Russian Journal of Nematology, 1995, 3 (1), 1 - 8

Terrestrial nematodes of the Galapagos Archipelago V: Description of *Aquatides coboi* sp. n., with a key to the genus (Dorylaimida: Nygolaimidae)

Paul De Ley and August Coomans

Instituut voor Dierkunde, Universiteit Gent, Ledeganckstraat 35, B-9000 Gent, Belgium.

Accepted for publication 30 August 1994

Summary. *Aquatides coboi* sp. n. was found on Isla Fernandina and Isla Santa Cruz of the Galapagos Archipelago. This new species is smaller than any known species of the genus (L = 0.7-1.0 mm) and appears to be autotokous (no males found, no sperm seen in fifty-two females). It has a lip region with sucker-shaped anterior surface and small liplets, a mural tooth measuring 11-15 μm, and very short uteri (5-16 μm). SEM photographs are shown. Two females from Isla Santa Cruz of the known species *A. thornei* are also described. A lattice key to *Aquatides* is presented.

Key words: new species, *Aquatides*, *A. coboi* sp. n., nematoda, key, taxonomy, Galapagos.

The genus *Aquatides* Heyns, 1968 currently contains ten species, characterized mainly by a linear nygolaimid mural tooth, a confluent lip region and a rounded, hemispherical or subclavate tail. Dichotomous keys to the genus are available (Heyns, 1968; Ahmad & Jairajpuri, 1982) but they do not include all known species or contain all relevant data now available.

In this paper we present the descriptions of one new and one known species, provide the first SEM observations of the genus and present a lattice key to the species.

MATERIAL AND METHODS

We refer to De Ley et al. (1993) for complete information on the soil samples studied and the terminology employed in the description of the dorylaim vagina. Eight females of *Aquatides coboi* sp. n. were submitted to critical point drying and sputter-coated for observation with a JEOL LSM-840 scanning electron microscope (SEM), but good results were obtained with only two of the specimens. The scale bars presented for the resulting electromicrographs (Fig. 1) were given by the electronics of the SEM, but do in fact slightly underestimate size of the photographed structures.

DESCRIPTIONS

Aquatides coboi sp. n. (Figs. 1 & 2)

Measurements: Table 1.

Females. Body ventrally arcuate, moderately curved to tightly coiled, curvature most prominent in prerectal region. Cuticle 'two-layered', 1-1.5 μm thick along most of body and 1.5-3 μm at tail tip. Observation with SEM reveals an 'inverted annulation' consisting of very thin circumferential ridges separated by bands of indented cuticle about twice as wide as the ridges (Fig. 1F).

Lip region truncate, usually continuous with neck contour or offset by a slight depression, but occasionally offset by a deep depression, probably varying under the influence of the *dilatatores buccae*. Lip region 11-15 μm wide and 4-6 μm high, symmetrical to very weakly asymmetrical with

Table 1. Measurements in μm of *Aquatides coboi* sp. n. and *A. thornei* (Schneider, 1937) Heyns, 1968.

