

RAPID GEOGRAPHIC SPREAD OF THE ALIEN ORCHID *EULOPHIA GRAMINEA* IN FLORIDA

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ABSTRACT. *Eulophia graminea* is a terrestrial orchid native to Asia that was found to be naturalized in Miami-Dade County, Florida in 2007, and by 2008 was known from five locations in that County. The public, through a newspaper story, orchid club members, native plant club members, and field botanists in southern Florida were requested to assist in detecting new locations of the orchid in order to monitor its spread. In addition, the author searched for the orchid in woodchip mulch habitats in the region. Readers of a Miami Herald newspaper story, Fort Lauderdale orchid club members, and field botanist colleagues detected the most occurrences of the orchid. By the fall of 2010, *E. graminea* had been detected in 67 sites in 7 counties in southeastern and southwestern Florida, occurring within a 16,000 km² area. While most of the occurrences were in landscapes at residential, educational and commercial locations, 16 occurrences were in parks and preserves, and four of these were in undisturbed native vegetation. Woodchip mulch remains the most common substrate in which the orchid grows, but the exact role that mulch plays in facilitating the growth and/or spread of the orchid is unknown.

Key words: detection, distribution, invasive plant, naturalization

INTRODUCTION

Eulophia graminea Lindl. (FIGURE 1) is a terrestrial orchid native to South and Southeast Asia and the subtropical islands of the western Pacific (Pemberton et al. 2008a). This orchid has naturalized in Darwin, New Territory, Australia (Macrae 2002), in South Africa near Durban (O'Conner et al. 2006), and in southern Florida (Pemberton et al. 2008a). Although the exact means of the orchid's introduction to Australia, South Africa and Florida are unknown, the orchid was offered for sale by Thai orchid sellers on eBay Australia, eBay South Africa and eBay in the USA (Pemberton et al. 2008a). This suggests that the orchid entered these countries via e-commerce and then subsequently escaped cultivation.

In Florida, *Eulophia graminea* was first found to be naturalized in Miami-Dade County in 2007 (Pemberton et al. 2008a). The orchid was detected at five different sites by the autumn of 2008. Four of the sites were in residential neighborhoods and other in the landscaping at a supermarket. From south to north, the occurrences spanned 35 km. This report deals with efforts to determine the spread and current distribution of this naturalized orchid in Florida.

Orchids rarely naturalize (Daehler 1998) and most of the orchids that have naturalized in Florida have not spread fast nor far (Liu & Pemberton 2010, McCartney 2010). *Eulophia graminea*, with its rapid geographic expansion, is exceptional.

METHODS

The chances of determining and documenting the spread of *Eulophia graminea* would be enhanced by more informed observers to detect it. To develop more informed observers, a number of tactics were undertaken. First the publication of the naturalization paper (Pemberton et al. 2008a), followed by the distribution of this paper to colleagues in Florida helped inform biologists, particularly field botanists. A Miami Herald illustrated article newspaper article was written by Georgia Tasker (2008) about the naturalization of *E. graminea*, with a request for readers finding the orchid to mail or email me the details of the location and photographs of the orchid. An article about the naturalization of *E. graminea* with photos was published in the magazine of the American Orchid Society (Pemberton et al. 2008b), with a request that readers mail or email me locality information and photographs of the plant if they encountered it. There are more than 25 chapters of the American Orchid Society in the three counties (Miami-Dade, Broward and Palm Beach) in southeastern Florida. A photograph of *E. graminea* and a similar request for information where the orchid was found was placed in the May 2008 and July 2010 issues of the newsletter of the Fort Lauderdale Orchid Society (Broward County) by editor Dot Henley. In addition, during the spring of 2008, flowering plants were taken to the meetings of the Dade County chapter of the Florida Native Plant Society and the Fort Lauderdale Orchid Society.

I also searched for the orchid during my regular outings in Broward County and Miami Dade Counties, with particular attention given to woodchip mulch, the habitat where most of the

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FIGURE 1. *Eulophia graminea*.

Eulophia graminea plants had been found. In addition, a one day survey was made along the eastern part of Palm Beach County was made in October 2010, with searches in mulched beds in supermarkets and shopping centers from Boca Raton in the southern part of the county to Palm Beach in the northern part of the county.

