

Thesis for Master of Science Degree

Title

Life Histories and Descriptions of some Colorado SYRPHIDAE of the ERISTALINAE Group, namely, Eristalis meigani Weid., Eristalis latifrons Loew, and Helophilus latifrons Loew.

by

Jack Manweiler

Respectfully submitted in partial fulfillment of the requirements for the Degree of Master of Science in Entomology at the Colorado Agricultural College, May 1, 1933.

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ENTITLED Life Histories and Descriptions of some Colorado SYRPHIDAE of the ERISTALINAE Group, namely, Eristalis meiganii Weid., E. latifrons Loew, and H. latifrons Loew.

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MAJORING IN Entomology

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FOREWORD

I wish to express my appreciation and hearty thanks for the kind assistance and cooperation of various members of the Entomology Department, to Dr. C. P. Gillette, and especially to Dr. C. R. Jones, under whose direct supervision this work was completed. Without his assistance, suggestions, contributions, and equipment, this project could not have been successfully completed.

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Introduction

The family SYRPHIDAE is one of the largest and most interesting in the order DIPTERA, and has attracted a great deal of attention in late years from many workers in the field of entomology. In this family there are approximately three hundred described species which constitute sixty genera. The group as a whole is very beautifully and boldly marked in the brightest of contrasting colors. Some of them have bright cross-bands upon the abdomen varying from a pale yellow to the most brilliant orange, alternating with bands of deep black. In some species the abdomen is entirely lustrous, and in others it is opaque. The thorax is also very beautifully marked and varies in the individual species from a dull greenish-grey color throughout to an alternation of black and yellowish-grey stripes running longitudinally with the body. Most species of this family are covered with pile of a black or yellow color. This family of insects is easily recognized by a thickened membrane of the wing known as a spurious vein and which runs longitudinally between the radial and medial veins. These flies have a great diversity of habit, and can be seen in warm spring and summer days hovering about host flowers, or darting here and there in short, swift spurts of flight, either silently or with a loud buzzing noise. Some members of this fam-

ily hover in the air in one place for a long period of time, and have been called hover flies as a result of this peculiar habit. Others seldom hover in mid-air, but are constantly on the wing moving about from plant to plant. Comstock says, (2), "Many of them mimic hymenopterous insects, thus some species resemble bumblebees, others the honey bee, and still others wasps; while some present but little resemblance to any of these". One species of fly looks very much like the male honey bee, and has been commonly known as the drone fly. The adult flies feed entirely upon the nectar and pollen of practically all varieties of flowers, but prefer some flowers to others. This can be seen by the large number of flies that frequent a certain type of flower in comparison to a few that frequent another type. The larvae of this family are as diversified as are the adults in structure as well as in habit. A generalized description cannot be given due to this diversity in structure. However, the larvae fall into two classes, those that are aphidophagus, and those that are aquatic. These latter larvae are known as the "rat-tailed" larvae, because they have a tail-like appendage through which they breathe that resembles the tail of a rat in miniature very closely in external appearance, and live in stagnant pools of water filled with decaying organic material and minute

organisms of many kinds.

Syrphid flies are exceedingly hard to raise, chiefly because their natural habitat is so hard to reproduce under artificial conditions. Even though the greatest care is exercised in handling these insects, the mortality rate is very high.

Object

The object of this project is to determine the entire life histories of the following insects:- Eristalis meiganii Weid., Eristalis latifrons Loew, and Helophilus latifrons Loew. The life cycles will include the habits, descriptions, duration, food, and etc. of the above named species. There has been very little work done on the above, and there is consequently a dire need for such a contribution. I wish to place this material before the students of Entomology.

History

Due to the fact that the majority of the members of this family are not considered as pests in any sense of the word, the history remains a trifle barren. Williston, in 1886, published an extended monograph of North American Syrphidae. The ERISTALINAE group was recognized in Europe before it was recognized in America.

Systematic Position

Practically all classifications are based upon the degree of specialization that is found in the various orders of any given class. There are, of course, differences of opinions as to the exact position each order should hold, varying with the person's viewpoint who compiled the classification. The general trend is to place any given order in an approximate position with relation to the other orders. The order DIPTERA is usually considered a highly specialized one.

Procedure

The entire problem must be carefully considered before work is commenced in order to better meet any emergencies arising during the course of the project. All artificialities which might have a direct bearing upon the development of the insects should be excluded as far as possible. The equipment used in this project was as follows:- Collecting net, temporary retention cages, permanent retention cages, feeding dishes, Syracuse dishes, petrie dishes, delicate paint brush, tweezers, scissors, metric rule, dropper, binoculars, and cards upon which to enter data.

When at the highest peak of work of the season, 18 petrie dishes were filled with larvae. It was nec-

essary to look at each dish twice daily and enter data upon the provided cards. Of the thirty odd attempts made to rear aquatic larvae, only three different species were reared to maturity. Several "batches" of Helophilus latifrons Loew were reared and more than one of each of the two remaining species. The petrie dishes were replenished with stagnant water daily.

The adults were fed a thick sugar solution. This was kept in a small bottle and tightly corked between the intervals of feeding to keep bacterial growth from starting. The most satisfactory dish used in feeding the adults was designed by Dr. C. R. Jones. This consisted of a small tube filled with sugar-water and inverted in a small tin holder, which not only retained the solution, but also held the tube in place. These were especially convenient because they could be cleaned with each refilling. Another type designed by the same person consisted of a small paper rectangular box, fitted with a lid in which small slits were cut. This device enabled the flies to lap the sugar-water without getting it over their entire bodies, which event usually resulted in death. In addition to keeping a

fresh supply of sugar- water in a dish in each cage, a small drop or two was placed upon the piece of gauze that covered the top of the cage. The flies lapped this solution through the gauze strip. No other food was given to the flies.

The larvae fed upon the organic material present in the sewage and ditch water, with which the large petrie dishes were filled, and in addition to this small particles of liver were ground to a fine pulp in a mortar dish and placed in each dish. A teaspoonful of tankage was added to each petrie dish at the time of transference of the eggs to the dish. This was a substance high in organic materials, and especially of proteins. It consisted of all the unusable portions of organic material that comes from a rendering plant. It may or may not contain bone, depending upon the demand for this commodity at the time of rendering. This amount of organic material in each dish was sufficient to nourish the larvae through their entire stage of development.

Special Treatment of Thesis Subject

The adults of this group are strong and rapid fliers. The larval stage is passed in the water, while the pupal case is formed above the level of the water. Sometimes the entire pupal case is visible, but more often only the upper end is visible .

