Naturalization of the Oil Collecting Bee Centris nitida (Hymenoptera, Apidae, Centrini), a Potential Pollinator of Selected Native, Ornamental, and Invasive Plants in Florida

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NATURALIZATION OF THE OIL COLLECTING BEE CENTRIS NITIDA (HYMENOPTERA, APIDAE, CENTRINI), A POTENTIAL POLLINATOR OF SELECTED NATIVE, ORNAMENTAL, AND INVASIVE PLANTS IN FLORIDA

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ABSTRACT

The neotropical bee Centris nitida Smith has naturalized in southeastern Florida and in Sarasota on the Gulf coast. This furry yellow and black bee has been confused with the closely related C. lanosa Cresson, a native bee restricted to northern Florida and the American Southwest and adjacent Mexico. Female C. nitida are smaller than those of both C. lanosa and C. errans Fox, a furry brown-colored native Centris which is sympatric with C. nitida in southern Florida. The 3 Centris bees now occurring in Florida are readily separated by their distinctive facial markings. Female C. nitida have a vertical black line in the middle of the clypeus. Centris nitida is a polylectic, oil-collecting bee observed to visit flowers of 28 species in 10 plant families, including 8 oil reward flower species in the Malpighiaceae, and 10 species of buzz pollinated flowers in the Fabaceae and Solanaceae in Florida. Centris nitida may have environmental impacts through pollination of selected native, ornamental and invasive plants, as well possible competition with the sympatric native C. errans through common usage of oil reward flowers.

Key Words: buzz pollination, Byrsonima lucida, Centris errans, Centris lanosa, oil-reward flowers

RESUMEN

La abeja neotropical, Centris nitida Smith, se ha naturalizado en el sureste de Florida. Esta abeja peluda de color amarillo y negro ha sido confundida con la cercana especie, C. lanosa Cresson, una abeja nativa que es restringida al norte de Florida y al Sur-oeste Americano y a la región adyacente de México. Las hembras de C. nitida son más pequeñas que las de C. lanosa y C. errans Fox, un centris peludo de color marrón que es nativo y simpátrico con C. nitida en el sur de Florida. Las tres abejas Centris que actualmente ocurren en Florida se separan fácilmente por sus marcas faciales distintas. Centris nitida es una abeja poliléctica que colecta aceite y que se observaron visitar las flores de 27 especies en nueve familias de plantas, incluyendo 8 especies con flores de de recompensa con aceite en la familia Malpighiáceas, y 10 especies de flores de polinización por zumbido en las familias Fabaceae y Solanaceae en el sur de Florida. El establecimiento de Centris nitida puede tener consecuencias ambientales por la polinización de seleccionadas plantas nativas, ornamentales, a invasivas, además posible competencia con la abeja nativa simpátrica C. errans por el uso común de las flores de recompensa de aceite.

Translation provided by the authors.
tions from Peru and Bolivia, and single 1985 Ricon Mountains, Pima Co., Arizona collection by Minckley (Droege et al. 2007). There may be some uncertainty about this Arizona occurrence because Snelling (1984) indicated that previous Arizona collections identified as C. confinis (Perez), a synonym of C. nitida, were misidentified.

**MATERIAL AND METHODS**

Centris nitida’s native range was determined from collection data from specimens in the Snow Entomology Museum Collection, University of Kansas, and the American Museum of Natural History, New York, and posted on the Discover Life Website (Droege et al. 2007) and Snelling (1984). We illustrated the differences in facial color patterns of C. nitida and Florida’s 2 native Centris with a photomontage system at the Florida Department of Agriculture and Consumer Services in Gainesville. To quantify size differences in these bees, we made measurements on specimens of C. nitida that we collected in Broward and Miami-Dade Counties, and of C. lanosa and C. errans from the Florida State Collection of Arthropods (FSCA) (Table 1). We also measured the 2 specimens of male C. nitida that were available at the FSCA to increase the sample size. Using a dissecting microscope, we measured the width of the dorsal surface of the thorax inclusive of the wing inserts, the length of the thorax, and the length of the abdomen. We summed the 2 measures of length and then multiplied that by the thorax width to obtain body sizes for the 3 species. We used One-Way ANOVA to determine the differences in body size among the 3 species. Bonferroni tests were used for post hoc pairwise comparisons. Male and female bees were analyzed separately. All statistical analyses were carried out with SPSS 13.0 (SPSS, Inc., Chicago).

