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# HABITAT SEGREGATION BY SPECIES OF *METAPHIDIPPUS* (ARANEAE: SALTICIDAE) IN MINNESOTA

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**ABSTRACT.** Four species of *Metaphidippus* (Araneae: Salticidae) occupied different habitat types in Minnesota; *M. arizonensis* was found exclusively in sand prairie; *M. flavipedes* was almost completely restricted to conifers; *M. insignis* primarily inhabited open, non-canopy vegetation (e.g., grasslands); whereas, *M. protervus* occupied most habitats, but most evidently shaded forest understory and wetlands. Reasons for such habitat partitioning are conjectural. Size differences among the four species probably were not ecologically significant based on Dyar's constant; however, competition for prey may have influenced habitat selection.

*Metaphidippus* is one of the largest genera of jumping spiders in North America (Richman & Cutler 1978). Revision of the genus by other workers will probably redefine the taxonomy and introduce new generic names; however, the species discussed here will remain in one genus.

When we first started collecting jumping spiders in Minnesota, it quickly became evident that different species were found only in specific habitats. This was particularly noticeable in species of *Metaphidippus* because our favorite collecting methods—sweep netting and beating vegetation—garnered large numbers of these vegetation-inhabiting spiders. Over a 25 year period, most parts of the state were visited and habitat data recorded whenever salticids were collected. The data was analyzed and a hypothesis for habitat segregation (Dyar's constant) considered.

## METHODS

Specimens of *Metaphidippus arizonensis* (Peckham & Peckham), *M. flavipedes* (Peckham & Peckham), *M. insignis* (Banks), and *M. protervus* (Walckenaer) were collected predominantly by sweep netting; however, beating foliage also yielded a few specimens. Collection heights were not controlled or recorded. If necessary, laboratory rearing was done in the case of antepenultimate and penultimate instars to confirm identifications based on adult genitalia. Spiders were kept at ambient temperatures in Petri dishes with moist pieces of sponge, and fed *Drosophila* adults and *Tribolium* larvae until mature. To avoid sampling bias, individual sites were counted only once even if repeatedly collected. A site was considered a stand of vegetation isolated from another stand by an intervening stand of different vegetation, or by a large physical obstacle. In many cases, collected sites were separated by many kilometers; others were adjacent and differed only in vegetation. All sites were in Minnesota. Collecting dates were from April–October.

Negative catches were not recorded; tabulated data consisted only of samples that yielded specimens. Carapace widths between row III eyes were measured with an ocular micrometer for 50 mature females of *M. flavipedes*, *M. insignis*, and *M. protervus*, and for 35 mature females of *M. arizonensis*. Tukey's Studentized Range (HSD) Test (SAS 1985) was used for comparisons of carapace widths among species at $P \leq 0.05$.

## RESULTS

Figure 1 shows the Minnesota counties collected and the species of *Metaphidippus* found. Table 1 compares species presence/absence within the different habitats. With only one exception, because of small sampling size (deciduous-tree foliage), species were unequally distributed within each habitat investigated (Table 1). We conclude that 1) specific habitats support few (1–3) species of *Metaphidippus*, and 2) species presence within a habitat usually is dominated by a single species, less frequently by two species.

Habitat breadth or specificity (i.e., the number

Table 1.—A comparison of species occurrence within and over all habitats studied in Minnesota, 1964 to 1989.

| | Sum of individual collections/habitat by *Metaphidippus* species | | | |
|---|---|---|---|---|
| Habitat | *arizonensis* | *flavipedes* | *insignis* | *protervus* |
| Conifer foliage | 0 | 41 | 0 | 0 |
| Deciduous-tree foliage | 0 | 1 | 0 | 3 |
| Coniferous-tree understory | 0 | 2 | 0 | 7 |
| Deciduous understory | 0 | 0 | 0 | 31 |
| Wetland | 0 | 0 | 1 | 10 |
| Old field | 0 | 0 | 1 | 6 |
| Mixed meadow | 0 | 0 | 13 | 10 |
| Mesic prairie | 0 | 1 | 19 | 1 |
| Sand prairie | 7 | 0 | 1 | 2 |
| Crops | 0 | 0 | 1 | 4 |
| All | 7 | 45 | 36 | 74 |

of habitats occupied by each species) also varied considerably among the four species of *Metaphidippus* (Table 2). For example, *M. arizonensis* was found only in sand prairie, whereas *M. protervus* was found in 9 of the 10 habitats investigated. However, these results must be interpreted with caution because sampling intensity varied among habitats.