Origin:-

All of the species of SYRPHIDAE included in this report are native to this country. The prime origin of the entire group is not definitely established, although it is quite probable that they are native to many countries besides our own. They have been reported from many countries, and appear to be exceptionally abundant wherever reported. Some of the earliest accounts of SYRPHIDAE came from central Europe centuries ago. This group was closely tied up with many superstitious beliefs of the day.

Food Plants:-

The adults of these species can be found upon various types of flowering plants, since they live upon the nectar found in flowers. They prefer certain flowers to others. The plant known commonly as the Buck-Brush, *Symphoricarpos* L. sp., was a favorite for these flies in this vicinity. This plant grows about three to three and one-half feet high, and one bush or one group of bushes may cover an area of from five to fifteen square feet in extent. They also fed upon a yellow flower of the golden-rod variety. Both of these plants were very common in the vicinity in which most of the collecting was carried on.

Distribution:-

These insects are cosmopolitan in distribution, being found wherever favorable conditions for their existence permits. Wherever there are any found, they are usually present in large numbers. They have been reported from all parts of Europe, Asia, Africa, North America, Japan, and on numerous islands. Professor Riley had a specimen in his collection of SYRPHIDAE, which was undoubtedly taken in the Western States, and which bears the date 1870. The group as a whole is usually abundant near wet and marshy places, although this swampy condition is not absolutely essential. The point at which most of the specimens were taken for this project was in the vicinity of the river approximately three miles east and slightly south of Ft. Collins, Colorado. Here the vegetation grew very rank and profuse.

Naturally there are many limitations which keep the insect from thriving in certain localities. It is essential that there be some water for the larval stage of the development. There must also be an abundance of flowering plants upon which the adults depend for their existence. Humidity plays an important part in the life history of this insect. Such factors as altitude have little effect upon the development of the insect, excepting such altitudes which will have such low temp-

peratures that the insects cannot carry out their life processes. Low temperatures have a decided effect upon the length of a life cycle. The larvae of this group were able to survive severe temperatures for a short period of time. Some of them were placed in the natural-temperature portion of the green house, where an excellent opportunity presented itself for observation during the cold spells of December and January. The larvae were frozen in their dishes for a short period of time, and when thawed out were apparently uninjured. When this was repeated and the temperature remained low for a longer period of time, the larvae died.

Economic importance:-

The members of the ERISTALINAE group are not considered as true pests, although some reports tend to hold this viewpoint, to a slight extent. Some authors have formed the opinion that these insects often act as depollinators of our common flowers to such an extent that sterility results. It is well known through extensive studies that pollen forms a portion of the food taken by adult forms. Brown, N. E., (1) states that the complete depollination of flowers of *Pelagonium* sp. by a syrphid fly is recorded, even the pollen that had been deposited upon the stigmas being removed. He con-

tinues, by saying, that the same agency may probably be the cause of the failure to set seed in the case of artificially pollinated plants, such as the South African Euphorbia gorgovis, experimented upon at the Royal Botanic Gardens in 1912. Mayne, R., (4), states that as "Cacao cultivation is expected to become one of the most important and valuable industries in the Belgian Congo, the author has considered it advisable to include in this list of pests of that plant, not only those species that require immediate control measures, but also those that have been collected in the course of some years' investigation or that have been reported as feeding on Cacao, even though their depredations appear at the present time to be quite insignificant, since these under changing external influences may become serious enemies of the cultivated plant. Insects occurring in the diseased parts of the plant are, Eristalis latifrons Loew, and etc."

Since the larvae of this group are aquatic in nature and act as scavengers, they are of slight economic importance. Wilson, G. F., (7), states that observations begun in 1912 at Wisely indicate that wind plays no part in the pollination of fruits, and that several insects besides bees are very active agents in pollination, such as some of the Syrphid flies. Taken on a comparative basis, the good accomplished by these

insects is far in excess to the detrimental effects.

General Seasonal History of the ERISTALINAE

Group

In this portion of the paper I will give the general characteristics of the various stages of development of the group taken collectively.

Egg:-

The eggs are deposited in sheathes of a single or a double layer, and vary in minor details of structure with the individual species studied. The number of eggs laid also varies, and may range from thirty to two hundred at one deposition. The eggs are all a creamy white and appear perfectly smooth to the naked eye, but when placed under a microscope, the surfaces appear definitely striated or irregularly marked. The egg is slightly larger at one end than at the other, and is ellipsoid in shape. The micropyle is located at the smaller end of the egg. The egg may vary in length slightly with an average of about 1.4 mm. The eggs are deposited near the edge of the water in moist places.

Larvae:-

The larvae of the ERISTALINAE are known as the rat-tail larvae due to an appendage through which they breathe

at the posterior end of the larvae. When first seen they are approximately five to six mm. in length and are grey-white in color. They grow quite rapidly and attain a size of approximately 20 mm. when full grown. The segments are not very distinct, and have a tendency to fuse. The outer covering of the worm is hyaline, enabling one to see portions of the internal anatomy. The tail can be stretched or shortened at will and has a rosette of small hairs at the distal end which keep the breathing tube above the surface of the water. The tail is very thin when elongated and very thick when shortened. Some of the larvae extended the tail to three inches in length and could possibly increase this distance more if necessary. Vialanes, H., (5) states that the retractile respiratory tube of the larva of *Eristalinae* is shortened by special muscles, and by elastic bands lodged in its interior. Each of these elastic bands consists of a single cell constructed in such a way as to perform the part of a thread of India-rubber, each cell containing an elastic fibre (similar to those observed in the cervical ligament of a mammal) which is coiled many times around the nucleus. The larvae are strictly aquatic in nature, but may climb out of the water on the bank of the pool or up small blades of grass. Some of the larvae climb the edge of the petrie dish, and when placed into the water will again climb out of the water. This may be due to

a lack of food or to some unfavorable element from which they are trying to escape. If not replaced, they will dry up on the edge of the dish. This stage usually lasts about ten days.

