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Studies of Michigan Lycosidae

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STUDIES OF MICHIGAN LYCOSIDAE

by

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Robert John Wolff

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INTRODUCTION

Wolf spiders are wandering, active spiders of the family Lycosidae. They are among the most important and abundant predators of the soil surface and leaf litter communities. Despite the dominance of lycosids there are still many aspects of the taxonomy, ecology and biology of these spiders which are unknown. This study is an attempt to take a broad look at many of these aspects and to become familiar with these interesting spiders.

An excellent description of spider natural history in the book 'American Spiders' (Gertsch, 1949) should be read by everyone interested in spiders. More recently, Turnbull (1973) reviewed the ecology of true spiders, and discusses some aspects of lycosid ecology. Wolf spiders generally do not build webs, but wander in search of prey or simply wait for insect prey to wander into them. Knost and Rovner (1975) demonstrated that wolf spiders will scavenge. The wandering habit of some lycosids makes pit fall trapping an effective, but biased, capture device. Head lights are useful for spotting wolf spiders, which are night active, because of the reflective properties of lycosid eyes (Wallace, 1937). Life history data may be easily obtained for lycosids because the females carry their egg sac attached to the spinnerets, and the young after hatching from the egg sac will hold on to special abdominal hairs (Rovner,

Higashi and Foelix, 1973). Soon after hatching, the young of many species leave the mother, climb to a high spot, and spin out silk until wind currents pick them up and transport them. This is termed ballooning and may account for the wide distribution of many species, though its efficiency has been questioned (Platnick, 1976).

Lycosids are often the dominant spiders on the ground surface. In Florida, wolf spiders accounted for 64%, 54%, 53% and 18% of the ground spiders in four different habitats (Muma, 1973). Uetz (1976) found lycosids dominant in three of four sites along a stream in Illinois, including over 90% in two of the sites.

Distribution in habitats is not well known for many species of spiders. Lowrie (1948) shows the distribution of spiders through the successional stages in the southern Lake Michigan area. Barnes (1953) gives the distribution of spiders in several plant communities along the Atlantic Ocean in North Carolina. In the Netherlands, Van der Aart (1973) analyzed wolf spider distribution and its correlation to vegetation structure. He found that the spiders are distributed in relation to the vegetation.

Wolf spiders and their systematic position are discussed by Kaston (1948). The family Lycosidae belongs to the superfamily Lycosoidea, which lack a cribellum (ecribellate), are three clawed (trionychous), have complicated genitalia (entelegyne) and have one or two rows

of tarsal trichobothria. This superfamily also includes the families Agelenidae, Pisauridae and Oxyopidae, or the funnel web weavers, fisher spiders and the lynx spiders respectively. Lycosids are recognized by the eight unequal eyes forming three rows and the lorum of the pedicel having an anterior sclerite fitting into a notch in the posterior sclerite. The order is the Araneae, which includes all spiders, and is in the class Arachnida.

The Michigan spider fauna is not very well known. Chickering (1932, 1933, 1934, and 1935) and Chickering and Bacorn (1933) listed species occurring in Michigan but the identifications are doubtful due to taxonomic difficulties. Drew (1967) contains a list of the spiders of Beaver Island, Charlevoix County and includes habitats of these species. Levi and Field (1954) and Levi, Levi and Kaspar (1958) contain Wisconsin records. Kaston (1955) has some Illinois records. The Connecticut spider fauna is given in Kaston (1948) with descriptions and habitat data, and is the best identification guide to eastern U. S. spiders. A key to lycosid genera is given by Kaston (1972) and Leech (1969), but both must be used with care. For example, due to variation in the number of cheliceral teeth (Gertsch, 1934), some specimens of Trochosa pratensis will key out to the genus Tarentula. Almost all species identification in Lycosidae depend on determining characteristics of the genitalia, though familiarity with the fauna of a region

may allow identification of some immatures.

The old fields used for habitat studies are as follows: the north side of the Kalamazoo Nature Center, Kalamazoo County, the NE 1/4 of the SW 1/4 of section 22, T1S, R11W, Michigan Meridian; and the Mott Preserve, Van Buren County, the NW 1/4 of the NW 1/4 of section 36, T2S, R13W, Michigan Meridian. The fields in the Upper Peninsula, which were compared with the above fields, are near the following locations: the corner of Bluff and Lincoln Streets, Marquette, Marquette County; M 28, 5 miles east of Newberry, Luce County; the intersection of M 28 and M 123, Chippewa County; and Indian Lake State Park, Schoolcraft County.

MICHIGAN FAUNA

The determination of the Michigan fauna is the first aspect of this study which must be considered. Correct identification, names, and morphological variation has been a major problem, partly due to the fact that lycosids have not been monographed since 1908 (Chamberlin). The Michigan fauna is characteristic of the Midwest and the eastern U. S. in general. Representatives of the northern Boreal fauna are also encountered, particularly in the Upper Peninsula. The Michigan distribution of most species is mapped (Figures 17-25).

Ecological data is sparse for most species of lycosids. Lowrie (1973) has reviewed Western Pardosa microhabitats, of which some species also occur in Michigan. Drew (1967) in a study of Beaver Island spiders includes habitat data for many of the Michigan lycosids. Much further study will be necessary to determine the microhabitats of lycosids. Habitat data is given when known, from personal collecting or existing collections. Life history data, which is given in Figures 1-16 for each species with 18 or more specimens, are graphed for only the first 25 specimens in each time period and category (males, females and females with egg sacs or young).

Each species may be identified from Kaston (1948) unless a different source is indicated.

Arctosa Koch, 1848

This genus is in need of revision due to species uncertainty, poor description, and lack of a generic definition. Kaston (1948) is the best identification guide at present. Connecticut has four species common with Michigan, each having a different fifth species. Wisconsin lists only record three species. Distribution of the species is given in Figure 1.

Arctosa emertoni Gertsch, 1934. Three females have been collected; 17 May, 16 July and 4 August.

Arctosa funerea (Hentz, 1844). Males were taken 8, 13, 16 June and 6, 19 July, and a female 8 June. They were taken from a mowed field, old field, garage floor, lake and pond edges and a *Typha* marsh.

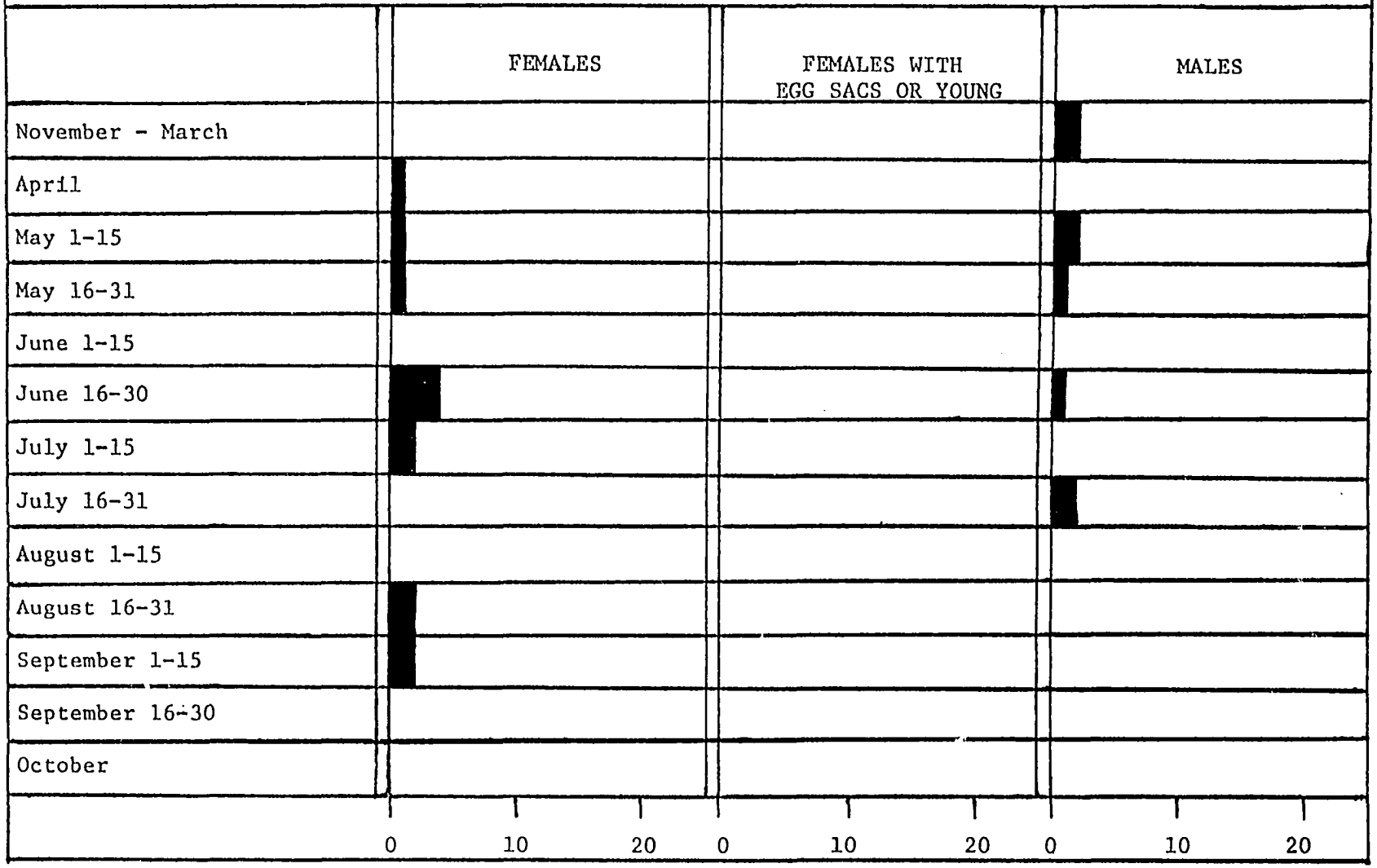
Arctosa littoralis (Hentz, 1844). Life history data is given in Figure 2. It appears maturity is reached in the spring. Collections are from under debris on sandy beaches, dune grass and a gravel pit.

Arctosa rubicunda (Keyserling, 1876). Males were collected 17, 23 May and 25 August from sandy hardwoods and a lake shore.

Arctosa quinaria (Emerton, 1894). A female was taken 23 August from Isle Royale, Keeweenaw County.

Figure 1. Michigan Arctosa

Figure 2. Arctosa littoralis



Geolycosa Montgomery, 1904

Wallace (1942) revised this genus. Other lycosid genera have most Michigan species in common with Connecticut, but Geolycosa pikei (Marx, 1881) and G. turricola (Treat, 1880) are found in New England while the two Michigan species are found in the Mississippi basin. Distribution of the species is given in Figure 3.

Geolycosa missouriensis (Banks, 1895). Coloration of some females is the same as that of males given by Wallace (1942). Endites and labium are light. Life history data are given in Figure 4. These data agree with Wallace (1942). Males and females mature in the fall, copulate, and the females overwinter. Egg sacs are produced in May and June. The female with an egg sac in early July (Fig. 2) possibly indicates a second brood. Young overwinter and reach maturity the second year. This species has been found in a pine-oak forest, flood plain forest, sandy blowout, pasture, sandy field and a lawn.

Geolycosa wrightii (Emerton, 1912). Variations from Wallace (1942) are found in some specimens. Females have tarsi and metatarsi II light. Males have dark patella, metatarsi and tarsi I and II. This species has a similar life history to G. missouriensis, and is found in Figure 5. Habitats are the beach and sand in a juniper stand.

