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CENTRORHYNCHUS KUNTZI FROM THE USA WITH DESCRIPTION OF THE MALE AND REDESCRIPTION OF *C. SPINOSUS* (ACANTHOCEPHALA: CENTRORHYNCHIDAE)

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ABSTRACT: *Centrorhynchus kuntzi* Schmidt and Neiland, 1966, reported here for the first time from the USA, occurred in *Bubo virginianus* in Florida and *Buteo jamaicensis*, *Buteo lineatus*, and *Buteo platypterus* in Louisiana. *Centrorhynchus kuntzi* males, previously undescribed, were 10 to 29 mm long with a large swelling near the anterior end of the trunk. The proboscis, averaging 1.14 mm in length and with a marked swelling near the middle at the level of proboscis receptacle insertion, was armed with 26 to 31 (usually 29) longitudinal rows of 22 to 26 (usually 24) hooks each. The first seven to nine (usually 8) hooks in each row possessed long, simple roots and the following 14 to 18 (usually 16) were rootless spines. *Centrorhynchus spinosus* (Kaiser, 1893) Van Cleave, 1924, occurred in *Melanerpes carolinus* in Louisiana and *Strix varia* in Florida and Louisiana. *Centrorhynchus spinosus* resembles *C. kuntzi* in the range in number of longitudinal rows of proboscis hooks, although *C. kuntzi* usually possesses one less row (30 in ♀, 29 in ♂), in the total number of proboscis hooks and spines in each longitudinal row, and in possessing a laterally flattened papilla at the posterior end of females. *Centrorhynchus spinosus* differs from *C. kuntzi* in lacking proboscis and trunk inflations, possessing a shorter proboscis, and having more, large, rooted proboscis hooks (usually 9 in ♀, 10 in ♂) and fewer rootless spines (usually 15) in each longitudinal row.

Centrorhynchus spinosus (Kaiser, 1893) Van Cleave, 1924, is purported to be a “well known” species of Acanthocephala and has been reported in the USA from seven avian species. Descriptions are based on the original (Kaiser, 1893) of an unspecified number of specimens, one immature female specimen (Van Cleave, 1916), and 22 specimens from a “Galapagos hawk” (Van Cleave, 1940). Van Cleave (1924) studied additional specimens identified by him as *C. spinosus* from the Leidy collection, but only slightly modified his 1916 description. Although they have not been located for reexamination, it is believed that the Galapagos specimens were not of this species and probably were representatives of *C. kuntzi* Schmidt and Neiland, 1966. When Van Cleave (1940) extended the definition of *C. spinosus* to include the Galapagos specimens, thereby incorporating features later ascribed to *C. kuntzi*, he provided a description that may have prevented recognition of *C. kuntzi* in the USA.

Centrorhynchus kuntzi males were not available for the original species description (Schmidt and Neiland, 1966) and have not been subsequently described. Further, the existing description of *C. spinosus*, based on few specimens and incorporating some features of a second species, prevented Schmidt and Neiland (1966) from ad-

equately distinguishing *C. kuntzi* from *C. spinosus*.

A large collection of *Centrorhynchus* from Louisiana has made sufficient material available to permit a fuller description of *C. spinosus*, description of *C. kuntzi* males (Fig. 1), and better distinction between the two species.

MATERIALS AND METHODS

The following descriptions are based on 54 (34♀, 20♂) specimens of *C. spinosus* and 161 (96♀, 65♂) specimens of *C. kuntzi* from birds collected in Louisiana. Table I lists sources and prevalence of these specimens. Additionally, the specimen (U.S.B.A.I. Helminthol. Coll., Hassall Coll. No. 6307) designated by Van Cleave (1916) as “type” of *C. spinosus*; the holotype (USNM Helminthol. Coll. No. 60771) and paratypes (USNM Helminthol. Coll. No. 60772) of *C. kuntzi*; and 10 specimens of *Centrorhynchus* from *Bubo virginianus* and one from *Strix varia*, all from Florida, were studied.

Ranges in the redescription of *C. kuntzi* incorporate Schmidt and Neiland’s (1966) original data (the types did not deviate), but means are for specimens of the present study only. The redescription of *C. spinosus* is based solely on present specimens with appropriate comparisons to type material and previously published descriptions in the Discussion.

All measurements are in micrometers with means in parentheses unless otherwise noted.

