

Plant nematodes from Australia : *Blandicephalanema bossi* n. sp., *Pateracephalanema pellitum* Andrassy, 1979 and *P. imbricatum* (Colbran, 1965) Mehta & Raski, 1971 (Nematoda : Criconematidae)

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SUMMARY

Blandicephalanema bossi n. sp. from New South Wales is characterised by its rounded first annule and rows of pectinate scales along the body. *B. bossi* n. sp. may be distinguished from *B. serratum* Mehta & Raski, 1971 by its longer stylet, fewer body annules and difference in shape of scales. It may be distinguished from *B. pilatum* Mehta & Raski, 1971 by the differences in shape of the first annule and scales, and fewer rows of scales at mid-body. Additional information is given for *Pateracephalanema pellitum* Andrassy, 1979, including a juvenile. New information is given for *P. imbricatum* Colbran, 1965, including description of previously unknown males and juveniles. A study of several populations of females shows *P. imbricatum* to be a variable species, with one or two lip annules, entire or crenate scales arranged in rows of eight or ten along the body.

RÉSUMÉ

Nématodes phytoparasites d'Australie : *Blandicephalanema bossi* n. sp., *Pateracephalanema pellitum* Andrassy, 1979 et *P. imbricatum* (Colbran, 1965) Mehta & Raski, 1971 (Nematoda : Criconematidae)

Blandicephalanema bossi n. sp. provenant de Nouvelle Galle du Sud est caractérisé par un premier anneau arrondi et des rangées d'écaillés pectinées sur le corps. *B. bossi* n. sp. se distingue de *B. serratum* Mehta & Raski, 1971 par un stylet plus long, un nombre plus faible d'anneaux du corps et la forme des écaillés; il se sépare de *B. pilatum* Mehta & Raski, 1971 par la forme différente du premier anneau et des écaillés, et le moindre nombre de rangées d'écaillés, à mi-corps. Des données complémentaires sont fournies sur *Pateracephalanema pellitum* Andrassy, 1979, y compris un juvénile, ainsi que sur *P. imbricatum* Colbran, 1965, y compris la description du mâle et des juvéniles jusque-là inconnus. L'étude de plusieurs populations a montré que *P. imbricatum* est une espèce assez variable, comportant un ou deux anneaux labiaux, des écaillés entières ou crénelées disposées en huit ou dix rangées longitudinales.

Two species of *Blandicephalanema* have been described from New Zealand. This genus had not previously been recorded in Australia, until another species, *B. bossi* n. sp. was collected in 1985 from rainforest in north eastern New South Wales. This collection, and that of specimens of *Pateracephalanema pellitum* Andrassy, 1979, and *P. imbricatum* Colbran, 1965 are part of a study of plant parasitic nematodes occurring in association with native vegetation in Australia.

Methods

Nematodes were relaxed by gentle heat, then fixed with 2 % formalin. They were processed by a method of slow evaporation (over seven days) of glycerine-ethanol at 40° and mounted in glycerine. Measurements of females include scales. Male spicules were measured along the mid-line. As previously mentioned (Reay &

Colbran, 1986) the body width is given instead of the ratio "a" (measured just posterior to the excretory pore). RZ = number of annules of female between excretory pore and vulva. RA = number of annules of males and juveniles between excretory pore and cloaca or anus respectively.

Blandicephalanema bossi n. sp.

(Figs 1, 2, 4D)

MEASUREMENTS

Female (paratypes, n = 44) : L = 0.538 mm \pm 0.05 (0.40-0.62); b = 3.6 \pm 0.25 (3.0-4.7); c = 21.4 \pm 3.8 (14.6-27.9); V = 89.7 \pm 1.1 (86.9-92.2); VL/VB 1.2 \pm 0.12 (1.0-1.5); stylet = 87.7 μ m \pm 4.1 (76.8-98.1); R = 69 \pm 2.0 (65-73); Rex = 24 \pm 0.93 (23-26); RZ = 34 \pm 1.4 (32-37); RV = 10 \pm 0.76 (8-11); RVan = 4 \pm 0.70 (3-5); Ran = 5 \pm 0.78 (4-7); tail = 26.3 μ m

