1.63 long, with proximal lobe scarcely detectable. Femur I 1.82 long. Anterior portion of internal genitalia with several elongate receptacula (Fig. 7) on each side.

Other material examined

One juvenile taken at the type locality, 2-9 November 1983 (P. Dyer, J. Lyon, registration number 1987/23, Western Australian Museum).

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Field and laboratory observations on prey items taken by the wolf spider, *Lycosa lenta* Hentz (Araneae, Lycosidae)

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Summary

Field and laboratory studies were conducted on the dietary intake of adult female *Lycosa lenta* Hentz from central Florida. Their natural diet included insects (85.7%) and arachnids (14.3%). Orthopteran insects comprised 44.4% of the total prey items, followed by arachnids, Hemiptera (11.3%), and Lepidoptera (9.8%). Acridid grasshoppers and cockroaches accounted for 28.5%. Hard-bodied insects or those which are well defended such as blister and bombadier beetles, stinkbugs and velvet ants, were avoided. These spiders prefer prey organisms smaller than themselves.

Introduction

In North America, wolf spiders (Lycosidae) are often common representatives of the ground-dwelling arthropod fauna (Gertsch, 1949). Although the predatory habits of these wandering, non-web building spiders are well known (Edgar, 1969; Ford, 1978; Rovner, 1980), little information is available concerning the prey taken by these and other spiders in the field (Nentwig, 1986, 1987). Our knowledge of the prey taken by non-web builders is limited to relatively few species compared to that of web builders (Nentwig & Wissel, 1986; Nentwig, 1987). Specimens of intact prey as well as prey remains can be readily collected from webs. Non-web builders, on the other hand, usually carry only one prey item in their chelicerae at any given time and are characterized by a relatively short ingestion time and low hunting success rate (Holling, 1966; Nakamura, 1972; Nentwig, 1986).

While studying the behavioural ecology and physiology of lycosid spiders, numerous specimens of *Lycosa lenta* Hentz from central Florida were collected with prey in their chelicerae. This provided an opportunity to analyze the prey captured and ingested by this spider. These spiders are typically nocturnal and are most frequently found on sandy substrates (Gertsch, 1949; personal observation). The purpose of the present study was to identify the types of prey captured by *L. lenta* in the field as well as to assess its dietary intake in the laboratory, in order to understand more fully the feeding ecology of this species. This is relevant in the light of recent interest in the importance of spiders as biological control agents (Riechert & Lockley, 1984).

Methods

Field observations on adult female *L. lenta* were conducted nightly (between 2100 to 0200 hrs) during May through August, 1987-1988. These spiders were associated with a mesic microhabitat surrounded by sand-pine dunes as previously described by Muma (1973), located on the west side of Florida State Road 540, 9.4 km south of Winter Haven. Dominant vegetation included scattered sand pine *(Pinus clausa)*, turkey oak *(Quercus laevis)*, scrub oak *(Q. ilicifolia)*, saw palmetto *(Serenoa repens)* and several grasses (Small, 1933; Davis, 1967). One hundred and thirty-three spiders with prey in their chelicerae were collected and placed in alcohol for subsequent identification. Since adult females were encountered much more frequently than were males or immature spiders, only the results for females are reported in this study. The mean body length (MBL) for all females was 18.9 mm and ranged from 16.4 – 22.3 mm. Prey items were in various stages of digestion, which made identification possible only to order or family in most cases.

Additional female spiders were collected and taken back to the laboratory to study their prey intake. Individuals were placed in plastic containers (15 × 10 ×

6 cm), provided with water and fed on a diet of crickets *(Acheta domestica)* and mealworms *(Tenebrio molitor)*. These prey species were chosen for maintenance purposes because they are not found at the study site and would therefore minimize any choice bias from confounding subsequent prey acceptability studies. Animals were maintained at 23 ± 1°C, 70 – 80% RH, and a 12 : 12 LD photoperiod. Spiders were deprived of food for one week before feeding experiments. All prey organisms used in the feeding studies were collected from the same site as the spiders and were used within 72 hr of their capture. The procedure used was similar to that reported by Nentwig (1986) and Young (1989). It consisted of placing an individual live prey in each container and recording the prey status after 24 hr. Prey organisms of different size classes and various taxa were tested. In order to minimize any effect of learning, prey of the same species were never presented consecutively, as suggested by Nentwig (1986).

