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A PRELIMINARY REPORT ON THE HYDRADEPHAGAN (COLEOPTERA) FAUNA OF SAN SALVADOR ISLAND, BAHAMAS WITH COMMENTS ON AVAILABILTY OF REPRODUCTIVE HABITATS

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ABSTRACT

The Hydradephaga (families Gyrinidae, Haliplidae, and Dytiscidae) are often well represented in small, temporary fresh-water habitats. However, Elliott (1993) listed *Hydaticus bimarginatus*, a dytiscid, as the only representative of the Hydradephaga on San Salvador. A survey of aquatic habitats and collections at lights in 2000 and 2001 yielded a total of 183 adult aquatic beetles, including 78 Hydradephaga. Taxa identified include Gyrinidae (*Dineutus*), Haliplidae (*Haliplus*), and Dytiscidae (*Copelatus*, *Cybister*, *Hydaticus*, *Laccophilus*, *Megadytes*, *Pachydrus*, and *Thermonectus*). The most frequently collected beetles were *Haliplus*, *Hydaticus*, *Pachydrus*, and *Thermonectus* with only one or two specimens collected of the other taxa. Two species of *Laccophilus* were collected, but each of the other genera was represented by one species. The larva of *Thermonectus* was the only immature collected.

Sinkholes sampled had a number of characteristics indicating suitability for breeding by some hydradephagan species (*e.g.*, *Cybister*). The emergent vegetation (*Eleocharis*, *Pluchea*, *Euphorbia*, *Paspalum*, *Phyla*, and *Dichromena*) within sinkholes both reflects and contributes to the necessary trophic status. This vegetation also provides a number of habitat features that are important to the life cycle of these beetles. The smaller roadway basins where adults were collected could serve as reproductive habitats during periods of persistent precipitation. These systems appeared to be highly eutrophic, supporting a diverse and rich micro- and macro-invertebrate fauna that is required to sustain the predaceous hydradephagan larvae. However, it is also possible that some, perhaps most, of the hydradephagans represented as adults are unable to establish and/or maintain reproductive populations on the island. To facilitate further studies of the hydradephagan beetles, keys to the adults and mature larvae of San Salvador are presented.

INTRODUCTION

Species of the hydradephagan families Haliplidae, Gyrinidae, and Dytiscidae and the polyphagan family Hydrophilidae are among the most frequently collected beetles in lentic habitats, particularly from small temporary habitats. Adults and larvae of most hydradephagans are predators, and the larger beetles (*e.g.*, *Cybister*) are often the largest predators in some small temporary systems (Barman and White 1995). Elliott's (1993) insect faunal list for San Salvador includes five species of Hydrophilidae, comparable to the number of species of Scaritinae (Coleoptera: Adephaga: Carabidae) on the island (Nichols 1988). However, only one hydradephagan species, the dytiscid *Hydaticus bimarginatus*, has been reported for the island (Elliott 1993). Given the vagility of most hydradephagan species, the convergence of wind currents on the Bahamas (Sealey 1994), patterns of hurricane and tropical storm tracks (Shaklee 1996) and the proximity of the islands to Florida and its rich coleopteran fauna (Epler 1996), the presence of only one hydradephagan species was surprising. In addition, aquatic hydradephagan and polyphagan species often breed in the same or similar habitats, suggesting that the Hydradephaga were under-collected on San Salvador.

Although Hydradephaga breed in a variety of habitats (*e.g.*, Wilson 1923, Spangler and Gillespie 1973, Aiken and Wilkinson 1985), temporary fresh-water sites appear to be preferred. Fifteen of nineteen dytiscid species in the northeastern United States selected and bred only in temporary sites even though permanent habitats were readily available (Barman 1996). The apparent preference for temporary habitats may be because many long-lived predators (e.g., fish and some odonates) are unable to maintain populations in these systems (Skelley 1997), resulting in a reduction in levels of predation on and/or intensity of competition for hydradephegans. Macrophytes in the systems used for breeding may also contribute to habitat complexity, negating the impact of predation or competition even when other predators are present. Aquatic and terrestrial plants in or near the basins that are flooded to produce ephemeral habitats contribute large amounts of detrital materials that make these habitats very productive and capable of simultaneously supporting large larval populations of several beetle species (Larson 1985). In addition, plants provide substrates from which adults and larvae of many species feed, and a number of hydradephagan species lay eggs either on or in plants.

