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The description of two new species of *Plagiorhyncus* Lühe, 1911 (Acanthocephala: Polymorphida: Plagiorhyncidae) from Turkey and New Zealand, with assessment of the status of species in the subgenus *Plagiorhynchus*

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Abstract. Two new species of polymorphid acanthocephalans in the genus Plagiorhynchus Lühe, 1911 are described. *Plagiorhynchus* (*Plagiorhynchus*) *newzealandensis* n. sp. is described from the New Zealand plover *Charadrius obscurus* Gmelin in New Zealand, and *Plagiorhynchus* (*Prosthorhynchus*) *ventrominispinosus* n. sp. is described from a mallard duck Anas platyrhynchos Linn. in Turkey. The specimens were not in an ideal shape, but enough information was extracted to provide meaningful descriptions. *Plagiorhynchus* (*Plagiorhynchus*) *newzealandensis* is characterized by a cylindrical proboscis with 22 rows of 17-18 hooks each, all hooks rooted with basals and pre-basals having anterior manubria, a female's reproductive system with four chambered, thick-walled uterine bell and a strong sphincter, and eggs with polar prolongation of the fertilization membrane. The ventro-posterior end of the proboscis of *P.* (*P.*) *ventrominispiniformis* is characteristically devoid of normal hooks that are replaced by miniature spiniform hooks of diminished size. Its proboscis has 23 longitudinal rows of 15-16 hooks, each showing dorsoventral differentiation, and its eggs have concentric shells. We have assessed information on the species in the subgenus *Plagiorhynchus* and updated its membership to 17 species that we consider valid to date and listed 8 species that we consider invalid, with annotations.

Keywords: *Plagiorhynchus*; Acanthocephala, two new species; New Zealand, Turkey.

Descrierea a două noi specii de *Plagiorhyncus* Lühe, 1911 (Acanthocephala: Polymorphida: Plagiorhynchidae) din Turcia şi Noua Zeelandă, cu evaluarea stării speciilor din subgenul *Plagiorynchus*

Rezumat. Sunt descrise două noi specii de acantocefali polimorfi din genul Plagiorhynchus Lühe, 1911. *Plagiorhynchus* (*Plagiorhynchus*) *newzealandensis* n. sp. este descris la ploverul din Noua Zeelandă Charadrius obscurus Gme, Noua Zeelandă, iar *Plagiorhynchus* (*Prosthorhynchus*) *ventrominispinosus* n. sp. este descris de la o raţă mare, Anas platyrhynchos Linn., din Turcia. Exemplarele nu au fost într-

o formă ideală, dar au fost extrase suficiente informaţii pentru a oferi descrieri semnificative. *Plagiorhynchus* (*Plagiorhynchus*) *newzealandensis* este caracterizat de un proboscis cilindric cu 22 de rânduri a câte 17-18 cârlige fiecare, toate cârligele înrădăcinate, cu bazale şi prebazale având manubria anterioară, sistemul reproducător al femelei cu clopot uterin cu patru camere, cu pereţi groşi şi un sfincter puternic şi ouă cu prelungire polară a membranei de fertilizare. Capătul ventro-posterior al proboscidei *P*. (*P*.) *ventrominispiniformis* este în mod caracteristic lipsit de cârlige normale care sunt înlocuite cu cârlige spiniforme miniaturale de dimensiuni reduse. Proboscisul său are 23 de rânduri longitudinale de 15-16 cârlige, fiecare prezentând diferenţiere dorsoventrală, iar ouăle sale au învelişuri concentrice. Am evaluat informaţiile despre specia din subgenul Plagiorhynchus şi am actualizat apartenenţa acesteia la 17 specii pe care le considerăm valabile până în prezent şi am enumerat 8 specii pe care le considerăm invalide, cu adnotări.

Cuvinte cheie: *Plagiorhyncus*, Acanthocephala, două specii noi, Noua Zeelandă, Turcia.

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Introduction

We have collected thousands of parasitic organisms from vertebrates over the years as part of an overall research program in North America and elsewhere in the world. Other collections were gifted to us for diagnosis or for joint research efforts. Significant collections were published. A few others were just saved and put aside after having been processed as whole mounts as reference material for future examination. We have started this series of investigations by exploring a small group of digeneans, cestodes, and nematodes that have not been previously studied or published (Amin and Rubtsova, 2023). Some of the polymorphid acanthocephalans are the subject matter of this study. These include the description of two new species, one in each of the two subgenera of *Plagiorhynchus* Lühe, 1911, from New Zealand and Turkey. The literature on acanthocephalans from New Zealand is not extensive, but McKenna (2010) published an updated list of the helminth and protozoan parasites from birds in New Zealand, including the acanthocephalans that he gifted us earlier. McKenna's (2010) review included 11 species of acanthocephalans and 126 references, representing an extensive update of previous checklists published earlier. The literature on acanthocephalans from birds in Turkey is scanty, but Kilinç et al. (2017) published a case study of a species of Plagiorhynchidae specimens which were also previously forwarded to us for study. We have additionally assessed the status of the species in the subgenus *Plagiorhynchus*. More publications are available on acanthocephalan parasites from Turkish anurans, e.g., Amin et al. (2012) and Tepe and Yilan (2021), as well as fish, e.g., Heckmann et al. (2010, 2011). Our specimens were not in perfect shape, and some of the morphological features and their measurements were inaccessible, but sufficient information was available to justify the identity of the new species.

