

AQUATIC LEPIDOPTERA (Moths)

In this very large terrestrial order, larvae and pupae of a few species in the family Pyralidae have become adapted to the aquatic environment. Larvae of *Neocataclysta*, *Nymphula*, and *Paraponyx* construct cases of plant materials and live in lentic environments where they feed on plants. *Parargyractis* larvae are lotic and feed on diatoms and algae growing on rocks. Although fairly common in some areas, aquatic Lepidoptera have not been studied in Wisconsin and very little is known about them. Larvae of additional species of Lepidoptera that live on emergent vegetation or bore into stems of aquatic plants may be collected while sampling aquatic habitats.

KEY TO GENERA OF AQUATIC LEPIDOPTERA LARVAE IN WISCONSIN

- 1a. Filamentous gills present 2
- 1b. Filamentous gills absent 3
- 2a. Gills branched, with up to 400 gill filaments; larvae in a case of material cut from the food plant (*Nuphar*, *Potamogeton*, *Vallisneria*, etc.) **Paraponyx**
- 2b. Gills unbranched, with about 120 gill filaments; larvae free-living on rocks in lotic situations **Parargyractis**
- 3a. Larva in a case constructed from its food plant 4
- 3b. Larva free-living, without a case terrestrial
- 4a. Body cylindrical, moniliform; head paler than body; case of *Lemna* on which it feeds **Neocataclysta**
- 4b. Body somewhat flattened, not moniliform; head darker than body; on *Lemna*, *Potamogeton*, *Nuphar*, or other plants from which case is built **Nymphula**

AQUATIC COLEOPTERA (Beetles)

In this, the largest insect order, only about 10% of the families have a majority of species with an aquatic stage. A few additional families have a limited number of aquatic species. About 1% of the known species of Coleoptera have an aquatic stage; and more than 300 aquatic species occur statewide. In Wisconsin there are six families in which most adults and larvae are aquatic (Dytiscidae, Elmidae, Gyrinidae, Haliplidae, Hydrophilidae, and Noteridae), two families in which adults are aquatic (Dryopidae, Hydraenidae), two families with aquatic larvae (Heliidae and Psephenidae), and one more family with a few species of aquatic larvae (Chrysomelidae). Pupae are terrestrial or live in air-filled cocoons. Life cycles, habitat, feeding habits, and distribution vary widely from family to family. Species keys can be used to accurately identify adults in most genera, but larvae cannot be identified to species and sometimes not even to genus.

HALIPLIDAE — Crawling Water Beetles (3 genera, 24 species)

Adults and larvae of *Haliphus* and *Peltodytes* are found among matted vegetation and debris along the shores of lakes, ponds, and slow streams, and are often abundant. Eggs are laid in the spring, larvae complete three instars on vegetation where they feed mostly on algae, and then pupate on shore under a stone or log. The aquatic adults, which emerge in summer or fall, are also mostly herbivorous.

DYTISCIDAE — Predaceous Water Beetles (27 genera, 140 species)

Both larvae and adults are predators, mainly on other arthropods. Larvae of most species complete their development in the spring, pupate on dry land in the summer, emerge in late summer or fall, and overwinter as adults. A few species overwinter as larvae, and in dry years, many may overwinter as pupae. Larvae and adults of most species can be collected in a variety of shallow, debris-laden, or vegetation-choked habitats. Ponds, small puddles, marshes, swamps, lake margins, and streams all harbor species, some of which may become abundant. Except for some lotic *Agabus*, most species are lentic and not very habitat specific. Adults often fly, especially just after emergence, and can be frequently collected at lights.

NOTERIDAE — Burrowing Water Beetles (3 genera, 3 species)

Although adults resemble small dytiscids in structure and habits, larvae are very different. The herbivorous larvae feed on plant roots and pupate within an air-filled cocoon on these roots in late summer. Adults emerge in fall and overwinter. *Suphisellus* is rare in southern Wisconsin; the other two genera have not been found, but occur in Michigan.

GYRINIDAE — Whirligig Beetles (2 genera, 26 species)

Both genera are common inhabitants of Wisconsin's ponds,

lakes, and streams. Larvae complete 3 instars during the summer months and pupate on shore. Adults emerge in late summer and fall, often congregating in large schools of mixed species. Species that inhabit ponds fly to wintering sites along large streams and lakes in the fall. Larvae are predaceous; adults are scavengers.

HYDROPHILIDAE — Water Scavenger Beetles (17 genera, 67 species)

Some genera (subfamily Sphaeridiinae) are not aquatic, and others represent a transition between aquatic and terrestrial environments, living largely at the water-land interface. *Chaetarthria* is mostly riparian, and the larvae of *Anacaena*, *Paracymus*, *Lacobioides*, and *Crenitis* are also riparian, with the adults of these genera having some affinity for the terrestrial environment. The rest of the genera are widespread and often abundant in a variety of aquatic habitats. *Sperchopsis*, *Crenitis*, and *Hydrobioides* inhabit lotic situations, although the latter may also occur in ponds. The remaining genera are primarily lentic, preferring weedy ponds, marshes, swamps, and lake margins, but also occurring along the margins of streams. The larvae have 3 instars and are predators, while the adults are scavengers and feed on a variety of food. All species are probably univoltine, with larvae most numerous in spring and early summer, and adults most abundant in late summer and fall. Most species probably overwinter as adults, but in some years pupae of some species may also overwinter.

HYDRAENIDAE — Minute Moss Beetles (2 genera, 5 species)

Only the adults are aquatic, and in Wisconsin they are rarely collected, perhaps because of their small size. A third genus, *Limnebioides*, may also occur; adults are only 1mm long and could be easily overlooked. The beetles are scavengers, and feed on dead animals and plant material in swamps and margins of streams.

PSEPHENIDAE — Water Penny Beetles (2 genera, 2 species)

Only the larvae are aquatic, attaching to rocks in streams or windswept lake shores where they scrape algae and diatoms

from rocks. There are apparently 6 larval instars and a 2-year life cycle. Pupation occurs in summer on moist rocks near the stream and adults emerge in less than 2 weeks. Adults are riparian, but enter the water to oviposit. Both species are fairly common throughout the state, but habitat requirements are specific and in a given stream *Psephenus* larvae can be abundant or absent.

ELMIDAE — Riffle Beetles (6 genera, 26 species)

Larvae and adults of all Wisconsin genera are aquatic. They are common in waterlogged wood (*Macronychus*, *Ancyronyx*, *Stenelmis*, *Dubiraphia*), in gravel substrate of streams (*Stenelmis*, *Optioservus*), among stream vegetation (*Dubiraphia*) and occasionally occur along margins of clean lakes (*Macronychus*, *Stenelmis*, *Dubiraphia*). *Microcyloopus* is rare. The herbivorous larvae have 5 or 6 instars, and most species probably require 2 years to complete their development. Adults are also herbivores. Upon emergence from the terrestrial pupal chamber, they fly and disperse widely, but after entering the water they rarely if ever leave the aquatic environment.

DRYOPIDAE — Riffle Beetles (1 genus, 2 species)

The environment and habits of *Helichus* adults are very similar to those of elmids, but the larvae are not aquatic. Although both species are distributed statewide, they are most common in the southwestern part of the state.

HELODIDAE — Marsh Beetles (4 genera, 22 species)

The herbivorous larvae can be frequently found in a variety of shallow lentic habitats, including tree holes. Almost nothing is known about their life cycle or biology.

CHRYSOMELIDAE (1 genus)

Larvae and pupae of *Donacia* inhabit and feed upon the roots and submerged stems of aquatic plants, especially water lilies. Oxygen is obtained from the plant. Although Chrysomelidae is a very large terrestrial family, larvae of this aquatic genus are apparently uncommon.

