

Final Report to Meg and Bert Raynes Wildlife Fund

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Project title: For everything there is a season – but the seasons, they are a changing:
Phenology shifts in the Tetons

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Background and Objectives

This is a report on year two of a project still in its pilot phase. In 2015, thanks to funding from the Meg and Bert Raynes Wildlife Fund, we retrieved, entered, and quality-controlled nearly 800 observations that Frank Craighead Jr. made of plant flowering and seeding dates (phenology) in the 1970s and 1980s. Craighead's notes included 258 species of flowering plants. Most observations were made in Grand Teton National Park, near Blacktail Butte.

We were interested in Craighead's data as a potential "baseline" of plant phenology patterns before climate change had started to significantly warm spring temperatures. Because Craighead's data spanned several years, we were able to relate first flowering date for 54 species to spring temperatures. The results showed very clearly that plants in the Tetons area are very sensitive to spring temperatures; since temperatures have warmed substantially since the 1970s, we expect that many plants are flowering earlier, potentially senescing earlier, and potentially no longer lining up in timing with other important ecological events such as the arrival of migratory birds and the emergence of insects.

At the end of the project's first year, we had identified 54 species for which we wanted to collect contemporary data to compare to Craighead's data. Nineteen of these we had identified as suitable for a citizen science component of future work — wherein the goal would be to set up a "phenology walk", ideally retracing Craighead's steps, along which citizen scientists could gather phenology data.

In our second year of the project, our goal was to begin preliminary field data collection, develop specific protocols, and build a relationship with Grand Teton National Park — all necessary steps to begin collecting a full set of contemporary data starting in 2017 and further our goal of having a functional citizen science program.

Our specific planned activities for the 2016 season (year two) were:

1. Liaising with Grand Teton National Park research staff to make them aware of our work and obtain necessary permits / permissions
2. Visiting the Blacktail Butte area 1-2 times per week
3. Walking through key habitat areas
4. Searching for early-flowering individuals or patches of the focal 19 species
5. Taking GPS coordinates of those locations
6. Compiling location information and deciding upon a "walking route" for future sampling
7. Putting together a route map and clear set of instructions for future sampling, simple enough that citizen scientists could participate in future data collection

Project Activities:

1. *Liaising with Grand Teton National Park research staff to make them aware of our work and obtain necessary permits / permissions*

Through a proposal process, we obtained a research permit for Grand Teton National Park for the spring-summer 2016 season. In fall 2016, we held a meeting with park Supervisory Biologist David Gustine and another meeting with park Plant Ecologist Kelly McCloskey. Through these meetings we explained the project objectives, our achievements to date, and our future aspirations. Both park biologists were enthusiastic about the project. We discussed a variety of scenarios of future work and ways in which the park could assist in this work.

2. *Visiting the Blacktail Butte area 1-2 times per week*
3. *Walking through key habitat areas*
4. *Searching for early-flowering individuals or patches of the focal 19 species*
5. *Taking GPS coordinates of those locations*

With help from a USGS intern, Sam Nillson, project research assistant, Stephanie Dykema, and volunteers Susan Marsh and Frances Clarke (Native Plant Society, Teton Chapter) we visited sites on and around Blacktail Butte 15 times between April and August 2016. We focused in on several locations that we thought were places Craighead was likely to have visited. On each field trip, we searched for flowering plants, identified flowering species and their phenological stage (newly emerged, newly flowering, peak of flowering, past peak, senescent, fruiting). We took GPS coordinates of patches of flowering plants and photographed plants. Because our field visits were frequent, we were able to identify early flowering patches in many cases. We eventually settled on two locations as the most likely areas where Craighead regularly walked in the 70s: the “cobbles and benches” south of Craighead’s cabin and east of Highway 89, and the Blacktail Butte trail from the parking lot along the west flanks of the butte and partway up the butte.

Although our initial plan had been to focus on the 19 species we had identified for citizen science, we soon realized that it made sense to collect data on all species we encountered. We found that there were many common and important species that Craighead had, surprisingly, not collected data on, or that he only had 1-2 years of data on, so they had not made our initial list.

