Tracking Great Black-backed Gulls (*Larus marinus*)

A GPS transmitter study in relation to Hollandse Kust West offshore wind farm



C.
C. Eikenaar, R.C. Fijn
H.M. Madden, M. Helberg

WAARDEN BURG Ecology

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Waardenburg Ecology Varkensmarkt 9, 4101 CK Culemborg, +31 (0)345 512710
info@waardenburg.eco, www.waardenburg.eco



Preface

This report stems from a contractual agreement between Ecowende CV and Waardenburg Ecology to provide services in relation to Hollandse Kust West wind farm.

Waardenburg Ecology was contracted to undertake ecological research on Great Black-backed Gulls as a sub-project of the wider ecological goals of Hollandse Kust West. This involves deploying GPS transmitters on adult gulls, analysing data, and producing reports for Ecowende. Waardenburg Ecology sub-contracted BirdLife Norway to assist with fieldwork, permit applications, and logistics in Norway.

The Waardenburg Ecology project team comprised Hannah Madden, Ruben Fijn, Cas Eikenaar and Rob van Bemmelen (Bird Ecology department). Fieldwork was carried out by Ruben Fijn and Cas Eikenaar (Waardenburg Ecology), Morten Helberg (BirdLife Norway) and Eldina Saldanoviç (Ecowende).



Summary

In 2022, Ecowende was granted permission to build an offshore wind farm in the Dutch North Sea named Hollandse Kust West (HKW). This wind farm has groundbreaking mitigation goals relating to the ecological effects of wind farms and serves as a prime location for research to assess whether the ecological effects of future wind farms can be reduced. One of the knowledge gaps relating to the potential effects of operational wind farms on birds that was identified during the tender phase of HKW relates to great black-backed gull collision and displacement. This is due to an absence of fundamental knowledge of great black-backed gull spatial and foraging ecology in the North Sea.

Filling this knowledge gap by GPS-tracking individual birds is one of the projects that falls under the ecological research program of HKW. The study at hand forms the first year of this project, which will track great black-backed gulls over multiple years, both prior to and following construction of the wind farm.

The GPS transmitters deployed during this first study year are performing well and are providing a wealth of spatial data. Thanks to these data, we have identified a core foraging area of the gulls breeding in our study area, information that may be useful for the wider protection of this declining species. Importantly, and in contrast to previous studies, we did not observe a negative effect of deployment of GPS transmitters on the gulls' breeding performance; equal numbers of chicks fledged from nests where one of the parents was equipped with a GPS transmitter and from nests where no parent carried a GPS transmitter. With these promising first results, we are confident that we will collect reliable long-term data, as well as detailed, broad scale information about distribution, habitat choice and (foraging) behaviour of great black-backed gulls in the North Sea.

Based on the data collected during the breeding period in 2024, two scientific articles will be prepared: one focusing on foraging preferences, and the second on flight heights.



Nederlandse samenvatting

In 2022 heeft Ecowende toestemming gekregen voor de bouw van Hollandse Kust West (HKW), een windpark in de Nederlandse Noordzee. HKW heeft baanbrekende mitigatiedoelen met betrekking tot de ecologische effecten van windparken. Daarnaast wordt in HKW onderzocht hoe de negatieve ecologische effecten van toekomstige windparken beperkt kunnen worden. Eén van de kennisleemtes over mogelijke effecten op vogels, aan het licht gekomen tijdens de tenderfase van HKW, gaat over de aanvaringsrisico's en het uitwijkgedrag van grote mantelmeeuwen in windparken. Deze kennisleemte bestaat, omdat er een gebrek is aan fundamentele kennis van de ruimtelijke- en foerageer-ecologie van grote mantelmeeuwen in de Noordzee.

Het dichten van deze kennisleemte door middel van GPS-tracking van individuele vogels is een van de projecten binnen het ecologische onderzoeksprogramma van HKW. Voorliggende studie gaat over het eerste jaar van dit project, waarin grote mantelmeeuwen over meerdere jaren gevolgd zullen worden, zowel voor als na de bouw van HKW.

De GPS-zenders die we dit eerste studiejaar hebben ingezet werken uitstekend en verzamelen een schat aan ruimtelijke data. Zo hebben we, bijvoorbeeld, het belangrijkste foerageergebied kunnen bepalen van de grote mantelmeeuwen uit ons studiegebied, informatie die gebruikt kan worden bij de bescherming van deze afnemende soort. In tegenstelling tot eerdere studies vonden wij geen negatief effect van de GPS-zenders op het broedsucces van de meeuwen; het aantal uitgevlogen jongen was even groot voor vogels met een zender als voor (controle) vogels zonder een zender. Met deze veelbelovende eerste resultaten hebben we goede hoop dat we betrouwbare lange-termijn data kunnen verzamelen over de verspreiding, de habitatkeuze en het (foerageer) gedrag van grote mantelmeeuwen in de Noordzee.



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1 Introduction

1.1 Background and aim

The great black-backed gull (*Larus marinus*) is a generalist seabird that breeds along the temperate and arctic coasts of the northern Atlantic Ocean. Globally, the species has been declining by 1.2 - 1.3% per year over the last decades (Lopez et al. 2023). This is concerning, especially since the great black-backed gull is among those seabird species identified as vulnerable to collision with wind turbines in offshore wind farms (OWFs; Buij et al. 2018; Potiek et al. 2019a). The coming decades will see a boost in the construction of OWFs in the North Sea, a potentially important habitat for great black-backed gulls. Resightings of (colour) leg rings and counts from aerial and ship surveys confirm that great black-backed gulls use the North Sea during migration and as a wintering ground (Potiek et al. 2019b; Duijns et al. 2020; SOVON 2023). The first 100 km from the Dutch and Belgian coastlines appear to be an especially important wintering ground for this species (Potiek et al. 2019b). One great black-backed gull, fitted with a GPS transmitter, was observed migrating over the North Sea (see Gyimesi et al. 2017). Borrmann et al. (2019) tracked seven individuals breeding on Foehr, a small island in northern Germany. The tracking, however, was limited to the breeding season and, consequently, all trips were short and did not extend beyond 10 km from the colony. Thus knowledge gaps remain regarding the spatial and foraging ecology of great black-backed gulls in the North Sea.

Recently (2021), the ‘Brown Bank’, a shallow food-rich area within the 100 km zone of the North Sea, was assigned Natura 2000 status, partly based on the (winter) occurrence of great black-backed gulls (García et al. 2019). Yet, information on great black-backed gulls’ spatial and foraging ecology in the North Sea is sparse. Ecowende, a joint venture of Shell, Eneco and Chubu Electric Power, will construct an OWF (Hollandse Kust West, HKW) some 50 km from the Dutch North Sea coast, in close proximity to the Brown Bank. As part of Ecowende’s research and monitoring plan, Waardenburg Ecology will research the spatio-temporal occurrence of great black-backed gulls in the North Sea - and HKW specifically. This will be achieved by deploying GPS transmitters on 25 individual gulls per year in 2024 and 2025 (pre-construction of HKW), and in 2027 and 2028 (post-construction).

In this progress report, we describe the activities completed during the first field season (2024). We also present the preliminary tracks and foraging preferences of the gulls during the breeding season, and the results of 2024 breeding success.



2 Materials and methods

2.1 Capture and GPS deployment

From 26 - 30 May 2024, a team from Waardenburg Ecology, consisting of bird ecologists Ruben Fijn and Cas Eikenaar, visited Norway to conduct fieldwork. Local assistance and expertise was provided by Morten Helberg of BirdLife Norway. Eldina Salkanoviç, ecologist from Ecowende, also participated in fieldwork activities.

Twenty-five adult great black-backed gulls were caught on their nests using walk-in traps, which were placed over suitable nests based on information collected leading up to fieldworkFigure 2.11). When the bird returned to its nest to incubate eggs or shelter chicks, it hit a string above the nest, triggering the hinged door to close behind it. After this, the bird typically relaxed and continues incubating (Figure 2.2). We targeted nests that were close to hatching or with freshly hatched chicks, thereby increasing the chance of success and reducing the risk of nest abandonment. All birds were caught on small islands in the Tregde archipelago, located in the most southern part of Norway (58° 01' N, 7°56' E). This area was selected based on the numerous sightings of great black-backed gulls originating from this area in the (Dutch) North Sea outside the breeding season (Duijns et al. 2019).



Figure 2.1 *A walk-in trap placed above the nest of a great black-backed gull. When the bird returns to the nest to incubate the eggs or shelter the chicks, it will hit a string above the nest, triggering the hinged door to close. After this, it typically relaxes and continues incubation, see Figure 2.2.*



Figure 2.2 A great black-backed gull incubating while in a walk-in trap.

Upon capture, the birds were placed in a bag to reduce stress and taken to an appropriate location for biometric data collection. Individuals were measured (wing, head-bill, tarsus and body mass) and received a unique metal and colour-ring on the (left/right) tarsus (as part of BirdLife Norway's ongoing ringing programme). Birds were sexed based on sexual size dimorphism in the wing and head. Per nest, only one member of the pair was captured.

After ringing, the birds were fitted with a OrniTrack-15 4GT GPS transmitter (Ornitela, Lithuania), weighing 15 g. Transmitters were attached using a Teflon ribbon leg-loop harness, weighing circa 0.5 g (Figure 2.3). The body mass of the gulls ranged from 1,370-1,940 g, meaning that the relative load of the transmitters plus harness was 0.8 – 1.1% of the bird's mass, far below the suggested permissible load limit of 3% (Philips et al. 2003).



Figure 2.3 *A GPS transmitter with the leg-loop harness (left) and a great black-backed gull flying with a transmitter on its back (right). Photo: Ruben Fijn.*

During the breeding season, the transmitters were set to record a GPS position every three minutes. At every GPS fix, flight altitude, speed and direction, and accelerometer data were logged. The latter were used during analysis to classify the birds' behaviour as transit, stationary or foraging. GPS data were uploaded via the GSM network twice a day. The frequency of GPS positioning was incrementally lowered when battery levels dropped to 75%, 50% or 25%. Outside the breeding season, the GPS settings will remain the same until a bird reaches the HKW concession area, or one of three other pre-defined areas in the North Sea, incorporating other OWFs. Here, GPS fixes will be made every 30 seconds, battery dependent. This should result in high resolution tracking data from great black-backed gulls in HKW and other North Sea OWFs.

To assess whether capture and deployment of a harness with GPS affected the gulls' breeding success, nests were monitored from 24-28 June and the number of (near fledging) chicks documented. If present, chicks were ringed as part of BirdLife Norway's ongoing ringing programme. Monitoring was performed on nests where one parent was fitted with a GPS transmitter, and on a same number of nests where no GPS devices were deployed (control nests).



3 Results

3.1 Deployment overview and nest success

All 25 (18 females and 7 males) gulls caught were adults (> 5 years old). Seven gulls were re-captures, which were ringed as chicks in the study area 7 - 16 years ago.

Table 3.1 presents the identity (colour ring) and sex of the individuals fitted with a GPS transmitter, as well as clutch size at the time of capture and the number of fledglings ringed later in the season. Mean clutch size was 2.64 (SD ± 0.57). Of the 25 birds with transmitters, five failed to produce fledglings. Including these five birds, mean fledging rate was 1.52 ± 1.01. Of the 25 control nests, eight failed to produce fledglings. Including these eight birds, mean fledgling rate was 1.48 ± 1.19.

