Avian Movement Models in Support of the Regional Assessments for Offshore Wind Energy Development

This document was compiled by the Regional Assessment of Offshore Wind Development Secretariat. It includes

- The context report *Avian Movement Models in Support of the Regional Assessments for Offshore Wind Energy Development*
- Maps presenting avian movement models described in said report

The report and maps were submitted to the Committee by Environment and Climate Change Canada in September 2024.

Contents

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Product Objective

This series of maps present movement models based on tracking data collected from birds moving through the offshore region of Atlantic Canada. The goal of these products is to identify spatial and temporal distributions of aerofauna in the Regional Assessment study area (Figure 1). Additionally, recommendations related to technology type and study design are provided, as well as the next steps to finalize products presented herein.

Movement and migration routes are highlighted as critical, due to the potential exposure of migrating wildlife to offshore wind energy development. To identify movement corridors, ECCC reviewed and analyzed tracking data for species that migrate into and out of the region or move through the region on route to breeding areas beyond Atlantic Canada. Tracking data were collected using devices deployed on animals that record locations over time, providing an information on where and when aerofauna are using offshore areas. Multiple tracking technologies exist, each with strengths and limitations (see Appendix A for a summary).

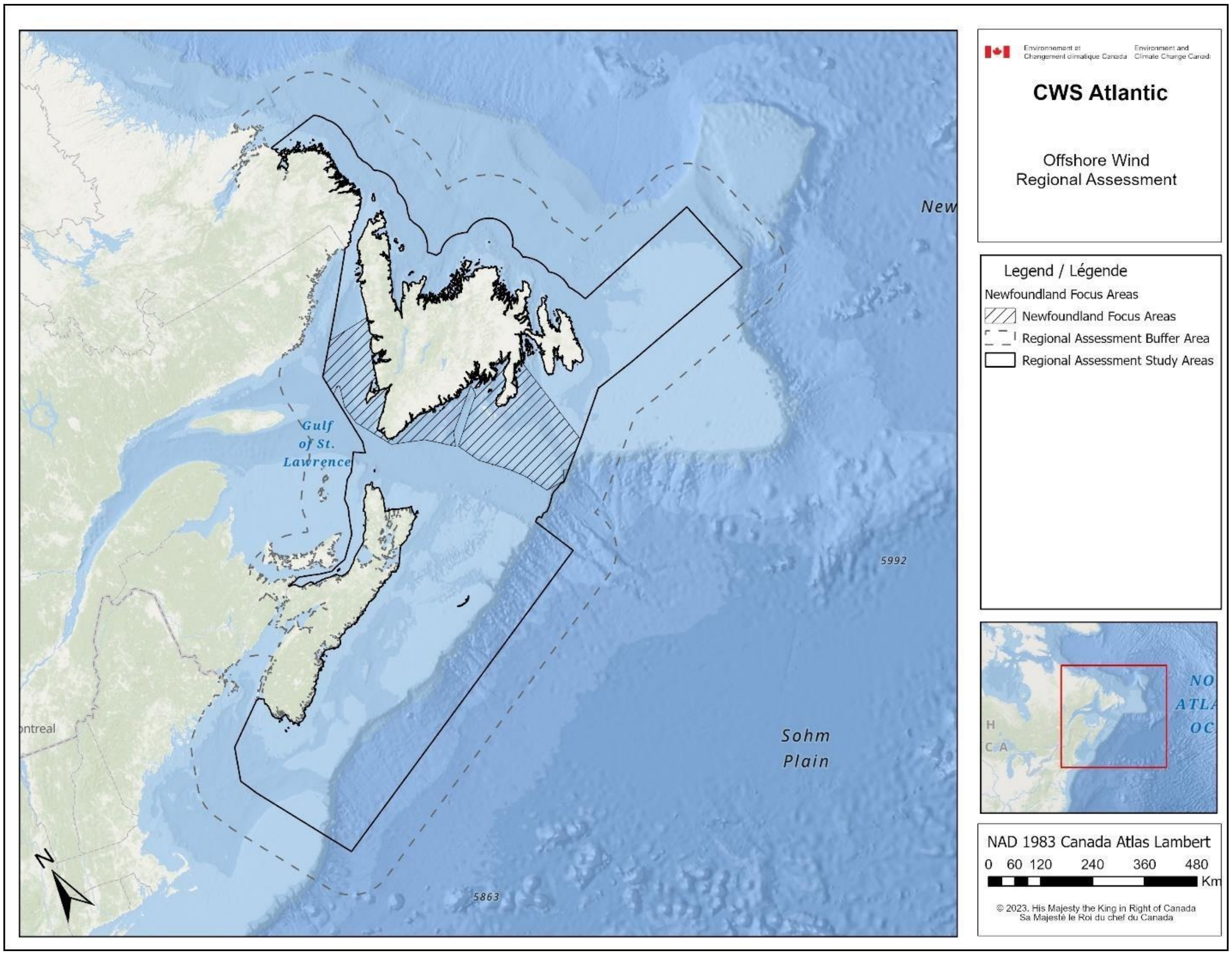


Figure 1: Regional assessment for offshore wind energy development study areas.

An extensive review of tracking efforts in the Atlantic Canada offshore region (Figure 1) was conducted, including birds tagged at colonies within the region and tracking data for birds passing through the region. Data were collected from a variety of sources including public datasets, internal ECCC data, and unpublished data from researchers.

Movement models were created for each season to address temporal distributions. Due to variation in accuracy and temporal resolution between tracking methods, different approaches were used depending on the number of locations, individuals tagged, and accuracy of the tracking device (please see Appendix A for information on tracking devices). Three approaches were used: plotting movement tracks, calculating kernel density estimates, and creating dynamic Brownian bridge movement models (dBBMM) (Figure 2). Most tracking studies do not occur throughout the whole year and are often targeted to a specific period of interest. Therefore, timing plots are provided to show the temporal period covered by the mapping products.

Further, if satellite data, either from GPS or Argos PTTs, were collected during the known migration period of a species, all location data were visually examined to determine if the migration period of an individual was captured. Migration tracks were then extracted from each tagged individual and plotted by species for an approximation of the migration corridors used.

Products can be accessed using the following links <links removed due to access only being granted to the Committee>:

- Kernel density utilization distribution
- Dynamic Brownian bridge movement models (dBBMM)
- Migration paths
- Tracks
- While not part of the movement models package, tracks for shorebirds provided by the Shorebird Collective can be found here: Shorebird tracks

Methodology

Data Collection and Preparation

An extensive review of avian tracking data in the Atlantic region was conducted, including birds tagged outside the region that pass through during migration periods. Data came from a variety of sources including:

- Public datasets (Movebank – https://www.movebank.org – and the Seabird Tracking Dataset – https://www.seabirdtracking.org/)
- Internal ECCC data
- Unpublished data from external researchers

In total, 2,702,347 unique locations across 42 species were collected from 73 datasets. A thorough description of all datasets is found in Appendix B. Different tracking devices were used across studies, and are described in Appendix A, along with strengths and limitations of each.

Since datasets came from various sources, they were pre-processed and compiled into a common format. This process included ensuring consistency in species names, date format, spatial coordinates, animal identifier, sensor type, and error associated with each location. Location error can vary between locations and was not always provided. Argos PTTs provide a location class instead of an error value, therefore, following the approach used by Spiegel et al. (2017), each error class was assigned an error value that represented the 95% error estimate of unfiltered Argos data recorded by Douglas et al. (2012). All error values are provided in Table 1. Note that some datasets provided locations estimated from a model that already considered the location error. In those cases, the error value was set as 1.

While GPS and GLS data were received with most erroneous data already filtered, this was not always the case with Argos data. Therefore, Argos PTT locations were filtered using a simple speed and angle filter that removes locations when the angle between three locations is too sharp or the speed between two locations is unrealistic (Freitas et al., 2008). The “argosfilter” R package v 0.7 (https://cran.r-project.org/web/packages/argosfilter/index.html) was used with a maximum speed set at 42m/sec and spikes with angles smaller than 15 and 25 degrees were removed if their extension was higher than 5000m and 10000m respectively. All datasets were then compiled into a single database. Duplicates were removed to ensure there was not more than one location with the same species, sensor, timestamp, and coordinates.

Table 1: Error associated with each tracking sensor. The reference column indicates the source from where values were extracted. A "Pers. Comm." value indicates decisions based on discussions with subject mater experts.

Sensor type		Error Value (m)	Reference
GPS / GPS-PTT		30	Spiegel et al. (2017)
Argos	LC3	1,500	Douglas et al. (2012)
	LC2	3,300	Douglas et al. (2012)
	LC1	7,600	Douglas et al. (2012)
	LC0	35,800	Douglas et al. (2012)
	LCA	59,600	Douglas et al. (2012)
	LCB	163,200	Douglas et al. (2012)
	LCZ	220,200	Douglas et al. (2012)
	LCG	Filtered out	Pers. Comm.
	No location class specified	10,000	Pers. Comm.
VHF		1,500	Upper rounding of maximum value from Zimmerman and Powell (1995)
GLS		100,000	Pers. Comm.
Modelled Locations		1	Pers. Comm.
No sensor/error provided		Filtered out	Pers. Comm.

Analyses

For each species, locations were first divided by season. Seasons were defined as: spring (April - May), summer (June- August), fall (September - October), and winter (November - March). The analysis method was selected depending on the number of locations and type of sensor. Individuals with fewer than 2 locations inside the study area were removed. The workflow used to select the analysis method is described in Figure 2. A summary of all analyses performed by species is found in *Table 2*. Sample sizes per species, season, and tag used for each product are found in Appendix C.

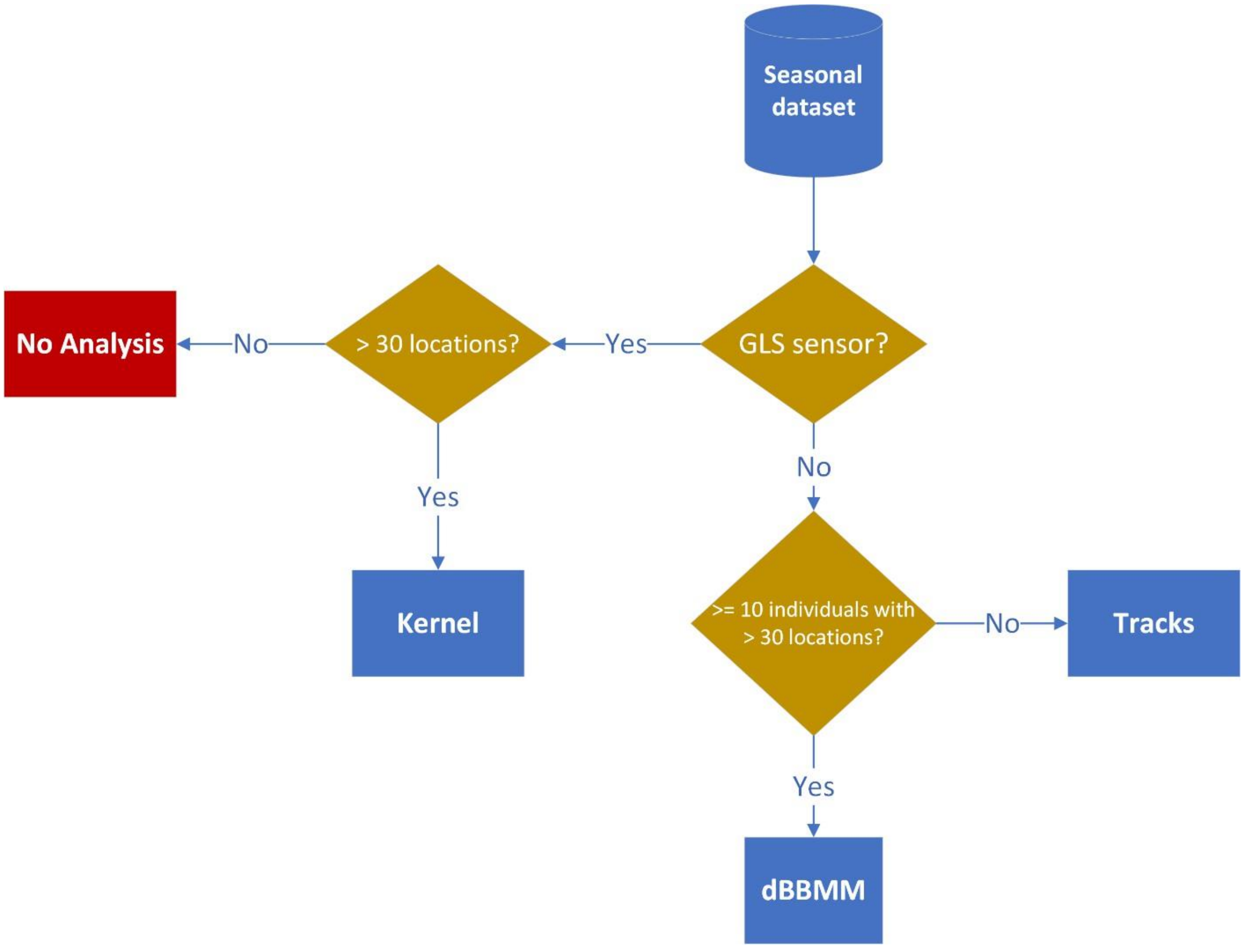


Figure 2: Workflow used to select which movement analysis to perform on seasonal data for each species.

<u>Table 2:</u> List of species per product and season. Species names with an asterisk refer to kernel models created with fewer than 10 individuals. Four-leter codes are provided for the following species: ABDU = American Black Duck, AMGP = American Golden-Plover, AMWO = American Woodcock, ARTE = Arctic Tern, ATPU = Atlantic Puffin, BBPL = Black-bellied Plover, BLGU = Black Guillemot, BLKI = Black-legged Kittiwake, BLSC = Black Scoter, COEI = Common Eider, COMU = Common Murre, CORS = Cory's Shearwater, COTE = Common Tern, DOVE = Dovekie, GBBG = Great Black-backed Gull, GLGU = Glaucous Gull, GRSH = Great Shearwater, HERG = Herring Gull, LESP = Leach's Storm Petrel, LEYE = Lesser Yellowlegs, LTDU = Long-tailed Duck, LTJA = Long-tailed Jaeger, MASH = Manx Shearwater, NOFU = Northern Fulmar, NOGA = Northern Gannet, PAJA = Parasitic Jaeger, PESA = Pectoral Sandpiper, RAZO = Razorbill, RTLO = Red-throated Loon, SOSH = Sooty Shearwater, SUSC = Surf Scoter, TBMU = Thick-billed Murre, WHIM = Whimbrel, WWSC = White-winged Scoter, WTTR = White-tailed Tropicbird.

Product	Spring	Summer	Fall	Winter
Tracks	BLKI, GLGU, IVGU, PAJA	BLKI, CORS, LTJA	CANG, COEI, CORS, LTJA, PAJA	GLGU, LTJA, NOFU
Dynamic Brownian Bridge Movement Models (dBBMMs)	ABDU, BLSC, HERG, LTDU, NOGA, RTLO, SUSC, WWSC	ABDU, ATPU, BLSC, COEI, COMU, GBBG, GRSH, HERG, NOGA, RAZO, ROST, SUSC, WHIM, WWSC	ABDU, GRSH, HERG, NOGA, SUSC, WWSC	ABDU, GRSH, HERG, NOGA, RTLO, SUSC, WWSC
Kernels	ATPU, BLGU*, BLKI, COMU, CORS, GLGU*, LTJA, MASH*, NOGA, PAJA*, RAZO, SOSH, TBMU	ATPU, BLGU*, BLKI, COMU, CORS, LTJA, NOGA, PAJA*, RAZO, SOSH, TBMU, WTTR	ATPU, BLGU*, BLKI, COMU, CORS, LTJA, MASH*, NOGA, PAJA*, RAZO, SOSH, TBMU, WTTR	ATPU, BLGU*, BLKI, COMU, CORS, GLGU*, LTJA, MASH*, NOGA, PAJA*, RAZO, SOSH, TBMU, WTTR
Migrations	ABDU, BLSC, GBBG, GLGU, HERG, LTDU, NOGA, PESA, RTLO, SUSC, WWSC	Not applicable	ABDU, BLSC, COEI, GRSH, HERG, LEYE, LTDU, LTJA, NOGA, PAJA, RTLO, SOSH, SUSC, WHIM	Not applicable

Kernel Density Utilization Distribution

A common way to quantify space use is to calculate a utilization distribution (UD). This gives the probability density that an animal is found at a given point in space. One approach to detect spatial patterns are point density kernel utilization distributions, which highlight areas where multiple locations are grouped together. This approach was used to process data collected using GLS sensors, due to their large location error (>100km) that hampers accurate modeling. Point density kernels were created using the "spatstat" R package (Baddeley and Turner 2005) using a bandwidth of 100,000m and a cell size of 10,000m. Kernels were calculated using all locations, even though some were not present inside the study area. A species-specific mapping example created using a kernel density utilization distribution is shown in *Figure 3*. All kernel density figures are available in Appendix C.

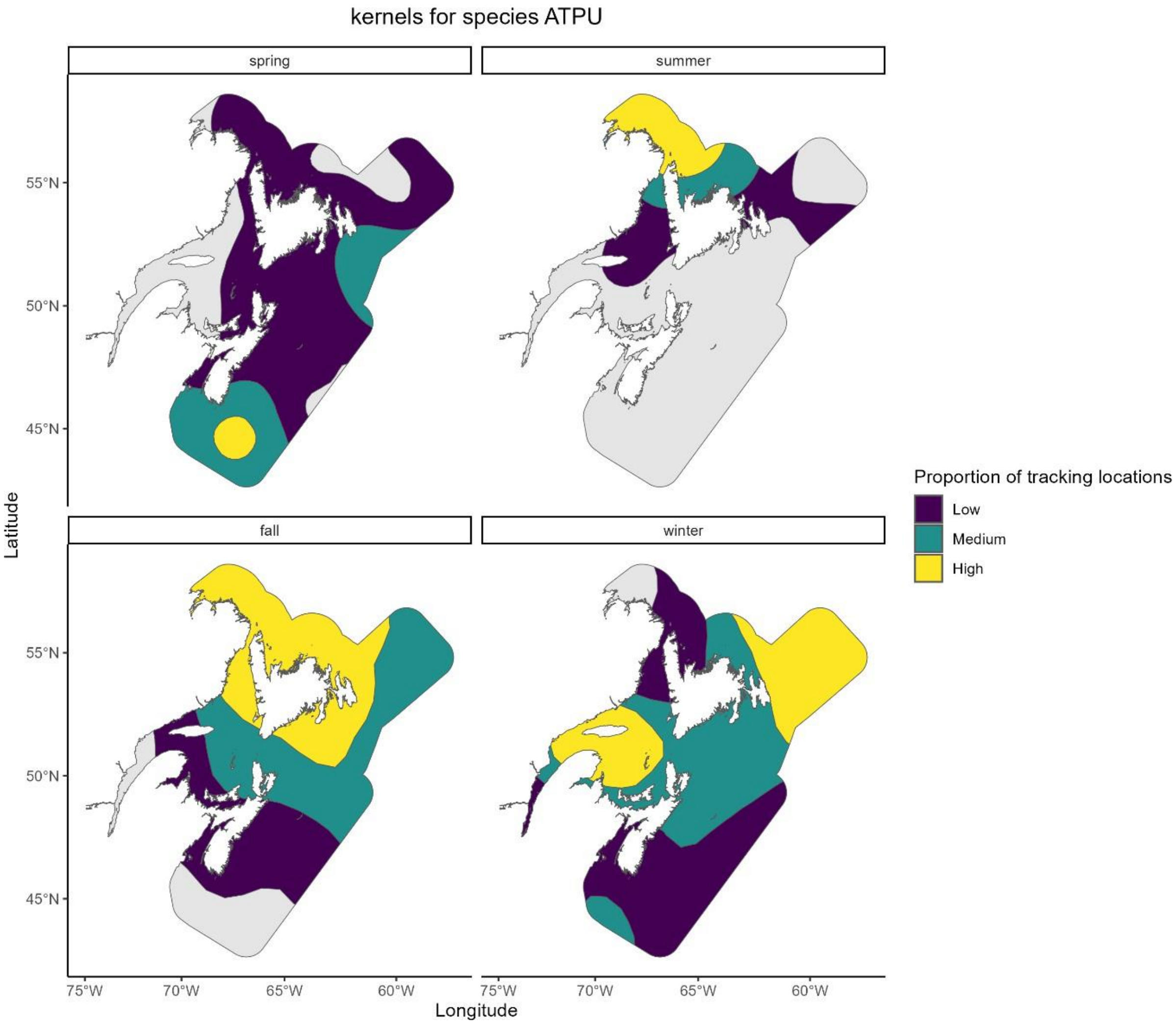


Figure 3: Seasonal utilization distribution (UD) for Atlantic puffin (ATPU) created using a kernel density movement model.

