Newsletter on the consortium NWO – NPP project “Arctic Migrants”

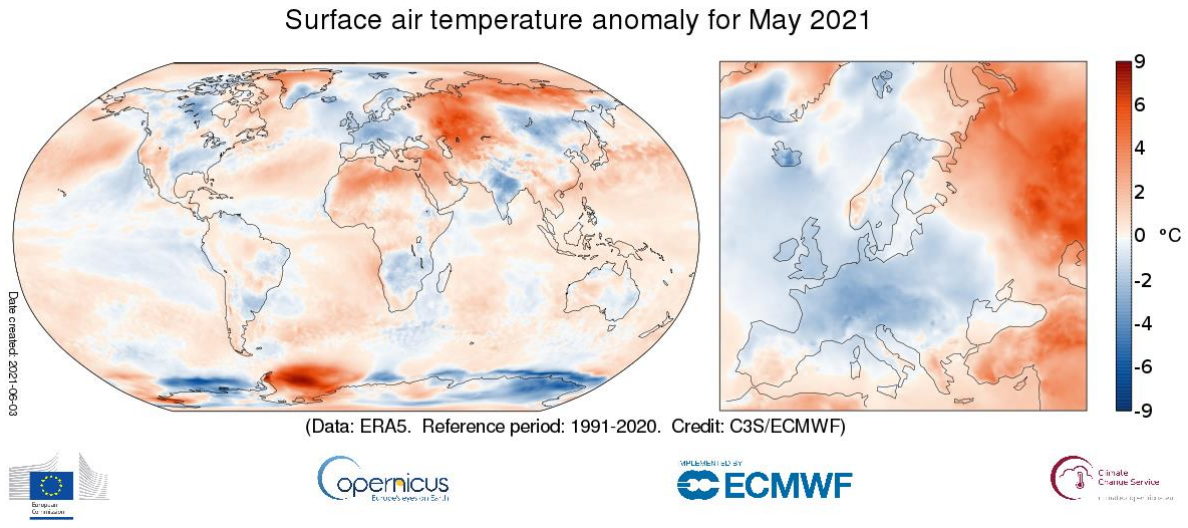
In 2021 a consortium of institutes and university groups from the Netherlands started working on the question how vulnerable Arctic migratory birds are to rapid climate change on their Arctic breeding grounds. The research is funded by the Netherlands Polar Programme (NPP) of the Dutch Research Council (NWO). We will combine the latest climate change models with data on migration and reproduction of Arctic migratory birds and the interaction with their food, with a focus on birds that spend part of the non-breeding season in the Netherlands. This consortium brings together a range of scientists from the Netherlands working on Arctic migratory birds, based at the Netherlands Institute of Ecology (NIOO), Netherlands Institute for Sea Research (NIOZ), Royal Netherlands Meteorological Institute (KNMI) and the Universities of Groningen (RUG), Amsterdam (UvA), Wageningen (WUR) and Radboud (RU).

The project started in 2021, and despite the COVID pandemic, we have been able to organize field expeditions to Svalbard, European Russia and Greenland in 2021 to collect data on Barnacle geese and Sanderlings. In addition, the first analyses have been conducted on climate change modelling as well as the changing spatial distribution of Arctic birds under climate change. Early 2022 has also seen a major shift in the world’s geopolitical situation, including the Arctic countries to which many migratory species travel to breed.

In this newsletter we want to look back at the field work conducted in 2021, highlight some examples of research published within our consortium in the past year, as well as shortly discuss the implications of current geopolitics on our project’s aims and plans.

A warming Arctic in 2021

2021 was again a warm year, being the Arctic’s 7th warmest year on record (NOAA Arctic report card 2021). Here we focus on conditions during the breeding season of birds in East Greenland, Svalbard and the West and Central Russian Arctic.



Snowmelt in the spring of 2021 was relatively early in most of the Arctic region, also witnessed by high May temperatures (see above figure). This was most visible in the Russian Arctic, but less so in other parts (including Svalbard and Greenland). Overall, it was less early than the record-breaking spring snowmelt in 2020. Summer temperatures were above average in the Central-Russian Arctic and Greenland East coast, but average on Svalbard and European Russian Arctic.

Field expeditions in 2021

Annually an expedition to Ny-Alesund is organized by Maarten Loonen to study the local population of Barnacle Geese. This year he was joined by postdoc Mo Verhoeven who aimed to study how forage plant quality is affected by cloud cover using shading treatments (see photo below), and how this might impact gosling growth. Spring started late on Svalbard, yet it was a successful season for the measurements on forage plants as well as on gosling growth.

"Shading cages" and late snowmelt on Svalbard in 2021. Pictures: Mo Verhoeven

Despite COVID-related troubles with visa for entering Russia, an international expedition went to the island of Kolguev in August 2021 to band moulting Barnacle geese. The expedition was very successful with more than 800 geese captured and ringed, including many juvenile geese. Ring readings in the countries around the North Sea in the following winter will provide estimates of survival of juvenile geese during their first autumn migration.

Goose catchers returning from the field on Kolguev Island. Picture: Helmut Kruckenberg

PhD-student Tom Versluijs organised a second expedition within his PhD project to Zackenberg Fjord in East Greenland to study growth in Sanderling chicks in relation to food availabillity. He had a very successful field season with many Sanderling broods that he could follow and measure until they fledged.

