

First records of *Icius subinermis* (Araneae: Salticidae) in North America, with notes on the local establishment of this species and its behavior in captivity

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Abstract. The first North American records are reported for the jumping spider genus *Icius*. They are based on a series of 8 specimens (3 male, 5 female) of *Icius subinermis* (Simon, 1937) collected on a fence in a city park in Philadelphia, Pennsylvania. Evidence of the wider, synanthropic establishment of *Icius subinermis* in the Philadelphia area is discussed, and preliminary notes on the behavior of this species in captivity are presented.

Keywords. introduced species, Philadelphia

The genus *Icius* was proposed by Simon in 1876 for the Palearctic species *Icius hamatus* (C. L. Koch, 1846), and currently includes 36 nominal species (World Spider Catalog, 2020). Of these 36, all are limited in their distribution to the Old World, except for four: *Icius dishonestus* (Keyserling, 1878), described from Uruguay; *Icius separatus* (Banks, 1903), described from Haiti; *Icius ildefonsus* (Chamberlin, 1924), described from Isla San Ildefonso off the Baja California peninsula in the Mexican state of Baja California Sur; and *Icius pallidulus* (Nakatsudi, 1943), described from Micronesia. Various North American species placed in the genus in decades long past have now been referred to other genera, notably *Tutelina* Simon, 1901. Richman (1988, in Richman & Cutler, 1988 [2008]) listed *I. ildefonsus* among the jumping spiders of Mexico, but wrote, "The genus *Icius* probably does not exist in the New World and the few species left ... will probably be reassigned as specialists get to them."

Here we describe the first records of the genus in North America, based on a series of 8 specimens (3 males, 5 females) collected in the United States: (Pennsylvania, Philadelphia Co., Delaware River Trail at Washington Avenue Green, N39.932825°, W75.142161°, on fence, 21 MAY 2020, coll. Matt Parr). Measurements of body length of these specimens (from anterior median eyes to tip of anal tubercle): five females, mean = 5.1 mm, three males, mean = 4.6 mm. Specimens will be deposited as vouchers in the Biodiversity Institute of the University of Kansas, Lawrence.

These specimens have proven on genitalic examination to be *Icius subinermis* (Simon, 1937), a European species found from the western Mediterranean to Germany and Macedonia (Logunov, 2015) and presumably introduced in North America by anthropogenic means. *I. subinermis* can be distinguished from *I. hamatus*, which it closely resembles and with which it shares a considerable range, by the appearance in the male of a much shorter terminal embolus, a small incurved palpal tibial apophysis, and

a poorly developed cheliceral crest. The female has much shorter insemination ducts than *I. hamatus* (Alicata & Cantarella, 1994).

Based on somatic characters, *Icius subinermis* could be confused in the field with a few of the native species in the area: *Marpissa formosa* (Banks, 1892), which has similar markings but is larger and more slender with heavier, dark forelegs in both sexes; *Pelegrina proterva* (Walckenaer, 1837), in which the dark lateral abdominal markings are broken into small spots; and, less likely, female *Maevia inclemens* (Walckenaer, 1837), in which the abdominal stripes have transverse chevrons posteriorly.

Figure 1 shows the appearance of an *I. subinermis* female with a captured midge (Diptera: Chironomidae); note the pale legs and the lateral abdominal stripes broken into large spots posteriorly. Figure 2 shows a male, its lateral abdominal stripes continuous and its forelegs dark. The lateral abdominal stripes are usually continuous in males and broken posteriorly in females.



Figures 1-2. Photographs of *Icius subinermis* taken in Philadelphia, Pennsylvania, on a fence beside the Delaware River Trail at Washington Avenue Green. **1**, Female with captured midge, May 2020. **2**, Male, June 2019.

