BIOLOGICAL NOTES ON *MEGATHYMUS STRECKERI* IN COLORADO (HESPERIOIDEA)

by CHARLES L. REMINGTON

The larval and pupal biology of *Megathymus streckeri* Skinner and its close relative, *M. texanus* Barnes & McDunnough, has been the last major biological type in the Megathyminæ remaining to be discovered. STALLINGS and TURNER (1958) have recently summarized for this highly specialized group the present knowledge of the life-histories, much of it previously unpublished. All known larvæ have one of the two following types of behavior: a) they construct a rather long silken "tent" at the top of a burrow going deep into the caudex of a *Yucca* or *Manfreda* plant* (Tribe Megathymini); or b) they excavate a relatively small cavity in the fleshy leaf of an *Agave* and eventually cover the exit hole with a silken "trap-door" (Tribe Ægialini). Excellent life-history descriptions of the two types are: a) for the Megathymine tent-builders those by C. V. RILEY (1876) for *Megathymus yuccæ* (Boisduval & Leconte) and by LUCIEN HARRIS JR., (1955) for *M. harrisi* H. A. Freeman; and b) for the Ægialine trap-door makers by COMSTOCK and DAMMERS (1934) for *Agathymus stephensi* (Skinner) and by ANCONA (1934) for *Ægiale hesperiaris* (Walker). Morphologically *M. streckeri* and *M. texanus* are normal *Megathymus* probably rather near *M. harrisi* and *M. cofaqui* (Strecker), both of which build proper "tents" but not until nearly ready to pupate. Therefore STALLINGS and TURNER (1958) reasonably assumed, with some hesitation, that *M. streckeri* and *M. texanus* would also prove to be tent-builders. It now appears probable that their hesitation was better than their assumption, as the following will show.

In early July 1955 (not 1935 as misprinted in Brown, *et al.*, 1956) I noticed a large patch of *Yucca* growing beside the road near Maysville, Chaffee Co., Colorado. Following long-established habit, I stopped and looked there for signs of *Megathymus*. Numerous previous searches in ideal-looking sites in Boulder County had been complete failures, and I had little hope here. Therefore it was an exciting surprise when a very large *Megathymus* flew up in front of me and whisked out of sight. Although they were not common, I was able to take a few that afternoon and a few others when I returned later in the week with my father and son, P. S. and E. E. REMINGTON. Again in 1957 we took specimens there. These all proved to be *M. texanus* and conformed to the generalization that specimens east of the mountain Divide are *texanus*, not *streckeri*. On these visits to the Maysville *Yucca* beds I spent several hours searching for "tents" in the center of the plants (the site for *M. yuccæ*) or under or beside the plants (the site for

* *Megathymus beulahæ* S. & T. is aberrant in feeding on an *Agave* (Stallings & Turner, 1958: p. 123).

M. harrisi), but I found no evidence of them. I also dug up several conspicuously unhealthy-looking plants and many sound ones, in the vain hope of finding burrows.

In July of 1957 I discovered a colony of *Megathymus streckeri* flying on a gravelly flat with a few *Yucca* plants, at Almont, Gunnison Co., Colorado. By this time I doubted seriously that *streckeri* or *texanus* constructs "tents", and I searched very carefully for other evidences of larvæ. The *M. streckeri* being scarce at this place, the number of larval workings was presumably small. Nevertheless I found three unsound-looking plants, each of which had a small pile of large, weathered fecal pellets very near. I found no visible evidence of a burrow-opening and began digging in the sand with a jacknife, my only available tool. To my disappointment, the expected pupal shells were not discovered, but I found that the underground caudex had been extensively eaten away, from the outside. No silk lining was found for the burrow in the sand, nor was any of the white waxy powder which is usually present in pupal burrows of megathymids. It is difficult to understand why pupal shells were not found, and the possibility remains that the feces and feeding were not from *M. streckeri.*

On 8 July, three days later, I found a much larger colony of *M. streckeri* on an extensive *Yucca* bed on a high hill several miles away, near Iola in Gunnison County. The flight period was then drawing to a close, and the wings of most individuals were worn. Females were ovipositing on *Yucca* plants all over the slopes, and it was easy to collect large numbers of eggs. As is usual with *Megathymus,* most of the eggs were glued on rather small plants with new, young leaves. Eggs were found on some large plants with new leaves, but none on small plants with only old, rather dry leaves. Most, but not all, eggs were on the underside of leaves, often far from the base. Some plants contained more than one egg. These were tallied, and the following list shows the number of eggs per plant (*i.e.,* per separate rosette of leaves) on the 32 egg-bearing plants scored:

1 egg — 25	3 eggs — 1
2 eggs — 5	6 eggs — 1.

It seems unlikely that more than one of these huge *Megathymus* could develop on a single small *Yucca* plant, but presumably more than one larva could find sufficient food by following the connected underground caudices. That this happens is doubtful, because a few plants bearing two or more empty eggshells were dissected at Iola some days after the hatching. In each instance the initial feeding holes of several larvæ were found, but only a single larva remained.

A few days later a much larger lot of eggs was collected at Iola, and only the plants having more than one egg were tallied. The following list shows the number of plants bearing from two to six eggs each and the number of individual leaves bearing more than one egg:

Plants	*Leaves*
2 eggs — 2	2 eggs — 6
3 eggs — 4	3 eggs — 0
4 eggs — 2	4 eggs — 0
5 eggs — 1	5 eggs — 0
6 eggs — 2	6 eggs — 1.

