chinnock, 1984), although it is now thought that it may also occur at altitudes above about 1000 m on Tahiti and the Marquesas Islands in the eastern Pacific. A few early specimens (e.g. MEL 47094) suggest that it may once have been present on Lord Howe Island, but it has not been collected there in recent years. The possibility that it may also occur naturally on the mainland of Australia should not be overlooked.

The species does occur in the Mount Lofty Ranges of South Australia from where it has been erroneously recorded as *H. punctata* (Black, 1978). However, these populations are believed to have been introduced.



Fig. 11. Silhouette of a frond of *Hypolepis dicksonioides*.

Representative specimens (12 specimens seen)

NORFOLK ISLAND: *F.C. Allen s.n.*, Mt Pitt, 1943 (CHR 229325); *R.J. Chinnock NK 49*, near Mt Pitt summit, 7.xii.1971 (AD); *R.J. Chinnock NK 50*, road above Ball Bay, 7.xii.1971 (AD); *P.S. Green 1396*, Mt Bates, 28.x.1963 (NSW); *Metcalfe s.n.*, (WELT P11538-9); *Robinson s.n.*, 1884 (MEL 47045).

PHILIP ISLAND: *R.J. Chinnock 5928*, Long Valley, 13.i.1984 (AD).

Ecology

Hypolepis dicksonioides can be found at all altitudes on Norfolk Island occurring on exposed clay banks, along forest margins and tracks or on stream banks in open situations. The more robust forms occur in wetter sites and fronds to 3 metres long were recorded at Ball Bay (*Chinnock NK 50*) while depauperate plants with sporogenous fronds 25 cm long were found on dry clay banks near Mt Pitt summit (*Chinnock NK 49*).

On Philip Island this species is an important pioneer fern, which, with *Pteris tremula* R. Br., forms dense thickets amongst rocks and along erosion channels in the upper part of "Long Valley".

Notes

The difficulty of distinguishing *H. dicksonioides* and *H. tenuifolia* in the Pacific and Australasian regions has been discussed in detail elsewhere (Brownsey & Chinnock, 1984, p. 67). Both are large ferns recognisable by their thick stipes, glandular hairy fronds and the presence of well-developed reflexed indusia protecting the sori. *Hypolepis dicksonioides* generally has longer, stouter, glandular hairs on the laminae (0.2-1.5 mm cf. 0.1-1 mm), and rather shorter, broader pinnules with more rounded tips than *H. tenuifolia* which has longer, narrower, more tapering pinnules. Those of *H. tenuifolia* tend to arise from the midribs at more acute angles. The indusia in *H. dicksonioides* are mostly green and only partially membranous, 0.3-0.8 mm wide, tend to taper towards the apex and often have glandular hairs on the margins. Those of *H. tenuifolia* are totally membranous, broad or almost hooded, 0.5-1.2 mm wide and often bear a few glandular hairs on the upper surface.



Fig. 12. Distribution of *Hypolepis dicksonioides* (○) and *H. tenuifolia* (●) in Australia (A) and on Norfolk and Philip Islands (B).

Brownsey & Chinnock (1984) noted a difference in chromosome number between *H. tenuifolia* from Samoa with $n = 52$ and *H. dicksonioides* from New Zealand with $n = 104$. An additional chromosome count of $n = 52$ from *H. tenuifolia* in Queensland is reported here (Fig. 14B), but no chromosome count has yet been made from Norfolk Island material. Further cytological investigation of Australian plants is clearly necessary, but we believe that *H. tenuifolia* is a tetraploid species ranging through tropical latitudes from Queensland to Pitcairn Island, and that *H. dicksonioides* is an octoploid species confined in the south-west Pacific region to Norfolk Island, the Kermadec Islands and New Zealand, and in the eastern Pacific to higher altitudes in Tahiti and the Marquesas Islands.

H. dicksonioides is certainly the only species of the genus occurring commonly on Norfolk Island today. Records of *H. punctata* (Turner, Smithers & Hoogland, 1968) are based on misidentifications, but one recent collection from Ball Bay (Sykes 106, 29.x.1971, CHR) has very membranous indusia suggesting that occasional plants of *H. tenuifolia* may also occur.

H. dicksonioides is closely related to *H. alpina* (Bl.) Hook., a species occurring at high altitudes in the Malesian region which will be discussed in more detail in a subsequent paper.

