

## SPIDERS IN INDIANA: SEVENTY-ONE NEW AND UPDATED DISTRIBUTION RECORDS

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**ABSTRACT.** Spiders are an integral part of many ecosystems, yet their diversity is understudied in Indiana. To uncover spider diversity within the state, spiders were collected from several ecosystems in many counties across the state. Moreover, spiders were re-identified within the collection of a former Indiana arachnologist, Thomas Parker. Herein we report sixty-four new state records for spider species and update seven species distribution records. These new records represent a 19% increase in the number of spider species known from Indiana, from 383 to 454. Some notable discoveries: 1) *Antrodiaetus unicolor*, *Cybaeus giganteus*, *Oecobius cellariorum*, and *Ummidia tuobita* represent species within four new families of spiders for the state (Antrodiaetidae, Cybaeidae, Oecobiidae, and Ctenizidae, respectively); and 2) *Dipoena nigra*, *Eidmannella pallida*, *Idionella rugosa*, *Neon nelli*, *Styloctetor purpureus*, *Paracornicularia bicapillata*, *Oreonetides beattyi*, *Larinia directa*, *Microneta viaria*, *Spintharus flavidus*, *Lepthyphantes turbatrix*, *Lupettiana mordax*, *Tapinocyba emertoni*, *Phylloneta pictipes*, *Ceratinopsidis formosa*, *Talanites exlineae*, and *Epiceraticelus fluvialis* represent species within 17 new genera for the state.

**Keywords:** Araneae, arachnid, range, extension, faunistics, state record

### INTRODUCTION

Spiders are a diverse group of arthropods, with approximately 46,000 species known worldwide (World Spider Catalog 2015). Within North America, approximately 3,800 species have been described (Bradley 2013). The latest inventory of spiders in Indiana recorded 383 species from the state (Sierwald et al. 2005). However, this estimate is ten years old, and compared to its closest neighbors, the state of Indiana has lagged in inventorying its spider diversity. The best evidence of this comes from an examination of spiders known from states surrounding the Great Lakes (Sierwald et al. 2005); either Indiana is depauperate in relation to Illinois, Ohio, Wisconsin, and Michigan or there has been inadequate

study of spider diversity within the state (383 spider species known from Indiana in comparison to 646, 571, 479, and 563 from Illinois, Ohio, Wisconsin, and Michigan, respectively). Although there may be some environmental differences among the states, we predict that continued inventory of spiders within the state will indicate that the latter explanation is more likely.

The earliest comprehensive work on Indiana spiders was a published talk at the Washington Entomological Society in 1891 by Fox that listed 77 species. A very detailed explanation of publications dealing with Indiana spiders prior to 1952 can be found in Elliot (1953). Published accounts by Banks (1907), Elliot (1932, 1953), Parker (1969), and Beatty (2002) brought the number of known spider species in Indiana to 383. Herein, we add 71 species to Beatty's (2002) list to

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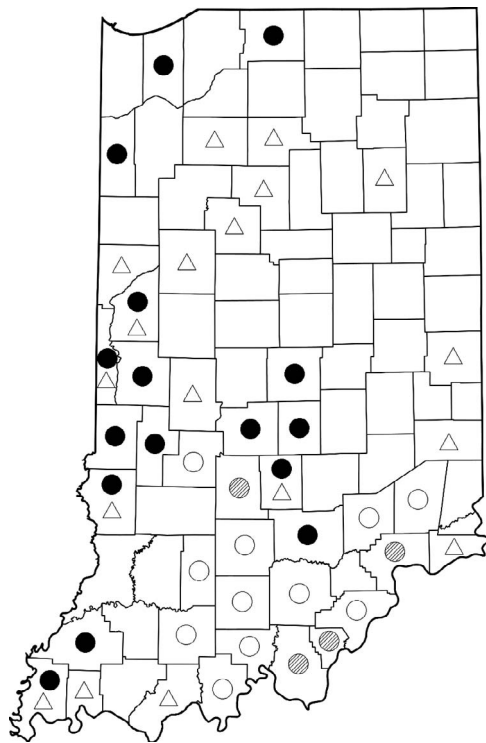


Figure 1.—Sampling locations and museum specimen locales by county. Closed circles represent counties in which only surface sampling was conducted; open circles represent counties in which only subterranean sampling was conducted (including sinkholes); cross-hatched circles represent counties in which both surface and subterranean sampling was conducted; triangles represent counties from which specimens were examined that were from the collections of T.A. Parker housed at the Purdue Entomological Research Collection.

bring the total number of spider species that are known to occur in Indiana to 454.

