Composition of spider prey captured by the wasp *Trypoxylon* (*Trypargilum*) *tridentatum tridentatum* in two habitats in an oasis in Baja California Sur, Mexico

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Abstract—*Trypoxylon* (*Trypargilum*) *tridentatum tridentatum* Packard (Hymenoptera: Crabronidae) is a spider-hunting wasp in mesic and xeric habitats in the arid Baja California peninsula of Mexico. Spider (Araneae) prey were collected every 2 weeks from wasp trap nests. Individuals of the family Araneidae were the most abundant prey (60.9%), followed by Theridiidae and Mimetidae. Dictynidae, Anyphaenidae, Salticidae, Uloboridae, Tetragnathidae, Miturgidae, and Philodromidae were captured only in the mesic habitat. An unidentified species of *Eriophora* Simon (Araneidae) was the most frequently collected spider in the xeric habitat (29.0%), followed by *Theridion submissum* Gertsch and Davis (Theridiidae) (24.0%), which was the commonest prey species in the mesic habitat (21.1%), and *Metepeira crassipes* Chamberlin and Ivie (Araneidae) (16.5%). Nineteen species and three families are newly recorded as prey. The araneids *Araneus lineatipes* (O.P.-Cambridge) and *Kaira alba* (Hentz) and the uloborids *Philoponella arizonica* (Gertsch) and *Uloborus segregatus* Gertsch are new records for Baja California.

Résumé—*Trypoxylon (Trypargilum) tridentatum tridentatum* Packard (Hymenoptera: Crabronidae) est une guêpe chasseresse d'araignées dans la péninsule aride de la Basse-Californie au Mexique. Nous avons récolté des araignées (Araneae) capturées comme proies dans les nids-pièges des guêpes à toutes les deux semaines. Les proies les plus abondantes consistent en des spécimens de la famille Araneidae (60,9 %), suivie des familles Theridiidae et Mimetidae. Les spécimens de Dictynidae, d'Anyphaenidae, de Salticidae, d'Uloboridae, de Tetragnathidae, de Miturgidae et de Philodromidae n'ont été capturés que dans l'habitat mésique. Une espèce non identifiée de *Eriophora* Simon (Araneidae) est l'araignée la plus fréquemment récoltée dans l'habitat xérique (29,0 %), suivi de *Theridion submissum* Gertsch et Davis (Theridiidae) (24,0 %), qui est l'espèce la plus commune de proie dans l'habitat mésique (21,1 %) et de *Metepeira crassipes* Chamberlin et Ivie (Araneidae) (16,5 %). Dix-neuf espèces et 3 familles sont signalées pour la première fois comme proies. Les aranéidés *Araneus lineatipes* (O.P.-Cambridge) et *Kaira alba* (Hentz) et les uloboridés *Philoponella arizonica* (Gertsch) et *Uloborus segregatus* Gertsch sont signalés pour la première fois en Basse-Californie.

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Although spiders are major predators of insects, some Diptera and Hymenoptera use spiders as food, using several predation strategies (Jiménez 1987). Wasps are important predators of many spider species, especially if they forage in a density-dependent manner (Wise 1993).

Depending on their foraging mode, spiders can be separated into web-building and hunting groups and subdivided into eight guilds. Among the hunting spiders are foliage runners, ground runners, stalkers, and ambushers; web-building spiders are divided into sheet-web builders, wandering sheet/tangle web weavers, orb-web weavers, and three-dimensional-web builders (Uetz *et al.* 1999). Webs also serve as a means of defense against predation, including cannibalism (Wise 2006) and predation by mud-dauber solitary wasps (Hymenoptera: Crabronidae) that specialize on

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spiders. Three-dimensional webs provide greater protection to spiders. Blackledge *et al.* (2003) found that apoid wasps such as mud-daubers captured more orb-web weavers (two-dimensional webs) than araneoid sheet-web weavers (three-dimensional webs), suggesting that construction of three-dimensional webs (and further diversification of these spiders) is favoured.

One important characteristic of apoid wasps is the variety of species captured by the females. These wasps collect prey from places often overlooked by people; thus, wasp nests can provide entomologists with a great assortment of spiders, including rare species. This is important from biological, ecological, and taxonomic perspectives (Genaro *et al.* 1989).