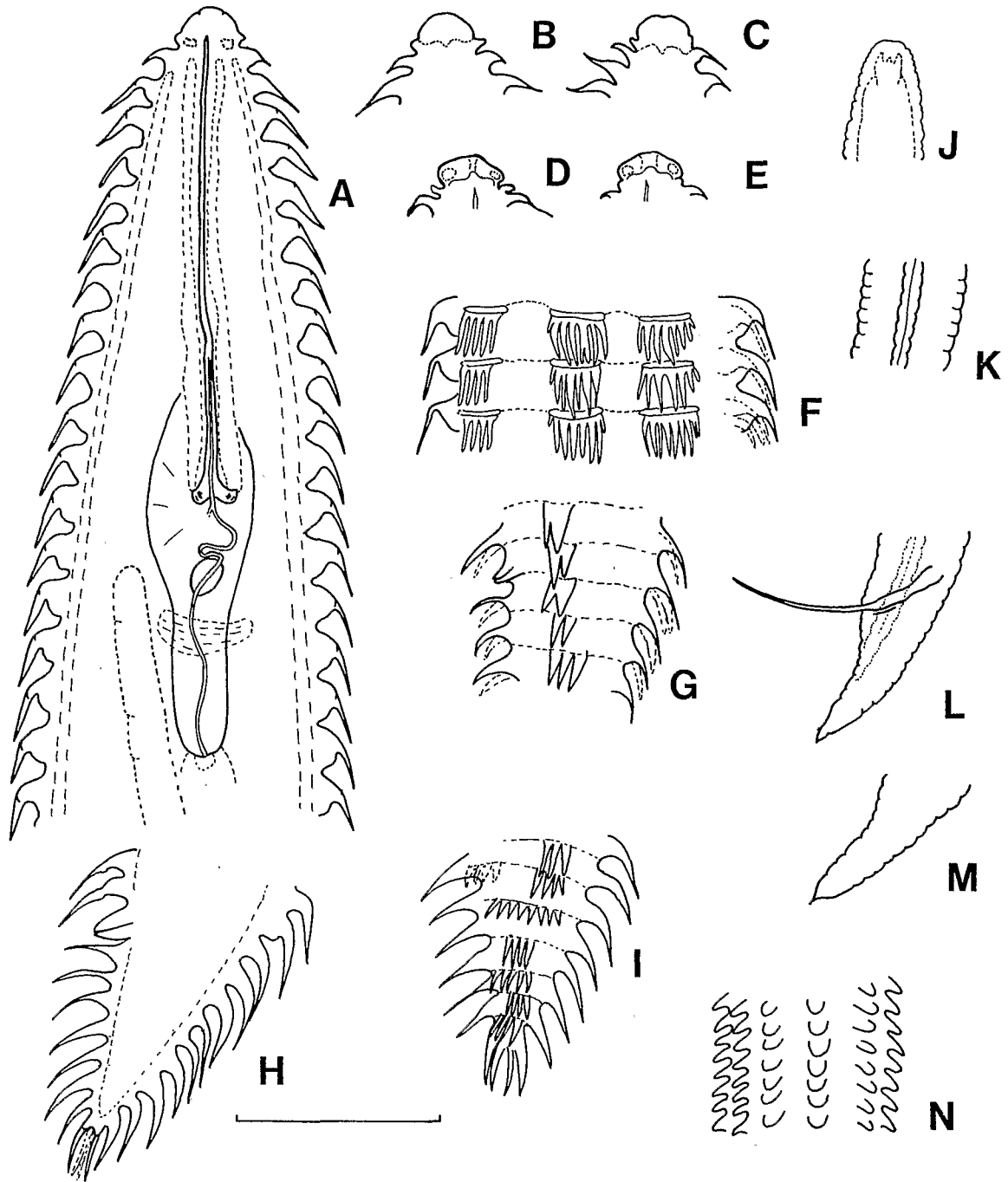


Fig. 1. *Blandicephalanema bossi* n. sp. Female. A : Anterior region; B, C : lateral view of lip region; D, E : dorso-ventral view of lip region; F : scales at mid-body; G-I : post-vulval region. Male. J : lip region; K : lateral field; L, M : tails. Juvenile. N : scales (Bar scale represents 40 μ m).

