Natural prey of the crab spider *Runcinia grammica* (Araneae: Thomisidae) on *Eryngium* plants

Elchin Fizuli oglu Huseynov
Institute of Zoology, Azerbaijan Academy of Sciences,
Block 504, passage 1128, Baku 370073, Azerbaijan

Summary

The natural prey of the crab spider *Runcinia grammica* (C. L. Koch, 1837) inhabiting *Eryngium* plants was studied in Absheron Peninsula, Azerbaijan. The percentage of specimens of *R. grammica* found while feeding was low (8.9%). Adult males fed significantly less frequently than adult and immature females. Investigation has shown that *R. grammica* is a polyphagous predator feeding on a wide range of arthropods. Representatives of four arthropod orders were found in its diet. The primary food of *R. grammica* was Diptera, which accounted for 65.9% of total prey. The length of prey killed by *R. grammica* ranged between 0.82 and 15.00 mm (mean 7.96 mm) and constituted from 40.2 to 202.7% (mean 134.0%) of the length of their captors. The most frequently captured prey were large arthropods, exceeding the size of the spiders (86.4%). Adult males, however, captured exclusively prey smaller than themselves.

Introduction

Crab spiders (Thomisidae) belong to the group of so-called cursorial spiders, which do not use silk for prey capture. Instead, they lie in ambush and wait until prey comes within reach of their long raptorial forelegs (Foelix, 1996). With over 2,000 described species, Thomisidae is among the largest families of spiders (Platnick, 2006). However, despite their great diversity and potential predatory significance, few studies have addressed the natural prey of thomisids. A survey of the arachnological literature revealed only fifteen works containing quantitative data on natural diets of crab spiders, from the genera *Aphantochilus* O. P.-Cambridge, 1870 (Castanho & Oliveira, 1997), *Diaea* Thorell, 1869 (Tarabaev, 1979), *Misumena* Latreille, 1804 (Erickson & Morse, 1997; Morse, 1979, 1981), *Misumenoides* F. O. P.-Cambridge, 1900 (Schmalhofer, 2001), *Misumenops* F. O. P.-Cambridge, 1900 (Agnew & Smith, 1989; Dean *et al.*, 1987; Romero & Vasconcellos-Neto, 2003), *Thomisus* Walckenaer, 1805 (Broekhuysen, 1948), *Tmarus* Simon, 1875 (Lubin, 1983), and *Xysticus* C. L. Koch, 1835 (Guseinov, 2006; Morse, 1983; Nyffeler & Benz, 1979; Ricek, 1982).

In the present paper I report on the natural prey of *Runcinia grammica* (C. L. Koch, 1837), the type species of the genus *Runcinia* Simon, 1875, the members of which, to my knowledge, have never been the subject of any special ecological or behavioural investigation. *Runcinia grammica* is distributed throughout the Palaearctic and in South Africa (Dippenaar-Schoeman, 1980). It is a medium-sized thomisid, with adult female body length of 5–8 mm. In common with other flower-dwelling crab spiders, *Runcinia* females are able to change their coloration from white to yellow and vice versa. Males are much smaller (2–4 mm in body length) than females and have constant creamy coloration, with dark annulations on the forelegs. *Runcinia grammica* seems to have an annual life cycle. Throughout the summer most of the population is represented by penultimate and adult individuals, though insignificant numbers of small immatures are regularly encountered together with them. At the beginning of July, females start to produce egg sacs which they attach to the branches of shrubs, where previously they hunted. It is remarkable that *Runcinia* females construct all their egg sacs (up to three) in the same place. These egg sacs have an irregular shape and are broadly attached to each other, so it is usually difficult to distinguish an individual sac within the resulting complex.