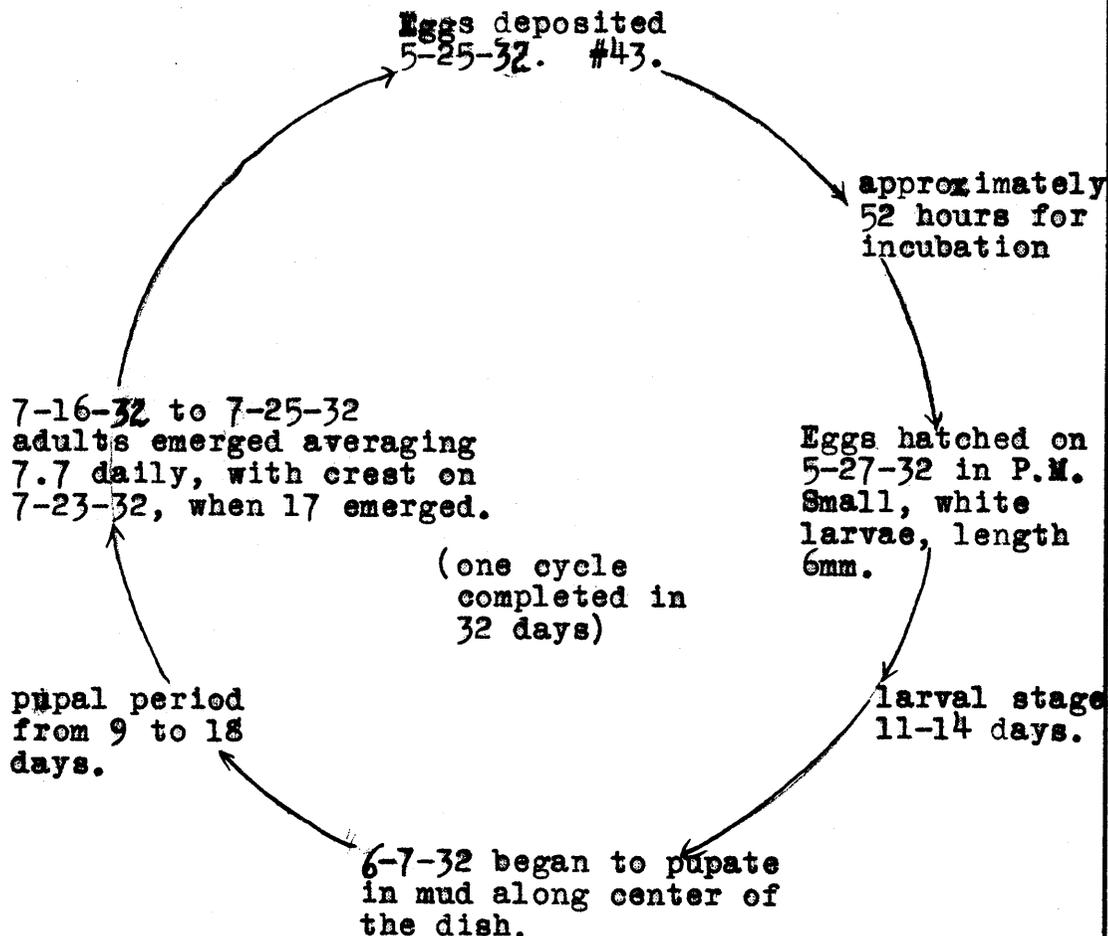
Pupa:-

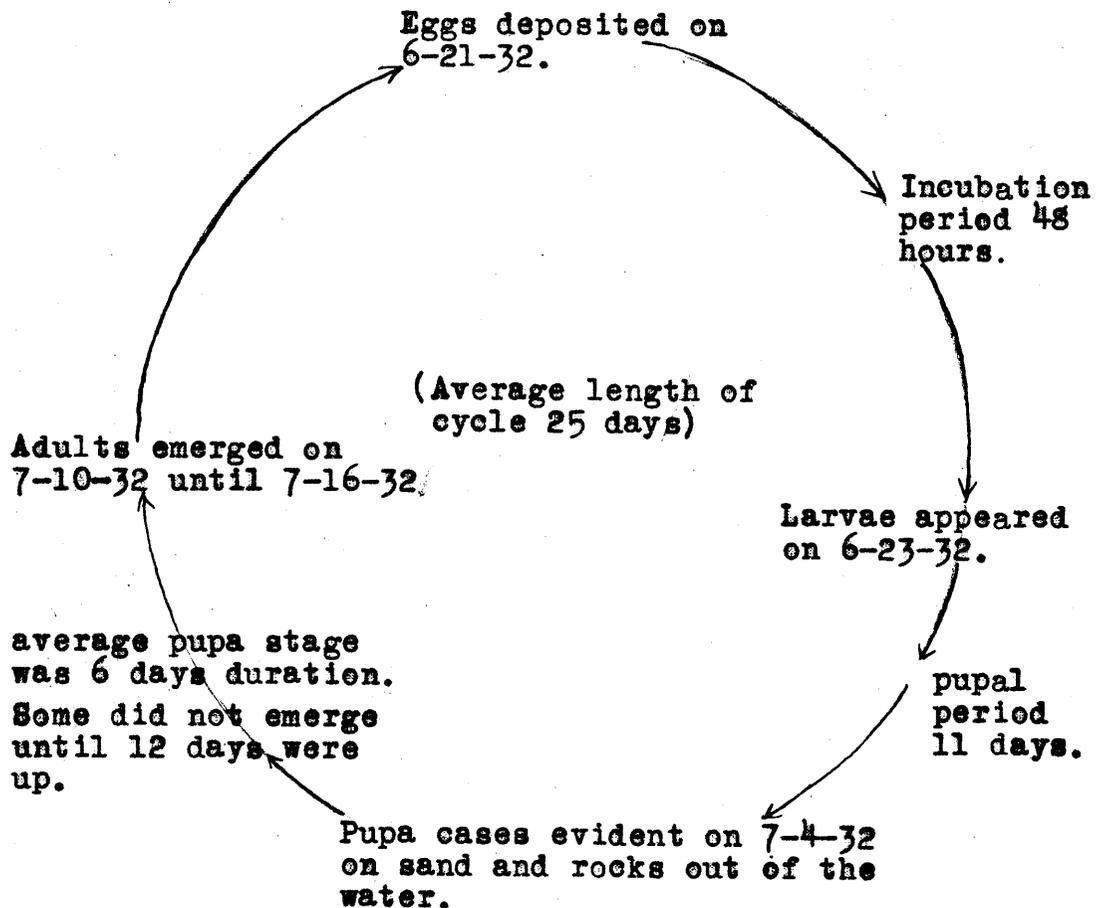
The pupa stage, or resting stage, takes place in the soft mud or sand above the water line. Here many cases may be found submerged in the mud. The case itself is brownish*red in color, distinctly segmented, and about one-half an inch in length. It is slightly elongated and has the dried tail of the larval stage still fastened at one end of the case. This tail is fixed and may be as long as the case. There is no apparent use for this structure in this stage of development. There are some variances in structure and size with the different species. The pupal stage lasts about 10 days.

