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THE IMPACT OF HABITAT FEATURES ON WEB FEATURES AND PREY CAPTURE OF *ARGIOPE AURANTIA* (ARANEAE, ARANEIDAE)

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ABSTRACT. Prey capture by the orb-web spider, *Argiope aurantia* Lucas 1833, depends on the type of the web-site selected. I analyzed *A. aurantia* web sites in open field and adjacent forest edge habitats to identify habitat features associated with web characteristics and prey capture. In the open field, the use of herbs or grass for web attachment was associated with smaller web diameters, and lower attachment heights and web heights. In both forest edge and open field, the distance to the nearest flower was less when web attachments were on composites. In the open field, webs attached to grass captured more orthopteran prey, and webs attached to herbs and composites captured more hymenopteran prey. The mean number of prey captured and the proportion of hymenopteran prey increased with higher web attachments in the open field habitat. Close proximity of webs to goldenrod in bloom in the open field habitat increased the mean number of prey captured and the proportion of hymenopteran prey. In the forest edge habitat, the presence of goldenrod was associated with more hymenopteran and orthopteran prey and with a higher mean prey number captured. Generally, webs in the open field habitat had more hymenopteran and orthopteran prey and higher mean prey number captured than the forest edge habitat. The web-site providing the greatest probability for encountering and capturing prey is predicted to be one with a tall composite plant for web attachment near goldenrod in bloom.

Keywords: Habitat selection, old-field habitat, predation, web-site

Web building spiders can increase prey capture by selecting sites providing high prey availability (Turnbull 1973; Riechert 1976; Riechert & Luczak 1982; Bradley 1993). Many factors determine web-site quality including thermal stress on the spider (Riechert & Tracy 1975; Tolbert 1979), web structure (Colebourn 1974; Greenstone 1984), and prey availability (Olive 1980; Howell & Ellender 1984). Web-site quality could be determined by habitat features of the web-site that influence prey encounter and capture. Therefore, a spider may select a high quality web-site by choosing habitat features associated with high prey capture rate.

Differences in habitat use can change a spider's diet (Brown 1981; Horton & Wise 1983) by changing prey availability (Olive 1980, 1981a, 1981b, 1982) and/or web characteristics (Greenstone 1984). If flowers in bloom attract insect pollinators to a habitat, then flowers close to a web-site can increase pollinators (e.g., Hymenoptera) encountering the web (see Howell & Ellender 1984; McReynolds & Polis 1987).

Two habitat features that influence important web characteristics are the type and height of plant used for web attachment (Enders 1973, 1975; Pasquet 1984). If sturdy plants such as trees and shrubs support larger stronger webs, then larger, more powerful prey items (e.g., Orthoptera) can be captured compared to webs on slighter plants such as grasses (Uetz et al. 1978; McReynolds & Polis 1987). If the flying insects (e.g., Hymenoptera) are at greater heights in vegetation where there is more open space for flight, then increasing the height of plant used for web attachment (thus increasing web height) can increase encounters with the web by flying insects (McReynolds & Polis 1987).

For habitat selection to be effective, different habitats or microhabitats must differ in effect on individual fitness, and the individual must be able to select the higher quality habitat based on some environmental cue or cues (Orians & Wittenberger 1991). However, temporal and spatial variations in habitat quality

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make it difficult to find and choose a high quality site (Orians & Wittenberger 1991), and the risk of movement from a web site increases the expediency of remaining in a lower quality site (Vollrath 1985). *Argiope aurantia* must select a web-site ensuring a high prey encounter rate in a heterogeneous old-field habitat with spatial variation in vegetation and flowers in bloom and temporal variation of flowers blooming and prey availability.

This paper describes associations between habitat features and estimates of prey capture for the orb-web spider, *A. aurantia*. The four habitat features considered were: plant type for web attachment, web attachment height on plant, nearest flower in bloom and nearest flower distance to web. In a heterogeneous environment of an old-field, these habitat features are possible cues for the spider to select a web-site with a high probability of prey capture. The plants chosen for web attachment could be the most influential habitat feature for the spider building a web. Therefore, a comparison among the various plant types chosen by spiders for the highest web attachment with other habitat features and web characteristics of *A. aurantia* could help establish associations. The main questions I address are: How do vegetative habitat features influence *A. aurantia*'s web characteristics and the number and type of prey captured? What habitat features are potential cues that could be used by the spider during web-site selection to choose a web-site with high probability of future prey capture?

METHODS

Study animal.—*Argiope aurantia* builds a large vertical orb-web on vegetation in old-field habitats. The diurnal spider then sits at the web hub to wait for prey snared in the web (Reed et al. 1969). Spiders capture large prey encountering the web by wrapping the prey in silk before delivering a bite (Robinson 1969; Robinson et al. 1969; Hardwood 1974). Wrapped prey remain on the web until carried to the hub for feeding. The female spiders reach maturity and produce eggs in September and October (Olive 1980; Horton & Wise 1983). The spiderlings survive the winter in the egg sac and emerge in April and May (Tolbert 1977).