Material and methods

The investigation was carried out in Absheron Peninsula, Azerbaijan. The three primary study sites were located near Shagan, Gres and Bina villages (40°27–30′N, 50°04–08′E), where over 95% of the total observation time was spent. Additionally, there were two secondary study sites located near Gala village and Ganly-Gyol Lake. The study sites were areas of ephemeral semidesert covered with the dwarf shrubs *Eryngium biebersteinianum* Newsky, *Alhagi pseudoalhagi* (M.B.) and *Noaea mucronata* (Forsk.), and herbs and grasses, predominantly *Calendula persica* C.A.M., *Senecio vernalis* Willd. & Kar., *Medicago denticulata* Willd., *Carduus arabicus* Jaqu., *Hirschfeldia incana* (L.), *Erodium cicutarium* (L.), *Hedypnois cretica* W., *Pterotheca marschalliana* (Rchb.), *Anagallis coerulea* Schreb., *Poa bulbosa* L., *Aegilops biuncialis* Vis., *Avena ventricosa* Bal., *Hordeum leporinum* Link. and *Koeleria phleoides* (Vill.). The habitats near Shagan, Bina and Ganly-Gyol were additionally characterised by planted pines, *Pinus eldaricus* Medw., while the other sites were treeless.

During the study period *Runcinia grammica* was abundant only on *Eryngium biebersteinianum*; observations therefore were concentrated exclusively on this plant. Most of the prey of spiders was sampled during three successive years: 1997 (2 July–9 August), 1998 (14 June–25 July) and 1999 (14 June–31 July). A few additional prey items were collected in 2006 (20–25 July). A total of 53 surveys were conducted during these periods which took a total of about 115.5 hours. All surveys were done in daylight hours between 11:00 and 21:00. During the surveys *Eryngium* plants were thoroughly searched for *R. grammica*, and the mouthparts of each individual found were inspected with a hand-lens of $\times 4$ magnification to avoid overlooking small prey. Spiders with prey in their chelicerae were captured with a transparent cup, placed in separate vials containing 75% ethyl alcohol, and brought back to the laboratory for measurement and prey identification. Spiders without prey were left in the field. At the same time, all spiders observed were classified into the following groups: (1) adult males, which could be easily distinguished by their coloration; (2) small juveniles, including all non-male spiders less than 4 mm in length; (3) solitary penultimate and adult females, comprising

all spiders exceeding 4 mm in length and without egg sacs; (4) females guarding their egg sacs. During each survey the numbers of spiders with and without prey were counted separately within each of these groups.

Results

In total, 503 specimens of *R. grammica* were observed, 44 of which (8.7%) had prey in their chelicerae. One female was consuming two prey items simultaneously. Thus the actual percentage of feeding events was slightly higher (8.9%). Among the spiders observed, 112 males (3 prey records ~2.7%), 44 small immatures (3 prey records ~6.8%), 314 penultimate and adult females (37 prey records ~11.8%), and 33 females with egg sacs (2 prey records ~6.1%) were recorded. The only statistically significant difference in percentage of feeding specimens was between males and solitary penultimate and adult females ($\chi^2=7.009$; df=1; $p<0.01$).

One *R. grammica* individual dropped its prey before it could be captured, so 44 prey items were collected for dietary analysis. These were distributed among four orders of arthropods (Table 1), including three from class Insecta: Diptera, Hymenoptera, Lepidoptera, and one from class Arachnida: Araneae. The dominant prey order was Diptera, which accounted for about two-thirds of the total prey (65.9%). All dipterans were flies (Brachycera); the most frequently caught were Bombyliidae (13 individuals), followed by Syrphidae (6), Phtiriidae (5), Stratiomyidae (2), Calliphoridae (1), Tachinidae (1) and Usiidae (1). The remaining insect prey included four moths (2 Pyraustidae, 1 Noctuidae, 1 unidentified), four parasitic wasps (3 Eucharytidae, 1 Braconidae) and one worker ant (*Plagiolepis* sp.). Among the spiders captured were three thomisids (two *Xysticus marmoratus* Thorell, 1875 and one *Thomisus onustus* Walckenaer, 1805), two salticids (*Pellenes geniculatus* (Simon, 1868) and *Heliophanus dunini* Rakov & Logunov, 1997) and one miturgid (*Cheiracanthium* sp.).