KEY TO GENERA OF AQUATIC COLEOPTERA IN WISCONSIN (ADULTS)

- 1a. Two pairs of eyes, a dorsal and a ventral pair divided by sides of head; meso- and metathoracic legs short, flattened; tarsi folding fanwise GYRINIDAE 9
- 1b. One pair of eyes; meso- and metathoracic legs not extremely flat; tarsi not folded fanwise 2
- 2a. Metacoxae expanded into large plates that cover 2 or 3 abdominal sterna and bases of metafemora (Fig. 1) HALIPLIDAE 10
- 2b. Metacoxae not expanded into large plates 3
- 3a. Prosternum with a postcoxal process that extends posteriorly to mesocoxae (Fig. 2); first visible abdominal sternum completely divided by metacoxal cavities (Fig. 2) 4
- 3b. Prosternum with postcoxal process absent or short; first visible abdominal sternum extending for its entire breadth behind coxal cavities (Fig. 3) 6
- 4a. Anterior of prosternum, its postcoxal process, and meso- and metasternum in same plane (Fig. 4); pro- and mesotarsi distinctly 5-segmented, segment 4 as long as 3 5
- 4b. Anterior of prosternum greatly depressed and not in same plane as its postcoxal process and meso- and metasternum (Fig. 5); pro- and mesotarsi appear to be 4-segmented (except *Bidessonotus*) with segment 4 very small and concealed between lobes of segment 3 DYTISCIDAE (in part) 14
- 5a. Prosternal process pointed; no curved spur or hooked apex on protibiae DYTISCIDAE (in part) 24
- 5b. Prosternal process truncate or rounded; protibiae with curved spur or hooked apex (Fig. 6) NOTERIDAE 12

- 6a. Antennae short, club-shaped with segment 4, 5, or 6 modified to form a cupule (Fig. 7); maxillary palpi usually longer than antennae 7
- 6b. Antennae filiform or pectinate, usually longer than maxillary palpi 8
- 7a. Antennae with 5 segments past cupule; less than 2.5mm long HYDRAENIDAE 39
- 7b. Antennae with 3 segments past cupule; 1.5-4.0mm long HYDROPHILIDAE 40
- 8a. Antennae slender, filiform; less than 4.5mm long 57
- 8b. Antennae short with pectinate club (Fig. 8); 5.0-6.3mm long DRYOPIDAE, *Helichus*
- 9a. GYRINIDAE — Scutellum visible; elytra with distinct rows of sharp punctures; 3-8mm *Gyrinus*
- 9b. Scutellum not visible; elytral punctures scattered and indistinct; 9-16mm *Dineutus*
- 10a. HALIPLIDAE — Pronotum with sides widest at base, convergent anteriorly (Fig. 9) 11
- 10b. Pronotum with sides of basal 2/3 nearly parallel (Fig. 10); 4.0-4.5mm *Brychius*
- 11a. Last segment of maxillary palpi conical, as wide and as long or longer than next to last (Fig. 11); 3.5-5.0mm *Pelodytes*
- 11b. Last palpal segment narrower and much shorter than next to last (Fig. 12) *Halipilus*
- 12a. NOTERIDAE — Prosternal process rounded posteriorly; 2.5-3.0mm *Pronoterus*
- 12b. Prosternal process truncate posteriorly 13
- 13a. Length 2.7-3.0mm *Suphisellus*
- 13b. Length 3.7-4.5mm *Hydrocanthus*

14a. DYTISCIDAE (in part) — Scutellum fully visible; apices of elytra and last abdominal sternum produced, acuminate; 4mm	Celina
14b. Scutellum covered by elytra; apex of abdomen not acuminate	15
15a. Less than 2.2mm long; metacoxal process not produced laterally, bases of trochanters entirely free (Fig. 13) ...	16
15b. More than 2.3mm long; metacoxal process produced laterally to cover bases of trochanters (Figs. 14, 22-25)	19
16a. Metatibiae straight, almost uniform in width (Fig. 15); metatarsal claws unequal; 1.8mm	Desmopachria
16b. Metatibiae arcuate, narrow at base (Fig. 16); metatarsal claws equal in length	17
17a. Pro- and mesotarsi distinctly 5-segmented; metacoxal lines strongly impressed and converging anteriorly across mid-metasternum to meet at mesocoxae (Fig. 17); 1.7-2.2mm ..	Bidessonotus
17b. Pro- and mesotarsi apparently 4-segmented; metacoxal lines not continuing onto mid-metasternum	18
18a. Head with transverse suture behind eyes (Fig. 18); 1.8-2.2mm	Liodesus
18b. Head without a transverse suture behind eyes; 1.6-2.0mm ..	Uvarus
19a. A diagonal carina crossing epipleura near base (Fig. 19) 20	
19b. No carina crossing epipleura	21
20a. Prosternal process broadly rounded at tip, and as wide as procoxae (Fig. 20); 2.4-2.6mm	Hydrovatus
20b. Prosternal process pointed at tip, and only half as wide as procoxae (Fig. 21); 2.3-5.4mm	Hygrotus
21a. Bases of metafemora touching metacoxal lobes (Fig. 22); 4.5-5.0mm	Laccornis
21b. Metafemora separated from metacoxal lobes by basal part of trochanters	22
22a. Posterior margin of metacoxal process truncate or angularly prominent at middle (Figs. 23, 24); 2.5-6.0mm	Hydroporus
22b. Posterior margin of metacoxal process incised at middle (Fig. 25)	23
23a. Metacoxal plates micropunctate with scattered larger punctures; pronotum with distinct sulcations laterally; 3.4-4.4mm	Oreodytes
23b. Metacoxal plates densely micropunctate, without larger punctures; pronotum without lateral sulci; 4.3-5.0mm	Deronectes
24a. DYTISCIDAE (in part) — Very large, 25-40mm	25
24b. Smaller, 4-17mm	26
25a. One large spur at apex of metatibiae twice as broad as other; beetle widest at posterior third; 28-33mm ..	Cybister
25b. Large spurs at apex of metatibiae subequal in width; beetle widest near middle; 25-40mm	Dytiscus
26a. Scutellum not visible; metatarsi with a single stout claw; 4.0-6.0mm	Laccophilus
26b. Scutellum fully visible; metatarsi with two claws	27
27a. Anterior margin of eyes emarginate above bases of antennae (Fig. 26)	28
27b. Eyes not emarginate above bases of antennae	36
28a. Metafemora with a linear group of stout setae ventrally near posterior, apical angle (Fig. 27)	29
28b. Metafemora without such setae	30
29a. Metatarsal claws of equal length or nearly so; 6.0-11.0mm ..	Agabus
29b. Outer metatarsal claw 2/3 or less length of inner claw; 8.0-11.5mm	Ilybius
30a. Prosternum with a median longitudinal furrow from near front margin to apex of prosternal process; 8.5-9.0mm	Matus
30b. Prosternum without a longitudinal furrow	31
31a. Metacoxal lines coming so close together posteriorly as almost to touch median line (Fig. 28); 4.5-5.5mm	Copelatus
31b. Metacoxal lines not converging so close to median line (Fig. 2)	32
32a. Metatarsal claws of same length, or nearly so; less than 9mm long	33
32b. Metatarsal claws obviously unequal in length; more than 9mm long	34
33a. Terminal palpal segments notched or emarginate at apex; 7.5-8.5mm	Coptotomus
33b. Terminal palpal segments not emarginate; 6.0-7.0mm	Agabetes
34a. Elytra sculptured with numerous parallel transverse grooves; 15-17mm	Colymbetes
34b. Elytra without transverse grooves	35
35a. Large black beetles with coarsely reticulate elytra; 14-16mm	Neoscutopterus
35b. Smaller beetles, with elytra not reticulate and usually irrorate; 9-11mm	Rhantus
36a. Outer margin of metasternal wings straight (Fig. 29); outer spur at apex of metatibiae acute; 12-14mm	Hydaticus
36b. Outer margin of metasternal wings arcuate (Fig. 30); outer spur at apex of metatibiae blunt, more or less emarginate ..	37
37a. Elytra densely punctate, and usually fluted and hairy in females; 12-16mm	Acilius
37b. Elytral punctation extremely fine or absent; females without fluted elytra	38
38a. Hind margin of mesofemora with stiff setae that are as long as or longer than femora are wide (Fig. 31); 9-13mm	Thermonectus
38b. Setae on hind margin of mesofemora only about half as long as femora are wide (Fig. 32); 11-16mm ..	Graphoderus
39a. HYDRAENIDAE — Maxillary palpi much longer than antennae; pronotum coarsely, closely punctate, sides without a transparent border; 1.8-2.2mm	Hydraena
39b. Maxillary palpi shorter than antennae; pronotum variously sculptured, almost always with a transparent border in at least basal half; 1.2-2.5mm	Ochthebius
40a. HYDROPHILIDAE — Pronotum with 5 longitudinal grooves; 2.8-4.5mm	Helophorus
40b. Pronotum without longitudinal grooves	41
41a. Pronotum granular and conspicuously narrower than elytral bases; scutellum very small; eyes protuberant; 3.5-4.0mm ..	Hydrochus
41b. Pronotum not appreciably narrower than base of elytra, or if so, scutellum elongate	42
42a. Basal segment of metatarsi longer than second; antennae usually longer than maxillary palpi; segment 2 of maxillary palpi much thicker than 3 or 4 ..	Sphaeridiinae (terrestrial)
42b. Basal segment of metatarsi shorter than second; antennae subequal to or shorter than maxillary palpi; segment 2 of maxillary palpi not, or very little thicker than 3 or 4	43
43a. Meso- and metasternum with a continuous median longitudinal keel, which is prolonged posteriorly into a spine between hind coxae (Fig. 3)	44
43b. Meso- and metasternum without a continuous median longitudinal keel	47
44a. Length 8-16mm	45
44b. Length 31-37mm	46
45a. Prosternum sulcate to receive anterior part of keel; 8-11mm	Tropisternus
45b. Prosternum carinate; 13-16mm	Hydrochara
46a. Prosternum sulcate, closed anteriorly; 32-37mm	Hydrophilus
46b. Prosternum bifurcate, open anteriorly; 31-33mm	Dibolocelus
47a. First 2 abdominal sternites with a common excavation covered by a fringe of long golden hairs arising from anterior margin of first abdominal sternite; 2mm (semiaquatic)	Chaetarthria
47b. Basal abdominal sternites normal	48
48a. Meso- and metatibiae with fringes of long swimming hairs; head strongly deflexed; scutellum elongate; 2.5-6.0mm	Berosus
48b. Meso- and metatibiae not fringed with swimming hairs; head not deflexed; scutellum almost as wide as long ..	49

