

A new species of *Protrellus* Cobb, 1920 (Nematoda, Thelastomatidae) parasite of the field cockroach *Blatella vaga* Hebard, 1919 (Blattodea, Blattidae) from Catamarca, Argentina

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Abstract

A new species of the genus *Protrellus*, *P. blatta* sp. nov. parasitizing a field cockroach *Blatella vaga* Hebard, 1919, from El Tala river, Catamarca, Argentina, is described and illustrated. It is characterized by having the mouth opening circular, the buccal capsule with eight very small teeth, the nerve ring around oesophageal corpus, the excretory pore anterior to vulva, the vulva anterior to base of oesophagus, didelphic, the posterior ovary reflexed anterior to rectum, about one third of a body length from posterior end, the egg ellipsoidal, colourless, bearing a lateral cuticular crest, tail conical, with long filiform projection, the male with testis single, outstretched, one spicule, very small, short and straight, gubernaculum absent, the genital papillae arranged in three pairs of ventrolateral papillae, of which the first pair are close together and preanal position, two pairs postanal, tail conical and short, less than one twentieth of total body. A taxonomic key of *Protrellus* species is given.

Keywords

Nematoda, *Protrellus*, new species, cockroach

Introduction

The thelastomatids with the vulva located anterior to the base of the oesophagus form a group of five genera: *Protrellus* Cobb, 1920, parasite of cockroach from Australia, Madagascar, India, North and South America; *Protrelloides* Chitwood, 1932, parasitizing Blattodea from North America; *Protrelleta* Chitwood, 1932, in cockroach from North and South America; *Napolitana* Kloss, 1959, parasite of Blattodea from South America; *Protrellatus* Farooqui, 1970, in cockroach from India.

The genus *Protrellus* was proposed by Cobb 1920 for a nematode from an Australian cockroach, omitting the figures in his description. Then, in 1926 Schwenk added another species called *P. galebi* to this genus. Travassos, in 1929, transferred to this genus the species that Galeb 1878 had described as *Oxyuris künckeli*. Later, Chitwood 1932 regarded *Protrellus* with its type species *P. aureus* Cobb, as a genus and species inquirenda in the sub-family Protrelloidinae, and proposed a new genus *Protrellina*, to accommodate only all the

other species which had been placed in *Protrellus* hitherto. The following year (1933) Chitwood remarked that *Protrellina* is a synonym of *Protrellus*, but from Cobb's poor and insufficient description made it impossible to include *Protrellus* in the familia Thelastomatidae. Basir 1956 reinstated the genus *Protrellus*, placing the genus *Protrellina* in synonymy with it. Kloss 1959, 1966 continued to recognise *Protrellina* but not *Protrellus*, and, in 1961, proposed *Aglaopterixia* for the species *P. manni* Chitwood, 1932. Adamson and van Waerebeke 1992 followed Basir's 1956 taxonomy and treated the genus *Aglaopterixia* Kloss, 1961 as a synonym of the genus *Protrellus*.

The fact that fifteen species of the genus *Protrellus* were collected from cockroaches (Adamson and van Waerebeke 1992; Shah *et al.* 2005, Table I) is important because cockroaches can carry human pathogens, such as *Salmonella* and *Escherichia coli*, which can result in human diseases, such as food poisoning or diarrhea, they also can transmit the hepatitis virus and have been known to spread dysentery and typhoid

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Table I. Reports of cockroaches as hosts of *Protrellus* species