Figure 3. Michigan Geolycosa

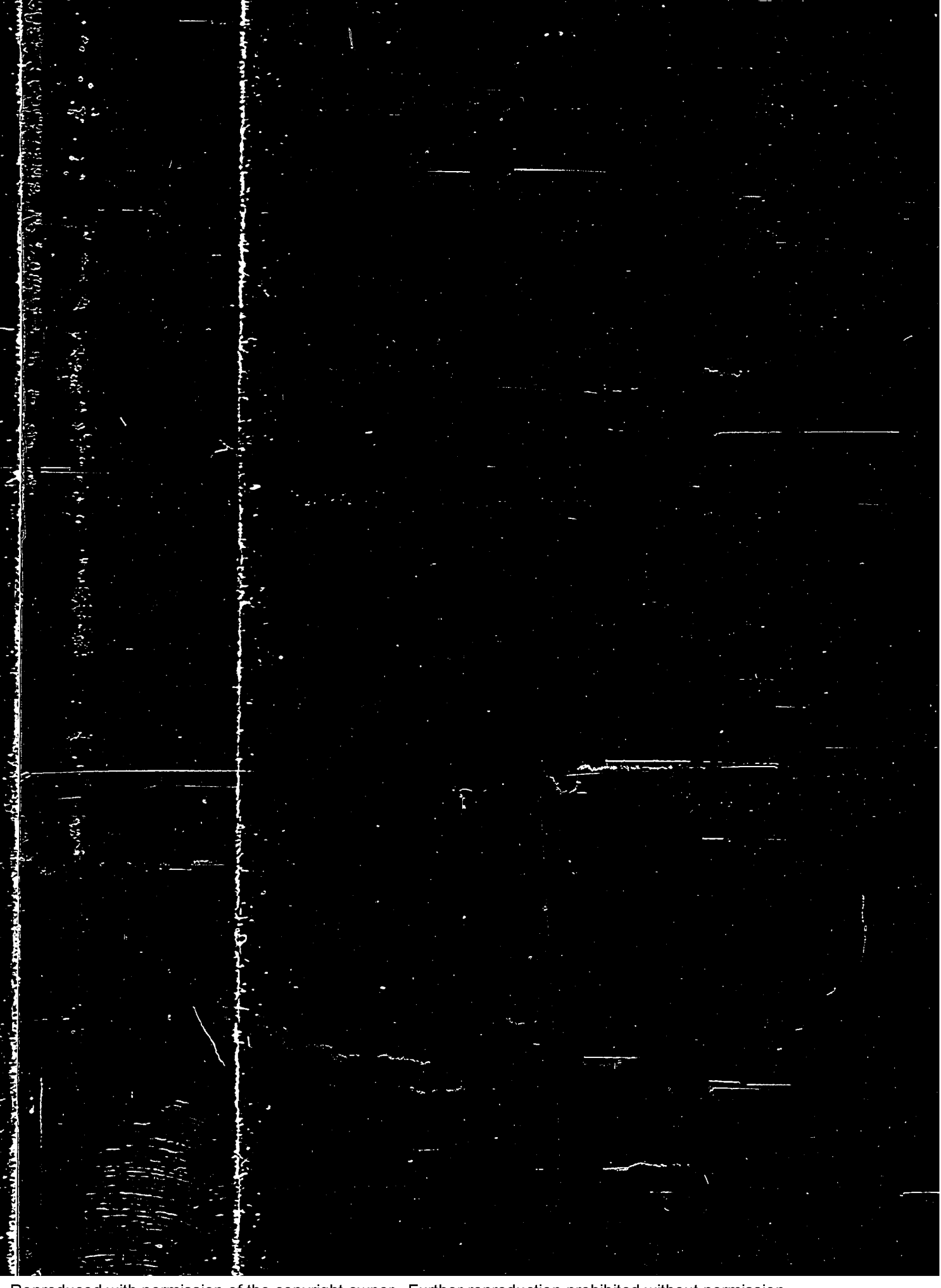


Figure 4. Geolycosa missouriensis

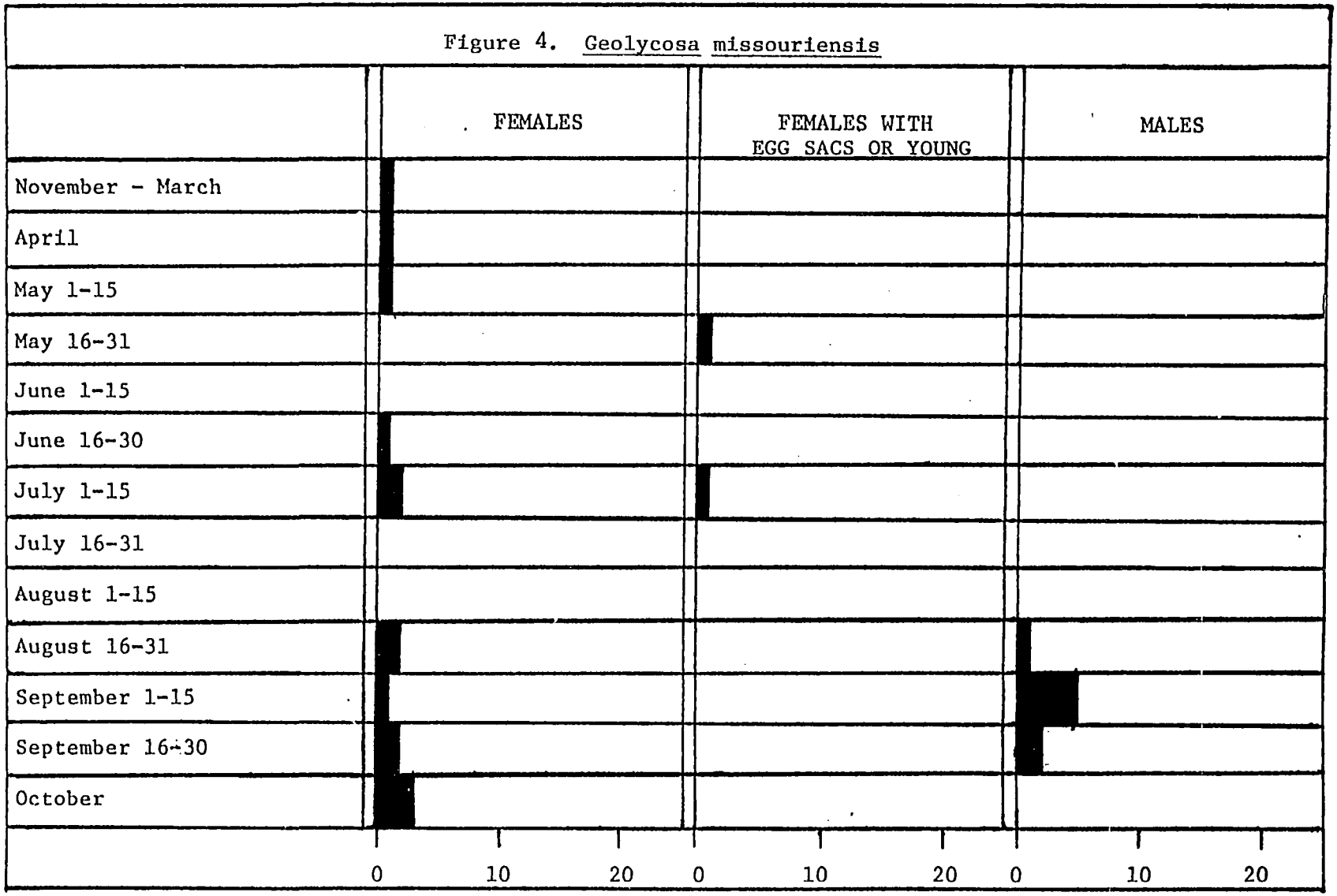
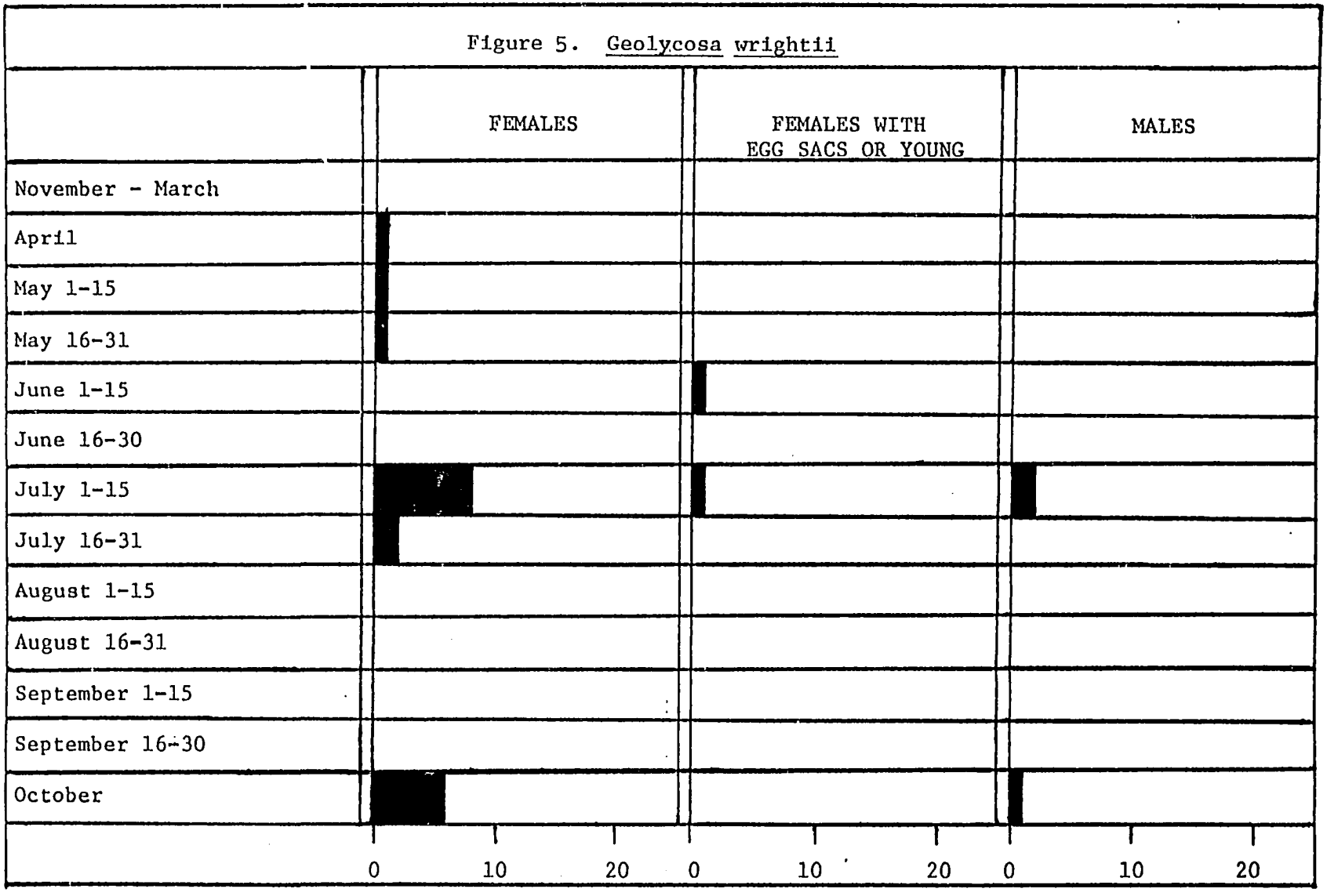


Figure 5. Geolycosa wrightii



Lycosa Latreille, 1804

Nine species are identified from Connecticut in Kaston (1948), with seven of these occurring in Michigan. Six species are reported from Wisconsin.

