

DESCRIPTION AND KEY TO LARVAE OF *CURCULIO* SPP. OF
EASTERN UNITED STATES AND CANADA
(COLEOPTERA: CURCULIONIDAE)

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Abstract.—A general description of *Curculio* larvae is given. Key characters are presented to separate 15 of the 16 described species of eastern North America. A brief key for separating *Curculio* larvae from *Conotrachelus* and lepidopterous larvae is presented.

This paper provides a general description and key for the larvae of 15 of the 16 *Curculio* species of eastern United States and Canada. *Curculio confusor* (Hamilton) is not included in the key because no larvae are known for this species.

Several of the species occur only in southern United States: *Curculio humeralis* (Casey) and *C. longidens* Chittenden from Missouri south through Texas east to Florida and north up the coast to New Jersey; *C. fulvus* Chittenden from coastal South Carolina south to Florida and westward along the coast to coastal east Texas; *C. victoriensis* Chittenden from Louisiana west to Arizona and north to southern Kansas. One other species, a western species, *C. nanulus* (Casey), is not included in the key. It may be found rarely in Texas (Gibson, 1969).

No previous taxonomic key to the larvae of *Curculio* has been published, but Scherf (1964) published a key to European *Curculio* by host plant. Several papers have described various larvae of Curculionidae (Boving & Craighead, 1930; Emden, 1938, 1952; Scherf, 1964). Larval characters of a few American species of *Curculio* have been briefly described and/or depicted by several authors (McClenahan, 1904; Chittenden, 1904, 1908; Leiby, 1925; Brooks and Cotton, 1929; and Peterson, 1960).

The larvae used in this paper were from several sources. Larvae of *C. sayi* (Gyllenhal), *C. proboscideus* Fabricius, *C. sulcatulus* (Casey), *C. pardalis* Chittenden, and *C. strictus* (Casey) were reared from identified parents. Larvae of *C. caryatipes* (Boheman), *C. caryae* (Horn), and *C. obtusus* (Blanchard) were obtained from host material. Larvae of *C. fulvus*, *C. humeralis* (Casey), *C. iowensis* (Casey), and *C. nasiceus* (Say) were obtained from host acorns (from individual trees) that were found through laboratory rearing of adults to contain only one species of *Curculio* larvae. The larvae of *C. victoriensis*, *C. orthorhynchus* (Chittenden), and *C. longidens* were isolated by removing identified larvae from among preserved larvae from acorn collections that contained one of these three in addition to identifiable larvae.