Cockroaches species	<i>Protrellus</i> species	Records	References
<i>Polyzostaria melanaria</i>	<i>P. aureus</i>	Australia	See revision Adamson and Van Waerebeke 1992
<i>Parcoblatta lata</i>	<i>P. aurifluss</i>	USA	Basir 1956
<i>Elliptoblatta antennata</i>	<i>P. behorefi</i>	Madagascar	Van Waerebeke 1969
<i>Periplaneta germanica</i>	<i>P. chauhani</i>	India	Jagannath Rao 1980
<i>Celatoblatta vulgaris</i>	<i>P. dalei</i>	New Zealand	Zervos 1987a
<i>Drymaplaneta variegata</i>	<i>P. dixonii</i>	New Zealand	Zervos 1987b
<i>Eurycotes</i> sp.	<i>P. eurycotesi</i>	Brazil	Skrjabin <i>et al.</i> 1966
<i>Ischnopteria</i>	<i>P. ischnopterae</i>	Brazil	Zervos 1987a,b
<i>Parasphaeria</i> sp.	<i>P. ituana</i>	Brazil	Zervos 1987a,b
<i>Periplaneta americana</i>	<i>P. künckeli</i>	Brazil	See revision Adamson and Van Waerebeke 1992
<i>Aglaopteryx diaphana</i>	<i>P. manni</i>	Cuba	Chitwood 1933
<i>Phyllodromia humbertiana</i>	<i>P. phyllodromi</i>	India	Skrjabin <i>et al.</i> 1966
<i>Gymnonyx grandidieri</i>	<i>P. rasolofi</i>	Madagascar	Van Waerebeke 1969
<i>Periplaneta americana</i>	<i>P. shamimi</i>	India	Manjur Shah <i>et al.</i> 2005
<i>Neostylopyga sexpustulata</i>	<i>P. travassosi</i>	India	Jagannath Rao 1980
<i>Blatella vaga</i>	<i>P. blatta</i>	Argentina	This report

fever (Brenner *et al.* 1987; Vythilingam *et al.* 1997). Products of cockroach infestations, including saliva, feces and cast skins, are sources of allergens and develop allergies that can trigger asthma in people, especially children (Eggleston *et al.* 1999; Sporik *et al.* 1999; Baumholtz *et al.* 2008). For all these reasons the cockroaches must be controlled, eliminating the use of insecticides that cause resistance in insects, and replacing them with natural parasites and pathogens. The field cockroach, *Blattella vaga*, prefers outdoor locations and is usually found in leaf litter, decaying vegetation, plant debris, and it also occurs under stones, clumps of earth, and similar objects. The field cockroach is believed to be an introduced species and was introduced from Asia into southern California, Arizona, New Mexico, and Texas. It is not repelled by light and can often be seen during the day.

In this investigation we report another species of the genus *Protrellus*, called *P. blatta* sp. nov. parasitizing a field cockroach *Blattella vaga* Hebard, 1919, and we cite for the first time this genus for Argentina. A taxonomic key of *Protrellus* species is given.

Materials and Methods

Twenty nymphs of the field cockroach *Blattella vaga* Hebard, 1919 (Blattodea, Blattidae) were found in the river coast of El Tala river (S 28°27'34,26", W 65°50'28,11"), Catamarca province, Argentina. They were collected by hand during 2010 autumn and were put in individual paper containers. The insects were dissected in Petri dishes filled with distilled water under a stereoscope microscope. A transverse incision was made along the posterior end of the abdomen and the digestive tract was removed to obtain the parasites (n = 44). Thirty-four nematodes were killed by placing them in distilled water at

60°C for 2 min. They were removed to 50% TAF solution in water for 48 hours then into pure TAF. All thirty-four specimens were used for drawings, photographed and measured with the aid of a lucida camera mounted on a Zeiss compound microscope. Measurements were made using an ocular micrometer and are given as the mean ± standard deviation followed by the range in parentheses. All measurements are given in micrometres (Table II).

In order to develop a more complete description of characters, we carry out an ultrastructural analysis using a scanning electron microscope (SEM), which has proven a better assessment of cuticular detail and to clarify the status of the nematodes. The ten remaining specimens were fixed in a cold solution of 1.5% glutaraldehyde/1.5% formaldehyde in 0.1M acidulate buffer (pH 7.35) overnight, postfixed in cold aqueous solution of 1% osmium peroxide overnight. The nematodes were dehydrated in an increasing ethanol series, critically point-dried, mounted on bronze blocks and gold-sputter coated and observed and photographed using a JEOL JSM 6360 LV.

Holotype and allotype specimens are deposited in the Invertebrate Department, Museo de Ciencias Naturales, La Plata, Argentina (MLP). Paratypes are deposited in the Centro de Estudios Parasitológicos y Vectores (CEPAVE), Nematoda collection, La Plata Argentina.

Results

Protrellus Cobb, 1920

Protrellus blatta sp. nov.

