SURVEY OF THE PSEUDOSCORPIONS OF MICHIGAN

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SURVEY OF THE PSEUDOSCORPIONS OF MICHIGAN

By

JOSEPH D. FENSTERMACHER

AN ABSTRACT

Submitted to the School of Graduate Studies of
Michigan State University in partial
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Approved T. Wayne Porter

ABSTRACT

This study was conducted as a preliminary survey of the species of pseudoscorpions found in Michigan and their habitat preferences. Approximately 1450 specimens were collected by the author. Around 500 additional specimens were made available for this survey from institutional and personal collections.

Records published prior to this study list four species of pseudoscorpions in the state. With the present survey the list has been increased to include twelve species, ten genera, five families, and three suborders. Three of the four previously recorded species were taken at new localities. An accurate species determination could not be made for six specimens. They appear to demonstrate the presence of three or four additional genera and species.

Pseudoscorpions have varied habitat preferences. Four species were found in the leaf litter and ground cover of deciduous forests: Chthonius tetrachelatus, Dactylochelifer coniosus, Microbisium confusum, and Pselaphochernes parvus. The latter two were taken also in rotten logs and wood debris. Microbisium brunneum was collected from sphagnum moss and bog debris. Several species were taken near the habitations of man: Chelifer cancroides in an abandoned shack; Lamprochernes minor and Paisochelifer callus in a grain bin.

A single collection of Lamprochernes oblongus was made from under the elytra of the beetle Alaus oculatus (Linnaeus). No ecological data are available on the Michigan collections reported in the literature; habitat information is recorded in this survey on collections involving nine species.

The present records of Michigan pseudoscorpions offer only limited distribution information. Microbisium confusum was taken throughout both the Northern and Southern Peninsulas. Lamprochernes oblongus appears to be widespread and common in the Southern Peninsula. Although only recorded from four scattered counties, Chelifer cancroides is probably found throughout the Southern Peninsula, also. The state records of the remaining species indicate only a small or local distribution at the conclusion of this study.

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TABLE OF CONTENTS

INTRODUCTION

Pseudoscorpions are small, secretive arachnids generally found in leaf litter, ground cover, rotten logs, and similar habitats. Because of their small size, one to several millimeters in length, and ability to masquerade as inanimate specks of dirt in their natural surroundings, these animals have been generally overlooked or ignored by collectors although pseudoscorpions are cosmopolitan and abundant.

With the development of the Berlese funnel method of collection as well as considerable work on the systematics of the order (Chamberlin, 1931; Hoff, 1949, 1958), our knowledge of the pseudoscorpions of North America has been expanding. Such states as California, New Mexico, and Illinois which have been extensively collected boast species lists of fifty, thirty-eight, and thirty representatives respectively (Hoff, 1959). Michigan, however, has only four species recorded (Hoff, 1958).

Previous citations of Michigan pseudoscorpions include Banks' (1895) original description of Chelanops morosus. This was later redescribed by Hoff (1947) as Dendrochernes morosus. The type locality of this pseudoscorpion is Isle Royale. Chelifer cancroides, a cosmopolitan species, was collected by H. G. Hubbard from Grosse Isle, Wayne County, and published by Banks (1895). Pseudoscorpions of this

species have also been taken from Rock Point, Douglas Lake, and Midland, Michigan (Hoff, 1950). The remaining two published Michigan pseudoscorpion species, Lamprochernes oblongus and Microbisium brunneum, were also collected by Hubbard in Detroit, Wayne County, and first cited by Banks (1895). Subsequent references to these were made by Beier (1932a, 1932b) and later by Hoff (1958).

In addition to the above mentioned species cited in the literature for Michigan, two other state records of pseudoscorpion species are known but unpublished. The following remarks are quoted from a personal communication with Dr. K. K. Bohnsack, San Diego State College, in reference to part of his doctoral research.

> "All my collecting or rather berlesing was done with material from an oak-hickory woods on the Edwin S. George Reserve and during three years of collecting only two species turned up; namely Dactylochelifer copiosus Hoff, and Microbisium confusum Hoff. The E. S. George Reserve is in Livingston County. They were collected in the soil cover as well as in the surface soil. M. confusum is an ubiquitous inhabitant of the forest litter in the midwestern and eastern states. D. copiosus is encountered less often in the same environment. During a year's sampling (April, 1949-April, 1950) in which I took 68 soil and 60 litter samples, I collected 140 specimens from the litter and 130 from the soil. The sample area was about 44 square inches and the depth of the soil sample was three inches. The lowest density of these animals occurred in August, and December through March. The remainder of the year there were rather uniform numbers per sample. In Sept. a peak population was obtained which when expanded to numbers per acre (for the litter and surface 3 inches of soil) would be approximately 1,300,000 pseudoscorpions.

"Here is a brief resume of the species and the months in which they were collected. The "S" indicates specimens taken from the soil, and "L" from the litter.

D. copiosus...Jan. (S), Feb. (L), Mar. (L), Apr. (S), May (L), July (L), Sept. (L), Oct. (L,S), Nov. (L).

M. confusum...Jan. (S), Feb. (L,S), Mar. (L), Apr. (L,S), May (L,S), June (L,S), July (L,S), Aug. (L,S), Sept. (L, S), Oct. (L,S), Nov. (L,S), Dec. L,S)."

The primary purpose of this study has been to enlarge our knowledge of the pseudoscorpion fauna of the state of Michigan by collecting as extensively as possible throughout the state and working on specimens already collected by other individuals. Secondarily, a record was kept of the type habitats in which collections were made and specimens found. No attempt was made to determine the distributions and ranges of specific pseudoscorpions within the state; however certain general distributional data were obtained.

COLLECTING METHODS

In this study the specimens were collected by the Berlese funnel technique or a modification of this technique. Small animals which dwell in leaf litter, soil, and debris such as pseudoscorpions can be efficiently and effectively collected in this manner.

In all samples the material that was to be placed in the funnel, e. g. leaf litter, was collected in large plastic bags. Leaf litter, debris, and top soil were picked up and placed in the bag either by hand or with a shovel. For some samples bark and rotten logs were collected by hand, broken up, and placed in collecting sacks.

The material was brought back to the laboratory and placed in a Berlese funnel or a similar funnel arrangement. While working at the W. K. Kellogg Biological Station, large funnels normally employed in capturing aquatic insects were utilized. The funnels were three feet in diameter and tapered to an opening of two inches in diameter. A fine screen was placed several inches above the latter opening and the funnels held upright by wooden butter tubs. Large mouth jars containing 70 per cent alcohol were placed in the butter tubs at a level permitting the bottom of the funnel to rest just inside the mouth of the jar. The collected material was placed in the funnel. A light with a five-inch reflector

was placed several inches above the material.