For study, larvae were positioned in a pocket cut into a styrofoam block and

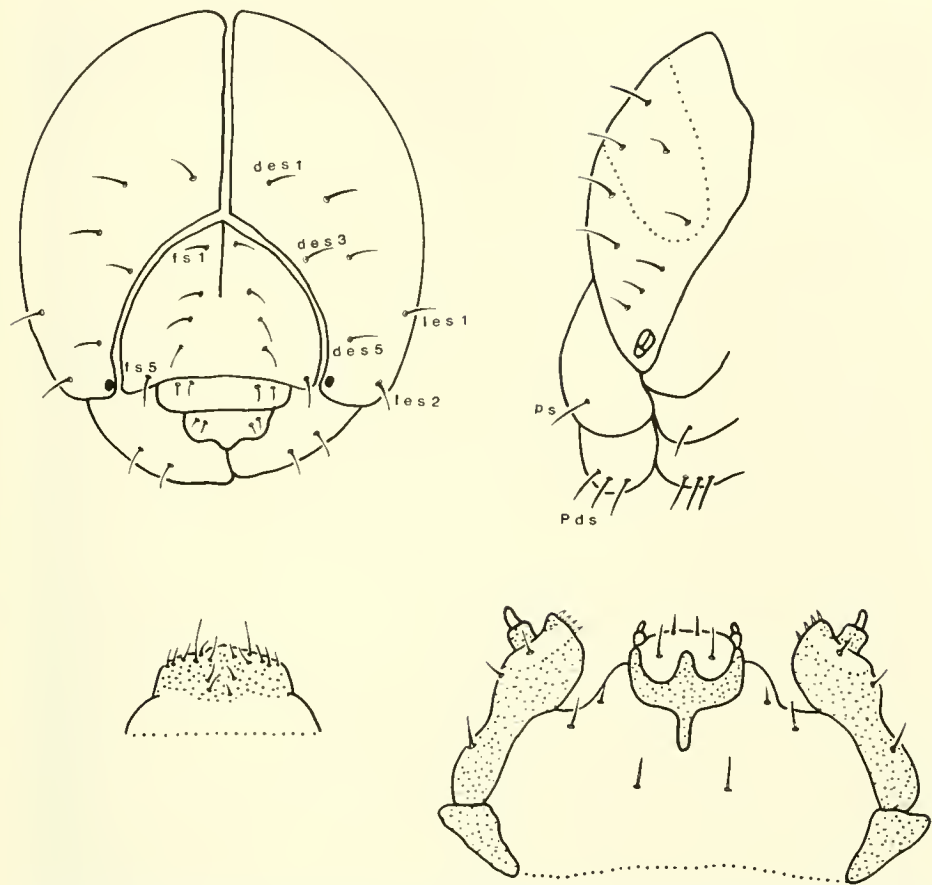


Fig. 1. Hypothetical *Curculio* larva head and mouthparts. a, Head capsule, des—dorsal epicranial setae, fs—frontal setae, les—lateral epicranial setae. b, Epipharynx. c, Maxillae and labium. d, Prothoracic segment, Pds—pedal setae, ps—pleural setae.

viewed under a stereomicroscope. Fourteen or more larvae of each species were studied except for *C. iowensis* and *C. caryatrypes* for which only three and two larvae, respectively, were available for study. The terminology used in this paper is that of Anderson (1947).

Curculio spp. larvae are found in nuts of *Carya* spp., *Castanea* spp., *Corylus* spp., and *Quercus* spp. of eastern North America. They can be separated from other larvae infesting these nuts by the following brief key:

- 1. Larva with legs Lepidoptera
- Larva legless, 6 to 20 mm long 2
- 2. Abdominal segments II to VII each with 3 dorsal plicae, prothorax without a pigmented sclerotized pronotal shield *Curculio* spp.
- Abdominal segments II to VII each with 4 dorsal plicae, prothorax with a pigmented sclerotized pronotal shield *Conotrachelus* spp.

Curculio larvae have typical characteristics of Curculionidae: they lack legs; the

