

***Echinuria uncinata* (Rudolphi) (Nematoda, Acuariidae) in *Netta peposaca* (Vieillot) (Aves, Anatidae) in South America¹**

Eliane F. da Silveira^{2,3}; José F. R. Amato² & Suzana B. Amato²

¹ Contribution number 476 of the Departamento de Zoologia, Universidade Federal do Rio Grande do Sul.

² Departamento de Zoologia, Instituto de Biociências, Universidade Federal do Rio Grande do Sul. Caixa Postal 15014, 91501-970 Porto Alegre, Rio Grande do Sul, Brasil. E-mail: jfamato@terra.com.br; sbamato@ufrgs.br

³ Departamento de Biologia, Museu de Ciências Naturais, Universidade Luterana do Brasil. 92425-900 Canoas, Rio Grande do Sul, Brasil. E-mail: labinvertebrados@ulbra.tche.br

ABSTRACT. This is the first report of a species of *Echinuria* Soloviev, 1912, on anamid hosts in South America, causing granulomas. It is also the first detailed description and record of a species of *Echinuria*, for South America in the Rosy-billed Pochard, *Netta peposaca* (Vieillot, 1816). Fifty-two rosy-billed pochards were examined for helminths in the Municipalities of Santa Vitória do Palmar (locality of Fazenda Sossego) and (locality of Ponta da Antena), State of Rio Grande do Sul, Brazil, and Alvear, Province of Corrientes, northern Argentina. Samples were obtained from 2003 to 2004. After the catch each bird was immediately frozen with dry ice. Prior to necropsy birds were sexed, weighted, measured, and the state of maturity (juvenile or adult) determined, based on the presence or absence of a bursa of Fabricius. The granulomas with the nematodes were found in the proximal esophagus at the junction with the proventriculus. Two birds had one (fistulated) and two granulomas, respectively. One of the birds was from the wintering grounds along the coastal region in the State of Rio Grande do Sul, southern Brazil. The other, from one of the breeding grounds in northern Argentina, was captured before the trip to the wintering grounds along the migratory flyway. Prevalence was 3.8% while the mean intensity of infection was 7.2. Morphometry of males and females and the comparison with previous descriptions and illustrations allowed the identification of the present specimens as *E. uncinata*.

KEY WORDS. Breeding grounds; granuloma; migratory flyway; northern Argentina; rosy-billed pochard; southern Brazil; wintering grounds.

RESUMO. *Echinuria uncinata* (Rudolphi) (Nematoda, Acuariidae) em *Netta peposaca* (Vieillot) (Aves, Anatidae) na América do Sul. Este é o primeiro registro de uma espécie do gênero *Echinuria* Soloviev, 1912, em hospedeiros anatídeos na América do Sul, causando granulomas. É, também, a primeira descrição detalhada e o primeiro registro de *Echinuria uncinata* (Rudolphi, 1819) Soloviev, 1912, para a América do Sul, e o primeiro registro de um nematóide acuarióide em *Netta peposaca* (Vieillot, 1816). Cinquenta e dois marrecões foram examinados para helmintos nas localidades de Fazenda Sossego e Ponta da Antena, Município de Santa Vitória do Palmar, Estado do Rio Grande do Sul, região Sul do Brasil e Alvear, Província de Corrientes, região Norte da Argentina. As amostras foram obtidas no período de 2003 a 2004. Imediatamente após o abate, cada ave foi congelada em gelo seco. As aves foram separadas por sexo, pesadas e medidas. O estado de maturidade de cada ave foi avaliado (juvenil ou adulto) com base na presença ou ausência da bolsa de Fabricius. Os granulomas, contendo os nematóides, estavam situados na base do esôfago quase junto à junção com o proventrículo. Duas aves estavam positivas, com um (fistulado) e dois granulomas, respectivamente. Uma das aves era proveniente do Brasil (pólo de invernã na planície costeira do Estado do Rio Grande do Sul). A outra da região Norte da Argentina, capturada em um dos pólos de nidificação, antes de empreender sua viagem em direção à costa brasileira ao longo de sua rota de migração. A prevalência da infecção foi de 3,8% e a intensidade média de infecção de 7,2. A morfometria de machos e de fêmeas permitiu a identificação dos espécimes como *E. uncinata*.

PALAVRAS-CHAVE. Granulomas; marrecão; norte da Argentina; pólo de invernã; pólo de nidificação; rota de migração; sul do Brasil.

Echinuria Soloviev, 1912 contained several species originally described in other genera that did not comply with a

clear generic diagnosis of possessing two rows of spines along each lateral side. CRAM (1927) made a comprehensive study of

the nematode parasites of birds in the “suborders Strongylata, Ascaridata, and Spirurata”, presenting a key for the 13 species of *Echinuria* known to that date. Eight of these species, including three which had originally been described by Molin in the mid 1860's from two Brazilian hosts, were transferred to the genus, becoming new combinations. One species was described as new. CRAM (1927) still retained in *Echinuria* species which later were transferred, mainly to the genus *Syncuaria* Gilbert, 1927. *Echinuria parva* was added to the list by CRAM (1928).

