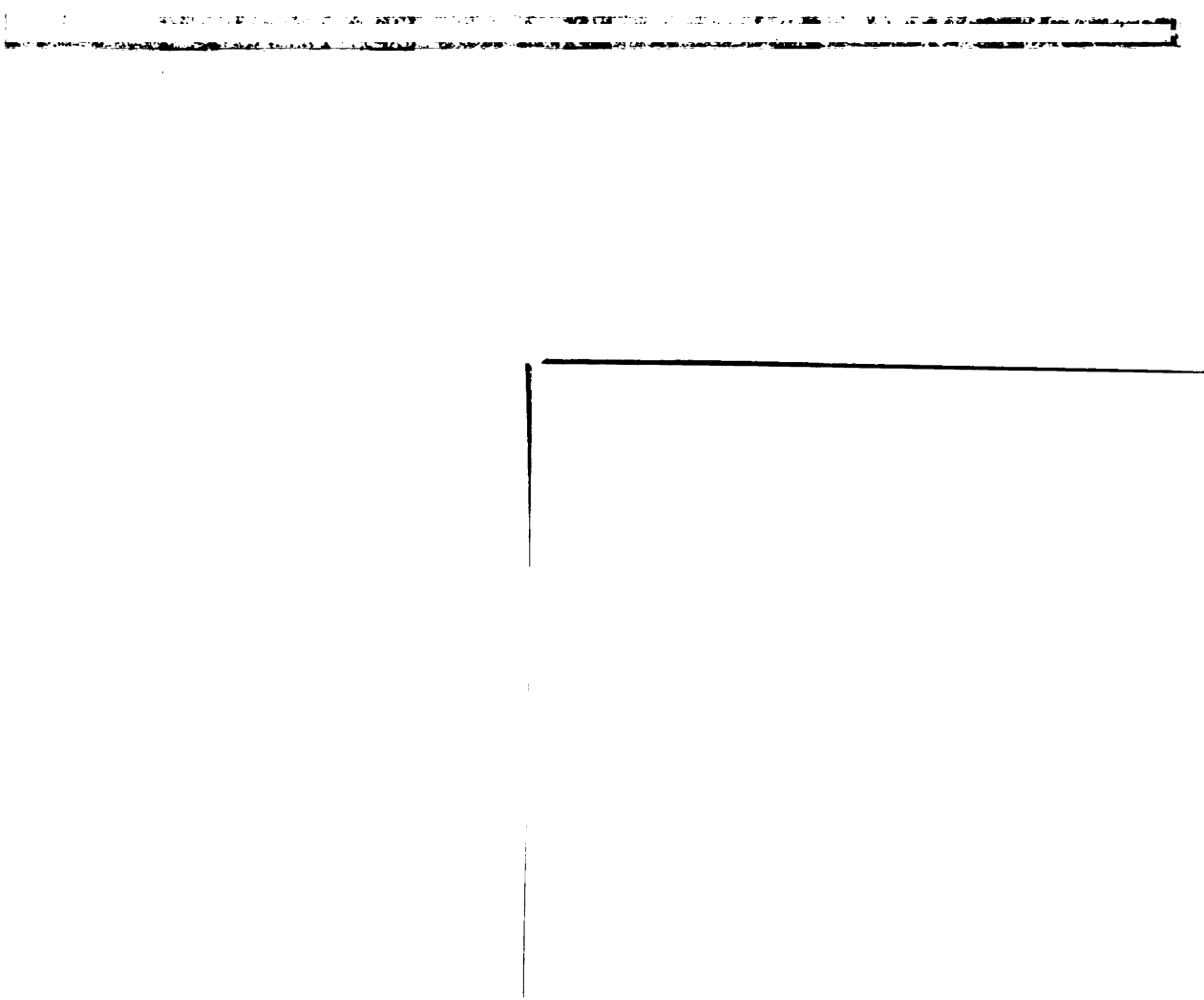
130
823
THS

SEASONAL PREY OF TRYPOXYLON BACKI SANDHOUSE (HYMENOPTERA : SPHECIDAE)

Thesis for the Degree of M. S.
MICHIGAN STATE UNIVERSITY
BRUCE JOHN WILDIE
1971

LIBRARY
Michigan State
University



SEASONAL PREY OF TRYPOXYLON BACKI SANDHOUSE

(HYMENOPTERA : SPHECIDAE)

By

Bruce John Wildie

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE

Department of Entomology

1971

ACKNOWLEDGMENTS

I am greatly indebted to my major academic advisor, Dr. Roland Fischer, for his guidance and patience rendered during the course of this study.