Dynamic Brownian Bridge Movement Models

Dynamic Brownian bridge movement models (dBBMMs) were developed when species were tracked using devices with higher spatial resolution, such as VHF, PTT, or GPS. dBBMMs provide more accurate utilization distributions than kernel density estimates as they account for spatial and temporal autocorrelation. These models are also robust to irregular sampling schedules associated with the duty cycles of the transmitters, and incorporates location error estimates (Kranstauber et al. 2012; Spiegel et al. 2017). One movement model was conducted per individual, using a grid with a cell size of 1,000m. Only individuals with at least 20 locations covering a minimum of 5 days were selected. Only locations inside the study areas are used for the model. All models were composited together for each season for species with at least 10 individuals. During compositing, individual rasters were weighted by the number of days of tracking data per individual compared to the total number of tracking days across the species and then summed. Utilization contour levels of 50%, 75%, and 95% were then calculated, representing high, medium and low usage, respectively. *Figure 4* presents an example of movement maps created using dBBMMs. All dBBMM figures are available in Appendix C.

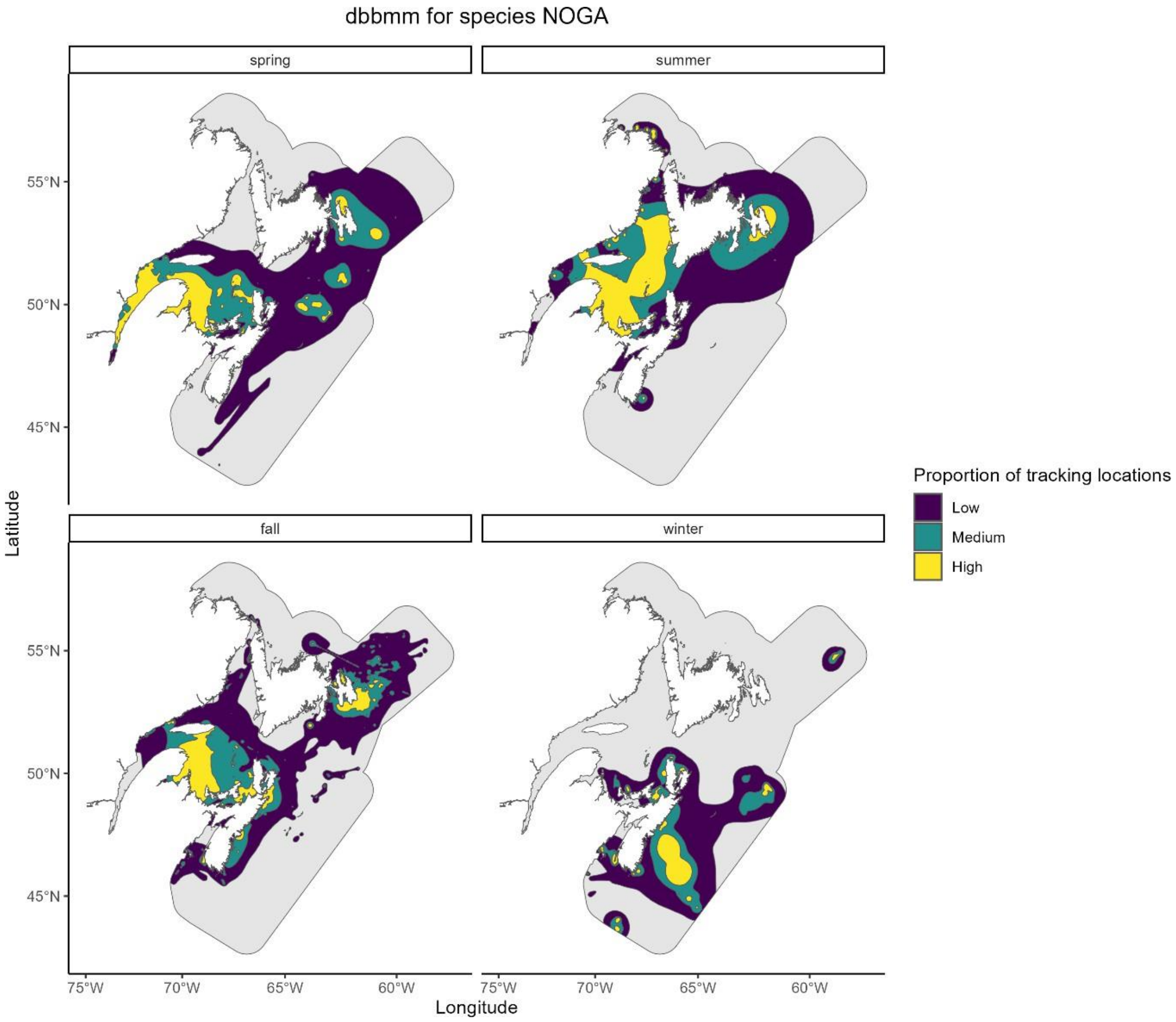


Figure 4: Seasonal Utilization distribution (UD) maps for Northern Gannets created using dynamic Brownian Bridge Movement Models (dBBMM).

Migration Paths

When tracking data overlapping the spring or fall migration periods was available, migration dates for an individual were determined by visual inspection of the tracks. Migration paths were plotted as the Euclidean distance between recorded locations. A buffer corresponding to the average error of all track locations for each individual was applied. All buffered tracks for a given migration period and species were then summed into a single map. No GLS migration data was extracted, due to the low accuracy compared to the size of the study area. An example migration path is provided in *Figure 5*. All migration path figures are available in Appendix D.

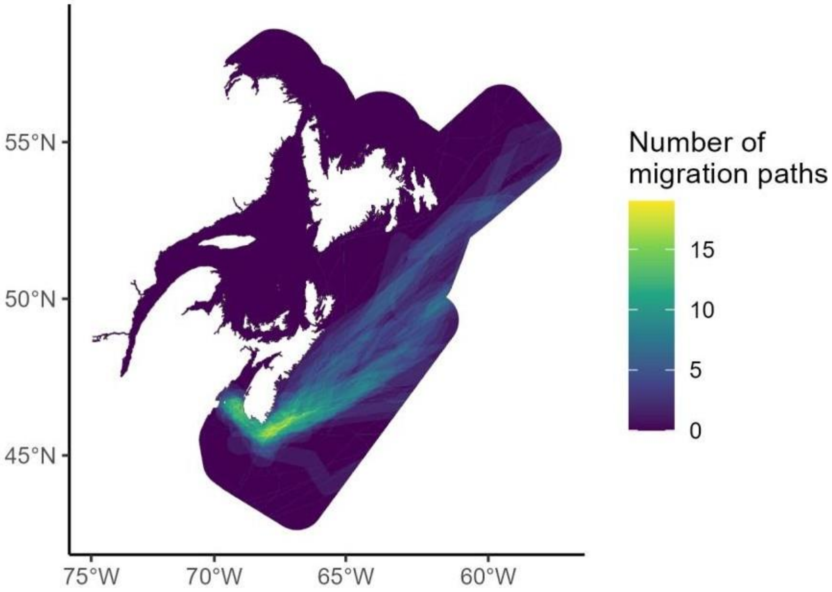


Figure 5: *Number of migration paths identified using movement telemetry during Fall for Great shearwater (GRSH).*

Tracks

When not enough data were available to perform dBBMMs outside of the migration periods, individual tracks (Euclidean distance between recorded locations) were mapped over the study area. Due to their low accuracy compared to the size of the study area, no tracks were plotted for GLS data. Example migration track maps are shown in *Figure 6*. All migration track figures are available in Appendix D.

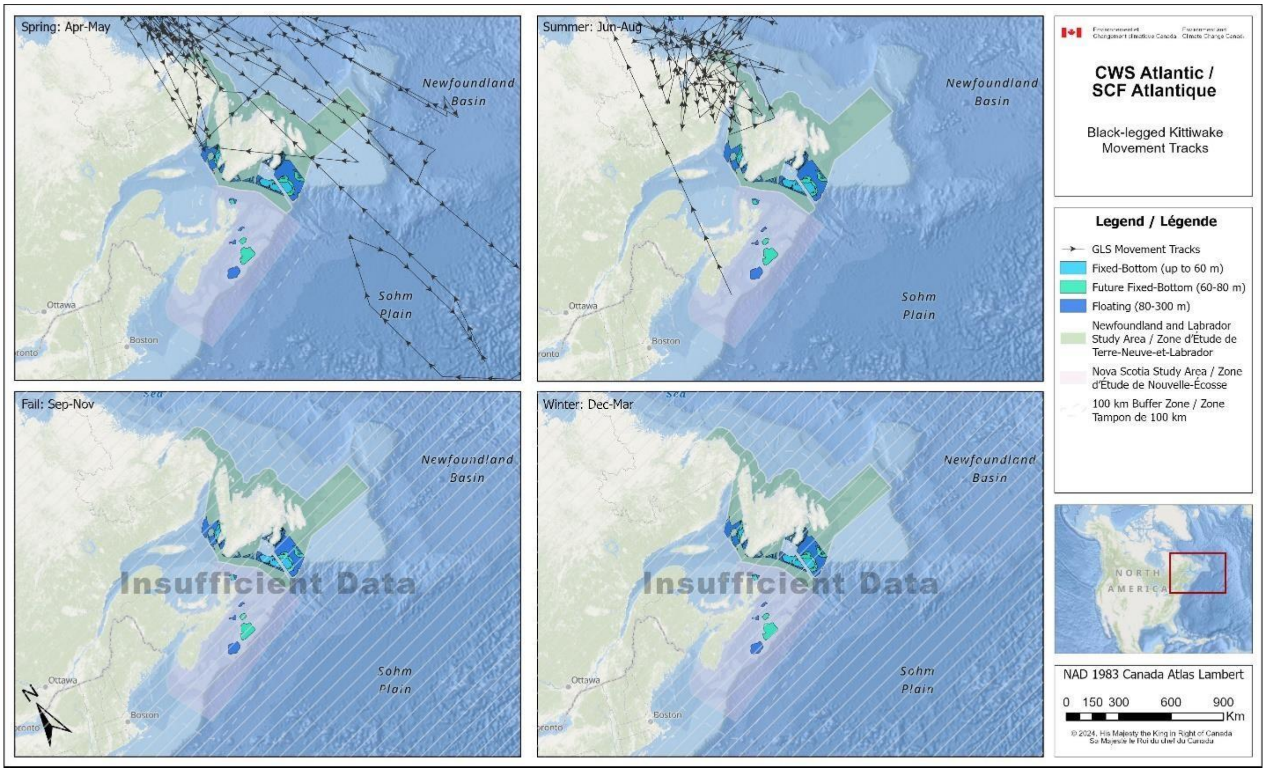


Figure 6: Seasonal movement tracks for Black-legged Kittiwake (BLKI).

Timing Plots

To provide the temporal repartition of the locations within a season, additional timing plots are provided for dBBMM and kernel density maps. Two sets of plots are provided. The first, using dBBMM, counts the number of locations in the study area for each species and each day of a season (*Figure 7*). Only the locations used in the movement models are considered. The total number of locations is also shown. All dBBMM timing plots are available in Appendix C. The second set of timing plots, using kernel density (*Figure 8: Number of tracked individuals across time whose locations were used to create the dBBMM maps presented in Figure 4.*Figure 8), count the number of individuals tracked each day of the season per species. All kernel density timing plots are available in Appendix C.

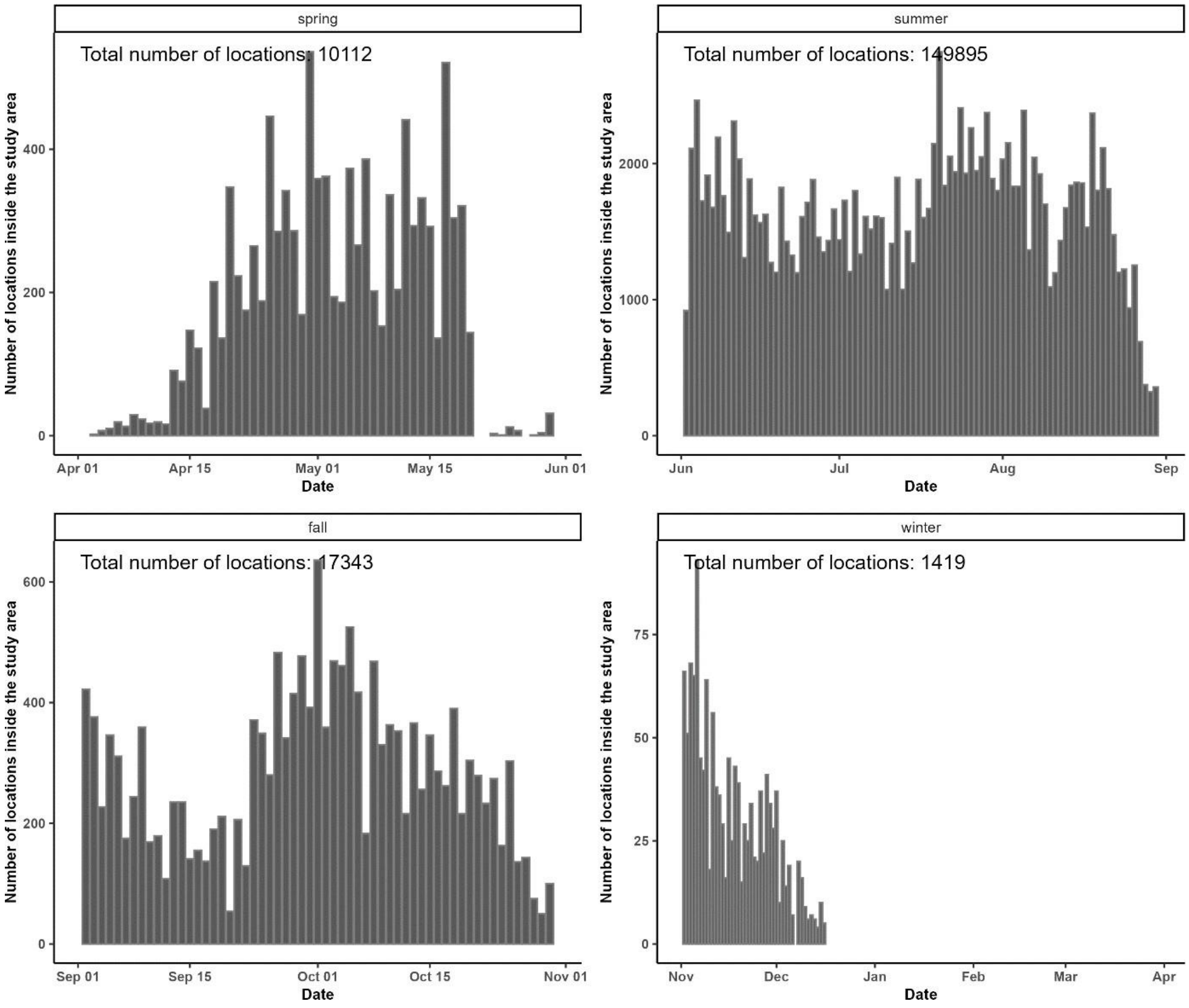
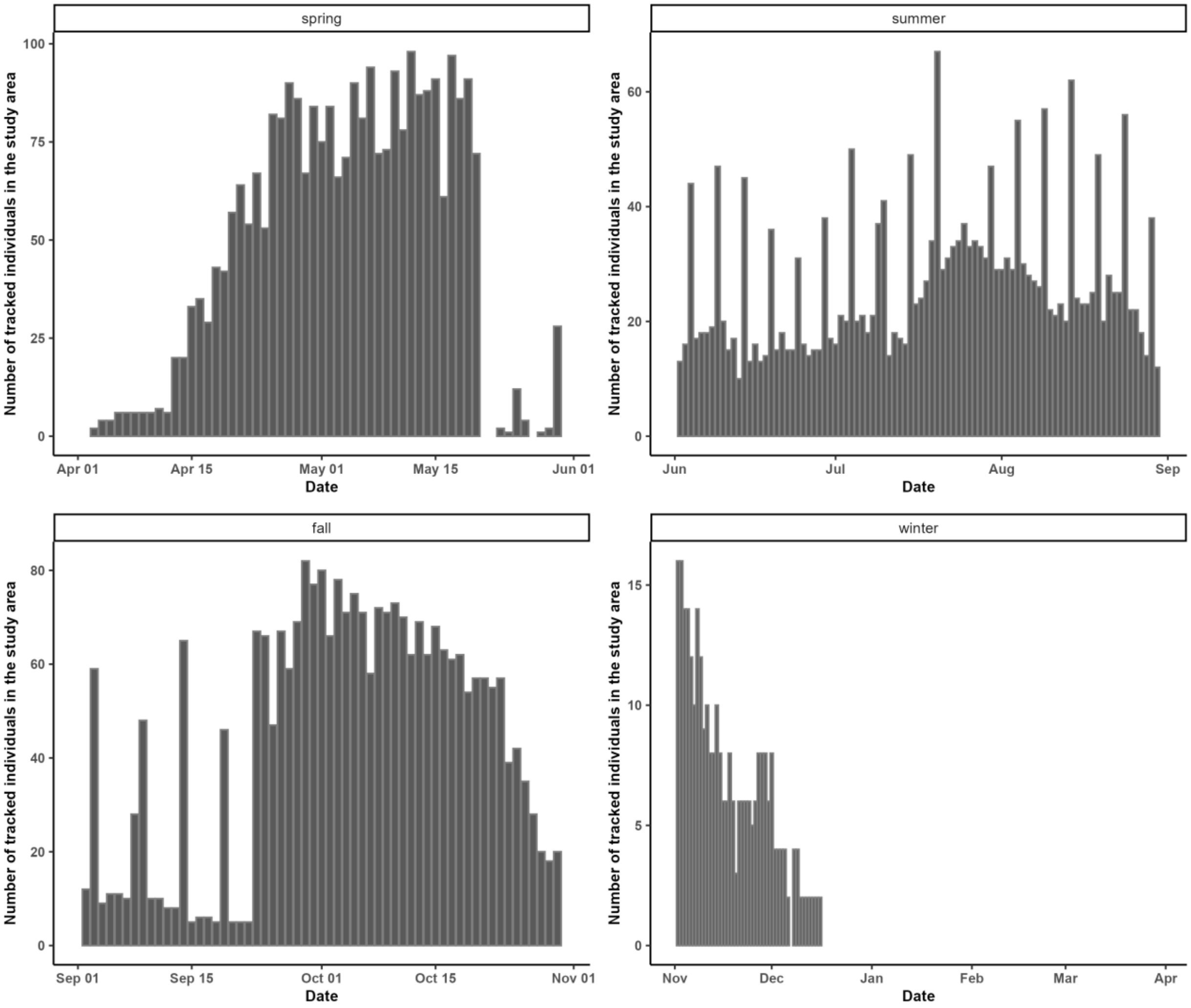


Figure 7: Temporal distribution of tracking locations used to create the dynamic Brownian Bridge Movement Model (dBBMM) maps for Northern Gannet (NOGA), as presented in Figure 4.



<u>Figure 8:</u> Number of tracked individuals across time whose locations were used to create the dBBMM maps presented in Figure 4.

Interpretation

Kernel density and dBBMM maps present areas of potential use by avian species. They identify three areas of probable use by individuals: high, medium, and low. Track maps identify where locations were recorded, as well as an added straight line between two consecutive locations to provide a simple estimation of the path taken by the individuals. Migration maps show tracks buffered by the average error location for the migration period.

As the available tracking data is limited in terms of number of individuals and spatial coverage, absence should be interpreted as a gap in data collection rather than no birds being present. Similarly, high usage areas might only reflect important areas for the tagged population and not the whole population. These products provide a baseline for the species studied and should be used as an indicator of where future efforts could be directed to increase knowledge of seasonal space use.

Timing plots show the number of locations by season and species. These plots should be considered when determining habitat use by the species. If tracking locations are lacking during a period when a species is known to be present, it can be assumed that this is the result of a data gap, and that the movement model does not accurately represent the spatial use of the species.