Lycosa aspersa Hentz, 1844. Mature specimens are from late August and September. Distribution is given in Figure 6.

Lycosa baltimoriana (Keyserling, 1876). Males have been taken 17 April, 23 May and 12 September. Female records are 1 May, 19 June, 9 July, 3 August, 13 September, 9, 10, 12, and 15 October. They have been collected from a pine tree, buildings, sand beach, old orchard and sandy hardwoods. Distribution is given in Figure 6.

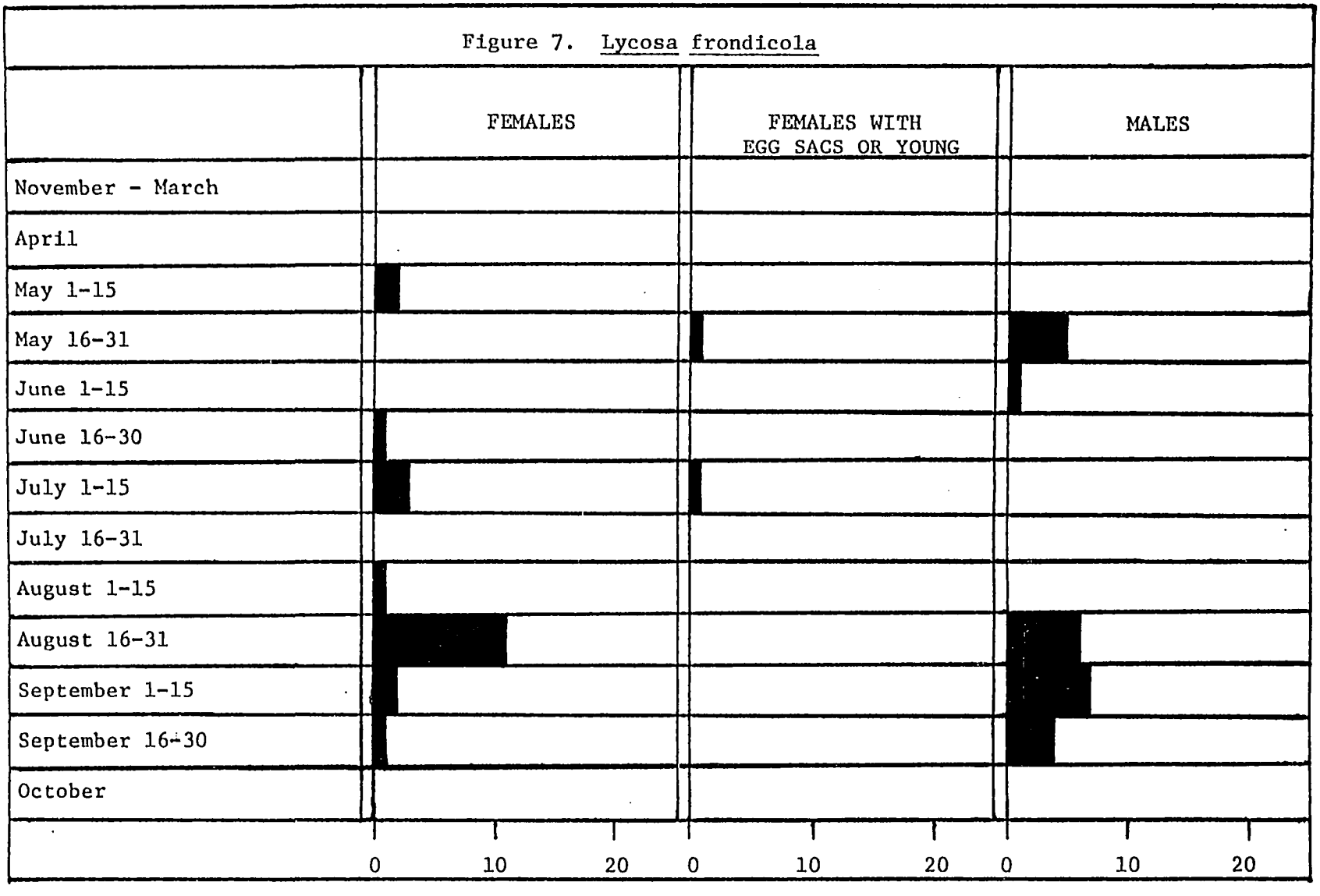
Lycosa carolinensis Walckenaer, 1837. Records are few; males 3 and 29 August and a female 7 September. Distribution is given in Figure 6. One specimen was taken in an oak forest. Kuenzler (1958) discusses the ecology of L. carolinensis in the south.

Lycosa frondicola Emerton, 1885. Life history data are given in Figure 7. Maturity is attained in late August and September. Egg sacs appear in late May through the end of June. They are found at night sitting on low vegetation in oak forests, oak-hickory forests, old fields and along roads. Distribution is given in Figure 6.

Lycosa gulosa Walckenaer, 1837. Life history data are given

Figure 6. Michigan Lycosa

Figure 7. Lycosa frondicola



in Figure 8. Maturity is gained in September. Egg sacs are made throughout May and early June. They are found on low vegetation at night in oak and flood plain forests. Distribution is given in Figure 9.

Lycosa helluo Walckenaer, 1837. Life history data are given in Figure 10. Records are from a flood plain forest, Typha marsh, building and lake shore. Distribution is mapped in Figure 9.

Lycosa punctulata Hentz, 1844. Males have been taken 9, 23 September and 7 October. A female was collected 4 August and a female with young on 30 July. These data agree with the life history presented by Eason and Whitcomb (1965). A flood plain forest is the only recorded habitat. Distribution is given in Figure 9.

Pardosa Koch, 1848

Eleven species are found in Michigan, eight of these are reported from Connecticut. Levi and Field (1954) lists ten species for Wisconsin and contains figures for identifying P. fuscula and P. groenlandica. Chamberlin (1908) has a figure for P. hyperborea.

Pardosa distincta (Blackwall, 1846). Life history data are given in Figure 11. Maturity is reached in the second half of June, with egg sacs appearing in late June, July, August and into September. Young overwinter as immatures. Distribution is mapped in Figure 12. Habitats include beach,

