

Psammomermis canterburiensis n. sp. (Mermithidae : Nematoda) parasitic in the New Zealand grass grub, *Costelytra zealandica* (Scarabaeidae : Coleoptera)

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Summary — *Psammomermis canterburiensis* n. sp. (Mermithidae : Nematoda) is described from the New Zealand grass grub, *Costelytra zealandica* (Scarabaeidae : Coleoptera). The new species is characterized by short spicules, the absence of cross fibers in both the post-parasitic juvenile and adult cuticles and the structure of the vagina. This is the first record of this genus in the southern hemisphere.

Résumé — *Psammomermis canterburiensis* n. sp. (Mermithidae : Nematoda) parasite d'un scarabée de Nouvelle-Zélande, *Costelytra zealandica* (Scarabaeidae : Coleoptera) — *Psammomermis canterburiensis* n. sp. (Mermithidae : Nematoda) est décrit, provenant d'un scarabée de Nouvelle-Zélande, *Costelytra zealandica* (Scarabaeidae : Coleoptera). Cette nouvelle espèce est caractérisée par des spicules courts, une cuticule ne comportant pas de fibres croisées tant chez les juvéniles post-parasitaires que chez les adultes, et la structure du vagin. C'est la première signalisation du genre dans l'hémisphère sud.

Key-words : Scarabaeidae, *Psammomermis*, *Costelytra*.

The New Zealand grass grub, *Costelytra zealandica* (White), is one of the most serious insect pests in New Zealand, causing year round damage to pastures. During routine sampling of grass grub populations, mermithid infested grubs were found in the Canterbury district of South Island, New Zealand. Mermithid infections had been noted previously (Kelsey, 1951; Hoy, 1955; Miller, 1971) however the specimens were never described and the biology remained unknown. The present paper describes this nematode as a new species of *Psammomermis* and presents information on its biology.

Mermithid-infected larvae of *Costelytra zealandica* were collected from soil in improved pastures in the foothill regions of the plains (altitude about 250 m) in the Canterbury District of the South Island in New Zealand from 1986 to 1989. In some instances, nematodes were collected directly from the soil. Areas where collections of mermithids were made included Wind-whistle, Grasmere, Wilson, Hyde and Methven.

The infected hosts were held in the laboratory until the nematodes emerged. The postparasites were transferred to separate containers with a layer of sand in the bottom and held at room temperature (20-25 °C). After molting to the adult stage, the nematodes were heat killed (60 °C), fixed in TAF and processed to glycerin.

Psammomermis Polozhentsev, 1941
[Kaiser, 1984, *emend.*]

Long, thin terrestrial mermithids varying in color from white to yellow; postparasitic juvenile and adult

cuticles usually relatively thin, with faint or no cross-fibers under the light microscope; mouth opening terminal or slightly shifted ventrally, lip papillae absent, six cephalic papillae arranged in one or rarely two planes (occasionally the lateral cephalic papillae are positioned anterior to the submedian papillae); amphids of small to medium size, flask to cup shaped, opening circular to elliptical; eight hypodermal chords; spicules paired, closely appressed, longer than body width at cloaca; vagina barrow or pear-shaped, muscular; vaginal canal straight or bent near the middle. Tail tip of postparasitic juvenile entire, with a cuticular appendage, or with a small knob.

Psammomermis canterburiensis n. sp.
(Figs 1, 2)

MEASUREMENTS

Female (n = 7) : L = 18 (10-28) cm; greatest diameter = 147 (132-158) µm; distance from head to nerve ring = 262 (238-276) µm; length of amphidial pouch = 8 (6-10) µm; diameter of amphidial opening = 1.5 (1.2-2.0) µm; length *vagina vera* = 45 (36-54) µm; length *vagina uterina* = 30 (24-35) µm; V = 51 (48-55); eggs spherical, 33 (32-35) µm in diameter; distance from false anus to tail tip = 180 (133-222) µm; distance from end of trophosome to tail tip = 198 (136-269) µm.