CHITWOOD & WEHR (1934) synonymized *Syncuaria* with *Echinuria* as their cordons were similar. *Echinuria* was revised at the time of the proposition of the new subfamily Echinuriinae Sobolev, 1943. *Echinuria uncinata* (Rudolphi, 1819) Soloviev, 1912 is a nematode parasite of anatid birds and the most commonly found species of the genus. It has been found associated to granulomas, in the esophagus, proventriculus, gizzard, and sometimes, the small intestine, in different parts of the world. Mortalities of wild and domestic birds have been associated to a high intensity of infection by this species and to its high pathogenicity. The other species, apparently, were found only on the occasion in which they were first described.

BUXTON *et al.* (1952) conducted experiments with ducks in a small lake in Great Britain and described the granulomas found in the proventriculus and their relationship to the physical condition of the dead birds. GIBSON & BARNES (1957) reported an outbreak of echinuriasis in domestic geese and ducks in the United Kingdom, showing the granulomas scattered over the surface of the proventriculus. CORNWELL (1963) worked with three species of anatids in southern Manitoba, Canada, describing the lesions and the physical alterations inflicted to the hosts by *E. uncinata*. The author linked the peak of bird mortality to the occurrence of drought in the areas of high concentration of birds; drought causing a high concentration of *Daphnia* spp. specimens (the intermediate host) in small lakes, thus increasing the chance for bird infection.

BEZUBIK (1956) briefly described and partially illustrated specimens of *E. uncinata* from several anatid hosts in Poland. Other papers have been published on parasites of anatids, where *E. uncinata* was listed: LALITHA & ALWAR (1960), CHANDRASEKHARAN & PETER (1969), and LONE *et al.* (1971) in India; JANSEN JR. & VAN DEN BROEK (1963) in the Zoological Garden of Copenhagen, Denmark; AVERY (1966a) in a species of the genus *Netta* Kaup, 1829 and AVERY (1966b) both in the UK; GEORGE & BOLEN (1975) in southern Texas, USA; and Zuchowska (1997) in Poland. Previously, ZUCHOWSKA (1970) had found 32% of the waterfowl species at the Lodz Zoo infected with *E. uncinata* and that 16% of the cases resulted in death. These reports did not include descriptions or illustrations which could allow the species confirmation.

AUSTIN & WELCH (1972) recorded the presence of *E. uncinata* in Canada. These authors described the life cycle and the larval stages found in several species of crustaceans collected from the wild, as well as in the laboratory, in addition to test several crustacean species as possible intermediate hosts. The

lesions found in the waterfowl at Delta, Manitoba were described and experiments were conducted with several species of anatids to determine their susceptibility to *E. uncinata*. OULD & WELCH (1980) studied the influence of stress on infected anatids in Canada. It was observed that stressed ducks were infected with larger size nematodes and had a higher intensity of infection. Recently, WORK *et al.* (2004) recorded a high degree of mortality among Laysan duck populations (*Anas laysanensis* Rothschild, 1892) in Laysan Island, Hawaii, due to *E. uncinata*.

FARIAS & CANARIS (1986) recorded *E. uncinata* in the Mexican duck, *Anas platyrhynchos diazi* Ridgway, 1886, from North Central Mexico and the southwestern United States, while FEDYNICH *et al.* (1996) recorded the presence of *E. uncinata* in the only helminth community structure and pattern study of two allopatric populations of *Anas fulvigula* Ridgway, 1874, conducted on a nonmigratory waterfowl species in North America.

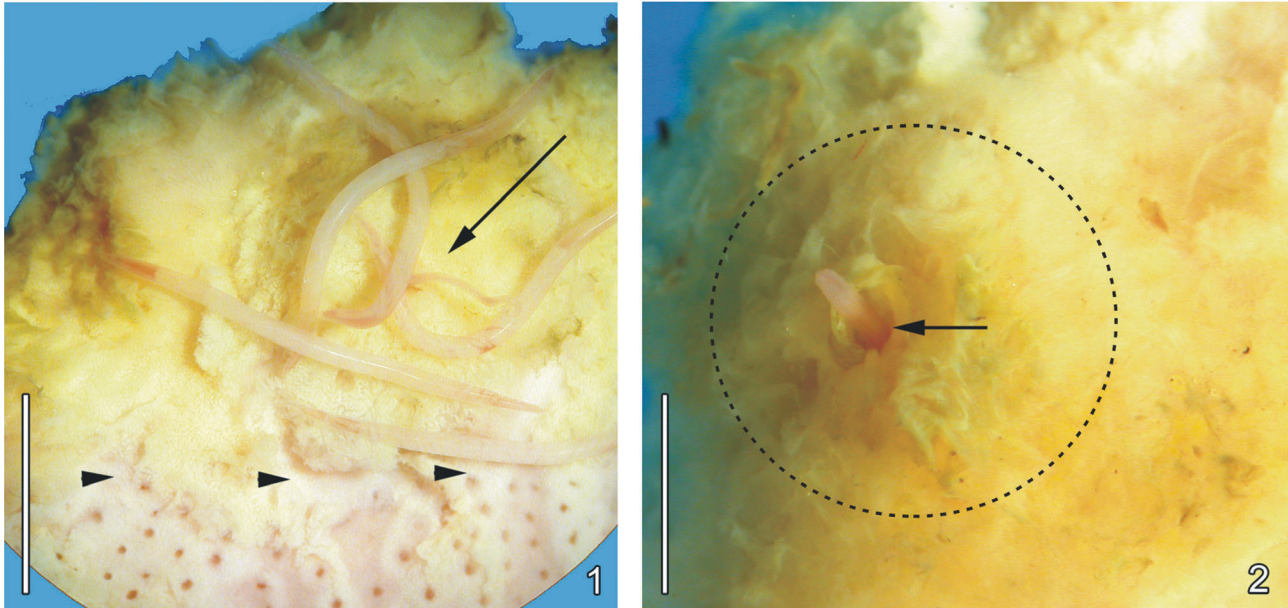
The external morphology of *E. uncinata* has been described by KENNEDY *et al.* (1973). These authors gave details about the cordons and the body spines, as well as the possible functions of both, based on optical and scanning electron microscopy (SEM). CLARK (1977, 1979) recorded the presence of *E. uncinata* and described a new species, *Echinuria australis* Clark, 1979, from *Anas superciliosa* Gmelin, 1789 of New Zealand, respectively. The author has indicated the smaller size of *E. australis* as one of the key characters for its differentiation from other species in the genus, comparing it to *E. uncinata*.