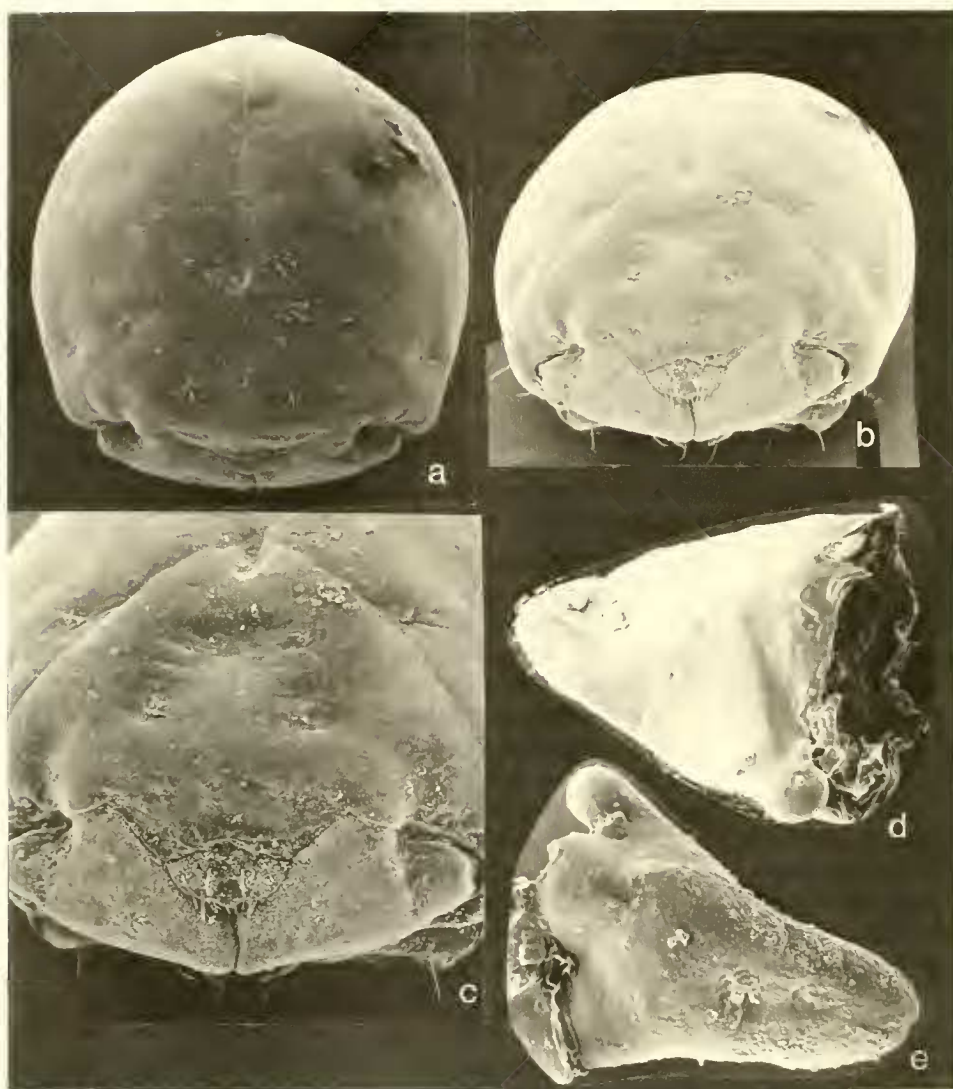


Fig. 2. Scanning electron micrographs of *Curculio sulcatulus*. a and b, Head capsule (46 \times). c, Frons, clypeus, labrum, and mandibles (72 \times). d and e, Mandibles, dorsal and ventral views (150 \times).

gular region and suture are absent; the mandibles are without a molar region; the hypopharyngeal sclerome is absent and the bracon is present; the 9th and 10th abdominal segments are soft and lack modifications such as cerci or soft lobes; the epicranial suture is present; the subfacial region of head and the ventral region of prothorax are contiguous. The mentum is connected laterally with the maxillary stipes.

ULTIMATE INSTAR *CURCULIO* LARVAE

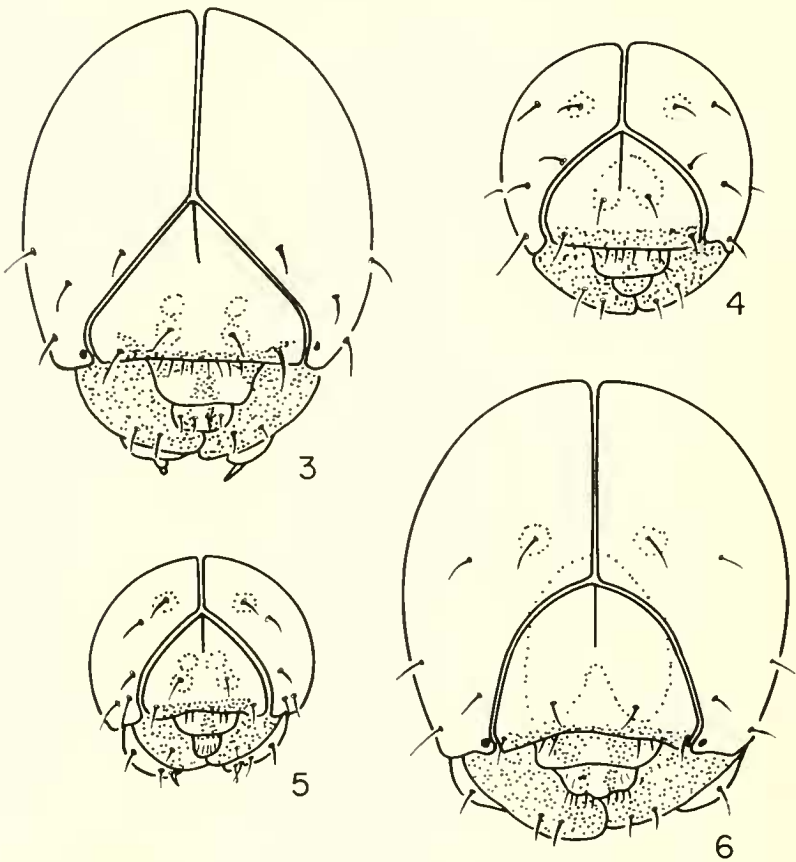
Subcylindrical, 7 to 20 mm long, legless, vary sparsely clothed with setae; moderately falciform to falciform; fleshy, white to dirty yellowish white, with a

Table 1. Selected traits for larval *Curculio* identification.