Figure 8. Lycosa gulosa

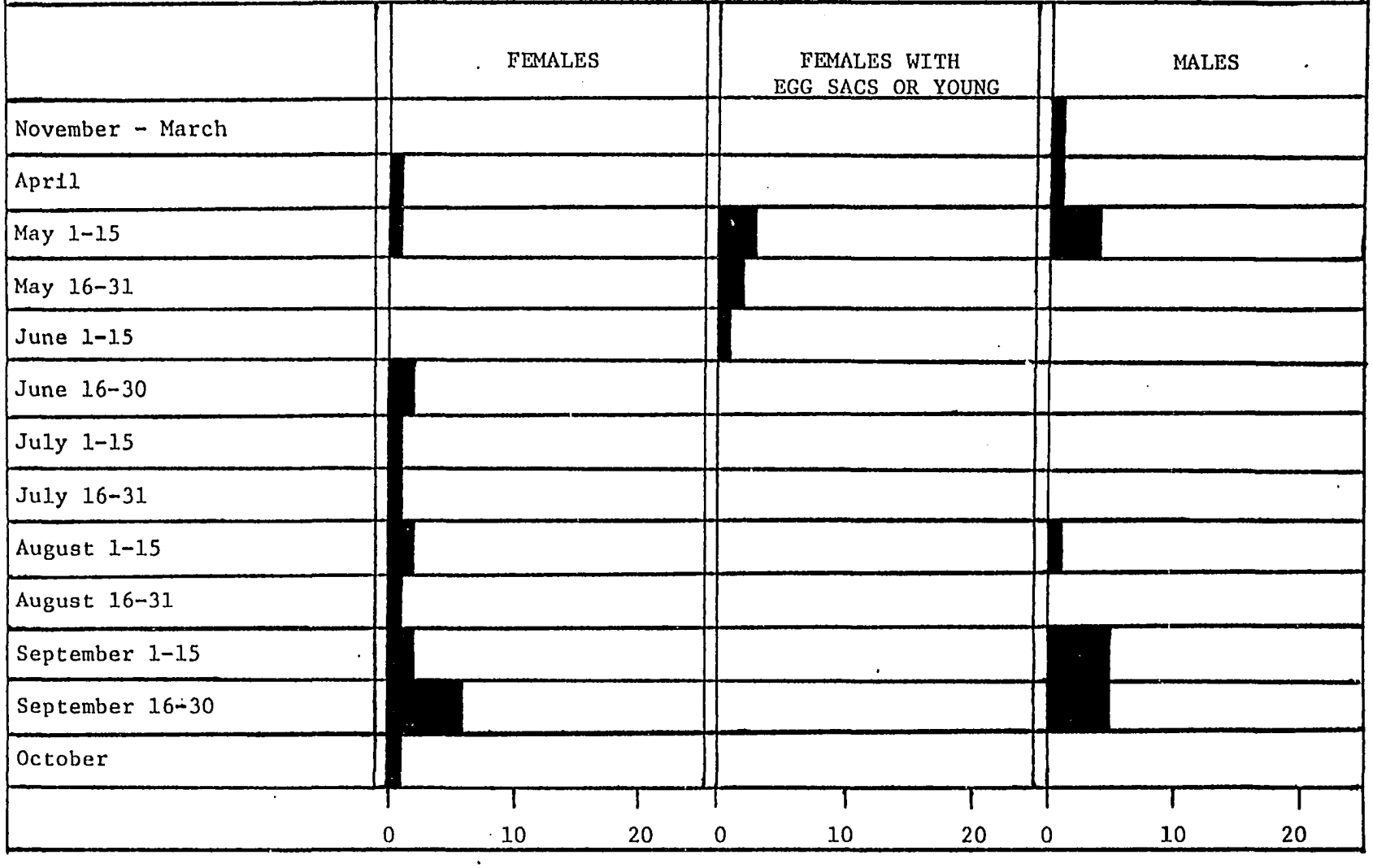


Figure 9. Michigan Lycosa

Figure 10. Lycosa helluo

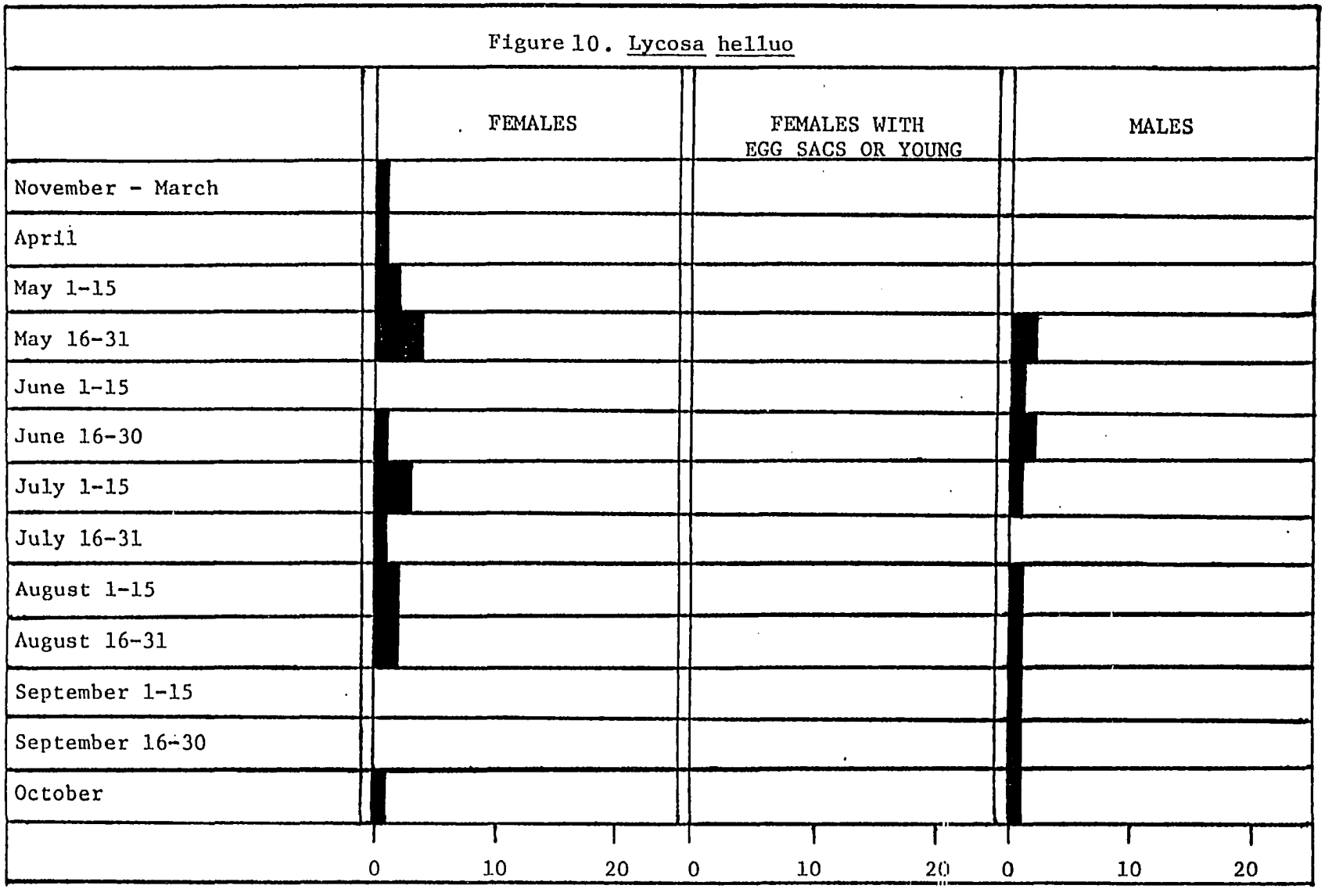


Figure 11. Pardosa distincta

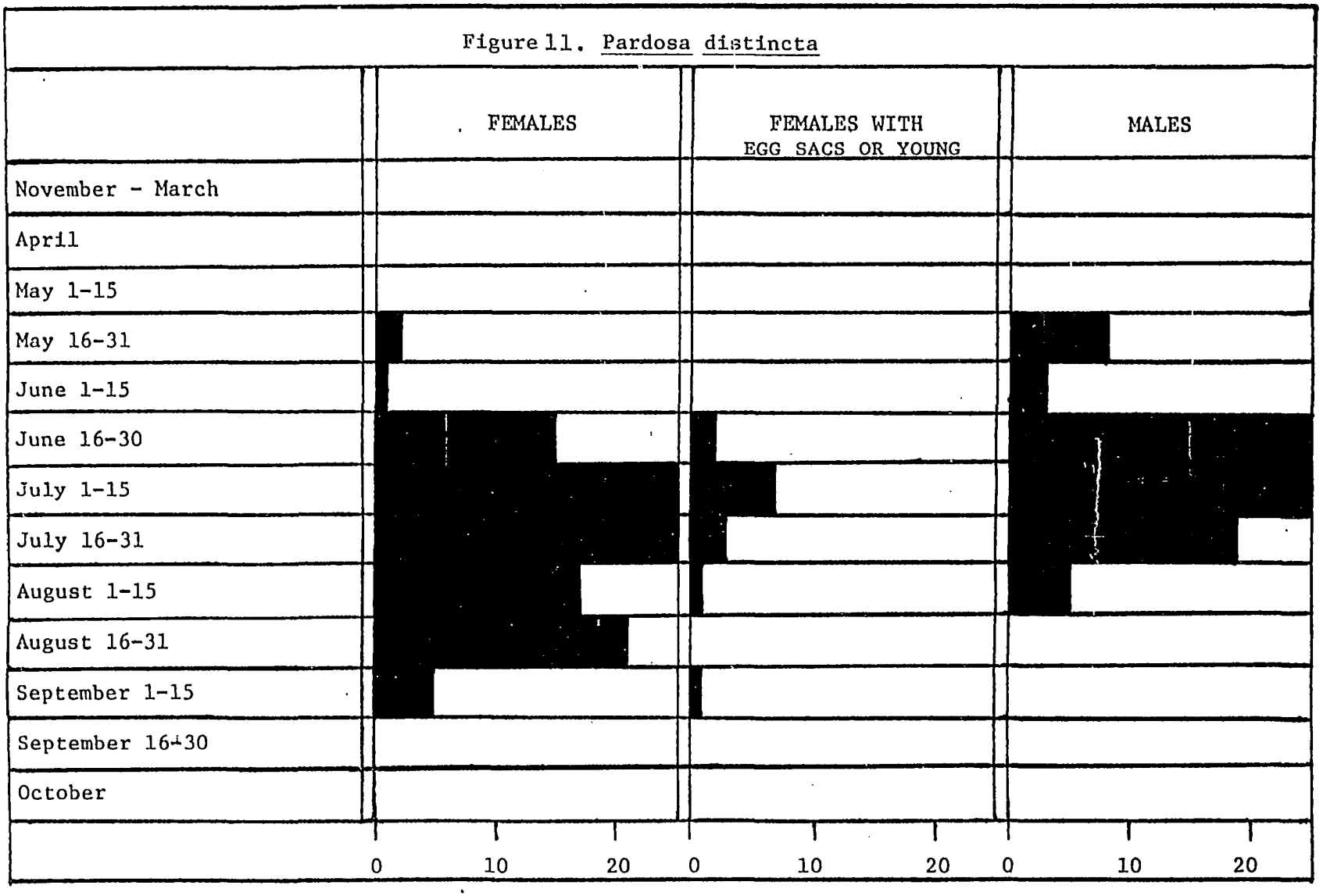


Figure 12. Michigan Pardosa

shore outcrop, old field, gravel pit, pine plantation, oak woods and maple woods.

Pardosa fuscula (Thorell, 1872). Mature males are found from late April to early June. A female with an egg sac was collected 16 July. They have been found on a sand beach, edge of pond and in a Typha marsh. Distribution is given in Figure 12.

Pardosa hyperborea (Thorell, 1869). A single male from a shore outcrop was taken 26 June on Isle Royale, Keeweenaw County.

Pardosa lapidicina Emerton, 1885. Life history data are given in Figure 13. Found in a fir climax forest and on rocky beaches, this species matures in late August and September. Egg sacs appear throughout the summer, particularly in July. Distribution is mapped in Figure 14.

Pardosa mackenziana (Keyserling, 1876). Life history data are given in Figure 15. Maturity is gained throughout May and June. Females with egg sacs have been collected in July, August and September. Habitats include corn and vegetable fields, old field, lawn, mud flat and swamp. Distribution is mapped in Figure 14.

Pardosa milvina (Hentz, 1844). Life history data are given in Figure 16. Maturity is gained throughout May and June. Females with egg sacs have been collected in July, August and September. Habitats include corn and vegetable fields, old field, lawn, mud flat and swamp. Distribution is mapped

