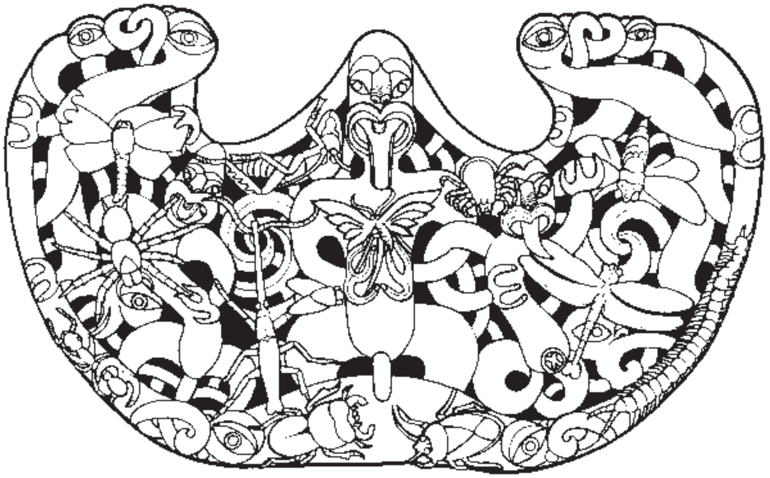

Fauna of New Zealand

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Criconematina

(Nematoda: Tylenchida)

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POPULAR SUMMARY

HE WHAKARĀPOPOTOTANGA

Phylum **Nematoda** Rudolphi, 1808

Class **Secernentea** von Linstow, 1908

Order **Tylenchida** Thorne, 1949

Suborder **Criconematina** Siddiqi, 1980

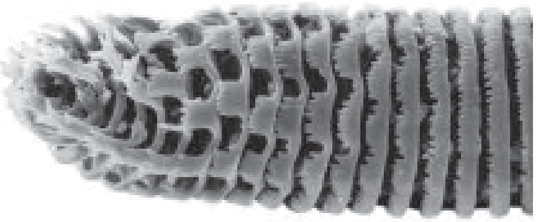

Illustration / Whakaahua: *Ogma sturhani* sp. nov. female posterior end (Illustrator / Kaiwhakaahua: B. E. Rhode).

Criconematina nematodes

Nematodes or eelworms are unsegmented roundworms – predominantly microscopic. The phylum Nematoda is subdivided into the classes Secernentea and Adenophorea. Plant parasitism occurs in Tylenchida of class Secernentea (the group to which the suborder Criconematina belongs), and Dorylaimida of class Adenophorea. Plant parasitic nematodes possess a hardened mouth piece – a stylet – with which they can puncture plant cells. In Tylenchida (Tylenchina, Hoplolaimina, and Criconematina) the stylet is a stomatostyle developing from tissues of the stoma (mouth). In the Dorylaimida (Longidoridae and Trichodoridae) the stylet is an odontostyle as it develops from oesophageal tissue; their feeding on plant roots can do direct damage to their host, but they are better known for their ability to transmit plant viruses.

Many tylenchids cause damage to agricultural crops, especially in monocultures where their population numbers can build up to high levels when favoured crops are replanted in quick succession. Criconematina, the suborder of tylenchs described in this monograph, generally feed on tree roots, and their damage is restricted to commercial orchards planted with infested plant material or replanted in infested soil. In their native habitat they generally cause no damage. Of the 68 species known to be present in New Zealand, 47 are endemic (46 belonging to the subfamily Criconematinae). In the family Criconematidae the cuticle has distinct transverse striae giving the specimens a ringed appearance. In the subfamily Criconematinae these rings bear scales or spines in the females or the juveniles or both.

Criconematids are microscopic. Their characters can only be observed with the compound microscope at high magnification using immersion oil. Specimens, therefore, have to be preserved and processed by fixing in a low concentration of formaldehyde and slow saturation with glycerol and subsequent mounting on microscope slides. Criconematids are transparent and the individual species

(continued overleaf)

Ngā nematode Criconematina

Ko te noke rango (te noke tuna ki ētahi), he momo noke porotaka he wehenga kore tōna tinana – he mōkitokito anō hoki te nuinga. I te pori Nematoda, e rua ngā karangatanga, ko te Secernentea me te Adenophorea. Tērā tētahi rōpū o te karangatanga Secernentea (te rōpū nō reira mai te pūtoi whāiti Criconematina) ko Tylenchida te ingoa, me tētahi anō o te karangatanga Adenophorea ko Dorylaimida te ingoa, he pirinoa te mahi a ēnei rōpū. He whai wāhanga kamukai āhua mārō ēnei toke rango pirinoa. Mā te wāhanga kamukai mārō nei e taea ai e rātou ngā pūtau tipu te werowero, e toroa ai ngā painga o roto. I ngā Tylenchida (ngāi Tylenchina, ngāi Hoplolaimina, me ngāi Criconematina), ka hangaia ngā wāhanga kamukai nei ki ngā pūtau o te waha, ā, ka kīia he stomatostyle. I ngā Dorylaimida (ngāi Longidoridae me ngāi Trichodoridae), ka tipu mai ngā wāhanga kamukai i ngā pūtau o te pū kai, nō reira ka kīia he odontostyle. I tā rātou kaikai i ngā pakiaka o te tipu, tērā tonu ka takakinotia te tipu, engari ko tā rātou harihari wheori tipu tā rātou mahi kino e kaha ake ana te mōhiotia.

He maha ngā tylenchid ka takakino i ngā tipu ahuwhenua. He kaha ake tēnei raruraru i ngā māra kotahi anake te momo kai e tipu ana i roto. Ā, ina tere tonu, ina rite tonu te whakatō i tētahi momo tipu e pai ana ki a rātou, kātahi ka hē kē atu. Kai ai te Criconematina, arā, te pūtoi whāiti o ngā tylench e whakaahuatia ana i tēnei tuhinga, i ngā pakiaka rākau, ā, ka whāiti mai ngā raruraru e hua ake ana i tēnei mahi a rātou ki ngā māra huarākau

(haere tonu)

can be identified on characters inside and on the surface of the body. In Criconematina, the two sexes differ markedly (sexual dimorphism) and several of the structures of the male are poorly developed or absent. Diagnostic characters, therefore, are restricted to the females. The main internal character is the stylet. Its base has distinct knobs for the adhesion of muscles that control the movement of the stylet. Both the length of the stylet and the size and shape of the knobs are used for the identification of species. Another useful internal character is the shape of the oesophagus. External characters are the length, width, and shape of the nematode. The size of the rings of the cuticle, their total number, and the number in front of the excretory pore and posterior to the opening of the female reproductive system are also important. In species with scales and spines, their number per cuticle ring and their length can all be useful. Characters of the lip region and the shape of the scales and their various appendages can best be demonstrated with photographs taken by a scanning electron microscope.

In New Zealand, taxonomic study of nematodes started in the early 1960s. Initially it only covered free-living nematodes, but gradually plant and insect parasitic nematodes were also included. The original intention of this contribution was to summarise all studies on Tylenchida and combine them in one work. It was soon recognised, however, that this would be too extensive a task. This monograph, therefore, is restricted to the Criconematina, covering a total of 68 species, 16 of which are new to science.

Contributor **Wim Wouts** was born in the Wieringermeer, approximately 60 km north of Amsterdam, the Netherlands. He attended high school at Alkmaar. After two years service in the Dutch army he studied Plant Pathology at the Agricultural University at Wageningen. During a six month practical in Florida the citrus nematode (*Radopholus similes*) awakened in Wim an interest in nematodes, the most visible of plant pathogens, that has lasted ever since. After graduation Wim was employed as a nematologist by Entomology Division, Department of Scientific and Industrial Research (DSIR) in New Zealand. As Entomology Division was being prepared for transfer from Nelson to Auckland, and there being little prospect for the establishment of permanent experimental plots, Wim developed an interest in the morphology and systematics of nematodes. Having been raised in one of the major seed potato producing areas of the Netherlands he had long been intrigued by the potato cyst nematode (PCN), a menace largely still absent in the newly reclaimed polder where he lived, and

(continued overleaf)

pakihi i muia ngā rākau e ēnei moroiti i mua i te whakatōkanga, ko te oneone rānei i muia. I ō rātou kāinga ake, me uaua ka raru he tipu i a rātou. O ngā momo e 68 e mōhiotia ana kei Aotearoa e noho ana, e 47 nō konei anake (e 46 nō te whānau whāiti Criconematinae). I te whānau Criconematidae, he maha ngā rārangi rere whakapae kei te kahuārai, ko te mōwhiti te āhua ki te titiro atu. I te whānau whāiti Criconematinae, he unahi, he tarakina rānei, ko ngā mea e rua rānei e mau mai ana ki ngā mōwhiti o ngā uwha, o ngā kōhungahunga, o rāua tahi rānei.

He hanga mōkitokito ngā Criconematid, nō reira hei āta tirotiro i ngā āhuatanga whāiti, me karu whakarahi pūhui kua meatia kia tino kaha tāna mahi, ā, me rumaki te arotahi ki te hinu i te tuatahi. Me āta rokiroki ngā tautauira nei, arā, me whakamate ngā pūtau katoa ki te formaldehyde, kātahi ka kōkuhu atu i te glycerol, ka tāpae ai ki waenganui i ngā papa kōataata. He pūataata ngā Criconematid, nō reira ka whāia ko ngā āhuatanga whakawaho, whakaroto anō hoki o te tinana hei tautohu i tēnā momo, i tēnā. I roto i a ngāi Criconematina, he tino rerekē te āhua o te toa me te uwha. Ko ētahi āhuatanga e kitea ana i ngā uwha, kei te tino ngoikore, kei te ngaro rānei i ngā toa. Nō reira, e whāia ana ko ngā āhuatanga kei ngā uwha hei tautohu i ngā momo. Ko te āhuatanga whakaroto matua, ko te wāhanga kamukai. He pūreke kei te pūtake e pai ai te piri atu o ngā uaua e whakataki ana i ngā nekeneke o ngā wāhanga kamukai. Ko te roa o ngā wāhanga kamukai tae atu ki te rahi me te āhua o ngā pūreke ētahi tino āhuatanga ka āta tirohia hei tautohu i ia momo. Ko tētahi atu tino āhuatanga o roto ka tirohia, ko te āhua o te pū kai. Ko ētahi āhuatanga o waho, ko te roa, te whānui me te hanga o te noke rango. Arā anō te rahi me te maha o ngā mōwhiti o te kahuārai, te maha o ngā mōwhiti kei mua i te nono, te maha anō kei muri i te puta o te uwha. I ngā momo whai unahi, whai tarakina, ka whaihua anō pea te tatau i te maha me te roa o ēnei hanga ki ia mōwhiti. Mā te whakamahi whakaahua kua tangohia ki te karu whakarahi irahiko matawai e pai ai te whakaatu i ngā āhuatanga i te takiwā o ngā ngutu, te āhua o ngā unahi, me ōna anō tāpiritanga.

I Aotearoa nei, i tīmata ngā mahi tirotiro i te whakarōpūtanga o ngā noke rango i ngā tau tuatahi o ngā 1960. Ko ngā noke rango nekeneke anake i tirohia i te tīmatanga, engari i te takanga o te wā ka uru mai anō ngā noke pirinoa ki ngā tipu me ngā ngārara. Ko te whāinga o tēnei tuhinga i te wā i whakaarohia tuatahitia ai, kia whakarāpopotongia ngā rangahautanga katoa o ngāi Tylenchida, ka whakakotahi ai ki te tuhinga kotahi. Engari kāore i roa ka kitea he whānui rawa te hao o tēnei kupenga. Nō reira, kua aro whāiti te tuhinga nei ki a ngāi

(haere tonu)

where severe regulatory measures were imposed on farmers to control it. This, and an increasing awareness of the paucity of knowledge regarding the identity of this important species, started a fascination with PCN and other cyst-forming nematodes (Heteroderidae). He gained a scholarship at the University of California, Riverside, U.S.A. to study the Heteroderidae, which allowed him to pursue a PhD. The discovery in the deserts of Southern California of Heteroderidae taxa that did not produce cysts revealed the versatility of the group. In his PhD thesis Wim proposed a phylogenetic system, based on the morphology of fully developed females, that encompassed both cyst- and non-cyst-forming categories and included many known taxa for which the association with Heteroderidae had been doubtful. Species definitions were based on characteristics of the cyst and the juvenile. He established as a separate family the root-knot nematodes, until then considered to belong to the Heteroderidae. Soon after his return to Nelson the Institute of Nematology at Muenster, Germany became interested in a classification of the most economically important cyst-forming-nematodes of Europe based on larval characters. With the help of an Alexander von

(continued overleaf)

Criconematina. Hui katoa, e 68 ēnā momo, 16 kātahi anō ka mōhiotia i te ao pūtaiao.

I whānau mai te kaituhi, a **Wim Wouts**, i Wieringermeer, i te āhua 60 km ki te raki o Amsterdam, i Hōrana. Ka haere ia ki te kura tuarua i Alkmaar. E rua tau ia e hōia ana i te ope taua Tatimana, kātahi ka ako i te Mātai Tahumaero Tipu i te Whare Wānanga Ahuwhenua i Wageningen. I a ia e mahi ana i tana kaupapa ā-ringa i Florida mō te ono marama, nā te noke rango rēmana (*Radopholus similes*) i whakaara ake te ngākaunui o Wim ki ngā noke rango, ko te noke rango hoki te pūtake tahumaero tipu e tino mārama ana te kitea. Kua mau tonu tēnei aro nui āna ki ngā noke rango tae mai ki tēnei wā. Ka whiwhi a Wim i tana tohu mātauranga, ka haere hei kaimātai noke rango i te Wāhanga Mātai Pepeke o te Tari Rangahau Pūtaiao, Ahumahi (DSIR) i Aotearoa. I te mea e nekehia ana te Wāhanga Mātai Pepeke i Whakatū ki Tāmaki-makau-rau, ā, e kore pea e taea te whakatū māra whakamātau pūmau i tō rātou wāhi noho hou, ka tahuri kē a Wim ki te whāwhā i te hanga me te whakapapa o ngā noke rango. I tipu ake a Wim i tētahi o ngā tino wāhi o Hōrana mō te whakatipu taewa tinaku, ā, kua roa ia e wairua pakirehua ana ki te noke rango hanga tuapuku i ngā taewa (te PCN). Kāore i tino kitea te noke nei i ngā whenua tāpotupotu o tana kāinga i whakahokia mai e Hinemoana, ā, he waeture torokaha i whakatūria mā ngā ringa ahuwhenua o reira hei kaupare atu i te hanga kino nei. Nā tēnei, me te kite iho anō he tino iti ngā mōhiotanga ki tēnei momo, ka toko ake i a ia te hiahia ki te titiro hōhonu ki te PCN me ērā atu noke hanga tuapuku (Heteroderidae). Ka whiwhi ia i tētahi karahipi i te Whare Wānanga o Karapōnia, i Riverside, U.S.A. hei tirotiro i a ngāi Heteroderidae, i āhei ai ia ki te whai i tana PhD. Nō te kitenga o ētahi huinga Heteroderidae i ngā koraha o Karapōnia kāore i hanga tuapuku, ka kitea te kaha o te rōpū nei ki te urutau ki ngā āhuatanga rerekē. I tana tuhinga PhD, ka tāpaea e Wim tētahi pūnaha tātai whakapapa, e aro ana ki te hanga o ngā uwha pakari. Ka uru mai ki tana pūnaha ngā wehenga hanga tuapuku me ērā kāore e hanga tuapuku, ā, ka uru mai anō ētahi rōpū i mōhiotia, engari kāore i whakaaetia whānuitia he hononga ō rātou ki ngā Heteroderidae. I whai ngā kupu tautuhi o mua i te hanga o ngā kōhungahunga anake, ā, ka whakaaturia e ia he whānau motuhake ngā noke rango pona-pakiaka – i mua atu i tērā ka pōhēhētia nō ngā Heteroderidae. Kāore i roa i muri i tana hokinga ki Whakatū, ka whakaarorangi te Pūtahi Mātai Noke Rango i Muenster, i Tiamana, ki tētahi whakarōpūtanga o ngā noke rango hanga tuapuku o Ūropi e tino pāpā ana ki te ōhanga, i runga i te āhua o ngā

(haere tonu)

Humboldt fellowship Wim was able to work in their laboratory and establish this classification.

From the mid-1970s, with the transfer to Auckland a reality, and the classification of the Heteroderidae accomplished, Wim worked on entomopathogenic nematodes, then generally known as *Neoaplectana*. He established the validity of the older name *Steinernema*, provided updated nomenclature for the group, clarified their life cycle (as well as the life cycle of species of the recently proposed genus *Heterorhabditis*), and developed a liquid medium for the nematodes to grow in. During this period he maintained excellent relationships with the Institute at Muenster resulting in several exchange visits. In the late 1980s training in Criconematidae classification at the Institute in Muenster was made possible by generous funding from the Humboldt Foundation. As Criconematidae are well represented in New Zealand they kept Wim busy from then on and well into his retirement. Several comprehensive works were published, most in joint authorship, and culminating in this present contribution.

During his time in Auckland Wim was very involved in the Dutch community: initially in the Dutch Club where he served as secretary and organised a drama group, and later in the Dutch Village Trust where he served on the Board and was Chairman for one year. Wim presently lives in Perth, Western Australia.

torongū. Me kore ake te tūranga paewai Alexander von Humboldt i āhei ai a Wim ki te mahi i tā rātou taiwhanga pūtaiao, ki reira whakatakoto ai i tēnei whakarōpūtanga.

Mai i ngā tau waenga o ngā 1970, kua neke kē te Wāhanga Mātai Pepeke ki Tāmaki, ā, kua oti tā Wim whakarōpū i ngā Heteroderidae, nō reira ka tahuri a Wim ki te tirotiro i ngā noke rango noho ki rō pepeke, i karangahia whānuitia i tērā wā ko ngāi *Neoaplectana*. Ka whakatūturu ia i te tika o tō rātou ingoa o mua, a *Steinernema*, ka hoatu ingoa hou ki ētahi o te rōpū, ka whakamārama ake i tō rātou mataora (tae atu ki te mataora o ngā momo o te puninga hou nō nā noa nei i whakatauria ai me rōpū motuhake, arā, o *Heterorhabditis*), ka mahia anō hoki e ia he momo wē e tipu ai ngā noke i roto. I tēnei wā ka torokaha tonu ana hono ki te Pūtahi i Muenster, me te aha, ka whakawhitiwhiti a Wim me ētahi tāngata o reira. I ngā tau whakamutunga o ngā 1980, ka riro mai he pūtea autaia tonu i te Humboldt Foundation i taea ai te whakahaere ngā whakangungutanga mō te whakarōpū i ngā Criconematidae i te Pūtahi i Muenster. I te mea he huhua tonu ngā Criconematidae i Aotearoa, ka haere tonu tēnei mahi āna ā, mutu noa tana mahi tūturu, ā, ahu atu ki ngā rā o te ahungarua. He maha ngā tuhinga hao whānui i tāia, ko te nuinga i tuhia ngātahitia ki ētahi atu, tae atu ki tēnei tuhinga nei nā.

I a ia i Tāmaki, ka kaha tonu te whai wāhi atu a Wim ki te hapori Tatimana: i te Karapu Tatimana, ko ia te hēkeretari, nāna anō i whakahaere tētahi rōpū whakaari, ā, i muri mai, i te Dutch Village Trust, ko ia tētahi o ngā mema o te Poari, ko ia anō te Tumuaki i tētahi tau. Kei Perth a Wim e noho ana ināianei, i Ahitereiria ki te Uru.

Translation by **H. Jacob**
Tāmaki-makau-rau / Auckland

Dedication

For our grandchildren Emily (Riverside, California)
and Lucas (Perth, Western Australia)

> *Whenever I have found out that I have blundered, or that my work has been imperfect, and when I have been contemptuously criticized …….it has been my greatest comfort to say hundreds of times to myself that I have worked as hard and as well as I could, and no man can do more than this…. thinking that I could not employ my life better than adding a little to Natural Science. This I have done to the best of my abilities, and critics may say what they like, but they cannot destroy this conviction.*
>
> Charles Darwin. (From: Renee Skelton (1987) *Charles Darwin and the Theory of Natural Selection.* Barron's Educational Series, Inc, page 107).

ABSTRACT

Sixty-eight species of Criconematina, in 13 genera, are recorded from New Zealand. Sixteen new species are described: *Criconema* (*Criconema*) *mackenziei* sp. nov., *C.* (*C.*) *makahuense* sp. nov., *C.* (*C.*) *nelsonense* sp. nov., *Criconema* (*Nothocriconema*) *grandisoni* sp. nov., *Macroposthonia campbelli* sp. nov., *Ogma alternum* sp. nov., *O. capitulatum* sp. nov., *O. catherinae* sp. nov., *O. inaequale* sp. nov., *O. mucronatum* sp. nov., *O. niagarae* sp. nov., *O. sturhani* sp. nov., *Syro tribulosus* sp. nov., *S. glabellus* sp. nov., *Blandicephalanema inserratum* sp. nov., and *B. nothofagi* sp. nov. Fourteen species introduced from other parts of the world are described from local material and illustrated. Of the endemic species, *Pateracephalanema imbricatum* is the only species shared with Australia. Because of the predominance of the subgenus *Nothocriconemella* in New Zealand, the cosmopolitan *Criconema* (*Nothocriconemella*) *sphagni* may be a New Zealand species now spread worldwide.

Siddiqi's (2000) classification of Criconematina, with 3 superfamilies, is accepted here. *Eubostrichus guernei* is recognised as a valid species and as the type species of *Criconema* Hofmänner & Menzel, 1914. In species with ornate cuticles, the type of scale or spine, rather than their orientation on the body, is considered phylogenetically significant. The genus *Criconema* is redefined, and the genera of the family Criconematidae (Criconematoidea) are rearranged accordingly. The taxon *Nothocriconema,* previously a synonym of *Criconema* is reinstated as subgenus *Criconema* (*Nothocriconema*) and the subgenus *Ogma* (*Pateracephalanema*) as genus *Pateracephalanema*. *Crossonema* is synonymised with *Ogma* and *Amphisbaenema* with *Blandicephalanema*.

For each species a detailed description of the female is given, including morphometrics and illustrations, supplemented with SEM micrographs of morphological details. Details of males and juveniles are given, if available. A diagnosis is presented to distinguish each species from other New Zealand species. Locations and plant species associations of each species are indicated and the significance of each species as a taxonomic unit is commented upon. Lists of nematode species present at various localities and associated with individual plant species are given in appendices. Keys to all taxa covered are provided.

Keywords. Nematoda, nematodes, Tylenchida, Criconematina, New Zealand, classification, distribution, biology, species endemism, fauna.

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CHECKLIST OF TAXA

Suborder CRICONEMATINA Siddiqi, 1980 28

Superfamily Criconematoidea Taylor, 1936 28

Family Criconematidae Taylor, 1936 28

Subfamily Criconematinae Taylor, 1936 28

Genus ***Criconema*** Hofmänner & Menzel, 1914 28
Subgenus ***Criconema*** Hofmänner & Menzel, 1914 ... 29
    aucklandicum Loof, Wouts & Yeates, 1997 29
    cristulatum Loof, Wouts & Yeates, 1997 30
    mackenziei sp. nov. 31
    makahuense sp. nov 31
    nelsonense sp. nov. 32
    spinicaudatum (Raski & Pinochet, 1976) Raski & Luc, 1985 33
Subgenus ***Nothocriconema*** Ebsary, 1981 34
    annuliferum (de Man, 1921) Micoletzky, 1925 34
    grandisoni sp. nov. 35
    lineatum Loof, Wouts & Yeates, 1997 35

  - ***magnum*** Loof, Wouts & Yeates, 1997 ... 36
  - ***undulatum*** Loof, Wouts & Yeates, 1997 ... 37
- Subgenus ***Nothocriconemella*** Ebsary, 1981 ... 38
  - ***mutabile*** (Taylor, 1936) Raski & Luc, 1985 ... 40
  - ***californicum*** Diab & Jenkins, 1966 ... 40
  - ***pasticum*** (Raski & Pinochet, 1976) Raski & Luc,1985 ... 42
  - ***alpinum*** Loof, Wouts & Yeates, 1997 ... 42
  - ***graminicola*** Loof, Wouts & Yeates, 1997 ... 43
  - ***acuticaudatum*** Loof, Wouts & Yeates, 1997 ... 44
  - ***sphagni*** Micoletzky, 1925 ... 44
  - ***macilentum*** (Raski & Pinochet, 1976) Raski & Luc, 1985 ... 45
  - ***crosbyi*** Wouts, 2000 ... 46
  - ***farrelli*** Wouts, 2000 ... 46
  - ***ramsayi*** Wouts, 2000 ... 46
  - ***dugdalei*** Wouts, 2000 ... 47
- Genus ***Ogma*** Southern, 1914 ... 47
  - ***alternum*** sp. nov. ... 49
  - ***campbelli*** Wouts, Yeates & Loof, 1999 ... 49
  - ***capitulatum*** sp. nov. ... 50
  - ***catherinae*** sp. nov. ... 51
  - ***civellae*** (Steiner, 1949) Mehta & Raski, 1971 ... 52
  - ***crenulatum*** Wouts, Yeates & Loof, 1999 ... 52
  - ***inaequale*** sp. nov. ... 53
  - ***latens*** Mehta & Raski, 1971 ... 54
  - ***mucronatum*** sp. nov. ... 55
  - ***niagarae*** sp. nov. ... 56
  - ***palmatum*** (Siddiqi & Southey, 1962) Siddiqi, 1986 ... 57
  - ***paucispinatum*** Wouts, Yeates & Loof, 1999 ... 58
  - ***polyandra*** Wouts, Yeates & Loof, 1999 ... 59
  - ***semicrenatum*** Wouts, Yeates & Loof, 1999 ... 60
  - ***sexcostatum*** Wouts, Yeates & Loof, 1999 ... 61
  - ***sturhani*** sp. nov. ... 62
  - ***subantarcticum*** Wouts, Yeates & Loof, 1999 ... 63
- Genus ***Syro*** Orton Williams, 1985 ... 63
  - ***glabellus*** sp. nov. ... 64
  - ***tribulosus*** sp. nov. ... 64
- Genus ***Pateracephalanema*** Mehta & Raski, 1971 ... 65
  - ***imbricatum*** (Colbran, 1956) Mehta & Raski, 1971 ... 65
- Genus ***Blandicephalanema*** Mehta & Raski, 1971 ... 66
  - ***serratum*** Mehta & Raski, 1971 ... 66
  - ***inserratum*** sp. nov. ... 67
  - ***nothofagi*** sp. nov. ... 68
  - ***pilatum*** Mehta & Raski, 1971 ... 69

- **Subfamily Macroposthoniinae** Skarbilovich, 1959 70
- Genus ***Macroposthonia*** de Man, 1880 ... 70
  - ***campbelli*** sp. nov. ... 70
  - ***rustica*** (Micoletzky, 1915) De Grisse & Loof, 1965 ... 71
  - ***xenoplax*** (Raski, 1952) De Grisse & Loof, 1965 71
- Genus ***Criconemoides*** Taylor, 1936 ... 72
- Subgenus ***Criconemoides*** Taylor, 1936 ... 72
  - ***informis*** (Micoletzky, 1922) Taylor, 1936 ... 72
- Subgenus ***Criconemella*** De Grisse & Loof, 1965 ... 73
  - ***parvus*** Raski, 1952 ... 73

- **Subfamily Hemicriconemoidinae** Andrássy, 1979 73
- Genus ***Hemicriconemoides*** Chitwood & Birchfield, 1957 ... 73
  - ***cocophillus*** (Loos, 1949) Chitwood & Birchfield, 1957 ... 74

- **Superfamily Tylenchuloidea** Skarbilovich, 1947 ... 74

- **Family Tylenchulidae** Skarbilovich, 1947 (Kirjanova, 1955) ... 74
- Genus ***Tylenchulus*** Cobb, 1913 ... 75
  - ***semipenetrans*** Cobb, 1913 ... 75
- Genus ***Trophotylenchulus*** Raski, 1957 ... 75
  - ***okamotoi*** (Minagawa, 1983) Siddiqi, 2000 ... 75

- **Family Sphaeronematidae** Raski & Sher, 1952 ... 76
- Genus ***Sphaeronema*** Raski & Sher, 1952 ... 76
  - ***californicum*** Raski & Sher, 1952 ... 77

- **Family Paratylenchidae** Thorne, 1949 ... 78
- Genus ***Paratylenchus*** Micoletzky, 1922 ... 78
- Subgenus ***Paratylenchus*** Micoletzky, 1922 ... 79
  - ***halophilus*** Wouts, 1966 ... 79
- Subgenus ***Gracilacus*** Raski, 1962 ... 80

- **Superfamily Hemicycliophoroidea** Skarbilovich, 1959 ... 80
- **Family Hemicycliophoridae** Skarbilovich, 1959 ... 80
- Genus ***Hemicycliophora*** de Man, 1921 ... 80
  - ***chathami*** Yeates, 1978 ... 80
  - ***halophila*** Yeates, 1967 ... 81

CONTENTS

- Acknowledgments ... 11
- Introduction ... 12
- Nematodes ... 12
  - Plant parasitic nematodes ... 12
  - Parasitic Tylenchida ... 12
- The suborder Criconematina ... 12
  - Earliest records in New Zealand ... 13
  - Endemism ... 13
- Plant nematology in New Zealand ... 13
- The origin of the New Zealand nematode fauna ... 14
- Morphological characters ... 14
  - Shape and size of the body ... 14
  - Stylet ... 15
  - Body wall ... 15

  Lip region 15
  Cephalic framework 15
  Oesophagus – intestine 15
  Reproductive system 18
Classification of the order Tylenchida 18
  The suborder Criconematina 18
  Criconematoidea 19
    Criconematidae 19
      Criconematinae 19
        Criconema 19
          Subgenus *Criconema* 20
          Other subgenera of *Criconema* 20
        Ogma 20
        Pateracephalanema 22
        Syro 22
        Blandicephalanema 22
      Macroposthoniinae 23
      Hemicriconemoidinae 24
  Tylenchuloidea 24
    Tylenchulidae 24
    Sphaeronematidae 24
    Paratylenchidae 24
  Hemicycliophoroidea 24
    Hemicycliophoridae 25
Material and methods 25
Systematics 27
  Key to the taxa of New Zealand Criconematina 27
  Definitions and descriptions 28
References 82
Appendix 1: The type species of the Criconematina 86
Appendix 2: Alphabetical list of Criconematina species and sites where collected 88
Appendix 3: Latitudinal list of sample sites and Criconematina species collected 92
Appendix 4: Alphabetical list of plant species and associated Criconematina species 98
Appendix 5: Alphabetical list of Criconematina species and associated plant species 103
Tables 3–13. Standard measurements of species 107
Illustrations 120
Species distribution maps 207
Taxonomic Index 222

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INTRODUCTION

Studies of plant nematode biodiversity in the past 40 years has demonstrated that species of the suborder Criconematina are disproportionately well represented in New Zealand. Over these years many new species were collected, and when I retired in 2001 a considerable number of these species were still undescribed. They are described in this work and combined with previously published information into a monograph on criconematids. This monograph should facilitate identification for the time being and form a solid base for future research on plant parasitic nematodes in New Zealand.

NEMATODES

Nematodes, or roundworms, are unsegmented, generally microscopic worms. Typically, their cuticle is transparent and internal structures can be observed through it. The digestive system is tubular with a buccal cavity anteriad, followed by the oesophagus, the intestine, and rectum, and the anus subterminally. There are females and males, their reproductive system consisting of one or two tubular gonads, but also hermaphroditism and parthenogenesis occurs. They comprise the phylum Nematoda.

In the humid New Zealand environment, the most commonly encountered and easiest to recognise nematodes are the mermithids. They parasitise insects, feeding on the fat body of the immature stage. Developing inside a host shorter than 5 cm, when they leave the insect mermithids may be longer than 30 cm. They mature in the soil, usually over a long period of time, and emerge during periods of prolonged rain. Crawling up on plants to lay eggs they can be easily seen with the naked eye.

Not all nematodes are parasites, as the majority of species are free-living. The plant and animal parasites together form a very large group, collectively capable of affecting almost all living organisms on earth. Vertebrate parasites can grow very long, the longest observed so far being 8 m, living in the placenta of sperm whales. Plant parasites are all microscopic in size.

Plant parasitic nematodes

In plant parasitic species the feeding stage is characterised by the presence of a stylet, a sharply pointed feeding tube in the buccal cavity, for piercing the wall of the host cell and feeding. Plant parasitic species are less numerous than free-living and animal parasitic species and have evolved in both the two classes of the phylum Nematoda, Cecernentia and Adenophorea.

In Adenophorea, plant parasitism is restricted to the families Trichodoridae (Diphterophorina, Dorylaimida) and Longidoridae (Dorylaimoidea, Dorylaimida). Species of these families can damage crops, but are better known for their ability to transmit plant viruses. Plant parasites of the class Cecernentia, generally known as the “true” plant parasites, are restricted to the order Tylenchida. All major plant damaging species belong to this taxon, including Criconematina.

Parasitic Tylenchida

In the order Tylenchida the females are generally less than 1 mm long and although typically slender they may be swollen to spherical in shape. Their stylet has evolved by transformation of the tissues of the wall of the mouth cavity, the stoma, and therefore is referred to as a stomatostyle. It is perfectly suited for puncturing the cells of plant roots. To facilitate passage of plant material through the narrow lumen of the stylet, on feeding the median bulb pumps digestive juices, excreted by the dorso-oesophageal gland, through the stylet into the plant cell for predigestion of the cell’s contents.

Plant parasitic nematodes need free water for locomotion and host finding. Below ground, within the soil environment, the relative humidity present at wilting point is more than adequate to allow movement. For survival in the absence of water and a host, plant parasitic nematodes have a survival stage. This survival stage may be the egg, any of the four juvenile stages, or the adult, depending on the species. The survival stage is capable of slowing down its metabolism and may be capable of anhydrobiosis. Because of this adaptability, damp soils, including rehydrated soils from the driest deserts, may be found teeming with nematodes. Typical survival stages are best known in non-criconematina. Tylenchs infecting above ground plant parts may survive for many years in their stored host. Cyst-forming species, in the absence of a host, may survive in soil for more than 10 years.

THE SUBORDER CRICONEMATINA

In Criconematina the procorpus and median bulb, the two anteriormost parts of the oesophagus, are amalgamated. In Criconematidae this amalgamated region surrounds the basal part of the retracted stylet with the stylet base residing in the middle of the median bulb. This gives the impression that the amalgamation of the anterior part of the oesophagus has provided the flexibility to accommodate and evolve long stylets — well over 100 µm in length in some species.

The length of the female varies from about 200 µm to almost 2 mm and their shape from slender to spherically swollen. Transverse striation marks the cuticle. It may be very fine or extremely coarse. When coarse, it forms a distinct annulation on the cuticle, with the surface of the individual annules varying from smooth to extensively ornate. The cuticle of the body may have an outer layer that varies from a single thin sheath to a complete extra cuticle. Several of the species have an association with agricultural crops and some cause damage to crops. The majority of hosts, however, are shrubs and trees. Although several species are known from a single site only, the suborder generally is spread worldwide.

Earliest records in New Zealand

The genera *Criconema* Hofmänner in Hofmänner & Menzel, 1914, *Criconemoides* Taylor, 1936, and *Macroposthonia* de Man, 1880 have been recorded associated with agricultural crops since 1958 (Stout 1958, 1960; Clark 1963; Yeates 1967, 1968, 1974, 1975). *Macroposthonia* (= *Mesocriconema* Andrássy, 1965) *xenoplax* (Raski, 1952) De Grisse & Loof, 1965 was recorded from *Prunus* sp. (Dale 1972a) and grape (Grandison & Atkins 1985). Wouts (1966) described the first new species of the suborder, *Paratylenchus halophilus*. None of these species is considered endemic.

Endemism

That there are many endemic Criconematina species in New Zealand became clear in the 1970s. Raski and coworkers (Mehta & Raski 1971; Raski & Pinochet 1976) then reported on Criconematinae found in a collection of about 100 samples I had taken to the University of California, Riverside, in the late 1960s. They proposed the new genus *Blandicephalanema* Mehta & Raski, 1971 and described the new species *B. serratum* Mehta & Raski, 1971, *B. pilatum* Mehta & Raski, 1971, *Ogma latens* (Mehta & Raski, 1971) Raski & Luc, 1987, *Criconema macilentum* (Raski & Pinochet, 1976) Raski & Luc, 1985, *C. pasticum* (Raski & Pinochet, 1976) Raski & Luc, 1985, and *C. spinicaudatum* (Raski & Pinochet, 1976) Raski & Luc, 1985.

Colbran (1965), in Australia, had earlier described *Pateracephalanema imbricatum* (Colbran, 1965) Mehta & Raski, 1971, a species endemic to Australasia and also present in New Zealand. Loof *et al.* (1997) and Wouts (2000) added 12 *Criconema* species, and Wouts *et al.* (1999) added 6 *Ogma* Southern, 1914 species. All these species belong to the subfamily Criconematinae. Besides Criconematinae, Criconematidae contains the subfamilies Hemicriconemoidinae Andrássy, 1979 and Macroposthoniinae Skarbilovich, 1959, two subfamilies represented by the cosmopolitan species *Hemicriconemoides cocophillus* (Loos, 1949) Chitwood & Birchfield, 1957, *Macroposthonia rustica* (Micoletzky, 1915) De Grisse & Loof, 1965, and *M. xenoplax*. I am also including the native species *M. campbelli* sp. nov. in *Macroposthonia*. The position of *M. campbelli* sp. nov., however, is not certain: it may belong to Criconematinae.

Undisputed endemism of the suborder Criconematina is, therefore, restricted to the subfamily Criconematinae. Within Criconematinae it is confined to the genera *Blandicephalanema*, *Criconema*, *Ogma* (= *Crossonema* Mehta & Raski, 1971), and *Syro* Orton Williams, 1985. *Bakernema* Wu, 1964, *Lobocriconema* De Grisse & Loof, 1965, and *Neolobocriconema* Mehta & Raski, 1971, the other 3 genera in Criconematinae, are not represented in New Zealand.

Blandicephalanema (= *Amphisbaenema* Orton Williams, 1982) and *Syro* species are restricted to the South Pacific region. With the addition of 2 new species to each genus, 6 nominal *Blandicephalanema*, including 4 endemic, and 3 *Syro* species, including 2 endemic, are now known.

Criconema and *Ogma* are distributed worldwide. The 4 new *Criconema* species described here bring to about 100 the number of species recognised in the genus, 19 being endemic to New Zealand. The 6 new *Ogma* species described here bring to 60 the total number of species recognised in this genus, 15 of which are endemic to New Zealand. The other 5 *Criconema* and 7 *Ogma* species known from New Zealand are considered introduced by humans over the last 200 years.

The 47 Criconematinae, including 40 endemic species, known from New Zealand, outnumber the mere 34 West-European, including just 7 *Criconema* and 8 *Ogma* species (Siddiqi 2000; Wouts & Sturhan 1999), by almost 50%. The actual difference is probably much greater, with the European species being collected exhaustively and the New Zealand species originating from limited collections, with many species probably still undiscovered.

PLANT NEMATOLOGY IN NEW ZEALAND

Clark (1963) gives a detailed account of the early development of plant nematology in New Zealand. As the first contribution to nematology he recognised Kirk's (1899) advisory leaflet for farmers on wheat cockle eelworm, *Anguina tritici* (Steinbuch, 1799) Dujardin, 1845. Kirk's subsequent reports in the Annual Reports of the Department of Agriculture of 1903 and 1907 of tubers of potatoes being attacked by a population of root-knot nematodes (*Meloidogyne* Goeldi, 1892) were misidentifications according to Clark (1963), the real cause being a combination of *Meloidogyne* sp. and *Ditylenchus destructor* Thorne, 1945.

A comprehensive list of plant parasitic nematodes first appeared in the Annual Report of the Department of Agriculture of 1908. A year later Kirk & Cockayne recorded root knot nematodes from cucumbers and tomatoes, and the beet cyst nematode, *Heterodera schachtii* Schmidt, 1871, from a local crop of mangold (Clark 1963). The next period of 25 years yielded no further records on nematodes.

In 1935 Reid & Cottier recorded *Aphelenchoides ritzemabosi* (Schwartz, 1911) Steiner, 1932 on chrysanthemum, and in 1937 Muggeridge & Cottier reported it causing death of black currant buds. Field trials with root knot nematode species on tomatoes, starting in the early 1940s, were reported by Jacks (1944, 1945, 1948, 1963) and Stanton (1956). Blair & Morrison (1949) reported on *Anguina tritici*, *Ditylenchus dipsaci* (Kûhn, 1857) Filipjev, 1936 and *Meloidogyne* sp. on wheat and oats, and Cottier (1956) published a summary of plant parasitic nematodes of New Zealand. Clark (1963) published the first authoritative list of plant parasitic nematodes. It contained 11 genera, 4 with no species, 3 with a single species, and 4 with 2 species. Updated by Dale (1972a), it increased to 14 genera, each with at least 1 species, and a total of 27 species including 4 virus-transmitting species. Knight *et al.* (1997) listed 31 genera, 4 without named species, totalling 78 species including 10 virus-transmitting ones. The increase in the total number of nematodes identified from New Zealand, including free-living and marine forms, was even more dramatic. Yeates (2005) listed more than 500 species in almost 300 genera.

The upsurge of new records of nematode species, and species descriptions, from New Zealand since the 1960s is the result of the fulltime employment of nematologists since then. The withdrawal of public funds in the early 1990s, when the government introduced its user pays policy, however, has caused a gradual reduction in nematological studies. Only ecological studies are continuing presently as nematological activities.

THE ORIGIN OF THE NEW ZEALAND NEMATODE FAUNA

The generally high relative humidity provides an environment ideally suited for the survival and development of plant parasitic nematodes. In agricultural crops cosmopolitan species are primarily represented. The abundance of different habitats in New Zealand and the resulting survival and evolution of a wide diversity of native plant species have enabled the development of many endemic plant-parasitic nematode species. Of special interest among them are species with a strong lineage with species evolved in neighbouring countries and continents. It has long been recognised that in *Radopholus* Thorne, 1949 (Pratylenchidae: Hoplolaimina) a strong lineage exists with Australian species, the genus being nearly restricted to these two countries except for some cosmopolitan species (Sher 1968). Similarly, in the genus *Globodera* (Heteroderidae: Hoplolaimina) a lineage seems to exist with South America where the Chilean Andes is postulated to represent the centre of origin (Mai 1977). *Globodera zelandica* Wouts, 1984 was described from New Zealand where infective juveniles and cysts of further species of the genus have been found in a variety of habitats, including subalpine regions. This general presence of *Globodera* species in New Zealand hints at their common ancestry with *Globodera* species from South America originating in Gondwanaland.

Among the Criconematina from New Zealand there is a strong lineage with both Australian and South American species. Species from the subantarctic islands associated with trees especially show a striking similarity with those from Southern Chile. A key factor in the parallel development of nematode species in South America and Australasia is the tenacity of their common or related ancestral hosts. They freely colonised our part of Gondwanaland, evolving in the process and allowing nematode species to evolve with them. Continental drift caused further spatial separation and the evolution into related, but different species in South America, New Zealand, and Australia, and in some of the much smaller island fragments of the South Pacific.

MORPHOLOGICAL CHARACTERS

Identification of plant-parasitic nematode species is usually based on characters of the adult female. Characters used for the identification of Criconematina are: the body shape, characters of the body wall, lateral field, secretory–excretory pore, stylet, oesophagus, and reproductive system and the morphology of the lip region and the tail (Fig. 1a).

Shape and size of the body

In Criconematina the body shape of the female depends on the feeding habit of the species. In species where feeding causes the plant cell to disintegrate, as in Criconematidae, the females continuously search for new cells to feed on and remain slender. The body length of such females may be diagnostic if they reach extreme values for the genus. Species that cause the plant cell to transform into a feeding site that actively accumulates nutrients suitable for nematode development, as in Tylenchulidae Skarbilovich, 1947 (Kirjanova, 1955) and Sphaeronematidae, generally have swollen, sessile females. In females of swollen species cuticular markings, internal characteristics, and the shape of the head are usually grossly distorted and unsuitable for diagnosis of the species. Swollen females, therefore, generally have fewer diagnostic characteristics than females of slender species. Their offspring, however, are produced in large quantities over a short period of time, and are plentiful when females are available and their characteristics are easily accessible, uniform, and reliable, and more than make up for the loss of characters in the females.

Stylet

The stylet consists of a conus, shaft, and base, representing the conical anterior part, a tubular central piece, and the knobs at the base of the stylet respectively. It is typical for the suborder that the length of the shaft (including the base of the stylet) is independent of the length of the conus. Wouts (2000) established that in the subgenus *Nothocriconemella* Ebsary, 1981, the length of the shaft is directly related to the size of the base of the stylet — this may be true also for the other genera of Criconematidae.

Diagnostic characters associated with the stylet are: the length of the stylet, the size and shape of the base of the stylet, and the length of the posterior part of the stylet relative to its total length.

Body wall

In Criconematoidea and Hemicycliophoroidea, the annulation of the cuticle is very strong. The number of annules, and the frequency with which they intersect, especially in the lateral region, is often characteristic for the species. A transparent cover may surround the cuticle. This cover may vary from a tight, rather brittle, easy to remove layer visible only as indistinct extensions of the ornamentions of the annules, as is characteristic in *Blandicephalanema*, to the persistent permanent double cuticle in *Hemicriconemoides* Chitwood & Birchfield, 1957 and *Hemicycliophora* de Man, 1921. In Criconematidae the annules may be adorned with an ornate posterior edge varying from a simple irregular fringe to a complex series of rows of overlapping or alternating smooth or palmate scales or spines. In this family, generally, lateral fields are present only in the males. When a lateral line or a lateral field is present in the female, even if it is restricted to part of the body, it is diagnostic at species level. Deirids and phasmids are lacking.

Tylenchuloidea have a cuticle with fine transverse striation and may have deirids, mechanoreceptors, in the lateral field on the anterior part of the body at the level of the secretory–excretory pore. In Tylenchulidae the secretory–excretory pore is located posteriorly, close to the vulva, and produces a gelatinous substance into which the eggs are laid.

Phasmids, chemoreceptors regularly present laterally on the posterior part of the body of tylenchs, usually in the vicinity of the anus or on the tail, have not been reported in Criconematina but may be present in species of the genus *Sphaeronema* Raski & Sher, 1952 (personal communication D. Sturhan, 2001).

Lip region

The lip region usually extends from the anterior end of the body to the base of the cephalic framework and may be 1 to 3 annules long. The relative size of the individual annules and the space between them is diagnostic for the species. At the base of the cephalic framework a constriction of the body or the sudden narrowing or widening of an annule may set the lip region characteristically off from the rest of the body. The anterior view of the lip region generally consists of a low labial disc around the mouth opening with 6 pseudolips symmetrically around it. The various modifications of this basic arrangement, best observed through scanning electron microscopy, can be characteristic for the species. Submedian lobes, raised growths on either side of the lateral lips, are well-documented variations of the lip region and usually characteristic at the genus level.

Cephalic framework

The cephalic framework is a hexaradiate, rigid structure in the head of tylenchs for the attachment of the muscles that protract the stylet. The shape and density of the cephalic framework may be diagnostic for some taxa, but rarely identifies a species. The depth it extends into the body may be used to establish the height of the lip region and the number of lip annules (Orton Williams 1985).

Oesophagus – intestine

The oesophagus consists of the procorpus, metacorpus (= postcorpus, median bulb), isthmus, and basal bulb; it does not include the stylet, which is part of the stoma *s.l.* In the measurements, however, the length of the oesophagus is taken from the anterior end of the animal and encompasses the stylet. In Criconematidae and Hemicycliophoridae the procorpus has amalgamated with the median bulb. The median bulb contains a valvular structure for pumping secretions from the dorsal oesophageal gland into the host cell and subsequent sucking up the cell’s predigested contents. The distance the opening of the dorsal oesophageal gland is located behind the base of the stylet may be diagnostic for other tylenchs but not for Criconematina. The size of the metacorpus may be of diagnostic value. The isthmus is a tube-shaped connection between the median and the basal bulb. Its diameter is characteristic at the family level. A nerve ring surrounds the isth-

Table 1. Classifications of plant-parasitic nematodes known to be present in New Zealand according to Siddiqi (1986), Maggenti *et al.* (1991), and Siddiqi (2000), and the classification used in this paper.

	Siddiqi 1986	Maggenti et al. 1991	Siddiqi 2000	This paper
suborder	HEXATYLINA	TYLENCHINA	TYLENCHINA	TYLENCHINA
infraorder			ANGUINATA	ANGUINATA
superfamily		TYLENCHOIDEA		
superfamily	ANGUINOIDEA		ANGUINOIDEA	ANGUINOIDEA
family	Anguinidae	Anguinidae	Anguinidae	Anguinidae
suborder	TYLENCHINA			
Infraorder			TYLENCHATA	TYLENCHATA
superfamily	TYLENCHOIDEA		TYLENCHOIDEA	TYLENCHOIDEA
family	Tylenchidae	Tylenchidae	Tylenchidae	Tylenchidae
family	Tylodoridae		Tylodoridae	Tylodoridae
family	Atylenchidae		Atylenchidae	Atylenchidae
family				Meloidogynidae
superfamily	DOLICHODOROIDEA		DOLICHODOROIDEA	DOLICHODOROIDEA
family	Dolichodoridae	Dolichodoridae	Dolichodoridae	Dolichodoridae
family		Belonolaimidae		
family			Telotylenchidae	Telotylenchidae
suborder			HOPLOLAIMINA	HOPLOLAIMINA
superfamily	HOPLOLAIMOIDEA		HOPLOLAIMOIDEA	HOPLOLAIMOIDEA
family	Hoplolaimidae	Hoplolaimidae	Hoplolaimidae	Hoplolaimidae
family	Pratylenchidae	Pratylenchidae	Pratylenchidae	Pratylenchidae
family	Heteroderidae	Heteroderidae	Heteroderidae	Heteroderidae
family	Meloidogynidae			
suborder	CRICONEMATINA		CRICONEMATINA	CRICONEMATINA
superfamily	CRICONEMATOIDEA	CRICONEMATOIDEA	CRICONEMATOIDEA	CRICONEMATOIDEA
family	Criconematidae	Criconematidae	Criconematidae	Criconematidae
subfamily	Criconematinae	Criconematinae	Criconematinae	Criconematinae
genus	*Criconema*	*Criconema*	*Criconema*	*Criconema*
subgenus	*Criconema*		*Criconema*	*Criconema*
subgenus	*Nothocriconemella*		*Nothocriconemella*	*Nothocriconemella*
subgenus				*Nothocriconema*
synonym	*Nothocriconema*		*Nothocriconema*	

genus	*Crossonema*		*Crossonema*	
genus	*Ogma*	*Ogma*	*Ogma*	*Ogma*
new synonym				*Crossonema*
genus				*Pateracephalanema*
subgenus	*Pateracephalanema*	*Pateracephalanema*	*Pateracephalanema*	
genus			*Blandicephalanema*	*Blandicephalanema*
subgenus	*Blandicephalanema*	*Blandicephalanema*		
subfamily	Macroposthoniinae		Macroposthoniinae	Macroposthoniinae
genus	*Macroposthonia*		*Macroposthonia*	*Macroposthonia*
genus	*Criconemoides*		*Criconemoides*	*Criconemoides*
subgenus			*Criconemoides*	*Criconemoides*
subgenus			*Criconemella*	*Criconemella*
genus	*Criconemella*	*Criconemella*		
subfamily	Hemicriconemoidinae		Hemicriconemoidinae	Hemicriconemoidinae
genus	*Hemicriconemoides*	*Hemicriconemoides*	*Hemicriconemoides*	*Hemicriconemoides*
superfamily	HEMICYCLIOPHOROIDEA		HEMICYCLIOPHOROIDEA	HEMICYCLIOPHOROIDEA
family	Hemicycliophoridae		Hemicycliophoridae	Hemicycliophoridae
subfamily	Hemicycliophorinae	Hemicycliophorinae	Hemicycliophorinae	Hemicycliophorinae
genus	*Hemicycliophora*	*Hemicycliophora*	*Hemicycliophora*	*Hemicycliophora*
superfamily	TYLENCHULOIDEA		TYLENCHULOIDEA	TYLENCHULOIDEA
family	Tylenchulidae	Tylenchulidae	Tylenchulidae	Tylenchulidae
subfamily	Tylenchulinae	Tylenchulinae	Tylenchulinae	Tylenchulinae
genus	*Tylenchulus*	*Tylenchulus*	*Tylenchulus*	*Tylenchulus*
genus	*Trophotylenchulus*	*Trophotylenchulus*	*Trophotylenchulus*	*Trophotylenchulus*
family	Sphaeronematidae		Sphaeronematidae	Sphaeronematidae
subfamily	Sphaeronematinae		Sphaeronematinae	Sphaeronematinae
genus	*Sphaeronema*	*Sphaeronema*	*Sphaeronema*	*Sphaeronema*
family	Paratylenchidae		Paratylenchidae	Paratylenchidae
subfamily	Paratylenchinae	Paratylenchinae	Paratylenchinae	Paratylenchinae
genus	*Paratylenchus*	*Paratylenchus*	*Paratylenchus*	*Paratylenchus*
genus		*Gracilacus*		
subgenus	*Paratylenchus*		*Paratylenchus*	*Paratylenchus*
subgenus	*Gracilacus*		*Gracilacus*	*Gracilacus*

mus. The length of the oesophagus can be diagnostic. It is used to calculate the “b” value of the de Man ratios, which expresses the length of the oesophagus as a proportion of the total length and is universally used as a character state in the description of a new species.

The intestine is syncytial, lacking a lumen, the rectum is obscure and short and the anus is a small pore. The only character of significance amongst these is the position of the anus relative to the end of the body, which may be diagnostic in terms of number of tail annules (RA) and tail length.

Reproductive system

In the suborder Criconematina the female reproductive system is monodelphic/prodelphic without a remnant of a posterior branch being present. It consists of the ovary, oviduct, spermatheca, uterus, vagina, and vulva. Sperm in the spermatheca, as an indicator of the presence of males, may be diagnostic. The position of the vulva is a diagnostic character, both as a percentage of the total length (V) and in number of body annules anterior to the tail terminus (RV). The vulva may be open or closed and the anterior lip may overlap the posterior lip.

The male has a single testis. Spicules and a gubernaculum, structures facilitating copulation, are present. Their shape, size, and position have not yet been studied sufficiently to appreciate their significance in the diagnosis of species. The cloacal region may lie in the contour of the body or may exhibit a protrusion characteristic for a genus. The tail may be ventrally enclosed by caudal alae that are difficult to observe and without diagnostic significance for the species. Characters of the male generally are of little use for the identification of the species.

CLASSIFICATION OF THE ORDER TYLENCHIDA

Many systems have been proposed for the classification of the plant parasitic nematodes of the order Tylenchida. The majority of these classifications included the aphelenchs as a suborder. Siddiqi (1986, 2000) and Hunt (1993) removed the aphelenchs from Tylenchida, a move with which I concur.

The more recent classifications by Siddiqi (1986, 2000) and Maggenti *el al*. (1988) and Maggenti (1990) differ generally and are compared in the first 4 columns of Table 1. Only categories represented in New Zealand are included. Categories where the systems agree are placed at the same level. Differences in the classifications are apparent from blank spaces. In the order Tylenchida both Siddiqi (2000) and Maggenti (1990) accept the suborder Tylenchina. Siddiqi (2000) also recognises Criconematina and Hoplolaimina Chizhov & Berezina, 1988, suborders Maggenti considers superfamily and family respectively within Tylenchina. Both authors agree on many of the families, but Siddiqi accepts Tylodoridae (Paramanov, 1967) Siddiqi, 1976, Atylenchidae Skarbilovich, 1959, Meloidogynidae (Skarbilovich, 1959) Wouts, 1973, Hemicycliophoridae Skarbilovich, 1959, Sphaeronematidae (Raski & Sher, 1952) Geraert, 1966, and Paratylenchidae Thorne, 1949, taxa Maggenti either rejects or considers subfamilies, and Maggenti accepts Belonolaimidae (Whitehead, 1960) Siddiqi, 1970, which Siddiqi rejects.

At the genus level the two systems differ further but at this level only differences within Criconematina are considered here. In Criconematidae Siddiqi accepts *Crossonema, Macroposthonia,* and *Criconemoides*, genera that Maggenti considers to be synonyms or *genus dubius*. Siddiqi accepts *Blandicephalanema*, a taxon Maggenti considers to be subgenus. In Paratylenchidae, Maggenti considers *Gracilacus* Raski, 1962 to be a genus; Siddiqi considers it a subgenus.

The classification of Criconematina followed here is presented in column 5 and is basically the one proposed by Siddiqi (2000), modified by the results presented in this work.

THE SUBORDER CRICONEMATINA

Classification of the New Zealand taxa of the suborder Criconematina

Suborder **CRICONEMATINA**
Superfamily CRICONEMATOIDEA
Family **CRICONEMATIDAE**
Subfamily CRICONEMATINAE
Genus ***Criconema***
Subgenus *Criconema*
- *Nothocriconemella*
- *Nothocriconema*
= ***Ogma***
= ***Pateracephalanema***
= ***Syro***
= ***Blandicephalanema***
- HEMICRICONEMOIDINAE
= ***Hemicriconemoides***
- MACROPOSTHONIINAE
= ***Macroposthonia***
= ***Criconemoides***
- *Criconemoides*
- *Criconemella*

- TYLENCHULOIDEA
= **TYLENCHULIDAE**
- TYLENCHULINAE
= ***Trophotylenchulus***
= ***Tylenchulus***
= **SPHAERONEMATIDAE**
- SPHAERONEMATINAE
= ***Sphaeronema***
= **PARATYLENCHIDAE**
- PARATYLENCHINAE
= ***Paratylenchus***
- *Paratylenchus*
- *Gracilacus*
- HEMICYCLIOPHOROIDEA
= **HEMICYCLIOPHORIDAE**
= ***Hemicycliophora***

The suborder Criconematina was proposed by Siddiqi in 1980 for Tylenchida with females in which the procorpus (= precorpus) of the oesophagus has amalgamated with the large muscular metacorpus (= postcorpus/median bulb); and the basal bulb, containing the 3 oesophageal glands, is small; and with males in which the oesophagus is degenerate.

Siddiqi (1986, 2000) further characterises the suborder as obligate plant parasites that show marked sexual dimorphism. The females may be slender, sausage-shaped or obese to spheroid, the males are always slender. The cuticle when coarsely striated generally has no lateral field but may have scales and spines or may be surrounded by a sheath. A finely striated cuticle is generally thin, and deirids and a lateral field may be present; phasmids are absent. The lip region of the female usually consists of 1–3, often modified, annules. The oral opening is a dorsoventral slit in a labial disc that is surrounded by 2 lateral and 4 submedian pseudolips, with no labial sensorial organs apparent. The cephalic framework is hexaradiate. The stylet of the female is of variable length and has well-developed knobs: large knobs are generally anchor-shaped. The procorpus is wide, surrounding the stylet base. The median oesophageal bulb is wide and muscular, containing a large valve. The isthmus is generally narrower than the basal bulb and very thin in some taxa. The orifice of the dorsal oesophageal gland is usually more than 4 µm from the base of the stylet and the oesophago-intestinal valve indistinct. In *Tylenchulus* Cobb, 1913 the secretory–excretory pore is located posteriorly and produces a gelatinous matrix in which the eggs are laid. The vulva is a transverse oval slit located posteriorly. The female reproductive system consists of a single anterior branch (monodelphic, prodelphic). The gonoduct consists of oviduct, spermatheca, and uterus with differentiated crustaformeria, or egg shell producing region, but without postvulval uterine sac. The spermatheca is offset laterally or ventrally, but is axial when distended with sperm. The vulval lips are open or closed, with or without the anterior lip overlapping the vulva. The slender males are monarchic, i.e., with a single anterior testis, and possess a stylet incapable of tissue feeding. The anus of the male is a small pore. The spicules are relatively long compared to those of other tylenchs, with a small head and slender shaft, often arcuate. The gubernaculum is straight or crescent shape. The caudal alae are not pronounced and may be absent. The cloacal lips are variable.

In these taxa locomotion may be assisted by the flexibility of the cuticle between the annules; and a cuticular sheath may be present in juveniles as well as in females. Submedian lobes may surround the oral disc; the length of the stylet shaft is independent of the length of the conus; and the intestine is syncytial, lacking a definite lumen.

Three superfamilies are recognised: Criconematoidea, Tylenchuloidea, and Hemicycliophoroidea.

CRICONEMATOIDEA: CRICONEMATIDAE

The superfamily Criconematoidea consists of the single family Criconematidae.

Females and juveniles of this family are spindle- or sausage-shaped, in the oesophagus the isthmus is wide relative to the width of the basal bulb, and the cuticle generally has retrorse annules that may bear scales or spines. The family Criconematidae consists of the subfamilies Criconematinae, Macroposthoniinae, and Hemicriconemoidinae.

CRICONEMATINAE

Criconematinae are characterised by the presence of spines or scales on the cuticle of both the females and the juveniles, except for *Criconema* in which only the juveniles have cuticular appendages and the females are smooth. In New Zealand Criconematinae is the best represented subfamily of the suborder Criconematina. Of the 7 genera recognised by Siddiqi (2000), *Criconema*, *Blandicephalanema*, *Ogma*, and *Crossonema* are present.

Criconema

Siddiqi (1986) recognises in the genus *Criconema* the subgenera *Criconema*, *Notholetus*, *Nothocriconemella*, and *Paracriconema*. In *Paracriconema* he places species with lip annules that are differentiated from the body annules. In 1984 Raski *et al.* redescribed *C. giardi*, the type species of *Criconema*, as a species with a differentiated lip region in the form of a single lip annule separated from the body annules by a constriction (collar). Siddiqi (2000), therefore, considered *Paracriconema* a synonym of *Criconema*.

The lip annule of *C. giardi* in some specimens indeed looks somewhat set off. Close examination, however, shows that it is not set off but very flexible. It may be retrorse or direct sideways or fold anteriad all in the same specimen, and directed anteriad it may look somewhat set off. In Fig. 4A Raski *et al.* (1984: 306) illustrate this very well. The lip annule drawn is retrorse and continuous with the body contour on one side of the animal but is directed forward and somewhat set off on the other side. The close-up of a normally occurring configuration of the head in their Fig 4B (p. 306) shows a regularly formed annule, not set off, and continuous with the body contour.

The type species *C. giardi*, therefore, has a regularly formed discus-shaped single lip annule, a character I have here recognised as characteristic for the subgenus *Criconema*.

Loof *et al.* (2001) recognise *C. guernei* as type species of *Criconema,* instead of *C. giardi*. As *C. giardi* and *C. guernei* were then considered synonyms this had no effect on the definition of the genus. As I explain in Appendix 1 I consider *C. guernei* a valid species. *Criconema guernei* and *C. giardi* both have the same head configuration and on the basis of that characteristic belong to the same subgenus *Criconema*. The change of type species, therefore, would not affect the definition of that subgenus. The presence of longitudinal rows of scales on the cuticle of *C. guernei*, however, profoundly changed the perception of both the genus and the subgenera. The scales make *C. guernei* identical to *Ogma terrestris* Raski & Valenzuela, 1987, as explained in appendix 1. *O. terrestris* is closely related to *C. spinicaudatum* (Raski & Pinochet, 1976) Raski & Luc, 1958. The 2 species differ only in that *C. spinicaudatum* has scales on the posterior part of the body, whereas in *O. terrestris* all body annules bear scales, and should belong to the same genus and subgenus. Their head configuration resembles that of several other *Criconema* species. These species are here combined in the subgenus *Criconema*. This new criterion for the subgenus *Criconema* allows the placement in it of species recognised by Siddiqi (2000) in the subgenus *Notholetus*. *Criconema* species with differentiated lip annules include *C. annuliferum* (de Man, 1921) Micoletzky, 1925, the type species of *Nothocriconema* De Grisse & Loof, 1965, the most senior and here recognised valid subgenus name for this group of species. Species with more than 1 undifferentiated lip annule are retained in the subgenus *Nothocriconemella*. *Notholetus* and *Paracriconema* are not recognised as valid subgenera.

Subgenus *Criconema*

This subgenus *Criconema* is characterised by a single, not distinctly set off, unmodified, somewhat discus-shaped lip annule, which is narrower than the 1st body annule, a rather high labial region, and a conically pointed, set off tail. The subgenus, and the 8 species from New Zealand considered to belong to it, are discussed in Appendix 1. Other species considered to belong to this taxon are: *C. giardi*; *C. cardamomi* (Khan & Nanjappa, 1972) Raski & Luc, 1985; *C. racemispinosa* Mehta, Raski & Valenzuela, 1982 new combination; and *C. spicatum* (Ebsary, 1981) Raski & Luc, 1985.

All these species have been described from the Southern Hemisphere, with the exception of *C. cardamomi* (India) and *C. spicatum* (Hawaii) which may have also originated from this region. The only known host of *C. cardamomi* is *Eletteria cardamomum* (L.) Maton (Zingiberaceae), a commercially grown plant that may not be its original host. *Criconema spicatum* was described from 2 females from moss packing material which may have originated somewhere in the Southern Hemisphere. Both species were described as having 2 lip annules, but in the illustration of *C. cardamomi* only 1 lip annule is present, and in that of *C. spicatum* the head is distorted, which may account for the apparent 2nd annule. The Southern Hemisphere occurrence suggests that these species have originated in Gondwanaland.

Other subgenera of *Criconema*

The subgenera *Nothocriconemella* Ebsary, 1981 and *Nothocriconema* De Grisse & Loof, 1965, contain species with females that lack ornamentation on the cuticle. *Nothocriconemella* species have 2 undifferentiated lip annules and the diameter of the anterior annule is not greater than that of the posterior annule. *Nothocriconema* species have 1 or 2 differentiated lip annules and the 1st lip annule may has a greater diameter than the 2nd. Like *Criconema*, *Nothocriconemella* is well represented in New Zealand. The subgenus *Nothocriconema* is poorly represented.

Ogma

The genus *Ogma* is characterised by females that have differentiated lip annules and coarse body annules. The body annules, on their posterior edge, bear outgrowths of different shapes varying from smooth spines and scales to ornate palmate structures arranged in longitudinal rows.

The ornamentation of the female cuticle should have facilitated the definition of the genus, but it has not. In the previous section *Ogma terrestris*, a species with an undifferentiated lip annule, was transferred to *Criconema*. Also the distinction between *Ogma* and other related genera is not at all clear. In *Ogma* the outline of the cuticle in cross-section appears wavy due to the presence of longitudinal ridges with spines and scales. Especially long and palmate scales form very distinct ridges with the anterior and posterior end views of specimens resembling cogwheels (Wouts *et al.* 1999). When the number of scales increases to more than 12 the ridges they form become less pronounced, the spaces between them become shallower, and the end view gradually changes to a more regular outline of continuous scales as is considered characteristic of *Crossonema*. The exact point where the ridges of *Ogma* make way for the continuous fringe of scales of *Crossonema*, however, is difficult to establish. Siddiqi (2000) puts the limit at 21. Species with more than 21 rows of spines are considered to have a continuous fringe and regular outline and to belong to *Crossonema*. In species with more than 14 scales, however, this number per specimen within the species becomes variable and makes this criterion unreliable and difficult to apply. The demarcation between *Ogma* and *Crossonema*, therefore, is not distinct. The 2 genera are here considered synonyms and their species are combined in the genus *Ogma*.

Categorising the subgenera within *Ogma* has been difficult too. In 1987 Siddiqi recognised 7 subgenera in *Ogma* (*Ogma*, *Blandicephalanema*, *Pellipecten* Siddiqi, 1986, *Croserinema* Khan, Chawla & Saha, 1976, *Homogma* Siddiqi, 1986, *Pateracephalanema* Mehta & Raski, 1971, and *Seriespinula*). In 2000 he only retained 4 of these (*Ogma*, *Pateracephalanema*, *Croserinema,* and *Seriespinula*), and added 2 new subgenera (*Orphreyus* Siddiqi, 2000 and *Macrocriconema* Minagawa, 1986).

Only *Croserinema* (with alternating scales) and *Seriespinula* (with continuous scales) are further discussed here. *Pateracephalanema* is recognised as a valid genus and *Orphreyus* and *Macrocriconema* do not occur in New Zealand.

To evaluate the significance of alternating scales it is important to know how scales generally appear on the cuticle of the nematode. In the genus *Ogma* it seems that the annules immediately behind the lip region are smooth or lobed and that further down the body the lobes gradually become longer and form a continuous fringe of spines. This fringe then subdivides and transforms into scales. That in different species this transformation of the fringed edge into rows of scales takes place on different parts of the body is best observed in the otherwise identical species O*gma palmatum* (Siddiqi & Southey, 1962) Siddiqi, 1986 and *O. civellae* (Steiner, 1949) Mehta & Raski, 1971*.* In *O. palmatum* the fringe of short spines on the lip region transforms to scales immediately below the lip region. Because the palmate scales of *O. palmatum* are unique within *Ogma* in that they alternate in position on the annules, Siddiqi (1996, 2000) placed it as only species in the subgenus *Croserinema*. In *O. civellae* the fringe of spines does not organise into ridges of scales until the postvulval region. To place species in which this process takes place over the first 5–10 body annules in a different genus or subgenus than those in which this process takes place near the postvulval region seems unjustified.

Mehta & Raski (1971) were the first to point this out. Mindful of the shared habitat of the 2 species, they wrote: "the juveniles of both are similar, if not identical. Cuticular markings of the adult head and tail region (when palmate in *civellae*) are similar in both. All other data (stylet length, total body annules, head annule size, total length, etc.) are well with agreement with each other. The major difference between these species is the type of markings on most of the body annules. However, the fact that sometimes unusually large numbers of single spines occur in *palmatum* brings them closer yet. Whether they are the same species, or closely related but distinct species is not certain. But due to this close relationship they are placed under the same genus".

I agree that these 2 species belong to the same genus and even the same subgenus *Ogma.* A similar example of almost identical species, differing only in the organisation of the scales on the cuticle, presents itself in 2 new species from a subalpine region of the South Island, described in this contribution. In one species the fringe of spines breaks up into rows of scales on the anterior part of the postvulval region. In the other species it starts on the first 2 or 3 body annules, so that scales are present along the length of the body. As observed by Mehta & Raski (1971) for *O. civellae* and *O. palmatum,* these new species, too, share their habitat, and it could be argued that they are the same species. They are obviously closely related. Again, I accept them as independent species in the genus and subgenus *Ogma*.

The shared habitat of the species in each example may be an indication of their recent development from each other.

The above examples seem to indicate that scaled species developed from fringed ones. If the transformation from a fringe of spines to palmate scales is a random process, one would expect that it could take place anywhere along the body. Forms intermediate between *O. civellae* and *O. palmatum*, with a change at mid-body for instance, might be expected. But this does not seem to occur. Scale change seems to be restricted to the lip region and the vulval region. That it does not have to take place in a regimented fashion is clear from the more or less alternating configuration of the scales of *O. palmatum* and of one of the new species described in this contribution. The restricted number of such species described compared to the overwhelmingly large number of nominal species with scales in regular rows, indicates that in the evolution of the species the arrangement in rows is the most successful. If scaled species develop from fringed species then, potentially, many more *Ogma* species exist in New Zealand, in the form of yet undiscovered, fully fringed predecessors of the longitudinally scaled, recently described, new species.

Within the genus *Ogma,* species with similar scales, either alternating (formerly subgenus *Croserinema*) or in longitudinal rows (formerly subgenus *Seriespinula*), seem more closely related than species with dissimilar scales. Scale type, therefore, seems to be the appropriate character to define subgenera. To organise all *Ogma* species in subgenera accordingly would require a thorough comparison of all species described. The inclusion of molecular data would be invaluable and would reinforce a phylogenetic classification. Such a comprehensive review, however, is not within the scope of this contribution and *Ogma* is here not subdivided.

The genus *Ogma* is well represented on native vegetation in New Zealand (Wouts *et al.* 1999) and Australia (Reay & Davies 1998). Especially common are species with palmate scales located on distinct ridges usually running from the base of the head to the tail region with a reduced number running through to the tail terminus. *Ogma* species with such scales include *O. campbelli, O. crenulatum, O. paucispinatum, O. polyandra, O. semicrenatum,* and *O. sexcostatum.* In these species the direction of the scales is posteriad. On contracted females the scales lie flat against the body, but they direct progressively further outward when the female body relaxes, and stand almost perpendicular to the axis of the body on fully extended females and on empty cuticles of decomposed specimens. The body of the female is generally curved gently ventrally, tapering anteriorly from the base of the stylet, posteriorly approximately from mid-body, and more acutely from the level of the vulva. The lip region is truncate and has 2 distinct annules. The anterior annule is generally directed anteriorly and surrounds the pseudolips. The oral opening is a dorsoventral slit located on an oval oral plate. The amphidial apertures are elongate, located on the lateral side of the oral plate and are surrounded by lateral pseudolips. The 2 dorsolateral and 2 ventrolateral pseudolips complete the lip region. The cephalic sclerotisation looks distinct in face view. The stylet is rigid. The vulva is distinct and closed and may be covered with a drop of resinous substance.

The body of the male is typical for the family. The body annules are distinct. The head is dome-shaped and has 5 or 6 more or less distinct annules. The region immediately surrounding the cloaca is irregularly annulated and distinctly protruding from the contour of the body, forming a platform where the cloaca is located, with the body acutely narrowing posterior to this region. The lateral field, with 4 incisures, protrudes from the body contour. The tail is slender.

Pateracephalanema

Pateracephalanema Mehta & Raski, 1971 originally included species with females with either 1 or 2 lip annules. Siddiqi (1986) synonymised the genus with *Ogma*, as a subgenus with females with a single lip annule and imbricate scales, restricting it to species described by Colbran in the 1960s. *Criconema pectinatum* Colbran, 1962, the only *Pateracephalanema* species with 2 lip annules was transferred to the new subgenus *Pellipecten*. Siddiqi (2000), without changing the definition, returned *C. pectinatum* to the subgenus *Pateracephalanema*. He may have assumed that *C. pectinatum*, too, had a single lip annule. Colbran (1962) in the original description mentions a single annule and his illustration only vaguely indicates a second one. Mehta & Raski (1971), however, in their drawing of the head clearly indicate the presence of a second annule. *Criconema pectinatum* is, therefore, here removed from *Pateracephalanema*, but retained in *Ogma*. *Pateracephalanema* is removed from *Ogma* and reinstated as the valid genus for the Australian species with a single lip annule and imbricate scales.

Syro

Orton Williams (1985) proposed the genus *Syro* for a new species from New Guinea, with females with a single lip annule and more than 12 rows of low scales, with or without spines, on the body annules; the number of scales on the dorsal side of the body differing from that on the ventral side; branched appendages trailing posterior to the tail terminus; and a postvulval region wider than long. Heat-relaxed females were further characterised by a rather thick, typically curved body. Seven species were included “that do not resemble each other closely”. Siddiqi (2000) synonymised Syro with the subgenus *Ogma* (*Pateracephalanema*). I feel this does not do justice to the unique characteristics of the species in either of the taxa. With the discovery of 2 new species that very closely resemble the type species, *Syro vexillatrix* Orton Williams, 1985, the distinct single lip ring of *Syro* species, unique among scaled species, together with its curved body shape and low scales, justify recognition of *Syro* as an independent genus.

Blandicephalanema

The genus *Blandicephalanema* Mehta & Raski, 1971 was proposed for species from New Zealand characterised by females with a lip region consisting of a high lip ring that gradually tapers to a rounded anterior end, supported by a narrow base-ring, altogether giving the lip region a narrow, dome-shaped appearance. The 4 species known in the genus, *B. serratum*, *B. pilatum*, and 2 new species, are all from Australia and New Zealand, a further indication of the common origin and long and close geographical association between these 2 countries.

The genus *Amphisbaenema* Orton Williams, 1982 resembles *Blandicephalanema*. It was erected to accommodate *A. paradoxiger* Orton Williams, 1982 from [Western] Samoa (Orton Williams 1982). Raski & Luc (1985) synonymised *Amphisbaenema* with *Criconema*, but Decraemer *et al*. (1996) reinstated it as a valid genus. Decraemer & Geraert (1992) reported *A. paradoxiger* from Papua New Guinea. According to them *Blandicephalanema* differs from *Amphisbaenema* by the strong but low head sclerotisation being restricted to the 2nd lip annule, and the different structure of head and body cuticle.

Because of the flexibility of the cuticle of Criconematidae the significance of the sclerotisation covering 1 or 2 annules within a genus is far from clear. The main differences between the 2 taxa, therefore, seem to be head and cuticle structure. The structure of the head and cuticle, however, are influenced strongly by the extracuticular layer present in the two taxa.

Decraemer *et al.* (1996) give a detailed description of this layer in *Amphisbaenema*. Between the annules it resembles more or less polygonal scales cemented to the surface like interlocking pieces of a puzzle forming a coarse paving. This is quite different from the extracuticular layer of *Blandicephalanema.* But within *Blandicephalanema* there is considerably variation between species. It is a loose layer with scales and other outgrowths on *B. serratum*, but a fairly persistent, continuous layer of imbricate scales about as long as wide grown together in *B. pilatum,* very similar to that described by Decraemer *et al.* (1996) for *Amphisbaenema* juveniles.

The main difference between *Blandicephalanema* and *Amphisbaenema* seems to be that in *Amphisbaenema* the extracellular layer is more persistent. Because of this the configuration of the lip region has been interpreted differently.

Decraemer *et al.* (1996), using scanning electron microscopy, found that pseudolips are not present in *A. paradoxiger*. Unfortunately, as suggested by Raski & Luc (1985), by not first removing the extra cuticular layer that obscures all characteristics of the lip region, they may have overlooked the pseudolips. Not only does the extracuticular layer obscure the lip region, it also holds it tightly together which makes both the basal lip annule and the pseudolips very difficult to observe. With the extracuticular layer present the head of *Blandicephalanema* "can consist of a single large dome-shaped annulus as long as the sclerotisation and offset from the first body annule" exactly as described for *Amphisbaenema* (Decraemer & Geraert 1992). In the absence of the extracuticular layer the head seems to open up, with the basal lip somewhat enlarging and becoming more distinct and the pseudolips becoming recognisable as individual lobes, or as Decraemer & Geraert (1992) describe it for *Amphisbaenema* "the head region is formed by 2 annuli more or less amalgamated, with a dome-shaped first annulus and a wider second annulus with rounded outline". The 2nd annulus can be considerably wider and distinctly set off from both the 1st lip annule and the 1st body annule. The 1st lip annule may be long (Decraemer & Geraert 1992). Decraemer & Geraert (1992) photographed an *Amphisbaenema* head with the extracuticular layer present. In that state as in *Blandicephalanema* with the extracuticular layer present, the pseudolips are indistinct. In the absence of the extracuticular layer the *Amphisbaenema* head would have shown pseudolips.

The shape of the female head and body of *Blandicephalanema* and *Amphisbaenema*, therefore, are the same. In both taxa an obvious extracuticular layer is formed and they originate from the same general geographic region. They are here considered to belong to the same genus. The genus *Amphisbaenema* is synonymised with *Blandicephalanema*.

Jairajpuri & Southey (1984) compared the extracuticular layer of their new species *Nothocriconema shepherdae* (Jairajpuri & Southey, 1984) Raski & Luc, 1985 with the subcrystalline layer of heteroderids. In heteroderids this layer seems to form from excess sugars, excreted by the nematode female, converted by a yeast-like fungus to long-chain fatty acids. Changed to their calcium salt they form the subcrystalline layer. The origin of this layer in *N. shepherdae* is quite different. Jairajpuri & Southey (1984) indicate that although bacterial cells may be present on the outside of the layer, there is no evidence of fungi or other organisms beneath the layer. In *Blandicephalanema* this layer has scales and spines and other structures associated with it and is obviously part of the cuticle formed during moulting. In *N. shepherdae*, *Macroposthonia hymenophorum* (Wouts & Sturhan, 1999) Siddiqi, 2000, *Criconemoides lamellatum* Raski & Golden 1966, *Neolobocriconema braziliensis* (Raski & Pinochet) Hashim, 1984, *Criconema amicorum* (Orton Williams, 1982) Raski & Luc, 1985, and *Criconema* (*Criconema*) *psephinum* (Bernard, 1982) Raski & Luc, 1985, all with an extracuticular layer, this is probably similarly the case.

MACROPOSTHONIINAE

Macroposthoniinae are characterised by the absence of scales and spines on the cuticle of both the females and the juveniles. In New Zealand *Macroposthonia xenoplax* and *M. rustica* have only been found associated with grasses, weeds, and crops and must be considered introduced species; *Criconemoides* (*Criconemella*) *parvus* Raski, 1952 has been regularly encountered associated with native vegetation and could be considered endemic. Its worldwide distribution, however, is an indication not that it is endemic, but that its wide host range includes some of our native plant species. Together with a new species from Campbell Island these 3 are the only species representing this subfamily in New Zealand.

HEMICRICONEMOIDINAE

Hemicriconemoidinae are characterised by a double cuticle, formed by a sheath of round body annules, that surrounds the body. Only *Hemicriconemoides cocophillus* represents this subfamily in New Zealand. Although fairly widely spread in New Zealand its worldwide distribution precludes it from being considered endemic.

TYLENCHULOIDEA

This superfamily is characterised by having females and juveniles that have a thin cuticle with fine transverse striae and an oesophagus with a narrow isthmus. The 2nd stage juvenile, hatching from the egg, is the infective stage. For the New Zealand species it has been the stage most frequently encountered. In moist soil at 15°C, juveniles of the citrus nematode *Tylenchulus semipenetrans* Cobb, 1913 survive without a host for up to 2.5 years (Baines 1950). For further development and long-term survival of the species host roots in the soil are required. Citrus nematodes have been observed to survive, after their host trees were removed, for up to 9 years on roots that survived deep in the ground for that period of time (Baines *et al.* 1962).

The superfamily Tylenchuloidea consists of 3 families, Tylenchulidae, Sphaeronematidae, and Paratylenchidae.

TYLENCHULIDAE

Tylenchulidae are characterised by having swollen females that are not spherical or subspherical, but have a distinct postvulval region. The secretory–excretory pore is located some distance behind the oesophageal region and produces a gelatinous matrix in which the eggs are laid.

The family is represented in New Zealand by the genera *Tylenchulus* and *Trophotylenchulus* Raski, 1957. These are each represented by a single species that is rarely encountered.

In Tylenchulidae the feeding 2nd, 3rd, and early 4th stage juveniles (J4) are ectoparasites and do not swell. For sustained feeding the adult female needs a permanent feeding site of transformed cortical cells. In *Tylenchulus* the female forms the feeding site — nurse cells with hypertrophied nuclei. In *Trophotylenchulus* it seems the J4 establishes the feeding site — a syncytium. Once a feeding site is established the nematode becomes sessile, starts swelling, and transforms into a mature female.

The body seems to swell primarily dorsally and anterior to the vulva, because the ventral side of the swollen female is generally concave, the postvulval region is distinct, and beyond the anus a tail-like extension is present. *Tylenchulus semipenetrans*, the only representative of the genus in New Zealand, is a cosmopolitan pest of citrus. Present in large numbers, especially under the warm climatic conditions of Southern California, they can cause considerable growth reduction and yield loss. In New Zealand this species is rare and damage has so far only been recorded on grape vines. Lack of damage may be due to the generally low soil temperatures and the fact that the majority of commercial citrus trees are grafted on resistant *Poncira trifoliata* rootstock. It is an introduced species present only on introduced hosts.

SPHAERONEMATIDAE

Sphaeronematidae are characterised by the spherical or subspherical female lacking a postvulval region and with the secretory–excretory pore located in the oesophageal region.

Sphaeronematidae is a small family represented in New Zealand by the genus *Sphaeronema.* Specimens of *Sphaeronema* are rarely encountered. Sufficient material for identification was present only for a single species. For sustained feeding the preadult and adult female need a feeding site, a syncytium, formed of pericycle and phloem cells. The feeding site is probably initiated by the early J4. Once a feeding site has been established the J4 gradually increases in size and transforms into a somewhat swollen preadult female in about 7 days. The posterior part of the body remains exposed outside the root. In the last moult the tail is lost and the adult sessile female swells symmetrically and becomes an almost spherical body, with minute terminally located vulval lips. The eggs are laid in a gelatinous matrix.

PARATYLENCHIDAE

Paratylenchidae are characterised by having vermiform females with a stylet usually more than 20 mm long. There are more than 100 described species worldwide. In New Zealand the family is represented by the genus *Paratylenchus* Micoletzky, 1922. Like tylenchulids and sphaeronematids, female paratylenchs are small. Paratylenchs do not develop a specialised feeding site and remain slender. They are not rare in New Zealand, but they have not been studied in detail and will not be described individually. They are distinguished in a key (p. 79). Some species have been found associated with native vegetation but they are generally not considered endemic.

HEMICYCLIOPHOROIDEA

The superfamily Hemicycliophoroidea is characterised by females and juveniles that have an elongate, vermiform body with a thick cuticle with more than 200 rounded annules lacking spines or scales, and an oesophagus with a wide isthmus.

Type and only family present in New Zealand: Hemicycliophoridae

HEMICYCLIOPHORIDAE

The family Hemicycliophoridae is characterised by the thick body sheath of the female and juveniles and the strongly arcuate shape of the spicules of the male.

Hemicycliophoridae are well represented on native vegetation and some species may be endemic. The species collected in New Zealand have not been studied in detail and will therefore be represented in this paper only by the 2 species described by Yeates (1967, 1978). The other populations will be discussed briefly and their characters listed.

MATERIAL AND METHODS

Collecting of the material was done throughout the year, with summer collecting restricted to low lying humid areas and riverbeds. Collections from the subantarctic islands were obtained through cooperation with participants of scientific expeditions there. To avoid the effect of summer drying on nematodes close to the soil surface, the top 3–10 cm of soil were generally removed before digging up a 0.5–1 kg soil sample with a spade. Specimens were extracted from soil and litter by decantation and sieving, and sugar-flotation and centrifugation. Extracted material was fixed in hot 4% formalin and specimens were processed to glycerol through a slow glycerol method and mounted in dehydrated glycerol between cover glasses held in aluminium slide holders as described by Wouts & Sher (1971). Light microscope observations and measurements were made on specimens mounted in glycerol. For observation in a Philips 505 SEM, specimens fixed in 4% formalin were cleansed ultrasonically, then passed through a graded ethanol series (50–70–90–100%), critical point dried, mounted on a stub, and coated with gold in an Emscope SP2000 sputter cryo unit.

In the descriptions and the diagnoses it is the female of the species that is referred to, unless a different stage is clearly indicated. For measuring the best specimens were selected. When males and juveniles of good quality were available they were measured too. When scales were present the body width was measured excluding scales, and the de Man ‘a’ ratio was calculated using this width. Scales were measured along their length, not by the distance they stand out from the body. The dimensions in the Tables are given in µm as an average, plus or minus the variability as standard error, with the range in parentheses, except for the total length, which is given in millimeters.

In the Criconematina the convention for the abbreviations of the various characters is as follows:

L = total body length in mm

a = body length/greatest body width

b = body length/distance from anterior end to junction of oesophagus and intestine

c = body length/tail length

c’ = tail length/anal body width

V = distance of vulva from anterior end x100/body length

PV/VB = length of postvulval part of body/body width at vulva

PV = length of postvulval part of body in µm

St%L = stylet length x100/body length

Rex = number of the annule, counted from anterior end, on which the secretory–excretory pore lies

RV = number of the annule, counted from tail end, on which the vulva lies

Ran = number of the annule, counted from tail end, on which the anus lies

R = total number of body annules

Length of oesophagus = distance from anterior to the oesophageal intestinal junction

Length of stylet shaft = length of the lower part of the stylet, including the stylet base.

Table 2. Distribution of type specimens to institutions.

Genus	*Criconema*			*Ogma*					*Syro*		*Blandicephanema*		*Macroposthonia*
species	*mackenziei*	*nelsonense*		*capitulatum*	*alternum*	*catherinae*	*mucronatum*	*sturhani*	*tribulosus*	*glabellus*	*inserratum*	*nothofagi*	*campbelli*
Stage	females	females (juveniles)	males	females	females (juveniles)	females	females	females (juveniles)	females (juveniles)	females (juveniles)	females	females	females
Institutions specimens sent to:													
National Nematode Collection of New Zealand	3(1)	82(35)	23	6	2(12)	4(14)	11(39)	13(6)	122(6)	3	58	29	5
IACR-Rothamsted, England	2	6	-	1	1	1	1	1	6	-	5	2	
Agricultural University Wageningen, the Netherlands	2	5	5	1	1	1	2	1	8	4	5	2	1
University of California, Davis, USA	2	4	5	1	1	1	2	1	6	4	5	2	1
University of California, Riverside, USA	2	4	-	-	1	1	2	1	7	-	5	2	
USDA Nematode Collection, Beltsville, Maryland, USA	2	5	5	1	1	1	2	1	10	3	5	2	
Zoological Institute, RAS, St Petersburg, Russia	2	-	-	-	1	1	1	1	10	3	5	2	
Centre for Land and Biological Resources Research, Central Experimental Farm, Ottawa, Canada	2	5	-	1	1	1	2	1	6	-	5	2	
Institut fuer Nematologie und Wirbeltierkunde, BBA, Muenster, Germany	2	4	-	1	1	1	1	1	2(6)	-	5	2	

SYSTEMATICS

From the discussion above the following key to the taxa of the suborder Criconematina can be constructed.

Key to the taxa of New Zealand Criconematina

1 Females and juveniles with thin cuticle with narrow rounded annules, isthmus thin .... TYLENCHULOIDEA ...(p. 74)... 2

— Females and juveniles with thick, sometimes double, cuticle with coarsely rounded, retrorse, or ornate annules, isthmus wide 6

2(1) Females slender, rarely enlarged on all sides, never saccate, stylet more than 20 µm long, with long conus; juveniles strongly curved ventrally .... PARATYLENCHIDAE: PARATYLENCHINAE ... .(p. 78)… 3

— Females swollen, stylet less than 20 µm long, conus normal, males and juveniles not strongly curved 4

3(2) Stylet of female <40 µm long .... …(p. 79)… ***Paratylenchus*** **(*Paratylenchus*)**

— Stylet of female >40 µm long .... …(p. 80)… ***Paratylenchus*** **(*Gracilacus*)**

4(2) Fully developed females subspherical or spherical, without postvulval region, secretory–excretory pore in oesophageal region ..... SPHAERONEMATIDAE: SPHAERONEMATINAE .... …(p. 76)… ***Sphaeronema***

— Fully developed female not subspherical or spherical, with a distinct postvulval region, secretory–excretory pore behind oesophageal region .... TYLENCHULIDAE: TYLENCHULINAE ....(p. 74)... 5

5(4) Females coiled spirally, secretory–excretory pore anteriorly at <60% of body length, secretory–excretory duct of male and juveniles directed posteriorly .... …(p. 75)… ***Trophotylenchulus***

— Females curved ventrally, not coiled, secretory–excretory pore posteriorly at 68–85% of body length, secretory–excretory duct of males and juveniles directed anteriorly .... …(p. 75)… ***Tylenchulus***

6(1) Females and juveniles elongate-vermiform, usually >0.6 mm long. With double cuticle, outer cuticle loose from inner cuticle. Annules round, not retrorse, no cuticular outgrowths. Body recessed conspicuously just behind vulva. Stylet base rounded. Male tail elongate, spicules semicircular, caudal alae high .... HEMICYCLIOPHOROIDEA: HEMICYCLIOPHORIDAE .... …(p. 80)… ***Hemicycliophora***

— Females and juveniles spindle- or sausage-shaped, usually <0.5 mm long. Cuticle single or double, or loose outer sheath may be present; when double, outer cuticle not loose from inner cuticle, but both cuticles tightly together. Annules may be retrorse and may have cuticular outgrowths. Body not recessed conspicuously behind vulva. Stylet base anchor-shaped. Male tail short, spicules curved, caudal alae low or lacking ..... CRICONEMATOIDEA: CRICONEMATIDAE .... …(p. 28)… 7

7(6) Female with tightly fitting double cuticle; juveniles with scales or spines usually arranged irregularly or alternating within rows .... HEMICRICONEMOIDINAE ..... …(p. 73)…***Hemicriconemoides***

— Female without double cuticle; juvenile scales or spines, if present, almost always arranged in longitudinal rows 8

8(7) Cuticle of females and juveniles without scales or spines MACROPOSTHONIINAE ....(p. 70)... 9

— Cuticle of females and juveniles with scales or spines (*Criconema* females without spines) CRICONEMATINAE ....(p. 28)... 10

9(8) Vulva open, submedian lobes usually present, separate .... …(p. 70)… ***Macroposthonia***

— Vulva closed, submedian lobes, if present, not separate .... …(p. 72)… ***Criconemoides***

10(8) 1st annule not distinctly differentiated, never funnel-shaped, annules in anterior region of the female generally smooth but may be crenate, serrated, or with short smooth scales 11

— 1st annule funnel-shaped or otherwise distinctly differentiated, body annules with scales, spines, or other outgrowths 13

11(10) Lip annule single, body annules with smooth scales at least on postvulval region, scales absent on tail annules, showing distinctly set off tail in contracted specimens .... …(p. 29)… ***Criconema (Criconema)***

— Lip annules single or double, scales or other distinct cuticular ornamentation lacking 12

12(11) 2 lip annules, not differentiated from body annules, 1st annule smaller in diameter than 2nd .... …(p. 38)… ***Criconema (Nothocriconemella)***

— Usually 2 lip annules, differentiated from body annules, 1st annule may be wider than 2nd .... …(p. 34)… ***Criconema (Nothocriconema)***

13(10) Head annule narrow, dome-shaped, not discoid ... . …(p. 66)… ***Blandicephalanema***

— Head annule normal to large, discoid, usually funnel-shaped 14

14(13) 2 lip annules .... …(p. 47)… ***Ogma***

— 1 lip annule 15

15(14) Annules with rows of contiguous, imbricate scales .... …(p. 65)… ***Pateracephalanema***

— Annules with short, distinctly separated rows of smooth or spined scales .... …(p. 63)… ***Syro***

DEFINITIONS AND DESCRIPTIONS

SUBORDER CRICONEMATINA Siddiqi, 1980

Tylenchida. **Females**. Of various shape, rarely endoparasitic. Oral aperture often appearing I-shaped. Submedian lip area lobe-like in several genera. Stylet variable in length. Shaft always about 8–12 µm long. Stylet knobs variable in shape, large knobs generally anchor-shaped. Procorpus and metacorpus amalgamated. 3 oesophageal glands contained in small basal bulb. Phasmids absent, although some have been observed in *Sphaeronema* juveniles (Sturhan, personal comm. 2000). Excretory pore and anus small, round pores. Vulva a transverse slit usually at more than 85% of the body length; ovary monodelphic, prodelphic. Postvulval uterine sac absent. Spermatheca small, offset, ventral or subventral to the axis of the gonoduct.

Male. Shows marked sexual dimorphism; stylet and oesophagus degenerate, does not feed.

Type superfamily Criconematoidea Taylor, 1936

Other superfamilies
  Hemicycliophoroidea Skarbilovich, 1959
  Tylenchuloidea Skarbilovich, 1947.

SUPERFAMILY Criconematoidea Taylor, 1936

Criconematoidi Paramonov, 1967

Criconematina. **Females**. Short (less than 1 mm long) and sausage-shaped with thick (in some taxa) double cuticle, and coarse, usually retrorse, annules with or without scales, spines or other configurations; lateral fields generally absent, rarely expressed as mismatch of annulations or as a deep lateral groove. Cephalic region with 1 or 2, rarely 3 annules, an indistinct oral disc bearing I-shaped oral aperture surrounded by 6 pseudolips, with or without submedian lobes; no sensory papillae or pits on surface. Stylet well developed and long. Conus markedly longer than shaft, basal knobs prominent, anchor-shaped. Length of shaft not proportional to total length of stylet, but to weight of stylet base. Orifice of dorsal oesophageal gland 3–6 µm behind stylet base. Oesophagus well developed, criconematoid; procorpus broad, posteriorly expanded, without constriction continuing into a slightly broader, very muscular metacorpus with large, elongated valve plates; isthmus broad, short, distinctly narrower than small, basal bulb that is set off from the intestine and contains 3 oesophageal glands. A small non-cellular cardia may be present. Position of secretory–excretory pore variable, generally near level of base of oesophagus. Anus obscure in many species.

Males. Slender, with cuticle thinner than in females and annules always rounded, non-feeding, developing by metamorphosis from a much wider juvenile. Lateral fields present, with incisures. Cephalic region usually continuous, rounded and striated. Stylet absent. Oesophagus hardly showing any structure. Gonoduct packed with numerous, small, round sperm. Spicules elongate, straight to arcuate, proximally cephalated and distally pointed; gubernaculum simple, fixed. Tail short. Caudal alae low or absent, adanal, subterminal, or terminal, occasionally absent.

Juveniles resembling females in general morphology, except for the characters of the reproductive system. Ectoparasites of roots.

Type and only family Criconematidae Taylor, 1936

FAMILY Criconematidae Taylor, 1936

Ogmidae Southern, 1914
Macroposthoniidae Skarbilovich, 1959
Madinematidae Khan, Chawla & Saha, 1976

Criconematoidea. As it is the only family it takes the characters of the superfamily.

SUBFAMILY Criconematinae Taylor, 1936

Ogminae Southern, 1914

Criconematidae. **Females**. Annules 25–200, usually retrorse and with spines or variously ornamented scales on the posterior edge arranged either as a continuous fringe or in longitudinal rows along the length of the body. Double cuticles or lateral fields generally lacking. Cephalic annules 1 or 2. Stylet 64–160 µm long, flexible if long. Vulva 4–25 annules from terminus, vulval lips protruding or anterior lip overhanging. Tail varying in shape from narrowly drawn out to conically pointed or blunt and rounded if the last tail annules are retracted.

Juveniles. Annules retrorse, with spines or scales either as continuous fringe or arranged in longitudinal rows along the length of the body.

Nominal genera present in New Zealand
  Criconema Hofmänner & Menzel, 1914 **(Type genus)**
  Ogma Southern, 1914
  Pateracephalanema Mehta & Raski, 1971
  Syro Orton Williams, 1985
  Blandicephalanema Mehta & Raski, 1971

GENUS *Criconema* Hofmänner & Menzel, 1914

Cerchnotocriconema Bernard, 1982
Nenocriconema Darekar & Khan, 1982
Nothocriconema De Grisse & Loof, 1965
Nothocriconemella Ebsary, 1981
Notholetus Ebsary, 1981
Paracriconema Ebsary, 1981

Criconematinae. **Females**. Length 0.2–0.8 mm. Annules 35–140. Cephalic region with 1–3 annules, that may or may not be differentiated. Body annules round or retrorse, margins smooth or crenate; in species with undifferentiated lip annules a fringe of more or less distinct smooth scales may be present. Lip region elevated with 6 pseudolips, submedian lobes usually lacking. Stylet 45–150 µm long. Vulva closed, 2–25 annules from terminus. Tail conically pointed to round, without scales.

4th-stage juveniles with 8–18 rows of scales.

Type species *Criconema guernei* (Certes, 1889) Hofmänner & Menzel, 1914

=*Eubostrichus guernei* Certes, 1889; *Hoplolaimus guernei* (Certes, 1889) Menzel, 1917; *Iota guernei* (Certes, 1889) Micoletzky, 1925; *Ogma guernei* (Certes, 1889) Schuurmans Stekhoven & Teunissen, 1938.

Subgenera present in New Zealand

Criconema (*Criconema*) Hofmänner & Menzel, 1914
Criconema (*Nothocriconemella*) Ebsary, 1981
Criconema (*Nothocriconema*) Ebsary, 1981

Subgenus *Criconema* Hofmänner & Menzel, 1914

Genus *Criconema*. **Females**. Annules 60–120, retrorse, their margins smooth, crenate, or with short hairs or rounded scales; lateral indentation expressed on at least part of the body in some species. Cephalic region usually with single, discus-shaped annulus, narrower than 1st body annule. Stylet 45–130 µm long. Vulva 10–20 annules from terminus, lips protruding; vagina straight. Tail in contracted animals generally set off from rest of body.

Males. Lateral field with 3 or 4 incisures; caudal alae low or may be absent.

4th-stage juveniles. 8–18 rows of scales, each tipped with a pointed spine or some other extension.

Type species *Criconema* (*Criconema*) *guernei* (Certes, 1889) Hofmänner & Menzel, 1914

Nominal species present in New Zealand

Criconema (*Criconema*) *aucklandicum* Loof, Wouts & Yeates 1997
C. (*C.*) *cristulatum* Loof, Wouts & Yeates, 1997
C. (*C.*) *mackenziei* sp. nov
C. (*C.*) *makahuense* sp. nov.
C. (*C.*) *nelsonense* sp. nov
C. (*C.*) *spinicaudatum* (Raski & Pinochet, 1976) Raski & Luc, 1985.

Key to the species of the subgenus *Criconema* (*Criconema*) known from New Zealand

1 Body annules with scales throughout .... …(p. 32)… ***C.* (*C.*) *nelsonense***

— Body annules with scales only on postvulval region 2

2(1) Body annules without hairs on posterior edge, scales on postvulval region distinct, tail distinctly set off from rest of body 3

— Body annules with fringe of fine hairs on posterior edge, scales on postvulval region indistinct, tail set off only when postvulval region contracted 5

3(2) Stylet >80 µm long …(p. 31)… ***C.* (*C.*) *mackenziei***

— Stylet <80 µm long 4

4(3) Stylet <65 µm long, knobs <10 µm wide, L >0.5mm, tail >25 µm long .... …(p. 31)… ***C.* (*C.*) *makahuense***

— Stylet >65 µm long, knobs >10 µm wide, L <0.5 mm, tail <25 µm long …(p. 33)… ***C.* (*C.*) *spinicaudatum***

5(2) Average length about 0.4 mm, stylet *ca* 90 µm, average tail >30 µm long …(p. 29)… ***C.* (*C.*) *aucklandicum***

— Average length > 0.5 mm, stylet *ca* 75 µm, average tail <30 µm long .... …(p. 30)… ***C.* (*C.*) *cristulatum***

Criconema (*Criconema*) *aucklandicum* Loof, Wouts & Yeates, 1997

Fig. 2; 3e

Measurements: Table 3.

Morphology. **Females**. Body straight or gently curved ventrad. Lateral lines or lateral field not observed. Cephalic region rounded, with single, smooth, saucer-shaped annule supporting elevated labial region. Lip region looks set off from body because the annule is directed anteriorly and the body annules are retrorse. Body annules thorn-shaped in side view, posterior outer edge with fringe of hairs *ca* 3 µm in length. About 1 body annule anterior to level of vulva annules become faintly undulant with low, rounded projections developing; posterior to level of vulva these projections become progressively longer, forming 8–10 smooth, rounded scales. Scales greatly reducing in size and number or absent on tail. Hairs on scales more pronounced than on rest of annule. Tail annules cylindrical, with swollen edges bearing distinct fringe of hairs. Stylet rigid. Excretory pore near level of base of oesophagus, obscure in most specimens. Vulva distinct, with 2 conically rounded, closed lips, protruding about same distance as body scales. Vagina angled anteriad. Spermatheca filled with small sperm *ca* 1 µm in diameter. Body posterior to vulva narrowing gradually to attenuate, conical tail with a narrow, rounded to pointed terminus. Tail set off from body; tail annules cylindrical with swollen anterior and posterior edges bearing distinct fringe of hairs.

Males. Body annules distinct, *ca* 3.3 µm wide. Head rounded, somewhat flattened anteriorly, with 3 or 4 annules; cuticle at base of head in one specimen somewhat thicker, giving head the appearance of being set off from rest of body. Characters of oesophagus obscure. Spicules almost straight anteriorly, curved posteriorly. Gubernaculum slightly curved. Caudal alae present. Lateral field protruding from body contour, with 2 incisures. Tail slender, with terminus finely pointed; annules of hyaline posterior portion with minute barbs.

Juveniles. Body sausage-shaped. Labial region slightly elevated. Head with thin, retrorse labial annule. Body annules retrorse, with minute scales on outer edge. Scales arranged in longitudinal rows, up to 14 at midbody, decreasing in number anteriorly and posteriorly. Scales triangular, bluntly rounded with 2 or 3 digitate extensions, apparently present also on lip annule, increasing in length on posterior part of body but greatly reduced or absent on 3 or 4 posteriormost tail annules. Tail conical, not drawn out.

Differential diagnosis. *Criconema* (*Criconema*) *aucklandicum* has a single lip annule continuous in width with the contour of the rest of the body, smooth body annules forming scales posterior to the vulva, a pointed tail made up of fused annules, and a fringe of hair on the posterior edge of the body annules. *Criconema* (*C.*) *aucklandicum* differs from *C.* (*C.*) *cristulatum*, its closest relative, in the greater average length of the body (520 v. 410 µm), stylet (89 v. 74 µm), and tail (33 v. 24 µm).

Material examined. Holotype, 33 paratypes, and 80 non-type specimens. **Holotype**: female, AU, Auckland Island, Mt Raynal, J. A. K. Farrell, 4 January 1973. Type host unknown. National Nematode Collection of New Zealand (NNCNZ). **Paratypes**: 31 females, 2 males, same data as holotype. **Other specimens**: 75 females and 5 juveniles from the type locality (NNCNZ).

Distribution (Map 1). *Criconema* (*C.*) *aucklandicum* has been found only on Auckland Island. Host unknown.

– / – / AU.

Criconema* (*Criconema*) *cristulatum Loof, Wouts & Yeates, 1997

Fig. 3a–d; 4; 5

Measurements: Table 3.

Morphology. **Females**. Body gently curved ventrad. Lateral lines or lateral field present posteriorly as superficial groove in scales. Cephalic region, lip region, spermatheca, vulva, vagina, postvulval region, and scales on posterior part of the body and tail as in *C.* (*C.*) *aucklandicum*. Annules on anterior part of body smooth, retrorse, posterior edge with a distinct fringe of hairs, *ca* 3 µm in length, becoming faintly undulated from mid-body posteriorly; near vulva undulations developing into 8–10 smooth, rounded scales, generally arranged more or less in longitudinal rows, becoming narrower and longer between vulva and anus, and greatly reduced or absent on tail. Hairs on scales more pronounced than on rest of annule, irregular in direction. Tail annules cylindrical; expanding posterior edges generally covered in hair. Stylet rigid. Excretory pore near level of base of oesophagus. Tail distinctly set off from body by absence of protrusions, and, in some populations, by presence of a distinct crest of hairs on posterior edge of annules. Hairs may wash off during processing.

Males. Body slightly curved ventrad. Body annules distinct, *ca* 2.5–3.0 µm wide. Head rounded, with 3 or 4 indistinct annules; cuticle at base of head in some specimens somewhat thicker, giving head the appearance of being set off from rest of body. Males otherwise as in *C.* (*C.*) *aucklandicum*.

Differential diagnosis. *Criconema* (*C.*) *cristulatum* females can be recognised by the smooth body annules forming scales posterior to the vulva, the sharp tail made up of fused annules, and the fringe of hairs on the posterior edge of the body annules. Minute hairs or spines on the posterior outer edge of the body annules also occur in *C.* (*C.*) *aucklandicum*, *C.* (*C.*) *certesi* Raski & Valenzuela, 1986, and *C.* (*C.*) *racemispinosum* (Mehta, Raski & Valenzuela, 1982) Siddiqi, 1986. Of these only *C.* (*C.*) *aucklandicum* is present in New Zealand. *Criconema* (*C.*) *cristulatum* differs from *C.* (*C.*) *aucklandicum,* its closest relative, in the smaller average length of the body (av. L = 0.41 v. 0.52 mm), stylet (av. 74 v. 89 µm) and tail (av. 24 v. 33 µm). Both *C.* (*C.*) *cristulatum* and *C.* (*C.*) *aucklandicum* differ from *C.* (*C.*) *racemispinosum* by the shorter females (L <0.5 v. >0.5 mm) and by the continuous fringe of hairs on the body annules which in *C.* (*C.*) *racemispinosum* are spines or spikes, or hairs concentrated in clusters in more or less alternating rows. *Criconema* (*C.*) *cristulatum* differs from *C.* (*C.*) *certesi* by its shorter average length (av. L = 0.41 v. 0.66 mm), shorter stylet (av. 74 v. 102 µm), and lower number of body annules (av. 73 v. 82).

Material examined. Holotype, 198 paratypes, and 90 non-type specimens. **Holotype**: female, from native vegetation comprising *Carpodetus serratus*, *Coprosma* sp., tree fuchsia (*Fuchsia excorticata*), and *Myrsine* sp., SL, Tokanui, W. M. Wouts, 19 October 1971 (NNCNZ). **Paratypes**. 60 females from the type locality; 138 female from the following hosts and localities: *Cyathodes empetrifolia*, Makahu Spur, Kaweka Range HB; *Sarcocornia quinqueflora*, Sandy Bay, NN; *Halocarpus bidwillii*, Mt Domett, NN; *Celmisia sessiliflora*, Mt Arthur, NN; toru (*Toronia toru*) and pigeonwood (*Hedycarya arborea*), Cape Foulwind, Westport, BR; black beech (*Nothofagus solandri*), Parnassus, NC; *Pentachondra* sp. and *Gunnera* sp. in pasture, Porters Pass, MC; tussock and native vegetation, Lake Lyndon, MC; tree fuchsia (*Fuchsia excorticata*) in *Nothofagus* forest, Milford Sound, FD; *Coprosma* sp., Winton, Southland, SL; grass and weeds in a swamp, Oreti Beach, Invercargill, SL (NNCNZ). **Other specimens**: 87 females and 3 juveniles from the same localities as the paratypes (NNCNZ).

Distribution (Map 2). *Criconema* (*C.*) *cristulatum* is predominantly present in the north and the south of the South Island and seems to prefer a slightly elevated altitude. A single find at higher altitude in the North Island is consistent with this.

HB / NN, BR, NC, MC, FD, SL.

Criconema (*Criconema*) *mackenziei* sp. nov.

Fig. 6a,b; 7

Measurements: Table 3.

Morphology. **Females**. Body straight or gently curved ventrad, tapering anteriorly from level of base of stylet and posteriorly from about 1 body width anterior to vulva. Lateral lines and lateral field lacking. Labial region very high, amphidial aperture large. Cephalic framework heavy, covering 2 annules, occasionally restricted to 1 annule. Lip annules not set off, continuous with contour of body. 1st lip annule crenate, pointing sideways or somewhat posteriad, 2nd annule smooth or finely crenate, intermediate in diameter between 1st lip annule and 1st body annule. Outer edge of body annules smooth, retrorse, from about 1 body width anterior to vulva becoming faintly undulant and developing low, rounded projections which become progressively longer, from the position of the vulva forming smooth, rounded scales; scales on annules numbering about 18 at level of vulva, reducing in number posteriorly, from level of anus suddenly absent, giving tail a denuded, distinctly set off appearance. Stylet long, rigid; stylet base heavy, compact, usually almost flat anteriorly. Isthmus not very narrow, about 1/2 as wide as basal bulb. Excretory pore distinct when located on the outer edge of a body annule, located somewhat posterior to base of oesophagus. Vulva distinct, with 2 smooth rounded lips, closed, protruding from outline of body about same distance as scales. Vagina angled anteriad. Ovary single, outstretched, reaching area of oesophagus. Spermatheca oval, filled with round sperm *ca* 2 µm in diameter. Anus rarely distinct, its position obvious from sudden absence of scales. Tail narrowing gradually to finely rounded or pointed terminus. Tail annules fused. Joints of annules on tail distinct.

Males. Not observed.

Juveniles. Body tapering anteriorly and posteriorly from midbody, posteriorly more progressively from about 2 body widths from terminus. Labial region dome-shaped, not raised. Cephalic region with 2 annules, continuous with rest of body; both annules with distinct, finely crenate, outer edges. Cephalic framework heavy. 1st body annules distinctly crenate, from 3rd body annule carrying 10 scales, increasing to about 16 scales at midbody. Scales semicircular, with slightly drawn out distinctly crenate posterior edge, on posterior part of body slightly longer than on rest of body, lacking on tail. Stylet long; stylet base heavy, compact, outer edge turned anteriad. Tail set off, terminus finely pointed. Joints of tail annules with distinctly crenate outer edge.

Type host and locality. Native vegetation, SI, Tin Range, near Table Hill, Stewart Island, NZMS 260 D49/162389.

Material examined. Holotype and 19 paratypes. **Holotype**: female from the type locality,. E. H. C. McKenzie, 14 February 1998. Holotype on slide 182, National Nematode Collection of New Zealand, Landcare Research, Auckland (NNCNZ). **Paratypes**: same data as holotype; distributed as indicated in Table 2 (p. 26).

Differential diagnosis. *Criconema* (*C.*) *mackenziei* sp. nov. is characterised by the distinctly set off tail caused by scales present on the posterior part of the body suddenly being absence on the fused annules of the tail. *C.* (*C.*) *mackenziei* sp. nov. shares this characteristic with *C.* (*C.*) *spinicaudatum*. It can be distinguished from this species by the longer body (av. L = 0.62 v. 0.47 mm), stylet (av. 110 v. 70 µm), oesophagus (av. 160 v. 110 µm), and tail (av. 33 v. 20 µm).

Distribution (Map 3). *Criconema* (*C.*) *mackenziei* sp. nov. has been found only in the type locality on Stewart Island.

– / SI.

Etymology. *Criconema* (*C.*) *mackenziei* is named in honour of Dr E. H. C. McKenzie, Landcare Research, Auckland for his contributions to the National Nematode Collection.

Criconema (*Criconema*) *makahuense* sp. nov.

Fig. 6c, d

Measurements: Table 3.

Morphology. **Females**. Body straight or gently curved ventrad, tapering anteriorly from level of base of stylet and posteriorly from about 1 body width anterior to vulva. Lateral lines and lateral field lacking. Labial region high as if located on basal ring. Cephalic framework distinct, covering 1 annule. Lip annule crenate, not set off, continuous with body annules, pointing sideways or somewhat posteriad. Outer edge of body annules smooth, retrorse, from about base of stylet becoming faintly undulant and developing about 14 low, rounded projections at midbody which become progressively longer, at position of the vulva forming smooth, rounded scales; scales numbering about 12 at level of vulva, reducing in number posteriorly and from level of anus suddenly absent giving the tail a denuded, distinctly set off appearance. Tail annules fused. Stylet not very long, rigid; stylet base moderate, compact, usually with outer edge turned anteriad. Isthmus narrow, about 1/3 width of basal bulb. Excretory pore distinct when located on outer edge of a body annule, about 1 body width posterior to base of oesophagus. Vulva distinct, with 2 smooth rounded lips, closed, protruding from outline of body about same distance as scales. Vagina angled anteriad. Ovary single, outstretched, reaching area of oesophagus. Spermatheca round to oval, filled with round sperm *ca* 2 µm in diameter. Anus rarely distinct, its position obvious from sudden absence of scales on tail. Tail distinctly set off, narrowing gradually to finely rounded or pointed terminus. Joints of annules on tail distinct, occasionally with fine hairs.

Males. Not observed.

Type host and locality. *Cyathodes empetrifolia*. HB, Makahu Spur, Kaweka Range, Napier NZMS260 U20 042077.

Material examined. Holotype and 2 paratypes. **Holotype**: female, from the type locality, Q. W. Roberts, February 1972. Holotype on slide 183. **Paratypes**: females, same data as holotype. National Nematode Collection of New Zealand, Landcare Research, Auckland (NNCNZ).

Differential diagnosis. The females of *C.* (*C.*) *makahuense* sp. nov. are characterised by smooth scales increasing in length over the length of the female body, maximum length between vulva and anus, lacking on tail annules, giving the tail a set off appearance. A set off tail is also present in *C.* (*C.*) *cristulatum*, *C.* (*C.*) *aucklandicum*, *C.* (*C.*) *mackenziei,* and *C.* (*C.*) *spinicaudatum*. *Criconema* (*C.*) *makahuense* sp. nov. differs from these species in that the undulation of the body annules as a precursor of scale formation begins on the anterior part of the body (versus on the posterior part in the other species) and the greater number of body annules (av. R >100 v. R <100). *C.* (*C.*) *makahuense* sp. nov. further differs from *C.* (*C.*) *spinicaudatum*, its closest relative, by the shorter average stylet length (av. about 60 v. >70 µm), from *C.* (*C.*) *mackenziei*, *C.* (*C.*) *cristulatum,* and *C.* (*C.*) *aucklandicum* by its more slender body (av. a = about 15 v. 9–13), and from the latter 2 by the lack of a distinct fringe of hair on the body annules, a tail more distinctly set off, and a shorter stylet (av. about 50 v. >70 µm).

Distribution (Map 4). *Criconema* (*C.*) *makahuense* sp. nov. has been found only in the type locality in the Kaweka Range, Napier, HB.

HB / –.

Etymology. *Criconema* (*C.*) *makahuense* is named after the locality the species was found, Makahu Spur in the Kaweka Range, Hawkes Bay.

***Criconema* (*Criconema*) *nelsonense* sp. nov.**

Fig. 8a–f, 9c–i, 10, 11

Measurements: Table 3.

Morphology. **Females**. Body gently curved ventrad to C-shaped, tapering anteriorly from base of oesophagus, and posteriorly from just anterior of vulva. Lateral lines or lateral field observed only in extended specimens. Cephalic region with slightly lobed, discus-shaped, single annule, continuous with body contour. Labial region rounded with oval oral plate, amphidial apertures small slits lateral to oral plate, 6 pseudolips surrounding oral plate, 2 lateral ones slightly larger than the others. Cephalic sclerotisation prominent. Anterior body annules with 8, low, rounded projections; projections becoming progressively longer and more frequent on subsequent annules, reaching maximum number of 20 at midbody and becoming slightly narrower posterior to vulva. Stylet rigid. Excretory pore, near level of base of oesophagus, observed in few specimens only. Vulva distinct, with 2 smooth, rounded lips; lips slightly parted in most specimens, protruding about same distance as body scales. In lateral aspect each lip wider than a body scale, and both lips together wider than a body annule. Vagina approximately 1/2 body diameter long, angled slightly anteriad. Spermatheca oval to round, offset, ventrad, filled with round sperm about 1 µm in diameter. Body posterior to vulva narrowing progressively. Tail appearing distinctly set off from body due to sudden absence of protruding annules and scales; terminus narrowly rounded.

Males. Body slightly curved to C-shaped, tapering anteriorly from midbody, and posteriorly from anterior end of spicules. Body annules distinct. Head rounded, with 2 or 3 annules, occasionally set off from rest of body. Cephalic framework present. Stylet lacking. Oesophagus degenerate, its junction with intestine observed in only 3 specimens. Excretory pore obscure. Spicules paired, slender, curved gently anteriorly, more pronounced posteriorly. Gubernaculum curved. Caudal alae not observed. Lateral field protruding from body contour, with 3 incisures, giving the appearance of 4 lateral lines. Tail conical, usually with terminus pointed, occasionally with a short mucro. Males developing through metamorphosis.

Juveniles. Body sausage-shaped, tapering from midbody anteriad and posteriad. Labial region slightly elevated. Head with thin, non-retrorse labial annule. Body annules retrorse, with fringe of minute spikes on outer edge. Scales arranged in longitudinal lines, increasing in number to about 14 at midbody and decreasing in number posteriorly. Scales triangular in shape, bluntly rounded, increasing in length on posterior part of body, absent only on labial ring and on last 1 or 2 tail annules. Tail conical, not drawn out. Juvenile stages apparently seasonal or very short-lived as only few juveniles were found, and those present were generally moulting, some having 2 skins around them.

Type host and locality. Matai (*Prumnopitys taxifolia*), black beech (*Nothofagus solandri*), and rimu (*Dacrydium cupressinum*), gleyed yellow-brown earth, NN, Eves Valley, Nelson, New Zealand, NZMS 260 N27/181857.

Material examined. Holotype and 150 paratypes. **Holotype**: female from the type locality, W. M. Wouts 11 August 1971. Holotype on slide 197, National Nematode Collection of New Zealand, Landcare Research, Auckland (NNCNZ). **Paratypes**: 150 females, same collecting data as holotype, slides distributed as indicated in Table 2 (p. 26).

Differential diagnosis. The distinguishing characters of *C.* (*C.*) *nelsonense* sp. nov are: number of body annules approximately 100, bearing up to 20 cuticular scales. Scales smooth with posterior edge rounded, on 1st body annule resembling low undulating lobes, increasing in size on first 5 body annules, and varying in number with circumference of body. Head annule single, saucer-shaped, smaller in diameter than the 1st body annule, outer edge lobed, rounded. Stylet rigid, approximately 60 µm long.