Dice-Lerra diagrams of carapace width measurements are given in Figure 2 for the four species of *Metaphidippus*. Means for all species pairs were significantly different ($P \leq 0.05$), except the pair *M. insignis* – *M. protervus*.

## DISCUSSION

Species partitioning by habitat is a well known phenomenon among many groups of animals (Schoener 1974). Good examples exist for the predominantly ground-dwelling lycosid spiders in the genus *Pardosa* (Den Hollander & Lof 1974; Greenstone 1980; Hallander 1970; Lowrie 1973; Vlijm & Kessler-Geschiere 1967; Vogel 1972). However, habitat partitioning among non-snare building, vegetation-inhabiting spiders has been little investigated. A few papers discuss the habitat preferences of individual species (Jennings 1976, and papers cited therein; Jennings & Collins 1987b), but rarely in the context of coexisting phylogenetically related species. Turner & Polis (1979) considered the members of a raptorial, non-snare building guild of spiders on inflorescences of a coastal sagebrush community in California. Included were three species of the crab spider genus *Misumenops*. Each species overlapped in occurrence on the shrubs, but the two common *Misumenops* species were most frequently found on different shrub species. Turner & Polis (1979) concluded that it was unlikely that widespread competition for food and space resources occurred among guild members. Interference competition, i.e., interspecific predation by guild members, was evoked as the determinator of guild structure (Turner & Polis 1979).

Within *Metaphidippus*, species determinations can be difficult. Misidentifications are possible, indeed probable. For example, it is likely that *M. exiguus* (Banks) found on jackpine (*Pinus banksiana* Lamb.) in Manitoba (Bradley & Hinks 1968) are *M. flavipedes* (Peckham & Peckham). Nevertheless, clearly there are indicated habitat preferences for *Metaphidippus* species in the literature (Allen et al. 1970; Berry 1970; Dondale et al. 1979; Ives 1967; Jennings & Collins 1987a, b; Legner & Oatman 1964; Lowrie 1968; Mason & Paul 1988; Stiettenroth & Horner 1987; Young & Lockley 1990).

Table 2.—Comparison of *Metaphidippus* species occurrence among 10 habitats in Minnesota, 1964 to 1989.

| Species | No. of habitats species found in | Sum of collections yielding species |
|---|---|---|
| *M. arizonensis* | 1 | 7 |
| *M. flavipedes* | 4 | 45 |
| *M. insignis* | 6 | 36 |
| *M. protervus* | 9 | 74 |
| All species | 10 | 162 |

