

Do dandelions compete with native plants for pollinator visits?

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Abstract:

In Gothic Colorado, the invasive common dandelion or *Taraxacum officinale* has slowly made its way through the meadows and along the road flourishing as people aid in dispersing its seeds as the wind carries them. Due to this, the focus of this study is to determine if dandelions compete with native plants for pollinators. Temporary plots were placed alongside the Stupid Falls Meadow, the Gothic road, the beaver ponds on the 401 trail, Emerald lake, and the Mexican cut. These temporary plots focused on three native species: *Pseudocymopterus montanus*, *Valeriana occidentalis*, and *Ranunculus glaberrimus*. The plots measured 2x meters and three times a week the plots were observed based on the natural phenology of the plots rotating every 5 minutes between plots. Based on a t-test there was no significant difference in visits between *Taraxacum officinale* and *Pseudocymopterus montanus*. The t-test showed that there was a significant difference between *Taraxacum officinale* and *Valeriana occidentalis*. *Valeriana occidentalis* received more visits. There was a significant difference between *Taraxacum officinale* and *Ranunculus glaberrimus* based on visits, favoring *Taraxacum officinale*. This showed that competition for pollinator visits with *Taraxacum officinale* depends on the plant species being compared to and that sometimes competition between each other is apparent and sometimes there is no competition. More research should be conducted in order to grasp to what extent invasive species have on native communities.

Introduction:

As the world becomes more globalized, the impact of non-native species is more apparent and needs to be studied. The nature of invasive species can be described as aggressive and resilient making them difficult to eradicate. Invasive species can change the composition of the landscape both physically and chemically. In many instances, they can easily outcompete native plants and be a determining factor for community composition (Arias, 2023). After all, the competitive advantages that both native and invasive species have are different in terms of their competitive ability between the native range and the introduced one (Lee, 2021). Along the roads and trails surrounding Gothic, Colorado the invasive dandelion (*Taraxacum officinale*) flourishes. They are effortlessly spotted along the roads and trails near Gothic Colorado and compete with native plant communities.

The common dandelion is native to Europe and Asia, being a medicinal and gastronomic plant with properties in its roots, flowers, and leaves (Rothfeld, 2016). This flower is part of the Asteraceae family meaning that they have compound flowers. The implication is that while the head of the dandelion may look like one flower it is instead made up of many flower clusters that range up to 200 per flower head (Meet, n.a). It is clear that these invasive species compete for space and many times succeed in creating a monocrop through parts of the meadows. With an increasing number of dandelions moving and growing into areas where natives are present. Pollinators carry mixed pollen loads containing dandelion pollen. This in turn lowers the quality of the pollen for effective pollination (Kandori, 2009). Dandelions bloom for several weeks while many native species bloom for a shorter period of time. Ecological factors such as climate change, invasive species, and habitat destruction are all elements that play into species competition, exclusion, and extinction (Burkle & Alarcón, 2011). This is why studying how dandelions are affecting native flowering populations is important to try to understand how and to what extent this invasive species is changing the meadows of Gothic Colorado and the neighboring areas. The purpose of this study is to determine if dandelions compete with native

plants for pollinators. The hypothesis for this experiment is that there will be a greater mean number of pollinators choosing dandelions instead of native flowers.

Methods:

The 2023 summer in Gothic was unusually dry resulting in a condensed blooming season. Thus temporary plots were set in places alongside the Stupid Falls Meadow, the Gothic road, the beaver ponds on the 401 trail, Emerald lake, and the Mexican cut. These temporary plots were measured in 2x meters and three times a week the plots were observed based on the natural phenology of the plots. They were observed from 10:00 am -2:00 pm, rotating every 5 minutes between plots. Each plot had to have a minimum of 10 dandelions and 10 flowers from a native plant species. Only the visits where the insect would land on the reproductive part of the flower were recorded as a legitimate pollinator visit. The interaction between dandelions and whatever native plant is in bloom determined how the plots were moved throughout the meadow; mimicking the run of a season. At the end of the data collection, I calculated the mean number of pollinator visits per species per minute for plots that contained the same species and then performed an F-test to determine what version of the sample t-test to perform so as to determine if dandelions are competing with native flowering species such as *Pseudocymopterus montanus*, *Valeriana occidentalis*, and *Ranunculus glaberrimus*. *Pseudocymopterus montanus* is a yellow flat compound flower, that blooms in both early and mid-season. During the early season bloom, they grow in sunny dry forests, while in the mid-season they prefer shady moist meadows. *Valeriana occidentalis* is known to grow in subalpine forests during the early season alongside streams, open forests, and sunny moist meadows. *Valeriana occidentalis* is white and grows in umbels of many small flowers. *Ranunculus glaberrimus* is a yellow five-petal flower that blooms in the early season. This plant prefers sunny, moist, meadows, and an open forest.