Sanderling chicks and a "sticky trap" to catch arthropods, the main prey for shorebird chicks. Pictures: Tom Versluijs

New research published in 2021

Climate change

The earth is not only warming up, but we are also seeing more extreme climate variability. A study on this topic revealed that ***temperature extremes are becoming more common*** with a warming mean temperature, but precipitation extremes are more reliant on climate variability. As the latter is much less understood, we are still in the dark on how precipitation extremes are going to change in the future, while we have a much better understanding of changes in temperature extremes.

Vegetation and habitat change

With a warming climate, the permafrost in the Arctic tundra region is thawing. A study on satellite imagery of the East Russian Arctic showed that this leads to a ***decline of shrubs and an increase of wetland vegetation***. Another study showed that in northern peatlands, ***trees can establish after permafrost melts***, but only under cover of shrubs. Together, this shows that climate warming will also change the breeding habitats of Arctic bird species.

Effects of climate on reproductive success of birds

A warming climate results in earlier springs with earlier peaks of food availability, such as peaks of emergence of arthropod prey for shorebird and songbird chicks, and the peak in forage plant quality for herbivorous waterfowl chicks. When bird species do not change their timing of egg-laying to earlier springs, this can result in a mismatch between the period when chicks hatch and grow up and the moment when most food is available. A review study showed that advancements of food peaks are faster in the Arctic compared to more temperate areas, which highlights the ***potential for larger phenological mismatches in the Arctic***, where chicks hatch after the main food peak has already passed.

Two studies analyzed the effects of mismatches on the growth of chicks. A study on Red Knots and two related shorebird species found that ***chicks hatching when the food peak of arthropod prey has already passed indeed grow slower*** than chicks hatching before the food peak. Interestingly, this effect on growth is counteracted by higher temperatures, which reduce energetic costs of chicks, but only for Red Knot chicks growing up under the coldest conditions (in high-Arctic Canada). A study on Barnacle Geese showed that ***goslings also grow slower when hatching later***. However, this effect was only visible in the Arctic, but not in populations breeding in temperate areas, probably due to generally low food quality and slow growth in temperature areas.

In order to evaluate the effect of climate change on populations, it is important to take into account all phases determining reproductive success. One of these phases, which is difficult to study, is the nest initiation phase. A study on Pink-footed Geese showed how to ***measure 'breeding propensity'*** (i.e., the fraction of birds making a breeding attempt) in an unbiased manner ***from data collected by GPS-loggers***. With this new technique, it was possible to determine if birds started nesting, and if so, whether they bred successfully. This will be an important tool to study such aspects of reproductive

success in populations of Arctic migratory populations. When considering multiple aspects of climate change on population growth, a study on Barnacle Geese on Svalbard found that these ***mostly profit from earlier springs***, as this increased their chances of successful reproduction and led to population growth.

Migratory birds may be able to better match the moment of chick hatch with local food abundance when they can start breeding earlier, which means that they also need to adjust their timing of migration. A review paper showed that ***many Arctic migratory bird species have adjusted their timing of spring migration*** in past decades, more so than other species groups such as marine mammals in the Arctic. In contrast, changes in breeding range are less often recorded in migratory birds than in marine mammals.

Policy relevance in a changing world

The main aim of this project is to increase our understanding of how we can protect migratory birds which breed in the Arctic from impacts of climate warming. Migratory birds that visit the Netherlands truly make connections across borders, with wintering areas in Western Africa and Europe, and breeding grounds stretching from Canada to central Russia. Along their flyways, these birds encounter many different stressors, including habitat loss, hunting as well as effects of climate warming. For policy measures to result in meaningful protection of birds, such measures also need to reach across borders, as for example is being organized in treaties such as African-Eurasian Waterbird Agreement (AEWA) and the Conservation of Arctic Flora and Fauna (CAFF) in the Arctic Council. Such treaties require special attention, especially in current times of geopolitical crisis.

In this project our scientific collaborations follow the migration of birds, and these are also impacted by the current geopolitical crisis. Where we have warm connections with Russian researchers with whom we have together studied shorebirds and geese in the Arctic summering sites for over 20 years, the joint collaborations and field expeditions with Russian institutes are currently put on hold. While we are happy that tracking devices still allow us to follow migratory birds to breeding grounds in Arctic Russia, and data from previous years allow us to model changes in distributions and populations of these species, we are missing out on studying current impacts of climate warming on reproductive efforts. Out of necessity, we will in the coming years focus our efforts in studying reproductive efforts of species breeding on Arctic sites to which we have access in Svalbard and Greenland, while relying on continuous collection of tracking data for birds breeding in the Russian Arctic.

At the same time, we are already taking the first steps to connect our research to conservation by teaming up with policy makers. First contacts have been established with the people developing a climate dashboard for the Wadden Sea area. Within the framework of the programme "*Naar een rijke Waddenzee*", the goal is to map how climate change will affect the Wadden Sea area, and what this would mean for birds. For migratory birds, this evaluation includes the effects occurring in the Wadden sea as well as effects elsewhere along the flyway.