

Is Climate Change Impacting Plant-Pollinator Relationships?

BIOS 35502-01: Practicum in Field Biology

Joel A. Smith

Advisor: Rose Marie Muzika

2015

Abstract: Velvet leaf huckleberry (*Vaccinium myrtilloides*), meadowsweet (*Spiraea alba*), and leatherleaf (*Chamaedaphne calyculata*) commonly grow near bogs and lakes on the UNDERC property. These shrubs typically live in similar conditions, but flower at different times, and little is known about who their pollinators are. The purpose of my project was to capture the first flower dates from two of each of these species with a mounted trail camera, which is a published research need, and to verify which species pollinate them with field observations. These two components of the project would go a long way in calculating whether or not a mismatch in timing is happening with these shrubs and their pollinators. Are these shrubs flowering when their pollinators are there to do their jobs, or are these shrubs flowering earlier or later than the traditional flowering dates published in the plant books at UNDERC? Ten individual shrub study sites were constructed at five different locations on the UNDERC property to conduct this research. Time constraints ended up limiting the data for this work because only a couple of my tagged shrubs were starting to flower before our last research week was up, which means no pollinators either, but a good foundation was set with the data I did collect as baseline data for future long term ecological research if anyone would wish to continue what I started in future UNDERC classes.

Introduction:

The relationships between plants and their pollinators is critical for the success of both the plant, and the pollinator. Plant – pollinator interactions are a critical component of a healthy plant community and a healthy ecosystem. (Solga 2014) Understanding the timing of the interactions between plants and pollinators is a published research need, and if the rates of plant - pollinator interactions that have traditionally always happened decreased it could potentially have large negative impacts on the plants, and the pollinators. (Forrest 2015) If flowers are blooming earlier, or later due to climate change, and their pollinators are not responding in the same way to the environmental cues that caused the flowers to bloom earlier or later; than the the chance of a mismatch in timing could potentially be quite large. (Solga 2014) Very little work, or published research has been done on the topic of plant - pollinator timing (Forrest 2015), which is exactly why I chose this for my project. When I first designed this project I was only going to use large cranberry (*Vaccinium macrocarpon*), and velvet leaf huckleberry (*Vaccinium myrtilloides*) for my two shrubs to study. This proved a difficult task after I realized that the large cranberry is not as abundant as I had hoped, so getting enough samples did not seem plausible. Leatherleaf is almost genetically identical to large cranberry (Szczecinska 2014), and is widely distributed in all the bog areas where I could not find large cranberry, so I decided to use leatherleaf instead. Velvet leaf huckleberry and leatherleaf are both in the *Ericaceae* family though, so I decided to add one more shrub from another family in order to represent a larger part of the plant family in this work. I noticed there was meadowsweet, a member of the *Rosaceae* family, almost everywhere that I found velvet leaf huckleberry and leatherleaf, so I decided to add meadowsweet to this research project as well.

Methods:

Some research has been done to determine the first flowering dates of several shrubs in this area, however there is an absence of information about the duration of the flowering period. The velvet leaf huckleberry typically flowers in May and June. Leatherleaf has traditionally flowered during April and May, while meadowsweet can flower between June and September. Between my cameras I installed at some of my sites, and the 40 site visits I made during this project the plan was to identify as many pollinators on my tagged shrubs as possible. Over 200,000 animal species may be plant pollinators on Earth, (Solga 2014) but the velvet leaf huckleberry shrubs that were a part of my study are not very productive this year, and my meadowsweet and leatherleaf are not flowering yet.

My project was spread out pretty evenly over the entire UNDERC property with five study locations all together. Within the five study sites I had ten study plots. Each study plot has five tagged shrubs that represent the species being studied at that plot. The exception is at my study site labeled R1, where I had nine tagged meadowsweet shrubs. The other exception was at my site labeled VL3, where I had six tagged velvet leaf huckleberry shrubs. Every one of my study sites bordered a bog or lake except for the site that had R1 and VL3. I leaned very heavily on photography to record the phenology of my shrubs throughout the ten week course for two reasons. The first reason is because I knew we would be very involved with our school work, which could make weekly site visits difficult to coordinate. The second reason is because catching the first flower dates of these shrubs is imperative. I used two different kinds of cameras. For my individual shrub photos that I took during my site visits of each tagged shrub I

used a Nikon Coolpix S3600, and I used a Bushnell eight megapixel trail camera to record the phenology of two individual shrubs of each species for the duration of the project.