The mud-dauber *Trypoxylon tridentatum tridentatum* Packard nests in preexisting cavities and readily nests in artificial trap-nests. Females construct nests and provision them with paralyzed spiders. Nests consist of a linear series of cells that are subdivided by mud partitions and usually preceded by an empty vestibular cell and an entrance plug made of mud (Coville and Coville 1980; Coville 1982). In this study we determined the species composition of the spider prey of *T. t. tridentatum* in a xeric habitat and a mesic habitat associated with an oasis in the State of Baja California Sur, Mexico.

A survey of wasp trap nests was conducted at the La Presa Buena Mujer oasis (24°05′02″N, 110°11′26″W). Wasps were sampled along six 100 m linear transects, three set perpendicular to the stream in the mesic vegetation and three in the xeric vegetation. Transects of both types were set 600 m from each other. Ten sets of trap-nests were placed at 10 m intervals along each transect, suspended from branches of trees about 1.5 m above the ground. Trap-nests consisted of 4.0 cm × 9.1 cm × 17.4 cm blocks of wood with four 6 mm diameter holes drilled 15.2 cm into each block (Jiménez and Tejas 1994). A soda straw (6 mm diameter) was placed in each hole. Trap-nests were inspected every 2 weeks from April through October 2004 and nests that had been provisioned were collected and transported to the laboratory. Soda straws were replaced with new ones.

At the laboratory, nest contents were examined. Cell contents were preserved in 70% alcohol in preparation for identifying spider species. All spiders were identified to species level under a Zeiss dissecting stereomicroscope. Voucher specimens of the spiders and wasps are deposited in the Arachnid and Insect Collection at the Centro de Investigaciones Biológicas del Noroeste, La Paz, Baja California Sur, Mexico.

Trypoxylon tridentatum tridentatum provisioned their nests with spiders belonging to 10 families. Spiders of the family Araneidae were the most frequent prey in both the xeric and mesic habitats, comprising 42.3% of genera, 45.4% of species, and 60.9% of individuals. Only Theridiidae and Mimetidae were found in both habitats. Dictynidae, Anyphaenidae, Salticidae, Uloboridae, Tetragnathidae, Miturgidae, and Philodromidae were found only in the mesic zone (Table 1). An araneid species of the genus *Eriophora* Simon was the most abundant species in the xeric zone (29.0%), followed by the theridiid *Theridion submissum* (Gertsch and Davis) (24.0%). In the mesic zone, the commonest prey was *T. submissum* (21.1%), followed by the araneid *Metepeira crassipes* Chamberlin and Ivie (16.5%). Of 33 spider species identified, 16 were found in both habitats, 3 were exclusive to the xeric zone, and 14 were exclusive to the mesic zone (Table 1).

Captured spiders yielded new records of families and species as prey for *T. t. tridentatum* (Table 1).

Prey captured by the wasps in both habitats were mainly Araneidae (60.9%). Jiménez and Tejas (1994) obtained similar results (63.3%) for *T. t. tridentatum* in the Cape Region in the southeastern part of the State, while Coville (1986) found that araneids represented 59%–83% of the prey in wasp nests in Arizona and California. In Oregon, O'Brien (1982) found four trap-nests containing *Metepeira grandiosa* Chamberlin and Ivie as the exclusive prey of *T. t. tridentatum*; in our study, *Eriophora* sp. was the most commonly captured species. In studies of solitary wasps in Missouri (Rau 1934) and Wisconsin (Medler 1967), only one nest of this wasp species was found in each State; the prey species were not recorded. In studies of the spider prey of wasp species in the *nitidum* group of the *Trypoxylon* subgenus *Trypargilum* (Coville 1979, 1981; Coville and Coville 1980; Camillo *et al.* 1993; Camillo and Brescovit 1999; Coville *et al.* 2000; Culin and Robertson 2003), araneids were preferred, followed by theridiids. These studies demonstrate that *T. t. tridentatum* overwhelmingly prefer web-weaving araneoid spiders. In our study, small numbers of mimetid wandering spiders were captured by wasps in both zones. These spiders, which are themselves predators of other spiders, might have been captured from

Table 1. Abundance of spider prey of *Trypoxylon tridentatum tridentatum* at the Presa Buena Mujer oasis, Baja California Sur, Mexico.