- 49a. Maxillary palpi stout and short, about same length as antennae; last segment of palpi as long or longer than next to last 50
- 49b. Maxillary palpi slender, much longer than antennae; last palpal segment usually shorter than next to last 55
- 50a. Length 6-10mm 51
- 50b. Length 2-4mm 52
- 51a. Lateral margins of elytra weakly serrate basally (Fig. 33); meso- and metatarsi with scattered fine hairs dorsally; 8-9mm **Sperchopsis**
- 51b. Lateral margins of elytra without serrations; meso- and metatarsi with a dorsal fringe of fine swimming hairs; 6-10mm **Hydrobius**
- 52a. Metatibiae arcuate (Fig. 34); elytra without sutural striae; 2.5-4.0mm **Laccobius**
- 52b. Metatibiae not arcuate (Fig. 35); elytra with sutural striae (Fig. 36) 53
- 53a. Prosternum longitudinally carinate; mesosternum with a strong transverse ridge; black or nearly black with a metallic sheen; 2.0-2.5mm **Paracymus**
- 53b. Prosternum not carinate; mesosternum with toothlike protuberance, low transverse ridge, or smooth; dark brown to nearly black 54
- 54a. Mesosternum with a toothlike protuberance **Anacaena**
- 54b. Mesosternum with a low transverse ridge, or smooth **Crenitis**
- 55a. All tarsi 5-segmented, basal segment small; 2.5-9.5mm **Enochrus**
- 55b. Meso- and metatarsi 4-segmented 56
- 56a. Mesosternum with a transverse carina; only sutural striae of elytra impressed; 3.0-6.0mm **Cymbiodyta**
- 56b. Mesosternum with a prominent conical process; elytra with many impressed striae; 6.0-8.0mm **Helocombus**
- 57a. ELMIDAE — Legs very long (Fig. 37), mesofemora as long or longer than basal width of elytra; elytra never with longitudinal testaceous vittae 58
- 57b. Legs of normal size (Figs. 38-40), mesofemora less than 3/4 basal width of elytra; elytra often with longitudinal testaceous vittae 59
- 58a. Unicolorous dark brown; 2.7-3.7mm **Macronychus**
- 58b. Elytra with conspicuous orange markings (Fig. 37); 2.7-3.5mm **Ancyronyx**
- 59a. Dorsal surface of pronotum smooth, except for punctures; lateral margin of pronotum smooth (Fig. 38); elongate beetles (Fig. 38); 2.0-3.5mm **Dubiraphia**
- 59b. Dorsal surface of pronotum with basal carinae (Fig. 39) or scattered bumps, sulci, and carinae (Fig. 40); lateral margin of pronotum at least weakly serrated (Figs. 39, 40) ... 60
- 60a. Surface of pronotum smooth, except for punctures and basal carinae (Fig. 39); 1.7-3.5mm **Optioservus**
- 60b. Surface of pronotum rough, with bumps, sulci, and carinae (Fig. 40) 61
- 61a. Large, more than 2.5mm; tomentum absent; 2.7-4.2mm **Stenelmis**
- 61b. Small, less than 2.5mm; tomentum present (Fig. 41); 1.7-2.2mm **Microcylloepus**

KEY TO GENERA OF AQUATIC COLEOPTERA IN WISCONSIN (LARVAE)

- 1a. Each tarsus with 2 claws; legs 5-segmented 2
- 1b. Each tarsus with 1 claw; legs apparently 4-segmented (except Haliplidae) 4
- 2a. Abdomen with 4 conspicuous hooks on last segment; abdominal segments with at least 8 pairs of lateral filaments (Fig. 1) GYRINIDAE 9
- 2b. No hooks on last abdominal segment; if lateral abdominal filaments are present, there are only 6 pairs 3