#### METHODS

Spiders were collected from multiple localities using a variety of methods over the past ten years (Fig. 1). The majority of specimens were collected from 2014 to 2015. Many spiders were collected from Morgan-Monroe State Forest (Morgan Co. and Monroe Co., Indiana; MMSF henceforth) and Yellowwood State Forest (Brown Co., Indiana; YSF henceforth) as part of the Hardwood Ecosystem Experiment (HEE) from 15 January 2015 to 6 February 2016. Spiders at these locations were collected from pitfall traps or from leaf litter using Berlese funnels in the lab. Pitfall

traps consisted of 88.7 ml (3 oz) plastic cups recessed into the soil so that the top was flush with the soil surface. Pitfall traps were half-filled with soapy water and allowed to collect arthropods for two weeks before being collected. Pitfall traps were established in pairs approximately 10 m apart. Sites for pitfall trap pairs were at least 80 m apart. Twelve pitfall traps were set and collected (at six sites) in MMSF and 36 were set and collected (at 18 sites) in YSF on six occasions: 1/17/2015–1/31/2015, 3/15/2015–3/29/2015, 5/18/2015–5/31/2015, 7/25/2015–8/8/2015, 9/20/2015–10/4/2015, and 1/23/2016–2/6/2016. Three or four handfuls (2–3 L) of leaf litter were collected from each of the pitfall trap sites and transferred to the lab in plastic bags. Leaf litter from each site was placed into a Collapsible Berlese Funnel Trap (BioQuip, Product No. 2832). An LED light (Triangle Bulbs, 13-Watt PAR30 Flood Light Bulb, Model No. T97005-4) was placed at the top and a vial of ethanol was placed at the bottom of each funnel trap. Each trap was allowed to extract for two to three days before being inspected.

Other spiders were collected from Glacier's End Nature Preserve (Johnson Co., Indiana; GENP henceforth) during a bioinventory on 16 April 2015 and supplemental sampling on 17 March 2016. More collections were done at MMSF during bioinventories on 22 June 2014 and 13 September 2014. These spiders were collected by hand using manual aspirators (BioQuip, Product No. 1135B) and by litter sifting using a litter reducer (BioQuip, Product No. 2834) and a canvas beating sheet (BioQuip, Product No. 2840C).

Further sampling of spiders was done by sweeping vegetation, sifting leaf litter, and hand collecting in various wooded areas in Clay, Floyd, Fountain, Gibson, Harrison, Jefferson, Monroe, Newton, Parke, Posey, Sullivan, Vermillion, and Vigo Counties in July and August 2015. Additional sampling in these counties was done at night using a headlamp. Moreover, four pitfall traps were set in Vigo Co. during the summer of 2015.

Several new spider distribution records came from cave and sinkhole habitats. These records were provided by J. Lewis from his exhaustive sampling of over 750 Indiana caves and sinkholes during 1976–2015. We examined 631 spiders from these sampling efforts. Spiders were collected from caves by hand collecting and pitfall trapping using 118 ml (4 oz) containers baited with limburger cheese.

In addition to collecting, a small part of Parker's (1969) spider collection (his "miscellaneous" spider specimens) at the Purdue Entomological Research Collection (PERC) was examined and re-identified. These specimens were examined because the latest list of Indiana spiders (Sierwald et al. 2005) unquestioningly used Beatty's (2002) list. However, Beatty did not re-examine Parker's (1969) collection and therefore could not have caught misidentifications or partial identifications (see Beatty 2002). All specimens from PERC were kept there as vouchers.

Spiders were identified by the lead author using Ubick et al.'s *Spiders of North America* (2005) and hundreds of associated keys and records. Only adult specimens were considered for records unless identification of the immature could be completed with certainty. All nomenclature follows that used by the World Spider Catalog (World Spider Catalog 2015). Distribution records of all species found were compared against the most recent peer-reviewed article in a scientific journal that contained a list of species located in Indiana (see Sierwald et al. 2005). As explained by Sierwald et al. (2005), their distribution list of spiders in Indiana was taken directly from Beatty (2002) with no modification. There is a newly-released online database of species distributions throughout North America hosted by the American Arachnological Society (see Bradley 2015), but we have decided not to use this list due to its lack of peer-review and frequent conflict (over omission and inclusion) with Sierwald et al.'s (2005) published list.

