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A SYSTEMATIC STUDY OF MICHIGAN CHELONETHIDA  
(ARACHNIDA), AND THE POPULATION STRUCTURE  
OF MICROBISIUM CONFUSUM HOFF IN A BEECH-  
MAPLE WOODLOT.

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A SYSTEMATIC STUDY OF MICHIGAN CHELONETHIDA (ARACHNIDA),  
AND THE POPULATION STRUCTURE OF MICROBISIUM CONFUSUM  
HOFF IN A BEECH-MAPLE WOODLOT

By

Sigurd Oscar Nelson, Jr.

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## ABSTRACT

### A SYSTEMATIC STUDY OF MICHIGAN CHELONETHIDA (ARACHNIDA), AND THE POPULATION STRUCTURE OF MICROBISIUM CONFUSUM HOFF IN A BEECH-MAPLE WOODLOT

By

Sigurd Oscar Nelson, Jr.

The systematics of Michigan Chelonethida (Pseudoscorpionida) and the population structure analysis of Microbisium confusum Hoff in a beech-maple woodlot are given.

Twenty-nine species of pseudoscorpions are reported from Michigan, including two new species, Dinocheirus horricus and Parachelifer monroensis, and an undetermined species of Pseudogarypus.

Disjunct distributions are discussed. Indirect evidence of phoresy is presented.

A key to Michigan pseudoscorpions, and an account of each species including data related to identification, distribution and habitat preference are included.

Data concerning life stages, number of generations per year, and density are presented in the population analysis of M. confusum in beech-maple litter. The maximum density of all life stages reached 154.9 per square

Sigurd Oscar Nelson, Jr.

meter and dropped below 20, except for winter months, on a single occasion. All life stages overwintered. Males were not found. Parameters influencing the above are discussed.

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**PART I**

## INTRODUCTION

Pseudoscorpions are small arachnids less than eight millimeters long. They superficially resemble true scorpions except for the absence of a postabdomen and accompanying sting. These animals are diverse in their habits, and often occur in large numbers, but due to their small size and secretive behavior they usually go unobserved.

More than 2,000 species of pseudoscorpions have been described placing them among the major orders of Arachnida in number of species. Only spiders, mites, and harvestmen have greater numbers of species. Yet little is known about the biology of this group.

Due to the general lack of knowledge concerning pseudoscorpions a twofold study was initiated. The objective of the first study was to advance the knowledge of pseudoscorpion systematics by the presentation of keys and descriptions along with the ecology and distribution of Michigan species. The object of the second study was to determine the population structure of Microbisium confusum Hoff and some of the parameters influencing this species in a beech-maple litter situation.

## LITERATURE REVIEW

The recorded history of pseudoscorpions is dated to Aristotle's De Animalibus Historiae, while the systematic history of pseudoscorpions began with the recognition of two species by Linnaeus in the tenth edition of Systema Naturae, 1758. The order Faux Scorpiones (Pseudoscorpiones) was first used by Latreille (1806-9) and included pseudoscorpions and solpugids. In 1876 Thorell proposed the ordinal name Chelonethi. Today the ordinal name Chelonethida is widely accepted in America while Pseudoscorpionidea is preferred in Europe.

While earlier works were of a classificatory nature along with species descriptions, major efforts were initiated in both the United States and Europe in the early 1930's by J. C. Chamberlin and M. Beier, respectively. Morphological monographs on pseudoscorpions have been written by Kaestner (1927), Chamberlin (1931), Beier (1931-1941), Roewer (1940) and Vachon (1949). Beier, during the years 1958-1967, published extensive keys for various parts of the world, and Hoff (1958) published a key to North American genera.

The systematics of North American pseudoscorpions has been extensively advanced by Chamberlin especially during the 1930's, Hoff (1944-64) and Muchmore during the past decade. In Michigan preliminary studies of pseudoscorpions were made by Fenstermacher (1959) and Manley (1969).

While the aforementioned works were of a morphological and systematic nature, Weygoldt (1969) published The Biology of Pseudoscorpions, a 145-page comprehensive volume with emphasis on reproduction and development. Recent papers related to life history analyses and quantitative sampling by Gabbutt have contributed to the population ecology of pseudoscorpions.



## COLLECTING METHODS

Many pseudoscorpions, especially larger species, were collected by hand picking from under bark, boards, or by sifting rotten wood. Occasionally this method yielded a large number of individuals. However, due to the secretive nature and small size of the animals, many individuals were probably overlooked.

Samples of leaf litter, soil, bark, small mammal and bird nesting materials, and woody debris were removed to the laboratory and placed in Tullgren funnels. Tullgren funnels consist of two main parts; a lower funnel and an upper reflector containing a low power (25-50W) light source. A one-eighth inch screen is placed in the lower funnel, atop which samples thought to contain pseudoscorpions are placed. The light source is placed above the sample thus creating a temperature-moisture gradient. As time passes the uppermost portion of the sample progressively becomes warmer and drier, thus driving most arthropods, including pseudoscorpions, downward into a collecting jar. The drying time varies from a few hours to a few weeks dependent upon the moisture content and volume of the sample. The collecting jar usually

contains ethyl alcohol, however, during this study ethylene glycol was used. Ethyl alcohol is more volatile than ethylene glycol and its use may cause fumes to enter the funnel, thus hampering the extraction of many arthropods. The surface tension of ethylene glycol is sufficiently low to entrap specimens. As ethylene glycol is not a preservative the extracted arthropods should be transferred to 70 per cent ethyl alcohol.

Field collections were placed in large plastic bags along with date locality information. Those samples not immediately placed in Tullgren funnels were stored in a cold room maintained at approximately 45°F. All samples were allowed to reach room temperature before being placed in the funnels.

Sample materials were removed from the plastic bags and those substances too large to be placed in the funnels were broken down. Materials were loosely placed in the funnels in such a manner that a slope to an open central region was created, thus facilitating movement of the arthropods downward into the collecting jar. The collecting jars were examined for pseudoscorpions. Pseudoscorpions were removed from the collecting jars, placed in vials containing 70 per cent ethyl alcohol along with proper date locality information, and stored until a critical examination was made.

Specimens were also obtained by examining collections made previously by other individuals.

## PREPARATION OF MATERIAL

The examination of most pseudoscorpion species requires proper orientation and magnification of materials. It is imperative that specimens be prepared as indicated by Hoff (1949), as outlined below.

Pseudoscorpions were individually placed in a Syracuse watch glass containing 70 per cent alcohol. The chelicerae and pedipalps were removed from the body along with one of the first and fourth walking legs at the coxal-trochanteral joint. The chela was separated from the tibia of one pedipalp and the palpal fingers were spread apart. The above appendages were placed in beechwood creosote for clearing. After piercing the abdominal pleural wall the body was placed in a test tube containing 10 per cent KOH. The test tube was heated in a boiling water bath until internal materials were dissolved. Care was taken to avoid overtreatment in the KOH solution. When overtreated, bleaching and discoloration resulted. The body was transferred from KOH to distilled water and allowed to stand for approximately 24 hours. By gently creating a pumping action on the abdomen with a small needle, excess visceral material was removed. Next,

the body was placed in a 1/50 N HCl solution, neutralizing any remaining KOH. After the above treatment the body was transferred to the beechwood creosote vial containing the appendages and allowed to clear overnight.

All specimens were mounted directly from beechwood creosote to Canada balsam. Microscope slides, after cleaning, were divided into approximately three equal parts. The first part was reserved for the slide label while the remaining two-thirds of the slide was used for mounting the specimen. The body and palps were placed under one coverslip which was supported by two finely drawn glass rods. Occasionally smaller specimens did not require support. The body was mounted ventral side up while the palp with the chela attached was mounted dorsal side up. The chela, previously removed from the other palp, was mounted lateral side up. The chelicerae and legs were placed under a second coverslip without supporting rods, thus compressing the legs for measuring purposes.

Slides were labeled with the proper date locality information and placed in a drying oven. Specimens were identified through the use of numerous publications, the majority of which were authored by C. Clayton Hoff.

The prepared slides were examined with a compound microscope at powers of 100 and 430X. An ocular micrometer was used to measure important body parts. Standard

measurements, illustrated by Chamberlin (1931), were used. All absolute measurements are given in millimeters.

## DISTRIBUTION

Pseudoscorpions as an Order are cosmopolitan in distribution. They reach their greatest densities and diversity in the tropics and subtropics, yet many are present in the temperate regions. Many families are cosmopolitan in distribution while others may be more localized. Still others are circumtropical or circum-polar. The genus Neobisium is circum-polar in distribution, with N. muscorum Leach occurring as far north as northern Scandinavia, and N. jugorum (L. Koch) occurring as high as 2900 meters in the Alps. The species Chelifer cancroides (Linnaeus) and Cheiridium museorum (Leach) are cosmopolitan.

The dispersal of pseudoscorpions resulting in such widespread distribution is of considerable interest. As terrestrial arthropods lacking a flight mechanism, their ability to disperse would appear limited. However, effective dispersal mechanisms do exist. Vachon (1940, 1947a, 1947b) reported large numbers of pseudoscorpions attached to insects and birds. This use of one species by another species for transportation is called phoresy. Vachon believed phoretic behavior to be prevalent among adult

females and Gabbutt (1970) felt that dispersal may be facilitated by adult longevity. Mammals may also serve as carriers. Indeed, man, although not necessarily in a literal phoretic sense, may be responsible for the wide-spread distribution of many species, especially those species that are associated with domestic situations (buildings) such as Chelifer cancroides. Chamberlin (1938) reported many species of pseudoscorpions taken at coastal quarantine stations from incoming merchandise. Finally, air currents may be responsible for the wide-spread distribution of many species, especially smaller pseudoscorpions.

Of the pseudoscorpions found in Michigan only Chelifer cancroides is found throughout the United States. Only one other species, Microbisium confusum Hoff is found west of the Continental Divide. Many Michigan species are widely distributed east of the Rocky Mountains. M. confusum and Lamprochernes oblongus (Say) are distributed from the eastern States as far west as Colorado. Apochthonius moestus (Banks) is widely distributed throughout the eastern and southcentral States as far west as New Mexico. Chthonius tetrachelatus (Preyssler) is an eastern species that also occurs in Europe. Eastern and central species are: Microbisium brunneum (Hagen), Larca granulata (Banks), Illinichernes distinctus Hoff, Dinocheirus pallidus (Banks), Mirochernes dentatus (Banks), and Paisochelifer callus

(Hoff). Syarinus enhuycki Muchmore and Hesperochnes tamiae Beier occur in the northeast, while Mundochthonius rossi Hoff and Lamprochnes minor Hoff occur in the North-central States. Species that occur in the Midcentral States include: Parachernes squarrosus Hoff, Psela-phochnes parvus Hoff, Hesperochnes ewingi (Hoff), H. lymphatus (Hoff), Acuminochnes crassopalpus (Hoff), and Idiochelifer nigripalpus (Ewing). Still other species show disjunct distributions Apocheiridium stannardi Hoff is found in Michigan, Illinois, and Colorado, while Acuminochnes tacitus Hoff is only found in Michigan and Colorado, and Hesperochnes amoenus Hoff is only found in Michigan and South Dakota.

Disjunct populations could result from a number of factors. First, they could be actual relict populations. Relict populations are those populations that originally encompassed a much larger area, but due to habitat changes isolated or disjunct pockets of the species occur. Secondly, dispersal resulting from phoretic behavior or by man could result in disjunct populations. Thirdly, in groups of species lacking in-depth systematics and distributional studies disjunct records occur. Finally, disjunct populations could artificially occur based on misidentification of species.

Within Michigan many species are widespread, while others when adequate records are present, show definite



geographic patterns. Species occurring in both the Upper and Lower Peninsula are: Mundochthonius rossi, Microbisium brunneum, M. confusum, Apocheiridium stannardi, Dinocheirus pallidus, Acuminochernes tacitus, Dendrochernes morosus (Banks), and Chelifer cancroides. Only two species, Pseudogarypus sp. and Hesperochernes amoenus, occur exclusively in the Upper Peninsula, although Mundochthonius rossi, taken from five western counties in the Upper Peninsula, is represented in the Lower Peninsula by a single specimen from Ingham County. Larca granulata, Lamprochernes oblongus, L. minor, Pselaphochernes parvus, Mirochernes dentatus, Dinocheirus horricus n. sp., and Dactylochelifer copiosus Hoff are generally widespread in the Lower Peninsula. Species found only in the southern one-half of the Lower Peninsula are: Chthonius tetrachelatus, Hesperochernes lymphatus, H. ewingi, Acuminochernes crassopalpus, and Idiochelifer nigripalpus. The following species have been collected too infrequently to establish any distributional patterns: Syarinus enhuycki, Parachernes squarrosus, Hesperochernes tamiae, and Paisochelifer callus. To this list of infrequent records must be added three species taken only from those counties adjacent to Indiana and Ohio: Apochthonius moestus, Illinichernes distinctus, and Parachelifer monroensis n. sp.

## ECOLOGY AND HABITAT PREFERENCES

Pseudoscorpions are reported from a wide variety of habitats, often occurring in large numbers. Physical factors essential for the well-being of most species are adequate crevices enabling the pseudoscorpions to retreat, areas of optimum relative humidity, and favorable temperatures. Weygoldt (1969) reported Neobisium muscorum only reproduces in captivity at temperatures approximately 15 to 18°C. Other factors, yet unknown to researchers, may be of considerable importance.

Only a few quantitative studies of pseudoscorpions have been undertaken. Their small size and secretive behavior probably discourages many investigators. Usually, if numbers of individuals are reported, they represent a single sample and are not indicative of the population structure within a given locality. Still, these numbers are of importance and often reach considerable magnitude. For example, forty-seven individuals of Microbisium confusum were extracted from 10 square cm. of pine litter of an unknown depth; fifty-five individuals of Idiochelifer nigripalpus were hand-picked from the bark of black cherry. These numbers, however,

are of little value in determining population structure. Only random quantitative sampling over a period of time will supply information concerning the population dynamics of a species. Gabbutt (1967) found total numbers of Chthonius ischnocheles (Hermann) in Oxon, England to range from 128.5 to 619.7 individuals per square meter over a two-year period, excluding winter months.

Many species of pseudoscorpions live in leaf litter and soil, under the bark of trees, in tree hollows, under stones, and within rock crevices. Still other species are found in the nests of mammals, birds, and insects. Other species are associated with domestic situations and are found in buildings such as barns, greenhouses, and private homes. Of more recent interest are the cavernicolous species, chiefly Chthonidae and Neobisiidae.

A number of species inhabit the seashore. Weygoldt (1969) reported a zonation of four different species of pseudoscorpions from the high-tide line to the sand dune area along the coast of North Carolina. Neobisium maritimum (Leach), a European species, occupies an intertidal zone and is submerged twice daily.

The habitat associations of pseudoscorpions collected in Michigan are shown in Table 1. Some of the more common associations are discussed below.

Nine species of pseudoscorpions were taken from litter and soil, with the Heterosphyronida and Diplosphyronida

TABLE 1.--Species habitat associations.

	Litter and soil	Rotten logs and stumps	Tree hollows	Under bark	Sphagnum	Moss, fungi, lichens and liverworts	Shavings and sawdust	Grain bins	Under boards	Nests	Old straw and hay	Phoresing	Pit traps	Miscellaneous
<b>HETEROSPHYRONIDA</b>														
<u>Chthonius tetrachelatus</u>	X	X		X		X			X					
<u>Apochthonius moestus</u>	X													
<u>Mundochthonius rossi</u>	X	X	X											
<b>DIPLOSPHYRONIDA</b>														
<u>Microbisium brunneum</u>	X	X		X	X	X								x <sup>1</sup>
<u>Microbisium confusum</u>	X	X	X	X	X	X	X			X	X		X	x <sup>2</sup>
<u>Syarinus enhuycki</u>	X													
<u>Larca granulata</u>			X-X <sup>a</sup>							X <sup>a</sup>				x <sup>3</sup>
<b>MONOSPHYRONIDA</b>														
<u>Pseudogarypus sp.</u>		X	X	X										
<u>Apocheiridium stannardi</u>			X	X						X				
<u>Lamprochernes oblongus</u>				X						X		X		
<u>Lamprochernes minor</u>							X	X	X	X				
<u>Parachernes squarrosus</u>		X		X										
<u>Pselaphochernes parvus</u>	X	X	X	X							X			
<u>Dendrochernes morosus</u>				X										
<u>Hesperochernes ewingi</u>				X <sup>b</sup>		X				X <sup>b</sup>				
<u>Hesperochernes lymphatus</u>				X		X						X		
<u>Hesperochernes amoenus</u>		X												
<u>Hesperochernes tamiæ</u>													X	
<u>Illinichernes distinctus</u>			X <sup>c</sup>							X <sup>c</sup>				
<u>Mirochernes dentatus</u>			X <sup>d</sup>	X						X <sup>d</sup>				
<u>Dinocheirus pallidus</u>			X <sup>e,f</sup>							X <sup>e,f</sup>				
<u>Dinocheirus horricus</u>														
<u>Acuminochernes tacitus</u>		X	X <sup>g</sup>							X <sup>g</sup>	X			
<u>A. crassopalpus</u>		X	X <sup>h</sup>							X <sup>h</sup>				
<u>Chernetinae nymphs</u>		X	X	X						X				
<u>Chelifer cancroides</u>										X	X			x <sup>4</sup>
<u>Palisochelifer callus</u>								X <sup>5</sup>						
<u>Idiochelifer nigripalpus</u>				X										
<u>Parachelifer monroensis</u>	X													
<u>Dactylochelifer copiosus</u>	X				X	X								x <sup>6</sup>
<u>Cheliferidae nymphs</u>				X						X				

a-h indicate the same sample; 1: base of Carex sp.; 2: Cedar strippings; 3: under stones; 4: domestic situations; 5: collected with Lamprochernes minor; 6: collected atop automobile hood at black light

occurring most frequently. Microbisium confusum is ubiquitous, but occurred most frequently in litter and soil.

Microbisium brunneum was taken most often from bog sphagnum, although this species is not limited to sphagnum. This species is also known to occur in litter and soil, rotten woody debris, and under elm bark in a flooded area. Hoff (1949) reported this species to be associated with the tamarack bogs of northern Illinois and the cypress swamps of southern Illinois.

Thirteen species of pseudoscorpions were collected from under the bark of dead trees (Table 2). Idiochelifer nigripalpus, reported by Hoff (1949) to occur under the bark of living trees, was collected under the bark scales of live black cherry, Prunus serotina Ehrh. Lamprochernes oblongus was collected from under the bark of seven different trees and appeared to show some habitat specificity for bark, but not for any specific tree species. Pseudoscorpions were most frequently collected from under the bark of dead sugar maple, Acer saccharum Marsh, American elm, Ulmus americana Linnaeus, and black oak, Quercus velutina Lam.

Eleven species have been collected within the hollows of trees in association with rotten wood and debris (Table 3). Six of these species belong to the subfamily Chernetinae, with Dinocheirus pallidus occurring most often in tree hollows. No apparent specificity was

TABLE 2.--Pseudoscorpions found under the bark of dead trees.

	<u>Pinus banksiana</u> <u>Jack pine</u>	<u>P. resinosa</u> <u>Red pine</u>	<u>Pinus sp.</u>	<u>Picea sp.</u> <u>Spruce</u>	<u>Salix sp.</u> <u>Willow</u>	<u>Populus tremu-</u> <u>loides Aspen</u>	<u>Quercus alba</u> <u>White oak</u>	<u>Q. rubra</u> <u>Red oak</u>	<u>Q. velutina</u> <u>Black oak</u>	<u>Quercus sp.</u>	<u>Ulmus americana</u> <u>American elm</u>	<u>Prunus serotina</u> <u>Black cherry</u>	<u>Acer saccharum</u> <u>Sugar maple</u>	<u>A. rubrum</u> <u>Red maple</u>	Unknown
<u>C. tetrachelatus</u>													2		
<u>M. brunneum</u>											1				
<u>M. confusum</u>		1												1	1
<u>Pseudogarypus sp.</u>															1
<u>A. stannardi</u>									1	1					1
<u>L. oblongus</u>	1		1			1			1			1	1	1	
<u>P. squarrosus</u>					1										
<u>P. parvus</u>								1			1		2		
<u>D. morosus</u>				1											1
<u>H. ewingi</u>											1				1
<u>H. lymphatus</u>							1								
<u>M. dentatus</u>									1						
Chernetinae nymphs						1									
<u>I. nigripalpus</u>											1				

TABLE 3.--Pseudoscorpions present in tree hollows.

	<u>Pinus strobus</u> White pine	<u>Populus tremu-</u> <u>loides</u> Aspen	<u>P. grandidentata</u> Large-tooth aspen	<u>P. deltoides</u> Cottonwood	<u>Ostrya virginiana</u> Ironwood	<u>Betula lutea</u> Yellow birch	<u>Fagus grandi-</u> <u>folia</u> Beech	<u>Quercus alba</u> White Oak	<u>Q. rubra</u> Red oak	<u>Ulmus americana</u> American elm	<u>Prunus serotina</u> Black cherry	<u>Acer spicatum</u> Mountain maple	<u>A. saccharum</u> Sugar maple	<u>A. rubrum</u> Red maple	<u>Fraxinus pennsyl-</u> <u>vanica</u> Red ash	Unknown
<u>Mundochthonius rossi</u>					1								2			
<u>Microbisium confusum</u>											1		3		1	
<u>Larca granulata</u>	1	1							1					1		
<u>Pseudogarypus</u> sp.	1								1				1			
<u>Apocheiridium stannardi</u>																1
<u>Pselaphochernes parvus</u>													1			
<u>Illinichernes distinctus</u>									1m							
<u>Mirochernes dentatus</u>							1	1-1m	1				1		1-1m	
<u>Dinocheirus pallidus</u>			1i		1		2	2	1m	1		1m	1		1m	
<u>Acuminochernes tacitus</u>		1m					1		1				3		1m	
<u>A. crassopalpus</u>			1i	1			2			1					1m	
Chernetinae nymphs							1	1								1

<sup>i</sup>insect nests<sup>m</sup>mammal nests

shown between a pseudoscorpion and any tree species. Sugar maple was the most common tree with hollows containing pseudoscorpions.

Often the tree hollows contained the remains of mammal, bird, and insect nests (Table 4), or less frequently the active nests of a small mammal or bumble bees. These nests often contained a rich supply of food. Pseudoscorpions feed on small arthropods. The presence of a pseudoscorpion within the nest may have been the result of phoresy.

The only direct record of possible phoresy was reported by Fenstermacher (1959). He reported Lamprochernes oblongus from under the elytra of the elaterid beetle, Alaus oculatus (Linnaeus). However, indirect evidence of phoresy does exist. Such evidence points to phoresy even though the pseudoscorpion is not collected attached to a carrier. Female Hesperochernes ewingi, H. lymphatus and Dinocheirus pallidus were collected, on separate dates, in aerial net traps (Fig. 1) erected to capture flying insects. There is a possibility that the pseudoscorpions entered the traps via air currents and were not attached to a carrier at any time. Apocheiridium stannardi and Lamprochernes oblongus were collected from nest boxes of the wood duck, Aix sponsa (Linnaeus). The boxes, attached to dead trees in a flooded area, were completely surrounded by ice when collected (Fig. 2), but during more seasonal periods would



TABLE 4.--Pseudoscorpions found in nests of insects, birds and mammals.

	Unknown small mammal	Mouse nest	<u>Microtus</u> sp.	<u>Peromyscus</u> <u>leucopus</u>	<u>Mus musculus</u>	<u>Tamias striatus</u> <u>E. chipmunk</u>	<u>Sialia sialis</u> <u>E. bluebird</u>	<u>Turdus migrator-</u> <u>ius</u> American robin	<u>Aix sponsa</u> <u>Wood duck</u>	<u>Bombus</u> <u>americanorum</u>	<u>Bombus</u> <u>bimaculatus</u>	<u>Apis mellifera</u> <u>and vespula</u> sp.
<u>Chthonius tetrachelatus</u>											1	
<u>Microbisium confusum</u>		1	1				1					
<u>Larca granulata</u>						1						
<u>Apocheiridium stannardi</u>									1			
<u>Lamprochernes minor</u>										1		
<u>Lamprochernes oblongus</u>									1			
<u>Illinichernes distinctus</u>	1a											
<u>Hesperochernes ewingi</u>				1								
<u>Mirochernes dentatus</u>	1			1								
<u>Dinocheirus pallidus</u>	1-1a			1b								1c
<u>Acuminochernes tacitus</u>				1		1						
<u>A. crassopalpus</u>				1b								1c
Chernetinae nymphs								1				
<u>Chelifer cancroides</u>										1		
Cheliferidae nymphs										1		

a, b, and c indicate the same nest

Fig. 1. Aerial net traps erected to capture flying insects.

Fig. 2. Nest box of the wood duck, Aix sponsa, surrounded by ice.



Figure 1



Figure 2

be surrounded by water. However, man may have introduced nesting materials containing pseudoscorpions, therefore, phoresy would not have occurred. A male Dactylochelifer copiosus was collected, atop an automobile hood, at a black light. The black light was used to attract flying insects. Finally, a female Hesperochnes tamiae was collected in a pit trap, and may have entered phoretically.

Weygoldt (1969) reported that many species, including several Chthonius species, and some Chernetidae and Cheliferidae, construct silken chambers in order to hibernate. He indicated that the pseudoscorpions resisted extraction by Tullgren funnel methods. During winter months, November through March, sixteen species of pseudoscorpions were collected in addition to unidentified chernetine and cheliferid nymphs (Table 5). All of the above species, with the exception of the cheliferid nymph, were extracted using a Tullgren funnel.

Sixteen samples yielded more than one species of pseudoscorpion (Table 6). In four samples, three species were present. Microbisium confusum and Dinocheirus pallidus occurred most frequently with other species although these two species were never collected together. Eight of these samples were taken from tree hollows. It is not the intent of the writer to imply that any of the samples were homogeneous in nature. However, Hoff (1959) stated that inter-species associations are probably the result of

TABLE 5.--Winter collections.

Species	Months	Adults	Nymphs
<u>Apochthonius moestus</u>	March	X	
<u>Mundochthonius rossi</u>	November	X	X
<u>Microbisium brunneum</u>	December	x	
<u>Microbisium confusum</u>	November, December January, February	X	X
<u>Larca granulata</u>	December	X	
<u>Apocheiridium stannardi</u>	February	X	
<u>Lamprochernes oblongus</u>	February		X
<u>Acuminochernes crassopalpus</u>	March	X	
<u>Dinocheirus pallidus</u>	February, March	X	X
<u>Dinocheirus horricus</u>	January	X	X
<u>Mirochernes dentatus</u>	February, March	X	?
<u>Hesperochernes ewingi</u>	February	X	
<u>Hesperochernes lymphatus</u>	February	X	
<u>Hesperochernes amoenus</u>	November	X	X
<u>Chernetinae nymphs</u>	March		X
<u>Chelifer cancroides</u>	November, January, February	X	
<u>Dactylochelifer copiosus</u>	November, December, March	X	X
<u>Cheliferidae nymphs</u>	February		X

TABLE 6.--More than one species from the same sample.

Locality	Habitat	Species
Baraga Co. T49N: R33W: S19	Hollow at the base of a live sugar maple	<u>Mundochthonius rossi</u> <u>Microbisium confusum</u>
Genesee Co. T 9N: R 7E: S 2	Old honey bee nest and wasp nest in hollow of a largetooth aspen	<u>Dinocheirus pallidus</u> <u>Acuminochernes crassopalpus</u>
Gogebic Co. T48N: R45W: S36	Leaf litter	<u>Mundochthonius rossi</u> <u>Microbisium confusum</u>
Grand Traverse Co. T26N: R10W: S31	Old straw in fallen barn	<u>Microbisium confusum</u> <u>Dinocheirus horricus</u> <u>Chelifer cancrroides</u>
Houghton Co. T51N: R35W: S19	Hollow at the base of a dead sugar maple	<u>Mundochthonius rossi</u> <u>Microbisium confusum</u>
Huron Co. T16N: R 9E: S12	<u>Peromyscus leucopus</u> nest in the hollow of a live red maple	<u>Mirochernes dentatus</u> <u>Dinocheirus pallidus</u> <u>Acuminochernes crassopalpus</u>
Ingham Co. T 4N: R 1W: S30	Hollow in a live beech	<u>Dinocheirus pallidus</u> <u>Acuminochernes crassopalpus</u>
Ingham Co.	Grain bin	<u>Lamprochernes minor</u> <u>Pseudochelifer callus</u>
Ingham Co. T 4N: R 1W: S18	Inside an elm stump	<u>Chthonius tetrachelatus</u> <u>Microbisium brunneum</u> <u>Pselaphochernes parvus</u>
Kalamazoo Co.	Ground nest of <u>Bombus bimaculatus</u>	<u>Chthonius tetrachelatus</u> Chernetinae nymph
Lake Co. T19N: R13W: S22	Rotten wood in hollow of a live white oak	<u>Mirochernes dentatus</u> <u>Dinocheirus pallidus</u>
Lenawee Co. T 6S: R 3E	Beech-maple leaf litter	<u>Apochthonius moestus</u> <u>Microbisium confusum</u>
Marquette Co. T46N: R28W: S15	Jack pine stump material	<u>Mundochthonius rossi</u> <u>Hesperochernes amoenus</u>
Oakland Co. T 7N: R16E:	Hollow at the base of a live red ash	<u>Microbisium confusum</u> <u>Larca granulata</u> Chernetinae nymph
Ogemaw Co. T21N: R 4E: S15	Leaf litter	<u>Microbisium confusum</u> <u>Syarinus enhuyoki</u>
St. Joseph Co. T 6S: R11W: S 2	Hollow in a live red oak with a small mammal nest	<u>Dinocheirus pallidus</u> <u>Tiliichernes distinctus</u>

common responses of both species to common microenvironmental factors. He further stated that the above responses result in two species occupying the same microhabitat, but probably not the same ecologic niche.

## EXTERNAL MORPHOLOGY

Important aspects of morphology are included herein to aid in the identification of Michigan pseudoscorpions. The serious student is directed to Chamberlin (1931), Beier (1932a, 1932b) and Roewer (1937) for more detailed morphological accounts.

### CEPHALOTHORAX

Pseudoscorpions are characterized by a cephalothorax bearing six pairs of appendages. The cephalothorax is broadly fused to a segmented abdomen. The first pair of appendages are preoral chelate chelicerae. The second pair of appendages are postoral chelate pedipalps. The last four pairs of appendages are walking legs. Figure 3 illustrates the general body form of a chernetid pseudoscorpion.

The cephalothorax lacks apparent segmentation and is covered dorsally by a carapace and ventrally by coxae. A sternum is lacking in most species. The sternum is represented in a few genera of the Heterosphyronida by an inter-coxal tubercle. The carapace is unsegmented, but may bear one or two transverse furrows in some



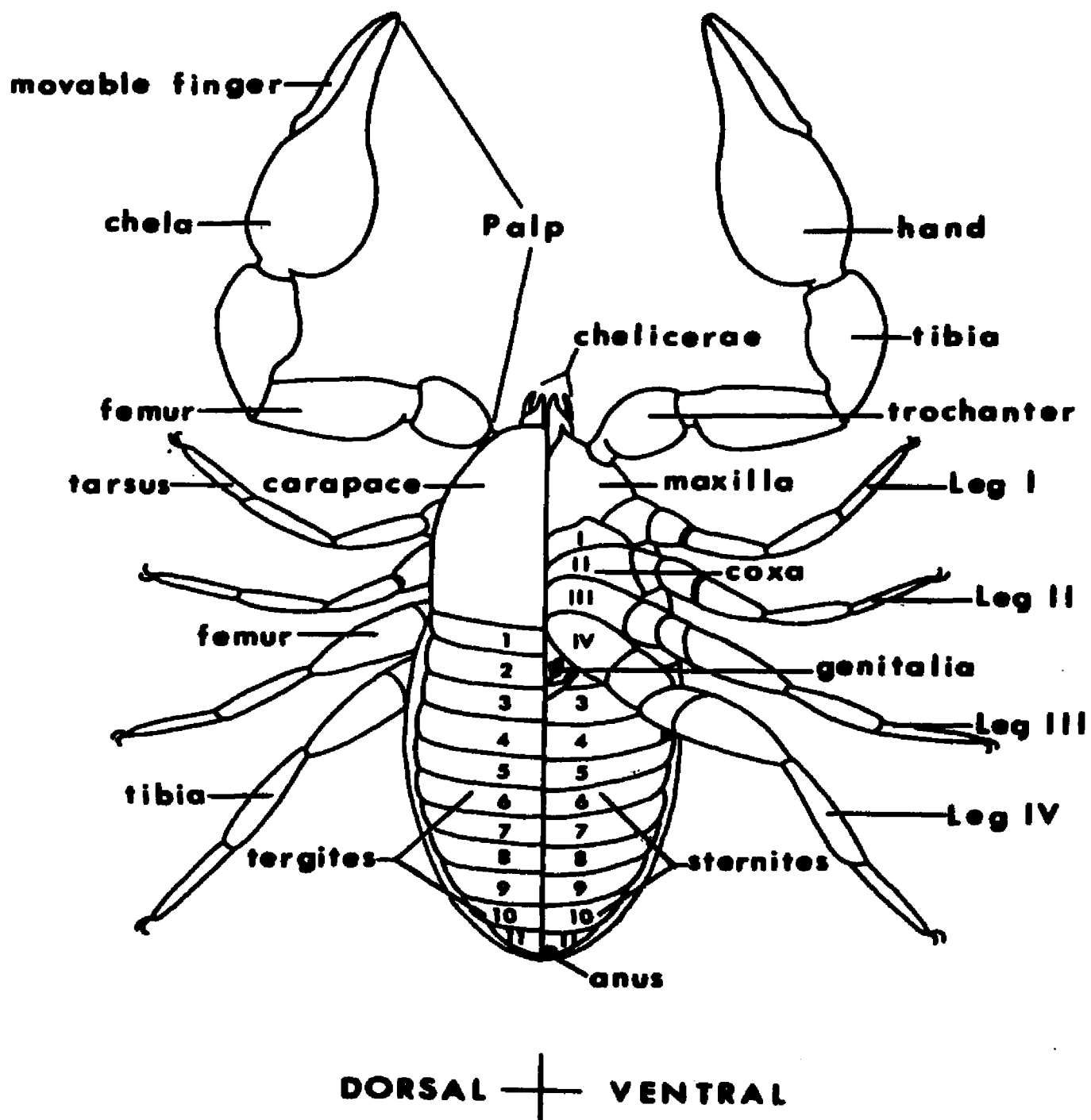


Fig. 3. Generalized body form of a chernetid pseudoscorpion.

species. Eyes when present, number one or two pairs. The eyes are located on the laterocarapacal margin. The mouth is located at the anterior end of the cephalothorax, superficially posterior to the chelicerae.

#### CHELICERAE

The chelicerae consist of two segments; a basal segment or fixed finger, and a movable finger. The chelicerae function in spinning silk, grooming and holding food. Considerable variability exists in chelicerel size among pseudoscorpions. In general, the chelicerae of the Chthonioidea and Neobisioidea are large while the chelicerae of the Monosphyronida and Garypoidea are small. Structures of taxonomic importance are shown in Fig. 5.

The number, position, and structure of setae on the chelicerel palm vary. Usually five setae are present on the exterior surface of the palm. The setae may be acuminate or bear a variable number of denticulations. Normally, only one seta is present on the movable finger.

A flagellum is present on the lateral margin of the subventral surface. The number of blades vary from one to twelve. Blades may be simple or may be unilaterally pinnate or serrate. The presence of three or four blades are of taxonomic importance in the Chernetinae.

A galea is present at the apex of the movable finger. The galea functions in spinning silk and consists of a

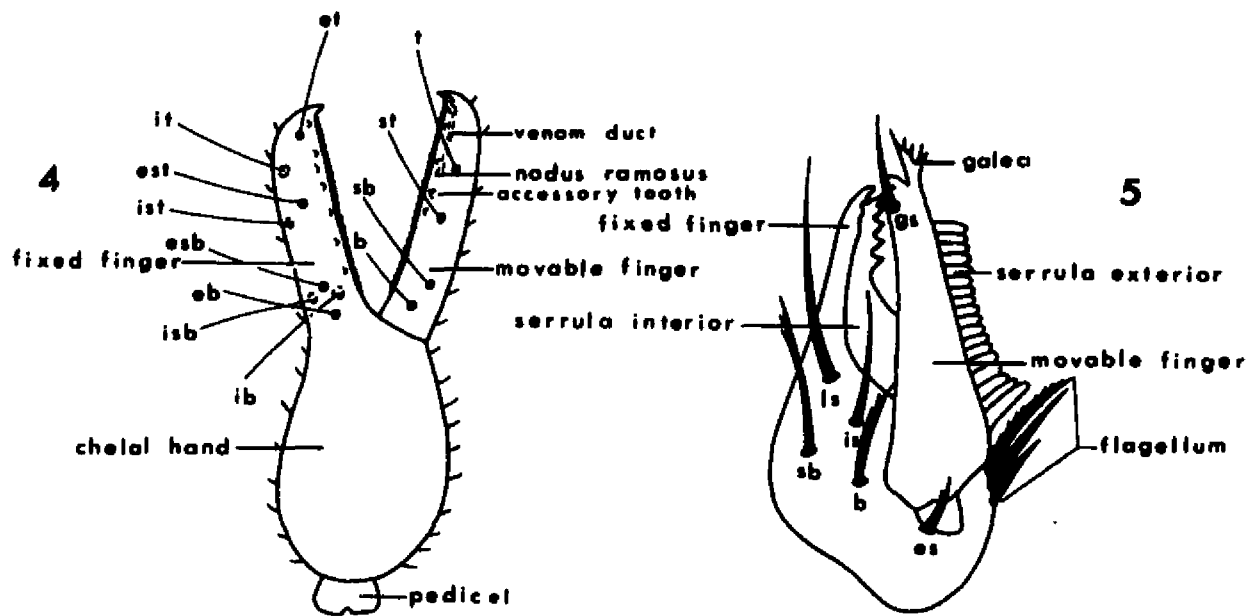


Fig. 4. Palp of a female Pselaphochernes parvus Hoff, lateral view. Setae: b, basal; sb, sub-basal; st, subterminal, and t, terminal. On the fixed finger the prefix i indicates interior and e indicates exterior.

