

SHORT COMMUNICATION

An updated list of Opiliones introduced to USA and Canada: a community science project

Shahan Derkarabetian^{1*}, Nicholas Adams^{2*}, Bernard Bal³, Pascal Dubois⁴ and Dylan Jacques-Fero⁵: ¹Department of Organismic and Evolutionary Biology, Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA; E-mail: sderkarabetian@gmail.com; ²Boerne, TX, USA; ³Asters-CEN74, Annecy, Haute-Savoie (74), France; ⁴Maclas, Loire (42), France; ⁵Natick, MA, USA. *Equal contribution

Abstract. Community science has contributed significantly to biodiversity and conservation related research. iNaturalist is a popular community science application, where community-submitted photo documentation of observed taxa has led to a large natural history database. Here, we present results of an iNaturalist project focusing on documenting Opiliones introduced to the USA and Canada. Including all observations made in this project up through 31 December 2021, there were 849 total observations (486 research grade), which included 16 introduced species (excluding multiple species of uncertain status), 11 of which were newly recorded for the USA and Canada. We provide an updated checklist of introduced species, including updated distributions for previously recorded species. This research was facilitated by the community science platform iNaturalist, which allows easy interactions between scientists of all types.

Keywords: BugGuide, community scientist, harvester, harvestmen, iNaturalist

<https://doi.org/10.1636/JoA-S-22-007>

Community science has positively increased appreciation and interest in our planet's biodiversity among the general public by allowing public participation in science in an everyday casual manner. Community participation has contributed to biodiversity and conservation related research (Gardiner & Roy 2022), leading to projects that utilize large-scale community-acquired datasets that are used for many purposes (e.g., Winterton et al. 2012; Neate-Clegg et al. 2020; Putman et al. 2021). One of the most popular community science applications is iNaturalist (online at www.inaturalist.org), where anyone with a camera or cellular phone can submit GPS-tagged organismal observations that are identified by the community, resulting in an extraordinarily large natural history database.

iNaturalist is a critical resource for specimen-based studies; observations inform the distribution of taxa or uncover previously unrecorded or undescribed species, especially in poorly studied taxa like Opiliones (harvesters), which have 62,000+ observations in the US and Canada alone. Many introduced taxa have also been documented, including in Opiliones. In the most recent study focusing on Opiliones species introduced to the USA and Canada, Shear (2016) noted five species that were introduced: *Nemastoma bimaculatum* (Fabricius, 1775), *Oligolophus tridens* (C. L. Koch, 1836), *Opilio parietinus* (DeGeer, 1778), *Paroligolophus agrestis* (Meade, 1855), *Rilaena triangularis* (Herbst, 1799), *Trogulus tricarinatus* (Linnaeus, 1767), and an additional two species, *Mitopus morio* (Fabricius, 1779) and *Phalangium opilio* Linnaeus, 1758, which have an uncertain status as native or introduced. More recently, Cokendolpher & Holmberg (2018) also reported *Lophopilio palpinalis* (Herbst, 1799) from Canada.

This present study provides an updated checklist of Opiliones introduced to the USA and Canada as of 31 December 2021 and is largely based on an iNaturalist project started by author NA (online at www.inaturalist.org/projects/introduced-harvestmen-in-the-us-and-canada). For most species, identifications were made by the authors using the uploaded photographs. For some species, fresh specimens were collected from public lands to confirm identifications; vouchers were deposited in the Museum of Comparative Zoology, Harvard University (MCZ:IZ 162395–162406, 162782, 162783). Authors NA (iNaturalist username: harvestman-man), BB (username: bbinsecte), and PD (username: pdubois) are community scientists and

experts in Opiliones identification and are the top three identifiers of Opiliones on iNaturalist. Author SD (username: sclerobonus) is an academic scientist and the fourth ranked iNaturalist Opiliones identifier. SD and NA are experts in North American Opiliones, BB and PD are experts in the European fauna, where most of the introduced taxa originate. Author DJF (username: dylancreatures) is an avid iNaturalist observer, most importantly in Florida. References to iNaturalist observations are noted in the text as “iNat: [observation number]”, which corresponds to [www.inaturalist.org/observations/\[observation number\]](http://www.inaturalist.org/observations/[observation number]). “Newly introduced” refers to species not previously noted in Shear (2016) or Cokendolpher & Holmberg (2018). The widespread *Phalangium opilio* is the most observed Opiliones (>7900 observations, >4100 research grade), and its status as native or introduced in the US and Canada is uncertain. As such, we did not include this species in our iNaturalist project. Similarly, *Mitopus morio* (Fabricius, 1779) was excluded due to uncertainty as an introduced species, historical taxonomic confusion, and potential cryptic species (Arthofer et al. 2013; Shear 2016; Cokendolpher & Holmberg 2018).