Island:	*Aquatides coboi* sp. n.			*A. thornei*
Sample:	Fernandina 18		Santa Cruz 7	Santa Cruz 11
	Holotype	Paratypes		
n		15	6	2
L	984	871 ± 90 (712-1000)	876 ± 50 (803-950)	1376 - 1174
Body width	31	28 ± 5 (19-34)	26-29	31 - 37
Pharyx	292	262 ± 23 (216-292)	289 ± 9 (276-300)	336 - 384
Tail	12	11 ± 2 (8-14)	12-14	21
ABW	18	16 ± 2 (12-19)	16 ± 1 (15-19)	23 - 27
a	32	31 ± 3 (27.5-39)	29-32	37 - 38
b	3.4	3.3 ± 0.2 (3.1-3.7)	3.0 ± 0.2 (2.7-3.4)	3.5 - 3.6
c	82	78 ± 11 (62-100)	67 ± 5 (59-73)	56 -66
c'	0.7	0.6-0.8	0.7-0.9	0.8 - 0.9
Odontostyle	12	13 ± 1 (11-15)	11-14	12.5
Nerve ring	98	88 ± 8 (71-98)	94 ± 6 (86-102)	106 - 120
Expansion	156	139 ± 16 (109-171)	55 ± 2 (52-60)	190 196
Prerectum	?	26 ± 2 (23-30)	24 ± 5 (19-35)	32
Rectum	16	15 ± 2 (10-18)	16 ± 17	21
Vagina	10	10 ± 1 (8-12)	8 - 11	13 - 15
V (% body)	46	48 ± 2 (45-53)	48 ± 2 (46-51)	49 - 51
G1 (% body)	6	7 ± 1 (5-10)	8 ± 1 (6-10)	7 - 8
G2 (% body)	7	8 ± 1 (6-10)	7 - 10	8

subdorsal lips 0-1 μm higher than subventral lips (Figs. 1C,D; 2B,C,H,I). Lips almost completely amalgamated. Amphids stirrup-shaped with slit-like opening, 5-6 μm wide.

Perioral region under light microscope usually sucker-shaped, somewhat reminiscent of *Discolaimus* (but without overall disc-shape of entire lip region - cf. Figs. 1A,B; 2B,C,H,I), under SEM with six small, striated liplets lying in a circular depression. Guiding ring plicate, at 5-10 μm from anterior end. Mural tooth attached right- (n=9) or left-subventrally (n=10), linear, straight, 0.9-1.1 lip region widths (LRW) long and 0.5-1 μm wide. Stomatal lining surrounding mural tooth slightly refringent, often with bipartite appearance. Odontophore length uncertain, pharyngeal lining thickest at 15-19 μm from mural tooth but not distinctly interrupted. Mural tooth retractors and protractors present, as well as somatic muscle bands modified anteriorly into *dilatatores buccae*.

Slender part of pharynx muscular, anteriorly swollen and more transparent than elsewhere, encircled by nerve ring at about one-third of pharynx length, widening gradually to a posterior expansion at two-fifths to middle of pharynx. Excretory pore as such not visible, but a short part of the assumed excretory duct usually distinct just below the ventral cuticle opposite the nerve ring. Pharyngeal gland nuclei and openings often difficult to discern, located as follows (n=13 for DO and DN; n=10 for others):

DO 53-60%	S1N1 77-81%	S2N 86-90%	K=94-100
DN 59-65%	S1N2 77-81%	S2O 84-90%	K'=95-100
DO-DN 4.5-6.4%	dist. 0.0-0.9%		

Radial muscle fibers of pharyngeal expansion surrounded by a thin sheath forming three basal pockets (Fig. 2D); sheath partly covered by three longitudinal muscle bands lying opposite the lumen radii (Fig. 2E) as described for *A. deconincki* (Jairajpuri & Coomans, 1977). Cardia 9-14 μm long, anteriorly with three pear-shaped glands alternating with the basal pockets.

Vulva transverse. Vagina extending over 28-52% of VBW. Pars distalis vaginae 3-4 μm long with straight walls. Pars refringens vaginae absent. Pars proximalis