VICENTE *et al.* (1995) listed three species of *Echinuria* described by Molin in the mid 1800's as occurring in Brazil, because, apparently, they did not see the work of WONG *et al.* (1986) who transferred two of these species from *Echinuria* to *Syncuaria* and the third to *Desportesius* (Chabaud & Campana) Skrjabin, Sobolev & Ivashkin, 1965.

The present paper is the first record of a species of *Echinuria* causing granulomas on any anatid host in South America; the first detailed description of a species of *Echinuria*, from South America; and the first record of *E. uncinata* (extending its known geographical distribution) to the South American continent. This is the first record of acuarioid nematodes in the Rosy-billed Pochard, *Netta peposaca* (Vieillot, 1816).

MATERIAL AND METHODS

Fifty-two rosy-billed pochards (*N. peposaca*), known in Brazil as ‘marrecão’, were captured by shot gun, with permission of the Instituto Brasileiro do Meio Ambiente e Recursos Naturais Renováveis (IBAMA) (license N° 042/2004/RS) in the Municipalities of Santa Vitória do Palmar (33°16'13"S, 053°26'28"W) – locality of Fazenda Sossego and (33°04'03"S, 053°19'20"W) – locality of Ponta da Antena, State of Rio Grande do Sul, southern Brazil, and Alvear (29°09'13"S, 056°54'34"W), Province of Corrientes, northern Argentina. Samples were obtained from 2003 to 2004. Each host was immediately frozen with dry ice. Prior to necropsy birds were sexed, weighted, measured, and had the state of maturity (juvenile or adult) deter-



Figures 1-2. Granulomas caused by *Echinuria uncinata*: (1) specimens over the granuloma in the proximal esophagus, bordering proventriculus (head arrows), bar = 5 mm; (2) granuloma showing a nematode protruding from fistula (dashed circle shows the limits of the granuloma), bar = 5 mm.

mined, based on the presence or absence of a bursa of Fabricius. Nematodes were fixed in 65°C A.F.A. (AMATO *et al.* 1991), cleared in lactophenol (HUMASON 1972), and mounted in Canada balsam. Spicules were removed with fine needles and mounted in deFaure's (deF) medium (AMATO *et al.* 2003). Measurements are in micrometers (μm) unless otherwise indicated; ranges are followed (between parentheses) by the mean \pm the standard deviation values, and the number of specimens measured for a given character (when different than the stated number measured). Ecological concepts were used according to BUSH *et al.* (1997). Photomicrographs were taken with a Zeiss Axiolab microscope equipped with phase contrast or with a Leica DMR Hc differential interference contrast (DIC) microscope with Nomarski's prisms. Duck carcasses were deposited in the Coleção Ornitológica do Museu de Ciências Naturais da Fundação Zoobotânica do Rio Grande do Sul (MCN), Porto Alegre, Rio Grande do Sul, Brazil. Helminth voucher specimens were deposited in the Coleção Helminológica do Instituto Oswaldo Cruz (CHIOC), Rio de Janeiro, RJ, Brazil.