Figure 13. Pardosa lapidicina

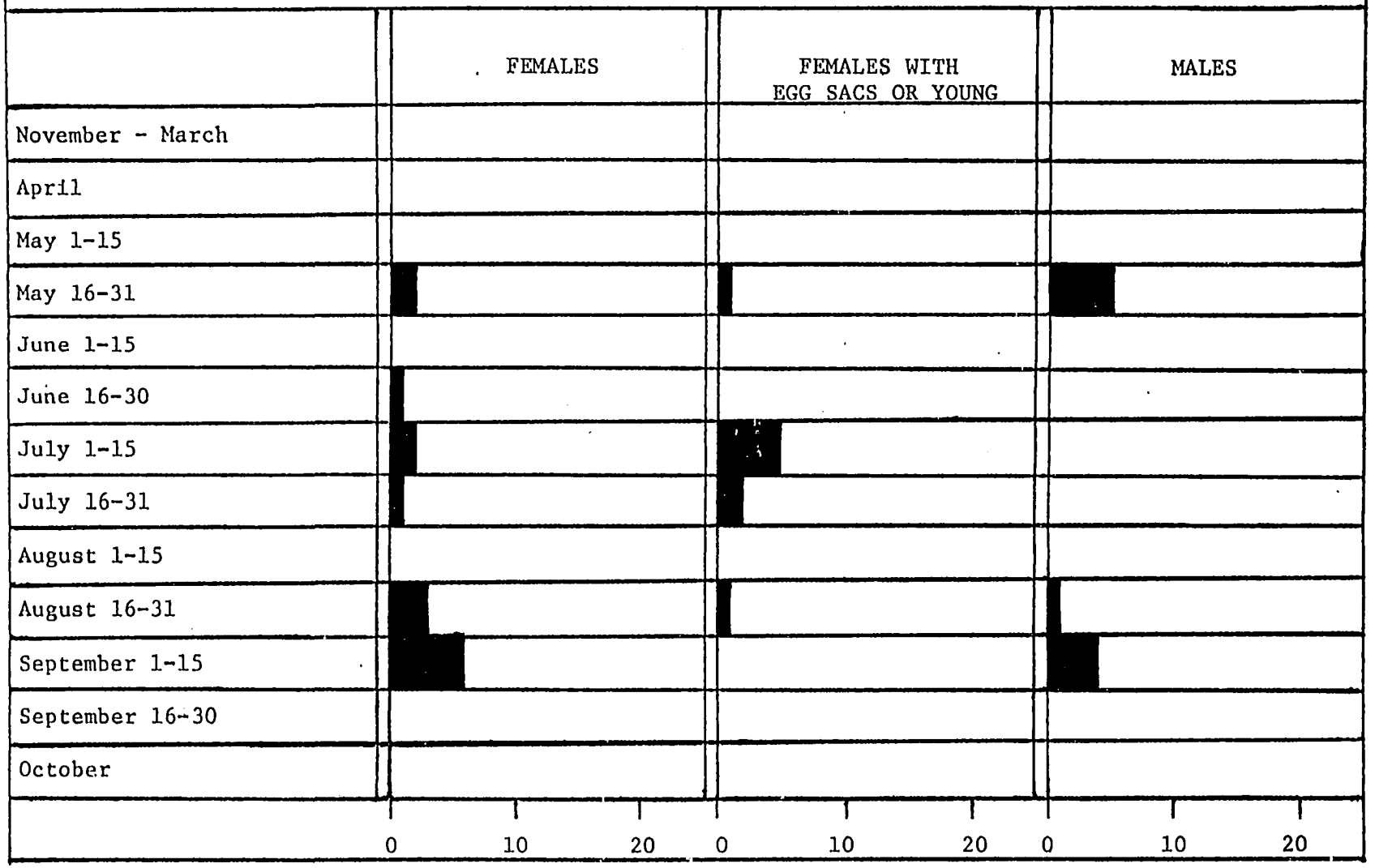


Figure 14. Michigan Pardosa

Figure 15. Pardosa mackenziana

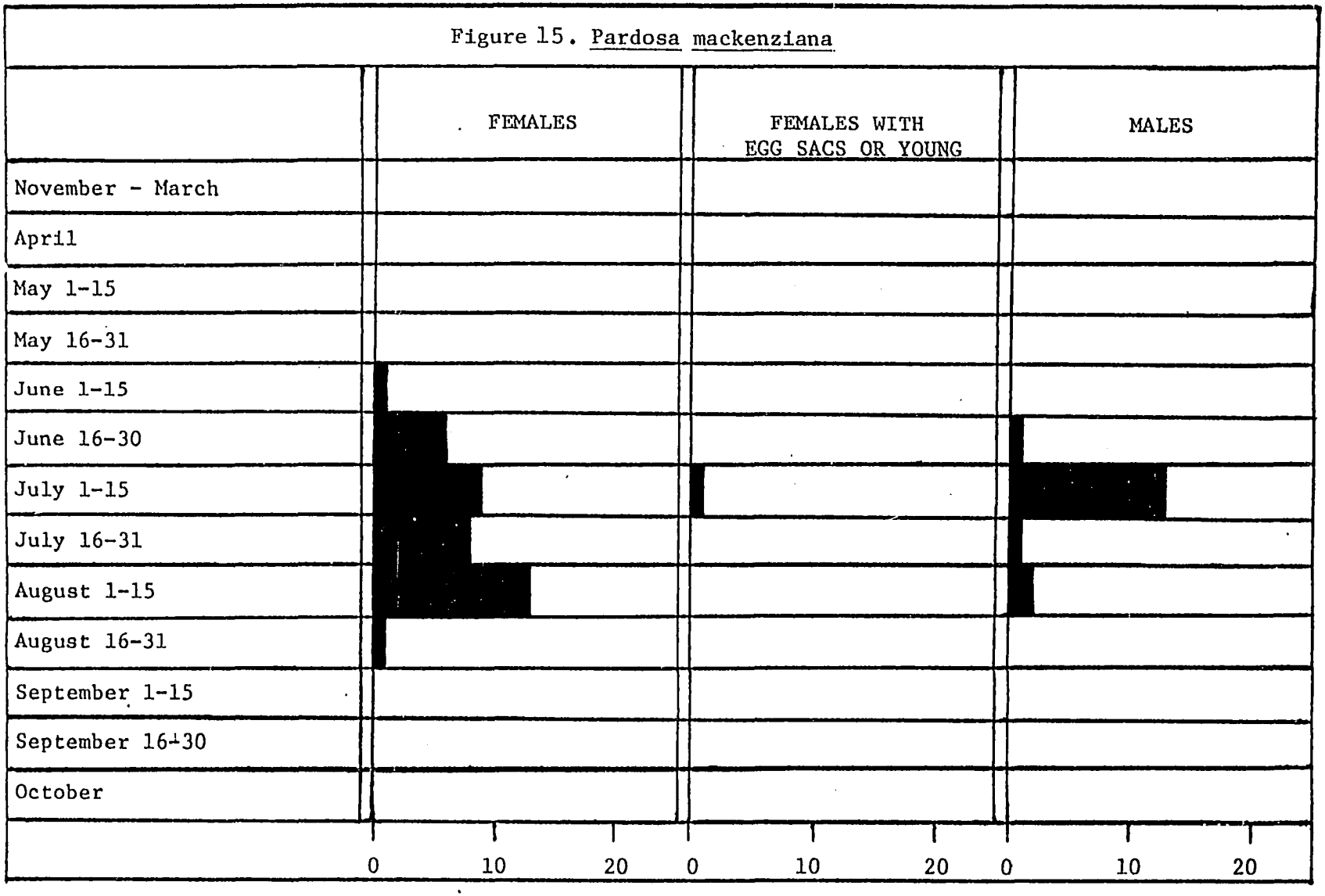
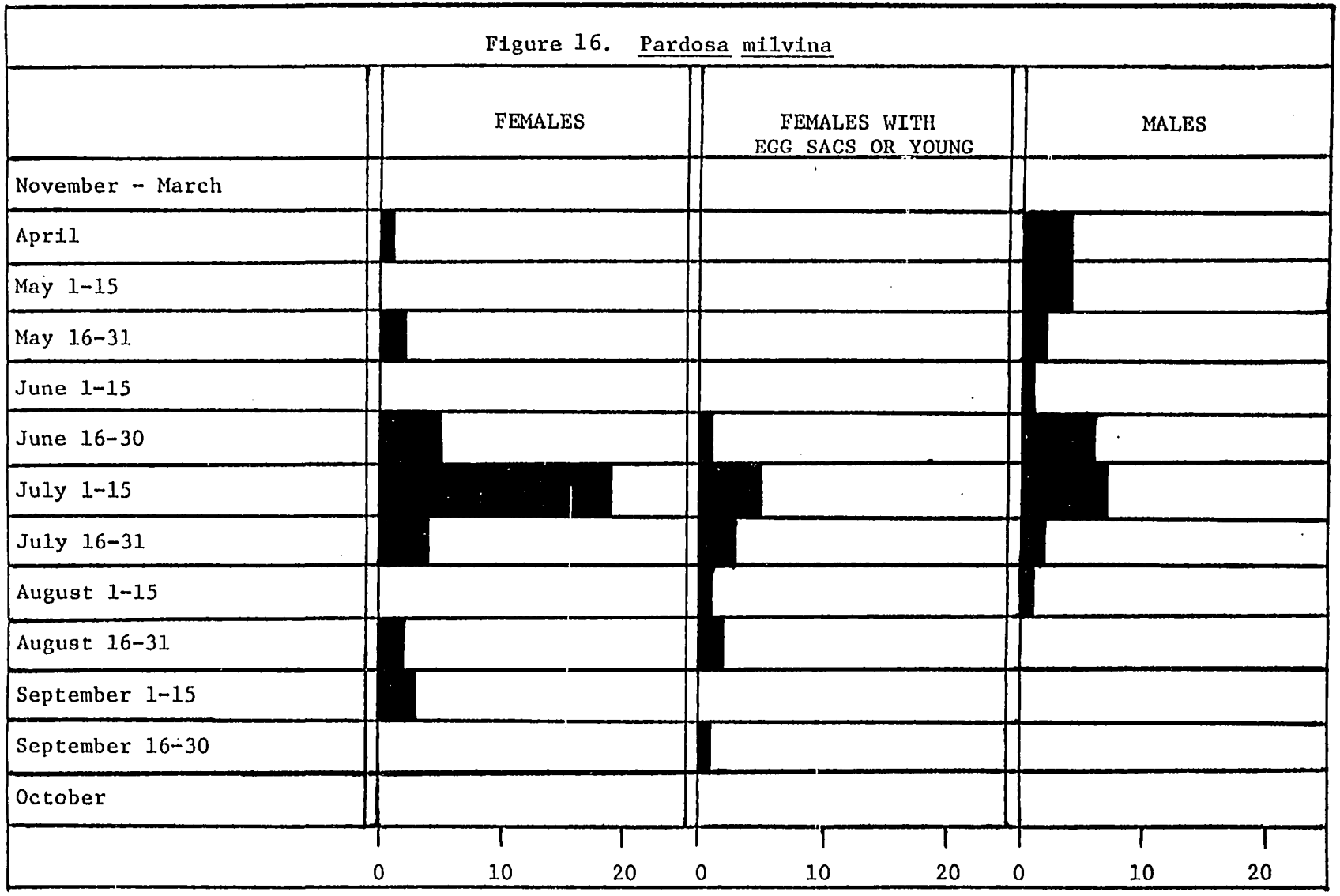


Figure 16. Pardosa milvina



in Figure 14.

Pardosa modica (Blackwell, 1846). Life history data are given in Figure 17. Maturity is reached in late fall and early spring. Collections are from old fields, oak forests, marsh and lake shore. Distribution is given in Figure 18.

Pardosa moesta Banks, 1892. Life history data are given in Figure 19. This species matures at the very beginning of May. In 1975, no mature specimens were collected in the first week of May (most were penultimate), while in 1976, after a warm spring, approximately eighty per cent of the spiders were mature. Less than eight per cent were immature in the last week of May in 1976. Egg sacs are produced in May, June and July, indicating that two egg sacs are made. Distribution is mapped in Figure 18. Habitats include a mowed field, old field, corn field, garden, gravel pit, rocky shore, Typha marsh and oak forest.

Pardosa saxatilis (Hentz, 1844). Life history data are given in Figure 20. Maturity is attained in late May. Egg sacs are carried in June and July, with probably two sacs produced by the female. Distribution is given in Figure 21. This species is known from corn fields, old field, mowed field, gravel pit, Typha marsh and oak woods.

Pardosa xerampelina (Keyserling, 1876). Life history data are given in Figure 22. Maturity is reached in May, with egg sacs collected in July. Habitats include rocky shore,

