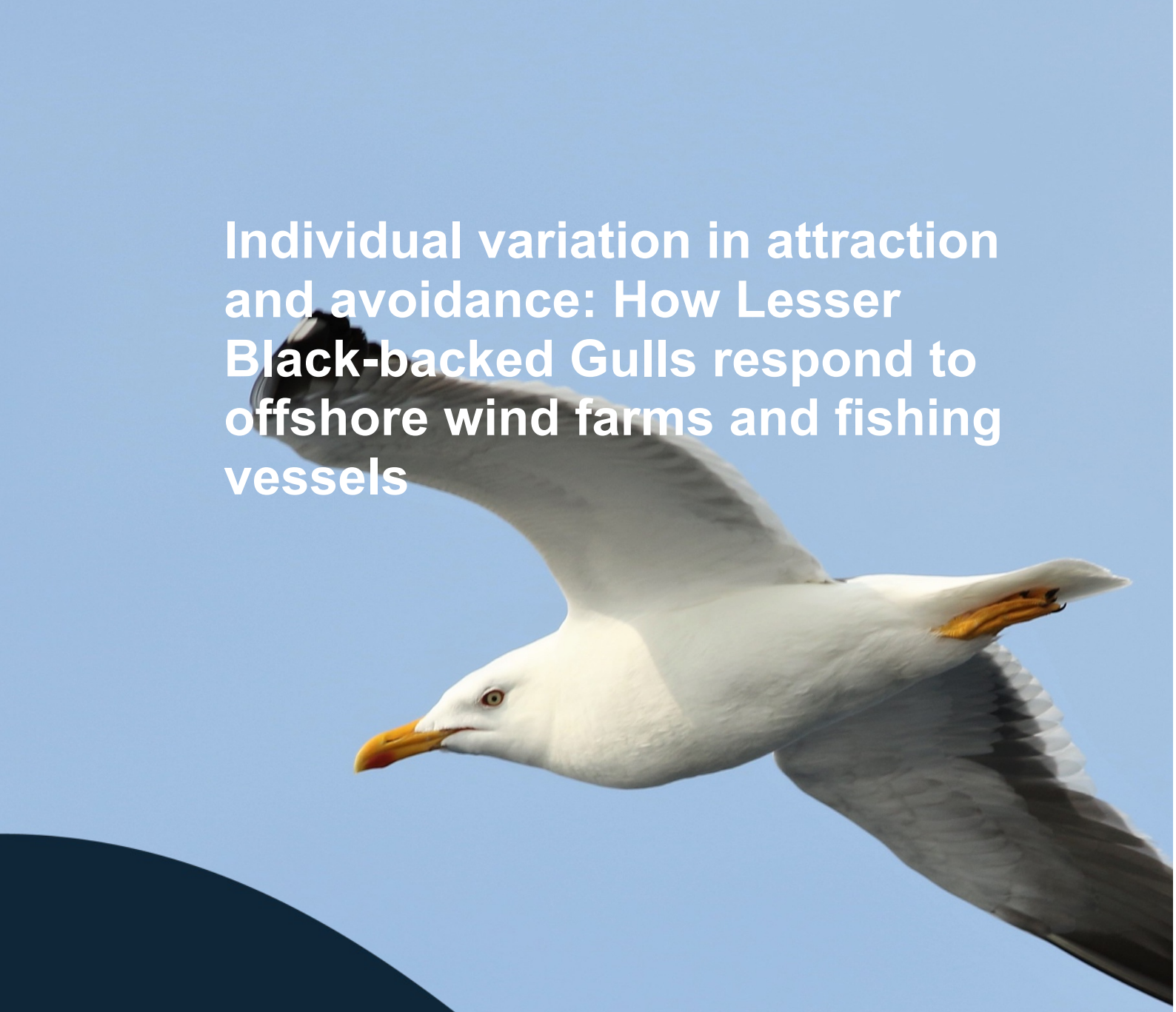
# Individual variation in attraction and avoidance: How Lesser Black-backed Gulls respond to offshore wind farms and fishing vessels



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# Individual variation in attraction and avoidance: How Lesser Black-backed Gulls respond to offshore wind farms and fishing vessels

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# Preface

This report is the result of the assignment with zaaknummer 31199233 ‘Analyseren GPS gegevens meeuwen buiten broedseizoen’ of Rijkswaterstaat Water Verkeer en Leefomgeving (RWS). This involves carrying out analyses of GPS data of large gulls which were collected for an earlier Wozep project on Neeltje Jans in the Delta area.

This assignment was supervised by Henri Zomer and Jos de Visser (RWS). Both provided comments on previous versions of this manuscript and are greatly acknowledged for their input and the smooth cooperation.

Data for this project was collected in a collaborative project between Waardenburg Ecology and Instituut voor Natuur- en Bos Onderzoek (Brussel - INBO). Eric Stienen and Nicolas Vanermen are acknowledged for the use of data.

The team that executed this task consisted of Rosemarie Kentie (Nederlands Instituut voor Onderzoek der Zee – NIOZ), Rob van Bemmelen and Ruben Fijn (Waardenburg Ecology).

A modified version of this report is intended to be published in a peer-reviewed journal in due course, with potentially co-authors of INBO and University of Amsterdam as well.

The authors thank everyone who has contributed to this report.

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# Summary

Offshore wind farms are increasing rapidly in number and scale, posing potential risks for seabirds. While some seabirds avoid offshore wind farms, others are attracted to them. Collision rate models use parameters such as avoidance rate, flight height and flight speed, to predict the risk of collisions of birds with wind turbines. Discard-feeding seabirds could appear to avoid offshore wind farms, while in fact they are attracted to fishing activities which are, within most wind farms, restricted or not allowed. Here we studied the avoidance and attraction of 58 GPS-tracked Lesser Black-backed Gulls (*Larus fuscus*) to both offshore wind farms and fishery activity within the foraging range from their breeding colony during the pre-breeding, breeding and post-breeding period. We used a Step Selection Analysis to estimate relative selection strength to the offshore wind farms in reach and areas with fishery activity, including individual variability. Individuals varied greatly in the time they spent at sea and stayed longer at sea during weekdays than during weekends. Gulls were 1.7 times as likely to avoid the offshore wind farm and 1.5 times as likely to select areas with recent fishery activity compared to areas without. The avoidance of windfarms and attraction to fisheries varied substantially between individuals. Individual variation in avoidance of offshore wind farms varied most during the breeding period, while the attraction to fishing activity varied most during the pre-breeding period. We expected a difference in avoidance of the offshore wind farm during weekends when fishery intensity were four times lower, and gulls at sea were likely more relying on self-foraging, however, we found no difference. The findings of individual variability in avoidance behaviour suggest that collision rate model might benefit from incorporating behavioural heterogeneity rather than assuming uniform population responses. This research contributes valuable empirical data to improve the biological realism of collision rate models.

# Nederlandse samenvatting

Offshore windparken nemen snel in aantal en omvang toe, wat potentiële risico's voor zeevogels met zich meebrengt. Terwijl sommige zeevogels offshore windparken mijden, voelen anderen zich erdoor aangetrokken. Beide gedragingen kunnen schadelijke gevolgen hebben: vermijding kan leiden tot habitatverlies of barrières creëren ten opzichte van foerageergebieden, terwijl aantrekking het risico op botsingen kan vergroten. Zeevogels die zich voeden met visserij-discards lijken offshore windparken te mijden, terwijl ze waarschijnlijk worden aangetrokken door visserijactiviteiten die in de meeste landen verboden zijn in de parken, en daar dus niet voorkomen. In dit onderzoek bestudeerden we de vermijding en aantrekkingskracht van kleine mantelmeeuwen (*Larus fuscus*) voor zowel de offshore windparken als de visserijactiviteiten binnen hun foerageergebied. We gebruikten stapselectieanalyses om de relatieve selectiesterkte te schatten voor offshore windparken en gebieden met visserijactiviteiten en namen individuele variabiliteit mee in deze modellen. Individuen varieerden sterk in de tijd die ze op zee doorbrachten en bleven doordeweeks langer op zee dan in het weekend. Op zee gebruikten vogels anderhalf keer zo vaak gebieden met recente visserijactiviteiten in vergelijking met gebieden zonder. Op populatieniveau vermeden meeuwen offshore windparken, maar individuele reacties varieerden aanzienlijk. We veronderstelden dat als het vermijden van windmolenparken werd aangestuurd door aantrekking tot nabijgelegen visserijactiviteiten, meeuwen minder windmolenvermijding zouden vertonen tijdens de weekenden, wanneer de visserijintensiteit vijf keer lager was dan tijdens weekdagen. We vonden echter geen verschil in relatieve selectiesterkte voor het offshore windmolenpark tussen weekdagen en weekenden. Er is verder onderzoek nodig om te bepalen of dit patroon het gevolg is van actieve vermijding van windturbines of van andere oorzaken, zoals verschillen in prooibeschikbaarheid binnen versus buiten het windmolenpark. Een ander onderwerp voor toekomstige studies is de mate van seizoensgebondenheid in het vermijden van windmolenparken en aantrekking tot visserijactiviteiten. In de bijlage hebben we nog enige aanvullende resultaten opgenomen over zilvermeeuwen (*Larus argentatus*).

# 1 Introduction

Coastal shelf seas, such as the North Sea, are among the most heavily human impacted marine habitats in the world (Halpern *et al.* 2015). Fishery intensities and shipping traffic are high, and offshore wind farms are increasing in number, area and the size of individual turbines (Emeis *et al.* 2015, Gusatu *et al.* 2021). To become carbon neutral in 2050, the EU's wind power action plan will accelerate construction of new offshore wind farms in near future (European Commission 2023). These human activities can impact wildlife, especially apex predators such as seabirds (Furness and Camphuysen 1997, Hazen *et al.* 2019).

Offshore wind farms can affect seabirds directly by increased mortality rates due to collisions with wind turbines, or indirectly via habitat loss if seabirds avoid wind farm areas (Mendel *et al.* 2019). Offshore wind farms can also act as a barrier, leading to increased flight costs (Thaxter *et al.* 2024). An important driver of both collision risk and habitat loss is the extent to which a bird is either attracted to or avoiding offshore wind farms (Dierschke *et al.* 2016, Johnston *et al.* 2022). For example, some species such as Great Cormorants (*Phalacrocorax carbo*) and European Shags (*Phalacrocorax aristotelis*) have been observed to use the base of turbines to perch (Dierschke *et al.* 2016), species such as Lesser Black-backed Gulls (*Larus fuscus*) have been seen foraging on the fouling communities on the foundations (Vanermen *et al.* 2014), while others, such as Loons (Gavia spp.) avoid the offshore wind farm and associated shipping traffic up to 16 km distance thereby substantially reducing their foraging area (Mendel *et al.* 2019).

Because fishing is prohibited in many offshore wind farms, discard-feeding seabirds, such as Lesser Black-backed Gulls (*Larus fuscus*), Northern Fulmar (*Fulmarus glacialis*), Black-legged Kittiwakes (*Rissa tridactyla*) (Sherley *et al.* 2019) probably have a lower tendency to enter a wind farm. However, avoidance of wind farms could then be driven by the attraction to fishing vessels outside and absence of fishing vessels within offshore wind farms, instead of an avoidance of the wind farm per se. As experiments have been done to study the feasibility of passive fishing (gillnets, handline fishing, mechanical jigging and multi-species pots) within wind farms (Neitzel *et al.* 2024), fishing within wind farms may be more common at a wider scale in future, thereby potentially altering the avoidance rate of discard-feeding seabirds and increasing the risk of collisions with turbines.

Based on flight height, manoeuvrability and foraging behaviour at night, large gulls such as Lesser Black-backed Gulls and Herring Gulls (*Larus argentatus*) are often listed as particularly vulnerable to collisions with turbines at sea (Furness *et al.* 2013, Bradbury *et al.* 2014). Studies on the avoidance of wind farms by Lesser Black-backed Gulls have shown mixed results (Vanermen *et al.* 2014, Dierschke *et al.* 2016, Johnston *et al.* 2022). One reason for the variation in responses could be the large individual differences within species in how they respond to environmental conditions, such as found in Black-legged

Kittiwakes (Rissa tridactyla) (O'Hanlon *et al.* 2024). Another reason could be the distribution of nearby fisheries. Although the effects of an absence of fishing activity within wind farms was acknowledged, it was thus far not feasible to include fishing activities in previous studies. With the development of fishery tracking websites such as the Global Fishing Watch (Global Fishing Watch 2025), this is now within reach.

Lesser Black-backed Gulls have a varied diet ranging from marine to terrestrial food (Camphuysen *et al.* 2024). Previous studies have shown that Lesser Black-backed Gulls spent less time at sea during the weekends, when fishery activity is lowest compared to weekdays (Tyson *et al.* 2015, Sotillo *et al.* 2019). Foraging patterns of gulls also vary between colonies, depending on colony size (Corman *et al.* 2016), but other factors, such as distance to foraging areas, likely also play an important role in habitat choice. Lesser Black-backed Gulls breeding on Texel, the Netherlands, for instance, spent between 25% and 78% of their time at sea (depending on sex and breeding phase) (Camphuysen *et al.* 2015), while gulls breeding in South Walney, UK, hardly spent any time offshore (Clewley *et al.* 2023).

Developments of GPS-tracking now allow studying wind farm avoidance behaviour in more detail (Johnston *et al.* 2022, Fijn *et al.* 2024) and on an individual level (O'Hanlon *et al.* 2024). Here, we studied habitat use at sea of a Lesser Black-backed Gull colony located relatively close to an offshore wind farm (~40 km). Gulls were tagged with GPS trackers in 2020 and 2021. We first investigated how much time they spent at sea, and inside the offshore wind farm and if this differed per breeding phase or during weekdays or weekends, when commercial fisheries are less active. We investigated the fight speed and height at sea and whether this differed inside or outside the offshore wind farm as these are important parameters for collision risk models (Masden *et al.* 2021). Then we studied simultaneously the attraction / avoidance of windfarms and fishery activity at sea using Step Selection Analyses (SSA; (Thurfjell *et al.* 2014, Avgar *et al.* 2016, Chatterjee *et al.* 2024). An SSA is based on the principles of resource selection analyses and compares the properties of actual used steps (two subsequent GPS positions) with randomly chosen available steps at each time interval. The randomly chosen available steps are generated for each used step using the distribution of step lengths and turning angles from the data. Spatial and temporal characteristics can be linked to the start and/or end of each random and used step. With habitat characteristics at the end of each step, selection coefficients of certain habitat types within reach can be estimated, whereas habitat characteristics at the start of each step allow estimation of the influence of habitat on movement behaviour (i.e. speed and direction). Recent developments in these models made it possible to add individual random slopes (Muff *et al.* 2020), and thereby acknowledging and focussing on individual differences in habitat selection.

We tested the following hypotheses: (1) gulls are attracted to areas with fishing activity, (2) gulls avoid the offshore windfarm area, (3) gulls spent less time at sea during weekends due to lower fishing intensity compared to weekdays, and (4) gulls at sea are avoiding the wind farm area less during weekends than during weekdays because of the general absence of, and therefore draw to, fisheries.

# 2 Materials and methods

## 2.1 Fieldwork

Lesser black-backed gulls breeding on the artificial island Neeltje Jans (Figure 2.1) in the south of the Netherlands were tagged with GPS loggers (OT-15-3GCT) of 15g manufactured by Ornitela (Vilnius, Lithuania; ornitela.com), attached with a permanent wing harness (Thaxter *et al.* 2015). All tags were less than 3% of the body weight. 25 Gulls were tagged between 20-5-2020 and 2-6-2020, and 50 gulls were tagged between 25-5-2021 and 2-6-2021. The settings of the GPS loggers varied per time of day and location, with a position recoded every 900 seconds inside the colony, 180 seconds outside the colony and 20 seconds inside the offshore wind farm area within the home range of the gulls. From dusk to dawn, the position inside the colony was recorded every 1800 seconds and outside the colony every 900 seconds, but the settings for positions inside the wind farm remained every 20 seconds. Gulls were captured with walk-in cages on the nest during the incubation phase and received a metal ring and a coloured plastic ring with a unique inscription. Individuals were weighed and measured, and sex was based on body size (Camphuysen *et al.* 2024). In 2021, nests of a large subset of individuals (n=40) were monitored for hatching success, hatching date, and presence of chicks until 25 June (halfway fledging for the eldest chick in the study).

## 2.2 Habitat data

The offshore wind farm complex nearest to the breeding colony lies 40 km in westerly direction and consist of the wind farms in Dutch waters (Borssele I-IV) and wind farms in Belgian waters (Norther, C-Power, Rentel, Northwind, Seastar, Belwind, Northwester 2 and Mermaid). We calculated a buffer of 1 km around each wind turbine present in 2021. The wind turbine locations from Borssele were downloaded from ESRI NL (published by Nationaal Georegister), those from the Belgian wind farms were downloaded from GeoNetwork (published by the Royal Belgian Institute for Natural Sciences). For each turbine we calculated a buffer of one km around its base, after which we filled the gaps within the perimeter to arrive at a polygon for the entire offshore wind farm (Figure 2.1). Fisheries data was downloaded from Global Fishing Watch (Global Fishing Watch 2025), which provides apparent fishing intensity in hours of fishing based on AIS and sailing speed, using version 3 of their AIS data pipeline (Figure I.4.1). The resolution of fishing intensity data is at 0.01˚ on a daily scale (from midnight to midnight UTC).

## 2.3 GPS-data selection

We selected data of GPS-tagged Lesser Black-backed Gulls between 01-03-2021 and 31-09-2022 and kept only those points in the North Sea north of 51.0˚N (Figure 2.1, Table 2.1,

Appendix IV for details on individual bird). Most gulls arrive in the breeding area in April and start to migrate southwards in August (Camphuysen *et al.* 2024). We removed GPS location data which were obtained by four or less satellites to assure accuracy of the GPS positions (0.195% of all data locations). We checked the remaining positions for abnormal speeds and removed positions where the calculated speed (distance divided by time) between locations was > 75 km/u but the instantaneous GPS speed registered by the loggers was < 25 km/u (0.055% of the locations). Thoroughly checking the data showed that these positions were very likely wrong positions. We categorized three time periods based on the nest data from 2021: the pre-breeding period between arrival in the area until 15 May, the breeding period between 15 May and 15 July, and the post-breeding period from 15 July until departure from the area (Figure 2.1, Table 2.1, Appendix IV for details for individual birds).

## 2.4 Time spent at sea and in the wind farm

We summed the time a bird spent at sea or within the perimeter (with a buffer of one km) of the offshore wind farm per day and analysed if this differed between breeding phases and between days during the week (Mon – Thu) or weekends (Fri – Sun). We used a general linear mixed model with a *tweedie* distribution, as the data has a cluster of zeroes, using the package glmmTMB (Brooks *et al.* 2017). Random intercepts were included for individual and model fit was assessed with the package Dharma (Hartig 2022).

## 2.5 Flight speed and height

We assessed the flight speed, based on instantaneous GPS ground speed, and flight height of gulls inside and outside the offshore wind farm. Flight speed showed a bimodal distribution, of which the lower mode likely represents floating on tidal currents or resting at the base of the wind turbine. We therefore selected, per individual per breeding period and within and outside the OWF, the speed of the second mode (faster than 10 km/h) and kept those of individuals with 10 or more measurements. As flight heights showed a wide variation partly due to erroneous measurements but no bimodality, and a strong skew to low values, we used the median in flight height per individual when their instantaneous GPS speed was higher than 5 km/h to remove gulls resting at sea, for each breeding period and inside and outside the OWF to model the differences, and kept those of individuals with 10 or more measurements. Modal speed and median heights per individual per breeding period and within and outside the offshore wind farm was used as dependent variable in a linear mixed model with a gaussian distribution and individuals as random intercept. Statistical significance of the explaining variables ‘within offshore wind farm’, ‘breeding period’ and its interaction were tested with a chi-square test.

## 2.6 Step selection analysis

Steps are defined as the connections between consecutive individual GPS locations. Step length is the distance between consecutive locations, and turning angle is the change in directionality between consecutive steps (Fortin *et al.* 2005, Signer *et al.* 2019). The time between GPS locations should be regular, not too short so step lengths can be long enough

to reach a different habitat, and not too long to maintain a high enough resolution. Based on visual inspection of the foraging tracks overlaying the habitat maps, and considering the sampling scheme of the GPS loggers, we resampled the tracking data to 15 minutes with a tolerance of 2 minutes using the function track_resample from the amt package (Signer *et al.* 2019), keeping bursts (consecutive locations with 15 minutes intervals) of more than 3 locations. When using an average commuting speed of 32.4 km/h (Shamoun-Baranes *et al.* 2016, Thaxter *et al.* 2019), a distance of 8 km could be covered per step.

We generated 25 random steps for each used step using the random_steps function from the package amt (Signer *et al.* 2019), using a gamma distribution for step lengths and a Von Mises distribution for turning angles. See Figure I.4.2 and Figure I.4.3 for the distribution of step lengths and turning angles. We removed positions which fell outside the area with known fishing intensity (Appendix Figure I.4.1), and random positions which fell on land. For each end point of the step we extracted whether gulls were within the wind farm perimeter, or within a grid cell of 0.01 x 0.01 degrees where fishing activity took place within 24 hours. To be able to estimate if temporal drivers influence the movement of individuals, we defined if a step started in a weekend (including Friday), when fishing intensity is five times lower than during weekdays (see Figure 3.1).

We ran SSA models as conditional logistic regressions using mixed models with a Poisson distribution in glmmTMB (Brooks *et al.* 2017, Muff *et al.* 2020). Used steps versus random steps were used as a dependent variable, and step ID (the grouping variable to link observed with random steps) as random intercept of which we fixed its variance to $10^6$ to avoid shrinkage to the mean (see Muff *et al.* 2020). To estimate individual differences, we included individual random slopes per environmental variable and included the log of step length and the cosines of the turning angle as fixed effects, to reduce bias in parameter estimation (Forester *et al.* 2009). We first ran models including the environmental variables ‘within wind farm’ and ‘at fisheries activity’, both with an interaction with breeding periods (pre-breeding, breeding, and post-breeding). We then ran SSA models where we allowed the selection coefficient for ‘within wind farm’ to differ between weekdays (high fishing intensity) and weekends (low fishing intensity). We compared, per breeding period, the latter model to the model without weekend effects using a likelihood ratio test.

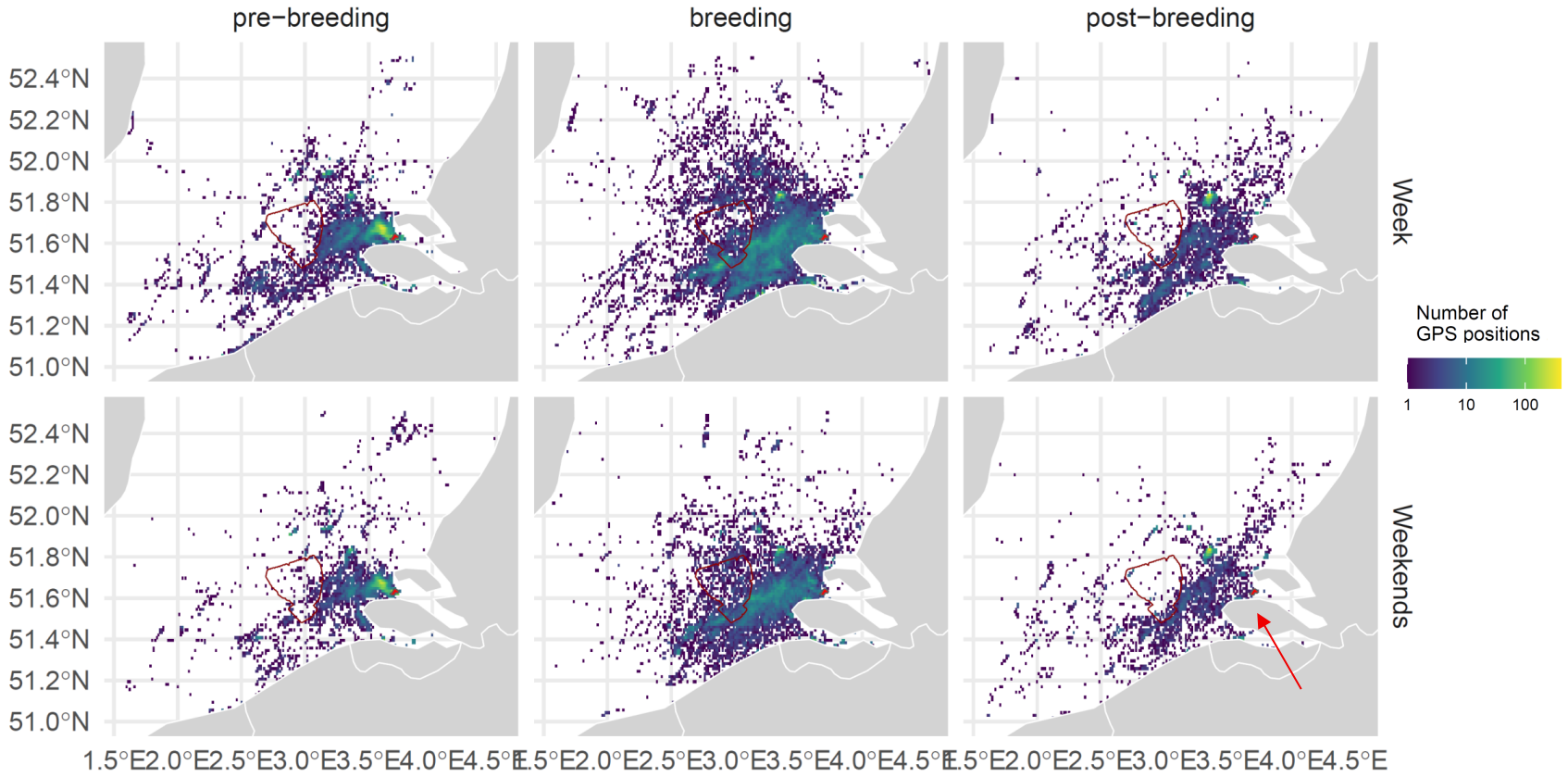


*Figure 2.1* *Density of GPS positions of Lesser Black-backed Gulls (regularized positions with 20 minutes) at sea in relation to the offshore windfarm and the colony in the different breeding periods and during the week (Mon – Thu) and weekends (Fri – Sun). The red outline encompasses the offshore wind farm with a 1000 m buffer. The red arrow indicates the colony.*

*Table 2.1* *Cumulative numbers of GPS positions of Lesser Black-backed Gulls in the study region north of 51.0˚N in and outside offshore windfarms during different months and years. Each figure is given as the total number of positions with the % of the overall total in brackets.*

| Year | Month | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Outside OWF | | | | | | | | | | | | |
| | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** |
| 2021 | 0 (0%) | 0 (0%) | 578 (0.7%) | 68 (0.1%) | 2,416 (2.8%) | 65,283 (76.8%) | 15,602 (18.4%) | 1,012 (1.2%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |
| 2022 | 0 (0%) | 371 (0.7%) | 3,900 (7.4%) | 6,827 (12.9%) | 6,557 (12.4%) | 16,313 (30.8%) | 13,133 (24.8%) | 5,931 (11.2%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |
| Inside OWF | | | | | | | | | | | | |
| 2021 | 0 (0%) | 0 (0%) | 4,161 (0.9%) | 10,448 (2.2%) | 16,592 (3.5%) | 267,670 (57.2%) | 136,671 (29.2%) | 22,231 (4.8%) | 8,459 (1.8%) | 901 (0.2%) | 608 (0.1%) | 14 (0.0%) |
| 2022 | 14 (0.0%) | 1,502 (0.4%) | 19,925 (4.8%) | 42,858 (10.3%) | 99,063 (23.9%) | 106,852 (25.8%) | 116,950 (28.2%) | 20,631 (5.0%) | 6,839 (1.6%) | 0 (0%) | 0 (0%) | 0 (0%) |

# 3 Results

## 3.1 Fishing intensity

Fishing intensity around the colony was lower during the weekends including Friday (on average 270 hours per day) than on Mondays until Thursdays (on average 1066 hours per day). Weekly maximum fishing intensity was highest in the breeding period in 2021 (Figure 3.1). See Figure I.4.1 for the spatial distribution of fishing activity around the colony, which shows that no fishing took place within the wind farm and most fishing took place south east of the wind farm near shore.