A total of 849 observations (486 research grade) were made through 31 December 2021. Our project only includes observations that were confidently identified by at least one of us. Sixteen introduced species (not including *Mitopus morio* and *Phalangium opilio*) were recorded, 11 of which were newly introduced (Table 1). Six and eight species are newly reported for the USA and Canada, respectively. All previously recorded species have expanded distributions (Table 1), except for *Opilio parietinus*, which showed a substantially smaller distribution than literature records. This pattern is also seen in iNaturalist observations across its native range in Europe, deserving further study. Below we discuss newly introduced species.

Two *Leiobunum* C.L. Koch, 1839 (Sclerosomatidae) species are newly introduced. Specimens of both species were observed and collected from multiple localities in the Pacific Northwest (Washington and British Columbia). (1) *Leiobunum rotundum* (Latreille, 1798) native to western Europe had most observations centered around Vancouver, B.C., extending south along the Interstate 5 corridor to Seattle, Washington, northwest with observations along the coast of Strait of Georgia, and northeast near Kamloops, B.C. (2)

Table 1.—Species introduced to the USA and Canada.

Species	Literature	Community observations	First Sighting Date / Location
Newly recorded species			
<i>Leiobunum rotundum</i> (54)	-	BC* ; WA*	12 August 2012 Renton, WA
<i>Leiobunum blackwalli</i> (32)	-	BC* ; WA*	3 October 2016 Seattle, WA
<i>Dicranopalpus ramosus</i> (19)	-	OR*	20 July 2019 Cannon Beach, OR
<i>Oligolophus hanseni</i> (26)	-	BC ; NB? ; NL? ; NS? ; PE? ; PM?	21 September 2018 Halifax, NS
<i>Opilio canestrinii</i> (12)	-	BC*	19 August 2020 Tsawwassen, BC
<i>Opilio saxatilis</i> (9)	-	ON ; NS	5 September 2016 Coldbrook, NS
<i>Nemastoma lugubre</i> (3)	-	BC* ; NB? ; NS* ; ON? ; QC?	17 July 2019 Québec City, QC
<i>Erginulus subserialis</i> (4)	-	FL*	21 October 2018 Redland, FL
<i>Cynortoides quadrispinosa</i> (23)	-	FL*	9 July 2005 Tamarac, FL
<i>Nelima</i> sp. (5)	-	NS	30 September 2020 Dartmouth, NS
<i>Odiellus</i> sp. (2)	-	NY	21 July 2020 Long Island, NY
Previously recorded species			
<i>Lophopilio palpinalis</i>	NB	-	-
<i>Oligolophus tridens</i> (92)	AB; BC; NB; NL; NS; ON; PE; QC; SK; ME; VT	AB ; BC ; MB ; NL ; NS ; ON ; QC ; AK ; MA ; ME ; MI ; MN ; NH ; NY ; VT ; PM	-
<i>Opilio parietinus</i> (12)	AB; BC; MB; ON; SK; QC; CO; IA; ID; IL; MA; ME; MI; MT; ND; NE; NH; NM; NY; OH; PA; SD; TX; UT; VT; WI; WY	AB ; BC ; NB ; NS ; QC	-
<i>Paroligolophus agrestis</i> (106)	AB; BC; NS; WA	BC ; NS ; OR* ; WA	-
<i>Rilaena triangularis</i> (385)	BC; NS; MA; ME; NY; WA	BC ; NB ; NS ; ON ; PE ; QC ; AK ; ID ; MA ; ME ; MI ; MN ; NH ; NY ; VT ; WA	-
<i>Nemastoma bimaculatum</i>	ON; QC	NB? ; ON? ; QC?	-
<i>Trogulus tricarinatus</i> (6)	MA; NY	QC ; CT ; MA* ; NY	-

