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First Records of *Perdita bequaerti* (Hymenoptera: Andrenidae) from New England

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ABSTRACT: We document the first New England records of the bee *Perdita bequaerti* Viereck. *Perdita bequaerti* is a specialist on Asteraceae flowers, especially *Helianthus*, and is native to much of eastern North America, where it is often associated with predominantly sandy habitats. Previous records indicated *P. bequaerti* reached the northeastern extent of its range in the state of New York, but in August 2019, during a survey of bees on *Helianthus*, we collected five specimens of *P. bequaerti* at two sites in western Massachusetts. Both sites were located on small-scale farms with abundant non-native *Helianthus*, on soils characteristic of sandy outwash plains and silty floodplains. These records constitute an extension of *P. bequaerti*'s known range into New England.

KEYWORDS: Apoidea, bees, *Helianthus*, sunflowers, range extension, Massachusetts

The genus *Perdita* Timberlake includes over 600 species of mostly oligolectic bees from North and Central America and the Caribbean (Michener, 2007; Ascher and Engel, 2012; Portman *et al.*, 2016), making it the most diverse North American bee genus (Portman and Griswold, 2017). *Perdita* are most diverse and abundant in arid regions of northern Mexico and the southwestern United States (Danforth, 1989, 1991; Michener, 2007; Portman *et al.*, 2016), with fewer than 30 species found east of the Mississippi River (Mitchell, 1960; Ascher and Pickering, 2020) and only four species previously recorded from New England (Ascher and Pickering, 2020). All *Perdita* are small, ranging from 2 to 9 millimeters (mm) in length (Michener, 2007), and are typically ground-nesters in sandy soils (Eickwort, 1977; Portman *et al.*, 2016), with several species known to nest communally (Michener, 1963; Danforth, 1989, 1991). Within the eastern United States, two *Perdita* species, *P. albipennis* Cresson and *P. bequaerti* Viereck, are morphologically distinctive due to the females' strongly recurved mandibles, in contrast to the elongated mandibles of the males (Mitchell, 1960). Together, these two species comprise the sole representatives of the subgenus *Cockerellia* in this region (Mitchell, 1960).

Perdita bequaerti has been recorded from Florida north to New York, and west to Minnesota, Missouri, and New Mexico (Mitchell, 1960; Deyrup *et al.*, 2002; Bried and Dillon, 2012; Ascher

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and Pickering, 2020; SCAN, 2020). *Perdita bequaerti* is fairly large for the genus at 7–8 mm, and is sexually dimorphic in coloration, with females having more extensive yellow markings on the face and abdomen than males (Mitchell, 1960). Little data has been published on *P. bequaerti*'s nesting biology, but Deyrup *et al.* (2002) mentioned that it is a communal nester. *P. bequaerti* is oligolectic on flowers in the Asteraceae, with an apparent preference for *Helianthus* (sunflowers) (Mitchell, 1960; Grundel *et al.*, 2011; Hall and Ascher, 2011; Rowe *et al.*, 2018). However, it sometimes visits flowers of several other Asteraceae genera, including *Balduina*, *Coreopsis*, and *Solidago* (Deyrup *et al.*, 2002; Grundel *et al.*, 2011; Hall and Ascher, 2011; Rowe *et al.*, 2018), and it has been recorded specializing on *Balduina angustifolia* (Pursh) B.L. Rob. in a south-central Florida ecosystem where *Helianthus* is absent (Deyrup *et al.*, 2002; Weekley *et al.*, 2006). Mitchell (1960) reported *P. bequaerti* floral records on *Physalis* (Solanaceae), but these may be in error, as the original source of these observations (Robertson, 1929) actually refers to a synonym of *Perdita halictoides* Smith, a *Physalis* specialist. There are two other isolated records of *P. bequaerti* visiting non-Asteraceae flowers, on *Monarda punctata* L. (Lamiaceae) (Grundel *et al.*, 2011) and *Polygonella gracilis* Meisn. (Polygonaceae) (SCAN 2020).

