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Aquatic Stages of Stratiomys normula unilimbata Loew. (Diptera: Stratiomyiidae)

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Aquatic stages of Stratiomys normula unilimbata *Loew. (Diptera: Stratiomyiidae)*

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ABSTRACT — A study of the life cycle and behavior of the *Stratiomys normula unilimbata* Loew. in a pond in Itasca State Park, Minnesota, showed that larvae overwinter in the bottom of the shallow pond and emerge in July. Some of the mortality factors are suggested, including the ichneumonid parasite, *Ceratophygadeuon* sp., reared from the larva and drowning of the pupa following a sudden increase in water level. Drastic reduction of the water level would also result in larval mortality.

This fly was originally described as the species, *Stratiomyia unilimbata* Loew, with later synonyms, *Stratiomys jonesi* and *Stratiomys unilimbata jonesi.* James and Steyskal (1952) reduced this to a subspecies, *Stratiomys normula unilimbata* Loew, and described it as a western form occurring commonly in the great plains.

Reference to the larva of this species as *Stratiomyia normula* is made by Johannsen (1922) who separates it from others by use of a taxonomic key. Johannsen (1935) also makes a very brief mention of *S. normula* but adds no information about its morphology or ecology. Even though the adult has been identified and described as a subspecies the larva remains, as yet, unseparated from other members of the species. The adult of this species was identified by Dr. Edwin Cook, University of Minnesota, St. Paul.

This study was undertaken during the late spring of 1969, on a population of *Stratiomys normula unilimbata* found at the site of a pond that was created by an old gravel pit excavation in Itasca State Park, just off the campus of the University of Minnesota Forestry and Biological Station. The pond is on the periphery of a gravel pit, and during the summer is about 70 feet long and 25 feet wide. It reaches a width of 2 to 3 times the summer dimension during the early spring but this is very shallow and soon it withdraws to about its stable size. It is about 1½ feet deep with a vertical bank on the north side, and gradually decreases to the south edge. Even so, except in the spring, the south margin rarely fluctuated over one foot on each side of the markers established in early June. The water was very clear, and *Typha* grew along the margins as well as in some on the more shallow regions of the pond. As the summer progressed an increasing amount of *Cladophora* and *Lemma minor* was evident. The most conspicuous aquatic fauna snail, *Lymnea,* several species of Odonata naiads. Cladocera and Notonectidae. There was also a large population of tadpoles of *Rana pipiens.*

The habitat of the *Stratiomys* larvae was specifically along the south shoreline of the pond. The larvae were found along the water line where they were often covered with plant materials (esp. *Lemma*) and settling debris after receding of the shore line. In one instance 75% of larvae were found in the wet sand between water and 8″ away from it. They were also common in the water to a depth of about 2 inches. After late June the larvae were also found in the floating *Cladophora* mats that grew along the periphery of the pond but extended into depths greater than 2 inches. (Note photograph of larva in Fig. 1). Pupae were also commonly found in these mats. It is believed that considerable mortality occurred to pupae in situations where the water receded so the *Cladophora* mat settled on the ground and became fixed. After the next rain and a rising of the water level occurred the mat frequently adhered to the ground and became covered with one or two inches of water. In this situation several floating pupae (alive) were found, but also many dead pupae below the surface of the water in the mats.

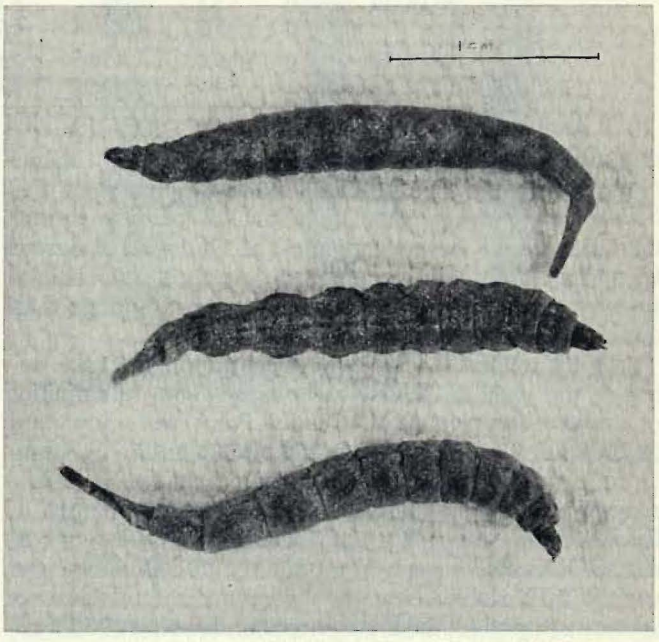

FIGURE 1—Last instar larvae of *S. normula unilimbata.* Scale line on photo = 1 cm.

