NATURAL ENEMIES OF SPIDERS: MUD DAUBER WASPS IN EAST TEXAS[1/]

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ABSTRACT

Spider prey analysis of sphecid wasps was conducted in an east Texas farmland area. Two spider families, Araneidae and Theridiidae, comprised > 90% of the wasps' diet. The most abundant prey of these wasps were the orb-weavers, Gea heptagon (Hentz) (57.1% of total), and Acanthepeira stellata (Walckenaer) (17.7%). The southern black widow, Latrodectus mactans (F.) (5.9%), was also an important component of the diet of these wasps. Remaining families represented < 10%. These sphecid wasps are fairly selective hunters on two-three families of spiders. Individual wasps occasionally may choose predominantly from a single species of spider. Data of other workers are compared to our study.

INTRODUCTION

Female mud dauber wasps provide spiders as food for their immatures. The wasps construct mud nests containing several tubular brood cells. After being stung and paralyzed, the spiders are transported to the nests; and each brood cell is provisioned with some spiders. The wasp then lays an egg on one of these spiders. After hatching, the wasp larva consumes the well-preserved spiders in the brood cell, pupates, and later the adult emerges through a hole chewed in the brood cell.

Two species of sphecid wasps that occur in the United States often exist sympatrically. They are the yellow-legged mud dauber, Sceliphron caementarium (Drury), and the steel-blue mud dauber, Chalybion californicum (Saussure), an obligate hyperparasite. Sceliphron caementarium builds its own nests; C. californicum breaks into the nests of S. caementarium, empties the brood cells, fills them with its own prey, lays an egg and then reseals the nest (Rau 1935b, Muma and Jeffers 1945). The predatory behavior of the two wasp species are described in detail by Eberhard (1970) and Coville (1976, 1987). We analyzed the diet of mud dauber wasps in east Texas to determine their ecological role as predators in a rural area.

MATERIALS AND METHODS

The studies were conducted during the summer of 1985 on

[1/]Hymenoptera: Sphecidae

the L. N. Brown farm, located 5.6 km west of Austonio, near Crockett, Houston Co., east Texas. The farm buildings are surrounded by extensive grassland that serves as a horse pasture and is occasionally mown. The area is dominated by cotton fields and grazing land. Wasp nests were removed from inside and outside of farm buildings in June and July. Dorris (1969) noted that wasps emerged from nests in Arkansas from June to early September, and June and July were the best months for collecting.

A total of 69 nests were collected; 23 nests contained spiders and 20 of these nests contained identifiable spiders. Wasps from the remaining 46 nests had consumed the prey and emerged. The prey were removed from the brood cells and preserved in 70% ethyl alcohol. They were later identified under a microscope to the lowest taxon possible. Voucher specimens were deposited in the collection of the Department of Entomology at Texas A&M University.

Besides the actual prey of the wasps, we also assessed their potential prey (spiders occurring in the wasps' environment) by sampling spiders from the cotton plants and grassland (composed of various grasses and low growing annual Dicotyledonae) near the farm. Twenty-five D-Vac samples (Dietrick 1961) consisting of 1 m of row each were taken weekly in cotton for 13 weeks from June to early September (total spiders = 923). Ten D-Vac samples were taken every three weeks in grassland (330 spiders) on four sampling dates from July to early September, and an undetermined number of samples were taken by sweeping in grassland (1,252 spiders) on nine sampling dates from June to early September. They were returned to the laboratory and later identified and counted under the microscope. Taxonomic literature of spiders is scattered among numerous publications, but Spider Genera of North America by Roth (1985) contains references to revisions of the various groups. Vogel (1970) presents a list of spider species recorded from Texas along with references.

RESULTS AND DISCUSSION

The prey were collected from Sceliphron caementarium or Chalybion californicum nests (Table 1). Since we could not identify the wasp species by its nest and since adult wasps do not remain with the nest, we present the prey of both wasp species grouped together (Table 1).

The wasps' prey consisted exclusively of spiders. Most wasp nests contained one to three species from one or two families. Spiders of the families Araneidae (78.1% of total), Theridiidae (13.0%), Oxyopidae (6.9%), Salticidae (1.6%), Lycosidae (0.2%), and Thomisidae (0.2%) were found in the wasps' nests. The Araneidae and Theridiidae comprised > 90% of the wasps' diet.

Spiders often captured by the wasps included the orb-weavers Gea heptagon (Hentz) (57.1%) and Acanthepeira stellata (Walckenaer) (17.7%) which made up 75% of the wasps' prey. The next most abundant components in the wasps' diet were the comb-footed spiders Tidarren haemorrhoidale (Bertkau) (7.1%) and Latrodectus mactans (F.) (5.9%) and the lynx spider Oxyopes salticus Hentz (6.5%). However, all T. haemorrhoidale were found in one nest, and most O. salticus were found in another nest. Of the spiders collected frequently by wasps, G. heptagon, A. stellata and O. salticus were abundant on the

TABLE 1. Spiders Used as Prey in the Brood Cells of 20 Mud Dauber Wasp Nests Collected on a Farm in east Texas (June/July 1985).