During late July through September, 2019, we conducted a survey of bees on *Helianthus* at 14 farms in the Connecticut River Valley of western Massachusetts. Out of more than 1100 bees sampled during this project, we collected five specimens of *P. bequaerti* (Fig. 1) from two farms. On 14

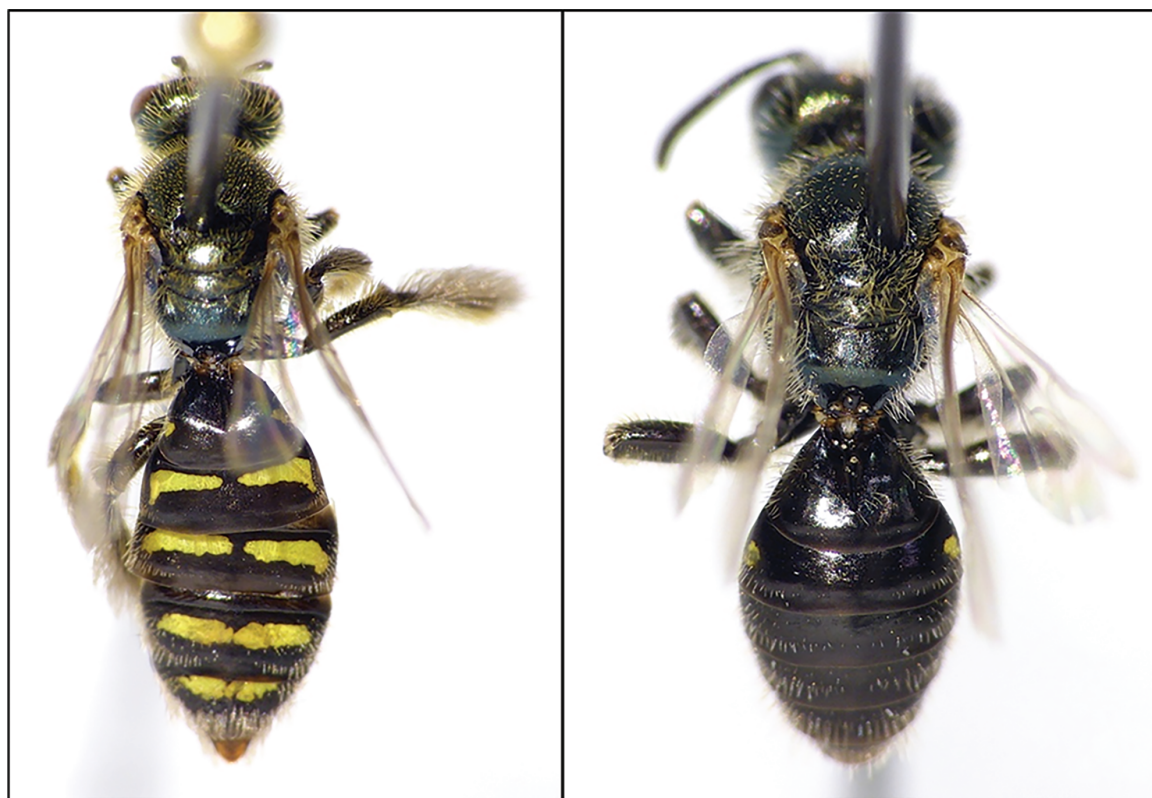


Figure 1. Female (left) and male (right) *P. bequaerti* from Hadley, MA. Photo credit: J. C. Roch.

August 2019, we collected a single female *P. bequaerti* on *Helianthus annuus* L. at Golonka Farm in Hatfield, Massachusetts (42.4147°N -72.6134°W). Roughly two weeks later, on 29 August 2019, we collected four more individuals of *P. bequaerti* (one female and three males) at Astarte Farm in Hadley, Massachusetts (42.3380°N -72.5994°W). Two males were collected from *Helianthus annuus*, while the female and a third male were collected from *Helianthus maximiliani* Shrad. Both females clearly exhibited the highly reflexed mandibles characteristic of the subgenus *Cockerellia* (Fig. 2). These five specimens represent the first records of *P. bequaerti* from New England, with



Figure 2. Face of female *P. bequaerti* from Hatfield, MA, showing the strongly recurved mandibles. Photo credit: J. C. Roch.

the closest previous records over 100 kilometers (km) to the west-northwest (Fig. 3), at Albany Pine Bush Preserve in New York (Bried and Dillon, 2012). All five specimens are vouchered at the Museum of Comparative Zoology at Harvard University.