Sierwald et al. (2005) predicted the presence of certain species in Midwestern states based on their distribution in other nearby states. If a species was predicted by Sierwald et al. (2005) to be present in Indiana, we have indicated that prediction with a "P" next to the listing. We have also found and examined spiders from Indiana that were reported to occur in the state by other authors but were not included in Sierwald et al.'s (2005) list. These records have been denoted by an asterisk (\*) before the listing and the author of the original record is stated. Voucher specimens for all epigeal (surface-dwelling) collected species were deposited in the spider collection at Indiana State University. Cave-collected spiders were deposited in the entomological collection at Southern Illinois University until they were transferred to the Illinois Natural History Survey (INHS) in the mid-2000s.

## RESULTS

Of 3,917 spider specimens examined, 71 species were new or updated records for Indiana. Within these new records are four new families (Antrodiaetidae, Ctenizidae, Cybaeidae, and Oecobiidae) and 17 new genera (*Ceratinopsidis*, *Dipoena*, *Eidmannella*, *Epiceraticelus*, *Idionella*, *Larinia*, *Lepthyphantes*, *Lupettiana*, *Microneta*, *Neon*, *Oreonetides*, *Paracornicularia*, *Phylloneta*, *Spintharus*, *Styloctetor*, *Tapinocyba*, and *Talanites*) for the state. Approximately 55% (39/71) of the species we located within the state were predicted to exist in Indiana by Sierwald et al. (2005). With these added and updated records, Indiana now has 454 known spider species within the state, yet is still ranked last among states in the Midwest in the number of identified spider species. Each new or updated species record is listed below alphabetically by taxonomic family and then alphabetically by scientific name within the family. Ranges are largely taken from the American Arachnological Society website (Bradley 2015).

### Agelenidae

*Agelenopsis emertoni* Chamberlin & Ivie, 1935

**P** – occurs from Nova Scotia to Florida and west to Colorado. One male specimen was collected in a forested area in West Terre Haute, Vigo Co. on 28 August 2015.

### Antrodiaetidae

\**Antrodiaetus unicolor* Hentz, 1842 **P** – is known from the eastern United States, from Georgia to New York and west to Arkansas. A single female specimen was found in Brown Co. in 2013. This species was previously captured by Coyle (1971) in Jefferson Co.

### Anyphaenidae

*Lupettiana mordax* O. Pickard-Cambridge, 1896 – occurs in the southeastern United States and California. One female was captured on Blunk Knob, south of Georgetown, Floyd Co. on 24 August 2015.

### Araneidae

*Acanthepeira cherokee* Levi, 1976 – occurs in the southeastern United States, from Texas to Virginia. One male was collected from

Not So Grand Cave II near Laconia in Harrison Co. in March 1997. One immature specimen was also collected from MMSF (Monroe Co.) in September 2015.

*Araneus cingulatus* Walckenaer, 1841 **P** – ranges from New York south to Florida and west to Texas and Illinois. One female was found near a woodland road northwest of Brazil, Clay Co. in July 2015.

*Cyclosa conica* Pallas, 1772 **P** – is distributed throughout Canada and most of the United States except for the southeast and some central states. A male and female were collected from MMSF and YSF (Monroe and Brown Co.) in August and June of 2015, respectively.

*Eustala emertoni* Banks, 1904 **P** – occurs from New York south to Florida and west to Texas and Kansas. One female was found in a grassy field in Vigo Co. in July 2015.

*Larinia directa* Hentz, 1847 – occurs in the southern United States, from California to Florida. One immature specimen was found in Vigo Co. in September 2015.

#### Atypidae

*Sphodros coylei* Gertsch & Platnick, 1980 – is only known from South Carolina, Virginia, and Ohio. This specimen's location is the most western known occurrence of the species. One male specimen misidentified as "*Atypus milberti*" (*Sphodros rufipes*) was examined and re-identified as this species within Parker's (1969) collection at PERC. This single specimen was collected by Gary Finni from South Pine Creek in Warren Co. in May 1968.

*Sphodros rufipes* Latreille, 1829 **P** – occurs on the East Coast of the United States, from New York to Florida and west to Texas. Six females were collected from Buzzard Roost in Hoosier National Forest, Perry Co., in September 2015.

#### Corinnidae

*Castianiera variata* Gertsch, 1942 **P** – has a Midwestern distribution, but extends south to Louisiana, west to Kansas, east to Pennsylvania, and north to Ontario. We collected one female beneath discarded cardboard from a yard in Terre Haute and a second female from another residen-

tial yard in West Terre Haute, Vigo Co. in July 2015.

