Nemobius sylvestris (Orthoptera, Trigonidiidae, Nemobiinae) in North America

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Abstract

The wood cricket *Nemobius sylvestris* (Bosc, 1792) is herein reported in North America for the first time. The species is currently known to be established in the vicinity of Rochester, New York, and Seattle, Washington, indicating two separate introductions. It is unclear when the species was first introduced to the region, nor what its potential ecological effects may be. The presence of this species in the USA was first noted via photos posted to iNaturalist, highlighting the value of citizen/community science platforms in detecting novel introductions.

Keywords

introduced species, United States

Introduction

Introduced insect species in North America have been of significant public interest in recent years due to the establishment and subsequent spread of major invasive pests such as the emerald ash borer *Agrilus planipennis* Fairmaire, 1888, and spotted lanternfly *Lycorma delicatula* (White, 1845) (Herms and McCullough 2014, Lee et al. 2019). The insect order Orthoptera contains some of the world's most significant pest species, including the desert locust *Schistocerca gregaria* Forsskål, 1775 (Song 2004), yet of the approximately 18 nonnative species of Orthopterans established in North America, only five have reached pest proportions, all crickets. Three species of South American *Neoscapteriscus* Cadena-Castañeda, 2015, mole crickets established for decades in the southern USA are major turfgrass pests but have been controlled in recent years due to the combined efforts of several different biocontrol agents (Frank and Walker 2006). The European mole cricket *Gryllotalpa gryllotalpa* (Linnaeus, 1758), introduced into the northeastern USA, was responsible for root damage in nurseries in New Jersey (Weiss 1915). An unidentified species of *Orocharis* (currently misidentified on SINA as *Xenogryllus unipartitus* (Karny, 1915) (Tony Robillard pers. com.) caused damage to lychee groves in Homestead, FL, during the 1990s (SINA 2021). Introduced members of other orthopteran families, such as Tettigoniidae (katydids), have not affected humans so far and appear to have negligible ecological impact.

Newly introduced organisms may be noticed first by private citizens. Recently, citizen/community platforms such as iNaturalist.org have provided the first detection for numerous introduced species and helped in tracking the expanding ranges of such species (Agarwal 2017, Pelozuelo et al. 2020). In this note, I report on the establishment of a European species of cricket, *Nemobius sylvestris* (Bosc, 1792) (Orthoptera: Trigonidiidae), in the USA that was first detected via iNaturalist. This species is native to much of Europe and northern Africa, where it occurs in the leaf litter of open deciduous woodland edges (Brouwers and Newton 2009). It exhibits a two-year life cycle in the UK in which overwintering eggs hatch in June/July, nymphs develop to 5th instar by fall, overwinter in leaf litter, and mature the following summer (Gabbutt 1959). The species is widespread in its native range but is listed as a species of conservation concern in the UK due to its need for intact woodland habitats (Brouwers and Newton 2009).

Materials and methods

Records.—Photos of an unidentified cricket species were posted to iNaturalist by several different users in late 2020 and early 2021. The author discovered these images while identifying Orthopteran images on the website and recognized that they did not represent any native North American species. Additional records from iNaturalist were found by searching for observations of crickets in the vicinity of the previously located observations, as well as in other states bordering the east and west coasts. The crickets pictured were tentatively determined to be *Nemobius sylvestris* based on comparisons with photos from the Orthoptera Species File online (Cigliano et al. 2021). The author visited the locality of the most recent New York iNaturalist photo on May 24th, 2021 and collected seven nymphs. These individuals were taken into captivity and reared on a diet of carrots, lettuce, and fish flakes. Identification was verified using Vickery and Johnstone (1970) from the adult specimens once these individuals matured. A male and female of *Allonemobius socius* (Scudder, 1877), collected in College Station, Texas, were utilized for comparisons.

