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## PROTOSPIRURA KAINDIENSIS N. SP. (SPIRURA: SPIRURIDAE) AND OTHER HELMINTHS FROM PSEUDOHYDROMYS (MURIDAE: HYDROMYINAE) FROM PAPUA NEW GUINEA

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**ABSTRACT:** One cestode and 3 species of nematodes are recorded from *Pseudohydromys murinus* and *Pseudohydromys occidentalis* (Muridae: Hydromyinae), from Papua New Guinea, for the first time. *Heterakis fieldingi* (Ascaridida: Heterakidea) has previously been known from Australia. *Odilia* sp. resembles *Odilia praeputialis* in the orientation of the synlophe and the number and size of ridges but differs in the length of spicule and lack of a praepuce. *Protospirura kaindiensis* n. sp. (Spirurida: Spiruridae) is readily distinguished from all other members of the genus by the number and arrangement of caudal papillae and the length of the spicules.

Although significant collections of New Guinea fauna have been amassed by natural history museums over the past 140 yr, and comprehensive surveys of the mammalian fauna began with the Archbold Expeditions of the 1920s to 1950s (Flannery, 1995), there have been no systematic attempts to document the helminth parasites of the mammals. There are no published records of gastrointestinal helminths from the rodents.

The rodent fauna of New Guinea comprises only representatives of the family Muridae. It is abundant and diverse, being one of the most species-rich, for the size of the landmass, in the world (Flannery, 1995). The Hydromyini, 1 of 4 subgroups of the Hydromyinae of Australia and New Guinea, are a monophyletic group, thought to have originated in montane New Guinea, with 9 genera, 8 endemic, including *Pseudohydromys* Rummel, 1934 (Flannery, 1995). Little is known about the biology and habits of the eastern and western shrew-mouse, *Pseudohydromys murinus* Rummel, 1934 and *Pseudohydromys occidentalis* Tate, 1951. They are found in montane forest habitats at altitudes between 2,100 and 3,600 m and may be predominantly insectivorous (Flannery, 1995).

As part of an ongoing study on the helminth fauna of the rodents of New Guinea, all the available murids, stored as whole specimens in 70% ethanol, in the Bernice Bishop Museum, Honolulu, Hawaii (BBM) and the Australian Museum, Sydney were examined for gastrointestinal helminths. This material included 6 specimens of *Pseudohydromys*. Examination of these individuals revealed 3 species of nematode, 1 new to science is described in this paper, and new hosts records for the others are given below.

There were no records of parasite material from *Pseudohydromys* in the national parasite collections of Australia, France, the United Kingdom or the United States of America.

### MATERIALS AND METHODS

Complete digestive tracts of individuals of *P. murinus* and *P. occidentalis* were carefully removed from whole bodies that had been stored in 70% ethanol. Of the 6 specimens of *P. murinus* in the museum collection only 2 individuals, registration numbers 56592 and 56596, had been preserved with digestive systems in situ. Both were collected by P. Woolley on 1 December 1982 and 6 December 1982 at Mt. Kaindi, elevation 2,250 m, 7°21'S, 146°41'E in the Wau area of Morobe Province, Papua New Guinea. One specimen of *P. occidentalis*, registration number 105241, was collected by T. Bukam on 8 August 1976 at Bokubet, elevation 2,850 m, 10 km east of Feramin 5°13'S, 141°14'E, San-

daun Province. The tissues of this latter animal were hard, brittle, and difficult to dissect.

The 3 digestive tracts were examined with the aid of a dissecting microscope, and all helminths found were removed for identification. Nematodes were cleared in lactophenol prior to examination. Figures were drawn with the aid of a drawing tube and measurements, in millimeters unless otherwise stated, taken using an ocular micrometer. Specimens have been deposited in the United States National Museum Helminthological Collection, U.S. Dept. of Agriculture, Beltsville, Maryland (USNM) and the BBM.

### RESULTS

Cestode fragments were found in the small intestine of 1 *P. murinus*. Two male *Heterakis fieldingi* Smales, 1996 (Ascaridida: Heterakidae) were found in the small intestine of *P. murinus*. Measurements as follows: length, 4.7, 4.9; width 0.20, 0.27; esophagus length 512, 516 µm; esophagus bulb width 87, 86 µm; excretory pore 297, 313 µm from anterior end; tail 230, 200 µm long; spicules 250, 290 µm long; preanal sucker diameter 40 µm. This is a new host record.

