LANKESTERIANA 26(1): 65–76. 2026. doi: http://dx.doi.org/ 10.15517/sjs8k094

ORCHIDS NATURALIZED IN FLORIDA

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Abstract. Florida's naturalized orchids are mostly terrestrials (10/15, 5/10 epiphytes), horticultural escapes (14/15), native to Asia (10/15), tropical America (4/10), and Africa (1/15). Only 3 species are widespread in Florida, *Eulophia graminea*, *Eulophia maculata*, and *Zeuxine strateumatica*, and can be considered invasive based on their spread beyond the areas of their initial establishments. Most of the other orchid species occur in one or two counties and have spread little so are considered naturalized but not invasive. The longest naturalized orchids (5/15) escaped more than 50 years ago, another group (5/10) more than 20 years ago, while the most recently naturalized species (5/10) less than 20 years ago. The 15 naturalized orchids comprise 12% (15/117 species) of Florida's orchid flora, which is higher than most other places except for Hawaii's (18/21) which has only 3 native orchids. Most orchids naturalized in Florida (10/15) have also naturalized elsewhere in the world. Failure to reproduce is the reason why most orchids don't naturalize. To attempt to understand how Florida's 15 naturalized orchids have overcome this barrier, the literature was examined to learn what their breeding systems and pollinators are in their native areas. This enabled predictions to be made about how these orchids reproduce in Florida. Four of the orchids need no pollinators because they are autogamous or apomictic. The native region pollinators of two of the orchids occur in Florida, five of the orchids are probably pollinated by congeneric species of their native area pollinators (*Apis*, *Centris* and *Xylocopa*), Two of the orchids are pollinated by close analogues of their native area pollinators (butterflies and hummingbirds). Overcoming other barriers to their naturalization, such as the lack of suitable mycorrhizal fungi or the inability to deal with abiotic limitations, has occurred but are poorly known and understood.

Keywords / Palabras clave: barreras de naturalización, comercio ornamental, *Eulophia*, floras de orquídeas, horticultura, horticulture, naturalization barriers, orchid floras, ornamental trade, pollinators, polinizadores, *Zeuxine*

Florida is famous for being invaded by diverse animals and plants. Burmese pythons (*Python bivittatus* Kuhl, 1820) have adversely impacted mammals in Everglades National Park (Dorcas *et al.,* 2012), while lionfish (*Pterois volitans* L., 1758) and the Asian swamp eel (*Monopterus albus* Zuiew, 1793) threaten native marine and freshwater fish (Sabapathy, 2019; US Fish and Wildlife Service, 2014). Invasive plants such as punk tree (*Melaleuca quinquenervia* (Cav.) S.T.Blake) and Old World climbing fern (*Lygodium microphyllum* (Cav.) R.Br.) have transformed whole wetland environments (Laroche and Ferriter, 1992; Pemberton and Ferriter, 1998). Then there are numerous naturalized species, seemingly more benign species, that are decreasing the proportion of Florida's biota that is native.

Among these are 15 naturalized orchids (Wunderlin *et al*., 2025; Pemberton & Downing, 2025). In this paper, these orchids and their characteristics will be defined. Orchids naturalize much less often than other kinds of plants due to their need for specialist pollinators and mutualistic fungi to enable seed germination (Daehler, 1998). How Florida's naturalized orchids have been able to overcome these barriers to naturalization is explored.

General characteristics and occurrence of the naturalized orchids. These 15 orchids are taxonomically diverse and limited, belonging to different genera, except for two genera *Eulophia* R.Br and *Cymbidium* Sw. that have three and two naturalized species respectively (Table 1). Ten of the orchids are native to Asia, five native to tropical America and one [*E. maculata* (Lindl.) Rchb.f.] is native to Africa. Ten of the orchids are terrestrials while five are epiphytes. Almost all (14/15) of these orchids are likely horticultural escapes except for *Zeuxine strateumatica* (L.) Schltr. which is thought to have been introduced with grass seed (Ames, 1938).

ORCID of the Author: RWP
Received 16 February 2026; accepted for publication 21 April 2026. First published online: 30 April 2026.

