

A NOTE ON *TRYPARGILUM ARIZONENSE*
IN TRAP NESTS FROM ARIZONA, WITH A
REVIEW OF PREY PREFERENCES AND
COCOON STRUCTURE IN THE
GENUS (HYMENOPTERA, SPHECIDAE)*

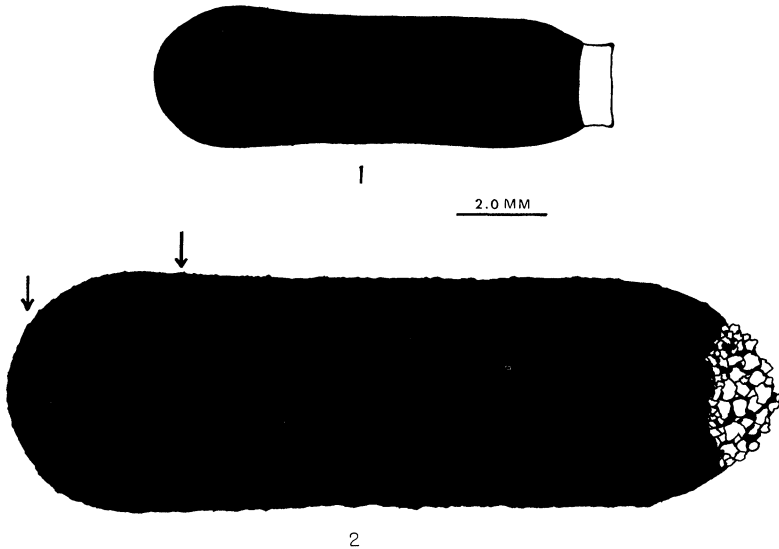
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In early July, 1965, trap nests were placed out in two open areas in Tucson, Pima Co., Arizona. At the USDA Experiment Station farm, 8 blocks of 6 nests each were situated upon the north- and south-facing weathered windowsills of an abandoned storage shed, surrounded by low weeds and sheep pasture. About one mile away, an equal number of nests were placed at various points upon an exposed brick wall along a graveled, sparsely weedy parking lot in a residential area. All nests in both areas were placed from 5 to 8 feet above the ground. Three bore diameters and lengths were available in about equal numbers: $\frac{1}{4}$ inch diameter bores, 77 mm long; $\frac{3}{16}$ inch, 124 mm long; and $\frac{1}{8}$ inch, 110 mm long.

Of 56 completed nests collected by late August, 29 proved to be *Trypargilum arizonense* Fox, a species widely distributed in the western United States. Nothing has been previously reported on its biology except a questionable record (under the name *rufozonalis*) claiming it to be dug from nests in a clay bank in Nebraska (Smith, 1908). This paper presents information on life history, nest architecture and prey preferences of *T. arizonense* and attempts to relate certain data to those recorded for other species of *Trypargilum*.

Life History. The egg of *Trypargilum arizonense* is laid on the venter of the abdomen of the last (outermost) spider placed in the cell. No information was obtained on developmental stages, but the larva has been described by Evans (1957). As is true for most other *Trypargilum* species, the cocoon is dark brown, heavily varnished and brittle, and enclosed in a delicate silken matrix. The cocoon shape is, however, quite clearly diagnostic (Fig. 1). At the anterior end, as in *T. clavatum* (see Krombein, 1967), the cocoon is truncate and bears a pale collar projecting about 0.5 mm outward; however, it differs from *clavatum* in lacking an anterior nipple. The collar has a grainy appearance as though particles from the cell partition had been incorporated into it, and the area inside the collar appears incompletely varnished or semi-translucent. At the rounded

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Figures 1 and 2. Diagrams of *Trypargilum* cocoons with the silken matrix removed; both drawn to the same scale. Anterior ends are at the right. Fig. 1. *T. arizonense*. Fig. 2. *T. politum*, arrows indicate the portion encircled by the pebble girdle.

posterior end, the cocoon bulges very slightly, especially where the meconium has been deposited. A series of 11 cocoons from $\frac{1}{4}$ inch diameter bores averaged 10.8 mm long (range, 9.5-12.0 mm); 12 cocoons from $\frac{3}{16}$ inch diameter bores averaged 11.1 mm (range, 10.0-12.5 mm). No correlations of cocoon length or cell position and adult sex were made. Twenty-four females and 16 males were reared from the nests. An unidentified chrysidid which escaped from one nest was the only parasite found.