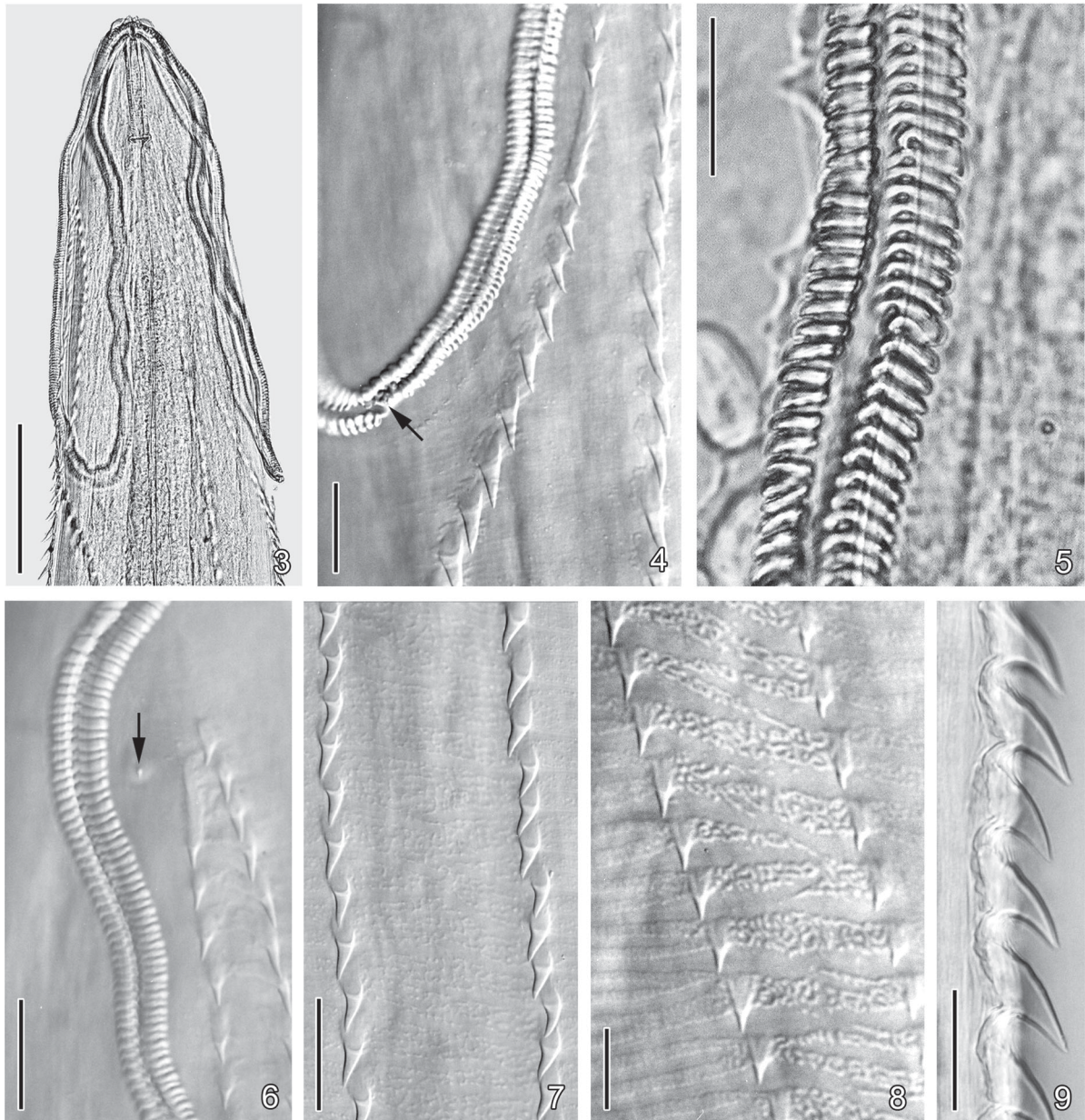
RESULTS

Echinuria uncinata (Rudolphi, 1819) Soloviev, 1912 Figs 1-26

Description. Body slender, attenuated at extremities. Females larger than males (proportion of 1.3: 1). Anterior end round, with two projecting pseudolabia (Figs 3 and 10), one amphidial pore, and two cephalic papillae on each side. Two

pairs of not recurrent but anastomosing cordons (Figs 3-6) arising from the pseudolabia, in the sides of the body, in average, 5.9% of total body length (TBL), in both sexes. Cordons formed by individual plates, with a central canal (Fig. 5). Deirids small (Fig. 6), at level of nerve ring, between cordons and first two spines of each row of body spines. Cuticle with fine striations (Figs 12 and 21) and four longitudinal, mostly parallel, lateral rows of spines, swinging to dorsal region between lateral ventral cordons (Figs 3 and 4), at level of nerve ring and meeting almost at posterior tip of body (Fig. 21). Spines change slightly in shape along body length; as well as cuticle texture between spine rows (Figs 6-9); at middle region of body the base narrows and tips are slightly curved, with the cuticle showing raised fine texture (Fig. 7); in posterior region spines have wider base and straight tip with cuticle showing more conspicuous texture (Fig. 8); spine length (tip to base) (Fig. 9) 30-42.5 (\bar{x} = 37.5 \pm 3.82). Excretory pore difficult to observe, located between cordons and posterior portion of nerve ring, just below level of cordon anastomosis. Buccal capsule long, with transversally striated cuticle (Fig. 10), and valve or sphincter at union with esophagus (Fig. 10). Nerve ring in narrower, anterior portion of muscular esophagus (Fig. 11). Muscular esophagus varying from 5.8 to 7.5% of TBL; glandular esophagus varying from 12 to 15% of TBL.

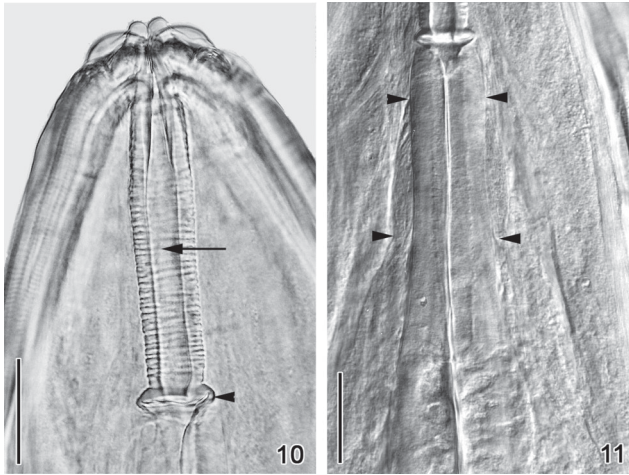
Males ($n = 7$). Males smaller than females, 9.4-12.7 mm (\bar{x} = 10.91 mm \pm 1.30) long, 300-400 (\bar{x} = 35 \pm 30) wide. Cordons 580-730 (\bar{x} = 644.29 \pm 58.27) long, corresponding to 5.9% of TBL and 67% of the added buccal capsule and muscular