Icius subinermis is a northwestern Mediterranean species in its natural range, and it remains common in parts of Portugal, Spain, France, and Italy, where it has a preference for damp habitats such as river banks and wet meadows (Bellmann, 1997). Over the last few decades, the species has also been observed in peridomestic or synanthropic habitats beyond the northwestern Mediterranean: in houses in Geneva, Switzerland (Maurer & Hänggi, 1990); in a greenhouse in Cologne, Germany (Jäger, 1995); in a restaurant garden in Ljubljana, Slovenia (Kostanjšek & Fišer, 2005); in a house in Enschede, Netherlands (Helsdingen, 2006); at an unspecified locality in the city of Jagodina, Serbia (Stanković, 2012); in the parking lot of a used car dealership in Brno, Czech Republic (Šich, 2015); indoors in the Faroe Islands (Lissner et al., 2016); and in an urban park in Budapest, Hungary (Korányi et al., 2017). These observations probably reflect introductions related to human activity; indeed Leroy et al. (2014) have projected that by 2050, under plausible climate change and changing land use scenarios, *Icius subinermis* may extend its range as far north as central Norway.

Icius has so far presented itself in North America only in similarly modified habitats. The specimens described herein were collected on a wooden fence (Figure 3) in a former industrial area, Pier 53, reclaimed in 2014 as a public park, Washington Avenue Green. This is the site of the Washington Avenue Immigration Station, through which more than a million human immigrants arrived in Philadelphia

between 1873 and 1915, subsequently used as a shipping pier before it burned to the ground in 1965 and was abandoned (Brannon & Aarons, 1965; Saffron, 2014). Between the fence and the Delaware River, a narrow strip of invasive vegetation flourishes untended: mugwort (*Artemisia vulgaris* L.), Japanese knotweed (*Reynoutria japonica* Hout.), mulberry trees (*Morus alba* L.), and princess trees (*Paulownia tormentosa* (Thunb.) Steud.).



Figure 3. Fence at Washington Avenue Green, beside the Delaware River, from which specimens of *Icius subinermis* were collected in May 2020.

In addition to the specimens reported here, all collected from a single locality in May 2020, a number of observations posted to the online community science platforms *BugGuide* and *iNaturalist* suggest that *Icius subinermis* may have been present in Philadelphia since at least 2014, and may now be established in a variety of localities across the city. The earliest of these observations, a photograph by Kenneth D. Frank of a spider on a bathroom wall inside his house in Center City, Philadelphia (N39.94779°, W75.18149°), uploaded to *BugGuide* on August 12, 2014 (<https://bugguide.net/node/view/976476>), was tentatively identified by *BugGuide* user "Bothrops07" (Samuel Brown) in June, 2019 as "a juvenile *Icius*, maybe *I. hamatus*." The spider depicted also fits the appearance of the now-confirmed species *Icius subinermis*, which resembles *I. hamatus* in its somatic characters. Frank is believed to be the first to photograph, and Brown the first to recognize *Icius* in the United States.

Subsequent *iNaturalist* observations, consisting of photographs taken between March, 2018 and September, 2020 and uploaded before November 19, 2020, by users Max Cavitch, Michael Long, Matt Parr, Amber Redfield, Julia Slavet, "srag," and Katie Stutzman, depict 16 Philadelphia spiders resembling *I. subinermis*, all of them on anthropogenic structures and surfaces. Most of these spiders have been observed in close proximity to the Delaware River, at various points from Washington Avenue Green in the south (the site of the records described here) to the neighborhood of Northern Liberties in the north (N39.96112°, W75.133369°), a distance of approximately two miles. Further to the west by approximately three miles are three observations from across the Schuylkill River, in the neighborhoods of Belmont (N39.96725°, W75.204575°), Powelton Village (N39.96133°, W75.191863°), and in The

Woodlands cemetery at University City/West Philadelphia (N39.946208°, W75.201426°). One significantly outlying observation, in a natural area near Moorestown, New Jersey (N40.010003°, W74.905531°), most likely does not give evidence of a distinct population; the spider involved was photographed on the vehicle of the observer, who had just driven from Old City, Philadelphia.

