Georgia Journal of Science

Volume 62 *No. 2 Scholarly Contributions from the Membership and Others*

Article 8

2004

A Redescription of the Mature Larva of Thermonectus basillaris (Harris) (Coleoptera: Dytiscidae: Dytiscinae)

Keith Carroll

E. H. Barman
Georgia College and State University, e.barman@gcsu.edu

A REDESCRIPTION OF THE MATURE LARVA OF *THERMONECTUS BASILLARIS* (HARRIS) (COLEOPTERA: DYTISCIDAE: DYTISCINAE)

Keith Carroll
Environmental Protection Division
Georgia Department of Natural Resources
Macon, GA 31211

E. H. Barman
Department of Biological & Environmental Sciences
Georgia College & State University
Milledgeville, GA 31061

Address Correspondence To:
E. H. Barman
Department of Biological & Environmental Sciences
Georgia College & State University
Milledgeville, GA 31061
e.barman@gcsu.edu

ABSTRACT

Mature larvae collected from Georgia ephemeral habitats were cultured into the adult stage and identified and described as *Thermonectus basillaris*.The legs of *T. basillaris* have fewer spiniform sensilla than reported for *Acilius mediatus*, and it appears that its two large dorsal stemmata are more massive than those of *A. mediatus*. These morphological differences indicate that nektonic larvae of *T. basillaris* and *A. mediatus* may be exploiting different prey regimes.

Key Words: Dytiscidae, *Thermonectus basillaris*, larva, *Acilius mediatus*, morphology, southeastern United States.

INTRODUCTION

The New World genus *Thermonectus* Crotch, in the tribe Aciliini, is represented in the Southeast by relatively few species, with Turnbow and Smith (1) having only two species of record for Georgia, *T. basillaris* (Harris) and *T. ornaticollis* Aubé. McWilliams (2) synonymized *T. ornaticollis* as a junior synonym of *T. nigrofasciatus* (Aub), assigning two subspecies, *T. n. nigrofasciatus* and *T. n. ornaticollis*. Larvae of Aciliini are usually characterized as nektonic predators of plankton. However, Wilson (3) reported observing larvae of *T. basillaris* and *T. n. ornaticollis* feeding on invertebrates (e.g., nymphs of *Notonecta*) on or near the water surface of small fishponds. Wilson's study also includes descriptions of mature larvae of *T. basillaris* and

T. n. ornaticollis, but his descriptions emphasize general larval appearance and lack the detailed analysis that are characteristic of more recent studies. Wilson's descriptions have been used for identification of these two species when they are the only representatives of the genus. However, Barman and Epler (4) reported that Wilson's descriptions have been erroneously interpreted and incorporated into keys (5; 6) so that larvae of both *T. basillaris* and *T. n. ornaticollis* are likely to be identified as *T. n. ornaticollis* in Georgia and elsewhere. The cranium of the mature larva of *T. basillaris* has been described, emphasizing mandibular morphology and internal cranial structures supporting extra oral digestion (7), but the restricted nature of this study limits its systematic value.

The objectives of this study are to redescribe the mature larvae of *Thermonectus basillaris* with an emphasis on leg chaetotaxy and to report a preliminary assessment of the ecological implications of selected morphological systems.

MATERIALS AND METHODS

Mature larvae and exuviae of mature larvae examined in this study were from the aquatic Coleoptera fluid collection (70% glycerated alcohol) of Georgia College & State University. These larvae were collected in Talbot County, Georgia USA, on 9 and 14 May 1997 and identified as *Thermonectus basillaris* by culture into the adult stage.

Measurements were obtained from dismembered specimens with head lengths taken dorsally from the posterior margin along the coronal suture to the anterior margin of the frontoclypeus, excluding the posterodorsal notch and frontoclypeal sensilla. All other measurements were taken at the longest or the widest aspects. Anatomical assessments were of eight larvae unless noted otherwise. A modification of a descriptive system proposed by Wolfe and Roughley (8) was used to enumerate sensilla by position or origin on segments of body and appendages, permitting comparisons between closely related taxa (9).