Spider Prey	Sex & Stage of Spider[a/]	Nest No.																				
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Sum
Theridiidae																						
Latrodectus mactans (F.)	i			4								1/	4							2		27
	m			1								1										2
	f												1									1
Tidarren haemorrhoidale (Bertkau)	f															36						36
Araneidae																						
Acanthepeira stellata (Walckenaer)	i			1			1	13	1	4		4	18	23	1	9		1			4	80
	m													1						1		2
	f												1	3	2						2	8
Argiope trifasciata (Forskal)	i					1						1	1									3
Eustala anastera (Walckenaer)	i	1						3					3									7
	f							1				1	2									4
Gea heptagon (Hentz)	i	4		21		3	5		6	3		1/		18		2		8	5	1	1	94
	m								1			1		2		1		1	1	1		8
	f	21		17		10	5		53	3		41	10	5	2	5		8	3	1	4	188
Neoscona arabesca (Walckenaer)	i							2														2
	f							1														1
Oxyopidae																						
Oxyopes salticus Hentz	i				5												1					6
	f				25												2					27
Peucetia viridans (Hentz)	i										2											2
Lycosidae																						
Pardosa pauxilla Montgomery	f				1																	1
Thomisidae																						
Xysticus sp.	i													1								1
Salticidae																						
Eris sp.	i							1						1								2
Other	i		2		3						1											6
Total		26	2	44	34	14	11	21	61	10	3	83	40	54	5	53	3	18	9	6	11	508

[a/] i = immature, m = male, f = female.

foliage of mixed grasses, annual Dicotyledonae and cotton plants of that farm area (Table 2). Latrodectus mactans is also common in that area (underrepresented in Table 2 based on our sampling methods). Tidarren haemorrhoidale was probably the most abundant spider in the barn where many wasps built their nests. Thus, the wasps captured primarily spiders that were abundant in that area. However, a comparison of actual prey (Table 1) and potential prey (Table 2) indicates that those wasps are selective predators, since the species diversity of the potential prey is higher than that of the actual prey.

TABLE 2. Percent Species Composition of Spiders (Potential Prey of Sphecid Wasps) from an east Texas Farmland Area in the Vicinity of a Mixed Colony of Sphecid Wasp Nests (summer 1985).

Spider Species	Grassland		Cotton
	Sweep	D-Vac	D-Vac
Uloboridae			
Uloborus glomosus (Walckenaer)		0.9	0.2
Dictynidae			
Dictyna segregata Gertsch & Mulaik	0.1	0.3	3.3
Theridiidae			
Achaearanea globosa (Hentz)		1.2	0.2
Argyrodes fictilium (Hentz)		0.3	
Latrodectus mactans (F.)	0.1		0.9
Theridion australe Banks	0.2	0.3	1.7
Theridion crispulum Simon			0.1
Theridion murarium (Emerton)	0.1		0.3
Thymoites sp.		0.3	
Tidarren sp.			0.1
Mysmenidae			
Mysmena incredula (Gertsch & Davis)		0.3	0.1
Linyphiidae			
Ceraticelus sp.	0.2	0.9	0.1
Eperigone eschatologica Crosby		0.3	0.8
Erigone autumnalis Emerton	0.1		0.2
Grammonota texana (Banks)	0.4	0.9	0.1
Other Linyphiidae		0.3	0.7
Araneidae			
Acanthepeira stellata (Walckenaer)	1.8	0.6	3.5
Argiope trifasciata (Forskal)	0.3	0.6	
Cyclosa turbinata (Walckenaer)	0.2	0.6	0.5
Eustala anastera (Walckenaer)	0.9		0.2
Gea heptagon (Hentz)	0.6	26.4	1.1
Glenognatha foxi (McCook)	0.2	2.4	1.0
Mangora gibberosa (Hentz)	0.9	0.9	0.2
Neoscona arabesca (Walckenaer)	4.1	0.9	0.7
Tetragnatha laboriosa Hentz	0.5	0.6	2.2
Other Araneidae	0.1		
Mimetidae			
Mimetus hesperus Chamberlin	0.1		0.1
Pisauridae			
Dolomedes sp.			0.1
Pisaurina mira (Walckenaer)			0.1

TABLE 2. cont.