A resolution of the 6th Symposium on the Natural History of the Bahamas calls for a documentation of the biodiversity of San Salvador (Deyrup 1996). The purpose of this study was an assessment of hydradephagan biodiversity on San Salvador and a survey of the island for the presence of temporary fresh-water habitats suitable for aquatic Coleoptera.

MATERIALS AND METHODS

Three habitats within Line Hole area were sampled (Figure 1) with a triangular dip-net from 6–12 July 2000, 15 May 2001 and again on 15 June 2001. Temporary roadside and wetland habitats within sinkholes were surveyed in 2000 (Figure 2). Precipitation during the month of May 2001 was exceptionally high and sinkholes and adjacent low-lying areas in Line Hole area were flooded. We were successful in collecting Coleoptera in temporary roadside

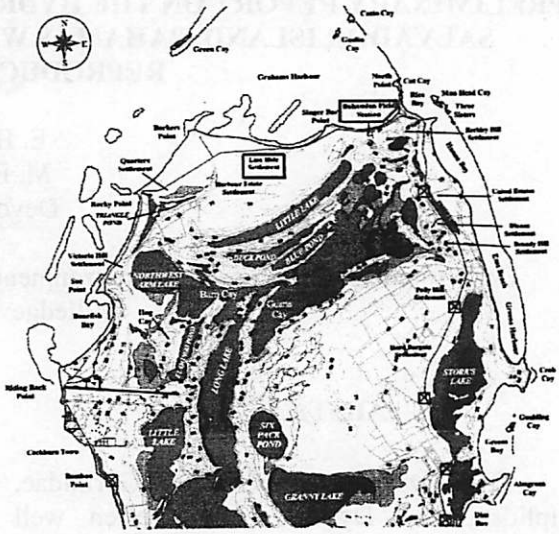

Figure 1. Map of northern San Salvador, showing collection sites (modified from Robinson and Davis, 1999).

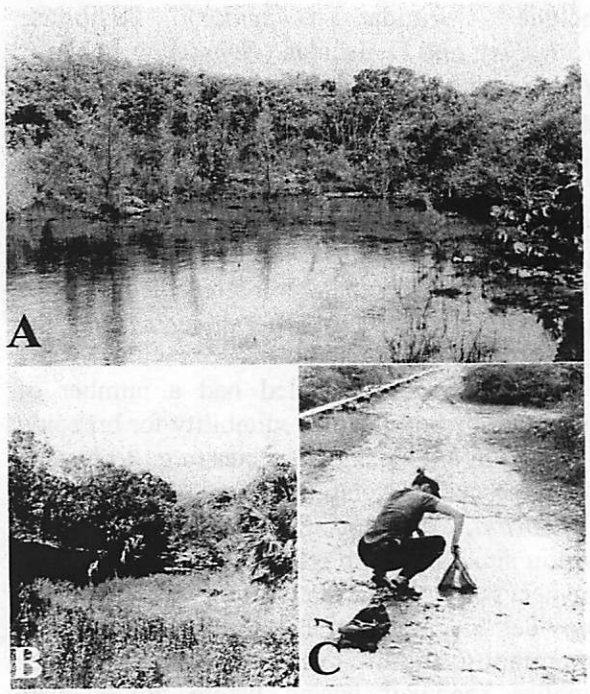

Figure 2. A - Temporary pond adjacent to Line Hole Road. B - Sink hole proximal to Line Hole Road. C - Dip net collecting from a short duration roadway habitat.

habitats, but not in sinkholes. In June 2001 hydradephegan adults and one immature were obtained from sinkhole habitats. Open areas within the Blackland communities of Line Hole also yielded collections of Dytiscidae. These collections were augmented with material collected at night in and around the lights of San Salvador Field Station. All insects were preserved in 70 percent alcohol and held in the Georgia College & State University Coleopteran Collection.

The key to the hydradephagan larvae is a simplification of a key (Barman 1998) to the Dytiscidae of Georgia (U.S.A.) modified to permit the exclusion of the Hydrophillidae and the inclusion of the Haliplidae and Gyrinidae. Larval descriptions are available for relatively few hydradephagan species, often making it impossible to identify the species represented by the larval stages. In some cases, larval genera (*e.g.*, *Cybister* and *Megadytes*) are inseparable. The composition of the key to the adults and illustrations and photographs are based on an examination of the material collected in this study, using the terminology of Snodgrass (1935), Borror *et al.*, (1989), and Epler (1996). Identification of the material is in progress and a species list will be published at a later date.

