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FACULTATIVE MONOPHAGY IN THE JUMPING SPIDER, *PLEXIPPUS PAYKULLI* (AUDOUIN) (ARANEAE: SALTICIDAE)

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INTRODUCTION

Field assessment of the natural diets of jumping spiders is difficult and time-consuming. In a recent 200 man-hour period of direct field observation in Texas (M. N. and D. A. D. unpubl.), only 50 of 700 jumping spider individuals encountered were feeding. Due to difficulties like these, little is known about the natural diets of jumping spiders and *Plexippus paykulli* (Audouin), a common jumping spider of approximately 9-12mm adult length, is no exception.

This species is geographically cosmopolitan in distribution (Platnick 1989). It was reported from Africa (Mathis and Berland 1933) and Asia (Rao et al. 1981, Miah et al. 1986). *Plexippus paykulli* was introduced to the American continent according to Edwards (1979a), and occurs from Florida to Texas, south to Paraguay (Edwards 1979a, Jackson and Macnab 1989). In North America, adult and immature *P. paykulli* can be found throughout the year and usually take up residence in and on buildings (Edwards 1979a), however, it also has been found in Florida citrus groves (Muma 1975, Mansour et al. 1982), and Alabama cotton fields (Skinner 1974). Females produce an egg-sac containing 35-60 eggs which they guard (Edwards 1979a).

The purpose of this paper is to present prey records observed for *P. paykulli*, providing evidence for a form of monophagy.

MATERIALS AND METHODS

Prey records were obtained from direct observation during the summers of 1988 and 1989 in a building in Bryan, Texas. *Plexippus paykulli* individuals were common in the building (3-4 individuals visible at a time), as was the German cockroach, *Blatella germanica* (L.). Very few other arthropods invaded the building, and those only

sporadically (mosquitoes, crickets and other spider species). *Plexippus paykulli* individuals built silken retreats on the edges of the ceiling. All predation observations were recorded, and in some cases, the prey records were based on indirect evidence (N=7, carcasses of insects found at spider feeding sites), while in 21 instances, spiders were directly observed feeding on the prey.

Dietary diversity (β) was computed using Levins' (1968) niche breath formula. The value of β calculated for *P. paykulli* was compared with 9 other cursorial hunting spiders based on data from the literature (Kiritani et al. 1972, Yeargan 1975, Jackson 1977, Turner and Polis 1979, Nyffeler et al. 1987).

RESULTS AND DISCUSSION

A total of 28 prey records of *P. paykulli* were obtained over a period of two years. In 1989, observed diet consisted entirely of a single prey species (N=24), the German cockroach, while the overall diet (1988-89) was 96% *B. germanica* (82-100%, 0.95 Confidence Interval, N=28).

Most of the German cockroaches consumed by *P. paykulli* were nymphs, most considerably smaller than the spider, but a few were adult. Prey size ranged from 3.4 to 19mm ($\bar{x} \pm SE = 6.79 \pm 0.96$mm). This agrees with other studies on similar sized salticids, such as *Phidippus* spp., which fed on prey ranging from ¼ to the same size as the spider (Roach 1987). Jackson and Macnab (1989) recorded *P. paykulli* overpowering prey up to more than twice the size of the spider individual. They reported that immobilization (at least immediately) was not greatly assisted by the injection of venom by *P. paykulli*, instead brute strength was used to overcome large arthropods, some of which have been noted to carry the spider away with them (flying, jumping or running), with the spider still clinging to the insect until the prey was overpowered. Jackson and Macnab (1989) also noted that *P. paykulli* spun a large retreat or nest-like web which could be used to assist in the capture of intruding potential prey. Nest-webs, as described in Jackson and Macnab (1989), have not been observed in Texas.

We observed no evidence that the *B. germanica* consumed by *P. paykulli* were already dead when the spiders found them (scavenging). However, *P. paykulli* was seen attacking, killing and subsequently eating cockroaches on several occasions (predation). Spider diets including cockroaches are also characteristic of other synanthropic cursorial hunting spiders (Edwards 1979b).

The strong predominance of a single prey species in the diet of *P. paykulli* indicates a trend towards monophagy. Jumping spiders have been observed to attack and consume prey selectively (Freed 1984, Roach 1987), but the monophagous feeding pattern described in this paper is rather an instance of facultative prey specialization, forced on the spider due to an abundance of a single prey taxon in the particular observational habitat. Since the German cockroaches were the only potential prey occurring in significant numbers, the scarcity of other arthropod species greatly lowered the probability of encountering and capturing alternate prey. [As Nyffeler and Benz (1988) noted on *Achaearanea riparia* (Blackwall), the same spider species which exhibits a polyphagous feeding pattern in an environment with high diversity of potential prey species may show a trend towards monophagy under the reverse conditions].

Plexippus paykulli is known from the literature as a polyphagous predator feeding on a wide variety of arthropod taxa including Odonata, Orthoptera, Homoptera, Lepidoptera, Diptera, Hymenoptera and other Araneae (Edwards et al. 1974, Edwards 1979a, Miah et al. 1986, Jackson and Macnab 1989). In a single study (Jackson and Macnab 1989), *P. paykulli* successfully fed upon individuals of 16 species of arthropods from 14 families and 6 orders including a conspecific of the same size.

Dietary studies on other jumping spiders have shown a similar polyphagous nature of predation on a variety of species in Insecta and Araneae (Jackson 1977, Dean et al. 1987, Roach 1987). Edwards et al. (1974), noted *Stoidis aurata* (Hentz) [=*Corythalia canosa* (Walck.); ed.'s note] exhibiting a specialized type of feeding behavior by preying upon ants; however, over twenty species of ants were attacked.