#### Ctenizidae

*Ummidia tuobita* Chamberlin, 1917 – is known from Illinois, Arkansas, Missouri, and Texas. A female and male were collected in Harrison Co. in September 2015. Minton (1955) described capturing *U. audouini* from Floyd Co., but this specimen may actually have been *U. tuobita* since *U. audouini* is only known from Louisiana and Texas.

#### Cybaeidae

*Cybaeus giganteus* Barrows, 1919 **P** – is known from Illinois, Ohio, New York, and North Carolina. One female was collected from Wools Whim Cave in Jennings Co. and more specimens from Bernice Chandler Cave (GC 06) in Ripley Co.

#### Dictynidae

*Cicurina itasca* Chamberlin & Ivie, 1940 – is largely confined to the states and provinces surrounding the Great Lakes with the exception of Quebec. This is the most southerly report of this species on record and extends this species' range south from Wisconsin by approximately 656 km from Fish Creek, Wisconsin. One female was collected at YSF (Brown Co.; N39.121056°, W-86.366832°) in February 2015 and another female was found in a sinkhole at HNF in Lawrence Co. in September 2015.

*Lathys immaculata* Chamberlin & Ivie, 1944 (Araneae, Dictynidae) – is largely restricted to the southeastern United States, but is also known to exist in Illinois. Two males and three females were collected at YSF and MMSF (Monroe and Brown Co.) March–May 2015.

#### Eutichuridae

*Cheiracanthium mildei* L. Koch, 1864 **P** – is an introduced species from Europe and has a spotty distribution, being present in the Midwest, East Coast, and West Coast, but only in certain states. Three specimens

were collected from buildings in Indianapolis, Marion Co., in July 2009, May 2015, and June 2015.

### Gnaphosidae

*Drassyllus covensis* Exline, 1962 – is known to occur in only six states in the southeastern United States, from Texas to New Jersey. Nine males and four females were found at MMSF and YSF (Monroe and Brown Co.) January–May 2015.

*Drassyllus dixinus* Chamberlin, 1922 – is known from the southeastern United States. One female was found in St. Joseph Co. in June 2015.

*Drassyllus fallens* Chamberlin, 1922 **P** – is widespread on the East Coast, from Quebec to Georgia and as far into the Midwest as Wisconsin and Illinois. Two males were found at YSF (Brown Co.) in April and June 2015.

*Gnaphosa fontinalis* Keyserling, 1887 **P** – occurs in the eastern and central United States, as far west as Texas and Oklahoma. Two males and one female were found at MMSF and YSF (Monroe and Brown Co.) in May 2015. Moreover, two males were found in Vigo Co. in July 2015.

*Micaria longipes* Emerton, 1890 **P** – is known throughout the United States and Canada. We found one male at MMSF (Monroe Co.) in June 2014.

*Sergiolus minutus* Banks, 1898 – is distributed largely in the southern United States, but can be found as far north as New York and occurs in Wisconsin and Illinois as well. One male specimen was collected at a landfill site in Terre Haute, Vigo Co. in May 2015.

*Talanites exlineae* Platnick and Shadab, 1976 – occurs throughout the southeastern United States. Multiple specimens were collected from Heron Cave in Crawford Co., Liar's Bluff Cave in Orange Co., and Rocky Hollow Hole in Perry Co. in September 1996.

### Hahniidae

\**Hahnina flaviceps* Emerton, 1913 **P** – has a southeastern distribution, occurring from Texas to North Carolina and north to Illinois. Three males were found in MMSF

(Monroe Co.) in March 2015 and four females and two males from YSF (Brown Co.) in March, May, and October 2015. This species was recorded from Indiana by Opell & Beatty (1976) but is not present in the lists of Beatty (2002) and Sierwald et al. (2005).

### Linyphiidae

*Agyneta angulata* Emerton, 1882 – occurs along the East Coast of North America, from Nova Scotia to Georgia and as far west as Missouri. One male was found at YSF (Brown Co.) in May 2015.

*Agyneta barrowsi* Chamberlin & Ivie, 1944 **P** – occurs in the southeastern United States, north into the Midwest and Ontario, and as far west as Nebraska. Two males and seven females were found at YSF (Brown Co.) February–June 2015.

*Agyneta evadens* Chamberlin, 1925 – is largely found in the central East Coast and Midwest, but also occurs in Alabama and Ontario. Two females were found at GENP (Johnson Co.) in April 2015.