Table 3.1 *The identity (colour ring), sex, clutch size at capture and number of fledglings ringed of the greater black-backed gulls fitted with a GPS transmitter. In a few cases, freshly hatched chicks were present in the nest when the parent was caught. These are included in clutch size.*

Bird /transmitter ID	Sex	Clutch size	Fledglings
J51HE/243282	Female	3	1
J52HE/243262	Female	3	0
J53HE/243266	Female	3	2
J54HE/243276	Male	3	2
J55HE/243269	Male	3	2
J56HE/243272	Female	3	1
J57HE/243264	Female	2	2
J58HE/243277	Female	1	1
J59HE/243281	Female	3	3
J61HE/243279	Female	3	2
J63HE/243259	Female	2	0
J64HE/243268	Male	2	0
J65HE/243283	Female	3	3
J66HE/243274	Female	3	3
J67HE/243265	Female	3	1

Bird /transmitter ID	Sex	Clutch size	Fledglings
J68HE/243275	Female	2	2
J69HE/243271	Male	2	0
J70HE/243278	Female	3	2
J71HE/243261	Male	3	1
J72HE/243280	Female	3	1
J73HE/243273	Female	3	2
J74HE/243270	Male	3	3
J75HE/243260	Female	3	2
J76HE/243263	Female	2	2
JR165/243267	Male	2	0

Since deployment, the transmitters have been performing satisfactorily and collected a large amount of spatio-temporal data. At the time of writing, one transmitter (ID 243278) stopped sending data on June 12th; this bird also experienced nest failure (Table 3.1). The last data upload from transmitter 243270 was August 14th; either the bird died or the device fell off and is lying on a beach in Røsnæs, Denmark. Similarly, transmitter 243263 last transmitted data on August 23rd and its last GPS location was Agger beach, Denmark. We are unable to confirm the fate of these birds.

Figure 3.1 shows all trips recorded during late incubation and chick rearing, separated into three behavioural states (stationary, transit and foraging). A foraging trip was defined as a bird being away from the nest site for at least 20 minutes at a minimum distance of 500 m from the nest. The GPS fixes along the coast of Denmark are from a bird that produced no fledglings. We assume this bird's nesting attempt failed sometime early in the chick-rearing period.

While the majority of trips occurred at sea (Figure 3.1), some individuals (transmitter ID 243262, 243277; Appendix I) also made inland trips to freshwater bodies, such as lake Dybovann and river Mandalselva, presumably to wash and preen. Other gulls (transmitter ID 243279, 243277, 243272, 243270; Appendix I) regularly visited the Støleheia waste facility located approximately 30 km north-east of the colony (Appendix I). This is a common practice among many gull species, since landfills offer a stable source of food (Coulson et al. 1987). Two gulls (transmitter ID 243280, 243265; Appendix I) remained entirely in the vicinity of the colony, never venturing further than 10 km, as did 243278 (Appendix I), however this transmitter only collected two weeks' worth of data.

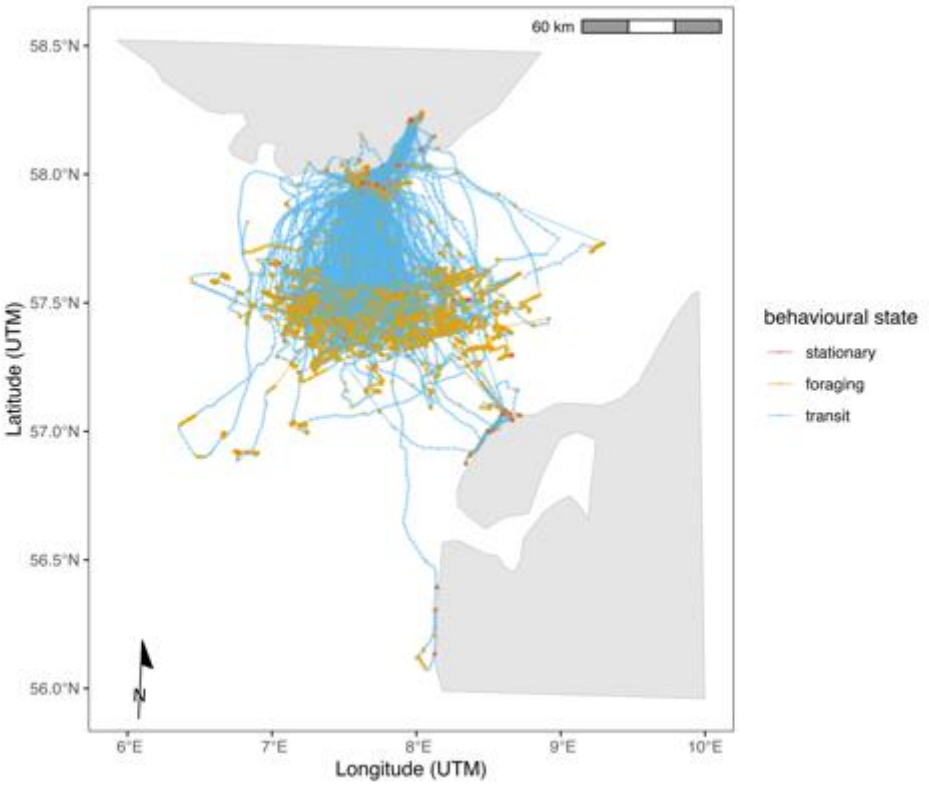


Figure 3.1 *GPS positions of great black-backed gulls (n = 25), recorded from 27 May – 31 July 2024. GPS fixes were collected every 3 minutes. Grey areas are the southern coast of Norway, where the gulls breed, and the north-western region of Denmark. Orange dots represent GPS fixes at which time the bird was foraging, blue dots represent flying, i.e. birds in transit between the breeding and foraging areas, and red dots show where the birds were stationary.*

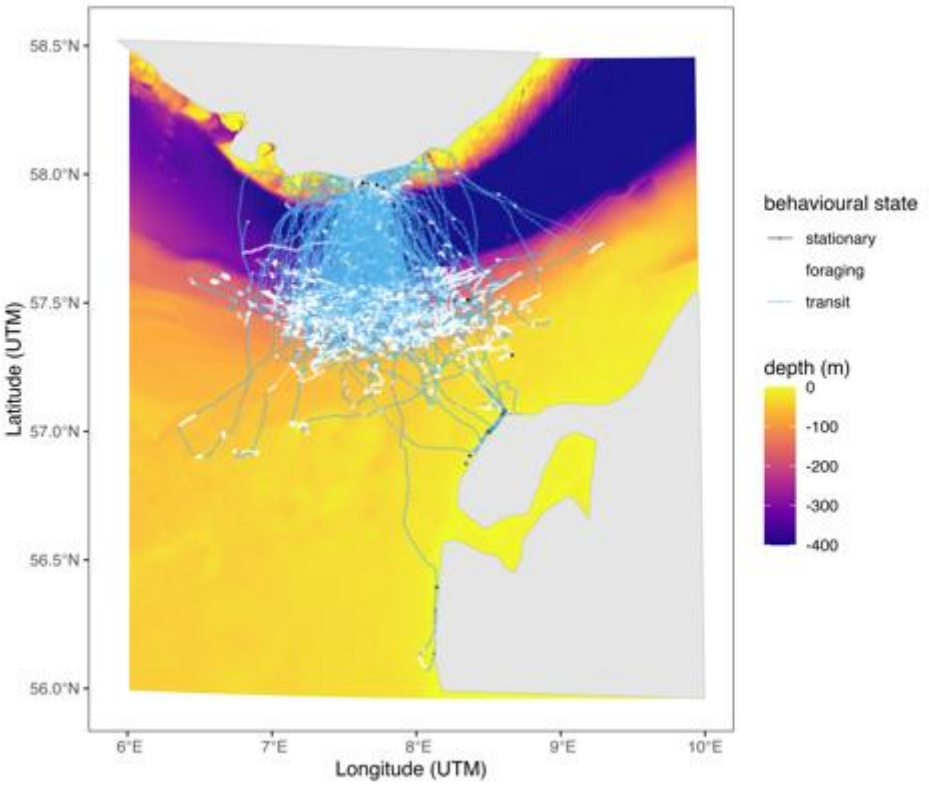


Figure 3.2 *GPS positions of great black-backed gulls (n = 25), recorded from 27 May – 31 July 2024. GPS fixes were collected every 3 minutes. Grey areas are the southern coast of Norway, where the gulls breed, and the north-western region of Denmark. White dots represent GPS fixes at which time the bird was foraging, blue dots represent flying, i.e. birds in transit between the breeding and foraging areas, and black dots show where the birds were stationary. The colour scale represents sea depth (yellow = 0 m; purple = -400 m).*

Based on preliminary data analysis from the breeding period, the tagged great black-backed gulls travel over an area of deeper water to preferentially forage in a marine habitat approximately 50-70 km to the south of the nesting area (Figure 3.2). This area is characterized by high variation in sea depth, whereby the associated upwelling likely results in an abundance of marine prey. While no primary productivity data were available from this area, upwellings contain higher concentrations of chlorophyll-*a* and thus a higher abundance of prey items (Paiva et al. 2010) for great black-backed gulls. The tagged birds were able to exploit this food-rich area to feed themselves and their chicks, meaning they did not have to forage too far from the colony.

Appendix I contains tracking maps of all 25 GPS-tagged great black-backed gulls from this study.



4 Discussion

In this progress report, we show that the GPS transmitters deployed during the 2024 breeding season are performing well and providing a wealth of spatial data. Thanks to these data, we have identified a core foraging area of 25 gulls breeding in the Tregde area, information that may be useful for the wider protection of this declining species. Regarding the goal of the current study, the transmitters will help identify where great black-backed gulls migrate to after departing the breeding area, which for this species is largely unknown. The transmitters will provide crucial long-term year-round information, for example whether great black-backed gulls from Norway migrate over the North Sea and, if so, whether they avoid existing OWFs or travel through them. The transmitters also provide information on flight altitude, crucial for assessing avoidance and the risk of collision with turbine blades. In addition, the transmitters will provide information about where the birds spend the winter, whether they travel to and stay in the same location or disperse to other areas. One aim of this current project is to examine whether great black-backed gulls migrate through and/or overwinter in the concession zone of HKW. We will be able to answer this once additional data have been collected over the coming months and years.

Comparative studies have reported great black-backed gulls being sensitive to harness-mounted GPS transmitters. Maynard et al. (2022) deployed GPS transmitters on eight great black-backed gulls using a leg-loop harness and reported breeding failure in six of these. Similarly, Lopez *et al.* (2024) fitted 11 great black-backed gulls with a GPS transmitter using thoracic (wing) harnesses and reported reduced hatching success compared with control birds. Bormann et al. (2019), however, reported no negative effects of body harness GPS transmitters on the reproductive success of seven birds caught during early incubation. Although our study was not designed to test for negative effects on reproduction of carrying a GPS transmitter, we have no reason to believe that it did. The mean number of fledglings produced in nests from birds carrying a GPS transmitter was 1.52, which is almost identical to the 1.48 fledglings produced in control nests. While we agree with Lopez et al. (2024) that extreme caution should be taken when using harnesses on great black-backed gulls (or any other avian species), our study shows that it is possible on this species without negatively affecting breeding performance.



