Offshore Wind Evidence + Change Programme

First-Time Migrating Fledglings: A Review of Biotelemetry Technology

ProcBe deliverable 1.5

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Contents

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1. Background

As part of WP1 in the ProcBe OWEC project, the objective of WP1C is to track first-time migrating Manx shearwater *Puffinus puffinus* fledglings from 3 SPA colonies. This work aims to address the knowledge gaps surrounding post-fledging behaviour within the Celtic and Irish seas, proposed sites for offshore wind development. Fledglings may have a differential vulnerability to offshore wind activities, with prior research indicating an increased likelihood of light attraction and groundings for first-time migrants (Syposz *et al.*, 2018; Syposz and Padget, 2023). Within the Celtic and Irish seas, naïve shearwaters must gain flight experience, and orient towards their migratory destination (Mueller *et al.*, 2013; Wynn *et al.*, 2022). It is therefore highly likely that first time migrants have a different spatial distribution to adults when migrating through proposed offshore wind sites for development. Through WP1C we aim to provide the first detailed tracks of post fledging migration for Manx shearwaters. However, tracking the post fledging movements of shearwaters poses numerous challenges. In this report we will review the types of technology available, their usage on first time migrants in other seabird species and suitability for deployment on shearwaters.

This project was initiated in response to a funding call by the Offshore Wind Evidence and Change programme which is funded by The Crown Estate. This programme seeks to support the growth of the offshore wind industry and the UK's net zero ambitions by funding research projects that contribute a wide-ranging base of data and evidence to resolve gaps in evidence and understanding of cumulative impacts on protected seabird populations, a high-level priority of the OWEC programme.

2. Technology Review: first Time Migrants

2.1 Geolocators (GLS)

Most available biotelemetry technology requires retrieval for data recovery. Fledgling shearwaters do not return to visit the breeding colony until their 2nd or 3rd year, and typically do not start breeding until their 4th or 5th year. Therefore, devices suitable for such long-term deployments must be durable and securely attached so as to last until retrieval, and lightweight so as to minimise disturbance to the tracked bird. Given these requirements, geolocator (GLS) devices are suitable for long term deployments on shearwaters. They are small (weighing <1g) and are securely attached to a custom-built leg ring (figure 1B), where devices can remain fastened for multiple years, with data being collected for 1-3 years before the device's battery is depleted (table 1). However, our previous work indicates low retrieval rates from fledgling shearwaters. Wynn *et al.*, 2022 deployed 54 geolocators on first-time migrating shearwaters, yet retrieved data from only 3 of these birds. Additionally, in a similar study tracking first migrations of puffins, only 2 out of 54 loggers were retrieved (Fayet, Shoji and Guilford, 2024). This low retrieval rate is likely due to multiple factors; 1) fledglings have a higher chance of

mortality with birds dying before their first breeding attempt, 2) competition for nest sites is high and locating newly established nests on a dense shearwater colony is challenging, 3) although the majority of Manx shearwaters return to their natal colony to breed, some dispersal to other breeding sites may occur. A 6 year BTO ringing project reported a mean recapture rate of fledgling shearwaters of 26.7% (Perrins, Harris and Britton, 1973). Given these limitations, geolocators are not commonly used for studies of first-time migrating seabirds.

