FEEDING HABITS OF THE SPIDERS CYCLOS A TURBINATA (WALCKENAER) AND LYCOS A RABIDA WALCKENAER

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ABSTRACT

Prey records of the orb-weaving spider Cyclosa turbinata (Walckenaer) and the wolf spider Lycosa rabida Walckenaer in an east Texas agroecosystem are presented. Aphids were numerically the most dominant component in the potential prey (based on D-Vac samples) as well as in the actual prey found in webs of C. turbinata. L. rabida was studied during the night using the head-light method (gleaming eyes) and ca. 4% of those collected were feeding. It is estimated that L. rabida captured less than one prey per spider daily.

INTRODUCTION

Cyclosa turbinata (Walckenaer) and Lycosa rabida Walckenaer are two of the most conspicuous species of the American spider fauna. The orb-weaver, C. turbinata (Araneidae), is unusual in that it decorates its web with the remains of insects and debris tied together with silk (Gertsch 1949). It has an adult length of 4.2 to 5 mm in females and 3 mm in males. According to a study by Spiller (1984) in California, C. turbinata has two generations per year. The first generation matures and reproduces in late spring and dies in early summer, and the second generation matures and reproduces during the summer and dies during the fall and winter.

L. rabida is a large wolf spider with an adult length of 16-21 mm in females and 11 mm in males. Females were found in east Texas carrying egg-sacs between late June and late July. In Connecticut and Kansas, L. rabida was found carrying egg-sacs in August and September (Kaston 1948, Fitch 1963). Both species were found to be members of spider communities in cotton agroecosystems of Arkansas and east Texas (Whitcomb et al. 1963, Dean et al. 1982). In this paper we present data about the feeding ecology of the two species in a farmland area in east Texas.

MATERIALS AND METHODS

Study Area. Investigations were conducted in an unsprayed...
cotton field (6.5 ha) in Houston County, east Texas, 8 km west of Austin (near Crockett) from June to mid-September 1985. The cotton variety 'CAMD-E' was planted on 27 May and emerged in the first week of June. The distance between rows was 1 m, with an average of 10.1 plants per m of row. The cotton agroecosystem was surrounded by and bordered on extensive meadows (composed of various grasses and low growing annual Dicotyledonae) that were rarely mown. *C. turbinata* was studied exclusively in cotton, while observations of *L. rabida* were conducted in cotton and in the adjacent habitats.

**Observations of *C. turbinata***. Since *C. turbinata* decorates its webs with the remains of prey (Rovner 1976), it is easy to assess the diet of this species by simply removing these decorations from the webs with forceps, preserving them in 70% ethyl alcohol and later identifying the prey items under a microscope. All insects found dead in webs are considered prey, regardless if the spiders were observed feeding on them or not.

In order to compare the actual prey found in the spider webs with the potential prey, 25 D-Vac samples, each of one m of row, were taken weekly for a 14 week period during the summer of 1985. Those collected arthropods were returned to the laboratory and later identified and counted under the microscope.

**Observations of *L. rabida***. This spider was studied during the night by the head-light method (Wallace 1937). During the night when a beam of white light is reflected on the eyes of a wolf spider, the eyes gleam in the darkness like small lights. Spiders blinded by the light beam generally remain motionless and can easily be captured along with their prey.

The prey capture rate (b) of *L. rabida* was calculated according to Edgar's (1970) method developed for wolf spiders with the following formula:

\[
b = \frac{T_f \times 60 \times w}{1 \times \text{MCT} \times 100},
\]

where \(T_f\) is the time (hours/day) available for feeding in the field, \(w\) is the percentage of spiders with prey in a sample, and \(\text{MCT}\) is the mean consumption time for prey.

The energy content of prey was calculated from the fresh weight according to formulas presented in Van Hook (1971) and in Moulder and Reichle (1972).