For the climate change aspect of my project I recorded the temperature in celsius during all forty of my site visits, along with recording the time, and writing a description of the weather going on at the time. GPS coordinates in NAD 83 were also recorded for all ten study plots, so that replication can happen each summer moving forward. Long term ecological research is a great way for a project like this to work, and this is definitely baseline data. Proving anything after just ten weeks of data collection will not be enough to convince anyone.

Results:

My results are bittersweet to me. I just wish there was more time to continue my project because then all of my tagged shrubs would be flowering, especially the shrubs that my trail cameras have been monitoring for the last ten weeks. Some of my velvet leaf huckleberry shrubs were already flowering when I started setting up my sites so I set up the two trail cameras assigned to record the phenology of two individual velvet leaf huckleberry that had zero flowers at that point. At that time I did not know that the production of all the velvet leaf huckleberry shrubs involved in my study would have such berry production, meaning very few flowers. Velvet leaf huckleberry flowers are really small too, so I was not able to catch any first flower dates for them with the trail cameras. There were very few flowers for my trail cameras to pick up, and the flowers that did develop all seemed to be on a part of the shrub that the camera could not see. Most of the huckleberry shrubs went through their flowering stage while our class did the last

three modules. Not being out there while the huckleberry shrubs were flowering meant that I did not see any pollinators. The two cameras I had pointed at two separate huckleberry shrubs did capture a lot of insects on the shrubs in several pictures. These insects may have been pollinators, but the pictures are not detailed enough to verify the the family of any of the insects in the pictures.

I also have a few thousand pictures of the two meadowsweet, and two leatherleaf shrubs I had tagged and chose for the trail cameras to record during the project. The pictures all turned out pretty well, but none of the four shrubs had started to flower yet by the time I had to tear my sites down. Both of these shrubs have bigger flowers than the velvet leaf huckleberry so if they had flowered before my site teardown dates we would have verified first flower dates, which would have met some published research needs. Out of all my tagged meadowsweet and leatherleaf shrubs only one meadowsweet shrub began to flower. I did not see a single potential pollinator on that shrub or any of my other tagged shrubs. As I already mentioned though, I did get valuable data that could help continue a long term ecological research project if somebody wanted to make this more than just baseline data. This project could split off into several other different directions too.

Discussion:

The data I collected could also be used to transition into a phenology and climate change study. Using the same methods of picture taking I did, one could replicate the research for several years, and compare the phenology temporally using the pictures I took along with the

temperature data I recorded. Somebody could also do research on any of the three species of shrubs I used to find out why they are not being productive or not flowering at all. For example a project could be done to find out if lack of prescribed low severity burning is why the velvet leaf huckleberry shrubs here have such a lack of production. There is existing work done that suggests lack of fire does have negative impacts on velvet leaf huckleberry production (Duchesne 2004). It would be important to find out if the low production is because of lack of fire, climate change or pollinator mismatch in timing.

If one wanted to work with leatherleaf they could try to find out if the reason they are not flowering yet here at UNDERC, as the literature suggested they would, because of climate change, mismatch in timing with their pollinators, or if their nutrient resorption in the bogs here at UNDERC is not right as suggested in a published study. (Wang 2014)

Only a few of the meadowsweet shrubs I have seen on the UNDERC property have started to flower, and only one of my tagged shrubs has flowers. Someone could look into that too. Several of my tagged meadowsweet shrubs for study had a lot of time during the day where they would not receive any sunlight at all because of a nearby crowded overstory of vegetation.

Meadowsweet has been shown to have the best flower production when in full sun and 40% shade. (Stanton 2010) If my research was to continue as a long term ecological study it may be necessary to determine if my tagged meadowsweet shrubs did not flower due to lack of sunlight, climate change or mismatch in pollinator timing.