Male (n = 10) : L = 2.1 (1.7-3.3) cm; greatest diameter = 129 (107-145) µm; distance from head to

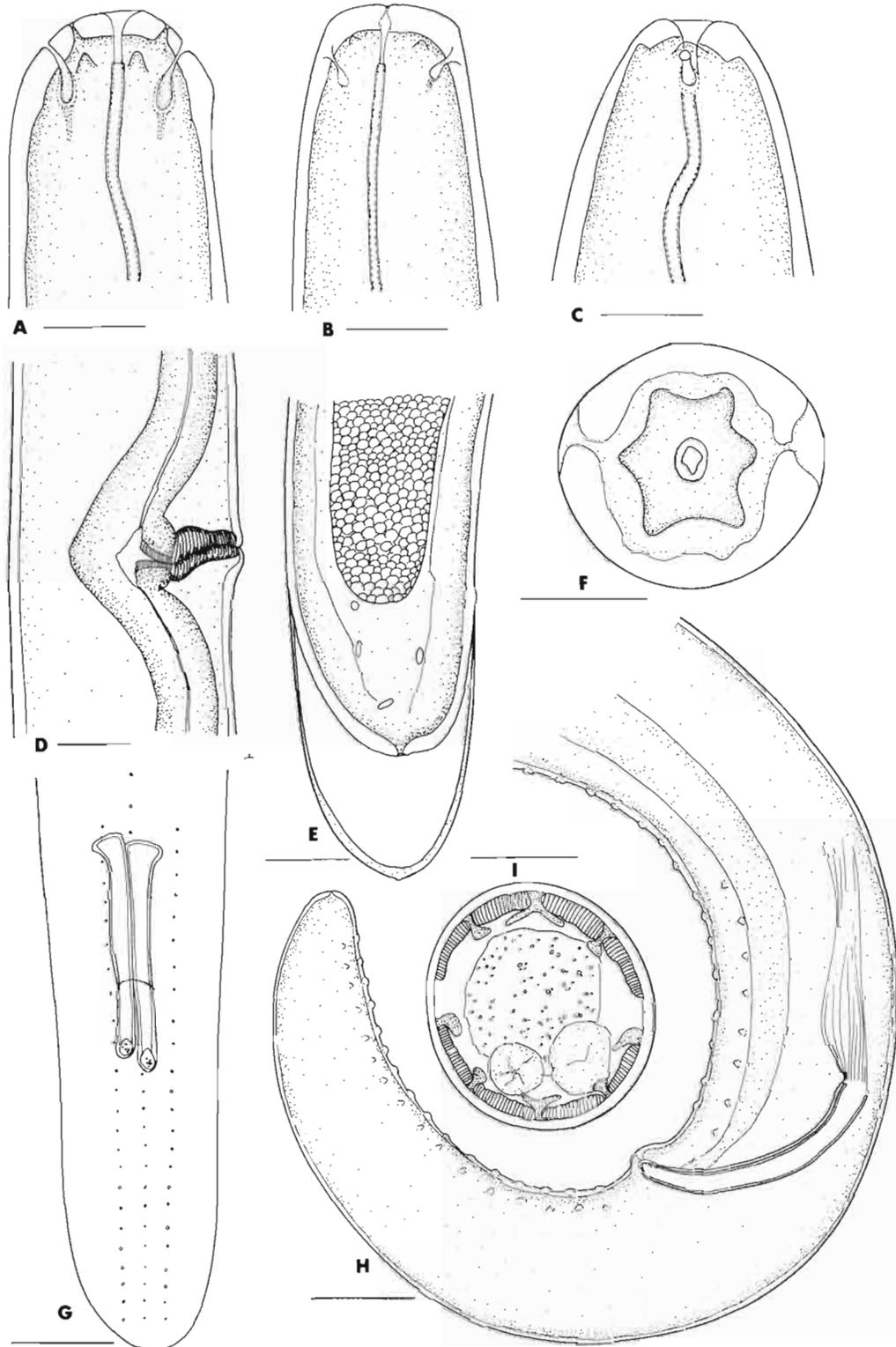


Fig. 1. *Psammomermis canterburiensis* n. sp. — A: Ventral view of male head; B: Ventral view of postparasitic female head; C: Lateral view of male head; D: Lateral view of vulvar area; E: Lateral view of tail of postparasitic female in process of molting; F: "En face" view of male; G: Ventral view of male tail; H: Lateral view of male tail; I: Cross section of male at midbody. (Bars equivalent: A, C, F = 25 μ m; B, D, E, G, H, I = 50 μ m).