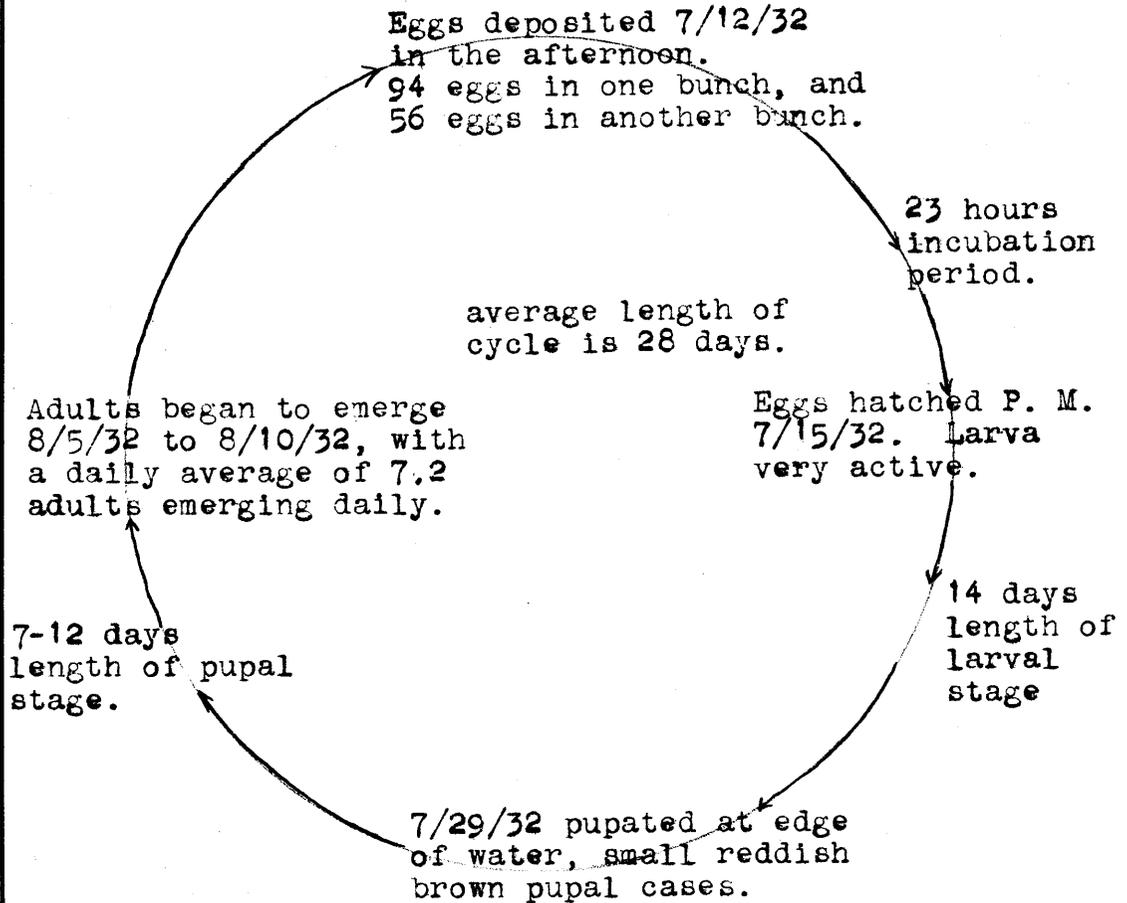
Adult:-

No general characterization can be given for the adults excepting that they are all strong fliers and feed on the nectar and pollen of flowers. I found all of the flies very hardy. Many of them lived for more than a week in captivity. I was successful in obtaining eggs from adults reared in captivity, but these eggs were apparently sterile, so that a second generation could not be run. Mating usually takes place within a few days after emergence of the adult.

Life Cycle of *Eristalis meiganii* Weid., ♂



Life Cycle of Eristalis latifrons Loew.

Life Cycle of Helophilus latifrons Loew.

Seasonal History of Eristalis meiganii, Weid.

Egg:-

The eggs of Eristalis meiganii Weid. are deposited upon moist sand, usually in bunches varying in number from a very few to more than one hundred. Most of the eggs were deposited in one mass, but a few were scattered about this one within a radius of one inch. They were placed close to the rim of the retaining cage. The egg is of a milky white color and is the shape of an elongated oval. One end is slightly larger than the other and very round. The average size of the egg in length is 1.4 mm and approximately .3 mm in diameter at the center. As the incubation period became longer, the eggs turned to a dim bluish-grey color. The entire period of incubation was slightly over two days, as illustrated by the accompanying life cycle.

Larvae:-

The larvae, when first hatched were very small and were hard to find. They remained at the edge of the water usually under the scum that had formed. They were approximately 6 mm. long when first noticed, indicating a rapid growth in the beginning. They were all very active in the early portion of the larval development, but became sluggish just before pupation. The outer covering of the larvae is transparent, enabling

one to see the internal organs quite plainly. The segments are hard to determine due to the ever-changing form of the larvae, and the fact that there are external creases in the outer covering. The maximum length of the larvae was about 13 mm. The anterior end is rounded and the posterior end slants gradually into the respiratory organ. This organ is densely striated and can be contracted and elongated at will. Pupation takes place in the mud, sand, and grass adjacent to the water in which the larvae develop.

Pupa:-

The puparium is oval in shape, being rounded anteriorly and pointed posteriorly due to the breathing appendage which adheres to the case. The puparium is the same shape when viewed from any angle. It is 11 mm. long and approximately one-half this distance in diameter. The color is dark greyish-brown and the segments are plainly visible. Two small projections can be seen at the anterior end of the puparium. The length of the larval and pupal periods are about the same in this insect, varying from 11 to 14 days for the larval stage and from 9 to 18 for the pupal stage. The anterior end is broken away upon the emergence of the adult and remains hinged to the puparium.

Adult:

The adults emerged for a period of 9 days, averaging 7.7 daily, and with a crest of emergence on the

7th day, when 17 emerged. They were able to fly almost immediately after emergence.

