

Atlantic puffin tagging report 2023, Skellig

Michael

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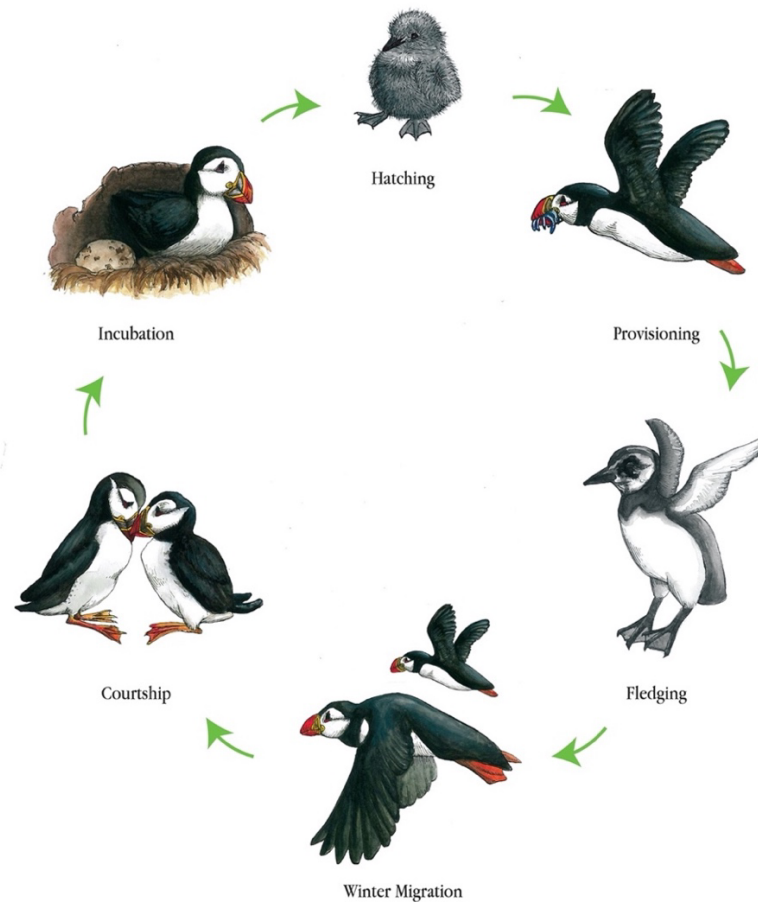


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Context

The Atlantic puffin (*Fratercula arctica*) is a seabird species found on several islands and high cliffs around the coast of Ireland. Puffins are typically monogamous and long-lived, with breeding delayed until 5 or 6 years old. A single egg is laid in early summer, which parents take turns incubating until it hatches, then taking turn provisioning the chick until it fledges in late July/early August. Once the breeding season is over, puffins migrate offshore until the next breeding attempt. Because of their low reproductive output, puffin populations are sensitive to impacts such as severe storms or pollution at sea, and invasive predatory species at the colony. In the 2000s, rapid population declines led to the species being classified as Endangered in Europe by the IUCN. Despite the emblematic status of the puffin, our knowledge of their ecology in Ireland is limited, especially concerning their behaviour and distribution at sea.



Simplified life cycle of the puffin (credit: Terra Dawson)

Skellig Michael supports populations of breeding puffins, Manx shearwaters, European storm petrels, northern fulmars, kittiwakes, razorbills and common guillemots. Skellig Michael's sister island, Little Skellig, hosts the largest gannet colony in Ireland with an estimated 35,000 breeding pairs (Newton et al 2015). Skellig Michael can support such numbers of seabirds due to its location on a productive expanse of continental shelf that benefits from shelf-edge upwellings. Complex currents passing the peninsulas and islands of County Kerry act to aggregate fish and plankton, further enriching the nearby habitat and increasing the availability of seabird prey.

Skellig Michael's cultural and natural heritage are often intertwined, with puffins, European storm petrels, and Manx shearwaters nesting in gaps in the stone walls, steps, and monastic structures. The number of visitors to the island is restricted to protect both natural and cultural features of the site. The regulation of visitors has helped keep the island free from rats and other introduced predators, which can quickly deplete breeding seabird numbers (Jones et al 2008). Tourists are restricted to well defined paths, which means that the natural burrows in the shallow soil are mostly safe from collapse from footfall.



Puffin burrows away from the stone steps are often quite shallow and would be liable to collapse were visitors given free reign of the island.

Ireland is currently expanding on its designation of Marine Protected Areas (MPAs), which must be informed by robust data on the abundance and distribution of seabirds in the waters surrounding breeding colonies.

Tracking studies

Aims and Methods

As part of ongoing UCC studies on seabird distribution, movement, and behaviour, we undertook fieldwork on Skellig Michael from 9th to 11th June 2023 with three major aims:

- To study the movements and fine-scale foraging behaviours of breeding adult puffins during the chick rearing period.
- To describe the migratory behaviours and the areas used by puffins outside the breeding season.
- To determine the duration, timing and location of moult in puffins, as this flightless period is critical for the species, impacting their foraging behaviour and ability to escape storms.