The commonness of these orchids in Florida is indicated by the number of counties in which the orchid has been collected (Wunderlin *et al*., 2025; Table 1). Only three of the naturalized orchids are widespread in Florida (Fig. 1). *E. graminea* Lindl., also collected from 25 counties, was first found in South Miami in 2007 (Pemberton *et al*., 2008) and has spread widely in the state (Pemberton, 2013; Fig. 1A–B). Beyond Florida, *E. graminea* has spread through the West Indies reaching Puerto Rico (Ackerman & Gónzález-Orellana, 2021) and in Texas where it appears to be very common in the Houston area due to more than 279 iNaturalist posts of it there (iNaturalist, 2026). *E. maculata* collected from 25 counties, is an African species that has spread slowly northward after it appeared in Brazil, reaching Florida by 1974 (Wetterer & Wetterer, 2022) (Fig. 1C–D). *Zeuxine strateumatica* first found in Indian River County on Florida's east coast in 1936 (Ames, 1938), has been collected from 48 counties (Fig. 1E–F).

Most of the others, such as *Phaius tankervilleae* (Banks) Blume (Robinson *et al*., 2011), are limited to one or two counties (Wunderlin *et al*., 2025). The greater naturalization of terrestrial orchids may be due to the large array of mycorrhizae in the soil and mulch environments in which they grow, or a widespread fungus that the orchid is able to exploit. Naturalized terrestrial orchids are probably also better able to survive the variable weather of subtropical Florida because their subterranean parts of these orchids may survive periodic freezes.

Of the five epiphytic orchids that have naturalized in Florida, the persistence of two of these species is questionable. *Laelia rubescens* Lindl. was found growing on Southern live oak trees (*Quercus virginiana* Mill.) in Miami-Dade County in 1990 by Roger Hammer (pers. com.). This author's search for the orchid at that site failed to find it; however, there is a 2019 iNaturalist post (iNaturalist, 2019) of the orchid in the Big Cypress National Wildlife Preserve in Collier County *ca*. 80 km west of where it was first found. The other, *Encyclia rufa* (Lindl.) Britton & Millsp., was collected from Brevard County on the east coast in 1926, but this orchid has not been seen in the last 10 years. One naturalized terrestrial orchid, *Bletia florida* (Salisb.) R.Br., appears to have disappeared from where it was first reported in Dade County, but has been found in Everglades National Park in 2022 (iNaturalist, 2022).

The year, if known, when these orchids were first detected or reported to be naturalized in Florida is given in Table 1. These dates are from the literature, and herbarium specimens cited by Wunderlin *et al*., (2025). The first orchid to naturalize in Florida is apparently *E. rufa* in 1926 followed by *Z. strateumatica* in 1936 (Ames, 1938). *Cymbidium aloifolium* (L.) Sw. and *C. dayanum* Rchb.f. are the most recent orchids reported to be naturalized in Florida (Pemberton & Downing, 2025; Pemberton & Downing, unpublished data). Large old plants of both species were found among naturalized populations of these plants, suggesting that they were naturalized much earlier than when they were reported.

When Roger Hammer made the first collection of *Cyrtopodium flavum* (Nees) Link & Otto ex Rchb. at the Boystown Preserve in Miami in 1997, hundreds of plants were growing at the site including large ones (R. Hammer, pers. com.), indicating that the population began much earlier than in 1997. The longer horticulture plants are marketed, the greater the chance of their naturalization and invasion (Pemberton & Liu, 2009). The longer naturalized plants have been established, the greater chance for them to become invasive (Gallagher *et al*., 2015). It is not known how long these orchids were naturalized before they were detected and reported, but five were first collected more than 50 years ago, another five more than 20 years ago, while the other five less than 20 years ago.

I have used the word naturalized for these orchids through this paper because of the absence of evidence of impact that these orchids have on Florida's environment. A widely accepted definition for an invasive species, which does not include impact, is that an invasive species is one which has spread beyond the population of their initial establishment (Blackburn *et al*., 2011). Only three of the naturalized orchid species readily meet this definition, *E. graminea, E. maculata*, and *Z. strateumatica*, which are widely distributed in Florida (Table 1). Seven of the naturalized species occur in single counties so have spread very little. Five of the orchid species occur in two or three counties, including counties that are geographically separated from one another, but the occurrences of these orchids in one or three separated counties could easily be due to separate naturalizations rather than spread. The populations of the five orchids that occur in two or three counties tend to be small and isolated,

TABLE 1. Naturalized orchids in Florida, USA. The species are from Wunderlin *et al.*, 2026, plus 1 (Pemberton & Downing, 2025), minus 5 species: *Epidendrum blancheanum* Urb. (= *E. acunae* Dressler), *Bulbopyllum pinelianum* (A.Rich.) Ormerod [= *B. pachyrachis* (A.Rich.) Griseb.], *Leochilus labiatus* Kuntze, and *Trichocentrum carthagenense* (Jacq.) M.W.Chase & N.H.Williams (Rogert Hammer, pers. com) which were collected only once; and *Ludisia discolor* which was found in the Fakahatchee Strand in 2010 but was removed by park officials (McCartney, 2010). Herbarium specimens were consulted in SERNEC (2026).