Fig. 5. Generalized chernetid chelicera, lateral view. Setae: b, basal; es, exterior; gs, galeal; is, interior; ls, laminal; sb, subbasal.

number of branches or rami. Often, in those species lacking a galea, a tubercle is present (Fig. 29).

Other structures of lesser taxonomic importance are the serrula exterior and interior, lamina exterior and marginal teeth. The serrula interior often fuses into a velum except for three or four terminal blades.

#### PEDIPALPS

The large pedipalps are composed of the following segments: the palpal coxa or maxilla, trochanter, femur, tibia, and chela. The pedipalps have a sensory and prehensile function. The chela consists of a movable finger opposed to a fixed finger (Fig. 4). The chela in the adult usually has a definite number of trichobothria or tactile setae present on each finger. The tactile setae are those setae arising from areolae. The arrangement and number of tactile setae are of significant taxonomic importance. The normal complement of tactile setae in the adult is twelve, eight on the fixed finger and four on the movable finger. The number of tactile setae present on nymphs is discussed on page 36. The non-tactile setae of the palpal segments vary from acuminate to leaf-like or bilaterally feathered. Often the setae may superficially appear acuminate, but bear a few minute denticulations.

A venom apparatus, when present, is found in the fixed finger, the movable finger, or both fingers. The main venom duct originates at a nodus ramosus, the point where numerous ducts arising from venom glands converge and terminates at a venedens. The main venom duct and nodus ramosus can usually be observed (Fig. 4).

The number, arrangement, and types of teeth present on the chelal fingers are important taxonomically. In the Chernetinae accessory teeth, in addition to marginal teeth, are present.

Finally, the length-width ratios, as well as absolute sizes of palpal podomeres are important for species determination.

## LEGS

The four pairs of legs are of considerable taxonomic importance. Seven segments, exclusive of the praetarsus, are the maximum number of segments present. These segments are: coxa, trochanter, pars basalis, pars tibialis, tibia, metatarsus, and telotarsus. Secondary fusion of the metatarsus and telotarsus into a single tarsal segment is of prime importance in the separation of the suborders. Thus, a single tarsal segment occurs in the first and second legs of the suborder Heterosphyronida (Figs. 11, 13), and all legs of the suborder Monosphyronida (Figs. 49, 50). The suborder Diplosphyronida retains

the metatarsus and telotarsus in all legs (Figs. 27, 28). The pars basalis and pars tibialis may be rigidly fused together (Fig. 50), or separated by a membranous articulation (Fig. 49).

Some members of the Heterosphyronida have modified setae, or coxal spines, present on the mesal portion of the first to third coxae (Figs. 14, 15, 18, 19, 21, 22). Among the Diplosphyronida and Monosphyronida only the genus Pseudogarypus has coxal spines. Chamberlin (1931) thought the above was probably parallelism. The fourth coxae of cheliferid males may be modified by the presence of anterolateral spurs (Fig. 94).

Tactile setae, present on the tibia or tarsus of many Monosphyronida, are of taxonomic importance. A tactile seta, according to Hoff (1949), is a seta that is longer than ordinary setae, acuminate, and directed at more of a right angle to the surface of the segment (Figs. 50, 56, 95). Occasionally a denticulate pseudotactile seta may be present on the tibia or tarsus.

Tarsal claws of some Cheliferidae may be distally split or may bear a subterminal inner tooth (Fig. 88).

#### ABDOMEN

The abdomen is composed of twelve segments, the last is reduced and represented only by a circum-anal ring. Each segment is represented dorsally by a tergite and

ventrally by a sternite. Both tergites and sternites may be divided medially into two halves. A pleural wall divides the tergites from the sternites. However, the eleventh tergite and sternite may fuse forming a single sclerite. The first sclerite is often reduced or fused to the second due to coxal development. The genital opening occurs between the second and third sternite. The second and third sternites are modified as genital opercula. The genitalia in the male is more complex than in the female. A pair of spiracles are present on the lateral margins of the third and fourth sternites. The tergites are usually unmodified, however in males of some species, the tergites are modified laterally as keels.

## DEVELOPMENT

A female pseudoscorpion lays 3 to 40 or more eggs of variable size and shape, depending on the species. The eggs are usually carried in a secreted brood sac attached to the genitalia of the female. A pumping organ developed by the embryos enable growth and development to occur within the brood sac by absorbing ovarian nutrient material. Within the brood sac two embryonic instars occur. Complete development from fertilization to hatching of the first postembryonic instar, the protonymph, varies with those species known from a few days to a few weeks. The protonymph usually leaves the brood sac and leads an independent life. However, according to Weygoldt (1969) Chthonius tetrachelatus does not have a free protonymph.

Postembryonic development prior to reaching sexual maturity usually involves three instars, the protonymph, deutonymph, and tritonymph. The adult does not molt following the three postembryonic molts.

The protonymph and successive nymphal instars are adult-like in general appearance. Basic differences in nymphs being: the absence of a genital opening, reduced



sclerotization, variation in segmental proportions, fewer setae, and a reduced number of trichobothria present on the palpal chelae. The protonymph has four trichobothria, three on the fixed palpal finger and one on the movable finger; the deutonymph eight, six on the fixed palpal finger and two on the movable finger; and the tritonymph ten, seven on the fixed palpal finger and three on the movable finger. The normal adult complement is twelve trichobothria, eight on the fixed palpal finger and four on the movable finger. According to Weygoldt (1969) only in the Ideoroncidae is the number of trichobothria increased, and in a few species the tritonymphal or even the deutonymphal complement is retained as adults. The tritonymphal complement is retained in the species of Microbisium.

**PART II**

**SYSTEMATIC ACCOUNTS**

## KEY TO SPECIES OF MICHIGAN PSEUDOSCORPIONS

The following key is modified in part from Hoff 1949 and 1958.

1. First and second legs with five segments exclusive of coxae, third and fourth legs with six segments exclusive of coxae (Figs. 11, 13).  
(Suborder Heterosphyronida) . . . . . 2  
All legs with the same number of segments . . . . . 4
2. Coxal spines acuminate and confined to coxae of first legs (Figs. 21, 22). .Apochthonius moestus  
Coxal spines not confined to coxae of first legs. . 3
3. Comb-like coxal spines confined to coxae of second legs (Figs. 18, 19). . .Mundochthonius rossi  
Feathered coxal spines on coxae of second and third legs (Figs. 14, 15). . .Chthonius tetrachelatus
4. All legs with six segments exclusive of coxae (Figs. 27, 28). (Suborder Diplosphyronida) . . . . . 5  
All legs with five segments exclusive of coxae (Figs. 49, 50). (Suborder Monosphyronida) . . . 8
5. Movable cheliceral finger dentate one-fifth or more of inner margin (Figs. 29, 32) . . . . . 6

- Movable cheliceral finger with a single tooth or  
with a small group of teeth at apex of inner  
margin (Fig. 37) . . . . . Larca granulata
6. Abdominal pleural membrane smoothly and longitudi-  
nally plicate . . . . . Syarinus enhuycki  
Abdominal pleural membrane granulate or granulo-  
striate . . . . . 7
7. Palpal femur less than 0.42 mm. long, length x  
width 2.4-2.93, if length is greater than  
0.4 mm., then length x width is less than  
2.8 . . . . . Microbisium confusum  
Palpal femur more than 0.4 mm. long, length x  
width 2.87-3.2. . . . . Microbisium brunneum
8. Four prominent eyes present (Fig. 41). . . . .  
. . . . . Pseudogarypus sp.  
Two eyes or none present . . . . . 9
9. Femora of all legs similar in structure (Figs. 42,  
43). . . . . Apocheiridium stannardi  
Femora of legs one and two different from femora of  
legs three and four (Figs. 49, 50). . . . 10
10. Well-developed venom apparatus in the movable chelal  
finger only (Fig. 4); accessory teeth, in  
addition to marginal teeth, almost always  
present on chelal fingers (Fig. 4). (Family  
Chernetidae) . . . . . 11

- Well-developed venom apparatus in both fixed and movable chelal fingers (Figs. 84, 85, 92); no accessory teeth present on chelal fingers (Figs. 84, 85, 91, 92). (Family Cheliferidae). . . . . 25
11. Tactile seta (may bear a few terminal and sub-terminal spinules) present on tibia of fourth leg (Fig. 50); abdominal pleural membrane smoothly striate. (Subfamily Lamprochernetinae) . . . . . 12
- Tactile seta absent on tibia of fourth leg; abdominal pleural membrane not smoothly striate. (Subfamily Chernetinae). . . . . 13
12. Dorsal view of chelal hand subquadrate, subtruncate at base (Fig. 48); length x width of chela 2.28-2.63; tactile seta of tibia submedian in position . . . Lamprochernes oblongus
- Dorsal view of chelal hand subovate, somewhat rounded at base (Fig. 51); length x width of chela 2.72-3.10; tactile seta of tibia near distal end . . . . . Lamprochernes minor
13. Tarsus of leg IV with a tactile seta (Figs. 50, 56) . . . . . 14
- Tarsus of leg IV without a tactile seta . . . . . 21
14. Fourth tarsus with tactile seta submedian in position (Fig. 56) . . . Pselaphochernes parvus

- Fourth tarsus with tactile seta subterminal in position . . . . . 15
15. All setae of fixed chelal finger, except et, confined to basal one-half of finger (Fig. 53) . . . . . Parachernes squarrosus
- At least it situated beyond middle of fixed chelal finger. . . . . 16
16. Movable chelal finger with tactile seta st closer to sb than to t (Fig. 58) . Dendrochernes morosus
- Movable chelal finger with tactile seta st midway or closer to t than to sb . . . . . 17
17. Cheliceral hand with seta sb and b acuminate. . . 18
- Cheliceral hand with seta sb denticulate and seta b acuminate or denticulate . . . . . 19
18. Length x width of male chela, exclusive of pedicel, 2.67-2.89; female 3.05-3.41; chela of both sexes usually more than 1.05 . . . . . Acuminochernes tacitus
- Length x width of male chela, exclusive of pedicel, 2.0-2.4; female 2.4-2.8; chela of both sexes usually less than 1.05 . . . . . Acuminochernes crassopalpus
19. Male with well-developed anvil-like process on inner surface of chelal hand (Fig. 63); in female, distance between tactile setae st and sb of movable chelal finger a little more than twice

distance between tactile setae t and st

. . . . . Mirochernes dentatus

Male without anvil-like process on inner surface of  
chelal hand; in female, distance between tac-  
tile setae st and sb on movable chelal finger  
seldom more than twice the distance between t  
and st (some females may actually run to

Mirochernes dentatus). . . . . 20

20. Length of male chela, exclusive of pedicel, less  
than 1.20 mm.; female less than 1.25 mm . .

. . . . . Dinocheirus horricus

Length of male chela, exclusive of pedicel, more  
than 1.20 mm.; female more than 1.25 mm . .

. . . . . Dinocheirus pallidus

21. Setae of palps and tergites bilaterally feathered  
and leaf-like (Figs. 73, 74), some relatively  
long clavate setae (longer than investing  
setae) near center of outer margin of fixed  
finger (Fig. 71) . . Illinichernes distinctus

Setae of palps and tergites not bilaterally  
feathered; no relatively long clavate setae  
on outer margin of fixed chelal finger . . . 22

22. Length of chela, exclusive of pedicel, more than  
1.25 mm.; length of femur more than 0.75 mm .

. . . . . Hesperochernes tamiae

- Length of chela, exclusive of pedicel, less than  
1.25 mm.; length of femur less than 0.75 mm . 23
23. Length of chela, exclusive of pedicel, less than  
0.9 mm.; length of femur usually less than  
0.55 mm. . . . . Hesperochnes ewingi
- Length of chela, exclusive of pedicel, more than  
0.9 mm.; length of femur usually more than  
0.55 mm. . . . . 24
24. Length of palpal chelal hand longer than or sub-  
equal to length of movable finger (Fig. 80) .  
. . . . . Hesperochnes lymphatus
- Length of palpal chelal hand considerably shorter  
than length of movable finger . . . . .  
. . . . . Hesperochnes amoenus
25. Posterior tergites bearing a seta in the center of  
each sclerotized half, in addition to periph-  
eral setae (Figs. 87, 89) . . . . . 26
- Posterior tergites bearing only peripheral setae  
on each sclerotized half (Fig. 96), except  
occasionally on the last one or two segments . 28
26. Tarsal claws of at least some legs bifid or bearing  
an accessory tooth (Fig. 88) . . . . . 27
- Tarsal claws of all legs without teeth. . . . .  
. . . . . Dactylochelifer copiosus
27. Cheliceral hand with seta sb absent. . . . .  
. . . . . Chelifer cancroides



Cheliceral hand with seta sb present. . . . .

. . . . . .Parachelifer monroensis

28. Fourth tibia about 1.25 times as long as fourth  
tarsus (Fig. 95); fourth coxae of males with  
anterolateral spur (Fig. 94) . . . . .

. . . . . Idiochelifier nigripalpus

Fourth tibia and fourth tarsus subequal in length

(Fig. 98); fourth coxae of males without

anterolateral spur . . . Paisochelifier callus

ORDER CHELONETHIDA

Suborder Heterosphyronida Chamberlin

Family Chthoniidae Hansen

Subfamily Chthoniinae Daday

Tribe Chthoniini Chamberlin

Chthonius (Ephippiochthonius) tetrachelatus (Preyssler)

Scorpio tetrachelatus Preyssler, 1790: 59.

Chthonius tetrachelatus, Simon, 1879: 70; Kew, 1911: 58; Chamberlin, 1929a: 73, 1929b: 154, 1931: 128; Roewer, 1937: 239; Vachon, 1941a: 442, 1941b: 540; Proctor, 1946: 510; Parks and Auerbach, 1954.

Chthonius longipalpus Banks, 1891: 164, 1895: 13; Ewing, 1911: 80.

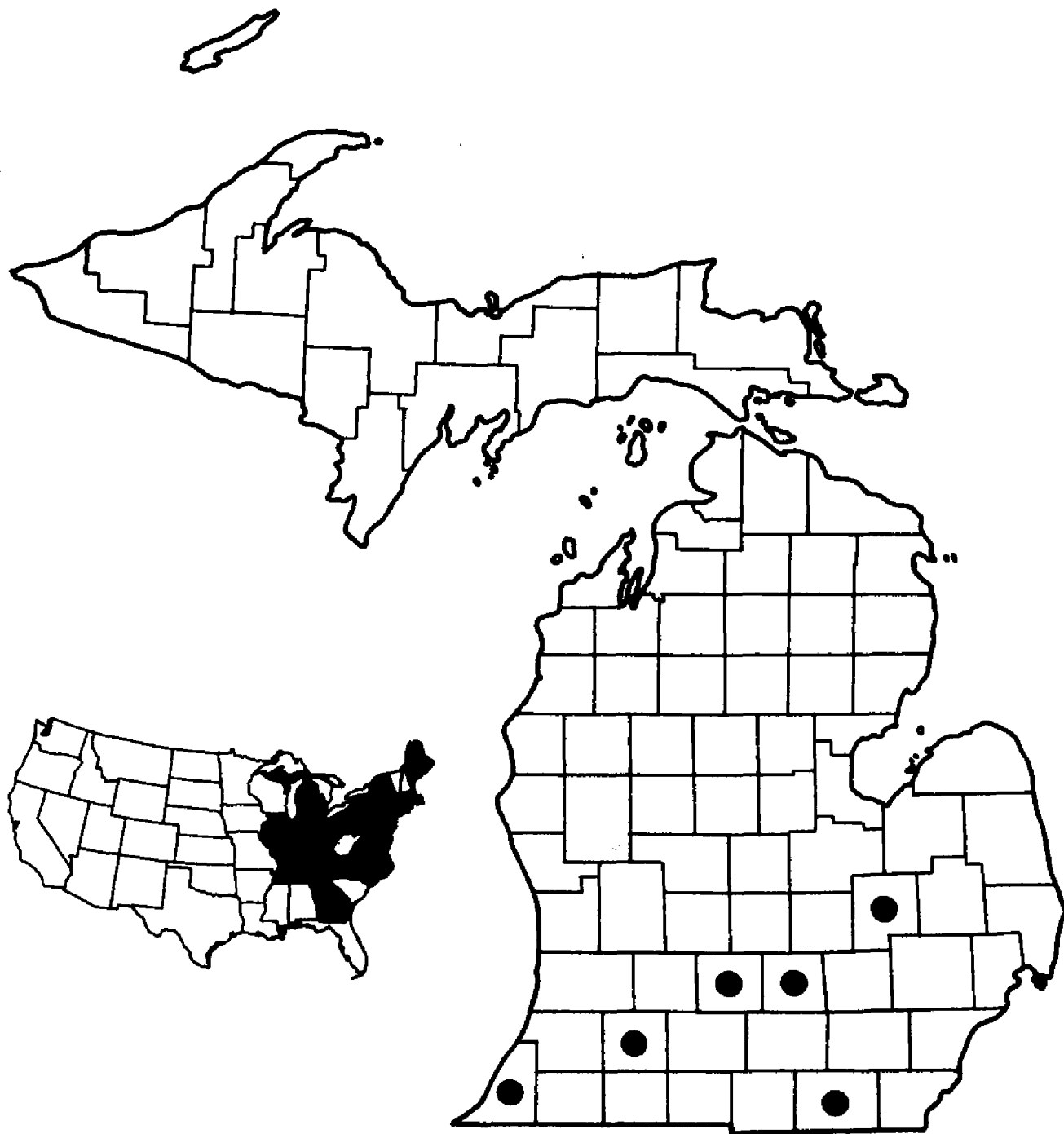
Chthonius (Ephippiochthonius) tetrachelatus, Beier, 1930b: 323, 1932a: 56, 1963: 57; Hadzi, 1933a: 179, 1933b: 139; Hoff, 1946b: 109, 1949: 433, 1951: 2, 1958: 3; Hoff and Bolsterli, 1956: 157; Fenstermacher, 1959: 13; Lawson, 1968: 116, Manley, 1969: 6.

This species is recognized by long, pointed, usually well separated, teeth on the chelal fingers; two tactile setae on the dorsum of the hand; and a depression between these setae and the finger base. Diagnostic characters are illustrated in Figures 11-16. Present Michigan

specimens agree well with those reported by Hoff (1951) in measurements and carapacal chaetotaxy. Whenever four setae were present along the posterior carapacal margin the two outermost setae were always smaller than the median setae. One female had three setae on the posterior carapacal margin. Measurements of three males include: chelal hand depth 0.14-0.15; length of chela x chelal hand depth 5.42-5.57. Measurements of five females include: chelal hand depth 0.16-0.18; length of chela x chelal hand depth 4.56-4.94.

Distribution (Map 1) and Habitat Preference. This species is widely distributed in the eastern part of the United States from Georgia to Maine, and as far west as Illinois. In Michigan it occurs in the southern one-half of the Lower Peninsula. This species occurs chiefly in leaf litter and ground cover. Two collections were made from under bark of a dead sugar maple. One collection was made from the ground nest of Bombus bimaculatus Cresson.

Records. GENESEE CO.: 12 May 1959, R. C. Graves, 2 males and 1 female. LENAWEЕ CO.: 9 Oct. 1969, R. A. Hoffman, 1 male, 1 female, 1 tritonymph, and 1 deutonymph from a dump. INGHAM CO.: 26 and 28 May 1958, J. Fenstermacher, 11 adults in leaf mold and ground cover; 28 Apr. 1967, G. V. Manley, 2 females and 1 tritonymph under debris in an old barn; 15 May 1967, S. Nelson, 2 females



Map 1. Distribution of  
Chthonius (Ephippiochthonius) tetrachelatus

and 3 nymphs inside elm stump. EATON CO.: 18 Sept. 1967, G. V. Manley, 1 male under liverworts growing atop sandstone; 8 Sept. 1968, S. Nelson, 1 male under dead sugar maple bark. KALAMAZOO CO.: 5-12 Aug. 1967, R. W. Husband, several individuals from ground nest of Bombus bimaculatus. BERRIEN CO.: 5 Aug. 1958, Sheila Nelson, 2 females under dead sugar maple bark.

Mundochthonius rossi Hoff

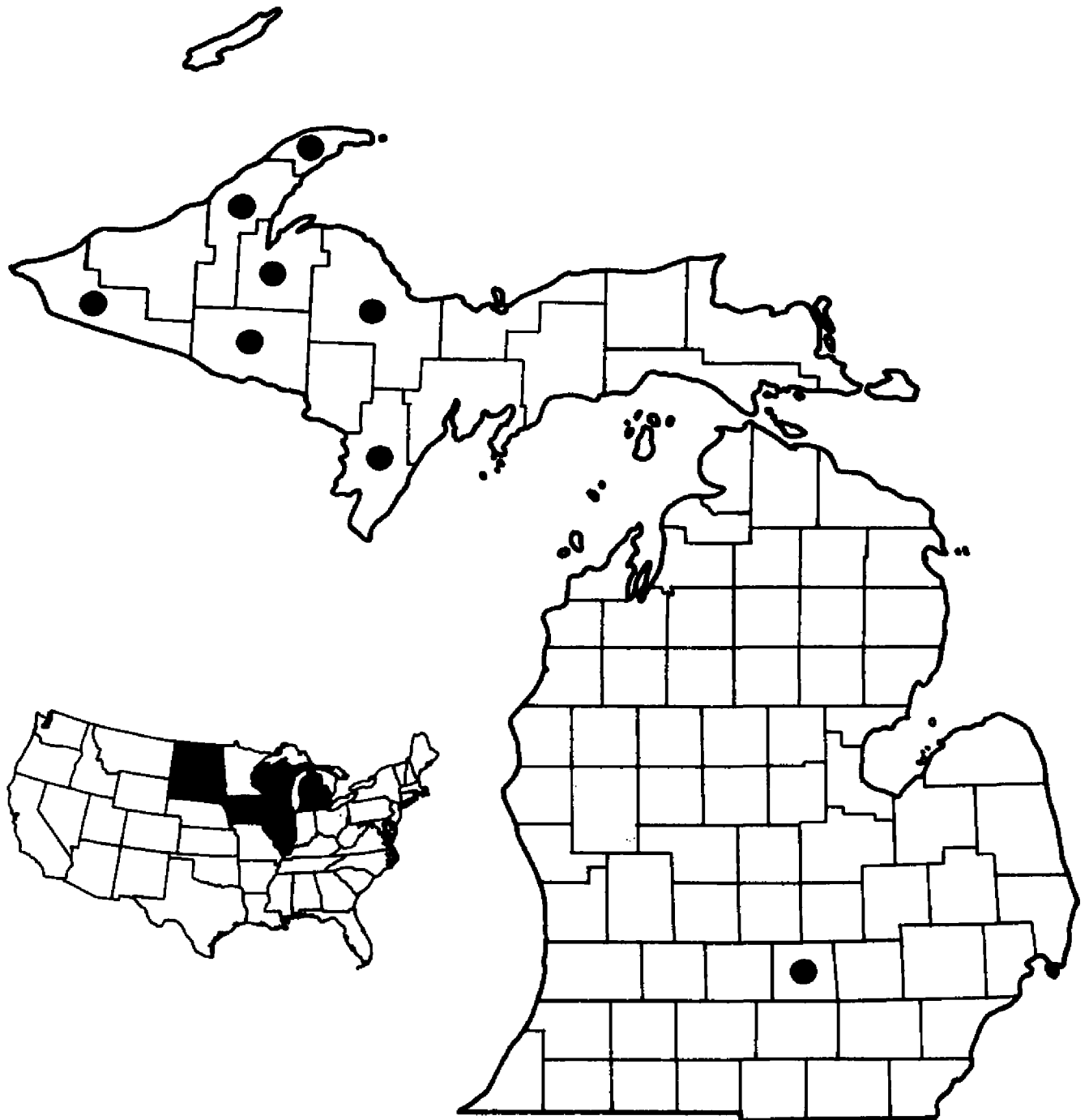
Mundochthonius rossi Hoff, 1949: 437, 1958: 5, 1963: 1; Hoff and Bolsterli, 1956: 158; Muchmore, 1968a: 110.

This species can be easily separated from other Michigan pseudoscorpions by the short comb-like coxal spines present on the mesal portion of coxa II. Diagnostic characters are illustrated in Figures 17-20. Michigan specimens agree in detail with those described by Hoff (1949). Measurements of six males include: body length 1.01-1.31; palpal femur 0.35-0.38 long, 0.087-0.092 wide, length x width 3.91-4.13; tibia 0.18-0.20 long, 0.10-0.12 wide, length x width 1.5-1.9; chela 0.55-0.58 long, 0.12-0.13 wide, length x width 4.23-4.67; chelal hand 0.12-0.13 deep; movable finger 0.33-0.38 long. Measurements of 13 females include: body length 1.11-1.29 long; palpal femur 0.35-0.39 long, 0.092-0.10 wide, length x width 3.7-4.02; tibia 0.19-0.21 long, 0.11-0.13 wide, length x width 1.61-1.91; chela 0.55-0.63 long,

0.13-0.15 wide, length x width 3.73-4.54; chelal hand 0.12-0.15 deep; movable finger 0.36-0.42 long. Movable fingers of two individuals 0.32 and 0.33 long, however, fingers of the opposite hands were 0.39 and 0.41 long respectively.

Distribution (Map 2) and Habitat Preference. This species occurs in the Northcentral States of Illinois, Iowa, Michigan, North Dakota, South Dakota, and Wisconsin. It has been extensively collected in the western one-half of the Upper Peninsula, but only one individual was collected in the Lower Peninsula. This species occurs most frequently in decomposed stump material, litter, and debris.

Records. INGHAM CO.: 23 Jan. 1967, S. Nelson, 1 male in leaf litter. MARQUETTE CO.: Aug.-Nov. 1967, Nov. 1968 and June 1970, S. Nelson, numerous individuals in jack pine stump material and litter. MENOMINEE CO.: 30 Aug. 1967, S. Nelson, 1 female in soil. BARAGA CO.: 28 and 29 Aug. 1968, S. Nelson, 1 male, 1 female in hollow at base of a sugar maple and numerous individuals in a live sugar maple hollow. IRON CO.: 10 Sept. 1967, S. Nelson, 1 deutonymph in leaf litter, 1 deutonymph inside a stump, and 1 individual inside a white pine stump. HOUGHTON CO.: 28 and 29 Aug. 1968, S. Nelson, numerous individuals in a dead sugar maple hollow, and numerous individuals in hollow at the base of a live



Map 2. Distribution of Mundochthonius rossi

sugar maple. KEWEENAW CO.: 17 April 1968, G. V. Manley, numerous individuals in leaf litter. GOGEBIC CO.: 29 Aug. 1968, 1 female in leaf litter.

Apochthonius moestus (Banks)

Chthonius moestus Banks, 1891: 165, 1895: 13; Coolidge, 1908: 114; Ewing, 1911: 80.

Apochthonius (Apochthonius) moestus, Chamberlin, 1929b: 153.

Apochthonius moestus, Chamberlin, 1929a: 67, 1931: 44, 92; Beier, 1930a: 202, 1932a: 41; Roewer, 1937: 238; Hoff, 1944: 125, 1945c: 311, 1946b: 105, 1949: 434, 1951: 4, 1952a: 42, 1956c: 2, 1958: 6, 1959: 33, 59; Hoff and Bolsterli, 1956: 158; Schuster, 1966: 182; Barr, 1967: 162; Muchmore, 1967: 89; Lawson, 1968: 72.

This species is separated from other Michigan pseudoscorpions by the nature of the coxal chaetotaxy. Three simple seta-like spines, each arising from a fissure, are reported on each coxa I (Figures 21-22). However, one female examined had only two such spines. Marginal chelal teeth are small and contiguous. Palpal measurements agree favorably with those reported by Hoff (1945c). Palpal measurements of a single male include: femur 0.46 long, 0.11 wide, length x width 4.18; chela 0.65 long, 0.14 wide, length x width 4.64; chelal hand 0.235 long, 0.14 deep; movable finger 0.42 long. Palpal measurements of two females include: femur 0.46 long, 0.10, 0.102



wide, length x width 4.51, 4.6; chela (only one individual measured) 0.68 long, width not determined; chelal hand 0.235 long, 0.15 deep; movable finger 0.47 long. Palps are illustrated in Figures 23, 24.

Distribution, Habitat Preference and Record. Apochthonius moestus occurs throughout the eastern and south-central portions of the United States (Map 3). Hoff (1949 1956c) reported this species to be abundant in litter and debris. The Michigan record is based on a single collection from LENAWEE CO.: 6 March 1969 by R. W. Husband of 1 male and 2 females in beech-maple litter.

#### Suborder Diplosphyronida Chamberlin

##### Superfamily Neobisioidea Chamberlin

##### Family Neobisiidae Chamberlin

##### Subfamily Neobisiinae Chamberlin

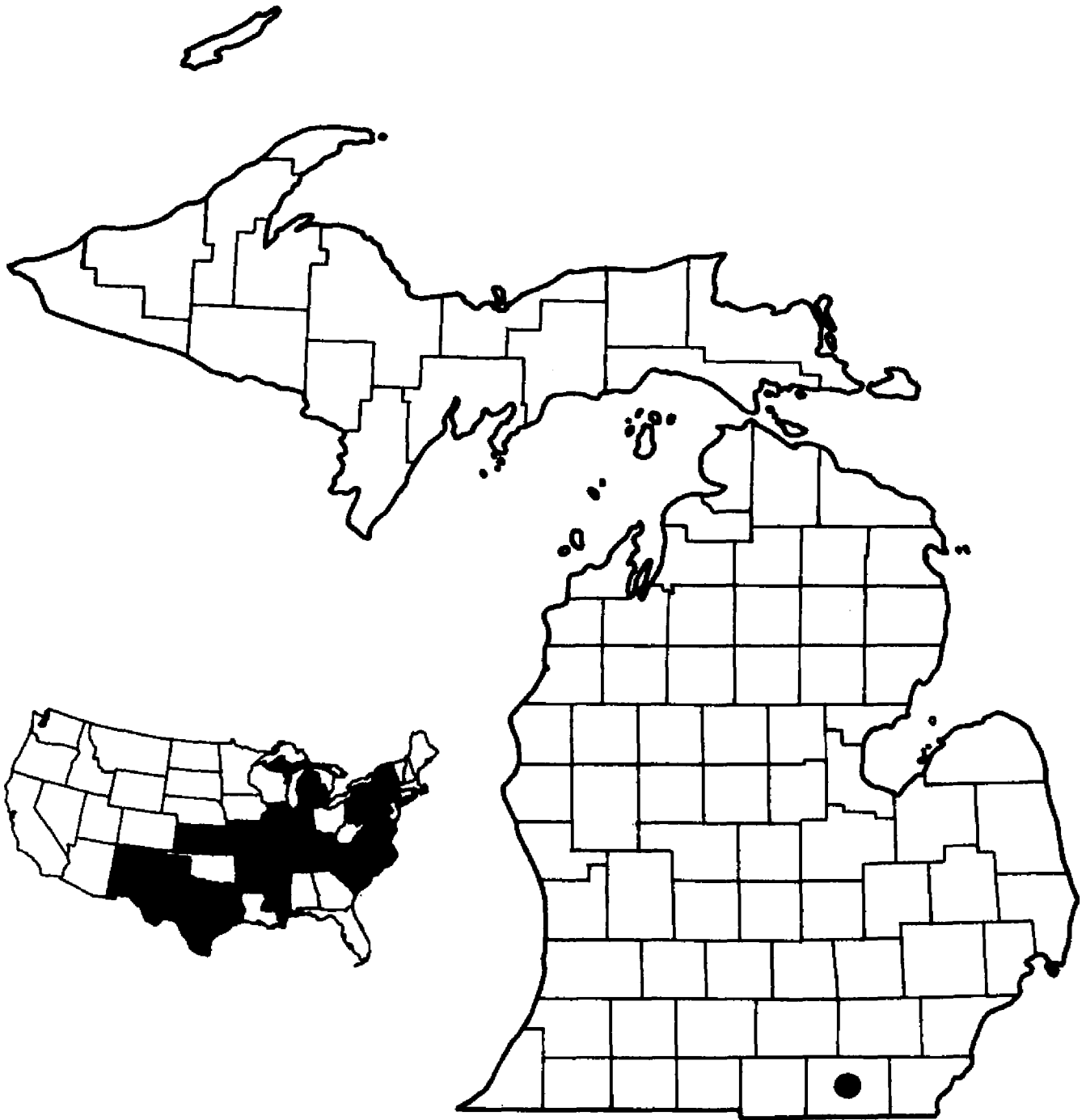
##### Microbisium brunneum (Hagen)

Obisium brunneum Hagen, 1869: 52, 1870: 269; Banks, 1895: 12; Coolidge, 1908: 113; Ewing, 1911: 79.

Microbisium brunneum, Chamberlin, 1930: 20; Beier, 1932a: 139; Roewer, 1937: 250; Hoff, 1944: 125, 1945b: 34, 1945c: 323, 1946a: 99, 1946b: 109, 1946c: 494, 1949: 445, 1958: 8; Hoff and Bolsterli, 1956: 161; Fenstermacher, 1959: 16; Manley, 1969: 6; Lawson, 1969.

Neobisium brunneum, Brimley, 1938: 497.

Microbisium near brunneum, McClure, 1943: 12.



Map 3. Distribution of Apochthonius moestus

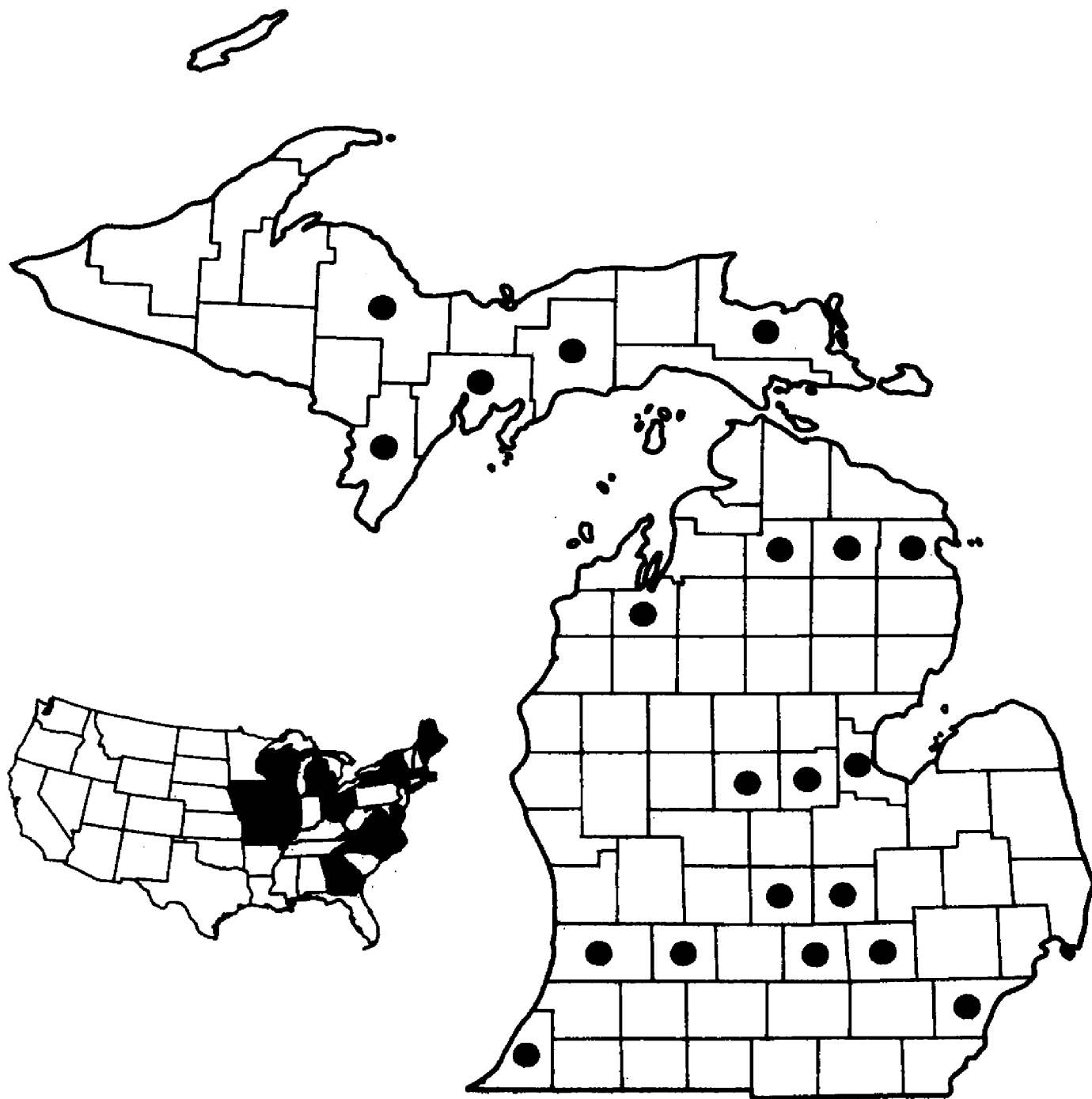
This species can be identified by the characters given in the key and illustrated in Figures 25, 26. A tritonymphal complement of trichobothria is present in the adult. A galea is absent, or only represented by a sclerotized knob. No males or tritonymphs are known for this species. Palpal femur measurements agree favorably with those reported by Hoff (1949). Palpal measurements of 18 females include: femur 0.43-0.51 long, length x width 2.87-3.2.

Distribution (Map 4) and Habitat Preference. This species is widely distributed throughout the Eastern and Midcentral States, from Maine to Georgia and as far west as Iowa and Missouri. It is widely distributed throughout the Upper and Lower Peninsulas of Michigan. This species is common to bogs and acid soil situations. Manley (1969) reported this species under elm bark in a flooded area and in moss covering jack pine.

Records. Numerous females and nymphs were taken predominately from sphagnum and ground cover throughout the year from widespread areas of the State.

Microbisium confusum Hoff

Microbisium confusum Hoff, 1946c: 496, 1949: 446, 1958: 9, 1961: 432, 1963: 2; Wray, 1950: 42; Hoff and Bolsterli, 1956: 160; Fenstermacher, 1959: 15; Lawson, 1968: 138, 1969; Manley, 1969: 6.