Larval Description

General aspect. – Body spindle-shaped, widest at or the near first abdominal segment (3), length (alcohol preserved specimens) about 16 mm excluding urogomphi; sclerotized areas pale yellowish-brown with irregular areas on head darker brown; broad lateral area of head below dorsal stemmata appearing much darker on some specimens.

Head. – Hyperprognathic, dorsoventral shape trapezoidal anterior to well-defined cervical region (7), cervical region delimited by a deep constriction and with prominent dorsal and ventral notches penetrating the entire length of the cervical region, occipital suture present, total length 1.86 - 1.98 mm ($\bar{x}$ = 1.92 ± 0.05 mm), width 1.30 - 1.46 mm ($\bar{x}$ = 1.37 ± 0.06 mm); coronal suture length 0.62 - 0.68 mm ($\bar{x}$ = 0.65 ± 0.02 mm); frontoclypeus, length 0.78 - 0.84 mm ($\bar{x}$ = 0.82 ± 0.02 mm), anterior mar-

gin with lamellae clypeales, adnasale well-developed; large rectangular sclerotized plate extending from between the adnasale and below the lamellae clypeales onto the cibarium; cranium largely glabrous, prominent sensilla of the head capsule included temporal spines, lamellae clypeales, and a group of spine-like sensilla ventral and anterior to cervical region; antenna four-segmented, total length 0.56 - 0.68 mm ($\bar{x}$ = 0.62 ± 0.05 mm) segments two and three with secondary segmentation, first segment 0.14 - 0.18 mm ($\bar{x}$ = 0.16 ± 0.02 mm), second segment 0.17 - 0.21 mm ($\bar{x}$ = 0.19 ± 0.02 mm), third segment 0.20 - 0.24 mm ($\bar{x}$ = 0.23 ± 0.01 mm), lacking accessory sensorial appendage, fourth segment 0.05 - 0.06 mm; two large anterodorsal stemmata each with a massive cellular sac (10) penetrating deeply into the cranial interior from beneath the corneal lens; remaining stemmata smaller with two lateral, one ventral, and one anterolateral near base of mandible, cellular sacs not visible externally; gular suture obscure; posterior tentorial pits visible mesoventrally.

Mouth parts. - Mandible falciform, mandibular channel partially closed medially, ventral edge serrated distally (7), mandibular abductor muscle with a dorsomedial origin (n = 1), proximal and lateral fringe of hair-like sensilla present; maxilla with galea long, robust and spur-like with ventral spines; stipes strongly arcuate, acute medially and distally beneath galea, medial edge strongly spinulous, spinulae larger medially on apex, apparent homologs of ancestral sensilla on ventral surface, prominent series of hair-like sensilla originating dorsolaterally, second dorsal series of hair-like sensilla terminating as a cluster near base of the palp, dorsomedial series becoming longer distally to terminate near base of galea, small scale like spinulae between dorsomedial and medial edge; maxillary palp three segmented, homologs of ancestral sensilla present; third segment, first segment 0.06 - 0.09 mm ($\bar{x}$ = 0.08 ± 0.01 mm), second segment 0.11 - 0.14 mm ($\bar{x}$ = 0.12 ± 0.01 mm), third segment 0.15 - 0.18 mm ($\bar{x}$ = 0.16 ± 0.01 mm) and secondarily segmented; labium rounded distally and protruding well beyond origins of palps, hair-like sensilla arising near base of each palp, small cone-like sensilla along distal rounded edge, ligula prominent with a shallow distal bifurcation with each short branch supporting a prominent sensillum, proximal segment of labial palp with lateral scale-like spinulae, first segment 0.21 - 0.27 mm ($\bar{x}$ = 0.25 ± 0.02 mm), second segment 0.18 - 0.20 mm ($\bar{x}$ = 0.18 ± 0.01 mm).

Thorax. – Pronotum elongate, laterally compressed anteriorly, prominent rectangular prosternal plate covering almost entire venter; thoracic nota glabrous; spiracles in pleural region under anterolateral margins of mesothoracic notum.