*Agyneta parva* Banks, 1896 – occurs in the south central and southeastern United States from Texas to Florida and north to Virginia. The Indiana collection extends its range approximately 316 km NW of its Kentucky locality. One female was found at GENP (Johnson Co.; N 39.357780°, W-86.167365°) in April 2015. A second specimen identified as "*Meioneta* sp." was examined and re-identified as this species within Parker's (1969) collection at PERC. This PERC specimen was collected from Santa Claus, Spencer Co., in May 1966.

*Agyneta serrata* Emerton, 1909 – has an eastern distribution, ranging from Texas to Florida and north to Ontario and Nova Scotia. Two male specimens identified as "*Meioneta* sp." were examined and re-identified as this species within Parker's (1969) collection at PERC. One specimen was collected by Gary Finni from South Pine Creek, Warren Co., in April 1968 and the other at Nussmeier Plantation near Santa Claus, Spencer Co., in May 1966.

\**Bathyphantes alboventris* Banks, 1892 **P** – has a northeastern distribution, ranging from Tennessee north to Quebec. One male and nine females were recorded from MMSF

(Monroe Co.) in September 2015 and three males and eight females from Fuzzy Hole Cave, Lawrence Co., in November 2015. Additional specimens were collected from Dryden Cave, Dryden Sinks Cave, Hammerhead Pit, and Meek Cave in Jennings Co. and Tincher Swallowhole Cave in Lawrence Co. This species was recorded on a distribution map by Ivie (1969), but was not stated as being from Indiana in the text of the manuscript. It is not clear if the distribution map specimens were collected by Ivie or were from the American Museum of Natural History.

*Ceraticelus similis* Banks, 1892 **P** – can be found from Quebec south to Georgia and west to Arizona. An unidentified female specimen was in Parker's (1969) collection at PERC. This specimen was collected by R.W. Meyer from Merritt's Pine Plantation, Tippecanoe Co., in July 1968.

*Ceratinops crenatus* Emerton, 1882 **P** – has an easterly distribution, occurring from Quebec south to Florida and west to Texas. Parker's (1969) collection at PERC had two male specimens. These were collected via pitfall traps from Merritt's Pine Plantation, Tippecanoe Co., in April 1968.

*Ceratinopsidis formosa* Banks, 1892 **P** – occurs from Ontario south to North Carolina and Tennessee. One male was found in Harrison Co. in August 2015.

*Epiceraticelus fluvialis* Crosby & Bishop, 1931 – is known from only three states: New Jersey, New York, and Ohio. Four males and one female were located at YSF and MMSF (Brown and Monroe Co.) during February–April 2015.

*Idionella rugosa* Crosby, 1905 – occurs in eastern Canada, New York, Connecticut, and Illinois. Two male specimens within Parker's (1969) collection at PERC that were misidentified as "*Ceraticelus laetus*" were examined and re-identified as this species. Both specimens were collected from Attica, Fountain Co., in April 1968.

*Islandiana cavealis* Ivie, 1965 – is only known from caves in Kentucky. We found multiple specimens in Stygian River Cave in Harrison Co. in September 1996. This record is approximately 145 km WNW of the closest known location in Kentucky.

*Islandiana flavoides* Ivie, 1965 – is only known from New York and Illinois. Two male

specimens within Parker's (1969) collection at PERC, marked as unidentified, were examined and identified as this species. One specimen was collected from Vanderburgh Co. in June 1966 and the other by R.W. Meyer from Merritt Pine Plantation, Tippecanoe Co., in August 1968.

*Lepthyphantes turbatrix* O. Pickard-Cambridge, 1877 **P** – is a northern species, known from throughout Canada, the Midwest, and northeastern United States. One male was found at MMSF (Monroe Co.) in September 2014.

\**Mermessus maculatus* Banks, 1892 **P** – exists throughout eastern United States and Canada and can be found as far west as Arizona. One male and 10 females were collected from MMSF (Monroe Co.) and 11 males and 13 females from YSF (Brown Co.) January 2015–February 2016. We also found one male and three females from GENP (Johnson Co.) in April 2015. Additional specimens were collected from Bordens Pit, Limekiln Hollow Pit, and Webers Swallowhole in Harrison Co., John Samples Cave in Jefferson Co., and Williams Cave in Lawrence Co. Millidge (1987) records this species from Montgomery Co.