<i>Curculio</i> Species	Host	Setae Present			Concavity at des 3	Concavity on Frons
		des	fs	les		
						See:
<i>caryatrypes</i>	<i>Castanea</i>	1, 2, 5	4, 5	1, 2	No	Fig. 6
<i>sayi</i>	<i>Castanea</i>	1, 2, 3, 5	4, 5	2	No	Fig. 5
<i>caryae</i>	<i>Carya</i>	3, 5	4, 5	1, 2	No	Fig. 3
<i>obtusus</i>	<i>Corylus</i>	1, 2, 3, 4	3, 5	1, 2	No	Fig. 4
<i>proboscideus</i>	<i>Quercus</i>	1, 2, 3, 4, 5	2, 3, 4, 5	1, 2	No	Fig. 9
<i>nasicus</i>	<i>Quercus</i>	3, 4	none	1, 2	No	Fig. 7
<i>longidens</i>	<i>Quercus</i>	1, 2, 3, 4	3, 4, 5	1, 2	No	Fig. 10
<i>orthorhynchus</i>	<i>Quercus</i>	1, 3, 4	4	2	Yes	Fig. 8
<i>sulcatulus</i>	<i>Quercus</i>	1, 3, 4	3	1, 2	Yes	Fig. 12
<i>pardalis</i>	<i>Quercus</i>	1, 3, 4	3	1, 2	Yes	Fig. 11
<i>strictus</i>	<i>Quercus</i>	1, 2, 3, 4	4, 5	1, 2	No	Fig. 15
<i>humeralis</i>	<i>Quercus</i>	1, 3, 4	3	0	Yes	Fig. 13
<i>fulvus</i>	<i>Quercus</i>	1, 3, 4	3, 5	1, 2	No	Fig. 17
<i>victoriensis</i>	<i>Quercus</i>	1, 2, 3, 5	4	2	Yes	Fig. 16
<i>iowensis</i>	<i>Quercus</i>	1, 2, 3, 4	4	0	Yes	Fig. 14

yellow, red, light reddish brown, light brown, or brown head. Head capsule small, lightly sclerotized, width varying with species, e.g. ca. 1.3 mm for *C. sayi* and ca. 2.1 mm for *C. caryatrypes*; mandibles sclerotized and darker.

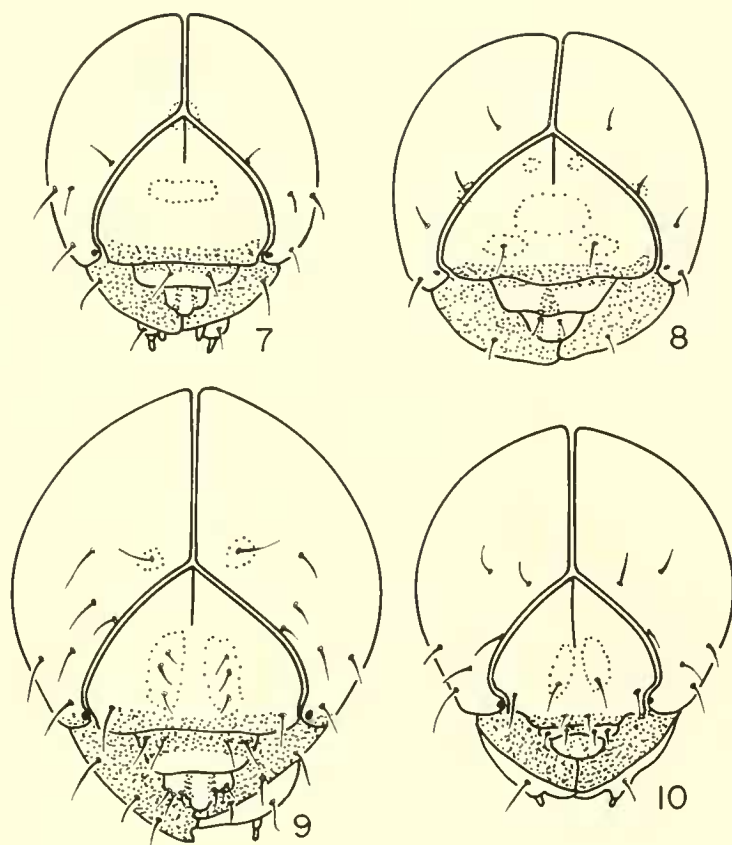
Head capsule (Figs. 1a, b, & c, 2 to 17).—Head free or only a little retracted, longer than wide or as wide as long; broadest at or near middle, rounded or narrowed anteriorly and moderately rounded posteriorly; ocelli absent; anterior ocellar spot present; antennae absent, represented only by a basal space; hypopharyngeal bracon absent; frontal suture distinguishable throughout length, epicranial suture less than ½ as long as head; endocarina distinct approximately ½ as long as frons; frons usually with 1 to 3 pairs of frontal setae (fs)—fs 1 absent in all specimens examined, fs 2 present only on *proboscideus*, fs 3 present on *obtusus*, *proboscideus*, *longidens*, *sulcatulus*, *pardalis*, *humeralis*, and *fulvus*, fs 4 present on all except *obtusus*, *nasicus*, *sulcatulus*, *pardalis*, *humeralis*, and *fulvus*, fs 5 present on all but *nasicus*, *orthorhynchus*, *sulcatulus*, *pardalis*, *humeralis*, *victoriensis*, and *iowensis*, (some setae may be absent on some specimens); dorsal epicranial setae (des) 1, 2, 3, and 4 usually present subequal and moderately long—des 1 present in all species except *nasicus*; des 2 absent in *caryae*, *nasicus*, *orthorhynchus*, *sulcatulus*, *pardalis*, *humeralis*, and *fulvus*; des 3 present in all species except *caryatrypes*; des 4 absent in *caryatrypes*, *sayi*, *caryae*, and *victoriensis* (in some specimens of *victoriensis* it is difficult to determine whether it is 4 or 5 that is absent); des 5 usually absent in all species except *caryatrypes*, *sayi*, *caryae*, and *proboscideus*. Lateral epicranial setae (les) 1 and 2 subequal in length moderately long—les 1 present on all species except *sayi*, *orthorhynchus*, *humeralis*, *victoriensis*, and *iowensis*, les 2 present on all species except *humeralis* and *iowensis*; clypeal setae 2 pair only, very short; anterior margin of frons variable, convex in center in *orthorhynchus*, straight or slightly convex in *obtusus*, *nasicus*, *proboscideus*, *longidens*, *caryae*, and *victoriensis*, concave centrally in *sayi*, *caryatrypes*, *pardalis*, *sulcatulus*, *humeralis*, *iowensis*, *strictus*, and *fulvus*.