Furthermore, we clarified the confusion surrounding the distribution of C. lanosa in Florida based on information in Snelling (1984), from J. Neff (University of Texas, Austin), and collection data of all C. lanosa specimens from various sources that we examined. In addition, we determined the distribution and the activity period for C. nitida from multiple information sources. Firstly, one of us (RWP) made observations on C. nitida in a Broward residential yard with a diverse flowering species including oil flowers from Sep 2004 to Jul 2006, during which time the bee was presumed to be C. lanosa. Secondly, we made observations and collections frequently in 2 residential gardens, I mentioned above, the other in Miami-Dade County, which harbored 15 plants of Brysonima lucida Rich. Ex Kunrh. (Malpighiaceae), a native oil reward flower species, during Mar to Sep 2007, after the identity of C. nitida became clear to us. Thirdly, we made 5 observation and collection trips to 5 rocky pinelands, the prime habitat for B. lucida, during Mar to May 2007, the peak flowering period of B. lucida in Miami-Dade and Monroe Counties, and 7 trips to the Fairchild Tropical Botanic Garden in Miami-Dade, where several large plants of B. lucida and many introduced species of oil reward flowers were planted. Fourthly, from Mar to Sep 2007 we visited Home Depot home improvement stores in Broward, Miami-Dade, Monroe, Martin, and Palm Beach Counties in southern Florida, and in Orlando, Orange County, in central Florida to observe whether or not C. nitida was present on the floral displays of Angelonia angustifolia Benth. (Scrophulariaceae), a popular ornamental plant with oil reward flowers. Because C. nitida predictably used A. angustifolia at the Home Depot stores in Broward and Miami-Dade Counties where the bee was known to be present, we used the Home Depot visits as a supplemental indicator of the bee’s presence or absence elsewhere. We also determined the distribution and activity period for C. errans based on our observations and collections during the same periods mentioned above. Finally, we summarized host plant information of the sympatric C. errans and C. nitida. Representative specimens of both bees will be placed in the Florida State Collection of Arthro-

**Table 1. Centris Species Body Size (Thorax Length + Abdomen Length) × Thorax Width (mm²) Comparison. Six of the 8 Males and All Females of C. nitida Were Collected From Southern Florida, and All Other Specimens Were Sampled From the Collection of the Florida State Museum of Arthropods. Different Letters Indicate a Statistical Difference in Body Size of Different Species.**

| Sex    | Bee species | n  | Mean body size (total length × thorax width mm²) | Std. Error |
|--------|-------------|----|--------------------------------------------------|------------|
| Female | C. errans   | 10 | 64.64 a (11.15 × 5.79)                              | 1.84       |
|        | C. lanosa   | 3  | 61.99 a (11.81 × 5.24)                              | 4.58       |
|        | C. nitida   | 10 | 52.14 b (10.64 × 5.01)                              | 1.26       |
| Male   | C. errans   | 10 | 58.80 a (10.16 × 5.79)                              | 1.89       |
|        | C. lanosa   | 10 | 54.17 a (9.70 × 5.59)                               | 2.44       |
|        | C. nitida   | 8  | 52.68 a (10.27 × 5.13)                              | 1.60       |
pods in Gainesville, the American Museum of Natural History in New York, and the Snow Entomology Museum Collection, University of Kansas in Lawrence.

