Project information

Keywords
Seabirds, phenology, phytoplankton, climate

Project title
Timing of reproduction in seabirds: large-scale comparisons, and links to population dynamics, climate and lower trophic levels (SEATIME)

Year
2016

Project leader
Contact leader: Zofia Burr, University Centre in Svalbard; University Centre in Svalbard leader: Øystein Varpe; Norwegian Polar Institute leader: Sébastien Descamps

Geographical localization of the research project in decimal degrees (max 5 per project, ex. 70,662°N and 23,707°E)
70.37N and 31.13E, 67.43N and 11.87E, 73.00N and 22.00E

Participants

- Norwegian Polar Institute: Sébastien Descamps
- University Centre in Svalbard: Øystein Varpe and Zofia Burr
- NINA, Tromsø: Tone Reiertsen and Kjell Einar Erikstad
- UiT The Arctic University of Norway: Rob Barrett
- Akvaplan-niva: Øystein Varpe
- NINA, Trondheim: Tycho Anker-Nilssen and Børge Moe
- IMR, Bergen: Mari Myksvoll and Frode Vikebø
- Uni Research Climate, Bjerknes Centre for Climate Research: Michel d. S. Mesquita

Flagship
Fjord and Coast

Funding Source

FRAM Fjord and Coast Flagship

Summary of Results

The aim of this project is to address ecological responses to changes in environmental conditions through the study of timing of seabird reproduction. To carry out an analysis on breeding timing changes and mechanisms in Norwegian seabird colonies we have hired Zofia Burr to work at UNIS, as planned. Scientific results from this work include compiling long-term data sets on phenology and breeding success for two study species: puffins (*Fratercula arctica*) on Hornøya and Hernyken, Røst and kittiwakes (*Rissa tridactyla*) on Hornøya, and determining the best environmental drivers for these species at these colonies. Hatching date was used as a standardized phenology measure, and proxies for fledging success were used to measure breeding success. Relevant environmental variables that represent marine and terrestrial conditions were gathered from available online data sources or from project partners who have environmental data available for use. Preliminary results from a model selection approach suggest that air temperature (likely as a proxy for snow melt and therefore burrow access) is the best predictor of puffin breeding timing at Hornøya. For kittiwakes at the same colony, the best predictor is Atlantic Water inflow during the previous months of December –March. This result highlights the difference in mechanisms; the former is a terrestrial limitation to breeding timing and a physical mechanism that is highly related to climate change, while the latter is a large-scale

oceanographic mechanism with large implications for lower trophic-level (therefore prey) dynamics. In this analysis, we quantified phytoplankton bloom timing on a coarse scale, but to further investigate lower trophic levels as drivers of breeding timing at a finer resolution, we have a master's student at UNIS, Svenja Halfter, working on quantifying phytoplankton bloom timing at a finer resolution in the Norwegian and Barents Seas. No environmental covariates improved a null model for puffin breeding timing at Røst, which exemplifies that the same species can respond differently to environmental predictors at different locations. In regards to breeding success, we also found different responses for the two species. For kittiwakes on Hornøya, breeding success was related to breeding timing, such that in years of earlier breeding the average number of chicks per nest was higher. However, no relationship was found for puffin breeding success and timing at either Hornøya or Røst.

We are also currently using a separate climatological approach to investigate the relationship between large-scale climate phenomena and breeding timing. We use environmental data extracted from the locations of known birds (from tracking data) for different months of the year as the birds move across the northern Atlantic. This enables a novel method to study how the conditions experienced by birds while they are away from the colony influences annual events at the seabird colonies, such as breeding timing.

We have also hired Sigurd Benjaminsen at NPI who has worked on the development of a pan-Arctic database on seabird breeding timing. So far >2400 hatching dates have been extracted and incorporated into this database. When finalized by the end of 2016, this database will be a unique tool to investigate changes in Arctic seabird populations in response to the warming of their environment. In 2017, environmental covariates (i.e. sea surface temperature and sea ice extent) will be added to the database, analyzed and used to produce a manuscript on changes in Arctic seabird timing as a result of Arctic warming.

