INSECT FAMILIES COMMON UNDER BARK IN ALBERTA

– ANNOTATED CHECK LIST AND KEYS

by

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INTRODUCTION

The purpose of this report is to assist field personnel of the Canadian Forestry Service in recognizing and identifying the insect families commonly found under the bark of trees and logs. Field keys that utilize only those characters readily discernible with a 10-power hand lens are devised. Illustrations are provided for each family that has been collected in or adjacent to Alberta by the field staff or by myself. The annotated check list includes notes on distribution, biology, and description of adults and larvae. Usually the keys and illustrations treat only those stages of the life cycle that occur under the bark. A glossary of descriptive terms is included.

Lack of suitable material has prevented the inclusion of a complete treatment of all the common families, but a list of families not included is provided. Incidental inhabitants, such as ants and ground beetles, are also not included; also, bark beetle adults are not keyed to genus and species (for field identification of bark beetles see D. S. Kusch, 1967). Hymenopterous parasites are grouped under one heading, with no

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attempt made to differentiate these to family, or even to superfamily. Nevertheless, in view of the urgent need by our field staff for a report like this, it was decided to present the available information now. When unidentifiable material is collected in quantity, a revision of the report is likely.

The key used differs slightly from most keys. In addition to the number in front of the key-couplet, the key used here has a number(s) in parentheses, which is the number that gives rise to the couplet under consideration. The number in the parentheses enables one to work backwards through the key to confirm an identification, or when an obvious "dead end" is reached, enables one to retrace his steps to where the error was made, instead of starting again at the beginning.

MATERIALS AND METHODS

The keys in this publication are original and are generally based on specimens collected in Alberta. Biological information for the annotated check list was gleaned from literature and supplemented by my observations. The photographic illustrations were produced at the Calgary Forest Research Laboratory, while the drawn figures were taken from the literature and modified to suit our special requirements. Definitions of terms in the glossary were mainly from Torre-Bueno (A glossary of Entomology, 1950, Brooklyn Entomological Society, Brooklyn, N.Y.).

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ARTIFICIAL KEY TO THE COMMON INSECT FAMILIES FOUND UNDER BARK

Key 1

1. Wings present, often a hard elytra ..... (nymphs and adult insects) 2

   Wings absent ..... (mostly immature insects) 4

2(1). Wings a hardened elytra of uniform texture meeting in a straight line down the back; chewing mouth parts (Beetles) ..... (adult Coleoptera) Key 2 (page 11)

   Wings with base hardened, tip membranous and overlapping; sucking mouth parts, a distinct beak (True Bugs) ..... (adult Hemiptera) 3

3(2). Abdomen very flat, expanded, extending beyond wings; sluggish insects (Fig. 28) (Flat Bugs) ..... Aradidae

   Abdomen not greatly flattened, not extending beyond wings; fast-running insects (Fig. 27) (Flower Bugs) .... Anthocoridae

4(1). Thoracic legs present, sometimes very small 5

Thoracic legs absent ..... (larvae and pupae) Key 3 (page 16)

5(4). Tiny adult grey insects (1-2 mm);
capable of jumping when disturbed
(Entomobryidae) ..... Collembola

Larger immature insects; not
capable of jumping 6

6(5). Abdominal prolegs present ..... (Lepidoptera larvae) 7

Abdominal prolegs absent,
at most with a projection on
the last abdominal segment 8

7(6). Large caterpillars (40-75 mm);
boring in xylem; most abdominal
segments with 4 dark dots (Carpen-
terworm, Prionoxystus robiniae) ..... Cossidae

Smaller larvae (20-40 mm);
tunneling in bark and phloem, or
in pitch exudate; dark dots on
abdominal segments absent (Pine
Pitch Moth, Vespemima sequoiae) ..... Aegeriidae

8(6). Sucking mouth parts, a distinct
beak present (nymphs) ..... (Hemiptera) 9

Chewing mouthparts, beak absent;
a distinct larva (larvae) ..... (Coleoptera) 10

9(8). Color a bright orange red,
sometimes a shining black;
not greatly flattened; fast
runners (Fig. 27) (Flower Bugs) ..... Anthocoridae

Color a dull brown; greatly
flattened; very sluggish
(Fig. 28) (Flat Bugs) ..... Aradidae

10(8). Terminal abdominal segment with
an appendage (urogomphus); appendage
may be either sclerotized and unmovable, or
segmented and movable, or dorsal or
ventral 14

Terminal abdominal segment without
any appendage (urogomphus) of any kind 11

11(10). Mandibles with tips pointing outward,
not meeting normally at midline
(Fig. 51) (False Click Beetles) ..... Melasidae

Mandibles pointing inward, meeting
normally at middle 12

12(11). Most abdominal segments with
distinct protuberances (called
ampullae) ventrally and dorsally 13

Abdominal segments normal, without
distinct protuberances (Fig. 55)
(Wrinkled Bark Beetles) ..... Rhysodidae

13(12). Thoracic legs shorter than
width of head (Fig. 31) (Round-
headed Wood Borers) ..... Cerambycidae

Thoracic legs long, subequal to
width of head (Fig. 50)

(Melandryid Bark Beetles) ..... Melandryidae

14(10). Urogomphi sclerotized, unsegmented,
unmovable, often upturned 17

Urogomphi not sclerotized,
each composed of 2 or 3 segments,
movable, usually not upturned 15

15(14). Mouth parts short, not visible
from above; body with scattered
long hairs, some hairs longer than
one abdominal segment (Fig. 56)
(Shining Fungus Beetles).....Scaphidiidae

Mouth parts long, easily visible
from above; body at most with short
scattered hairs, all hairs shorter
than one abdominal segment 16

16(15). Terminal abdominal segment with
ventrally projecting process,
process often used in walking;
legs long, usually longer than width
of insect (Figs. 38, 39, 40) (Rove Beetles) ..... Staphylinidae

Terminal abdominal segment without
ventrally projecting process; legs
short, shorter than width of insect
(Fig. 49) (Hister Beetles) ..... Histeridae

17(14). Antennae as long as or longer
than width of head 18

Antennae shorter than width of head 19

18(17). Venter of terminal abdominal segment with crescent-shaped row of spines (Fire Colored Beetles) ..... Pyrochroidae

Venter of terminal abdominal segment without crescent-shaped row of spines (Figs. 33, 34) (Flat Bark Beetles) ..... Cucujidae

19(17). Venter of terminal segment with crescent-shaped row of spines (Figs. 36, 37) (Flat Bark Borers) ..... Pythidae

Venter of terminal abdominal segment without crescent-shaped row of spines 20

20(19). Four sclerotized areas (spots) on thoracic segments in addition to pronotal plate 21

Distinct sclerotized areas on thoracic segments absent, pronotal plate may be present 22

21(20). Color pink or whitish, each abdominal segment with a transverse groove; hairs short, less than one-half width of body (Figs. 32, 46, 47) (Checkered Beetles) ..... Cleridae

Color whitish, each abdominal segment without transverse groove (but other transverse markings may be

present); hairs long, almost
as long as width of body (Figs. 52, 53)
(Ostomid Beetles) ..... Ostomidae

22(20). Most abdominal segments with distinct
protuberances (called ampullae)
ventrally and dorsally 23

Abdominal segments without
distinct protuberances 24

23(22). Legs short, distinctly shorter than
width of head (Fig. 31)
(Round-headed Wood Borers) ..... Cerambycidae

Legs long, subequal in length
to width of head (Fig. 50)
(Melandryid Bark Beetles) ..... Melandryidae

24(22). Texture of larvae tough, horny,
or leathery; usually yellow,
brown to dark brown 25

Texture of larvae never horny,
usually soft-bodied; white to
yellowish 26

25(24). Urogomphi two upturned spines
(occasionally absent); texture
of larvae leathery; pale yellow
(False Wire Worms) ..... Tenebrionidae

Urogomphi usually branched,
arising from a dorsal plate,

or dorsal plate without spines;
leathery and often horny; deep
yellow, brown to dark brown (Fig. 35)
(Wire Worms) .....Elateridae

26(24). Urogomphi upturned curved spines 27
Urogomphi straight, usually
branched (Fig. 54) (Root-eating Beetles) ..... Rhizophagidae

27(26). Some abdominal segments with
weakly sclerotized plates dorsally
(Fig. 50) (Melandryid Bark
Beetles) ..... Melandryidae
Abdominal segments without
sclerotized plates 28

28(27). Urogomphi a single pair of pointed
spines; predaceous on bark
beetle larvae (Fig. 48)
(Cylindrical Bark Beetle) ..... Colydiidae
Urogomphi in two pairs, often
branched; saprophagous, present
after bark beetles have left
(Sap-feeding Beetles) ..... Nitidulidae

Key 2

Artificial Key to the Adult Coleoptera Commonly Found Under Bark

1. Elytra truncate, leaving at least one abdominal segment exposed 2

Elytra entire, tips normally rounded, no abdominal segments exposed 6

2(1). Elytra very short, leaving 3 to 6 abdominal segments exposed; insect very elongate and slender (Figs. 22, 23) (Rove Beetles) ..... Staphylinidae

Elytra not excessively shortened, at most 1 to 2 abdominal segments exposed 3

3(2). Last abdominal segment conical; small shiny round beetles; fast runners (Fig. 21) (Shining Fungus Beetles) ..... Scaphidiidae

