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MATURITY AND REPRODUCTIVE ISOLATION OF COMMON SOLPUGIDS IN NORTH AMERICAN DESERTS[1]

Martin H. Muma[2]

Silver City, New Mexico 88061

ABSTRACT

Geographical and seasonal distributions of 26 common, systematically-collected, North American solpugids are analyzed. Geographic isolation and the premating isolating mechanisms of season, habitat, morphology, behavior and activity-time are inferred to be operative in preventing interspecific breeding.

INTRODUCTION

Recent systematic collection of solpugids, Muma (1963, 1966-1967, and unpublished), Allred and Muma (1971) and Brookhart (1965 and 1972), have produced the first meaningful ecological data on North American solpugids. All studies were designed to obtain taxonomical, biological, geographical and numerical data on solpugid species. As a corollary they have also produced data on seasonal maturity and possible reproductive isolation mechanisms of common North American solpugids. These phenomena are indicated and discussed here.

Sources and delineation of the data that will be utilized in the discussions that follow are detailed in Table 1. Muma (1963) utilized data collected by Allred et al. (1963) on 28 species represented by 395 adults and nearly 1,000 specimens; only 11 common solpugids are discussed here. Muma (1966a-e,1967) collected previously unpublished numerical data on seven solpugid species represented by 300 adults and over 600 specimens during his studies on solpugid biology; only the five common species are discussed here. Recently, Muma (unpublished) has collected numerical data on 12 species represented by 96 adults and over 250 specimens; only the four common species are discussed below. Allred and Muma (1971) recorded seven species represented by 44 adults and 71 specimens but only two were sufficiently common for discussion here. Brookhart (1972) summarized published (Brookhart, 1965) and unpublished data on 13 species represented by 321 adults; the eight common species are discussed here.

All of the numerical data for the adults of species to be discussed are presented in Table 2. For reference convenience and brevity the data are organized by solpugid classification, collection sites and seasonal occurrence.

[1] Contribution No. 269, Bureau of Entomology, Division of Plant Industry, Florida Department of Agriculture and Consumer Services, Gainesville, Florida 32601.

[2] Professor and Entomologist Emeritus, IFAS, University of Florida, Gainesville, Florida. Research Associate, Florida State Collection of Arthropods, Division of Plant Industry, Florida Department of Agriculture and Consumer Services, Gainesville, Florida. Research Associate, Department of Biological Sciences, Western New Mexico University, Silver City, New Mexico.

RESULTS AND DISCUSSION

Although it is not apparent from the summarized data, with rare exception, males appeared, attained peak abundance and disappeared earlier in the year than females. Muma (1963) first noted this phenomenon and from it inferred that copulation must take place as soon as the females appeared. However, Muma (1966b and 1966e) noted that males will mate several times with different females and that females, probably those that have exhausted their sperm supply, will mate a second time. Therefore, it is possible that earlier appearance and peak abundance of males is simply a biological survival mechanism to assure fertilization of females. The occasional earlier and later occurrence of females of such species as *Eremobates durangonus* Roewer, *Eremobates pallipes* (Say) and *Hemerotrecha fruitana* Muma are probably the effect of adverse stress factors such as temperature, humidity and food availability on individuals. Collections of certain species including *Eremobates zinni* Muma and *Eremochelis plicatus* (Muma) must remain enigmas until more refined studies are conducted.

In general there was a tendency for species of the same species-group to mature at the same time regardless of the geographic location, latitude, or altitude of the desert area in which they occurred. For instance adults of the recorded species of the *magnus* species-group of *Eremorhax* Roewer reached peak abundance in May and June; those of the *scaber* and *pallipes* species-groups of *Eremobates* Banks reached peak abundance in July and August; those of the *bilobatus* species-group of *Eremochelis* Roewer became abundant in June and July; and those of the *texana* species-group of *Hemerotrecha* Banks attained peak abundance in both or either the spring or fall. On the other hand, the *palpisetulosus* species-group of *Eremobates* and the *branchi* species-group of *Eremochelis* contained species, the adults of which became abundant at irregular times from March through August. This variation in peak adult abundance of closely related species indicates that factors other than geographic isolation are operating to prevent interbreeding of sympatric representatives of the order in North America.

Mayr (1970) in his discussion of factors that prevent specific interbreeding, segregated geographic isolation from "isolating mechanisms" of closely related species. He then classified the latter into premating mechanisms including seasonal, habitat, ethological, and mechanical and postmating mechanisms including gametic and zygotic mortality, hybrid inviability, and hybrid sterility. Synecological data such as that under discussion permit analyses and inferences only on the basis of premating isolating mechanisms. These are referred to, when applicable, in the following discussions which view the data from the standpoint of the collection site. Prior to such discussions, however, it should be noted that isolating mechanisms are broadly interpreted here as applicable to species of different genera and different species-groups as well as to closely related species.

At the northern edge of the Great Basin Desert Allred and Muma (1971) found only two species common enough to evaluate. Since these species were morphologically distinct members of two different genera in two different subfamilies of the Eremobatidae and matured at different times, they may be morphologically and behaviorally as well as seasonally isolated from interbreeding.

