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Distribution and Abundance Patterns of Spiders Inhabiting Cotton in Texas

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Contents

Distribution and Abundance Patterns of Spiders Inhabiting Cotton in Texas

D. A. Dean and W. L. Sterling

Department of Entomology

Texas A&M University

Abstract

Patterns of the distribution and abundance of spiders were determined in the major cotton growing areas of Texas during 1982-83. *Misumenops* spp., *Oxyopes salticus* Hentz, and *Tetragnatha laboriosa* Hentz were among the most abundant taxa of spiders throughout the state. *Misumenops* spp. were most abundant in West and Northwest Texas, with *M. celer* (Hentz) the most common species in these areas. *Oxyopes salticus* was the most abundant spider in all areas of the state except West, Northwest, and South Texas but was abundant in these areas. *T. laboriosa* was predominant from East to South Texas. Because these species were found in all areas sampled, they are good candidates for detailed studies evaluating the impact of spiders on destructive arthropods in agroecosystems.

The Texas Agricultural Experiment Station/Neville P. Clarke, Director/Texas A&M University System

Introduction

"In the development of science, empirically observed patterns almost always precede the discovery of causative principles that produce the patterns" (Ricklefs 1979). Thus, we need to know the patterns of distribution and abundance before the role of spiders can be determined. The role of spiders in cotton and other agroecosystems was reviewed by Riechert and Lockley (1984) but the role of most species is largely unknown (Nyffeler 1982). Spiders are predaceous on many species of insect pests; however, they also attack natural enemies of pests (Whitcomb and Bell 1964). Thus, it is largely unknown whether spiders contribute greater benefit by killing pest species, whether they are detrimental since they also feed on predators and parasites, or whether they are of little or no economic significance.

Understanding the role of spiders in agroecosystems is crucial since spiders are one of the dominant arthropod groups in agroecosystems (Fuchs and Harding 1976). Even if the impact of spiders proves to be economically neutral, the ability to predict this neutrality is important since spiders could then be eliminated as an important factor in predicting the dynamics of other arthropods. The cotton fleahopper *(Pseudatomoscelis seriatus* [Reuter]) model (Hartstack and Sterling 1986) uses numbers of six spider species to predict fleahopper dynamics.

The feeding ecology of *Peucetia viridans* (Hentz), *Oxyopes salticus* Hentz, and *Argiope aurantia* Lucas in a cotton field in East Texas was studied by Nyffeler et al. (1987a, b, c). Studies on other spider species in this cotton agroecosystem include Nyffeler et al. (1986, 1987d).

Spiders are known to prey on various cotton insect pests as well as natural enemies. McDaniel and Sterling (1979, 1982) reported that *Oxyopes salticus* and *Misumenops* spp. fed on *Heliothis virescens* (F.) eggs. These two taxa of spiders also fed on small larvae of *H. virescens* (McDaniel et al. 1981). *Oxyopes salticus* has also been observed to eat *P. seriatus* (Kagan 1943, Whitcomb and Bell 1964). *Misumenops* spp. fed on *Lygus* (Whitcomb and Bell 1964), while *M. celer* (Hentz) fed on *P. seriatus* and *Heliothis* spp. larvae (Kagan 1943). *Tetragnatha laboriosa* Hentz was found to feed on *P. seriatus* (Kagan 1943) and *Lygus lineolaris* (Palisot de Beauvois) (Wheeler 1973). Bailey and Chada (1968) determined that *O. salticus* fed on most instars of *H. zea* (Boddie), which occur in sorghum fields. Spiders also feed on natural enemies in cotton and serve as food for other arthropods (Whitcomb and Bell 1964).

The spiders found on cotton in the United States have been studied in several states: California (Leigh and Hunter 1969), Central (Kagan 1943) and East Texas (Dean et al. 1982), Arkansas (Whitcomb and Bell 1964), Mississippi (Lockley et al. 1979), Alabama (Skinner 1974), and South Carolina (Roach 1980). Only in Arkansas has the spider fauna been studies in all cotton gowing areas within the state. The objective of this study was to determine patterns in the distribution and abundance of common spiders in cotton fields in several areas of Texas. This survey was designed to indicate which spider species are sufficiently abundant and widely distributed to play a major role in the functioning of agroecosystems. Certainly, the abundance of a spider species will not always relate to its importance as a natural enemy of some pest or beneficial species, since there are other factors such as prey preferences and searching abilities that will affect its efficiency.