Description: Small nematodes. Female: cuticle annulated in all along the body. Mouth opening circular. Eight labio

Table II. Morphometric data for *Protrellus blatta* sp. nov., measurements in $\mu\text{m} \pm \text{SD}$ (range)

	Females (n = 27) Mean $\pm$ SD (range)	Males (n = 20) Mean $\pm$ SD (range)
Total length	3,969 $\pm$ 95.7 (3680.3–4,860.4)	992.25 $\pm$ 221.8 (770.6–124.3)
Diameter of head at level of cephalic papillae	32.48 $\pm$ 2.42 (30–35.2)	12.35 $\pm$ 0.72 (11.2–13.8)
Stoma length	9.28 $\pm$ 2.8 (6.5–12)	5.24 $\pm$ 1.4 (4.1–6.8)
Stoma width	8.12 $\pm$ 1.6 (6.5–9.8)	4.32 $\pm$ 1.1 (3.1–5.5)
Width of body at level of nerve ring	72 $\pm$ 4.13 (66–78)	19.5 $\pm$ 2.6 (16.5–22.6)
Maximum body diameter	153 $\pm$ 25.16 (128–180)	65 $\pm$ 12.6 (51.4–78.2)
Width of body at anus level	132 $\pm$ 15.5 (116–150)	56 $\pm$ 9.8 (47–66.2)
Width of body at level of vulva	122 $\pm$ 20 (100–150)	–
Distance anterior end to nerve ring	126 $\pm$ 47.6 (78–175)	52 $\pm$ 22.2 (28.6–76.7)
Oesophagus length	369 $\pm$ 24.4 (340–400)	146 $\pm$ 22.6 (122.8–170.4)
Distance from anterior end to excretory pore	144 $\pm$ 28.3 (110.5–174.8)	73 $\pm$ 25.4 (46.7–99.8)
Vagina length	118 $\pm$ 21.37 (95–140.6)	–
Vagina width	27 $\pm$ 3.8 (23.3–32.6)	–
V*%	4.31 $\pm$ 0.37 (3.9–5.1)	–
Length and width of eggs	81.2 $\pm$ 2.1 (78.2–83.5) x 32.48 $\pm$ 2.2 (29.8–35.4)	–
Spicule length	–	25 $\pm$ 1.35 (22.6–26.4)
Spicule width	–	2.52 $\pm$ 0.6 (1.92–3.25)
Tail-appendage length	216 $\pm$ 12.5 (210.6–235.6)	51.22 $\pm$ 12.8 (38.2–65.4)

*V: (distance from anterior end to vulva/body length) x 100.

papillae (Fig. 8). Amphids small and pore shaped. Buccal capsule with eight very small teeth (Figs 2, 9). Oesophagus consisting of an anterior corpus, an isthmus, and posterior valvular bulb basal (Figs 1, 12). Nerve ring around oesophageal corpus. Intestine wide at its anterior end, glands between intestine and rectum distinct. Excretory pore anterior to vulva (Figs 1, 12). Vulva anterior to base of oesophagus (Figs 1, 12). Didelphic. Posterior ovary reflexed anterior to rectum, about one third of a body length from posterior end. Eggs ellipsoidal, colourless, bearing a lateral cuticular crest (Figs 5, 11). Tail conical, with long filiform projection (Figs 4, 10).

Male: much smaller than female, similar structure to the female. Cuticle not distinctly annulated. Eight labial papillae. Amphids very small, pore shaped. Oesophagus with a corpus, an isthmus and a basal bulb valvated (Fig. 3). Nerve ring at level of oesophageal corpus. Excretory pore at the base of the oesophagus. Testis single, outstretched. One spicule, very small, short and straight (Fig. 7). No gubernaculum. Genital papillae arranged in three pairs of ventrolateral papillae, of which the first pair are close together and preanal position, two pairs postanal (Fig. 6). Tail conical and short, less than one twentieth of total body length (Figs. 6, 7).

Type material: holotype and allotype (MLP). Paratypes.

Type locality: El Tala river (S 28°27'34", W 65°50'28"), Catamarca province, Argentina.

Host: Nymphs of the cockroach *Blattella vaga* Hebard, 1919 (Blattodea, Blattidae).