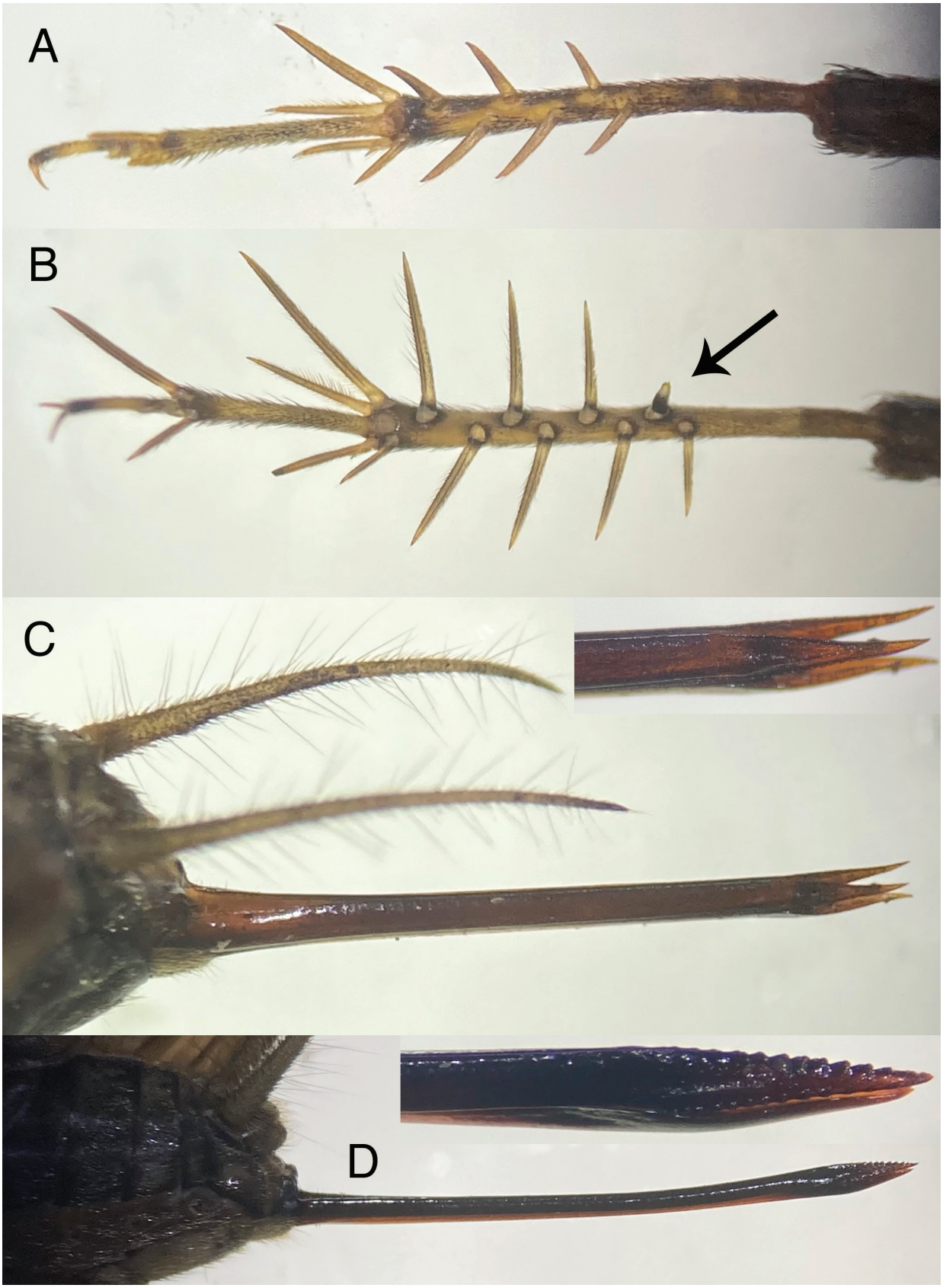

Fig. 1. Morphological characters of *Nemobius sylvestris* compared to *Allonemobius socius.* **A**. *N. sylvestris* male right hind tibia, dorsal view; **B**. *A. socius* male right hind tibia, dorsal view. Arrow points to glandular tibial spine; **C**. *N. sylvestris* ovipositor. Inset shows detail; **D**. *A. socius* ovipositor. Inset shows detail.