Confirmation of reports of possible occurrences of *E. graminea* was mostly made from photographs of the orchid sent by people reporting new locations. Some specimens of *E. graminea* were also received. Follow-up on site visits were made to check some orchid reports, and email and phone calls were made with biologist colleagues and orchid club members to discuss identifying characteristics of the discovered orchids. These included the size of the pseudobulbs, the nature of the leaves, and the height of the inflorescence, the three characteristics that readily separate this orchid from other orchids in Florida. Reports of *E. graminea* occurring in natural areas were investigated to try to learn more about the number of plants involved and their reproductive status.

RESULTS

The Miami Herald story about the orchid's naturalization produced 20 reader responses during the

two years following publication, with most coming during the first few months after publication. Thirteen of the responses were confirmed to be *E. graminea*, while five of the other reports were of *Oeceoclades maculata* Lindl., another naturalized orchid that often grows in wood chip mulch.

Oeceoclades maculata was first detected in Florida in Miami-Dade County during the early 1970s, and specimens have been collected from central Florida and as far north as Alachua County in northern Florida (McCartney 2010). *Oeceoclades maculata* is presumed to be native to Africa, but was first described from Brazil (McCartney 2010). *Eulophia graminea* is readily distinguished from *O. maculata* by its much larger pseudobulbs, which can be golf ball to baseball sized, compared to the 1–2 cm diameter pseudobulbs of *O. maculata*. The inflorescences of *E. graminea* are usually from 30–80 cm tall with many flowers, whereas those of *O. maculata* are usually 30 cm or less and bear few flowers. *Eulophia graminea* has deciduous leaves that are thin, light green and grass-like, but those of *O. maculata* are thick leathery, evergreen, and dark green marked with white.

Two other reports from the Herald story's request, were of the diminutive *Triphora gentianoides* (Sw.) Ames & Schltr., a native Florida orchid that also grows in mulch. This saprophytic orchid lacks leaves and pseudobulbs, and bears small greenish flowers on inflorescences usually less than 10 cm tall.

The Orchids article, the Dade County Native Plant Society outreach, and the May 2009 issue of the Fort Lauderdale Orchid Society Newsletter produced no responses. The 2010 issue of the Fort Lauderdale Orchid Society, however, produced eight reports of new locations of the orchid, seven of which proved to be *Eulophia graminea*. Also very productive, were the reports of colleagues, particularly for occurrences beyond Miami-Dade, Broward and Palm Beach Counties. The survey of Palm Beach County resulted in no discoveries of *E. graminea* plants north of Boca Raton in the southern part of the county.

The current known distribution of *E. graminea* is shown in map (FIGURE 2). The orchid has expanded from a single county, Miami Dade County in 2008, to more than seven counties in 2010. It has spread into the adjacent Broward County and to southern Palm Beach County, where along with Miami-Dade, the highest densities of the orchid now occur. The orchid has also made some long distance hops to more distant locations in Martin County to the north, the Florida Keys to the south, Collier County to the west and Lee County to the northwest, where it has been discovered on Sanibel Island adjacent to the west coast. These localities are, from their most proximate 2008 Miami Dade County localities,

