

# Cerulean Flaxlily – An Invasive Plant in Highlands Hammock State Park

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## Introduction

The cerulean flaxlily, *Dianella ensifolia*, is a perennial evergreen native to Australia, Southeast Asia, and Africa. It is also called dianella lily, flax-lily, umbrella dracaena, Benjuang, and sagatit. Although it is not prohibited by the State of Florida or listed by the Florida Exotic Pest Plant Council, it has been documented in natural areas of Highlands and Miami-Dade Counties in Florida. The largest known infestation in the state occurs in Highlands Hammock State Park, located in Sebring, Highlands County, in central Florida. Cerulean flaxlily currently infests or occurs in over 100 acres of the park.

Belonging to the family Hemerocallidaceae, the genus *Dianella* consists of about 181 species, forms and varieties worldwide. The cultivated variegated flaxlily (*Dianella tasmanica* 'Variegata') is commonly planted in Florida landscapes. Other species of this genus also have been cultivated and hybridized and are widely utilized in landscape settings. It is not uncommon to find *Dianella* species and cultivars promoted as "Florida friendly" landscape plants. Some forms or varieties of the cerulean flaxlily include *D. ensifolia* f. *albiflora*, *D. ensifolia* f. *aureovariegata*, *D. ensifolia* f. *racemulifera*, and *D. ensifolia* f. *straminea*. Common names of cultivars include border gold, border silver, Darwingold and sougold. Cultivars differ in coloration patterns or form in leaf variegation. The taxonomy of *Dianella* is still unclear as little research has been conducted on this genus.

Cerulean flaxlily has compressed flattened stems. Leaves have parallel venation with finely serrated margins. The serrations may only be visible on one margin of the leaf. The terminal florets form a panicle which grows beyond the height of the lily by about 0.25 m. The perfect flowers have three sepals and three petals and are white with a yellowish tint. Fruits are succulent, bright, violet-blue berries typically containing five shiny, black seeds. While the plant flowers and fruits most prolifically during the warm months of the year, some flowers and fruit can be present on plants throughout the year. The pulp of the berries is high in carbohydrates. It is eaten by some birds in their native habitat, which results in the spread of seeds. The seeds have been used as a natural rodenticide and are reported to be toxic to livestock, which indicates they are not likely to be dispersed by most mammals (Wang, 1984).

Propagation of the plant is by vegetative growth or seed. In its native range, the cerulean flaxlily occurs in open shrubland, evergreen rainforests, wet pinelands, coastal dunes, sandbars, grasslands and open lowland forests, from sea level to 1600 m. It occurs in a wide variety of niches in both temperate to tropical climates, and proliferates in open or shaded habitats. It seems to tolerate a wide range of temperature, light, moisture, soils and elevation. In



Highlands Hammock State Park (HHSP), we have observed it as an epiphyte on sabal palms. The very broad range of climatic tolerance of this plant demonstrates a potential threat for spread into other areas of Florida and the southeastern United States.

Some ethnobotanical uses of the cerulean flaxlily include treatment of intestinal worms, post-partum aches, poultices, ointments (boils, itching, rheumatism), fatigue, cosmetics, perfume, incense and rodent control.

Cerulean flaxlily is not prohibited by the State of Florida nor is it included on the Florida Exotic Pest Plant Council's 2007 List of Invasive Plant Species. *Betrock's PlantFinder* magazine (October 2008) listed thirteen species and cultivars of *Dianella* available from more than forty nurseries. In a *Sun-Sentinel* article (<http://www.sun-sentinel.com>, January 29, 2006), a landscape designer suggested planting *D. ensifolia* as one of many possible alternatives to planting trees vulnerable to hurricane damage. The University of Florida IFAS Assessment of Non-Native Plants in Florida's Natural Areas (<http://plants.ifas.ufl.edu/assessment/>) currently lacks the required three experts for each zone to produce a complete assessment.