8. *Hypolepis tenuifolia* (Forst. f.) Bernh. ex C. Presl, Tent. Pterid. 162 (1836).

Lonchitis tenuifolia Forst. f., Prodr. 80 (1786) — *Cheilanthes arborescens* Sw., Syn. Fil. 129 (1806), nom. nov. pro *Lonchitis tenuifolia* Forst. f. — *Phegopteris tenuifolia* (Forst. f.) Keys., Polyp. Herb. Bunge. 51 (1873).

Lectotype: J.R. & G. Forster s.n., Insulae Oceani Pacifici, no date (BM, here chosen).

Description (Figs 2D, 13H)

Rhizome long-creeping, 3-10 mm diameter, densely covered in pale brown hairs near growing apex, elsewhere more scattered hairs becoming red-brown. *Stipes* 40-170 cm long, 3.5-10 mm diameter, dark chestnut-brown at base, pale chestnut or yellow-brown above, bearing red-brown hairs at very base, replaced by colourless glandular and non-glandular hairs above (up to 5 mm long on uncoiling fronds); two dark prominent vertical bands on opposite sides of stipe. *Laminae* broadly ovate or broadly elliptic, 25-200 x 28-140 cm, bipinnate at apex, 4-5-pinnate at base. *Rachis* yellow-brown at base, green at apex, bearing colourless glandular and non-glandular hairs (up to 2 mm long). *Primary pinnae* in 10-30 pairs, opposite or subopposite, the longest at or near base 16-100 x 11-50 cm; upper ones narrowly ovate to ovate, lower ones ovate. *Secondary pinnae* ovate, 7-35 x 3.5-15 cm, those on the lower pinnae decreasing markedly in length along the pinnae. *Tertiary pinnae* ovate, 2-17 x 1-6 cm, midrib winged. *Quaternary pinnae* narrowly ovate, 0.5-3.5 x 0.2-1.2 cm, shallowly incised on smaller specimens, divided into ultimate segments up to 0.6 cm long on larger specimens. *Veins* reaching margin at a tooth apex, or sometimes ending just short of margin. *Hairs*: fine, colourless glandular and non-glandular hairs densely covering both lamina surfaces, veins and midribs but absent from margins, 0.1-0.8 mm long on lamina surfaces, up to 1 mm on midribs. *Sori* round or ovate, protected from earliest stages by reflexed, incised, rather broad, membranous flaps which bear occasional glandular hairs on the upper surface, 0.5-1.2 mm wide; lacking hairs amongst sporangia. *Spores* very pale under light microscope, perispores of inter-connecting flattened projections, (30-) 33-36 (-39) x (17-) 20-23 (-25) μm (7 populations).

Chromosome number

$n = 52$ (Fig. 14B)

R.J. Chinnock 5793 & P.J. Brownsey, N. Johnson R., 19 km SW of Russell R. Bridge on Innisfail-Cairns Rd, Queensland, 16.x.1982 (AD, WELT).

A count of $n = 52$ from Queensland material of *H. tenuifolia* confirms the suggestion made by Brownsey & Chinnock (1984, p. 72) that there is a ploidy difference between this species and the very closely related *H. dicksonioides* from New Zealand and Norfolk Island which has $n = 104$.

Samoan material of *H. tenuifolia* also has $n = 52$ (Manton & Vida, 1968).

Distribution (Fig. 12)

In recent years *Hypolepis tenuifolia* has been collected only from localities in the Atherton Tableland region of north Queensland, from Dalrymple Heights further south, and from Norfolk Island. Two early collections were made from the Brisbane area. The species has also been recorded from Lord Howe Island (e.g. Oliver, 1917) but these records refer to plants of *H. elegans*.

Outside Australia, *H. tenuifolia* ranges across the Pacific in tropical latitudes from New Caledonia through Fiji, Tonga, Samoa, the Cook Islands, Society Islands, and Austral Islands to Rapa, Mangareva and Pitcairn Island. It also occurs further north in Papua New Guinea and parts of S.E. Asia.

New Zealand plants referred to *H. tenuifolia* by Allan (1961) belong to either *H. ambigua* Brownsey & Chinnock or to *H. dicksonioides* (Brownsey & Chinnock 1984, p. 67).