Criconema (*C.*) *nelsonense* sp. nov. most closely resembles *C.* (*C.*) *guernei* (Fig 9a, b), and both can be distinguished from all other species of the genus by a continuous row of scales on all body annules including the anteriormost ones. *Criconema* (*C.*) *nelsonense* sp. nov. differs from *C.* (*C.*) *guernei* by its shorter body (av. L = 0.37 v. 0.51), tail (av. c = 27 v. 18), and stylet (av. 60 v. 64 µm), the more posterior position of the vulva (av. V = 92 v. 88), the greater body width (av. a = 10 v. 15), and the more distinctly demarcated tail.

Distribution (Map 5). *Criconema* (*C.*) *nelsonense* sp. nov. has been found only in the type locality at Eves Valley, NN.

– / NN.

Etymology. *Criconema* (*C.*) *nelsonense* is named after Nelson, the district the species was found.

***Criconema* (*Criconema*) *spinicaudatum* (Raski & Pinochet, 1976) Raski & Luc, 1985**

Nothocriconema spinicaudatum Raski & Pinochet, 1976; *Notholetus spinicaudatus* (Raski & Pinochet) Ebsary, 1981.

Fig. 3f, g; 8g, h; 12

Measurements: Table 3.

Morphology. **Females**. Body gently curved ventrad, tapering anteriorly, and posteriorly. Lateral lines and lateral field lacking. Cephalic region with slightly lobed, dish-shaped, single annule supporting rounded labial region, continuous with body contour. Anterior body annules smooth, rarely indented, near midbody becoming faintly undulant and developing low, rounded projections which progressively become longer, posteriorly forming smooth, rounded scales; scales numbering about 16 at level of vulva, between vulva and anus becoming slightly narrower with hyaline tips, absent on tail. Stylet rigid. Excretory pore near level of base of oesophagus, distinct in most specimens. Vulva distinct, with 2, smooth, rounded lips, closed, protruding about the same distance as body scales. Vagina angled anteriad. Spermatheca filled with round sperm *ca* 1 mm in diameter. Body posterior to vulva narrowing progressively. Tail distinctly set off from body due to sudden absence of protruding annules and scales, terminus very narrow, rounded.

Males. Not observed.

Differential diagnosis. *Criconema* (*C.*) *spinicaudatum* is most closely related to the species described above in that they all have tails with fused annules. The lack of scales on these annules makes the tail thinner, and it stands out against the much wider rest of the body where scales are present. In *C.* (*C.*) *spinicaudatum, C.* (*C.*) *mackenziei,* and *C.* (*C.*) *makahuense* the tail is more distinct and more consistently set off than in the other 2 species, where the degree to which the tail is set off is determined by the extent of contraction of the body. *Criconema* (*C.*) *spinicaudatum* can be distinguished from *C.* (*C.*) *makahuense* by the longer stylet (av. >70 µm v. *ca* 60 µm) and lower number of body annules (av. R<80 v. R >100) and from *C.* (*C.*) *mackenziei* by the shorter body (av. L= 0.42 mm v. 0.62 mm), stylet (av. 70 µm v. 110 mm) and oesophagus (av.110 µm v. 160 µm).

Material examined. 172 females and 11 juveniles from the following plant species and localities: putaputaweta (*Carpodetus serratum*), *Anisotome* sp., *Celmisia* sp., *Chionochloa flavescens*, *Kelleria* sp., *Leucogenes* sp., *Pentachondra* sp., *Phyllachne* sp, *Raoulia* sp., and *Viola* sp., Mt Dundas, Tararua Range, WN; tussock (*Chionochloa pallens*) grassland, Pukemoremore Basin, Tararua Range, WN; grass in silver beech (*Nothofagus menziesii*) forest, 60 km past Haast, OL; *Chionochloa* sp., small island off Ramp Point, CA; native vegetation, Dent Island, CA; *Carex* sp., *Coprosma ciliata*, broom (*Cytisus scoparius*), *Hebe elliptica* and tussock (*Chionochloa* sp.) Beeman Point (Perseverance Harbour), CA; *Bulbinella* sp., exposed west side Mt Dumas, CA; *Myrsine divaricata*, east side of Mt Dumas, CA; *Dracophyllum longifolium* and *Poa foliosa*, Six Foot Lake, CA (NNCNZ).

Distribution (Map 6). It appears *Criconema* (*C.*) *spinicaudatum* is associated with tussock. It is abundant on Campbell Island and commonly present at high altitude in the Tararua Range, WN. Although tussock in the South Island has been sampled repeatedly *C.* (*C.*) *spinicaudatum* has never been found on tussock there.

WN / – / AN, CA.

Remarks. *Criconema* (*C.*) *spinicaudatum* was described by Raski & Pinochet (1976) on the basis of 26 females, 1 male, and 3 juveniles from the Antipodes Islands, and 2 females and 12 males from Campbell Island, collected from native vegetation in 1962. The large number of additional specimens collected since then from these localities enabled a detailed comparison with the population from the South Island. This comparison showed that specimens from Campbell Island and the South Island are very similar, except that in the Campbell Island population the tail annules are more distinctly demarcated. They differ from the type specimens of the Antipodes Islands in that they are longer (0.46 v. 0.40 mm) and more slender (a = 11 v. 9), and have a shorter stylet (72 v. 76 µm), shorter tail (c = 24 v. 22), and more body annules (R= 95 v. 88). Although consistent, these differences on their own are not considered sufficient to justify the recognition of these populations as a different species.

Subgenus *Nothocriconema* Ebsary, 1981

Nenocriconema Darekar & Khan, 1981
Paracriconema Ebsary, 1981
Cerchnotocriconema Bernard, 1982.

Genus *Criconema*. **Females**. Annules 50–90, round or retrorse, their margins smooth or crenate but without ornamentation; lateral notches present in some species. Cephalic region with 1 or 2 annules, differentiated from body annules. Stylet 45–100 µm long. Vulval lips protruding, 3 to 10 annules from terminus, vagina straight. Tail not distinctly set off from rest of body; terminus rounded.

Males with 3 or 4 incisures in lateral fields, caudal alae low.

4th-stage juveniles with 8–18 rows of scales.

Nominal species present in New Zealand

Criconema (*Nothocriconema*) *annuliferum* (de Man, 1921) Micoletzky, 1925 **(Type species)**
C. (*N.*) *grandisoni* sp. nov.
C. (*N.*) *lineatum* Loof, Wouts & Yeates, 1997
C. (*N.*) *magnum* Loof, Wouts & Yeates, 1997
C. (*N.*) *undulatum* Loof, Wouts & Yeates, 1997

Key to the species of the subgenus *Nothocriconema*

1 Female 2nd and 3rd ring distinctly narrower than the lip ring, forming a distinct collar ....(p. 34)... ***C.* (*N.*) *annuliferum***

— Female 2nd and 3rd ring not forming a collar 2

2(1) Female body annules smooth, with lateral notches forming a distinct lateral line along the length of the body, undulation on anterior or posterior surface of the body annules lacking ...(p. 35)... ***C.* (*N.*) *lineatum***

— Female body annules not forming a distinct lateral line along the length of the body, undulations on anterior or posterior surface of annules present 3

3(2) In female distinct undulation present on posterior edge of annules ....(p. 35)... ***C.* (*N.*) *grandisoni***

—In female distinct undulation present on anterior edge of annules 4

4(3) Female large, about 0.7 mm long, coarsely annulated (R <65), stylet about 100 µm long ....(p. 36)... ***C.* (*N.*) *magnum***

— Females of moderate size, about 0.45 mm long, finely annulated (R >110), stylet about 80 µm long ....(p. 37)... ***C.* (*N.*) *undulatum***

Criconema (*Nothocriconema*) *annuliferum* (de Man, 1921) Micoletzky, 1925

Hoplolaimus annuliferus de Man, 1921; *Criconemoides annuliferus* (de Man, 1921) Taylor, 1936; *Nothocriconema* (*Nothocriconema*) *annuliferum* (de Man, 1921) De Grisse & Loof, 1965
Criconema annuliferum hygrophilum Andrássy, 1952; *Criconemoides hygrophilum* (Andrássy, 1952) Oostenbrink, 1960; *Nothocriconema hygrophilum* (Andrássy, 1952) De Grisse & Loof, 1965;
Criconema kirjanovae Krall, 1963
Criconema stygium Schneider, 1940; *Criconemoides stygium* (Schneider, 1949) Andrássy, 1959; *Nothocriconema stygium* (Schneider, 1940) De Grisse & Loof, 1965.

Fig. 13a, b

Measurements: Table 4.

Morphology. **Females**. Lip region flat. 2nd and 3rd lip annule of distinctly smaller diameter forming collar posterior to 1st lip annule. 2nd lip annule generally of smaller diameter and thinner than both 1st and 3rd annule. Cuticle thick. Body annules distinctly wider than lip annules. Annules rounded, not retrorse. Stylet long, knobs heavy. Vulva closed. Vagina straight. Postvulval region conical, about 1.5 times as long as body width at vulva.

Males. Not observed

Differential diagnosis. *Criconema* (*N.*) *annuliferum* can be easily identified by its long stylet of about 100 µm length, non retrorse smooth body annules, and the 2 narrower annules below the lip annule forming a distinct collar. This species has been found associated with roadside vegetation and commercial gardens only and is, therefore, considered to be an introduced species. *Criconema* (*N.*) *annuliferum* does not have close relatives among endemic New Zealand species.

Material examined. 16 females and 1 juvenile from the following plant species and localities: Roadside vegetation, Matai Valley, NN; Willow (*Salix* sp.), Wakefield, NN; Roadside vegetation Dunedin, DN; and Oreti Beach Road, Invercargill, SL (NNCNZ).

Distribution (Map 7). *Criconema* (*C.*) *annuliferum* is clearly an introduced species. It has never been found associated with any of the native species and has predominantly been found on roadside vegetation near major shipping ports. Knight (2001) reports it from a kiwifruit (*Actinidia deliciosa*) orchard, Appleby, NN.

– / NN, DN, SL.

Criconema (*Nothocriconema*) *grandisoni* sp. nov.

Fig. 13c, d; 14

Measurements: Table 4.

Morphology. **Females**. Body gently curved ventrad, tapering anteriorly from base of stylet, posteriorly from about position of spermatheca, most progressively posterior to vulva. Lateral line of lateral field slightly elevated, distinctly visible as series of hemispherical notches on posterior edge of annules, most obvious between position of vulva and anus, gradually disappearing anterior to base of oesophagus. Lip region with slit-like oral opening surrounded by oval oral plate. Amphidial apertures distinct, on sides of oral plate. Pseudolips present, amalgamated into ring surrounding oral plate. 1st lip annule with finely serrated edge, directed sideways or somewhat anteriad. 2nd lip annule superficially serrated, directed sideways or retrorse, generally thinner than 1st lip annule, but of same diameter or slightly wider, distinctly narrower than 1st body annule, giving head appearance of being slightly set off. Cephalic sclerotisation prominent. Body annules retrorse, with no hair or particulate matter adhering to them, changing from almost smooth to distinctly crenate and serrated over first 6–10 annules, distinctly serrated further posteriorly. Anastomoses infrequent. Stylet long, rigid, base wide and heavy. Vulval slit wide, closed, anterior vulval lip overlapping posterior lip, not protruding outside body contour. Ovaries generally straight, reaching base of oesophagus. Spermatheca oval, offset, ventrad, filled with fine sperm *ca* 1 µm in diameter. Posterior to vulva body generally narrowing ventrally giving postvulval region convex appearance, while dorsal side remains almost straight. Annules posterior to vulva not extending progressively. Anus distinct, located approximately halfway between vulva and tail terminus. Tail annules not different from body annules. Tail conically pointed with single or forked terminus.

Males. Not observed.

Type host and locality. Native vegetation, WD, state highway 8, 6 km east of Haast, NZMS 260 F37/933936.

Material examined. Holotype and 8 paratypes. **Holotype**: female, from type locality,. W. M. Wouts, 17 October 1971. Holotype on slide 184, Landcare Research, Auckland (NNCNZ). **Paratypes**: 8 females, same collecting data as holotype (NNCNZ).

Differential diagnosis. *Criconema* (*N.*) *grandisoni* sp. nov. most closely resembles *C.* (*N.*) *calvum* (Raski & Golden, 1966) Raski & Luc, 1985 in having 2 distinct lip annules. They differ from each other in the number and width of the body annules (av. R = 130, annule width about 4 µm in *grandisoni* sp. nov. v. R = 80, annule width 6–7 µm in *calvum*). *Criconema* (*N.*) *grandisoni* sp. nov. can be distinguished from all New Zealand *Nothocriconema* species by the large number of body annules (av. R = 130) and the crenate posterior edge of the body annules.

Distribution (Map 8). *Criconema* (*N.*) *grandisoni* sp. nov. has been found only in the type locality near Haast, WD.

– / WD.

Etymology. *Criconema* (*N.*) *grandisoni* has been named in honour of Dr G. S. Grandison, former employee of the Department of Scientific and Industrial Research, Auckland, for his contributions to the science of nematology.

Criconema (*Nothocriconema*) *lineatum* Loof, Wouts & Yeates, 1997

Fig. 15, 16a, b

Measurements: Table 4.

Morphology. **Females**. Body gently curved ventrad, tapering anteriorly from base of stylet and posteriorly from 2 or 3 annules anterior to vulva. Lateral field pronounced, single lateral groove as if a dorsal scale and a ventral scale meet without joining, absent on 4 or 5 anteriormost body annules and tail, Labial region with rectangular oral plate that looks almost detached; oral plate with large amphidial aperture on either side, surrounded by 6 pseudolips. Amphidial aperture not indenting oral plate. 2 lateral pseudolips larger than other 4. Pseudolips located on saucer-shaped, single lip annule with more or less smooth outline. Diameter lip annule 15–18 µm, first body annule 21–26 µm. Cephalic sclerotisation prominent. Body annules retrorse; outer edge finely serrated, with transparent extension. Extensions interconnected and loosely enclosing tail as if a continuous, perforated, thin skin surrounds entire animal. Stylet flexible. Excretory pore distinct, near level of oesophageal/intestinal junction or posterior to it. Vulva distinct, with 2 smooth, conical, closed lips protruding beyond body scales in lateral view; lips together as wide as body annules. Vagina approximately 1/2 body diameter long, angled anteriad. Spermatheca oval to round, offset, ventrad, filled with small sperm <1 µm in diameter. Tail conical, not always distinctly set off from body; annules with distinct posterior edge; anteriormost tail annules with small irregular outgrowths; terminus pointed.

Males. Not observed.

Differential diagnosis. *Criconema* (*Nothocriconema*) *lineatum* differs from all other *Criconema* species by the distinct line of the lateral field and the absence of scales on the annules of the cuticle. Because of the shape of the postvulval region *C.* (*N.*) *lineatum* resembles somewhat the species in the subgenus *Criconema* from which it differs by a lower R value (67–73 v. 76–86), the presence of a lateral field caused by laterally notched annules, and the absence of protuberances on the annules between the vulva and the anus, and the consequently less sharply set off tail.

Criconema (*Nothocriconema*) *lineatum* females have a hyaline extension of the body annules between the body annules and over the tail, giving the appearance of an enveloping thin film adhering to the outer margin of the body annules. This feature, together with the distinct lateral line, flexible stylet, protruding vulval lips, and elevated labial disc would justify generic status if more species with this combination of characteristics were discovered.

Material examined. Holotype, 71 paratypes, and 50 non-type specimens. **Holotype**: female *Nothofagus* sp. forest, Inangahua West State Forest, BR, J. S. Dugdale, 10 July 1972 (NNCNZ). **Paratypes**: 47 females, same data as holotype. 24 paratype females from the following hosts and localities: Native forest, Mangaehuehu Scenic Reserve, near Ohakune, TO; *Nothofagus* forest, Mt Domett, NN; *Neopanax anomalum*, red beech (*Nothofagus fusca*) and *Coprosma propinqua* in *Nothofagus* forest, Inangahua West State Forest, BR; *Nothofagus fusca* forest, Inangahua East State Forest, BR (NNCNZ). **Non-type specimens**: 38 females and 12 juveniles from the same localities as the type material (NNCNZ).

Distribution (Map 9). *Criconema* (*N.*) *lineatum* has a limited distribution. It has been found in the Buller region of the South Island and at a single site near Ohakune in the North Island.

TO / NN, BR.

Criconema* (*Nothocriconema*) *magnum Loof, Wouts & Yeates, 1997

Fig. 17, 18, 19

Measurements: Table 4.

Morphology. **Females**. Body very large and dark, slightly curved ventrad. Diameter of 1st annule 26–28 µm, of 2nd 32–35 µm; succeeding annules growing gradually wider. 1st annule distinctly set off. Anterior margin of body annules undulant. Stylet robust. Vulva closed; anterior lip not overhanging. Spermatheca empty. Anus located on 3rd or 4th annule from posterior end. Postvulval region conical with bluntly rounded terminus, which is lobate as in *Macroposthonia rustica.*

Males. Body gently curved ventrad, tapering anteriorly from midbody and posteriorly from about 1 body width anterior to the cloaca. Body annules distinct, without scales. Head dome-shaped, truncated anteriorly, not set off, with 5 or 6 more or less distinct annules; in some specimens head demarcated by slight groove. Cephalic sclerotisation and stylet lacking. Oesophagus rudimentary with narrow median bulb and basal bulb present in some specimens, junction with the intestine generally distinct. Excretory pore distinct, about 110 µm from anterior end, up to 1 body width posterior to junction of oesophagus with intestine. Hemizonid 2–4 annules anterior to secretory–excretory pore. Spicules paired, slender, gently curved. Gubernaculum curved. Cloaca not protruding from contour of body. Caudal alae not observed. Lateral field protruding from body contour, with 4 incisures. Tail slender, with blunt terminus.

4th stage juveniles. Body curved gently ventrad, widest girth near midbody, tapering anteriad and posteriad. Body annules each with 10 single, long, narrow scales located on distinct ridges running from 1st body annule to tail region with 5–6 ridges generally running through to near tail terminus. Last 1 or 2 tail annules without scales. In anterior and posterior end view rows of scales along length of body clearly visible. Scales on first 10 body annules gradually increasing in size, remaining more or less consistent in length over rest of body. Scales on ventral side of postvulval region not longer than on rest of body. Cephalic region truncate, with 2 distinct annules. Oral opening a dorsoventral slit located on oral plate. Amphidial aperture on lateral side of oral plate surrounded by lateral pseudolips. 2 dorsolateral and 2 ventrolateral pseudolips complete lip region. Outer edge of 1st lip annule distinctly crenate, directed anteriorly and surrounding lip region. 2nd lip annule about same size as anterior 1 or slightly wider, curved posteriad, with outer edge undulate. Body annules wide, scales directed posteriorly, lying flat against body on retracted specimens, directing progressively outward with relaxing of body, standing almost perpendicular to centre line of body on fully extended juveniles. Each scale consisting of wide, tapering lower 1/2 and long, narrower upper part of uniform width, bearing a fringe of hair-like appendages at slightly indented tip. Scales on contracted specimens easily overlapping base of scale of adjacent posterior annule. Detritus generally accumulating strongly along length of body. Stylet rigid. Excretory pore and anus not observed. Genital primordium observed in some specimens, extending from near future position of vulva to about midbody. Body posterior to vulva, disregarding scales, narrowing gradually to conical tail.

Differential diagnosis. *Criconema* (*Nothocriconema*) *magnum* can be easily recognised among the New Zealand species by its long body of about 0.7 mm, stylet length of almost 100 µm, and the distinct, undulate anterior surface of the body annules. Because of its large body size and long stylet this species resembles *C.* (*C.*) *certesi* Raski & Valenzuela, 1986, *C.* (*C.*) *crotaloides* (Cobb, 1924) Schuurmans Stekhoven & Teunissen, 1938 as redescribed by Raski & Golden, 1966, *C.* (*C.*) *giardi* (Certes, 1889) Micoletzky, 1925, *C.* (*C.*) *lanxifrons* (Orton Williams, 1982) Raski & Luc, 1985, and *C.* (*C.*) *psephinum* (Bernard, 1982) Raski & Luc, 1985. All these species, however, have an acute tail, more body annules (in *certesi* R = 75–88, in *giardi* R = 95–105, and in *lanxifrons* R = 101–110, v. about 60 in *magnum*), and lack undulation on the anterior surface of the body annules; the cuticle is smooth in *C.* (*C.*) *crotaloides* and *C.* (*C.*) *lanxifrons*, it bears fine spines in *C.* (*C.*) *certesi*, and platelets in the 2 other species. The 4th stage juvenile of *C.* (*C.*) *magnum* can be recognised by the 10 rows of distinctive, long, single, strip-like spines with wider tip.

Material examined. Holotype, 4 paratypes, and 127 non-type specimens. **Holotype**: female native forest, near summit road tunnel on Mount Messenger, Taranaki, TK, G. W. Yeates, August 1987 (NNCNZ). **Paratypes**: 4 females, same data as holotype. **Non-type specimens**: 53 females, 31 males, and 43 juveniles from native forest, Omahuta Forest, Mangamuka, Northland, ND; native vegetation, Pareheru Scenic Reserve, Waimangu, Rotorua, BP; miro (*Prumnopitys ferruginea*) in *Nothofagus* forest, West Inangahua State Forest, BR; rata (*Metrosideros robusta*) and rimu (*Dacrydium cupressinum*), Mawhera State Forest, BR; mixed native vegetation with tree fuchsia (*Fuchsia excorticata*), matai (*Prumnopitys taxifolia*), and rimu (*Dacrydium cupressinum*), Oreti Beach Road, Invercargill, SL (NNCNZ).

Distribution (Map 10). *Criconema* (*Nothocriconema*) *magnum* has a wide distribution being present from the northern part of the North Island, ND, to the southern part of the South Island, SL. It is not often encountered, but locally may be present in large numbers.

ND, TK, BP / BR, SL.

Remarks. In the original description of the species (Loof *et al.* 1997) juveniles and males were not described. Juveniles were available at that time, but because of their considerable size and the large scales on their body annules they were considered to be females of a new *Ogma* species. This remained so even after SEM photographs failed to disclose a vulva. They were not recognised as juveniles until detailed observations for a description of the species revealed the vague outline of a *C.* (*N.*) *magnum* female inside the cuticle of one of the specimens. Similarly, the discovery of a male in one of these juvenile skins enabled the identification of additional material in the original collection and the description of the male.

***Criconema* (*Nothocriconema*) *undulatum* Loof, Wouts & Yeates, 1997**

Fig. 16c–f; 20a–e

Measurements: Table 4.

Morphology. **Females**. Body curved ventrad, tapering slightly anteriad, strongly posteriad. Lateral lines or lateral field lacking. Pseudolips rather low; labial sclerotisation large, heavy; lip annule not retrorse, *ca* 15 µm wide, separated from body annules by short 'collar'; 1st body annule retrorse, *ca* 17 µm wide; succeeding annules retrorse, becoming gradually wider; outer edges smooth and anterior surfaces grooved. Some anastomoses in most specimens, especially on the tail. Stylet straight, slightly curved in some specimens. Excretory pore generally opposite terminal bulb. Vulva closed, lips large, protruding, not overhanging. Spermatheca empty. Postvulval body part conoid, tapering regularly to narrow terminus. Terminal annule sometimes with protruding appendage.

Males. Width of annules *ca* 2.5 µm, in 1 specimen many double annules of 5 µm. Lateral field with 3 lines. Anterior end rounded with central depression. Spicules curved. Gubernaculum widest in middle. Caudal alae present, not extending to terminus. Terminus rounded. Testis with or without sperm.

Differential diagnosis. *Criconema* (*Nothocriconema*) *undulatum* is characterised by the anterior margins of the annules being undulant. It shares this character with *Criconema* (*Nothocriconema*) *magnum,* but because of its smaller size (av. L <0.6 mm v. L >8 mm) and finer annulation (av. R >110 v. R <80) the 2 species do not resemble each other. *Criconema* (*Nothocriconema*) *undulatum* most closely resembles *C.* (*Nothocriconemella*) *pasticum* (Raski & Pinochet, 1976) Raski & Luc, 1985 in vulva position and stylet length. The undulant anterior margins of the body annules separate the 2 species. The 2 species further differ in that in *C.* (*N.*) *undulatum* the 1st lip annule is somewhat set off with the cephalic framework restricted to it and the greater number of body annules (R = 116–130 v. 101–110) and their somewhat angular outline, whereas the 1st lip annule in *C.* (*N.*) *pasticum* is not set off, the cephalic framework extends into the 2nd lip annule, and the body annules are evenly rounded.

Material examined. Holotype, 18 paratypes, and 23 non-type specimens. **Holotype**: female, *Metrosideros umbellata* forest, Deas Head, Auckland Island, AU, I. B. Campbell, February 1986 (NNCNZ). **Paratypes**: 16 females and 2 males, same data as holotype. **Non-type specimens**: 21 females, 1 male and 1 juvenile from rata (*Metrosideros robusta*) in mixed native forest, Mawhera State Forest, BR, and *Poa foliosa* and mosses, Stewart Island, SI (NNCNZ).

Distribution (Map 11). *Criconema* (*Nothocriconema*) *undulatum* has primarily been obtained from Auckland Island and Stewart Island. It seems to be associated with *Metrosideros*. The presence of this species at a single site in the South Island may be a reflection of the relatively rare occurrence and limited sampling of *Metrosideros* on the main islands of New Zealand.

– / BR, SI / AU.

Subgenus *Nothocriconemella* Ebsary, 1981

Genus *Criconema*. **Females**. Body annules 60–135, 4–6 µm wide, retrorse, without ornamentation or hairs, anastomoses rare; lateral notches on part of the body present in some species. Lip region not distinctly set off. Oral opening a narrow slit surrounded by an oral plate. Oral plate generally oval, with an amphidial aperture on each side, not protruding, surrounded by 6 pseudolips of about equal size. Cephalic region with 2, rarely 3 annules, not differentiated, not set off from each other or from the body annules by body outgrowth or collar. Anterior lip annule equal to or narrower than posterior lip annule. Posterior annule intermediate between anterior annule and 1st body annule. It is usually not exactly intermediate but slightly narrower, which may give the impression that the lip region is slightly set off. Stylet 50–160 µm long, flexible if long. Vulval lips conical, 5–21 annules from tail tip. Anterior lip generally overlapping the posterior lip (in *C.* (*N.*) *mutabile* (Taylor, 1936) Raski & Luc, 1985 the anterior lip does not overlap). Tail not distinctly set off from rest of body; terminus conically pointed or blunt and rounded depending on whether last tail annules are extended, regular in shape, or retracted.

Juveniles with rows of smooth or minutely spined scales.

Nominal species present in New Zealand

Criconema (*Nothocriconemella*) *sphagni* Micoletzky, 1925 **(Type species)**
C. (*N.*) *acuticaudatum* Loof, Wouts & Yeates, 1997
C. (*N.*) *alpinum* Loof, Wouts & Yeates, 1997
C. (*N.*) *californicum* Diab & Jenkins, 1966
C. (*N.*) *crosbyi* Wouts, 2000
C. (*N.*) *dugdalei* Wouts, 2000
C. (*N.*) *farrelli* Wouts, 2000
C. (*N.*) *graminicola* Loof, Wouts & Yeates, 1997
C. (*N.*) *macilentum* (Raski & Pinochet, 1976) Raski & Luc, 1985
C. (*N.*) *mutabile* (Taylor, 1936) Raski & Luc, 1985
C. (*N.*) *pasticum* (Raski & Pinochet, 1976) Raski & Luc, 1985
C. (*N.*) *ramsayi* Wouts, 2000

These species are morphologically very similar, some of them being distinguished only by the length of the stylet. For ease of diagnosis and identification they are therefore discussed in the sequence of their stylet length.

Key to the females of the species of *Criconema* (*Nothocriconemella*) present in New Zealand

1 Notches in annules of postvulval region form distinct lateral line ....(p. 46)... ***C.* (*N.*) *ramsayi***

— Notches in annules of postvulval region when present do not form a distinct lateral line 2

2 (1)Tail annules extended, fused, forming pointed tail terminus ....(p. 46)... ***C.* (*N.*) *crosbyi***

— Tail annules not extended, not fused, not forming finely pointed terminus 3

3(2) Stylet <105 µm long 4

— Stylet >105 µm long 11

4(3) R <86 5

— R >86 6

5(4) R >80, stylet base *ca* 9.5 µm wide, length of shaft of stylet *ca* 11µm long ....(p. 42)... ***C.* (*N.*) *alpinum***

— R <80, stylet base *ca* 10.5 µm wide, length of shaft of stylet *ca* 13mm long ...(p. 43)... ***C.* (*N.*) *graminicola***

6(4) Stylet base heavy, >11 µm wide, shaft of stylet >12 µm long............... ...(p. 44)... ***C.* (*N.*) *acuticaudatum***

— Stylet base not heavy, <10 µm wide, shaft of stylet <11 µm long.. 7

7(6) Average stylet <74 µm long 8

— Average stylet >74 µm long 9

8(7) Anterior vulval lip overlapping posterior vulval lip ....(p. 40)... ***C.* (*N.*) *californicum***

— Anterior vulval lip not overlapping posterior vulval lip ....(p. 40)... ***C.* (*N.*) *mutabile***

9(7) Average L >0.45 mm, R >110 ....(p. 46)... ***C.* (*N.*) *farrelli***

— Average L <0.45 mm, R <110 10

10(9) R >93, average stylet <82 µm long ....(p. 42)... ***C.* (*N.*) *pasticum***

— R <93, average stylet >82 µm long ....(p. 42)... ***C.* (*N.*) *alpinum***

11(3) Stylet base >12 µm wide, shaft of stylet >14 µm long, R >140 ....(p. 47)... ***C.* (*N.*) *dugdalei***

— Stylet base <12 µm wide, shaft of stylet <14 µm long, R <140 12

12(11) Last 5 tail annules extended as much as body annules ....(p. 44)... ***C.* (*N.*) *sphagni***

— Last 5 tail annules extended more than body annules . ...(p. 45)... ***C.* (*N.*) *macilentum***

The base of the stylet as a diagnostic character in the subgenus *Nothocriconemella* (Fig. 34; 35)

The size and shape of the base of the stylet are generally not used as diagnostic characters in the Criconematidae. In *C.* (*N.*) *farrelli,* however, the stylet base is so small that it obviously is diagnostic for this species. The fact that in criconematids the length of the shaft of the stylet is not correlated with the length of the conus or the total length of the stylet has been used as a diagnostic characteristic of the suborder (Siddiqi 1986). Wouts (2000) demonstrated that in *Nothocriconemella,* and possibly in Criconematidae generally, the length of the shaft is directly proportional to the size of the stylet base. Using the measurements of 10 specimens of each of the 12 species he was studying he demonstrated that the averages of length and width of the stylet base were proportional to the length of the shaft of the stylet, especially at the higher values. When the product of length and width of the stylet base was used, a correlation with the length of the shaft was even more apparent. *Criconema* (*N.*) *californicum*, *C.* (*N.*) *mutabile*, *C.* (*N.*) *pasticum,* and *C.* (*N.*) *farrelli* have small stylet bases and correspondingly short shafts. For the diagnosis of these species this correlation is of no significance. With the increase in base size from *C.* (*N.*) *alpinum* through *C.* (*N.*) *sphagni*, *C.* (*N.*) *graminicola, C.* (*N.*) *crosbyi, C.* (*N.*) *macilentum,* and *C.* (*N.*) *ramsayi* to *C.* (*N.*) *acuticaudatum* and the very large base in *C.* (*N.*) *dugdalei,* a close correlation with the length of the stylet shaft can be observed. Although this relationship may not be useful for the separation of all species of the subgenus, it effectively separates extremes like *C.* (*N.*) *farrelli* with a short shaft and small stylet base from *C.* (*N.*) *acuticaudatum,* a species with a similar stylet length yet with a long shaft and heavy stylet base.

For the identification of *Nothocriconemella* species, besides the size and shape of the stylet base, characters of the cephalic region and postvulval region are needed. For the species present in New Zealand these characters are presented in Fig. 35 in sequence of the length of the shaft of the stylet and size of the stylet base.

On the basis of these characters *Nothocriconemella* species can be distinguished as follows:

Criconema (*N.*) *mutabile, C.* (*N.*) *californicum, C.* (*N.*) *pasticum,* and *C.* (*N.*) *farrelli* have the smallest stylet base (Fig. 35a–l). Among them, *C.* (*N.*) *mutabile* is the only one with a short blunt tail terminus and straight vagina, and the edges of the 1st lip annule seem more or less fixed in lateral direction giving the lip region a flat appearance.

In *C.* (*N.*) *californicum, C.* (*N.*) *pasticum,* and *C.* (*N.*) *farrelli* the 1st lip annule is more flexible and usually directed posteriad giving the head a more rounded appearance. *Criconema* (*N.*) *farrelli* is unique among the species with a small stylet base because of its long stylet. *Criconema* (*N.*) *californicum* and *C.* (*N.*) *pasticum* can be distinguished from each other by their different stylet lengths.

Criconema (*N.*) *acuticaudatum, C.* (*N.*) *alpinum*, *C.* (*N.*) *crosbyi, C.* (*N.*) *graminicola, C.* (*N.*) *macilentum*, *C.* (*N.*) *ramsayi*, and *C.* (*N.*) *sphagni* have a moderately heavy stylet base (Fig. 35m–ag). *Criconema* (*N.*) *crosbyi* is unique because of its attenuated tail terminus, and *C.* (*N.*) *ramsayi* because of the lateral line on the postvulval region. *Criconema* (*N.*) *ramsayi* closely resembles *C.* (*N.*) *sphagni*, but the lip region and stylet base are more robust, the stylet is shorter and the postvulval region has consistently more annules, has a lateral groove and looks somewhat swollen. *Criconema* (*N.*) *graminicola* and *C.* (*N.*) *acuticaudatum* are very closely related. Because of the sideways-directed 1st lip annule their lip region resembles that of *C.* (*N.*) *mutabile.* Their heavy stylet base relative to their short stylet of about 80 µm, makes *C.* (*N.*) *graminicola* and *C.* (*N.*) *acuticaudatum* distinct from species with a similar or somewhat longer stylet length such as *C.* (*N.*) *alpinum*, and easy to recognise even in complex species mixes. The short stylet easily distinguishes them from *C.* (*N.*) *sphagni* and *C.* (*N.*) *macilentum* (stylet >100 µm long). A greater number of body annules and a longer postvulval region distinguish *C.* (*N.*) *acuticaudatum* from *C.* (*N.*) *graminicola. Criconema* (*N.*) *alpinum* can be distinguished from *C.* (*N.*) *sphagni* and *C.* (*N.*) *macilentum*, the remaining species of this group, by its shorter stylet of less than 100 µm. *C.* (*N.*) *alpinum* is further characterised by a somewhat blunt tail terminus, but this character is variable and most New Zealand populations of this species seem to have a more or less sharp tail. *Criconema* (*N*) *sphagni* and *C.* (*N.*) *macilentum* are closely related. *Criconema* (*N.*) *macilentum* has a higher lip region and a more sharply pointed tail with attenuated tail annules.

Criconema (*N.*) *dugdalei* (Fig. 35ah–aj) has the heaviest stylet base and is characterised by the very long stylet, which can be more than 150 µm long. The tail annules of this species are generally not fully extended, and the tail terminus can point in any direction.

Key characteristics of the species of (*Nothocriconemella*) are summarised in Table 6.

Criconema (Nothocriconemella) mutabile (Taylor, 1936) Raski & Luc, 1985

Criconemoides mutabilis Taylor, 1936; *Nothocriconema mutabile* (Taylor, 1936) De Grisse & Loof, 1965; *Nothocriconemella mutabilis* (Taylor, 1936) Ebsary, 1981

Criconemoides kashmirensis Mahajan & Bijral, 1973; *Criconema kashmirensis* (Mahajan & Bijral, 1973) Siddiqi, 1986; *Nothocriconemella kashmirense* (Mahajan & Bijral, 1973) Siddiqi, 1986

Criconemoides magnoliae Edward & Misra, 1964; *Criconema magnoliae* (Edward & Misra, 1964) Siddiqi, 1986

Nothocriconema mukovum Khan, Chawla & Saha, 1976; *Criconema mukovum* (Khan, Chawla & Saha, 1976) Yeates, Loof & Wouts, 1997

Criconemoides raskii Goodey, 1963; *Criconema raskii* (Goodey, 1963) Siddiqi, 1986

Criconemoides siddiqii Khan, 1964; *Criconema siddiqii* (Khan, 1964) Siddiqi, 1986; *Nothocriconemella siddiqii* (Khan, 1964) Siddiqi, 1986

Fig. 21a–c; 22a,b; 23a

Measurements: Table 5.

Morphology. **Females**. Body gently curved ventrad. Lateral line lacking. Cephalic region with 2 lip annules, generally directed sideways. Oral plate elongate, surrounded by 6 pseudolips, lateral ones larger than others. Laterally observed pseudolips visible as elevated lip cap with concave middle. Stylet straight, 40–65 µm long, stylet knobs well developed. Vagina straight, anterior vulval lip not overlapping posterior lip. Spermatheca without sperm. Postvulval region short. Tail blunt, with last tail annules retracted, tail generally slightly turned dorsad, tail annules not fused.

Males. Not observed.

Differential diagnosis. The species is unique in that in fresh and heat-killed females and juveniles the last 2 tail annules are fully retracted within the contour of the body, giving these stages a short postvulval area and rounded posterior end, in the female generally directed somewhat dorsad. In the New Zealand population the spermatheca is empty, but elsewhere populations have been reported with sperm present (Yeates *et al.* 1997). The generally short body size and characteristic tail in combination with a flexible 1st lip annule, more than 86 body annules, no lateral line on the postvulval region, a non-overlapping anterior vulval lip, and a 45–65 µm long stylet with a shaft less than 11 µm long and a base less than 11 µm wide, easily distinguish the species from the other species in the subgenus.

Type material examined. None.

Material examined. 79 females from citrus orchard, 66 Park Rd, Greenmeadows, Hastings, HB (NNCNZ).

Distribution (Map 12). *Criconema* (*N.*) *mutabile* has only been reported from citrus. The population studied was from a citrus orchard in Hastings. The Ministry of Agriculture and Forestry Plant Protection Centre had further collections of *C.* (*N.*) *mutabile* obtained in surveys of nematodes on lemon, grapefruit, mandarin, and sweet orange (Knight et al. 1997). *Criconema* (*N.*) *mutabile* is not known from native habitats and is considered an introduced species.

HB / – .

Remarks. Typical for this species is the *Nothocriconemella*-type head, fine transverse striae, straight vagina and dorsally curved tail with retracted last 2 annules. Further details of this species or its synonyms can be found in a wide variety of papers in the literature (Taylor 1936, Raski 1952, Andrássy 1963, Edward & Misra 1964, Khan 1964, Raski & Golden 1966, Van den Berg 1984, Yeates *et al.* 1997).

Criconema (***Nothocriconemella***) ***californicum*** Diab & Jenkins, 1966

Criconemoides californicus Diab & Jenkins, 1966; *Nothocriconemella californica* (Diab & Jenkins, 1966) Siddiqi, 1986

Fig. 21d–g; 22f, g

Measurements: Table 5.

Morphology. **Females**. Body curved gently ventrad. Lateral line lacking. Head with 2 lip annules. Oral plate elongate, surrounded by 6 pseudolips of approximately equal size. Stylet straight, 55–74 µm long, stylet base well developed. Anterior vulval lip overlapping posterior lip, spermatheca with sperm. Tail conically pointed, tail annules not fused.

Males. Not observed.

Differential diagnosis. *Criconema* (*N.*) *californicum* closely resembles *C.* (*N.*) *mutabile* in the configuration of the head, dimensions of stylet, shaft of stylet and stylet base, number of body annules more than 86, absence of lateral line on postvulval region, and tail annules not fused. *Criconema* (*N.*) *californicum* differs from *C.* (*N.*) *mutabile* in the overlapping anterior vulval lip (v. not overlapping) the conically pointed tail (v. blunt) and the presence of males (v. generally absent), as is apparent from the presence of sperm in the spermatheca.

Type material examined. None

Material examined. 1332 females and 3 juveniles from towai (*Weinmannia sylvicola*), Tutamoe, Northland, ND; kanuka (*Kunzea ericoides*), Dingle Dell, Kohimarama, Auckland, AK; native forest, Pareheru Scenic Reserve, Waimangu and *Cassinia vulvida*, Kaiangaroa Forest, both Rotorua, BP; regenerating native forest, Hinemaiaia Scenic Reserve, TO; black beech (*Nothofagus solandri*) forest, Waikare Stream, Tongariro National Park, TO; rimu (*Dacrydium cupressinum*) forest, Makatote River bank, Tongariro National Park, TO; native forest, Mangaehuehu Scenic Reserve, Ohakune, TO; seral broadleaf native forest, Experimental Station Taita, Hutt Valley, WN; manuka (*Leptospermum scoparium*), Governors Bay Havelock, SD; kahikatea (*Podocarpus dacrydioides*), black beech (*Nothofagus solandri*) and, cabbage tree (*Cordyline* sp.) in native vegetation, Rai Valley at bridge to Okiwi Bay, SD; rimu (*Dacrydium cupressinum*), *Coprosma* sp., toru (*Toronia toru*), black beech (*Nothofagus solandri*), bush lawyer (*Rubus cissoides*), Brooklyn Domain, NN; black beech (*Nothofagus solandri*) and mountain neinei (*Dracophyllum traversii*), Mt Domett, NN; cabbage tree (*Cordyline* sp.) and swamp, Melrose Bush, NN; *Celmisia sessiliflora* and *Celmisia spectabilis* in native vegetation, 1640 m on Mt Arthur, NN; New Zealand flax (*Phormium tenax*) and rimu (*Dacrydium cupressinum*), *Hebe* sp., totara (*Podocarpus totara*), titoki (*Alectryon excelsum*), EvesValley, NN; *Coprosma* sp., Spooners Range, NN; totara (*Podocarpus totara*) in native vegetation, Wairoa River, NN; marbleleaf (*Carpodetus serratus*) and *Pennantia* sp., Lee Valley, NN; pigeonwood (*Hedycarya arborea*) in native vegetation, 3 km south of Waimangaroa, NN; ricegrass (*Microlaena stipoides*), tree fern, 8 km on Nelson side of Lyell, BR; rimu (*Dacrydium cupressinum*) and rata (*Metrosideros robusta*) in mixed native forest, Mawhera State Forest, BR; *Elaecarpus hookerainus* and red beech (*Nothofagus fusca*), West Inangahua State Forest, BR; mixed native vegetation, Kumara Junction, WD; *Coprosma* sp. in native vegetation, Ross, WD; fivefinger (*Pseudopanax arboreus*) in native vegetation, bank of Haast River, WD; *Hymenanthera* sp. in mixed native forest, Redwood Pass Road Blenheim, MB; rimu (*Dacrydium cupressinum*), *Coprosma linarifolia* and *Aristotelia* sp., Rai Cemetery, Marlborough, MB; *Gunnera* sp. and *Pentachondra* sp., Porters Pass, MC; *Nothofagus* forest, Kowai Bush, Springfield, MC; native vegetation, 10 km from Lake Lyndon, MC; native vegetation, 2 km east of Queenstown, OL; mahoe (*Melicytus ramiflorus*), pigeonwood (*Hedycarya arborea*), *Schefflera digitata*, *Asplenium bulbiferum* and *Polystichum vestitum*, alt. 60 m Breaksea Island, FD; manuka (*Leptospermum scoparium*), Winton, SL; kowhai (*Sophora microphylla*) in native vegetation, Catlins State Forest Park, Progress Valley, SL; tree fuchsia (*Fuchsia excorticata*) and *Hebe* sp., Bluff, SL; rimu (*Dacrydium cupressinum*) and kowhai (*Sophora microphylla*) in native vegetation, Omaui, SL; mixed native vegetation, 20 km east of Tisbury, Southland, SL; *Dracophyllum scoparium* and *Coprosma ciliata*, Tucker Valley, CA; *Pleurophyllum criniferum* and sedge, Beeman Saddle slope, CA; Knight (2001) reports it from feijoa (*Feijoa sellowiana*), Auckland, Taranaki, and Wanganui (NNCNZ).

Distribution (Map 13). *Criconema* (*N.*) *californicum* seems the most commonly occurring Criconematina species of New Zealand. It is present at all latitudes from Tutamoe in the north to Bluff in the south and on Campbell Island. It can be found at all altitudes that allow plant grow. It has only been found associated with native vegetation and is clearly an endemic species. The lack of collections from the east and west of the North Island and the west of the South Island may be partly due to limited sampling in these areas and the higher incidence of cultivated land.

ND, AK, BP, TO, WN / SD, NN, BR, WD, MB, MC, OL, FD, SL / CA.

Remarks. *Criconema* (*N.*) *californicum* is very similar to *C.* (*N.*) *mutabile* and De Grisse (1967) synonymised it with that species, but Yeates *et al.* (1997) recently reestablished *C.* (*N.*) *californicum* as a valid species. *Criconema* (*N.*) *californicum* is also very similar to *C.* (*N.*) *pasticum*, the next species discussed. According to the original descriptions, the only difference between *C.* (*N.*) *californicum* and *C.* (*N.*) *pasticum* is the length of the stylet, 55–74 µm and 73–82 µm respectively. Comparison of *C.* (*N.*) *californicum* with the *C.* (*N.*) *pasticum* populations listed by Loof *et al.* (1997), revealed that, while the length of the stylet varied widely from 56–90 µm between otherwise identical populations, within populations the stylet length was remarkably stable, generally varying by less than 6 µm. This allowed populations to be subdivided according to stylet lengths of 56–59 µm, 60–65 µm, 65–74 µm (the majority), 75–83 µm, and 80–90 µm. Differences in the size of the stylet base, the outline of the body annules and the shape of the tail were observed between some populations, and occasionally a lateral groove was present, but these characters did not support any grouping. Future studies of these groups of populations may reveal characters that allow a grouping. In the meantime, however, the *status quo* is maintained, populations with a stylet shorter than 74 µm should be considered *C.* (*N.*) *californicum*, and those with a stylet of 74–90 µm, *C.* (*N.*) *pasticum* (Wouts 2000).

Criconema (*N.*) *californicum* females in populations from Lyell, Greymouth, and Haast on the West Coast of the South Island, Rai Valley, Nelson, and Campbell Island, have a lip region that more closely resembles that of *C.* (*N.*) *graminicola*. They are not *C.* (*N.*) *graminicola* because they lack the robust stylet and style base diagnostic for that species.

***Criconema* (*Nothocriconemella*) *pasticum* (Raski & Pinochet, 1976) Raski & Luc, 1985**

Nothocriconema pasticum Raski & Pinochet, 1976; *Nothocriconemella pastica* (Raski & Pinochet, 1976) Ebsary, 1981

Fig. 24a, b

Measurements: Table 5.

Morphology. **Females**. Body gently curved ventrad. Lateral line lacking. Head with 2 lip annules. Oral plate elongate, surrounded by 6 pseudolips of almost equal size, located on basal ring. Stylet straight, 74–90 µm long, stylet base well developed. Vulva closed, anterior vulval lip overlaps posterior lip. Tail conically pointed, tail annules not fused.

Males. Not observed.

Differential diagnosis. *Criconema* (*N.*) *pasticum* can be distinguished from *C.* (*N.*) *californicum* by its longer stylet of more than 73 (74–82) µm.

Type material examined. None.

Material examined. 339 females, 4 juveniles from kanuka (*Kunzea ericoides*), Dingle Dell, Auckland, AK; *Pentachondra* sp., *Gunnera* sp., and grassland, summit of Porters Pass, MC; native vegetation near Lake Lyndon, MC; *Hebe* sp. in native vegetation along state highway 6, Haast, opposite Albert Burn Valley, OL; coastal shrub land with *Dracophyllum longifolium, Olearia oporina, Hebe elliptica, Pimelea gnidia, Phormium tenax*, Breaksea Island, FD (NNCNZ).

Distribution (Map 14). *Criconema* (*N.*) *pasticum* has a limited distribution. It has been found in small numbers in 4 areas: a reserve in Auckland city, near Porters Pass, near Haast and in Fiordland.

AK / MC, OL, FD.

Remarks. Populations with the characteristics of *C.* (*N.*) *pasticum* and *C.* (*N.*) *californicum* are common in New Zealand. In these populations the length of the stylet varies from 56–90 µm. With no other characters available to distinguish populations with a short stylet from populations with a longer stylet, all populations could be considered a single species, but as discussed under *C.* (*N.*) *californicum*, populations with an average stylet length of 74–90 µm are here considered *C.* (*N.*) *pasticum*.

***Criconema* (*Nothocriconemella*) *alpinum* Loof, Wouts & Yeates, 1997**

Criconema alpinum Loof, Wouts & Yeates, 1997; *Nothocriconemella alpina* (Loof, Wouts & Yeates, 1997) Siddiqi, 2000.

Fig. 23b–g; 24c, d

Measurements: Table 5.

Morphology. **Females**. Body gently curved ventrad. Lateral line lacking. Lip region with 2 annules. Oral plate elongate, surrounded by 6 pseudolips of almost equal size, located on basal ring. Stylet straight, 83–99 µm long, stylet base well developed. Vulva closed, anterior vulval lip overlaps posterior lip. Tail conically pointed, tail annules not fused, last tail annules somewhat retracted forming a blunt tail.

Males. Not observed.

Differential diagnosis. *Criconema* (*Nothocriconemella*) *alpinum* is most closely related to *C.* (*N.*) *pasticum*. It can be distinguished from this species by its longer oesophagus, stylet, and shaft of the stylet (av. 126, 90, and 12.3 µm in *C.* (*N.*) *alpinum* v. 116, 78, and 9.3 µm in *C.* (*N.*) *pasticum*), and the heavier stylet base (av. 9.5 v. 8.0 µm). In individual specimens these characters may overlap. Such specimens can be distinguished from *C.* (*N.*) *pasticum* by the lower number of body annules (83–91 v. 101–109) and a generally less pointed terminus of the female tail.

Type material examined. 4 female paratypes, alpine vegetation with *Poa caespitose* and *Celmisia longifolia*, Mt Kosciusko, Australia, coll. T. G. Wood, August, 1968 (NNCNZ).

Other material examined. 395 females, 1 juvenile from *Pentachondra pumila*, Makahu Spur, Kaweka Range, HB; manuka (*Leptospermum scoparium*), Governors Bay, Havelock, SD; black beech (*Nothofagus solandri*) and bush lawyer (*Rubus cissoides*), Kaiteriteri, NN; *Olearia colensoi*, Mt Domett, NN; *Celmisia spectabilis* and *C. laricifolia*, Mt Arthur/Mt Lodestone, NN; rimu (*Dacrydium cupressinum*), Eves Valley, NN; *Hebe* sp., Haast, opposite Albert Burn Valley, WD; *Cassinia leptofylla* in mixed native forest, Redwood Pass Road, Blenheim, MB; *Dracophyllum* sp., Porters Pass, MC; *Hebe* sp., Lake Wanaka, OL; native vegetation, Winton, SL; *Hebe* sp., Bluff, SL; *Coprosma pumula*, *Hebe elliptica*, Beeman Saddle, CA (NNCNZ).

Distribution (Map 15). *Criconema* (*Nothocriconemella*) *alpinum* has been found at a single site in the North Island but is widely distributed in the South Island where it has been collected from about all regions, usually in moderate to low numbers in restricted areas. It is also present on Campbell Island. That it has not been found on Stewart Island is probably due to the limited sampling done there combined with the generally restricted local distribution of the species.

HB / SD, NN, WD, MB, MC, OL, SL / CA.

Remarks. *Criconema* (*Nothocriconemella*) *alpinum* was originally described from females collected from Mt Kosciusko, Australia. New Zealand populations identified as *C.* (*N.*) *alpinum* conform very well with this description, but the females generally are more extended, especially in the postvulval region, resulting in a greater length of the body, a relatively more anterior position of the vulva, an almost pointed or completely pointed tail, a lower ST%L value, and greater value for the de Man ratios a and b.

Criconema (*Nothocriconemella*) *graminicola* Loof, Wouts & Yeates, 1997

Nothocriconemella graminicola (Loof, Wouts & Yeates, 1997) Siddiqi, 2000.

Fig. 22c, d; 25a, b; 26

Measurements: Table 5.

Morphology. **Females**. Body gently curved ventrad. Lateral line lacking. Lip region low, wide, with 2 annules, 1st annule directed sideways or anteriorly, 2nd annule distinctly retrorse. Oral plate elongate, surrounded by 6 pseudolips of almost equal size. Stylet robust, straight, 62–81 µm long, stylet base large relative to stylet length, >10 µm wide. Vulva closed, anterior vulval lip overlapping posterior lip. Tail conically pointed, annules not fused.

Males. Not observed.

Diagnosis. The range of the stylet length of *C.* (*N.*) *graminicola* overlaps the ranges of the stylet lengths of *C.* (*N.*) *californicum* and *C.* (*N.*) *pasticum*. *Criconema* (*N.*) *graminicola* can be distinguished from these 2 species by the lower number of body annules (R = 73–86 v. 86–111) (Yeates *et al.* 1997). It shares this character with *C.* (*N.*) *justum* (Eroshenko, 1982) Siddiqi, 1986, a species not known to be present in New Zealand, from which it can be distinguished by the greater number of annules on the postvulval region (>11 v. <6). An easy supporting character for the identification of *C.* (*N.*) *graminicola* is the robust stylet and the stylet base of over 10 µm width, which is heavy relative to the stylet length, a similar width in other species of the subgenus usually accompanies a stylet more than 90 µm long. Also, the rather flat, wide lip region with sideways or anteriorly directed 1st lip annule and distinctly retrorse 2nd lip annule distinguish *C.* (*N.*) *graminicola* from its closest relatives, *C.* (*N.*) *californicum* and *C.* (*N.*) *pasticum*. *Criconema* (*N.*) *graminicola* shares these characters with *C.* (*N.*) *acuticaudatum*, the next species described, from which it can be distinguished by having less than 87 body annules (v. more than 87), the less extended postvulval annules and the shorter postvulval region (PV <61 v. >61).

Type material examined. Holotype and 5 female paratypes, tussock (*Chionochloa rigida* and *C. macra*), Carrick, FD, coll. G. W. Yeates, November 1971 (NNCNZ).

Other material examined. 270 females, 5 juveniles from tussock grassland (*Chionochloa rubra*), Papamanuka Stream, Tongariro National Park, TO; tussock (*Chionochloa rigida*), Tawhiti, Taranaki, TK; tussock (*Chionochloa pallens*, *C. flavescens*), putaputaweta (*Carpodetus serratum*) and *Olearia colensoi*, Mt Pukemoremore, Tararua Range, WN; *Olearia colensoi*, Mt Dundas, Tararua Range, WN; mountain neinei (*Dracophyllum traversii*), *Dacrydium bidwillii* and *Olearia colensoi*, Mt Domett, NN; *Kelleria dieffenbachii* and *Celmisia sessiliflora* in mixed vegetation, Mt Arthur, NN; *Celmisia laricifolia* in mixed native vegetation, Mt Lodestone, NN; tussock grassland (*Chionochloa* sp.), Red Hill (1130 m), Nelson, NN; native vegetation, Kumara Junction, WD; tussock (*Chionochloa rubra*), Harihari, WD; native vegetation, 6 km past bridge, Haast, WD; *Coprosma linariifolia*, Rai Valley Cemetery, MB; *Carmichaelia* sp. and *Gunnera* sp., in native vegetation, Porters Pass region, MC; mixed native vegetation, summit Burke Pass (890 m), MK; *Chionochloa pallens*, Tutoko Bench, Fiordland, FD; *Hebe* sp., Bluff Lookout, Bluff, SL (NNCNZ).

Distribution (Map 16). *Criconema* (*N.*) *graminicola* probably lives on tussock (*Chionochloa* spp.). It has been reported from many other native plant species, but always from sites where tussock may have been part of the local vegetation. In many samples tussock may not have been recorded at the time of collecting because of its general presence at the collection site. Tussock as a monoculture is predominantly present at higher altitudes. *Criconema* (*N.*) *graminicola* probably occurs in all higher, cooler areas except the subantarctic islands where *C.* (*N.*) *graminicola* seems to has evolved into *C.* (*N.*) *acuticaudatum*, a species with generally slightly greater dimensions, described by Loof *et al*. (1997).

TO, TK, WN / NN, WD, MC, AK, FD, SL.

***Criconema* (*Nothocriconemella*) *acuticaudatum* Loof, Wouts & Yeates, 1997**

Nothocriconemella acuticaudata (Loof, Wouts & Yeates, 1997) Siddiqi, 2000

Fig. 20f,g; 22e; 25c, d

Measurements: Table 5.

Morphology. **Females**. Body gently curved ventrad. Lateral line lacking. Lip region low, wide, with 2 annules, 1st annule directed sideways or anteriorly, 2nd annule distinctly retrorse. Oral plate elongate, surrounded by 6 pseudolips of almost equal size. Stylet robust, straight, 72–78 µm long, stylet base large relative to stylet length, >10 µm wide. Vulva closed, anterior vulval lip overlapping posterior lip. Tail conically pointed, annules not fused.

Males. Not observed.

Differential diagnosis. In general appearance, *Criconema* (*N.*) *acuticaudatum* looks identical to *C.* (*N.*) *graminicola*. Their stylet size is moderate, the stylet base heavy, the lip region flat and wide and a lateral line is lacking, and the tail sharp. They also share a subalpine habitat and tussock host (*Chionochloa* sp.).

Criconema (*N.*) *acuticaudatum* can be distinguished from *C.* (*N.*) *graminicola* by the greater number of body annules (R >86) and the more extended postvulval annules (PV >61). Also the 1st lip annule of *C.* (*N.*) *acuticaudatum* is not as distinctly anteriorly directed as in *C.* (*N.*) *graminicola,* and the resulting lip region, in side view, is less surrounded by the lip and appears higher. *Criconema* (*N.*) *acuticaudatum* has so far been obtained only from Campbell Island and the Auckland Islands. *Criconema* (*N.*) *acuticaudatum* differs from *C.* (*N.*) *californicum* and *C.* (*N.*) *pasticum* by the wider, lower lip region, the robust stylet base more than 11 µm wide, the sharp and longer postvulval area (62–78 v. 33–62 µm), the extended, not fused tail annules, the more anterior position of the vulva, and the sharper tail terminus.

Type material examined. Female holotype and 9 female paratypes, tussock (*Chionochloa* sp.), Beeman Hill, Campbell Island, coll. I. B. Campbell, February 1976 (NNCNZ).

Other material examined. 47 females from native vegetation, Mt Raynal, Auckland Islands; tussock (*Chionochloa antarctica*), small island off Ramp Point and on Beeman Hill; *Bulbinella* sp., Col Ridge; and *Hebe elliptica*, Beeman Point, Perseverance Harbour, Campbell Island, CA (NNCNZ).

Distribution (Map 17). *Criconema* (*N.*) *acuticaudatum* has been found only on Campbell Island and the Auckland Islands.

– / – / AU, CA.

***Criconema* (*Nothocriconemella*) *sphagni* Micoletzky, 1925**

Criconemoides sphagni (Micoletzky, 1925) Taylor, 1936; *Nothocriconema sphagni* (Micoletzky, 1925) De Grisse & Loof, 1965; *Nothocriconemella sphagni* (Micoletzky, 1925) Ebsary, 1981

Criconema grassator (Adams & Lapp, 1967) Siddiqi, 1986; *Criconemoides grassator* Adams & Lapp, 1967; *Nothocriconema grassator* (Adams & Lapp, 1967) De Grisse, 1967; *Nothocriconemella grassator* (Adams & Lapp, 1967) Ebsary, 1981.

Fig. 27a, b; 28h; 29a, b

Measurements: Table 5.

Morphology. **Females**. Body gently curved ventrad. Lateral lines lacking. Lip region generally with 2 annules, rarely 3, 1st lip annule generally directed anteriorly, 2nd annule directed laterally or retrorse. Oral plate elongate, surrounded by 6 pseudolips of almost equal size, subdorsal and subventral lips somewhat elevated, in lateral view slightly project from the lip region, but not located on a basal ring. Stylet flexible, stylet base well developed. Vulva closed. Anterior vulval lip overlapping posterior lip. Postvulval region conical, generally tapering regularly initially but more progressively posterior to anus, especially ventrally, making ventral outline convex, sometimes accentuated by slight dorsal upturn of the tail terminus, tail annules generally not extended, not fused.

Males. Not observed.

Differential diagnosis. *Criconema* (*N.*) *sphagni* is one of the longer species of the subgenus, reaching 0.6 mm in some specimens. The lip region resembles that of *C.* (*N.*) *mutabile*, consisting of an elongated lip cap surrounded by 6 pseudolips that are not located on a basal ring. *Criconema* (*N.*) *sphagni* differs from *C.* (*N.*) *mutabile, C.* (*N.*) *californicum, C.* (*N.*) *pasticum, C.* (*N.*) *alpinum, C.* (*N.*) *graminicola,* and *C.* (*N.*) *acuticaudatum* by its flexible and long stylet of >102 µm and large stylet base (9–11 µm wide) and long shaft (11–14 µm). In general morphology *C.* (*N.*) *sphagni* closely resembles *C.* (*N.*) *macilentum*, the next species described. It differs from *C.* (*N.*) *macilentum* in the morphology of the lip region and the shape of the tail.

Type material examined. None.

Material examined. 197 females and 3 juveniles from *Cassinia* sp., *Juncus* sp., and *Hebe* sp., Duncan Bay, Tennyson Inlet, SD; *Dacrydium bidwillii*, Mt Domett, NN; *Gaultheria* sp. and *Astelia* sp., Mt Lodestone, NN; whiteywood (*Melicytus ramiflorus*), Lee Valley, NN; *Carmichaelia* sp. and *Cassinia* sp., Nth side White Bluffs, Blenheim, MB (NNCNZ).

Distribution (Map 18). *Criconema* (*N.*) *sphagni* is distributed worldwide. In New Zealand it has been found only in the South Island, primarily in the northern regions but also in Fiordland. It was originally described from sphagnum moss and this is probably its real host. Because of the general distribution of this host throughout New Zealand, *Criconema* (*N.*) *sphagni* may be expected to have a much wider distribution than is presently indicated.

– / SD, NN, MB.

Remarks. A *Criconema* (*Nothocriconemella*) population from Lee Valley, Nelson, closely resembles *C.* (*N.*) *sphagni* in the general configuration of the lip region, and the flexible stylet. The morphometrics of 10 specimens of this population are presented separately in Table 5. Comparison of these figures with those presented for *C.* (*N.*) *sphagni* (from Blenheim, Table 5) shows that it differs in some major characteristics. The total length, stylet, and oesophagus are shorter (410, <102, and <145 v. 450, >103, and >145 µm), the secretory–excretory pore is closer to the anterior end (Rex <35 v. >35), and the body has fewer annules (R <107 v. R >107). These characteristics place this population intermediate between *C.* (*N.*) *sphagni* and *C.* (*N.*) *alpinum.* It also shares with this species the tendency of the last tail annule to be not fully extended, giving the tail tip a somewhat blunt appearance. This population may represent a new species, but because of the low lip region and the characteristic flexible stylet it is here considered a short version of *C.* (*N.*) *sphagni*.

***Criconema* (*Nothocriconemella*) *macilentum* (Raski & Pinochet, 1976) Raski & Luc, 1985**

Nothocriconema macilentum Raski & Pinochet, 1976; *Nothocriconemella macilenta* (Raski & Pinochet, 1976) Ebsary, 1981

Fig. 27c–f; 28a–g; 29c, d

Measurements: Table 5.

M**orphology**. **Females**. Body gently curved ventrad. Lateral lines lacking. Lip region high, with 2 annules, both generally directed laterally or retrorse. Oral plate elongate, surrounded by 6 pseudolips of almost equal size located on a basal ring. Stylet flexible, stylet base well developed. Vulva closed. Anterior vulval lip overlapping posterior lip. Postvulval region conical, generally tapering regularly to sharp terminus. Annules of tail region generally extended, not fused.

Males. Not observed.

Differential diagnosis. *Criconema* (*N.*) *macilentum* most closely resembles *C.* (*N.*) *sphagni*. They differ in that in the females of *C.* (*N.*) *macilentum* the stylet base is heavier, the pseudolips are located on a basal ring and the annules posterior to the vulva are more or less fully extended without being fused. The higher lip region is accentuated by the 1st lip annule being retrorse in most specimens. The fully extended annules on the posterior part of the body cause the last 4 or 5 tail annules to protrude less than the body annules, and the tail generally to look distinctly more drawn out than in *C.* (*N.*) *sphagni.* In some specimens, a slight lateral indentation in the postvulval region is present, with the 3rd or 4th annule from the terminus at times showing a deeper groove, but there is no general lateral line in the postvulval region. The tail annules of the juvenile are more extended than in the female and the tail more drawn out.

Type material examined. 3 female paratypes, collected 31 July 1963, Campbell Island, held at the University of California, Davis, USA (NNCNZ).

Other material examined. 178 females, 2 males, 7 juveniles from tussock (*Chionochloa flavescens*), Mt Dundas, Tararua Range, WN; native vegetation, Fox Glacier, WD; native vegetation Mt Raynal, Auckland Islands, AU; *Bulbinella* sp., South side top of small island off Ramp Point, Campbell Island, CA (NNCNZ).

Distribution (Map 19). *Criconema* (*N.*) *macilentum* has so far been found predominantly at high altitude on Mt Dundas, Tararua Range and in the cold climates of the subantarctic on Campbell Island and Auckland Islands. A single population found at sea level at Fox Glacier in the South Island is the only exception.

WN / WD / AU, CA.

Remarks. The females from Fox Glacier are long and have *ca* 120 body annules, the same as reported for the type material of *C.* (*N.*) *macilentum* collected on Campbell Island. The females from Auckland Island are shorter and the number of body annules is lower, but as they fall within the range of 4 specimens from the type locality, present in NNCNZ, they are also recognised as *C.* (*N.*) *macilentum*. These specimens are in excellent condition and their measurements are presented in table 5. They are distinct from *C.* (*N.*) *sphagni* because of the drawn out tail terminus and the higher lip region.

Criconema* (*Nothocriconemella*) *crosbyi Wouts, 2000

Fig. 28i, j; 30a, b; 31a, b

Measurements: Table 5.

Morphology. **Females**. Body gently curved ventrad, gradually tapering anteriorly and posteriorly. Lateral lines or lateral field lacking. Lip region wide, compact, with 2 annules of almost equal size, giving lip region somewhat cylindrical appearance. 1st lip annule retrorse or directed sideways, 2nd lip annule retrorse. Oral plate oval, not protruding, surrounded by 6 pseudolips of about equal size, located on basal ring. Stylet straight, apparently rigid, stylet base well developed. Vulva closed. Anterior vulval lip overlapping posterior lip. Spermatheca filled with small sperm. Anus distinct. Tail annules extended, fused, forming digitate tail terminus.

Males. Not observed.

Differential diagnosis. *Criconema* (*Nothocriconemella*) *crosbyi* can be distinguished from all other species of the subgenus in that the last 4–6 tail annules are extended, cylindrical, and fused to form narrow, digital terminus set off from rest of the tail.

Type material examined. Holotype and 113 female paratypes, *Bulbinella* sp. South side top of small island off Ramp Point, Campbell Island, coll. T. K. Crosby, 4 December 1975 (NNCNZ).

Other material examined. None.

Distribution (Map 20). *Criconema* (*Nothocriconemella*) *crosbyi* has been collected only from the type locality.

– / – / CA.

Criconema* (*Nothocriconemella*) *farrelli Wouts, 2000

Fig. 29h; 30c, d; 32a–d

Measurements: Table 5.

Morphology. **Females**. Body gently curved ventrad, lateral line lacking, posterior edge of annules in lateral region with faint undulations in most specimens. Cephalic region with 2 annules. Oral plate elongate, surrounded by 2 lateral and 4 distinct submedian pseudolips resting on hexagonal base-ring that rests on 1st lip annule. 1st lip annule vaguely crenate, generally retrorse, but may be directed outward or somewhat forward. 2nd lip annule retrorse. Stylet straight and flexible, stylet base narrow, delicate compared to length of stylet. Excretory pore obscure. Vulva closed, anterior vulval lip overlapping posterior lip. Spermatheca filled with small sperm. Anus distinct. Postvulval region tapering gradually to conically pointed tail. Tail gently turned dorsad in most specimens, tail annules not fused, last 2 or 3 tail annules generally less far extended than annules on rest of body, not set off from rest of tail.

Males. Not observed.

Differential diagnosis. *Criconema* (*N.*) *farrelli* closely resembles *C.* (*N.*) *alpinum*, *C.* (*N.*) *sphagni*, *C.* (*N.*) *macilentum, C.* (*N.*) *ramsayi,* and *C.* (*N.*) *dugdalei. Criconema* (*N.*) *farrelli* can be distinguished from these species by the narrow stylet base of less than 9 µm wide and from most of these species by the more than 0.50 mm long body. It can also be distinguished from *C.* (*N.*) *alpinum* by the greater number of annules on the body (R= 110–124 v. 83–91) and the postvulval region (RV = 15–19 v. 10–13), from *C.* (*N.*) *sphagni* by the shorter stylet (<102 v. >102 µm), high lip cap and prominent median lobes, from *C.* (*N.*) *macilentum* by the less extended tail terminus, from *C.* (*N.*) *ramsayi* by the more drawn out tail, the absence of a lateral groove on the tail, and the lower RV value (15–19 v. 18–22), and from *C.* (*N.*) *dugdalei* by the shorter stylet (<100 v. >135 µm).

Type material examined. Female holotype and 54 female paratypes, native vegetation, Mt D'Urville, Auckland Island, AU, coll. J. A. K. Farrell, 4 January 1963 (NNCNZ).

Other material examined. None.

Distribution (Map 21). *Criconema* (*N.*) *farrelli* has so far only been found on native vegetation, on the Auckland Islands.

– / – / AU.

Criconema* (*Nothocriconemella*) *ramsayi Wouts, 2000

Fig. 31c–f; 32e–h; 33a,b

Measurements: Table 5.

Morphology. **Females**. Body gently curved ventrad. Lateral line of lateral field distinctly present on annules posterior to vulva, gradually disappearing anterior to vulva. Cephalic region with 2 annules. 1st annule generally directed slightly anteriad or sideways, rarely retrorse. 2nd annule retrorse, occasionally directed sideways or anteriorly. Oral plate almost circular, surrounded by ring covering 6 distinct almost equal pseudolips that rest on 1st lip annule. Stylet straight, probably rigid, stylet base well developed. Vulva closed, anterior vulval lip overlapping posterior lip. Postvulval region tapering gradually, more acutely posterior to anus giving both dorsal and ventral side of tail convex appearance. Spermatheca filled with small sperm. Anus distinct. Last 2 or 3 tail annules generally partially extended as on rest of body, often irregularly divided, not set off from rest of tail. Tail terminus conically pointed, generally not turned dorsad.

Males. Not observed.

Differential diagnosis. *Criconema* (*N.*) *ramsayi* resembles the *Nothocriconemella* species with an average stylet length of about 100 µm. It can be distinguished from them by the distinct lateral groove present posterior to the level of the vulva and the greater number of annules on the postvulval region (about 20 v. about 16–18). It can be further distinguished from *C.* (*N.*) *sphagni* and *C.* (*N.*) *macilentum*, its closest relatives, by the shorter stylet (about 100 v. about 115 µm) and the less drawn out tail terminus and from *C.* (*N.*) *sphagni* by the high lip cap. It can be distinguished from *C.* (*N.*) *farrelli* by the heavier stylet base (9–11 v. 7–9 µm wide) and the less drawn out tail terminus, from *C.* (*N.*) *crosbyi* by the absence of fused tail annules and from *C. dugdalei* by the shorter stylet (about 100 v. >135 µm).

Type material examined. Female holotype and 110 female paratypes, lancewood (*Pseudopanax crassifolius*), Kumara Junction, WD, coll. W. M. Wouts, 16 October 1971 (NNCNZ).

Other material examined. None.

Distribution (Map 22). *Criconema* (*N.*) *ramsayi* has so far been found only at the type locality.

– / WD.

Criconema (*Nothocriconemella*) *dugdalei* Wouts, 2000

Fig. 29e–g; 32i–l; 33c–j

Measurements: Table 5.

Morphology. **Females**. Body gently curved ventrad. Lateral lines or lateral field not observed. Faint lateral notches on some tail annules present in some specimens. Cephalic region with 2 annules. Both annules retrorse, continuous with body annules. Oral plate oval. 4 distinct submedian pseudolips of almost same size as lateral pseudolips, consisting of 2 layers, giving raised appearance, resting on 1st lip annule. Stylet flexible, stylet base wide and heavy. Spermatheca filled with small sperm. Vulva closed. Anterior vulval lip overlapping posterior lip. Body abruptly narrowing immediately posterior to vulva. Annules posterior to vulva not extending progressively. Anus distinct. Last 4–6 tail annules partially extended like rest of tail annules, rarely fully extended, not set off from rest of tail, somewhat irregular in appearance in most specimens. Tail terminus conically pointed, turned slightly dorsad in most specimens.

Males. Not observed

Differential diagnosis. *Criconema* (*N.*) *dugdalei* most closely resembles *C.* (*N.*) *sphagni* and *C.* (*N.*) *macilentum.* It can be distinguished from *C.* (*N.*) *sphagni* and *C.* (*N.*) *macilentum* by the longer stylet (>135 v. <135 µm) and heavier stylet base (>11 v. <11 µm wide). It can further be distinguished from *C.* (*N.*) *sphagni* by the high lip cap and prominent, raised pseudolips, and from *C.* (*N.*) *macilentum* by the plumper body and the less drawn out, dorsally curved tail terminus. *Criconema* (*N.*) *dugdalei* females are generally characterised by a body somewhat wider than in most other members of the subgenus.

Type material examined. Female holotype and 35 female paratypes from *Olearia colensoi* from the type locality Mt Domett NN, coll. J. S. Dugdale, 2 December 1971 (NNCNZ).

Other material examined. 122 females and 14 juveniles, *Olearia colensoi* Dundas Hut Spur, Tararua Range, WN, col. G. W. Ramsay; *Olearia lyallii*, Penguin Creek, The Snares, coll. D. S. Horning jr. (NNCNZ).

Distribution (Map 23). *Criconema* (*N.*) *dugdalei* is probably restricted to higher altitude and cooler climates.

WN / NN / SN.

Remarks. *Criconema* (*N.*) *dugdalei* has been found only in association with *Olearia* species of the *colensoi* group. The population from the South Island has longer specimens with longer stylets than the other populations. As body and stylet lengths vary considerably within the species of the genus generally, these differences are considered population variations.

GENUS *Ogma* Southern, 1914

Croserinema Khan, Chawla & Saha, 1976
Crossonema Ebsary, 1981
Neocrossonema Ebsary, 1981
Pateracephalanema Mehta & Raski, 1971
Pseudocriconema Minagawa, 1984
Seriespinula Mehta & Raski 1976
Variasquamata Mehta & Raski, 1971.

Criconematinae. **Females**. Ornamentation on body annules in continuous fringe or organised in longitudinal rows. Ornamentation consists of scales or spines which may be smooth or carrying fringe of spines of wide variety of forms and shapes. Cephalic region with 2 differentiated annules distinctly set off from rest of body. Anterior annule generally of greater diameter than posterior annule. Outer edge of lip annules may be smooth, lobed, crenate, or with a continuous fringe of rounded spines. Vulva closed, lips conical. Tail annules may be contracted, forming blunt tail or may be extended or fused forming subconical or sharp tail. The 4th stage juvenile has spines or scales in longitudinal rows.

Type species *Ogma murrayi* Southern, 1914

=*Criconema murrayi* (Southern, 1914) Taylor, 1936; *Hoplolaimus murrayi* (Southern, 1914) Menzel, 1916; *Iota murrayi* (Southern, 1914) Micoletzky, 1925; *Variasquamata murrayi* (Southern, 1914) Khan, Chawla & Saha, 1976

Nominal species present in New Zealand

Ogma alternum sp. nov.
O. campbelli Wouts, Yeates & Loof, 1999
O. capitulatum sp. nov.
O. catherinae sp. nov.
O. civellae (Steiner, 1949) Mehta & Raski, 1971
O. crenulatum Wouts, Yeates & Loof, 1999
O. inaequale sp. nov.
O. latens Mehta & Raski, 1971
O. mucronatum sp. nov.
O. niagarae sp. nov.
O. palmatum (Siddiqi & Southey, 1962) Siddiqi, 1986
O. paucispinatum Wouts, Yeates & Loof, 1999
O. polyandra Wouts, Yeates & Loof, 1999
O. semicrenatum Wouts, Yeates & Loof, 1999
O. sexcostatum Wouts, Yeates & Loof, 1999
O. sturhani sp. nov.
O. subantarcticum Wouts, Yeates & Loof, 1999

Key to the females of the species of the genera *Ogma*, *Pateracephalanema,* and *Syro* present in New Zealand

1 Number of cephalic annules 1 .... *Pateracephalanema, Syro* 2

— Number of cephalic annules 2 .... *Ogma* 4

2(1) Number of scales 8, plate like, smooth ....(p. 65)... ***Pateracephalanema imbricatum***

— Number of scales >16, tongue-shaped, smooth, or with up to 3 digitate spines 3

3(2) Scales rugose or smooth .. ...(p. 64)... ***Syro glabellus***

— Scales with 2 or 3 short spines ....(p. 64)... ***Syro tribulosus***

4(1) Ornamentation on annules consisting of a continuous fringe of digitate spines, spines too numerous to recognise their orientation in longitudinal rows 5

— Ornamentation consisting of scales in longitudinal rows 6

5(4) Spines as long as or shorter than wide, never split at the tip ....(p. 62)... ***Ogma sturhani***

— Spines at least twice as long as wide and may be bi- or trifurcate ....(p. 52)... ***Ogma civellae***

6(4) Number of longitudinal rows of scales >12, not located on distinct ridges 7

— Number of longitudinal rows of scales 12 or less, usually located on distinct ridges 9

7(6) Scales with short digitate, blunt spines ....(p. 51)... ***Ogma catherinae***

— Scales smooth, tongue-shaped or square and somewhat indented 8

8(7) 1st lip annule funnel-shaped, both lip annules with fringe of digitate spines ....(p. 54).. ***Ogma latens***

— Both lip annules rounded, smooth ....(p. 50)... ***Ogma capitulatum***

9(6) Scales alternating in rows and on annules 10

— Scales continuous in rows and on annules 11

10(9) Spines on scales stubby, short and rounded and of even length ....(p. 57)... ***Ogma palmatum***

— Spines on scales conically pointed and varying in length ....(p. 49)... ***Ogma alternum***

11(9) 6 longitudinal rows of palmate scales 12

— More than 6 longitudinal rows of palmate scales ... 14

12(11) Digitate spines on scales extremely variable in length, varying in number from 2–20 ....(p. 53)... ***Ogma inaequale***

— Digitate spines on scales of comparable length and per individual fairly uniform in number 13

13(12) R <60 ....(p. 49)... ***Ogma campbelli***

— R >60 ....(p. 61)... ***Ogma sexcostatum***

14(11) Average length of stylet about 70 µm ....(p. 60)... ***Ogma semicrenatum***

— Average length of stylet > 70 µm 15

15(14) 8 longitudinal rows of scales, each scale with 7–10 spines ....(p. 59)... ***Ogma polyandra***

— 8–14 longitudinal rows of scales, scales with <7 spines 16

16(15) Lip annules without fringe of spines, possibly indistinctly crenate ....(p. 52)... ***Ogma crenulatum***

— Lip annules with fringe of spines or distinctly crenate 17

17(16) Spines on scales very finely pointed ....(p. 55)... ***Ogma mucronatum***

— Spines on scales blunt, not finely pointed 18

18(17) Number of spines per scale <4 19

— Number of spines per scale >4 ....(p. 63)... ***Ogma subantarcticum***

19(18) Scales <14 µm long...(p. 58)... ***Ogma paucispinatum***

— Scales >14 µm long ....(p. 56)... ***Ogma niagarae***

Ogma alternum sp. nov.

Fig. 36; 37a, b

Measurements: Table 7.

Morphology. **Females**. Body straight or almost straight, tapering anteriorly and posteriorly approximately from midbody. Lip region elevated. Oral aperture slit-like, surrounded by oval oral disc flattened laterally by amphidial apertures, surrounded by 6 regularly spaced pseudolips surrounded by 1st lip annule. 1st lip annule with fringe of about 50 short, rather thick, digitate spines directing laterally. 2nd lip annule crenate, diameter distinctly smaller than that of 1st annule. Body annules each with 4–6 palmate scales, which generally alternate with scales on adjacent annules but can be very irregular. Scales located on distinct ridges running from 2nd body annule to tail region. Scales on body annules variable, generally consisting of a semicircular solid base supporting a fringe of 4 (range 2–8) short, conically pointed, diverging appendages pointing posteriad. Base of scale and appendages of about equal length, reaching level of posterior edge of adjacent posterior annule. Short blunt spines occasionally present between scales. In postvulval region, especially ventrally, closer to tail terminus, base of scale growing longer while fringe becoming shorter with fewer appendages. Stylet rigid. Excretory pore and anus obscure. Vulva with 2 conically rounded lips protruding from the body slightly further than outer edge of adjacent annules. Vagina approximately 1/2 body diameter long, angled anteriad. Spermatheca offset, without sperm. Disregarding scales, body posterior to vulva narrowing gradually to conical tail. Tail terminus surrounded by scales of last body annules.

Males. Not observed.

4th stage juveniles. Cephalic region distinctly set off from rest of body, consisting of 2 annules with crenate outer edge directed laterally. Labial region with 6 pronounced pseudolips projecting from 1st lip ring. 2nd lip annule of about same diameter or slightly wider than 1st lip annule. Body annules with up to 10 scales organised in rows along length of body. Scales on anterior part of body consisting of swollen base with narrower swollen extension with blunt end. In some specimens swollen extensions of scales look like transparent cover over fine spines. Scales on posterior part of body deeply crenate, transforming into spines posteriorly. Tail conically pointed.

Type host and locality. Native vegetation, near Lake Lyndon, Porters Pass, MC, NZMS 260 K35/996622.

Type material. Holotype, 10 female, and 12 juvenile paratypes from the type locality, coll. D. Sturhan, November 2000. Holotype on slide 185, National Nematode Collection of New Zealand, Landcare Research, Auckland. For the distribution of the type material see Table 2 (p. 26).

Other material examined. 24 females and 2 juveniles, native vegetation, Makahu Spur, Napier, HB; 6 females and 10 juveniles, native vegetation, near Lake Lyndon, Porters Pass, MC (NNCNZ).

Differential diagnosis. *Ogma alternum* sp. nov. closely resembles *O. palmatum,* the only *Ogma* species described so far with rows of palmate scales alternating in position over consecutive body annules. *Ogma alternum* sp. nov. differs from *O. palmatum* in its shorter body (av. 370 v. 440 µm), stylet (av. 66 v. 85 µm) and oesophagus (av. 100 v. about 130 µm) and the longer palmate scales. Also the shape of the spines on the distal part of the scales is different in the 2 species. These spines are stubby, short, and rounded and generally of even length in *O. palmatum* whereas they are conical, of different length, and almost pointed in *O. alternum* sp. nov.. Although the structure of the scales of *O. palmatum* is variable (Jairajpuri 1963), these differences readily distinguish the 2 species. Chitambar (1992) reports an *O. palmatum* population from Darjeeling, W. Bengal, India with “small, single spines between palmate structures, irregular arrangement of palmate structures, and the presence of minute projections on individual spines”, all characters observed in *O. alternum* sp. nov. Unfortunately no morphometrics are presented for the Darjeeling population and its identity cannot be established with certainty.

Distribution (Map 24). *Ogma alternum* sp. nov. has a limited distribution. It has only been found at higher altitude in the Kaweka Range of the North Island and in the Porters Pass region of the South Island.

HB / MC.

Etymology. The name *Ogma alternum* is derived from the latin word *alternum* = alternate.

Ogma campbelli Wouts, Yeates & Loof, 1999

Fig. 38

Measurements: Table 7.

Morphology. **Females**. With general characters of *Ogma* species with palmate scales. Both cephalic annules with continuous fringe of about 50 digitate spines, anterior annule generally directing laterally or anteriorly, posterior annule of about same size as anterior one, generally directing posteriorly. Body annules each with 6 palmate scales located on 6 ridges, with 4 ridges generally running through to tail terminus. Scales consisting of solid base supporting fringe of up to 12 digitate parallel appendages. Appendages long, in contracted females easily overlapping base of scale of adjacent posterior annule. On ventral side of postvulval region, approaching tail terminus, base of scale grows longer while fringe becomes shorter with fewer appendages and total length of scale increases. Although the alignment of scales along this part of body remains in distinct rows, their lateral direction becomes very irregular and that makes them resemble a group of waving, twisted, serrated spatulas. Excretory pore distinct. Vulva with 2 conically rounded lips; vulval lips protruding from body somewhat further than base of scales of adjacent annules. Vagina approximately 1/2 body diameter long, angled anteriad. Spermatheca filled with sperm 2–3 µm in diameter. Body posterior to vulva, disregarding scales, narrowing gradually to conical tail. Tail terminus with modified scale as transparent extension. Anus obscure.

Males. Head truncate. Cuticle at base of head somewhat thicker and slightly widening, demarcating base of head. Hemizonid absent, secretory–excretory pore distinct, about 110 µm from anterior. Tail with finely pointed terminus.

Juveniles. Head annules with finely serrated edge directing outward. Body annules with 8 scales arranged in longitudinal ridges. Each scale consisting of semicircular, posteriorly directed base from edge of which about 10 irregular hairs, wider at base than at the tip, fan over groove between annules. Tail sharply pointed with transparent extension, probably formed from transformed scale.

Differential diagnosis. *Ogma campbelli* is characterised by 6 longitudinal ridges of palmate spines along the length of the body of the female, palmate spines that are longer on the postvulval region than on the rest of the body, a lip region in which both lip annules bear a fringe of unmodified spines, and a stylet that, on average, is about 75 µm long. *Ogma campbelli* most closely resembles *O. sexcostatum*, the other New Zealand *Ogma* species with 6 longitudinal rows of comb-like scales. It differs from *O. sexcostatum* in the greater body length (av. 0.49 v. 0.36 mm) and lower number of body annules (R = 50–57 v. 60–69) and resulting somewhat coarser body annulations, longer postvulval region (RV = 41–72 v. 23–42 µm) and, on the ventral side of the postvulval region, scales that are longer than on the rest of the body. *Ogma campbelli* also closely resembles *O. pectinatum* (Colbran, 1962) Siddiqi, 1986 and *O. pellitum* (Andrássy, 1979) Siddiqi, 1986. *Ogma campbelli* shares with these species the long, unmodified spines on the scales of the annules, giving the scales a comb-like appearance. It differs from these 2 species in that the scales are arranged along 6 longitudinal rows; the other species have 8 to 10 rows.

Type material examined. Holotype female, and 23 female and 2 male paratypes, from *Anisotome latifolia,* on a small island off Ramp Point, Campbell Island (NNCNZ).

Other material examined. None.

Distribution (Map 25). *Ogma campbelli* has only been found in the type locality on Campbell Island.

– / – / CA.

Ogma capitulatum sp. nov.

Fig. 37c, d; 39

Measurements: Table 7.

Morphology. **Females**. Body strongly curved ventrad, to open C, tapering anteriorly approximately from base of stylet and posteriorly from about one body width anterior to vulval region. Lip region not elevated. Oral plate slightly elevated. Oral opening a dorsoventral slit surrounded by rectangular oral plate with slit-shaped amphidial aperture on either side, surrounded by 1st lip ring. Pseudolips seem to be lacking. Lip ring with 6 lobes, lateral lobes slightly larger than others, outer edge smooth, directing laterally. Lobes could represent pseudolips, in which case 1st lip ring is missing or amalgamated with pseudolips, which would account for small diameter of 1st lip annule. 2nd lip annule of about same or slightly greater diameter as 1st but not lobed, smooth outer edge directing posteriorly. Cephalic framework distinct, may extend into 3rd annule, but generally restricted to first 2 annules. Body annules retrorse, first 3 to 4 body annules smooth, subsequent body annules with more or less continuous fringe of rounded, posteriorly directed scales. Scales gradually increasing in number over first 10 body annules, after reaching maximum number of about 20 per annule, becoming arranged in equally spaced longitudinal rows, reducing in number in postvulval region. Posterior outer edge of scales irregular with minute spines. Scales, about as long as width at base, in contracted females generally not reaching level of posterior edge of adjacent posterior annule, in postvulval region, generally not increasing in length, also on tail maintaining more or less regular orientation. Stylet rigid. Excretory pore located on ventral ridge of spines, resembling flattened annule without scale widened by duct running through it. Vulva a transverse slit with generally 2 conically rounded lips protruding from body at least as far as scales. Vulva lips in most specimens concave, forming cavity between them at level of body contour. Vagina approximately 1/2 body diameter long, angled anteriad. Spermatheca offset, with sperm. Body posterior to vulva, disregarding scales, narrowing to somewhat blunt terminus which is surrounded by scales of last body annules. Anus difficult to observe unless it emerges from outer edge of an annule. In specimens observed, annules of posterior vulval region contracted, forming very short tail.

Males. Not observed.

Type host and locality. Black beech (*Nothofagus solandri*), Brooklyn Domain, Nelson, NZMS 260 K30/085029.

Type material. Holotype, 12 female paratypes from the type locality, coll. W. M. Wouts, 27 May 1971. Holotype on slide 186, National Nematode Collection of New Zealand, Landcare Research, Auckland. Paratypes distributed as indicated in Table 2 (p. 26).

Other material examined. 24 females and 5 juveniles, kowhai (*Sophora microphylla*), Rai Valley, SD; lancewood (*Pseudopanax crassifolium*) and rimu (*Dacrydium cupressinum*), Eves Valley, NN, coll. W. M. Wouts, 27 May 1971 (NNCNZ).

Differential diagnosis. *Ogma capitulatum* sp. nov. is characterised by 2 rather narrow lip annules of almost equal width forming a characteristic cylindrical lip region, 16–20 longitudinal rows of scales, a stylet about 85 µm long and a blunt tail. Because of the large number of scales at midbody and 2 lip annules of almost equal diameter *O. capitulatum* sp. nov. closely resembles *Ogma duodevigintilineatum* (Andrássy, 1968) Andrássy, 1979. The new species differs from *O. duodevigintilineatum* in that the 2 lip annules are almost of equal diameter and thickness (v. 1st lip annule somewhat wider than the 2nd and thin), the scales are rounded (v. triangular), the tail is contracted, rounded, and with scales (v. extended tail with fused annules without scales), the body is shorter (av. L = 0.39 mm v. 0.49 mm), the stylet longer (av. 84 µm v. 77 µm), and the number of body annules (av. R = 99 v. 67) and the Rex value (av. 29 v. 16) greater. It also resembles *O. decalineatum* (Chitwood, 1957) Andrássy, 1979, *O. rhombosquamatum* (Mehta & Raski, 1971) Andrássy, 1979, and *O. simlaense* (Jairajpuri, 1963) Andrássy, 1979: in these species, however, the 1st lip annule is generally larger than the 2nd and the number of rows of scales is 10 or less.

Distribution (Map 26). *Ogma capitulatum* sp. nov. has so far only been found in the Nelson region.

– / SD, NN.

Etymology. The name *Ogma capitulatum* is derived from the latin word *capitulatum* = with knob-like head.

Ogma catherinae sp. nov.

Fig. 40; 41

Measurements: Table 7.

Morphology. **Females**. Body gently curved ventrad, tapering anteriorly from base of stylet, posteriorly from just anterior to level of vulva. Cephalic region distinctly set off from rest of body, with elevated lip region and 2 annules of which outer edge generally directed laterally. Lip region consisting of slit-like oral opening, oval oral disc, slit-like amphidial apertures and 6 pseudolips of equal size. 1st lip annule funnel-shaped with distinctly greater diameter than 2nd annule, outer edge covered with fringe of about 40 short spines, each about as wide as long. 2nd annule crenate, directed laterally. Body annules retrorse. Space between annules filled with detritus. Cuticle with 10–12 rows of palmate scales, on first 2 body annules starting off as continuous fringe of short stubby spines about 1.5 times as long as wide, splitting up in groups of 3–10 spines on next 1–3 annules. Between annule 6 and 10 these groups of spines transform into palmate scales that are arranged in longitudinal rows. Base of scales gradually increases in size over length of body, at midbody becoming about as long as spines, they progressively increase in length in postvulval region becoming 2–3 times as long as at midbody, resulting in spine-like, long scales standing out from body, carrying 3–6 blunt spines of irregular orientation, trapping large quantities of detritus in that area, obscuring anus and often vulva. Stylet long, flexible; base wide and heavy. Excretory pore and anus obscure. Ovaries generally straight, reaching base of oesophagus. Spermatheca oval, offset, ventrad, empty. Vulval slit wide, closed, protruding outside body contour about as far as the base of scales. Tail conically pointed, tail terminus surrounded by scales of posterior tail annules.

Males. Not observed.

Juveniles. Body tapering from base of stylet anteriorly and from about midbody posteriorly. Lip regions set off, with 2 annules of equal diameter. Outer edge of lip annules crenate. Scales on body about 10 µm long, arranged in 10 longitudinal rows, may stand irregularly in these rows and occasionally be absent. Scales consisting of wide base, narrowing to wide rounded tip, outer edge covered with fringe of sharply pointed, about 5 µm long spines, most densely at tip. Base of scales on tail longer than on rest of body. Scales of last body annules surround tail terminus.

Type host and locality. *Pentachondra pumila* and other subalpine vegetation, Porters Pass near Lake Lyndon, MC, NZMS 260 K35/998622.

Type material. Holotype, 12 female and 14 juvenile paratypes from the type locality, coll. D. Sturhan, 26 November 2000. Holotype on slide 187, National Nematode Collection of New Zealand, Landcare Research, Auckland. Paratypes distributed as indicated in table 2 (p. 26).

Other material examined. None.

Differential diagnosis. *Ogma catherinae* sp. nov. is characterised by its short palmate spines, long stylet and wide 1st lip annule. It resembles species with 8 rows of palmate scales described from New Zealand, especially *Ogma paucispinatum* and *O. crenulatum*, 2 species with short appendages on the scales. *Ogma catherinae* sp. nov. differs from these species in that it has 10–12 rows of scales along the body (v. 8 rows). It further differs from *O.*

crenulatum in that the outer edge of the 1st lip annule has a fringe of blunt spines (v. being crenate), the body is generally shorter (av. L = 0.43 mm v. 0.61 mm) and thinner (av. width = 48 v. 54), with a shorter postvulval region (av. PV = 27 v. 76) resulting in a more posterior position of the vulva (av. V = 93 v. 88) and fewer postvulval rings (RV = 5-6 v. 8-10).

Distribution (Map 27). *Ogma catherinae* sp. nov. has a limited distribution. It has so far only been found near Lake Lyndon, Mid Canterbury.

– / MC.

Etymology. *Ogma catherinae* is named in honour of Karen Knight, MAF Lincoln, for her contributions to the National Nematode Collection and to nematology in New Zealand generally.

Ogma civellae (Steiner, 1949) Mehta & Raski, 1971

Fig. 42a, b

Measurements: Table 7.

Morphology. **Females**. Body tapering anteriad and posteriad approximately from midbody, annules wide, each with fringe of short, parallel spines directed posteriad, giving annule retrorse appearance. Oral aperture dorsoventral slit surrounded by rectangular to oval oral disc indented laterally to accommodate amphidial aperture, and six almost regularly spaced pseudolips. 1st lip annule distinctly wider than 2nd lip annule, with continuous fringe of about 50 digitate spines, spines slightly longer than wide, directed anteriorly or laterally, occasionally grown together and showing bifid tips. 1st body annule wider than lip annules, outer edge with fringe of spines. Spines about as long as wide, gradually increasing in length over subsequent 5–10 body annules. Fully developed spines blunt, knobbed, or bifurcate at the tip in contracted females reaching level of posterior edge of adjacent posterior annule. Spines on the postvulval region, especially ventrally, combine into scales in random arrangement with solid base and slightly shorter palmate tip, overall longer than spines on rest of body. Excretory pore and anus obscure. Vulva with 2 conically rounded equal lips protruding from body slightly further than outer edge of adjacent annules. Vagina approximately 1/2 body diameter long, angled anteriad. Spermatheca offset, without sperm. Body posterior to vulva, disregarding scales, narrowing gradually to conical tail. Tail terminus surrounded by scales of last body annules.

Males. Not observed.

Diagnosis. *Ogma civellae* is characterised by its continuous fringe of short digitate spines on the body annules, blunt, knobbed, or bifurcated at the tips. *Ogma civellae* most closely resembles *Ogma palmatum* in general morphology, morphometrics, and arrangement of spines on the postvulval region. It can be easily distinguished from this species by the continuous fringe of narrow spines along the outer edge of the body annules (*vs*. continuous rows of palmate scales on alternate body annules).

Type material examined. None.

Material examined. 10 females, native vegetation, Haruru Falls Rd, Waitangi National Reserve, ND, coll. B. Boag; native vegetation Dingle Dell Reserve and trees in home garden and at Mt Albert Research Centre, Auckland, AK; native vegetation Tongariro National Park, TO, coll. W. M. Wouts; *Citrus* sp., Bushmere Rd, Gisborne, GB, coll. G. S. Grandison; red beech (*Nothofagus fusca*) Inangahua State Forest, Buller, BR, coll. J. S. Dugdale (NNCNZ).

Distribution (Map 28). *Ogma civellae* has been encountered in New Zealand associated with citrus in Gisborne and on native vegetation and ornamental plants in Auckland, the Central North Island, and Buller. Knight (2001) reports it from passionfruit (*Passiflora edulis*) in Taranaki. *Ogma civellae* has a worldwide distribution on cultivated plants (Mehta & Raski 1971). Its restricted distribution in New Zealand is probably a reflection of the limited sampling of cultivated and ornamental plants.

ND, AK, TK, TO, GB / BR.

Remarks. *Ogma civellae* was originally described from citrus and has a worldwide distribution. In New Zealand it has been found in habitats with native vegetation as well as on cultivated plants in urban environments and is assumed to be an introduced species.

Ogma crenulatum Wouts, Yeates & Loof, 1999

Fig. 43, 44

Measurements: Table 7.

Morphology. **Females**. With characters summarised for species with palmate scales (p. 22, end of *Ogma* section). Body straight or curved ventrad to open C. Lip region flat, protruding. Cephalic annules almost of equal size and both crenate, without fringe of spines. Anterior annule directed laterally, occasionally gently curved anteriorly, surrounding lip region. Posterior annule directing anteriorly, groove generally present laterally. Body annules each with 8 palmate scales located on distinct ridges running from base of head to tail region with number of scales increasing from 7–8 over first 8–10 body annules and 5–6 ridges generally running through to tail terminus. Scales on ventral side of postvulval region longer than on rest of body. 1st body annule occasionally with fringe. Palmate scales forming on 1st or 2nd body annule, increasing to 8 scales over first 4 body annules. Scales on body not observed to lie flat against body on contracted females. Each scale consisting of very short base supporting fringe of 5–7 sturdy, digitate, parallel appendages. Appendages short on most females, just reaching anterior edge of adjacent posterior annule. In postvulval region, especially ventrally, closer to tail terminus, base of scale growing longer while fringe becoming shorter, with fewer, occasionally forked appendages. On ventral side of tail total length of scales more than double those on body; alignment of scales along body remains in rows, because of their compact nature, their lateral direction not differing much from that on rest of body. Last tail annules usually modified into a hyaline terminal peg. Excretory pore located on ventral ridge, replacing scale, easy to observe. Vulva with 2 conically rounded lips protruding from body almost as far as body scales. Vagina approximately 1/2 body diameter long, angled anteriad. Spermatheca filled with sperm about 2 µm in diameter. Disregarding scales, body posterior to vulva narrowing gradually to conically pointed tail. Modified tail terminus more pronounced than on other species with palmate scales. Anus obscure.

Males. Head rounded anteriorly, not distinctly set off, base of head difficult to determine other than by longitudinal body muscles terminating there. Excretory pore and hemizonid distinct. Hemizonid 1–5 annules behind base of oesophagus, secretory–excretory pore 1–5 annules posterior to hemizonid. Caudal alae seem to be bending the tail dorsally in some specimens.

Juveniles. Head resembling female head, with 2 distinct annules separated by collar, with posterior one generally widest, both with smooth or possibly finely crenate edge directed outward. Body annules with 12 scales on longitudinal ridges. Each scale consisting of posteriorly directed, semicircular base from edge of which about 10 very fine irregular spines fan over groove between annules. Scales in tail region with higher base and shorter spines, but overall of about equal length to those on rest of body. Tail sharply pointed with transparent extension.

Differential diagnosis. *Ogma crenulatum* is characterised by 8 longitudinal ridges of palmate scales, each with 5–7 unmodified spines, along the length of the female body, the long stylet of about 100 µm, the heavy stylet base, the smooth to finely crenate outer edge of both lip annules, and the distinct tail peg. *Ogma crenulatum* resembles *O. pectinatum* (Colbran, 1962) Siddiqi, 1986, *O. pellitum* (Andrássy, 1979) Siddiqi, 1986*, O. feckneri* Reay & Davies, 1998, *O. campbelli*, *O. sexcostatum*, *O. polyandra*, *O. subantarcticum*, *O. semicrenatum,* and *O. paucispinatum* by the longitudinal rows of palmate scales on the body annules. It differs from them in that both cephalic annules are smooth or finely crenate and bear no appendages (v. at least one of them ornate). *Ogma crenulatum* resembles *O. octozonale* (Momota & Ohshima, 1974) Siddiqi, 1986 (= *O. sokliense* (Choi & Geraert, 1975) Siddiqi, 1986) and *O. feckneri* by the presence of an extended tail terminus, but differs from them by the presence of 8 rows of scales (v. 9 or 10) and the greater body length (av. L = 0.61 mm v. 0.44–0.49), it differs further from *O. sokliense* by having 2 lip annules of almost equal size (posterior annule much smaller in *O. sokliense*) and a greater number of body annules (R = 60–70 v. 50–60). *Ogma crenulatum* differs from *O. feckneri* in the long stylet (av. 106 v. 68) and the lesser number of annules on the postvulval region (RV = 8–10 v. 13–17).

Type material examined. Holotype, and 41 female and 3 male paratypes, totara (*Podocarpus totara*), matai (*Prumnopitys taxifolia*), rimu (*Dacrydium cupressinum*), and other native vegetation, Oreti Beach Road, Invercargill, SL, coll. W. M. Wouts; *Nothofagus* sp., Ulva Island, Stewart Island, SI, coll. E. H. C. McKenzie (NNCNZ).

Other material examined. 35 females, 8 juveniles, native vegetation, Tongariro National Park, TO, coll. W. M. Wouts; matai (*Prumnopitys taxifolia*) and rimu (*Dacrydium cupressinum*), Oreti Beach Road, Invercargill, SL; native vegetation Stewart Island, coll. G. S. Grandison (NNCNZ).

Distribution (Map 29). *Ogma crenulatum* has been isolated from 3 widely separated localities. Further sampling is required before a possible distribution of *O. crenulatum* in New Zealand can be suggested.

TO / SL, SI.

Ogma inaequale sp. nov.

Fig. 42c, d; 45

Measurements: Table 7.

Morphology. **Females**. With characters summarised for species with palmate scales at end of *Ogma* section (p. 22). Body gently curved ventrad, tapering anteriorly approximately from base of stylet and posteriorly from about 1 body width anterior to vulval region. Lip region almost flat. Oral plate slightly elevated. 1st lip annule funnel-shaped, with fringe of about 50 long, finger-like appendages about 5 times as long as wide, generally directing laterally. 2nd annule similar to 1st one, with same or slightly greater diameter, and fringe of about 50 finger-like appendages directed posteriorly. Cephalic framework distinct, restricted to 1st annule. Body annules directed sideways, with 6 rows of somewhat posteriorly directed palmate scales. Scales long; depending on width of scales, number of appendages per scale varying from 3 to more than 20. Relative position of scale in row very irregular, in side view scales of 1 row not in focus at same time, some seem missing. In postvulval region scales with fewer appendages than on rest of body. Appendages on scales variable in length, up to 1/2 body width long, generally directed sublaterally; collapsed against body they can cover 2–3 body annules. Anus not observed. Vulva transverse slit with 2 conically rounded lips protruding from body at least as far as base of scales. Vulval lips conically pointed, gaping. Vagina approximately 1/2 body diameter long, angled anteriad. Spermatheca offset, packed with sperm about 2 µm in diameter. Body, disregarding scales, posterior to vulva narrowing to sharply pointed terminus that is surrounded by scales of last body annules.

Males. Not observed.

4th stage juveniles. Body gently curved ventrad, tapering anteriorly and posteriorly from about midbody. Lip region raised somewhat. Cephalic region with 2 annules, each with crenate outer edge, separated by distinct collar. Cephalic framework extending through both annules. 1st annule almost flat anteriorly, directed laterally. 2nd annule thin and of smaller diameter than 1st annule. Body annules retrorse with 10 rows of elongate, conical scales with outer edge and blunt tips covered with fine spines. Spines longer on first 15–20 annules, scales longest and spines largest on last 10–15 annules. Scales of varying length, on outline of juvenile look alternating. Excretory pore and anus not observed. Tail conically pointed. Tail terminus surrounded by scales of last body annules.

3rd stage juveniles. Body gently curved ventrad, tapering anteriorly and posteriorly from about midbody. Lip region raised somewhat. Cephalic region with 2 distinctly crenate annules of about equal size, directed laterally, separated by distinct collar. Cephalic framework extending through both annules. Body annules retrorse with 8 rows of almost hemispherical scales with coarsely crenate outer edge covered with finely pointed spines. Scales all of about same size. Excretory pore and anus not observed. Tail conically pointed. Tail terminus with distinct tail peg.

Type host and locality. *Cyathodes empetrifolia*, Makahu Spur, Kaweka Ra, HB, NZMS 260 U20/042077.

Type material. Holotype, 2 female and 15 juvenile paratypes from the type locality, coll. Q. W. Roberts, February 1972. Holotype on slide 188, and all paratypes, National Nematode Collection of New Zealand, Landcare Research, Auckland.

Other material examined. None.

Differential diagnosis. *Ogma inaequale* sp. nov. is unique in the variability of the size of the scales of the female, and the number of appendages on the scales ranging from 3 to more than 20. Because of the fringe of appendages on the lip annules and 6 rows of long palmate scale *Ogma inaequale* sp. nov. resembles *O. sexcostatum,* and because of the irregular placement of the scales it resembles *O. palmatum* and *O. alternum*. It differs from these 3 species in that the appendages on the scales are very long and stand distinctly out from the body, as against almost flat against the body in the other species. *Ogma inaequale* sp. nov. further differs from *O. palmatum* and *O. alternum* in the somewhat longer stylet (approximately 97 v. av. 85 and 66 µm) and greater number of body annules (R is about 62–63 v. av. 51 and 49) and from *O. sexcostatum* in the longer stylet (av. 97 v. 77 µm).

Distribution (Map 30). *Ogma inaequale* sp. nov has so far only been found in the type locality in the Kaweka Ra, HB.

HB / –.

Etymology. The name *Ogma inaequale* is derived from the latin word *inaequalis* = unequal.

Ogma latens Mehta & Raski, 1971

Fig. 46a–d; 47

Measurements: Table 7.

Morphology. **Females**. Body straight or almost straight, tapering anteriorly from base of stylet and posteriorly from vulval region. Labial region raised. Oral opening dorsoventral slit surrounded by oval oral plate with slit-like amphidial aperture on either side, surrounded by 6 pseudolips, lateral ones slightly larger than others, surrounded by 1st lip annule. 1st lip annule distinctly wider than 2nd annule, each with continuous fringe of about 50 digitate spines, about twice as long as wide on 1st annule and about as long as wide on 2nd, directed laterally. Body annules each with up to 30 scales arranged in longitudinal rows along length of body reducing in number anteriorly and posterior to vulva. Scales predominantly tongue-shaped, also distally flattened and indented, in contracted females generally not reaching level of posterior edge of adjacent posterior annule, in postvulval region, especially ventrally, becoming deeply indented or single spines slightly longer than on rest of body. Excretory pore obscured by debris collected behind scales. Vulva with 2 conically rounded lips protruding from body slightly further than base of scales of adjacent annules. Vagina approximately 1/2 body diameter long, angled anteriad. Spermatheca offset, without sperm. Body, disregarding scales, posterior to the vulva narrowing gradually to conical tail. Tail terminus surrounded by elongated scales of last body annules. Anus obscure.

Males. Not observed.

Differential diagnosis. *Ogma latens*, with its fringe of tongue-shaped or distally flattened scales is very distinct among New Zealand *Ogma* species. According to Mehta & Raski (1971), *O. latens* is most closely related to *O. coronatum* (Schuurmans Stekhoven & Teunissen, 1938)

Mehta & Raski, 1971 and *Crossonema* (= *Ogma*) *taylori* (Jairajpuri, 1964) Mehta & Raski, 1971. It is distinguished from both these species by its more conoid tail, absence of elaborate spines on the tail, well-marked fringe of spines of the head, and elevated dome-shaped lip region.

Type material examined. None.

Material examined. 78 females, 5 males, and 4 juveniles, *Cyathodes empetrifolia*, Makahu Spur, Kawekas, HB; lancewood (*Pseudopanax crassifolium*) Tuna Bay, Tennyson Inlet, SD; *Celmisia laricifolia*, *Cyathodes pumila*, and *Hebe* sp. Mt Lodestone, Mt Arthur Range, NN, coll. J. S. Dugdale; native vegetation, Porters Pass near Lake Lyndon, MC, coll. W. M. Wouts; and *Coprosma antipoda*, *Helichrysum belllidioide*s, and tussock (*Poa foliosa*), between North Plain and Anchorage Bay, Antipodes Is., coll. D. S. Horning, 4 December 1978 (NNCNZ).

Distribution (Map 31). Except for a single female from the Marlborough Sounds all specimens are associated with subalpine vegetation. At higher altitude *O. latens* has a wide distribution, being present in both the North and South Island as well as on the Antipodes. That it has been found only in a small number of samples may indicate a limited host range.

HB / SD, NN, MC / AN.

Remarks. The description of *Ogma latens* by Mehta & Raski (1971) was based on 2 specimens collected by E. W. Dawson on the Antipodes Islands, 7 November 1962. The description here is based on the 50 females associated with *Coprosma antipoda* and *Helichrysum balllidioides* among tussock (*Poa foliosa*) and collected by D. S. Horning. The scales on the cuticle of all these specimens, especially on the postvulval region, are predominantly tongue-shaped. Mehta & Raski (1971) use this “simple, digitate, rounded shape” to distinguish *O. latens* from other species in the genus (in their key Mehta & Raski refer to spines on the tail, but obviously mean spines on the postvulval region). Specimens collected near Lake Lyndon, very similar to *O. latens,* but with predominantly almost square scales, were originally considered to be a different species. These specimens generally were less robust than those from the type locality, they were shorter (L= 360 mm v. 480 mm) and more slender (width = 37 µm v. 49 µm) and had a narrower lip region (17 µm v. 19 µm), shorter stylet (70 µm v. 84 µm) and shorter oesophagus (99 µm v. 127 µm). However, when scanning electron micrographs showed that square and tongue-shaped scales occur in both populations the difference in morphometrics between the two populations was considered insufficient for them to be recognized as separate species. *Ogma latens* seems predominantly present at higher altitude and cold climates. Only a single specimen was found at sea level at Tuna Bay, Tennyson Inlet, Marlborough Sounds. The scales on this specimen are of the square type but less numerous than on the type material. Posteriorly they may each have up to 4, minute projections. This specimen is in very poor condition with the digestive system and the shaft of the stylet completely disintegrated. Its identity, therefore, cannot be reliably determined. It may represent a new species.

Ogma mucronatum sp. nov.

Fig. 46e–g; 48

Measurements: Table 7.

Morphology. **Females**. Body curved gently ventrad, tapering anteriorly from base of stylet and posteriorly approximately from 1 body annule anterior to vulva. Lip region slightly elevated. Oral opening a dorsoventral slit in oval oral plate. Amphidial apertures elongate on lateral side of oral plate, surrounded by lateral pseudolips. 2 dorsolateral and 2 ventrolateral pseudolips complete lip region. Lip region truncate with 2 distinct annules. Anterior annule directed laterally and surrounding lip region. 2nd annule curved posteriad. Both lip annules with continuous fringe of about 30 short spines; spines with wide base and finely pointed tip. Body annules wide, outer edges perpendicular to axis of body. Body annules each with 8 palmate scales located on shallow ridges running from 2nd or 3rd annule to level of vulva, posteriorly gradually reducing in number to 4 on tail. Scales not always in strict rows. In anterior or posterior end view, 8 rows of scales along length of body clearly visible. Scales on tail somewhat longer than on rest of body. Scales on body annules curved posteriad. Each scale consisting of narrow base with usually 2, occasionally 3 or 4, very sharply pointed spines. On anterior part of body, base and spines of about equal length. On posterior part of body and on tail, base of scales gradually increasing in length and spines becoming shorter, the total length remaining about the same. Cephalic sclerotisation distinct, restricted to 1st lip annule. Stylet rigid. Excretory pore at level of base of oesophagus, distinctly visible as body annule without scale on ventral longitudinal ridge, observed in most specimens. Vulva distinct, closed, with 2 conically rounded, long lips, protruding from body about as far as total length of scales on adjacent annules. Vagina almost 1/2 body diameter long, angled anteriad. Spermatheca subspherical, set off, ventrad, filled with sperm 1–2 µm in diameter. Posterior to vulva body tapering gradually to conically pointed tail. Most specimens with distinct tail peg surrounded by scales of last body annule. Anus rarely observed, 2 or 3 annules from terminus.

Males. Not observed.

4th stage juveniles. Body almost straight, slightly swollen, tapering anteriorly and posteriorly. Cephalic region with 2 annules of almost equal size, separated by distinct collar, outer edge of annules deeply serrated. Cephalic framework extending through both annules. 1st body annule with fringe of short blunt spines. Rest of body with 8–10 rows of palmate scales. Scales with conical base and blunt apex with 2–5 rounded spines. Spines slightly shorter than base. Posteriorly number of scales gradually reducing to 4 on tail. Tail terminus with tail peg longer than scales on last body annules.

Type host and locality. Soil and roots of tree fuchsia (*Fuchsia excorticata*) on bank of Riwaka River about 5 km West of Riwaka, at the foot of Takaka Hill, NN, NZMS 260 N26/035177, coll. W. M. Wouts.

Type material. Holotype, 24 female, and 39 juvenile paratypes from the type locality, coll. W. M. Wouts, 12 Jan 1972. Holotype on slide 189, National Nematode Collection of New Zealand, Landcare Research, Auckland. Paratypes distributed as indicated in Table 2 (p. 26).

Other material studied. None.

Differential diagnosis. *Ogma mucronatum* sp. nov. most closely resembles *Ogma paucispinatum* with which it shares the length and shape of the body, the number of annules on the body and the postvulval region, the stylet length and the length of the oesophagus, the organisation of the lip region, the lip annules with a continuous fringe of up to 40 spines, 8 rows of scales with 2–4 short appendages about the length of the base of the scales, and scales that on the ventral side of the postvulval region are longer, and have fewer, shorter appendages that are more irregularly organised than on the rest of the body. It differs from *O. paucispinatum* by the finely pointed spines on the scales, spines that are short, rounded and blunt in *O. paucispinatum*.

Distribution (Map 32). *Ogma mucronatum* sp. nov. has been found only in the type locality.

– / NN.

Etymology. The name *Ogma mucronatum* is derived from the Latin word *mucronatus* = pointed.

Ogma niagarae sp. nov.

Fig. 49a, b

Measurements: Table 7.

Morphology. **Females**. With characters summarised for species with palmate scales at end of *Ogma* section (p. 22). Body slightly curved ventrad, tapering anteriorly and posteriorly from midbody. Cephalic region truncate with 2 distinct annules. Anterior annule directed laterally, surrounding raised lip region. 2nd annule curved posteriad. Both lip annules with continuous fringe of about 40 short blunt spines, on anterior annule about twice as long as wide, on posterior annule about as long as wide. Body annules wide, outer edge retrorse, each with 8 scales located on ridges running from 2nd or 3rd annule to level of vulva, posteriorly gradually reducing in number to 4 on tail. In anterior and posterior end view 8 rows of scales along length of body clearly visible. Scales curved posteriad, on 1st body annules consisting of base and usually 2, occasionally 3, rarely 4, blunt spines. Scales 15–20 µm long at midbody. Base of scale about as long as spines, posteriorly becoming shorter, total length of scales remaining about the same. Direction of scales on ventral part of tail irregular. Cephalic sclerotisation distinct, restricted to 1st lip annule. Stylet rigid. Excretory pore observed in 1 specimen only, 1 annule below base of oesophagus, distinctly visible as body annule without scale. Vulva distinct, closed, with 2 conically rounded, long lips protruding from body about as far as base of scales on adjacent annules. Vagina almost 1 body diameter long, angled anteriad. Spermatheca subspherical, set off, ventrad, filled with sperm about 2 µm in diameter. Posterior to vulva body tapering gradually to conically pointed tail. Tail terminus surrounded by scales of last body annule. Anus usually obscured by detritus, in a moulting specimen in J4 cuticle observed 3 annules from terminus.

Males. Not observed.

4th stage juveniles. Body almost straight, slightly swollen, tapering anteriorly and posteriorly from midbody. Cephalic region with 2 annules of almost equal size, separated by distinct collar, outer edge of 1st annule deeply serrated, 2nd annule crenate. Cephalic framework extending through both annules. 1st body annule with fringe of short blunt spines, rest of body with 8–10 rows of palmate scales. Scales about 20 µm long and 30 µm wide, constricted in the middle, tip with fringe of fine spines; spines shorter than scale. On posterior part of body number of scales gradually reducing to 4 on tail. Tail terminus with tail peg longer than scales on last body annule.

Type host and locality. Soil and roots of kowhai (*Sophora microphylla*), near Niagara, Catlins State Forest Park, SL, about 10 km from the southernmost coast of the South Island NZMS 260 G46/134946.

Type material. Holotype and 4 paratype females from the type locality, coll. D. Sturhan, 7 December 1996. Holotype on slide 190, National Nematode Collection of New Zealand, Landcare Research, Auckland.

Other material examined. None.

Differential diagnosis. *Ogma niagarae* sp. nov. is characterised by 8 longitudinal ridges of palmate scales at midbody of the female, each scale with 2–4 appendages, and by the presence of a fringe of rounded spines on the outer edge of both lip annules. The females of *O. niagarae* sp. nov. resemble the females of *O. paucispinatum*, *O. semicrenatum*, *O. melanesicum* Andrássy, 1979, and *O. feckneri* in the number of spines on the scales being restricted to 2–4. They differ from *O. paucispinatum* in the greater length of the scales (15 –20 µm v. 6–14 µm) and fewer body annules (about 50 v. about 57). *Ogma niagarae* sp. nov. females differ from *O. semicrenatum*, *O. melanesicum,* and *O. feckneri* in that they only have 8 rows of scales (v. 10). They further differ from *O. melanesicum* and *O. feckneri* females in the longer scales with fewer appendages (2 v. 5). They further differ from *O. semicrenatum* females in that they are generally more robust, longer (av. L = 0.59 v. 0.37 mm) and wider (av. 66 v. 49 µm), and have a longer postvulval region (av. PV = 63 v. 24), stylet (av. 105 v. 71 µm), and oesophagus (av. 145 v. 106 µm), and wider lip region (av. 24.1 v. 17 µm), and in *Ogma semicrenatum* females both lip annules (v. posterior annule only) have a distinct continuous fringe of up to 40 spines.

Distribution (Map 33). *Ogma niagarae* sp. nov. has been found only in the type locality.

– / SL.

Etymology. *Ogma niagarae* is named after Niagara Falls, a small waterfall in Southland, where it was found.

Ogma palmatum (Siddiqi & Southey, 1962) Siddiqi, 1986

Criconema palmatum Siddiqi & Southey, 1962; *Croserinema palmatum* (Siddiqi & Southey, 1962) Khan, Chawla & Saha, 1976; *Crossonema* (*Crossonema*) *palmatum* (Siddiqi & Southey, 1962) Mehta & Raski, 1971.

Fig. 49c–e; 50

Measurements: Table 7.

Morphology. **Females**. With characters summarised for species with palmate scales at end of *Ogma* section (p. 22). Oral aperture, oral disc, and amphidial apertures elevated, surrounded by 6 regularly spaced pseudolips surrounded by 1st lip annule. 1st lip annule distinctly wider than 2nd lip annule, both annules with fringe of about 50 short, rather thick, digitate spines. Body annules each with 4–6 palmate scales that generally alternate in position with scales on adjacent annules, but this can be very irregular especially on anterior and posterior part of body. Scales located on distinct ridges running from 2nd body annule to tail region. Scales on tail slightly longer than on rest of body. Scale consisting of a solid base that supports a fringe of generally 3 (range 2–6) short, digitate, usually blunt and parallel appendages, in contracted females reaching level of posterior edge of adjacent posterior annule. Base of scale and appendages of about equal length. In postvulval region, especially ventrally, closer to tail terminus, base of scale growing longer while fringe becoming shorter with fewer appendages. Excretory pore obscure. Vulva with 2 conically rounded lips protruding from the body slightly further than outer edge of adjacent annules. Vagina approximately 1/2 a body diameter long, angled anteriad. Spermatheca offset, without sperm. Disregarding scales, body posterior to vulva narrowing gradually to conical tail. Tail terminus surrounded by scales of last body annules.