Provided sufficient data about the gulls' migration routes and wintering locations are collected in 2024-2025, we may shift our focus in the next (2025) season from Tregde to a different breeding area in Norway. Studying birds from a different breeding area will provide better overall insight into the use of the North Sea by great black-backed gulls from a wider proportion and geographic spread of the population. Moreover, the number of accessible breeding pairs in Tredge is limited and trapping the partners of the birds caught in this breeding season will be difficult because of 'trap wariness'. Hence. it could be challenging to trap another (different) 25 great black-backed gulls. We are currently investigating potential sites with sufficient breeding pairs further north in Norway. (In the post-HKW construction study years (2027-2028), we plan to return to Tredge as by then the trap wariness will likely have worn off and new breeding birds settled).



5 Conclusions and recommendations

To conclude, GPS deployment using leg-loop harnesses did not adversely affect great black-backed gull breeding performance, and the transmitters are collecting fine-scale spatial data that will continue to provide detailed information about the birds' movements in the months and (hopefully) years to come. All 2024 fieldwork was completed according to the Execution Plan and can be considered successful. We recommend continuing with leg-loop harnesses in 2025, provided the permit allows and we can demonstrate to the Norwegian ethics committee that this project did not lead to negative effects on the tagged individuals.

At the time of writing (September 2024), some birds already departed the breeding area and migrated further south, whereas others remain in Norway. We will continue to monitor the GPS transmitters for battery life, as well as the live maps that show the birds' locations. All raw tracking data are uploaded remotely via the GSM network to Ornitela's web portal, which are downloaded in CSV format and backed up monthly on Waardenburg Ecology's internal server until Ecowende's environmental data repository is operational.

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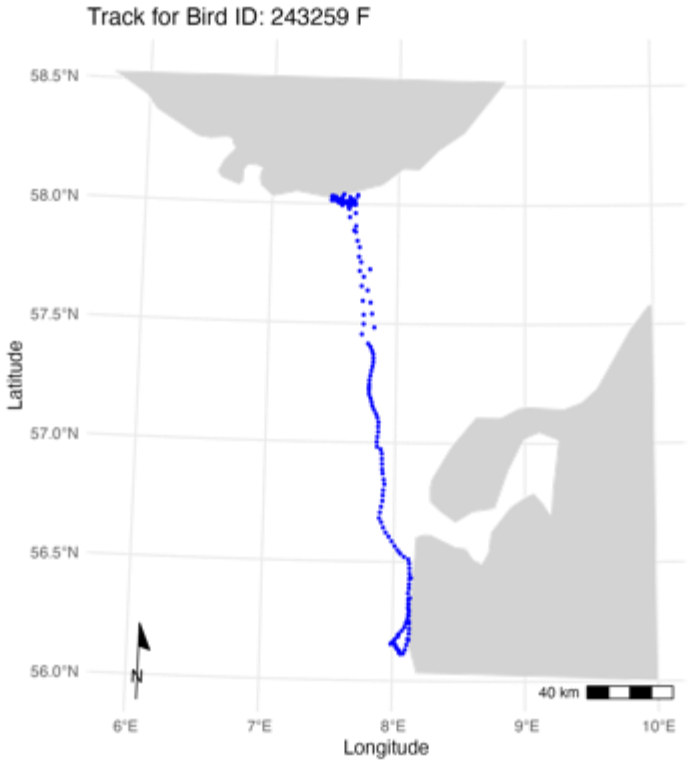
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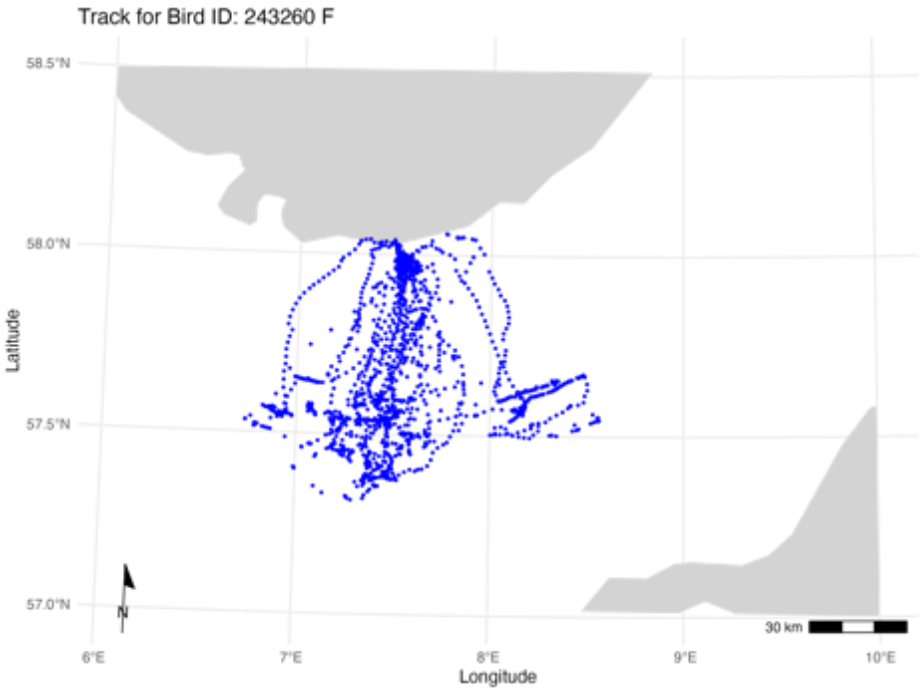
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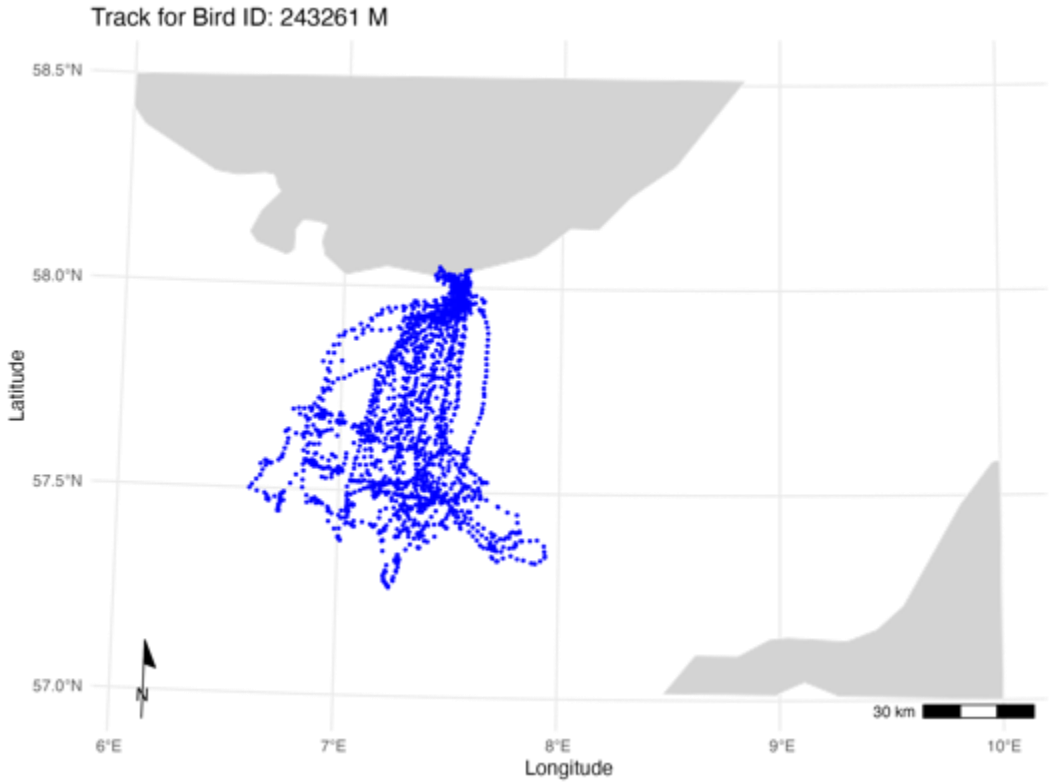
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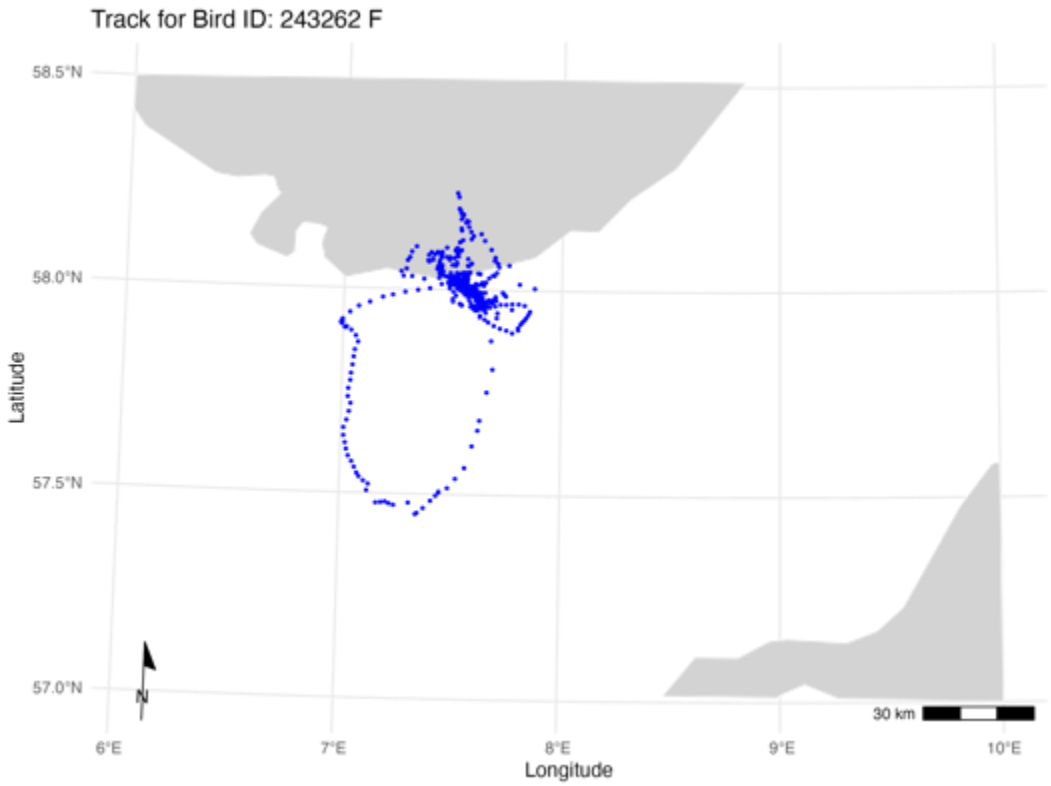
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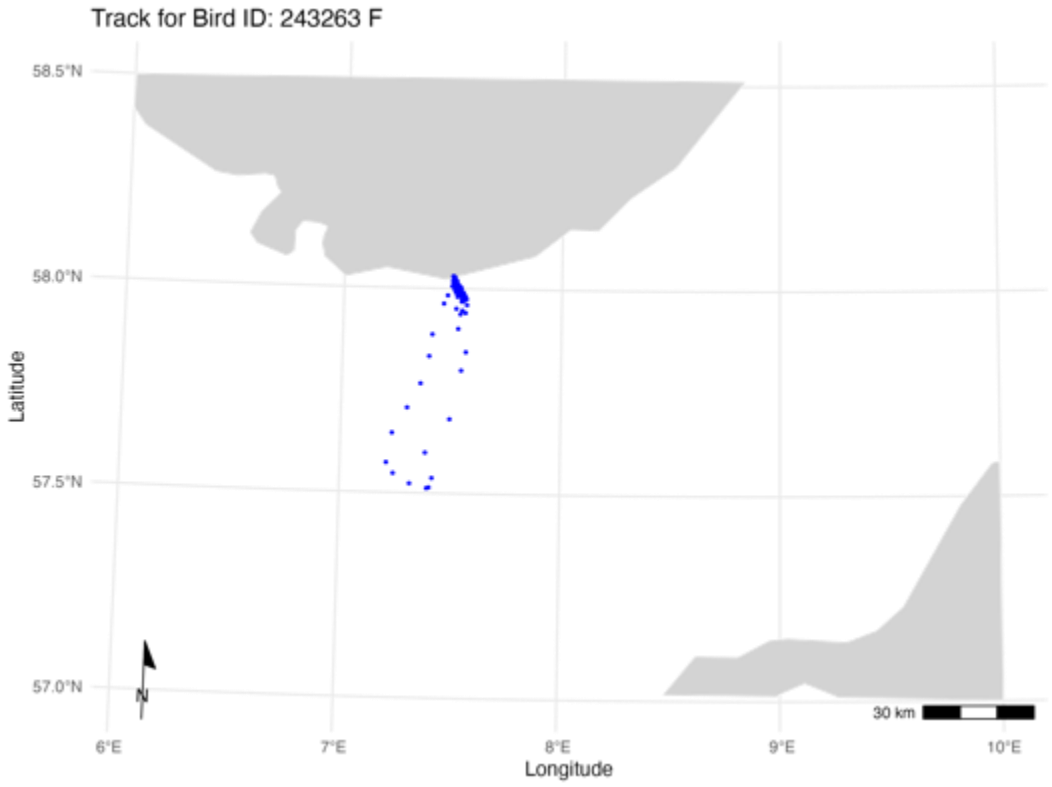
Maps showing individual tracks of GPS-tagged great black-backed gulls from the Tregde nesting site in Norway between 27 May and 31 July 2024.