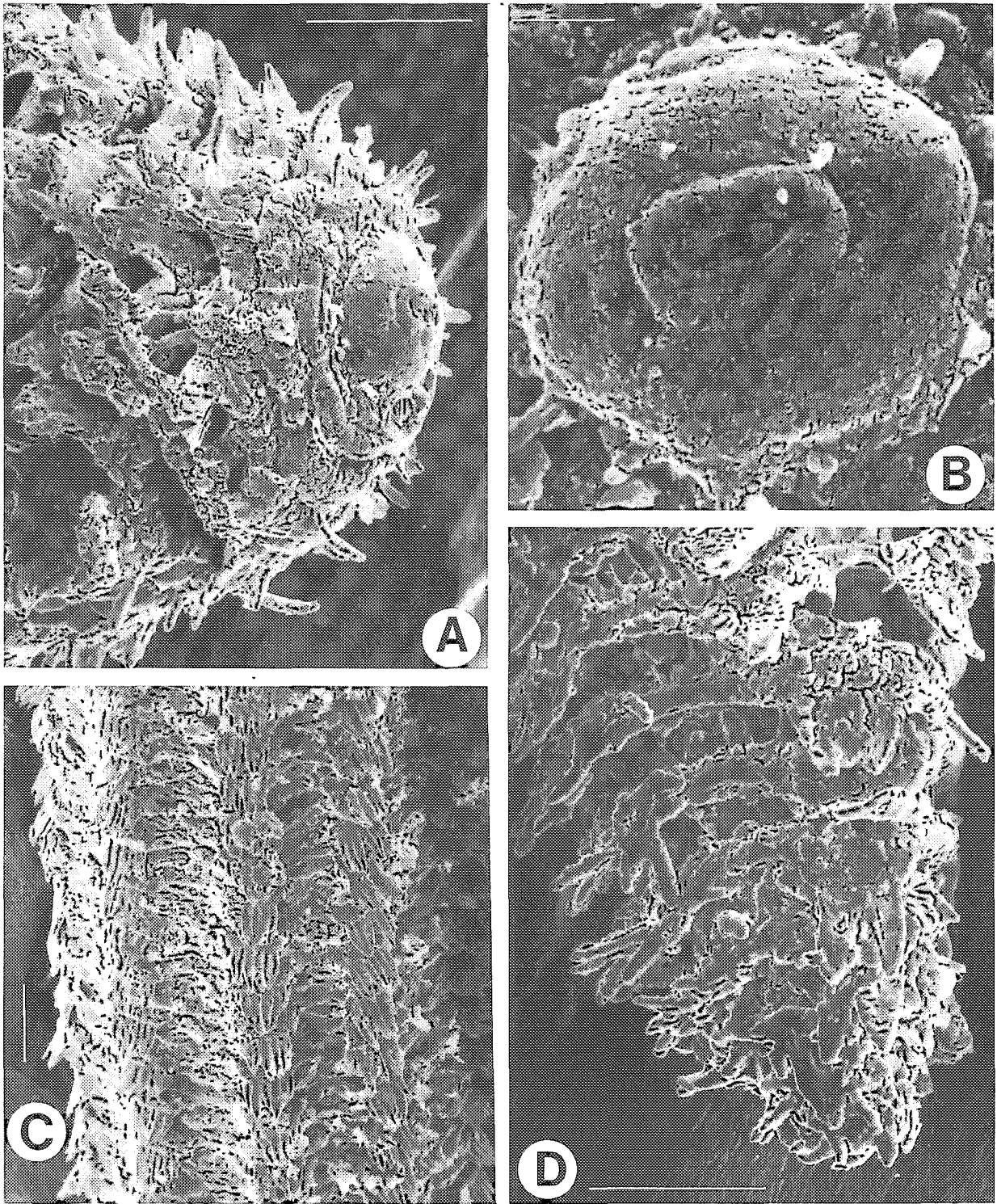


Fig. 2. *Blandicephalanema bossi* n. sp. SEM photos. Female. A : anterior region; B : en face; C : scales at mid-body; D : posterior region, vulva and anus visible. (Bar scales : A, C, D represent 10 μ m; B represents 2 μ m).

± 3.6 (20.7-32.0); body width = $65.5 \mu\text{m} \pm 5.5$ (51.7-78.2) ($n = 10$ for c, RVan, Ran and tail).

Male (paratypes, $n = 17$): L = $0.371 \text{ mm} \pm 0.03$ (0.34-0.42); c = 12.3 ± 1.16 (10.3-14.1); c' = 1.98 ± 0.18 (1.7-2.1); T = 36.7 ± 3.3 (30.1-42.8); R = 141 ± 3.5 (134-148); Rex = 55 ± 2.1 (52-58); RA = 79 ± 2.3 (75-81); Ran = 9 ± 1.4 (7-12); spicules = $44.1 \mu\text{m} \pm 1.9$ (40.9-48.3); gubernaculum = $6.1 \mu\text{m} \pm 0.75$ (5.1-7.4); anal body width = $15.5 \mu\text{m} \pm 1.2$ (14.0-18.2); tail = $30.5 \mu\text{m} \pm 3.1$ (25.5-38.6) ($n = 6$ for Rex and RA).

Juveniles J4 ($n = 1$): L = 0.390 mm ; stylet = $87.5 \mu\text{m}$; R = 71; J3 ($n = 6$): L = 0.290 mm (0.27-0.31); b = 3.0 (2.6-3.2); stylet = $59.7 \mu\text{m}$ (55.3-66.5); R = 76 (73-79); Rex ($n = 2$) = 28.

Holotype (female): L = 0.416 mm ; b = 3.3; V = 88.9; VL/VB = 1.1; stylet = $82.4 \mu\text{m}$; R = 73; RV = 10; body width = $53.1 \mu\text{m}$.

Allotype (male): L = 0.362 mm ; c = 12.5; c' = 1.9; T = 35.2; R = 143; Rex = 55; RA = 79; Ran = 9; spicules = $44.7 \mu\text{m}$; gubernaculum = $5.4 \mu\text{m}$; anal body width = $15.0 \mu\text{m}$; tail = $28.8 \mu\text{m}$.

DESCRIPTION

Females: Body stout, straight to slightly ventrally curved when relaxed, with retrorse annules. First annule rounded and dome-like. In dorso-ventral view, the spacious cavities within the lateral lips (see Mehta & Raski, 1971), are clearly visible. Oral disc slightly elevated. Second (?) annule collar-like with two broad lobes visible on the dorsal and ventral parts, but not visible laterally. Body annules ornamented with scales. Scales pectinate, in rows of eight at mid-body (one female with ten rows). Scales in anterior region have more "spines", five to ten spines per scale, usually gradually becoming reduced towards posterior region. Spines of posterior scales often appear to be fused to adjacent spines and therefore wider than spines of anterior scales. Spines of posterior scales reduced to two to five spines per scale. Spines of each scale reach to or slightly overlap the following annule. In some females the post-vulval scales are alternately arranged, or adjacent scales become continuous so that they are wider than prevulval scales. Stylet long, often slightly curved or even bent. Valve of median bulb posteriorly situated, terminal bulb cylindrical. Hemizonid obscure, excretory pore often obscure in lateral view. Gonad outstretched, often extending to the cesophagus. Spermatheca rounded to oval, usually packed with small sperm. Vulva conical, not projecting beyond scales. Anus frequently obscure, especially in lateral view. Post-vulval region conical, terminus usually with two spines.