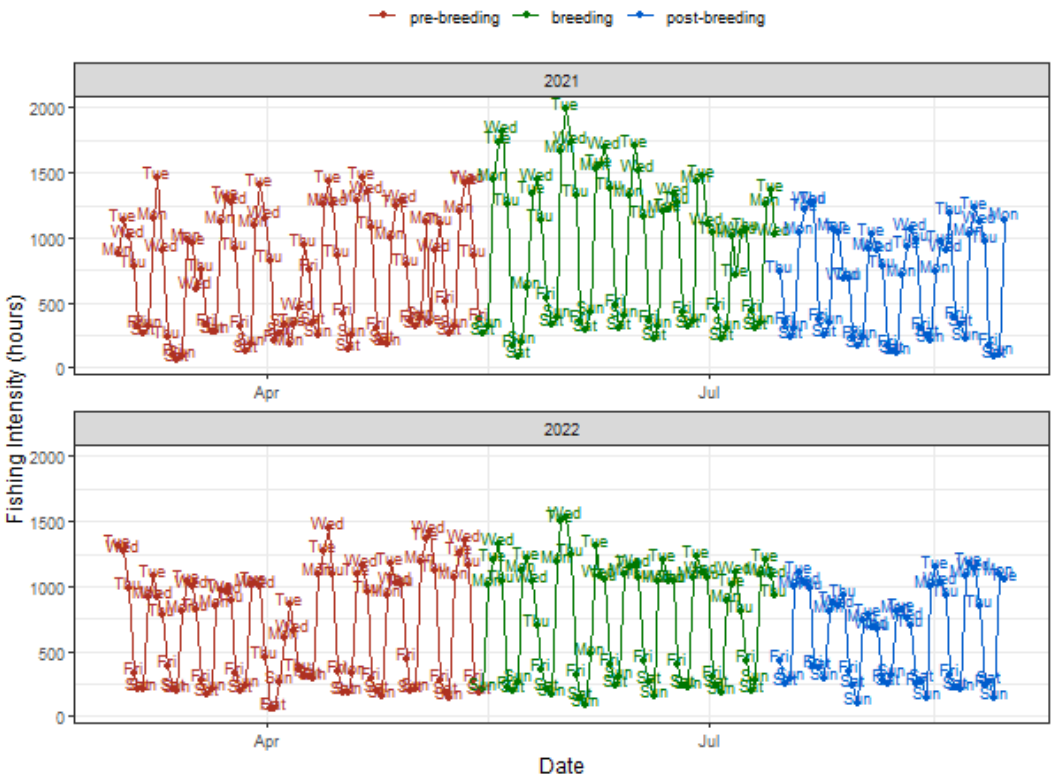


*Figure 3.1* *Daily fishing intensity, in hours fished per day, around the colony between 1 March 2021 and 31 August 2022. The breeding periods are coloured differently, and day of the week is shown in the graph.*

## 3.2 Time spent at sea and in the wind farm

We found large differences between individuals in the time they spent at sea and in the offshore wind farm during the period they are present in the Dutch North Sea (Figure 3.2, Figure 3.3). Gulls spend on average more time at sea during the week than during weekends, and during the pre-breeding period (Table 3.1). During the week in the pre-breeding period, gulls spent on average 5.18 (4..34 – 6.17 95% CI) hours at sea, while during the weekend in the breeding period this was 3.19 (2.68 – 3.80 95% CI) hours. The pattern per year is similar but with 4.21 (3.54 95% CI) hours at sea in 2021 they spent more time at sea than in 2022 when they spent 3.79 (3.19 – 4.51 95% CI) hours at sea (Figure 3.2, Table 3.1).

Gulls spent most time in the offshore wind farm during the breeding period compared to the pre- and post-breeding period (Figure 3.3). On average, gulls spent 0.035 hours (2 minutes) per day in the offshore wind farm during the breeding period; this average included gulls that never entered the offshore wind farm. During the pre- and post-breeding period the time spent in the offshore wind farm was on average 0.015 and 0.016 hours per day, which comes down to 1 minute per day. There was no difference in time spent in the offshore wind farm during weekends and weekdays, but the total time spent in the offshore wind farm differed per year (Table 3.1); 0.027 (0.014 – 0.052 95% CI) hours per day in 2021 and 0.015 (0.008 – 0.029 95% CI) hours per day in 2022. On a daily basis these are very low numbers, but over a whole season from arrival in the North Sea until departure, these numbers add up to on average 13 hours per gull in 2021, and 8 hours per gull in 2022.

*Table 3.1* *Results of statistical analyses on time spent per day at sea, and in the offshore wind farm per breeding phase and weekend (Fri-Sun) and weekdays (Mon-Thu).*

| Parameter | Chisq | df | P |
|---|---|---|---|
| *At sea* | | | |
| Weekend | 36.838 | 1 | < 0.001 |
| Period | 145.510 | 2 | < 0.001 |
| Weekend x Period | 4.035 | 2 | 0.133 |
| Year | 15.772 | 1 | < 0.001 |
| | Variance | St Dev | |
| random effect* | 0.442 | 0.665 | |
| *In OWF* | | | |
| Weekend | 2.347 | 1 | 0.126 |
| Period | 43.902 | 2 | < 0.001 |
| Weekend x Period | 0.862 | 2 | 0.650 |
| Year | 22.705 | 1 | < 0.001 |
| | Variance | St Dev | |
| random effect* | 5.508 | 2.347 | |

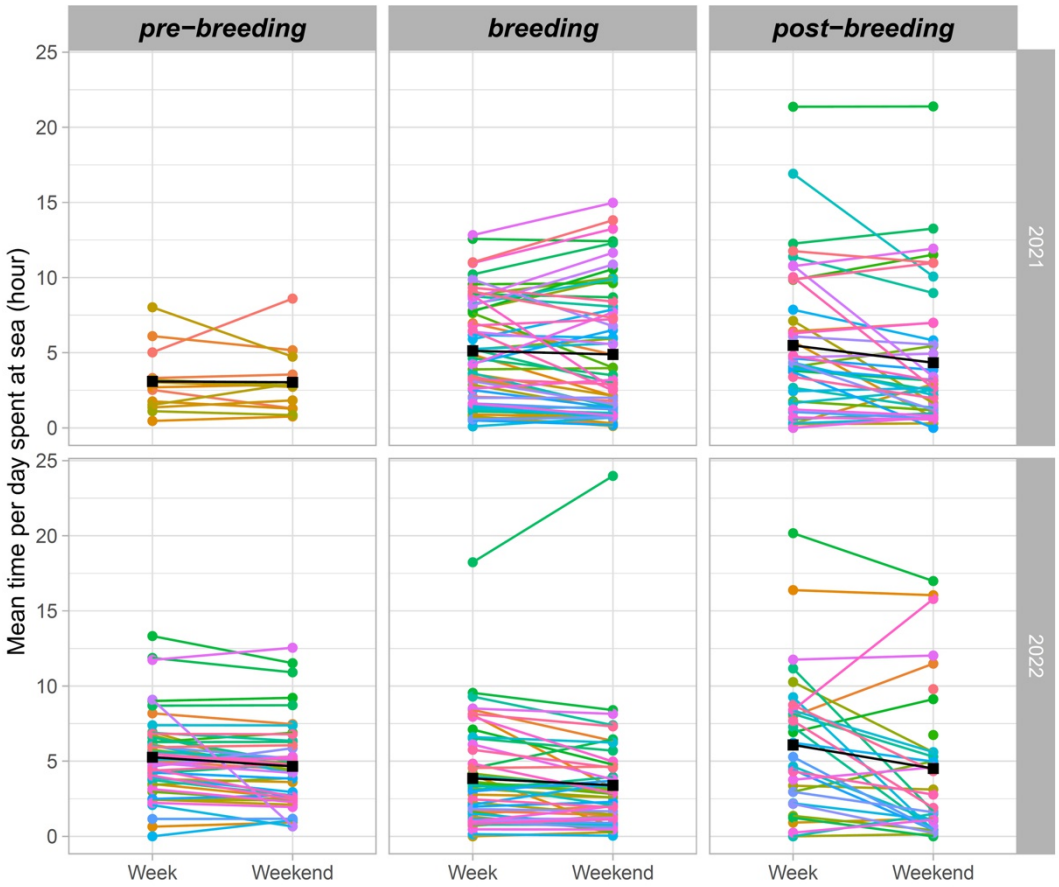


*Figure 3.2* *Mean daily time spent at sea per breeding phase differentiated for week (Mon – Thu) and weekend (Fri – Sun in 2021 and 2022). Coloured points and lines are individuals, black squares and lines are the overall averages.*

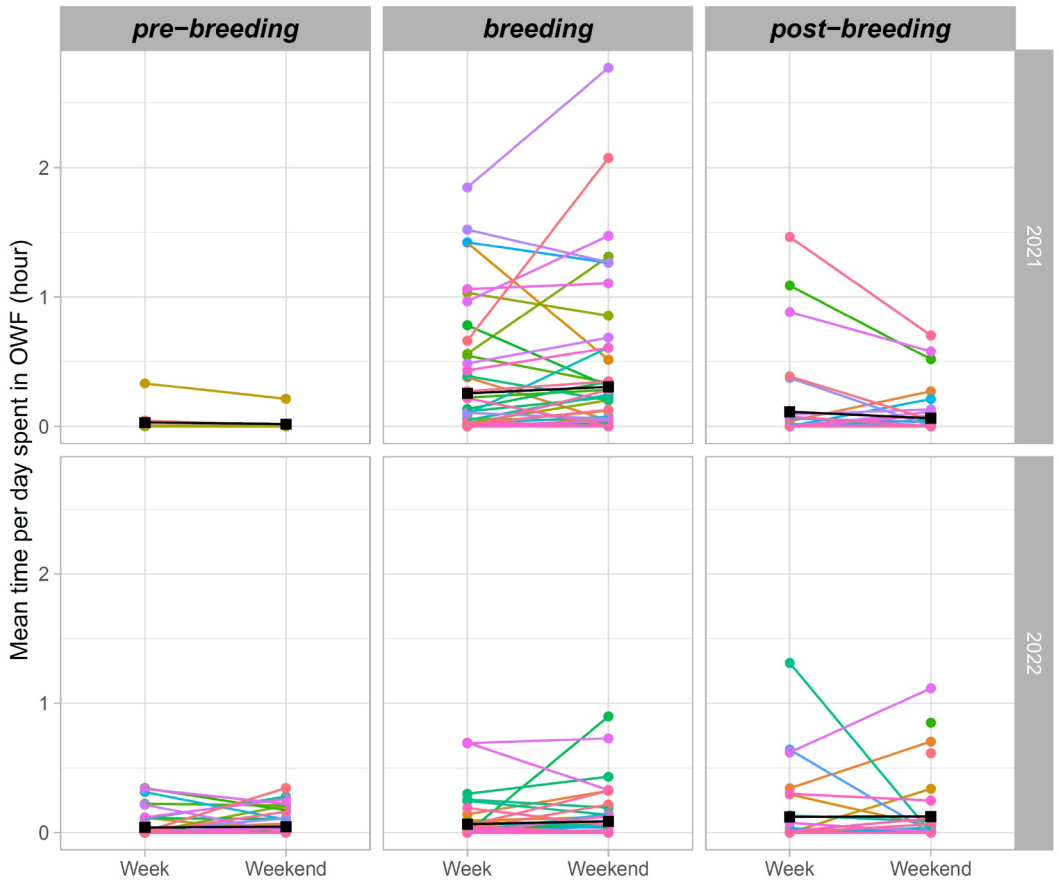


*Figure 3.3* *Mean daily time spent in offshore windfarms per breeding phase differentiated for week (Mon – Thu) and weekend (Fri – Sun) in 2021 and 2022. Coloured points and lines are individuals, black squares and lines are the overall averages.*

## 3.3 Flight speed and height

There was a large variation in flight speeds (Figure 3.4). Flight speed was higher inside than outside the OWF; seen over the total period that gulls were present in the North Sea, the mode of the speed was 35 km/h inside and 30 km/h outside the offshore wind farm (Figure 3.4), which differed statistically (Chisq = 16.529, df= 1, $p < 0.0001$).

There was no statistical difference in flight speed between breeding period (Chisq = 4.698, df = 2, $p = 0.095$). The median speeds were 32 km/h inside and 29 km/h outside the offshore wind farm, but these might be biased downwards towards floating speeds (the 'hump' at lower speeds).

Height measurements by GPS have substantial vertical errors (Schaub *et al.* 2023) and should therefore be considered with care. We compared flight height outside and inside OWF but selected data with speeds higher than 5 km/h to exclude resting behaviour. We also excluded points below -15 meter and above 275 meter to remove large erroneous measurements. Out of the 401,793 GPS-positions over sea and 5 km/hr, a total of 40,537 (10%) were below -15 meter and 3,380 (0.8%) above 275 meter.

We found a wide range in flight heights of Lesser Black-backed Gulls (Figure 3.5). Flight hight differed per breeding phase (Chisq = 27.033, df = 2, $p < 0.0001$) and for outside and inside the offshore wind farm (Chisq = 68.222, df = 1, $p < 0.0001$). During the breeding period the average median flight height was 34.8 meter (31.8 – 37.8 95% CI), while this was 22.6 meter (19.0 – 26.2 95% CI) in the pre-breeding period and 30.3 meter (26.6 – 33.9) in the post-breeding period. Within the offshore wind farm, the median flight height was on average 38.2 meter (34.8 – 41.6 95% CI) and outside this was 20.2 meter (17.8 – 22.6 95% CI).

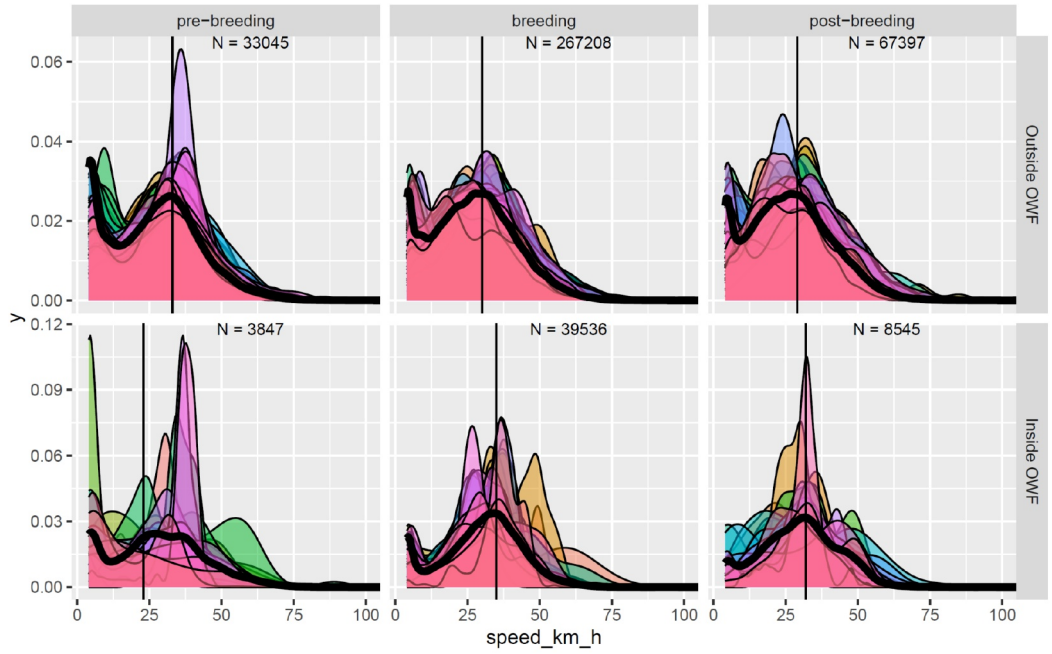


*Figure 3.4* *Distribution of flight speed of tagged Lesser Black-backed Gulls (faster than 3 km/h are shown), outside and inside the offshore wind farm (OWF), per breeding period. The thick black line shows the density plot of speeds of all data, and the coloured areas show density plots per individual. The vertical lines show the mode of all speeds larger than 5 km/h. The sample size of data points is shown in each graph.*

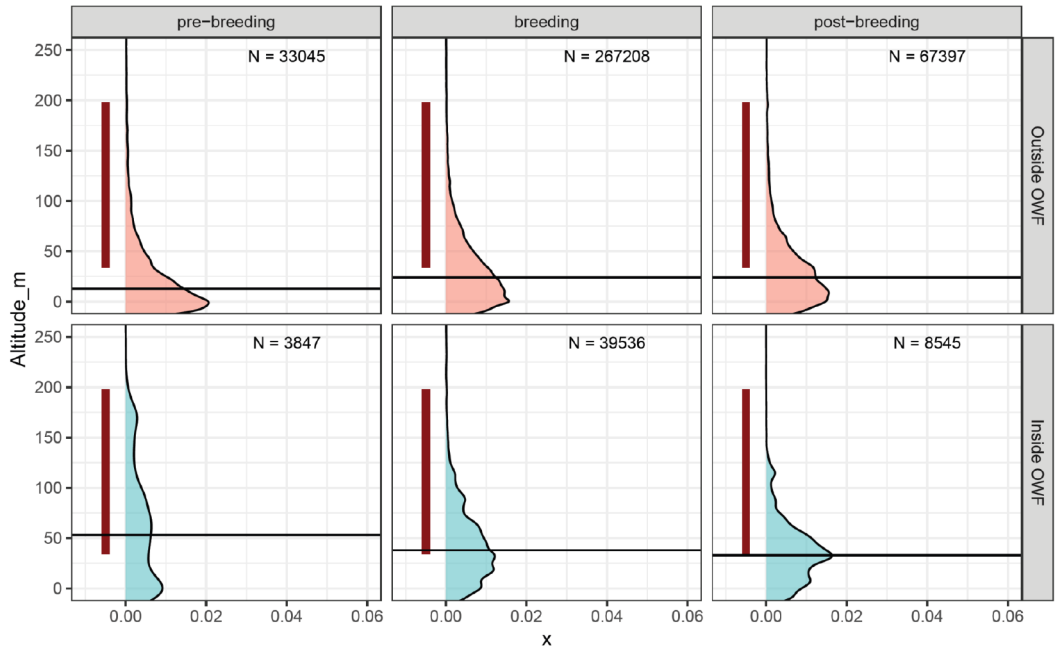


*Figure 3.5* *Distribution of flight height of tagged Lesser Black-backed Gulls outside and inside OWF per breeding period. The red vertical bar indicates the rotor-swept zone of wind turbines in OWF Borssele, and the horizontal lines show the median of flight heights.*

## 3.4 Attraction and avoidance of offshore wind farm and areas with fishing activities

After regularization of the GPS data, the dataset for the SSA encompassed 98,785 steps from 59 individuals, generating 2,567,191 used and random positions (Table 3.3). The proportion of used positions withing the OWF varied markedly across breeding periods: 6% during breeding, 2.6% during post-breeding and only 1.3% during pre-breeding.

On the population level, Lesser Black-backed Gulls revealed consistent behavioural patterns across all breeding periods. Gulls avoided the offshore wind farm, with the negative selection coefficients indicating they were 1.6 to 1.8 times more likely to avoid wind farm areas than to enter them when within range (Table 3.2, Figure 3.6). Conversely, gulls showed strong attraction to areas with active fishing, being 1.4 to 1.6 times more likely to select these areas compared to those without fishing activity (Table 3.2, Figure 3.6).

Individual variation in wind farm selection throughout the breeding periods was large and most prominent in the breeding period (Table 3.2, Figure 3.6). The selection coefficients for areas with active fishing differed most in the pre-breeding period (Figure 3.6).

*Table 3.2 Model estimates of the SSA model analyses for three breeding periods.*

| | Estimate | SE | z-value | P value | Random individual slope (variance; st dev) |
|---|---|---|---|---|---|
| **Pre-breeding period** | | | | | |
| In OWF | -0.575 | 0.120 | -4.811 | < 0.0001 | 0.065; 0.254 |
| At fishing activity | 0.303 | 0.075 | 4.059 | < 0.0001 | 0.121; 0.347 |
| **Breeding period** | | | | | |
| In OWF | -0.589 | 0.103 | -5.701 | < 0.0001 | 0.317; 0.563 |
| At fishing activity | 0.460 | 0.031 | 14.793 | < 0.0001 | 0.011; 0104 |
| **Post-breeding period** | | | | | |
| In OWF | -0.500 | 0.154 | -3.256 | 0.001 | 0.244; 0.494 |
| At fishing activity | 0.445 | 0.053 | 8.423 | < 0.0001 | 0.005; 00072 |
| | | | | | |
| Log_sl | -0.008 | 0.002 | -5.002 | < 0.0001 | |
| Cos_ta | 0.004 | 0.005 | 0.737 | 0.461 | |

*Table 3.3* *Sample sizes as used in the step selection analyses of individuals and GPS positions (used points), individuals entering the offshore wind farm, and the number of individuals attracted to, were indifferent, or avoided the offshore wind farm based on whether or not the 95% CI crossed 0. Note that this is sensitive to small sample sizes.*

| | Pre-breeding period (< 15 May) | Breeding period (15 May – 15 July) | Post-breeding period (> 15 July) |
|---|---|---|---|
| **Sample sizes** | | | |
| N individuals | 52 | 58 | 46 |
| N used points | 32013 | 48926 | 17810 |
| N individuals in OWF | 21 | 43 | 22 |
| Percentage of used points in OWF | 1.3 % | 5.8 % | 2.6 % |
| **N individuals** | | | |
| Attracted to OWF | 0 | 1 | 1 |
| Avoided OWF | 39 | 21 | 7 |
| Indifferent to OWF | 2 | 29 | 30 |

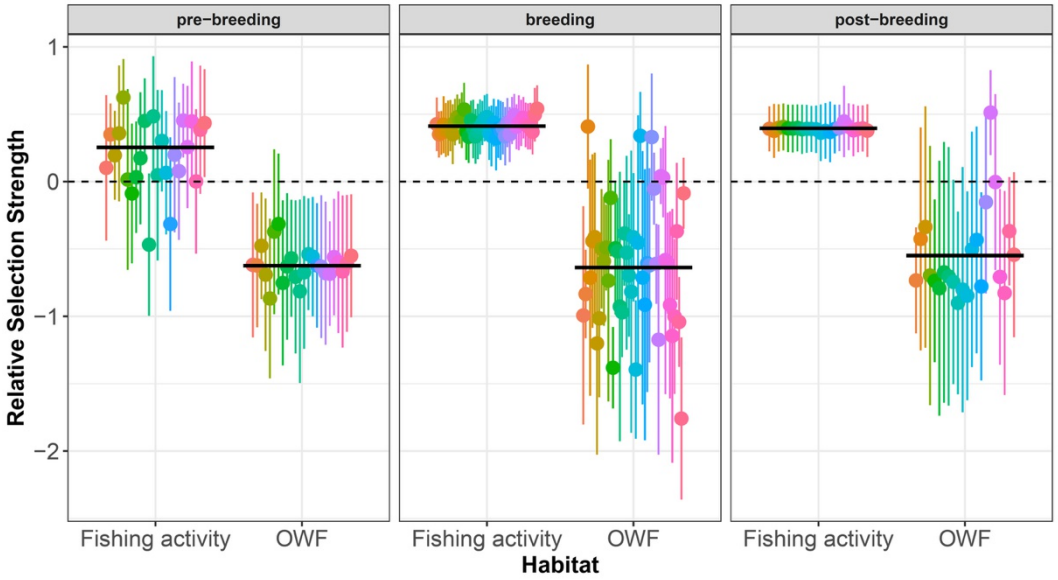


*Figure 3.6* *Conditional relative selection strength of Lesser Black-backed Gulls for areas with fishing activity and offshore wind farm during the pre-breeding, breeding and post-breeding period, where positive values indicate attraction and negative values indicate avoidance. Black lines are population means (fixed effects in the model), while coloured points and lines are individual estimates and confidence intervals (random effects). The log of step length is set at 6.57 per 20 min (see Figure I.4.2) and the cosines of the turning angle at 0 (see Figure I.4.3), representing a bird in flight going straight. Only estimates of individuals with >10 steps with a used or random location within the OWF are shown.*