Figs. 3 to 6. Head capsules of *Curculio* larvae. 3, *C. caryae*. 4, *C. obtusus*. 5, *C. sayi*. 6, *C. caryatrypes*.

Labrum broadly rounded with 2 to 3 (rarely 4) pair of small dorsal setae, and with 8 or 10 anterior setae of the epipharynx protruding along the front edge, slightly produced into clypeus at center of posterior edge; labral setae 1, 2, and 3 short; epipharynx (1b) with 3 pairs of anterolateral setae, 1 pair anteromedian setae, and 2 or 3 pairs median spines; mandibles triangular in outline, with 1 or 2 apical teeth, and sometimes with a poorly defined inner tooth (Fig. 2d, e); mandibular setae short or absent; labial palpus with 2 articles; premental sclerite complete, with anterior and posterior median extensions; postmentum with three pairs of setae, maxillae simple, palpus with 2 articles, without accessory process or setae (Fig. 1c). Cardio and stipes meet at right angles. Stipes fused with mala; mala armed with 10 setae on front edge. Labium is reduced and its parts consolidated (Fig. 1c).

Prothorax (Figs. 1d, 18 to 32).—Pronotum with 6 to 11 pairs of setae, prothoracic shield very lightly sclerotized and indefinite on most species (not visibly sclerotized on *C. strictus*). Spiracle bicameral. Prothorax with 1 to 7 pedal setae and 1 to 3 pleural setae.

