The influence of *Cirsium pitcheri* in the pollinator network of Door County, WI

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Introduction

Creating a compelling case to preserve a threatened or endangered species can be a challenge, especially when that species is a spiny thistle. A “selling factor” can increase both public interest as well as funding for protection. In the case of *Cirsium pitcheri*, this selling factor is its keystone role in the pollinator network of its habitat. By performing a modular network analysis, the importance of *Cirsium pitcheri* can be quantified in its relation to the declining bee populations and therefore to the crop based economy of the Door County, WI region.

Location and Methods

The Ship Canal Nature Preserve contains both dune and wooded habitats. 40 plots of a 5 meter radius were randomly established throughout the site. The plots were regularly observed for pollinator interactions over the course of two months.

Research Questions

How many unique insects visit *Cirsium pitcheri* for pollination?

Which pollinators are strongly dependent on *Cirsium pitcheri*?

What would happen to the pollinator network if *Cirsium pitcheri* were to go extinct?

Could the loss of *Cirsium pitcheri* lead to a pollinator network collapse?

Study Species – *Cirsium pitcheri*

Grows for 5-8 years

Cirsium pitcheri is native to the Great Lakes dunes and has been a threatened species since 1988 due to habitat destruction and a bio-control weevil originally intended for a different species of thistle.

Blooms once June-August

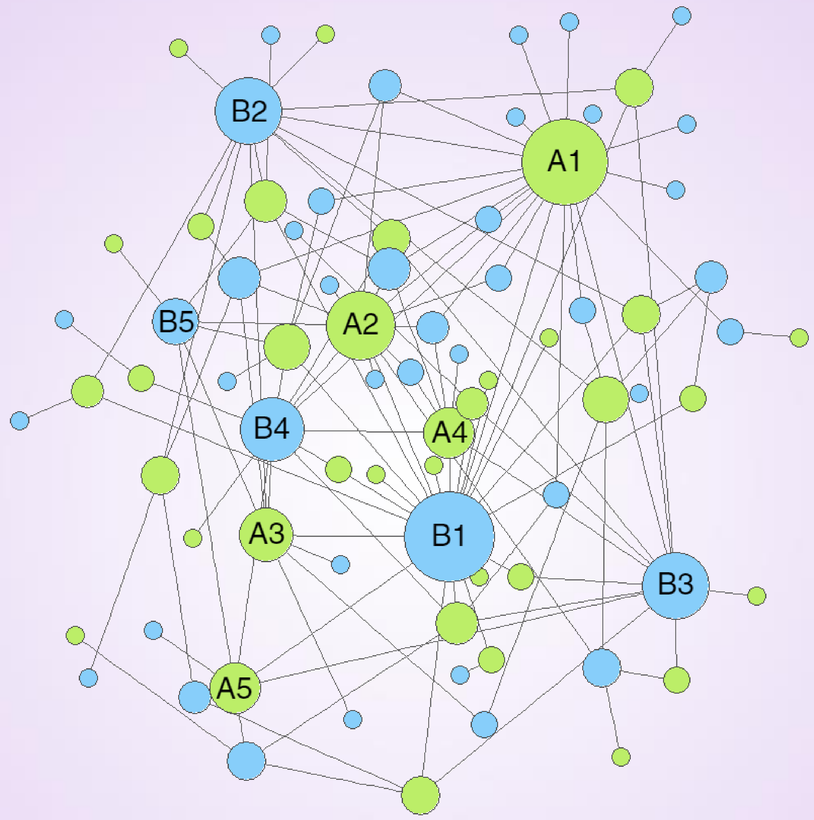

Figure 1 Pollinator Network A web showing interactions between all species in the network. Plants are shown in green and pollinators in blue. The size of each node is determined by its number of connections and total number of interactions. A1 - Cirsium pitcheri, A2 - Asclepias syraica, A3 - Lonicera morrowii , A4 - Acer spicata, A5 - Beteroa incana. B1 - Halictid, small black, B2 - Bombus impatiens, B3 - Hoverfly, B4 - European Skipper, B5 - Fly, other

References

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Results

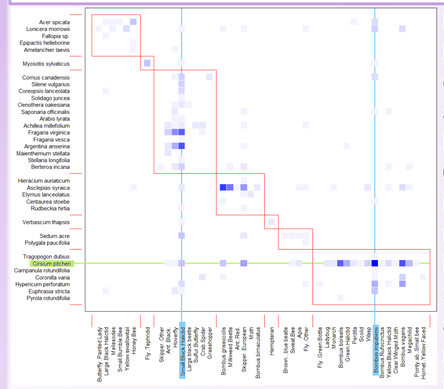

Figure 2 Network Modules The Network consists of 78 nodes and 7 modules and has a modularity of 0.47. *Cirsium pitcheri* is dominant in the module with the most insect species (16). Small black Halictids are dominant in the module with the most plant species (14)

Plants	Z	C	Insects	Z	C
Cirsium pitcheri[2]	2.24	0.27	*Bombus impatiens*[1]	3.37	0.69
Sedum acre[4]	1.92	0.40	*Small black halictid*[2]	2.38	0.58
Asclepias syriaca[4]	1.75	0.44	*European skipper*[3]	1.93	0.65
Achillea millefolium[4]	1.72	0.20	*Honey bee*[4]	1.57	0.38
Acer spicata[4]	1.50	0.04	*Fly, General*[4]	1.56	0.72

Figure 3 Top C/Z Values This table shows the five highest Z values among plants and insects. Z values denote how strongly connected a node is to other nodes, and therefore how strongly other nodes rely on it. C values denote how spread out a node’s connections are across modules. The network roles are labeled as: 1 – Network Hubs (C>0.62, Z>2.00), 2 – Module Hubs (C<0.62. Z>2.00), 3 – Connectors (C>0.62, Z<2.00), and 4 – Peripherals (C<0.62, Z<2.00).

Conclusion

20 unique insects have been sighted pollinating *Cirsium pitcheri* at our location

Bombus impatiens and Bombus borealis rely on *Cirsium pitcheri* more than other insects

Removal of *Cirsium pitcheri* from the network increases modularity which has been shown to decrease the persistence of pollinator networks

Loss of *Cirsium pitcheri*, a module hub, could lead to decline in *Bombus impatiens*, a network hub. Removal of network hubs has been shown to cause networks to collapse faster