Figures 3-9. External morphology of *Echinuria uncinata*: (3) anterior region, showing the lateral ventral cordons and the four lateral rows of spines, bar = 200 μ m; (4) point of cordon anastomosis (arrow) and the lateral rows of spines reaching the dorsal side of body, over the cordons (DIC), bar = 50 μ m; (5) higher magnification of the plates which form the cordons showing the central canal, bar = 25 μ m; (6) deirid (arrow) located at the level of first two spines, between the cordon and the beginning of the double rows of cuticular spines (DIC), bar = 50 μ m; (7 and 8) the double row of cuticular spines (DIC), (7) anterior region of the body showing the shape of spines and the fine texture of cuticle, bar = 50 μ m, (8) mid-region of body showing the irregular, coarser texture of cuticle between the rows of cuticular spines, bar = 25 μ m; (9) cuticular spines in lateral view, bar = 50 μ m.

esophagus lengths, respectively. Buccal capsule 122.5-135 (\bar{x} = 127.79 \pm 4.58) long; muscular esophagus 730-1000 (\bar{x} = 822.86 \pm 96.04) long; glandular esophagus 2.1-2.28 mm

(\bar{x} = 2.2 mm \pm 79.87; n = 5) long. Nerve ring in anterior portion of muscular esophagus, 225-250 (\bar{x} = 234.6 \pm 9.41; n = 6) from anterior extremity. Posterior region of body curved ventrally (Fig.



Figures 10-11. Anterior region of *Echinuria uncinata*: (10) pseudolabia and striated buccal capsule (arrow), with a valve or sphincter at union with esophagus (head arrow) (DIC), bar = 50 μ m; (11) anterior region of the muscular esophagus showing the nerve ring (limits pointed by head arrows) (DIC), bar = 50 μ m.

12). Tail 350-540 (\bar{x} = 431.7 \pm 71.32) long; four pairs of pre-cloacal, pedunculated papillae and five pairs of sessile, post-cloacal papillae, of which, the first two pairs are close together (Fig. 12); tip of tail with button-like process. Spicules hollow, dissimilar, unequal (Fig. 12); right spicule wider (Fig. 13), widest at center, 205-250 (\bar{x} = 224.6 \pm 19.5) long; proximal region with fine spine-like projections (Fig. 13); distal portion with a typical, specific, transparent membrane (Fig. 14) and two conical or spike-like projections, one proximal, larger, another distal, smaller (Fig. 14); left spicule slender, 550-725 (\bar{x} = 669.25 \pm 58.57) long; proximal end bell-shaped (Figs 15 and 16), distal end flared, with three or four points supporting thin-walled, open funnel-like tip (Figs 17-19); length of right /left spicules ratio 1: 2.2-3.41.

Females (n = 8). Females didelphic, prodelphic, larger than males, 12.7-15.6 mm (\bar{x} = 14.3 mm \pm 0.9) long; maximum width 700-900 (\bar{x} = 800 \pm 10). Cords 780-950 (\bar{x} = 856 \pm 69.1), as in males, covering 5.9% of TBL and 78.2% of added buccal capsule and muscular esophagus lengths. Buccal capsule 105-150 (\bar{x} = 133.2 \pm 16.2) long; muscular esophagus 810-1120 (\bar{x} = 961.5 \pm 114.4; n = 5) long; glandular esophagus 1.23-2.21 mm (\bar{x} = 1.78 mm \pm 0.5; n = 3) long. Nerve ring 257.5-312.5 (\bar{x} = 293.3 \pm 31.1; n = 3) from anterior extremity. Vulva in posterior region of body (Figs 20 and 23), at some distance from the anus, distant 1.11-1.95 mm (\bar{x} = 1.38 mm \pm 0.26) from posterior extremity; 1.2-1.72 mm (\bar{x} = 1.33 mm \pm 0.19; n = 6) distant from anus (Fig. 20), with thick, ring-like border, which might keep it open (Fig. 25); vagina short (Fig. 24), with thick walls (Figs 23 and 24), receiving both uteri from the front of the body (Fig. 23); eggs elliptical, thick-shelled (Fig. 25), 31.3-33.3 (\bar{x} = 32.3 \pm 1.0) long, 19.5-21.3 (\bar{x} = 20.3 \pm 0.8) wide, some-

times larvated. Anus is a horizontal slit (Fig. 22), with 'thickenings' anteriorly (Fig. 22). Tail short, conical, with tip rounded (Fig. 21), 210-300 (\bar{x} = 261.3 \pm 34) long.

Granulomas. Two birds had one (fistulated - Fig. 2) and two granulomas (Figs 1 and 2), respectively, in the proximal portion of the esophagus, contiguous to the proventriculus (Fig. 1). The nodules measured approximately 8 mm in diameter. All nematodes were removed from the nodules, but one specimen, which was free in the lumen of the proventriculus.