Seven nematodes from *P. murinus* (2 males, 5 females) *Odilia* sp. (Trichostrongyloidea: Heligmonellidae) were found in the small intestine. Measurements as follows:

**Males:** Length 1.5, 1.8 width at midbody 66, 63 µm; cephalic vesicle 34, 39 µm long by 23, 22 µm wide; esophagus 280, 300 µm long; spicules 190, 180 µm long.

**Females:** Length 1.8–2.2, width at midbody 59–74 µm; cephalic vesicle 34–50 µm long, 20–22 µm wide; esophagus 260–320 long; vagina vera 30 µm long; vulva to posterior end 84–96 µm; tail 26–37 µm long; short, conical; eggs thin shelled, ellipsoidal 65 × 30 µm. This *Odilia* sp. differs from all the known species of *Odilia* in spicule length and, or the number of ridges in the synlophe at the midbody region. Further study on additional specimens is needed to prepare a complete description.

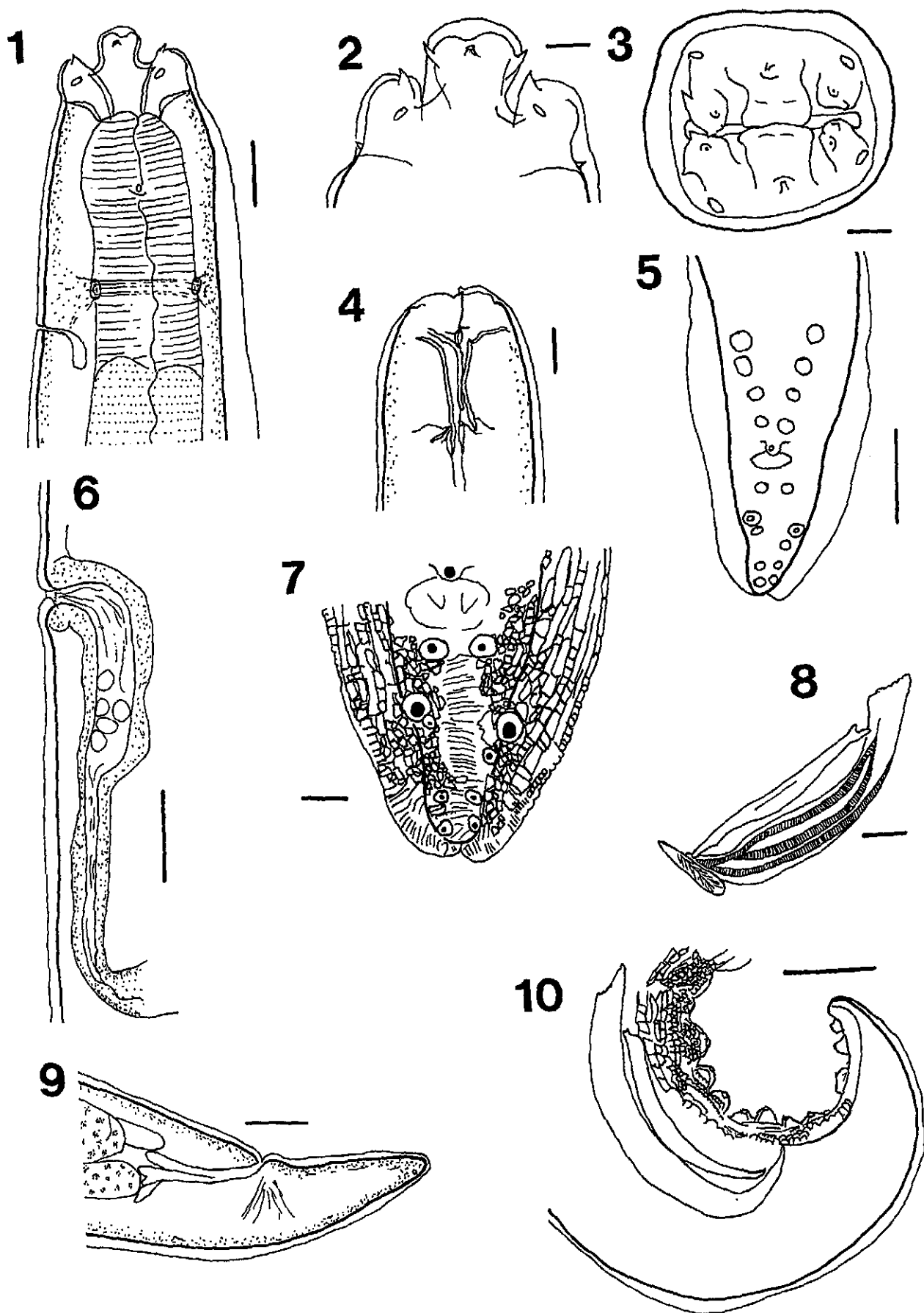
One larval nematode from *P. occidentalis* and 3 intact nematodes (2 males, 1 female), pieces of 6 males and 4 females from *P. murinus*, *Protospirura kaindienensis* n. sp. (Spiruroidea, Spirurida) were found in the stomach.