Photographs and maps.—Photographs of living specimens were taken using a Canon EOS Rebel T3 with attached Canon 100 mm macro lens and an external flash (Sunpak Auto 383 Super connected with a CowboyStudio 4 Channel Wireless Hot Shoe Flash Trigger and Receiver). Details of the hind tibiae and ovipositor were photographed using an iPhone and a Leica ES2 dissecting scope. All images were processed using Adobe Lightroom CC to crop and adjust white balance. Composite figures were put together with Adobe Photoshop CC. Maps were created with SimpleMappr (Shorthouse 2010). GPS data were acquired using Google Maps.

Specimens.—Specimens are deposited at the Cornell University Insect Collection (CUIC, Ithaca, NY, USA) and the Texas A&M University Insect Collection (TAMUIC, College Station, TX, USA).

Results

Nemobius sylvestris (Bosc, 1792)

Material examined.—USA • 4♂, 3♀; New York, Monroe Co, Channing H. Philbrick Park; 43.127598, -77.482463; 24 May 2021; B. Woo leg;. 1♂, CUIC; 3♂, 3♀, TAMUIC • 1 nymph; same locality; 08 May 2021; https://www.inaturalist.org/observations/78163683 • 1 nymph; same locality; 26 May 2021; https://www.inaturalist.org/observations/80436300 • 1 nymph; same locality; 03 June 2021; https://www.inaturalist.org/observations/82337154 • 1 nymph; same locality; 25 June 2021; https://www.inaturalist.org/observations/84491906 • 1♀; Univ. of Rochester River Campus; 43.131557, -77.631649; 11 September 2020; https://www.inaturalist.org/observations/65836637 • 1♂; MLK Jr. Memorial Park; 43.154131, -77.6023841; 16 July 2021; https://www.inaturalist.org/observations/87327902 • 1 nymph; Washington; King Co.; Renton; 47.4827, -122.225945; 12 May 2021; https://www.inaturalist.org/observations/78524305 • 1 nymph; SeaTac Park; 47.481667, -122.313611; 07 May 2021; https://www.inaturalist.org/observations/82370524 • 1♀; Renton; 07 November 2020; https://www.inaturalist.org/observations/64390177 • 1 nymph; 106th Ave NE; 47.701607, -122.198671; 23 October 2020; https://www.inaturalist.org/observations/63410553 • 1 nymph; Renton; 47.492725, -122.180177; 08 July 2020 https://www.inaturalist.org/observations/52450292 • 1 nymph; Codiga Park; 47.489145, -122.26908; 26 April 2020; https://www.inaturalist.org/observations/43798862 • 1♀; McAuliffe Park; 47.704563, -122.197816; 06 October 2019; https://www.inaturalist.org/observations/34487275 • 1♀; Bothell Landing Park; 47.756939, -122.210152; 07 October 2018; https://www.inaturalist.org/observations/17427199 • 1 nymph; Hitt's Hill Park; 47.55413, -122.285381; 28 April 2018; https://www.inaturalist.org/observations/11708950 • 1 nymph; same locality and date; https://www.inaturalist.org/observations/11708950 • 1 nymph; Lewis Creek Park; 47.550518, -122.124166; 25 May 2017; https://www.inaturalist.org/observations/29595726 • 1♂; White Center; 01 November 2014;https://www.inaturalist.org/observations/1082123 • 1♀; Westcrest Park; 01 November 2014; https://www.inaturalist.org/observations/1054939 • 1 nymph, Pierce Co.; 3rd St. E; 47.257305, -122.180313; 20 June 2020; https://www.inaturalist.org/observations/50369172.