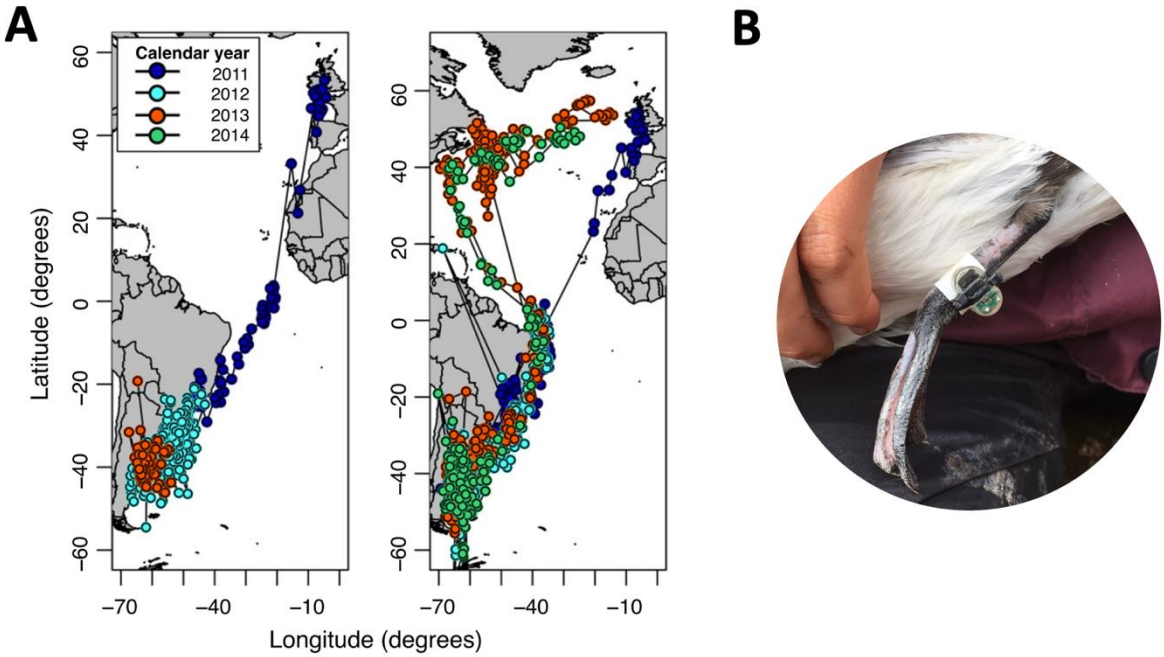

Figure 1. Geolocator deployments on first time migrating shearwaters. A) The GLS derived position estimates of 2 fledgling birds (one bird per panel) taken from Wynn et al, 2021. Each colour represents a year of data and points represent position estimates. B) An image representing a geolocator deployment, where the GLS is mounted on a custom-built plastic leg ring.

2.2 Platform Terminal Transmitter (PTT) tags

Alternatively, there are biotelemetry devices available that do not require retrieval and submit data remotely. Platform Terminal Transmitter (PTT) devices allow position data to be downloaded remotely and can include solar charging of batteries to lengthen deployment durations. They typically use satellite communication systems to transmit data from tagged animals to researchers, who can access and analyse the information through secure online platforms. These tags therefore have applications in the study of first migrating seabirds, with previous deployments on juveniles including frigate birds with the Argos PTT-100, Microwave Telemetry Inc (Corbeau *et al.*, 2020), Scopoli's shearwaters with the Argos PTT-100, Microwave Telemetry Inc (Afán *et al.*, 2019) and streaked shearwaters with the PinPointGPS, Lotek Argos tag (Yoda *et al.*, 2017). These devices can be lightweight (~3.5g), therefore minimising loading. In most seabirds, PTT devices are deployed through attachment to the back feathers using tape, assuring they will fall off naturally through preening or moulting (figure 2B). In a study led by Wynn *et al*, 2021, 10 Lotek PinPoint GPS Argos tags were deployed on 10 fledgling shearwaters. However, most devices failed to record more than 2-3 days of data because of technology failure.

Only 3 devices recorded 7 days of data (figure 2A), meaning many failed to record the movements of shearwaters through the Celtic and Irish sea. Other studies using PTT tags also had low success rates, with 8/15 deployment on Scopoli's shearwaters lasting less than 15 days (Afán *et al.*, 2019) and a low GPS fix rate in streaked shearwaters (Yoda *et al.*, 2017). Most PTT tags used in other seabird studies would additionally be too heavy (table 1) for deployment on Manx shearwaters during migration.