Results:

An F-test comparing the variance in visits/minute/flower between *Pseudocymopterus montanus* vs. *Taraxacum officinale* resulted in a $F = 1.491$, $df = 16$, $p = 0.216$, which means that the variances are equal. I thus performed a t-test assuming equal variances ($t = 0.860$, $df = 32$, $P = 0.500$) and no significant difference between *Pseudocymopterus montanus* and *Taraxacum officinale* (Figure 1).

An F-test comparing the variance in visits/minute/flower between *Valeriana occidentalis* vs. *Taraxacum officinale* resulted in a $F = 0.090$, $df = 5$, $p = 0.009$, which means that the variances are equal. I thus performed a t-test assuming unequal variances ($t = -2.995$, $df = 6$, $P = 0.024$) and a significant difference in the visits with *Valeriana Occidentalis* receiving more visits (mean = 0.010, SE = 0.002) than *Taraxacum officinale* (Figure 2).

An F-test comparing the variance in visits/minute/flower between *Ranunculus glaberrimus* vs. *Taraxacum officinale* resulted in a $F = 1.649$, $df = 4$, $p = 0.3198$, which means that the variances are equal. I thus performed a t-test assuming equal variances ($t = 3.421$, $df = 8$, $P = 0.009$) and a significant difference in the visits with *Taraxacum officinale* receiving more visits (mean = 0.0676, SE = 0.0092) than *Ranunculus glaberrimus* (Figure 3).

Discussion:

The expansion of invasive species whether that be due to humans or natural dispersal is a concern to native populations. In Gothic Colorado, the study of *Taraxacum officinale* has not been studied very much. The existing research that can be found on *Taraxacum officinale* in

Gohtic Colorado has been by Kristina Niovi Jones *Do Dandelion Flowers Influence Seed Set of a Native Plant (Delphinium nuttallianum) in Subalpine Meadows?* This research showed how when *Taraxacum officinale* was removed from plots with *Delphinium nuttallianum* there was no competition in pollination between both species based on seed count. In fact, their data actually suggest that in plots where dandelions were removed, *Delphinium nuttallianum* produced fewer seeds, and in plots with *Taraxacum officinale* *Delphinium nuttallianum* actually produced more seeds. *Taraxacum officinale* Pollen Depresses Seed Set of Montane Wildflowers Through Pollen Allelopathy by Deirdre Loughnan. Hand pollination on the two native species *Erythronium grandiflorum* and *Erysimum capitatum* using *Taraxacum officinale*'s pollen. Both flowers showed a decreased seed set in comparison to flowers that were hand-pollinated using pollen that contained no *Taraxacum officinale* pollen. These projects touched on how the quality of pollen can be influenced by the presence of pollen from *Taraxacum officinale*. This highlights how important it is to quantify the effects of *Taraxacum officinale* on native communities. Based on the outcome from both papers the conclusion was that they can affect some plants but not all.

This invasive species can be seen easily taking over the roadsides and is slowly making its way up toward higher elevations. This is why I decided to research if *Taraxacum officinale* is competing with native flowering plants through pollinator competition. Using temporary plots and focusing on three flowering species which were *Pseudocymopterus montanus*, *Valeriana occidentalis*, and *Ranunculus glaberrimus* I was able to figure out that the results varied similarly mirroring previous projects. Occasionally *Taraxacum officinale* does outcompete native flowers, other times it's vice versa and native flowers outcompete dandelions. Lastly, the third option based on my results sometimes they are the same and no competition between both species is happening. Due to the unexpected and prolonged dry season this year 2023, the phenology of many flowering species was condensed and quickly went into senesced, *Taraxacum officinale* being one of them. Due to this the sample size of this project was relatively small. In the future, I look forward to continuing this research, expanding it, and overall gathering more data. More research should be done in order to figure out to what extent *Taraxacum officinale* reaches and gather more information on other native flowers. That said, the fact that *Taraxacum officinale* is present among these native plants shows that this is competition enough for lowering biodiversity, seed count, and increasing its range.

