

**DOES LINARIA VULGARIS, AN
INVASIVE, INTERFERE WITH THE
POLLINATION OF THE NATIVE
SPECIES, POTENTILLA
PULCHERRIMA?**

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Abstract

The need for information on invasive species has been growing more and more pressing as they continue to spread and crowd out native plants. Alarm over invasive species is often concerned with the vegetative crowding and homogenized habitats that they create. It has recently been recognized that the competition for pollinators between invasive and native plants is a pressing issue. This paper explores the competition over pollinator visitation between *Linaria vulgaris*, an invasive, and *Potentilla pulcherrima*, a native. Pollinator visits to patches with 100% *P. pulcherrima* were observed and compared with visitation to patches with 50% *P. pulcherrima* and 50% *L. Linaria*. Results yielded no significant difference between the number of visitors to *P. pulcherrima* when *L. vulgaris* was present. The presence of *L. vulgaris* did, however, alter the set of *P. pulcherrima* visitors. The alteration of the pollinator set of *P. pulcherrima* may or may not be important and future research should be conducted to determine the importance of different pollinators.

Introduction

A growing concern exists today over invasive plants and their impacts on native species. Much of the alarm involves the topic of vegetative dominance of invasive plants. When an invasive moves into a habitat and is successful it can come to spatially dominate and vegetatively crowd out native species (Agren and Fagerstrom 1980), creating homogeneous stands that may lower biodiversity in an area.

Native plants compete with invasive species for resources such as light, water, and nitrogen (Ghazoul 2002). Brown et al. (2002) recognized a new competition: the

competition between flowers for pollinator visitation. They found that when Winged Loosestrife was in the presence of an invasive congener, Purple Loosestrife, it had a reduced pollinator visitation rate and a reduced seed set. There has been other research in this area (Robertson 1895, Free 1968, Grabas and Laverty 1999, Chittka and Schurkens 2001). However, Kristina Jones (2004) found that even when *Delphinium nuttallianum* is competing with the invasive *Taraxacum officinale* there is no reduction on seed set. These contrasting results indicate that there is not enough information on this subject. Yet another confusing factor is that it has also been recognized that the quality, in addition to the quantity, of pollination to native plants in the presence of invasive species can be altered (Waser 1978).

The invasive species to be used is *Linaria vulgaris* and is an invasive in Gunnison County, Colorado. It was introduced to the Gothic area as an ornamental (Irwin personal communication) and has become quite successful in the past the years. *L. vulgaris* has a yellow flower, is pollinated by bumble bees, and has rather high nectar loads (Arnold 1982).

Potentilla pulcherrima is the native being used. It is a co-occurring species that is yellow and attracts flies and bumble bees as pollinators (Martin 2004). *P. pulcherrima* and *L. vulgaris* were chosen for this study because of their overlapping range, flowering time and pollinator species. Considering all the similarities between the two flowers there is a good chance of competition between the native and invasive species for pollinator visitation.

This experiment will explore the competition between *P. pulcherrima*, a common native, and *L. vulgaris*, a thriving invasive, for pollinators. The null hypothesis is that the

presence of *L. vulgaris* will have no effect on the number of pollinator visitations to *P. pulcherrima*. Alternatives to the null are that the presence of *L. vulgaris* could either: 1.) increase the number of visitors to the native by attracting more insects to the area or 2.) decrease the number of visitors to the native by distracting them from the native.

Methods

Study organisms- *Linaria vulgaris* is in the family Scrophulariaceae. It is native to the steppes of south-eastern Europe and south-western Asia but has been introduced to Japan, Australia, New Zealand, South Africa, Jamaica, Chile and North America (Saner et al. 1994) According to Saner et al. (1994) the distribution in North America is 2200-2800m, but it is obviously moving up in latitude, as it occurs in Gothic, Colorado at 2900m. No characteristic community for *L. vulgaris* has been described. The continued spread of this species can be attributed to it's attraction as an ornamental garden plant, considerable phenotypic plasticity, high seed production, vegetative reproduction, high persistence after establishment, winged seeds for long distance dispersal and a deep taproot.