Synonyms. *Spiroptera uncinata* Rudolphi, 1819; *Dispharagus uncinatus* (Rudolphi, 1819) Railliet, 1893; *Acuraria* (*Hamannia*) *uncinata* (Rudolphi, 1819) Railliet, Henry & Sisoff, 1912; *Hamannia uncinata* (Rudolphi, 1819) Stiles & Hassall, 1920.

Host. *Netta peposaca* (Vieillot, 1816) - new host record (NHR).

Host specimens deposited. MCN N^os 2775 - male; 2776 - female.

Localities. Fazendas Sossego and Ponta da Antena, Municipality of Santa Vitória do Palmar, State of Rio Grande do Sul, southern Brazil, and Alvear, Province of Corrientes, northern Argentina.

Site of infection. Proximal esophagus, almost at the junction with the proventriculus, within granulomas, one of them fistulated.

Prevalence. 3.8%.

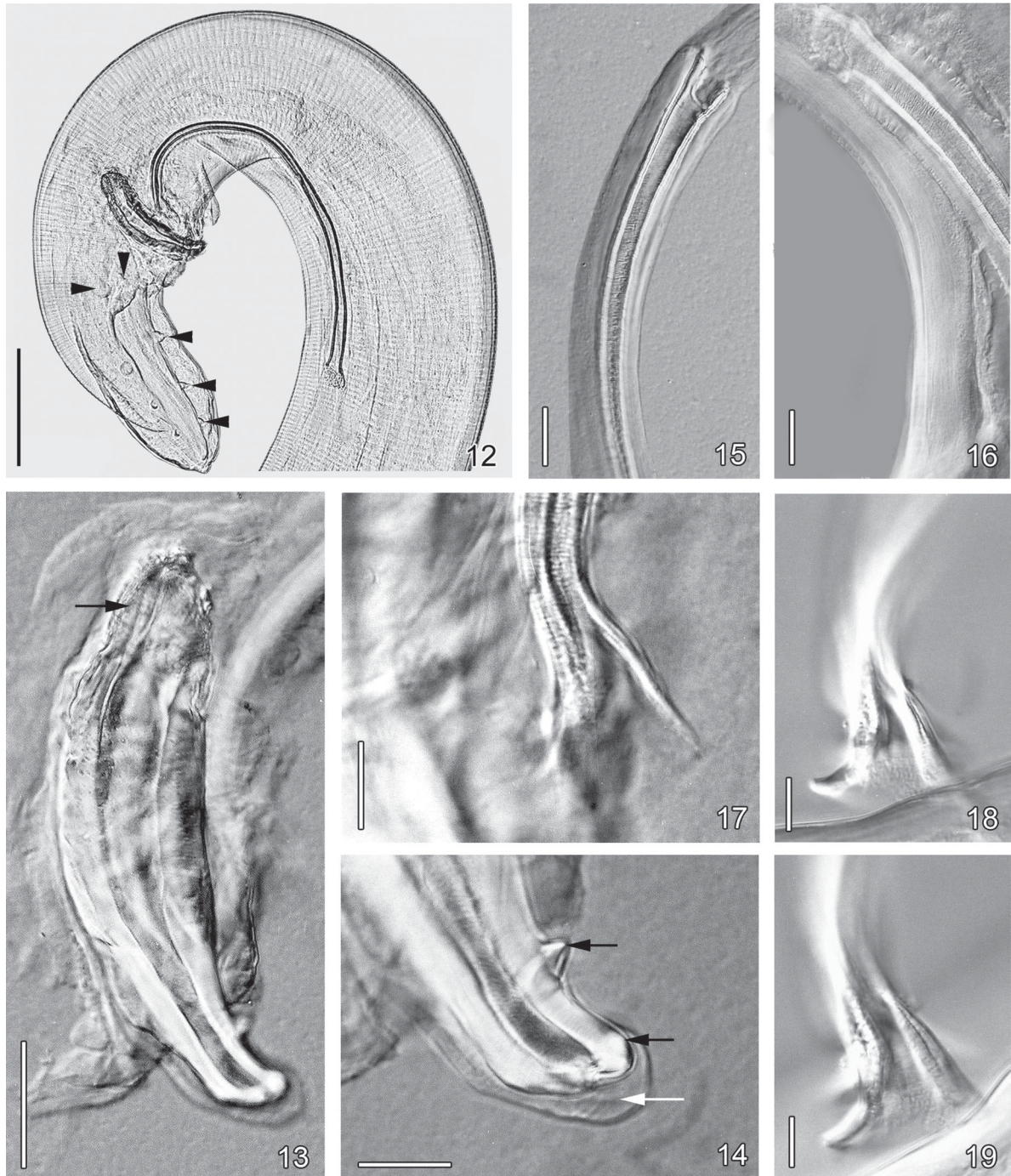
Mean intensity of infection. 7.2.

Voucher specimens deposited. CHIOC N^os 36.627 - female; 36.628 - male.

