### Thesis Prospectus 2023-24

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**Student Final Submission (date):**

**Faculty Reader Approval (date):**

**MES Director Approval (date):**

1. Working title of your thesis[[1]](#endnote-1).

Phenological Asynchrony Between Onset of Green-Up and Spring Arrival for 61 Migratory Songbirds of Conservation Concern in Alaska

1. In 250 words or less, summarize the key background information needed to understand your research problem and question.

With temperature change variation, migratory birds have been found to have shifts in migratory timing of arrival. Early or delayed green-up has resulted in some birds arriving earlier or later than expected. Migratory birds are one of the most vulnerable to climate change because it can impact their movement and timing while also impacting their habitat needs, breeding, and food availability. With temperature variations, green-up timing and arthropod availability can impact a species’ survival. With spring green-up timing occurring earlier or later, arrival time can be troublesome if they arrive before enough resources are available or if they arrive too late. Research will be focused on two separate locations in Alaska. Both Fairbanks and Anchorage will be the areas of focus to include central and south-central areas in the study.

1. State your research question(s).

Is the amount of phenological asynchrony (the difference between spring arrival and green-up) changing for migratory birds in Alaska?

1. Situate your research problem within the relevant literature. What is the theoretical and/or practical framework of your research problem?

Referencing a study done by Mayor et al. (2017) and Youngflesh et al. (2021), we hope to identify key findings in any shifts in migration and differentiate any species that show a trend of phenological asynchrony particularly those of greatest conservation concern in Alaska.

* Practical:

The practical framework for my research problem is how to analyze and answer how eBird data can be useful in studying phenology of migratory birds in Alaska. Data will be analyzed by utilizing biodiversity-specific crowdsourced data from eBird and an already existing modeling approach from R software to associate any changes in phenology with climatic changes and variations in green up. Data will also be used from species lists from the Alaska State Wildlife Action Plan. Following the approach by Mayor et al. (2017), this study will be focused solely on Alaska. Alaska was chosen as the location of choice due to northern latitudes experiencing an acceleration in climate change leading to concerns about the cascading effects of temperature changes impacting plant communities, arthropod abundance, and bird migration timing. This study can be helpful in highlighting which species are most impacted with climatic variability greatly affecting higher latitude environments.

* Theoretical:

Climate is a huge factor in phenological shifts and timing of migratory bird arrival. It can also impact other phenological events such as breeding and demography. Using climate data to determine green-up timing it can be compared with eBird data on timing of arrival to see if green-up timing impacts the arrival of birds. Using this approach in analyzing both climate and eBird data, the success of a species can hopefully be determined as well as determine which species are of greatest conservation concern.

1. Explain the significance of this research problem. Why is this research important? What are the potential contributions of your work? How might your work advance scholarship?

This research is important as it can contribute relevant and needed analysis of a growing conservation concern of migratory bird timing of arrival. Referencing relevant literature, this project can help provide important information on what species are experiencing phenological shifts. Previous studies have been done across North America where it has shown variation in arrival timing for both the east and the west of North America. This work builds on previous work which suggested that birds in central Alaska tend to arrive after green-up, whereas those in southcentral arrived before green-up. This project can also be helpful in assisting with necessary data for The Alaska State Wildlife Action Plan, a resource that provides important action recommendations for species that are species of greatest conservation need. For example, when species such as migratory aerial insectivores arrive too early, limited food resources and colder temperatures can drastically affect nestling success thus reducing their population. With delayed or early green up, insect populations such as arthropods like larvae, beetles, flies, and ants that migratory birds depend on can also be reduced. This research can help detect any species that could possibly be at risk for phenological asynchrony and provide key information for state agencies and other organizations on what birds may need further attention and research.

1. Summarize your study design[[2]](#endnote-2). If applicable, identify the key variables in your study. What is their relationship to each other? For example, which variables are you considering as independent (explanatory) and dependent (response)?

Independent/Explanatory variable: climatic changes overtime/green up variation

Dependent/Response variable: timing of arrival for migratory birds.

For study design, eBird data will first be analyzed in R software to create .csv files that can be later used to compare arrival timing. Statistical analysis will be run to examine the files to locate trends in green-up and migratory bird arrival. Possible statistical tests may be linear mixed models and linear regression. Data will be run to locate any trends in green-up and arrival and phenological shifts in birds. Knowledge in R software and ArcGIS will be necessary to complete the research.