Representative specimens examined (24 specimens seen)

QUEENSLAND: *F.M. Bailey s.n.*, Mulgrave R., vi-vii.1889 (BRI 114714); *F. Burt s.n.*, Enoggera, Brisbane, x.1912 (BRI 114715); *R.J. Chinnock 5793 & P.J. Brownsey*, 19.3 km SW of Russell R. bridge on Innisfail-Cairns Road, 16.x.1982 (WELT); *M.S. Clemens s.n.*, Dalrymple Heights, viii-xi.1947, ix-x.1947 (K, BRI 142708, 139468); *A.W. Dockrill 1299*, State Forest Rd 675, E. Mulgrave, 7.x.1976 (BRI); *M.J. Manski s.n.*, Edge Hill, Cairns (BRI 12641); *P.R. Messmer s.n.*, Big Tableland, nr Cooktown, 24.vii.1952 (NSW P8528); *P.R. Messmer s.n.*, Stuarts Ck, Daintree R., 10.viii.1952 (NSW P2825); *L.S. Smith 3768*, Emerald Creek, 8 km N of Danbulla, 15.viii.1948 (BRI); *C.T. White s.n.*, Atherton, i.1918 (BRI 114718, 257772).

NORFOLK ISLAND: *Backhouse s.n.*, 4.iii.1835 (BM); *W.R. Sykes 106*, Ball Bay, 29.xi.1971 (CHR).

Ecology

This is a rare species collected only occasionally from Queensland and Norfolk Island. Few details of its preferred habitat are known, but it may favour disturbed soils in open situations near streams in rainforest. It has been recorded up to 1000 m altitude.

Notes

The characteristic features of *H. tenuifolia* and its distinction from *H. dicksonioides* are discussed above (p. 24). The morphological range and distribution of this species in Australia require further investigation.

Excluded taxon

Hypolepis tenuifolia var. *hirsuta* C. White et Goy, Victorian Naturalist 54: 148 (1938).

Holotype: *C.T. White 10702*, Mt Spurgeon, Cook District, north Queensland, ix.1936 (BRI 210974-5).

The type specimen has been re-identified by D.A. Smith as *Calcuta villosa* C. Chr., a species described from Papua New Guinea with a distribution extending to Indonesia and Australia. It is rare and localised in tropical Australia (Jones & Clemesha, 1981).

