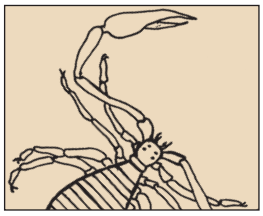
RESEARCH/MANAGEMENT
FINDINGS

"He who would study the false scorpions, either biologically or morphologically, will find his reward in the fascination of the bizarre and the little known, for indeed they constitute one of the most peculiar and one of the lesser known groups of animals."

— J.C. CHAMBERLIN, 1931



D WATERMOLEN

Pseudoscorpion Records from Wisconsin

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INTRODUCTION

The order Pseudoscorpiones[1] constitutes a small but well-defined group of the arthropod class Arachnida. Writing nearly a century ago, Ewing (1911) characterized this order as "one that has never been very extensively studied." That characterization remains accurate today, with virtually no one seriously investigating the group in North America.

When the Wisconsin Department of Natural Resources undertook work on the state's *Comprehensive Wildlife Conservation Plan*, biologists were unable to assess the conservation status of pseudoscorpions and it was noted that at that time we could not compile a list of species occurring in the state, indicate how species were distributed, or identify factors responsible for observed distributions (Wisconsin DNR 2005, p. 6-67). This situation results from a combination of factors, including the relative obscurity of the group, their small size, cryptic nature, and inaccessible taxonomy, a lack of taxonomic specialists working on the group, and a lack of readily available reference materials (i.e. literature and specimens).

In the species accounts and discussion presented here, I provide a synthesis of available literature records for species documented from the state. I list citations for original species descriptions, highlight habitats in which each species occurs, and comment on distribution and available Wisconsin records, as well as on records from adjacent states. This report helps address the *Comprehensive Wildlife Conservation Plan's* recommendation that "efforts should be made to compile and make available catalogs of existing taxonomic and related references for Wisconsin invertebrate groups" (WDNR 2005, p. 8-1). It must, however, be viewed simply as a starting point for work with this group.

METHODS

I reviewed the principal literature pertaining to this group, including every item dealing with pseudoscorpions published in the *Journal of Arachnology* (vols. 1-33, 1973-2005), *American Museum Novitates* (nos. 1-3499; 1935-2005), *Canadian Entomologist* (vols. 1-137, 1868-2005), and *Entomological News* (vols.1-116, 1890-2005). I identified pseudoscorpion research published in other outlets using various electronic databases (e.g., *Biological Abstracts*, 1969-2005; *Zoological Record*, vols. 115-141; 1978-2005). In addition, I examined much of the literature cited in these primary sources. In total, I combed through more than 650 relevant research papers and scholarly notes for Wisconsin records.

I follow the taxonomic arrangement put forth by Muchmore (1982) and Harvey (2006) and provide citations to original species descriptions as these are sometimes helpful for identification. Habitat notes are derived primarily from Hoff (1946, 1949), Hoff and Bolsterli (1956), Weygoldt (1969), Muchmore (1990), and Buddle (2005) and are provided here to suggest habitats to target when developing sampling strategies. With each species account, maps with shaded counties depict the distribution of published records.

[1] *Authors of older literature refer to the order as Pseudoscorpionida, Pseudoscorpionidea, Chelonethida, or Chernetes, occasionally with the common names chela-spinners or false scorpions. Pseudoscorpiones is the ordinal name accepted currently and pseudoscorpions is the popular name used most commonly.*

WISCONSIN DEPT. OF NATURAL RESOURCES

ANNOTATED CHECKLIST

Order Pseudoscorpiones

Pseudoscorpions resemble tiny scorpions without the long, narrow tail and sting apparatus (Figure 1). They range in size from <1 mm to about 7 mm in length. The body is divided into an anterior cephalothorax (prosoma) and posterior abdomen (opisthosoma). A single carapace covers the cephalothorax. The abdomen is divided into 11 or 12 segments that are covered dorsally and ventrally by plates (tergites and sternites, respectively) that may be divided or undivided. Six pairs of appendages arise from the cephalothorax. The anterior most is a pair of short, 2-segmented chelicerae that are used in feeding. The pincers of these contain glands that secrete silk. The second pair of appendages (pedipalpi) has conspicuously large pincers (chela) that usually contain venom glands and are used in food gathering and defense. The remaining four pairs of appendages are walking legs, the tarsi of which are variably segmented and taxonomically significant. The second and third sternites are modified as sexually dimorphic genital opercula. Numerous setae, some of which are specialized sensory organs, cover the body and appendages. The number and arrangement of long, thin setae (trichobothria) on the chela are used in species identification. Weygoldt (1969) and Muchmore (1982, 1990) provide additional anatomical descriptions and details.