Limitations and Assumptions

While all efforts were made to be as exhaustive as possible during inventory of existing tracking data, the data used to present the movement models is heterogeneous. These products include data that may vary in spatial accuracy, temporal resolution, or even in the available information that is associated with the tracking data. For instance, data retrieved on public datasets usually follow a defined standard so all the data on the platform are similar in terms of column names, filtering process or metadata. However, these same standards are not consistent with data from other sources. Some information might be missing, such as the associated error in a different format, or the tagging location. The variety of tracking devices used also leads to differences in the quality of products, as illustrated by the number of approaches taken herein and the different resolution between methods.

Trade-offs between factors such as battery lifespan can lead to inconsistencies across datasets in terms of accuracy, number of locations, temporal resolution, and recording period. Long-term studies typically do not have the same temporal resolution as short-term studies. For instance, several datasets that included records spanning several months and overlapping migration periods also had a low temporal resolution (e.g., one location daily or every few days), making it difficult to identify migration routes. Conversely, some studies with high temporal resolution (e.g., collecting multiple locations per day or per hour), have shorter durations and tend to miss migration periods.

Additionally, due to the limited number of individuals tracked, these movement products should not be considered as representative of the whole population of a species. Unless the number of tracking devices deployed is large enough, and individuals are tagged throughout the study area, they represent only the tracked individuals. Therefore, an absence of movement in an area does not indicate that no birds are present, only that habitat use was not able to be determined with the tracking data available. Conversely, the presence of a high usage area with a low number of tracked individuals does not mean that this area is heavily used by all individuals of that species. However, this can help detect trends of habitat use that can help inform follow-up studies.

These products focus on species that breed or forage into the Atlantic offshore region. However, some species use the region only as a migratory corridor. For instance, some species of shorebirds breed in the Arctic and enter the study area only during the fall migration. Those species can be under-represented, as tracking data is scarce due to the logistical difficulties of deploying tracking devices in the breeding or wintering areas. The movement models presented emphasise the tracking data available for a given season and the known spatial use of the birds. However, these products have a coarse temporal resolution and do not incorporate the biology of each presented species. Fine-scale spatial and temporal habitat use will depend on the species and factors such as their foraging and breeding strategies. Habitat use will also depend on population size and colony sizes. Age of birds can also influence habitat use and young individuals are often considered more vulnerable.

Finally, the movement models presented here are limited to avian species. To our knowledge, there are no tracking studies that describe the behaviour of bats and flying invertebrates (i.e., Monarch) in the offshore. Due to the size and weight of recording devices, these products are limited to individuals that are sufficiently large to carry the device and does not include small-bodied birds such as shorebirds.

Recommendations

- When possible, use high accuracy tracking device, such as GPS trackers.
- Movement data should be analysed with movement models that account for tracking error, such as dynamic Brownian bridge movement models.
- Tracking devices should be programmed to record for an extended period that covers both the spring and fall migration for migrants, and the whole year for residents/facultative migrants. If such a deployment is not possible, consider several deployments so all life stages spent in the study area by a given species are covered. A few long-term tracks can be more informative than a higher number of short-term tracks (Thaxter et al. 2017).
- Ensure the number of tracking devices deployed is representative of population in the area of interest. For example, between 13 and 41 birds were found to be required for Lesser Black-backed Gulls (*Larus fuscus*) to accurately describe 95% of their estimated habitat use (Thaxter et al. 2017). On wide-ranging species with high inter-individual variation, at least 17 to 21 devices were required to minimise variations between individuals (Gutowsky et al. 2015). In both cases, increasing the number of tagged individuals also increases coverage of the total habitat used (Beal et al. 2023). Based on current literature, a minimum of 30 devices per species and colony should be deployed to ensure adequate representation. For colonial birds, devices should be deployed across all colonies expected to intersect with potential development areas. If deploying devices at all colonies that intersect an area of interest is not feasible, a modelling approach using tracking data of individuals from

representative colonies can be used to create species predictive distributions.

- Consider deploying devices across several years, as this better describes the total habitat used (Beal et al. 2023).
- Ensure there is appropriate spatial variation between tracked individuals. If multiple colonies are present in or near the area of interest, distribute tracking devices on individuals across multiple colonies of importance.
- Deploy devices across age classes for a species, especially if different behaviours, habitat use, or migratory pathways are expected to occur.
- When possible, devices that record flight height data should be favoured, due to the lack of accurate flight altitude information for several species and the importance of altitude when considering collision vulnerability.

Next Steps

ECCC will continue to finalize the products presented herein, including the following:

- Update mapping products using the official ECCC-CWS template. Include timing plots within the seasonal maps to identify the time coverage of the product.
- Review track products to include data not applicable to the dBBMM process and ensure consistency across products.
- Include Leach’s Storm-petrel data.

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Appendix A: Devices used to collect avian movement data

Name	Description	Pros	Cons
GPS (Global Positioning System) or GPS-PTT (GPS receivers coupled with Argos Platform Transmitter Terminals)	Satellite receivers	High spatial accuracy Temporal resolution can be high (every few minutes)	Often do not cover the whole year
Argos Platform Transmitter Terminals (PTT)	Satellite emitters	Variable accuracy (250m to 10km) Temporal resolution variable (few hours to few days)	Lower accuracy than GPS Duty cycles can miss the migration phase
GLS (Global Location Sensor)	Light sensing devices. Infers position based on daylight duration	Low battery consumption Whole year coverage	Low accuracy (100km) Does not work well near the equinoxes
VHF	Radio emitters	Low impact tags, easily deployed	Only detects presence in proximity of a receiver
Modelled location (not a device)	Data that has been published after having been processed through another model	Location error has already been included inside the model	

Appendix B: Tracking datasets used in avian movement analyses

Avain Tracking Datasets

id	dataset_name	alpha	sensor	source	source_id	description	contacts	license	citation
1	Study - NC Breeding ABDU	ABDU	GPS	Movebank	1404033416	American black duck brood movements, habitat use, and survival	Amanda Hoyt; Chris Williams	Creative Commons 1.0 Universal	
2	North-East American Canada goose migration	CANG	GPS	Movebank	2105214573		Manon Sorais	Creative Commons 1.0 Universal	Sorais M., Patenaude-Monette M., Sharp C., Askren R., LaRocque A., Leblon B., and Giroux J.-F.
7	Common/King Eiders; East Bay Island, Nunavut;	COEI	PTT	Movebank	43747715	This study is participating in the Arctic Animal Movement Archive (AAMA).	Holly Hennin, Grant Gilchrist, Anders Mosbech, Christian Sonne	Creative Commons Attribution	
7	Common/King Eiders; East Bay Island, Nunavut;	KIEI	PTT	Movebank	43747715	This study is participating in the Arctic Animal Movement Archive (AAMA).	Holly Hennin, Grant Gilchrist, Anders Mosbech, Christian Sonne	Creative Commons Attribution	
20	Atlantic Seabird Study (Surf Scoters)	SUSC	PTT	Movebank	1508766		Alicia Berlin	Creative Commons Attribution	Stenhouse IJ, Berlin AM, Gilbert AT, Goodale MW, Gray CE, Montevecchi WA, Savoy L, Spiegel CS. 2020. Assessing the exposure of three diving bird species to offshore wind areas on the U.S. Atlantic Outer Continental Shelf using satellite telemetry. Divers
170	Roseate tern (Sterna dougalii), North Brother Island, Canaa	ROST	GPS	Movebank	1623435186	Telemetry study performed on roseate terns using GPS devices during the incubation period.	Julie McKnight, Isabeau Pratte	Creative Commons 1.0 Universal	Pratte, Isabeau, Robert A. Ronconi, Shawn R. Craik, Julie McKnight (2021) Spatial ecology of endangered roseate terns and foraging habitat suitability around a colony in the western North Atlantic. Endangered Species Research 44:339-350
172	Bermuda petrel GPS tracking data during the breeding season	BEPE	GPS	Movebank	713265704	Tracking Bermuda Cahow using eObs data loggers	Andre Francis Raine, Carina Gjerdrum		
180	Thick-Billed Murre 2008-2010 Digges Islands	TBMU	GLS	Seabird Tracking Database	1112	data collected using GLS locators as part of an International Polar Year study comparing inter-specific and inter-colony year-round movements of TBMU and COMU. see https://research.library.mun.ca/6375/	Laura McFarlane Tranquilla, William Montevecchi, H. Grant Gilchrist, Mark Mallory	Requested on public dataset	
181	Razorbill GPS Grand Colombier	RAZO	GPS	Seabird Tracking Database	2041		Karine Delord	Requested on public dataset	
182	Common Guillemot GPS Grand Colombier	COMU	GPS	Seabird Tracking Database	2040		Karine Delord	Requested on public dataset	
183	Atlantic Puffin GPS Grand Colombier	ATPU	GPS	Seabird Tracking Database	2039		Karine Delord	Requested on public dataset	
184	Ivory Gull Seymour Island	IVGU	PTT	Seabird Tracking Database	1743		Mark Mallory	Requested on public dataset	
185	Nothern Fulmar Cape Vera	NOFU	PTT	Seabird Tracking Database	1738		Mark Mallory	Requested on public dataset	
186	Thick-billed Murres 2008-2010 Prince Leopold Island BAS loggers	TBMU	GLS	Seabird Tracking Database	1115	data collected using GLS locators as part of an International Polar Year study comparing inter-specific and inter-colony year-round movements of TBMU and COMU. see https://research.library.mun.ca/6375/	Laura McFarlane Tranquilla, William Montevecchi, H. Grant Gilchrist, Mark Mallory	Requested on public dataset	
187	Thick-billed Murres 2007-2008 Minarets	TBMU	GLS	Seabird Tracking Database	1114	data collected using GLS locators as part of an International Polar Year study comparing inter-specific and inter-colony year-round movements of TBMU and COMU. see https://research.library.mun.ca/6375/	Laura McFarlane Tranquilla, William Montevecchi, H. Grant Gilchrist, Mark Mallory	Requested on public dataset	
195	Black-legged Kittiwake from Prince Leopold Island, GLS, migration 2008-09	BLKI	GLS	Seabird Tracking Database	1051		Mark Mallory	Requested on public dataset	
198	Foraging Leach's Storm-Petrel_GPS_Bon Portage 2017	LESP	GPS	Seabird Tracking Database	1360		Ingrid L. Pollet	Requested on public dataset	
199	Sooty Shearwater, Kidney Island, GLS, 2017-2018	SOSH	GLS	Seabird Tracking Database	1587	Data collected using Migrate Technology F100 geolocators, which record absolute light intensity, rather than clipped light intensity. Data processed using Benjamin Merkel's probGLS package (i.e. using SST correction), so there are locations right through	Ewan Wakefield	Requested on public dataset	
200	Cory's Shearwater, Corvo, GLS, 2017-2018	CORS	GLS	Seabird Tracking Database	1586	Data collected using Migrate Technology F100 geolocators, which record absolute light intensity, rather than clipped light intensity. Data processed using Benjamin Merkel's probGLS package (i.e. using SST correction), so there are locations right through	Ewan Wakefield	Requested on public dataset	
201	Herring Gulls (Larus Argentatus); Ronconi; Sable Island, Canada	HERG	GPS	Movebank	1080341737	Argos and GPS tracking of herring gulls breeding on Sable Island, Nova Scotia, Canada.	Robert Ronconi	Creative Commons 1.0 Universal	Herring Gulls (Larus Argentatus); Ronconi; Sable Island, Canada
201	Herring Gulls (Larus Argentatus); Ronconi; Sable Island, Canada	HERG	PTT	Movebank	1080341737	Argos and GPS tracking of herring gulls breeding on Sable Island, Nova Scotia, Canada.	Robert Ronconi	Creative Commons 1.0 Universal	Herring Gulls (Larus Argentatus); Ronconi; Sable Island, Canada
202	American Herring Gulls - GPS - Lobster Bay, Southwest Nova Scotia, Canada	HERG	GPS	Movebank	2944153255	American Herring Gulls were tracked from two colonies in Lobster Bay, Southwest Nova Scotia, using solar-powered GPS devices from Ecotone Telemetry (Gdynia, Poland; Harrier-M or Harrier-L, Kite-M, and URIA 240). Fifteen adults were captured during incubat	SarahGutowsk, Mark Mallory	Creative Commons 1.0 Universal	The Kespukwitk/Southwest Nova Scotia Priority Place Coastal Islands Working Group contributed significantly to the project through participation in a collaborative planning process that identified the impacts of problematic native species as a threat to
203	Herring Gulls (Larus Argentatus); Ronconi; Brier Island, Canada	HERG	GPS	Movebank	1071134107	GPS tracking of herring gulls breeding on Brier Island, Bay of Fundy, Nova Scotia, Canada.	Robert Ronconi	Creative Commons 1.0 Universal	Ronconi RA, Shlepr KR. 2020. Data from: Study "Herring Gulls (Larus Argentatus); Ronconi; Brier Island, Canada". Movebank Data Repository. <a href="https://www.doi.org/10.5441/001/1.282vr7kd" target="_blank">https://ww

204	Herring Gulls (Larus Argentatus); Ronconi; Kent Island, Canada	HERG	GPS	Movebank	1071101052	Argos and GPS tracking of herring gulls breeding on Kent Island, Bay of Fundy, Nova Scotia, Canada.	Robert Ronconi	Creative Commons 1.0 Universal	Ronconi RA, Shlepr KR. 2020. Data from: Study "Herring Gulls (Larus Argentatus); Ronconi; Kent Island, Canada". Movebank Data Repository. <a href="https://www.doi.org/10.5441/001/1.t5n4s456" target="_blank">https://www.
204	Herring Gulls (Larus Argentatus); Ronconi; Kent Island, Canada	HERG	PTT	Movebank	1071101052	Argos and GPS tracking of herring gulls breeding on Kent Island, Bay of Fundy, Nova Scotia, Canada.	Robert Ronconi	Creative Commons 1.0 Universal	Ronconi RA, Shlepr KR. 2020. Data from: Study "Herring Gulls (Larus Argentatus); Ronconi; Kent Island, Canada". Movebank Data Repository. <a href="https://www.doi.org/10.5441/001/1.t5n4s456" target="_blank">https://www.
206	Northern Gannet Breeding Season GPS Data from Cape St. Mary's, NL, Canada: 2019 to 2022	NOGA	GPS	Movebank	2630711281		Kyle d'Entremont, William A. Montevecchi	Creative Commons Attribution-NonCommercial	d'Entremont KJN, Davoren GK, Montevecchi WA. 2023. Data from: Study "Northern Gannet Breeding Season GPS Data from Cape St. Mary's, NL, Canada: 2019 to 2022". Movebank Data Repository. <a href="https://www.doi.org/10.5441/001/1.5km7v2s3&
207	Atlantic Seabird Study (Red-Throated Loons)	RTLO	PTT	Movebank	37025629	This project was funded by the Bureau of Ocean Energy Management (BOEM) through IAA #M12PG00005 with the U.S. Fish and Wildlife Service (USFWS), with the additional support of the U.S. Department of Energy (DOE), the Sea Duck Joint Venture (SDJV), the Ba	Alicia Berlin	Creative Commons Attribution	Stenhouse IJ, Berlin AM, Gilbert AT, Goodale MW, Gray CE, Montevecchi WA, Savoy L, Spiegel CS. 2020. Assessing the exposure of three diving bird species to offshore wind areas on the U.S. Atlantic Outer Continental Shelf using satellite telemetry. Divers
209	Whimbrel Numenius phaeopus North America Smith/Watts/Winn	WHIM	PTT	Movebank	7073245	The whimbrel is a large, Holarctic, highly migratory shorebird. The North American race (N.p. hudsonicus) includes two disjunct breeding populations, both of which winter primarily in Central and South America. The western population breeds in Alaska and	The Center for Conservation Biology (CCB)		Watts BD, Smith FM, Hines C, Duval L, Hamilton DJ, Keyes T, Paquet J, Pirie-Dominix L, Rausch J, Truitt B, et al. 2021. The costs of using night roosts for migrating whimbrels. J Avian Biol. e02629. https://doi.org/10.1111/jav.02629

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210	Glaucous gull Elliott Coats	GLGU	GLS	Movebank	1767692280	Many populations of migratory seabirds differ in their migration strategies, where individuals travel in different directions to separate wintering areas. These migratory strategies may expose individuals to different threats, thus understanding migrator	Allison Patterson, Kyle Elliott	Creative Commons Attribution	Baak JE, Patterson A, Gilchrist HG, Elliott KH. 2021. Data from: First evidence of diverging migration and overwintering strategies in glaucous gulls (Larus hyperboreus) from the Canadian Arctic. Movebank Data Repository. <a href="https://www.doi.
210	Glaucous gull Elliott Coats	GLGU	GPS	Movebank	1767692280	Many populations of migratory seabirds differ in their migration strategies, where individuals travel in different directions to separate wintering areas. These migratory strategies may expose individuals to different threats, thus understanding migrator	Allison Patterson, Kyle Elliott	Creative Commons Attribution	Baak JE, Patterson A, Gilchrist HG, Elliott KH. 2021. Data from: First evidence of diverging migration and overwintering strategies in glaucous gulls (Larus hyperboreus) from the Canadian Arctic. Movebank Data Repository. <a href="https://www.doi.
211	Long-tailed Jaeger - GLS - Canadian Arctic	LTJA	GLS	Movebank	1978212368	This study contains the migratory tracks of Long-tailed Jaegers monitored with light-level geolocators (GLS) on Bylot Island and Igloolik Island since 2014. RAW light, temperature and wet data, annotated twilights and estimated locations are provided. Th	Yannick Seyer, Nicolas Lecomte	Creative Commons Attribution	Seyer Y, Gauthier G, Lecomte N. 2022. Data from: Study "Long-tailed Jaeger - GLS - Canadian Arctic". Movebank Data Repository. <a href="https://www.doi.org/10.5441/001/1.558kn337" target="_blank">https://www.doi.org/10
212	Long-tailed Jaeger - PTT - Canadian Arctic	LTJA	PTT	Movebank	1978859802	This study contains the migratory tracks of Long-tailed Jaegers monitored with Argos transmitters (PTT-100) on Bylot Island in 2008. RAW and processed data are provided. This study is participating in the Arctic Animal Movement Archive (AAMA).	Yannick Seyer	Creative Commons Attribution	Seyer Y, Gauthier G, Bêty J, Therrien J-F, Lecomte N. 2021. Seasonal variations in migration strategy of a long-distance Arctic-breeding seabird. Mar Ecol Prog Ser. 677:1-16. https://doi.org/10.3354/meps13905
213	TBMUCOMU.GastonMontevecchi.NWAtlantic	COMU	GLS	Movebank	14381504	Using solar geolocators, Thick-billed Murres and Common Murres were tracked year-round(nonbreeding period). Colonies included Prince Leopold, Coats, Digges, Minarets, Gannets, Funk, and Gull Islands, in the eastern Canadian Arctic and eastern Canada. Data was collected as part of an International Polar Year study and published in McFarlane Tranquilla 2014 (https://research.library.mun.ca/6375/)	Laura McFarlane Tranquilla, AJ Gaston, WA Montevecchi	Creative Commons Attribution	https://research.library.mun.ca/6375/
213	TBMUCOMU.GastonMontevecchi.NWAtlantic	TBMU	GLS	Movebank	14381504	Using solar geolocators, Thick-billed Murres and Common Murres were tracked year-round(nonbreeding period). Colonies included Prince Leopold, Coats, Digges, Minarets, Gannets, Funk, and Gull Islands, in the eastern Canadian Arctic and eastern Canada. Dat	Laura McFarlane Tranquilla, AJ Gaston, WA Montevecchi	Creative Commons Attribution	
215	Snowy owl - North America	SNOW	PTT	Movebank	12112706	We encourage users of these data to contact the data owners to answer any questions you may have regarding the data and proposed uses. This study is participating in the Arctic Animal Movement Archive (AAMA).	Audrey Robillard, Jean-Francois, Therrien	Creative Commons Attribution	
216	Cory's Shearwater, GLS data, Vila (Azores)	CORS	GLS	Seabird Tracking Database	975		Jacob Gonzalez-Solis	Requested on public dataset	

217	Puffin GLS 2020 21	ATPU	GLS	Seabird Tracking Database	1926	Puffin GLS data from 2 colonies; Skellig Michael, Co Kerry and Little Saltee, Co Wexford plus associated light and activity data	Mark Jessopp	Requested on public dataset	