Map 4. Distribution of Microbisium brunneum

This species was described by Hoff (1946c) on the basis of 127 females. The first male was reported by Lawson (1969). Among species at hand are males determined by W. B. Muchmore, and those identified from the J. Fenstermacher collection. A re-examination of more than 500 individuals in the Fenstermacher collection resulted in the discovery of only two males. This species is reported to reproduce parthenogenetically. No tritonymphs are known for this species. A tritonymphal complement of trichobothria is present in the adult. The trichobothria present on the palpal fingers of the protonymph, deutonymph, and adult female are illustrated in Figures 6-8. A cheliceral galea is absent, or only represented by a sclerotic knob (Fig. 29). This species can be identified by the characters given in the key and illustrated in Figures 27-31. Present specimens agree well with those described by Hoff (1946c, 1949), and those exceptions discussed by Hoff and Bolsterli (1956). Michigan males, although generally larger, agree in detail with the male described by Lawson. Measurements of the three Michigan males include: body length 1.4-1.59; palpal femur 0.33-0.37 long, 0.12-0.15 wide, length x width 2.4-2.78; tibia 0.27-0.34 long, 0.14-0.19 wide, length x width 1.68-1.93; chela without pedicel 0.58-0.64 long, 0.20 wide (only one properly oriented for measuring width), length x width 2.9; movable finger

Figs. 6-8. Palpal chelae of Microbisium confusum  
Hoff, showing trichobothria. Fig. 6.  
Adult female. Fig. 7. Deutonymph.  
Fig. 8. Protonymph.

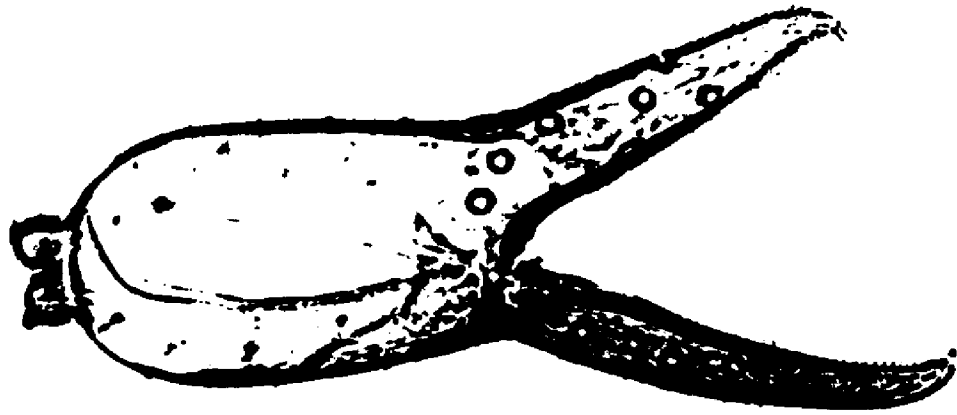


Figure 6

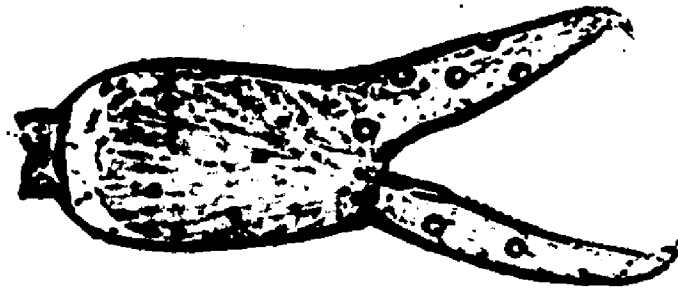


Figure 7



Figure 8

0.32-0.36 long. Fourth leg with entire femur 0.34-0.36 long, 0.12-0.14 deep, length x depth 2.43-3.1; tibia 0.265-0.30 long, 0.07-0.08 deep, length x depth 3.6-4.28; metatarsus 0.10-0.11 long, 0.05 deep, length x depth 2.0-2.2; telotarsus 0.17-0.18 long, 0.046-0.05 deep, length x depth 3.47-3.6. The male and female genitalia are illustrated in Figures 9-10.

Distribution (Map 5) and Habitat Preference. This species is widely distributed, occurring in the northeastern and northcentral portions of the United States as far west as Colorado. It is widely distributed throughout the State of Michigan. Microbisium confusum is the most common species of pseudoscorpion present in Michigan. The habitats of present specimens are shown in Table 1.

Records. Several hundred females and nymphs were taken predominately in litter and soil throughout the year from all portions of the State. Only three males were found. Two males were collected in INGHAM CO. on 12 and 31 May 1958 by J. Fenstermacher. One male was collected in Southern Michigan in August 1965 by S. V. Johnson.



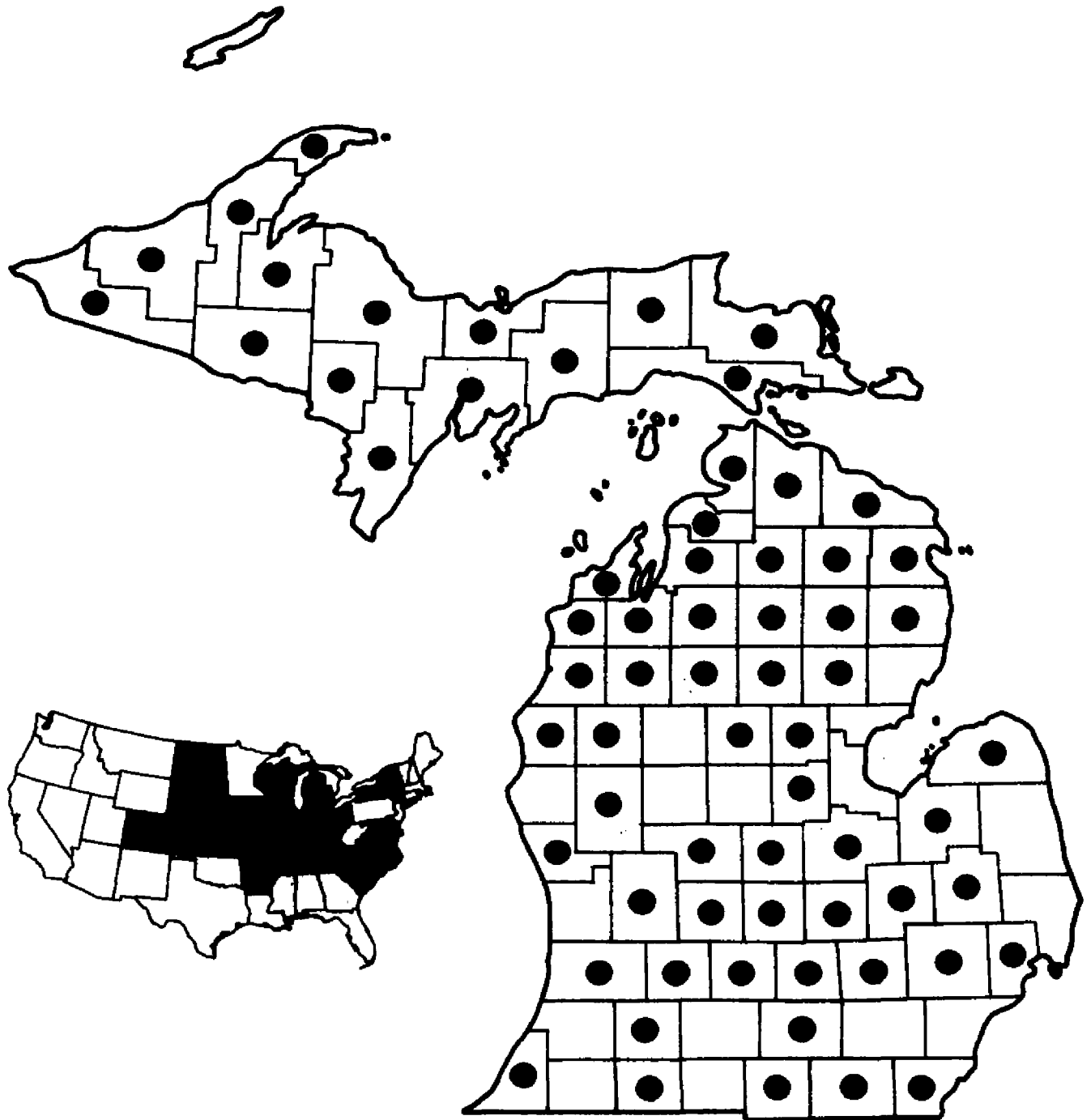
Figs. 9, 10. Genital region of Microbisium confusum Hoff. Fig. 9. Male. Fig. 10. Female.



Figure 9



Figure 10



Map 5. Distribution of Microbisium confusum

## Family Syarinidae Chamberlin

## Subfamily Syarininae Chamberlin

Syarinus enhuycki Muchmore

Syarinus enhuycki Muchmore, 1968b: 112.

The genus Syarinus, until 1956, has been known only from the western United States. Hoff and Bolsterli (1956) reported a single female from Wisconsin and assigned it to S. granulatus. Since, Kaisila (1964) described the species S. palmeni from Newfoundland, based on a single male. Syarinus enhuycki was described by Muchmore (1968b), based on several specimens, from the northern Appalachian mountain region. In the latter publication, Muchmore stated that the Wisconsin specimens are probably to be referred to as S. enhuycki. Present Michigan specimens are assigned to S. enhuycki based on the trifid nature of the cheliceral galea, and the stouter palpal tibia. The galea of the male is submedially divided into three slender, simple branches, while the galea of the female is subbasally divided into three long, stout rami, each with 2-4 short, sharp terminal branches. However, through personal communication with Dr. Muchmore the status of both Michigan and Wisconsin specimens remains somewhat unclear. More specimens from the northeastern and northcentral areas are needed in order to further understand this group. Diagnostic characters are given in the key and illustrated in Figures 32-35. Measurements of a single male include: body length

3.18; palpal femur 0.85 long, 0.245 wide, length x width 3.47; tibia 0.83 long, 0.30 wide, length x width 2.77; chela without pedicel 1.35 long, 0.38 wide, length x width 3.53; movable finger 0.63 long. Measurements of a single female include: palpal femur 0.87 long, 0.265 wide, length x width 3.28; tibia 0.84 long, 0.31 wide, length x width 2.71; chela without pedicel 1.42 long, 0.42 wide, length x width 3.38; movable finger 0.69 long.

Distribution (Map 6), Habitat Preference and Records. Syarinus enhuycki occurs in the States of Michigan, New Hampshire, New York, Pennsylvania, and perhaps Wisconsin. Muchmore (1968b) reported this species to occur under rocks in damp deciduous woods. The Michigan records are from Ogemaw and Presque Isle Counties. OGEMAW CO.: 10 July 1967 and 25 April 1968, S. Nelson, 1 male, 1 tritonymph, and 1 deutonymph in leaf litter and soil. PRESQUE ISLE CO.: 19 April 1968, G. V. Manley, 1 female in leaf litter.

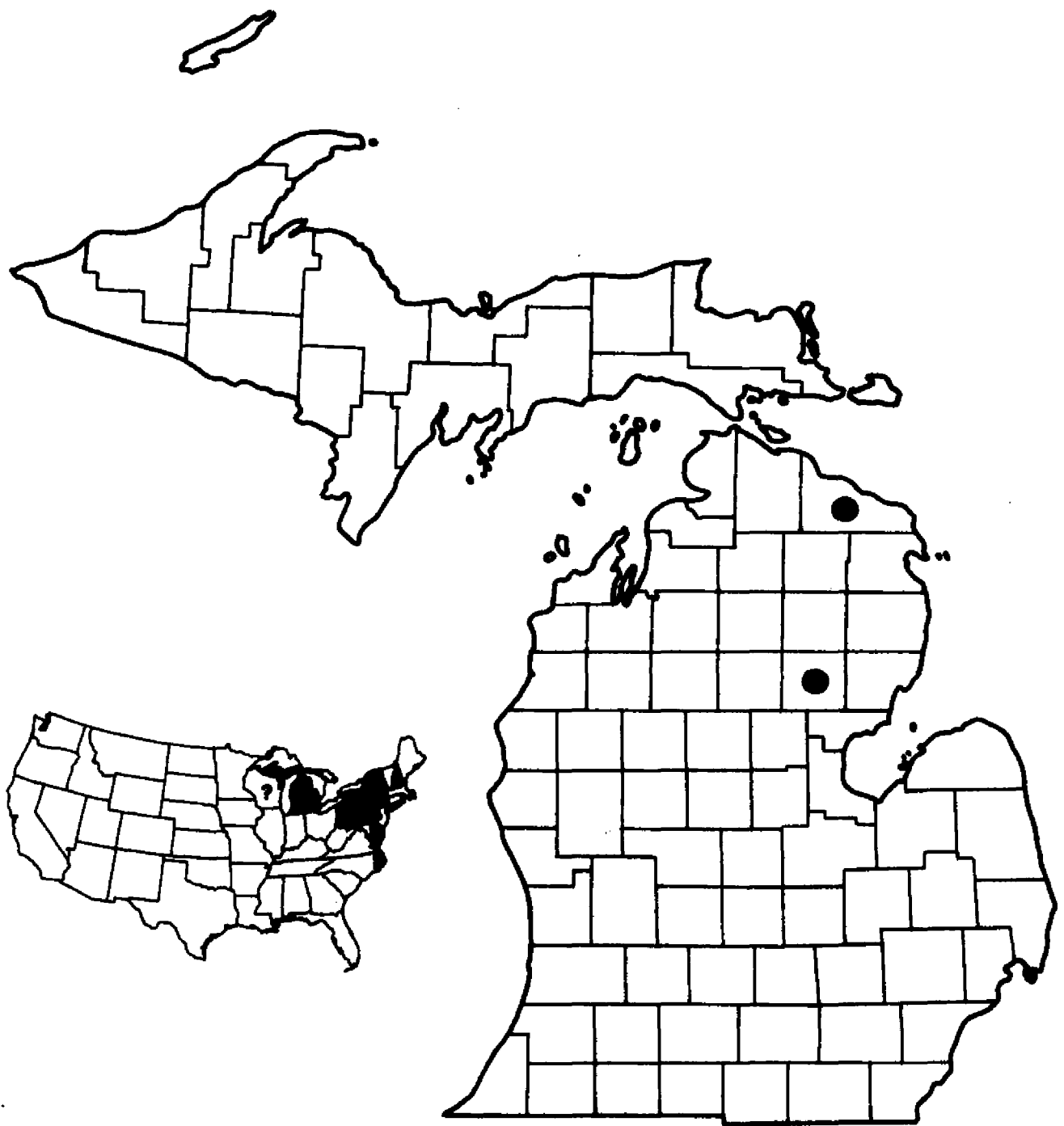
Superfamily Garypoidea Chamberlin

Family Garypidae Hansen

Subfamily Garypinae Simon

Larca granulata (Banks)

Garypus granulatus Banks, 1891: 163; Coolidge, 1908:



Map 6. Distribution of Syarinus enhuycki

Larca granulata, Chamberlin, 1930: 616; Beier, 1932a: 224; Roewer, 1937: 268; Hoff, 1946b: 109, 1949: 447, 1958: 15; Hoff and Bolsterli, 1956: 163; Weygoldt, 1969: 59.

This species can easily be separated from other Michigan pseudoscorpions by the characters given in the key and illustrated in Figures 36-38. Only two trichobothria are present on the movable chelal finger. A triangular carapace is broadly connected to a stout abdomen. The present Michigan male is more robust than the male reported by Hoff and Bolsterli (1956), but agrees in detail with the male described by Chamberlin (1930). Female specimens, generally agree with those previously described by Hoff (1949), and Hoff and Bolsterli (1956). Measurements of the single male include: body length 1.73 (abdomen contracted); palpal femur 0.57 long, 0.14 wide, length x width 4.07; tibia 0.50 long, 0.16 wide, length x width 3.13; chela without pedicel 0.77 long, 0.20 wide, length x width 3.85; chelal hand 0.38 long, 0.18 deep; movable finger 0.40 long. Measurements of five females include: body length 1.8-2.07 (body untreated); palpal femur 0.64-0.68 long, 0.155-0.17 wide, length x width 4.0-4.32; tibia 0.54-0.58 long, 0.18-0.19 wide, length x width 3.0-3.11; chela without pedicel 0.85-0.91 long, 0.23-0.25 wide, length x width 3.52-3.79; chelal hand 0.41-0.44 long, 0.20-0.21 deep; movable finger 0.44-0.47 long.

Distribution (Map 7) and Habitat Preference. This species occurs in the States of Illinois, Michigan, New York, and Tennessee. Present specimens were collected in the Lower Peninsula from Alpena, Clare, Grand Traverse, and St. Clair Counties. This species was reported by Hoff (1949) from debris and moss on sandstone ledges, and by Hoff and Bolsterli (1956) from the nest of a packrat, Neotoma sp. Michigan specimens were collected from tree hollows, and from the nest of the eastern chipmunk, Tamias striatus (Linnaeus), in the hollow of a white pine.

Records. ST. CLAIR CO.: 27 July 1968, S. Nelson, 1 male in hollow at base of a live red maple. ALPENA CO.: 24 May 1969, G. V. Manley, 1 female from a limestone crevice. CLARE CO.: 20 Dec. 1968, G. V. Manley, 1 female in aspen hollow. GRAND TRAVERSE CO.: 4 Sept. 1968, G. V. Manley, 1 female inside oak hollow and 1 female in hollow at base of a white pine.

Suborder Monosphyronida Chamberlin

Superfamily Feaelloidea Chamberlin

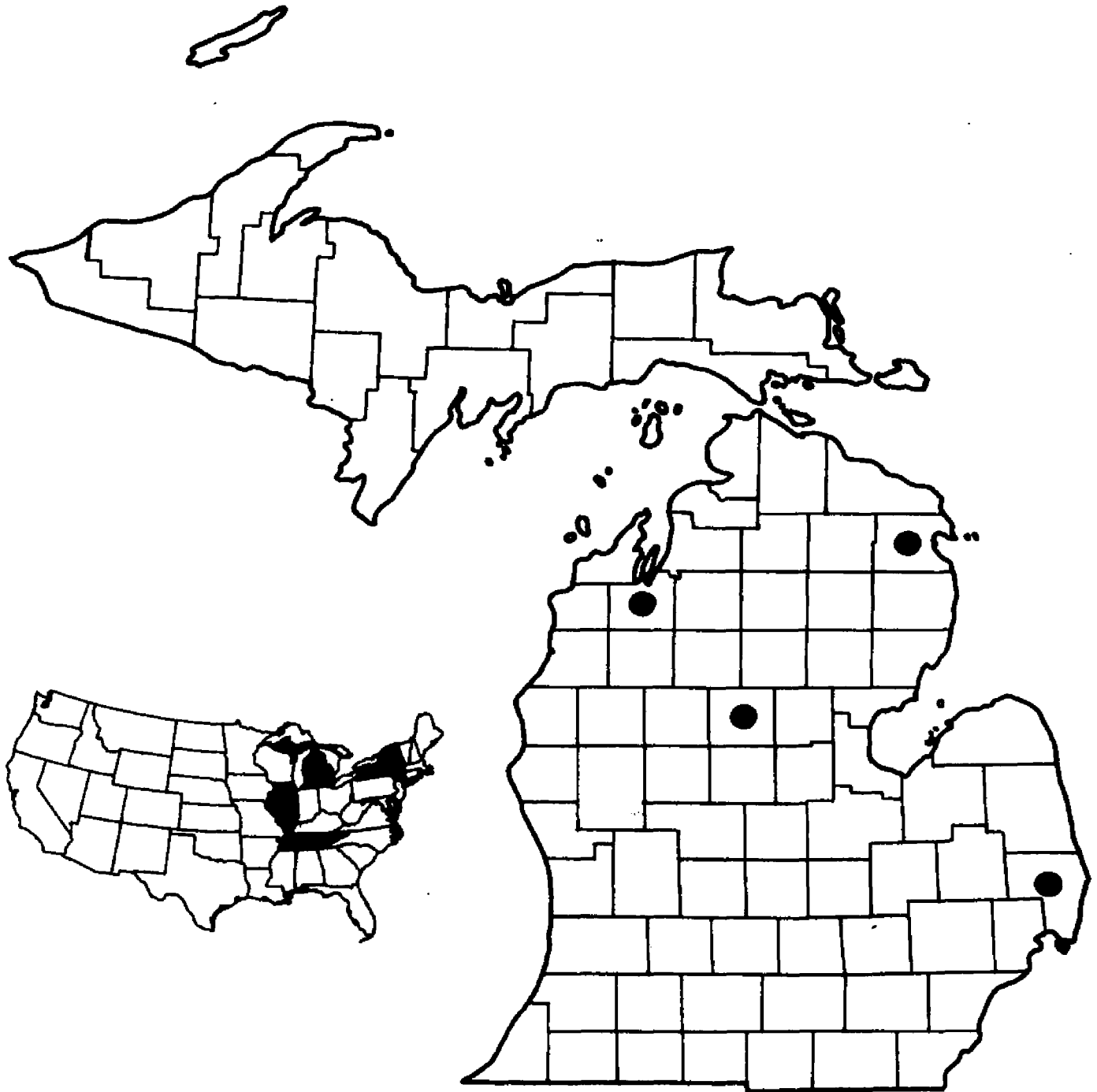
Family Pseudogarypidae Chamberlin

Pseudogarypus sp.

Figs. 39-41

At present three species are in the genus Pseudogarypus. Pseudogarypus bicornis (Banks) and P. hesperus Chamberlin are western species while P. banksi



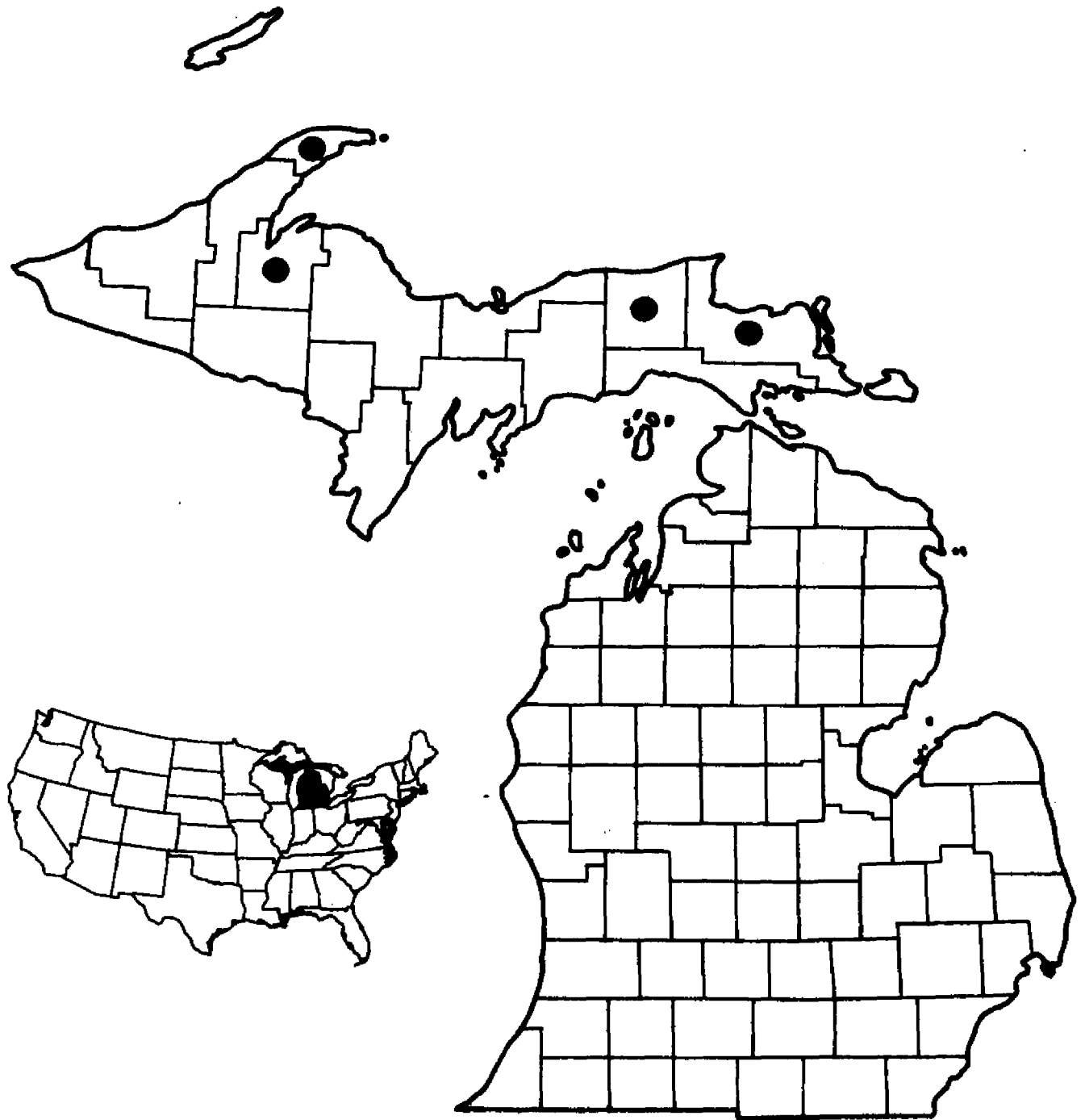


Map 7. Distribution of Larca granulata

Jacot occurs in New Hampshire. Fenstermacher (1959) and Manley (1969) reported P. hesperus from Michigan. Present specimens, conspecific with those reported by Fenstermacher and Manley, may represent a new species. Dr. William B. Muchmore is presently working on this genus and, through personal communication, indicated that he has yet to find reliable criteria to establish the Michigan specimens as a new or existing species.

Distribution (Map 8) and Habitat Preference. This species, assigned to Pseudogarypus hesperus by Fenstermacher and Manley, was reported from Chippewa, Keweenaw, and Luce Counties. Other specimens were collected in the Upper Peninsula counties of Baraga and Chippewa. This species occurs in tree hollows, under bark, and in rotten logs.

Records. CHIPPEWA CO.: Apr. 1968, G. V. Manley, 1 male in tree hollow; 28 Aug. 1968, S. Nelson, several individuals in a live sugar maple hollow. LUCE CO.: 6 June 1957, R. R. Dreisbach, 1 adult (cited from Fenstermacher, 1959). BARAGA CO.: 28 Aug. 1968, S. Nelson, 1 female from hollow at base of a live white pine. KEWEENAW CO.: 15 Apr. 1968, G. V. Manley, several specimens from tree hollows, under bark and in rotten logs.



Map 8. Distribution of Pseudogarypus sp.

## Superfamily Cheiridiodea Chamberlin

## Family Cheiridiidae Chamberlin

Apocheiridium stannardi Hoff

Apocheiridium stannardi Hoff, 1952b: 193, 1958: 19, 1961: 444; Hoff and Bolsterli, 1956: 164.

This species can easily be separated from other Michigan pseudoscorpions by the characters given in the key and illustrated in Figures 42-46. Hoff and Bolsterli (1956) reported that Illinois specimens lacked apparent sexual dimorphism in the size and shape of palpal podomeres. Michigan females, on the other hand, differ markedly from males in the size and shape of palpal podomeres. Males from Michigan agree favorably with males from Illinois described by Hoff (1952b), and reported by Hoff and Bolsterli (1956), however, Michigan females have longer and more slender palpal podomeres.

Measurements of three males include: body length 1.23-1.29; palpal femur 0.33-0.34 long, 0.083-0.093 wide, length x width 3.55-4.12; tibia 0.275-0.29 long, 0.087-0.093 wide, length x width 2.96-3.33; chela without pedicel 0.41-0.44 long, 0.12 wide, length x width 3.42-3.5; movable finger 0.21-0.24 long. Measurements of seven females include: body length 1.29-1.5; palpal femur 0.35-0.40 long, 0.083-0.098 wide, length x width 3.8-4.46; tibia 0.28-0.33 long, 0.09-0.099 wide, length x width

3.0-3.4; chela without pedicel 0.47-0.53 long, 0.12-0.15 wide, length x width 3.4-3.77; movable finger 0.25-0.30 long.

Distribution (Map 9) and Habitat Preference. This species occurs in Colorado, Michigan, and Illinois. Michigan specimens were collected in both the Upper and Lower Peninsula. Present specimens were collected from under bark, a tree hollow, and in a wood duck nest box.

Records. LIVINGSTON CO.: 4 May 1960, W. Suter, 1 male and 4 females. SHIAWASSEE CO.: 18 Feb. 1970, S. Nelson, 1 individual from nest box of the wood duck Aix sponsa. CLINTON CO.: 30 Apr. 1967, S. Nelson, 1 female under dead elm bark. BARRY CO.: 21 Feb. 1970, S. Nelson, 1 individual under dead red maple bark. CHIPPEWA CO.: 17 Apr. 1968, G. V. Manley, 1 female from tree hollow.

#### Superfamily Cheliferoidea Chamberlin

##### Family Chernetidae Menge

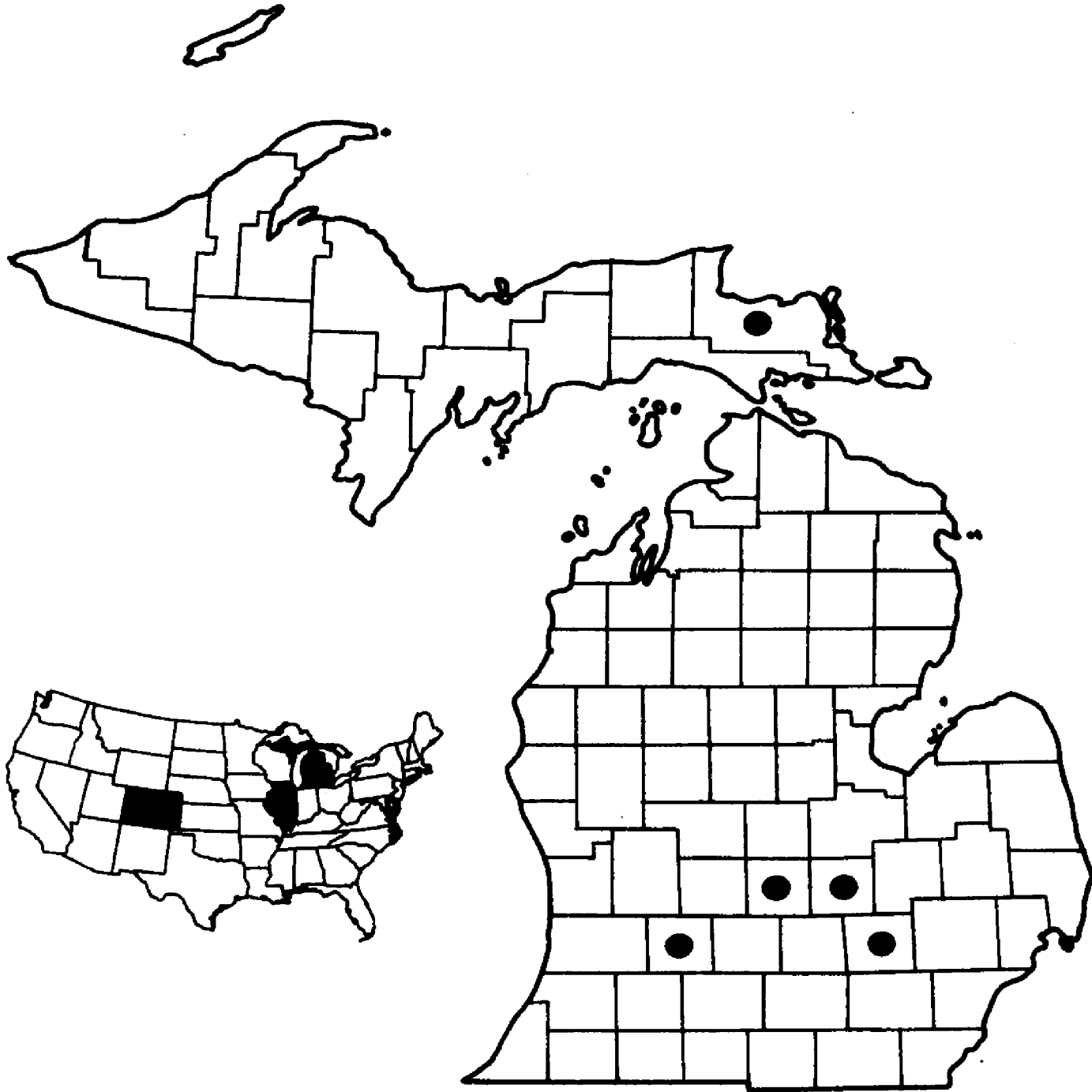
##### Subfamily Lamprochernetinae Beier

##### Lamprochernes oblongus (Say)

Chelifer oblongus Say, 1821: 64.

Chelifer alius Leidy, 1877: 261.

Chelanops oblongus, Banks, 1893: 64, 1895: 5; Berger, 1905: 407; Coolidge, 1908: 110; Ewing, 1911: 79; Chamberlin, 1931: 47, 119.



Map 9. Distribution of Apocheiridium stannardi

Chelanops (Lamprochernes) oblongus, Banks, 1895: 4.

Chelifer (Lamprochernes) oblongus, Ellingsen, 1909: 368.

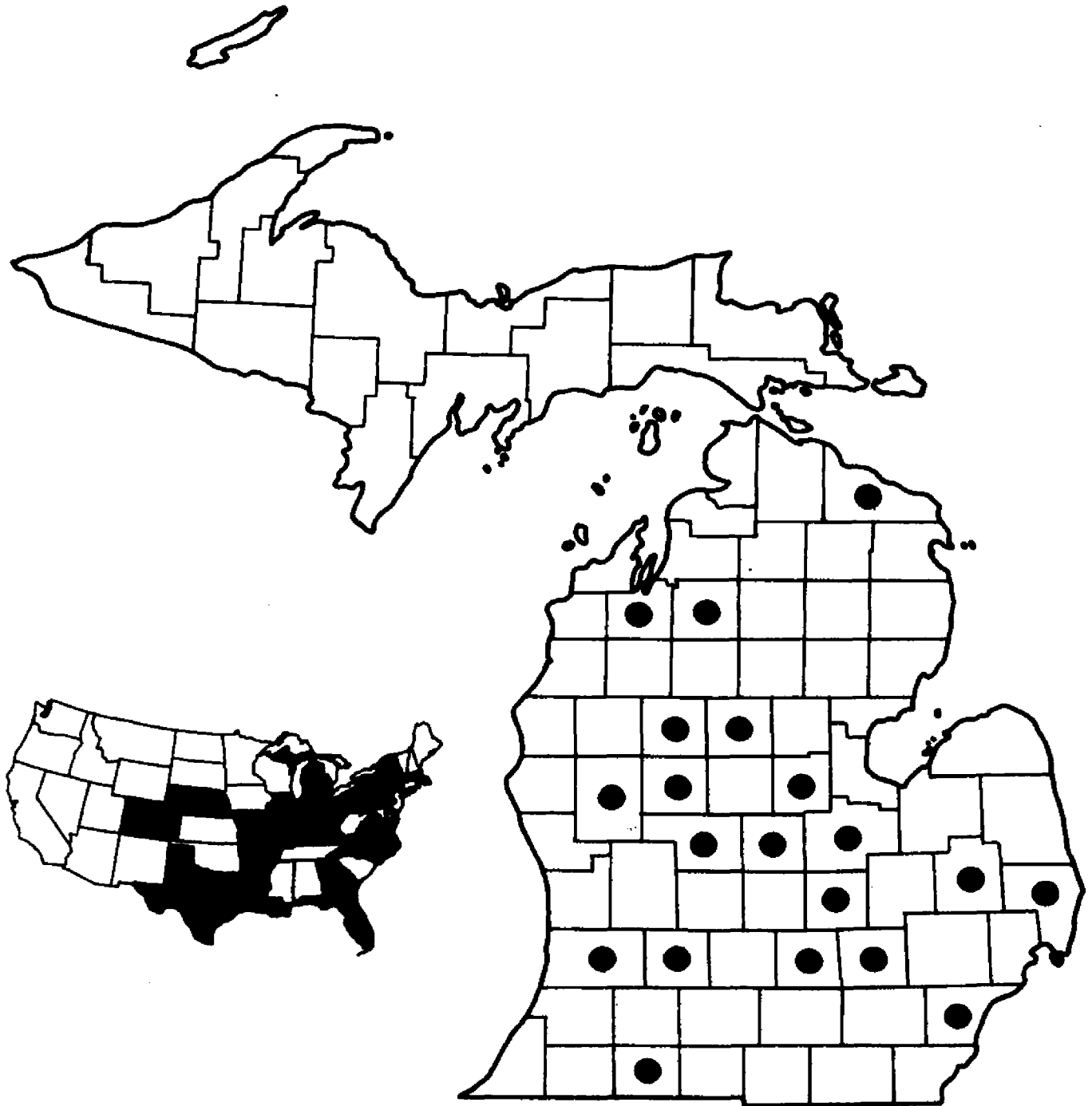
Lamprochernes oblongus, Beier, 1932b: 84; Roewer, 1937: 289; Hoff, 1945b: 37, 1947: 477, 1949: 450, 1958: 20, 1961: 444; Hoff and Bolsterli, 1956: 165; Fenstermacher, 1959: 18; Manley, 1969: 7; Weygoldt, 1969: 114.

This species can be separated by the characters given in the key and illustrated in Figures 47-50. Setae of the body and palps are long and appear acuminate, however, one or two minute subterminal spinules usually are present. Specimens agree well with those reported by Hoff (1949). Measurements of three males include: body length 2.05-3.13; palpal femur 0.44-0.46 long, 0.22-0.25 wide, length x width 1.8-2.0; tibia 0.46-0.48 long, 0.24-0.245 wide, length x width 1.88-2.0; chela without pedicel 0.73-0.79 long, 0.30-0.32 wide, length x width 2.28-2.63; chelal hand about 0.42-0.43 long, 0.29-0.31 deep; movable finger 0.33-0.38 long. Measurements of four females include: body length about 2.35-2.87; palpal femur 0.45-0.49 long, 0.21-0.24 wide, length x width 2.04-2.19; tibia 0.44-0.48 long, 0.23-0.255 wide, length x width 1.83-2.04; chela without pedicel 0.775-0.82 long, 0.31-0.35 wide, length x width 2.29-2.56; chelal hand 0.42-0.44 long, 0.27-0.33 deep; movable finger 0.37-0.41 long.