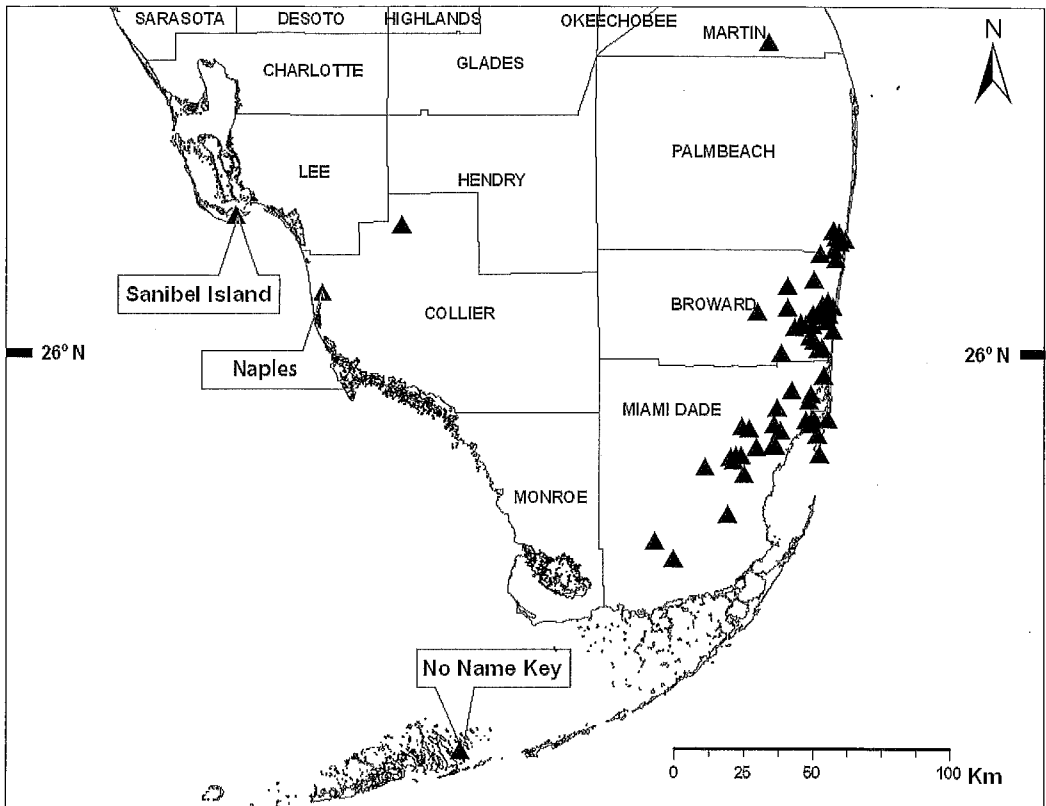


FIGURE 2. Map of the known distribution of *Eulophia graminea*, an invasive orchid, in November 2010. In the autumn of 2008, the orchid was known from only five sites in Miami-Dade County in southeastern Florida.

132 km north, 151 km south, 142 km west and 197 km northwest. The north to south distance of *E. graminea* between localities is 278 km, while the east to west distance is 177 km, while the area within which the orchid occurs is ca. 16,000 km².

The current distribution is comprised of 67 known localities at this writing in November 2010, compared to five in the early fall of 2008. Current localities include not only the landscapes of residential areas and public spaces such as schools and commercial businesses, but also parks and preserves. Sixteen of the 67 occurrences are in parks and preserves but most of these were in mulch or disturbed sites. Four of the 16 occurrences in parks were in undisturbed natural vegetation.

Eulophia graminea has been found in natural vegetation at two preserves in Miami Dade County in the pine rockland habitat. These include a few plants in the Tamiami Pineland Complex Addition (found by Robin Gray-Urgelles and Joy Klien, via Jennifer Possley and Hong Liu), and a larger infestation in the preserve associated with the Miami Zoo (Jennifer Possley via Hong Liu). A 10 March 2010 assessment was made at the zoo preserve and the orchid was found in two patches

about 100 m apart. One patch had three flowering plants, while the other patch had seven flowering plants. Some plants were growing on almost bare rock beneath and between pines in light shade to full sun. The plants were smaller than usual, probably due to growing in these hot dry sites. The vegetation was undisturbed and the only other apparent exotic plant was the yellow cowhorn, *Cyrtopodium flavum* Link & Otto ex Rchb., a native of Brazil, which I am also studying (Liu & Pemberton 2010). These pine rockland habitats, as the name suggests have exposed rock, and are dominated by spaced *Pinus elliottii* Engelm. and have an understory of scattered saw palmetto palms [*Serenoa repens* (W. Bartram) Small]. This is a fire adapted community and the densities of plants depend on the how frequent and recent fire occurs. The pine rockland community has rare endemic plants (Snyder et al. 1990) and is a much reduced and highly valued habitat in southern Florida.

