

## A COMPARATIVE STUDY OF THE LARVAE OF SIX SPECIES OF SILPHA<sup>1</sup>

(Coleoptera, Silphidae)

CARL K. DORSEY,

Department of Entomology, University of Maryland,  
College Park, Maryland

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Observations are here presented that were made during a study of the larvae of six species of the genus *Silpha*. Three species, *S. americana* L., *inaequalis* Fab., and *noveboracensis* Forst., were associated with the adult stage by the writer by processes of rearing. The other three species, *surinamensis* Fab., *ramosa* Say, and *lapponica* Hbst. are determined specimens lent to the writer for study by the U. S. National Museum.

### BIOLOGICAL OBSERVATIONS

Although the primary objective in the rearing operations was that of associating larval and adult stages of *americana*, *inaequalis* and *noveboracensis*, some biological observations were inevitable and certain of these will be included. The specimens used in rearing attempts were confined to the three last-mentioned species; all references to biological notes will pertain to these unless otherwise indicated. The investigations were carried on at the University of Maryland, College Park, Maryland, May 3 to September 1, 1939.

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### FIELD OBSERVATIONS

For the purpose of attracting adult silphids a freshly killed cat was placed in a sheltered place near the edge of a woods on May 3. Four days later adults of all three species were first noticed on and around the carcass feeding and mating; *americana* being less numerous than the other two. By May 10, practically all of the beetles had disappeared. On May 12, small silphid larvae, varying in length from 5 to 8 mm., were observed around the carcass. On May 16, two other similar attractant baits were deposited; in this case, also, it was four days later when adult silphids were first noticed in any numbers near the carrion. On this date *americana* was present in greater numbers than either of the other two species. Small silphid larvae were first found under the carrion on May 26.

The adults and larvae of all three species apparently prefer the moist conditions under a carcass in contact with the soil; at least, they were always found in greater numbers in these locations. They were occasionally seen in the decomposed carcass and frequently among the hair, in the trash and leaves nearby. Both adults and larvae were observed feeding on decaying flesh, usually near softer parts and excretions. However, the larvae feed principally on the dried remains of hide, sinew, shreds of meat, etc., which is all that is left after the dipterous larvae have finished with the carcass. On two different occasions, *americana* larvae were seen feeding unprotected on exposed shreds of dried meat during a heavy rain. Both larvae and adults seek cover when exposed to the force of the direct rays of the sun. On cloudy days they are much more in evidence, crawling over and around the carrion. When an infested carcass is disturbed, adults and larvae quickly hide in nearby trash, etc.; *americana* moves much faster than either of the other two species.

It would seem that carrion has the greatest attracting powers for the adults after it reaches a certain state of decomposition. According to the writer's observations, that is about four days after the deposition of a freshly killed carcass. After this state has been reached, the dipterous maggots literally take possession and adult silphids disappear.

### REARING OPERATIONS

In associating silphid larvae with their adult forms by rearing, various types of cages were used. All rearing operations

were carried on in a tightly screened insectary; each cage or group of cages was placed in an individual screened container.

The mortality in most of these cages was very high; in fact, only two larvae were carried through to the pupal stage, one of which reached the adult stage. The most successful type of cage proved to be a tightly screened one covered entirely with gauze; a layer of soil covered the bottom. A freshly killed guinea pig was placed in each of these cages accompanied by about twelve adult beetles. Each cage was furnished with a water container; it is important that water be kept before the beetles and larvae.

Much interference and trouble was caused by fly larvae, both in adult and larval cages; it seemed almost impossible to exclude them even from screen cages covered with gauze. The maggots would become so numerous in the cage and the accompanying slime so abundant that the silphids would soon die. It is thought by Steele (14) that adult *Necrophorus orbicollis* Say, *tomentosus* Web., *Silpha americana* L. and *noveboracensis* Forst. probably prefer maggots to carrion as food. The writer did not experiment at all extensively along these lines; however, upon two different occasions, adult beetles of *Silpha americana*, *inequalis* and *noveboracensis* were isolated in containers and denied food for twenty-four hours, after which time live maggots were deposited in each container. In both cases only *americana* fed upon the maggots; an adult would viciously seize a maggot and devour it within five minutes time. Silphid larvae tested similarly did not attack the maggots. Goe (5) speaks of adult *inequalis* readily eating freshly killed flies. Maggots may be an important item in the diet of silphid adults; however, the writer found that the beetles lived about as long in cages containing uninfested meat as they did in those containing meat infested with maggots. A cage of *noveboracensis* adults lived twenty days on maggotless carrion; another similar group lived twenty-four days in a cage containing infested carrion; *inequalis* lived fifteen days on maggotless carrion as compared with a similar group which lived eighteen days on infested carrion; *americana* lived seventeen days on maggotless carrion as compared with a similar group, which lived nineteen days on infested meat.