I wish to extend my thanks to Dr. Gordon Guyer, Dr. Richard Sauer, and Dr. T. Wayne Porter for serving on my guidance committee.

I wish to extend my appreciation to Dr. Richard Sauer and Norman Platnick for their assistance in the determination of spiders for this study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE AND GRAPH

INTRODUCTION

Trypoxylon is a genus of slender, black, solitary wasps of worldwide distribution. Currently there are 16 recognized nearctic species. All utilize a preformed cavity (i.e., beetle burrows, hollow twigs, straw, or other cavities of suitable diameter) in which they build their linear nests. Spiders are used as provisions for their nests.

Two noteworthy studies exist on the prey relationships of the closely related Trypargilum clavatum (Say). Rau (1928) records 93 spiders distributed among 17 genera from four nests. He concludes that the female wasp is quite adaptable in her prey selection and that she hunted primarily in vegetation. Muma and Jeffers (1945) record 311 spiders representing seven families for the same wasp. They conclude that the collecting environs and prey size are the major limiting factors affecting the provisioning habits of the wasp. Visitation by the wasp to flowers accounted for large numbers of Salticidae and Thomisidae.

Generally, wasps of the Genus Trypoxylon are considerably smaller in size than the members of Trypargilum. Thus, prey selection must also be different because a Trypoxylon is simply too small to transport many of the larger spiders utilized by Trypargilum.

Krombein (1958) recorded the linyphiid spider, Tennesselum formicum (Emerton), from a T. backi nest in Virginia. In 1967 he found several nests of the same wasp in Maryland containing 5-7 spiders of the same species of Erigonidae. Except for these isolated instances nothing is known concerning the prey relations of this species of Trypoxylon.

A rather unique situation, in which large numbers of nests of T. backi were available for study, has allowed me to study the prey of this species. My objectives were to determine: 1) the groups of spiders utilized; 2) their seasonal variation, if any; and 3) the factors which might impinge upon the type of spider preyed upon.

METHODS AND TECHNIQUES

The study was carried out on the premises of Gull Lake Kellogg Biological Station of Michigan State University in Kalamazoo County, Michigan. Trypoxylon backi nests in large numbers in the hollow reeds forming the windmill roof on the grounds of the Station (Figure 1). The habitat surrounding the windmill can best be described as a "park type" habitat. The windmill is situated on the shore of Gull Lake on a small island approximately 50 yards long and 20 yards wide. The island is bordered on one side by Gull Lake and on the other three sides by a narrow "lagoon". A picket fence separates the windmill from the remainder of the island with low bushes and vines growing along the edge of the water. The grass in the area is kept cut for the most part but usually is not trimmed along the lake and lagoon.

Throughout the summer 89 nests were collected from the windmill. These nests contained 189 cells provisioned with 5047 spiders. The nests were marked while the wasp was in the act of provisioning, and when completed they were taken into the laboratory. The nests were then opened and the spiders were counted and preserved in alcohol. The spiders were kept separate according to nest, cell and the date each nest was completed.