The two Massachusetts *P. bequaerti* sites are relatively similar in terms of overall habitat. Both sites are on fairly small-scale, low-intensity farms in Hampshire County, situated less than 9 km apart on opposite sides of the Connecticut River (Fig. 3). The farms consist of open agricultural habitat containing a wide variety of agricultural crops and some flowering ornamentals, set within a suburban to semi-rural context. However, despite their similar habitats, GIS analysis (ArcGIS ArcMap 10.7.1, ESRI, Redlands, CA) indicates that the landscapes surrounding the farms are somewhat dissimilar. The landscape within a 2.5-km radius of the Hadley site is dominated by agriculture (41.6%), followed by forest (22.3%); while the landscape in the same radius around the Hatfield site is primarily forested (52.6%), with less agricultural land (26.4%). These were the only two sites where *P. bequaerti* was collected during our 2019 survey, and only in limited numbers, despite abundant

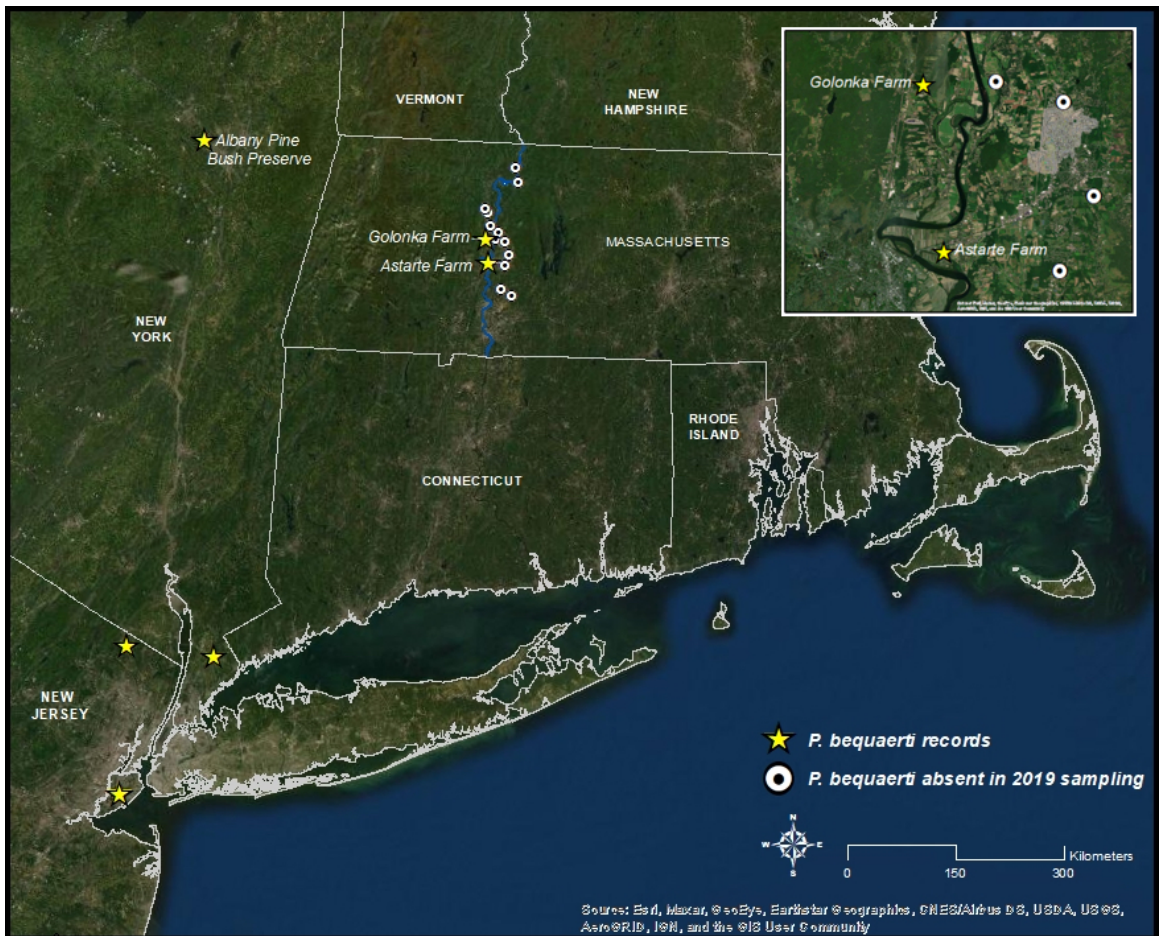


Figure 3. Map showing all published *P. bequaerti* localities in the northeastern United States (north of Maryland), including the 2019 Massachusetts records. Sites sampled in 2019 where *P. bequaerti* was absent are also shown. The Connecticut River in Massachusetts is highlighted in blue. Non-Massachusetts *P. bequaerti* records are from Bried and Dillion (2012) and Ascher and Pickering (2020). Image credit: ArcGIS ArcMap.

Helianthus (and often other Asteraceae) at all 14 farms surveyed. This suggests that *P. bequaerti* is not especially abundant or widespread in this area, at least in agricultural habitats, and that its populations may be localized or limited by environmental factors.