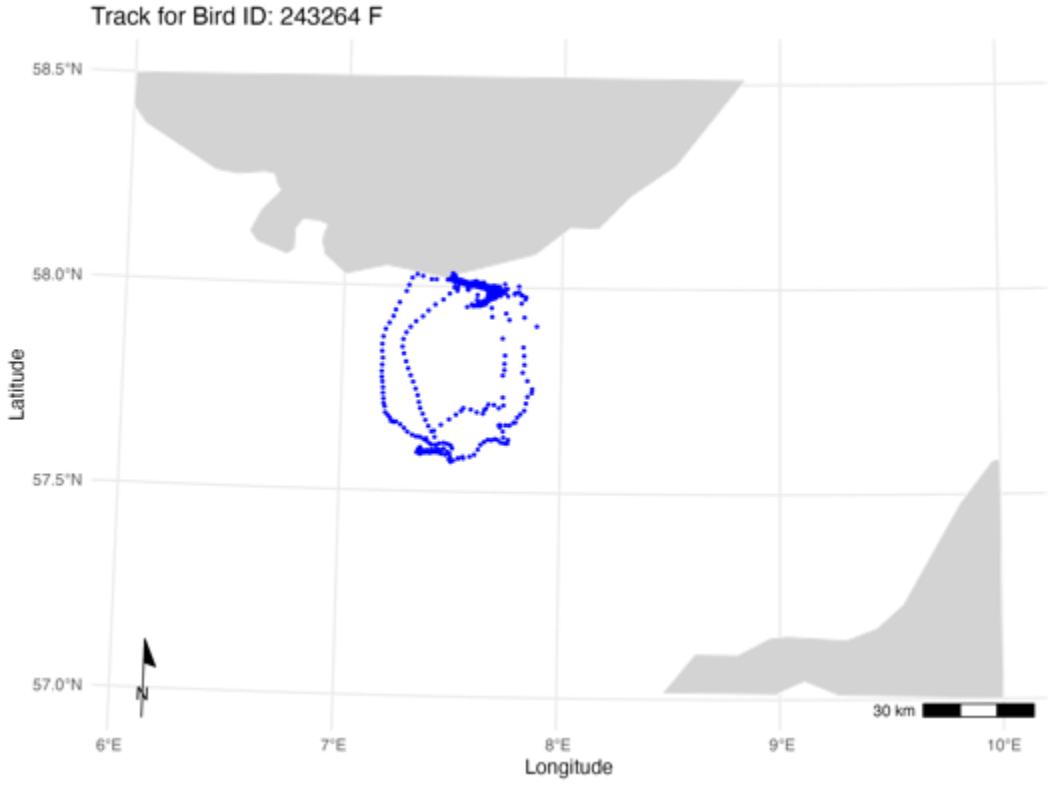


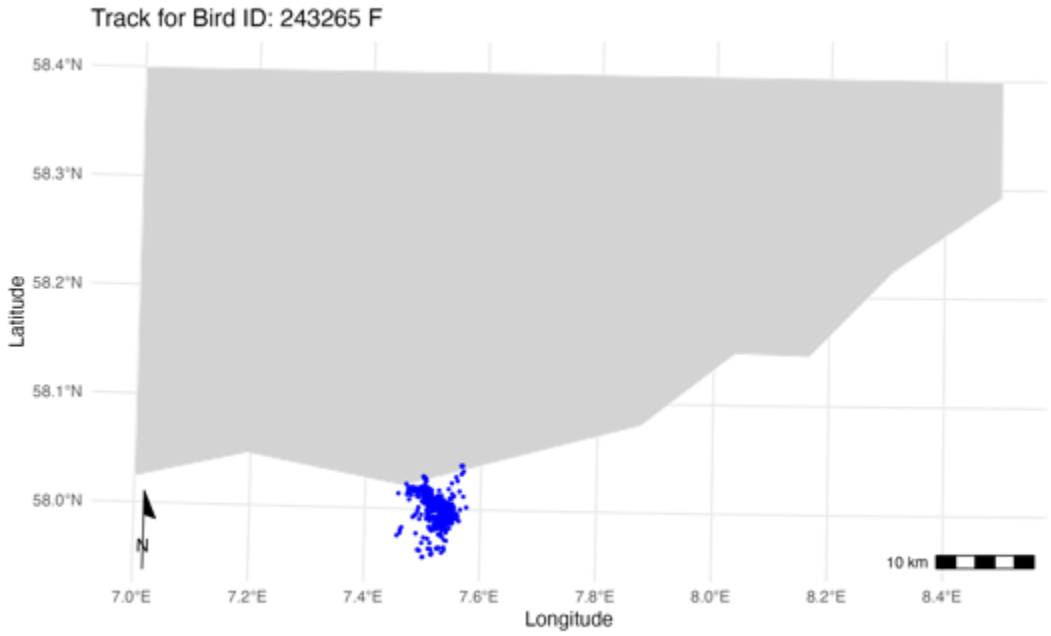


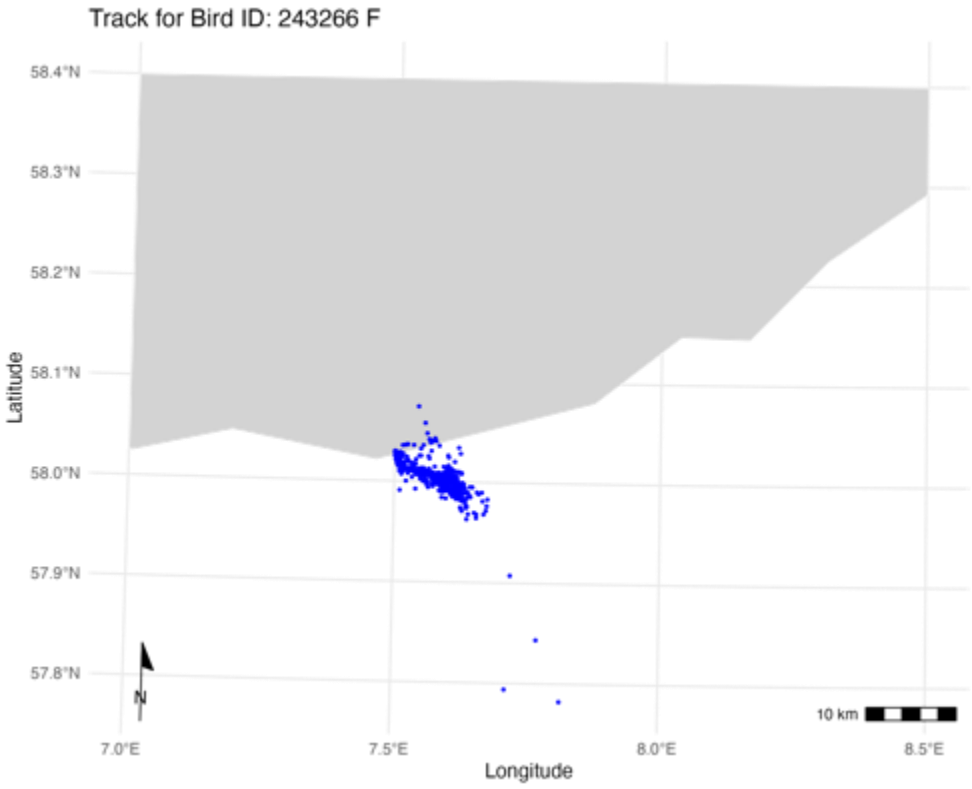

Track for Bird ID: 243261 M
58.5°N
58.0°N
57.5°N
57.0°N
Latitude
6°E
7°E
8°E
9°E
10°E
Longitude
N
30 km

