How do Storm-petrels interact with marine developments and light pollution in the north-east Atlantic? A pilot study in the Faroe Islands.

Nocturnal seabirds such as European Storm-petrels (*Hydrobates pelagicus*) are secretive species whose ecology and biology are still little understood, owing to their elusive behaviours, highly oceanic existence and small size. As species overwhelmingly active during the night-time, these seabirds are also particularly susceptible to the effects of artificial light at night ('ALAN'). A growing body of research has been shedding light on how these species interact with artificial light in the marine environment, but significant knowledge gaps remain; this is of particularly pressing concern as anthropogenic developments in the marine environment increase, and the potential effects of lighting associated with such developments remains largely unknown.

The objective of this ongoing study is to assess how European Storm-petrels interact with offshore wind farms, marine fish-farm operations and sources of artificial light at night around the Faroe Islands and wider north-east Atlantic region. The project is centred on the Faroe Islands, an archipelago located midway between the Shetland Isles and Iceland, which is home to internationally-important breeding populations of seabird species and hosts the largest known colony of European Storm-petrels in the World (c. 50,000 breeding pairs). We plan on utilising a number of field-based methods to investigate the key objectives of the project, including GPS tracking Storm-petrels, thermal-imaging surveys at night and behavioural lighting experiments.

During the summer of 2021, a two-month pilot study was made possible by generous funding provided by the Seabird Group, a Faroese travel grant and a fish farm company in the Faroes collaborating in the research. This pilot study period provided invaluable opportunities to investigate the Nólsoy colony study site, assess research methodologies and meet the various individuals, groups and organisations locally who are now involved in the continued development of this research project in the Faroe Islands. This work was continued during summer 2022, and we hope that acquisition of wider funding opportunities will enable the full development of the project into a multi-year study.

Critical to any work taking place in the colony on Nólsoy was the invaluable knowledge and assistance from local ornithologists Jens-kjeld Jensen and Jógvan Thomsen, both of whom live in the village on the north side of the island, and have been involved in the study of the colony for many years. Jens-kjeld and Jógvan very kindly showed us around the colony and departed innumerable insights into the behaviours and breeding biology of Storm-petrels in this area. Over previous winters (largely over winter 2020-2021) Jens-kjeld and Jógvan installed over 30 artificial Storm-petrel nestboxes throughout the colony in the hope that they will become occupied and provide accessible nests to enable work such as the GPS tracking we hoped to carry out. This number has since been increased to close to 60, and will be bolstered to 100 nestboxes by spring 2023.

One of the main activities over summer 2021 involved carefully monitoring these artificial nestboxes and assessing their usage by Storm-petrels; comparing various differences in the box design and location within the colony to see which is preferred. Overall, nine of the 27

boxes studied in the 2021 season were used to varying degrees by Storm-petrels, with two boxes hosting pairs that successfully fledged chicks. The seven other boxes involved prospecting birds, pairs semi-constructed nests inside, and other pairs laying an egg but ultimately failing during incubation for unknown reasons. During the 2022 season, 28 out of 59 nestboxes were used to some degree, with 14 incubating pairs and seven boxes successfully fledging chicks. This already presents an exciting rate of uptake by Storm-petrels in the colony, and will allow for a host of monitoring activities to take place over coming years.

Another key focus for the 2021 piloty study was to carry out night-time surveys on fish farm installations around the Faroese archipelago; assessing potential interactions of seabirds with these platforms under the cover of darkness, especially with regards to any influence of artificial light sources associated with the installations. A well-established fish farm company called 'Hiddenfjord' very kindly agreed to collaborate with us for this element of the research project, allowing researchers to visit a fish farm in the fjord of Velbastadur at night and use thermal imaging cameras to carry out timed scan surveys of the surrounding area (using the Pulsar Axion XM30S). A total of three night-time visits were made to the fish farm during August and September, and these surveys revealed that Storm-petrels were regularly frequenting the waters immediately surrounding the fish farm installations. The visits to the farm on 29 August and 5 September 2021 recorded 61 and 104 individual Storm-petrels respectively over a two-hour period, with varying degrees of foraging and commuting behaviours noted. Several bright lights were present on the fish farm for the duration of the surveys, but no obvious attraction to these light sources were noted, although their presence could have played a wide influence in the presence of Storm-petrels in the area of the fjord itself. Following these pilot surveys, we hope to expand this night-time survey work to other fish farms across the Faroes and across wider periods of the Storm-petrel breeding season, as well as comparing periods at night when lights are not operating on the installations.

In addition to the thermal imaging surveys carried out on the Velbastadur fish farm, night-time surveys using this survey method were also trialled along the coast and at-sea off the island of Nólsoy aboard a small vessel. A particular focus for these surveys is the proposed construction of an offshore wind farm in the sea c.4km east of Nólsoy. This wind farm is due to be constructed between 2022 and 2025, with the potential to influence various seabird species commuting to and from their breeding colonies on the island. Any data gathered will therefore be of great importance to help inform how this development might affect the internationally important seabird populations breeding on Nólsoy. We carried out two offshore surveys around the proposed wind farm location (at night on 24 August and 8 September 2021), and this provided very useful initial data on Storm-petrel behaviour and abundance at-sea off the colony; for example, a mean number of 44 birds per 15-minute survey was recorded on 24 August 2021, with 72 birds per 15-minute survey on 8 September 2021. Again, this is a method we hope to expand and utilise more in the study.

After an exciting two seasons in the development stage for this project, we hope to acquire funding to fully pursue the questions we have set out to address. The core team involved in the project at present include myself, Dr Rob Thomas (Cardiff University) and Dr Sjúrður

Hammer (Faroes Environment Agency), but we have a suite of collaborative partners to thank for the invaluable input thus far, and to the Seabird Group for contributing to the first pilot study season of the project in 2021.