Figure 17. Pardosa modica

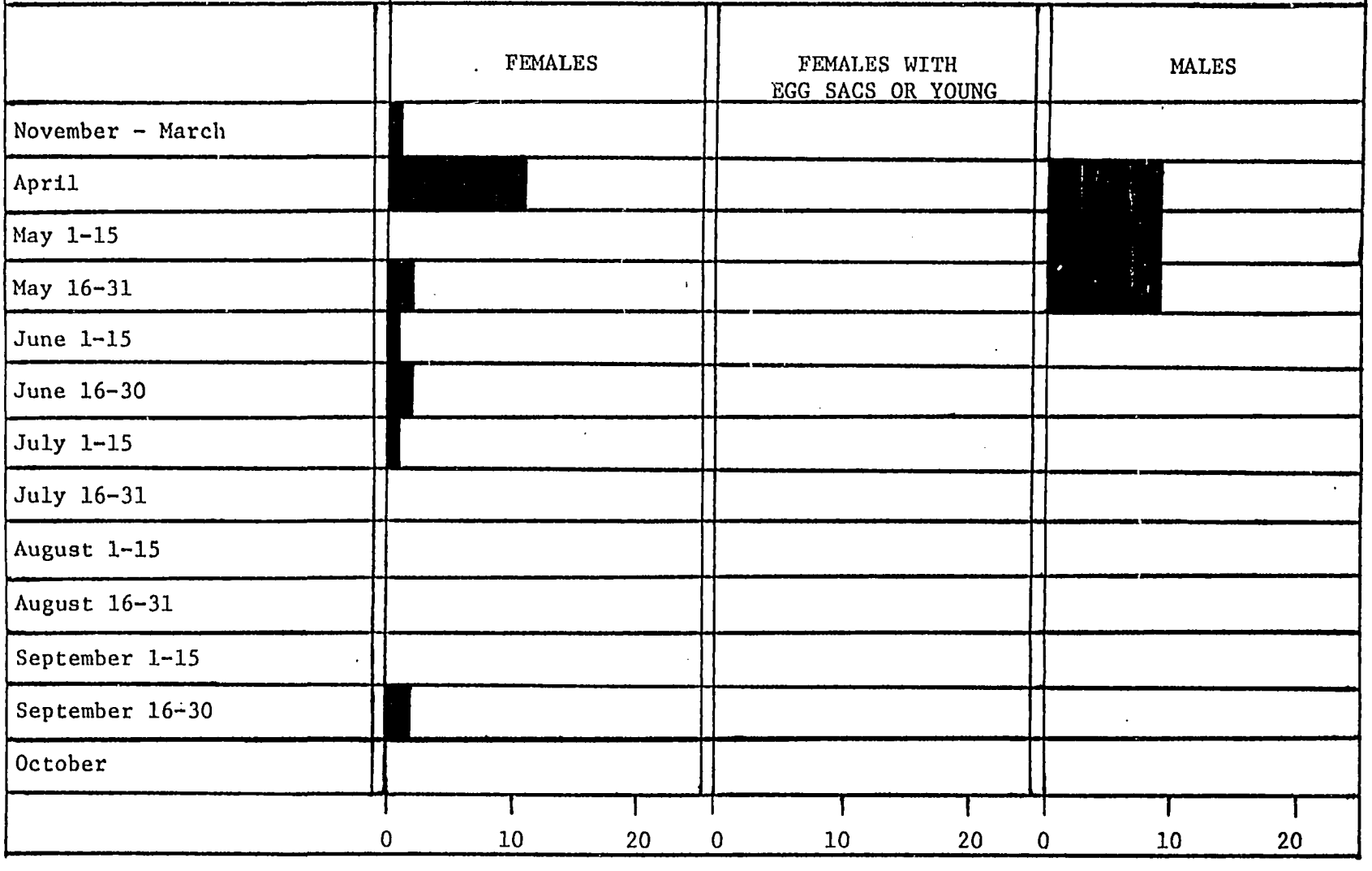


Figure 18. Michigan Pardosa

Figure 19. Pardosa moesta

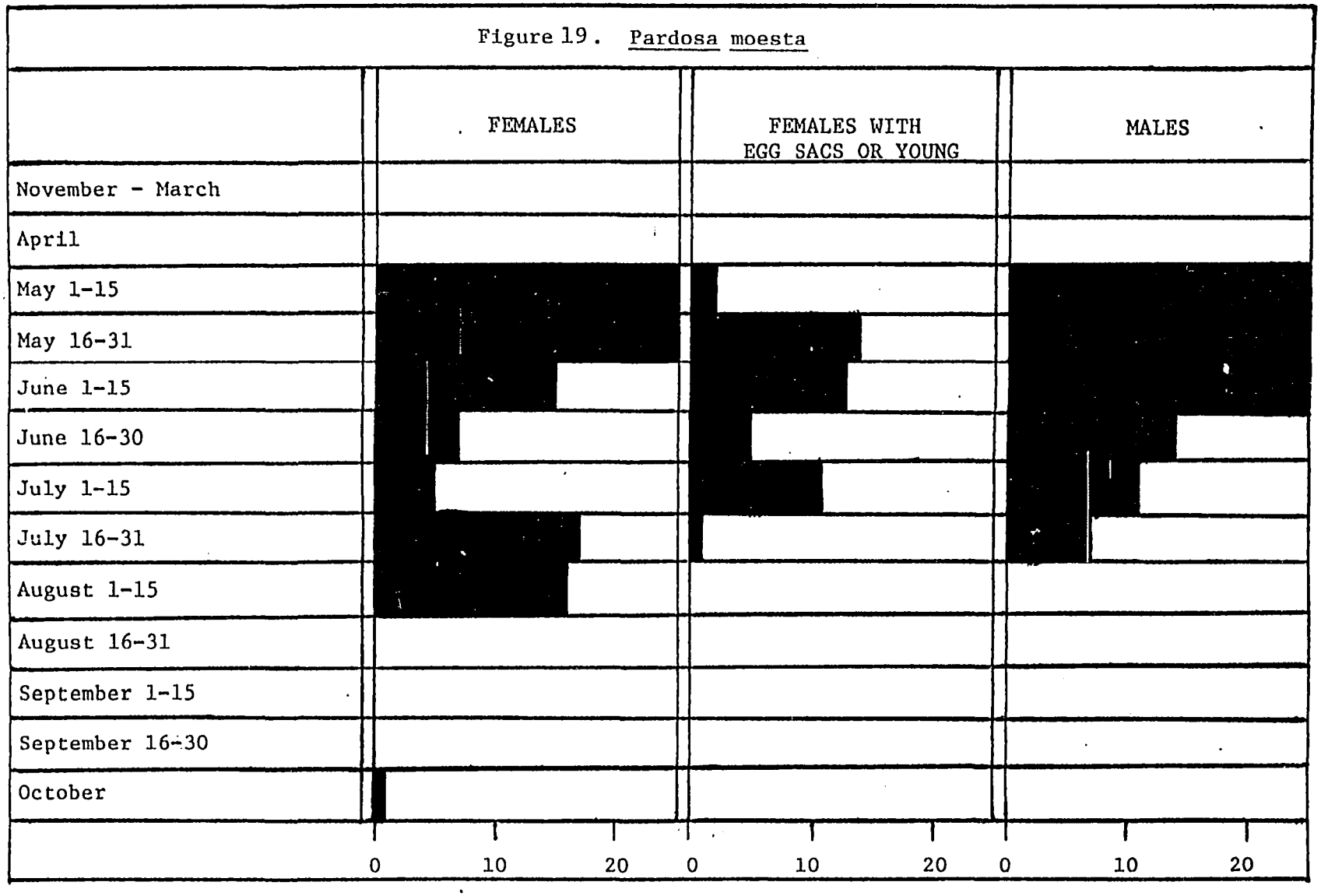


Figure 20. Pardosa saxatilis

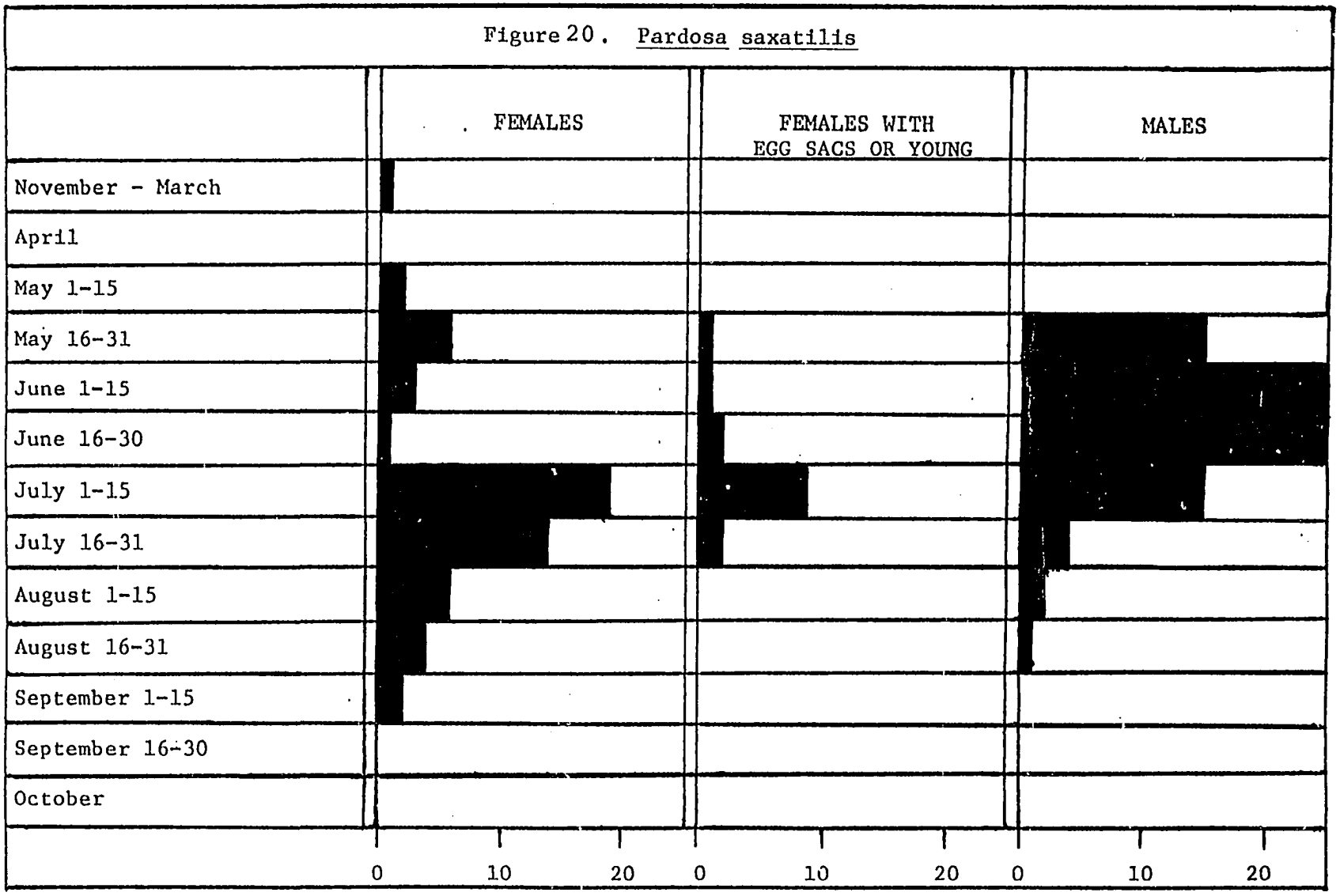
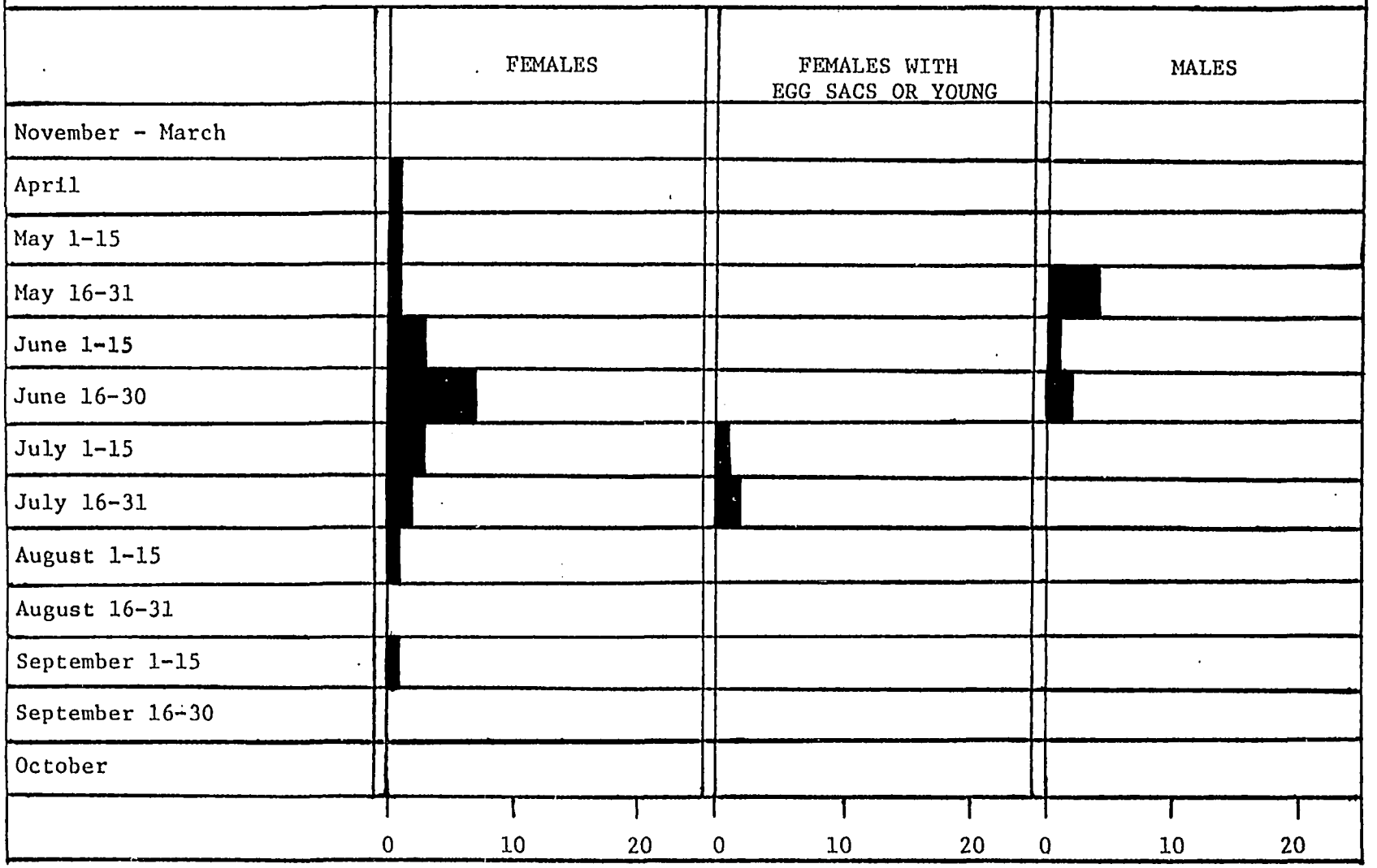


Figure 21. Michigan Pardosa

Figure 22. Pardosa xerampelina



birch-maple forest and a roadside. Distribution is mapped in Figure 21.