Eulophia graminea was found at the Woodmont Natural Area in northern Broward County by Pat Howell. Scattered plants, ca. 12, including some in flower, were growing in sand along the margin

of a Pine Flatwoods community. Pine Flatwoods communities occur at lower elevations than do Pine Rocklands, and are usually subject to fire and summer flooding. This is a widespread habitat in Florida, also dominated by the pine *Pinus elliotii* overstory, but is a rare community type in urbanized Broward, Miami Dade and Palm Beach counties.

Eulophia graminea was found in natural vegetation in a Cypress Strand community dominated by *Taxodium ascendens* Brongn. at the Pepper Ranch preserve in Collier County, to the west of Miami Dade County, by Steve Woodman-see. A single plant was growing at the base of a red maple (*Acer rubrum* L.), in shade. The swamp had been modified to lower water levels, so that the orchid was not inundated.

The orchid was found in the central Florida Keys, apparently on No Name Key. An unknown person dropped a specimen of the orchid by the Big Pine Key State Park Visitor Center requesting an identification, and saying the plant was from the adjacent No Name Key (Kristie Killam via Keith Bradley). It is not known whether the plant was growing in a residential setting or in natural vegetation.

Other notable occurrences of the orchid, but not in natural vegetation, include plants found at two locations on Sanibel Island off the west coast in Lee County by Jenny Evans and Kennedy Hansen. Both occurrences were in gardens and involved flowering plants. The important Ding Darling National Wildlife Refuge that occurs on the island could be subject to invasion by the orchid. Several flowering plants of *E. graminea* were found in the Hungry Man Preserve in southern Martin County to north the main populations, growing along a disturbed canal bank in open sun by Pam Boody. In Oleta State Park in northern Miami-Dade County, hundreds of plants were found in an open area about 0.5 ha by Hong Liu. The site had been cleared of vegetation and then mulched with wood chips. When this population was visited during March 2010, the woodchips had for the most part weathered and disappeared. There were many large plants with large baseball sized pseudobulbs and old inflorescences, but no seedlings. *Eulophia graminea* plants were found in Everglades National Park south of Miami near the research center by John Ogden. A small number of plants were growing on a soil and marl hill formed by the lowering of the land level to remove the invasive weed Brazilian pepper (*Schinus terebinthifolius* Raddi). Two of these plants were flowering.

Of the 67 localities, clear information exists about whether or not the orchids were growing in mulch at 44 localities. Of these, *Eulophia graminea* plants were growing in mulch at 30 locations.

DISCUSSION

While *Eulophia graminea* is obviously spreading in Florida, it is possible that it could have been more widespread than previously believed, but undetected. The purposeful development of informed observers resulted in most of the discovered localities. In 2007 and 2008 few people recognized the orchid. The difference between the responses to requests for detections and reports in the May 2009 newsletter of the Fort Lauderdale Orchid Society, when no reports were obtained, and the August 2010 issue, when seven sightings were reported, probably represents the detection of the northern spread into Broward County, where most members of the society live. This coincides with my own experience of seeing no plants in Broward County until September 2009, although I looked for them for two prior years, and then seeing many more after that date.

Not only is the increasing number of sites and geographic spread of the orchid impressive, but it is notable that the orchid has invaded natural areas. The current densities of plants at these sites are low and their impact appears to be negligible. This however could change. The densities of naturalized orchid *Oeceoclades maculata* in forests in Veracruz Mexico are such that they appear to be displaying native orchids (Hågsater et al. 2005).

The relationship of the orchid to woodchip mulch is not understood. Previously, the orchid was found growing in mulch at all but one site (Pemberton et al. 2008a). Since then the orchid has been found growing in many other substrates including rock, sand, and bare earth. The mulch where the orchid is found is for the most part woodchip mulch imported to the sites. The dyed red or brown mulch, sold by Home Depot and other stores, has become the most common mulch for use around shrub and tree plantings at residential and commercial landscapes in Southern Florida. Mulch may be a good site for germination of the seed of *Eulophia graminea*, and both the orchid's pseudobulbs and seed might be introduced to new sites via mulch.