Methods and Materials

Cotton plants were sampled from 11 counties in Texas in 1982 and 23 counties in 1983 (including 10 of the 11 counties sampled in 1982). The cotton was either untreated throughout the season or had not received any insecticide applications within about 3 weeks of sampling. Cotton was sampled in the major growing areas 1-3 times during the season. During part of 1982, 25 row samples, 1 meter (m) each, were taken in each field. For the remainder of 1982 and all of 1983, 10 row samples, 20 m each, were taken per field. Nearly 15,000 m of cotton rows were sampled in 80 fields during these 2 years. All sampling was done by D-Vac except for some sweeping or general searching, when time permitted, to collect adults or additional species. Abundance is based on D-Vac sampling only. Spiders were killed with carbon tetrachloride and returned to the laboratory for storage in a freezer until identifications could be made. Voucher specimens are housed in the spider collection at Texas A&M University. Identification of species was based on adult specimens.

Counties sampled in the different areas include:

West Texas: Howard, Martin, Mitchell, Pecos, Reeves, and Tom Green.

Northwest Texas: Crosby, Floyd, Gaines, Hale, Hockley, Lubbock, and Terry.

North Texas: Collin, Delta, Hill, and Kaufman.

Central Texas: Williamson.

Southeast Texas: Fort Bend and Wharton.

South Texas: Frio, Hidalgo, Nueces, and San Patricio.

Collections from East Texas are from Walker County and cover the years 1978-81 using only D-Vac sampling for comparative purposes. The different areas shown in Figure 1 are based on the crop reporting districts in *Texas Field Crop Statistics* (Texas Department of Agriculture 1984).

Results

Cotton is grown in many areas of Texas and a total of 2.3 million hectares of cotton was planted in 1982 (Texas Department of Agriculture 1983) and 1.6 million hectares in 1983 (Texas Department of Agriculture 1984). In the samples taken during these years, emphasis was placed on the identification, distribution, and abundance of the more common species.

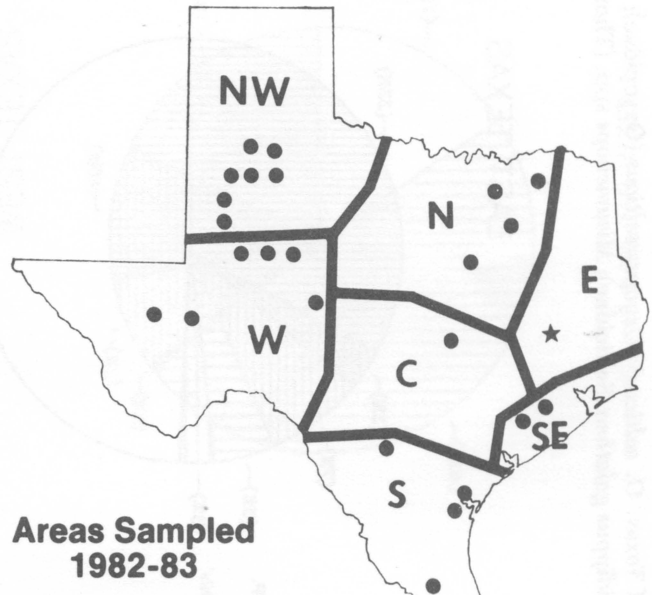
Misumenops spp., *Oxyopes salticus*, and *Tetragnatha laboriosa* were the most abundant taxa of spiders throughout the state (Fig. 2). *Misumenops* spp. were most abundant in West and Northwest Texas. *Misumenops celer* was the numerically dominant *Misumenops* species in all areas of the state except South Texas where *M. dubius* (Keyserling) was more abundant. *Oxyopes salticus* was the most abundant spider in all areas of the state except West, Northwest, and South Texas. *Tetragnatha* *laboriosa* was most abundant in East and Southeast Texas and least abundant in West, Northwest, and Central Texas. These three taxa of spiders comprised about 45 percent of total spiders in East and Southeast Texas; 64 percent in South Texas; 85 percent in Northwest Texas; and about 75 percent in West, North, and Central Texas. The highest density of spiders was in East and Central Texas with 2.28 and 1.04/m, respectively (Fig. 2). A total of 6,948 spiders were collected by D-Vac during these 2 years.