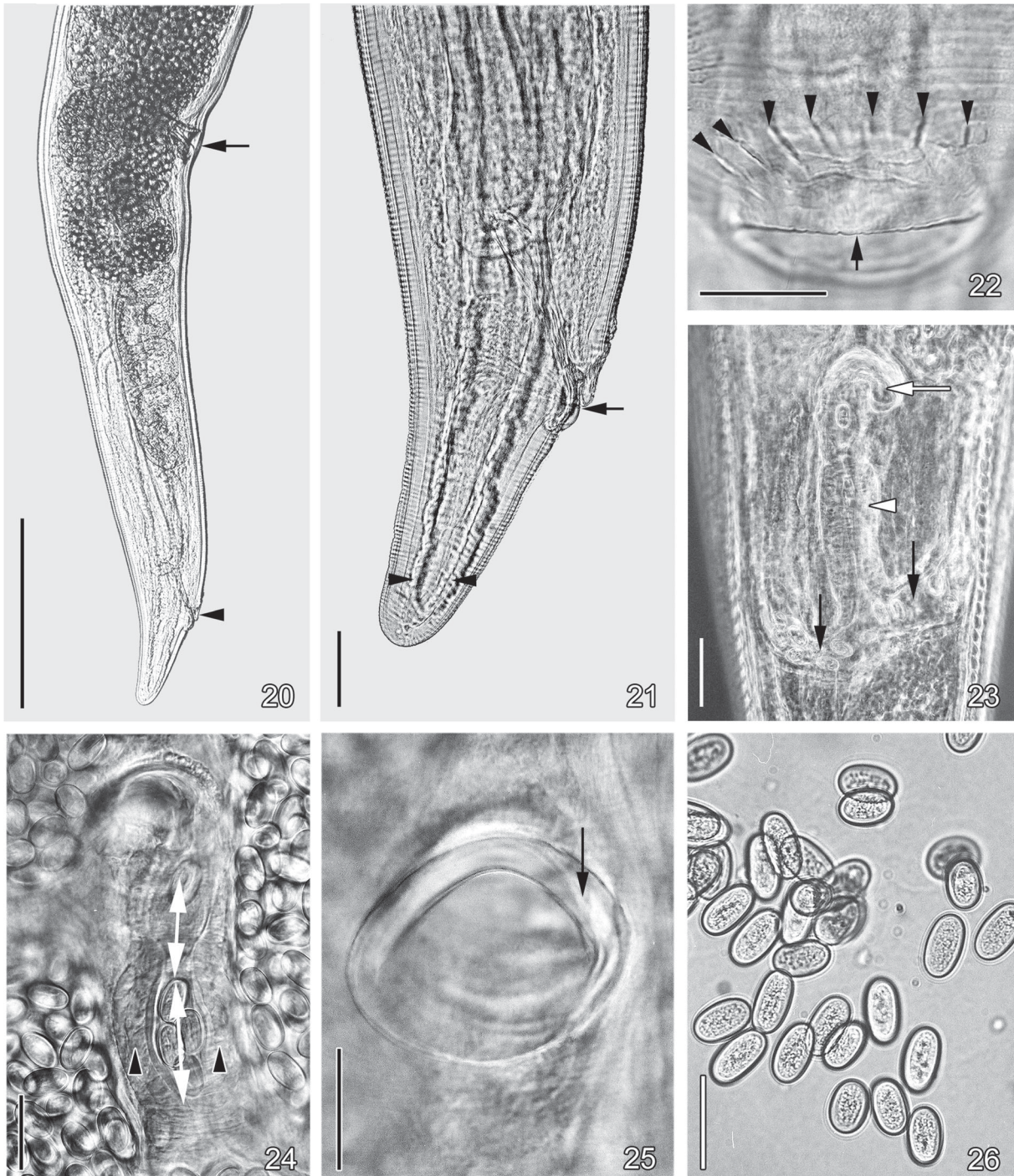
DISCUSSION

Wong *et al.* (1986), in a revision of *Syncuaria*, transferred, based on type specimen examinations, four species which were incorrectly placed in *Echinuria*: *Syncuaria leptoptili* (Geddes, 1916) Sobolev, 1943; *Syncuaria hargilae* (Baylis & Daubney, 1923) Sobolev, 1943; *Syncuaria squamata* (Linstow, 1883) Wong, Anderson & Bartlett, 1986; and *Syncuaria decorata* (Cram, 1927) Wong, Anderson & Bartlett, 1986. Two additional species (collected in Brazil) were considered as *species inquirendae*: *Syncuaria calcarata* (Molin, 1860) Sobolev, 1943, from *Aramus guarauna guarauna* (Linnaeus, 1766) (= *Ibis guarauna*) and *Syncuaria longeorinata* (Molin, 1860) Skryabin, Sobolev & Ivashkin, 1965, from *Ciconia maguari* (Gmelin, 1789). The third species collected in Brazil, which Molin, in the mid 1860's, described as a species of *Echinuria* was transferred to *Desportesius*, becoming *Desportesius longevaginatus* (Molin, 1860) Wong, Anderson & Bartlett, 1986. Thus, up to the present, there have been no species of *Echinuria* collected from autochthonous anatids either in Brazil or South America.