Distribution (Map 10) and Habitat Preference. Lamprochernes oblongus is well represented in the east from New England to Florida and as far west as Colorado. In Michigan it was collected throughout the entire Lower Peninsula. This species normally occurs under the bark of dead trees. Fenstermacher (1959) reported specimens of L. oblongus from under the elytra of elaterid beetles of the species Alaus oculatus (Linnaeus). Manley (1969) reported L. oblongus from under bark of logs and stumps. Manley's reference to Fenstermacher's report (1959) of L. oblongus from grain bins was not supported by Fenstermacher's collection or thesis. Present Michigan specimens were collected under bark of both coniferous and deciduous trees. One specimen was collected in a nest of a wood duck.

Records. ST. JOSEPH CO.: 27 July 1968, S. Nelson, 1 female under bark of a sugar maple stump. BARRY CO.: 10 Aug. 1968, S. Nelson, 5 individuals under bark of a dead black oak. ALLEGAN CO.: 9 July 1963, R. C. Graves, 1 male and 2 females under pine bark. LAPEER CO.: 1 May 1963, R. C. Graves, 1 male under bark of log. SHIAWASSEE CO.: 18 Feb. 1970, S. Nelson, 5 nymphs in a wood duck nest box. SAGINAW CO.: 22 July 1968, S. Nelson, 2 males and 1 nymph under bark of a dead black cherry. NEWAYGO CO.: 1 July 1968, Sheila Nelson, 1 male under bark of a dead Aspen tremuloides Michx., and S. Nelson,





Map 10. Distribution of Lamprochernes oblongus

1 female under bark of a dead red maple. KALKASKA CO.: 9 July 1968, Sheila and S. Nelson, 9 individuals under bark of a dead red maple. GRAND TRAVERSE CO.: 12 July 1929, C. F. Beyer, 1 male and 3 females. PRESQUE ISLE CO.: 11 Aug. 1968, S. Nelson, 1 male under bark of a dead jack pine. In addition to the above, Fenstermacher (1959) and Manley (1969) reported Lamprochernes oblongus from the following counties: Clare, Gratiot, Livingston, Ingham, Mecosta, Midland, Montcalm, Osceola, St. Clair, and Wayne.

Lamprochernes minor Hoff

Lamprochernes minor Hoff, 1949: 453, 1958: 21, 1961: 445; Levi, 1953: 59; Hoff and Bolsterli 1956: 166; Fenstermacher, 1959: 20; Manley, 1969: 7.

This species is separated from L. oblongus by the characters given in the key and illustrated in Figures 51, 52. Setae of the body and palps as in L. oblongus. Present specimens agree well with those described by Hoff (1949) and reported by Hoff and Bolsterli (1956). Measurements of three females include: body length 1.87 (abdomen contracted) -2.57; palpal femur 0.51-0.53 long, 0.24-0.25 wide, length x width 2.04-2.14; tibia 0.54-0.57 long, 0.24-0.26 wide, length x width 2.08-2.25; chela without pedicel 0.86-0.90 long, 0.31-0.32 wide, length x width 2.72-2.9; chelal hand 0.45-0.46 long, 0.275-0.31 deep; movable finger 0.44-0.46 long.

Distribution (Map 11) and Habitat Preference. This species occurs in the States of Colorado, Illinois, Michigan, Minnesota, North Dakota, and Wisconsin. In Michigan it occurs in both the northern and southern portions of the Lower Peninsula. Lamprochernes minor occurs in a diversity of habitats--see Records.

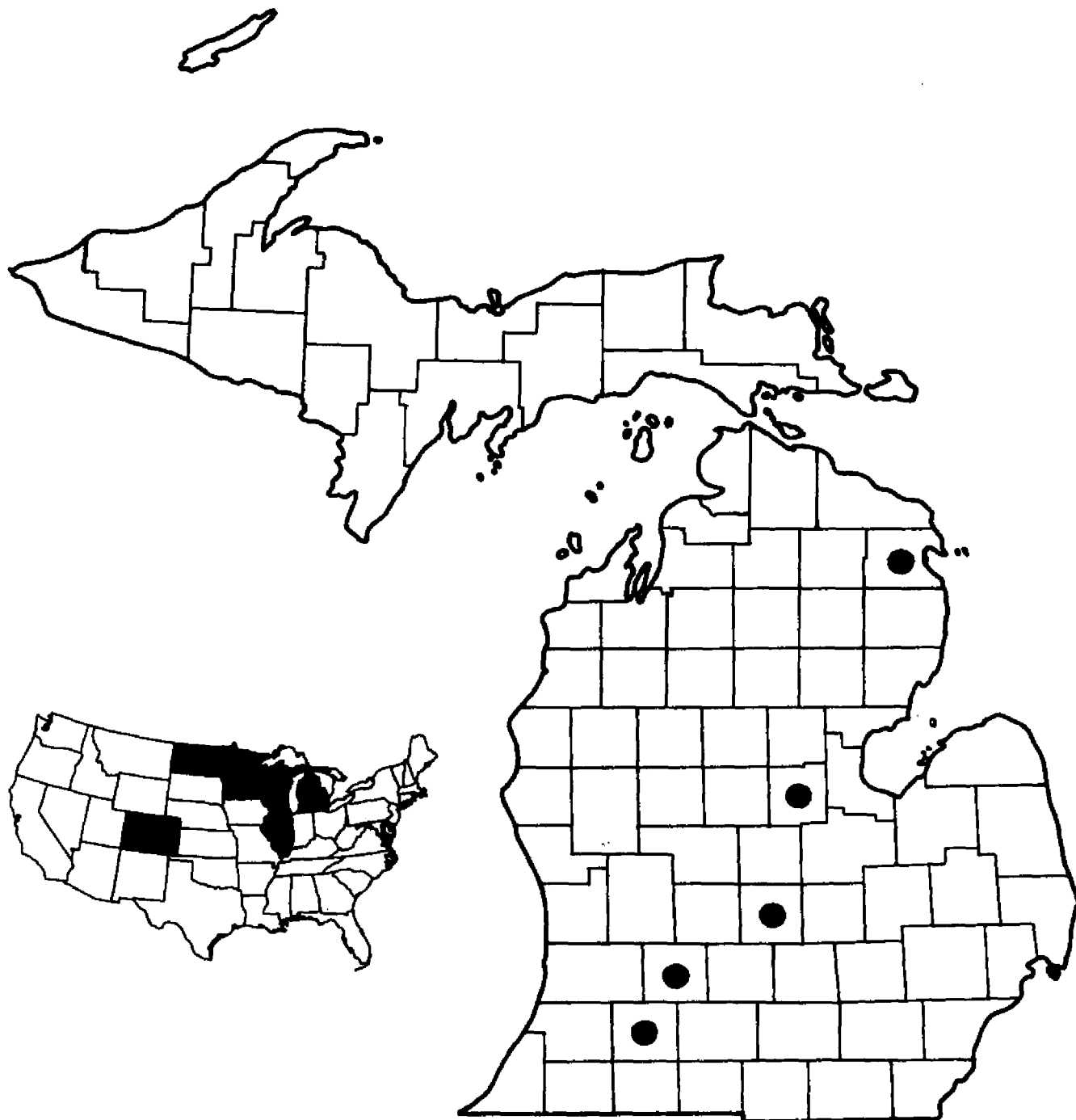
Records. KALAMAZOO CO.: 12 Sept. 1963, R. W. Husband, 1 female from nest of Bombus americanorum (Fabricius), and 16 Apr. 1964, R. W. Matthews, 1 female in rotten straw. BARRY CO.: 4 Aug. 1959, R. J. Snider, 1 female from log sample. CLINTON CO.: 24 Oct. 1956, R. A. Scheibner, several adults. MIDLAND CO.: 8 Aug. 1945, R. R. Dreisbach, 1 adult (cited from Fenstermacher 1959). ALPENA CO.: 3 Aug. 1967, G. V. Manley, several individuals from under bark lying on a sawdust pile.

#### Subfamily Chernetinae

#### Parachernes squarrosus Hoff

Parachernes squarrosus Hoff, 1949: 456, 1958: 30; Hoff and Bolsterli, 1956: 169.

This species is easily separated from other Michigan pseudoscorpions by the characters given in the key and illustrated in Figures 53, 54. Present specimens agree in detail with those described by Hoff (1949). Measurements of a single male include: body length 1.73 (body untreated); palpal femur 0.47 long, 0.20 wide, length x width 2.35; tibia 0.48 long, 0.22 wide, length x width



Map 11. Distribution of Lamprochernes minor

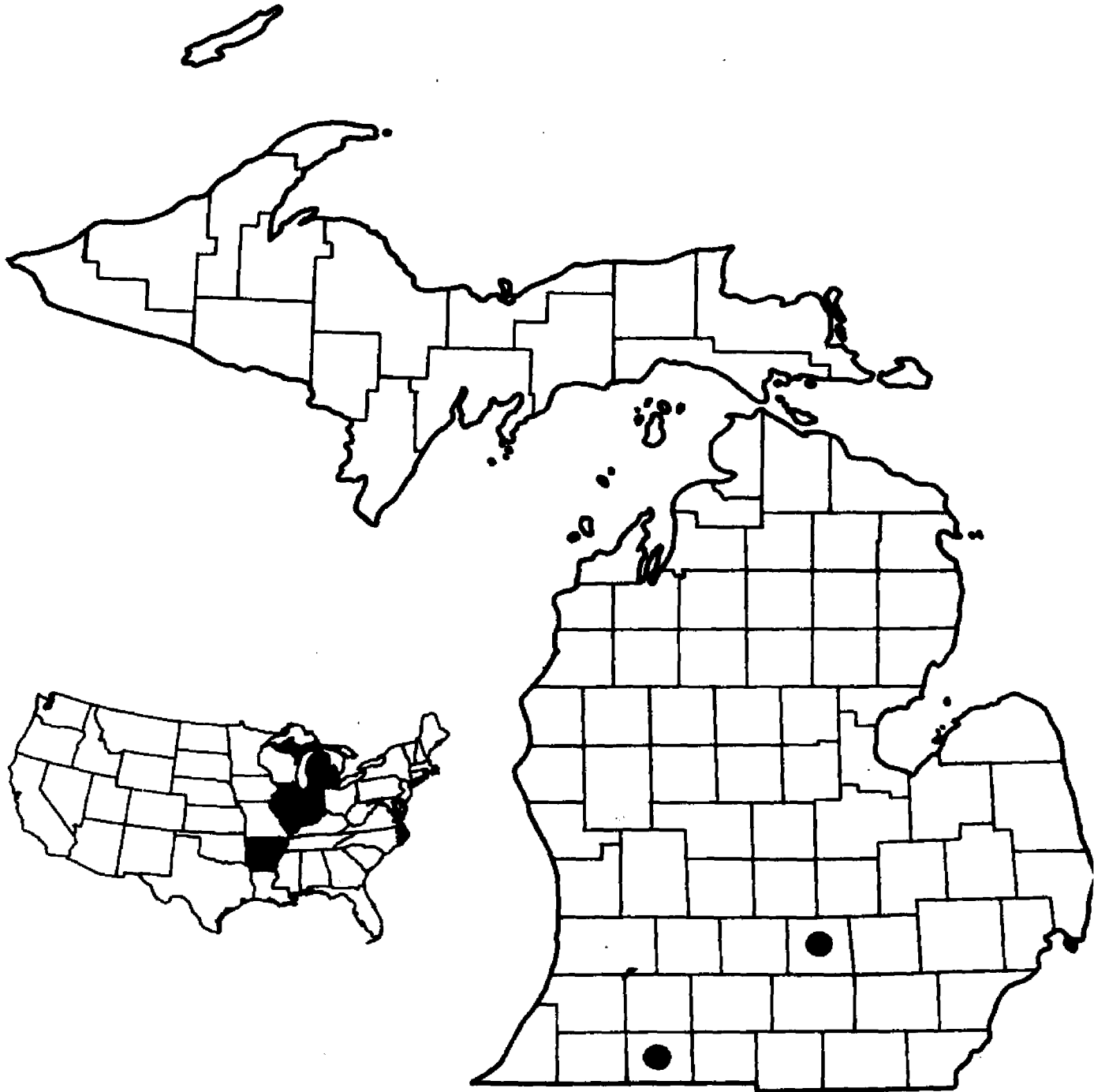
2.18; chela without pedicel 0.81 long, 0.35 wide (twisted); movable finger 0.46 long. Measurements of a single female include: body length 2.46; palpal femur 0.47 long, 0.20 wide, length x width 2.35; tibia 0.49 long, 0.22 wide, length x width 2.23; chela without pedicel 0.84 long, 0.34 wide, length x width 2.47; chelal hand 0.46 long, 0.34 deep; movable finger 0.44 long.

Distribution (Map 12), Habitat Preference and Records. This species occurs in the Midcentral States of Arkansas, Illinois, Indiana, and Michigan. The Michigan records are from St. Joseph and Ingham Counties. ST. JOSEPH CO.: 26 July 1968, S. Nelson, 1 female under bark of a dead willow. INGHAM CO.: 24 Aug. 1967, G. V. Manley, 1 male under bark of old log.

Pselaphochernes parvus Hoff

Pselaphochernes parvus Hoff, 1945b: 38, 1949: 461, 1958: 31; Hoff and Bolsterli, 1956: 168; Fenstermacher, 1959: 21; Lawson, 1968: 188; Manley, 1969: 8.

This species is recognized by the characters given in the key and illustrated in Figures 4, 55, 56. Present specimens agree with those of Hoff (1945b, 1949). Measurements of two males include: body length 1.81, 1.82; palpal femur 0.45, 0.46 long, 0.19, 0.20 wide, length x width 2.3, 2.42; tibia 0.485, 0.49 long, 0.2, 0.22 wide, length x width 2.23, 2.43; chela without pedicel 0.84, 0.84 long, 0.25, 0.275 wide, length x width 3.15, 3.34;

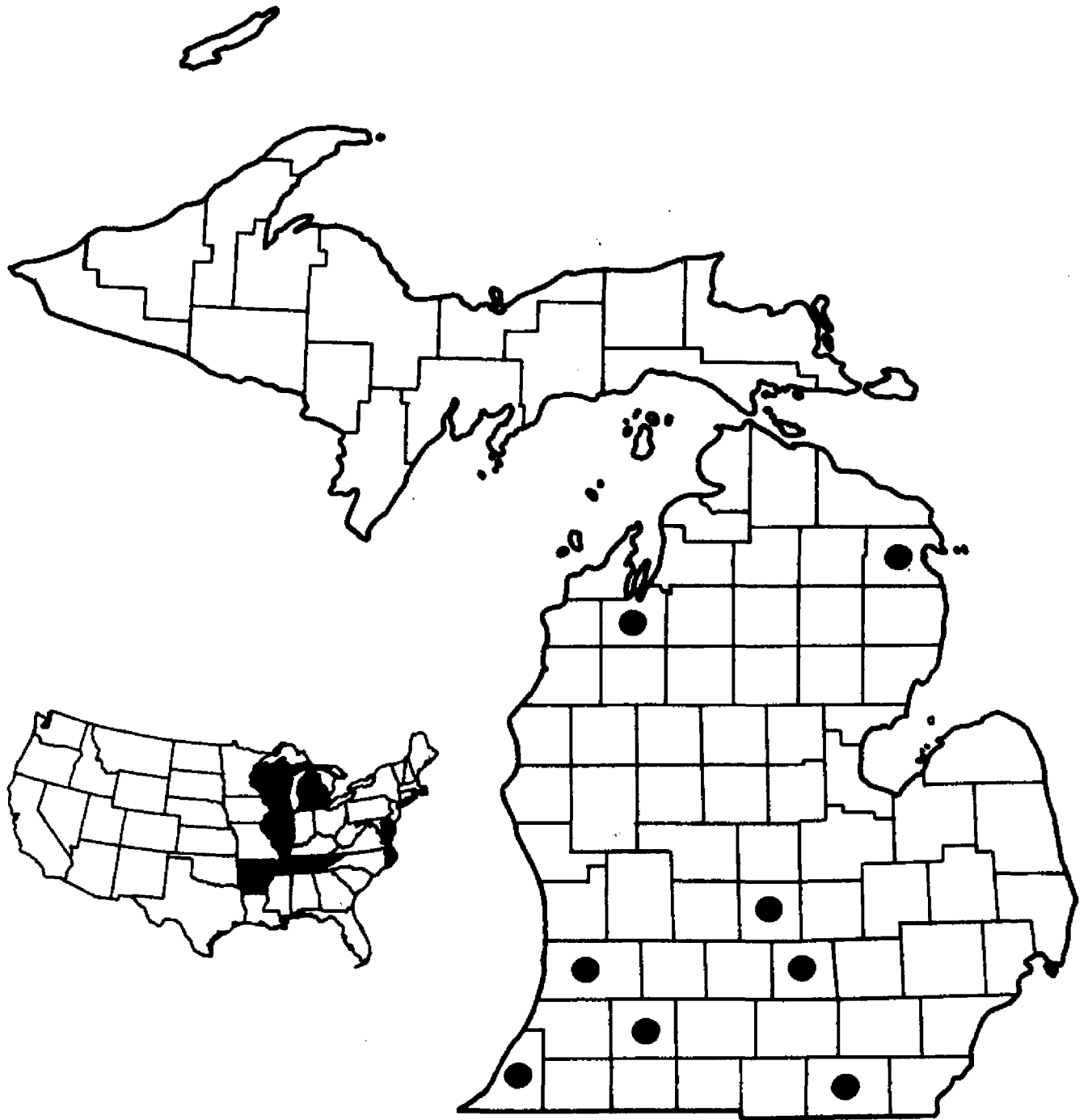


Map 12. Distribution of Parachernes squarrosus

chela hand 0.41 long, 0.25, 0.27 deep; movable finger 0.45 long. Measurements of six females include: body length 1.93-2.32; palpal femur 0.47-0.525 long, 0.19-0.21 wide, length x width 2.45-2.57; tibia 0.49-0.56 long, 0.21-0.235 wide, length x width 2.28-2.55; chela without pedicel 0.85-0.95 long, 0.29-0.31 deep; movable finger 0.43-0.51.

Distribution (Map 13) and Habitat Preference. This species occurs in the Midcentral States of Arkansas, Illinois, Michigan, Tennessee, and Wisconsin. It is distributed throughout the Lower Peninsula of Michigan. Hoff (1949) reported P. parvus from rotting logs, hollow trees, woody debris, and ground cover. Nests of small mammals were present in two of the tree hollows. Michigan specimens were collected under bark, inside tree hollows, in leaf litter, rotten logs, and in rotten straw. Manley's (1969) record of P. parvus from a mouse nest was possibly based on the misidentification of Dinocheirus pallidus.

Records. LENAWEE CO.: 6 Oct. 1967, S. Nelson, 1 deutonymph under elm bark. BERRIEN CO.: 5 Aug. 1968, S. Nelson, 1 female and 1 deutonymph under dead sugar maple bark. KALAMAZOO CO.: 9 July 1957, J. Fenstermacher, 1 tritonymph (cited from Fenstermacher, 1959); 22 June 1960, R. J. Snider, 1 female under log; and 16 April 1964, R. W. Matthew, 4 individuals in rotten straw. INGHAM CO.: 11



Map 13. Distribution of Pselaphochernes parvus



to 28 May 1958, J. Fenstermacher, several individuals in leaf litter and rotten logs; 6 April 1968, S. Nelson, 1 female inside sugar maple hollow; 12 June 1968, S. Nelson, 2 females and 1 tritonymph under dead sugar maple bark; 25 June 1968, S. Nelson, 2 males and 1 female inside sugar maple hollow; 3 Oct. 1968, G. Klee, 1 female in old stump. ALLEGAN CO.: 24 June 1968, S. Nelson, 1 female under dead red oak bark. GRAND TRAVERSE CO.: no date, G. V. Manley, 1 female in tree hollow. In addition to the above, Manley (1969) reported P. parvus from Clinton and Alpena Counties.

Dendrochernes morosus (Banks)

Chelanops morosus Banks, 1895: 7; Coolidge, 1908: 111.

Neochernes morosus, Beier, 1932b: 169, 1932c: 533; Roewer, 1937: 299.

Dendrochernes morosus, Hoff, 1947: 536, 1949, 464, 1956b: 43, 1958: 29; Fenstermacher, 1959: 22; Manley, 1969: 8.

This species is known only from Michigan on the basis of a few individuals. Hoff (1947) re-examined the type material which consisted of two specimens.

Manley (1969) reported "several" individuals without indicating sex. The present specimen, a single female, agrees well with Hoff's description except for its larger size. Diagnostic characters are given in the key and illustrated in Figures 57, 58. Measurements of

the above specimen and a female specimen in the Manley collection (given in parentheses) include: body length 3.31 (2.96); palpal femur 0.75 (0.72) long, 0.30 (0.28) wide, length x width 2.5 (2.57); tibia 0.74 (0.71) long, 0.35 (0.33) wide, length x width 2.13 (2.15); chela without pedicel 1.25 (1.25) long, 0.50 (0.50) wide, length x width 2.5 (2.5); chelal hand 0.71 (0.72) long, 0.525 (0.49) deep; movable finger 0.66 (0.66) long. Fourth leg with pars basalis 0.29 (0.27) long, 0.19 (0.17) deep, length x depth 1.53 (1.59); pars tibialis 0.56 (0.50) long, 0.22 (0.20) deep, length x depth 2.55 (2.5); tibia 0.56 (0.52) long, 0.14 (0.12) deep, length x depth 4.0 (4.33); tarsus 0.40 (0.39) long, 0.10 (0.097) deep, length x depth 4.0 (4.02); tactile seta of tarsus 0.265 (0.27) from proximal margin.

Distribution (Map 14) and Habitat Preference. Known only from Michigan. Previously known only from Keweenaw Co.: mainland and Isle Royale, Lake Superior. Present record extends the range of this species to the northern part of the Lower Peninsula. No habitat data were given with the type collection.

Records. KEWEENAW CO.: H. G. Hubbard, 2 adults on Isle Royale (cited from Banks, 1895); and May 1968, G. V. Manley, 1 female under bark of dead spruce. MONTMORENCY CO.: 2 Sept. 1959, R. L. Fischer, 1 male under dry bark.



Map 14. Distribution of Dendrochernes morosus

Acuminochernes tacitus Hoff

Acuminochernes tacitus Hoff, 1961: 450.

This species was described from Colorado and is the only record to date. The description was based on two males, three females, and two tritonymphs. The present Michigan specimens, two males, eight females, and three tritonymphs were tentatively identified as A. tacitus. Michigan males generally have longer and more slender podal segments, however, the females generally agree with those described by Hoff. More specimens from both States, along with the examination of type materials are needed before a definite assignment of Michigan specimens can be made. Diagnostic characters are given in the key and illustrated in Figures 59, 60. Measurements of two males include: body length 2.52, 2.69; palpal femur 0.75, 0.765 long, 0.28, 0.29 wide, length x width 2.64, 2.68; tibia 0.72, 0.74 long, 0.29, 0.30 wide, length x width 2.4, 2.55; chela without pedicel 1.30, 1.37 long, 0.45, 0.48 wide, length x width 2.85, 2.89; chelal hand 0.67, 0.71 long, 0.43, 0.44 deep; movable finger 0.71, 0.745 long. Fourth leg with pars basalis 0.26, 0.275 long, 0.18, 0.18 deep, length x depth 1.5, 1.58; pars tibialis 0.53, 0.535 long, 0.19, 0.20 deep, length x depth 2.77, 2.67; tibia 0.62, 0.63 long, 0.11, 0.13 deep, length x depth 4.69, 5.64; tarsus 0.48, 0.49 long, 0.076, 0.092 deep, length x depth 5.33, 6.32; tactile seta of tarsus

0.35, 0.36 from proximal margin; genitalia as in original description. Measurements of eight females include: body length 2.18-3.02; palpal femur 0.6-0.74 long, 0.22-0.27 wide, length x width 2.64-2.9; tibia 0.57-0.70 long, 0.24-0.28 wide, length x width 2.37-2.61; chela without pedicel 1.09-1.30 long, 0.32-0.39 wide, length x width 3.03-3.41; chelal hand 0.50-0.62 long, 0.32-0.38 deep; movable finger 0.61-0.71 long. Fourth leg with pars basalis 0.24-0.30 long, 0.15-0.18 deep, length x depth 1.5-1.7; pars tibialis 0.43-0.54 long, 0.16-0.20 deep, length x depth 2.5-2.82; tibia 0.50-0.63 long, 0.10-0.13 deep; length x depth 4.85-5.35; tarsus 0.42-0.51 long, 0.07-0.087 deep, length x depth 5.66-6.48; tactile seta of tarsus 0.30-0.35 from proximal margin.

Distribution (Map 15) and Habitat Preference. This species occurs in Colorado and Michigan. Michigan specimens were collected from both Peninsulas north of the 44th parallel. Hoff (1961) reported A. tacitus from woody debris within hollow stumps and trees, nests of rodents, and from the nest of a flicker. Michigan specimens were collected from tree hollows, two of which contained nests of small mammals.

Records. BENZIE CO.: 14 Oct. 1968, S. Nelson, 1 tritonymph in hollow of a live sugar maple. CHEBOYGAN CO.: 12 Aug. 1968, S. Nelson, 1 male, 2 females, and 1 tritonymph in hollow in sugar maple stump; and 1 female



Map 15. Distribution of Acuminochernes tacitus

in a live red oak hollow. CHIPPEWA CO.: 26 Aug. 1969, S. Nelson, 1 female in a live beech hollow. MARQUETTE CO.: 31 Aug. 1968, S. Nelson, 1 female in nest of Tamias striatus (eastern chipmunk) in a live trembling aspen hollow. BARAGA CO.: 29 Aug. 1968, S. Nelson, 1 female in a dead sugar maple hollow. ONTONAGON CO.: 29 Aug. 1968, S. Nelson, 1 male and 2 females in nest of Peromyscus leucopus (Rafinesque) in a live red maple hollow; and 1 female in straw in old barn.

Acuminochernes crassopalpus (Hoff)

Hesperochernes crassopalpus Hoff, 1945b: 43.

Acuminochernes crassopalpus, Hoff, 1949: 477, 1958: 25, 1961: 454; Parks and Auerbach, 1954: 210; Hoff and Bolsterli, 1956: 174.

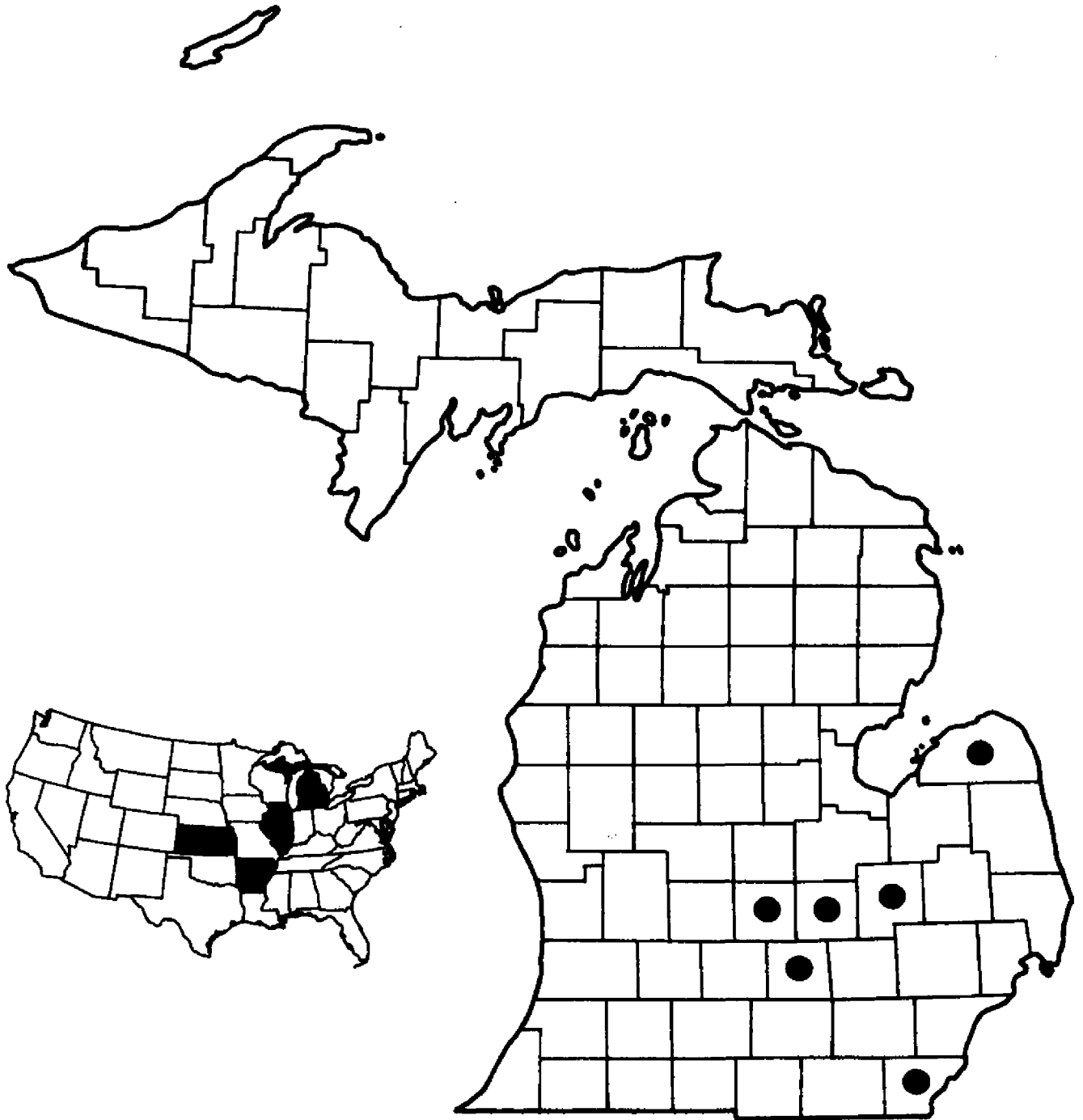
Present specimens agree with those reported by Hoff (1945b, 1949). This species is identified by the characters given in the key and illustrated in Figures 61, 62. Measurements of five males include: body length 1.9-2.16; palpal femur 0.53-0.57 long, 0.255-0.30 wide, length x width 1.9-2.1; tibia 0.53-0.60 long, 0.27-0.285 wide, length x width 1.81-2.13; chela without pedicel 0.92-1.00 long, 0.38-0.50 wide, length x width 2.0-2.42; chelal hand 0.44-0.45 long, 0.42-0.5 deep; movable finger 0.47-0.60 long. Measurements of six females include: body length 2.0-2.31 (two with abdomen contracted measured 1.63 and 1.76); palpal femur 0.49-0.56 long, 0.24-0.275

wide, length x width 1.96-2.15; tibia 0.51-0.59 long, 0.235-0.27 wide, length x width 2.04-2.19; chela without pedicel 0.89-1.02 long, 0.34-0.42 wide, length x width 2.42-2.6; chelal hand 0.44-0.48 long, 0.35-0.40 deep; movable finger 0.47-0.55 long.

Distribution (Map 16) and Habitat Preference. This species occurs in the Midcentral States of Arkansas, Illinois, Kansas, and Michigan. Present specimens were collected in the southeastern quarter of the Lower Peninsula. This species is reported by Hoff (1949) from debris in tree hollows, a decayed log, and the stomach of a red-bellied woodpecker. All Michigan specimens were collected from tree hollows or crevices. Two hollows contained nests--see Records.

Records. MONROE CO.: 27 Apr. 1969, S. Nelson, several individuals in a live cottonwood hollow. INGHAM CO.: 21 Mar. 1968, S. Nelson, 1 male in a live beech hollow; 25 Sept. 1968, G. V. Manley, 2 males and 1 tritonymph. GENESEE CO.: 16 Oct. 1968, S. Nelson, several individuals from a live largetooth aspen hollow with nests of wasps and honey bees. SHIAWASSEE CO.: 27 Feb. 1970, S. Nelson, 2 females in a live beech hollow. CLINTON CO.: 30 Sept. 1968, S. Nelson, 1 male and 1 female in debris from crevice in a dead elm. HURON CO.: 10 Oct. 1968, S. Nelson, several individuals from hollow in a live red maple with nest of Peromyscus leucopus.





Map 16. Distribution of Acuminochernes crassopalpus

Mirochernes dentatus (Banks)

Chelanops dentatus Banks, 1895: 6; Coolidge, 1908: 111; Chamberlin, 1931: 123; Brimley, 1938: 497.

Mirochernes dentatus, Beier, 1930a: 216 (but not pp. 217-218), 1932b: 182; Roewer, 1937: 303; Hoff, 1945b: 49, 1947: 502, 1949: 478, 1958: 25; Parks and Auerbach, 1954: 210; Hoff and Bolsterli, 1956: 176; Weygoldt, 1969: 30.

Chernes dentatus, Chamberlin, 1931: 124.

Males of this species can easily be identified by the anvil-like process on the inner surface of the chelal hand. Females, on the other hand, are separated with difficulty from Dinocheirus pallidus by the characters given in the key. Diagnostic characters are illustrated in Figures 63-65. Measurements of seven females include: body length 2.05-3.15; palpal femur 0.55-0.74 long, 0.25-0.32 wide, length x width 2.14-2.4; tibia 0.56-0.73 long, 0.26-0.32 wide, length x width 2.07-2.33; chela without pedicel 1.00-1.23 long, 0.36-0.45 wide, length x width 2.73-2.97; chelal hand 0.46-0.58 long, 0.36-0.45 deep; movable finger 0.58-0.72 long.

Distribution (Map 17) and Habitat Preference. This species occurs in the Eastern and Central States of Arkansas, Florida, Illinois, Indiana, Michigan, North Carolina, and Virginia. Hoff and Bolsterli (1956) questioned the Florida record of Banks (1895). Present

Map 17. Distribution of Mirochernes dentatus

specimens, collected only in the Lower Peninsula, represent the first Michigan records of this species. Mirochernes dentatus occurs most frequently in woody debris within tree hollows. Michigan specimens were taken from under bark and from tree hollows. The tree hollows contained nests of small mammals in two instances.

Records. SHIAWASSEE CO.: 18 Feb. 1970, S. Nelson, 1 male from red maple hollow. INGHAM CO.: 21 Mar. 1968, S. Nelson, 1 male (palp only) in live sugar maple hollow. ALLEGAN CO.: 6 Aug. 1968, S. Nelson, 1 male and 4 females in live white oak hollow. HURON CO.: 16 Oct. 1968, S. Nelson, 1 male and 1 female in nest of Peromyscus leucopus in live red maple hollow. LAKE CO.: 14 Oct. 1968, S. Nelson, several specimens from rotten wood in a live white oak hollow. MASON CO.: 2 July 1968, Sheila and S. Nelson, 1 male and 1 female, and possibly 2 nymphs under bark of a dead black oak.

Dinocheirus horricus, new species

Male. The description of the male is based on four individuals (the holotype and three paratypes). Measurements (in mm.) are first given for the holotype followed in parentheses by corresponding measurements expressed as the range of all four individuals. Body fairly stout; golden-brown in color; body length 2.12 (2.0-2.42). Carapace 0.79 (0.765-0.825) long, 0.65 (0.60-0.714) wide; anterolateral margin rounded; with two well-marked

transverse furrows, posterior furrow nearer to posterior carapacial margin than to median furrow; posterior carapacial margin with 11 or 12 clavate and multi-denticulate setae; eyes absent; surface of carapace moderately granular. Abdomen 1.35 (1.22-1.60) long, 1.17 (0.89-1.17) wide. Tergites all divided except eleventh; intertergal space rugose; tergites moderately granular to scale-like in sculpturing; setae clavate and multi-denticulate; each tergal half of first tergite with 8 (7-9) setae, of second 10, 8 (8-10), maximum number of setae on any tergal half 12 (10-12). Sternites 4-10 divided; sternites with scale-like sculpturing less pronounced than tergites; setae of sternites four and five acuminate, acuminate setae of sternites 6-10 progressively being replaced by subclavate setae; each sternal half of fourth sternite with 4 (4-5) setae, of fifth 12 (10-12), maximum number of setae on any sternal half 14 (15). Pleural membrane very rugose. Each anterior stigmatic plate with three acuminate setae, each posterior plate with one acuminate seta.

Chelicera moderately stout, a rich golden-brown in color; hand with net-like markings; basal seta acuminate, subbasal seta with a few terminal and subterminal denticulations; flagellum with four setae, longest flagellar seta unilaterally serrate distal two-thirds; chelicera 0.25 (0.24-0.255) long, 0.13 (0.13-0.138) wide at base.

Fixed finger moderately slender; lamina exterior conspicuous; inner margin of apical tooth with three or four weak denticles, inner margin of finger with two strong and three weak denticles; serrula interior with terminal four plates free, each with strongly serrate margins. Movable finger with subapical lobe inserted near base of apical tooth, distad from insertion of galeal seta; a weak denticle may be present on finger margin near insertion of galeal seta; galeal seta to tip of galea; galea with 5-6 terminal and sub-terminal rami (Fig. 68); serrula exterior with 18-19 ligulate plates; length of movable finger 0.18 (0.16-0.214) long.

Palps moderately stout; reddish-brown in color; anterior and lateral surfaces of maxilla, trochanter and flexor surface of femur, tibia, and finger bases moderately granular; extensor surface of femur, tibia, and entire chelal hand weakly granular to smooth; setae of maxilla acuminate to subclavate; flexor setae of trochanter, femur, tibia, and chelal hand clavate and multidenticulate; extensor setae subclavate to clavate and multidenticulate; setae of chelal fingers acuminate. Trochanter 0.38 (0.38-0.46) long, 0.24 (0.23-0.255) wide. Femur with pedicel sharply set-off from body; flexor margin evenly convex proximally, evenly concave distally; extensor margin flatly convex, tapering distally; femur 0.64 (0.62-0.69) long, 0.265 (0.25-0.27) wide, length x

width 2.42 (2.42-2.6). Tibia with stout pedicel; flexor margin slightly bulging at center, weakly concave distally; extensor margin evenly convex; tibia 0.63 (0.61-0.70) long, 0.285 (0.28-0.285) wide, length x width 2.21 (2.18-2.5). Chela with flexor margin evenly convex; extensor margin less convex; fingers slightly curved; chela without pedicel 1.11 (1.08-1.15) long, 0.41 (0.38-0.43) wide, length x width 2.71 (2.67-2.84). Chelal hand with pedicel subcentral in dorsal view, ventral in lateral view; chelal hand about 0.52 (0.51-0.54) long, 0.40 (0.39-0.42) deep; movable chelal finger 0.59 (0.58-0.64) long. Tactile setae as illustrated in Figures 66, 67; est nearer to esb than to et; each finger with about 43 (40-45) marginal teeth and four to seven internal and external accessory teeth; nodus ramosus varying from midway between t and st to closer to st.