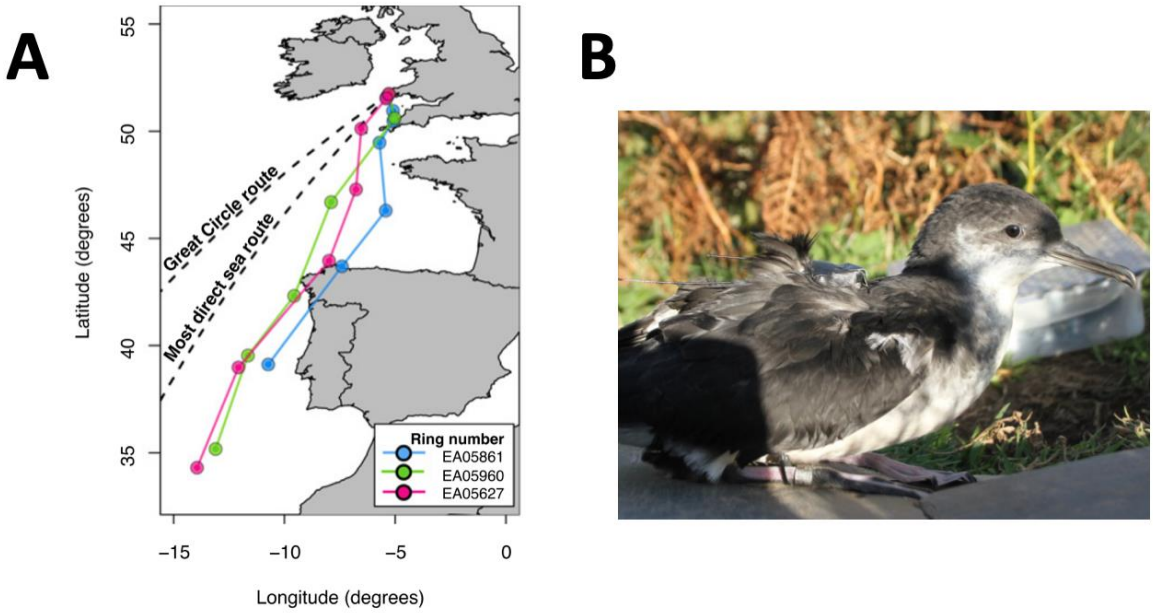

Figure 2. PTT Deployments on first time migrating Manx shearwater. A) The post-fledging movements of 3 PTT tracked birds from Skomer island taken from (Wynn *et al*, 2021). Each colour represents an individual fledgling's movement and each point represents a daily position (with 7 days recorded in total. B) A photograph taken from the thesis of Wynn, 2021 illustrating a PTT back mounted deployment (Lotek PinPoint GPS Argos tag) on a fledgling Manx shearwater.

3. Global System for Mobile Communication (GSM)

GPS devices can also send data remotely through the Global System for Mobile Communication (GSM), where position data are sent directly through to the researchers' mobile phone. Developments in GSM technology now allow device settings (e.g. fix rate) to be modified post deployment, therefore increasing the likelihood of receiving high quality data. These have been applied in other studies of seabird first migrations with 22 Orlog's gulls tagged with CatTraQ GSM devices (Ravasi *et al.*, 2019). However, these deployments were short lasting (table 1) as these devices were designed to track domestic cats with a limited battery life, and were additionally without the solar charging features available in other remote download devices. In a water bird, the Chinese egret, 39 juveniles were tagged with HBQ-2512S devices from Global Messenger. However, 15 of these devices failed to record data (Huang *et al.*, 2021). Meanwhile, 10 lesser black backed gulls were tagged with ornitela OT15 solar charging GSM transmitters (Borrmann *et al.*, 2021) and in this study all deployments successfully collected data for over 2

months. Ornitela devices therefore appear to provide promising technology for recording seabird first migrations. In September 2023, we conducted tests using Ornitela OrniTrack-T9D 3G transmitters devices on 10 juvenile birds from Lighthouse island in the Copelands group. All devices successfully recorded the passage of juveniles through the Celtic and Irish sea and we were able to adjust device settings post deployment to maximise data recording. However, temporal resolution in the first few days proved limited because of power drainage during the nights post deployment but pre-fledging when birds had not left the colony. Our tests allowed us to determine how best to maximise power saving prior to fledging using a combination of geofencing around the study colony (high temporal resolution is only triggered once the bird leaves the immediate vicinity of the colony), and judicious selection of target birds most likely to fledge on the same night as deployment. We now have some confidence that OrniTrack-T9D devices will prove capable of providing appropriately high spatio-temporal resolution to track fledglings as they pass through the Celtic sea and where our test data are appropriate these may also be added to the data arising from the project itself.