The eight common solpugid species recorded by Brookhart (1972) were collected from two different geographic areas, one on the east slope of the Wet Mountains east of the Great Basin Desert, the other on the high plains north of the Chihuahuan Desert. All three of the species found east of the Great Basin Desert attained peak adult abundance

Table 1.–Sources and delineation of data utilized in discussion.

Authority	Desert Studied	Location	Methods Utilized	Study Duration	Source No.
Muma (1963)	Mojave-Great Basin	Mercury, Nevada	Dry Can-traps	36 months	I
Muma (1966a-e, 1967)	Sonoran-Chihuahuan	Portal, Arizona	Selective-searching Night-lighting	Three years; May through September	II
Muma (unpublished)	Chihuahuan	Silver City, New Mexico	Killing-preserving Can-traps	12 months	III
Allred and Muma (1971)	North of Great Basin	Snake River Basin, Idaho	Dry Can-traps	15 months	IV
Brookhart (1972)	East of Great Basin-North of Chihuahuan	Southern Colorado	Dry Can-traps	Five years; May through October	V

during May, June and July, and so maybe either morphologically or behaviorally isolated from interbreeding. However, as noted by Brookhart, the three species also occupied three different habitats: *Eremobates mormonus* (Roewer) was a valley-high plains form, *Eremochelis bilobatus* (Muma) inhabited the thorn-thickets and shrubby area of the ridges and foothills, and *Hemerotrecha fruitana* Muma was a montane species. Since all eight species were collected north of the Chihuahuan Desert, the above remarks also apply to these three species taken in this latter area. The most abundant solpugid north of the Chihuahuan Desert was *E. pallipes*. Although it attained peak adult abundance later in the season than most other species, it was the only member of its species-group collected commonly and could be morphologically and behaviorally isolated from other species-groups of *Eremobates* and other genera. Two closely related members of the *palpisetulosus* species-group of *Eremobates*, *E. bantai* Brookhart and *E. palpisetulosus* Fichter, attained peak adult abundance during June according to Brookhart's collections. Although minor morphological differences between the two species perhaps operate as mechanical isolating mechanisms and behavioral isolating mechanisms may be inferred, further studies are needed. A similar situation is posed by the simultaneous peak abundance of *Eremorhax puebloensis* Brookhart and *E. mumai* Brookhart. However, in this instance the smaller size, minor morphological differences and limited habitat of *E. mumai* suggest that mechanical, ethological or habitat factors may be operative as isolating mechanisms.

Since the four common solpugids collected at the western edge of the Chihuahuan Desert near Silver City, New Mexico, during 1972-1973 are placed in two different genera representing three different species-groups, it is possible that both mechanical and ethological factors could be involved as isolating mechanisms for most of the species. However, the two closely related species of the *palpisetulosus* species-group of *Eremobates*, *E. hessei* Roewer and *Eremobates* undescribed species were seasonally isolated; peak adult abundance of the latter occurred in April and the former in July. In fact all of the solpugids collected at this site were somewhat isolated seasonally, *Eremobates*, undescribed species, attained peak adult abundance in April, *Eremorhax*, undescribed species, in May, *E. hessei* in July and *E. pallipes* in July and August.

Table 2.–Seasonal maturity of some common North American solpugids. Boldface emphasizes peak abundance.

Identity of Species	Source No.	Number of Adults Collected J-F	M-A	M-J	J-A	S-O	N-D	Total
Eremobatidae								
Eremorhax Roewer								
magnus species-group								
pulcher Muma	I			**16**	11			27
undescribed species	III			**3**	1			4
mumai Brookhart	V			**4**				4
puebloensis Brookhart	V			**4**				4
Eremobates Banks								
scaber species-group								
zinni Muma	I				**11**			11
septentrionis Muma	IV				**16**			16
mormonus (Roewer)	V			2	**60**			62
palpisetulosus species-group								
kraepelini Muma	I		10	**14**				24
purpusi (Roewer)	I			**12**	2			14
palpisetulosus Fichter	II			**35**	10			45
hessei (Roewer)	II				**14**			14
hessei (Roewer)	III				**26**			26
undescribed species	III		14	**15**	3			32
palpisetulosus Fichter	V			7	1			8
bantai Brookhart	V			**10**	5			15
pallipes species-group								
durangonus Roewer	II			1	**80**	1		82
pallipes (Say)	III				**21**	2	1	24
pallipes (Say)	V			16	**139**	22		177
Eremochelis Roewer								
branchi species-group								
bidepressus (Muma)	I		**6**	**6**				12
insignitus Roewer	I			18	**50**			68
bilobatus species-group								
plicatus (Muma)	I			3	**13**			16
bilobatus (Muma)	II			45	**86**			131
bilobatus (Muma)	V			8	**7**	2		17
Hemerotrecha Banks								
banksi species-group								
californica (Banks)	I		1	90	19	4		114
serrata species-group								
serrata Muma	I			3	20	5		28
texana species-group								
proxima Muma	I					**6**	3	9
denticulata Muma	I	1	**5**	2		2	2	12
denticulata Muma	IV		3	2		**10**		15
fruitana Muma	V		1	**24**	3	1		29
Ammotrechidae								
Ammotrechula Roewer								
peninsulana (Banks)	II			**20**	8			28
Branchia Muma								
potens Muma	I			8	**13**			21

