Odonatologica 9 (4): 325-328 *December 1, 1980*

OBSERVATIONS ON FEEDING AGGREGATIONS OF *ORTHEMIS FERRUGINEA* (FABRICIUS) IN COSTA RICA (ANISOPTERA: LIBELLULIDAE)

A.M. YOUNG
Section of Invertebrate Zoology, Milwaukee Public Museum, Milwaukee, Wisconsin 53233, United States

Received June 4, 1980 / Accepted July 23, 1980

Large and dense feeding aggregations of *O. ferruginea* directly over large trays of black pepper berries drying in the sun were studied near La Virgen, Heredia Province, Costa Rica. Several years of general observation on this species in northeastern Costa Rica revealed adult densities of less than one dragonfly/m^2 at roadside ditches and clearings in secondary growth forest. Yet the densities observed over the black pepper ranged from 1.4 to 1.8 dragonflies/m^2, a large increase over nearby habitats. Daily abundance of *O. ferruginea* over the black pepper was 30-50 individuals, predominantly males. Adults arrived each morning by 07.00 hours reaching peak densities by 07.30 hours, and flying over the fruit and capturing small flies as prey. The deliberate removal of the trays of fruit results in a sudden exodus of the dragonflies from the area. Undisturbed departures are usually by 08.00 hours. *O. ferruginea* opportunistically aggregates in areas of habitat where large densities of prey occur, although the mechanism underlying such behavior was not determined.

INTRODUCTION

Orthemis ferruginea is widespread in the southern United States, Central America, and the Caribbean (CALVERT, 1908; PAULSON, 1968) where it is associated with small bodies of stagnant water and roadside ditches. Dragonflies are highly opportunistic predators that assemble in large numbers to feed on aggregations of prey (CORBET, 1980). In this paper I compare the densities of foraging *O. ferruginea* at familiar habitats such as roadside ditches and clearings in secondary succession, with those at aggregations of small flies associated with trays of fermenting fruit. There are

strikingly greater densities of the dragonflies at the aggregations of prey than in other habitats examined.

MATERIAL AND METHODS

The general study area, which includes streams, roadside ditches, clearings in secondary forest succession, and a sprawling farm complex, is located in northeastern Costa Rica about 8 km north of La Virgen, Heredia Province (10°23'N, 84°07'W, elevation 220 m). The region is best described as transitional premontane-to-lowland tropical wet forest (HOLDRIDGE, 1967) with a short and erratic dry spell between January and March each year. The farm complex includes a large and exposed concrete slab area (10 x 10 m), outfitted with large wooden trays on small wheels fitted into iron rails. These trays are often filled with fermenting cacao (*Theobroma cacao*) or black pepper (*Piper nigrum*) fruits and rolled into the exposed area for drying in the sun. Fermenting black pepper attracts relatively greater numbers of small flying insects during the early stages of drying than does the cacao. Sometimes the trays are kept loaded with fermenting fruit for many successive days.

Over a total of 54 days (1.0-3.0 hrs per day) of observation between June 1972 and September 1979 I noted the maximal densities of *O. ferruginea* adults at several roadside ditches (4.0 to 16.0 m^2 areas) and clearings (50-100 m^2 areas) in the secondary succession between a cacao plantation and primary forest. This dragonfly species is generally very abundant in the area and easy to observe. During the wet seasons of 1978 and 1979 I examined unusually dense aggregations of *O. ferruginea* over the trays (total area of about 28 m^2) when filled with black pepper fruits in the initial stages of fermentation in the sun. I made counts of the dragonflies in the aggregations for ten mornings for both years and from 06.30 to 09.00 hrs. Temperature data was readily available from a wet-and-dry bulb thermometer no more than three meters from the trays. General weather conditions were also noted. I attempted to document the assembling pattern of the dragonflies each morning at this site, including arrival times and eventual break-up of aggregations. Using a small aerial net I made some sweeps over the fruit to determine the small flying insects present. A few aerial sweeps were also taken on one morning over the low vegetation at one of the roadside ditches where *O. ferruginea* forages. On one morning in 1979 I deliberately rolled the trays of black pepper back under the shed during a period of peak numbers in the aggregation in order to determine if the aggregation would dissipate.