Males. Not observed.

Differential diagnosis. *Ogma palmatum* closely resembles *O. alternum* and *O. inaequale,* 2 new species with alternating or irregularly placed palmate scales. *Ogma palmatum* differs from *O. alternum* in the longer body (av. L = 0.44 v. 0.37 mm), stylet (av. 80 v. 67 µm), and oesophagus (av. 130 v. about 100 µm), and the shape of the scales. Although within *O. palmatum* the scale structure varies considerably (Jairajpuri 1963) the shape of the spines on the distal part of the scales is fairly characteristic and quite different from that of *O. inaequale*. The 2 species can be readily distinguished on the basis of this character alone. In *O. palmatum* these spines are generally stubby, short and rounded, and of even length, whereas in *O. alternum* they are conical, of differing lengths, and almost pointed.

Ogma palmatum differs from *O. inaequale* in the constancy of the dimensions of the scales (v. variability in size), the shorter appendages on the scales, the number of appendages per scale ranging from 2–6 (v. 3 to more than 20), the somewhat shorter stylet (av. 85 v. 97 µm) and lower number of body annules (av. R = 51 v. 61–63).

Type material examined. None.

Material examined. 22 females from a flower garden, Wakefield, NN, coll. W. M. Wouts; dense native bush, Haruru Falls Rd, Waitangi National Reserve, ND, coll. B. Boag (NNCNZ).

Distribution (Map 34). *Ogma palmatum* has been found predominantly associated with cultivated plants. Mehta & Raski (1971) found it associated with fig (*Ficus carica*, Nelson), and Knight (2001) reports it from feijoa (*Feijoa sellowiana*, Nelson) and passion fruit (*Passiflora edulis*, Taranaki). It has a worldwide distribution and is considered an introduced species.

ND, TK / NN.

Remarks. The morphometrics of the *O. palmatum* populations from New Zealand closely agree with the measurements presented in the original description of the species. Mehta & Raski (1971) point out the common occurrence of this species with *O. civellae* and express their uncertainty about the independence of these 2 species. In New Zealand such a coincidence has not been observed and SEM photographs showing the distinct nature of the scales confirm the validity of each of the species. *Ogma palmatum* was initially considered to occur also on alpine vegetation, but a close comparison of the morphology of the scales and a thorough analysis of the morphometrics revealed that these populations represent the independent species described above as *O. alternum*.

Ogma palmatum, until now, has been the only species described with rows of alternating scales. This would suggest that species with alternating scales are rare. This may be true worldwide, but is not true for New Zealand. Here, *O. alternum* is the 2nd species with this characteristic and further populations of species with this characteristic are known. The number of complete specimens of these other populations available for study was insufficient to describe them as new species. A population from red beech (*Nothofagus fusci*), Inangahua State Forest, Nelson, collected by J. S. Dugdale in 1972 consists of 3 females, which is insufficient for SEM. Their stylets are long but cannot be measured because the shaft is deteriorated and the base dissolved. These females are about 0.8 mm long, straight or slightly curved ventrad. Their cuticle has 18 rows of elongate scales. The scales are forked distally into 2 or 3 spines and are longer than the width of the body annules. On the anterior and posterior part of the body they are arranged in rows, irregularly alternating, while they are rarely in rows on the rest of the body. The scales on the postvulval region are not distinctly longer than those on the rest of the body. Between the scales the edge of the annules is smooth. The lip region is raised and has 2 annules each with a crenate outer edge directed laterally. The 1st annule is wavy and distinctly wider than the 2nd annule. The 1st body annule has 8 scales, a number that gradually increases to about 18 scales at midbody. The vulva is a transverse slit and has a smooth outline. The secretory–excretory pore is distinct, an anus was not observed. The tail is conically pointed with its terminus surrounded by scales of the last body annules. They differ from *O. palmatum* and *O. alternum* females by their larger bodies (longer than 0.70 mm v. less than 0.50 mm), wider lip annules (1st lip annule >30 µm wide v. <25 µm wide), longer stylet (>120 µm v. <90 µm), longer postvulval region (PV >60 µm v. PV <50 µm) and greater number of spines at midbody (18 v. 8).

Ogma paucispinatum Wouts, Yeates & Loof, 1999

Fig. 51; 52

Measurements: Table 7.

Morphology. **Females**. With characters summarised for species with palmate scales at end of *Ogma* section (p. 22). Body straight or curved gently ventrad, tapering anteriorly and posteriorly. Lip region flat, protruding. Lip region with 2 annules of almost equal size, each with continuous fringe of up to 40 short, digitate spines. Posterior lip annule generally curving posteriad. Body annules each with 8 palmate scales located on distinct ridges running from base of head to tail region with number of scales increasing from 7 to 8 over first 8–10 body annules and 5 or 6 ridges generally running through to tail terminus. Scales short, overlapping only 1/2 base of scale of adjacent posterior annule, not observed to lie flat against the body on retracted females. Each scale consisting of solid base supporting 2 or 3 digitate, parallel appendages, each about as long as base of scale. Because of rather long base, 2-pronged scales, when directed towards viewer, resemble cloven hooves. In postvulval region, especially ventrally, closer to tail terminus, base of scale growing longer while appendages becoming shorter, total length of these scales up to about 1.5 times longer than on rest of body; while their alignment along post vulval region remains in rows their lateral direction becomes irregular. Number of appendages on these scales generally 2, not twisting. Stylet rigid. Excretory pore distinct on ventral ridge as missing scale. Vulval lips conically rounded, protruding from body almost as far as scales. Vagina approximately 1/2 a body diameter long, angled anteriad. Spermatheca filled with sperm about 2 µm in diameter. Body, posterior to vulva, disregarding scales, narrowing gradually to conically pointed tail. Tail terminus surrounded by scales of posterior annules. Anus indistinct, observed only in specimens with extended tail.

Males. Not observed.

Juveniles. Lip annules 2, both with fringe of digitate appendages, 1st annule directed anteriad, 2nd annule directed outward. Body annules with 10–12 scales on longitudinal ridges. Each scale consisting of an irregularly shaped, posteriorly directed base with spike-like extensions that have drawn out tips, the total resembling gloves with finely drawn out fingers. Scales in tail region with higher base and carrying more spines, overall slightly longer than on rest of body. Tail sharply pointed with scales of last body annules surrounding tail terminus.

Differential diagnosis. *Ogma paucispinatum* is characterised by 8 longitudinal ridges of palmate spines, each with 1–3 unmodified, long spines, and by the presence of unmodified spines on the outer edge of both lip annules.

Ogma paucispinatum resembles *O. polyandra, O. subantarcticum*, *O. semicrenatum,* and *O. crenulatum* in its 8 longitudinal rows of palmate scales. It differs from them in that the scales bear only 1–3 unmodified spines (v. 5 or more). It further differs from *O. semicrenatum* and *O. crenulatum* in that unmodified spines are present on both lip annules. In body and stylet length, number of body annules, and number of spines per body scale *O. paucispinatum* most closely resembles *O. sokliense* Choi

& Geraert, 1975, from which it differs by having 2 lip annules of almost equal size (posterior annule much smaller in *O. sokliense*), both with ornamentation (v. no ornamentation), and the presence of 8 rows of scales (v. 9).

Type material examined. Holotype female and 48 female paratypes from mahoe (*Melicytus ramiflorus*), Mokoroa Falls, AK, coll. G. J. Cox, 22 August 1977, and marbleleaf (*Carpodetus serratum*) Buller Gorge near Lyell, BR, coll. M. Hurst, May 1971 (NNCNZ).

Other material examined. 18 females and 9 juveniles, from the type host and type locality, and from marbleleaf (*Carpodetus serratum*) Buller Gorge near Lyell, BR, coll. M. Hurst, May 1971, and native vegetation, Milford Sound, FD, coll. D. Sturhan, 26 November 1988 (NNCNZ).

Distribution (Map 35). *Ogma paucispinatum* has been found only on native vegetation at low altitude. It is an endemic species and has a wide distribution. The relatively small number of specimens present in the collection may be a reflection of limited sampling.

AK / BR, FD.

Ogma polyandra Wouts, Yeates & Loof, 1999

Fig. 53; 54

Measurements: Table 7.

Morphology. **Females**. With characters summarised for species with palmate scales at end of *Ogma* section (p. 22). Body generally curved gently ventrad tapering anteriorly from base of stylet, posteriorly from vulval area. Cephalic annules 2, both of same diameter, with continuous fringe of about 60 digitate spines; spines on anterior annule generally directed laterally, on posterior annule directed laterally or posteriorly. Body annules each with 8 palmate scales located on distinct ridges running from base of head to tail region with 4 ridges generally running through to tail terminus. Scales on body annules consisting of small solid base supporting fringe of up to 12 digitate, parallel appendages. Appendages long, in contracted females overlapping adjacent posterior annule. On ventral side of postvulval region, closer to tail terminus, base of scale growing longer while fringe becoming shorter with fewer appendages, without overall length of scales substantially changing. Although alignment of these ventral scales remains in distinct rows, lateral direction becomes irregular, with some becoming perpendicular to axis of body or even curved slightly anteriad, giving postvulval region bushy appearance. Excretory pore 2–5 annules below base of oesophagus, distinctly visible as missing scale on ventral ridge. Vulval lips conically rounded, protruding from the body slightly further than base of scales of adjacent annules. Vagina approximately 1/2 a body diameter long, angled anteriad. Spermatheca filled with sperm about 2 µm in diameter. Disregarding scales, body posterior to vulva narrowing gradually to conical tail. Tail terminus usually surrounded by scales of last body annules, in some specimens with transparent extension. Anus indistinct.

Males. Head dome-shaped, cuticle at base of head with a slight constriction. Body annules and hemizonid distinct, secretory–excretory pore 4 or 5 annules posterior to hemizonid. Stylet lacking. Oesophagus degenerate. Spicules paired, gently curved. Gubernaculum curved. Region anterior and posterior to cloaca distinctly raised. Caudal alae present. Lateral field raised, with 4 incisures. Tail terminus finely pointed, generally ventrally concave just after midtail.

Juveniles. Lip annules 2, each with finely serrated edge directing outward. Body annules with 10 scales on longitudinal ridges, each scale consisting of a posteriorly directed base carrying 3–5 irregular spines that converge distally; spines widest at their base, overlapping adjacent annule. Tail sharply pointed, terminus surrounded by scales of last body annules.

Differential diagnosis. *Ogma polyandra* is characterised by 8 longitudinal ridges of palmate spines, each with about 10 appendages, both lip annules bear a fringe of unmodified spines, stylet about 90 µm, and a pointed tail terminus. *Ogma polyandra* most closely resembles *O. pectinatum* Colbran, 1962 with which it shares 8 rows of palmate scales, each scale with a fringe of more than 7 spines. It differs from *O. pectinatum* by the longer body (av. L = 0.45 v. <0.39 mm) and stylet (av. 92 v. <70 µm) and the more pointed tail terminus. *Ogma polyandra* also closely resembles *O. semicrenatum*, *O. paucispinatum,* and *O. crenulatum*, but differs from them in that the number of spines on the scales is 10–12 (v. <7).

Type material examined. Holotype female, 55 paratype females, and 23 paratype males, tussock (*Chionochloa* sp.), Cape Foulwind Rd, Westport, BR, coll. M. G. Hurst, 5 May 1971 (NNCNZ).

Other material examined. 165 females, 26 males, and 43 juveniles from native vegetation, Omahuta State Forest, ND; tawa (*Beilschmiedia tawa*), Tuna Bay, SD; miro (*Prumnopitys ferruginea*), Riwaka River bank, NN; tussock (*Chionochloa* sp.), Cape Foulwind, BR; rimu (*Dacrydium cupressinum*), State Highway 6, Greymouth, BR; lancewood (*Pseudopanax crassifolium*), Kumara Junction, WD; native vegetation, along Haast River, WD; fivefinger (*Pseudopanax arboreus*) and *Hymenanthera* sp., Redwood Pass Rd, Blenheim, MB; kowhai (*Sophora microphylla*) in native vegetation, Rakaia River near Mt Hutt, MC, coll. D. Sturhan; *Gunnera* sp., *Pentachondra* sp., and alpine vegetation, Porters Pass region, MC; kowhai (*Sophora microphylla*), near Niagara, SL, all collected by

W. M. Wouts; *Olearia lyallii*, Penguin Creek, The Snares. coll. D. S. Horning jr. (NNCNZ).

Distribution (Map 36). *Ogma polyandra* is a native species of New Zealand. It is fairly common and has a wide distribution. It has been found from as far North as the Omahuta Forest, mid-Northland to as far south as Tokanui, Southland and The Snares. Its high frequency in the northern part of the South Island is an indication of the more intense collecting of soil samples carried out in that region.

ND / SD, NN, BR, WD, MB, MC, SL / SN.

Remarks. The populations from native vegetation at Omahuta Forest, near Mangamuka, rimu at Greymouth, and subalpine vegetation near Porters Pass differ from *O. polyandra* from the type locality in that the scales on the postvulval region are distinctly longer than on the rest of the body. In the Greymouth population the individual scales at midbody further have about 7, and those in the Porters Pass population up to 16 appendages, whereas in the Mangamuka population their number is about 10, the same as in the type material. As no further characteristics distinguish these populations they are here considered *O. polyandra*. The number of appendages per scale apparently is very variable.

A single specimen from Auckland Island with the characteristics of *O. polyandra*, but a short stylet of about 70 µm and about 7–10 appendages per scale keys to *O. pectinatum*. As this is a very poorly preserved specimen and no further specimens could be obtained from the original sample this species is not separately described.

Ogma semicrenatum Wouts, Yeates & Loof, 1999

Fig. 55, 56

Measurements: Table 7.

Morphology. **Females**. With characters summarised for species with palmate scales at end of *Ogma* section (p. 22). Body straight or curved gently ventrad to open C. Lip region flat, protruding. Oral opening located in H-shaped oral plate. Lip region with 2 annules, anterior annule covering 2nd one completely in face view, outer edge more or less crenate, directed laterally. Posterior annule with fringe of short appendages, generally curved anteriorly, in some specimens laterally or posteriorly. Body annules narrow, each with 8–10 palmate scales located on distinct ridges running from base of head to tail region with number of scales increasing from 8–10 over first 6 body annules and 5 or 6 ridges generally running through to tail terminus. Scales on tail slightly longer than on rest of body. On 1st body annule scales occasionally grown together into fringe. Scales consisting of a solid base that supports a fringe of 4–6 digitate, converging appendages. Appendages short, only in contracted females overlapping base of scale of adjacent annule. In postvulval region, especially ventrally closer to tail terminus, base of scale growing longer, its fringe becoming shorter with fewer appendages, total length of these scales may be about 1.5 times longer than on rest of body. Although alignment of scales along postvulval region remains in distinct rows, their lateral direction becomes irregular. Excretory pore located on ventral ridge of spines, not distorting spine it emerges from. Vulval lips conically rounded protruding about twice as far as base of scales of adjacent annules. Vagina approximately 1/2 a body diameter long, angled anteriad. Spermatheca filled with sperm about 2 µm in diameter. Disregarding scales, body posterior to the vulva narrowing gradually to conically pointed tail. Tail terminus surrounded by scales of tail annules. Anus obscure.

Males. Head not distinctly set off. In most specimens rudimentary median bulb and basal bulb present and junction with the intestine distinct. Hemizonid 2–5 annules below base of oesophagus, secretory–excretory pore 1–6 annules posterior to hemizonid. Caudal alae present. Tail strongly curved; terminus finely rounded.

Juveniles. Body curved ventrad into open C. Lip annules both with smooth outer edge, directing outward. Body annules with 10–12 scales in longitudinal ridges, each scale consisting of hemispherical, posteriorly directed base carrying sharp spines; spines widest at their base, fan over groove between annules. Scales in tail region slightly longer than on rest of body, with higher base and shorter spines. Tail sharply pointed, scales of last body annules surrounding tail terminus.

Differential diagnosis. *Ogma semicrenatum* is characterised by 10 longitudinal ridges of palmate scales, each with fewer than 7 appendages, at midbody of the female, and by the lack of spines on the 1st lip annule and the fringe of spines on the 2nd annule. *Ogma semicrenatum* closely resembles *O. melanesicum* Andrássy, 1979 and *O. feckneri* Reay & Davies, 1998 in the moderate body size and stylet, short spines on the scales, 10 rows of scales and the number of spines per scale being restricted to 2–6. It differs from these species in that the edge of the 1st lip annules is smooth or faintly crenate and only the 2nd lip annule has a fringe of appendages, whereas both lip annules have a distinct fringe of spines in *O. melanesicum* and short appendages in *O. feckneri. Ogma semicrenatum* further differs from *O. feckneri* by the shorter female body (av. L = 0.37 v. 0.48 mm) and the greater number of postvulval body annules (RV= 6–8 v. 13–17) and scales on the tail (v. absent). *Ogma semicrenatum* also closely resembles *O. polyandra*, *O. paucispinatum*, *O. subantarcticum,* and *O. crenulatum* species that have their scales organised in 8 longitudinal rows (v. 10 in *O.*

semicrenatum). With the exception of *O. crenulatum,* they also all have unmodified spines on the 1st lip annule (v. absent). *Ogma crenulatum* differs by the longer body (L <0.5 v. >0.4 mm) and stylet (av. 100 v. 70 µm).

Type material examined. Holotype female, 60 paratype females, and 4 paratype males, kahikatea (*Podocarpus dacrydioides*), Lake Mahinapua Track, Hokitika, WD, coll. W. M. Wouts, October 1971 (NNCNZ).

Other material examined. 113 females and 14 juveniles from kamahi (*Weinmannia racemosa*), *Coprosma* sp., and *Pseudowintera* sp., East Logan Creek, Tararua Range, WN; lancewood (*Pseudopanax crassifolium*) and other native vegetation, Westport, BR; rata (*Metrosideros robusta*) and *Quintinia* sp. in native forest, Mawhera State Forest, BR; kahikatea (*Podocarpus dacrydioides*) and other native vegetation, Kumara Junction, WD; native vegetation, Haast, WD; native vegetation, Omaui, SL; matai (*Prumnopitys taxifolia*) and other native vegetation, at Waimatua and at lower Mataura River, SL; *Nothofagus* sp. forest, Stewart Island, SI (NNCNZ).

Distribution (Map 37). *Ogma semicrenatum* is native to New Zealand. It is common along the west and south coasts of the South Island with a single find in the Tararua Range in the North Island.

WN / BR, WD, SL, SI.

Ogma sexcostatum Wouts, Yeates & Loof, 1999

Fig. 57, 58

Measurements: Table 7.

Morphology. **Females**. With characters summarised for species with palmate scales at end of *Ogma* section (p. 22). Body generally curved gently ventrad. Each lip annule with continuous fringe of about 60 digitate spines; fringe on anterior annule generally directed laterally or anteriorly and on posterior annule directed laterally or posteriorly. Body annules with palmate scales located on 6 distinct ridges running from base of head to tail region, with 4 ridges generally running through to tail terminus. Scales on ventral side of postvulval area as long as on rest of body or slightly shorter. Scales consisting of small solid base supporting fringe of up to 12 digitate, parallel appendages. Appendages long, in contracted females overlapping adjacent posterior annule. On ventral side of postvulval region, approaching tail terminus, base of scale growing longer while fringe becoming shorter with fewer appendages, without overall length of scales changing substantially. Although alignment of these ventral scales remains in distinct rows, lateral direction becomes irregular, with some even curved slightly anteriad. Excretory pore between ridges, at base of oesophagus, rarely observed. Vulva slightly open in some specimens, with 2 conically rounded lips, protruding from body about same distance as base of scales of adjacent annules. Vagina approximately 1/2 a body diameter long, angled anteriad. Spermatheca filled with sperm about 2 µm in diameter. Disregarding scales, body posterior to vulva narrowing gradually to conical tail. Tail terminus usually surrounded by scales of last body annules, in some specimens with transparent extension. Anus indistinct.

Males. Not observed.

Juveniles. Head annules directed outward, each with fringe of fine digitate spines. Body annules with scales arranged in 8 longitudinal ridges, each scale consisting of a semicircular posteriorly directed base carrying *ca* 10 irregular hairs; hairs wider at base than at tip, fan over groove between annules. Tail sharply pointed; transparent extension probably formed from modified scale.

Differential diagnosis. *Ogma sexcostatum* is characterised by 6 longitudinal ridges of palmate spines along the length of the body of the female; palmate spines on the postvulval area not longer than on the rest of the body; a lip region with both annules bearing a fringe of unmodified spines; and a stylet about 75 µm long. *Ogma sexcostatum* most closely resembles *O. campbelli* in the long, comb-like scales arranged in 6 rows along the body. It differs from *O. campbelli* by its shorter body (av. L = 0.36 v. 0.49 mm) and greater number of body annules (R = 60–69 v. 50–57) and the resulting finer body annulations, and the shorter postvulval region (RV = 23–42 v. 41–72 µm) with irregular scales on its ventral side.

Type material examined. Holotype and 112 female paratypes from kowhai (*Sophora microphylla*), on bank of Riwaka River, about 5 km west of Riwaka, NN, coll. W. M. Wouts, 12 January 1972 (NNCNZ).

Other material examined. 259 females and 16 juveniles from mahoe (*Melicytus ramiflorus*) and other native vegetation, Mokoroa Falls, AK; kanuka (*Kunzea ericoides*), Dingle Dell Reserve, Auckland, AK; tawa (*Beilschmiedia tawa*) and mangeao (*Litsea calicaris*), Pareheru Scenic Reserve, Rotorua, BP; native vegetation, Greystoke Reserve, Marton, WN; white-pine (*Podocarpus dacrydioides*) and pukatea (*Laurelia novae-zelandiae*), Tuna Bay, Marlborough, SD; kowhai (*Sophora microphylla*) and tree fuchsia (*Fuchsia excorticata*), Takaka Hill, Riwaka, NN; native vegetation, Kina Beach, NN; rimu (*Dacrydium cupressinum*) and totara (*Podocarpus totara*), Eves Valley, NN; titoki (*Alectryon excelsus*), Snowden's Bush, NN; titoki (*Alectryon excelsum*) and karaka (*Corynocarpus laevigatus*), Melrose Bush, NN; marbleleaf (*Carpodetus serratus*), Lee Valley, NN; *Coprosma tenmucaulis*, West Inangahua State Forest, BR; tree fuchsia (*Fuchsia excorticata*), Kumara Junction, WD; native vegetation, 6 km past Haast, WD; grasses and native vegetation, near Lake Lyndon, MC; kowhai (*Sophora microphylla*), Rai Valley, MB; 60 km past Haast, OL; karaka (*Corynocarpus laevigatus*), Te Hapupu, Chatham Is. and kawakawa (*Macropiper excelsum*), Point Munning, Chatham Is. (NNCNZ).

Distribution (Map 38). *Ogma sexcostatum*, present in the centre of New Zealand and on the Chatham Islands, seems to prefer a moderate climate. It is absent from the northern part of the North Island and the southern part of the South Island and has been found once only at higher altitude.

AK, BP, WN / SD, NN, BR, WD, MB, MC, OL / CH.

Ogma sturhani sp. nov.

Fig. 59; 60

Measurements: Table 7.

Morphology. **Females**. Body gently curved ventrad, tapering anteriorly from base of stylet, posteriorly from just anterior to level of vulva. Lip region raised, consisting of almost rectangular oral disc, oral opening a dorsoventral slit, amphidial aperture not indenting lateral side of oral disc, and 6 pseudolips of almost equal size, lateral ones seem somewhat smaller than sublateral ones, surrounded by 1st lip annule. Cephalic region distinctly set off from rest of body. 1st lip annule funnel-shaped, of slightly greater diameter than 2nd annule, outer edge covered with fringe of about 40 short spines, each about as wide as long. 2nd lip annule crenate. Both annules generally directed laterally Body annules with continuous fringe of short, stubby, blunt spines about 1.5 times as long as wide, on posterior part of body forming palmate scales by splitting up into groups of 3–10. Base of these scales gradually increases in size, from a length equal to that of spines they carry at vulva level to about 2–3 times that length on tail; resulting long scales standing out from body, carrying 2–5 blunt spines of irregular orientation, trapping large quantities of detritus in that area, obscuring anus and often vulva. Outer edge of annules strongly curved posteriad, often pointing towards body, except posteriorly where palmate scales project out sublaterally. Stylet long, flexible, base wide and heavy. Ovaries generally straight, in some specimens invading region of oesophagus. Spermatheca oval, offset, ventrad, filled with sperm. Vulval slit wide, closed, protruding outside body contour about as far as base of scales. Excretory pore distinct when located on edge of an annule. Tail conically pointed, tail terminus surrounded by scales on posterior tail annules.

Males. Not observed.

Type host and locality. Subalpine vegetation, Porters Pass near Lake Lyndon, Mid Canterbury, MC, NZMS 260 K35/ 996622.

Type material. Holotype, 21 females, and 6 juvenile paratypes from the type locality, coll. D. Sturhan, 26 November 2000. Holotype on slide 191, National Nematode Collection of New Zealand, Landcare Research, Auckland. Paratypes distributed as indicated in Table 2 (p. 26).

Other material examined. None.

Differential diagnosis. *Ogma sturhani* sp. nov. is characterised by a continuous fringe of short spines on the outer edge of the body annules, long stylet and wide 1st lip annule with a fringe of short blunt spines. Because of the fringe of short spines on the body annules it does not resemble any of the species described from New Zealand. Other nominal species with short spines are *O. taylori*, *O. coronatum*, *O. taylatum* Khan, Chawla & Saha, 1976, *O. dryum* Minagawa, 1979, *O. haguei* Reay & Davies, 1998, *O. aquitanense* (Fies, 1968) Mehta & Raski, 1971, *O. paracivellae* Decraemer & Geraert, 1992, and *O. malabricum* Muthukrishnan, 1987. Of these species the spines of *O. coronatum* and *O. taylatum* are irregular in form and more properly classed as scales. *Ogma sturhani* sp. nov. differs from *O. taylori* and *O. paracivellae* by its smaller number of body annules (R = 45–51 v. 53–70) and crenate lip annules (notched in *taylori*, with finger-like projections in *paracivellae*). *Ogma sturhani* sp. nov. distinctly differs from *O. aquitanense* and *O. haguei* by its smaller number of body annules and annules to the secretory–excretory pore (R=45–51 v. 84–105; Rex=13–16 v. 27–36), smaller number of annules on the postvulval region (RV=6–8 v. 8–16) and the spines on the postvulval region transformed to scales distinctly longer than the spines on the body. The females of *Ogma sturhani* sp. nov. have a shorter stylet than those of *O. acquitanense* (82–102 v. 101–120 µm) and a longer stylet than those of *O. haguei* (81–92 µm). *Ogma sturhani* sp. nov. differs from *O. dryum* in that the 2nd lip annule is a distinct annule with crenate outer edge (v. a smooth collar-like annule in *O. dryum*), the elongation of the scales on the postvulval region, the more anterior position of the secretory–excretory pore (Rex = 13–16 v. 16–19) and the more posterior position of the vulva (V = 93–96 v. 82–87; PV = 22–40 v. 47–71; RV = 6–8 v. 10–12). *Ogma sturhani* sp. nov. is also closely related to *O. malabricum.* It shares with this species most of its characters but differs because in *O. malabricum* the 1st lip annule is notched, as in *O. taylori* and the 2nd lip annule is smooth and collar-like as in *O. haguei* (v. with fringe of spines and crenate). It further differs in that *O. sturhani* sp. nov. has more annules on the postvulval region (RV = 6–8 v. RV = 4) and the spines in this region are transformed into extended palmate scales (v. extended blunt or bifid spines).

Ogma sturhani sp. nov. is considered most closely related to *O. catherinae,* a species with longitudinal rows of scales on the cuticle, described earlier in this section. Their close relationship was discussed in detail (p. 21) and was considered evidence that species with similar spines on the body annules are monophyletic and belong to the same genus and subgenus.

Distribution (Map 39). *Ogma sturhani* sp. nov. has so far only been found in the type locality.

– / MC.

Etymology. *Ogma sturhani* is named in honour of Dr D. Sturhan, Germany, for his many contributions to the science of nematology, both in New Zealand and world wide.

Ogma subantarcticum Wouts, Yeates & Loof, 1999

Fig. 61

Measurements: Table 7.

Morphology. **Females**. With characters summarised for species with palmate scales at end of *Ogma* section (p. 22). Body large, annules each with 8 palmate scales located on distinct ridges running from base of head to tail region with 4 ridges generally running through to tail terminus. Scales on tail distinctly longer than on rest of body. Both lip annules of about same diameter and each with continuous fringe of about 50, rather thick, digitate spines. Posterior annule curved posteriad. Scales on 1st body annule occasionally growing together into fringe. Scale on body annules consisting of solid base supporting fringe of 4–6 digitate parallel appendages. Appendages long, in contracted females easily overlapping base of scale of adjacent posterior annule. In postvulval region, especially ventrally, closer to tail terminus, base of scale growing longer while fringe becoming shorter with fewer appendages their alignment remaining in distinct rows, but their lateral direction becoming very irregular. Total length of these scales may be double that of those at midbody. Excretory pore distinct as spineless scale on ventral ridge. Vulva with 2 conically rounded lips, protruding from body about twice as far as base of scales of adjacent annules. Vagina approximately 1/2 body diameter long, angled anteriad. Spermatheca filled with sperm about 2 µm in diameter. Disregarding scales, body posterior to vulva narrowing gradually to conical tail. Tail terminus with modified scale as transparent extension. Anus obscure.

Males. Head truncated anteriorly, cuticle at base of head somewhat thicker and slightly widening, demarcating the base of the head. Excretory pore and hemizonid distinct. Tail terminus finely rounded.

Juveniles. Head annules both with fine, crenate edge directed outward. Body with 8 longitudinal rows of scales. Each scale consisting of conical, posteriorly directed base from edge of which about 10 irregular spines, wider at base than at tip, fan over groove between annules. Scales in tail region have higher base and shorter spines but are of about equal length as on rest of body. Tail sharply pointed with transparent extension, probably formed from transformed scale.

Differential diagnosis. *Ogma subantarcticum* is characterised by females that are on average longer than 0.45 mm, 8 longitudinal ridges of palmate spines, each with less than 7 appendages, a lip region in which both lip annules bear a fringe of unmodified spines, and a long stylet of about 100 µm.

Ogma subantarcticum most closely resembles *O. pectinatum*, *O. pellitum* (Andrássy, 1979) Siddiqi, 1986, and *O. polyandra*. *Ogma subantarcticum* shares with these species 8 rows of scales and the unmodified, long spines on these scales, giving the scales a comb-like appearance. It differs from these 3 species by its greater body size (av. L >0.5 v. <0.5 mm) and longer stylet (av. 102 v. <85 µm) and in that there are fewer than 7 spines on the scales, whereas in the other species either the scales have more than 7 spines or the spines are not restricted to rows of scales but form a continuous fringe along the edge of the body annules.

Type material examined. Holotype, 8 female paratypes, and 8 male paratypes, tussock (*Poa* sp.), and *Bulbinella* sp., from the exposed west side of top St Col, Campbell Island, coll. T. K. Crosby, 4 December 1975, 1 empty female skin, from *Olearia lyallii*, Penguin Creek, The Snares, coll. D. S. Horning Jr. (NNCNZ).

Other material examined. 3 females from native vegetation, Monument Harbour, head of Six Foot Lake, Campbell I. (NNCNZ).

Distribution (Map 40). *Ogma subantarcticum* was described from Campbell Island. A single empty female skin shows it is present in The Snares too.

– / – / SN, CA.

GENUS *Syro* Orton Williams, 1985

Criconematinae. **Females**. Body thick, strongly curved, C-shaped when relaxed. Number of annules more than 75. Cephalic region with single expanded, funnel-shaped annule, pseudolips present, submedian lobes absent. Body with numerous scales arranged in longitudinal rows, may be unequally distributed between dorsal and ventral side of body in some species. Scales simple, bifurcate or with several points, dichotomised in some species. On posterior part of body appendages usually modified, elongate, sometimes “antler-like”, with 1 or 2 dichotomies. Appendages on tail annules may extend beyond posterior end of body. Stylet 57–118 µm long. Postvulval region with 4–15 annules.

Juveniles. With 12–14 longitudinal rows of scales, each scale divided into 2 equal parts by deep incision, bearing 2 or more spines on each part.

Type species. *Syro vexillatrix* Orton Williams, 1985
Ogma (*Pateracephalanema) vexillatrix* (Orton Williams, 1985) Raski & Luc, 1987; *Pateracephalanema vexillatrix* (Orton Williams, 1985) Raski & Luc, 1987.

Nominal species present in New Zealand
Syro glabellus sp. nov.
S. tribulosus sp. nov.

Syro glabellus sp. nov.

Fig. 62a, b; 63

Measurements: Table 8.

Morphology. **Females**. Body strongly curved, C-shaped, tapering anteriorly approximately from base of stylet and posteriorly from about 1 body width anterior to vulva. Lip region not elevated, not projecting from 1st lip annule. Oral opening a dorsoventral slit surrounded by rectangular oral plate; oral plate with slit-shaped amphidial apertures on either side, and surrounded by 6 pseudolips, lateral ones slightly larger than others, surrounded by coarsely crenate 1st lip annule. Lip annule funnel-shaped, directed laterally, distinctly wider than 1st body annule. Cephalic framework distinct. 1st body annule with smooth outer edge directed laterally or posteriorly. Subsequent body annules with regularly spaced, rounded, posteriorly directed short scales, initially 8–10, increasing to 20–26 at midbody, in contracted females generally not reaching level of posterior edge of adjacent posterior annule. Scales on first 10 annules irregularly arranged, in longitudinal rows on rest of body, in postvulval region reducing in number and gradually becoming longer, on tail reaching twice length of those on rest of body, especially ventrally irregular in direction and occasionally slightly indented distally, obscuring anus. Excretory pore obscured by accumulated debris on cuticle. Vulva a transverse slit with generally 2 conically rounded lips, protruding from body slightly further than outer edge of adjacent annules. Vulval lips in most specimens concave on inside, forming enclosed space between them. Vagina approximately 1/2 a body diameter long, angled anteriad. Spermatheca offset, with sperm. Body, disregarding scales, posterior to vulva narrowing gradually to conical tail. Tail terminus with tail peg, surrounded by elongated scales of last body annules.

Males. Not observed.

Type host and locality. *Melicytus ramiflorus*, Ness Valley, Auckland, AK, NZMS 260 S11/003640.

Type material. Holotype and 17 female paratypes from the type locality, coll. G. J. Cox, 26 September 1977. Holotype on slide 193, National Nematode Collection of New Zealand, Landcare Research, Auckland. Paratypes distributed as indicated in Table 2 (p. 26).

Other material examined. 12 females and 1 juvenile from rimu (*Dacrydium cupressinum*), near summit Mangamuka Gorge, ND; native vegetation Waitangi Forest and Omahuta Forest, ND. coll. W. M. Wouts, March 1975 (NNCNZ).

Differential diagnosis. *Syro glabellus* sp. nov. females most closely resemble *Ogma coronatum* Schuurmans Stekhoven & Teunissen, 1938 females. *Syro glabellus* sp. nov. females share with this species the typical 1st lip annule set off by a distinct collar and the equally spaced fringe of scales on the body annules. *Syro glabellus* sp. nov. can be distinctly distinguished from *Ogma coronatum* by its shorter females with smaller "a" value (av. L= 0.44 mm v. 0.85, av. a = 8.1 v. 15.7) and body annules only 1/3 width of *O. coronatum* (av. L/R = 440/85 = 5.2 v. 850/50 = 17). It may further differ in the morphology of the lip region, which for *O. coronatum* is illustrated as distinctly protruding (v. not protruding in *S. glabellus* sp. nov.) and the pattern of the outer edge of the 1st body annule, character states not known for *O. coronatum*.

Distribution (Map 41). *Syro glabellus* sp. nov. has a limited distribution, it has so far only been found at lower altitude in Northland and Auckland.

ND, AK / –.

Etymology. The name *Syro glabellus* is derived from the Latin word *glabellus* = smooth.

Syro tribulosus sp. nov.

Fig. 64; 65

Measurements: Table 8.

Morphology. **Females**. Body strongly curved, C-shaped, tapering anteriorly approximately from base of stylet and posteriorly from about 1 body width anterior to vulval region. No lateral field or lateral line. Lip region not elevated, not projecting from 1st lip annule. Oral opening a dorsoventral slit surrounded by rectangular oral plate with slit-shaped amphidial apertures on either side. 6 pseudolips, lateral ones slightly larger than others, surrounded by lip annule. Lip annule funnel-shaped, coarsely crenate, directed laterally, distinctly wider than 1st body annule. Cephalic framework distinct, restricted to lip annule. 1st body annule with smooth outer edge directed laterally or posteriorly. Subsequent body annules with triangular, posteriorly directed, distally generally bifid (occasionally 2 indentations present) scales, their number increasing from about 8 anteriorly to 16–20 at midbody. Scales, slightly longer than width at base, in contracted females generally not reaching level of posterior edge of adjacent posterior annule, scales on 1st 5–10 annules irregularly arranged, in longitudinal rows on rest of body, in postvulval region reducing in number and gradually becoming longer, on tail reaching twice length of those on rest of body, on ventral side irregular in direction, obscuring anus. Stylet rigid. Excretory pore obscured by accumulated debris on cuticle. Vulva a transverse slit with generally 2 conically rounded somewhat concave lips, forming enclosed space between them, protruding from body slightly further than outer edge of adjacent annules. Vagina approximately 1/2 a body diameter long, angled anteriad. Spermatheca offset, with large sperm. Disregarding scales, body posterior to vulva narrowing gradually to conical tail. Tail terminus with tail peg, surrounded by elongated scales of last body annules.

Males. Not observed.

Type host and locality. Kowhai (*Sophora microphylla*), *Carmichaelia* sp., kahikatea (*Podocarpus dacrydioides*), miro (*Prumnopitys ferruginea*), ngaio (*Myoporum laetum*), putaputaweta (*Carpodetus serratus*), kowhai (*Sophora microphylla*), and rimu (*Dacrydium cupressinum*), Rai Valley, Marlborough, MB, NZMS 260 O27 584998, 597990 and 598991.

Type material. Holotype, 177 paratype females, and 6 paratype juveniles from the type locality, coll. W. M. Wouts, 20 July 1972. Holotype on slide 192, National Nematode Collection of New Zealand, Landcare Research, Auckland. Paratypes distributed as indicated in Table 2 (p. 26).

Other material examined. 107 females and 25 juveniles from kanuka (*Kunzea ericoides*), Dingle Dell, Auckland, AK; *Olearia* sp., fivefinger (*Pseudopanax arboreus*), rimu (*Dacrydium cupressinum*), Tuna Bay, SD; lancewood (*Pseudopanax crassifolius*); totara (*Podocarpus totara*); treefern (*Cyathea dealbata*), and native vegetation in pasture, Duncan Bay, SD; *Coprosma* sp., totara (*Podocarpus totara*), *Schefflera digitata*, lancewood (*Pseudopanax crassifolius*), pigeonwood (*Hedycarya arborea*), tawa (*Beilschmiedia tawa*), and silver beech (*Nothofagus menziesii*), near McLennan, SL (NNCNZ).

Differential diagnosis. The females of *Syro tribulosus* sp. nov. most closely resemble *S. vexillatrix* and *S. glabellus* females in the width of the lip annule, the size of the stylet base, and the length of the body and the stylet. It differs from *S. vexillatrix* in the evenly spaced (unevenly spaced in *vexillatrix*) greater number of longitudinal rows of scales at midbody (16–20 v. 12–16), the greater number of body annules (R= 79–96 v. 46–63) and annules on the postvulval region (RV=10–14 v. 5–6), the longer postvulval region (PV = 24–45 µm v. 10–26 µm), and the relatively more anterior position of the vulva (V= 91–94 v. 95–96). It differs from *S. glabellus* by the dichotomous scales (v. smooth) and the on average longer females (av. L = 0.52 v. 0.44 mm).

Distribution (Map 42). *Syro tribulosus* sp. nov. is restricted to low lying coastal areas of Auckland and the northern and southern part of the South Island.

AK / SD, MB, SL.

Etymology. The name *Syro tribulosus* is derived from the Latin word *tribulosis* = difficult.

Remarks. The females of *S. tribulosis* and *S. glabellus* differ in characters that can be measured, or observed by SEM but cannot be very well illustrated. The drawing of Fig. 62a for *S. glabellus* therefore has not been repeated for *S. tribulosus*, but applies to both species.

Females of a *S. tribulosus* population from native vegetation at Dingle Dell, Auckland, differ slightly from the type material. They have rather wide scales, especially on the anterior part of the body, with predominantly 3 spines (v. conically pointed scales with predominantly 2 spines). They also have a slightly shorter body (0.47 v. 0.52 mm) and oesophagus (143 v. 153 µm) and wider body (53 v. 50 µm) resulting in a lower “a” value (8.9 v. 10.5).

GENUS *Pateracephalanema* Mehta & Raski, 1971

Criconematinae. Body annules with imbricate scales. Scales organised on continuous ridges running full length of body. Lip region with single annule.

Nominal species present in New Zealand

Pateracephalanema imbricatum (Colbran, 1956) Mehta & Raski, 1971 (**Type species**)

Pateracephalanema imbricatum (Colbran, 1956) Mehta & Raski, 1971

Criconema imbricatum Colbran, 1965; *Ogma imbricatum* (Colbran, 1965) Mehta & Raski, 1971

Fig. 62c,d; 66

Measurements: Table 8.

Morphology. **Females**. Body straight or slightly curved ventrad, tapering anteriorly approximately from base of stylet and posteriorly from level of vulva. Labial region elevated, with slit-like oral opening on oval oral disc. Amphidial apertures, almost as long as oral opening, located on either side of oral disc. Thin, small ring surrounds oral disc and amphidial apertures in some specimens. 6 pseudolips follow this thin ring, lateral ones somewhat larger than others, with lip ring surrounding them completing labial region. Outer edge of lip ring smooth, directed laterally. Lip ring followed by narrowing collar setting lip distinctly off from rest of body. Cephalic framework distinct, restricted to lip annule and collar. Posterior edge of body annules with 8, equally spaced, raised indentations forming 8 longitudinal rows of concave, posteriorly more or less flat scales. In postvulval region scales modified by indentations and grooves making them coarsely crenate, closer to tail scales amalgamate and bear short blunt spines, especially ventrally where they become raised and irregular in direction and obscure anus. Excretory pore distinct, because of smooth surface of this species not obliterated by detritus, accentuating ventral indentation of annule it is located on. Vulva a transverse slit; vulval lips conically rounded, protruding from body about as far as adjacent scales, directing posteriad, making vagina look somewhat S-shaped. Tail terminus surrounded by scales of last body annules, blunt.

Males. Not observed.

Differential diagnosis. *Pateracephalanema imbricatum* most closely resembles *Pateracephalanema australe* (Colbran, 1963) Mehta & Raski, 1971, from which it can be distinguished by the longer stylet (L = 63–77 v. 50–56 µm). *Pateracephalanema imbricatum* can be easily distinguished from *Ogma* species present in New Zealand by the single lip ring and the scales covering the body like a harness.

Type material examined. None.

Material examined. 28 females from ngaio (*Myoporum laetum*), Great Island, Three Kings Island, TH; lancewood (*Pseudopanax crassifolium*) in black beech (*Nothofagus solandri*) forest, crossing Desert Rd and Mangatowai Stream, Central Plateau, TO; black beech (*Nothofagus solandri*) in vegetation, along Wairoa River, NN; *Desmoschoenus spiralis*, Birdlings Flat, Lake Ellesmere, MC (NNCNZ).

Distribution (Map 43). *Pateracephalanema imbricatum* was originally described from Australia. When it was first found on the Three Kings Islands it was considered to be an Australian native having reached the outer islands of New Zealand. Further finds in the middle of the North and the South Island, however, make it clear that the species is well established here, albeit limited in numbers, and restricted to regions close to free-flowing water.

TH / TO / NN, MC.

Remarks. In her redescription of *Pateracephalanema imbricatum*, Reay (1987) mentions that in several populations from New South Wales usually a 2nd lip annule was present in the collar-like region below the 1st lip annule. The scales in these populations have crenate posterior edges and become bifurcated and lobed on the tail. Among these, the population from Banda Banda further differs in that they have 10 rows of scales instead of 8. Morphometrically these populations are identical to the type specimens from Fraser Island, Queensland, and were considered the same species. Similar variations were not observed among the New Zealand populations.

GENUS *Blandicephalanema* Mehta & Raski, 1971

Ogma (*Blandicephalanema*) (Mehta & Raski, 1971) Siddiqi, 1986

Amphisbaenema Orton Williams, 1982 (**new synonymy**).

Criconematinae. **Female**. Body straight or slightly curved ventrad. Body annules retrorse, with or without scales, cuticle covered with crust that may form spines or scales when body scales are present. Crust easily rubs off in species with few scales (8-10 scales per body annule). Head shape variable, generally with high, dome-shaped anterior part resting on a basal annule. Dome-shaped anterior part consists of almost circular, elevated oral disc, with distinct amphidial aperture on either side, surrounded by 6 pseudolips, lateral ones slightly larger than others. Inside head diffuse structure can be observed below each pseudolip, large on lateral side, considerably smaller on subdorsal and sublateral sides. The outer edge of basal annule slightly lobed following contour of pseudolips. Stylet flexible. Ovaries outstretched may reach level of stylet base. Spermatheca spherical. Scale on last tail annule may be modified into hyaline terminal peg.

Males. Not observed.

Nominal species present in New Zealand

Blandicephalanema serratum Mehta & Raski, 1971 (**Type species**)
Blandicephalanema inserratum sp. nov.
B. nothofagi sp. nov.
B. pilatum Mehta & Raski, 1971

Blandicephalanema serratum Mehta & Raski, 1971

Ogma serratum (Mehta & Raski, 1971) Siddiqi, 1986
Ogma mehrasi Siddiqi, 1986
Fig. 67; 68

Measurements: Table 9.

Morphology. **Females**. Dome-shaped anterior part of lip region consists of elevated oral disc with small slit-shaped amphidial aperture on either side, surrounded by 6 pseudolips. Lateral pseudolips larger and extend further down than other pseudolips, as a result, head looks different laterally from dorsoventrally. In lateral view it shows more or less distinct lip cap followed by dome-shaped region which may have slight constriction in its lower 1/2, and distinct basal annule. In dorsoventral view it looks high and square with faint basal annule. Basal lip annule irregularly lobed, without scales. Posteriorly projecting, transparent spines visible from 2nd body annule, increasing in size over next 5–10 annules, their number generally increasing from 6–8 over 1st 3–5 body annules, arranged in rows on ridges along length of body, reducing in number in postvulval region, with 4 or 5 ridges generally running to close to tail terminus. Scales slightly longer than wide, in contracted animals just reaching posterior edge of adjacent annule, on tail not longer than on rest of body. Scales blunt, with finely serrated margins that continue somewhat more pronounced as dented veil between scales on posterior edge of annules. Veil and scales with SEM seen as membrane covering entire body, including lip region, membrane easily rubbed off, exposing rows of short stumps below scales and irregular, short spines between stumps. Stylet base 9–10 µm across. Excretory pore 2–3 annules below level of base of oesophagus. Anus often obscured by debris trapped between annules.

Differential diagnosis. *Blandicephalanema serratum* most closely resembles *B. bossi* Reay, 1992 in the 6–8 longitudinal rows of scales along the length of the body. It differs from this species in the type of scale (with crenate outer edge v. palmate) and the shorter body (L = 0.42 v. 0.54 mm) and stylet (av. 72 v. 87 µm).

Type material examined. None.

Material examined. 324 females and 8 juveniles from moss (*Pabulum* sp. and others), East Logan Creek, Tararua Range, WN; hard beech (*Nothofagus truncata*) forest, Kaitoke Waterworks Reserve, Hutt Valley, WN; seral broadleaf forest, Taita, Hutt Valley, WN; hardwood forest, Orongorongo Valley Field Station, WN; moss (*Pabulum* and others), Whisky Falls, Lake Rotoiti, NN; manuka (*Leptospermum scoparium*), Kaiteriteri back beach, NN; grasses, Whangamoa Hill, NN; pigeonwood (*Hedycarya arborea*) and *Coprosma australis*, 3 km south of Waimangaroa, NN; pigmy pine (*Lepidothamnus laxifolius*), Coral Track to Rome Ridge, Mt Arthur, NN; silver beech (*Nothofagus menziesii*), five finger (*Pseudopanax arboreus*), Buller Gorge, BR; blechnum fern (*Blechnum discolor*), Inangahua R./Coal Creek Reserve, BR; red beech (*Nothofagus fusca*), West Inangahua State Forest, BR; mountain beech (*Nothofagus* sp.), Kowai Bush, Springfield, MC; black beech (*Nothofagus solandri*) and low native vegetation, Sharplin Falls, MC (NNCNZ).

Distribution (Map 44). *Blandicephalanema serratum* is well distributed in the northern part of the South Island as well as the Wellington region of the North Island. It is probably associated with *Nothofagus* spp. and can be found on this host at altitudes as low as sea level and as high as the slopes of Mt Arthur.

WN / NN, BR, MC.

Remarks. Studying populations that had previously (Wouts *et al.* 1999) been identified as *B. serratum*, it was observed that the number of scales per annule varies from 6–12 but is constant within populations. Since 8 scales, as reported for the type material, always correlated with a shorter stylet, generally large serrated scales, and the presence of a veil with short spines between the scales these characters were considered diagnostic for the type species. In population with 10 rows of scales the scales and the posterior edge of the annules between the scales are almost smooth. They are described below as a new species identified by these characteristics. A single population from Buller, Westland, consisting mainly of empty female skins, showed 6 rows of scales on the cuticle. Because of the poor condition of these specimens no further characters could be established to justify recognition of this population as an independent species.

Blandicephalanema inserratum sp. nov.

Fig. 69–71

Measurements: Table 9.

Morphology. **Females**. Lip region with elevated oral disc, with small slit-shaped amphidial aperture on lateral sides, surrounded by 6 pseudolips. Lateral pseudolips larger and extend further down than other pseudolips. As a result heads look different laterally from dorsoventrally. In lateral view lip cap is followed by dome-shaped pseudolips, which may have slight constriction in their lower 1/2, and distinct basal annule; in dorsoventral view region of pseudolips looks high and square and basal annule faint. Basal annule irregularly lobed, without scales. Posteriorly projecting, transparent, more or less blunt scales present from 1st body annule, increasing in size over next 5–15 annules and increasing in number from 8–10 over first 3–5 body annules, arranged in longitudinal rows on ridges along length of body, reducing in number in postvulval region, with 4 or 5 rows generally running to close to tail terminus. Scales slightly longer than wide, in contracted animals just reaching posterior edge of adjacent annule, on tail not longer than on rest of body. Scales with irregular margins. Between scales posterior edge of annules smooth. Scales with SEM seen as part of membrane covering entire body, including lip region, easily rubbed off, exposing rows of short stumps below scales and smooth posterior edge of annules. Stylet base about 9 µm across. Excretory pore 2–3 annules below level of base of oesophagus. Anus often obscured by debris trapped between annules.

Type host and locality. Kahikatea (*Podocarpus dacrydioides*), Rai Valley, Marlborough, NZMS 260 O27/584998.

Type material. Holotype and 98 female paratypes from the type locality, coll. W. M. Wouts, 20 Jul 1972. Holotype on slide 194, National Nematode Collection of New Zealand, Landcare Research, Auckland. Paratypes distributed as indicated in Table 2 (p. 26).

Other material examined. 56 females from rangiora (*Brachyglottis repanda*), black beech (*Nothofagus solandri*), bush lawyer (*Rubus cissoides*), rimu (*Dacrydium cupressinum*), Brooklyn Domain, NN; black beech (*Nothofagus solandri*), Riwaka River bank, NN; black beech (*Nothofagus solandri*) and kahikatea (*Podocarpus dacrydioides*), Eves Valley, NN; black beech (*Nothofagus solandri*), Wairoa River, Mt Heslington, turnoff, Nelson, NN; totara (*Podocarpus totara*) and matai (*Prumnopitys taxifolia*), Wairoa River, NN; matai (*P. taxifolia*), Lee Valley, NN; totara (*Podocarpus totara*), Murchison, NN; kahikatea (*Podocarpus dacrydioides*) and coprosma (*Coprosma linarifolia*), Rai Valley, MB (NNCNZ).

Differential diagnosis. *Blandicephalanema inserratum* sp. nov. most closely resembles *B. serratum* in general morphology and is identical in morphometrics. It differs from *B. serratum* in the greater number of rows of scales (10 v. 8), between the scales the smooth (v. distinctly dented) outer edge of the body annules and the somewhat conical scales (v. blunt).

Distribution (Map 45). *Blandicephalanema inserratum* sp. nov. is probably associated with black beech (*Nothofagus solandri*). It has so far only been found in the Nelson region where it is common at low altitude.

– / NN, MB.

Etymology. The name *Blandicephalanema inserratum* is derived from the Latin word *inserratus* = without serration.

Blandicephalanema nothofagi sp. nov.

Blandicephalanema bossi of Wouts *et al.* (1999), misidentification.

Fig. 72a–d; 73; 74

Measurements: Table 9.

Morphology. **Females**. Body slightly curved ventrad, tapering from level of base of style anteriad and approximately from level of vulva posteriad. Lip region with elevated, almost spherical oral disc with distinct slit-shaped amphidial aperture on lateral sides, surrounded by 6 pseudolips located on distinct basal annule. Lateral pseudolips larger than other pseudolips. In lateral view pseudolips form dome-shaped lip region that may have slight constriction in lower half. Basal lip annule of greater diameter than region of pseudolips, irregularly lobed. Scales with SEM seen as part of membrane covering entire body, including lip region, easily rubbed off, exposing rows of short stumps below scales and smooth posterior edge of annules. When membranous crust is removed from the lip region lip cap protrudes further from anterior end, becoming very prominent, and basal region seems to expand making anterior lip ring dome-shaped and basal annule more prominent. 1st body annule irregularly lobed, with smooth edge. From 2nd or 3rd annule on membranous crust forming posteriorly projecting, transparent scales, resembling 2 or 3 conically pointed, sharp spines, generally of different length, joined at base, increasing in size over next 5–10 annules, increasing in number from 8–10 over 1st 3–5 body annules, arranged in longitudinal rows on ridges along length of body, reducing in number in postvulval region, with 5 or 6 ridges generally running to close to tail terminus. Scales longer than wide, generally overlapping edge of adjacent posterior annule, on tail somewhat longer and more irregular in direction than on rest of body. Stylet flexible; knobs heavy, about 14–15 µm across. Excretory pore large, emerging from a scale without spines or with very short spines, making it look wider, about 24 annules from anterior end, below level of base of oesophagus. Anus indistinct.

Males. Not observed.

Type host and locality. Native vegetation in black beech (*Nothofagus solandri*) forest, Desert Rd and Mangatowai Stream intersection, North Island, NZMS 260 T19/490238.

Type material. Holotype and 45 paratypes from the type locality, coll. W. M. Wouts, 12 December 2000. Holotype on slide 195, National Nematode collection of New Zealand, Landcare Research, Auckland. Paratypes distributed as indicated in Table 2 (p. 26).

Other material examined. 102 females and 15 juveniles from *Nothofagus* sp., Waikare Stream, National Park, TO; black beech (*Nothofagus solandri*), Desert Rd, Mangatowai Stream, Central Plateau, TO; *Nothofagus truncata* forest, Kaitoke Waterworks Res., Hutt Valley, WN; manuka (*Leptospermum scoparium*) and black beech (*Nothofagus solandri*), Kaiteriteri back beach, NN; black beech (*N. solandri*), lancewood (*Pseudopanax crassifolius*), rimu (*Dacrydium cupressinum*), black beech (*Nothofagus solandri*), Eves Valley, NN; red beech (*Nothofagus fusca*) and miro (*Prumnopitys ferruginea*), Inangahua State Forest, BR; beech (*Nothofagus* sp.), Reefton, BR; mountain beech (*Nothofagus* sp.), Kowai Bush, Springfield, MC; mountain beech (*Nothofagus* sp.) forest with *Pseudopanax crassifolium*, *Dracophyllum longifolium*, *Myrsine divaricata*, *Uncinia gracilenta*, and *Freycinetia baueriana banksii*, Breaksea Island, FD (NNCNZ).

Differential diagnosis. *Blandicephalanema nothofagi* sp. nov. is characterised by a body more than 0.5 mm and a stylet more than 100 µm long and 10 rows of scales, each scale carrying 3–6 sharply pointed spines of irregular size. Because of the presence of spines on scales *B. nothofagi* sp. nov. most closely resembles *B. bossi* (Fig. 75). It differs from this species in the longer stylet (100–116 v. 76–99 µm), the very large stylet base (approximately 14 v. <10 µm wide) and the shape and irregular size of the conically pointed spines on the scales (v. palmate scales). In *B. nothofagi* sp. nov. the scales are narrow and the number of spines per scale in the anterior region varies from 2–4 (v. 5–10 in *B. bossi*). Spines in *B. nothofagi* sp. nov. are longer and distinctly overlap the adjacent posterior annule (v. just overlapping in *B. bossi*). In both species the number of spines gradually reduces to 2 or 3 towards the posterior region. Spines on posterior scales may be fewer and wider than on the anterior scales, as if some have fused.

Distribution (Map 46). Like the other *Blandicephalanema* species, *B. nothofagi* sp. nov. is closely associated with *Nothofagus* species, especially with black beech (*N. solandri*), but has a wider distribution. It has been found at several sites in Nelson and Fiordland and could be generally present along the west coast of the South Island. As it is also present in the Central Plateau of the North Island it does not seem to be restricted by altitude.

TO, WN / NN, BR, MC, FD.

Etymology. *Blandicephalanema nothofagi* is named after its hosts, *Nothofagus* spp.

Remarks. Populations of *Blandicephalanema* sp., here described as *B. nothofagi* sp. nov., were identified by Wouts *et al.* (1999) as *B. bossi*. SEM photographs have since revealed, that these populations have scales that are very irregular in form, consisting of 3–5 spines of different size, quite different from the short pectinate scales of *B. bossi* (Fig. 75). *Blandicephalanema bossi,* therefore, has not yet been recorded from New Zealand.

Blandicephalanema pilatum Mehta & Raski, 1971

Ogma pilatum (Mehta & Raski, 1971) Siddiqi, 1986

Fig. 72e, f; 76; 77

Measurements: Table 9.

Morphology. **Females**. In the absence of the transparent crust, head shape variable, generally consisting of more or less distinct, almost circular lip cap, wide pseudolip region, and distinct basal annule, in all directions resembling dorsoventral configuration of lip region of *B. serratum*. Outer edge of basal annule lobed around each of the 6 pseudolips. 1st body annule irregularly lobed. Body annules at midbody each with 18–30 scale bases running in longitudinal ridges, their number reducing from base of head anteriorly and from level of vulva posteriorly. Scale bases on each ring not covered with individual scales, except in postvulval region, but per annule collectively covered with more or less continuous, posteriorly directed crust, with irregularly serrated posterior edge reaching base of scales on adjacent annule, somewhat reduced in length towards anterior end of body, but present up to 1st body annule. Lip region generally covered with crust too. In postvulval region transparent crust forms narrow, flat, spiked tips, on ventral side raised almost perpendicular to axis of body. Crust more firmly adhering to cuticle than in species with scales. In specimens prepared for scanning electron microscopy crust generally collapsed against the body forming an even cover. Transparent crust occasionally lost, especially in postvulval region, exposing scale bases. Stylet flexible, knobs about 10 µm across. Excretory pore observed as scale base without cover, about 27 annules from anterior end. Anus distinct when not obscured by debris.

Males. Not observed.

4th stage juveniles. Compact, tapering anteriorly and posteriorly from about midbody. Labial region raised, dome-shaped. Cephalic region with 2 undifferentiated annules continuous with body contour. Body annules with 10–12 rows of scales at midbody. Scales about 1.5 times as long as width of body annules, conical in shape, tapering until just before apex where they slightly widen to form bi- or tri-dentate tip. Scales on posterior part of body longer and widening at tip more pronounced. Body and scales covered with thin crust of refractive particles. Stylet about 70 µm long. Excretory pore and anus distinct as annule without scale in ventral row of scales. Excretory pore about 24 annules from anterior end, anus about 5 annules from tail tip. Number of body annules about 75. Tail conically pointed, terminus surrounded by scales of last body annules giving it a blunt appearance.

Differential diagnosis. In general morphology *Blandicephalanema pilatum* very closely resembles the other species of the genus. It is distinct by having more than 15 scale bases (v. 10 or fewer) per body annule and the membranous sheath covering these bases not being subdivided into distinct lobes or scales, but forming a continuous cover with serrated extensions over the body annules.

Type material examined. None.

Material examined. 409 females and 11 juveniles from rimu–beech–broadleaved species native forest, Mangaehuehu Scenic Reserve, Nat. Park, TO; hard beech (*Nothofagus truncata*) forest, Kaitoke Waterworks Reserve, Hutt Valley, WN; native forest dominated by silver beech (*Nothofagus menziesii*), Orongorongo Valley Field Station Ridge, WN; mountain neinei (*Dracophyllum traversii*), silver beech (*Nothofagus menziesii*), *Astelia fragrans*, *Nothofagus solandri,* and *Olearia colensoi*, Mt Domett

4200', NN; cabbage tree (*Cordyline* sp.), Greymouth, Westland, BR; red beech (*Nothofagus fusca*), *Coprosma propinqua*, *C. tenuicaulis*, miro (*Prumnopitys ferruginea*), Inangahua State Forest, BR; black beech (*Nothofagus solandri*), miro (*Prumnopitys ferruginea*), and *Lophomyrtus* sp., Reefton, BR; silver beech (*Nothofagus menziesii*) and native vegetation, 60 km past Haast, OL; miro (*Prumnopitys ferruginea*), silver beech (*Nothofagus menziesii*), and native vegetation, McLennan, SL (NNCNZ).

Distribution (Map 47). Like the other *Blandicephalanema* species, *B. pilatum* is closely associated with *Nothofagus* species, especially silver beech (*Nothofagus menziesii*). Its wide distribution along the west coast of the South Island and prevalence in Buller coincides with that of *B. nothofagi*. It does not seem to be restricted by altitude. It is present in small numbers in Southland and in the centre of the North Island.

TO, WN / NN, BR, OL, SL.

SUBFAMILY Macroposthoniinae Skarbilovich, 1959

Macroposthoniinae Ivanova, 1976
Madinematinae Khan, Chawla & Saha, 1967
Criconemellinae Khan & Saeed, 1985

Females. Body with 40–200 retrorse annules with smooth, rough, or crenate edges. Cuticular appendages (e.g. scales, spines), sheath, and lateral fields lacking.

Juveniles. Body annules retrorse with smooth, rough, or crenate margins, lacking cuticular appendages.

Nominal genera represented in New Zealand
Macroposthonia de Man, 1880. **Type genus**
Criconemoides Taylor, 1936

GENUS *Macroposthonia* de Man, 1880

Madinema Khan, Chawla & Saha, 1981
Mesocriconema Andrássy, 1965
Neobakernema Ebsary, 1981
Pakcriconemoides Shahina & Maqbool, 1993
Seshadriella Dareka & Khan, 1981.

Criconematinae. **Females**. Up to 0.8 mm in length. Body annules 40–150 in number, without distinct ornamentation. Lip region with 4 submedian lobes, separated by pseudolips transformed to labial plates. Stylet rigid. Vulva open. Tail terminus varying from rounded to pointed.

Males. Lateral field consisting of lateral ridge with 2–4 incisures, region rounded, caudal alae distinct.

Juveniles. Without scales or spines, but may have other types of ornamentation.

Type species *Macroposthonia annulata* de Man, 1880
=*Criconemoides kirjanovae* Andrássy, 1962; *Criconemella kirjanovae* (Andrássy, 1962) Luc & Raski, 1981; *Macroposthonia kirjanovae* (Andrássy, 1962) Siddiqi, 1986; *Mesocriconema kirjanovae* (Andrássy, 1962) Loof & De Grisse, 1989; *Neocriconema kirjanovae* (Andrássy, 1962) Diab & Jenkins, 1965.

Nominal species present in New Zealand
Macroposthonia campbelli sp. nov.
M. rustica (Micoletzky, 1915) De Grisse & Loof, 1965
M. xenoplax (Raski, 1952) De Grisse & Loof, 1965

Macroposthonia campbelli sp. nov.

Fig. 78

Measurements: Table 10.

Morphology. **Females**. Body gently curved ventrad to an open C, tapering anteriorly from base of stylet, posteriorly from about position of spermatheca, but generally more progressively posterior to anus. Between vulva and anus lateral line of lateral field distinctly visible as series of hemispherical notches in posterior edge of annules, gradually disappearing anterior to vulva and posterior to anus. Cephalic region with single annule. Lip region dome-shaped. Sublateral lobes, if present, small. Lip annule smooth, directed laterally, slightly set off from body annules. Body annules retrorse, on anterior part of body almost smooth, from approximately 10th annule becoming progressively more distinctly serrated. Anastomoses rare on body, common on tail. Cephalic sclerotisation prominent. Stylet rigid. Ovaries generally straight, reaching base of oesophagus. Spermatheca oval, offset, ventrad, filled with fine sperm about 1 µm in diameter. Vulval slit wide, open, not protruding outside the body contour. Outer edge of vulval lips serrated. Posterior to vulva, body generally narrowing ventrally giving postvulval region convex appearance and turning tail somewhat dorsad. Anus distinct, located on posterior 1/2 of postvulval region. Tail conically pointed, generally with single pointed terminus.

Males. Not observed.

Type host and locality. *Dracophyllum longifolium* along stream, North East Harbour, Campbell Island.

Type material. Holotype and 7 paratypes from the type locality, coll. T. K. Crosby, 13 November 1975. Holotype on slide 196, National Nematode Collection of New Zealand, Landcare Research, Auckland. Paratypes distributed as in Table 2 (p. 26).

Other material examined. None.

Differential Diagnosis. Of the *Macroposthonia* species with annules with a serrated posterior edge *M. campbelli* sp. nov. most closely resembles *M. citricola* Siddiqi, 1965 in that the lip annule is distinctly marked off from the next annules. It differs from *M. citricola* in that the lip region, observed laterally with light microscopy, shows no lateral lobes; some elevations could be interpreted as sublateral lobes but are much smaller than in *M. citricola*. *Macroposthonia campbelli* sp. nov. further differs from *M. citricola* in that it is slender (av. a = 12.5 v. 10), has a longer stylet (>55 µm v. <55) and more body annules (R >100 v. <80).

Distribution (Map 48). *Macroposthonia campbelli* has only been found on Campbell Island.

– / – / CA.

Etymology. *Macroposthonia campbelli* is named after Campbell Island the locality where it was found.

Remarks. *Macroposthonia* species are characterised by the presence of submedian lobes and an open vulva. Submedian lobes are lacking in *M. campbelli. Macroposthonia campbelli,* therefore, could be considered a new taxon. *Macroposthonia* species are especially common in the Northern Hemisphere with almost 20, of the just over 100 known species, occurring in Northern Europe. The submedian lobes may have evolved there. The new taxon resembling *Macroposthonia*, evolved in the Southern Hemisphere, may have failed to develop such lobes. For the time being, it is placed in *Macroposthonia,* as only species of the subfamily endemic to New Zealand.

Macroposthonia rustica (Micoletzky, 1915) De Grisse & Loof, 1965

Criconema rusticum Micoletzky, 1915; *Hoplolaimus rusticus* (Micoletzky, 1915) Menzel, 1917; *Mesocriconema rusticum* (Micoletzky, 1915) Loof & De Grisse, 1989

Criconemoides lobatus Raski, 1952; *Macroposthonia lobata* (Raski, 1952) Siddiqi, 1986

Madinema loma Khan, Chawla & Saha, 1976; *Criconemella loma* (Khan, Chawla & Saha, 1976) Luc & Raski, 1981; *Macroposthonia loma* (Khan, Chawla & Saha 1976) Siddiqi, 1986

Criconema quadricorne Kirjanova, 1948; *Criconemoides quadricornis* (Kirjanova, 1948) Raski, 1958; *Macroposthonia quadricornis* (Kirjanova, 1948) De Grisse & Loof, 1965; *Macroposthonia quadricornis* (Kirjanova, 1948) Ivanova, 1976; *Mesocriconema quadricorne* (Kirjanova, 1948) Ebsary, 1991

Macroposthonia rusium Khan, Chawla & Saha, 1976; *Criconemella rusium* (Khan, Chawla & Saha, 1976) Luc & Raski, 1981; *Mesocriconema rusium* (Khan, Chawla & Saha, 1976) Loof & De Grisse, 1989

Fig. 79a,b

Measurements: Table 10.

Morphology. **Females**. Body strongly curved ventrally, C-shaped, generally less than 0.5 mm long. Posterior margin of annules smooth. Anastomoses few or none. Head truncate with large submedian lobes. In some specimens lobes not distinctly elevated from lip cap and look like an anterior ring. Lip region continuous with contour of body. Stylet base anchor-shaped. Spermatheca empty. Vagina straight. Tail tip curved dorsad, last tail annules generally not extended, giving it a blunt appearance. Vagina straight.

Males. Not observed.

Diagnosis. *Macroposthonia rustica* can be recognised by the open vulva in combination with the large submedian lobes, giving the head a flat appearance, and the blunt, dorsally curved tail.

Type material examined. None.

Material examined. 47 females from old orchard, Waitakere Ranges, and One Tree Hill, Auckland, AK; improved pasture, Silverstream, Hutt Valley, WN; peas (*Pisum sativum*), Nayland Road, Nelson, NN; pigeonwood (*Hedycarya arborea*), toru (*Toronia toru*), fern, Cape Foulwind Westport, BR; *Pentachondra* sp. in subalpine vegetation, Porters Pass, MC; improved pasture, MAF biogas trial Invermay, SL; miro (*Prumnopitys ferruginea*), *P. taxifolia,* and other native vegetation, Winton, SL (NNCNZ).

Distribution (Map 49). *Macroposthonia rustica* is not very common, but has a very wide distribution. As it is a cosmopolitan species and mainly associated with cultivated plants it is considered an introduced species.

AK, WN / NN, BR, MC, SL.

Macroposthonia xenoplax (Raski, 1952) De Grisse & Loof, 1965

Criconemoides xenoplax Raski, 1952; *Criconemella xenoplax* (Raski, 1952) Luc & Raski, 1981; *Mesocriconema xenoplax* (Raski, 1952) Loof & De Grisse, 1989.

Fig. 79c–f

Measurements: Table 10.

Morphology. **Females**. Body straight or slightly curved ventrally. Up to 0.8 mm long. Anastomoses few or none. Annules on postvulval area may be finely serrated and have lateral incisures. Head with distinct submedian lobes, separated by labial plates. 1st lip annule follows contour of body. Annules retrorse, generally including lip annule. Stylet robust, knobs heavy, anchor-shaped. Vagina S-shaped. Spermatheca filled with sperm. Postvulval region, when contracted, about as long as wide. Last body annules generally not extended giving tail blunt appearance.

Males. Not observed

Differential diagnosis. *Macroposthonia xenoplax* can be recognised by its lip region with distinct sublateral lobes, the open vulva, S-shaped vagina, and blunt tail. It can be distinguished from *M. rustica* by its longer body (R = about 0.6 mm v. about 0.45 mm) and stylet (about 70 µm v. 55 µm) and the S-shaped vagina.

Type material examined. None.

Material examined. 32 females and 1 juvenile from *Leucopogon fasciculatus*, Western Springs mud flats, Auckland, AK; grape vine (*Vitis vinifera*) in home garden, Waikanae, WN; native vegetation and grass, Kina Beach, NN; flower garden, Wakefield, NN; cultivated soil, Cromwell, Otago, CO; peach tree (*Prunus persica*) orchard, Hanning Road, Alexandra, CO (NNCNZ).

Distribution (Map 50). *Macroposthonia xenoplax*, like *M. rustica,* is not very common, has a very wide distribution, is a cosmopolitan species mainly associated with cultivated plants, and considered an introduced species.

AK, WN / NN, CO.

GENUS *Criconemoides* Taylor, 1936

Criconemella De Grisse & Loof, 1965

Macroposthoniinae. **Females**. Body less than 1 mm long. Cuticle with less than 200 annules. Posterior edge of annules generally smooth but may be crenate or rough, without ornamentation. Cephalic annules not differentiated, continuous with contour of body. Submedian pseudolips may be modified to resemble lobes. Stylet generally rigid, less than 100 µm long. Vulva closed, anterior lip not overhanging, generally just protruding beyond the body contour. Tail terminus convex-conoid or rounded.

Males. Cephalic region rounded, lateral field with 3 or 4 lateral lines. Caudal alae present.

Juveniles. Without distinct ornamentation on the posterior edge of the body annules.

Type species. *Criconemoides morgensis* (Hofmänner in Hofmänner & Menzel, 1914) Taylor, 1936

=*Criconema morgense* Hofmänner in Hofmänner & Menzel, 1914; *Hoplolaimus morgensis* (Hofmänner, 1914) Menzel, 1917; *Criconemoides pseudohercyniensis* De Grisse & Koen, 1964; *Macroposthonia pseudohercyniensis* (De Grisse & Koen, 1964) De Grisse & Loof, 1965; *Mesocriconema pseudohercyniense* (De Grisse & Koen, 1964) Andrássy, 1965; *Neocriconema pseudohercyniense* (De Grisse & Koen, 1964) Diab & Jenkins, 1965; *Macroposthonia taylori* De Grisse & Loof, 1965; *Criconemoides taylori* (De Grisse & Loof, 1965) Siddiqi, 1986.

De Grisse & Loof (1965) proposed the name *Criconemella* for *Criconemoides* species with females <0.3 mm long, with fine, pointed, mostly crenate body annules and a trapezoid postvulval region. Siddiqi (2000) recognises *Criconemella* as a subgenus.

Subgenera present in New Zealand

Criconemoides Taylor, 1936
Criconemella De Grisse & Loof, 1965

Subgenus *Criconemoides* Taylor, 1936

Genus *Criconemoides*. **Females**. Body generally more than 0.3 mm long. Body annules coarse, postvulval region not trapezoid. Stylet rigid, more than 50 µm long.

Males with 4 lateral lines.

Type species. *Criconemoides* (*Criconemoides*) *morgensis* (Hofmänner in Hofmänner & Menzel, 1914) Taylor, 1936

As for type species of genus.

Nominal species present in New Zealand

Criconemoides (*Criconemoides*) *informis* (Micoletzky, 1922) Taylor, 1936

Criconemoides (*Criconemoides*) *informis* (Micoletzky, 1922) Taylor, 1936

Hoplolaimus informis Micoletzky, 1922; *Criconema informe* (Micoletzky, 1922) Micoletzky, 1925; *Criconemella informis* (Micoletzky, 1922) Ebsary, 1991; *Macroposthonia informis* (Micoletzky, 1922) De Grisse & Loof, 1965

Criconemoides complexus Jairajpuri, 1964; *Macroposthonia complexa* (Jairajpuri, 1964) De Grisse & Loof, 1965

Criconemoides fimbriatus Thorne & Malek, 1968

Criconemoides flandriensis De Grisse, 1964.

Fig. 80a–c

Measurements: Table 10

Morphology. **Females**. Stylet heavy, rigid, about 80 µm long. Lip region with distinct lip cap surrounded by 4 distinct labial plates. Lip annule funnel-shaped; edge directed laterally or curved anteriorly, narrower and thinner than 1st body annule. Annules gradually increasing to maximum thickness in 1st 4 body annules. Body annules retrorse, posteriorly smooth. Tail longer than wide, with last annule not fully extended, giving it a somewhat blunt appearance. Some anastomoses of annules in most specimens. Vulva closed.

Males. Not observed.

Diagnosis. As the only *Criconemoides* species present in New Zealand it can be easily recognised by distinct labial plates and funnel-shaped lip annule of smaller diameter than the 1st body annule. Body annules smooth. Stylet about 77 µm long, robust. Vulva closed, vulval lips not overlapping, vagina straight. Tail variable, rarely extended and pointed, more commonly somewhat rounded terminally.

Type material examined. None.

Material examined. 12 females and 2 juveniles from fig (*Ficus carica*) in the garden of the Cawthron Institute, NN (NNCNZ).

Distribution (Map 51). *Criconemoides informis* has so far only been found at a single site in Nelson.
– / NN.

Remark. Because it has only been found once within New Zealand, associated with an introduced plant species, *C.* (*C.*) *informis* must be considered an introduced species.

Subgenus *Criconemella* De Grisse & Loof, 1965

Genus *Criconemoides*. **Females**. Body small, less than 0.3 mm long. Body annules fine, more than 90 in number. Postvulval region trapezoid. Stylet generally less than 40 µm long.

Males. With 3 lateral lines.

Nominal species present in New Zealand
Criconemoides (*Criconemella*) *parvus* Raski, 1952

Criconemoides (*Criconemella*) *parvus* Raski, 1952

Criconemella parva (Raski, 1952) De Grisse & Loof, 1965
Criconemoides microserratus Raski & Golden, 1966; *Criconemella microserratus* (Raski & Golden, 1966) Siddiqi, 1986
Neocriconema adamsi Diab & Jenkins, 1965; *Criconemoides adamsi* (Diab & Jenkins, 1965) Tarjan, 1966; *Criconemella adamsi* (Diab & Jenkins, 1965) Siddiqi, 1986.

Fig. 80d,e

Measurements: Table 10.

Morphology. **Female**. Anteriorly body gradually tapers. Lip region flat because labial lobes and labial disc are located in one plane. Sometimes lobes somewhat elevated showing flat anterior with 2 fine lateral points projecting. 1st 2–3 annules gradually increasing in width. Body annules fine, <2 µm wide. Posterior edges of annules retrorse, finely serrated, in cross section resembling cutting edge of fine, steel saw-blade. Body annule immediately anterior to vulva generally projecting somewhat from body contour. Anastomoses not uncommon. Vulva open. Post vulval region convex-triangular, tail end generally bluntly rounded. Spermatheca filled with sperm.

Males. Not observed.

Differential diagnosis. *Criconemoides* (*C.*) *parvus* can be easily recognised by its short body, finely crenate, fine annulation of the body, shortish stylet of <50 µm, open vulva, and rounded postvulval area.

Type material examined. None.

Material examined. 117 females from mixed native forest, Greystoke Forest Reserve Marton, WI; *Coprosma* sp., sycamore (*Acer pseudoplatanus*), pine (*Pinus radiata*), Rai Valley opposite bridge to Okiwi Bay, SD; black beech (*Nothofagus solandri*), tree fuchsia (*Fuchsia excorticata*), and totara (*Podocarpus totara*) in native vegetation, Moss Picnic Area, Motueka, NN; totara (*P. totara*) in mixed native forest, Lee Valley, NN; five finger (*Pseudopanax arboreus*) and other native vegetation, Kumara Junction, WD; miro (*Prumnopitys ferruginea*), *Hymenanthera* sp., *Hebe* sp., and five finger (*Pseudopanax arboreus*) in mixed native forest, Haast River bank, WD; *Hymenanthera* sp. in mixed native forest, Redwood Pass Road, Blenheim, MB; manuka (*Leptospermum scoparium*), *Coprosma* sp., and other vegetation, Winton, SL (NNCNZ).

Distribution (Map 52). *Criconemoides* (*Criconemella*) *parvus* has been found almost exclusively associated with native vegetation. It could be a native species but as it is cosmopolitan it is considered introduced. It is fairly common at lower altitude in the coastal regions of the South Island. It has not yet been obtained from the east coast but is expected to be present there. In the North Island it has been found only once, at a site of similar latitude as the most northern finds of the South Island. Climatic conditions may have prevented it from spreading further north.
WI / SD, NN, WD, MB, SL.

SUBFAMILY Hemicriconemoidinae Andrássy, 1979

Criconematidae. **Females**. Body with double cuticle. Both cuticles closely associated and appearing as 1. Annules round, rarely retrorse, lacking scales spines or other ornamentation. Lateral field lacking, lateral groove may be present. Cephalic region with 2 or 3 annules. Submedian lobes absent. Vulva open or closed.

Males. As characteristic for family. Lateral field usually with 4 lines. Caudal alae present or absent.

Juveniles. With single cuticle, usually with alternating rows of scales or spines.

Nominal genera present in New Zealand.
Hemicriconemoides Chitwood & Birchfield, 1957 (**type genus**).

GENUS *Hemicriconemoides* Chitwood & Birchfield, 1957

Iota Cobb, 1913

Hemicriconemoidinae. As only genus it takes the diagnosis of the subfamily.

Type species. *Hemicriconemoides wessoni* Chitwood & Birchfield, 1957.

=*Hemicycliophora wessoni* (Chitwood & Birchfield, 1957) Goodey, 1963; *Hemicriconemoides annulatus* Pinochet & Raski, 1975

Nominal species present in New Zealand

Hemicriconemoides cocophillus (Loos, 1949) Chitwood & Birchfield, 1957

Hemicriconemoides cocophillus (Loos, 1949) Chitwood & Birchfield, 1957

Criconemoides cocophillus Loos, 1949; *Hemicycliophora cocophilla* (Loos, 1949) Goodey, 1963

Fig. 81

Measurements: Table 11.

Morphology. **Females**. Body curved gently ventrad, rarely to open C. Tapering anteriorly from base of stylet, posteriorly approximately from 1/2 body width anterior to vulval area, more acutely posterior to vulva. Body annules smooth, anastomoses rare. Cephalic region truncate with 2 annules not set off from rest of body, distinct from body annules because they are rounded, direct laterally and have thin cuticle. Body annules retrorse with angular appearance. Cephalic sclerotisation distinct. Stylet short, flexible, stylet base anchor-shaped. Excretory pore not observed. Vulva distinct, open, with 2 rounded lips protruding from body contour about as far as body annules. Vagina straight to slightly curved, about 2/3 body width long, angled anteriad. Spermatheca subspherical, offset, ventrad, filled with small sperm. Tail conical. Tail terminus with 2 distinct annules that look fused. Anus generally visible as slightly shorter annule halfway along postvulval area.

Males. Not observed.

Differential diagnosis. *Hemicriconemoides cocophillus* is the only representative species of the genus in New Zealand. It can therefore be easily recognised by characters of the genus. Both cuticles closely associated and appearing as 1. Annules round, rarely retrorse, lacking scales, spines, or other ornamentation. Lateral field lacking, lateral groove may be present. Cephalic region with 2 or 3 annules. Submedian lobes absent.

Type material examined. None.

Material examined. 102 females from rata (*Metrosideros robusta*) in mixed native forest, Tutamoe, ND; native forest, near summit road tunnel on Mount Messenger, TK; rata (*M. robusta*), rimu (*Dacrydium cupressinum*) and Q*uintinia* sp. in mixed native forest, Mawhera State Forest, BR; lancewood (*Pseudopanax crassifolium*) and rimu (*Dacrydium cupressinum*) in native vegetation, Hokitika, WD; *Poa foliosa* and mosses, Stewart Is, SI (NNCNZ).

Distribution (Map 53). *Hemicriconemoides cocophillus* has been found exclusively associated with native vegetation, but is a cosmopolitan species and not considered native to New Zealand. It has a wide distribution being found at low altitude from Tutamoe in the north to Stewart Island in the south. Although not very commonly encountered in soil samples, it is not rare.

ND, TK / BR, WD, SI.

Remarks. The characteristics listed here vary somewhat from those presented in the original description and presented in the literature generally. The specimens measured are shorter (L= 0.32–0.40 v. 0.40–0.56 mm) and have a shorter stylet (44–48 v. 47–58 µm) and shorter tail (c=20–34 v. 13–18), and the morphology of the lip and the tail terminus is different. The lip region illustrated by Loos (1949) in the original description of the species and by Dasgupta *et al.* (1969) has a more or less distinct labial disc, followed by a rounded lip annule. They illustrate a tail that regularly tapers to a conical terminus. In the New Zealand material a labial disc is absent and the 2 annules of the tail terminus look fused because they are not retrorse, but follow the body contour. Despite these differences the material studied is considered H. *cocophillus*. The differences in body length and lip and tail morphology are probably due to differences in degree of relaxation at time of fixation. Differences in stylet length cannot be explained other than that populations in different countries may show minor variations in this character. The long tail measured by Dasgupta *et al.* (1969) may be the result of a misdiagnosis of the position of the anus. In the New Zealand material the anus is consistently located near the middle of the postvulval region.

SUPERFAMILY **Tylenchuloidea** Skarbilovich, 1947

Tylenchulidoidea Raski & Siddiqui, 1975; Tylenchocriconematoidea Raski & Siddiqui, 1975

Criconematina. **Females**. Body small, cuticle thin, finely annulated. Lip region not set off, isthmus slender and well differentiated, anus non-functional.

Males. Non-feeding. Stylet and oesophagus degenerate or lacking. Spicules arcuate with pointed tail.

Juveniles. Slender, straight to arcuate, stylet well developed.

Tylenchuloidea families represented in New Zealand

Tylenchulidae Skarbilovich, 1947
Sphaeronematidae Raski & Sher, 1952
Paratylenchidae Thorne, 1949

FAMILY Tylenchulidae Skarbilovich, 1947 (Kirjanova, 1955)

Tylenchuloidea. **Females**. Body elongate obese, ventrally curved, with distinct postvulval region. Stylet <16 µm long; knobs rounded. Secretory–excretory pore usually well posterior to the level of the base of the oesophagus, producing gelatinous matrix. Tail present, short.

Males. As typical for the superfamily.

Juveniles. Slender, straight to slightly arcuate. Stylet well developed.

Nominal genera present in New Zealand
Tylenchulus Cobb, 1913 (**type genus**)
Trophotylenchulus Raski, 1957

GENUS *Tylenchulus* Cobb, 1913

Tylenchulidae. **Females**. Body enlarged behind median bulb, to width of up to 100 µm. Neck long, distorted by plant tissue. Middle part of body ventrally arcuate, not spiral-form, posterior to vulva acutely narrowing. Postvulval region elongate. Tail tapering to narrow rounded terminus; tail peg may be present. Stylet <16 µm long; knobs distinct. Excretory system opening at about 75% of body length, producing gelatinous matrix in which eggs are deposited. Young female slender, secretory–excretory pore at about 80% of body length.

Males. Excretory pore at about 55% of body length. Caudal alae lacking. Tail tapering to narrow, rounded terminus.

2nd-stage juveniles. Body slender, lateral field with 2 incisures. Deirids present. Excretory pore at about 55%. Stylet <16 µm long; knobs distinct, rounded. Tail elongate; terminus rounded.

Nominal species present in New Zealand
Tylenchulus semipenetrans Cobb, 1913 (**Type species**)

Tylenchulus semipenetrans Cobb, 1913

Fig. 82

Morphology. **Mature females**. Sedentary. Neck long, embedded in host tissue. Exposed part of body swollen, mostly on dorsal side, ventrally arcuate; postvulval region gradually tapering to rounded terminus or tail peg. Excretory pore close to vulva, surrounded by papilla-like outgrowths, produces gelatinous matrix in which eggs are deposited.

Late 4th stage juveniles. Migratory, slightly swollen, slightly curved ventrally.

Males. Slender and straight. Stylet and oesophagus degenerate.

2nd stage juveniles. Slender, almost straight, lateral field with 2 incisures. Deirids present. Excretory pore just below 50% of body length, rectum and anus obscure. Tail conically pointed with fine rounded tip.

Differential diagnosis. *Tylenchulus semipenetrans* can be easily distinguished from most other plant-parasitic species by its swollen females. It can be distinguished from the cyst-species of the family Heteroderidae (Hoplolaimina) and the root-knot nematodes of the family Meloidogynidae (Hoplolaimina) by the presence of a distinct, tail-shaped postvulval region. It can be distinguished from *Trophotylenchulus* (Tylenchina) species, its nearest relatives in this country, by its non-spiral-shaped females.

Type material examined. None.

Material examined. *Tylenchulus semipenetrans* on citrus (*Citrus* sp.) can be easily recognised. Therefore, in the past, no reference material has been deposited in the National Collection. The information presented here is from written records only and from information in the literature.

Distribution (Map 54). *Tylenchulus semipenetrans* is an introduced species, causing damage to some older citrus trees not grafted on resistant strains of *Poncirus trifoliata* rootstock. In the early 1980s it was also found associated with Pinotage grapes (*Vitis vinifera*) in the Waikato, WO, and with Riesling in Hawkes Bay, GB. Knight (2001) reports it from persimmon (*Diospyros kaki*), Northland, Auckland, and Gisborne and avocado (*Persea americana*), Gisborne. It seems to be restricted to the North Island.

ND, AK, WO, GB / –.

GENUS *Trophotylenchulus* Raski, 1957

Ivotylenchulus Hashim, 1984; *Trophonema* Raski, 1957

Tylenchulidae. **Mature females**. Sedentary, swollen, neck embedded in host tissue, exposed posterior part swollen, mostly on dorsal side, coiled ventrally for more than 360°. Stylet about 15 µm long. Excretory pore at level of isthmus; secretory–excretory duct with large cell that produces gelatinous substance for matrix on egg-laying female. Postvulval region gradually tapering to rounded or pointed terminus.

Males. Excretory pore at less than 60% of body length.

2nd stage juveniles. Hatch from eggs. Body slender, almost straight, lateral field with 2 incisures. Deirids present. Excretory pore at about 25% of body length. Tail conically pointed with fine rounded tip. Migratory, probably until they have established feeding site.

3rd and 4th stage juveniles gradually increasing in size, relax in single helix or loose coil.

Type species *Trophotylenchulus floridensis* Raski, 1957
=*Tylenchulus floridensis* (Raski, 1957) Maggenti, 1962

Nominal species present in New Zealand
Trophotylenchulus okamotoi (Minagawa, 1983) Siddiqi, 2000

Trophotylenchulus okamotoi (Minagawa, 1983) Siddiqi, 2000

Trophonema okamotoi Minagawa, 1983
Fig. 83

Measurements: Table 11.

Morphology. **Young females**. Body swollen, coiled in double helix, tapering anteriorly and posteriorly from midbody. Head conically tapering to narrow anterior end. Stylet distinct, stylet base anteriorly tapering or rounded. Dorsooesophageal gland orifice about width of stylet base below level of stylet base. Procorpus long, gradually widening to amalgamate with median bulb; median bulb elongate, lemon-shaped, with large valve. Isthmus narrow. Basal bulb pyriform. Excretory pore immediately behind hemizonid, near level of anterior end of basal bulb. Ovaries well developed, anteriorly almost reaching base of oesophagus, posteriorly extending about 1/2 a body width beyond vulva. Vulva a transverse slit with prominent lips. Anus slightly protruding from body contour. Tail strongly curved ventrad, conically pointed with rounded terminus, terminus pointing towards anus. Older females more strongly swollen between base of oesophagus and vulva.

Late 4th stage juveniles. As young females, but excretory–secretory cell very large, almost as long as length of oesophagus, with large nucleus at distal end. Anus bulging distinctly outside body contour.

Infective, resistant 2nd stage juveniles. Body slender, about 15 µm wide, slightly curved ventrally, more strongly in tail region, tapering anteriorly from level of median bulb, posteriorly from anus. Head dome-shaped with blunt anterior end. Stylet of similar size as in female, basal knobs large. Dorsal oesophageal gland opening about 1/2 body width below stylet base. Procorpus long and narrow with basal part gradually widening to amalgamate with elongate oval median bulb. Median bulb with large suction valve. Isthmus narrow, with nerve ring around middle section, posteriorly gradually widening to form elongate basal bulb with 3 distinct nuclei. Cardiac valve distinct in most specimens. Excretory pore at level of nerve ring, with long duct leading to large secretory–excretory cell almost at midbody; this cell almost filling body width, about 5 body widths long, with large nucleus in posterior 1/2. Hemizonid more or less at level of secretory–excretory pore. Genital primordium oval, almost filling width of body, located in posterior 1/3 of body. Anus not pronounced, generally recognisable by refractive caudalid. Tail conically tapering to narrow, rounded, sometimes set off, digitate terminus. Lateral field and deirids not observed.

Males were present in the sample, but because several criconematid species were represented in the sample their allocation to a specific species was uncertain.

Differential diagnosis. The identification of the Fiordland material as *Trophotylenchulus okamotoi* is based on the original description of the species by Minagawa (1983) and findings by Gomez Barcina & Castillo (1990) and Inserra *et al.* (1993). According to these authors *T. okamotoi* is very similar to *T. arenarium* (Raski, 1956) Siddiqi, 1999 but like the Fiordland material differs from it by the tail terminus being bluntly rounded or narrowly rounded as against pointed or minutely digitate. The morphometrics obtained from the Fiordland material agree well with those presented for *T. okamotoi* by Brzeski (1998).

Type material examined. None.

Material examined. 21 females and 34 juveniles from *Chionochloa pallens* around the lakes at Tutoko Bench, FD. 8 infective juveniles and 2 males of an unidentified *Trophotylenchulus* species were found on native vegetation, Kaiangaroa Forest, Rotorua, BP; kowhai (S*ophora microphylla*) in silver beech (*Nothofagus menziesii*) forest, on bank of Riwaka River, at the foot of Takaka Hill, NN; and *Halocarpus bidwilli*, Mt Domett, NN (NNCNZ).

Distribution (Map 55). *Trophotylenchulus okamotoi* has only been identified positively from Tutoko Bench, Fiordland, but specimens from Rotorua and Nelson probably belong to the same species. The species therefore seems to be rare but with wide distribution. As it occurs worldwide it is not considered native to New Zealand.

BP? / NN?, FD.

FAMILY Sphaeronematidae Raski & Sher, 1952

Meloidoderitidae Kirjanova & Poghossian, 1973

Tylenchuloidea. **Adult females** spherical or subspherical, secretory–excretory pore located in oesophageal region. Length of the stylet 15 µm or less, conus and shaft of equal length or conus slightly longer, knobs rounded. Isthmus slender. Vulva a transverse slit, terminal. Uterus swells to form a thick-walled chamber that fills most of the body cavity. Tail absent. Males and juveniles as typical for the superfamily.

Nominal genera present in New Zealand

Sphaeronema Raski & Sher, 1952 (**type genus**)

GENUS *Sphaeronema* Raski & Sher, 1952

Sphaeronematidae. **Mature females**. Sedentary, neck embedded in host tissue, exposed posterior part swollen on dorsal and ventral side, spherical. Stylet short, about 20 µm long. Excretory pore at level of isthmus. Vulva terminal, usually with distinct vulval lips.

Males. Body slender and straight, non-feeding. Stylet and oesophagus degenerate, caudal alae lacking.

2nd stage juveniles. Hatching from egg, slender, almost straight, migratory. Oesophageal glands usually confined to basal bulb, but overlap intestine considerably in some species. Deirids present. Tail conically pointed with finely rounded or pointed tip.

Type species and only species present in New Zealand.
Sphaeronema californicum Raski & Sher, 1952

Sphaeronema californicum Raski & Sher, 1952

Fig. 84

Measurements: Table 12.

Morphology. **Females**. Body hemispherical, about 0.3 mm in diameter. Cuticle swollen, about 5 µm thick. Lip region anteriorly flat or concave. Stylet about 16 µm long, stylet base round or slightly sloping anteriorly. Neck about 50 µm long, irregular in shape with local swellings especially near level of opening of dorsal oesophageal gland, possibly to accommodate accumulating glandular material in swollen duct of dorsal gland. Median bulb with large suction valve, located at base of neck in younger females, but in anterior part of body in fully swollen females. Oesophageal glands extended lobes, draped ventrally along inner surface of female body. Excretory pore distinct, short distance below base of neck, at level of oesophageal glands. Young females with large central cavity connected to vulva; in fully swollen females this cavity may contain a few eggs, reproductive system fills body. Vulva prominent, vulval lips dome-shaped, distinctly projecting from posterior part of body. Anus not observed.

Males. Body slender, arcuate to C-shaped. Slightly longer than the juveniles. Non-feeding. Head conical, flat anteriorly, with 3–4 faint annules, not set off from rest of body. Cephalic framework faintly developed. Stylet absent. Oesophagus visible in some specimens, median bulb and basal bulb degenerate. Excretory pore and hemizonid near level of base of oesophagus. Testes about 1/3 body length long, filled with sperm about 1.5 µm in diameter, fill body. Spicules paired, with distinct manubrium, shaft curved ventrally. Gubernaculum curved distinctly stronger then adjacent part of spicules. Bursa not observed. Tail tapering gradually to finely pointed terminus.

Juveniles. Body slightly curved ventrally, especially in the tail region. Head dome-shaped with slight indentation anteriorly, distinctly wider than high. Cephalic framework prominent. Stylet short, heavy, shaft and conus of about equal length. Stylet knobs rounded anteriorly with distinct cavity posteriorly. Opening of dorso-oesophageal gland about 4 µm from base of stylet. Oesophagus narrowing somewhat anterior to median bulb. Median bulb elongate, about twice as long as wide, it widest part generally filling body cavity, with distinct valve. Isthmus narrow. Nerve ring indistinct. Oesophageal glands in irregularly shaped basal bulb distinctly overlap the intestine in most specimens. Nucleus of the dorsal gland approximately at middle of basal bulb, nuclei of the subventral glands in posterior 1/2 of the basal bulb. Hemizonid distinct. Excretory pore at level of hemizonid, less than 1 body width below median bulb. Genital primordium located at about 80% of body length, its size probably depends on level of development of juvenile; small, elongate and not filling body in younger specimens and about 1.5 body lengths long, with rounded anterior and posterior ends and filling body in more developed juveniles. Anus and rectum obscure in most specimens. Tail gradually tapering to fine, sometimes bluntly rounded terminus. A minute mucron may be present.

Differential diagnosis. *Sphaeronema californicum* is characterised by the perfectly round smooth body of the fully developed female, less than 0.5 mm in diameter, with distinctly protruding vulval lips on its posterior end. The juvenile is about 0.45 mm and the stylet about 15 µm long and the tail terminus generally somewhat blunt.

Type material observed. None.

Other material observed. 8 females, 2 males, 18 juveniles, kowhai (*S. microphylla*), foot of Takaka Hill, NN; 44 females and 10 juveniles, kowhai (*Sophora microphylla*), Progress Valley, near Niagara, SL; 3 males, 9 juveniles, five finger (*Pseudopanax arboreus*), Taiko Camp, Chatham Is. (NNCNZ).

Distribution (Map 56). *Sphaeronema californicum* was obtained from a pure stand of kowhai at Progress Valley, about 10 km from the southernmost coast of the South Island. It propagated well on kowhai in the glasshouse and this native plant species must be considered its natural host. *Sphaeronema* material was also obtained from the bank of the Riwaka River, at the foot of the Takaka Hill, a habitat very similar to that of Progress Valley, consisting of mixed vegetation including kowhai, and from the Chatham Is. The Nelson material, however, has distinctly shorter juveniles and the Chatham I. material shows morphological characteristics different from both the Southland and Nelson population. They could each represent a different species. Because of insufficient material none of the populations could be identified with certainty or described in detail. None of the material is in perfect agreement with the description of *S. californicum* but as each population shows some of its characteristics they are all identified as that species. On Map 56 the localities of all 3 populations are indicated.

– / NN, SL / CH.

Remarks. Siddiqi (2000) split up the subfamily Sphaeronematinae: *Sphaeronema* for species with a basal bulb and the vulva on a cone-like protuberance; *Goodeyella* Siddiqi, 2000 for species with a basal bulb but without a vulval protuberance; *Tumiota* Siddiqi, 2000 for species with no basal bulb but with the glands overlapping the intestine and no vulval protuberance. The New Zealand specimens from kowhai have no basal bulb but the vulva is located on a distinct vulval protuberance. This is the 4th possible combination of these 2 characteristics and could justify the recognition of this material as a new genus. This, however, would create a group of similar genera that, except for *Sphaeronema,* are each represented by a single species. They are here considered variations within, and synonyms of S*phaeronema*. A comparison of the morphometrics of the 3 populations from New Zealand shows that there are considerable differences between them. When sufficient material becomes available each may prove to be a different species. The Chatham I. specimens are the largest of the 3 populations. The juveniles on average are 495 µm long as compared to 425 in the Niagara and 380 in the Nelson population. These greater dimensions are reflected in all body parts measured. The stylet is longer, the oesophagus is longer, the stylet knobs are heavier, and the genital primordium is located further posteriorly (Table 12). Only the hyaline part of the tail seems to be shorter or absent in the Chatham I. specimens. It is further different in that the juvenile tail terminus, although very narrow, is more or less rounded and may have a mucron, while it is sharply pointed in the other populations. It appears that in *Sphaeronema,* species with larger juveniles produce females of greater diameter. The transition from infective juvenile to young female seems to take place at a considerable loss to body length, the minimum body length of the female in all populations being only a fraction of the minimum juvenile length, especially in species with short juveniles (*S. californicum* and *S. minutissimum* Goodey, 1958, 34%; *S. cornubiense* Van den Berg & Spaull, 1982, 37%) with the female length remaining small also in its later development. Species with longer juveniles take a much smaller loss (*S. rumicis* Kirjanova, 1970, 58%; and *S. whittoni* Sledge & Christie, 1962, 83%) and may recover from it, developing into females longer than the infective juveniles (*S. whittoni* juvenile length = 430 µm, maximum female length = 650 µm). This phenomenon is also reflected in the New Zealand populations.

The Nelson population with a juvenile length of 380 µm is closest to *S. californicum*. The female length of 340 µm is considerably greater than the maximum of 209 µm reported for *S. californicum* females, but this may be a reflection of the more efficient extraction of swollen nematodes from Nelson by the sugar flotation method. From the New Zealand material it seems that the length of the female may be reflected by the relative position of the genital primordium of the juvenile. The position of the primordium is at 70% in the longer Chatham I. juveniles and at 66% in the other populations. It could be envisaged that in the transformation to female the juvenile body posterior to the genital primordium is lost. With the genital primordium proportionally more posterior in longer specimens a greater part of the juvenile body is retained and the development of a larger female with a greater diameter results. The female length of the Chatham I. population is not given because only a single, distorted female was available. This female however had the largest diameter of all specimens available.

FAMILY **Paratylenchidae** Thorne, 1949

Tylenchocriconematidae Raski & Siddiqui, 1975

Tylenchuloidea. **Females**. Vermiform, curving ventrally when relaxed, less than 0.5 mm long. Remaining elongate when swollen. Lateral field present. Stylet well developed, conus may be twice as long as shaft; knobs rounded. Isthmus slender, basal bulb small. Excretory pore at level of base of oesophagus; secretory–excretory cell not enlarged. Vulva with or without lateral cuticular flaps. Postvulval uterine sac short or lacking. Males and juveniles as typical for the superfamily.

Nominal genera present in New Zealand

Paratylenchus Micoletzky, 1922 (**type genus**)

GENUS ***Paratylenchus*** Micoletzky, 1922

Gracilacus Raski, 1962; *Paratylenchoides* Raski, 1973
Gracilpaurus Ganguly & Khan, 1990

Paratylenchidae. **Females**. Body slender, sometimes slightly obese but never cylindroid, bent ventrad. Cuticle finely annulated. Vulva a large transverse slit. Ovaries without postvulval uterine sac. Postvulval region ventrally curved, longer than vulval body width, gradually tapering to a sharp or rounded terminus.

Males. Stylet and oesophagus degenerate or absent. Spicules small, ventrally curved, cephalated. Caudal alae absent in New Zealand species.

Juveniles. May have fully developed oesophagus and stylet.

Type genus. *Paratylenchus bukowinensis* Micoletzky, 1922.

Raski (1962) introduced the genus *Gracilacus* for species with a stylet longer than 43 µm. This taxon was recognised by Siddiqi (1986, 2000) as subgenus.

Subgenera present in New Zealand

Paratylenchus Micoletzky, 1922
Gracilacus Raski, 1962

Remarks. Only a small number of *Gracilacus* species is present but *Paratylenchus* is widely distributed in New Zealand, both in cultivated fields and in native environments. Although *P. halophilus* was the first plant-parasitic nematode described from New Zealand, species of the genus have never been actively searched for, identified, or studied except in surveys carried out by the Ministry of Agriculture and Forestry. Knight (2001) recently published the result of one such survey. The species identified in these surveys are those listed below under nominal species present in New Zealand. *Paratylenchus halophilus*, the only species of which material is held in the National Nematode Collection, will be described. Of the other species no more than a name is known, therefore, no detailed descriptions, illustrations, or distribution maps are provided. They can be identified with the key following this section, based on characters from the literature (Esser 1992; Siddiqi 2000).

Subgenus *Paratylenchus* Micoletzky, 1922

Paratylenchoides Raski, 1973

Genus *Paratylenchus*. **Females** vermiform. Excretory pore near region of basal oesophageal bulb. Stylet 12–40 µm long.

Type species. *Paratylenchus bukowinensis* Micoletzky, 1922

Nominal species present in New Zealand

Paratylenchus (*Paratylenchus*) *elachistus* Steiner, 1949
P. (*P.*) *halophilus* Wouts 1966
P. (*P.*) *minutus* Linford, 1949, in Linford, Oliveira & Ishii 1949
P. (*P.*) *nainianus* Edward & Misra, 1963
P. (*P.*) *nanus* Cobb, 1923
P. (*P.*) *neoamblycephalus* Geraert, 1965
P. (*P.*) *projectus* Jenkins, 1956
P. (*P.*) *tateae* Wu & Townshend, 1973

Key to the females of *Paratylenchus* species present in New Zealand

1 Stylet >50 µm long 2

— Stylet <40 µm long 3

2(1) Spermatheca ovoid to ovoid-elongate .... ***P.* (*Gracilacus*) *aonli***

— Spermatheca spherical .... ***P.* (*G.*) *straeleni***

3(1) Average length female stylet <22 µm 4

— Average length female stylet >22 µm 6

4(3) Female head conoid, lips projecting with rectangular outline .... ***P.* (*Paratylenchus*) *tateae***

— Female head rounded to conoid-truncate 5

5(4) Average length of stylet 20–22 µm, tail slender conoid, terminus finely rounded to acute .... ***P.* (*P.*) *elachistus***

— Average length of stylet 16–18 µm, tail evenly conoid, terminus rounded .... ***P.* (*P.*) *minutus***

6(3) Average L <300 µm, secretory–excretory pore <55 µm from anterior end, submedian lobes distinct .... ***P.* (*P.*) *nainianus***

— Average L >300 µm, secretory–excretory pore >60 µm from anterior end, submedian lobes obscure 7

7(6) Head conoid-truncate, slightly set off 8

— Head rounded to rounded-truncate, not set off 9

8(7) Tail finely conoid, terminus rounded, sometimes narrowly digitate, males present ....(p. 79)... ***P.* (*P.*) *halophilus***

— Tail bluntly rounded or bluntly digitate, males absent .... ***P.* (*P.*) *projectus***

9(7) Tail subacute .... ***P.* (*P.*) *nanus***

— Tail slender conoid to finely rounded terminus .... ***P.* (*P.*) *neoamblycephalus***

Paratylenchus (*Paratylenchus*) *halophilus* Wouts ,1966

Fig. 85

Measurements: Table 11.

Morphology. **Females**. Body cylindrical, usually assuming open C after being killed by gentle heat, gradually tapering anteriorly from stylet base and posteriorly from vulval region. Tail terminus finely pointed or digitate, not annulated. Tail often slightly swollen near terminus. Body width at midbody about 15 µm. Body annules about 1.3 µm wide. Lateral field with 4 equally spaced incisures. Deirids and phasmids not observed. Dorsal oesophageal gland orifice about 3.2 µm behind stylet. Hemizonid slightly raised. Excretory pore at level of hemizonid. Spermatheca almost spherical, about 10 µm in diameter. Vulval flaps inconspicuous. Anus indistinct, number of tail annules about 20.

Males. Lateral field with 4 equally spaced incisures. Stylet and oesophagus degenerate. Hemizonid conspicuous, secretory–excretory pore near hemizonid. Spicules almost straight, distal end curved. Tail about 10 µm long, tapering abruptly from middle of tail, terminus extended, and sharply pointed.

Differential diagnosis. *Paratylenchus* (*P.*) *halophilus* resembles *P.* (*P.*) *tenuicaudatus* Wu, 1961 and *P.* (*P.*) *minusculus* Tarjan, 1960 in stylet length and position of the vulva. It differs from these species in having a digitate, finely pointed tail. The females are smaller than *P.* (*P.*)

tenuicaudatus and larger than *P.* (*P.*) *minisculus* females. It further has more closely spaced transverse cuticular striae than *P.* (*P.*) *tenuicaudatus* (annule width 1.3 µm v. 1.5–3.0 µm), a dorsal gland orifice closer to the base of the stylet (3.2 µm v. 6–9 µm), a shorter tail (30 µm v. 37–58 µm) with fewer transverse cuticular striae (15–20 v. 26–35) and the presence of males. It has a less distinctive post vulval uterine branch than *P.* (*P.*) *minusculus*, and fewer transverse cuticular striae on the tail (15–20 v. 28–30) (Wouts 1966).

Type material examined. 1 female holotype and 9 female and 7 male paratypes, *Sarcocornia australis*, Rough Island, NN, NZMS260 N27 216916. coll. W. M. Wouts (NNCNZ).

Other material examined. None

Distribution (Map 57). *Paratylenchus* (*P.*) *halophilus* has been found only on Rough Island, Nelson, NN.
– / NN.

Subgenus *Gracilacus* Raski, 1962

Gracilpaurus Ganguly & Khan, 1990

Genus *Paratylenchus*. **Mature females** generally swollen in prevulval region. Female stylet 41–119 µm long, flexible. Position secretory–excretory pore variable from near stylet base to opposite nerve ring.

Type species. *Gracilacus epacris* (Allen & Jensen, 1950) Raski, 1962 (=*Paratylenchus* (*Gracilacus*) *epacris* (Allen & Jensen, 1950) Goodey, 1963).
=*Cacopaurus epacris* Allen & Jensen, 1950; *Paratylenchus epacris* (Allen & Jensen, 1950) Goodey, 1963.

Nominal species present in New Zealand
Paratylenchus (*Gracilacus*) *aonli* Misra & Edward, 1971
P. (*G.*) *straeleni* (De Coninck, 1931) Oostenbrink, 1960

SUPERFAMILY Hemicycliophoroidea Skarbilovich, 1959

Criconematina. **Females**. Body more than 0.5 mm long, vermiform, straight to arcuate, cuticle thick, annules wide and round. Submedian lobes lacking. Stylet more than 50 µm long, stylet base rounded. Isthmus short and wide. Reproductive system monodelphic, prodelphic.

Males. With degenerate oesophagus and no stylet. Caudal alae prominent. Spicules long, strongly curved. Single hypoptygma on posterior lip of cloaca.

Type and only family represented in New Zealand
Hemicycliophoridae Skarbilovich, 1959

FAMILY Hemicycliophoridae Skarbilovich, 1959

Hemicycliophoroidea. **Females and juveniles** with double cuticle. Both cuticles of approximately equal thickness and interconnected in lip region; vulval lips protruding.

Males. With single cuticle. Spicules strongly curved, semicircular, U- or hook-shaped.

Type and only genus represented in New Zealand
Hemicycliophora de Man, 1921

GENUS *Hemicycliophora* de Man, 1921

Procriconema Micoletzky, 1925

Hemicycliophoridae. **Females**. Body almost straight with double cuticle, distinctly recessed behind vulva. Cephalic region broadly rounded, not set off from rest of body. Vulva wide. Tail elongate.

Males. Spicules semicircular. Cloacal lips form penial tube. Caudal alae adanal.

Juveniles. Resembling females except for sexual characteristics.

Type species *Hemicycliophora typica* de Man, 1921
=*Procriconema membranifer* Micoletzky, 1925; *Hemicycliophora membranifer* (Micoletzky, 1925) Loos, 1948.

Nominal species present in New Zealand
Hemicycliophora chathami Yeates, 1978
H. halophila Yeates, 1967

Remarks. The genus *Hemicycliophora* is not rare in New Zealand. From the material available it is apparent that several different species are represented, some probably undescribed. The material, however, has never been studied in detail and identified to species. Only the 2 species described from New Zealand will be diagnosed and discussed further, with the populations that could belong to these species listed.

Hemicycliophora chathami Yeates, 1978

Fig. 86c–h

Measurements: Table 13.

Morphology. **Female**. Body slender, slightly curved ventrad when killed by gentle heat. Annules on outer cuticle about 4 µm wide. From base of oesophagus to level of anus annulations on lateral side of body disjunct, varying from not or slightly offset to up to 1/2 a body annule width apart, forming region resembling lateral field. Lip region rounded, with 3 annules. 1st lip annule distinctly smaller than other 2, may be amalgamated with 2nd lip annule. Posterior edge of 2nd lip annule crenate. Posterior edge of 1st annule probably crenate too, but located on curvature of head it is generally obscured. 3rd lip annule smooth or crenate. Body annules generally somewhat rough posteriorly but not crenate. Stylet long, flexible; stylet base sloping, forming basal cavity. Hemizonid immediately anterior to secretory–excretory pore near level of oesophageal–intestinal junction. Spermatheca subspherical, containing sperm. Vulval lips in outer cuticle irregular, in inner cuticle slightly protruding. Tail tapering acutely initially, more gently towards tail terminus giving it drawn-out appearance. Terminus finely rounded.

Male. Gently curved ventrad. Lateral field not observed. Head set off, truncate-conoid, without annulations. Stylet and oesophagus degenerate. Hemizonid 2–6 annules anterior to secretory–excretory pore, at beginning of intestine. Spicules semicircular, length of curve 67 µm. Tail elongate-conoid with finely pointed terminus.

Differential diagnosis. *Hemicycliophora chathami* is characterised by having females with more than 225 body annules, a mean stylet length of about 100 µm, and modified vulval lips. These characters distinguish the species from the majority of *Hemicycliophora* species. The presence of interrupted annules in the lateral field, the basal cavity of the stylet, and the slender tail, set it apart from the remaining species of the genus (Yeates 1978).

Type material examined. Holotype, 23 female, 6 male and 14 juvenile paratypes, sphagnum moss (*Sphagnum cymbifolium*), bracken (*Pteridium aquilinum*), *Gleichenia* sp., *Blechnum* sp., grasses, *Dracophyllum* sp., *Carex* sp., and *Senecio* sp., near Mt Dieffenbach, Chatham Island, CH, 12 February 1973 (NNCNZ).

Other material examined. 209 females, 13 males and 10 juveniles, from the following hosts and localities. Miro (*Prumnopitys ferruginea*) in kauri forest, 30 km NE of Dargaville, ND; native vegetation, Stanley Is, Mercury Is, CL; five finger (*Pseudopanax arboreus*), Coromandel, CL; *Hebe* sp and *Coprosma* sp., below car park Bluff Lookout, SD; kowhai (*Sophora microphylla*), Progress Valley, near Niagara, SD; tree fuchsia (*Fuchsia excorticata*), black beech (*Nothofagus solandri*), tutu (*Coriaria arborea*), and rimu (*Dacrydium cupressinum*), Brooklyn Domain, NN; kowhai (*Sophora microphylla*), tree fuchsia (*Fuchsia excorticata*), black beech (*Nothofagus solandri*), rimu (*Dacrydium cupressinum*), totara (*Podocarpus totara*), and miro (*Prumnopitys ferruginea*), base Takaka Hill, NN; *Macropiper excelsum*, Ruby Bay, NN; matai (*Prumnopitys taxifolia*), rimu (*Dacrydium cupressinum*), New Zealand flax (*Phormium tenax*), and other native vegetation, Eves Valley, NN; five finger (*Pseudopanax arboreus*), Rai Saddle, NN; matai (*Prumnopitys taxifolia*), totara (*P. totara*), and black beech (*Nothofagus solandri*), Wairoa River, NN; totara (*Podocarpus totara*), Wairau Valley, NN; tree fuchsia (*Fuchsia excorticata*), Hokitika, WD; kahikatea (*Podocarpus dacrydioides*), Lake Mahinapua, Haast, WD; native vegetation near Haast and 30 km SE past Haast, WD; *Aristotelia serrata* and kowhai (*Sophora microphylla*), Rai Valley, MB; *Carmichaelia* sp., Porters Pass, MC; *Bulbinella* sp., St Col slope, CA; *Hebe elliptica*, Beeman Pt, Perseverance Harbour, CA; and *Coprosma ciliata*, Tucker Valley, CA (NNCNZ).

Distribution (Map 58). *Hemicycliophora chathami* has a wide distribution. It has been found in all of the major collecting areas including Campbell Island and the Chatham Islands, both at low and high altitude. It represents about half the total number of *Hemicycliophora* populations in NNCNZ. It seems to be restricted to native vegetation and could be an endemic species.

ND, CL / SD, NN, WD, MB, MC / CH, CA.

Remarks. Yeates (1978) observed that, on the Chatham Islands, the length of *H. chathami* females differed from site to site and according to their length he split up the species into 2 subspecies. The population with small females of about 1 mm, present at site 994919, he named *Hemicycliophora chathami chathami* Yeates, 1978, and the populations at the other sites, with females of 1.2–1.5 mm, *Hemicycliophora chathami major* Yeates, 1978.

Recognition of the species as 2 subspecies accords great variability to the species. It makes the boundaries of the species so wide that also *Hemicycliophora halophila*, the only other species described from New Zealand, could belong to it. The type material of the 2 species differs, however, in that *H. chathami* has a relatively narrow head and a somewhat slender tail, characteristics used here to distinguish the two species.

Hemicycliophora halophila Yeates, 1967

Fig. 86a,b

Measurements: Table 13.

Morphology. **Females**. Body slender, slightly curved ventrad when relaxed by gentle heat. Annules on outer cuticle about 4 µm wide, along edge, marked by delicate longitudinal stripes. Annulations on lateral side of body disjunct. Cephalic region as in *H. chathami*. Lateral field represented by disjunctions in cuticular annulation. Stylet flexible, stylet base anteriorly sloping. Excretory pore slightly posterior to base of oesophagus, hemizonid not observed. Vulva distinct, anus not observed. Postvulval region tapering gradually, more progressively in tail region, to convex-conoid, slightly attenuated tail terminus.

Differential diagnosis. The form of the cuticular markings of *H. halophila* distinguish it from all other described species, except *H. aquatica* (Micoletzky, 1913) Loos, 1948, a species not reported from New Zealand. In *H. aquatica* the lateral field is not marked by disjunct annules (Yeates 1978). *Hemicycliophora halophila*, in general morphology, is very similar to *H. chathami* from which it can be distinguished by a relatively narrower head and a more slender tail.

Type material examined. Holotype, 11 female and 2 juvenile paratypes, *Desmoschoenus spiralis,* Taylors Mistake, Banks Peninsula, MC, and *D. spiralis* and *Ammophila arenaria,* Himatangi Beach, Manawatu WN (NNCNZ).

Other material examined. 45 females and 5 juveniles from the following hosts and localities. *Kelleria dieffenbachii*, sedge, *Raoulia grandiflora,* and *Celmisia sessiliflora,* Mt Arthur, NN; *Desmoschoenus spiralis*, Birdlings Flat, Lake Ellesmere, MC; New Zealand flax (*Phormium tenax*), Oreti Beach, Invercargill, SL; and *Hymenanthera chathamica* S.E. Island, Chatham Islands CH (NNCNZ).

Distribution (Map 59). *Hemicycliophora halophila* is predominantly present in the sandy coastal region of the North and the South Island. Its presence on Mt Arthur indicates that it tolerates low temperatures.

WN / NN, MC, SL / CH.

Remarks. The markings on the cuticle described by Yeates in the original description should easily distinguish *H. halophila* from other described species. These markings, however, are very difficult to observe in the type material, they are not present on all specimens, and, when present, then not on all annules. The comparatively broad head and relatively short blunt tail, described in the original description, and observed in females recovered from the type locality in September 1990, seem better characters to identify *H. halophila*. Head and tail shape clearly distinguishes it from *H. chathami* the only other *Hemicycliophora* species described from New Zealand. On the basis of these characters *H. halophila* populations in the National Nematode Collection were identified. They all differed from the type species by the shorter females (0.8 mm v. >1 mm) and stylet (80 v. >100 µm). This suggests that Yeates' observation on the great variability of the length of the females of *H. chathami* is also true for *H. halophila*. Ironically, a single population from the Chatham Islands, the type locality of *H. chathami,* provided the best morphological fit with the type material of *H. halophila*.