Last abdominal segment not conical 4

4(3). Elytra with four distinct yellow-brown markings (Fig. 14) (Sap-feeding Beetles) ..... Nitidulidae

Elytra uniform in color 5

5(4). Shiny black beetles, roundly rectangular; antennae geniculate (Fig. 64); often feigns death (Fig. 10) (Hister Beetles) ..... Histeridae

Elongate beetles, at most with faint sheen, brown to black; antennae

straight (Fig. 19) (Root-eating Beetles) ..... Rhizophagidae

6(1). Pronotum bright-orange, yellow or red; elytra bluish-black (Fig. 9) (Pleasing Fungus Beetles) ..... Erotylidae

Pronotum same color as elytra, never bright orange 7

7(6). Head prolonged into a distinct snout (Fig. 6) (Weevils) ..... Curculionidae

Head normal, not prolonged into a snout 8

8(7). Hind angles of pronotum prolonged into distinct backward-pointing spines (Fig. 8) (Click Beetles) ..... Elateridae

Hind angles of pronotum not prolonged into a spine 9

9(8). Elytra with two colors or more 10

Elytra uniformly colored 12

10(9). Antennae distinctly capitate (Fig. 61); body flat and oval in shape; pronotum expanded; elytra mottled grey, brown and white (Sap-feeding Beetles) ..... Nitidulidae

Antennae clavate (Fig. 62) 11

11(10). Pronotum narrow, narrower than

elytra at base, pronotum rounded
and without lateral margin;
abdominal segments often red (Fig. 1)
(Checkered Beetles) ..... Cleridae

Pronotum wide, as wide as elytra
at base, pronotum with lateral
margin (Fig. 13) (Hairy Fungus Beetles) ..... Mycetophagidae

12(9). Pronotum with 2 longitudinal
depressions on each side of middle;
larger insects (12-20 mm)
(Fig. 18) (Flat Bark Borers) ..... Pythidae

Pronotum variously sculptured,
but without two longitudinal
depressions; small to large insects 13

13(12). Small (1-3 mm) round beetles,
shiny, usually black; fast runners;
many capable of feigning death by
rolling up into an imperfect ball
(Fig. 11) (Round Fungus Beetles) ..... Leiodidae

Elongate beetles, small to large
(one larger Ostomidae is rounded) 14

14(13). Pronotum and elytra with distinct
deep longitudinal grooves;
antennae moniliform (Fig. 65);
very elongate and narrow beetles
(Fig. 20) (Wrinkled Bark Beetles) ..... Rhysodidae

Pronotum and elytra at most shallowly grooved, usually not grooved; antennae not moniliform; not excessively elongated beetles 15

15(14). Antennae distinctly capitate (Fig. 61) 16

Antennae filiform or clavate (Figs. 62, 63) 18

16(15). Larger beetles (7-15 mm), brown to black; head and pronotum large (Figs. 15, 16, 17) (Ostomid Beetles) ..... Ostomidae

Smaller insects (2-6 mm); pronotum and head not noticeably large 17

17(16). Stout, cylindrical beetles; tibia broad and with large spines (Bark Beetles) ..... Scolytidae

Elongate, flattened beetles; tibia without large spines (Figs. 2, 3) (Cylindrical Bark Beetles) ..... Colydiidae

18(15). Antennae distinctly clavate, usually last 5 to 6 segments enlarged 19

Antennae filiform (or nearly so), no segments distinctly larger than any adjacent segment 20

19(18). More or less elongate, parallel-
sided beetles; elytra without
pubescence; tarsal formula 5:5:4
(Figs. 24, 25, 26) (Darkling Beetles) ..... Tenebrionidae

Oval, flattened beetles; elytra with
distinct pubescence; tarsal formula
4:4:4 or 3:4:4 (Fig. 13)
(Hairy Fungus Beetles) ..... Mycetophagidae

20(18). Very flat beetles, elongate and
parallel-sided; antennae long,
often reaching middle of elytra;
tarsal formula 5:5:5 (Figs. 4, 5)
(Flat Bark Beetles) ..... Cucujidae

Elongate beetles, not greatly
flattened; antennae shorter,
reaching only base of elytra;
elytra often pubescent; tarsal
formula 5:5:4 (Fig. 12)
(Melandryid Bark Beetles) ..... Melandryidae

Key 3

Artificial Key to the Legless Larvae Under Bark

1. Larvae 3

Pupae in cocoons or puparia 2

2(1). Egg-shaped or nearly so; puparia hard and brittle; segmentation lines often present ..... Diptera

Sausage-shaped or shaped like a sardine can; cocoon soft; segmentation lines absent (Fig. 45) ..... Parasitic Hymenoptera

3(1). Distinct sclerotized head capsule present and visible from above (sometimes small and partially drawn into prothorax 4

Head capsule absent, or not visible from above 12

4(3). Abdomen with a distinct terminal spine; pronotum humped (Fig. 57) (Horntails) ..... Siricidae

Abdomen without terminal spine; pronotum normal 5

5(4). Head capsule an elongated cone 6

Head capsule not elongated into a cone 7

6(5). Thorax and last abdominal segment with dark brown sclerites: abdomen white (Fig. 44) ..... Xylophagidae

Thorax and last abdominal segment equally as sclerotized as abdomen, each abdominal segment with transverse row of short stout setae (Fig. 41) (Soldier Flies) ..... Stratiomyidae

7(5). Pronotum with one or two sclerotized plates; abdomen white 8

Pronotum not sclerotized, or not more sclerotized than rest of body 9

8(7). Pronotum with sclerotized plates, both dorsally and ventrally, pronotum flattened and much wider than abdomen (Figs. 29, 30) (Flat-headed Wood Borers) ..... Buprestidae

Pronotum with sclerotized plate dorsally only, pronotum not flattened and not much wider than abdomen (Fig. 31) (Round-headed Wood Borers) ..... Cerambycidae

9(7). Larvae C-shaped; headcapsule brown 10

Larvae not C-shaped; more or
less straight; head capsule
brown, dark brown or black 11

10(9). Larvae in broods, arising from
a distinct egg gallery (sometimes
feeding together in a common "cave",
Dendroctonus valens) (Bark Beetles) ..... Scolytidae

Larvae in aggregates, each in a
meandering mine; characteristic
pupal cells in the wood (Fig. 7)
(Weevils) ..... Curculionidae

11(9). Abdomen terminating in several
fleshy projections; larvae dirty white,
yellow or grey (Fig. 43)
(Crane Flies) ..... Tipulidae

Abdomen not terminating in several
fleshy projections; larvae white
(Fungus Flies) ..... Mycetophilidae

12(3). Larvae distinctly carrot-shaped 16

Larvae variable, not carrot-shaped 13

13(12). Abdomen terminating in a tubular
spiracle (Fig. 42)
(Bee-flies) ..... Syrphidae

Abdomen terminating in normal
rounded lobes 14

14(13). Meso- and metathorax with black spatula-shaped structure; larvae white, or often pink or yellow (Fig. 58) (Gall Midges) ..... Cecidomyiidae

Meso- and metathorax without black spatula-shaped structure; larvae white 15

15(14). Larvae small (5-8 mm), parallel-sided; abdomen with small ventral pseudopods; predators of bark beetles (Meditera spp.) (Fig. 59) (Long-legged Flies) ..... Dolichopodidae

Larvae small to large, spindle-shaped (tapering towards each end); head capsule present but drawn into prothorax; parasites of bark beetles and wood borers (Braconidae, Ichneumonidae, Chalcidoidea) ..... Parasitic Hymenoptera

16(12). Abdominal segments with ventral swellings for movement; capable of "jumping" when disturbed .... Clusiidae

Abdominal segments without ventral swellings or swellings very reduced; not capable of "jumping" when disturbed 17

17(16). Terminal spiracles placed near dorsal margin of last abdominal segment; predators of bark beetles (Fig. 60) ..... Lonchaeidae

Terminal spiracles placed near centre of last abdominal segment; saprophagous ..... Otitidae

ANNOTATED CHECK LIST OF FAMILIES

COLEOPTERA

Buprestidae

Biology: Buprestids are wood borers as larvae and may feed on foliage or fungi as adults. Larvae may be found in freshly cut logs, dying trees, and also in rotten wood. Some species mine the inner bark, a few species tunnel the outer bark of living trees or cause gall-formation on shrubs. A few are leaf miners.

Adult: Medium to large insects, elongate and oval, often depressed. Usually with a distinct bronze metallic sheen, sometimes black or bright metallic green.

Larva (Figs. 29, 30): Cream to nearly white, legless. Prothorax greatly enlarged and flattened with well developed sclerotized subequal plates on ventral and dorsal surface. The genus Agrilus (Fig. 30) has a terminal pair of sclerotized forcep-like structures on the last abdominal segment.

Distribution: Throughout Alberta in all tree species and many shrubs.

Cerambycidae

Biology: Larvae of Alberta species are wood feeders. They are found within trunks, branches, twigs and roots. Usually they are phloem feeders in the early larval stages, boring into wood as mature larvae. A few species feed

exclusively on phloem. Adults of many species feed on the twigs of their host, while others feed on nectar and pollen of flowers.

Adult: Medium to large, elongated and cylindrical insects with antennae usually long, sometimes longer than the length of the body. Distinct broad tarsi, with spongy pads. Tarsal formula appearing as 4:4:4.

Larva (Fig. 31): Near white, body thick, robust, fleshy and cylindrical. Thorax wider than the head or abdomen, prothorax with a sclerotized place dorsally (none ventrally). Legless or legs small and reduced.