RESULTS

Redescriptions

***Centrorhynchus spinosus* (Kaiser, 1893) Van Cleave, 1924**

General: Trunk cylindrical, elongate, with slight constriction anteriorly, but swelling lacking. Neck short, 22 to 53 (40) long and 312 to 413 (356) wide at base.

Proboscis nearly cylindrical, slight constriction at insertion of receptacle but marked swelling lacking; armed with 29 to 33 longitudinal rows of 22 to 27 hooks each. First eight to 11 (usually 9 in ♀, 10 in ♂) hooks in each row with long, simple roots; next 13 to 17 (usually 15) rootless spines. Anteriormost spine in each row transitional, with four short, laterally directed, rootlike processes. Hooks 31 to 43 (36) long anteriad, 34 to 48 (40) long at end of rooted row; rootless spines 29 to 46 (37) long. Largest hook-roots 53 to 70 (59) long. Double-walled proboscis receptacle inserted at slight constriction in proboscis, 1.06 to 1.78 mm (1.25) long. Brain, about in middle of receptacle just posterior to neck-trunk junction, elliptical, 140 to 254 (192) long by 58 to 67 (60) wide. Lemnisci, 1.10 to 1.78 mm (1.57) long, extend well posteriad of the proboscis receptacle.

Male: Mature males 20.0 to 27.2 mm (23.6) long by 0.8 to 1.1 mm (0.9) at widest point (just anterior to slight constriction in trunk), 0.3 to 0.5 mm (0.4) wide at neck-trunk junction, 0.4 to 0.7 mm (0.5) wide at posterior end. Proboscis 806 to 1,018 (965) long by 173 to 230 (197) wide at apex, 240 to 264 (250) at widest point (just anterior to insertion of receptacle), 202 to 235 (218) wide at receptacle insertion, 307 to 356 (332) wide at base; armed with 29 to 32 (usually 30) longitudinal rows of 23 to 27 (usually 25) hooks each. Testes two, located behind slight constriction in trunk, elliptical, approximately equal in size, 595 to 922 (748) long by 278 to 614 (380) wide. Four tubular cement glands of slightly different lengths begin at rear of second testis and extend 6.9 to 11.4 mm (9.1) posteriad. Saeftigen's pouch 1.4 to 1.8 mm (1.5) long. Entire male system occupying 66.1 to 72.9% (69.3) of trunk length.

Female: Gravid females, containing eggs with fully developed membranes and spined acanthors, 19.0 to 33.7 mm (25.4) long by 0.4 to 1.2 mm (0.8) at widest point (just anterior to slight trunk constriction), 0.4 to 0.8 mm (0.4) wide at neck-trunk junction, 0.6 to 1.0 mm (0.7) wide at posterior end. Trunk with prominent, laterally flattened papilla at posterior end, varying in shape from digitiform to conical depending upon degree of trunk distension by eggs. Proboscis 931 to 1,104 (1,014) long by 173 to 259 (194) wide at apex, 240 to 356 (282) wide at widest point (just anterior to insertion of receptacle), 221 to 336 (285) wide at receptacle insertion, 317 to 432 (361) wide at base; armed with 30 to 33 (usually 31) longitudinal rows of 22 to 26 (usually 24) hooks each. Reproductive tract, anterior edge of uterine bell to subterminal genital pore, 1.7 to 2.4 mm (2.0) long; occupying 6.8 to 9.6% (8.1) of trunk length.

Eggs: Dissected from body cavity or measured through body wall, eggs 42 to 53 (47) long by 17 to 22 (19) wide; living eggs passed by females in water 50 to 55 (53) long by 22 wide. Thin outer shell sculptured with longitudinal ridges and grooves. Fertilization membrane with small polar prolongations.

***Centrorhynchus kuntzi* Schmidt and Neiland, 1966**

General: Trunk cylindrical, elongate with large swelling near anterior end. Trunk width at swelling approximately three times greater than at junction with neck. Neck short, 21 to 72 (43) long and 288 to 590 (416) wide at base. Proboscis nearly cylindrical except for marked swelling near middle at level of proboscis

receptacle insertion; armed with 26 to 35 longitudinal rows of 22 to 27 hooks each. First seven to nine (usually 8) hooks in each row with long, simple roots; next 14 to 18 (usually 16) rootless spines. Anteriormost spine in each row transitional, with four short, laterally directed, rootlike processes. Hooks 41 to 50 (46) long anteriad, 36 to 48 (39) long at end of rooted row; rootless spines 29 to 48 (36) long. Largest hook-roots 53 to 75 (64) long. Double-walled proboscis receptacle inserted at base of proboscis swelling, 1.08 to 1.87 mm (1.35) long. Brain, about in middle of receptacle just posterior to neck-trunk junction, elliptical, 154 to 216 (190) long by 43 to 62 (57) wide. Lemnisci, 1.10 to 2.74 mm (2.02) long, extend well posteriad of the proboscis receptacle.