Pirata Sundevall, 1833

Members of this genus are very small inhabitants of moist and wet areas. They are abundant in most of these habitats in Michigan. A revision of this genus is in press (Wallace and Exline) with descriptions of new Michigan species (Wallace, personal communication). Species previously recorded from Michigan are Pirata insularis Emerton, 1885, P. minutus Emerton, 1885, P. montanus Emerton, 1885, P. maculatus Emerton, 1909, P. arenicola Emerton, 1909, P. marxi Stone, 1890 and P. piratica (Clerck, 1757). These same species are reported for Connecticut, with only six listed from Wisconsin.

Schizocosa Chamberlin, 1904

Revision of this genus is underway (Dondale, in prep.). The following species have been identified from Michigan: S. avida (Walchenaer, 1837), S. bilineata (Emerton, 1885), S. crassipalpis (Emerton, 1909), S. crassipes (Walckenaer, 1837) and S. saltatrix (Hentz, 1844).

Tarentula Sundevall, 1833

Only one species occurs in Michigan, Wisconsin and Connecticut. The generic character of two teeth on the retromargin of the fang furrow was found to be variable.

A specimen of T. aculeata has a single tooth on the left, and one specimen had many small teeth on the fang furrow. Tarentula aculeata (Clerck, 1757). Distribution of this species is mapped in Figure 23 and life history data are presented in Figure 24. This species has been found in a bog, grass field and along shore outcrops.

Trabea Simon, 1876

Trabea aurantiaca (Emerton, 1885) has been reported from Wisconsin and Connecticut, but no specimens have yet been collected in Michigan.

Trochosa Koch, 1848

The distribution of the two Trochosa species are given in Figure 25.

Trochosa avara Keyserling, 1876. Life history data is given in Figure 26. Maturity is attained in September. Copulation probably occurs in the fall with females overwintering and producing young in May and June, as males have not been collected in the spring or summer.

Trochosa pratensis (Emerton, 1885). Life history data are given in Figure 27. Maturity is reached in late fall and early spring, especially May as shown graphically by the peak of males. Young are produced from early May until mid July. This species has been found in old field, pasture, roadside, rocky beach, hawthorn forest and hardwood forest.

Figure 23. Michigan Tarentula

Figure 24. Tarentula aculeata

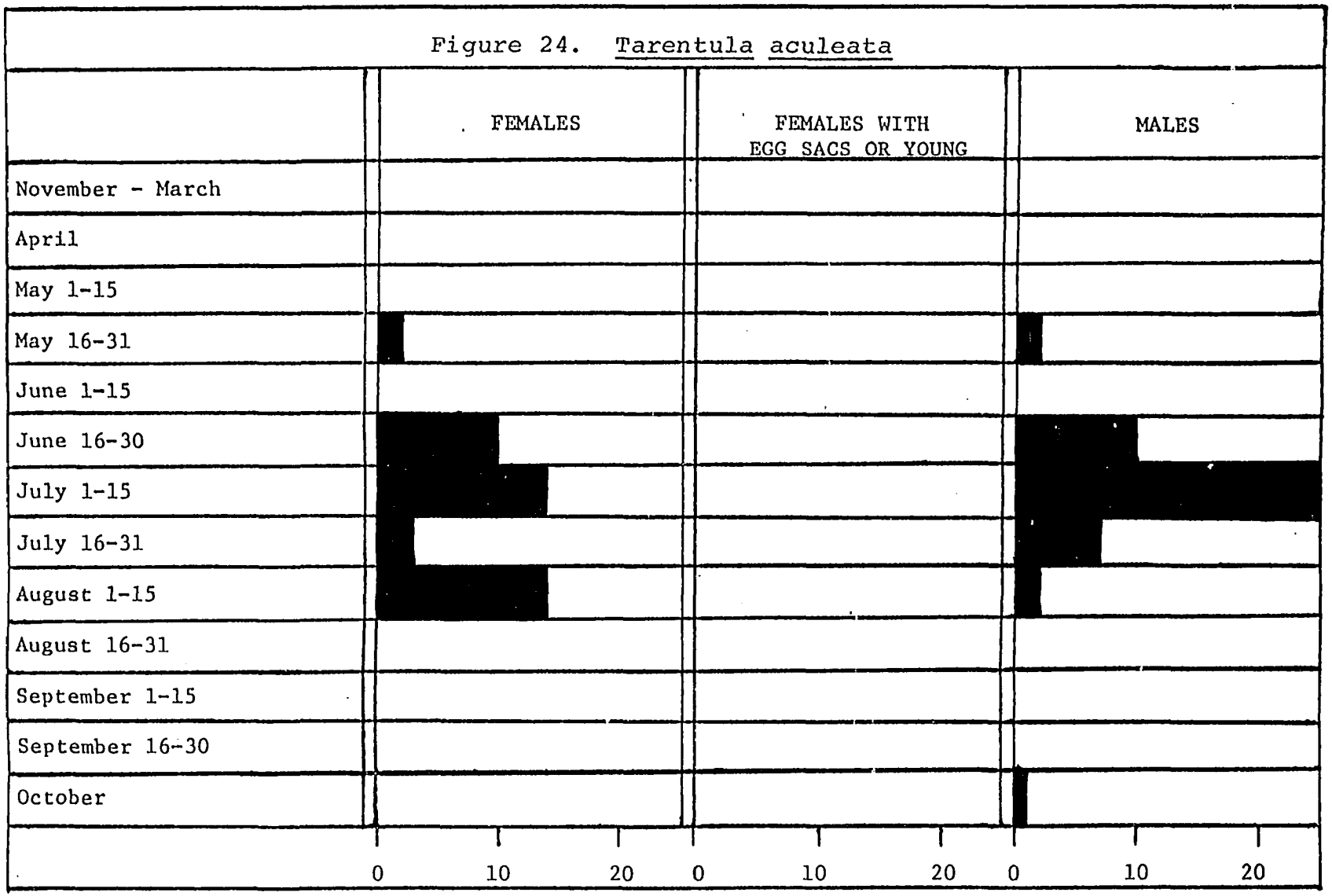


Figure 25. Michigan Trochosa

Figure 26. Trochosa avara

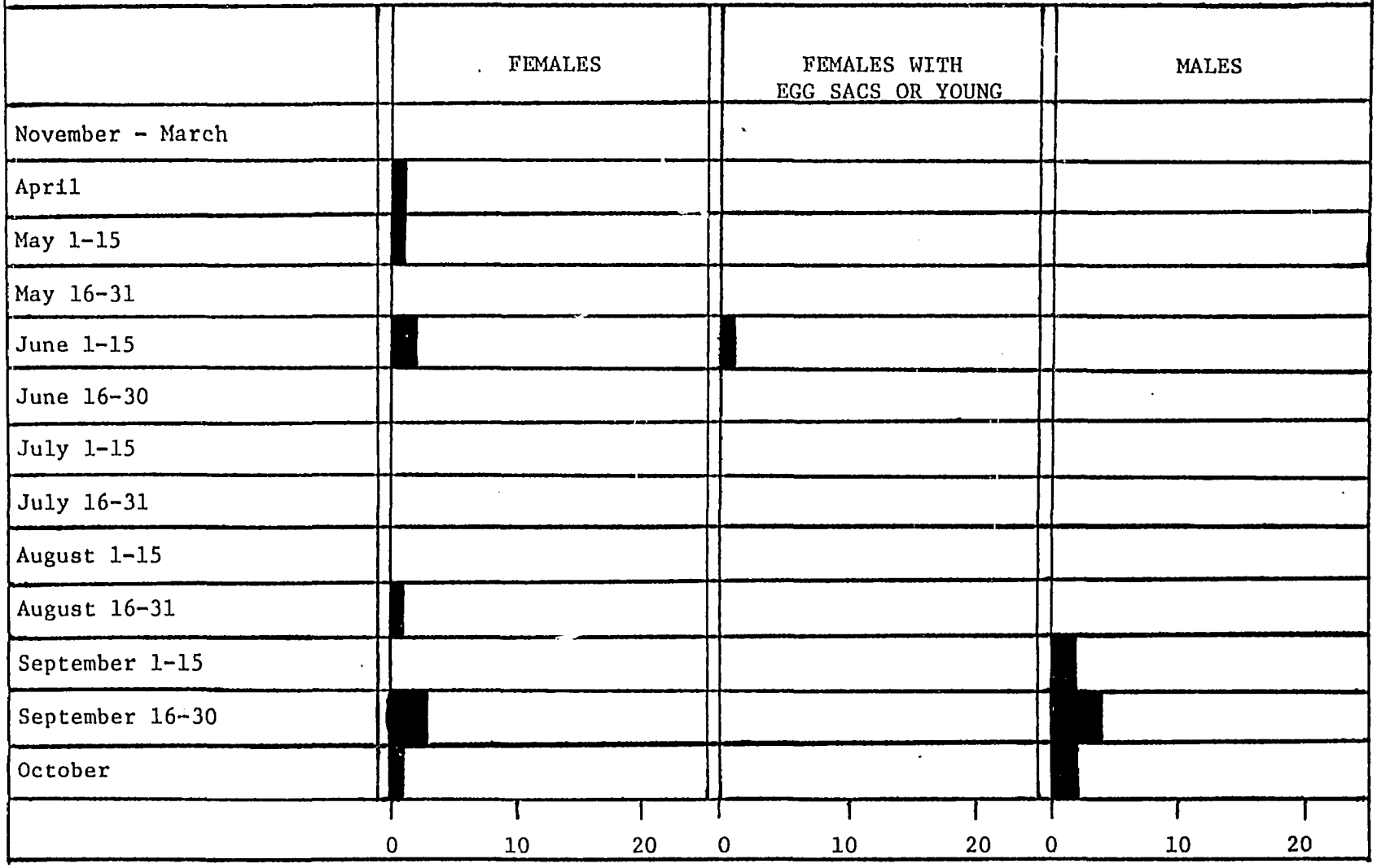
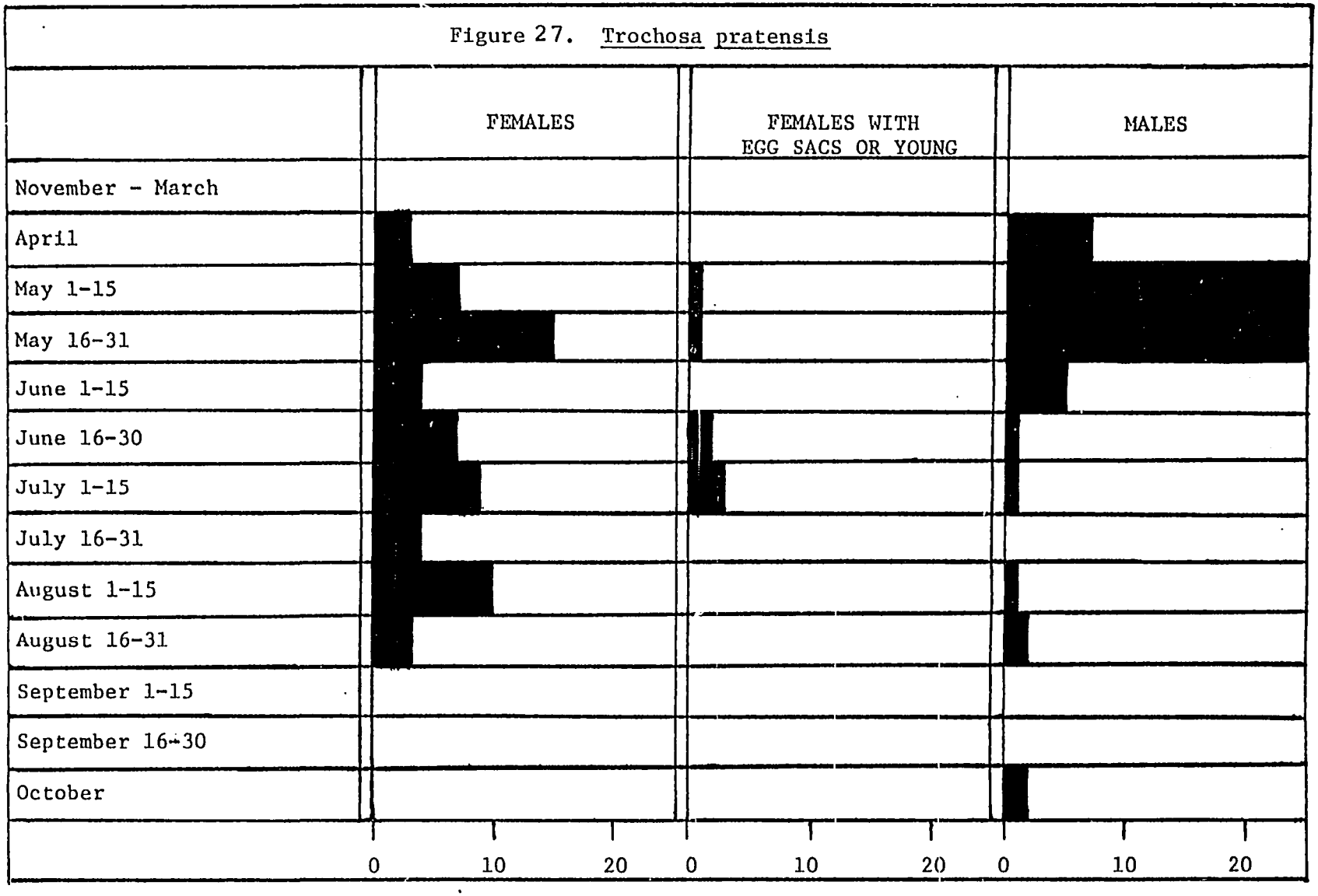