Materials and methods

The specimens reported in this presentation were collected using routine methods for the examination of relevant hosts. Specimens of the subgenus *Plagiorhynchus* were collected from the New Zealand plover *Charadrius obscurus* Gmelin by Philip McKenna in 2002 through the courtesy of the Department of Conservation (DOC) (40°21.3′S, 175°36.7′E). The birds were

frozen prior to post-mortem, and then the worms were recovered and initially preserved in 10% formalin. McKenna (2010) recorded *Plagiorhynchus* sp. from *Charadrius obscurus* Gmelin. Specimens of the subgenus *Prosthorhynchus* were collected from a dead mallard duck, *Anas platyrhynchos* Linn. in Ercek District, Van Province (38°29′39″N 43°22′48″E) , Turkey, by Őzlem Orunç Kilinç before they were received by us in 2014. For microscopical examination, specimens were placed in water overnight or until fully extended, then fixed in 70% ethanol. In our Scottsdale, Arizona, facility, acanthocephalans were punctured with a fine needle and subsequently stained in Mayer's acid carmine (digeneans and cestodes were stained in Semichon's acetocarmine), de-stained in 4% hydrochloric acid in 70% ethanol, dehydrated in ascending concentrations of ethanol (24 hr each), and cleared in 100% xylene, then in 50% Canada balsam and 50% xylene (24 hr each). Worms were then whole-mounted in Canada balsam.

Line drawings

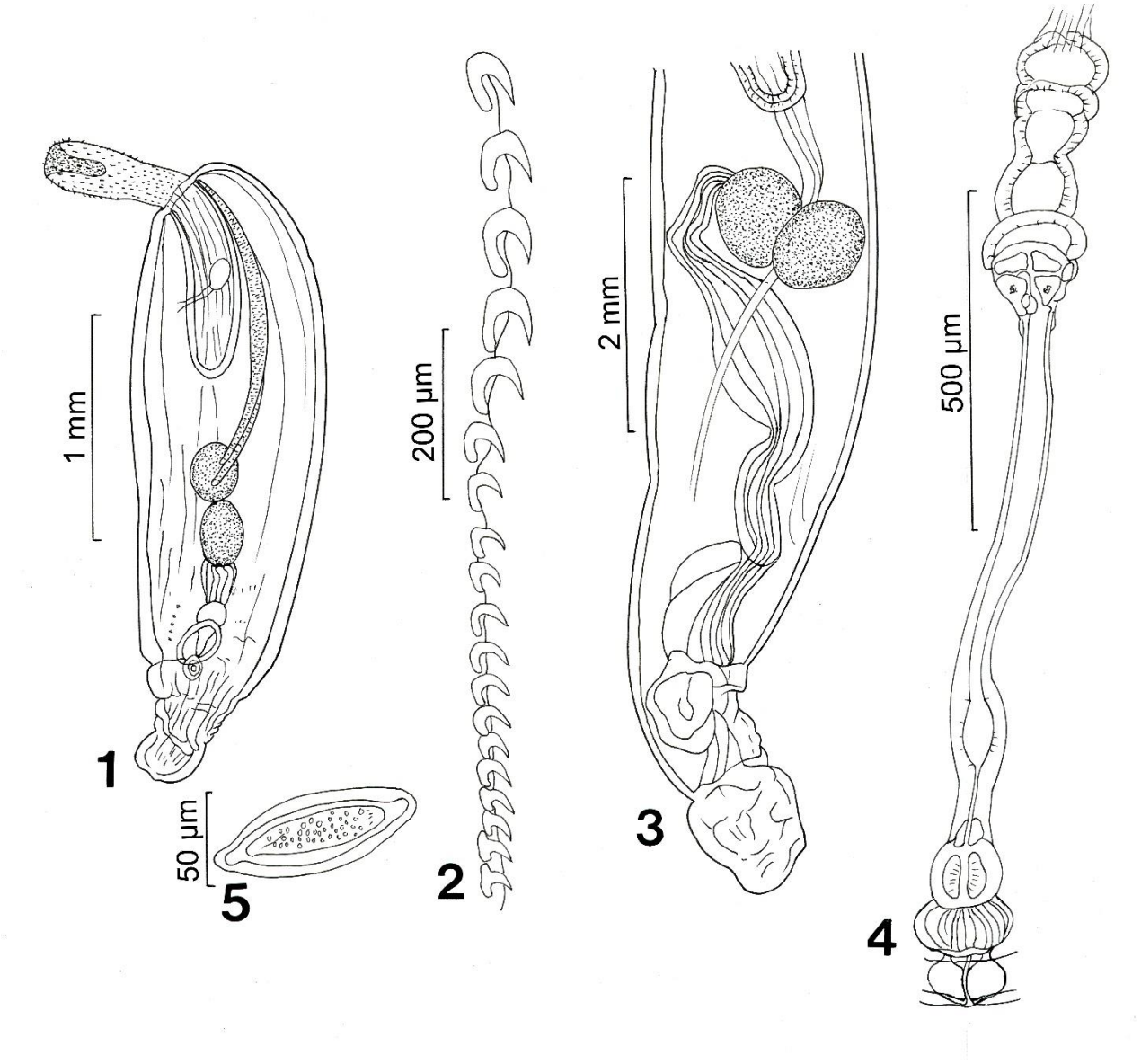
Line drawings were created using a Ken-A-Vision microprojector (Ward's Biological Supply Co., Rochester, N.Y.), which uses cool quartz iodine with 150W illumination. Images of the stained whole-mount specimens were projected vertically on 300-series Bristol draft paper (Starthmore, Westfield, Massachusetts), then traced and inked with India ink. The completed line drawings are subsequently scanned at 600 pixels on a USB and subsequently downloaded to a computer.

