THE SCENT OF A GHOST

Orchid Floral Fragrances and Their Niche in Conservation

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WHAT IS FLORAL FRAGRANCE?

It is the blend of chemicals emitted by a flower to attract pollinators. These chemicals sometimes cannot be detected by our nose.
WHY STUDY FLORAL FRAGRANCE?

Knowing the floral compounds may help improve measures to attract specific pollinators, increasing pollination and fruit-set to augment conservation.

Chemical compounds can be introduced to increase pollinator density.

FLORAL FRAGRANCE: BACKGROUND INFORMATION

90 plant families worldwide have been studied for floral fragrance, especially the Orchidaceae.  

> 97% of orchid species remain unstudied

Of all plants studied so far, the 5 most prevalent compounds are: limonene (71%), (E)-β-ocimene (71%), myrcene (70%), linalool (70%), and α-pinene (67%)
POSSIBLE POLLINATORS

BEES
Found to pollinate via mimicry

POSSIBLE POLLINATORS

WASPS
Similar as bees
POSSIBLE POLLINATORS

FLIES
Dracula spp. produce a smell similar to fungus where the eggs are laid

POSSIBLE POLLINATORS

MOTHS
Usually white, large and fragrant at night
CASE STUDY

The Ghost Orchid

*State Endangered*

*Dendrophylax lindenii*

The Ghost Orchid

Range: S Florida to Cuba

Epiphyte of large cypress domes and hardwood hammocks

Often affixed to pond apple or pop ash

Leafless

Flowers May-August
Understanding *in situ* pollination biology is critical for conservation.

Leafless at maturity (Roots are photosynthetic)

Seed capsule

Most fragrant at night
Sweet-smelling (somewhat fruity)
White coloration, long nectar spur suggest pollination by hawkmoths

Photo: Emily Massey
The Giant Hawkmoth, *Cocytius antaeus* Drury

**DISTRIBUTION**

The Giant Hawkmoth, *Cocytius antaeus* Drury

[Map of the distribution of the Giant Hawkmoth, *Cocytius antaeus* Drury]
Larval food source\(^5\)

*Annona glabra* L.

Pond Apple

Larva of Giant Sphinx Moth

www.youtube.com/watch_popup?v=ca--GxFe2Zg#t=30
HOW CAN WE COLLECT A FLOWER’S SCENT?

1. Apparatus sturdy, yet light-weight
2. Contain non-volatile components
3. Prolonged exposure to floral compounds
4. Clean air to replace filtered floral headspace
5. Not harmful to epiphytes
6. Accommodate a range of floral sizes

EXTRACTION OF GHOST ORCHID FLORAL FRAGRANCE IN SITU

Site located in Collier Co., FL
13 ghost orchids in flower at time
Population size = ca. 50 individuals
Sampling carried out over 2 nights
Flowers sampled on 3 plants

Photo: Larry Richardson
APPARATUS DIAGRAM

1 = rubber stopper, 2 = glass flask, 3 = Parafilm, 4 = oven bag, 5 = stem enclosure, 6 = air exit, 7 = filtered incoming air

1. Sturdy, yet lightweight
   2 students could carry all materials

2. Apparatus contain non-volatile components
   Oven bags and glass were used

3. Prolonged exposure to floral compounds
   At least 2 hours of exposure per unit of study

4. Clean air to replace filtered floral headspace
   Charcoal filter for incoming air

5. Not harmful to epiphytes
   Sturdy stand and seal was created with a plastic tie and bag

6. Accommodate a range of floral sizes
   A large bell flask was used
Battery-powered vacuum pump

Adsorbent

Charcoal filter

PVC pipe

**GC SPECTRAL ANALYSIS**

- solvent background
- $\alpha$-pinene
- 3-carene
- sabinene
- (E)-3-carene
- linalool
- (E)-$\alpha$-bergamotene
- (E,E)-$\alpha$-farnesene

![Graph showing GC spectral analysis results](image)
**WHY (E,E)-α-FARNESENE?**

**CLUES:**

Odorless to humans

Oddly, often associated with insects and/or insect-damaged plants[^8]

Aphids (Hemiptera: Apidae) known to release trans-β-farnesene as an alarm pheromone when disturbed[^9]
Could insects on the ghost orchid at time of sampling explain the prevalence of (E,E)-α-farnesene in the sample?

MAYBE SO!

**HOW CAN WE KNOW THE POLLINATOR?**

Gas Chromatography-Electroantennographic Detection

Clean air and compounds are puffed on insect antennae attached to the opening of an electrode

GC/EAD tests what compounds elicit the antennal response of insects

Monitors the electrical potential of each compound

Results show which compounds are detectable by the insect’s antennae
IMPLICATIONS FOR CONSERVATION

1. Determine if a pollinator is being attracted through chemicals
2. Align pollinator surveys with peak emittance
3. Introduction of a synthetic “blend” of compounds (e.g., air pollution)\(^\text{11}\)
4. Compounds may elude to other environmental interactions we do not “see”

FUTURE WORK

What pollinates this orchid?

How is floral fragrance affected by its carbon source (i.e., mycotropy)?

What role do insects have on published floral fragrance analyses?
WORKS CITED