\**Mermessus trilobatus* Emerton, 1882 **P** – can be found throughout the United States and Canada. Two males from PERC that were misidentified as "*Eperigone contorta*" and "*Eperigone indicabilis*" were identified as this species. Both of these specimens were collected from Americus in Tippecanoe Co. One was collected in August 1968 and the other was collected on an unknown date. Moreover, one unidentified female specimen from PERC was identified as this species and was collected from Lafayette in October 1968. Millidge (1987) records this species from Adams and Marion Co.

*Microneta viaria* Blackwall, 1841 **P** – occurs throughout Canada, the Midwest, and as far south as New Mexico. Two males and five females were found at Eagle Creek Park, Indianapolis, Marion Co., in September 2015.

\**Oreonetides beattyi* Paquin et al., 2009 – is known from Appalachian caves and west to southern Indiana. Two males and 11 females of this recently described species (Paquin et al. 2009) were collected from

caves throughout southern Indiana during 2000–2007 (see collections by Lewis in Paquin et al. 2009).

*Paracornicularia bicapillata* Crosby & Bishop, 1931 – is only known from three states: Illinois, Missouri, and Mississippi. One male was discovered in YSF (Brown Co.) in March 2015.

*Styloctetor purpureus* Keyserling, 1886 **P** – has an eastern distribution, but can be found as far west as Texas. Four females were found from MMSF (Monroe Co.) and GENP (Johnson Co.) in June 2014 and April 2015, respectively.

*Tapinocyba emertoni* Barrows & Ivie, 1942 – is only known from Ohio. Thirty females and 13 males were found at GENP (Johnson Co.), YSF (Brown Co.), and MMSF (Monroe Co.) February–October 2015.

*Tenuiphantes sabulosus* Keyserling, 1886 **P** – is distributed throughout North America, but is more prevalent in the East and Midwest. Eight females were found at GENP (Johnson Co.) and YSF (Brown Co.) from January to April 2015. In addition, multiple specimens were found in Hoosier National Forest's Swallow Hole, JJ's Sister Cave, and Williams Cave in Lawrence Co.

*Walckenaeria brevicornis* Emerton, 1882 **P** – occurs largely in the eastern United States but has been found as far west as Kansas. One male was hand collected at GENP (Johnson Co.) in March 2016.

*Walckenaeria communis* Emerton, 1882 **P** – has a wide distribution throughout Canada and most of the United States. One female was found within the leaf litter in a sinkhole at Hoosier National Forest, Orange Co., in November 2015.

*Walckenaeria directa* O. Pickard-Cambridge, 1874 **P** – is known to exist throughout Canada and most of the United States, especially in the Northeast. One female was found at YSF (Brown Co.) in February 2016.

### Lycosidae

*Arctosa virgo* Chamberlin, 1925 – is distributed in several East Coast and Midwest states. Two females were found in August 2015: one at MMSF (Monroe Co.) and another at YSF (Brown Co.).

*Gladicosa pulchra* Keyserling, 1877 **P** – is distributed throughout the southern United States, from Colorado to Florida, north to New Jersey. One female was collected from a sinkhole 1.1 km west of Deuchars in Hoosier National Forest, Crawford Co., in November 2015. An additional six specimens were collected from Floyd Co. (one male in August 2015), Orange Co. (one female in September 2014), Perry Co. (two males and one female in September 2015), Brown Co. (one female in September 2015), Harrison Co. (one female 25 August 2015), and Crawford Co. (one male in October 2015).

*Schizocosa crassipes* Walckenaer, 1837 – occurs along the East Coast, Midwest, and central portions of the United States. Two females were found at MMSF (Monroe Co.) in June 2015.

*Varacosa shenandoa* Chamberlin & Ivie, 1942 – occurs on the eastern and central region of the United States in addition to Quebec in Canada. One female was found at the Indiana Dunes National Lakeshore in Porter Co. in September 2015.

### Nesticidae

\**Eidmannella pallida* Emerton, 1875 – can be found throughout the United States and eastern Canada. One female was collected from Porter Cave, Owen Co., in September 2014. Other specimens were found in Binkley Cave (Harrison Co.), Crew 88 Cave (Orange Co.), and Guetig Cave (Washington Co.). This species was recorded from Mayfield's Cave (Monroe Co.) and Porter Cave (Owen Co.) by Gertsch (1984).

### Oecobiidae

*Oecobius cellariorum* Dugès, 1836 **P** – is a non-native species that occurs throughout the southern United States, from Arizona to Maryland. Two immature specimens were collected in a greenhouse in Terre Haute in Vigo Co. in August 2015.