1. Describe the data that will be the foundation of your thesis. Will you use existing data, or gather new data (or both)? Describe the process of acquiring or collecting data[[3]](#endnote-3).

Existing eBird data provided from eBird data platform (ebird.org) will be used and run using R software specifically utilizing R package “auk” for data extraction and processing. Landcover data using satellite/remotely sensed data (MODIS) to estimate onset of greenness.

1. Summarize your methods of data analysis. If applicable, discuss any specific techniques, tests, or approaches that you will use to answer your research question.

We will be running data through R using the “auk” package to obtain .csv files of individual species. This data will be used to estimate the timing of arrival of birds. The data can also be used later in the project to run statistical analysis. Using the approach by Youngflesh et al (2021), Bayesian GAM models in R can be used to obtain species-specific spring-arrival estimates for both Anchorage and Fairbanks.

ArcGIS will be used to gain visuals in vegetation greenness. We will be using remote-sensing data from USGS EarthData (a green-up landcover product) that measures vegetation greenness for each year. We will use this to estimate each year of green-up for 2001-2022 for both Anchorage and Fairbanks. Using 113-kilometer buffers as our spatial unit for each location, we can then determine green-up for each year. With this data we hope to obtain estimates of spring arrival with each species and year with sufficient data.

1. Address the ethical issues[[4]](#endnote-4) raised by your thesis work. Include issues such as risks to anyone involved in the research, as well as specific people or groups that might benefit from or be harmed by your thesis work, perhaps depending on your results. List any specific reviews you must complete first (e.g., Human Subjects Review or Animal Use Protocol Form).

For this study we do not need any reviews and the data has already been collected through eBird. With any study, there are always ethical things to consider such as how the findings of the study might be used. If there is no asynchrony found, will needed conservation efforts and further research for sensitive species be lessened?

1. List specific research permits[[5]](#endnote-5) or permissions you need to obtain before you begin collecting data (e.g. landowner permissions, agency permits).

n/a

1. Reflect on how your positionality as a researcher could affect your results and how you will account for this in the research process[[6]](#endnote-6).

As someone who believes that climate change is accelerating at an alarming rate and impacting bird migration, I am potentially biased due to that. For example, if our findings do not find any asynchrony, I will ensure that I eliminate any biases in the research process.

1. Provide at least a rough estimate of the costs associated with conducting your research, if any.  Provide details about each budget item so that the breakdown of the final cost is clear.

The only cost that I have is for presenting thesis work in Alaska at the Alaska Bird Conference in December. Final budget estimate is about $875 to account for airfare, lodging, and registration fees for the conference.

1. Provide a detailed working outline of your thesis.

**Introduction:**

Discuss information on what brought on the study based on other research and how it may be different in Alaska. Also provide a brief description of what migratory birds inhabit Alaska and why and current impacts to their demography. Then provide a roadmap for readers for what will be discussed later on.

**Literature Review:**

**Climate Change and Alaska**

1. Climate change is accelerating at an alarming rate in northern latitudes which could be impacting green up.
2. Different ecoregions in Alaska (shrubland, boreal forests, arctic and alpine tundra, temperate rainforests, riverine, freshwater, coastal) which is home to a large variety of songbirds.
3. Climate change is likely causing a shift between migratory timing and spring greenup.

**2. Migratory Birds**

1. Population dynamics and migratory bird abundance
2. eBird database for obtaining observations (Youngflesh et al. 2021).
3. Seasonal migration and flyways
4. Migration routes and stopover sites.
5. Once migration is started, evidence indicates that decisions are made based on environmental cues related to different measures of ecological productivity, including temperature and greenness (La Sorte et al. 2014).
6. Reproduction and fitness
7. Demography and regional impacts

**3. Green-up and Resource Availability**

1. Resource abundance/food availability
2. Trophic cascades and impact of insect abundance

* Lack of predation on insects from birds can cause increase of insect outbreaks and intensifying defoliation of trees (Mayor et al. 2017)

1. Habitat availability and possible insect decline (Shipley et al. 2020).

* Insect availability and impacts of limited food abundance in correlation with plant emergence.

