Natural prey of the lynx spider *Oxyopes lineatus* (Araneae: Oxyopidae)

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The natural prey of the lynx spider *Oxyopes lineatus* Latreille, 1806 was studied in a meadow in the subtropical zone of Azerbaijan. The percentage of specimens of *O. lineatus* found while feeding was low (4.3%). Spiders were observed feeding both day and night. The investigation has shown that *O. lineatus* is a polyphagous predator feeding on a wide range of arthropods, with representatives of nine arthropod orders found in its diet. The primary food of *O. lineatus* was Diptera, Hymenoptera, and Homoptera, which collectively made up about three quarters of all prey. Worker ants constituted about 20% of the diet suggesting that *O. lineatus* is a myrmecophagic spider. The length of prey killed by *O. lineatus* ranged between 0.50 and 8.50 mm (mean 2.72 mm), varying from 12.1 to 171.4% (mean 61.4%) of the length of their captors. The most frequently captured prey were arthropods not exceeding the length of the spiders (87.5%).

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1. Introduction

The lynx spiders of the genus *Oxyopes* Latreille, 1804 are typical cursorial hunters, which possess relatively keen eyesight and do not use silk for prey capture (Kovoor & Munoz-Cuevas 1997). Instead, they actively pursue their prey and seize it with a leap (Cutler *et al*. 1977). In common with other cursorial spider groups, the information on the prey of *Oxyopes* is limited. The species best studied in this respect is the striped lynx spider, *Oxyopes salticus* Hentz, 1845 from North America (Lockley & Young 1987, Nyffeler *et al*. 1987a, 1992, Agnew & Smith 1989, Bardwell & Averill 1997). Less extensive quantitative data are available on the natural prey of *Oxyopes globifer* Simon, 1876 from Azerbaijan (Huseynov 2006), *O. apollo* Brady, 1964 from USA (Agnew & Smith 1989*), O. licenti* Schenkel, 1953 and *O. sertatus* L. Koch, 1877 from Japan (Furuta 1977). Likewise, there are qualitative accounts on the food of the North American gray lynx spider, *O. scalaris* Hentz, 1845, in the field and laboratory (Cutler *et al*. 1977, Carroll 1980). *Oxyopes chittrae* Tikader, 1965, *O. javanus* Thorell, 1887, *O. pandae* Tikader, 1969 and *O. ratnae* Tikader, 1970 have been observed feeding on some common insect pests in India (Krishnasamy *et al*. 1984, Monga & Sadana 1988, Dhulia & Yadav 1994, Kumar & Velusamy 1996, Sadana & Goel 1996, Sebastian *et al*. 2004). It is surprising that nothing is known about the natural prey of such common Central European lynx spiders as *Oxyopes heterophthalmus* (Latreille, 1804), *O. lineatus* Latreille, 1806 and very little about the prey of *O. ramosus* (Martini & Goeze, 1778) (Baehr & Baehr 1987). Thus when I found a dense population of *Oxyopes lineatus*, I decided

to study its diet to fill this gap in our knowledge. *O. lineatus* is a West Palearctic species distributed from Western Europe to Central Asia (Levy 1999). It is a medium-sized lynx spider, with an adult body length of 6–8 mm. *O. lineatus* inhabits herbaceous vegetation in open unshaded areas, such as grasslands, meadows, and crop fields.

2. Material & Methods

The investigation was carried out within the Hyrcan National Park, situated in the subtropical forest zone of the South-East of Azerbaijan. The study site was a meadow bordered with Hyrcan relic forest near Khanbulan village (38º40'N; 48º52'E). The vegetation of the meadow consisted of shrubs *Rubus* spp. and various grasses, weeds and forbs. Daytime observations (between 11:00 and 20:00 hours) were made daily from 23.–31.V.2006 and took 47 hours in total. A few additional diurnal prey items were collected from 1.–8.VI.2006 during non-quantitative observations. Night-time observations (between 01:00 and 05:00 hours) were made from 5–9 June 2006 and took ca. 10 hours in total. During the surveys, grassy vegetation was thoroughly searched for spiders, and each encountered *O. lineatus* individual was captured in a transparent glass vial. In the vial the spiders' chelicerae were inspected with a hand-lens of 4 × magnification to prevent tiny prey being overlooked. Specimens with prey in their chelicerae were placed in separate vials containing 75% ethyl alcohol and brought back to the laboratory for prey size measurement and prey identification. Voucher specimens of *O. lineatus* and their prey items were deposited at the arthropod collection of the Institute of Zoology, Azerbaijan Academy of Sciences.

3. Results

In total, 1,700 specimens of *O. lineatus* were observed, 74 of which had prey in their chelicerae (4.3%). Among these, 1467 spiders were found during the daylight hours (68 with prey ~ 4.6%), and 233 ones during the period of darkness (6 with prey ~ 2.6%). There was no statistically significant difference in the percentage of feeding spiders between the two periods of observation ($\chi^2 = 1.456$, $df = 1$, $p > 0.1$).