For the other collections, Berlese funnels used were patterned after those described by Hoff (1949). The funnels measured twelve inches in diameter across the top and tapered to seven-eights inch in diameter at the bottom. The sides were fifteen inches high. The screen was placed approximately five inches above the bottom opening, a change from the type used by Hoff. The funnels were placed in medium sized excelsior cans and the bottom ends inserted in the tops of large mouthed jars containing 70 per cent ethyl alcohol. Similar funnels, with electric lights installed in the small openings, were inverted and placed flush over the tops of the funnels held by the cans. The material from which animals were to be collected was placed in the bottom funnel.

In both set-ups the remaining procedure is identical. The lights were turned on and left on for several days generating enough heat to dry the material and drive most of the small animals down through the sample and the screen and finally into the jar of alcohol. When the samples were completely dried and all of the animals collected, specimens in the jar were sorted and placed in bottles containing 70 per cent alcohol. Each bottle was assigned a collection number which corresponded to the previously recorded date and locality information in the collection journal.

A minimum of three and a maximum of seven funnels were run at a time throughout the various collecting periods. In general all funnels were filled and emptied at the same time. Both funnel arrangements gave excellent results throughout the collecting period.

LABORATORY PREPARATION OF MATERIALS FOR MICROSCOPIC STUDY

For proper identification of pseudoscorpions, the specimen must be cleared, partially dismembered, and mounted on a microscope slide. Microscopic magnifications from 75x to 645x were required to study the various morphological features of taxonomic importance.

Methods of preparation previously recommended were rather difficult and foreboding (Chamberlin, 1931; Hoff, 1949). In this study a simpler technique was used. This method, which is used by the U. S. National Museum in mounting arthropods, involves the use of Hoyer's solution both as a clearing agent and mounting medium.

Hoyer's solution was prepared by combining 50 grams of distilled water, 200 grams of chloral hydrate, 30 grams of clear crystals of gum Arabic, and 20 grams of glycerine. The mixture was heated gently in a double boiler until all ingredients were dissolved. The solution was then filtered through glass wool and coarse filter paper using a suction flask-Büchner funnel arrangement.

The specimens were placed in small vials containing Hoyer's solution several days prior to mounting in order to initiate the clearing process. Prior to mounting, all specimens were transferred into small beakers of distilled water to remove the rather sticky Hoyer's solution from the speci-

mens to facilitate handling. The washed pseudoscorpions were placed on the slide and blotted partially dry with paper towels. By using fine insect pins and a dissecting microscope, the chelicerae and pedipalps were removed. The chela was in turn removed from one pedipalp, and the fingers of the chela were spread apart. The chelicerae and the removed chela were mounted lateral side uppermost. The entire pedipalp was mounted dorsal side up. The body was mounted on its dorsal side under the same cover slip with the appendages.

The slides were placed in drying ovens set at 60° C. for at least 24 hours. After sufficient drying the slides were removed and cleaned with a razor blade and an alcohol soaked cloth. Since Hoyer's solution is water soluble, it is necessary to ring the slides several times. Fingernail polish, diluted slightly with acetone to make it spread more easily, was used in the ringing process.

DETERMINATION OF SPECIMENS

All specimens were determined to genus by means of a key published by Hoff (1958). By use of this key, checking and comparing descriptions, measurements and morphological characteristics with the original descriptions and other literature, the identification of species was made. A calibrated American Optical Microstar binocular microscope with an integral illuminator base and variable transformer was used to study and identify the specimens.

Five specimens, after tentative determinations by the author, were sent to Dr. C. Clayton Hoff, University of New Mexico, for confirmation. For the other determinations, a sufficiently large series of specimens for each species was obtained to make their identification certain.

DISCUSSION OF RESULTS

The results of this survey will be presented in three parts. The first section will be devoted to a key of the known species found to date in the state of Michigan. The second section will consist of brief species diagnoses, ecological data, and date-locality information for those Michigan chelonethids which have been previously described. The last section will contain a discussion of the five specimens for which positive determination could not be made.

Key to the species of pseudoscorpions of Michigan

A knowledge of the external morphology of pseudoscorpions is necessary in the use of this key and in the following species descriptions. The more important morphological features are illustrated in the appendix. Further information has been provided by the works of Chamberlin (1931) and Hoff (1949).

This key is designed to cover only those species of pseudoscorpions known from the state of Michigan to date. Since there are undoubtedly other species uncollected as yet, some specimens will not fit the key. Such specimens should be checked through the key to the genera of North American

pseudoscorpions (Hoff, 1958) and the literature for determination.

1. Tarsus of first leg with one segment, tarsus of fourth leg subdivided to form two segments; chelal fingers without venom apparatus (suborder Heterosphyronida) .....Chthonius tetrachelatus (p.13)
   Tarsi of all legs similar; venom apparatus usually present in at least one chelal finger.....2

2. Tarsi of all legs divided (suborder Diplosphyronida)..3
   Tarsi of all legs undivided (suborder Monosphyronida).. 5

3. Pleural membrane of abdomen granulate; moveable chelal finger with three tactile setae, fixed finger with seven.....4
   Pleural membrane of abdomen longitudinally striate; moveable chelal finger with four setae, fixed finger with eight.....Syarinus sp. (p.28)

4. Palpal femur 0.4 mm. long or less; length between 2.42 and 2.89 times the width..... .....Microbisium confusum (p.15)
   Palpal femur more than 0.4 mm. long; length between 2.87 and 3.2 times the width..... .....Microbisium brunneum (p.16)

5. With four prominent eyes..... .....Pseudogarypus hesperus (p.17)
   With two eyes or none.....6

6. Venom apparatus developed in only the moveable chelal finger; chelal fingers almost always with accessory teeth..... 7
   Venom apparatus developed in both chelal fingers; no accessory teeth present on chelal fingers.....13

7. Pleural membrane smoothly striate, never wrinkled, rugose, or granulate; tactile seta present on tibia of fourth leg.....8
   Pleural membrane not smoothly striate; no tactile seta on tibia of fourth leg.....9

8. Hand of chela subquadrate in dorsal view, subtruncate at base; chela exclusive of pedicle less than 0.8 mm. long.....Lamprochernes oblongus (p.18)

Hand of chela subovate in dorsal view, basal margin rounded; chela exclusive of pedicle more than 0.8 mm. long.....Lamprochernes minor (p.20)

9. Flagellum of chelicera with three blades; tarsus of fourth leg with tactile seta near midpoint.....
.....Pselaphochernes parvus (p.21)
Flagellum of chelicera with four blades; tarsus of fourth leg without a tactile seta or with a distal tactile seta.....10

10. Tarsus of fourth leg with a tactile seta.....11
Tarsus of fourth leg without a tactile seta.....
.....Hesperochernes sp. (p.29)

11. Moveable chelal finger with tactile seta st.closer to sb than to t.....Dendrochernes morosus (p.22)
Moveable chelal finger with tactile seta st closer to t than to sb.....12