### Phrurolithidae

*Phrurolithus singulus* Gertsch, 1941 – has previously been recorded from Virginia,

Tennessee, Alabama, Georgia, and Florida. One male was found from Mill Creek Sink at Hoosier National Forest, Crawford Co., in September 2015. This is a northwestern range extension and this record is approximately 382 km NW of its closest previously recorded location in Tennessee.

*Scotinella fratrella* Gertsch, 1935 **P** – is only known from three states (Texas, Illinois, and Ohio) and one Canadian province (Ontario). One male specimen within Parker's (1969) collection at PERC identified as "*Phrurolithus* sp.?" was examined and re-identified as this species. This specimen was collected by R.W. Meyer from Santa Claus, Spencer Co., in June 1968.

*Scotinella redempta* Gertsch, 1941 **P** – occurs in the southeastern United States and north through Virginia, Ohio, and into Ontario. One male and six females were captured at GENP (Johnson Co.) and YSF (Brown Co.) February–May 2015. Multiple specimens were also found in Pikes Peak Pit in Washington Co.

#### Pisauridae

*Dolomedes albineus* Hentz, 1845 – is distributed in the southeastern United States from Texas to Florida and north to Virginia and Missouri. Fourteen specimens were collected from a variety of locations. A male was collected from MMSF (Monroe Co.) in June 2015. Five females were found in West Terre Haute in Vigo Co. in June 2015. Two females and a male were found in Vigo Co. in June and July 2015. One juvenile was located in Floyd Co. in August 2015 and another in Perry Co. in September 2015. Finally, one juvenile was found in Putnam Co. and two more in Clay Co. in October 2015.

*Pisaurina dubia* Hentz, 1847 **P** – occurs largely in the eastern United States, from Kansas to Massachusetts and south to Florida. Two males and one female were found near an urban structure in West Terre Haute, Vigo Co., in May 2015.

#### Salticidae

*Colonus puerperus* Hentz, 1846 – can be found in the eastern and central United States.

Four males were found in September 2015 from MMSF (1; Monroe Co.), YSF (2; Brown Co.), and Eagle Creek Park (1; Marion Co.).

*Neon nelli* Peckham & Peckham, 1888 **P** – is distributed across Canada and along the Eastern Seaboard and in the central United States. One female was found at GENP (Johnson Co.) in April 2015.

*Loxosceles rufescens* Dufour, 1820 **P** – is a non-native species that occurs throughout the United States, from Pennsylvania to California. Twenty-one specimens (11 males, 9 females, 1 immature) were found in a building in Terre Haute, Vigo Co. during 2005–2015.

#### Theridiidae

*Dipoena nigra* Emerton, 1882 **P** – is distributed throughout the United States and Canada. One female was found at YSF (Brown Co.) in May 2015.

*Enoplognatha caricis* Fickert, 1876 **P** – occurs largely in the northern United States and Canada, though specimens have been found in Texas and Colorado. One female was found at MMSF (Monroe Co.) in June 2014.

*Parasteatoda tabulata* Levi, 1980 – is a non-native species that is largely restricted to eastern Canada, but has been found in Illinois. One female was found at MMSF (Monroe Co.) in June 2014.

*Phylloneta pictipes* Keyserling, 1884 **P** – is known to occur in the southeastern United States, Illinois, and Ohio. One female was found at MMSF (Monroe Co.) in September 2015.

*Robertus frontatus* Banks, 1892 **P** – is largely restricted to the East Coast except for a record from Manitoba, Canada. Two males and three females were found from MMSF (Monroe Co.) in September and October 2015. We also located two males and seven females in YSF (Brown Co.) in March, April, June, and August 2015.

*Spintharus flavidus* Hentz, 1850 **P** – occurs in the southeastern United States, from Texas to Florida, north to New York. One female was found at MMSF (Monroe Co.) in September 2015.

*Theridion cheimatos* Gertsch & Archer, 1942 – occurs on the East Coast from Ohio to



Florida. This record is a western range extension. The closest previously documented location of this species is in Ohio, 326 km ENE of our record. One male was found from YSF (Brown Co.) in September 2015.

*Thymoites marxi* Crosby, 1906 – occurs in the southeastern United States, from Texas to Florida, north to New York. Two females were found at MMSF (Monroe Co.) in September 2015 and one female at GENP (Johnson Co.) in March 2016. These records represent a NW range extensions for the species. The closest previously documented location of this species is in Tennessee, 329 km S of our record.