- 3a. Posterior half of abdomen conspicuously narrowed (Fig. 2); legs and cerci often elongate DYTISCIDAE 13
- 3b. Posterior half of abdomen little narrowed (Fig. 3); legs and cerci short NOTERIDAE 12
- 4a. Legs distinctly 5-segmented; abdomen terminating in 1 or 2 long filaments (Fig. 4) HALIPLIDAE 10
- 4b. Legs apparently 4-segmented; abdomen not terminating in long filaments 5
- 5a. Mandibles large, readily visible from above (Fig. 5) HYDROPHILIDAE 34
- 5b. Mandibles not readily visible from above 6
- 6a. Antennae long, filiform, as long as head and thorax combined (Fig. 6) HELODIDAE 43
- 6b. Antennae much shorter than head and thorax combined 7
- 7a. Body oval and extremely flat (Fig. 7); head completely concealed from dorsal view PSEPHENIDAE 46
- 7b. Body elongate, round, or triangular in cross section; head exposed 8
- 8a. Body elongate and sclerotized, with a ventral movable operculum closing a caudal chamber containing gills (Fig. 8) ELMIDAE 47
- 8b. All terga rounded and pale; grub-like larvae with 2 spines on last abdominal segment (Fig. 9) CHRYSOMELIDAE, **Donacia**
- 9a. GYRINIDAE — Head narrowed posteriorly to form a distinct collar (Fig. 10) **Dineutus**
- 9b. Elongate head not narrowed posteriorly to form a collar (Fig. 11) **Gyrinus**
- 10a. HALIPLIDAE — Each body segment with 2 or more long, spinelike filaments, each half as long as body .. **Peltodytes**
- 10b. Spines on body segments less than length of a segment 11
- 11a. Third antennal segment 2-3 times as long as second **Haliphus**
- 11b. Third antennal segment shorter than second **Brychius**
- 12a. NOTERIDAE — Mandibles stout, bifid at tip; third antennal segment no longer than fourth **Suphisellus**
- 12b. Mandibles slender, not bifid at tip; third antennal segment at least twice as long as fourth **Hydrocanthus**
- 13a. DYTISCIDAE — Lateral gills on abdominal segments 1 to 6 **Coptotomus**
- 13b. No lateral gills on abdominal segments 14
- 14a. Head with a frontal projection (Fig. 12) 15
- 14b. Head without a frontal projection 20
- 15a. Cerci with secondary hairs (Fig. 13) **Deronectes, Oreodytes**
- 15b. Cerci with only primary hairs (Fig. 14) 16
- 16a. Cerci short, less than length of last abdominal segment 17
- 16b. Cerci distinctly longer than last abdominal segment ... 18
- 17a. Cerci very short, about 1/4 length of last abdominal segment **Laccornis**
- 17b. Cerci nearly as long as last abdominal segment; recurved tracheal trunks projecting past last segment (Fig. 15) **Celina**
- 18a. Frontal projection notched laterally (Figs. 16, 17) **Hygrotus, Hydroporus**
- 18b. Frontal projection without lateral notches (Fig. 12) ... 19
- 19a. Larva greatly widened in middle (Fig. 12) **Hydrovatus**
- 19b. Larva not greatly widened in middle; not more than 2.5mm long **Bidessonotus, Liodesus, Uvarus**
- 20a. Abdominal segments 7 and 8 with a lateral fringe of long swimming hairs 29
- 20b. Abdominal segments 7 and 8 without a lateral fringe of long swimming hairs 21
- 21a. Cerci extremely short, ventral, difficult to see (Fig. 18) ... **Agabetes**
- 21b. Cerci at least 1/4 length of last abdominal segment ... 22
- 22a. Pro- and mesothoracic legs chelate, with inner apex of tibiae formed into a long serrated process parallel to and as long as tarsi (Fig. 19) **Matus**
- 22b. Legs not chelate 23
- 23a. Cerci with only primary hairs, usually 7 in 2 whorls (Fig. 14) 24
- 23b. Cerci with numerous secondary hairs (Figs. 13, 25) 26

- 24a. Fourth antennal segment double, one half very short (Fig. 20); mandibles with an area of serrations on inner edge (Fig. 21) **Copelatus**
- 24b. Fourth antennal segment single; mandibles without serrations 25
- 25a. Lateral margin of head more or less compressed or keeled; spines on posterolateral margins of head usually on a line that would intersect or pass just below ocelli (Fig. 22) **Ilybius**
- 25b. Lateral margin of head not keeled; spines on posterolateral margins of head usually on a line that would pass well below ocelli (Fig. 23) **Agabus**
- 26a. Fourth antennal segment more than 2/3 length of third .. 27
- 26b. Fourth antennal segment less than 1/2 length of third .. 28
- 27a. Cerci with several short, spinelike, setae on outer edge (Fig. 24); head not more than 2.5mm wide **Rhantus**
- 27b. Cerci with at most 2 or 3 short setae (Fig. 25); head often about 3mm wide **Colymbetes**
- 28a. A row of spines on posterolateral margin of head; fourth antennal segment less than 1/4 as long as third; head less than 1.3mm wide **Laccophilus**
- 28b. No spines on posterolateral margin of head; fourth antennal segment about 1/3 as long as third **Agabus**
- 29a. Maxillary stipes at least 4 times as long as wide (Fig. 26) 30
- 29b. Maxillary stipes broad, not more than 3 times as long as wide (Fig. 27) 32
- 30a. Head with long teeth anteriorly; cerci absent **Cybister**
- 30b. Head without long teeth anteriorly; cerci present 31
- 31a. Cerci with lateral fringes; labium without projecting lobes ..
..... **Dytiscus**
- 31b. Cerci without lateral fringes; labium with 2 projecting lobes (Fig. 28) **Hydaticus**
- 32a. Ligula apically bifid (Fig. 29) **Acilius**
- 32b. Ligula simple (Fig. 30) 33
- 33a. Ligula nearly equal to or longer than first segment of labial palps (Fig. 30) **Graphoderus**
- 33b. Ligula not as long as first segment of labial palps
..... **Thermonectus**
- 34a. HYDROPHILIDAE — First 7 abdominal segments with long lateral gills, some 2-3 times width of a segment .. **Berosus**
- 34b. Lateral gills absent or shorter than width of a segment .. 35
- 35a. Nine complete abdominal segments, tenth reduced but distinct **Helophorus**
- 35b. Eight complete abdominal segments, 9 and 10 reduced and united 36
- 36a. Gula well-developed and attaining occipital opening; antennae arising farther forward than mandibles; sclerotized plates on abdominal segments **Hydrochus**
- 36b. Gula reduced and not attaining occipital opening; antennae not arising anterior to point of insertion of mandibles .. 37
- 37a. First antennal segment at least twice as long as next 2 together (Fig. 31); femora with fringes of long swimming hairs 41
- 37b. First antennal segment no more than slightly longer than following 2 segments (Fig. 32); femora without fringes of long swimming hairs 38
- 38a. Mandibles asymmetrical, the right with 2 teeth, the left with only 1; abdomen with prolegs on segments 3 to 7 **Enochrus**
- 38b. Mandibles symmetrical, each with 2 or 3 inner teeth; abdomen without prolegs 39
- 39a. Labroclypeus with more than 6 teeth, those on right not clearly defined **Cymbiodyta**
- 39b. Labroclypeus with 4 or 5 prominent teeth 40
- 40a. Middle tooth on labroclypeus smaller than others (Fig. 33); prosternum entire **Sperchopsis**
- 40b. All teeth of labroclypeus subequal (Fig. 34); prosternum with a mesal fracture **Hydrobius**
- 41a. Head subspherical; antennae 4-segmented; each mandible with a single inner tooth, which is larger and bifid on right mandible (Fig. 35) **Hydrophilus**
- 41b. Head subquadrangular, narrowed behind; antennae 3-segmented; each mandible with more than 1, usually 2, inner teeth 42
- 42a. Mentum with sides nearly straight (Fig. 36); lateral gills rudimentary tubular projections with several terminal setae **Tropisternus**
- 42b. Mentum with sides convergent basally (Fig. 37); lateral gills fairly well developed and pubescent **Hydrochara**
- 43a. HELODIDAE — Anterior margin of hypopharynx with a central cone bearing 1 pair of flat spines (Fig. 38); head with 3 ocelli on each side **Eldodes**
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- 44a. Sides of abdominal segments with setae similar to those on dorsum, although usually more numerous **Cyphon**
- 44b. Sides of abdominal segments 3-6 with a regular row of very short, flattened setae that differ markedly from setae on dorsum (Fig. 39) 45
- 45a. Anterior of labrum straight, with corners bent under to expose inner portion in dorsal view (Fig. 40) .. **Prionocyphon**
- 45b. Anterior of labrum simply emarginate (Fig. 41) **Scirtes**
- 46a. PSEPHENIDAE — Abdominal pleura separated from each other (Fig. 7); no gills on abdominal segments 2-6 **Ectopria**
- 46b. Abdominal pleura contiguous; gills on abdominal segments 2-6 **Psephenus**
- 47a. ELMIDAE — Prothorax with a posterior sternum (Fig. 42) 48
- 47b. Prothorax without a posterior sternum (Fig. 43) 50
- 48a. Posterolateral angles of anterior abdominal segments produced (Fig. 44) **Ancyronyx**
- 48b. Posterolateral angles of abdominal segments not produced 49
- 49a. Anterior margin of head with a distinct tooth on each side (Fig. 45) **Stenelmis**
- 49b. Anterior margin of head without a distinct tooth on each side **Microcylloepus**
- 50a. Last abdominal segment 5 times longer than wide
..... **Dubiraphia**
- 50b. Last abdominal segment less than 3 times as long as wide 51
- 51a. Mesopleuron divided (Fig. 46) **Macronychus**
- 51b. Mesopleuron undivided (Fig. 47) **Optioservus**
- Desmopachria, Neoscutopterus, Dibolocelus, Helocombus, and Pronoterus** not keyed.