Although orchids rarely naturalize (Daehler 1998) or spread much if they do (Liu & Pemberton 2010), two other naturalized orchids are showing up in more places in Florida. Plants of the yellow cowhorn orchid, *Cyrtopodium flavum* [previously *C. polyphyllum* (Vell.) Pabst ex F. Barros] has been recently found in well separated locations in southern Florida (Pemberton & Liu 2011). The nun's hood orchid [*Phaius tankervilleae* (Banks) Blume] has recently been discovered to be naturalized in central Florida (D. Robinson et al. 2011).

NOTE added to the proof, Since November 2010, many new localities of the orchid have been detected in Lee County on Florida's southwest coast. *Eulophia graminea* has also been found on

Key Largo in the northern Keys, which is quite distant from the No Name Key location in the middle Keys. The orchid has also become more abundant and wide spread in Palm Beach County. During the summer of 2012, *E. graminea* was discovered in Port St. Lucie in St. Lucie County north of Martin County on the east coast of Florida. This is the most northern known locality for the orchid in Florida and ca. 185 km north of Miami where it was first detected in 2007. By March, 2013, the orchid had been discovered in Charlotte, Hernando, Okeechobee, Polk, and Orange counties in central Florida (Roger Hammer, personal communication).

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LITERATURE CITED

- Daehler, C.C. 1998. The taxonomic distribution of invasive plants: ecological insights and comparison to agricultural weeds. *Biological Conservation* 84:167–180.
- Hágsater, E., M.A. Soto Arenas, G.A. Salazar Chavez, R.J. Machorro, M.A. Lopes Rosas, and R.L. Dressler. 2005. Las orquídeas de México. *Productos Farmaceuticos, S.A. de C.V.*, Mexico.
- Liu, H. and R.W. Pemberton. 2010. Pollination of an invasive orchid (*Cyrtopodium polyphyllum*) by an invasive oil-collecting bee (*Centris nitida*) in southern Florida. *Botany (Canadian J. Botany)*. 88: 290–295.
- Macrae, C. 2002. New Weed Found in Darwin. Department of Business, Industry and Resource Development, Primary Industry and Fisheries, Northern Territory Government, Australia. (website last accessed 31 January 2008).
- McCartney, C. 2010. Aliens among us: foreign orchids go wild in south Florida. *Orchids* 79: 577–585.
- O'Conner, M., T. Govender and K. Jolliffe. 2006. *Eulophia graminea* - The ET Orchid. *Orchids South Africa* 37: 128–131.
- Pemberton, R., T. Collins and S. Koptur. 2008a. An Asian orchid, *Eulophia graminea* (Orchidaceae: Cymbidieae), naturalizes in Florida. *Lankesteriana* 8: 5–14.
- Pemberton, R.W., T. Collins and S. Koptur. 2008b. Alien, terrestrial orchid (*Eulophia graminea*) naturalizes in Florida. *Orchids* 77: 412–413.
- Pemberton, R.W. and H. Liu. 2011. Yellow cowhorn orchid, *Cyrtopodium flavum*, spreading in Florida. *Journal of the Botanical Research Institute of Texas* 5: 331–335.
- Robinson, D.J., E. Gandy, C. VanHoek and R.W. Pemberton. 2011. Naturalization of the nun's hood orchid (*Phaius tankervilleae*) in central Florida. *Botanical Research Institute of Texas*. 5: 337–339.
- Snyder, J.R., A. Herndon and W.B. Robertson. 1990. South Florida rockland. Pp. 230–277 in R.L. Myers and J.J. Ewel, eds. *Ecosystems of Florida*. University of Central Florida Press, University Presses of Florida, Orlando.
- Tasker, G. 2008. Asian orchid making its home here. *Miami Herald* July 5.

NEW COMBINATIONS AND SYNONYMS IN THE MAXILLARIINAE (ORCHIDACEAE)

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ABSTRACT. Twelve orchid species previously described in the genus *Maxillaria* are transferred to *Camaridium*, *Heterotaxis*, *Inti*, *Pityphyllum*, and *Sauvetea*. In addition, 19 new heterotypic synonyms in the subtribe Maxillariinae are presented; these and a few others are discussed and/or typified.