The early instar larvae are subjected to predation by dragonfly naiads and very likely by dytiscid larvae and other insects and birds in the area. During the summer 78 adults were reared. There were two ichneumonid parasites that emerged from last instar larvae. These were *Ceratophygaduon* sp. (Acknowledgment of determination is hereby made to R. W. Carlson, Smithsonian In-

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stitution). They emerged by boring a found hole in the dorsum of the 3rd thoracic somite. They emerged just following the peak of the adult *Stratiomys* emergence in mid-July. (Table 1). During this period several adults of this parasite were collected on vegetation in the vicinity of the pond.

The larvae are exposed to great temperature fluctuations. Temperatures were not taken in the immediate vicinity of the larvae found above the water line, but the temperature in the shallow water adjacent to larvae reached 108 degrees F. (shaded thermometer) on July 14 at 3 p.m. It reached at least 100 degrees on several other days also. During this time there was much larval activity.

The larvae move actively on wet shortlines and in water less than 2 inches deep. They will often live suspended with their heads in the bottom sediments and their bodies almost vertical, to allow the respiratory tube to reach the surface of the water. In deeper water a bubble of air will always be found at the end of the respiratory tube. This bubble seems to be held in place by the hairs surrounding the aperture (Johannsen 1935). It is probable that the bubble acts as a "lung" in allowing exchange of gases from the surrounding water.

It was found that larvae could be reared experimentally in a jar of pond water. The larvae surfaced occasionally but lived at the bottom of the deep container in the pond soil. A few larvae pupated, after which time they began to float, and later emerged in the water. In the experimental group a screen was placed below the surface of the water, to prevent the larvae from surfacing. These larvae held the small respiratory "bubble" for about 2 days, but lost it and were drowned within 3 days. Prior to drowning the larvae attempted to surface quite frequently.

The larvae are very active and move extensively prior to pupation. This crawling is achieved by placing the head in the sand and pulling forward by bringing the head under the body. At a temperature of 70° F. this was repeated about 40 times in a minute. Their normal activity at this time is to crawl out of the water and pupate in the wet sand near the edge of the water. They tunnel into the sand until they achieve a position as

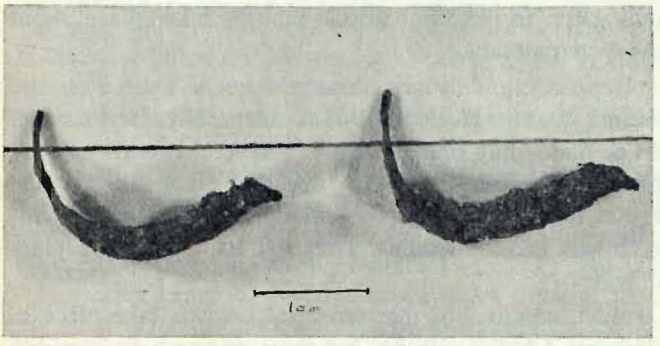

FIGURE 2. Pupa of *S. normula unilimbata. Horizontal* line represents surface of soil. Scale line on photo = 1 cm.

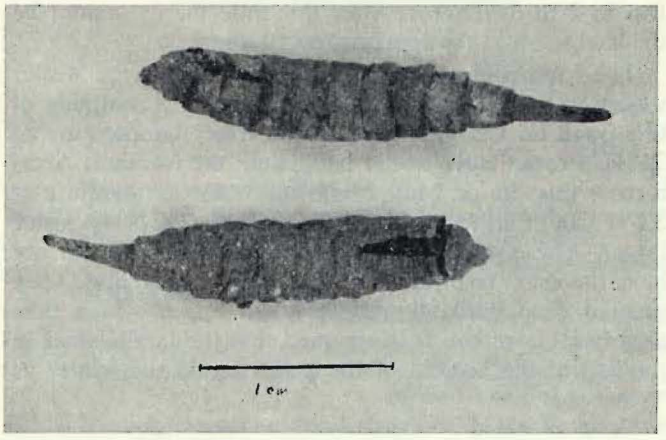

FIGURE 3—Pupa of *S. normula unilimbata* showing typical emergence opening. Scale line on photo = 1 cm.

shown in Fig. 2. During the period of pupation, which, depending on the temperature to which the individual is exposed, lasts approximately 12 days, the pupa often appears to dry rather severely. It appears that during this period the species is capable of withstanding severe drying with no adverse effect. Pupation occurs within the last larval exoskeleton, and is recognized by a recurving of the caudal end (as can be seen by comparison of larval and pupal photographs). At this time the exoskeleton becomes hard and lifeless. The anterior end of pupa is formed behind the mesothoracic somite and does not extend into the most caudal 3 or 4 somites of the abdomen.