Table 1. Prey of *Oxyopes lineatus* classified by order, family, number caught and percentage composition.

Prey taxa	N	%
Diptera	[22]	[25.3]
Sciaridae	6	6.9
Chloropidae	5	5.7
Camillidae	2	2.3
Cecidomyiidae	1	1.1
Ceratopogonidae	1	1.1
Unidentified adult	2	2.3
Unidentified larvae	5	5.7
Hymenoptera	[22]	[25.3]
Formicidae	18	20.7
Pteromalidae	2	2.3
Eulophidae	1	1.1
Braconidae	1	1.1
Homoptera	[22]	[25.3]
Cicadellidae	12	13.8
Aphididae	6	6.9
Chaitophoridae	2	2.3
Phloeomyzidae	1	1.1
Callaphididae	1	1.1
Thysanoptera	[8]	[9.2]
Aelothripidae	8	9.2
Lepidoptera	[2]	[2.3]
Unidentified larvae	2	2.3
Orthoptera	[1]	[1.1]
Tettigonidae	1	1.1
Coleoptera	[1]	[1.1]
Coccinellidae	1	1.1
Araneae	[7]	[8.0]
Araneidae	3	3.4
Thomisidae	2	2.3
Philodromidae	1	1.1
Salticidae	1	1.1
Acari	[2]	[2.3]
Ixodoidea	2	2.3
Total	87	100.0

One *O. lineatus* dropped its prey before it could be captured. However, 14 additional prey items were collected during non-quantitative observations. Thus, 87 prey items were included in the dietary analysis. The prey belonged to nine orders of arthropods: seven from the class Insecta and two from the class Arachnida (Table 1). The dominant prey orders were Diptera, Homoptera, and Hymenoptera, which collectively constituted over three quarters of the total prey (75.9%). Most of the hymenopterans captured were ants

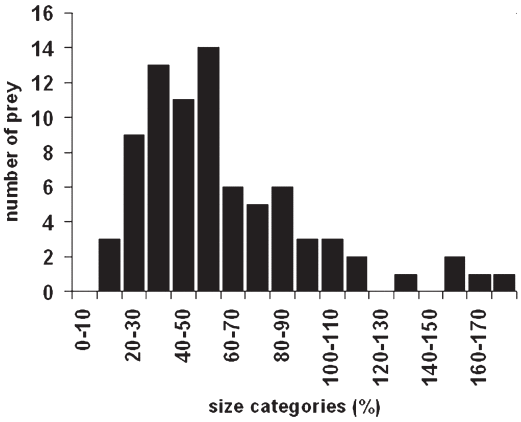

Fig. 1. Distribution of prey in different size categories (body lengths of prey expressed as percentages of the body length of their captors).

(81.9%). They included representatives of the subfamilies Formicinae (7 *Plagiolepis* sp., 5 *Lasius* sp., 1 *Camponotus* sp.) and Dolichoderinae (5 *Tapinoma* sp.). Except for one winged male of *Tapimona*, all ants were workers. Other hymenopterans comprised two Pteromalidae, one Eulophidae and one Braconidae. Homopterans were represented by aphids (6 Aphididae, 2 Chaitophoridae, 1 Phloeomyzidae, 1 Callaphididae) and leafhoppers (12 Cicadellidae). Most of the aphids captured (60%) were wingless individuals. Diptera were represented by both nematocerans (6 Sciaridae, 1 Cecidomyiidae, 1 Ceratopogonidae, 1 unidentified) and brachycerans (5 Chloropidae, 2 Camillidae, 1 unidentified). Additionally, five unidentified dipteran larvae were captured by *O. lineatus*. The remaining insects included eight adult thrips (Aelothripidae), one nymph grasshopper (Tettigonidae), one beetle larvae (Coccinellidae), and two unidentified caterpillars (Lepidoptera). Among spiders captured were three Araneidae (male and female *Mangora acalypha* (Walckenaer, 1802), juvenile *Argiope bruennichi* (Scopoli, 1772), two Thomisidae (both juvenile *Xysticus* sp.), one Philodromidae (unidentified juvenile), and one Salticidae (female *Talavera aequipes* (O.P.-Cambridge, 1871)). Other arachnids were two ticks (Ixodoidea).