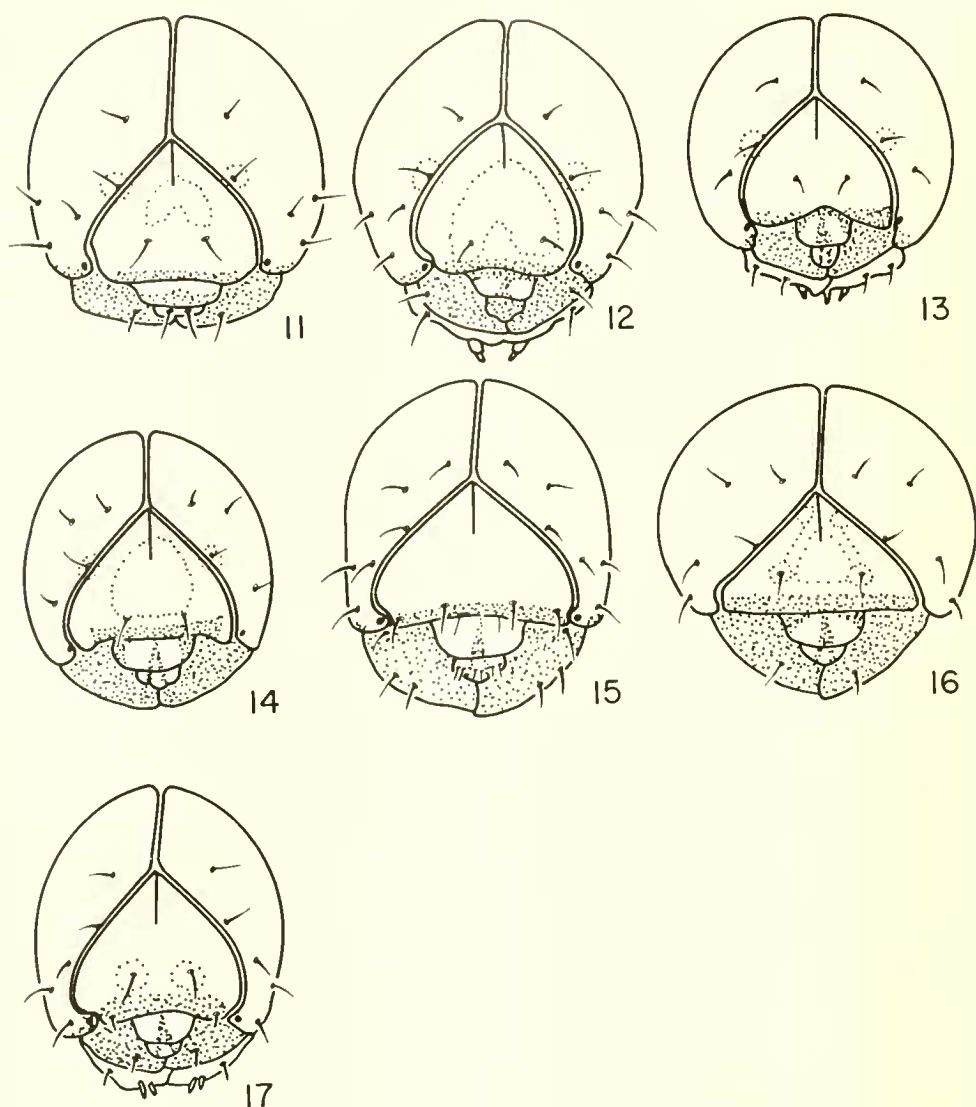


Figs. 7–10. Head capsules of *Curculio* larvae. 7, *C. nasicus*. 8, *C. orthorhynchus*. 9, *C. proboscideus*. 10, *C. longidens*.

Abdomen.—With 8 pairs of spiracles, all lateral and bicameral, similar to prothoracic pair. Typically abdominal segments I to VII with 3 transverse dorsal plicae, abdominal segment VIII with 2 dorsal plicae, and abdominal segment IX undivided. Anus X-shaped. Pedal lobes not bulging. Pleura I to VIII and epipleurum usually with 1 or 2 setae each. Eusternum with 1 seta. Pedal area with 1 to 5 setae. Ninth abdominal segment with 1 pair of moderately long setae dorsally, and epipleurum with 1 pair of setae. Epipleural seta (eps) 1 tiny, located antero-dorsal from eps 2. Pleural seta 1 tiny, located antero-dorsal from ps 2.

The larvae are not able to move forward when on their side or back. Forward movement on a smooth surface is difficult.

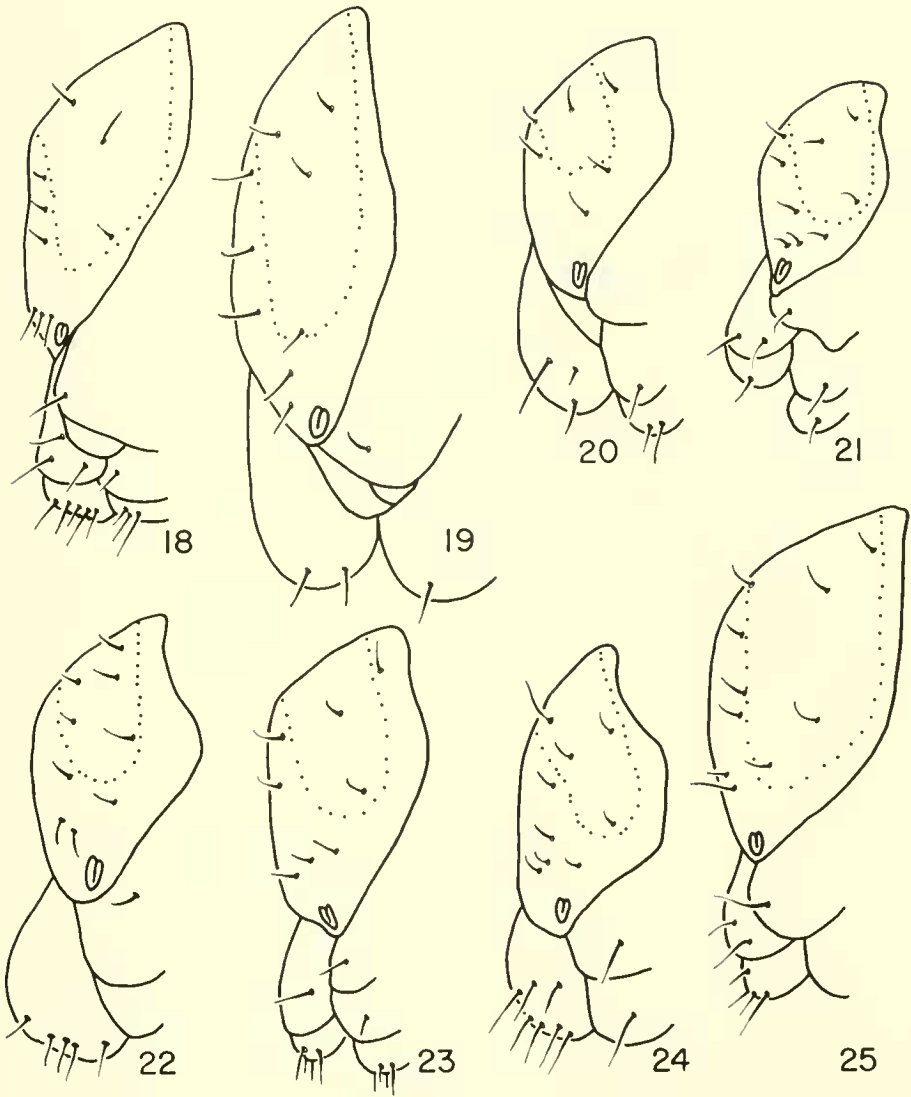
Variation in ultimate instar (mature) larvae makes it difficult to identify some larvae accurately. The larval length and head capsule size vary between specimens of some species. The number of setae on the head may vary due to breaking off or shaving off during emergence from the host nut. Usually the setae of the body are reliable but again some may be broken off. It is important to look at both sides of the head or larvae when keying. If the larvae will not key out, then other characters found in Table 1 will be of assistance.