Scientific name Common name	Native region	Epiphyte or terrestrial	No. Counties found in	Year first found	References & Herbarium Specimens
Bletia florida Slender pinepink	Cuba, Jamaica	Terrestrial	1	2002	Brown, 2002
Bletilla striata Chinese ground orchid	China	Terrestrial	1	1979	FLAS136675
Cymbidium aloifolium Aloe leaved cymbidium	Asia	Epiphyte, Lithophyte	1	2025	Pemberton & Downing, 2025
Cymbidium dayanum Day's cymbidium	Asia	Epiphyte	3	2023	FLAS290648; Pemberton & Downing, unpublished data
Cyrtopodium flavum Yellow cowhorn orchid	Brazil	Terrestrial, Lithophyte	3	1997	USF220833
Encyclia rufa Rufous butterfly orchid	Bahamas	Epiphyte	1	1926	NY468306
Epidendrum radicans Star orchid	Tropical America	Terrestrial	1	1956	GH02029670
Eulophia andamanensis Andaman crown orchid	Southeast Asia	Terrestrial	1	2018	USF297837
Eulophia graminea Chinese crown orchid	Asia	Terrestrial	25	2007	Pemberton *et al.,* 2008; Pemberton, 2013
Eulophia maculata Monk orchid	Africa	Terrestrial	25+	1974	Wetterer & Wetterer, 2022
Laelia rubescens Pale laelia	Central America	Epiphyte	1	*ca.*1990	R. Hammer pers. com.
Phaius tankervilleae Nun's hood orchid	Asia	Terrestrial	2	1965	Robinson *et al*., 2011
Spathoglottis plicata Philippine ground orchid	India to Australia	Terrestrial	2	2001	USF230623
Vanilla planifolia Commercial vanilla	Tropical America	Epiphyte	3	1933	Small, 1933
Zeuxine strateumatica Lawn orchid	China	Terrestrial	48+	1936	Ames, 1938

while *E. graminea. E. maculata* and *Z. strateumatica* are not only geographically widespread but are often common where they occur. The relatively small body sizes and low densities of naturalized orchids may limit their abilities to compete with and displace other vegetation so their direct impacts are limited. However, indirect ecological impacts can occur as in the interesting case in Puerto Rico reported by Recart *et al*. (2013). The invasive orchid *Spathoglottis plicata* Blume is a host of a flower feeding native weevil which also used the native orchid *Bletia patula* Hook. as a host. When *S. plicata* grows near *B. patula*, the native *B. patula* has more weevils and lower fruit set. *Spathoglottis plicata* has no impact on its own but when it grows near *B. patula* and hosts the weevil, it indirectly negatively impacts *B. patula.*