Table 1. Results of preliminary surveys of the hydradephagan fauna of San Salvador Islands, Bahamas.

FAMILY	GENUS	NUMBER
GYRINIDAE	*Dineutus*	2
HALIPLIDAE	*Haliplus*	22
DYTISCIDAE	*Copelatus*	1
	Cybister	1
	Hydaticus	14
	Laccophilus	1
	Laccophilus	2
	Megadytes	2
	Pachydrus	12
	Thermonectus	21

RESULTS AND DISCUSSION

Our survey revealed that the hydradephagan fauna of San Salvador is greater than previously reported (Elliott 1993). A total of 173 adult aquatic beetles were collected, including 67 hydradephagan adults in the following taxa: Gyrinidae (*Dineutus*), Haliplidae (*Haliplus*), and Dytiscidae (*Copelatus*, *Cybister*, *Hydaticus*, *Laccophilus*, *Megadytes*, *Pachydrus*, and *Thermonectus*) (Table 1). The beetles most frequently collected during the surveys were *Haliplus*, *Hydaticus*, and *Thermonectus*, with the remaining taxa represented by only one or two specimens. At least two species of the dytiscid genus *Laccophilus* were collected, but each of the other genera was represented by one species.

A mature larva of the dytiscid genus *Thermonectus* (Figure 3 A) was collected on 15 June 2001 from the narrow shelf region of a filled sinkhole (Figure 3 B). The scarcity of larvae is not surprising because larvae of most species are present usually for only a few weeks annually and in a limited number of habitats (Barman 1996). In contrast, adults may be collected year round in a variety of habitats in warm temperate areas; however, the collection of adults does not mean that all of the beetles collected during this survey have reproductive populations on San Salvador. We stress that the results of the present study are preliminary and other taxa may not have been sampled. A better estimate of abundance of species and the total numbers of species present will be obtained by additional sampling of sinkholes and other habitats.

The presence of a larva, newly emerged (teneral) adults, and relatively large numbers of mature adults of *Thermonectus* indicates that this species is probably indigenous to San Salvador. Although larvae were not found, it is likely that *Hydaticus bimarginatus* is breeding

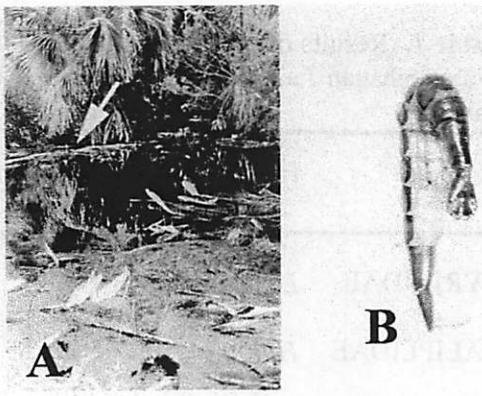

Figure 3. A- Larval habitat, showing area of collection.. B - Mature larva of *Thermonectus.*

on the island because it has been collected previously (Elliott 1993) and because it was commonly observed in a variety of habitats. The haliplid species may be indigenous since adults were numerous in a variety of habitats and it may have limited dispersal abilities because of its small size. Several of the taxa collected were represented by only one or two individuals, perhaps a reflection of the brevity of the surveys rather than of the rarity of the beetles on the island. However, it is possible that these taxa represent vagrants or transients that have dispersed from other nearby landmasses where reproduction occurs and that these species reproduce on the island only sporadically or not at all.

A number of habitats sampled have characteristics that indicate suitability for breeding by some hydradephagan species. Adult dytiscids were observed and collected in temporal wetlands located in flooded open areas within the scrub (Figure 2A). The algal flora of these wetlands was dominated by the green algal genus *Chara* and characterized by thick, algal mats. Specimens of *Pachydrus* collected on 15 June 2001 coexisted with odonate larvae that were observed perching within the upright thalli of *Chara*. Sinkholes (Figure 2B and 3A) had varying amounts of detrital material from palms (*Sabal palmetto*) and dense growths of emergent vegetation. The emergent vegetation (*Eleocharis*, *Pluchea*, *Euphorbia*, *Paspalum*, *Phyla*, and *Dichromena*) in and around the sinkholes both reflects and contributes to the necessary trophic status. Hydradephagan adults were also collected from temporary habitats in roadways (Figure 2C) that lacked emergent vegetation; however, these systems may not persist long enough to permit completion of life cycles. All systems collected appeared to be highly eutrophic, supporting a diverse and rich micro- and macro-invertebrate fauna that is required to sustain the predaceous hydradephagan larvae.