Distribution: Throughout Alberta in all tree species, a few species in shrubs.

Cleridae

Biology: All bark-inhabiting species are generally predaceous on other insects, especially bark beetles and their broods. The larvae follow bark beetle tunnels to reach their prey. Adults are found on the outside of the tree and prey on adult bark beetles as they attack the host.

Adult (Fig. 1): Head prominent, wider than prothorax. Elytral pubescence with contrasting colors often in a checker pattern. Abdominal segments often red.

Larva (Figs. 32, 46, 47): White or pink to red, body with short hairs. Legs and urogomphi present. Prothorax with a heavily sclerotized plate dorsally; mesothorax and metathorax each have 2 small sclerotized plates dorsally. Abdominal segments with a transverse depression. Urogomphi

upturned arising from a sclerotized plate. Very similar to ostomid larvae.

Distribution: Throughout Alberta, principally in conifers. Some adults may be found feeding on flowers.

Colydiidae

Biology: Adults and larvae are predaceous on small soft-bodied insects. They are found in bark beetle and wood borer galleries.

Adult (Figs. 2, 3): Small, 2-4 mm in length, slender and elongate in shape; reddish brown to nearly black. Antennae clubbed, inserted under a distinct frontal ridge. Pronotum sometimes with serrated border (Lasconotus spp.). Elytra covering abdomen and not truncate. Tarsal formula 4:4:4.

Larva (Fig. 48): Dirty white, 3-5 mm in length. Legs and sclerotized urogomphi present. Head narrower than prothorax.

Distribution: Throughout Alberta, mostly in conifers.

Cucujidae

Biology: Adults of some species are predaceous on bark beetles or other soft-bodied insects and mites; other species apparently are scavengers. Larvae are general predators.

Adult (Figs. 4, 5): Elongate, very flat; usually brown. One large species, common under the bark of aspen, is bright red (Fig. 5). Elytra entire, covering abdomen. Antennae long, slender, filiform. Tarsal formula 5:5:5.

Larva (Figs. 33, 34): Pale yellow-brown; distinctly flattened, sides subparallel, integument tough and shiny. Head wider than prothorax. Antennae comparatively long (longer thanone-half the width of head). Urogomphi present and upturned; curved row of spines absent on venter of last segment.

Distribution: Throughout Alberta, mostly in conifers, one large red species common in aspen.

Curculionidae (*Pissodes* spp.)

Biology: The larvae are gregarious and are phloem feeders of dead and dying trees. Pupal cells are constructed in the outer portion of the sapwood and covered with tightly packed frass (Fig. 7 damage).

Adult (Fig. 6): Head prolonged into long slender snout. Antennae geniculate, inserted on the snout. Mottled grey-brown with white markings.

Larva: Cream to near white; with a C-shaped, cylindrical body. Legs absent. Appearance very close to bark beetle larvae.

Distribution: Throughout Alberta in conifers.

Elateridae

Biology: The adults produce clicking sounds while flipping into the air after being placed on their backs. Adults occur on flowers, leaves and beneath the bark. Most larvae feed on decaying matter.

Adult (Fig. 8): Elongate, tapering posteriorly; brown to black. Pronotum with hind angles pointed. The underside of the prothorax has a slender spine.

Larva (Fig. 35): Yellow, reddish-brown or darker; body elongate, cylindrical and heavily sclerotized. Legs short. End of last segment round, flat, and generally with upturned urogomphi.

Distribution: Throughout Alberta in all tree species and shrubs.

Erotylidae

Biology: Adults and larvae feed on fungi under the bark. The adults hibernate gregariously under the bark. Adults are often attracted to sap in spring.

Adult (Fig. 9): 3.5-5 mm in length, compact rectangular beetle. Black with reddish-yellow pronotum.

Larva: Pale white to pale brown; body spindle-shaped and subparallel. Urogomphi long. Central area of each segment is heavily sclerotized and bears a stout spiny, tubular process; process may be branched.

Distribution: Along the mountains in most conifers.

Histeridae

Biology: General predators on soft-bodied insects and mites. One small species is known to cause considerable mortality of bark beetle eggs.

Adult (Fig. 10): 1-4 mm in length, flat, roundly rectangular; shiny black.

Antennae capitate, and geniculate. Legs short with tibia broad and spiny. Elytra truncate, leaving last abdominal segment or two exposed. Many feign death when disturbed.

Larva (Fig. 49): Pale yellow or near white; body elongate, subcylindrical, slightly flat. Prothorax distinctly sclerotized and pigmented. Urogomphi present, not sclerotized, two segmented and movable. Larva sluggish and soft-bodied.

Distribution: Throughout Alberta in all tree species.

Leiodidae

Biology: Adults and larvae feed on fungi, especially slime molds. Some species occur in bark beetle galleries.

Adult (Fig. 11): Small-sized, 1-3 mm in length, highly convex; shiny, brown to black in color. Pronotum expanded, much broader than head. Fast running insects but many species "play possum" and roll into a "ball" when disturbed.

Larva: White, minute, up to 5 mm in length, body flattened. Last abdominal segment with a short peg-like proleg. Two segmented urogomphi present.

Distribution: Throughout Alberta in conifers.

Melandryidae

Biology: Larvae and adults are found under the bark and in dead wood, often in proximity to fungi. Some are carnivorous and others feed on decaying

plant material. The larvae of one species is predaceous on wood borer larvae and greatly resemble cerambycid larvae.

Adult (Fig. 12): Small to medium elongate beetles of various forms; chestnut brown or dark in color. Pronotum as wide as base of elytra. Tarsal formula 5:5:4.

Larva (Fig. 50): Pale yellow to white; body elongate, fleshy and cylindrical. Pro-thorax longer than meso- or metathorax. Urogomphi usually present and curved, sometimes absent.

Distribution: Throughout Alberta in coniferous and deciduous trees.

Melasidae

Biology: The larvae are found in decayed wood, under bark or sometimes in newly dead trees. The larvae of wood boring species characteristically bore across the grain.

Adult: Moderate, 3-15 mm in length, elongate; brown to black. Antennae filiform. Resemble elaterids in having the pronotum with hind angles pointed, but differ in that the clicking sound is less pronounced.

Larva (Fig. 51): Near white; body elongate, subcylindrical with an enlarged prothorax. Head distinctly depressed with mandibles pointing outward. Urogomphi and legs absent.

Distribution: Throughout Alberta in most tree species.

Mycetophagidae

Biology: Adults and larvae feed exclusively on fungi, and are found in

shell fungi, under bark and in rotting wood.

Adult (Fig. 13): Small, 2-4 mm in length, obovate, broad and flat. Brown to dark black, sometimes with orange or reddish markings. Antennae clavate. Elytra entire, densely pubescent. Tarsal formula 4:4:4 or 3:4:4.

Larva: Light brown; body elongate, subcylindrical, slightly depressed. Urogomphi present and curved upward.

Distribution: Throughout Alberta in most tree species.

Nitidulidae

Biology: Adults and larvae generally are vegetable feeders; feeding on dead, decaying or fermenting plant or animal matter. Larvae of a few species are recorded to be predaceous on bark beetles. Larvae are found in old galleries of buprestids, cerambycids and bark beetles.

Adult (Fig. 14): Small and flat beetles with clubbed antennae. Two distinct forms are common under bark: rectangular, elytra shiny black with 4 yellow-brown markings, elytra truncate leaving one abdominal segment exposed; oval, pronotum and elytra expanded, mottled grey, brown and white, elytra entire, covering abdomen.

Larva: Near white; body elongate, flat cylindrical, rather fleshy and slightly sclerotized. Urogomphi in two pairs, often branched. Proleg present on last abdominal segment.

Distribution: Throughout Alberta in all trees and many shrubs.

Ostomidae

Biology: The larvae are predators, commonly found under bark and in galleries of wood-boring insects. The adults are predaceous on adult bark beetles outside the tree.

Adult (Figs. 15, 16, 17): Brown, blue, green or black; body elongate and flat, or oval and flat. Head and pronotum distinctly large. Sometimes there is a distinct constriction between thorax and base of elytra.

Larva (Figs. 52, 53): White, body elongate, flat and cylindrical, with long hairs. Prothorax with a heavily sclerotized plate dorsally. Meso- and metathorax each have 2 small sclerotized plates dorsally. Abdominal segments without transverse depression. Urogomphi dark brown. Very similar to clerid larvae.

Distribution: Throughout Alberta mostly in conifers.

Pyrochroidae

Biology: The adults are found on flowers and shrubs. The larvae are found under bark of coniferous and deciduous trees. The larvae are general predators under bark.

Adult: Black with bright reddish or yellowish pronotum. Large eyes, antennae serrated or branched. The head narrows abruptly behind eyes to form a slender neck. Elytra broader than abdomen.

Larva: Dirty white or yellow; body elongate, flat, heavily sclerotized

and parallel-sided. Head flat, sclerotized, lightly pigmented and subequal in width to prothorax. Ring of spines on venter of last abdominal segment. Urogomphi present and deeply pigmented. Similar to pythid larvae.

Distribution: Throughout Alberta in all tree species and shrubs.

Pythidae

Biology: Adults and larvae are general predators and are usually found in old bark beetle galleries. The pupal cell is constructed between the bark and the wood, consisting of a ring of tightly packed frass.

Adult (Fig. 18): Large beetles, 12-20 mm in length, partially flattened; brown to black. Pronotum with two longitudinal depressions.