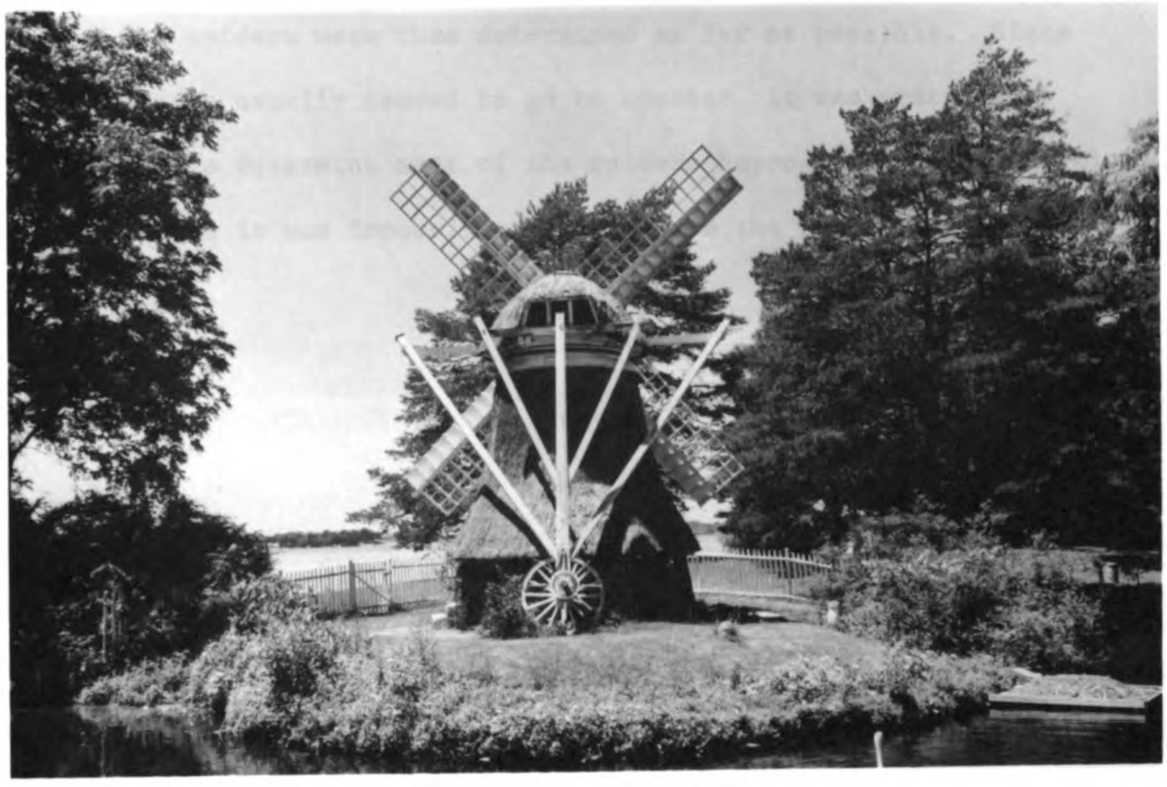


Figure 1.--The study area

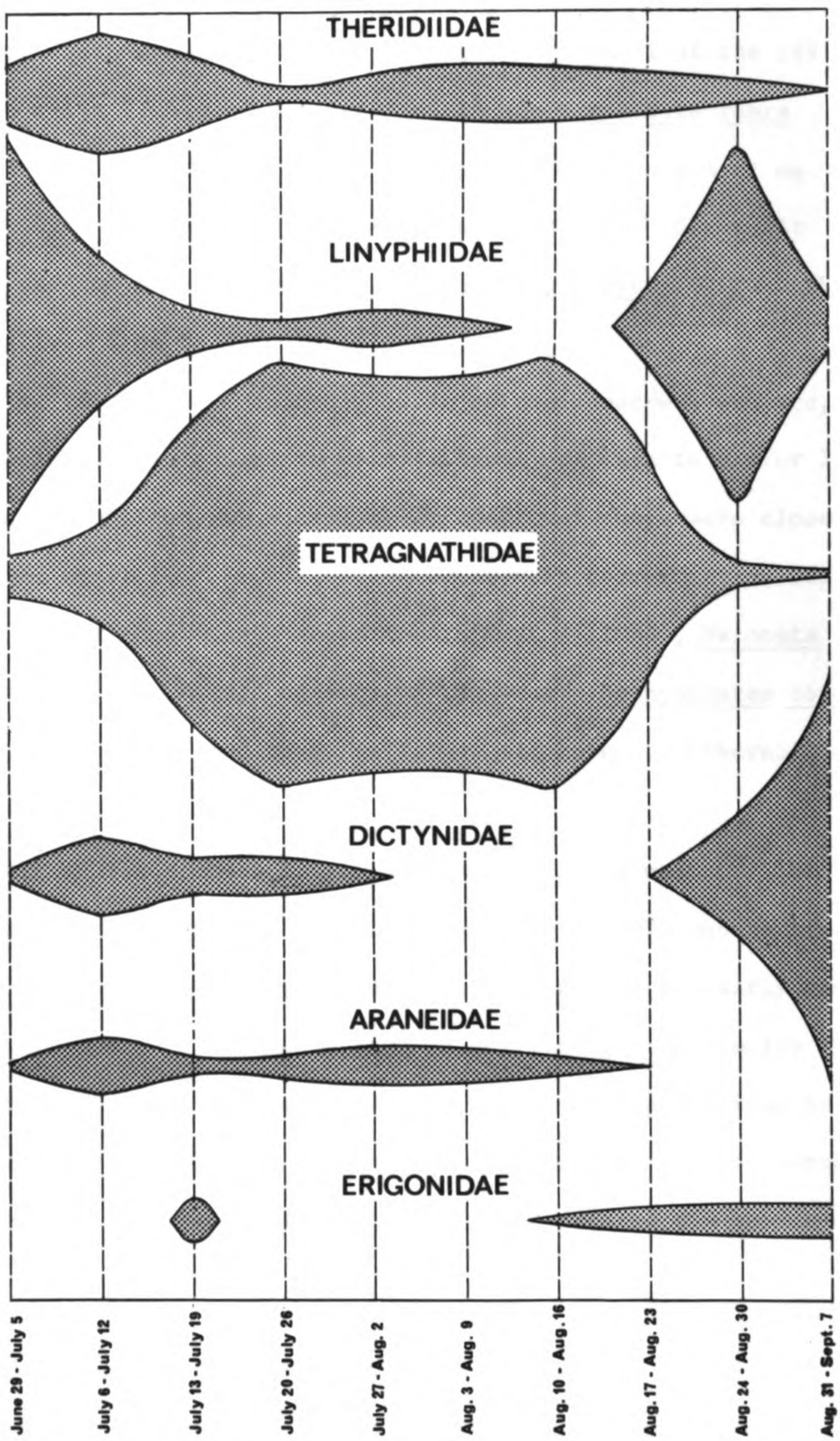
The spiders were then determined as far as possible. Since genitalia are usually needed to go to species, it was practically impossible to determine most of the spiders beyond the generic level. In many cases it was impossible to determine the spider beyond the family level.

SEASONAL DISTRIBUTION

Trypoxylon backi adults are active in southern Michigan from the middle of June through early September. Throughout this period the spiders, used as prey by the wasp continue their cycle of growth and maturation. Completion of their life cycle may not necessarily be concomitant with the needs of the wasp for prey. Spiders which may be utilized as prey at one period of wasp activity may be too large, too small, or essentially nonexistent at other times during the active season of the wasp.

Distinct differences in the spiders utilized from one part of the season to another may be noted in Graph 1. There are wide variations in the number of spiders of each family utilized as the season progresses. Many of the variations can be explained by looking at the life histories of the spider families involved.

Linyphiidae. At the beginning of the nesting season (29 June through 5 July) the linyphiids were a major source of prey, comprising 76 per cent of all spiders utilized during this period. This early summer peak usage of the linyphiids rapidly dwindled at mid-season to virtually no use as prey. At the end of August, a second peak usage occurred at which time this group of spiders comprised



Graph 1.--Seasonal distribution of spider families

70 per cent of the prey (Table 2). A total of 1117 spiders were determined as Linyphiidae and were represented in 71 of the 189 examined cells (Table 1). A total of 13 adult Meioneta fabra (Keyserling), all females except a single male, from a nest on 23 July, were used as prey from 29 June to 23 July. Six adult females and two adult males of Bathyphantes pullatus (O. P. Cambridge) were utilized from 29 June to 15 July.

The Linyphiidae, commonly known as the sheet-web weavers, build their webs in a variety of situations but seem to prefer low bushes or shrubs and may occasionally construct their webs close to the ground or in leaf litter. They apparently overwinter as adults or late instar immatures. According to Kaston (1948), Meioneta fabra may be found at all seasons of the year. Bathyphantes concolor (Wider), closely related to B. pullatus, are known to hibernate as adults and deposit eggs in May.