Several *Hemicycliophora* species in the National Collection are morphologically different from *H. chathami* and *H. halophila*. Some of them may represent new species. Time did not allow me to study them in detail or describe them fully. Listed under the plant species they were collected from, the following categories can be recognised. *Agathis australis* and native vegetation, Omahuta forest, Northland, NZMS 260 O05 602657 and *Cyathodes empetrifolia*, Makahu Spur, Kaweka Range, Napier, NZMS 260 U20 042077: in these populations the tail of the female is longer and more finely pointed than in *H. chathami*, also the lateral line is more distinct. Grapes (*Vitis vinifera*), home garden, Waikanae; *Metrosideros kermadecensis* and *Melicytus ramiflorus*, Blue Lake, Raoul Is, 19°16'S, 177°55'W; and *Olearia lyallii*, Penguin Creek, Snares Is: the tail region of the females in these populations tapers gradually to a very sharp point and does not appear to be set off. *Hebe elliptica*, Beeman Pt, Perseverance Harbour, Campbell I., 52°33'S, 169°08'E; and native vegetation, Mt Raynal, Auckland I. and the Antipodes: the females are about 1.5 mm long and the males seem to have large amphidial apertures or other large pores in the head.

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Appendix 1. THE TYPE SPECIES OF THE CRICONEMATINA

Eubostrichus guernei Certes, 1889, the valid type species of *Criconema*

The classification of the genus *Criconema* has been subjected to many changes and even at present has not stabilised. Instability started the moment Hofmänner & Menzel (1914) introduced the name, by not designating a type species. They erected the taxon to accommodate their populations of tylenchs from Switzerland with very coarse annulations, 1 population with and 1 without ornamentation on the annules. The population without ornamentation they described as *Criconema morgense* Hofmänner in Hofmänner & Menzel, 1914. The population with ornamentation they considered identical to *Eubostrichus guernei* material borrowed from L.A. Jägerskiöld, originally collected by Richter from Heard Island and the Kerguelen on a South Pole expedition. Their ornate material later proved to be different from *E. guernei*, however, and was described as *Hoplolaimus menzeli* Stefanski, 1924 {= *Ogma menzeli* (Stefanski, 1924) Mehta & Raski, 1971}. The genus *Criconema*, as proposed by Hofmänner & Menzel for the nominal species *C. guernei* and *C. morgense*, therefore, was based on observations on *O. menzeli* and *C. morgense*. Stiles & Hassall (1920) suggested that *E. guernei* was probably the type species. Taylor (1936) accepted this, and *E. guernei* has been accepted as type species of *Criconema* ever since. Loof *et al.* (2001) pointed out that according to the International Code of Zoological Nomenclature, a vague indication such as given by Stiles & Hassall is not sufficient to validate a type species. The definite endorsement by Taylor (1936) would have been a valid dedication but was pre-dated by Micoletzky's (1925) designation of *C. morgense* as the type species. Accepting *C. morgense* as the type species would cause major changes to the classification of the criconematids because *C. morgense* is the valid type species of the well-established genus *Criconemoides* (Taylor 1936). Loof *et al.* (2001), therefore, requested the International Commission for Zoological Nomenclature to set aside Micoletzky's (1925) designation of *C. morgense* and formally validate *E. guernei* as type species of the genus *Criconema.*

Criconema guernei a juvenile of *C. giardi* (Certes, 1889) Micoletzky, 1925

The uncertainty of the identity of *E. guernei* further complicates its selection as type species of *Criconema*. Certes (1889) describes two *Criconema* species with coarsely annulated cuticles, *Dorylaimus giardi* (= *Criconema giardi*) with smooth body annules and *Eubostrichus guernei* (= *Criconema guernei*) with ornamentation on the annules. To establish the identity of these two species Raski and co-workers collected material from the type locality at Orange Bay, Terra del Fuego, Chile (Raski *et al.* 1984). From the material collected there they concluded that *C. giardi* and *C. guernei* are two different stages of the same species, *C. guernei* the juvenile stage and *C. giardi* the adult, and synonymized the names. As *C. giardi* has priority of publication *Criconema giardi* became the valid name of the type species.

For this action to be valid, however, it must be accepted that *E. guernei* is a juvenile and that this juvenile is *C. giardi* (Raski *et al.* 1984). But this is not at all certain.

The identity of the Criconematinae juveniles from Tierra del Fuego

It is very difficult to identify a criconematid juvenile. Raski and co-workers were well aware of this. By their own admission, *C. guernei* as a juvenile form "could pertain to one of several genera of Criconematidae, without permitting a safe attribution to one or the other" (Raski *et al.* 1984). Safe attribution of a juvenile to a certain species can be done when it has unique features or when only a single species is present at a site. But *C. giardi* juveniles have no unique features and the species was not the only species collected by Raski and co-workers from Terra del Fuego. At least two criconematids were present, *C. giardi* and *Ogma terrestris* Raski & Valenzuela, 1987. Raski *et al*. (1984) described *C. giardi* juveniles as 0.37–0.54 mm long and with "scales arranged in longitudinal rows of variable number (ten to fifteen)". In the description of *O. terrestris* three juveniles "(*fourth stage?*)" are described. They are 0.33–0.38 mm long and their scales increase in length and number to 18–19 at mid-body. It seems therefore that *O. terrestris* juveniles are somewhat shorter and have more rows of scales than *C. giardi.* In criconematids, however, the body annules are flexible which makes the length of the body extremely variable. The length also depends on the juvenile stage measured. For neither of the two species, however, the individual juvenile stage measured was identified, largely negating the value of their morphometrics. The number of rows of scales in each species would be a more reliable character, but neither *C. giardi* nor *O. terrestris* matches the six rows on *E. guernei* indicated by Certes (1889). How Raski and co-workers in 1984 then reliably (safely) attributed the various juveniles in their samples from Terra del Fuego to *C. giardi* and their new species *O. terrestris* — *O. terrestris* had not yet been described — and how they subsequently decided that *C. giardi* and not *O. terrestris* juveniles represented *C. guernei* was never explained. A more fundamental question, however, is: is *C. guernei* really a juvenile?

Criconema guernei is not a juvenile

Raski *et al.* (1984), De Grisse (1969) and Mehta & Raski (1971) accepted Hofmänner & Menzel's (1914) suggestion that *C. guernei* could be a juvenile. Hofmänner & Menzel suggested this because in their population only juveniles showed longitudinal rows of scales, on the adults the scales formed a continuous fringe. They also observed that *C. guernei* was short relative to the length of their own Swiss population. It has since been established, however, that many species exist with rows of scales on the females including several species with short females, i.e. *Ogma terrestris*. De Grisse (1969), Mehta & Raski (1971) and Andrássy (1979) accepted that *C. guernei* is a juvenile also because, in their opinion, in the original description the presence of a vulva is not indicated. That Certes observed a vulva in *C. guernei*, however, is obvious. In his description, Fig. 5 illustrates a female in ventral view. In that perspective the vulva usually appears as a vague, somewhat U-shaped structure, and such a structure is distinctly indicated (Fig. 1(a)). That Certes was illustrating a female is further clear from his description. He writes: "In Fig. 5 the animal is seen <<en face>> [=ventrad], it is drawn laterad on the Figure 7 and 8" (Raski *et al.* 1984). The presence of a vulva is the only feature by which Certes could have determined the orientation of the animal. In the description of *C. giardi*, Certes reported the presence of a vulva (genital papilla). He obviously knew what the vulva looked like. The illustration in Fig. 5 is 160 mm long, and the distance from the anterior end to the U-shaped structure illustrated measures 138 mm, i.e. it is located at 86.3% of the body length, a value just within the range given for the position of the vulva in *Ogma terrestris* (86–90%) (Raski & Valenzuela 1987). Therefore, there is no valid reason why *C. guernei* should be a juvenile. It is a female.

The identity of *Eubostrichus guernei*

According to the original description, *C. guernei* is a species with six rows of scales, a set off tail (Certes 1889) and an estimated length of 0.400 mm (Raski *et al.* 1984). Accepting this description is based on a female, *C. guernei* closely resembles *O. terrestris,* a species collected from the same locality. The two species should be considered conspecific. *Ogma terrestris* females are 0.42–0.59 mm long and have a maximum of 21 scales at midbody and a conically pointed tail. The length of 0.400 mm for *C. guernei* does not fall within the range for *O. terrestris* females. But the 0.400 mm is an estimate (Raski *et al.* 1984), and Certes (1889) repeatedly states that the length of the body is variable. Considering their very similar number of body annules — estimated for *C. guernei* from 100 (Taylor 1936) to 110 (Raski et al. 1984) and measured 91–102 for *O. terrestris* — the relatively small difference in body length is probably due to the difference in fixation.

A different number of rows of scales and the set off tail, therefore, are the only characters separating *C. guernei* from *O. terrestris*. The number of rows of scales indicated in the original description of *C. guernei*, however, is incorrect. Raski *et al.* (1984) suggested that their "actual number cannot be six" the "true number is more evidently at least eight, but can be greater" and make it 15. I agree with Raski *et al*. that to form the cuticular pattern illustrated by Certes there must be more than 6 rows of scales. Some female specimens of *Criconema* (*Criconema*) *nelsonense* sp. nov. from New Zealand (Fig. 1(c)) form the same cuticular pattern as illustrated for *C. guernei.* The scales of these females are identical in form and number to the scales of *O. terrestris.* From a detailed study of hundreds of specimens of this new species it was possible to interpret the pattern illustrated by Certes. Certes drew the two rows of scales he observed as a series of short, oblique, parallel stripes (Fig. (1a)). In his illustration the two rows are interconnected across the body of the nematode by broken lines. In region a of Fig. 1(a), enlarged in Fig. 1(b), ten such lines are present, exactly two for each of the five body annules in this region. These lines are formed because the specimen is compresses somewhat and the top half of the scales immediately below the coverslip is stuck against the coverslip and their outlines are obscured. Only the anterior and posterior side of the base of these scales can be observed. Perpendicular to the body axis, these dense, refractive margins form the two interconnections per body annule drawn by Certes. Although the flattened scales on top of the body are not visible the non-flattened scales on either side of them are distinct. They lie on the curvature of the body and their oblique dense anterior and posterior edges refract the light, manifesting themselves along the body as longitudinal bands of bright, oblique, short stripes, two for each scale as illustrated by Certes. As the scales have a posterior direction and taper apically, the stripes of each scale converge slightly posteriorly (Fig. 1(d)). The scales further down the side of the body reflect light too, but, because they are superimposed on each other they lack contrast and form no pattern. Therefore, for the pattern to be able to form, the scales must be regularly rounded, the specimen must be flattened somewhat and the scales making the pattern should be located on the curvature of the body about one scale width away from the centre line of the specimen. Juveniles do not form the pattern. Their scales are somewhat angular at the base and, therefore, not capable of forming either the pattern on the body or the straight lines across the body illustrated by Certes (1889), which is further evidence that *E. guernei* is not a juvenile.With each of the rows of scales illustrated on

Eubostrichus guernei one scale removed from the centre line, there must be two scales separating them and there must be about 18–20 scales on the circumference of the body, as in *O. terrestris* and *C.* (*C.*) *nelsonense* sp. nov.

The set off tail in *C. guernei* remains the only character distinctly distinguishing *O. terrestris* from *C. guernei*. To be able to interpret the significance of a set off tail it should be understood why it appears set off. In *C.* (*C.*) *nelsonense* sp. nov a set off tail is caused by the combination of a contracted, scaled postvulval region and the absence of scales on the tail annules. *Criconema guernei* and *O. terrestris* also have a scaled postvulval area and no scales on the tail. Contracted, they too, should show a set off tail. In contracted specimens the outline of each scaled annule is retrorse and looks like a compact, almost hemispherical hook, sharply set off from the rather superficial, un-scaled tail annules. The more the postvulval region is contracted the more set off the tail becomes (Fig. 9d, e). In extended specimens the outline of the annule is less retrorse and the scale lower, and looks thorn-shaped or pointed. The distinction between body annule and tail annule becomes obscure and the taper of the tail completely regular, especially when at the same time the tail itself is somewhat contracted. Generally, only one state may be expected in a collection, the one determined by the timing and the process of fixation. The paratypes of *Ogma terrestris* are fully extended, hence the not distinctly set off tail described for this species (Fig. 9b). *Criconema* (*C.*) *nelsonense* sp. nov. material, present in the New Zealand collection, predominantly consists of contracted specimens and shows a tail that is distinctly set off. Certes observed both tail types and illustrated the contracted type in Fig. 5 and the extended type in Fig. 8. Fig. 8 closely resembles the tail of *O. terrestris*. It is typically the tail of an extended specimen, with the scales along the body almost perpendicular to the centre line of the body, and the transgression from the part of the tail with to the part without scales going unnoticed. Certes believed that the orientation of the specimen was the cause of these two appearances, with the set off tail only showing in dorso-ventral view. He found the difference between the two types of tails so striking that he warned that it could lead one to believe in the existence of two distinct species. Despite this warning Raski *et al.* (1984) estimated that the illustration of the stretched posterior body in “Figure 8 represents a species different from what figured in Figure 5”. However, considering Certes’ observation and the type of scales illustrated they obviously represent the same species.

No character, therefore, convincingly separates *C. guernei* from *Ogma terrestris*. They are the same species: *Criconema guernei* is the valid name and *Ogma terrestris* a new synonym.

Appendix 2. Alphabetical list of Criconematina species and sites where collected

Blandicephalanema inserratum

Brooklyn Domain, NN	N26/020126
Eves Valley, NN	N27/964833
Lee Valley, NN	N28/233777
Murchison, NN	M29/534332
Rai Cemetery, MB	O27/584998
Riwaka River bank, foot of Takaka Hill, NN	N26/036178
Wairoa River, NN	N28/181738
Wairoa River, NN	N28/198753

Blandicephalanema nothofagi

Breaksea Island, 60 m, FD	B44/135946
Eves Valley, NN	N27/181857
Eves Valley, NN	N27/964833
Inangahua East State Forest, Reefton, BR	L30/200061
Inangahua West State Forest, Reefton, BR	K30/085029
Kaiteriteri back beach, NN	N26/112190
Kaiteriteri back beach, NN	N26/153188
Kaitoke Waterworks Res., Hutt Valley, WN	S26/944143
Kowai Bush, Springfield, MC	L35/230680
Mangatowai Stream, Desert Rd, TO	T19/490238
Waikare Stream, Tongariro National Park, TO	S19/273227

Blandicephalanema pilatum

Greymouth, BR	K29/015296
Haast, SH6, 60 km past bridge south, OL	G38/183714
Inangahua East State Forest, Reefton, BR	L30/189067
Inangahua East State Forest, Reefton, BR	L30/200061
Inangahua West State Forest, Reefton, BR	K30/085029
Kaitoke Waterworks Res., Hutt Valley, WN	S26/944143
Mangaehuehu Scenic Reserve, Ohakune, TO	S20/213932
McLennan, SL	G47/390028
Mt Domett, NN	M26/534164
Orongorongo Valley Field Station Ridge, WN	R27/761815

Blandicephalanema serratum

Coral Track to Rome Ridge, Arthurs P, NC	K33/921077
East Logan Creek, Tararua Range, WN	S25/184508
Experimental Station Taita, Hutt Valley, WN	R27/749012
Greymouth, BR	K29/015296
Inangahua R./Coal Creek Res., BR	L29/198213
Inangahua West State Forest, Reefton, BR	K30/085029
Kaiteriteri back beach, NN	N26/153188
Kaitoke Waterworks Res., Hutt Valley, WN	S26/944143
Kowai Bush, Springfield, MC	L35/230680
Orongorongo Valley Field Station Ridge, WN	R27/761815
Sharplin Falls, MC	K36/820300
Waimangaroa, 3 km south, NN	K29/056410
Whangamoa Hill, NN	O27/542048
Whisky Falls, Lake Rotoiti, NN	N29/957288

Criconema (C.) aucklandicum

Mt Raynal, AU	50°53’S/165°50’E

Criconema (C.) cristulatum

Cape Foulwind Westport, BR	K29/830388
Makahu Spur, Kaweka Range, HB	U20/042077
Milford Sound, FD	D40/117994
Mt Arthur, NN	M27/830987
Mt Domett, NN	M26/534164

Oreti Beach, Invercargill, SL	E47/434093
Parnassus, NC	O32/366410
Porters Pass region, MC	K35/055673
Porters Pass, near Lake Lyndon, MC	K35/996622
Sandy Bay, NN	N26/091212
Tokanui, SL	G47/159977
Winton, SL	E45/491495

Criconema (C.) mackenziei

Tin Range, Table Hill, Stewart Island, SI	D49/162389

Criconema (C.) makahuense sp. nov

Makahu Spur, Kaweka Range, HB	U20/042077

Criconema (C.) nelsonense

Eves Valley, NN	N27/181857

Criconema (C.) spinicaudatum

Beeman Pt, Perseverance Harbour, CA	52°33’S/169°08’E
Dent Island, CA	52°32’S/169°03’E
Haast, SH6, 60 km past bridge south, OL	G38/183714
Monument Harbour, head of Six Foot Lake, CA	52°36’S/169°09’E
Mt Dumas, east side, CA	52°34’S/169°06’E
Mt Dumas, exposed west side, CA	52°34’S/169°05’E
Mt Dundas, Tararua Range, WN	S25/167506
Mt Pukemoremore, Tararua Range, WN	S25/184521
small island off Ramp Point, CA	52°32’S/169°02’E

Criconema (N.) acuticaudatum

Beeman Hill, CA	52°37’S/169°07’E
Beeman Point, Perseverance Harbour, CA	52°33’S/169°08’E
Mt Raynal, Auckland Is, AU	50°53’S/165°50’E
small island off Ramp Point, CA	52°32’S/169°02’E
St Col, exposed west side, top, CA	52°32’S/169°06’E

Criconema (N.) alpinum

Albert Burn Valley, SH 6, OL	I39/970432
Beeman Saddle, Perseverance Harbour, CA	52°33’S/169°08’E
Bluff, SL	E47/527892
Eves Valley, NN	N27/964833
Governors Bay, Havelock, SD	P27/913927
Kaiteriteri back beach, NN	N26/113195
Lake Wanaka, OL	F39/056425
Makahu Spur, Kaweka Range, HB	U20/042077
Mt Domett, NN	M26/534164
Mt Lodestone, NN	N27/886041
Porters Pass region, MC	K35/055673
Redwood Pass Rd, Blenheim, MB	P28/988581
Winton, SL	E45/491495

Criconema (N.) annuliferum

Dunedin, DN	I44/227837
Maitai Valley, NN	O27/379902
Oreti Beach Road, Invercargill, SL	E47/450087
Wakefield, NN	N28/140770

Criconema (N.) californicum

Bluff, SL	E47/527892
Breaksea Island, alt. 60 m FD	B44/135946
Brooklyn Domain, NN	N26/020126
Dingle Dell Reserve, Kohimarama, AK	R11/759809
Eves Valley, NN	N27/964833
Governors Bay, Havelock, SD	P27/913927
Haast River bank, WD	F37/928933
Hinemaiaia Scenic Res., Lake Taupo, TO	U18/723566
Inangahua West State Forest, Reefton, BR	K30/085029
Kaiangaroa Forest, Rotorua, BP	V16/138108
Kowai Bush, Springfield, MC	L35/230680
Kumara Junction, WD	J32/575467
Lee Valley, NN	N28/233777
Lyell, 8 km on Nelson side, BR	L29/277316
Makatote River bank, Tongariro N. Park, TO	S20/163136
Mangaehuehu Scenic Res., Ohakune, TO	S20/213932
Mataura River 20km east of Tisbury, SL	F47/812032
Mawhera State Forest, BR	K32/796598
Melrose Bush, NN	N27/291886
Mt Arthur, NN	M27/830987
Mt Domett, NN	M26/534164
near Niagara, Catlins State Forest Park, SL	G46/134946
Omaui, SL	E47/628075
Pareheru Sc. Res., Waimangu, Rotorua, BP	U16/030196
Porters Pass region, MC	M35/150808
Porters Pass, near Lake Lyndon, MC	K35/996622
Queenstown, 2 km east, OL	F41/706668
Rai Cemetery, MB	O27/584998
Rai Valley opposite bridge to Okiwi Bay, SD	O27/598991
Redwood Pass Rd, Blenheim, MB	P28/988581
Ross, WD	I33/288102
Spooners Range, NN	N28/016690
Taita, Experimental Station, Hutt Valley, WN	R27/749012
Tucker Valley, Beeman Sad. slope, CA	52°33’S/169°06’E
Tutamoe, ND	O06/456196
Waikare Stream, Tongariro Nat. Park, TO	S19/273227
Waimangaroa, 3 km south NN	K29/056410
Wairoa River, NN	N28/181738
Winton, SL	E45/491495

Criconema (N.) crosbyi

small island off Ramp Point, CA	52°32’S/169°02’E

Criconema (N.) dugdalei

Mt Domett, 4200', NN	M26/521158
Dundas Hut spur, Tararua Range, WN	S25/183515
Penguin Creek, SN	48°01’S/166°36’E

Criconema (N.) farrelli

Mt D’Urville, AU	50°41’S/166°05’E

Criconema (N.) graminicola

Bluff Lookout, SL	E47/528891
Burke Pass, summit 890 m, MK	I38/182766
Carrick, CO	F41/981674
Haast, 6 km past, WD	F37/933936
Harihari, WD	I34/126810
Kumara Junction, WD	J32/575467
Mt Arthur, NN	M27/830987
Mt Domett, NN	M26/534164
Mt Dundas, Tararua Range, WN	S25/167506
Mt Lodestone, NN	N27/886041
Mt Pukemoremore, Tararua Range, WN	S25/184521
Papamanuka Stream, Tongariro Nat. Park, TO	S19/286286
Porters Pass region, MC	K35/038649
Porters Pass region, MC	M35/150808
Rai Cemetery, MB	O27/584998
Red Hill,1130 m, Nelson, NN	N28/239560

Tawhiti, TK	Q21/254754
Tutoka Bench, FD	D40/108073

Criconema (N.) grandisoni

Haast, 6 km past WD	F37/933936

Criconema (N.) lineatum

Inangahua East State Forest, Reefton, BR	L30/200061
Inangahua West State Forest, Reefton, BR	K30/085029
Mangaehuehu Scenic Reserve, Ohakune, TO	S20/213932
Mt Domett, NN	M26/534164

Criconema (N.) macilentum

Fox Glacier, WD	H35/698441
Mt Dundas, Tararua Range, WN	S25/167506
Mt Raynal, AU	50°53’S/165°50’E
Sth of top small island off Ramp Pnt, CA	52°32’S/169°02’E

Criconema (N.) magnum

Inangahua West State Forest, Reefton, BR	K30/085029
Mawhera State Forest, BR	K32/796598
Mount Messenger, near road tunnel TK	Q18/488553
Omahuta Forest, Mangamuka, ND	O05/602657
Oreti Beach Road, Invercargill, SL	E47/450087
Pareheru Sc. Res., Waimangu, Rotorua, BP	U16/030196

Criconema (N.) mutabile

Hastings, HB	Y18/467695

Criconema (N.) pasticum

Albert Burn Valley, opposite SH 6, OL	I39/970432
Breaksea Island, 60 m, FD	B44/135946
Dingle Dell Reserve, Kohimarama, AK	R11/759809
Porters Pass region, MC	K35/055673
Porters Pass, near Lake Lyndon, MC	K35/996622

Criconema (N.) ramsayi

Kumara Junction, WD	J32/576465

Criconema (N.) sphagni

Duncan Bay, Tennyson Inlet, SD	P26/755140
Lee Valley, NN	N28/233777
Mt Domett, NN	M26/534164
Mt Lodestone, NN	N27/886041
White Bluffs, Blenheim, Nth side MB	P28/047612

Criconema (N.) undulatum

Deas Head, AU	50°31’S/166°13’E
Mawhera State Forest, BR	K32/796598
Stewart Island	D48/210537

Criconemoides informis

Nelson, garden Cawthron Institute, NN	O27/346928

Criconemoides parvus

Greystoke Forest Reserve, Marton, WI	S23/175300
Haast River bank WD	F37/928933
Haast River bank, WD	F37/928940
Haast, 6 km past WD	F37/933936
Kumara Junction, WD	J32/575467
Lee Valley, NN	N28/233777
Moss Picnic Area, Motueka, NN	N26/035177
Rai Valley opposite bridge to Okiwi Bay, SD	O27/598991
Redwood Pass Rd, Blenheim, MB	P28/988581
Winton, SL	E45/491495

Hemicriconemoides cocophillus

Kumara Junction, WD	J32/576465
Mawhera State Forest, BR	K32/796598
Mount Messenger, near road tunnel, TK	Q18/488553
Tutamoe, mixed native forest, ND	N18/195072

Hemicycliophora chathami

Beeman Point, Perseverance Harbr. CA	52°33’S/169°08’E
Bluff Lookout, SL	E47/528891
Brooklyn Domain, NN	N26/020126
Chatham Is., CH	NZMS240 031965, 040978,
Chatham Is., CH	065003, 068065,
Chatham Is., CH	833267, 690245,
Chatham Is., CH	994919
Dargaville, 30 km NE, ND	O06/442168
Eves Valley, NN	N27/181857
Haast bridge, 30 km SE, WD	G37/159884
Haast, 0.75 km East, WD	F37/902982
Kumara Junction, WD	J32/570493
Lake Mahinapua Track, Hokitika, WD	J33/380217
near Niagara, Catlins State Forest Park, SL	G47/135947
Rai Saddle, MB	O27/565015
Rai Valley, near bridge, SD	O27/597990
Rai Valley, near cemetery, MB	O27/583997
Rakaia River near Mount Hutt, MC	K35/004625
Riwaka River bank, foot of Takaka Hill, NN	N26/036178
Ruby Bay, NN	N27/171994
Stanley Is, Mercury Is, CL	T10/686029
Stanley Is, Mercury Is, CL	T12/526470
St Col, exposed W side top, CA	52°32’S/169°06’E
Wairau Valley, NN	P28/869744
Wairoa River, NN	N28/208778

Hemicycliophora halophila

Birdlings Flat, Lake Ellesmere, MC	M37/840088
Himatangi Beach, WN	S24/995894
Mt Arthur, NN	N27/902052
Oreti Beach, Invercargill, SL	E47/434093
S.E. Island, Chatham Is., CH	NZMS240 762115
Taylors Mistake, Banks Peninsula, MC	N36/919360

Macroposthonia campbelli

North East Harbour, CA	52°31’S/169°13’E

Macroposthonia rustica

Cape Foulwind Westport, BR	K29/830388
Invermay, MAF biogas trial, SL	I44/066796
Nelson, Nayland Road, NN	N27/281877
One Tree Hill, AK	R11/630768
Porters Pass region, MC	K35/055673
Silverstream, Hutt Valley, WN	R27/778049
Waitakere Ranges, AK	Q11/474695
Winton, SL	E45/491495

Macroposthonia xenoplax

Cromwell, CO	G41/100600
Hanning Road, Alexandra, CO	G42/214490
Kina Beach, NN	N27/139045
Waikanae, WN	R26/838338

Wakefield, NN	N28/140770
Western Springs mud flats, AK	R11/667818

Ogma alternum

Makahu Spur, Kaweka Range, HB	U20/042077
Porters Pass, near Lake Lyndon, MC	K35/996622

Ogma campbelli

small island off Ramp Point, CA	52°32'S/169°02'E

Ogma capitulatum

Brooklyn Domain, NN	N26/020126
Eves Valley, NN	N27/964833
Rai Valley opposite bridge to Okiwi Bay, SD	O27/598991

Ogma catherinae

Porters Pass, near Lake Lyndon, MC	K35/996622

Ogma civellae

Dingle Dell Reserve, Kohimarama, AK	R11/759809
Inangahua West State Forest, Reefton, BR	K30/085029
Mt Albert Research Centre, AK	R11/651763
Waikare Stream, Tongariro National Park, TO	S19/273227
Waitangi State Forest, ND	Q05/264665

Ogma crenulatum

Desert Rd, Mangatowai Stream, TO	T19/490238
Oreti Beach Road, Invercargill, SL	E47/450087
Ulva Island, Stewart Island, SI	E48/382533

Ogma inaequale

Makahu Spur, Kaweka Range, HB	U20/042077

Ogma latens

Makahu Spur, Kaweka Range, HB	U20/042077
Mt Lodestone, NN	N27/886041
Nth Plain & Anchorage Bay, betw., AN	49°42'S/178°47'E
Porters Pass, near Lake Lyndon, MC	K35/996622
Tuna Bay, SD	P27/734112

Ogma mucronatum

Riwaka River bank, foot of Takaka Hill, NN	N26/036178

Ogma niagarae

near Niagara, Catlins State Forest Park, SL	G46/134946

Ogma palmatum

Nelson, Cawthron Institute garden, NN	O27/346928
Waitangi State Forest, ND	Q05/264665
Wakefield, NN	N28/140770

Ogma paucispinatum

Lyell, about 7.5 km west, Buller Gorge, BR	L29/280325
Milford Sound, FD	D40/117994
Mokoroa Falls, AK	Q11/407839

Ogma polyandra

Cape Foulwind, BR	K29/923384
Greymouth, State Highway 6, BR	K29/928320
Haast River bank, WD	F37/930939
Kumara Junction, WD	J32/576465
near Niagara, Catlins State Forest Park, SL	G47/135947
Omahuta Forest, Mangamuka, ND	O05/602657
Penguin Creek, SN	48°01'S/166°36'E
Porters Pass region, MC	K35/240576
Porters Pass, near Lake Lyndon, MC	K35/996622
Rakaia River near Mount Hutt, MC	K35/004625
Rakaia River near Mount Hutt, MC	K35/006426
Redwood Pass Rd, Blenheim, MB	P28/988581
Redwood Pass Rd, Blenheim, MB	P28/990575
Riwaka River bank, foot of Takaka Hill, NN	N26/036178
Tuna Bay, SD	P27/734112

Ogma semicrenatum

Cape Foulwind, Westport, BR	K29/830388
East Logan Creek, Tararua Range, WN	S25/184508
Haast River bank, WD	F37/928933
Kumara Junction, WD	J32/575467
Kumara Junction, WD	J32/580473
Lake Mahinapua Track, Hokitika, WD	J33/380217
Mataura River, 20 km east of Tisbury, SL	F47/812032
Mawhera State Forest, BR	K32/796598
Omaui, SL	E47/627074
Ulva Island, Stewart Island, SI	E48/382533
Waimatua, SL	E47/629076

Ogma sexcostatum

Dingle Dell Reserve, Kohimarama, AK	R11/759809
Eves Valley, NN	N27/181857
Greystoke Forest Reserve, Marton, WI	S23/175300
Haast, 6 km past, WD	F37/933936
Haast, 60 km past bridge south, OL	G38/183714
Inangahua West State Forest, Reefton, BR	K30/085029
Kina Beach, NN	N27/135050
Kumara Junction, WD	J32/564473
Lee Valley, NN	N28/233777
Melrose Bush, NN	N27/291886
Mokoroa Falls, AK	Q11/407839
Pareheru Sc. Res., Waimangu, Rotorua, BP	U16/030196
Point Munning, CH	NZMS240 737802
Porters Pass, near Lake Lyndon, MC	K35/996622
Rai Valley, near bridge, SD	O27/597990
Rai Valley opposite bridge to Okiwi Bay, SD	O27/598991
Riwaka River bank, foot of Takaka Hill, NN	N26/036178
Snowden's Bush, NN	N27/183807
Te Hapupu, CH	NZMS240 625728
Tuna Bay, SD	P27/734112

Ogma sturhani

Porters Pass, near Lake Lyndon, MC	K35/996622

Ogma subantarcticum

Beeman Hill, CA	52°35'S/169°07'E
Monument Harbour, head Six Foot Lake, CA	52°36'S/169°09'E
Penguin Creek, SN	48°01'S/166°36'E
St Col, exposed West side top, CA	52°32'S/169°06'E

Paratylenchus (P.) halophilus

Rough Island, NN	N27/216916

Pateracephalanema imbricatum

Birdlings Flat, Lake Ellesmere, MC	M37/840088
Desert Rd x Mangatowai Stream, TO	T19/490238
Great Island, Three Kings Island, TH	L01/312816
Wairoa River, NN	N28/181738

Sphaeronema californicum

Moss Picnic Area, Motueka, NN	N26/035177
near Niagara, Catlins State Forest Park, SL	G46/134946
Taiko Camp, Chatham Is., CH	NZMS260 CH2/387416

Syro glabellus

Mangamuka Gorge, ND	O05/422681
Ness Valley, AK	S11/003640
Omahuta Forest, Mangamuka, ND	O05/602657
Waitangi State Forest, ND	Q05/264665

Syro tribulosus

Dingle Dell Reserve, Kohimarama, AK	R11/759809
Duncan Bay, Tennyson Inlet, SD	P27/736098
McLennan, near, SL	G47/390028
Rai Valley opposite bridge to Okiwi Bay, SD	O27/598991
Tuna Bay, SD	P27/734112

Trophotylenchulus okamotoi

Tutuko Bench, FD	D40/108073

Trophotylenchulus sp.

Kaiangaroa Forest, Rotorua, BP	V16/138108
Moss Picnic Area, Motueka, NN	N26/035177
Mt Domett, NN	M26/534164

Tylenchulus semipenetrans

Gisborne, GB	S13/024200
Te Kauwhata, WO	V21/472690

Appendix 3. Latitudinal list of sample sites and Criconematina species collected

L01/312816 (Great Island, Three Kings Island, TH)
Pateracephalanema imbricatum

Q05/264665 (Waitangi State Forest, ND)
Ogma civellae
Ogma palmatum
Syro glabellus

O05/422681 (Mangamuka Gorge, ND)
Syro glabellus

O05/602657 (Omahuta Forest, Mangamuka, ND)
Criconema (*N.*) *magnum*
Ogma polyandra
Syro glabellus

O06/442168 (Dargaville, 30 km NE, ND)
Hemicycliophora chathami

O06/456196 (Tutamoe, ND)
Criconema (*N.*) *californicum*

T10/686029 (Stanley Is, Mercury Is, CL)
Hemicycliophora chathami

S11/003640 (Ness Valley, AK)
Syro glabellus

Q11/407839 (Mokoroa Falls, AK)
Ogma paucispinatum
Ogma sexcostatum

Q11/474695 (Waitakere Ranges, AK)
Macroposthonia rustica

R11/630768 (One Tree Hill, AK)
Macroposthonia rustica

R11/651763 (Mt Albert Research Centre, AK)
Ogma civellae

R11/667818 (Western Springs mud flats, AK)
Macroposthonia xenoplax

R11/759809 (Dingle Dell Reserve, Kohimarama, AK)
Criconema (*N.*) *californicum*
Criconema (*N.*) *pasticum*
Ogma civellae
Ogma sexcostatum
Syro tribulosus

T12/526470 (Stanley Is, Mercury Is, CL)
Hemicycliophora chathami

S13/024200 (Gisborne, GB)
Tylenchulus semipenetrans

U16/030196 (Pareheru Scenic Reserve, Waimangu, Rotorua, BP)
Criconema (*N.*) *californicum*
Criconema (*N.*) *magnum*
Ogma sexcostatum

V16/138108 (Kaiangaroa Forest, Rotorua, BP)
Criconema (*N.*) *californicum*
Trophotylenchulus sp.

N18/195072 (Tutamoe, mixed native forest, ND)
Hemicriconemoides cocophillus

Y18/467695 (Hastings, HB)
Criconema (*N.*) *mutabile*

Q18/488553 (Mt Messenger, near road tunnel, TK)
Criconema (*N.*) *magnum*
Hemicriconemoides cocophillus

U18/723566 (Hinemaiaia Scenic Reserve, Lake Taupo, TO)
Criconema (*N.*) *californicum*

S19/273227 (Waikare Stream, Tongariro Nat. Park, TO)
Blandicephalanema nothofagi
Criconema (*N.*) *californicum*
Ogma civellae

S19/286286 (Papamanuka Str., Tongariro Nat. Park, TO)
Criconema (N.) graminicola

T19/490238 (Mangatowai Stream, Desert Rd, TO)
Blandicephalanema nothofagi
Ogma crenulatum
Pateracephalanema imbricatum

U20/042077 (Makahu Spur, Kaweka Range, HB)
Criconema (*C.*) *cristulatum*
Criconema (C.) makahuense
Criconema (*N.*) *alpinum*
Ogma alternum
Ogma inaequale
Ogma latens

S20/163136 (Makatote R. bank, Tongariro Nat. Park, TO)
Criconema (*N.*) *californicum*

S20/213932 (Mangaehuehu Scenic Reserve, Ohakune, RI)
Blandicephalanema pilatum
Criconema (*N.*) *californicum*
Criconema (*N.*) *lineatum*

Q21/254754 (Tawhiti, TK)
Criconema (*N.*) *graminicola*

V21/472690 (Te Kauwhata, WO)
Tylenchulus semipenetrans

S23/175300 (Greystoke Forest Reserve, Marton, WI)
Criconemoides parvus
Ogma sexcostatum

S24/995894 (Himatangi Beach, WN)
Hemicycliophora halophila

S25/164521 (Mt Pukemoremore, Tararua Range, WN)
Criconema (*N.*) *graminicola*

S25/167506 (Mt Dundas, Tararua Range, WN)
Criconema (*C.*) *spinicaudatum*
Criconema (*N.*) *macilentum*
Criconema (*N.*) *graminicola*

S25/183515 (Dundas Hut spur, Tararua Range, WN)
Criconema (*N.*) *dugdalei*

S25/184508 (East Logan Creek, Tararua Range, WN)
Blandicephalanema serratum
Ogma semicrenatum

S25/184521 (Mt Pukemoremore, Tararua Range, WN)
Criconema (*C.*) *spinicaudatum*
Criconema (*N.*) *graminicola*

N26/020126 (Brooklyn Domain, NN)
Blandicephalanema inserratum
Criconema (*N.*) *californicum*
Ogma capitulatum
Hemicycliophora chathami

N26/035177 (Moss Picnic Area, Motueka, NN)
Criconemoides parvus
Sphaeronema californicum
Trophotylenchulus sp.

N26/036178 (Riwaka River bank, foot Takaka Hill, NN)
Blandicephalanema inserratum
Hemicycliophora chathami
Ogma mucronatum
Ogma polyandra
Ogma sexcostatum

N26/091212 (Sandy Bay, NN)
Criconema (*C.*) *cristulatum*

N26/112190 (Kaiteriteri back beach, NN)
Blandicephalanema nothofagi

N26/113195 (Kaiteriteri back beach, NN)
Criconema (*N.*) *alpinum*

N26/153188 (Kaiteriteri back beach, NN)
Blandicephalanema nothofagi
Blandicephalanema serratum

M26/521158 (Mt Domett, 4200', NN)
Criconema (*N.*) *dugdalei*

M26/534164 (Mt Domett, NN)
Blandicephalanema pilatum
Criconema (*C.*) *cristulatum*
Criconema (*N.*) *alpinum*
Criconema (*N.*) *californicum*
Criconema (*N.*) *graminicola*
Criconema (*N.*) *lineatum*
Criconema (*N.*) *sphagni*
Trophotylenchulus sp.

P26/755140 (Duncan Bay, Tennyson Inlet, SD)
Criconema (*N.*) *sphagni*

R26/838338 (Waikanae, WN)
Macroposthonia xenoplax

S26/944143 (Kaitoke Waterworks Res., Hutt Valley, WN)
Blandicephalanema nothofagi
Blandicephalanema pilatum
Blandicephalanema serratum

N27/135050 (Kina Beach, NN)
Ogma sexcostatum

N27/139045 (Kina Beach, NN)
Macroposthonia xenoplax

N27/171994 (Ruby Bay, NN)
Hemicycliophora chathami

N27/181857 (Eves Valley, NN)
Blandicephalanema nothofagi
Criconema (C.) nelsonense
Hemicycliophora chathami
Ogma sexcostatum

N27/183807 (Snowden's Bush, NN)
Ogma sexcostatum

N27/216916 (Rough Island, NN)
Paratylenchus (*P.*) *halophilus*

N27/281877 (Nayland Road, NN)
Macroposthonia rustica

N27/291886 (Melrose Bush, NN)
Criconema (*N.*) *californicum*
Ogma sexcostatum

O27/346928 (Cawthron Institute garden, NN)
Criconemoides informis
Ogma palmatum

O27/379902 (Maitai Valley, NN)
Criconema (*N.*) *annuliferum*

O27/542048 (Whangamoa Hill, NN)
Blandicephalanema serratum

O27/565015 (Rai Saddle, NN)
Hemicycliophora chathami

O27/583997 (Rai cemetery, MB)
Hemicycliophora chathami

O27/584998 (Rai Cemetery, MB)
Blandicephalanema inserratum
Criconema (*N.*) *californicum*
Criconema (*N.*) *graminicola*

O27/597990 (Rai Valley near bridge, SD)
Hemicycliophora chathami
Ogma sexcostatum

O27/598991 (Rai Valley opp. bridge to Okiwi Bay, SD)
Criconema (*N.*) *californicum*
Criconemoides parvus
Ogma capitulatum
Ogma sexcostatum
Syro tribulosus

P27/734112 (Tuna Bay, SD)
Ogma latens
Ogma polyandra
Ogma sexcostatum
Syro tribulosus

P27/736098 (Duncan Bay, Tennyson Inlet, SD)
Syro tribulosus

R27/749012 (Taita Experimental St., Hutt Valley, WN)
Blandicephalanema serratum
Criconema (*N.*) *californicum*

R27/761815 (Orongorongo Val. Field Station Ridge, WN)
Blandicephalanema pilatum
Blandicephalanema serratum

R27/778049 (Silverstream, Hutt Valley, WN)
Macroposthonia rustica

M27/830987 (Mt Arthur, NN)
Criconema (*C.*) *cristulatum*
Criconema (*N.*) *californicum*
Criconema (*N.*) *graminicola*

N27/886041 (Mt Lodestone, NN)
Criconema (*N.*) *alpinum*
Criconema (*N.*) *graminicola*
Criconema (*N.*) *sphagni*
Ogma latens

N27/902052 (Mt Arthur, NN)
Hemicycliophora halophila

P27/913927 (Governors Bay Havelock, SD)
Criconema (*N.*) *alpinum*
Criconema (*N.*) *californicum*

N27/964833 (Eves Valley, NN)
Blandicephalanema inserratum
Blandicephalanema nothofagi
Criconema (*N.*) *alpinum*
Criconema (*N.*) *californicum*
Ogma capitulatum

N28/016690 (Spooners Range, NN)
Criconema (*N.*) *californicum*

P28/047612 (White Bluffs, Nth side, Blenheim, MB)
Criconema (*N.*) *sphagni*

N28/140770 (Wakefield, NN)
Criconema (*N.*) *annuliferum*
Macroposthonia xenoplax
Ogma palmatum

N28/181738 (Wairoa River, NN)
Blandicephalanema inserratum
Criconema (*N.*) *californicum*
Pateracephalanema imbricatum

N28/198753 (Wairoa River, NN)
Blandicephalanema inserratum

N28/208778 (Wairoa River, NN)
Hemicycliophora chathami

N28/233777 (Lee Valley, NN)
Blandicephalanema inserratum
Criconema (*N.*) *californicum*
Criconema (*N.*) *sphagni*
Criconemoides parvus
Ogma sexcostatum

N28/239560 (Red Hill (1130 m), Nelson, NN)
Criconema (*N.*) *graminicola*

P28/869744 (Wairau Valley, NN)
Hemicycliophora chathami

P28/988581 (Redwood Pass Rd, Blenheim, MB)
Criconema (*N.*) *alpinum*
Criconema (*N.*) *californicum*
Criconemoides parvus
Ogma polyandra

P28/990575 (Redwood Pass Rd, Blenheim, MB)
Ogma polyandra

K29/015296 (Greymouth, BR)
Blandicephalanema pilatum
Blandicephalanema serratum

K29/056410 (Waimangaroa, 3 km south, NN)
Blandicephalanema serratum
Criconema (*N.*) *californicum*

L29/198213 (Inangahua R./Coal Creek Res., BR)
Blandicephalanema serratum

L29/277316 (Lyell, 8 km on Nelson side, BR)
Criconema (*N.*) *californicum*

L29/280325 (Lyell, about 5 ml west, Buller Gorge, BR)
Ogma paucispinatum

M29/534332 (Murchison, NN)
Blandicephalanema inserratum

K29/830388 (Cape Foulwind, Westport, BR)
Criconema (*C.*) *cristulatum*
Macroposthonia rustica
Ogma semicrenatum

K29/923384 (Cape Foulwind, BR)
Ogma polyandra

K29/928320 (Greymouth, State Highway 6, BR)
Ogma polyandra

N29/957288 (Whisky Falls, Lake Rotoiti, NN)
Blandicephalanema serratum

K30/085029 (Inangahua West State Forest, Reefton, BR)
Blandicephalanema nothofagi
Blandicephalanema pilatum
Blandicephalanema serratum
Criconema (*N.*) *californicum*
Criconema (*N.*) *lineatum*
Criconema (*N.*) *magnum*
Ogma civellae
Ogma sexcostatum

L30/189067 (Inangahua East State Forest, Reefton, BR)
Blandicephalanema pilatum

L30/200061 (Inangahua East State Forest, Reefton, BR)
Blandicephalanema nothofagi
Blandicephalanema pilatum
Criconema (*N.*) *lineatum*

O32/366410 (Parnassus, NC)
Criconema (*C.*) *cristulatum*

J32/564473 (Kumara Junction, WD)
Ogma sexcostatum

J32/570493 (Kumara Junction, WD)
Hemicycliophora chathami

J32/575467 (Kumara Junction, WD)
Criconema (*N.*) *californicum*
Criconema (*N.*) *graminicola*
Criconemoides parvus
Ogma semicrenatum

J32/576465 (Kumara Junction, WD)
Criconema (*N.*) *ramsayi*
Hemicriconemoides cocophillus
Ogma polyandra

J32/580473 (Kumara Junction, WD)
Ogma semicrenatum

K32/796598 (Mawhera State Forest, BR)
Criconema (*N.*) *californicum*
Criconema (*N.*) *magnum*
Criconema (*N.*) *undulatum*
Hemicriconemoides cocophillus
Ogma semicrenatum

I33/288102 (Ross, WD)
Criconema (*N.*) *californicum*

J33/380217 (Lake Mahinapua Track, Hokitika, WD)
Hemicycliophora chathami
Ogma semicrenatum

K33/921077 (Coral Track to Rome Ridge, Arthurs Pass, NC)
Blandicephalanema serratum

I34/126810 (Harihari, WD)
Criconema (*N.*) *graminicola*

K35/004625 (Rakaia River near Mount Hutt, MC)
Hemicycliophora chathami
Ogma polyandra

K35/006426 (Rakaia River near Mount Hutt, MC)
Ogma polyandra

K35/038649 (Porters Pass region, MC)
Criconema (*N.*) *graminicola*

K35/055673 (Porters Pass region, MC)
Criconema (*N.*) *alpinum*
Criconema (*C.*) *cristulatum*
Criconema (*N.*) *pasticum*
Macroposthonia rustica

M35/150808 (Porters Pass region, MC)
Criconema (*N.*) *californicum*
Criconema (*N.*) *graminicola*

L35/230680 (Kowai Bush, Springfield, MC)
Blandicephalanema nothofagi
Blandicephalanema serratum
Criconema (*N.*) *californicum*

K35/240576 (Porters Pass region, MC)
Ogma polyandra

H35/698441 (Fox Glacier, WD)
Criconema (*N.*) *macilentum*

K35/996622 (Porters Pass, near Lake Lyndon, MC)
Criconema (*C.*) *cristulatum*
Criconema (*N.*) *californicum*
Criconema (*N.*) *pasticum*
Ogma alternum
Ogma catherinae
Ogma latens
Ogma polyandra
Ogma sexcostatum
Ogma sturhani

K36/820300 (Sharplin Falls, MC)
Blandicephalanema serratum

N36/919360 (Taylors Mistake, Banks Peninsula, MC)
Hemicycliophora halophila

F37/902982 (Haast, 0.75 km East, WD)
Hemicycliophora chathami

F37/928933 (Haast River bank, WD)
Criconema (*N.*) *californicum*
Criconemoides parvus
Ogma semicrenatum

F37/928940 (Haast River bank, WD)
Criconemoides parvus

F37/930939 (Haast River bank, WD)
Ogma polyandra

F37/933936 (Haast, 6 km past, WD)
Criconema (*N.*) *graminicola*
Criconema (*N.*) *grandisoni*
Criconemoides parvus
Ogma sexcostatum

G37/159884 (Haast, 30 km SE past bridge, WD)
Hemicycliophora chathami

M37/840088 (Birdlings Flat, Lake Ellesmere, MC)
Hemicycliophora halophila
Pateracephalanema imbricatum

I38/182766 (Burke Pass summit (890 m), MK)
Criconema (*N.*) *graminicola*

G38/183714 (Haast, SH6 60 km past bridge south, OL)
Blandicephalanema pilatum
Criconema (*C.*) *spinicaudatum*
Ogma sexcostatum

F39/056425 (Lake Wanaka, OL)
Criconema (*N.*) *alpinum*

I39/970432 (Albert Burn Valley, SH 6, OL)
Criconema (*N.*) *alpinum*
Criconema (*N.*) *pasticum*

D40/108073 (Tutuko Bench, FD)
Criconema (*N.*) *graminicola*
Trophotylenchulus okamotoi

D40/117994 (Milford Sound, FD)
Criconema (*C.*) *cristulatum*
Ogma paucispinatum

G41/100600 (Cromwell, CO)
Macroposthonia xenoplax

F41/706668 (Queenstown, 2 km east, OL)
Criconema (*N.*) *californicum*

F41/981674 (Carrick, CO)
Criconema (*N.*) *graminicola*

G42/214490 (Hanning Road, Alexandra, CO)
Macroposthonia xenoplax

I44/066796 (Invermay, MAF biogas trial, SL)
Macroposthonia rustica

B44/135946 (Breaksea Island, 60 m, FD)
Blandicephalanema nothofagi
Criconema (*N.*) *californicum*
Criconema (*N.*) *pasticum*

I44/227837 (Dunedin, DN)
Criconema (N.) annuliferum

E45/491495 (Winton, SL)
Criconema (*C.*) *cristulatum*
Criconema (*N.*) *alpinum*
Criconema (*N.*) *californicum*
Criconemoides parvus
Macroposthonia rustica

G46/134946 (near Niagara, Catlins State Forest Park, SL)
Criconema (*N.*) *californicum*
Ogma niagarae
Sphaeronema californicum

G47/135947 (near Niagara, Catlins State Forest Park, SL)
Hemicycliophora chathami
Ogma polyandra

G47/159977 (Tokanui, SL)
Criconema (*C.*) *cristulatum*

G47/390028 (near McLennan, SI)
Blandicephalanema pilatum
Syro tribulosus

E47/434093 (Oreti Beach, Invercargill, SL)
Criconema (*C.*) *cristulatum*
Hemicycliophora halophila

E47/450087 (Oreti Beach Road, Invercargill, SL)
Criconema (N.) annuliferum
Criconema (N.) magnum
Ogma crenulatum

E47/527892 (Bluff, SL)
Criconema (*N.*) *alpinum*
Criconema (*N.*) *californicum*

E47/528891 (Bluff Lookout, SL)
Criconema (*N.*) *graminicola*

Hemicycliophora chathami

E47/627074 (Omaui, SL)
Ogma semicrenatum

E47/628075 (Omaui, SL)
Criconema (*N.*) *californicum*

E47/629076 (Waimatua, SL)
Ogma semicrenatum

F47/812032 (Mataura River 20 km east of Tisbury, SL)
Criconema (*N.*) *californicum*
Ogma semicrenatum

D48/210537 (Stewart Island)
Criconema (*N.*) *undulatum*

E48/382533 (Ulva Island, Stewart Island, SI)
Ogma crenulatum
Ogma semicrenatum

D49/162389 (Tin Range/Table Hill, Stewart Island, SI)
Criconema (*C.*) *mackenziei*

48°01'S/166°36'E (Penguin Creek, SN)
Criconema (*N.*) *dugdalei*
Ogma polyandra
Ogma subantarcticum

49°42'S/178°47'E (betw. Nth Plain & Anchorage B, AN)
Ogma latens

50°31'S/166°13'E (Deas Head, AU)
Criconema (*N.*) *undulatum*

50°41'S/166°05'E (Mt D'Urville, AU)
Criconema (*N.*) *farrelli*

50°53'S/165°50'E (Mt Raynal, Auckland Is, AU)
Criconema (C.) aucklandicum
Criconema (*N.*) *acuticaudatum*
Criconema (*N.*) *macilentum*

52°31'S/169°13'E (North East Harbour, CA)
Macroposthonia campbelli

52°32'S/169°02'E (small island off Ramp Point, CA)
Criconema (*C.*) *spinicaudatum*
Criconema (*N.*) *acuticaudatum*
Criconema (N.) crosbyi
Criconema (*N.*) *macilentum*
Ogma campbelli

52°32'S/169°03'E (Dent Island, CA)
Criconema (*C.*) *spinicaudatum*

52°32'S/169°06'E (St Col, exposed west side, top, CA)
Criconema (*N.*) *acuticaudatum*
Hemicycliophora chathami
Ogma subantarcticum

52°33'S/169°06'E (Tucker Val., Beeman Saddle slope, CA)
Criconema (*N.*) *californicum*

52°33'S/169°08'E (Beeman Pnt, Perseverance Harb, CA)
Criconema (*C.*) *spinicaudatum*
Criconema (*N.*) *acuticaudatum*
Criconema (*N.*) *alpinum*
Hemicycliophora chathami

52°34'S/169°05'E (Mt Dumas, exposed west side, CA)
Criconema (*C.*) *spinicaudatum*

52°34'S/169°06'E (Mt Dumas, east side, CA)
Criconema (*C.*) *spinicaudatum*

52°36'S/169°09'E (Monument Harbour, head of Six Foot Lake, CA)
Criconema (*C.*) *spinicaudatum*
Ogma subantarcticum

52°37'S/169°07'E (Beeman Hill, CA)
Criconema (*N.*) *acuticaudatum*
Ogma subantarcticum

NZMS240 625728 (Te Hapupu, CH)
Ogma sexcostatum

NZMS240 737802 (Point Munning, CH)
Ogma sexcostatum

NZMS240 762115 (S.E. Island, Chatham Is., CH)
Hemicycliophora halophila

NZMS240 031965, 040978, 065003, 068065, 690245, 833267 and 994919 (Chatham Is., CH)
Hemicycliophora chathami

NZMS260 CH2/387416 (Taiko Camp, Chatham Is., CH)
Sphaeronema californicum

Appendix 4. Alphabetical list of plant species and associated Criconematina species

Acer pseudoplatanus, sycamore, Aceraceae
Criconemoides parvus

Actinidia deliciosa, kiwi fruit, Actinidiaceae
Criconema (N.) annuliferum.

Agathis australis, Araucariaceae
Hemicycliophora sp.

Alectryon excelsus, titoki, Sapindaceae
Criconema (N.) californicum
Ogma sexcostatum

Ammophila arenaria, Poaceae
Hemicycliophora halophila

Anisotome latifolia, Apiaceae
Ogma campbelli

Anisotome sp., Apiaceae
Criconema (C.) spinicaudatum

Aristotelia serrata, Elaeocarpaceae
Hemicycliophora chathami

Aristotelia sp., Elaeocarpaceae
Criconema (N.) californicum

Asplenium bulbiferum, Aspleniaceae
Criconema (N.) californicum

Astelia fragrans, Liliaceae
Blandicephalanema pilatum

Astelia sp., Liliaceae
Criconema (N.) sphagni

Beilschmiedia tawa, tawa, Lauraceae
Ogma polyandra
Ogma sexcostatum
Syro tribulosus

Blechnum discolor, blechnum fern, Blechnaceae
Blandicephalanema serratum
Hemicycliophora chathami

Blechnum sp., blechnum fern, Blechnaceae
Criconema (N.) sphagni

Brachyglottis repanda, rangiora, Asteraceae
Blandicephalanema inserratum

Bulbinella sp., Liliaceae
Criconema (C.) spinicaudatum
Criconema (N.) acuticaudatum
Criconema (N.) crosbyi
Criconema (N.) macilentum
Hemicycliophora chathami
Ogma subantarcticum

Carex sp., Cyperaceae
Criconema (C.) spinicaudatum
Criconema (N.) sphagni
Hemicycliophora chathami

Carmichaelia sp., Fabaceae
Criconema (N.) graminicola
Criconema (N.) sphagni
Hemicycliophora chathami
Syro tribulosus

Carpodetus serratum, putaputaweta, Grossulariaceae
Criconema (C.) cristulatum
Criconema (C.) spinicaudatum
Criconema (N.) californicum
Criconema (N.) graminicola
Ogma paucispinatum
Ogma sexcostatum
Syro tribulosus

Cassinia fulvida, Asteraceae
Criconema (N.) californicum

Cassinia leptophylla, Asteraceae
Criconema (N.) alpinum

Cassinia sp., Asteraceae
Criconema (N.) sphagni

Celmisia laricifolia, Asteraceae
Criconema (N.) alpinum
Criconema (N.) graminicola
Ogma latens

Celmisia sessiliflora, Asteraceae
Criconema (C.) cristulatum
Criconema (N.) californicum
Criconema (N.) graminicola
Criconema (N.) macilentum
Hemicycliophora halophila

Celmisia spectabilis, Asteraceae
Criconema (N.) alpinum
Criconema (N.) californicum

Celmisia sp., Asteraceae
Criconema (C.) spinicaudatum

Chionochloa antarctica, tussock, Poaceae
Criconema (N.) acuticaudatum

Chionochloa flavescens, tussock, Poaceae
Criconema (C.) spinicaudatum
Criconema (N.) graminicola
Criconema (N.) macilentum

Chionochloa macra, tussock, Poaceae
Criconema (N.) graminicola

Chionochloa pallens, tussock, Poaceae
Criconema (C.) spinicaudatum
Criconema (N.) graminicola
Trophotylenchulus okamotoi

Chionochloa rigida, tussock, Poaceae
Criconema (N.) graminicola

Chionochloa rubra, tussock, Poaceae
Criconema (N.) graminicola

Chionochloa sp., tussock, Poaceae
Ogma polyandra
Criconema (N.) graminicola

Citrus sp., Rutaceae
Criconema (N.) mutabile
Ogma civellae
Tylenchulus semipenetrans

Coprosma antipoda, Rubiaceae
Ogma latens

Coprosma australis, Rubiaceae
Blandicephalanema serratum

Coprosma ciliata, Rubiaceae
Criconema (*C.*) *spinicaudatum*
Criconema (*N.*) *californicum*
Hemicycliophora chathami

Coprosma linarifolia, Rubiaceae
Blandicephalanema inserratum
Criconema (*N.*) *californicum*
Criconema (*N.*) *graminicola*

Coprosma propinqua, Rubiaceae
Blandicephalanema pilatum
Criconema (*N.*) *lineatum*

Coprosma pumila, Rubiaceae
Criconema (*N.*) *alpinum*

Coprosma sp., Rubiaceae
Criconema (*C.*) *cristulatum*
Criconema (*N.*) *californicum*
Criconemoides parvus
Hemicycliophora chathami
Ogma semicrenatum
Syro tribulosus

Coprosma tenuicaulis, Rubiaceae
Blandicephalanema pilatum
Ogma sexcostatum

Cordyline sp., cabbage tree, Agavaceae
Blandicephalanema pilatum
Criconema (*N.*) *californicum*

Coriaria arborea, tutu, Coriariaceae
Hemicycliophora chathami

Corynocarpus laevigatus, karaka, Corynocarpaceae
Ogma sexcostatum

Cyathea dealbata, silver treefern, Cyatheaceae
Syro tribulosus

Cyathodes empetrifolia, Epacridaceae
Criconema (*C.*) *cristulatum*
Criconema (C.) makahuense
Hemicycliophora sp.
Ogma inaequale
Ogma latens

Cyathodes pumila, Epacridaceae
Ogma latens

Cytisus scoparius, broom, Fabaceae
Criconema (*C.*) *spinicaudatum*

Dacrydium bidwillii, Podocarpaceae
Criconema (*N.*) *sphagni*

Dacrydium cupressinum, rimu, Podocarpaceae
Blandicephalanema inserratum
Blandicephalanema nothofagi
Criconema (C.) nelsonense
Criconema (*N.*) *alpinum*
Criconema (*N.*) *californicum*
Criconema (*N.*) *magnum*
Hemicriconemoides cocophila
Hemicycliophora chathami
Ogma capitulatum
Ogma crenulatum
Ogma polyandra
Ogma sexcostatum
Syro glabellus
Syro tribulosus

Desmoschoenus spiralis, Cyperaceae
Hemicycliophora halophila
Pateracephalanema imbricatum

Diospyros kaki, persimmon, Ebenaceae
Tylenchulus semipenetrans

Dracophyllum longifolium Epacridaceae
Blandicephalanema nothofagi
Criconema (*C.*) *spinicaudatum*
Criconema (*N.*) *pasticum*
Hemicycliophora sp.
Macroposthonia campbelli

Dracophyllum scoparium, Epacridaceae
Criconema (*C.*) *spinicaudatum*
Criconema (*N.*) *californicum*

Dracophyllum sp., Epacridaceae
Criconema (*N.*) *alpinum*
Criconema (*N.*) *sphagni*
Hemicycliophora chathami

Dracophyllum traversii, mountain neinei, Epacridaceae
Blandicephalanema pilatum
Criconema (*N.*) *californicum*
Criconema (*N.*) *graminicola*

Elaeocarpus hookerianus, Elaeocarpaceae
Criconema (*N.*) *californicum*

Feijoa sellowiana, feijoa, Myrtaceae
Criconema (*N.*) *californicum*
Ogma palmatum

Ficus carica, fig, Moraceae
Criconemoides informis
Ogma palmatum

Freycinetia baueriana banksii, Pandanaceae
Blandicephalanema nothofagi

Fuchsia excorticata, tree fuchsia, Onagraceae
Criconema (*C.*) *cristulatum*
Criconema (*N.*) *californicum*
Criconema (*N.*) *magnum*

Criconemoides parvus
Hemicycliophora chathami
Ogma mucronatum
Ogma sexcostatum

Gaultheria sp., Ericaceae
Criconema (*N.*) *sphagni*

Gleichenia sp., Gleicheniaceae
Criconema (*N.*) *sphagni*
Hemicycliophora chathami

Gunnera sp., Gunneraceae
Criconema (*C.*) *cristulatum*
Criconema (*N.*) *californicum*
Criconema (*N.*) *graminicola*
Criconema (*N.*) *pasticum*
Ogma polyandra

Halocarpus bidwillii, Podocarpaceae
Criconema (*C.*) *cristulatum*
Trophotylenchulus sp.

Hebe elliptica, Scrophulariaceae
Criconema (*C.*) *spinicaudatum*
Criconema (*N.*) *acuticaudatum*
Criconema (*N.*) *alpinum*
Criconema (*N.*) *pasticum*
Hemicycliophora chathami
Hemicycliophora sp.

Hebe sp., Scrophulariaceae
Criconema (*N.*) *alpinum*
Criconema (*N.*) *californicum*
Criconema (*N.*) *pasticum*
Criconema (*N.*) *sphagni*
Criconemoides parvus
Hemicycliophora chathami
Ogma latens

Hedycarya arborea, pigeonwood, Monimiaceae
Blandicephalanema serratum
Criconema (*C.*) *cristulatum*
Criconema (*N.*) *californicum*
Macroposthonia rustica
Syro tribulosus

Helichrysum bellidioides, Asteraceae
Ogma latens

Hymenanthera chathamica, Violaceae
Hemicycliophora halophila

Hymenanthera sp., Violaceae
Criconemoides parvus
Ogma polyandra

Juncus sp., Juncaceae
Criconema (*N.*) *sphagni*

Kelleria dieffenbachii, Thymelaeaceae
Criconema (*N.*) *graminicola*
Hemicycliophora halophila

Kelleria sp., Thymelaeaceae
Criconema (*C.*) *spinicaudatum*
Hemicycliophora halophila

Kunzea ericoides, kanuka, Myrtaceae
Criconema (*N.*) *californicum*
Criconema (*N.*) *pasticum*
Ogma sexcostatum
Syro tribulosus

Laurelia novae-zelandiae, pukatea, Monimiaceae
Ogma sexcostatum

Lepidothamnus laxifolius, pigmy pine, Podocarpaceae
Blandicephalanema serratum

Leptospermum scoparium, manuka, Myrtaceae
Blandicephalanema nothofagi
Blandicephalanema serratum
Criconema (*N.*) *alpinum*
Criconema (*N.*) *californicum*
Criconemoides parvus

Leucogenes sp., Asteraceae
Criconema (*C.*) *spinicaudatum*

Leucopogon fasciculatus, Epacridaceae
Macroposthonia xenoplax

Litsea calicaris, mangeao, Lauraceae
Ogma sexcostatum

Lophomyrtus sp., Myrtaceae
Blandicephalanema pilatum

Macropiper excelsum, kawakawa, Piperaceae
Hemicycliophora chathami
Ogma sexcostatum

Melicytus ramiflorus, mahoe, Violaceae
Criconema (*N.*) *alpinum*
Criconema (*N.*) *californicum*
Hemicycliophora sp.
Ogma paucispinatum
Ogma sexcostatum
Syro glabellus

Metrosideros kermadecensis, kermadec pohutukawa, Myrtaceae
Hemicycliophora sp.

Metrosideros robusta, rata, Myrtaceae
Criconema (*N.*) *californicum*
Criconema (*N.*) *magnum*
Criconema (*N.*) *undulatum*
Hemicriconemoides cocophila
Ogma semicrenatum

Metrosideros umbellata, southern rata, Myrtaceae
Criconema (*N.*) *undulatum*

Microlaena stipoides, ricegrass, Poaceae
Criconema (*N.*) *californicum*

Myoporum laetum, ngaio, Myoporaceae
Pateracephalanema imbricatum
Syro tribulosus

Myrsine divaricata, Mysinaceae
Blandicephalanema nothofagi
Criconema (*C.*) *spinicaudatum*

Myrsine sp., Mysinaceae
Criconema (*C.*) *cristulatum*

Neopanax anomalum, Araliaceae
Criconema (*N.*) *lineatum*

Nothofagus fusca, red beech, Nothofagaceae
Blandicephalanema nothofagi
Blandicephalanema pilatum
Blandicephalanema serratum
Criconema (*N.*) *californicum*
Criconema (*N.*) *lineatum*
Ogma civellae

Nothofagus menziesii, silver beech, Nothofagaceae
Blandicephalanema pilatum
Blandicephalanema serratum
Criconema (*C.*) *spinicaudatum*
Syro tribulosus
Trophotylenchulus sp.

Nothofagus solandri, black beech, Nothofagaceae
Blandicephalanema inserratum
Blandicephalanema nothofagi
Blandicephalanema pilatum
Blandicephalanema serratum
Criconema (*C.*) *cristulatum*
Criconema (C.) nelsonense
Criconema (*N.*) *alpinum*
Criconema (*N.*) *californicum*
Criconemoides parvus
Hemicycliophora chathami
Ogma capitulatum
Pateracephalanema imbricatum

Nothofagus sp., beech, Nothofagaceae
Blandicephalanema pilatum
Criconema (*N.*) *californicum*
Criconema (*N.*) *lineatum*
Ogma crenulatum
Ogma semicrenatum

Nothofagus truncata, hard beech, Nothofagaceae
Blandicephalanema nothofagi
Blandicephalanema pilatum
Blandicephalanema serratum

Olearia colensoi, Asteraceae
Blandicephalanema pilatum
Criconema (*N.*) *alpinum*
Criconema (N.) dugdalei
Criconema (*N.*) *graminicola*

Olearia lyallii, Asteraceae
Criconema (N.) dugdalei
Hemicycliophora sp.
Ogma polyandra
Ogma subantarcticum

Olearia oporina, Asteraceae
Criconema (*N.*) *pasticum*

Olearia sp., Asteraceae
Syro tribulosus

Passiflora edulis, passion fruit, Passifloraceae
Ogma civellae
Ogma palmatum

Pennantia sp., Icacinaceae
Criconema (*N.*) *californicum*

Pentachondra pumila, Epacridaceae
Criconema (*N.*) *alpinum*
Ogma catherinae

Pentachondra sp., Epacridaceae
Criconema (*C.*) *cristulatum*
Criconema (*C.*) *spinicaudatum*
Criconema (*N.*) *californicum*
Criconema (*N.*) *pasticum*
Macroposthonia rustica
Ogma polyandra

Persea americana, avocado, Lauraceae
Tylenchulus semipenetrans

Phormium tenax, New Zealand flax, Agavaceae
Criconema (*N.*) *californicum*
Criconema (*N.*) *pasticum*
Hemicycliophora chathami
Hemicycliophora halophila

Phyllachne sp., Stylidiacae
Criconema (*C.*) *spinicaudatum*

Pimelea gnida, Thymelaeaceae
Criconema (*N.*) *pasticum*

Pinus radiata, pine, Pinaceae
Criconemoides parvus

Pisum sativum, pea, Fabaceae
Macroposthonia rustica

Pleurophyllum criniferum, Asteraceae
Criconema (*N.*) *californicum*

Poa foliosa, tussock, Poaceae
Criconema (*C.*) *spinicaudatum*
Criconema (*N.*) *undulatum*
Hemicriconemoides cocophila
Ogma latens

Poa sp., tussock, Poaceae
Ogma subantarcticum

Podocarpus dacrydioides, kahikatea, Podocarpaceae
Blandicephalanema inserratum
Criconema (*N.*) *californicum*
Hemicycliophora chathami
Ogma semicrenatum
Ogma sexcostatum
Syro tribulosus

Podocarpus totara, totara, Podocarpaceae
Blandicephalanema inserratum
Criconema (*N.*) *californicum*
Criconemoides parvus

Hemicycliophora chathami
Ogma crenulatum
Ogma sexcostatum
Syro tribulosus

Polystichum vestitum, Dryopteridaceae
Criconema (*N.*) *californicum*

Prumnopitys ferruginea, miro, Podocarpaceae
Blandicephalanema nothofagi
Blandicephalanema pilatum
Criconema (*N.*) *magnum*
Criconemoides parvus
Hemicycliophora chathami
Macroposthonia rustica
Ogma polyandra
Syro tribulosus

Prumnopitys taxifolia, matai, Podocarpaceae
Blandicephalanema inserratum
Criconema (C.) nelsonense
Criconema (*N.*) *magnum*
Hemicycliophora chathami
Macroposthonia rustica
Ogma crenulatum
Ogma semicrenatum

Prunus persica, peach, Rosaceae
Macroposthonia xenoplax

Pseudopanax arboreus, five finger, Araliaceae
Blandicephalanema serratum
Criconema (*N.*) *californicum*
Criconemoides parvus
Hemicycliophora chathami
Ogma polyandra
Sphaeronema californicum
Syro tribulosus

Pseudopanax crassifolium, lancewood, Araliaceae
Blandicephalanema nothofagi
Criconema (N.) ramsayi
Hemicriconemoides cocophila
Ogma capitulatum
Ogma latens
Ogma polyandra
Ogma semicrenatum
Pateracephalanema imbricatum
Syro tribulosus

Pseudowintera sp., Winteraceae
Ogma semicrenatum

Pteridium aquilinum, bracken, Dennstaedtiaceae
Hemicycliophora chathami

Quintinia sp., Grossulariaceae
Hemicriconemoides cocophila
Ogma semicrenatum

Raoulia grandiflora, Asteraceae
Hemicycliophora halophila

Raoulia sp., Asteraceae
Criconema (*C.*) *spinicaudatum*

Rubus cissoides, bush lawyer, Rosaceae
Blandicephalanema inserratum
Criconema (*N.*) *alpinum*
Criconema (*N.*) *californicum*

Salix sp., willow, Salicaceae
Criconema (*N.*) *annuliferum.*

Sarcocornia australis, glasswort, Chenopodiaceae
Paratylenchus (*P.*) *halophilus*

Sarcocornia quinqueflora, Chenopodiaceae
Criconema (*C.*) *cristulatum*

Schefflera digitata, Araliaceae
Criconema (*N.*) *californicum*
Syro tribulosus

Senecio huntii, Asteraceae
Criconema (*N.*) *sphagni*

Senecio sp., Asteraceae
Criconema (*N.*) *sphagni*
Hemicycliophora chathami

Sophora microphylla, kowhai, Fabaceae
Criconema (*N.*) *californicum*
Hemicycliophora chathami
Ogma capitulatum
Ogma niagarae
Ogma polyandra
Ogma sexcostatum
Sphaeronema californicum
Syro tribulosus
Trophotylenchulus sp.

Sphagnum cymbifolium, Sphagnaceae
Criconema (*N.*) *sphagni*
Hemicycliophora chathami

Toronia toru, toru, Proteaceae
Criconema (*C.*) *cristulatum*
Criconema (*N.*) *californicum*
Macroposthonia rustica

Uncinia gracilenta, Cyperaceae
Blandicephalanema nothofagi

Viola sp., Violaceae
Criconema (*C.*) *spinicaudatum*

Vitis vinifera, grape, Vitaceae
Hemicycliophora sp.
Macroposthonia xenoplax
Tylenchulus semipenetrans

Weinmannia racemosa, kamahi, Cunoniaceae
Ogma semicrenatum

Weinmannia sylvicola, towai, Cunoniaceae
Criconema (*N.*) *californicum*

Appendix 5 Alphabetic list of Criconematina species and associated plant species

Blandicephalanema inserratum
Brachyglottis repanda, rangiora, Asteraceae
Coprosma linarifolia, Rubiaceae
Dacrydium cupressinum, rimu, Podocarpaceae
Nothofagus solandri, black beech, Nothofagaceae
Podocarpus dacrydioides, kahikatea, Podocarpaceae
Podocarpus totara, totara, Podocarpaceae
Prumnopitys taxifolia, matai, Podocarpaceae
Rubus cissoides, bush lawyer, Rosaceae

Blandicephalanema nothofagi
Dacrydium cupressinum, rimu, Podocarpaceae
Dracophyllum longifolium, Epacridaceae
Freycinetia baueriana banksii, Pandanaceae
Leptospermum scoparium, manuka, Myrtaceae
Myrsine divaricata, Mysinaceae
Nothofagus fusca, red beech, Nothofagaceae
Nothofagus solandri, black beech, Nothofagaceae
Nothofagus truncata, hard beech, Nothofagaceae
Prumnopitys ferruginea, miro, Podocarpaceae
Pseudopanax crassifolium, lancewood, Araliaceae
Uncinia gracilenta, Cyperaceae

Blandicephalanema pilatum
Astelia fragrans, Liliaceae
Coprosma propinqua, Rubiaceae
Coprosma tenuicaulis, Rubiaceae
Cordyline sp., cabbage tree, Agavaceae
Dracophyllum traversii, mountain neinei, Epacridaceae
Lophomyrtus sp., Myrtaceae
Nothofagus fusca, red beech, Nothofagaceae
Nothofagus menziesii, silver beech, Nothofagaceae
Nothofagus solandri, black beech, Nothofagaceae
Nothofagus sp., beech, Nothofagaceae
Nothofagus truncata, hard beech, Nothofagaceae
Olearia colensoi, Asteraceae
Prumnopitys ferruginea, miro, Podocarpaceae

Blandicephalanema serratum
Blechnum discolor, blechnum fern, Blechnaceae
Coprosma australis, Rubiaceae
Hedycarya arborea, pigeonwood, Monimiaceae
Lepidothamnus laxifolius, pigmy pine, Podocarpaceae
Leptospermum scoparium, manuka, Myrtaceae
Nothofagus fusca, red beech, Nothofagaceae
Nothofagus menziesii, silver beech, Nothofagaceae
Nothofagus solandri, black beech, Nothofagaceae
Nothofagus truncata, hard beech, Nothofagaceae
Pseudopanax arboreus, five finger, Araliaceae

Criconema (*C.*) *aucklandicum*
Host association unknown

Criconema (*C.*) *cristulatum*
Carpodetus serratum, putaputaweta, Grossulariaceae
Celmisia sessiliflora, Asteraceae
Coprosma sp., Rubiaceae
Cyathodes empetrifolia, Epacridaceae
Fuchsia excorticata, tree fuchsia, Onagraceae
Gunnera sp., Gunneraceae
Halocarpus bidwillii, Podocarpaceae
Hedycarya arborea, pigeonwood, Monimiaceae
Myrsine sp., Mysinaceae
Nothofagus solandri, black beech, Nothofagaceae
Pentachondra sp., Epacridaceae
Sarcocornia quinqueflora, Chenopodiaceae
Toronia toru, toru, Proteaceae

Criconema (*C.*) *mackenziei*
Host association unknown

Criconema (*C.*) *makahuense*
Cyathodes empetrifolia, Epacridaceae

Criconema (*C.*) *nelsonense*
Dacrydium cupressinum, rimu, Podocarpaceae
Nothofagus solandri, black beech, Nothofagaceae
Prumnopitys taxifolia, matai, Podocarpaceae

Criconema (*C.*) *spinicaudatum*
Anisotome sp., Apiaceae
Bulbinella sp., Liliaceae
Carex sp., Cyperaceae
Carpodetus serratum, putaputaweta, Grossulariaceae
Celmisia sp., Asteraceae
Chionochloa flavescens, tussock, Poaceae
Chionochloa pallens, tussock, Poaceae
Coprosma ciliata, Rubiaceae
Cytisus scoparius, broom, Fabaceae
Dracophyllum longifolium, Epacridaceae
Dracophyllum scoparium, Epacridaceae
Hebe elliptica, Scrophulariaceae
Kelleria sp., Thymelaeaceae
Leucogenes sp., Asteraceae
Myrsine divaricata, Mysinaceae
Nothofagus menziesii, silver beech, Nothofagaceae
Pentachondra sp., Epacridaceae
Phyllachne sp., Stylidiacae
Poa foliosa, tussock, Poaceae
Raoulia sp., Asteraceae
Viola sp., Violaceae

Criconema (*N.*) *acuticaudatum*
Bulbinella sp., Liliaceae
Chionochloa antarctica, tussock, Poaceae
Hebe elliptica, Scrophulariaceae

Criconema (*N.*) *alpinum*
Cassinia leptophylla, Asteraceae
Celmisia laricifolia, Asteraceae
Celmisia spectabilis, Asteraceae
Coprosma pumila, Rubiaceae
Dacrydium cupressinum, rimu, Podocarpaceae
Dracophyllum sp., Epacridaceae
Hebe elliptica, Scrophulariaceae
Hebe sp., Scrophulariaceae
Leptospermum scoparium, manuka, Myrtaceae
Melicytus ramiflorus, mahoe, Violaceae
Nothofagus solandri, black beech, Nothofagaceae
Olearia colensoi, Asteraceae
Pentachondra pumila, Epacridaceae
Rubus cissoides, bush lawyer, Rosaceae

Criconema (*N.*) *annuliferum.*
Actinidia deliciosa, kiwi fruit, Actinidiaceae
Salix sp., willow, Salicaceae

Criconema (*N.*) *californicum*
Alectryon excelsus, titoki, Sapindaceae
Aristotelia sp., Elaeocarpaceae

Asplenium bulbiferum, Aspleniaceae
Carpodetus serratum, putaputaweta, Grossulariaceae
Cassinia fulvida, Asteraceae
Celmisia sessiliflora, Asteraceae
Celmisia spectabilis, Asteraceae
Coprosma ciliata, Rubiaceae
Coprosma linarifolia, Rubiaceae
Coprosma sp., Rubiaceae
Cordyline sp., cabbage tree, Agavaceae
Dacrydium cupressinum, rimu, Podocarpaceae
Dracophyllum scoparium, Epacridaceae
Dracophyllum traversii, mountain neinei, Epacridaceae
Elaeocarpus hookerianus, Elaeocarpaceae
Feijoa sellowiana, feijoa, Myrtaceae
Fuchsia excorticata, tree fuchsia, Onagraceae
Gunnera sp., Gunneraceae
Hebe sp., Scrophulariaceae
Hedycarya arborea, pigeonwood, Monimiaceae
Kunzea ericoides, kanuka, Myrtaceae
Leptospermum scoparium, manuka, Myrtaceae
Melicytus ramiflorus, mahoe, Violaceae
Metrosideros robusta, rata, Myrtaceae
Microlaena stipoides, ricegrass, Poaceae
Nothofagus fusca, red beech, Nothofagaceae
Nothofagus solandri, black beech, Nothofagaceae
Nothofagus sp., beech, Nothofagaceae
Pennantia sp., Icacinaceae
Pentachondra sp., Epacridaceae
Phormium tenax, New Zealand flax, Agavaceae
Pleurophyllum criniferum, Asteraceae
Podocarpus dacrydioides, kahikatea, Podocarpaceae
Podocarpus totara, totara, Podocarpaceae
Polystichum vestitum, Dryopteridaceae
Pseudopanax arboreus, five finger, Araliaceae
Rubus cissoides, bush lawyer, Rosaceae
Schefflera digitata, Araliaceae
Sophora microphylla, kowhai, Fabaceae
Toronia toru, toru, Proteaceae
Weinmannia sylvicola, towai, Cunoniaceae

Criconema (*N.*) *crosbyi*
Bulbinella sp., Liliaceae

Criconema (*N.*) *dugdalei*
Olearia colensoi, Asteraceae
Olearia lyallii, Asteraceae

Criconema (*N.*) *farrelli*
Host association unknown

Criconema (*N.*) *graminicola*
Carmichaelia sp., Fabaceae
Carpodetus serratum, putaputaweta, Grossulariaceae
Celmisia laricifolia, Asteraceae
Celmisia sessiliflora, Asteraceae
Chionochloa flavescens, tussock, Poaceae
Chionochloa macra, tussock, Poaceae
Chionochloa pallens, tussock, Poaceae
Chionochloa rigida, tussock, Poaceae
Chionochloa rubra, tussock, Poaceae
Coprosma linarifolia, Rubiaceae
Dracophyllum traversii, mountain neinei, Epacridaceae
Gunnera sp., Gunneraceae
Kelleria dieffenbachii, Thymelaeaceae
Olearia colensoi, Asteraceae

Criconema (*N.*) *grandisoni*
Host association unknown

Criconema (*N.*) *lineatum*
Coprosma propinqua, Rubiaceae
Neopanax anomalum, Araliaceae
Nothofagus fusca, red beech, Nothofagaceae
Nothofagus sp., beech, Nothofagaceae

Criconema (*N.*) *macilentum*
Bulbinella sp., Liliaceae
Celmisia sessiliflora, Asteraceae
Chionochloa flavescens, Poaceae

Criconema (*N.*) *magnum*
Dacrydium cupressinum, rimu, Podocarpaceae
Fuchsia excorticata, tree fuchsia, Onagraceae
Metrosideros robusta, rata, Myrtaceae
Prumnopitys ferruginea, miro, Podocarpaceae
Prumnopitys taxifolia, matai, Podocarpaceae

Criconema (*N.*) *mutabile*
Citrus, sp., Rutaceae

Criconema (*N.*) *pasticum*
Dracophyllum longifolium, Epacridaceae
Gunnera sp., Gunneraceae
Hebe elliptica, Scrophulariaceae
Hebe sp., Scrophulariaceae
Kunzea ericoides, kanuka, Myrtaceae
Olearia oporina, Asteraceae
Pentachondra sp., Epacridaceae
Phormium tenax, New Zealand flax, Agavaceae
Pimelea gnida, Thymelaeaceae

Criconema (*N.*) *ramsayi*
Pseudopanax crassifolium, lancewood, Araliaceae

Criconema (*N.) sphagni*
Astelia sp., Liliaceae
Blechnum sp., Blechnaceae
Carex sp., Cyperaceae
Carmichaelia sp., Fabaceae
Cassinia sp., Asteraceae
Dacrydium bidwillii, Podocarpaceae
Dracophyllum sp., Epacridaceae
Gaultheria sp., Ericaceae
Gleichenia sp., Gleicheniaceae
Hebe sp., Scrophulariaceae
Juncus sp., Juncaceae
Senecio huntii, Asteraceae
Senecio sp., Asteraceae
Sphagnum cymbifolium, Sphagnaceae

Criconema (*N.*) *undulatum*
Metrosideros robusta, rata, Myrtaceae
Metrosideros umbellata, southern rata, Myrtaceae
Poa foliosa, tussock, Poaceae

Criconemoides informis
Ficus carica, fig, Moraceae

Criconemoides parvus
Acer pseudoplatanus, sycamore, Aceraceae
Coprosma sp., Rubiaceae
Fuchsia excorticata, tree fuchsia, Onagraceae
Hebe sp., Scrophulariaceae
Hymenanthera sp., Violaceae
Leptospermum scoparium, manuka, Myrtaceae
Nothofagus solandri, black beech, Nothofagaceae

Pinus radiata, pine, Pinaceae
Podocarpus totara, totara, Podocarpaceae
Prumnopitys ferruginea, miro, Podocarpaceae
Pseudopanax arboreus, five finger, Araliaceae

Hemicriconemoides cocophillus
Dacrydium cupressinum, rimu, Podocarpaceae
Metrosideros robusta, rata, Myrtaceae
Poa foliosa, tussock, Poaceae
Pseudopanax crassifolium, lancewood, Araliaceae
Quintinia sp., Grossulariaceae

Hemicycliophora chathami
Aristotelia serrata, Elaeocarpaceae
Blechnum sp., Blechnaceae
Bulbinella sp., Liliaceae
Carex sp., Cyperaceae
Carmichaelia sp., Fabaceae
Coprosma ciliata, Rubiaceae
Coprosma sp., Rubiaceae
Coriaria arborea, tutu, Coriariaceae
Dacrydium cupressinum, rimu, Podocarpaceae
Dracophyllum sp., Epacridaceae
Fuchsia excorticata, tree fuchsia, Onagraceae
Gleichenia sp., Gleicheniaceae
Hebe elliptica, Scrophulariaceae
Hebe sp., Scrophulariaceae
Macropiper excelsum, kawakawa, Piperaceae
Nothofagus solandri, black beech, Nothofagaceae
Phormium tenax, New Zealand flax, Agavaceae
Podocarpus dacrydioides, kahikatea, Podocarpaceae
Podocarpus totara, totara, Podocarpaceae
Prumnopitys ferruginea, miro, Podocarpaceae
Prumnopitys taxifolia, matai, Podocarpaceae
Pseudopanax arboreus, five finger, Araliaceae
Pteridium aquilinum, bracken, Dennstaedtiaceae
Senecio sp., Asteraceae
Sophora microphylla, kowhai, Fabaceae
Sphagnum cymbifolium, Sphagnaceae

Hemicycliophora halophila
Ammophila arenaria, Poaceae
Celmisia sessiliflora, Asteraceae
Desmoschoenus spiralis, Cyperaceae
Hymenanthera chathamica, Violaceae
Kelleria dieffenbachii, Thymelaeaceae
Kelleria sp., Thymelaeaceae
Phormium tenax, New Zealand flax, Agavaceae
Raoulia grandiflora, Asteraceae

Hemicycliophora sp.
Agathis australis, Auraucariaceae
Cyathodes empetrifolia, Epacridaceae
Dracophyllum longifolium, Epacridaceae
Hebe elliptica, Scrophulariaceae
Melicytus ramiflorus, mahoe, Violaceae
Metrosideros kermadecensis, Myrtaceae
Olearia lyallii, Asteraceae
Vitis vinifera, grape, Vitaceae

Macroposthonia campbelli
Dracophyllum longifolium, Epacridaceae

Macroposthonia rustica
Hedycarya arborea, pigeonwood, Monimiaceae
Pentachondra sp., Epacridaceae
Pisum sativum, pea, Fabaceae
Prumnopitys ferruginea, miro, Podocarpaceae
Prumnopitys taxifolia, matai, Podocarpaceae
Toronia toru, toru, Proteaceae

Macroposthonia xenoplax
Leucopogon fasciculatus, Epacridaceae
Prunus persica, peach, Rosaceae
Vitis vinifera, grape, Vitaceae

Ogma campbelli
Anisotome latifolia, Apiaceae

Ogma capitulatum
Dacrydium cupressinum, rimu, Podocarpaceae
Nothofagus solandri, black beech, Nothofagaceae
Pseudopanax crassifolium, lancewood, Araliaceae
Sophora microphylla, kowhai, Fabaceae

Ogma catharinae
Pentachondra pumila, Epacridaceae

Ogma civellae
Citrus sp., Rutaceae
Nothofagus fusca, red beech, Nothofagaceae
Passiflora edulis, passion fruit, Passifloraceae

Ogma crenulatum
Dacrydium cupressinum, rimu, Podocarpaceae
Nothofagus sp., beech, Nothofagaceae
Podocarpus totara, totara, Podocarpaceae
Prumnopitys taxifolia, matai, Podocarpaceae

Ogma inaequale
Cyathodes empetrifolia, Epacridaceae

Ogma latens
Celmisia laricifolia, Asteraceae
Coprosma antipoda, Rubiaceae
Cyathodes empetrifolia, Epacridaceae
Cyathodes pumila, Epacridaceae
Hebe sp., Scrophulariaceae
Helichrysum bellidioides, Asteraceae
Poa foliosa, tussock, Poaceae
Pseudopanax crassifolium, lancewood, Araliaceae

Ogma mucronatum
Fuchsia excorticata, tree fuchsia, Onagraceae

Ogma niagarae
Sophora microphylla, kowhai, Fabaceae

Ogma palmatum
Feijoa sellowiana, feijoa, Myrtaceae
Ficus carica, fig, Moraceae
Passiflora edulis, passion fruit, Passifloraceae

Ogma paucispinatum
Carpodetus serratum, putaputaweta, Grossulariaceae
Melicytus ramiflorus, mahoe, Violaceae

Ogma polyandra
Beilschmiedia tawa, tawa, Lauraceae
Chionochloa sp., tussock, Poaceae
Dacrydium cupressinum, rimu, Podocarpaceae
Gunnera sp., Gunneraceae

Hymenanthera sp., Violaceae
Olearia lyallii, Asteraceae
Pentachondra sp., Epacridaceae
Prumnopitys ferruginea, miro, Podocarpaceae
Pseudopanax arboreus, five finger, Araliaceae
Pseudopanax crassifolium, lancewood, Araliaceae
Sophora microphylla, kowhai, Fabaceae

Ogma semicrenatum
Coprosma sp., Rubiaceae
Metrosideros robusta, rata, Myrtaceae
Nothofagus sp., beech, Nothofagaceae
Podocarpus dacrydioides, kahikatea, Podocarpaceae
Prumnopitys taxifolia, matai, Podocarpaceae
Pseudopanax crassifolium, lancewood, Araliaceae
Pseudowintera sp., Winteraceae
Quintinia sp., Grossulariaceae
Weinmannia racemosa, kamahi, Cunoniaceae

Ogma sexcostatum
Alectryon excelsus, titoki, Sapindaceae
Beilschmiedia tawa, tawa, Lauraceae
Carpodetus serratum, putaputaweta, Grossulariaceae
Coprosma tenuicaulis, Rubiaceae
Corynocarpus laevigatus, karaka, Corynocarpaceae
Dacrydium cupressinum, rimu, Podocarpaceae
Fuchsia excorticata, tree fuchsia, Onagraceae
Kunzea ericoides, kanuka, Myrtaceae
Laurelia novae-zelandiae, pukatea, Monimiaceae
Litsea calicaris, mangeao, Lauraceae
Macropiper excelsum, kawakawa, Piperaceae
Melicytus ramiflorus, mahoe, Violaceae
Podocarpus dacrydioides, kahikatea, Podocarpaceae
Podocarpus totara, totara, Podocarpaceae
Sophora microphylla, kowhai, Fabaceae

Ogma sturhani
Host association unknown

Ogma subantarcticum
Bulbinella sp., Liliaceae
Olearia lyallii, Asteraceae
Poa sp., tussock, Poaceae

Paratylenchus (*P.*) *halophilus*
Sarcocornia australis, glasswort, Chenopodiaceae

Pateracephalanema imbricatum
Desmoschoenus spiralis, Cyperaceae
Myoporum laetum, ngaio, Myoporaceae
Nothofagus solandri, black beech, Nothofagaceae
Pseudopanax crassifolium, lancewood, Araliaceae

Sphaeronema californicum
Pseudopanax arboreus, five finger, Araliaceae
Sophora microphylla, kowhai, Fabaceae

Syro glabellus
Dacrydium cupressinum, rimu, Podocarpaceae
Melicytus ramiflorus, mahoe, Violaceae

Syro tribulosus
Beilschmiedia tawa, tawa, Lauraceae
Carmichaelia sp., Fabaceae
Carpodetus serratum, putaputaweta, Grossulariaceae
Coprosma sp., Rubiaceae
Cyathea dealbata, silver tree fern, Cyatheaceae
Dacrydium cupressinum, rimu, Podocarpaceae
Hedycarya arborea, pigeonwood, Monimiaceae
Kunzea ericoides, kanuka, Myrtaceae
Myoporum laetum, ngaio, Myoporaceae
Nothofagus menziesii, silver beech, Nothofagaceae
Olearia sp., Asteraceae
Podocarpus dacrydioides, kahikatea, Podocarpaceae
Podocarpus totara, totara, Podocarpaceae
Prumnopitys ferruginea, miro, Podocarpaceae
Pseudopanax arboreus, five finger, Araliaceae
Pseudopanax crassifolium, lancewood, Araliaceae
Schefflera digitata, Araliaceae
Sophora microphylla, kowhai, Fabaceae

Trophotylenchulus okamotoi
Chionochloa pallens, tussock, Poaceae

Trophotylenchulus sp.
Halocarpus bidwillii, Podocarpaceae
Nothofagus menziesii, silver beech, Nothofagaceae
Sophora microphylla, kowhai, Fabaceae

Tylenchulus semipenetrans
Citrus, sp., Rutaceae
Diospyros kaki, persimmon, Ebenaceae
Persea americana, avocado, Lauraceae
Vitis vinifera, grape, Vitaceae

Tables 3–13. Standard measurements of species.

Table 3. Measurements of species of *Criconema* (*Criconema*)

Criconema	*aucklandicum*[1]		*cristulatum*[1]		*mackenziei*	
body parts measured (µm) and ratios	females	males	females	males	holotype female	paratype females
n	17	2	25	10		20
L (mm)	0.52±0.013 (0.44–0.64)	0.56, 0.46	0.41±0.009 (0.33–0.50)	0.44±0.012 (0.41–0.48)	0.68	0.62±0.068 (0.53–80)
diameter at midbody	44±1.2 (38–50)	20	39±0.4 (35–47)	17.5±0.25 (17–18)	50	51±2.5 (46–58)
diameter at vulva	34±0.9 (29–42)		30±0.4 (27–33)		39	38±1.5 (36–42)
length of stylet	89±0.8 (84–96)		74±0.57 (68–79)		106	108±3.3 (102–115)
height of stylet base	4.0±0.11 (3.5–4.5)		3.3±0.07 (3.0–4.0)		4	4.0±0.40 (3–5)
width of stylet base	10±0.16 (8.5–11)		8.7±0.15 (7–10)		13	11.7±0.90 (10–14)
width of lip region	16±0.25 (14–18)		14.4±0.18 (12–16)		18	17.8±1.05 (16–20)
length of oesophagus	129±2.1 (115–145)		105±1.0 (95–120)		157	156±6.9 (144–170)
length of tail	33±1.4 (25–48)	44, 47	24±0.84 (14–32)	47±1.8 (43–53)	35	33±3.7 (24–40)
R	75±0.71 (68–79)		73±0.67 (65–78)		98	95±1.9 (91–98)
Rex	21±0.63 (19–22)				26	26±1.2 (24–28)
RV	12±0.24 (10–14)		12±0.20 (10–14)		14	13.1±0.77 (12–14)
Ran	7.0±0.23 (5–8)		7.0±0.15 (5–8)		9	8.0±0.45 (7–9)
a	10.7±0.3 (9.0–12.8)	28	10.3±0.23 (8.0–12.8)	25±0.38 (24–26)	13.6	12.2±1.34 (10.2–15.4)
b	4.0±0.07 (3.6–4.6)		3.9±0.6 (3.3–4.6)		4.3	4.0±0.35 (3.4–4.9)
c	16.0±0.55 (12.7–18.9)	12.7, 9.7	18±0.6 (13–25)	9.2±0.28 (8.5–10.1)	19.5	19±3.2 (14–28)
V	87±0.22 (86–89)		88±0.18 (86–90)		90	90±1.0 (88–91)
length of spicules		39, 37		36±1.0 (34–40)		
length of gubernaculum		10.9		9.8±0.37 (9–11)		

Criconema	*makahuense*		*nelsonense*			*spinicaudatum*[1]		
body parts measured (µm) and ratios	holotype female	paratype females	holotype female	paratype females	paratype males	juveniles	females	males
n		2		16	10	5	10	2
L (mm)	0.52	0.49, 0.48	0.44	0.37±0.015 (0.30–0.50)	0.43±0.01 (0.37–0.45)	0.24±0.016 (0.25–0.29)	0.47±0.008 (0.41–0.49)	0.49, 0.50
diameter at midbody	31	33, 34	36	36±1.2 (28–47)	22.5±(19–28)	34±4.0 (27–48)	42±1.3 (35–48)	
diameter at vulva	23	25, 28	27	27±0.9 (20–36)			32±0.73 (27–35)	
length of stylet	60	62, 60	61	60±0.71(53–64)		55±1.3 (50–57)	72±0.87 (68–76)	
height of stylet base	3.5	3.5, 3.5	3	3.0±0.13 (2.5–4.0)		3.6±0.24 (3–4)	4.7±0.23 (4.0–6.0)	
width of stylet base	9	9.0, 8.5	7.5	7.2±0.16 (6.0–8.5)		8.4±0.24 (8–9)	11±0.3 (10–13)	
width of lip region	14	12.5, 13.0	9	10.7±0.18 (9–12)		9.5±0.5 (8.5–11)	15±0.24 (13.5–16)	
length of oesophagus	93	103, 106	92	99±2.0 (85–115)			114±1.2 (105–125)	
length of tail	16	16, 14	17	14.2±0.8 (9–20)	25±1.2 (18–30)		20±1.2 (14–26)	
R	104	103, 101	100	120±1.1 (95–110)			88±1.5 (79–95)	185
Rex	29	28, 30	29	31±0.8 (29–34)			24±0.5 (23–25)	53
RV	11	10, 11	10	10.8±0.25 (9–12)			11±0.3 (10–13)	
Ran	6	5, 5	5	6.3±0.36 (5–10)			7±0.28 (5–8)	17
a	16.8	14.9, 14.1	12.3	10.2±0.35 (8.5–13.0)	19±0.7 (15–23)		11±0.25 (10–12)	23
b	5.61	4.76, 4.51	4.8	3.8±0.10 (3.2–4.8)		7.2±0.77 (5.7–10)	4.1±0.06 (3.8–4.3)	5.2, 6.3
c			26	27±1.6 (19–41)	17.5±0.8 (13–23)	2.7±0.22 (2.1–3.4)	24±1.5 (19–32)	11.6, 13.0
V	92	92, 91	93	92±0.26 (91–94)			91±0.25 (90–93)	
length of spicules					58±1.0 (53–63)			40
length of gubernaculum					12.5±0.27 (11–14)			

[1]/ Measurements taken from Loof et al. (1997).

Table 4. Measurements of species of *Criconema* (*Nothocriconema*)

Criconema	*annuliferum*	*grandisoni*		*lineatum*[1]	*magnum*		*undulatum*[1]	
body parts measured (µm) and ratios	females	holotype female	paratype females	females	females[1]	juveniles	females	males
n	10		10	10	4	20	30	2
L (mm)	0.60±0.043 (0.52–0.66)	0.41	0.45±0.037 (0.38–0.49)	0.46±0.014 (0.37–0.56)	0.60–0.89	0.45±0.056 (0.37–0.55)	0.43±0.015 (0.32–0.53)	0.50, 0.51
diameter at midbody	55±4.50 (49–62)	37	40±3.11 (33–45)	61±4.1 (52–68)		48±8.3 (37–60)		
diameter at vulva	40±3.61 (36–46)	31	33.4±1.74 (30–35)	37±2.5 (32–40)				
length of stylet	102±3.69 (97–107)	100	101±5.3 (88–108)	84±4.3 (77–91)	89–101	73±3.9 (66–78)	82±0.5 (78–87)	
height of stylet base	4.7±0.45 (4–5.5)	3.5	3.5±0.47 (3.0–4.6)	4.6±0.57 (3.5–6)		3.5±0.39 (3–4)		
width of stylet base	12.8±0.64 (12–13.5)	11	10.2±0.64 (9.0–11.0)	11.6±0.99 (10–13)		10.7±0.64 (9–11)		
width of lip region	23±1.0 (22–25)	13.5	14.4±0.49 (13.5–15.0)	16±0.67 (15–17)		17.5±1.86 (15–21)		
length of oesophagus	148±6.7 (136–161)	138	147±8.35 (134–160)	120±7.19 (108–136)		125±5.6 (118–137)		
PV	56±9.84 (44–72)	56	60.9±4.41 (54–70)	41±4.8 (33–48)	79–95		54±1.3 (44–67)	
length of tail	24±3.7 (19–31)	31	33±2.17 (28–35)	18.6±3.92 (12–25)				18, 37
R	62±1.72 (60–65)	120	132.5±4.86 (120–138)	73±2.9 (66–77)	58–65	69±2.8 (64–74)	121±0.6 (115–130)	
Rex	18.8±1.1 (17–20)		39±1.56 (37–42)	25±1.10 (23–26)	17–19		35±0.24 (33–38)	
RV	8.6±0.49 (8–9)	18	19.1±1.22 (18.0–21.0)	8.8±0.54 (8–10)	9–11		15.3±0.13 (15–17)	
Ran	4.7±0.45 (4–5)	11	11.1±0.70 (10.0–12.0)	4.8±0.54 (4–6)			9.6±0.16 (8–11)	14
a	10.9±0.90 (9.3–12.5)	11.1	11.3±1.42 (8.9–14.5)	7.5±0.88 (6.4–9.3)	7.3–12.3	9.5±1.22 (8.4–12.3)	11.8±0.23 (10.2 -14.5)	21, 27
b	4.0±0.29 (3.6–4.8)	3	3.1±0.20 (2.7–3.3)	3.8±0.43 (3.1–4.7)	3.9–5.3	3.6±0.43 (3.1–4.3)	3.6±0.05 (3.3–4.1)	
c	27±3.9 (21–34)	13.2	13.6±1.60 (10.9–17.0)	26±4.7 (17.8–34.7)			15.9±0.30 (12.9–19.4)	13,16
V	91±1.3 (89–93)	86	86±1.0 (84–88)	91±1.0 (89–93)	87–89		88±0.14 (87–90)	
PV/VB	1.4±0.17 (1.1–1.7)	1.8	1.8±0.16 (1.7–2.3)	1.1±0.10 (0.9–1.2)	1.2–1.6		1.6±0.04 (1.4–2.1)	
St%/L	17.2±1.12 (15.8–18.7)	24.4	22.8±2.36 (18.4–26.0)	18.5±2.19 (15.5–22.6)	11–16	16.5±2.37 (13.2–19.6)	18.1±0.58 (16–20)	
length of spicules								42, 60

[1]/ Measurements taken from Loof et al. (1997).

Table 5. Measurements of species of *Criconema* (*Nothocriconemella*)

Criconema body parts measured (µm) and ratios	*mutabile* females	*californicum* females	*pasticum* females	*alpinum* females	*graminicola*[1] females	*acuticaudatum*[1] females
n	10	20	20	20	10	10
L(mm)	0.38±0.024(0.33–0.41)	0.37±0.029(0.31–0.40)	0.39±0.020(0.36–0.43)	0.37±0.021(0.34–0.41)	0.35±0.04(0.29–0.40)	0.43±0.05(0.40–0.46)
diameter at midbody	28±1.3(27–31)	33±2.5(29–37)	31±2.0(28–34)	37±1.2(34–38)		
diameter at vulva(VB)	24±1.6(21–26)	27±1.9(24–30)	25±1.3(23–27)	30±1.0(28–32)		
diameter at anus	19.8±1.47(16.0–21.0)	16.7±0.47(16.0–17.0)	17.7±0.84(16.0–19.0)	18.8±1.45(16.0–21.0)		
length of stylet	53±2.1(51–58)	65±1.7(62–67)	78±3.2(73–83)	89±2.3(86–94)	68±0.70(62–81)	75.7±0.52(72–78)
length of stylet shaft	9.8±0.71(8.5–11.0)	11.1±0.60(10.5–12.0)	9.3±0.78(8.5–11.0)	12.3±0.60(11.5–13.0)		
height of stylet base	3.4±0.32(3.0–4.0)	2.9±0.23(2.5–3.0)	2.8±0.34(2.5–3.5)	3.6±0.37(3.0–4.5)		
width of stylet base	8.1±0.37(7.5–8.5)	8.4±0.62(7.0–9.0)	8.0±0.85(6.5–10.0)	9.5±0.45(8.5–10.0)		
width of first lip annule	11.5±0.39(11.0–12.0)	13.3±0.46(13.0–14.0)	11.3±0.51(10.5–12.0)	12.4±0.90(10.0–13.0)	12–13	11
length of oesophagus	93±3.27(88–98)	101±5.4(88–108)	116±3.0(112–122)	126±3.0(121–132)		(106–121)
PV	30±2.8(26–35)	49±4.8(40–56)	45±3.0(40–49)	50±3.6(47–56)	51±0.66(43–61)	72±2.19(62–78)
length of tail	16.9±1.97(14.0–20.0)	24.5±2.29(21.0–27.0)	20.0±1.41(18.0–23.0)	21.9±3.93(17.0–30.0)		38±0.80(33–42)
R	115±4.4(108–121)	88±2.3(85–92)	104±2.2(101–109)	88±2.6(83–91)	80±0.49(73–86)	93±0.56(88–95)
Rex	28±0.7(27–29)	26±1.0(25–27)	32±2.1(29–35)	26±1.8(24–30)	24.5±0.19(22–27)	28±0.30(27–30)
RV	11.5±0.67(11.0–13.0)	14.7±0.78(13.0–16.0)	14.1±0.70(13.0–15.0)	13.7±0.90(13.0–15.0)	12.8±0.20(11–14)	15.2±0.17(14–16)
Ran	8.0±0.00(8.0–8.0)	8.5±0.71(8.0–10.0)	7.7±0.64(7.0–9.0)	7.4±0.68(7.0–9.0)	7.1±0.09(6–8)	8.6±0.21(7–10)
a	13.5±0.79(12.1–14.8)	11.3±1.28(9.7–13.9)	12.9±1.00(11.0–14.2)	10.2±0.74(8.9–11.2)	9.6±0.018(7.6–11.3)	11.7±0.15(11–13)
b	4.1±0.24(3.7–4.4)	3.6±0.22(3.4–4.1)	3.4±0.16(3.1–3.7)	3.0±0.18(2.7–3.2)	3.5±0.04(2.9–4.1)	3.7±0.068(3.5–4.1)
c	22.8±2.10(20.0–26.7)	14.9±1.37(12.9–16.7)	19.7±1.45(17.0–21.7)	17.4±2.82(13.3–22.4)	13.5±0.30(9.1–18.5)	11.4±0.22(10.4–13.8)
V	92±0.7(91–94)	87±0.7(86–88)	89±0.5(88–90)	87±0.6(86–88)	85±0.21(82–88)	83±0.27(81–85)
PV/VB	1.3±0.09(1.2–1.5)	1.8±0.23(1.4–2.1)	1.8±0.07(1.7–2.0)	1.7±0.13(1.5–1.9)	1.66±0.02(1.4–2.0)	2.33±0.03(2.1–2.5)
St%L	14.0±1.01(12.8–16.2)	17.9±1.58(15.4–20.4)	19.8±1.27(18.4–22.8)	24±1.65(22–26)		
width median bulb	13.8±0.87(12.5–15.0)	15.6±1.20(14.0–18.0)	14.2±0.71(13.0–15.5)	18.0±1.31(16.0–21.0)		
width basal bulb	10.1±1.67(8.5–13.5)	9.6±0.80(8.5–11.0)	9.1±0.54(8.5–10.0)	11.2±0.55(10.0–12.0)		
c’				19.6(16-24)	17.5(16-19)	

Table 5 (continued). Measurements of species of *Criconema* (*Nothocriconemella*)

Criconema	*sphagni* from Lee Valley	*sphagni* from Blenheim	*macilentum*[1]	*crosbyi*[1]	*farrelli*[1]	*ramsayi*[1]	*dugdalei*[1]
body parts measured (µm) and ratios	females	females	females	females	females	females	females
n	10	10	20	20	20	20	20
L(mm)	0.41±0.018(0.37-0.44)	0.45±0.036(0.38-0.51)	0.42±0.032(0.36-0.48)	0.54±0.038(0.46-0.61)	0.56±0.028(0.50-0.62)	0.49±0.025(0.46-0.58)	0.48±0.03(0.44-0.53)
diameter at midbody	32±0.9(30-33)	33±1.7(29-35)	35±1.09(33-37)	40±1.7(36-43)	39±2.3(35-44)	38±1.7(33-41)	43±1.8(40-46)
diameter at vulva(VB)	28±2.0(25-31)	28±2.1(25-32)	29±1.6(27-32)	32±2.1(28-35)	32±2.3(28-36)	34±1.7(30-37)	34±1.4(32-37)
diameter at anus	18.9±1.22(17.0-21.0)	20.0±1.55(17.0-22.0)	20±1.2(18-22)	21±1.67(17-24)	23.5±1.64(21-27)	23±1.4(19-25)	20±1.3(17-23)
length of stylet	97±3.3(91-102)	118±4.1(111-125)	116±3.74(111-125)	95±2.4(90-99)	93(89-102)	99±2.6(94-104)	150±3.9(141-159)
length of stylet shaft	10.2±0.45(9.5-11.0)	11.2±0.98(10.0-13.0)	13.4±1.26(11.0-16.0)	13.4±0.79(12.0-15.0)	10.5±0.76(9.0-12.0)	13.8±0.96(12-15.5)	16.2±1.0(15.0-18.0)
height of stylet base	3.2±0.23(3.0-3.5)	3.5±0.50(2.5-4.0)	3.8±0.41(3.0-4.5)	3.8±0.42(3.0-4.5)	3.1±0.28(2.5-3.5)	4.0±0.37(3.5-4.5)	4.2±0.26(3.5-4.5)
width of stylet base	8.9±0.32(8.5-9.5)	9.4±0.80(8.0-11.0)	10.3±0.55(9.5-11.0)	10.5±0.57(9.5-11.5)	7.7±0.62(7.0-9.0)	9.9±0.43(9.0-11.0)	13.1±0.72(12.0-14.5)
width of first lip annule	11.2±0.68(10.5-12.0)	11.0±0.63(10.0-12.0)	12.1±0.62(11.5-13.5)	15.2±0.78(14.0-17.0)	12.5±0.56(11.5-13.5)	16.8±0.84(15.0-18.0)	13.8±0.47(13.0-15.0)
length of oesophagus	132±6.0(122-143)	153±3.6(148-161)	152±5.5(140-161)	137±4.8(130-150)	140±6.05(131-152)	150±5.0(142-166)	188±5.3(177-197)
PV	46±3.4(40-51)	50±5.4(43-60)	60±5.7(46-70)	79±10.9(57-92)	70±6.4(56-84)	63±5.4(54-78)	60±4.7(54-72)
length of tail	21.7±2.72(18.0-27.0)	25±3.3(21-30)	33±3.6(26-41)	46±5.8(30-54)	37±4.8(29-48)	32±4.5(22-42)	29±3.0(23-35)
R	101±3.2(96-106)	114±2.1(110-117)	100±3.32(91-105)	104±2.74(98-108)	117±3.9(110-124)	128±4.4(118-136)	110±2.3(105-115)
Rex	32±0.9(30-33)	37±0.6(36-38)					
RV	14.1±0.70(13.0-15.0)	15.0±0.47(14.0-16.0)	15.9±0.93(14-18)	17.6±1.01(15.0-19.0)	17.1±0.97(15.0-19.0)	20±1.0(18.0-22.0)	17.3±0.79(16.0-19.0)
Ran	8.0±0.45(7.0-9.0)	9.0±0.63(8.0-10.0)	9.7±0.80(8-11)	11.4±1.07(10.0-14.0)	10.5±0.83(9.0-12.0)	11.3±0.73(10.0-13.0)	9.8±0.70(9.0-11.0)
a	12.9±0.61(11.8-14.1)	13.7±0.98(12.2-15.5)	12.1±1.10(10.6-14.0)	13.5±0.70(12.1-14.8)	14.5±0.67(13.4-15.7)	12.9±0.95(11.2-15.2)	11.3±0.67(10.1-12.4)
b	3.1±0.15(2.9-3.3)	2.9±0.21(2.5-3.2)	2.8±0.17(2.5-3.1)	4.0±0.27(3.3-4.3)	4.0±0.21(3.5-4.3)	3.3±0.14(3.1-3.5)	2.6±0.14(2.3-2.8)
c	19.2±2.36(15.2-22.8)	17.6±1.86(15.4-21.2)	12.9±1.70(10.3-16.3)	11.9±1.67(10.2-17.1)	15.4±1.78(12.3-18.8)	15.7±2.35(12.9-22.4)	17.0±1.59(14.2-20.3)
V	89±0.5(88-90)	89±0.7(88-90)	86±1.20(84-88)	86±1.6(84-90)	88±0.8(86-90)	87±0.9(86-89)	88±1.0(86-89)
PV/VB	1.6±0.10(1.5-1.8)	1.8±0.11(1.5-1.9)	2.0±0.19(1.6-2.4)	2.4±0.31(1.7-2.8)	2.2±0.11(1.9-2.4)	1.9±0.12(1.6-2.1)	1.8±0.1(1.6-2.0)
St%L	23.6±1.27(21.7-25.8)	26.5±1.90(24.0-30.9)	28±2.2(24-31)	17.5±1.14(15.7-20.1)	16.7±1.10(14.7-18.3)	20.2±1.23(16.7-22.1)	31±2.0(28-36)
width median bulb	15.4±0.62(14.0-16.0)	16.6±1.20(15.0-19.0)	17.1±1.41(15-21)	19±0.98(17-22)	21±1.89(16-23)	18±1.30(16-21)	22±1.7(19-26)
width basal bulb	9.8±1.25(8.0-12.0)	9.6±0.66(9.0-11.0)	10.8±1.12(9.5-13)	11.2±1.25(10.0-14.0)	12.0±1.62(10.0-16.0)	11.4±1.08(9.5-14.0)	12.6±0.94(11.0-14.0)
c'	1.3±0.10(1.1-1.4)	1.6±0.16(1.2-2.0)	2.3±0.26(1.6-2.7)	1.6±0.14(1.3-1.8)	1.4±0.16(1.2-1.7)	1.4±0.16(1.2-1.7)	1.4±0.11(1.3-1.7)

[1]/ Measurements taken from Wouts (2000).

Table 6. Key diagnostic characters of species of *Criconema* (*Nothocriconemella*) in sequence of stylet length.[1]

species:	L (mm)	stylet (µm) length	W base	L shaft	R	RV	postvulval area lateral line	tail extended	anterior annules fused	vulval lip overlapping
mutabile	0.35 (0.29–0.42)	55 (52–60)	8	9.8	103 (97–114)	11 (9–12)	absent	no	no	no
californicum	0.33 (0.29–0.39)	66 (55–74)	7.5	9.8	96 (86–105)	13.4 (11–17)	absent	no	no	yes
graminicola	0.35 (0.29–0.40)	68 (62–81)	10.3	12.8	80 (73–86)	12.8 (11–14)	absent	no	no	yes
acuticaudatum	0.43 (0.40–0.46)	76 (72–78)	11.1	14.3	93 (88–95)	15.2 (14–16)	absent	yes	no	yes
pasticum	0.34 (0.27–0.39)	77 (73–82)	7.5	10	102 (94–111)	13 (12–17)	absent	no	no	yes
alpinum	0.33 (0.29–0.37)	91 (83–99)	9.5	11.2	88 (83–91)	11.0 (10–13)	absent	no	no	yes
farrelli	0.56 (0.50–0.62)	93 (89–102)	7.7	10.5	117 (110–124)	17.1 (15–19)	absent	no	no	yes
crosbyi	0.54 (0.46–0.61)	95 (90–99)	10.5	13.4	104 (98–108)	17.6 (15–19)	absent	yes	yes	yes
ramsayi	0.49 (0.46–0.58)	99 (94–104)	9.9	13.8	128(118–136)	20 (18–22)	present	no	no	yes
sphagni	0.39 (0.35–0.41)	114 (106–120)	9.4	11.4	94 (90–97)	15 (13–16)	absent	no	no	yes
macilentum	0.42 (0.36–0.48)	116 (111–125)	10.3	13.4	100 (91–105)	15.9 (14–18)	absent	yes	no	yes
dugdalei	0.48 (0.44–0.53)	150 (140–159)	13.1	16.2	110 (105–115)	17.3 (16–19)	absent	no	no	yes

[1]/ Measurements taken from Wouts (2000).

Table 7. Measurements of species of *Ogma*

Ogma	*alternum*		*campbelli*[1]	*capitulatum*		*catherinae*		*civellae*
body parts measured	holotype	paratype		holotype	paratype	holotype	paratype	paratype
(µm) and ratios	female	females	females	female	females	female	females	females
n		22	22		20		10	6
L(mm)	0.34	0.37±0.035(0.31–0.44)	0.49±0.053(0.35–0.57)	0.47	0.39±0.049(0.25–0.47)	0.34	0.43±0.09(0.28–0.59)	0.46±0.037(0.40–0.50)
diameter at midbody	35	38±2.6(33–43)	52±6.1(40–63)	43	44±3.6(39–52)	50	48±3.0(42–52)	52±4.5(45–59)
diameter at vulva(VB)	26	25±2.8(21–32)	65±7.8(50–78)	37	36±2.6(31–41)	38	35±3.2(30–41)	30±3.3(27–35)
length of stylet	61	66±3.1(60–72)	77±4.5(69–86)	86	84±4.3(76–92)	100	97±3.6(91–103)	97±5.2(92–105)
height of stylet base	3	3.6±0.31(3.0–4.0)	4.0±0.67(3.0–6.0)	4.5	4.0±0.34(3.5–5.0)		3.8±0.24(3.5–4.0)	4
width of stylet base	9.5	10.5±0.72(9.0–12.0)	10.1±1.11(7.0–12.0)	12.5	11.8±0.94(10.0–13.0)	12	11.9±0.54(11.0–13.0)	12.9±0.74(12.0–14.0)
width of first lip annule	17	20.5±1.87(16.5–25.0)	19.2±1.50(16.0–22.0)	11	11.4±0.87(10.0–13.0)	25	24.3±1.27(21.0–25.0)	28.3±2.62(25.0–33.0)
length of oesophagus	102	100±7.1(88–113)	116±11.3(98–137)	124	123±9.6(109–147)	142	138±5.1(131–143)	130±7.7(119–141)
PV	32	35±5.4(28–48)	56±8.56(41–72)	31	33±6.0(25–47)	27	27±5.3(19–36)	42±6.60(32–50)
length of tail			34±7.99(23–52)	15	12.9±3.51(6.0–20.0)			
R	46	48±2.8(44–54)	53±1.60(50–57)	95	99±3.1(94–106)	48	46±1.7(44–49)	45±2.36(41–48)
Rex	15			28	29±1.2(28–31)	14	15.0±0.9(13.0–16.0)	
RV	7	7.3±0.65(6.0–9.0)	6.5±0.81(5.0–9.0)	12	11.4±0.80(10.0–13.0)	6	5.8±0.40(5.0–6.0)	6.3±0.43(6.0–7.0)
Ran			3.5±0.87(2.0–5.0)	6	6.2±0.83(5.0–8.0)			
a	9.7	9.6±0.90(8.0–11.4)	9.5±1.31(7.7–12.0)	11	9.0±1.13(6.2–11.2)	6.82	9.0±1.68(6.2–11.8)	8.9±0.98(7.4–10.1)
b	3.3	3.7±0.28(3.0–4.1)	4.2±0.45(3.3–4.9)	3.8	3.3±0.26(2.9–3.9)	2.4	2.6±0.48(2.0–3.4)	3.5±0.35(3.0–4.0)
c			15.0±3.36(9.1–20.6)	31.7	32±10.6(17.8–58.7)			
V	91	90±1.42(88–93)	88±2.1(84–92)	93.5	92±1.4(88–94)	92	93±1.4(90–95)	91±2.2(87–94)
PV/VB	1.2	1.4±0.22(1.0–1.9)	0.9±0.10(0.7–1.0)	0.8	0.9±0.14(0.6–1.1)	0.7	0.8±0.10(0.5–0.9)	1.4±0.29(1.1–1.9)
St%L	18.0	17.9±1.69(15.1–21.5)	16.0±1.92(12.4–20.8)	18.5	21.1±2.21(18.5–28.5)	29.3	23.8±5.29(17.5–35.3)	22.1±2.63(19.4–26.4)

Ogma	*crenulatum*[1]		*inaequale*		*latens*	*mucronatum*		*niagarae*	
body parts measured			holotype	paratype		holotype	paratype	holotype	paratype
(µm) and ratios	females	males	female	females	females	female	females	female	females
n	20	3		2	10		18		5
L(mm)	0.61±0.04(0.55–0.69)	0.55±0.02(0.50–0.55)	413	0.37, 0.44	0.48±0.03(0.43–0.52)	0.48	0.50±0.03(0.43–0.54)	0.56	0.59±0.022(0.56–0.62)(n=4)
diameter at midbody	54±2.7(44–57)	26.3±1.25(25–28)	38	41, 44	49±3.98(42–55)	49	53±3.9(45–60)	70	66±4.4(60–72)(n=4)
diameter at vulva(VB)	54±4.1(49–66)		26	28, 30	29±1.80(25–32)	37	39±3.5(32–45)	43	42±3.7(38–49)
length of stylet	106±4.0(98–115)		97	90, 101	84±3.75(80–91)	101	105±4.3(95–111)	102	105±3.0(102–110)
height of stylet base	5.5±0.62(4.4–7.1)		3.5	3.5, 4.0	3.1±0.20(3.0–3.5)	4.5	4.3±0.30(3.5–4.5)	4.5	4.6±0.37(4–5)
width of stylet base	12.5±0.97(10.6–14.2)		11	10.5, 12.0	9.5±0.47(8.5–10.0)	12	12.4±0.92(10.5–14.0)	13.5	13.5±1.00(12–15)
width of first lip annule	20.0±1.1(18–22)		23	23.5, 26.0	19.1±1.14(17.0–21.0)	21	22±1.2(19–24)	22.5	24.1±1.43(23–26)(n=4)
length of oesophagus	152±7.3(140–169)		133	131, 137	127± 6.63(115–138)	133	139±11.5(107–156)	148	145±2.7(141–148)(n=4)
PV	76±6.5(65–88)		37	22, 34	34.4±3.29(28–41)	42	45±5.5(34–53)	63	63±3.4(59–69)
length of tail	69±6.9(59–86)	54±2.9(50–57)							10.0, 13.0
R	66±1.8(60–70)		62	62, 63	54.5±1.50(53–58)	50	50±1.7(47–54)	52	50±1.2(49–52)
Rex				10.0, 9.0	17.9±1.12(16.0–20.0)		15.4±0.95(14.0–17.0)		15
RV	9.0±0.62(8.0–10.0)				7.0±0.45(6.0–8.0)	7	7.8±0.74(7.0–9.0)	8	8.2±0.40(8.0–9.0)
Ran	8.0±0.62(7.0–9.0)								3, 3
a	9.5±0.55(8.2–10.5)	20.0 ±1.44(20–22)	10.9	8.9, 9.9	9.9±0.78(8.8–11.4)	9.7	9.5±0.79(7.9–11.0)	8	8.8±0.59(8.0–9.5)(n=4)
b	4.0±0.32(3.5–4.6)		3.1	2.8, 3.2	3.8±0.19(3.5–4.1)	3.6	3.6±0.34(2.9–4.4)	3.8	4.1±0.21(3.8–4.4)(n=4)
c	8.9±0.82(7.5–11.1)	9.8±0.77(8.8–10.6)							47
V	88±1.0(86–90)		91	94, 92	93±0.75(92–94)	91	91±1.1(89–93)	89	89±0.5(89–90)(n=4)
PV/VB	1.4±0.12(1.0–1.6)		1.4	0.8, 1.1	1.2±0.10(1.0–1.4)	1.1	1.2±0.15(0.8–1.4)	1.47	1.5±0.06(1.4–1.6)
St%L	17.4±1.30(15.3–20.0)		23.5	25, 23	17.7±1.04(15.9–18.8)	21.3	21±1.7(18–25)	18.2	17.7±0.40(17.2–18.2)(n=4)
length of spicules		54±0.9(53–55)							
length of gubernaculum		13.3 ±0.47(13.0–14.0)							

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[1]/ Measurements taken from Wouts et al. (1999).