### DISCUSSION

Although this study slightly extends the range of *Epiceraticelus fluvialis* and *Tapinocyba emertoni* (west), *Phrurolithus singulus* and *Islandiana cavealis* (north), and *Paracormicularia bicapillata* and *Ummidia tuobita* (east), most of these records are “gap-filling” ones whereby Indiana lacks records of these species’ existence although surrounding states do hold such records. For example, *Araneus cingulatus*, *Agelenopsis emertoni*, *Cyclosa conica*, *Drassyllus fallens*, *Dipoena nigra*, *Enoplognatha caricis*, *Microneta viaria*, *Neon nelli*, *Tenuiphantes sabulosus*, *Walckenaeria brevicornis*, and *Walckenaeria directa* are known from every Midwestern state surrounding Indiana (MI, WI, IL, and OH). An additional piece of evidence for this point is that Sierwald et al. (2005) predicted that 203 new species distribution records would eventually be found in Indiana. Approximately 55% (39/71) of the species we located within the state were on this list of predicted species. These patterns suggest that the lack of records for these species in Indiana is more an artifact of insufficient sampling rather than differences in habitat.

Some of the new records are associated with cave and sinkhole habitats in the karst regions of southern Indiana (*E. pallida*, *I. cavealis*, and *O. beattyi*), where Lewis (2012) reported sampling over 600 caves as well as other karst habitats. In North America, the erigonine (a subfamily of Linyphiidae) linyphiids are well-established in the cooler, northerly latitudes. It is thus not surprising that these spiders would constitute an important part of terrestrial cave communities in Indiana. The troglobite (obligate cave inhabitant) *Phanetta*

*subterranea* is nearly ubiquitous in Indiana caves and *Porrhomma cavernicola* is equally widespread, but more sporadic in occurrence. New records for other troglobitic linyphiids in Indiana have been slow to accumulate as the spiders are difficult to find, but persistence in sampling has resulted in the discovery of a number of rare species. *Oreonitides beattyi* was discovered in caves in the Hoosier National Forest (Lewis et al. 2002) and Big Oaks National Wildlife Refuge (Lewis & Rafail 2002; Paquin et al. 2009). Although rare and seemingly patchy in distribution, *O. beattyi* has proved to be relatively widespread in the east-central United States. *Islandiana cavealis* has been found in Indiana only in Stygian River Cave, despite searching in nearly 200 caves in the Blue River area (Lewis 1998). Likewise, in Indiana *Bathypantes weyeri* has only been found in Guetig Hole, a one-room cave in Washington County (Lewis 1998). This species is cave-limited in a range spanning Arkansas to Virginia (Ivie 1969), but has been reported from surface habitats in eastern Canada (Paquin et al. 2010) and Illinois (Sierwald et al. 2005).

In contrast to the cryophilic erigonines, the presence of another assemblage of spiders is emerging with sampling in Indiana cave entrances and sinkhole floors. These habitats are apparently sufficiently buffered from the extremes of the surface climate in Indiana to provide acceptable habitat for spiders otherwise known from more southerly localities (e.g., *P. singulus*). Unlike the troglobitic linyphiids that are able to thrive in the food-poor environments of deep cave habitats, none of this assemblage of species is particularly cave-adapted and in Indiana these spiders occur in sheltered sinkhole floors and cave entrances, but not deep into caves. In this way, these spiders profit from the sheltered environments while remaining in habitats where prey is abundant.

About half of the species (~44%) mentioned in this study were discovered to exist in Indiana after only 14 months of sampling two locations (MMSF and YSF). While this may be because arachnology in Indiana is a fairly nascent field, the characteristics of several species in our list may have contributed to our knowledge of their recent local existence. For instance, many of the spiders on our list are tiny (< 2 mm), rarely seen, and difficult to identify, even when proper keys are available. For example, the first definitive key to North American linyphiid genera by Draney & Buckle (2005) opened the door to the identifica-

tion of many smaller spiders in the US. Similarly, a key to the female erigonine linyphiids still does not exist (but see Sandlin 2015).

Sierwald et al. (2005) predicted the occurrence of 203 more spider species in Indiana than were known at the time. In this study, we discovered only 39 of those 203 species (19%), indicating that the list of Indiana spiders is far from complete. Moreover, our discovery of 32 spider species that were not even predicted to occur in the state further suggests that there is much more spider diversity present in Indiana than is thought to exist. Our hope is that more extraordinary discoveries about spider diversity will emerge with greater sampling of the diverse array of Indiana habitats and an increase in taxonomic clarity.

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