218	STB - Leach's Storm Petrel	LESP	GPS	STB	0	Points are classified as one of three behavioural states: transit, extensive search, and intensive search. Behavioural states were estimated using a Hidden Markov model, with a cyclic function 'time of day' informing changes in the design matrix [DM = (li	Katharine Studholme, April Hedd	ECCC Dataset	
219	ATPU Gannet Island GLS	ATPU	GLS	STB	0	Tracking data for ATPU breeding on the Gannet Is, Labrador between 2015-2019.	Dave Fifield, April Hedd	ECCC Dataset	
220	Sooty Shearwater - GLS - Falkland Island 2007-2009	SOSH	GLS	STB	0	GLS data for Sooty Shearwaters that breed in the Falkland Islands (2007-2009), but spend their non-breeding season in the North Atlantic. I've only included data for when they are resident in the northern hemisphere. Some metadata are also included in t	April Hedd	ECCC Dataset	
221	Foraging Leach's Storm-Petrel Bird Island 2013	LESP	GLS	Seabird Tracking Database	1142		Ingrid L. Pollet	Requested on public dataset	
222	Foraging Leach's Storm-Petrel Country Island 2012 2013	LESP	GLS	Seabird Tracking Database	1141		Ingrid L. Pollet	Requested on public dataset	
223	Puffin Overwintering	ATPU	GLS	Seabird Tracking Database	1048		Mark Jessopp	Requested on public dataset	
224	BEPE_incubation_2020	BEPE	GPS	Seabird Tracking Database	1577		Letizia Campioni, Jeremy Lee Madeiros, Carina Gjerdrum, Mónica C. Silva	Requested on public dataset	
225	Black-legged Kittiwake from Kippaku, GLS, non-breeding 2008-2011	BLKI	GLS	Seabird Tracking Database	1049		Morten Frederiksen	Requested on public dataset	
226	CWS - LEYE - Tracks	LEYE	PTT	CWS	0	Tracks for Lesser Yellowlegs from satellite tags deployed in 2023	Julie Paquet	ECCC Dataset	
227	CWS - WHIM - Tracks	WHIM	PTT	CWS	0	Satellite tags deployed on Miscou (Whimbrel)	Julie Paquet	ECCC Dataset	
228	CWS - ABDU - Satellite	ABDU	PTT	CWS	0	Data associated with https://onlinelibrary.wiley.com/doi/full/10.1002/wlb3.01000	Matthew English		Peck, Liam E., Matthew D. English, Gregory J. Robertson, Shawn R. Craik, and Mark L. Mallory. 2022. "Migration Chronology and Movements of Adult American Black Ducks Anas Rubripes Wintering in Nova Scotia, Canada." Wildlife Biology 2022 (1): e01000. https
229	GBBG tracks from Devil's Island	GBBG	GPS	CWS	0		Rob Ronconi	ECCC Dataset	Maynard, Laurie D, and Robert A Ronconi. 2018. "Foraging Behaviour of Great Black-Backed Gulls Larus Marinus near an Urban Center in Atlantic Canada: Evidence of Individual Specialization from GPS Tracking."
230	White-tailed Tropic bird GLS data - MUN	WTTR	GLS	MUN	0	GLS data for White-tailed Tropicbirds	Mejías, M.A	Requested directly to the owner	Mejías, M.A., Wiersma, Y.F., Wingate, D.B. and Madeiros, J.L., 2017. Distribution and at-sea behavior of Bermudan White-tailed Tropicbirds (Phaethon lepturus catesbyi) during the non-breeding season. Journal of Field Ornithology, 88(2), pp.184-197.
231	USFWS_LEYE	LEYE	GPS	USFWS	0	Lesser Yellowlegs tracvks fron the USFWS	Zak Pohlen		
232	USFWS_AMGP	AMGP	GPS	USFWS	0	AMGP GPS tracsk from USFWS	Zak Pohlen		
234	PMAD - Madeira gadfly petrel GPS track data	PMAD	GPS	CWS	0	Madeira gadfly petrel GPS track data	Monica Sila, Paulo Catry, José Pedro Granadeiro, Carina Gjerdrum	Requested directly to the owner	
235	PDES - Pterodroma Desertas GPS tracking data	PDES	GPS	CWS	0		Monica Sila, Paulo Catry, José Pedro Granadeiro, Carina Gjerdrum	Requested directly to the owner	Ventura et al. 2020, http://dx.doi.org/10.1098/rspb.2019.1775
236	GRSH - MEPS 2017 - Great Shearwater	GRSH	PTT	CWS	0	MEPS 2017 dataset is described in https://www.int-res.com/abstracts/meps/v574/p211-226/ We used your Bay of Fundy data (2006-2009), Linda's coastal Maine data (2010-2012), and SBNMS (2013-2014). I confined the boundaries of that analysis to the Gulf of M	Rob Ronconi, Linda Welch, Stellwagen Bank National Marine Sanctuary, Dave Wiley	ECCC Dataset	https://www.int-res.com/abstracts/meps/v574/p211-226/
237	GRSH - FMS 2021 - Great Shearwater	GRSH	PTT	CWS	0	we again used the same datasets as MEPS 2017, except the SBNMS data was from 2014-2019, plus we included data from deployments at GRSH colonies. AND in this case, we modeled only individual birds that migrated (not all birds that were tagged), and the mo	Rob Ronconi, Linda Welch, Stellwagen Bank National Marine Sanctuary, Dave Wiley	ECCC Dataset	https://www.frontiersin.org/articles/10.3389/fmars.2022.938033/full
238	SOSH - Bay of Fundy	SOSH	PTT	CWS	0	tracking data from 4 Sooty Shearwater PTTs deployed in the Bay of Fundy. These have never been published, but original tracks were put on these websites: http://www.seaturtle.org/tracking/index.shtml?project_id=237 http://www.seaturtle.org/tracking/ind	Rob Ronconi	ECCC Dataset	
239	Razorbill - year-round tracking data - GLS	RAZO	GLS	CWS	0	Year-round Razorbill tracks from 5 colonies: 1) Machias Seal Island, Bay of Fundy, 2) James Island, Northeast coast of NL, 3) Biquette Island, Quebec, 4) Gull Island, Witless Bay, NL, and 5) Gannet Islands, Labrador These are not published or written u	Heather Major, Mark Dodds, Rob Ronconi	ECCC Dataset	
240	Black Guillemot - year-round movement data from 2 colonies	BLGU	GLS	CWS	0	Black Guillemot data from Country Island, NS, and Kent Island, NB. Described in this paper: http://www.marineornithology.org/article?rn=1399	Rob Ronconi	ECCC Dataset	http://www.marineornithology.org/article?rn=1399
241	BEPE - GPS - 2019-2022	BEPE	GPS	CWS	0	GPS data for Bermuda Petrel in 2019-2022	Laetizia Camponi, Carina Gjerdrum		The Incubation and chick-rearing data of 2019 and 2022 have been used in a mansucript that is in press. For now you can cite them as "Campioni L, Ventura F, Granadeiro JP, Madeiros J, Gjerdrum C, Silva MC (in press) Combining bio-logging, stable isotopes
242	Shorebird Data - Atlantic Canada	AMGP	GPS	SSCC	0	Shorebird tracks provided by the Shorebird Collective	Alexandra Anderson		Refer to shorebirdcollective_v2023_10_10_ATLCAN_citations.csv for citations
242	Shorebird Data - Atlantic Canada	AMWO	GPS	SSCC	0	Shorebird tracks provided by the Shorebird Collective	Alexandra Anderson		Refer to shorebirdcollective_v2023_10_10_ATLCAN_citations.csv for citations

242	Shorebird Data - Atlantic Canada	BBPL	PTT	SSCC	0	Shorebird tracks provided by the Shorebird Collective	Alexandra Anderson		Refer to shorebirdcollective_v2023_10_10_ATLCAN_citations.csv for citations
242	Shorebird Data - Atlantic Canada	HUGO	PTT	SSCC	0	Shorebird tracks provided by the Shorebird Collective	Alexandra Anderson		Refer to shorebirdcollective_v2023_10_10_ATLCAN_citations.csv for citations
242	Shorebird Data - Atlantic Canada	LEYE	GPS	SSCC	0	Shorebird tracks provided by the Shorebird Collective	Alexandra Anderson		Refer to shorebirdcollective_v2023_10_10_ATLCAN_citations.csv for citations
242	Shorebird Data - Atlantic Canada	PESA	PTT	SSCC	0	Shorebird tracks provided by the Shorebird Collective	Alexandra Anderson		Refer to shorebirdcollective_v2023_10_10_ATLCAN_citations.csv for citations
242	Shorebird Data - Atlantic Canada	REPH	PTT	SSCC	0	Shorebird tracks provided by the Shorebird Collective	Alexandra Anderson		Refer to shorebirdcollective_v2023_10_10_ATLCAN_citations.csv for citations
242	Shorebird Data - Atlantic Canada	WHIM	PTT	SSCC	0	Shorebird tracks provided by the Shorebird Collective	Alexandra Anderson		Refer to shorebirdcollective_v2023_10_10_ATLCAN_citations.csv for citations
244	Tracking data from Ronconi et al. 2022 paper	ARTE	VHF	CWS	0	Cleaned unfiltered tracking data that came from many contributors and was the primary data for the predictive models in Ronconi et al. 2022 https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full	Rob Ronconi, see also METADATA file		https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full
244	Tracking data from Ronconi et al. 2022 paper	ATPU	GPS	CWS	0	Cleaned unfiltered tracking data that came from many contributors and was the primary data for the predictive models in Ronconi et al. 2022 https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full	Rob Ronconi, see also METADATA file		https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full
244	Tracking data from Ronconi et al. 2022 paper	BLGU	GPS	CWS	0	Cleaned unfiltered tracking data that came from many contributors and was the primary data for the predictive models in Ronconi et al. 2022 https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full	Rob Ronconi, see also METADATA file		https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full
244	Tracking data from Ronconi et al. 2022 paper	BLKI	GPS	CWS	0	Cleaned unfiltered tracking data that came from many contributors and was the primary data for the predictive models in Ronconi et al. 2022 https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full	Rob Ronconi, see also METADATA file		https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full
244	Tracking data from Ronconi et al. 2022 paper	COEI	PTT	CWS	0	Cleaned unfiltered tracking data that came from many contributors and was the primary data for the predictive models in Ronconi et al. 2022 https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full	Rob Ronconi, see also METADATA file		https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full
244	Tracking data from Ronconi et al. 2022 paper	COMU	GPS	CWS	0	Cleaned unfiltered tracking data that came from many contributors and was the primary data for the predictive models in Ronconi et al. 2022 https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full	Rob Ronconi, see also METADATA file		https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full
244	Tracking data from Ronconi et al. 2022 paper	COTE	VHF	CWS	0	Cleaned unfiltered tracking data that came from many contributors and was the primary data for the predictive models in Ronconi et al. 2022 https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full	Rob Ronconi, see also METADATA file		https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full
244	Tracking data from Ronconi et al. 2022 paper	GBBG	GPS	CWS	0	Cleaned unfiltered tracking data that came from many contributors and was the primary data for the predictive models in Ronconi et al. 2022 https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full	Rob Ronconi, see also METADATA file		https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full
244	Tracking data from Ronconi et al. 2022 paper	GBBG	PTT	CWS	0	Cleaned unfiltered tracking data that came from many contributors and was the primary data for the predictive models in Ronconi et al. 2022 https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full	Rob Ronconi, see also METADATA file		https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full
244	Tracking data from Ronconi et al. 2022 paper	HERG	GPS	CWS	0	Cleaned unfiltered tracking data that came from many contributors and was the primary data for the predictive models in Ronconi et al. 2022 https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full	Rob Ronconi, see also METADATA file		https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full
244	Tracking data from Ronconi et al. 2022 paper	HERG	GPS-PTT	CWS	0	Cleaned unfiltered tracking data that came from many contributors and was the primary data for the predictive models in Ronconi et al. 2022 https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full	Rob Ronconi, see also METADATA file		https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full
244	Tracking data from Ronconi et al. 2022 paper	LESP	GLS	CWS	0	Cleaned unfiltered tracking data that came from many contributors and was the primary data for the predictive models in Ronconi et al. 2022 https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full	Rob Ronconi, see also METADATA file		https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full
244	Tracking data from Ronconi et al. 2022 paper	NOGA	GPS	CWS	0	Cleaned unfiltered tracking data that came from many contributors and was the primary data for the predictive models in Ronconi et al. 2022 https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full	Rob Ronconi, see also METADATA file		https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full
244	Tracking data from Ronconi et al. 2022 paper	RAZO	GPS	CWS	0	Cleaned unfiltered tracking data that came from many contributors and was the primary data for the predictive models in Ronconi et al. 2022 https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full	Rob Ronconi, see also METADATA file		https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full
244	Tracking data from Ronconi et al. 2022 paper	ROST	GPS	CWS	0	Cleaned unfiltered tracking data that came from many contributors and was the primary data for the predictive models in Ronconi et al. 2022 https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full	Rob Ronconi, see also METADATA file		https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full
244	Tracking data from Ronconi et al. 2022 paper	ROST	VHF	CWS	0	Cleaned unfiltered tracking data that came from many contributors and was the primary data for the predictive models in Ronconi et al. 2022 https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full	Rob Ronconi, see also METADATA file		https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full
244	Tracking data from Ronconi et al. 2022 paper	TBMU	GPS	CWS	0	Cleaned unfiltered tracking data that came from many contributors and was the primary data for the predictive models in Ronconi et al. 2022 https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full	Rob Ronconi, see also METADATA file		https://www.frontiersin.org/articles/10.3389/fmars.2022.816794/full
245	ABDU - Black Duck Joint Venture	ABDU	GPS	BDJV	0	GPS Tracking data from the Black Duck Joint venture			
246	Black-legged Kittiwake, GLS, Isle of May	BLKI	GLS	Seabird Tracking Database	1102		Francis Daunt	Requested on public dataset	
247	Northern Gannet (Diving Bird Study)	NOGA	PTT	Movebank	3168000943	Satellite tracking of Northern Gannets. This study is participating in the Arctic Animal Movement Archive (AAMA).	Alicia Berlin	Creative Commons 1.0 Universal	Spiegel, C. S., Berlin, A. M., Gilbert, A. T., Gray, C. O., Montevecchi, W. A., Stenhouse, I. J., Ford, S. L., Olsen, G. H., Fiely, J. L., Savoy, L., Goodale, M. W., & Burke, C. M. (2017). Determining fine-scale use and movement patterns of diving bird s

248	Northern Gannet (Morus bassanus); Fifield; Canada	NOGA	GLS	Movebank	1424990296	Over-winter GLS tracking of Northern Gannets from eastern Canada to eastern/southern US and western Africa	Dave Fifield		Fifield, D. A., Montevecchi, W. A., Garthe, S., Robertson, G. J., Kubetzki, U., and Rail, J.-F. 2014. Migratory tactics and wintering areas of Northern Gannets (Morus bassanus) breeding in North America. Ornith Monog 79:1-63.
249	Herring Gulls (Larus Argentatus); Clark; Massachussets, United States	HERG	GPS	Movebank	1080341217	Argos and GPS tracking of herring gulls wintering near the Quabbin Reservoir in Massachusetts, United States. This study is participating in the Arctic Animal Movement Archive (AAMA).	Christin Anderson, Dan Clark	Creative Commons 1.0 Universal	Clark DE, Mackenzie SA, Koenen K, Whitney J, DeStefano S. 2020. Data from: Study "Herring Gulls (Larus Argentatus); Clark; Massachussets, United States". Movebank Data Repository. https://www.doi.org/10.5441/001/1.3th8b5q3
249	Herring Gulls (Larus Argentatus); Clark; Massachussets, United States	HERG	PTT	Movebank	1080341217	Argos and GPS tracking of herring gulls wintering near the Quabbin Reservoir in Massachusetts, United States. This study is participating in the Arctic Animal Movement Archive (AAMA).	Christin Anderson, Dan Clark	Creative Commons 1.0 Universal	Clark DE, Mackenzie SA, Koenen K, Whitney J, DeStefano S. 2020. Data from: Study "Herring Gulls (Larus Argentatus); Clark; Massachussets, United States". Movebank Data Repository. https://www.doi.org/10.5441/001/1.3th8b5q3
250	Great Shearwater Fundy	GRSH	PTT	Seabird Tracking Database	665	Great Shearwater Fundy	Robert Ronconi, Peter Ryan	Requested on public dataset	
251	Sooty Shearwater, Bay of Fundy	SOSH	PTT	Seabird Tracking Database	656	Sooty Shearwater, Bay of Fundy	Robert Ronconi, Andrew Westgate	Requested on public dataset	
252	Geos SantaMaria Data 2008-2011	CORS	GLS	Seabird Tracking Database	1839	Geos SantaMaria Data 2008-2011	Maria Magalhaes	Requested on public dataset	
253	Geos Corvo Data 2009-2011	CORS	GLS	Seabird Tracking Database	1722	Geos Corvo Data 2009-2011	Maria Magalhaes	Requested on public dataset	
254	Foraging of Leach's Storm-Petrel Bon Portage 2012 2015	LESP	GLS	Seabird Tracking Database	1140		Ingrid L. Pollet	Requested on public dataset	
255	ATPU Newfoundland GPS	ATPU	GPS	STB	0	Data 2016 2019 2022 203	Katie Studholme, April Hedd	ECCC Dataset	
256	BLKI NL GPS	BLKI	GPS	STB	0	Data from 2016	Katie Studholme, April Hedd	ECCC Dataset	
257	COMU NL GPS	COMU	GPS	STB	0	Data from 2023	Katie Studholme, April Hedd	ECCC Dataset	
258	HERG NL GPS	HERG	GPS	STB	0	Data from 2023	Katie Studholme, April Hedd	ECCC Dataset	
259	Black Scoters SDJV dbbmm locations	BLSC	PTT	Seaduck Joint Venture	0	Data used for creating dbbmms provided by the SDJV	Seaduck Joint Venture, see metadata	Requested directly to the owner	
260	Long-tailed-duck SDJV dbbmm locations	LTDU	PTT	Seaduck Joint Venture	0	Data used for creating dbbmms provided by the SDJV	Seaduck Joint Venture	Requested directly to the owner	
261	Northern Gannet SDJV dbbmm locations	NOGA	PTT	Seaduck Joint Venture	0	Data used for creating dbbmms provided by the SDJV	Seaduck Joint Venture	Requested directly to the owner	
262	Red-throated Loon SDJV dbbmm locations	RTLO	PTT	Seaduck Joint Venture	0	Data used for creating dbbmms provided by the SDJV	Seaduck Joint Venture	Requested directly to the owner	
263	Surf Scoter SDJV dbbmm locations	SUSC	PTT	Seaduck Joint Venture	0	Data used for creating dbbmms provided by the SDJV	Seaduck Joint Venture	Requested directly to the owner	
264	White-winged Scoter SDJV dbbmm locations	WWSC	PTT	Seaduck Joint Venture	0	Data used for creating dbbmms provided by the SDJV	Seaduck Joint Venture	Requested directly to the owner	

Appendix C: Kernel Density and dBBMM

Sample sizes used for avian movement analyses

Sample sizes used to create kernel and dBBMM models are provided. These data can be used to identify data gaps between species and/or seasons. Sample size should be used in conjunction with timing plots, as a multiple locations reflect a higher recording frequency.

Kernel Density Utilization Distributions

The number of locations used to create the kernel density utilization distribution maps are found here:

<Link removed due to access granted only to the Committee>

Note that kernels use locations outside the study area. The number of locations found within the study area are listed in column "n_locs_in_sa". Note that only GLS data was used to create kernel density

utilization distributions.

.