The five common solpugid species collected by Muma (1966a-e,1967) from the San Simon Valley of Arizona between the Sonoran and Chihuahuan Deserts may be morphologically and behaviorally isolated. On the other hand, prior to summarization in Table 2,

the data showed that the two closely related species of the *palpisetulosus* species-group of *Eremobates*, *E. palpisetulosus* and *E. hessei* and one of the *pallipes* species-group, *E. durangonus* Roewer were also somewhat seasonally isolated. *E. palpisetulosus* attained peak adult abundance in June, *hessei* in July and *durangonus* in August. It should also be pointed out that the nearly equal-sized eremobatid, *Eremochelis bilobatus* (Muma), and the ammotrechid, *Ammotrechula peninsulana* (Banks), both inhabited the thorn-thickets in the foothills of the Chiricahua Mountains, and even though distinctive morphologically, also attained adult abundance during different months, the latter in June, the former in July.

Since the 12 common solpugids recorded from the Nevada Test Site at the conjunction of the Mojave and Great Basin Deserts by Muma (1963) were classified in two families, five genera and eight species-groups, the isolation mechanisms can be inferred to be largely mechanical and ethological. However, the *branchi* species-group of *Eremochelis* was represented by *E. bidepressus* (Muma) which attained peak adult abundance during April and May and *E. insignitus* Roewer which attained abundance during July, indicating a seasonal isolation. Also the *texana* species-group of *Hemerotrecha* was represented by *H. denticulata* Muma which attained peak female abundance in the spring and *H. proxima* Muma which attained peak female abundance in the fall, indicating a degree of seasonal isolation possibly reinforced by an associated male behavioral isolation. Another recorded species of this genus, *Hemerotrecha californica* (Banks), is worthy of special mention here. Although it could be both mechanically and seasonally isolated from all other members of the genus at this site, it and other members of the *banksi* group of the genus are also the only known diurnal species in North America, indicating the possible existence of a fifth premating isolation mechanism, temporal isolation. Only two closely related solpugids found at the Test Site were not seasonally or temporally isolated from interbreeding. These were *Eremebates kraepelini* Muma and *E. purpusi* (Roewer) of the *palpisetulosus* species-group. Minor morphological differences between these species may reflect the existence of mechanical and ethological isolating mechanisms, but such cannot be determined without additional study.

SUMMARY

Many genera and species-groups of North American solpugids contain species that are geographically isolated and tend to mature at the same time of the year regardless of the location, latitude or altitude of the desert areas in which they occur. However, certain species-groups, particularly those involving sympatric species, exhibit a wide range of species maturity dates. Broadly interpreted, the premating isolating mechanisms of season, habitat, mechanics and behavior can be inferred to be operative among such sympatric species for the prevention of interspecific breeding. In the case of *Hemerotrecha californica* (Banks) a temporal isolation can also be inferred since it and other members of the *banksi*-group are the only known diurnal solpugids in North America.

LITERATURE CITED

Allred, D. M., and M. H. Muma. 1971. Solpugids of the National Reactor Testing Station, Idaho. Great Basin Nat. 31(3):164-168.

Allred, D. M., D. E. Beck, and C. D. Jorgensen. 1963. Biotic communities of the Nevada Test Site. Brigham Young Univ. Sci. Bull., Biol. Ser., 2(2):1-52.

Brookhart, J. 1965. Two new solpugids from Colorado and notes on other species. J. New York Entomol. Soc. 73:151-155.

Brookhart, J. 1972. Solpugids (Arachnida) in Colorado. Southwestern Nat. 17:31-41.

Mayr, E. 1970. Populations, species and evolution: An abridgment of animal species and evolution. Harvard University Press, Cambridge. 453 p.

Muma, M. H. 1963. Solpugida of the Nevada Test Site. Brigham Young Univ. Sci. Bull., Biol. Ser., 3(2):1-13.

Muma, M. H. 1966a. Egg deposition and incubation for *Eremobates durangonus* with notes on the eggs of other species of Eremobatidae (Arachnida:Solpugida). Florida Entomol. 49:23-31.

Muma, M. H. 1966b. Mating behavior in the solpugid genus *Eremobates* Banks. Anim. Behav. 14:346-350.

Muma, M. H. 1966c. Feeding behavior of North American Solpugida (Arachnida). Florida Entomol. 49:199-216.

Muma, M. H. 1966d. Burrowing habits of North American Solpugida (Arachnida). Psyche 73:251-260.

Muma, M. H. 1966e. The life cycle of *Eremobates durangonus* (Arachnida:Solpugida). Florida Entomol. 49:233-242.

Muma, M. H. 1967. Basic behavior of North American Solpugida. Florida Entomol. 50:115-123.