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Range extension of *Megachile lanata* (Hymenoptera: Megachilidae), a non-native sunn hemp pollinator, in Florida

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Megachile lanata (F.) (Hymenoptera: Megachilidae) is a polylectic pollinator that is native to India and northern Africa. It was introduced to the Antilles during slave trading sometime during the sixteenth to eighteenth centuries (Mitchell 1960; Genaro 2008). The bee was noted as "Habitat in America" in the original species description, which could indicate its presence in the Antilles, or suggest that Fabricius thought the bee was present on the North American mainland (Fabricius 1775). Collection records of the first published occurrence of this species were noted as Kingston and Port Antonio, Jamaica, in 1891 when it was described as *Megachile martindalei* (Fox 1891). It was noted as present in south Florida in 1958, and was assumed to have come from Cuba (Krombein et al. 1958). Published literature has reported the species in only 2 Florida counties (Miami-Dade and St. Lucie) as recently as 2005 (Leavengood & Serrano 2005). Here we present findings of a single *Megachile lanata* specimen captured at Halfmoon Wildlife Management Area in northwest Sumter County, Florida, in a blue/yellow vane trap on 4 Apr 2017 during a pollinator restoration experiment. The trap was located in an unmanaged, cow excluded, Bahia (*Paspalum notatum* Flüggé) (Poaceae) pasture that is returning to a longleaf pine (*Pinus palustris* Mill.) (Pinaceae) flatwoods ecosystem. This finding represents a 260 km (about 160 mi) range extension from the previous county records that spurred this investigation.

A recent publication reported 2 specimens collected in southern Polk County (Campbell et al. 2017), and additional specimens have been collected recently from John U. Lloyd and Lover's Key State Parks in Broward and Lee counties (Abbate 2017). Several different online databases and museum collections were used to increase specimen records used in this study, with previously unpublished date and location information. We also used photographed observations from iNaturalist. The specimen collected in Halfmoon Wildlife Management Area is still the northernmost record. However, by compiling 58 specimen records and observations of *M. lanata* present in 10 additional counties (Table 1), we were able to roughly map out the species' range shift over time (Fig. 1).

Table 1. Florida counties with *Megachile lanata* collection records. (Note: The Miami-Dade earliest record is based on literature estimates of *Megachile lanata* arrival to Florida.)

County	Locale	# of specimens	Earliest record	Records
St. Lucie	Ft. Pierce	2	Sep 1990	a, b
Collier	Naples	32	Sep 1998	a, f
Glades	Lakeport	2	May 2012	a
Broward	John U. Lloyd State Park, Ft. Lauderdale	3	Jan 1984	a, b, h
Sumter	Halfmoon Wildlife Management Area	1	Apr 2017	this study
Polk	Bartow	5	Mar 2016	g
Lee	Lovers Key State Park, Sanibel	4	Jun 2007	b, h
Orange	Wedgefield, Oakland, Orlando	3	Apr 2018	c, e
Osceola	Epcot	1	Mar 2018	e
Miami-Dade	Kendall, STA 3/4	2	1958	b, e, i
Palm Beach	Lake Worth	2	Jan 2005	b
Seminole	Central Florida Zoo	1	Mar 2016	c

[a]Florida State Collection of Arthropods
[b]US Geological Survey Native Bee Inventory and Monitoring Laboratory
[c]University of Central Florida Collection of Arthropods
[d]Archibald Biological Research Station
[e]iNaturalist Research Grade Observations
[f]Museum of American Natural History
[g](Campbell et al. 2017)
[h](Abbate 2017)
[i](Krombein et al. 1958)