Etymology: The name refers to the host.

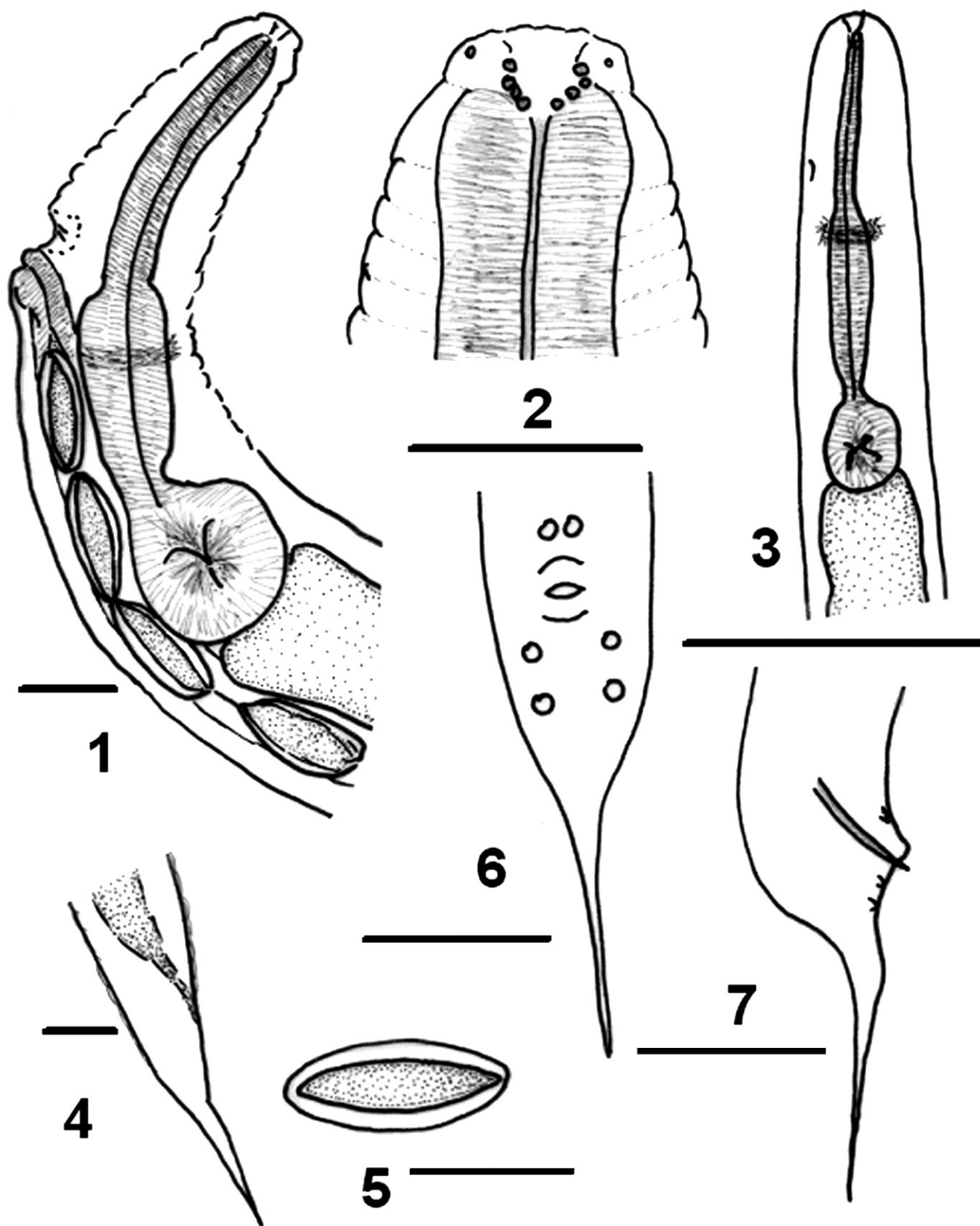
Site of infection: Intestine, midgut.

Prevalence: 40%.