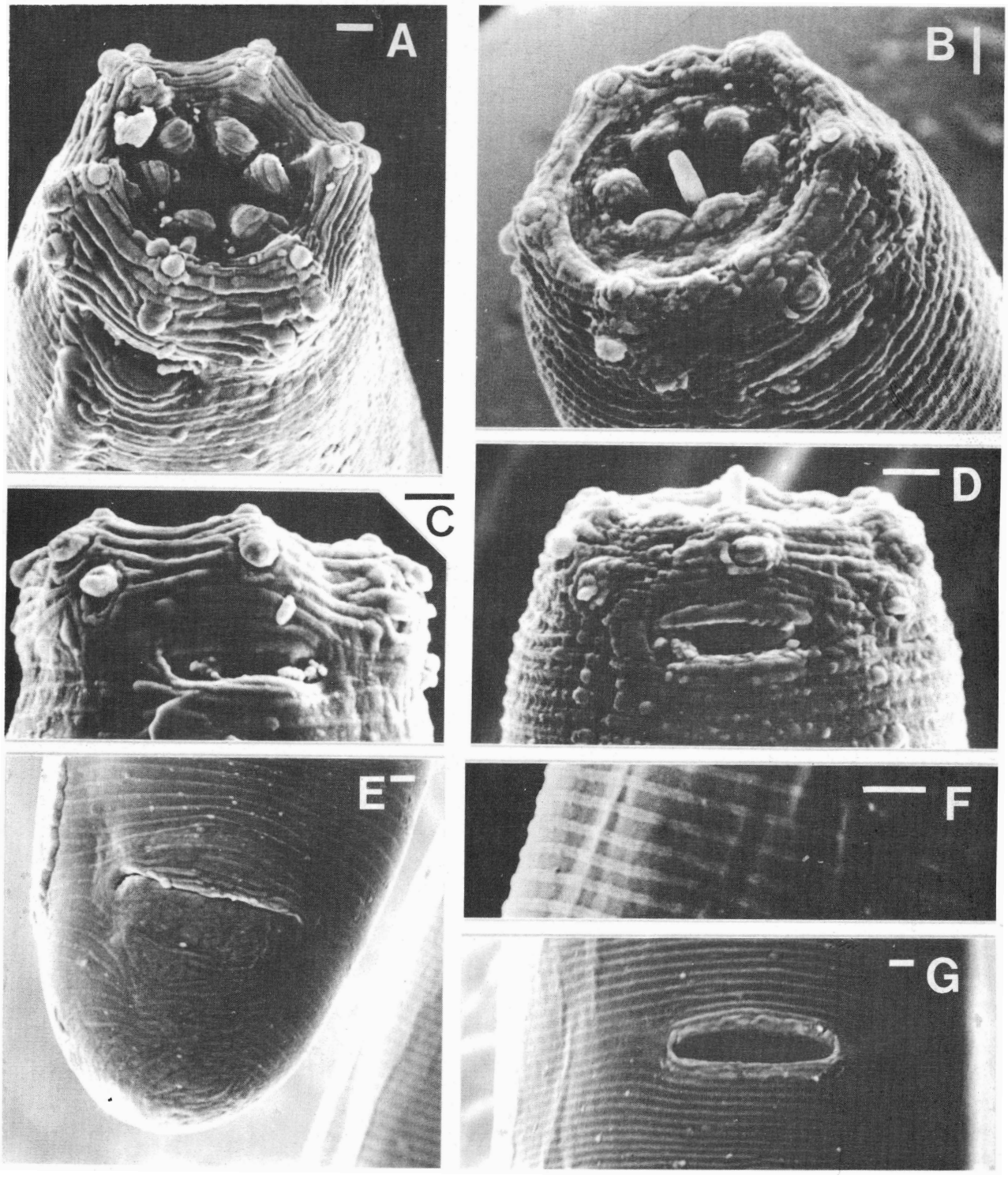

Fig. 1. *Aquatides coboi* sp. n. (females only). A, B: Lip region in anteriolateral view; C, D: Lip region in lateral view (C is same female as A, D is same as B); E: Tail; F: Cuticle near mid-body; G: Vulva. Scale bars represent 1 μm.