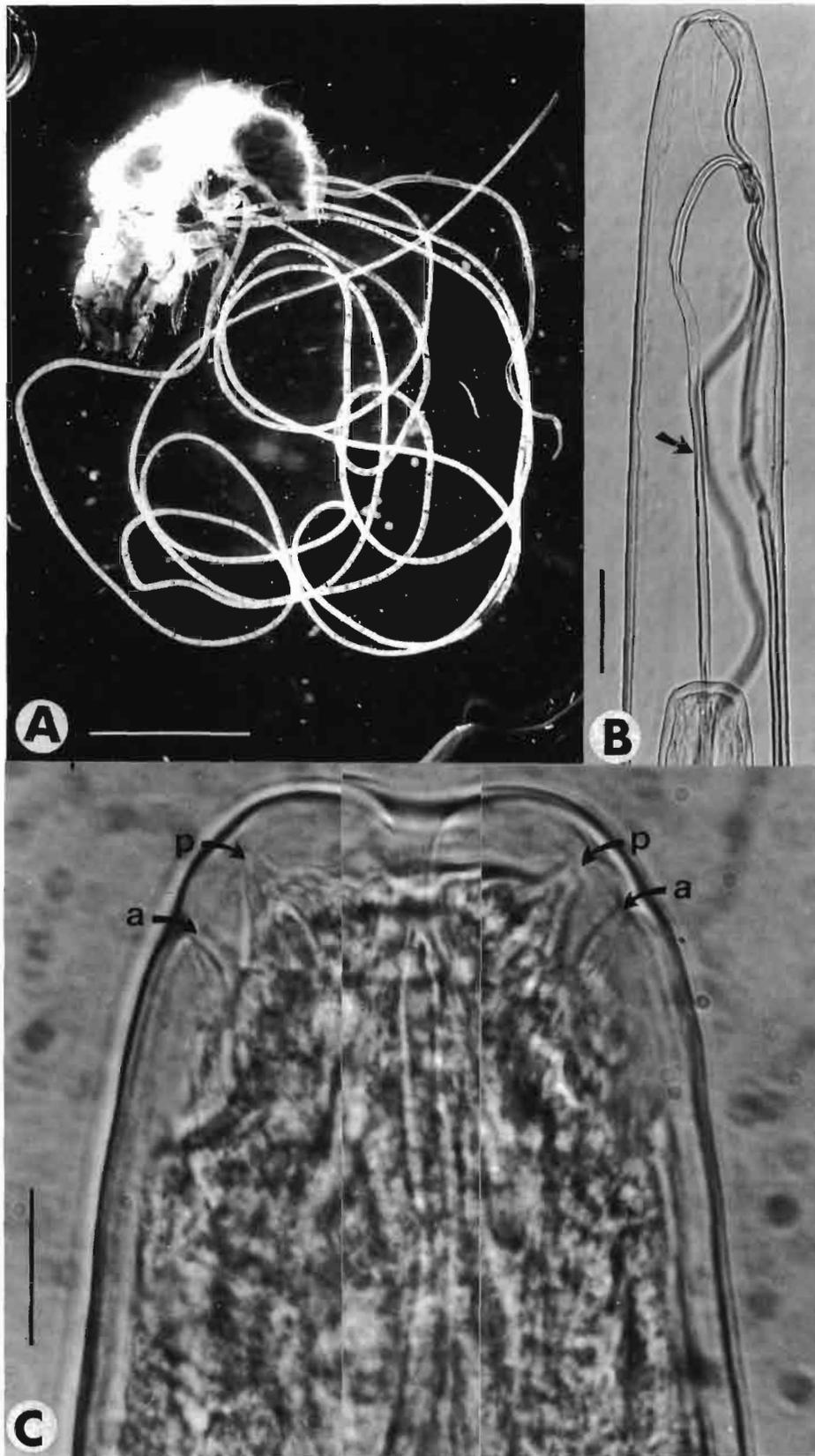


Fig. 2. *Psammomermis canterburiensis* n. sp. — A: Postparasitic juvenile emerging from an infected *C. zealandica* grub; B: Anterior end of postparasitic juvenile in process of molting. Note shed lining of pharyngeal tube (arrow); C: Ventral view of male head showing anteriorly placed lateral cephalic papillae (P) and amphids (A). (Bars equivalent: A = 3.5 mm; B = 280 μ m; C = 11 μ m).

nerve ring = 224 (206-253) μm ; length of amphidial pouch = 9 (8-10) μm ; diameter of amphidial opening = 2.2 (1.9-2.6) μm ; length of spicules = 135 (120-163) μm ; greatest width of spicule shaft = 13 (11-16) μm ; length of tail = 281 (180-317) μm ; width of tail = 107 (85-124) μm .