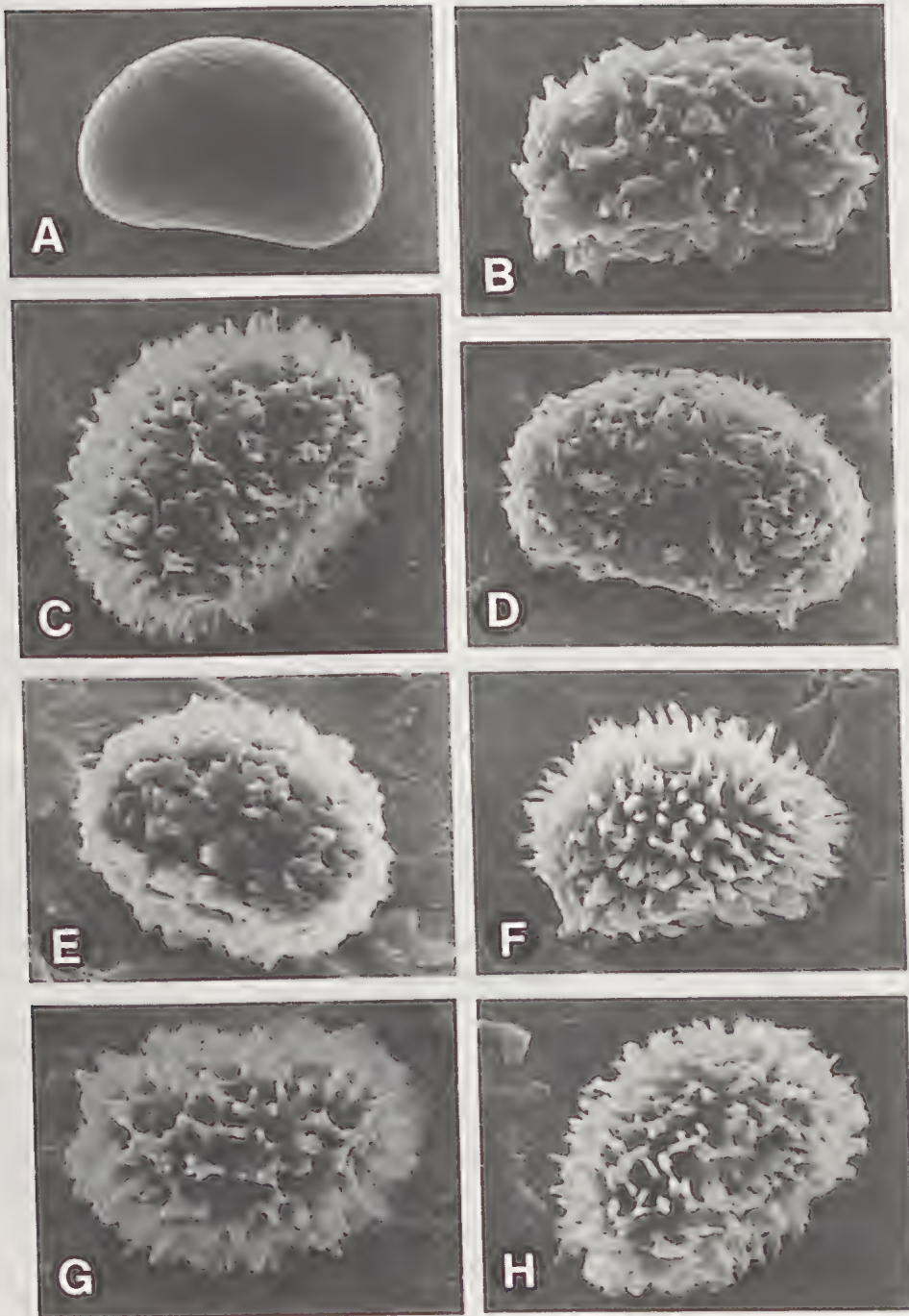


Fig. 13. Scanning electron micrographs (x1200) of spores. A, *Hypolepis distans*; B, *H. amaurorachis*; C, *H. rugosula*; D, *H. muelleri*; E, *H. glandulifera*; F, *H. elegans*; G, *H. dicksonioides*; H, *H. tenuifolia*.

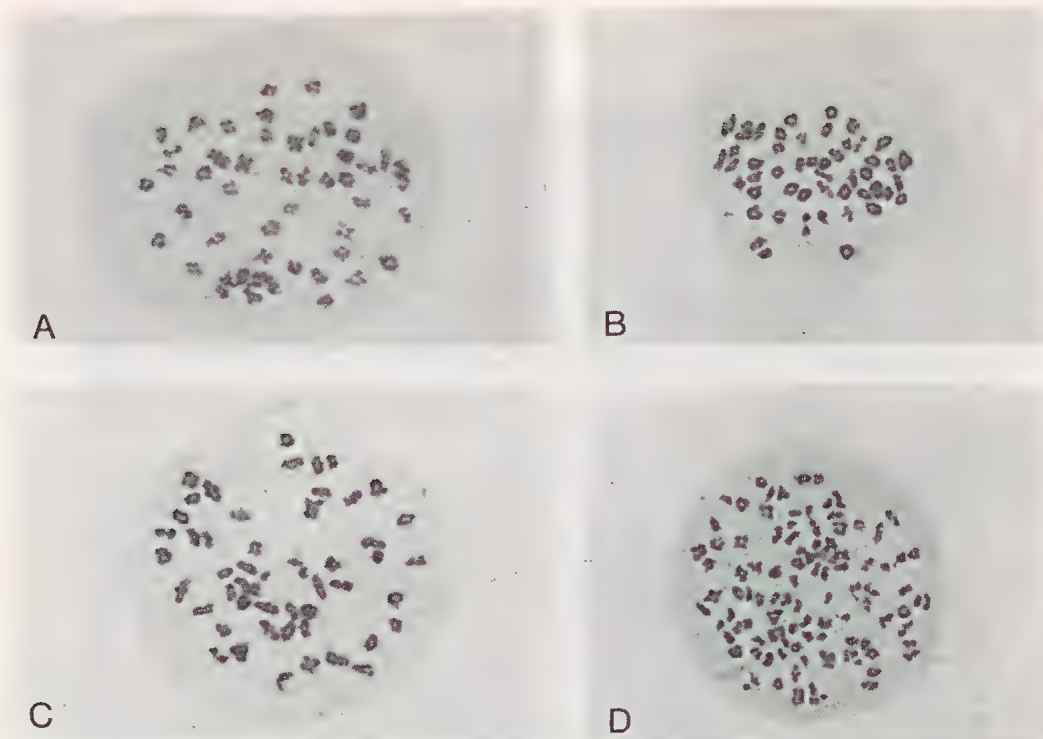


Fig. 14. Permanent acetocarmine preparations of diakinesis (x1000). A, *Hypolepis muelleri*, Pomona, Queensland, showing 49 bivalents; B, *H. tenuifolia*, North Johnson River, Queensland, showing 52 bivalents; C, *H. glandulifera*, Millaa Millaa Falls, Queensland, showing 52 bivalents; D, *H. rugosula*, Otway Ranges, Victoria, showing c. 104 bivalents.

