Occurrence of Parasitoid Wasps, *Baeus* sp. and *Gelis* sp., in the Egg Sacs of the Wolf Spiders *Pardosa moesta* and *Pardosa sternalis* (Araneae, Lycosidae) in Southeastern Idaho

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Cobb, Lisa M., and Vincent A. Cobb. 2004. Occurrence of parasitoid wasps, *Baeus* sp. and *Gelis* sp., in the egg sacs of the wolf spiders, *Pardosa moesta* and *Pardosa sternalis* (Araneae, Lycosidae) in southeastern Idaho. Canadian Field-Naturalist 118(1): 122-123.

Egg sacs of the wolf spiders *Pardosa moesta* and *Pardosa sternalis* were sampled for two years during June to September in southeastern Idaho. Parasitoid wasps, *Baeus* sp. (Sceleonidae) and *Gelis* sp. (Ichneumonidae), were observed in the egg sacs of both *Pardosa* species. Of 322 egg sacs examined, 14.6% were parasitized. Parasitism of egg sacs occurred throughout most of the *Pardosa* egg sac-carrying season.

Key Words: Wolf Spider, *Pardosa moesta*, *P. sternalis*, egg sac, predation, parasitic wasps, *Baeus* sp., *Gelis* sp., parasitoid, reproduction.

Parasitic wasps are well known predators of spiders and may serve as either ectoparasites (e.g., externally feeding on the body) or endoparasites (e.g., feeding on eggs and developing young within egg sacs) (Foelix 1982). Larval endoparasites that consume spiders eggs are classified as parasitoids (Roberts and Janovy 2000) with the most speciose family of parasitoid wasps being the Ichneumonidae (Godfray 1994). To parasitize a spider egg sac, wasps insert their ovipositor into the wall of the egg sac and lay eggs which develop into larvae and predate the spider eggs (Austin 1985).

Female wolf spiders (Lycosidae) have the conspicuous behavior of carrying their egg sacs attached to their spinnerets. Although it would appear that such behavior could provide substantial maternal care, parasitism of egg sacs still occurs. The wasps *Baeus* (Scelionidae) and *Gelis* (Ichneumonidae) have been found in previous studies to be common parasitoids of Lycosidae egg sacs (Kaston 1948; Edgar 1971a; Austin 1985).

Wolf spiders in the genus *Pardosa* are common ground-dwelling spiders throughout much of the northern hemisphere (Edgar 1971b; Dondale and Redner 1990; Buddle et al. 2000). Their reproductive period may last several months (Edgar 1971b; Cobb 1992; Buddle 2000) and some species may produce multiple clutches during a single season (Edgar 1971b; Wolff 1981).

The main focus of this study was an investigation of the reproductive ecology of *P. moesta* (Banks) and *P. sternalis* (Thorell) in eastern Idaho. Cobb (1992) suggested that in southeastern Idaho both species have a tendency to produce multiple clutches within a season. During the study, *P. moesta* and *P. sternalis* females and their egg sacs were collected between one and five times per month from June through September of 1990 and 1991. All collections occurred in a two hectare meadow near the base of Scout Mountain (Caribou National Forest, Bannock County, Idaho) at an elevation of approximately 2000 m. During the late spring and early summer the meadow was marshy, fed by a mountain stream. However, in late summer and early fall the meadow was dry and had been grazed by cattle. For each spider and corresponding egg sac we collected a variety of morphometric data, which included female mass, clutch mass, and clutch size. While examining the egg sacs we discovered several of them were parasitized.

Identifiable parasitoids of *P. moesta* and *P. stenalis* egg sacs were wasps of the families Scelionidae and Ichneumonidae. P. M. Marsh, of the USDA Agricultural Research Station, Beltsville, Maryland, identified the scelionid specimens as *Baeus* sp., and the ichneumonids at *Gelis* sp. All but two of the identifiable parasitoids for both *Pardosa* species were *Baeus* sp. Two egg sacs of *P. sternalis* were found with a single *Gelis* sp. each. The *Gelis* were collected on 23 June and 22 July 1991. Pupal parasitoids inside the egg sacs could not be identified to species. Because not all individual parasitoids could be identified, other parasitoid genera may have been present in the egg sacs.

Of 134 egg sacs for *P. moesta* and 188 egg sacs for *P. sternalis*, 47 were infected with parasitoids (14.6% parasitism overall). Within these infected egg sacs 281 parasitoids were counted. Parasitism rate was 12.7% for *P. moesta* and 16% for *P. sternalis* (Table 1). Egg sacs were found parasitized from June to September for *P. moesta* and *P. sternalis*. During mid and late May 1990, a sample of egg sacs was collected from *P. sternalis* but none contained parasitoids. All of the *P. sternalis* egg sacs in the May collection contained eggs only and no spider instar stages, indicating egg

TABLE 1. Number of parasitized egg sacs for *Pardosa moesta* (n = 134) and *Pardosa sternalis* (n = 188) from southeastern Idaho. Data are represented as number of egg sacs with parasitoids (number of egg sacs sampled).

	P. moesta		*P. sternalis*	
Month	1990	1991	1990	1991
June	0 (23)	–	8 (37)	1 (8)
July	1 (40)	1 (9)	7 (45)	3 (30)
August	12 (25)	–	6 (15)	1 (21)
September	0 (27)	3 (10)	2 (17)	2 (15)

sac formation had begun only recently. The number of parasitoids per egg sac varied considerably. Mean (± SE) number of parasitoids per egg sac for *P. moesta* was $\bar{x}$ = 5.1 ± 1.4 (range = 2 - 15) in 1990 and $\bar{x}$ = 6.5 ± 2.3 (range = 1 - 12) in 1991. For *P. sternalis*, the number of parasitoids per egg sac was $\bar{x}$ = 5.7 ± 1.6 (range = 1 - 37) in 1990 and $\bar{x}$ = 8.4 ± 4.6 (range = 1 - 35) in 1991.

This study indicates that parasitism occurred throughout the egg carrying season and was highest in August 1990 and September 1991. Interestingly, these high parasitism rates correspond to times when *Pardosa* in this region are producing smaller egg clutches (Cobb 1992). Several species of *Pardosa* have their greatest reproductive output early in the reproductive season and produce smaller egg sacs and fewer eggs later in the season (Eason 1969). Potentially, these higher parasitism rates in the late summer could have resulted in selection for greater spring reproduction in *Pardosa*. Although parasitism has been documented for several species of *Pardosa* (Eason et al. 1967), recorded levels of parasitism are uncommon and variable. Eason (1969) indicated egg parasitism rates of less than one percent in *P. lapidicina* in Arkansas, while Edgar (1971a) observed levels that ranged from 3% to 35% in Scotland. Our data indicate variable and sometimes high levels of parasitism as well. Such high levels of parasitism have been shown to reduce the number of spiders in the field (van Baarlen et al. 1994) as well as the recruitment of young (Edgar 1971a). Although we have documented seasonal variation in parasitism rate, we do not know if these *Pardosa* populations are being negatively impacted by parasitoids.

Acknowledgments

We thank P. M. Marsh of the U.S. Department of Agriculture for identifying parasitoid wasps and J. Redner of the Canadian Department of Agriculture for the initial identification of spider specimens. Funding for this project was provided partly by a grant to L. Cobb from the Idaho State University Graduate Research Committee.

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Received 4 March 2002
Accepted 14 June 2004