In no instance, either under field conditions or in rearing cages, was an egg found on or in carrion; in all cases observed the egg was laid either on top of or just beneath the soil surface. In one cage an egg was found sticking to the screen side of the cage.

A series of adult females of each species was dissected and counts were made of the ovarian eggs. *Inequalis* averaged nine, *noveboracensis* eight, and *americana* ten. The incubation period for the eggs of all three species in the rearing cages was about six days.

Silphid larvae, when closely confined together, have a tendency to be cannibalistic. The larger ones occasionally attack the smaller ones; they quickly eat away the softer sternal regions and devour the body contents.

The *inequalis* and *noveboracensis* larvae which were successfully reared to the pupal stage made smooth, oval, earthen cells in the bottom of the cage. The *inequalis* larva was about 7 mm. long and 2.7 mm. wide when collected in the field; there was an ecdysis on May 21 and another on May 23. The larva entered the prepupal stage on May 30 and the pupal stage on June 1. The adult emerged June 9. The *noveboracensis* larva was about 13 mm. long and 6 mm. wide when collected in the field. The first change was noticed when the larva entered the prepupal stage on May 25. The pupal stage commenced May 29; the pupa died on June 1.

#### DESCRIPTION OF LARVAE

The material on which the following descriptions are based is in the U. S. National Museum. Microscope slide mounts were made of the head appendages, external and internal mouthparts of all species studied. All measurements were made with an ocular micrometer.

#### GENERIC DESCRIPTION OF LARVAE

*Body* campodeiform; wider than depth from dorsum to sternum in all body regions; entire length of dorsum of body segments marked with a narrow, shallow, central, longitudinal impression which in *inequalis*, *noveboracensis* and *surinamensis* is light-colored; in *americana*, *ramosa* and *lapponica* the color is similar to that of rest of dorsum.

*Head* broader than long; sclerotized external spots of distal ends of dorsal tentorial arms (fig. 43, DT) contiguous with frontal sutures and more or less in line with antennal sockets; dorsal occipital region furnished with two small, strong setae on each side.

*Mandible* (fig. 38) with broad, sub-triangular base tapering to posterior region of the strong and gradually tapering incisor lobe, apex bears two teeth which are acute and usually slightly serrate; mandible with a small seta at base of incisor lobe, adjacent to outer margin, on ventral surface; posterior, outer, lateral base of mandible, on dorsal surface, with one strong seta accompanied by several smaller ones.

*Clypeo-frontal* suture distinctly defined only at lateral margins; *clypeo-labral* suture distinct; *clypeus* broadly trapezoidal, broader posteriorly, with posterior lateral angles sharply defined by heavily sclerotized carinae of clypeo-frontal suture.

*Labrum* bilobed, sub-trapezoidal with anterior angles rounded, each posterior lateral angle bears a light-colored L-shaped marking (fig. 30, L) the arms of which extend to lateral, posterior margin; two setae borne between the posterior arm of the L-shaped marking and the clypeo-labral suture, one adjacent to anterior clypeal angle and one mesad and caudad of latter seta; *labral cleft* furnished on each side with a small seta; a long, strong seta on each anterior labral margin and one strong seta caudad and mesad of last mentioned seta.

*Dorsal ocelli* four in number, round to irregular ovate, arranged around the periphery of a small, round, sclerotized mound; *ventral ocelli* two in number, rounded, located on lateral margin of ventral surface of the head.

*Antennae* three-segmented with first two segments clavate and rather sparsely setose; second segment bearing a *sensory area* on the inner, anterior surface; third segment smaller, usually subulate; inner face of *antennal socket* furnished with a seta.

*Maxillary palpiger* closely connected with stipes; *mala* and *stipes* fused, stipes bearing two large setae anterior and one seta posterior to base of palpus; ventral surface of stipes furnished with one large seta caudad of palpus and adjacent to inner margin and one mesad of base of palpus; several small setae scattered over remainder of surface; *maxillary lobes* free distally, fused proximally; *maxillary palpus* three-segmented.

*Galea* with rounded, thickly-haired, brush-like tip which in *americana* extends posteriorly on inner, dorsal surface of stipes towards the base of palpus.

*Lacinia* (fig. 57, LC) furnished anteriorly with comb-like row of strong, broad spines; another similar row immediately dorsal to first with spines much shorter and arranged in a row like saw-teeth; lacinia furnished proximally with numerous very small spiculi.