Acknowledgements:

I would like to thank the Bernard J. Hank Family Endowment for giving me this opportunity to study on their property. I would also like to thank Charles Goodluck, and Charmaye OldElk for helping me with my field work.

Works Cited

- Duchesne, L. C., & Wetzel, S. (2004). Effect of Fire Intensity and Depth of Burn on Lowbush Blueberry, *Vaccinium angustifolium*, and Velvet Leaf Blueberry, *Vaccinium myrtilloides*, Production in Eastern Ontario. *Canadian Field-Naturalist*, *118*(2), 195–200.
- Forrest, J. R. K. (2015). Plant - pollinator interactions and phenological change: what can we learn about climate impacts from experiments and observations? *Oikos*, *124*(1), 4–13.
- Johansson, J., Nilsson, J.-Å., & Jonzén, N. (2015). Phenological change and ecological interactions: an introduction. *Oikos*, *124*(1), 1–3.
- Michelle Solga. (n.d.). Timing is Everything: An Overview of Phenological Changes to Plants and Their Pollinators.
- Stanton, K. M., Weeks, S. S., Dana, M. N., & Mickelbart, M. V. (2010). Light Exposure and Shade Effects on Growth, Flowering, and Leaf Morphology of *Spiraea alba* Du Roi and *Spiraea tomentosa* L. *HortScience*, *45*(12), 1912–1916.
- SZCZECIŃSKA, M., GOMOLIŃSKA, A., SZKUDLARZ, P., & SAWICKI, J. (2014). Plastid and nuclear genomic resources of a relict and endangered plant species: *Chamaedaphne calyculata* (L.) Moench (Ericaceae). *Turkish Journal of Botany*, *38*(6), 1229–1238.
- Szczecińska, M., Sawicki, J., Wąsowicz, K., & Hołdyński, C. (2009). Genetic variation of the relict and endangered population of *Chamaedaphne calyculata* (Ericaceae) in Poland. *Dendrobiology*, *62*, 23–33.
- Wang, M., Murphy, M., & Moore, T. (2014). Nutrient resorption of two evergreen shrubs in response to long-term fertilization in a bog. *Oecologia*, *174*(2), 365–377.