12. Male with strongly developed anvil-shaped process on the inner surface of chelal hand. (Females of Mirochernes and Dinocheirus difficult to separate).....
.....Mirochernes sp. (p.28)
Male without an anvil-shaped process on the inner surface of the chelal hand.....Dinocheirus sp. (p.28)

13. Dorsal plates of the entire posterior half of the abdomen bearing a seta in the center of each sclerotized half in addition to peripheral setae.....14
Dorsal plates of the posterior half of the abdomen with only peripheral setae on each sclerotized half, except occasionally on last several segments.....15

14. Tarsal claws acute; subterminal setae of fourth pedal tarsus acute.....Dactylochelifer copiosus (p.24)
Tarsal claws of the fourth leg bifid or with an accessory tooth; subterminal setae of fourth pedal tarsus denticulate.....Chelifer cancroides (p.23)

15. Tibia and tarsus of the fourth leg subequal in length; coxae without spurs.....Paiochelifer callus (p.25)
Tibia 1.25 times as long as the tarsus of the fourth leg; coxae of fourth leg with anterolateral spurs....
.....Idiochelifer nigripalpus (p.26)

Species descriptions

The following descriptions include sufficient morpholo-

gical detail to fully characterize and delineate the species. In the citations preceding each diagnosis, the author has included only the literature necessary for accurate determinations and pertinent distributional information.

The specimens collected by R. R. Dreisbach, Midland, Michigan, and by Dr. K. K. Bohnaack, San Diego State College, are deposited in their personal collections. The remaining material is deposited in the Michigan State University Entomology Museum, East Lansing, Michigan.

Chthonius (Ephippiochthonius) tetrachelatus (Preyssler)

Scorpio tetrachelatus Preyssler (1790, p.59).
Chthonius tetrachelatus var. maculatus Menge. Stecker (1875, p.314).
Chthonius longipalpus Banks (1891, p.164).
Chthonius longipalpus Banks. Ewing (1911, p.80).
Chthonius tetrachelatus (Preyssler). Chamberlin (1929, p.73).
Chthonius (Ephippiochthonius) tetrachelatus (Preyssler). Hadzi (1933a, p.139; 1933b, p.179).
Chthonius tetrachelatus (Preyssler). Vachon (1941a, p.442; 1941b, p.540).
Chthonius tetrachelatus (Preyssler). Proctor (1946, p.510).
Chthonius (Ephippiochthonius) tetrachelatus (Preyssler). Hoff (1946a, p.109; 1949, p.433; 1951, p.2; 1958, p.3).
Chthonius (Ephippiochthonius) tetrachelatus (Preyssler). Hoff and Bolsterli (1956, p.157).

This species is the only member of the suborder Heterosphyronida found in Michigan to date. Chthonius tetrachelatus is widely distributed in Europe, northern Africa, and eastern United States.

GENERIC MORPHOLOGICAL CHARACTERS: An undivided tarsus on the first leg and a divided tarsus on the fourth leg; a

transversely oriented spiracles which are not surrounded by a separate sclerite; the coxae of the second and third leg with a group of short, feathered, median spines; an intercoxal tubercle with a pair of short setae between the coxae of legs three and four; no venom apparatus in either chelal finger.

SPECIFIC MORPHOLOGICAL CHARACTERS: Long, pointed teeth on the chelal fingers; a dorsal transverse pair of setae on the chelal hand; in lateral view a marked depression between these setae and the chelal fingers.

HABITAT PREFERENCE: Specimens were collected from leaf mold and ground cover samples taken in deciduous woods.

TYPE SPECIMEN: Unable to be located by the author.

TYPE LOCALITY: Unable to be determined by the author.

MICHIGAN RECORDS: Ingham Co., May 26, 1958, 6 adults, Fenstermacher; May 28, 1958, 5 adults, Fenstermacher.

Microbisium Chamberlin

GENERIC MORPHOLOGICAL CHARACTERS: All legs with divided tarsi; inner margin of moveable cheliceral finger dentate; chelicerae without laminal setae; granulate pleural membrane; unique reduction in number of tactile setae on the chelal hand, seven on the fixed finger and three on the moveable finger; venom apparatus in the fixed finger only.

Microbisium confusum Hoff

Microbisium brunneum Hoff (non Hagen), in part (1944, p. 125; 1945a, p.34; 1946a, p.109).
Microbisium confusum Hoff (1946b, p.496), (1949, p.446; 1958, p.9).
Microbisium confusum Hoff. Hoff and Bolsterli (1956, p.160).

M. confusum is the most common and widely distributed species of paeudoscorpion in the eastern part of the United States including Michigan.

SPECIFIC MORPHOLOGICAL CHARACTERS: The length of the palpal femur is never more than 0.4 mm.; the length of the femur is between 2.42 and 2.89 times the width.

HABITAT PREFERENCE: Microbisium confusum was found in virtually all samples from which pseudoscorpions were obtained. It was also found in the collections of other individuals. Forest litter, top soil, and rotten logs are its common habitats.

TYPE SPECIMAN: Deposited in the collection of the State Natural History Survey, Urbana, Illinois.

TYPE LOCALITY: Antioch, Illinois.

MICHIGAN RECORDS: Many adults and nymphs were taken throughout the year. Kalamazoo County, July 2 through July 23, 1957, Fenstermacher; Ingham County, April 12 through May 31, 1958, Fenstermacher; Kalkaska County, July 2 through August 9, 1958, Fenstermacher; Antrim County, July 31, 1958, Fenstermacher, August 5, 1958, Fenstermacher; Luce County, September 4, 1958, Porter; Alger County, September 4, 1958,

Porter; Schoolcraft County, September 4, 1958, Porter; Mackinac County, June 7, 1957, Dreisbach; Midland County, Dreisbach; Livingston County, April 1949 through April 1950, Bohnsack; October 27, 1949, through May 27, 1950, Hairston and Byer; August 9 through August 25, 1951, Wallace; October 27, 1951 through June 7, 1953, Pruitt; June 26 through August 1, 1954, Wallace.

Microbisium brunneum (Hagen)

Obisium brunneum Hagen (1869, p.52).
Obisium brunneum Hagen. Banks (1895, p.12).
Microbisium brunneum (Hagen). Chamberlin (1930, p.20).
Microbisium brunneum (Hagen). Beier (1932a, p.139).
Microbisium brunneum (Hagen). McClure (1943, p.12).
Microbisium brunneum (Hagen), in part. Hoff (1944, p.125; 1946a, p.109).
Microbisium brunneum (Hagen). Hoff (1945d, p.494; 1949, p.445; 1958, p.8).
Microbisium brunneum (Hagen). Hoff and Bolsterli (1956, p.161).

Microbisium brunneum is not as common and widespread as Microbisium confusum; however both species have been found closely associated in bog situations (Hoff, 1949).