Description of adult of Eristalis meiganii Weid, as given by Williston, (6), as follows:-

"♂, ♀. Length, 10 to 12 mm. Face black, shining, thickly clothed with yellow pollen and pile, leaving the tubercle, the oral margin, and the cheeks shining black. Frontal triangle a little shining along the middle in the female the front reddish pollinose, more shining above the antennae. Antennae black, third joint somewhat reddish; arista reddish, briefly pilose near the base. Eyes pilose, in the male contiguous for a short distance only; posterior lateral orbits white-pollinose. Thorax black, shining, on the dorsum with a coppery luster, leaving two opaque, light colored, rather broad stripes, reaching from the front to the scutellum, limited by three narrow, opaque, black stripes; pile of dorsum light reddish-yellowish, scarcely apparent from above; pile of the pleurae whitish. Scutellum subtranslucent yellowish or reddish on the outer part. Abdomen in the male as follows: first segment black; second segment orange-yellow, broadly on the sides and narrowly across on the hind border, elsewhere opaque black; on the posterior part of the black includes nearly a third of the width of the segment; the sides approach each other a little towards the front and then

at nearly right angles extend outward along the anterior margin of the segment; the latter prolongations are convex on their hind borders and reach acutely nearly to the lateral margins; third segment with large, similar colored spots, confluent with the yellow in front, but rounded on the internal posterior angles and usually not quite reaching the yellow of the hind margins; across the middle of the segment a shining metallic band interrupted in the middle, elsewhere the black is opaque; fourth segment wholly shining, with a narrow yellow hind margin and sometimes with a small spot of opaque black in front; hypopygium shining black. In the female the markings are rarely like those of the male, chiefly shining black; the second segment sometimes with a small reddish spot on the side, the opaque marking as in the male; the third and fourth segments sometimes rather broadly whitish pollinose on the hind border; the hind margins more narrowly reddish-yellow. Legs black, a little stout; tip of femora and base of tibiae reddish or whitish yellow. Wings hyaline; stigma minutely brownish; in the female with a large faint brownish spot."

Seasonal History of Eristalis latifrons Loew.

Egg:-

The egg is chalky-white in color, ovate, and about 1.5 mm. in length and approximately .3 mm. in diameter in the middle. One end is slightly rounder than the other. The micropyle is located at this more truncated end. The egg turns slightly darker in color as the period of incubation approaches an end. The incubation period lasted 48 hours. The eggs were deposited in moist sand in the center of the retention cage in a double layer. A few were scattered about the cage.

Larvae:-

The larvae are hardly distinguishable from those described earlier in the paper. They were very active when first noticed, and this activity dwindled gradually until they became both sluggish and restless just before pupation. The maximum length reached was approximately 20 mm. with a width of about 7 mm.

Pupa:-

The puparium was of a dull greyish-brown color, 15.5 mm. in length, oval, bilaterally symmetrical, segmented, and the caudal appendage remained intact. This appendage was usually as long as the body of the puparium. Pupation took place in the sand and mud along the edge of the water. The end from which the adult emerged was

always uppermost. Here again, the lengths of the larval and pupal stage were about the same, usually varying from 6 to 12 days.

Adult:-

The adults emerged for a period of 6 days, breaking through the anterior end of the puparium. Williston, (2) describes the adult as follows: "♂, ♀. Length, 9 to 14 mm. Face a little concave below the antennae, concealed beneath dense yellowish-white pollen, and the pile of the same color; in the middle with a rather broad shining bare stripe; the cheeks also bare and shining black. Antennae black, third joint brownish-black; arista reddish yellow, bare. Eyes pilose, contiguous in the male, the suture between them rather short (about half as long as the interval between the apex of the frontal triangle and the root of the antennae); front in female rather broad, the sides a little convergent above, grayish pollinose, beset with dense grayish-white pile, shining along the middle, especially below, the vertex darker. Thorax greenish-black, unicolorous, shining, beset with yellow or yellowish pile, sometimes more orange-colored, denser on the pleurae. Scutellum reddish-brown, translucent; second abdominal segment with a yellow triangle of the usual shape on each side, sometimes brownish-yellow; an opaque black cross band on the anterior margin, another one along

the posterior side of the yellow triangles; the latter is interrupted or subinterrupted in the middle, oblique on each side, and not reaching the lateral margins; a smooth bluish-black space is inclosed between the two cross-bands and the triangles; a narrow shining triangular space between the hind cross-band and the yellowish-white posterior margin of the segment, which bears a fringe of pale golden-yellow pile; the third and fourth segments have the same pale-yellowish posterior margin and fringe of pale-golden pile; on the fourth segment, however, the fringe is broader, and takes in the whole posterior half of the segment; on the posterior half of the third segment there is on each side in the male usually an elongated opaque black streak; the anterior margin of the third segment has a narrow pale border, as if prolonging the hind margin of the preceding segment. Hypopygium black. Legs black; tip of the femora and basal half of the tibiae yellowish-white; on the middle pair three-fourths of the tibiae yellowish-white, and the base of the tarsi are of a pale color. Wings hyaline; stigma small, brown."

Seasonal History of Helophilus latifrons, Loew.

Egg:-

The egg of this fly is a creamy white, and appears smooth to the naked eye. However, when placed under magnification, the chorion is distinctly and ir-

regularly marked. The average length of the egg is 1.5 mm. and diameter at the center approximately .3 mm. One end of the egg, at which the micropyle is located, is slightly smaller than the other end. The entire egg is ovate in shape. The eggs are deposited upon the moist sand in any protected place, such as under a leaf or at the rim of the retaining cage, in a double layer, and varying from a few to one hundred and fifty in number. The egg turns to a bluish-grey color as the incubation period progresses. The average length of incubation is 23 hours.

Larvae:-

The larvae of this insect are similar in many respects to the larvae of the insects belonging to the genus *Eristalis*. The outer covering is hyaline and wrinkled very much. The larvae are aquatic, remaining at the bottom of the dish. They breathe by means of a tail-like appendage at the posterior end. This has a rosette of hairs at the distal end to keep it afloat. This can be lengthened and shortened from a distance of 3 inches to less than 1 inch by actual measurement. Some of the larvae burrow in the mud and become very sluggish just before pupation. The segments are very indistinct, as are also the prolegs. Attached to, and surrounding the anus is a set of fibrous appendages, that

are kept in constant motion. I do not know the purpose or function of this. The maximum length attained was 30 mm., and the width about 10 mm. The length of the larval period varied from 10 to fifteen days, with an average length of 14 days. Pupation took place in the mud adjacent to the stagnant water.

Pupa:-

The puparia were dull greyish-brown in color, segmented, ovate, bilaterally symmetrical, rounded at one end and sloping to the caudal appendage at the other. The respiratory tube adhered to the puparium in all cases. The length of the puparium was approximately 15 mm. and about 5 mm. at the largest diameter. The length of this period ranged from 7 to 12 days. At the anterior end were two small tooth-like projections.