Site Visit Data

Date	Site	Temperature C*	Time 24hr	Weather Description	Notes
6/12/2015	LL2	24	14:15	Sunny, blue skies	
6/12/2015	VL1	25	15:05	Sunny, blue skies	Installed camera VL1-3
6/18/2015	LL2	15.5	14:35	overcast, feels really warm and humid	Installed camera LL2-1
6/18/2015	R2	16	16:20	some clouds, mostly blue sky	installed camera R2-2, tagged shrubs, South end of Morris Lake
6/18/2015	LL1	16	16:30	mostly blue skies	
6/18/2015	VL1	15	17:40	blue skies, feels warm and humid	
6/18/2015	LL3	15	17:35	blue skies, feels warm and humid	
6/19/2015	R1	18	9:09	blue skies	installed camera R1-1
6/19/2015	VL3	22	11:35	blue skies	installed camera VL3-7
6/19/2015	VL2	23	14:30	partially cloudy, mostly blue skies	
6/19/2015	R3	23	14:30	partially cloudy, mostly blue skies	
6/19/2015	LL4	25	15:30	Partially cloudy, mostly blue skies	installed camera LL4-2
6/25/2015	VL2	24.5	13:30	cloudy	only recorded temp, no data collection or individual shrub photos
6/25/2015	LL4	24.5	13:30	cloudy	only recorded temp, no data collection or individual shrub photos
6/25/2015	R3	24.5	13:30	cloudy	only recorded temp, no data collection or individual shrub photos
6/28/2015	R2	22	15:00	raining	checked trail cam (R2-2), downloaded pictures, no data collection or individual shrub photos
6/28/2015	LL2	22.5	16:40	raining	checked trail cam (LL2-1), downloaded pictures, no data collection or individual shrub photos
6/28/2015	LL4	24.5	17:15	overcast, feels really warm and humid	checked trail cam (LL4-2), downloaded pictures, no data collection or individual shrub photos
6/28/2015	VL1	22.5	15:30	raining	checked trail cam (VL-3), downloaded pictures, no data collection or individual shrub photos
6/28/2015	R1	22	14:45	raining	checked trail cam (R1-1), downloaded pictures, no data collection or individual shrub photos
6/28/2015	VL3	22	14:50	raining	checked trail cam (VL3-7), downloaded pictures, no data collection or individual shrub photos
7/13/2015	VL1	22	12:30	cloudy	tore down site completely, flagging and camera
7/13/2015	LL3	22	13:00	cloudy	tore down site completely, flagging and camera
6/10/2015	VL1	18.5	11:18	Partially cloudy, mostly blue skies	Put tags on shrubs, bog habitat, not much sun to tagged shrubs
6/10/2015	LL3	20	11:41	Partially cloudy, mostly blue skies	Put tags on shrubs, bog habitat, not much sun to tagged shrubs
6/10/2015	R3	20.5	15:00	Partially cloudy, mostly blue skies	Put tags on shrubs, bog habitat, next to Kickapoo Lake
6/10/2015	LL4	21	15:30	Partially cloudy, mostly blue skies	Put tags on shrubs, bog habitat, next to Kickapoo Lake
6/10/2015	VL2	21	15:54	Partially cloudy, mostly blue skies	Put tags on shrubs, bog habitat, next to Kickapoo Lake
6/11/2015	VL3	21	17:00	cloudy and overcast, feels warm and humid	huck patch next to R1 site
6/9/2015	LL2	26	15:00	blue skies, feels warm and humid	set up site (no camera yet), tagged shrubs, right on S.E. edge of Bay lake
6/9/2015	LL1	20	13:30	blue skies, feels warm and humid	set up site (no camera yet), tagged shrubs, right on S end of Morris Lake
7/14/2015	R1	18	16:00	Partially cloudy, mostly blue skies	tore down site completely, flagging and camera
7/14/2015	VL3	18	16:30	Partially cloudy, mostly blue skies	tore down site completely, flagging and camera
7/17/2015	LL2	20	10:19	overcast, feels really warm and humid	tore down site completely, flagging and camera
7/17/2015	R2	23	11:13	overcast, some blue sky	tore down site completely, flagging and camera
7/17/2015	LL1	23	11:37	overcast, some blue sky	tore down site completely, flagging and camera
7/18/2015	LL4	22	19:53	Blue Skies	tore down site completely, flagging and camera
7/18/2015	VL2	22	20:30	Clear Skies (getting dark)	tore down site completely, flagging and camera
7/18/2015	R3	22	20:53	Clear Skies (getting dark)	tore down site completely, flagging and camera

Site and Shrub Identities

Site abbreviation	Shrub Scientific Name	Shrub Common Name
LL	<i>Chamaedaphne calyculata</i>	Leatherleaf
R	<i>Spiraea alba</i>	Meadowsweet
VL	<i>Vaccinium myrtilloides</i>	Velvet Leaf Huckleberry

Site Install and Teardown Information

Site	Install Date	Camera Install Date	Site Teardown Date	GPS (NAD 83)
R1-1	6/4/2015	6/19/2015	7/14/2015	N 46°15'34.1" W 089°32'04.0"
R2-2	6/8/2015	6/18/2015	7/17/2015	N 46°15'23.9" W 089°31'21.3"
R3	6/10/2015		7/18/2015	N 46°13'28.5" W 089°29'55.1"
VL1-3	6/10/2015	6/12/2015	7/13/2015	N 46°13'59.5" W 089°34'08.9"
VL2	6/10/2015		7/18/2015	N 46°13'28.5" W 089°29'55.1"
VL3-7	6/11/2015	6/19/2015	7/14/2015	N 46°15'34.1" W 089°32'04.0"
LL1	6/9/2015		7/17/2015	N 46°15'23.9" W 089°31'21.3"
LL2-1	6/9/2015	6/18/2015	7/17/2015	N 46°14'15.3" W 089°29'55.1"
LL3	6/10/2015		7/13/2015	N 46°13'59.5" W 089°34'08.9"
LL4-2	6/10/2015	6/19/2015	7/18/2015	N 46°13'28.5" W 089°29'55.1"