Of course, the remaining 23 eggs on these multi-egg plants were on 23 leaves. The eggs on a single plant were obviously laid at different times in at least most instances, as could be seen by the color differences. Newly-laid eggs are a uniform light green; after three days they are reddish, shading into green at the base. Several times green and red eggs were found side by side on a single leaf. Furthermore, the females observed ovipositing at Almont and Iola always flew some distance between the laying of successive eggs.

Most eggs hatched, but about 10% produced parasitic Hymenoptera, a species of Eupelmidæ.

Many of the newly-hatched larvæ were preserved for taxonomic studies and are being described in a general analysis of the larvæ of Megathyminæ now in press. They were dark red, with black heads and prothoracic shields. A few were placed on fresh young *Yucca* plants which had been transplanted to my research quarters at the Rocky Mountain Biological Laboratory. They moved to the bases of leaves and began boring into these succulent bases, with little or no evidence of nest construction. This is unlike newly-hatched *M. yuccæ* in Florida, which fashion nests by fastening together the tips of young leaves with many silken fibers. This supports the view that *M. streckeri* is not a "tent"-maker. The behavior of first instar larvæ of *M. harrisi* and *M. cofaqui* has not been described, nor has the method of larval feeding on the *Yucca* caudices been reported. The annual move back to Yale University at the end of the summer forced us to abandon the laboratory rearing of *M. streckeri*. One larva had reached the second instar and was preserved on 20 August.

Foodplant specificity in Megathyminæ is of very great evolutionary interest. The field evidence collected by the STALLINGS and TURNER group and H. A. FREEMAN indicates that these Giant Skippers may have a distinct foodplant-sibling species on almost every species of *Agave* and *Yucca*. A long series of carefully controlled foodplant experiments will be required before the specificity is understood. For such studies I have had a plantation of species of *Yucca, Nolina,* and *Agave* established at the Archbold Biological Station in Highlands Co., Florida, with the enthusiastic and substantial support of the Director, RICHARD ARCHBOLD, and the Botanist, LEONARD J. BRASS. Having plenty of eggs of *M. streckeri* at hand in 1957, we tried a preliminary experiment with this species. Ten eggs were sent by air to Mr. BRASS at the Station. Six of the ten eggs hatched, from 21 to 24 July. Mr. BRASS put three new larvæ on plants of *Yucca aloifolia* and three on *Y. smalliana*. *Y. aloifolia* is a tree-yucca; *Y. smalliana* is a subspecies or species closely related to *Y. filamentosa* and has the low rosette type of leafage.

In late December, five months later, I inspected all six plants minutely *in situ* for signs of *Megathymus* larvæ. No trace of original or recent feeding was found, and no frass or "tents". The six plants were carefully dug out of the soft sand, intact including even small rootlets, and dissected until it was certain that no larvæ and no perceptible burrows were present. Every leaf was removed, and the stems, caudices, and roots were cross-sectioned with a sharp knife about every three inches. All underground parts were intact and showed no evidence of external feeding. Without question, none of the *M. streckeri* larvæ survived long on either Florida species of *Yucca*. The Colorado foodplants of *M. streckeri* and *M. texanus,* presumed to be *Yucca baileyi* and *Y. glauca,* are not yet present in the Florida garden, so proper experimental controls could not be used. The most likely cause of death is unsuitability of these two *Yucca* species as food for *M. streckeri,* presumably because of phytotoxins for which the insect has not evolved physiological adaptations (see Remington, 1958: p.799). It is possible that predators or parasites eliminated the larvæ at the Archbold Station, but at least one or two should have survived such an enemy. The *Y. aloifolia* plants onto which larvæ were introduced were rather large and stout, and it may be that the age of the plants accounts for the inability of *M. streckeri* to live on the *Y. aloifolia.* We have found this with *M. yuccæ* on *Y. aloifolia.* However, the three plants of *Y. smalliana* were in optimum condition for *Megathymus* larvæ, and yet on that species the failure was equally complete. The age of the plants seems inadequate to account alone for the failure of *M. streckeri* on *Y. aloifolia.*

Summary

1. *Megathymus streckeri* and *M. texanus* probably do not make tents either as young or full-grown larvæ, unlike other species of the Tribe Megathymini.

2. *M. streckeri* often lays more than one egg per small plant, but not at one sitting. Probably not more than one larva survives on each plant. There is an important egg parasite (Eupelmidæ) in the locality studied.

3. There is evidence for some foodplant specificity in *M. streckeri,* in that a few larvæ placed on *Yucca aloifolia* and *Y. smalliana* died, probably in the first instar.

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NINETIETH BIRTHDAYS FOR PROF. GEROULD AND DR. JONES

Two outstanding American authorities on special aspects of biology of Lepidoptera have just celebrated their 90th birthdays. First, on 2 October, was Professor JOHN H. GEROULD, of Dartmouth College. He is the discoverer of the inheritance of the white female form of *Colias* and a noted authority on larval heart action and on butterfly hybridization. Next, on 13 January, was Dr. FRANK MORTON JONES, of Wilmington, Delaware. He has been a lifelong investigator of the biology of insectivorous plants and their insect associates, of the systematics of the Psychidæ, and of insect edibility and its relation to adaptive coloration.

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