Results and Discussion

The types of prey captured and ingested by *L. lenta* in the field are listed in Table 1. One hundred and thirty-three prey organisms were collected from adult spiders and identified to order, family, genus or species, depending on the degree of digestion. Prey consisted of insects (85.7%) and arachnids (14.3%). Orthopteran insects comprised 44.4% of the total prey items, followed by arachnids (14.3%), Hemiptera (11.3%), Lepidoptera (9.8%) and Coleoptera (9.0%). Acridid grasshoppers and cockroaches (Blattidae) together comprised 28.5% of the prey collected. Although previous arthropod sampling studies using sticky traps, sweep nets and pitfall traps showed that beetles were among the most numerous of prey taxa found at this site, the frequency of their capture suggests that these spiders avoid hard-bodied prey. Laboratory studies on prey acceptance by the wolf spider, *Pardosa lugubris* (Walck.) (Nentwig, 1986), showed a significant preference for soft-bodied arthropods such as flies, cockroaches, grasshoppers and spiders, and a total rejection of heavily chitinized beetles. Most prey records available for other lycosids are associated with the genus *Pardosa* (see review by Nentwig, 1987). Studies on *P. lugubris* (Edgar, 1969; Nentwig, 1986), *P. amentata* (Clerck) (Edgar, 1970), *P. chelata* (Müller) (= *P. lugubris)* and *P. pullata* (Clerck) (Hallander, 1970), and *P. ramulosa* (McCook) (Greenstone, 1976) from other areas of North America and Europe, report the following percentage composition of prey types collected in the field: Collembola (2-43%), Diptera (23-67), Hemiptera (2-11), Homoptera (3-24), Hymenoptera (4-7), Lepidoptera (8) and Thysanoptera (34-46%). It is interesting to note that the representation of Thysanoptera and Diptera is much higher than that found for *L. lenta* (3.8, 2.3) in the present study. This is most likely attributable to the smaller body size of *Pardosa* spiders. Smaller predators are more likely to exhibit a preference for smaller prey (Gardner, 1966; Holling, 1966; Curio, 1976; Punzo, 1989), although lycosids are known to attack prey considerably larger

Prey taxon	Number of prey items
Arachnida (14.3)	
Araneae	
Gnaphosidae (1.5)	
Poecilochroa sp. (A)	2
Lycosidae (9.1)	
Lycosa sp. (I)	3
Pardosa sp. (A)	5
Undetermined (I, A)	7
Phalangida (A) (1.5)	2
Insecta (85.7)	
Coleoptera (9.0)	
Carabidae (A)	2
Cerambycidae	
Psyrassa sp. (A)	1
Cicindelidae (A)	1
Lampyridae	
Photinus sp. (A)	2
Scarabaeidae	
Pelidnota punctata (A)	2
Tenebrionidae	
Alobates sp. (A)	1
Undetermined (A)	3
Collembola (A) (3.0)	4
Dermaptera	
Forficulidae	
Forficula auricularia (A)	1
Diptera (2.3)	
Muscidae (A)	1
Undetermined (A)	2
Hemiptera (11.3)	
Coreidae	
Acanthocephala sp. (A)	1
Corizidae (I)	1
Lygaeidae (A, I)	4, 2
Miridae	
Horcias sp. (I)	1
Reduviidae	
Phymata sp. (A)	1
Undetermined (I, A)	2, 3
Hymenoptera	
Formicidae (A)	2
Lepidoptera (9.8)	
Arctiidae (L)	1
Geometridae (L)	1
Noctuidae (L, A)	3, 4
Nymphalidae (L)	2
Undetermined (L)	2
Orthoptera (44.4)	
Acrididae (15.0)	
Melanoplus sp. (I)	5
Schistocerca sp. (I)	6
Undetermined (A)	9
Blattidae (13.5)	
Periplaneta americana (I, A)	12, 6
Gryllidae (5.3)	
Gryllus sp. (A)	7
Gryllotalpidae (2.3)	
Gryllotalpa hexadactyla (I)	3
Tettigoniidae (3.0)	
Scudderia sp. (A)	2
Undetermined (I)	2
Undetermined (I, A) (5.3)	4, 3
Thysanoptera (3.8)	5

Table 1: Prey items captured by *Lycosa lenta* during field observations (n = 133 spiders and prey items). Life cycle stage of prey indicated as A (adult), I (immature) or L (larva). Percentage of total prey is given in parentheses.

than themselves (Nentwig & Wissel, 1986). In addition, orthopteran insects were noticeably absent from the prey records reported for *Pardosa,* whereas they comprise a major component of the diet of *L. lenta* in central Florida. A more recent study by Hayes & Lockley (1990) on predation by wolf spiders associated with cotton fields showed that *Lycosa antelucana* Montgomery and *Pardosa milvina* (Hentz) fed primarily on Coleoptera and anopheline mosquitoes and to a lesser extent on Hemiptera, Lepidoptera and non-insect arthropods. It should also be pointed out that in the present study, insects associated with distasteful or noxious properties, such as meloid blister beetles, coccinellid beetles, bombadier beetles (*Brachinus* spp., Tenebrionidae), leaf bugs (Coreidae), stink bugs (Pentatomidae) and velvet ants (Mutillidae), commonly found at the study site, were almost absent from the prey associated with *L. lenta.*