*Cardo* irregularly sub-triangular, marked rather centrally by a Y-shaped suture with arms of Y directed towards posterior margin; anterior lateral margin furnished with two small setae.

*Ligula* bilobed.

*Glossa* with anterior margin thickly furnished with very short hairs, dorsal surface fleshy and furnished with numerous longitudinal rows of very fine, strong setae; lateral margin supported by a narrow, elongate sclerome.

*Hypopharyngeal scleromes* symmetrical and well-defined; *bracon* and *rod* strong.

*Mentum* small; *submentum* trapezoidal with flaring base.

*Gula* small.

*Labial palpus* two-segmented, extending beyond glossa.

*Epipharynx* (fig. 30, EP) bilobed, with heavily sclerotized anterior and lateral margins furnished with rows of short, strong spines gradually

diminishing in size laterad; posterior region of the heavily sclerotized lateral margin furnished with a short, strong spine<sup>2</sup>; a short, rectangular spine<sup>3</sup> lies on each side of epipharyngeal cleft; caudad and slightly laterad of rectangular spine lies an oval area densely covered with slender spinules more or less parallel with anterior epipharyngeal margin; *first porous area* (fig. 30, IPA) is located between inner tips of the areas of slender spinules; caudad and laterad of first porous area lies *second porous area* (fig. 30, IIPA); caudad and laterad of these porous areas an elongate, oval area densely furnished with short, fine spiculi; about one-half the length from distal to proximal limits of the densely spined area and adjacent to the inner margins is located two quincunx-porous areas (fig. 30, QPA); immediately anterior to last mentioned pores lies a flatly parabolic<sup>4</sup> row of minute pores extending from one lobe to the other; in line with this row on each side, but laterad, lies two minute setae, the first about two-thirds the length of parabolic row from the last pore, the second about one-half the length of parabolic row laterad of first.

*Spiracles* annular; opening kidney-shaped, wide, directed laterad and slightly caudad; *mesothoracic spiracle* about two times the size of other spiracles; *metathoracic spiracle* greatly reduced in size and probably non-functional; *abdominal spiracles* on first to eighth segments inclusive, borne ventrally near lateral anterior angle of dorsal shield.

*Tergum* rather sparsely setose; anterior lateral angle of *prothoracic shield* rounded, posterior lateral angle U-shaped; *mesothorax* similar to prothorax, but wider and only about seven-tenths as long; *metathorax* similar to other two, being about equal in width to mesothorax, but only about six-tenths as long as prothorax.

*Dorsal shields* (fig. 8) of abdomen sub-triangular, with anterior lateral angle rounded and furnished with two<sup>5</sup> strong setae accompanied by several smaller ones; posterior angle acute, directed laterad and slightly caudad; lateral margin furnished with several strong setae accompanied by smaller ones. Ten *abdominal segments* tapering from first to last, first five about equal in length, six to nine slightly longer; tenth segment trapezoidal, with strong setae on posterior half, with anus in which is located the *eversible anal processes* (fig. 3, AP); *tergum* and *sternum* furnished with numerous rather strong setae; posterior margin of the sternum of each segment with a row of long setae; *urogamphi* borne sub-dorsally between ninth and tenth abdominal segments.

*Legs* gradually increasing in length from first to third; furnished with numerous spine-like setae; *coxa* large, sub-pyriform, with deep longitudinal groove on outer face; *trochanter* small; *femur* about equal in length to *coxa*; *tibia* slightly shorter than femur; *tarsungulus* long, strong, with two small, lateral spines.

*Sternal plate* of prothorax orbicular, somewhat flattened anteriorly; *presternal sclerome* triangular, apex directed laterad, with a contiguous

<sup>2</sup>*surinamensis* has four.

<sup>3</sup>Absent in *ramosa*.

<sup>4</sup>*lapponica* more acutely parabolic.

<sup>5</sup>*novboracensis* has four to five.

plate lying laterad and caudad of it; *episternal sclerame* surrounding the anterior and lateral coxal margins; *epimeron* narrow, elongate, located adjacent to lateral coxal margin; *basisternum* soft, lighter in color and furnished with a small, central group of fine setae; *sternal plate* of first abdominal segment trapezoidal, accompanied on each side by a small rounded sclerite near lateral, sternal margin.

*Ventral shields* (fig. 2, VS) on abdominal segments two to eight inclusive similar to those of the dorsum; the lateral margins never extend beyond inner margin of spiracular *peritreme*; posterior margin furnished with a row of strong setae, surface sparsely setose.