Eighty prey items were measured. Their length varied from 0.50–8.50 mm (mean ± *S.D.*: 2.72 ± 1.72 mm), varying from 12.1 to 171.4% (61.4 ± 35.3%) of the length of their captors, which ranged from 3.25–5.75 mm (4.36 ± 0.48 mm). The size distribution of the prey in relation to that of their captors is shown in Fig. 1. Most of the prey did not exceed the length of their captors (87.5%), with small (not exceeding half the size of the spiders) and medium-sized (from 50% to 100% of spider body length) prey being about equally common (45.0% and 42.5% respectively). Large prey, exceeding the length of the spiders, constituted 12.5% of total prey measured, with four items (5.0%) being larger than 150% of spider body length. Large prey consisted of leafhoppers, orthopteran and lepidopteran larvae. All other prey types were smaller than their captors.

4. Discussion

The percentage of *O. lineatus* individuals found with prey in their chelicerae was low (< 5%), as is usual with cursorial spiders (Nentwig 1986, Nyffeler & Breene 1990) and lynx spiders in particular (Nyffeler *et al*. 1987a, b, 1992, Huseynov 2006). It is worth noting that *O. lineatus* was observed feeding at night, though less frequently than during daylight hours (but the difference was not statistically significant). Night-time feeding was also recorded in other lynx spiders, *Oxyopes salticus* and *Peucetia viridans* (Hentz, 1832) (Nyffeler *et al*. 1987a, b), suggesting that it is probably a widespread behaviour in Oxyopidae. In the present study, however, it is difficult to imagine how *O. lineatus* could capture nocturnal prey because spiders were very inactive at night. During night observations they were motionless, sitting on or hanging from stems of grass. Even when disturbed, spiders moved very slowly. This is apparently related to low night temperatures at the time of the study (12–15ºC), while diurnal temperatures reached up to 33ºC. It is possible, therefore, that spiders observed feeding at night consumed prey that they had captured before sunset. However, the fact that all nocturnal feeding events were recorded between 02:00 and 04:00 hours, i.e. from 4 to 6 hours after sunset, makes this hypothesis less likely, since the average time of prey consumption in similar-sized *O. salticus* was found to be less than 60 min (Nyffeler *et al*.

1987a).On the last night of observations (9.VI.) spiders were considerably more mobile, so it is highly likely that with progression of the hot season (late VI.–VII.) *O. lineatus* could significantly increase their nocturnal activity. Nocturnal foraging by *O. lineatus* should be investigated in the future.

The investigation has shown that *O. lineatus* is a polyphagous predator feeding on a wide range of arthropods. Compared to another grass-dwelling cursorial spider, *Tibellus macellus* Simon, 1875 (Philodromidae), which was studied at the same site and during the same period of time, *O. lineatus* has a significantly greater diet breadth. In contrast to *T. macellus*, which fed primarily on aphids (Huseynov, unpubl.), many groups of prey (ants, leafhoppers, aphids, midges, flies, thrips, spiders) contributed in more or less similar proportion (from 8 to 20%) to the diet of *O. lineatus*. This is comparable to the observations of other lynx spiders, which are known to have broad diets (see Nyffeler 1999). Another characteristic of the feeding ecology of *O. lineatus* is predation on ants (myrmecophagy). Worker ants, possessing effective defensive equipment, are not palatable to most cursorial spiders (Nentwig 1986), but spiders of the genus *Oxyopes* seem to be an exception. Worker ants were found among the prey of all *Oxyopes* species, where data on natural prey is available: *O. salticus* (Nyffeler *et al*. 1987a), *O. globifer* (Huseynov 2006), *O. apollo* (Agnew & Smith 1989), *O. scalaris* (McIver 1989), *O. ramosus* (Baehr & Baehr 1987), *O. licenti* and *O. sertatus* (Furuta 1977).

The present study which revealed a high level of worker ant predation by *O. lineatus* (ca. 20% of the total diet) supports the hypothesis that myrmecophagy is a common phenomenon within the genus *Oxyopes* and probably the whole family Oxyopidae (Huseynov 2006). However, unlike other myrmecophagic cursorial spiders from the families Salticidae, Gnaphosidae, Thomisidae, and Zodariidae, which have evolved a highly specialized predatory behaviour against worker ants (Soyer 1953, Heller 1976, Oliveira & Sazima 1984, 1985, Li & Jackson 1996, Pekar 2004), almost nothing is known about the adaptations that allow lynx spiders to subdue this well-defended prey, except for speculation by Baehr & Baehr (1987) about the role of leg spines in protection of *O. ramosus* against ants.

The experimental study of prey size preference in spiders has shown that most cursorial spiders do not accept prey exceeding 150% of their own body length. The preferred prey length tends to be equal to or less than the length of the spider (Nentwig & Wissel 1986). My findings agree with this generalization. Most of the prey of *O. lineatus* (87.5%) were smaller than the spiders, while those larger than their captors usually did not exceed 150% of the spider's length. The mean value and range of relative length of prey of *O. lineatus* were comparable to those recorded in other lynx spiders (Nyffeler *et al*. 1987a, b, 1992, Huseynov 2006).

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