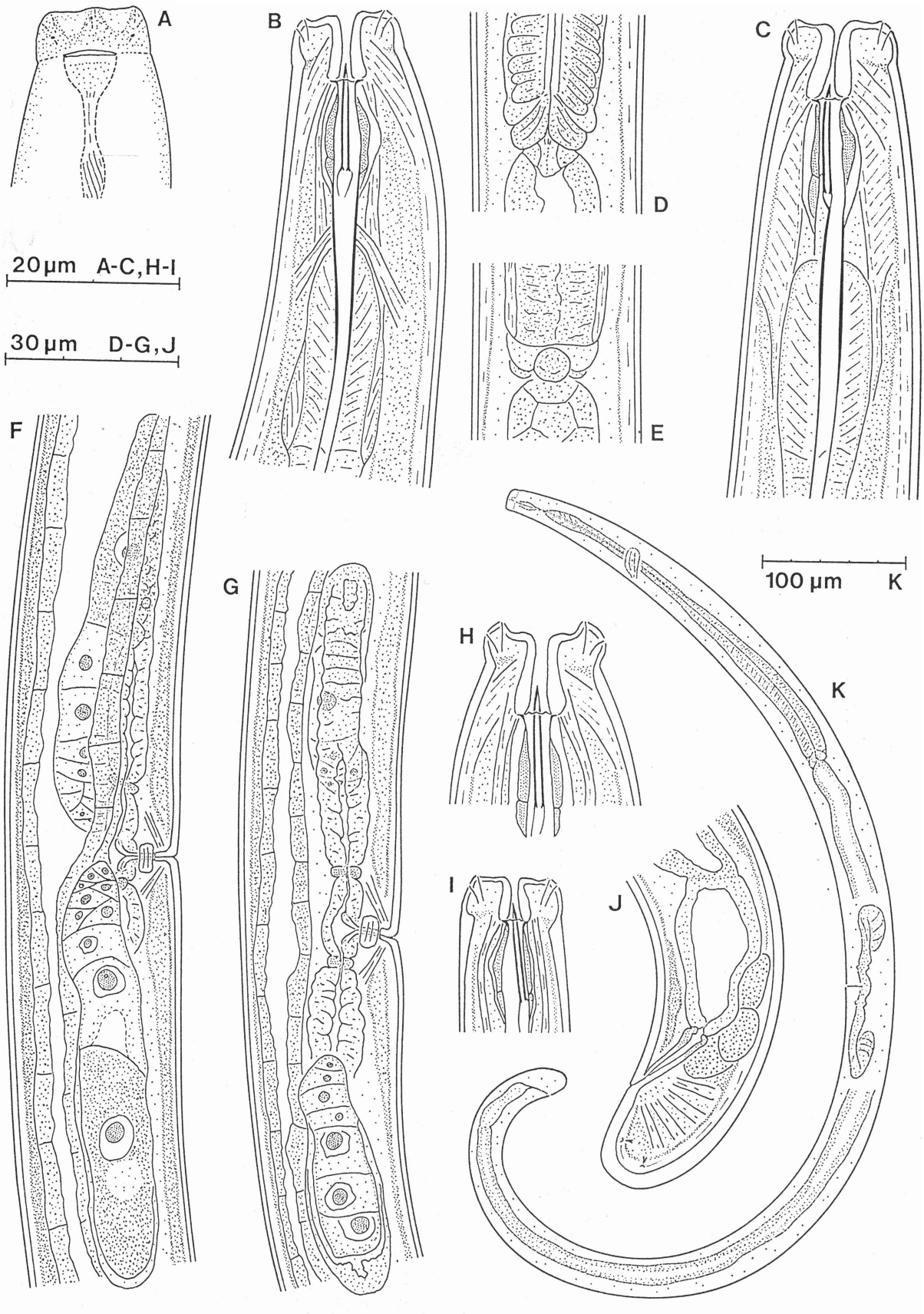

Fig. 2. *Aquatides coboi* sp. n. (females only). A: Anterior end of holotype in surface view; B,C,H,I: Anterior end in median view; D,E: Cardia region in respectively median and surface view; F,G: Reproductive system; J: Tail; K: Holotype female.

vaginae 5-8 μm long, much longer than wide, with straight, parallel contours, distally encircled by sphincter over 3-4 μm. Vulval dilators attached to pars distalis vaginae, vaginal dilators not seen. Ovaries on alternate sides of intestine with anterior ovary on left side in eleven females, on alternate sides with anterior ovary on right in eight, and both on right side in one female. Oocytes containing a nucleus with very large nucleolus as well as several very large granules. Uteri very short in all specimens: anterior uterus 9 μm ± 3 (5-16) long (n=18), posterior uterus 9 μm ± 2 (6-13) long (n=17). No females with sperm or eggs.