Male: Mature males 10.0 to 29.0 mm (19.1) long by 0.7 to 1.8 mm (1.3) wide at swelling, 0.4 to 0.6 mm (0.4) wide at neck-trunk junction, 0.4 to 0.8 mm (0.6) wide at posterior end. Proboscis 816 to 1,296 (1,140) long by 168 to 278 (220) wide at apex, 288 to 348 (316) wide at swelling, 240 to 289 (257) wide at receptacle insertion at base of swelling, 307 to 528 (385) wide at base; armed with 26 to 31 (usually 29) longitudinal rows of 22 to 26 (usually 24) hooks each. Testes two, at least one located in trunk swelling, elliptical, approximately equal in size, 499 to 1,104 (792) long by 108 to 461 (259) wide. Four tubular cement glands of slightly different lengths begin at rear of second testis and extend 9.5 to 15.4 mm (12.2) posteriad. Saeftigen's pouch 1.2 to 2.0 mm (1.6) long. Entire male system occupying 72.9 to 84.0% (77.7) of trunk length.

Female: Gravid females, containing eggs with fully developed membranes and spined acanthors, 20.0 to 48.0 mm (37.4) long by 1.0 to 2.0 mm (1.5) wide at swelling, 0.5 to 0.6 mm (0.5) wide at neck-trunk junction, 0.8 to 1.4 mm (1.0) wide at posterior end. Trunk with prominent, laterally flattened papilla at posterior end, varying in shape from digitiform to conical depending upon degree of trunk distension by eggs. Proboscis 870 to 1,709 (1,257) long by 186 to 288 (249) wide at apex, 288 to 413 (345) wide at swelling, 240 to 326 (265) wide at receptacle insertion at base of swelling, 360 to 590 (405) wide at base; armed with 27 to 35 (usually 30) longitudinal rows of 23 to 27 (usually 24) hooks each. Reproductive tract, anterior edge of uterine bell to subterminal genital pore, 1.2 to 2.1 mm (1.7) long; occupying 3.8 to 6.5% (5.0) of trunk length.

Eggs: Dissected from body cavity or measured through body wall, eggs 41 to 60 (51) long by 15 to 22 (20) wide; thin outer shell sculptured with longitudinal ridges and grooves. Fertilization membrane with small polar prolongations.

Specimens deposited: *Centrorhynchus kuntzi*, USNM Helminthol. Coll. Nos. 76604 (♂) and 76605 (♀); *C. spinosus*, USNM Helminthol. Coll. Nos. 76606 (♀) and 76607 (♂).

Hosts and localities: See Table I.

Site of infection: All specimens of this study were from the small intestine.

Remarks

Centrorhynchus spinosus and *C. kuntzi* resemble each other in the number of longitudinal rows of proboscis hooks. They also have the same

TABLE I. *Host and geographical distribution of confirmed Centrorhynchus spinosus and C. kuntzi.*

	No. exam.	No. inf.	Range	$\bar{x}$ /inf. bird	Locality	Reference
<i>Centrorhynchus spinosus</i>						
<i>Accipiter cooperii</i>					Connecticut: North Franklin	USNM Helminthol. Coll. No. 40620
<i>Bubo virginianus</i>					Florida: Alachua Co.	This study
<i>Herodias egretta</i>		1	1	1.0	Unknown	Van Cleave, 1916
<i>Melanerpes carolinus</i>	53	3	1–2	1.7	Louisiana: Tangipahoa Par.	This study
<i>Strix varia</i>					Florida: Pasco Co.	This study
<i>S. varia</i>	8	6	2–10	8.2	Louisiana: East Baton Rouge, Tangipahoa, and West Baton Rouge par.	This study
Unknown					Florida	Kaiser, 1893
<i>Centrorhynchus kuntzi</i>						
<i>B. virginianus</i>					Florida: Alachua Co.	This study
<i>Buteo jamaicensis</i>	3	1	2	2.0	Louisiana: Iberville Par.	This study
<i>Buteo lineatus</i>	3	3	11–72	36.3	Louisiana: Pointe Coupee Par.	This study
<i>Buteo magnirostris</i>		1	3	3.0	Nicaragua: Rio Escondido, El Recreo	Schmidt and Neiland, 1966
<i>Buteo platypterus</i>	2	2	23–27	25.0	Louisiana: Iberville Par.	This study