RESULTS

Discovery of C. nitida in Southern Florida

We first encountered C. nitida in Ft. Lauderdale, Broward County in southeastern Florida in 2004, while making observations of the recently naturalized orchid bee Euglossa viridissima Friese (Pemberton & Wheeler 2006). Both the orchid bee and C. nitida were commonly seen collecting (buzzing) pollen from the flowers of cultivated Senna and some Solanum species. Centris nitida also was observed collecting oil from the flowers of the cultivated native B. lucida in the same residential garden in Ft. Lauderdale. This bee was presumed to be C. lanosa, a similar-sized black and yellow species known to occur in Florida (Mitchell 1962), and reported from Miami-Dade County (Pascarella et al. 1999; Pascarella 2007). However, attempts to confirm the bee's identity with the keys in Mitchell (1962) and the keys in Pascarella (2007)—his Bees of Florida website (based on Mitchell’s keys) failed. The bee was subsequently successfully keyed as C. nitida with the Centris key on Discover Life website (Droege et al. 2007). Correspondence with S. Droege, the lead author of the Discover Life Apoidea section (along with S. Kolski, J. Ascher, and J. Pickering), indicated that the inclusion of C. nitida in the key as a species known from Florida, was based on his collection of 2 male C. nitida along a Palm Beach County, Florida canal on Jan 26, 2005. Those bees were identified by John Ascher, who compared them to specimens in the American Museum of Natural History collection.

We examined the 2 specimens included in the Pascarella’s 1999 paper and website (2007) records for C. lanosa in Miami-Dade County, and found them both to be C. nitida. These specimens (housed in the K. Waddington laboratory, Department of Biological Sciences, University of Miami) were collected at the Fairchild Tropical Botanic Garden and the University of Miami, Coral Gables in 1997 and identified by J. Pascarella. These specimens constitute the earliest known collections of C. nitida in Florida and the eastern United States. We also examined “C. lanosa” specimens collected a year later in 1998 by Suzanne Koptur in the Rockdale Pineland, Miami-Dade County. We determined that these specimens (housed in the Koptur Laboratory at Florida International University, Miami) also are C. nitida. These early collection sites, the Rockdale Pineland and the University of Miami, are ca. 11 km apart, so it appears that C. nitida was already relatively widespread within southeastern Miami-Dade County by 1998, occurring in both urban garden and natural environments. The misidentifications were due to C. nitida’s resemblance to C. lanosa (both are robust black and yellow medium sized furry bees) and probably to Michell (1962) listing C. lanosa’s distribution simply as Florida.

Distinguishing the 3 Centris Bees in Florida

While C. nitida’s yellow and black furry appearance resembles that of C. lanosa, this coloration distinguishes C. nitida from C. errans, which is furry brown. The color patterns of the faces of the 3 Centris bees differ markedly (Fig. 1). The black vertical line on the mostly cream colored clypeus of the face of female C. nitida readily separates it from the female of C. lanosa, which has a black face with a light colored band in the center just below the antennal insertions, and the female of C. errans, which has a black face with a white inverted “T” on the clypeus at the base. The faces of the males of these Centris species are yellow marked with black in distinctive patterns that separate them from each other and the females (Fig. 1).

The 3 bees also differed statistically in body size (Between groups MS = 407.57, F_{2,20} = 14.17, P < 0.001). Females of C. nitida were smaller than females of both C. errans and C. lanosa (Bonferroni tests, Table 1). Males of the 3 Centris species, however, were not significantly different (Between groups MS = 65.30, F_{2,20} = 1.43, P = 0.263, one-way ANOVA, Table 1).

Centris nitida Specimens Collected in Florida

Mar: 1♂ perched next to Cyrtopodium punctatum (L.) Lindl. plant, 4 III 2007, Ft. Lauderdale, FL, RW Pemberton; 1♂ on Cyrtopodium punctatum flowers, Fairchild Tropical Botanic Garden, Coral Gables, FL, 16 III 2007, H. Liu and R.W. Pemberton; 8♂ on Byrsonima lucida flowers, 23 III 2007, Kendall Lakes, Miami-Dade Co. FL, H. Liu; 4♀ on Byrsonima lucida flowers, 25 III 2007, Ft. Lauderdale, R.W. Pemberton; 1♂ on Suessenuthia multiseta (Rusby) Wassh. & J.R.I.Wood flowers, 25 III 2007, Ft. Lauderdale, FL, R.W. Pemberton; 2♂ on Cyrtopodium punctatum flowers, 25 III 2007, Ft. Lauderdale, FL, R.W. Pemberton; 1♂ on Byrsonima lucida flowers, 25 III 2007, Kendall Lakes, Miami-Dade FL, H. Liu; 1♀ on Byrsonima lucida flowers, 27 III 2007, Kendall Lakes, Miami-Dade FL, H. Liu; 1♀ on Byrsonima lucida flowers, 31 III 2007, Kendall Lakes, Miami-Dade Co. FL, H. Liu. 1♀ on Oncidium sphaelatum Lindl. flowers, 5 IV 2007, Ft. Lauderdale, FL, R.W. Pemb-
Fig. 1. *Centris* spp. collected in Florida showing the head and distinctive faces of female and male bees of: A. female *C. nitida*, B. male *C. nitida*, C. female *C. lanosa*, D. male *C. lanosa*, E. female *C. errans*, and F. male *C. errans*. The vertical black line in the center of the clypeus of female *C. nitida* readily separates this bee from the others, even in flight.
Pemberton & Liu: Naturalization of Centris nitida in Florida