Additional collecting is required for characterization of hydradephagan biodiversity and the availability of coleopteran reproductive habitats on San Salvador. A simplified method of identifying organisms is important in any natural history survey and the keys to adults and larvae of the Hydradephaga should promote and support future studies on San Salvador.

KEY TO GENERA OF THE KNOWN ADULT HYDRADEPHAGA OF SAN SALVADOR

1a. Antennae clubbed with terminal segments wider than proximal segments (as in Fig. 4A); posterior margin of first abdominal abdominal tergite extending completely across abdomen (Fig. 4B)..... .....Hyrophillidae

1b. Antennae filiform (Fig. 4C and 4F); first abdominal segment divided by metacoxae so that the posterior margin does not extend across abdomen (Fig. 4C); or hind coxae are expanded into large plates that conceal most of the abdomen (Fig. 4D); (Hydradephaga) **2**

2a. Metacoxae enlarged to form plates that cover most of the abdomen (Fig. 4D); ca. 3-4 mm in length (Haliplidae) ....*Haliplus*

2b. Metacoxae not as above, abdominal segments exposed, larger beetles **3**

3a. Compound eyes divided on each side by a narrow exoskeletal band, resulting in the appearance of four eyes (Gyrindidae) ..... *Dineutus*

3b. Compound eyes not as above (Dytiscidae) **4**

4a. Length greater than 20 mm **5**

4b. Length less than 20 mm **6**

5a. Length less than 25 mm ..... *Cybister*

5b. Length greater than 25 mm ..... *Megadytes*

6a. Fore and middle legs appearing to be four-segmented. tarsus three bilobed with tarsal segment four minute and located between lobes (Fig. 4E) ..... *Pachydrus*

6b.. Fore and middle legs distinctly five-segmented, tarsus three not as above **7**

7a. Length less than 6 mm **8**

7b. Length greater than 6 mm **9**

8a. Elytra with multiple well-defined striae (Fig. 4F)..... *Copelatus*

8b. Elytra without striae ..... *Laccophilus*

9a. Lateral margin of metasternal wing straight ..... *Hydaticus*

9b. Lateral margin of metasternal wing curved ..... *Thermonectus*

KEY TO GENERA OF THE KNOWN MATURE AQUATIC COLEOPTERAN LARVAE OF SAN SALVADOR

1a. Legs (excluding claws) with four or fewer segments ..... Hyrophillidae

1b. Legs, (excluding claws) with five segments (Fig. 5A) ..... Hydradephaga

2a. Nine or ten abdominal segments **3**

2b. Eight abdominal segments (Dytiscidae) **4**

3a. One tarsal claw; terminal abdominal segment prolonged into a rat-like tail, (Haliplidae) ..... *Haliplus*

3b. Two tarsal claws; terminal abdominal segments not as above with prominent hooks (Gyrindidae) ..... *Dineutus*

4a. Frontoclypeus extended anteriorly to form a tripartite nasale, consisting of a large spatulate section flanked by two smaller projections (Fig. 5B); ca. 5.5 mm ..... *Pachydrus*

4b. Frontoclypeus not as above, extending only just beyond bases of antennae (Fig. 5C); 10 mm or longer **5**

5a. Abdominal segments seven and eight with lateral fringes of sensilla (Fig. 5D) **7**

5b. Abdominal segments seven and eight without lateral fringes of sensilla **6**

6a. Urogomphus shorter than last abdominal and with seven long spines..... ..... *Copelatus*

6b. Urogomphus longer than the last abdominal segment and with more than seven (numerous) long spines ..... *Laccophilus*

7a. Anterior margin of frontoclypeus deeply incised (Fig. 5E) ..... *Cybister* and *Megadytes*