**SPECIES LIKELY TO BE FOUND IN
WISCONSIN AND MOST RECENT
KEY TO SPECIES**

HALIPLIDAE

- Brychius** — *hungerfordi**
Haliphus — *apostolicus*, *blanchardi*, *borealis*, *canadensis*,
connexus, *cribrarius*, *fasciatus*, *immaculicollis*, *leopardus*,
longulus, *ohioensis**, *nitens**, *pantherinus*, *subguttatus*,
tripsis (Adult keys Wallis 1933a)
Peltodytes — *duodecimpunctatus*, *dunavani**, *edentulus*,
*lengi**, *litoralis**, *pedunculatus**, *sexmaculatus*, *tortulosus*
(Adult keys Roberts 1913, Descr. Young 1961)

DYTISCIDAE

- Acilius* — *fraternus*, *mediatus*, *semisulcatus*, *sylvanus*
(Adult keys Hilsenhoff 1975)
Agabetes — *acuductus*
Agabus — *aeruginosus**, *ambiguus*, *antennatus*, *anthracinus*,
bifarius, *canadensis*, *confinis*, *confusus*, *discolor**,
disintegratus, *erichsoni*, *erythropterus**, *gagates*, *leptapsis**,
*obtusatus**, *phaeopterus*, *punctatus*, *semipunctatus**,
semivittatus, *seriatus*, *subfuscatus**, *tristis**, *velox**
(Adult keys Fall 1922a, Leech 1938)
*Bidessonotus** — *inconspicuus**
Celina — *angustata*
Colymbetes — *longulus**, *seminger**, *sculptilis*
(Adult keys Hatch 1928)
Copelatus — *chevrolati**, *glyphicus* (Adult keys Young 1954)
Coptotomus — *interrogatus*
Cybister — *fimbriolatus*
Deronectes — *griseostriatus*, *depressus* (Adult keys Fall 1923,
Zimmerman and Smith manuscript)
Desmopachria — *convexa*
Dytiscus — *cordieri**, *dauricus*, *fasciventris*, *harrisii**, *hybridus*,
marginalis, *sublimatus**, *verticalis* (Adult keys Hatch 1928,
Wallis 1950)
Graphoderus — *fasciatocollis*, *liberus*, *occidentalis*, *perplexus*
(Adult key Wallis 1939a)
Hydaticus — *modestus*, *piceus* (Adult keys Blatchley 1910)
Hydroporus — *baldiellus**, *clypealis*, *columbianus**, *consimilis*,
dentellus, *despectus*, *dichrous*, *fuscipennis*, *glabriusculus*,
*hybridus**, *melanocephalus**, *mellitus*, *niger*, *notabilis*,
*obscurus**, *paugus*, *planiusculus*, *pulcher*, *rectus*, *semiflavus*,
signatus, *solitarius*, *somnus*, *spurius**, *stagnalis*,
*striatopunctatus**, *striola*, *superioris*, *tartaricus**, *tenebrosus*,
triangularis, *tristis*, *vitiosus**, *vittatipennis*, *vittatus*, *wickhami*
(Adult keys Fall 1923, Young 1953b)
Hydrovatus — *pustulatus*
Hygrotus — *acaroides*, *canadensis**, *compar*, *dissimilis*, *farctus*,
impressopunctatus, *infuscatus**, *laccophilinus*, *nubilus*,
*patruelis**, *sayi*, *suturalis**, *turbidus*
(Adult keys Fall 1919, Anderson 1971, manuscript)
Ilybius — *ater**, *augustior**, *biguttulus*, *confusus**, *denikei*,
*fraterculus**, *ignarus**, *laramaeus*, *pleuriticus*, *subaeneus*
(Adult keys Wallis 1939b)
Laccophilus — *biguttatus*, *fasciatus**, *maculosus*, *proximus*,
*undatus** (Adult key Zimmerman 1970)
Laccornis — *conoideus*, *deltoides**, *difformis**
(Adult key Fall 1923)
Liodessus — *affinis*, *flavicollis*, *fuscatus* (Adult Key 1954)
Matus — *bicarinatus**, *ovatus* (Adult key Young 1953a)
*Neoscutopterus** — *angustus**
Oreodytes — *laevis**, *scitulus* (Adult key Hatch 1933)
Rhantus — *binotatus*, *consimilis*, *frontalis**, *sinuatus****,
*suturellus**, *wallisi* (Adult keys Hatch 1928, Wallis 1933b,
Zimmerman and Smith 1975)
Thermonectus — *basillaris*, *ornaticollis*
(Adult key Blatchley 1910)
Uvarus — *granarius*, *lacustris* (Adult key Young 1954)

NOTERIDAE

- Hydrocanthus** — *iricolor**
*Pronotus** — *semipunctatus**
Suphisellus — *puncticollis*

GYRINIDAE

- Dineutus* — *assimilis*, *discolor*, *hornii*, *nigrior*
(Adult key Hatch 1929)
Gyrinus — *aeneolus*, *affinis*, *analis*, *aquiris*, *bifarius*, *confinis*,
dichrous, *frosti*, *hatchi**, *impressicollis*, *latilimbus*, *lecontei*,
lugens, *maculiventris*, *marginellus*, *minutus*, *parcus*,
pectoralis, *piceolus**, *pugionis*, *ventralis*, *wallisi*
(Adult key Fall 1922b, Descr. Wallis 1926a, 1926b)

HYDROPHILIDAE

- Anacaena* — *limbata*
Berosus — *aculeatus**, *fraternus**, *infuscatus**, *ordinatus**,
*peregrinus**, *pugnax*, *striatus**
(Adult keys Wooldridge 1967, Matta 1974)
*Chaetarthria** — *pallida**
Crenitis — *digestus*, *longulus** (Adult key Willson 1967)
Cymbiodyta — *acuminata*, *blanchardi*, *chamberlaini**, *minima*,
semistriata, *toddi*, *vindicata* (Adult key Smetana 1974)
*Dibolocelus** — *ovatus**
Enochrus — *blatchleyi**, *cinctus*, *collinus*, *consors*, *consortus*,
diffusus, *hamiltoni*, *ochraceus*, *perplexus*, *pygmaeus*, *sayi*
(Adult key Gunderson manuscript)
Helocombus — *bifidus*
Helophorus — *lacustris**, *linearis**, *lineatus**, *nitidulus**,
*oblongus**, *tuberculatus**
Hydrobius — *fuscipes*, *melaenus*, *tumidus**
(Adult key Wooldridge 1967)
Hydrochara — *obtusata*
Hydrochus — *brevitarsus**, *currani*, *granulatus*, *neosimplex* _
(manuscript name — Hellman), *pseudosquamifer*, *rutipes*,
scabratus, *setosus**, *squamifer*, *subcupreus*
(Adult key Hellman manuscript)
Hydrophilus — *triangularis*
Laccobius — *agilis*, *arenarius**, *minutoides**, *spangleri**
(Adult key Willson 1967, Cheary manuscript)
Paracymus — *confluens**, *despectus**, *subcupreus*
(Adult key Wooldridge 1966)
Sperchopsis — *tesselatus*
Tropisternus — *blatchleyi*, *columbianus*, *ellipticus*, *glaber*,
lateralis, *mixtus*, *natator* (Adult key Spangler 1960)