Centris nitida is restricted to the northern part of the state. We examined specimens of C. lanosa in the Florida Arthropod Collection, Gainesville and found they were from only 3 northern Florida counties (Alachua, Clay, and Gilchrist). These were the only specimens listed by Snelling (1984). Centris lanosa has a disjunct distribution occurring in Kansas, Texas, Oklahoma (Snelling 1984), and Arizona (J. Neff, pers. comm.), and then in northern Florida (Snelling 1984) and southern Georgia (J. Neff, pers. comm.), where its plant associate, Krameria lanceolata Torr. (Krameriaceae), occurs (J. Neff, pers. comm.). Krameria lanceolata, which has oil reward flowers gathered by females of C. lanosa to provision their brood, is absent from southern Florida (Wunderlin & Hansen 2003).

Our observations and collections indicate that C. nitida occurs in Miami-Dade, Broward, and Palm Beach Counties in southeastern Florida. We also collected this species on the Gulf coast in Sarasota about 60 km south of Tampa. The Sarasota collection site is ca. 260 km from the nearest collection site in southeastern Florida (West Palm Beach in Palm Beach County). Interestingly, the bees were commonly observed to gather oils from the flowers of potted plants of A. angustifolia at Home Depot stores in both Broward and Miami-Dade Counties. It was not unusual to see multiple bees foraging on the flowers of the potted plants in these stores at the same time. However, we did not observe C. nitida in a Monroe County Home Depot store, or in the Navy Wells Pineland natural area 2 km north of the Everglades National Park, or in the pinelands on Big Pine Key, Monroe County, when B. lucida was abundant and in peak bloom. Similarly, we did not detect C. nitida on A. angustifolia at the visited Home Depot stores in Martin or Orange Counties. This may indicate that C. nitida may not have yet reached the ENP, Monroe County, the southern most part of southern Florida, or north of Palm Beach County on the

Centris errans Specimens Collected in Southern Florida

Mar: 2♀ on Cyrtopodium punctatum flowers, 16 III 2007, Fairchild Tropical Botanic Garden, Coral Gables, FL, R.W. Pemberton and H. Liu; 2♀ on Brysonima lucida flowers, 23 III 2007, Kendall Lakes, Miami-Dade Co. FL, H. Liu. Apr: 2♀ on Brysonima lucida flowers, 1 IV 2007, R.W. Pemberton and H. Liu, Navy Wells Pineland, Miami-Dade Co., FL, 3♀ on Brysonima lucida flowers, 14 IV 2007, Seminole Wayside Park, Homestead, FL, R.W. Pemberton. May: 1♀ on Brysonima lucida flowers, 6 V 2007, Ft. Lauderdale, FL, R.W. Pemberton; 1♀ on Brysonima lucida flowers, 1♀ on Stigmaphyllon sagraneum A. Juss. flowers, 1♀ on Galphimia gracilis Bartl. flowers, 8 May 2007, Fairchild Tropical Botanic Garden, Coral Cables, FL, H. Liu and R.W. Pemberton; 1♀ on Brysonima lucida flowers, 28 V 2007, Boystown Pineland County Park, Miami-Dade Co., FL, H. Liu. Jun: 1♀ on potted Brysonima lucida flowers, 5 VI 2007, Boystown Pineland County Park, Miami-Dade Co., FL, H. Liu.