Through this process, we identified a set of 72 species (see attached table) that would be excellent candidates for a full research program that compares past with present phenology (potentially modeling future phenology as well). Of these, we identified 23 species that would be excellent candidates for citizen science data collection (species that are easy to identify, common, and charismatic).

6. *Compiling location information and deciding upon a “walking route” for future sampling*

We have compiled best GPS locations for each species on our 72 species list (some have very specific locations and some are widespread over a broad area). We are in the process of figuring out a walking route that could be recommended for citizen scientists to collect data on 5-10 species. This could later be expanded to the full list of 23 citizen science species, but we want to test out citizen science methods and instructions with a smaller number of species.

7. *Putting together a route map and clear set of instructions for future sampling, simple enough that citizen scientists could participate in future data collection*

We are working to develop instructions, using photos, diagrams, and step by step instructions for making field observations on 5-10 species and entering those observations into the Nature's Notebook app. This will be completed by the end of February 2017, in preparation for the 2017 field season during which we hope to pilot test these methods

Other project activities:

- Corinna Riginos and Geneva Chong led a “Mardy’s Front Porch Conversation” about this project at the Murie Center of Teton Science Schools in July 2016.
- Corinna Riginos presented a poster on this project at the Greater Yellowstone Science Conference at Jackson Lake Lodge in October 2016.
- Grand Teton National Park’s Margaret Wilson invited Corinna Riginos to give a public talk on climate change and the Tetons area as part of a Climate Friendly Parks outreach initiative. Riginos spoke to an audience of about 200 about climate change and its likely impacts on the Tetons, including an introduction to this project.
- Stephanie Dykema presented a poster on this project at the first ever Wyoming Citizen Science conference in Lander in December 2016.
- Corinna Riginos and her work on this project and climate change were the front-page feature in *Planet Jackson Hole* in May 2016.
- We have started identifying future funding sources and cultivating relationships towards future funding requests.

Conclusions and Next Steps

We met all project objectives for the 2016 season and are ready to expand the project in several directions. Pending further funding, our next steps will be:

1. Begin collecting detailed phenology data, through field visits every 2-3 days, on the 72 species of flowering plants on our “research list.” In addition to collecting data on first flowering date, we will also collect data on peak flowering date, seeding/fruitleting, and senescence. Although we do not have historic data on all of these phenological stages, we feel it is important to begin tracking changes in all of these parameters, especially since peak flowering date and seeding/fruitleting date have important consequences for species of birds, mammals, and insects that feed upon plant resources such as nectar and fruits.
2. Expand our historic data set by obtaining data from herbarium records. Several herbaria exist that include many records from the Tetons area. Herbarium records will expand our

data to include more geographic locations in the Tetons area, more years of phenology data, and more phenological stages (since collectors often noted things like seed set).

3. Through items 1 and 2, we will eventually be able to model the relationship between climatic data and plant phenology, which will enable us to model future changes in plant phenology that might be expected in a warming climate.
4. Begin piloting citizen science data collection on 5-10 species of plants. Provide select groups with data collection instructions and protocols, observe their work in the field, and gather feedback from them about the experience, challenges, ways to improve the instructions, etc. Pilot test recording and working with data using the Nature's Notebook app from the National Phenology Network.
5. Work with Grand Teton National Park interpretation staff to explore whether it would be possible to eventually create a "Phenology Walk" with permanently labeled locations and plants and interpretive materials (e.g. signs about phenology, climate change, and the Craighead legacy) at Blacktail Butte.

Financial reporting

Details of expenditures are given below. PI time is under-used because the PI (Corinna Riginos) has not claimed any funded time and has used the allocated money for other activities.

LINE ITEM	BUDGET	USED	REMAINING
Research Tech	1,651.00	-1,332.20	318.80
PI Time	800.00	-314.27	485.73
Benefits	175.00	-80.16	94.84
Travel	260.00	-260.00	0.00
Bookkeeping	278.00	-278.00	0.00
Misc. Costs	250.00	-37.69	212.31
Balance	3,414.00	-2,302.32	1,111.68

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