

UC San Diego

Other Scholarly Work

Title

The Life History and Development of *Lypha dubia* Fall. (Dipt., Tachinidae)

Permalink

<https://escholarship.org/uc/item/0v73k3nd>

Journal

The Entomologist, 102

Author

Cheng, Lanna

Publication Date

1969-02-01

Data Availability

The data associated with this publication are within the manuscript.

Peer reviewed

THE LIFE HISTORY AND DEVELOPMENT OF *Lypha dubia* FALL. (DIPT., TACHINIDAE)

By LANNA CHENG

(Hope Department of Entomology, University Museum, Oxford)

Introduction

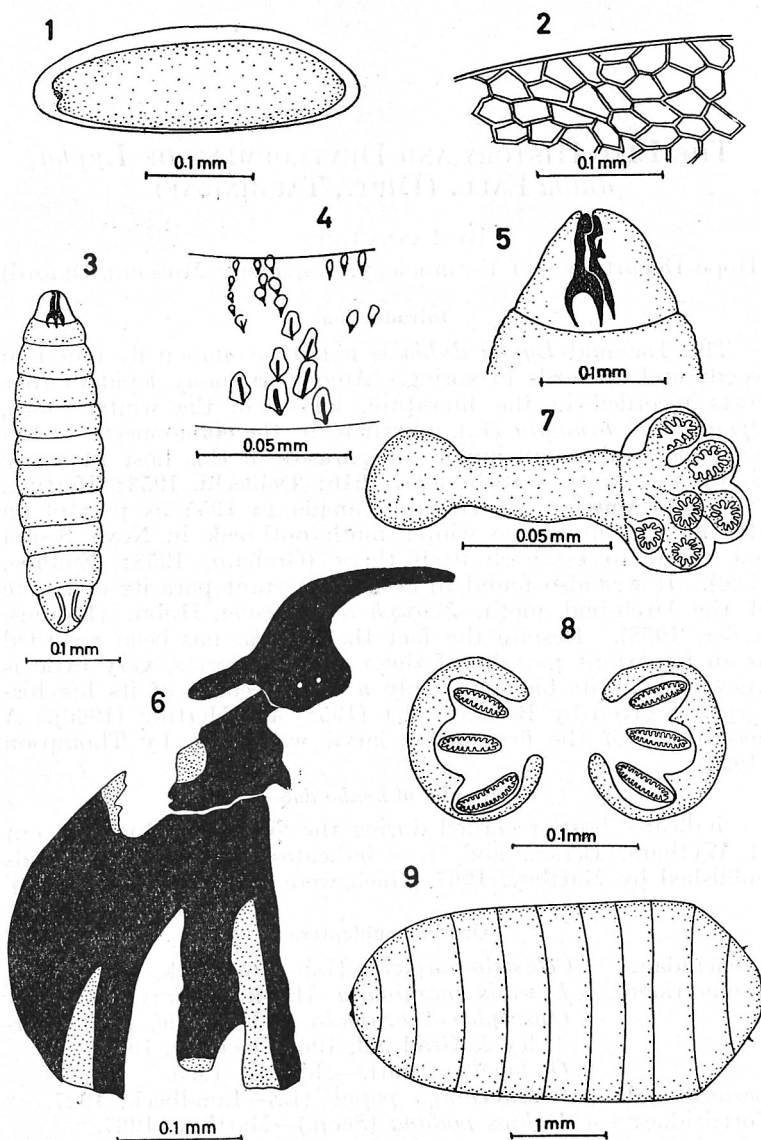
The Tachinid *Lypha dubia* is a fairly common fly found in woods and orchards in spring. Among its many lepidopterous hosts recorded in the literature, larvae of the winter moth, *Operophtera brumata* (L.), appear to be the commonest. It has been recorded as an important parasite of this host in many European countries (Schreiner, 1916; Delucchi, 1953; Herting, 1965) and was introduced into Canada in 1955 as part of an attempt to control the winter moth outbreak in Nova Scotia but failed to establish itself there (Graham, 1958; Embree, 1966). It was also found to be an important parasite of larvae of the larch-bud moth, *Zeiraphera griseana* Hubn. (Baltensweiler, 1958). Despite the fact that *Lypha* has been recorded as an important parasite of these economic pests, very little is known about its biology. Only a brief account of its life history was given by Baltensweiler (1958) and Herting (1960). A description of the first instar larva was given by Thompson (1923).