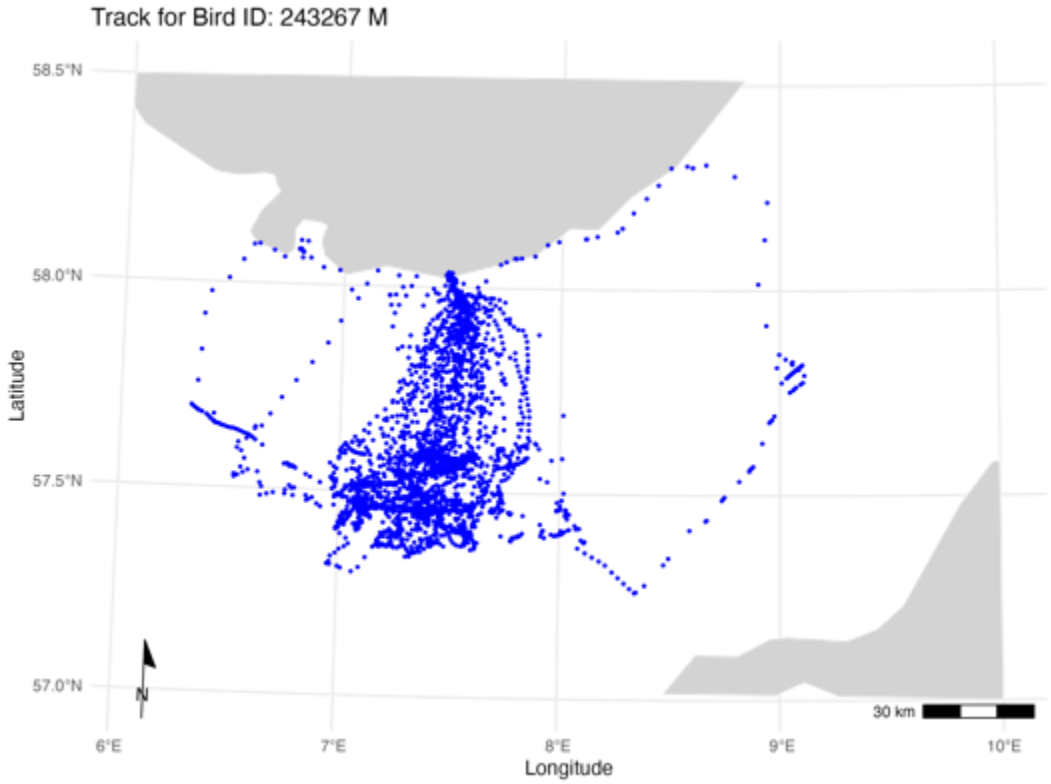

Track for Bird ID: 243262 F
58.5°N
58.0°N
57.5°N
57.0°N
Latitude
6°E
7°E
8°E
9°E
10°E
Longitude
N
30 km

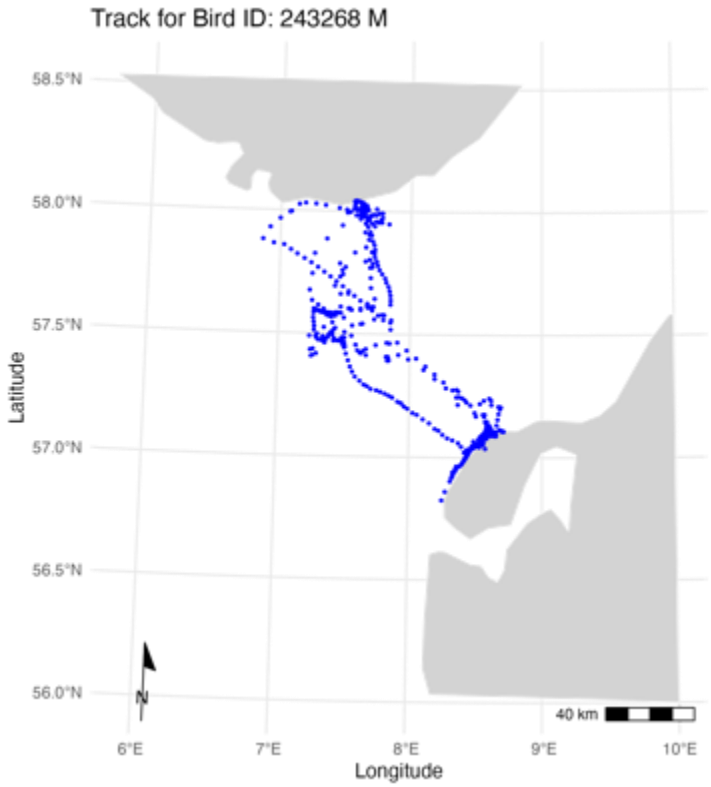

Track for Bird ID: 243263 F
58.5°N
58.0°N
57.5°N
57.0°N
Latitude
N
30 km
6°E
7°E
8°E
9°E
10°E
Longitude

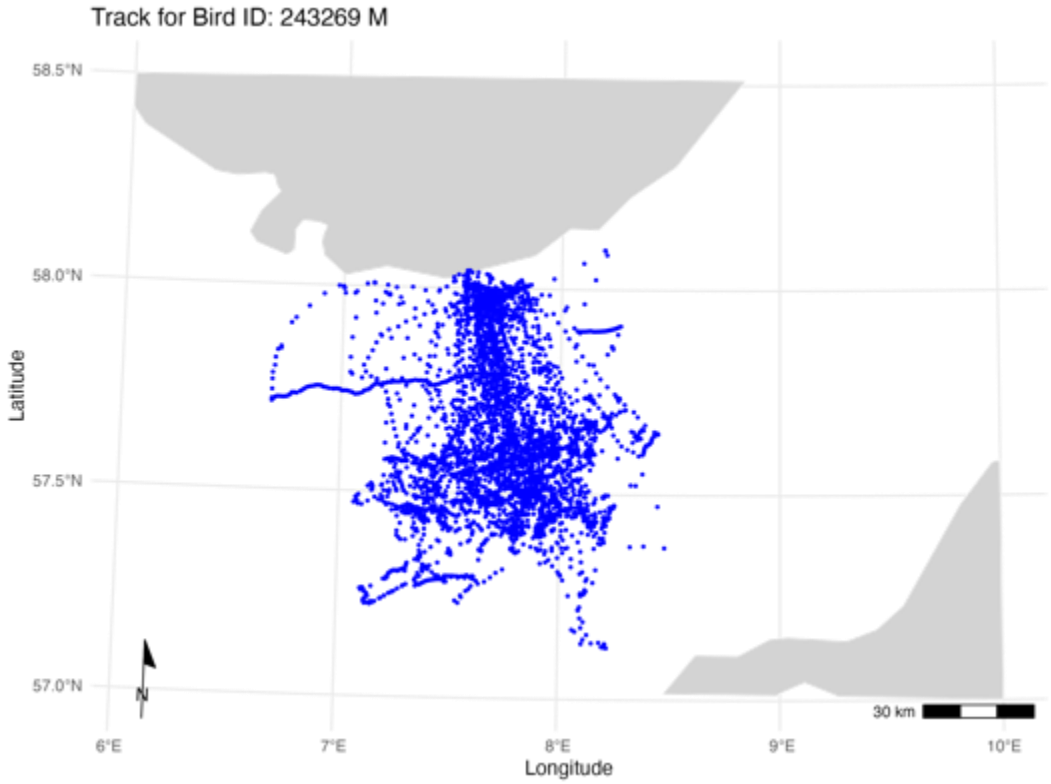

Track for Bird ID: 243264 F
58.5°N
58.0°N
57.5°N
57.0°N
Latitude
N
30 km
6°E
7°E
8°E
9°E
10°E
Longitude

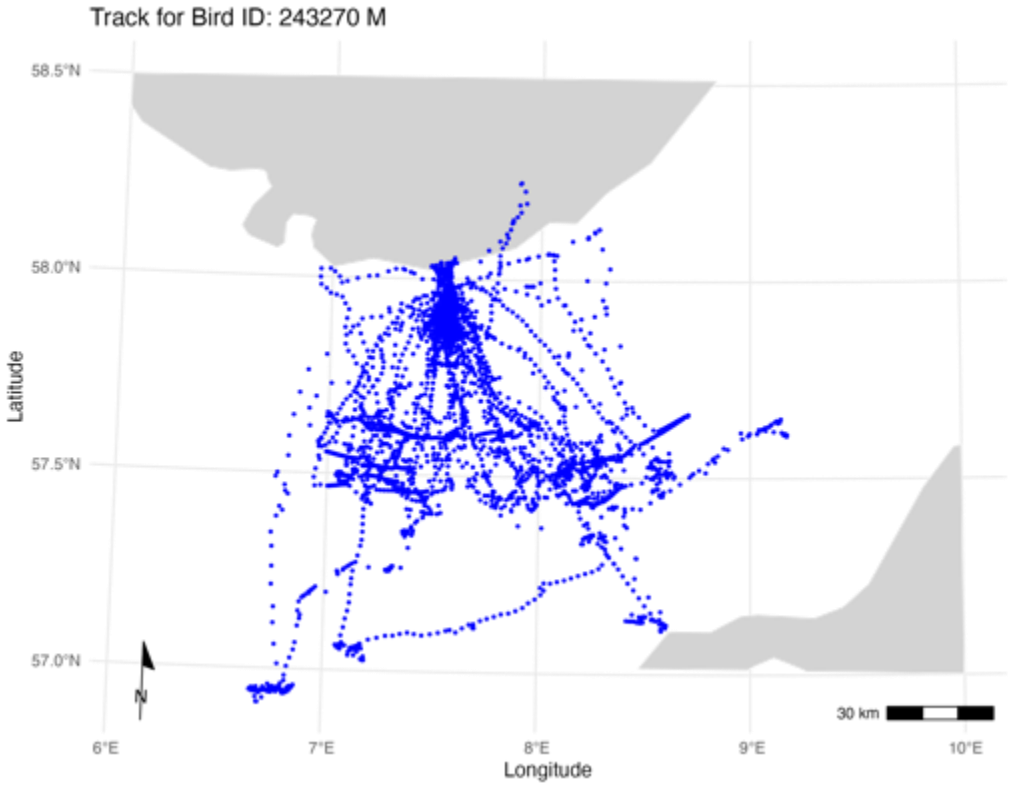

Track for Bird ID: 243265 F
58.4°N
58.3°N
58.2°N
58.1°N
58.0°N
Latitude
N
10 km
7.0°E
7.2°E
7.4°E
7.6°E
7.8°E
8.0°E
8.2°E
8.4°E
Longitude

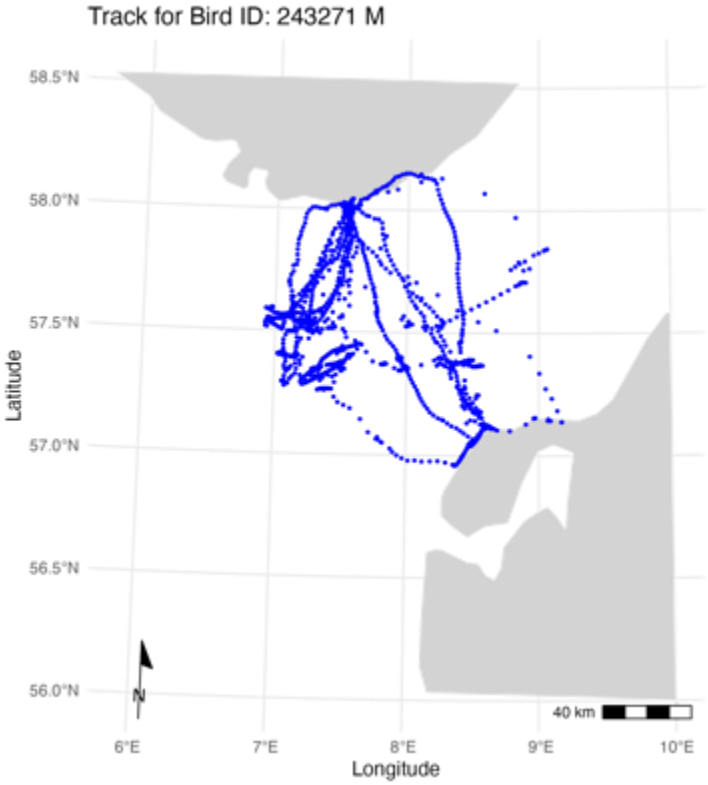

Track for Bird ID: 243266 F
58.4°N
58.3°N
58.2°N
58.1°N
58.0°N
57.9°N
57.8°N
Latitude
N
10 km
7.0°E
7.5°E
8.0°E
8.5°E
Longitude