Oxyopes salticus is the most abundant spider on cotton in Texas (Dean et al. 1982), Arkansas (Whitcomb et al. 1963), Alabama (Skinner 1974), and South Carolina (Roach 1980). It is one of the most abundant in guar (Rogers and Horner 1977) and peanuts (Agnew et al. 1985) in Texas; alfalfa in Virginia (Howell and Pienkowski 1971); soybean in South Carolina (Roach 1980) and Iowa (Bechinski and Pedigo 1981); and sorghum in Oklahoma (Bailey and Chada 1968). It is found throughout the eastern half of the United States and in the far west, but is not reported from the Rocky Mountain region or the Great Basin, and is rarer in the northern states (Brady 1964). *Oxyopes salticus* appears to be an excellent colonizer of cotton fields. The genus *Misumenops* is the second most abundant taxon on cotton in Texas. It is frequently included in lists of spiders of other crops as one of the more abundant spiders and is widely distributed throughout the United States and *M. celer* is common in most of the United States but is rare in the northeast (Kaston 1981). *Tetragnatha laboriosa* was more abundant in East Texas than other areas and is usually listed as one of the most abundant species in many crops: corn in Ohio (Everly 1938); alfalfa in Kentucky (Culin and Yeargan 1983), New York (Wheeler 1973), and Virginia (Howell and Pienkowski 1971); and soybean in Illinois (LeSar and Unzicker 1978), Iowa (Bechinski and Pedigo 1981), and Kentucky (Culin and Yeargan 1983). *Tetragnatha laboriosa* is found throughout North America (Levi 1981).

Table 1 presents a list of the spider species and the counties in which they were collected. *O. salticus* was most abundant in Hill (0.77/m) and Collin Counties (0.57/m) in North Texas, and abundant in Williamson County (Central Texas) with 0.47/m. *Misumenops* spp. were most abundant in Pecos (0.26/m) and Reeves (0.33/m) Counties in West Texas; Floyd (0.29/m) and Hale (0.31/m) Counties in Northwest Texas; and Williamson County (0.29/m) in Central Texas. *Tetragnatha laboriosa* was more abundant in Southeast Texas (Fort Bend 0.12/m and Wharton 0.08/m), South Texas (Nueces 0.09/m), and North Texas (Collin 0.06/m) than in other areas.

Dictyna spp. (found at all locations except Central and Southeast Texas) were more dominant in East (0.07/m), West (Reeves 0.09/m, Tom Green 0.06/m), and Northwest (Floyd 0.05/m, Hale 0.05/m) Texas than other areas. *Grammonota texana* (Banks) was collected only in North (Delta 0.17/m), Central (0.02/m), and South Texas (Nueces 0.03/m). It also was present on cotton in Walker County in East Texas. *Metaphidippus galathea* (Walckenaer) was most abundant in Central Texas (0.04/m) and Southeast Texas (Wharton 0.03/m). *Theridion* spp. were not found in West, Central, or Southeast Texas. Other species of spiders were either not abundant or only found in certain areas.

Collin and Nueces Counties had the most species, i.e. 22 and 24, respectively, though more samples were taken in these two counties. Only three genera of spiders contained more than three species each (*Dictyna*, *Theridion*, and *Misumenops*). *Oxyopes salticus* was found in all counties sampled and *Tetragnatha laboriosa* was found in all but Crosby and Gaines Counties in Northwest Texas.