Prerectum 1.1-2.3 times as long as ABW. Rectum 0.8-1.1 times ABW. Tail bluntly dorsally convex-conoid, shorter than ABW, with two pairs of caudal pores.

Male. Not found.

Type locality and habitat. Sampling locality 18 (40 females, 42 juveniles): at 800 m altitude on SW slope of Isla Fernandina, Galapagos, Ecuador. Humid soil in fern-sedge zone with some *Psychotria* and *Zanthoxylum*.

Other localities. Isla Santa Cruz: Sample 7 (11 females, 4 juveniles).

Type material. Holotype and eleven paratype females kept on slide Nos. 3793-3800 in the Nematode Collection of the Instituut voor Dierkunde, Universiteit Gent, Belgium. Eighteen paratype females in poorer condition are also kept at this address, but filed in the Galapagos collection. Other paratype females distributed as follows: three in the Moscow State University Zoological Museum, Russia; three in the National Nematode Collection of India, New Delhi, India; two in the National Nematode Collection of New Zealand, Auckland, New Zealand; three in the collection of the Rand Afrikaans University, Johannesburg, South Africa; and three in the USDA Nematode Collection, Beltsville, Maryland, USA.

Etymology. The specific epithet was chosen in honour of Mr. M. Cobo, whose help was invaluable as a guide and participant of the Fernandina expedition.

Differential diagnosis. The new species, *A. coboi*, differs from others in the genus by its smaller size (cf. Table 2) and presumably autotokous reproduction. The very short uteri (5-16 μm long) may represent another useful difference, but this can be compared only with the few published drawings (Fig. 1C in Jairajpuri & Coomans, 1977; Figs. 5E, 6C, 7E in Ahmad & Jairajpuri, 1982) as the uterus length is not given in any of the published descriptions. Apart from Fig. 5E in Ahmad & Jairajpuri (1982), which shows the uteri to be 13-16 μm long in a specimen identified as *A. aquaticus*, the other three figures depict uteri that are 189 μm long (but with egg!) for *A. deconincki*, 70 μm for *A. thornei* and 55 μm for *A. christicki*. Also, the uteri in two females of *A. thornei* (24-25 μm) described below from another locality on Isla Santa Cruz were substantially longer than those of *A. coboi*. Finally, the more or less sucker-shaped perioral region differs from most published drawings of lateral views of the lip region in *Aquatides*, and may also be of diagnostic value.

Aquatides thornei (Schneider, 1937) Heyns, 1968 (Fig. 3)

Measurements: Table 1.

Female. Body ventrally coiled. Cuticle 'two-layered', 1-1.5 μm thick along most of body, 2.5-3 μm at tail tip. Lip region of largest female offset by a weak depression, somewhat cap-shaped, 15 μm wide and 7 μm high, symmetrical (other female fixed with lip region turned laterally). Lips almost completely amalgamated. Amphids stirrup-shaped with slit-like opening, 5 μm wide.

Perioral region with six protruding, rounded liplets (Fig. 3B). Guiding ring plicate, at 6 μm from anterior end. Mural tooth attached right- (n=1) or left-subventrally (n=1), linear, straight, 1.0 LRW long and 1 μm wide. Stomatal lining surrounding mural tooth slightly refringent. Odontophore 22 μm long, its base distinct. Mural tooth retractors and protractors present, as well as somatic muscle bands modified anteriorly into *dilatatores buccae*.