All adults of both B. pullatus and M. fabra were utilized by the wasp before the end of July. Many of the 1092 undeterminable immature linyphiids were late instar forms for both the early and late summer peaks. Presumably, egg deposition by both species occurred in late July or early August. The young spiderlings hatching from these eggs were either too small to be used as prey or perhaps were not making webs at this early stage and escaped the notice of the wasp in this manner.

Tetragnathidae. The Linyphiidae are quickly replaced in use as prey in early July by the Tetragnathidae. During the latter

TABLE 1.--Per cent of total spiders used as prey by Tropoxylon backi by weekly intervals

	29 June--5 July	6 July--12 July	13 July--19 July	20 July--26 July	27 July--2 Aug.	10 Aug.--16 Aug.	24 Aug.--30 Aug.	31 Aug.--7 Sept.
THERIDIIDAE	11.4	23.3	14.3	2.3	7.0	11.3	2.2	0
LINYPHIIDAE	76.0	29.6	8.9	3.2	7.0	0	70.6	11.1
TETRAGNATHIDAE	8.0	19.5	58.6	83.6	78.5	83.9	3.5	1.0
DICTYNIDAE	2.0	15.7	7.1	7.1	.5	0	23.5	80.6
ARANEIDAE	.8	11.6	3.0	3.8	7.0	3.2	0	0
ERIGONIDAE	0	0	7.8	0	0	1.2	0	6.7

TABLE 2.--Numbers of spiders used as prey by Tropoxylon backi

	No. of cells in which represented	Adult females	Adult males	Immatures	Total	% of
THERIDIIDAE	67	0	0	555	555	11.0
LINYPHIIDAE	71	21	4	1092	1117	22.3
TETRAGNATHIDAE	107	0	0	2300	2300	45.6
DICTYNIDAE	53	80	1	643	724	14.3
ARANEIDAE	62	0	0	273	273	5.4
ERIGONIDAE	14	12	4	60	76	1.5
SALTICIDAE	2	0	0	2	2	--

portion of July and much of August, immature spiders of the genus Tetragnatha composed 80 per cent of the prey for T. backi. Because of their immature state none of the 2300 specimens from 107 cells could be identified further than genus. This genus is the most abundant prey group of T. backi, comprising over 45 per cent of the total spiders used by the wasp (Table 1).

Spiders of the genus Tetragnatha, the long-jawed orbweavers, build their webs in a meadow or in tall grass near water. Of species which are known to occur in the immediate vicinity of the nesting site, Kaston (1948) reports that mature T. versicolor Walckenaer have been collected from April through September. Cocoons are made in May, June and July. He also reports that T. straminea Emerton matures in late May and that adults may be taken through October. From these reports and collection data on other species of Tetragnatha, it appears that they overwinter either as late instar immatures or matures and lay their eggs in late spring or early summer. This would account for the large number of immatures taken in July and August by the wasps. Likewise, this also accounts for the lack of specimens used as prey early or late in the season when adults and late instar immatures would be the dominant portion of the spider population. Adults and late instar immatures of the genus Tetragnatha would undoubtedly be too large for the wasp to transport.

Dictynidae. The Dictynidae build their webs in a wide variety of places depending on the species. However, most prefer to build above the ground using fences, walls, the tops of bushes, or a single leaf of a plant for support of the web.

The Dictynidae overwinter either as adults or late instar immatures and mature in the spring. Kaston (1948) reports that Dictyna roscida (Hentz) overwinters in the penultimate instar or as adults and that mature specimens of Dictyna brevitarsis Emerton have collected from June through August.

From late June through early August, 80 mature female specimens and a single mature male of Dictyna brevitarsis Emerton were utilized as prey and were represented in 13 cells. All specimens taken early in the season were mature and of this species, and undoubtedly, are representatives of the overwintering population. No additional dictynids were taken until the third week in August. It appears that the dictynids are a minor element for prey of T. backi during most of the season; however, during late August and early September, the 643 immature dictynids comprised as much as 80 per cent of the spiders utilized by the wasp. Many of the early September dictynids were penultimate instar individuals, and while undeterminable, they were probably representatives of immature D. brevitarsis, descendents of the adults which were preyed upon earlier in the season.