Adult:-

The adults emerged for a period of 5 days, with a daily average of 7.2. Williston, (2), describes the adult as follows: "♂,♀. Length, 13 to 15 mm. Face yellow, thickly covered with light yellow pollen and pile, leaving in the middle a moderately broad, shining, reddish-yellow stripe, which ends acutely a little below the antennae; the lower end at the oral margin black. Cheek black, shining, pollinose behind. In profile the face is moderately concave above, from the

tubercle to the oral margin nearly perpendicular and straight; the lower border of the cheeks forms with the plane of the occiput but little more than a right angle. The front in the male is broad above, in width fully equal to half the distance between the foremost ocellus and the base of the antennae; across the ocelli black, a little shining, with black pile; below the front ocellus the black color is concealed beneath dense yellow pile, and wholly pollinose, a small triangle above the base of the antennae shining, reddish or brownish yellow. Scutellum wholly translucent yellow, on the outer part, sparsely and shortly black pilose, but chiefly yellow pilose. First abdominal segment grayish pollinose, with a black spot near the outer part, and the sides yellow. In the male the remaining segments as follows: Second segment with a broad light-yellow cross-band, interrupted in the middle, leaving a broad flattened triangle in front, opaque black, connected by a median stripe with a narrow posterior shining black cross-band; third segment with a similar yellow band, more narrowly interrupted, touching the front margin, rounded on the inner angles behind, and leaving a broader posterior shining black band; the opaque black is confined to a semi-circular or semi-oval spot in the middle in front, separated from a smaller one behind by two intervening, oblique, yellowish pollinose, trans-

verse, nearly contiguous spots; fourth segment narrowly yellow on the sides, across the middle a grayish-yellowish pollinose cross-band, convex in the middle in front, broadly emarginate behind; the black shining; the posterior margin yellowish; hypopygium black, concealed beneath dense yellowish pollen. In the female the shining black cross-bands on the posterior part of the second and third segments is broader; the yellow cross-band of the third segment is narrower and more broadly separated, connected in the middle or nearly so by yellowish pollen; the black spot in front is usually not oval, but forming a more or less elongate band, attenuated on the sides, but not reaching the lateral margin; the next segment similar to that in the male, but the yellow pollinose black band narrower and more gently bi-concave; fifth segment shining black, with a yellowish pollinose cross-band; the yellow on the sides of the fourth segment in both sexes may encroach on the ground of the cross-bands, and also similarly in the fifth segment in the female. Legs yellow; base of front and middle femora, distal end of the front tibiae and the whole of the front tarsi, the tip of middle tarsi and the whole of the hind legs, except the distal end of the femora and the base of tibiae, black; the extreme tip of hind femora also black. Wings hyaline; stigma yellowish. Dorsum of thorax densely light yellow or ochraceous o-

paque, with three sub-opaque black stripes, of nearly equal width throughout, the middle one a little broader; pile yellow, pleurae densely gray pollinose."

Control

Since this group of insects is not considered a pest it will not be necessary to go into control measures.

Dissemination

These insects may be disseminated naturally through strong wind currents or through floods, but little opportunity for artificial dissemination is afforded.

Summary

Three species were reared to maturity in this project, namely, Eristalis meigani Weid., Eristalis latifrons Loew, and Helophilus latifrons Loew. The highest peak of the work was at hand when eighteen petrie dishes were filled with aquatic larvae.

The eggs were deposited in each case upon moist sand, and during the period of incubation turned slightly bluish in color. They averaged approximately 1.3 mm. in length, and were deposited in numbers ranging from 30 to 200 at one laying. The larvae were all aquatic and fed upon decaying organic material placed

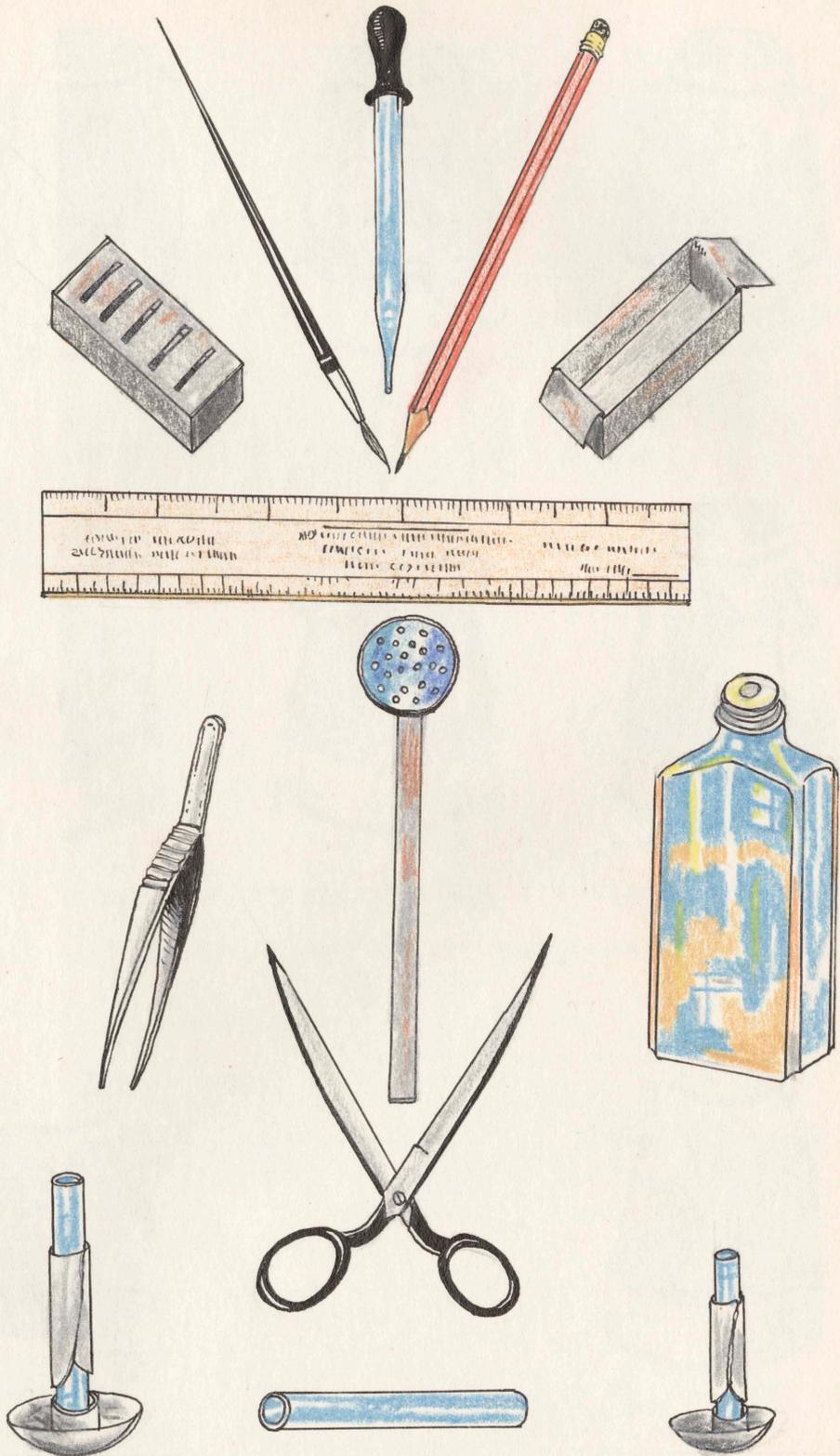
in the water. The pupae were somewhat similar in appearance for all of the species studied. The adults were fed a sugar solution as often as the supply diminished. Generally, members of the ERISTALINAE group are not considered as pests, although some reports have been made of the depollination of flowers. The beneficial effects outweigh the detrimental effects very much.