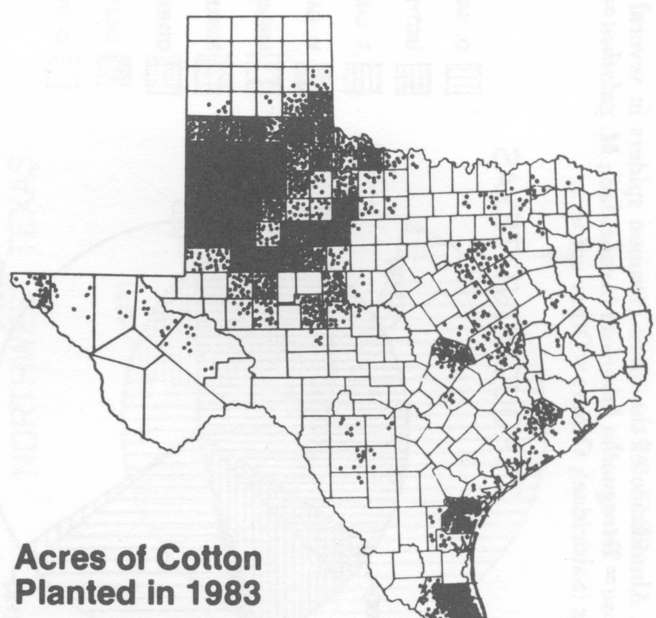
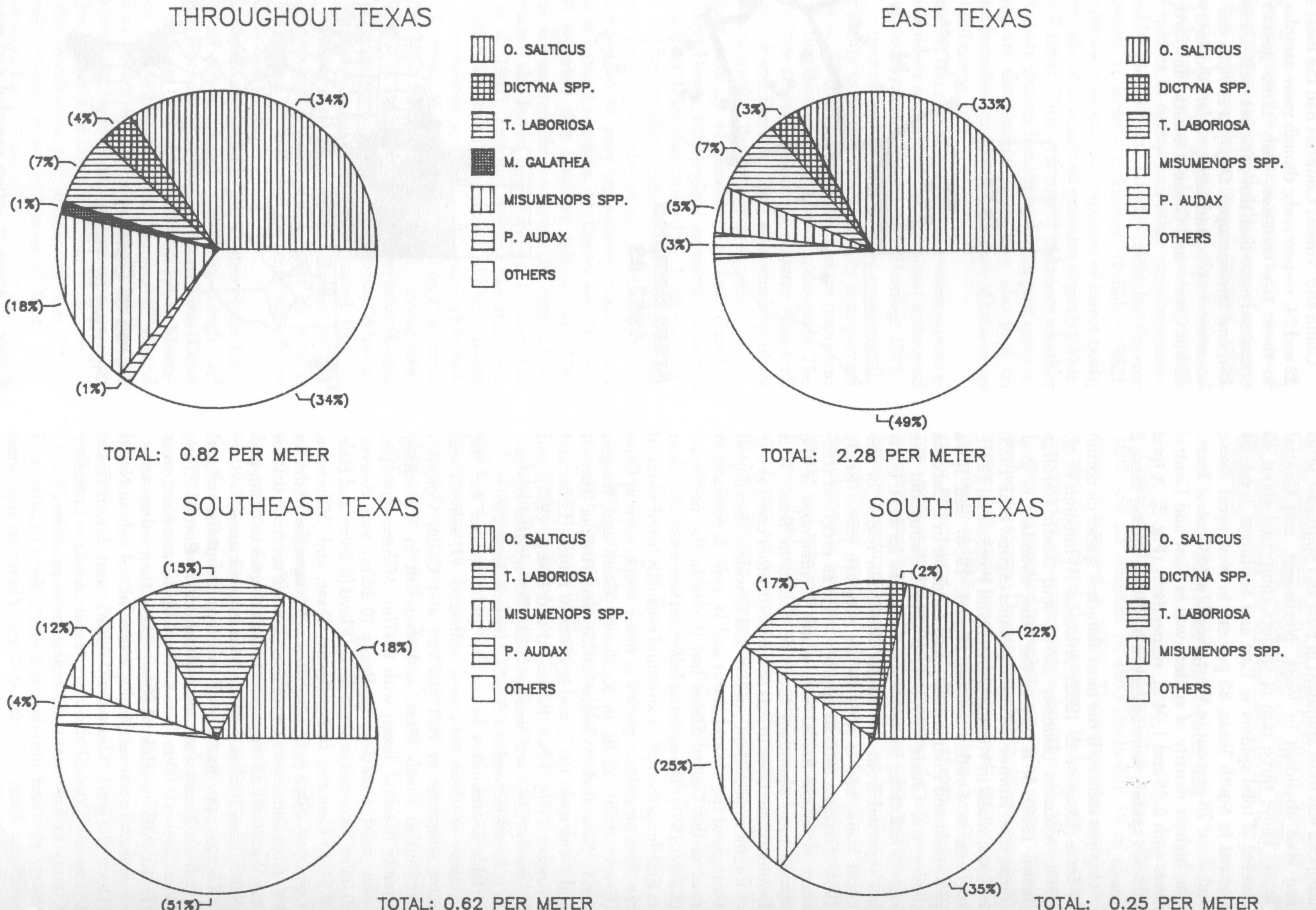
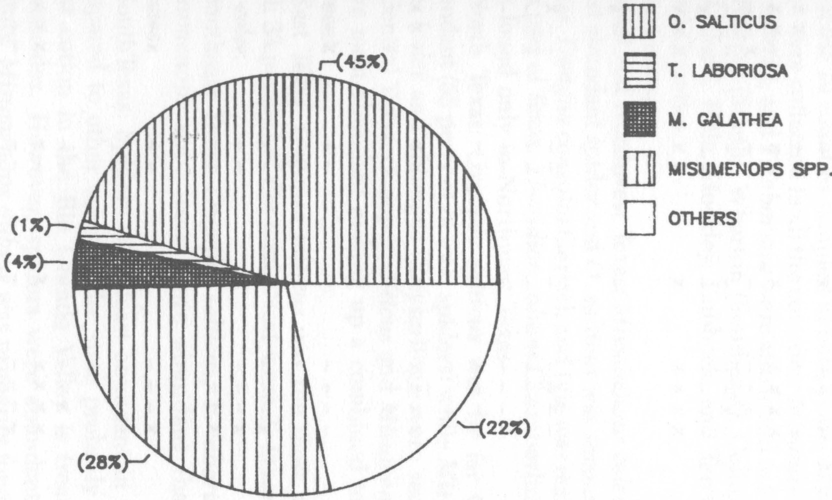