Notes: Literature records based on Cokendolpher & Lee (1993), Bragg & Holmberg (2009), Cokendolpher & Holmberg (2018), Shultz (2019), and Marullo-Masson & Charron (2022). For community observations, state/provinces in bold indicate new records, asterisks (*) indicate specimens collected, question marks (?) indicate uncertain species identifications. Numbers in parentheses indicate the number of observations in iNat (as of Dec. 31 2021). Abbreviations correspond to Canadian provinces or US states: AB = Alberta; BC = British Columbia; MB = Manitoba; NB = New Brunswick; NL = Newfoundland and Labrador; NS = Nova Scotia; ON = Ontario; PE = Prince Edward Island; QC = Québec; SK = Saskatchewan; AK = Alaska; CO = Colorado; IA = Iowa; ID = Idaho; IL = Illinois; FL = Florida; MA = Massachusetts; ME = Maine; MI = Michigan; MN = Minnesota; MT = Montana; ND = North Dakota; NE = Nebraska; NH = New Hampshire; NM = New Mexico; NY = New York; OH = Ohio; OR = Oregon; PA = Pennsylvania; SD = South Dakota; TX = Texas; UT = Utah; VT = Vermont; WA = Washington; WI = Wisconsin; WY = Wyoming; PM = Saint Pierre & Miquelon.

Leiobunum blackwalli Meade, 1861 native to western Europe, had observations from southern B.C. (including Vancouver, Richmond, Burnaby, and Abbotsford), northern Seattle, and a single observation from Hope, B.C. All observations are associated with suburban areas. In some locations, both species occur syntopically. They can be distinguished from each other by the color of the ocularium, which is mostly black in *L. rotundum* and pale with a thin black center line in *L. blackwalli*.

Four species of Phalangiiidae are newly recorded. (1) *Dicranopalpus ramosus* (Simon, 1909), commonly called the “Fork-palped Harvester,” is native to the western Mediterranean, but has spread northward since the late 1960s (Wijnhoven & Prieto 2015, and references therein). *Dicranopalpus ramosus* was recorded from multiple observations in Cannon Beach, Oregon, associated with buildings. This species can be easily recognized by its deeply forked palps and unique

resting posture (e.g., iNat: 95004471), although in Europe it can be difficult to tell apart from *D. caudatus* Dresco, 1948. (2) *Oligolophus hanseni* (Kraepelin, 1896) native to northern Europe and western Russia, is newly recorded from Queen Elizabeth Park in Vancouver, B.C. from a single well photographed observation, and from several observations across New Brunswick, Nova Scotia, Prince Edward Island, and Saint-Pierre (although a collectivity of France, we include it here). (3) *Opilio canestrinii* (Thorell, 1876), native to Italy but considered introduced in many European countries, is newly recorded from a small region near Delta, B.C. with multiple observations from forested parts of Ladner Harbour Park and suburban neighborhoods of the Tsawwassen peninsula, and a single potential observation from southern Ontario. Most observations are associated with housing or other human development. (4) *Opilio saxatilis* C.L. Koch, 1839 native to parts of Europe, is newly recorded from southeastern Canada, with

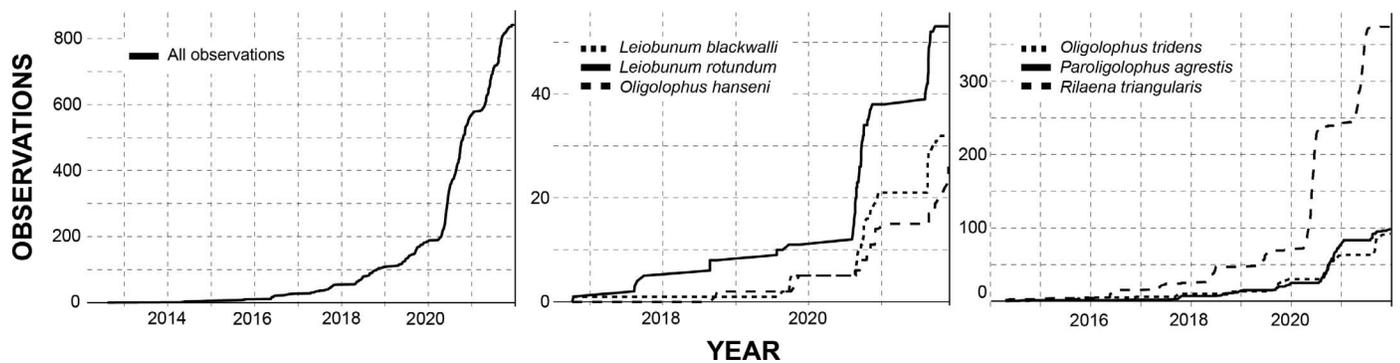


Figure 1.—Cumulative observations through time for all observations across all species in the project (left), three newly recorded introduced species (middle), and three previously recorded introduced species (right). Note varying axes.

observations from suburban areas of Toronto, Sudbury (Ontario), and localities across Nova Scotia. Regarding the previously recorded introduced species *Lophopilio palpinalis*, native to northern Europe, we have not identified any iNaturalist observations from US or Canada. Even in its native range there are relatively few observations, as they live in forest litter.