Males: Body ventrally curved when relaxed. Lip region blunt, continuous with body annules, five or six

lip annules in most specimens; lip annules small. Body annules becoming coarser and appearing to be paired, at least to mid-body. Stylet absent, oesophagus degenerate. Hemizonid one or two annules long. Excretory pore frequently obscure. Testis packed with rounded sperm. Lateral field with three lateral lines, the outer ones coarsely crenate, the inner one often indistinct. Caudal alae very reduced, extending to mid-tail. Spicules arcuate, gubernaculum curved. Tail ventrally curved, conoid, smooth in terminal portion and usually with spicate tip.

Juveniles: J4 and J3 similar in body and head shapes to adult females. J4 with an estimated eight or nine rows of scales at mid-body. The scales are pectinate with five to seven spines anteriorly, reduced to two to three wider spines on the tail. J3 with rows of scales along the body which are entire, conical to rounded in shape. In most specimens the posterior scales also have a short conical to rounded process on the posterior edge of each scale.

TYPE SPECIMENS

Holotype (female) and *allotype* (male) deposited in nematode collection, South Australian Museum, North Terrace, Adelaide, South Australia, 5000, No. 305C(g) and 305B(IV) respectively.

Paratypes: 36 females, thirteen males and seven juveniles at Waite Agricultural Research Institute Nematode Collection, Glen Osmond, South Australia, 5064. Two females and one male at each of the following nematode collections: Queensland Museum, Brisbane, Queensland, 4006, Australia; Commonwealth Institute of Parasitology, St Albans, Herts., England; Muséum national d'Histoire naturelle, Laboratoire des Vers, Paris, France; University of California Davis Nematode Collection, Davis, CA95616, USA.

TYPE HABITAT AND LOCALITY

Collected in September, 1985, by Wauchope Research Staff for J. A. Simpson, of the Forestry Commission of New South Wales, from Banda Banda Reserve, Mt Boss State Forest, north-west of Wauchope, New South Wales. Approximate latitude $31^{\circ} 10'S$, longitude $152^{\circ} 24'E$, altitude 1 050 m on ridgetop plateau. Cool temperature undisturbed (closed) rainforest, dominated by *Nothofagus moorei* (F. V. Muell) J. H. Maiden (Negrohead Beech), with associated *Ceratopetalum apetalum* D. Don (Coachwood), also *Sloanea woollsi* F. V. Muell, *Doryphora sassafras* Endl., and *Orites excelsa* R. Br. Shrubs include *Cryptocarpa meissneri* F. V. Muell, *Tasmannia insipida* (R. Br. ex DC) A. C. Smith and *Caldcluvia paniculata* D. Don. Ground layer includes *Blechnum watsii* Tindale and *Drymophila moorei* Baker.