Results

Plagiorhynchus (*Plagiorhynchus*) *newzealandensis* n. sp.

(Polymorphida: Plagiorhynchidae) (Figs. 1-5)

Seven males, including one juvenile, and 3 gravid females were collected from the New Zealand plover *Charadrius obscurus* Gmelin by Philip McKenna in 2002. McKenna (2010) recorded *Plagiorhynchus* sp. from *C. obscurus*. In a 2002 personal correspondence, Philip expressed difficulties in procuring well-prepared specimens amenable to microscopical diagnosis, but I was welcome to keep them. The specimens provided were "far from ideal", but over 20 years later, we were able to extract enough information for a description. The species clearly belongs in the subgenus *Plagiorhynchus,* as the female gonopore is terminal and the eggs have polar prolongation of the fertilization membrane, as has been determined by Schmidt and Kuntz (1966) and Amin et al. (1999). The specimens have similarities to other species in the subgenus *Plagiorhynchus* but are distinguished from them by a number of distinctive characteristics. Our specimens did not fit the descriptions of known members of the subgenus or the latest key to Dimitrova's (2009) 9 species that she considered valid. Compared to *P.* (*P.*) *newzealandensis*, many of the other species of *Plagiorhynchus* differ by having more than four cement glands, smaller hooks, a normal uterine bell, rootless posterior filiform hooks, and testes in tandem. The New Zealand plover is found in two populations in New Zealand that feed on small sand hoppers and insects and occasionally on small aquatic invertebrates, fish, and crabs (Marchant and Higgins, 1993).



Figures 1-5. Line drawings of specimens of *Plagiorhynchus* (*Plagiorhynchus*) *newzealandensis* n. sp. from the New Zealand plover *Charadrius obscurus.* **1.** Holotype juvenile male showing the two subequal lemnisci, tandem testes found only in juveniles, and primordia of cement glands, Saefftigen's pouch and cement reservoir. **2.** One complete row of the posterior 19 hooks of the holotype male in Fig. 1. Note that all hooks are rooted and that the basal and pre-basal hook roots have anterior manubria. **3.** The posterior part of a sexually mature male showing the oblique testes and 6 cement glands. **4.** The allotype female reproductive system showing the 4 chambered, thick-walled uterine bell, the distally enlarged long uterus, the one strong highly muscular sphincter, and prominent vagina.

Description

General. Based on the subgeneric diagnosis of *Plagiorhynchus* by Schmidt and Kuntz (1966) and Amin et al. (1999). Specimens are small-medium and fusiform-elongate with females not much larger than males (Fig. 1). Secondary lacunar vessels transverse throughout trunk. Proboscis cylindrical with hooks in straight longitudinal rows (Fig. 2, in part) without dorsoventral differentiation. All hooks rooted. Blades generally similar in length to roots, somewhat smaller anteriorly and more gradually reduced posteriorly where they assume spiniform shape (Fig. 2). Roots about as long as blades or slightly shorter, broad and curved upwards distally. Basal hook with moderate root and a slightly shorter anterior manubrium. Manubria gradually becoming

shorter more anteriorly until completely disappear by third hook from basal hook then both blades and roots continue to increase anteriorly until they reach full size more anteriorly. Proboscis receptacle double-walled with cephalic ganglion near its middle. Lemnisci subequal, moderately long and slender, longer than receptacle, reaching to middle of anterior testis (Fig. 1).

Males. See measurements in Table 1. Testes pre-equatorial in adults, contiguous. tandem in juveniles (Fig. 1) but oblique in adults (Fig. 3). Cement glands tubular, 6, staggering anteriorly, longest extending anteriorly to base of anterior testis (Fig. 3). Robust Saefftigen's pouch overlapping posterior end of cement gland duct. Bursa almost round and gonopore terminal. Juveniles with primordia of cement glands, Saefftigen's pouch, and cement reservoir (Fig. 1)

Females. Reproductive system long with terminal gonopore, 3 distal expansions including one highly muscular sphincter adjoining terminal bulbous vagina, long uterus, prominent selector apparatus, and 4-chambered thick walled, long and narrow uterine bell (Fig. 4). Eggs elliptical with polar prolongation of fertilization membrane (Fig. 5).