When compared to nine other cursorial hunting spiders (Table 1), the dietary diversity (value β), was significantly lower in *P. paykulli* than in the others, while the overall mean value of all 10 species listed was 19 times higher than

the value for *P. paykulli* alone. *Peucetia viridans* (Hentz), the species with the highest dietary diversity, had a value 53 times higher than that of *P. paykulli* (β = 3.6 vs. 0.067), while the crab spider *Xysticus californicus* (Keyserling), characterized by Turner and Polis (1979) as a food specialist, had dietary diversity three times higher than *P. paykulli* (β = 0.2 vs. 0.067).

Monophagy in spiders is not common, and is usually observed in habitats providing high numbers of particular types of prey (Riechert and Lockley 1984). Greenstone (1979) suggested that in spiders, polyphagy may be necessary for nutritional reasons by optimizing essential amino acid composition. However, the southern black widow spider, *Latrodectus mactans* (Fab.), individuals can be raised to adulthood fairly easily on a single species (*Drosophila*), although all attempts to rear the striped lynx, *Oxyopes salticus* Hentz, on a single species diet of laboratory *Drosophila* stock have met with failure (R. G. B. unpubl.). In 1989, *P. paykulli* females produced viable offspring regardless of the highly limited diet, which implies that the nutritional quality of the food supply was sufficient for survival of this spider species in the habitat investigated.

Plexippus paykulli is abundant around human habitats and, according to Edwards (1979a), is found almost exclusively around man-made structures. Edwards (1979a) also considers this spider to be an important natural control agent against a variety of human pests including mosquitos and muscoid flies as well as other pests. Mathis and Berland (1933) reported *P. paykulli* to be a predator of mosquitoes in African houses, and the spider was also reported as a predator of insect pests in Bangladesh (Miah et al. 1986) and India (Rao et al. 1981). *Plexippus paykulli* also occurs in Florida citrus groves (Muma 1975, Mansour et al. 1982) and Alabama cotton fields (Skinner 1974), but its role as a predator in these ecosystems has not been described. We suggest the *P. paykulli* specimens found away from man-made structures may have been involved in a migration process.

The capability of certain jumping spiders to narrow down their "feeding niche" (sensu Krebs 1985) under conditions of low potential prey species diversity suggests that these spiders may react with increased predation rates towards certain insect pests when the pest numbers rise to an abundant level due to an excess food supply and/or a lack of controlling factors such as other natural enemies or harsh climatic conditions. Some additional evidence of this can be found in Breene et al. (1989), where high percentages of the field populations of 3 salticid species collected in a cotton field were radioactively implicated as feeding on locally abundant irradiated cotton fleahoppers, *Pseudatomoscelis seriatus* (Router). One of these three species, *Phidippus audax* (Hentz), demonstrated a functional response to fleahopper prey in the field where the daily consumption of prey individuals increased with increasing prey density (Breene et al. 1990). In a largely similar manner, but in a different habitat, *P. paykulli* individuals may have learned to become expert cockroach hunters, especially since *B. germanica* appears capable of supplying all the necessary requirements for the jumping spider's growth and reproductive needs.

The ability of polyphagous predators to narrow down their feeding niche, in effect concentrating on an abundant prey source, is a characteristic that could be of great significance from the natural control point of view, both for urban and agricultural ecosystems.

SUMMARY

Predation by the jumping spider, *Plexippus paykulli* (Audouin), was recorded in a synanthropic habitat in Texas. Prey ranged in size from 3.4 to l9mm ($\overline{x}$ ± SE = 6.79 ± 0.96mm) and consisted almost entirely of the German cockroach, *Blatella germanica* (L.) (96%, N=28). When compared to 9 other species of cursorial hunting spiders using Levins' niche breath formula, the value for *P. paykulli* was 3 times lower than the value for the species with the narrowest prey diversity, to 53 times lower than the species with the broadest, indicating a trend toward monophagy. However, *P. paykulli* is known as a highly polyphagous predator with a broad feeding niche and the low dietary diversity observed is probably facultative monophagy, a feeding strategy invoked by a plethora of a single prey species accompanied by scarcity of alternative prey within the habitat. The ability of jumping spiders to narrow down their feeding niche during periods of an abundance of a single prey species and simultaneous rarity of other prey is significant from the standpoint of natural control, both in urban and agricultural settings.

TABLE 1. Comparison of the dietary diversity (β) values of 10 cursorial hunting spiders, based on literature data. Increased β value indicates higher dietary diversity.

Spider species	β*
Lycosidae	
Pardosa pseudoannulata (Boes. & Str.) [= *Lycosa pseudoannulata*] [a]	0.5
Pardosa ramulosa (McCook) [a]	1.0
Oxyopidae	
Oxyopes salticus Hentz [a]	0.9
Peucetia viridans (Hentz) [b]	3.6
Thomisidae	
Misumenops deserti (Schick) [b]	2.5
Misumenops importunus (Keyserling) [b]	0.6
Misumenops lepidus (Thorell) [b]	2.9
Xysticus californicus (Keyserling) [b]	0.2
Salticidae	
Phidippus johnsoni (Peckham and Peckham) [a]	1.2
Plexippus paykulli (Audouin) [c]	0.067
Mean Value	1.3

* Dietary diversity (β) was computed using Levins' (1968) niche breadth formula.
[a] Computed based on prey records by Kiritani et al. (1972); Yeargan (1975); Jackson (1977); Nyffeler et al. (1987).
[b] Data from Turner and Polis (1979). [c] Based on data from this paper.

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