Figure 1. Areas of cotton sampled and cotton acreage planted in Texas in 1983 (1 dot = 1,000 acres). Star in East Texas represents sampling from 1978-81.

Figure 2. Abundance of the more common spiders in several areas of Texas. *O. salticus* = *Oxyopes salticus* (Oxyopidae); *Dictyna* spp. (Dictynidae); *T. laboriosa* = *Tetragnatha laboriosa* (Araneidae); *M. galathea* = *Metaphidippus galathea* (Salticidae); *Misumenops* spp. (Thomisidae); *P. audax* = *Phidippus audax* (Salticidae); Others = Other spiders.

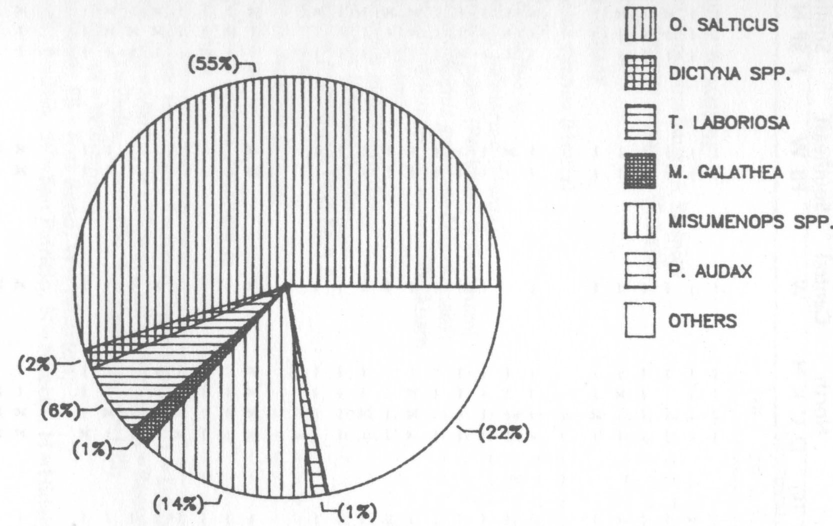


CENTRAL TEXAS



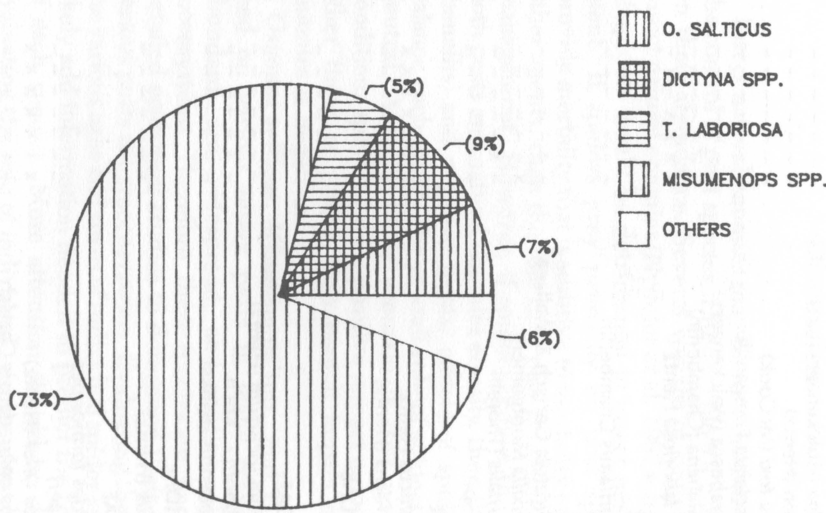
TOTAL: 1.04 PER METER

NORTH TEXAS



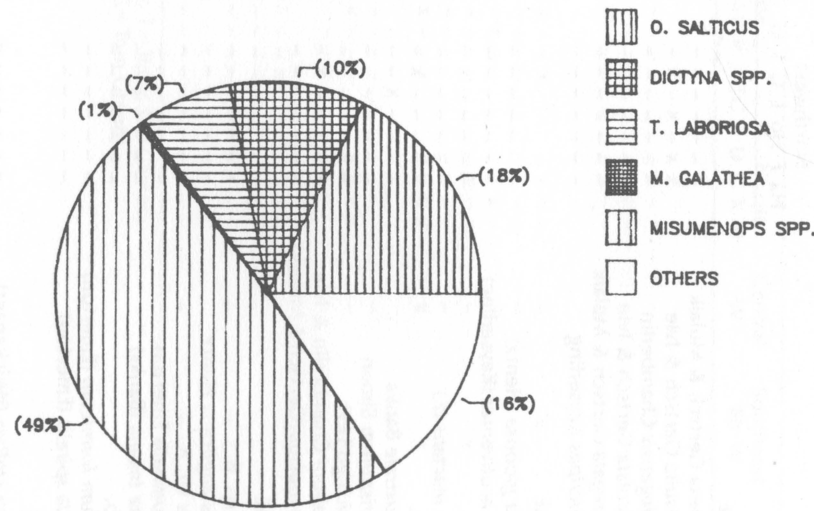
TOTAL: 0.85 PER METER

NORTHWEST TEXAS



TOTAL: 0.31 PER METER

WEST TEXAS



TOTAL: 0.39 PER METER

TABLE 1. SPIDERS COLLECTED FROM COTTON AND COUNTIES [a] IN WHICH THEY WERE COLLECTED

	Northwest							West						North				Central	Southeast		South			
	Ha	F	Ho	L	C	T	G	Ma	H	Mi	R	P	TG	D	C	K	H	W	FB	W	F	SP	N	H
DICTYNIDAE																								
Dictyna annexa Gertsch & Mulaik	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–
Dictyna consulta Gertsch & Ivie	x	x	–	x	–	x	–	–	–	x	x	–	x	–	–	–	–	–	–	–	–	–	–	–
Dictyna mulegensis Chamberlin	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–
Dictyna reticulata Gertsch & Ivie	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–
Dictyna segregata Gertsch & Mulaik	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	x	–
Dictyna volucripes Keyserling	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–
THERIDIIDAE																								
Achaearanea globosa (Hentz)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–
Coleosoma acutiventer (Keyserling)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–
Euryopis sp.	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x
Latrodectus mactans (F.)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–
Steatoda sp.	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Theridion australe Banks	–	–	–	–	x	–	–	–	–	–	–	–	–	x	x	x	–	–	–	–	–	x	x	–
Theridion crispulum Simon	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–
Theridion hidalgo Levi	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–
Theridion rabuni Chamberlin & Ivie	x	x	x	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Thymoites expulsus (Gertsch & Mulaik)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–