Table 7 (continued). Measurements of species of *Ogma*

Ogma body parts measured (µm) and ratios	*palmatum* females	*paucispinatum*[1] females	*polyandra*[1] females	 males	*semicrenatum*[1] females	 males
n	5	23	23	20	23	6
L(mm)	0.46±0.027(0.41–0.48)	0.57±0.047(0.51–0.68)	0.45±0.066(0.32–0.56)	0.47± 0.02(0.43–0.50)	0.37±0.044(0.31–0.48)	0.39±0.02(0.35–0.42)
diameter at midbody	48±3.7(45–55)	59±6.90(46–70)	47±4.43(40–56)	24.8±1.29(22–27)	40.2±2.35(35–46)	21.5±0.76(20 -22)
diameter at vulva(VB)	26±2.6(23–30)	57±8.23(41–66)	49±3.98(41–55)		40.4±2.95(34–45)	
length of stylet	85±3.9(79–90)	103±4.37(90–114)	92±8.32(76–117)		71.1±3.45(65–78)	
height of stylet base	3.5±0.32(3.0–4.0)	4.7±0.72(3.5–6.2)	4.0±0.65(3.0–5.0)		3.4±0.51(3.0–4.0)	
width of stylet base	10.5±0.55(9.5–11.0)	11.4±1.20(8.8–13.3)	10.8±1.21(9.0–12.0)		9.3±1.02(8.0–12.0)	
width of first lip annule	22±1.10(21–24)	23.2±1.95(20–29)	19.5±1.44(16–22)		16.5±1.05(15–19)	
length of oesophagus	123±10.9(107–136)	147±7.6(132–159)	135±9.7(118–154)		110±4.4(103–119)	
PV	38±4.9(30–42)	69±15.7(33–96)	46±6.8(36–58)		38±61(27–53)	
length of tail		60±14.1(28–84)	40±6.5(29–53)	46±3.3(40–50)	33±5.1(24–43)	35 ±3.8(31–43)
R	51±1.9(48–53)	57±2.61(52–61)	64±3.1(58–70)		70±2.8(65–75)	
RV	7.0±0.71(6.0–8.0)	8.4±1.12(6.0–10.0)	6.7±0.83(6.0–9.0)		6.7±0.65(6.0–8.0)	
Ran		7.7±0.95(5.0–9.0)	5.7±0.83(5.0–8.0)		5.7±0.65(5.0–7.0)	
a	9.6±0.83(8.2–10.5)	8.0±1.14(6.2–10.1)	9.6±1.43(7.2–12.8)	19.1±1.31(16.9–21.7)	7.8±1.00(6.7–10.7)	18.0±1.37(15.9–19.9)
b	3.7±0.14(3.5–4.0)	3.9±0.30(3.5–4.5)	3.3±0.40(2.7–4.1)		3.3±0.39(2.9–4.6)	
c		10.0±2.98(7.6–20.2)	11.2±1.52(7.5–13.7)	10.3±0.85(9.2–11.9)	11.5±1.50(8.6–13.8)	11.1±1.10(9.2–12.8)
V	92±1.2(91–94)	88±2.4(85–94)	90±1.5(85–91)		90±1.3(87–92)	
PV/VB	1.5±0.14(1.3–1.7)	1.2±0.18(0.8–1.5)	1.0±0.12(0.8–1.2)		0.9±0.14(0.6–1.2)	
St%L	18.7±0.72(17.5–19.5)	18.0±1.35(15.4–19.7)	20.8±2.46(15.6–26.0)		19.4±2.33(13.5–23.0)	
length of spicules				51 ±3.2(43–58)		43±2.3(39–45)
length of gubernaculum				16.1 ±3.15(11–20)		8.83±0.69(8–10)

Ogma body parts measured (µm) and ratios	*sexcostatum*[1] females	*sturhani.* holotype female	 paratype females	*subantarcticum*[1] females	 males
n	22		19	8	8
L(mm)	0.36±0.036(0.29–0.43)	0.58	0.51±0.074(0.36–0.67)	0.52±0.057(0.46–0.63)	0.49±0.04(0.45–0.59)
diameter at midbody	40.5±3.33(33–46)	45	43±3.7(38–51)	64.4±4.0(56–71)	25.4 ±0.46(25–26)
diameter at vulva(VB)	40±4.15(30–49)	33	33±3.1(27–38)	47±4.31(41–55)	
length of stylet	78±7.2(62–90)	92	88±4.3(82–102)	102±1.54(99–104)	
height of stylet base	3.6±0.58(3.0–5.0)	4	3.7±0.30(3.5–4.5)	4.4±0.58(3.5–5.0)	
width of stylet base	8.7±1.20(6.0–11.0)	12	10.9±0.67(10.0–12.5)	12.7±1.42(10.5–15.0)	
width of first lip annule	20.7±1.37(19.0–23.0)	21	20.1±1.12(18.0–22.0)	24.7±1.15(23.0–26.5)	
length of oesophagus	118.8±10.45(104–142)	138	128±6.3(117–139)	149±5.95(142–162)	
PV	33.9±4.76(23–42)	22	30±3.7(22–40)	52.7±60(41–61)	
length of tail	24±3.72(18–31)				46±4.5(38–52)
R	63±2.22(60–69)	47	47±1.5(45–51)	53.2±1.86(51–57)	
Rex		15	14.7±0.47(14.0–15.0)	17.0±1.15(15.0–18.0)	
RV	7.6±0.84(6.0–9.0)	8	6.8±0.61(6.0–8.0)	7.3±0.50(7.0–8.0)	
Ran	5.6±0.84(4.0–7.0)				
a	9.0±1.23(6.8–11.1)	12.9	11.9±1.61(8.4–14.2)	8.1±0.74(7.3–9.2)	19.4±1.68(17.4–23.3)
b	3.0±0.26(2.6–3.6)	4.2	4.0±0.48(3.0–4.8)	3.5±0.40(3.0–4.2)	
c	15.4±2.00(13.0–20.1)				10.8±1.02(9.4 -12.3)
V	91±1.03(89–94)	96	94±0.9(93–96)	90±1.18(88–91)	
PV/VB	0.9±0.13(0.7–1.1)	0.7	0.9±0.10(0.7–1.1)	1.1±0.13(0.9–1.4)	
St%L	21.9±2.59(16.1–26.5)	15.9	17.7±2.25(14.6–23.1)	19.7±1.96(16.0–22.0)	
length of spicules					62±3.2(55–65)
length of gubernaculum					11.4 ±0.56(10.5–12)

[1]/ Measurements taken from Wouts et al. (1999).

Table 8. Measurements of species of *Syro* and *Pateracephalanema*

Species	*S. glabellus*		*S. tribulosus*		*P. imbricatum*
body parts measured (µm) and ratios	holotype female	paratype females	holotype female	paratype females	females
n		20		20	10
L(mm)	0.35	0.44±0.062(0.34–0.55)	0.38	0.52±0.059(0.38–0.59)	0.44±0.056(0.34–0.51)
diameter at midbody	49	54±9.8(41–73)	41	50±5.9(41–62)	34±1.4(31–36)
diameter at vulva(VB)	32	33±5.1(26–42)	28	33±2.5(30–40)	24±1.8(22–28)
length of stylet	98	105±6.8(94–118)	96	101±3.6(93–108)	69±4.1(63–77)
length of stylet shaft	14	16.0±1.13(14.0–18.0)	15	16.9±1.90(14–22)	11.9±0.63(11–13)
height of stylet base	4.5	4.1±0.41(3.0–5.0)	4	4.3±0.43(4.0–5.0)	3.7±0.24(3.0–4.0)
width of stylet base	13	11.6±0.82(10.0–13.0)	12	12.3±0.81(11.0–14.0)	9.6±0.62(9.0–11.0)
width of first lip annule	16	19.4±1.65(15.0–22.0)	19	18.1±1.09(16.0–20.0)	20.0±1.10(19.0–23.0)
length of oesophagus	134	152±14.4(130–181)	124	153±7.0(124–171)	116±6.6(105–124)
PV	38	32±5.9(21–42)	40	38±5.7(25–45)	17.0±1.8(13.0–20.0)
R	85	85±2.3(80–88)	86	85±3.8(79–96)	74±4.0(67–81)
RV	12	11.7±0.84(10.0–13.0)	12	11.6±0.97(10.0–14.0)	7.1±0.83(6.0–9.0)
a	7.1	8.1±0.99(6.8–10.8)	9.5	10.5±1.48(8.3–13.4)	13.1±1.64(11.0–15.5)
b	2.6	2.9±0.26(2.5–3.3)	3.0	3.4±0.41(2.5–4.0)	3.8±0.52(2.9–4.6)
V	89	93±1.4(89–95)	90	93±1.8(90–94)	96±0.5(95–97)
PV/VB	1.2	1.0±0.18(0.7–1.3)	1.4	1.2±0.19(0.7–1.5)	0.7±0.10(0.5–0.8)
St%L	28.3	24±2.5(19–29)	25.4	20±2.9(16.0–28.0)	16.0±2.7(13.0–21.0)

Table 9. Measurements of species of *Blandicephalanema*

Blandicephalanema body parts measured (µm), and ratios	*serratum* females	*inserratum* holotype female	paratype females	*nothofagi* holotype female	paratype females	*pilatum* females
n	10		20		20	10
L(mm)	0.42±0.029(0.37–0.45)	0.48	0.39±0.052(0.25–0.49)	0.62	0.6±0.057(0.51–0.70)	0.50±0.034(0.44–0.55)
diameter at midbody	36±0.71(35–37)	50	41±3.2(35–50)	65	74±8.2(60–92)	45.9±5.20(40–60)
diameter at vulva(VB)	28.3±2.68(24–31)	30	23±2.9(18–30)	42	40±4.2(32–50)	25.7±25(22–30)
diameter at anus	12		10.3±1.97(7.0–15.0)			
length of stylet	71.5±4.39(68–79)	73	76±4.3(69–85)	100	104±4.1(100–116)	88.9±1.81(85–92)
length of stylet shaft	13.0±1.22(12.0–15.0)	12	12.7±1.66(10.0–16.0)	21	19.0±1.18(17–21)	15.0±0.72(13.0–16.0)
height of stylet base	3.1±0.22(3.0–3.5)	4.5	3.4±0.35(3.0–4.5)	5.5	4.6±0.33(4.0–5.5)	3.8±0.24(3.5–4.0)
width of stylet base	9.4±0.41(9.0–10.0)	10	9.2±0.77(8.0–11.5)	15	14.5±0.55(14–15)	10.7±0.75(9.0–12.0)
width of second lip annule	12.0±1.22(11.0–14.0)	13	10.9±1.73(8.0–13.0)	17	14.4±1.24(12.0–17.0)	12.9±0.66(12.0–14.0)
length of oesophagus	98.3±7.40(86–105)	103	111±7.2(93–124)	153	147±9.3(132–168)	130±5.64(124–142)
PV	41.5±4.56(36–46)	46	42±5.8(34–56)	49	42±5.5(31–53)	45.6±4.43(38–56)
length of tail			17.3±1.72(15.0–21.0)	16		
R	78±4.5(73–83)	78	77±3.7(69–81)	70	69±2.0(67–74)	88.5±2.29(84–92)
Rex	25±1.0(24–26)		26±0.9(25–27)	24	24±1.0(22–26)	28±0.82(27–29)
RV	10.3±1.09(9.0–12.0)	10	10.3±0.78(9.0–12.0)	10	8.2±0.68(7–9)	9.3±0.78(8.0–10.0)
Ran	5		5.3±0.58(4.0–6.0)			3.9±0.64(3–5)
a	11.5±1.02(9.9–12.7)	9.4	9.5±0.94(7.2–11.8)	9.5	8.2±1.16(6.1–10.5)	10.9±1.16(8.2–12.3)
b	4.2±0.10(4.1–4.3)	4.6	3.4±0.48(2.3–4.6)	4	4.1±0.41(3.4–4.9)	3.8±0.27(3.4–4.4)
c			22±3.4(13–27)	39		
V	90±0.78(89–91)	91	90±1.3(87–92)	92	93±1.0(91–95)	91±1.2(88–93)
PV/VB	1.5±0.17(1.2–1.6)	1.5	1.8±0.25(1.4–2.3)	1.2	1.1±0.13(0.8–1.3)	1.8±0.15(2.0–1.5)
St%L	17.4±2.41(15.5–21.5)	15.3	19.8±3.07(15.3–29.9)	16.2	18±1.8(15–21)	18.0±1.16(16.3–19.5)

Table 10. Measurements of species of *Macroposthonia* and *Criconemoides*

Genus	*Macroposthonia*				*Criconemoides*	
Subgenus					(*Criconemoides*)	(*Criconemella*)
Species	*rustica*[1]	*xenoplax*[1]	*campbelli*		*informis*	*parvus*
body parts measured (µm) and ratios	females	females	holotype female	paratype females	females	females
n	15	12		7	10	10
L(mm)	0.38–0.45	0.57±0.014(0.50–0.75)	0.41	0.42±0.024(0.37–0.45)	0.58±0.06(0.46–0.65)	0.26±0.02(0.23–0.28)
Diameter at midbody			32	34±1.1(32–36)	54±2.64(51–60)	21.0±2.05(18–24)
diameter at vulva(VB)			27	27±1.6(25–30)	40.4±2.37(37–46)	16.3±1.42(14–19)
diameter at anus			15	14.3±1.28(12.0–16.0)		
length of stylet	52–55	71.1±(69–74)	58	60±1.0(58–62)	78±2.8(72–82)	47±1.7(44–49)
length of stylet shaft			8	7.9±0.19(7.5–8.0)	17.7±1.17(15.0–19.0)	10.2±0.81(9.0–12.0)
height of stylet base			3	2.8±0.24(2.5–3.0)	5.0±0.7(4.0–6.0)	2.4±0.4(2.0–3.0)
width of stylet base			8	7.6±0.30(7.0–8.0)	13.3±0.90(12.0–15.0)	6.7±0.78(6.0–9.0)
width of first lip annule			12	12.7±0.56(11.5–13.0)	22.4±1.43(20.0–25.0)	7.1±0.54(6.0–8.0)
length of oesophagus			105	99±3.4(95–105)	135±8.5(127–157)	80±3.5(73–86)
PV			43	43±6.0(30–51)	53±8.8(37–70)	15.7±1.73(14–20)
length of tail			14	14.0±2.00(11.0–18.0)		
R	90–112	99(94–104)	107	106±2.0(102–108)	62±3.0(57–67)	139±5.7(128–147)
Rex	26–31	27.5(26–30)	28	26±1.2(25–28)	17±0.5(17–18)	44
RV	6–8	8.1(7–9)	14	14.3±1.30(11.0–15.0)	7.3±0.46(7.0–8.0)	10.6±0.80(10.0–12.0)
Ran	4–6		7	6.5±0.71(5.0–7.0)		
a	10–13	12.9(11–16)	12.8	12.5±0.60(11.5–13.2)	11.0±1.0(9.0–12.0)	12.0±1.3(11.0–15.0)
b	3.6–4.8	4.2(3.8–5.4)	3.9	4.3±0.24(3.8–4.7)	4.3±0.34(3.5–4.7)	3.2±0.10(3.1–3.5)
c	25–40	20.7(17–23)	30	30±3.4(25–37)		
V	93–95	93.3(92–95)	89.5	90±1.3(89–93)	91±1.0(89–92)	94±0.6(93–95)
PV/VB	0.7–1.0		1.6	1.6±0.21(1.2–1.8)	1.3±0.2(1.0–1.7)	1.0±0.1(0.8–1.3)
St%L	12–14	12.6(10–14)	14.1	14.3±0.72(13.6–16.0)	13.7±1.32(12.5–16.7)	18.2±0.85(17.0–19.5)

[1]/ Measurements taken from Loof et al.(1997).

Table 11. Measurements of *Hemicriconemoides cocophillus*, *Trophotylenchulus okamotoi,* and *Paratylenchus halophilus*

species	*H. cocophillus*	*T. okamotoi*		*P. halophilus*[1]	
body parts measured (µm) and ratios	females	females	juveniles	females	males
n	10	6	10	10	8
L(mm)	0.34±0.021(0.32–0.40)	0.54±0.061(0.44–0.63)	0.37±0.02(0.32–0.40)	0.32–0.39	0.27–0.31
Diameter at midbody	28±1.5(26–30)		13.8±0.98(12.0–16.0)		
diameter at vulva(VB)	23±1.6(20–25)	21, 31, 26			
diameter at anus	15.9±1.36(15.0–19.0)	15.4±1.50(13.0–17.0)			
length of stylet	46±1.2(44–48)	16.5±1.66(14.0–18.0)	15.6±0.35(15.0–16.0)	26-30	
length of stylet shaft	7.1±0.39(6.5–8.0)	8	7.3±0.47(7.0–8.0)		
height of stylet base	2.8±0.25(2.5–3.0)				
width of stylet base	7.8±0.51(7.0–8.5)	4.5, 3.5, 3.5	3.4±0.30(3.0–4.0)		
width of first lip annule/head	8.2±0.87(7.0–10.0)	6.5, 6.5			
distance base of stylet to d.gl. opening		5.7±1.17(4.0–7.0)	3.8±0.43(3.0–4.5)		
distance ant. end to valve in m.b.			65±6.0(56–77)		
distance ant. end to excr. pore		85±21.6(61–122)	89±5.7(80–102)		
length of oesophagus	85±2.9(80–91)	138±19.1(100–160)	115±6.5(103–127)		
PV	26±2.8(20–30)				
ant. end to primordium			245±12.4(220–260)		
primordium%L			0.7±0.02(0.6–0.7)		
length of tail	13.0±2.27(10.0–17.0)	48±4.6(42–56)	44±5.0(35–51)		
V	90	74, 74		76–80	
a	12.2±0.86(10.8–13.8)		27±2.9(22–32)	19–25	24–28
b	4.0±0.23(3.7–4.6)	4.1±0.45(3.5–4.8)	3.3±0.19(2.9–3.5)	4.1–4.6	
c	27±4.2(20–34)	11.3±2.11(8.5–14.0)	8.4±1.11(7.3–10.8)	11.4–14.0	12–17
c’	0.8±0.11(0.6–1.0)				
width of median bulb of oesophagus	12.7±0.98(11.0–14.0)	16.4±1.85(14.0–19.0)			
width of basal bulb of oesophagus	8.4±1.14(6.0–10.0)	16, 14			
length spicules					18–21
length gubernaculum					3.5–4.5
R	111±2.8(105–115)				
RV	11.0±0.77(10.0–12.0)				
Ran	7.3±1.09(5.0–9.0)				
PV/VB	1.1±0.14(0.9–1.4)				
St%L	13.6±0.75(11.9–14.6)				

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[1]/ Measurements taken from Wouts(1966).

Table 12. Measurements of *Sphaeronema californicum*

locality body parts measured (µm) and ratios	Riwaka(Nelson) males	 juveniles	Niagara(Southland) juveniles	Chatham Is. males	 juveniles
n	2	8	7	3	4
L(mm)	0.39, 0.39	0.38±0.012(0.37–0.40)	0.43±0.024(0.41–0.47)	0.52, 0.53, 0.50	0.50±0.017(0.47–0.51)
diameter at midbody	15, 13	13.3±0.1(12.0–15.0)	16.5±1.4(14–18)	11, 12, 12	15.5±1.0(15.0–17.0)
diameter at vulva					
diameter at anus	9				9.8±0.3(9.5–10.0)
length of stylet		14.9±0.64(14.0–16.0)	16.3±0.8(15–17)		16.6±0.5(16.0–17.0)
length of stylet shaft		7.1±0.2(7.0–7.5)			7.3±1.8(6.0–8.5)
width of stylet base		2.9±0.2(2.5–3)	3.4±0.38(3.0–4.0)		3.6±0.25(3.5–4.5)
distance base of stylet to d.gl.o.					3.5±0.7(3.0–4.0)
distance ant. end to valve in m.b.			66±2.2(63–69)		75±0.7(74–76)
distance ant. end to excr. pore		92±4.5(84–96)	113±9.9(106–120)	92	113±2.0(111–115)
length of oesoph			140±6.1(145–130)		142±6.9(134–151)
width of head		6.0 ±0.3(5.5–6.5)		4.0, 4.5	7.1±0.63(6.5–8.0)
ant. end to primordium		252±18(216–268)	280±7.8(265–290)		345±13.2(325–355)
primordium%L			66±3.4(60–69)		69±0.8(68–70)
length of tail	38		43±2.7(41–47)	54, 47, 51	47±2.0(45–49)
a	26, 30	29±2.2(26–32)	26±2.6(24–30)	48, 44, 42	32±1.2(30–34)
b			3.1±0.3(2.8–3.5)		3.5±0.1(3.3–3.5)
c	10.2		9.8±0.4(9.2 -10.0)	9.7, 11.3, 9.9	10.5±0.8(9.5–11.2)
width of median bulb of oesophagus		6.0 ±0.5(5.5–6.5)			8.8±0.29(8.5–9.0)
width of primordium		6.9±0.6(6.0–8.0)			
length spicules	21			21, 21, 22	
length gubernaculum	7			10, 9.5	

Table 13. Measurements of species of *Hemicycliophora*

Species subspecies body parts measured (µm) and ratios	*chathami*[1] *chathami* females	 males	 *major* females	 males	*halophila*[2] females	 males
n	9	7	29	9	12	7
L (mm)	1.02(0.92–1.12)	0.90(0.76–0.96)	1.30(1.00–1.58)	1.06(0.92–1.18)	1.13(1.03–1.21)	0.90(0.76 -0.96)
length of stylet	99.4(93–108)		142(120–163)		113(105–125)	
opening dorsal gland to stylet					7.6(6.2–10.6)	
distance ant. end to excr. pore		139(115–158)		179(170–197)		139(115–158)
R	252(241–265)		275(249–308)			
Rst	24.5(23–26)		31.0(27–36)			
Rex	44.1(42–47)		50(45–55)			
Rv	200(189–222)		219(193–247)			
VT/VB	4.7(4.3–5.1)		4.92(3.8–6.3)			
V	85.7(84–88)		85(83–88)		87.0(85.1–88.2)	
a	25.8(23–30)	30.9(27–35)	25.5(21.0–31.0)	31.6(27–44)	19.8(17.8–22.5)	30.9(27–35)
b	5.9(5.5–6.8)		5.35(4.6–6.6)		5.6(5.4–5.9)	
c		5.8(5.6–6.0)		5.6(5.1–6.0)		5.8(5.6–6.0)
length spicules		66.6(64–70)		81.7(75–85)		67(64–70)

[1]/Measurements taken from Yeates (1978).

[2]/Measurements taken from Yeates (1967).

ILLUSTRATIONS

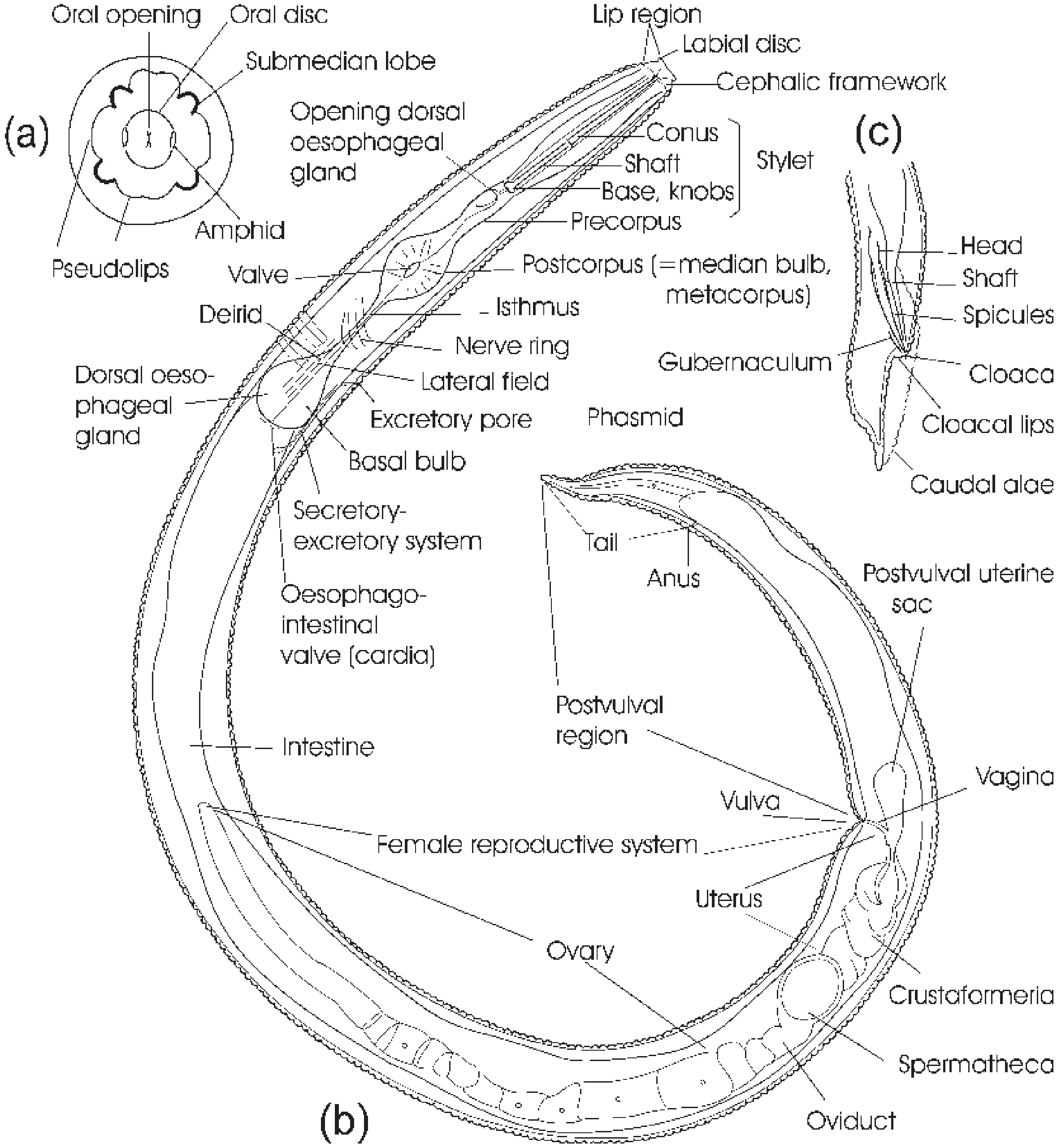

Fig. 1a Schematic view of a tylenchid nematode. **(a)** Face view. **(b)** Female, entire. **(c)** Male.

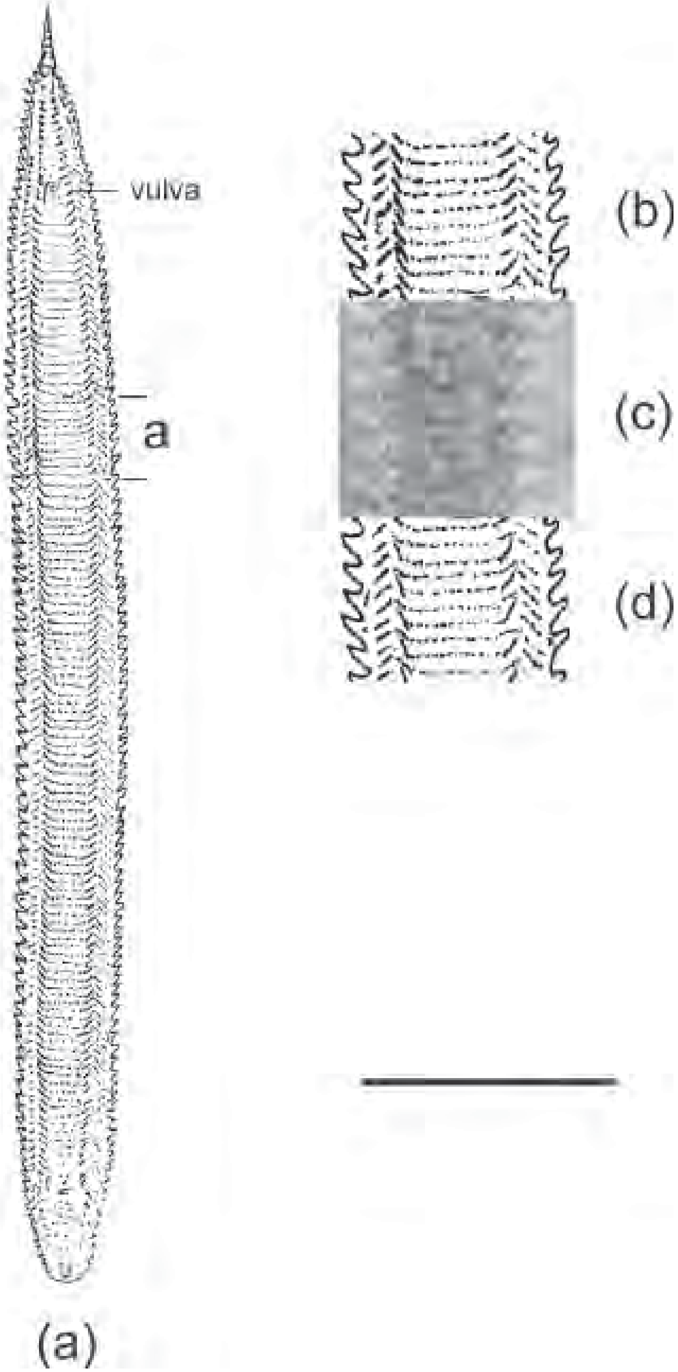

Fig. 1 (a) *Criconema* (*Criconema*) *guernei* female, traced from the original drawing by Certes (1889), showing the position of the vulva and two rows of scales. In region **a** 10 broken lines across the body indicate the anterior and posterior margins of the bases of the scales of 5 body annules. **(b)** region **a** of **(a)** enlarged, showing more clearly the two broken lines per body annule. **(c)** photograph of surface of somewhat flattened *C.* (*C.*) *nelsonense* female showing longitudinal rows of scales in a pattern identical to that in (b), the pattern illustrated by Certes (1889) for *C.* (*C.*) *guernei*. **(d)** A copy of **(b)** but oblique lines of scales slightly changed to reflect the pointed nature of the scales, giving the rows a perfect fit with *C.* (*C.*) *nelsonense.* Scale bar = 80 µm for **(a)**, 40 µm for **(b)**, **(c)**, **(d)**.

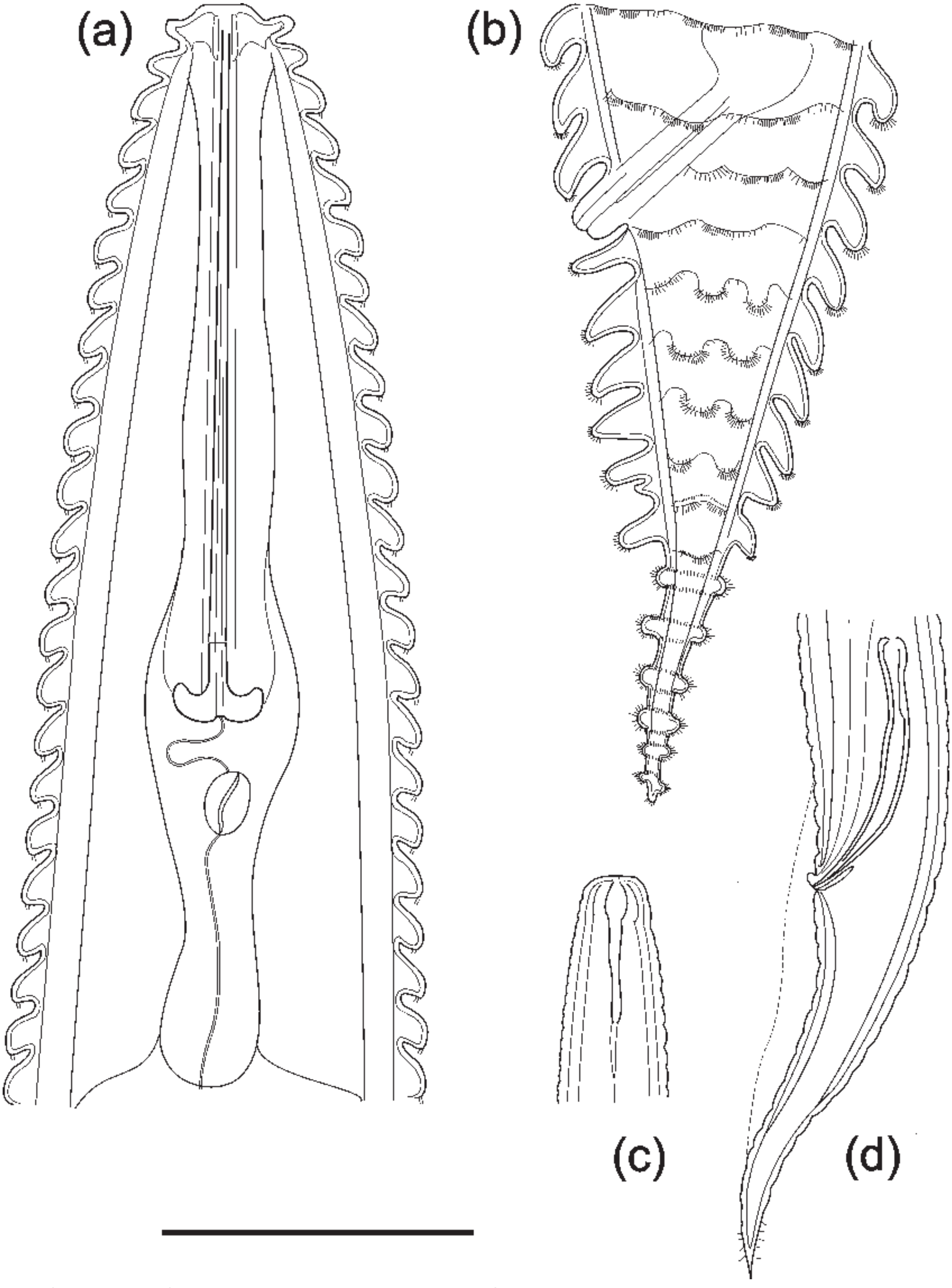

Fig. 2 *Criconema* (*Criconema*) *aucklandicum*. **(a)–(b)** female: **(a)** anterior region; **(b)** posterior region. **(c)–(d)** male: **(c)** anterior region; **(d)** posterior region. Scale bar = 40 μm.

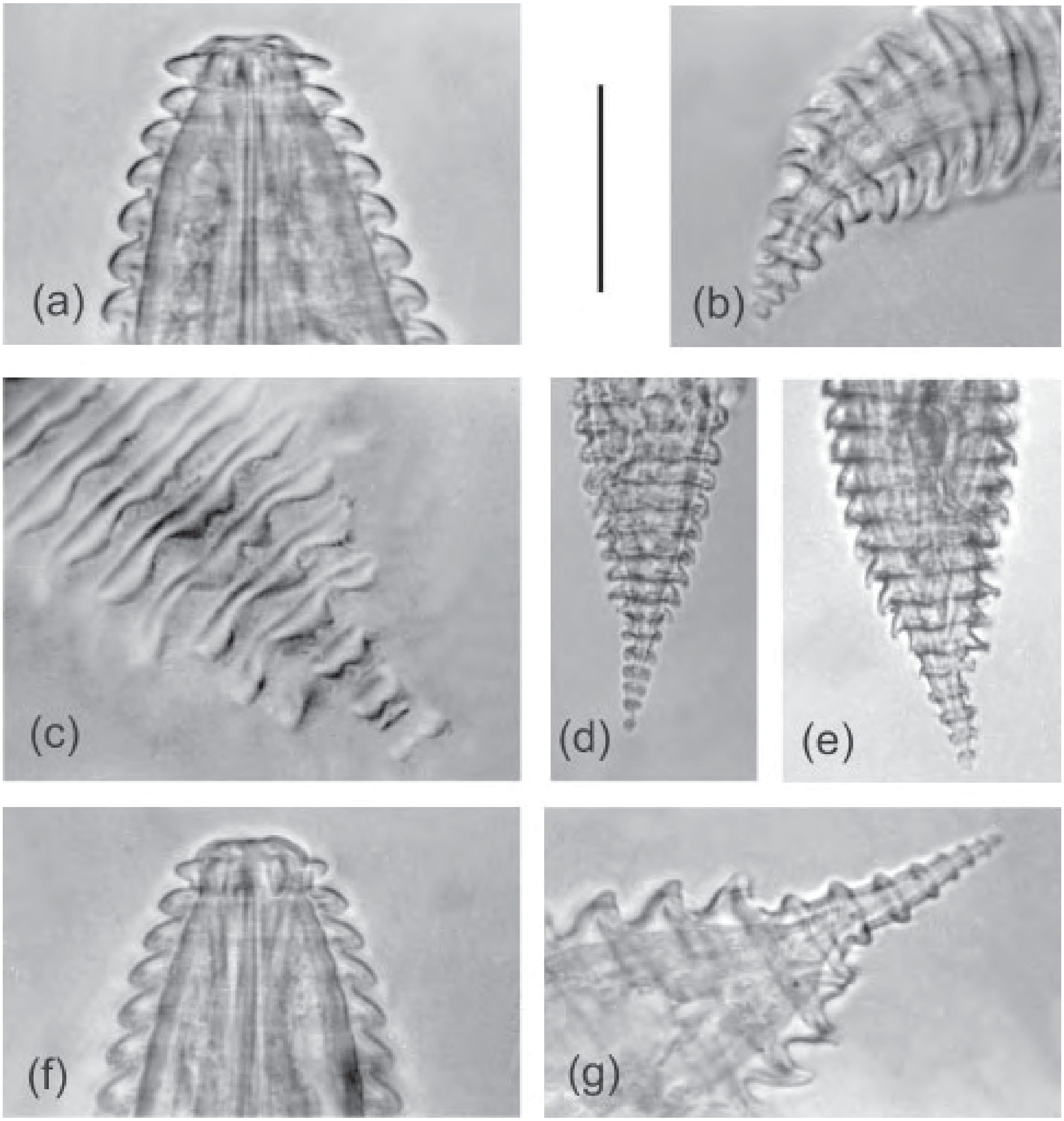

Fig. 3 Light micrographs. **(a)–(d)** *Criconema* (*Criconema*) *cristulatum*, female: **(a)** anterior region; **(b)** posterior region of a specimen from a population without hairs on tail; **(c)** scales between vulva and anus, lateral aspect, showing groove; **(d)** posterior region of a specimen from a population with hairs on tail. **(e)** *C.* (*C.*) *aucklandicum*, female, posterior region. **(f)–(g)** *C.* (*C.*) *spinicaudatum,* female: **(f)** anterior region; **(g)** posterior region. Scale bar = 20 µm for **(a)–(c)**, **(f)**, **(g)**, 40 µm for **(d) (e)**. (Published with permission of the *New Zealand Journal of Zoology*).

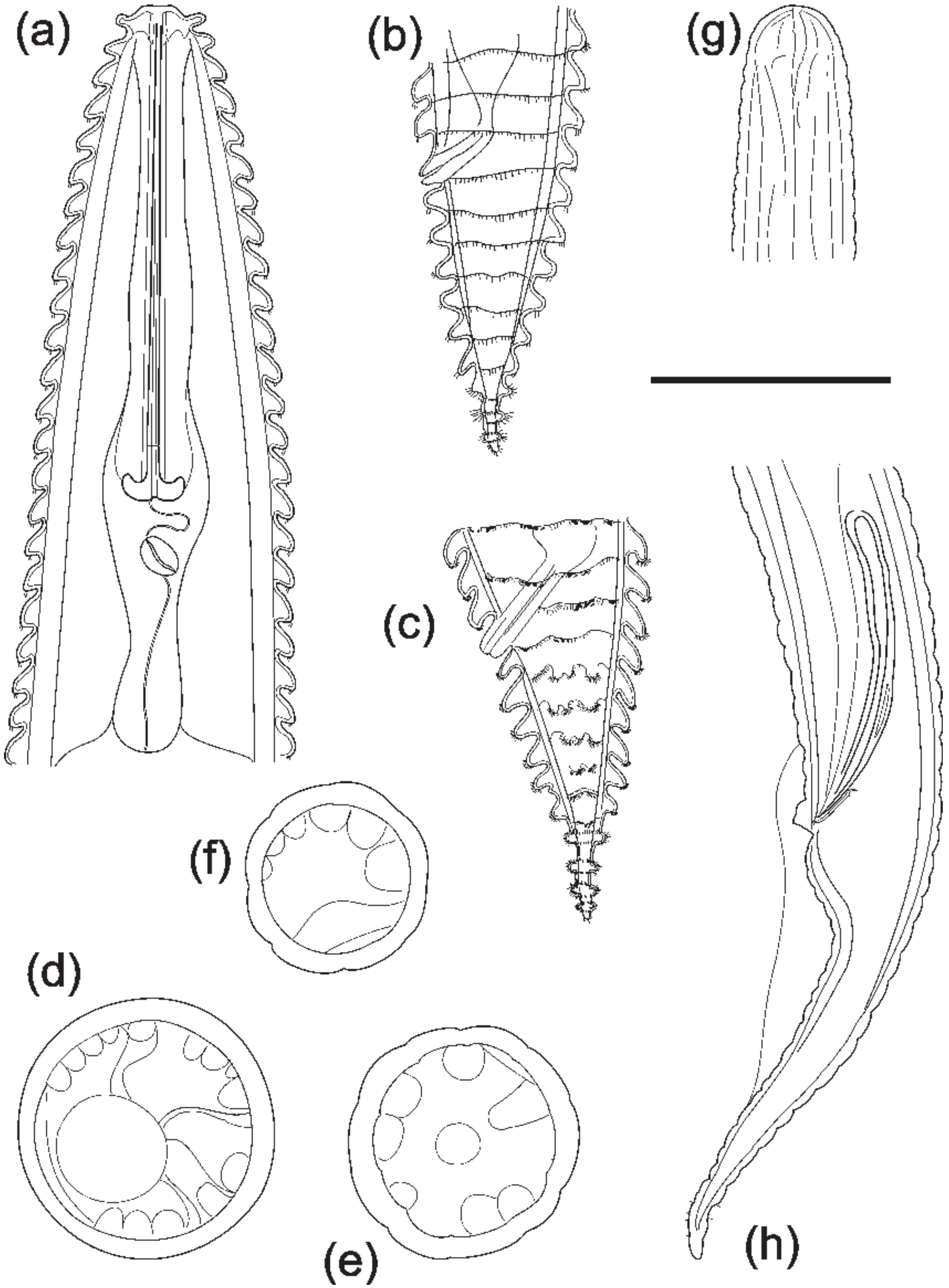

Fig. 4 *Criconema* (*Criconema*) *cristulatum*. **(a)–(f)** female: **(a)** anterior region; **(b)–(c)** different configurations of postvulval region; **(d)** cross-section at mid-body; **(e)** cross-section 1 annule anterior to vulva; **(f)** cross-section 2 annules posterior to vulva. **(g)–(h)** male: **(g)** anterior region; **(h)** posterior region. Scale bar = 40 µm. (Adapted from the *New Zealand Journal of Zoology*).

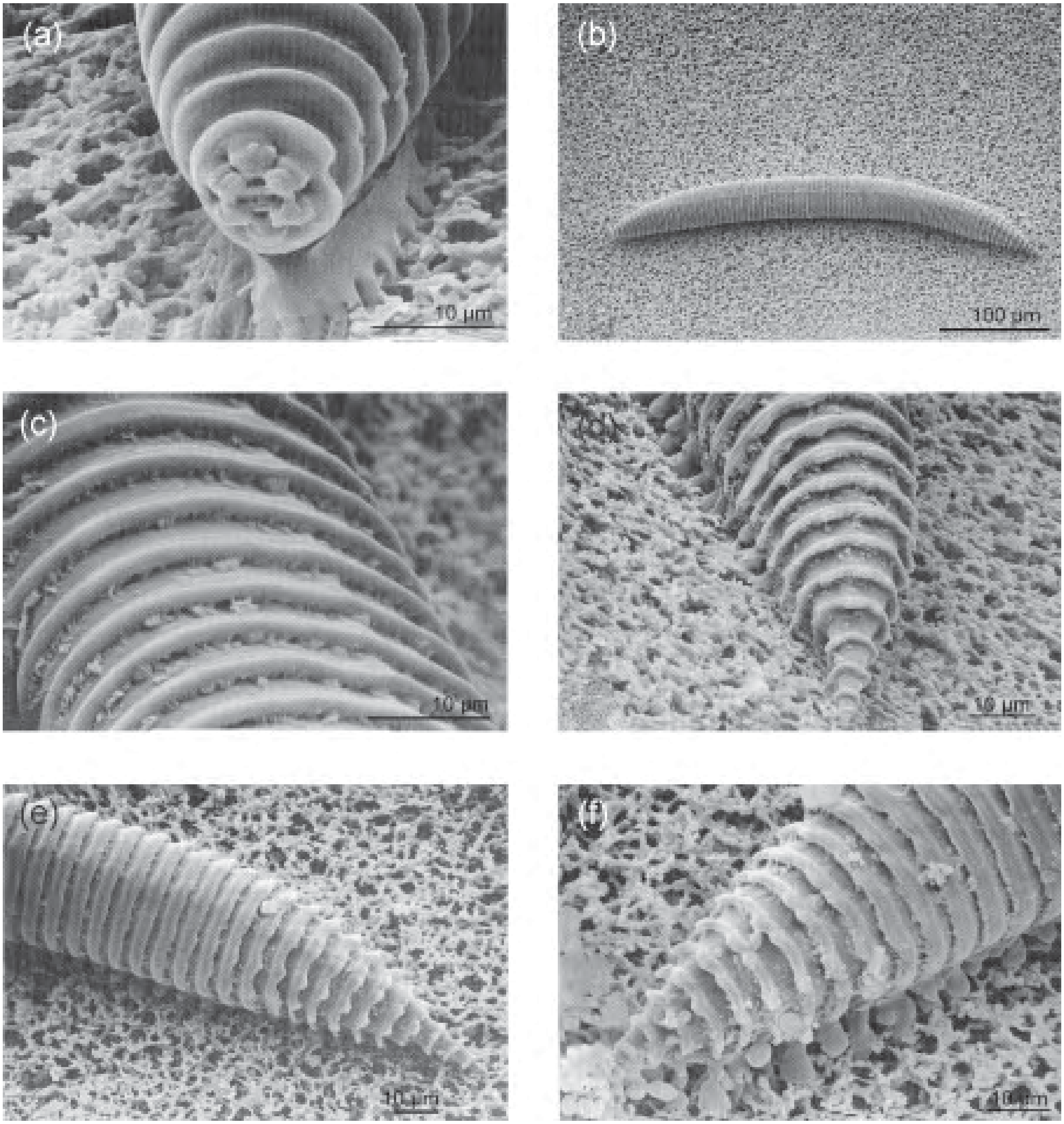

Fig. 5 SEM micrographs. *Criconema* (*Criconema*) *cristulatum*, female: **(a)** *en face* view; **(b)** body, entire; **(c)** cuticle at midbody showing fringe of hairs on posterior edge of annules; **(d)** posterior region showing scales and hairs on posterior edge of body annules; **(e)** posterior region showing transition of cuticle from smooth to scaled posteriorly; **(f)** posterior region showing indentation of lateral scales. Scale bar = 10 µm for **(a)**, **(c)**–**(f),** 100 µm for **(b)**. (Published with permission of the *New Zealand Journal of Zoology*).

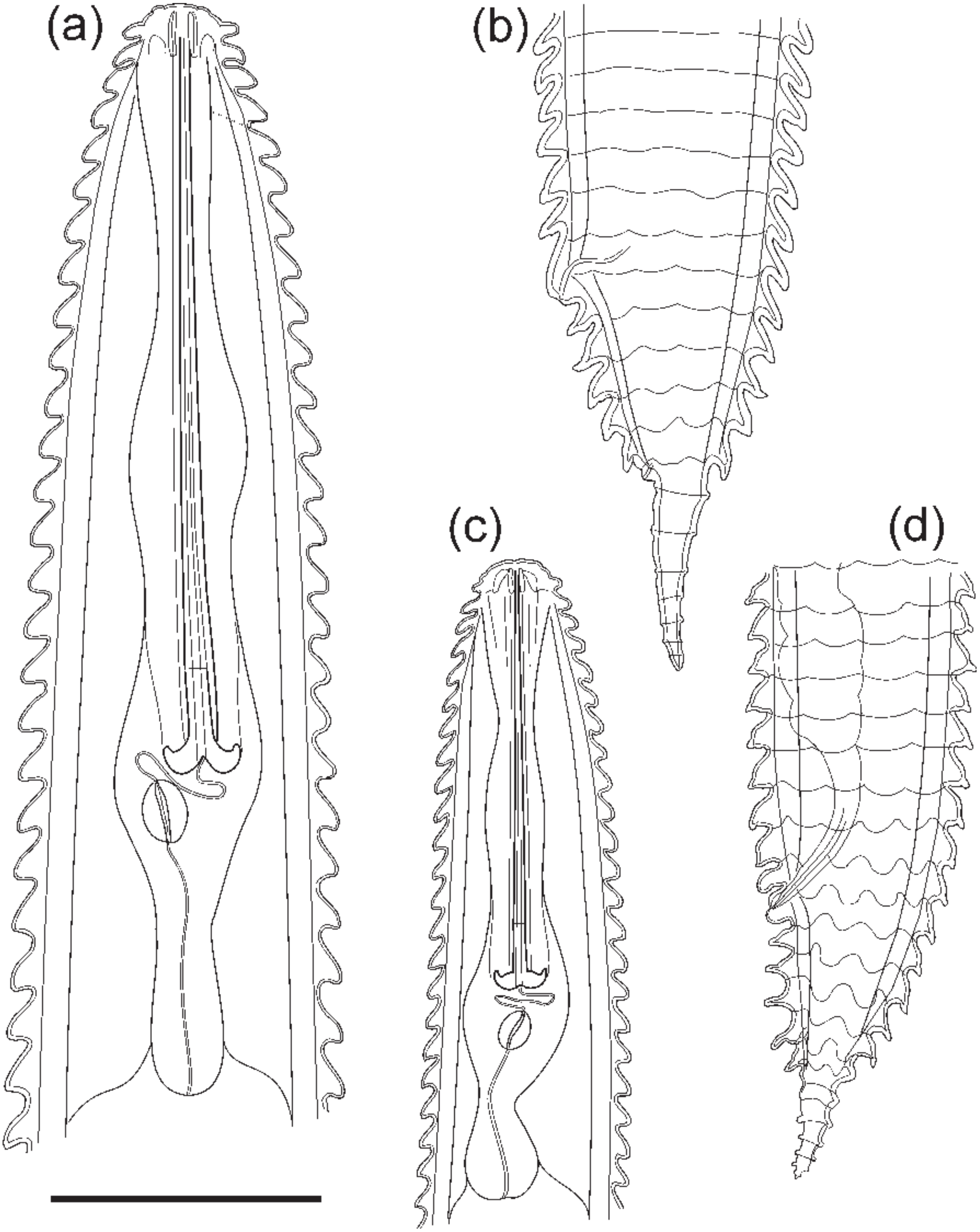

Fig. 6 (a)–(b) *Criconema mackenziei* sp. nov., female: **(a)** anterior region; **(b)** posterior region. **(c)–(d)** *C. makahuense* sp. nov., female: **(c)** anterior region; **(d)** posterior region. Scale bar = 40 μm.

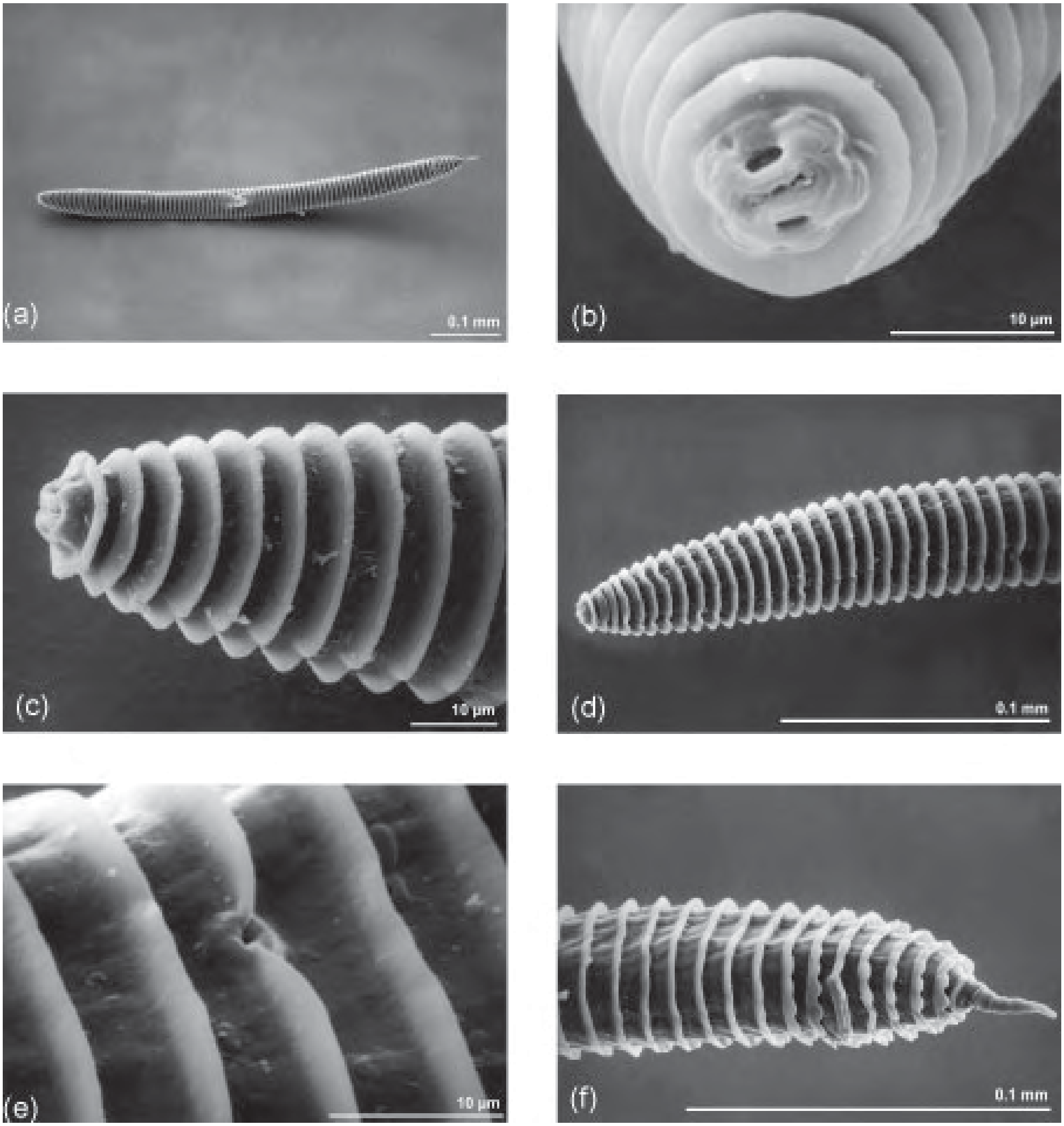

Fig. 7 SEM micrographs. *Criconema* (*Criconema*) *mackenziei* sp. nov., female. **(a)** body, entire; **(b)** lip region, *en face* view; **(c)** anterior region; **(d)** anterior region, overview; **(e)** excretory pore; **(f)** posterior region, ventral view.

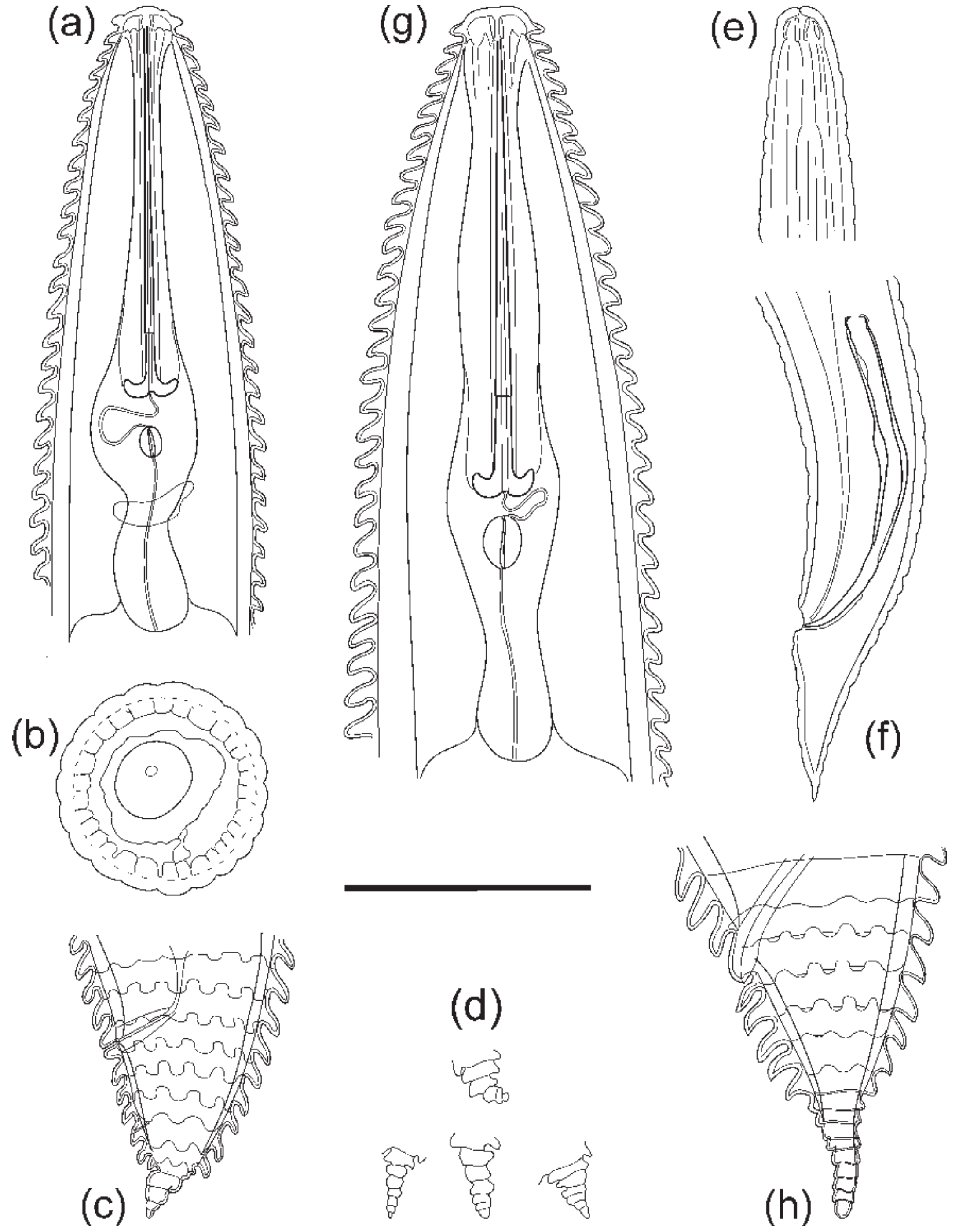

Fig. 8 (a)–(f) *Criconema* (*Criconema*) *nelsonense* sp. nov., **(a)–(d)** female: **(a)** anterior region; **(b)** cross section at midbody; **(c)** posterior region; **(d)** different configurations of the tail terminus. **(e)–(f)** male: **(e)** anterior region; **(f)** posterior region. **(g)–(h)** *C.* (*C.*) *spincaudatum*, female: **(g)** anterior region; **(h)** postvulval region. Scale bar = 40 µm.

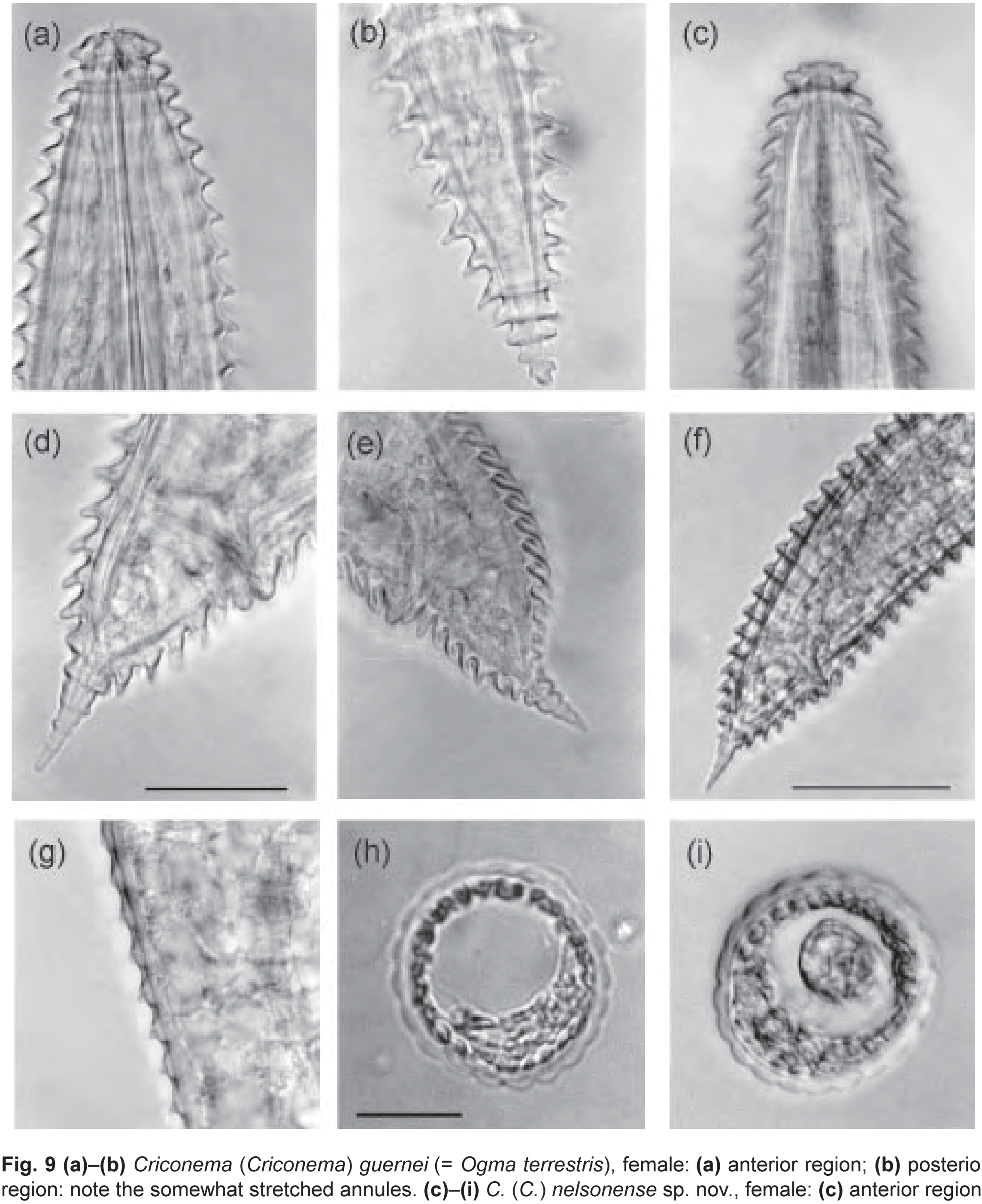

Fig. 9 (a)–(b) *Criconema* (*Criconema*) *guernei* (= *Ogma terrestris*), female: **(a)** anterior region; **(b)** posterior region: note the somewhat stretched annules. **(c)–(i)** *C.* (*C.*) *nelsonense* sp. nov., female: **(c)** anterior region; **(d)** posterior region; note the more retrorse, more contracted annules compared to **(b)**; **(e)** posterior region with strongly contracted annules; **(f)** posterior region at lower magnification: note the similarity in tail shape with *C.* (*C.*) *guernei* in Fig. 1a; **(g)** cuticle on fully stretched annules; **(h)** cross-section below the oesophagus; **(i)** cross-section at midbody. Scale bar = 40 µm for **(a)–(e)**, **(g)**, 40 µm for **(f)**, and 20 µm for **(h)**, **(i)**.

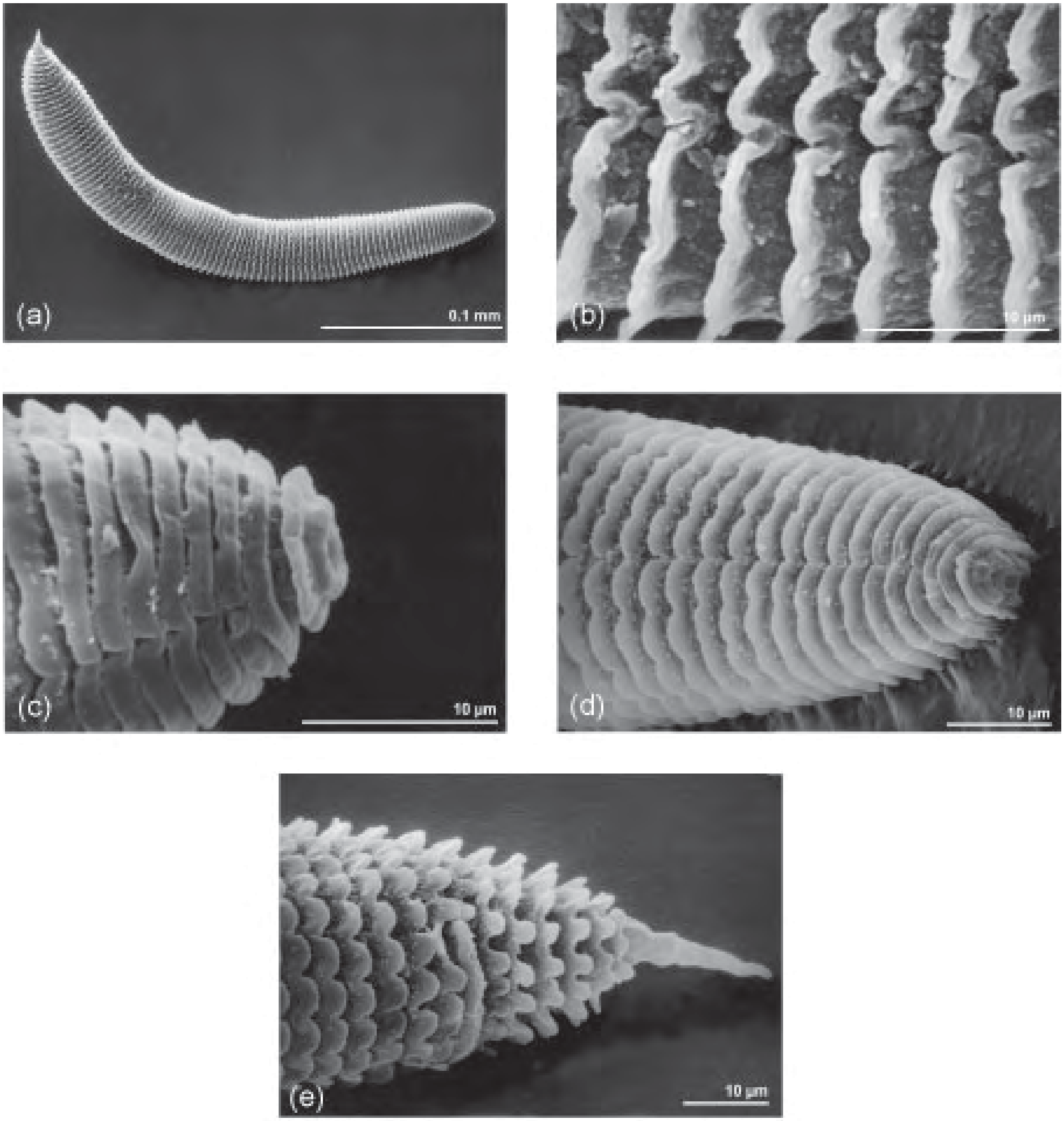

Fig. 10 SEM micrographs. *Criconema* (*Criconema*) *nelsonense* sp. nov. female: **(a)** body, entire; **(b)** cuticle at midbody showing shallow scales and lateral line; **(c)** head region, lateral; **(d)** anterior region, showing lip region; **(e)** postvulval region, ventral.

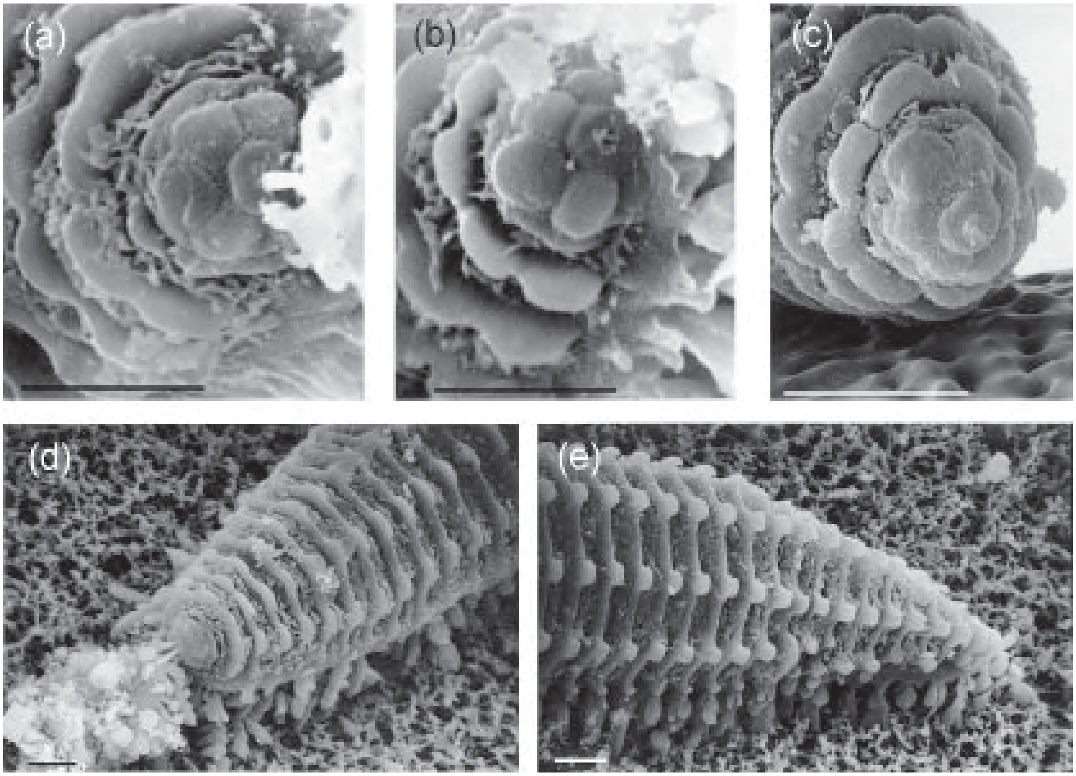

Fig. 11 SEM micrographs. *Criconema* (*Criconema*) *nelsonense* sp. nov., female: **(a)–(c)** lip regions, *en face* views; **(d)** anterior region; **(e)** posterior region.

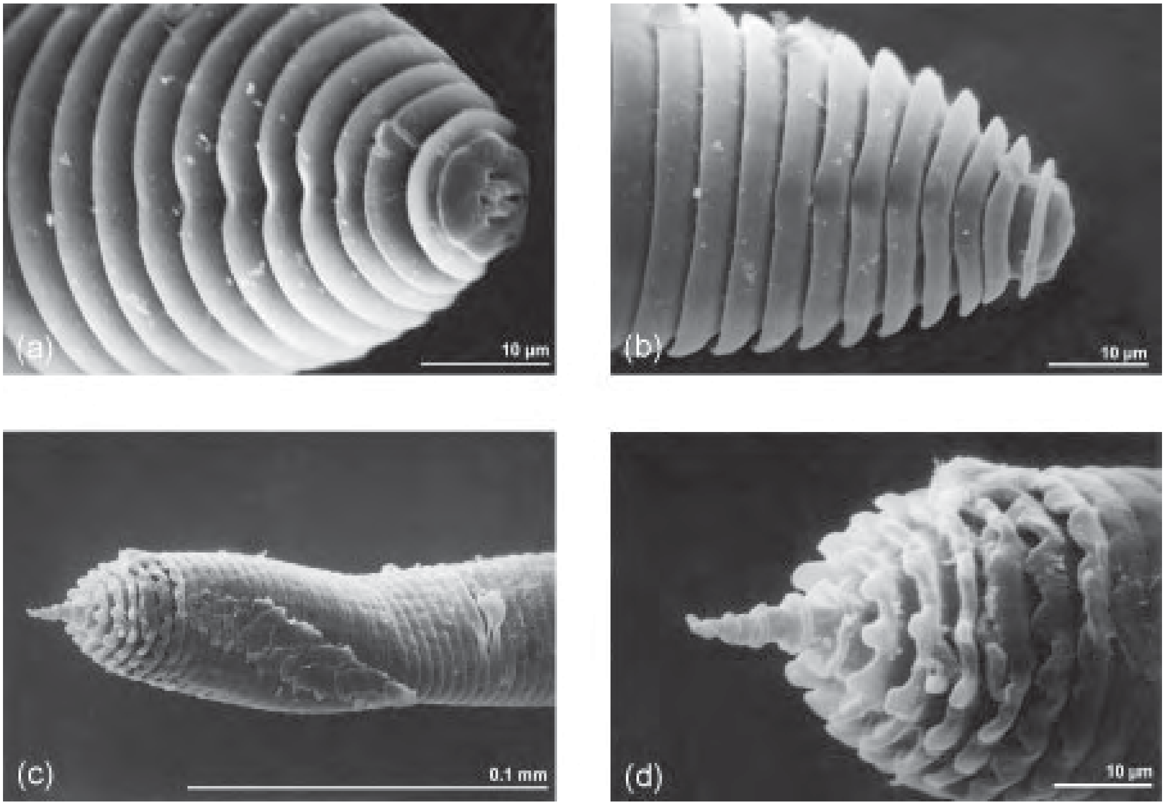

Fig. 12 SEM micrographs. *Criconema* (*Criconema*) *spinicaudatum*, female: **(a)** anterior region, sublateral view; **(b)** anterior region, lateral view; **(c)** posterior region, ventral view; **(d)** enlarged detail of (c).

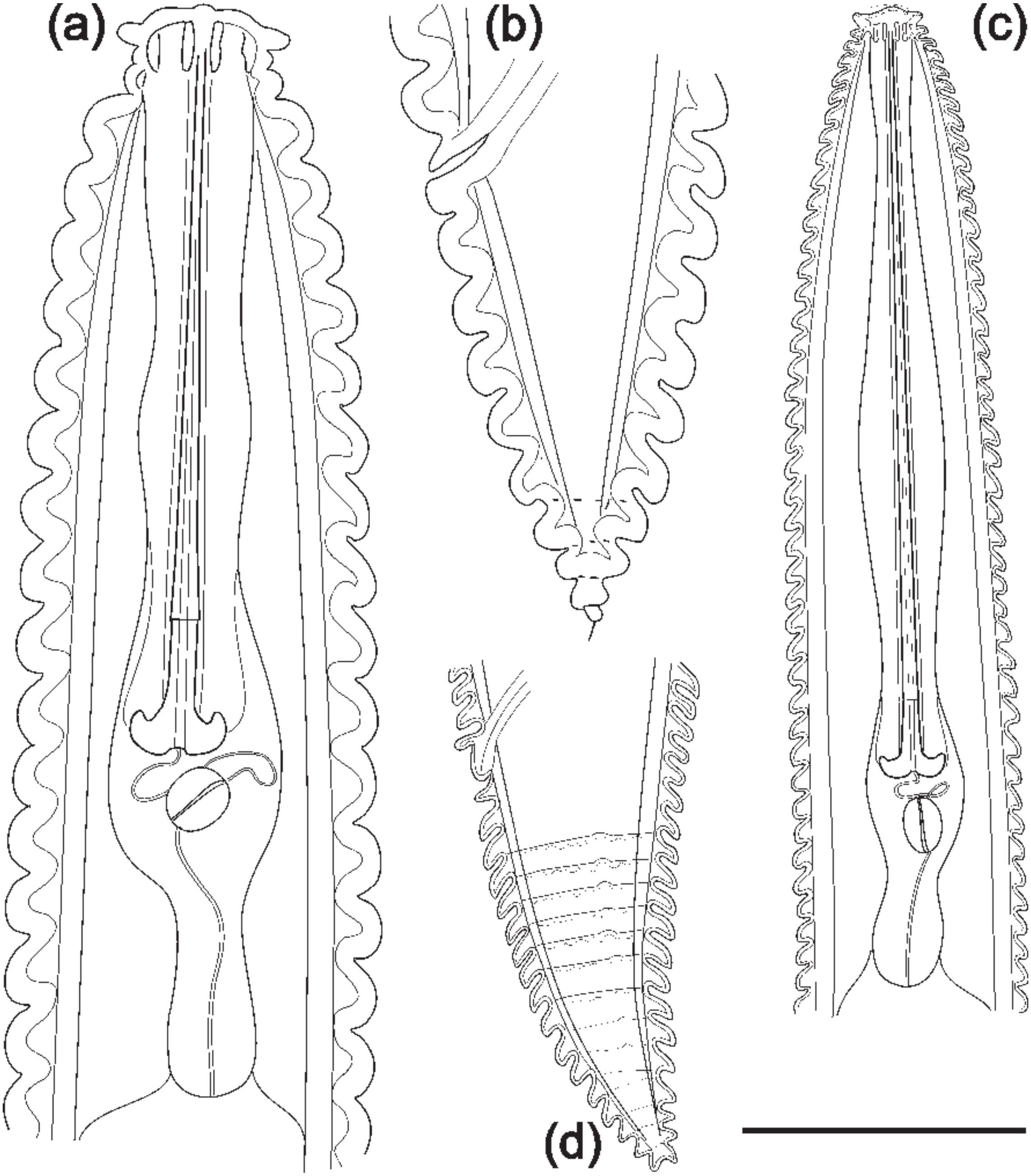

Fig. 13 (a)–(b) *Criconema* (*Nothoriconema*) *annuliferum,* female: **(a)** anterior region; **(b)** postvulval region. **(c)–(d)** *C.* (*N.*) *grandisoni*, female: **(c)** anterior region; **(d)** postvulval region. Scale bar = 40 µm.

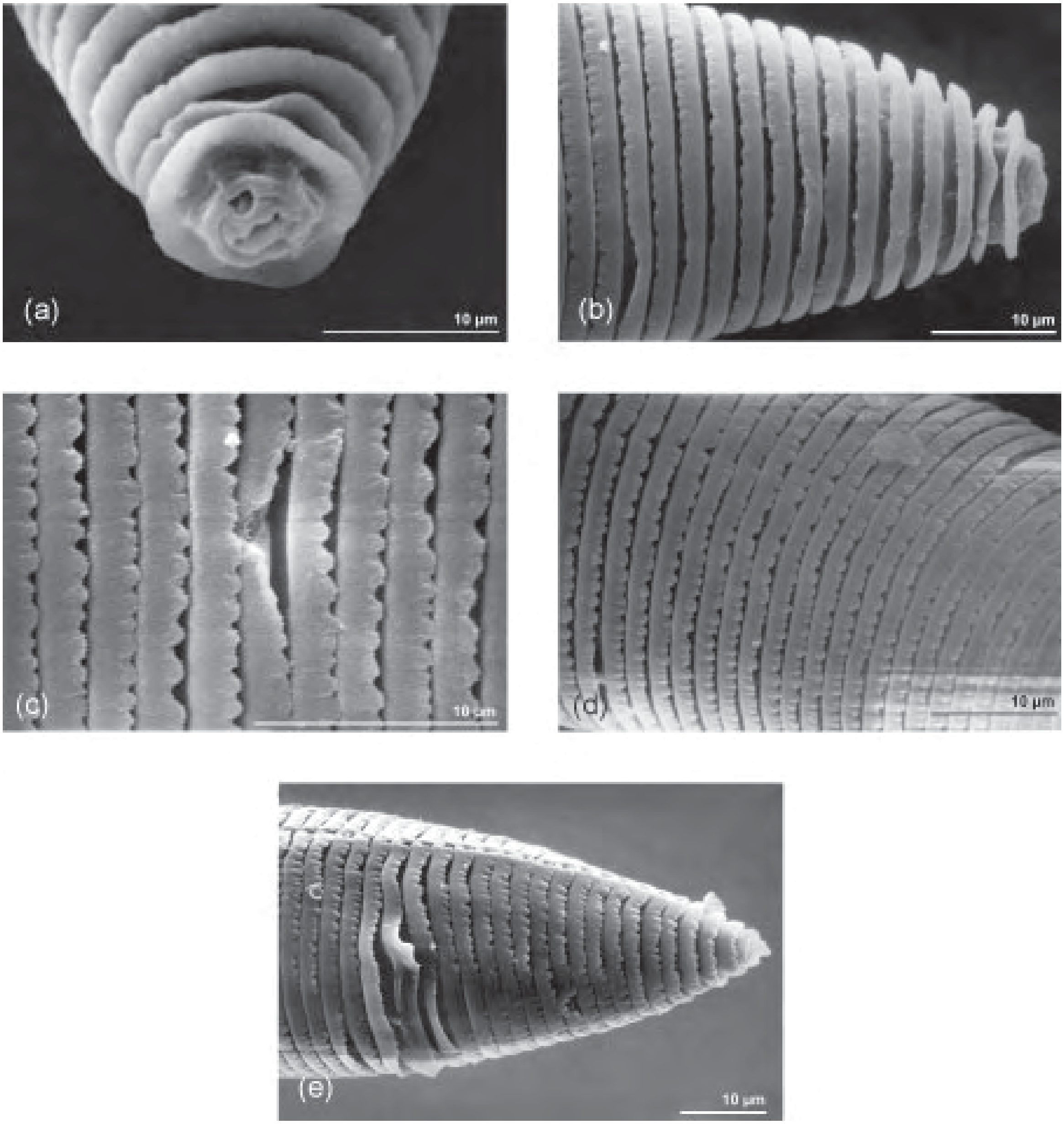

Fig. 14 SEM micrographs. *Criconema* (*Nothocriconemella*) *grandisoni*. **(a)** lip region; **(b)** anterior region, lateral view; **(c)** region of excretory pore; **(d)** cuticular pattern at midbody; **(e)** postvulval region, sublateral view.

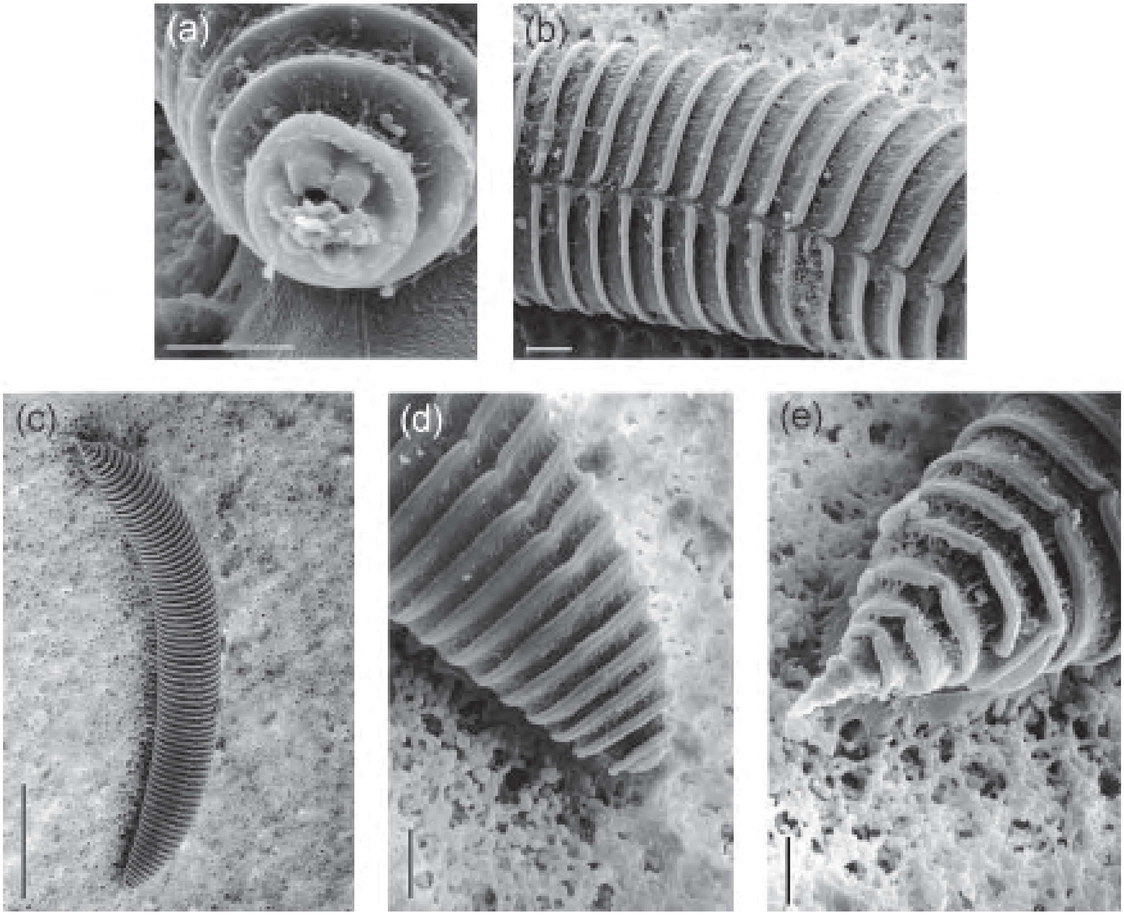

Fig. 15 SEM micrographs. *Criconema* (*Nothocriconema*) *lineatum*, female: **(a)** lip region, *en face* view; **(b)** cuticle at midbody, showing the distinct lateral groove and the perforated membrane between the body annules**; (c)** body, entire; **(d)** anterior region; **(e)** postvulval region. Scale bar **(a)–(b) (e)–(i)** = 10 μm; bar **(d)** = 100 μm.

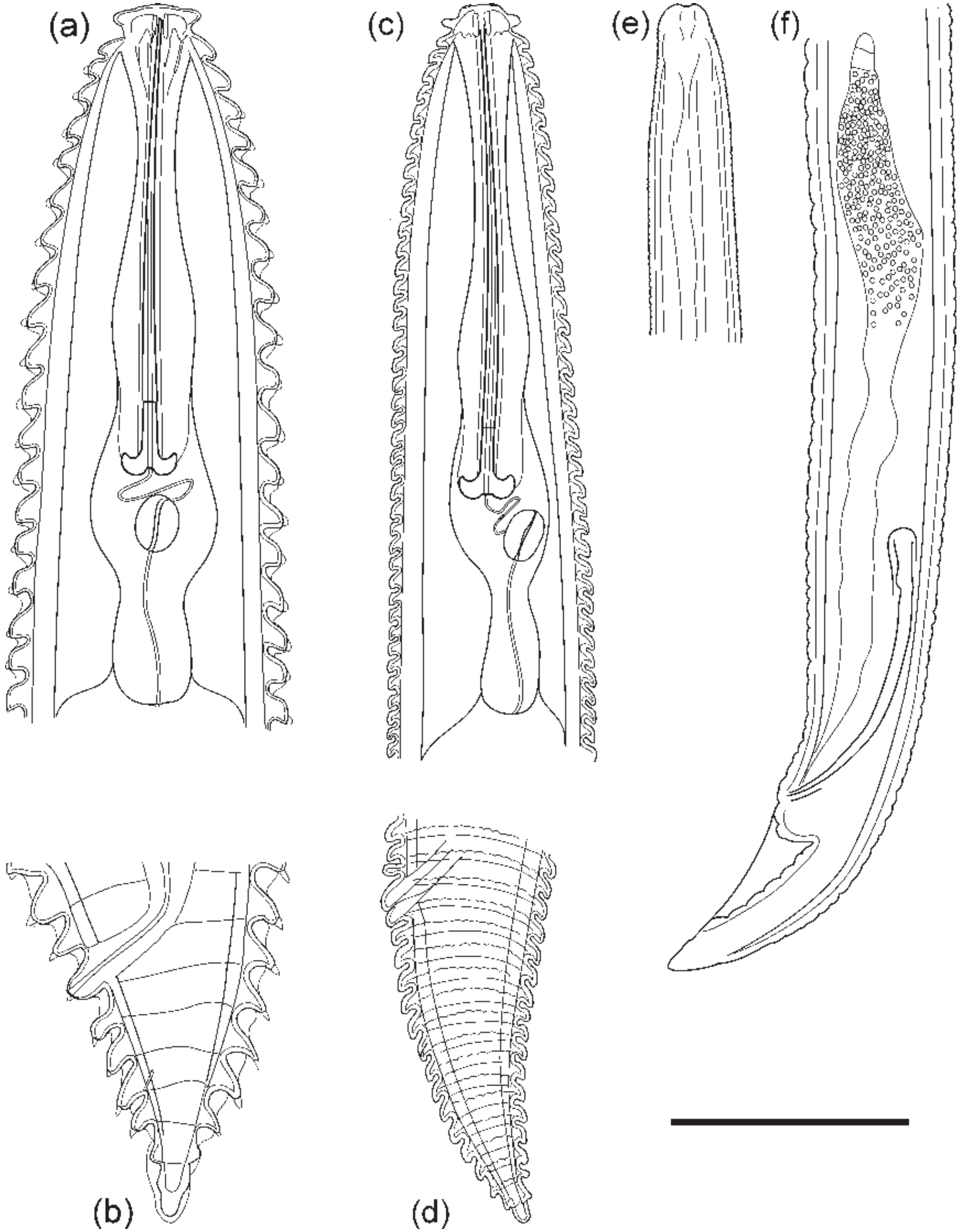

Fig. 16 (a)–(b) *Criconema* (*Nothocriconema*) *lineatum*, female: **(a)** anterior region; **(b)** postvulval region. **(c)–(f)** *C.* (*N.*) *undulatum*: **(c)–(d)** female: **(c)** anterior region; **(d)** postvulval region. **(e)–(f)** male: **(e)** anterior region; **(f)** posterior region. Scale bar = 40 µm.

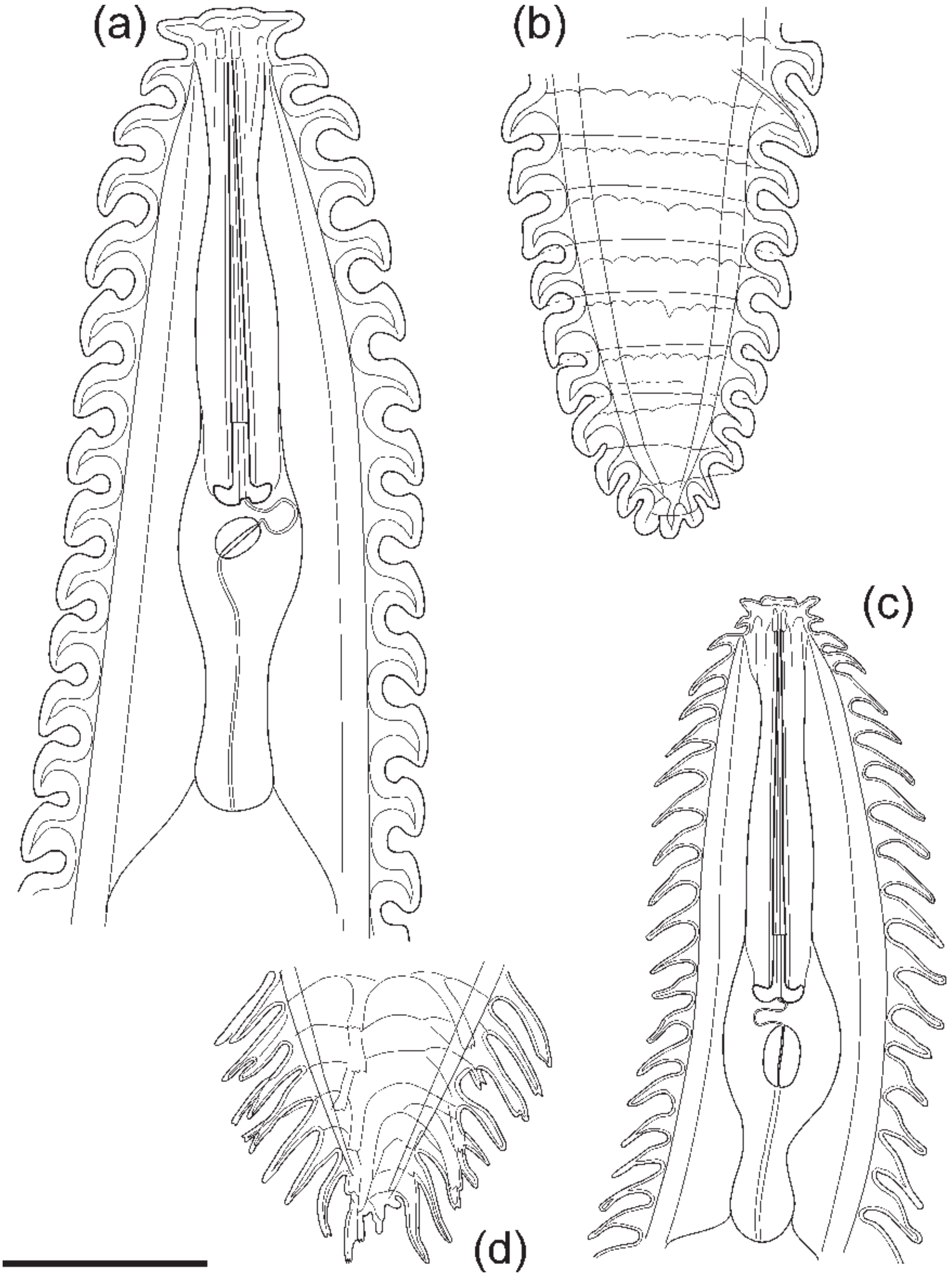

Fig. 17 *Criconema* (*Nothocriconema*) *magnum*, **(a)**–**(b)** female: **(a)** anterior region; **(b)** postvulval region. **(c)**–**(d)** juvenile: **(c)** anterior region; **(d)** posterior region. Scale bar = 40 µm.

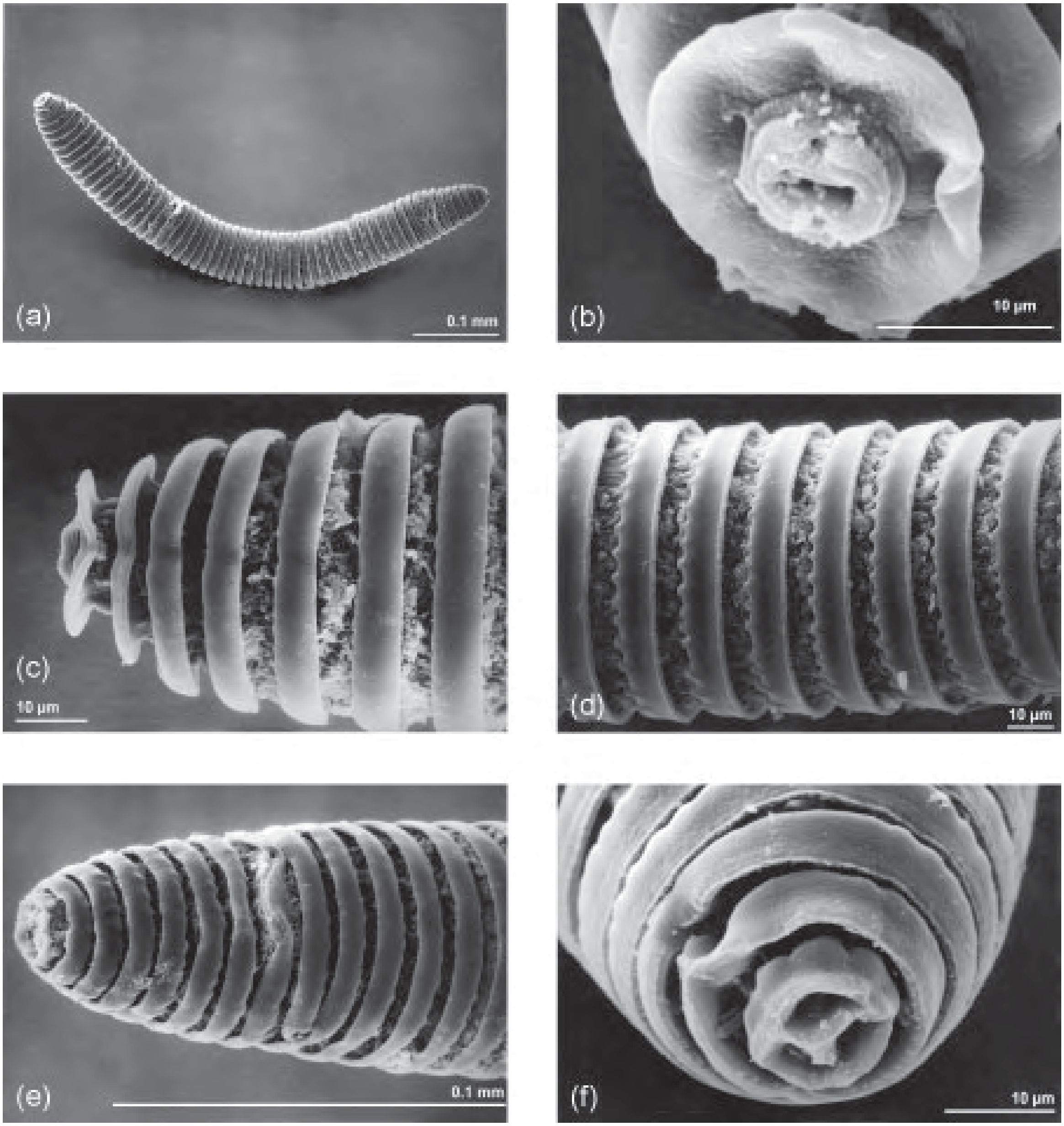

Fig. 18 SEM micrographs. *Criconema* (*Nothocriconema*) *magnum*, female: **(a)** body, entire; **(b)** lip region, *en face* view; **(c)** anterior region, lateral view; **(d)** undulating anterior edge of annules at midbody (head of specimen towards left of the photograph); **(e)** posterior region; **(f)** tail, end view.

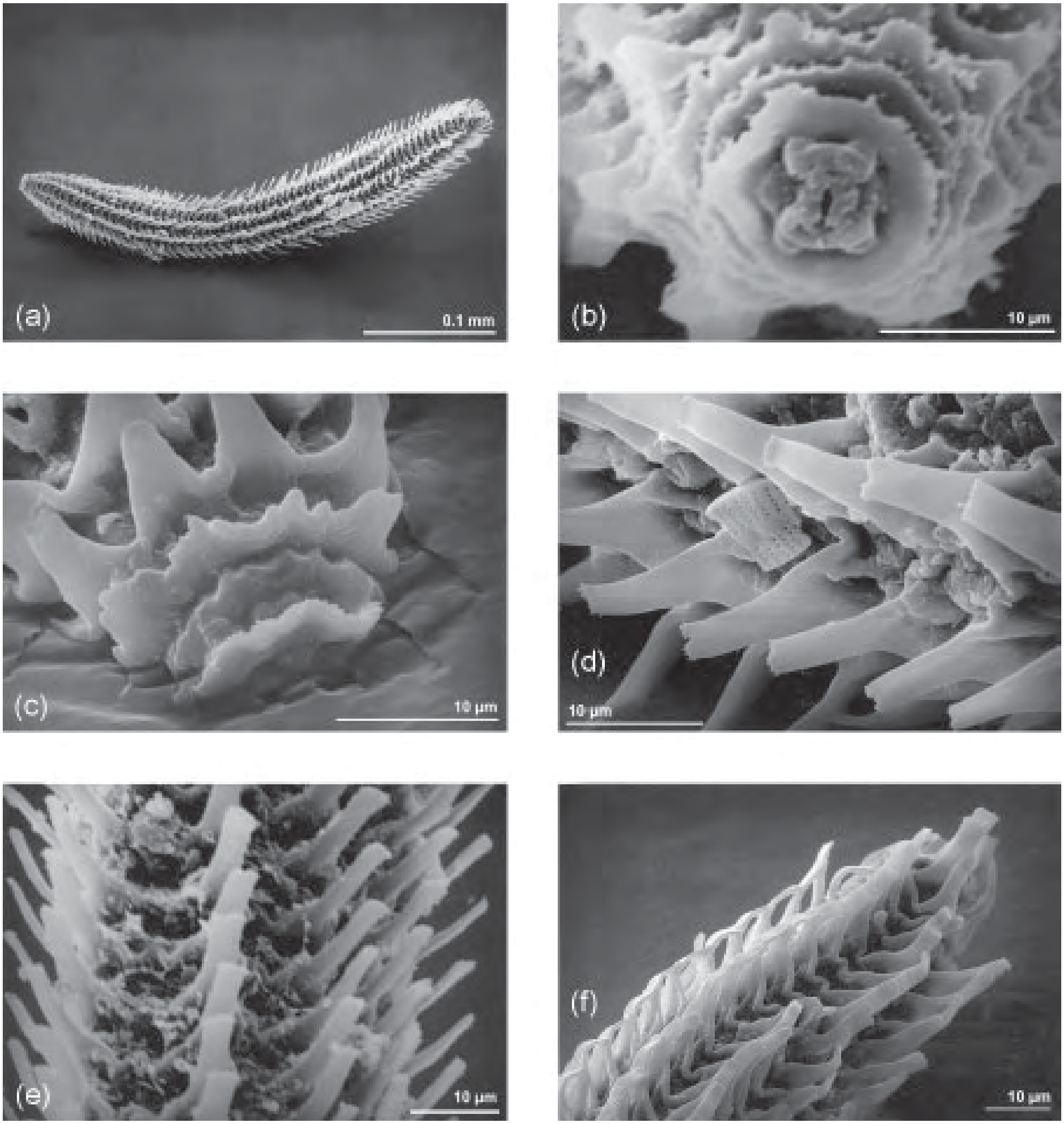

Fig. 19 SEM micrographs. *Criconema* (*Nothocriconema*) *magnum* juvenile: **(a)** body, entire; **(b)** lip region, *en face* view; **(c)** lip region, lateral view; **(d)–(e)** scales at midbody; **(f)** scales at posterior end.

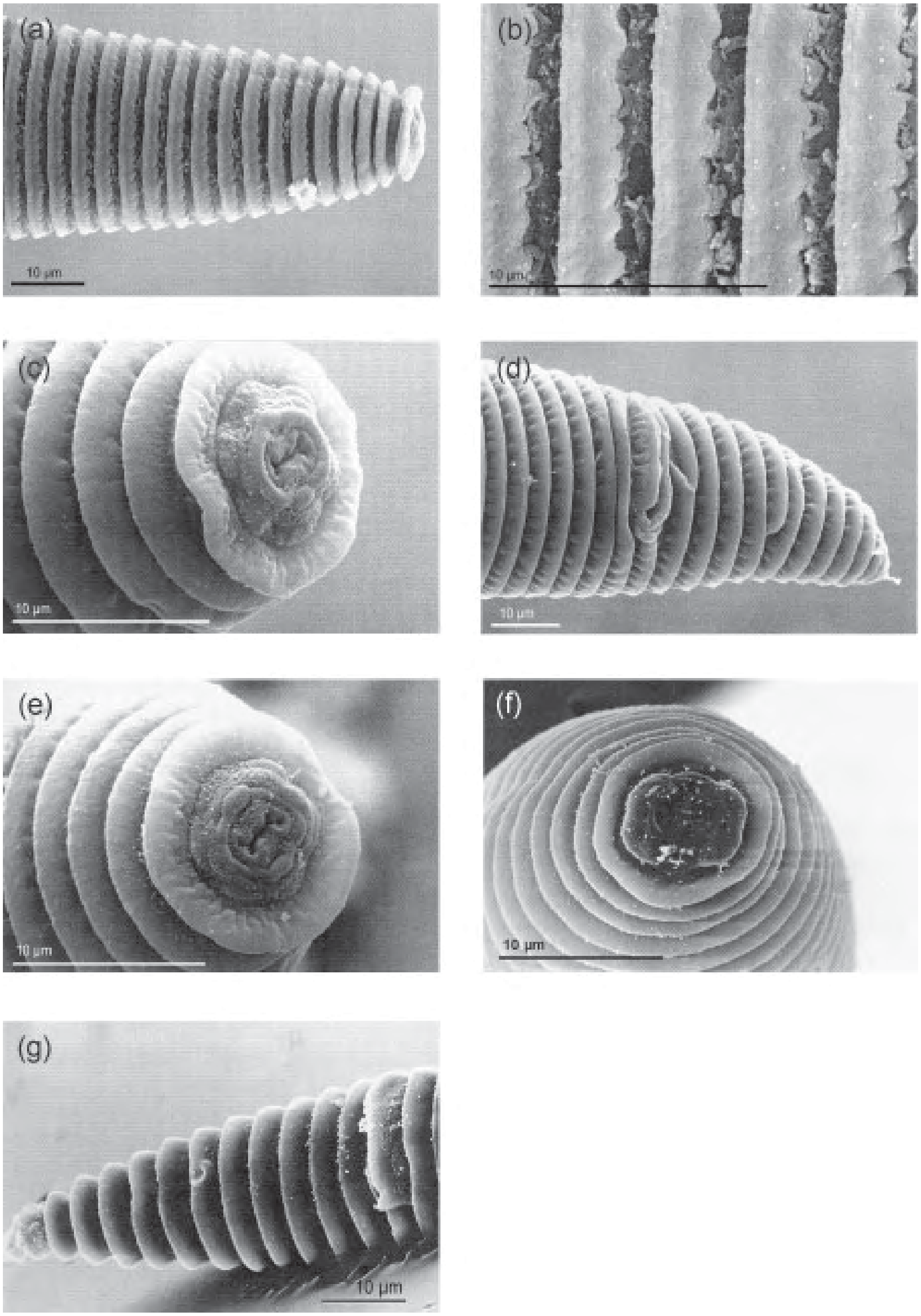

Fig. 20 SEM micrographs. **(a)–(e)** *Criconema* (*Nothocriconema*) *undulatum*, female: **(a)** anterior region; **(b)** undulation on anterior surface of annules (head of specimen towards right of the photograph); **(c)** **(e)** *en face* views of head; **(d)** posterior region, subventral view. **(f)–(g)** *C.* (*N.*) *acuticaudatum*, female: **(f)** *en face* view of lip region; **(g)** postvulval region, ventral view. (Published with permission of the *New Zealand Journal of Zoology*).

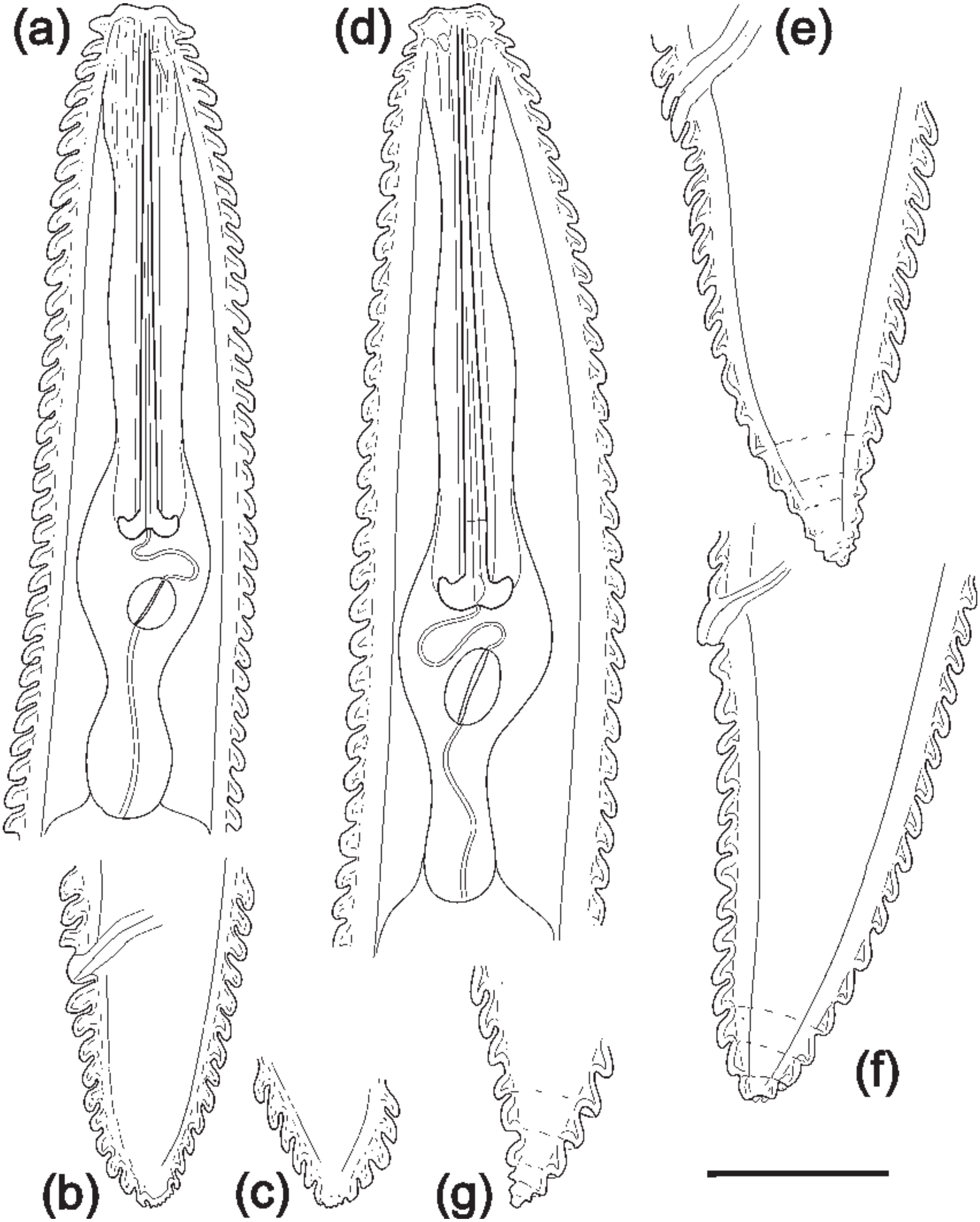

Fig 21 *Criconema* (*Nothocriconemella*) females. **(a)–(c)** *C.* (*N.*) *mutabile*: **(a)** anterior region; **(b)** postvulval region; **(c)** tail terminus variant. **(d)–(g)** *C.* (*N.*) *californicum*: **(d)** anterior region; **(e)** postvulval region; **(f)** postvulval region variant; **(g)** tail terminus variant. Scale bar = 20 µm. (Adapted from the *Russian Journal of Nematology*).

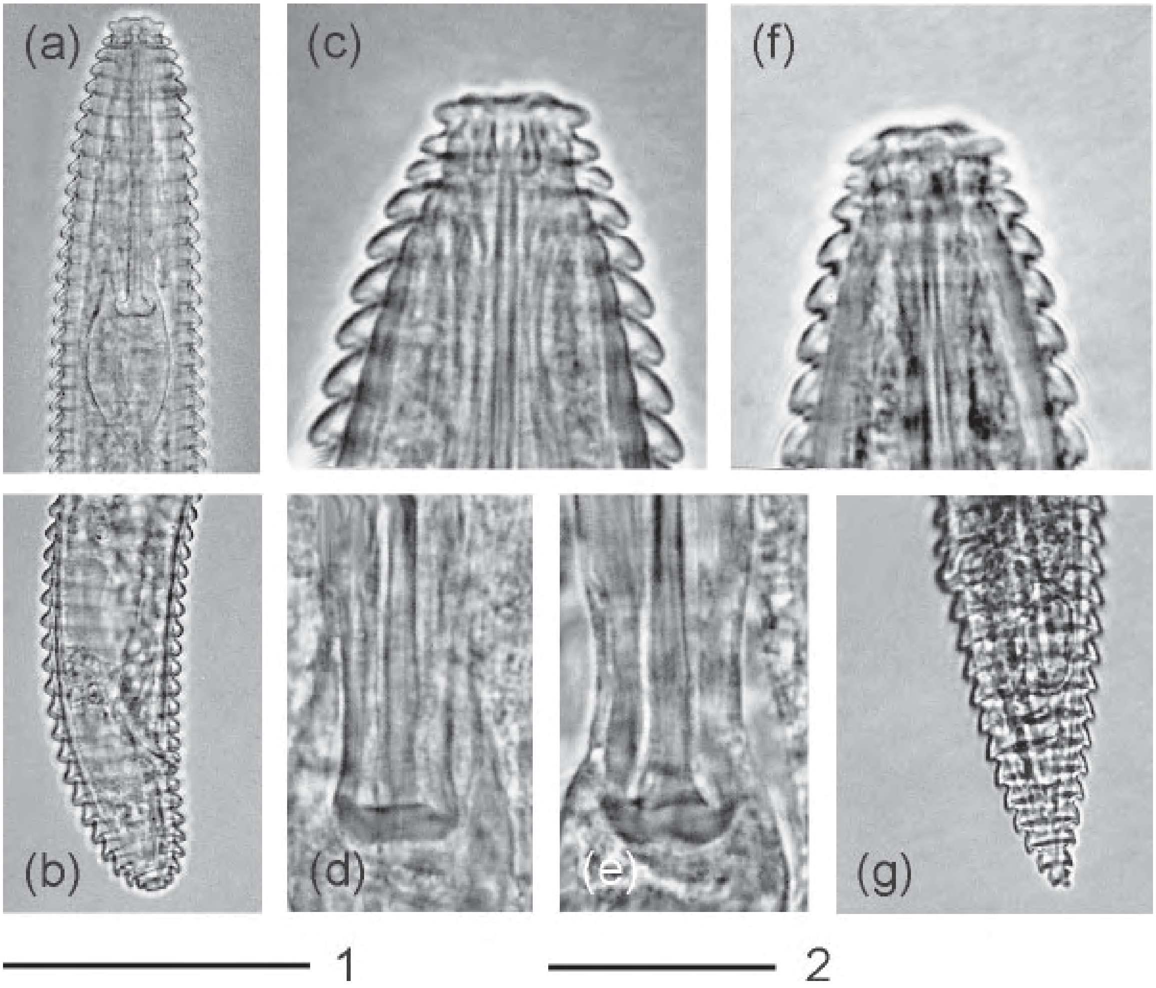

Fig. 22 *Criconema* (*Nothocriconemella*) females. **(a)–(b)** *C.* (*N.*) *mutabile*: **(a)** anterior region; **(b)** posterior region. **(c)–(d)** *C.* (*N.*) *graminicola*: **(c)** anterior region; **(d)** stylet base. **(e)** *C.* (*N.*) *acuticaudatum* stylet base. **(f)–(g)** *C.* (*N.) californicum* population from Lyell with low, flat lip region: **(f)** anterior region; **(g)** postvulval region. Scale bar 1 = 50 µm for **(b)**, **(g)**. Scale bar 2 = 50 µm for **(a)** and 20 µm for **(c)–(f)**. (Published with permission of the *Russian Journal of Nematology*).

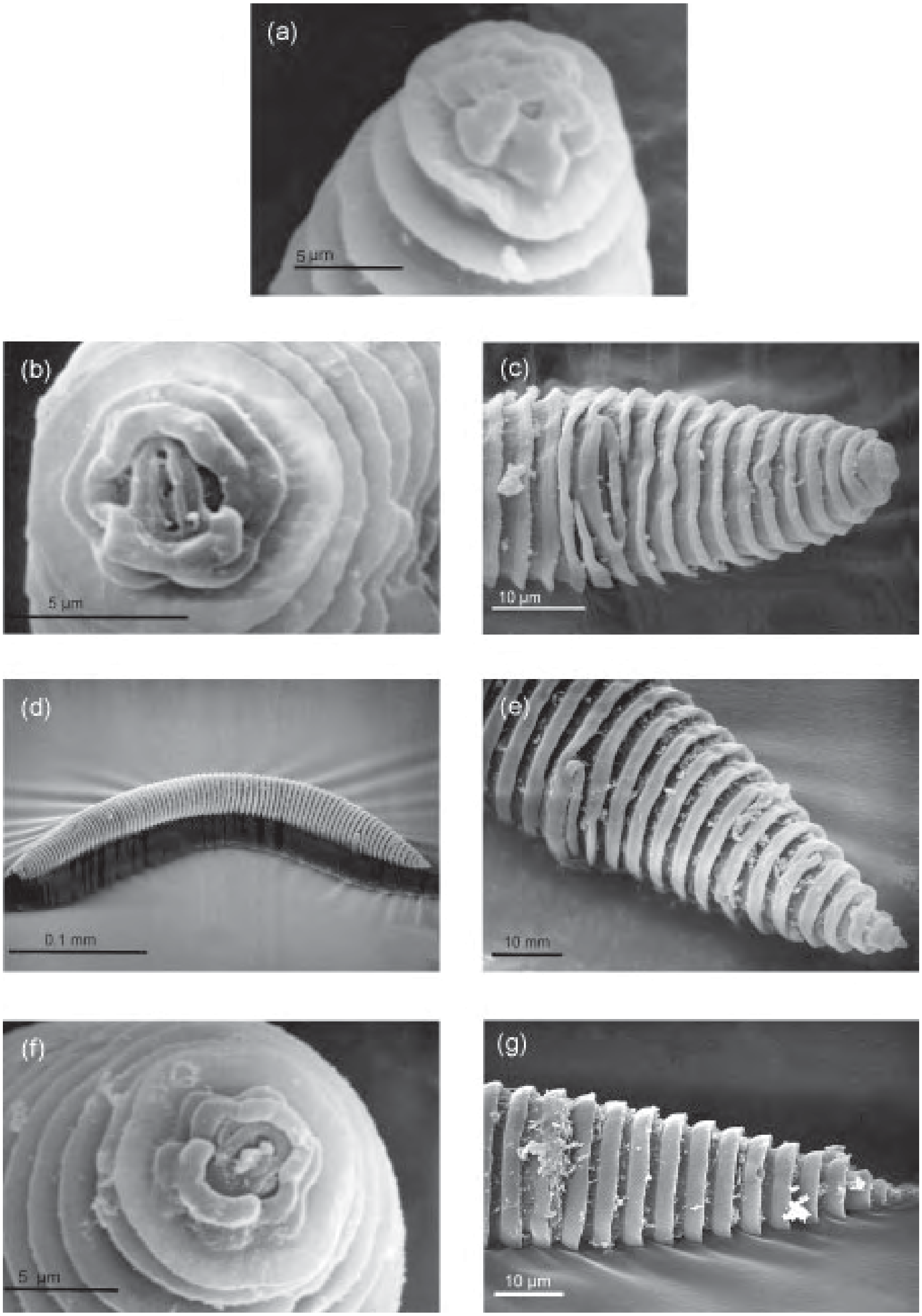

Fig. 23 SEM micrographs. *Criconema* (*Nothocriconemella*) females. **(a)** *C.* (*N.*) *mutabile* lip region, *en face* view. **(b)–(g)** *C.* (*N.*) *alpinum*: **(b)–(c)** Porters Pass population: **(b)** lip region, *en face* view; **(c)** postvulval region. **(d)–(e)** Haast Pass population: **(d)** body entire; **(e)** postvulval region. **(f)–(g)** Mt Lodestone population: **(f)** lip region, *en face* view; **(g)** postvulval region. (Published with permission of the *Russian Journal of Nematology*).