A single species of Dyspnoi in the family Nemastomatidae is newly recorded. *Nemastoma lugubre* (Müller, 1776), native to Europe and western Russia, was recorded from Vancouver, B.C. in a small patch of forest near the Iona Island Treatment Plant just north of Vancouver International Airport (iNat: 95006485). We also acquired a male from near Canning, Nova Scotia (iNat: 102549565). Both records were confirmed as *N. lugubre* based on male genitalia. Regarding the previously recorded species *Nemastoma bimaculatum*, Shear (2016) noted records from Montréal, Québec derived from LeSage (1977) and added an additional record from Toronto, Ontario. Recently, Marullo-Masson & Charron (2022) confirmed *N. bimaculatum* in Québec via male genitalia. iNaturalist observations included records of *Nemastoma* from forested suburban regions from both Québec City and Toronto, with additional observations from across Nova Scotia and a single observation from southern New Brunswick. *Nemastoma* can be difficult to identify from photos, and these two species have a confusing taxonomic history – *N. lugubre* was once considered a subspecies of *N. bimaculatum* – making verifying historical records difficult. As such, many eastern observations were left at the genus level, and marked “uncertain” in Table 1. Similarly, the previously recorded *Trogulus* is difficult to identify to species from photos. Our recently collected specimens were all females (iNat: 110871671) preventing species confirmation. However, the COI barcode of one specimen (GenBank ON478153) is most similar to *T. tricarinatus* (GenBank KX537373), although this is not conclusive confirmation of species identity.

Two species in the largely tropical family Cosmetidae are newly recorded from southern Florida. Specimens for both species were collected from the same locality and observation event (iNat: 69987164). (1) *Erginulus subserialis* Pickard-Cambridge, 1905, a large and easily recognizable species, had four observations from suburban and agricultural areas in southern Miami-Dade County. This species is native to Central America from southern Mexico to Costa Rica, where it is commonly observed. (2) *Cynortoides quadrispinosa* Goodnight & Goodnight, 1942 native to Jamaica. Observations have been made in its native distribution (iNat: 97850852). This species had twenty-three iNaturalist observations from urban and suburban areas in Miami-Dade and Broward counties. BugGuide (bugguide.net) also has several observations of *C. quadrispinosa* from the same areas. This species was commonly misidentified as *Vonones ornatus* (Say, 1821) (now in *Libitoides* Roewer, 1912), but is easily differentiated based on the number and size of dorsal spines, location and curvature of the yellow pigmented band on the dorsum, and color of the leg femora in

relation to body color. For visual comparisons, see observations of *C. quadrispinosa* (iNat: 71169819) and *V. ornatus* (iNat: 13960733).

We also note two taxa of uncertain species identity that are not conspecific to native species of the USA and Canada. First, there were multiple observations of a species of *Nelima* Roewer, 1910 from agricultural and residential areas of Nova Scotia. Second, there were two observations of *Odiellus* Roewer, 1923 from a forested suburban area of Long Island, NY. These are similar to *O. spinosus*, but confirmation was not possible as fresh specimens could not be obtained.

Among all newly recorded species, six are from the Pacific Northwest, centered around Seattle and Vancouver, three from northeastern US and southeastern Canada, and two from southern Florida. The two species from Florida represent the first records of introduced Laniatores. All introduced species in the northern US and Canada are native to Europe, North Africa, or southwestern Asia / Caucasus, while those introduced to Florida are from Central America and Jamaica. Not surprisingly, many of the observations are highly localized around large metropolitan areas with international ports of entry. The presence of multiple newly introduced species in southern Florida is not surprising given the abundance and diversity of introduced species in this area.

Most of the newly recorded species were observed relatively recently, but the oldest observation dates to 2005. Two newly introduced species had observations which occurred prior to Shear (2016): *Lejobunum rotundum* in 2012 (iNat: 34985864) and *Cynortoides quadrispinosa* in 2005 (online at <https://bugguide.net/node/view/23737>). For *L. rotundum*, 10 further observations were made between 2016 and 2019, and 41 observations were made in 2020 and 2021. Similar trends in observations were evident in other commonly encountered species, including those that were established prior to Shear (2016) (Fig. 1), indicating this underlying trend is likely due to the increasing popularity of iNaturalist since its inception in 2014. We note, initial introductions for each of these species could have taken place earlier than the earliest observations noted in Table 1. However, our inspections of both recent and historical Opiliones material in natural history museums with significant collections (Seattle area – Burke Museum; Florida – Museum of Comparative Zoology) did not uncover any of these newly introduced species.