Column name	Value
alpha	4 letters alphanumerical species code
season	Season for which the locations were used
n_inds	Number of individuals
n_locs_used	Number of locations used in the kernel analysis
n_locs_in_sa	Number of locations inside the study area

alpha	season	n_inds	n_locs_used	n_locs_in_sa
ATPU	fall	24	3017	615
ATPU	spring	20	2874	214
ATPU	summer	24	3359	621
ATPU	winter	24	8611	1234
BLGU	fall	7	157	155
BLGU	spring	5	263	238
BLGU	summer	7	341	331
BLGU	winter	7	686	672
BLKI	fall	40	1990	263
BLKI	spring	39	2865	17
BLKI	summer	40	3357	20
BLKI	winter	40	9915	1812
COMU	fall	44	2539	1161
COMU	spring	44	4549	2298
COMU	summer	45	4420	2654
COMU	winter	46	13228	6137
CORS	fall	28	2456	21
CORS	spring	28	4182	61
CORS	summer	28	4334	16
CORS	winter	28	9839	115
GLGU	fall	1	244	0
GLGU	spring	1	211	1
GLGU	summer	1	150	0
GLGU	winter	1	601	12
LTJA	fall	22	3800	8
LTJA	spring	17	2081	76

alpha	season	n_inds	n_locs_used	n_locs_in_sa
LTJA	summer	23	957	43
LTJA	winter	22	7104	3
MASH	fall	2	229	15
MASH	spring	2	61	0
MASH	winter	2	590	2
NOGA	fall	46	1587	1161
NOGA	spring	42	2465	837
NOGA	winter	46	16995	2404
PAJA	fall	2	52	5
PAJA	spring	2	114	9
PAJA	summer	1	1	0
PAJA	winter	2	261	4
RAZO	fall	29	2007	1709
RAZO	spring	29	1527	836
RAZO	summer	29	1469	1251
RAZO	winter	29	4920	2992
SOSH	fall	36	2491	352
SOSH	spring	40	4166	565
SOSH	summer	40	7193	4645
SOSH	winter	24	4986	0
TBMU	fall	88	7040	1107
TBMU	spring	87	7304	1050
TBMU	summer	88	3173	714
TBMU	winter	88	24782	5023
WTTR	fall	39	2053	236
WTTR	spring	27	774	0
WTTR	summer	35	2131	34
WTTR	winter	39	8705	624

Dynamic Brownian Bridge Movement Models

The number of locations used to create the dBBMM maps can be found here: <Link removed due to access granted only to the Committee>. Only locations found within the study area were used to create dBBMM models

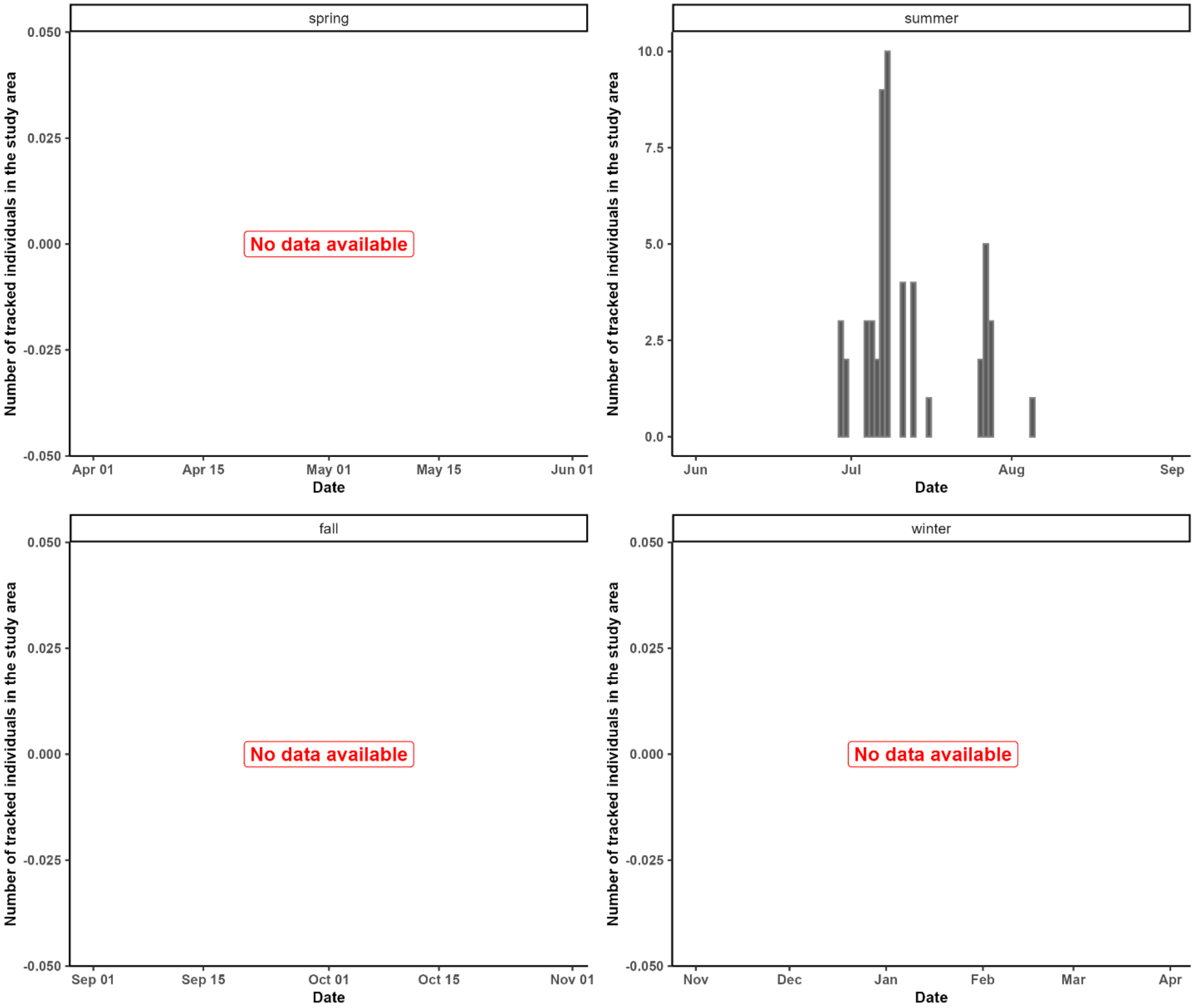
Column name	Value
alpha	4 letters alphanumerical species code
season	Season for which the locations were used
n_inds	Total number of individuals
n_locs	Total number of locations used
n_locs_GPS	Number of GPS locations used
n_locs_PTT	Number of Argos PTT locations used
n_inds_GPS	number of individuals tagged with a GPS tracker
n_inds_PTT	number of individuals tagged with a PTT tracker

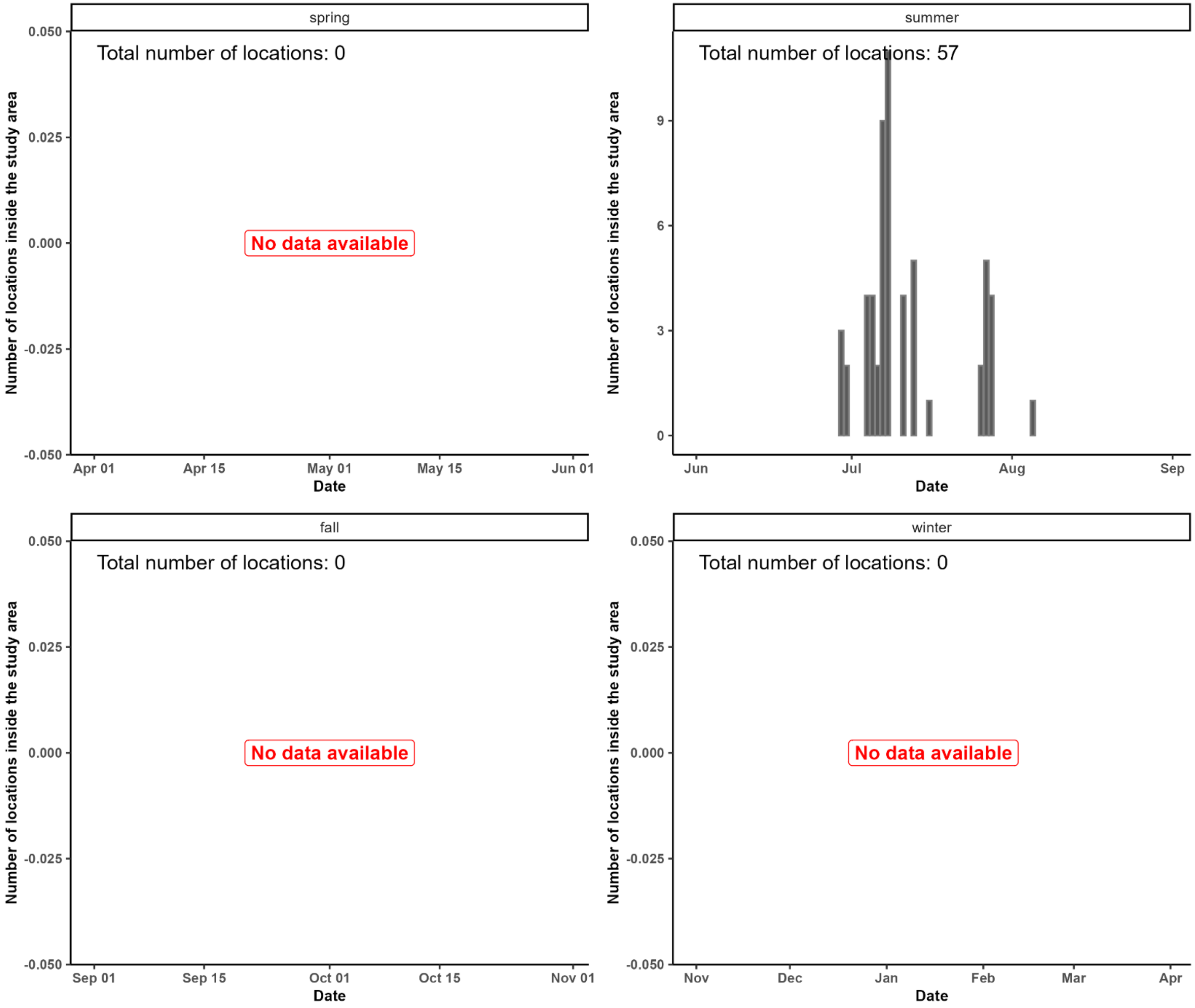
alpha	season	n_inds	n_locs	n_locs_GPS	n_locs_PTT	n_inds_GPS	n_inds_PTT
ABDU	fall	30	8753	8654	99	27	3
ABDU	spring	33	7375	7375	NA	33	NA
ABDU	summer	29	12225	12093	132	27	2
ABDU	winter	24	8638	8611	27	23	1
ATPU	summer	24	5866	5866	NA	24	NA
BLSC	spring	51	3430	NA	3430	NA	51
BLSC	summer	17	828	NA	828	NA	17
COEI	summer	12	1386	NA	1386	NA	12
COMU	summer	15	25730	25730	NA	15	NA
GBBG	summer	10	16318	9608	6710	4	6
GRSH	fall	77	9375	NA	9375	NA	77
GRSH	summer	115	11990	NA	11990	NA	115
GRSH	winter	15	1385	NA	1385	NA	15
HERG	fall	31	31534	30984	550	27	4
HERG	spring	55	96052	94503	1549	50	5
HERG	summer	67	316739	313463	3276	61	6
HERG	winter	18	6713	6636	77	16	2
LTDU	spring	13	607	NA	607	NA	13
NOGA	fall	93	17343	6524	10819	12	81

alpha	**season**	**n_inds**	**n_locs**	**n_locs_GPS**	**n_locs_PTT**	**n_inds_GPS**	**n_inds_PTT**
NOGA	spring	101	10112	NA	10112	NA	101
NOGA	summer	102	149895	148529	1366	59	43
NOGA	winter	20	1419	NA	1419	NA	20
RAZO	summer	43	24445	24445	NA	43	NA
ROST	summer	12	4188	4188	NA	12	NA
RTLO	spring	80	10771	NA	10771	NA	80
RTLO	winter	24	3290	NA	3290	NA	24
SUSC	fall	172	17533	NA	17533	NA	172
SUSC	spring	131	13279	NA	13279	NA	131
SUSC	summer	41	2368	NA	2368	NA	41
SUSC	winter	11	837	NA	837	NA	11
WHIM	summer	12	684	NA	684	NA	12
WWSC	fall	43	2578	NA	2578	NA	43
WWSC	spring	10	636	NA	636	NA	10
WWSC	summer	22	1667	NA	1667	NA	22
WWSC	winter	16	1544	NA	1544	NA	16

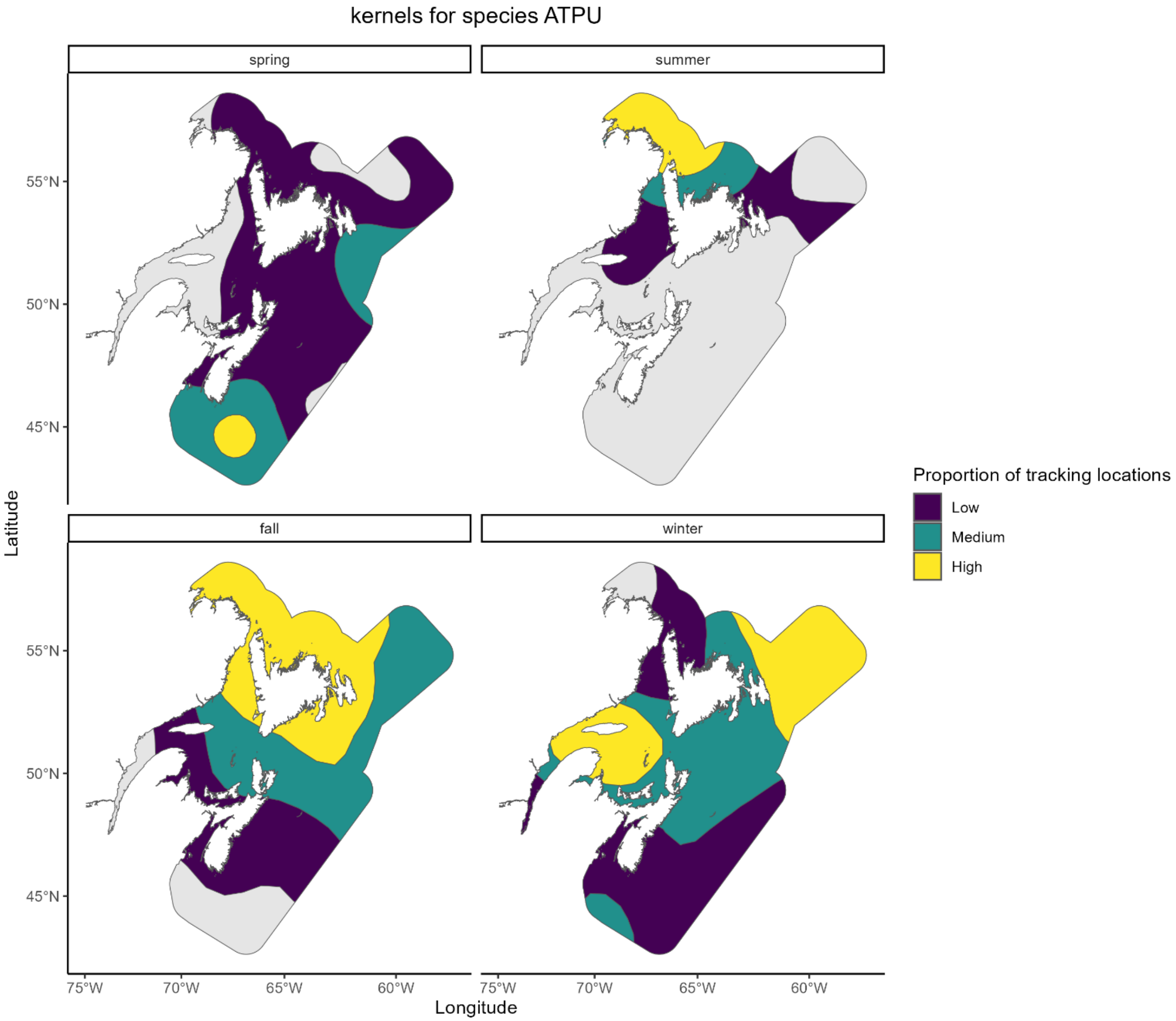
Mapping Products: Kernel Density Utilization Distribution Models

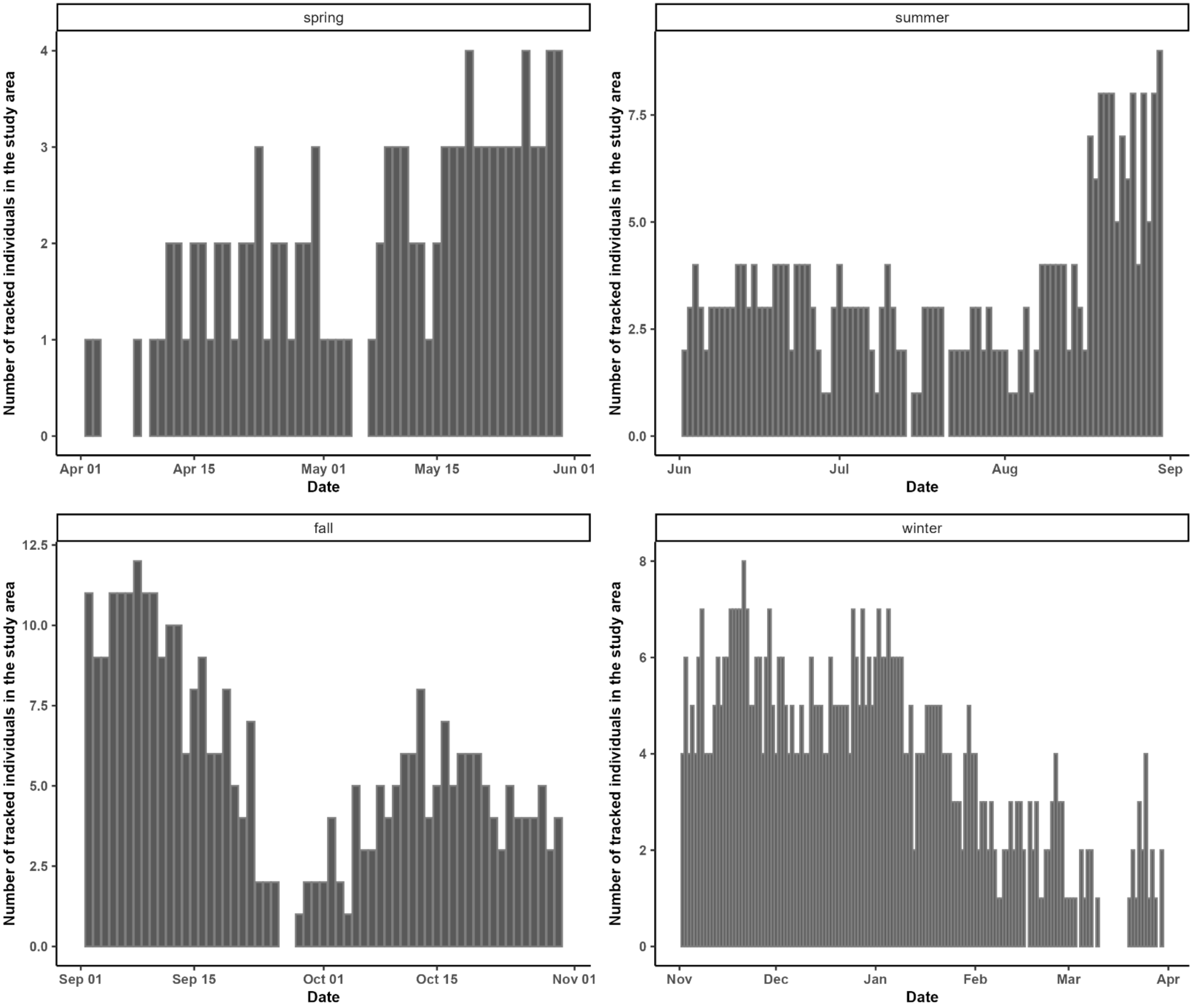
Arctic Tern (ARTE)