SPECIFIC MORPHOLOGICAL CHARACTERS: Palpal femur more than 0.4 mm. long; length of femur between 2.87 and 3.2 times the width.

HABITAT PREFERENCE: Specimens were taken from bog soil and litter and by sight from sphagnum moss.

TYPE SPECIMEN: Deposited in the Museum of Comparative Zoology, Harvard University.

TYPE LOCALITY: Massachusetts.

MICHIGAN RECORDS: Wayne County, H. G. Hubbard, (cited from literature); Clinton County, June 3, 1958, 3 adults, Fenstermacher; Barry County, June 27, 1958, 3 adults, Porter; Midland County, April 12, 1957, 1 adult, Dreisbach.

Pseudogarypus hesperus Chamberlin

Pseudogarypus hesperus Chamberlin (1931, p.232).
Pseudogarypus hesperus Chamberlin. Hoff (1958, p.18).

Pseudogarypus hesperus is a rare pseudoscorpion having been previously recorded only in the state of Washington. The Michigan record is based on a single female specimen.

GENERIC MORPHOLOGICAL CHARACTERS: Undivided tarsus on all legs; four prominent eyes; sclerotic shield protecting the posterior pair of eyes; pseudocoxal spines on the coxae of the first pair of legs.

SPECIFIC MORPHOLOGICAL CHARACTERS: Marginal teeth of the chela basally contiguous; number of chelal teeth about 32 on the fixed finger and 26 on the moveable finger.

HABITAT PREFERENCE: No information published.

TYPE SPECIMEN: Deposition not published with original description.

TYPE LOCALITY: Puyallup, Washington.

MICHIGAN RECORDS: Luce County, June 6, 1957, 1 adult, Dreisbach.

Lamprochernes Tömösvary

GENERIC MORPHOLOGICAL CHARACTERS: Undivided tarsus on all legs; venom apparatus on the moveable chelal finger only; smoothly striate abdominal pleura; femoral articulation of legs one and four distinctly different; dorsal tactile seta on the tibia and proximal tactile seta on the tarsus of the fourth leg; interior terminal seta of the fixed chelal finger farther from the finger tip than the distance between the interior subterminal and the interior subbasal setae.

Lamprochernes oblongus (Say)

Chelifer oblongus Say (1821, p.64).
Chelanops oblongus Say. Banks (1895, p.5).
Chelifer (Lamprochernes) oblongus (Say). Ellingsen (1909, p.368).
Chelanops oblongus (Say). Ewing (1911, p.79).
Chelanops oblongus (Say). Banks (1911, p.638).
Chelanops oblongus (Say). Pratt (1916, p.410).
Lamprochernes oblongus (Say). Beier (1932b, p.84).
Lamprochernes oblongus (Say). Hoff (1945a, p.37; 1949, p.450; 1958,p.20).
Lamprochernes oblongus (Say). Hoff and Bolsterli (1956, p.165).

Although not collected during this study, L. oblongus appears to be widespread throughout the state and has been taken by several other collectors. It has a wide geographic range in the United States, extending from Massachusetts to Florida and westward to the Great Plains.

SPECIFIC MORPHOLOGICAL CHARACTERS: Outline of the

chelal hand when viewed dorsally subquadrate; length of chela exclusive of the pedicel of less than 0.8 mm.

HABITAT PREFERENCE: A group of specimens was collected by R. L. Fischer in Ingham County on April 15, 1948, under the elytra of beetles of the species Alaus oculatus (Linneaus). A similar association of these two species was reported by Leidy (cf. Coolidge, 1908). A report on L. oblongus from Illinois (no ecological data are available on the other Michigan specimens) indicates that its normal habitat is under the bark of oak logs and stumps.

NEOTYPE SPECIMEN: Deposited in the collection of the Illinois State Natural History Survey, Urbana, Illinois.

NEOTYPE LOCALITY: Havana, Illinois.

MICHIGAN RECORDS: Saginaw County, May through August 1949, 6 adults, Dreisbach; May 23, 1956, 2 adults, Dreisbach; Midland County, May 28, 1941, 2 adults, Dreisbach; June 11, 1945, 2 adults, Dreisbach; June 16, 1945, 1 adult, Dreisbach; May 6, 1948, 1 adult, Dreisbach; May 16, 1956, 1 adult, Dreisbach; Clare County; June 26, 1944, 1 adult, Dreisbach; July 1, 1944, 1 adult, Dreisbach; Montcalm County, September 10, 1949, 1 adult, Dreisbach; La Peer County, June 2, 1942, 1 adult, Dreisbach; Gratiot County, August 2, 1947, 1 adult, Dreisbach; Mecosta County, June 25, 1949, 1 adult, Dreisbach; Osceola County, 1 adult, Dreisbach; St. Clair County, May 29, 1949, 1 adult, Dreisbach; Grand Traverse County, July 12,

1929, 7 adults, Byer.

Lamprochernes minor Hoff

Lamprochernes minor Hoff (1949, p.453), (1958, p.21).
Lamprochernes minor Hoff. Levi (1953, p.59).
Lamprochernes minor Hoff. Hoff and Bolsterli (1956, p.166).

This species shows closer relationships to European and North African species of Lamprochernes than it does to L. oblongus, the other Michigan species of this genus.

SPECIFIC MORPHOLOGICAL CHARACTERS: Granular carapace; chelal length less pedicel of greater than 0.8 mm.; chela outline sub-ovate in dorsal view.

HABITAT PREFERENCE: Date available for one collection; the pseudoscorpions collected in Clinton County were taken by sight in a grain bin. A similar collection of L. minor is reported in the literature (Hoff and Bolsterli, 1956); the specimen(s) was taken from a railroad grain car.

TYPE SPECIMEN: Deposited in the collection of the Illinois State Natural History Survey collection, Urbana, Illinois.

TYPE LOCALITY: Urbana, Illinois.

MICHIGAN RECORDS: Midland County, August 8, 1945, 1 adult, Dreisbach; October, 1945, 1 adult, Dreisbach; Clinton County, October 24, 1956, 30 adults, Scheibner.

Pselaphochernes parvus Hoff

Pselaphochernes parvus Hoff (1945, p.38; 1949, p.461: 1958, p.31).
Pselaphochernes parvus Hoff. Hoff and Bolsterli (1956, p.168).

This is the species of Pselaphochernes that is definitely known from the nearctic region. A doubtful record of the European species P. scorpioides is listed from Kentucky.

GENERIC MORPHOLOGICAL CHARACTERS: Femoral articulation of the first and fourth leg distinctly different; median tactile seta on the tarsus of the fourth leg, but no tibial tactile seta present on the fourth leg; venom apparatus in only the moveable chelal finger; pleural membrane granulate; cheliceral flagellum of three blades; internal setae of the fixed chelal finger not basally grouped.