DESCRIPTION

Adults: Medium to large, but relatively narrow white to yellow colored nematodes; cuticle smooth, lacking cross fibers; mouth opening terminal or in a few cases, shifted slightly ventral; six cephalic papillae arranged in a single circle or occasionally the two lateral papillae are advanced and form a second plane over the two sub-ventral and two subdorsal papillae; cuticularized portion of pharyngeal lumen begins 11 (9-13) μm from the tip of the head; amphids medium, flask shaped, amphidial openings circular; amphids approximately same size in both sexes; amphids located posterior to the lateral head papillae, with openings orientated in a slightly dorsal-lateral position; eight hypodermal cords at midbody; vagina barrow-shaped, muscular, vaginal canal angled at junction between the *vagina vera* and *vagina uterina*, vulva sometimes raised above the body due to pressure from expanded vagina; eggs spherical, showing no or only initial stages of embryonic development in the uterus. Spicules medium sized (length greater than body width at cloaca), paired, slightly curved, yellow, closely appressed; spicule tips serrate, covered with a fine membrane; cloacal area swollen; genital papillae in three rows, post cloacal papillae vary from 14 to 20 per row; pre cloacal papillae in the middle, ventral row vary from 27 to 33, those in lateral rows usually extend only half the distance of the middle row; tail tip of both sexes rounded, smooth; a small pointed projection of hypodermal tissue frequently transverses the cuticle in the tail tip of both sexes. Disc-shaped spherical protein crystals (3-6 μm in diameter) occur in the body cavity of both sexes.

Postparasitic juvenile (n = 15): Cephalic papillae and amphids smaller and less conspicuous than in adults; lateral head papillae may be prominent; tail tip entire or frequently with a minute knob or button at the tip; final molt consists of a thick outer (3rd stage) cuticle and a thin, fine inner (4th stage) cuticle; both cuticles lack cross fibers.

TYPE HOST AND LOCALITY

Costelytra zealandica (White), Scarabaeidae, Coleoptera. Pastures near Methven, South Island, New Zealand.

TYPE SPECIMENS

Holotype (male) and *allotype* (female) deposited in the National Museum of New Zealand collection. *Paratypes* deposited in the Division of Nematology, University of California, Davis, California.

DIAGNOSIS AND RELATIONSHIPS

Medium to large mermithids with the body narrow in proportion to its length. Both adult and post-parasitic juvenile cuticles lack noticeable cross fibers. There are six cephalic papillae, eight hypodermal cords and medium sized amphids. The short, muscular vagina is separated into *vagina vera* and *vagina uterina* portions. The spicules are paired, separate, slightly curved and of medium length.

The structure, shape and size of the spicules and vagina separate the new species from previously described members of the genus *Psammomermis*. Thus, *P. tiliae* Rubtsov, 1972 has a straight vagina undivided into *vera* and *uterina* portions and a ventrally displaced mouth. *P. byssina* Rubtsov, 1976 has stronger curved spicules which are pointed at their tips and the post-parasites possess a pronounced cuticular spine at the tip of the tail. The present species differs from *P. alechini* Artyukhovskiy & Kharchenko, 1965, *P. busuluk* Polozhentsev, 1952, *P. kulagini* Polozhentsev, 1941 and *P. korsakowi* Polozhentsev, 1941 by the shorter spicules. In addition, the vaginal canal of *P. korsakowi* is straight and the eggs are larger (100 μm long) than those of *P. canterburiensis* n. sp. *P. cornicularis* Kaiser, 1984 differs from *P. canterburiensis* n. sp. in the shape of the spicules, shape of the male tail and by the presence of a cuticular spine on the post-parasites. From *P. conjuncta* Kaiser, 1984 and *P. minor* Kaiser, 1984 the present species differs in the length and shape of the spicules. *P. filiformis* Kaiser, 1984 differs from the present species by its larger amphids and the longer, filiform spicules.