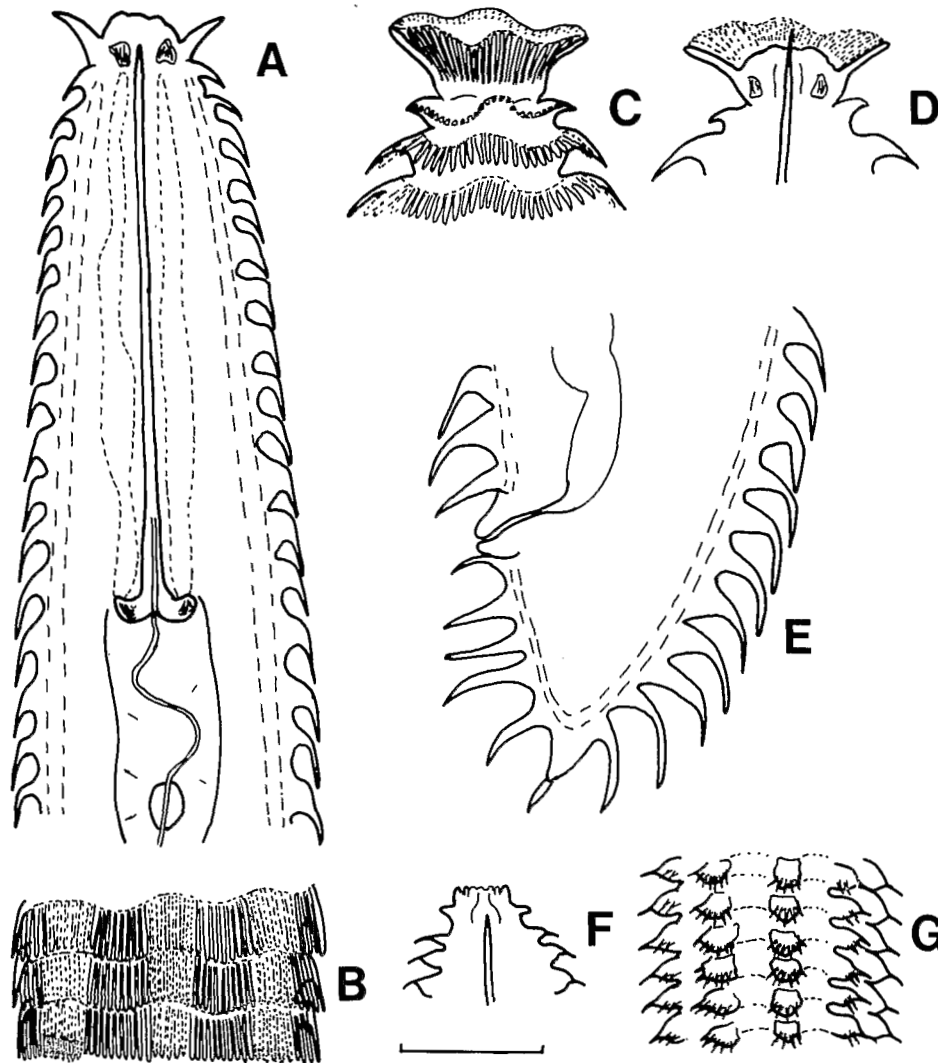


Fig. 3. *Pateracephalanema pellitum* Andrassy, 1979. Female. A : anterior region; B : scales at mid-body; C, D : lip region; E : post-vulval region. Juvenile. F : lip region; G : scales. (Bar scale represents 20 μ m).

DIAGNOSIS AND RELATIONSHIPS

Two other species of *Blandicephalanema* have been described, *B. serratum* Mehta & Raski, 1971 and *B. pilatum* Mehta & Raski, 1971. *B. bossi* n. sp. differs from *B. serratum* by its longer stylet (76-98 vs 63-67), fewer body annules (65-73 vs 70-85), difference in shape of scales and lack of serrations between the scales. *B. bossi* n. sp. may be distinguished from *B. pilatum* by the different shape of the first annule, and differences in scales. The scales of *B. bossi* n. sp. are pectinate, in eight rows at mid-body, whereas those of *B. pilatum* are in 28 rows at mid-body, and the scales are rounded each with a single spine. The transfer of *Seriespinula cactus* An-

drassy, 1979 to *Blandicephalanema* by Ebsary (1981) is not accepted here as *S. cactus* does not have the rounded head annule characteristic of *Blandicephalanema*.

Pateracephalanema pellitum Andrassy, 1979 (Fig. 3)

In 1979, Andrassy described three females of this species, which were collected from "forest soil, in the vicinity of Perth, Western Australia". Seven females and one juvenile have since been collected from three localities in New South Wales. The New South Wales specimens differ in some respects from the Western Australian specimens.

MEASUREMENTS

Females (n = 7) : L = 0.412 mm \pm 0.09 (0.31-0.54); b = 3.3 \pm 0.39 (2.8-3.8); c = 16.8; V = 92.1 \pm 1.04 (90-94); VL/VB = 0.9 \pm 0.16 (0.7-1.2); stylet = 77.1 μ m \pm 3.7 (70-82); R = 70 \pm 3.96 (63-77); Rex = 24 \pm 2.5 (21-29); RZ = 39 \pm 1.7 (35-40); RV = 7 \pm 0.64 (6-8); RVan = 2; Ran = 4; tail = 18.4 μ m; body width = 49.7 μ m \pm 6.0 (41-57).

(n = 1 for tail, c, RVan and Ran).

Juveniles J4 (n = 1) : L = 0.34 mm; b = 3.1; stylet = 56.9 μ m; R = 77; Rex = 26.

DESCRIPTION

Females : Body straight to ventrally curved. Lip region with one or two annules. First annule usually directed forwards, fringed and may be convoluted in outline. Second annule, present in four of seven females, much smaller, collar-like, crenate, sometimes with convoluted edge. Body annules ornamented with continuous fringe, usually slightly overlapping the following annule, and longer in post-vulval region. Ten rows of longitudinal ridges are present. Vulval lips conoid, appearing recessed within fringe. Spermatheca oval, with or without sperm. Anus often obscure. Tail conoid, with long fringes.

Juvenile : One J4 was collected. Body slightly ventrally curved. First annule crenate, directed forward and with the appearance of being protruded. Second annule collar-like, directed sideways, finely crenate. Stylet and oesophagus similar to adult female. Body ornamented with ten rows of conspicuous, somewhat hexagonal scales. Each scale bears a fringe of short pointed spines, overlapping the scale edge, the spines being longer towards the posterior portion of each scale. Tail conoid.

Male : unknown.

HABITAT AND LOCALITIES

Five females and one juvenile were collected from Murramarang National Park, New South Wales, one female from Morton National Park, New South Wales and one from McPherson State Forest, New South Wales. Each of these localities have sandy soil and *Banksia* spp. as dominant vegetation. At Morton N.P. and McPherson S.F., *Eucalyptus* spp. are also present.

Pateracephalanema imbricatum (Colbran 1965)
Mehta & Raski, 1971
(Figs 4A-C, 5)

Specimens of *Pateracephalanema imbricatum* have been collected from fifteen different localities in four

states of Australia. Several of these populations show considerable variation when compared with Colbrans original description.

