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SHORT COMMUNICATION

Long-Term Outcomes of Venus Flytrap (*Dionaea muscipula*) Establishment

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Abstract

Determining the success or failure of rare plant establishment requires long-term monitoring, but such monitoring is seldom conducted. A 2004 census of Venus flytrap populations created by seeding and transplanting was compared to a similar census in 2010. Of the 18 original populations, three were destroyed by logging operations, 12 decreased and three increased. Venus flytraps face several limitations keeping populations small. Consistent soil moisture and the presence of population remnants improved the long-term management outcomes.

Key words: carnivorous plants, Carolina bay, conservation, habitat creation, population trends, rare plant.

Introduction

A recent review determined that carnivorous plants worldwide are experiencing numerous threats but extinction risks are poorly understood (Jennings & Rohr 2011). Furthermore, the unique selection pressures leading to carnivory in plants have only recently been linked to characterizations of habitats and management approaches that might contribute to restoration or preservation of carnivorous plant populations (Ellison et al. 2003; Brewer 2005; Brewer et al. 2011). As such, when restoration of carnivorous plants does occur, it is important to verify that short-term management has led to long-term population viability.

The Venus flytrap (*Dionaea muscipula* Ellis) is a carnivorous angiosperm with leaves modified into snap traps. The endemic range includes a small area of northeastern South Carolina and southeastern North Carolina. The species occurs in pine savannas on poor sandy soils and is associated with narrow transition zones between wet shrub bogs (pocosins) and drier pine forests. The margins of shallow depressions such as Carolina bays often include this habitat (Luken 2005c). Threats to the species include habitat destruction, the absence of fire and plant collecting (Jennings & Rohr 2011).

Luken (2005b) described the results of a project where mechanical mowing, soil clearing, transplanting and seeding were used to increase the number of Venus flytrap populations. A single application of mowing and clearing in 2003 allowed the establishment of new Venus flytrap populations by 2004. However, at the time of the project, it was unclear if these established Venus flytrap populations were viable over the long-term (Luken 2005b).

This article presents data on the established Venus flytrap populations 6 years after the initial restoration activities. An initial and final census of plants is presented to illustrate the degree to which restoration activities produced viable populations.

Methods

This study occurred in Lewis Ocean Bay Heritage Preserve (lat 33°47′N, long 78°52′W) in Horry County, South Carolina. In May 2003, nine sites located on Carolina bay rims were chosen for restoration activities At each site, a 10 × 20 m opening was created with a front-mounted mechanical mower capable of removing and chopping small trees and dense shrub-dominated vegetation. Two permanent 0.5-m^2 plots were established in each mowed opening, one presumably drier and at the top of the bay rim, the other presumably wetter and at the bottom of the bay rim. The root mat was removed from these plots. Venus flytrap seeds (240/plot) were sown into the plots and nine adult plants transplanted adjacent to each plot. In 2004, plots and areas adjacent were searched for seedlings and plants.

Regrowth of vegetation following mechanical mowing was rapid, making it difficult to monitor plants after 2004. However, in April 2009, a large wildfire swept through the preserve and uniformly burned all the study sites and the adjacent Carolina bays. The clearing of detritus and vegetation associated with the fire allowed a precise count of Venus flytrap plants in May 2010. Because the fire did not burn into the organic soil and because the Venus flytrap is fire-adapted, it was assumed no fire-related mortality. Furthermore, it was assumed that the fire released all existing plants from dormancy.

Results

Of the 18 permanent plots established in 2003, 15 still existed by 2010. Three plots were destroyed by machinery used in

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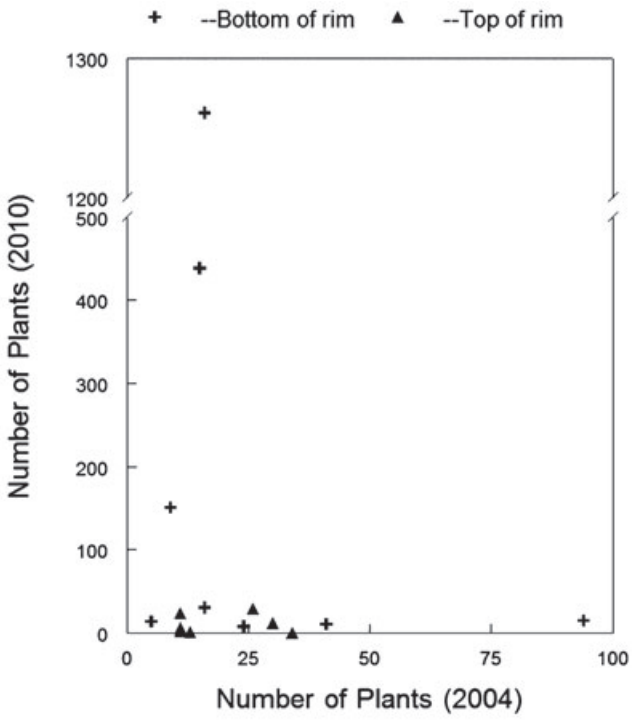

Figure 1. Number of Venus flytrap plants recorded in 2004 and 2010 at two topographic positions on the rims of Carolina bays in South Carolina.

a post-fire salvage logging operation. In 12 of the plots, the number of Venus flytrap plants was lower than in 2004 (Fig. 1). However, in three of the plots located at the bottom of bay rims, Venus flytrap numbers greatly exceeded those of 2004 (Fig. 1).

Discussion

This census of Venus flytrap populations 6 years after habitat creation and plant introduction revealed the full range of possible long-term outcomes. Clearly, relatively small Venus flytraps with poorly developed root systems are susceptible to soil disturbances associated with large tree-harvesting equipment. Salvage logging operations occur on a scale that is not compatible with protecting small isolated populations of Venus flytraps and thus machinery should be kept out of areas likely to include Venus flytraps. Jennings and Rohr (2011) listed agriculture, including wood and pulp harvesting, as the most common threat to carnivorous plants worldwide, while Koopman and Carstens (2010) linked declining populations of pitcher plants in Louisiana to multi-use land management not focused on rare plants.

The most common outcome of plant introduction was population persistence but at relatively low numbers. The same outcome in a similar habitat has been observed when plants were seasonally monitored over 3 years (Luken 2007), thus suggesting that Venus flytraps currently face limitations to population expansion even in prime habitats. Brewer et al. (2011) proposed that carnivory in plants is primarily an adaptation to wet soils and low or declining populations of Venus flytraps have been linked to seedling mortality and failed seed production during periods of drought (Luken 2007). The role of drought in declining Venus flytrap populations is supported by the fact that only plots at the bottoms of bay rims showed population increases. However, it is also possible that illegal plant collecting is a contributing factor (Luken 2005a).

The least common outcome was the development of relatively large populations of Venus flytraps. The population of 1,261 plants in 2010 included a large number of plants released from dormancy in 2003 by the mowing operation. These "volunteers" clearly persisted through time and contributed to population expansion. Therefore, the ability to create large Venus flytrap populations likely hinges on manager ability to clear vegetation in areas where Venus flytraps once thrived, an approach that could be facilitated by maintaining good long-term records of population locations and by habitat-focused searching for remnant populations.

Implications for Practice

- Develop many small Venus flytrap populations in consistently wet habitats as opposed to developing a few large populations in areas with variable moisture.
- Focus management in areas where Venus flytrap populations previously existed.
- Protect restored Venus flytraps from large machinery such as that used in tree-harvesting.

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