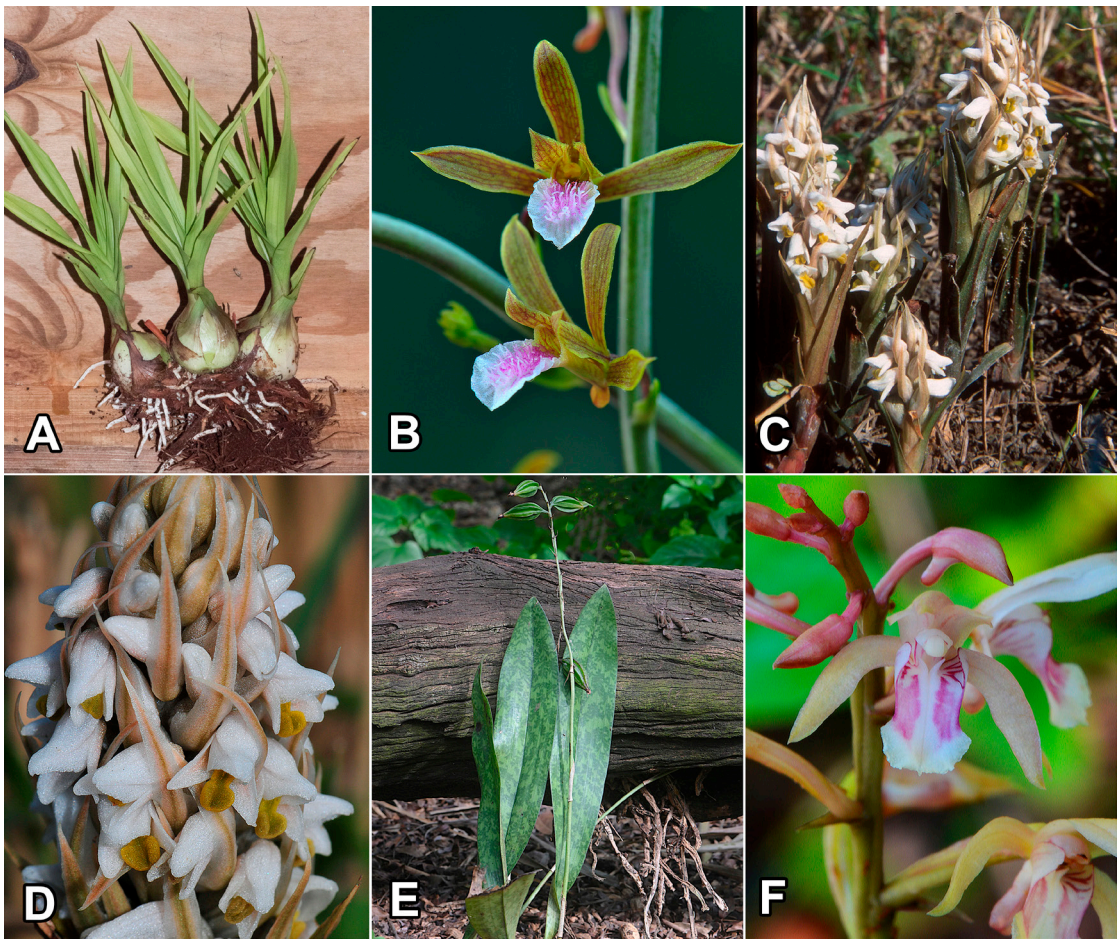

FIGURE 1. The three most widespread naturalized orchids in Florida. The Chinese crown orchid, *Eulophia graminea* (**A**. habit. **B**. single flowers), first found in 2007 (Pemberton *et al.,* 2008). The lawn orchid *Zeuxine strateumatica* (**C**. habit. **D**. inflorescence), first found in 1936 (Ames, 1938). Photographs by Roger Hammer. The monk orchid, *Eulophia maculata* (**E**. habit. **F**. single flower), first found in 1974 (Wetterer & Wetterer, 2022).

Overcoming barriers to naturalization: need for pollinators. The inability to reproduce is an important barrier to orchid naturalization, which is a major reason why orchids naturalize less frequently than other plants (Daehler, 1998). Most orchids have single pollinators (Ackerman *et al*., 2023), and these pollinators rarely occur in the regions beyond the native areas where orchids are grown as ornamentals. To attempt to understand how these 15 naturalized orchids have overcome this critical barrier, the scientific literature was examined to learn what their breeding systems and pollinators are in their native regions (Table 2). This enabled predictions to be made about their probable pollination in Florida.

The pollination of only a few of these orchids has been studied in Florida. *Cyrtopodium flavum* is pollinated by a naturalized oil-collecting bee (*Centris nitida* Smith, 1874) in Florida (Liu & Pemberton, 2010), similar to its *Centris* spp. pollinators in its native Brazil (Pansarin *et al*., 2008). *Vanilla planifolia* Andrews was found to be infrequently visited during a study in Florida but was pollinated by the honeybee (*Apis mellifera* L., 1758) and a female of the naturalized orchid bee (*Euglossa dilemma* Bembé & Eltz, 2011) (Pemberton *et al*., 2023). The pollinators of this orchid are unknown in its native tropical America (Lubinsky *et al*., 2006; Quezada-Euán *et al*., 2024).