**RESULTS AND DISCUSSION**

**Observations of Cyclosa turbinata**. Webs were built in mid-August with an average diameter of 9.13 ± 1.37 cm (\(\bar{x} \pm \text{SD}\)). Forty-two percent of the 118 prey items that were removed from the web were so strongly macerated by the spiders' chelicerae that they could not be identified (Table 1). Aphids dominated numerically in the actual prey (38.1% of the total diet) as well as in the potential prey (75% in D-Vac samples) of *C. turbinata*. The other components in the spiders' diet consisted of small dipterans, small hymenopterans, leafhoppers, thrips, a small coleopteran, and a worker of the red imported fire ant (*Solenopsis invicta* Buren). *C. turbinata* was observed feeding on the cotton fleahopper, *Pseudatomo-
sceIs seriatus (Reuter), in woolly croton fields. C. turbi-
nata seems primarily to be a predator of small flying insects; 
thus, it is a potentially important predator of the cotton 
flea hopper, which is a key pest of cotton in east Texas.

TABLE 1. Diet* of the Orb-weaving Spider Cylcoso 
turbinata in an East Texas Cotton Agroecosystem.

<table>
<thead>
<tr>
<th>Prey type</th>
<th>% caught in web</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphids</td>
<td>38.1</td>
</tr>
<tr>
<td>Small dipterans</td>
<td>7.6</td>
</tr>
<tr>
<td>Small hymenopterans</td>
<td>5.9</td>
</tr>
<tr>
<td>Leafhoppers</td>
<td>2.5</td>
</tr>
<tr>
<td>Thrips</td>
<td>1.7</td>
</tr>
<tr>
<td>Small coleopteran</td>
<td>0.8</td>
</tr>
<tr>
<td>Red imported fire ant</td>
<td>0.8</td>
</tr>
<tr>
<td>Unidentified (strongly mascred)</td>
<td>42.4</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

* Based on 118 prey items collected from orb-webs during summer 1985.

Why do C. turbinata decorate their webs with the remains of prey? One explanation is that the web decorations serve as 
concealment of the spider (Marples 1969). C. turbinata spends 
the daylight hours in the center of their webs and thus are 
exposed to the attacks of diurnally visual searching predators 
such as sphecid wasps. However, since the debris of the web 
decoration are of similar color, size and shape as the spider 
itself, C. turbinata becomes inconspicuous in the middle of 
this decoration (Fig. 1).

To test Marples' hypothesis, we analyzed the diet of 
spider-hunting sphecid wasps. Many sphecid wasps (mainly Cha-
lybion californicum (Saussure)) were observed in this study 
area in 1985. The same area was also inhabited by numerous C. 
turbinata (potential prey for wasps). Twenty mud dauber wasp 
nests were sampled in that area in June/July, broken up, and the 
spiders stored in the brood cells were identified. The 
diet of these sphecid wasps consisted of > 75% orb-weaving 
spiders. Among 510 spiders killed by the wasps there were no 
specimens of C. turbinata. From this we conclude that C. 
turbinata is very rare, or never, captured by the sphecid 
wasps, which implies that the web decorations indeed function 
as an effective defense mechanism against spider-hunting 
flying predators, such as sphecid wasps.

Observations of Lycosa rabida. During several nights we 
detected numerous (ca. 50) L. rabida with this method. Few L. 
rabida were found in cotton. In contrast, many specimens of 
this species were found in the adjacent habitats, only a few 
meters from the edge of the cotton field. Only two of the L. 
rabida encountered were carrying prey between their chelicerae 
(ca. 4% of the observed spiders were feeding). Likewise, only 
a low proportion of the large wolf spiders, Lycosa punctulata
FIG. 1. Web of *Cyclosa turbinata* showing debris (spider in center).
Hentz and Lycosa carolinensis Walckenaer, were feeding (Shook 1978, Nyffeler unpubl. data). One L. rabida was consuming a large grasshopper. The other spider was feeding on the cricket, Acheta domesticus (L.), of 25 mm body length.

Observations concerning the diet of L. rabida have previously been made in other parts of the United States. In Kansas, Fitch (1963) observed L. rabida feeding on grasshoppers and smaller members of their own species. In Arkansas cotton fields, Whitcomb et al. (1963) found L. rabida to be a predator of lepidopteran larvae and moths. In South Carolina old fields, Kuenzler (1958) observed L. rabida feeding on grasshoppers, lepidopteran larvae, moths, coleopterans, roaches, and spiders.