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Tables/ Figures:

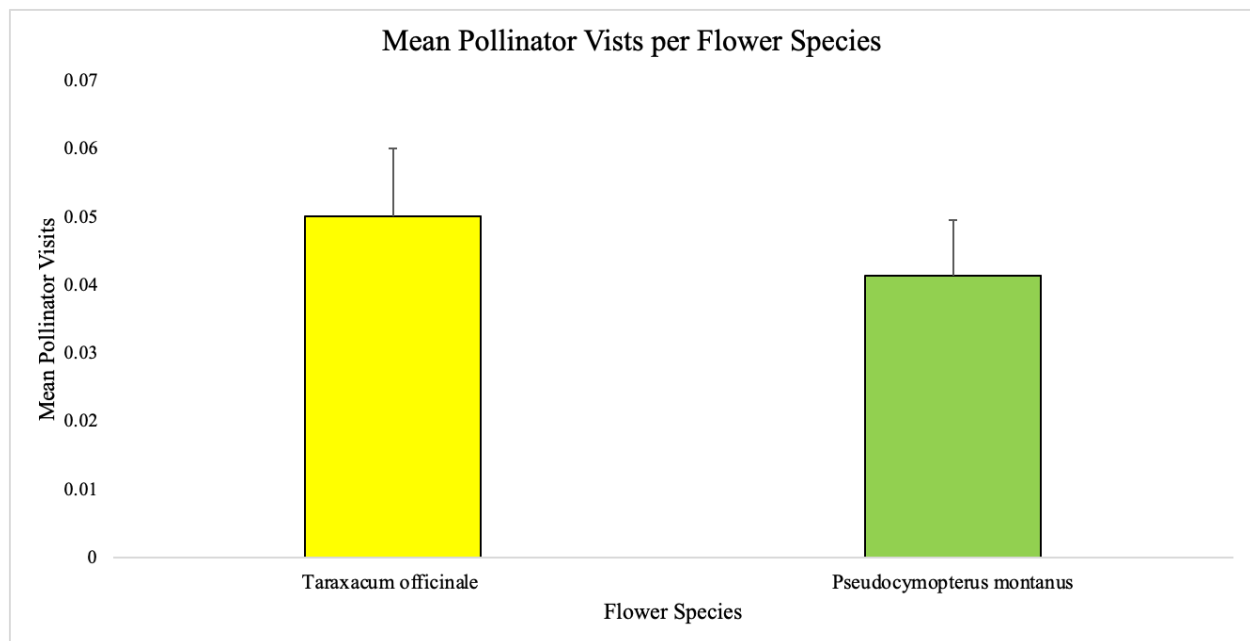


Figure 1: Mean pollinator visits between *Taraxacum officinale* and *Pseudocymopterus montanus*. *Taraxacum officinale*'s standard error is 0.0099 and the standard deviation is 0.0410. For *Pseudocymopterus montanus* standard error is 0.0081 and the standard deviation is 0.0336. Both the T-test and error bars show that there isn't a difference between pollinator visits.