The predicted pollinators of the other 13 orchids fall into a number of categories. There are four orchids that do not need pollinators to set fruit. *Eulophia graminea, E. maculata,* and *S. plicata* are autogamous, while *Z. strateumatica* is apomictic (Ackerman, 2007). *Eulophia andamanensis* Rchb.f. has not been studied but because *Eulophia* species usually lack nectar (C. Peter, pers com.) it is probably a deceit orchid, or autogamous like the other two naturalized *Eulophia* spp. in Florida. There are the pollinators of two orchids in their native area which also occur in Florida. The common honeybee (*A. mellifera*) which pollinates *Bletilla striata* (Thunb.) Rchb.f. (Chung & Chung, 2005) in South Korea was introduced to both South Korea and Florida. The polka-dot wasp moth (*Syntomeida epilais* Walker, 1854), the pollinator of *Encyclia rufa* in its native Bahamas (Esperón & Sauleda, 2012), also occurs in Florida (Bug Guide, 2026).

Then there are congeneric species of orchid pollinators in the native area which occur in Florida. *Cymbidium aloifolium* and *C. dayanum* are pollinated by an Asian honeybee (*Apis cerana* Fabricius, 1793) in their native Asia (Adit *et al*. 2022, Matsuda & Sugiura 2019), so they are predicted to be pollinated by the similar-sized common honeybee (*A. mellifera*) in Florida. As mentioned above, *Cyrtopodium flavum* is pollinated by *Centris* species in Brazil, is pollinated by *C. nitida* in Florida (Liu & Pemberton, 2010). *Phaius tankervilleae* is pollinated by *Xylocopa violacea* L., 1758 in its native area (Buragohain *et al*., 2016), is probably pollinated by *Xylocopa virginica* L., 1771 in Florida.

In addition, there are analogs, pollinators that are taxonomically and morphologically similar to the orchid's pollinators in their native regions. *Epidendrum radicans* Pav. ex Lindl., pollinated by butterflies in its native tropical America (Bierzychudek, 1981), is probably pollinated by butterflies in Florida as well. *Laelia rubescens* is pollinated by hummingbirds in Costa Rica (Trapnell & Hamrick, 2004) and a social wasp (*Polybia* sp.) in Mexico (Cen, 2016). This suggests pollination by hummingbirds or social wasps in Florida. Finally, the pollinators of the two remaining orchids, *Bletia florida* and *Eulophia andamanensis*, are unknown in their native regions so their pollinators in Florida are less predictable. Peter (2009) studied the pollination of 11 *Eulophia* species in South Africa and found that five are pollinated by bees, two by beetles, while four are autogamous.

Although orchids have a wide variety of breeding systems (Sun, 1997), outcross deception is more common in these naturalized orchids than in orchids overall (Neiland & Wilcock, 1998). Deception occurs in 100% (11/11) of the outcrossing naturalized orchids in Florida (Table 2), compared to about *ca*. 30% of orchids overall (Neiland and Wilcock, 1998), and 44.6% of the orchids in the Ackerman *et al*. pollination database (Ackerman *et al*., 2025). Nectarless orchids have fewer visitors but higher outcross rates (Neiland & Wilcock, 1998). This phenomenon occurs because visitors to nectarless orchids spend shorter times on these plants before abandoning them and moving to the flowers of other plants while carrying the pollen from the flowers of plants previously visited. Visitors to rewarding (nectar bearing) orchids spend longer times on the same plant, moving from flower-to-flower, causing more pollination with self pollen (getionagamy). Also, having more outcrossing in these 11 naturalized orchids may have made them better adapted to Florida's environment.

Overcoming the need for mycorrhizal associations. The absence of suitable mycorrhizal fungi is thought to be another important barrier to orchid naturalization (Daehler, 1998). The mycorrhizal associates of orchids are mostly unknown, both in their native and introduced regions. The fungi associated with a few naturalized orchids (*Cyrtopodium flavum* and *Eulophia graminea*) in Florida appear to be common saprophytes (Downing *et al*., 2020). This suggests that either there is less specificity in fungal associates of naturalized orchids than with their pollinators, or they are more widely available than their pollinators. The lack of needed fungi may be less of a barrier to orchid naturalization than has been presumed. However, Bayman *et al*. (2016) found many orchid mycorrhizae in the roots of *Eulophia* (as *Oeceoclades*) *maculata*, but only one widespread fungus was successful in germinating the seed.