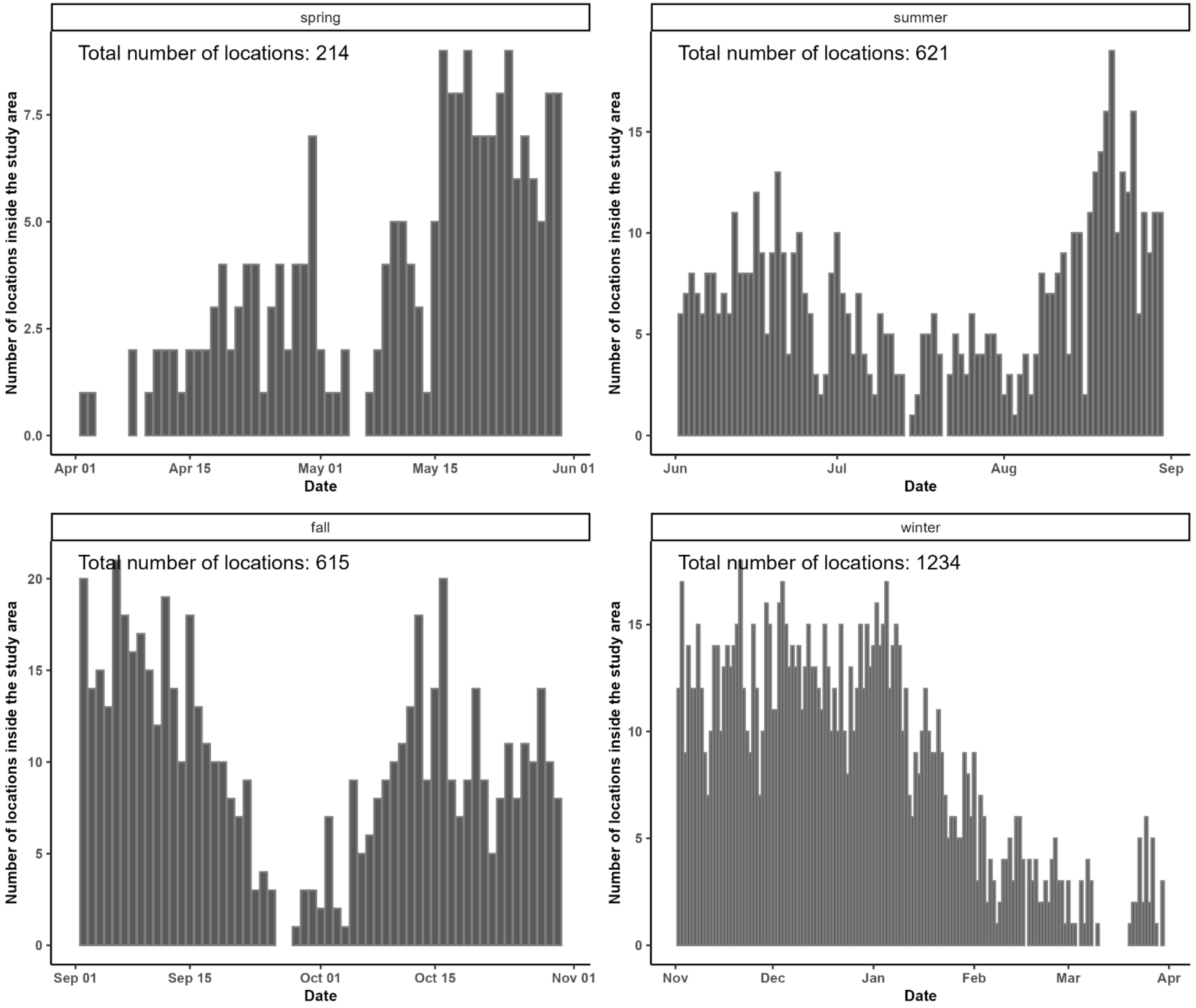



spring
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
Number of locations inside the study area
summer
Total number of locations: 57
9
6
3
0
Jun
Jul
Aug
Sep
Date
Number of locations inside the study area
fall
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
Number of locations inside the study area
winter
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Nov
Dec
Jan
Feb
Mar
Apr
Date
Number of locations inside the study area

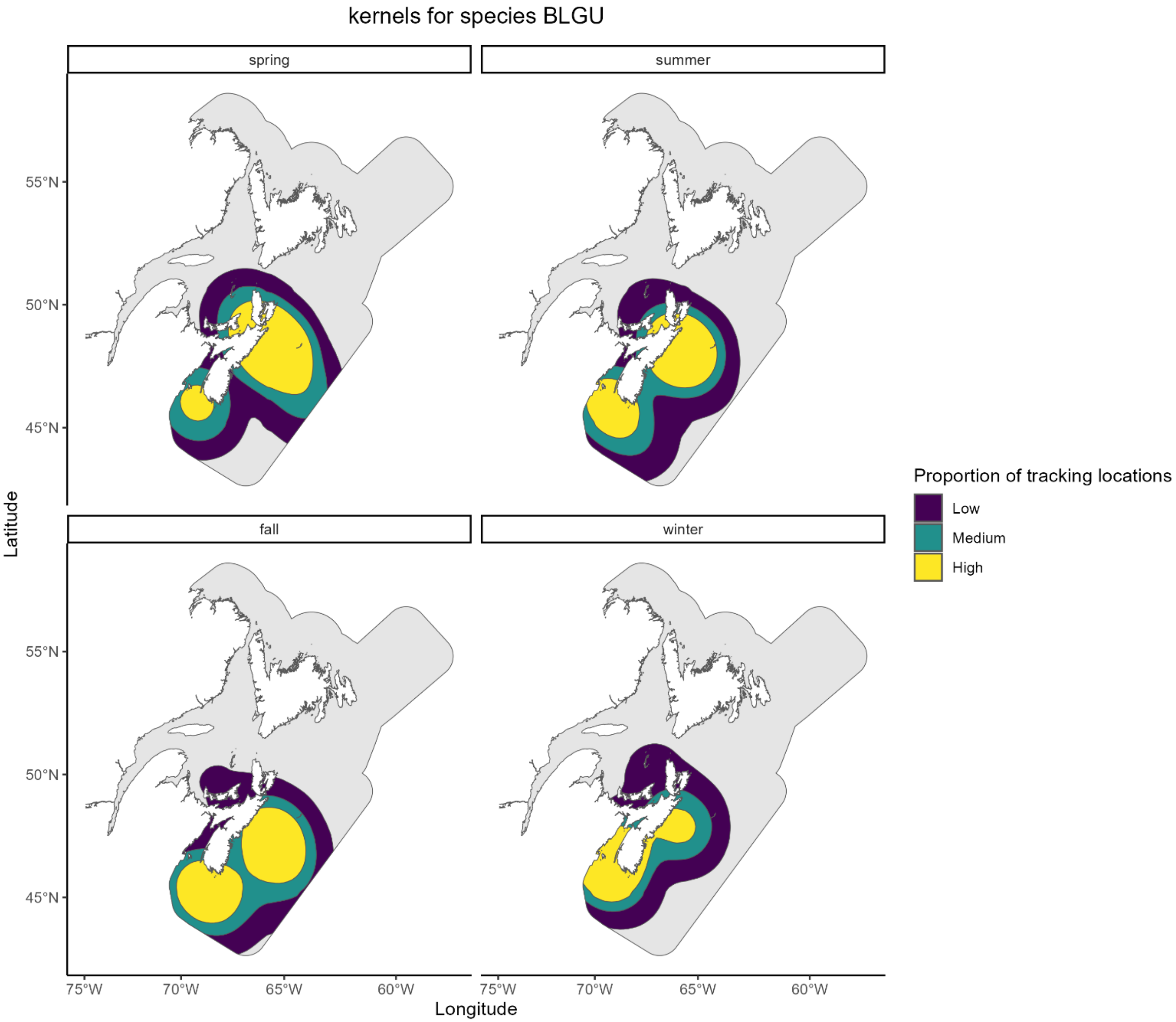
Atlantic Puffin (ATPU)

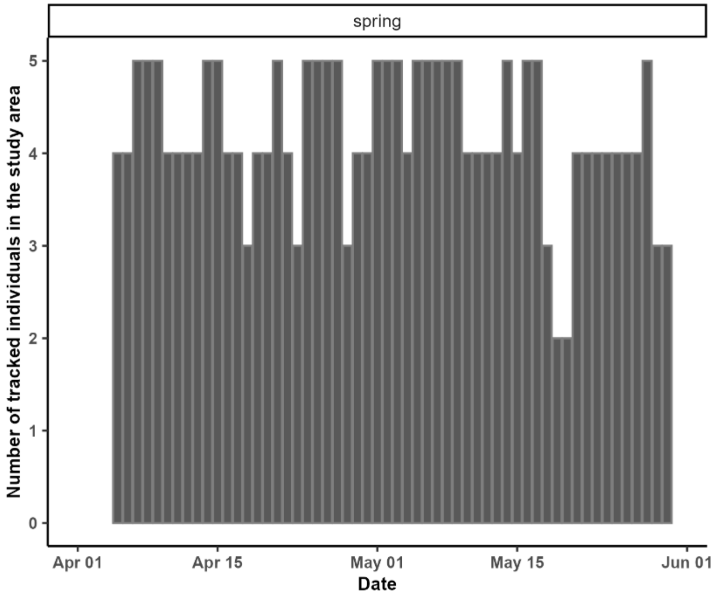


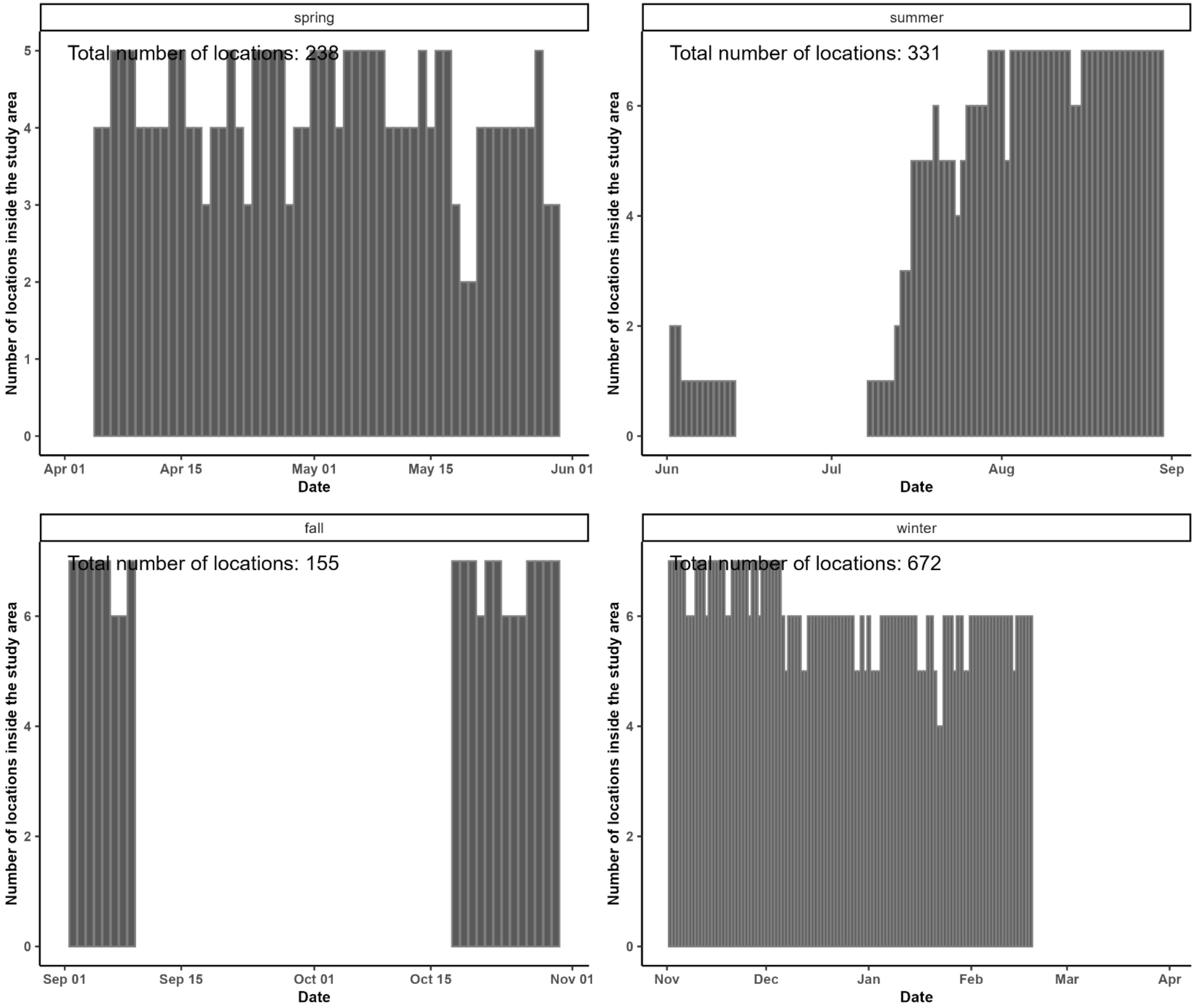

spring
summer
fall
winter
Number of tracked individuals in the study area
Date
0
1
2
3
4
Apr 01
Apr 15
May 01
May 15
Jun 01
0.0
2.5
5.0
7.5
Jun
Jul
Aug
Sep
0.0
2.5
5.0
7.5
10.0
12.5
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
0
2
4
6
8
Nov
Dec
Jan
Feb
Mar
Apr


spring
Total number of locations: 214
summer
Total number of locations: 621
fall
Total number of locations: 615
winter
Total number of locations: 1234
Number of locations inside the study area
Date
0.0
2.5
5.0
7.5
0
5
10
15
20
Apr 01
Apr 15
May 01
May 15
Jun 01
Jun
Jul
Aug
Sep
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Nov
Dec
Jan
Feb
Mar
Apr

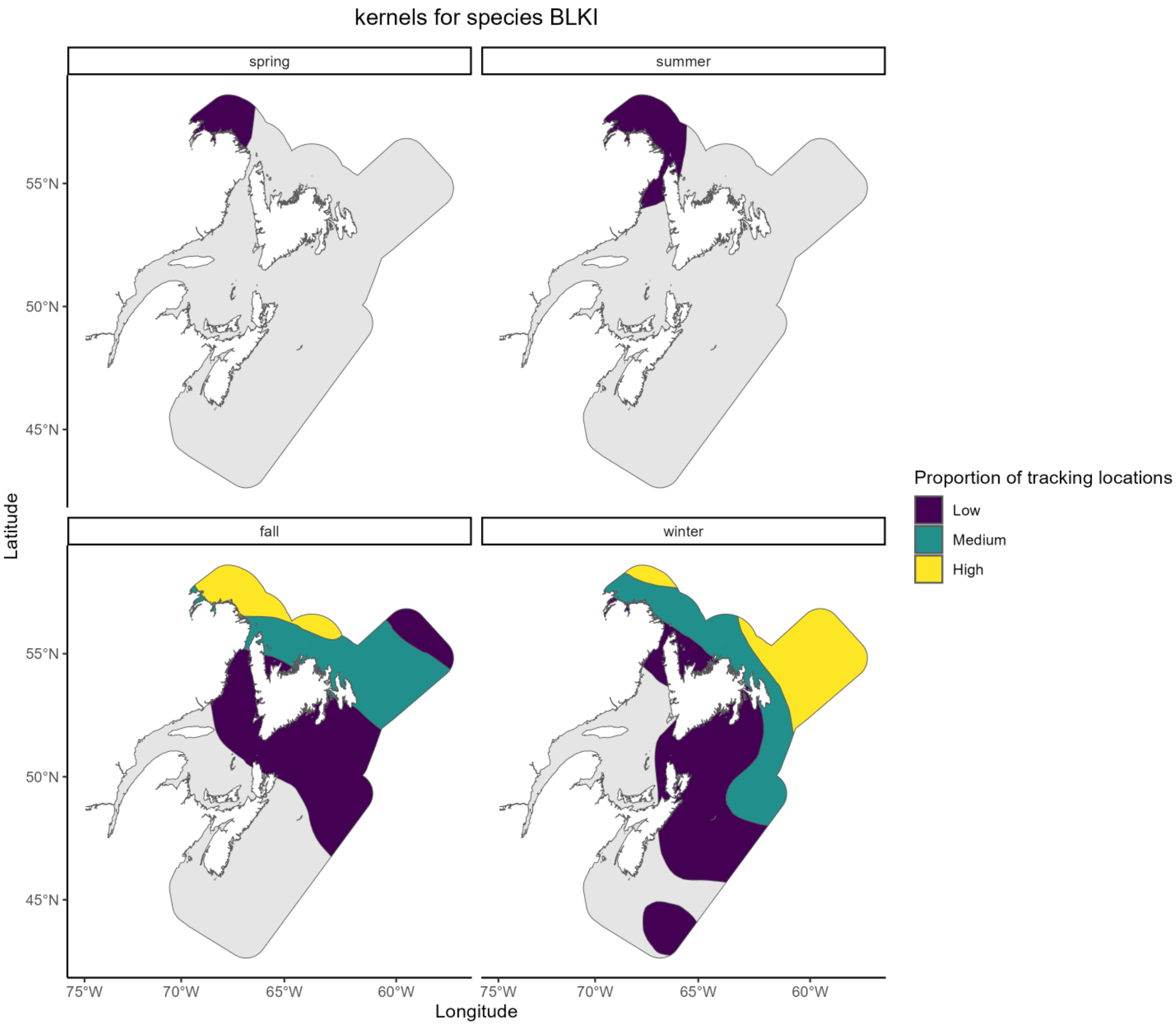
Black Guillemot (BLGU)

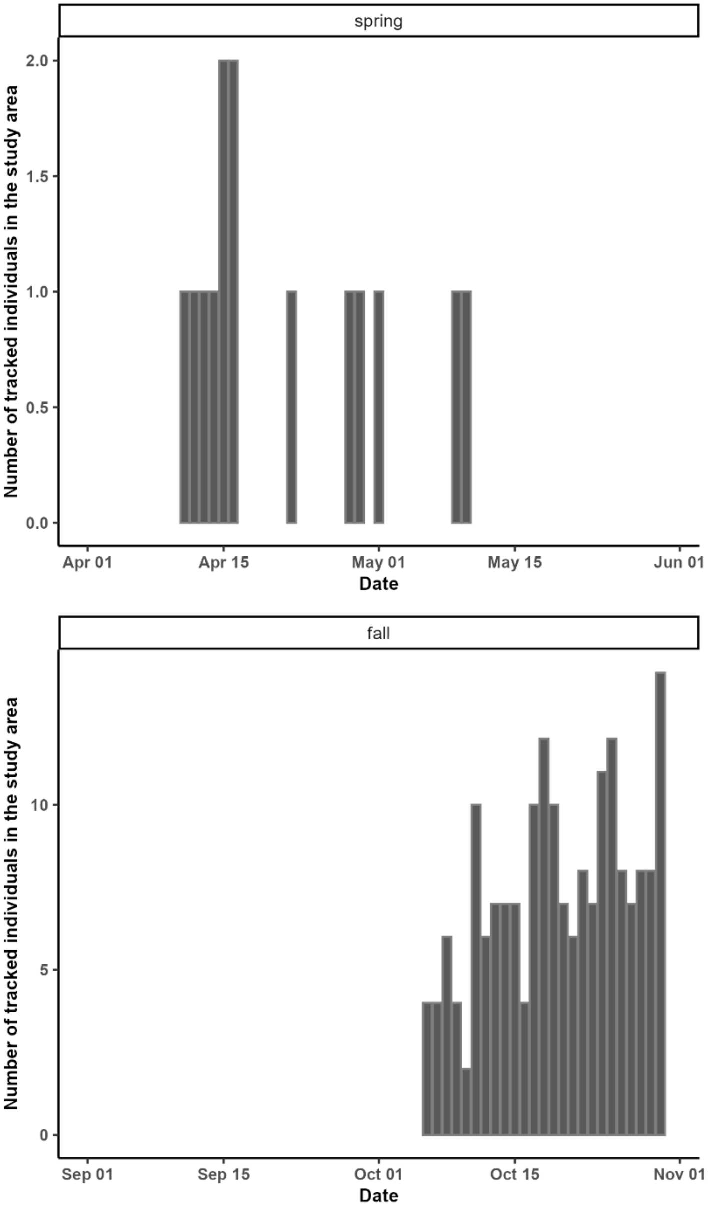


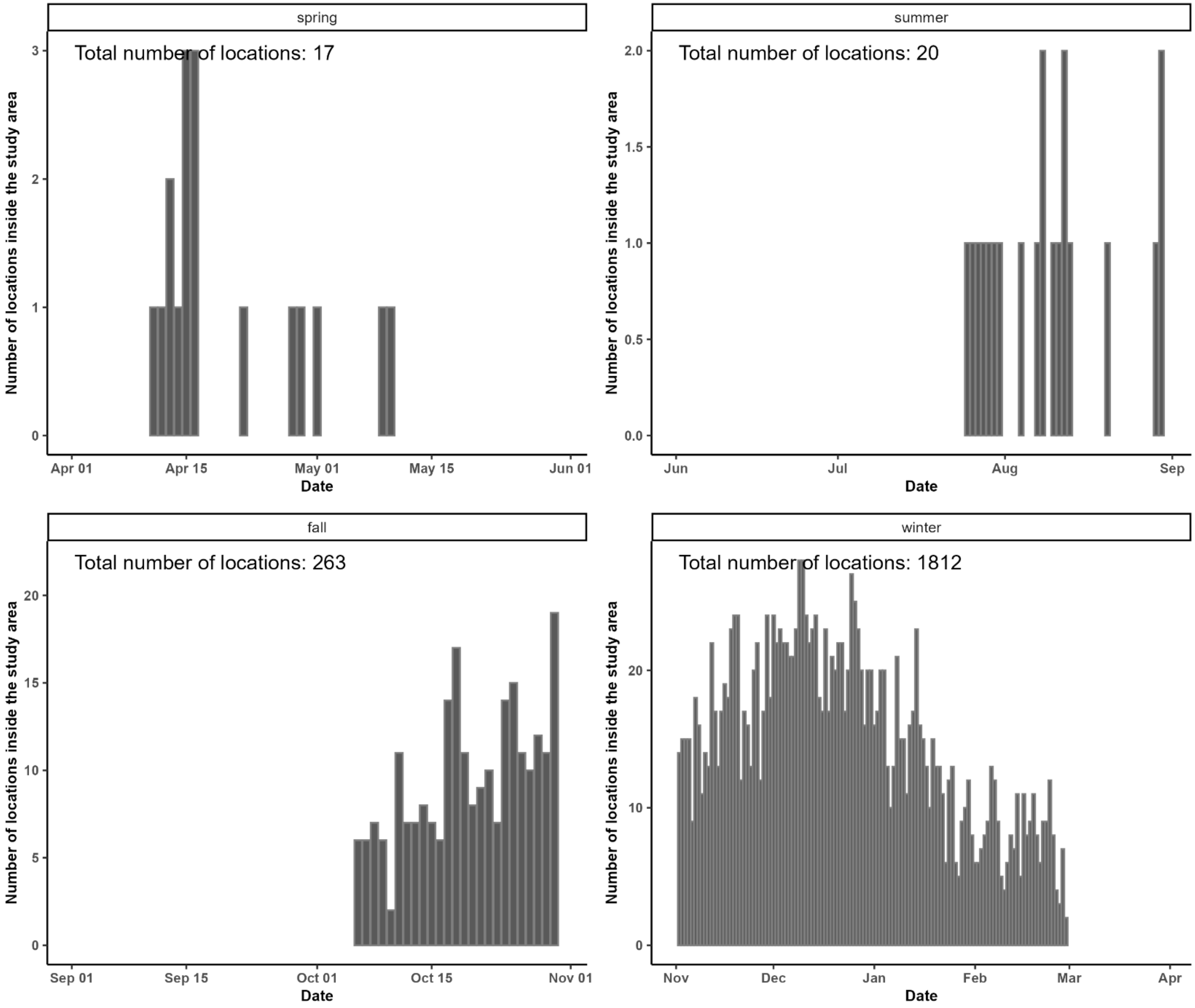

spring
Number of tracked individuals in the study area
0
1
2
3
4
5
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Number of tracked individuals in the study area
0
2
4
6
Jun
Jul
Aug
Sep
Date
fall
Number of tracked individuals in the study area
0
2
4
6
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Number of tracked individuals in the study area
0
2
4
6
Nov
Dec
Jan
Feb
Mar
Apr
Date


spring
Total number of locations: 238
Number of locations inside the study area
0
1
2
3
4
5
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 331
Number of locations inside the study area
0
2
4
6
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 155
Number of locations inside the study area
0
2
4
6
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 672
Number of locations inside the study area
0
2
4
6
Nov
Dec
Jan
Feb
Mar
Apr
Date