Theridiidae. The Theridiidae, the comb-footed spiders, is a large family whose members build webs of irregular meshes which may be built in a variety of places. According to Kaston Theridion tepidariorum (C. L. Koch) often builds its nest in the corners of rooms, the angles of windows, on bridges, or on fences. Theridion differens Emerton builds its web in grass and on low bushes and has also been collected from cedar and pine trees. In general, bushes, trees or buildings are preferred as sites for the Family Theridiidae.

Most of the species of the family Theridiidae whose biology is known overwinter as adults or late instar immatures. According to Bonnet (1935), individuals of Theridion tepidariorum (C. L. Koch) may live for more than a year after reaching maturity. Theridion unimaculatum Emerton is an example of a species whose maturity is attained in early spring and the adults are present throughout the summer.

All of the 555 Theridiidae, representing 11 per cent of the spiders collected by T. backi, were immature. The adults of this family are undoubtedly too large to be utilized. The lack of use of theridiids by the wasp, especially in mid and late summer, is perhaps a reflection of the size problem because more late instar individuals would be present late in the season.

Araneidae. A total of 273 immature spiders of the family Araneidae, representing slightly over 5 per cent of all spiders, were utilized by T. backi. Of these, 168 were immature Aranea spp., 60 were immature Araniella displicata (Hentz), 25 were Neoscona spp., and 20 others were not determinable to genus because they were far too immature.

The genera of orb weavers utilized by T. backi are all known to build their webs in bushes, shrubbery, and on or near structures. According to Kaston (1948), Neoscona arabesca (Walckenaer) builds its webs in tall grass or low bushes, while Neoscona benjamina (Walckenaer) is found in open woods and on fences or shrubbery about dwellings. Kaston reports that Araniella displicata builds a very

small web in tall grasses and bushes. The web is often in the space enclosed by the bending of a single large leaf. The genus, Aranea, has been collected from a variety of habitats, but most species prefer to construct their webs in an arboreal habitat such as bushes or pine trees. Many of the araneids, such as Metepeira labyrinthea (Hentz), overwinter as spiderlings within the cocoon. Dondale (1961) reports that Araneilla displicata (Hentz) appears to take more than one year to mature; however, this may vary depending upon climatic conditions. Wiehle (1931) in Germany and Nielsen (1932) in Denmark found that the young of Aranea diadema Linnaeus emerge in May, attain their maximum growth for the year in the fall, and overwinter as half-grown immatures who reach maturity the following August. Kaston reports mature specimens of Epeira undata (Olivier) present during the entire year. Hibernation occurs during any of its stages of development. Epeira trifolium Hentz makes its egg sacs in late September and early October and the adults usually die before winter (Kaston 1948). The young ordinarily emerge the following spring. It appears that, although all stages may be present the year around, the young usually emerge in the spring of the year.

Since most of the species, especially the genera collected by T. backi, would be too large to be utilized as adults, the early instar immatures would be the only size group available for a prey group by T. backi. The araneids supplant the early summer use of linyphiids prior to the heavy use of the tetragnathids in late July. Apparently, the araneids fill the gap left by the maturing linyphiids prior to the time of eclosion and general availability of immature

tetragnathids. They thus form a minor, but yet most important, element in the continuance of spider predation on a seasonal basis.

Erigonidae and Salticidae. According to Kaston (1948), most of the species of the Erigonidae (Micryphantidae) are found under dead leaves near the ground, although a few of the species are arboreal. A total of 12 female and 4 male matures and 60 immature specimens were recovered from T. backi nests. This represents 1.5 per cent of all spiders used. Since the specimens could not be determined beyond the family level, it was impossible to ascertain whether they were arboreal or ground inhabitants.

The Salticidae, the jumping spiders, commonly pursue their prey rather than resort to the construction of a web for trapping the prey. Many, however, may construct silken retreats beneath stones or debris or in curled up leaves. Only two immature specimens of the jumping spiders were found in T. backi nests. This represented considerably less than one per cent of the total spiders. Presumably, their use by the wasp is only a chance occurrence.