Influences of polyploidy and self-compatibility. There are other biological characteristics that are associated with plant naturalization. Self-compatibility is one of these characteristics (Kinlock *et al*., 2025), and orchids usually have a high degree of self-compatibility. Ackerman *et al*. (2023) reported

Table 2. Naturalized orchids in Florida and their reproduction.

Scientific name Common name	Pollinator in native region	Reference	Breeding System	Reference	Predicted pollinator in Florida
Bletia florida Slender pinepink	unknown	-	deceit?	Sosa, 1992	*Apis mellifera*
Bletilla striata Chinese ground orchid	*Tetralonia nipponensis*	Sugiura, 1995	deceit	Sigiura, 1995	*Apis mellifera*
	Apis mellifera	Chung & Chung, 2005	deceit	Ackerman *et al.,* 2025	-
Cymbidium aloifolium Aloe leaved cymbidium	*Apis cerana*	Adit *et al.*, 2022	deceit	Adit *et al.,* 2022	*Apis mellifera*
Cymbidium dayanum Day's cymbidium	*Apis cerana*	Matsuda & Sugiura, 2019	deceit	Matsuda & Sigiura, 2019	*Apis mellifera*
Cyrtopodium flavum Yellow cowhorn orchid	*Centris* spp., rain assisted selfing	Pansarin *et al.,* 2008	deceit	Liu & Pemberton, 2010	*Centris nitida*[1]
Encyclia rufa Rufous butterfly orchid	*Syntomeida epilais* (polka-dot moth)	Esperón & Sauleda, 2012	deceit?	-	*Syntomeida epilais*
Epidendrum radicans Star orchid	Butterflies	Bierzychudek, 1981	deceit	Ackerman, 2007	butterflies
Eulophia andamanensis Andaman crown orchid	unknown	-	deceit?	-	unknown
Eulophia graminea Chinese crown orchid	autogamy	-	autogamy	Ackerman, 2007	autogamy
Eulophia maculata Monk orchid	autogamy	-	autogamy	González-Díaz & Ackerman, 1988	rain assisted, autogamy
Laelia rubescens Pale laelia	hummingbirds	Trapnell & Hamrick, 2004	deceit	Trapnell & Hamrick, 2004	hummingbirds
	Polybia	Cen, 2016	deceit	Ackerman *et al.,* 2025	social wasps
Phaius tankervilleae Nun's hood orchid	*Xylocopa violacea*	Buragohain *et al.,* 2016	deceit	Ackerman, 2007	*Xylocopa virginica*
Spathoglottis plicata Philippine ground orchid	autogamy	Ackerman, 2007	autogamy	Ackerman, 2007	autogamy
Vanilla planifolia Commercial vanilla	unknown	Lubinsky *et al.,* 2006	deceit	Pemberton *et al.,* 2023	*Apis mellifera*[2] *Euglossa dilemma*[2]
Zeuxine strateumatica Lawn orchid	apomixis	Ackerman, 2007	apomixis	Ackerman, 2007	apomixis

[1]Liu & Pemberton, 2010. [2]Pemberton *et al.,* 2023.

that only 12% of 1076 orchid species are self-incompatible. Polyploidy is known to increase plant naturalization (Te Beest *et al*., 2012), and orchids show a remarkable amount of polyploid and aneuploid variation (Givnish *et al*., 2015). Polyploidy is known in some of the 15 naturalized orchids in Florida, including *E. maculata* (Dematteis and Daviña, 1999) and *V. planifolia* (Bory *et al*., 2008), and may occur in some of the other species as well.

Proportion of naturalized orchids in Florida and other orchid floras. The 117 orchid species in Florida, including the 15 naturalized species, means that the naturalized orchids comprise 13% of the state's orchid flora. To put this proportion in perspective, the numbers of naturalized orchids in various other places were sought through the literature and correspondence with orchid specialists in those places. Table 3 gives the proportions of

Table 3. Proportion of naturalized orchids in the orchid floras.