number of hooks in each row (22–27), but in *C. spinosus* there are more (8–11) large, rooted ones and fewer (13–17) rootless spines than in *C. kuntzi* (7–9 and 14–18, respectively). The usual numbers of large rooted hooks (9 in ♀, 10 in ♂, *C. spinosus*; 8 in both sexes, *C. kuntzi*) and rootless spines (15 and 16 in both sexes of *C. spinosus* and *C. kuntzi*, respectively) show the same distinction as do the ranges. Schmidt and Neiland (1966) noted that hooks of *C. spinosus* are longer than those of *C. kuntzi*, but this was based on reports of Kaiser (1893) and Van Cleave (1924) of several specimens described as having unusually long hooks. No such specimen was observed in the present collection and hook lengths of the two species were similar.

Schmidt and Neiland (1966) reported that *C. spinosus* possesses a longer proboscis than does *C. kuntzi*. The proboscis length they cited for *C. spinosus* was given by Van Cleave (1924) for specimens from a Galapagos hawk and greatly exceeds that of all previous reports. The Galapagos hawk specimens, because of other features, are thought to be *C. kuntzi* (see Discussion). The original description of *C. kuntzi* reported a shorter proboscis, but only one (holotype) of the three specimens upon which it was based had a fully evaginated proboscis. Reexamination of that specimen confirmed the reported length; however, proboscides of female *C. kuntzi* of the present collection were seldom less than 1,000 long and averaged 1,257 long. Those of males averaged 1,140 long. Proboscides of *C. spinosus* females, on the other hand, were frequently less than 1,000 long and averaged only 1,014 long.

Proboscides of males averaged only 963 long. Now that male *C. kuntzi* and larger collections of both *C. kuntzi* and *C. spinosus* have been studied, it is evident that the proboscis of *C. kuntzi* is longer than that of *C. spinosus*.

Proboscides of *C. spinosus* and *C. kuntzi* differ also in shape and width (Figs. 2, 3). Those of *C. kuntzi* are wider and possess pronounced swellings whereas the narrower proboscides of *C. spinosus* are slightly constricted at the receptacle insertion but lack marked swellings.

The most conspicuous difference between *C. spinosus* and *C. kuntzi* is in trunk shape (Figs. 4, 5). Although trunk lengths are similar, *C. spinosus* is much more slender and lacks the conspicuous inflation of *C. kuntzi*. All known *Centrorhynchus* cystacanths possess inflated foretrunks, but in birds *C. spinosus* juveniles assume a nearly cylindrical shape at least by the time they are 7.5 mm long, well short of the length at maturity. Figures 6 and 7 compare trunk shapes of equal-sized juvenile *C. spinosus* and *C. kuntzi*.

Females of both *C. spinosus* and *C. kuntzi* possess laterally flattened papillae at the posterior end. Schmidt and Neiland (1966) believed *C. kuntzi* to differ from *C. spinosus* in possession of this process. Although not adequately illustrated by Van Cleave (1916, Fig. 1), examination of the specimen (U.S.B.A.I. Helminthol. Coll., Hassall Coll. No. 6307) designated a "type" by Van Cleave, for what he believed to be the first description of *C. spinosus*, revealed the terminal papilla. Van Cleave (1924) later described "... lateral postgenital papillae" for *C. spinosus*. The

FIGURES 1-7. Camera lucida drawings of *Centrorhynchus spinosus* and *C. kuntzi*. 1. *C. kuntzi*, adult male. 2. *C. spinosus*, proboscis. 3. *C. kuntzi*, proboscis. 4. *C. spinosus*, outline of female trunk-shape. 5. *C. kuntzi*, outline of female trunk-shape. 6. *C. spinosus*, 7.5-mm-long juvenile male from *Strix varia*. 7. *C. kuntzi*, 7.5-mm-long juvenile male from *Buteo jamaicensis*. The projection beside Figure 6 applies equally to Figures 6 and 7.

papillae vary considerably in shape, from digitiform in young females to conical in older, distended worms, but no consistent difference between the two species was detected.