### DESCRIPTION

*Protospirura kaindiensis* n. sp.  
(Figs. 1–10)

**General:** Spiruroidea: Spiruridae. Large stout worms. Cuticle thick, with transverse striations. Anterior extremity with highly developed pseudolabia raised above mouth opening. Mouth opening dorsoventrally elongated, surrounded by 2 larger lateral and 4 smaller submedian elevations, each with 2 denticles. Four large submedian cephalic papillae,

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2 subdorsal and 2 subventral papillae in cuticular depressions and 2 amphids forming outer circle. Small labial papillae not seen. Pharynx thick-walled, laterally compressed. Esophagus divided into anterior muscular and posterior glandular portions. Nerve ring surrounds posterior of muscular portion of esophagus, excretory pore slightly posterior to nerve ring. Deirids small, anterior to nerve ring. Phasmids subterminal.

**Male** (holotype and paratype): Length 23, 20, width at midbody 0.48, 0.48. Anterior end 0.16, 0.18 diameter. Pharynx 0.08, 0.07 long. Muscular portion of esophagus 0.30, 0.26 long; glandular portion of esophagus 4.56, 4.76 long. Deirids 0.26, 0.22; nerve ring 0.40, 0.39; excretory pore 0.47, 0.47 from anterior extremity. Caudal alae thick. Posterior ventral surface ornamented with numerous longitudinal striae preanally; irregular and transverse patterns postanally. Spicules markedly dissimilar, left spicule slender, 0.31, 0.33 long; right spicule stout, alate, 0.48, 0.45 long. Gubernaculum 0.90 long. Nine pairs, 1 unpaired caudal papillae; 4 pairs preanal, 1 median on anterior anal lip, 5 pairs postanal papillae, second pair largest. Tail conical 0.30, 0.33 long with blunt tip.

**Female** (holotype): Length 40, width at midbody 0.73. Anterior end 0.25 diameter. Pharynx 0.83 long. Muscular portion of esophagus 0.24 long; glandular portion of esophagus 4.6 long. Deirids 0.31, nerve ring 0.36, excretory pore 0.55 from anterior extremity. Vulva without ornamentation, 9 from anterior extremity. Vagina directed posteriorly. Tail conical 0.44 long. Eggs elliptical, embryonated, 59.5–62.5 × 33–36  $\mu$ m.

**Larva:** Length 2.8, width at midbody 0.16. Anterior end 0.07 diameter. Esophagus 1.25 long, tail 0.15 long.

#### Taxonomic summary

**Specimens deposited:** Holotype USNM Helm. Coll. no. 89857, and allotype 89858, paratypes (1 male, pieces of 6 males, 4 females) BBM, Honolulu, Hawaii, reg. no. 56592.

**Type host:** *Pseudohydromys murinus*.

**Type locality:** Mt. Kaindi, 07°21'S 146°41'E, Wau, Morobe Province.

**Site in host:** Stomach.

**Date of collection:** 1 December 1982.

**Etymology:** Species name is taken from the type locality.

#### Remarks

Although only 3 intact worms were examined, the pieces of male and female worms dissected from the host stomachs included both anterior and posterior ends that were also examined. These measurements were consistent with those of the holotype, allotype, and paratype, given here.