Larva (Figs. 36, 37): Near white to yellow; body elongate, parallel-sided and flat. Urogomphi short, curved upward with tooth-like spine on the inner margin. Ring of spines present on venter of last abdominal segment.

Distribution: Throughout Alberta in conifers.

Rhizophagidae

Biology: Adults and larvae are predaceous on soft-bodied mites and insects and are found in recently dead trees and logs.

Adult (Fig. 19): Flat, elongate, 1.5-3 mm in length; shiny brown to black. Head flattened, with clubbed antennae. Elytra truncate, leaving one or more abdominal segments exposed.

Larva (Fig. 54): White, cream to pale yellow; minute, soft-bodied without sclerotized plates. Urogomphi straight, not curved upward, and unmovable.

Distribution: Throughout Alberta mostly in conifers.

Rhysodidae

Biology: Adults and larvae are found under bark of moist, decaying logs. The larvae are said to be predaceous. The adults often hibernate in groups under the bark.

Adult (Fig. 20): Very elongate, narrow, and cylindrical; dark reddish brown. Antennae moniliform. Pronotum with a deep longitudinal groove. Elytra with deep longitudinal grooves and ridges.

Larva (Fig. 55): White, body cylindrical, soft-bodied and fleshy. Urogomphi absent. Thoracic legs 5-segmented, each leg terminating in 2 claws.

Distribution: Along the mountains in the south-west corner of Alberta in conifers.

Scaphidiidae

Biology: Adults and larvae are associated with fungi. They are found in moist materials such as rotten wood, beneath dead leaves, and under bark of logs and stumps. The adults sometimes remain motionless when disturbed, at other times move off at considerable speed.

Adult (Fig. 21): Small, shiny and convex, with body tapering at both ends;

black or brown. Elytra bearing rows of punctures, truncate and exposing the last abdominal segment, which is conical and pointed.

Larva (Fig. 56): Yellow-brown, soft-bodied, wedge-shaped and with a small head. Urogomphi present and movable. Body with long scattered hairs.

Distribution: Throughout Alberta mostly in conifers.

Scolytidae[1]

Biology: The larvae and adults are strictly bark or fungi feeders and are found in living, dying or dead woody trees and shrubs.

Adult: Small, 1-6 mm in length, stout to moderately elongate, cylindrical with a geniculate clubbed antennae; brown to black. Head withdrawn into prothorax. Tarsal formula appearing as 4:4:4.

Larva: White, body C-shaped, cylindrical and fleshy. Head sclerotized and pigmented. Urogomphi absent.

Distribution: Throughout Alberta in all tree species.

Staphylinidae

Biology: Adults and larvae are common in decaying plant material. The biology of those occurring under bark is not definitely known. One genus seems to be saprophagous while the others are probably predaceous on soft-bodied insects and mites.

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[1] For identification see D. S. Kusch, "An annotated check list of the common bark beetles found in Alberta with a field key to genera". Information Report A-X-8, Forest Research Laboratory, Calgary, Alberta.

Adult (Figs. 22, 23): Medium-sized, very elongate, slender, sides parallel; black, brown, reddish, sometimes with red spots only. Elytra very short exposing 3 to 6 abdominal segments. The adults when alarmed run rapidly for shelter, sometimes holding the tip of the abdomen up and forward over their backs.

Larva (Figs. 38, 39, 40): White to yellow-brown; 3-15 mm in length, body elongate, slender, tapering toward posterior end. Urogomphi present, movable and segmented. Characteristic peg-like proleg on last abdominal segment.

Distribution: Throughout Alberta in all trees and shrubs.

Tenebrionidae

Biology: Adults and larvae feed on decaying plant material. Those found in logs are general scavengers in bark beetle tunnels, feeding on decaying phloem, on decaying wood or on dead insects. Many nocturnal adults hide under bark during the day.

Adult (Figs. 24, 25, 26): Small to large, highly variable in general appearance; brown or black. No macroscopic distinguishing characters. Elytra entire, often parallel-sided, eyes notched by antennal insertion. Tarsal formula 5:5:4.

Larva: Mostly creamy-white; body elongate, slender, more or less cylindrical. Integument often horny and tough. Head almost spherical. Last abdominal segment with dark, unsegmented, fixed urogomphi, usually upturned.

Distribution: Throughout Alberta in all tree species and shrubs.

Agromyzidae

Biology: The adults are plant feeders and have a wide range of hosts. The larvae of many species are leaf miners, others cambium miners. Most of the larval attacks occur near the base of the tree. In Eastern Canada, mines of one species cause a lumber defect known as "pitch-ray flecks". This injury is sometimes serious enough to degrade the quality of lumber.

Adult: Small-sized, black or yellow. Head longer than wide; abdomen flat.

Larva: Near white, 4-5 mm in length. Cylindrical and somewhat carrot-shaped.

Distribution: Throughout Alberta in deciduous trees.

Cecidomyiidae

Biology: Most species are leaf miners or gall makers. The larvae of some species are found on dead vegetation, under moist bark or in sap of living trees. Larvae are scavengers.

Adult: Small delicate flies with broad wings.

Larva (Fig. 58): Near white to cream, yellow, orange, or pink to red; small, 2-4 mm in length, spindle-shaped and smooth-skinned with a small, lightly sclerotized head. Mesothorax with a distinct "breast bone".

Small cone-shaped sclerotized plate on the prothoracic segment.

Distribution: Throughout Alberta in most tree species.

Chironomidae

Biology: Adults, known as midges, are weak fliers. They form swarms in evenings. Most larvae are aquatic, a few live under bark, in decaying vegetation, and in sap of wounded trees. Terrestrial larvae are scavengers.

Adult: Small, slender-bodied with a large thorax and slender legs. Resemble adult mosquito.

Larva: White or blue; body elongate, cylindrical and worm-like. Body often with a dorsal tuft of hairs on the last segment. Prolegs absent but with a pair of soft foot-like appendages on the prothorax.

Distribution: Throughout Alberta in most tree species.

Clusiidae

Biology: Adults and larvae are scavengers. The larvae live under bark of trees and in decaying wood. The adults are found in moist places and in proximity to decaying wood. The larvae are able to jump when disturbed.

Adult: Small, slender flies with a large head; wings with black or brown markings.

Larva: White; body slender, cylindrical, carrot-shaped with indistinct segmentation. Small mouth-hooks visible. Abdomen with transverse ventral swellings for locomotion.

Distribution: Throughout Alberta in most tree species.

Dolichopodidae

Biology: Adults are found near moist places. The larvae and adults are general predators. The larvae are found in decaying vegetation and under bark of trees. The larvae of one species are predaceous on bark beetles and wood-boring larvae.

Adult: Small, with a slender tapering body; often with metallic green or blue sheen. Commonly called "long-legged flies".

Larva (Fig. 59): Cream to grey-white; body parallel-sided and pointed on each end. Front of head with a small brown, oval sclerotized plate; prothorax with a small crescent-shaped sclerotized plate. Last abdominal segment with deep transverse groove.

Distribution: Throughout Alberta in most conifer species.

Lonchaeidae

Biology: The larvae of most species are scavengers but a few are predators. The larvae that are predaceous attack bark beetles and other bark-inhabiting insects. The adults prefer moist, shady places.

Adult: Small oval flies, with a flat abdomen; metallic black. Females with a long triangular ovipositor.

Larva (Fig. 60): Creamy white; body carrot-shaped. Head and prothorax not sclerotized. Transverse ventral swellings present. Terminal spiracles

placed near dorsal margin of last abdominal segment.

Distribution: Throughout Alberta in most tree species.

Mycetophilidae

Biology: Adults are found in moist places, about decaying wood and fungi. The larvae live in mushrooms, under bark of moist decayed trees, and in any juicy decaying plant material.

Adult: Moderately small, rather delicate, slender flies with a small rounded or somewhat elongated head; wings large. Basal segment (coxa) of the leg unusually long and characteristic. Similar to mosquitoes.

Larva: Opaque white with a small shiny black head; body very elongate and narrow. Legs absent.

Distribution: Throughout Alberta in most tree species.

Otitidae

Biology: Adults and larvae are found in moist places. The larvae can be found under bark of trees and within decaying material. The adults frequent meadows. Both adults and larvae are saprophagous.

Adult: Small to medium, with brown, black or yellow markings on wings.

Larva: Near white to cream; moderate, 6-10 mm in length, distinctly carrot-shaped. Terminal spiracles placed near center of last abdominal segment.

Distribution: Throughout Alberta in most tree species.

Rhagionidae

Biology: Adults and larvae are general predators. The larvae are predaceous on other insect larvae and on soft-bodied invertebrates. Many species are aquatic, the larvae of some live under bark, in decaying wood, in burrows of wood-boring insects, and in tree stumps. The adults are found near moist places, on decayed logs, and often on bark beetle trees where they prey on incoming bark beetles.

Adult: Small to medium, almost hairless with a long and tapering body, and rather long legs.

Larva: White; body cylindrical, parallel-sided and tapering anteriorly. Head with a sclerotized plate. Abdomen often terminating in four short pointed processes.

Distribution: Throughout Alberta in most tree species.

Stratiomyidae

Biology: Species that are found under bark feed on decaying phloem tissue. They prefer very moist or wet areas under the bark. They are usually found in aggregations.

Adult: Small to moderately large, with head short and usually wider than thorax; antennae prominent, held in front of head to form a "Y". Called "soldier flies" because of conspicuous markings.