Legs golden-brown in color; surface of segments varying from smooth to very weak scale-like sculpturing. First leg with extensor setae subclavate and multidenticulate; flexor setae chiefly acuminate on trochanter, tibia and tarsus, subclavate on pars basalis and pars tibialis. Trochanter of holotype about 0.15 long, 0.137 wide. Femur with pars basalis 0.14 (0.107-0.15) long, 0.137 (0.112-0.14) deep; pars tibialis with flexor margin flatly convex; extensor margin evenly convex; 0.35 (0.34-0.35) long, 0.12 (0.12-0.13) deep. Tibia with flexor

margin evenly convex distal three-fourths; extensor margin evenly convex proximally, evenly concave distally; 0.36 (0.35-0.40) long, 0.092 (0.09-0.097) deep, length x depth 3.91 (3.89-4.12). Tarsus with flexor margin flatly convex; extensor margin flatly concave to straight; 0.36 (0.35-0.37) long, 0.064 (0.064-0.066) deep, length x depth 5.62 (5.47-5.62).

Fourth leg with extensor setae subclavate; flexor setae chiefly acuminate, subclavate and multidenticulate on entire pars tibialis. Trochanter 0.28 (0.27-0.28) long, 0.14 (0.14) deep. Entire femur with flexor margin nearly straight; extensor margin of pars tibialis evenly convex; pars basalis about 0.22 (0.22-0.23) long, 0.15 (0.15-0.16) deep; pars tibialis 0.46 (0.45-0.495) long, 0.17 (0.17-0.18) deep; entire femur 0.63 (0.62-0.67) long. Tibia with flexor margin evenly convex; extensor margin convex proximally, flatly concave distally; 0.52 (0.51-0.56) long, 0.107 (0.10-0.11) deep, length x depth 4.86 (4.86-5.1). Tarsus subcylindrical; 0.42 (0.41-0.44) long, 0.079 (0.075-0.079) deep, length x depth 5.32 (5.32-5.79); tactile seta of tarsus 0.29 (0.28-0.32) from proximal end.

Genitalia with 18 (18-19) acuminate setae on the face of the anterior operculum and eight (six to eight) acuminate setae along the anterior lip, four (three to four) on each side of the genital slit; posterior



operculum with four (three to five) short setae along the posterior lip of the genital slit and 20 (19-22) acuminate setae scattered on the face of the posterior operculum, some of which form an irregular row along the posterior margin of the operculum.

Female. The description of the female is based on five mounted individuals (the allotype and four paratypes). Measurements (in mm.) first given for the allotype are usually followed in parentheses by corresponding measurements expressed as the range of all five individuals. Female is similar to male in most respects except one female is somewhat larger in size than both males and other females. Body of female 2.40 (2.04-3.13), usually under 2.70. Carapace about 0.86 (0.82-0.93) long. Posterior carapacial margin with about 11-14 clavate and multidenticulate setae. Chaetotaxy and sculpturing of tergites and sternites similar to male.

Chelicera similar to male; flagellum with four setae, longest flagellar seta unilaterally serrate; chelicera of one paratype with penultimate seta unilaterally serrate; galea with six simple rami distal one-half; galeal seta not to tip of galea; serrula exterior with 16-19 ligulate plates. Chelicera 0.255 (0.23-0.26) long, 0.153 (0.138-0.153) wide at base; movable finger 0.215 (0.198-0.229) long.

Palp essentially as in male except absolute size of lone female mentioned above; palpal shape, color, setae,

and sculpturing similar to males; granulations not as pronounced as in male. Trochanter 0.45 (0.42-0.51) long, 0.245 (0.23-0.28) wide; femur 0.67 (0.64-0.76, usually less than 0.70) long, 0.28 (0.255-0.31) wide, length x width 2.39 (2.39-2.56); tibia 0.65 (0.63-0.77, usually less than 0.70) long, 0.29 (0.28-0.33) wide, length x width 2.24 (2.24-2.33); chela without pedicel 1.12 (1.08-1.22, usually less than 1.15) long, 0.42 (0.39-0.45) wide, length x width 2.67 (2.67-2.85); chelal hand about 0.56 (0.55-0.65) long, 0.425 (0.39-0.44) deep; movable finger 0.64 (0.59-0.71) long. Each finger with 39-44 marginal teeth and usually four to six internal and external accessory teeth; tactile setae and nodus ramosus as in male.

Legs of female larger and more slender than male; similar in color, sculpturing, and chaetotaxy; pars tibialis of fourth leg with both acuminate and subclavate setae. First leg with trochanter 0.173 long, 0.133 deep; femur with pars basalis 0.153 long, 0.147 deep; pars tibialis 0.34 (0.32-0.38) long, 0.133 (0.127-0.15) deep; tibia 0.38 (0.35-0.43) long, 0.092 (0.092-0.10) deep, length x depth 4.13 (3.76-4.3); tarsus 0.38 (0.36-0.41) long, 0.067 (0.064-0.067) deep, length x depth 5.67 (5.61-6.2). Fourth leg with trochanter 0.305 long, 0.163 deep; femur with pars basalis 0.25 long, 0.168 deep; pars tibialis 0.49 long, 0.183 deep, entire femur 0.68 (0.66-0.79) long; tibia 0.56 (0.53-0.64) long, 0.11 (0.10-0.12)

deep, length x depth 5.09 (5.09-5.4); tarsus 0.43 (0.43-0.48) long, 0.076 (0.076-0.081) deep, length x depth 5.66 (5.66-6.04); tactile seta of tarsus 0.306 (0.296-0.35) from proximal end.

Genitalia with 22 (22-23) acuminate setae scattered on the face of the anterior operculum; posterior operculum with 12 (8-12) acuminate setae in a row along posterior rim; each seminal receptacle in the form of a long coiled tubule terminating in a spherical sac.

Tritonymph. The description of the tritonymph is based on three mounted paratypes. Measurements (in mm.) are expressed as the range of all three individuals. Body and appendages similar to adult, but with lighter color, fewer setae, and smaller size; sculpturing as in adult; body 1.74-1.95 long. Carapace with 10-13 clavate and multidenticulate setae along posterior carapacial margin; carapace 0.61-0.65 long, 0.485-0.54 wide. Tergites with a maximum number of eight setae on each tergal half; sternites with a maximum number of 9-10. Abdominal setae shape as in adult. Pleural membrane very rugose. Each anterior stigmatic plate with two (one stigmatic plate of one individual with one) setae, each posterior stigmatic plate with one seta.

Chelicera lighter in color, smaller in size than adult; chelicera 0.20-0.215 long, 0.115-0.122 wide at base; movable finger 0.15-0.18 long; sb denticulate,

b acuminate; galea with four to five simple rami; galeal seta not to tip of galea; serrula exterior with 16 ligulate plates.

Palps similar to adult in sculpturing and chaetotaxy, smaller in size and with a stouter femur and tibia. Trochanter 0.28-0.32 long, 0.16-0.18 wide; femur 0.39-0.44 long, 0.18-0.21 wide, length x width 2.05-2.2; tibia 0.40-0.45 long, 0.20-0.23 wide, length x width 1.96-2.05; chela without pedicel 0.755-0.83 long, 0.26-0.29 wide, length x width 2.79-2.9; chelal hand without pedicel 0.36-0.41 long, 0.275-0.32 deep; movable finger 0.40-0.44 long. Movable finger with three tactile setae; b or sb wanting; st midway between t and b or sb. Fixed finger with seven tactile setae; ist wanting; it beyond midpoint of finger; ib and isb paired; eb and esb paired; est nearer to esb than to et; et about midway between it and finger tip. Each finger with about 28-30 marginal teeth, and three or four internal and external accessory teeth. Nodus ramosus varying from level proximal to t to level of t.

Legs lighter in color, smaller in size and stouter than adult; sculpturing very weak to absent; fourth tarsus with a tactile seta 0.19-0.20 from proximal end.

Deutonymph. The description of the deutonymph is based on two paratypes. Measurements (in mm.) are given for both individuals. Body and appendages lighter in color and smaller in size than tritonymph; body 1.27,

1.38 long. Tergites with a maximum number of six setae on each tergal half; sternites with a maximum number of six to eight. Each anterior and posterior stigmatic plate with one seta.

Chelicera lighter in color and smaller in size than tritonymph; sb denticulate, b acuminate; galea with four simple rami; serrula exterior with 14 ligulate plates.

Palps lighter in color and smaller in size than tritonymph; tibia stouter; flexor surface of chelal hand moderately granular. Femur 0.275, 0.29 long, 0.13, 0.145 wide, length x width 2.12, 2.0; tibia 0.28, 0.295 long, 0.14, 0.16 wide, length x width 2.0, 1.84; chela without pedicel 0.53, 0.59 long, 0.18, 0.20 wide, length x width 2.95, 2.95; movable finger 0.255, 0.30 long. Movable finger with two tactile setae; one, probably st, a little distad to midpoint of finger and about at level of nodus ramosus; the second, b or sb, subbasal in position. Fixed finger with six tactile setae; it beyond midpoint of finger; et nearer to it than to finger tip; eb or esb absent; est nearer to esb or eb than et; ist apparently wanting; ib a little proximad from level of isb. Each finger with 26-28 marginal teeth; accessory teeth absent except for a single internal accessory tooth near the tip of the fixed finger.

Legs lighter in color and smaller in size than tritonymph; fourth tarsus with tactile seta 0.14 from proximal end.

Protonymph. Two protonymph paratypes mounted. Body and appendages lighter in color and smaller in size than deutonymph. Cheliceral galea with three rami; serrula exterior with 10-11 plates. Palps smaller in size, but chelal hand more slender than deutonymph; movable finger with a single tactile seta located about 40 per cent of finger length from proximal end; fixed finger with three tactile setae, two external and one internal; one external and one internal basal in position, other external distad to midpoint of finger; each finger with 23-24 marginal teeth; accessory teeth absent; nodus ramosus about 40 per cent of finger length from distal end. Fourth tarsus with tactile seta located beyond midpoint of segment.

Diagnosis. With typical Dinocheirus facies. The new species appears related to Dinocheirus astutus Hoff from New Mexico and Dinocheirus validus (Banks) from California and New Mexico. Males of D. horricus differ from D. astutus by a branched galea (Fig. 68), less depth to the chelal hand, and a smaller body size. No clear-cut characters can separate females of D. horricus from those of D. astutus. Dinocheirus horricus is separated from D. validus by differences in size and shape of podomeres. Dinocheirus horricus can be separated from the only other species of Dinocheirus from Michigan, Dinocheirus pallidus (Banks) by its smaller size and the shape of the palpal femur (Fig. 66, 70). Dinocheirus horricus

differs from Dinocheirus solus Hoff from Illinois by length of the palpal podomeres and the width and depth of the chelal hand.

Distribution (Map 18).

Type Locality. INGHAM CO., Michigan: same as for holotype male. Type specimens: male holotype, 2 male, 3 tritonymph, 2 deutonymph, and 2 protonymph paratypes were taken from old hay and straw within a collapsed barn, T 4N: R 1E: S 4, 31 Jan. 1968, collected by G. V. Manley. One male and 4 female paratypes, same locality, 25 Apr. 1967, collected by G. V. Manley. Female allotype, same locality, 28 Apr. 1967, collected by S. Nelson, Jr. GRAND TRAVERSE CO.: 1 female paratype was taken from old hay and straw within a collapsed barn, T 26N: R10W: S31, 26 June 1967, collected by S. Nelson, Jr.

Deposition of Material. The holotype male, allotype female, 1 male paratype, 3 female paratypes, and all nymphal paratypes are deposited in the Michigan State University Entomology Museum. Two paratype males and 2 paratype females have been retained in the author's collections.

Dinocheirus pallidus (Banks)

Chernes pallidus Banks, 1890: 152.

Chelanops pallidus, Banks, 1895: 8; Coolidge, 1908: 112; Ewing, 1911: 76.



Map 18. Distribution of Dinocheirus horricus



Neochernes pallidus, Beier, 1932b: 167, 1932c: 533;  
Roewer, 1937: 299.

Hesperochnes pallidus, Hoff, 1947: 509.

Dinocheirus pallidus, Hoff, 1949: 472, 1958: 26;  
Manley, 1969: 11.

This species is known only on the basis of a few individuals. Hoff (1947) re-examined the type material which consisted of a single female. Hoff (1949) described the male based on four individuals, and also reported two females. Present Michigan specimens agree well with the descriptions as given by Hoff. Two individuals possess cheliceral chaetotaxal anomalies consisting of an extra palmer seta and a denticulate basal seta, respectively. Diagnostic characters are given in the key and illustrated in Figures 69, 70. Measurements of ten Michigan males include: body length 2.47-2.85; palpal femur 0.75-0.87 long, 0.265-3.0 wide, length x width 2.68-3.19; tibia 0.74-0.84 long, 0.28-0.32 wide, length x width 2.39-2.71; chela without pedicel 1.21-1.34 long, 0.43-0.49 wide, length x width 2.69-3.0; chelal hand 0.62-0.69 long, 0.42-0.47 deep; movable finger 0.68-0.74 long. Measurements of seven females include: body length 2.88 (abdomen contracted)-3.61; palpal femur 0.8-0.9 long, 0.255-0.31 wide, length x width 2.73-3.14; tibia 0.74-0.85 long, 0.28-0.34 wide, length x width 2.45-2.73; chela without pedicel 1.30-1.48

long, 0.45-0.53 wide, length x width 2.7-2.93; chelal hand 0.64-0.73 long, 0.42-0.535 deep; movable finger 0.70-0.79 long.

Distribution (Map 19) and Habitat Preference. Dinocheirus pallidus occurs in the Midcentral States of Arkansas, Illinois, Indiana, and Michigan as well as the State of New York. Present records extend the range of this species to the eastern portion of the Upper Peninsula. This species occurs most frequently in tree hollows, some of which contain nests of small mammals and insects. One individual was taken in an aerial net erected to capture flying insects.

Records. ST. JOSEPH CO.: 17 July 1969, S. Nelson, several individuals from small mammal nest in red oak hollow. INGHAM CO.: 13 Sept. 1967, G. V. Manley, 1 female in maple hollow; 9 Mar. 1968, G. V. Manley, 1 male from insect-chewed wood in an ironwood tree; 31 Mar. 1968, S. Nelson, 1 male in beech hollow. SHIAWASSEE CO.: 2 Apr. 1968, S. Nelson, 1 female in white oak hollow; 18 Feb. 1970, S. Nelson, several individuals in live beech hollow. GENESEE CO.: 16 Oct. 1968, S. Nelson, several individuals in abandoned mammal nest in mountain maple hollow and largetooth aspen with wasp and honey bee nest. SAGINAW CO.: 11 Sept. 1968, J. Truchan, 2 females in rotary trap (aerial net). TUSCOLA CO.: 16 Oct. 1968, S. Nelson, 1 female in hollow at base of a dead elm. HURON CO.: 16 Oct. 1968, S. Nelson, 1 male

Map 19. Distribution of Dinocheirus pallidus

from nest of Peromyscus leucopus in red maple hollow.  
 LAKE CO.: 14 Oct. 1968, S. Nelson, several individuals  
 from rotten wood in white oak hollow. GRAND TRAVERSE CO.:  
 4 Sept. 1968, G. V. Manley, 1 male and 1 female in tree  
 hollow. KALKASKA CO.: cited from Manley (1969). CHIP-  
 PEWA CO.: 26 Aug. 1969, S. Nelson, 1 male in live sugar  
 maple hollow.

Illinichernes distinctus Hoff

Illinichernes distinctus Hoff, 1949: 481, 1958: 25;  
 Hoff and Bolsterli, 1956: 169; Lawson, 1968: 192.

This species is recognized by the characters given  
 in the key and illustrated in Figures 71-74. As leg  
 segments of Michigan specimens are generally shorter and  
 somewhat stouter than those reported by Hoff (1949)  
 these measurements along with palpal measurements are  
 included. Measurements of a single male include: body  
 length 1.75; palpal femur 0.59 long, 0.20 wide, length x  
 width 2.95; tibia 0.54 long, 0.22 wide, length x width  
 2.45; chela without pedicel 0.82 long, 0.31 wide, length  
 x width 2.65; chelal hand 0.41 long, 0.31 wide; movable  
 finger 0.44 long. Fourth leg with entire femur 0.51  
 long, 0.14 deep (across pars tibialis), length x depth  
 3.64; tibia 0.41 long, 0.097 deep, length x depth 4.23;  
 tarsus 0.36 long, 0.07 deep, length x depth 5.14.  
 Measurements of two females include: body length 1.82,

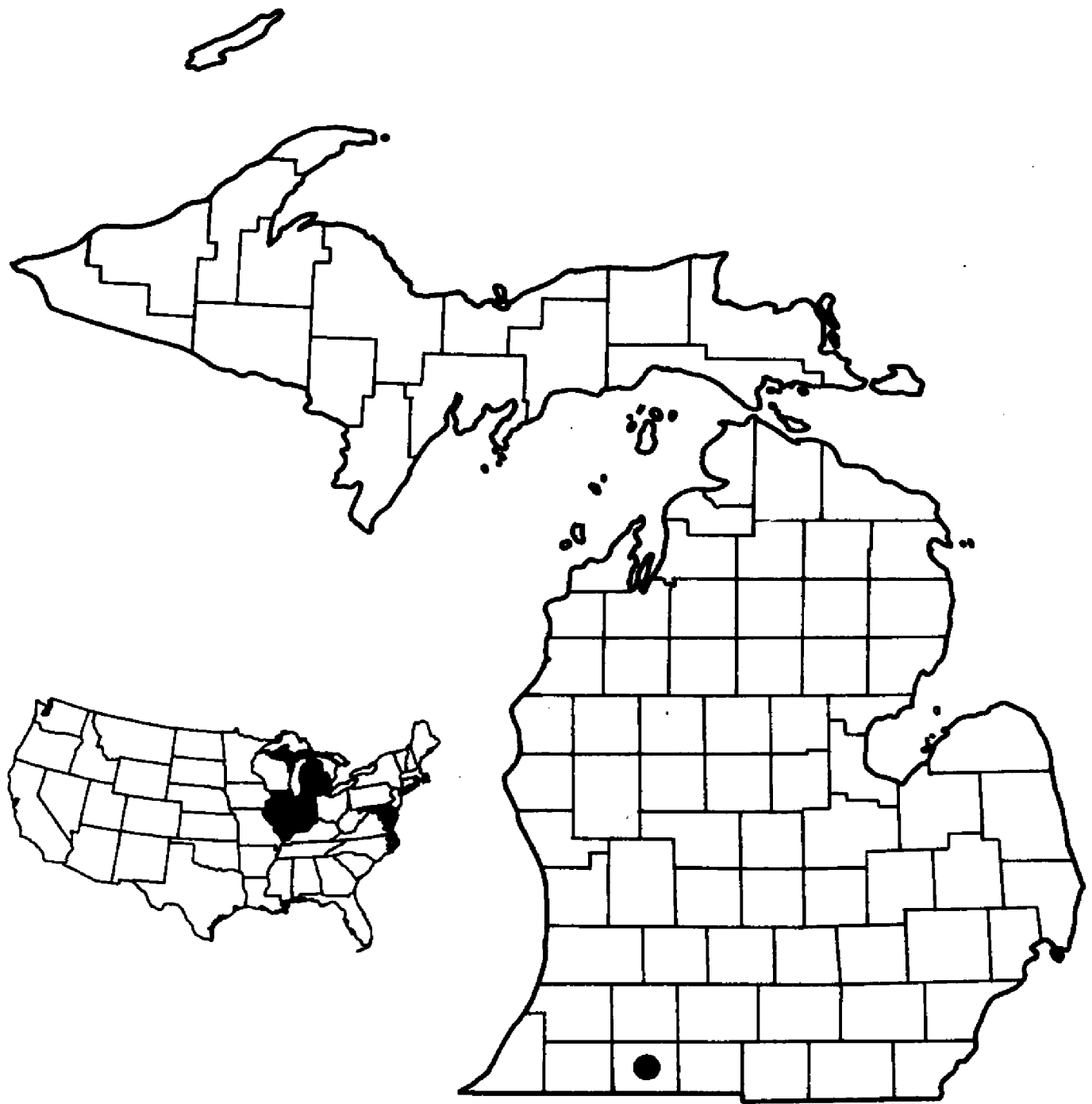
1.84 (both with abdomen contracted); palpal femur 0.6, 0.66 long, 0.21, 0.23 wide, length x width 2.86, 2.87; tibia 0.56, 0.61 long, 0.22, 0.255 wide, length x width 2.39, 2.54; chela without pedicel 0.82, 0.90 long, 0.32, 0.37 wide, length x width 2.56, 2.44; chelal hand 0.40, 0.47 long, 0.37, --deep; movable finger 0.45, 0.46 long. Fourth leg with entire femur 0.51, 0.57 long, 0.14, 0.17 deep (across pars tibialis), length x depth 3.35, 3.64; tibia 0.43, 0.46 long, 0.09, 0.10 deep, length x depth 4.6, 4.78; tarsus 0.36, 0.37 long, 0.07, 0.08 deep, length x depth 4.62, 5.14.

Distribution (Map 20), Habitat Preference and Record. This species occurs in the States of Illinois, Indiana, Maryland and Michigan. The Michigan record is based on a single collection from ST. JOSEPH CO.: 17 July 1969 by S. Nelson of 1 male and 2 females and possibly nymphs in a small mammal nest within a live red oak hollow.

Hesperochnes tamiae Beier

Hesperochnes tamiae Beier, 1930a: 214; Roewer, 1937: 302; Proctor, 1946: 510; Hoff and Clawson, 1952: 15; Hoff 1958: 23.

The present material agrees favorably with the original description by Beier (1930a). Diagnostic characters are given in the key and illustrated in Figures 75, 76. Measurements of a single female include: body length 3.30; palpal femur 0.89 long, 0.34 wide, length x width 2.62;



Map 20. Distribution of Illinichernes distinctus

tibia 0.87 long, 0.36 wide, length x width 2.42; chela without pedicel 1.35 long, 0.52 wide, length x width 2.6; chelal hand 0.66 long, 0.53 deep; movable finger 0.77 long.

Distribution (Map 21), Habitat Preference and Record. This species is known only from the Northeastern States of Maine, Michigan, New York, and Vermont. The type material was collected from the nest of the eastern chipmunk, Tamias striatus. The Michigan record is based on a single collection from INGHAM CO.: 11 Oct. 1967 by G. Klee of 2 females from a pit-trap set in an oak-hickory forest floor.

Hesperochnes ewingi (Hoff)

Reginachernes ewingi Hoff, 1949: 466, 1958: 25; Hoff and Bolsterli, 1956: 176.

Hesperochnes ewingi, Hoff, 1963: 3.

This species is known only from Illinois and Michigan on the basis of few individuals. Hoff's description (1949) consisted only of a holotype female and an allotype male. Hoff and Bolsterli (1956) subsequently reported a single male. Present specimens agree with those described by Hoff (1949), and Hoff and Bolsterli (1956). Diagnostic characters are given in the key and illustrated in Figures 77, 78. Measurements of two Michigan specimens include: body length 1.95, 2.16; palpal femur 0.525, 0.53 long, 0.22, 0.23 wide, length x width 2.3, 2.39; tibia 0.52, 0.53 long, 0.225, 0.23 wide, length x width

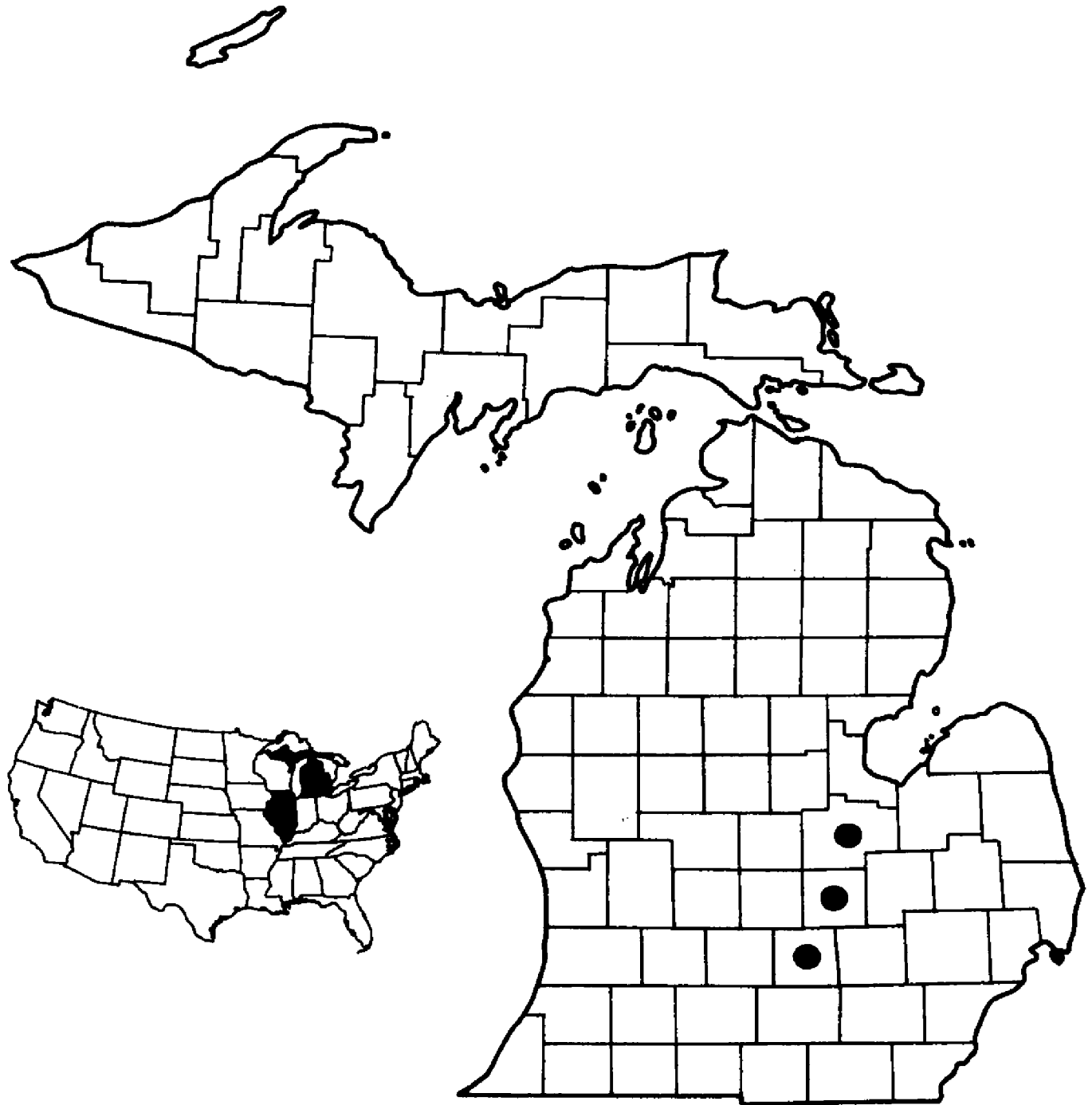


Map 21. Distribution of Hesperochoernes tamiae



2.3, 2.31; chela without pedicel 0.84, 0.87 long, 0.33, 0.36 wide, length x width 2.42, 2.55; chelal hand 0.39, 0.41 long, 0.33,--deep; movable finger 0.46, 0.47 long. Fourth leg with entire femur 0.48, 0.50 long, 0.14, 0.15 deep (across pars tibialis), length x depth 3.33; 3.43; tibia 0.39, 0.40 long, 0.097, 0.097 deep, length x depth 4.02, 4.1; tarsus (only one measured) 0.32 long, 0.071 deep, length x depth 4.51. Genitalia with posterior operculum with 19 scattered setae, many of which form an irregular marginal row, and 8 smaller setae just posterior to the posterior rim of the aperture; anterior operculum with 32, 38 scattered setae. Measurements of a single female include: body length about 1.73 (abdomen not treated); palpal femur about 0.54 long, 0.22 wide, length x width 2.45; tibia 0.535 long, 0.24 wide, length x width 2.23; chela without pedicel 0.88 long, 0.32 wide, length x width 2.78; chelal hand 0.44 long, 0.32 deep; movable finger 0.45 long. Fourth leg with entire femur 0.53 long, 0.17 deep (across pars tibialis), length x depth 3.05; tibia 0.41 long, 0.11 deep, length x depth 3.73; tarsus 0.31 long, 0.08 deep, length x depth 3.87.

Distribution (Map 22) and Habitat Preference. This species has been collected only in Illinois and Michigan. Present Michigan specimens were taken in three counties adjacent to each other in the southern one-half of the Lower Peninsula. Hoff (1949) reported this species from



Map 22. Distribution of Hesperochoernes ewingi

leaf mold and beneath the bark of an oak tree. In Michigan H. ewingi was collected from bracken fungi, a mouse nest under bark, and an aerial net erected to capture flying insects.

Records. INGHAM CO.: 23 Apr. 1964, R. W. Matthews, 1 male from bracken fungi. SHIAWASSEE CO.: 18 Feb. 1970, S. Nelson, 1 male from mouse nest under bark. SAGINAW CO.: 16 Sept. 1968, J. Truchan, 1 female from rotary trap (aerial net).

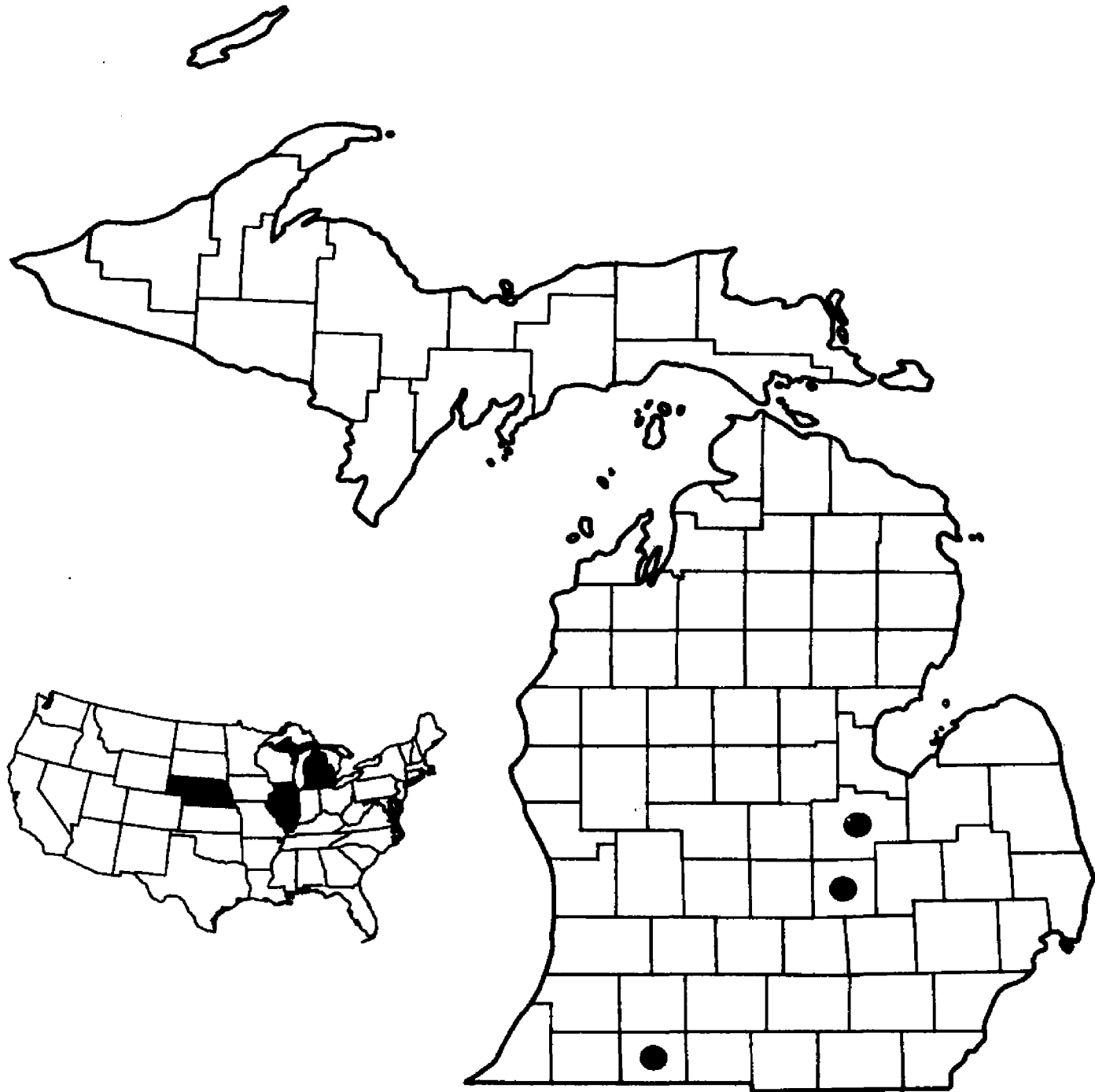
Hesperochnes lymphatus (Hoff)

Reginachernes lymphatus Hoff, 1949: 467, 1958: 25; Hoff and Bolsterli, 1956: 176.

Hesperochnes lymphatus, Hoff, 1963: 3.

Present specimens, consisting of three females, agree in detail with the original description. One chelicera of one individual had an extra denticulate seta on the hand. Diagnostic characters are given in the key and illustrated in Figures 79, 80. Measurements include: body length 2.22-2.86; palpal femur 0.56-0.63 long, 0.235-0.28 wide, length x width 2.25-2.45; tibia 0.57-0.63 long, 0.265-0.29 wide, length x width 2.11-2.17; chela without pedicel 0.95-1.02 long, 0.35-0.40 wide, length x width 2.55-2.74; chelal hand 0.50-0.55 long, 0.31,--deep; movable finger 0.49-0.51 long.

Distribution (Map 23) and Habitat Preference. This species occurs in Illinois, Michigan, and Nebraska.



Map 23. Distribution of Hesperochernes lymphatus

Present specimens were collected in three counties in the southern one-half of the Lower Peninsula. Michigan specimens were collected from bracken fungi, under bark, and an aerial net erected to capture flying insects.

Records. ST. JOSEPH CO.: 27 July 1968, Charles Cole, 1 female under bark of a dead white oak. SHIAWASSEE CO.: 18 Feb. 1970, S. Nelson, 1 female from bracken fungi. SAGINAW CO.: 7 June 1968, J. Truchan, 1 female from rotary trap (aerial net).

Hesperochnes amoenus Hoff

Hesperochnes amoenus Hoff, 1963: 3.

Present Michigan specimens, except for somewhat smaller body lengths, agree well with the original description. Diagnostic characters are given in the key and illustrated in Figures 81, 82. Measurements of two Michigan males include: body length 1.92, 2.08; palpal femur 0.56, 0.61 long, 0.22, 0.22 wide, length x width 2.54, 2.77; tibia 0.54, 0.54 long, 0.24, 0.24 wide, length x width 2.18, 2.18; chela without pedicel 0.99, 1.02 long, 0.35, 0.35 wide, length x width 2.83, 2.9; chelal hand 0.45, 0.475 long, 0.31, 0.32 deep; movable finger 0.57, 0.59 long. Measurements of six Michigan females include: body length about 2.02-2.45 (1.80, 1.82 for two specimens with body untreated); palpal femur 0.58-0.64 long, 0.22-0.25 wide, length x width

2.32-2.67; tibia 0.54-0.59 long, 0.235-0.265 wide, length x width 2.15-2.3; chela without pedicel 1.04-1.12 long, 0.34-0.39 wide, length x width 2.78-3.08; chelal hand 0.495-0.56 long, 0.33-0.35 deep; movable finger 0.58-0.62 long.

Distribution (Map 24) and Habitat Preference. This species occurs only in South Dakota and Michigan. The present specimens were collected in Marquette and Keweenaw Counties of the Upper Peninsula. Hoff (1963) reported this species associated with leaf litter of birch, aspen, bur oak, and debris and decomposing wood of yellow-pine stumps and logs. Michigan specimens were collected from a rotten log and from decomposing wood of jack pine stumps.

Records. MARQUETTE CO.: 8 Sept. 1967, 24 Nov. 1967, 29 Aug. 1968, S. Nelson, 2 males, 3 females, 2 tritonymphs, 2 deutonymphs, 3 protonymphs, and unmounted specimens in jack pine stump material. KEWEENAW CO.: 17 Apr. 1968, G. V. Manley, 3 females from rotten log.