Master and PhD-students involved in the project

There is one master's student on the project based at UNIS, Svenja Halfter, working on her master's thesis titled 'Long-term phenology of marine plankton in the North Atlantic and Arctic Ocean'. She began mid-August 2016, and aims to complete here thesis by April 2017 with the further goal of publishing her findings.

For the Management

Understanding the mechanisms that drive seabird breeding timing will provide insight into how biological systems are coupled to physical environmental conditions. For management, it is valuable to know what is driving patterns in breeding timing and how timing is linked to breeding success in order to predict how seabird populations might be threatened. This is especially important if the conditions influencing breeding timing are changing, and breeding timing is linked to breeding success. More generally, breeding timing is one aspect of seabird biology that can provide insight into what is happening in the marine environment that the birds rely on for prey during the productive spring and summer periods in Norway. In addition, it is essential to know when important events that have implications for animal populations are happening in order to plan appropriately or react correctly in the case of an unforeseen event, such as an oil spill.

Published Results/Planned Publications

No publications yet, but we plan for submission of two articles in 2017 on the following topics:

- 1) Comparing and explaining mechanisms for temporal trends in seabird breeding timing in Norway, and relating them to breeding success. (Planned to submit to Marine Ecology Progress Series before June.)

- 2) Are Arctic seabirds breeding earlier as a response to Arctic warming?

Communicated Results

FRAM events:

1) Forskningsdagene, October 2016 at the FRAM Centre. All day attendance at a poster and interactive game to represent the importance

of breeding timing for seabirds.

2) Framdagen, November 2016. Poster introducing project goals and preliminary results.

3) Fram Flagship meeting, October 2016. Oral presentation on project goals and preliminary results.

Workshops, presentations, courses and conferences:

4) Project workshop at UNIS, September 2016 with project participants and seabird ecologists from the UK.

5) Interdisciplinary open lecture at UNIS by Michel Mesquita in September, 2016

6) Pacific Seabird Group Annual Meeting. Abstract submitted for February 2017 in Tacoma, Washington.

7) Project content discussed during University Centre in Svalbard Bachelor Course *AB-204, Arctic Ecology and Population Biology*, taught by Øystein Varpe.

Interdisciplinary Cooperation

This project has connected several disciplines through building a group of biologists, oceanographers and a climatologist to ask questions about what environmental factors might influence how seabirds schedule breeding timing, with opportunities to provide insight on other ecosystem components through linking biological and physical conditions. We represent 8 institutions, including climate institutes outside of the Fram Centre, such as the Bjerknes Centre for Climate Research and Uni Research Climate.

Budget in accordance to results

Of the allocated 350,000 NOK:

- 137,500 has been spent on the salary of Zofia Burr for part-time work at UNIS as a Scientific Assistant to work on the project. With these funds, she has taken care of administrative aspects of the project, organized a workshop in Longyearbyen, analyzed data and continues to lead the preparation of one manuscript.

- 60,000 NOK was spent on the workshop in Longyearbyen the week of September 25-30, 2016.

- 20,000 NOK has been spent on Zofia Burr's travels to Longyearbyen carry out the work on the project, and for travels and accommodation to Tromsø for the annual Flagship meeting and to attend the Forskningsdagene at the FRAM Centre.

- 125,000 NOK will have been used by NPI by the end of 2016 to hire, Sigurd Benjaminsen, to build the database on pan-Arctic seabird phenology.

Could results from the project be subject for any commercial utilization

No

Conclusions

This study links an annual biological event to physical environmental conditions, thus highlighting potential responses to global climate change. We have shown that there is substantial inter-annual variability in breeding timing, and that this annual event is related to the yearly breeding success of seabirds in kittiwakes at a Barents Sea colony. We are working towards quantifying the physical drivers of breeding timing, so the mechanistic relationships between breeding timing and the physical environment are better understood. In the future, this project aims to focus on the research of the phenology of lower trophic levels. Quantifying the timing of ecological events at lower trophic levels is a valuable contribution to the growing field of phenology, which deserves further attention as the risk for desynchronization of ecological interactions strengthens.