Habitat.—Habitat utilization by adult female *A. aurantia* was investigated from 4 September–1 October 1989, 22 September–25 October 1990, 14 September–13 October 1991, and 13 September–17 October 1992 in early successional old-field habitats located on the property of Blue Mountain College, Blue Mountain, Mississippi (1 km N of Blue Mountain on Tippah County Road 805). I divided the old-field into two habitats, open field and forest edge. Open field habitat was old pastures, and forest edge habitat was the margin between woods and mowed lawns for a softball field and golf course. Both habitats had a mixed grass-herbaceous vegetation of an early successional stage. The herbaceous vegetation included many species that bloom in the late summer and early autumn, such as goldenrod (*Solidago* spp.), boneset (*Eupatorium perfoliatum*), ironweed (*Vernonia* sp.), fleabane (*Erigeron* spp.), sunflower (*Helianthus* spp.), other composites (Asteraceae), honeysuckle (*Lonicera japonica*) and partridge pea *(Cassia* sp.). Shrubs (e.g., blackberry, *Rubus* sp. and pasture rose, *Rosa* sp.) and some early successional trees (e.g., sweetgum, *Liquidambar styraciflua*; *Sassafras albidum*; and sumacs, *Rhus* spp.) were also common in both habitats. Willows (*Salix* sp.) occurred in a boggy area of the open field. The two habitats mainly differed in the presence of canopy trees. The open field had saplings of early successional trees but very few large trees to shade the other vegetation, while the forest edge had canopy trees shading the grass-herbaceous vegetation daily.

Data collection.—Habitat and web characteristics of adult female *A. aurantia* spiders were gathered by walking through the open field or along the forest edge and finding a spider at the web hub. This search was not considered to be a census of the spider population in either habitat. The animals were collected in batches, uniquely marked on the dorsal abdomen with a permanent marker, and released within 24 hours on vegetation of the open field or forest edge habitat. The marked spiders were found on a web after release and observed as long as they remained at the web-site. Foraging data were collected by observing captured and wrapped prey in the web. If the web-site was abandoned, attempts were made to find again the marked spider and continue to record data at the new web-site. Foraging data were collected at several web-sites at one time for a total of 88 web-sites in the forest edge and 57 web-sites in the open field. Additional data were collected on web and habitat characteristics from spiders that escaped collection for marking, were not found again after mark and release, or were found later near marked spiders.

Habitat and web parameters measured were: (1) the plant used for the highest web attachment point (grass, composite, herb, shrub, or tree), (2) web attachment height on that plant, (3) taxon of nearest flower in bloom to the web hub (goldenrod, boneset, ironweed, fleabane, sunflower, other composites, honeysuckle, or partridge pea) or, if no flower was within four meters, then recorded as ‘‘no flower,’’ (4) distance from nearest flower blossom to the web hub, (5) web height at the orb hub, and (6) vertical web diameter. Ironweed, fleabane, sunflower, boneset, and other composites were pooled into ‘‘composite flower’’ class in the forest edge habitat, and honeysuckle and partridge pea were pooled into ‘‘other flower’’ class. In the open field habitat, all flowers except goldenrod and boneset were pooled into the ‘‘other flower’’ class.

Foraging data were collected by observing webs of marked individuals between 1600–1900 h to record any prey wrapped (i.e., captured) by the spider during the day. Foraging variables for each marked individual included: (1) number of wrapped prey present in the web, (2) prey taxon, and (3) prey size (length of body and width of abdomen). The mean number of days of collecting foraging data of marked individuals at a particular web-site was 2.6 days in the forest edge and 5.6 days in the open field. The mean prey number captured per day for each marked individual could then be calculated. I identified to order each prey item while on the web and measured the length when the condition of the remains allowed. Orthoptera and Hymenoptera had the highest proportions, with other insect orders (Coleoptera, Diptera, Lepidoptera, Hemiptera, Homoptera, Odonata, and Mecoptera) and arachnid orders (Araneae and Opiliones) pooled into ‘‘other prey’’ class because of low numbers expected in contingency tables. To reduce disturbance to the spider, prey items were not removed from the web. Unidentifiable prey were pooled with ‘‘other prey’’ class.

Data analyses.—Comparisons between certain habitat features and other habitat features, web characteristics, and spider prey capture were performed. Comparisons of relative proportion in a contingency table of a habitat feature and prey taxa captured used the adjusted *G*-test for independence. The data from individual spiders were pooled in habitat classes of the contigency table. Habitat classes or prey taxa classes were pooled when the assumption of expected values greater than five was violated. Comparisons of means were performed using analysis of variance (ANOVA) after using the Barlett’s test (corrected) for homogeneity of variance test. If the class variances were heterogeneous, the Kruskal-Wallis test (corrected for ties) compared three or more classes and the Mann-Whitney *U*-test (corrected for ties) tested differences between two classes. Unplanned comparisons of a significant ANOVA were performed using the Student-Newman-Keuls Multiple Comparisons test (Sokal & Rohlf 1981). Associations between two variables were determined using a parametric test (product-moment correlation) if the assumption of linearity was not violated.