#### SPECIFIC DESCRIPTIONS

##### *Silpha americana* L.

Twenty-five full-grown larvae; thirty immature larvae and numerous cast skins collected by the writer in College Park, Md., May 3 to September 1, 1939, around various carrion.

*Egg* when freshly laid ovoidal, chorion smooth and cream-colored with slight greenish tinge; about 3.12 mm. long and 2.27 mm. wide.

Length of *first instar larva* about 7.00 to 7.80 mm.; extreme width of metathorax about 3.00 to 3.80 mm. Length of *full-grown larva* about 24.00 to 25.00 mm.; extreme width of metathorax about 7.00 mm.; dorsum of mature larva black, sternum a grayish-black. Extreme width of *cranium* of first instar larva about 1.90 mm. Extreme width of *cranium* of mature larva about 3.10 mm.

Surface of *epicranium* reticulate; with a few very small setae. *Frons* more tuberculate, punctate, bearing several setae in each *anterior frontal angle* near antennal suture. *Frontal sutures* gradually concave anteriorly, extending posteriorly to a rounded, abrupt curve thence caudad to define a broadly U-shaped area; *posterior frontal angle* nearly 180°, located opposite the dorsal ocellar group; *epicranial suture* about two-fifths the length of the head. *Clypeus* with three setae on each half, one located near clypeo-labral suture near sagittal line of head, one located on lateral clypeal margin two-thirds the distance from posterior to anterior margin, and one located laterad and slightly caudad of first mentioned seta. *Labrum* with a wide carina on each side parallel with sloping lateral margin and one central carina perpendicular to clypeo-labral suture.

*Antenna* about as long as distance between inner, anterior region of bases of antennal sockets; first two segments about equal in length; *sensory area* consisting of irregular, oval, semi-transparent, plate-like spots; third segment most setose, tapering to a rather blunt apex, about four-fifths as long as other two segments, but only two-fifths as wide as anterior end of second. *Mandible* about as long as distance on epicranium between posterior, dorsal margin and base of antennal socket. Comb-like row of spines on *lacinia* consisting of twelve to thirteen hamate spines. *Maxillary palpus* sparsely setose; second segment clavate, broadest of the three; third segment subulate and the longest. Distal and proximal sclerites of *prementum* each bearing two strong setae

on each half and several small ones. *Labial palpus* with clavate first segment about twice the length of subulate second. *Second porous area* (fig. 30, IIPA) of *epipharynx* with each proximal pore provided with two openings. *Glossa* (fig. 12, GL) with rounded anterior margin; cleft about as deep as width of glossa (fig. 13, LCT).

Anterior inner margin of *prothoracic shield* furnished with a small, strong setae on each side; posterior margin of *dorsal shield* with four strong setae.

*Vrogomphus* with first segment slightly concave along inner margin, about equal in length to tenth abdominal segment, with three strong setae on apical portion and numerous small setae on remainder of surface; second segment very small, bluntly subulate, only one-sixth as long as first, with two apical setae and several minute ones on remainder of surface.

##### *Silpha inaequalis* Fab.

Thirty full-grown larvae, forty immature larvae, one pupa and numerous cast skins collected by the writer in College Park, Md., May 3 to September 1, 1939, around various carrion.

*Egg* when freshly laid sub-globular, chorion cream-colored with greenish tinge, pitted with numerous shallow indentations; about 1.59 mm. long and 1.31 mm. wide.

Length of *first instar larva* about 5.68 mm.; extreme width of *metathorax* about 2.69 mm. Length of *full-grown larva* about 16.61 mm.; extreme width of *metathorax* about 5.60 mm. Extreme width of *cranium* of first instar larva about 1.27 mm. Extreme width of *cranium* of mature larva about 2.03 mm.

*Epicranium* tuberculous, rather sparsely setose, with a row of setae immediately caudad of posterior region of frontal sutures. *Frontal suture*, *maxillary palpus* and *second porous area* of *epipharynx* similar to that of *americana*. *Frons* tuberculous with three strong setae in each *anterior frontal angle* and several smaller ones on remainder of surface. *Clypeus* with six strong setae on each side in anterior and lateral region accompanied by numerous smaller ones. *Labrum* similar to that of *americana*, but lacking the lateral carinae, being furnished instead with a small, rounded carina cephalad and slightly laterad of central carina on each half.

*Antenna* about as long as the distance between inner, anterior bases of antennal sockets; first and third segments about equal in length, second the longest; *sensory area* in form of a short, blunt cone about as high as width at base. *Mandible* about four-fifths as long as the distance on epicranium between posterior dorsal margin and the base of antennal socket. Comb-like row of spines on *lacinia* consisting of ten to eleven slightly hamate spines. *Distal sclerite* of prementum with two strong setae on each half and several smaller ones; *proximal sclerite* with three strong setae on each side and several smaller ones. *Labial palpus* with subulate second segment about two-fifths the length of clavate first. *Glossa* (fig. 15) with anterior margin rounded; cleft about one-half as deep as width of glossa.

