DISTRIBUTION OF FOODPLANT CHEMORECEPTORS ON THE FEMALE FLORIDA QUEEN BUTTERFLY, *DANAUS GILIPPUS BERENICE* (NYMPHALIDAE)

JUDITH MYERS
Dept. Zoology, Indiana University, Bloomington, Indiana

Fox (1966) considers the structure of the prothoracic legs of butterflies and relates this to their possible chemosensory function. He points out that in the nymphalid butterflies the forelegs are greatly reduced. The forelegs of the males of these butterflies lack the post-tarsus and have fusion of the tarsal subsegments while the females have forelegs reduced in size without loss of any parts. Further study by Fox revealed that the foretarsi of females in all families of the Nymphaloidea have clusters of trichoid sensilla associated with spines on the tarsi which were not found on the foretarsi of males or on the mid- or hindtarsi of either sex. Fox relates this finding to the work of Ilse (1937) who reported that *Pieris brassicae* females, placed on a green surface would drum the surface with their forelegs. In his own experiments Fox observed three species of nymphalids to scrape with their forelegs the surface on which they were rested, and he suggests that the drumming of the forelegs on plants releases chemicals which stimulate the trichoid sensilla on the foretarsi. In this way the specific larval food plants might be identified.

In an attempt to localize the chemoreceptors which play a role in food plant identification by female queen butterflies, *Danaus gilippus berenice* (Cramer), ablation of likely sites of the receptors, the antennae and the tarsi, was carried out. The egg laying ability of treated females was tested by releasing groups of females in cages in which the larval foodplant, *Asclepias*, was provided. Two types of cages were used. One of these was a large outdoor screened cage (approximately 8 feet by 8 feet by 7 feet high) and the foodplant stalks were placed in vials which were attached to the sides of the cage. The other type of cage was much smaller and was constructed of cheese cloth which was stretched around two aluminum wire rings about 1.5 feet in diameter and 2 feet apart, so as to form a tube. The tops and bottoms of the cages were fastened with draw strings. The cages were placed over a bouquet of *Asclepias*. These cages could be readily moved and for the tests were always placed out-of-doors.

All tests were performed at the Archbold Biological Station in Lake Placid Florida. Two species of *Asclepias* were used for the egg laying experiments, namely, *Asclepias tuberosa rolfsii* and *A. humistrata*. Tarsi of the middle and hindlegs of the female butterflies were cut off at the junction of the basal segment of the tarsi with scissors. The complete fore-

TABLE 1. EGG LAYING OF FEMALE QUEEN BUTTERFLIES WITH VARIOUS SITES OF CHEMORECEPTORS REMOVED OR BLOCKED

Sites of Chemoreceptors Removed	No. of Females	Cage Type	*Asclepias* Species	Eggs
Forelegs	5	Cloth	*A. t. rolfsii* & *A. humistrata*	yes
Mid- & hindtarsi & antennae	18	Screen & Cloth	*A. t. rolfsii* & *A. humistrata*	yes
All tarsi and antennae	15[1]	Screen	*A. t. rolfsii*	no
All tarsi	12	Cloth	*A. t. rolfsii*	no
Mid- & hindtarsi	5	Cloth	*A. t. rolfsii*	yes

[1] 12 of these retested with the same result.

legs, which are quite reduced in queen butterflies and not used for walking, were removed. Chemoreceptors on the antennae were blocked by painting the complete antennae with Testor's Pla paint (Testor Corporation, Rockford, Ill.). The categories of treated females are shown on Table 1. Butterflies used in the tests were collected from the Devil's Garden area in Hendry County Florida.

These tests were most general in nature. However, because the foodplant choice is so specific in the queen butterfly and the recognition of this foodplant is necessary for the elicitation of egg laying, egg laying by only a few females serves as a valid indication that the chemoreceptors which are stimulated by the foodplant are still present. The opposite situation is more difficult, that is to conclusively say that after the removal of structures possibly bearing chemoreceptors, the females will never lay eggs. The mid- and hindtarsi and complete prolegs of 27 queen females were removed and none laid eggs. Twelve of these were retested on a second day with the same result. On the other hand, blocking the chemoreceptors on the antennae, removing mid- and hindtarsi with the forelegs intact and removal of only the forelegs did not inhibit egg laying in queen butterfly females (Table 1). From this it might be concluded that tarsal chemoreceptors are necessary for food plant recognition, and those on the reduced forelegs are sufficient for egg laying but are not necessary when mid- and hindtarsi are present. Since the forelegs are not used in walking or grasping, the failure of females with mid- and hindtarsi plus the forelegs removed cannot by explained simply as a physical inhibition.

The foretarsi of the queen butterfly do have what appear to be trichoid sensilla associated with the spines. These are not quite like those de-

scribed by Fox (1966) (for other nymphalid butterflies) which are in groups at the bases of the spines. But rather, in the female queen butterfly the sensilla partially wrap around the spines and the tips are next to the tips of the spines. The mid- and hindtarsi have several types of sensilla so that it is impossible to even suggest which might be those which are stimulated by the foodplant.

That the prothoracic legs seem to have chemoreceptors involved in foodplant recognition possibly explains why they are maintained when they do not serve a function in ambulation. Another hypothesis is that the foretarsi of the females are protected because of the reduced size of the forelegs. It would seem that the tarsi of the other two pairs of legs would be exposed to considerable wear and danger of damage. However, the forelegs are held next to the thorax and are not subject to these situations. Therefore, the reduction of the forelegs of the nymphalid butterflies may be a mechanism for protecting this site of chemoreceptors and permitting egg laying by the females over a longer period of time. An analogous situation in butterflies might be that of the sucrose receptors on the antennae which cause a behavioral response, proboscis extension, only when the tarsi are removed (Frings and Frings, 1959). This would be an example of a "backup system" for mid- and hindtarsal chemoreceptors. Evidence relating to the hypothesis that foreleg reduction is a mechanism for protecting this site of chemoreceptors might be gained by surveying a wild population of butterflies to determine if damage to the tarsi of the mid- and hindlegs is common. This would give some indication of the selective pressure which might be acting.

ACKNOWLEDGMENTS

I am grateful to Miss Mary Walter for her assistance and to Mr. Richard Archbold and the staff of the Archbold Biological Station where the work was done. The work was conducted while I was supported by P.H.S. Training Grant directed by Dr. Kenneth Roeder, Tufts University.

LITERATURE CITED

FOX, R. M., 1966. Forelegs of butterflies. I. Introduction: chemoreception. J. Res. Lepid., 5: 1–12.

FRINGS, H. and M. FRINGS, 1959. Studies on antennal contact chemoreception by the wood nymph butterfly, *Cercyonis pegala*. J. N. Y. Ent. Soc., 67: 97–106.

ILSE, D., 1937. New observations on responses to colour in egg laying butterflies. Nature, 140: 544–5.