Adult emergence is accomplished by splitting the exuvium in an "I" fashion, with the anterior cross-bar being at the front ¼ of the mesonotum and the caudal bar being in the anterior ¼ of the first abdominal tergite (Fig. 3). It then digs through about ⅓ inch of sand to the surface to escape. The newly emerged fly crawls about actively for a minute or so (until finding a stem or leaf to ascend). It quickly expands its wings so it appears per-

TABLE 1. Emergence Record of Adult *Stratiomys*, July 1969.

Date	No. of ♂	No. of ♀	Cumulative Totals ♂	Cumulative Totals ♀
4	1	1	1	1
5	0	1	1	2
6	2	2	3	4
7	1	0	4	4
8	3	5	7	9
9	3	2	10	11
10	3	4	13	15
11	2	5	15	20
12	3	5	18	25
13	0	1	18	26
14	4	2	22	28
15	2	7	24	35
16*	4	5	28	40
17	2	3	30	43
18	1	1	31	44
19	1	0	32	44
20	0	0	32	44
21	1	0	33	44
22	0	0	33	44
23	0	1	33	45

* emergence of parasites.

fect in 2 to 3 minutes. After this time the fly cannot be induced to move for another 5 to 10 minutes.

The succeeding generation of larvae enter the winter season in the last or next to the last instar. (Sampling of this pond on October 19 with the water temperature at 38°F. showed more of the latter than the former). A return to this site on May 1 with the water temperature at 32° F. and thin ice on the surface yielded two last instar larvae. These were in about 3½" of water and did not have the usual respiratory bubble at the caudal end. They seemed dead until allowed to warm up, at which time they became active. It is assumed that the larvae were in the soil of the bottom of the pond during the winter as this shallow body of water certainly freezes through to the bottom.

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ENTOMOLOGY

Terrestrial isopods of Minnesota

JAMES E. SARGENT*

ABSTRACT — Eight species of terrestrial isopods (sub-order Oniscoidea) were collected in Minnesota. Six of them had not been recorded previously. Observations on habitat, distribution, size and coloration were noted. An analytical key to the species within the state is included.

Because of their abundance and wide-spread distribution, the terrestrial Isopoda (sub-order Oniscoidea) are familiar to many people, if only by visual recognition (Figures 1-b and 2). Prior to this study, little was known of the isopods of Minnesota. Arcangeli (1932) reported finding *Cylisticus convexus* (DeGeer) at St. Paul and Frontenac; and Gunderson (1962) collected *Tracheoniscus rathkei* (Brandt) at Stillwater.

The purpose of this study in 1971 was to determine what species commonly occur in the state and to record observations concerning their natural history and distribution. Specimens were collected in a short search of an area. These and unidentified specimens in the Entomology museum at the University of Minnesota were identified on the basis of descriptions in Van Name (1936) and Hatchett (1947). The museum specimens are summarized in Table I.

The specimens collected in this study, besides those listed in Table I, included *Armadillidium nasatum* Budde-Lund and *Oniscus asellus* Linnaeus (Table II.). (Figures 1-a-1-c). These findings indicate distribution within counties of all the species recorded and collected. An analytical key to the species found in Minnesota accompanies this paper.

Biology of terrestrial isopoda

Isopods make up a large part of the Class Crustacea. The external anatomy of the terrestrial isopods is characterized by a permeable cuticle and fourteen legs. The name "Isopoda," meaning "equal feet," is more accurate descriptively for the terrestrial isopods than for the aquatic isopods.

Since these crustaceans live on land, their water balance must be protected. Commonly they will live in damp places, where there is less loss of moisture through their pseudotrachea and gills (Figs. 1-d, 1-e). Aggregation is not uncommon in suitable places, or as a mans to conserve moisture (Allee, 1926). Some species can also roll up and are thus called "pillbugs" (Fig. 2). This may also retard dessication. Molting is an especially crucial event because of the possibility of large water losses. Eggs and young are kept moist in a brood pouch until they are born alive. As they grow they molt, but only half of the cuticle at once. The split occurs between the fourth and fifth segments of the thorax with the posterior half first and then the anterior half up to several days later. In the adult isopod molting takes place about every two months.

Reproduction usually does not begin until after the second year (Heeley, 1941). Generally, fertilization takes place only once a year but several broods may be produced. Heeley (1941) observed that an average brood for *P. scaber* was 24 individuals and for *A. vulgare* was 113 individuals. They live to about three years of age.

Most activities of the terrestrial isopods take place in darkness (Abbot, 1918), but their response to humidity levels is stronger than their reaction to light. (Waloff, 1941). The preference for damp habitats varies between

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