Host List of *Lypha dubia*

(+ indicates hosts recorded during the 'oak survey' carried out at Wytham, Berks., and ++ indicates 'oak survey' records published by Matthey, 1967, which were new to the literature).

Order: Lepidoptera

- Lycaenidae: *Celastrina argiolus* (L.)—Lundbeck, 1927.
Geometridae: + *Erannis marginaria* (Borkh.)—Carr, 1935.
+ *Operophtera brumata* (L.)—Wylie, 1960; Varley & Gradwell, 1963; Herting, 1965.
O. *fragata* Scharf.—Herting, 1965.
Lasiocampidae: *Poecilocampa populi* (L.)—Lundbeck, 1927.
Tortricidae: ++ *Archips podana* (Scop.)—Matthey, 1967.
+ *Epiblema solandriana* (L.)—Herting, 1960.
++ *Eucosma isertana* (F.)—Matthey, 1967.
+ *Evertria buoliana* (Schiff.) Bergold & Ripper. 1937.
++ *Pandemis cerasana* (Hubn.)—Matthey, 1967.
+ *Semasia diniana* Gn.—Herting, 1960.



Lypha dubia, fig. 1, egg; fig. 2, chorion; fig. 3, larva; fig. 4, spines on larval keels; fig. 5, head of larva; fig. 6, mandibles and head sclerites; fig. 7, anterior spiracle of larva; fig. 8, posterior spiracles; fig. 9, puparium.

- + + *Tortricodes tortricella* (Hubn.)—Matthey, 1967.
- + + *Tortrix viridana* L.—Matthey, 1967.
- Zeiraphera griseana* Hubn. — Baltensweiler, 1958.

Order: Coleoptera

- Chrysomelidae: *Melasoma populi* L.—Lundbeck, 1927.
Chrysolina sp.—Townsend, 1934.

Order: Diptera

- Syrphidae: *Merodon* sp.—Van Emden, 1954.

Life History

Lypha has only one generation a year. The adults emerge in late March or early April and can be seen in the field until mid- or late-June. Emergence trap records from the 'oak survey' (1950-1967) show that males emerge up to 14 days earlier than females. Shortly after emergence the flies are often seen sunning themselves on tree trunks. Mating probably occurs soon after female emergence and the females feed for some 3 to 4 weeks before their eggs are fully matured. The food source of the adult is not known. Adults have been seen to rest on young leaves of sallow which were coated by a layer of honeydew secreted by aphids. Such leaves have been brought back to the laboratory but the adults have not been observed to feed on this honeydew. In the laboratory the females lived 4 to 5 weeks which was 10 to 14 days longer than the males.

The females have an average egg complement of 150. Dissection of females collected in the field showed that egg maturation is a continuous process. Females collected during the early half of the egg laying period contained both mature and immature eggs.

The egg, when fully developed, contains a ready to hatch first instar larva. It is laid near the host and the first instar larva usually crawls out from the egg shell as soon as the egg is laid. In some cases a larva is deposited instead of an egg. The time taken for a larva to penetrate into the host is about five minutes but the time each larva spends in finding a suitable spot for penetration is very variable. Several larvae were observed to spend as long as 2 to 3 hours crawling over the body of the host before finally penetrating into it; others spent as little as 5 to 10 minutes.

There are three larval instars within the host and larval development is completed about twelve days after the time of initial penetration of the parasite larva into the host. In the laboratory the puparium is usually formed outside the host larva and beneath the surface of the 'vermiculite' which was

provided for them. In the field the parasite larva is usually carried down to the ground by the host larva which is then left and the parasite's puparium is formed in the soil; occasionally the puparium is formed within the cocoon of the host. If the parasite larva is within a host which pupates on the tree (e.g. *T. viridana*), the third instar larva leaves the host and falls to the ground independently. The puparium remains beneath the surface of the soil overwinter and the adult emerges the following spring.