*Table 3.4* *Model estimates of the relative selection strength of offshore wind farms in weekdays (Mon-Thu) and weekends (Fri-Sun).*

| Period | Weekdays (SE) | Weekend (SE) |
|---|---|---|
| Pre-breeding | -0.678 (0.160) | -0.472 (0.156) |
| Breeding | -0.654 (0.108) | -0.500 (0.112) |
| Post-breeding | -0.535 (0.171) | -0.458 (0.179) |

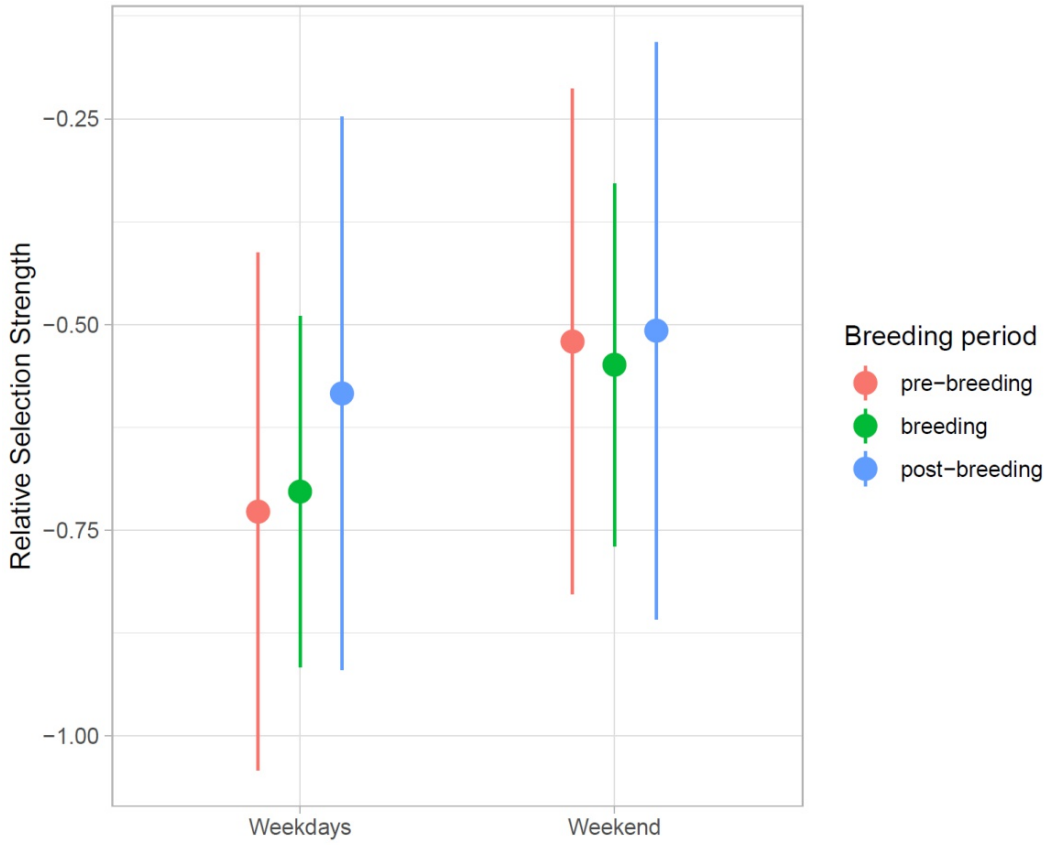


*Figure 3.7* *Conditional relative selection strength of the offshore wind farm during weekdays (Mon – Thu) and weekends (Fri – Sun), where negative values indicate avoidance. The log of step length is set at 6.57 per 20 min and the cosines of the turning angle at 0, representing a bird in flight going straight.*

## 3.5 Attraction to offshore wind farms during the weekend?

We did not find a significant difference in attraction on the population level to offshore wind farms during weekdays and weekends in any breeding period, nor when considering the entire period ($\chi^2$ = 5.616, df = 3, p = 0.13, Table 3.4, Figure 3.7). Estimates in all models show that gulls in general avoided offshore wind farms, during weekdays and weekends.

# 4 Discussion and conclusion

We used a step selection analysis to estimate Lesser Black-backed Gulls' selection strength to areas with recent fishing activity (within a time span of 24 hours) and a large offshore wind farm complex within their foraging range. We found that, in general, gulls were attracted to areas with fishing activity and avoided the offshore wind farm. On a population level, gulls were almost 1.5 times as likely to select areas with fishing activity than without, and 1.7 times as likely to select an area outside the offshore wind farm than inside, if given the opportunity. Because fishing with trawlers is not allowed inside the offshore wind farm, we cannot rule out that instead of actively avoiding the offshore wind farm, gulls were instead attracted to fishery activities outside the wind farm.

To investigate whether wind farms were avoided less when no or little fishing took place, we compared the selection strength to the offshore wind farm during weekdays (Mon – Thu) and during weekends (Fri – Sun) when fishing intensity was on average four times lower. However, there was no significant difference in selection strength to offshore wind farms, suggesting that gulls preferred to stay outside the offshore wind farm area when there was likely no or little fishing activity nearby.

Note that the step selection analysis estimates show how likely it is that an individual selects one habitat over another on the basis that these habitats are otherwise equal in availability (Fieberg *et al.* 2021), and that it does not examines the behaviour of an individual in that habitat.

## 4.1 Time spent at the North Sea

Although we only selected location data at sea, we observed large individual variation in how many hours individuals spent at sea per day. Some gulls spent almost all their time at sea, assumingly to forage and rest, while others only spent some days at sea. During the breeding period from 15 May until 15 July gulls spent on average least time at sea on a daily basis (4.15 hours) than during the pre- (5.05 hours) and post-breeding (5.89 hours) periods, after they have arrived in the North Sea and before they depart. That they spent less time at sea during the breeding period can be explained by the time they need to attend their eggs or chicks.

On average, gulls spend more time at sea during weekdays than weekends when fisheries activity is lowest, although the difference was relatively small: on average 4.3 hours per day during weekdays and 3.7 hours during the weekend. Lesser Black-backed Gulls breeding on Texel, the Netherlands, also reduced foraging time in the fished areas in the Wadden Sea during weekends compared to weekdays (Tyson *et al.* 2015). The magnitude of this difference varied between colonies: gulls breeding on Texel showed a much larger

contrast (27% of their time in the Wadden Sea during weekdays versus 1% during weekends), while gulls breeding on Neeltje Jans showed a smaller difference (18% of their time at sea during weekdays in the breeding period, versus 16% during weekends). Similarly, gulls breeding in the neighbouring colony of Zeebrugge spent approximately 40% of their trips at sea during weekdays compared to 20% during weekends (Sotillo *et al.* 2019). Overall, the time spent at sea varies considerably among colonies, for instance, gulls breeding in a UK colony spent less than 1.25% of their time offshore (Clewley *et al.* 2023), while gulls from a German colony spent almost half of their foraging trips at sea (Garthe *et al.* 2016). The Zeebrugge study showed that foraging at sea implied larger energy expenditure rates while time investments were shorter compared to terrestrial foraging (Sotillo *et al.* 2019). However, the proximity to alternative food sources such as urban areas (Spelt, 2019} or landfills (Langley *et al.* 2021) likely influenced these time investments.

## 4.2 Attraction and avoidance of fished areas and offshore wind farm

Bottom trawling was the main type of fishing around the colony (Global Fishing Watch 2025). This type of fishing produces many discards (undersized or unwanted fish and invertebrates thrown back to sea), which is a food source for many seabirds (Sherley *et al.* 2019). Lesser Black-backed Gulls are known as discard specialists (Camphuysen 1995, Sherley *et al.* 2019, Camphuysen *et al.* 2024), however, they also self-forage on subsurface pelagic fishes and crabs (Baptist *et al.* 2019). Interestingly, there was less variation between individuals in the selection coefficient to areas with active fishing in the breeding and post-breeding period compared to the pre-breeding period. Lesser Black-backed Gulls breeding on Texel are also observed to rest at sea (Shamoun-Baranes *et al.* 2011), which they most often do before the breeding period (R. Kentie pers. obs.). Perhaps, the larger individual variation in the pre-breeding period is a result of differences in prey or discard availability or of other behaviours than foraging at sea, typical for the pre-breeding period. During the breeding and post-breeding period, there was little individual variation in selection strength for areas with fishing activity. Even if the selection strength for areas with fishing activity was high, it does not necessarily mean that individuals only or predominantly foraged on discards; we only show that if given the choice between an area with fishing activity and without, they would rather select the area with fishing activity.

On a population level, gulls avoided the offshore wind farm area, but there was large individual variation, particularly during the breeding period. Some individuals were attracted to the wind farm, while others actively avoided the area. Lesser Black-backed Gulls have been observed to use the base of the turbines to rest (Vanermen *et al.* 2014, Dierschke *et al.* 2016), or to forage on pelagic prey in between the turbines (Vanermen *et al.* 2014). A study on Kittiwakes also found substantial individual variation in selection strength to various environmental covariates, making it difficult to predict population responses to local stressors such as OWFs (O'Hanlon *et al.* 2024). Whether attraction to the wind farm area is a repeatable trait, which individuals (e.g. with certain personalities or life history traits) are attracted to the wind farm, and their behaviour inside the wind farm, needs further research. Understanding their behaviour within wind farms helps determine if and how

much individuals are more at risk of collision within wind farms and potential energetic consequences of avoidance or attraction of wind farms.

In general, Lesser Black-backed Gulls avoided the offshore wind farm equally during weekdays and the weekend, when fishery activity was at its minimum. If gulls were avoiding the offshore wind farm primarily because fishery activities were not allowed inside and not because they avoided wind turbines, we would have expected a lower avoidance rate during the weekend. However, it is also possible that prey availability inside the wind farm is lower than outside, or that gulls are attracted to other prey species which do actively avoid wind farms. Detailed data on prey distribution may help in disentangling the effects of foraging opportunities and active avoidance of wind farms.

## 4.3 Flight speed and height inside and outside OWFs

We found that the mode of flight speed was on average 35 km/h within the OWF, which is 5 km/h faster than when they fly at sea outside the OWF. There was little variation between breeding periods, although during the pre-breeding period the average mode speed was lower than in the other periods. This difference in speed outside and within the OWF might be related to foraging behind fishing vessels which sail at lower speeds, and only outside OWFs. Note, however, that there are large variations in speeds, also between individuals. Wind speed and flight direction (from or towards the colony) affect flight speed (Masden *et al.* 2021) and individual size might also influence flight speed. Collision Rate Models are sensitive to flight speed (Masden *et al.* 2021), which means that these numbers are needed to be used with precaution.

Height measurements by GPS should be interpreted with care (Schaub *et al.* 2023) and we did found large errors. If we assume that these errors are similar inside and outside the OWF, we found that gulls fly on average higher within the OWF (median 38 m) compared to outside the OWF (median of 23 m). There were differences in flight height between breeding periods, and gulls seemed to fly higher inside the OWF during the pre-breeding period. Median flight height inside the OWF overlapped in each breeding period with the lowest rotor-swept zone of the wind turbines. Previous studies found that straight-line segments of flight, representing commuting flight, correlated with higher flights (Corman and Garthe 2014). Therefore, that gulls fly faster and higher within the OWF may suggest that gulls behave differently within the OWF compared to outside. This most likely corresponds to the absence of fisheries within the wind farms.

## 4.4 Application of our results in Collision Rate Modelling

Avoidance, flight speed and flight height are important parameters of Collision Rate Models (CRM) that are used to predict the number of casualties due to collisions with offshore wind turbines. In the report at hand, we present new figures for all three parameters, however, we also show large variation between individuals and over the season. Since the various levels of avoidance (micro, meso and macro) are lumped in CRMs to one figure, the (macro-)avoidance rate of this study is not directly applicable to these models. Yet, this study gives a very precise insight in the level and variation in individual macro-avoidance

based on GPS-tracking data in contrast to general avoidance rates based on survey data. Our new estimates of flight speed and flight height could be directly applied in CRMs and our results suggest that birds fly slightly higher within wind farms compared to outside. This will have consequences for the predicted mortality in CRMs. We therefor suggest repeating our analyses with more data (f.e. with Lesser Black-backed Gulls from Belgium, Rotterdam or Texel) to test the robustness of our results. Furthermore, it is advised to perform a sensitivity analysis of the consequences of changing parameters first. A similar strategy should be applied for flight speed although the predicted consequences will be less. Our data also suggest variation in input parameters for CRMs during different periods of the year. Application of this variation in these models is not straightforward but can be applied as has been done recently with specific avoidance rates of Northern Gannet for the breeding and the non-breeding period in the latest version of the KEC (IJntema *et al.* 2025).

## 4.5 Conclusions

In general, we found that Lesser Black-backed Gulls, when at sea, were attracted to areas with active fishing, and were avoiding the offshore wind farm within their foraging range. However, not every individual avoided the wind farm, some were attracted to it. This individual variation must be taken into account when considering effects of offshore wind farms on population levels. Because gulls avoided the wind farm equally during weekends and weekdays, this suggests that the wind farm is actively avoided instead of a larger attraction to the area outside the wind farm where fishing occurred. Within the OWF, gulls flew faster and higher, indicating different behaviour compared to outside the wind farm, likely caused by the absence of fishing activity. However, if fishing would be allowed, gulls might enter the wind farm more often and change their behaviour, potentially increasing collision risk. Yet, the flight height of gulls specifically behind fishing vessels plays a significant role in terms of potential collisions as well.

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# Appendix I – Supporting Information

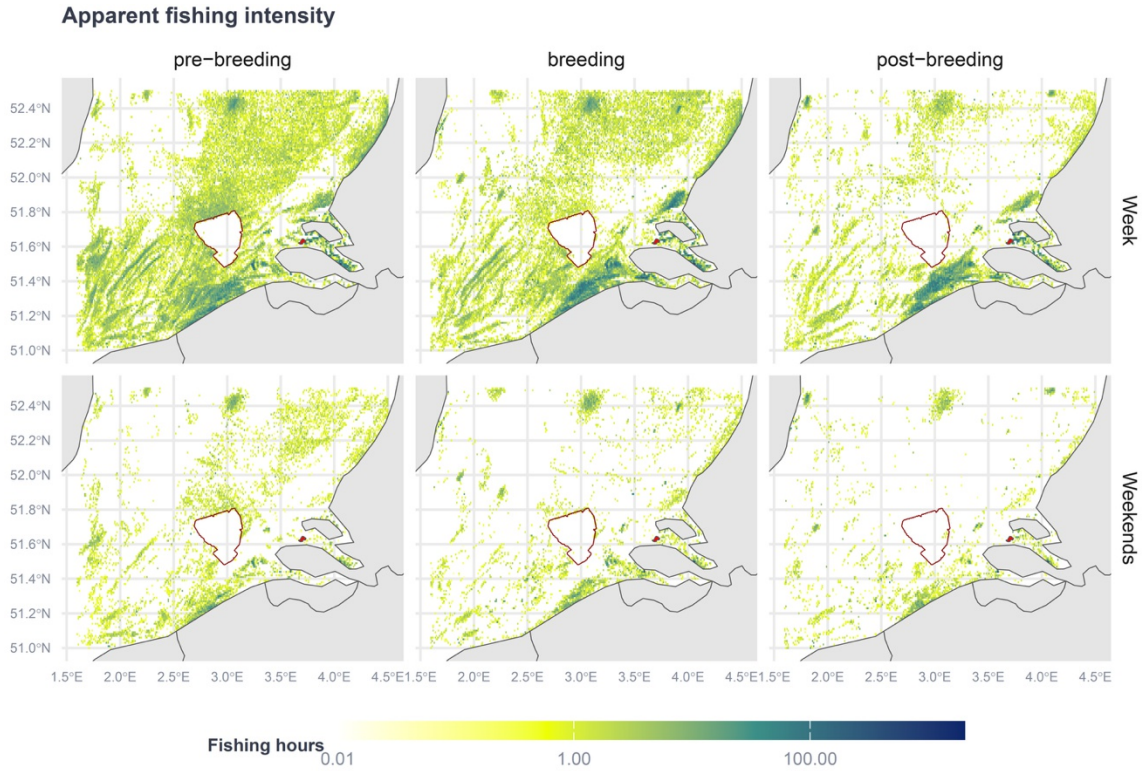



*Figure I.4.1* *Map of fishing intensity around the breeding colony at Neeltje Jans in 2021 and 2022 in hours summed per breeding period and during the week and the weekend. Fishery data comes from Global Fishing Watch.*

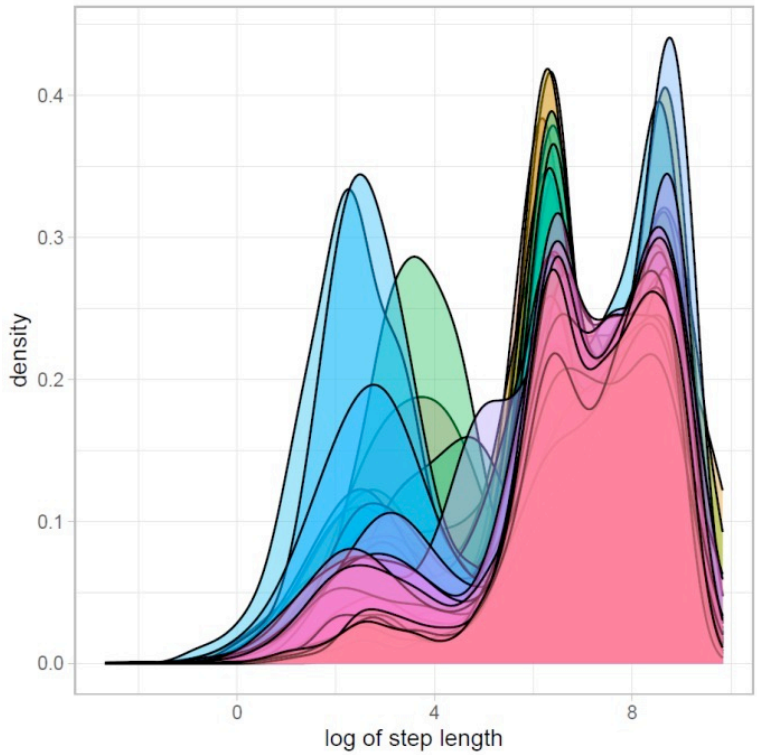



*Figure I.4.2* *Distribution of (log of) step length in km, per 15 min, coloured per individual.*

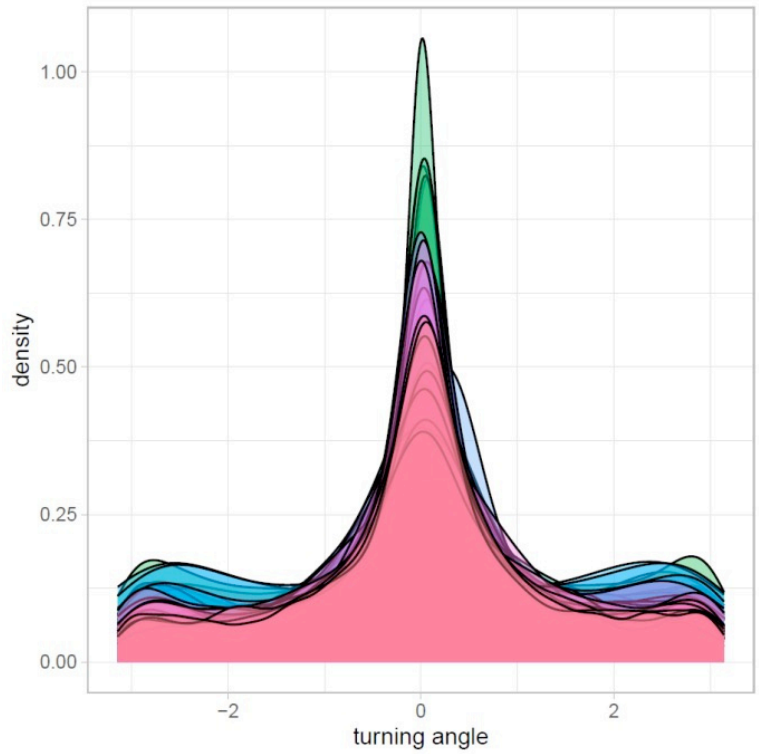



*Figure I.4.3* *Distribution of turning angles, coloured per individual. A turning angle of 0 means that the path goes straight.*

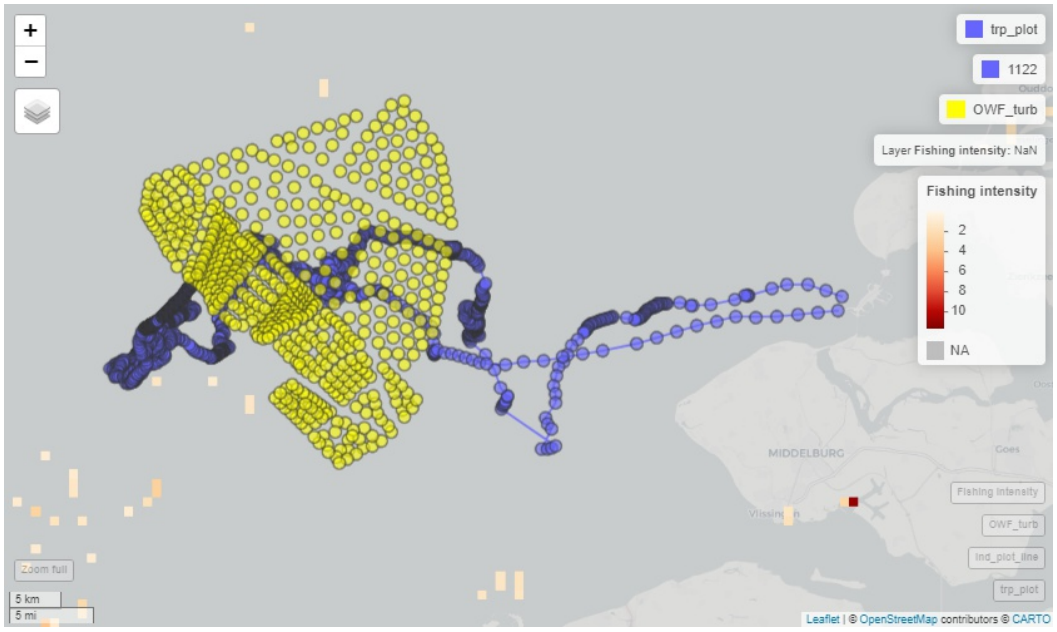



*Figure I.4.4 Foraging trip of individual 211276 on Saturday 12-6-2021.*

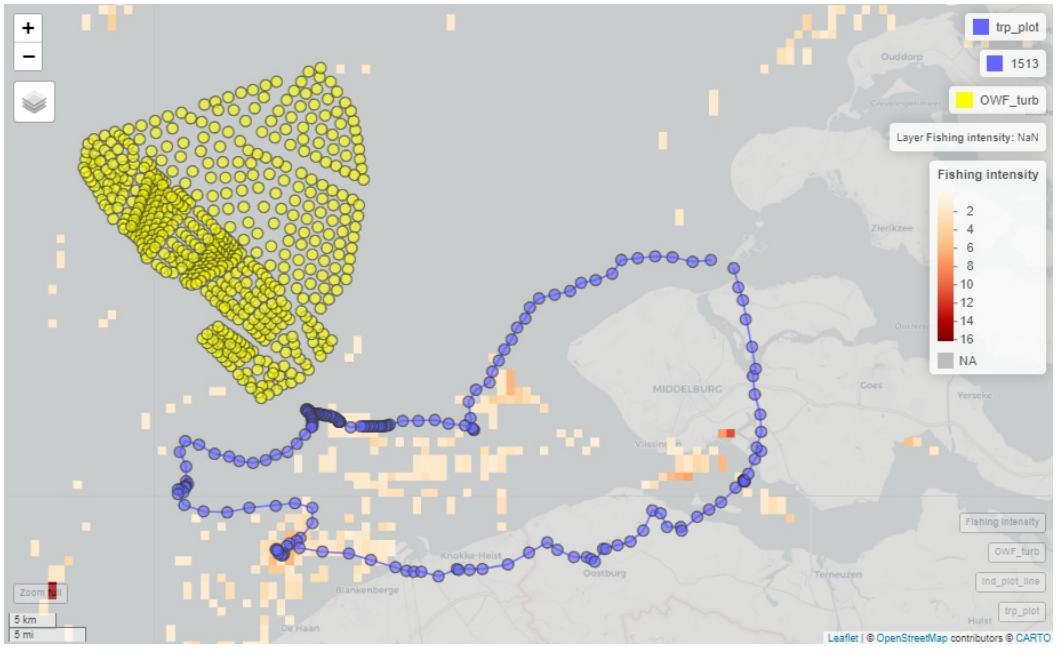



*Figure I.4.5 Foraging trip of individual 211279 on Monday 14-6-2021.*

# Appendix II - Information on Herring Gulls

We additionally investigated the possibility that Herring Gulls from the same breeding colony entered the offshore wind farm (Borssele and the Belgian wind farms). We used tracking data in the year of tagging in 2020, as in 2021 no new birds were tagged (Vanermen *et al.* 2022). The construction of Borssele (the Northeastern part of the wind farm, Figure II.4.6) started in 2019 and it became operational in the end of 2020. The Belgium part of the wind farm was operational before 2020. After the breeding season, from July onwards, Herring Gulls of Neeltje Jans dispersed and spent most time in the coastal zone, typically within 15 km from the coast (Vanermen *et al.* 2022). This pattern of dispersal after the breeding season was also found in other colonies (Camphuysen *et al.* 2011). We therefore focussed on the period June and July, because this was the period with most data and the highest likelihood of coming close to the offshore wind farm near the breeding colony.