Larva (Fig. 41): Dirty white to deep brown; 4-15 mm in length, body

cylindrical. Head inconspicuous and prolegs absent. Each segment with short or long setae dorsally. Integument horny and tough. Will "play possum" and often be discarded as dead.

Distribution: Throughout Alberta in all tree species, more common in hardwoods.

Syrphidae

Biology: Most adults are nectar and pollen feeders and are found almost anywhere. Some larvae are found under bark and in wet decayed logs. These larvae are saprophagous.

Adult: Small to large, with large wings. Many species resemble bees or wasps.

Larva (Fig. 42); Creamy white; body thick, fleshy and often wrinkled. Abdomen often terminating in a tubular spiracle. Mouth parts black and conspicuous, mandibles sometimes widely separated.

Distribution: Throughout Alberta in most tree species and shrubs.

Tipulidae

Biology: The larvae generally are aquatic, a few feed on decaying wood and roots of plants. The adults are found near moist places. The larvae are commonly called "leather jackets".

Adult: Slender, elongate body with a distinct "V" on the thorax, with long fragile legs. Commonly called "crane flies" or "mosquito hawks".

Larva (Fig. 43): Dirty white, yellow, grey to muddy brown or near black; body cylindrical or somewhat flattened, wrinkled, with a soft exoskeleton. Last abdominal segment with a distinct "star-shaped" projection consisting of several fleshy lobes.

Distribution: Throughout Alberta in most tree species.

Xylophagidae

Biology: The larvae are found under bark of dead trees and are predators of bark beetles and other insect larvae. The adults are found near decaying wood and near moist locations.

Adult: Similar to rhagionids.

Larva (Fig. 44): Creamy white; body somewhat carrot-shaped. Head capsule black and cone-shaped. Prothorax and mesothorax tapering and heavily sclerotized. Last abdominal segment with a sclerotized plate.

Distribution: Throughout Alberta in most conifers.

Hymenopterous Parasites

Biology: Numerous species of many families are included under this heading. Larger species lay their eggs from the outside of the bark, while smaller species enter the galleries to find a host before laying eggs. Most have one-year life cycles.

Adult: With four membranous wings and generally with a long slender abdomen. Many species are black or bluish. Several common species around recently felled logs have red abdomens.

Larva: Internal parasites are variable in shape. External parasites are spindle-shaped, with white head capsules which are usually withdrawn into the prothorax.

Pupa (Fig. 45): Enclosed in cocoons. Most commonly, cocoons are shaped like a wiener or like an oval sardine can.

Distribution: Throughout Alberta in all tree species.

Siricidae

Biology: The larvae are wood borers, attacking dying deciduous and coniferous trees. Round larval mines are tightly packed with granular frass. Pupation occurs within the burrows of the larvae, in a thin parchment-like cocoon.

Adult: Long cylindrical body, with head, thorax and abdomen of equal width.

Black or metallic blue or combination of black, red and yellow. Females with long ovipositors and sheaths. Both sexes with distinct sharp spine on tip of abdomen.

Larva (Fig. 57): Near white; large, 20-30 mm in length, cylindrical with a circular light-colored head. Prothorax humped and prolegs absent. The larvae are deeply segmented with a single terminal abdominal spine.

Distribution: Throughout Alberta in most tree species. One species is abundant in firs, while another common species feeds in birch.

LEPIDOPTERA

Aegeriidae

Biology: Larvae are wood borers attacking crowns, stems, trunks or roots of living trees. They are usually associated with wounds. They feed on phloem, causing the tree to exude fairly large amounts of pitch. The adults are swift, strong fliers, fly during the day, and feed on flowers.

Adult: Moderate-sized, stout-bodied with wings generally free of scales; yellow and black in color. Forewings and hindwings are narrow and transparent with hind-wings broader. Greatly resemble wasps and are often mistaken for them.

Larva: Near white; large, 20-35 mm in length. Typical caterpillar, with prolegs on most abdominal segments.

Distribution: In lodgepole pine in British Columbia very close to the Alberta border.

Cossidae

Biology: The adults are nocturnal fliers, and deposit their eggs on the bark of trees. The larvae bore into the wood making large meandering galleries, often causing serious injury.

Adult: Large, stout-bodied moths with grey, brown and white mottled wings. The larger female with smoky-colored hind wings, is easily distinguished from the smaller male with orange hind wings.

Larva: Reddish-white with a brown head; large, 40-80 mm in length. A distinct caterpillar with prolegs.

Distribution: In poplars in southern Alberta.

Anthocoridae

Biology: The adults are found on and under the bark while the nymphs generally are under the bark. Both adults and nymphs are general predators on insect eggs and small larvae; characteristically fast runners.

Adult: Small, 2-4 mm in length; shining black with pale yellow elytra, other species are shining black or black with dark brown elytra.

Nymph (Fig. 27): Bright red or shiny black; resemble adults.

Distribution: Throughout Alberta in most tree species.

Aradidae

Biology: Adults and nymphs are found under bark or in narrow crevices in wood or felled logs. The adults and nymphs are gregarious and feed on fungi.

Adult (Fig. 28): Moderate-sized, 7-10 mm in length, body oval and greatly flattened; dark brown or black. Head longer than it is wide and longer than prothorax, with a distinct beak. Abdomen wider than wings.

Nymph: Dull dark brown; resemble adults.

Distribution: Throughout Alberta in most conifers.

LIST OF INSECT FAMILIES

Coleoptera

	Latin Name	Common Name
1.	Buprestidae	Metallic or flat-headed wood borers
2.	Cerambycidae	Long-horned or rounded-headed wood borers
3.	Cleridae	Checkered beetles
4.	Colydiidae	Cylindrical bark beetles
5.	Cucujidae	Flat bark beetles
6.	Curculionidae	Curculios or weevils
7.	Elateridae	Click beetles
8.	Erotylidae	Pleasing fungus beetles
9.	Histeridae	Hister beetles
10.	Leiodidae	Round fungus beetle
11.	Melandryidae	Melandryid bark beetles
12.	Melasidae	False click beetles
13.	Mycetophagidae	Hairy fungus beetles
14.	Nitidulidae	Sap-feeding beetles
15.	Ostomidae	Ostomid or bark gnawing beetles
16.	Pyrochroidae	Fire colored beetles
17.	Pythidae	Flat bark borers
18.	Rhizophagidae	Root-eating beetles
19.	Rhysodidae	Wrinkled bark beetles
20.	Scaphidiidae	Shining fungus beetles
21.	Scolytidae	Bark beetles

	Latin Name	Common Name
22.	Staphylinidae	Rove or short-winged beetles
23.	Tenebrionidae	Darkling beetles

Diptera

1.	Agromyzidae	Cambium miners
2.	Cecidomyiidae	Gall midges
3.	Chironomidae	Midges
4.	Clusiidae	(no common name)
5.	Dolichopodidae	Long-legged flies
6.	Lonchaeidae	(no common name)
7.	Mycetophilidae	Fungus gnats
8.	Otitidae	Picture-winged flies
9.	Rhagionidae	Snipe flies
10.	Stratiomyidae	Soldier flies
11.	Syrphidae	Hover, bee or flower flies
12.	Tipulidae	Crane flies
13.	Xylophagidae	(no common name)

Hymenoptera

1.	(Many Families)	Parasites
2.	Siricidae	Horn-tailed wasps

Lepidoptera

Latin Name	Common Name
1. Aegeriidae	Clearwing moths
2. Cossidae	Carpenterworms

Hemiptera

1. Anthocoridae	Flower bugs
2. Aradidae	Flat bugs

LIST OF INSECT FAMILIES NOT INCLUDED

THAT MAY BE FOUND UNDER BARK

Coleoptera

	Latin Name	Common Name
1.	Cephaloidae	False long-horned beetles
2.	Cryptophagidae	Cryptophagid beetle
3.	Lathridiidae	Minute ground scavenger beetles
4.	Lycidae	Net-winged beetles
5.	Oedemeridae	Oedemerid beetles
6.	Orthoperidae	Minute fungus beetles
7.	Pselaphidae	Short-winged mold beetles
8.	Ptiliidae	Feather-winged beetles
9.	Scydmaenidae	Ant-like stone beetles
10.	Throscidae	Throscid beetles

Diptera

1.	Anthomyiidae	(no common name)
2.	Bibionidae	March flies
3.	Ceratopogonidae	Biting Midges
4.	Coenomyiidae	(no common name)
5.	Empidae	Dance flies
6.	Mydaidae	Mydas flies
7.	Sarcophagidae	Flesh flies
8.	Sciaridae	Dark-winged fungus gnats

GLOSSARY

Ampulla -- A blister or blister-like structure on the surface.

Capitate -- The abrupt enlarging at tip of antenna.

Clavate -- The gradual thickening of antenna toward tip.

Dorsal -- The upper surface of the body.

Elytra -- The anterior hardened wings of beetles.

Entire -- Pertaining to an even unbroken margin, or normally rounded and not shortened.

Exudate -- Any discharge from the body pores or openings.

Exude -- To ooze or flow through minute openings.

Filiform -- Thread-like joints, cylindrical in shape.

Frass -- Solid insect excrement.

Fusiform -- Spindle-shaped, broad in middle, tapering towards each end.

Geniculate -- Knee-jointed.

Gregarious -- Living in societies or communities, but not social.

Integument -- The outer covering or cuticle of the insect body.