Behaviour and Site of Oviposition

In the literature *Lypha* females have been reported to deposit their eggs or larvae in the vicinity of hosts (Lundbeck, 1927; Van Emden, 1954; Herting, 1960); Baltensweiler (1958) found that the females oviposited on silk webs spun by host caterpillars.

Laboratory experiments carried out during the present study have shown that the presence of a silk web spun by a larva of *T. tortricodes* or *T. viridana*, even in the absence of the host, is able to initiate egg laying by the female. In the case of the winter moth larvae, which do not spin well-formed webs, the presence of the food plant of the host as well as the host itself was necessary to induce females to oviposit.

Lypha larvae have been found in all parts of the body of the host, but of a total of 584 *Lypha* larvae examined in Winter Moth larvae 28 per cent. were found in the thoracic region and 72 per cent. were in the abdomen. There was also a distinct difference in the distribution of parasite larvae on different surfaces of the host; some 79 per cent. were found on the lower lateral and ventral surfaces whilst only 21 per cent. were on the dorsal surface.

Description of the Egg and Larval Stages

The egg is macrotype, yellowish white in colour and oval. When viewed laterally the dorsal surface is convex and the ventral surface is flat or slightly concave (fig. 1). The chorion is very thin, semi-transparent and with fine reticulate sculpturing (fig. 2).

The first instar larva develops while the egg is still inside the body of the female. Eggs containing fully developed larvae measure 0.10-0.17 mm. in breadth and 0.42-0.53 mm. in length. The larvae is elongate with a pointed anterior end but almost truncate posterior end (fig. 3). The dorsal surface is covered with scales and spines but the ventral surface is comparatively bare. These scales, which probably serve to protect the larva against desiccation, are not heavily chitinized. They are sub-pentagonal in shape with median longitudinal keels while the spines have broad rounded

bases but pointed tips (fig. 4). The head of the larva is short and conical and bears the strongly sclerotized cephalopharyngeal skeleton which consists of an anterior pair of mouth hooks or mandibular sclerites, an intermediate pair of hypostomal sclerites, a posterior pair of pharyngeal sclerites, and a number of accessory sclerites. The shape and arrangement of these sclerites are characteristic of the species and are of taxonomic use. The mouth hooks of the first instar are rather square in shape and are joined to the pharyngeal sclerites by long, thin, intermediate sclerites (fig. 5). Each pharyngeal sclerite has two wings which are arranged one above the other when viewed laterally. The wings are fused anteriorly and are pointed at the distal end. The last abdominal segment bears the two stigmata which are light brown but the openings are darkly pigmented and have very irregular outlines. Each stigma is about ten times as long as wide and slightly curved outwards anteriorly.

The second instar larva is similar to the first in body structure but is of greater size and has less cuticular armature. The cephalopharyngeal skeleton is well developed and is much bigger than that of the first instar and similar in form to that of the third instar larva described below.

The third instar larva is about twice the size of the second instar. There is again little cuticular armature at this stage. The cephalopharyngeal skeleton is well developed with the anterior, intermediate, and posterior sclerites clearly separated from one another (fig. 6). The mouth hooks are quite different in form from those of the first instar. The larva is amphipneustic with a pair of anterior spiracles situated at the lateral sides of the second thoracic segment in addition to the posterior spiracles. Each anterior spiracle has a rather long and tubular felt chamber with an expansion at its base (fig. 7). The aperture has six oval-shaped small openings arranged in a circle. Each small opening has a cuticular lining with inward projections, giving a flower-like appearance. The hind spiracles are as in the first instar. Each spiracular trunk trifurcates and opens to the exterior by oval shaped openings (fig. 8).

Development of the Larva within the Host

The first instar larva takes three to four days to complete its development. Moulting occurs at the end of this period and is followed by a further rapid increase in size. The cephalopharyngeal skeleton of the first instar is often found loosely attached to the shed first instar skin which remains on the new larval skin near the posterior end of the larva.