Distribution of Centris Species in Florida
southeastern coast. Although one of the early collections of *C. nitida* was from the Rockdale pine-land in 1998, our survey in pine rocklands did not locate the bee.

The specimen data for our *C. errans* collections indicate that this species has a larger geographic range, a greater number of floral species associations, and a longer activity period in Florida than previously understood. This bee was thought to be limited to the pine rockland habitats of Miami-Dade and Monroe Counties, where its native oil reward species, *B. lucida*, occurs (Pascarella 2007). We collected a single bee from the flowers of a cultivated *B. lucida* planted in a Ft. Lauderdale garden in Broward County, which is one county north of Miami-Dade County, and well beyond the natural range of the plant.

**Centris nitida** and **Centris errans** Floral Records in Florida

*Centris nitida* was observed visiting the flowers of 28 species in 10 different plant families to collect pollen, edible oil, and nectar (Table 2); the bee appears to be polylectic. *Centris errans*, by contrast, was observed to visit the flowers of only 5 species (Table 2). Females of both *C. nitida* and *C. errans* collect the edible oil rewards of flowers to provision their brood or construction of nests. *Centris nitida* was observed to visit 8 oil reward flower species in 5 genera of the Malpighiaceae; all but 1 were introduced ornamental plants, and a single species in the Schrophulariaceae, *A. angustifolia*, an introduced ornamental plant, native to South America (Table 2). *Centris errans* was observed to visit 3 oil reward flower species belonging to the Malpighiaceae, 2 of which were introduced ornamentals, whereas 1 is native to southern Florida (Table 2).

Females of both *Centris* species are able to buzz poricidal (opening by terminal pores) anthers of flowers to remove pollen. *Centris nitida* was observed to buzz flowers of 10 species of plants in the genera *Exacum*, *Lycianthes*, *Senna* and *Solanum* to collect pollen (Table 2), while *C. errans* was observed to buzz flowers of *Chamacea-rista keyensis* (Liu & Koptur 2003). Territories of male *C. nitida* territories were observed on and around small *Malpighia emarginata* trees in 4 places in 3 counties. Male territories also were seen near potted plants of *A. angustifolia*, *Gal-phimia gracilis* (Malpighiaceae), and *Cyrtopodium punctatum*. Both *C. nitida* and *C. errans* visited orchid flowers (Table 2), but the details of these interactions (Pemberton & Liu, unpublished data) will be reported elsewhere.

**Phenology of Centris nitida and C. errans** in Florida

From 2004 to 2006, observations of adult *C. nitida* activity, in conjunction with studies of *E. viridissima*, indicate that *C. nitida* to be present during the months Apr, May, Jun, Jul, Sep, Oct, Nov, and Dec. Attempts to collect *C. nitida* in 2007 from Mar through Feb successfully located bees in every month, although they were more abundant in the spring and summer months.

We collected *C. errans* from Mar to Jun. The May and Jun collections were after the recognized adult activity period of Mar to Apr (Michell 1962).

**DISCUSSION**

Environmental impacts related to the naturalization of *C. nitida* may occur primarily through the bee’s pollination of selected native, ornamental, and invasive plants. Twenty two of the 28 species (78.6%) visited by *C. nitida* are introduced plants in Florida, 7 of these plants were naturalized, while 1, *Senna pendula* (L) Roxb., is a Category I invasive plant (http://www.fleppc.org). The value of urban landscapes in providing the specialized flowers needed by native *Centris* has been recently discussed by Koptur (2006). However, introduced oil reward flower species in urban landscapes could promote mutualism with *C. nitida* and lead to increased abundance of these plants and the bee. *Centris nitida* appears to be polylectic because of the large number of plant species it visits. In contrast, the close association of *C. errans* with *B. lucida* coupled with our observations of the bee visiting only 2 other species of Malpighiaceae, suggests that it is oligolectic. Mitchell (1962), however, lists flower records for *C. errans* that include 5 additional genera and families: *Borrichia* (Asteraceae), *Carambola* (Oxalidaceae), *Eugenia* (Myrtaceae), *Ocimum* (Labiae-acae), *Securidaca* (Polygalaceae).