Macroscopic -- Something that can be seen by the naked eye.

Mesothorax -- The second thoracic segment which bears the middle legs and anterior wings of adults.

Metathorax -- The third thoracic segment which bears the hind legs and second pair of wings of adults.

Moniliform -- Beaded, like a necklace.

Mottled -- Marked with spots or streaks of different colors.

Obovate -- Inversely egg-shaped.

consists of 4 segments).

Tarsus -- The divided appendage attached to the apex of the tibia; a foot.

Tibia -- The fourth division of the leg, articulated at the proximal end to the femur and bearing on the distal end the tarsus.

Transverse -- Running across at right angles to the length of the insect; from side to side.

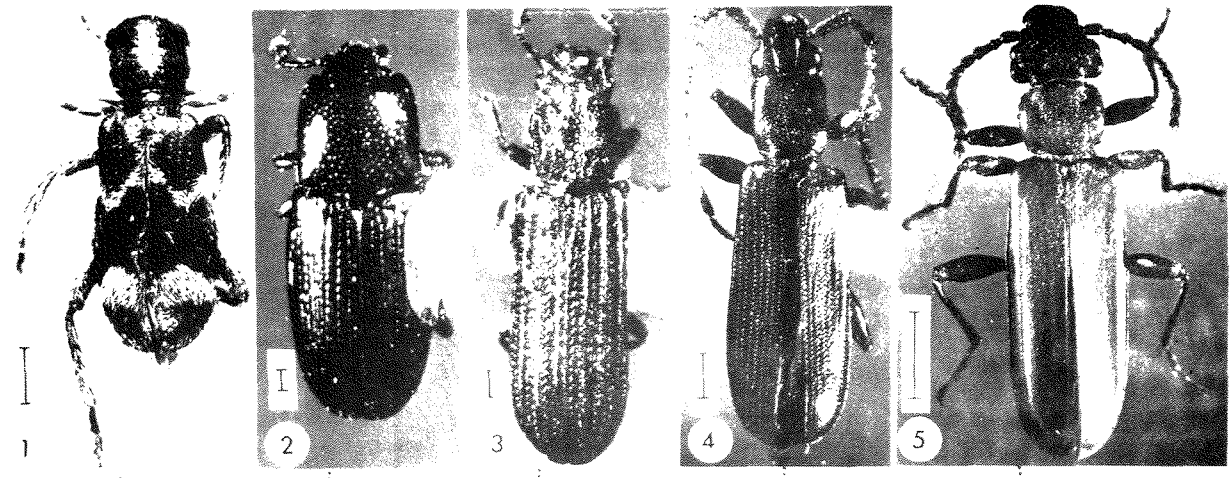
Truncate -- Cut off squarely at tip.

Urogomphus (pl. urogomphi) -- A fixed or mobile process found dorsally on the terminal segments of certain larvae.

Venter -- The undersurface of the body.

LIST OF FIGURES
(Scale: line represents actual size)

Hymenopterous Parasite	Figure 45	Cocoon
Leiodidae	Figure 11	Adult
Lonchaeidae	Figure 60	Larva
Melandryidae	Figure 12	Adult
Melandryidae	Figure 50	Larva
Melasidae	Figure 51	Larva
Moniliform	Figure 65	Antenna
Mycetophagidae	Figure 13	Adult
Nitidulidae	Figure 14	Adult
Ostomidae	Figures 15, 16, 17	Adult
Ostomidae	Figures 52, 53	Larva
Pythidae	Figure 18	Adult
Pythidae	Figures 36, 37	Larva
Rhizophagidae	Figure 19	Adult
Rhizophagidae	Figure 54	Larva
Rhysodidae	Figure 20	Adult
Rhysodidae	Figure 55	Larva
Scaphidiidae	Figure 21	Adult
Scaphidiidae	Figure 56	Larva
Siricidae	Figure 57	Larva
Staphylinidae	Figures 22, 23	Adult
Staphylinidae	Figures 38, 39, 40	Larva
Stratiomyidae	Figure 41	Larva
Syrphidae	Figure 42	Larva
Tenebrionidae	Figures 24, 25, 26	Adult
Tipulidae	Figure 43	Larva
Xylophagidae	Figure 44	Larva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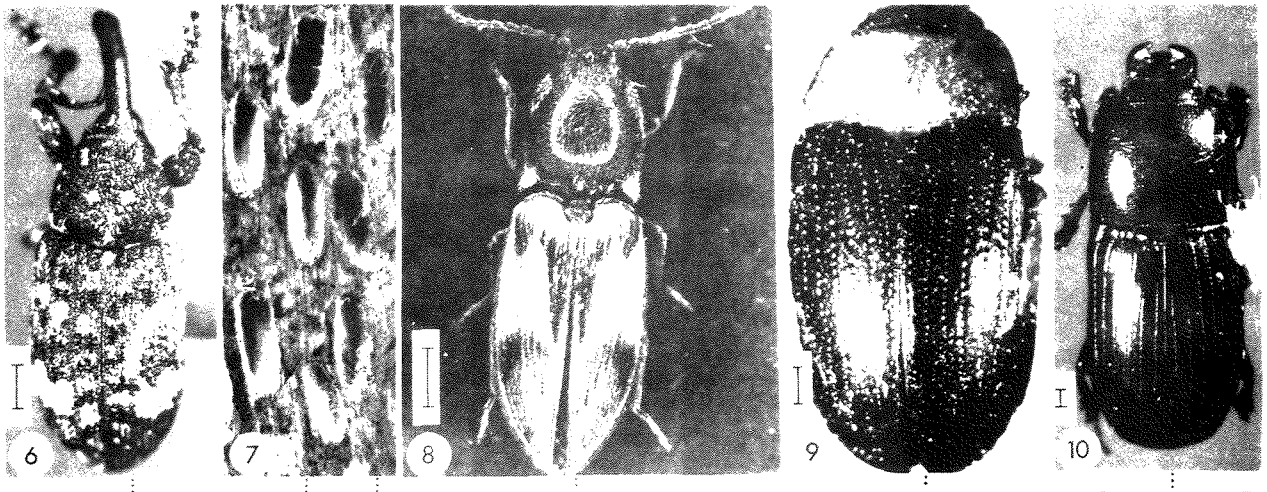
COLYDIIDAE
CUCUJIDAE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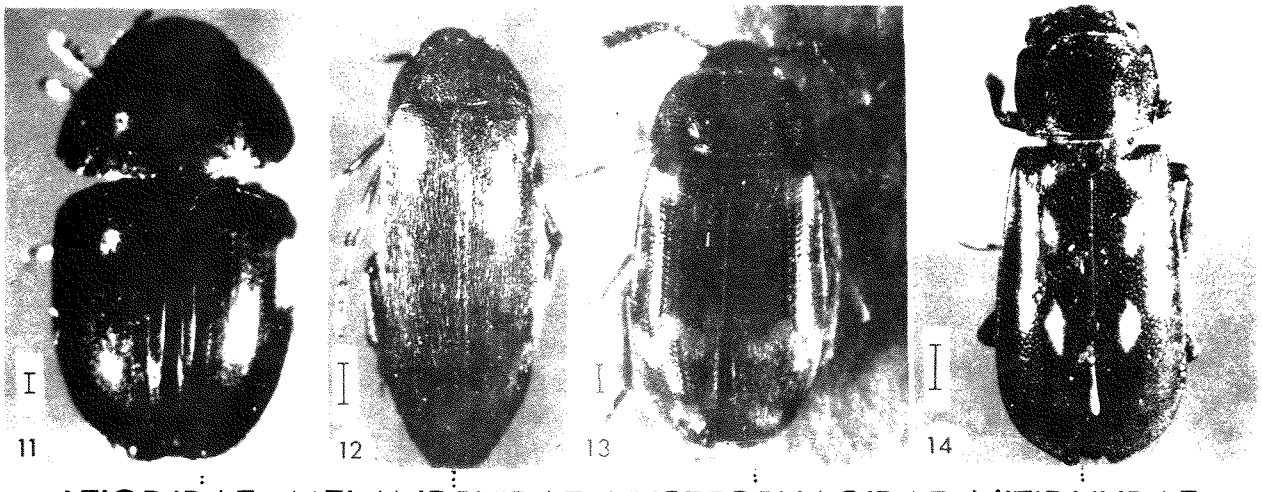
Damage
ELATERIDAE
EROTYLIDAE
HISTERIDAE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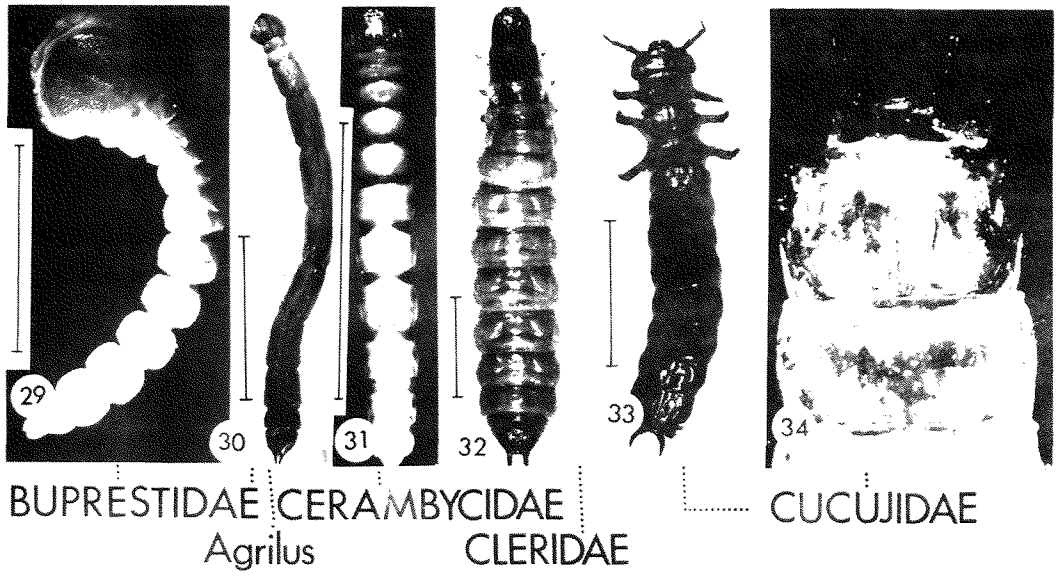
LEIODIDAE
MELANDRYIDAE
MYCETOPHAGIDAE
NITIDULIDAE