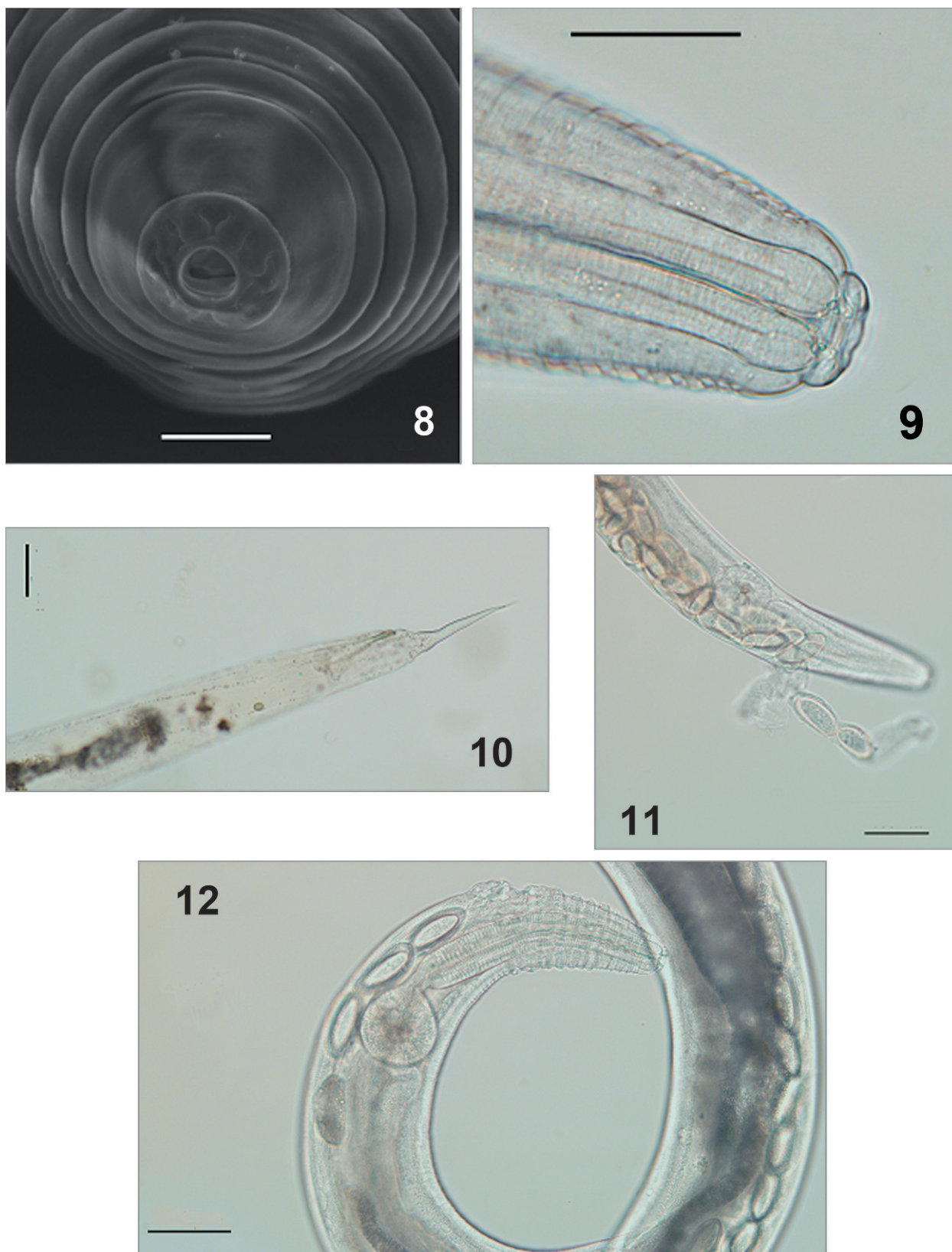
Number of nematodes per nymph: 1–8.