The average length of the period of incubation was approximately twenty four hours, varying with the temperature at the time. The larval period extended over a period of six to fifteen days in the four species reared. The average length of the pupal stage was approximately twelve days. Descriptions of these various stages may be found in the main body of the thesis.

Literature cited

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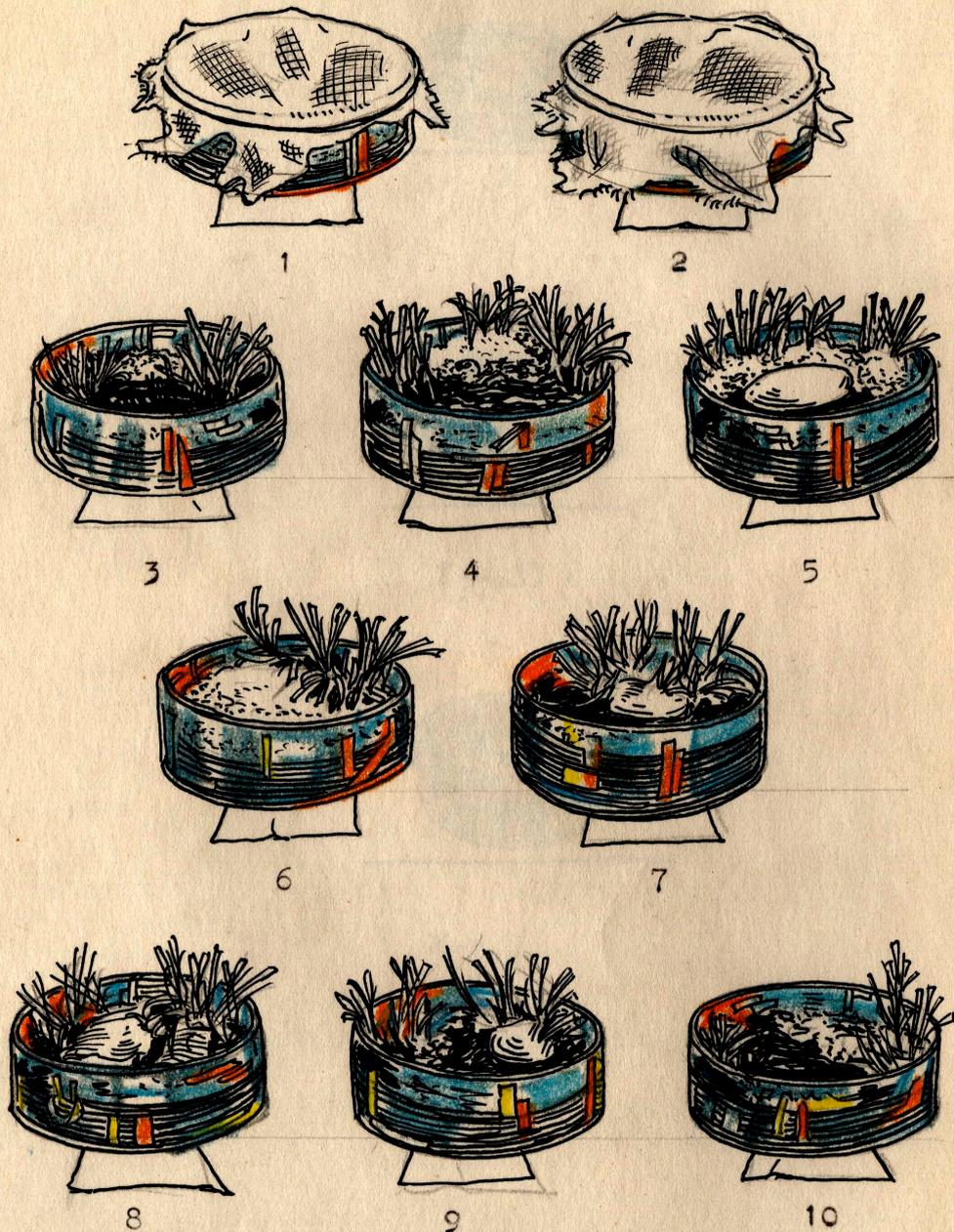


Instruments used in work.



Breeding cages, in which adult insects were retained until oviposition, and after emergence from pupal stage.





Large dishes used in rearing aquatic larvae, showing method of retaining flies after emergence (1-2), and dishes while insects were in the larval state.



X--.3



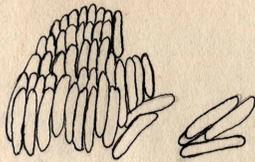
X--.33



X--.3

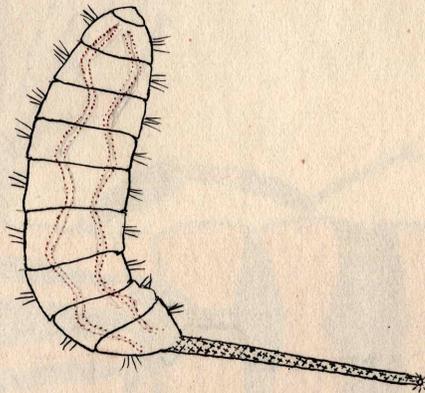
Dishes used in rearing aphidophagus larvae.