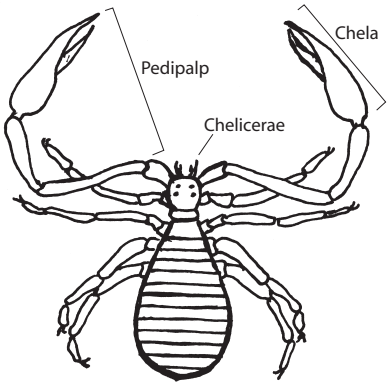
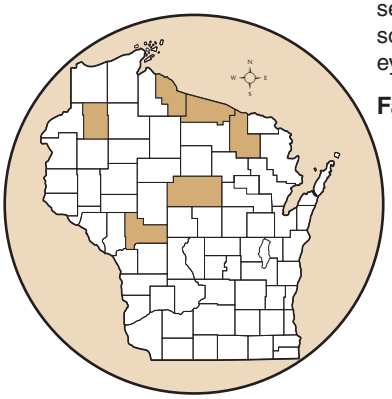


Figure 1. *A pseudoscorpion.*

Superfamily Chthonioidea

Members of this superfamily are tiny, measuring only 1-2 mm in length. In this group, the tarsi of walking legs 1 and 2 consist of a single segment each, but those of legs 3 and 4 have two segments each (i.e. the legs are heterotarsate). Members of this group have large chelicerae, sometimes as long as two-thirds the length of the carapace (Muchmore 1982). Most have four eyes positioned laterally near the front of the carapace.



Mundochthonius rossi

Family Chthoniidae

1. ***Mundochthonius rossi*** **Hoff, 1949**

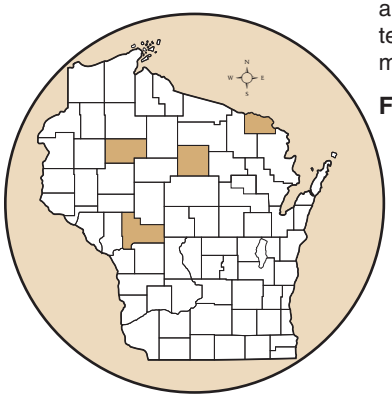
Original Description – Hoff (1949):437. See Harvey (1991) for full synonymy.

Habitat – Sandstone outcrops, litter and mossy debris on rock ledges or at the bases of outcrops; deciduous and mixed coniferous-deciduous forest litter.

Remarks – The only available Wisconsin records for *M. rossi* come from Hoff and Bolsterli (1956) who reported this species from four northern counties and Jackson and Marathon counties in the central part of the state.

Superfamily Neobisioidea

Members of this superfamily are variable in size, ranging from <1 mm to over 6 mm long. In this group, the tarsi of all walking legs consist of two segments (diplotarsate). The chelicerae are moderately large, about half as long as the carapace (Muchmore 1982). The abdominal tergites and sternites are undivided. These pseudoscorpions usually have four eyes, but some members of the group have only two and a few have none at all.



Microbisium brunneum

Family Neobisiidae

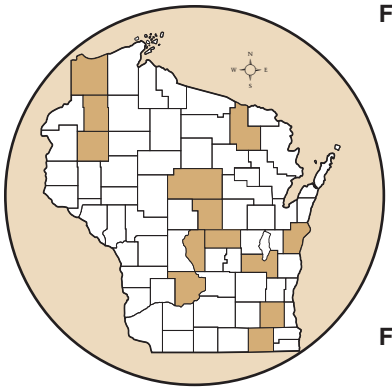
2. ***Microbisium brunneum*** **(Hagen, 1868)**

Original Description – Hagen (1869):52. See also Hoff (1946). See Harvey (1991) for full synonymy.

Habitat – Bogs, boreal forest litter and sphagnum moss.