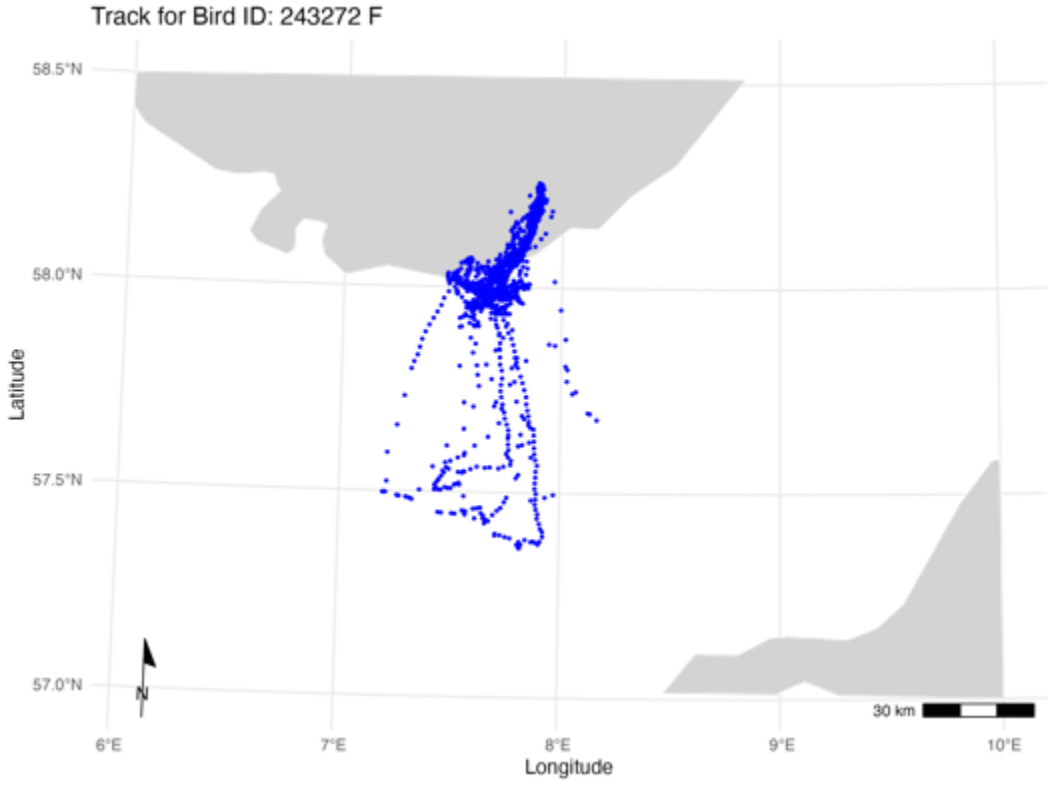

Track for Bird ID: 243267 M
58.5°N
58.0°N
57.5°N
57.0°N
Latitude
6°E
7°E
8°E
9°E
10°E
Longitude
N
30 km

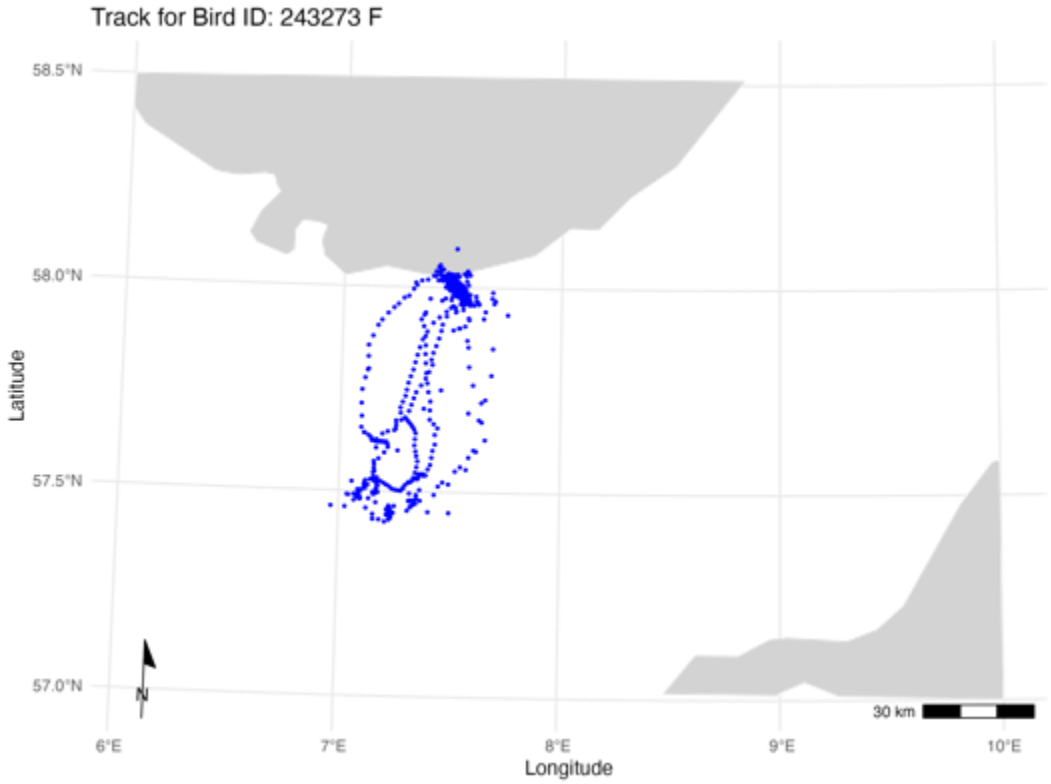

Track for Bird ID: 243268 M
58.5°N
58.0°N
57.5°N
57.0°N
56.5°N
56.0°N
Latitude
6°E
7°E
8°E
9°E
10°E
Longitude
N
40 km

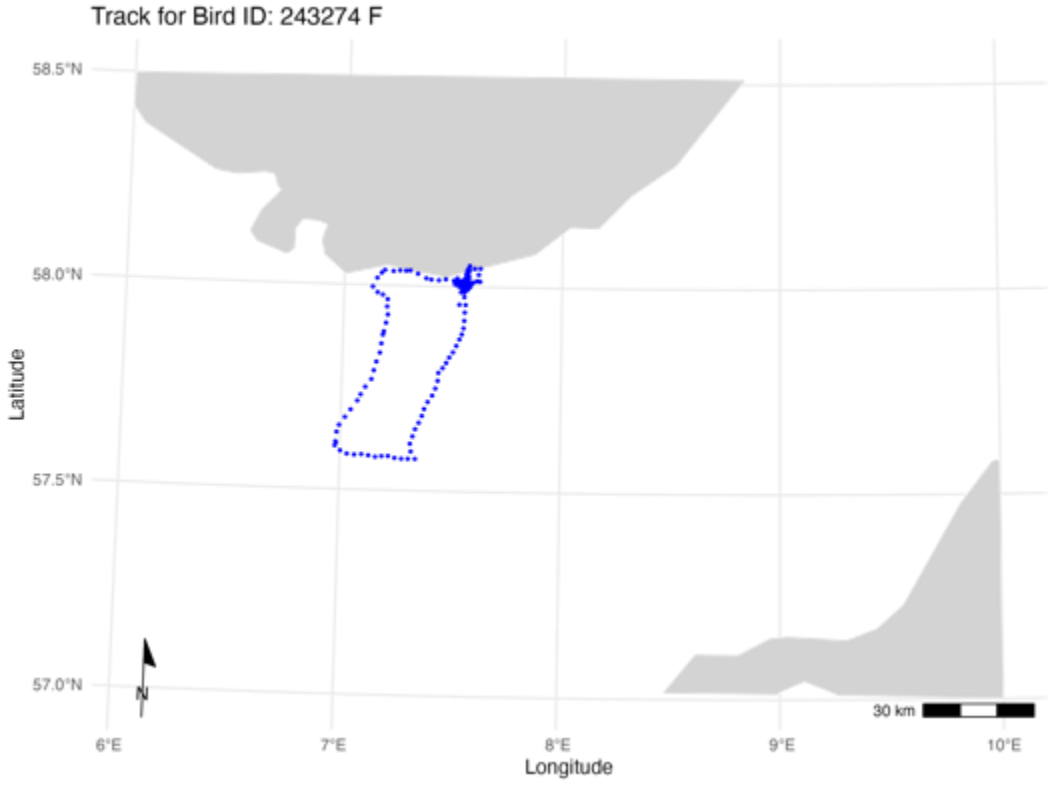

Track for Bird ID: 243269 M
58.5°N
58.0°N
57.5°N
57.0°N
Latitude
N
30 km
6°E
7°E
8°E
9°E
10°E
Longitude

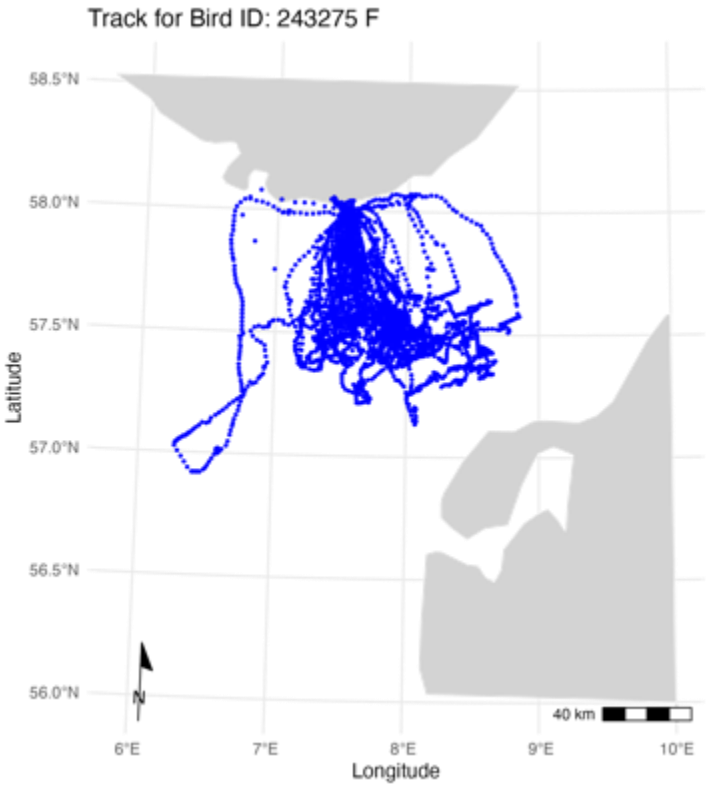

Track for Bird ID: 243270 M
58.5°N
58.0°N
57.5°N
57.0°N
Latitude
N
30 km
6°E
7°E
8°E
9°E
10°E
Longitude