The second instar larva requires another three or four days to complete its development and the second moult occurs within the host seven or eight days after parasitization. The mouth parts of the second, as well as those of the first instar, are often

found on the body of the newly moulted larva; thus the stage of the parasite larva can often be ascertained by counting the number of mouth parts on its body.

The third instar larva continues to feed inside the body of the host until it is fully developed, by which time it usually occupies the whole body cavity of the host. The parasite larva is then ready to emerge from the host in order to form the puparium.

The site of exit of the larva from the host is marked by a more or less rounded hole which is often found on the mid-ventral surface of the abdomen of the host; its position is not in any way related to the original site of penetration. After crawling out from the host the parasite larva usually spent two to three hours moving about in the 'vermiculite' provided before it became still and finally shortened to form the puparium (fig. 9).

The puparium is white and transparent when first formed; it turns opaque and beige in colour after about one hour. The tanning process continues until the puparium is a dark reddish brown, this usually takes about ten hours. The puparium is fully hardened within 24 hours of the commencement of puparium formation.

The growth of the first and second instar larva does not appear to greatly affect the normal development of the host. The parasitised 5th instar winter moth larvae used in the experiments continued to feed, and advance to the prepupal stage without apparently suffering any inhibition in growth. The parasite probably does not attack the vital organs of the host larvae at this stage but feeds on the body fluids and fat body of the host. Dissections of hosts revealed that the gut and other body structures of the host remain quite intact. By the time the parasite larva has reached its third instar the host is moribund. Dissections at this stage revealed that the body content of the host is liquid and there is no trace of either muscle or fat body.

The total period taken for the parasite larva to complete its development within the host thus ranges from ten to 15 days. The average period for the 30 individuals studied was 12.5 days.

Development of the Larva after Leaving the Host

When a newly formed puparium is dissected within one day of formation a prepupal instar of the fly is found. The skin of the prepupa is strongly attached to the puparial wall and at this stage it is not possible to separate the two without damaging the prepupa. This fact has also been observed by Snodgrass (1924) and Fraenkel (1938). The prepupa does not show any of the adult characters.

A prepupal moult, as distinct from the pupal moult, occurs two or three days after puparial formation. The pupa thus

formed is enveloped by an extremely thin and transparent pupal skin separating it from the outer shell which now consists of the puparial wall as well as the cast prepupal skin. It is comparatively easy to dissect the pupa out from the puparium at this stage. The pupa is white in colour with a clear division between the head, thorax, and abdomen. The antennae, legs, and wings of the pupa become well differentiated four or five days after the prepupal moult. These appendages are all neatly tucked under the ventral surface of the body and are darker in colour than the rest of the pupa. At this stage the halteres appear as two fleshy lobes on the lateral sides of the metathorax; the hind spiracles are completely closed and the anterior spiracles have been replaced by two breathing horns which are situated at the ends of two fleshy subocular lobes on the thorax, one or both of which may have pierced through the puparial wall. The pupa continues to develop and by the 9th day after puparial formation the eyes are well formed but appear rather translucent; the appendages have grown considerably in length and become darker but the rest of the body is still whitish and opaque. Segmentation of the abdomen is only faintly distinguishable and there is no trace of any differentiation of external reproductive organs. The abdomen occupies about two-thirds of the puparial cavity at this stage. By about the 16th day the mouth parts of the fly are distinguishable. Bristles and hairs appear on a 21-day old pupa but are still whitish and opaque.

The pupal moult occurs around the 25th day after puparial formation. The imago thus formed shows all the adult characters and is enclosed in a very thin and transparent pupal skin. The eyes are crimson, the appendages brown, and the bristles and hair black, but the general body colour is still white. The abdominal segmentation is distinct at this stage but the sexes are still not readily separable as there are no visible external reproductive organs. The subocular lobes which bore the breathing horns have now disappeared. About ten days after the pupal moult the external reproductive organs are well-developed and sexes are distinctly separable. The imago remains at this stage throughout the winter until it is ready to emerge the following spring.

