Project title: Pioneering an international collection of non-invasive biological samples for the North Atlantic black-legged kittiwake.

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Project Background and Rationale

The North Atlantic black-legged kittiwake, *Rissa tridactyla tridactyla*, (hereafter 'kittiwake', Figure 1), is a subspecies of migratory[1] Laridae gull with extensive breeding areas around the North Atlantic and its bordering seas[2]. The species is classified as 'Vulnerable' on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species and the total abundance of breeding pairs is declining globally[3]. The kittiwake is a wide-ranging apex predator and a valuable marine indicator species of, e.g., marine plastic pollution[4], keystone prey abundance[5] and ocean climate and competitor forcing[6]. Kittiwake populations function as national networks[7 – 10] nested within international metapopulations[11], in which long-term population trends differ, often profoundly, at both regional and international scales[12, 13]. Researchers require species-level biological datasets to answer large-scale questions and to inform appropriate environmental assessments, marine spatial planning decisions and the execution of offshore renewables compensatory measures at the ecosystem-level.

Figure 1: A North-Atlantic kittiwake, *R. t. tridactyla*, in flight over St Andrews Bay, Fife, East Scotland. Photograph: G. Ellis.

Project Objectives

The aim of this project was to bring together stakeholders from across the North Atlantic and its bordering seas to generate a resource bank for large-scale population genetics, stable isotope and heavy metal pollutant analyses.

The specific project objectives were as follows:

1) To establish, maintain and strengthen national and international research collaborations.
2) To build a collection of non-invasive biological samples (NBS), representative of the North Atlantic kittiwake metapopulation.
3) To facilitate the collection of NBS without excluding stakeholders due to the costs incurred.
4) To provide an opportunity to further develop the use of NBS in population genetics for marine ornithological research.
5) To maximise the value of this project by publishing sample metadata towards the development of new collaborative research projects.

Methodology

Project partners and collaborators were identified and contacted via international conferences, word of mouth, and social media platforms where appropriate. Sampling kits were designed, put together and posted out to project partners in time for the start of the 2023 kittiwake breeding season (Figure 2).

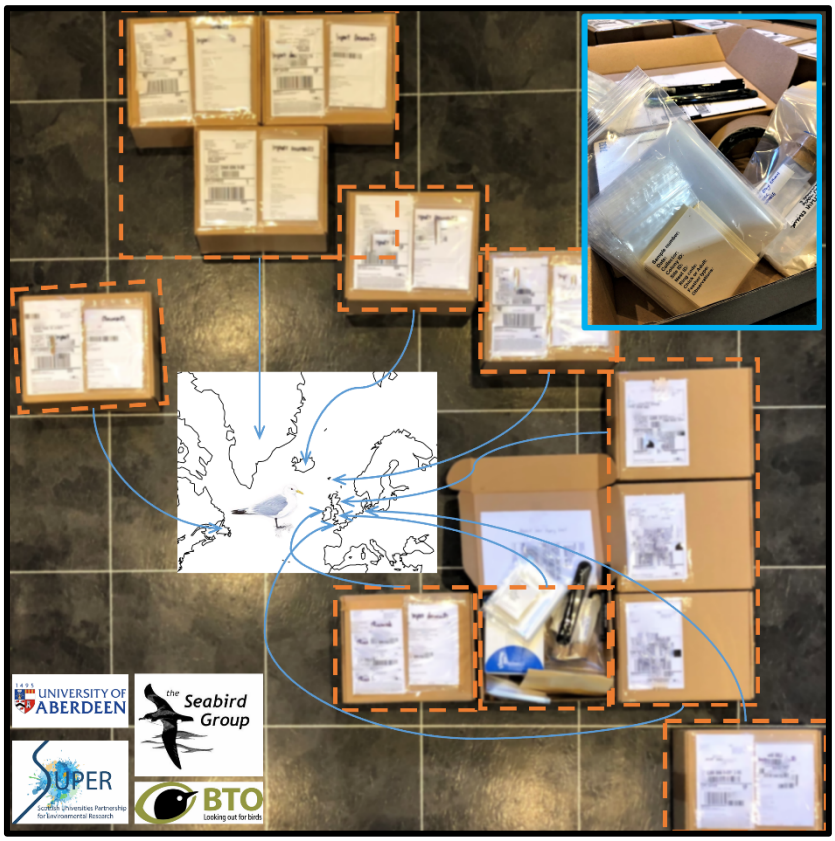

Figure 2: Sampling kit boxes ready to be posted to project partners in (clockwise from left): Newfoundland Canada, Greenland, Iceland, the Faroe Islands, Helgoland Germany, Scotland, France, Ireland, Wales and Cornwall England.

Non-invasive biological samples (kittiwake feathers and an ectoparasite of the kittiwake, the common seabird tick, *Ixodes uriae*) were collected over the 2023 kittiwake breeding season. Samples were posted to, stored and inventoried at the University of Aberdeen, UK, following best practice for genetic material and accepted professional standards (i.e., ICOM Code of Ethics for Museums).