Characters to separate from native North American crickets.—The genus *Nemobius* currently includes six species distributed in the Old World and in the Neotropics, although Barranco et al. (2013) reviewed these six species and concluded that only *N. sylvestris* (the type species of the genus) and their newly described *N. interstitialis* Barranco, Gilgado & Ortuño, 2013, are likely to belong in the genus. *N. interstitialis* can be ruled out since it lacks tympana, possesses differently shaped tegmina, and occurs in a restricted, partially subterranean, rocky habitat (Barranco et al. 2013). Historically, the entire Nemobiine fauna of the USA was included in *Nemobius* (Hebard 1913) before being split into five different genera by Vickery and Johnstone (1970): *Allonemobius*, *Eunemobius*, *Neonemobius*, *Pictonemobius*, and *Hygronemobius*. *Nemobius sylvestris* can be separated from all other members of the subfamily present in North America by several morphological characters, most notably the absence of glandular hind tibial spines in the male (present in males of all North American genera) and female ovipositor shape and tooth dentation (Fig. 1). The ovipositor is straight,about as long as the hind femur, and without teeth. Straight ovipositors are also found in *Allonemobius* and *Pictonemobius*, but these genera possess large teeth on the upper valves (Vickery and Johnstone 1970). The distoventral spurs of the hind tibiae of *Nemobius* are unequal in length, with the inner spur slightly shorter than the outer. In the North American genera, these spurs are either equal in length or the inner spur is much longer than the outer. In the field, both adults and nymphs of *N. sylvestris* may be recognized by their unique color pattern, which is unlike any other North American nemobiine: head black with pale Y-shaped marking, and pronotum very pale with dark speckles (Figs 2, 3).

In Washington (WA), the only other nemobiine species present is *Allonemobius fasciatus* (De Geer, 1773), which has the distoventral spurs more robust, with the inner spur longer than the outer. It also has a toothed ovipositor as described above, as well as longitudinal stripes on the head that are absent in *Nemobius. A. fasciatus* occurs in open grassy meadows as opposed to the woodland leaf litter habitat of *N. sylvestris*.

In New York (NY), there are five species of *Allonemobius*, two of *Neonemobius*, and one of *Eunemobius*. These are all readily distinguishable from *Nemobius* by the hind tibial spur armature, ovipositor shape, and color patterns. All of these species are also univoltine, with only eggs overwintering. Habitat is another useful clue—of the eight native NY species, only three habitually inhabit woodland leaf litter.

Habitat and phenology in New York State.—At Channing H. Philbrick Park, nymphs (Fig. 2) were collected in leaf litter of a small patch of forest surrounded by suburbs. Although the major forest trees were native species, such as *Platanus occidentalis* L., most of the lower vegetation in the area consisted of introduced invasive European plants, including *Chelidonium majus* L., *Vincetoxicum rossicum* (Kleopow) Barbar., *Artemisia vulgaris* Burm.f., *Alliaria petiolata* (M.Bieb.) Cavara & Grande, *Vinca minor* L., and *Hedera helix* L.. Nymphs of *Nemobius sylvestris* were easy to collect as they were far less active than native NY ground crickets (pers. obs.). Individuals cohabitated well and were never seen to cannibalize. In captivity under similar temperature conditions to outdoors, the first male matured on June 20th and the first female on June 28th.

Discussion

This note represents the first documented occurrence of *Nemobius sylvestris* in North America and is also the first Nearctic record of the genus *Nemobius* as currently defined; a thorough taxonomic revision of the genus is needed. As in its native range, the species overwinters as mid-instar nymphs here, with adults living from

