Do magnet species, floral diversity and fire management influence pollination success in the rewardless orchid *Calopogon barbatus*?

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Introduction

Pollination success in rewardless flowers may be influenced by proximity to rewarding flowers. The *magnet species hypothesis* proposes that nearby rewarding flowers increase pollination success by attracting pollinators (Laverty 1992, Johnson et al. 2003). The *remote habitat hypothesis* proposes that nearby rewarding flowers decrease pollination success by competing for pollinators (Lammi and Kuitunen 1995).

photo: B. Inouye

Figure 1. Rewardless *Calopogon barbatus* in recently burned area of Apalachicola National Forest.

Burning has been shown to increase diversity of flowering plants (Provencher et al. 2003), and floral diversity has been linked to pollination success in some species (Ghazoul 2006). Changes in floral composition at a recently burned site may influence pollination success of naturally occurring flowers. The effect of prescribed fire on floral composition may be particularly interesting for pollination of rewardless orchids if an increase in floral diversity or abundance corresponds with an increase in pollination success.

QUESTIONS:

1. **Is there evidence for the magnet species or remote habitat hypotheses in *Calopogon barbatus* populations?**
2. **Does recent burn influence diversity or abundance of flowering plants near *C. barbatus* populations?**
3. **Does recent burn influence pollination success in *C. barbatus*?**

Methods

We tested the effects of neighboring plants on orchid pollination success in two ways: six reward-offering magnet plants of two species were placed around target orchids to test the magnet species hypothesis, and orchid pollination rates were recorded in unburned and recently burned sites to test for effects of abundance and diversity of flowering plants.

Numbers of flowering plant species and flowering stems were recorded along three 50-m transects at each site where *C. barbatus* populations occurred. Species accumulation curves assessed sampling effort; curves reaching asymptotes indicated adequate sampling.

For each target orchid, buds and open untriggered flowers (focal flowers) were recorded; no orchid had fewer than two buds or untriggered flowers. Orchid pollination success was measured by fruit set of focal flowers.

photo: B. Inouye

System

Calopogon species (*C. barbatus*, *C. pallidus*, *C. tuberosus*), occur naturally in boggy areas of Apalachicola National Forest (ANF) in North Florida. *C. barbatus* begins blooming in early spring, followed by *C. pallidus* and *C. tuberosus*. All three species offer no reward to pollinators, and may depend on naïve pollinators and co-occurrence with rewarding flowers of similar color and size (including swamp coreopsis, dewthread and savannah meadow beauty) to ensure pollination.

The prescribed fire regime in ANF rotates low-intensity burns through forest compartments every 3-5 years. Fires remove undergrowth and leave longleaf pine standing. Regeneration is rapid and observation suggests that abundance of flowering plants increases in the year immediately following a burn. All three *Calopogon* species were observed at burned sites surveyed in this study; only *C. barbatus* was found at unburned sites.

Figure 2. ANF savannah 1 day, 1 week, and 2 weeks post-burn.

photos: T. Miller

Figure 3. Rewardless *Calopogon tuberosus* (left) and *Calopogon pallidus* (right).

Figure 4. Reward offering *Rhexia alifanus* (savannah meadow beauty).

Results

1. **Experimental magnet plants had no effect on pollination success in *C. barbatus*.**

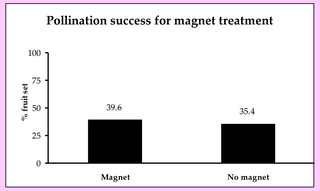

Figure 5. Results non-significant: GLM, z=-1.4, p=0.15.

2. **Species richness and abundance of flowering plants are not significantly different in recently burned sites.**

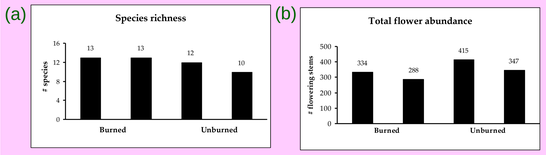

Figure 6 (a-b). Results non-significant: (a) GLM, t=1, p=0.4, (b) GLM, t=-1.7, p=0.2.

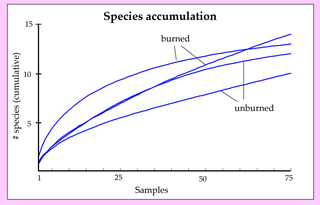

Figure 7. Species accumulation curves indicate insufficient sampling.

3. **Recent burn had no effect on pollination success of *C. barbatus*.**

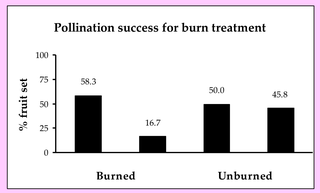

Figure 8. Results non-significant: GLM, z=-1.7, p=0.09.

Conclusions

Neither the magnet species hypothesis nor the remote species hypothesis is supported; proximate experimental rewarding flowers had no effect on pollination success of *C. barbatus*. Effects of density of magnet plants were not addressed here; further experiments should explore the possibility of a threshold density in demonstrating a magnet effect.

Predictions of increased diversity and abundance of flowering plants following a burn were not supported. Species accumulation curves suggest that, particularly for sites 102 and 106, sampling was insufficient. Future research should include greater replication of sites and more extensive sampling.

Pollination success was significantly lower at one burned site; due to low replication of burn treatments, this effect cannot be attributed to burn status. As there were no significant differences in flowering plant species richness or abundance between any sites, differences in fruit set cannot be attributed to natural flower diversity or abundance.

An unexplored avenue is the influence of pollinator abundance and diversity. Future studies on this system should include an assessment of the abundance and diversity of orchid pollinators.

Literature cited

Ghazoul, J. 2006. Floral diversity and the facilitation of pollination. *Journal of Ecology* 94:295-304.

Johnson, S.D., C.I. Peter, L.A. Nilsson, and J. Agren. 2003. Pollination success in a deceptive orchid is enhanced by co-occurring rewarding magnet plants. *Ecology* 84:2919-2927.

Lammi, A. and M. Kuitunen. 1995. Deceptive pollination in *Dactyloriza incarnata*: an experimental test of the magnet species hypothesis. *Oecologia* 101:500-503.

Laverty, T.M. 1992. Plant interactions for pollinator visits: a test of the magnet species effect. *Oecologia* 89:502-508.

Provencher, L., A.R. Pitt, and D.R. Gordon. 2003. Predictors of species richness in northwest Florida longleaf pine sandhills. *Conservation Biology* 17:1660-1671.

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