Remarks

This is the first species of the genus *Protrellus* cited for Argentina, which is expanding its global distribution. Currently there are fifteen valid species of the genus *Protrellus* Cobb, 1920: *P. aureus* Coob, 1920; *P. aurifluus* (Chitwood, 1932) Basir, 1956; *P. behorefi* Van Waerebeke, 1969; *P. chauhani* Rao, 1980; *P. dalei* Zervos, 1987; *P. dixonii* Zervos, 1987; *P. eurycotesi* (Kloss, 1961) Skrjabin, Schikhobalova et Lagodovskaya, 1966; *P. ischnopteria* (Kloss, 1966) Zervos, 1987; *P. ituana* (Kloss, 1966) Zervos, 1987; *P. künckeli* (Galeb, 1877) Schwenk, 1926; *P. manni* (Chitwood, 1932) Chitwood, 1933; *P. phyllodromi* (Basir, 1942) Skrjabin, Schikhobalova et Lagodovskaya, 1966; *P. rasolofi* Van Waerebeke, 1969; *P. shamimi* Manjur Shah, Rizvi et Jairajpuri, 2005; and *P. travassosi* Jagannath Rao, 1980; which share the following characteristics: mouth opening circular or triangular, eight labio papillae, oesophagus with corpus, isthmus and basal bulb valvated, excretory anterior to vulva, vulva anterior to base of oesophagus, the eggs oval or ellipsoidal, colourless, yellow, yellow green, or yellow brown, often bearing a polar or lateral cuticular crest or boss, or lateral groove, tail of female conical to attenuate, male with a single spicule, two to five pairs of genital papillae, tail male subconical.



Figs 1–7. *Protrellus blatta* sp. nov. 1. Anterior end of female showing the oesophagus, eggs, vagina, excretory pore. 2. Stoma with teeth. 3. Anterior end of male. 4. Posterior end of female. 5. Egg. 6. Posterior end of male in ventral view. 7. Posterior end of male in lateral view. Bars = 1, 2, 3, 5, 6, 7: 50 μ m; 4: 100 μ m



Figs 8–12. *Protrellus blatta* sp. nov. **8.** Anterior end of female showing the cephalic papillae (SEM). **9.** Stoma with teeth. **10.** Posterior end of female. **11.** Female oviposition. **12.** Anterior end of female showing the oesophagus, eggs, vagina, excretory pore. Bars = 8: 10 μ m; 9: 50 μ m; 10, 11, 12: 100 μ m

Protrellus aureus can be separated from our new species in having the female oesophagus short (0.438 mm long), tail acutely pointed, one spicule, linear and acute. *P. aurifluus* is distinguished by the position of the vulva near base of oesophagus, posterior ovary reflexed once in region of rectum, egg crest prominent, two pairs of caudal papillae in male which one pair is preanal and the other postanal. *P. behorefi* differs in the posterior uterus reflexed about one third of a body length from anterior end, tail conical. *P. chauhani* is separated by having larger eggs (0.11 to 0.14 mm x 0.04 to 0.05 mm) and shorter male tail, one twentieth of total body length. *P. dalei* is characterized by the tail very short, conical, formed of two or three indistinct convex conoids of diminishing size, eggs oval, slightly broader at one end, shell thickened slightly at both ends, more so at pointed end, surface punctuate, with operculum. *P. dixonii* is different by having four pairs of caudal papillae in male, cuticular annulations broad and narrow anterior to vulva. *P. eurycotesi* can separate by the vulva is located in the posterior third of corpus, eggs ellipsoidal, laterally compressed, presenting a strongly developed and sclerotized protuberance, finely striated surface. *P. ischnopteria* differs by the position of the vulva which is about half way along oesophageal corpus, excretory pore not evident, posterior ovary reflexed twice anterior to rectum, egg crest reduced. *P. ituana* is distinguished by the posterior uterus reflexed about one sixth of a body length from posterior end, tail subulate, eggs oval with small spines on all surfaces, excretory pore without lip. *P. künckeli* is characterized by having the vulva in the region of oesophagus basal bulb. *P. manni* has the egg bearing a crest with cuticular bosses, female tail with medial constriction, oesophagus corpus bent before union with isthmus, vulva near posterior end of corpus, two ovaries. *P. phyllodromi* can be separated by the egg without crest but with two lateral grooves, and the female tail short not filiform. *P. rasolofi* with a cuticular fold tongue-shaped, ovary reflexed in the region of the rectum, tail long and filiform, a pair well development of preanal papillae, two pairs of postanal papillae which the first pair is reduced and the second one is located in the tail.