Tracked Herring Gulls never entered the offshore wind farm in 2020 between 1 June and 31 July (when we had most tracks of Herring Gulls; 22 individuals with suitable tracks) (Figure II.4.6). In general, Herring Gulls rarely come closer than 23 km to the offshore wind farm (Figure II.4.7), mostly staying close to shore. Only 8 tracks of 3 individuals came closer than 10 km to the offshore wind farm (Figure II.4.7, Figure II.4.9, Figure II.4.10, Figure II.4.11), and the nearest a Herring Gull approached the wind farm was 1 km (Figure II.4.8).

Herring Gulls are known to forage closer to shore than Lesser Black-backed Gulls (Camphuysen 1995, Camphuysen 2013, van Donk *et al.* 2020). The figures shows that this also applies to the Herring Gulls breeding at Neeltje Jans. Whether or not Herring Gulls are attracted to offshore wind farms is therefore not possible to test with this dataset, since the wind farms seem out of reach of their foraging range.

An important parameter of Collision Rate Models is the flight speed of birds. Our data also allow quantification of this flight speed. There is a wide range of speeds of Herring Gulls when they are at sea (Figure II.4.12). Only speeds larger than 5 km/h are shown in this graph, however, there is still a ‘hump’ of lower speeds, which may be birds floating at sea, sitting at vessels, or showing other behaviours than flying. The second ‘hump’ shows the average flight speed, which is 33 km/h. However, there is large variety in speed, as flight speed depends on wind speed, soaring conditions, size of the bird and direction (Shamoun-Baranes *et al.* 2016).

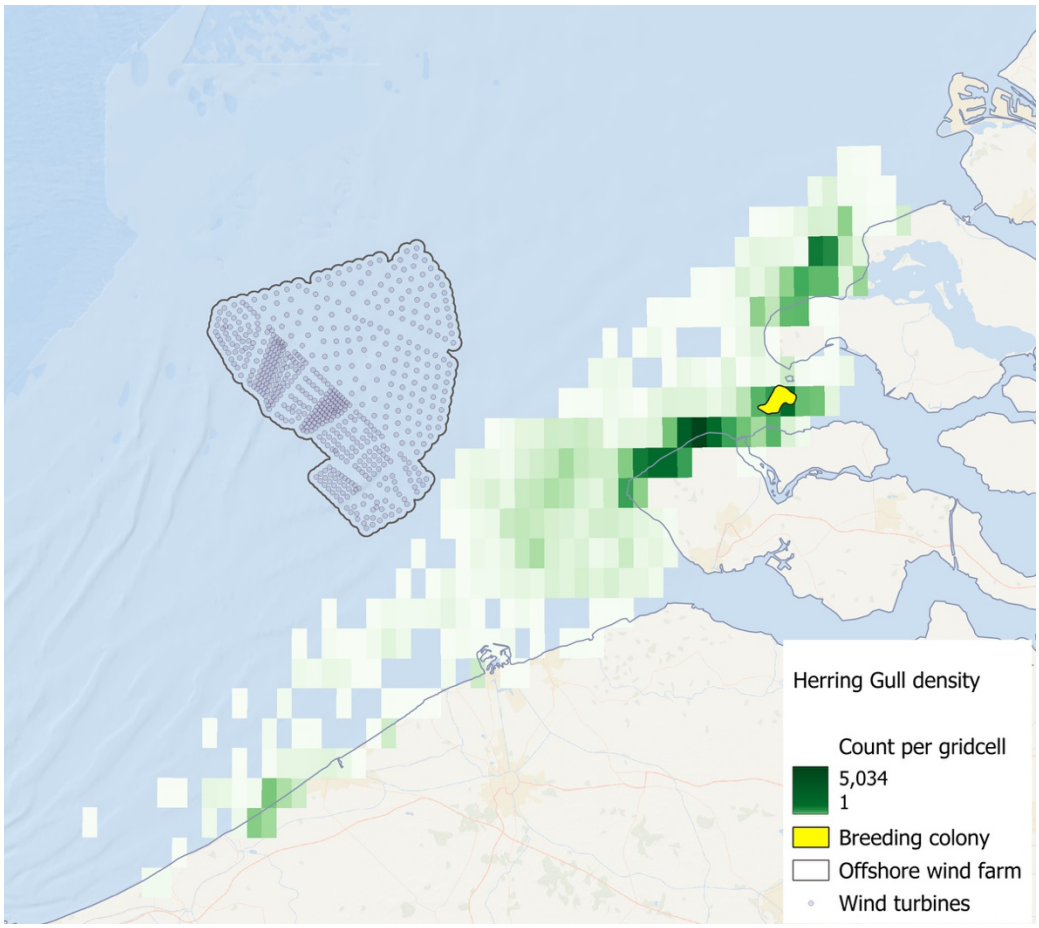



*Figure II.4.6* *Density of GPS positions of Herring Gulls (regularized positions with 15 minutes) at sea in relation to the offshore windfarm and the colony between 1 June and 30 July 2020.*

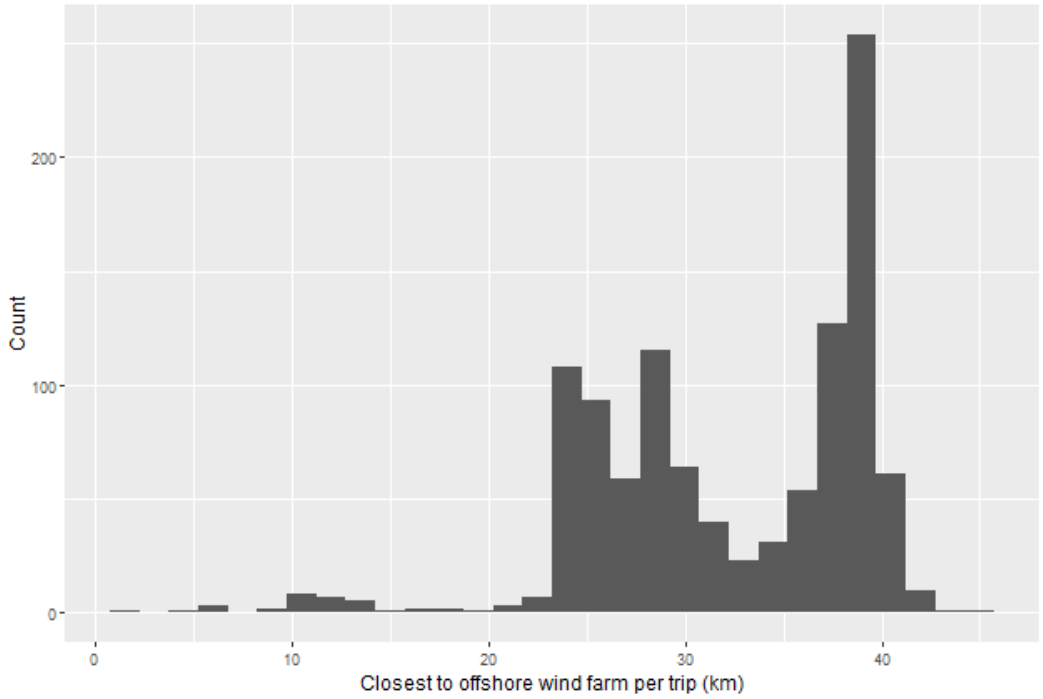



*Figure II.4.7* *Minimum distance per foraging trip to offshore wind farm. The colony is situated at ~39 km distance, thus when a Herring Gull flies in the other direction than the offshore windfarm, the closest it was, was when it left or entered the colony.*

*Figure II.4.8* *The foraging trip of the Herring Gull which approached the offshore wind farm nearest.*

*Figure II.4.9 Foraging trip of a Herring Gull which approached the wind farm at less than 10 km.*

*Figure II.4.10 Foraging trip of a Herring Gull which approached the wind farm at less than 10 km.*

*Figure II.4.11* *Foraging trip of a Herring Gull which approached the wind farm at less than 10 km.*

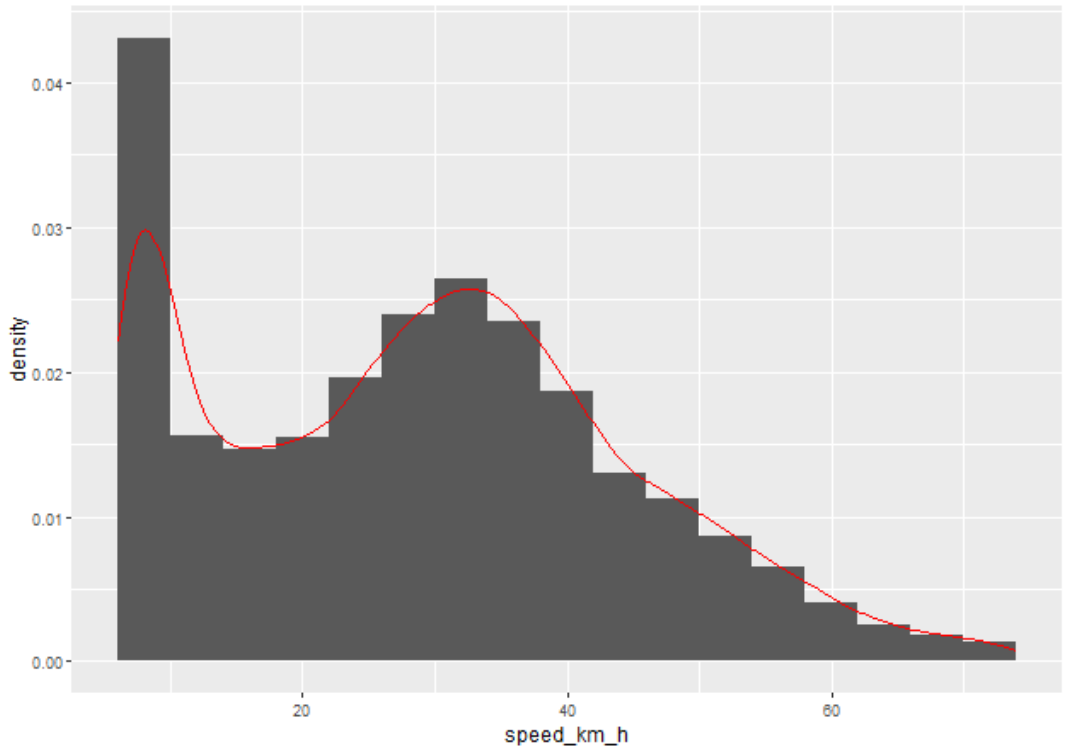
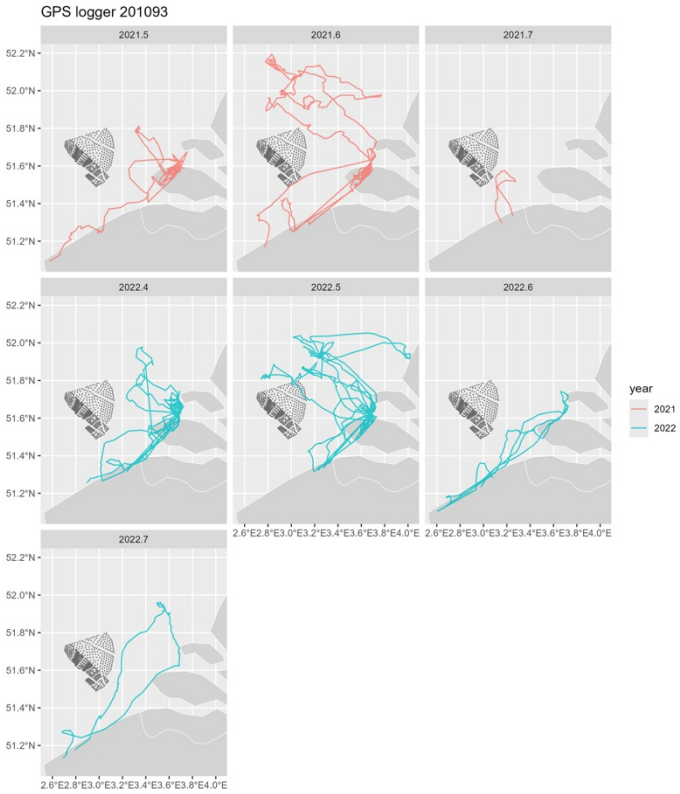



*Figure II.4.12* *Speed per logged GPS location of Herring Gulls at the North Sea. Speeds faster than 5 km/h are shown.*

# Appendix III – Year-round maps of Lesser Black-backed Gulls per month



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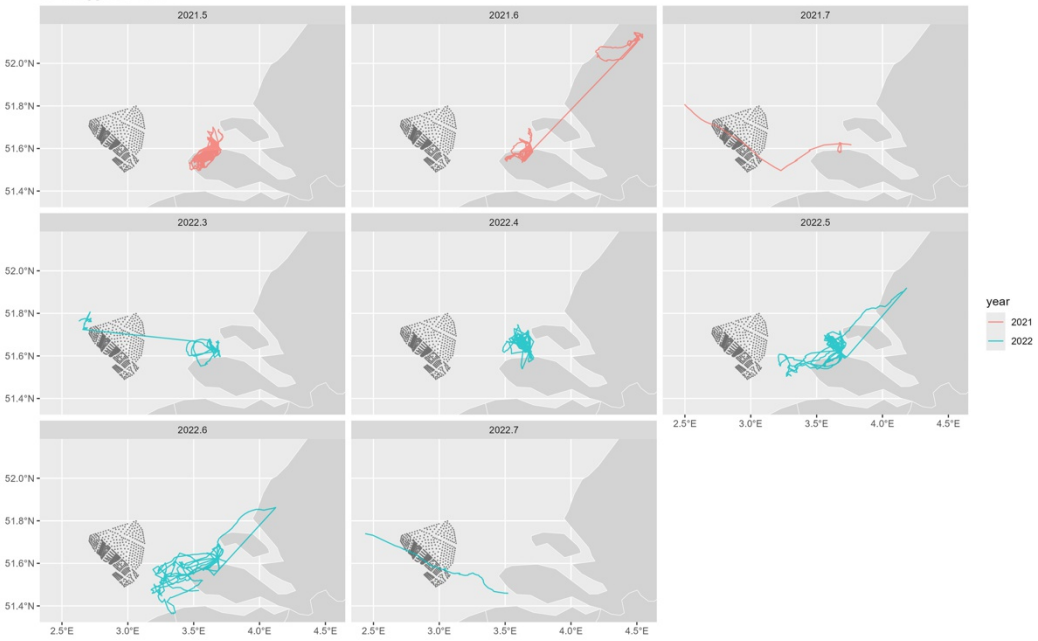


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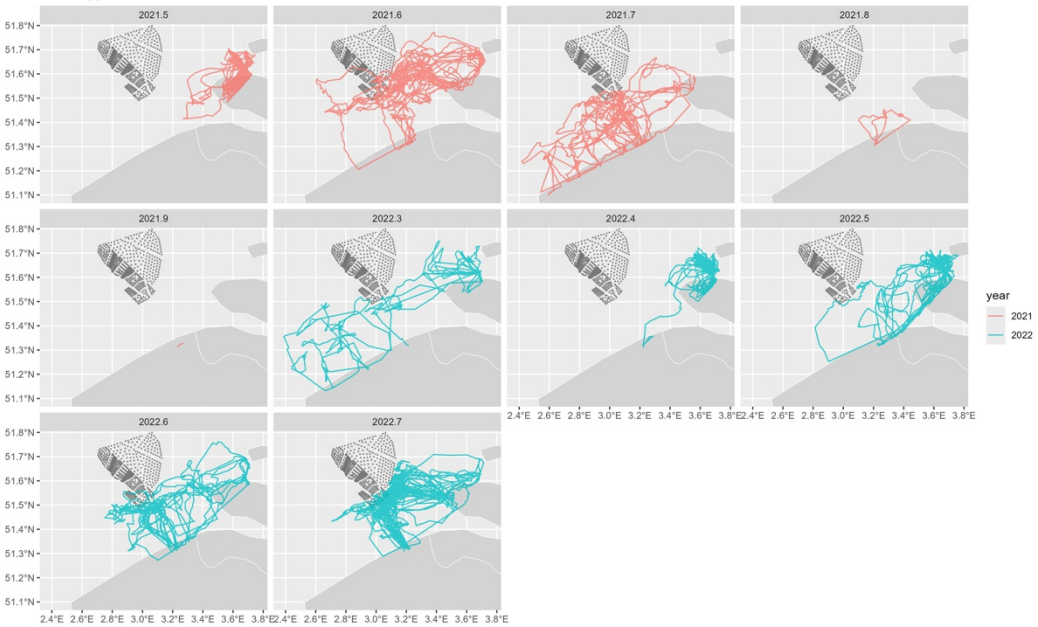

