Effects of warming on pollination in the high tundra

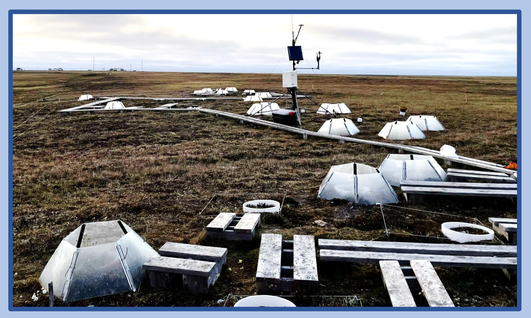
Nina Gropp, Dr. Robert Hollister
Grand Valley State University, Biology Department

Abstract

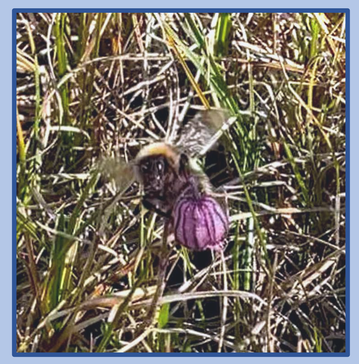
As the world has warmed, the Arctic has warmed three times faster.[1] Plant responses to climate change have included earlier phenological development and increased reproductive effort.[2] This may impact ecological relationships, including pollination. To better understand plant-pollinator interactions, 60 visitor watches were conducted during the summer of 2021 at Utqiaġvik, Alaska. Observations were carried out on both control and experimentally warmed plots. During each observation, flowering plant species, insect landings, and insects present were recorded. Pollinator visits were on average greater in the warmed plots. These findings suggest that pollinators and their activity may change as the Arctic continues to warm. Continuing to collect pollinator observations will give a better understanding of how ecological relationships may change as the region warms.

Methods

Sixty visitor observations were carried out during the summer of 2021 in Utqiaġvik, Alaska on the ITEX dry heath and wet meadow plots. Each visitor observation consisted of a 10-minute observation at either a warmed or control ITEX plot. During the observation, flowering plant species, insect landings, and insects present were recorded. A landing was noted as a pollinator encountering the reproductive part of a flowering plant. Landings were distinguished from insects present. Insects were recorded as present when they were hovering directly above the plot or inside the plot but did not land on the reproductive part of an open flower. Insects were identified to order. Temperature and Photosynthetically Active Radiation (PAR) was recorded at a nearby weather station. Flowers were counted at the plot within 5 days of the pollinator observations.



Barrow dry site, showing plots experimentally warmed with OTCs and control plots



Left: Hymenoptera on *Melandrium apetalum*

Right: Diptera on *Potentilla Hyparctica*

Results

Table 3. R^2 values of correlations for present pollinators and pollinator landings with temperature, PAR, and flowers.

	Present	Landings
Temperature	0.27	0.08
PAR	<0.01	<0.01
Flowers	<0.01	0.03

Table 2. Total counts of pollinators present by identification for all visitor observations.

Order	Further ID	Count
Coleoptera	Unknown	5
Diptera	Fly	70
	Midge	3
	Mosquito	6
	Syrphidae	2
	Unknown	69
Hymenoptera	Bombus	3
	Unknown	2
Other	Spider	7

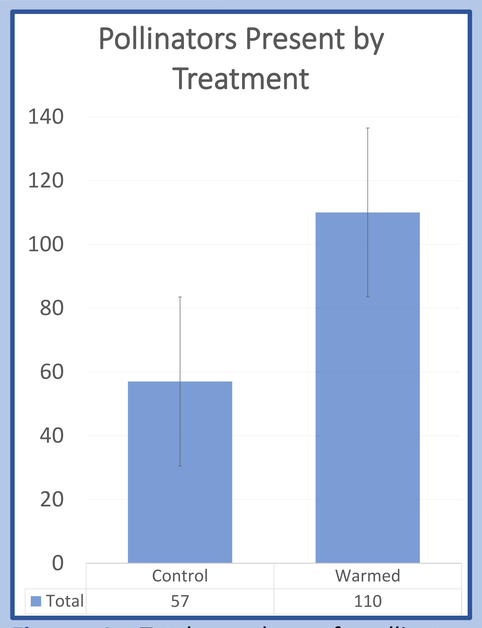


Figure 1. Total number of pollinators observed in control and warmed plots with standard error

Table 1. One-way ANOVA tables for Treatment and Flowers, Pollinators Present, and Pollinator Landings.

		Df	Sum Sq	Mean Sq	F Value	Pr(>F)
Treatment and Flowers	Treatment	1	35755	35755	2.816	0.099
	Residuals	58	736553	12699		
Treatment and Present	Treatment	1	57.2	57.23	8.578	**0.005**
	Residuals	58	387	6.67		
Treatment and Landings	Treatment	1	25.5	25.502	3.921	0.053
	Residuals	50	325.2	6.504		

Discussion and Conclusion

More pollinators were observed in experimentally warmed plots than control plots (Figure 1, Table 1). Most pollinators observed were in the order Diptera (Table 2). Although it was found that there is a significant difference in pollinators present between the control and warmed plots, there was no significant correlation between pollinators present, or pollinator landings, and temperature, PAR, or flowers present, although the strongest correlation was temperature (Table 3). To further investigate the difference between the control and warmed plots, the correlation for present pollinators and NDVI could be examined. This was the first year of pollinator data collection in Utqiaġvik. A larger data set would also help to understand the relationship between warming and the increase of pollinator visitation.

Acknowledgements

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