Legs. – (Fig. 1, Tables I and II) Range of respective lengths of pro-, meso-, and metalegs, excluding trochanters and claws, 3.0 to 3.3, 3.3 to 3.5, and 3.3 to 3.4 mm; coxal sutures absent; trochanters with 7 - 10 sensilla, secondary homolog of TR_2 not observed; anteroventral and posterodorsal natatory sensilla present on femur, tibia, and tarsus; tarsus with anteroventral series restricted to proximal half and posterodorsal series along the length of

the segment; tibia without ventral spinulae, tarsal ventral spinulae robust, present anteroventrally on distal half; posterior tarsal claw shorter than anterior and broadly spinous ventrally.

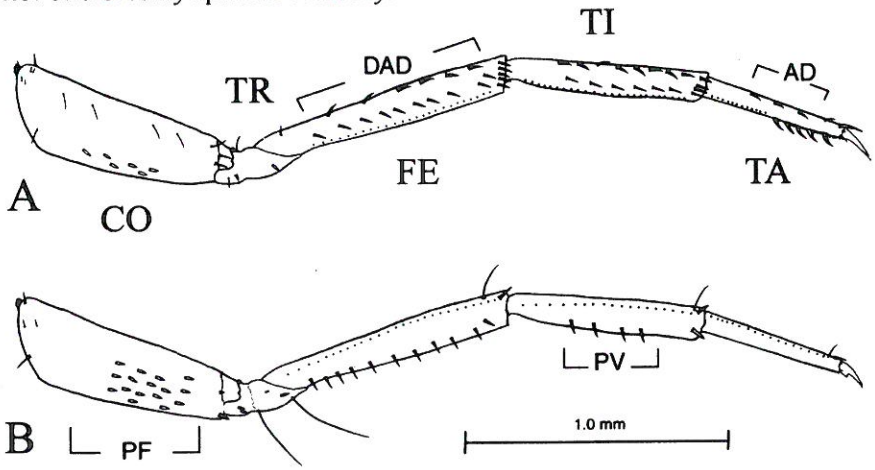

Figure 1. Anterior (a) and posterior (b) views of the prothoracic appendage of *Thermonectus basillaris* (Harris). Abbreviations: AD, anterodorsal; co, coxa; DAD, dorsal anterodorsal; PF, posterior face; PV, posteroventral; fe, femur; TA, TARSUS ti, tibia; AND; TR, TROCHANTER.

Table I. Measurements (N=8, unless noted otherwise; in mm) of Thoracic Appendage Segments of *Thermonectus basillaris* (Harris).

Segment	Mean	Standard Deviation	Range
Procoxa	0.87	0.07	0.80 - 0.96
Mesocoxa	0.96	0.04	0.90 - 1.05
Metacoxa	0.98	0.03	0.95 - 1.04
Protrochanter	0.41	0.04	0.36 - 0.48
Mesotrochanter	0.43	0.03	0.39 - 0.47
Metatrochanter	0.43	0.05	0.35 - 0.48
Profemur	1.09	0.06	1.01 - 1.20
Mesofemur	1.15	0.05	1.07 - 1.22
Metafemur	1.08	0.05	1.01 - 1.14
Protibia[1]	0.73	0.06	0.69 - 0.86
Mesotibia	0.79	0.08	0.69 - 0.93
Metatibia	0.77	0.02	0.75 - 0.81
Protarsus[2]	0.51	0.02	0.47 - 0.54
Mesotarsus	0.56	0.02	0.51 - 0.59
Metatarsus	0.57	0.02	0.54 - 0.60

[1] N=7; [2] N=6

Table II. Sensillar distribution on legs of the mature larva of *Thermonectus basillaris* (Harris).