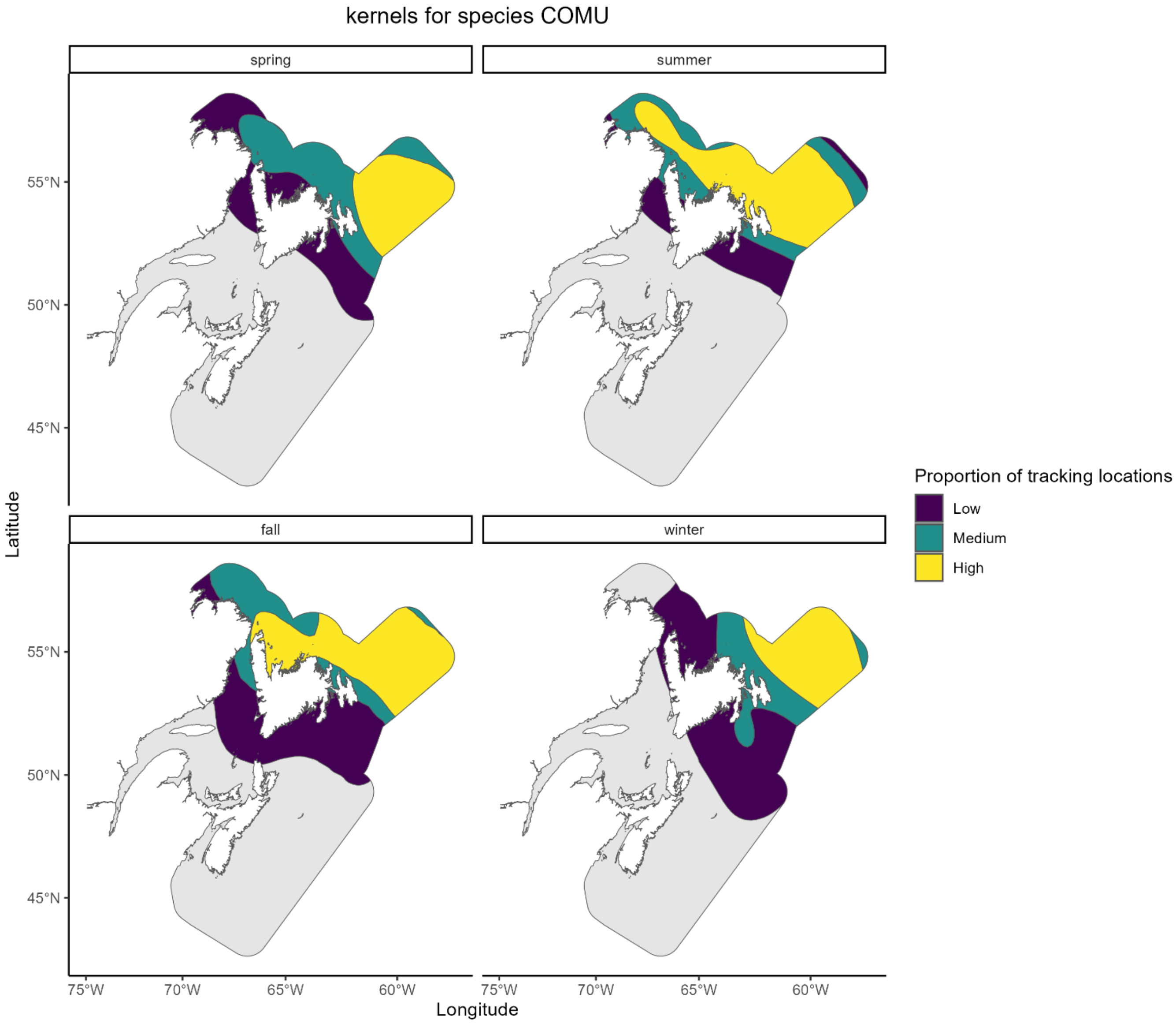
Black-legged Kittiwake (BLKI)

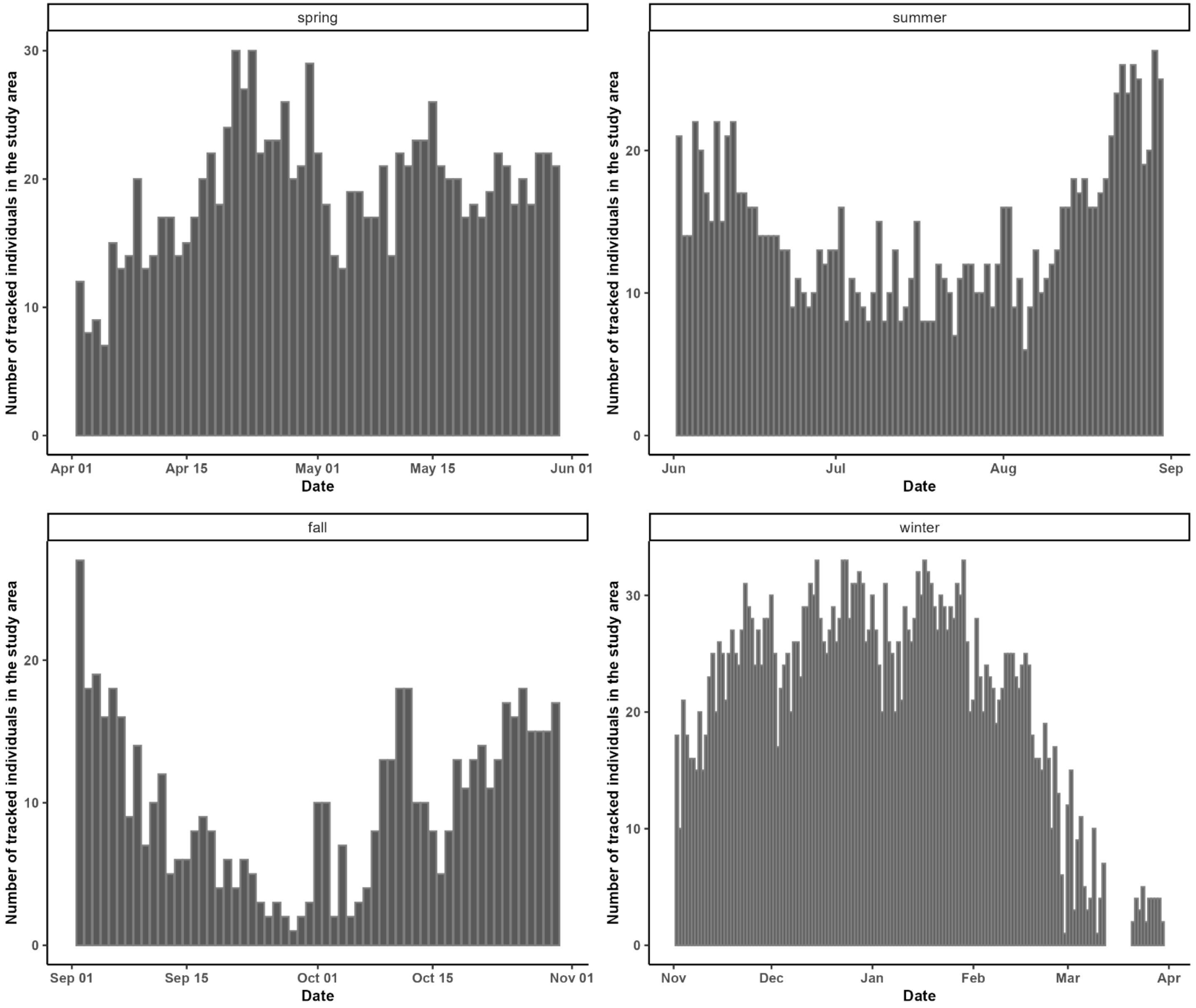



spring
summer
fall
winter
Number of tracked individuals in the study area
Date
0.0
0.5
1.0
1.5
2.0
Apr 01
Apr 15
May 01
May 15
Jun 01
0.00
0.25
0.50
0.75
1.00
Jun
Jul
Aug
Sep
0
5
10
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
15
Nov
Dec
Jan
Feb
Mar
Apr

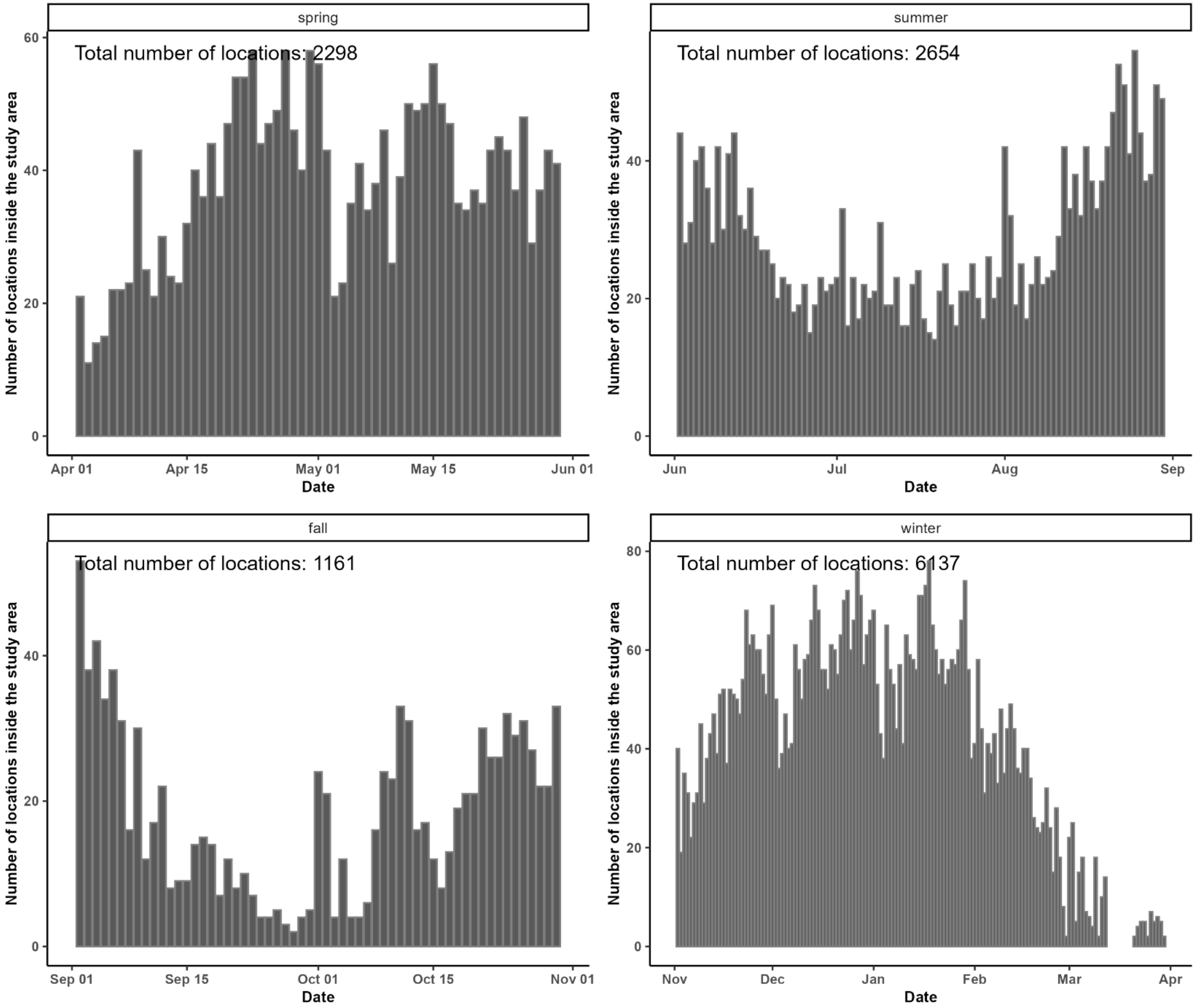

spring
Total number of locations: 17
Number of locations inside the study area
3
2
1
0
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 20
Number of locations inside the study area
2.0
1.5
1.0
0.5
0.0
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 263
Number of locations inside the study area
20
15
10
5
0
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 1812
Number of locations inside the study area
20
10
0
Nov
Dec
Jan
Feb
Mar
Apr
Date

Common Murre (COMU)

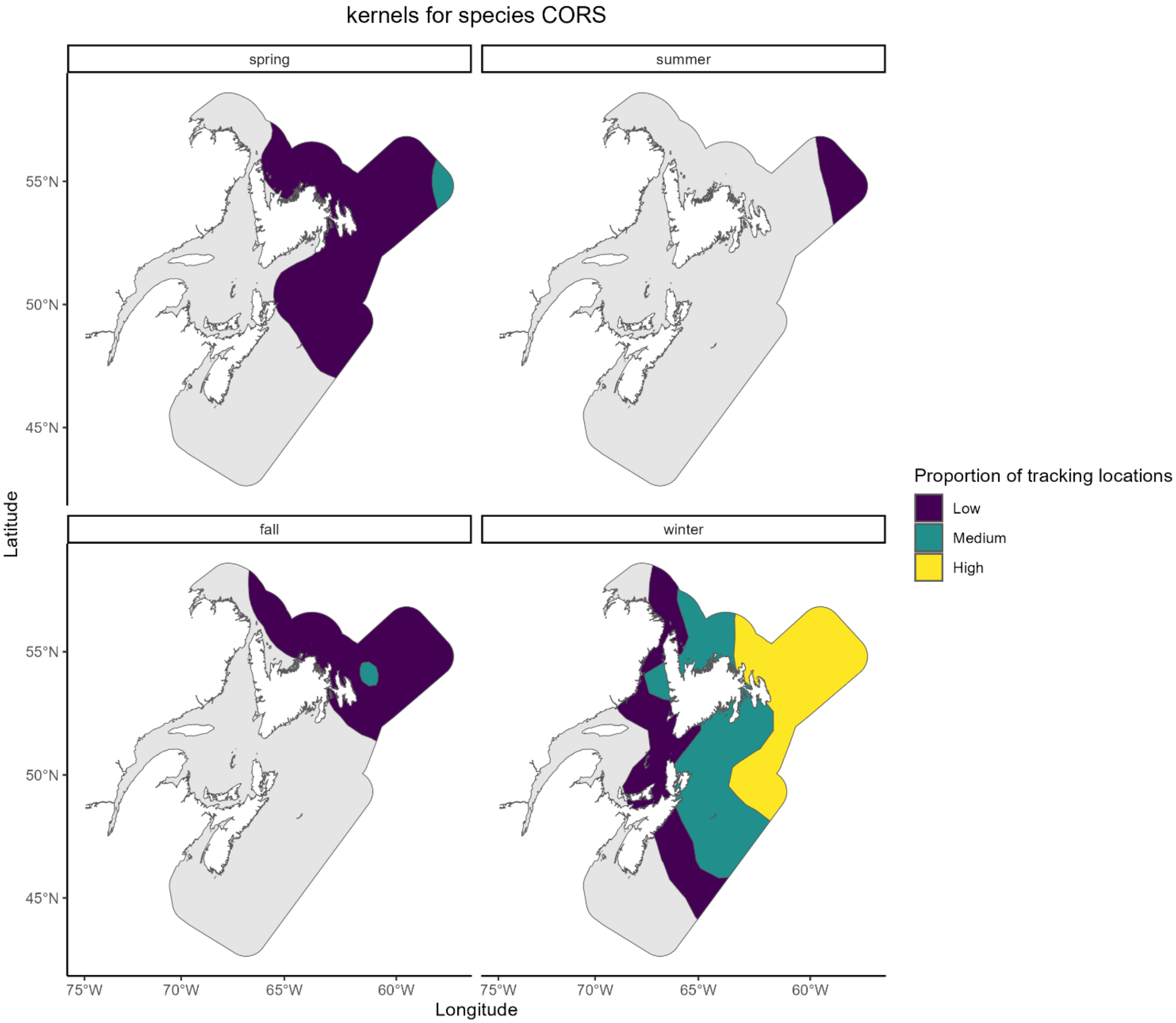


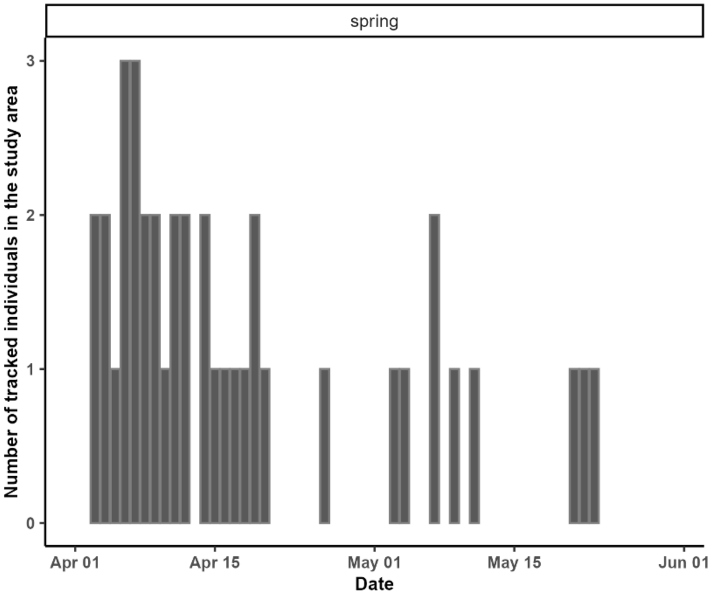


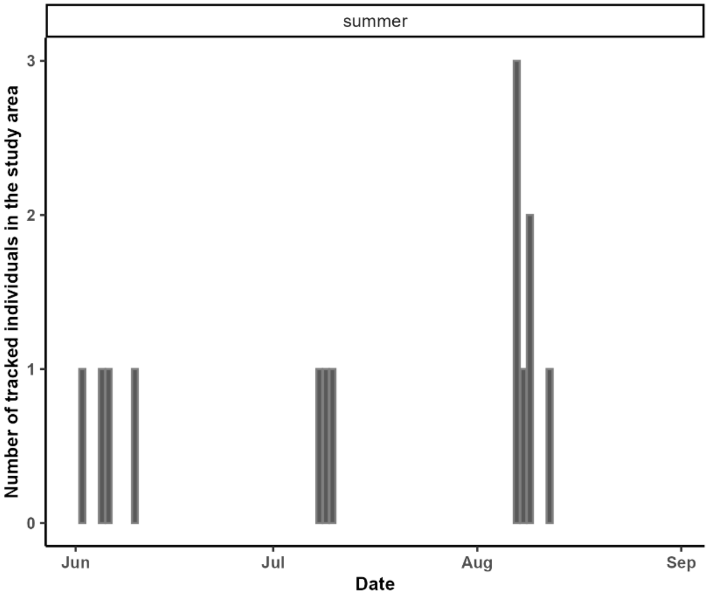
spring
summer
fall
winter
Number of tracked individuals in the study area
0
10
20
30
Apr 01
Apr 15
May 01
May 15
Jun 01
Jun
Jul
Aug
Sep
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Nov
Dec
Jan
Feb
Mar
Apr
Date