## A Problematic Species in Highlands Hammock State Park

The cerulean flaxlily has been documented in natural areas of Highlands and Miami-Dade Counties in Florida. It is not known if the species is spreading in Miami-Dade County. The largest known infestation in Florida occurs in Highlands Hammock State Park,

located in Sebring, Highlands County. When the property was first dedicated as a state park in 1936, a small portion of the site was a botanical garden. Records in the park's Civilian Conservation Corps museum document all the plants introduced into the botanical gardens prior to 1936, including *D. ensifolia* and more than thirty other lilies.

Even though the cerulean flaxlily has been present at the park for decades, there is no historical mention of the plant being invasive there. Despite being well surveyed by botanists over the years, the park's species lists do not include *D. ensifolia* as invading the natural areas until park naturalist Carol Beck included it in 1962.

Over the past 10 years, park staff noted that cerulean flaxlily was becoming more common and spreading from its original location in the footprint of the botanical garden. After a lag time of about 60 years, the population seemed to reach a critical mass and is now expanding rapidly. Cerulean flaxlily currently infests or occurs in over 100 acres of the park. Observations following the 2007-2008 winter season showed heavy damage to the plants, which may have been caused by the low temperatures experienced locally. The warmer winter trend of the past decade may be a contributing factor to the plant's rapid expansion.

The epicenter of the cerulean flaxlily park infestation is the hammock area north, west, and south of the campground. In these areas, the plant forms a dense groundcover that excludes native herbs, grasses, and ferns that typically characterize the substrata of a hydric hammock. The annual, perennial and deciduous native ground cover appears incapable of competing with the robust, evergreen flaxlily. In dense areas where flaxlily infestations are high, native plant cover is often < 10%.

Cerulean flaxlily spreads most quickly by vegetative propagation. However, individual plants have been found at great distances from the epicenter on recently acquired parcels of the park in seepage slope, mesic pine flatwoods, and even scrub communities, suggesting that it also spreads by seed and that it tolerates a wide range of environmental conditions. The flaxlily also has been found in areas where cutthroat grass, an endemic species, occurs. Despite the toxicity of the fruit, it is presumed that wildlife consume it and facilitate seed dispersal since single plants have been documented far from known populations. Plantlets and fruit also can be spread on vehicles and equipment during routine use throughout the park. Park staff recently observed the plant growing within the city of Sebring.

The ability of the flaxlily to colonize any unsaturated habitat type is of critical concern. The most newly invaded habitat at the park is the mesic pine flatwood community south and west of the hammock epicenter. Prescribed fire staff report that the plant does not burn well, but it is quick to expand into recently burned areas before native vegetation can recover. It is possible that fire scarifies the seeds and increases germination rates. Infestation of cerulean



flaxlily in fire dependent communities may severely alter fire behavior and community structure.

Past control efforts have consisted of both herbicide treatment and mechanical removal. No single treatment has proven successful. Regrowth from underground rhizomes has required multiple treatments. Non-target damage to any desirable native vegetation also is of great concern as native species are critical to restoring infested areas.

## Ongoing Research to Control Cerulean Flaxlily

In November 2007, herbicide screening trials were initiated using eight herbicides (Table 1). The goal was to find the appropriate rate and combination of herbicides to control cerulean flaxlily with the fewest number of treatments and the least amount of non-target damage. Plots were retreated after 6 months. During evaluations conducted three months after the initial treatments, we found promising results with Vista (93% reduction) and a tank mix of 1.5% Rodeo + 1.5% Renovate 3 (91% reduction).

During evaluations conducted six-months after treatments, we observed that only Habitat (imazapyr) provided acceptable results with >95% reduction in cover and no re-growth. It was somewhat surprising to observe 25-50% re-growth in plots treated with Vista

and with Rodeo + Renovate 3, since our three month evaluation indicated high mortality of cerulean flaxlily. This reminds us that controlling dense infestations of invasive plants requires long term monitoring. Escort XP, which targets and blocks the same enzyme in plants as Habitat, provided 89% reduction at six months but some regrowth was observed. No other herbicides from the first trials were effective in reducing the cover of flax lily.