Plate I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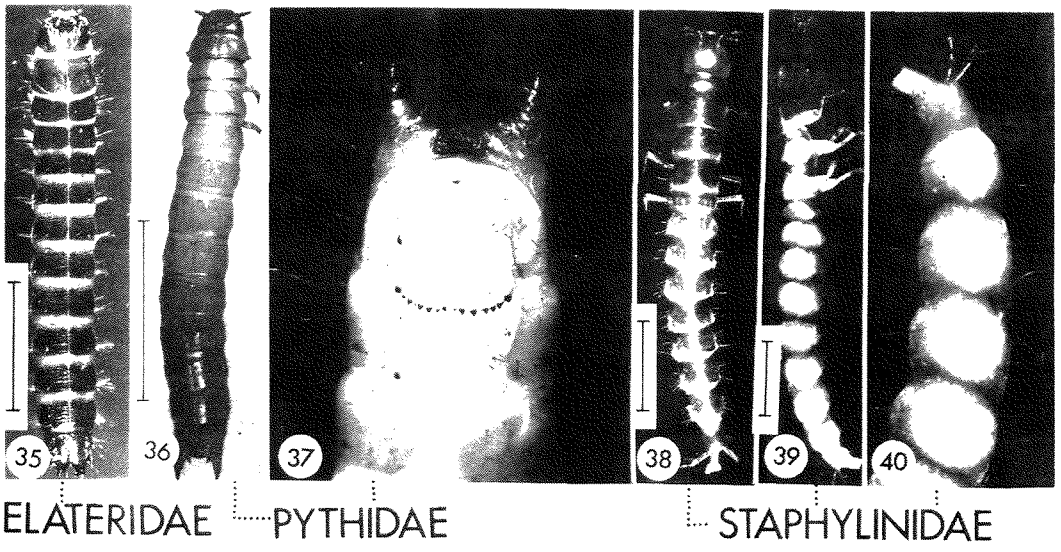
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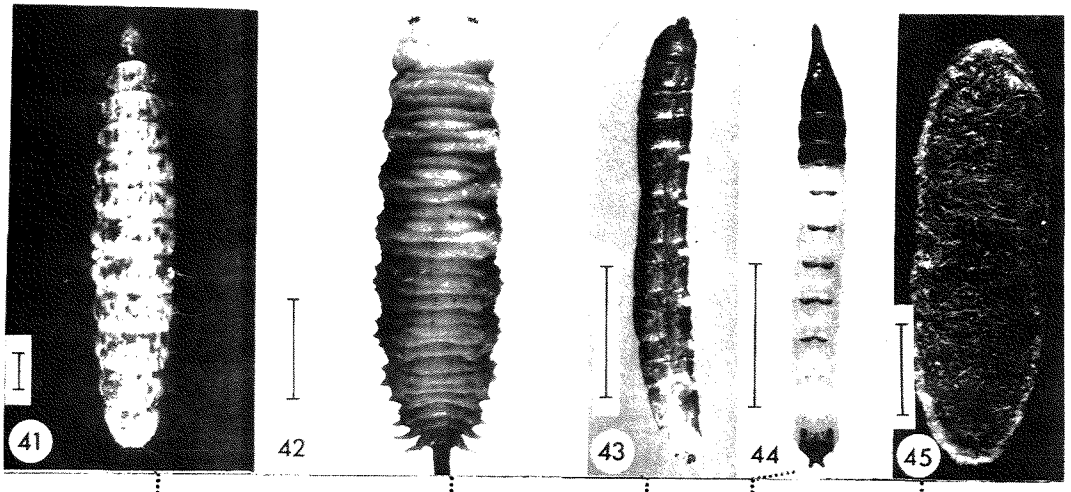
ELATERIDAE
PYTHIDAE
STAPHYLINIDAE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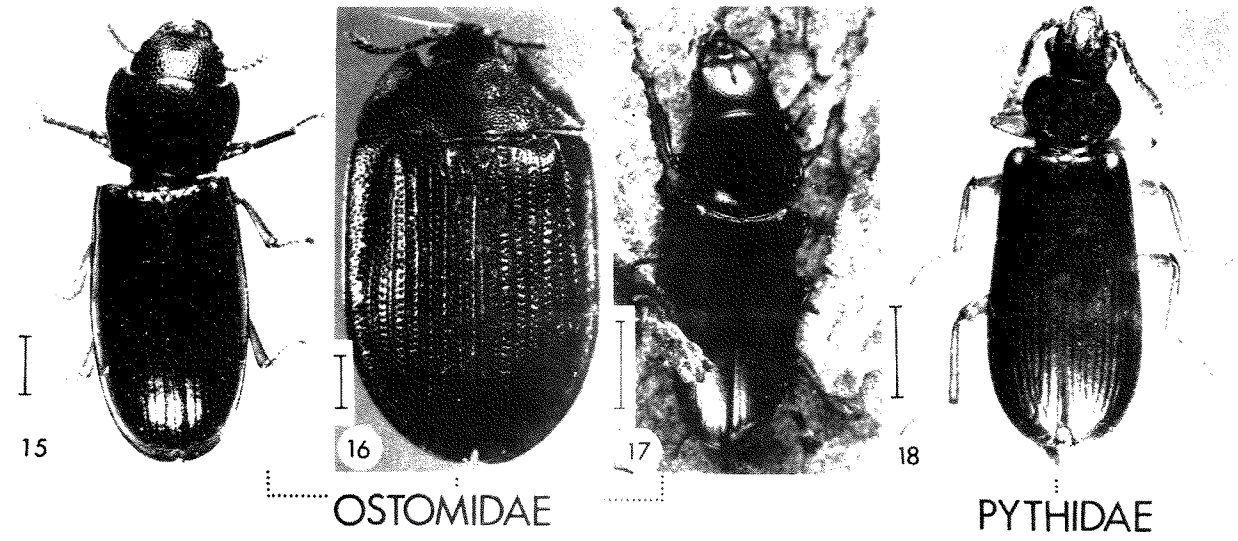
STRATIOMYIDAE
SYRPHIDAE
TIPULIDAE
HYMENOPTEROUS
XYLOPHAGIDAE
PARASITE