RESULTS

Plant types used for web attachment.—In the forest edge, mean web attachment height, web height, and web diameter were not significantly different among plants used for web attachment (Table 1A). Nearest flower distance to the web was significantly different among those plants used for attachment in forest edge habitats and that distance was shorter with the web attached to a composite instead of grass, herbs, shrubs, or trees (Table 1A).

The mean web attachment heights of webs on grass and herbs were significantly lower than with shrubs, trees, and composites in the open field (Table 1B). Web heights were significantly different among the types of plants used for web attachment in the open field, with webs using shrubs higher than those using grass or herbs (Table 1B). Web diameters were also different among the types of plants used for web attachment in the open fields, with webs attached to composites larger than webs attached to herbs (Table 1B). In addition, the variances of nearest flower distance among web attachment plants in the open field were significantly heterogeneous; and the mean distance to the nearest flower was great-

Table 1.—Parameters associated with plant types for attachment of *Argiope aurantia* webs in forest edge and open field habitats. All mean values ± standard error (SE). Means that are followed by the same letter are not significantly different (unplanned comparisons, $P < 0.05$).

	Mean attachment height (cm)	n	Mean hub height (cm)	n	Mean web diameter (cm)	n	Mean nearest flower distance (cm)	n
A. Forest edge								
Grass-Herbs	108.3 ± 5.8	30	63.6 ± 4.1	25	44.6 ± 2.1	25	186.9 ± 27.3a	16
Composites	118.1 ± 10.6	16	62.1 ± 5.0	12	38.8 ± 2.9	12	38.8 ± 19.5b	16
Shrubs	110.2 ± 6.5	23	63.8 ± 4.8	20	45.8 ± 2.1	20	120.0 ± 25.0a	20
Trees	124.6 ± 5.3	54	69.0 ± 3.9	49	48.1 ± 2.1	48	133.2 ± 14.2a	45
ANOVA	$F_{3,\,119} = 1.61$ ns		$F_{3,\,102} = 0.51$ ns		$F_{3,\,91} = 2.00$ ns		$F_{3,\,93} = 6.28$ $P < 0.001$	
B. Open field								
Grass	97.6 ± 3.9ac	17	66.5 ± 3.8a	17	40.6 ± 2.8ab	17	109.4 ± 23.6	18
Herbs	90.6 ± 7.8a	9	57.5 ± 4.6a	8	34.4 ± 4.8a	8	55.7 ± 22.7	7
Composites	121.8 ± 7.3b	14	76.8 ± 6.6ab	14	50.4 ± 2.6b	14	25.4 ± 16.2	14
Shrubs	127.5 ± 6.2b	26	88.3 ± 5.0b	26	42.9 ± 2.4ab	26	103.5 ± 26.5	24
Trees	130.0 ± 9.7bc	6	75.0 ± 8.3ab	6	50.0 ± 7.0ab	6	75.0 ± 18.9	6
ANOVA	$F_{4,\,67} = 5.97$ $P < 0.001$		$F_{4,\,66} = 4.34$ $P < 0.01$		$F_{4,\,66} = 2.89$ $P < 0.05$			
Bartlett statistic							14.03, $P < 0.01$	
Kruskal-Wallis							12.98, $P < 0.05$	

er when the attachment plants were grasses or shrubs (Table 1B).

The diet in the web of marked *A. aurantia* was compared among the plants used for web attachment as the mean number of prey captured per day, the taxa of prey captured, and prey size of taxa. The mean prey numbers among classes of plants for web attachment were not significantly different at the forest edge (Table 2A) or in the open field (Table 2B). However, variances in mean prey number among classes of plants for web attachment were significantly heterogeneous for both habitats (Table 2). The proportions of prey taxa captured among the various attachment plants were significantly different for the open field but not for the forest edge (Fig. 1). In the open field, webs attached to herbs captured a higher proportion of hymenopteran prey and when attached to grass a higher proportion of orthopteran prey (Fig. 1B). The size of orthopteran prey among classes of plants for web attachment was not significantly different in either habitat (Fig. 2). Hymenopteran prey sizes and other prey sizes were significantly different among classes in the forest edge but not in the open field (Fig. 2). For both hymenopteran prey and other prey, mean prey size was greater in the herb-grass than the tree-shrub class in the forest edge habitat though not as predicted. In a comparison among prey taxa, mean prey size of orthopteran prey was significantly larger than hymenopteran or other prey in the forest edge ($F_{2,61} = 29.0$, $P < 0.001$) and open field ($F_{2,167} = 109.6$, $P < 0.001$) (see Fig. 2).