36



x-5

Eggs of *Helophilus latifrons*, Loew.



x 2

Larva of *Helophilus latifrons*, Loew.

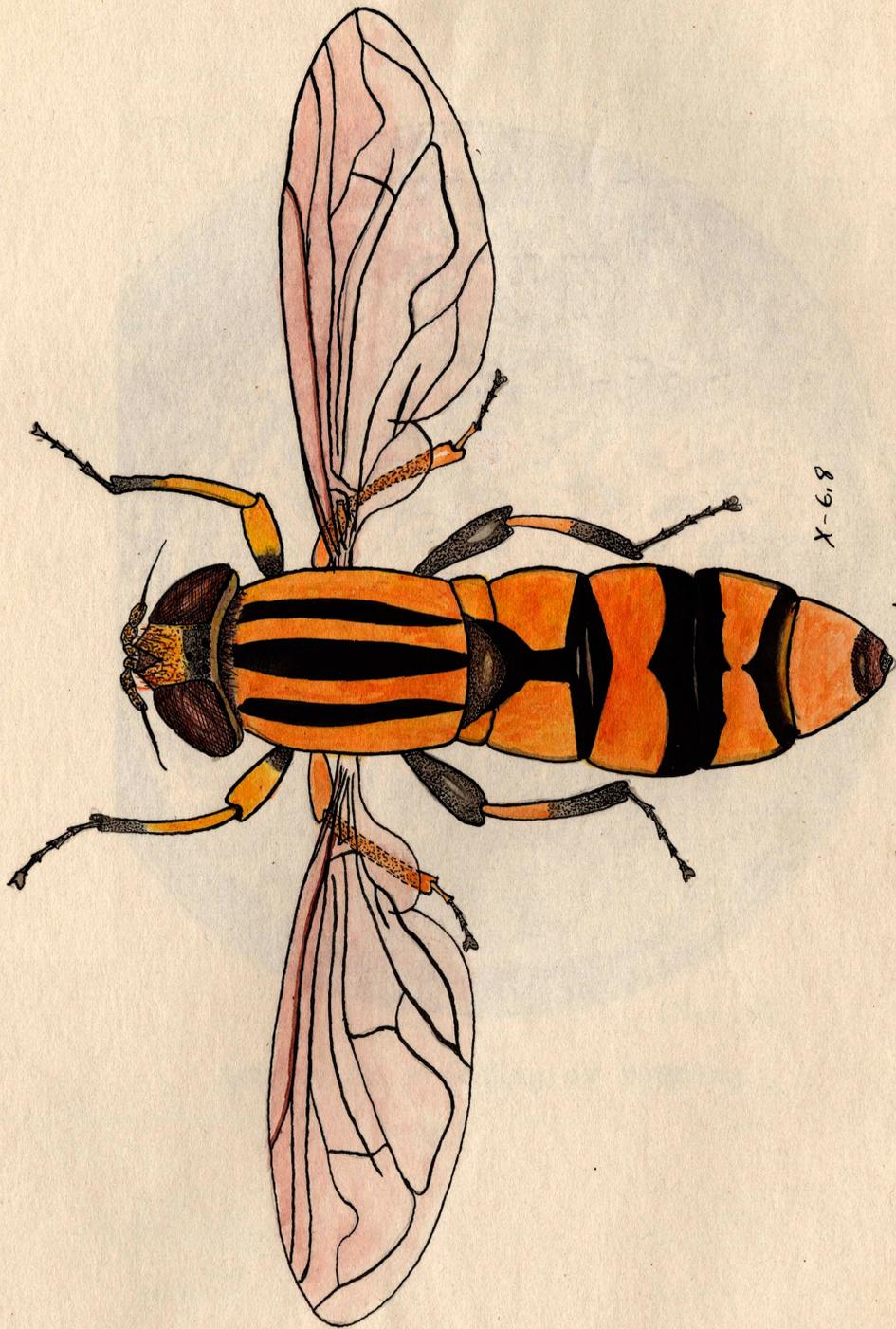


x-3

x-3

Pupa Cases of *Helophilus latifrons*, Loew.

37



X-6.8

♂ *Helophilus latifrons*, Loew.



(X--.4)

Larvae in breeding or rearing
dish.

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The bibliography included with this paper is one listing all publications on the ERISTALINAE group available here. Many of these were not consulted because they did not have a direct bearing upon the particular species taken up in this paper. A synopsis of some was read when the title indicated that they might be of value in preparing this paper. That portion of the literature used in the preparation of this paper is listed under the heading of literature cited.

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Outline of Thesis for Master of Science
Degree

Title

Life Histories and Descriptions of some Colorado Syrphidae of the ERISTALINAE Group, namely, Eristalis meigani Weid., Eristalis latifrons Loew, and Helophilus latifrons Loew.

Introduction:-

A general discussion of the subject dealt with is given, together with statements concerning the characteristics of the group. The reasons for the choice of the project are also included.

Object:-

The object of this project is to describe and determine the entire life history of the above named insects.

History:-

The known habits and previous work done on these insects is reviewed. This includes only workers who dealt with the specific insects named in the title.

Systematic position

In which the systematic position of the family SYRPHIDAE is discussed in relation to other families of this order.

Procedure

Special emphasis is given here to the manner in which breeding cages and other articles of equipment are prepared so that the insects are handled with efficiency and a minimum danger of injury from unnatural sources. Also an account of the care, food, and other necessities in connection with all the stages of the insect are given.

Special treatment of thesis subject

The following points are included in this portion of the thesis in regard to the entire group: habits, Origin (native or introduced), food plant, distribution, limitations, such as food and climatic conditions, and economic importance.

General seasonal history of the ERISTALINAE group

Generalized description of the various stages of development of the group taken collectively is given.

Seasonal History

The habits of the four species named in the title are discussed here in detail. In the egg stage, the time of deposition, place of deposition, structure, and duration of the periods are given. In the larval stage, the incubation period, morphological structure, and food given are discussed. In the pupal stage, the time of pupation, location of the puparia, structure, position, and duration of the period are discussed. In the adult stage, the time of emergence, description of the adult, and food given are discussed. A life cycle for each insect reared is included.

Summary

A summary of the work is given in these pages, dealing primarily with the species named in the title.

Literature cited:-

A list of the literature together with the author of the article of actual quotations is given here.

Bibliography:-

An alphabetical presentation of all books, periodicals, bulletins, and other references used in the preparation of this paper or that have preceded this topic of discussion are given.