LINYPHIIDAE																								
Ceraticelus sp. B	–	–	–	–	–	–	–	–	–	x	–	–	–	x	x	x	x	x	x	x	–	–	x	–
Ceratinopsis anglicana Hentz	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–
Ceratinopsis sp. A	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	x	–	–	–
Erigone autumnalis Emerton	–	–	–	–	–	–	–	–	–	–	–	–	–	x	x	–	–	–	–	–	–	–	–	–
Grammonota texana (Banks)	–	–	–	–	–	–	–	–	–	–	–	–	–	x	x	x	–	x	–	–	–	x	x	–
Meioneta sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–
Tennesseellum formicum (Emerton)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	x	x	–
Walckenaeria spiralis (Emerton)	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–
ARANEIDAE																								
Acanthepeira stellata (Walckenaer)	–	–	–	–	–	–	–	–	–	–	–	–	–	x	x	–	–	x	x	x	–	–	x	–
Cyclosa turbinata (Walckenaer)	–	–	–	–	–	–	–	–	–	–	–	–	–	x	x	x	–	x	–	x	–	–	–	–
Eustala anastera (Walckenaer)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–
Eustala cepina (Walckenaer)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–
Gea heptagon (Hentz)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	x	x	–
Glenognatha foxi (McCook)	–	–	–	–	–	–	–	–	–	–	–	–	–	x	x	x	x	x	x	x	–	x	x	–
Mangora fascialata Franganillo	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–
Neoscona arabesca (Walckenaer)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–
Neoscona utahana (Chamberlin)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–
Tetragnatha laboriosa Hentz	x	x	x	x	–	x	–	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
MIMETIDAE																								
Mimetus puritanus Chamberlin	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–
LYCOSIDAE																								
Pardosa delicatula Gertsch & Wallace	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–
Pardosa pauxilla Montgomery	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–
Pardosa sternalis (Thorell)	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Schizocosa sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–
OXYOPIDAE																								
Oxyopes salticus Hentz	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Peucetia viridans (Hentz)	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	x	–	–	x	–	–	–
GNAPHOSIDAE																								
Micaria sp.	–	–	–	–	–	–	–	–	x	–	x	–	–	–	–	–	–	–	–	–	x	–	–	–
CLUBIONIDAE																								
Chiracanthium inclusum (Hentz)	–	–	–	–	–	–	–	–	x	–	–	–	–	x	–	–	–	–	–	x	–	–	–	–