Web attachment height.—Web characteristics and diet were compared to web attachment height in both habitats. Web height (in cm) was positively correlated with web attachment height (in cm) in forest edge ($y = 0.494x + 9.4$, $r^2 = 0.575$, $n = 102$, $F = 139.58$, $P < 0.001$) and open field ($y = 0.614x + 5.47$, $r^2 = 0.596$, $n = 71$, $F = 101.82$, $P < 0.001$). Web diameter (in cm) was positively correlated with web attachment height (in cm) in both habitats, but the relationship is not as strong for web diameter as web height in forest edge ($y = 0.171x + 25.9$, $r^2 = 0.256$, $n = 104$, $F = 35.1$, $P < 0.001$) and open field ($y = 0.152x + 25.9$, $r^2 = 0.124$, $n = 71$, $F = 9.77$, $P < 0.01$). A more

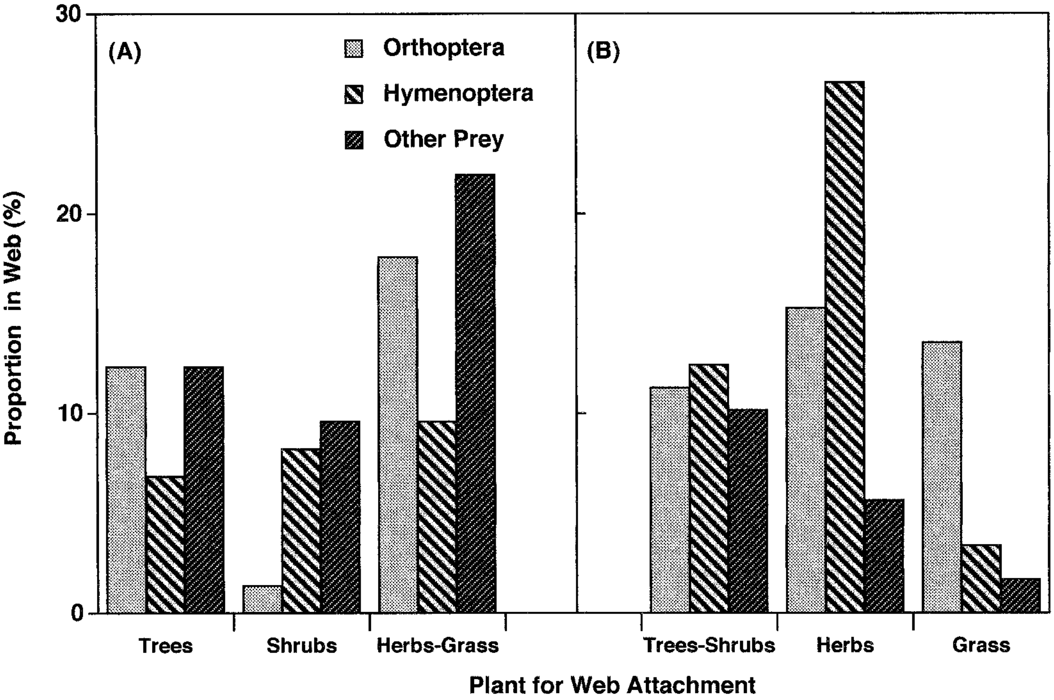

Figure 1.—The proportion (%) of prey taxa captured in the webs of *Argiope aurantia* among plant types for web attachment in two habitats. (A) In the forest edge, the frequency of prey taxa was not significantly different among classes ($G_{adj} = 6.53$, ns, $df = 4$, $n = 73$). (B) In the open field, the frequency of prey taxa was significantly different among classes ($G_{adj} = 26.13$, $P < 0.001$, $df = 4$, $n = 177$).

Table 2.—Mean prey number captured per day per individual *Argiope aurantia* for plant types for attachment of webs in forest edge and open field habitats.

	Mean	SE	*n*
A. Forest edge			
Herbs-Grass	0.32	0.08	23
Composites	0.61	0.15	14
Shrubs	0.64	0.25	14
Trees	0.28	0.08	36
Bartlett statistic		17.13, $P < 0.001$	
Kruskal-Wallis statistic	5.08, ns		
B. Open field			
Herbs	0.64	0.16	7
Grass	0.30	0.10	15
Composites	1.01	0.30	12
Shrubs	0.45	0.09	17
Tree	1.38	0.79	6
Bartlett statistic		39.74, $P < 0.001$	
Kruskal-Wallis statistic	8.16, ns		