Appendage	Location[1]	Coxa	Femur	Tibiae	Tarsus
	DAD	3 - 6	6 - 9	8 - 9	5 - 7
	AV	3 - 7	9 - 13	4 - 8	0
	ADi	2	5 - 6	3 - 5	2 sm
Proleg	APr[2]	6	NA	NA	NA
	PD	0	0	0	1 + 1 hrl
	PDi	2	1 + 1 hrl	1 - 2 +1 hrl	2 sm
	PV	NA	10 - 14	3 - 7	0
	PF	8 - 17	NA	NA	NA
	PPr[2]	4	NA	NA	NA
	DAD	6 - 11	9 - 14	4 - 11	4 - 6
	AV	3 - 7	7 - 13	8 - 12	0
	ADi	2	5 - 6	3 - 5	2 sm
	APr[2]	6	NA	NA	NA
Mesoleg	PD	0	0	0	1 + 1 hrl
	PDi	2	1 + 1 hrl	1 - 2 +1hrl	2 sm
	PV	NA	11 - 14	4 - 5	0
	PF	5-16	NA	NA	NA
	PPr[2]	4	NA	NA	NA
	DAD	8 - 12	9 - 14	9 - 11	5 - 6
	AV	4 - 6	11 - 16	10 - 14	0
	ADi	2	6 - 8	4 - 6	2 sm
	APr[2]	6	NA	NA	NA
Metaleg	PD	0	0	0	1 2 + 1 hrl
	PDi	2	1 + 1 hrl	1 - 2 + 1 hrl	2 sm
	PV	NA	10 - 13	4 - 5	0
	PF	3 - 7	NA	NA	NA
	PPr[2]	4	NA	NA	NA

[1]Abbreviations: ADDi, anterodorsal distal; AF, anterior face; APr, anteroproximal; AV, anteroventral; AVDi, anteroventral distal; DAD, dorsal anterodorsal; hrl, hair-like; PD, posterodorsal; PF, posterior face; PPr, posterior proximal; PV, posteroventral; PDDi, posterodorsal distal; and PVDi, posteroventral distal.

[2]These data represent a composite enumeration

Abdomen. – Abdominal terga one - six extending onto ventrolateral areas, with lateral sclerotization increasingly progressively, segments seven and eight completely sclerotized; segment eight 1.88 - 2.14 mm ($\bar{x}$ = 2.01 mm, n=5); siphon length 0.21 - 0.40 mm ($\bar{x}$ = 0.28 mm, n = 5); segments one - six with ventrolateral spiracles, spiracles on segment seven below natatory sensilla; tergites one - six glabrous, non sclerotized areas of segments two-four with posteroventral hair-like sensilla; two -seven with a ventrolateral series of hair-like sensilla, segments seven and eight each with well-defined lateral series of hair-like natatory sensilla;

Urogomphus. - Single segmented, length 0.81 - 0.90 mm ($\bar{x}$ = 0.85 mm, n = 4) with 4 apical sensilla, 3 long hair-like prominent sensilla arising from the proximal third and one shorter sub distal spine-like sensillum near origin of urogomphus.

DISCUSSION

The general shape (3) of the larva of *Thermonectus basillaris* and the distribution and morphology of sensilla on the larval legs are consistent with descriptions provided for other Aciliini larvae (e. g., 9, 11). Nilsson (9) reported that within the Dytiscinae primary sensillum TR_2 was present on trochanters of *Dytiscus*, *Hydaticus*, and *Cybister* but absent on *Eretes*, *Acillius*, and *Graphoderus*. Secondary homologs of TR_2 were not found on *T. basillaris*, although homologs of the remaining primary sensilla appear to be present. The homologs of the primary sensilla and the secondary sensilla are distributed in patterns on legs that appear similar to those of other Aciliini. However, there are fewer spines on the legs of *T. basillaris* than reported for *Acilius mediatus* (Say). As an example, the profemur of *T. basillaris* has 27 to 44 non-natatory sensilla (Table 3), contrasting significantly with the range of 56 to 75 sensilla that was reported for *A. mediatus* (11).

Table III. A comparison of the number of Sensilla and their patterns of distribution on legs of mature larvae of *Aculius mediatus* (SAY) and *Thermonectus basillaris* (Harris).

Location[1]	*Acilius mediatus*[2]	*Thermonectus basillaris*
DAD	10 - 15	4 - 9
ADi	7 - 9	4 - 6
AV	16 - 21	9 - 13
PDi	0 - 1	0 - 1
PV	23 - 29	10 - 15
Total	56 - 75	27 - 44

[1] Abbreviations are: ADi, anterior distal; AV, anterior ventral; DAD, dorsal anterodorsal; PDI, posterior distal; and PV, posterior ventral.
[2] Data taken from Sizer and Barman (11).