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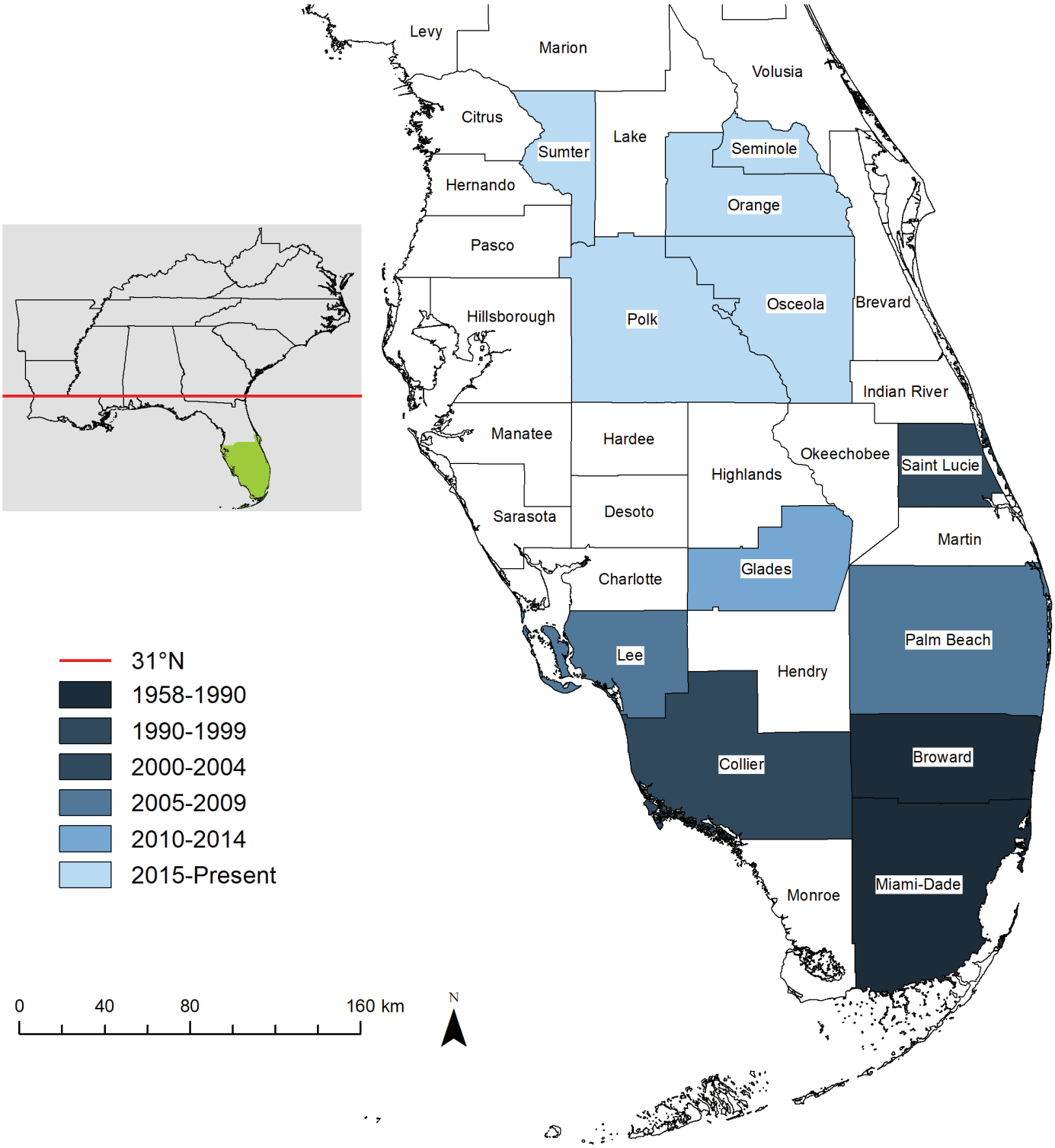

Fig. 1. Distribution of *Megachile lanata* in Florida based on museum specimens, published literature, and online database resources. The northernmost record in Sumter County is over 260 km (about 160 mi) away from the previously published northernmost location in St. Lucie County. The line at 31°N indicates the northernmost specimen record from its native range in India, which may indicate a possible range in the US.