Table 1. Morphometrics of *Plagiorhynchus* (*Plagiorhynchus*) *newzealandensis* n. sp. from the New Zealand plover *Charadrius obscurus.*

Character	Mature males	Gravid females	Juvenile male
Sample size	6	3	1
Trunk length X width (mm)	7.87-9.12 X 1.82-2.38	8.75-9.62 X 2.07-2.25	2.75 X 0.87
Proboscis L X W (mm)	1.09-1.24 X 0.22-0.29	1.20-1.36 X 0.22-0.29	0.87 X 0.21
Number of hook rows	22	22	22
Number of hooks per row	17-18	17-18	17-18
Largest hook length	60-62	68-73	42
Length of hook root	55-57	65-69	45
Length of basal hooks	36-40	42-43	22
Proboscis receptacle L X W (mm)	1.67-2.25 X 0.26-0.37	2.55-2.65 X 0.33-0.35	0.90 X 0.25
Subequal lemnisci length (mm)	___	___	1.21 & 1.35
Anterior testis length X width	650-870 X 520-600	XXX	250 X 250
Posterior testis length X width	620-750 X 450-650	XXX	270-170
Cement gland L X W (mm)	3.87-4.77 X 0.12-0.15	XXX	Undeveloped
Saefftigen's pouch L X W (mm)	0.75-0.87 X 0.40-0.47	XXX	Undeveloped
Bursa length X width (mm)	1.00-1.25 X 0.87-1.125	XXX	Not seen
Reproductive syst. L (mm) (uterus L & uterine bell L.)	XXX	1.25 (625 & 325) (n=1)	XXX
Ripe egg length X diameter	XXX	92-103 X 27-38	XXX

Taxonomic summary

Type host. New Zealand plover *Charadrius obscurus* Gmelin.

Type locality. New Zealand near Palmerston North (40°21.3′S 175°36.7′E).

Site of infection. Intestine.

Specimens deposited at the Harold W. Manter Laboratory of Parasitology, Nebraska State Museum at Lincoln: Male holotype (Coll. no. 217061), female allotype (Coll. no. 217062).

Etymology. The new species is named for the type locality; New Zealand.

Remarks

I. Taxonomy

Meyer (1931) created Plagiorhynchinae as a subfamily of Polymorphidae, where he included 4 genera: *Plagiorhynchus* Lühe, 1911; *Prosthorhynchus* Kostylew, 1915; *Sphaerechinorhynchus* Johnston and Deland, 1929 and *Porrorchis* Fukui, 1929. Much confusion has taken place between the first two genera, as summarized by Golvan (1956). Schmidt and Kuntz (1966) synonymized *Prosthorhynchus* with *Plagiorhynchus* and reduced the two genera to subgenera of the genus *Plagiorhynchus* s. lat. The two major and consistent characteristics distinguishing these two subgenera apart are the position of the female gonopore (terminal in *Plagiorhynchus* and subterminal in *Prosthorhynchus*) and the presence of polar prolongation of the egg fertilization membrane (in *Plagiorhynchus*) or its absence in *Prosthorhychus*. These distinguishing features have proven to be solid but not invariable, as documented by Amin et al. (1999). In their designation of the two subgenera, Schmidt and Kuntz (1966) listed 8 species in the subgenus *Plagiorhynchus,* and Amin (1985) listed 8, Dimitrova (2009) listed 11, Khatoon and Bilqees (2011) listed 10, and Amin (2013) listed 22 species subject to editing because of additions and deletions. In the genus *Plagiorhynchus*, Petrochecko (1958) listed 2 species, Yamaguti (1963) listed 8, Khokhlova (1986) listed 6, and Golvan (1994) listed 18 species. After examination of the literature and specimens at hand, we have determined that the subgenus *Plagiorhynchus* includes the following 17 valid species listed below:

Valid species in the subgenus *Plagiorhynchus*:

1. *P.* (*P.*) *aznari* García-Varela, Park, Hernández-Orts, Pinacho-Pinacho, 2019 from Mexico.

2. *P*. (*P.*) *allisonae* Smales, 2002 from New Zealand.

3. *P.* (*P.*) *charadrii* (Yamaguti, 1939) Van Cleave, 1951 [syn. *Prosthorhynchus charadrii* Yamaguti, 1939] (nec Golvan, 1956) from Taiwan & Japan.

4. *P.* (*P.*) *charadriicola* (Dollfus, 1953) Golvan, 1956 [syn. *Prosthorhynchus charadriicola* Dollfus, 1953] from North Africa.