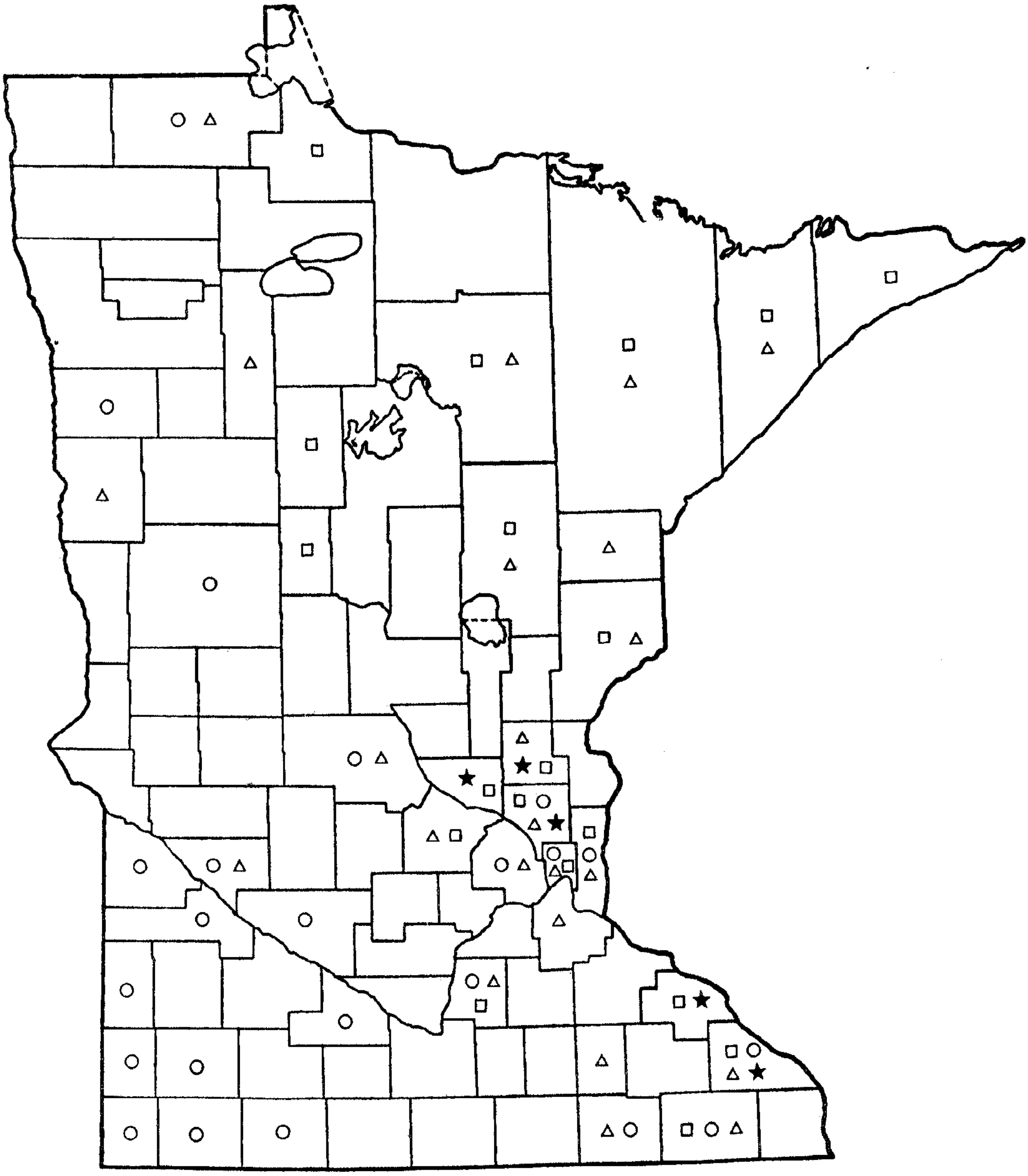

Figure 1.—Localities of *Metaphidippus* species collected in Minnesota. *M. arizonensis* = ★, *M. flavipedes* = □, *M. insignis* = ○, *M. protervus* = △.

During our study, special efforts were made to collect spiders on tamarack, *Larix laricina* (Du Roi) K. Koch, because it is the only deciduous conifer in Minnesota. Despite these efforts no species of *Metaphidippus* was found, although another jumping spider, *Eris militaris* (Hentz), did occur. Interestingly, Ives (1968) reported both *E. militaris* and *M. protervus* from tamarack in Manitoba; however, *M. flavipedes* is the expected conifer-inhabiting *Metaphidippus* in Manitoba, as reported by Bradley & Hinks (1968). In Minnesota, *M. flavipedes* was collected on all species of conifers sampled except for tamarack and northern white-cedar (*Thuja occidentalis* L.); however, the latter was scarcely sampled. Stratton et al. (1979) also sampled northern white-cedar in Minnesota and found several genera of salticids, but species of *Metaphidippus* were identified only to genus. In his investigation of spiders on a small island in northern Lake Michigan,