Place	Number of orchids	Number of naturalized	Percent of naturalized	Reference
Florida	117	15	12.82	Wunderlin *et al*., 2025; Pemberton & Downing, 2025
Bhutan	462	0	0	S. Dalstrom, pers. com.
California	34	1	2.94	Jepson's eflora, 2026
Cuba	312	6	1.92	Mujica & González, 2015
Hawaii	21	18	85.7	Gallaher *et al*., 2020
Panama	1360	4	0.029	Bogarín *et al*., 2014; D. Bogarín, pers. com
Puerto Rico	147	11	7.5	J.D. Ackerman, pers. com
South Africa	470	1	0.02	C. Peter, pers. com.
Sri Lanka	188	4	2.23	Fernando & Omerod, 2008
Taiwan	497	4	0.8	Lin & Liu, 2025; T.P. Lin, pers. com.

the orchid floras that naturalized species comprise. Naturalized orchids comprise 85.7% of Hawaii's orchid flora because it has 18 naturalized orchids but only 3 native orchids. Its 18 naturalized orchids are the most similar to the number of species (15) naturalized in Florida, but a much larger proportion than Florida's 13% (Table 3). At the other end of the spectrum is Bhutan which has 462 native orchids but no naturalized orchids. Close to this are Panama with 1360 orchids including 4 naturalized species (0.29%). and South Africa with 470 orchids including just one naturalized species (0.2%). The percentage of orchid floras that naturalized orchids comprise depends on the number of native species as well as the number of alien orchids. Both the number of naturalized orchids in Florida (15) and the proportion of the orchid flora that they comprise is 13% (15/118), which is much higher than all other orchid floras examined except Hawaii.

Occurrence of naturalized orchids elsewhere. Two thirds, 10/15, of the orchids naturalized in Florida have naturalized elsewhere. These places (the countries, islands, and U.S. states) are shown in Table 4. Five of these 10 orchids have naturalized widely and occur on multiple continents. These are *Eulophia maculata*, *Phaius tankervilleae*, *Vanilla planifolia* and *Zeuxine strateumatica*. *Vanilla planifolia* occurs in 40 places, followed by *E. maculata* in 30 places and *S. plicata* in 14. Only 3/15 occur within the continental United States in addition to Florida: *Bletilla striata* in Maryland, *E. graminea* in Texas, and *Z. strateumatica* in California and six states in the southeastern United States. Hawaii and Puerto Rico share the most naturalized orchids with Florida, numbering 5 and 7 species respectively. The naturalization of many tropical orchids in Florida, Hawaii and Puerto Rico is due to the intensity of horticultural marketing in these areas which are climatically suitable for these orchids. In Panama most orchids in cultivation are mostly local species so there are fewer foreign orchids to naturalize, hence the low orchid naturalization percentage.

Limiting abiotic factors. The lack of suitable pollinators and mycorrhizal fungi may be the reason for orchids not naturalizing, but it could also be due to abiotic factors. The Ackerman *et al*. (2024) study used the Maxent Model to predict suitable areas for *Arundina graminifolia* (D.Don) Hochr. Florida was not predicted to be climatically suitable for this orchid.

Biological characteristics that promote naturalization. There are other biological characteristics that are associated with plant naturalization. Self-compatibility is one of these characteristics (Kinlock *et al*., 2025), and orchids usually have a high degree of self-com-

Table 4. Naturalized orchids in Florida, USA, that are naturalized elsewhere.

Scientific name Common name	No. USA States	No. places	Places naturalized beyond Florida	Reference
Bletia florida Slender pinepink	1	2	Trinidad	POWO, 2026
Bletilla striata Chinese ground orchid	2	2	Maryland	POWO, 2026
Cymbidium aloifolium Aloe leaved cymbidium	1	1	None	Pemberton & Downing, 2025
Cymbidium dayanum Day's cymbidium	2	2	Hawaii	POWO, 2026
Cyrtopodium flavum Yellow cowhorn orchid	1	1	None	
Encyclia rufa Rufous butterfly orchid	1	1	None	
Epidendrum radicans Star orchid	1	3	Cuba, Puerto Rico	POWO, 2026
Eulophia andamanensis Andaman crown orchid		1	None	None
Eulophia graminea Chinese crown orchid	4	6	Bahamas, Cuba, Mexico, Puerto Rico, U.S.A (Texas)	POWO, 2026; Ackerman *al*., 2021
Eulophia maculata Monk orchid	1	30	Central & South America, West Indies	POWO, 2026
Laelia rubescens Pale laelia	1	1	None	
Phaius tankervilleae Nun's hood orchid	2	7	Cuba, Jamaica, Mauritius, Panama, Puerto Rico, U.S.A (Hawaii)	POWO, 2026
Spathoglottis plicata Philippine ground orchid	2	14	Cayman I., Comoros, Cuba, Dominican Rep., Leeward I., Marquesas, Nauru, Panama, Puerto Rico, Reunion, Seychelles, Society I., U.S.A (Hawaii), Windward I.	POWO, 2026
Vanilla planifolia Commercial vanilla	2	40	Bangladesh, D.R. Congo, Dominican Rep., Indonesia, Madagascar, Papua NG, Puerto Rico, Reunion, S. Amer-part, U.S.A (Hawaii), and others	POWO, 2026
Zeuxine strateumatica Lawn orchid	5	17	Argentina, Bahamas, Bermuda, Brazil, Cuba, Jamaica, Puerto Rico, Saudi Arabia, Türkiye, U.S.A. (Alabama, Calif., Georgia, Hawaii, Louisiana, Mississippi, Texas)	POWO, 2026