SPECIFIC MORPHOLOGICAL CHARACTERS: Denticulate or clavate body setae; single internal accessory tooth on each chelal finger; somewhat flattened external margin of the chelal hand.

HABITAT PREFERENCE: Many pseudoscorpions of this species were taken in leaf litter and rotten logs from deciduous woods.

TYPE SPECIMEN: Deposited in the collection of the Illinois State Natural History Survey, Urbana, Illinois.

TYPE LOCALITY: Washington County, Arkansas.

MICHIGAN RECORDS: Kalamazoo County, July 9, 1957, 1 tritonymph, Fenstermacher; Ingham County, May 11 through May

28, 1958, 16 adults, Fenstermacher.

Dendrochernes morosus (Banks)

Chelanops morosus Banks (1895, p.7).
Dendrochernes morosus (Banks). Hoff (1947, p.536).

The only record of this species is from Michigan. The type specimen was collected by H. G. Hubbard from Isle Royale, Keweenaw County and described by Banks (1895).

GENERIC MORPHOLOGICAL CHARACTERS: Tarsi of all legs undivided; femur and femoral articulation of first leg distinctly different from that of fourth leg; venom apparatus in only moveable chelal finger; no accessory teeth; pleural membrane rugose or granulate; flagellum of four blades; tarsus with tactile seta; moveable chelal finger with the subterminal tactile seta nearer the subasal than the terminal.

SPECIFIC MORPHOLOGICAL CHARACTERS: Palpal tibia slim and slightly bulging; inner margin of fixed chelal finger not regularly convex; pedal podomeres short.

HABITAT PREFERENCE: No habitat information is available for this single collection.

TYPE SPECIMEN: Deposited in Museum of Comparative Zoology, Harvard University.

TYPE LOCALITY: Isle Royale, Keweenaw County.

MICHIGAN RECORD: Keweenaw County, 2 adults, Hubbard (cited from literature).

Chelifer cancroides (Linnaeus)

Acarus cancroides Linnaeus (1758, p.616).
Chelifer cancroides Fourcroy (1785, p.526).
Chelifer muricatus Say, in part (1821, p.63).
Chelifer cancroides (Linnaeus). Hagen (1869, p.51).
Chelifer cancroides (Linnaeus). Packard (1886, p.43).
Chelifer cancroides (Linnaeus). Banks (1895, p.3).
Chelifer cancroides (Linnaeus). Ellingsen (1908, p.163; 1909, p.384).
Chelifer cancroides (Linnaeus). Ewing (1911, p.73).
Chelifer cancroides (Linnaeus). Beier (1932b, p.236).
Chelifer cancroides (Linnaeus). Brimley (1938, p.497).
Chelifer cancroides (Linnaeus). Hoff (1944, p.123; 1949, p.486; 1950, p.1; 1956, p.3; 1958, p.32).
Chelifer cancroides (Linnaeus). Proctor (1946, p.510).
Chelifer cancroides (Linnaeus). Hoff and Clawson (1952, p.35).
Chelifer cancroides (Linnaeus). Hoff and Bolsterli (1956, p.177).

This species of pseudoscorpions is the one commonly encountered by man and can be found in all parts of the world. It is the only species of the genus Chelifer found in North America.

GENERIC MORPHOLOGICAL CHARACTERS: Undivided tarsus on all legs; distinctly different femoral articulation on the first and fourth leg; venom apparatus in both chelal fingers; flagellum made up of three setae; subterminal setae of the fourth pedal tarsus denticulate and tarsal claw of the same leg bifid; divided tergites with a central seta; cheliceral hand without a subbasal seta.

SPECIFIC MORPHOLOGICAL CHARACTERS: Males 2.5 to 3.5 mm. long; females 3.0 to 4.5 mm. long; palpal femur 5.3 times as long as wide; palpal tibia 4.1 times as long as wide.

HABITAT PREFERENCE: One collection was taken from an abandoned shack; no information is available for the remaining specimens.

TYPE SPECIMEN: Deposited in the Cornell University Museum, Ithaca, New York.

TYPE LOCALITY: Otto, New York.

MICHIGAN RECORDS: Cheboygan County, August 10, 1940, 2 adults, Porter; Midland County, 1949, 1 adult, Dreisbach; July 18, 1950, 1 adult, Dreisbach; Washtenaw County, 1958, 1 adult, Fenstermacher; Wayne County, Hubbard (cited from literature).

Dactylochelifer copiosus Hoff

Dactylochelifer copiosus Hoff (1945a, p.53; 1945b, p.521; 1949, p. 491; 1958, p.35).
Dactylochelifer copiosus Hoff. Hoff and Bolsterli (1956, p.178).

Members of this monosphyronid species are common deciduous forest inhabitants of central United States. The other species of the genus are found throughout the palearctic region.

GENERIC MORPHOLOGICAL CHARACTERS: Undivided tarsus on all legs; distinctly different femoral articulation on the first and fourth leg; venom apparatus in both fingers of the chelal hand; posterior tergites with a seta in the center of each plate in addition to a row of peripheral setae; tarsal

claws without teeth; no tactile seta on the fourth pedal tarsus; and short, denticulate or clavate setae on the body palps.

SPECIFIC MORPHOLOGICAL CHARACTERS: Male 2.3 to 2.6 mm. long; female 2.4 to 3.15 mm. long: palpal femur length 3.9 to 4.25 times width; anterior stigmatic plate devoid of setae; posterior plate with a single seta.

HABITAT PREFERENCE: Specimens were taken from leaf litter and top soil.

TYPE SPECIMEN: Deposited in Illinois State Natural History Survey collection, Urbana, Illinois.

TYPE LOCALITY: Washington County, Arkansas.

MICHIGAN RECORDS: Many adults and nymphs were taken at several sites. Kalamazoo County, July 23, 1957, Fenstermacher; July, 1957, Porter; Livingston County, April 1949 through April 1950, Bohnsack; June 17 through August 10, 1954, Wallace; October 14, 1951, through April 19, 1952, Pruitt.

Paisochelifer callus (Hoff)

Hysterochelifer callus Hoff (1945b, p.515).
Paisochelifer callus (Hoff). Hoff (1946c, p.487), (1949, p.489; 1950, p.10; 1958, p.33).

P. callus is a rare monosphyronid pseudoscorpion previously found only in Illinois and Maryland. A single male constitutes Michigan's lone record of this species.

GENERIC MORPHOLOGICAL CHARACTERS: Undivided tarsus; markedly different femoral articulations on the first and fourth leg; venom apparatus in both chelal fingers; three setae in the flagellum; posterior tergites with only peripheral setae; tibia and tarsus of the fourth leg subequal in length; distal tactile seta on the fourth pedal tarsus.

SPECIFIC MORPHOLOGICAL CHARACTERS: Male 1.65 to 1.95 mm. long; female 1.55 to 2.15 mm. long; palpal femur length 3.35 to 3.65 times width; palpal tibia length 2.4 to 2.7 times width.