Emergences of adult *T. arizonense* during August and September 1965 suggested more than one generation per year; furthermore, because trap nests were not placed out until July, it seems likely that the nesting wasps were themselves second-generation individuals. Therefore, it seems likely that *T. arizonense* in Tucson probably has at least two, perhaps three or more, generations per year.

One other species of *Trypargilum*, *T. t. tridentatum* Packard, also used the trap nests and may possibly have competed for the intermediate ($\frac{3}{16}$ ") bores; however, only 3 *tridentatum* nests were obtained, 2 in $\frac{3}{16}$ " and 1 in a $\frac{1}{8}$ " bore. No prey records for

tridentatum were obtained in our study, but Krombein (1967) gives extensive documentation of prey and nest architecture for this species from four localities in Arizona. Two of our *tridentatum* nests were parasitized by unidentified chrysidid wasps.

Nest Architecture. Table 1 summarizes various features of the nest architecture for the 29 completed nests obtained. As is the case for most twig nesting wasps and bees, a typical nest consists of a linear series of provisioned cells separated by partitions, an empty vestibular cell, and an outer plug. The partitions and plug were of mud; partitions were uniformly about 1 mm thick, but the nest plug was of variable depth (see Table 1) and usually not quite flush with the nest entrance. Nearly all nests were begun with a scant mud spot at the bottom of the bore; 4 nests also had an empty space preceding the first provisioned cell. No intercalary cells were found.

Length of the provisioned cells was quite variable, probably at least in part due to differences in size and packing of prey. The last provisioned cell, in particular, was commonly much longer than the others; omitting this cell leads to an "amended" cell length (Table 1) which is less variable and smaller, a more accurate indication of the usual cell size.

Table 1. Comparison of *Trypargilum arizonense* nest architecture in two bore sizes, Tucson, Arizona, July-August 1965. Measurements are averages in millimeters; ranges are given in parentheses.

	$\frac{1}{4}$ " bore, 77 mm long	$\frac{3}{16}$ " bore, 124 mm long
no. of completed nests	19	10
no. of completed cells	51	34
nest plug thickness	2.9 (1 - 5)	2.6 (1 - 4)
nest plug recession	1.3 (0 - 4)	1.0 (0 - 3)
vestibular cell length	25.3 (11 - 55)	32.5 (13 - 50)
provisioned cells per nest	2.7 (1 - 4)	3.4 (2 - 5)
provisioned cell length	15.9 (10 - 52)	22.2 (13 - 57)
"amended" cell length	13.1 (10 - 19)	18.4 (13 - 25)

Prey. Table 2 lists the spiders taken as prey by *T. arizonense*; interestingly, a majority (70%) were immature. There were 8 to 19 spiders per cell (mean 11.8) in 16 fully provisioned cells; differences in spider size probably account for most of this variation, and

it seems likely that at some seasons a greater proportion of mature spiders may be taken. Like other species of *Trypargilum* (see below), *T. arizonense* is not specific in its prey choice. Represented in our sample were at least 13 genera representing 6 families, and in one cell 7 species from 3 families were found. However, a decided preference was shown for vagabond or wandering spiders (especially Thomisidae), with only a few snare-building species taken. This suggests that *T. arizonense* hunts for spiders crawling on grass, flowers and foliage, also encountering there a certain number of snare-builders involved in activities away from the web.

Table 2. The prey of *T. arizonense*: 212 spiders from 17 cells of 13 nests, Tucson, Arizona, July-August 1965. Determinations by Dr. H. W. Levi; specimens deposited in the Museum of Comparative Zoology, Harvard University.