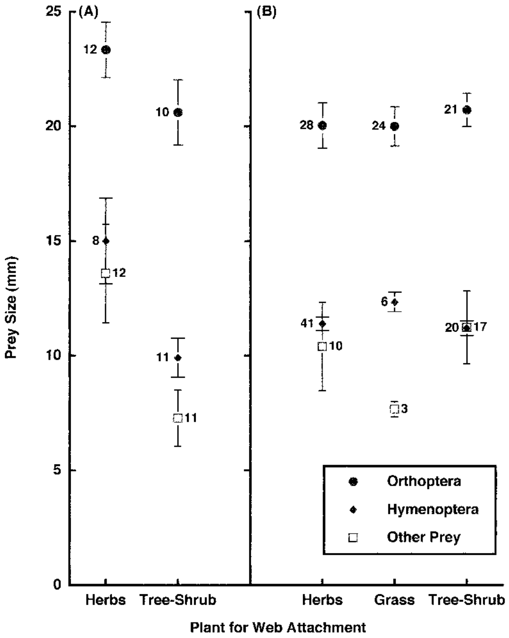

Figure 2.—The mean size (±SE, *n*) of orthopteran prey, hymenopteran prey, and other prey captured in the webs of *Argiope aurantia* among plant types for web attachment in two habitats. (A) In the forest edge, prey size was significantly different among classes for hymenopteran prey ($F_{1, 17} = 7.48$, $P < 0.05$) and other prey ($F_{1, 21} = 6.16$, $P < 0.05$) but not orthopteran prey ($F_{1, 20} = 2.20$, ns). (B) In the open field, prey size was not significantly different among classes for orthopteran prey ($F_{2, 70} = 0.19$, ns), hymenopteran prey ($F_{2, 64} = 1.03$, ns), and other prey ($F_{2, 27} = 0.44$, ns).

direct relationship between web attachment height and web height can exist because web attachment height determined the maximum web height, but web heights below maximum did occur. Web attachment height had a significant effect on these web characteristics but was not the only factor.

The observed diet of *A. aurantia* was compared among web attachment height classes as the number of prey captured per day per individual, and the taxa of prey caught. The mean prey number was not significantly different among web attachment height classes in the forest edge (Table 3A) but was in the open field, with the most prey captured in higher web attachments (Table 3B). The variances in prey number for web attachment heights were significantly heterogeneous for both habitats (Table 3). The proportions of prey taxa captured among the web attachment height classes were not significantly different in the forest edge but were in the open field (Fig. 3) where higher webs captured a high proportion of hymenopteran prey and a low proportion of orthopteran prey (Fig. 3B).

Nearest flower.—The nearest flower in bloom was compared to spider diet in both habitats. The mean number of prey captured was significantly different among the four nearest flower classes in the forest edge, with lower number of prey captured per day with no flower near the web than with goldenrod nearby (Table 4A). There was no difference in mean number of prey captured among the three flower classes in the open field (Table 4B). The variances in prey number among nearest flower classes were significantly heterogeneous for both habitats with a high variance in prey number for the goldenrod class (Table 4). The proportions of prey taxa were significantly different among nearest flower classes in the forest edge and open field (Fig. 4). In the forest edge, the proportions of orthopteran and hymenopteran prey were higher with goldenrod nearby; but in the open field, the proportion of hymenopteran prey was higher with goldenrod, and orthopteran prey proportion was highest with the other flower class.

Nearest flower distance.—The nearest flower distance was compared to spider diet in both habitats. In the forest edge, mean number of prey captured was not significantly different between nearest flower distance classes of 0–50 cm and > 50 cm for any of the nearest flower taxa: goldenrod, composites, or other flowers (Table 5A). In the open field, only goldenrod had a significant difference in mean number of prey captured between nearest flower distance classes, with more prey caught by spiders near goldenrod than spiders > 50 cm from goldenrod (Table 5B). The proportions of prey taxa captured were not significantly different among the nearest flower distance classes for the forest edge but were significantly different for the open field (Fig. 5), with the proportion of hymenopteran prey increasing when the web was closer to a flower.

Habitat comparisons.—A measure of habitat quality was estimated by comparing spider diets between the two habitats. In the forest edge, the mean number of prey captured per day was significantly less (mean ±SE = 0.40