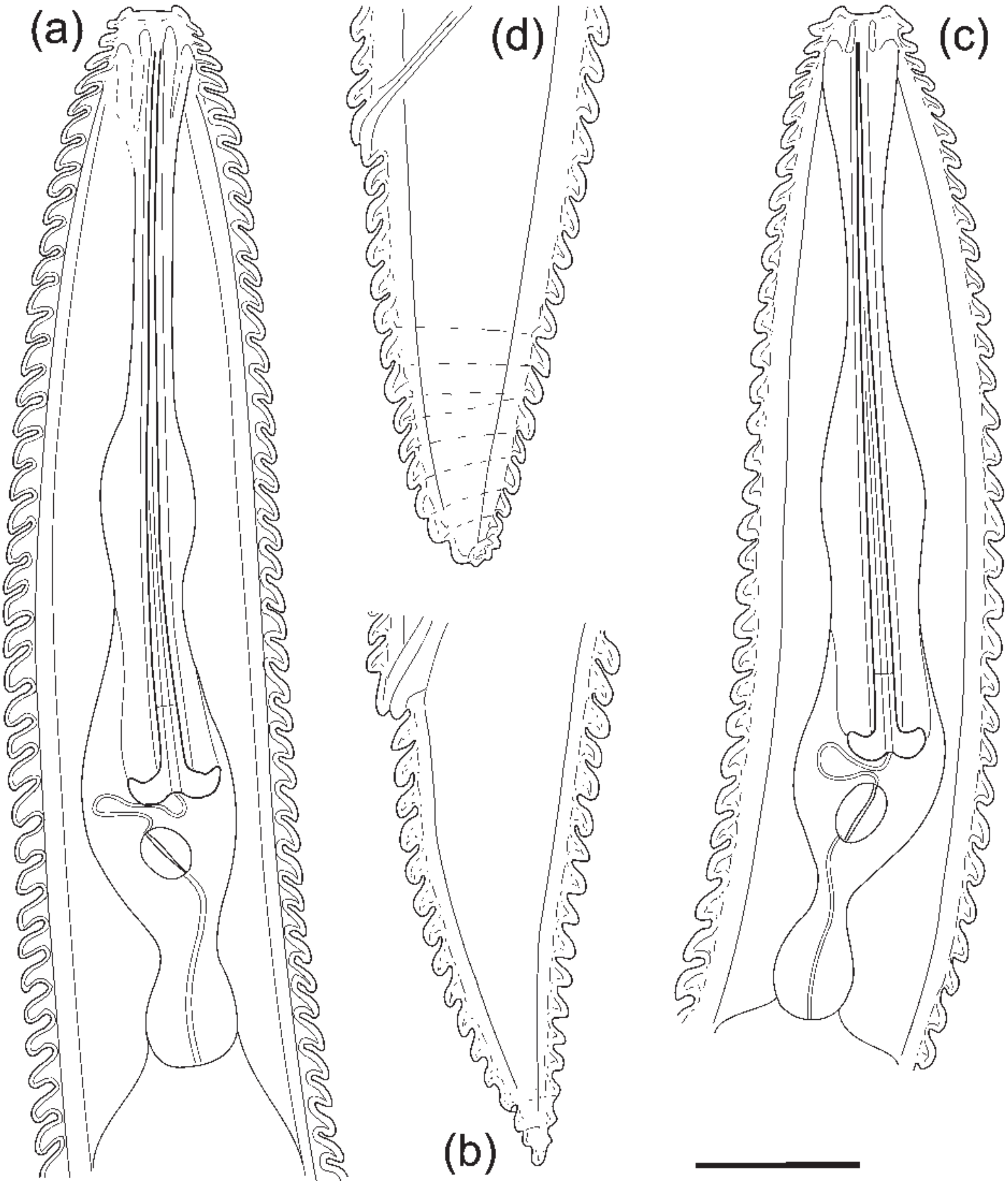

Fig. 24 *Criconema* (*Nothocriconemella*) females. **(a)–(b)** *C.* (*N.*) *pasticum*: **(a)** anterior region; **(b)** postvulval region. **(c)–(d)** *C.* (*N.*) *alpinum*: **(c)** anterior region; **(d)** postvulval region. Scale bar = 20 µm. (Adapted from the *Russian Journal of Nematology*).

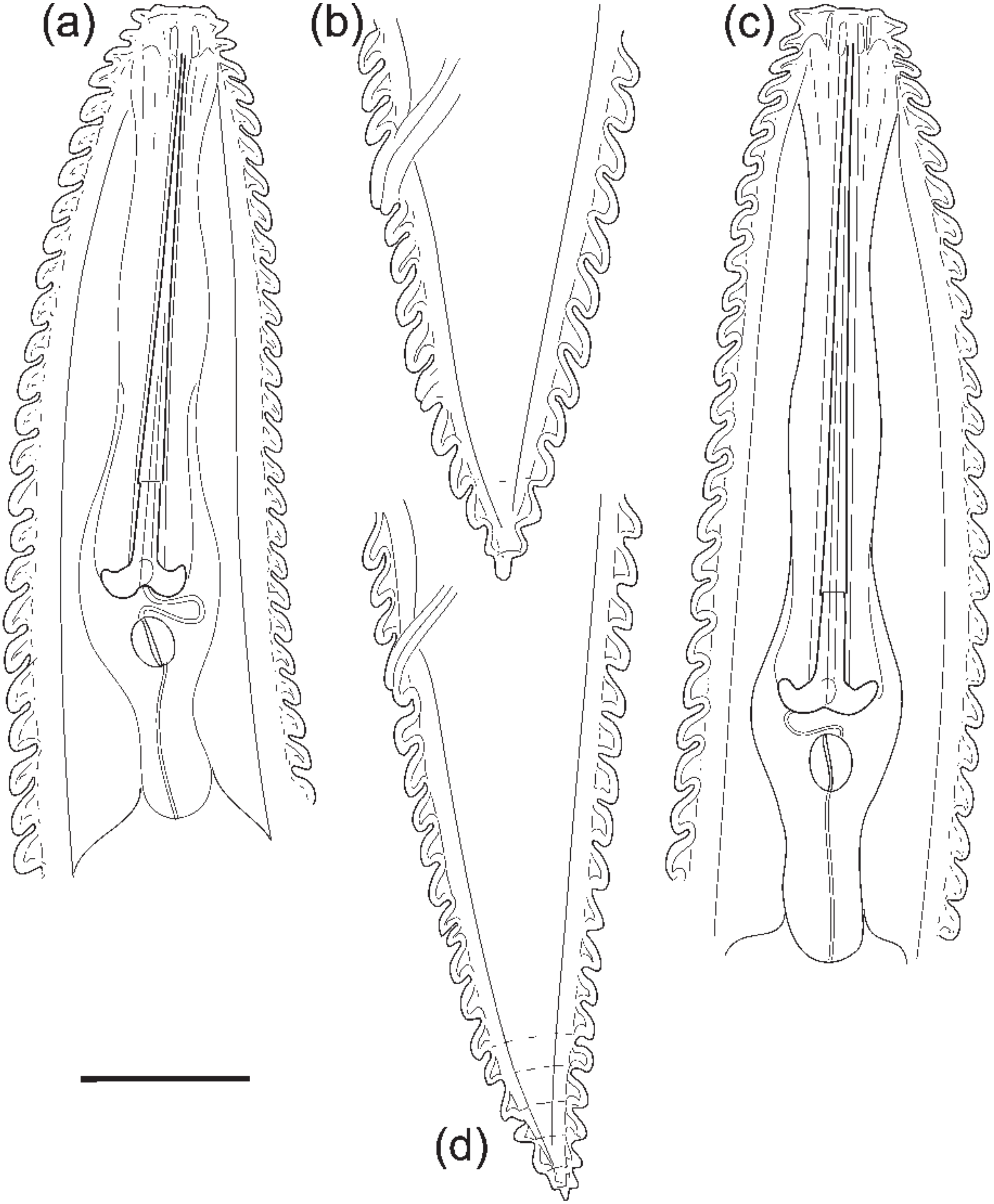

Fig. 25 *Criconema* (*Nothocriconemella*) females. **(a)–(b)** *C.* (*N.*) *graminicola*: **(a)** anterior region; **(b)** postvulval region. **(c)–(d)** *C.* (*N.*) *acuticaudatum*: **(c)** anterior region; **(d)** postvulval region. Scale bar = 20 µm. (Adapted from the *Russian Journal of Nematology*).

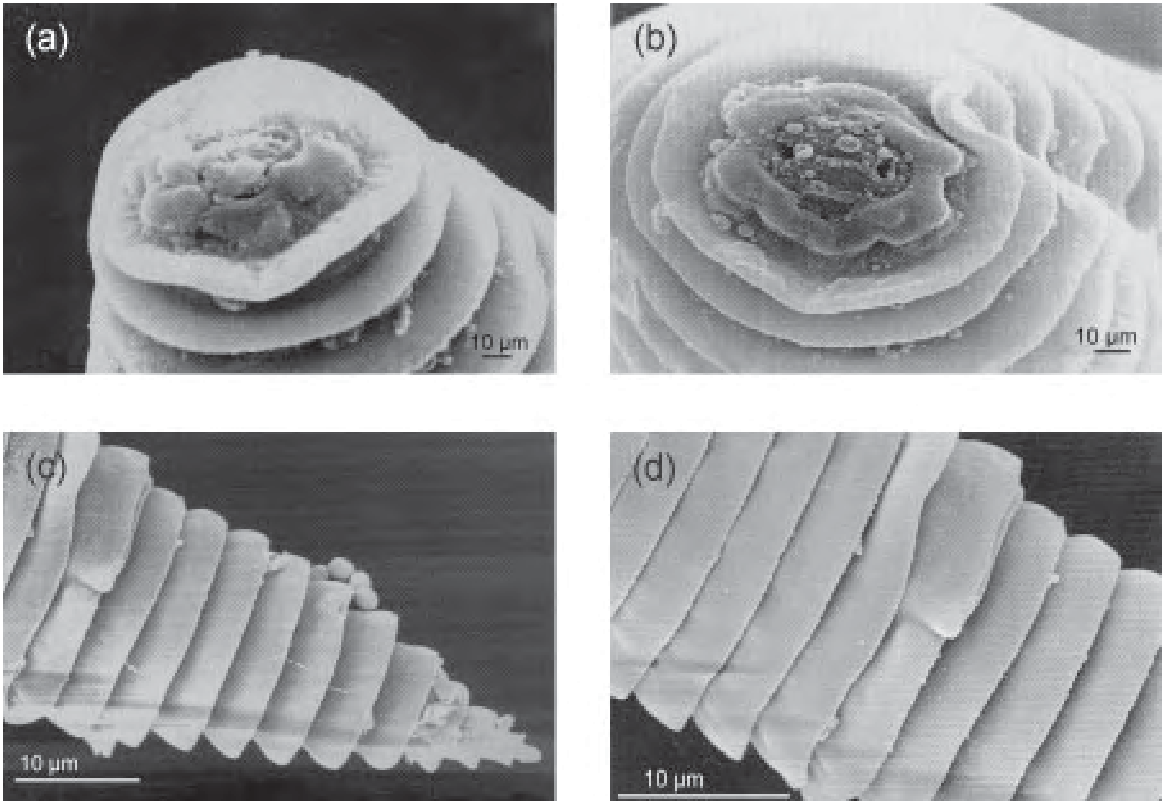

Fig. 26 SEM micrographs. *Criconema* (*Nothocriconemella*) *graminicola* female. **(a)**–**(b)** *en face* view of head; **(c)** postvulval region, subventral view; **(d)** vulva, subventral view. (Published with permission of the *New Zealand Journal of Zoology*).

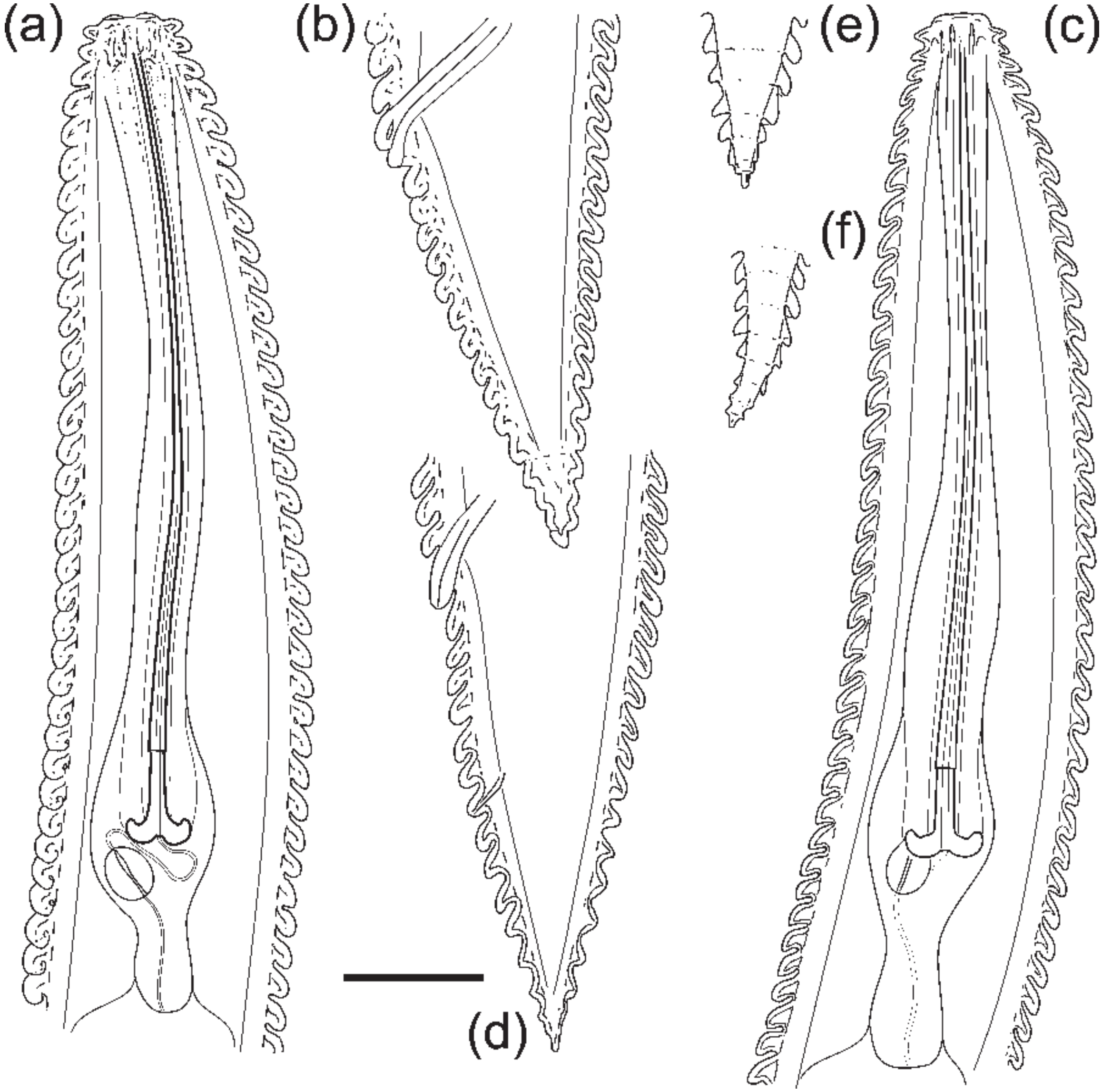

Fig. 27 *Criconema* (*Nothocriconemella*) females. **(a)–(b)** *C*. (*N*.). *sphagni*: **(a)** anterior region; **(b)** postvulval region. **(c)–(f)** *C*. (*N*.) *macilentum*: **(c)** anterior region; **(d)** postvulval region; **(e)–(f)** tail terminus variants. Scale bar = 20 µm. (Adapted from the *Russian Journal of Nematology*).

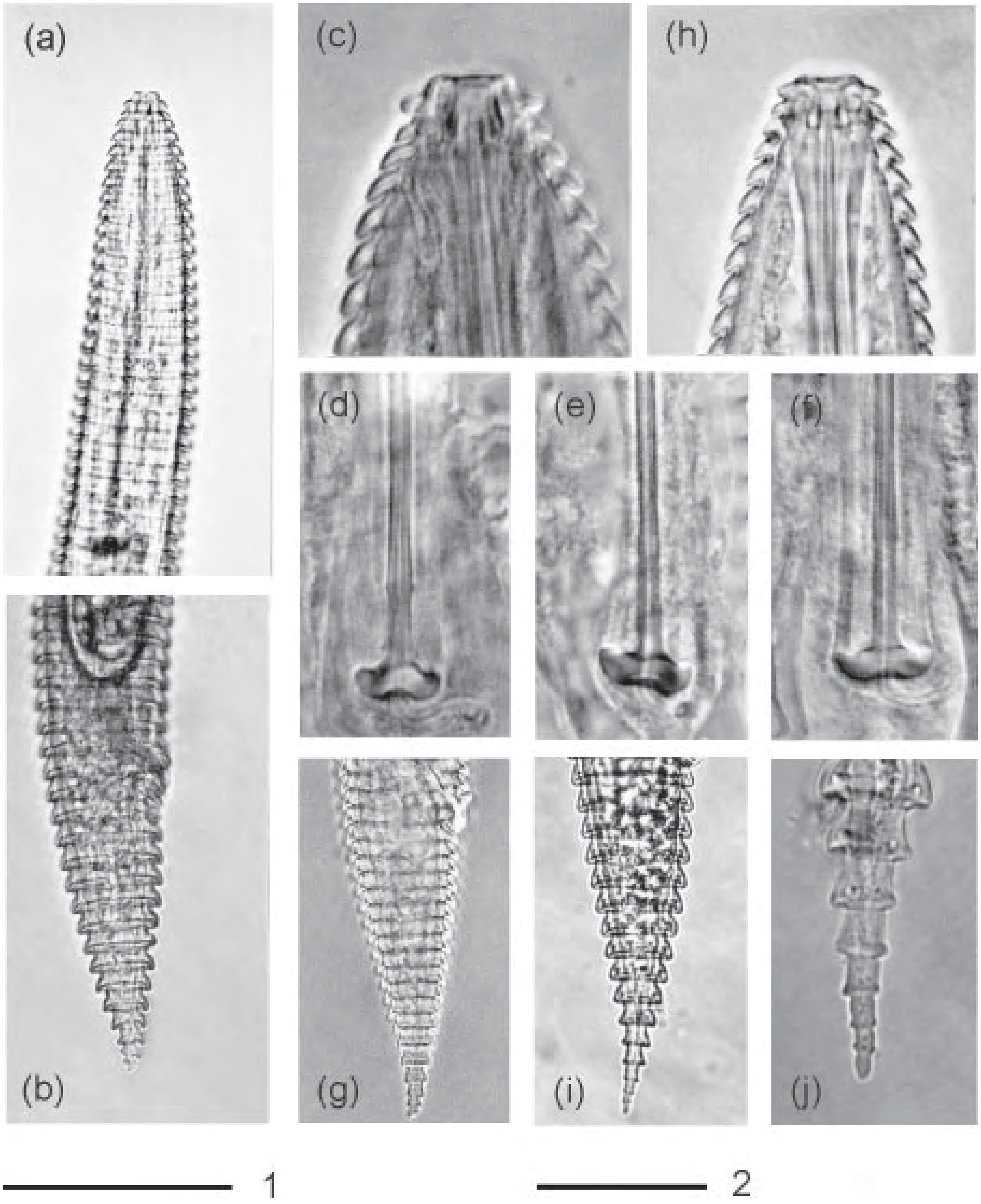

Fig. 28 *Criconema* (*Nothocriconemella*) females. **(a)**–**(g)** *C.* (*N.*) *macilentum*: **(a)** anterior region; **(b)** posterior region; **(c)** anterior region, close up; **(d)**–**(f)** posterior part of stylets: **(d)** Fox Glacier population; **(e)** Campbell Island population; **(f)** Auckland Islands population. **(g)** postvulval region. **(h)** *C.* (*N.*) *sphagni,* anterior region. Note the low labial region of *C. (N.) sphagni* **(h)** relative to *C.* (*N.*) *macilentum* **(c)**. **(i)**–**(j)** *C.* (*N.*) *crosbyi*: **(i)** postvulval region; **(j)** tail terminus. Scale bar 1 = 50 mm for **(b)**, **(g)**, **(i)** and 20 mm for **(c)**. Scale bar 2 = 50 µm for **(a)** and 20 µm for **(d)**, **(f)**, **(h)**, **(j)**. (Published with permission of the *Russian Journal of Nematology*).

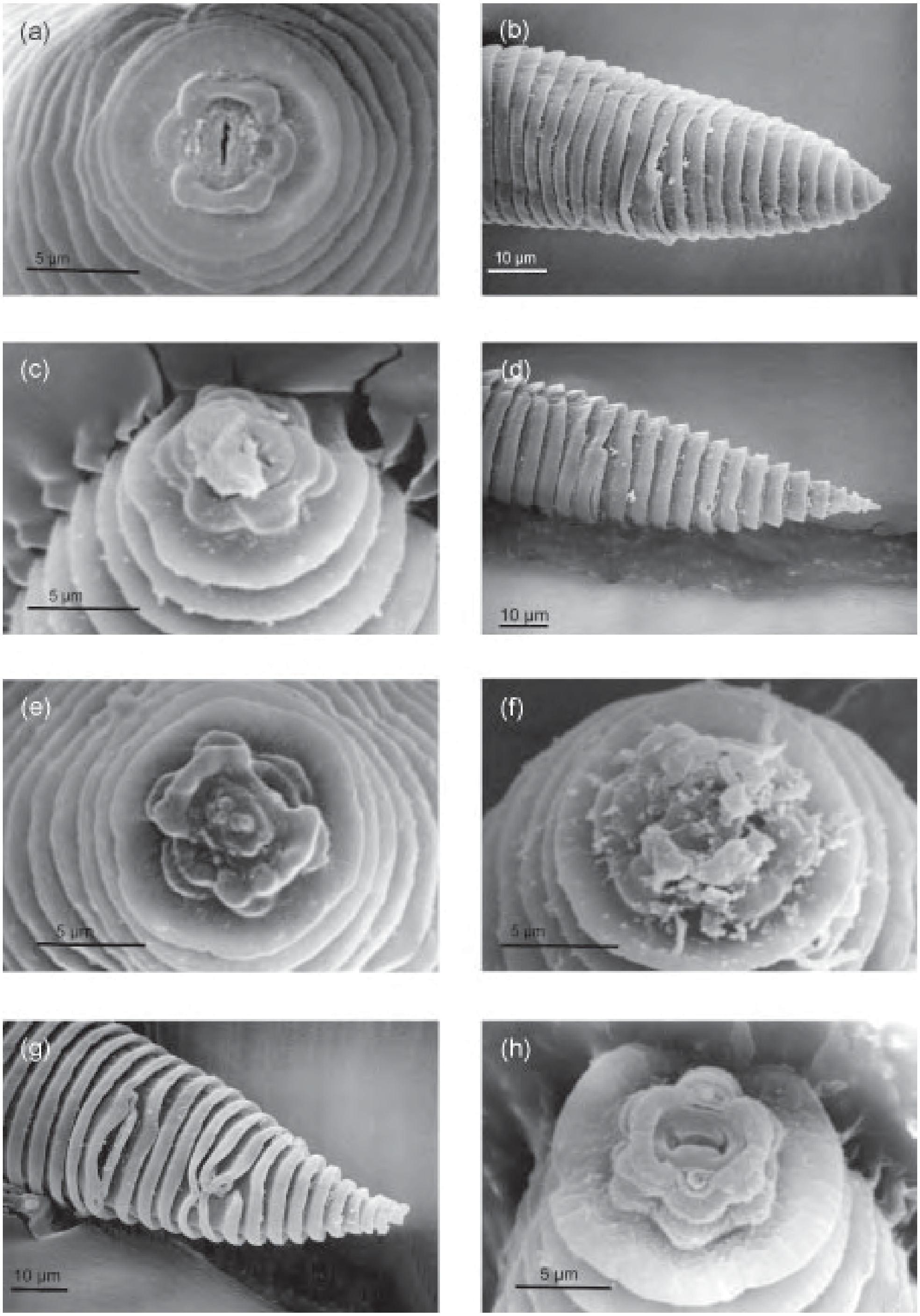

Fig. 29 SEM micrographs. *Criconema* (*Nothocriconemella*) females. **(a)–(b)** *C.* (*N.*) *sphagni*: **(a)** lip region, *en face* view; **(b)** postvulval region. **(c)–(d)** *C.* (*N.*) *macilentum*: **(c)** lip region, *en face* view; **(d)** postvulval region. **(e)–(g)** *C.* (*N.*) *dugdalei*: **(e)–(f)** lip regions, *en face* view; **(g)** postvulval region. **(h)** *C.* (*N.*) *farrelli*, lip region, *en face* view. (Published with permission of the *Russian Journal of Nematology*).

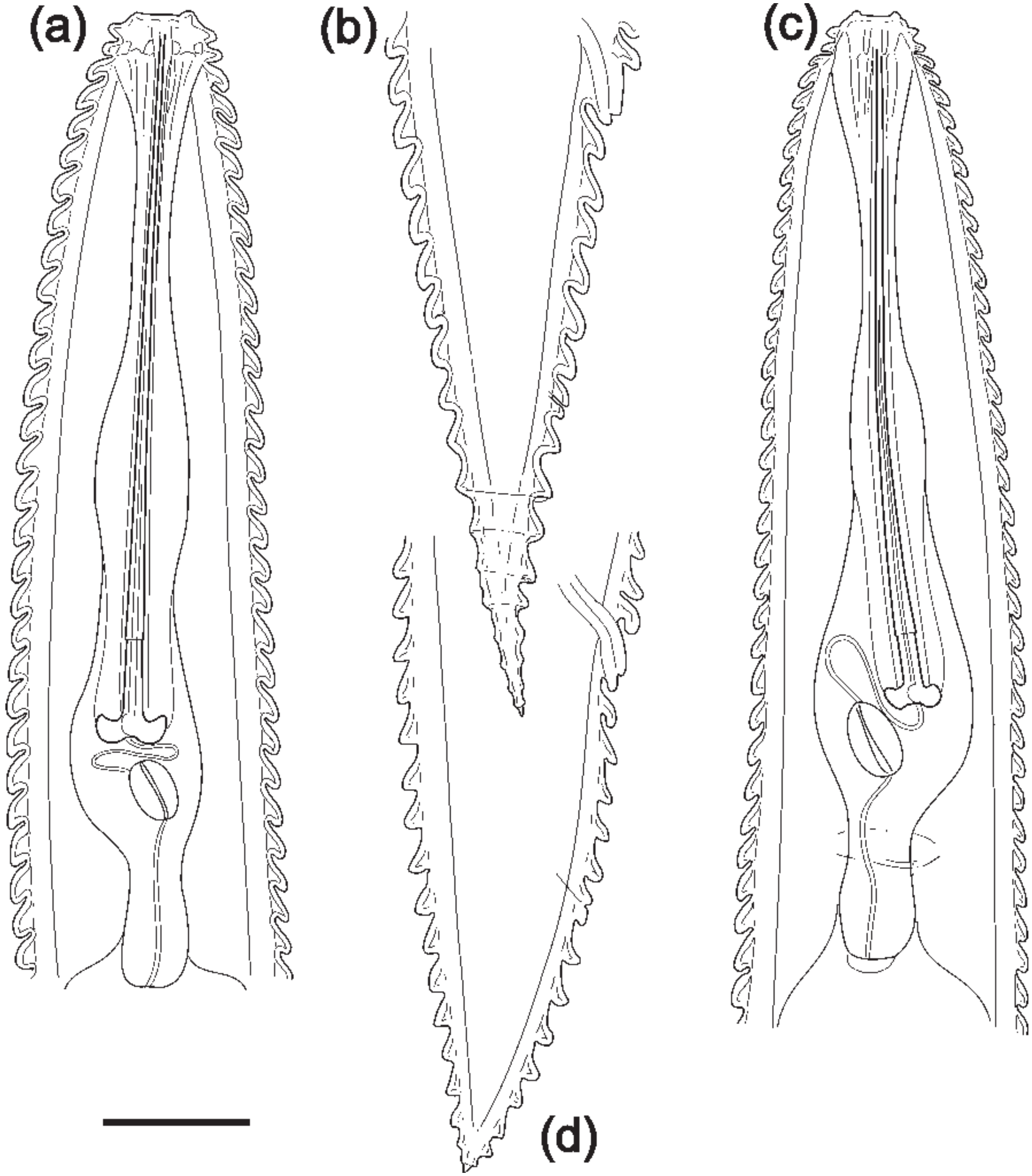

Fig. 30 *Criconema* (*Nothocriconemella*) females. **(a)–(b)** *C.* (*N.*) *crosbyi*: **(a)** anterior region; **(b)** postvulval region. **(c)–(d)** *C.* (*N.*) *farrelli*: **(c)** anterior region; **(d)** postvulval region. Scale bar = 20 µm. (Adapted from the *Russian Journal of Nematology*).

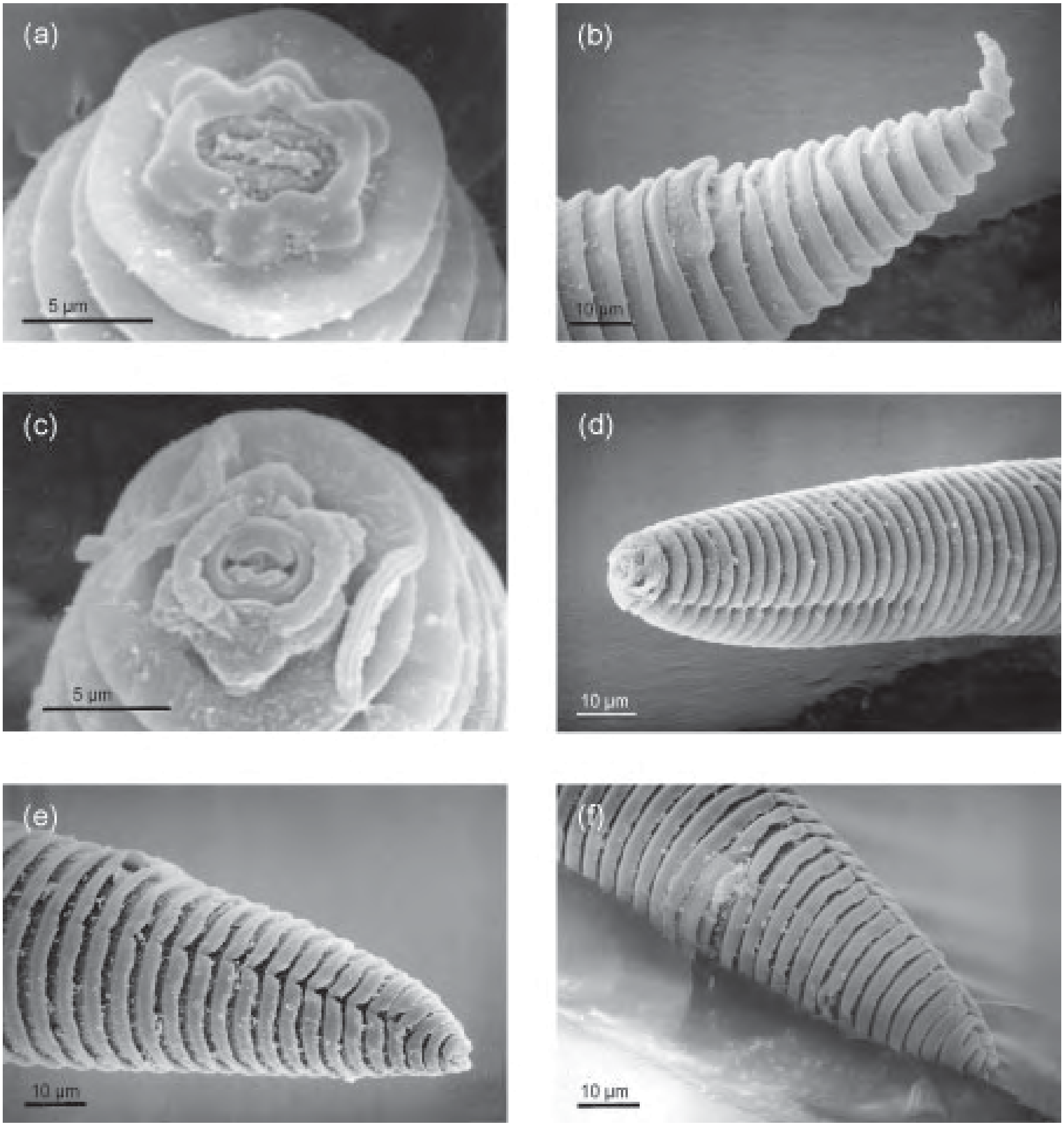

Fig. 31 SEM micrographs. *Criconema* (*Nothocriconemella*) females. **(a)–(b)** *C.* (*N.*) *crosbyi*: **(a)** lip region, *en face* view; **(b)** postvulval region. **(c)–(f)** *C.* (*N.*) *ramsayi*: **(c)** lip region, *en face* view; **(d)** anterior region; **(e)** postvulval region, lateral view; **(f)** postvulval region, subventral view. (Published with permission of the *Russian Journal of Nematology*).

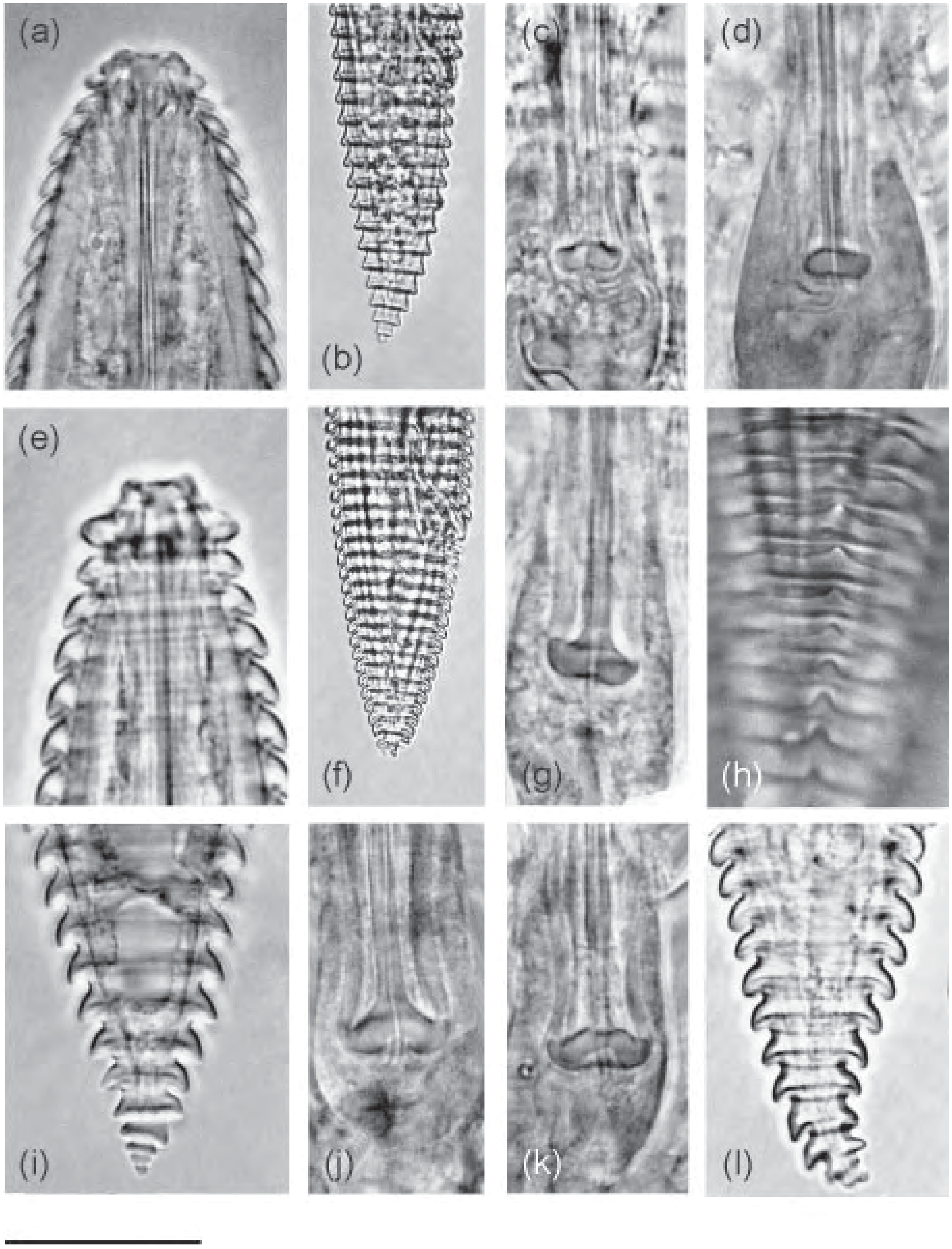

Fig. 32 *Criconema* (*Nothocriconemella*) females. **(a)–(d)** *C.* (*N.*) *farrelli*: **(a)** anterior region; **(b)** postvulval region; **(c)–(d)** stylet base of 2 specimens. **(e)–(h)** *C.* (*N.) ramsayi*: **(e)** anterior region; **(f)** postvulval region; **(g)** stylet base; **(h)** lateral field with groove on tail. **(i)–(l)** *C.* (*N.*) *dugdalei*: **(i)** Tail; **(j)** stylet base Mt Dundas population; **(k)** Stylet base Mt Domett population; **(l)** tail. Scale bar = 50 μm for **(b)**, **(f)** and 20 μm for **(a)**, **(c)–(e)**, **(g)–(l)**. (Published with permission of the *Russian Journal of Nematology*).

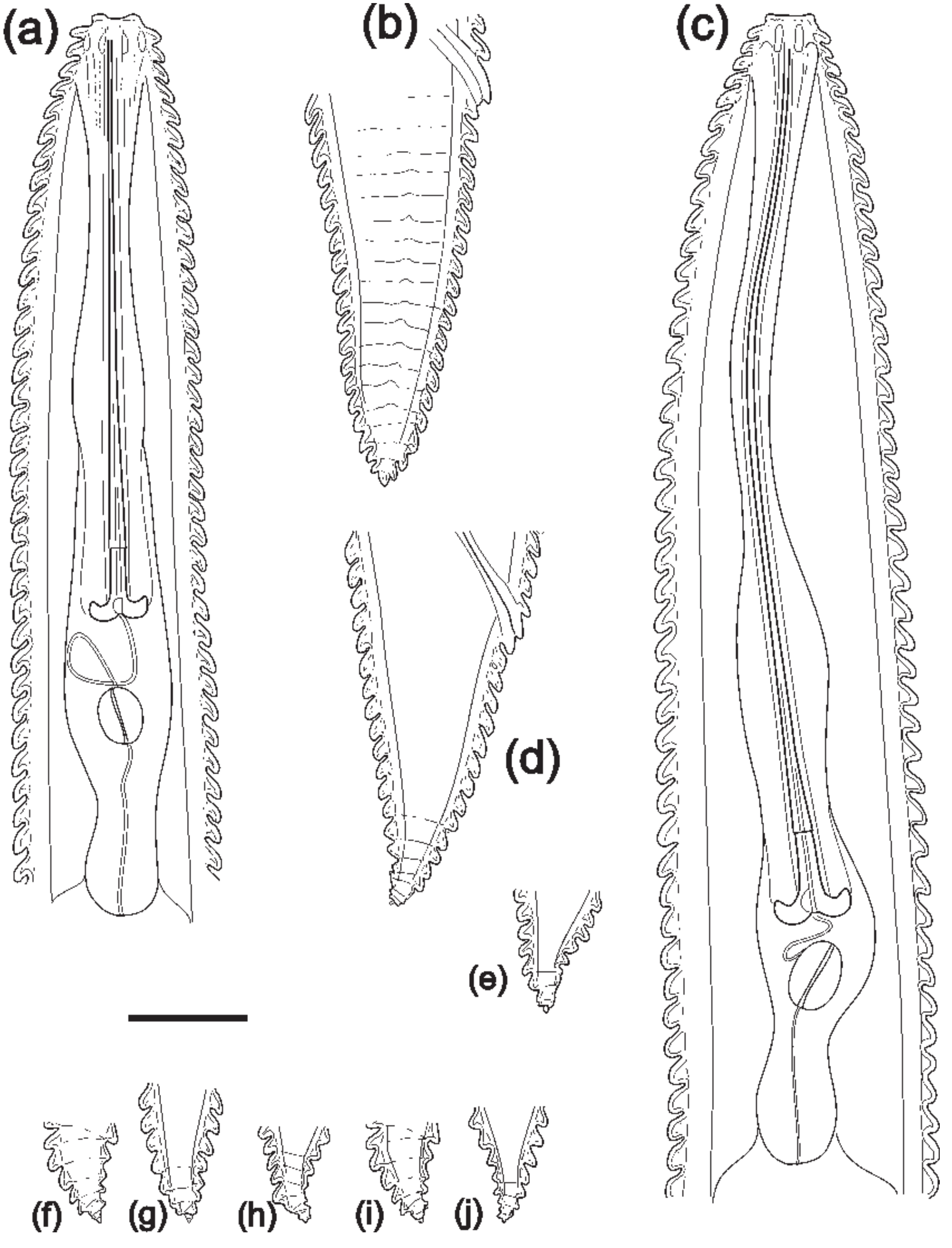

Fig. 33 *Criconema* (*Nothocriconemella*) females. **(a)–(b)** *C.* (*N.*) *ramsayi*: **(a)** anterior region; **(b)** postvulval region. **(c)–(j)** *C.* (*N.*) *dugdalei*: **(c)** anterior region, **(d)** postvulval region; **(e)–(j)** tail terminus variants. Scale bar = 20 µm. (Adapted from the *Russian Journal of Nematology*).

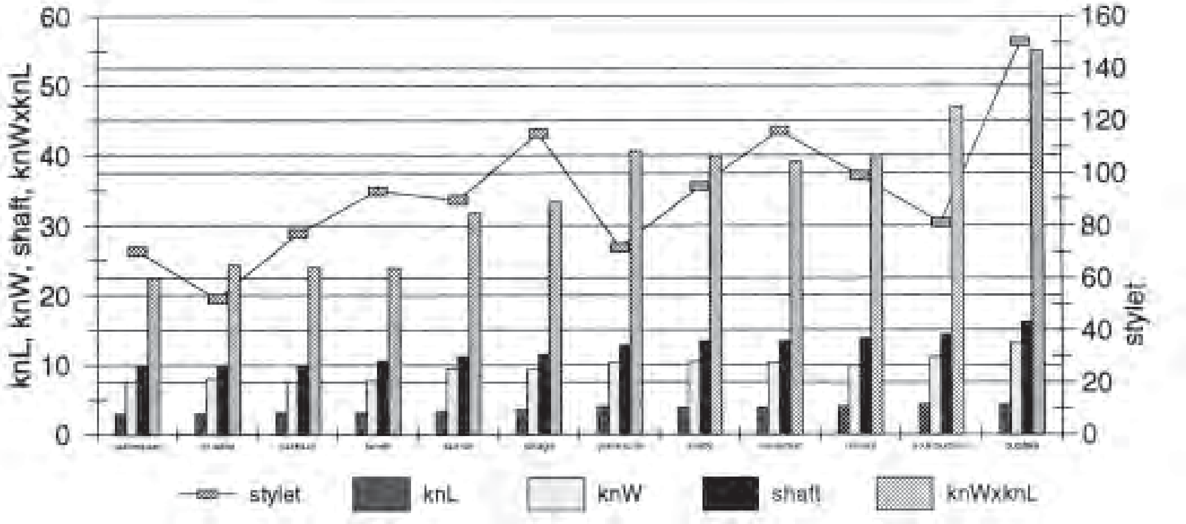

Fig. 34 *Criconema* (*Nothocriconemella*) females. Stylet length, height (knL) and width (knW) of the stylet base, length of the shaft of the stylet and the knLxknW product arranged in sequence of increasing length of the shaft of the stylet. (Published with permission of the *Russian Journal of Nematology*).

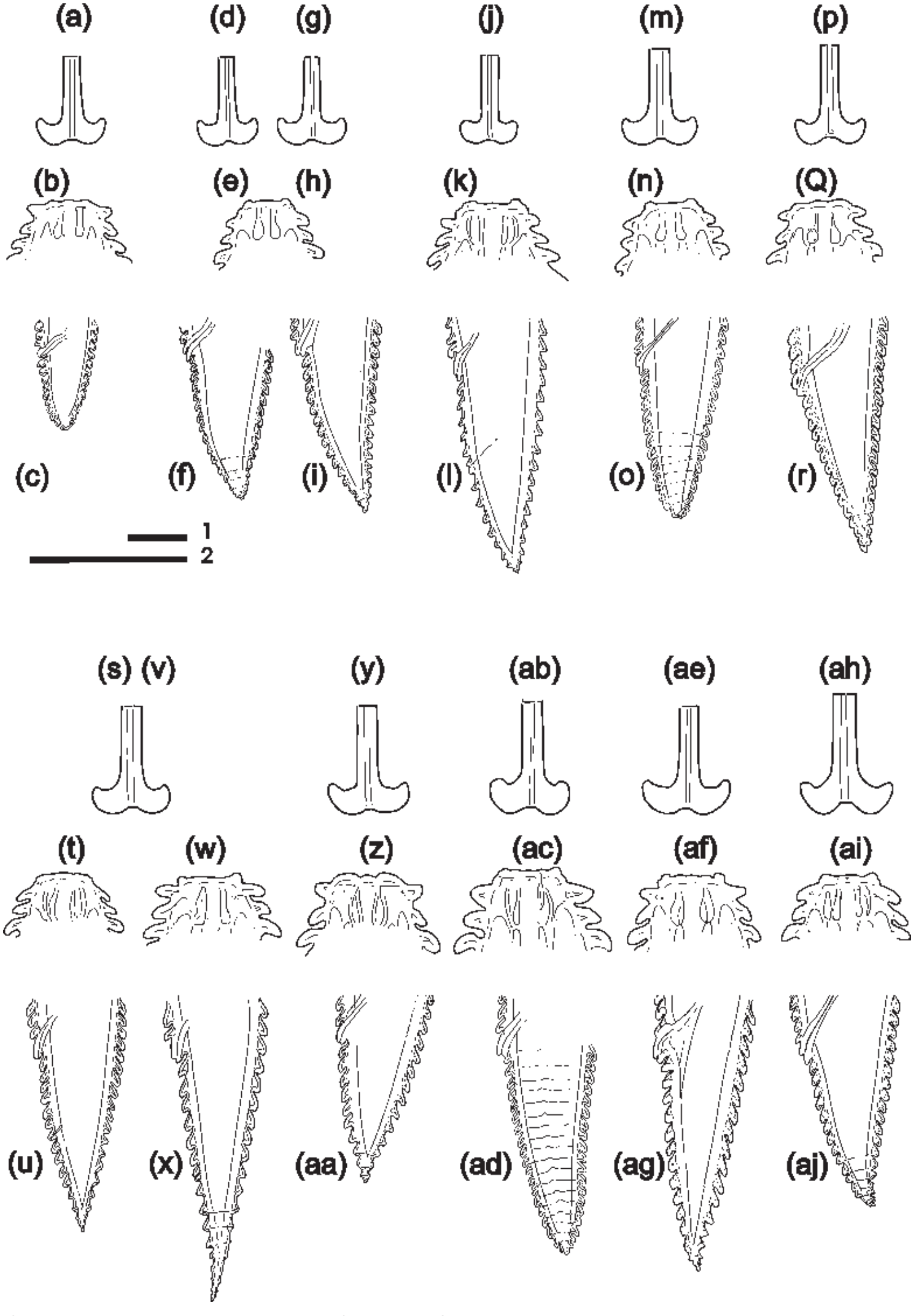

Fig. 35 *Criconema* (*Nothocriconemella*) females. Stylets, lip regions and postvulval areas. **(a)–(c)** *C.* (*N.*) *mutabile*; **(d)–(f)** *C.* (*N.*) *californicum*; **(g)–(i)** *C.* (*N.*) *pasticum*; **(j)–(l)** *C.* (*N.*) *farrelli*; **(m)–(o)** *C.* (*N.*) *alpinum*; **(p)–(r)** *C.* (*N.*) *sphagni*; **(s)–(u)** *C.* (*N.*) *macilentum*; **(v)–(x)** *C.* (*N.*) *crosbyi*; **(y)–(aa)** *C.* (*N.*) *graminicolum*; **(ab)–(ad)** *C.* (*N.*) *ramsayi*; **(ae)–(ag)** *C.* (*N.*) *acuticaudatum*; **(ah)–(aj)** *C.* (*N.*) *dugdalei*. Scale bar for the postvulval areas (1) = 20 µm, Scale bar for the stylets and heads (2) = 20 µm. (Adapted from the *Russian Journal of Nematology*).

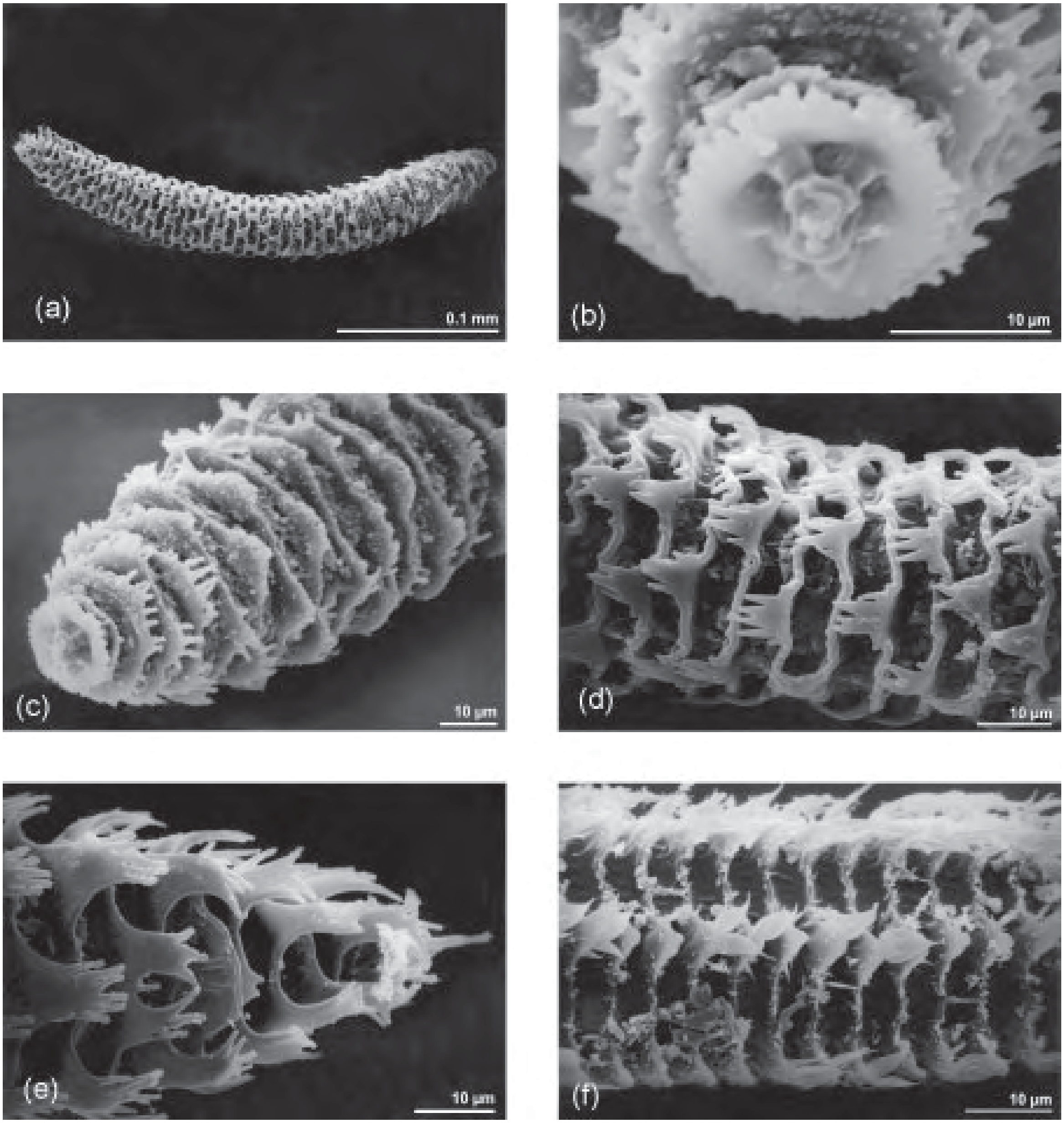

Fig. 36 SEM micrographs. *Ogma alternum* sp. nov. **(a)–(e)** female: **(a)** body, entire; **(b)** lip region, *en face* view; **(c)** anterior region, lateral view; **(d)** scales at midbody; **(e)** postvulval region, ventral view. **(f)** juvenile, scales at midbody.

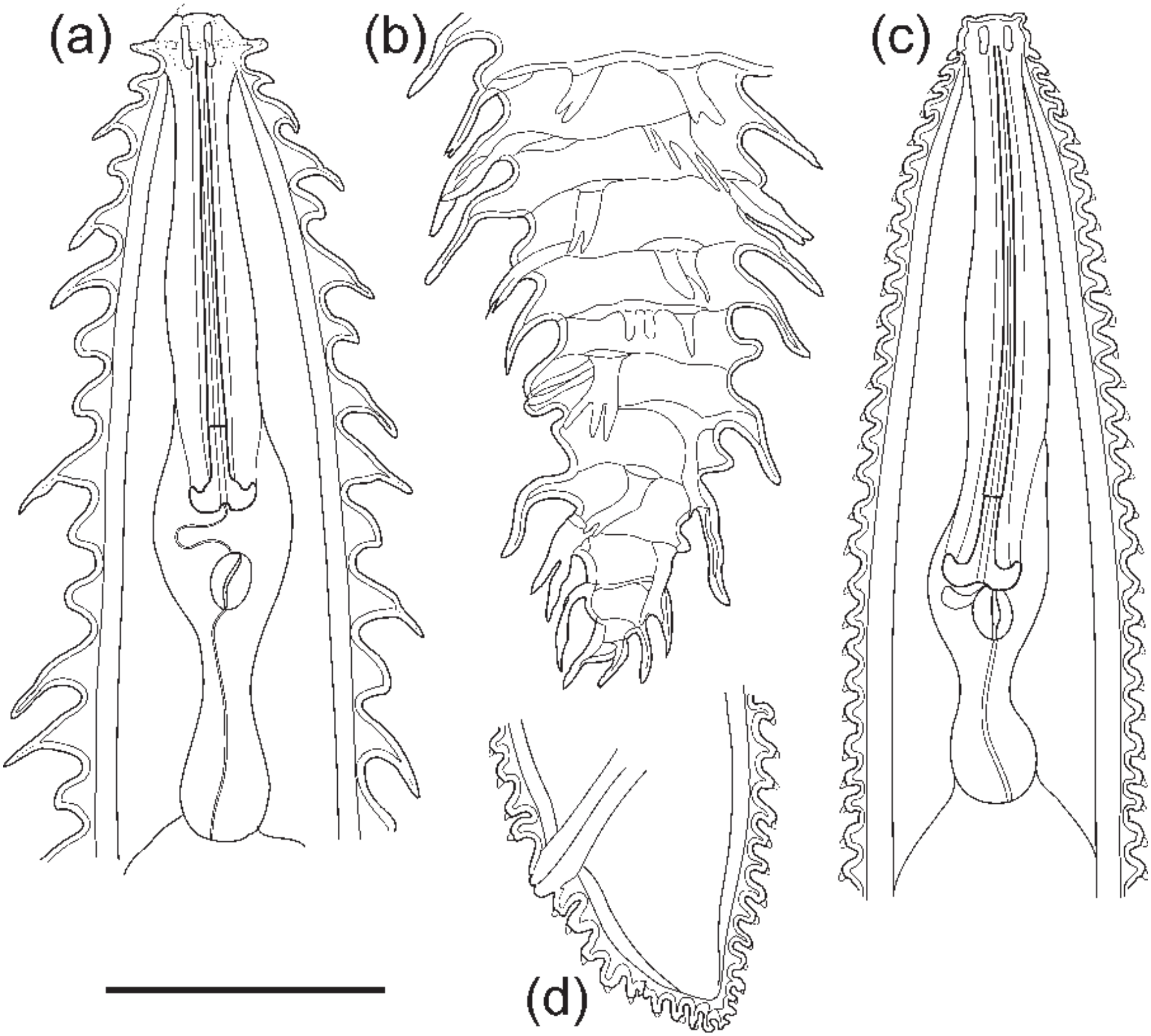

Fig. 37 (a)–(b) *Ogma alternum* sp. nov. female: **(a)** anterior region; **(b)** postvulval region. **(c)–(d)** *Ogma capitulatum* sp. nov., female: **(c)** anterior region; **(d)** postvulval region. Scale bar = 40 µm.

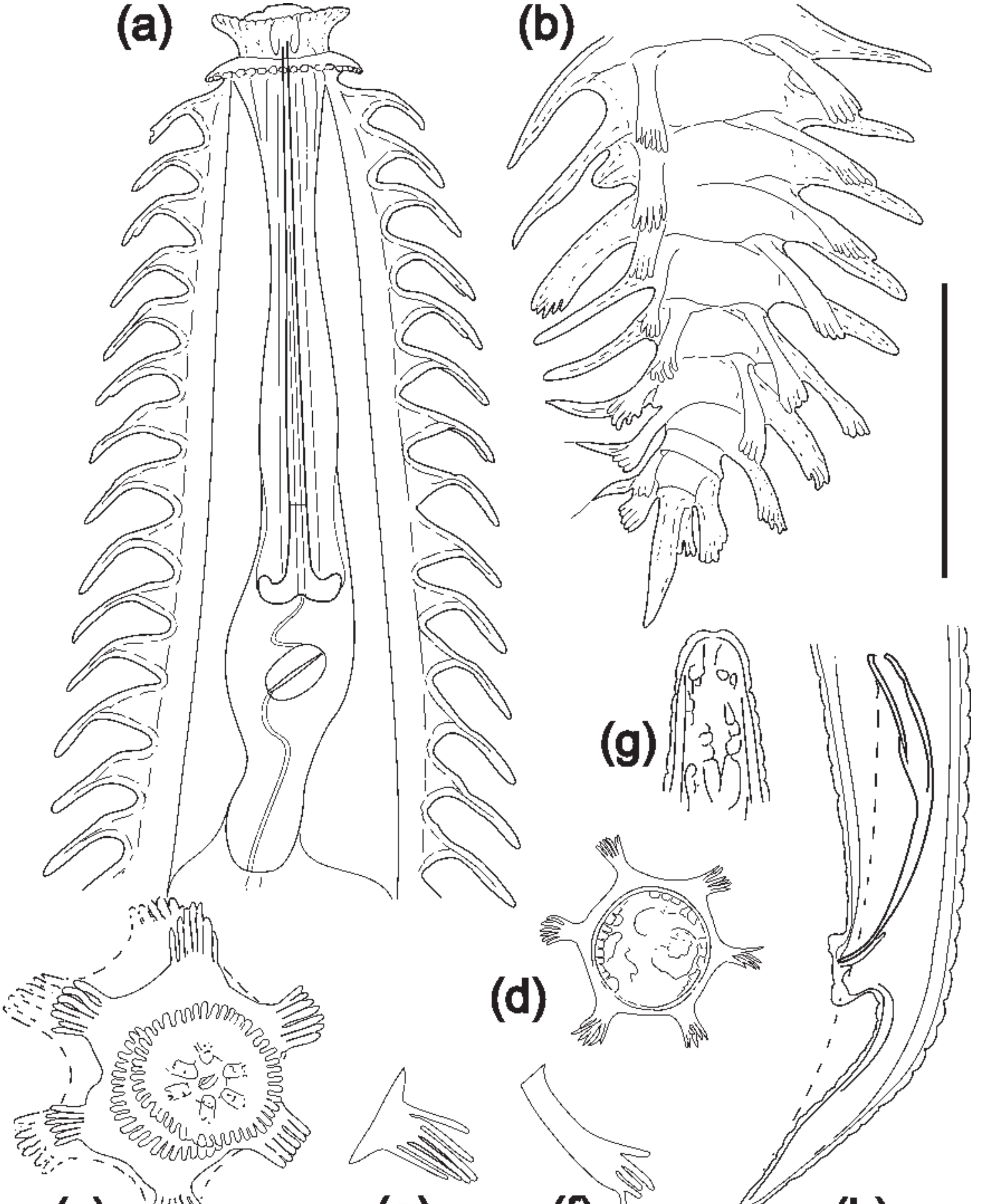

Fig. 38 *Ogma campbelli.* **(a)–(f)** female: **(a)** anterior region; **(b)** postvulval region; **(c)** lip region, *en face* view; **(d)** cross section at midbody; **(e)** scale at midbody; **(f)** scale on ventral side of tail region. **(g)–(h)** male: **(g)** anterior region; **(h)** posterior region. Scale bar = 50 µm for **(d)** and 20 µm for others.

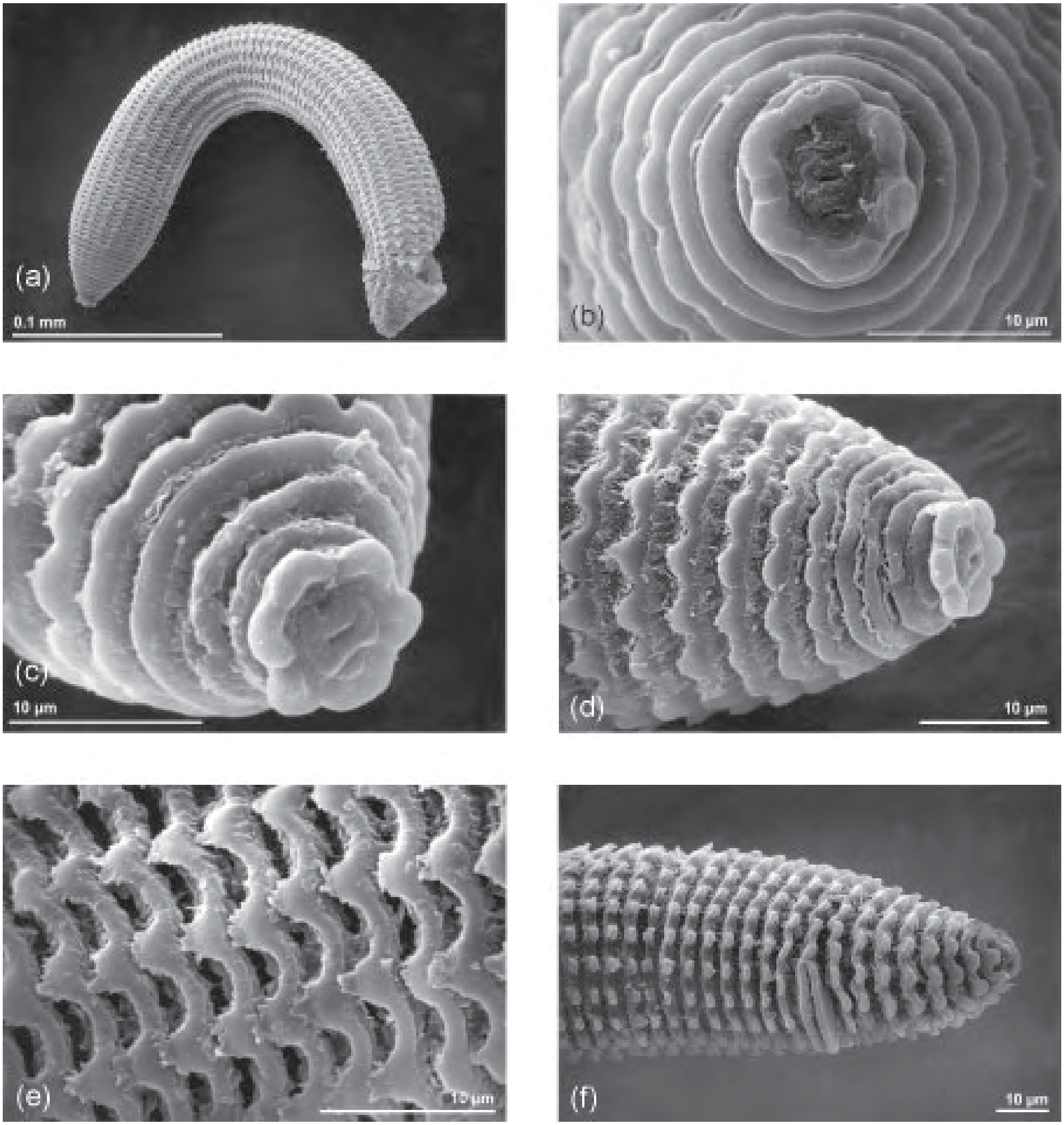

Fig. 39 SEM micrographs. *Ogma capitulatum* sp. nov., female. **(a)** body, entire; **(b)–(d)** anterior region: **(b)** *en face* view; **(c)** sublateral view; **(d)** lateral view; **(e)** cuticular pattern at midbody; **(f)** posterior region, sublateral view.

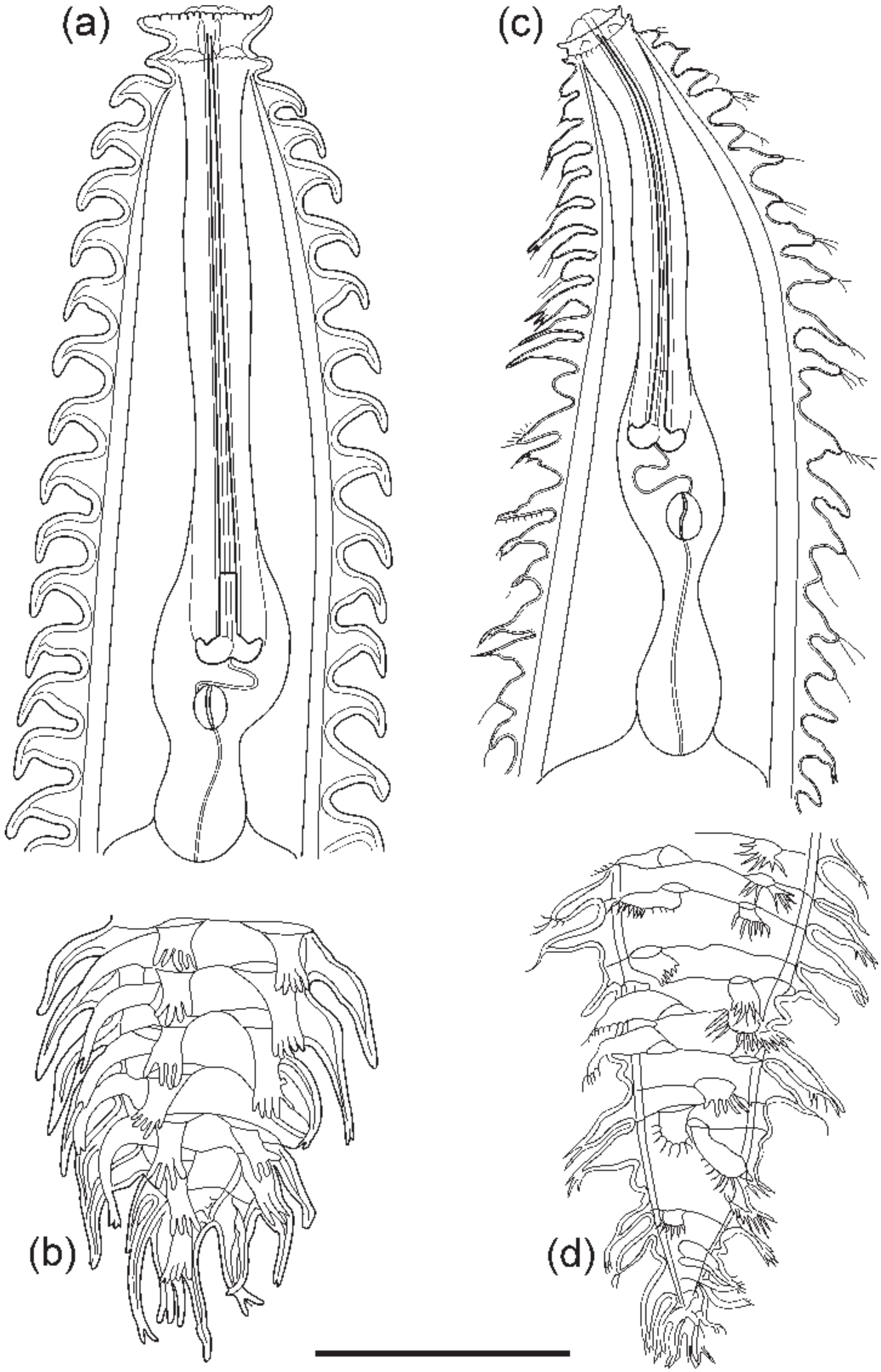

Fig. 40 *Ogma catharinae* sp. nov. **(a)**–**(b)** female: **(a)** anterior region; **(b)** postvulval region. **(c)**–**(d)** juvenile: **(c)** anterior region; **(d)** posterior region. Scale bar = 20 µm.

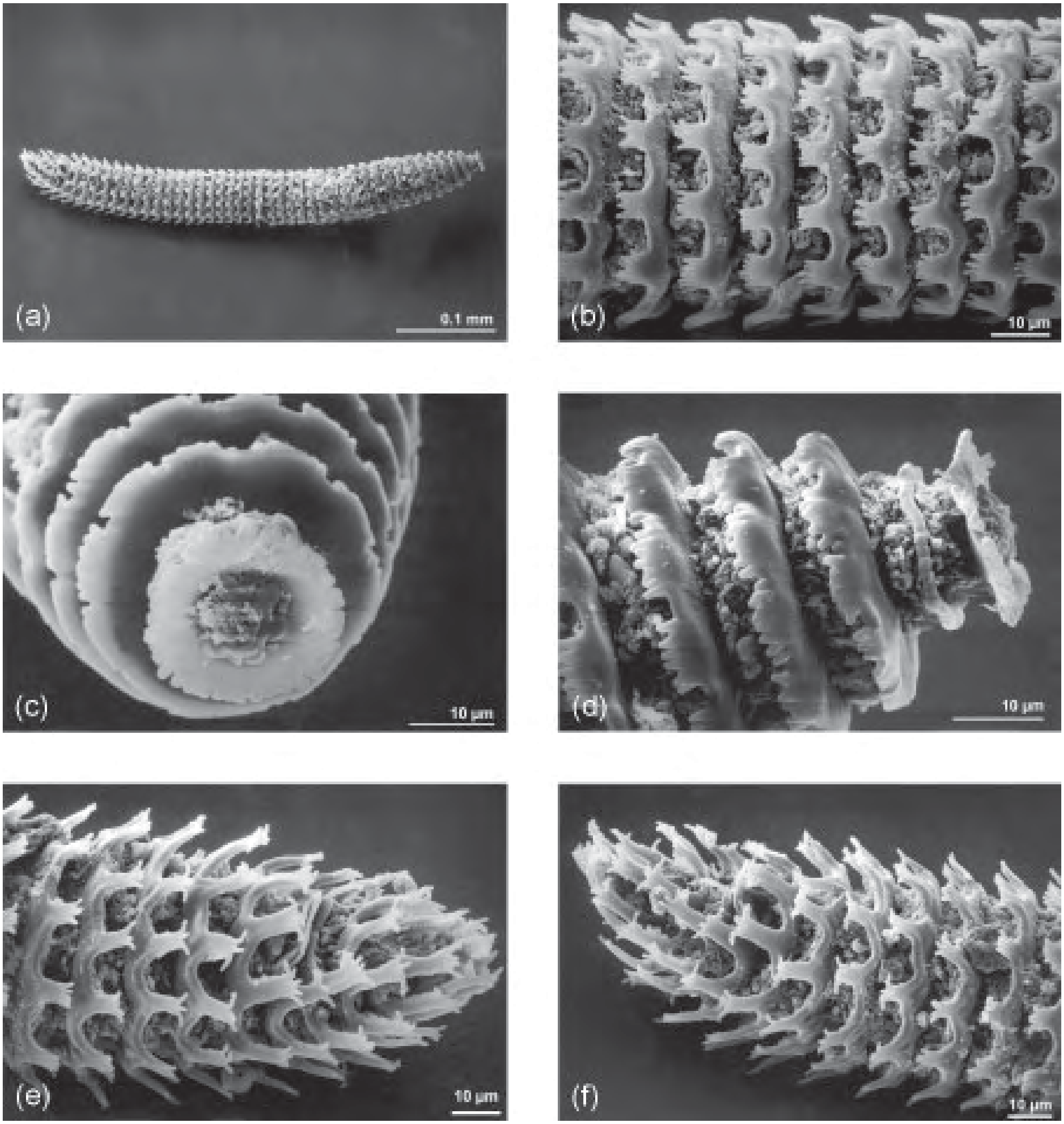

Fig. 41 SEM micrographs. *Ogma catharinae* sp. nov. female. **(a)** body, entire; **(b)** cuticular pattern at midbody; **(c)** lip region, *en face* view; **(d)** anterior region, lateral view; **(e)–(f)** posterior region, subventral views.

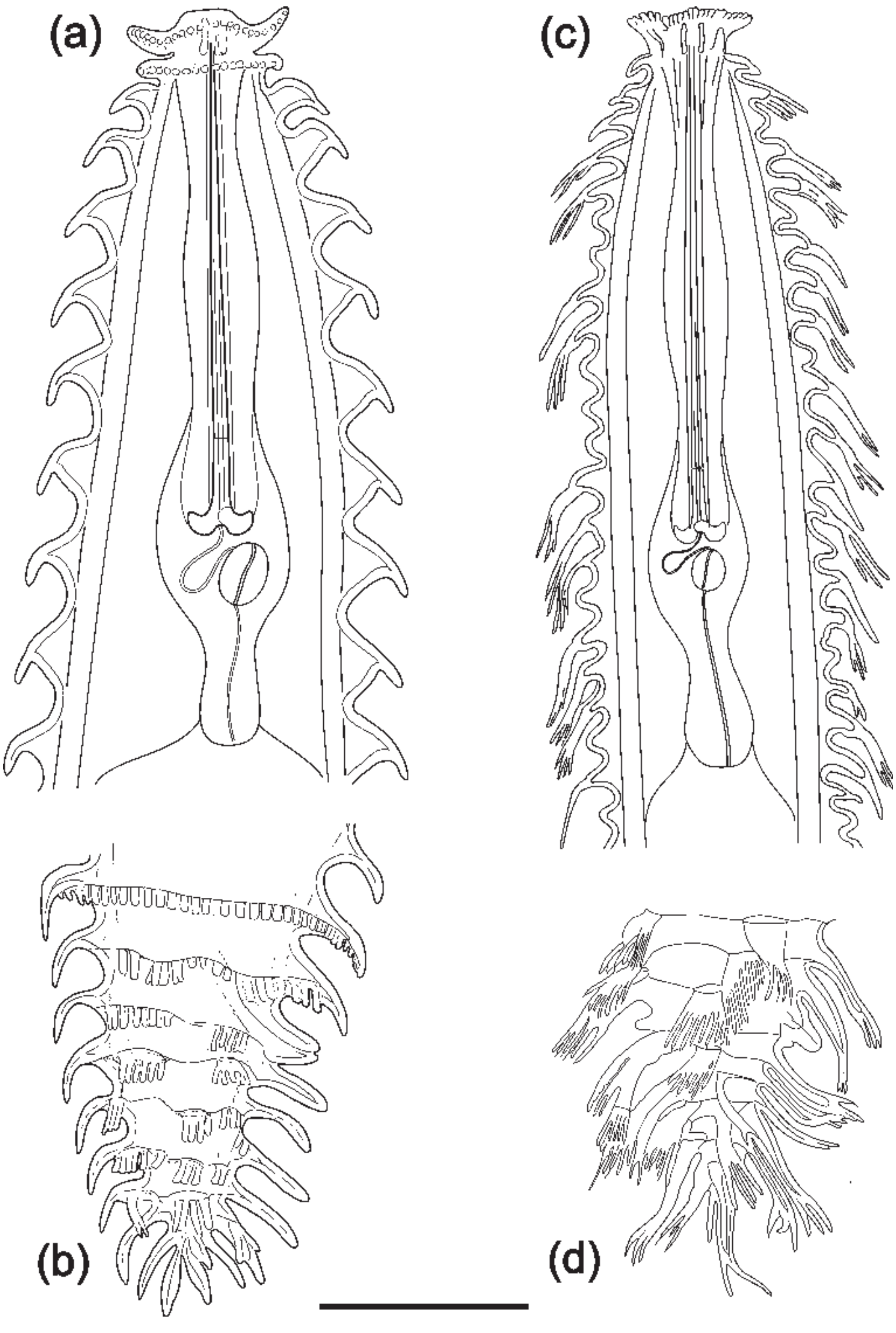

Fig. 42 (a)–(b) *Ogma civellae*, female: **(a)** anterior region; **(b)** postvulval region. **(c)–(d)** *Ogma inaequale* sp. nov., female: **(c)** anterior region; **(d)** postvulval region. Scale bar = 40 μm.

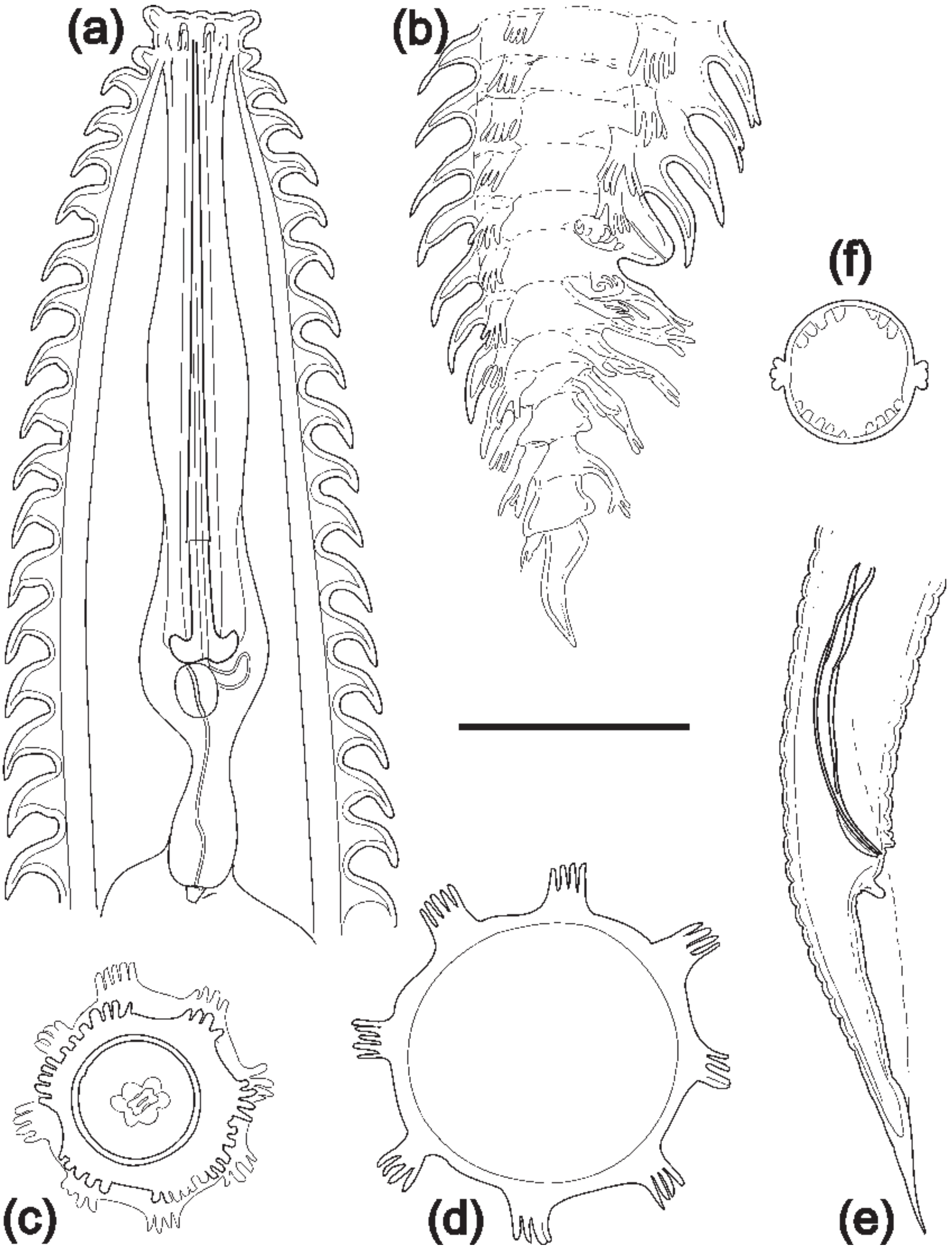

Fig. 43 *Ogma crenulatum*. **(a)–(d)** female: **(a)** anterior region; **(b)** postvulval region; **(c)** labial region, *en face* view; **(d)** cross section at midbody. **(e)–(f)** male: **(e)** tail region; **(f)** cross section at midbody. Scale bar = 40 µm. (Published with permission of *Nematology*).

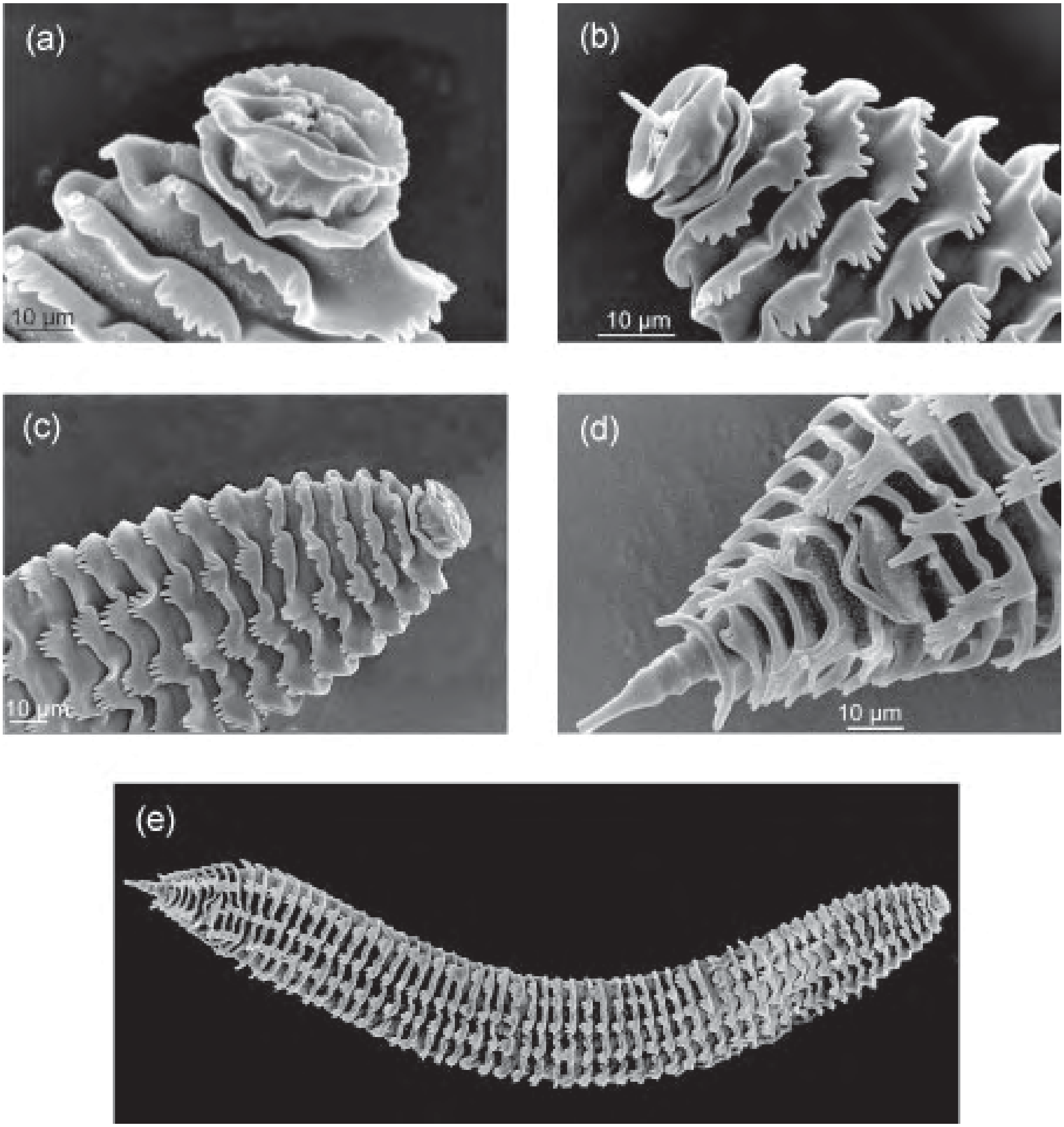

Fig. 44 SEM micrographs. *Ogma crenulatum*, female. **(a)–(c)** anterior region; **(d)** postvulval region, ventral view; **(e)** body, entire. (Published with permission of *Nematology*).

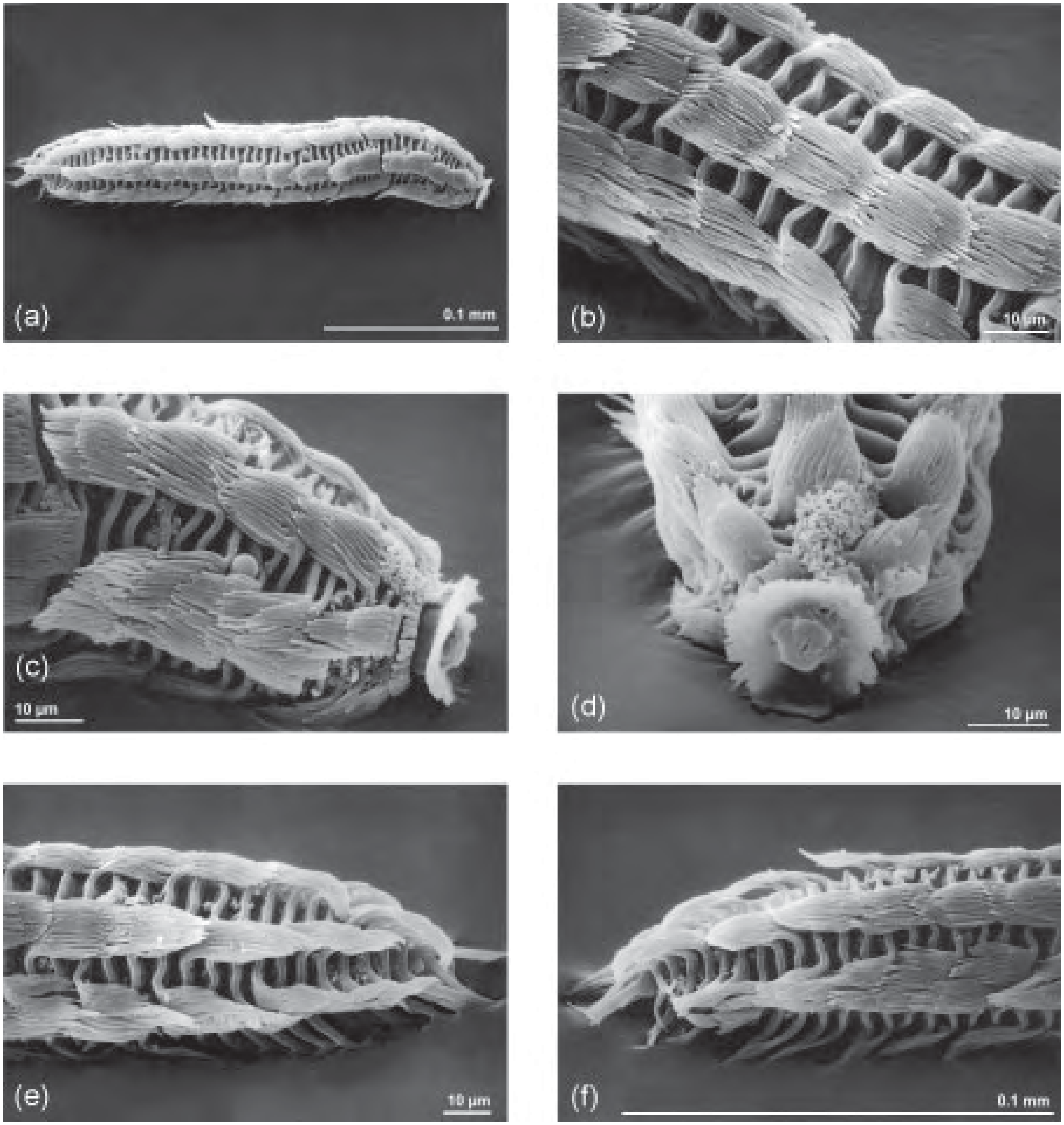

Fig. 45 SEM micrographs. *Ogma inaequale* sp. nov., female. **(a)** body, entire; **(b)** palmate scales of irregular length, at midbody; **(c)** anterior region, lateral; **(d)** lip region, *en face* view; **(e)**–**(f)** posterior region: **(e)** ventral view; **(f)** lateral view.

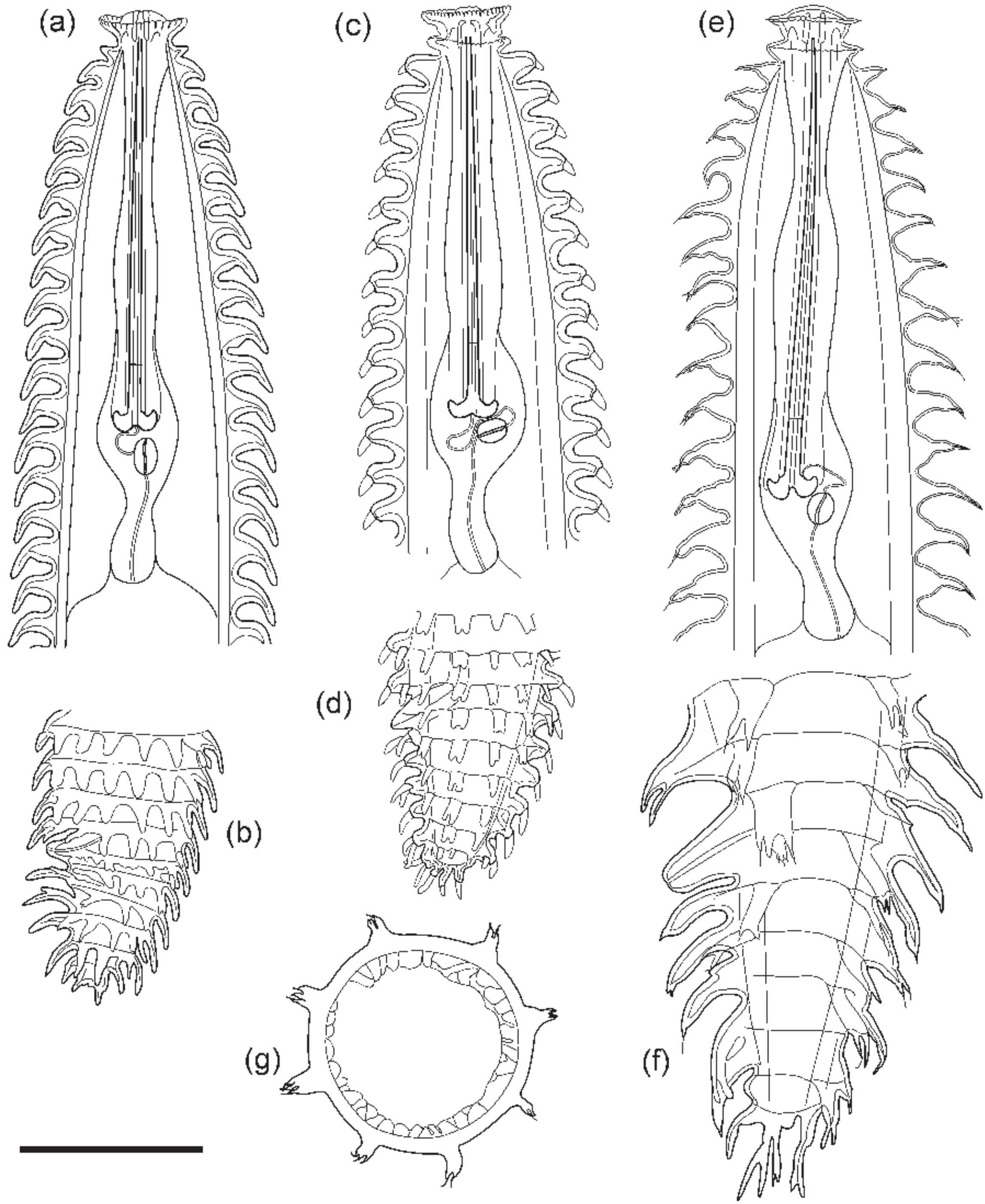

Fig. 46 (a)–(d) *Ogma latens* female: **(a)–(b)** specimen with rounded scales: **(a)** anterior region; **(b)** posterior region. **(c)–(d)** specimen with indented scales: **(c)** anterior region; **(d)** posterior region. **(e)–(g)** *Ogma mucronatum* sp. nov., female: **(e)** anterior region; **(f)** posterior region; **(g)** cross section at midbody. Scale bar = 40 µm.

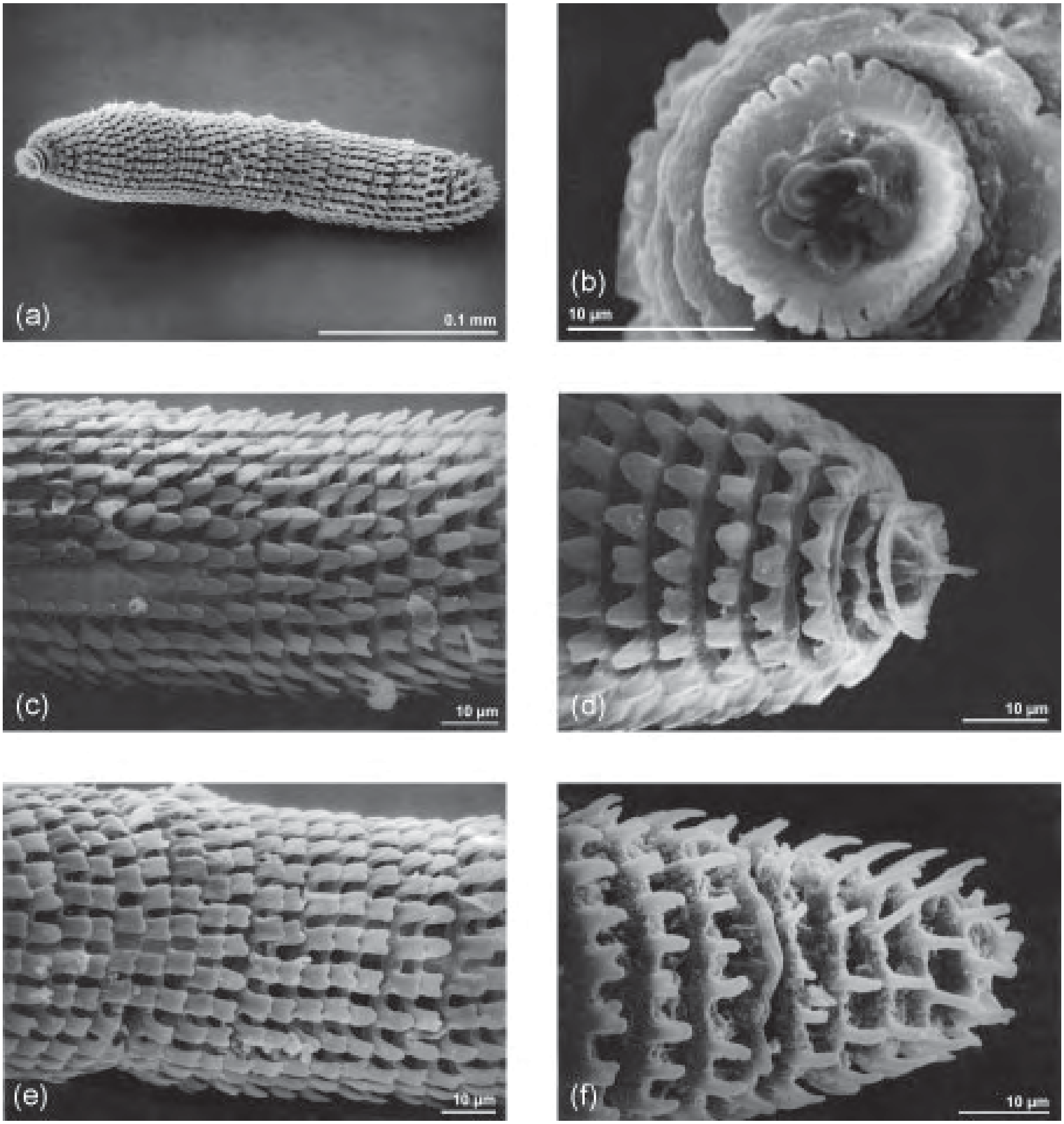

Fig. 47 SEM micrographs. *Ogma latens* female. **(a)** body, entire; **(b)** lip region, *en face* view; **(c)** tongue-shaped scales at midbody; **(d)** anterior region, lateral; **(e)** blunt scales at midbody; **(f)** postvulval region, ventral view.

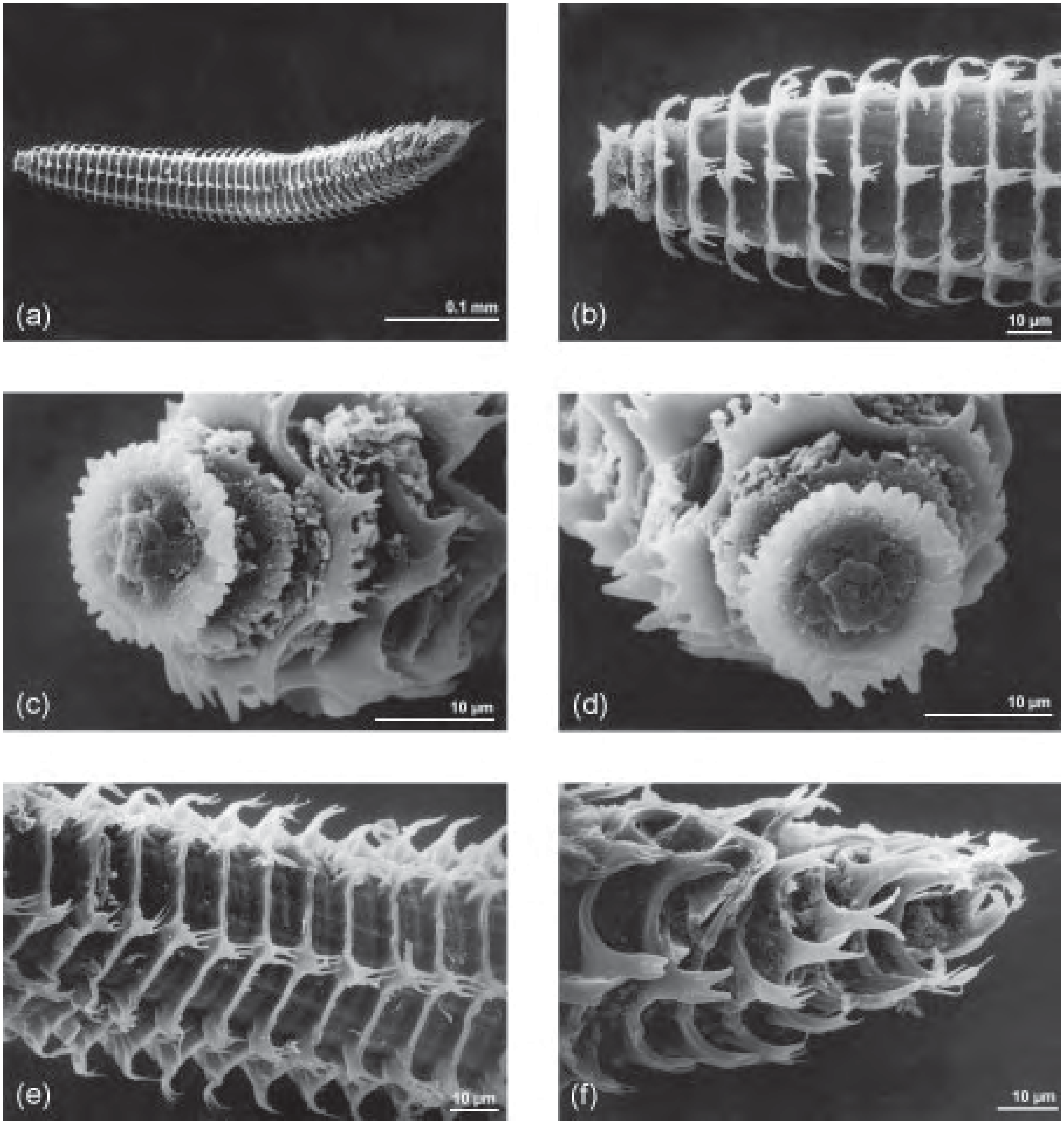

Fig. 48 SEM micrographs. *Ogma mucronatum* sp. nov., female. **(a)** body, entire; **(b)** anterior region, lateral view; **(c)** lip region, sublateral view; **(d)** lip region, *en face* view; **(e)** scales at midbody; **(f)** postvulval region, ventral view.

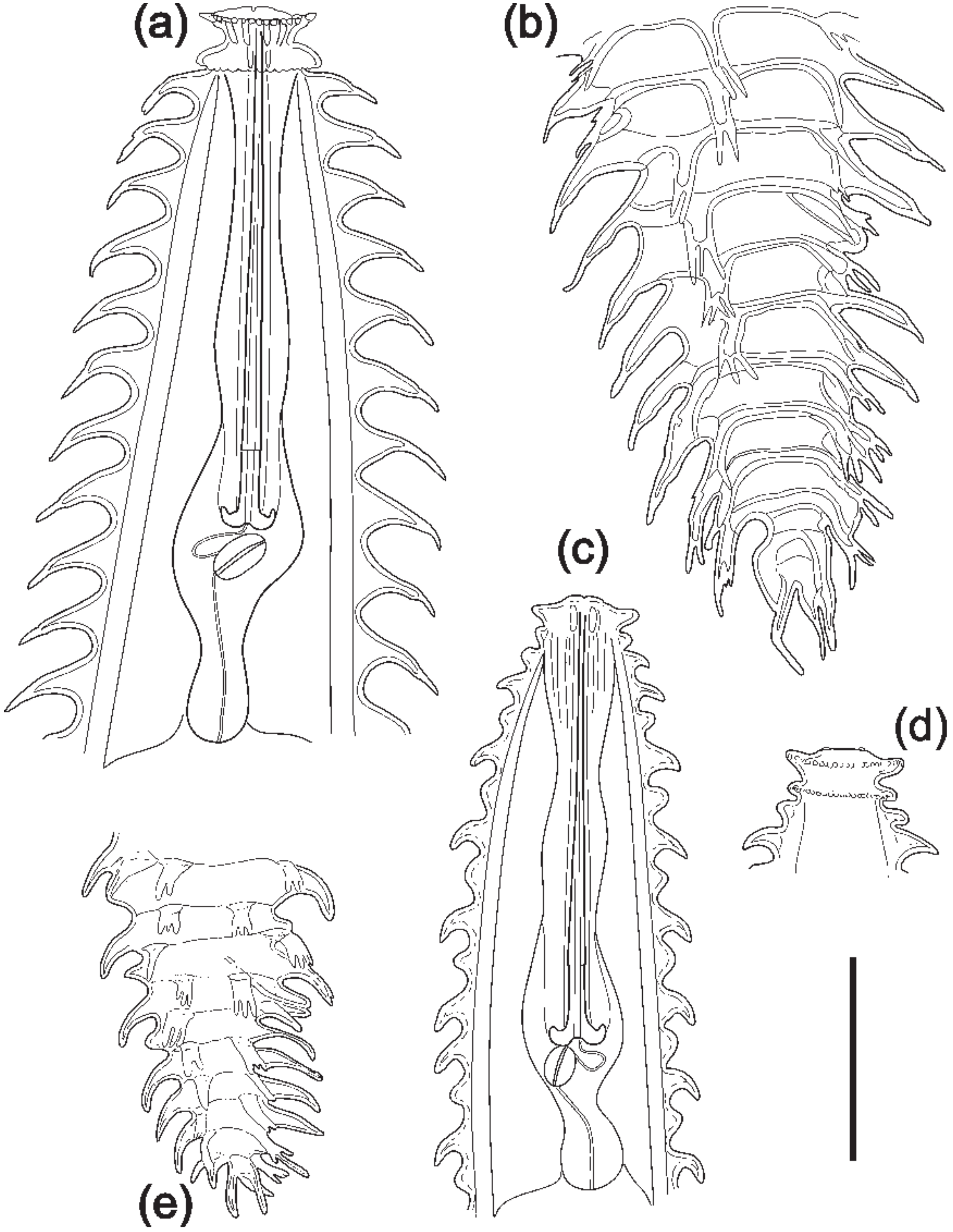

Fig. 49 (a)–(b) *Ogma niagarae* sp. nov,: **(a)** anterior region; **(b)** postvulval region. **(c)–(e)** *Ogma palmatum*, female: **(c)** anterior region; **(d)** alternative lip region; **(e)** postvulval region. Scale bar = 40 µm.

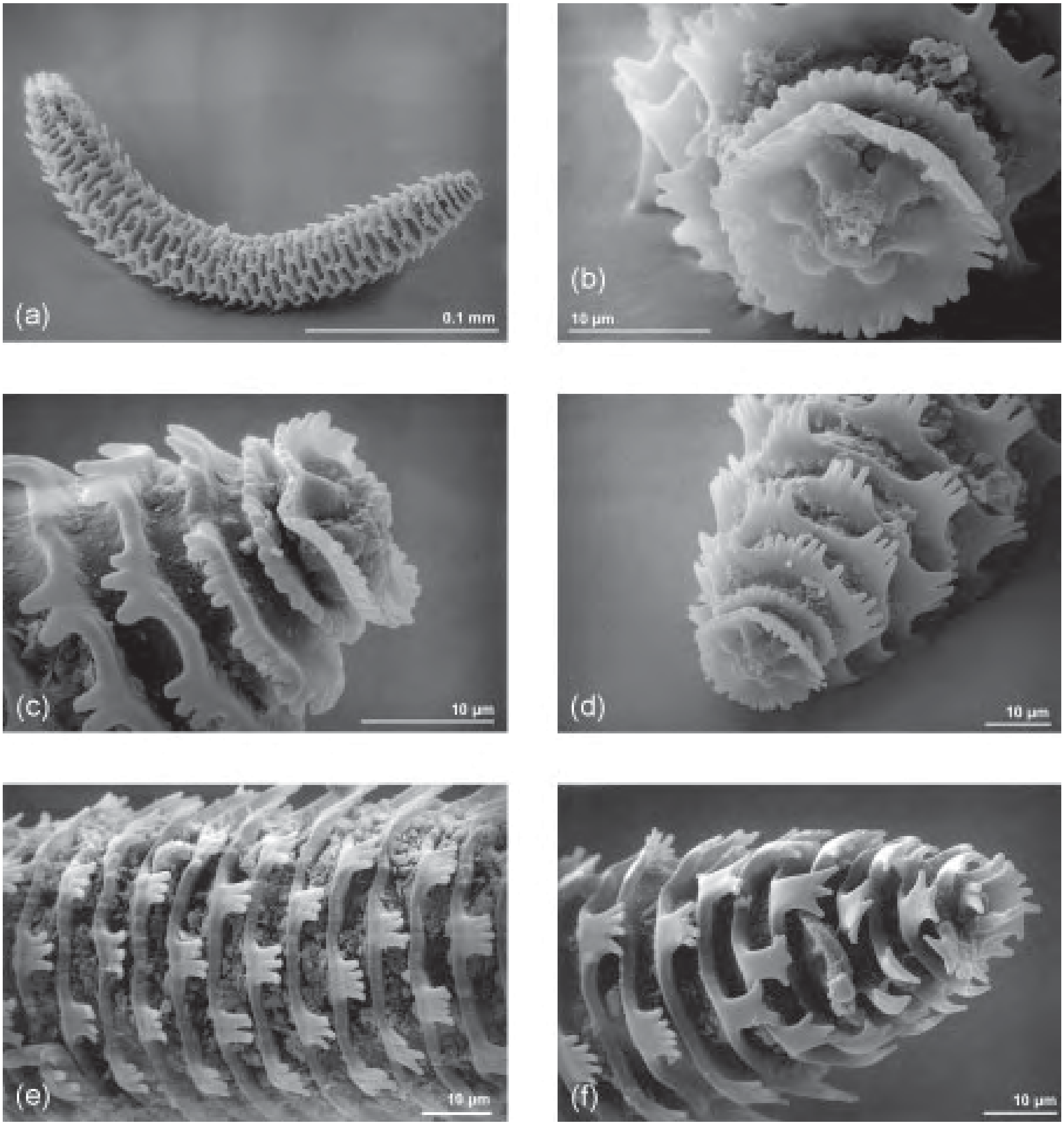

Fig. 50 SEM micrographs. *Ogma palmatum*, female. **(a)** body, entire; **(b)** lip region, *en face* view; **(c)–(d)** anterior region, sublateral view; **(e)** alternating, palmate scales at midbody; **(f)** posterior region, ventral view.

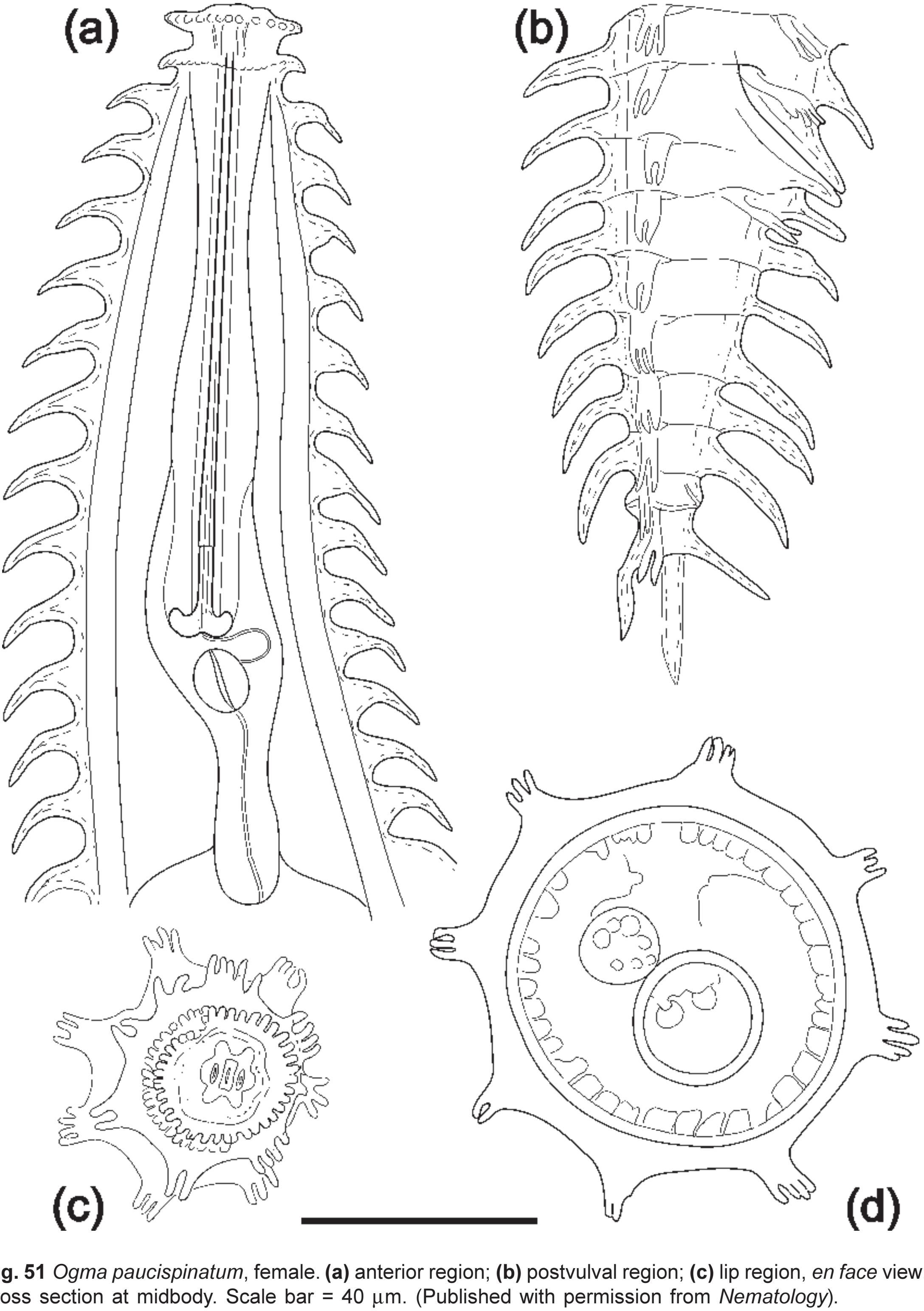

Fig. 51 *Ogma paucispinatum*, female. **(a)** anterior region; **(b)** postvulval region; **(c)** lip region, *en face* view; **(d)** cross section at midbody. Scale bar = 40 µm. (Published with permission from *Nematology*).

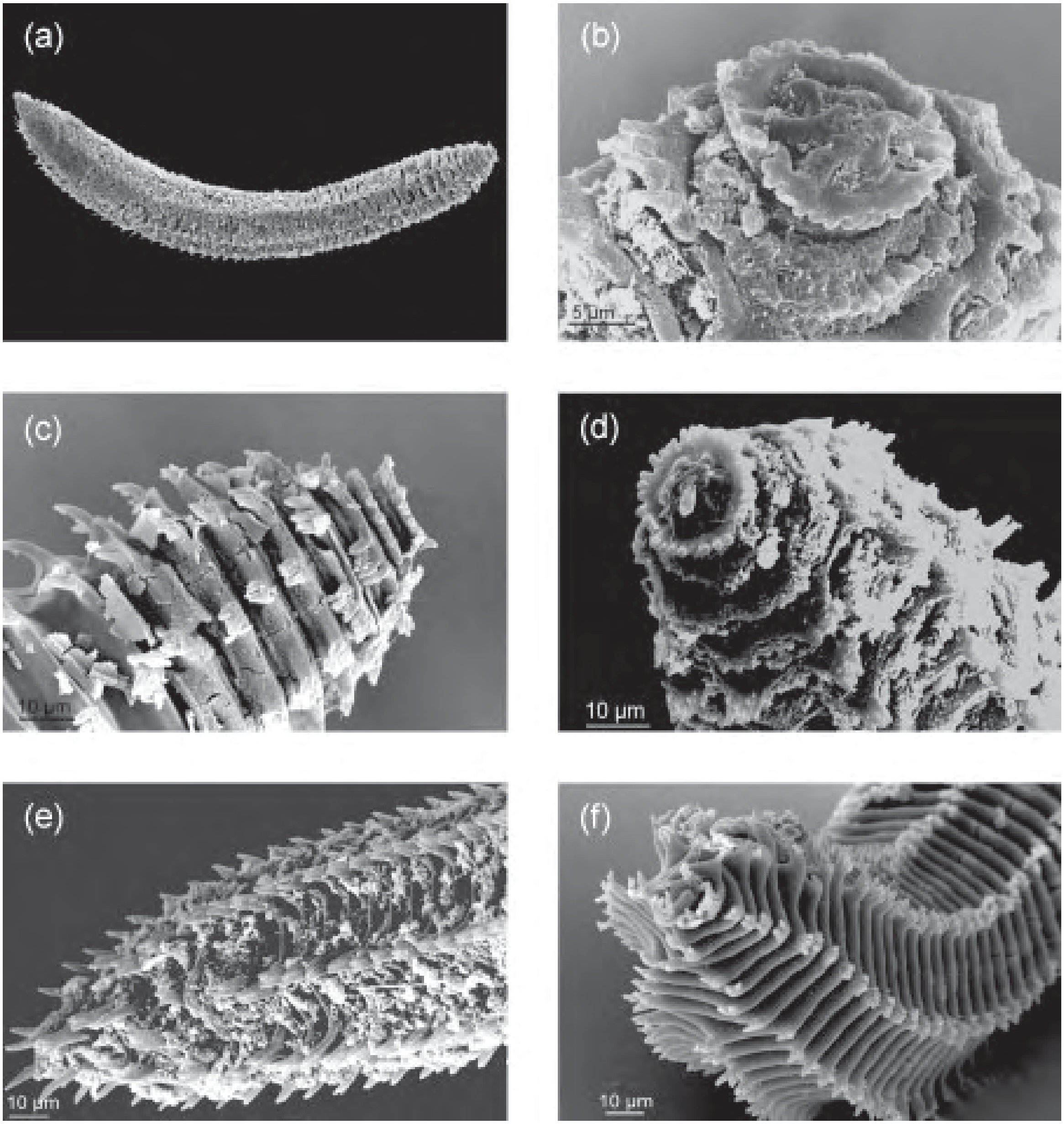

Fig. 52 SEM micrographs. *Ogma paucispinatum*, female. **(a)** body, entire; **(b)** lip region, *en face* view; **(c)–(d)** anterior region; **(e)** posterior region, ventral view; **(f)** posterior region, terminal view. (Published with permission of *Nematology*).