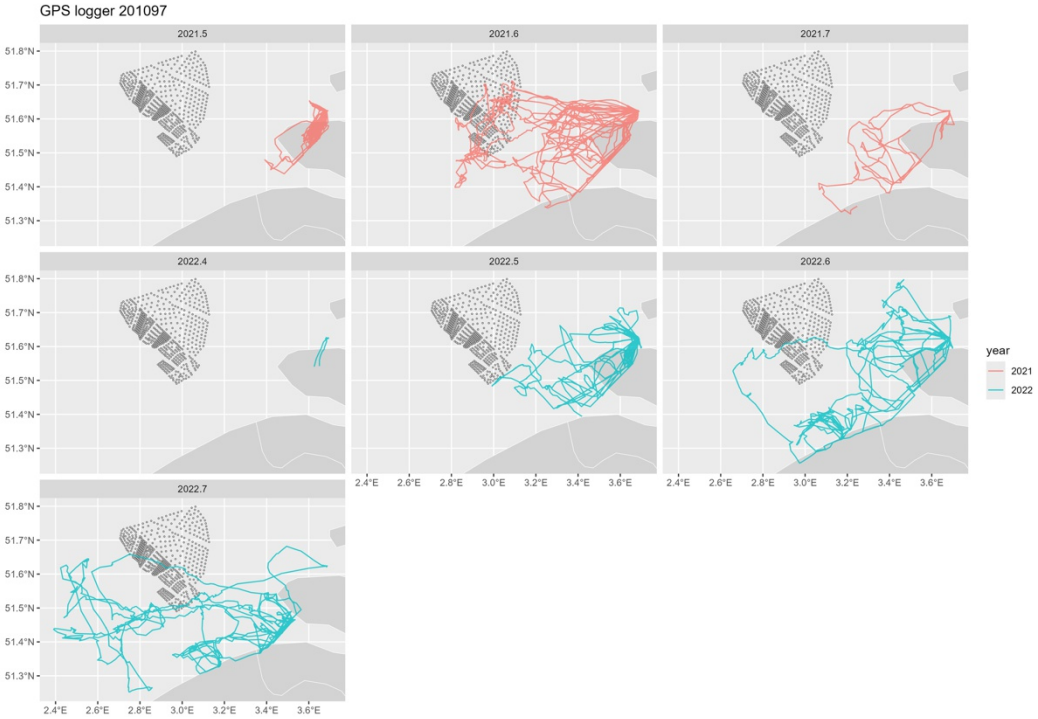
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51.4°N
51.3°N
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year
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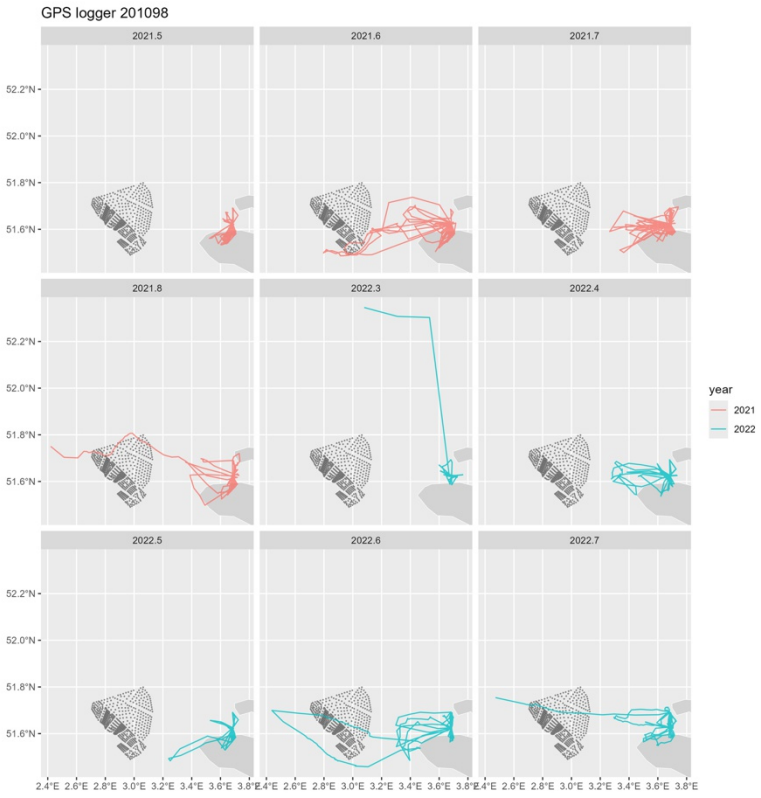
2022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year
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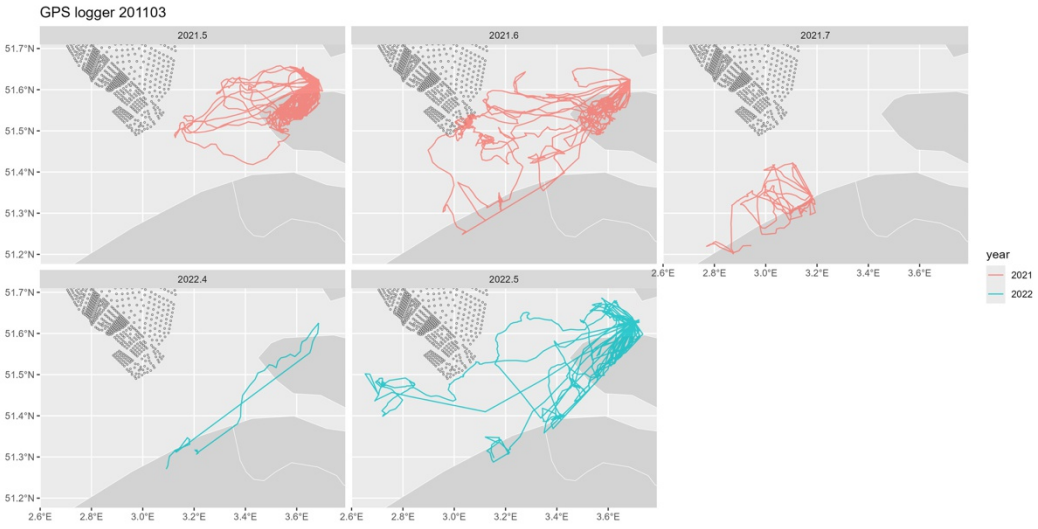
2022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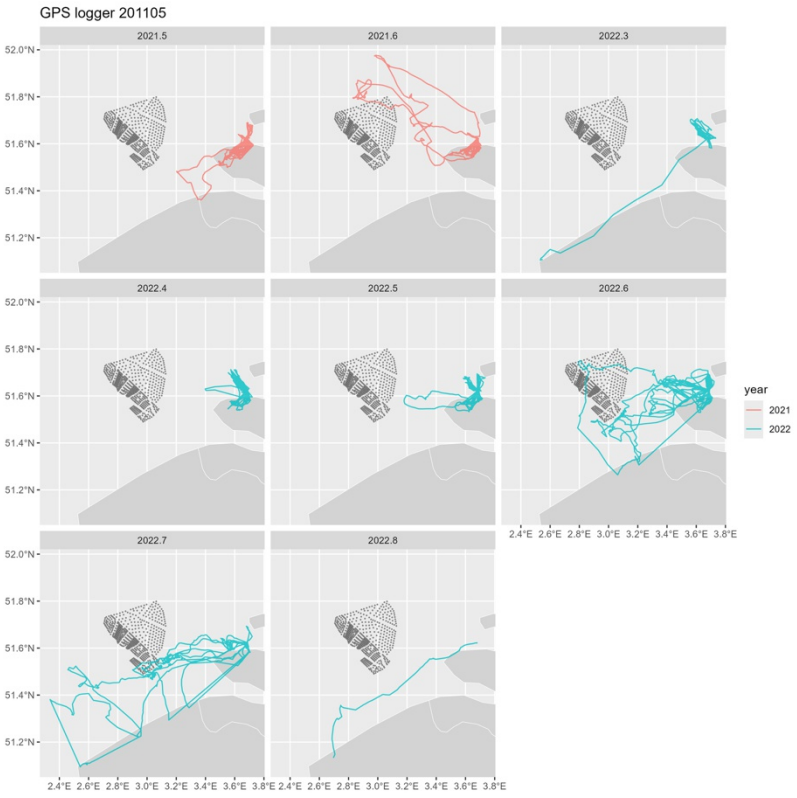
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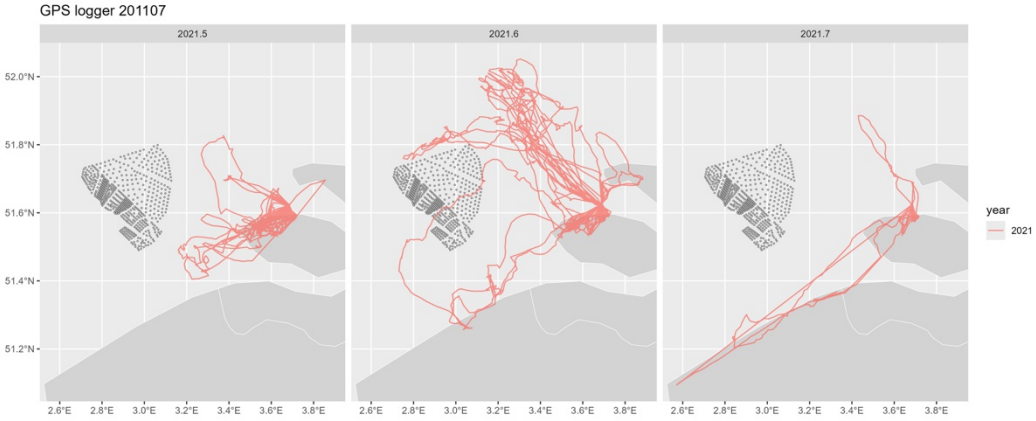
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year
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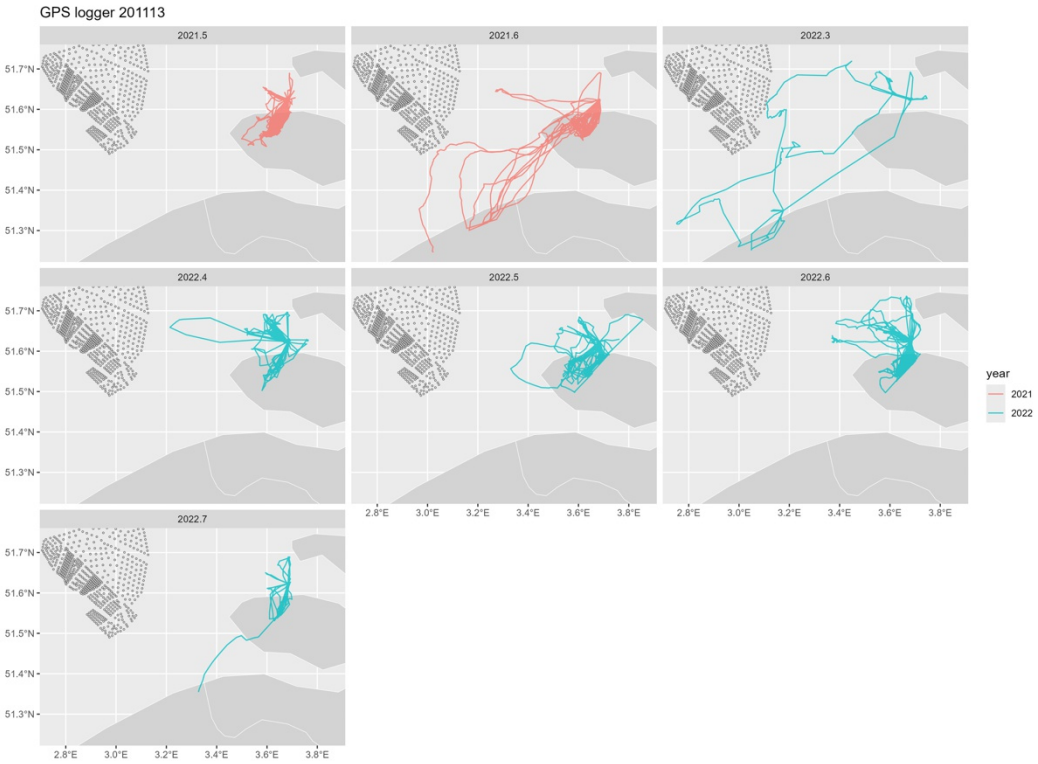
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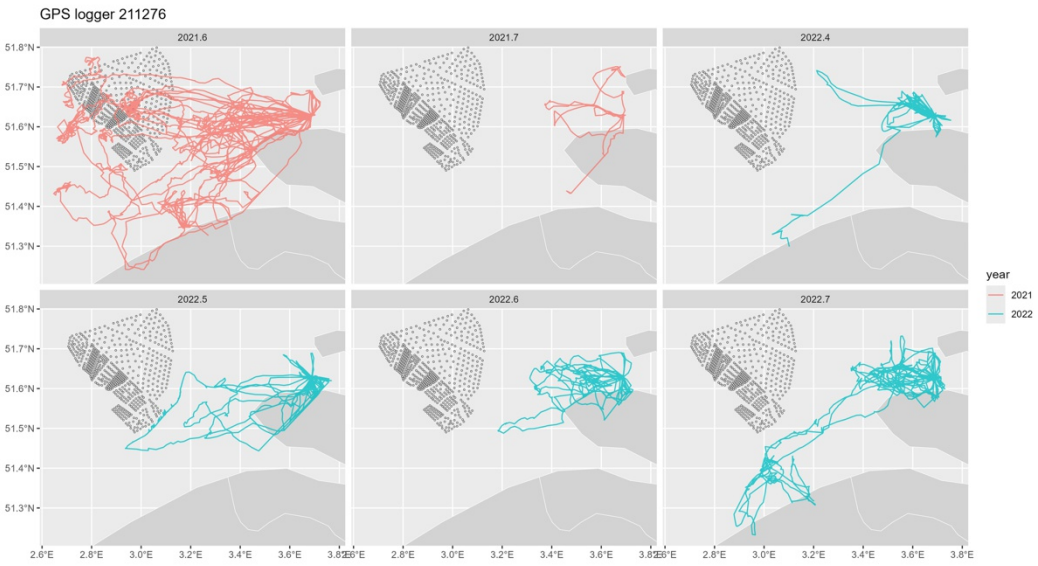
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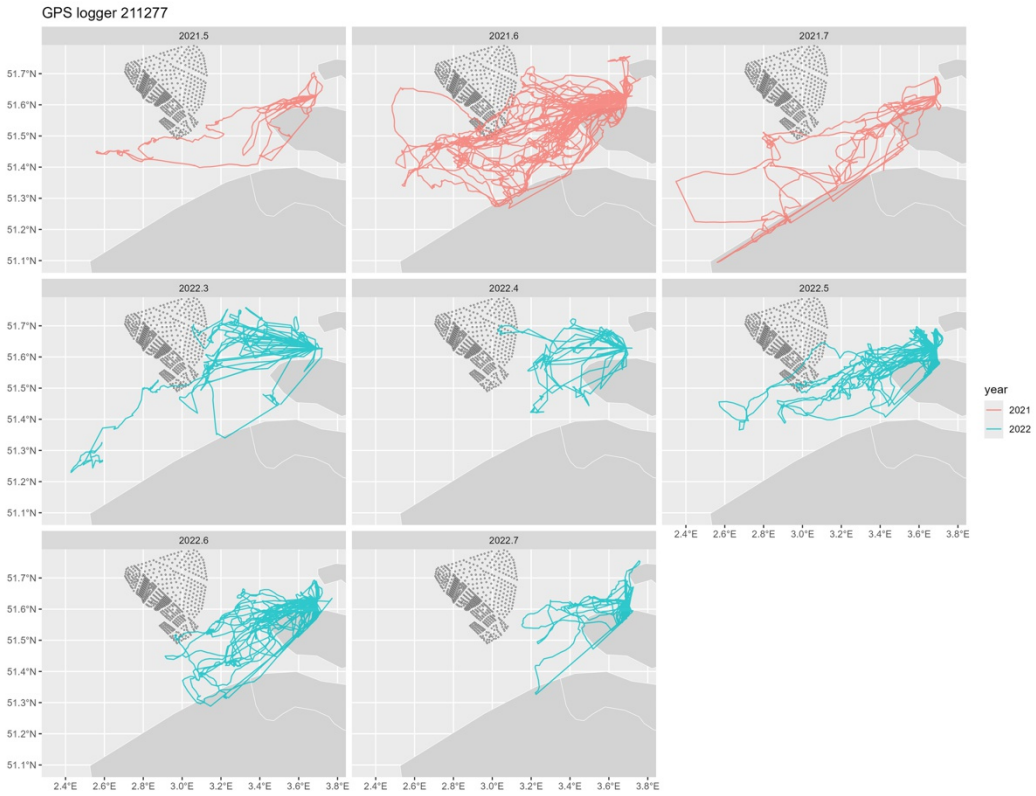
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2021
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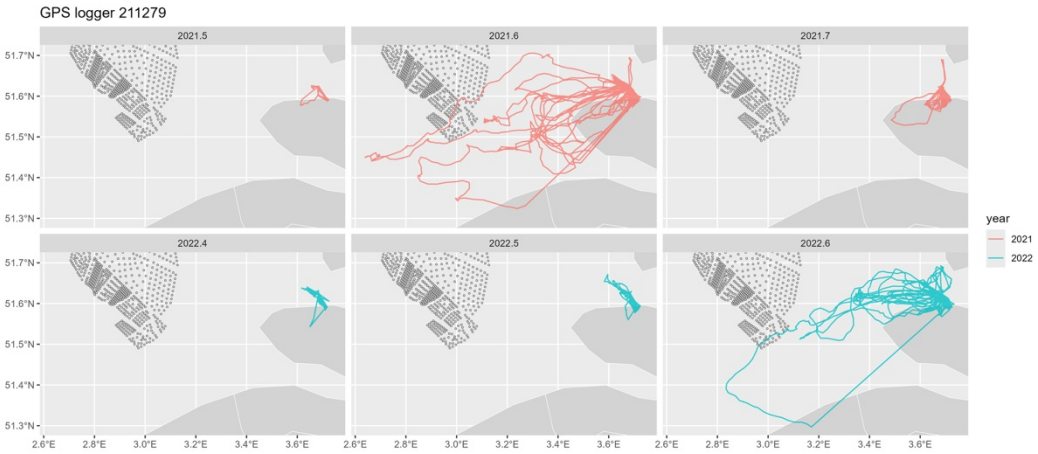
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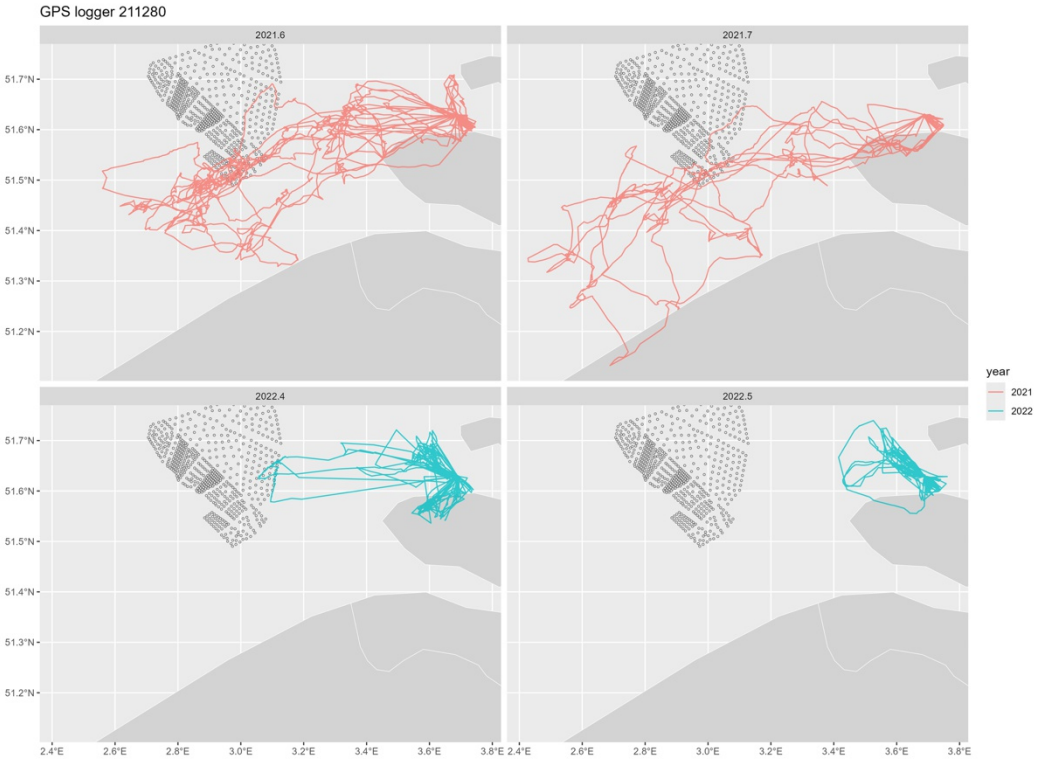
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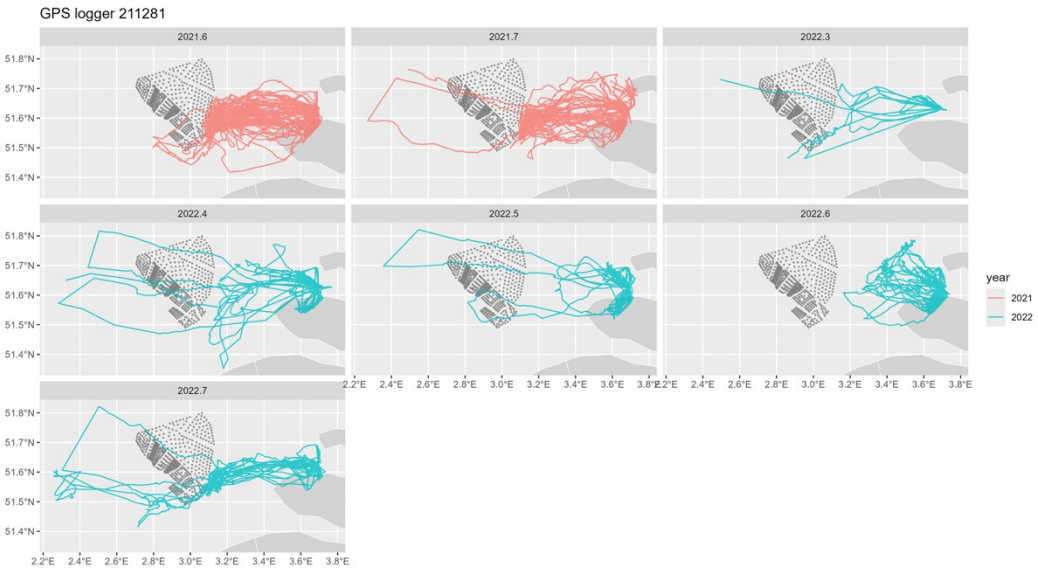
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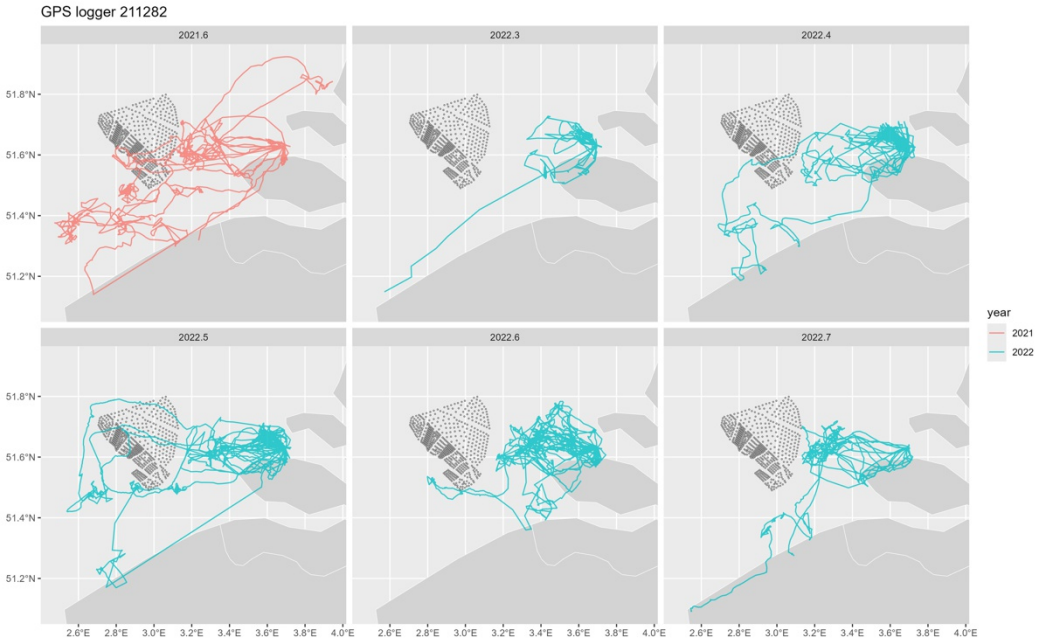
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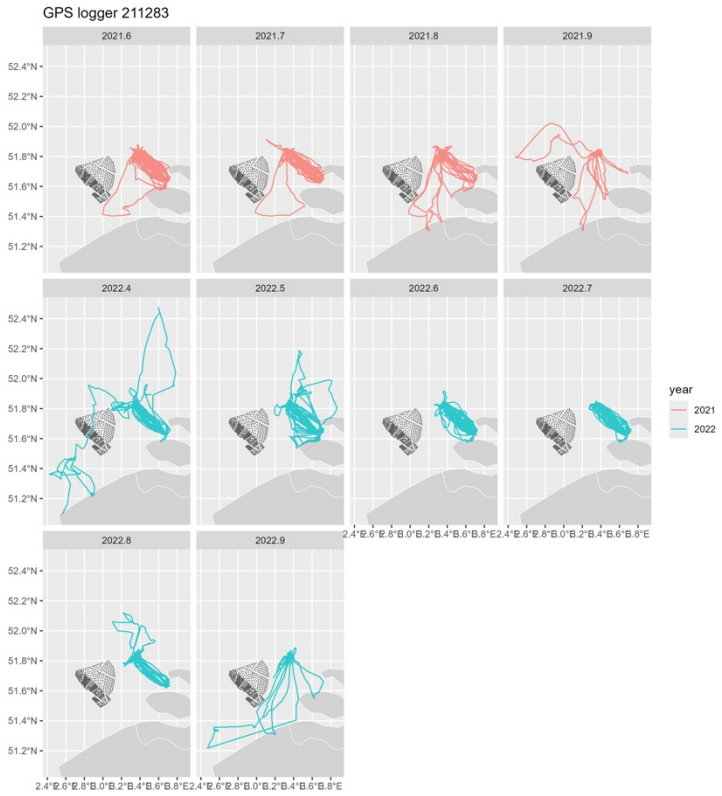
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2022.4
2022.5
2022.6
2022.7
2022.8
2022.9
52.4°N
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51.6°N
51.4°N
51.2°N
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2.6°E
2.8°E
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3.2°E
3.4°E
3.6°E
3.8°E
year
2021
2022