It appears that *C. nitida* has a disjunct distribution, in southeastern Florida and in the Sarasota area of the west coast, 2 well separated areas. We do not know if *C. nitida* occurs between these areas. Surveys in Naples on southwest coast failed to detect the bee. The disjunct distribution raises the possibilities of 2 separate introductions of this bee to Florida. Alternatively, *C. nitida* could have been introduced to one area, and then subsequently spread or was moved to the other. Because *C. nitida* is known to nest within wood (Frankie et al. 1993), it may have been introduced as a nest within wood or hollow wooden objects. The recently introduced orchid bee (*E. viridissima*) also nests within enclosed spaces (Scov & Wiley 1995), which suggests that it may have also been imported as a nest(s). All but 1 of the 17 bees accidentally imported and established in North America live in hollow plant stems or other pre-formed cavities (Ascher 2001), supporting the idea that bees with this type of nests are more able to naturalize than bees that are ground nesters.
The occurrence of *C. nitida* in the Ricon Mountains, Pima County, Arizona appears to be in USDA Hardiness Zone 9 (http://www.cobra-plant.com/Zone.GIF). The distribution of *C. nitida* in southeastern Florida is within USDA Hardiness Zone 10b. Zone 9 occupies the northern 2/3 of the Florida peninsula, extending to the Georgia border along the east coast and almost to Cedar Key on the west coast of Florida. If *C. nitida* is dependent on oil reward flowers, it would need to use the flowers of ornamental members of the Malpighiaceae or the common ornamental herb *A. angustifolia*, which it already uses in southern and southwestern Florida, to extend northward.

TABLE 2. FLOWER SPECIES VISITED BY *CENTRIS NITIDA* AND *C. ERRANS* IN SOUTHERN FLORIDA. OBSERVATIONS ARE THE AUTHORS EXCEPT WHERE INDICATED BY FOOTNOTES. NATIVE SPECIES ARE IN BOLD, AND NATURALIZED SPECIES ARE UNDERLINED. INTERACTIONS WITH ORCHID SPECIES WILL BE DISCUSSED IN DETAIL ELSEWHERE.

| Plant family and species | Resource collected | *Centris nitida* | *Centris errans* |
|-------------------------|--------------------|-----------------|-----------------|
| Acanthaceae              |                    |                 |                 |
| *Stuessenguthia multisetosa* | Nectar           |                 |                 |
| Fabaceae                |                    |                 |                 |
| *Bauhinia blakeana*     | Nectar             |                 | X               |
| *Chamaecrista keyensis* | Pollen             |                 |                 |
| *Parkinsonia aculeata*  | Pollen             |                 | X               |
| *Senna alata*           | Pollen             |                 | X               |
| *Senna ligustrina*      | Pollen             |                 | X               |
| *Senna mexicana*        | Pollen             |                 | X               |
| *Senna pendula*         | Pollen             |                 | X               |
| Gentianaceae            |                    |                 |                 |
| *Exacum affine*         | Pollen             |                 | X               |
| Lythraceae              |                    |                 |                 |
| *Cuphea sp.*            | Nectar             |                 | X               |
| Malpighiaceae           |                    |                 |                 |
| *Brysonima lucida*      | Oil                | X               | X               |
| *Bunchosia armenica*    | Oil                | X               |                 |
| *Galpinia gracilis*     | Oil                | X               | X               |
| *Malpighia coccigera*   | Oil                | X               |                 |
| *Malpighia emarginata*  | Oil                | X               |                 |
| *Malpighia linearis*    | Oil                | X               |                 |
| *Malpighia punicea*     | Oil                | X               |                 |
| *Stigmaphyllon sagraenum* | Oil             | X               |                 |
| Myrtaceae               |                    |                 |                 |
| *Calytranthus pallens*  | Pollen and nectar? | X               |                 |
| Orchidaceae             |                    |                 |                 |
| *Cyrtopodium polyphyllum* | None            |                 | X               |
| *Cyrtopodium punctatum* | None              | X               |                 |
| *Oncidium sphacelatum*  | None              | X               |                 |
| Scrophulariaceae        |                    |                 |                 |
| *Angelonia angustifolia* | Oil               |                 | X               |
| Solanaceae              |                    |                 |                 |
| *Lycianthes rantonnetii* | Pollen           |                 | X               |
| *Solanus seaforthianum* | Pollen           |                 | X               |
| *Solanus sisymbriofolium* | Pollen          |                 | X               |
| *Solanus wenlandii*     | Pollen           |                 | X               |
| *Solanus wrightii*      | Pollen           |                 | X               |
| Verbenaceae             |                    |                 |                 |
| *Stachytopheta urticifolia* | Nectar        |                 | X               |