HYDRAENIDAE (Adult key Blatchley 1910)

- Hydraena* — *pennsylvanica**
Ochthebius — *cribricollis**, *foveicollis**, *nitidus**, *putnamensis**

PSEPHENIDAE

- Ectopria* — *nervosa*
Psephenus — *herricki*

ELMIDAE

- Ancyronyx* — *variegata*
Dubiraphia — *bivittata*, *minima*, *quadrinotata*, *robusta*, *vittata*
(Adult key Hilsenhoff 1973)
Macronychus — *glabratus*
Microcylloepus — *pusillus*
Optioservus — *fastiditus*, *trivittatus* (Adult key Brown 1972)
Stenelmis — *bicarinata*, *concinna*, *crenata*, *decorata*,
douglasensis, *markelli*, *musgravei*, *quadrimaculata*,
sandersoni, *vittipennis*, + several undescribed
(Adult key Brown 1972)

DRYOPIDAE (Adult key Brown 1972)

- Helichus* — *lithophilus*, *striatus*

HELODIDAE (No larval key)

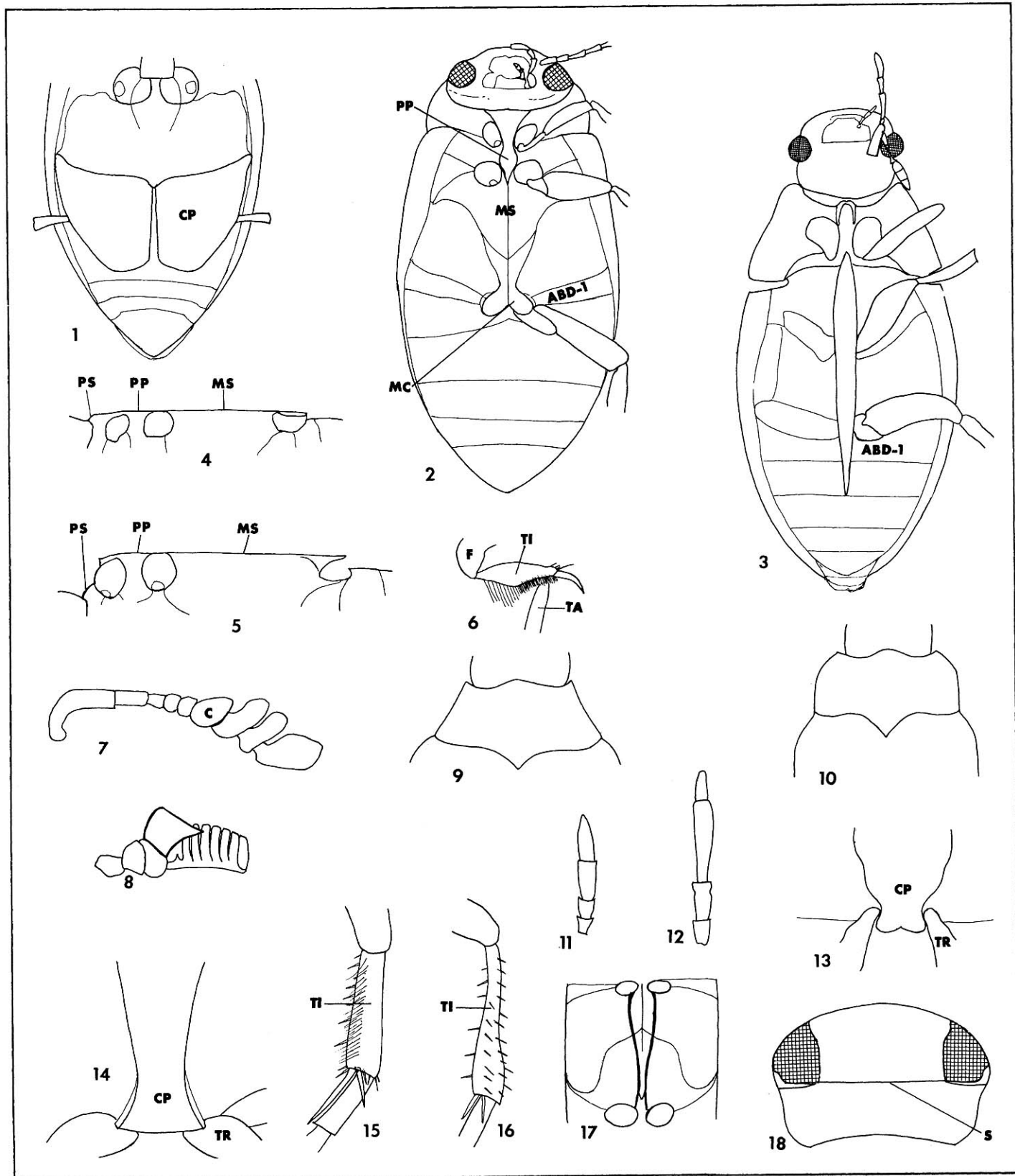
- Cyphon* — *aliceae**, *alvahi*, *americanus**, *collaris*, *craigi*,
*diffusus**, *elutus*, *modestus*, *nebulosus*, *obscurus*, *punctatus*,
*perplexus**, *pusillus*, *shenefelti*, *variabilis*
Elodes — *fuscipennis*, *pulchella*, *thoracica*
Prionocyphon — *discoideus**, *limbatus**
Scirtes — *orbiculatus*, *tibialis*