Remarks – Banks (1895) called *M. brunneum* "the common species in the northern states" and listed collection localities in Massachusetts, Michigan, New York, Ohio, and Utah. Ewing (1911) also referred to *M. brunneum* as "a common species in the northern states," but listed localities only in Iowa and Massachusetts. It has since been reported from 5 Canadian provinces and 15 states, including Wisconsin.

Hoff and Bolsterli (1956) report *M. brunneum* from four counties in central and northern Wisconsin. In Illinois, *M. brunneum* occurs in "great numbers in the tamarack bogs of the northern part of the state" (Hoff 1946), so we might expect to find *M. brunneum* in similar habitats in southern Wisconsin as well.



Microbisium parvulum

Family Neobisiidae *(continued)*

3. ***Microbisium parvulum*** **(Banks, 1895)**

Original Description – Banks (1895):12. See also Hoff (1946) and Nelson (1984). See Harvey (1991) for full synonymy.

Habitat – Woodland litter and leaf mold; sphagnum moss in tamarack bogs.

Remarks – Nelson (1984) examined 20 *M. parvulum* specimens from unspecified Wisconsin localities, and Hoff and Bolsterli (1956) reported *M. parvulum* from 13 counties scattered around the state. *M. parvulum* has a wide range in the eastern United States.

Family Syarinidae

4. ***Syarinus enhuycki*** **Muchmore, 1968**

Original Description – Muchmore (1968):112. See Harvey (1991) for full synonymy.

Habitat – Deciduous forests, damp litter, under rocks, in soil to a depth of several centimeters.

Remarks – Species of *Syarinus* generally occur in montane biotopes in the Holarctic region, but lowland records from more northern latitudes also exist (Harvey 1998). Hoff and Bolsterli (1956) recorded *S. granulatus* Chamberlin 1930 in Wisconsin based upon a single female specimen. Muchmore (1968), however, reexamined this Marathon County specimen and a tritonymph collected along with it. He found the female to conform more to *S. enhuycki* than to *S. granulatus* in most measurements. Similarly, measurements of the tritonymph fell within the range of *S. enhuycki* tritonymphs. Muchmore (1968) felt "these specimens from Wisconsin are probably to be referred to *S. enhuycki*, but until further collections are made in the central United States their exact status must remain uncertain." I concur with this assessment and suggest that these records tentatively be assigned to *S. enhuycki* rather than *S. granulatus*.

Syarinus enhuycki

Superfamily Cheliferoidea

Most members of this superfamily measure 2-3 mm in length. In this group, the tarsi of all walking legs consist of a single segment (monotarsate). In addition, the femora of legs 1 and 2 differ in morphology and articulation from those of legs 3 and 4. The chelicerae are short, about one-third as long as the carapace (Muchmore 1982). The abdominal tergites and sternites are usually divided. Cheliferoids have two eyes or none at all.

Family Cheliferidae

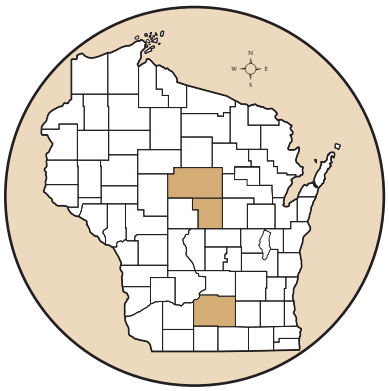
5. ***Chelifer cancroides*** **(Linnaeus, 1758)**

Original Description – Linnaeus (1758): 616. See Harvey (1991) for full synonymy.

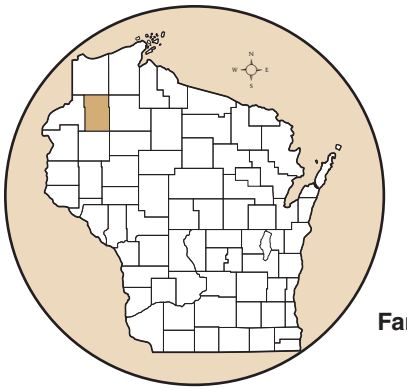
Habitat – Buildings, houses, barns, chicken coops; bee hives; bird nests; occasionally, rodent nests.

Remarks – Banks (1895) believed "this common species probably occurs all over the United States" and Weygoldt (1969) considered *C. cancroides* to be a cosmopolitan species. It is one of the very few pseudoscorpions with a common name: house pseudoscorpion. Because of its widespread occurrence and its relatively large size, we know comparatively much about its biology.