The Seabird Group Research Grant was used to fund 50% of the total project costs. This grant was integral to the project values in that it enabled us to remove financial barriers to the inclusion of stakeholders who could not otherwise fund the purchase of the required research consumables. Ultimately, this meant that the collection of samples was representative of the North Atlantic black-legged kittiwake metapopulation unit, excluding other factors (see **Outcomes to Date**), rather than biased towards locations and stakeholders able to fund research consumables and postage costs.

Animal Welfare Considerations: This project is targeting non-invasive biological samples to reduce the use of invasive sampling (i.e., venous blood samples) within ornithological research. The project has successfully completed full ethical review by the home institution of the applicant (University of Aberdeen), including full justification of sampling methods and sampling effort with due consideration of approaches to Replace, Reduce and Refine animal use and to ensure the ethical handling of birds.

Persons handling birds held permit/s allowing named individual/s to handle birds (i.e., BTO ringing permit for Britain and Northern Ireland or international equivalent). Project-partners also followed standardized sampling protocols. Post-fieldwork debriefs allowed us to evaluate the project success and facilitate the refinement of practices between sampling events.

The potential for the transfer of avian influenza between birds, geographic regions and between species (i.e., from bird material to humans) was mitigated by following all relevant regional restrictions, the BTO guidelines for handling birds, and DEFRA guidelines for the import of biological material. Sampling kits were designed following consultation with biosecurity experts with extensive experience handling invasive and zoonotic pathogens. Samples were transported with all required legal documentation.

Ticks were removed directly from kittiwakes to sample the correct race of *I. uriae*, which has been shown to be host specific[14, 15]. A feeding tick can be removed from the head of an adult bird, secured in the hand, in approx. 30 seconds (UK CEH, pers. comms.), therefore we were confident that tick sampling could be achieved without extending handling times beyond normal for the bird.

Outcomes to Date

The majority of sampling kits have been returned following successful field seasons (Table 1). There were reduced sampling opportunities at some sites due to technical difficulties (Ireland), a poor breeding season (Cornwall, SW England) and resurgence of avian flu (Aberdeenshire, Scotland).

Table 1: Numbers of sampling kits posted out in May 2023 and returned by November 2023.

Number of sampling kits sent out	15
Number of sampling kits returned	13
Number of sampling kits retained by project partners until 2024	2*

* Aberdeenshire, Scotland and Cornwall, SW England.

Kittiwake feather samples were collected from across the North Atlantic Ocean and have been received at the University of Aberdeen (Figure 3).

Figure 3: The geographic spread of kittiwake feather samples obtained from breeding colonies around the North Atlantic Ocean (region shaded blue) over the course of this project to date.

Where birds were being handled for ringing, all project partners searched for kittiwake-associated ticks. However, in all of these locations, with the sole exception of the Isle of May, Scotland, ticks were found to be absent (the Faroe Islands, Canada, Greenland). During the initial stages of the project, it was found that the kittiwake colony in Spain, at the southernmost point of the known breeding range, was no longer active and as such no monitoring work and therefore no sampling opportunities were available at this site. Feather samples from additional locations were also donated to the project, where word had spread of the objectives.

We are grateful to the following project partners and collaborators for collecting feather samples and for contributing to the continued success of this project (in no particular order): Bob Swann, Andrew Call and the Highland Ringing Group; Signe Christensen-Dalsgaard and Brett Sandercock (Norwegian Institute for Nature Research); David Jardine, Janet Jardine and Anne Middleton; Andy Rickeard and the Northumberland Ringing Group; Tom Hart and Alice Edney (University of Oxford); Matt Wood (University of Gloucestershire) and Freya Blockley; Mark Newell, Francis Daunt, Carrie Gunn, Ella Benninghaus and Sam Langlois-Lopez (UK Centre for Hydrology and Ecology); Ólafur Pétursson (Skalanes); Abbie Heaney, Rosie Norman, Rosie Milne, Laila Lotz and Laura Munro (University of Glasgow); David Tierney (Government of Ireland); Mark Jessopp (University College Cork); Steve Newton (BirdWatch Ireland); Sylvain Poisblaud and Stella (Groupe ornithologique et naturaliste (agrement regional Hauts-de-France); Sjúrður Hammer, Jens Keld Jensen, Johannis Danielsen and Bergur Olson (The Faroese Wildlife Agency); Jochen Dierschke and Robert Rollins (Institute for Avian Research); April Hedd and Joshua Cunningham (Environment Canada and Climate Change); Sebastien Descamps and Hallvard Strøm (Norwegian Polar Institute); Flemming Ravn Merkel, Anders Mosbech, Kasper Lambert Johansen and Morten Frederikson (Aarhus University); Aili Labansen (Greenland Institute of Natural Resources); Debs Allbrook (University of Exeter); Ruben Fijn and Rob van Bemmelen (Waardenburg Ecology); Gerry van der Meijden (TotalEnergies).

Next Steps

All feather samples are presently being documented and subsampled at the University of Aberdeen, Scotland. An inventory of all feather material available for further research projects, in particular stable isotope and heavy metal analyses, will be published online in December 2023 and an open call put out for bids to use the material. Genetic analysis for microsatellite markers is scheduled to take place over February and March 2024 and these outputs will be used within a PhD project identifying patterns of population connectivity for kittiwakes at differing spatial scales.

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