7b. Anterior margin of frontoclypeus smoothly rounded anteriorly (Fig. 1B) **4**

8b. Labium with a well-developed ligula (Fig. 5F) ..... *Thermonectus*

8a. Labium lobed (Fig. 5G) ..... *Hydaticus*

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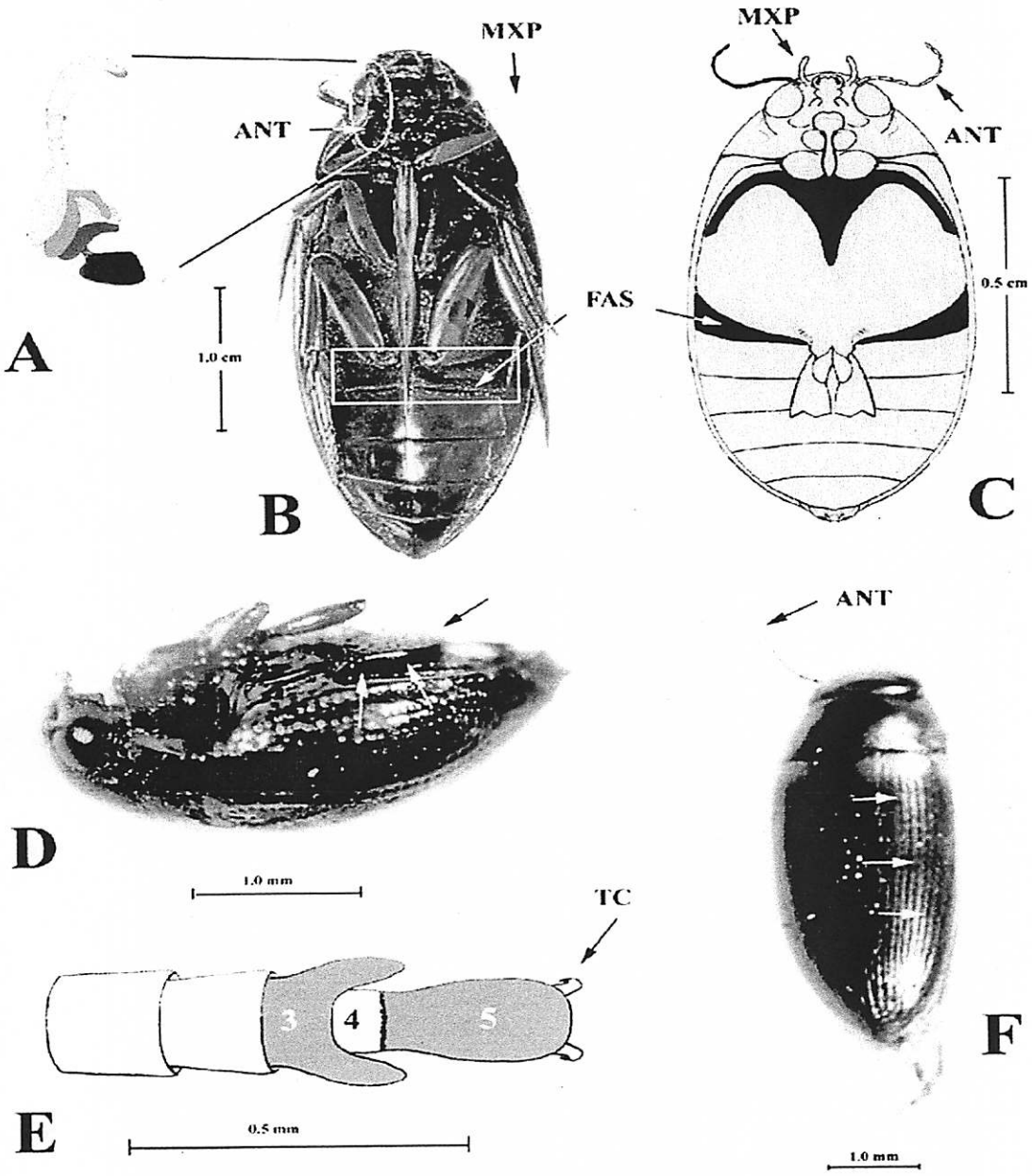

Figure 4. A - Clubbed antenna (ANT) of hydrophilid. B - Ventral view of hydrophilid showing first abdominal tergite (FAS) extending completely across abdomen, antenna (ANT), and elongate maxillary palp. C - Ventral view of a dytiscid showing first abdominal segment (FAS) divided by metacoxae so that the posterior margin does not extend across abdomen, filiform antenna (ANT), and short maxillary palp. D - Lateral view of a haliplid showing hind coxae expanded into large plates that conceal most of the abdomen. E - Fore and middle legs appearing to be four-segmented, tarsus three bilobed with tarsal segment four minute and located between lobes. F - Dorsal view of *Copelatus* showing mutiple well-defined striae on elytra.