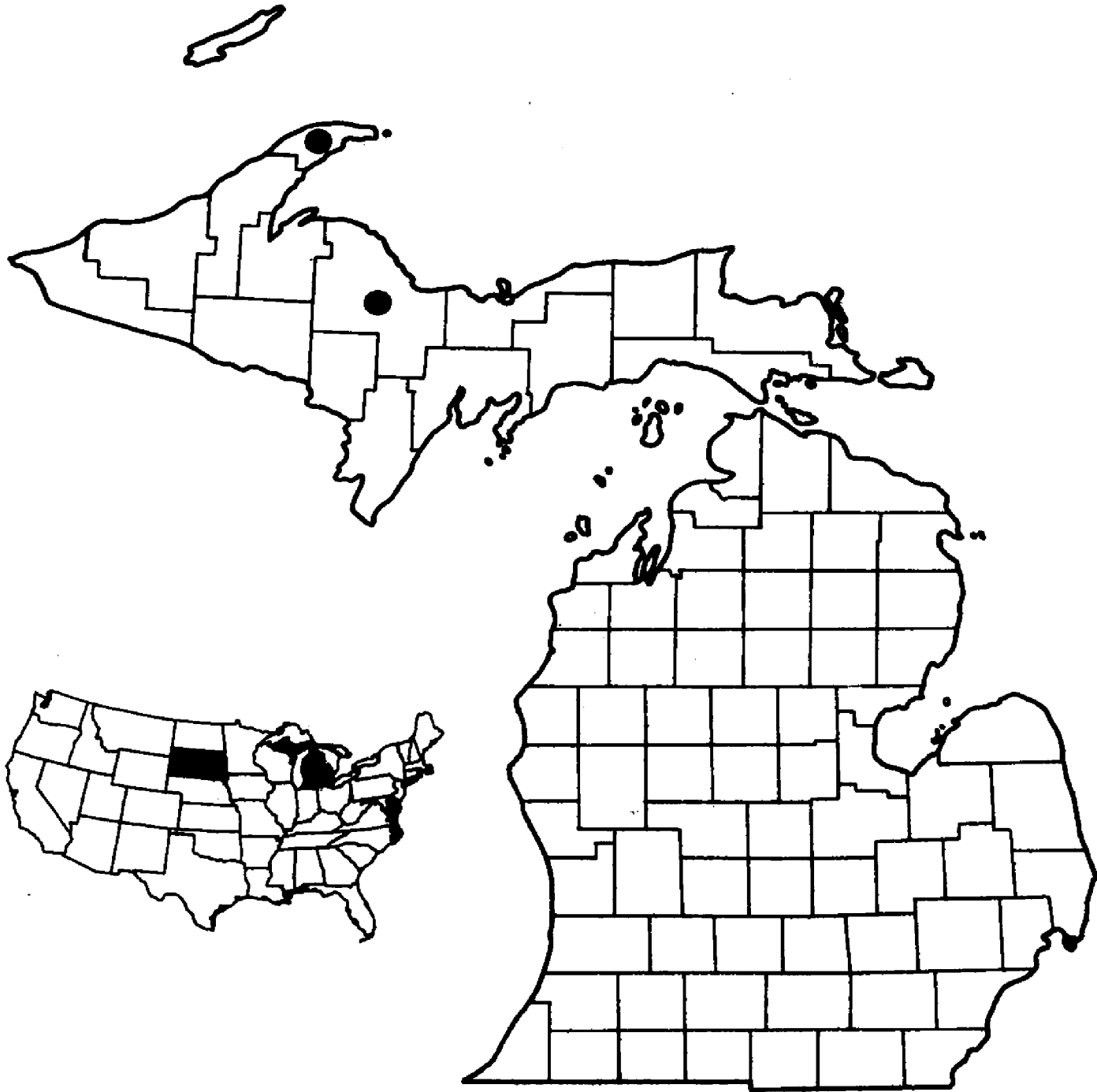
#### Family Cheliferidae Hagen

##### Subfamily Cheliferinae Simon

##### Tribe Dactylocheliferini Beier

##### Dactylochelifer copiosus Hoff

Dactylochelifer copiosus Hoff, 1945a: 521, 1945b: 53, 1949: 491, 1956a: 28, 1958: 35, 1964: 31; Hoff and



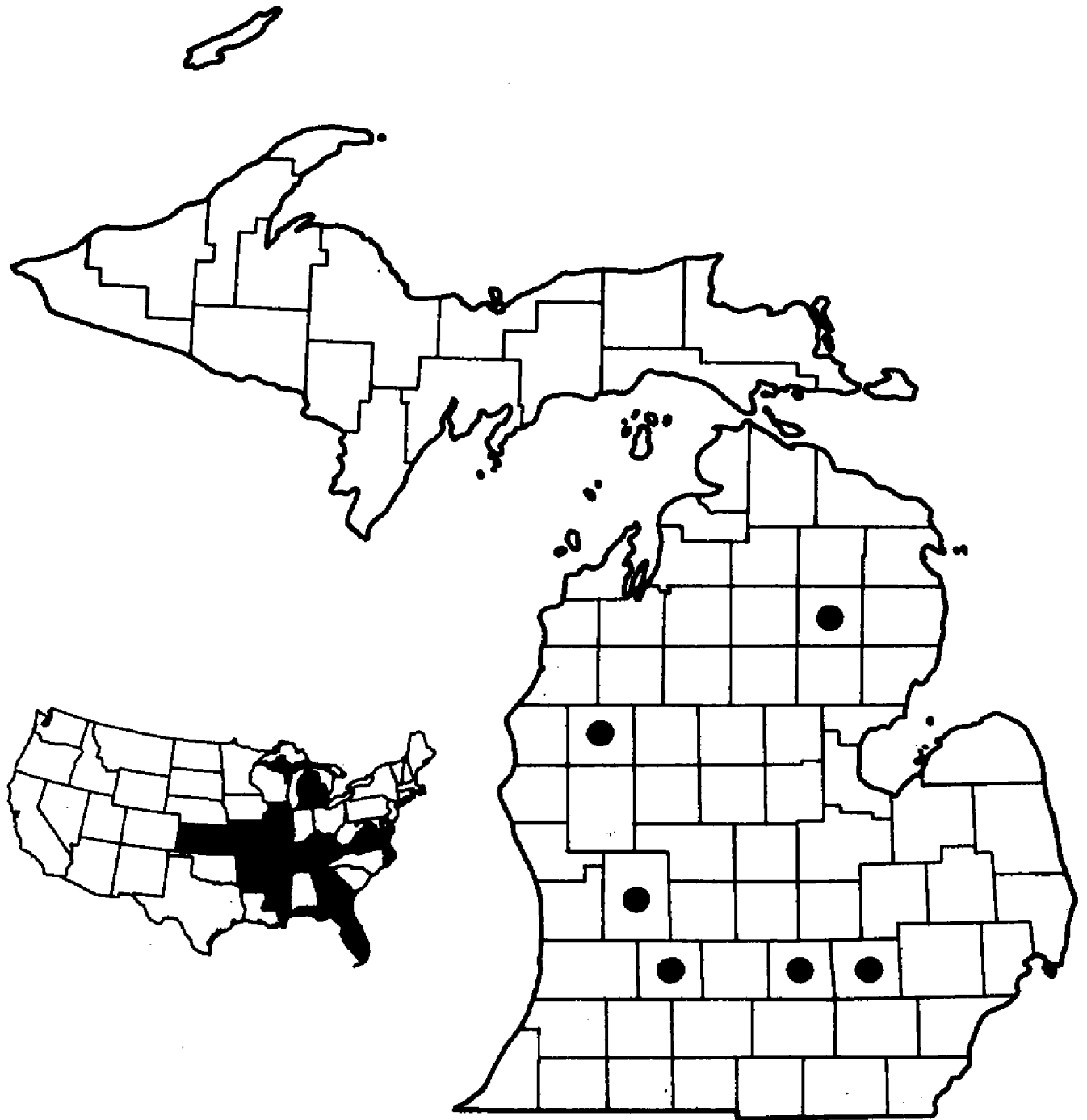
Map 24. Distribution of Hesperochoernes amoenus

Bolsterli, 1956: 178; Fenstermacher, 1959: 24; Lawson, 1968: 200; Manley, 1969: 9.

This species can be recognized by the characters given in the key and illustrated in Figures 83, 84. Present specimens agree well with those described by Hoff (1945a, 1949). Measurements of four males include: body length 2.51-2.74 long; palpal femur 0.76-0.88 long, 0.20-0.22 wide, length x width 3.73-4.0; tibia 0.76-0.81, 0.22-0.255 wide, length x width 3.24-3.45; chela without pedicel 1.30-1.35 long, 0.30-0.34 wide, length x width 3.97-4.09; chelal hand 0.62-0.67 long, 0.28-0.31 deep; chelal finger 0.71-0.75 long. Measurements of five females include: body length 2.59-3.37; palpal femur 0.86-0.9 long, 0.21-0.23 wide, length x width 3.91-4.19; tibia 0.82-0.87 long, 0.24-0.26 wide, length x width 3.28-3.5; chela without pedicel 1.38-1.48 long, 0.34-0.37 wide, length x width 3.76-4.09; chelal hand 0.68-0.71 long, 0.30-0.33 deep; movable finger 0.73-0.78 long.

Distribution (Map 25) and Habitat Preference. This species occurs in the Southeastern and Midcentral States of Arkansas, Florida, Georgia, Illinois, Kansas, Kentucky, Michigan, Mississippi, Missouri, Tennessee, and Virginia. In Michigan it is distributed throughout the Lower Peninsula. Fenstermacher (1959) reported this species from Kalamazoo and Livingston Counties. Manley (1969), omitting Fenstermacher's findings, reported it from





Map 25. Distribution of Dactylochelifer copiosus

Clinton, Monroe, Oscoda, and Shiawassee Counties. Manley, however, through personal communication, indicated that the Clinton and Shiawassee County records were the result of misplaced map points intended for Ingham and Livingston Counties. Manley's record of D. copiosus from Monroe County was based on the misidentification of Parachelifer monroensis n. sp. This species occurs most frequently in leaf litter and ground cover. Michigan specimens were collected from litter and ground cover, sphagnum, and atop an automobile hood at a black-light.

Records. LIVINGSTON CO.: numerous individuals throughout the year collected in litter and soil. INGHAM CO.: 28 Apr. 1970, J. Donahue, 1 male collected at black-light atop automobile hood. BARRY CO.: 10 Aug. 1965, T. W. Porter, 1 male from sphagnum. KENT CO.: 20 Oct. 1968, P. Scruby, 1 female in leaf litter. LAKE CO.: 14 Oct. 1968, S. Nelson, several individuals in white oak litter. Fenstermacher (1959) and Manley (1969) also reported this species from Kalamazoo and Oscoda Counties.

#### Tribe Cheliferini Chamberlin

##### Chelifer cancroides (Linnaeus)

Acarus cancroides Linnaeus, 1758: 616.

Chelifer cancroides, Fourcroy, 1785: 526; Hermann, 1804: 114; Latreille, 1804: 141, 1806: 132; Hahn, 1834: 52; Koch, 1843: 41; Menge, 1855: 30; Hagen, 1869: 51, 1870: 264; Simon, 1879: 23; Packard, 1888: 43; Banks,

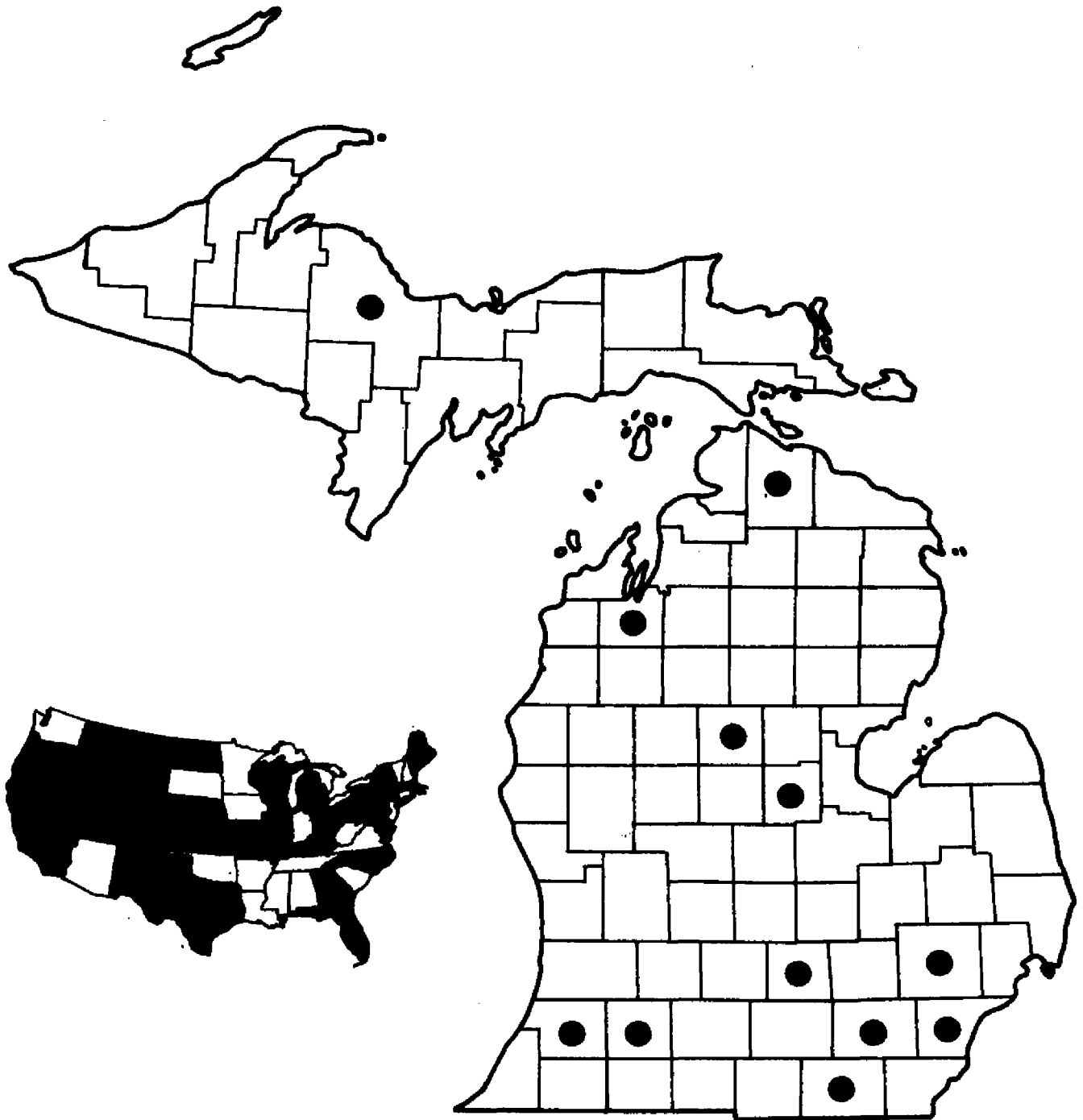
1895: 3; Ellingsen, 1908: 163, 1909: 384; Coolidge, 1908: 109; With, 1908: 220; Ewing, 1911: 66; Kew, 1911: 48; Beier, 1930b: 199, 1932b: 236, 1963: 287; Chamberlin, 1931: 24; Kaestner, 1931: 73; Roewer, 1937: 312; Brimley, 1938: 497; Hoff, 1944: 123, 1949: 486, 1950: 1, 1956a: 3, 1958: 32, 1959: 35, 64, 1964: 6; Proctor, 1946: 510; Levi, 1948: 290, 1953: 53; Hoff and Clawson, 1952: 35; Hoff and Bolsterli, 1956: 177; Fenstermacher, 1959: 23; Manley, 1969: 9; Weygoldt, 1969.

Chelifer cancroides var. dentatus Ewing 1911: 73.

This species is recognized by the characters given in the key and illustrated in Figures 85-88. Present Michigan specimens generally agree with those reported by Hoff (1949). Measurements of four males include: body length 2.79-3.5; palpal femur 1.04-1.27 long, 0.19-0.23 wide, length x width 4.57-5.52; tibia 0.91-1.11 long, 0.22-0.27 wide, length x width 3.44-4.17; chela without pedicel 1.53-1.86 long, 0.34-0.41 wide, length x width 4.0-4.54; chelal hand 0.72-0.82 long, 0.32-0.40 deep; movable finger 0.86-0.92 long. Measurements of four females include: body length 2.88-3.62; palpal femur 1.03-1.17 long, 0.20-0.25 wide, length x width 4.52-5.15; tibia 0.85-1.05 long, 0.21-0.28 wide, length x width 3.57-4.24; chela without pedicel 1.45-1.78 long, 0.33-0.43 wide, length x width 4.0-4.39; chelal hand 0.69-0.80 long, 0.32-0.41 deep; movable finger 0.77-0.97 long.

Distribution (Map 26) and Habitat Preference. This species is worldwide in distribution, and occurs throughout the United States. Fenstermacher (1959) and Manley (1969) reported it from the Lower Peninsula of Michigan. Present records extend the range of C. cancroides to the Upper Peninsula. This species according to Hoff (1949), is found in those habitats associated with man such as dwellings, barns, chicken houses, beehives, and nests of starlings and sparrows. Michigan specimens were collected in association with man.

Records. LENAWEЕ CO.: several individuals throughout the year in private homes. WAYNE CO.: H. G. Hubbard (cited from Banks, 1895). WASHTENAW CO.: 1958, J. Fenstermacher, 1 individual (cited from Fenstermacher, 1959). KALAMAZOO CO.: 9 Sept. 1963, R. W. Husband, 1 female in nest of Bombus americanorum. VAN BUREN CO.: 20 Aug. 1968, S. Nelson, 1 male and 1 female from old hay in barn. OAKLAND CO.: cited from Manley (1959). INGHAM CO.: several individuals throughout the year in private homes, and 30 Jan. 1968, S. Nelson, 1 male and 1 female from museum dermestid room. MIDLAND CO.: 1949, R. R. Dreisbach, 2 individuals (cited from Fenstermacher, 1959). CLARE CO.: 1966, G. V. Manley, 1 male. GRAND TRAVERSE CO.: 13 Aug. 1968, S. Nelson, 1 male and 1 female from old straw in collapsed barn. CHEBOYGAN CO.: 10 Aug. 1940, T. W. Porter, 1 male and 6 July 1950,



Map 26. Distribution of Chelifer cancroides

A. L. Edgar, 2 females in deserted house. MARQUETTE CO.:  
24 Aug. 1968, S. Nelson, 1 female from old straw in  
barn.

Parachelifer monroensis, new species

Dactylochelifier copiosus, Manley, 1969: 9, in part.

Male. Unknown.

Female. Description based on two individuals (the holotype and one paratype). Measurements and ratios given for the holotype followed in parentheses by those of the paratype. Body and legs a rich golden to golden-brown in color, palps reddish-brown in color; body length 3.24 (3.58), but body of holotype not treated in KOH.

Carapace coarsely and evenly granular; posterior margin of carapace with scale-like sculpturing; setiferous tubercles numerous, appearing more pronounced on the lateral carapacial margins; setae clavate, short and terminally denticulate; semi-truncate anterior carapacial margin with four setae, posterior margin with 10 or 11 setae; carapace with two transverse furrows, posterior furrow nearer to the posterior carapacial margin than to the median furrow; one pair of well-developed eyes; carapace 1.00 (0.99) long, about 0.84 (0.86) wide; ocular width of holotype about 0.45.

Abdomen with tergites divided; each tergal half with well-developed scale-like sculpturing; setae clavate, short and terminally denticulate, becoming slightly

longer more posteriad; maximum number of setae on any tergal half 10; peripheral setae and often another seta occur in each half, the seta subcentral in position in more posterior tergites becoming progressively nearer posterior tergal margin in more anterior tergal halves (Fig. 89). Sternites 5-10 divided, with scale-like sculpturing less pronounced than tergites; setae acuminate. Pleural membrane with irregular longitudinal striations. Anterior stigmatic plates asetaceous; posterior plates with a single acuminate seta.

Chelicera similar to legs in color; surface of hand with reticulate sculpturing; flagellum with three blades, anterior blade unilaterally serrate; basal seta denticulate; subbasal seta appears acuminate; chelicera about 0.31 (0.30) long, 0.168 (0.168) wide at base. Fixed finger with serrula interior with 3-5 free terminal serrated teeth, basal teeth fused into a velum; inner margin of apical tooth with two or three small denticles, inner margin of finger with three denticles. Movable finger with large scale-like markings; serrula exterior with 17 to 18 ligulate plates; galea with six rami, confined to the distal third; galeal seta extending beyond tip of galea; movable finger 0.235 (0.23) long.

Palps with maxilla, trochanter, femur, and flexor surface of tibia coarsely and evenly granular, less granular on extensor surface of the tibia and entire

chela; setiferous tubercles moderately well-developed on dorsal protuberance of trochanter, entire femur, weakly developed to absent on tibia. Setae of maxilla acuminate to paucidenticulate; setae of trochanter, femur, tibia, and chelal hand stout and denticulate, flexor setae generally stouter than extensor setae; setae of chelal fingers acuminate. Chela of paratype in dorsal view ruptured, appearing more robust than holotype. Palpal trochanter 0.54 (0.53) long, 0.30 (0.29) wide. Dorsal view of palp, and lateral view of chela illustrated in Figures 90,91. Femur with flexor margin irregularly concave; extensor margin nearly straight centrally and convex at ends; 1.09 (1.05) long, 0.27 (0.255) wide, length x width 4.04 (4.12). Tibia with flexor margin flatly convex proximally, weakly concave toward distal end; extensor margin with proximal end flatly concave, distal end evenly convex; 0.95 (0.94) long, 0.31 (0.305) wide, length x width 3.06 (3.08). Chela without pedicel 1.67 (1.59) long, 0.45 wide, length x width of holotype 3.71. Chelal hand in dorsal view with flexor margin flatly convex; extensor margin nearly straight; about 0.85 (0.82) long, 0.39 deep (holotype only). Movable finger 0.86 (0.86) long. Each finger of holotype with a marginal row of 49 contiguous teeth; no accessory teeth present. Movable finger with four tactile setae, arranged as follows: t removed from finger tip by



slightly more than one-third of finger length, st slightly nearer to t than to sb as seen in lateral view; sb and b paired, less than two areoles apart. Fixed finger with eight tactile setae (only seven observed in dorsal view of holotype, esb or eb not seen), arranged as follows: et nearer to the finger tip than to it; est nearer to esb than to et; esb and eb paired, about two areoles apart; ist nearer to isb than to it; isb and ib paired, less than two areoles apart; isb less than one areole distad to esb. Nodus ramosus of fixed finger to level of it; not observed in movable finger.

Legs with scale-like sculpturing; subterminal setae toothed; tarsal claws with an accessory tooth. First leg with flexor setae acuminate on tarsus, paucidenticulate on tibia, pars tibialis and pars basalis; extensor setae denticulate. Trochanter about 0.215 (0.205) long, 0.158 (0.153) deep. Femur with pars basalis about 0.20 (0.16) long, 0.194 (0.18) deep; pars tibialis with flexor margin slightly bulging; extensor margin evenly convex; 0.42 (0.42) long, 0.17 (0.17) deep. Tibia with flexor margin evenly convex; extensor margin evenly convex proximally, evenly concave distally; 0.46 (0.46) long, 0.122 (0.122) deep, length x depth 3.77 (3.77). Tarsus with flexor and extensor margins flatly convex; 0.43 (0.41) long, 0.087 (0.092) deep, length x depth 4.94 (4.46).

Fourth leg with flexor setae acuminate, except paucidenticulate on tibia; extensor setae denticulate. Trochanter 0.38 (0.39) long, 0.235 (0.18) deep. Entire femur with flexor margin nearly straight; extensor margin evenly convex; 0.90 (0.89) long, 0.29 (0.295) deep, length x depth 3.1 (3.02). Tibia with flexor margin evenly convex; extensor margin evenly convex proximally, evenly concave distally; 0.695 (0.70) long, 0.14 (0.15) deep, length x depth 4.96 (4.67). Tarsus with flexor margin flatly concave; extensor margin flatly convex; 0.52 (0.485) long, 0.102 (0.102) deep, length x depth 5.1 (4.75); tactile seta of tarsus 0.41 (0.38) from proximal end.

Genitalia of holotype with two acuminate setae on the face of the anterior operculum and nine and ten acuminate setae respectively, in an irregular row anterior to and to each side of the genital opening; posterior operculum with 11 acuminate setae forming a single row. Genitalia of paratype not discernible.

Tritonymph. A single tritonymph, designated as a paratype, is the only nymph available. Body lighter in color, smaller in size, and with sculpturing and setiferous tubercles similar to the adult; body 2.77 long. Carapace with a pair of well-developed eyes; 11 posterior carapacial setae; carapace 0.76 long, 0.59 wide.

Abdomen with tergites divided; maximum number of setae on any tergal half is eight. Stigmatic plates and pleural membrane as in adult.

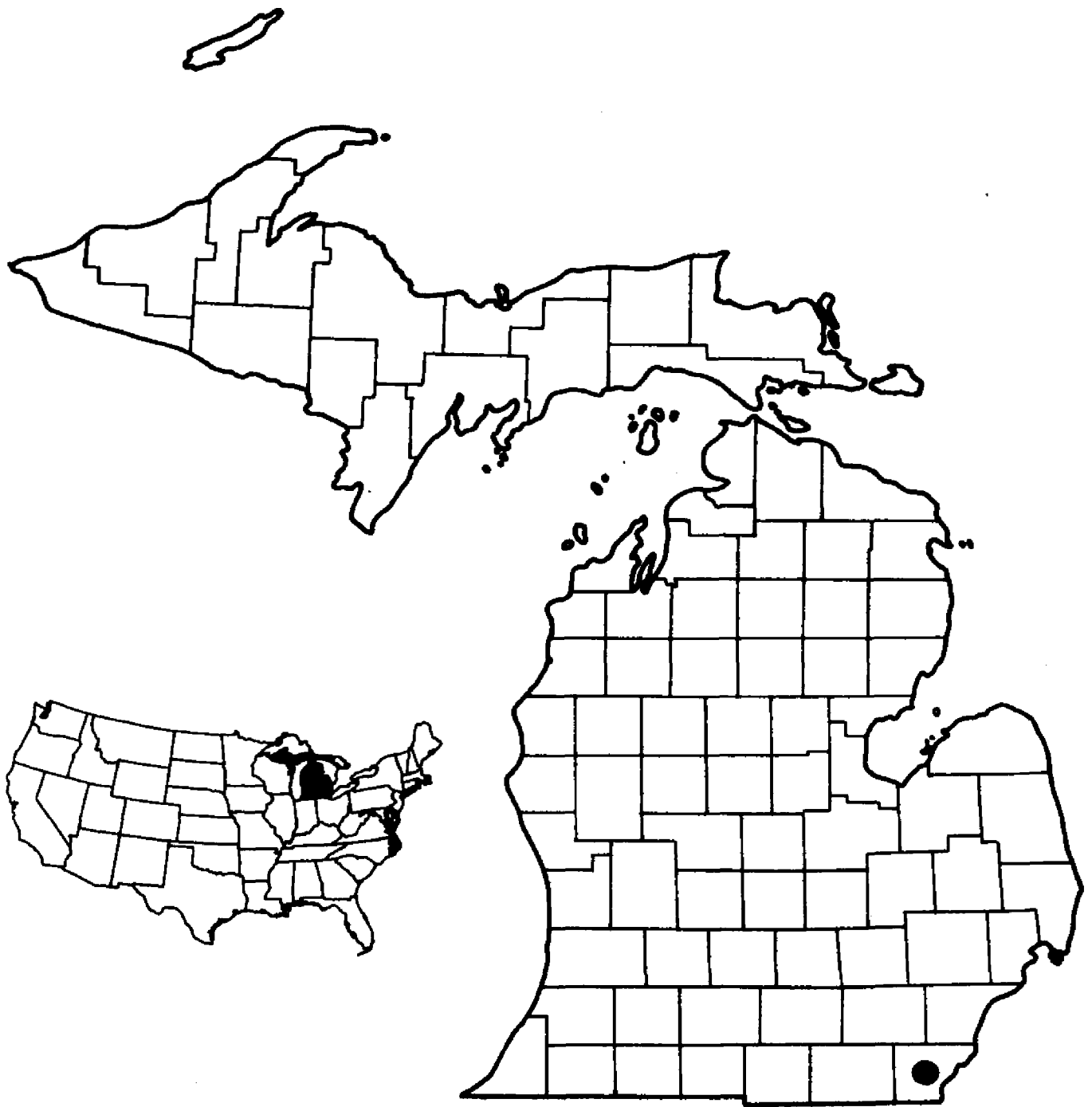
Chelicera with sculpturing similar to adult; smaller in size, 0.235 long, width at base 0.13. Cheliceral hand with setae sb and b with minute denticles; flagellum with three blades, anterior blade unilaterally serrate. Movable finger with serrula exterior with 17 ligulate plates; galea with five terminal rami; movable finger 0.16 long.

Palps with chaetotaxy and sculpturing similar to adult; palps lighter in color, and with stouter segments; trochanter 0.38 long, 0.23 wide; femur 0.76 long, 0.20 wide, length x width 3.8; tibia 0.66 long, 0.235 wide, length x width 2.81; chela without pedicel 1.16 long, 0.32 wide, length x width 3.63; chelal hand about 0.60 long, 0.29 deep. Movable finger with three tactile setae; t or st distad to midpoint of finger; movable finger with a marginal row of 36 contiguous teeth; length of movable finger 0.58. Fixed finger with tactile seta ist wanting; est nearer to sb than to et; eb and esb paired about two areoles apart; it nearer to est than to et; ib and isb paired, less than one areole apart; isb distad to esb; fixed finger with a marginal row of 33 contiguous teeth. Accessory teeth absent on both the movable and fixed fingers.

Legs lighter in color, and with fewer setae than the adult; segments stouter. Fourth leg with entire femur 0.64 long, 0.19 wide; tibia 0.48 long, 0.11 wide; tarsus 0.34 long, 0.087 wide; tactile seta of tarsus broken at base.

Diagnosis. With typical Parachelifer facies. The new species is separated from many species in the genus by the length, width, and length x width ratios of palpal podomeres. This species has palpal podomeres that are generally more robust than other species of Parachelifer described from the United States, except for two western species, Parachelifer scabriculus (Simon) and Parachelifer montanus Chamberlin. Parachelifer montanus is known only from males. Parachelifer monroensis females differ from females of P. scabriculus by the presence of a more slender chela in dorsal view, a movable finger subequal to or longer than the chelal hand, and the position of the tactile seta present on the fourth tarsus. Parachelifer montanus has a more slender palpal femur and tibia than P. monroensis, but a more robust chela. Parachelifer monroensis females differ from females of P. longipalpus Hoff from the midcentral States by the presence of more robust palpal podomeres, a more slender femur and tibia of the fourth leg, and the position of the tactile seta present on the fourth tarsus.

Distribution (Map 27).



Map 27. Distribution of Parachelifer monroensis

Type Locality. MONROE CO., Michigan: same as for holotype female. Type specimens: female holotype, female paratype and tritonymph paratype were taken from oak litter; T 8S: R 6E: S 20 N.E.1/4; 9 Oct. 1967; collected by George Klee.

Deposition of Material. The holotype female and tritonymph paratype are deposited in the Michigan State University Entomology Museum. The paratype female has been retained in the author's collections.

Idiochelifer nigripalpus (Ewing)

Chelifer cancroides var. nigripalpus Ewing, 1911: 71.

Chelifer nigripalpus, Chamberlin, 1931: 52.

Idiochelifer nigripalpus, Chamberlin, 1932: 19;

Roewer, 1937: 312; Hoff, 1946d: 26, 1946e: 486, 1949: 487, 1950: 3, 1958: 34; Hoff and Bolsterli, 1956: 177;

Fenstermacher, 1959: 26; Manley, 1969: 9.

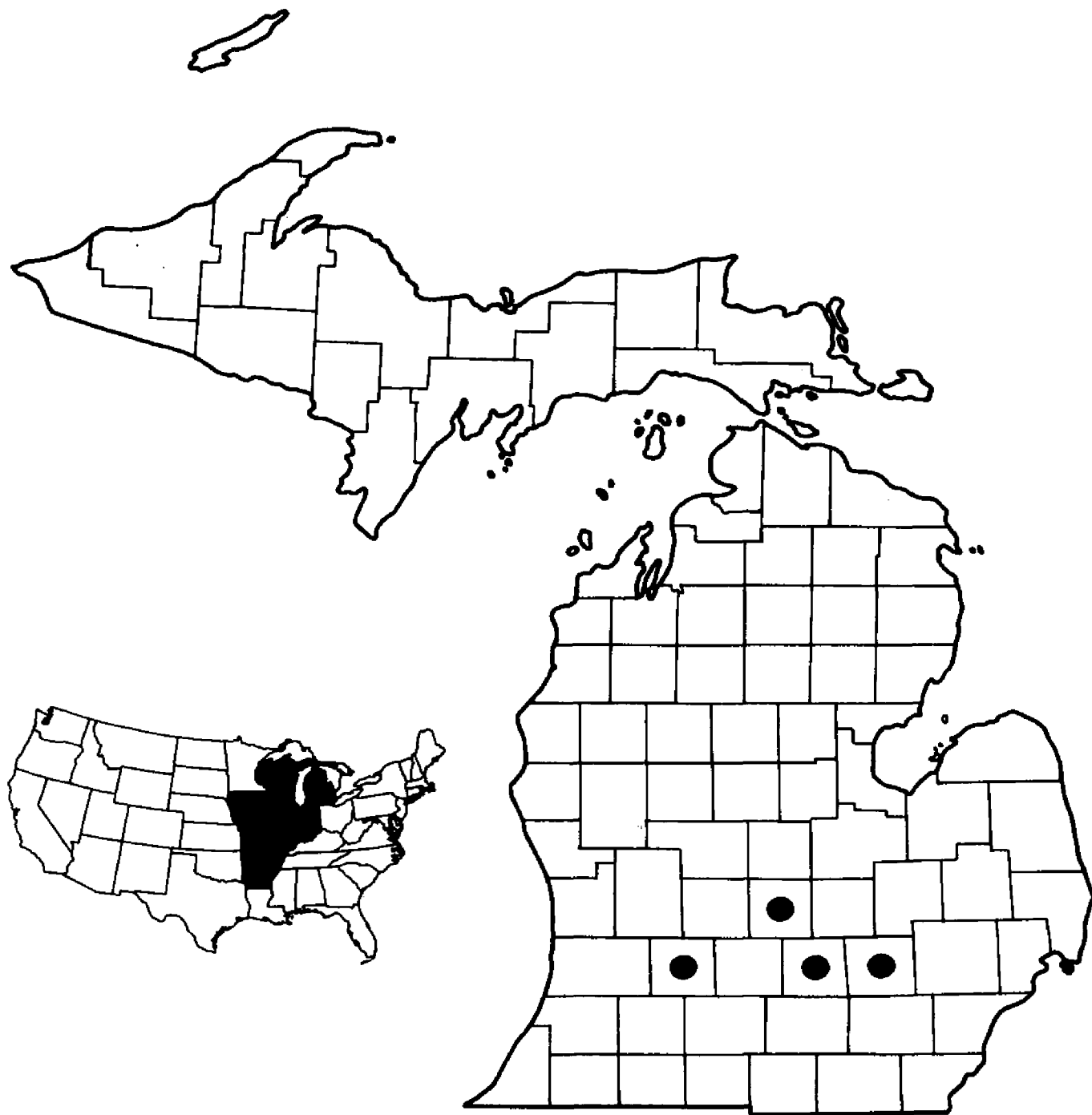
Hysterochelifer longidactylus Hoff, 1945a: 511.

This species is recognized by the characters given in the key and illustrated in Figures 92-96. Present Michigan specimens, except for greater body length, agree with those described by Hoff (1946d, 1949). Measurements of four males include: body length 2.38-2.5; palpal femur 0.765-0.84 long, 0.18-0.19 wide, length x width 4.31-4.67; tibia 0.68-0.71 long, 0.21-0.22 wide, length x width 3.09-3.38; chela without pedicel 1.30-1.35 long, 0.30-0.33 wide, length x width 4.0-4.33; chelal hand

about 0.60-0.61 long, 0.29-0.316 deep; movable finger 0.73-0.785 long. Measurements of three females include: body length 2.86-3.08; palpal femur 0.81-0.86 long, 0.18-0.20 wide, length x width 4.28-4.37; tibia 0.68-0.71 long, 0.20-0.24 wide, length x width 2.96-3.4; chela without pedicel 1.36-1.44 long, 0.32-0.37 wide, length x width 3.89-4.25; chelal hand 0.63-0.65 long, 0.30-0.32 deep; movable finger 0.74-0.83 long.

Distribution (Map 28) and Habitat Preference. This species occurs in the Midcentral States of Arkansas, Illinois, Indiana, Iowa, Michigan, Missouri, and Wisconsin. In Michigan it is confined to the Lower Peninsula. Fenstermacher (1959) reported this species from Livingston County. Manley (1969) reported it from Clare, Clinton, and Ingham Counties, however, the record from Clare County was based on the misidentification of Chelifer cancroides. The present specimens were collected in Barry and Ingham Counties. This species occurs most frequently from under bark or bark scales of both living and dead trees.

Records. LIVINGSTON CO.: 24 July 1954, Wallace, 1 male. INGHAM CO.: 8 Sept. 1967, G. V. Manley, 1 male under boards atop old straw. BARRY CO.: more than sixty individuals collected by Invertebrate Zoology Class, Sheila and S. Nelson in Aug. 1968 under the bark scales



Map 28. Distribution of Idiochelifer nigripalpus



of black cherry and under bark of dead elm. CLINTON CO.: cited from Manley (1969).

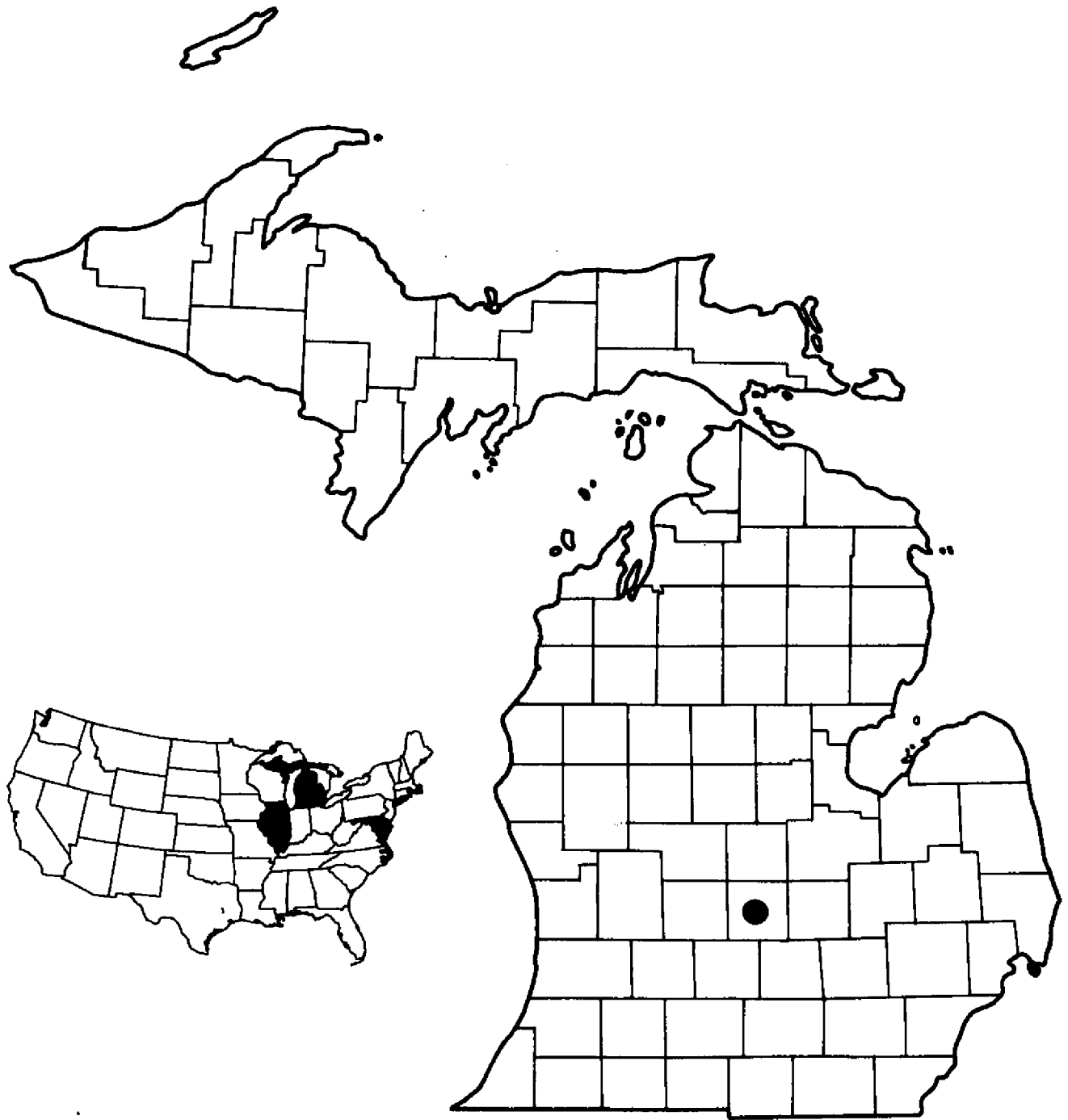
Paisochelififer callus (Hoff)

Hysterochelififer callus Hoff, 1945a: 515.