5. *P.* (*P.*) *crassicollis* (Villot, 1875) Lühe, 1911 (type species) [syns. *Echinorhynchus crassicollis* Villot, 1875; *Plagiorhynchus inflatus* Creplin, 1829; *P. lanceolatus* (von Linstow, 1876) Lühe, 1911] from North Europe.

6. *P*. (*P.*) *freitasi* Vicente, 1977.

7. *P.* (*P.*) *karachiensis* Muti-Ur-Rahman, Khan, Khatoon and Bilqees, 2008. Described as "different in body size, arrangement of hooks and egg size" but in agreement with the subgenus *Plagiorhynchus.*

8. *P.* (*P.*) *kuntzi* Gupta and Fatma, 1987. Included here even though female gonopore was occasionally near terminal and polar prolongation of egg fertilization membrane was not always evident. Such variations are not uncommon. We do not agree with Dimitrova's (2009) uncertain position of this species.

9. *P*. (*P.*) *lemnisalis* Belopolskaya, 1958 (nec *lemniscalis*) from SSSR.

10. *P*. (*P.*) *linearis* (Westrumb, 1821) Golvan, 1956 [syns. *Echinorhynchus linearis* Westrumb, 1821 (nec *lineare*); *Plagiorhynchus sternae* Rudolphi, 1819; *Prosthorhynchus linearis* (Westrumb, 1821) Meyer, 1932] from Europe.

11. *P.* (*P.*) *menurae* (Johnston, 1912) Golvan, 1956 [syn. *Prosthorhynchus menurae* Johnston, 1912] from New South Wales, Australia.

12. *P*. (*P*.) *newzealandensis* n. sp.

13. *P*. (*P*.) *odhneri* Lundström, 1942 from Scandinavia & SSSR.

14. *P*. (*P*.) *paulus* Van Cleave and Williams, (1950) 1951 (nec *paulum*) [syn. *Prosthorhynchus paulus* Van Cleave et Williams, 1951] from Alaska.

15. *P.* (*P.*) *ponticus* Lisitsyna, 1992 from Ukraine.

16. *P.* (*P.*) *rectus* (Linton, 1892) Van Cleave, 1918 (nec Sprehn, 1942) [syn. *Prosthorhynchus rectus* (Linton, 1892) Travassos, 1926] from Mexico. It was originally described from one male and one immature female that Van Cleave (1918) gave no details about its genital system and absent eggs. It was accepted in *Prosthorhynchus* by Meyer, 1932, Petrochenko, 1958, and Amin (1985) but later (Amin. 2013) and Golvan (1994) relegated it to *Plagiorhynchus*.

17. *P*. (*P*.) *totani* (Porta, 1910) Golvan, 1956 [syns. *Echinorhynchus totani* Porta, 1910; *Prosthorhynchus totani* (Porta, 1910) Meyer, 1932] from Italy. It is included in Dimitrova's (2009) key despite its former consideration as Plagiorhynchinae *incertae sedis*.

Species considered invalid and reasons:

1. *P.* (*P*.) *limnobaeni* (Tubangui, 1933) Golvan, 1956. The two males were described in and kept in *Prosthorhynchus* by Petrochenko (1958), Yamaguti (1963) Schmidt and Kuntz (1966) and Amin (1985, 2013) and included in the key to *Prosthorhynchus* by Amin et al. (1999) despite its former relegation to *Plagiorhynchus* by Van Cleave and William's (1951) and Golvan (1956).

2. *P.* (*P*.) *pigmentatum* (de Marval, 1902) Meyer, 1933 [syn. *Centrorhynchus cylindraceum* of de Marval 1905]. It is included in the key to the subgenus *Prosthorhynchus* by Amin et al., 1999)

3. *P.* (*P*.) *pittarum* Tubangui, 1935 is in the subgenus *Prosthorhynchus* fide Golvan, 1994.

4. *P.* (*P*.) *reticulatus* (Westrumb, 1821) Golvan, 1956 (nec *reticulatum*) [syn. *Prosthorhynchus reticulatus* (Westrumb, 1821) Travassos, 1926]. This species is known from aquatic birds in Brazil and has been considered in *Prosthorhynchus* by Meyer (1932, Petrochenko (1958), Yamaguti, 1963), Schmidt and Kuntz (1966), Amin (1985) and Amin et al. (1999).

5. *P.* (*P*.) *rosai* (Porta, 1910) Golvan, 1956 [syns. *Echinorhynchus brumpti* Blanc and Cauchemez, 1911; *Plagiorhynchus brumpti* Blanc and Cauchemez, 1911]. This species has also been synonymized with *Prosthorhynchus cylindraceus* fide Golvan (1956).

6. *P.* (*P*.) *rostratus* (de Marval, 1902) (incertae sedis fide Golvan, 1994) (nec *rostratum*). Meyer (1932), Petrochenko (1958), and Yamaguti (1963) recognized it in *Prosthorhrynchus* and Golvan (1956) and Schmidt (1981) synonymized it with *Prosthorhynchus cylindraceus*. Schmidt and Kuntz (1966) and Amin (1985) listed it in the Plagiorhynchinae *incertae sedis*.