DISCUSSION AND CONCLUSIONS

Species representing seven families of spiders were utilized by T. backi. The prey of T. backi do not seem to be restricted to a single species of spider nor to a few closely related species. The ecological habitat occupied by the spider appears to be the most critical factor in the selection of prey. When the various groups of spiders are compared with respect to their habitats and habits, it may be noted that all of the spiders are "arboreal". They live either in the vegetation or on structures such as fences or buildings. Also, they all form some type of web which is used to assist in capturing their prey.

The wasp does, however, restrict its hunting habits to elevated positions in vegetation. The fact that all of the spiders utilized form a web could indicate that T. backi searches for the web rather than the spider. Since adult males do not construct a web as regularly as the female, the relative inabundance of males to females (9 to 113) would also support the last conclusion.

The fact that all of the spiders collected construct a web may indicate that the hunting methods are similar to those reported by Rau (1944) for Trypargilum politum (Say). He reports observing a specimen of T. politum flying into the web of a house spider, shaking

the web several times, and apparently waiting for the spider to attack. When no response was elicited after several minutes, the wasp flew into another web and again attempted to provoke an attack by the spider. Although there is no direct evidence, this type of hunting would explain the predominance of web building forms in the prey of T. backi.

The size of the spider preyed upon is very important in the selection of prey and in the seasonal variation of the prey. For this small wasp, the size of prey is the main cause of the variation in the prey from one part of the season to the next. All of the groups listed are present in varying numbers throughout the season; however, the abundance of the various sizes changes throughout the year.

Many spiders may have an initial molt within the egg sac, followed by a second molt either in the egg sac or in the immediate area. Dispersal thus occurs during the third instar--a stage which may be important in the size relationship of the spider to be used as prey. The wasp, at this time, may take advantage of the dispersal of the spiders by returning time and again to this dispersal area for prey. The female wasp is possibly opportunistic at such times of initial dispersal. By taking advantage of the large numbers of small spiders and their ready availability, the wasp decreases her hunt-search time. This method seems to be more efficient than taking longer periods of time in search of larger spiders in areas of uncertainty. Some data to substantiate this premise may be noted in two three-celled nests. In the first nest 39 of 39, 37 of 38, and

63 of 70 prey spiders were immature tetragnathids. Likewise, in the second nest 61 of 63, 38 of 39, and 71 of 75 prey spiders were tetragnathids. The total elapsed time spent provisioning her cell with a large number of small spiders was less than the elapsed time spent constructing her cell with fewer but larger spiders. This would lend credence to the supposition that the wasp was obtaining her prey with little search time in an area of high incidence--presumably the initial dispersal period from the vicinity of the spider egg sac.

LITERATURE CITED

LITERATURE CITED

Bonnet, P. 1935. Theridion tepidariorum C. L. Koch, araignee cosmopolite. Repartition, cycle vital, moeurs. Bull. Soc. Nat. Hist. Toulouse 68: 335-386.

Dondale, C. D. 1961. Life Histories of some common spiders from trees and shrubs in Nova Scotia. Can. Jour. Zool. 39: 777-787.

Kaston, B. J. 1948. Spiders of Connecticut. Connecticut State Geological and Natural History Survey Bull. 70. 874 pp.

Krombein, K. V. 1958. Misc. Prey Records of solitary wasps III (Hym.; aculeata). Proc. Biol. Soc. of Wash. 71: 21-26.

1967. Trap-nesting Wasps and Bees: Life Histories, Nests, and Associates. Smithsonian Press: Washington, D.C. 570 pp.

Muma, M. H. and W. F. Jeffers. 1945. Studies of the spider prey of several mud-dauber wasps. Ann. Ent. Soc. Amer. 38: 751-753; 2 pls.

Nielsen, E. 1932. The Biology of Spiders. Copenhagen, Vol. I. 248 pp.; II. 723 pp.

Rau, P. 1928. Field Studies in the behavior of the non-social wasps. Trans. Acad. Sci. St. Louis 25: 325-489. 10 pls.

Wiehle, H. 1931. Neue Beitrage zur Kenntnis des Fanggewebes der Spinnen aus den familien Argiopidae, Uloboridae und Theridiidae. Ztschr. Morph. Oekol. Tiere, 20: 349-400.

MICHIGAN STATE UNIVERSITY LIBRARIES
3 1293 03178 6068