In other states, records of *P. bequaerti* are often associated with well-drained sandy habitats, such as sandhills and scrub (Deyrup *et al.*, 2002), coastal and lake-associated dunes (Grundel *et al.*, 2011; Abbate *et al.*, 2019), oak savannas (Jean, 2010; Grundel *et al.*, 2011), riverside “micro-deserts” (Droegge *et al.*, 2009), and pitch pine-scrub oak barrens (Bried and Dillon, 2012). None of these habitat types occur at the two farms where *P. bequaerti* was collected in Massachusetts, but the Connecticut River Valley does contain sandy soils as a result of past glacial activity, including areas of sandy, xeric outwash plains from the historical presence of Glacial Lake Hitchcock (Motzkin *et al.*, 1999). Soil maps indicate that the area of the Hatfield site where *P. bequaerti* was collected is situated on Windsor loamy sand, a highly sandy soil type associated with outwash plains and pitch pine-scrub oak barrens elsewhere in western Massachusetts (California Soil Re-

source Lab 2020). Communication with the farm owners of the Hatfield site confirmed that some areas of the farm have especially sandy soil, including the field where *P. bequaerti* was found (E. Golonka, pers. comm.). By contrast, the Hadley site's soils have a much lower sand content, and are classified as silt loams formed in deposits of fine silty or sandy alluvium (California Soil Resource Lab 2020). Such soil types are more characteristic of floodplains (California Soil Resource Lab 2020), due to the Hadley site's close proximity (less than 1 km) to the Connecticut River.

While *P. bequaerti* has been collected from pitch pine-scrub oak barrens at the Albany Pine Bush Preserve in New York (Bried and Dillon, 2012), it has been absent during sampling in western Massachusetts pitch pine-scrub oak barrens at the Montague Plains Wildlife Management Area (JM, pers. obs.). Although *Helianthus* is not present in these barrens (Hawthorne, 2017), they do have an abundance of *Solidago*, which *P. bequaerti* was recorded visiting in Grundel *et al.* (2011). Interestingly, bee surveys in Florida recorded a similar pattern of habitat occurrence in this species, with *P. bequaerti* found on *Helianthus* and other Asteraceae on farms, while being absent in natural habitats, including sandhills, in the same county (Hall and Ascher, 2010, 2011).

Although *P. bequaerti* is known to be oligolectic on *Helianthus* and other Asteraceae, data on the species it uses as natural floral hosts in New England are lacking, since *P. bequaerti* has not previously been recorded in this region. Most of *P. bequaerti*'s recorded floral host species do not occur in Hampshire County, Massachusetts, or occur only as naturalized non-natives or cultivated plants (Native Plant Trust 2020). Of its recorded floral hosts, only *Helianthus divaricatus* L. (Mitchell, 1960; Grundel *et al.*, 2011) and *Solidago* (Grundel *et al.*, 2011) are native to Hampshire County; however, two additional *Helianthus* species are also native, and several non-native *Helianthus* are naturalized (Native Plant Trust 2020). Given *P. bequaerti*'s apparent preference for *Helianthus*, we expect that one or more of the native species serves as *P. bequaerti*'s primary natural floral host in Massachusetts. Both Massachusetts farms where *P. bequaerti* was collected had an abundance of *Helianthus* (albeit non-native species) in cultivated and/or fallow areas, and so provided a higher density of *P. bequaerti*'s favored floral host than may be found in many natural areas. This likely increased the farms' habitat favorability for *P. bequaerti*.

In conclusion, we found that western Massachusetts farms with abundant non-native *Helianthus* (such as *H. annuus* and *H. maximiliani*) can support the presence of *P. bequaerti*, and that such farms include but are not limited to those with highly sandy soils. We collected multiple individuals of *P. bequaerti* at two such farms, supporting a range extension for this species into New England. Given the small size of the bee, its host specialization, and a relative lack of previous sampling in agricultural environments in this area, we expect that this is a preexisting population that has previously gone unrecorded, and which was only discovered due to intensive sampling on its preferred floral host in a relatively undersampled habitat. This illustrates how increased sampling, even in anthropogenic habitats or on non-native plants, can lead to a more comprehensive understanding of bee diversity and distribution, which are both essential for informing bee conservation efforts. Further sampling of *Helianthus* and other Asteraceae in western New England, especially on farms or in habitats with sandy soils, may help to more fully document the extent of *P. bequaerti*'s range in this region.

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