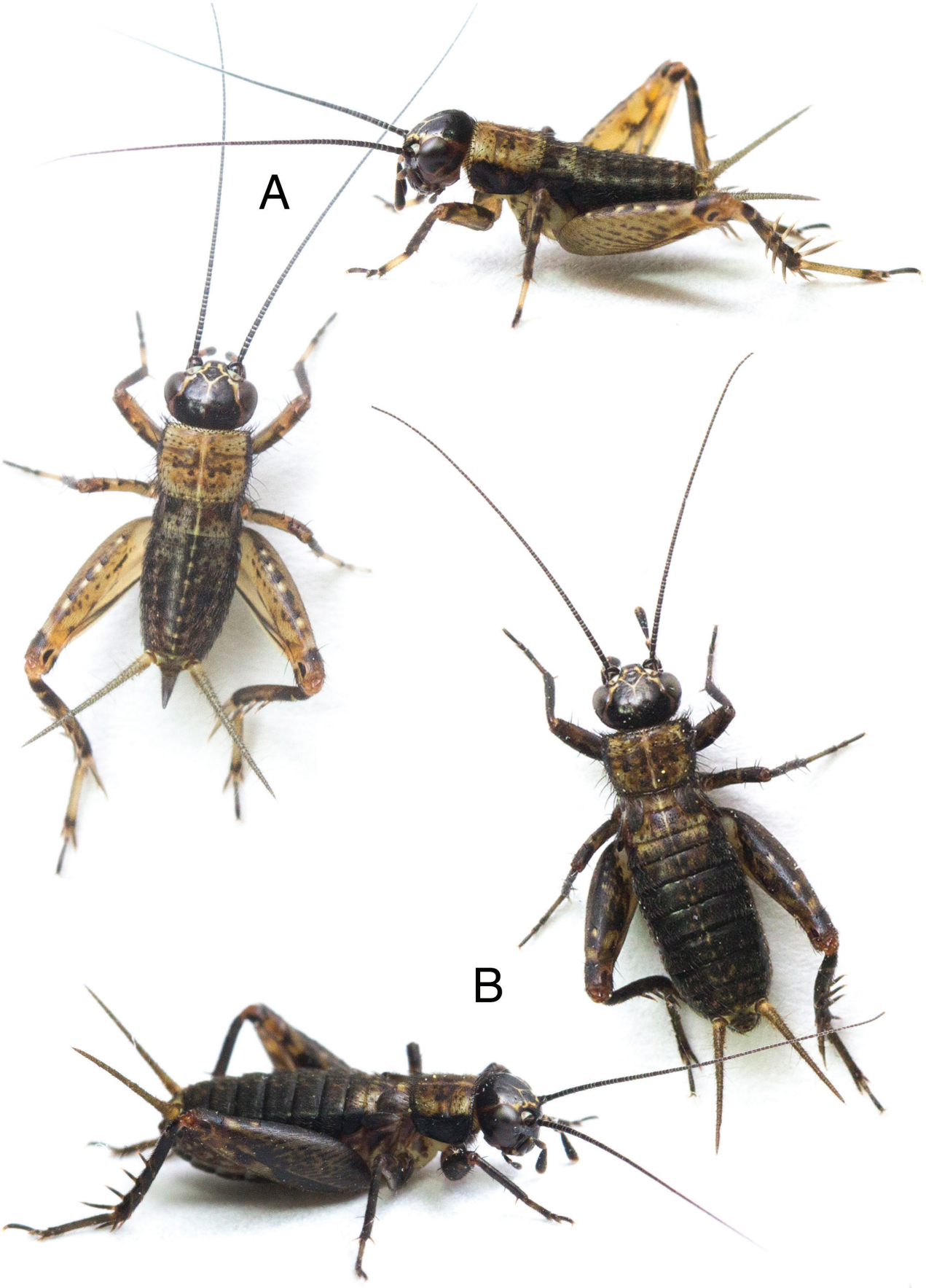

Fig. 2. *Nemobius sylvestris* female (**A**) and male (**B**) nymphs from Channing H. Philbrick Park.