1. First primary food source for nestlings, fuel for migration (Mayor et al. 2017)
2. Optimal habitat and nest site selection/condition
3. Ecoregions and trends in phenological intervals (Mayor et al. 2017)
4. NDVI and MODIS
5. Satellite/Remotely sensed vegetation cover to show onset of greenness.

**4. Asynchrony and Phenological Shifts**

1. Climate change, weather, and temperature fluctuations (Youngflesh et al. 2021)
2. Chick hatch before resource abundance/reduced fitness (Mayor et al. 2017).
3. Arriving too late could mean fewer nest site selection/mates (Mayor et al. 2017)
4. Negative fitness consequences and biodiversity loss.
5. Arriving too early could increase risk of freezing and losing nestlings.

**5. Modeling**

1. Logistic generalized additive models (GAMs) to derive estimates (Youngflesh et al. 2021)
2. Estimates of arrival (half-maximum)
3. Bayesian spatial autoregressive models to obtain estimates of phenology (Youngflesh et al. 2021)
4. R package rstanarm
5. Use estimates to determine any shifts in spring arrival by identifying species or populations with the most extreme phenological asynchronies.

**6. Conclusion**

Summarize the importance of each topic and how these modeling approaches will be useful in our research as well. Also discuss how climate change is impacting Alaska specifically and that continued research in phenology studies is important for the future of birds.

**Manuscript:**

1. **Introduction**

Discuss current impacts on migratory birds in Alaska and study areas (Anchorage and Fairbanks) as well as the current study design for the project.

1. **Methods**
2. eBird data analysis using R software (Auk package) for data extraction and processing.
3. Landcover data using satellite/remotely sensed data (MOTIS/NDVI) to show onset of greenness.
4. Use R for statistical analysis.
5. Bayesian (GAM) for estimating arrival.
6. Estimates of arrival (half-maximum)
7. **Results**

Any results acquired using R for estimating spring arrival.

1. **Discussion**

Discussing results and any significance of our findings

1. **Conclusion**

Closing conclusions on the research and future outcomes based on results.

1. Provide a specific work plan and a timeline for each of the major tasks in the work plan. Be as realistic and specific as you can at this point, including the deadlines for Spring quarter.

**Fall:**

* Finalize literature review and poster presentation.
* Start back up on data analysis in R and running script (code in R) to have some data to present in December for the conference.

**Winter:**

* Work on drafts during winter break and have the methods section and introduction ready for peer review for the beginning weeks of the quarter.
* Continue data analysis and obtain arrival estimates for each species for results section.
* Attend thesis workshops through the quarter and have drafts ready for each week we meet:
* Winter Week 1: Working draft of Introduction for peer review (revise and submit to reader 1 week later)
* Winter Week 3: Working draft of Methods for peer review (revise and submit to reader 1 week later)
* Winter Week 5: Final draft of Lit Review for peer review (revise and submit to reader 1 week later)
* Winter Week 7: Storyline of Results
* Winter Week 9: Working draft of Results (then revise and submit to reader 1 week later)
* Continue revising each section of the thesis.

**Spring:**

* Finalize all analysis and get thesis complete draft ready for week two of Spring quarter to submit to reader.
* Request to present during week 5.
* Finalize thesis writing after draft review to have ready for thesis presentations in June.
* Submit final draft of thesis to reader.
* Get graduation preparations ready.

1. Who (if anyone), beyond your MES thesis reader, will support your thesis (in or outside of Evergreen)? Be specific about who they are and in what capacity they will support your thesis. If you are working with an outside agency or expert, be specific about their expectations for your data analysis or publication of results.

We are collaborating with Alaska Fish and Game, specifically Julie Hagelin and April Harding Scurr (Wildlife Biologists in Fairbanks AK). They have been collaborating with John Withey on this research prior to me volunteering as an intern assisting with data and then later thesis work. They have been really supportive in feedback and guidance on what resources to use and the best next steps going forward. We hope to publish the research once it is completed.

1. Provide the 5 most important references you have used to identify the specific questions and context of your topic, help with issues of research design and analysis, and/or provide a basis for interpretation. Annotate these references with notes on how they relate to/will be helpful for your thesis. For any other sources cited in your prospectus in other answers, provide a complete bibliographic citation here as well.