RESULTS

The usual densities of adult *O. ferruginea* at roadside ditches in this region is 0.35 ± 0.18 (S.D., N=24) dragonflies/m^2 and 0.46 ± 0.21 (S.D., N=30) in secondary succession clearings for the same periods. The assembling of *O. ferruginea* at the trays of fruit followed a similar pattern each morning. On

sunny mornings the dragonflies arrived by 7.00 a.m. (18-21°C) and remained until 8.00 a.m. (27.0-29.0°C). Their departure was very sudden. On overcast mornings, they arrived later. While aggregated over fruit, no other *O. ferruginea* were seen at nearby water-filled ditches streams (all within 5-10 m). Following the break up of the aggregation, usually 3-6 were eventually spotted in these habitats. The daily abundance in the aggregation ranged from 30-50 individuals (36±9.4, N=10 days), predominantly males. A few tenerals were noticed, although there was no pattern of steady recruitment of newly--emerged adults. Arrivals each morning were initially slow, with 1-5 individuals present in the first 20 minutes in sunny weather. By 7.30 a.m. densities ranged from 1.4 to 1.8 adults/m^2, representing a 3-6 fold increase over nearby habitats.

Sweep samples of insects 0-10 cm above the fermenting fruits when the dragonflies were aggregated revealed 8-15 species of Diptera (daily abundance 70-200 individuals), mostly Tephritidae and Drosophilidae (size range 2-5 mm). The dragonflies captured and devoured prey, their darting and swooping motions resembling the foraging antics of many libellulids (CORBET, 1962). Sweeps over vegetation adjacent to a roadside ditch occupied by *O. ferruginea* yielded only 30-55 individuals of dipterous insects.

When the fruit-filled trays were deliberately rolled back under a shed after the aggregation had formed, the dragonflies quickly left the site (within 7 min.). Likewise, when only empty and thoroughly dry trays were rolled out on other days, a few *O. ferruginea* appeared briefly and then left.

DISCUSSION

Dragonflies assemble to feed on aggregations of suitable prey (CORBET, 1980) and it is not unusual for a species which normally forages at low density to switch opportunistically to exploit aggregations of prey (WILLIAMS, 1976). A typical low density foraging pattern of *O. ferruginea* in the present study is that seen for this species at roadside ditches and clearings in secondary forest. Under these conditions prey densities are essentially non--aggregated, thus precluding the formation of large assemblages of the dragonfly. Such facultative behaviour allows dragonflies to utilize occasional and patchy dense resources of food. Undoubtedly this is the situation with *O. ferruginea* over large accumulations of black pepper fruits: the flies swarming a fruit are a concentrated food supply for the dragonflies. The behaviour might be particularly adaptive for large-bodied and robust dragonflies such as *O. ferruginea* with high energy mobilization demands (MILLER, 1961) since it results in the exploitation of a concentrated food supply.

The proximal cues associated with the formation of *O. ferruginea* assemblages at aggregations of prey were not determined in this study. But

from what is generally known about odonate visual perception (e.g., SOKAL, 1947) and foraging (CORBET, 1980), the individual dragonflies probably encounter the swarms of flies each morning, with recruitment governed largely by the recognition of conspecifics already at the site. Whether or not the dragonflies associate the trays of fruit with a food supply over successive days cannot be ascertained from this descriptive study. Removal of the trays implies a removal of the aggregated prey, thus causing a disbandment of the *O. ferruginea* assemblage. The normal break-up of such assemblages is probably the result of prey leaving the area in response to rising air temperatures, a particularly stressful condition for small-bodied dipterans.

ACKNOWLEDGEMENTS

The preliminary studies summarized here were by-products of field research supported by grants from the National Science Foundation, Friends of the Milwaukee Public Museum, and The American Cocoa Research Institute. I thank Dr. ROBERT HUNTER, ADAN QUESADA, and JAVIER SOLIS for assistance. Dr. DENNIS R. PAULSON, a modern-day pioneer in tropical odonatology, kindly provided the initial descriptions of the dragonfly species for me in 1969.

REFERENCES

CALVERT, P.P., 1908 [1892-1908]. Odonata. *Biologia cent.-am.* (Zool.) 50: I-XXX, 17-420, map 1, pls. 2-10.

CORBET, P.S., 1962. *A biology of dragonflies.* Quadrangle Books, Chicago.

CORBET, P.S., 1980. A biology of Odonata. *Ann. Rev. Ent.* 25: 189-217.

HOLDRIDGE, L.R., 1967. *Life zone ecology.* Trop. Sci. Center, San Jose, Costa Rica.

PAULSON, D.R., 1968. Odonata from Isla San Andres, western Caribbean Sea. *Ent. News* 79: 229-231.

MILLER, P.L., 1961. Spiracle control in dragonflies. *Nature, Lond.* 191: 623.

SOKAL, R.R., 1947. The anatomy of the head capsule of the dragonfly Pantala flavescens Fabricius. *Notes Ent. chin.* 11: 157-223.

WILLIAMS, C.E., 1976. Neurocordulia (Platycordulia) xanthosoma (Williamson) in Texas. *Great Lakes Ent.* 9: 63-73.