The nematodes found in *N. peposaca* were determined as belonging to the genus *Echinuria* and identified as *E. uncinata* by the following characters: anterior region with four cords not recurrent, but anastomosed posteriorly; cuticle with four lateral rows of longitudinal spines along the entire length of the body; males with unequal and dissimilar spicules; right spicule with two conical or spike-like projections and a trans-



Figures 12-19. Posterior region of male *Echinuria uncinata*: (12) showing five pairs of post-cloacal papillae (head arrows pointing one papilla of each pair), bar = 250 μ m; (13) right spicule (DIC), proximal region showing fine granules (arrow), bar = 50 μ m; (14) right spicule (DIC), showing conical or spike-like projections (larger spike and smaller spike –black arrows) and transparent membrane (white arrow) bar = 50; (15) proximal extremity of left spicule (DIC), bar = 30 μ m; (16) proximal extremity of left spicule, another view (DIC), bar = 25 μ m; (17) distal extremity of left spicule, showing the flared, three pointed distal end (DIC), bar = 20 μ m; (18) distal extremity of left spicule, showing the flared, thin-walled, open funnel-like tip (DIC), in a different position, bar = 25 μ m; (19) distal extremity of left spicule, showing the flared, thin-walled, open funnel-like tip (DIC), another position, bar = 20 μ m.



Figures 20-26. Posterior region of adult female *Echinuria uncinata*: (20) vulva (black arrow) and anus (black head arrow), bar = 250 μ m; (21) caudal region showing anus (black arrow) and the lateral rows of cuticular spines meeting almost at the tip of body (black head arrows), bar = 50 μ m; (22) anus, a horizontal slit-like opening (arrow) with series of 'thickenings' anteriorly (head arrows) (DIC), bar = 50 μ m; (23) vulva (white arrow), muscular vagina (head arrow), and the two uteri joining the vagina (black arrows), bar = 100 μ m; (24) muscular vagina (double headed white arrows) with eggs, showing its thick walls (black head arrows) (DIC), bar = 10 μ m; (25) vulva with thick border (arrow) (DIC), bar = 50 μ m; (26) thick-shelled, elliptical eggs, bar = 50 μ m.

parent membrane, in the distal area, which, according to CLARK (1979) is characteristic of this species; and, females with the vulva in the posterior region of the body.

In the present work, the total length of males of *E. uncinata* found in *N. peposaca* varied from 9.4-12.3 mm. CRAM (1927) recorded males with 8-10 mm in length, while BEZUBIK (1956) reported males with 7-9 mm in length, from the United States and Poland, respectively. AUSTIN & WELCH (1972) recorded males 4.35-9.75 mm long, in Canada; while McDONALD (1974) indicated a length variation of 8-12.8 mm. Females of *E. uncinata* varied from 12.7-15.6 mm in length, which is well within the range (12-20.5 mm) given by McDONALD (1974), but smaller than the measurements (12-18.5 mm) given by CRAM (1927), and larger than that (10.57 mm) recorded by AUSTIN & WELCH (1972). The structure of cordons observed in the specimens of the present work (Fig. 5) was similar to that described by KENNEDY *et al.* (1973) seen with light microscopy and with SEM, being formed by curved plates with a median canal, slightly irregular at the point of anastomosis.

Echinuria uncinata has been cited as a species highly pathogenic to anatid birds (CORNWELL 1963, AUSTIN & WELCH 1972, WORK *et al.* 2004, among others, including many reports in the Russian literature). In the present study such a condition has not been observed. Overall prevalence was low (3.8%), but the species was present in two disjunct sampling areas along the migratory flyway of this bird: a. - the coastal region of the State of Rio Grande do Sul, where the rosy-billed pochards spend the winter – wintering grounds, and, b. - the northern region of Argentina – one of the breeding grounds. Low prevalence of *E. uncinata* has also been found by FEDYNICH *et al.* (1996) in two allopatric populations (Florida – 2 of 20 = 10% and Texas – 1 of 20 = 5%) of *A. fulvigula*, a nonmigratory anatid. These authors also found low intensities of infection (Florida – 5 and 6 and Texas – 2), as it is reported in the present work. According to WORK *et al.* (2004), this nematode can cause significant mortalities in bird populations under stress, such as drought, in which case birds would concentrate in small water collections, thus increasing the chance of being exposed to infected intermediate hosts. Apparently this has not been the case either in the study of FEDYNICH *et al.* (1996) or in the present study.

AUSTIN & WELCH (1972) indicated that the age of the host may play a role in the susceptibility to parasitism, the older ducks being more resistant to infection, as were the birds in the present work. These authors found numerous worms and granulomas in five eider ducklings (*Somateria mollissima* Linnaeus, 1758), which died, and suggested that it was indicative of a high degree of susceptibility due to the age of the birds. These authors also conducted experiments using several species of anatids and found that: “all granulomas were located along the isthmus between the proventriculus and gizzard except in the domestic geese”, where the nematodes were found also at the junction of the esophagus and the proventriculus, as found in the present work.

In the present study the granulomas were limited to the proximal esophagus, almost at the junction with the proventriculus (Figs 1 and 2). The restriction to the proximal esophagus without infecting the proventriculus, gizzard, and the proximal portion of the duodenum could be related to the low intensities of infection found, which, in turn, could be due to the fact that the ducks now examined belonged to wild flocks, not confined to zoos or bird sanctuaries, as it was recorded in the majority of the previous published reports. This might be an indication that birds in free ranges can act as natural reservoirs for the parasite that in ecologically stable environments may not represent great threat to wild populations, as CRAM (1925) had already suggested. The fact that up to now there have been no records of domesticated anatids infected by any species of *Echinuria* in South America may mean that, at least in Brazil, bird mortalities are not usually officially reported.

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