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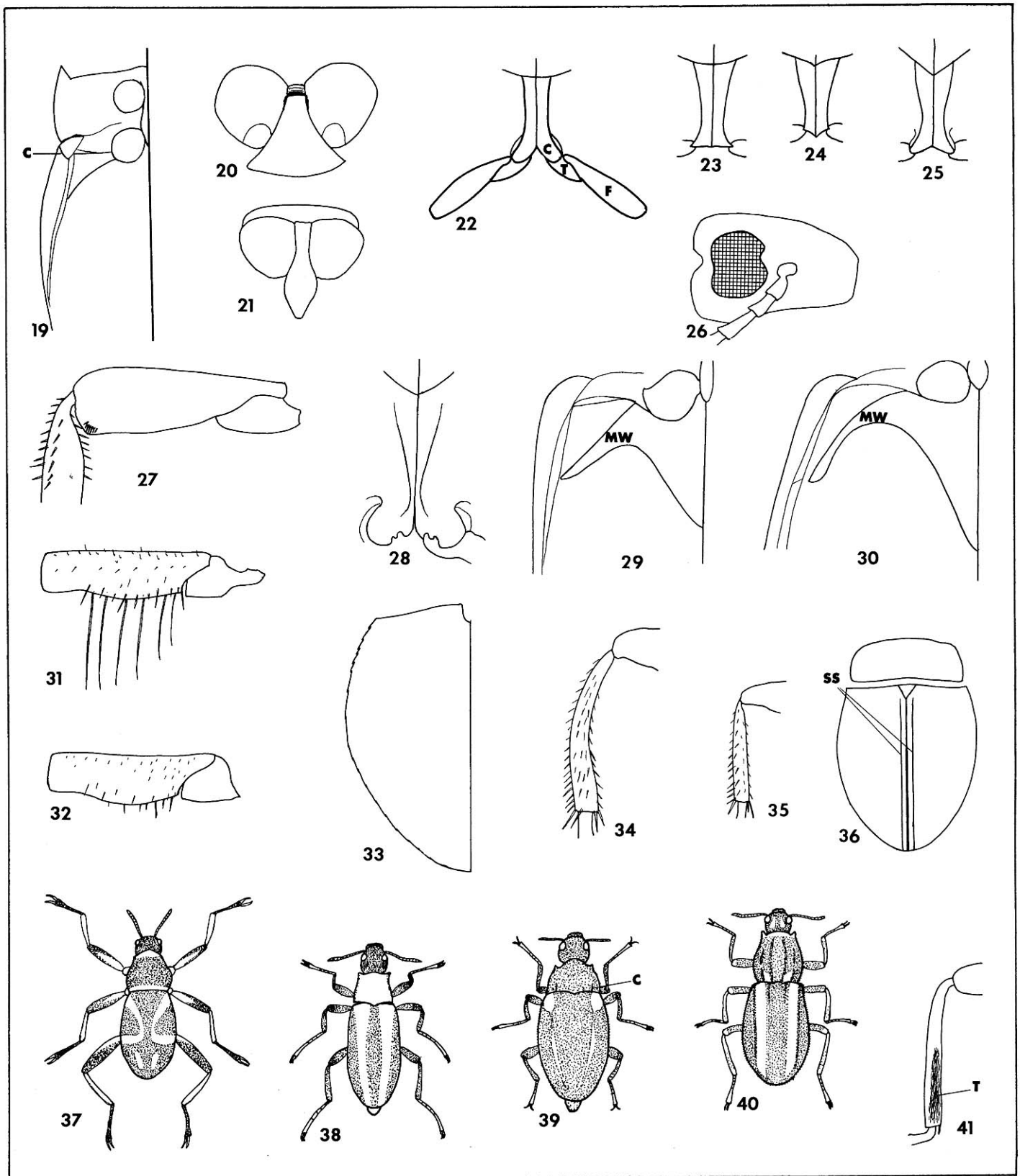
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- Anderson, R. D., School of Sciences, Southern Utah State College, Cedar City, Utah 84720 — *Hygrotus*
- Cheary, B. S., Union Carbide Corp., P.O. Box 1906, Salinas, California 93901 — *Laccobius*
- Gunderson, R., Department of Biological Sciences, St. Cloud State College, St. Cloud, Minnesota 56301 — *Enochrus*
- Hellman, J. L., Department of Entomology, University of Maryland, College Park, Maryland 20742 — *Hydrochus*
- Zimmerman, J. R. and A. H. Smith, Department of Biology, Box 3 AF, Las Cruces, New Mexico 88003 — *Deronectes*



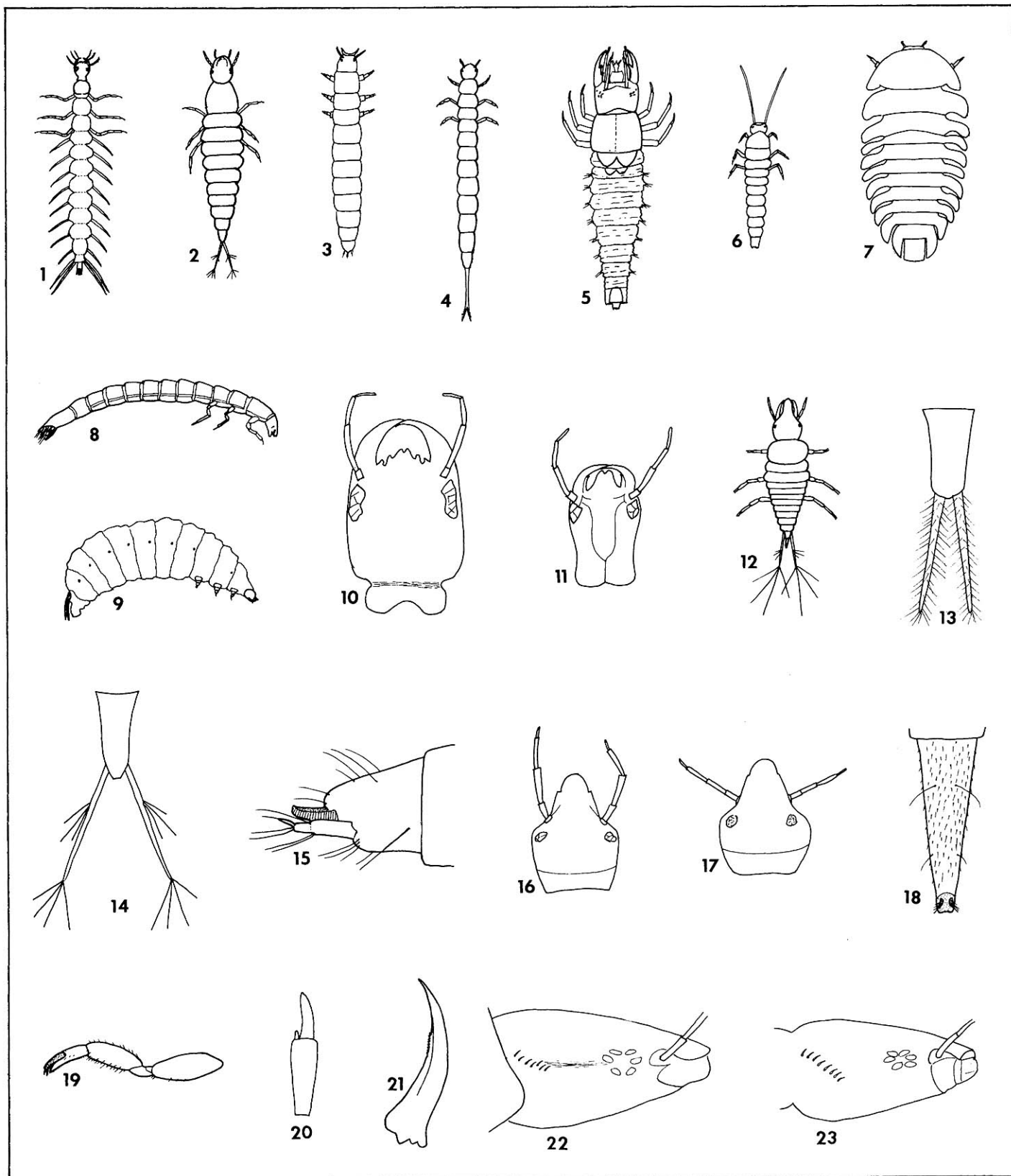
Figures 1-18. — Coleoptera adults. 1. Ventral view of posterior of *Halipilus* showing coxal plates (CP). 2. Ventral view of *Agabus* showing prosternal process (PP), first abdominal segment (ABD-1), metacoxal process (MC), and metasternum (MS). 3. Ventral view of *Tropisternus* showing first abdominal segment (ABD-1). 4. Lateral view of thoracic sterna of *Agabus* (ventral side up) showing prosternum (PS), its postcoxal process (PP), and mesosternum (MS). 5. Lateral view of thoracic sterna of *Hydroporus* showing prosternum (PS), its postcoxal process (PP), and mesosternum (MS). 6. Profemur (F), tibia (TI), and tarsus (TA) of

Hydrocanthus. 7. Antenna of *Tropisternus* showing cupule (C). 8. Antenna of *Helichus*. 9. Pronotum of *Halipilus*. 10. Pronotum of *Brychius*. 11. Maxillary palp of *Peltodytes*. 12. Maxillary palp of *Halipilus*. 13. Metacoxal process (PC) and trochanters (TR) of *Desmopachria*. 14. Metacoxal process (CP) and trochanters (TR) of *Hydroporus*. 15. Metatibia (TI) of *Desmopachria*. 16. Metatibia (TI) of *Liodessus*. 17. Meso- and metasternum of *Bidessonotus*. 18. Dorsal view of head of *Liodessus* showing transverse suture (S).