La Sorte, F. A., Fink, D., Hochachka, W. M., DeLong, J. P., & Kelling, S. (2014). Spring phenology of ecological productivity contributes to the use of looped migration strategies by birds. *Proceedings of the Royal Society B: Biological Sciences*, *281*(1793), 20140984. <https://doi.org/10.1098/rspb.2014.0984>

This source is helpful in providing information on migratory bird flyways and arrival timing based on temperature, elevation, and average greenness. Looking at ecological productivity, this article discusses migration success and breeding success in migratory birds traveling in spring and autumn.

La Sorte, F. A., & Graham, C. H. (2021). Phenological synchronization of seasonal bird migration with vegetation greenness across dietary guilds. *Journal of Animal Ecology*, *90*(2), 343–355. <https://doi.org/10.1111/1365-2656.13345>

This source looks into remotely sensed vegetation data to analyze migratory bird arrival with greenup and phenological asynchrony. It provides helpful information on how phenological asynchrony can affect population success.

Mayor, S. J., Guralnick, R. P., Tingley, M. W., Otegui, J., Withey, J. C., Elmendorf, S. C., Andrew, M. E., Leyk, S., Pearse, I. S., & Schneider, D. C. (2017). Increasing phenological asynchrony between spring green-up and arrival of migratory birds. *Scientific Reports*, *7*(1), Article 1. <https://doi.org/10.1038/s41598-017-02045-z>

This source is helpful in providing information on how birds are impacted by phenological shifts with variation in spring green up and is also the project that this thesis will be modeling. This source provides valuable information on how these shifts can affect the demography of species and poses the question if birds can keep up with climate change.

Shipley, J. R., Twining, C. W., Taff, C. C., Vitousek, M. N., Flack, A., & Winkler, D. W. (2020). Birds advancing lay dates with warming springs face greater risk of chick mortality. *Proceedings of the National Academy of Sciences*, *117*(41), 25590–25594. <https://doi.org/10.1073/pnas.2009864117>

This source has information on insectivorous migratory birds and how temperature fluctuations can affect nestling survival. It goes into the negative impacts of arriving too early and how a delay in spring green up can alter insect populations needed for food source for birds.

Youngflesh, C., Socolar, J., Amaral, B. R., Arab, A., Guralnick, R. P., Hurlbert, A. H., LaFrance, R., Mayor, S. J., Miller, D. A. W., & Tingley, M. W. (2021). Migratory strategy drives species-level variation in bird sensitivity to vegetation green-up. *Nature Ecology & Evolution*, *5*(7), 987–994. <https://doi.org/10.1038/s41559-021-01442-y>

This source has valuable information on species-level sensitivities to variation in spring green up and has helpful information on how novel traits in different migratory birds can influence how they respond to shifts in spring arrival and how some species may adapt better than others.

1. You are not locked into this title; we want you to identify the main point or topic of your thesis. [↑](#endnote-ref-1)
2. You might discuss a selection of case studies, sampling methods, experimental design, and/or specific hypotheses you will test. You should also address any specialized knowledge or skills that are necessary to complete the research. [↑](#endnote-ref-2)
3. If you are planning to use existing data, explain the specific source, contact information, arrangement with collaborating agencies, and expectations about use of data and final products of your research. If you are planning to gather new data, describe specific methods, time, place, and equipment that will be required. [↑](#endnote-ref-3)
4. If you’re not sure where to start, consult a ‘Code of Ethics’ or other similar document from an academic society in an applicable field of study. [↑](#endnote-ref-4)
5. If you are collecting ANY samples or data, even observational data, on public lands (city, county, state and/or federal) it is your responsibility to find out the permit requirements BEFORE you collect data. Conducting research with tribal members/on tribal lands will have different and additional requirements. [↑](#endnote-ref-5)
6. Your *positionality as a researcher* refers to the fact that one’s “…beliefs, values systems, and moral stances are as fundamentally present and inseparable from the research process as [one]’s physical, virtual, or metaphorical presence when facilitating, participating and/or leading the research project…” (The Weingarten Blog 2017). [↑](#endnote-ref-6)