Slender part of pharynx muscular, anteriorly moderately to strongly swollen and more transparent

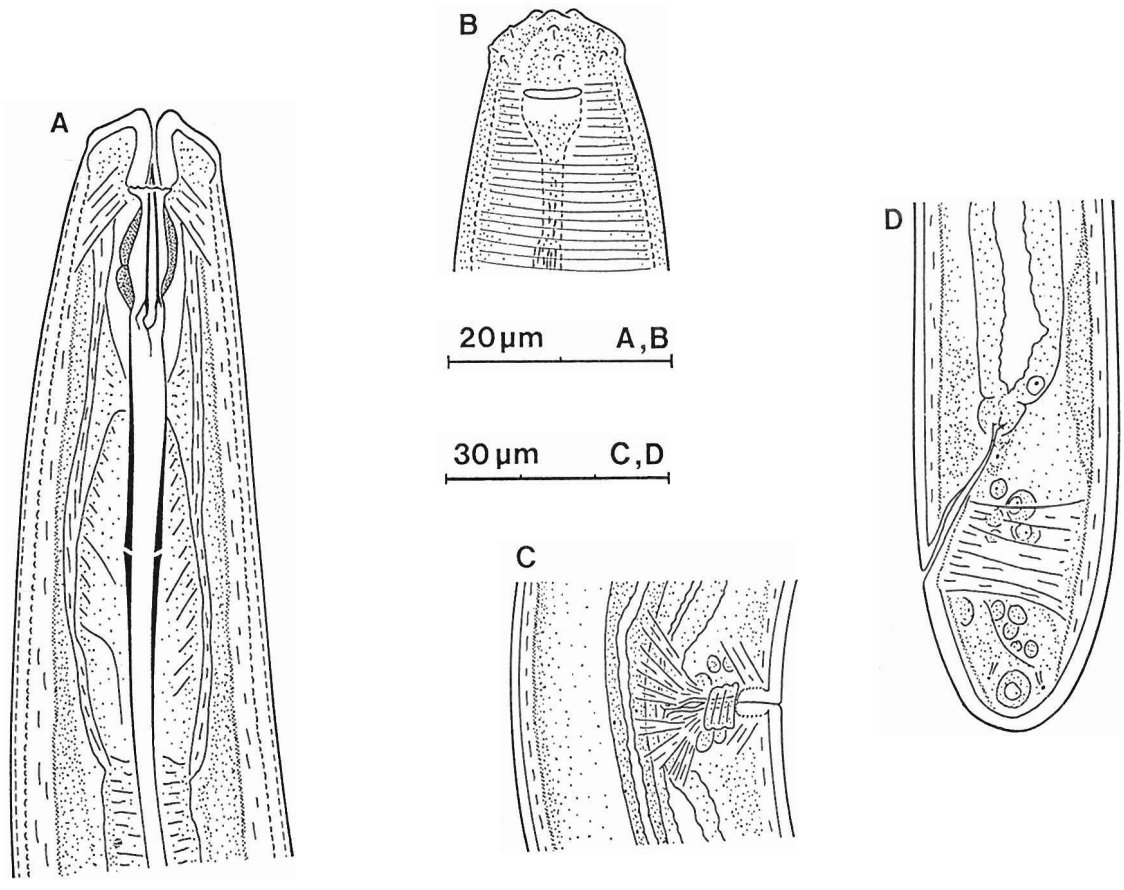

Fig. 3. *Aquatides thornei* (Schneider, 1937) Heyns, 1968 (two females). A: Anterior end in median view; B: Anterior end in surface view; C: Vagina; D: Tail.

than elsewhere, encircled by nerve ring at about one-third of pharynx length, widening gradually to a posterior expansion at two-fifths to middle of pharynx. Excretory pore or duct not visible.