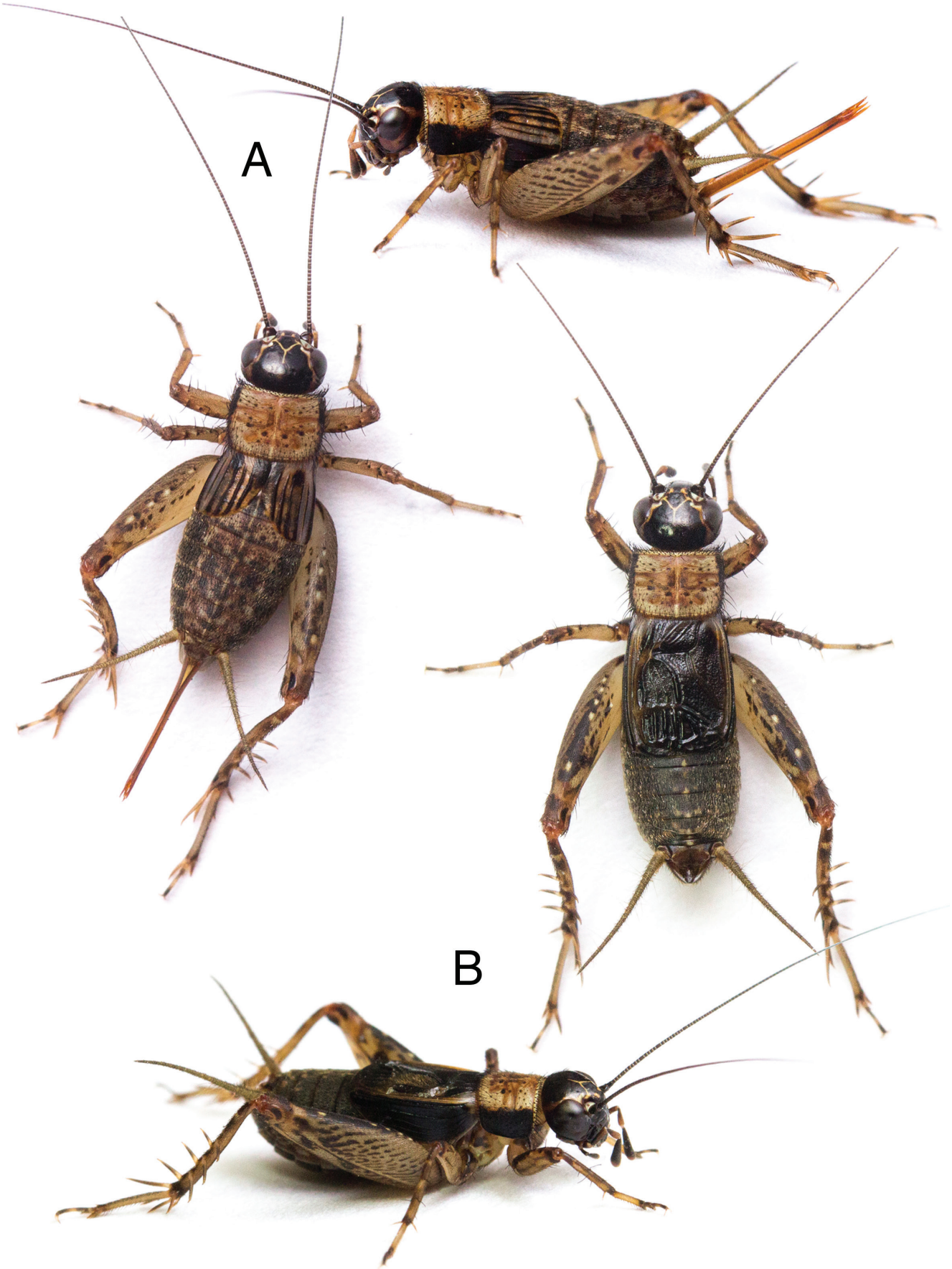

Fig. 3. *Nemobius sylvestris* female (**A**) and male (**B**) adults from Channing H. Philbrick Park.

Fig. 4. Current documented distribution of *Nemobius sylvestris* in the USA.

early summer until fall. Further work would be needed to confirm the presence of the two-year life cycle in North American populations. In searching through cricket images from across the USA, the author was only able to find putative *Nemobius* images from WA and NY. These two widely separated populations (Fig. 4) are around cities with much commerce and international exchange. The WA population has been present since at least 2014 and is so far known only from photos; although the insects in the photos are readily separable from any other cricket species occurring in the area based on color pattern, specimens should be collected from this area to properly document their presence. The NY population has been present since at least 2020. It is unknown how long the species has actually occurred in the USA, since it is inconspicuous and does not occur in homes or damage agricultural crops. *N. sylvestris* is unlikely to become a pest due to its generalist feeding habits and current restriction to habitats containing mainly introduced species. It may, however, eventually spread to more intact native forests, where its effects on native leaf litter fauna cannot be predicted. There is another introduced European Orthopteran in the Rochester NY area, *Leptophyes punctatissima* (Bosc, 1792), that has also apparently escaped notice for quite some time and continues to have a restricted range (SINA 2021). Genetic comparisons of the introduced populations with those in Europe would be warranted to determine their exact origins. The introduced populations of these Orthopteran species should be monitored to detect range expansions or any negative effects on native flora and fauna.

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