Protrellus shamimi is different by having five pairs of caudal papillae and the caudal appendage which is modified into a short filiform projection in male, and the tail in female is bluntly conical. *P. travassosi* differs in having the egg with a crest in the middle and absence of cuticular protuberances on it.

Protrellus blatta sp. nov. is characterized by having the mouth opening circular, the buccal capsule with eight very small teeth, the nerve ring around oesophageal corpus, the excretory pore anterior to vulva, the vulva anterior to base of oesophagus, didelphic, the posterior ovary reflexed anterior to rectum, about one third of a body length from posterior end, the egg ellipsoidal, colourless, bearing a lateral cuticular crest, tail conical, with long filiform projection, the male with testis single, outstretched, one spicule, very small, short and straight, gubernaculum absent, the genital papillae arranged in three

pairs of ventrolateral papillae, of which the first pair are close together and preanal position, two pairs postanal, tail conical and short, less than one twentieth of total body. For all the above we consider *Protrellus blatta* sp. nov. has unique features that allow separate from other species of the genus.

Key to species in the genus Protrellus (modified Zervos 1987)

1. Female tail conical, with long filiform projection 2
– Female tail short, no filiform projection 5
2. Female excretory pore without lip, posterior ovary reflexed anterior to rectum, about one third of a body length from posterior end, egg ovoid without crest or bosses 10
– Female excretory pore with lip, posterior ovary reflexed at or posterior to rectum, egg ovoid without crest or bosses, 3
3. Female cuticular annulations broad and narrow anterior to vulva, excretory pore with thin circular or oval lip, muscular ovijector, 4 pairs of genital papillae *P. dixonii*
– Female cuticular annulations more or less uniform anterior to vulva, excretory pore covered by flap or not, no ovijector, 3 pairs of genital papillae 4
4. Mouth subtriangular, excretory pore covered by a flap *P. rasolofi*
– Mouth rounded, excretory pore without any cover *P. blatta* sp. nov.
5. Female: vulva in region of oesophageal basal bulb *P. künckeli*
– Female: vulva anterior to oesophageal basal bulb 6
6. Excretory pore not evident, vulva not salient, with ovijector *P. eurycotesi*
– Excretory pore evident, vulva salient, with or without ovijector 7
7. Female tail plainly conical 8
– Female tail with small appendix or pronounced constriction 9
8. Female vulva about half way long oesophageal corpus, excretory pore not evident, posterior ovary reflexed twice anterior to rectum, egg crest reduced *P. ischnopterae*
– Female vulva near base of oesophageal corpus, excretory pore evident, posterior ovary reflexed once in region of rectum, egg crest prominent *P. aurifluus*
9. Female tail with medial constriction, oesophageal corpus bent before union with isthmus, vulva near posterior end of corpus, lateral crest of egg with cuticular bosses *P. manni*
– Female tail with short appendix, oesophageal corpus lineal, vulva about half way along corpus, lateral crest of egg without bosses 10

10. Female: length of head to vulva >270, egg >100 long, without lateral groove 11
 - Female: length of head to vulva <230, egg <85 long, with or without lateral groove 12
11. Female 6000 long, 100 wide, without ovijector, tail acutely pointed, mouth opening triangular, excretory pore without lip, male 610 long, spicule linear and acute *P. aureus*
 - Female 2980–4900 long, 130–310 wide, with ovijector, tail conical composed of diminishing conoids, mouth opening circular, excretory pore with lip, male 840–1148 long, spicule round proximally, wide medially, pointed distally, linear but not acute *P. dalei*
12. Female: vulva 6.5% of body length from anterior end, nerve ring 5.6% of body length from anterior end, tail plainly conical, egg with two lateral grooves *P. phyllodromi*
 - Female: vulva 3.2–5.5% of body length from anterior end, nerve ring 2.2–4.3% of body length from anterior end, tail subulate or composed of diminishing convex conoids, egg without lateral grooves 13
13. Female: posterior uterus reflexed about one sixth of a body length from posterior end, tail subulate, excretory pore without lip, egg oval *P. ituana*
 - Female: posterior uterus reflexed about one third of a body length from anterior end, tail not subulate, composed of diminishing convex conoids, excretory pore with lip, egg crescentrically ovoid *P. behorefi*

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