Pharyngeal gland nuclei distinct, located as follows:

DO 62-64%	S1N1 80-83%	S2N 90-91%	K=100
DN 67%	S1N2 80-83%	S2O 91%	K'=100
DO-DN 5.2-5.5%	dist. 0.0-0.3%		

Radial muscle fibers of pharyngeal expansion surrounded by a thin sheath forming three basal pockets that are more confluent with the cardiac glands than in *A. coboi*; sheath probably partly covered by three perradial longitudinal muscle bands. Cardia 10-11 µm long, anteriorly with three pear-shaped glands alternating with the basal pockets.

Vulva transverse. Vagina extending over 41-42% of VBW. Pars distalis vaginae 4-6 µm long with straight walls. Pars refringens vaginae absent. Pars proximalis vaginae 9 µm long, much longer than wide, with straight, parallel contours, distally encircled by sphincter over 3-4 µm. Vulval dilators attached to pars distalis vaginae, distinct vaginal dilators attached to pars proximalis vaginae. Ovaries on alternate sides of intestine with anterior ovary on right side in both females. Oocytes with a few large cytoplasmic granules, oocyte nuclei of largest female with two nucleoli.

Table 2. Lattice key to the species of *Aquatides* Heyns, 1968.

Species	L * (mm)	Lip region width (μm)	Lip region asymmetry distinct	Odontostyle length* (μm)	Spicule length* (μm)	Ventral spicule contour notched	Remarks
A. coboi sp. n.	0.71-1.0	11-15	—	11-15	no males	no males	uteri only 5-16 μm long, perioral area sucker-shaped
A. thornei (Shneider, 1937)	1.2-1.7-*2.4*	12-16	—	*13*-17-18	*27*-43-50	—	
A. intermedius (de Man, 1880)	1.6-2.1-*2.3*	14-17	—	17-19-*20*	50	+	anterior swelling very prominent**
A. aquaticus (Thorne, 1930)	*2.1*-2.3-3.2	19-23	—	*13*-18-22-*23*	50-69	±	possibly junior synonym of *A. shadini*
A. shadini (Filipjev, 1928)	3.0-3.9	20-22	—	17-18	67	+	
A. rotundicaudatus Thorne, 1974	3.0-3.3	20***	?	20	?	+	female tail subclavate
A. smoliki Thorne, 1974	3.3-3.6	26***	—	24-26	?	+	
A. christei (Heyns, 1968)	1.7-2.7	19-26	+	19-24	42-55	+	
A. christicki Ahmad & Jairajpuri, 1982	1.5-1.8	19-23	+	19-23	36-39	—	
A. deconincki Jairajpuri & Coomans, 1977	*1.6*-2.4-2.9	24***	+	*24*-26-29	*55*-59-63	—	odontostyle weakly curved, female tail subclavate
A. kaburakii (Imamura, 1931)	1.5-1.9	?	?	± 13.5	?	+	*sp. inq.*

* - Numbers in italics are from specimens other than types.
** - Reliability of this character needs confirmation.
*** - Measured on drawing in original description.

Anterior uterus 25 μm long (n=2), posterior uterus 24-25 μm long (n=2). Neither female with sperm or eggs.

Prerectum 1.2-1.4 times as long as ABW. Rectum 0.9-1.0 times ABW. Tail bluntly convex-conoid, shorter than ABW, with two pairs of caudal pores.

Male. Not found.

Locality. Isla Santa Cruz: Sample 11 (2 females, 3 juveniles).

Justification of identification. Our specimens do not agree completely with any published description, and because we found only two females (one of which had an upturned lip region) we could not identify them with confidence. They are similar to *A. thornei* in overall measurements (cf. Schneider, 1937 & Table 2) and are therefore provisionally identified as such. In the largest of our two females, the anterior pharyngeal swelling was very prominent. This feature is supposedly characteristic of *A. intermedius*, but instead of identifying our specimens as such we think the reliability of this character should be queried. However, this does imply that *A. intermedius* might be a senior synonym of *A. thornei* (cf. Table 2).