Clubiona abbotti L. Koch	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–
Trachelas deceptus (Banks)	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–
ANYPHAENIDAE																								
Aysha gracilis (Hentz)	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	x	–	–	–
THOMISIDAE																								
Misumenoides formosipes (Walckenaer)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–
Misumenops celer (Hentz)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	–	x	x	x	x	–
Misumenops coloradensis Gertsch	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–
Misumenops dubius (Keyserling)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	x	x	x	x	x
Misumenops oblongus (Keyserling)	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	x	–	–	x	x	–	–	–
Xysticus sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	x	–

TABLE 1. (CONTINUED)

	Northwest							West						North				Central	Southeast		South			
	Ha	F	Ho	L	C	T	G	Ma	H	Mi	R	P	TG	D	C	K	H	W	FB	W	F	SP	N	H
PHILODROMIDAE																								
Ebo punctatus Sauer & Platnick	x	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Philodromus pratariae (Scheffer)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–
Tibellus sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	x	–	–	–	–	–	–
SALTICIDAE																								
Agassa cyanea (Hentz)	x	–	–	–	–	–	–	–	–	x	–	–	x	–	x	–	–	–	x	–	x	–	–	–
Eris sp.	–	–	–	–	–	x	x	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–
Habronattus sp.	x	x	–	x	–	–	–	–	–	x	–	–	–	x	x	x	–	x	–	–	–	x	x	–
Hentzia palmarum (Hentz)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	x	–	–	x	–	–	x	–
Marpissa pikei (Peckham & Peckham)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–
Metaphidippus galathea (Walckenaer)	–	–	–	–	–	–	–	–	–	x	–	–	x	x	x	x	x	x	–	x	x	–	x	–
Metaphidippus sp. cf. *manni* (Peckham & Peckham)	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Phidippus audax (Hentz)	–	x	–	–	–	–	–	–	–	x	–	–	–	x	x	x	x	–	–	x	–	–	–	x
Phidippus texanus Banks	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–
Sassacus papenhoei Peckham & Peckham	–	x	–	–	–	–	–	x	x	–	–	–	x	–	–	–	–	–	–	–	–	–	–	–
Sitticus dorsatus (Banks)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–
Thiodina sp.	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–	–	–	x	x	–	–	–	–
Zygoballus rufipes Peckham & Peckham	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	x	–	–