Anterior inner margin of *prothoracic shield* furnished with two small, strong setae on each side.

*Urogomphus* about equal in length to tenth abdominal segment; first segment slightly concave along inner margin, with several small, strong setae on apical portion and numerous smaller ones on remainder of surface; second segment about three-tenths as long as first, bluntly subulate with two apical setae and several minute ones on remainder of surface.

*Dorsal shield* with one oblique marking (fig. 8) in anterior lateral region; posterior margin with five to seven strong setae.

*Pupa* similar to that of *noveboracensis*; pupal skin too badly mutilated after emergence of adult to permit accurate description.

#### *Silpha noveboracensis* Forst.

Thirty-five full-grown larvae, forty-five immature larvae, one pupa and numerous cast skins collected by the writer in College Park, Md., May 3 to September 1, 1939, around various carrion.

*Egg* when freshly laid sub-globular, chorion smooth, cream-colored with slight greenish tinge; about 1.76 mm. long and 1.31 mm. wide.

Length of *first instar larva* about 5.60 mm.; extreme width of *metathorax* about 2.70 mm. Length of *full-grown larva* about 14.50 mm.; extreme width of *metathorax* about 6.20 mm. Extreme width of *cranium* of first instar larva about 1.20 mm. Extreme width of *cranium* of mature larva about 2.00 mm.

The following parts as in *inequalis*: *Epicranium*, *frons*, *frontal sutures*, setation of *clypeus*, *labrum*, *antenna*, *mandible*, *maxillary* and *labial palpi*, *second porous area* of *epipharynx*, *sclerites* of *prementum*; anterior inner margin of *prothorax*.

Comb-like row of spines of *lacinia* consisting of ten slightly hamate spines. *Glossa* (fig. 18) with anterior margin rounded; cleft about as deep as width of glossa. *Dorsal shield* with two oblique, linear markings (fig. 7), one on dorsal and one on ventral surface; posterior margin with seven to eight strong setae.

*Pupa* exarate, slightly arcuate, cream-colored; extreme length about 13.20 mm.; extreme width of prothorax about 5.68 mm.

*Abdomen* gradually tapering; with nine segments, eight of them complete, but the sternum of the first missing; ninth segment small, furnished with two fleshy *cerci* each with a long, apical spine; two small annulated processes immediately ventral to *anus*; each lateral margin of abdominal segments two to seven inclusive, with a lateral process bearing a long, slender spine.

*Spiracles* on first eight abdominal segments. *Head* concealed when body is viewed dorsally; longer than wide; *vertex* rounded. *Epicranium* and *frons* furnished sparsely with small setae. *Labrum* deeply emarginate. *Pronotum* sub-trapezoidal with lateral margins well-rounded; posterior margin with a wide, even, central extension (fig. 55); anterior margin with two pairs of long, slender spines; posterior margin furnished

with a row of fine setae; remainder of pronotal surface thickly furnished with small setae, denser along margin. *Scutellum* of mesothorax large, triangular; scutellum of metathorax broadly triangular and partially obscured by that of mesothorax.

#### *Silpha ramosa* Say

One full-grown and one immature larva from vial marked "Tenino Wash., May 29, 1892, under stones in a meadow." Collector unknown.

*Egg* unknown. *First instar larva* unknown.

Length of *full-grown larva* about 20.50 mm.; extreme width of *metathorax* about 5.60 mm. Extreme width of *cranium* of mature larva about 2.40 mm. *Epicranium* and *frons* slightly punctate, reticulate and sparsely setose. Three strong setae borne in each *anterior frontal angle*; mesad of these is located a row of three strong setae on each side. *Frontal sutures* similar to those of *americana* except the *posterior frontal angle* which is slightly less than 180°. *Clypeus* with a row of five strong setae on each side adjacent to anterior margin; one smaller seta on each lateral margin and numerous small setae on remainder of surface. *Labrum* as in *inequalis* except that the arms of the lateral L-shaped marking are much wider. *Antenna* slightly longer than extreme width of *cranium*; second segment shortest and third segment longest of the three; *sensory area* as in *americana*; segments furnished with very fine setae; those of the second segment slightly stronger. Length of *mandible* about one-half the extreme width of head. Comb-like row of spines on *lacinia* consisting of eleven to twelve subulate spines. *Maxillary* palpus similar to that of *americana*. *Sclerites* of *prementum* with arrangement of setae as in *americana*. *Labial palpus* as in *americana* except that second segment is about three-fifths the length of the first. *Second porous area* of *epipharynx* consisting of one bi-porous area on each side. Central *reclangular spines* on anterior epipharyngeal margin lacking. *Glossa* (fig. 21) flattened anteriorly; with rounded, inner anterior angle, outer anterior angle more acute; cleft not quite as deep as width of glossa. Anterior inner margin of *prothoracic shield* furnished with one small, strong seta and numerous smaller ones on each side; posterior margin of *dorsal shield* with four strong setae.