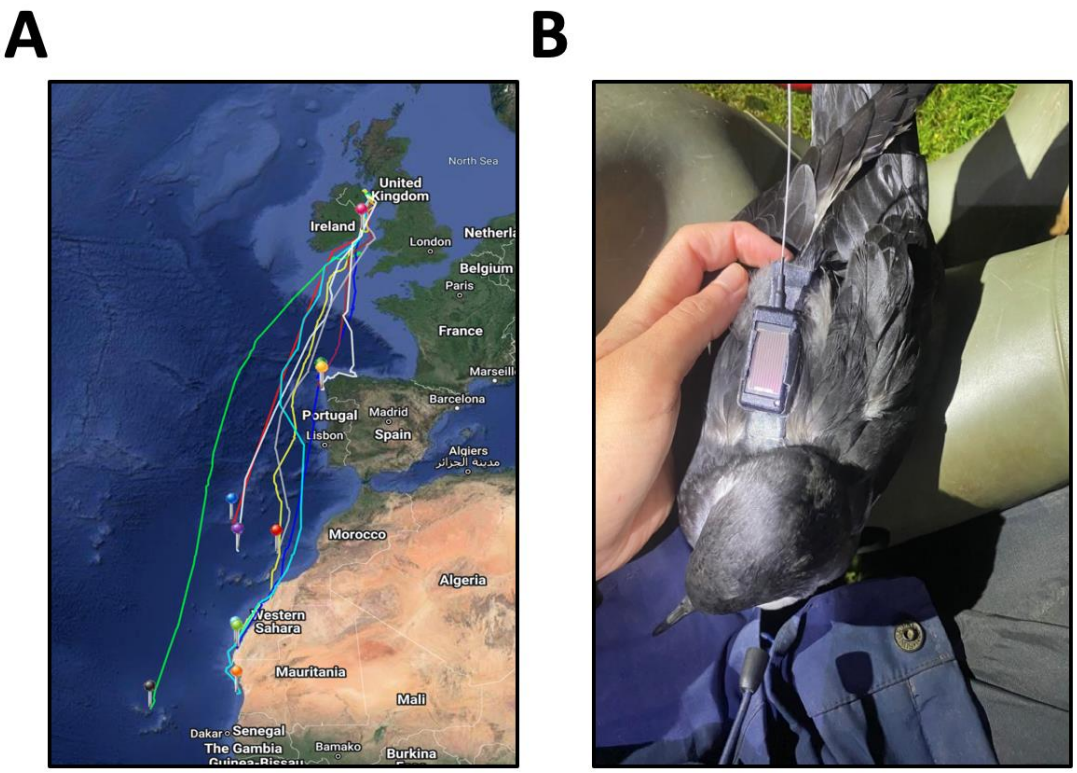

Figure 3. Ornitela GSM deployments on first-time migrating shearwaters. A) Migrations of 10 juveniles tracked during migration and B) attachment of Ornitela device.

4. Summary of Biotelemetry Technology

Device Type	*Model*	*Company*	*Weight (g)*	*Device Attachment*	*Accuracy*	*Data Recovery*	*References*
Geolocator	C65 Super	MigrateTecnology	~1	3-6 years	200-300 km	Following retrieval	Wynn et al 2021; Fayet et al, 2024
PTT	PinPoint GPS Argos	Lotek	3.5/11	1-2 weeks	~18m	Remote	Wynn et al, 2021; Yoda et al, 2017
PTT	Argos PTT-100	Microwave Telemetry inc	9.5/18	1-100 days	18m	Remote	Afan et al, 2019; Corbeau et al, 2018
GSM	HQB-2512S	Global Messenger	14	1-2 weeks	5	Remote	Huang et al, 2021
GSM	CatTraQ live	Mr Lee	17	~2.5 days	5	Remote	Ravasi et al, 2019
GSM	OT15-2G	Ornitela	19.5	~2.5 months	5	Remote	Borrmann et al, 2021

Table 1. A summary of biotelemetry technology used in studies of seabird first migrations.

5. Technology Selection

In this report we have outlined the biotelemetry technology available for tracking first time migrating seabirds. Given the pressing need to understand the movements of juvenile shearwaters with respect to offshore wind developments, devices fitted with remote download technology seem most appropriate, with archival loggers requiring a 2-4 year wait time, and other studies reporting an associated low recovery rate. PTT tags do not seem like a reliable option as device failure appears common, both in other seabird studies and in previous work led by our research group (Wynn *et al*, 2021). Meanwhile, the results of deployments using ornitela GSM devices appear promising. In most cases data were transmitted throughout the duration of the deployment, devices are solar powered so are long-lasting, and the settings can be changed post duration to maximise data collection. We therefore conclude that OrniTrack-T9D

3G transmitters are currently the most appropriate devices for tracking fledgling Manx shearwaters and that they are likely to provide suitable spatio-temporal resolution over the period during which birds are utilising the Irish and Celtic seas at the start of their first migration. Following discussions with development engineers at Ornitela we have learned that the same system we tested in 2023 will remain fully functional in 2024. However, there is some doubt as to the GSM landscape in the UK from 2025 following the potential shut down of 3G. Ornitela are clearly thinking about this potential problem for the future of their system in the UK, and how to respond technologically, and we will in addition attempt to determine during 2024 whether GSM reception via Irish mainland receivers may continue to provide good coverage despite any such shutdown. Nevertheless, our choice of device for the second tranche of fledgling deployments (in 2025) will need to remain flexible until we have sufficient further information, probably early in 2025.

6. References

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