Hybrids

As in other genera of ferns, plants of *Hypolepis* with aborted spores and with morphological characteristics inconsistent with any known species are assumed to be of hybrid origin. In the course of this investigation, a few herbarium specimens with these attributes have been found. The small number of such specimens suggests that hybridism between Australian species is uncommon, and, since we have had no personal experience of hybridism in the field, it is difficult to be certain of the parentage of these putative hybrids.

There is reasonably good morphological evidence for the combination *H. muelleri* x *rugosula*, but that for a second combination, *H. muelleri* x *glandulifera*, is much less certain. A third combination, *H. amaurorachis* x *rugosula* has not been found, but since the two parent species are known to grow in the same areas and are closely related, hybrids between them can be anticipated. Further study of any putative *Hypolepis* hybrids in the wild is clearly desirable.

Hypolepis muelleri x *rugosula*

Specimens examined

QUEENSLAND: *P. Grimshaw s.n.*, South Bald Rock, Girraween Nat. Park, 28.v.1978 (BRI 339959).

NEW SOUTH WALES: *S. Clemesha s.n.*, Perry's Lookout, Blackheath, 8.ii.1973 (AD, NSW).

VICTORIA: *W.R. Archer s.n.*, Mornington Peninsula, Nepean State Park, trib. of Main Ck nr junction with Lightwood Ck, 13.v.1979 (MEL 1515069); *A.C. Beauglehole 43682*, Mt Porepunkah, 7.2 km NNE of Bright, 29.xi.1973 (MEL 522651); *A.C. Beauglehole 15879*, Victoria Range, E side of Castle Rock, upper reaches of Deep Ck, 6.xi.1966 (MEL 522678); *A.C. Beauglehole 41630*, Rosedale Shire, Holey Plains, Merrimans Creek, 11.iii.1973 (MEL 522692); *A.C. Beauglehole 41332*, Nunniong Plateau, Little Reedy R. W of junction with Reedy R., 2.ii.1973 (MEL 522685); *R. Melville 3842*, Kallista, Clematis Gully, 11.v.1953 (MEL 47077, BRI 56160).

Notes

This hybrid is intermediate in morphology between the two parent species and can be recognised by the combination of reddish brown stipes characteristic of *H. rugosula* together with occasional hairs in the sorus, typical of *H. muelleri*. The hairs on the remainder of the laminae are sharp and slightly curled as in *H. muelleri*, but rather longer than is usual in that species. Glandular hairs are generally absent. In a few specimens, the sporangia, as well as the spores, are aborted.

Manton & Sledge (1954, p. 149) reported a chromosome count of $2n = c. 150$ from an Australian plant of *Hypolepis* collected by R. Melville. It had "about half a dozen pairs and nearly 140 univalents" at meiosis, and the spores were aborted. This was evidently a plant of hybrid origin, presumably derived from parental species with $n =$ approximately 50 and 100 respectively. It is virtually certain the plant was a hybrid between *H. muelleri* and *H. rugosula* — the former having a chromosome number of $n = 49$ and the latter $n = 104$ (Fig. 14). Specimens of this hybrid collected by Melville are in BRI and MEL (cited above).

Hypolepis muelleri x *glandulifera*

Specimens examined

VICTORIA: *H.I. Aston 589*, Dandenong Ranges, c. 1 km E of Belgrave, near Hardy Ck at Belgrave-Gembrook rail crossing, 2.viii.1960 (MEL 77353); Dunip Ck (MEL 47104).

Notes

Neither of these specimens is a complete frond, each lacking the stipe and lower pinnae, so that their parentage is difficult to determine. However, the fronds are more highly dissected than those of the previous combination, the lamina hairs longer and more numerous, and the soral hairs more numerous. This would be consistent with the suggested parentage, *H. muelleri* x *glandulifera*.

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