[a]Northwest: Ha=Hale, F=Floyd, Ho=Hockley, L=Lubbock, C=Crosby, T=Terry, G=Gaines;
West: Ma=Martin, H=Howard Mi=Mitchell, R=Reeves, P=Pecos, TG=Tom Green;
North: D=Delta, C=Collin, K=Kaufman, H=Hill;
Central: W=Williamson;
Southeast: FB=Fort Bend, W=Wharton;
South: F=Frio, SP=San Patricio, N=Nueces, H=Hidalgo.

Of the 10 counties sampled in both years, *Misumenops* spp. were collected in all the counties. *Misumenops* spp., *O. salticus*, and *T. laboriosa* were also found in both years in Nueces (South); Wharton (Southeast); Collin (North); and Floyd, Hale, Hockley, Lubbock, and Terry (Northwest) Counties.

Area Summary

West and Northwest Texas: *Misumenops celer* was the most abundant spider and *O. salticus* was second in West Texas. *Dictyna consulta* Gertsch and Ivie was restricted to this part of Texas. *Theridion rabuni* Chamberlin and Ivie was found only in Northwest Texas.

North Texas: *Oxyopes salticus* was by far the most abundant (55 percent of total spiders) while *Misumenops* spp. (*celer* and *oblongus* [Keyserling]) were second.

Central Texas: *Oxyopes salticus* and *Misumenops* spp. were most abundant making up a combined total of 73 percent.

East Texas: *Oxyopes salticus* was the most abundant with 33 percent of the total. Next were *T. laboriosa* and *M. celer.*

Southeast Texas: *Oxyopes salticus*, *T. laboriosa*, and *Misumenops* spp. were more abundant than other species.

SouthTexas: Spiders were least abundant in this area compared to other areas of the state probably because most cotton in the Rio Grande Valley is treated with insecticides. However, spiders were abundant in Frio County. *Misumenops dubius* was primarily found in this area.

Discussion

Insect natural enemies may be rendered ineffective in the control of pest species if spiders have a major impact on their abundance. Several species of spiders feed on insect natural enemies (Nyffeler et al. 1987 a,b). This role of spiders would be detrimental to insect pest management. If spiders prey primarily on pest species and provide mortality that is additive to mortality provided by other agents, then the role they play is beneficial to pest management. However, if spiders reduce the impact of both pests and natural enemies equally, then the positive (benefits) and negative (costs) effects of spiders would balance each other. The overall role of spiders would be neutral. A more likely scenario is that under some conditions spiders have a positive impact on pests and at other times or places their overall impact on natural enemies is negative.

Oxyopes salticus, *Misumenops* spp., and *T. laboriosa* feed on various insect pests in many crops, can be abundant, are widespread, and readily colonize agroecosystems. Therefore, these species are candidates for detailed ecological studies to determine their impact on various pests in agroecosystems. Evaluating the impact of the various ages and sexes of individual spider species will likely add information needed to predict the true impact of each species. More attention should be devoted to evaluating the role of individual species of spiders rather than lumping them together as a group (Whitcomb 1974). No two species of spiders are likely to play exactly the same role in an agroecosystem. Each species will have its own prey preference, phenology, general density, dynamics, natural enemies, etc. Whether beneficial or detrimental in an agroecosystem, understanding the ecological roles of the major spider species may prove useful in developing future pest management strategies.

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