Based on results of our initial research, we initiated additional experiments in the greenhouse using three rates of the most promising herbicides: Habitat, Escort XP, Vista, Rodeo, and Renovate 3, either alone or in tank mixes (Table 2). These herbicides also were applied in the field at one rate during September 2008.

## Conclusions and Future Plans

We observed >95% control and no regrowth at six months post-treatment using 1% Habitat (imazapyr). No other herbicide or tank mix tested was as effective and regrowth was observed at six months. We are concerned about using Habitat on large-scale treatments due to potential damage to native shrubs and trees, but hypothesize that using lower rates of Habitat in tank mixes of Rodeo or Renovate 3 may provide enough control to prevent regrowth. We are currently testing Habitat alone at three rates, and at lower rates

in tank mixes with Rodeo or Renovate 3. In addition, we are testing Escort XP alone at three rates, and a tank mix of Vista and Rodeo at three rates in greenhouse and field screening trials.

Our initial herbicide trials indicate that cerulean flaxlily is very difficult to eliminate from natural areas. Due to the plant's underground rhizomes, it is likely that several herbicide treatments and long term monitoring will be required for control.

Although cerulean flaxlily currently has a limited range, its spread at Highlands Hammock State Park and its life history indicate invasive potential at nearly any point of introduction. Eradication of this plant in the park is important to stop its potential spread into other areas of Florida.

**Table 1.** Treatments used during initial herbicide screening trials in November 2007.

Herbicide	Product name	Rate
Aminopyralid	Milestone	0.13% product
Asulam	Asulam	1.00% product
Fluroxypyr	Vista	0.80% product
Glyphosate	Rodeo	3.00% product
Glyphosate + triclopyr	Rodeo + Renovate 3	1.50% product (each)
Imazapic	Plateau	1.50% product
Imazapyr	Habitat	1.00% product
Metsulfuron methyl	Escort XP	2.00 oz / 100 gallon
Triclopyr	Renovate 3	3.00% product



5x5 m plot pre-treatment (Habitat)



5x5 m plot six months post-treatment (Habitat)



5x5 m plot pre-treatment (Escort XP)



5x5 m plot six months post-treatment (Escort XP)

**Table 2.** Treatments used for greenhouse trials. Asterisks indicate herbicide trials replicated in the field in September 2008.

Herbicide	Product name	Rate
Imazapyr	Habitat	0.50% product 1.00% product 2.00% product *
Metsulfuron methyl	Escort XP	1.00 oz / 100 gallon 2.00 oz / 100 gallon 4.00 oz / 100 gallon *
Imazapyr + glyphosate	Habitat + Rodeo	0.10% + 3.00% product 0.25% + 3.00% product * 0.50% + 3.00% product
Imazapyr + triclopyr	Habitat + Renovate 3	0.10% + 3.00% product 0.25% + 3.00% product * 0.50% + 3.00% product
Fluroxypyr + glyphosate	Vista + Rodeo	0.20% + 3.00% product 0.40% + 3.00% product * 0.80% + 3.00% product

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## Meet a couple of IPC's Valuable Employees



**Robert Servis** has been part of the IPC team since 2005. After graduating from Eckerd College with a degree in Natural Sciences in 2004, Bobby worked as an SCA student for the National Park Service before taking a job with IPC in 2004. Bobby works as a regional supervisor working on projects including Fairfax County Parks in Virginia, Fort Detrick Military Base in Maryland and City of Pittsburgh Parks. IPC would like to thank Bobby for his years of service and look forward to many more.

**Drew Gentry** graduated with a degree in Environmental Science from Appalachian State University in 2004 and worked for the National Park Service's southeast EPMT and the Nature Conservancy prior to starting with IPC in 2007. Drew is an instrumental part of the IPC team and now works as a regional supervisor. His projects range from coastal North Carolina to the Virgin Islands.... Keep up the good work Drew!



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