The occurrence of a prepupal moult within the puparium as well as a pupal moult has been previously recorded for two other families of Cyclorrhaphous flies, the Trypetidae and the Calliphoridae (Fraenkel, 1938). To what extent this moult is a regular feature in the development of Cyclorrhaphous flies is not known.

Acknowledgements

This work was carried out in the Hope Department of Entomology, Oxford during the tenure of a Commonwealth Scholar-

ship. I am deeply indebted to my supervisor, Mr. G. R. Gradwell, for his ever-generous help and criticisms throughout the period of this study. I also wish to thank him and Prof. G. C. Varley for allowing me to use their 'oak survey' data.

References

- BALTENSWEILER, W., 1958. Zur Kenntnis der Parasiten des grauen Lärchen-wicklers *Zeiraphera griseana* Hb.) ein Oberengadin. *Mitt. schweiz. Aust. forstl. Vers. Wes.*, **34**: 399-478. BERGOLD, G., & RIPPER, W., 1937. *Perilampus tristis* Mayr als Hyperparasit der Kiefertrieb-wicklers (*Rhyacionia buoliana* Schiff.). *Z. Parasitkde.*, **9** (3): 394-417. CARR, J. W., 1935. *The Invertebrate Fauna of Nottinghamshire*. Supplement. Nottingham. DELUCCHI, V., 1953. Die Parasitierung der frostspannerraupen (*Operophtera brumata*) im frühjahr 1953. *Schweiz Z. Obst- u. Wein.*, **62**: 462-463. EMBREE, D. G., 1966. The role of introduced parasites in the control of the winter moth in Nova Scotia. *Can. Ent.*, **98**: 1159-1168. FRAENKEL, G., 1938. The number of moults in the Cyclorrhaphous flies (Diptera). *Proc. R. ent. Soc. Lond. (A)*, **13**: 158-160. GRAHAM, A. R., 1958. Recoveries of introduced species of parasites of the winter moth, *Operophtera brumata* (L.) (Lepidoptera: Geometridae), in Nova Scotia. *Can. Ent.*, **90**: 595-596. HERTING, B., 1960. Biologie der Westpäläarktischen Raupenfliegen (Diptera: Tachinidae). *Monogr. angew. Ent.*, **16**: 1-188. ———, 1965. Die parasiten der in Nordwest-deutschland an Obstbäumen und Laubholz schädlich auftretenden Spanner- und Eulenraupen ((Lep: Geometridae, Noctuidae, Thyatiridae). *Z. angew. Ent.*, **55** (3): 236-263. LUNDBECK, W., 1927. *Diptera Danica. Part VII. Platypozidae, Tachinidae*. Copenhagen. MATTHEY, W., 1967. The natural history of three oak-feeding tortricids: *Ptycholoma lecheana* (L.), *Pandemis cerasana* (Hb.) and *Batodes angustiorana* (Haw.). *Entomologist*, **100**: 115-120. SCHREINER, J. F., 1916. *Cheimatobia brumata* L. and its control. [In Russian] (Summary in English) *Rev. Appl. Ent.*, **A 4**, 141. SNODGRASS, R. E., 1924. Anatomy and metamorphosis of the apple maggot, *Rhagoletis pomonella* Walsh. *J. Agri. Res.*, **28** (1): 1-36. THOMPSON, W. R., 1923. Recherches sur les Diptères Parasites. Les larves primaries des Tachinidae du groupe des Echinomyiinae. *Annls Epiphyt.*, **9**: 137-201. TOWNSEND, C. H. T., 1934. Manual of Myiology. Part VIII. Oestroid Generic Diagnoses and Data. Itaquaecetuba. VAN EMDEN, F. I., 1954. Diptera Cyclorrhapha, Calytrata *Handbk Ident. Br. Insects*, **10** (4) (a): 1-133. VARLEY, G. C. & GRADWELL, G. R., 1963. The interpretation of insect population changes. *Proc. Ceylon Ass. Advmt. Sci.* (1962) **18**: 142-156. WYLIE, H. G., 1960. Insect parasites of the winter moth *Operophtera brumata* (L.) (Lepidoptera: Geometridae) in western Europe. *Entomophaga* **5** (2): 111-129.