The results from the laboratory studies on prey capture are shown in Table 2. These observations support the field observations. Hard-bodied prey such as carabid beetles have a low acceptance rate. In addition, those insects which are capable of secreting defensive chemicals, such as *Brachinus* sp., meloids, coccinellids and pentatomids, as well as velvet ants (Mutillidae) which are equipped with a venomous sting, are rejected by these spiders. The results also indicate that prey from acceptable taxa are rejected if they exceed a certain size category. The percentage capture and ingestion rate for acridid grasshoppers is 95% for those with a MBL of 10.9 mm, and only 10% for those with MBL of 23.1 mm. Similar results were found for the cockroach, *Periplaneta americana.* This agrees with previous studies showing that most non-web building spiders capture prey between 50-80% of their own size (Anderson, 1974; Nentwig & Wissel, 1986). Although lycosids have been referred to as wandering spiders (Gertsch, 1949; Hallander, 1970) and considered to be active hunters, *L. lenta* remains stationary while waiting for suitable prey and can be considered a Type I sit-and-wait predator as defined by Schoener (1971). This behaviour is apparently found in many lycosids (Ford, 1978) which exhibit a sit-and-wait strategy interrupted by periodic movements between patches. As a result, energy costs are low during periods when the spider is stationary, while at the same time, periodic movement allows the animal to leave an area characterized by low prey density.

Prey species	Mean body length of prey (mm)	Mean body length of *L. lenta* (mm)	Percentage capture and ingestion
Coleoptera			
Carabidae			
Chlaenius sericeus (A)	5.4	17.8	20
Brachinus sp. (A)	11.1	17.5	0
Coccinellidae			
Hippodamia convergens (A)	4.7	17.4	10
Lampyridae			
Photinus pyralis (A)	14.6	17.3	90
Meloidae			
Pyrota sp. (A)	7.1	16.9	5
Hemiptera			
Lygaeidae			
Dystercus andreae (A)	12.2	18.1	5
Pentatomidae			
Megantia histrionica (A)	10.1	17.7	15
Orthoptera			
Acrididae			
Schistocerca americana (I)	10.9	16.8	95
(A)	23.1	18.2	10
Blattidae			
Periplaneta americana (I)	15.1	17.9	90
(A)	27.1	18.2	0
Gryllidae			
Gryllus assimilis (A)	14.7	18.1	90
Hymenoptera			
Mutillidae			
Dasymutilla occidentalis (A)	5.3	17.1	0

Table 2: Laboratory experiments on prey items taken by *Lycosa lenta.* Life cycle stage of prey indicated as A (adult) or I (immature). n = 20 for each prey species. All prey were collected from the same locality as *L. lenta.*

These nocturnal spiders also captured fireflies (Lampyridae) in the field and captured and ingested these soft-bodied insects during the laboratory feeding experiments. Previous records of lycosids feeding on lampyrids were reported by Lloyd (1973). Wolf spiders that have smaller body sizes, such as *Pardosa* and *Pirata,* have been shown to feed extensively on aphids in the field (Nentwig, 1987). In the present study, there were no observations of *L. lenta* (MBL, 16.4-22.3 mm) feeding on aphids in the field. However, further studies are necessary to determine whether immature specimens will capture aphids as well as collembolans.

In conclusion, the dietary intake of adult *L. lenta* can be characterized as rather general, with a wide variety of arthropods being accepted. Results also indicate a predominance of soft-bodied prey and an avoidance of aggressive or noxious species commonly encountered in its habitat. In contrast, some spiders can exhibit extreme polyphagy as well as specialization. The ctenid spider, *Cupiennius salei* (Keyserling), is extremely polyphagous, accepting a wide variety of poisonous or distasteful insects including pentatomids, bees and ants, as well as centipedes (Nentwig, 1986). The salticid, *Stoidis aurata* (Hentz) (Edwards *et al.,* 1974), on the other hand, feeds almost exclusively on ants, as do most zodariid spiders (Harkness, 1976). Hymenoptera constitute a major portion of the diet of many flower-dwelling thomisids (Hobby, 1940), while some spiders have been reported to feed exclusively on termites (Dippenaar & Meyer, 1980) and other spiders (Legendre, 1961). To date, no lycosids have been shown to exhibit this kind of specialization, and most are considered to be generalists (Edgar, 1970; Greenstone, 1976; Nentwig, 1986).

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