

Comparing pollinator visitation rate and fruit set of the state-endangered downy paintbrush (*Castilleja sessiliflora*) in Illinois and the surrounding region

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Downy paintbrush (*Castilleja sessiliflora*) is endangered in the state of Illinois, and previous data has suggested it may suffer from low reproductive success due to low fruit set (K. Wenzell and J. Fant, unpublished data). To investigate whether *C. sessiliflora* might be experiencing low reproductive success due to low pollinator visitation, I conducted pollinator observations and measured fruit set of this native prairie forb in Illinois and the surrounding region. By doing so, I will examine the research questions: 1) Do pollinator visitation and fruit set differ at restored and remnant populations of *C. sessiliflora* at Nachusa Grasslands in Illinois? And 2) Do pollinator visitation and fruit set differ at populations in Illinois and in the surrounding region?

I visited six populations of *C. sessiliflora* in 2018 and conducted pollinator observations and quantified fruit set at five of them. These five populations are: Nachusa Grasslands Remnant population and Nachusa Restoration population, Franklin Grove, IL, Illinois Beach State Park Zion, IL, Spring Creek Prairie, Red Wing, MN, Felton Prairie SNA, Felton, MN. Sampling was conducted in June-July, 2018. A sixth field site, Smith Reiner Drumlin Prairie SNA, Cambridge, WI, was visited and the population of *C. sessiliflora* was scouted for intended observations in 2019. The population was no longer in flower when it was located in 2018, so pollinator observations could not be performed here during this field season.

Findings to date:

Population	State	Pollinator visitation rate	Total open flowers for pollinator observations	Fruit to flower ratio (mean +/- sd)
Nachusa Remnant	IL	0.96	25	0.24 +/- 0.23
Nachusa Restoration	IL	0	53	0.23 +/- 0.15
Illinois Beach State Park	IL	0.057	174	0.3 +/- 0.17
Spring Creek Prairie	MN	0.96	25	0.54 +/- 0.18
Felton Prairie	MN	0	11	0.72 +/- 0.15

Table 1. Pollinator visitation rate and fruit set rate for five populations of *C. sessiliflora* in the northeastern extent of the species range. Pollinator visitation rate is the number of visits to a flower by a pollinator relative to the total number of open flowers observed in a focal area. Pollinator observations were performed for 440 minutes at each site, over 1-2 days. Mean fruit to flower ratio is the proportion of flowers produced by an individual plant that successfully produced a fruit, averaged across a population (n = 30 for all populations except Nachusa Remnant, where n = 15). It is a measure of fruit set, which depends in part on pollination success.

Early Conclusions and Additional Work:

Based on observations from the 2018 field season, the remnant population of *C. sessiliflora* at Nachusa Grasslands experienced much higher pollinator visitation compared to the restored population (pollinator visitation rate of 0.96 vs 0, i.e., no observed pollinator visits; Table 1). Despite this observation, fruit set was similar at both sites (0.24 vs 0.23 fruit to flower ratio; Table 1). Previous data showed higher fruit set at the remnant compared to the restoration in 2017. In 2017, pollinator visitation to the restored population was also found to be very low, as no pollinator visits were recorded during observation periods, as was the case in 2018. These observations will be continued in 2019 in order to gather more data on interannual variation, to better assess the long-term trend of pollination and fruit set at these populations. Nonetheless, these preliminary findings suggest that pollinator visitation to the restored population of *C. sessiliflora* at Nachusa Grasslands may be consistently low across years. Low pollination could contribute to low fruit set and poor reproductive success, although other factors (such as stressful abiotic conditions or herbivory) may also negatively impact seed set. Additional work planned for 2019 will help better understand these trends.

Across the northeastern range extent of *C. sessiliflora*, both pollinator visitation rate and fruit to flower ratio varied greatly among sites (Table 1). Given that *C. sessiliflora* is listed as endangered in Illinois, we wanted to examine whether the species fares better elsewhere in the region than it does in Illinois. Pollinator visitation rate varied widely from 0 to 0.96 both within Illinois and within Minnesota, suggesting that while populations vary in their pollination rates, Illinois populations do not appear to receive fewer pollinator visits overall than those in Minnesota, where the species is considered secure. However, fruit to flower ratio appears to be lower in Illinois (ranging from 0.23 to 0.3) compared to populations in Minnesota (0.54 to 0.72). While another year of data will allow for more robust conclusions to be drawn, these preliminary findings indicate *C. sessiliflora* may be experiencing lower fruit set, and potentially lower reproductive success, in Illinois compared to elsewhere in its northeastern range extent. However, this trend may be driven by factors other than pollinator visitation rate, given that visitation was similar across states. Increased sampling and more thorough statistical analyses, planned for 2019, will further elucidate these trends and allow for a better understanding of the health and persistence of populations of *C. sessiliflora* in the Midwest.