Paisochelififer callus, Hoff, 1946e: 487, 1949: 489, 1950: 10, 1958: 33; Fenstermacher, 1959: 25; Manley, 1969: 9.

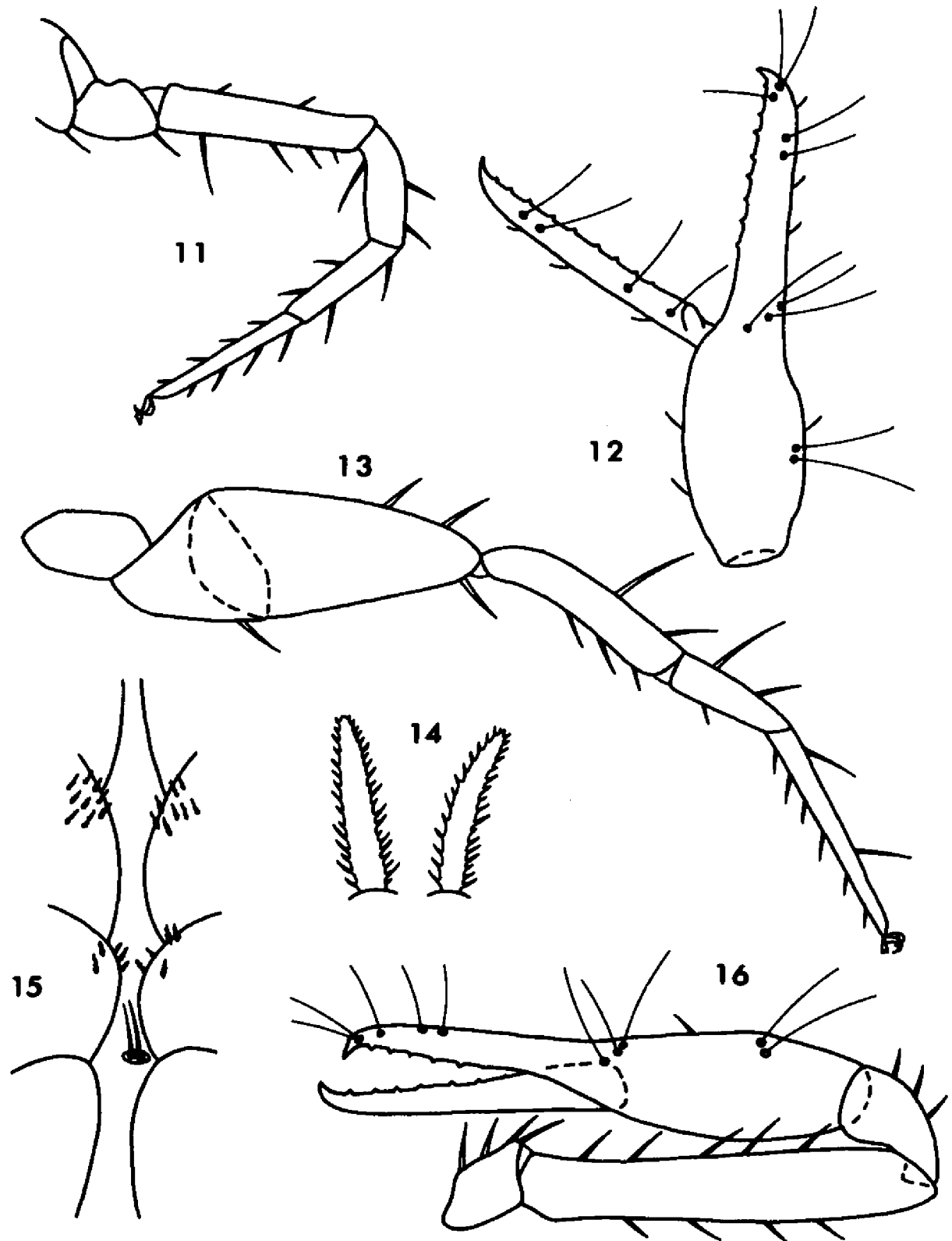
This species is known from Michigan on the basis of a single male, initially reported by Fenstermacher (1959), and subsequently by Manley (1969). Diagnostic characters are given in the key and illustrated in Figures 97, 98. Measurements of Fenstermacher's specimen agree with Hoff (1945a) with the exception of a slightly wider chelal hand. Measurements include: body length 2.12; palpal femur 0.62 long, 0.18 wide, length x width 3.42; tibia 0.56 long, 0.235 wide, length x width 2.38; chela without pedicel 1.07 long, 0.36 wide, length x width 2.97; chelal hand 0.5 long, 0.30 deep; movable finger 0.59 long.

Distribution (Map 29), Habitat Preference and Record. This species occurs in the States of Illinois, Maryland, and Michigan. Fenstermacher's reference to Washington County, Arkansas as the type locality of P. callus was in error. The Michigan record is based on a single collection from CLINTON CO.: 24 Oct. 1956 by R. A. Scheibner of 1 female from a grain bin collected with Lamprochernes minor.

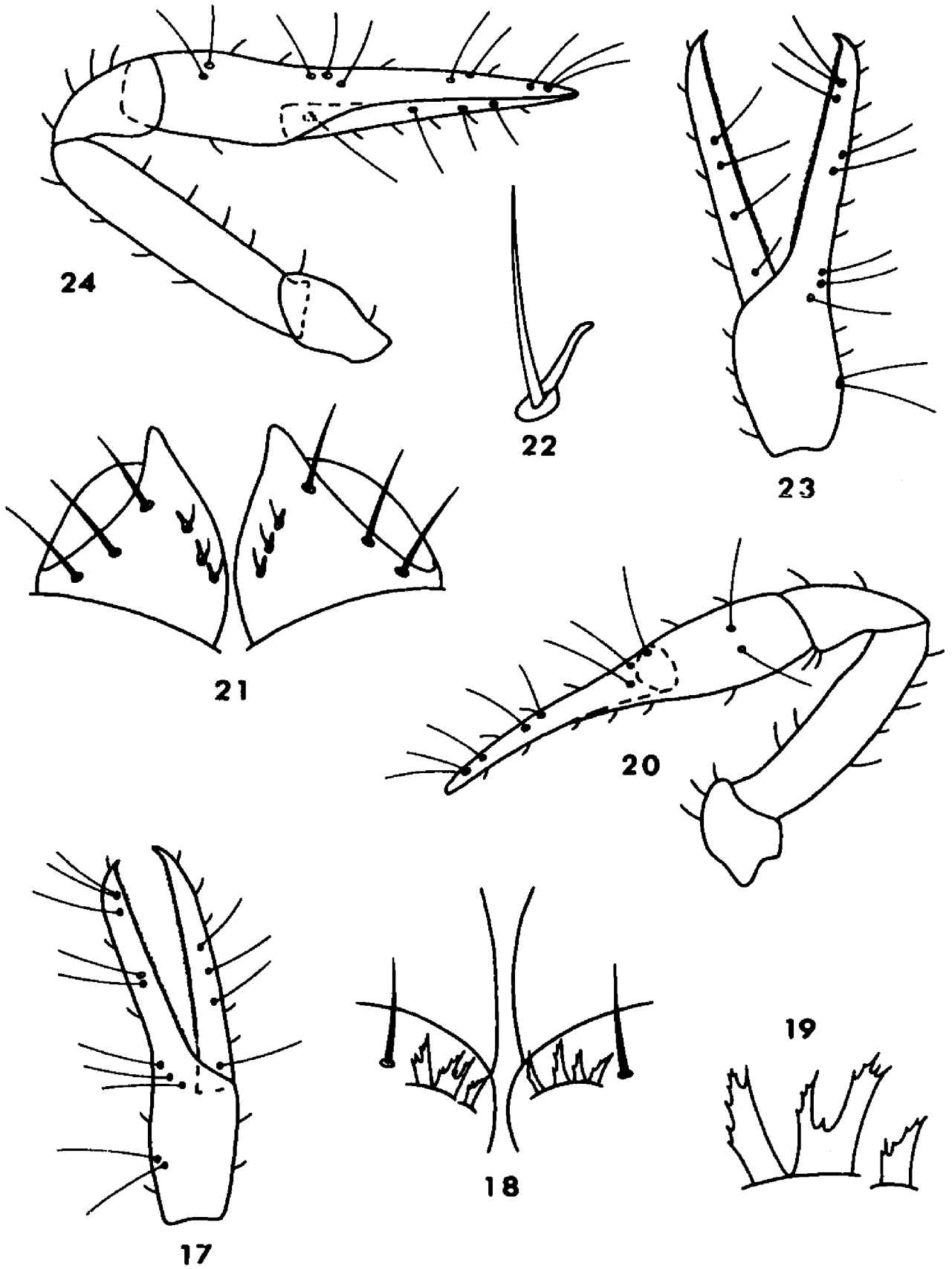


Map 29. Distribution of Paisochelifer callus

Figs. 11-16. Chthonius (Ephippiochthonius) tetrachelatus (Preyssler), female. 11. First leg. 12. Lateral view of chela. 13. Fourth leg. 14. Feathered coxal spines. 15. Coxal area with feathered coxal spines and inter-coxal tubercle. 16. Dorsal view of palp.



- Figs. 17-20. Mundochthonius rossi Hoff, female. 17. Lateral view of chela. 18. Second coxae with comb-like coxal spines. 19. Comb-like coxal spines. 20. Dorsal view of palp.
- Figs. 21-24. Apochthonius moestus (Banks). 21-23. Female. 24. Male. 21. First coxae with spines. 22. Coxal spine. 23. Lateral view of chela. 24. Dorsal view of palp.

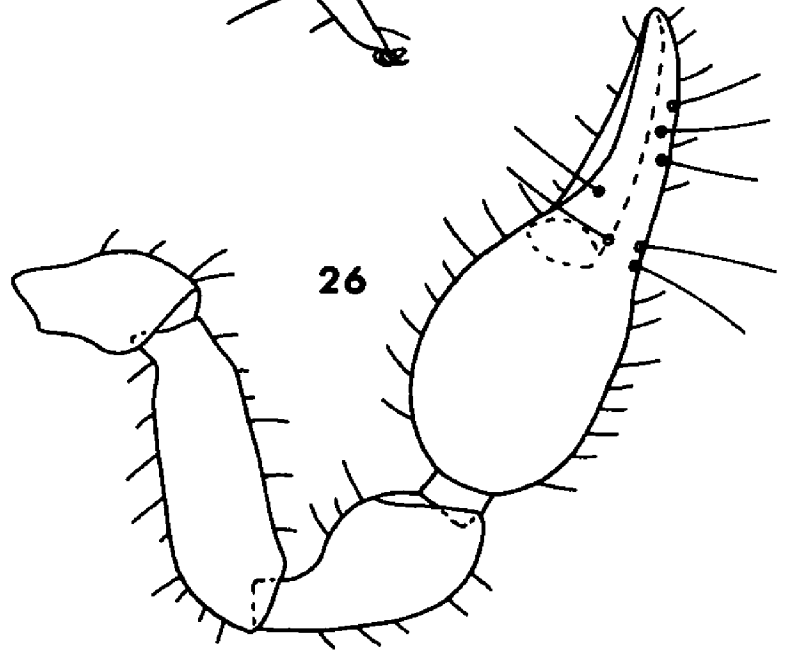
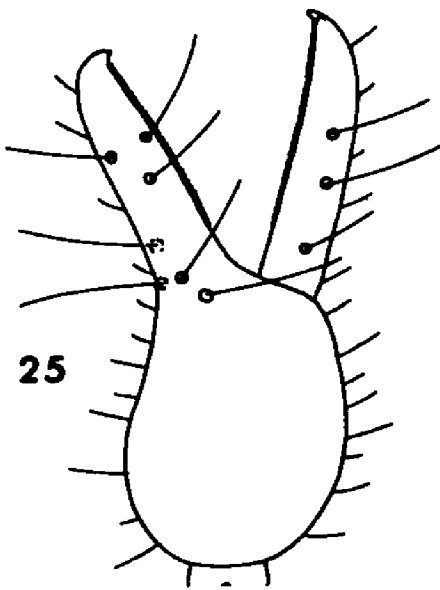
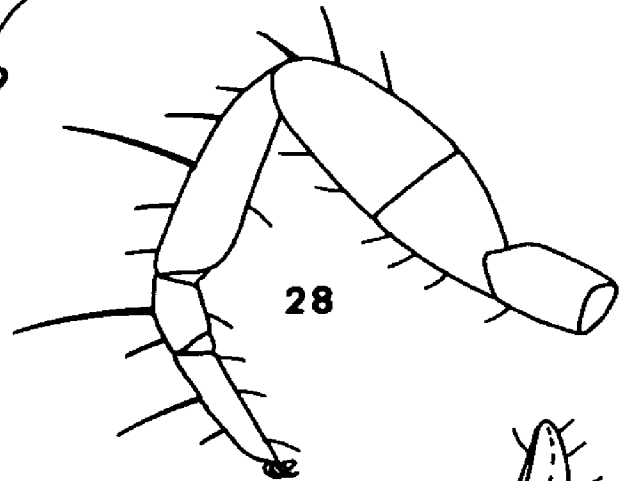
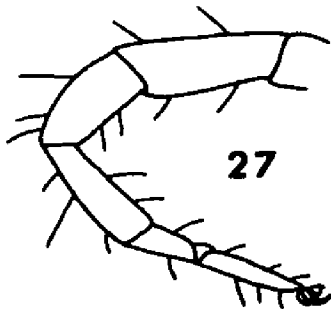
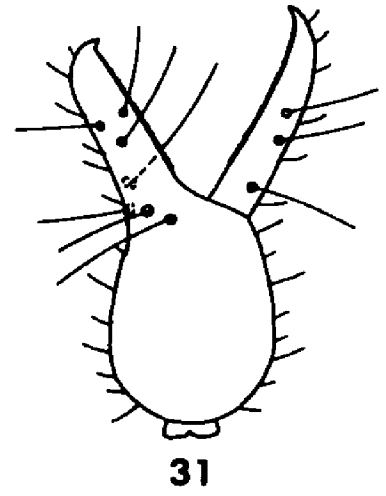
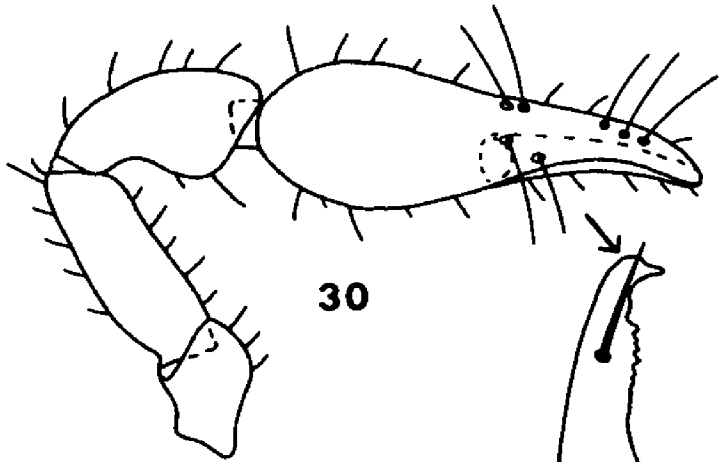


Figs. 25-26. Microbisium brunneum (Hagen), female.

25. Lateral view of chela. 26. Dorsal view of palp.

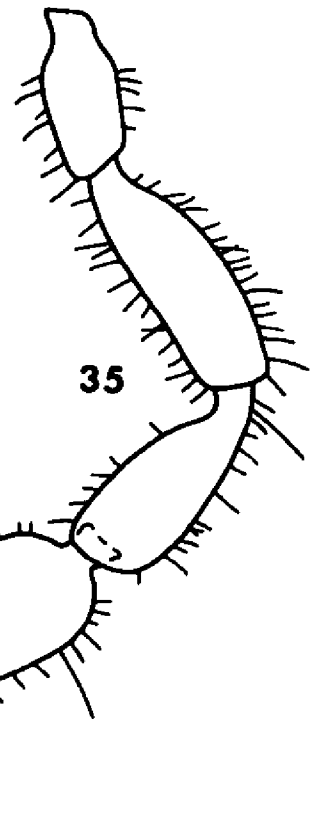
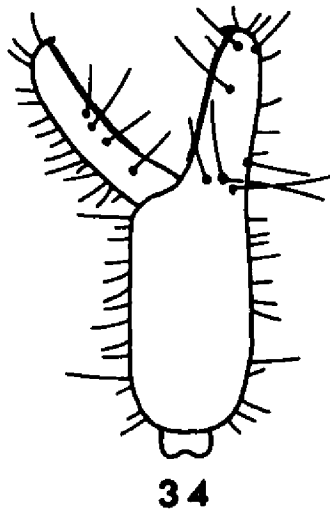
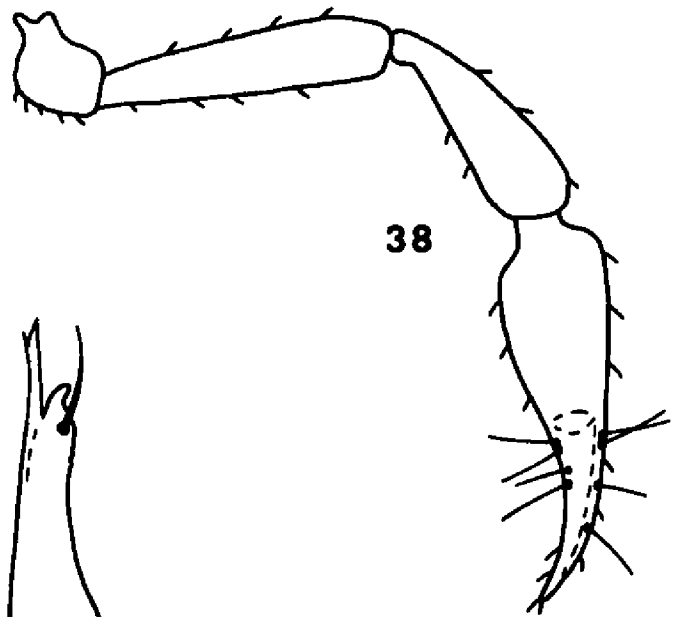
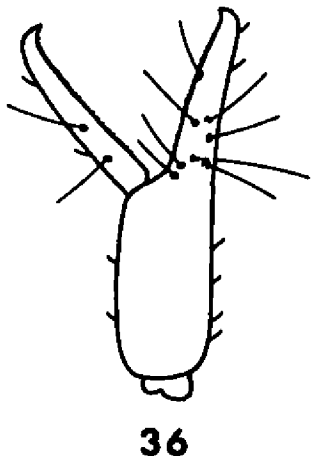
Figs. 27-31. Microbisium confusum Hoff, female. 27.

First leg. 28. Fourth leg. 29. Movable finger of chelicera with sclerotized knob. 30. Dorsal view of palp. 31. Lateral view of chela.



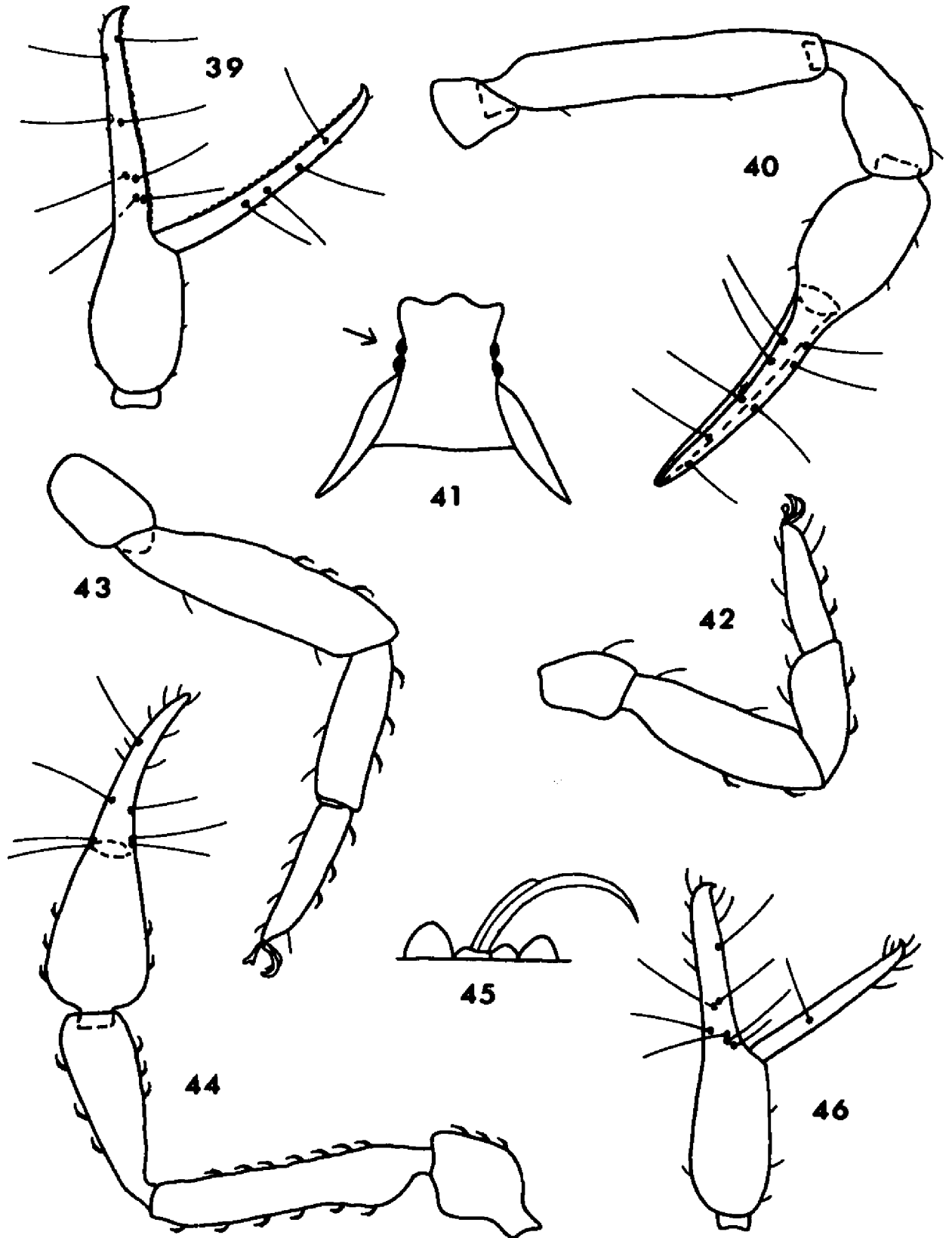


- Figs. 32-35. Syarinus enhuycki Muchmore. 32, 35.  
Female. 33, 34. Male. 32, 33. Movable  
fingers of chelicerae. 34. Lateral view  
of chela. 35. Dorsal view of palp.
- Figs. 36-38. Larca granulata (Banks), male. 36.  
Lateral view of chela. 37. Movable  
finger of chelicera. 38. Dorsal view  
of palp.



Figs. 39-41. Pseudogarypus sp., male. 39. Lateral view of chela. 40. Dorsal view of palp. 41. Carapace with eye pattern.

Figs. 42-46. Apocheiridium stannardi Hoff. 42, 43. Female. 44-46. Male. 42. First leg. 43. Fourth leg. 44. Dorsal view of palp. 45. Palpal seta. 46. Lateral view of chela.

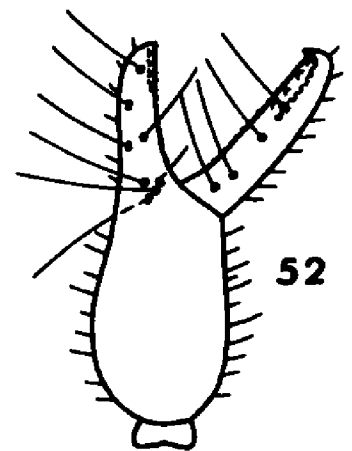
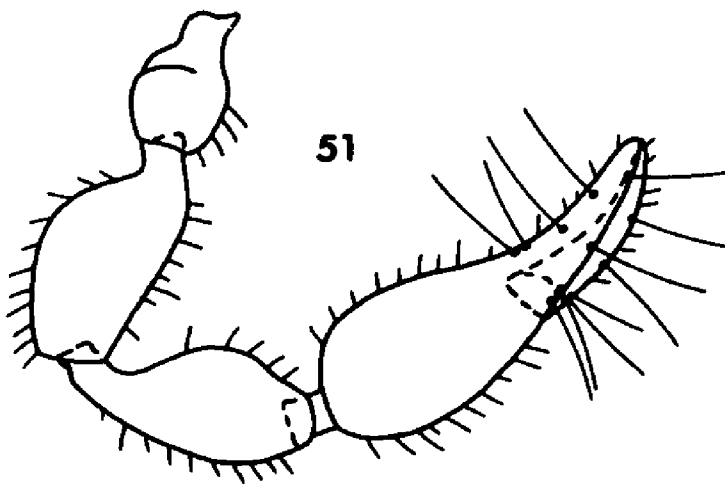
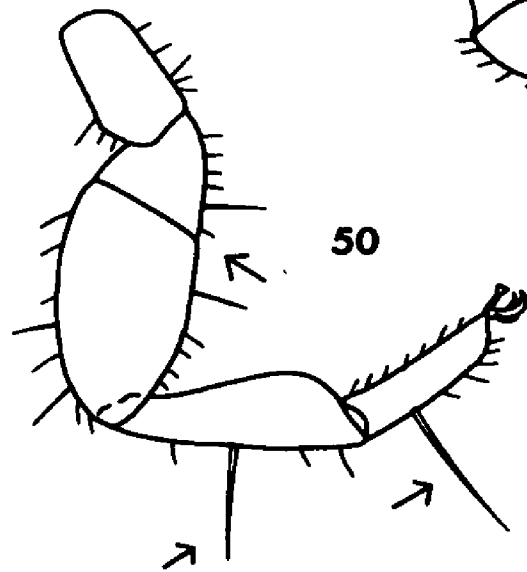
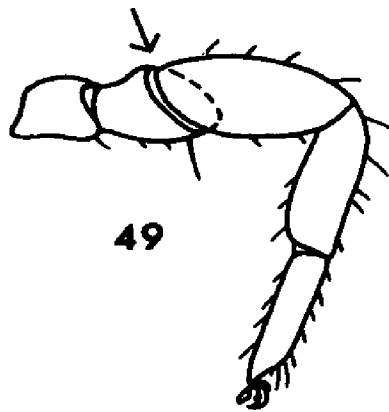
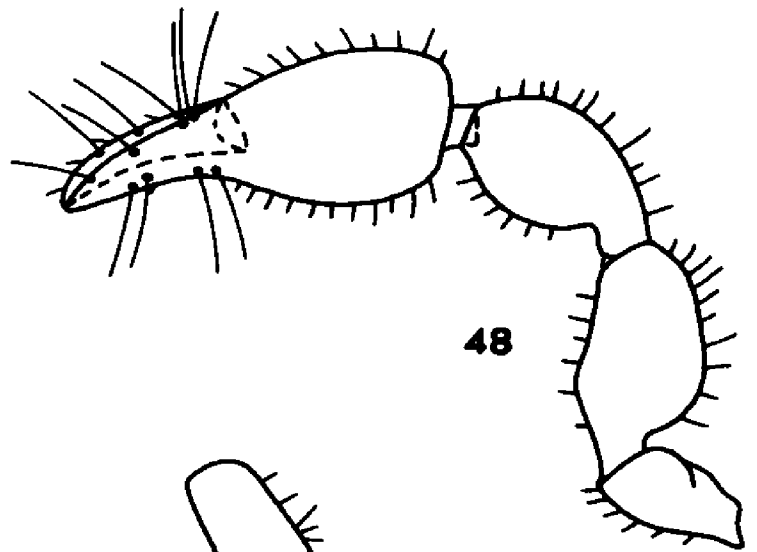
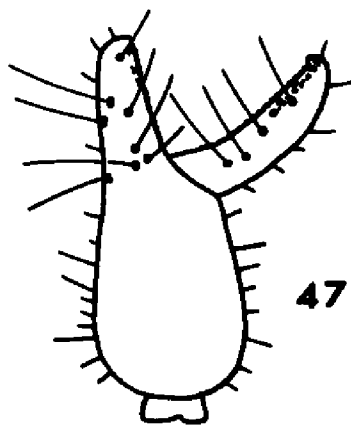


Figs. 47-50. Lamprochernes oblongus (Say), female.

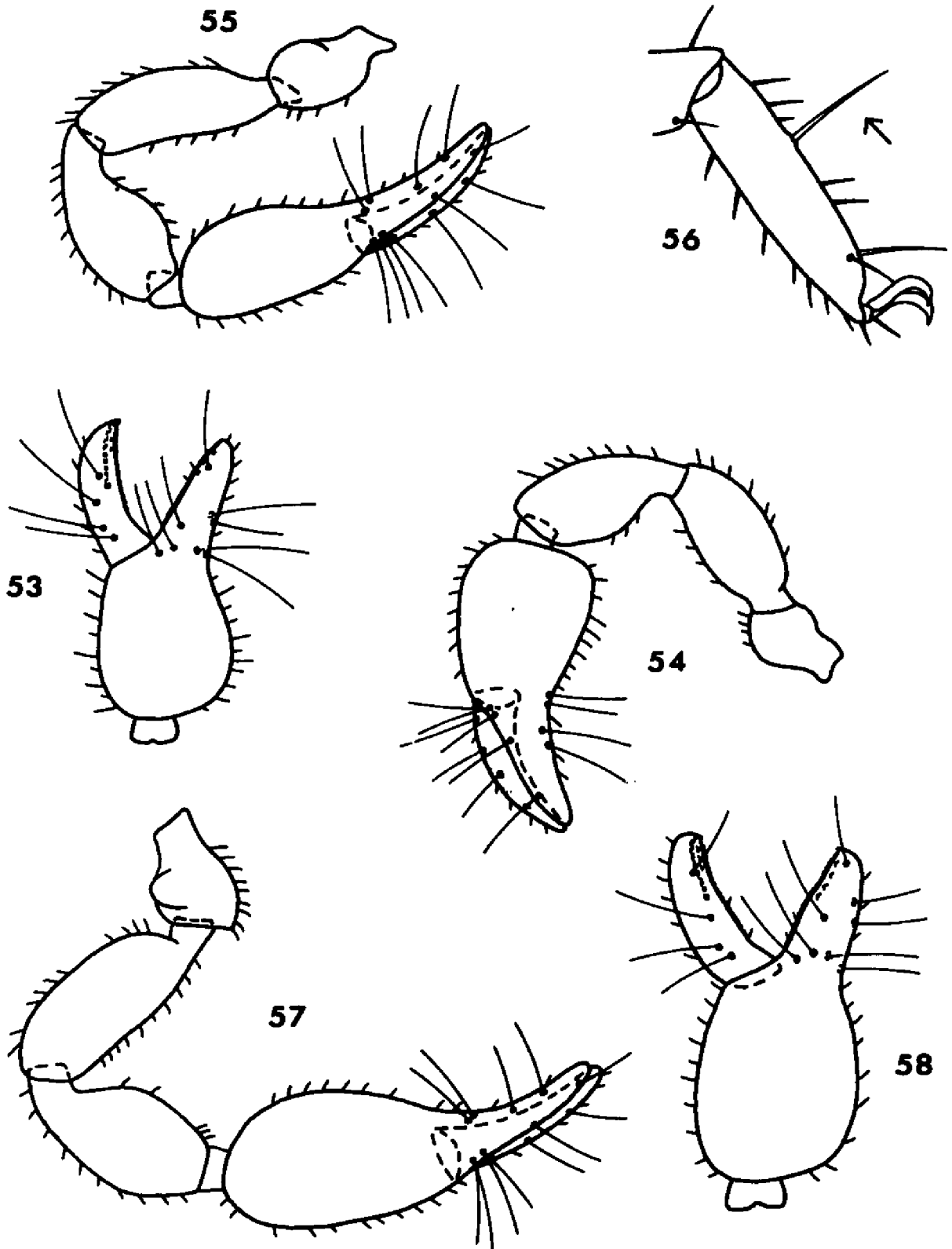
47. Lateral view of chela. 48. Dorsal view of palp. 49. First leg. 50. Fourth leg.

Figs. 51-52. Lamprochernes minor Hoff, female. 51.

Dorsal view of palp. 52. Lateral view of chela.



- Figs. 53-54. Parachernes squarrosus Hoff, female.  
53. Lateral view of chela. 54. Dorsal view of palp.
- Figs. 55-56. Pselaphochernes parvus Hoff, female.  
55. Dorsal view of palp. 56. Fourth tarsus.
- Figs. 57-58. Dendrochernes morosus (Banks), female.  
57. Dorsal view of palp. 58. Lateral view of chela.



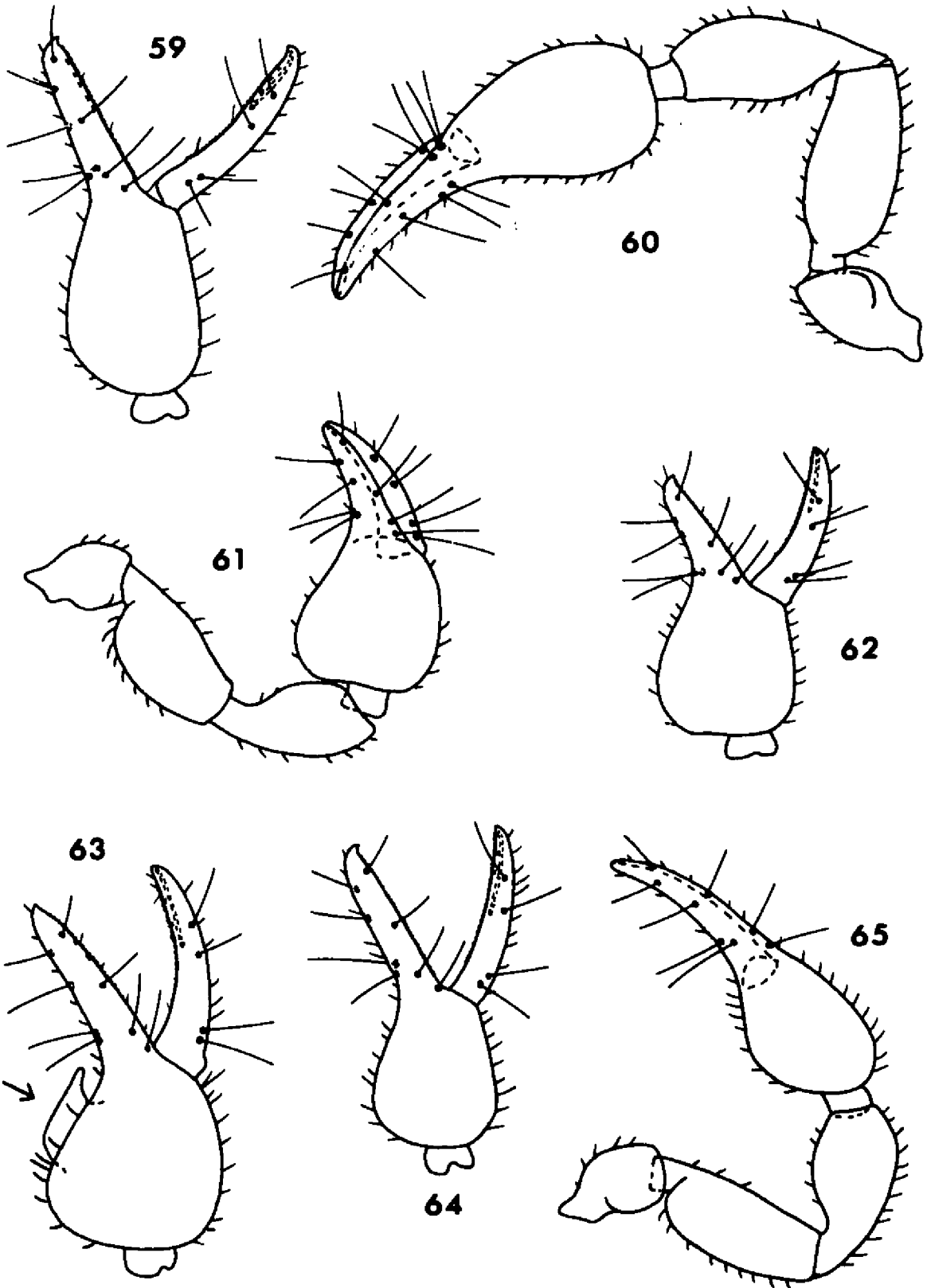


Figs. 59-60. Acuminochernes tacitus Hoff, male.