Prey	N	%
Insecta		
Diptera	[29]	[65.9]
Bombyliidae	13	29.5
Syrphidae	6	13.6
Phtiriidae	5	11.4
Stratiomyidae	2	4.5
Calliphoridae	1	2.3
Tachinidae	1	2.3
Usiidae	1	2.3
Hymenoptera	[5]	[11.4]
Eucharytidae	3	6.8
Braconidae	1	2.3
Formicidae		
Plagiolepis sp.	1	2.3
Lepidoptera	[4]	[9.1]
Pyraustidae	2	4.5
Noctuidae	1	2.3
Unidentified	1	2.3
Arachnida		
Araneae	[6]	[13.6]
Thomisidae		
Xysticus marmoratus	2	4.5
Thomisus onustus	1	2.3
Salticidae		
Heliophanus dunini	1	2.3
Pellenes geniculatus	1	2.3
Miturgidae		
Cheiracanthium sp.	1	2.3
Total	44	100.0

Table 1: Prey composition of *Runcinia grammica*.

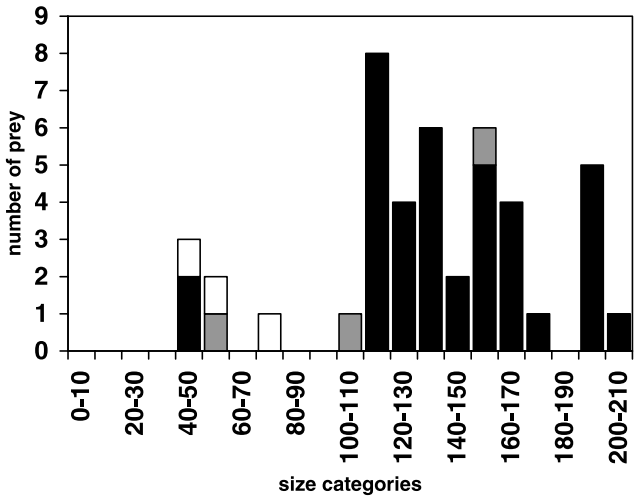

Fig. 1: Distribution of prey of different sex/age groups of *Runcinia grammica* (black=penultimate and adult females, grey=small immatures, white=adult males) in different size categories (body lengths of prey expressed as percentages of the body lengths of their captors).

Forty-four prey items were measured. Their length varied from 0.82 to 15.00 mm (mean ± SD: 7.96 ± 2.88 mm) and constituted from 40.2 to 202.7% (134.0 ± 42.0%) of the length of their captors, which ranged from 2.05 to 8.50 mm (5.90 ± 1.56 mm). The size distribution of the prey in relation to the sizes of their captors is shown in Fig. 1. Most of the prey exceeded the length of their captors (38, =86.4%), while small prey, not exceeding the length of the spiders, were represented by only six items (13.6%). The small prey consisted of five spiders and an ant. Among the spiders captured only one was larger than its captor. The other large prey included all the representatives of Diptera, Lepidoptera and parasitic Hymenoptera. It is worth noting that all the prey captured by males (exclusively spiders) did not exceed the length of their captors (Table 2). In contrast similar-sized small juveniles caught prey mostly larger than themselves (Table 2).

Discussion

The percentage of specimens of *R. grammica* found while feeding was comparable to those recorded in other crab spiders (Dean *et al*., 1987; Guseinov, 2006; Nyffeler & Benz, 1979; Romero & Vasconcellos-Neto, 2003). It is notable that males of *R. grammica* fed significantly less frequently than large immatures and females. Laboratory investigations on feeding of *Ebrechtella tricuspidata* (Fabricius, 1775) have also revealed that males feed less often than females (Hukusima &

Miyafuji, 1970). This fact is probably attributable to the specific life style of crab spider males (as well as most other spider males), which emphasises searching for mates (Sullivan & Morse, 2004). In contrast, penultimate and adult females, which need a high intake of food for growth and yolk production respectively, spend much of their time waiting for prey (Morse, 1981, 1995). Another group of *Runcinia* individuals that could have a reduced rate of prey capture are egg-guarding females. Since thomisids are pronounced ambushers, the choice of prey-rich foraging sites is an important trait of their foraging strategy (Morse & Fritz, 1982; Robakiewicz & Daigle, 2004). While guarding their eggs, crab spider females have no opportunity to change their locations, which might result in a reduced percentage of prey capture compared with solitary females. This suggestion was found to be true for a lithophilous crab spider, *Xysticus loeffleri* Roewer, 1955 (Guseinov, 2006). Although the percentage of egg-guarding females of *R. grammica* found with prey was about half that of pre-reproductive females, this difference is not statistically significant, owing to the small number of observations of egg-guarding females during the present study (only 33 events). Feeding by guarding females of *Runcinia* requires further investigation.