Salticidae (23)	Oxyopidae (6)
<i>Agassa</i> — 2	<i>Oxyopes tridens</i> Brady — 3
<i>Habronattus</i> — 5	<i>Oxyopes</i> sp. — 3 (juv.)
<i>Metaphidippus</i> — 7	Clubionidae (1)
<i>Phidippus</i> — 2	undet. juvenile — 1
<i>Synemosyna</i> — 1	Dictynidae (1)
undet. juveniles — 6	<i>Dictyna</i> — 1
Thomisidae (177)	Araneidae (4)
<i>Ebo</i> — 1	undet. juveniles — 4
<i>Misumenops</i> — 97 (incl. 61 juv.)	
<i>Philodromus</i> — 2 (juv.)	
undet. juveniles — 77	

Prey Preferences in the Genus Trypargilum. The marked and differing prey choices exhibited by members of this genus (see Krombein, 1967) and the reasonably adequate quantitative data on prey in past literature (records exist for 10 of the 12 Nearctic species and subspecies) make possible an attempt at consolidation of prey preference data in tabular form in hopes of revealing such trends as might occur in the genus. The results of this survey are presented in Table 3. The *Trypargilum* species are arranged in groups according to the classification of Richards (1934) and Sandhouse (1940), a system based on adult morphology. (It is worth noting that larval morphology, while incompletely known, appears to follow the same subdivisions (Evans, 1957, 1959).) For ease of comparison of prey records, the family level was chosen; identifications of lower spider taxa, especially in the older literature, are less reliable, and the taxonomy (and biology) of many genera remains unstudied.

Table 3. Spiders used by North American *Trypargilum* species. Figures given are percentages of total records for each species; X, no quantitative data; Oc, occasional (less than 1%).

		No. of localities	No. of records	Araneidae	Theridiidae	Linyphiidae	Dicynidae	Tetragnathidae	Mimetidae	Thomisidae	Salticidae	Oxyopidae	Anypheidae	Clubionidae	Lycosidae	Pisauridae	Lyssomanidae	Gnaphosidae	Sources*
NITIDUM GROUP																			
	<i>tridentatum</i>																		
	<i>tridentatum</i>	2	535	69	29		1		1										5
	<i>tridentatum</i>																		
	<i>archboldi</i>	1	160	82	17				1										5
	<i>collinum</i>																		
	<i>collinum</i>	1	83	93	7														5
	<i>collinum</i>																		
	<i>rubrocinctum</i>	6	493	71	27	Oc		2											3, 5, 8, 10, 11
POLITUM GROUP																			
	<i>politum</i>	2	486	97	3														9, 12, 13
PUNCTULATUM GROUP																			
	<i>striatum</i>	6	768	94	Oc				Oc	3	Oc		2	Oc		Oc			4, 5, 6, 8, 10, 11, 12
SPINOSUM GROUP																			
	<i>clavatum</i>	5	1108	15	Oc	Oc	Oc			18	59	2	4	1	Oc	Oc			5, 9, 12
	<i>texense</i>	4	101	20			16			4	27	24		9					1, 2, 7
	<i>johannis</i>	2	152	23			4		1	16	24	4		1			28	X	5
	<i>arizonense</i>	1	212	2			Oc			84	11	3		Oc					new record unknown
	<i>californicum</i>																		unknown
	<i>spinosum</i>																		unknown

*Key to Sources: 1, Hartman, 1905; 2, Hungerford and Williams, 1912; 3, Krombein, 1954; 4, Krombein, 1956; 5, Krombein, 1967; 6, Krombein and Evans, 1954; 7, Kurczewski, 1963; 8, Medler, 1967; 9, Muma and Jeffers, 1945; 10, Peckham and Peckham, 1895; 11, Peckham and Peckham, 1898; 12, Rau, 1928; 13, Rau, 1944.