Thermonectus basillaris larvae have massive columnar cellular sacs beneath the four large dorsal lenticular cornea that are observable externally, as reported by Wilson (3). These structures penetrate almost to the venter of the cranial interior. Although the dorsal stemmata of *Acilius mediatus* are also large and penetrate deeply into the interior, they do not appear from the exterior to be as massive as those of *T. basillaris*. If this difference is confirmed by additional observations and comparisons, this would indicate that larvae of *A. mediatus* and *T. basillaris* have different sensory requirements associated with the dorsal stemmata. Wilson (3) reported observing *Thermonectus* larvae feeding on surface dwelling organisms. If the prey regimes of *Thermonectus* larvae include large numbers of these animals rather than the zooplankton diet attributed to the Aciliini (e.g., 12), morphological differences within some systems would be expected. Although additional observations are required, the massive dorsal stemmata and the apparent reduction in femoral chaetotaxy may be indications that *T. basillaris* and *A. mediatus* are feeding in different areas of the water column and exploiting different prey assemblages.

ACKNOWLEDGEMENTS

Aquatic Coleoptera Laboratory project No. 48. This project was supported in part by a Faculty Research Grant awarded by the Office of Research Services, Georgia College & State University.

REFERENCES

1. Turnbow R and Smith CL: An annotated checklist of the Hydradephaga (Coleoptera) of Georgia. J Ga Entomol Soc 18: 429-443, 1983.
2. McWilliams KL: A taxonomic revision of the North American species of the genus *Thermonectus* Dejean (Coleoptera: Dytiscidae). Ph.D. thesis, Indiana University, Bloomington, Indiana, 220 pp., 1968.
3. Wilson CB: Water beetles in relation to pondfish culture, with life histories of those found in fishponds at Fairport, Iowa. Bull Bur Fish, Wash 39: 231-345, 1923.
4. Barman EH and Epler JH: Errors in descriptions of larvae of *Thermonectus* Dejean (Coleoptera: Dytiscidae). Southeast Nat, in press.
5. Brigham WU: Aquatic Coleoptera. Pp. 10.1-10.136 *in* Brigham AR, WU Brigham and A Gnilka (eds.). Aquatic Insects and Oligochaetes of North and South Carolina. Midwest Aquatic Enterprises, Mahomet, IL, 1982.

6. Epler JH: Identification manual for the water beetles of Florida (Coleoptera: Dryopidae, Dytiscidae, Elmidae, Gyrinidae, Haliplidae, Hydraenidae, Hydrophilidae, Noteridae, Psephenidae, Ptilodactylidae, Scirtidae). Florida Dept Environ Protection, Tallahassee, FL. 257 pp., 1996.
7. Barman EH and Carroll K: Anterior cranial morphology of the mature larva of *Thermonectus basillaris* (Harris) (Coleoptera: Dytiscidae). Ga J Sci 60: 156-160, 2002.
8. Wolfe GW and Roughley RE: Description of the pupa and mature larvae of *Matus ovatus ovatus* Leech (Coleoptera: Dytiscidae) with a chaetotaxal analysis emphasizing mouth parts, legs, and urogomphus. Proc Acad Nat Sci Phil 137: 61-79, 1985.
9. Nilsson AN: A review of primary setae and pores on legs of larval Dytiscidae (Coleoptera). Can J Zool 66: 2283-2294, 1988.
10. Snodgrass RE: Principles of Insect Morphology. New York: McGraw-Hill, 667 pp; illus, 1935.
11. Sizer RL and Barman EH: Natural history of *Acilius mediatus* (Say) (Coleoptera: Dytiscidae: Aciliini) in central Georgia with a description of its mature larva. Ga J Sci 56: 165-174, 1998.
12. Galewski K: A study on morphobiotic adaptations of European species of the Dytiscidae (Coleoptera). Bull Entomol Pol 41: 488-702, 1971.