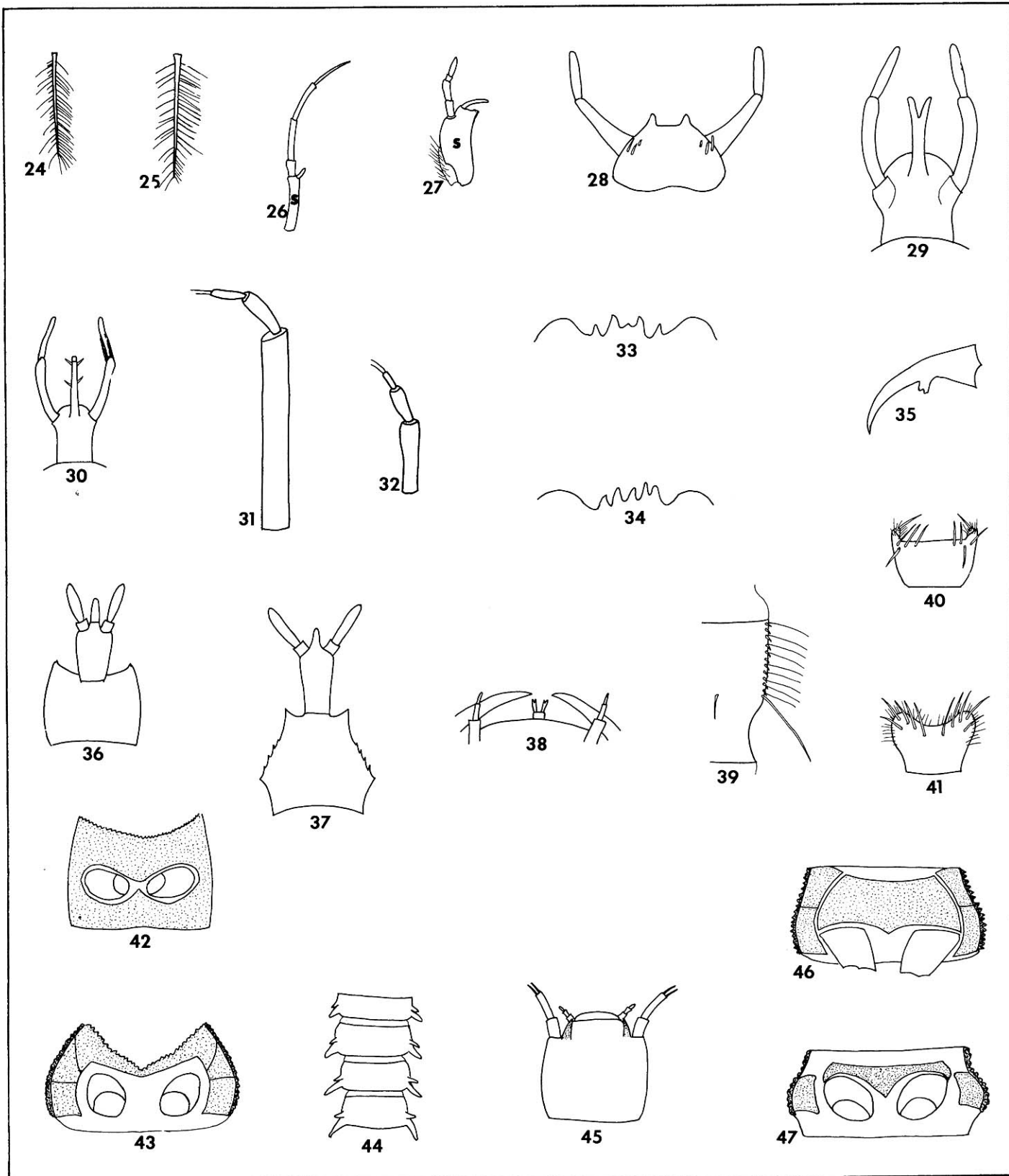
Figures 19-41. — Coleoptera adults. 19. Ventral view of meso- and metathorax of *Hygrotus* showing carina (C). 20. Procoxae and prosternal process of *Hydrovatus*. 21. Procoxae and prosternal process of *Hygrotus*. 22. Metacoxal lobes (C), trochanters (T), and femora (F) of *Laccornis*. 23 and 24. Metacoxal processes of *Hydroporus*. 25. Metacoxal process of *Deronectes*. 26. Lateral view of head of *Agabus*. 27. Ventral view of metafemur of *Agabus*. 28. Metacoxal plates of *Copelatus*. 29. Metasternum of

Hydaticus showing metasternal wing (MW). 30. Metasternum of *Acilius* showing metasternal wing (MW). 31. Mesofemur of *Thermonectus*. 32. Mesofemur of *Graphoderus*. 33. Elytron of *Sperchopsis*. 34. Metatibia of *Laccobius*. 35. Metatibia of *Anacaena*. 36. Elytra of *Anacaena* showing sutural striae (SS). 37. Dorsal view of *Ancyronyx*. 38. Dorsal view of *Dubiraphia*. 39. Dorsal view of *Optioservus* showing basal carina (C). 40. Dorsal view of *Stenelmis*. 41. Protibia of *Optioservus* showing tomentum (T).



Figures 1-23. — Coleoptera larvae. 1. Dorsal view of *Gyrimus*. 2. Dorsal view of *Agabus*. 3. Dorsal view of *Pronoterus*. 4. Dorsal view of *Haliphus*. 5. Dorsal view of *Tropisternus*. 6. Dorsal view of *Scirtes*. 7. Dorsal view of *Ectopria*. 8. Lateral view of *Stenelmis*. 9. Lateral view of *Donacia*. 10. Dorsal view of head of *Dineutus*. 11. Dorsal view of head of *Gyrimus*. 12. Dorsal view of *Hydrovatus*. 13. Last abdominal segment and cerci of *Laccophilus*. 14. Last abdominal segment and cerci of *Agabus*. 15. Lateral view of

last abdominal segment and cerci of *Celina* (after Spangler 1973). 16 and 17. Dorsal view of heads of *Hygrotus*. 18. Ventral view of last abdominal segment of *Agabates* (after Spangler and Gordon 1973). 19. Prothoracic leg of *Matus* (after Spangler and Gordon 1973). 20. Last two antennal segments of *Copelatus* (after Spangler 1962). 21. Mandible of *Copelatus* (after Spangler 1962). 22. Lateral view of head of *Ilybius*. 23. Lateral view of head of *Agabus*.



Figures 24-47. — Coleoptera larvae. 24. Cercus of *Rhantus*. 25. Cercus of *Colymbetes*. 26. Ventral view of right maxilla of *Dytiscus* showing stipes (S). 27. Ventral view of right maxilla of *Acilius* showing stipes (S). 28. Labium of *Hydaticus*. 29. Labium of *Acilius*. 30. Labium of *Graphoderus*. 31. Antenna of *Tropisternus*. 32. Antenna of *Hydrobius*. 33. Anterior margin of fronto-clypeus of *Sperchopsis*. 34. Anterior margin of fronto-clypeus of *Hydrobius*. 35. Dorsal view of right mandible of *Hydrophilus*. 36.

Labium of *Tropisternus*. 37. Labium of *Hydrochara*. 38. Ventral view of anterior margin of head of *Elodes*. 39. Lateral margin of sixth abdominal tergum of *Scirtes*. 40. Dorsal view of labrum of *Prionocyphon*. 41. Dorsal view of labrum of *Scirtes*. 42. Prosternum of *Stenelmis*. 43. Prosternum of *Optioservus*. 44. Dorsal view of abdominal segments 2-5 of *Ancryonyx*. 45. Dorsal view of head of *Stenelmis*. 46. Mesosternum and mesopleura of *Macronychus*. 47. Mesosternum and mesopleura of *Optioservus*.