*Urogomphus* with single segment furnished with one strong apical seta and numerous smaller ones on remainder of surface; shorter than tenth abdominal segment.

*Pupa* unknown.

#### *Silpha lapponica* Hbst.

One full-grown larva from vial marked "San Jose, Calif.;" collector, host and date of collection unknown.

*Egg* unknown. *First instar larva* unknown.

Length of *full-grown larva* about 17.00 mm.; extreme width of *metathorax* about 4.60 mm. Extreme width of *cranium* of mature larva about 2.20 mm.

*Epicranium* reticulate, slightly tuberculate, sparsely setose. *Frons* reticulate and sparsely setose; furnished with three strong setae in each anterior frontal angle. *Frontal sutures* similar to those of *americana*, but more narrowly U-shaped. *Clypeus* with two strong setae on each half near anterior margin; one seta on each lateral margin; remainder of surface sparsely furnished with small setae. *Labrum* as in *inequalis*.

*Antenna* about as long as width of posterior margin of clypeus; first and third segments about equal in length; second segment longest of the three; sensory area as in *inequalis*; segments sparsely setose. *Mandible* slightly shorter than width of proximal margin of labrum. Comb-like row of spines on *lacinia* consisting of ten slightly hamate spines. *Maxillary palpus* similar to that of *americana*. Arrangement of setae on sclerites of *prementum* as in *americana*. *Labial palpus* similar to that of *americana*. *Second porous area of epipharynx* consisting of a tri-porous area on each side. *Glossa* (fig. 24) with flattened anterior margin, anterior angles well rounded; cleft slightly deeper than width of glossa.

Anterior inner margin of *prothoracic shield* furnished with two setae, one strong, one smaller, on each side; posterior margin of *dorsal shield* furnished with two strong setae.

Tenth abdominal segment about three-fifths the length of first segment of *urogomphus*; second segment of *urogomphus* small; both segments sparsely furnished with small, strong setae.

*Pupa* unknown.

#### *Silpha surinamensis* Fab.

Four full-grown larvae and one immature larva from vial marked "Michipicoten Island, L. Sc., July, 1876, in fish offal"; collector unknown.

*Egg* unknown. *First instar larva* unknown.

Length of *full-grown larva* about 26.00 mm.; extreme width of *metathorax* about 6.10 mm. Extreme width of *cranium* of mature larva about 2.70 mm.

*Epicranium* tuberculate, sparsely furnished with scattered setae. *Frons* tuberculate, very sparsely setose; two strong setae borne in each anterior frontal angle. *Frontal sutures* similar to those of *americana*. *Clypeus* short and broad, furnished with setae as in *lapponica*, but with two additional setae located rather centrally on anterior margin. *Labrum* somewhat similar to that of *inequalis*, but directed rather sharply ventrad. *Carinae* not prominent.

*Antenna* slightly longer than width of anterior margin of clypeus; first segment longest and widest of the three; second segment slightly longer than third; third subulate and less than one-half as wide as apex of second; *sensory area* a minute, very blunt cone; all three segments sparsely setose.

*Mandible* about as long as combined length of first and second antennal segments. Comb-like row of spines on *lacinia* consisting of nine spines. *Maxillary palpus* with segments about equal in length and sparsely setose; third subulate and much narrower than other two.

*Sclerites of prementum* with arrangement of setae as in *americana*. *Labial palpus* with first segment clavate; second segment subulate and only two-fifths as long as first; both segments without setae. *Second porous area* (fig. 34) of epipharynx consisting of three pores on each side. *Glossa* (fig. 27) with rounded anterior margin; cleft about one-third as deep as width of glossa. Anterior inner margin of *prothoracic shield* without prominent setae; posterior margin of *dorsal shield* with four to five strong setae.

Tenth abdominal segment about two-fifths as long as first segment of *urogomphus*; second segment of *urogomphus* about one-sixth the length of the first; first segment furnished with small, strong setae, the bluntly subulate second segment very sparsely setose.

*Pupa* unknown.