Figs. 11-17. Head capsules of *Curculio* larvae. 11, *C. pardalus*. 12, *C. sulcatulus*. 13, *C. humeralis*. 14, *C. iowensis*. 15, *C. strictus*. 16, *C. victoriensis*. 17, *C. fulvus*.

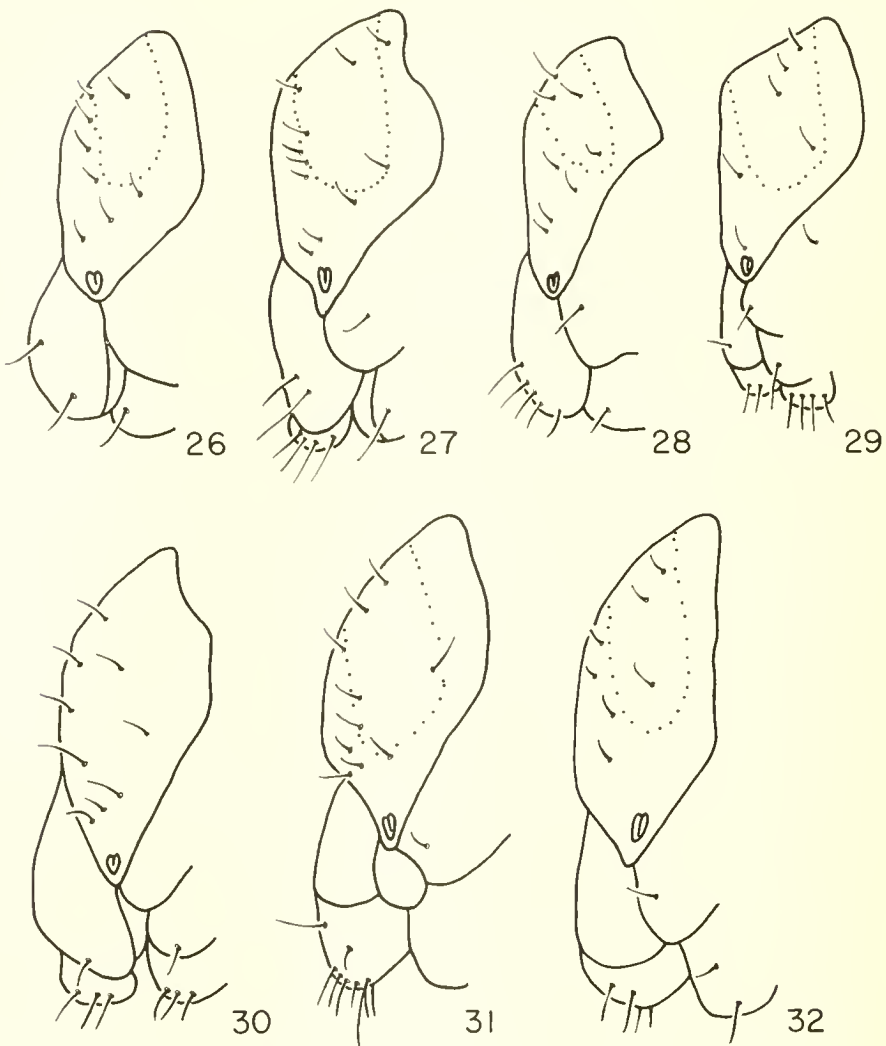
KEY TO THE MATURE LARVAE OF *CURCULIO* SPECIES FROM EASTERN UNITED STATES AND CANADA