The northern shift of *Megachile lanata* could affect pollination across the Florida landscape, especially of the *Crotalaria* (Fabaceae) genus. This bee species could act as a pollinator of *Crotalaria juncea* L. (Fabaceae) (sunn hemp), which is a beneficial cover crop in Florida. In India, *M. lanata* is used for pollination of commercially grown sunn hemp; this plant, and several close relatives, have been introduced into Florida. Specimen records indicate that Floridian *Crotalaria* host plants include *C. juncea*, as well as *C. pallida* Aiton, *C. retusa* L. (all Fabaceae), and *Stachytarpheta urticifolia* Sims (Verbenaceae). *Croatalaria juncea* is a rapidly growing, humid temperate, cover crop used to suppress weeds, prevent erosion, improve soil fertility, and provide animal fodder (Krueger et al. 2008). Due to its flower structure,

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bees must be have sufficient body length and weight to successfully pollinate *C. juncea* (Krueger et al. 2008). *Megachile lanata* is the only reported pollinator of *C. juncea* in Florida. However, other bees in the *Megachile* genus are present in the state and also may act as suitable pollinators (Krueger et al. 2008). Sunn hemp cultivation in Florida has been limited by low seed production and an absence of effective pollinators. Research investigating other methods to increase seed production through self-pollination and use of ethephon (a growth regulator) did not work consistently, which implies successful seed production to local pollinators (Krueger et al. 2008). More research is required to determine which pollinator species are responsible. All previously listed *M. lanata* plant hosts are established in Florida and are non-native. One host species, *S. urticifolia*, is considered invasive, and is listed on the Florida Exotic Pest Plant Council's Invasive Species List (Howell 2017). This suggests that *M. lanata* could be an invasive bee, but empirical data showing that this species facilitates the spread of *S. urticifolia* would be required to adequately support such labeling.

With its relatively recent introduction into Florida, little is known about *M. lanata* ecology in the North American mainland. In Cuba, *M. lanata* is the most successful habitat generalist of its genus, and thrives in multiple ecosystems while other *Megachile* are observed only in wooded areas (Genaro 2008). *Megachile lanata*'s generalism may allow this non-native bee to compete with other native bees, particularly in the *Megachile* genus, partially explaining its northward expansion in Florida. The lack of seasonality in the activity of *M. lanata* also may contribute to its success and range extension in the state, with specimen collection records occurring in every mo except Dec. As aboveground cavity-nesters, *M. lanata* could compete for nesting sites with other cavity-nesting bees or wasps. Other non-native *Megachile*, such as *Megachile sculpturalis* (Smith) (Megachilidae), have been shown to displace native carpenter bees from their nesting sites (Laport & Minckley 2012; Roulston & Malfi 2012).

Megachile lanata has been present in Florida since 1958, but almost all specimens have been recorded in the past 20 years (56 of 58 records between 1998 and 2018). The northernmost records are within the past 3 yr, indicating that *M. lanata*'s range is rapidly expanding northward, and becoming more common in Florida. Increasing temperatures associated with global climate change and regional land use changes may help explain this northward shift. Access to specimens from India was limited to the Discover Life database (https://www.discoverlife.org); records were found as far as 31°N. If *M. lanata* is able to spread to a similar latitude in North America, its range could include all of Florida and parts of the Southeastern Coastal Plain.

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Summary

Megachile lanata, a pollinator of multiple *Crotalaria* species, spread from North Africa to the Antilles during the 16th to 18th centuries, and is assumed to have entered Florida from Cuba in the late 1950s. This non-native species has spread over 260 km (about 160 mi) north of previously published locations in Florida, and is now present in 12 counties. Its current northernmost record was in Sumter County during Apr 2017 at 28.935°N.

Key Words: invasive; woolly wall bee; cavity-nesting bee; leaf cutter bee; India; climate change; range expansion

Sumario

Megachile lanata, un polinizador de múltiples especies de *Crotalaria*, se extendió desde el norte de África hasta las Antillas durante los siglos XVI y XVIII y se cree que ingresó a Florida desde Cuba a finales de los años 50. Esta especie no-nativa se ha propagado por más de 260 km (alrededor 160 mi) al norte de las ubicaciones previamente publicadas en Florida, y ahora está presente en 12 condados. Su registro actual más septentrional fue en el condado de Sumter en abril de 2017 a 28.935°N.

Palabras Clave: especie invasiva; abeja de pared lanuda; abeja anidadora de cavidades; abeja cortadora de hojas; India

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