As Bilsing's (1920) cage experiments revealed, Lycosa spp. feed in captivity on a wide range of different arthropod groups which characterizes them as nonspecific feeders. Also the small wolf spiders of the genus Pardosa are known to be nonspecific feeders (review in Nyffeler & Benz 1981). In contrast to Pardosa spp. which feed on small prey, large prey apparently play an important role in the nutrition of Lycosa spp. Due to morphological and ethological adaptations, L. rabida and other Lycosa spp. are able to overpower insects that are larger than the spider itself (Rovner 1980). We observed L. rabida killing and eating large grasshoppers in cages. Prey insects were crushed between the spiders' powerful chelicerae until nothing but a mass of fine pulp remained. The same behavior was observed in Lycosa carolinensis by Bilsing (1920). This behavior indicates that such large wolf spiders are very efficient feeders that can extract the maximum amount of calories from a prey item. Small Pardosa have been observed chewing down their prey to a meat ball, which enables them to utilize a prey item efficiently and to transport it easily (Nyffeler & Benz 1979, 1981).

The prey capture rate (b) of L. rabida was calculated with Edgar's formula (1970) as previously described. The following values were used: T_f = 9 (according to our current knowledge, L. rabida is a nocturnal feeder in the field; in east Texas in summer between ca. 2100 and 0600 h.), w = 4 (based on our observations), and MCT = 240 (based on our observations). On this basis it was calculated that L. rabida captured less than one prey per spider daily.

If L. rabida captures a cricket of 800 mg fresh weight, then this spider can feed on prey that has an energy content of 1512 calories. According to our observations, almost the entire biomass of a prey item was consumed by L. rabida. However, Moulder & Reichle (1972) concluded that 82% of a killed Acheta domesticus (dry weight) was consumed by this spider species. If we are conservative and consider Moulder & Reichle's lower value, then we conclude that a spider can extract 1240 calories from a large prey item.

According to Van Hook (1971), L. rabida has an estimated food consumption rate of 0.59 calories/mg spider dry weight per day. An adult female with a dry weight of 120 mg (500 mg fresh weight) would consume food at a rate of ca. 71 calories/day.

If we compare this estimated daily food consumption rate with the value of 1240 calories that can be extracted by a spider from one single large prey item, then it is evident that an adult L. rabida can survive with a capture rate of < 1
prey per day, since a spider can ingest 14.5 times the daily demand in one meal.

Besides the ability of Lycosa spp. to overpower large prey and extract a maximum amount of energy, still other feeding mechanisms operate that maximize food utilization by these spiders. The ability to capture multiple prey (Rovner & Knost 1974), to scavenge (Knost & Rovner 1975), and to starve for a considerable time (Anderson 1974) are some such adaptations.

In the ecosystem described in this paper, large grasshoppers and crickets were abundant and probably served as one of L. rabida’s major food sources. Other spiders in this ecosystem that were observed utilizing large orthopterans as a food source included Lycosa mactans (F.), Argiope aurantia (Lucas), and Argiope trifasciata (Forskal).

With a body length of 16 to 21 mm in adult females, L. rabida is one of the largest spider species of the cotton agroecosystem. According to cage experiments, L. rabida is capable of killing the green lynx spider, Peucetia viridans (Hentz), which itself is a large spider (ca. 11 mm in length). Hence, L. rabida likely feeds near the top of the food chain of the cotton agroecosystem.

Since Lycosa spp. were observed feeding on the larvae and adults of different lepidopterans and coleopterans both in the laboratory (Bilsing 1920) and field (Kuenzler 1958, Whitcomb et al. 1963), these large wolf spiders can be considered as potential predators of bollworm, tobacco budworm, and boll weevil. These three species are all important pests in cotton. In east Texas cotton fields, L. rabida occurs in low densities, and we cannot expect that it is a key predator of cotton pests (sensu Sterling 1984). However, in an eastern Tennessee old field, Lycosa spp. were considered to be the dominant invertebrate predators (Van Hook 1971).

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LITERATURE CITED