1. Host *Quercus* (oak acorns) 5
- Host not *Quercus* 2
2. Host *Carya* (pecan & hickory) (Figs. 3 & 19) *caryae* (Horn)
- Host *Castanea* (chestnut & chinquapin) or *Corylus* (hazelnut) 3
3. Host *Corylus* (Figs. 4 & 20) *obtusum* (Blanch.)
- Host *Castanea* 4
4. Head capsule round; 1.3 mm wide; larva ca. 10 mm long (Figs. 5 & 21)
..... *sayi* (Gyll.)



Figs. 18 to 25. Prothoracic segments of *Curculio* larvae (18 and 24 drawn $\frac{1}{3}$ scale of others). 18, *C. caryatrypes*. 19, *C. caryae*. 20, *C. obtusus*. 21, *C. sayi*. 22, *C. nasicus*. 23, *C. orthorhynchus*. 24, *C. proboscideus*. 25, *C. longidens*.

- Head capsule higher than wide; 2.1 mm wide; larva 18 to 20 mm long (Figs. 6 & 18) *caryatrypes* (Boh.)
- 5. Head capsule height from frons apex 1.7 to 2.1 mm; concavities on frons either horizontally oval or obliquely vertical twin ovals, if apparently inverted U then there are no concavities around des 3 6
- Head capsule height from frons apex 1.3 to 1.5 mm; concavities on frons variable but never oval, if inverted U then there are always concavities around des 3 9



Figs. 26-32. Prothoracic segments of *Curculio* larvae. 26, *C. pardalis*. 27, *C. sulcatulus*. 28, *C. humeralis*. 29, *C. iowensis*. 30, *C. strictus*. 31, *C. victoriensis*. 32, *C. fulvus*.

6. No setae on frons; central concavity oval and horizontal on frons, fs 4 or its socket not in concavity; head capsule height 1.7 mm (Figs. 7 & 22) *nasicus* (Say)
- One to 4 pair setae on frons; central concavity oval and vertical, if horizontal on frons then fs 4 or its socket is in concavity; head capsule height 1.7 to 2.0 mm 7
7. Concavities on frons vertical twin ovals or inverted U shape 8
- Concavities on frons a central horizontal oval and 4 corner concavities at fes 1 and fes 4 positions; head capsule height 1.7 mm (Figs. 8 & 23) *orthorhynchus* (Chitt.)
8. Concavity on frons vertical twin ovals or two lines of 3 concavities, if twin ovals then 2 or 3 pair of setae are in the concavities; 2 to 4 pair of

- setae on frons; concavity at des 1; head capsule height 2.0 mm (Figs. 9 & 24) *proboscideus* F.
- Concavity on frons inverted U or vertical twin ovals, if twin ovals then only 1 pair of setae is in the concavities; 3 pair setae on frons; no concavity at des 1; head capsule height 1.85 mm (Figs. 10 & 25) ... *longidens* Chitt.
9. One pair setae on frons; 3 or 4 pair epicranial setae 10
- Two pair setae on frons; 5 or 6 pair epicranial setae 13
10. Concavity on frons inverted U shape 11
- Concavity on frons absent or not an inverted U shape 12
11. Eight setae on each side of pronotum, fs 4 or its socket is not in frons concavity (Figs. 11 & 26) *pardalis* Chitt.
- Eleven setae on each side of pronotum, fs 4 or its socket is in frons concavity (Figs. 2, 12 & 27) *sulcatulus* (Casey)
12. No concavity on frons (Figs. 13 & 28) *humeralis* (Casey)
- Concavity on frons triangular (Figs. 14 & 29) *iowensis* (Casey)
13. No concavity on frons; head capsule yellow and lightly sclerotized, pronotal plate not sclerotized (Figs. 15 & 30) *strictus* (Casey)
- Concavity on frons at least around fs 4; head capsule light brown, pronotal plate lightly sclerotized 14
14. Concavity around des 3 and irregularly in central frons (Figs. 16 & 31) *victoriensis* Chitt.
- No concavity around des 3 or centrally on frons (Figs. 17 & 32) *fulvus* Chitt.

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