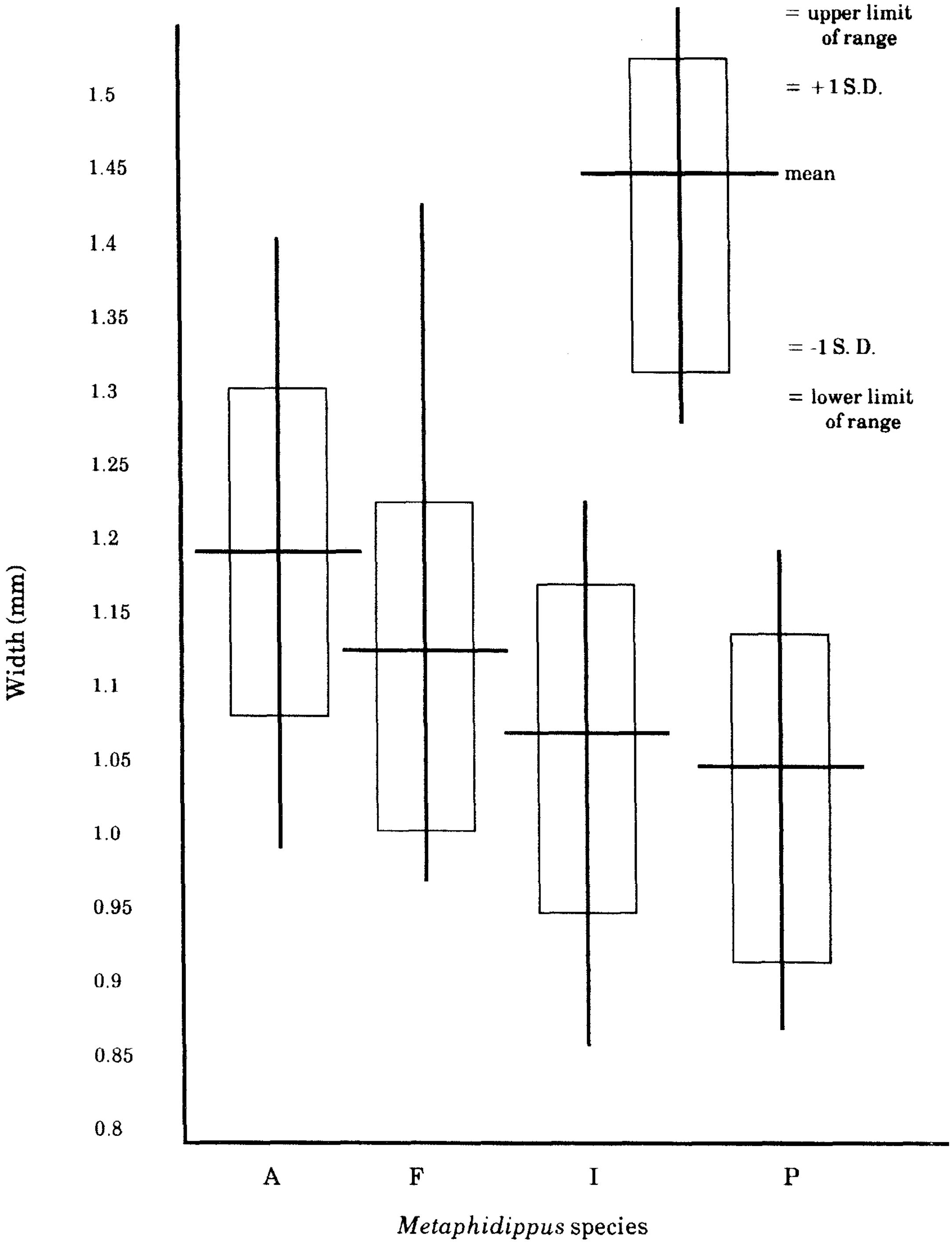

Figure 2.—Dice-Lerra Diagram for distance between row III eyes in four *Metaphidippus* species. (A = *Metaphidippus arizonensis*, F = *M. flavipedes*, I = *M. insignis*, P = *M. protervus*).

Drew (1967) carefully collected from different vegetation types including trees. *M. flavipedes* was among the commonest species collected on *Juniperus communis* (reported as *J. depressus*) and on northern white-cedar, whereas *M. protervus* was commonest in the herb-shrub stratum of the upland hardwood forest. Both species of *Metaphidippus* occurred at lower frequencies in the old field community and in other communities (marshes, beach).

That small salticid species should partition by type of space occupied, rather than successive temporal occurrence, was predicted by Enders (1975) based on previous habitat-sampling studies. The *Metaphidippus* species we investigated had similar temporal occurrences of adults, i.e., many mature males and rare mature females in September and October. Both sexes of all four species are mature in May and June, with mature females persisting into August. However, we did not closely measure temporal succession at any one site where two or more species were found. Nevertheless, our data lends support to Enders' hypothesis that species segregate by habitat.

One possible reason for habitat segregation by *Metaphidippus* species is competition for similar sized prey. However, with general collections such as ours, the morphological information of the specimens themselves is often the only data that can be analyzed. Prosomal size differences were statistically significant among all but one of the six species-pair combinations, but it may not be ecologically significant. In the laboratory, Horner & Starks (1972) found that the average percentage difference of prosomal length between molts of *Metaphidippus galathea* (Walckenaer) was 18% (Dyar's constant). Dyar's constant has been evoked as a means of determining the minimum difference in ecological isolation for prey size among different instars of a spider species (Enders 1976). The same explanation should account for size differences among closely related species. The greatest percentage difference among prosomal measurements in the species pairs discussed here was less than 13% (*M. arizonensis* vs. *M. protervus*). Assuming that the average percent difference (18%) between instars of *M. galathea* also applies to species of *Metaphidippus* found in Minnesota, then prosomal size differences among species apparently were not significant in determining ecological isolation. We conclude that these species show a potential of competing for similar sized prey based on the absence of appreciable size differences.

This paper demonstrates that species of *Metaphidippus* occupy different habitats in Minnesota. Size differences among the *Metaphidippus* species apparently are not great enough to prevent competition for similar sized prey. Other approaches, including experimental studies, should provide some answers as to how habitat separation is maintained.

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