59. Lateral view of chela. 60. Dorsal view of palp.

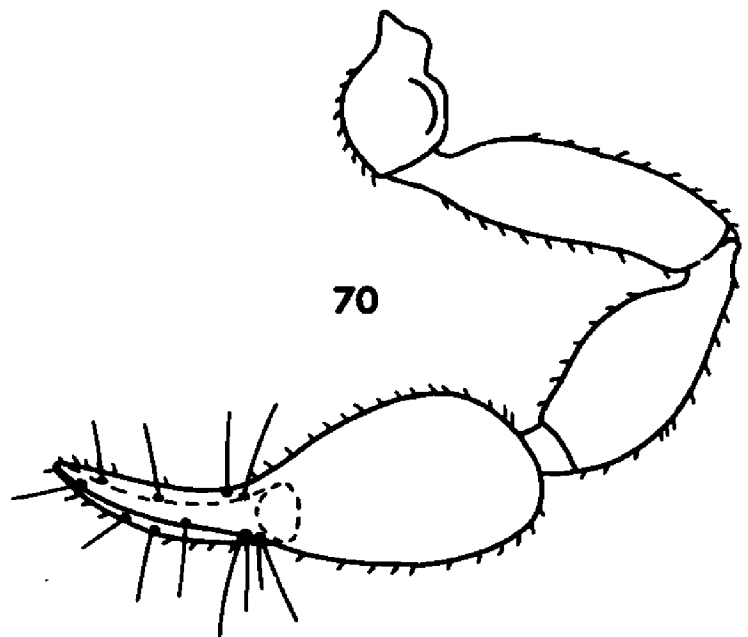
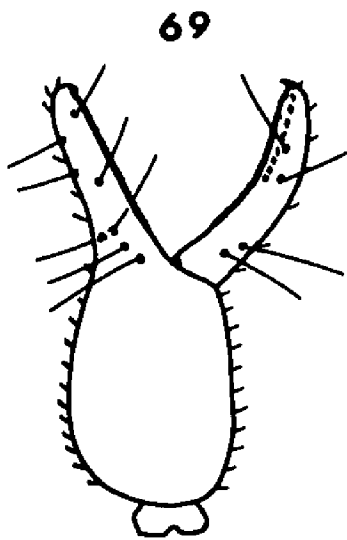
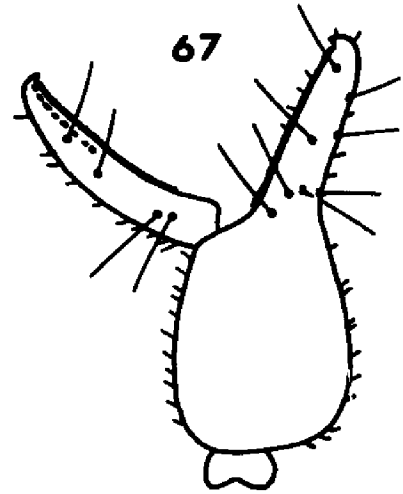
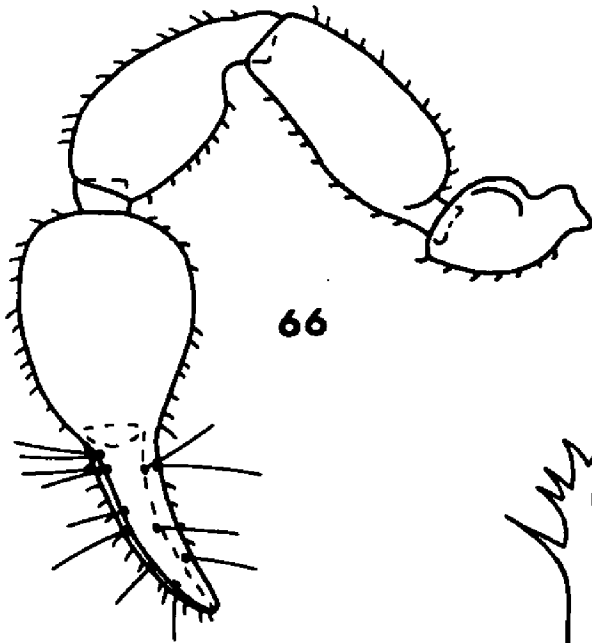
Figs. 61-62. Acuminochernes crassopalpus (Hoff), male. 61. Dorsal view of palp. 62. Lateral view of chela.

Figs. 63-65. Mirochernes dentatus (Banks). 63. Male. 64, 65. Female. 63. Lateral view of chela. 64. Lateral view of chela. 65. Dorsal view of palp.



Figs. 66-68. Dinocheirus horricus, new species,  
male. 66. Dorsal view of palp. 67.  
Lateral view of chela. 68. Chelicer  
galea.

Figs. 69-70. Dinocheirus pallidus (Banks), male.  
69. Lateral view of chela. 70. Dorsal  
view of palp.



Figs. 71-74. Illinichernes distinctus Hoff, male.

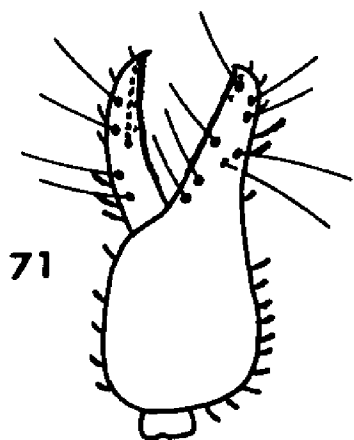
71. Lateral view of chela. 72. Dorsal view of palp. 73, 74. Palpal setae.

Figs. 75-76. Hesperochernes tamiae Beier, female.

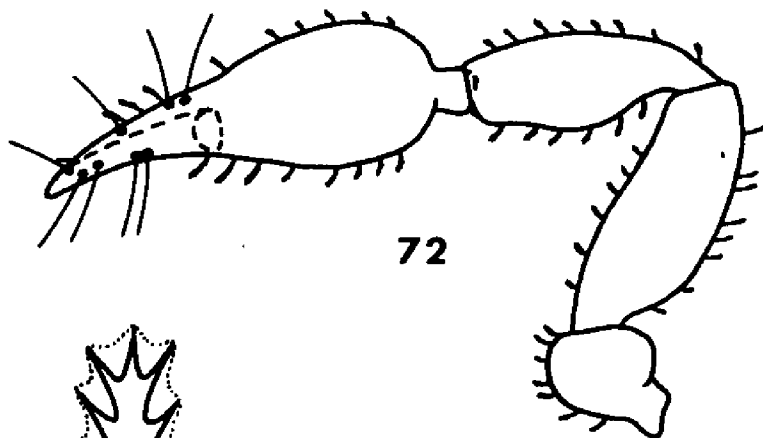
75. Dorsal view of palp. 76. Lateral view of chela.

Figs. 77-78. Hesperochernes ewingi (Hoff), male.

77. Lateral view of chela. 78. Dorsal view of palp.



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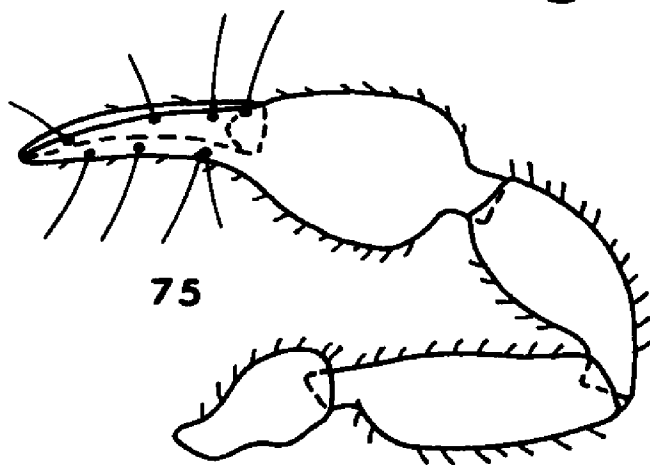
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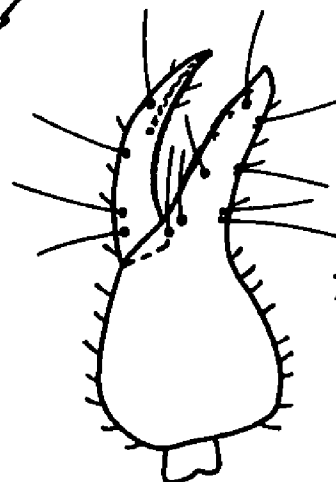
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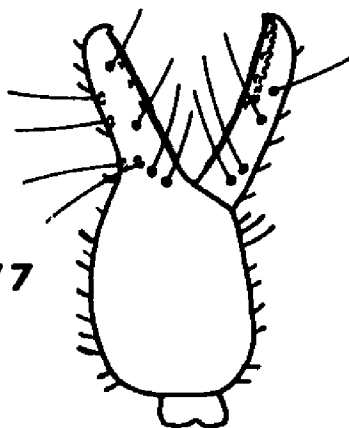
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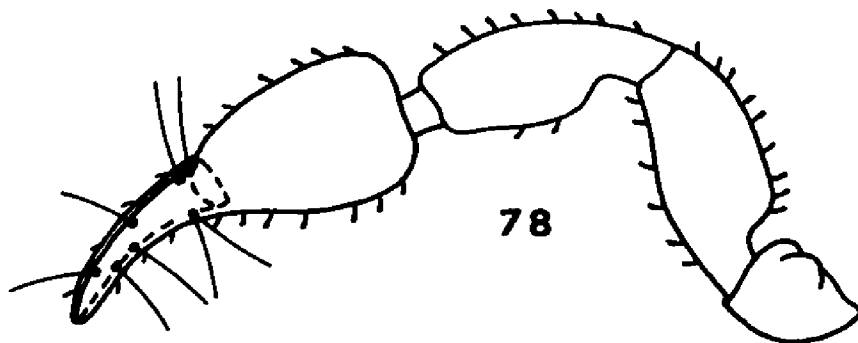
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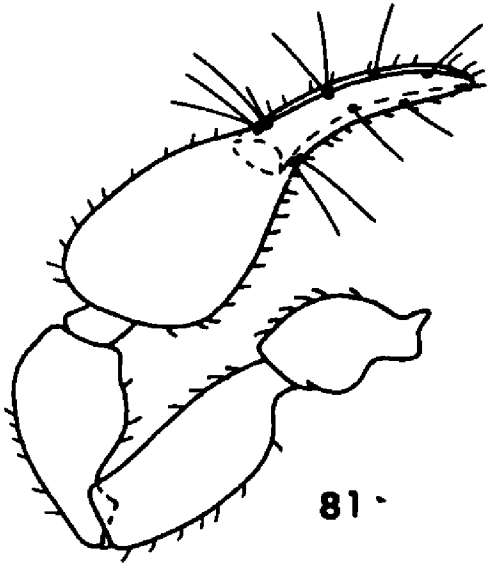
Figs. 79-80. Hesperochnes lymphatus (Hoff), female.

79. Lateral view of chela. 80. Dorsal view of palp.

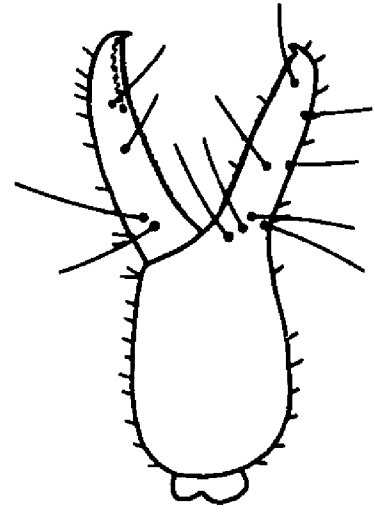
Figs. 81-82. Hesperochnes amoenus Hoff. 81. Male.

82. Female. 81. Dorsal view of palp.

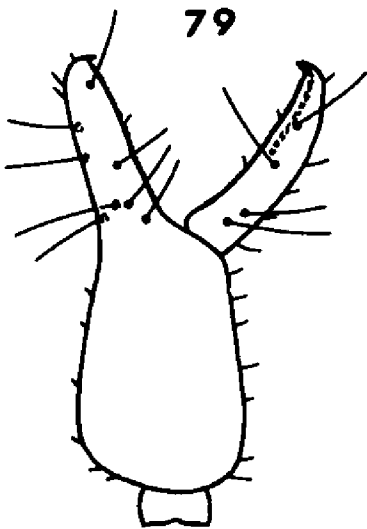
82. Lateral view of chela.



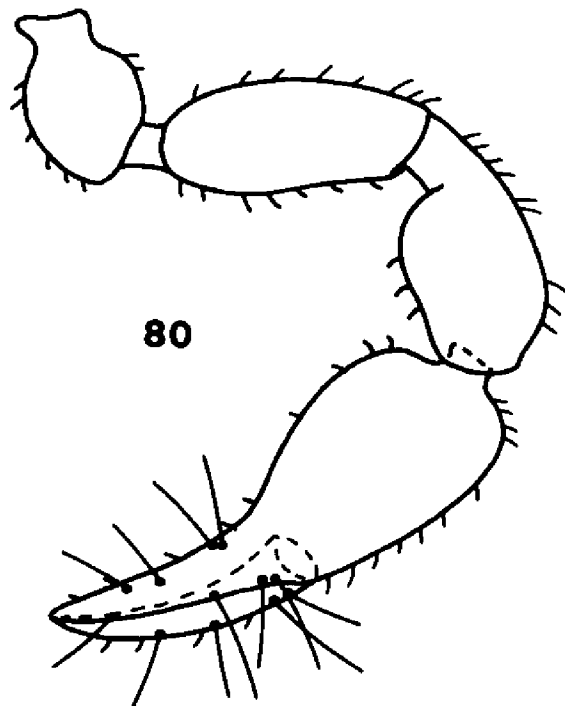
81 -



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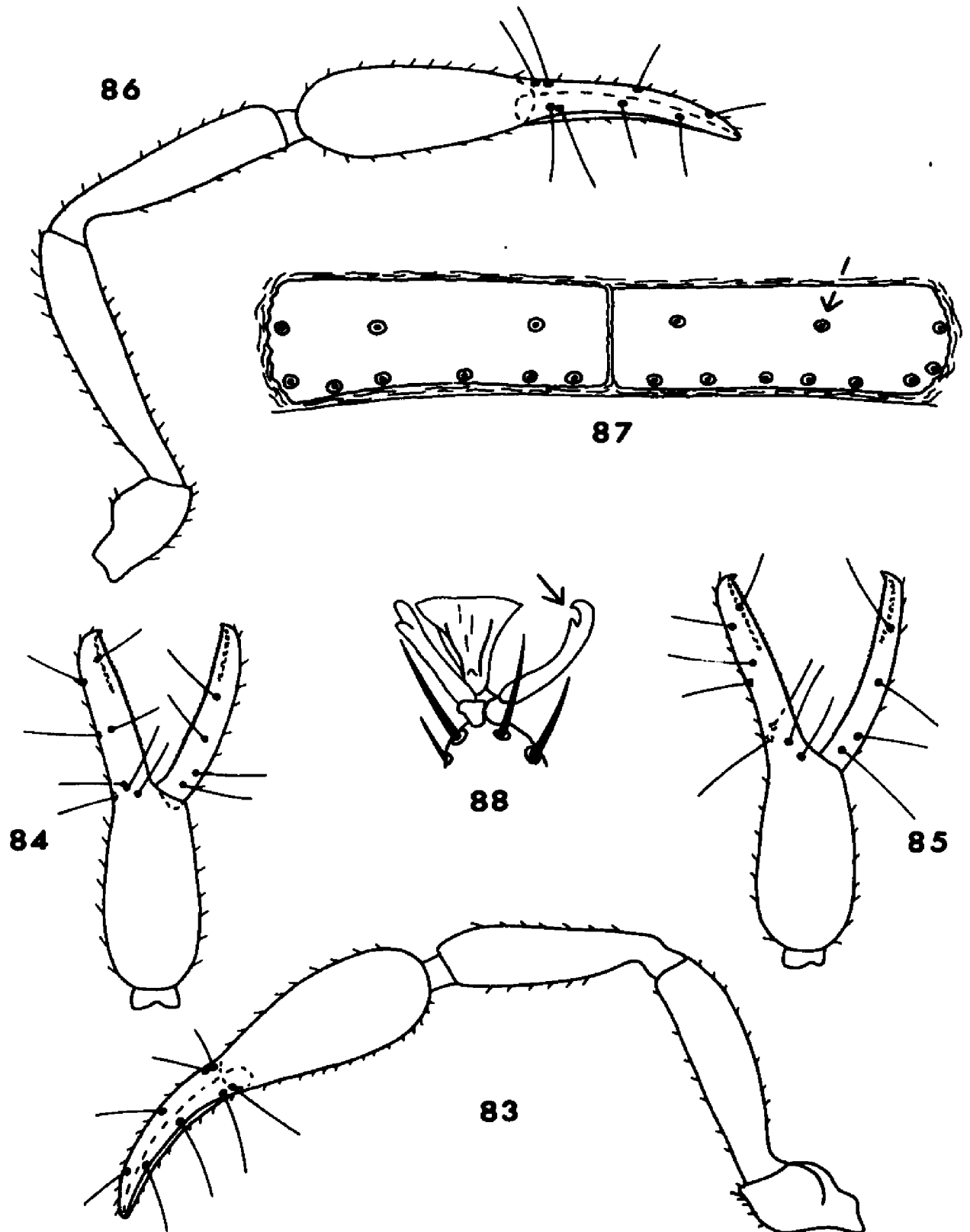
Figs. 83-84. Dactylochelifer copiosus Hoff, female.

83. Dorsal view of palp. 84. Lateral view of chela.

Figs. 85-88. Cheliifer cancroides (Linnaeus), female.

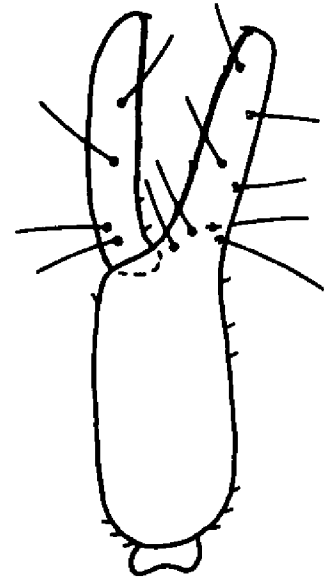
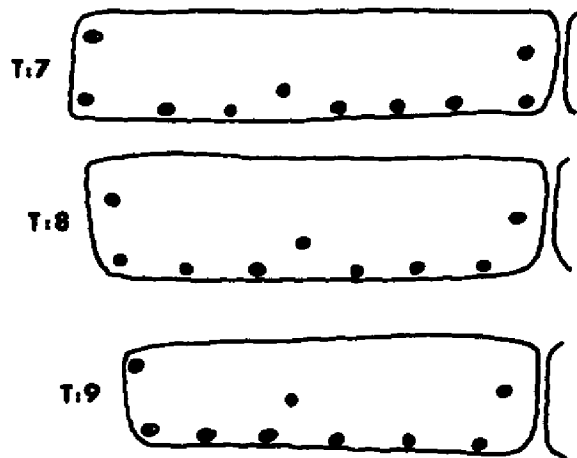
85. Lateral view of chela. 86. Dorsal view of palp. 87. Tergal halves.

88. Tarsal claw.

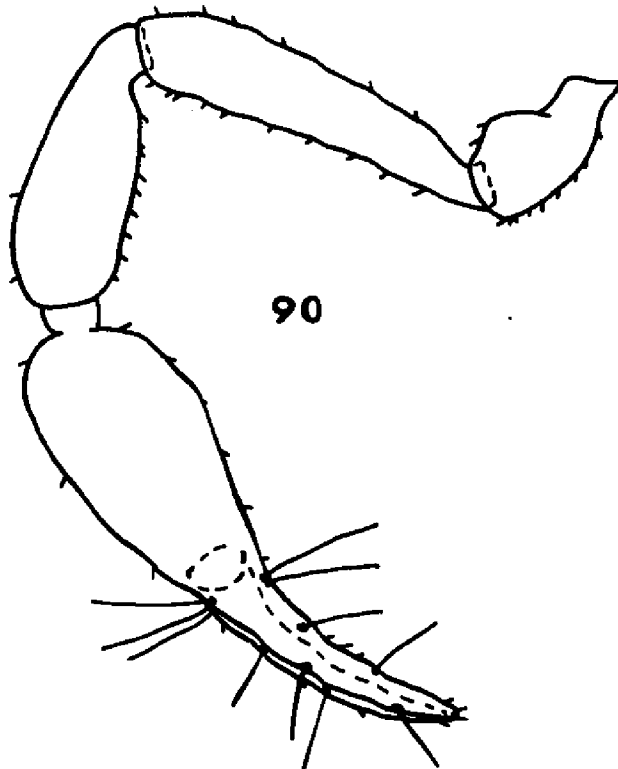


Figs. 89-91. Parachelifer monroensis, new species,  
female. 89. Tergites 7-9. 90. Dorsal  
view of palp. 91. Lateral view of  
chela.

89



91



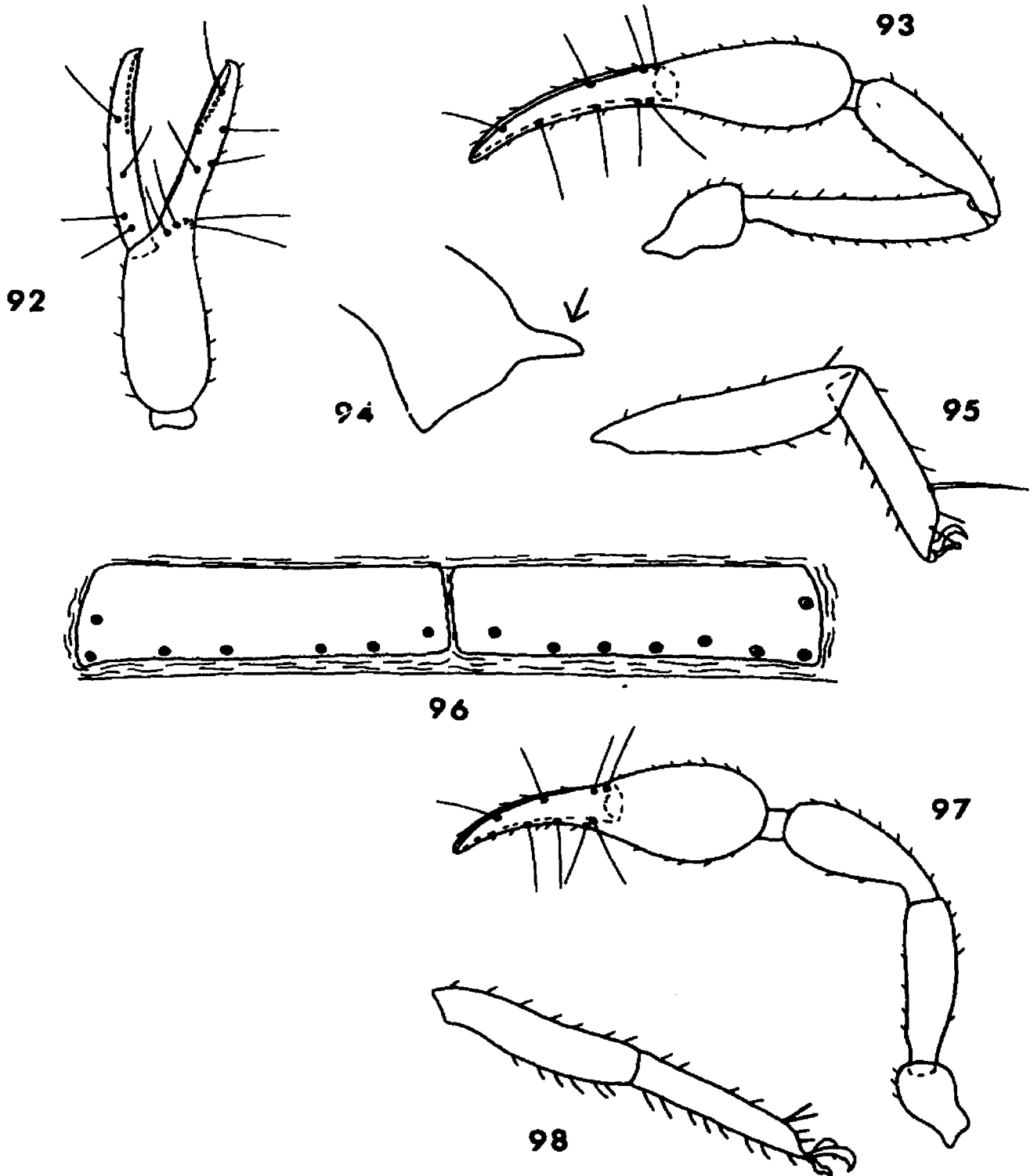
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Figs. 92-96. Idiochelifer nigripalpus (Ewing), male.

92. Lateral view of chela. 93. Dorsal view of palp. 94. Fourth coxa with anterolateral spur. 95. Tibia and tarsus of fourth leg. 96. Tergal halves.

Figs. 97-98. Paisochelifer callus (Hoff), female.

97. Dorsal view of palp. 98. Tibia and tarsus of fourth leg.



**PART III**

**POPULATION STRUCTURE OF MICROBISIUM CONFUSUM  
HOFF IN A BEECH-MAPLE WOODLOT**

## INTRODUCTION

Few quantitative population studies of pseudoscorpions have been reported. Gabbutt (1967) examined three species of pseudoscorpions from beech litter in Oxon, England. Chthonius ischnocheles (Hermann) reached a peak of 619.7 individuals per square meter during August. Earlier preliminary studies by Gabbutt and Vachon (1963) showed maximum densities of C. ischnocheles never exceeded 100 per square meter from oak litter in Devon, England. The maximum density for Roncus lubricus L. Koch and Neobisium muscorum Leach, occurring with C. ischnocheles from beech litter in Oxon, was nearly 300 and 85 individuals per square meter respectively. Maximum densities for all three species reached nearly 900 in August and were consistently around 500 per square meter. Gabbutt and Vachon (1965) found that N. muscorum, in sycamore-ash litter in Cheshire, England, barely exceeded 100 per square meter. Van der Drift (1951), on the other hand, reported densities of N. muscorum, from beech litter in Holland, to average only eight per square meter.

The intent of this study is to quantitatively determine the population structure of Microbisium confusum



Hoff. This species is widely distributed, occurring in the northeastern and northcentral portions of the United States as far west as Colorado. This species is the most common pseudoscorpion present in Michigan, and is found in a wide variety of habitats, forest litter and soil being the most common.

## METHODS AND MATERIALS

Toumey Woodland, a beech-maple climax woodlot, was selected as the site to study the life-history of Microbisium confusum. The woodlot is irregular in shape with a maximum length times width of approximately 500 by 200 meters. The site is contiguous with the Michigan State University campus proper. Within the woodlot a study area of 40 x 60 meters was plotted at 10 meter intervals. The area selected was generally level in terrain and was covered by a dense overstory of beech-maple.

Approximately twice monthly, for a twelve-month period, litter and soil were sampled randomly from ten different sample sites. Litter samples were one-ninth of a square meter. As an equal area of soil would be too large in volume to effectively handle, soil cores 5.7 centimeters in diameter were taken directly beneath the litter samples to a depth of seven centimeters. Litter and soil samples were removed to the laboratory in large plastic bags where the contents were examined using Tullgren funnel techniques.

The extracted pseudoscorpions were prepared using the method described by Hoff (1949).

## RESULTS AND DISCUSSION

A total of 182 individuals was collected during this study of which there were 72 protonymphs, 43 deutonymphs, and 67 adult females.

The population structure of Microbisium confusum is shown in Table 7. During this study no tritonymphs, or males were found. M. confusum was described by Hoff (1946c) on the basis of 127 females. The first record of a male was reported by Lawson (1969). It is thought that females of this species reproduce parthenogenetically. These females, according to Weygoldt (1969), may represent neotenic tritonymphs as the number of trichobothria present in the adults represents the number normally present in tritonymphs of other species.

The total population, prior to an examination of each life stage, showed a spring and fall pulse. However, an examination of the component parts showed the composition of each pulse to differ. The component parts are shown in Figures 99-101. Winter months, December through March, were deleted from the figure as numbers of individuals collected during this period were not indicative of the actual population structure. Perhaps

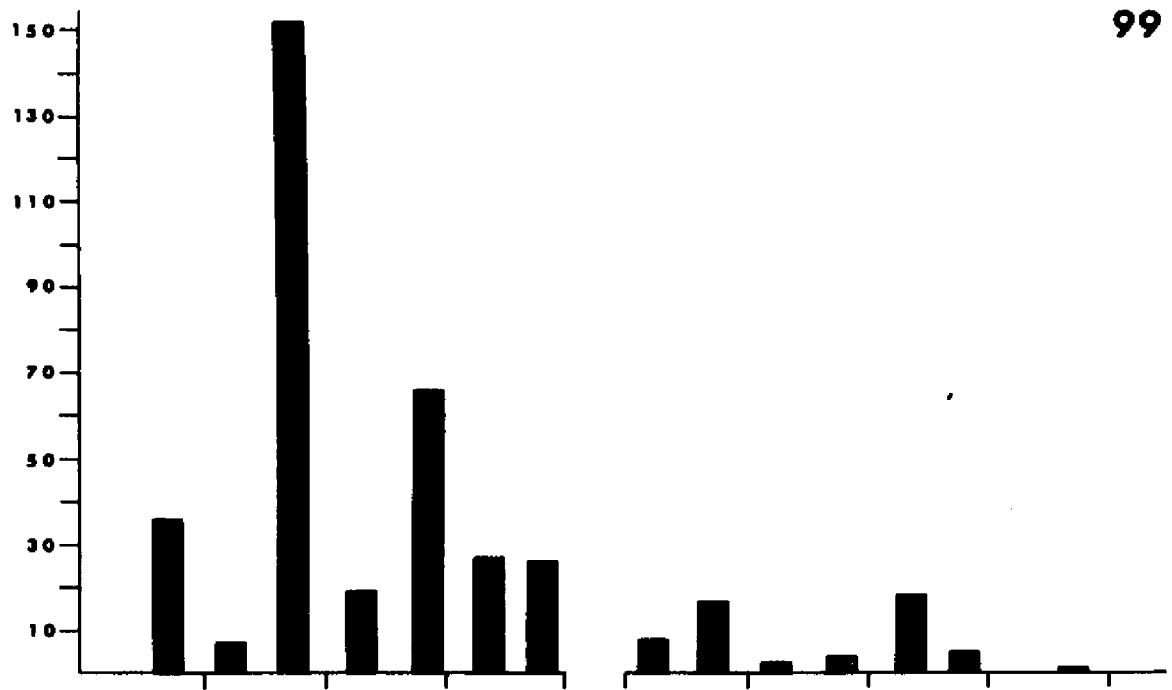
TABLE 7.--The life stages and number per square meter of Microbisium confusum in Toumey Woodland during the period 5 January 1969 to 3 January 1970.

Date	Protonymphs	Deutonymphs	Adult Females	Total
5 January	0	0	0	0
19 January	0	0	7.9	7.9
8 February	0	0	15.9	15.9
23 February	0	0	0	0
10 March	0	0	0	0
23 March	0	0	0	0
8 April	7.9	17.7	0.9	26.5
20 April	16.8	20.4	74.1	111.3
4 May	2.2	28.1	46.3	76.6
26 May	3.6	3.6	16.8	24.0
10 June	17.7	0	31.8	49.5
24 June	4.5	0.9	20.4	25.8
8 July	0	0	27.3	27.3
28 July	0.9	13.2	13.2	27.3
17 August	36.3	4.5	3.6	44.4
5 September	7.2	1.8	0.9	9.9
19 September	152.2	0.9	1.8	154.9
10 October	19.2	0	14.7	23.9
24 October	66.0	14.1	15.0	95.1
7 November	27.3	41.4	27.3	96.0
21 November	26.4	40.6	26.4	93.4
5 December	13.2	0	13.2	26.4
19 December	0	0.9	27.3	28.2
3 January	13.2	0	0	13.2

Figs. 99-101. Microbisium confusum Hoff. 99.

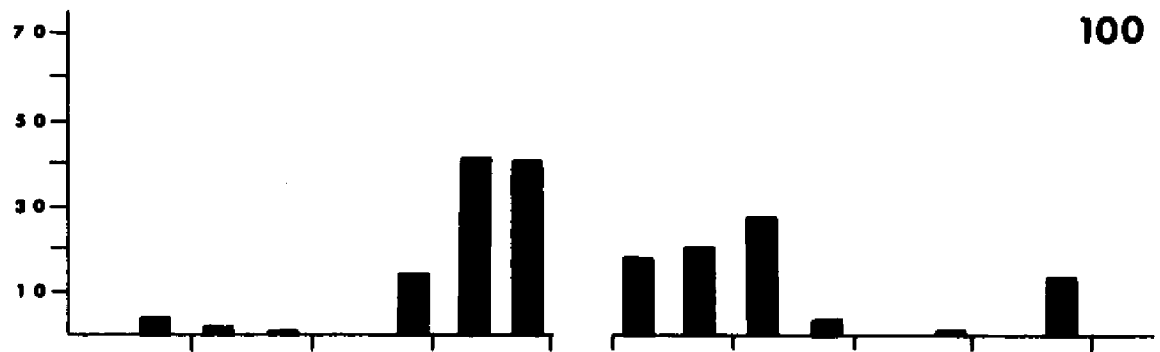
Protonymph density. 100. Deutonymph  
density. 101. Adult female density.

99

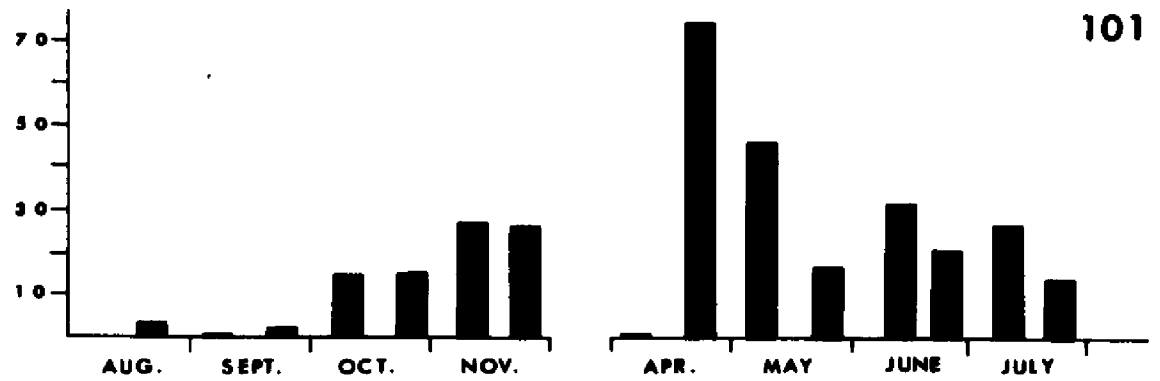


NO. / M³

100



101



the collection made on 8 April also falls into the above category. Soil temperature on this date was 40°F. Relatively high densities of all stages were present in November and April. During the winter months the densities decreased and became erratic. No pseudoscorpions were collected during this period from frozen soil or litter, or unfrozen litter above frozen soil. However, all life stages overwintered. Protonymphs were collected in unfrozen litter or soil in January, deutonymphs in December, and adult females during December through February. Gabbutt (1970) reported over-wintering mortality to be negligible, and attributed the decrease in observed densities to migration into the soil and/or hibernation. He suggested that individuals encased in silken chambers are not extracted.

During the period April through June the protonymph density was relatively low. No protonymphs were collected in early July and only 0.9 per square meter were collected in late July. The protonymph density began to increase in August and by late September rapidly reached a peak of 152.2 per square meter. This sudden increase was followed by a sharp drop prior to another marked increase in late October. In November the protonymph density remained relatively constant at about 27 per square meter.

Deutonymphs, on the other hand, reached a peak of 41.4 per square meter during early November. The deutonymph density remained at least 17.7 per square meter, exclusive of the winter months, through early May.

The peak density for adult females was reached in late April and decreased to zero in September. The females reached a density of at least 14.7 per square meter during October and November.

During the non-winter period protonymphs averaged 25.9, deutonymphs 12.5, and adult females 21.2 per square meter. The deutonymphs represented about one-third of the total nymphal population, while adult females represented a 1.7 increase over deutonymphs. This discrepancy in adults might be attributed to an extraction differential of different life stages or the occurrence of more than one generation of adults. With regard to the former, Gabbutt (1970) reported the efficiency of pseudoscorpion extraction not to exceed 80 per cent with protonymph and deutonymph numbers obtained without prejudice to tritonymphs and adults. If the latter were true, then the absence of adults in early September would require an explanation. Gabbutt (1970) explained the absence of females during certain periods of the year as being due to their construction of silken chambers for brood purposes. The absence of females during early September suggested females were in unextractable brood



chambers. No females with eggs or embryonic stages attached were collected during this study. If more than one generation were present, then an increase of females would be expected to parallel the abrupt increase in protonymphs in late September. This increase in females did not occur until October.

These data do not indicate that more than one generation is produced during a single year. Of six species examined by Gabbutt (1969) only one species, Neobisium muscorum, produced more than one generation per year, and this did not hold for all populations of this species.

## SUMMARY

Twenty-nine species of pseudoscorpions are reported from Michigan including two new species, Dinocheirus horricus and Parachelifer monroensis, and an undetermined species of Pseudogarypus.

In general, species tend to exhibit clear-cut distributional patterns. Still other species show disjunct patterns of distribution which could be the result of relict populations, phoresy, inadequate records, or misidentification of species. Eight species occur in both the Upper and Lower Peninsula, while only two species occur exclusively in the Upper Peninsula. Three species occur only from those counties adjacent to Indiana and Ohio.

Nine species were taken from litter and soil. Thirteen species were collected from under bark of dead trees. Eleven species were collected within hollows of trees in association with rotten wood and debris. Often these trees contained remains of mammal, bird, and insect nests, or less frequently the active nests of a small mammal or bumble bees. Sixteen species were collected

during winter months, November through March. Sixteen samples yielded more than one species.

Microbisium confusum is the most common pseudoscorpion in Michigan, and occurs in a wide variety of habitats, forest litter and soil being the most common. The abundance of this species in forest litter and soil led to a population study in a beech-maple woodlot. Microbisium confusum reached a maximum density of 154.9 per square meter and dropped below 20, except for winter months, on a single occasion. The period of December through March was interpreted as a "suspended" period with an absence of marked growth and/or mortality. Protonymphs reached a peak density in September, deutonymphs in November, and adult females in late April. No males of Microbisium confusum were collected during this study, nor was this species collected in brood chambers or hibernacula. There was no evidence that more than one generation of M. confusum was produced per year, however, females present in the fall may represent more than one generation.

## **APPENDIX**



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