To study the fine-scale movements and behaviour of puffins during chick rearing we deployed 12 GPS tags (3.6 g, Nanofix, PathTrack) on breeding adults captured at the burrow entrance. We successfully retrieved 10 of those tags using the same method and data was collected from 8 individuals as 2 tags had malfunctioned.

The study of puffins' movements outside the breeding season requires tags with a long battery life combined with a low weight. We used Global Location Sensors (GLS), or geolocators (1.5g, Lotek mk4083) that we attached to the legs of study puffins using a darvic leg ring. We deploy these tags in the breeding season to be retrieved the next year. This year, we successfully retrieved 7 of the 20 geolocators deployed in 2021 as well as one geocator deployed in 2020. At least three additional birds equipped in 2021 or 2022 were observed in the colony but evaded recapture. We deployed new GLS on 18 individuals in 2023 with plans to recover these and any remaining tags deployed in the previous years during the 2024 breeding season.

To accurately identify patterns of behaviour thought to be consistent with flightless moult (Darby et al, 2022), 11 of the 18 individuals equipped with GLS tags were equipped with two

tags (one on each leg) to avoid misclassification due to birds tucking either one or both legs into the plumage while resting on the sea surface.

All bird capture, handling, ringing and tagging was approved by the UCC Animal Ethics Committee and conducted under licenses issued by the British Trust for Ornithology and the Irish National Parks and Wildlife Service with permission from the Office of Public Works who have responsibility for managing the site.

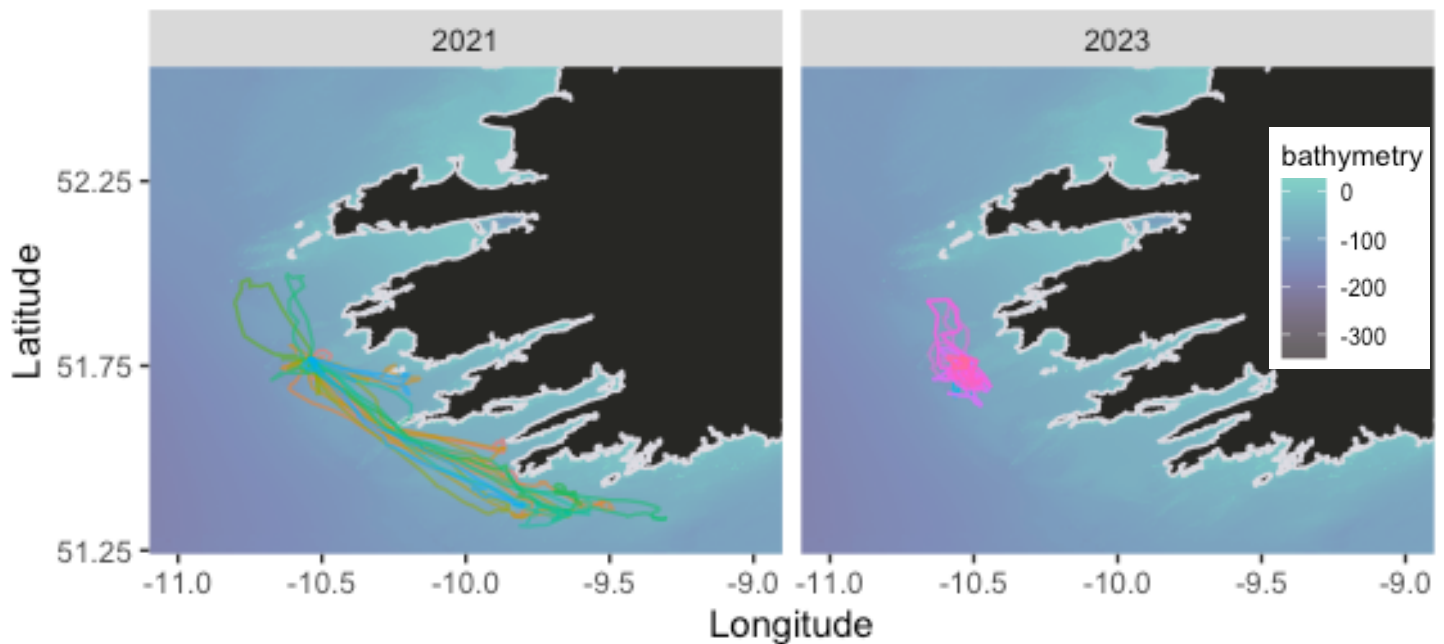


Puffin with a geolocator attached to a darvic leg ring.