DISCUSSION

Van Cleave (1916) reported what he believed to be an undescribed species of *Acanthocephala* from *Herodias egretta* taken from an unmentioned locality. Based on a single, immature female he described and named *Centrorhynchus spinosus*. His description matches that given here in all regards except proboscis length and trunk width. Examination of his type specimen (U.S.B.A.I. Helminthol. Coll., Hassall Coll. No.

6307) revealed that the proboscis was partially invaginated and that Van Cleave's (1916) reported length of 650 was of the evaginated portion only. The diameter of the anterior part of the body was reported to be 6.6 mm (Van Cleave, 1916) and represents a misplaced decimal point as the type specimen actually measures 0.659 mm. With these corrections, Van Cleave's first description of *C. spinosus* agrees fully with the redescription given here.

Kaiser (1893) described *Echinorhynchus spinosus* from an unknown host collected in Florida. Except that he considered the posterior portion of the proboscis to be a spined neck, his description differs from the present redescription in only

two respects. Some of his specimens were longer (up to 45 mm ♂; 60 mm ♀) and although most hook lengths were within the range reported here, some were described as 62 long. Van Cleave (1924) also noted that some hooks of this species were very long (ca. 60), but stated that most were about 48 long. Kaiser's specimens are unavailable for study.

Van Cleave (1924) examined specimens from *Strix nebulosa*, great gray owl, collected in Florida and identified as *Echinorhynchus hystrix* and *E. caudatus* by Leidy. He concluded that Leidy's specimens and his from *H. egretta* were conspecific with *E. spinosus* of Kaiser, making the correct generic assignment and name *Centrorhynchus spinosus* (Kaiser, 1893) Van Cleave, 1924. His accompanying description of Leidy's specimens added egg dimensions (48–54 long and 24 wide) and the fact that female trunks terminate in papillae to the description of the species. Both of these features are in agreement with the present redescription.

In a report on Acanthocephala collected by the Allan Hancock Pacific Expedition, Van Cleave (1940) identified specimens from an unknown "Galapagos hawk," collected from the Galapagos Islands, as *C. spinosus*. In the accompanying description he noted that mature worms had conspicuous inflations of the trunks; proboscides longer than originally described, 1.0 to 1.3 mm long; and eggs 50 to 60 by 20 to 24. Previously, no report of *C. spinosus* had mentioned or illustrated other than a fully cylindrical trunk. Proboscis and egg lengths exceeded all previous reports for *C. spinosus*. In each of these three features, the Galapagos specimens differed from previous descriptions of *C. spinosus* and matched subsequent descriptions (Schmidt and Neiland, 1966; present study) of *C. kuntzi*. The fact that Van Cleave did not recognize the Galapagos specimens as distinct from *C. spinosus* (probably resulting from the fact that then-existing descriptions had been based on very few specimens) may have permitted the occurrence of *C. kuntzi* in the USA to go unnoticed until now.

It is unlikely that all previous reports of *C. spinosus* can be verified or corrected. However, all specimens in the USNM Helminthol. Coll. identified as this species have been reexamined. Specimens from *Bubo virginianus*, great horned owl, and *Strix varia*, barred owl (Nos. 40328 and 40329, respectively), collected in 1933 at Ithaca,

New York, proved to be *C. conspectus* Van Cleave and Pratt, 1940. Specimens from *S. nebulosa*, great gray owl, from North Carolina in 1936 (No. 41752) were also *C. conspectus*. Only the specimen deposited by Van Cleave (1916) as his holotype and a specimen from *Accipiter cooperii*, Cooper's hawk, collected in 1939 at North Franklin, Connecticut, proved to be *C. spinosus*. Nickol (1969) reported *C. spinosus* from *S. varia*, *Melanerpes carolinus* (= *Centurus carolinus*), red-bellied woodpecker, *Buteo platypterus*, broad-winged hawk, and *B. lineatus*, red-shouldered hawk, all collected in southern Louisiana. Only the specimens from *S. varia* and *M. carolinus* are *C. spinosus*; those from the other hosts are *C. kuntzi* (Table I).

Ten of several dozen acanthocephalans from *B. virginianus* collected in Florida were stained and mounted for critical examination. Two of the 10 were *C. kuntzi* and eight were *C. spinosus*. In this collection of mixed species, there was no intermediate form. It appears that although these species are morphologically variable, distinctions outlined here do not grade into each other.

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