C. cancroides has been recorded from Wisconsin several times. Ewing (1911) collected three *C. cancroides* specimens, two males and a female, from "under the bark of a conifer" at Portage (Portage County) in September 1909. Levi's (1948) specimens were undoubtedly collected in Wisconsin, as he later (Levi 1953) reported collecting about 85 specimens in Madison (Dane County). Most were found on walls inside houses or stranded on smooth surfaces such as bathtubs, but he noted that others were "found under various conditions: several in laundry, one in a bed, another with a telephone bill, and one on a loaf of bread." He also found two outside in a manure pile co-occurring with *Lamprochernes minor*. Finally, Levi (1949, 1953) noted an apparent case of phoresy involving a silverfish. Hoff and Bolsterli (1956) reported *C. cancroides* from Marathon County. Pellitteri and Boush (1983) collected over 100 specimens from southern Wisconsin feed mills during their assessment of stored-product insect pests, but they did not provide specific locality information for their pseudoscorpion collections.



Chelifer cancroides



Idiochelifer nigripalpus

Lamprochernes minor

Pselaphochernes parvus

6. ***Idiochelifer nigripalpus* (Ewing, 1911)**

Original Description – Ewing (1911):73. See Harvey (1991) for full synonymy.

Habitat – Deciduous forests, under bark of trees (chiefly oak and hickory), both living and dead.

Remarks – Hoff (1949) listed Wisconsin among the north-central states where *I. nigripalpus* was then known to occur. In addition, he believed some of Ewing's (1911) records for *C. cancroides* might apply to this species. Later, Hoff (1950) reported on three specimens from the Illinois Natural History Survey that were collected under pine bark at Kimball Lake (Washburn County) in 1945.

Family Chernetidae

7. ***Lamprochernes minor* Hoff, 1949**

Original Description – Hoff (1949):453. See Harvey (1991) for full synonymy.

Habitat – Moist organic debris, beneath the bark of logs and stumps; phoretic on insects.

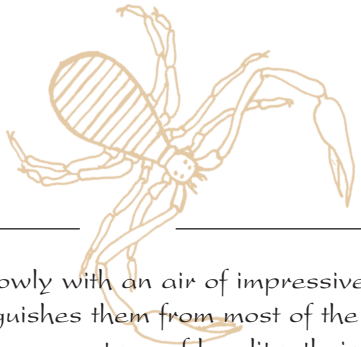
Remarks – Levi (1949, 1953) collected *L. minor* from two sites in Dane County in 1949. He found some on the bark of cottonwood logs "outside of Madison" and others in a manure pile at an abandoned farm in Madison. The latter specimens were found "on the undersides of timbers and roofing material that lay on the manure," as well as in the manure itself. Levi thought perhaps the specimens from the two different sites represented different, though closely related, species due to differences he observed in behavior and the percentage of survival in captivity (Levi 1953). He found no morphological distinctions, however, between the two groups. Those from the manure pile co-occurred with *Chelifer cancroides*.

8. ***Pselaphochernes parvus* Hoff, 1945**

Original Description – Hoff (1945):38. See Harvey (1991) for full synonymy.

Habitat – Deciduous forests, in rotting wood or under bark of logs and stumps, moist litter and compost.

Remarks – The only Wisconsin report of *P. parvus* comes from Hoff and Bolsterli (1956) who reported this species from Dane County, apparently based on Levi's (1949) unpublished records from a leaf pile near Picnic Point on the University of Wisconsin campus.



"False-scorpions walk slowly with an air of impressive dignity and calm deliberation which distinguishes them from most of the other small arthropods that inhabit the same type of locality, their enormous pedipalps spread out in front of them like the antennae of an insect."