Biological observations and discussion

During the present investigation, we recovered *P. canterburiensis* n. sp. from grass grub larvae and soil samples taken from pastures infested with grass grubs. Mermithid infected adult beetles (presumably *P. canterburiensis* n. sp. since that is the only species that has been found attacking *C. zealandica*) were reported by Hoy (1955) and such adults could assist the natural distribution of *P. canterburiensis* n. sp. in the South Island. It is not known if *P. canterburiensis* n. sp. is specific to *C. zealandica* since there are a number of other soil inhabiting Scarabaeidae in New Zealand. Brown (1963) discovered unidentified mermithids parasitizing adults of *Pyronota edwardsi* (Sharp) (the kiriwai manuka chafer) at Dry Creek (also in the District of Canterbury in South Island) during the months of October, November and December. Brown noted that parasitized female *P. edwardsi* deposited few or no eggs.

Postparasites of *P. canterburiensis* n. sp. that emerged from field collected grass grubs molted in approximately 30 days at room temperature (20-25 °C). A wide range of sizes of female *P. canterburiensis* n. sp. were recovered in the present study. It is probable that the larger females

came from grubs with a two year life cycle (this occurs in isolated populations at higher elevations) and smaller females from grubs with an annual life cycle.

Because of the resemblance of *Psammomermis* to members of the genus *Mesomermis* von Daday, 1911 Poinar had originally synonymized the two genera (Poinar, 1979). However, on the basis of the present study and the investigation of Kaiser (1984), the establishment of *Psammomermis* as a separate genus is now clear. There is still considerable variation within the described species of *Psammomermis* and the genus may be further split after more study. Although Polozhentsev (1941) stated that only six hypodermal cords were present in *P. kulagini* and *P. korsakowi*, these should be re-examined. Eight cords were recorded for *P. canterburiensis* n. sp. in the present study and Kaiser (1984) reported eight hypodermal cords for the species he studied.

During the month of November, adults of *P. canterburiensis* n. sp. were located near the harder subsoil, some 26-30 cm deep in pasture soil. The mermithids were coiled up into a ball and the females were near the end of their egg laying period. Grass grubs infected with fully developed mermithids had a distinct orange color. The bodies of the larger female parasites extended throughout the host hemocoels, including the head capsule. Most infected grass grubs died immediately after the emergence of the parasites, however, some hosts remained alive for several hours. The infestations appeared to be restricted to particular areas, especially those with ample moisture throughout the year. In these areas, the rate of infection was relatively low (< 10 %). Further studies are required to determine the effect of *P. canterburiensis* n. sp. on grass grub populations, however, their effect in certain areas (with adequate humidity, etc.) might possibly reduce the grass grub population below damaging levels.

The forward movement of the lateral cephalic papillae in some individuals of *P. canterburiensis* n. sp. is interesting since it demonstrates an unusual situation in mermithids. Perhaps the most extreme case of this phenomenon was reported for *Orthomermis oedobranthus* (Poinar, 1964) where the adults possessed pronounced lateral head papillae that were set off from the remainder. In *P. canterburiensis* n. sp., the lateral papillae are similar in size to the submedial cephalic papillae and in some individuals have just moved forward. It is interesting to note that in *P. cornicularis*, Kaiser (1984) described a pair of anterior hypodermal pegs or projections in the form of labial papillae. However, these hypodermal pegs were medial in position and therefore apparently do not correspond to the advanced lateral papillae in some

specimens of *P. canterburiensis* n. sp. Most likely, the hypodermal pegs of *P. cornicularis* correspond to the terminal innervated hypodermal peg that occurs on *Aranimermis giganteus* Poinar & Early, 1990.

This is the first report of a *Psammomermis* from the southern hemisphere and this find suggests that the genus is probably world wide in distribution. Although the hosts of only three species of *Psammomermis* are known, all of these are representatives of the family Scarabaeidae, which implies that this genus of mermithids may be restricted to this host family.

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