Examination of Table 3 shows clear differences in prey preference among the members of the genus *Trypargilum*; these appear to parallel the morphological species groupings. Three groups, Nitidum, Politum and Punctulatum, show decided preferences for snare-building spiders (Araneidae, Theridiidae, Tetragnathidae, Linyphiidae, Dictynidae) while members of the Spinosum group take predominantly wandering or vagabond spiders (Salticidae, Thomisidae, Oxyopidae, Lycosidae, Anyphaenidae, etc.). Furthermore, members of the first three groups do not appear to take prey across as wide a spectrum as do members of the Spinosum group (2-4 families as opposed to 6-11 families). One family, the Araneidae, is preyed on in varying percentages by every *Trypargilum* species for which data are available. Strikingly, *T. politum* appears restricted almost entirely to two genera in this family, *Neoscona* and *Eustala* (Muma and Jeffers, 1945), suggesting quite specialized hunting behavior. Within the Spinosum group, *T. clavatum* exhibits a decided preference for Salticidae and *T. arizonense* for Thomisidae, while *T. texense* and *T. johannis* take approximately equal numbers of Salticidae, Oxyopidae and Araneidae. Predicting from the table, we would expect *T. californicum* and *T. spinosum* to also prefer spiders of the vagabond or wandering type.

Cocoon Structure in Trypargilum. Cocoon structure insofar as known also agrees with the groupings of Richards (1934) and Sandhouse (1940). Krombein (1967) has obtained data for all the North American representatives of the Nitidum and Punctulatum groups and for two species in the Spinosum group. Data on *T. politum* and *T. arizonense* are presented here.

The Spinosum group, to which *T. arizonense* belongs, is characterized by cocoons with a truncate anterior end and a distinct pale collar; *T. johannis* and *T. clavatum* cocoons have, in addition, a weak nipple development which is absent in *T. arizonense*. While there are at least four references to nests of *T. texense* in the literature, no description of the cocoon is available; based on the trend shown by the known species' cocoons, we would predict this species (as well as *T. californicum* and *T. spinosum*) to have cocoons with the anterior end truncate and collared.

Cocoons of species belonging to the Nitidum group have the anterior end either rounded (*T. tridentatum tridentatum*, *T. t. archboldi*) or truncate with a prominent nipple (*T. collinum collinum*, *T. c. rubrocinctum*). There is no trace of anterior collar development as is characteristic of the Spinosum group, although nipple development occurs in representatives of both groups.

The unique cocoon of *T. striatum*, with its strongly flared anterior end, would appear to justify the placement of this species in the Punctulatum group by itself. Interestingly, the distinctive shape of this cocoon has caused at least three different authors to describe it (Krombein, 1956, 1967; Balduf, 1961; Medler, 1967). By contrast, the cocoon of the common pipe organ wasp, *T. politum*, has to our knowledge never previously been described in detail, despite an extensive literature on that species. (Also, surprisingly, only one extensive prey analysis has been made for *T. politum*; see Table 3.)

Trypargilum politum cocoons (Fig. 2) are the largest in the genus, almost twice the size of those of *T. arizonense*. As in other species of the genus, the cocoon is enveloped in a delicate silken matrix; however, incorporated into the matrix is a 2-4 mm wide girdle of sand grains encircling the posterior end of the cocoon. This girdle is easily brushed off when the cocoon is handled. The anterior end is rounded as in *T. tridentatum tridentatum*, but rather than being smooth, bears a conspicuous crown of larger, unincorporated, unvarnished sand pebbles (see Fig. 2). Also, the crown is distinctly lighter in color, appearing tan whereas the remainder of the cocoon is dark reddish brown. The surface of the cocoon walls has the texture and appearance of varnished coarse sandpaper, due to numerous sand grains incorporated into it; in this respect as well as in the presence of a pebble crown and girdle, the cocoons of *T. politum* differ from those of all other known *Trypargilum* species. The source of the cocoons was a 12-celled *T. politum* nest in the Museum of Comparative Zoology collection. Nine cocoons containing dead fully formed females averaged 19.0 mm (18.0-20.0 mm) and two cocoons containing males averaged 17.5 mm (17.0-18.0 mm); one cell had fragmented dried spiders.

Conclusion. In summary, prey preferences, cocoon structure, larval and adult morphology are in general agreement in indicating at least four phyletic lines within the genus *Trypargilum*. The analysis of biological characters might profitably be extended to include other ethological, architectural and morphological characters; unfortunately, the fragmentary, often isolated observations in the present literature are insufficient for such an analysis at this time. However, the ready availability of most *Trypargilum* species through the trap nest technique makes them a particularly suitable subject for such an evolutionary study.

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