7. *P.* (*P*.) *spiralis* (Rudolphi, 1809) Golvan, 1956 [syn. *Echinorhynchus spiralis* Rudolphi, 1809]. Dimitrova and Georgiev (1994) relegated this species to the monotypic *Adreirhynchus* Dimitrova and Georgiev, 1994 because of its trunk spines.

8. *P.* (*P*.) *urichi* (Cameron, 1936) Golvan, 1956. This is a poorly described species from carnivores in Trinidad that was considered valid only by Golvan (1956, 1994), and Yamaguti (1963) placed it in *Prosthorhynchus.* Schmidt and Kuntz (1966) and Amin (1985) considered it as *Plagiorhynchus* and Plagiorhynchinae *incertae sedis*.

II. Diagnosis

We recognize that *P.* (*P*.) *newzealandensis* n. sp. can be readily distinguished from the other 16 species in the subgenus *Plagiorhynchus* herein and valid by a combination of characters, especially the anatomy of the uterine bell, one highly muscular sphincter adjoining a bulbous vagina, shape of hook roots, number of cement glands, position of testes, and size of eggs. The uterine bell in *P.* (*P*.) *newzealandensis* is uniquely 4-chambered, thick-walled, and 325 long and narrow. All hooks are rooted with rectangular roots about as long as blades. Basal hook root with prominent anterior manubrium. Manubria become shorter more anteriorly until

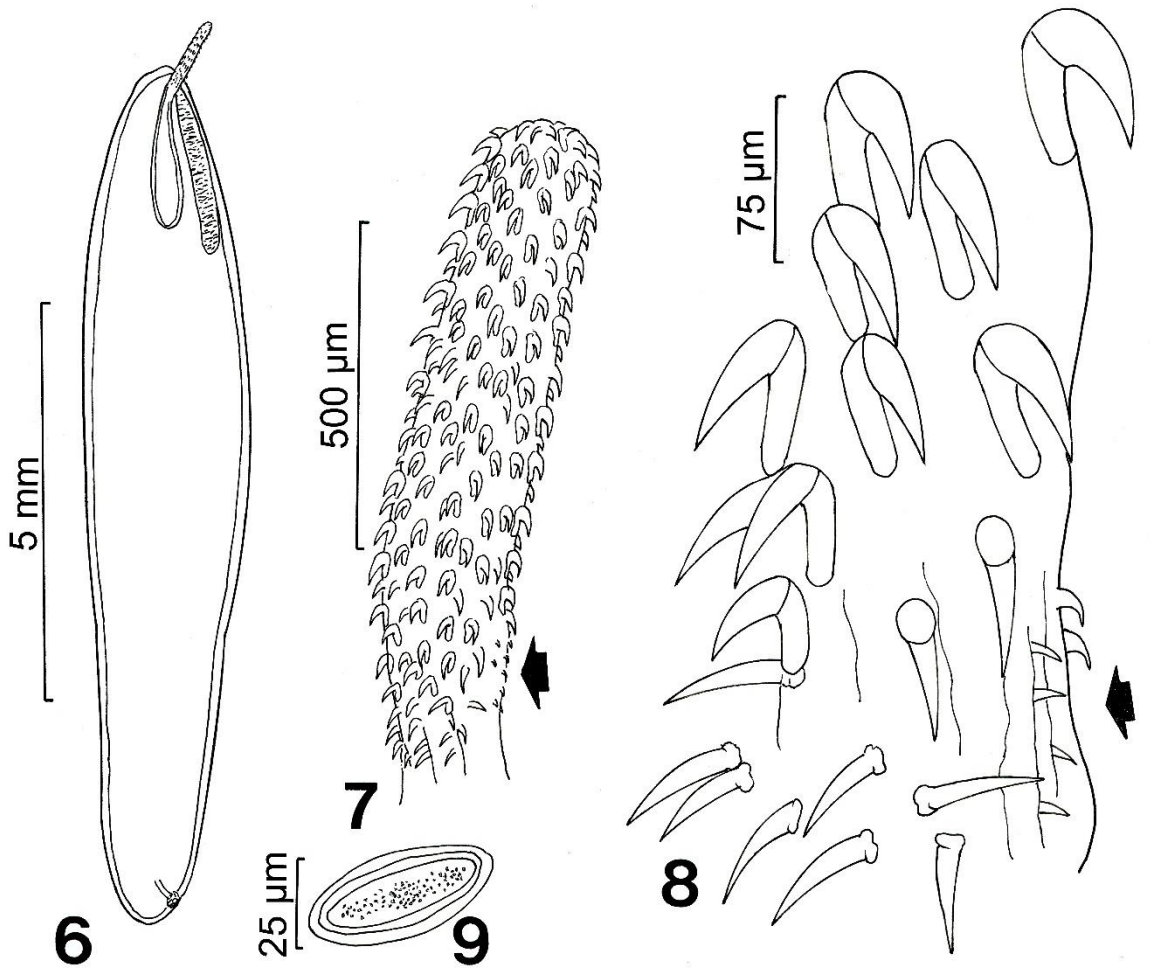
they completely disappear by the third hook from the basal, then both hooks and roots continue to increase anteriorly until they reach full size more anteriorly. The cement glands are 6, but they can be 5, 6, or 8 in other species. The testes are in tandem in juveniles but become totally oblique when they become larger in adults. The eggs are elliptical, 92-103 by 27-38, which is different from most other species.