RESUMEN. Doce especies de orquídeas previamente descritas en el género *Maxillaria* son transferidas a *Camaridium*, *Heterotaxis*, *Inti*, *Pityphyllum* y *Sauvetea*. Además, se presentan 19 sinónimos heterotípicos nuevos para la subtribu Maxillariinae; éstos y algunos otros son comentados y/o tipificados.

Key words: *Camaridium*, *Heterotaxis*, *Inti*, *Maxillaria*, *Pityphyllum*, *Rhetinantha*, *Sauvetea*, Typification

INTRODUCTION

A comprehensive study of the phylogenetic relationships of the orchid subtribe Maxillariinae (Whitten et al. 2007) demonstrated that the taxonomically complex genus *Maxillaria* was grossly polyphyletic as circumscribed traditionally. Thus, a new generic classification (Blanco et al. 2007) and detailed descriptions of each genus (Whitten et al. 2009) were published soon after. Since then, several species were described using the traditional circumscription of *Maxillaria*, and thus it is necessary to transfer these to the appropriate genera to bring them into line with the new classification system. Several of these and other older names have recently been transferred by other authors; e.g., *Camaridium darienense* (J.T. Atwood) Szlach. & Sitko, *Christensonella huntii* (Christenson) S. Koehler, *C. paranaensis* (Barb. Rodr.) S. Koehler, *C. subulifolia* (Schltr.) S. Koehler, *Maxillariella dichaeoides* (D.E. Benn. & Christenson) Szlach. & Sitko, *Mormolyca calimaniensis* (V.P. Castro) F. Barros & L.R.S. Guim., and *Mormolyca vanillosma* (Christenson) J.M.H. Shaw. In the present contribution, new combinations are provided for the remainder.

In addition, new synonyms in the Maxillariinae are presented with commentary. Data included in brackets in the type citations below (mostly country and/or current major political divisions) have been inferred from the available locality information in the protologue and/or the type specimen labels.

A list of accepted species that belong to each of the newly circumscribed genera was presented in Blanco et al. (2007). According to their morphology, the following recently described taxa or recently published new names belong in *Maxillaria sensu stricto* (in the restricted circumscription of Blanco et al. 2007, and Whitten et al. 2009): *Maxillaria bettymooreana* Christenson, *M.*

calendulina Christenson, *M. canarina* D.E. Benn. & Christenson, *M. cesarfernandezii* Christenson, *M. colombiana* Christenson (although this is doubtfully different from *M. grandiflora* (Kunth) Lindl.), *M. coniformis* D.E. Benn. & Christenson (synonymized below under *M. longissima* Lindl.), *M. crispiloba* Sauvêtre & McIlmurray, *M. × doucetteana* Christenson, *M. erecta* Christenson, *M. farinosa* Arévalo & Christenson, *M. flabellata* D.E. Benn. & Christenson, *M. hajekii* D.E. Benn. & Christenson, *M. leucopurpurea* D.E. Benn. & Christenson, *M. ortizii* Christenson, *M. roseola* Christenson, *M. saueri* Christenson, *M. striolata* D.E. Benn. & Christenson, *M. tectasepala* Christenson, *M. tenebrifolia* Arévalo & Christenson, *M. vallisnerioides* Christenson, *M. vasquezii* Christenson, and *M. visseri* D.E. Benn. & Christenson. *Maxillaria pachyacron* Schltr. also belongs in *Maxillaria sensu stricto*; it was accidentally omitted from the list of species that belong in that genus in Blanco et al. (2007).

Soto Arenas (in Hágsater & Soto Arenas 2008) put *Maxillariella tuerckheimii* (Schltr.) M.A. Blanco & Carnevali in the synonymy of *Maxillaria anceps* Ames & C. Schweinf. (= *Maxillariella anceps* (Ames & C. Schweinf.) M.A. Blanco & Carnevali).

Szlachetko et al. (2012) recently published an alternative classification system for the subtribe Maxillariinae. The recognized genera in that classification are too numerous, and many of them are polyphyletic or paraphyletic as circumscribed by the authors. A detailed critique to that system will be published separately (Whitten et al., in preparation).

NEW COMBINATIONS

Camaridium atrovinaceum (Christenson) M.A. Blanco, **comb. nov.**