Figure 27. Trochosa pratensis



Specimens with two teeth on the retromargin of the fang furrows rather than the usual three have been seen from Michigan.

HABITAT STUDIES

Particular attention was given to the lycosid fauna and ecology of two old fields in Southwest Michigan. The first was on the north side of the Kalamazoo Nature Center, in Kalamazoo County. The other field was at the Mott Preserve in Van Buren County. Determination of the lycosid fauna in these fields, their distribution, relative numbers, a population estimate and study methods have been evaluated.

Pitfall trapping is a common method of determining the fauna of a habitat. It is among the most consistent sampling methods used (Turnbull, 1973). Its major drawback is that it preferentially samples spiders which are active wanderers. This is not too serious a problem with lycosids, as most are very active. Geolycosa are not collected often because of their sedentary habits.

Population estimates are difficult to obtain because of inadequate sampling methods. Attempts to use a half square meter sampler proved ineffective as the highly mobile lycosids escaped over the edges and under the sampler due to ground irregularities. A sample with sharp edges which could be sunk into the soil would prevent escape from under the edges. But particularly in large populations many spiders escape over the edges due to the inability of the researcher to observe and capture along the complete perimeter.

Mark and recapture is a valuable method for estimating populations. In its simple form (Odum, 1971) mark and recapture provides a reasonable estimate of a population. The major problem with mark-recapture is how to mark the spiders. The handling and marking must not injure the spider and the mark must not bias the recapture by making the spider more noticeable. In order to mark a spider with paint, ventrally in order to not bias collecting, immobilization with cold or carbon dioxide is necessary. This is not practical in the field in terms of the equipment or time and the small size of some spiders. Fluorescent dye in powder form, applied with a paint brush to the dorsum of the abdomen, is not visible except under blacklight. This method is suitable if care is taken not to injure the spider with the brush, or to use too much powder, with it thus becoming visible or possibly blocking the booklungs or tracheae.

Old Fields

Kalamazoo Nature Center's old field is a highly diverse area, ranging from dry in the higher portions to wet springs at the low end of the field. Eight lycosid species have been identified from this field: Pardosa moesta (93 specimens), P. saxatilis (11), P. distincta (4), P. modica (1), Schizocosa bilineata (3), S. crassipalpis (1), S. crassipes (1), and Trochosa pratensis (7).

The upper dry portions of the field are characterized by the species Pardosa distincta, which prefers dry habitats (Vogel, 1964 and Lowrie, 1973) and vegetation which is sparse. The Schizocosa species occur primarily in the upper areas of the field. P. moesta also is found here, though Lowrie (1973) only found it in moist habitats in the Western United States. Moisture is available each morning in the dry area from the dew.

Through the central parts of the field P. moesta is most abundant. Though found in all field habitats, rather than just moist (Lowrie, 1973), P. moesta does prefer long grass and on cooler days is very abundant on matted grass exposed to the sun. The larger lycosids such as Trochosa pratensis are most common in this area of the field.

In the moist low areas of the field P. moesta and two Pirata species are abundant.

The old field at the Mott Preserve is flat and primarily grasses, bordering an oak forest. Three species have been identified from the field: Pardosa moesta (90 specimens), P. distincta (1), and Lycosa frondicola (1). Four additional specimens of unidentified (immature) species were collected. L. frondicola is abundant in the oak woods and ecotonal area bordering the field and the specimen collected in the field was probably an accidental wanderer.

An old field in Marquette, Marquette County which was predominantly grass with sparse areas and exposed rock

yielded nine P. distincta and fifteen P. moesta.

Sparse roadside vegetation in Luce County had one P. moesta and eleven P. distincta. In thick roadside grass in Chippewa County only P. moesta was observed. A field in Schoolcraft County with varied vegetation contained P. moesta (5), P. distincta (3) and L. frondicola (2). Found in a corn field in Kalamazoo County were P. moesta (3), P. saxatilis (2), P. milvina (2), S. avida (1) and Pirata arenicola (1).

Population Estimate

The one attempt to study populations (as described above) which worked well enough to give a population estimate was the mark and recapture method. Only lycosids were captured for this study though salticids, gnaphosids, thomisids and cluboinids were also present on the soil and matted vegetation in this old field.

An area five meters by five meters, 25 square meters, was staked off at the Mott Preserve. On 14 May 75 lycosids were captured, marked with fluorescent dye, and released. It was raining all day on 15 May, so recapture was on 16 May. 112 lycosids were captured, brought to the laboratory and checked for dye. Nine spiders showed the dye. A simple calculation is then used to estimate the population (Odum, 1971).

$$\frac{\text{MARKED}}{\text{POPULATION}} = \frac{\text{RECAPTURED MARKED}}{\text{CAPTURED}}$$

$$\frac{75}{P} = \frac{9}{112}$$

$$P = 933/25 \text{ square meters}$$

$$\text{or } P = 138{,}726/\text{acre}$$

$$\text{or } P = 37/\text{square meter}$$

One hundred eight of the 112 spiders collected on recapture were Pardosa moesta.

The validity of this estimate depends upon many assumptions. The highly mobile nature of lycosids would tend to cause an overestimate of the population. Recapture soon after release probably minimized error from this source. If territoriality or home range occupancy were exhibited by the lycosids the accuracy of the results would be increased due to reduced wandering from the sample area. Mortality may be negligible due to the short interval between marking and recapture. Loss of markings due to molting is also negligible due to the maturity of most specimens (101 of the 112 recaptured). Turnbull (1973) discusses 37 population estimates by numerous authors, indicating that 37/square meter may be a reasonable estimate.

DISCUSSION

One major conclusion may be drawn from this study, that the systematics, distribution, ecology and biology of wolf spiders are insufficiently known. The studies reported here are preliminary, they provide a foundation for further studies.

The majority of lycosid species which probably occur in Michigan are reported here. A notable exception is Trabea aurantiaca, a small species probably overlooked in collecting since it is found in neighboring states. Forty species are listed from Michigan with 31 of these also found among the 40 species of lycosids reported from Connecticut. Thirty-five species are in common with the 36 recorded from Wisconsin. Distribution within Michigan is rather unknown, though interesting patterns emerge from the data which is available. The only large lycosids of the genera Arctosa, Geolycosa, Lycosa and Trochosa which are here reported from Michigan's Upper Peninsula are L. frondicola and T. pratensis. Two Pardosa species are found only in the northern areas of the state, P. groenlandica and P. mackenziana, while P. fuscula, P. milvina, P. modica and P. saxatilis have primarily been collected from the Lower Peninsula. The distribution data suffers from the bias that the most intensive collections were made in Kalamazoo, Ingham, Clinton,

Livingston and Shiawasee Counties. Collections from Isle Royale, Keeweenaw County and Beaver Island, Charlevoix County are the largest from the northern areas of Michigan.

The life history data may often be confusing. Most species have one generation a year, with maturity occurring in the spring for some and in the fall for other species. The large lycosids, such as Geolycosa and some Lycosa have a two year life cycle. This may vary with species or with climate and needs to be investigated further.

The habitat studies open up two interesting questions. The first is what significance over 100,000 wolf spiders per acre has on the populations of insects. Certainly the impact must be great, and the opportunities endless for studying energy flow in various habitats. The second question is how as many as eight species of closely related spiders can live in one habitat. Research on competition and population dynamics would find ideal conditions for study with these spiders. The comments on microhabitats show some means of avoiding competition by the spiders. Selection of food by size and attaining maturity at different times allow for partitioning of resources.

Comparison shows that P. moesta matures earlier than the species it competes with, P. distincta, P. saxatilis, and P. milvina (Figures 7, 10, 12 and 13). Vegetation structure promotes horizontal distribution in these species. Pardosa moesta is most abundant in thick vegetation,

P. distincta is more common in sparse vegetation and *P. milvina* and *P. saxatilis* occur most frequently in open areas often lacking vegetation. How these last two species avoid competition is unknown.

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