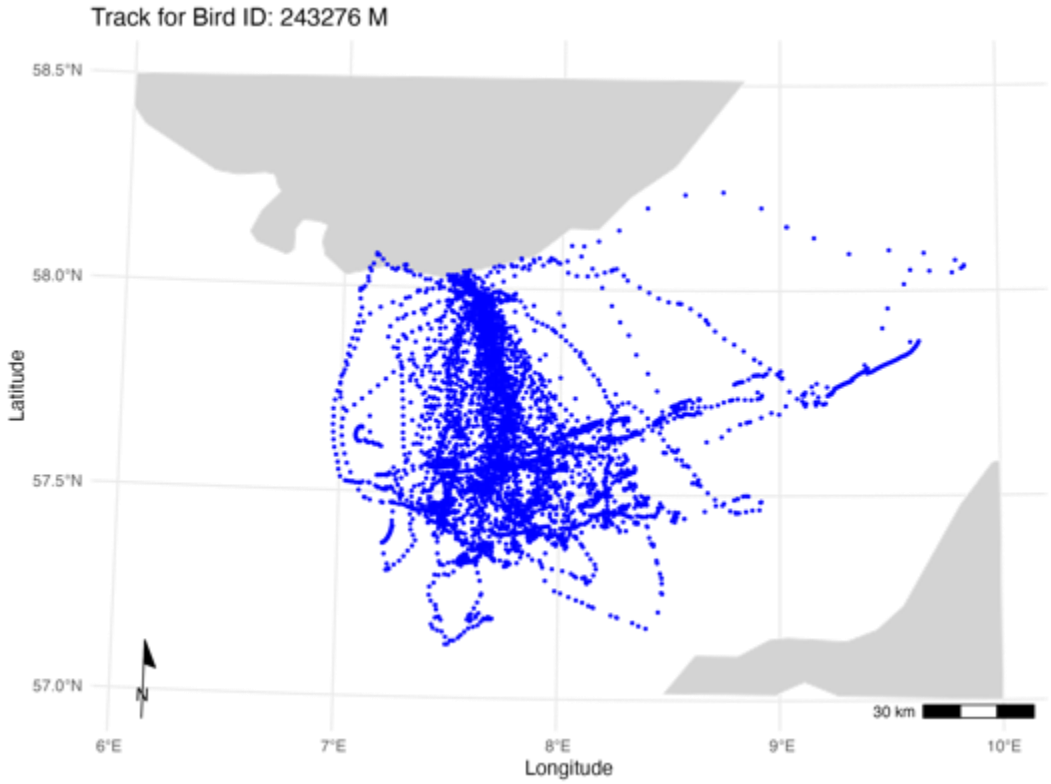

Track for Bird ID: 243271 M
58.5°N
58.0°N
57.5°N
57.0°N
56.5°N
56.0°N
Latitude
N
40 km
6°E
7°E
8°E
9°E
10°E
Longitude

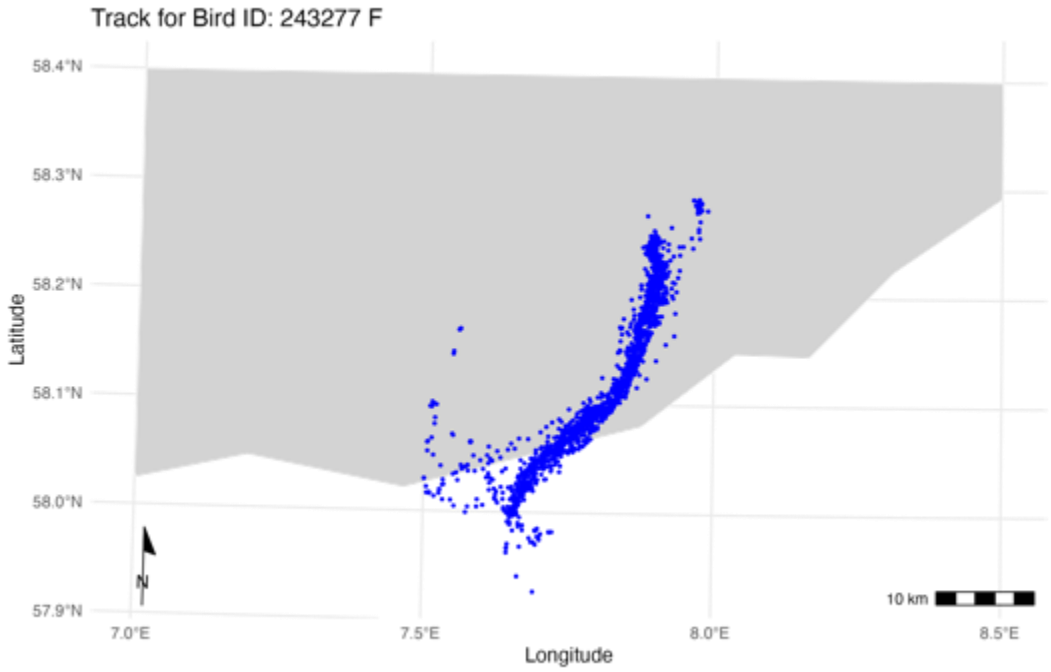

Track for Bird ID: 243272 F
58.5°N
58.0°N
57.5°N
57.0°N
Latitude
N
30 km
6°E
7°E
8°E
9°E
10°E
Longitude

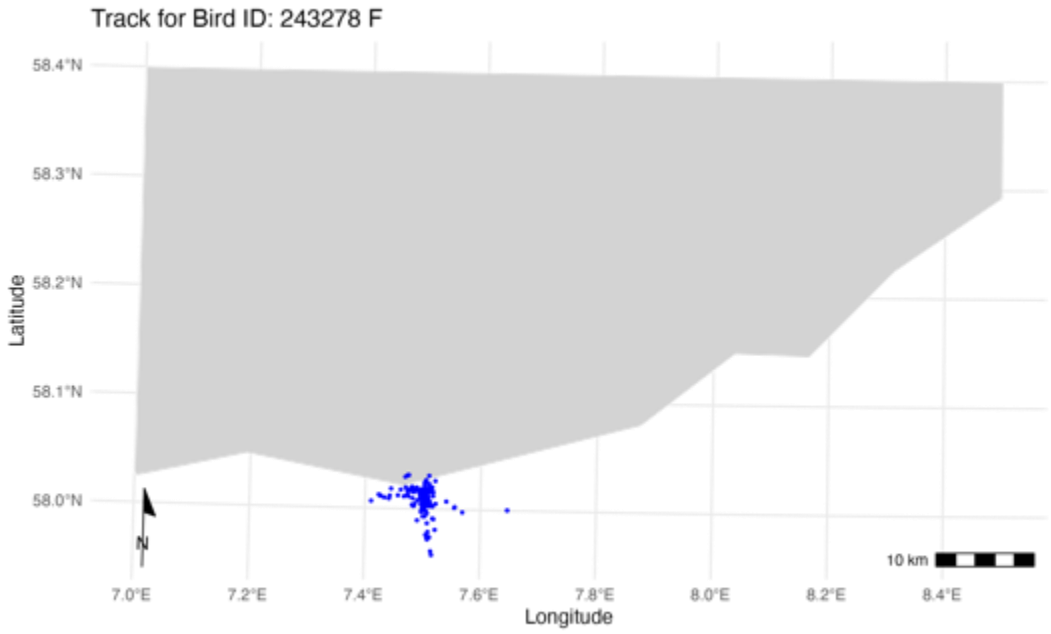

Track for Bird ID: 243273 F
58.5°N
58.0°N
57.5°N
57.0°N
Latitude
N
30 km
6°E
7°E
8°E
9°E
10°E
Longitude

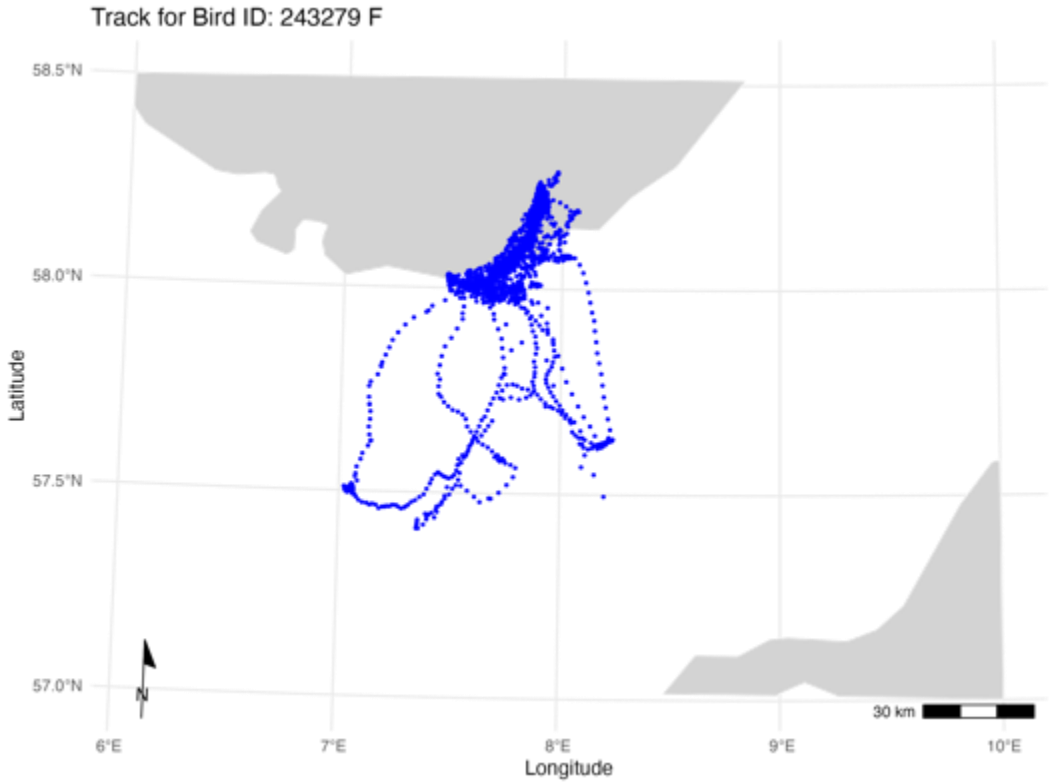

Track for Bird ID: 243274 F
58.5°N
58.0°N
57.5°N
57.0°N
Latitude
N
30 km
6°E
7°E
8°E
9°E
10°E
Longitude