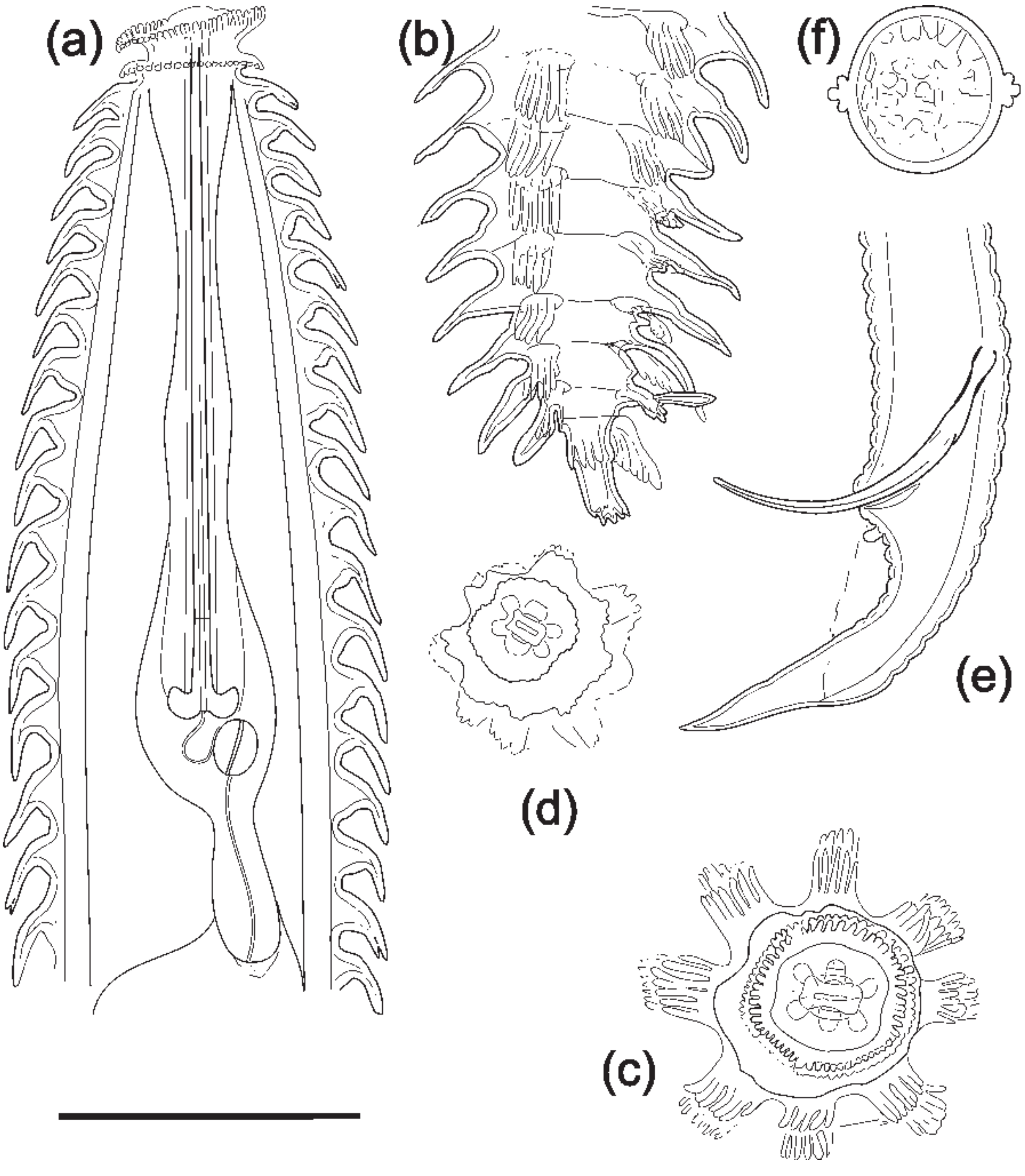

Fig. 53 *Ogma polyandra*. **(a)**–**(c)** female: **(a)** anterior region; **(b)** postvulval region; **(c)** lip region, *en face* view. **(d)** juvenile lip region, *en face* view. **(e)**–**(f)** male: **(e)** tail region; **(f)** cross section at midbody. Scale bar = 40 µm. (Published with permission of *Nematology*).

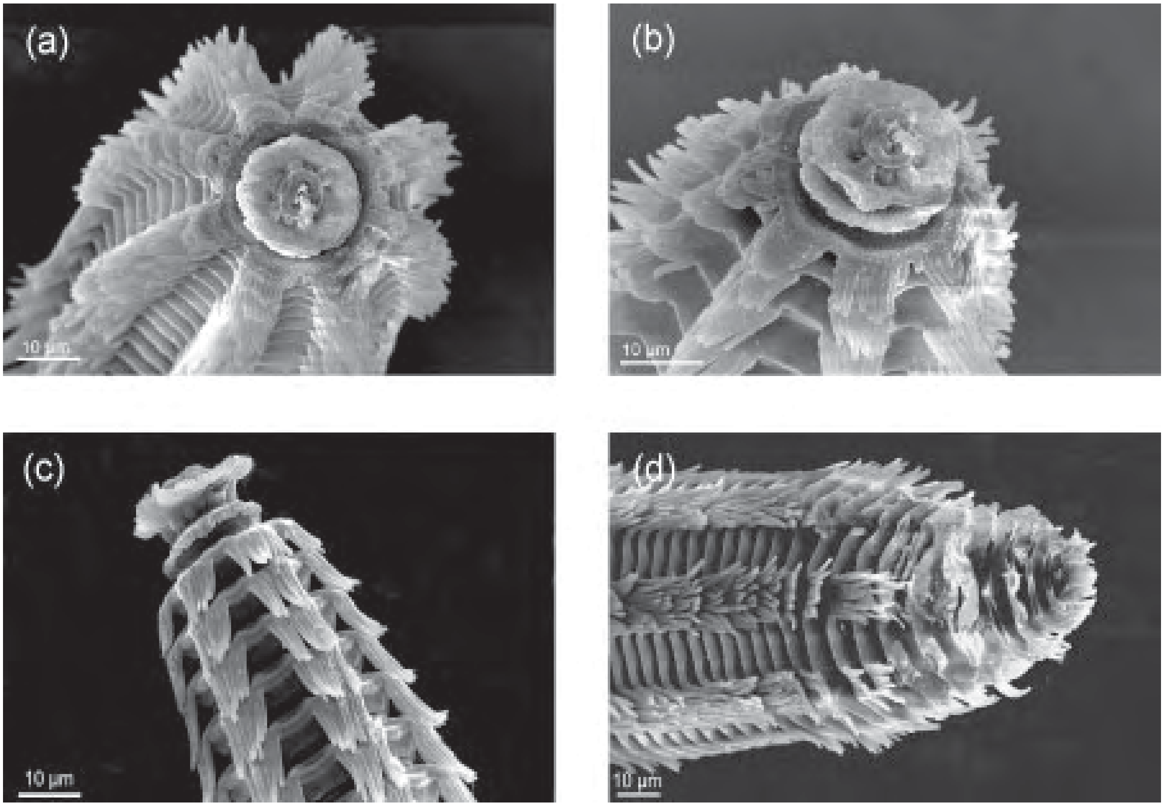

Fig. 54 SEM micrographs. *Ogma polyandra*, female. **(a)–(b)** anterior region, *en face* view; **(c)** anterior region, lateral view; **(d)** posterior region, ventral view. (Published with permission of *Nematology*).

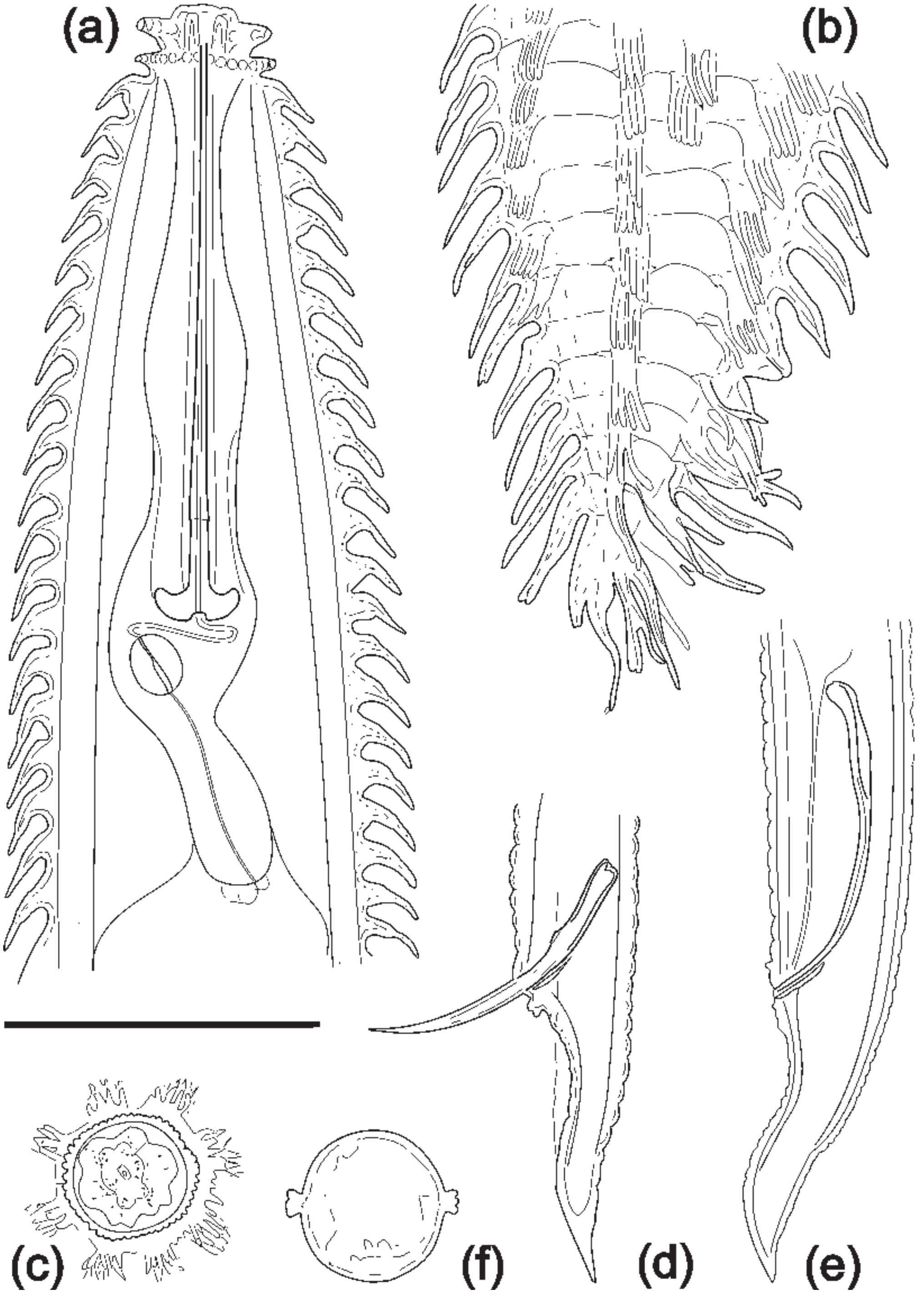

Fig. 55 *Ogma semicrenatum.* **(a)–(c)** female: **(a)** anterior region; **(b)** postvulval region; **(c)** lip region, *en face* view. **(d)–(f)** male: **(d)–(e)** tail region; **(f)** cross section at midbody. Scale bar = 40 µm. (Published with permission of *Nematology*).

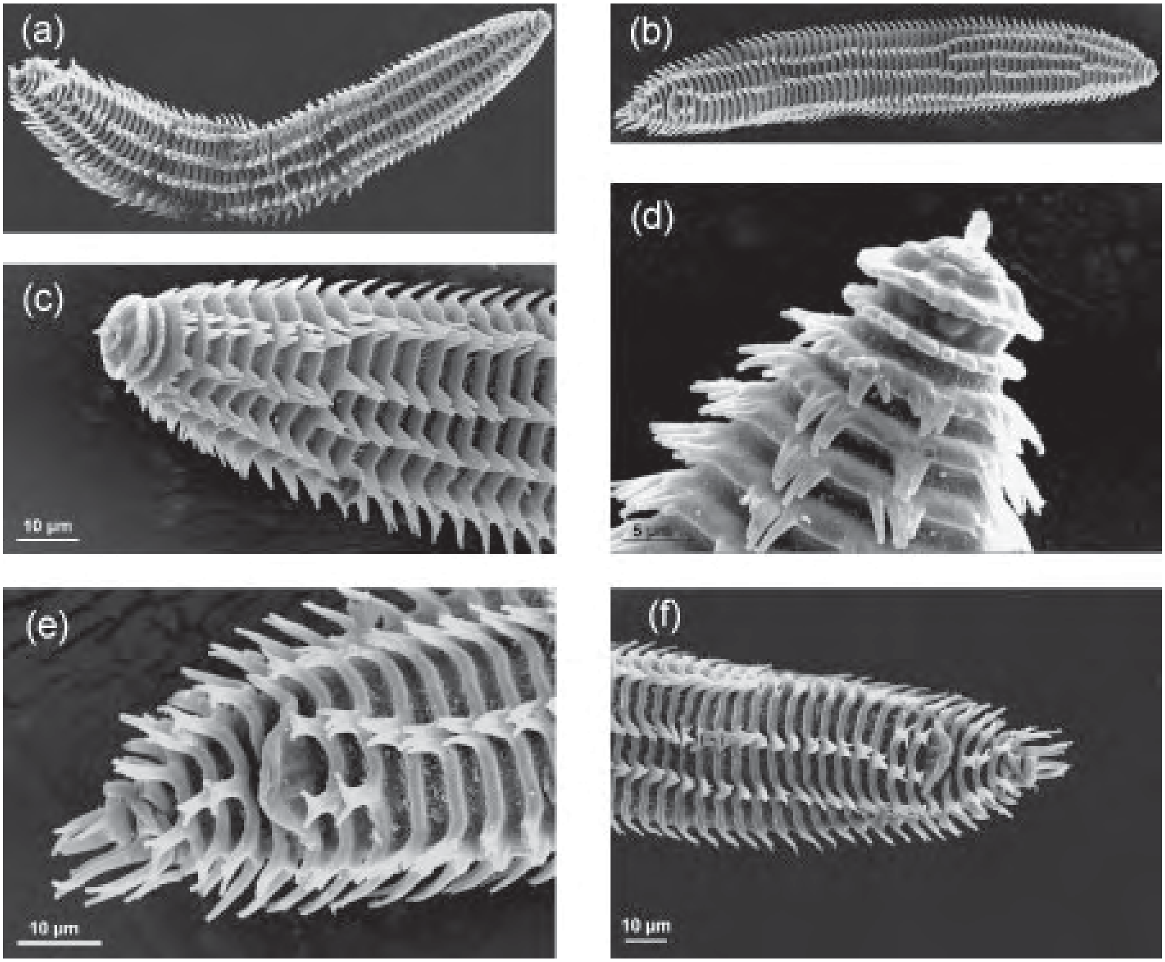

Fig. 56 SEM micrographs. *Ogma semicrenatum*, female. **(a)–(b)** body, entire; **(c)–(d)** anterior region, lateral view; **(e)–(f)** posterior region, ventral view. (Published with permission of *Nematology*).

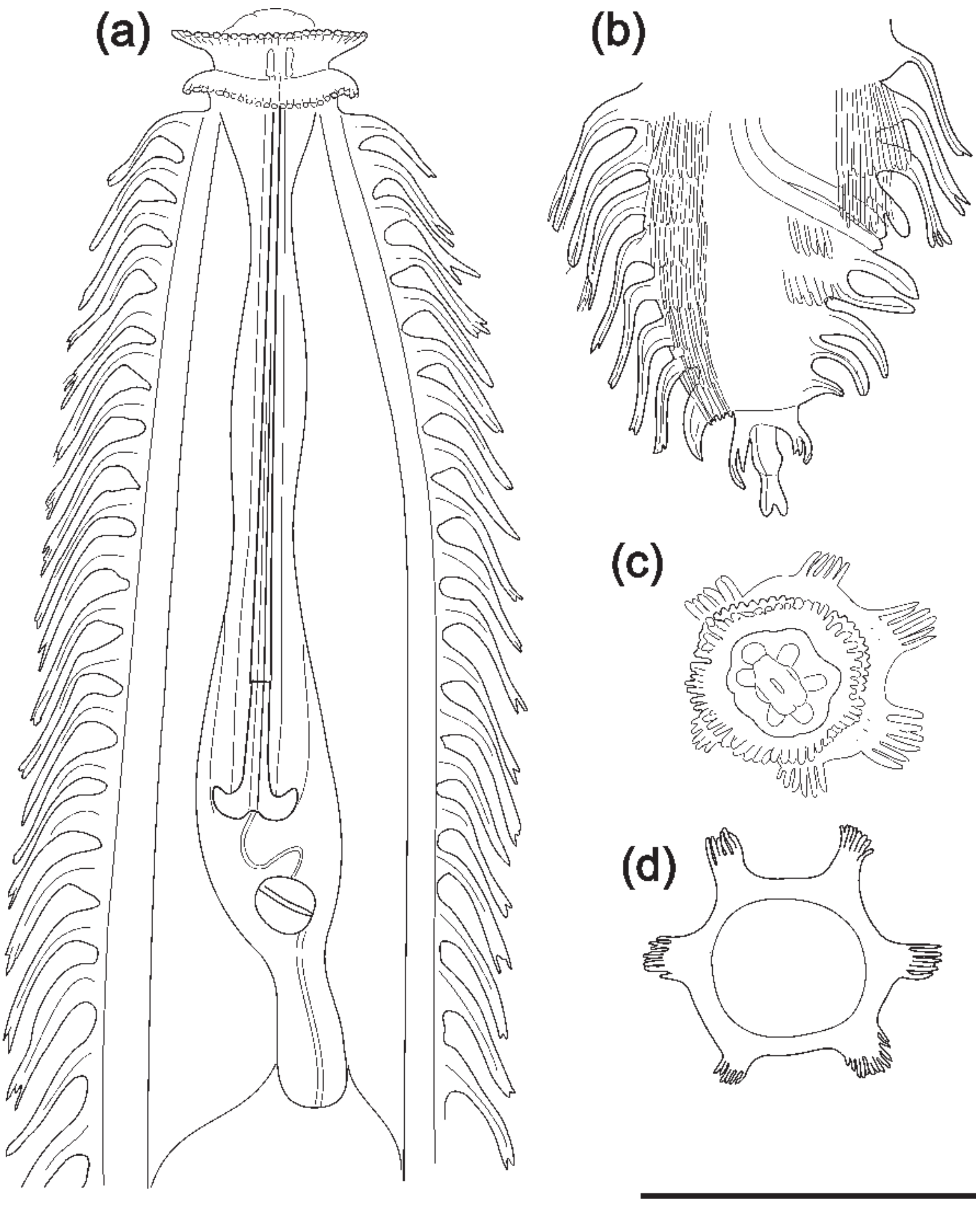

Fig. 57 *Ogma sexcostatum*, female. **(a)** anterior region; **(b)** postvulval region; **(c)** lip region, *en face* view; **(d)** cross section at midbody. Scale bar = 40 µm. (Published with permission of *Nematology*).

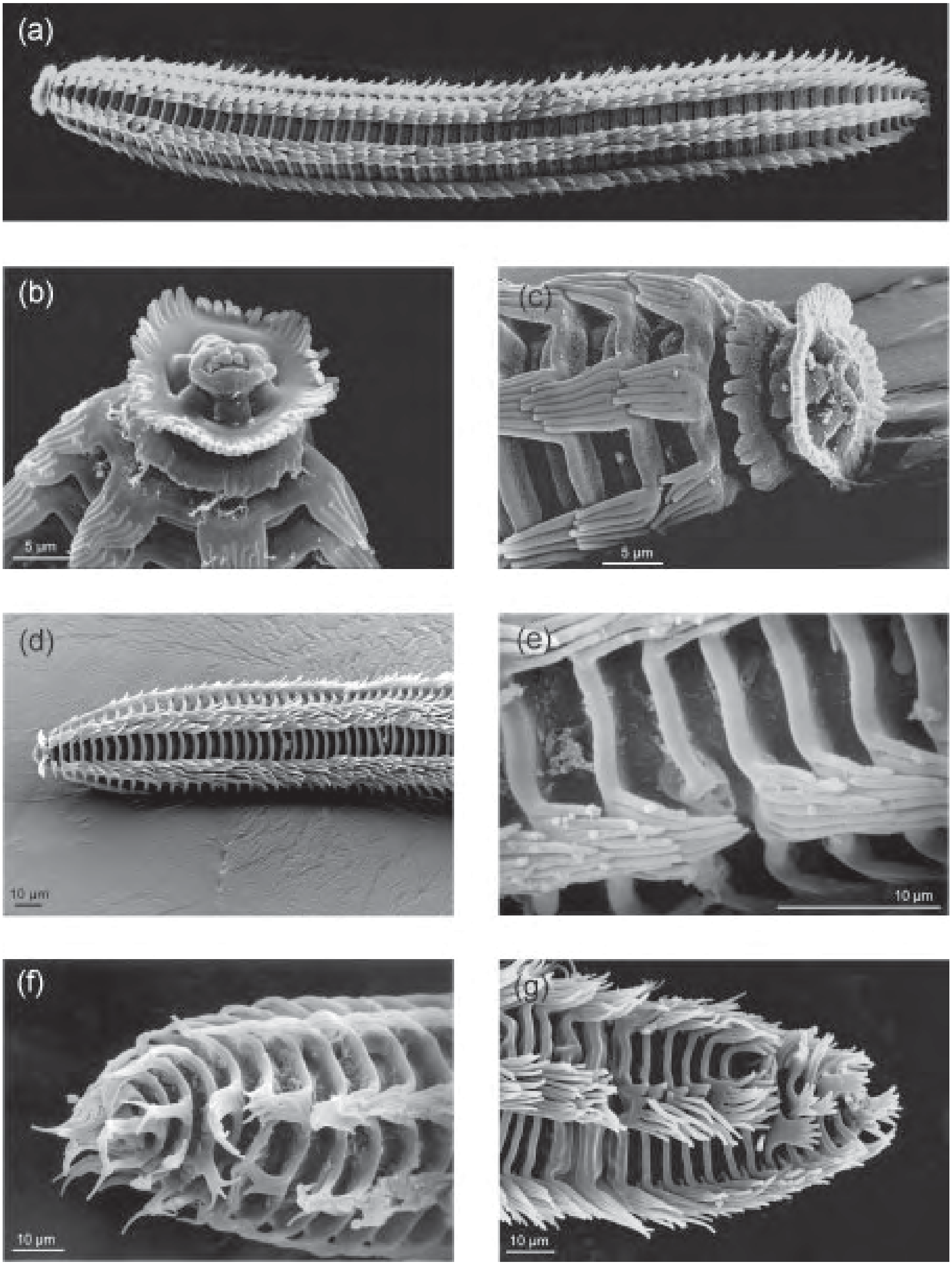

Fig. 58 SEM micrographs. *Ogma sexcostatum*, female. **(a)** body, entire; **(b)** lip region, *en face* view; **(c)–(d)** anterior region, lateral view; **(e)** excretory pore; **(f)–(g)** posterior region, ventral view. (Published with permission of *Nematology*).

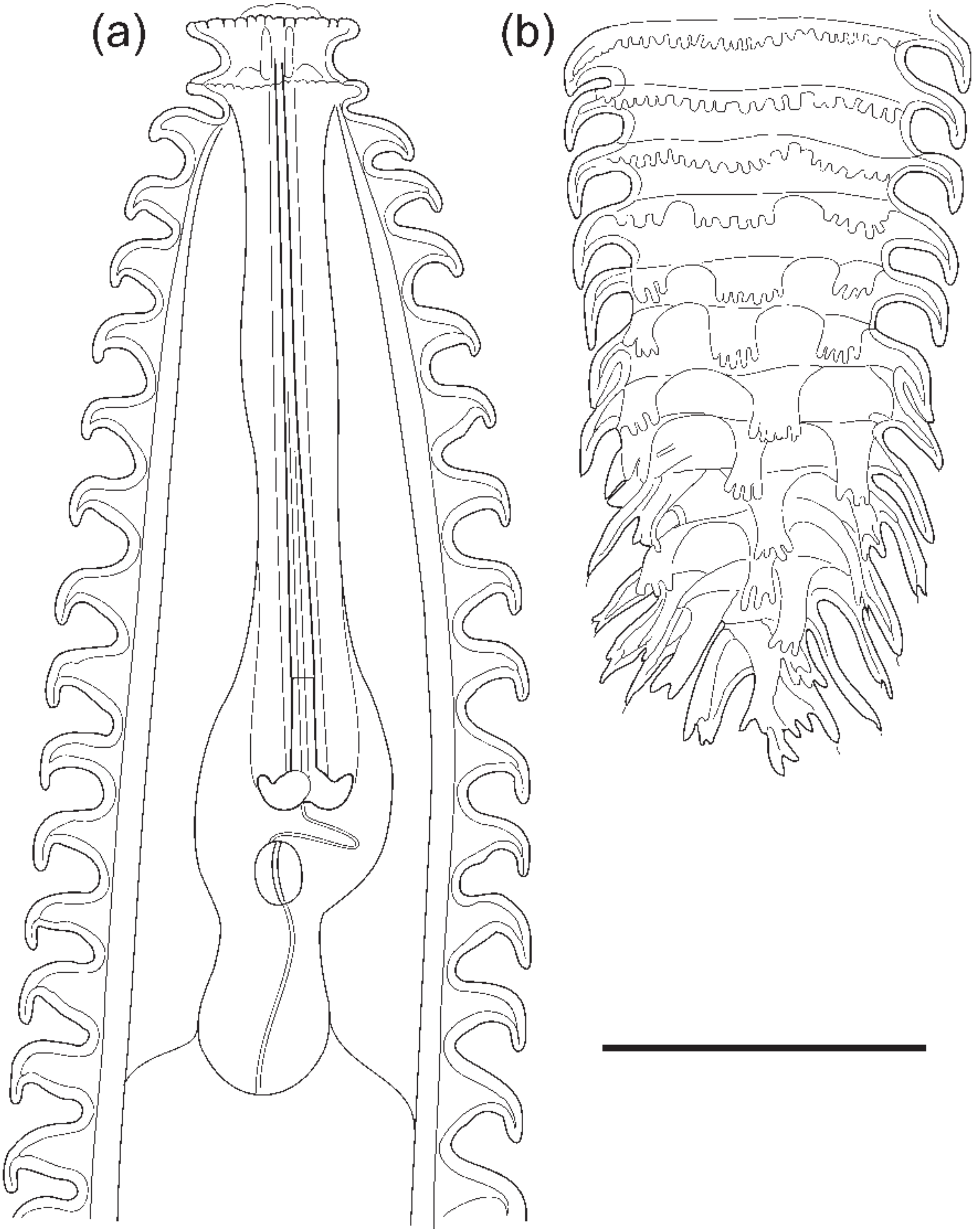

Fig. 59 *Ogma sturhani* sp. nov. female. **(a)** anterior region; **(b)** posterior region. Scale bar = 40 µm.

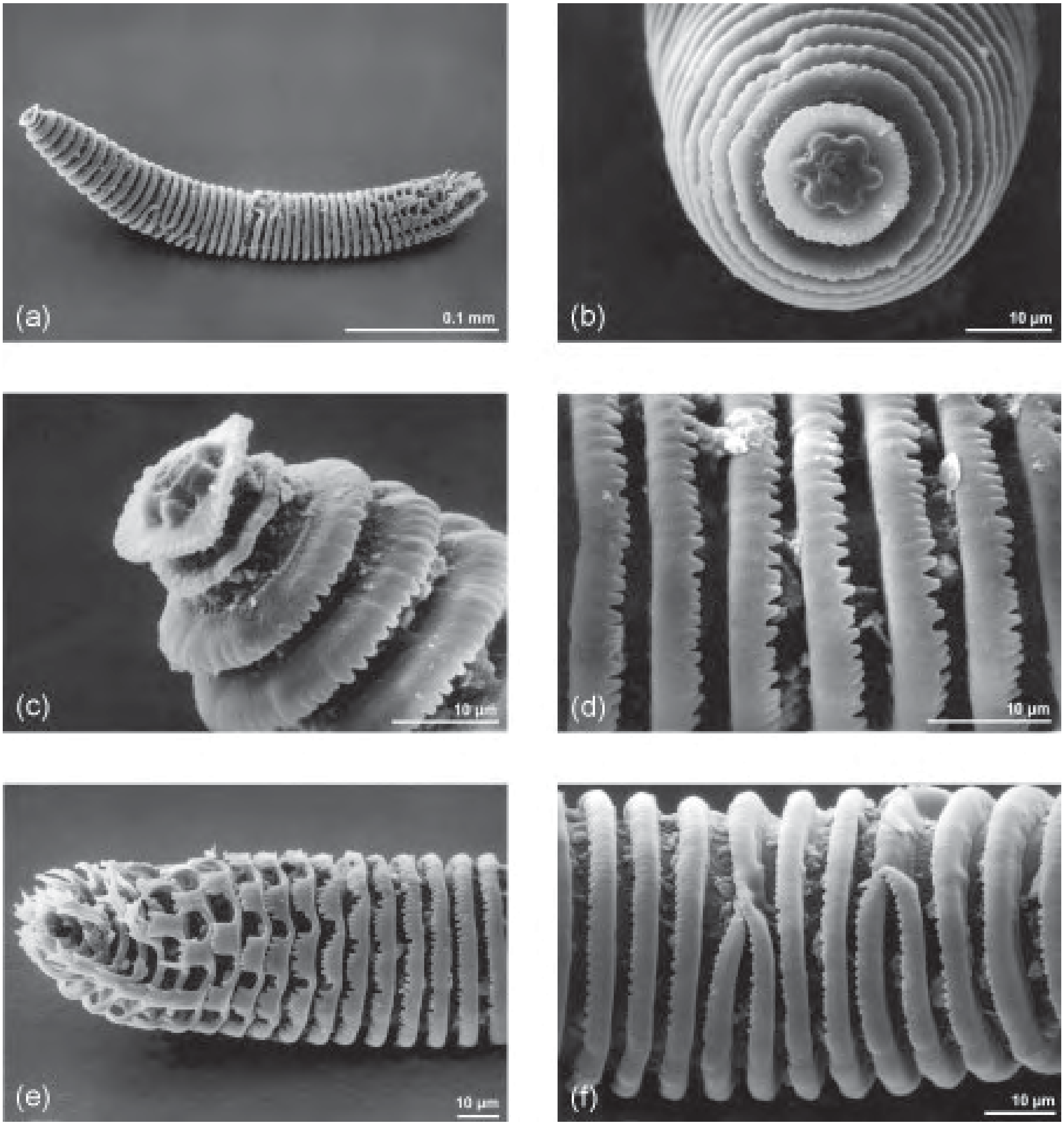

Fig. 60 SEM micrographs. *Ogma sturhani* sp. nov., female. **(a)** body, entire; **(b)** lip region, *en face* view; **(c)** anterior region, lateral view; **(d)** cuticular pattern at midbody; **(e)** posterior region, ventral view. **(f)** anastomosis of annules at midbody.

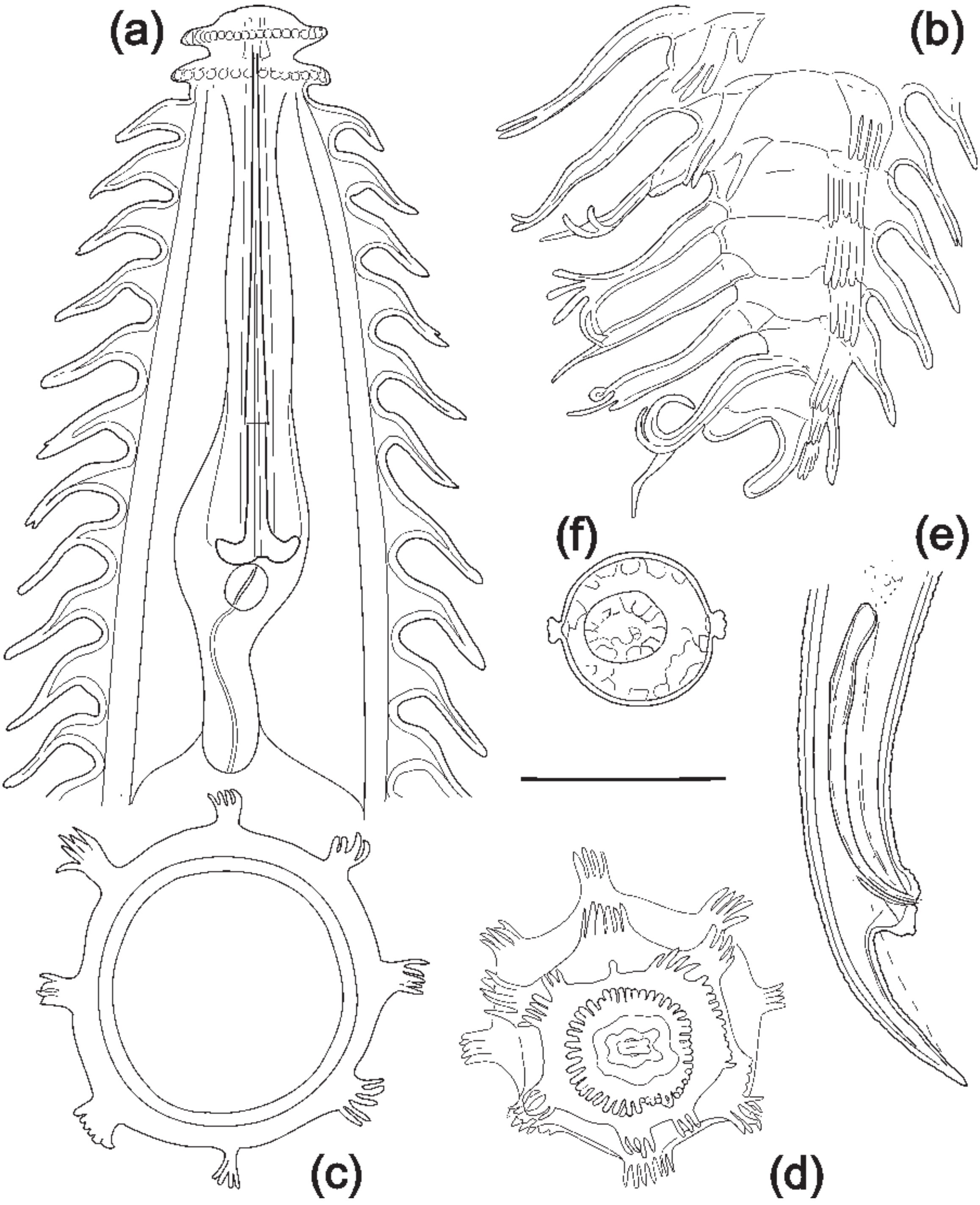

Fig. 61 *Ogma subantarcticum*. **(a)–(d)** female: **(a)** anterior region; **(b)** postvulval region; **(c)** cross section at midbody; **(d)** lip region, *en face* view. **(e)–(f)** male: **(e)** tail region; **(f)** cross section at midbody. Scale bar = 40 µm. (Published with permission of *Nematology*).

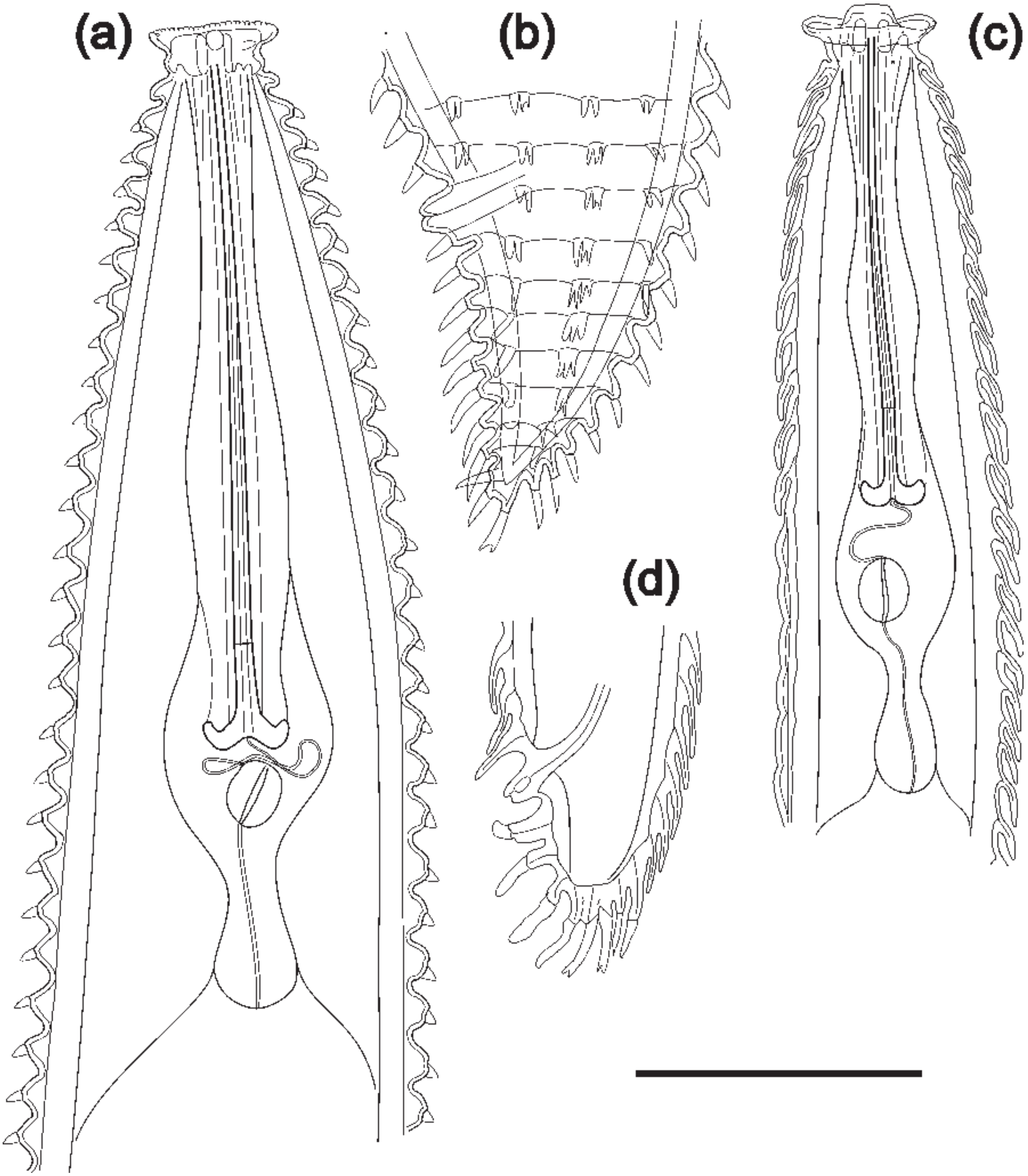

Fig. 62 (a)–(b) *Syro glabellus* sp. nov., female: **(a)** anterior region; **(b)** posterior region. **(c)–(d)** *Pateracephalanema imbricatum*, female: **(c)** anterior region; **(d)** posterior region. Scale bar = 20 µm.

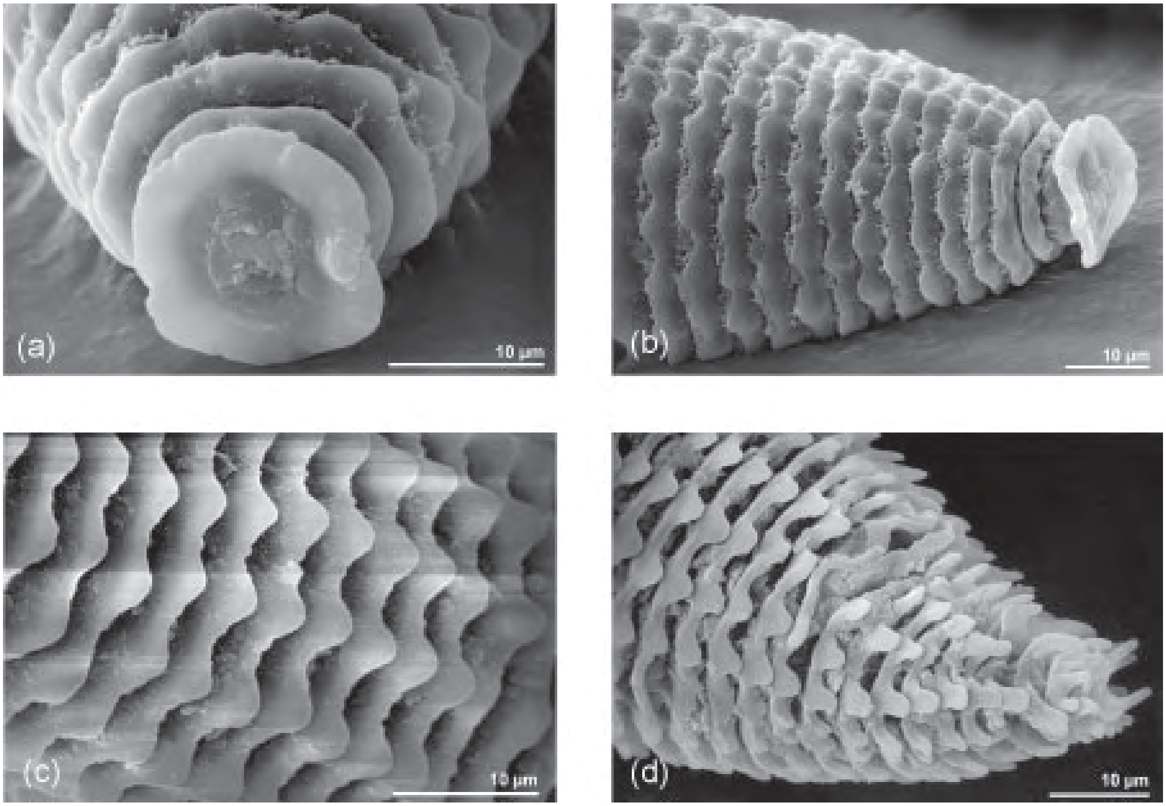

Fig. 63 SEM micrographs. *Syro glabellus* sp. nov., female. **(a)** lip region, *en face* view; **(b)** anterior region, lateral view; **(c)** cuticular pattern at midbody showing smooth scales without spines; **(d)** posterior region, subventral view.

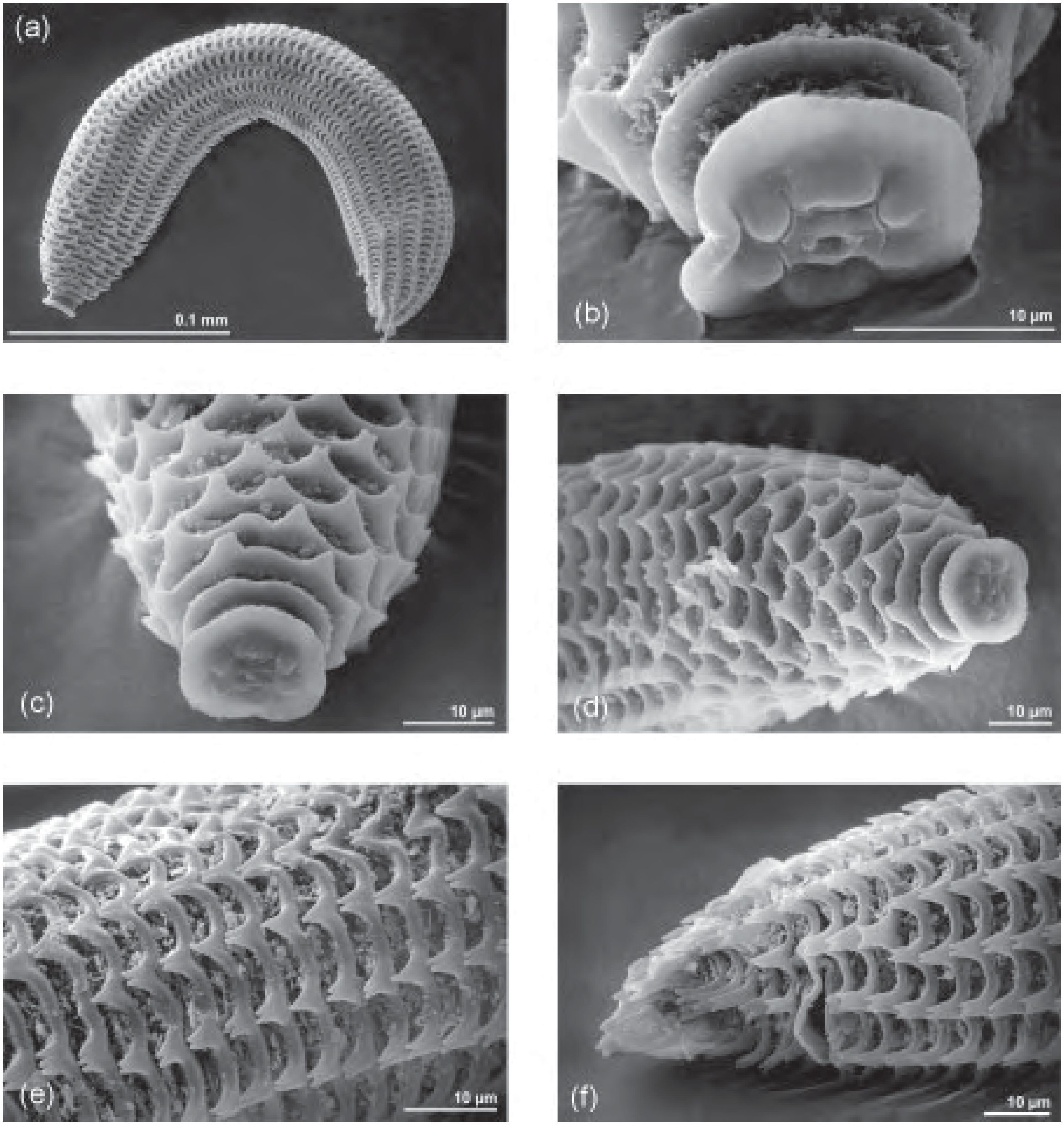

Fig. 64 SEM micrographs. *Syro tribulosus* sp. nov. female. **(a)** body, entire; **(b)**–**(d)** anterior region; **(e)** cuticular pattern at midbody showing scales predominantly with 2 spines; **(f)** posterior region, ventral view.

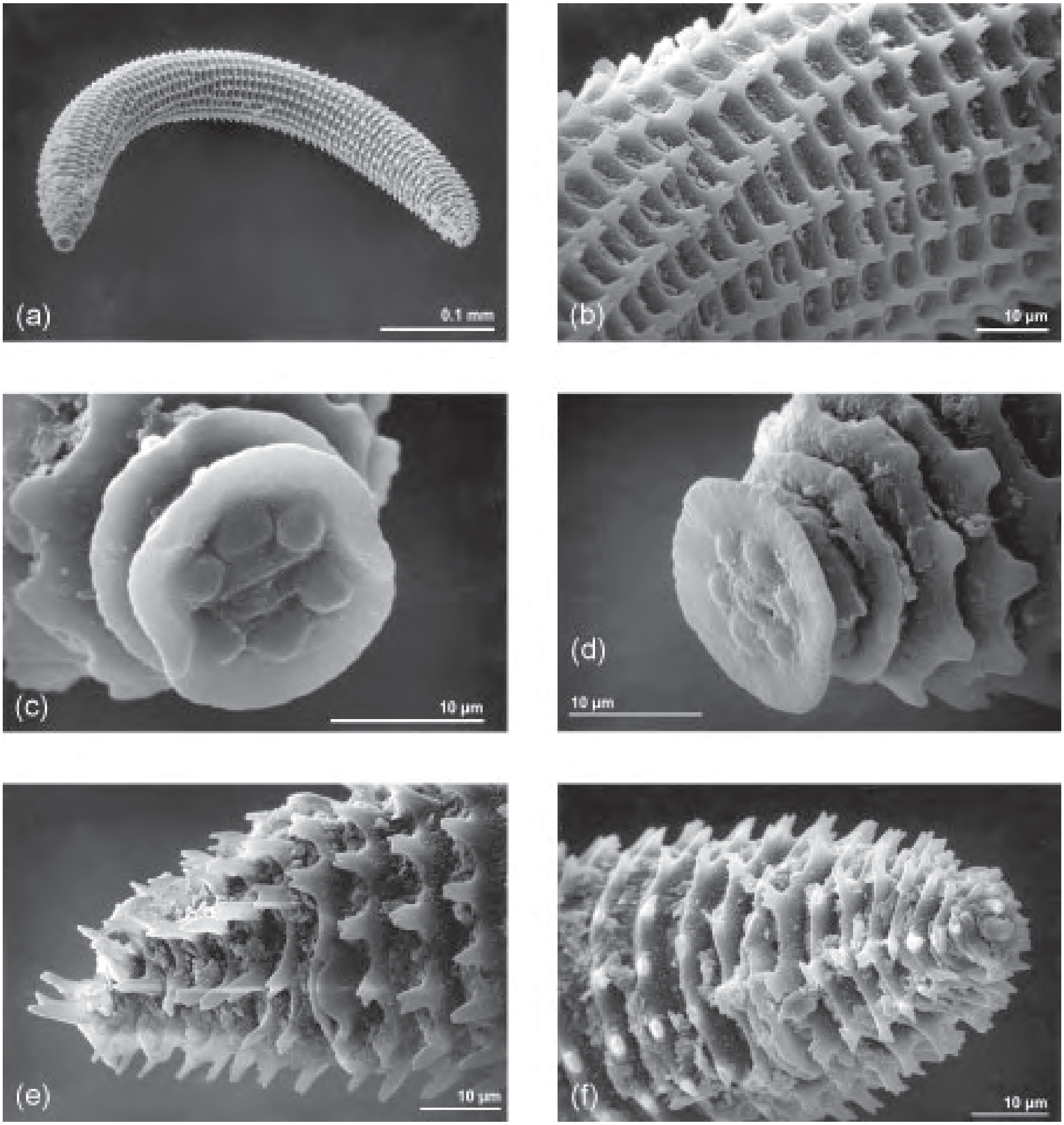

Fig. 65 SEM micrographs. *Syro tribulosus* sp. nov., female. **(a)** body, entire; **(b)** cuticular pattern at midbody showing scales predominantly with 3 spines; **(c)**–**(d)** lip region; **(e)**–**(f)** postvulval region, ventral view.

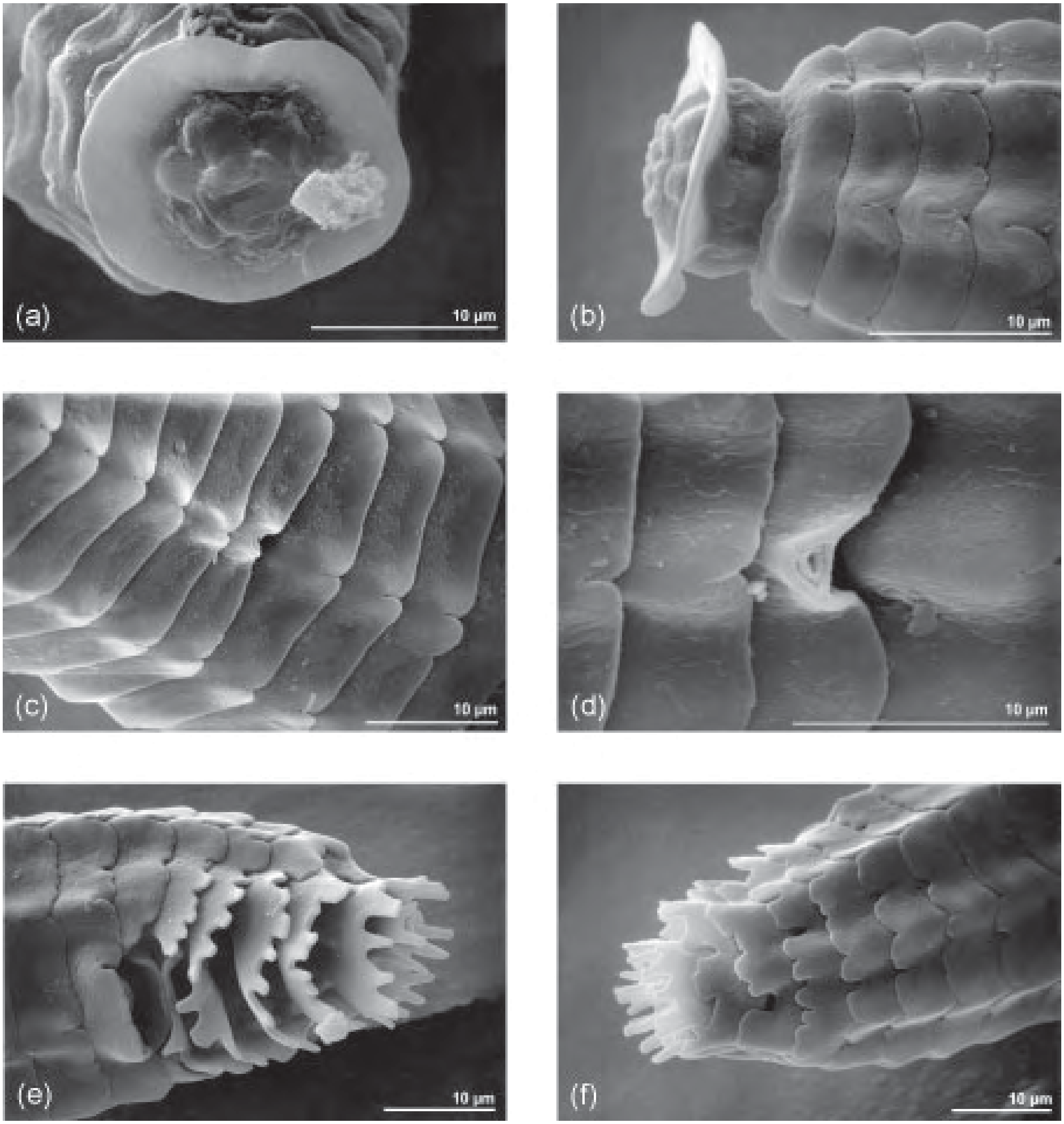

Fig. 66 SEM micrographs. *Pateracephalanema imbricatum*, female. **(a)** lip region, *en face* view; **(b)** anterior region, lateral view; **(c)** scales near excretory pore; **(d)** excretory pore; **(e)** postvulval region, ventral view; **(f)** postvulval region, dorsal view.

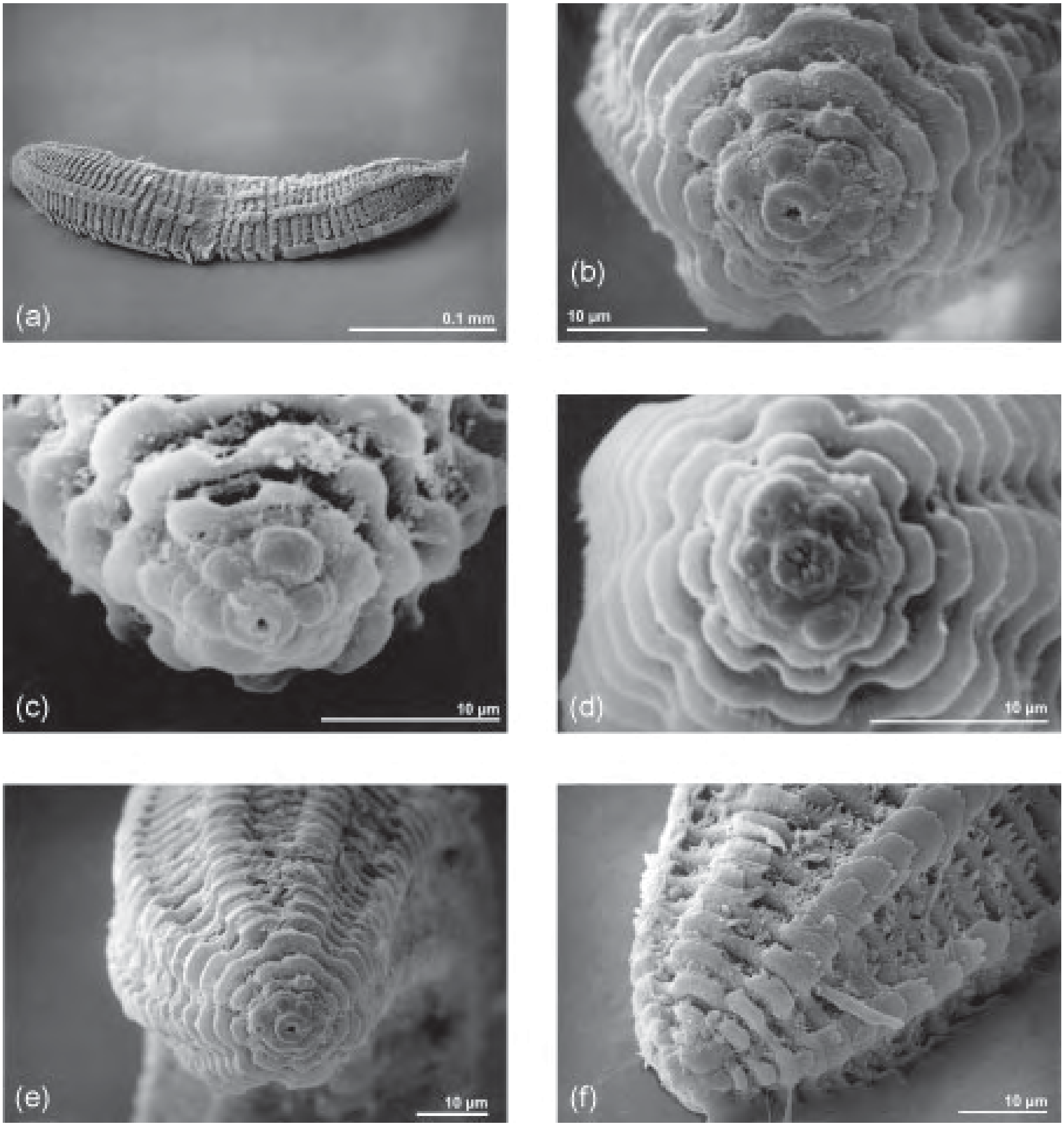

Fig. 67 SEM micrographs. *Blandicephalanema serratum*, female. **(a)** body, entire; **(b)** lip region with cuticular crust present, *en face* view; **(c)–(d)** lip region with cuticular crust partially removed, *en face* view; **(e)–(f)** anterior region, **(e)** *en face* view; **(f)** lateral view.

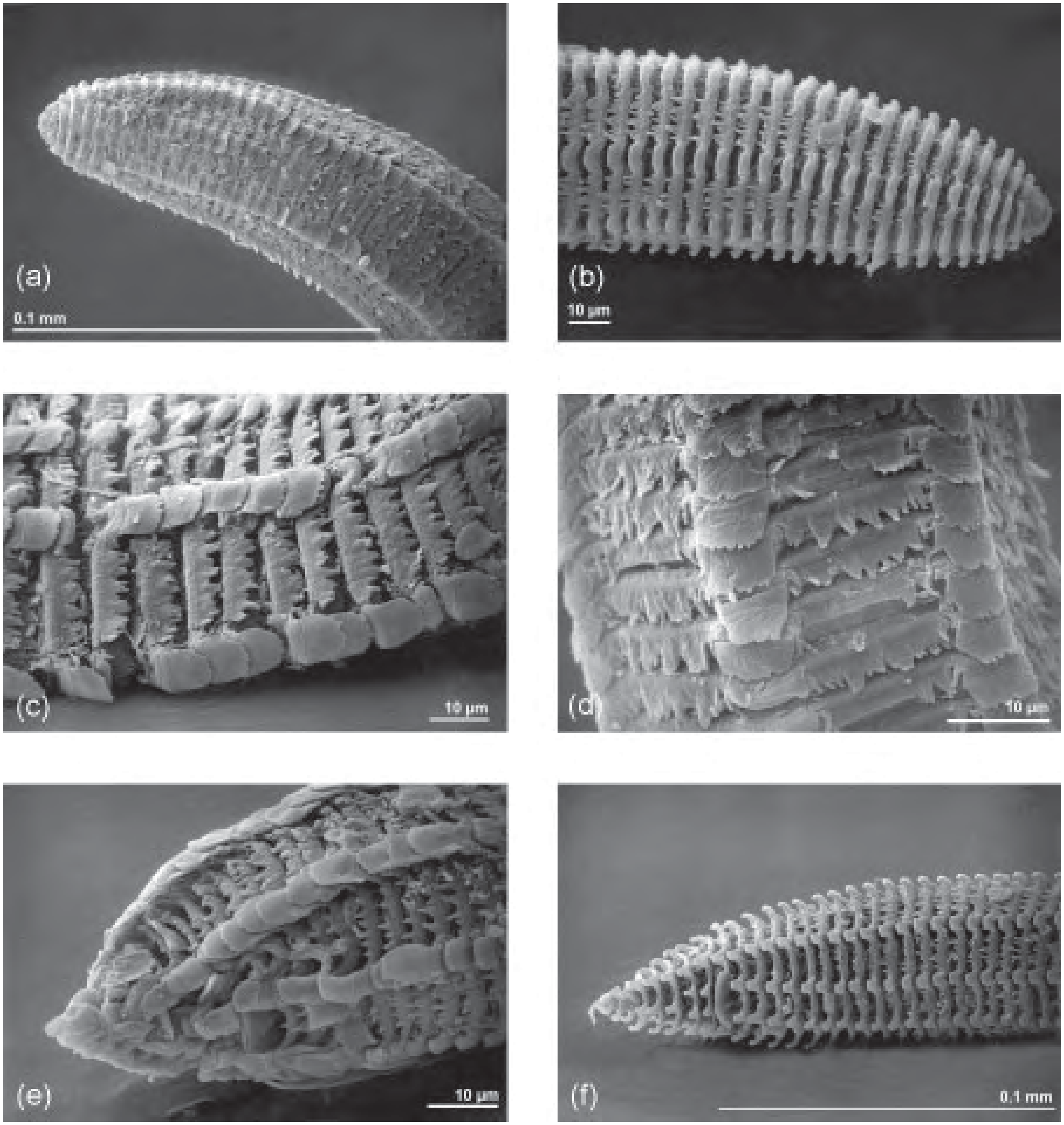

Fig. 68 SEM micrographs. *Blandicephalanema serratum*, female: **(a)** anterior region showing scales of the cuticular crust, and serration between scales, lateral view; **(b)** anterior region with crust of scales removed, showing support elements underneath; **(c)**–**(d)** scales of the cuticular crust, and serration between scales at midbody; **(e)**–**(f)** posterior region: **(e)** showing scales of the cuticular crust and serration between them, subventral view; **(f)** with cuticular crust removed, ventral view.

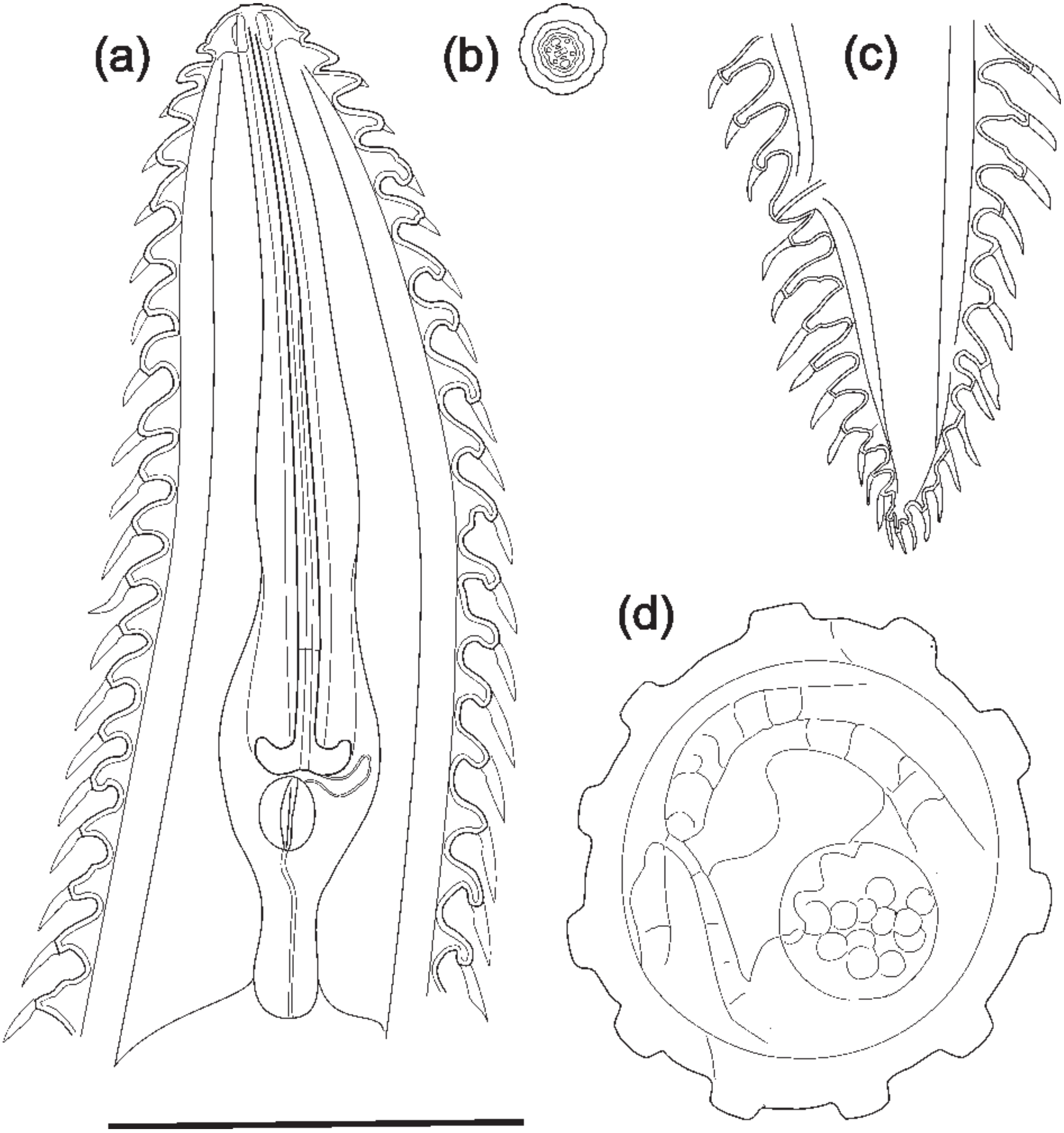

Fig. 69 *Blandicephalanema inserratum* sp. nov., female. **(a)** anterior region; **(b)** lip region, *en face* view; **(c)** postvulval region; **(d)** cross section at midbody. Scale bar = 40 μm.

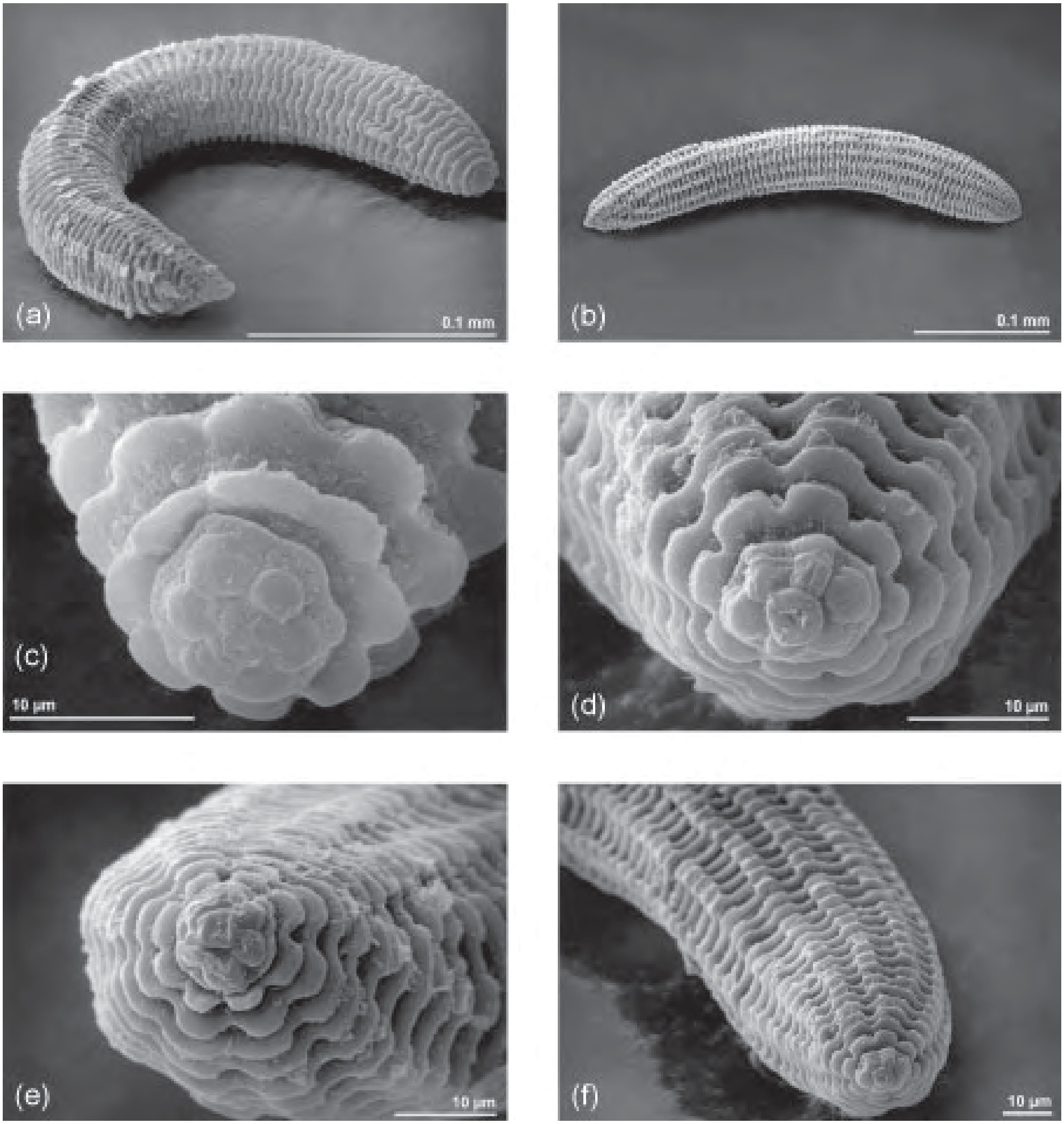

Fig. 70 SEM micrographs. *Blandicephalanema inserratum* sp. nov., female. **(a)–(b)** body, entire; **(c)** lip region with cuticular crust present, *en face* view; **(d)–(f)** anterior region with cuticular crust removed, *en face* views.

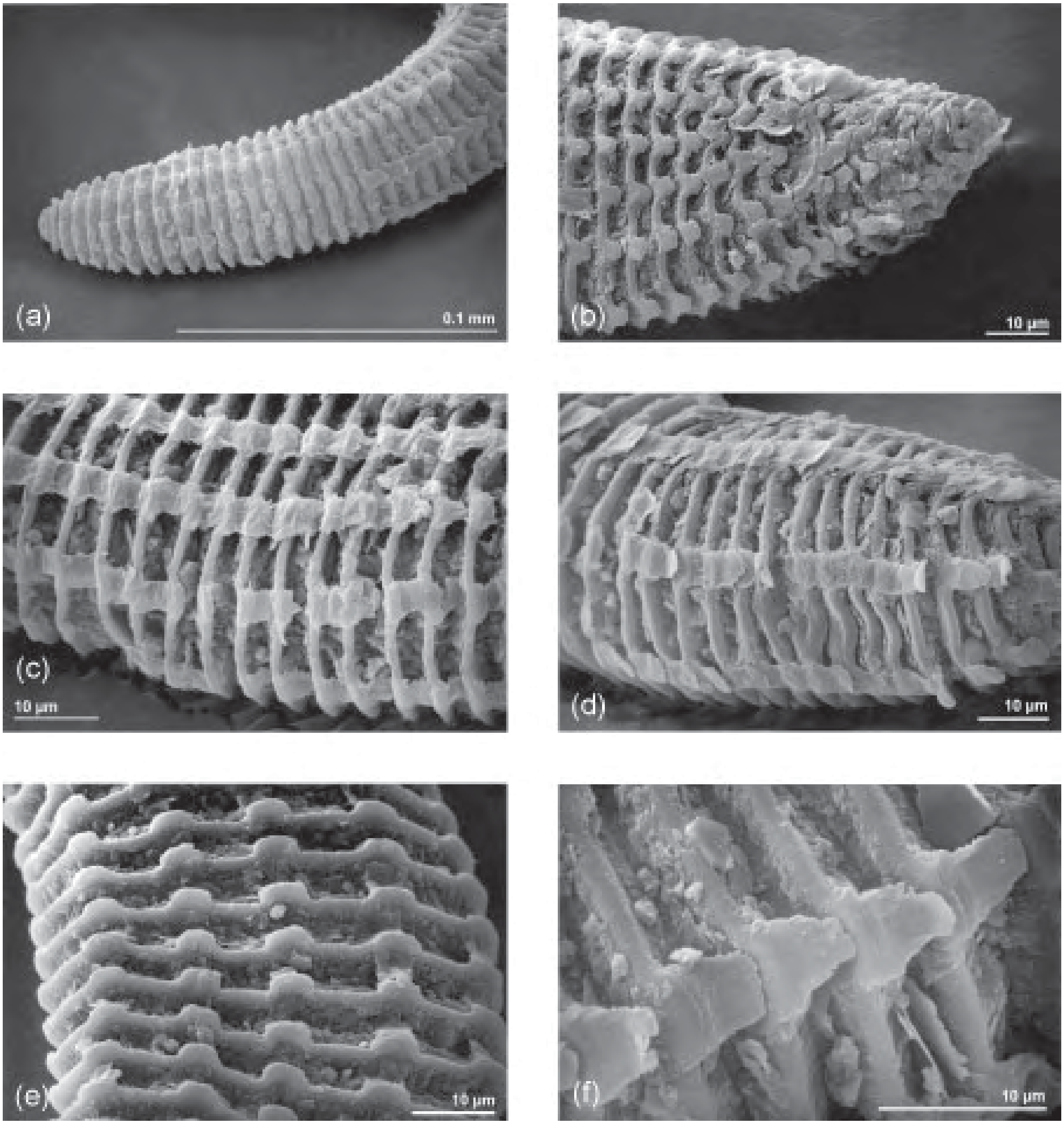

Fig. 71 SEM micrographs. *Blandicephalanema inserratum* sp. nov., female. **(a)** anterior region with cuticular crust and scales, showing the absence of inserration between scales; **(b)** posterior region with scales partially removed; **(c)** cuticular crust and scales at midbody; **(d)** cuticular crust and scales at posterior end; **(e)** midbody, with crust removed, showing stumps supporting the scales; **(f)** scales enlarged.

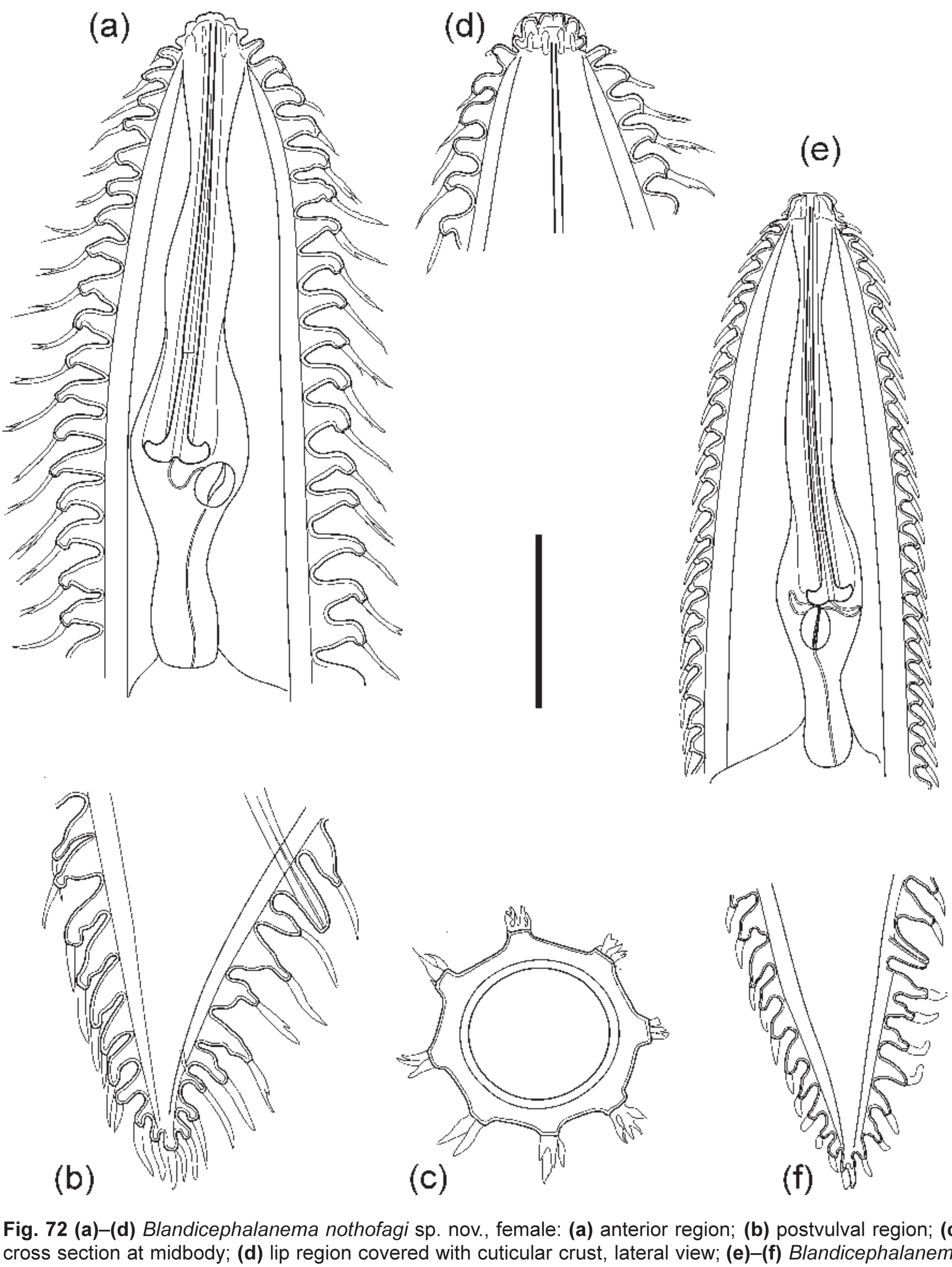

Fig. 72 (a)–(d) *Blandicephalanema nothofagi* sp. nov., female: **(a)** anterior region; **(b)** postvulval region; **(c)** cross section at midbody; **(d)** lip region covered with cuticular crust, lateral view; **(e)–(f)** *Blandicephalanema pilatum*, female: **(e)** anterior region; **(f)** postvulval region. Scale bar = 40 µm.

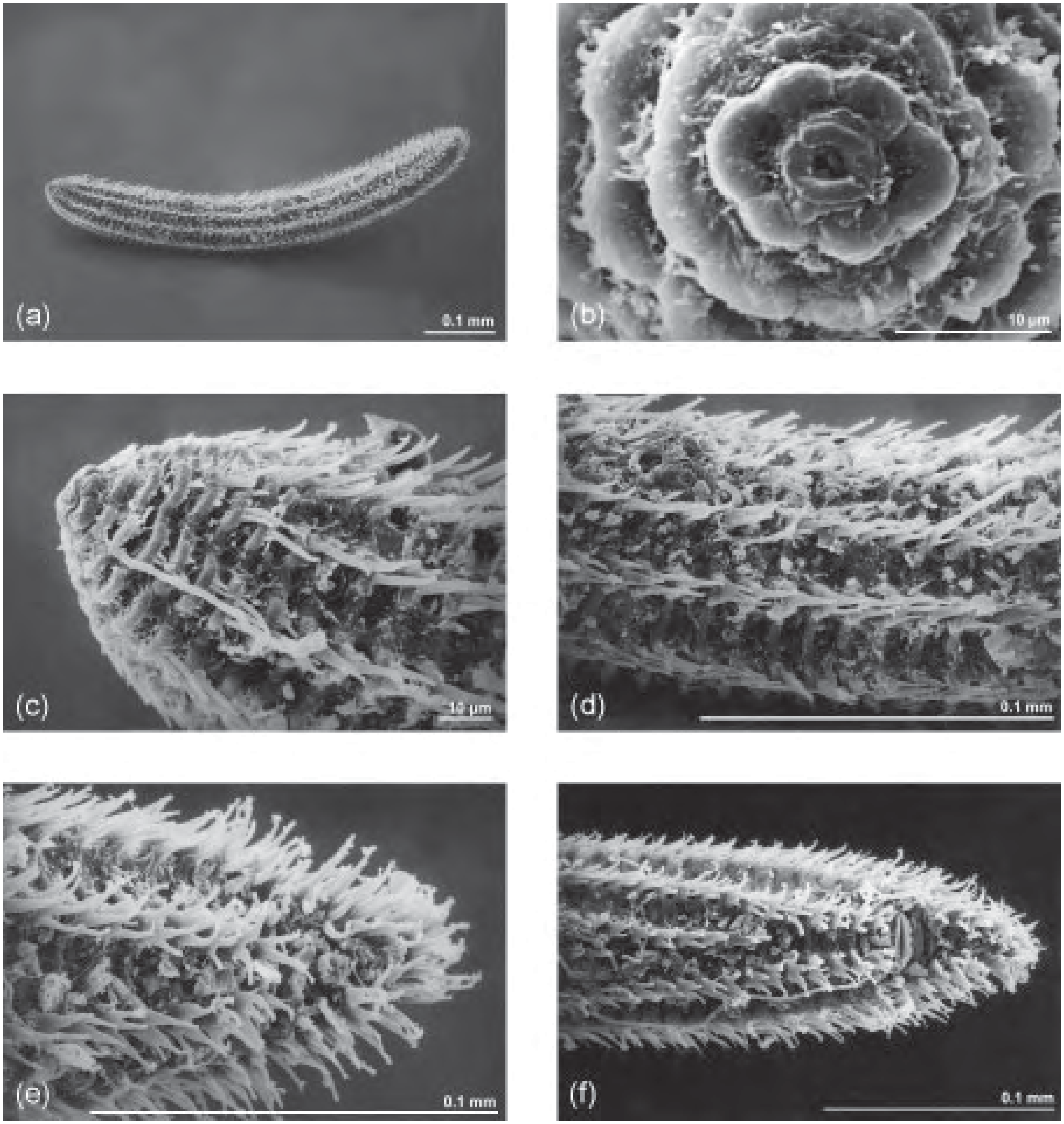

Fig. 73 SEM micrographs. *Blandicephalanema nothofagi* sp. nov., female, with cuticular crust in place. **(a)** body, entire; **(b)** lip region, *en face* view; **(c)** anterior region, lateral view; **(d)** midbody; **(e)** postvulval region; **(f)** posterior region, ventral view.

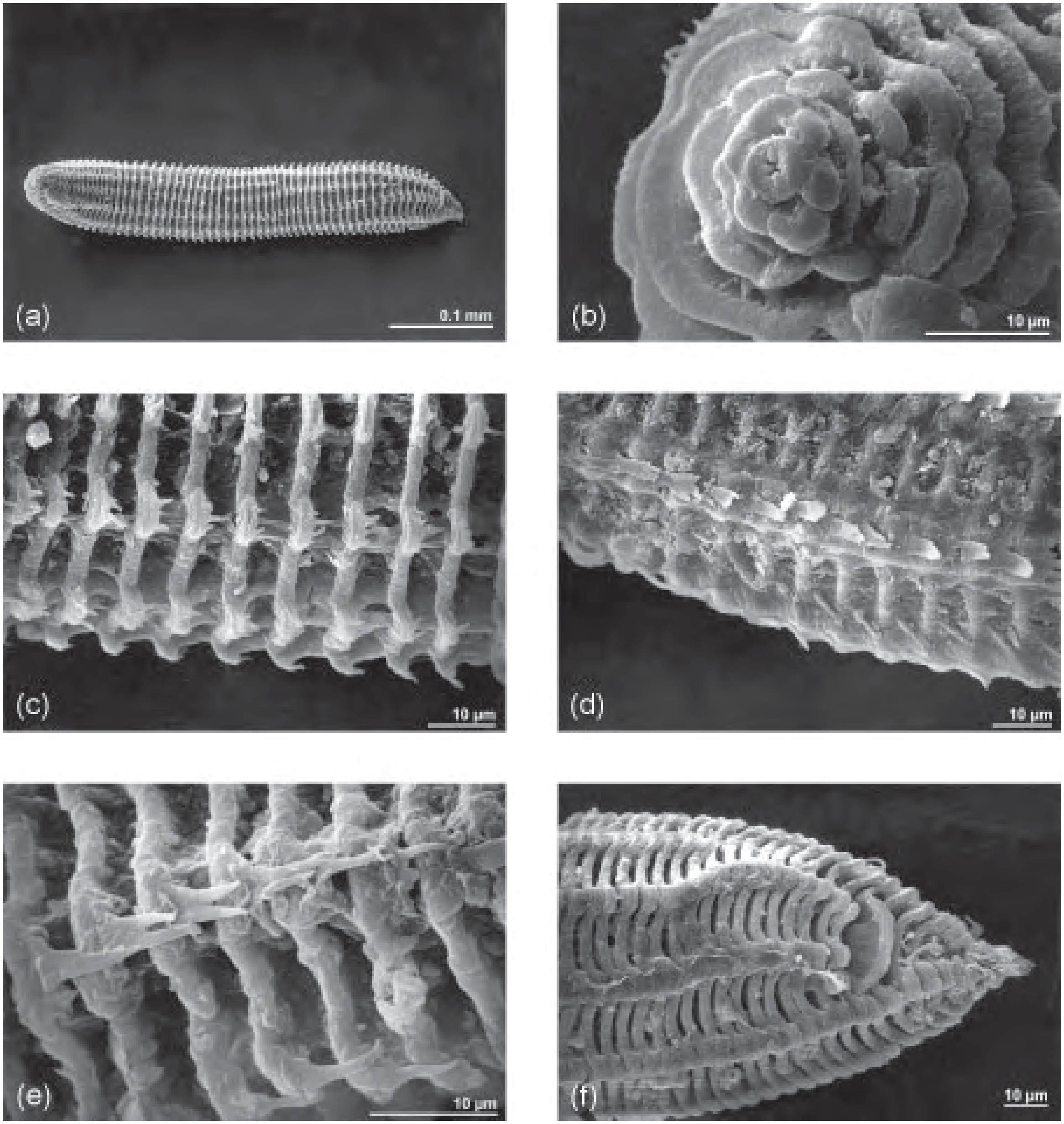

Fig. 74 SEM micrographs. *Blandicephalanema nothofagi* sp. nov., female. **(a)** body, entire, with cuticular crust removed; **(b)** lip region; **(c)** midbody, showing the cuticular outgrowths supporting the spined scales of the cuticular crust; **(d)**–**(e)** cuticle at midbody with crust of scales partially present; **(f)** posterior region, with crust of scales removed.

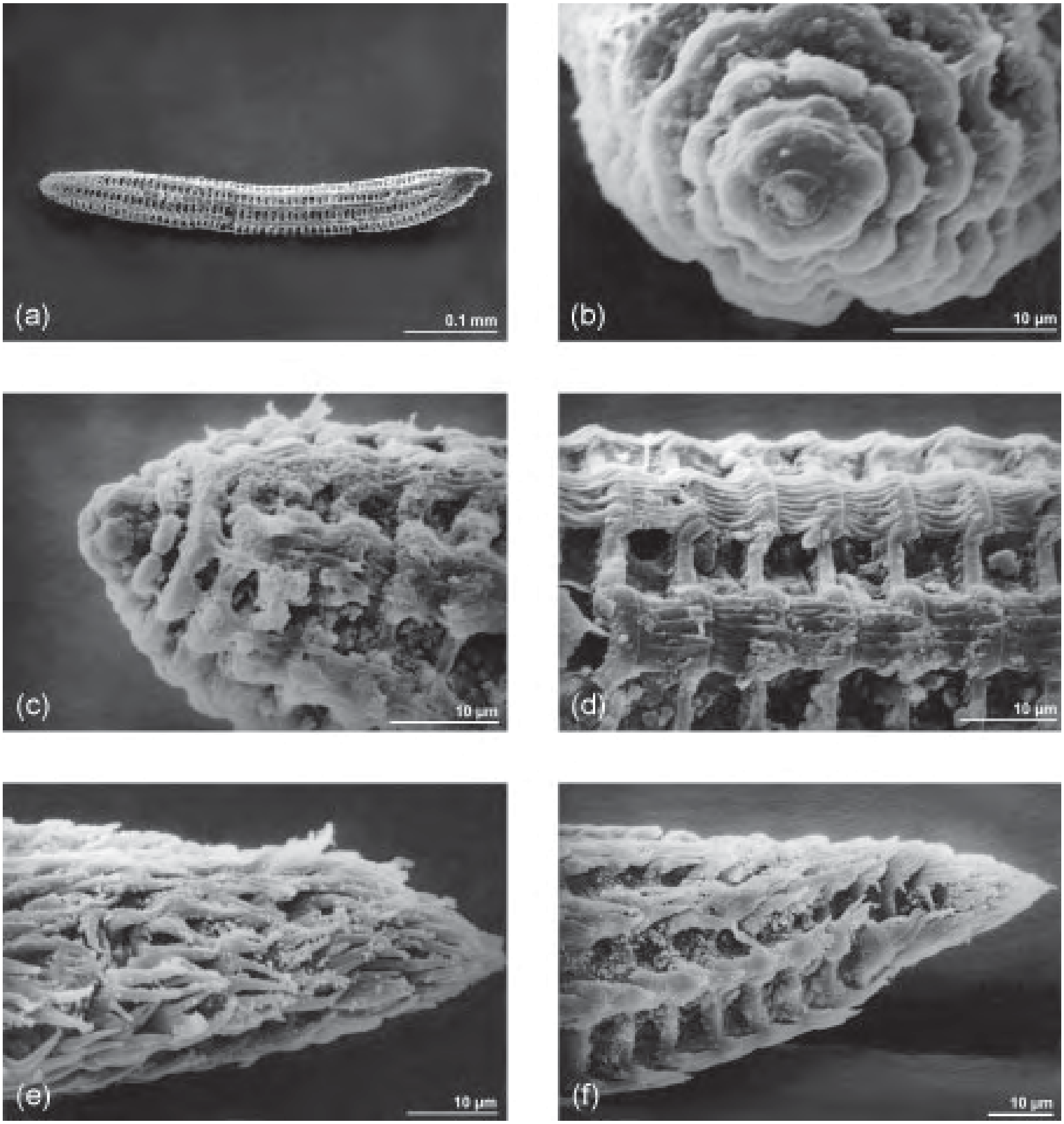

Fig. 75 SEM micrographs. *Blandicephalanema bossi* female. **(a)** Body, entire; **(b)** lip region, *en face* view; **(c)** anterior end, lateral view; **(d)** scales at midbody; **(d)** posterior end, dorsal view; **(e)** posterior end ventral view.

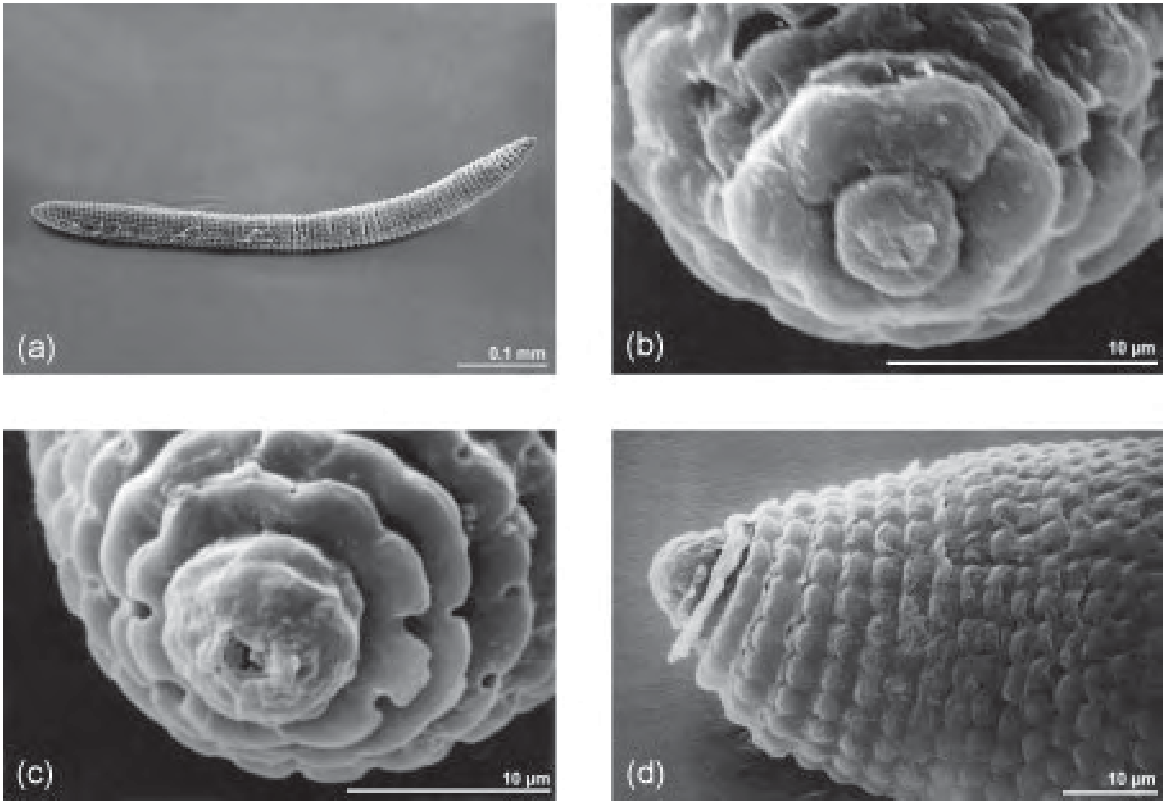

Fig. 76 SEM micrographs. *Blandicephalanema pilatum*, female. **(a)** body, entire; **(b)** lip region with cuticular crust removed, *en face* view; **(c)** lip region with cuticular crust present, *en face* view; **(d)** anterior region with cuticular crust collapsed over the underlying cuticular outgrowths, lateral view.

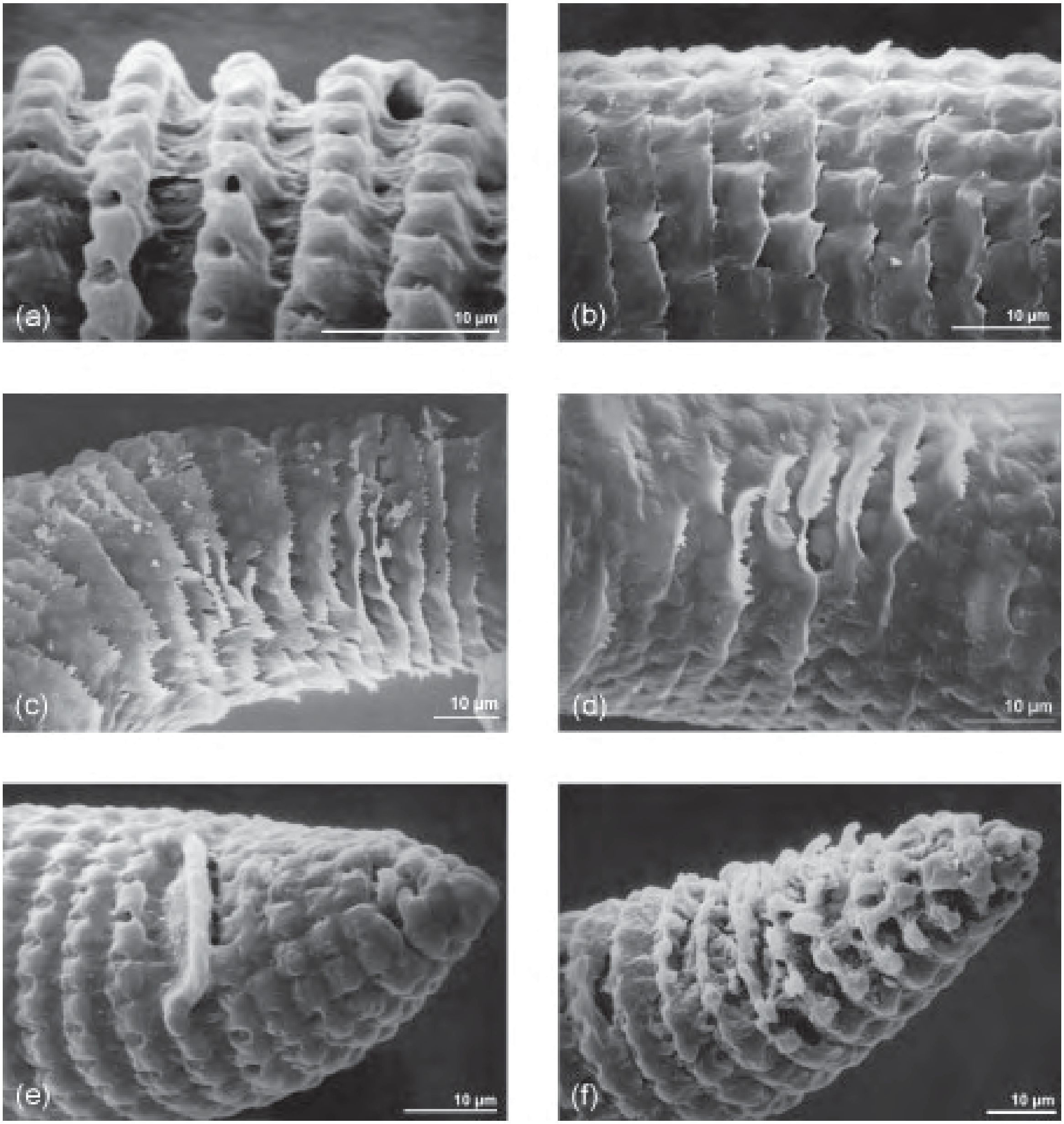

Fig. 77 SEM micrographs. *Blandicephalanema pilatum*, female. **(a)** midbody, with cuticular crust collapsed over the underlying cuticular outgrowths; **(b)–(d)** midbody with in–tact cuticular crust shown as a continuous cover, hiding underlying cuticular outgrowths, **(e)** postvulval region with collapsed cuticular crust, ventral view; **(f)** postvulval region with partially collapsed cuticular crust, subventral view.

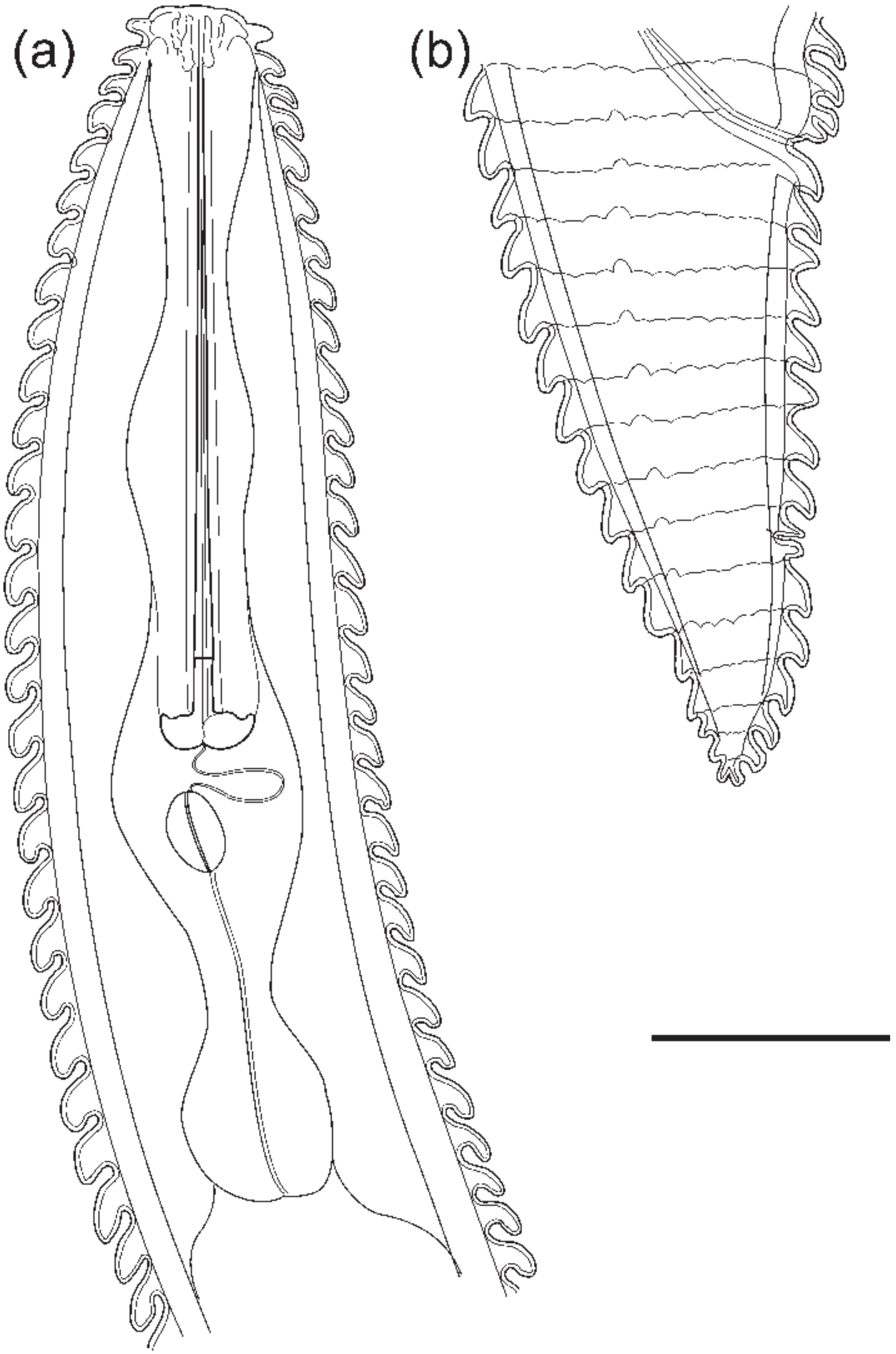

Fig. 78 *Macroposthonia campbelli* sp. nov. female: **(a)** anterior region; **(b)** postvulval region. Scale bar = 20 μm.

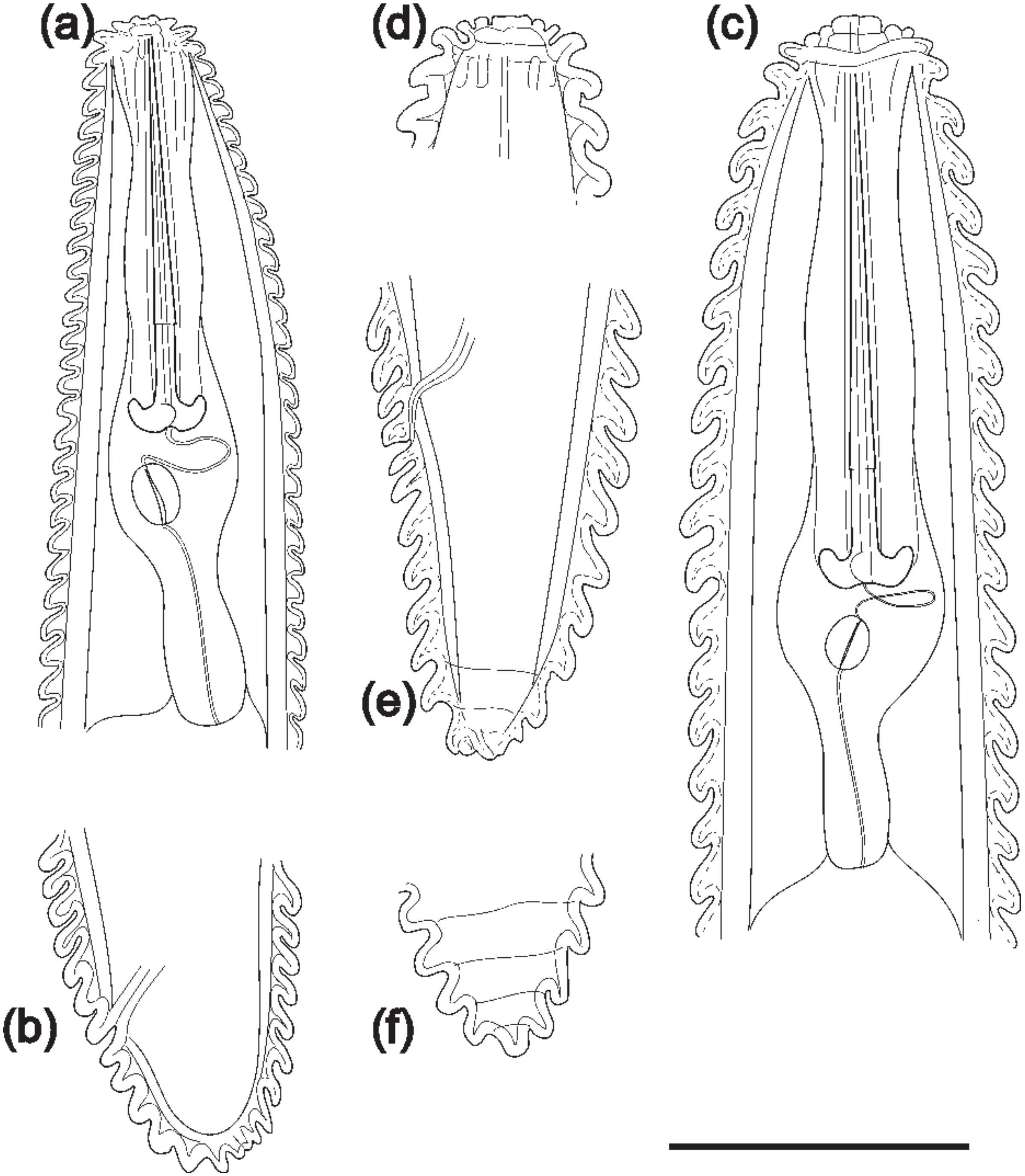

Fig. 79 (a)–(b) *Macroposthonia rustica* female: **(a)** anterior region; **(b)** posterior region. **(c)–(f)** *M. xenoplax* female: **(c)** anterior region; **(d)** lip region variant; **(e)** postvulval region; **(f)** tail terminus variant. Scale bar = 40 µm.

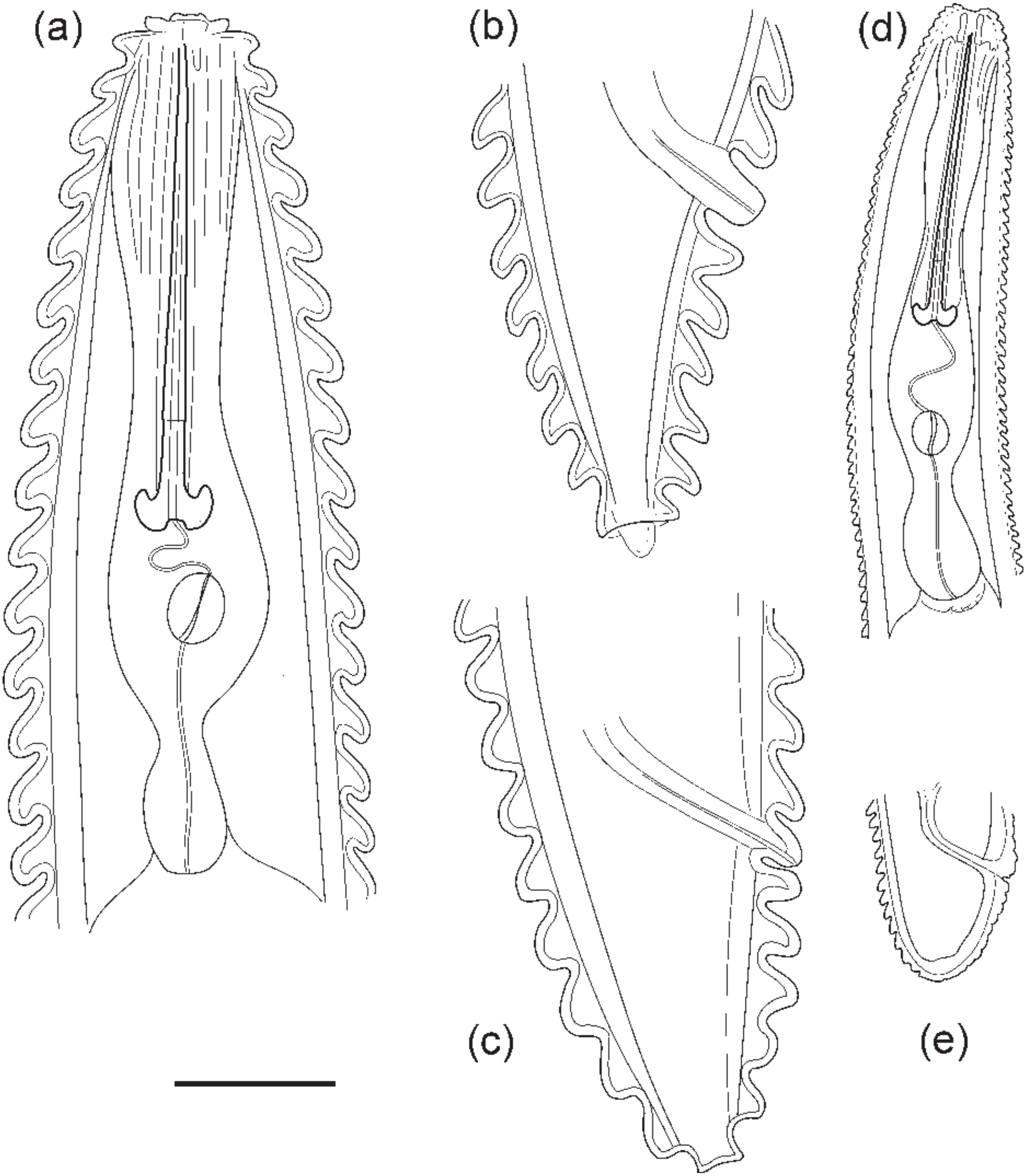

Fig. 80 (a)–(c) *Criconemoides* (*Criconemoides*) *informis*: **(a)** anterior region; **(b)–(c)** postvulval region variants. **(d)–(e)** *Criconemoides* (*Criconemella*) *parvus,* female: **(d)** anterior region; **(e)** postvulval region.female. Scale bar = 40 µm.

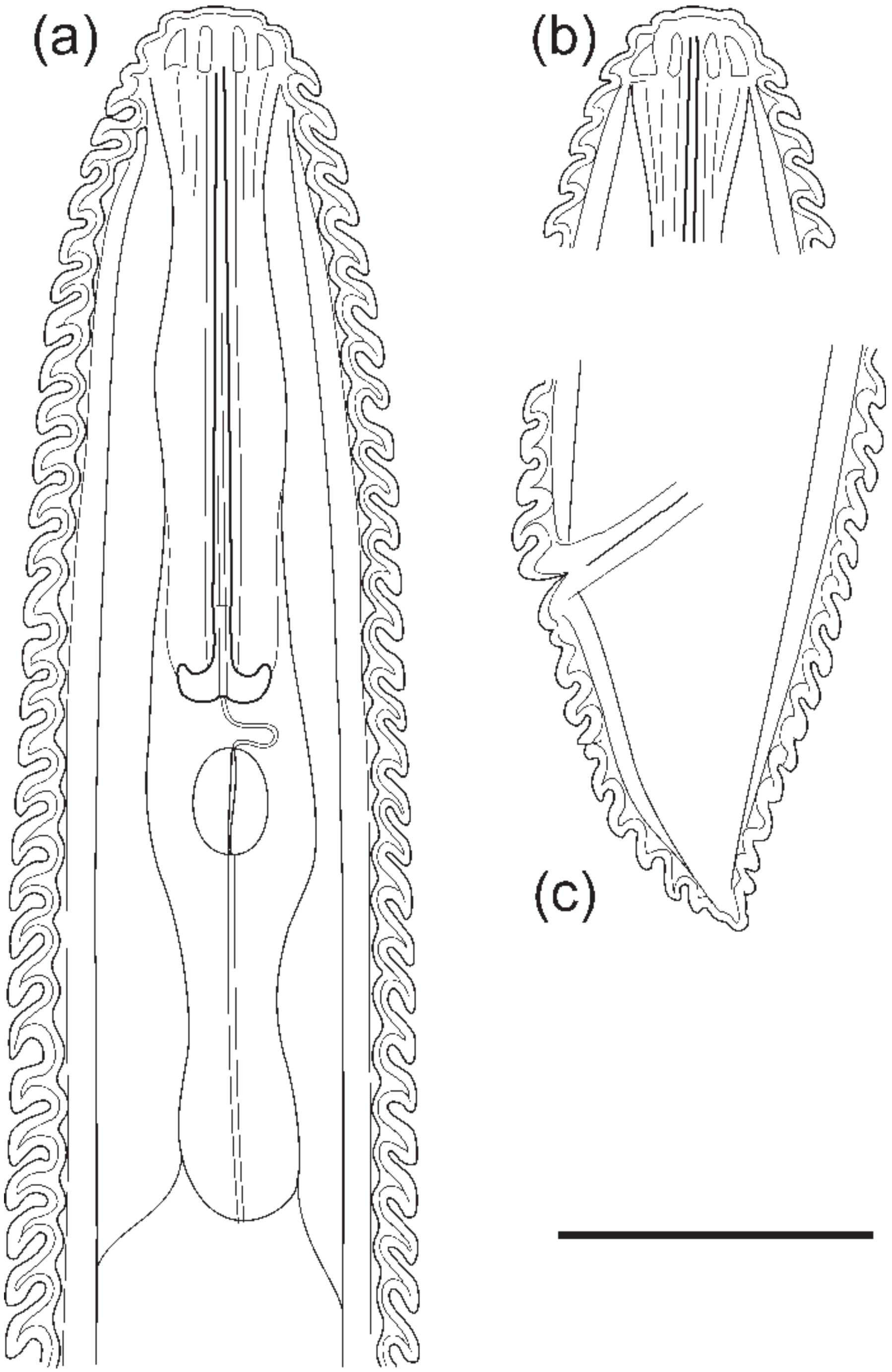

Fig. 81 *Hemicriconemoides cocophillus* female. **(a)** anterior region; **(b)** variation of lip region; **(c)** postvulval region. Scale bar = 20 µm.

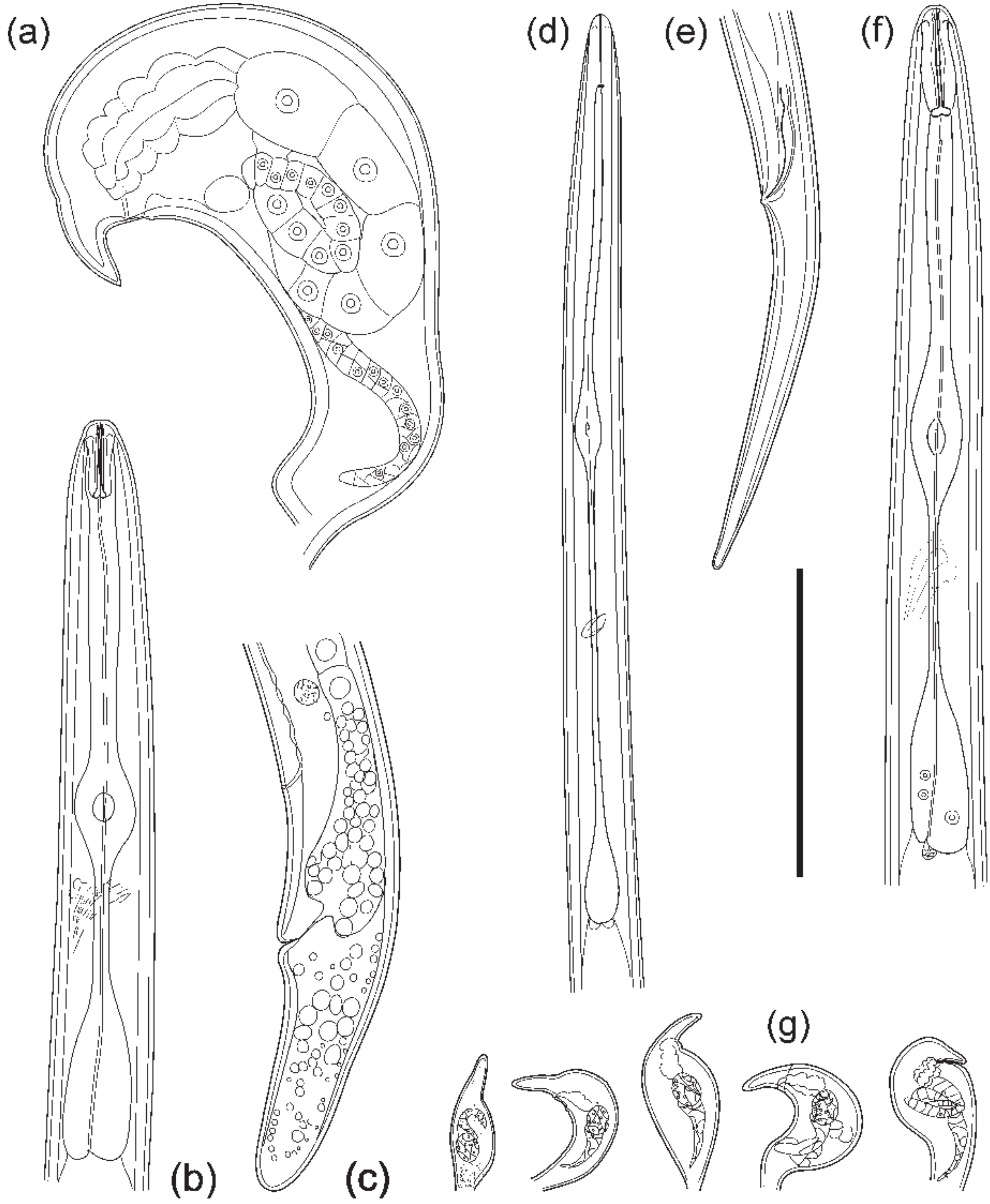

Fig. 82 *Tylenchulus semipentrans*. **(a)** female, body; **(b)–(c)** young, immature female: **(b)** anterior region; **(c)** posterior region; **(d)–(e)** male: **(d)** anterior region; **(e)** posterior region; **(f)** juvenile, anterior region; **(g)** different shapes of adult female bodies. Scale bar = 35 μm for **(d)–(f)**; 50 μm for **(b)–(c)**; 115 μm for **(a)**; 400 μm for **(g)**.

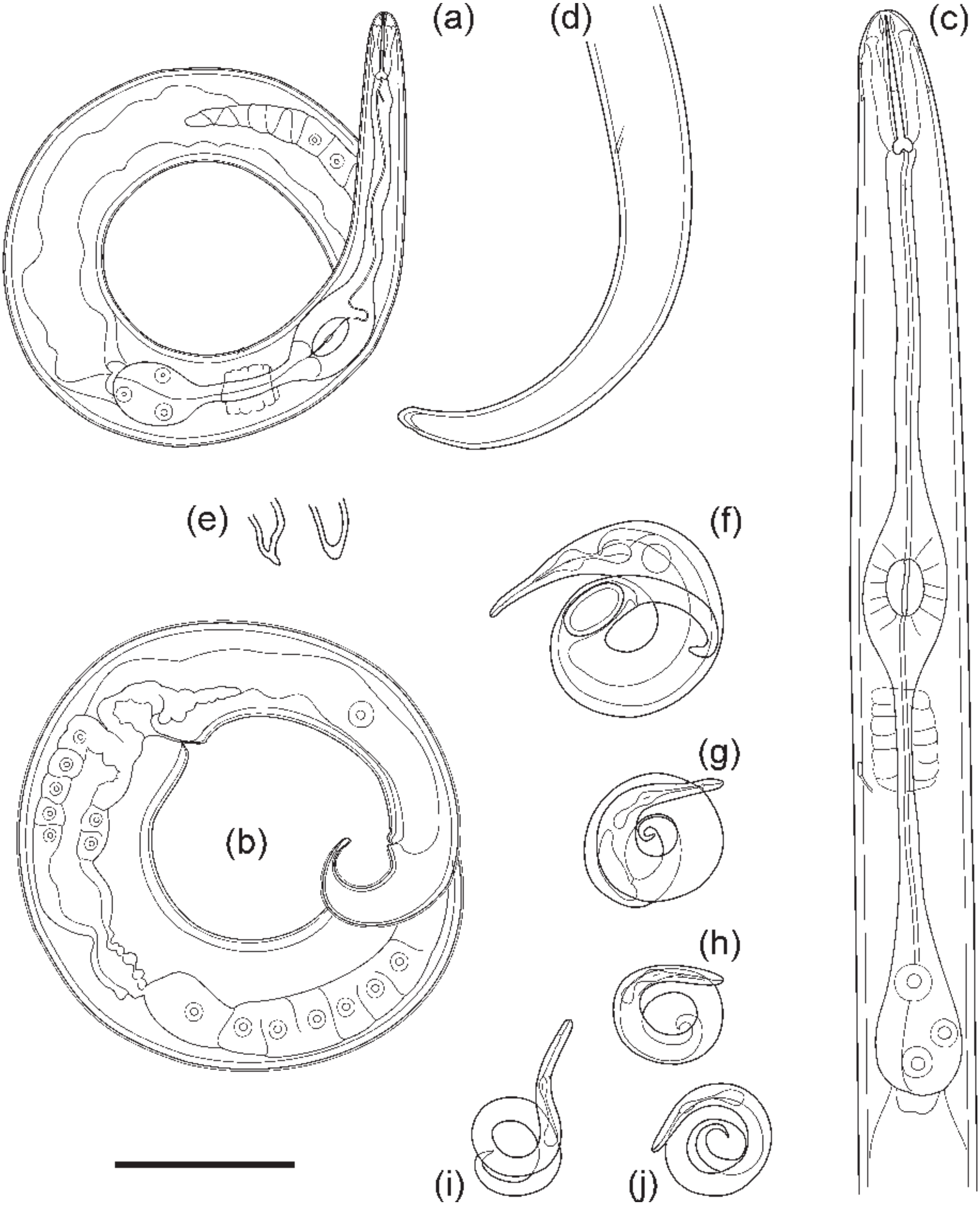

Fig. 83 *Trophotylenchulus okamotoi.* **(a)**–**(b)** female: **(a)** anterior half; **(b)** posterior half. **(c)**–**(d)** juvenile: **(c)** anterior region; **(d)** tail; **(e)** variations of tail terminus. **(f)**–**(g)** developing females; **(h)**–**(i)** developing pre-adult juveniles. Scale bar = 20 µm for **(c)**, **(e)**; 40 µm for **(a)**, **(b)**; 120 µm for **(f)**, **(j)**.