This investigation has shown that *R. grammica* is a polyphagic predator feeding on a wide range of arthropods. Insect groups captured by *Runcinia* (Diptera, Hymenoptera, Lepidoptera) are typical prey of flower-dwelling thomisids (Agnew & Smith, 1989; Hobby, 1931, 1940; Lovell, 1915; Morse, 1981, 1983; Schmalhofer, 2001; Turner, 1946). Likewise, the prevalence of dipterans is characteristic of the diets of many anthophilous crab spiders (Broekhuysen, 1948; Erickson & Morse, 1997; Morse, 1979; Nyffeler & Benz, 1979; Ricek, 1982). All the winged hymenopterans captured by *R. grammica* were parasitic wasps, but other flower-dwelling thomisids are known to feed frequently on stinging bees and wasps (Hobby, 1931, 1940; Lovell, 1915; Morse, 1981; Schmalhofer, 2001) and large sphecoid wasps were found among the prey of *Thomisus onustus* hunting on *Eryngium* (Huseynov, in prep.). Perhaps *Runcinia* is less prone to attack large stinging hymenopterans than *Misumena*, *Misumenoides* and *Thomisus*. While some crab spiders are highly specialised ant predators (Lubin, 1983; Mathew, 1954; Oliveira & Sazima, 1984, 1985), worker ants are usually missing in the diets of anthophilous thomisids (but see Romero & Vasconcellos-Neto, 2003) and laboratory experiments have shown that *Misumena vatia* (Clerck, 1757) avoids attacking ants (Nentwig, 1986). Only one ant was captured by *R. grammica* during the present study. In contrast, worker ants contributed a significant portion to the diet of coexisting *T. onustus* (Huseynov, in prep.). It should be noted, however, that only young immatures of *T. onustus* were found feeding on ants. Only a small proportion of the observed individuals of *R. grammica* were young instars and it was one of these that captured the ant. In the laboratory, small immatures of *Runcinia* also sometimes accepted ants (Huseynov, unpublished). Investigation of the diet of early instars of *R. grammica* is needed to clarify the question of myrmecophagy in this species. Bristowe (1941) stated that flower-dwelling thomisids (*Misumena*, *Thomisus*) are so apt to take winged insects that they avoid attacking crawling arthropods, including spiders. In contrast to this statement, *R. grammica* was observed feeding on spiders. Spiders have also been found among the prey of some other anthophilous thomisids, though not very frequently (Agnew & Smith, 1989; Broekhuysen, 1948; Dean *et al*., 1987; Romero & Vasconcellos-Neto, 2003). It is remarkable that two-thirds of the spider prey of *Runcinia* were captured by either males or small immatures. Perhaps small individuals of *R. grammica* rely to a greater extent on crawling prey than penultimate and adult females.

The experimental study of prey size preference in spiders has shown that while most cursorial spiders prefer prey not exceeding their own size, the crab spider *Xysticus cristatus* (Clerck, 1757) readily accepts insects twice its own size (Nentwig & Wissel, 1986). The observations for *R. grammica*, most prey of which exceeded the length of the spiders, agree with this finding. Moreover, these observations suggest that *Runcinia* prefers to catch large prey, because small prey were abundant on *Eryngium* and constituted the bulk of the diet of the jumping spider *Heliophanus dunini* inhabiting this plant (Huseynov, 2006). The ability of crab spiders to take very large prey has been emphasised by many researchers (Bristowe, 1941; Hobby, 1931, 1940; Lovell, 1915; Morse, 1981; Ricek, 1983) and the mean relative length of prey captured by flower-dwelling crab spiders in the field was found to be $171 \pm 68\%$ (Nentwig & Wissel 1986). One can conclude, therefore, that the prey-size spectrum of *R. grammica* is typical of anthophilous thomisids. However, the males of *R. grammica* are probably different, because all their prey were smaller than themselves. Unfortunately, more or less detailed data on the prey of crab spider males are lacking in the arachnological literature. Some authors have briefly noted that males of *Thomisus* and *Misumena* feed on small insects (Chien & Morse, 1998; Levy, 1970). In contrast, my observations of *T. onustus* indicate that males of this species are able to catch very large prey