Potentilla pulcherrima, in the family Rosaceae, is a native to the area. The plant is a long-lived herbaceous perennial and grows primarily in open subalpine meadows in mountainous regions (Stinson 2004). On the western slope of the Rocky Mountain range, this species is found between 2200 and 3700m in altitude (Stinson 2004). It is quite prominent in the RMBL area and is continually flowering for most of the summer.

Study site- The experiment was conducted in Copper Creek Meadow just outside of the Rocky Mountain Biological Laboratory (elevation 9,500ft) in the Elk Mountains,

Gunnison County, Colorado (107°W, 39°N). The meadow is bordered on the south by a conifer forest and on the north by an aspen grove and talus slope and has an average snowmelt date of May 22 (Barr 2004). This meadow was chosen because of the high occurrence *P. pulcherrima*. However, there were a few other flowers blooming in the meadow during the study including: *Erigeron spp.*, *Achillea millefolium*, *Agoseris aurantiaca*, and *Cirsium spp.*

Experimental Design- Three 1x2m plots were set up in Copper Creek Meadow. The plots were selected based on their even distribution of *Potentilla pulcherrima* flowers and low frequencies of other flowering plants. Plots were cleared of other flowers and the number of *P. pulcherrima* in each plot was recorded.

Each morning stalks of *Linaria vulgaris* were collected, put in transportable vials with water and destaminated. Enough *L. vulgaris* stalks were collected to provide a number of flowers equal to the number of *P. pulcherrima* in each plot.

Plots were observed on July 30-31 and August 2 between 1000 and 1600. Each plot was watched for .5hr with no alteration. Immediately after that the vials of *L. vulgaris* were introduced evenly throughout the plot and the plot was observed for a second .5hr period. The hour during which each plot was observed were alternated so that each plot was observed during a different timeslot each day. Observations consisted of noting which type of pollinator (Fly, Bumble Bee, Hymenoptera, Ant, Wasp, Beetle or True Bug) visited and how many visitations there were within the plot.

Statistical Analysis- Any differences in the number of visitations between plots with or without *L. vulgaris* will be analyzed using t-test. A χ^2 test will be used to examine any differences in pollinator set in the presence of the invasive.

Results

A Paired T-Test showed no significant difference between the number of pollinators visiting each plot with or without *Linaria vulgaris*. There were, however, far more total visitors to the pure *Potentilla pulcherrima* plots (588) than when *L. vulgaris* was present (459).

Using a χ^2 test one can see that there was a different set of pollinators when *L. vulgaris* was present in the plots ($\chi^2=61.04$, $df=6$, $P=0.00$).

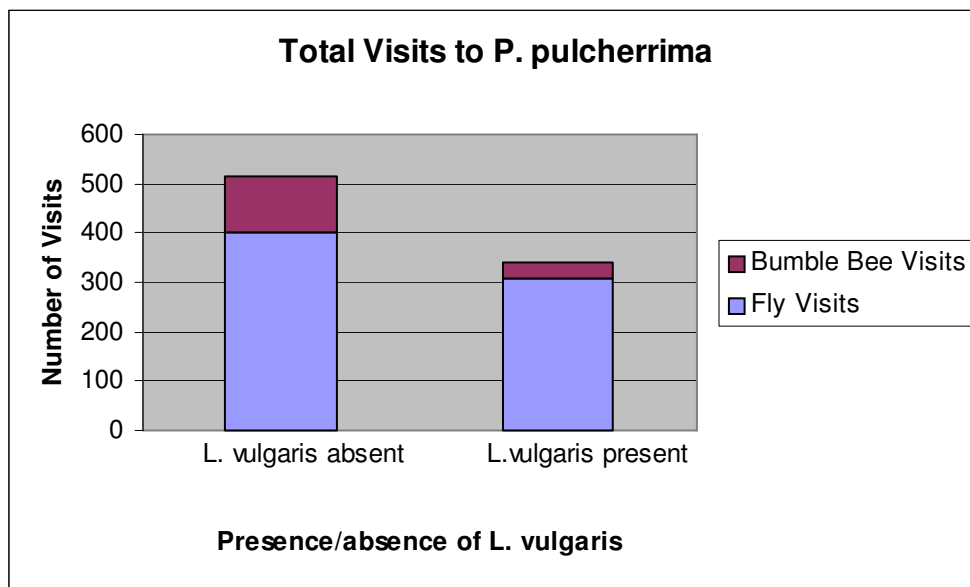


Figure 1. The number of fly visits to *P. pulcherrima* in the absence of *L. vulgaris* was 403 and 111 bumble bee visits. When the invasive was present there were 310 fly and 30 bee visits.