HABITAT PREFERENCE: This species was collected by sight in a grain bin with a group of Lamprochernes minor.

TYPE SPECIMEN: Deposited in the collection of the State Natural History Survey, Urbana, Illinois.

TYPE LOCALITY: Washington County, Arkansas.

MICHIGAN RECORDS: Clinton County, October 24, 1956, 1 adult, Scheibner.

Idiochelifer nigripalpus (Ewing)

Chelifer muricatus Say, in part (1821, p.63).
Chelifer cancroides var. nigripalpus Ewing (1911, p.73).
Chelifer nigripalpus Ewing. Chamberlin (1931, p.19).
Hysterochelifer longidactylus Hoff (1945b, p.511).
Idiochelifer nigripalpus (Ewing). Hoff (1946b, p.26; 1949, p.487; 1950, p.3; 1958, p.34).
Idiochelifer nigripalpus (Ewing). Hoff and Bolsterli (1956, p.177).

Pseudoscorpions of this monotypic genus are known from the north-central part of the United States only. This species is commonly found under the bark of trees (Hoff, 1949).

GENERIC MORPHOLOGICAL CHARACTERS: Undivided tarsus on all legs; femoral articulation of the first and fourth leg distinctly different; venom apparatus developed in both chelal fingers; flagellum of chelicera with three blades; denticulate subterminal setae on fourth pedal tarsus; tarsal claws of fourth leg simple and acute; coxae with spurs; tergal plates with only peripheral setae; and tibia 1.25 times as long as the tarsus of fourth leg.

SPECIFIC MORPHOLOGICAL CHARACTERS: Males with coxal sacs lacking atria; females with small, median cribiform plates; male 2.1 to 2.35 mm. long; female 2.1 to 2.55 mm. long; palpal femur length 4.3 to 4.6 times the width.

HABITAT PREFERENCE: No ecological information is available for the single specimen collected by Wallace.

TYPE SPECIMEN: Deposited in the Cornell University Museum, Ithaca, New York.

TYPE LOCALITY: Ames, Iowa.

MICHIGAN RECORDS: Livingston County, July 24, 1954, 1 adult, Wallace.

Discussion of undetermined specimens

Five specimens, after tentative determination by the author, were sent to Dr. C. Clayton Hoff of the University of New Mexico for confirmation. In the opinion of Dr. Hoff (personal communication) no positive identification can be made on these specimens at the present; however, a brief discussion of each will be given to provide information which may be of value to further studies made in Michigan.

A single diplosphyronid pseudoscorpion was collected in Delta County by R. R. Dreisbach on July 7, 1955. This specimen is probably a tritonymph of the genus Syarinus. This is indicated by the smoothly striate nature of the pleural membrane; the strongly oblique femoral articulation on the fourth leg; the presence of a galea; and the contiguous marginal teeth on the chela. Species determinations on all immature specimens are difficult without an accompanying series of adults. In addition, this specimen apparently does not belong to the known Syarinus species of the Great Lakes area, S. granulosus, thus making even a tentative determination impossible.

In the family Chernetidae, the generic characteristics of the Mirochernes-Dinocheirus-Reginachernes-Hesperochernes complex is very inadequately described. Three damaged female specimens were taken in three different counties by as many different collectors, and all three examples belong to

this complex. Each of these three pseudoscorpions appears to be missing a tactile seta on the fourth pedal tarsus although this can not be accurately determined. The presence of such a morphological character would place them in either the genus Mirochernes or Dinocheirus. The criteria of separation between females of these two genera is rather nebulous, hinging upon the distance between the tactile setae of the moveable chelal finger. In Mirochernes the distance between the subterminal and subbasal setae is at least a little more than twice the distance between the terminal and subterminal setae; in Dinocheirus the first measurement is seldom more than twice the second. It is practically mandatory to have males before a positive generic determination can be made. The specimens were collected by R. R. Dreisbach from Livingston County, May 28, 1944; by A. S. Watson from Washtenaw County, May 5, 1941; and by G. Steyskal from Wayne County, June 16, 1952.

Another single tritonymph was collected by the author on May 22, 1958, in Ingham County. Because of the granulate pleural membrane, four blades in the flagellum, and the nature of the tactile seta on the fourth pedal tarsus, it probably belongs to the genus Dinocheirus. No accurate species determination can be made due to the inadequate descriptions and the age of the specimen.

The last specimen was taken by R. R. Dreisbach in Saginaw

County on June 6, 1949. This specimen is probably a member of the genus Hesperochernes; however, the number of setae in the flagellum can not be distinguished with certainty to confirm such an identification. Also the denticulate nature of the basal and subbasal cheliceral setae, once thought to be diagnostic for the genus, are not constant generic characters. The taxonomy of this group is in need of further analyzation and revision.

SUMMARY

The preceding discussion makes a substantial increase in our knowledge of the pseudoscorpion fauna of the state of Michigan. The most recently published record (Hoff, 1958) indicates four species representing four genera, three families, and two suborders present in the state. With this survey the list has been increased to include twelve species, ten genera, five families, and three suborders. Six specimens for which an accurate determination could not be made appear to demonstrate the presence of three or four additional genera and species.

Pseudoscorpions occupy a variety of habitats. Ecological data are available on collections involving nine species. Four species were found in the leaf litter and ground cover of deciduous forests: Chthonius tetrachelatus, Microbisium confusum, Pselaphochernes parvus, and Dactylochelifer coniosus. Two of these, M. confusum and P. parvus, were taken also in rotten logs and wood debris. Microbisium brunneum was collected from sphagnum moss and debris in bogs. Three species were found in domestic situations: Chelifer cancroides in an abandoned shack; Lamprochernes minor and Paiochelifer callus in a grain bin. An interesting collection of Lamprochernes oblongus was made from under the elytra of the beetle Alaus oculatus (Linnaeus) indicating a possible

symbiotic relationship.

Microbisium confusum was taken in sufficient collections to indicate a continuous distribution throughout both the Northern and Southern Peninsulas of Michigan. Lamprochernes oblongus appears to be widespread and common throughout the Southern Peninsula. Although only recorded from four scattered counties, Chelifer cancroides is probably found throughout the Southern Peninsula also. For the remaining species, the present records only list small or local distributions.