Sex/age group	n	Length of spiders (mm)		Length of prey (mm)		Length of prey (%)	
		Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD
Males	3	2.05–3.62	3.01 ± 0.85	0.82–2.75	1.81 ± 0.96	40.2–75.9	57.0 ± 17.9
Small immatures	3	2.75–4.00	3.52 ± 0.67	1.62–6.00	4.00 ± 2.21	59.1–157.9	108.8 ± 49.4
Penultimate and adult females	38	4.12–8.50	6.32 ± 1.20	2.75–15.00	8.75 ± 2.09	45.1–202.7	142.1 ± 36.0
Total	44	2.05–8.50	5.90 ± 1.56	0.82–15.00	7.96 ± 2.88	40.2–202.7	134.0 ± 42.0

Table 2: Length of prey of different sex/age groups of *Runcinia grammica*.

(Huseynov, in prep.). At present, it is difficult to make any proper conclusion on this question, since the numbers of prey collected from males of both *Runcinia* and *Thomisus* are very small.

References

AGNEW, C. W. & SMITH, J. W. 1989: Ecology of spiders (Araneae) in a peanut agroecosystem. *Envir. Ent.* **18**: 30–42.

BRISTOWE, W. S. 1941: *The comity of spiders* **2**: 229–560. Ray Society, London.

BROEKHUYSEN, G. J. 1948: The behaviour and the life history of a Javanese spider, *Thomisus* sp. *J. ent. Soc. sth. Afr.* **10**: 135–164.

CASTANHO, L. M. & OLIVEIRA, P. S. 1997: Biology and behaviour of the neotropical ant-mimicking spider *Aphantochilus rogersi* (Araneae: Aphantochilidae): nesting, maternal care and ontogeny of ant-hunting techniques. *J. Zool., Lond.* **242**: 643–650.

CHIEN, S. A. & MORSE, D. H. 1998: The roles of prey and flower quality in the choice of hunting sites by adult male crab spiders *Misumena vatia* (Araneae, Thomisidae). *J. Arachnol.* **26**: 238–243.

DEAN, D. A., STERLING, W. L., NYFFELER, M. & BREENE, R. G. 1987: Foraging by selected spider predators on the cotton fleahopper and other prey. *SWest. Ent.* **12**: 263–270.

DIPPENAAR-SCHOEMAN, A. S. 1980: The crab-spiders of southern Africa (Araneae: Thomisidae). 1. The genus *Runcinia* Simon, 1875. *J. ent. Soc. sth. Afr.* **43**: 303–326.

ERICKSON, K. S. & MORSE, D. H. 1997: Predator size and the suitability of a common prey. *Oecologia* **109**: 608–614.

FOELIX, R. F. 1996: *Biology of spiders*. Harvard University Press, Cambridge, Massachusetts.

GUSEINOV, E. F. 2006: The prey of a lithophilous crab spider *Xysticus loeffleri* (Araneae, Thomisidae). *J. Arachnol.* **34**: 37–45.

HOBBY, B. M. 1931: Spiders and their insect prey. *Proc. ent. Soc. Lond.* **5**: 107–110.

HOBBY, B. M. 1940: Spiders and their prey. *Entomologist's mon. Mag.* **76**: 258–259.

HUKUSIMA, S. & MIYAFUJI, M. 1970: Life histories and habits of *Misumenops tricuspidatus* Fabricius (Araneae: Thomisidae). *A. Rep. Soc. Plant Prot. North Jap.* **21**: 5–12 [in Japanese, with English summary].

HUSEYNOV, E. F. 2006: Natural prey of the jumping spider *Heliophanus dunini* (Araneae: Salticidae) associated with *Eryngium* plants. *Bull. Br. arachnol. Soc.* **13**: 293–296.

LEVY, G. 1970: The life cycle of *Thomisus onustus* (Thomisidae: Araneae) and outlines for the classification of the life histories of spiders. *J. Zool., Lond.* **160**: 523–536.

LOVELL, J. H. 1915: Insects captured by the Thomisidae. *Can. Ent.* **47**: 115–116.