- J.L. Cloudsley-Thompson, 1958

DISCUSSION

In North America, pseudoscorpions have been neglected, with very few investigators working on the order at any given time[2]. Prior to Ewing's (1911) systematic notes, the only significant works published were a handful of species descriptions by Banks (1890, 1891, 1893, 1895, 1908, 1909) and a preliminary North American species list by Coolidge (1908). Chamberlin (1929, 1930, 1931) contributed to the classification of the order. Later, Beier (1932a, b) and Roewer (1936, 1937, 1940) included North American species in their world-wide monographs. Hoff (1958) compiled the first meaningful list of species occurring north of Mexico and provided a key to genera then known. Many additional species (more than 200!) have since been described. Muchmore provided a useful synopsis of the order (1982) and a reasonably complete key to North American genera (1990). Harvey (1991) cataloged all valid species (through 1988, with a few later ones) and gave the reported distribution of each. Unfortunately, his *Catalogue* did not remain valid for very long as significant taxonomic changes were introduced shortly after (e.g., Harvey 1992, 1993). More recently, Harvey (2006) provided an up-to-date, online North American checklist with known distributions indicated by U.S. state and Canadian province, but this latter work, though very useful, lacks synonymies and reference citations making it difficult to access pertinent information for individual species. Although a bit older, the regional surveys by Hoff (1949) and Nelson (1975) and the synthesis of biological information by Weygoldt (1969) have remained important references for the order.

Of the approximately 3,250 described species, just over 400 have been recorded from the United States and Canada (Harvey 2002, 2006). Checklists for most states, however, include only a handful of species. For example, while 30 species have been reported from both Illinois and Michigan, only 3 and 4 are known from Minnesota and Iowa, respectively (Table 1). This situation almost certainly results from a lack of survey effort in the latter states rather than a zoogeographic phenomenon, as many additional species can be expected from these states (Hoff 1956).

I have found records of the Wisconsin occurrence of only 8 species in 5 families. Some of these records remain uncertain (e.g., *S. enhuycki*, *P. parvus*), but this tally is certainly far short of the total number of species that occurs here. For example, Illinois and Michigan share 14 species in common that have yet to be recorded from Wisconsin (Table 1), although they probably occur here as well. An additional species, *Chthonius ischnocheles* (Hermann 1804), recorded from both Illinois and Minnesota also likely occurs in Wisconsin. Although many pseudoscorpions have been described from caves, there is a surprising lack of records from the Upper Midwest (Peck and Christiansen 1990, Peck 1998) and we have yet to document a single species from a Wisconsin cave or mine site. Some pseudoscorpions are known to be commensals or inquilines of mammal, bird, ant, or bee nests (Beier 1948, Weygoldt 1969, Holldobler and Wilson 1990), but Wisconsin records of these also appear to be absent from the literature. Nonetheless, careful surveys of these habitats may prove fruitful in turning up new records.

The conservation status of pseudoscorpions in Wisconsin remains unknown as little progress has been made in answering the most basic conservation questions for this group. Only Levi (1948, 1949, 1953) has studied Wisconsin pseudoscorpions seriously and biologists have yet to conduct a statewide, systematic survey. Only limited collecting has occurred in the state and available museum collections have yet to be examined by a specialist (a task beyond my expertise and the scope of this preliminary work). As a result, nothing definitive can be said about population or geographic distribution trends.

Our lack of knowledge is unfortunate. Pseudoscorpions have been found in densities upwards of 900 to 1,000 per square meter (Weygoldt 1969). Since they often feed on arthropods that can be problematical for humans, such as mites and ants, and likely play a regulatory role within the soil community (Eisenbeis and Wichard 1987), they may be an important ecological indicator. With their potential ecological value and with so much work yet to be done on the order, pseudoscorpions make an excellent subject for study. Their taxonomy, distribution, phenology, population dynamics, conservation status, habitat selectivity, niche preferences, and trophic relationships remain areas that could benefit from additional research. Literature cited in this report, especially the works by Harvey (1991, 2006), Muchmore (1990), and Weygoldt (1969), can serve as starting points for interested investigators. Much of this literature is specialized and some works appear in obscure sources. Nonetheless, I have had little trouble obtaining pertinent references through interlibrary loan services.

Both the Milwaukee Public Museum and the University of Wisconsin Insect Research Collection have small collections of unidentified pseudoscorpions that merit examination (J.P. Jass, pers. comm.; S. Krauth, pers. comm.). Additional material has likely accumulated in the Illinois Natural History Survey, American Museum of Natural History, and Field Museum of Natural History collections during the 50 years since Hoff and Bolsterli (1956) examined material from these institutions. Future investigators will want to consult these collections, as well as Harvard University's Museum of Comparative Zoology, where at least some of Levi's (1948, 1949, 1953) vouchers are likely to be found.