GPS logger 211284
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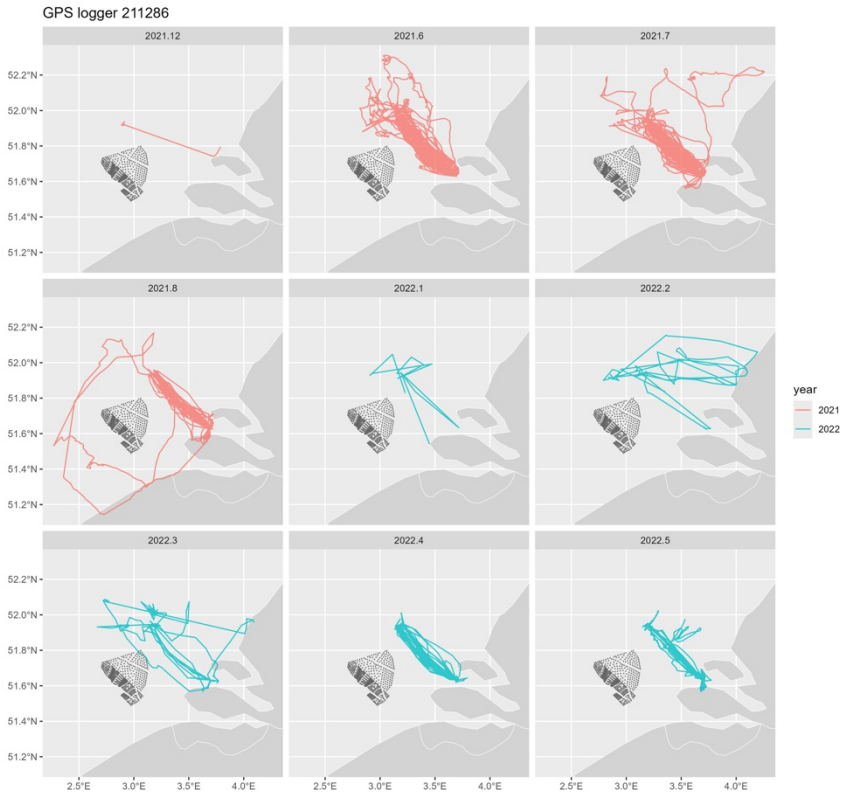
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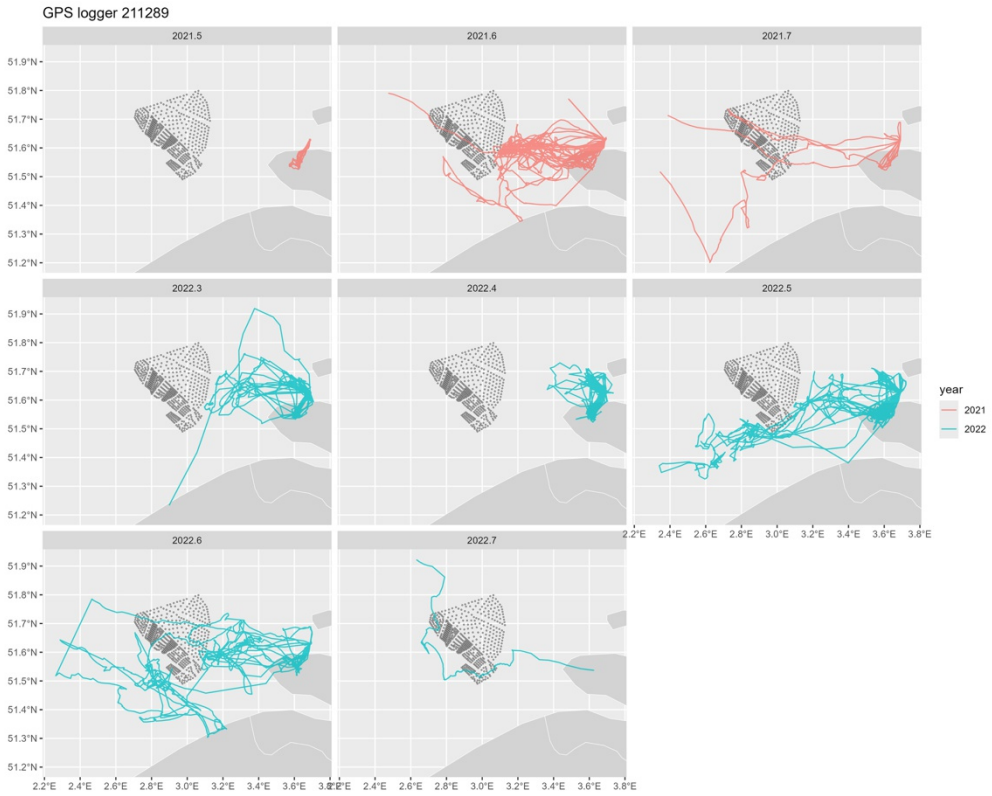
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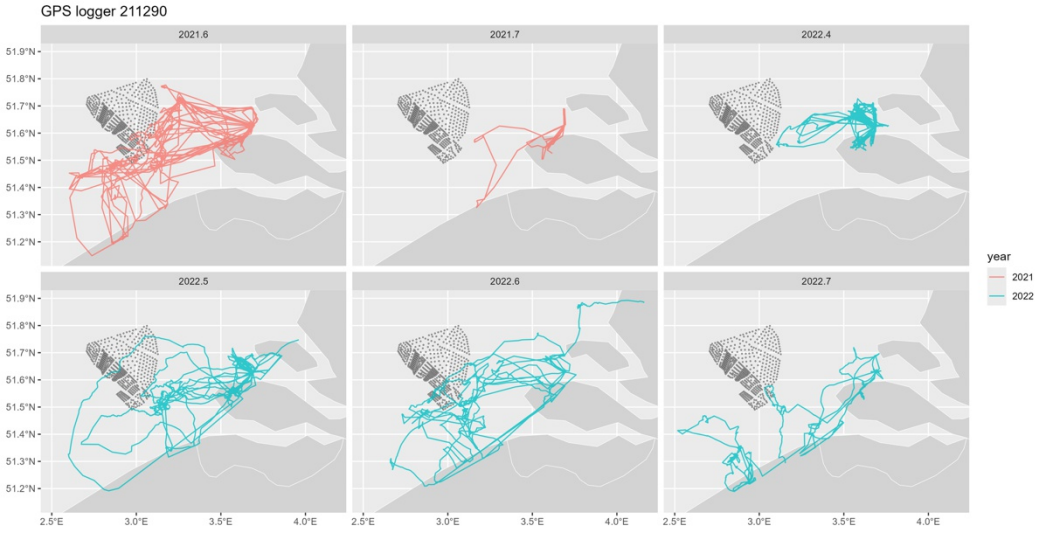
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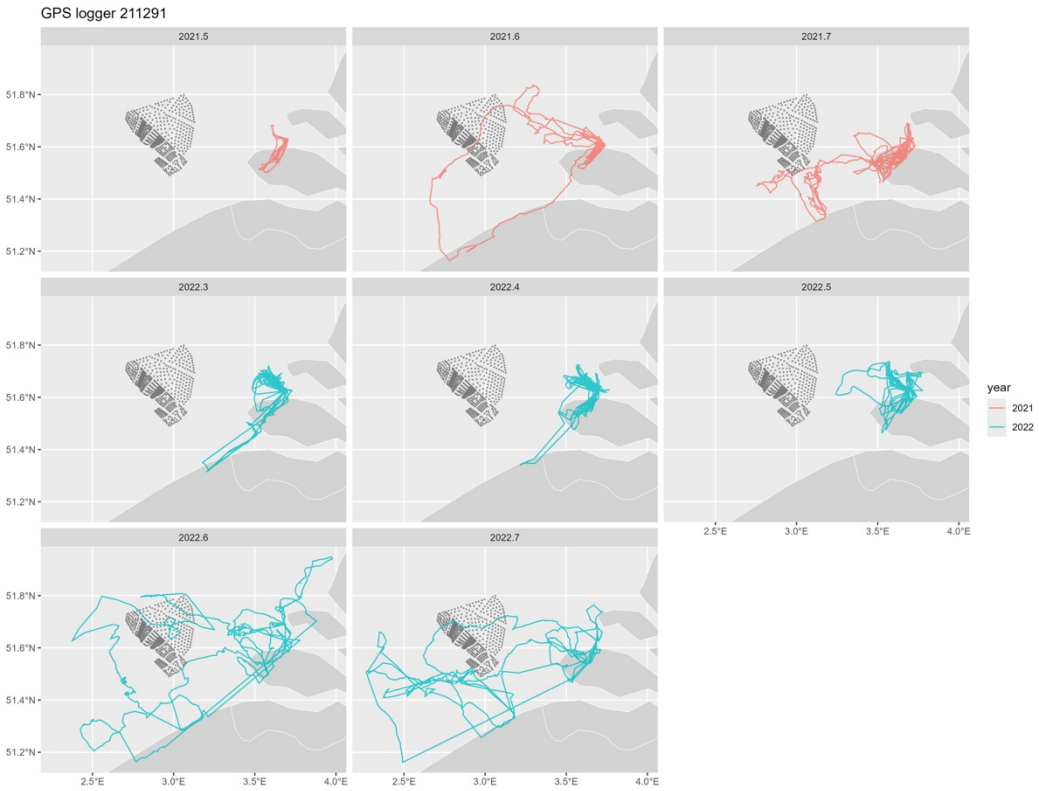
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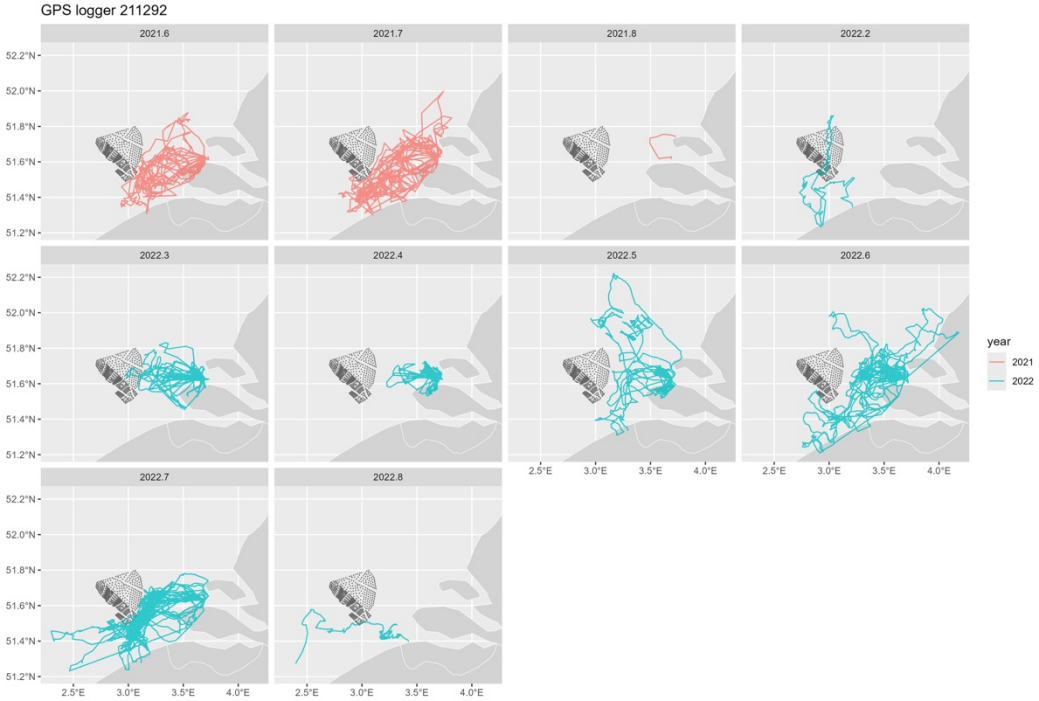
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51.8°N
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year
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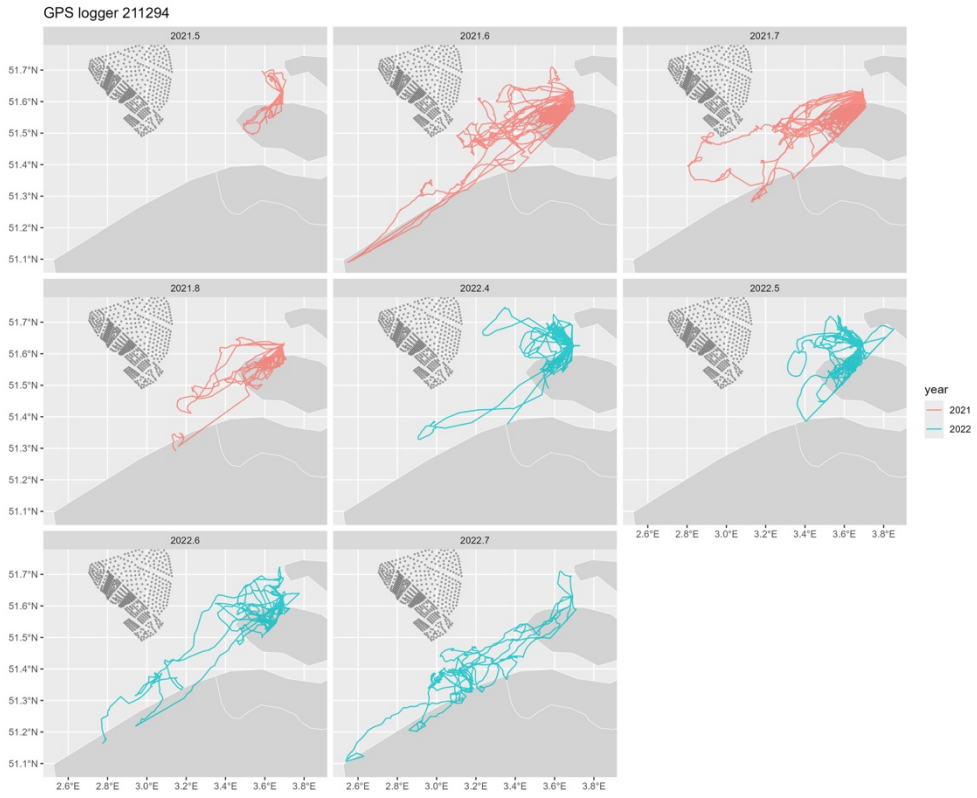
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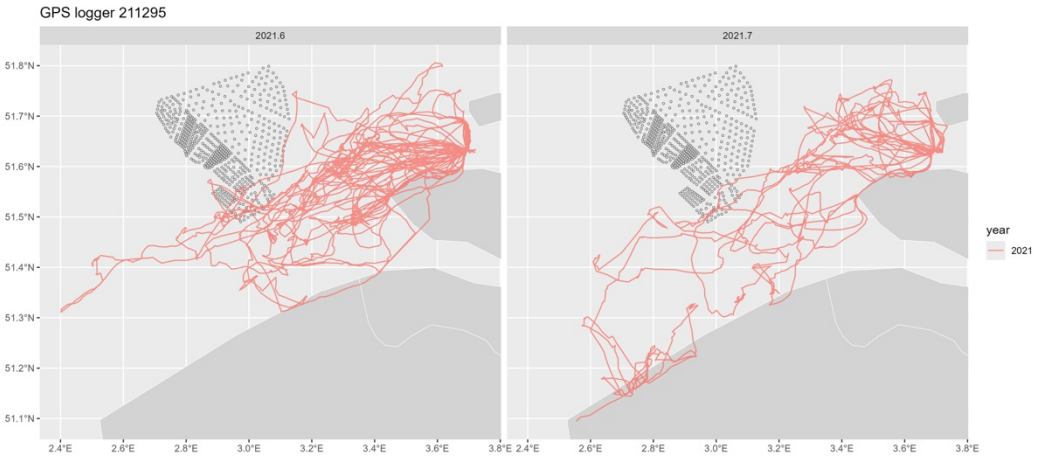
2022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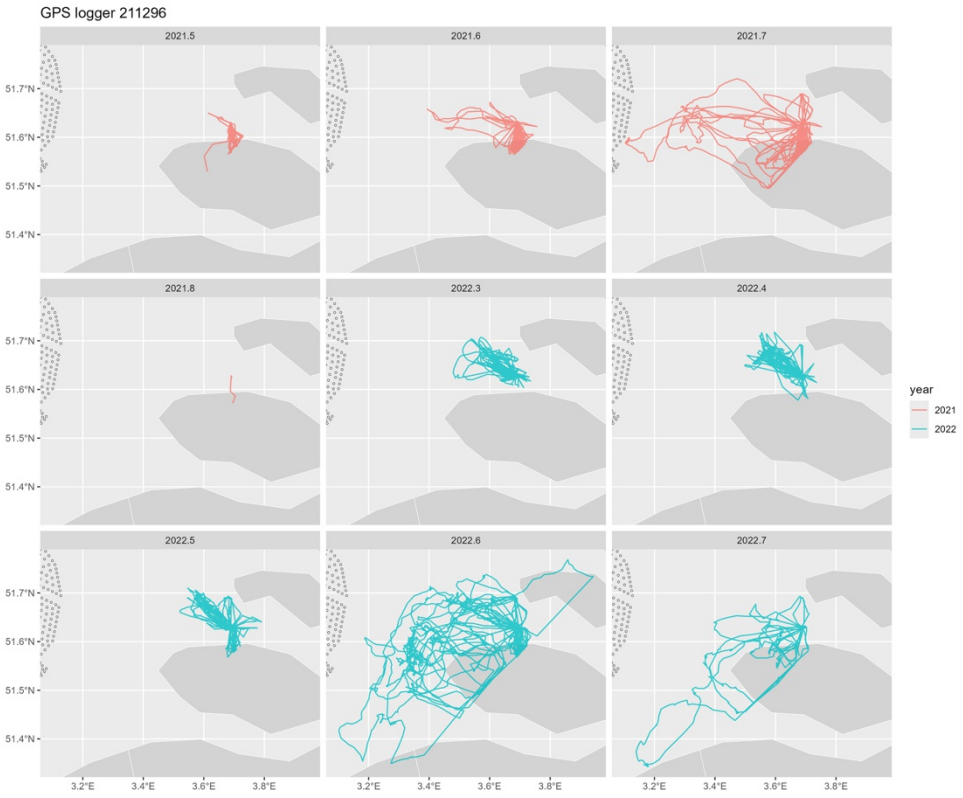
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year
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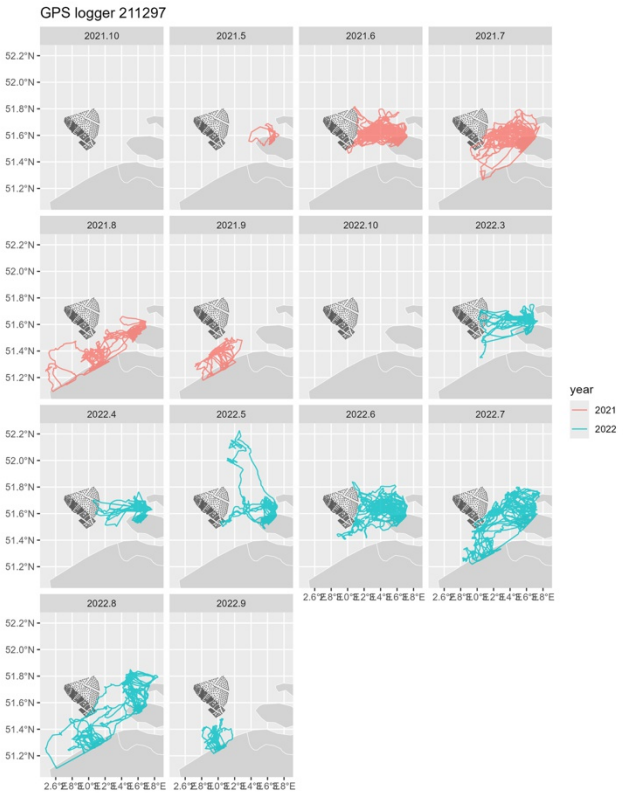
GPS logger 211297
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2022.5
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2022.7
2022.8
2022.9
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51.6°N
51.4°N
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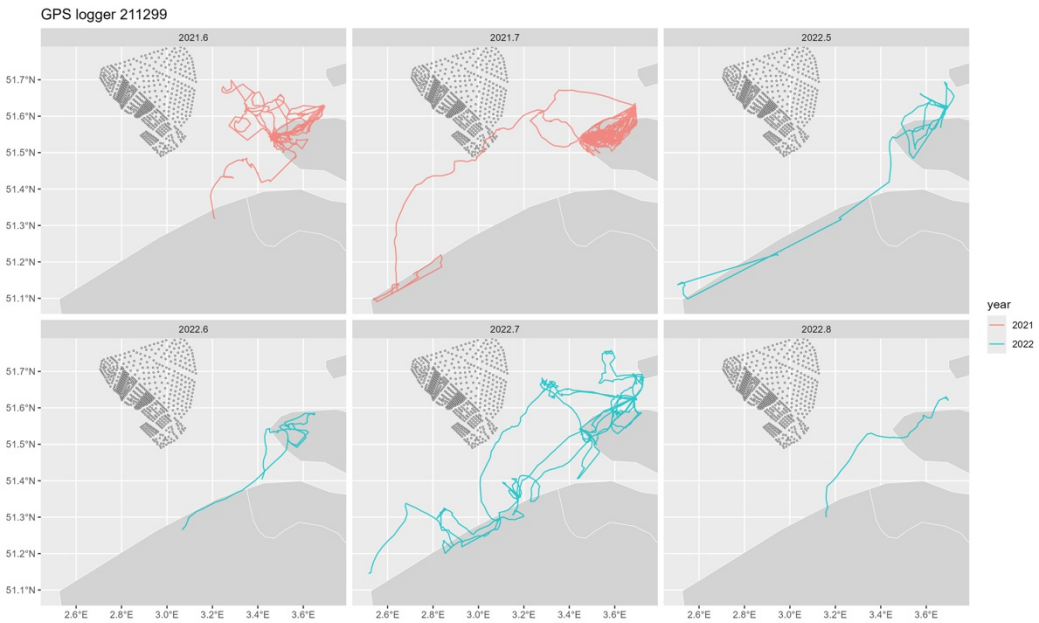
GPS logger 211299
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51.2°N
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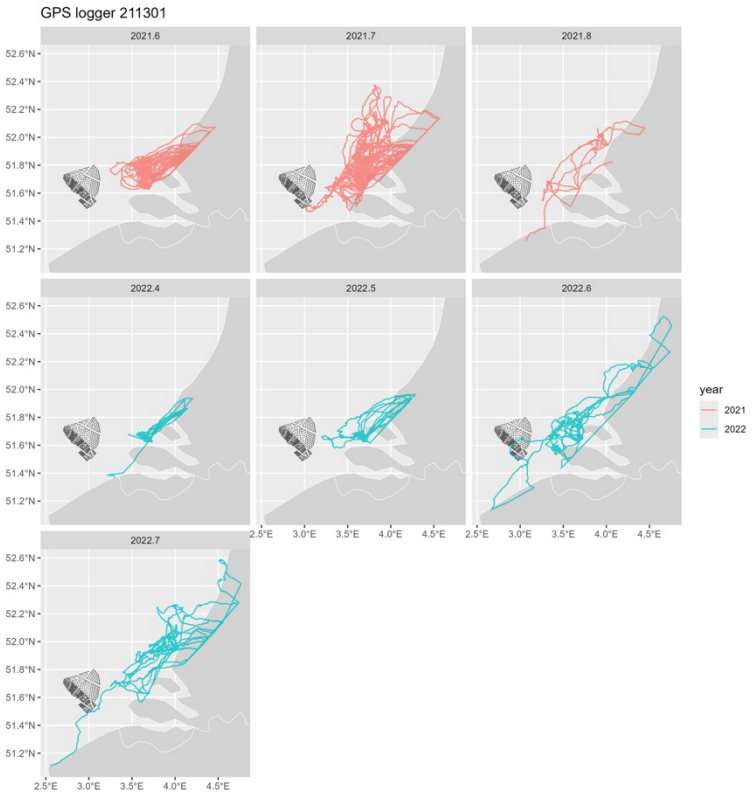
year
2021
2022


GPS logger 211301
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52.2°N
52.0°N
51.8°N
51.6°N
51.4°N
51.2°N
2.5°E
3.0°E
3.5°E
4.0°E
4.5°E
year
2021
2022

GPS logger 211302
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2021.6
2021.7
51.8°N
51.6°N
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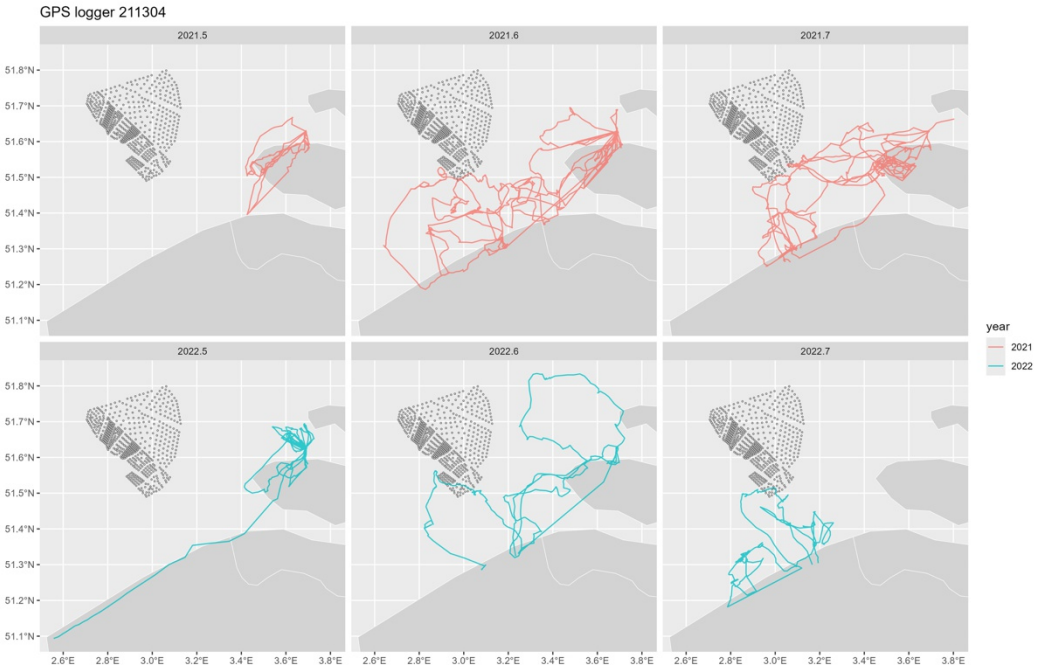
3.4°E
3.6°E
year
2021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2022.7
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51.4°N
51.3°N
51.2°N
51.1°N
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3.0°E
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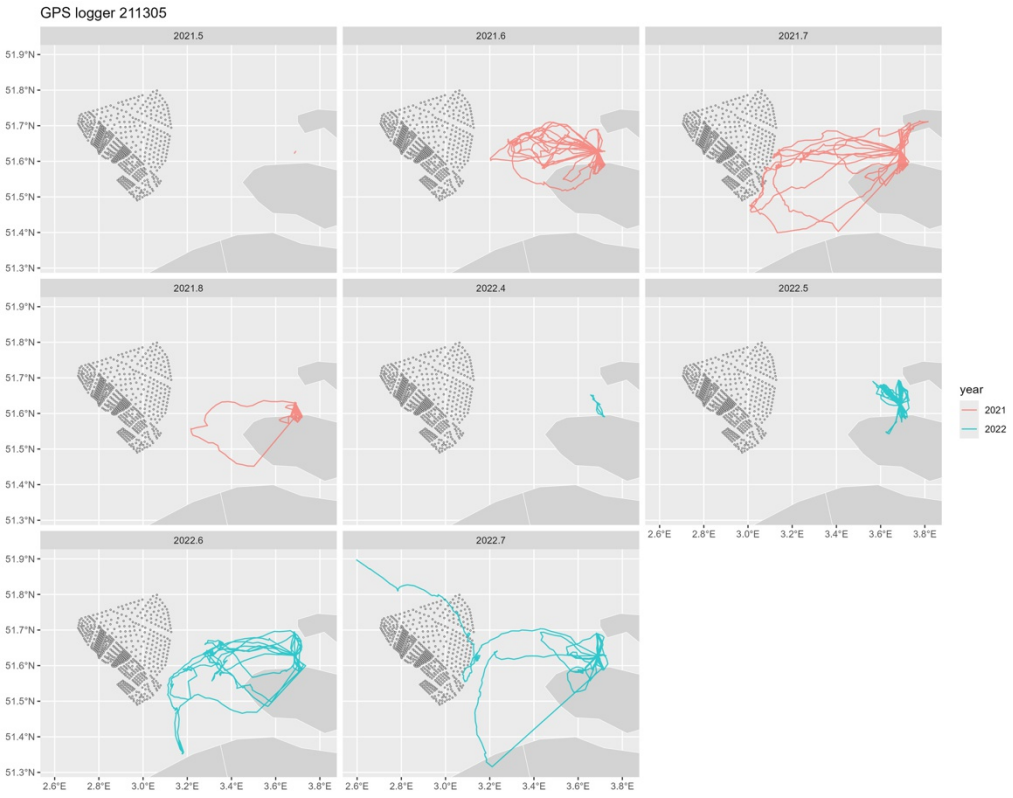
3.6°E
3.8°E
year
2021
2022


GPS logger 211305
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51.7°N
51.6°N
51.5°N
51.4°N
51.3°N
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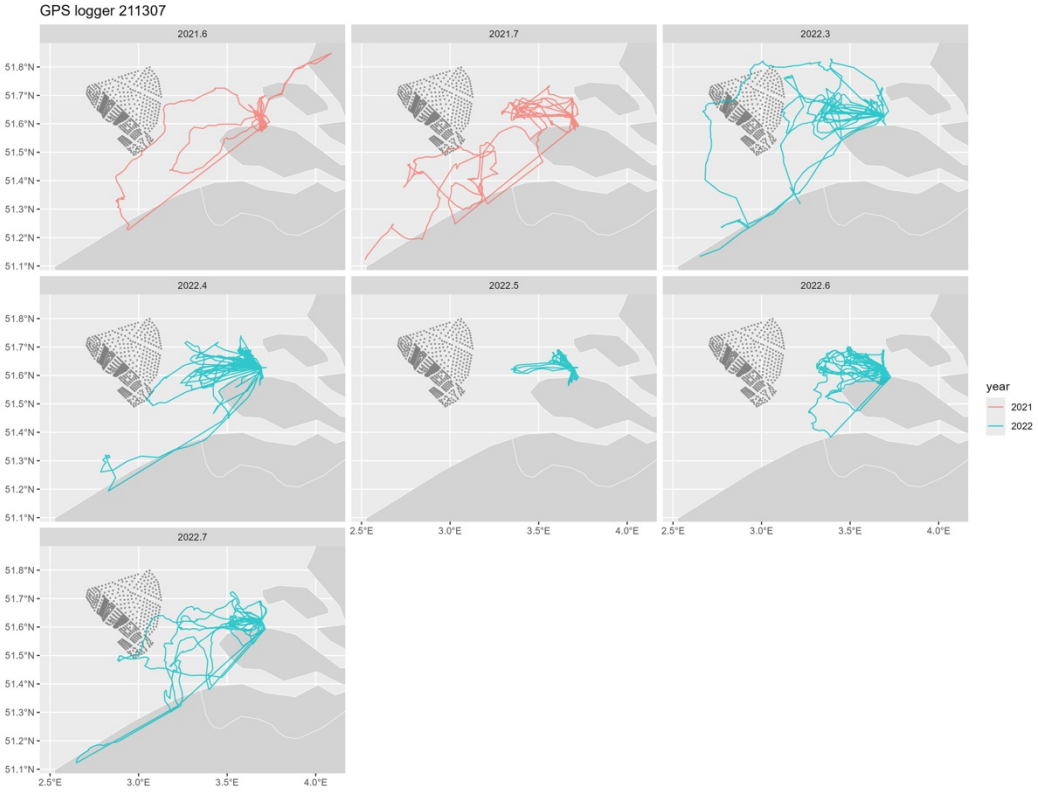
3.8°E
year
2021
2022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51.5°N
51.4°N
51.3°N
51.2°N
51.1°N
2.5°E
3.0°E
3.5°E
4.0°E
year
2021
2022

GPS logger 211308
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2021.6
2021.7
51.7°N
51.6°N
51.5°N
51.4°N
51.3°N
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2.6°E
2.8°E
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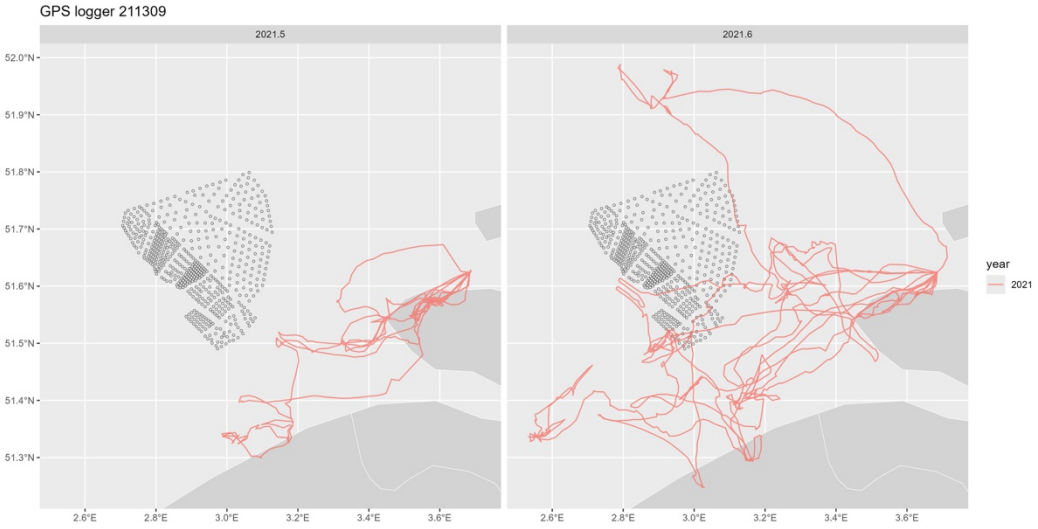
3.4°E
3.6°E
year
2021