Hansen (1982) published notes and data on the natural history of *Icius hamatus*, a species closely related to *I. subinermis*, including the former species' preferred habitats, web-building, courtship and mating habits, egg-deposition, and post-embryonic development. No comparably detailed investigations of *Icius subinermis* are known to exist, an absence that the following notes attempt to begin to remedy. Following collection, the specimens reported herein were sent from Philadelphia to Lawrence, Kansas, in cork-stoppered, single-dram, borosilicate glass shell vials (Bioquip); all survived the 10 days in transit, a journey comparable to the approximately 15 days it now takes a cargo ship to travel from the western Mediterranean to a mid-Atlantic United States port. Captive specimens were maintained in small plastic petri dishes with a piece of a wooden beverage stirrer, and a piece of damp sponge. They fed readily on small leafhoppers and acalypterate flies swept from a backyard lawn.

Three attempted courtship encounters were observed on July 10, 2020. Females were placed in a clear plastic container with a diameter of 10 cm and a height of 4.5 cm. After 1/2 hour a male was introduced. In all three cases upon spotting the female the male extended the front legs straight forward and vibrated the legs close to the prosoma with a short amplitude and approached the female. The females noticed the males, but in only one case was there a close approach. In the case of the one successful mating, after three sidling approaches over an 11-minute period, the male in addition to the front leg vibration raised the abdomen slightly and vibrated it for a very short period, about two seconds. With the legs still extended the male climbed atop the female from the front and tilted the female's abdomen to her left side and applied a palp to the epigynal area. There was obvious swelling and contracting of the palpus. It was unclear if any palpal switching occurred. After approximately eight minutes the male disengaged. They were kept together for another 20 minutes with several approaches by the male but no further interactions. In addition, three male/male interactions were observed in the same arena. Males upon noticing other males either moved away or appeared to ignore each other, without initiating agonistic interaction. There is a strong probability of stridulation being involved in the courtship from the male's vibration of the front legs (Maddison, 1987), but recording equipment was not used to confirm this. The mated female made an eggsac 42 days after copulation. Two first-instar spiderlings were observed 35 days after the sac was noted. The number of eggs were not counted to avoid disturbing the eggsac, but assumed to be a low number.

Icius subinermis joins at least eight other non-indigenous salticids now known to have established populations in the northeastern United States. These include *Salticus scenicus* (Clerck, 1757), probably introduced during the colonial era; *Attulus fasciger* (Simon, 1880) and *Attulus pubescens* (Fabricius, 1775), both present over 50 years ago; *Pseudeuophrys erratica* (Walckenaer, 1826), new in the 1980s; *Myrmarachne formicaria* (De Geer, 1778), noted in upstate New York in 2011 after earlier reports from Ohio; *Hakka himeshimensis* (Dönitz & Strand, 1906), first reported in 2011; *Heliophanus kochii* (Simon, 1868), first reported on the basis of a single specimen in Buffalo, New York, in 2016, and now established in New York City; and *Pseudeuophrys lanigera* (Simon, 1871), to date known only from female specimens collected at two localities in New York City in 2019 (Cutler, 1990 [2008]; Gall & Edwards, 2016; Kaldari et al., 2011; unpublished observations of the authors). Of these, all but *Hakka himeshimensis* are exclusively or principally associated with peridomestic or anthropogenically altered habitats; *Hakka* has been seen to inhabit both manmade riprap and natural rocky areas next to water, both salt and estuarine.

The ecological impacts of these introductions have yet to be studied in any detail, and there is currently no evidence that *Icius subinermis* is spreading rapidly, or that it ought to be considered an invasive species. The population reported here was observed to be directly competing for midge-prey on May 21, 2020, with *Salticus scenicus*, also introduced, in the same microhabitat; over a dozen individuals of each species were observed within a few hours on that day, but none were readily visible on several other occasions. The native *Phidippus audax* (Hentz, 1845) sometimes appears on the same fence; but other native salticids seen in the immediate vicinity, at Washington Avenue Green, including *Tutelina elegans* (Hentz, 1846), *Hentzia palmarum* (Hentz, 1832), *Phidippus clarus* (Keyserling, 1885), *Paraphidippus aurantius* (Lucas, 1833), *Pelegrina galathea* (Walckenaer, 1837), and an undetermined species of *Peckhamia*, probably *P. picata* (Hentz, 1846), have been noted at different times of the year and in different microhabitats, and continue to exist alongside the new arrival.

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