These localities are the following :

— Sandy Creek Conservation Park, South Australia - sandy soil with open mixed bushland.

— Charleville, Queensland - two localities of sandy soils, with Spinifex open woodland and Cypress Woodland.

— Halls Gap to Dunkeld, Grampian ranges, Victoria - tall *Eucalyptus* forest.

— Barcoongerie State Forest, New South Wales - sandy gravel soil of dry blackbutt forest.

— Ravensbourne National Park, Queensland - subtropical rainforest.

— Morton National Park, New South Wales, sandy soil with mixed bushland.

— Murramarang National Park, New South Wales, sandy soil with mixed bushland.

— Pigeon House Mountain, New South Wales - *Eucalyptus* bushland.

— Ben Boyd National Park, New South Wales - *Eucalyptus* and *Banksia* bushland.

— Banda Banda reserve, Mt. Boss State Forest, New South Wales. Undisturbed (closed), cool temperate rainforest dominated by *Nothofagus moorei* with associated *Ceratopetalum apetalum*.

— Cockerawombeeba reserve, Mt. Boss State Forest, New South Wales. Undisturbed mature forest of *Eucalyptus microcorys* F.v. Muell., with *Lophostemon confertus* (R.Br.) Wilsn & Waterhouse.

MEASUREMENTS

Females : See Table 1.

Males (n = 2) : L = 0.363-0.369 mm; c = 9.9-10.7; c' = 2.4-2.6; T = 37.1-39.7; R = 152-155; Rex = 41-47; RA = 95-98; Ran = 13; Spicules = 37.0-37.6 μ m; gubernaculum = 4.8-5.8 μ m; anal body width = 13.9-14.7 μ m; tail = 34.6-36.8 μ m.

Juveniles, J4 (n = 1) (Ravensbourne) : L = 0.251 mm; stylet = 52.7 μ m; R = 89; 10 rows of scales; J4 (n = 1) (Davies Creek) : L = 0.273 mm; stylet = 59.5 μ m; R = 66; Rex = 21; RA = 40; Ran = 5; tail = 11.1 mm; 10 rows of scales; J4 (n = 2) (Banda Banda) : L = 0.334-0.375 mm; stylet = 71.4-74.4 μ m; R = 84-89; Ran = 5; 10 and 12 rows of scales; J3 (n = 1) (Davies Creek) : L = 0.204 mm; stylet = 42.5 μ m; R = 83; Rex = 25; 8 rows of scales.

DESCRIPTION

Females (n = 52) : Body usually ventrally curved. Lip region with one or two annules. First annule large and saucer-like, directed forwards or sideways with six

Table 1
Pateracephalanema imbricatum : Measurements of females from twelve localities.

Locality	n	Stylet	L	V %	VL VB	R	Rex	RV	Lip Annules	Rows Scales	Scale crenation		
											100 %	p-V	Absent
Fraser Island (Type locality)	11	67-80	0.23-0.41	89-93		70-72	22-23	8	1	8	—	—	11
Sandy Creek	3	64-68	0.43-0.50	93-95	0.8-1.0	71-75	21-26	6-7	1	8	—	2	1
Charleville	3	64-69	0.40-0.46	93-96	0.6-1.0	74-85	26-27	6-8	1	8	—	2	1
Halls Gap	3	62-66	0.35-0.41	92-94	0.8-1.1	71-78	22-23	6-7	1	8	—	2	1
Barcoongerie	2	56-57	0.33-0.39	93-95	0.8	66-69	23	5-6	1	8	—	1	1
Ravensbourne	6	76.6 (67-83)	0.38 (0.31-0.43)	94 (93-95)	0.9 (0.8-1.0)	79 (74-81)	26 (24-28)	6 (5-6)	2	1 × 7 5 × 8	5	1	—
Morton	3	72-91	0.34-0.50	93-94	0.9-1.0	83-89	27-30	6-7	2	8	3	—	—
Murramarang	3	91-96	0.44-0.47	93-95	0.8-1.1	80-85	27-29	6-7	2	8	2	1	—
Pigeon H. Mtn.	7	81.4 (73-89)	0.43 (0.39-0.49)	92.5 (92-93)	1.2 (1-1.4)	92 (91-95)	29 (28-30)	9.6 (9-10)	2	8	5	1	1
Ben Boyd	5	77.1 (75-83)	0.43 (0.37-0.50)	90.6 (89-92)	1.3 (1.1-1.5)	88 (84-92)	27 (26-28)	11 (10-12)	2	8	5	—	—
Banda Banda	4	86-92	0.45-0.54	92-95	0.7-1.1	80-85	28-30	6-7	2	10	3	1	—
Cockerawombeeba	3	76-87	0.39-0.47	93-95	0.7-0.8	78-81	25-28	6-7	2	8	1	2	—
Total*	52	76.2 (56-96)	0.42 (0.31-0.54)	93 (89-96)	0.95 (0.6-1.5)	80 (66-95)	26 (21-30)	7 (5-12)	1 or 2	7, 8 or 10	28 (54 %)	17 (33 %)	7 (13 %)

* 15 localities (11 detailed above), type locality excluded.

pseudo-lips. Second head annule narrower than first, collar-like, directed sideways, or may be absent. Body covered in rows of retrorse imbricate scales, usually in eight rows, rarely ten at mid-body. Scales usually with straight or convex edge, entire over whole body or with crenate posterior edge. Crenate scales may occur over entire body, from mid-body, or just on post-vulval region. Scales usually overlap following annule as well as adjacent scales. Tail scales may be entire, finely to coarsely crenate or lobed. Stylet may be longer or shorter than originally described. Sperm present in 79 % of females studied. Post-vulval region conoid, variable in length (18-39 µm).