Considering the other 16 valid species listed above, we find *P.* (*P.*) *newzealandensis* to have close similarities to three other species in structural organization. We find ***P.* (*P.*) *allisonae*,** also described from New Zealand (Smales, 2002, Figs. 8-12) to show considerable superficial similarities to but differ from *P.* (*P.*) *newzealandensis* by having a smaller rotund fusiform trunk, marginally overlapping hook formula, the largest hooks to be 49-50 long, an outer wall of receptacle with spirally arranged muscle fibers, split lemnisci, smaller tandem testes, 8 tubular cement glands, a vagina with 3 sphincters, and longer eggs. ***Plagiorhynchus* (*P.*) *kuntzi*** from India shows more general organizational similarities to *P.* (*P.*) *newzealandensis* especially upon examination of Figs. 1 and 2 in Gupta and Fatma (1987). However, in *P.* (*P.*) *kuntzi*, the proboscis has only 16-17 longitudinal rows each with 13-14 hooks, compared to 22 hook rows each with 17-18 hooks in *P.* (*P.*) *newzealandensis*, and the basal hooks are rootless. Also, the trunk, proboscis, hooks, four cement glands, bursa, and eggs in the Indian species are distinctly different and smaller. ***Plagiorhynchus* (*P.*) *ponticus*** from Ukraine also has close organizational similarities to *P.* (*P.*) *newzealandensis,* which are readily noticeable when one examines Lisitsyna's (2019) Fig. 44 (p. 128) and considers the somewhat overlapping hook formula and the similar size of proboscis, receptacle, and testes. However, in *P.* (*P.*) *ponticus*, the uterine bell is normal without chambers, eggs and female reproductive system are longer, cement glands are 5 (not 6), testes are tandem (not oblique), lemnisci are about as long as the receptacle (Fig. 44a), and the basal hooks are rootless.

***Plagiorhynchus* (*Prosthorhynchus*) *ventrominispiniformis* n. sp.**

Polymorphida (Plagiorhynchidae) (Figures 6-9)

Four gravid females were received and whole-mounted on one slide from a purported species of "wild duck" in Turkey by Őzlem Orunç Kilinç in 2014. The packed eggs so obscured the internal organs of the acanthocephalans that only limited observations could be made, hence the delay in researching these specimens. Running the specimens through the key to the 21 species of the subgenus *Prosthorhynchus* in Amin et al. (1999) reached an impasse, but the visible sub-ventral position of the female gonopore, the data of the proboscis armature, and the ellipsoid eggs with concenteric shells supported the erection of a new species in *Prosthorhynchus*. In a 2017 case report, an identical species of *Plagiorhynchus* was reported from six female specimens collected by Kilinç et al. (2017) from one dead mallard duck, *Anas platyrhynchos* Linn., in Ercek District, Van Province, Turkey. Kilinç et al. (2017) provided two light microscope images of a female and a proboscis similar to ours but did not name the subgenus. These authors did not describe the anatomy of the worms but provided limited measurements of trunk (9.07 mm by 1.32-1.57 mm), proboscis (0.92 mm by 0.29-0.30 mm), ventral hooks (70-75) and eggs (45-60 by 17-30) that were identical to ours and the hook arrangement of their specimens at 20-24 rows with 15-18 hooks each overlapped with that of our specimens. Őzlem apparently sent us in 2014 a sample of their females that they published in 2017.



Figures 6-9. Line drawings of females of *Plagiorhynchus* (*Prosthorhynchus*) *ventrominispiniformis* n. sp. from *Anas platyrhynchos* in Ercek District, Van, Turkey. **6.** The holotype female showing the trunk shape and the proportion of the proboscis to the receptacle and the slightly longer lemnisci. Only the subterminal gonopore is shown since the packed eggs obscured all other structures. **7.** The proboscis with an arrow pointing to the miniature hooks at the posterior end of the ventral side. **8.** A higher magnification of the area of the basal-ventral miniature hooks showing adjacent normal hooks for comparison. 9. A ripe egg with concentric shells