LUBIN, Y. D. 1983: An ant eating crab spider from the Galapagos. *Notic. Galapagos* **37**: 18–19.

MATHEW, A. P. 1954: Observations on the habits of two spider mimics of the red ant *Oecophylla smaragdina* (Fabr.). *J. Bombay nat. Hist. Soc.* **52**: 249–263.

MORSE, D. H. 1979: Prey capture by the crab spider *Misumena calycina* (Araneae: Thomisidae). *Oecologia* **39**: 309–319.

MORSE, D. H. 1981: Prey capture by the crab spider *Misumena vatia* (Clerck) (Thomisidae) on three common native flowers. *Am. Midl. Nat.* **105**: 358–367.

MORSE, D. H. 1983: Foraging patterns and time budgets of the crab spiders *Xysticus emertoni* Keyserling and *Misumena vatia* (Clerck) (Araneae: Thomisidae) on flowers. *J. Arachnol.* **11**: 87–94.

MORSE, D. H. 1995: Changes in biomass of penultimate-instar crab spiders *Misumena vatia* (Araneae, Thomisidae) hunting on flowers late in the summer. *J. Arachnol.* **23**: 85–90.

MORSE, D. H. & FRITZ, R. S. 1982: Experimental and observational studies of patch choice at different scales by the crab spider *Misumena vatia*. *Ecology* **63**: 172–182.

NENTWIG, W. 1986: Non-webbuilding spiders: prey specialists or generalists? *Oecologia* **69**: 571–576.

NENTWIG, W. & WISSEL, C. 1986: A comparison of prey lengths among spiders. *Oecologia* **68**: 595–600.

NYFFELER, M. & BENZ, G. 1979: Nischenüberlappung bezüglich der Raum-und Nahrungskomponenten bei Krabbenspinnen (Araneae: Thomisidae) und Wolfspinnen (Araneae: Lycosidae) in Mähwiesen. *Revue suisse Zool.* **86**: 855–865.

OLIVEIRA, P. S. & SAZIMA, I. 1984: The adaptive bases of ant-mimicry in a neotropical aphantochilid spider (Araneae: Aphantochilidae). *Biol. J. Linn. Soc.* **22**: 145–155.

OLIVEIRA, P. S. & SAZIMA, I. 1985: Ant-hunting behaviour in spiders with emphasis on *Strophius nigricans* (Thomisidae). *Bull. Br. arachnol. Soc.* **6**: 309–312.

PLATNICK, N. I. 2006: *The world spider catalog, version 7.0*. <http://research.amnh.org/entomology/spiders/catalog81-87/>

RICEK, E. W. 1982: Die Lauerposten der Krabbenspinne *Xysticus bifasciatus* C. L. Koch. *Linzer biol. Beitr.* **14**: 15–22.

ROBAKIEWICZ, P. & DAIGLE, W. 2004: Patch quality and foraging time in the crab spider *Misumenops asperatus* Hentz (Araneae: Thomisidae). *NEast. Nat.* **11**: 23–32.

ROMERO, Q. R. & VASCONCELLOS-NETO, J. 2003: Natural history of *Misumenops argenteus* (Thomisidae): seasonality and diet on *Trichogoniopsis adenantha* (Asteraceae). *J. Arachnol.* **31**: 297–304.

SCHMALHOFER, V. R. 2001: Tritrophic interactions in a pollination system: impacts of species composition and size of flower patches on the hunting success of a flower-dwelling spider. *Oecologia* **129**: 292–303.

SULLIVAN, H. L. & MORSE, D. H. 2004: The movement and activity patterns of similar-sized adult and juvenile crab spiders *Misumena vatia* (Araneae, Thomisidae). *J. Arachnol.* **32**: 276–283.

TARABAEV, C. K. 1979: Peculiarities of morphology and biology of a crab spider *Diaea dorsata* Fabr. (Aranei, Thomisidae) in the southeast of Kazakhstan. *Ent. Obozr.* **58**: 200–210 [in Russian].

TURNER, A. H. 1946. The prey of *Misumena calycina* (Arachn., Thomisidae). *Entomologist's Rec. J. Var.* **58**: 113–114.