Hoff (1949) and Nelson (2006) provide directions for specimen preparation and examination, tasks that admittedly can be tedious and time-consuming. For accurate identification, individual specimens must be dissected, cleared, and mounted for microscopic examination of the minute details of the chelicerae, pedipalpi, and walking legs. This takes considerable skill and practice and as Nelson (2006) so eloquently states, "Once you've attempted—or witnessed someone else—dissecting and identifying a pseudoscorpion, you'll no longer wonder why so little is known about pseudoscorpions." Identification can be further complicated by the fact that available keys are inadequate for identifying nymphs and some female specimens. In spite of these challenges, however, opportunities abound to add to our knowledge of these fascinating creatures and it is my hope that this checklist will stimulate the latent interest of Wisconsin naturalists.

[2] *For much of the latter part of the Twentieth Century, W.B. Muchmore completed most of the taxonomic work on North American pseudoscorpions. A recent status and needs assessment (Coddington, et al. 1990), however, pointed out that following his retirement, there appeared to be no trained pseudoscorpion taxonomists to take his place leaving us with no one actively studying the group in North America.*

Table 1. *Pseudoscorpion species reported from the Upper Midwest (based on Hoff [1949, 1958], Hoff and Bolsterli [1956], Manley [1969], Nelson [1975], Snider and Nelson [1991], Cooney and Snider [1995], and Harvey [2006]).*

Species	MN	IA	WI	IL	MI
Family Chthoniidae					
Apochthonius moestus (Banks 1891)				✓	✓
Chthonius (Chthonius) ischnocheles (Hermann 1804)	✓			✓	
Chthonius (Ephippiochthonius) tetrachelatus (Preyssler 1790)				✓	✓
Kleptochthonius (Kleptochthonius) multispinosus (Hoff 1945)				✓	
Mundochthonius cavernicola Muchmore 1968				✓	
Mundochthonius rossi Hoff 1949		✓	✓	✓	✓
Mundochthonius sandersoni Hoff 1949				✓	
Family Tridenchthoniidae					
Verrucaditha spinosa (Banks 1893)				✓	
Family Pseudogarypidae					
Pseudogarypus banksi Jacot 1938					✓
Family Neobisiidae					
Microbisium brunneum (Hagen 1868)		✓	✓	✓	✓
Microbisium parvulum (Banks 189	✓	✓	✓	✓	✓
Family Syarinidae					
Syarinus enhuycki Muchmore 1968			?		✓
Family Larcidae					
Larca granulata (Banks 1891)				✓	✓
Family Cheiridiidae					
Apocheiridium (Apocheiridium) stannardi Hoff 1952				✓	✓
Cheiridium firmum Hoff 1952				✓	
Cheiridium museorum (Leach 1817)					✓
Family Sternophoridae					
Idiogaryops paludis (Chamberlin 1932)				✓	
Family Cheliferidae					
Chelifer cancroides (Linnaeus 1758)			✓	✓	✓
Dactylochelifer copiosus Hoff 1945				✓	✓
Idiochelifer nigripalpus (Ewing 1911)		✓	✓	✓	✓
Pasiochelifer callus (Hoff 1945)				✓	✓
Parachelifer longipalpus Hoff 1945				✓	
Parachelifer monroensis Nelson 1975					✓
Family Chernetidae					
Acuminochernes crassopalpus (Hoff 1945)				✓	✓
Acuminochernes tacitus Hoff 1961					✓
Americhernes oblongus (Say 1821)				✓	✓
Chernes amoenus (Hoff 1963)					✓
Chernes ewingi (Hoff 1949)				✓	✓
Chernes lymphatus (Hoff 1949)				✓	✓
Dendrochernes morosus (Banks 1895)					✓
Dinocheirus horricus Nelson and Manley 1972					✓
Dinocheirus pallidus (Banks 1890)				✓	✓
Dinocheirus solus Hoff 1949				✓	
Hesperochernes tamiae Beier 1930					✓
Illinichernes distinctus Hoff 1949				✓	✓
Microchernes dentatus (Banks 1895)				✓	✓
Parachernes (Parachernes) virginicus (Banks 1895)				✓	✓
Lamprochernes minor Hoff 1949	✓		✓	✓	✓
Pselaphochernes parvus Hoff 1945			✓	✓	✓

"Because they are so small and have shy, retiring habits, pseudoscorpions are little known and seldom found unless specifically sought."

- J.L. Cloudsley-Thompson, 1958

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