Males (n = 2) : Males only collected from Wilson River Primitive Reserve, Mt. Boss State Forest, New South Wales. Body ventrally curved when relaxed. Lip region continuous with body contour, with five or six lip annules. Stylet absent, oesophagus degenerate. Lip annules small, body annules somewhat coarser. Hemizonid extending over two annules. Testis packed with rounded sperm. Lateral field with four lines which are all smooth in one specimen, the outer ones are slightly irregular (but not crenate) in the other. Caudal alae reduced. Spicules arcuate, gubernaculum slightly angular in lateral view. A collar-like structure surrounds the

cloacal opening, and appears to be similar to that described for males of *P. australe* (Colbran, 1963) Mehta & Raski, 1971. Tail tapering, annulated to terminus which is pointed and dorsally reflexed.

Juveniles : J4 and J3 with two lip annules, of similar diameter. J4 with an estimated ten, rarely twelve rows of conoid to rounded scales, edged with short or long, fine, hair-like spines. J3 similar to J4, with similar scales in eight rows. Tail conoid.

DISCUSSION

1. - *Pateracephalanema imbricatum*

This species was first described from Queensland specimens (Fraser Island), which have one large, saucer-like lip annule, and eight rows of entire, imbricate scales covering the body.

Specimens from several localities in New South Wales are readily distinguished from the usual form of *P. imbricatum* by the presence of a distinct collar-like second annule (Fig. 4 B). Further study shows that the scales of many specimens are crenate along the posterior edge, a crenation which often becomes coarser in the post-vulval region, and tail scales may be bifurcate or