#### KEY SEPARATING THE LARVAE OF SILPHA

1. *Urogomphus* with one segment.
  - Third antennal segment longer than second; sensory area on second antennal segment in form of plate-like spots (p. 129)..... *ramosa*
2. *Urogomphus* with two segments.
  - A. *Urogomphus* longer than tenth abdominal segment..... (1)
    - (1) *Urogomphus* more than twice the length of tenth abdominal segment; first segment of labial palpus at least three times the length of second; labrum directed sharply ventrad (p. 130)..... *surinamensis*
    - (2) *Urogomphus* not twice the length of tenth abdominal segment; first segment of labial palpus not three times length of second..... (a)
      - (a). Ligular lobes rounded anteriorly; sensory area on second antennal segment plate-like; usually black in color (p. 126), *americana*
      - (b). Ligular lobes more flattened anteriorly; sensory area on second antennal segment a very small, blunt cone (p. 129)..... *lapponica*
  - A.A. *Urogomphus* not longer than tenth abdominal segment..... (1)
    - (1). Sensory area on second antennal segment bluntly conical in form and definitely extending erect from the surface at least as high as width at base; third segment of maxillary palpus slightly longer than second; dorsal shields not overlapping; shields with one oblique marking in anterior, distal portion; terga not marked with prominent dark spots (p. 127)..... *inequalis*
    - (2). Dorsal shields closer together and often overlapping; shields with two oblique, linear markings; terga marked with evenly arranged, prominent, dark spots; otherwise same as (1) A.A. (p. 128), *novaboracensis*

#### SUMMARY

The foregoing study has revealed a number of rather distinctive generic characteristics as well as characters which are definitive for each species. The external anatomy of the larvae of the genus *Silpha*, generally speaking, is similar. The variation in the structure of certain anatomical parts is obvious enough, in most cases, to permit of rather easy separation of the species. The characters of the internal and external mouthparts and the tenth abdominal segment together with the accompanying appendages of the ninth proved to be most useful for

taxonomic purposes. The structure of the epi- and hypopharyngeal regions suggests that the careful study of corresponding regions in other Staphylinoidae might prove to be helpful in future taxonomic investigations among those larvae.

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EXPLANATION OF PLATES<sup>6</sup>

## PLATE I

Fig. 1, *Silpha americana* L. Dorsal view. 2, *Silpha americana* L. Ventral view. 3, *Silpha noveboracensis* Forst. Ninth and tenth abdominal segments, ventral view. Anal processes everted. 4, *Silpha surinamensis* Fab. Ninth and tenth abdominal segments, dorsal view. 5, *Silpha ramosa* Say. Ninth and tenth abdominal segments, dorsal view. 6, *Silpha lapponica* Hbst. Ninth and tenth abdominal segments, dorsal view. 7, *Silpha noveboracensis* Forst. Dorsal shield, dorsal view. 8, *Silpha inaequalis* Fab. Dorsal shield, dorsal view. 9, *Silpha americana* L. Ninth and tenth abdominal segments, dorsal view. 10, *Silpha noveboracensis* Forst. Ninth and tenth abdominal segments, dorsal view. 11, *Silpha inaequalis* Fab. Ninth and tenth abdominal segments, dorsal view.

## PLATE II

Fig. 12, *Silpha americana* L. Labium, dorsal view. 13, *Silpha americana* L. Labium, ventral view. 14, *Silpha americana* L. Labium, lateral view. 15, *Silpha inaequalis* Fab. Labium, dorsal view. 16, *Silpha inaequalis* Fab. Labium, ventral view. 17, *Silpha inaequalis* Fab. Labium, lateral view. 18, *Silpha noveboracensis* Forst. Labium, dorsal view. 19, *Silpha noveboracensis* Forst. Labium, ventral view. 20, *Silpha noveboracensis* Forst. Labium, lateral view. 21, *Silpha ramosa* Say. Labium, dorsal view. 22, *Silpha ramosa* Say. Labium, lateral view. 23, *Silpha ramosa* Say. Labium, ventral view.

## PLATE III

Fig. 24, *Silpha lapponica* Hbst. Labium, dorsal view. 25, *Silpha lapponica* Hbst. Labium, ventral view. 26, *Silpha lapponica* Hbst. Labium, lateral view. 27, *Silpha surinamensis* Fab. Labium, dorsal view. 28, *Silpha surinamensis* Fab. Labium, ventral view. 29, *Silpha surinamensis* Fab. Labium, lateral view. 30, *Silpha americana* L. Labrum, ventral view showing epipharynx. 31, *Silpha inaequalis* Fab. Labrum, ventral view showing epipharynx. 32, *Silpha lapponica* Hbst. Labrum, ventral view showing epipharynx. 33, *Silpha ramosa* Say. Labrum, ventral view showing epipharynx. 34, *Silpha surinamensis* Fab. Labrum, ventral view showing epipharynx. 35, *Silpha noveboracensis* Forst. Labrum, ventral view showing epipharynx. 36, *Silpha inaequalis* Fab. Mandible, ventral view. 37, *Silpha ramosa* Say. Mandible, ventral view.