Plate II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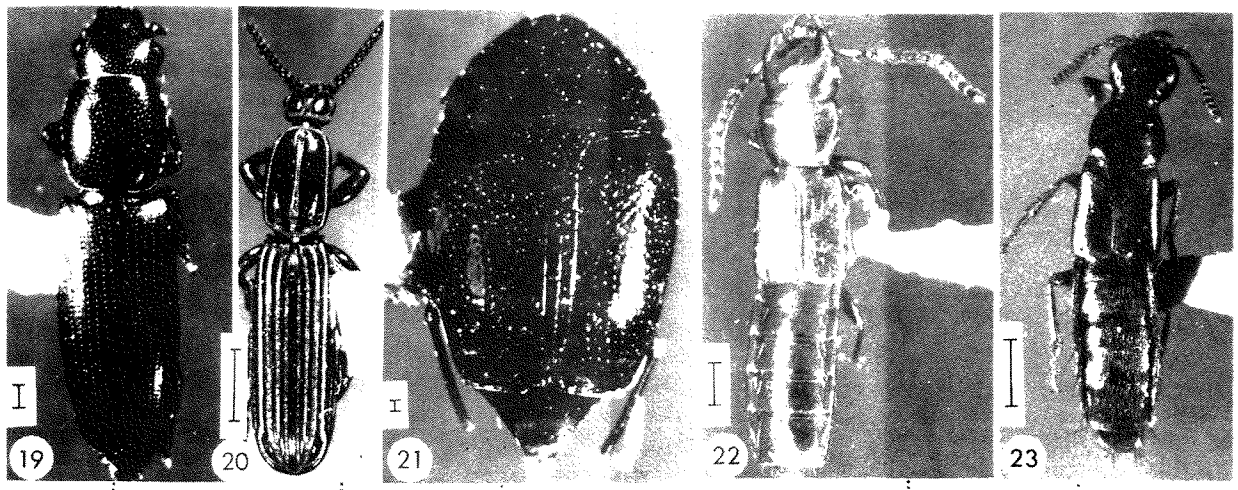
PYTHIDAE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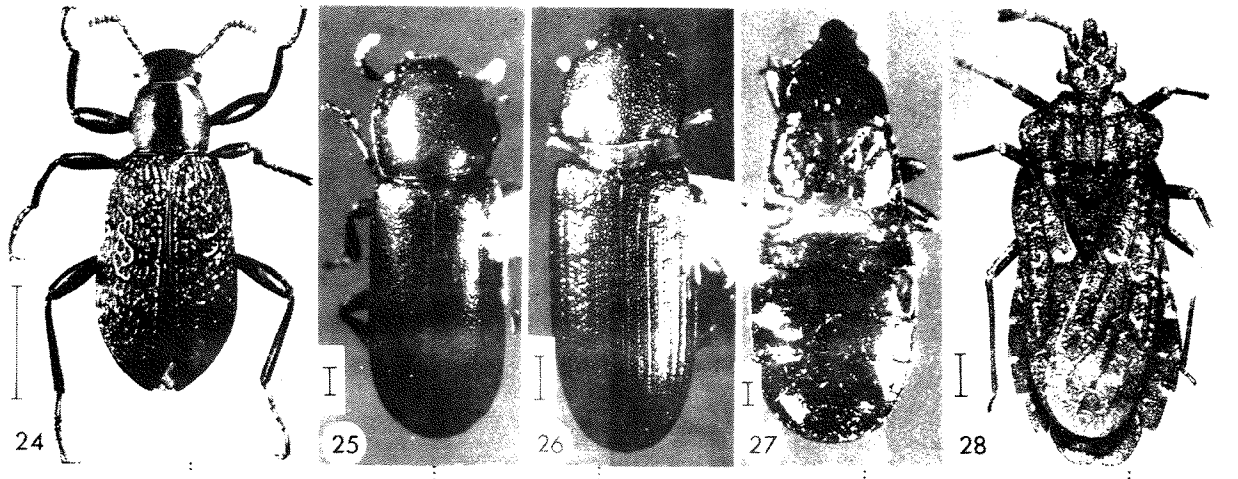
RHYSODIDAE
SCAPHIDIIDAE
STAPHYLINIDAE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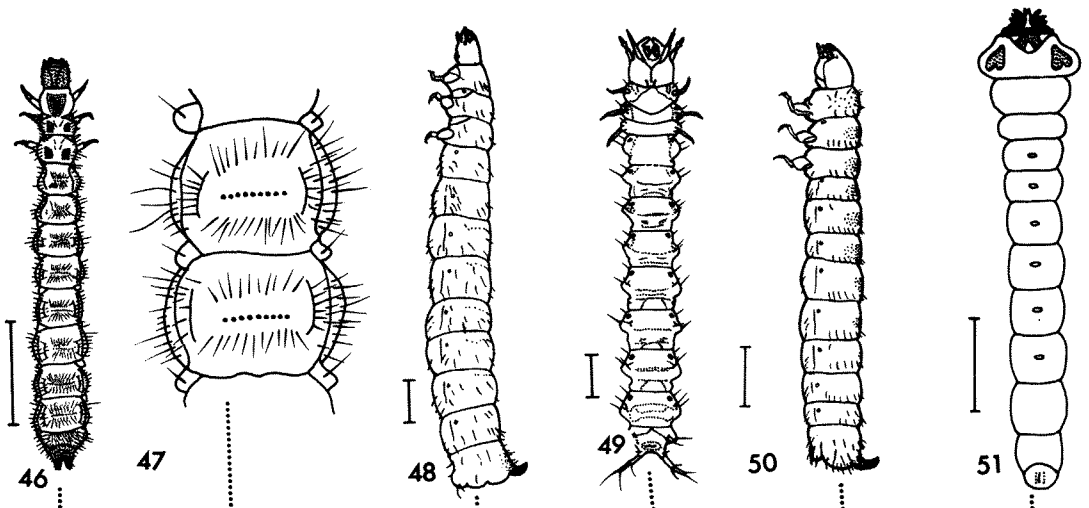
TENEBRIONIDAE
ANTHOCORIDAE
ARADIDAE

Plate III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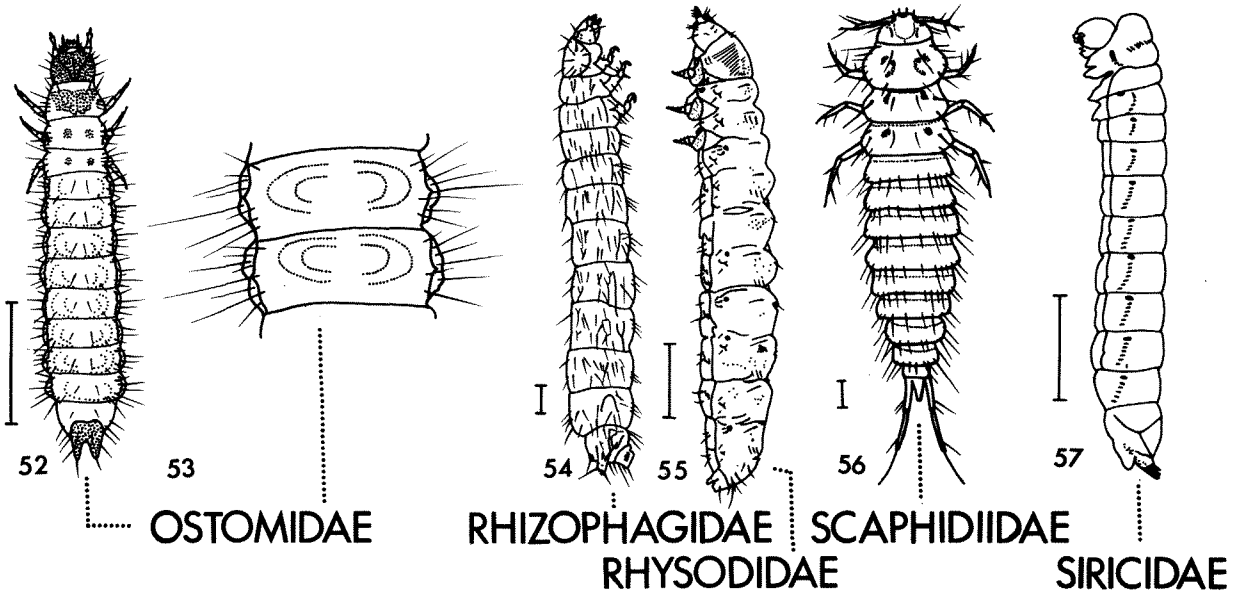
COLYDIIDAE
HISTERIDAE
MELANDRYIDAE
MELASIDAE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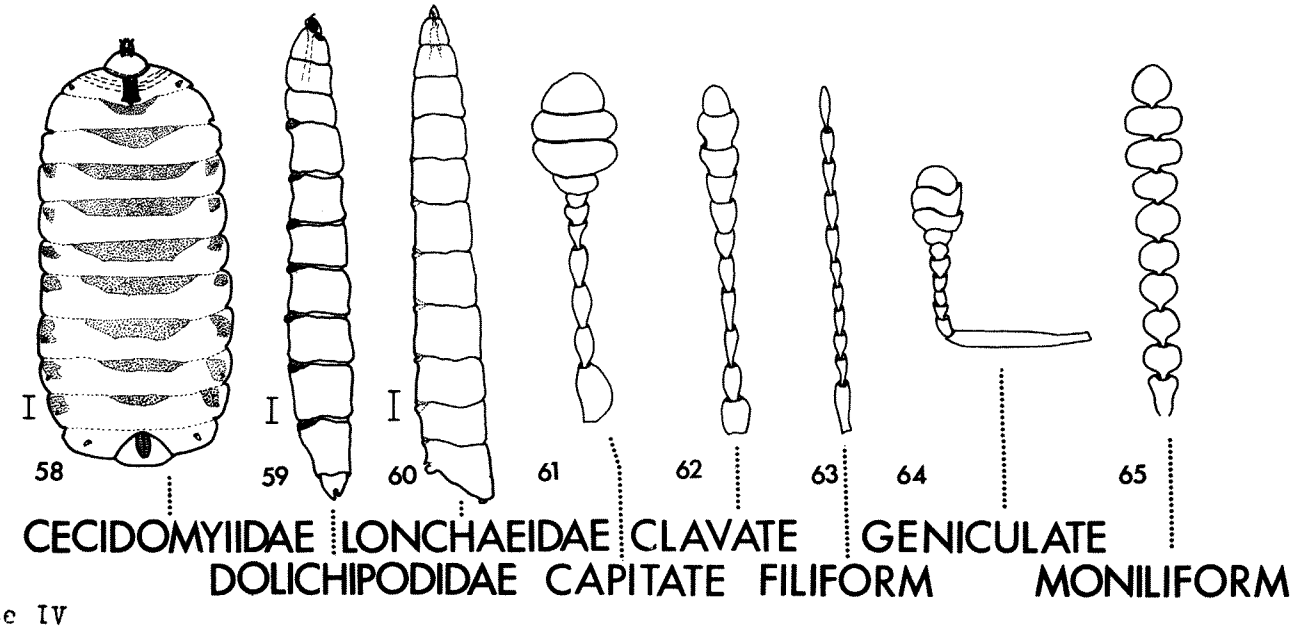
RHYSODIDAE
SCAPHIDIIDAE
SIRICIDAE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CECIDOMYIIDAE
DOLICHIPODIDAE
LONCHAEIDAE
CAPITATE
CLAVATE
FILIFORM
GENICULATE
MONILIFORM

Plate IV

LITERATURE FOR FURTHER REFERENCE

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