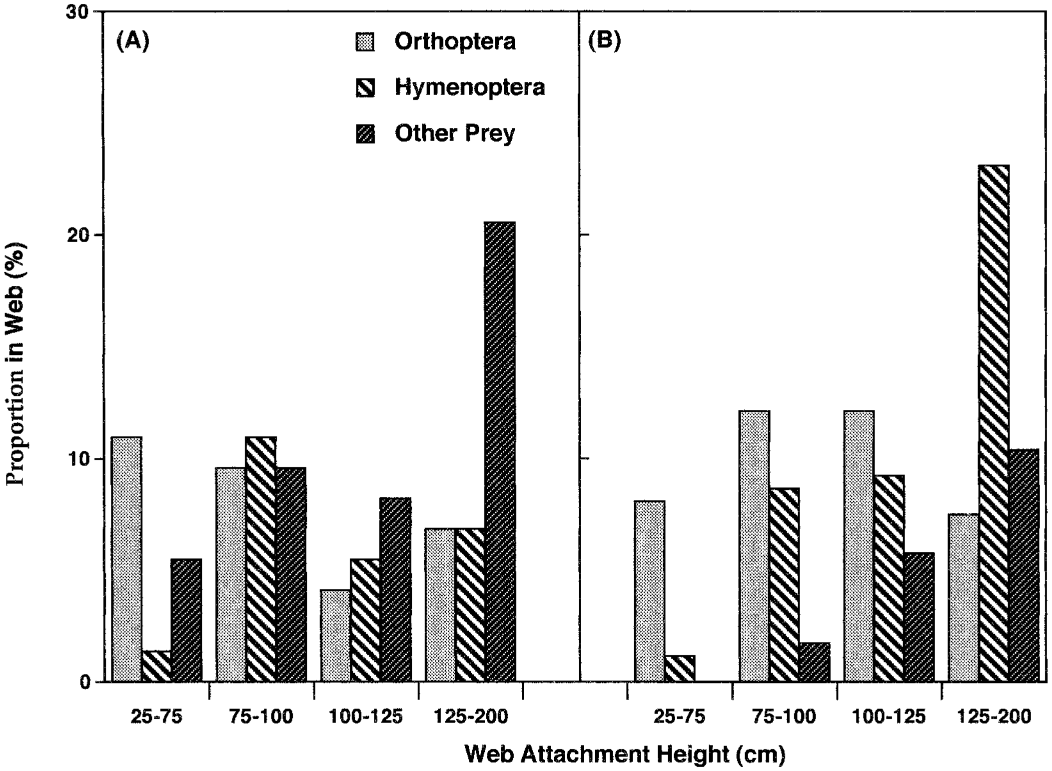

Figure 3.—The proportion (%) of prey taxa captured in the webs of *Argiope aurantia* among web attachment height classes in two habitats. (A) In the forest edge, the frequency of prey taxa was not significantly different among classes ($G_{adj} = 10.25$, ns, $df = 6$, $n = 73$). (B) In the open field, the frequency of prey taxa was significantly different among classes ($G_{adj} = 37.86$, $P < 0.001$, $df = 6$, $n = 173$).

Table 3.—Mean prey number captured per day per individual *Argiope aurantia* for web attachment heights in forest edge and open field habitats.

	Mean	SE	*n*
A. Forest edge			
50–100 cm	0.42	0.08	31
100–125 cm	0.42	0.16	23
125–150 cm	0.41	0.15	19
150–200 cm	0.31	0.11	14
Bartlett statistic		7.60, $P < 0.05$	
Kruskal-Wallis statistic	1.50, ns		
B. Open field			
50–100 cm	0.44	0.08	16
100–125 cm	0.49	0.17	24
125–200 cm	1.11	0.29	16
Bartlett statistic		19.62, $P < 0.001$	
Kruskal-Wallis statistic	9.66, $P < 0.01$		

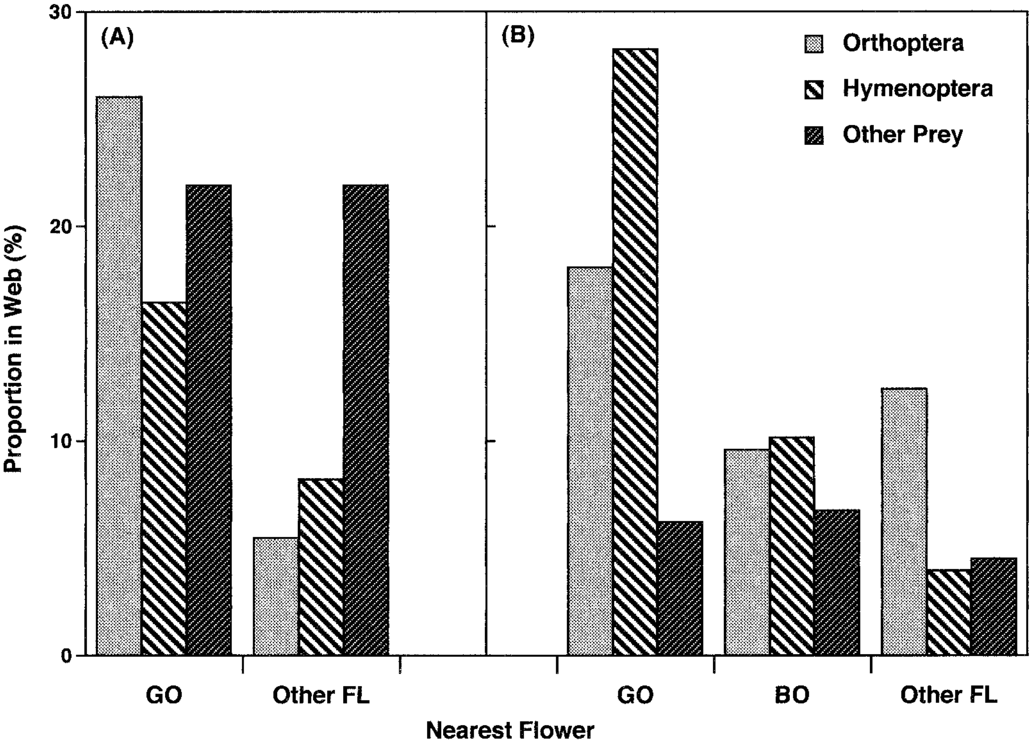

Figure 4.—The proportion (%) of prey taxa captured in the webs of *Argiope aurantia* among nearest flower classes in two habitats. (A) In the forest edge, the frequency of prey taxa was significantly different among classes ($G_{adj} = 6.37$, $P < 0.05$, $df = 2$, $n = 73$). (B) In the open field, the frequency of prey taxa was significantly different among classes ($G_{adj} = 16.4$, $P < 0.01$, $df = 4$, $n = 177$). *Abbreviations:* BO = boneset, GO = goldenrod, Other Fl = other flowers.