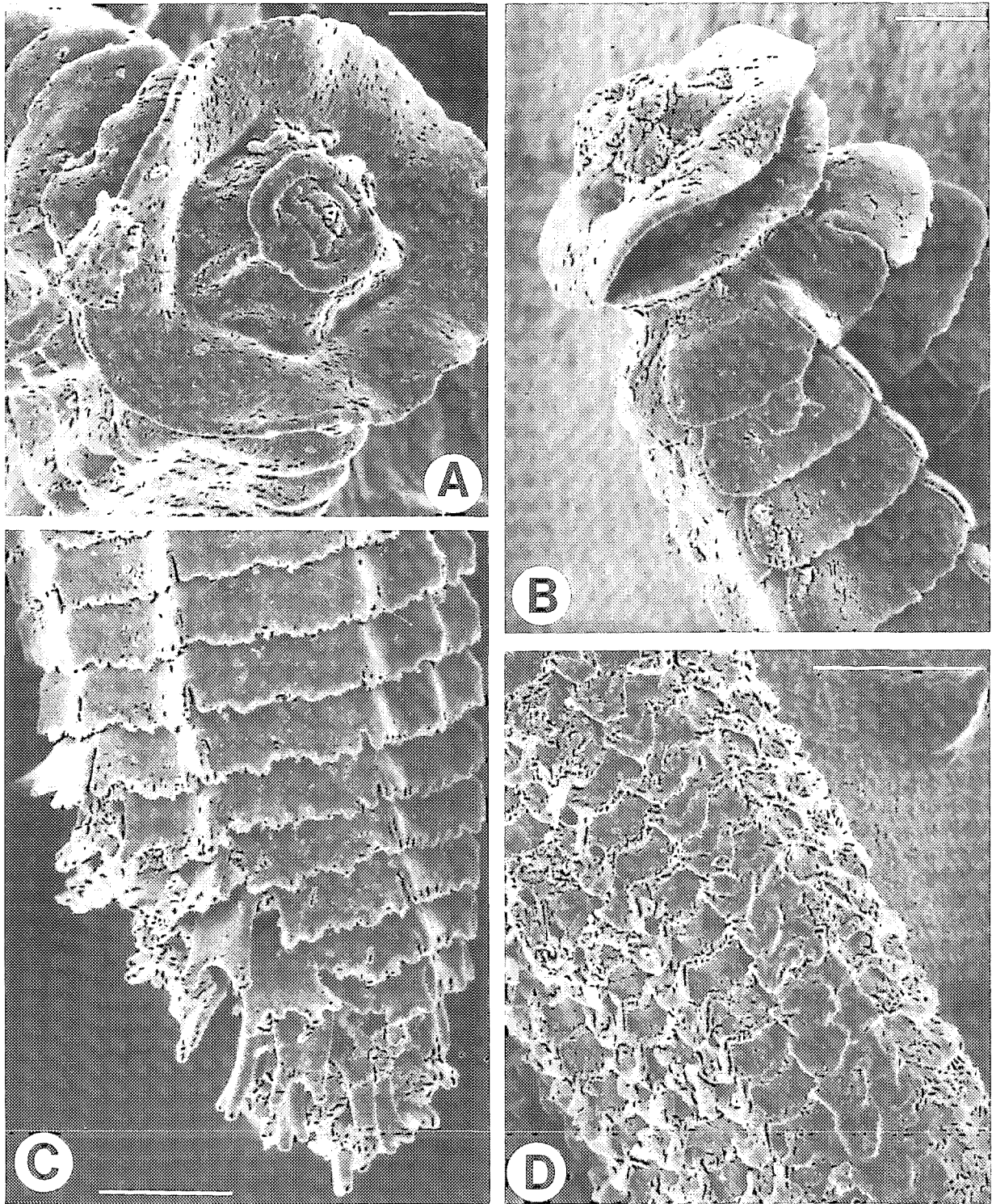


Fig. 4. *Pateracephalanema imbricatum* (Colbran, 1965) Mehta & Raski, 1971. SEM photos. Female. A : en face; B : anterior region; C : post-vulval region. *Blandicephalanema bossi* n. sp. Juvenile. D : scales at mid-body. (Bar scales : A, B represent 4 μ m; C, D represent 10 μ m).

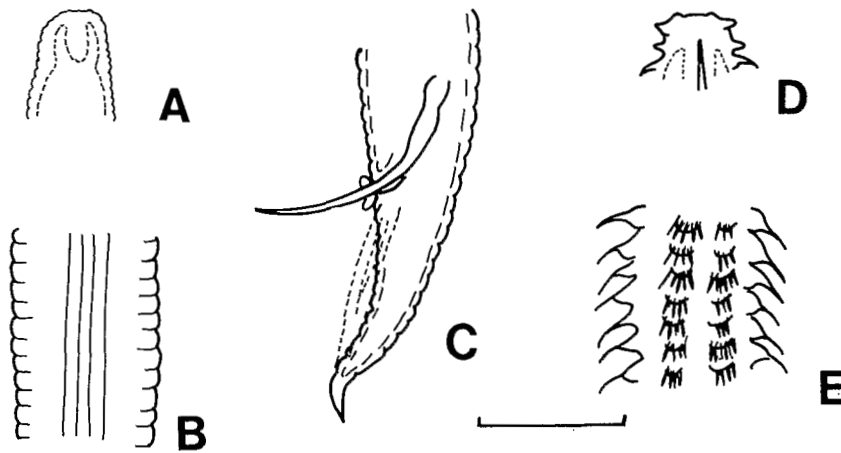


Fig. 5. *Pateracephalanema imbricatum* (Colbran, 1965) Mehta & Raski, 1971. Male. A : lip region; B : lateral field; C : tail. Juvenile. D : lip region; E : scales. (Bar scale represents 20 μ m).

lobed (Fig. 4 C). As a number of specimens with one lip annule also have been collected, these were studied in more detail. Several of these with one lip annule were found to have crenate scales on the post-vulval region (63%), although none could be found to have crenate scales on the rest of the body. In females with two lip annules, specimens usually have all crenate scales, or crenate scales on the post-vulval region only. Measurements (Tab. 1) show differences from the type population, but when specimens are grouped according to one or two lip annules, there is an overlap of nearly all measurements.

Specimens from Banda Banda reserve show additional variation, as the females have ten rows of scales instead of eight, as well as two lip annules, and crenate scales over the entire body. If this population were considered alone, it might well be thought to represent a new species. The number of lip annules is known to vary in species of other genera, and has been shown in this paper to vary in *P. pellitum*. Similarly the degree of ornamentation of scales or annules can vary considerably within a species. Thus it seems that this is a very variable species, with populations from the type locality and Banda Banda reserve representing two extremes of one species.

2. - The genus *Pateracephalanema*

In 1986, Siddiqi reduced the genus *Pateracephalanema* to subgeneric status, and erected the subgenus *Pellipecten* to accommodate *P. pectinatus* (Colbran, 1962) Mehta & Raski 1971 and *P. pellitum*, both as subgenera under the genus *Ogma* Southern, 1914. The species mentioned here no longer fully comply with the characteristics given by Siddiqi and other workers. Although

the first annule is large and saucer shaped, it may be accompanied by a second lip annule. Also, until now, species included under the subgenus *Pateracephalanema* (Siddiqi, 1986) have been considered to have smooth scales. In 1985 Orton Williams described a new genus *Syro*, which includes three new species. Numerous specimens of a Criconematid have been collected from eastern Australia, which fit the description of *S. hughdavidii* Orton Williams, 1985. The Australian specimens are similar to *Crossonema palmatum* (Siddiqi & Southey, 1962) Mehta & Raski, 1971, differing principally in the palmate scales which are arranged in rows instead of alternately. Furthermore specimens from some localities grade into *Pateracephalanema pectinatum*, and can only be distinguished by the first lip annule, usually crenate in *C. palmatum* and fringed in *P. pectinatum*. Thus the taxonomy of this group of nematodes appears to be in a state of uncertainty. The use of the genus *Pateracephalanema*, as defined by Metha and Raski (1971), has been retained, as it covers the variation described in this paper.

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