Hasegawa (1990) summarized the status of *Protospirura* Seurat, 1914, recognizing 9 species. *Protospirura kaindiensis* n. sp., the 10th species, is a typical example of the group.

*Protospirura kaindiensis* can be readily differentiated from all other members of the genus in having 5 pairs of postanal papillae (*Protospirura okinavensis* Hasegawa, 1990 has 4 pairs and all the others more than 5 pairs) and the dimensions of the spicules.

Other distinguishing characters are as follows: *Protospirura anopla* Kreis, 1938, *Protospirura armeniana* Aloan, 1951, *Protospirura chaubaudi* Vuylsteke, 1964, *Protospirura numidica* Seurat, 1914 *Protospirura peromysci* Babero and Mathias, 1967, *Protospirura suslica* Schult, 1916 and *P. okinavensis* have 4 denticles, not 2, on each element of the pseudolabia. *Protospirura muricola* Geddoelst, 1916 with 2 denticles on each element of the pseudolabia has spicules of near equal length (about 0.42). *Protospirura pseudomuris* Yokohata and Abe, 1989, also with 2 denticles on each element of the pseudolabia (see Hasegawa, 1990), has the slender right spicule (0.68) longer than the broader left (0.33) (see Yokohata and Abe, 1989). *Protospirura kaindiensis* has the broader right spicule (0.46) longer than the slender right (0.32).

#### DISCUSSION

Flannery (1995) suggested that there have been multiple invasions of the Australia–New Guinea region by murids, at least 1 being the arrival of the ancestral Hydromyinae in the late Miocene, early Pliocene (about 5 million yr ago). Movement of these now endemic rodents between Australia and New Guinea is thought to have been in both directions and can be related to the emergence of land bridges across the Torres Strait linking 2 land masses in the Pleistocene era. Although *Pseudohydromys* is 1 of the genera restricted to New Guinea (Flannery, 1995), the helminth fauna it harbors is indicative of such migrations.

*Heterakis fieldingi* has previously been recorded only from 1 of the 2 hydromyine species that occur in both Australia and New Guinea, *Hydromys chrysogaster* Geoffroy, 1804 and only in northern Australia. *Odilia* sp. were thought to have evolved in isolation in Australia from nematodes resembling *Nippostrongylus* Lane, 1923 a genus that occurs commonly in south east Asia (Durette-Desset, 1985; Beveridge and Durette-Desset, 1992). The discovery of *Odilia mallomyos* Hasegawa and Syaf-ruddin, 1994 in *Mallomys* Thomas, 1898 from Irian Jaya and now a second species of *Odilia* in *Pseudohydromys*, both hosts endemic to New Guinea, give added weight to the possibility of Hydromyine host migration in either direction. It throws open, however, the question of where the genus *Odilia* may have evolved.

The finding of a new species of a spirurid *P. kaindiensis* may, by contrast, be indicative of the relative isolation of murid hosts since their arrival in the New Guinea region. *Protospirura* sp. has not previously been reported from Australian rodents, but the ecologically equivalent, superficially similar spirurid *Mastophorus muris* Gmelin, 1780 has (Smales, 1997). Further surveys are needed to determine whether *Mastophorus* is restricted to Australia and more recently arrived *Rattus* sp. host (Smales, 1997) and *Protospirura* restricted to New Guinea and hydromyine hosts.

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FIGURES 1–10. *Protospirura kaindiensis* n. sp. from *Pseudohydromys murinus* from Papua New Guinea. 1. Anterior end, right lateral view. 2. Cephalic end, right lateral view. 3. En face view. 4. Cephalic end, optical section dorsoventral view. 5. Male posterior end, ventral view. 6. Vagina, right lateral view. 7. Male tail, ventral view. 8. Spicules and gubernaculum. 9. Female tail, left lateral view. 10. Male posterior end, right lateral view. Scale Bars 1, 10 = 100  $\mu$ m; 2 = 25  $\mu$ m; 3, 4, 7, 8 = 50  $\mu$ m; 5, 6, 9 = 200  $\mu$ m.

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