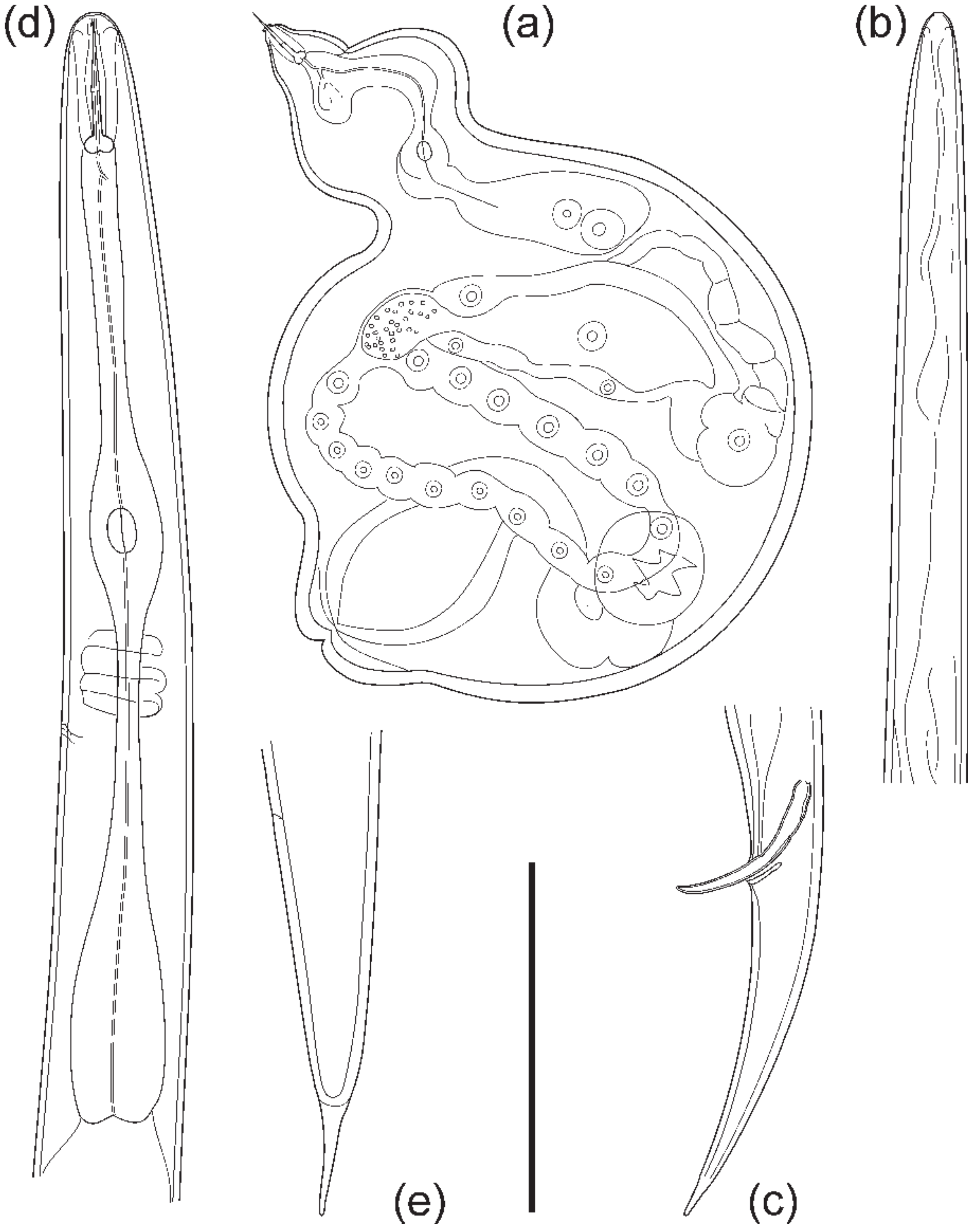

Fig. 84 *Sphaeronema californicum*. **(a)** female, body, entire; **(b)–(c)** male: **(b)** anterior region; **(c)** posterior region. **(d)–(e)** juvenile: **(d)** anterior region; **(e)** posterior region. Scale bar = 40 µm for **(b)–(e)**; 80 µm for **(a)**.

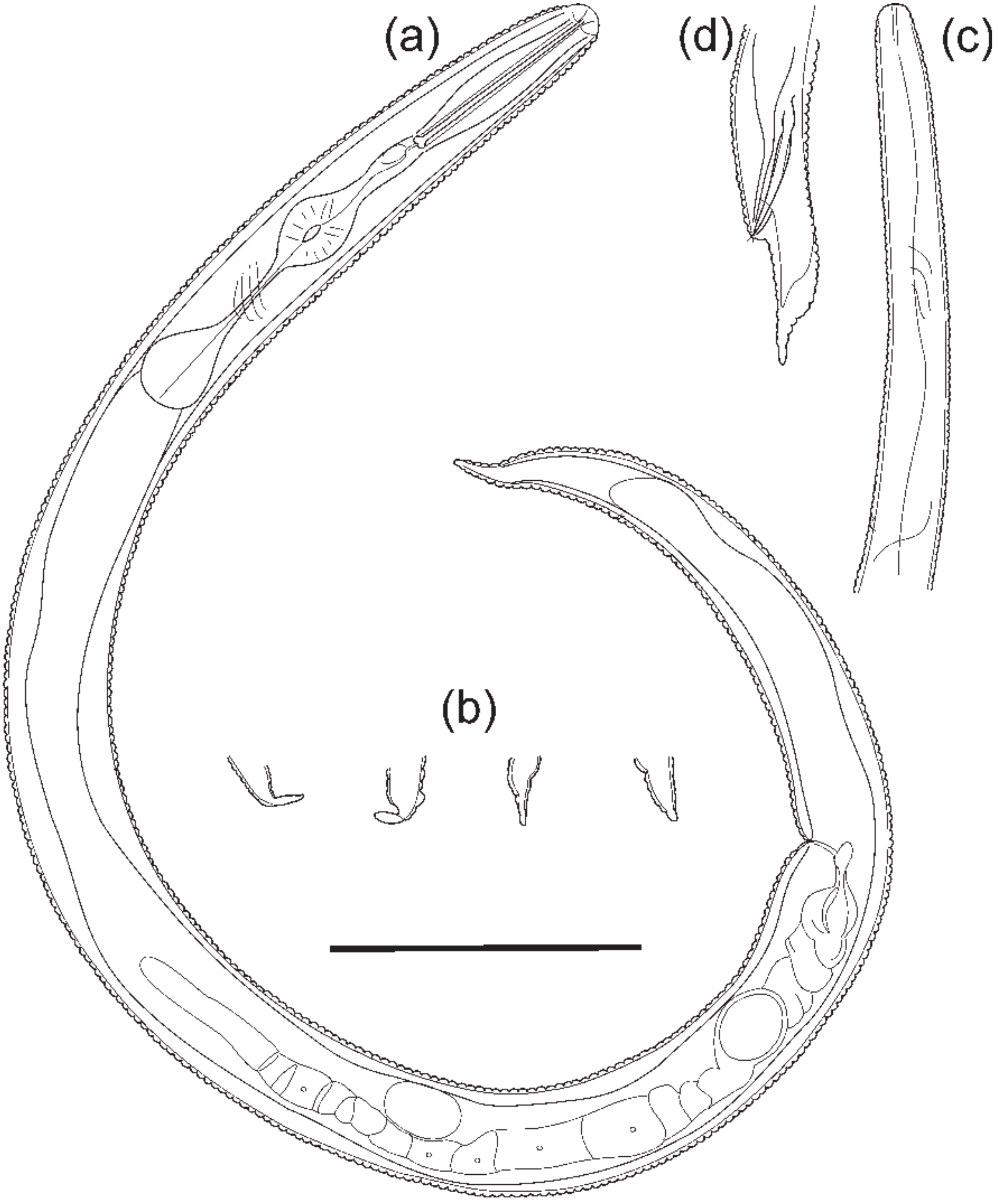

Fig. 85 *Paratylenchus halophilus.* **(a)–(b)** female: **(a)** body, entire; **(b)** alternative tail termini; **(c)–(d)** male: **(c)** anterior region; **(d)** posterior region. Scale bar = 40 µm.

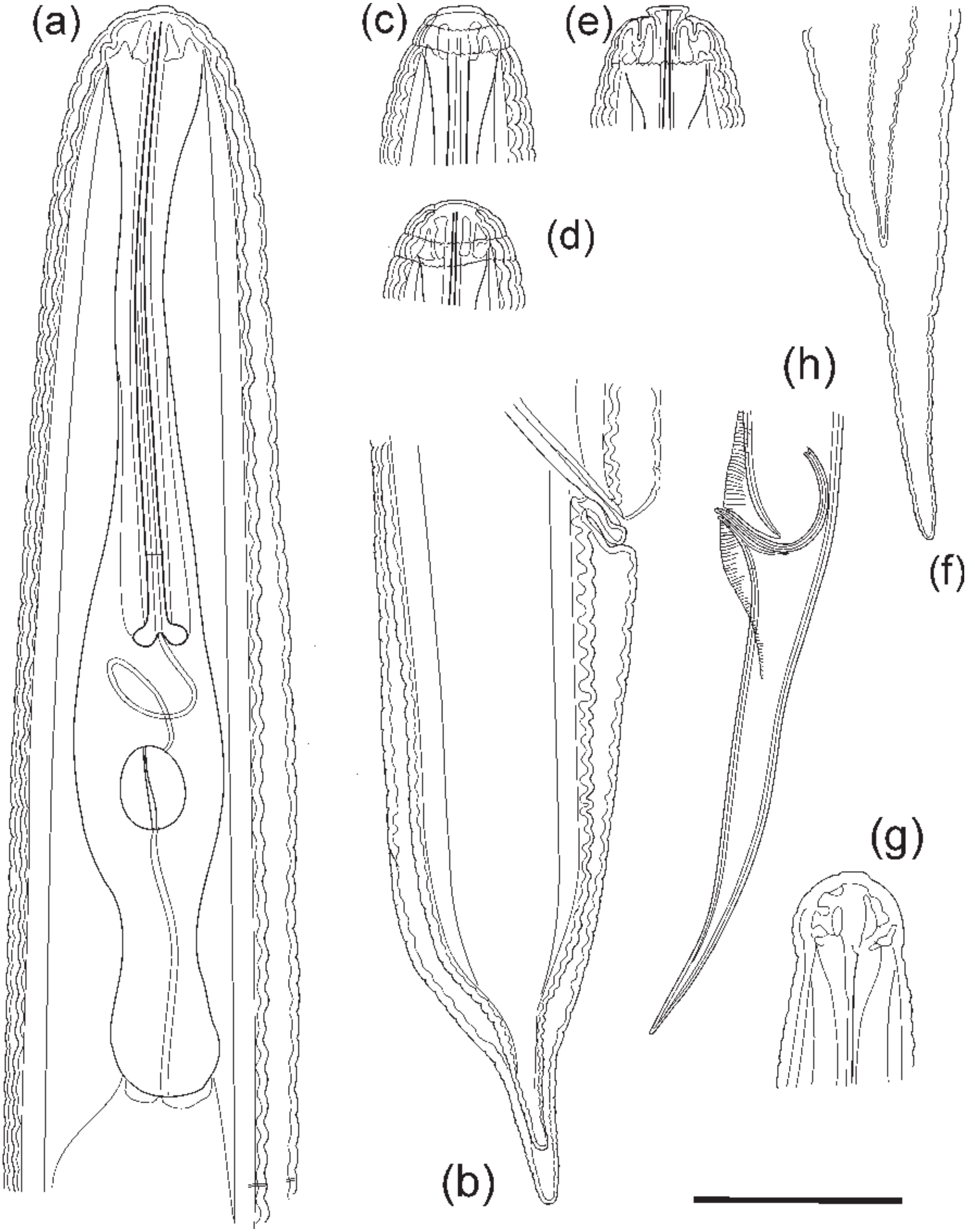

Fig. 86 (a)–(b) *Hemicycliophora halophila,* female: **(a)** anterior region; **(b)** posterior region. **(c)–(h)** *H. chathami*: **(c)–(f)** female: **(c)–(d)** lip region dorsoventral view; **(e)** lip region lateral view; **(f)** tail region. **(g)–(h)** male: **(g)** lip region; **(h)** posterior region. Scale bar = 40 μm.

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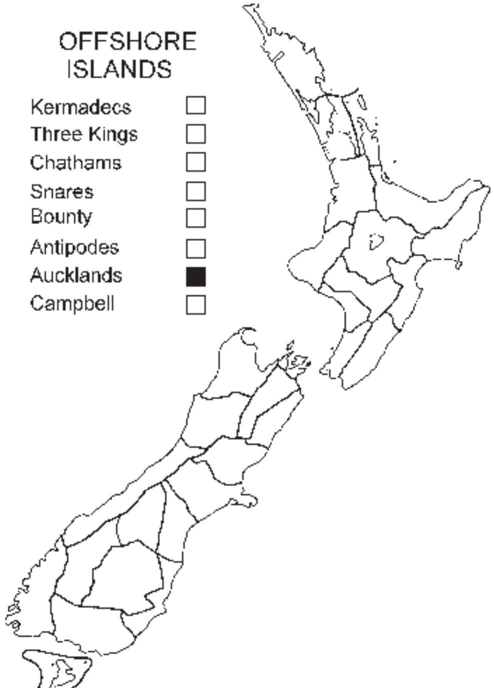
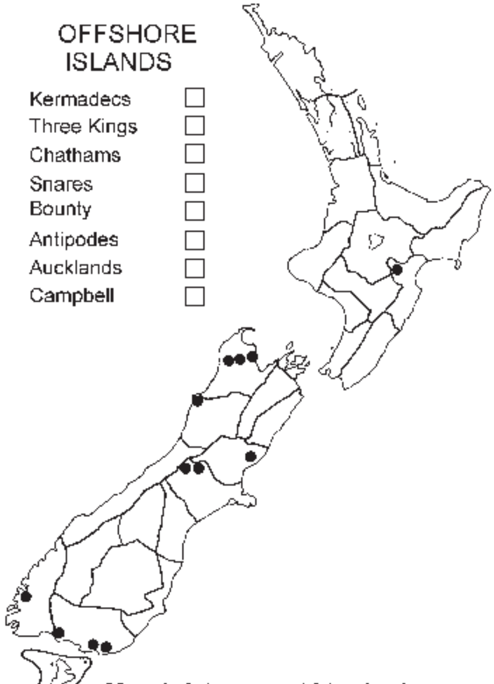
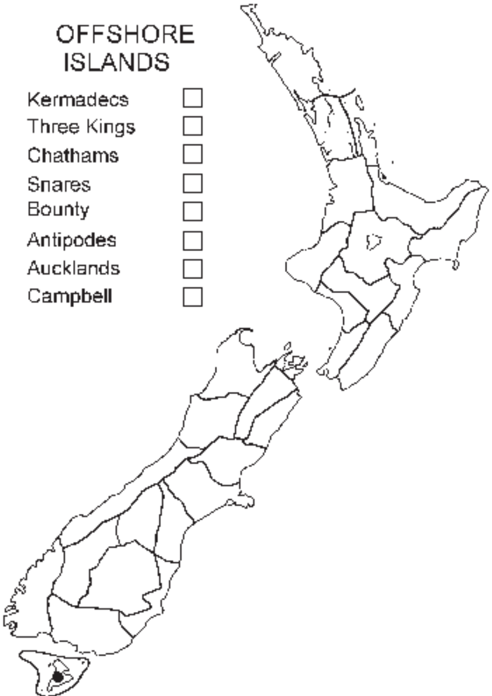


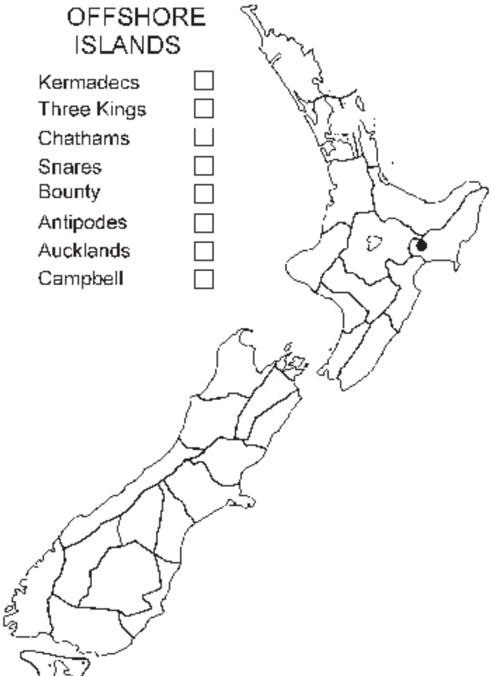
Map 1 *Criconema (C.) aucklandicum*



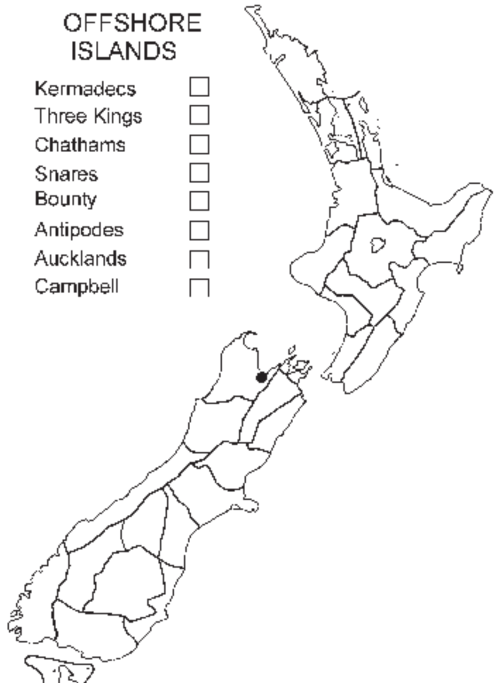
Map 2 *Criconema (C.) cristulatum*



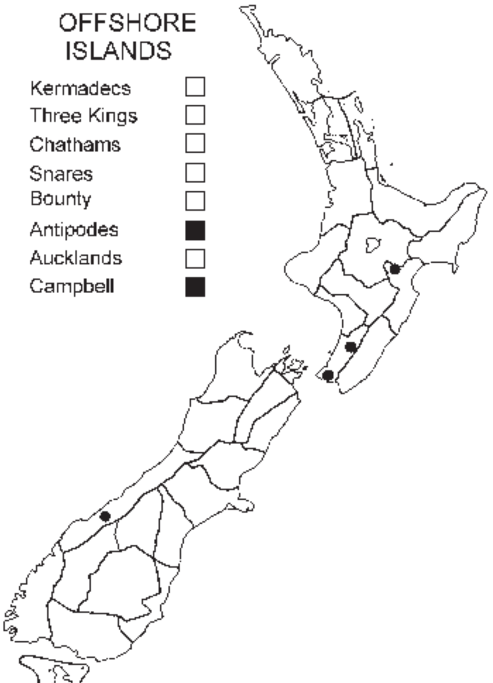
Map 3 *Criconema (C.) mackenziei*



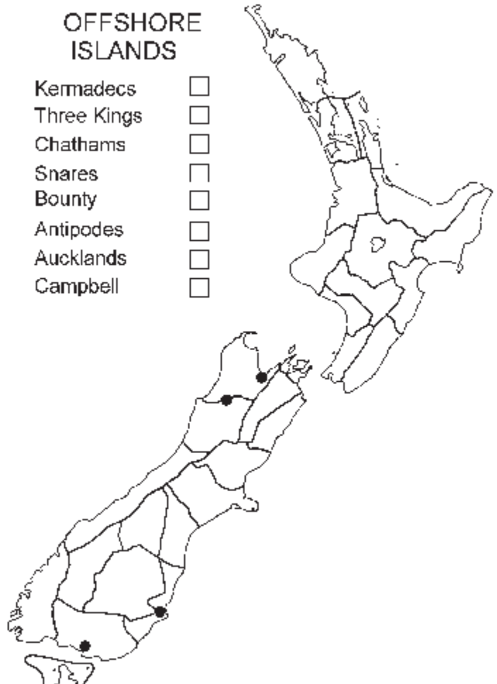
Map 4 *Criconema (C.) makahuense*



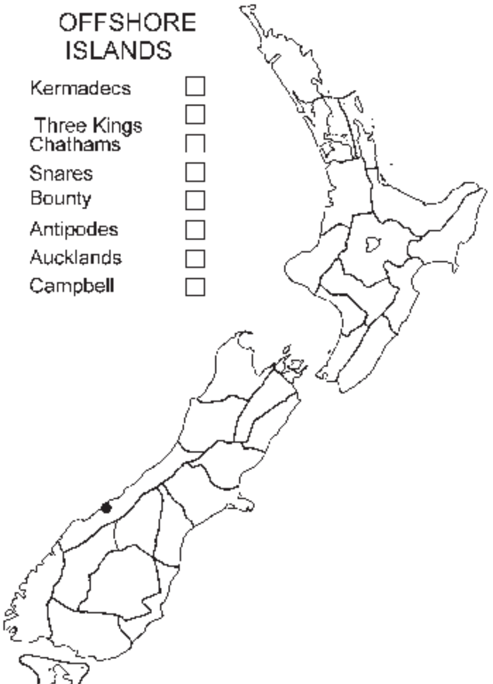
Map 5 *Criconema (C.) nelsonense*



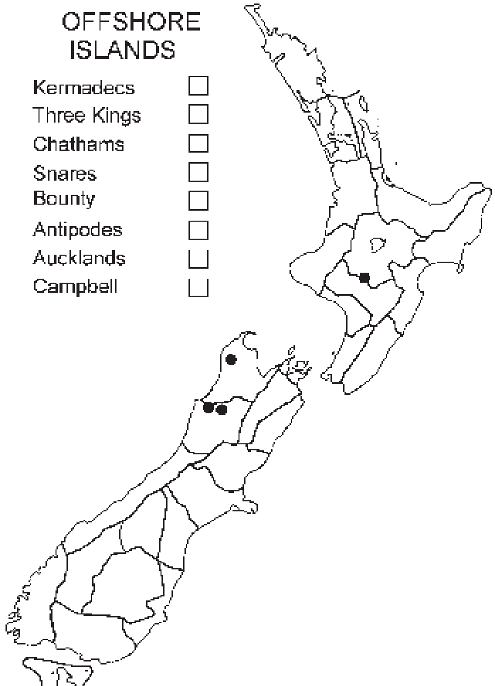
Map 6 *Criconema (C.) spinicaudatum*



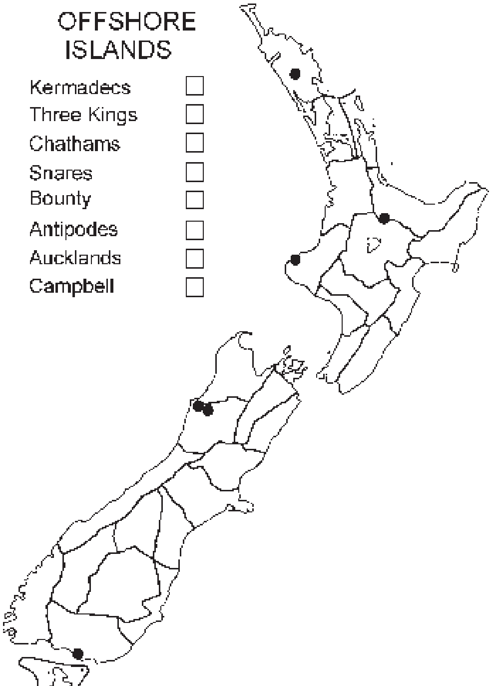
Map 7 *Criconema (N.) annuliferum*



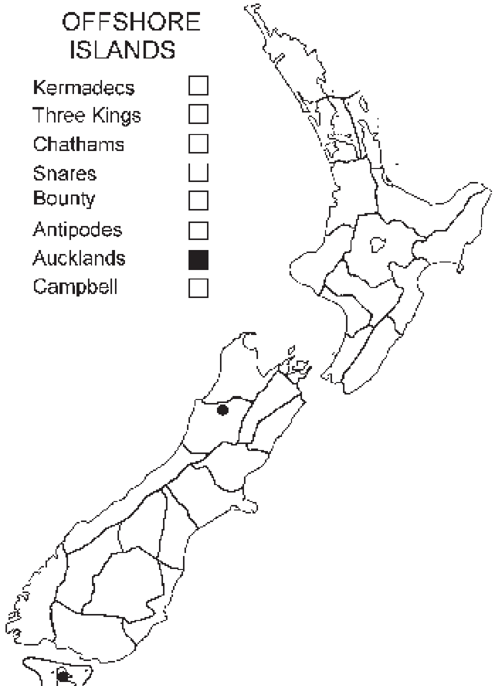
Map 8 *Criconema (N.) grandisoni*



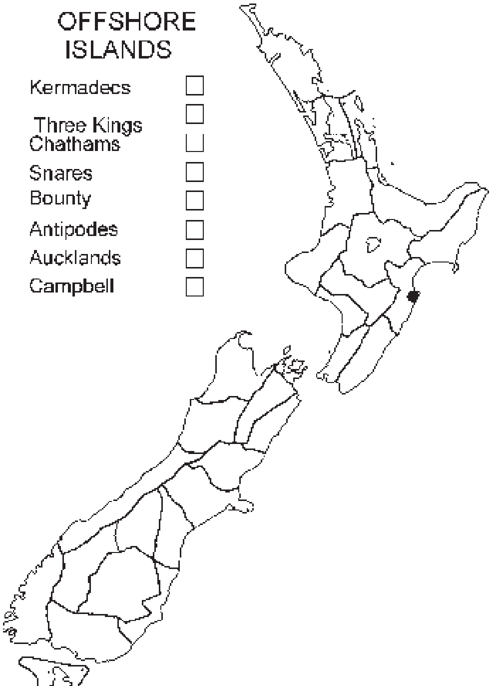
Map 9 *Criconema (N.) lineatum*



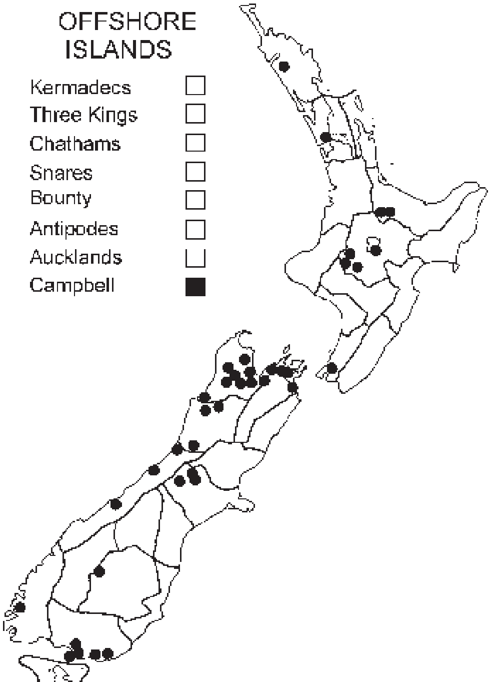
Map 10 *Criconema (N.) magnum*



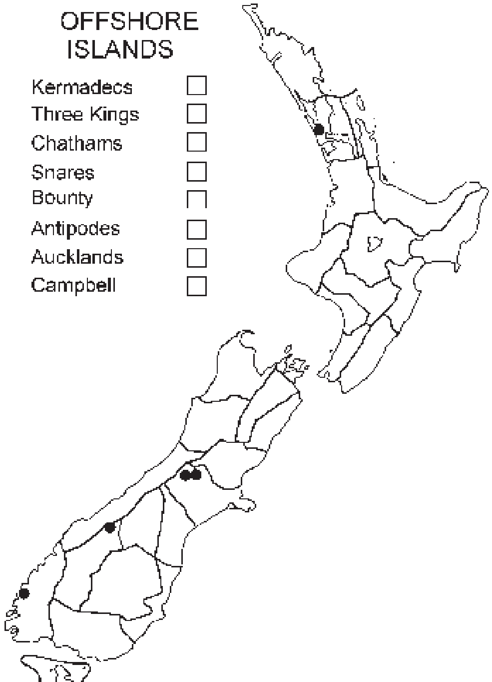
Map 11 *Criconema (N.) undulatum*



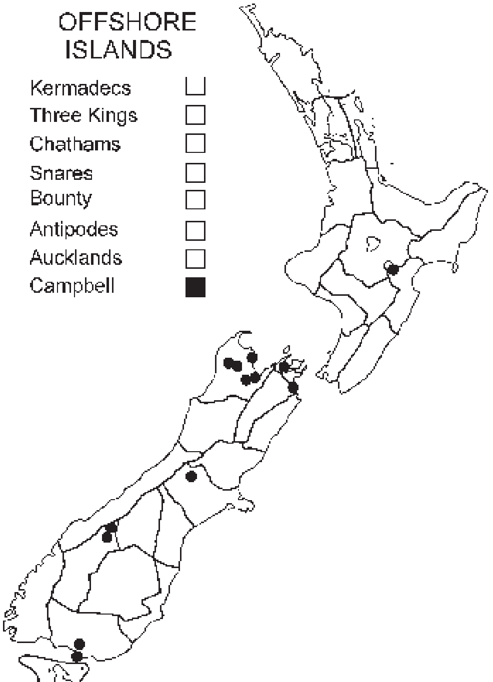
Map 12 *Criconema (N.) mutabile*



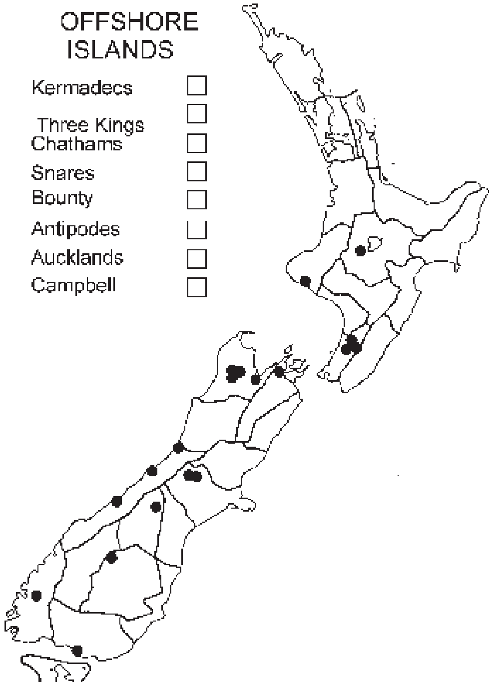
Map 13 *Criconema (N.) californicum*



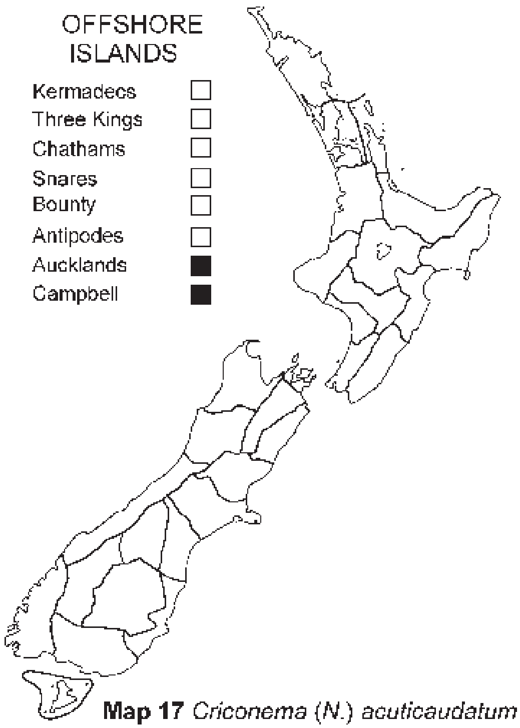
Map 14 *Criconema (N.) pasticum*



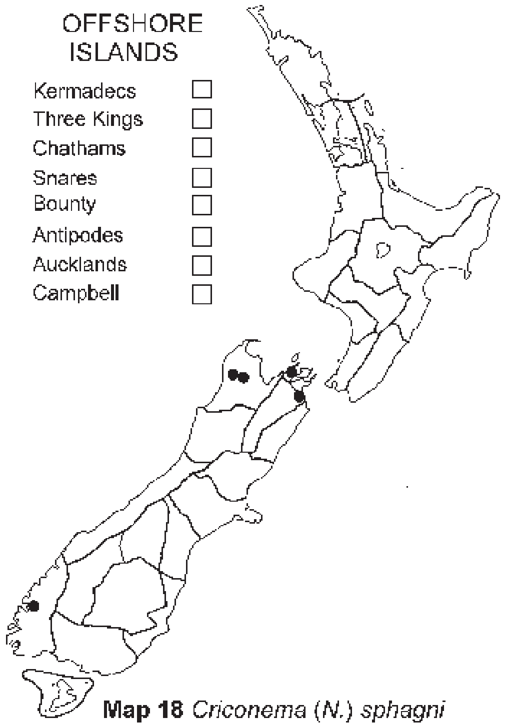
Map 15 *Criconema (N.) alpinum*



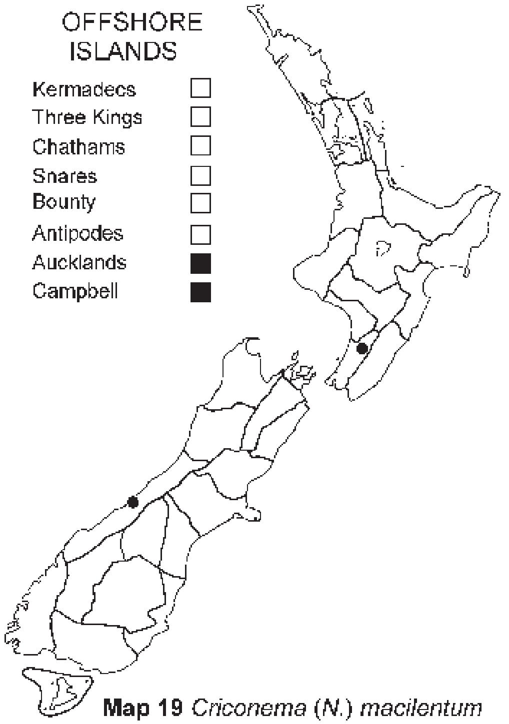
Map 16 *Criconema (N.) graminicola*



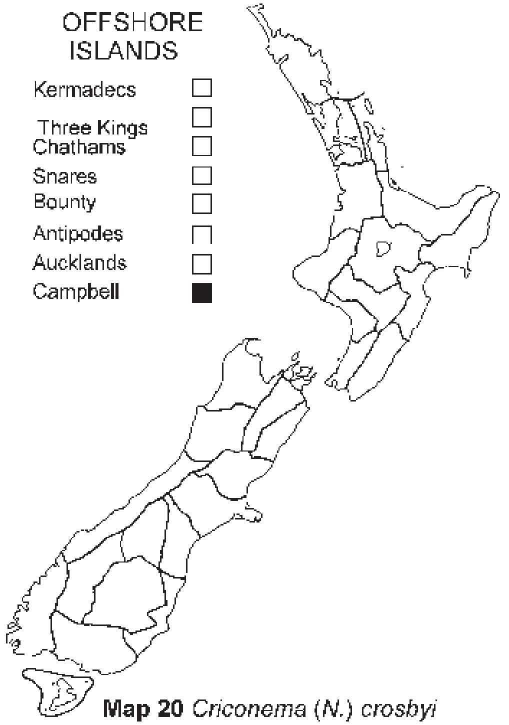
Map 17 *Criconema* (*N.*) *acuticaudatum*



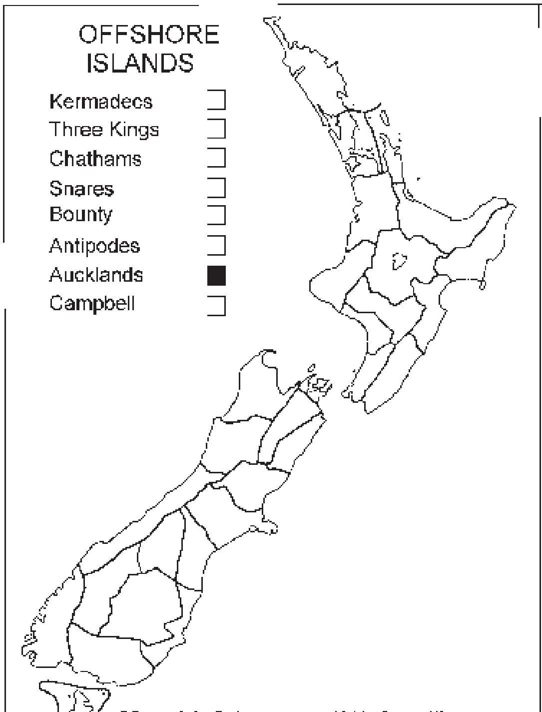
Map 18 *Criconema* (*N.*) *sphagni*



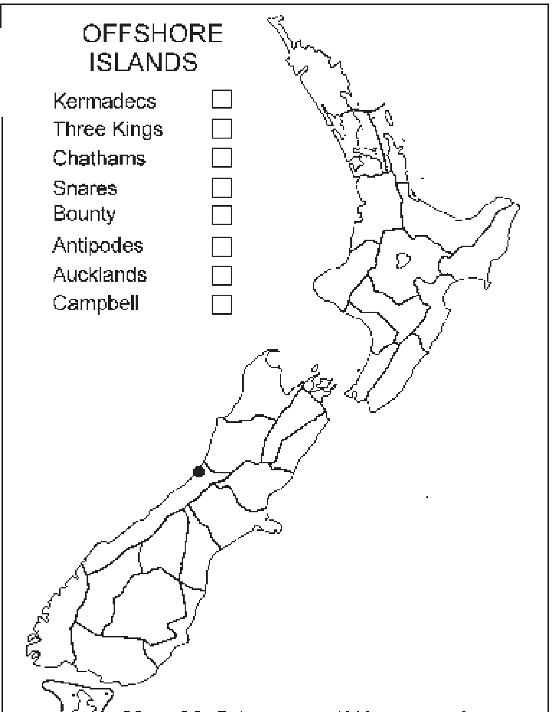
Map 19 *Criconema* (*N.*) *macilentum*



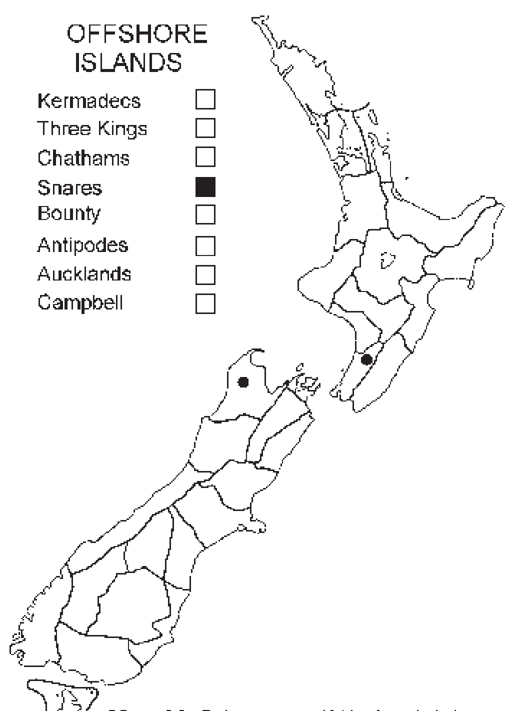
Map 20 *Criconema* (*N.*) *crosbyi*



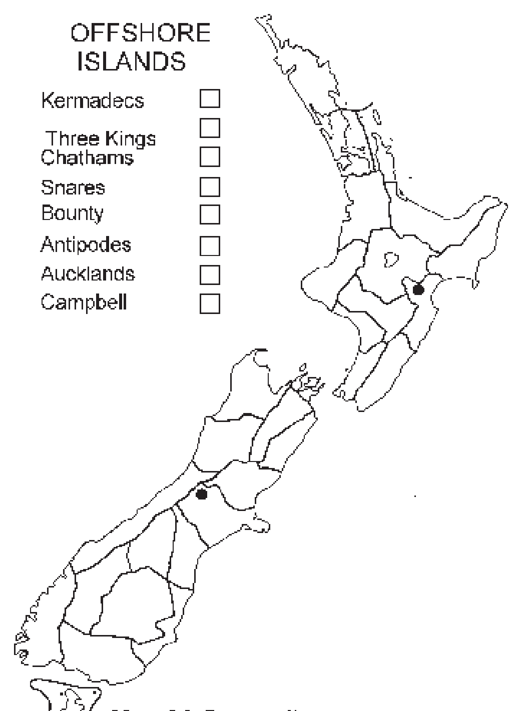
Map 21 *Criconema* (*N.*) *farrelli*



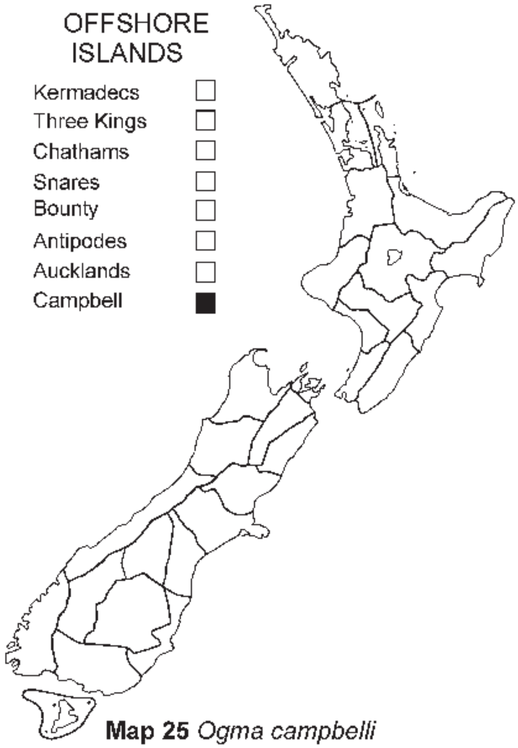
Map 22 *Criconema* (*N.*) *ramsayi*



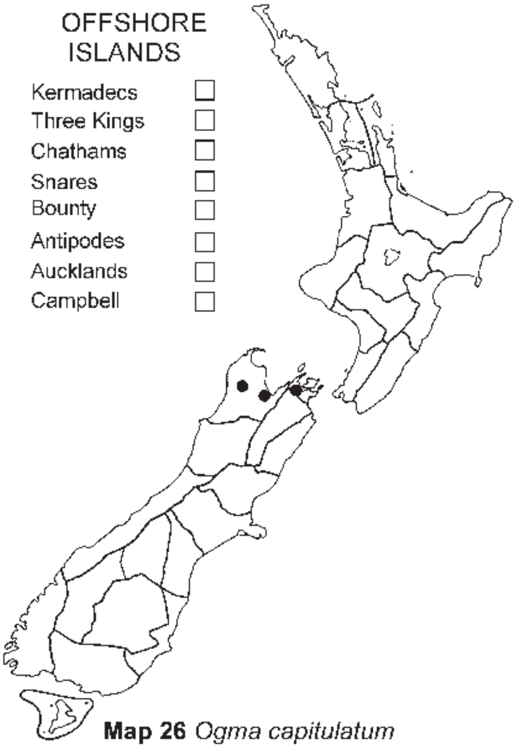
Map 23 *Criconema* (*N.*) *dugdalei*



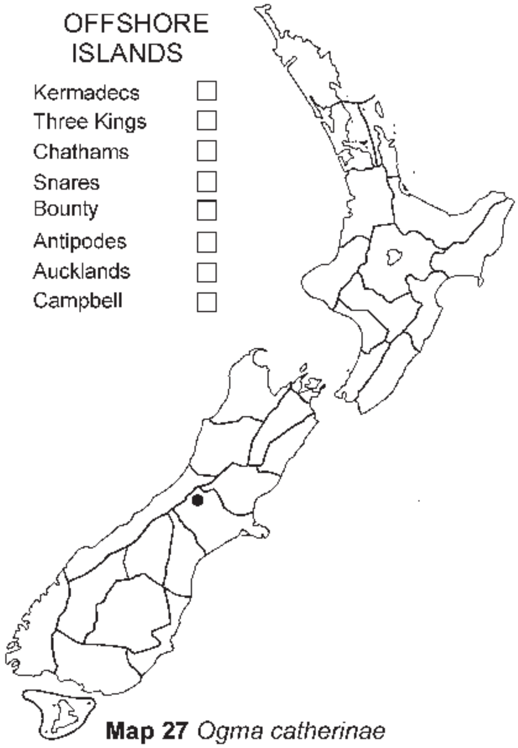
Map 24 *Ogma alternum*



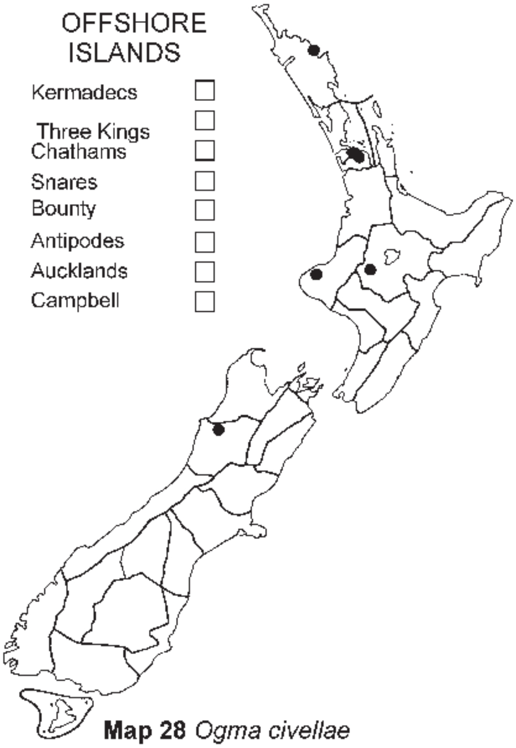
Map 25 *Ogma campbelli*



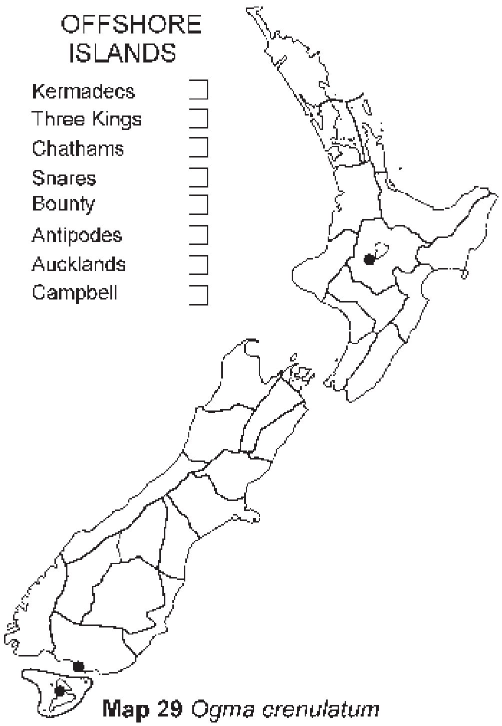
Map 26 *Ogma capitulatum*



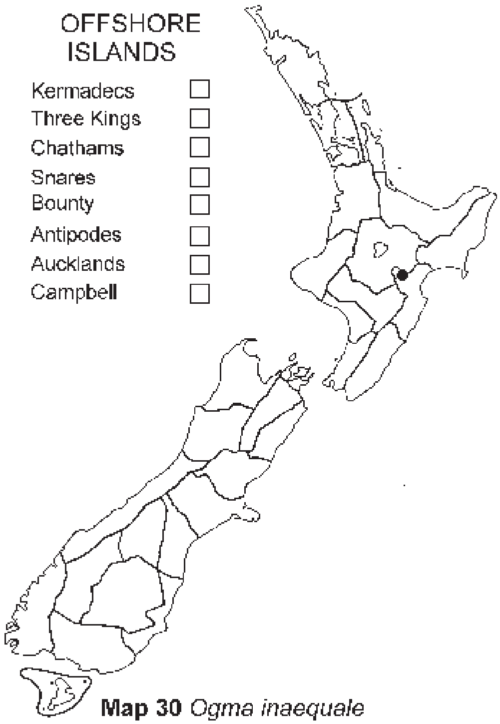
Map 27 *Ogma catherinae*



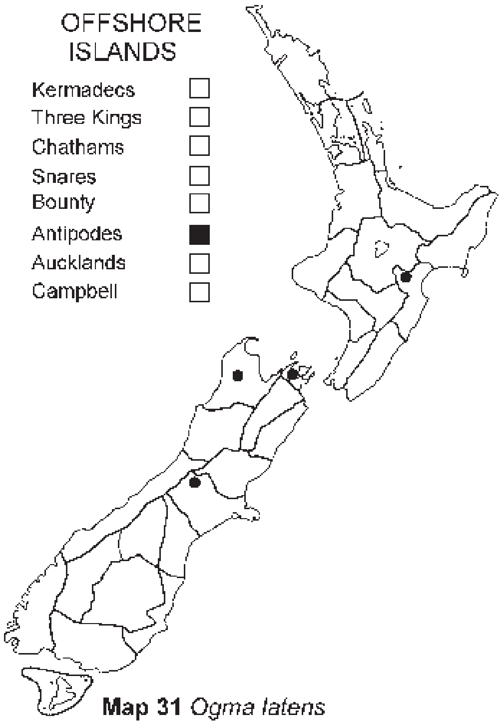
Map 28 *Ogma civellae*



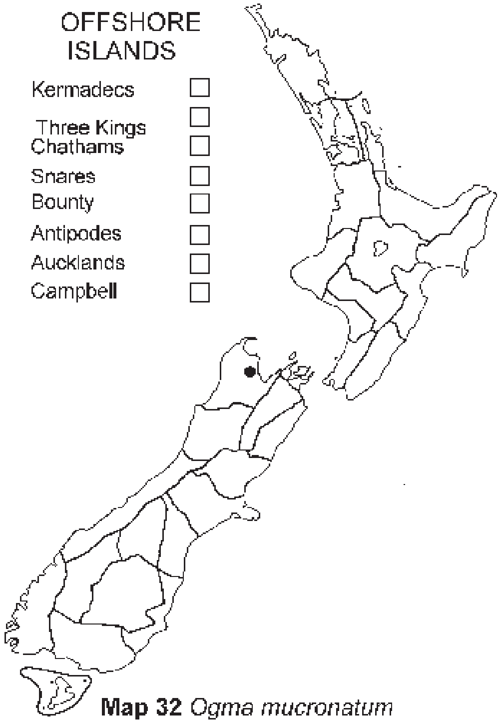
Map 29 *Ogma crenulatum*



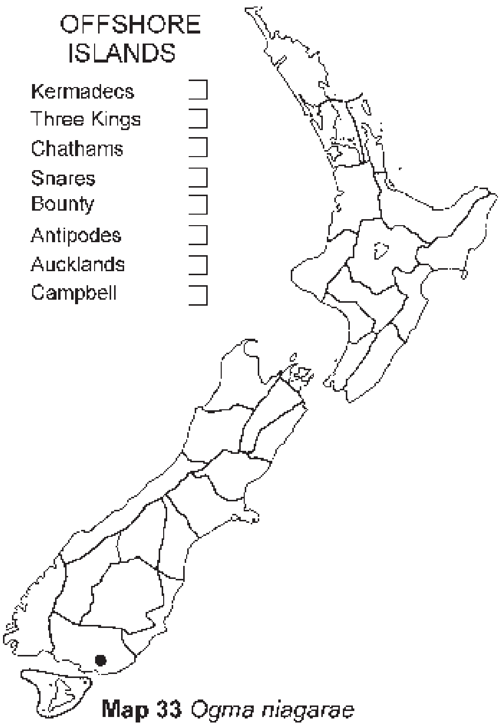
Map 30 *Ogma inaequale*



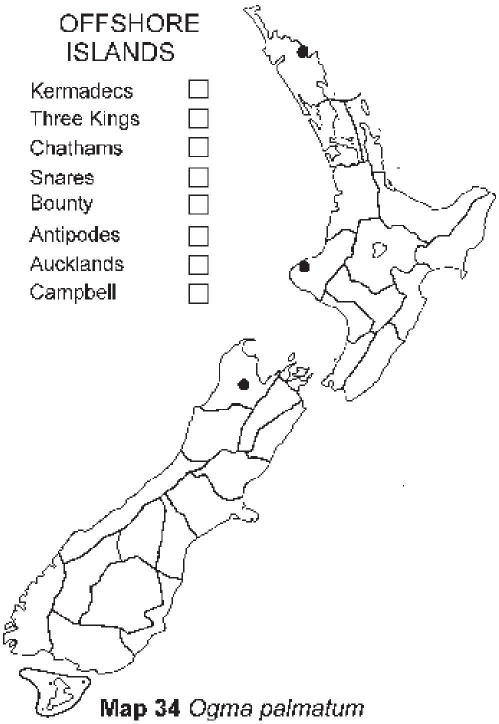
Map 31 *Ogma latens*



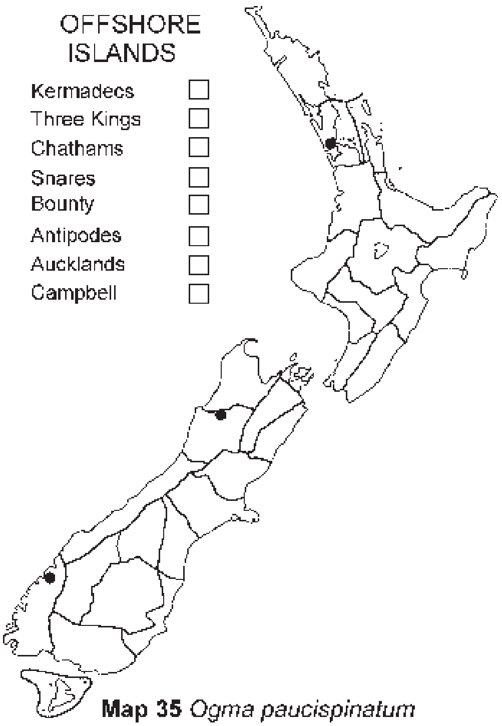
Map 32 *Ogma mucronatum*



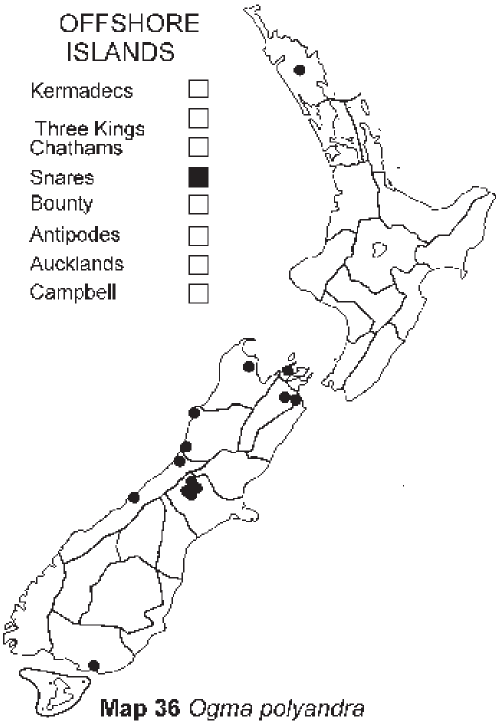
Map 33 *Ogma niagarae*



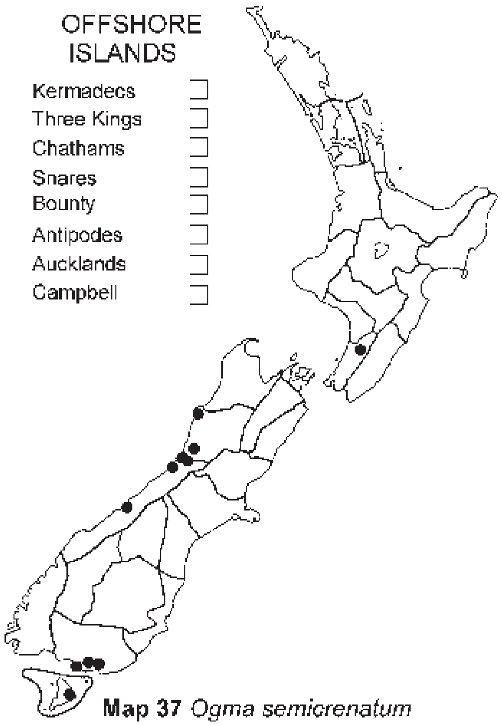
Map 34 *Ogma palmatum*



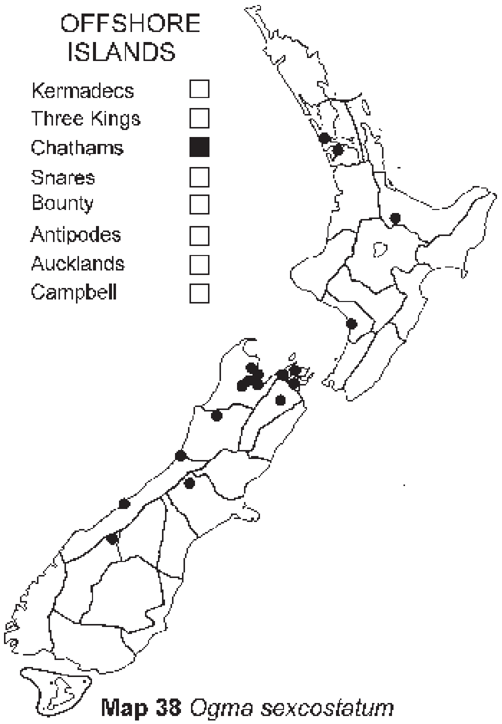
Map 35 *Ogma paucispinatum*



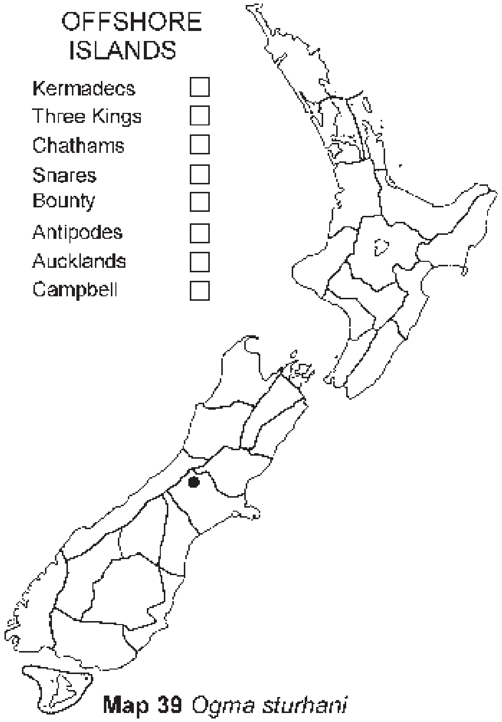
Map 36 *Ogma polyandra*



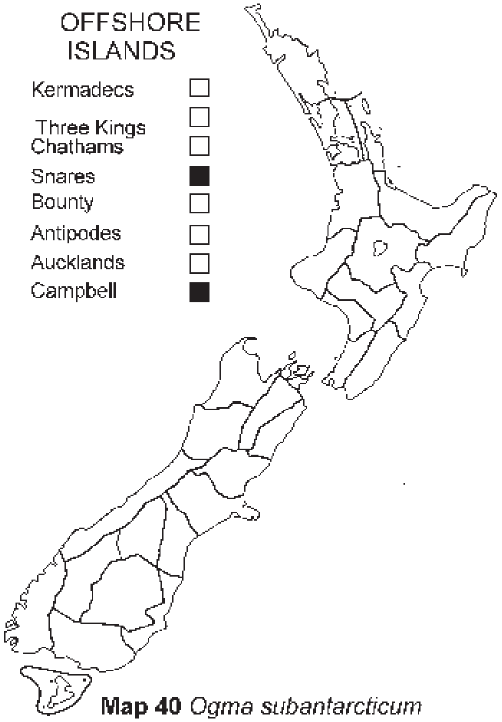
Map 37 *Ogma semicrenatum*



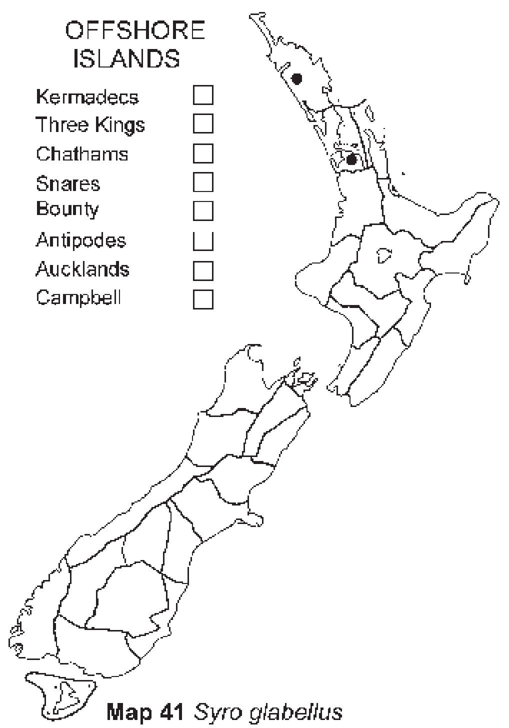
Map 38 *Ogma sexcostatum*



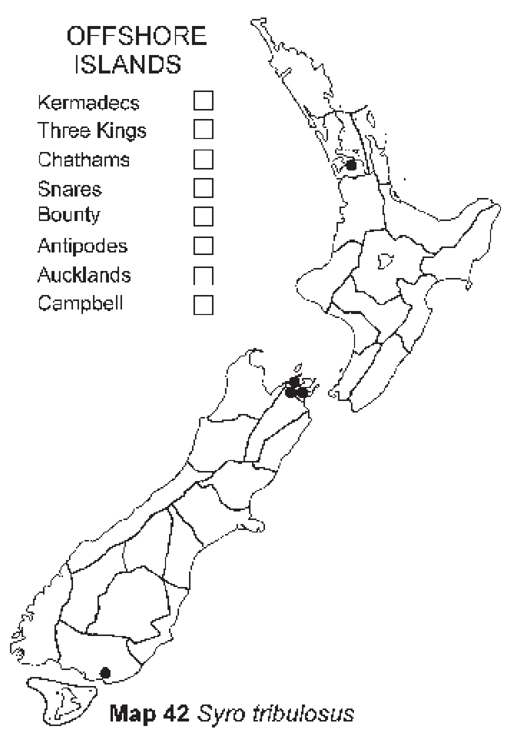
Map 39 *Ogma sturhani*



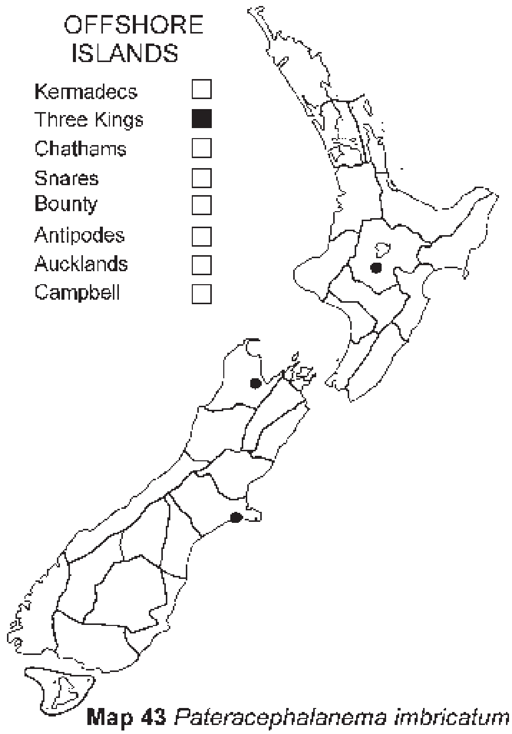
Map 40 *Ogma subantarcticum*



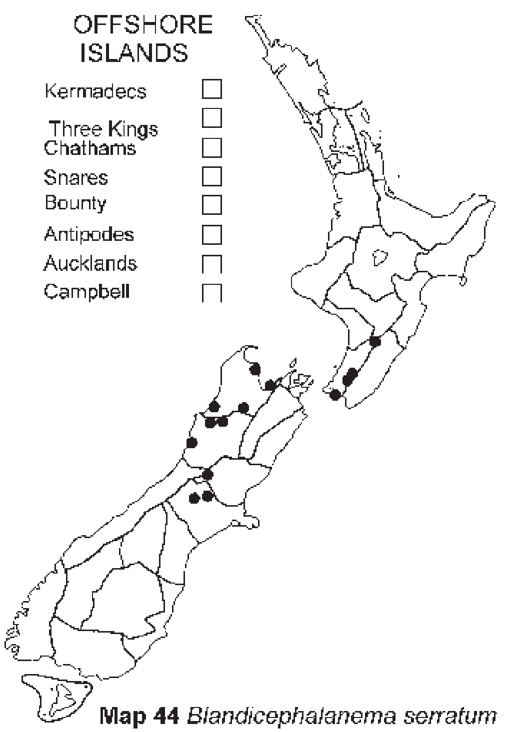
Map 41 *Syro glabellus*



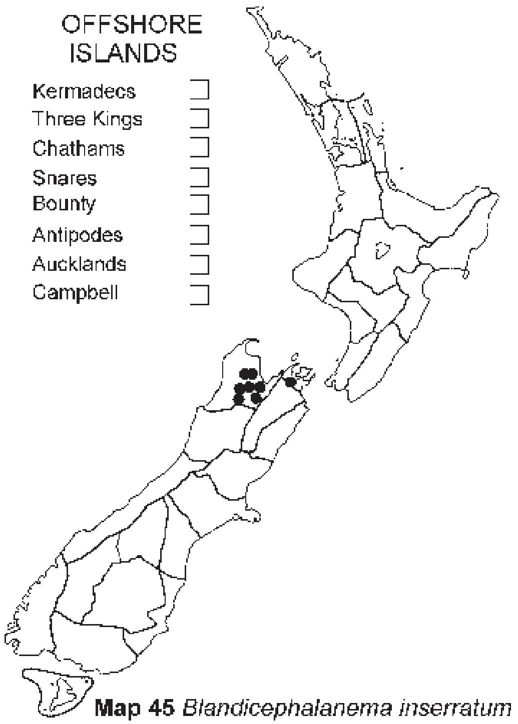
Map 42 *Syro tribulosus*



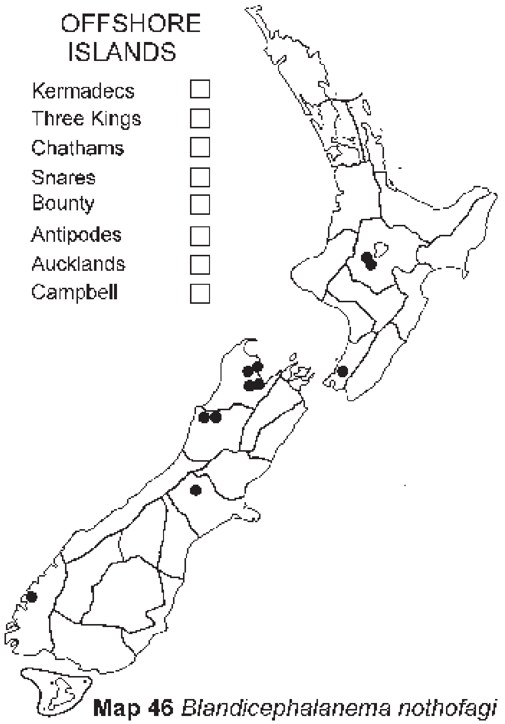
Map 43 *Pateracephalanema imbricatum*



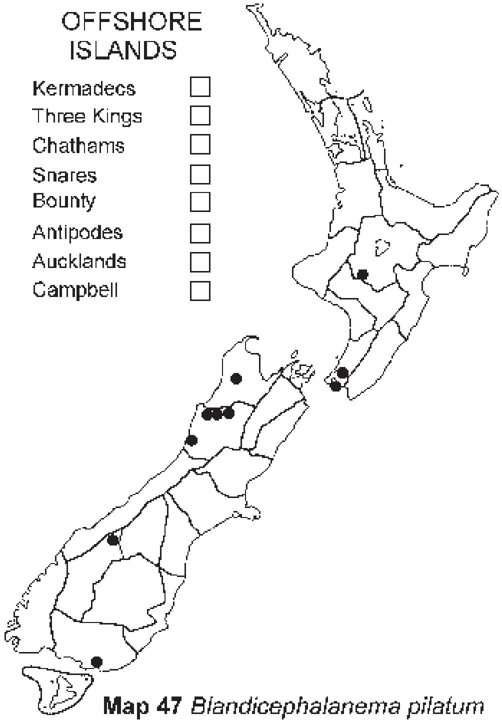
Map 44 *Blandicephalanema serratum*



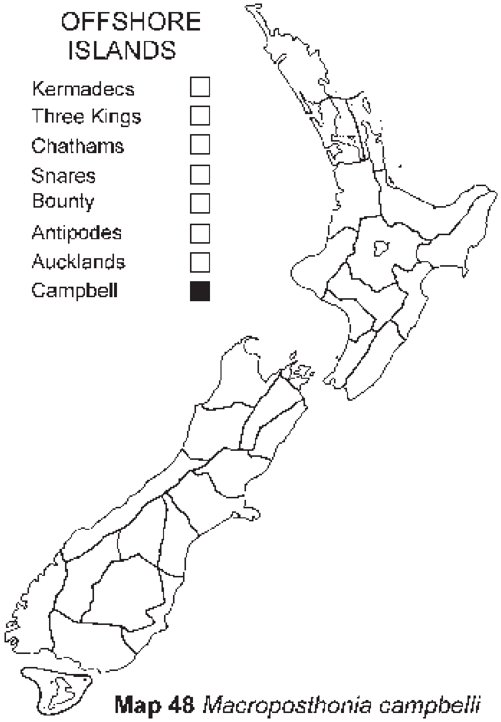
Map 45 *Blandicephalanema inserratum*



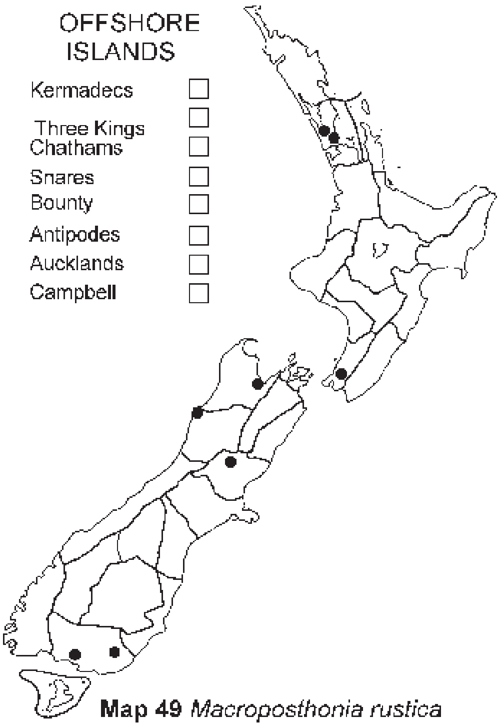
Map 46 *Blandicephalanema nothofagi*



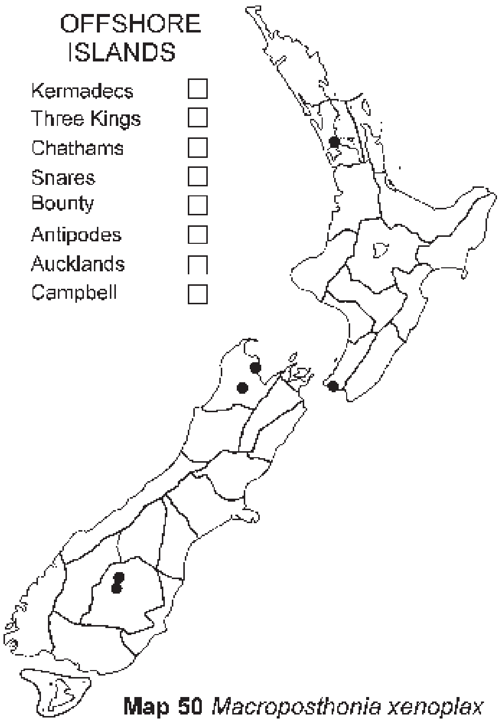
Map 47 *Blandicephalanema pilatum*



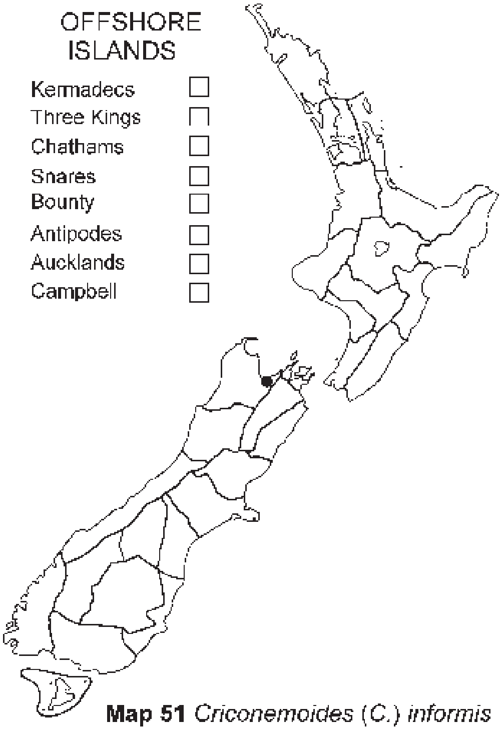
Map 48 *Macroposthonia campbelli*



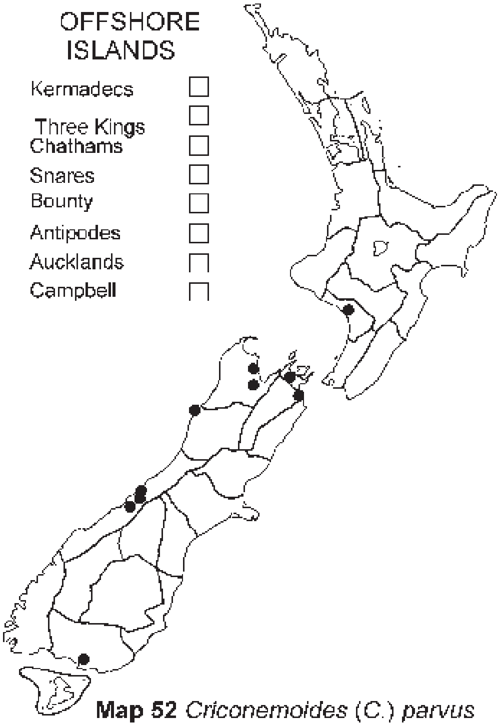
Map 49 *Macroposthonia rustica*



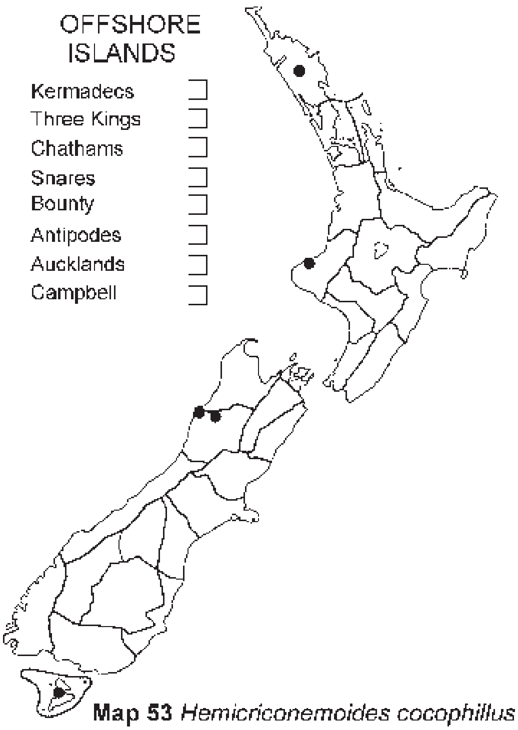
Map 50 *Macroposthonia xenoplax*



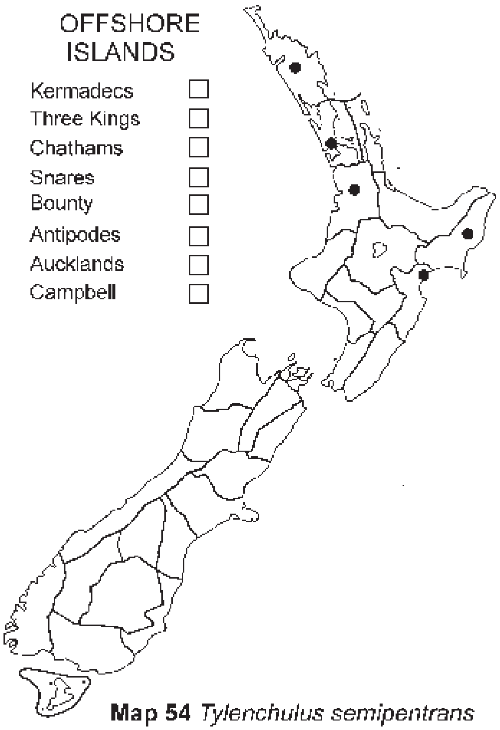
Map 51 *Criconemoides* (*C.*) *informis*



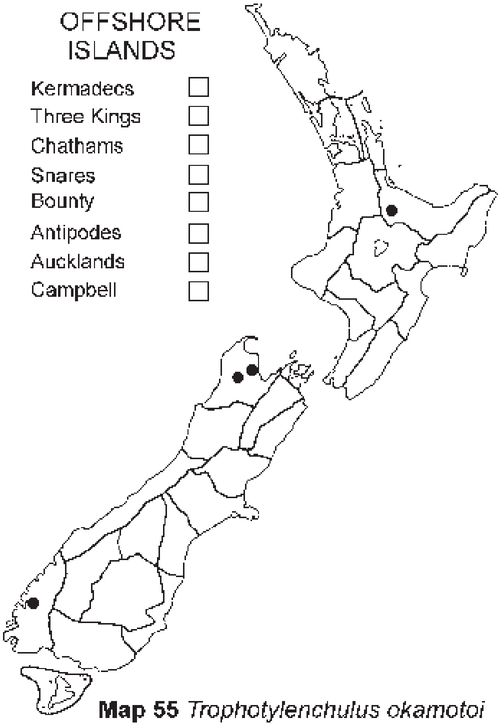
Map 52 *Criconemoides* (*C.*) *parvus*



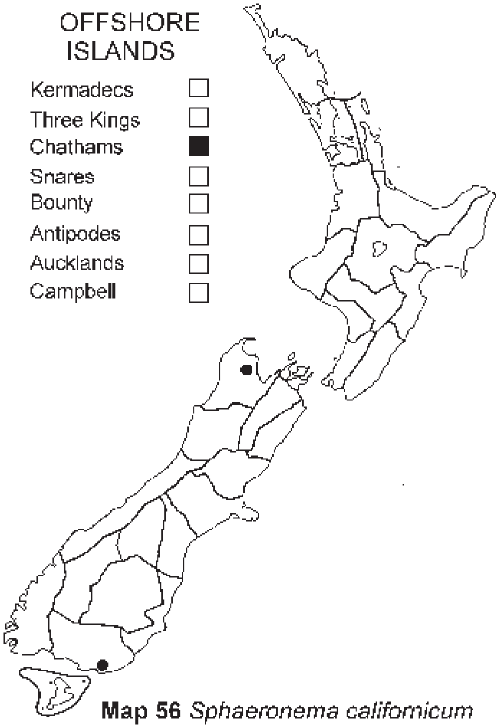
Map 53 *Hemicriconemoides cocophillus*



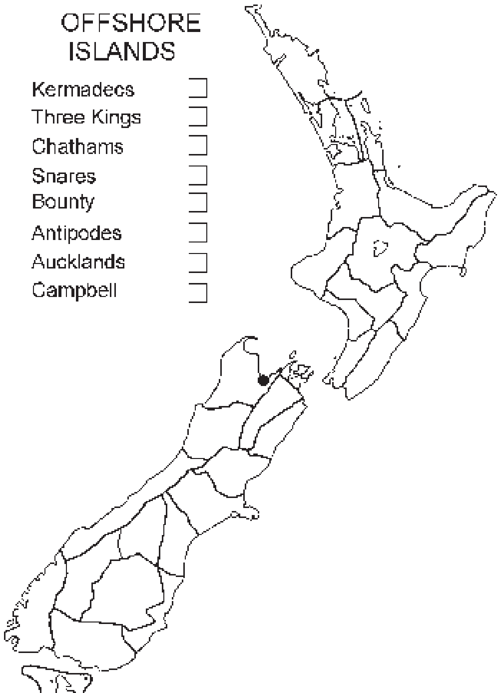
Map 54 *Tylenchulus semipentrans*



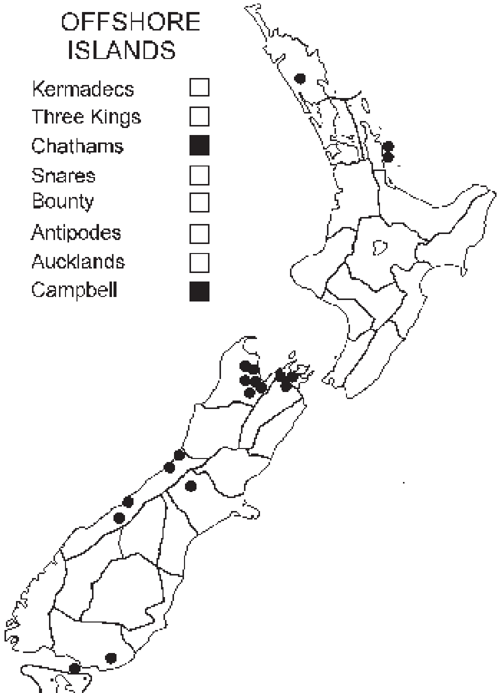
Map 55 *Trophotylenchulus okamotoi*



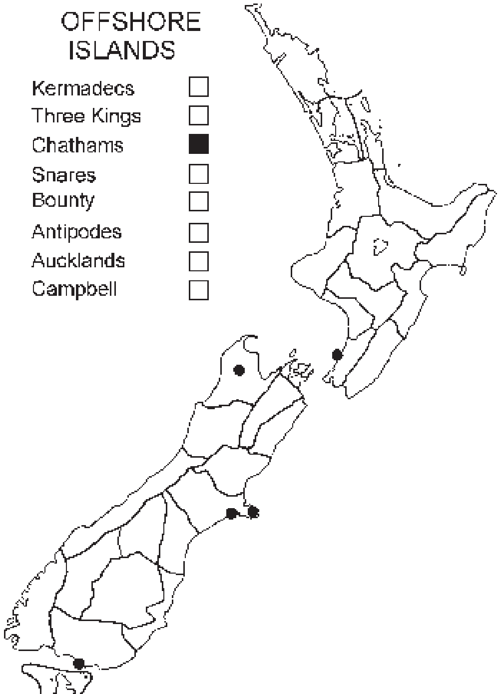
Map 56 *Sphaeronema californicum*



Map 57 *Paratylenchus (P.) halophilus*



Map 58 *Hemicycliophora chathami*



Map 59 *Hemicycliophora halophila*

TAXONOMIC INDEX

This index covers the nominal taxa mentioned in the text, regardless of their current status in taxonomy (excluding Table 1, pages 16–17, and Appendices 3 and 4, pages 92–102). In the case of synonyms, the combinations of generic and specific names listed are those originally published by authors, and may differ from combinations implicit in current usage. Taxa in **bold** indicate valid names of genera and species described in this work. Page numbers in **bold** indicate descriptions. The letter "**f**" after a page indicates a **figure**, "**k**" a **key** (other mentions of taxon may occur on same page), "**m**" a **distribution map**, and "**p**" a **photograph**.

acquitanense, Ogma 62
acuticaudata, Nothocriconemella 44
acuticaudatum, Criconema (Nothocriconemella) 38, 39k, 40, 43, **44**, 89, 103, 109, 111, 140p, 142p, 145f, 154, 155f, 211m
adamsi, Criconemella 73; Criconemoides 73; Neocriconema 73
alpina, Nothocriconemella 42
alpinum, **Criconema (Nothocriconemella)** 38, 39k, 40, **42, 43**, 44–46, 89, 103, 109, 111, 143p, 144f, 154, 155f, 210m; Criconema 42
alternum, Ogma 9, 48k, **49**,54, 57, 58, 91, 112, 156p, 157f, 212m
amicorum, Criconema 23
Amphisbaenema 9, 13, 22, 23, 66
Anguina 13, 14
annulata, Macroposthonia 70
annulatus, Hemicriconemoides 74
annuliferum, Criconema (Nothocriconema) 34k, 35, 89, 103, 108, 133f, 208m; Criconema 20; Nothocriconema (Nothocriconema) 34
annuliferus, Criconemoides 34; Hoplolaimus 34
aonli, Paratylenchus (Gracilacus) 79k, 80
Aphelenchoides 14
aquatica, Hemicycliophora 81, 82
aquitanense, Ogma 62
arenarium, Trophotylenchulus 76
Atylenchidae 18
aucklandicum, Criconema (Criconema) 29k, 30, 32, 88, 103, 107, 122f, 123p, 207m
australe, Pateracephalanema 66

Bakernema 13
Belonolaimidae 18
Blandicephalanema 9, 13, 18, 19, 21–23, 27k, 28, **66**, 67–70, 195
Blandicephalanema inserratum 9, 26, 66, **67, 68**, 88, 103, 115, 189f, 190p, 191p, 218m
Blandicephalanema nothofagi 9, 26, 66, **68, 69**, 70, 88, 103, 115, 192f, 193p, 194p, 218m
Blandicephalanema pilatum 13, 22, 23, 66, **69, 70**, 88, 103, 115, 192f, 196p, 197p, 218m
Blandicephalanema serratum 13, 22, 23, **66, 67**, 68, 69, 88, 103, 115, 187p, 188p, 217m
bossi, Blandicephalanema 67–69, 195p
braziliensis, Neolobocriconema 23
bukowinensis, Paratylenchus 78, 79

Cacopaurus 80
californicum, Criconema (Nothocriconemella) 38, 39k, **40, 41**, 42–44, 89, 103, 109, 111, 141f, 142p, 154, 155f, 210m; Nothocriconemella 40
californicum, Sphaeronema 77, 78, 92, 106, 118, 204f, 220m
californicus, Criconemoides 40
calvum, Criconema (Nothocriconema) 35
campbelli, Macroposthonia 9, 13, 26, **70, 71**, 90, 105, 116, 198f, 218m
campbelli, Ogma 22, 48k, **49, 50**, 53, 61, 91, 105, 112, 158f, 213m
capitulatum, Ogma 9, 26, 48k, **50, 51**, 91, 105, 112, 157f, 159p, 213m
cardamomi, Criconema 20
catherinae, Ogma 9, 26, 48k, **51, 52**, 63, 91, 105, 112, 160f, 161p, 213m
Cerchnotocriconema 28, 34
certesi, Criconema (Criconema) 30, 37
chathami chathami, Hemicycliophora 81, 119
chathami major, Hemicycliophora 81, 119
chathami, Hemicycliophora 80, 81, 82, 90, 105, 119, 206f, 221m
citricola, Macroposthonia 70, 71
civellae, Ogma 21, 48k, **52**, 57, 91, 105, 112, 162f, 213m
cocophila, Hemicycliophora 74
cocophillus, Hemicriconemoides 13, 24, **74**, 90, 105, 117, 201f, 220m; Criconemoides 74
complexa, Macroposthonia 72
complexus, Criconemoides 72
cornubiense, Sphaeronema 78
coronatum, Ogma 54, 62, 64
crenulatum, Ogma 22, 48k, 51, **52, 53**, 58–60, 91, 105, 112, 163f, 164p, 214m
Criconema 9, 13, 18–20, 22, 23, 27k, **29,** 30, 33–38, 40, 42–45, 47, 57, 71, 72, 86–88, 121, 129
Criconema (Criconema) aucklandicum 29k, 30, 32, 88, 103, 107, 122f, 123p, 207m
Criconema (Criconema) cristulatum 29k, **30, 31**, 32, 88, 103, 107, 123p, 124f, 125p, 207m
Criconema (Criconema) mackenziei 9, 26, 29k, **31**, 32, 33, 89, 103, 107, 126f, 127p, 207m
Criconema (Criconema) makahuense 9, 29k, **31, 32**, 33, 89, 103, 107, 126f, 207m
Criconema (Criconema) nelsonense 9, 26, 29k, **32, 33**, 86–89, 103, 107, 128f, 129p, 131p, 208m
Criconema (Criconema) spinicaudatum 29k, 31, 32, **33, 34**, 89, 103, 107, 123p, 128f, 132p, 208m
Criconema (Nothocriconema) annuliferum 34k, 35, 89, 103, 108, 133f, 208m
Criconema (Nothocriconema) grandisoni 9, 34k, **35**, 90, 104, 108, 133f, 134p, 208m

Criconema (Nothocriconema) lineatum 34k, **35, 36**, 90, 104, 108, 135p, 136f, 209m
Criconema (Nothocriconema) magnum 34k, **36, 37**, 38, 90, 104, 108, 137f, 138p, 139p, 209m
Criconema (Nothocriconema) undulatum 34k, **37, 38**, 90, 104, 108, 136f, 140p, 209m
Criconema (Nothocriconemella) acuticaudatum 38, 39k, 40, 43, **44**, 89, 103, 109, 111, 140p, 142p, 145f, 154, 155f, 211m
Criconema (Nothocriconemella) alpinum 38, 39k, 40, **42, 43**, 44–46, 89, 103, 109, 111, 114f, 143p, 154, 155f, 210m
Criconema (Nothocriconemella) californicum 38, 39k, **40, 41**, 42–44, 89, 103, 109, 111, 141f, 142p, 154, 155f, 210m
Criconema (Nothocriconemella) crosbyi 38k, 39, **46, 47**, 89, 104, 110, 111, 148p, 150f, 151p, 154, 155f, 211m
Criconema (Nothocriconemella) dugdalei 38, 39k, 40, 46, **47**, 89, 104, 110, 111, 149p, 152p, 153f, 154, 155f, 212m
Criconema (Nothocriconemella) farrelli 38, 39k, **46**, 47, 89, 104, 110, 111, 149p, 150f, 152p, 154, 155f, 212m
Criconema (Nothocriconemella) graminicola 38, 39k, 40, **43, 44**, 45, 89, 104, 109, 111, 142p, 145f, 146p, 154, 155f, 210m
Criconema (Nothocriconemella) macilentum 38, 39k, 40, 44, **45**, 46, 47, 90, 104, 110, 111, 147f, 148p, 149p, 154, 155f, 211m
Criconema (Nothocriconemella) mutabile 38, 39k, **40**, 41, 44, 90, 104, 109, 111, 141f, 142p, 143p, 154, 155f, 209m
Criconema (Nothocriconemella) pasticum 38, 39k, 40, 41, **42, 43**, 44, 90, 104, 109, 111, 144f, 154, 155f, 210 m
Criconema (Nothocriconemella) ramsayi 38k, 39, **46, 47**, 90, 104, 110, 111, 151p, 152p, 153f, 154, 155f, 212m
Criconema (Nothocriconemella) sphagni 9, 38, 39k, 40, **44**, 45–47, 90, 104, 110, 111, 147f, 148p, 149p, 154, 155f, 211m; Criconemoides 44; Nothocriconema 44; Nothocriconemella 44
Criconematidae 9, 13,14, 18, 19, 27k, 28, 73, 86
Criconematina 9, 12–14, 18, 19, 27k, 28, 74, 80
Criconematinae 13, 18, 19, 27k, 28, 29, 48, 63, 65, 66, 70, 86
Criconematoidea 9, 18, 19, 27k, 28
Criconematoidi 28
Criconemella 18, 23, 70–73
Criconemellinae 70
Criconemoides 13, 18, 23, 27k, 34, 40, 41, 44, 70, 71, **72**, 73, 74, 86
Criconemoides (Criconemella) parvus 23, **73**, 90, 104, 116, 200f, 219m
Criconemoides (Criconemoides) informis 72, 73, 90, 104, 116, 200f, 219m
cristulatum, Criconema (Criconema) 29k, **30, 31**, 32, 88, 103, 107, 123p, 124f, 125p, 207m
crosbyi, Criconema (Nothocriconemella) 38k, 39, **46, 47**, 89, 104, 110, 111, 148p, 150f, 151p, 154, 155f, 211m
Croserinema 21, 22, 47, 57
Crossonema 9, 13, 18, 19, 47, 55, 57
crotaloides, Criconema (Criconema) 37

decalineatum, Ogma 51
destructor, Ditylenchus 13
dipsaci, Ditylenchus 14
Ditylenchus 13, 14
Dorylaimus 86
dryum, Ogma 62
dugdalei, Criconema (Nothocriconemella) 39k, 40, 46, **47**, 89, 104, 110, 111, 149p, 152p, 153f, 154, 155f, 212m
duodevigintilineatum, Ogma 51

elachistus, Paratylenchus (Paratylenchus) 79k
epacris, Cacopaurus 80; Gracilacus 80; Paratylenchus 80; Paratylenchus (Gracilacus) 80
Eubostrichus 9, 29, 86, 87

farrelli, Criconema (Nothocriconemella) 38, 39k, **46**, 47, 89, 104, 110, 111, 149p, 150f, 152p, 154, 155f, 212m
feckneri, Ogma 53, 57, 60
fimbriatus, Criconemoides 72
flandriensis, Criconemoides 72
floridensis, Trophotylenchulus 75; Tylenchulus 75

giardi, Criconema 19, 20, 86, 87; Criconema (Criconema) 37; Dorylaimus 86
glabellus, Syro 9, 26, 48k, **64**, 65, 92, 106, 114, 182f, 183p, 217m
Globodera 14
Goodeyella 77
Gracilacus 18, 19, 27k, 78, 79, **80**
Gracilpaurus 78, 80
graminicola, Criconema (Nothocriconemella) 38, 39k, 40, **43, 44**, 45, 89, 104, 109, 111, 142p, 145f, 146p, 154, 155f, 210m; Nothocriconemella 43
grandisoni, Criconema (Nothocriconema) 9, 34k, **35**, 90, 104, 108, 134p, 208m
grassator, Criconema 44; Criconemoides 44; Nothocriconema 44; Nothocriconemella 44
guernei, Criconema 20, 86–88; Criconema (Criconema) 29, 33, 121f, 129p; Eubostrichus 9, 29, 86, 87; Hoplolaimus 29; Iota 29; Ogma 29

haguei, Ogma 62
halophila, Hemicycliophora 80, **81, 82**, 90, 105, 119, 206f, 221m
halophilus, Paratylenchus (Paratylenchus) 79k, 80, 91, 106, 117, 205f, 221m; Paratylenchus 13, 79
Hemicriconemoides 13, 15, 18, 27k, **73**, 74
Hemicriconemoides cocophillus 13, 24, **74**, 90, 105, 117, 201f, 220m

Hemicriconemoidinae 13, 19, 24, 27k, 73
Hemicycliophora 15, 19, 27k, 74, **80**, 81, 82, 105, 119
Hemicycliophora chathami 80, 81, 82, 90, 105, 119, 206f, 221m
Hemicycliophora halophila 80, **81, 82**, 90, 105, 119, 206f, 221m
Hemicycliophoridae 18, 19, 25, 27k, 80
Hemicycliophorinae 27k
Hemicycliophoroidea 19, 25, 27k, 28, 80
Heterodera 14
Homogma 21
Hoplolaimina 18
Hoplolaimus 29, 34, 47, 71, 72, 86
hygrophilum, Criconema annuliferum 34; Criconemoides 34; Nothocriconema 34
hymenophorum, Macroposthonia 23

imbricatum, Pateracephalanema 9, 13, 48k, **65, 66**, 91, 106, 114, 182f, 186p, 217m; Criconema 65; Ogma 65
inaequale, Ogma 9, 48k, **53, 54**, 57, 91, 105, 112, 162f, 165p, 214m
informe, Criconema 72
informis, Criconemoides (Criconemoides) 72, 73, 90, 104, 116, 200f, 219m; Criconemella 72; Hoplolaimus 72; Macroposthonia 72
inserratum, Blandicephalanema 9, 26, 66, **67, 68**, 88, 103, 115, 189f, 190p, 191p, 218m
Iota 29, 47, 73
Ivotylenchulus 75

justum, Criconema (Nothocriconemella) 43

kashmirense, Nothocriconemella 40
kashmirensis, Criconema 40; Criconemoides 40
kirjanovae, Criconema 34; Criconemella 70; Criconemoides 70; Macroposthonia 70; Mesocriconema 70; Neocriconema 70

lamellatum, Criconemoides 23
lanxifrons, Criconema (Criconema) 37
latens, Ogma 13, 48k, **54, 55**, 91, 105, 112, 166f, 167p, 214m
lineatum, Criconema (Nothocriconema) 34k, **35, 36**, 90, 104, 108, 135p, 136f, 209m
lobata, Macroposthonia 71
lobatus, Criconemoides 71
Lobocriconema 13
loma, Criconemella 71; Macroposthonia 71; Madinema 71

macilenta, Nothocriconemella 45
macilentum, Criconema (Nothocriconemella) 38, 39k, 40, 44, **45**, 46, 47, 90, 104, 110, 111, 147f, 148p, 149p, 154, 155f, 211m; Criconema 13; Nothocriconema 45
mackenziei, Criconema (Criconema) 9, 26, 29k, **31**, 32, 33, 89, 103, 107, 126f, 127p, 207m
Macrocriconema 21
Macroposthonia 9, 13, 18, 23, 27k, **70**, 71, 72
Macroposthonia campbelli 9, 13, 26, **70, 71**, 90, 105, 116, 198f, 218m
Macroposthonia rustica 13, 23, 36, 70, **71**, 72, 90, 105, 116, 199f, 219m
Macroposthonia xenoplax, 13, 23, 70, **71, 72**, 90, 105, 116, 199f, 219m
Macroposthoniidae 28
Macroposthoniinae 13, 18, 19, 23, 27k, 70
Madinema 70, 71
Madinematidae 28
Madinematinae 70
magnoliae, Criconema 40; Criconemoides 40
magnum, Criconema (Nothocriconema) 34k, **36, 37**, 38, 90, 104, 108, 137f, 138p, 139p, 209m
makahuense, Criconema (Criconema) 9, 29k, **31, 32**, 33, 89, 103, 107, 126f, 207m
malabricum, Ogma 62
mehrasi, Ogma 66
melanesicum, Ogma 57, 60
Meloidoderitidae 76
Meloidogyne 13, 14
Meloidogynidae 18, 75
membranifer, Hemicycliophora 80; Procriconema 80
menzeli, Hoplolaimus 86; Ogma 86
Mesocriconema 13, 70–72
microserratus, Criconemella 73; Criconemoides 73
minusculus, Paratylenchus (Paratylenchus) 79, 80
minutissimum, Sphaeronema 78
minutus, Paratylenchus (Paratylenchus) 79k
morgense, Criconema 72, 86
morgensis, Criconemoides (Criconemoides) 72; Hoplolaimus 72
mucronatum, Ogma 9, 26, 48k, **55, 56**, 91, 105, 112, 166f, 168p, 214m
mukovum, Criconema, 40; Nothocriconema 40
murrayi, Criconema 47; Hoplolaimus 47; Iota 47; Ogma 47; Variasquamata 47
mutabile, Criconema (Nothocriconemella) 38, 39k, **40**, 41, 44, 90, 104, 109, 111, 141f, 142p, 143p, 154, 155f, 209m; Nothocriconema 40
mutabilis, Criconemoides 40; Nothocriconemella 40

nainianus, Paratylenchus (Paratylenchus) 79k
nanus, Paratylenchus (Paratylenchus) 79k
nelsonense, Criconema (Criconema) 9, 26, 29k, **32, 33**, 86–89, 103, 107, 128f, 129p–131p, 208m
Nenocriconema 28, 34
neoamblycephalus, Paratylenchus (Paratylenchus) 79k
Neobakernema 70
Neocriconema 70, 72, 73
Neocrossonema 47
Neolobocriconema 13, 23
niagarae, Ogma 9, 48k, **56, 57**, 91, 105, 112, 169f, 215m
Nothocriconema 9, 18, 20, 23, 27k, 28, 29, 33, **34**, 35–38, 40, 42, 44, 45

Nothocriconemella 9, 15, 18–21, 27k, 28, 29, **38**, 39–47
nothofagi, Blandicephalanema 9, 26, 66, **68, 69**, 70, 88, 103, 115, 192f, 193p, 194p, 218m
Notholetus 19, 20, 28

octozonale, Ogma 53
Ogma 9, 13, 18–22, 27k, 28, 29, 37, **47**, 48k, 49–66, 69, 86–88, 129
Ogma alternum 9, 26, 48k, **49**,54, 57, 58, 91, 112, 156p, 157f, 212m
Ogma campbelli 22, 48k, **49, 50**, 53, 61, 91, 105, 112, 158f, 213m
Ogma capitulatum 9, 26, 48k, **50, 51**, 91, 105, 112, 157f, 159p, 213m
Ogma catherinae 9, 26, 48k, **51, 52**, 63, 91, 105, 112, 160f, 161p, 213m
Ogma civellae 21, 48k, **52**, 57, 91, 105, 112, 162f, 213m
Ogma crenulatum 22, 48k, 51, **52, 53**, 58–61, 91, 105, 112, 163f, 164p, 214m
Ogma inaequale 9, 48k, **53, 54**, 57, 91, 105, 112, 162f, 165p, 214m
Ogma latens 13, 48k, **54, 55**, 91, 105, 112, 166f, 167p, 214m
Ogma mucronatum 9, 26, 48k, **55, 56**, 91, 105, 112, 166f, 168p, 214m
Ogma niagarae 9, 48k, **56, 57**, 91, 105, 112, 169f, 215m
Ogma palmatum 21, 48k, 49, 52, 54, **57, 58**, 91, 105, 113, 169f, 170p, 215m
Ogma paucispinatum 22, 48k, 51, 53, 56, 57, **58, 59**, 60, 91, 105, 113, 171f, 172p, 215m
Ogma polyandra 22, 48k, 53, 58, **59, 60**, 63, 91, 105, 113, 173f, 174p, 215m
Ogma semicrenatum 22, 48k, 53, 57–59, **60, 61**, 91, 106, 113, 175f, 176p, 216m
Ogma sexcostatum 22, 48k, 53, 54, **61, 62**, 91, 106, 113, 177f, 178p, 216m
Ogma sturhani 5, 9, 26, 48k, **62, 63**, 91, 106, 113, 179f, 180p, 216m
Ogma subantarcticum 48k, 53, 58, 60, **63**, 91, 106, 113, 181f, 216m
Ogmidae 28
Ogminae 28
okamotoi, Trophotylenchulus **75**, **76**, 92, 106, 117, 203f, 220m; Trophonema 76
Orphreyus 21

Pakcriconemoides 70
palmatum, Ogma 21, 48k, 49, 52, 54, **57, 58**, 91, 105, 113, 169f, 170p, 215m; Criconema 57; Croserinema 57; Crossonema (Crossonema) 57
paracivellae, Ogma 62
Paracriconema 19, 20, 28, 34
paradoxiger, Amphisbaenema 23
Paratylenchidae 18, 24, 27k, 74, 78
Paratylenchinae 27k
Paratylenchoides 78, 79
Paratylenchus 13, 19, 24, 27k, **78**, 79, 80
Paratylenchus (Paratylenchus) halophilus **79k, 80**, 91, 106, 117, 205f, 221m
parva, Criconemella 73
parvus, Criconemoides (Criconemella) 23, **73**, 90, 104, 116, 200f, 219m
pastica, Nothocriconemella 42
pasticum, Criconema (Nothocriconemella) 38, 39k, 40, 41, **42, 43**, 44, 90, 104, 109, 111, 144f, 154, 155f, 210m; Criconema 13; Nothocriconema 42
Pateracephalanema 9,18, 21, 22, 27k, 28, 47, 48k, 64, **65**, 66
Pateracephalanema imbricatum 9, 13, 48k, **65, 66**, 91, 106, 114, 182f, 186p, 217m
paucispinatum, Ogma 22, 48k, 51, 53, 56, 57, **58, 59**, 60, 91, 105, 113, 171f, 172p, 215m
pectinatum, Criconema 22; Ogma 22, 50, 53, 59, 60, 63
Pellipecten 21, 22
pellitum, Ogma 50, 53, 63
pilatum, Blandicephalanema 13, 22, 23, 66, **69, 70**, 88, 103, 115, 192f, 196p, 197p, 218m; Ogma 69
polyandra, Ogma 22, 48k, 53, 58, **59, 60**, 63, 91, 105, 113, 173f, 174p, 215m
Procriconema 80
projectus, Paratylenchus (Paratylenchus) 79k
psephinum, Criconema (Criconema) 23, 37
Pseudocriconema 47
pseudohercyniense, Mesocriconema 72; Neocriconema 72
pseudohercyniensis, Criconemoides 72; Macroposthonia 72

quadricorne, Criconema 71; Mesocriconema 71
quadricornis, Criconemoides 71; Macroposthonia 71

racemispinosa, Criconema 20
racemispinosum, Criconema (Criconema) 30
Radopholus 14
ramsayi, Criconema (Nothocriconemella) 38k, 39, **46, 47**, 90, 104, 110, 111, 151p, 152p, 153f, 154, 155f, 212m
raskii, Criconema 40; Criconemoides 40
rhombosquamatum, Ogma 51
ritzemabosi, Aphelenchoides 14
rumicis, Sphaeronema 78
rusium, Criconemella 71; Macroposthonia 71; Mesocriconema 71
rustica, Macroposthonia 13, 23, 36, 70, **71**, 72, 90, 105, 116, 199f, 219m
rusticum, Criconema 71; Mesocriconema 71
rusticus, Hoplolaimus 71

schachtii, Heterodera 14
semicrenatum, Ogma 22, 48k, 53, 57–59, **60, 61**, 91, 106, 113, 175f, 176p, 216m
semipenetrans, Tylenchulus 24, **75**, 92, 106, 202f, 220m
Seriespinula 21, 22, 47
serratum, Blandicephalanema 13, 22, 23, **66, 67**, 68–70, 88, 103, 115, 187p, 188p, 217m; Ogma 66
Seshadriella 70
sexcostatum, Ogma 22, 48k, 50, 53, 54, **61, 62**, 91, 106, 113, 177f, 178p, 216m
shepherdae, Nothocriconema 23

siddiqii, Criconema 40;
  Criconemoides 40;
  Nothocriconemella 40
simlaense, Ogma 51
sokliense, Ogma 53, 58, 59
Sphaeronema 15, 19, 24, 27k, 28, **76**, 77, 78
Sphaeronema californicum **77**, 78, 92, 106, 118, 204f, 220m
Sphaeronematidae 14, 18, 19, 24, 27k, 74, 76
Sphaeronematinae 19, 27k, 77
sphagni, Criconema (Nothocriconemella) 9, 38, 39k, 40, **44**, 45–47, 90, 104, 110, 111, 147f, 148p, 149p, 154, 155f, 211m; Criconemoides 44;
  Nothocriconema 44;
  Nothocriconemella 44
spicatum, Criconema 20
spinicaudatum, Criconema (Criconema) 29k, 31, 32, **33, 34**, 89, 103, 107, 123p, 128f, 132p, 208m; Criconema 13, 20;
  Nothocriconema 33
spinicaudatus, Notholetus 33
straeleni, Paratylenchus (Gracilacus) 79k, 80
sturhani, Ogma 5, 9, 26, 48k, **62, 63**, 91, 106, 113, 179f, 180p, 216m
stygium, Criconema 34;
  Criconemoides 34;
  Nothocriconema 34
subantarcticum, Ogma 48k, 53, 58, 60, **63**, 91, 106, 113, 181f, 216m
Syro 9, 13, 18, 22, 27k, 28, 48k, **63**, 64. 65
Syro glabellus 9, 26, 48k, **64**, 65, 92, 106, 114, 182f, 183p, 217m
Syro tribulosus 9, 26, 48k, **64, 65**, 92, 106, 114, 184p, 185p, 217m

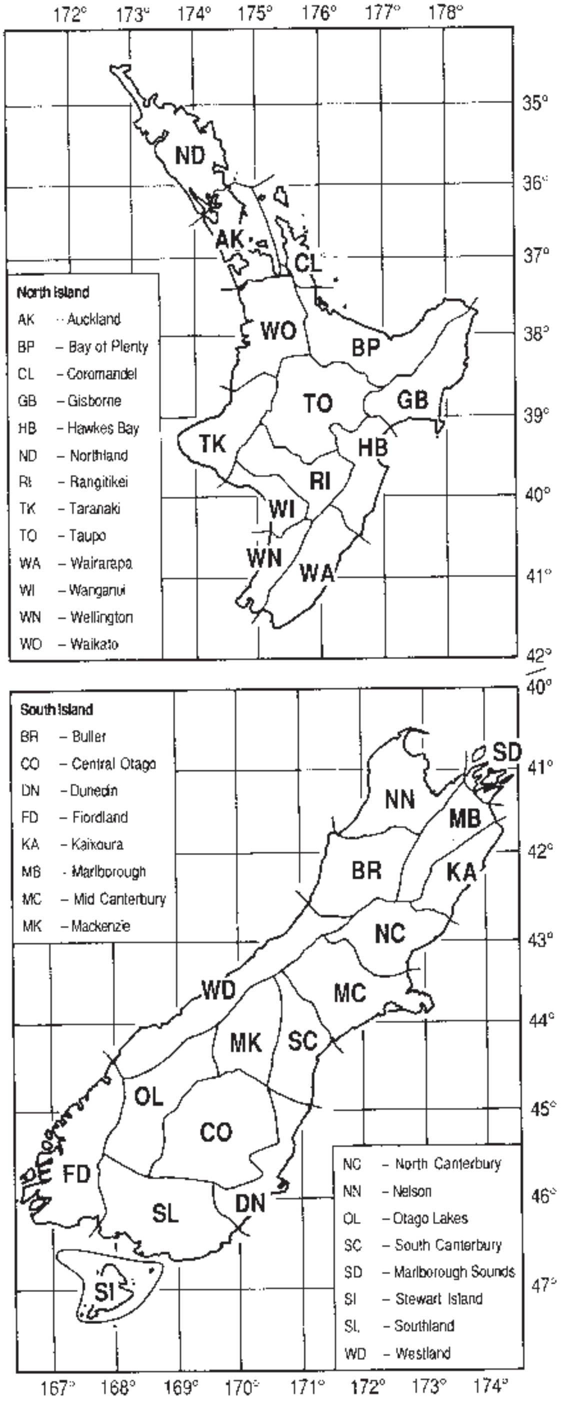
tateae, Paratylenchus (Paratylenchus) 79k
taylatum, Ogma 62
taylori, Criconemoides 72;
  Crossonema 55; Macroposthonia 72; Ogma 62
tenuicaudatus, Paratylenchus (Paratylenchus) 79, 80
terrestris, Ogma 20, 86–88, 129p
tribulosus, Syro 9, 26, 48k, **64, 65**, 92, 106, 114, 184p, 185p, 217m
tritici, Anguina 13, 14
Trophonema 75, 76
Trophotylenchulus 19, 24, 27k, **75**, 76, 92, 106
Trophotylenchulus okamotoi **75**, **76**, 92, 106, 117, 203f, 220m
Tumiota 78
Tylenchida 18, 19, 28
Tylenchina 18
Tylenchocriconematidae 78
Tylenchocriconematoidea 74
Tylenchulidae 14, 18, 19, 24, 27k, 74, 75
Tylenchulidoidea 74
Tylenchulinae 19, 27k
Tylenchuloidea 19, 24, 27k, 28, 74–76, 78
Tylenchulus 19, 24, 27k, **75**, 76
Tylenchulus semipenetrans 24, **75**, 92, 106, 202f, 220m
Tylodoridae 18
typica, Hemicycliophora 80

undulatum, Criconema (Nothocriconema) 34k, **37, 38**, 90, 104, 108, 136f, 140p, 209m

Variasquamata 47
vexillatrix, Pateracephalanema 64;
  Syro 22, 64, 65

wessoni, Hemicriconemoides 73;
  Hemicycliophora 74
whittoni, Sphaeronema 78

xenoplax, Macroposthonia 13, 23, 70, **71, 72**, 90, 105, 116, 199f, 219m; Criconemella 71;
  Criconemoides 71;
  Mesocriconema 71
zelandica, Globodera 14



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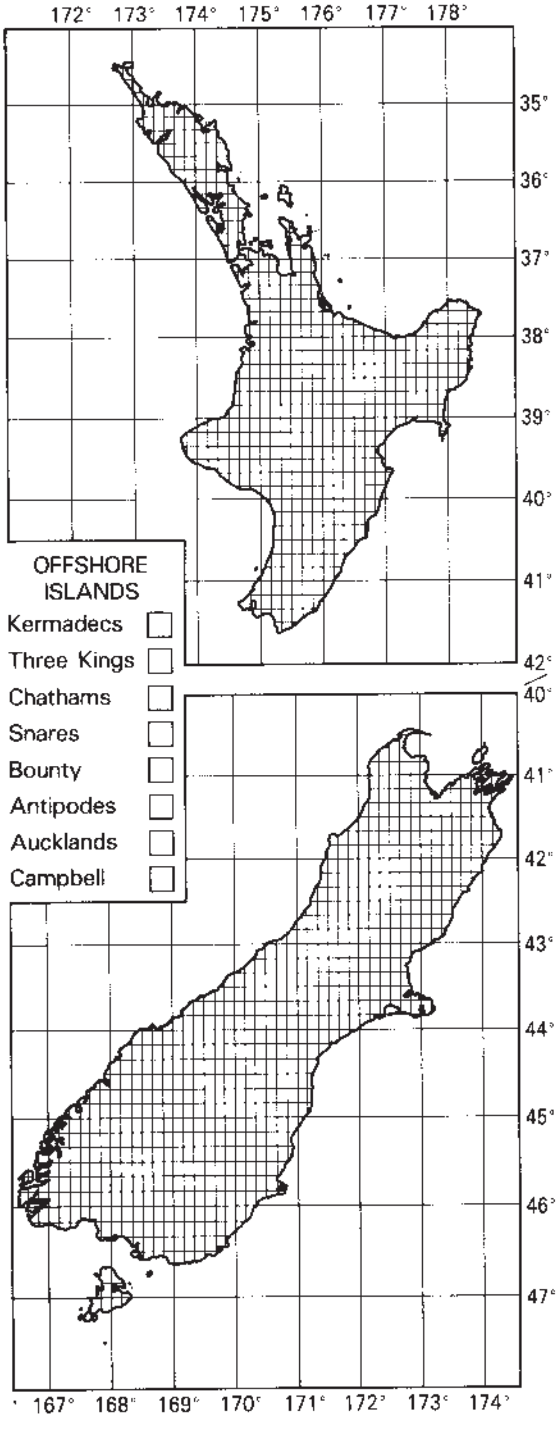

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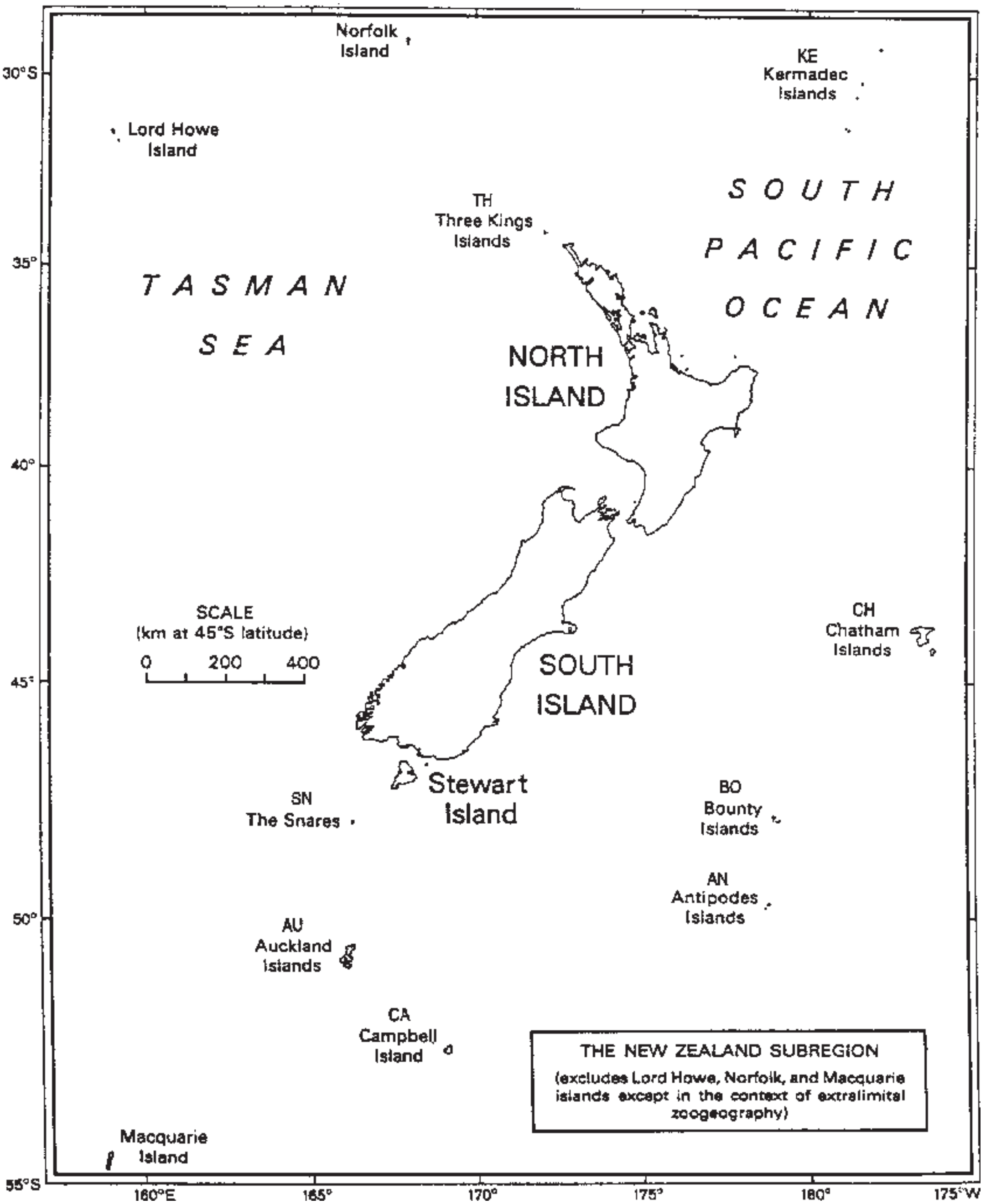

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Acari

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Eriophyoidea except Eriophyinae (*D.C.M. Manson*, FNZ 4, 1984)
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Araneae

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Crustacea

Amphipoda

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Mollusca

Gastropoda

Naturalised terrestrial Stylommatophora (*G.M. Barker*, FNZ 38, 1999)

Nematoda

Tylenchida: Criconematina (*W. M. Wouts*, FNZ 55, 2006)

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Kua whakatūria tēnei huinga pukapuka hei whakahauhau i ngā tohunga whai mātauranga kia whakaputa i ngā kōrero poto, engari he whaikiko tonu, e pā ana ki ngā aitanga pepeke o Aotearoa. He tōtika tonu te āhua o ngā tuhituhi, engari ko te tino whāinga, kia mārama te marea ki ngā tohu tautuhi o ia ngārara, o ia ngārara, me te roanga atu o ngā kōrero mō tēnā, mō tēnā.

He titiro whāiti tā tēnei pukapuka ki ngā mea noho whenua, kāore he tuarā; i pēnei ai i te mea kei te mōhio whānuitia ngā mea whai tuarā, ā, ko ngā mea noho moana, koirā te tino kaupapa o te huinga pukapuka *Marine Fauna of N.Z.*

Ka āhei te tangata ki te **whakauru tuhituhinga** mehemea kei a ia ngā tohungatanga me ngā rauemi e tutuki pai ai tana mahi. Heoi anō, e wātea ana te Kohinga Angawaho o Aotearoa hei āta tirotiro mā te tangata mehemea he āwhina kei reira.

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Ko te hunga pīrangi **hoko pukapuka**, me tuhi ki *Fauna of N.Z.*, Manaaki Whenua Press, Manaaki Whenua, Pouaka Poutāpeta 40, Lincoln 8152, Aotearoa.

E rua ngā tūmomo kaihoko: “A” – kaihoko tūmau, ka tukua ia pukapuka, ia pukapuka, me te nama, i muri tonu i te tānga; “B” – ka tukua ngā pānui whakatairanga me ngā puka tono i ōna wā anō.

Te utu (tirohia “Titles in print”, whārangi 229). Ko te kōpaki me te pane kuini kei roto i te utu. Me utu te hunga e noho ana i Aotearoa me Ahitereiria ki ngā tāra o Aotearoa. Ko ētahi atu me utu te moni kua tohua, ki ngā tāra Merikana, ki te nui o te moni rānei e rite ana.

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