Community scientist participation has been critical in finding, identifying, and collecting introduced Opiliones. There are shortcomings to iNaturalist, like the difficulty of identifying some taxa (like Opiliones) from photos, and “false research grade” observations, which have been discussed at length in the iNaturalist forums (e.g., <https://forum.inaturalist.org/t/false-research-grade-observations/14193>). In our experience, most of these issues can be resolved with direct communication between observers and identifiers on a case-by-case basis. This present study was easily facilitated through

iNaturalist by providing an accessible forum for easy communication, collaboration, and dissemination of information between different types of scientists with different experience and backgrounds who all share the same interests. Our community-scientist maintained iNaturalist project serves as an updated (and ongoing) checklist of introduced Opiliones, and this report serves as a baseline for future changes in their distribution. Future work should identify the origin and timing of introductions using genetic data, which would also clarify the species whose status as introduced or native is still uncertain.

ACKNOWLEDGMENTS

We thank the many community scientists who contributed observations on iNaturalist. Rod Crawford sent detailed lists of identified Opiliones held in the Burke Museum. Paula Rodríguez Flores expertly sequenced COI for *Trogulus*. Ian Paterson (iNat username: ipat) kindly sent *Nemastoma* from Nova Scotia. We thank Brittany Damron and Stuart J. Longhorn for initial discussions on the introduced Cosmetidae. We thank Jeff and Liz Christner for providing accommodation for author NA to collect in the Pacific Northwest. We thank Mark Harvey, Jeffrey Shultz, and Sarah Boyer for constructive comments during review. No external funding was used; all effort by the authors was voluntary and associated costs were paid for personally.

LITERATURE CITED

- Arthofer W, Rauch H, Thaler-Knoflach B, Moder K, Muster C, Schlick-Steiner BC et al. 2013. How diverse is *Mitopus morio*? Integrative taxonomy detects cryptic species in a small-scale sample of a widespread harvestman. *Molecular Ecology* 22:3850–3863.
- Bragg PD, Holmberg RG. 2009. The harvestmen (Arachnida, Opiliones) of British Columbia. *Journal of the Entomological Society of British Columbia* 106:29–37.
- Cokendolpher JC, Holmberg RG. 2018. Harvestmen of the family Phalangidae (Arachnida, Opiliones) in the Americas. *Special Publications, Museum of Texas Tech University*. No. 67:1–44.
- Cokendolpher JC, Lee VF. 1993. Catalogue of the Cyphopalpatores and bibliography of the harvestmen (Arachnida, Opiliones) of Greenland, Canada, USA, and Mexico. Vintage Press, Lubbock, Texas.
- Gardiner MM, Roy HE. 2022. The role of community science in Entomology. *Annual Review of Entomology*, 67:437–456. doi:10.1146/annurev-ento-072121-075258
- LeSage L. 1977. Première mention de *Nemastoma bimaculatum* (Fabricius) pour l'Amérique du Nord (Opiliones: Nemastomatidae). *Naturaliste Canadien* 104:485.
- Marullo-Masson D, Charron J. 2022. Redécouverte de *Nemastoma bimaculatum* (Fabricius 1775) (Opiliones: Nemastomatidae) sur le Mont Royal. *Hutchinsonia* 2:68–70.
- Neate-Clegg MH, Horns JJ, Adler FR, Aytekin MÇK, Şekerçioğlu ÇH. 2020. Monitoring the world's bird populations with community science data. *Biological Conservation* 248:108653.
- Putman BJ, Williams R, Li E, Pauly GB. 2021. The power of community science to quantify ecological interactions in cities. *Scientific Reports* 11:1–8.
- Shear WA. 2016. New Canadian records of *Nemastoma bimaculatum* (Fabricius), and a brief summary of introduced Eurasian harvestmen in North America (Arachnida, Opiliones). *Zootaxa* 4088:139–140.
- Shultz JW. 2019. Opiliones of Canada. *ZooKeys* 819:57–65.
- Wijnhoven H, Prieto CE. 2015. *Dicranopalpus caudatus* Dresco, 1948: Not a synonym of *Dicranopalpus ramosus* (Simon, 1909) but a valid species after all (Arachnida, Opiliones). *Revista Ibérica de Aracnología* 26:25–34.
- Winterton SL, Guek HP, Brooks SJ. 2012. A charismatic new species of green lacewing discovered in Malaysia (Neuroptera, Chrysopidae): the confluence of citizen scientist, online image database and cybertaxonomy. *ZooKeys* 214:1–11.

Manuscript received 9 February 2022, revised 14 May 2022, accepted 16 May 2022.