Discussion

Contrary to the prediction that the presence of *Linaria vulgaris* would lower the number of pollinator visitations to *Potentilla pulcherrima*, there was not a significant difference between the number of visitors to *P. pulcherrima* when *L. vulgaris* was present

versus when it was not. However, there were 588 visits to *P. pulcherrima* when there was no *L. vulgaris* present and 459 visits when the invasive was present. The fact that there were more than 100 more visits to *P. pulcherrima* in the absence of the invasive indicates that there is a biological trend, but that there was too much variation in the data and not a big enough sample size to get around that noise.

The X^2 test shows that there is a significant difference in the types of pollinators that are visiting *P. pulcherrima* when *L. vulgaris* is present. As one can see in Figure 1 there was less fly (403 vs. 310) and bumble bee (111 vs. 30) visitation in the presence of *L. vulgaris*. This indicates that the bumble bees are not visiting the *P. pulcherrima* when the invasive is present.

Future research should be focused on the importance of different pollinators, such as flies and bumble bees, and which species are most important for pollen transfer and pollination, in order to determine if the change in the set of pollinators visiting *P. pulcherrima* is detrimental. Finally, plots with different densities of *L. vulgaris* should be examined in order to find at what levels it begins to impart negative affects on *P. pulcherrima*.

Bibliography

Agren, G. I., and T. Fagerstrom. 1980. Increased or decreased separation of flowering time?: The joint effect of competition for space and pollination in plants. *Oikos* 35:161-164.

Arnold, R. M. 1982. Pollination, predation and seed set in *Linaria vulgaris* (Scrophulariaceae). *American Midland Naturalist* 107: 360-369.

Barr, b. 2004. Gothic weather. <http://www.rmb1.org/weather/gothwea.shtml>.

Brown, B. J. and R. J. Mitchell. 2001. Competition for pollination: Effects of pollen of an invasive plant on seed set of a native congener. *Oecologia*, 129: 43-49.

Brown, B. J. et al. 2002. Competition for pollination between an invasive species (Purple Loosestrife) and a native congener. *Ecology* 83(8):2328-2335.

Chittka, L., and S. Schurkens. 2001. Successful invasion of a floral market. *Nature* 411:653

Ghazoul, J. 2002. Flowers at the front line of invasion? *Ecological Entomology* 27:638-640.

Jones, K. N. 2004. Do Dandelion flowers influence seed set of a native plant (*Delphinium nuttallianum*) in subalpine meadows? *Am. Midl. Nat.* 151:201-205.

Kearns, C. A., and Inouye, D. W. 1994. Fly pollination of *Linum lewisii* (Linaceae). *American Journal of Botany* 81(9):1091-1095.

Martin, B. A. 2004. Do pollination syndromes hold up in the field? *RMBL Field Ecology*, Summer 2004.

Martin, B. A. 2004a. Does the invasive *Linaria vulgaris* interfere with pollinator visitation to the native *Potentilla pulcherrima*? *RMBL Field Ecology*, Summer 2004.

Saner, M. A. et al. 1994. The biology of Canadian weeds. 105 *Linaria vulgaris* Mill. *Canadian Journal of Plant Science*. ???

Stinson, K.A. 2004. Natural selection favors rapid reproductive phenology in *Potentilla pulcherrima* (Rosaceae) at opposite ends of a subalpine snowmelt gradient. *Am. J. Bot.* 91:531.

Waser, N. M. 1978. Competition for hummingbird pollination and Sequential flowering in two Colorado wildflowers. *Ecology* 59:934-944.

Waser, N. M. 1983. Competition for pollination and floral character differences among sympatric plant species: A review of evidence, p. 277-293. In: C.E. Jones and R.J. Little (eds.). *Handbook of Experimental Pollination Biology*. Van Nostrand Reinhold, New York. 558 p.