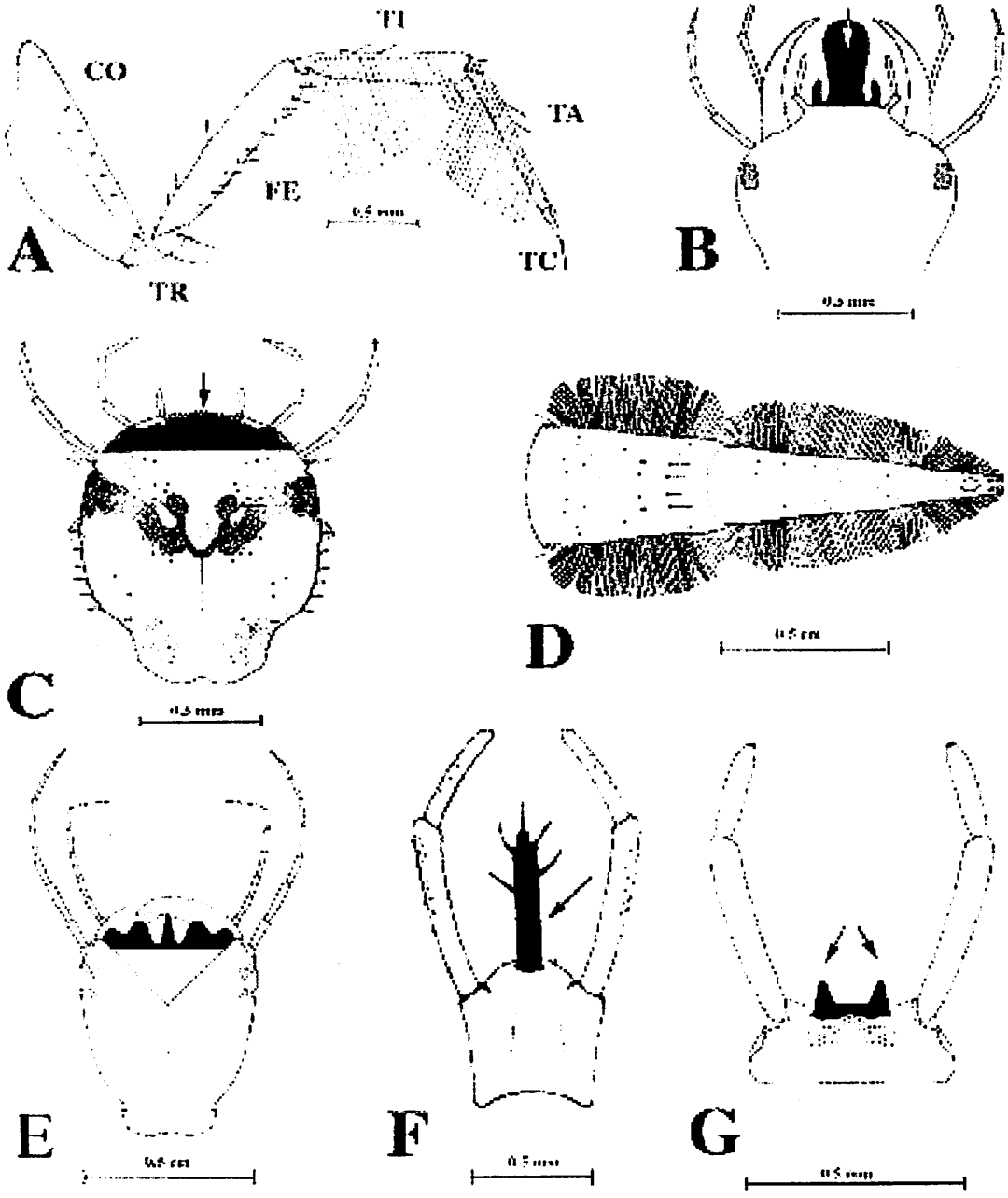

Figure 5. A - Hydradephagan leg with five segments (excluding claws). B - Dorsal view *Pachydrus* head, showing tripartite nasale with a large spatulate section flanked by two smaller projections. C - Dorsal view of *Laccophilus* head with frontoclypeus extending only just beyond bases of antennae. D - Lateral fringes of sensilla on abdominal segments seven and eight. E - Dorsal view of *Cybister* head showing deeply incised anterior margin of frontoclypeus F - Well-developed ligula of the labium of *Thermonectus*. G - Lobed labium of *Hydaticus*.