Lycosidae			
Lycosa rabida (Walckenaer)	0.2	0.6	0.1
Pardosa sp.	0.2	1.2	1.5
Schizocosa avida (Walckenaer)	0.1	0.6	
Other Lycosidae	0.3		
Oxyopidae			
Oxyopes apollo Brady	0.1	0.3	0.3
Oxyopes salticus Hentz	32.5	32.4	67.2
Peucetia viridans (Hentz)	1.3	0.3	0.3
Clubionidae			
Cheiracanthium inclusum (Hentz)	0.1		1.3
Clubiona catawba Gertsch	0.1		
Anyphaenidae			
Aysha gracilis (Hentz)	0.2		2.0
Wulfila saltabunda (Hentz)		0.6	0.2
Thomisidae			
Misumenoides formosipes (Walckenaer)	0.2		
Misumenops asperatus (Hentz)	0.1		
Misumenops celer (Hentz)	0.9	0.3	
Misumenops dubius (Keyserling)	0.2		
Misumenops sp. (immatures)	30.0	10.3	2.8
Xysticus sp.	0.3		
Philodromidae			
Philodromus sp.	4.2	5.5	1.3
Tibellus duttoni (Hentz)	4.3	2.4	
Salticidae			
Eris sp.	0.1		
Habronattus coecatus (Hentz)	0.1	0.6	
Hentzia palmarum (Hentz)	0.1		0.3
Metaphidippus galathea (Walckenaer)	7.7	2.8	2.1
Phidippus audax (Hentz)	5.1	2.8	1.8
Phidippus pius Scheffer	0.1		
Sarinda hentzi (Banks)	0.1		0.1
Thiodina puerpera (Hentz)	0.2		0.1
Zygoballus rufipes (G. & E. Peckham)	0.3	0.3	0.1

Unfortunately, in this study we were not able to determine which of the spiders listed in Table 1 were killed by *C. californicum* or *S. caementarium*. However, other authors were able to determine these two wasp species' diets separately, as represented in Table 3. The following pattern emerges: *C. californicum* captured predominantly spiders of the families Araneidae and Theridiidae (> 90% of the wasps' diet). In Oklahoma, *Latrodectus mactans* was found to be an "index species" prey of *C. californicum* (Horner and Klein 1979). *Sceliphron caementarium* attacks primarily spiders of the families Araneidae, Thomisidae, and Salticidae. Spiders of the genera *Oxyopes* and *Misumenops* are typical prey of *S. caementarium* (Horner and Klein 1979).

The similarity of the diets of *C. californicum* and *S. caementarium* was calculated by the niche overlap formula of Horn (1966) using prey data from the literature (Muma and Jeffers 1945, Horner and Klein 1979). Overlap values range from zero to 1.0, from entirely different to identical diets, respectively. The calculation was carried out at family level of the identified prey items, but these values may be overest-

imated when compared with calculation at species level. From the data of Muma and Jeffers (1945) we calculated an overlap value of 0.36, and a value of 0.39 from the data of Horner and Klein (1979). These values indicate that the diets of both wasp species in general are distinct, even if some spiders (orb-weavers) are common to the diets of both.

TABLE 3. Proportion of Five Major Food Components in Diets of Sceliphron caementarium and Chalybion californicum.

	Sceliphron caementarium[a/]				Chalybion californicum[a/]			
	MD	MO	MS	OK	MD	MO	OK	FL
	%	%	%	%	%	%	%	%
Theridiidae	0.5	-	8.1	-	67.8	85.9	29.5	25.2
Araneidae	55.7	87.9	36.7	29.5	26.9	13.9	70.0	72.7
Oxyopidae	9.5	2.2	3.0	5.9	1.6	-	-	0.4
Thomisidae	16.1	4.9	19.0	63.1	1.8	0.1	-	1.1
Salticidae	10.1	4.0	20.0	1.0	1.6	0.1	-	0.1
Others	8.1	1.0	13.2	0.5	0.3	-	0.5	0.5

[a/]MD: Maryland - Muma and Jeffers (1945).
MO: Missouri (S.c.) - Rau (1935a), (C.c.) - Landes et al. (1987).
MS: Mississippi - Dorris (1970).
OK: Oklahoma - Horner and Klein (1979).
FL: Florida - Landes et al. (1987).

The species-specific prey preferences may be explained by the different hunting behavior of the two wasp species. Rau (1935b) and Muma and Jeffers (1945) found that S. caementarium hunts among foliage and flowers, while C. californicum searches for spiders near the ground and around and in buildings.

A comparison of our data (Table 1) with those from the literature reveals that the prey of most wasp nests collected in this study fit the foraging pattern of C. californicum (exceptions: nests no. 2, 4, 10, 13, 16). Evidence for this pattern is indicated by the following observations: 1) foliage-hunting spiders (Oxyopidae, Thomisidae, Salticidae), apparently typical prey of S. caementarium, are missing in the prey of most wasp nests; 2) in 80% of the wasp nests, spiders were found that build their webs close to the ground (G. heptagon, immature A. stellata, L. mactans). Latrodectus mactans, described in literature as an "index prey" of C. californicum (Irving and Hinman 1935, Rau 1935a, Horner and Klein 1979), were found in four wasp nests; 3) a large number of the barn-dwelling spider T. haemorrhoidale was found in wasp nest no. 15; and 4) most wasps that hatched from mud dauber nests brought into the laboratory were C. californicum. On the farm C. californicum was more common than S. caementarium.

Sphecid wasps could be useful in their collection of

poisonous spiders of the genus Latrodectus (Irving and Hinman 1935, Rau 1935a). In Maryland and Oklahoma ca. 25% of the diet of C. californicum consisted of Latrodectus (Muma and Jeffers 1945, Horner and Klein 1979). At the same time these wasps are natural enemies of spiders which feed on cotton insects (Nyffeler et al. 1988). These spider-hunting wasps are themselves occasionally killed by web-building spiders (Obin 1982).

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