DISCUSSION

Differentiation from one another of the previously described species of *Aquatides* is more difficult than from *Aquatides coboi* sp. n., because their diagnostic characters are variable, inconspicuous and few in number. This is further complicated by the lack of information available of some species (*A. kaburakii, A. shadini* and to a lesser extent *A. rotundicaudatus*), also, three of the more important papers dealing with the genus (Heyns, 1968; Thorne, 1974; Ahmad & Jairajpuri, 1982) are not entirely compatible in their species descriptions and diagnoses. An identification key based on reliable characters cannot be prepared for *Aquatides* without re-examination of most species and an assessment of the intraspecific variability in the

genus. However, to assist with the identification of members of the genus a lattice key of presumably reliable differentiating characters reported in the literature is given in Table 2.

It should be noted that all described specimens of *Aquatides* have been reported to have a straight or, at most, weakly arcuate body posture upon fixation. However, our specimens were always distinctly curved, and occasionally even tightly coiled. Whereas body posture may provide a reliable feature under standardized circumstances of fixation, it is probably unreliable when used for comparison between differently treated specimens. The presence of liplets in *Aquatides* has not been recorded previously, but they are probably present in at least some of the known species (cf. Fig. 158 & 160 in Heyns, 1968).

ACKNOWLEDGEMENT

The senior author is a postdoctoral researcher with the Belgian National Fund for Scientific Research.

REFERENCES

Ahmad, M. & Jairajpuri, M. S. 1982. Nygolaimina of India. *Records of the Zoological Survey of India, Miscellaneous Publication, Occasional Paper* 34: 71 p.

De Ley, P., Loof, P. A. A. & Coomans, A. 1993. Terrestrial nematodes from the Galapagos Archipelago II: Redescription of *Aporcelaimellus obtusicaudatus* (Bastian, 1865) Altherr, 1968, with review of similar species and a nomenclature for the vagina in Dorylaimida (Nematoda). *Bulletin van het Koninklijk Belgisch Instituut voor Natuurwetenschappen, Biologie* 63: 13-34.

Heyns, J. 1968. A monographic study of the nematode families Nygolaimidae and Nygolaimellidae. *Entomology Memoirs* 19: 144 p.

Jairajpuri, M. S. & Coomans, A. 1977. Nematodes of high altitudes in India VII. *Aquatides deconincki* sp. n. (Dorylaimida: Nematoda). *Indian Journal of Nematology* 5: 243-245.

Schneider, W. 1937. Freilebende Nematoden der Deutschen Limnologischen Sundaexpedition nach Sumatra, Java und Bali. *Archiv für Hydrobiologie*, Suppl.-Bd. XV: 30-108.

Thorne, G. 1974. Nematodes of the Northern Great Plains - Part II - Dorylaimoidea in part (Nemata: Adenophorea). *South Dakota State University Agricultural Experiment Station, Technical Bulletin* 41: 120 p.

De Ley P., Coomans A. Почвенные нематоды Галапагосского архипелага. V. Описание *Aquatides coboi* sp. n. с ключем для рода (Dorylaimida: Nygolaimidae).

Резюме. Описывается *Aquatides coboi* sp. n., обнаруженный на островах Фернадина и Санта-Крус Галапагосского архипелага. Новый вид характеризуется наименьшими отмеченными для рода *Aquatides* размерами тела (длина тела 0.7-1.0 мм), а также аутотокией (самцы не были обнаружены, также как и присутствие спермиев у 52 обследованных самок). Передний конец тела *A. coboi* sp. n. присосковидный, с небольшими губами, длина пристенного зуба 11-15 мкм, матка очень короткая (5-16 мкм). Приводятся фотографии, сделанные в сканирующем электронном микроскопе. Дано описание двух самок *A. thornei*, обнаруженных на острове Санта-Крус. Приводится таблица дифференциальных признаков для видов рода *Aquatides*.