patibility (Neiland & Wilcock, 1998). Polyploidy is known to increase plant naturalization (Te Beest *et al*. 2012), and orchids show a remarkable amount of polyploid and aneuploid variation (Givnish *et al*., 2015). Polyploidy is known in some of the 15 naturalized orchids in Florida, including *E. maculata* (Dematteis & Daviña, 1999) and *V. planifolia* (Bory *et al*., 2008), and may occur in some of the other species as well.

Most orchids prefer ephemeral habitats which they reach by producing numerous wind-borne seed (Acker-

man, 2007). This suggests preadaptation to Florida habitat types was not needed by these naturalized orchids. In Brazil *Cyrtopodium flavum* grows on rock outcrops (Pansarin *et al*., 2008), whereas the biggest population in Florida is in a Pine Rockland at Boystown Preserve in Miami, but it also occurs in many other habitats (Pemberton & Liu, 2011). *Laelia rubescens* occurs largely in anthropogenically altered habitat (Trapnell & Hamrick, 2004). *Eulophia graminea* often grows in mulch (Pemberton *et al*., 2008) which has become extensively used in recent years. The orchid was introduced to Puerto Rico with mulch imported from Florida (Ackerman & Gónzález-Orellana, 2021).

Nonnative ornamental orchids that fail to naturalize in Florida. It is of interest to note that some very commonly grown non-native ornamental orchids that are well-pollinated in Florida have not naturalized. *Guarianthe skinneri* (Bateman) Dressler & W.E. Higgins was pollinated by the naturalized orchid bee *Euglossa dilemma* (Pemberton, 2007). The orchid bee quickly discovered and visited newly exposed flowers and removed more than half of the pollinaria of this orchid. *Oncidium sphacelatum* Lindl. was pollinated by the naturalized oil-collecting bee *Centris nitida*, whose pollination induced a much higher fruit set than has been recorded in the native area (Pemberton, 2008). *Arundina graminifolia* is pollinated by the common honeybee, which caused half of the flowers to set fruit (Pemberton, unpublished), which is much higher than has been recorded in places like Hawaii, Mauritius, and Puerto Rico, where it has naturalized (Ackerman *et al*., 2024). These orchids have overcome the pollination barrier yet have not naturalized. The lack of suitable mycorrhizal fungi may be the reason for their failure, but it could also be due to abiotic factors. The Ackerman *et al*. (2024) study used the species distribution modeling program Maxent to predict suitable areas for *Arundina graminifolia*. Florida's climate was not predicted to be suitable for this orchid.

Influence of orchid clubs and commerce. But this is the story of a small number of orchids that have naturalized in Florida, which are relatively numerous compared to smaller numbers of orchids that have naturalized in other places. Marketing brought most of these foreign orchids to Florida, which is driven by the popularity of growing orchids as a hobby. An indication of this is the large number of orchid clubs in the state. For instance, in the three heavily populated counties of southeastern Florida there are 25 orchid clubs affiliated with the American Orchid Society and additional unaffiliated clubs. The ability of these naturalized orchids to reproduce is a primary factor for their success, but the other important factors are as yet unknown.

Acknowledgements. I wish to thank Roger Hammer for his generous contributions to this manuscript including providing information about Florida's orchids and providing his attractive photographs, as well as his helpful edit of the manuscript. My helpful wife Joanne Pemberton made the plate. The efforts of reviewers and editors to improve the manuscript are appreciated.

Author Contributions. Sole author.

Funding. No funding was obtained to support this research.

Conflicts of Interest. The author declares no conflicts of interest related to this study.

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