		Xeric habitat				Mesic habitat			
Family	Species	♀	♂	J	Total	♀	♂	J	Total
Araneidae	*Acacesia* Simon (unidentified species)			2	2				
	Araneus pegnia (Walckenaer)		1	2	3	4	4	14	22
	Araneus detrimentosus (O. P.- Cambridge)		1	26	27	2	9	25	36
	Araneus lineatipes (O. P.- Cambridge)*†	1	2		3				
	Argiope argentata (Fabricius)			1	1		1	4	5
	Cyclosa turbinata (Walckenaer)			1	1	4		4	8
	Eriophora Simon (unidentified species)			117	117			100	100
	Eustala brevispina Gertsch and Davis*					1		5	6
	Eustala californiensis (Keyserling)			3	3	4	2	30	36
	Eustala rosae Chamberlin and Ivie*			6	6	1		12	13
	Kaira alba (Hentz)*†			2	2				
	Larinia directa (Hentz)			9	9	4	2	44	50
	Mangora O.P. - Cambridge (unidentified species) *							5	5
	Metepeira crassipes Chamberlin and Ivie	2	1	18	21	10	10	119	139
	Neoscona Simon (unidentified species)*			47	47			98	98
Anyphaenidae*	*Hibana incursa* (Chamberlin)*					2		15	17
Dictynidae	*Dictyna* Sundevall (unidentified species)*					2		1	3
	Mallos pallidus (Banks)*					15	6	5	26
Mimetidae	*Mimetus* Hentz (unidentified species)*	1	3	8	12		1	7	8
	Mimetus hesperus Chamberlin*	1	1	31	33	6		28	34
Miturgidae*	*Cheiracanthium* C.L. Koch (unidentified species)*							8	8
Philodromidae*	*Philodromus* Walckenaer (unidentified species)*							4	4
Salticidae	*Dendryphantes* C.L. Koch (unidentified species)*					1		1	2
	Dendryphantes melanomerus Chamberlin*					2		1	3
	Thiodina hespera Richman and Vetter					1		1	2
Tetragnathidae	*Leucauge argyra* (Walckenaer)*					1		7	8
	Tetragnatha Latreille (unidentified species)*							12	12
Theridiidae	*Euryopis californica* Banks	6	1		7	1	1	3	5
	Latrodectus Walckenaer (unidentified species)*		1	8	9			2	2
	Theridion positivum Chamberlin	2	1	1	4	5	3	2	10
	Theridion submissum Gertsch and Davis	28	2	67	97	75	26	77	178

Table 1 (*concluded*).

Family	Species	Xeric habitat				Mesic habitat			
		♀	♂	J	Total	♀	♂	J	Total
Uloboridae	*Philoponella arizonica* (Gertsch)†					2			2
	Uloborus segregatus Gertsch*†					1			1
Total		41	14	349	404	144	65	634	843

Note: ♀, adult females; ♂, adult males; J, juveniles.
*New record of family and (or) species of *T. t. tridentatum* prey in peninsular Baja California.
†New record of spider species in peninsular Baja California.

the webs of other spiders (Jiménez and Tejas 1994). Krombein (1967) found araneid, theridiid, and mimetid spiders in the nests of *T. tridentatum*; 98%–100% of these were araneids and theridiids.

The remaining families, Anyphaenidae, Dictynidae, Miturgidae, Philodromidae, Salticidae, Tetragnathidae, and Uloboridae, were found only in nests in the mesic habitat, which suggests a greater diversity of prey in this zone. A lower temperature, a higher moisture level, and more abundant vegetation probably provide a greater variety of microhabitats to support spider species. In the mesic zone, tetragnathid spiders were gathered only near bodies of water. Correa (2004) found that spiders in this family were located only on vegetation close to water.

An additional advantage of our survey method is that the trap-nests yielded spider families and species not found by other investigators (O'Brien 1982; Coville 1986; Jiménez and Tejas 1994). The new findings (Table 1) include 19 species and three families. This approach to field surveys demonstrated that the spider fauna in oases of Baja California Sur is more diverse than previously described and that wasps can be important predators of spiders in these restricted environments.

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