Table 4.—Mean prey number captured per day per individual *Argiope aurantia* for nearest flower in bloom in forest edge and open field habitats.

	Mean	SE	*n*
A. Forest edge			
Composite Flowers	0.37	0.11	26
Goldenrod	0.53	0.12	32
Other Flowers	0.51	0.16	14
No Flower	0.08	0.06	16
Bartlett statistic		13.71, $P < 0.01$	
Kruskal-Wallis statistic	5.08, $P < 0.01$		
B. Open field			
Boneset	0.54	0.14	16
Goldenrod	0.80	0.24	20
Other Flowers	0.59	0.19	21
Bartlett statistic		6.96, $P < 0.05$	
Kruskal-Wallis statistic	1.05, ns		

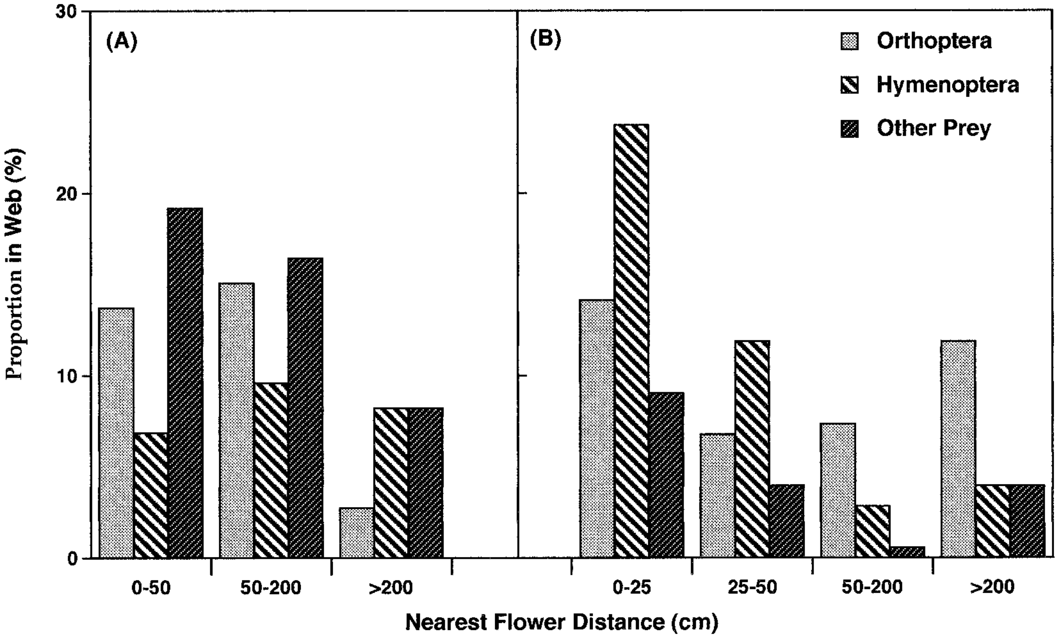

Figure 5.—The proportion (%) of prey taxa captured in the webs of *Argiope aurantia* among nearest flower distance classes in two habitats. (A) In the forest edge, the frequency of prey taxa was not significantly different among classes (G_{adj} = 4.34, ns, $df = 4$, $n = 73$). (B) In the open field, the frequency of prey taxa was significantly different among classes (G_{adj} = 20.26, $P < 0.01$, $df = 6$, $n = 177$).

±0.06, $n = 88$), than in the open field (0.65 ±0.12, $n = 57$) ($U = 1924.0$, $P < 0.05$). The variances in prey number between habitats were significantly heterogeneous ($F = 2.33$, $df = 56, 87$, $P < 0.001$). The proportions of prey taxa captured were significantly different between the two habitats (Fig. 1, $G_{adj} = 18.51$, $df = 2$, $P < 0.001$), with the proportions of both hymenopteran and orthopteran prey higher in the open field. Therefore, the forest edge habitat had lower quality prey capture sites for *A. aurantia* than the open field.