Results and outcomes

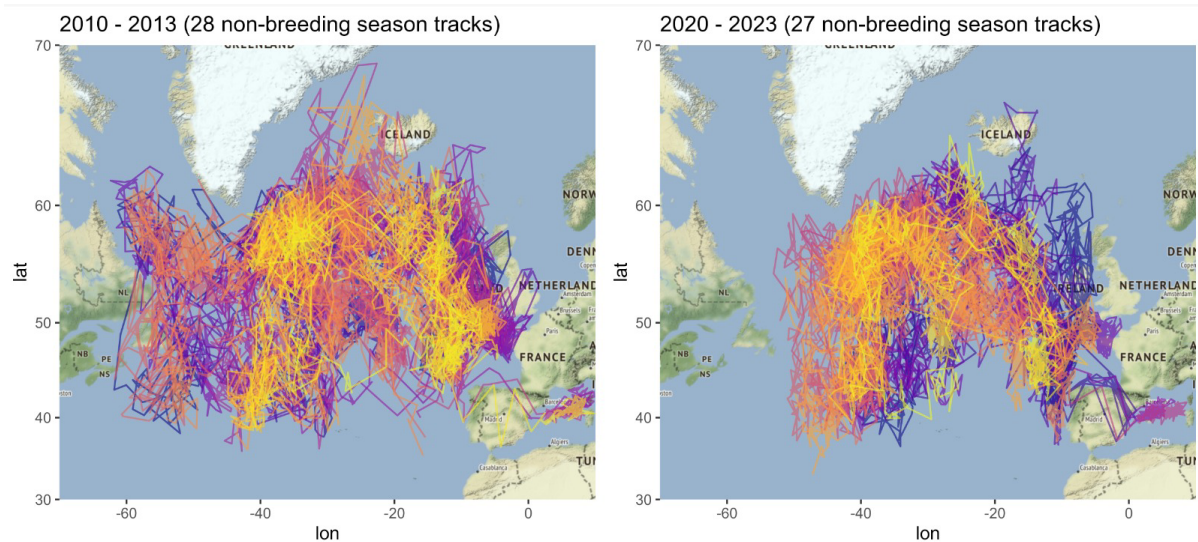
We collected fine-scale data on the movements and dive behaviour of 10 individuals in 2021 and 8 individuals in 2023 using GPS trackers which provide accurate locations ($\pm 10\text{m}$) every 5 minutes. GPS-tagged puffins travelled much further in 2021 (mean maximum distance from the colony = 33.2km) compared to 2023 (mean maximum distance from the colony = 5.6km). A difference between the years can also be observed in the diving behaviour of these individuals with more frequent but shallower dives in 2023 (mean depth of 10.6m) compared to 2021 (mean depth of 24.8m).

The reason for the difference in movement patterns between 2021 and 2023 is still unknown. The differences in breeding stage and the marine heatwave of 2023 could have played a role in this. These preliminary results highlight the importance of accounting for the highly dynamic aspect of Atlantic puffin foraging activity when designating MPAs.



GPS tracks of 10 puffins from Skellig Michael during the 2021 (left) and 2023 (right) breeding season. Each color represents one individual tracks. In 2021, their foraging range brings them far beyond the coverage of current MPAs.

Geolocator tags are only accurate to $\pm 200\text{km}$, but the year-round data provide broad scale information on migration routes and overwintering distribution. Data from tags successfully downloaded in 2021 and 2023, show an overwintering distributions across the North Atlantic between September-February, with hotspots southeast of Greenland in the autumn, and more widely in the east Atlantic in winter. The distribution is comparable to tracking data collected from Skellig Michael in 2010-2013, although there are suggestions the fewer individuals travelled all the way across the Atlantic to the eastern coast of North America than previously that warrants further investigation.



GLS tracks of puffins from Skellig Michael during the non-breeding season. The maps on the left show areas used by puffins in 2010-2013, on the right are the areas used in 2020-2023. Though the overall migration pattern has remained similar, there has been a noticeable shift in areas used between the two periods.

Future work

There are currently 37 puffins equipped with geolocators due to return to Skellig Michael next spring for the breeding season. We aim to retrieve most of these in summer 2024, and as in previous years, this could be achieved with a small team over a single weekend. We aim to collect additional GPS tracking data from puffins breeding on Skellig Michael to further our understanding into their foraging ranges and behaviours during the chick rearing stage. Further work is required to detect an effect of years on foraging hotspots and to increase sample sizes to better inform the Skellig Management Plan and aid designation of Marine Protected Areas for puffins.

Acknowledgements

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References

- Darby, J. H., Harris, M. P., Wanless, S., Quinn, J. L., Bråthen, V. S., Fayet, A. L., Clairbaux, M., Hart, T., Guilford, T., Freeman, R., & Jessopp, M. J. (2022). A new biologging approach reveals unique flightless molt strategies of Atlantic puffins. *Ecology and Evolution*, 12, e9579. <https://doi.org/10.1002/ece3.9579>
- Jones, H., Tershy, B., Zavaleta, E., Croll, D., Keitt, B., Finkelstein, M., & Howald, G. (2008). Severity of the Effects of Invasive Rats on Seabirds: A Global Review. *Conservation Biology : The Journal of the Society for Conservation Biology*, 22, 16–26. <https://doi.org/10.1111/j.1523-1739.2007.00859.x>
- Newton SF, Harris MP, Murray S (2015) Census of gannet *Morus bassanus* colonies in Ireland in 2013-2014. *Irish Birds* 10:215-220