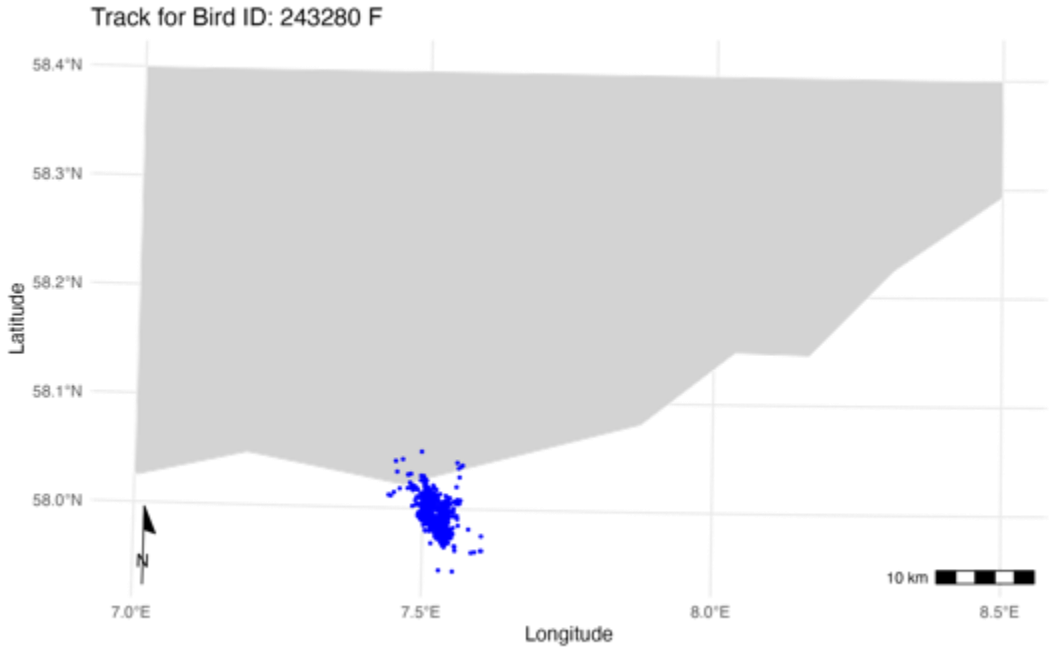

Track for Bird ID: 243275 F
58.5°N
58.0°N
57.5°N
57.0°N
56.5°N
56.0°N
Latitude
N
40 km
6°E
7°E
8°E
9°E
10°E
Longitude

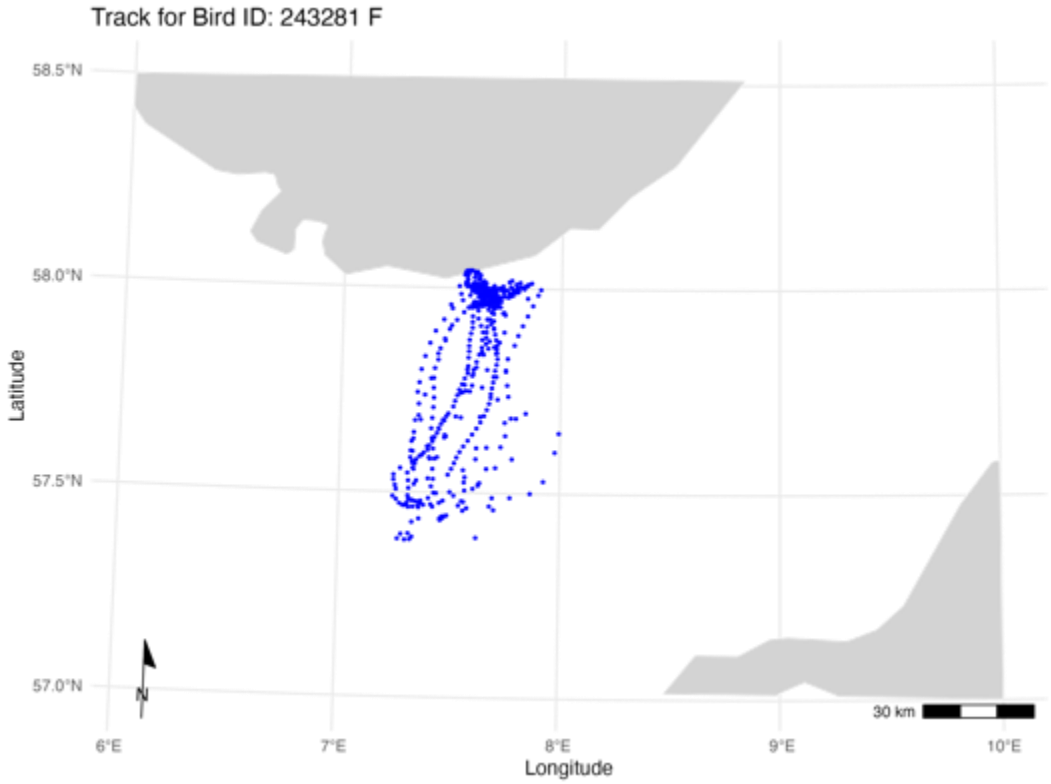

Track for Bird ID: 243276 M
58.5°N
58.0°N
57.5°N
57.0°N
Latitude
N
30 km
6°E
7°E
8°E
9°E
10°E
Longitude

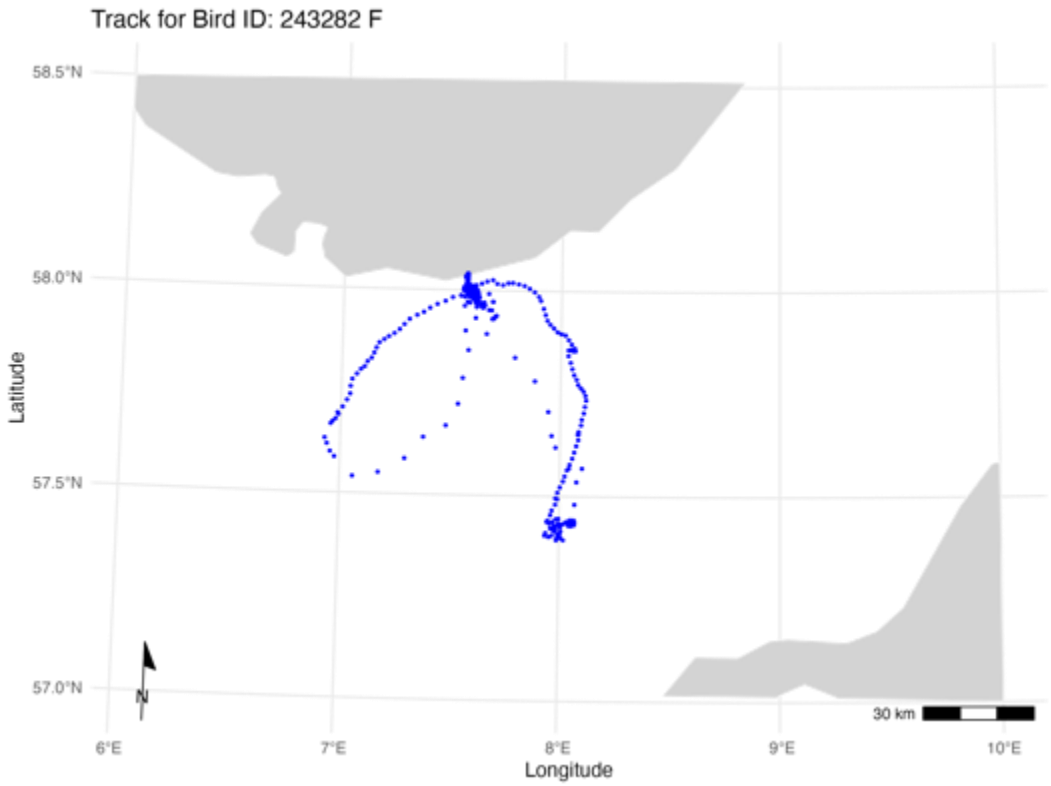

Track for Bird ID: 243277 F
58.4°N
58.3°N
58.2°N
58.1°N
58.0°N
57.9°N
Latitude
7.0°E
7.5°E
8.0°E
8.5°E
Longitude
N
10 km

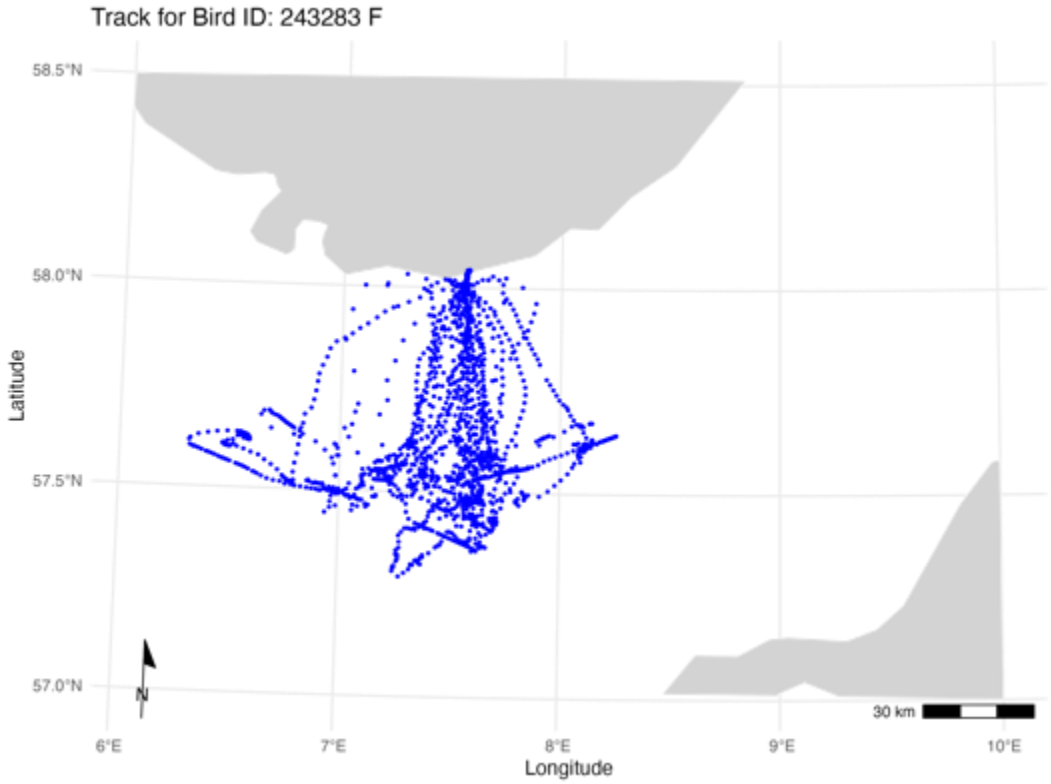

Track for Bird ID: 243278 F
58.4°N
58.3°N
58.2°N
58.1°N
58.0°N
Latitude
7.0°E
7.2°E
7.4°E
7.6°E
7.8°E
8.0°E
8.2°E
8.4°E
Longitude
N
10 km


Track for Bird ID: 243279 F
58.5°N
58.0°N
57.5°N
57.0°N
Latitude
N
30 km
6°E
7°E
8°E
9°E
10°E
Longitude


Track for Bird ID: 243280 F
58.4°N
58.3°N
58.2°N
58.1°N
58.0°N
Latitude
N
10 km
7.0°E
7.5°E
8.0°E
8.5°E
Longitude


Track for Bird ID: 243281 F
58.5°N
58.0°N
57.5°N
57.0°N
Latitude
N
30 km
6°E
7°E
8°E
9°E
10°E
Longitude


Track for Bird ID: 243282 F
58.5°N
58.0°N
57.5°N
57.0°N
Latitude
N
30 km
6°E
7°E
8°E
9°E
10°E
Longitude


Track for Bird ID: 243283 F
58.5°N
58.0°N
57.5°N
57.0°N
Latitude
N
30 km
6°E
7°E
8°E
9°E
10°E
Longitude