## PLATE IV

Fig. 38, *Silpha americana* L. Mandible, dorsal view. 39, *Silpha americana* L. Mandible, ventral view. 40, *Silpha surinamensis* Fab. Mandible, ventral view. 41, *Silpha lapponica* Hbst. Mandible, ventral view. 42, *Silpha noveboracensis* Forst. Mandible, ventral view. 43, *Silpha americana* L. Head, dorsal view. 44, *Silpha americana* L. Head, ventral view. 45, *Silpha noveboracensis* Forst. Head, dorsal view. 46, *Silpha noveboracensis* Forst. Head, ventral view. 47, *Silpha inaequalis* Fab. Head, ventral view. 48, *Silpha inaequalis* Fab. Head, dorsal view. 49, *Silpha lapponica* Hbst. Head, dorsal view. 50, *Silpha lapponica* Hbst. Head, ventral view.

## PLATE V

Fig. 51, *Silpha ramosa* Say. Head, dorsal view. 52, *Silpha ramosa* Say. Head, ventral view. 53, *Silpha surinamensis* Fab. Head, dorsal view. 54, *Silpha surinamensis* Fab. Head, ventral view. 55, *Silpha noveboracensis* Forst. Pupa, dorsal view. 56, *Silpha noveboracensis* Forst. Pupa, ventral view. 57, *Silpha americana* L. Maxilla, ventral view. 58, *Silpha americana* L. Metathoracic leg viewed from the front.

<sup>6</sup>All drawings were made by the writer.

ABBREVIATIONS USED ON THE FIGURES

- A*, anus.  
*AFA*, anterior frontal angle.  
*ANP*, annulated process.  
*ANT*, antenna.  
*AP*, anal process.  
*AS*, antennal socket.  
*B*, base of mandible.  
*C*, cercus.  
*CD*, cardo.  
*CFS*, clypeo-frontal suture.  
*CLP*, clypeus.  
*CLS*, clypeo-labral suture.  
*CX*, coxa.  
*DOC*, dorsal ocelli.  
*DS*, dorsal shield.  
*DT*, dorsal spots of distal tentorial arms.  
*EP*, epipharynx.  
*EPC*, epipharyngeal cleft.  
*EPM*, epimeron.  
*ES*, epicranial suture.  
*ESTSC*, episternal sclerome.  
*FEM*, femur.  
*FR*, front.  
*FS*, frontal suture.  
*GA*, galea.  
*GL*, glossa.  
*GU*, gula.  
*HB*, hypopharyngeal bracon.  
*HPHY*, hypopharynx.  
*HPHYS*, hypopharyngeal sclerome.  
*HR*, hypopharyngeal rod.  
*INL*, incisor lobe of mandible.  
*LB*, labium.  
*LBPLP*, labial palp.  
*LC*, lacinia.  
*LCT*, ligular cleft.  
*LEG*, leg.  
*LIG*, ligula.  
*LM*, labrum.  
*MD*, mandible.  
*MS*, mesothoracic shield.  
*MT*, mentum.  
*MTS*, metathoracic shield.  
*MXPLP*, maxillary palp.  
*IPA*, first porous area of epipharynx.  
*IIPA*, second porous area of epipharynx.  
*PFA*, posterior frontal angle.  
*PLP*, palp.  
*PMT*, postmentum.  
*PNT*, pronotum.  
*POC*, postociput.  
*POS*, postoccipital suture.  
*PRMT*, prementum.  
*IPRMT*, anterior subdivision of prementum.  
*IIPRMT*, posterior subdivision of prementum.  
*PS*, prothoracic shield.  
*PSCL*, presternal sclerome.  
*PSTPL*, sternal plate of prothorax.  
*PT*, tentorial pits.  
*QPA*, quinque-porous area of epipharynx.  
*RS*, rectangular spine.  
*SA*, sensory area.  
*SCT*, scutellum.  
*SP*, spiracle.  
*ST*, stipes.  
*T*, tergum.  
*TAR*, tarsungulus.  
*TIB*, tibia.  
*TR*, trochanter.  
*UG*, urogomphus.  
*VOC*, ventral ocelli.  
*VSS*, ventral shield.  
*W*, wing.