1Liu & Koptur 2003.
2Horticultural name, botanical name uncertain.
3J. Pascarella collection, see others’ collection records.
The bee already occurs in Broward, Palm Beach, and Sarasota Counties, north of the distribution of*B. lucida*, the only oil reward flower plant native to southern Florida. When it reaches the central and northern Florida peninsula, it could encounter*K. lanceolata*, another native plant with oil reward flowers. As mentioned above, this plant fosters the presence of*C. lanosa* in both northern Florida and in Texas and Arizona. Although not detected in this study, *C. nitida* could spread into the Everglades National Park and in the Florida Keys (Monroe County), where *B. lucida* is abundant in understory of the rocky pinelands. Only a single *C. nitida* was detected in the surveyed rocky pinelands in this study, although it was previously collected in an urban rocky pineland in 1998 (as *C. lanosa*) by S. Koptur. This bee was commonly encountered in urban gardens and parks and this contrast suggest that *C. nitida* may continue to have a greater presence in human habitats than natural areas, which have fewer floral resources for the bee.

The naturalization of *C. nitida* in southern Florida and its potential spread to northern Florida creates the possibility of competition between this exotic bee and Florida’s 2 native *Centris*. Both exploitative and interference competition have been suggested in introduced honey bee-native bee interactions (Gross & Mackay 1998; Dupont et al. 2004), and both types of competition could be involved here. There is overlap in floral oil reward plant species used by *C. nitida* and the native*C. errans* in southern Florida, as well as geographic sympatry in Broward and Miami-Dade Counties. We have observed both species to forage at the same time on*B. lucida* flowers in Miami-Dade County but did not observe aggression or apparent physical inference. Larger body size may favor*C. errans* over *C. nitida* in direct contact (interference competition), but the apparent greater abundance of *C. nitida* may favor it over*C. errans* in exploitative competition.

If *C. nitida* spreads into the range of *C. lanosa* in northern Florida, the 2 bees may compete for the resources of*K. lanceolata*. Competition for nest sites between *C. nitida* and the native*Centris* will not occur. *Centris lanosa* and *C. errans* belong to subgeneric taxa (subgenus Centris and subgenus Paracentris) in which all members nest in the ground (J. Neff, pers. comm.), while *C. nitida* is reported to nest in wood (Frankie et al. 1993). Food resource competition with non-*Centris* bees is unlikely to occur for floral oils but might occur for pollen and nectar flowers and for nest sites between *C. nitida* and other wood nesters such as some megachild bees.

In the limited interaction involving *C. nitida* and the orchid bee (*E. viridissima*) some bumping has been observed among bees at the flowers of*Senna* species with poricidal dehiscent anthers, but the bees appeared to be only momentarily deflected from foraging. Because these tropical bees have naturalized in subtropical southern and southwestern Florida relatively recently, their long-term persistence, environmental interactions, and impacts are unknown. The outcomes of potential competition between *C. nitida*, *E. viridissima* and other bees in Florida also will depend on their foraging patterns in relationship to resource availability (Schaffer et al. 1979). More studies are needed to understand the impacts of these newly naturalized solitary bees on Florida’s environments.

Although naturalized bees are relatively rare compared to naturalized plants, increasing numbers of exotic bees are being detected in temperate North America (Ascher 2001). Until recently only 3 exotic bees, *Apis mellifera* L., *Megachile lanata* (Fabricius) and *M. concinna* Smith, were known from Florida (Deyrup et al. 2002). With the recent naturalizations of *E. viridissima* (Pemberton & Wheeler 2006) and *C. nitida* the number of exotic bees in Florida has almost doubled.

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