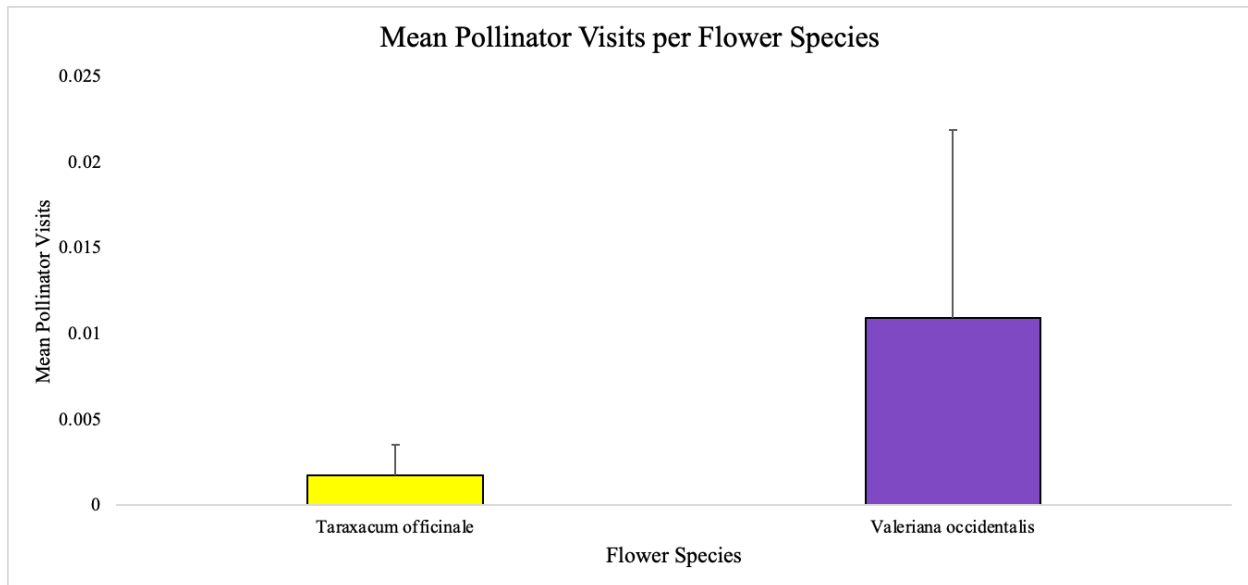


Figure 2: Mean pollinator visits between *Taraxacum officinale* and *Valeriana occidentalis*. *Taraxacum officinale*'s standard error is 0.0008 and the standard deviation is 0.0021. For *Valeriana occidentalis*'s standard error is 0.0029 and the standard deviation is 0.0071. Both the T-test and error bars show that there was a significant difference between *Taraxacum officinale* and *Valeriana occidentalis*, favoring *Valeriana occidentalis*.

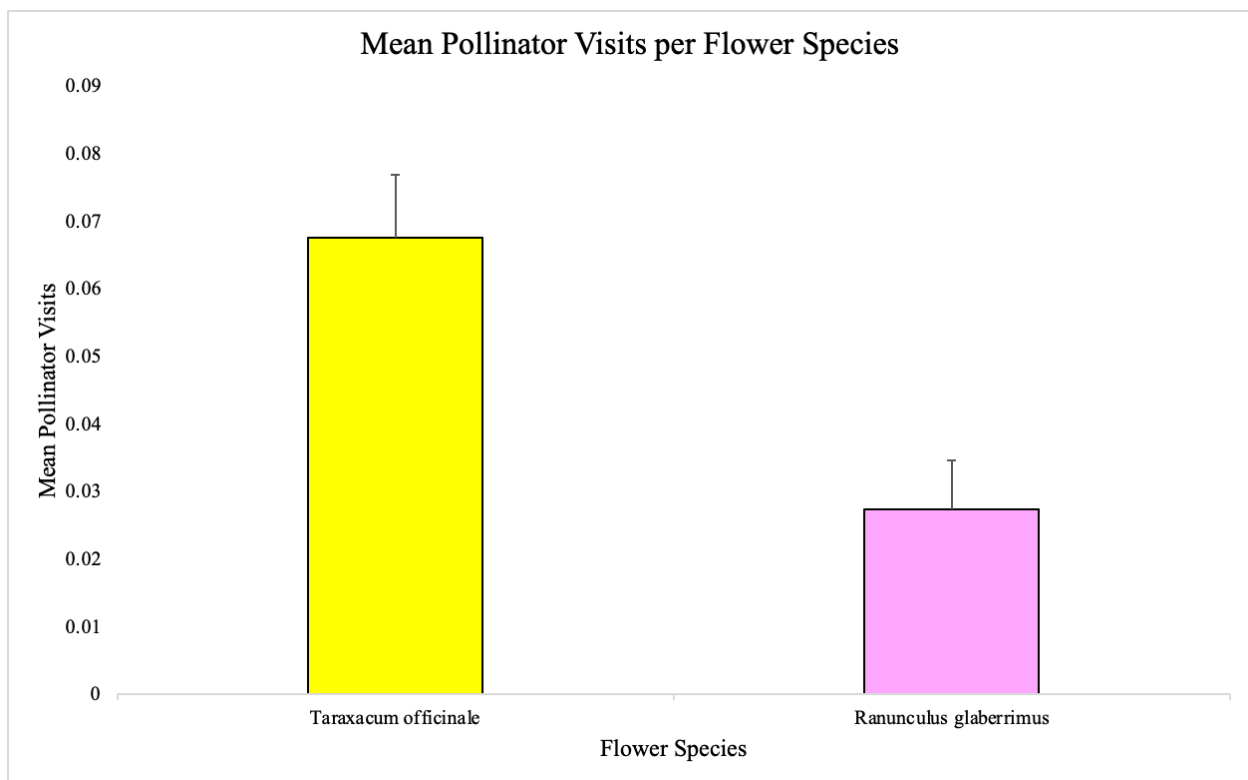


Figure 3: Mean pollinator visits between *Taraxacum officinale* and *Ranunculus glaberrimus*. *Taraxacum officinale*'s standard error is 0.0092 and the standard deviation is 0.0207. For *Ranunculus glaberrimus* standard error is 0.0072 and the standard deviation is 0.0161. Both the T-test and error bars show that there was a significant difference between *Taraxacum officinale* and *Ranunculus glaberrimus*, favoring *Ranunculus glaberrimus*.