GPS logger 211309
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51.5°N
51.4°N
51.3°N
2.6°E
2.8°E
3.0°E
3.2°E
3.4°E
3.6°E
year
2021

GPS logger 211310
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2021.7
2021.8
2022.3
51.8°N
51.6°N
51.4°N
51.2°N
2.4°E
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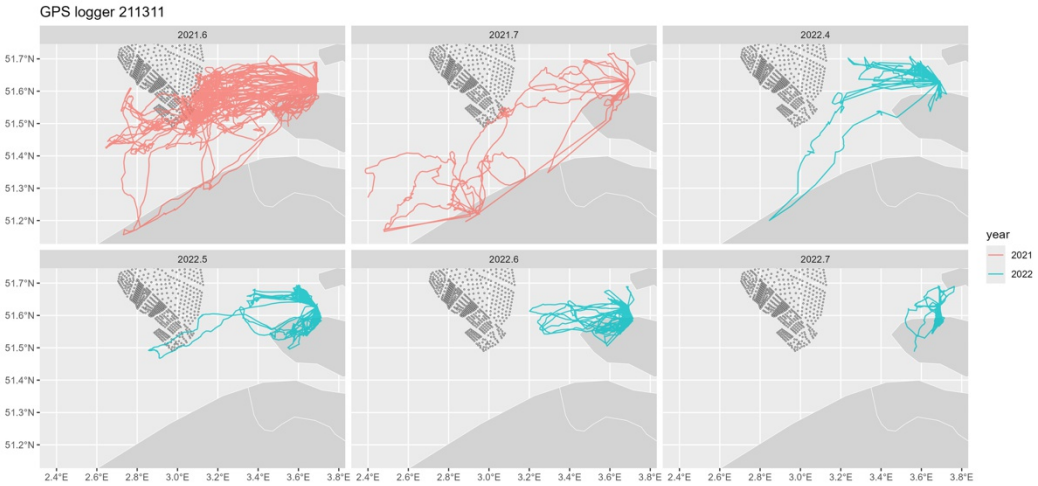
3.6°E
3.8°E
year
2021
2022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51.3°N
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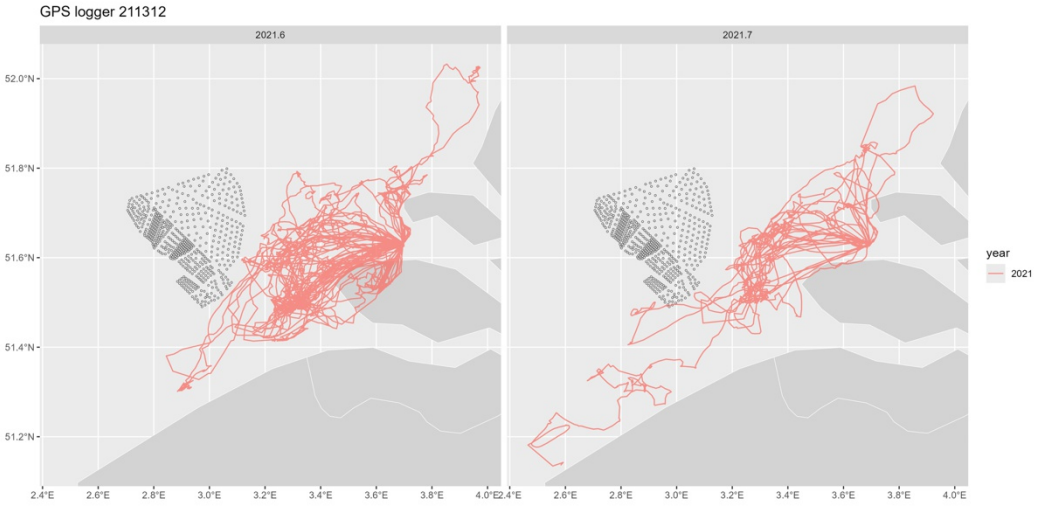
3.6°E
3.8°E
year
2021
2022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year
2021

GPS logger 211313
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3.5°E
4.0°E
4.5°E
year
2021
2022

GPS logger 211314
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2021.6
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2022.4
2022.5
2022.6
2022.7
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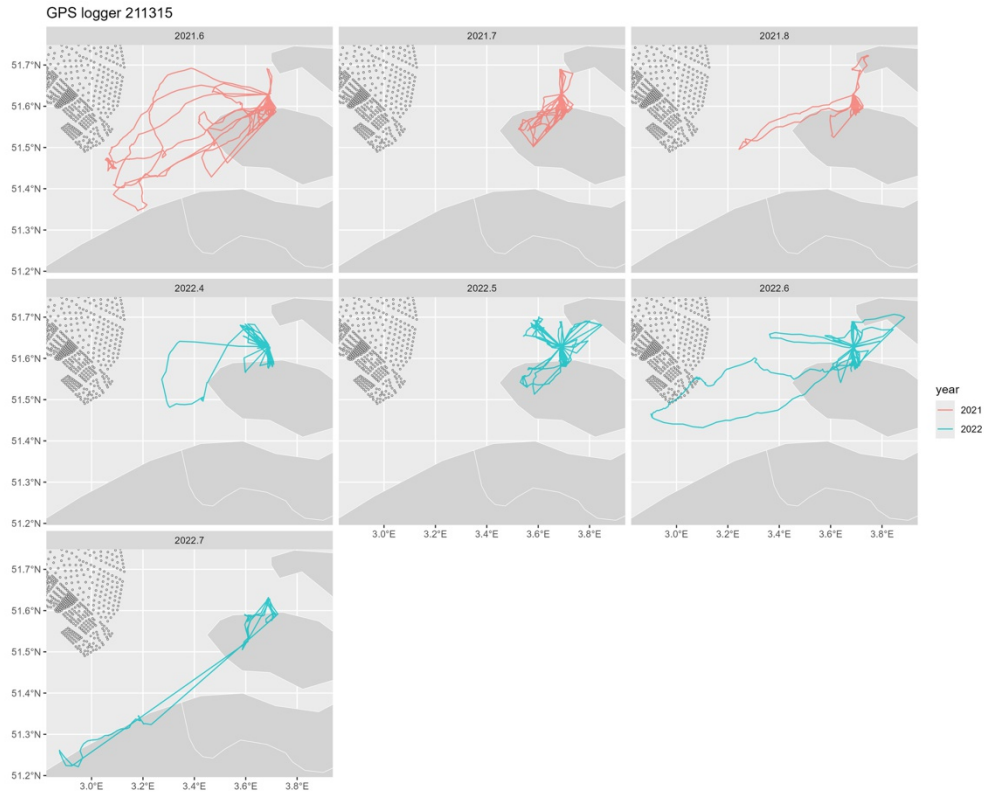
4.0°E
year
2021
2022


GPS logger 211315
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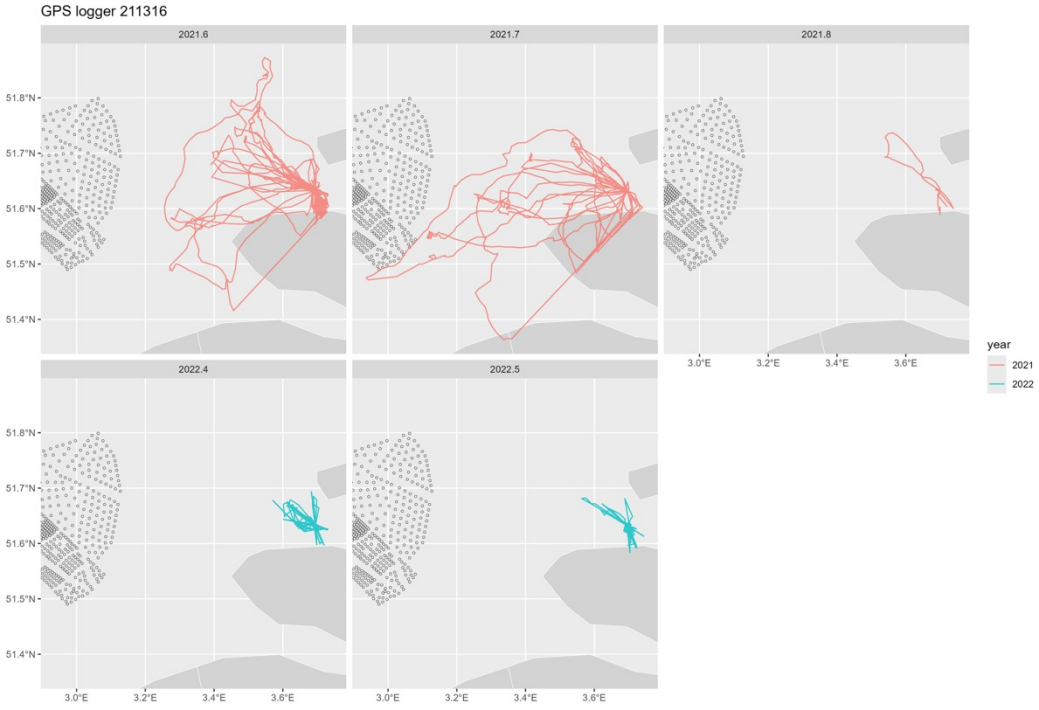
3.6°E
3.8°E
year
2021
2022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3.4°E
3.6°E
year
2021
2022

GPS logger 211317
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2021.7
2022.3
2022.4
2022.5
2022.6
2022.7
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52.0°N
51.8°N
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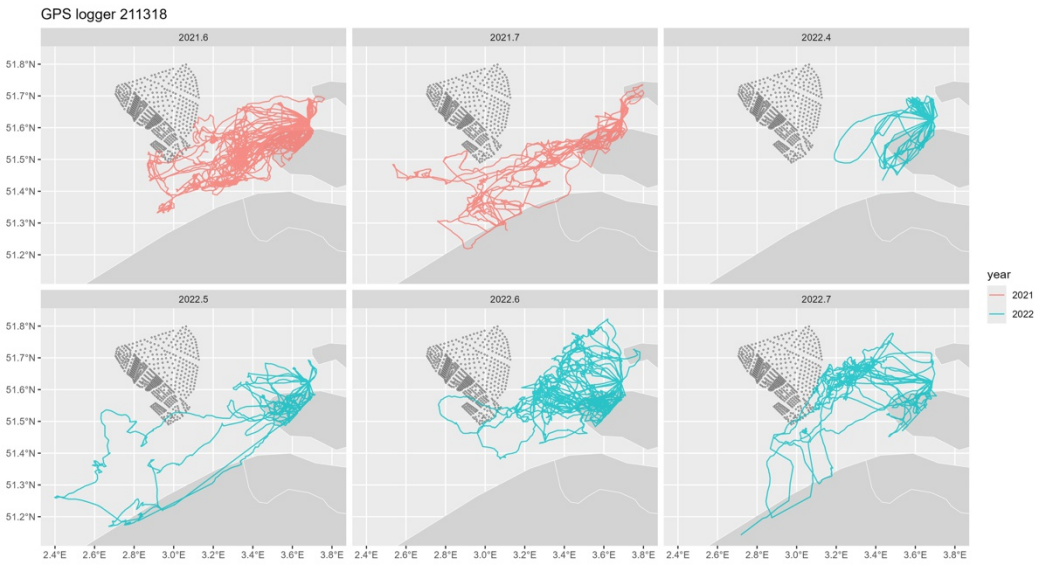
3.5°E
4.0°E
year
2021
2022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year
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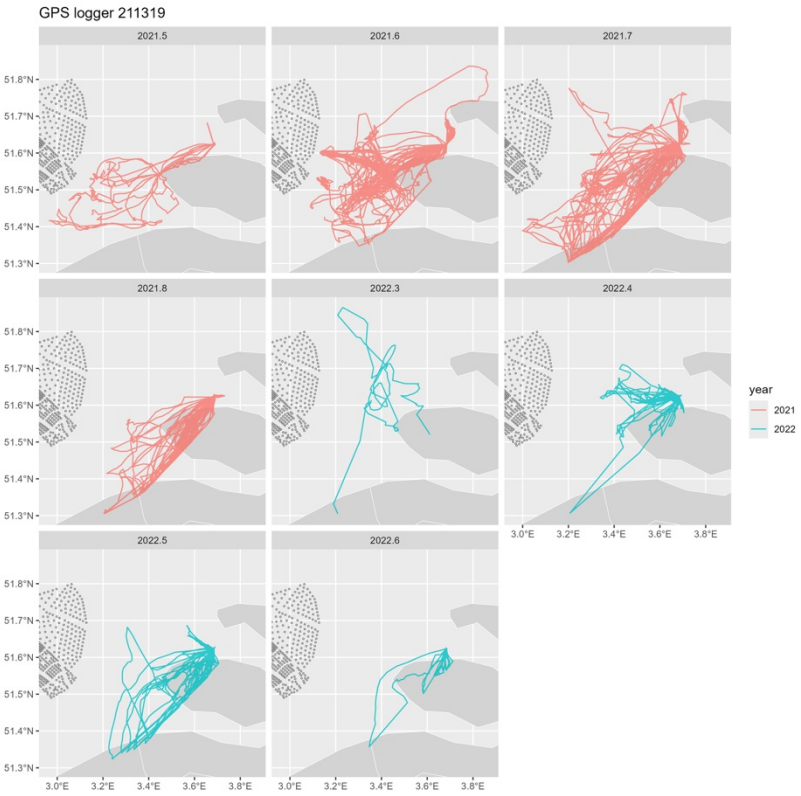
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2022.5
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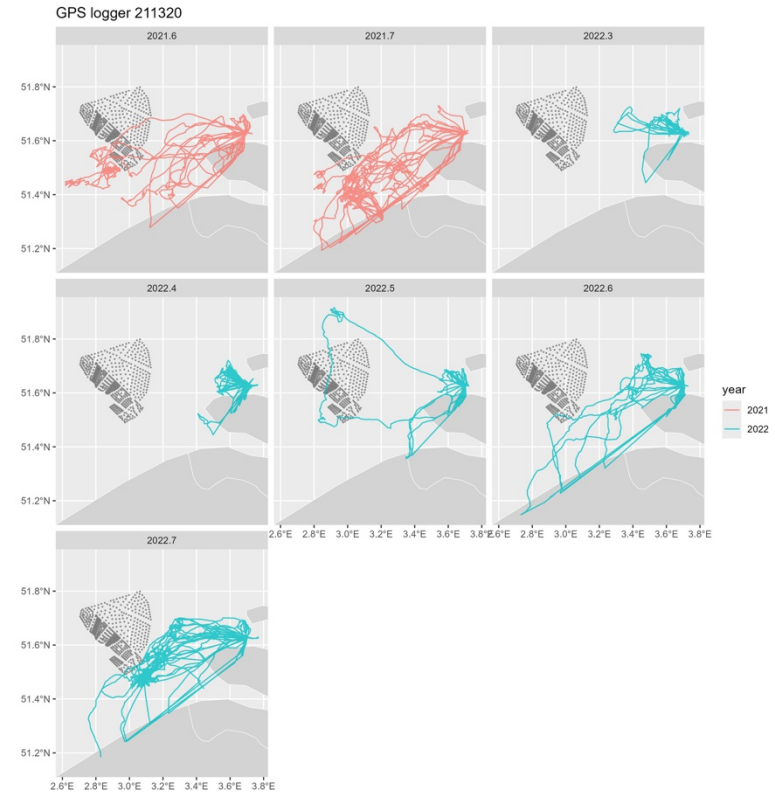
3.8°E
year
2021
2022


GPS logger 211320
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51.2°N
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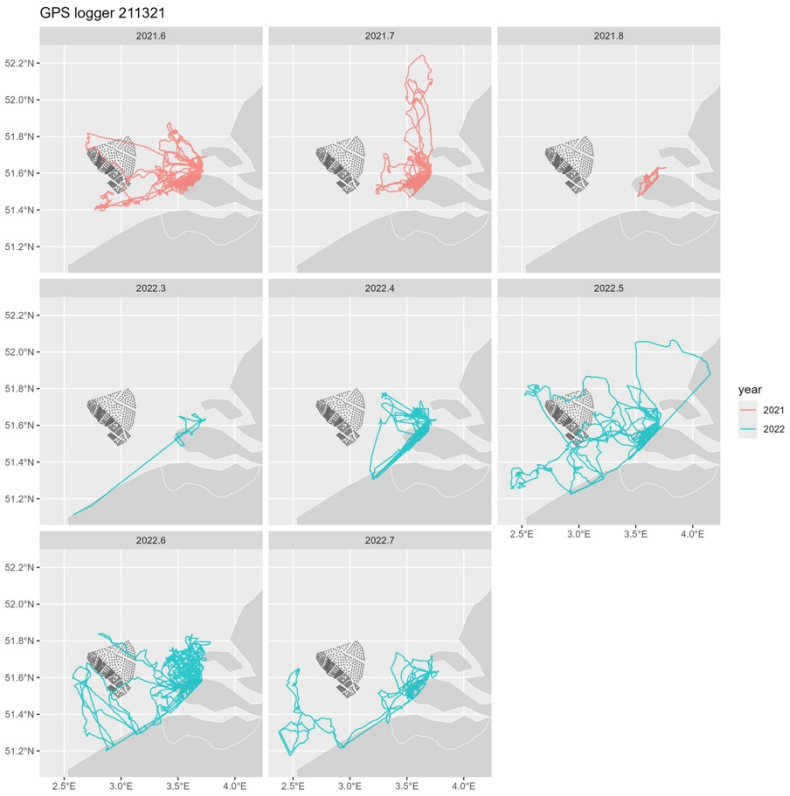
3.4°E
3.6°E
3.8°E
year
2021
2022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2022.6
2022.7
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51.8°N
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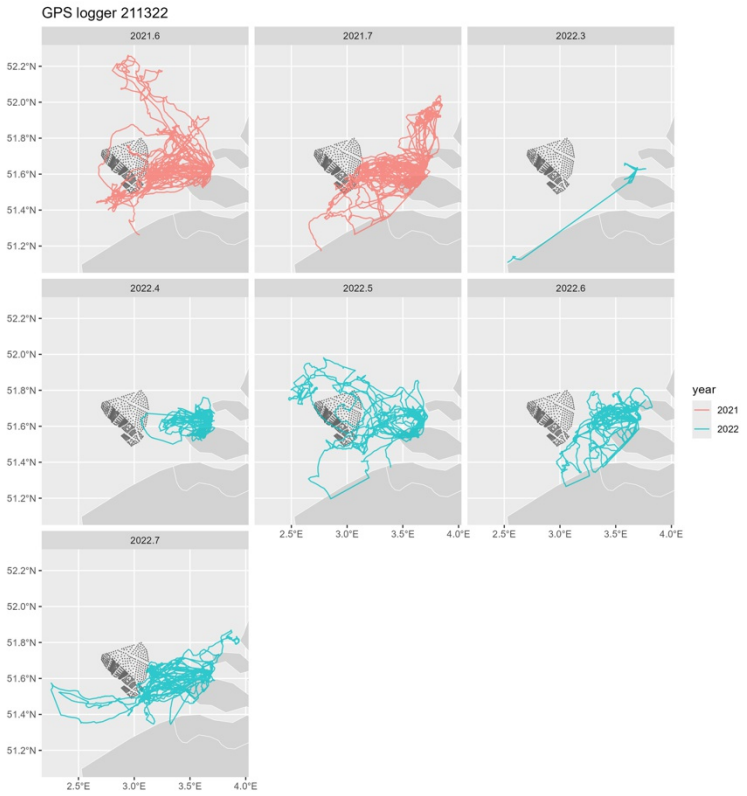
3.0°E
3.5°E
4.0°E
year
2021
2022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51.6°N
51.4°N
51.2°N
2.5°E
3.0°E
3.5°E
4.0°E
year
2021
2022

GPS logger 211323
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51.6°N
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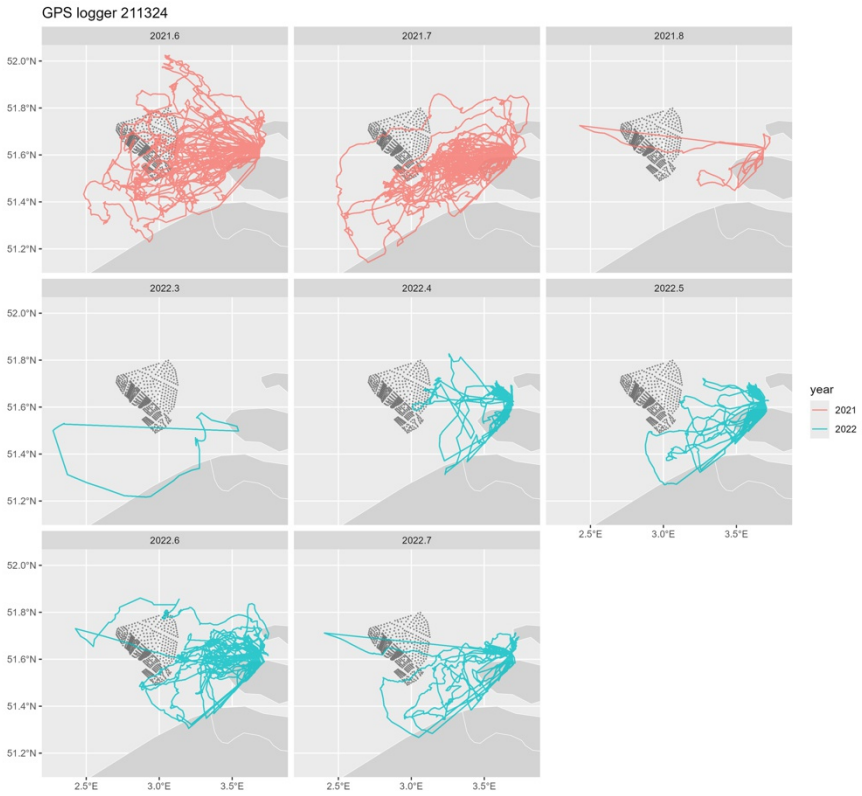
year
2021


GPS logger 211324
2021.6
2021.7
2021.8
2022.3
2022.4
2022.5
2022.6
2022.7
52.0°N
51.8°N
51.6°N
51.4°N
51.2°N
2.5°E
3.0°E
3.5°E
year
2021
2022

# Appendix IV – Number of data points of Lesser Black-backed Gulls per year, month and individual

**Number of locations in North Sea per year, month and individual**

| | Year: | 2021 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Month | | | | | | | | | | 2021 Total |
| GPS ID | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| 201089 | 101 | 1824 | 361 | | | | | | | | 2286 |
| 201090 | | | 1 | 4 | 41 | | | | | | 46 |
| 201093 | | 105 | 386 | 1477 | 65 | | | | | | 2033 |
| 201095 | 181 | 772 | 371 | 265 | 237 | | | | | | 1826 |
| 201096 | 1292 | 2083 | 999 | 8534 | 5697 | 243 | | | | | 18848 |
| 201097 | | 361 | 637 | 4880 | 539 | | | | | | 6417 |
| 201098 | 57 | 115 | 43 | 254 | 172 | 208 | | | | | 849 |
| 201100 | | 308 | 39 | | | | | | | | 347 |
| 201103 | | 228 | 817 | 2839 | 246 | | | | | | 4130 |
| 201105 | | 479 | 263 | 1302 | | | | | | | 2044 |
| 201107 | 99 | 820 | 858 | 3895 | 235 | | | | | | 5907 |
| 201109 | 2874 | 1935 | 830 | 5277 | 480 | | | | | | 11396 |
| 201110 | | 258 | 306 | 235 | 191 | 11 | | | | | 1001 |
| 201112 | 135 | 940 | 637 | 1197 | 1593 | 1214 | | | | | 5716 |
| 201113 | | 288 | 271 | 428 | | | | | | | 987 |
| 211275 | | | 110 | 171 | | | | | | | 281 |
| 211276 | | | | 12439 | 517 | | | | | | 12956 |
| 211277 | | | 1085 | 7462 | 1888 | | | | | | 10435 |
| 211278 | | | | 15697 | 2845 | 794 | | | | | 19336 |
| 211279 | | | 143 | 2186 | 683 | 299 | | | | | 3311 |
| 211280 | | | | 7735 | 4673 | 1 | | | | | 12409 |
| 211281 | | | | 15798 | 8168 | | | | | | 23966 |
| 211282 | | | | 6996 | | | | | | | 6996 |
| 211283 | | | | 5603 | 7889 | 9973 | 5451 | | | | 28916 |
| 211284 | | | 1623 | 12190 | 1811 | | | | | | 15624 |
| 211285 | | | 325 | 185 | | | | | | | 510 |
| 211286 | | | | 4870 | 5017 | 3095 | | | | 13 | 12995 |
| 211287 | | | 12 | | | | | | | | 12 |
| 211288 | | | | 537 | | | | | | | 537 |
| 211289 | | | 21 | 9727 | 1656 | | | | | 1 | 11405 |
| 211290 | | | | 8444 | 66 | | | | | | 8510 |
| 211291 | | | 67 | 1294 | 2085 | | | | | | 3446 |
| 211292 | | | | 4835 | 4077 | 43 | | | | | 8955 |
| 211293 | | | | 473 | 347 | | | | | | 820 |
| 211294 | | | 163 | 2087 | 1516 | 314 | | | | | 4080 |
| 211295 | | | | 4410 | 4275 | | | | | | 8685 |
| 211296 | | | 40 | 439 | 1001 | 7 | | | | | 1487 |
| 211297 | | | 113 | 3278 | 2513 | 1132 | 1733 | | | | 8769 |
| 211298 | | | | 79 | 119 | | | | | | 198 |
| 211299 | | | | 727 | 761 | | | | | | 1488 |
| 211300 | | | 245 | 735 | | | | | | | 980 |
| 211301 | | | | 2349 | 4037 | 615 | | | | | 7001 |
| 211302 | | | 3097 | 12605 | 623 | | | | | | 16325 |
| 211303 | | | | 277 | 213 | | | | | | 490 |
| 211304 | | | 130 | 2268 | 2017 | 131 | | | | | 4546 |
| 211305 | | | | 601 | 1396 | 202 | 5 | | | | 2204 |
| 211306 | | | 51 | 376 | 129 | | | | | | 556 |
| 211307 | | | | 481 | 892 | | | | | | 1373 |
| 211308 | | | 1975 | 2651 | 717 | | 978 | 901 | 608 | | 7830 |
| 211309 | | | 426 | 2271 | | | | | | | 2697 |
| 211310 | | | | 5807 | 2486 | 2245 | | | | | 10538 |
| 211311 | | | | 17874 | 1421 | | | | | | 19295 |
| 211312 | | | | 4030 | 2784 | | | | | | 6814 |
| 211313 | | | | 15603 | 12709 | 41 | | | | | 28353 |
| 211314 | | | 1 | 4125 | 164 | | 265 | | | | 4555 |
| 211315 | | | | 966 | 183 | 152 | | | | | 1301 |
| 211316 | | | | 1198 | 913 | 83 | 27 | | | | 2221 |
| 211317 | | | | 12259 | 4521 | | | | | | 16780 |
| 211318 | | | | 3236 | 2922 | | | | | | 6158 |
| 211319 | | | 1676 | 4810 | 2406 | 765 | | | | | 9657 |
| 211320 | | | | 2066 | 4209 | | | | | | 6275 |
| 211321 | | | | 2036 | 1326 | 150 | | | | | 3512 |
| 211322 | | | | 14565 | 10347 | 13 | | | | | 24925 |
| 211323 | | | 886 | 8895 | | | | | | | 9781 |
| 211324 | | | | 52620 | 34455 | 1512 | | | | | 88587 |
| **Grand Total** | **4739** | **10516** | **19008** | **332953** | **152273** | **23243** | **8459** | **901** | **608** | **14** | 552714 |