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LIST OF APPENDICES

Appendix A

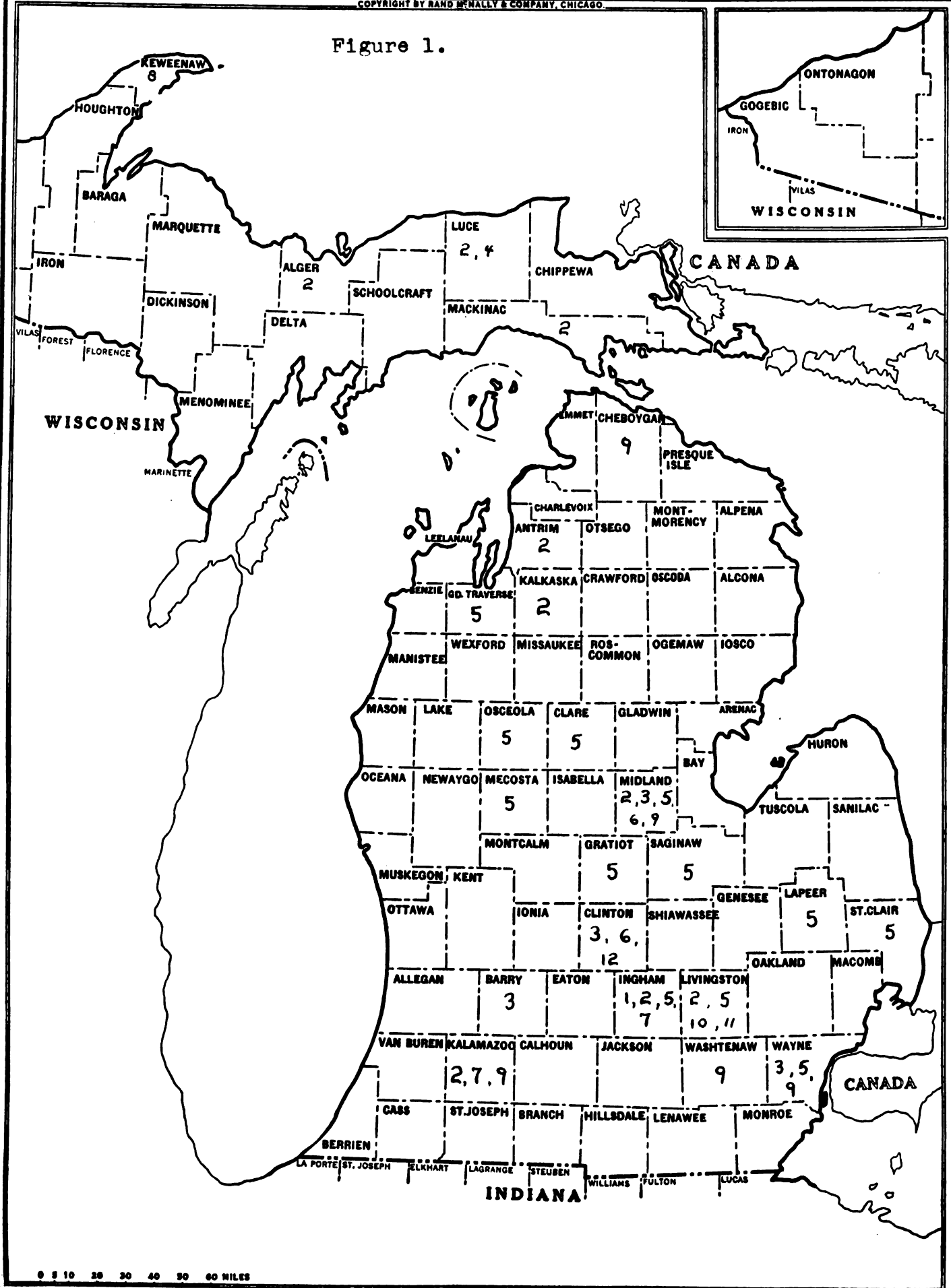
Figure 1. Distribution of pseudoscorpions in Michigan.

LEGEND

1. *Chthonius tetrachelatus*
2. *Microbisium confusum*
3. *Microbisium brunneum*
4. *Pseudogarypus hesperus*
5. *Lamprochernes oblongus*
6. *Lamprochernes minor*
7. *Pselaphochernes parvus*
8. *Dendrochernes morosus*
9. *Chelifer cancroides*
10. *Dactylochelifer copiosus*
11. *Idiochelifer nigripalpus*
12. *Paisochelifer callus*

RAND McNALLY LOOSE LEAF OUTLINE MAP MICHIGAN

Figure 1.



This Map is also available in size 17 x 22

Appendix B

Morphology illustrations

Figure 2. Lamprochernes oblongus. Dorsal view of chelicera. The setae important in taxonomy are indicated by the standardized designations: b, basal seta; es, exterior seta; gs, galeal seta; is, interior seta; ls, laminal seta; sb, subbasal seta. (After Hoff.)

Figure 3. Chelifer cancroides. Lateral view of chelal hand of palp. The standardized symbols used for the tactile setae of the moveable finger are as follows: b, basal seta; sb, subbasal seta; st, subterminal seta; t, terminal seta. On the fixed finger, e indicates exterior and i indicates interior; either is used in connection with t, sb, and the like. (After Hoff.)