Description

With characters of the genus *Plagiorhynchus* and the subgenus *Prosthorhynchus* as designated by Schmidt and Kuntz (1966) and Amin et al. (1999). The description is based on the 4 gravid whole-mounted females in our possession. Trunk elliptical elongate 7.50-10.00 mm long by 1.50-2.05 mm wide at middle (Fig. 6). Proboscis cylindrical, straight, tilted ventrad,1.00-1.10 mm long by 0.19-0.23 mm wide, with 23 longitudinal rows of 15-16 hooks each (Fig. 7) showing dorsoventral differentiation. All hooks with prominent posteriorly directed roots except for posterior-most 2-3 dorso-lateral rootless 47-57 long spiniform hooks (Fig. 8). Dorsal hooks at middle 60-68 long by 20-23 wide at base. Ventral rooted hooks larger and more robust, 70-75 long by 25-35 wide at base. Two basal and pre-basal spiniform hooks with vestigial stube. Proboscis devoid of 5 normal basal and pre-basal ventral hooks usually measuring 47-57 in length dorso-laterally for a distance of about 260 and replaced by 5 ventral mini-spiniform hooks measuring 12-20 long (Fig. 8). Proboscis receptacle double-walled with cephalic ganglion near its middle, 1.50-1.62 mm long by 0.20-0.23 mm wide, inserted at base of

proboscis. Lemnisci finger-like, plumb, 2.00 long by 0.27 mm wide, longer than receptacle. Gonopore subterminal. Eggs ellipsoid with concentric shells (Fig. 9), 48-55 long by 22-27 in diameter.

Taxonomic summary

Type host. Mallard duck *Anas platyrhynchos* Linn.

Type locality. Van Province (38°29′57″N 43°40′13″E), Eastern Turkey.

Site of infection. Intestine.

Specimens deposited at the Harold W. Manter Laboratory of Parasitology, Nebraska State Museum at Lincoln: Female holotype (Coll. no. 217060) and paratypes on one slide.

Etymology. The new species is named for the 5 ventral posterior mini spiniform hooks on the proboscis replacing normal hooks.

Remarks

While many characters of this species are similar to those of other species of the subgenus *Prosthorhynchus* as designated by Schmidt and Kuntz (1966) and Amin et al. (1999), our attempts to identify it with species in the latter authors' key or through the literature and the examination of specimens in the authors collection have failed. The one character that stands out and that distinguishes *P.* (*P.*) *ventrominispiniformis* n. sp. from all others in the subgenus is the absence of normal ventral posterior proboscis hooks or spiniform hooks basally and their replacement by 5 ventral rings of miniature spiniform hooks. A combination of this character and the proboscis hook armature, shape, and measurements distinguish this species from others in the subgenus *Prosthorhynchus.* The scarcity of the few egg-packed specimens and the fact that all 4 females were already whole-mounted before we came to the realization of the specific identity made it impossible to perform any molecular or metal analyses.

Discussion

We describe two new species of the genus *Plagiorhynchus*, one in each of the two subgenera, from New Zealand and Turkey. We provide well-documented characteristics distinguishing them from the most closely related species of each subgenus, especially *Plagiorhynchus,* to satisfactorily validate their taxonomic status. Comparisons with other less similar species would not have been helpful. We compared *P.* (*P.*) *newzealandensis,* which has 6 tubular cement glands, with 3 other species of the same subgenus, *Plagiorhynchus*, which has 4, 5, and 8 cement glands, 4 in *P. kuntzi*, 8 in *P. alisonae*, and 5 in *P. ponticus*. Six cement glands are also encountered in other species of the same subgenus, such as *P. crissicollis* and *P. chardrii*. Schmidt and Kuntz (1966) reported 3 to 6 cement glands in *Plagiorhynchus*. These observations should be viewed in light of the concept of taxonomic utility of cement gland types and numbers as conceived by Van Cleave (1949), where he indicated 2 to 8 glands in Palaeacanthocephala with special reference to Rhadinorhynchidae, subject to variations. The genus *Rhadinorhynchus* Lühe, 1911, "normally" has 4 cement glands, but Amin et al. (2011) recognized 38 valid species, including 4 species with atypical cement gland numbers. These 4 species are *Rhadinorhynchus dollfusi* (Gupta and Fatma, 1987) and *Rhadinorhynchus echeneisi* Gupta and Gupta, 1980, with two glands each, and *Rhadinorhynchus capensis* Bray, 1974, and *Rhadinorhynchus trivandricus* George and Nadakal, 1978, with 7 and 8 glands, respectively. Clearly, the number of cement glands is not a universally fixed taxonomic trait at the generic or even the subgeneric level. "Fixed" generic traits are accepted to include the position of the cephalic ganglion and the number of proboscis receptacle walls. However, as Amin et al. (2011) noted, the "normal" cephalic ganglion position at the middle of the receptacle in *Rhadinorhynchus* was also observed to be at its posterior end in *Rhadinorhynchus chongmingnensis* Huang, Zheng, Deng, Fan, Ni, 1988, *R. dollfusi*, *Rhadinorhynchus ganapatti* Chandra, Rao, Shyamasundari, 1985, and *Rhadinorhynchus keralensis* Gupta and Fatma, 1987. One species, *Rhadinorhynchus ditrematis* Yamaguti (1939), had a single-walled proboscis receptacle. We conclude that morphological traits and those

with proposed genetic constitutions are subject to deviation from perceived norms at the level of lower taxa.

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Ethical approval. The authors declare that they have observed all applicable ethical standards.

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