Number of locations in North Sea per year, month and individual

| | Year: | 2022 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Month | | | | | | | | | 2022 Total |
| GPS ID | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
| 201089 | | | | | | | | | | |
| 201090 | | | | | | | | | | |
| 201093 | | | | 546 | 1747 | 272 | 443 | | | 3008 |
| 201095 | | | 288 | 509 | 719 | 878 | 432 | | | 2826 |
| 201096 | | | 1466 | 1460 | 2845 | 6895 | 14474 | | | 27140 |
| 201097 | | | | 56 | 1847 | 2653 | 4785 | | | 9341 |
| 201098 | | | 85 | 122 | 38 | 275 | 298 | | | 818 |
| 201100 | | | | | | | | | | |
| 201103 | | | | 22 | 1671 | | | | | 1693 |
| 201105 | | | 254 | 721 | 444 | 3217 | 3846 | 91 | | 8573 |
| 201107 | | | | | | | | | | |
| 201109 | | | 1101 | 45 | 7 | | | | | 1153 |
| 201110 | | | | 1598 | 1041 | 269 | | | | 2908 |
| 201112 | | | 451 | 1045 | 1054 | 636 | 2109 | 377 | | 5672 |
| 201113 | | | 866 | 526 | 521 | 506 | 97 | | | 2516 |
| 211275 | | | | | | | | | | |
| 211276 | | | | 672 | 870 | 1086 | 2518 | | | 5146 |
| 211277 | | | 2264 | 971 | 2963 | 1932 | 631 | | | 8761 |
| 211278 | | | | 1072 | 1419 | 1854 | 2293 | 452 | | 7090 |
| 211279 | | | | 299 | 719 | 1338 | 1 | | | 2357 |
| 211280 | | | | 1644 | 563 | | | | | 2207 |
| 211281 | | | 1313 | 3156 | 2141 | 1223 | 6368 | | | 14201 |
| 211282 | | | 343 | 2318 | 6838 | 5099 | 2054 | | | 16652 |
| 211283 | | | | 2993 | 5812 | 4884 | 6139 | 8412 | 3770 | 32010 |
| 211284 | | | 1106 | 2603 | 8260 | 5440 | 165 | | | 17574 |
| 211285 | | | | | | | | | | |
| 211286 | 14 | 713 | 874 | 912 | 2828 | | | | | 5341 |
| 211287 | | | | | | | | | | |
| 211288 | | | | | | | | | | |
| 211289 | | | 1369 | 637 | 7337 | 7798 | 880 | | | 18021 |
| 211290 | | | | 1108 | 3094 | 4027 | 1765 | | | 9994 |
| 211291 | | | 539 | 769 | 1839 | 2910 | 4775 | | | 10832 |
| 211292 | | 1160 | 2789 | 664 | 3227 | 4575 | 13817 | 1024 | | 27256 |
| 211293 | | | | 530 | 542 | 264 | 122 | | | 1458 |
| 211294 | | | | 725 | 1684 | 864 | 1864 | | | 5137 |
| 211295 | | | | | | | | | | |
| 211296 | | | 481 | 419 | 1212 | 2637 | 835 | | | 5584 |
| 211297 | | | 2385 | 1490 | 2686 | 6469 | 7907 | 5182 | 1203 | 27322 |
| 211298 | | | | 446 | 518 | 81 | 1593 | | | 2638 |
| 211299 | | | | | 1062 | 20 | 929 | 22 | | 2033 |
| 211300 | | | | | 81 | 12 | 76 | | | 169 |
| 211301 | | | | 441 | 837 | 2070 | 1918 | | | 5266 |
| 211302 | | | | | | | | | | |
| 211303 | | | | 188 | 1847 | 723 | 7 | | | 2765 |
| 211304 | | | | | 2749 | 1571 | 1170 | 62 | | 5552 |
| 211305 | | | | 63 | 387 | 765 | 1118 | | | 2333 |
| 211306 | | | 772 | 632 | 642 | 555 | 446 | | | 3047 |
| 211307 | | | 1878 | 1166 | 527 | 901 | 1067 | | | 5539 |
| 211308 | | | | | | | | | | |
| 211309 | | | | | | | | | | |
| 211310 | | | 256 | | | | | | | 256 |
| 211311 | | | | 1023 | 1532 | 613 | 222 | | | 3390 |
| 211312 | | | | | | | | | | |
| 211313 | | | | 4040 | 4320 | 8837 | 5249 | 8582 | 626 | 31654 |
| 211314 | | | 1534 | 585 | 1455 | 5734 | 10560 | 2358 | 1240 | 23466 |
| 211315 | | | | 157 | 451 | 407 | 65 | | | 1080 |
| 211316 | | | | 189 | 110 | | | | | 299 |
| 211317 | | | 357 | 809 | 2380 | 3770 | 360 | | | 7676 |
| 211318 | | | | 491 | 1733 | 3846 | 3278 | | | 9348 |
| 211319 | | | 169 | 456 | 778 | 297 | | | | 1700 |
| 211320 | | | 362 | 616 | 1235 | 1238 | 4496 | | | 7947 |
| 211321 | | | 82 | 649 | 3780 | 5951 | 1413 | | | 11875 |
| 211322 | | | 72 | 1628 | 7732 | 4297 | 10253 | | | 23982 |
| 211323 | | | | | | | | | | |
| 211324 | | | 369 | 6474 | 5496 | 13476 | 7245 | | | 33060 |
| **Grand Total** | **14** | **1873** | **23825** | **49685** | **105620** | **123165** | **130083** | **26562** | **6839** | **467666** |

Number of locations on land (north of 51 degrees latitude) per year, month and individual

| | Year: | 2021 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Month | | | | | | | | | | 2021 Total |
| GPS ID | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| 201089 | 145 | 1453 | 2090 | | | | | | | | 3688 |
| 201090 | | | 10 | 57 | 468 | | | | | | 535 |
| 201093 | | 800 | 2130 | 2554 | 1337 | | | | | | 6821 |
| 201095 | 1135 | 4256 | 5196 | 8633 | 9476 | 5092 | 1697 | 170 | 7 | | 35662 |
| 201096 | 622 | 5748 | 7519 | 6368 | 5809 | 9255 | 2439 | | | | 37760 |
| 201097 | | 1779 | 5991 | 5493 | 4511 | | | | | | 17774 |
| 201098 | 571 | 1815 | 2163 | 3115 | 1922 | 2669 | 2210 | 817 | | | 15282 |
| 201100 | | 4965 | 2418 | 6023 | 1669 | | | | | | 15075 |
| 201103 | | 705 | 5569 | 3804 | 1134 | | | | | | 11212 |
| 201105 | | 3704 | 6712 | 3732 | 965 | | | | | | 15113 |
| 201107 | 181 | 3488 | 6089 | 5265 | 2045 | | | | | | 17068 |
| 201109 | 1720 | 7069 | 5434 | 6187 | 11861 | 11321 | 5918 | 1705 | 766 | 383 | 52364 |
| 201110 | | 3027 | 9101 | 7080 | 9989 | 747 | | | | | 29944 |
| 201112 | 425 | 5300 | 6250 | 6241 | 7491 | 3293 | | | | | 29000 |
| 201113 | | 1998 | 5978 | 6884 | | | | | | | 14860 |
| 211275 | | 40 | 2093 | 3554 | | | | | | | 5687 |
| 211276 | | 50 | | 2807 | 655 | | | | | | 3512 |
| 211277 | | 50 | 608 | 3712 | 2759 | | | | | | 7129 |
| 211278 | | 50 | | 2052 | 6431 | 847 | | | | | 9380 |
| 211279 | | 40 | 1275 | 6602 | 10550 | 7281 | | | | | 25748 |
| 211280 | | 40 | | 4648 | 9725 | 101 | | | | | 14514 |
| 211281 | | 40 | | 6272 | 8877 | 10802 | 4792 | 1705 | 899 | 256 | 33643 |
| 211282 | | 50 | | 3072 | | | | | | | 3122 |
| 211283 | | 40 | | 1801 | 1391 | 735 | 217 | | | | 4184 |
| 211284 | | 40 | 773 | 2559 | 8214 | 10374 | 1947 | 2065 | 187 | | 26159 |
| 211285 | | 49 | 307 | 325 | | | | | | | 681 |
| 211286 | | 50 | | 7034 | 6851 | 5315 | 4439 | 1481 | 95 | 3 | 25268 |
| 211287 | | 40 | 2314 | 892 | | | | | | | 3246 |
| 211288 | | 50 | | 7988 | | | | | | | 8038 |
| 211289 | | 40 | 1145 | 5374 | 11437 | 11381 | 6683 | 2162 | 1061 | 201 | 39484 |
| 211290 | | 50 | | 1347 | 669 | | | | | | 2066 |
| 211291 | | 49 | 1143 | 6028 | 5762 | | | | | | 12982 |
| 211292 | | 50 | | 1059 | 784 | 54 | | | | | 1947 |
| 211293 | | 50 | | 5351 | 5650 | | | | | | 11051 |
| 211294 | | 40 | 1053 | 5653 | 8134 | 2663 | | | | | 17543 |
| 211295 | | 50 | | 7815 | 3984 | | | | | | 11849 |
| 211296 | | 50 | 1287 | 6507 | 7674 | 433 | | | | | 15951 |
| 211297 | | 50 | 1061 | 4242 | 7142 | 9844 | 5938 | 2232 | 938 | | 31447 |
| 211298 | | 40 | | 3549 | 878 | 142 | | | | | 4609 |
| 211299 | | 50 | | 9724 | 8408 | | | | | | 18182 |
| 211300 | | 50 | 1585 | 3492 | | | | | | | 5127 |
| 211301 | | 40 | | 6626 | 7224 | 3258 | | | | | 17148 |
| 211302 | | 40 | 664 | 2820 | 1312 | | | | | | 4836 |
| 211303 | | 50 | | 5777 | 590 | | | | | | 6417 |
| 211304 | | 50 | 2117 | 8283 | 10554 | 3923 | | | | | 24927 |
| 211305 | | 50 | 12 | 3224 | 4142 | 2196 | 322 | 2144 | 110 | | 12200 |
| 211306 | | 50 | 1575 | 7163 | 2484 | | | | | | 11272 |
| 211307 | | 49 | | 9803 | 2200 | | | | | | 12052 |
| 211308 | | 40 | 1329 | 6937 | 11735 | 11276 | 3460 | 1331 | 527 | | 36635 |
| 211309 | | 50 | 1268 | 1231 | | | | | | | 2549 |
| 211310 | | 50 | | 6252 | 7199 | 4373 | | | | | 17874 |
| 211311 | | 50 | | 3496 | 1557 | | | | | | 5103 |
| 211312 | | 50 | | 7877 | 1828 | | | | | | 9755 |
| 211313 | | 50 | | 1349 | 2302 | 760 | | | | | 4461 |
| 211314 | | 48 | 54 | 5533 | 1526 | | | | | | 7161 |
| 211315 | | 40 | | 6410 | 8511 | 6121 | | | | | 21082 |
| 211316 | | 40 | | 8576 | 4666 | 2346 | 27 | | | | 15655 |
| 211317 | | 50 | | 1530 | 8136 | 10876 | 2973 | 1953 | 196 | | 25714 |
| 211318 | | 50 | | 8978 | 6189 | | | | | | 15217 |
| 211319 | | 40 | 813 | 4401 | 7150 | 6461 | | | | | 18865 |
| 211320 | | 50 | | 7448 | 3802 | | | | | | 11300 |
| 211321 | | 40 | | 10189 | 9172 | 2230 | | | | | 21631 |
| 211322 | | 40 | | 2085 | 4326 | 1 | | | | | 6452 |
| 211323 | | 40 | 913 | 3340 | 179 | | | | | | 4472 |
| 211324 | | 150 | | 5685 | 9015 | 32160 | 17031 | 5325 | 1020 | | 70386 |
| **Grand Total** | **4799** | **48512** | **96039** | **319908** | **290451** | **178330** | **60093** | **23090** | **5806** | **843** | **1027871** |

Number of locations on land (north of 51 degrees latitude) per year, month and individual

| | Year: | 2022 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Month | | | | | | | | | | 2022 Total |
| GPS ID | 3 | 4 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 201089 | | | | | | | | | | | |
| 201090 | | | | | | | | | | | |
| 201093 | | | | 2041 | 3704 | 927 | 199 | | | | 6871 |
| 201095 | 1 | 92 | 905 | 1462 | 4517 | 8222 | 9979 | 4096 | 1315 | 245 | 30834 |
| 201096 | | | 441 | 2540 | 5466 | 6185 | 3252 | 18 | | | 17902 |
| 201097 | | | | 1524 | 6697 | 5880 | 3962 | | | | 18063 |
| 201098 | | | 597 | 1128 | 1513 | 2915 | 4836 | 4589 | 1022 | 999 | 17599 |
| 201100 | | | | | | | | | | | |
| 201103 | | | | 648 | 4258 | | | | | | 4906 |
| 201105 | | | 373 | 2745 | 4531 | 5278 | 2300 | 82 | | | 15309 |
| 201107 | | | | | | | | | | | |
| 201109 | 434 | 1351 | 1767 | 272 | 70 | | | | | | 3894 |
| 201110 | | | | 2713 | 9059 | 5755 | | | | | 17527 |
| 201112 | | | 809 | 2295 | 5044 | 4496 | 3635 | 641 | | | 16920 |
| 201113 | | | 314 | 2445 | 6393 | 6249 | 1291 | | | | 16692 |
| 211275 | | | | | | | | | | | |
| 211276 | | | | 1860 | 4605 | 5934 | 3235 | | | | 15634 |
| 211277 | | | 607 | 2521 | 4363 | 5035 | 4597 | | | | 17123 |
| 211278 | | | | 1755 | 5911 | 5071 | 7094 | 1608 | | | 21439 |
| 211279 | | | | 2420 | 6305 | 5472 | 147 | | | | 14344 |
| 211280 | | | | 2286 | 3128 | 2921 | 5852 | 1014 | 44 | | 15245 |
| 211281 | 566 | 1490 | 1852 | 4159 | 10816 | 11567 | 11458 | 12196 | 4515 | 1532 | 60151 |
| 211282 | | | 353 | 3525 | 7746 | 7571 | 2775 | | | | 21970 |
| 211283 | | | | 744 | 1908 | 1832 | 1679 | 552 | 167 | | 6882 |
| 211284 | | | 308 | 1236 | 2559 | 7810 | 13592 | 9326 | 2684 | 834 | 38349 |
| 211285 | | | | | | | | | | | |
| 211286 | 1 | 109 | 1012 | 1792 | 3357 | | | | | | 6271 |
| 211287 | | | | | | | | | | | |
| 211288 | | | | | | | | | | | |
| 211289 | 7 | | 730 | 2270 | 4542 | 7878 | 13735 | 10026 | 4771 | 1944 | 45903 |
| 211290 | | | | 1715 | 8207 | 7789 | 2108 | | | | 19819 |
| 211291 | | | 827 | 2533 | 7228 | 7878 | 2942 | | | | 21408 |
| 211292 | | 13 | 645 | 1995 | 5380 | 5025 | 1775 | 35 | | | 14868 |
| 211293 | | | | 1650 | 4886 | 5564 | 1367 | | | | 13467 |
| 211294 | | | | 1292 | 7771 | 7493 | 3337 | | | | 19893 |
| 211295 | | | | | | | | | | | |
| 211296 | | | 836 | 2656 | 6132 | 6622 | 5456 | | | | 21702 |
| 211297 | | | 459 | 1914 | 5099 | 6848 | 5911 | 8778 | 6267 | 3461 | 38737 |
| 211298 | | | | 860 | 4223 | 2777 | 1914 | | | | 9774 |
| 211299 | | | | | 2694 | 3429 | 2745 | 189 | | | 9057 |
| 211300 | | | | | 198 | 365 | 228 | | | | 791 |
| 211301 | | | | 1841 | 11238 | 10679 | 8882 | | | | 32640 |
| 211302 | | | | | | | | | | | |
| 211303 | | | | 276 | 6937 | 4688 | 612 | | | | 12513 |
| 211304 | | | | | 7437 | 11448 | 10803 | 1446 | | | 31134 |
| 211305 | | | | 451 | 4779 | 5080 | 6253 | 8432 | 3426 | 1361 | 29782 |
| 211306 | | | 719 | 2219 | 5755 | 6023 | 1772 | | | | 16488 |
| 211307 | | | 441 | 1783 | 3068 | 3860 | 1851 | | | | 11003 |
| 211308 | | | | | | | | | | | |
| 211309 | | | | | | | | | | | |
| 211310 | | | 56 | | | | | | | | 56 |
| 211311 | | | | 983 | 5442 | 8127 | 2332 | | | | 16884 |
| 211312 | | | | | | | | | | | |
| 211313 | | | | 800 | 1129 | 1214 | 1053 | 584 | 762 | | 5542 |
| 211314 | | | 208 | 1516 | 5735 | 5315 | 3801 | 1318 | 631 | | 18524 |
| 211315 | | | | 1378 | 5550 | 6174 | 6269 | | | | 19371 |
| 211316 | | | | 786 | 1330 | 76 | | | | | 2192 |
| 211317 | | | 321 | 1360 | 4175 | 2692 | 3863 | 2231 | 435 | 319 | 15396 |
| 211318 | | | | 1710 | 5502 | 8715 | 1944 | | | | 17871 |
| 211319 | | | 101 | 3339 | 8308 | 6816 | | | | | 18564 |
| 211320 | | | 407 | 1353 | 2466 | 2405 | 1534 | | | | 8165 |
| 211321 | | | 173 | 2280 | 7777 | 6963 | 3154 | | | | 20347 |
| 211322 | | | 90 | 2181 | 4318 | 7428 | 2391 | | | | 16408 |
| 211323 | | | | | | | | | | | |
| 211324 | | | 1254 | 6873 | 16047 | 12972 | 26979 | 28812 | 9309 | 3117 | 105363 |
| **Grand Total** | **1009** | **3055** | **16605** | **90125** | **265303** | **271463** | **204894** | **95973** | **35348** | **13812** | **997587** |

**Number of locations in OWF (north of 51 degrees latitude) per year, month and individual**

| | Year: | 2021 | | | | | |
|---|---|---|---|---|---|---|---|
| | Month | | | | | | 2021 Total |
| GPS id | 3 | 4 | 5 | 6 | 7 | 8 | |
| 201089 | 2 | 1 | 14 | | | | 17 |
| 201093 | | | | 147 | | | 147 |
| 201095 | | | | | 136 | | 136 |
| 201096 | 3 | | | 1232 | 474 | | 1709 |
| 201097 | | | | 2447 | | | 2447 |
| 201098 | | | | 11 | | 53 | 64 |
| 201103 | | | | 698 | | | 698 |
| 201105 | | | | 160 | | | 160 |
| 201107 | | | | 167 | | | 167 |
| 201109 | 573 | 67 | 27 | 396 | 73 | | 1136 |
| 201113 | | | | | | | |
| 211276 | | | | 5114 | | | 5114 |
| 211277 | | | 36 | 820 | 41 | | 897 |
| 211278 | | | | 2929 | 138 | | 3067 |
| 211279 | | | | 172 | | | 172 |
| 211280 | | | | 2121 | 852 | | 2973 |
| 211281 | | | | 1193 | 501 | | 1694 |
| 211282 | | | | 1454 | | | 1454 |
| 211283 | | | | | | | |
| 211284 | | | 1085 | 874 | | | 1959 |
| 211286 | | | | | | | |
| 211289 | | | | 640 | 583 | | 1223 |
| 211290 | | | | 1789 | | | 1789 |
| 211291 | | | | 96 | 48 | | 144 |
| 211292 | | | | 322 | 577 | | 899 |
| 211295 | | | | 130 | 105 | | 235 |
| 211297 | | | | 22 | 23 | | 45 |
| 211299 | | | | | 219 | | 219 |
| 211301 | | | | | 21 | | 21 |
| 211302 | | | 1140 | 5851 | | | 6991 |
| 211304 | | | | 106 | 184 | | 290 |
| 211305 | | | | | 145 | | 145 |
| 211307 | | | | 3 | 30 | | 33 |
| 211308 | | | 114 | 355 | 109 | | 578 |
| 211309 | | | | 407 | | | 407 |
| 211310 | | | | 1538 | 147 | 647 | 2332 |
| 211311 | | | | 3579 | 328 | | 3907 |
| 211312 | | | | | 8 | | 8 |
| 211313 | | | | 4181 | 3315 | | 7496 |
| 211314 | | | | 866 | | | 866 |
| 211315 | | | | | | | |
| 211316 | | | | | 16 | | 16 |
| 211317 | | | | 2447 | 500 | | 2947 |
| 211318 | | | | 18 | 46 | | 64 |
| 211320 | | | | 116 | 64 | | 180 |
| 211321 | | | | 101 | | | 101 |
| 211322 | | | | 1643 | 3037 | | 4680 |
| 211323 | | | | 330 | | | 330 |
| 211324 | | | | 20808 | 3882 | 312 | 25002 |
| Grand Total | 578 | 68 | 2416 | 65283 | 15602 | 1012 | 84959 |

**Number of locations in OWF (north of 51 degrees latitude) per year, month and individual**

| | Year: | 2022 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Month | | | | | | | 2022 Total |
| GPS id | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| 201089 | | | | | | | | |
| 201093 | | | | 24 | | | | 24 |
| 201095 | | | | | | 266 | | 266 |
| 201096 | | 122 | | 19 | 519 | 1536 | | 2196 |
| 201097 | | | | 56 | 370 | 224 | | 650 |
| 201098 | | | | | 41 | 106 | | 147 |
| 201103 | | | | 5 | | | | 5 |
| 201105 | | | | | 579 | 1052 | | 1631 |
| 201107 | | | | | | | | |
| 201109 | | 438 | | | | | | 438 |
| 201113 | | 62 | | | | | | 62 |
| 211276 | | | | 11 | | | | 11 |
| 211277 | | 108 | 505 | 342 | 106 | | | 1061 |
| 211278 | | | | | | 85 | | 85 |
| 211279 | | | | | 69 | | | 69 |
| 211280 | | | 982 | | | | | 982 |
| 211281 | | 494 | 507 | 381 | | 659 | | 2041 |
| 211282 | | | 116 | 433 | 35 | 9 | | 593 |
| 211283 | | | 36 | | | | | 36 |
| 211284 | | 234 | 682 | 364 | 2070 | | | 3350 |
| 211286 | | 49 | | | | | | 49 |
| 211289 | | | | 664 | 1553 | 263 | | 2480 |
| 211290 | | | | 665 | 567 | 94 | | 1326 |
| 211291 | | | | | 621 | 1100 | | 1721 |
| 211292 | 371 | 716 | | | 107 | 549 | 37 | 1780 |
| 211295 | | | | | | | | |
| 211297 | | 612 | 408 | 106 | 69 | 501 | 178 | 1874 |
| 211299 | | | | | | | | |
| 211301 | | | | | 240 | 36 | | 276 |
| 211302 | | | | | | | | |
| 211304 | | | | | 81 | 54 | | 135 |
| 211305 | | | | | | 231 | | 231 |
| 211307 | | 281 | 95 | | | 125 | | 501 |
| 211308 | | | | | | | | |
| 211309 | | | | | | | | |
| 211310 | | 84 | | | | | | 84 |
| 211311 | | | | 172 | | | | 172 |
| 211312 | | | | | | | | |
| 211313 | | | 772 | 1014 | 3307 | 1996 | 5687 | 12776 |
| 211314 | | 700 | | | 1956 | 2660 | 29 | 5345 |
| 211315 | | | | | 87 | | | 87 |
| 211316 | | | | | | | | |
| 211317 | | | | 152 | 231 | 121 | | 504 |
| 211318 | | | | 37 | 160 | 161 | | 358 |
| 211320 | | | | 202 | 87 | 148 | | 437 |
| 211321 | | | | 784 | 722 | | | 1506 |
| 211322 | | | 504 | 1027 | | 491 | | 2022 |
| 211323 | | | | | | | | |
| 211324 | | | 2220 | 99 | 2736 | 666 | | 5721 |
| Grand Total | 371 | 3900 | 6827 | 6557 | 16313 | 13133 | 5931 | 53032 |