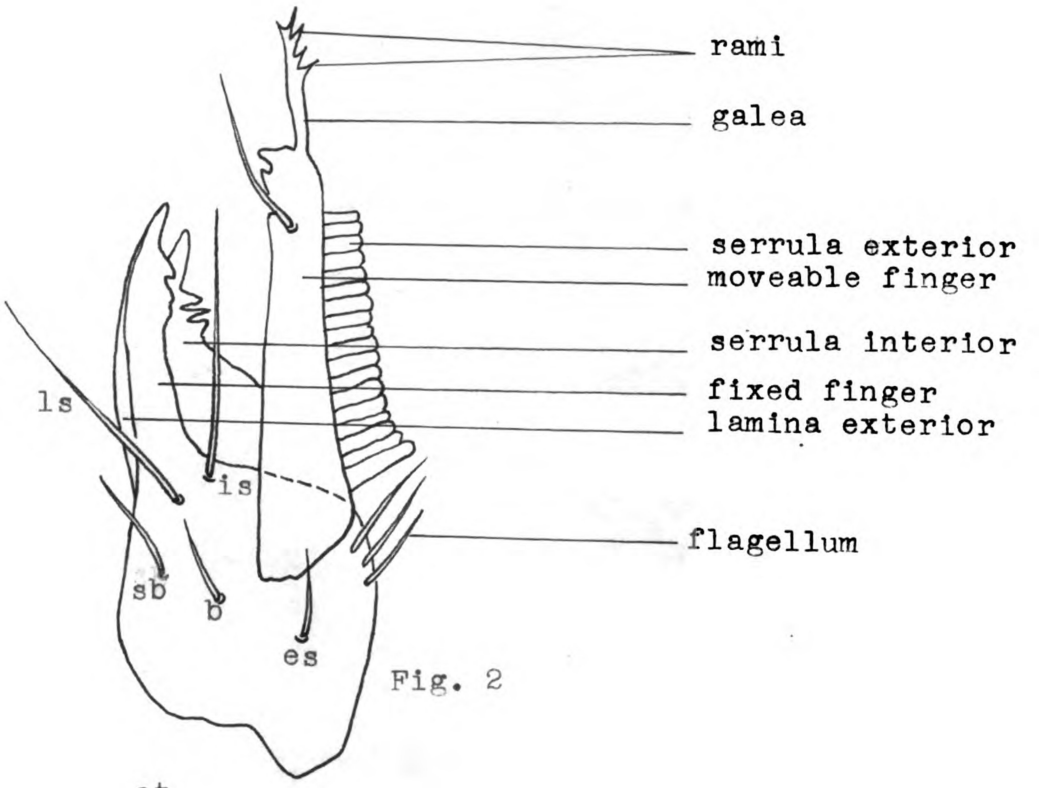

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Fig. 2

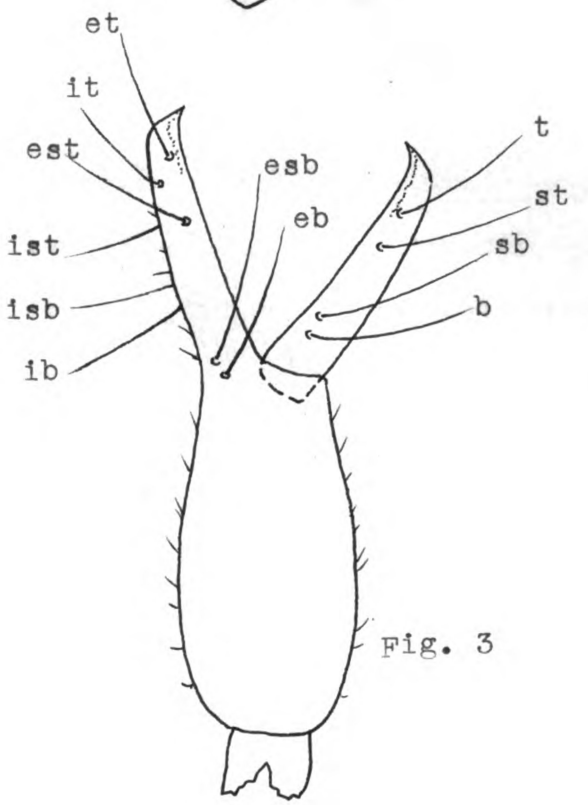
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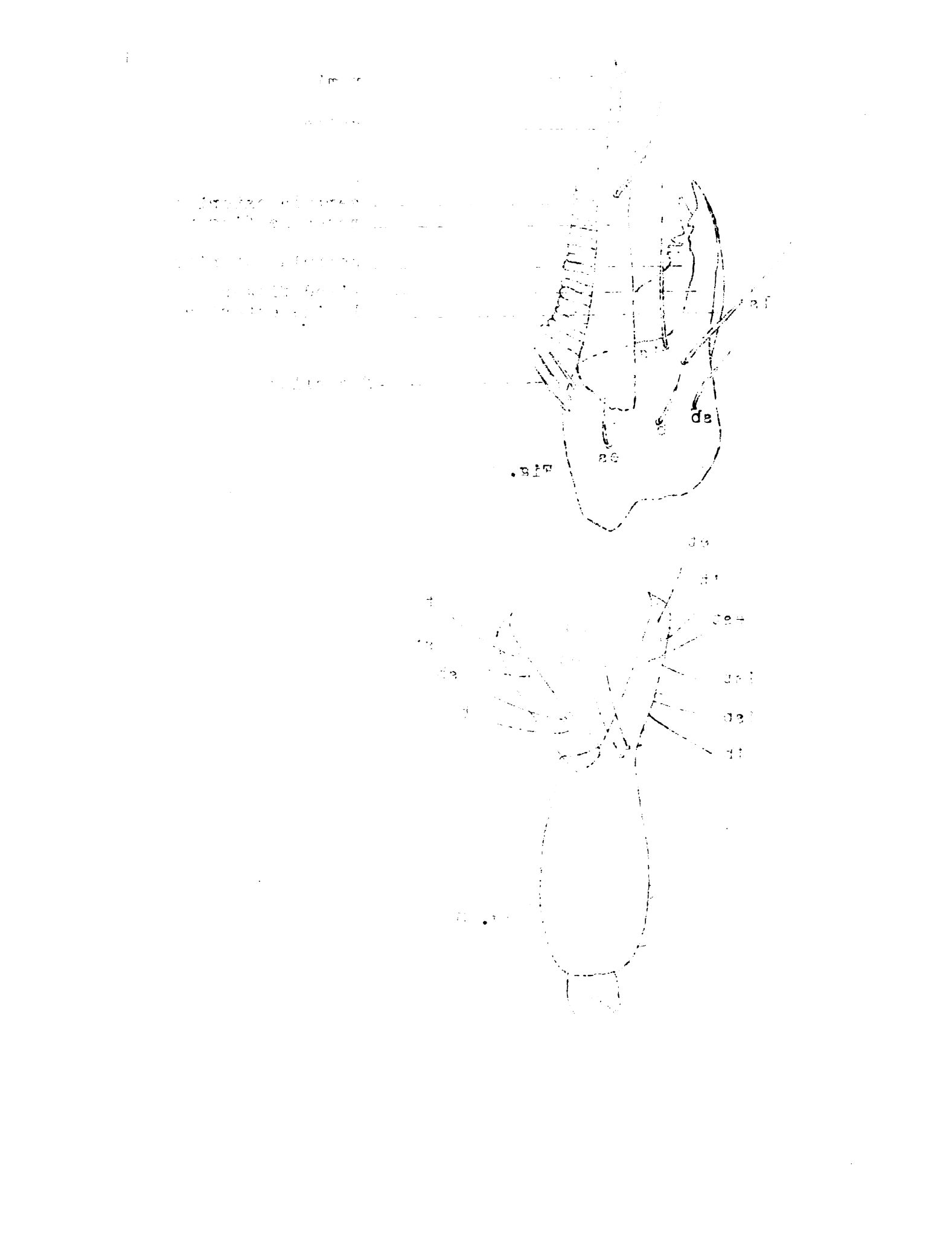
Fig. 3



Appendix B (continued)

Figure 4. Chernes cervus. Bifid tarsal claw of tarsus. (After Chamberlin.)

Figure 5. Pselaphochernes parvus. Tarsus of fourth leg showing dorsal tactile seta. (After Hoff.)

Figure 6. Syarinus obscurus. Longitudinally striate pleural membrane of abdomen. (After Chamberlin.)

Figure 7. Dactylochelifer copiosus. Male genital complex of highly specialized type showing coxal sacs with medially paired atria (above) and statumen convolutum with laterally paired genital sacs (below). (After Hoff.)

Figure 8. Chelifer scabriculus. Tarsus of fourth leg showing a denticulate subterminal seta. (After Chamberlin.)

Figure 9. Lamprochernes ellipticus. Genital area of female with special reference to setae. (After Hoff.)