DISCUSSION

A possible explanation for the difference in prey capture between the two habitats is the differences in the relative density of grass and herbaceous vegetation affecting prey availability (Olive 1980, 1981a) and/or the presence of flowers in bloom that attract *A. aurantia* prey. The two habitats also differ in abiotic environmental factors (e.g., the presence of shade) that could influence the spider directly or through prey availability (Riechert & Tracy 1975). Enders (1973) observed that *A. aurantia* shifts from closed sites with perennials (description similar to the forest edge habitat) to open sites (i.e., open field) as they enter adulthood. However, more adult *A. aurantia* in this study remained in the forest edge habitat because mowed lawns could act as a barrier to their movement.

Habitat utilization can determine the structure and size of the web (Colebourn 1974; Pasquet 1984; Lubin et al. 1993). Web height at the hub influenced the diet of *A. aurantia* through an increase in the proportion of Hymenoptera and a decrease in Orthoptera captured as the prey capturing surface was positioned higher (McReynolds & Polis 1987). The present results are consistent: a similar association was found between web attachment height and proportions of prey taxa, and a positive correlation existed between web attachment height and web height. This increase in web attachment height was also associated with increased prey capture. Maybe spiders select web-sites providing high web attachments to increase web height. This, in turn, increases the frequency of encounter and capture of higher flying Hymenoptera and increases the total number of prey captured

Table 5.—Mean prey number captured per day per individual *Argiope aurantia* for distance to nearest flower in bloom of different flower types in forest edge and open field habitats.

	Mean	SE	n	Mann-Whitney U'
A. Forest edge				
Composite Flowers				
0–50 cm	0.42	0.20	11	$U' = 72.0$
>50 cm	0.24	0.11	12	$P = 0.73$, ns
Goldenrod				
0–50 cm	0.6	0.19	11	$U' = 131.5$
>50 cm	0.37	0.09	20	$P = 0.38$, ns
Other Flowers				
0–50 cm	0.64	0.17	6	$U' = 28.5$
>50 cm	0.46	0.29	7	$P = 0.29$, ns
B. Open field				
Boneset				
0–50 cm	0.6	0.12	10	$U' = 44.5$
>50 cm	0.43	0.32	6	$P = 0.12$, ns
Other Flowers				
0–50 cm	0.69	0.48	8	$U' = 42.5$
>50 cm	0.67	0.13	7	$P = 0.09$, ns
Goldenrod				
0–50 cm	1.32	0.43	10	$U' = 89.5$
>50 cm	0.28	0.08	10	$P < 0.01$

(McReynolds & Polis 1987). However, these results do not support the prediction that sturdier plants used for web attachment support stronger, larger webs and therefore capture larger and stronger prey such as orthopterans.

The presence of flowers near the web site may directly affect prey capture of *A. aurantia* by attracting insect pollinators, herbivorous insects, and their arthropod predators. Results suggest that proximity to goldenrod increases prey capture probability more than any other flower. In both habitats, Hymenoptera were captured near goldenrod, maybe because this plant attracts more insect pollinators than other flowers in old-field habitats during late summer and autumn. In the forest edge, the capture of Orthoptera also increased near goldenrod, maybe because goldenrod with associated grass or herbaceous vegetation also attracts more herbivorous insects than the trees and shrubs that are common at the forest edge. Nearest flower and nearest flower distance appear to be good indicators of prey capture and may be predictors of prey availability and web-site quality, although nearest flower and nearest flower distance do not indicate the presence and density of other flowers in bloom near the web site. Further research is required to test the above predictions on the effect of goldenrod on prey availability and web-site quality.

Prey capture at a web-site can fluctuate (Janetos 1982; Bradley 1993; Vollrath 1985), and the risk to a spider in selecting a web-site can increase with temporal and/or spatial variation in prey availability (Caraco & Gillespie 1986; Gillespie & Caraco 1987; Smallwood 1993). The data on within web-site variance needed to evaluate the decisions made by individual spiders on their tenure at web-sites (see Caraco et al. 1995) are not available in this paper. However, when based on the between web-site variance, web-site quality is highly variable within habitat classes (e.g., high mean and variance of prey number in the goldenrod class of the open field habitat). One explanation for spatial and temporal variability among web-sites is that attractiveness of the flowers to insect pollinators around the web-site changes over time, changing prey availability at various web-sites. These hypotheses need further testing.

The predicted high quality web-site for *A. aurantia* (i.e., one that shows a high mean prey number) is a combination of habitat features including a tall (> 125 cm) plant for web attachment near (< 50 cm) goldenrod in bloom. However, with the high variance, there is a risk that an individual will not capture the minimum energy requirements. Caraco et al. (1995) predict that solitary spiders such as *A. aurantia* should be more risk-prone by selecting highly variable foraging sites because these places would occasionally yield sufficient energy for survival and reproduction while less variable (with the average below the minimum) sites rarely or never yield sufficient energy. Therefore, a spider should select a web-site with certain habitat features—not to ensure constant prey availability—but to increase the probability of occasional high prey capture. In addition, selection of a web-site by *A. aurantia* with the above habitat features should increase the probability of sufficient prey capture for survival and reproduction. The major emphasis of further research is to establish whether *A. aurantia* does select or prefer web-sites with these predicted habitat features.

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