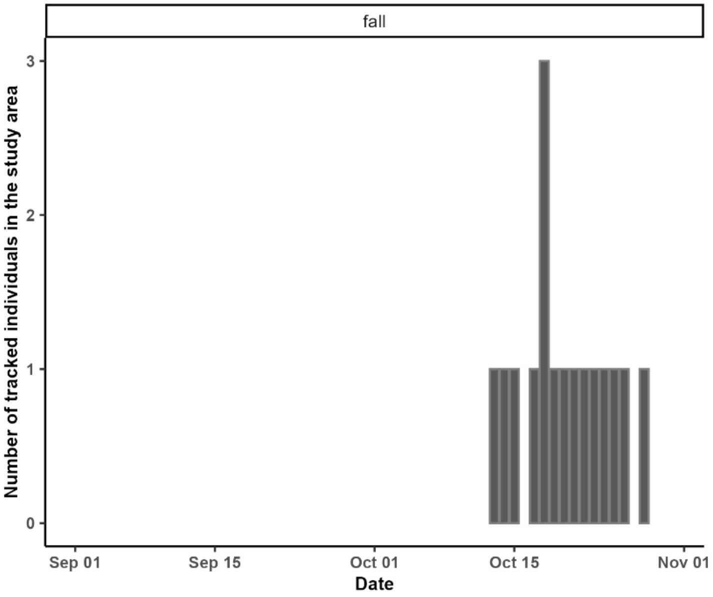

spring
Total number of locations: 2298
Number of locations inside the study area
60
40
20
0
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 2654
Number of locations inside the study area
40
20
0
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 1161
Number of locations inside the study area
40
20
0
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 6137
Number of locations inside the study area
80
60
40
20
0
Nov
Dec
Jan
Feb
Mar
Apr
Date

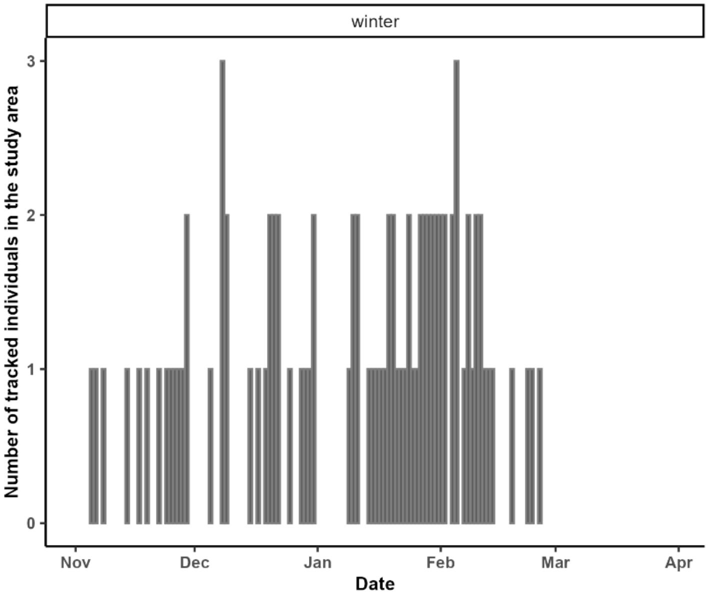
Cory's Shearwater (CORS)

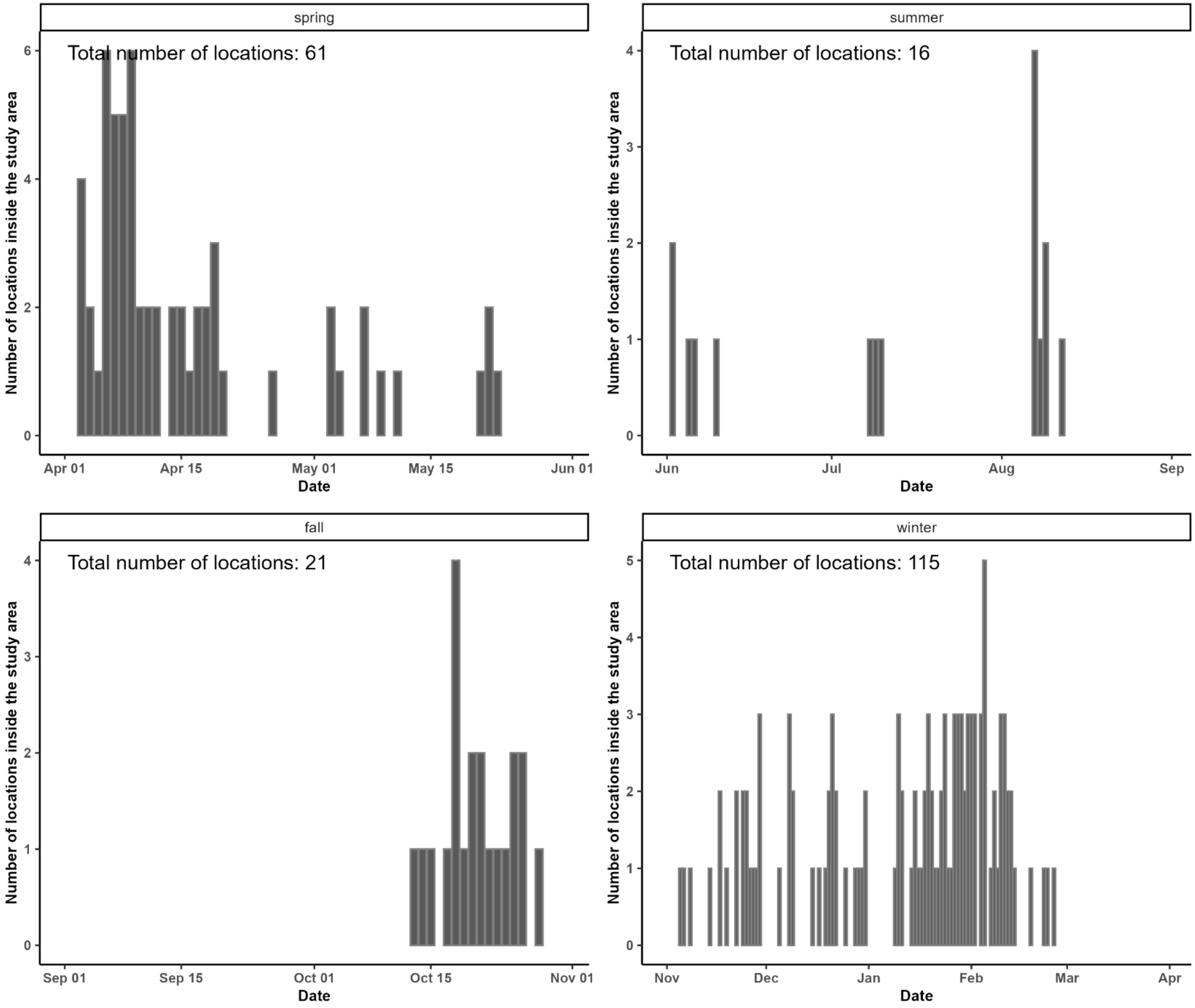



spring
Number of tracked individuals in the study area
0
1
2
3
Apr 01
Apr 15
May 01
May 15
Jun 01
Date

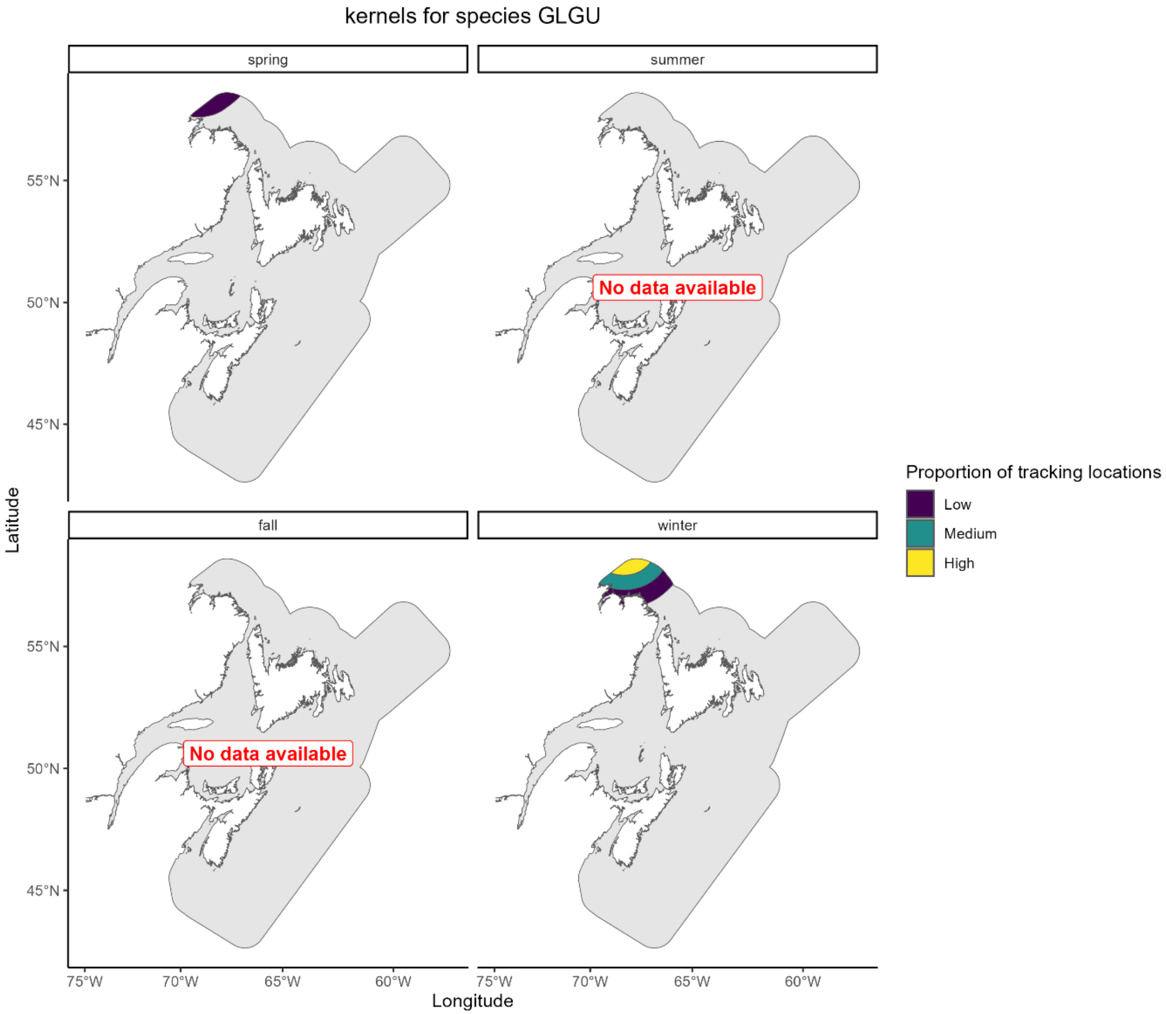

summer
Number of tracked individuals in the study area
0
1
2
3
Jun
Jul
Aug
Sep
Date

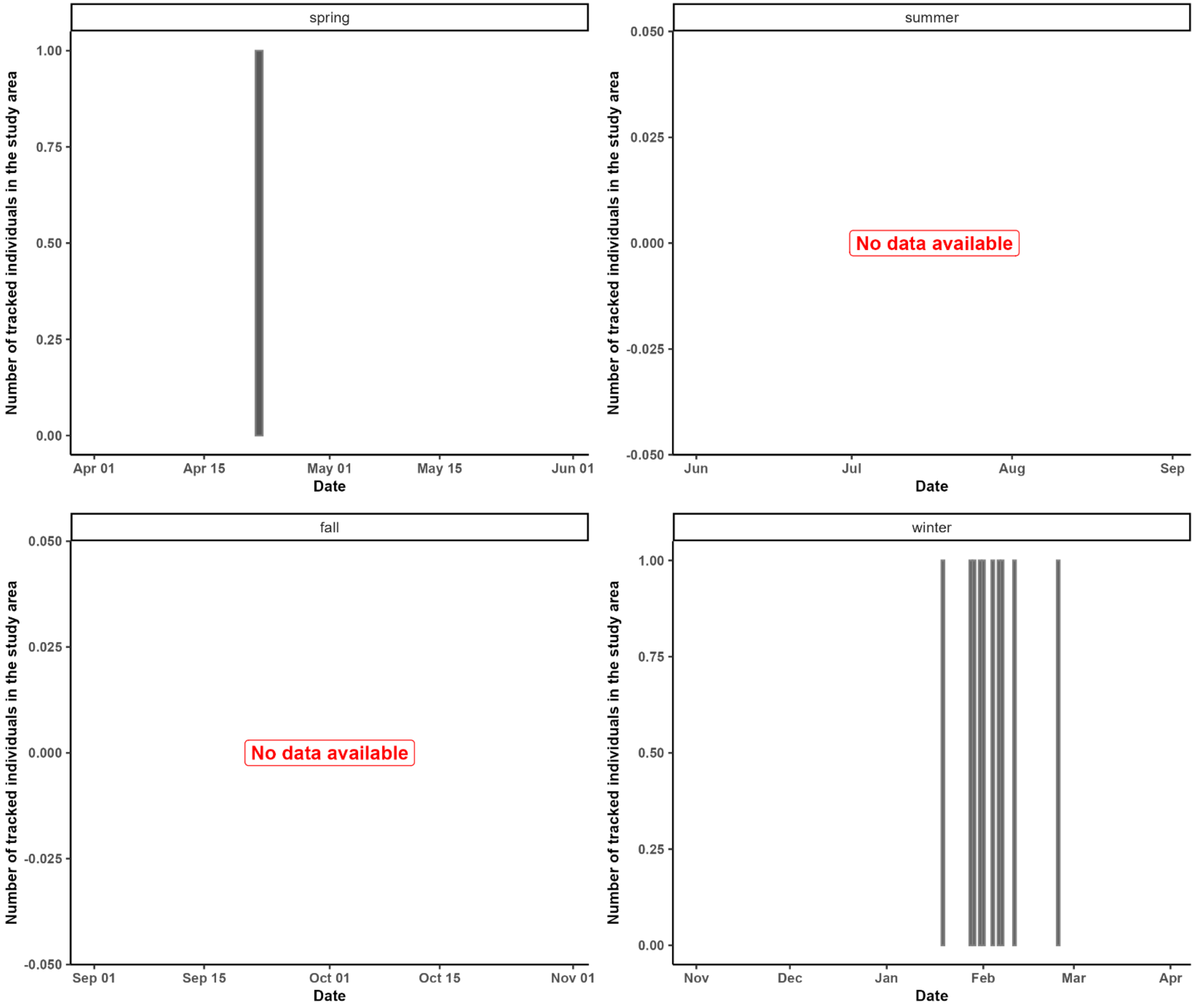

fall
Number of tracked individuals in the study area
0
1
2
3
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date

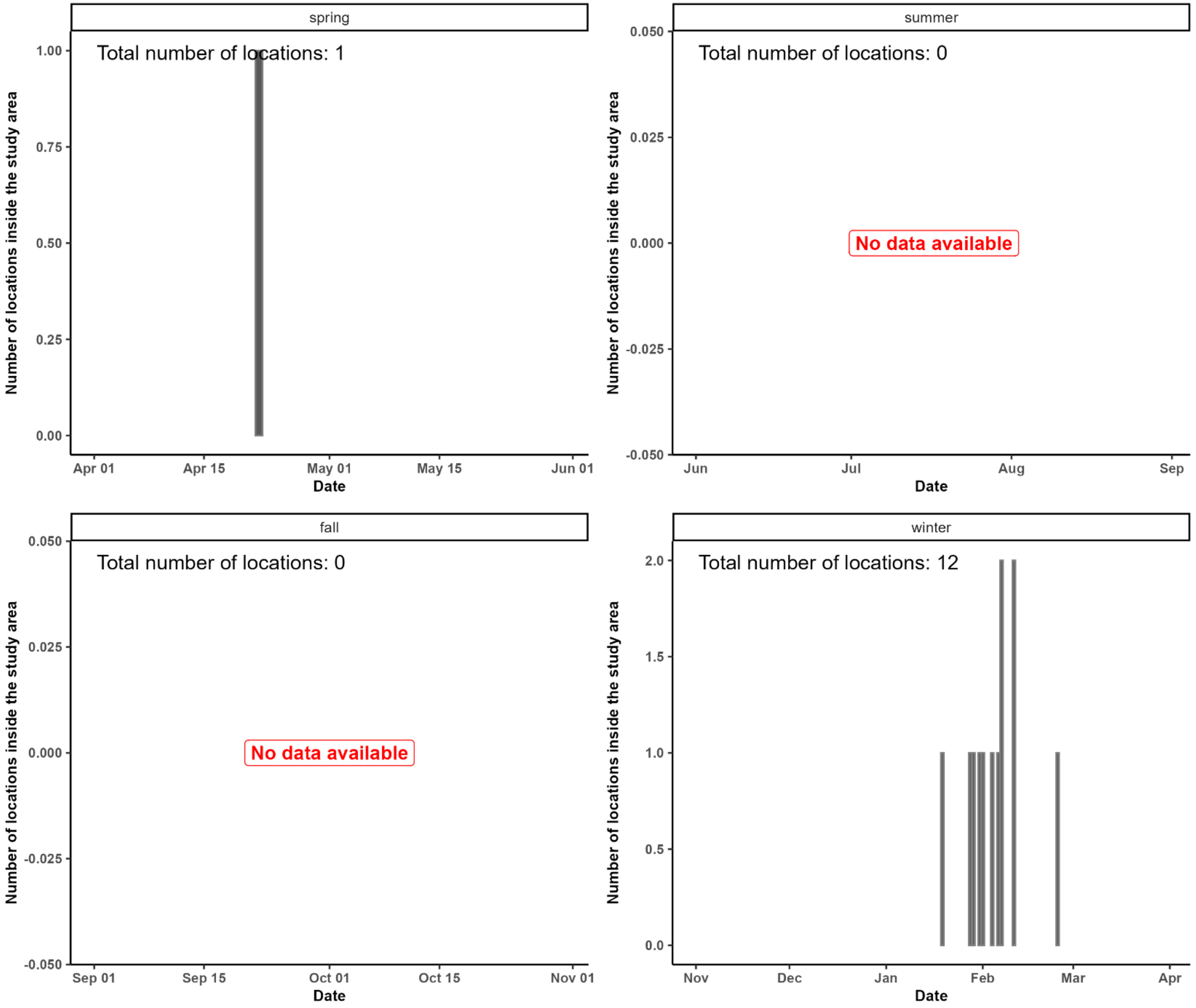

winter
Number of tracked individuals in the study area
0
1
2
3
Nov
Dec
Jan
Feb
Mar
Apr
Date


spring
Total number of locations: 61
Number of locations inside the study area
0
2
4
6
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 16
Number of locations inside the study area
0
1
2
3
4
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 21
Number of locations inside the study area
0
1
2
3
4
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 115
Number of locations inside the study area
0
1
2
3
4
5
Nov
Dec
Jan
Feb
Mar
Apr
Date

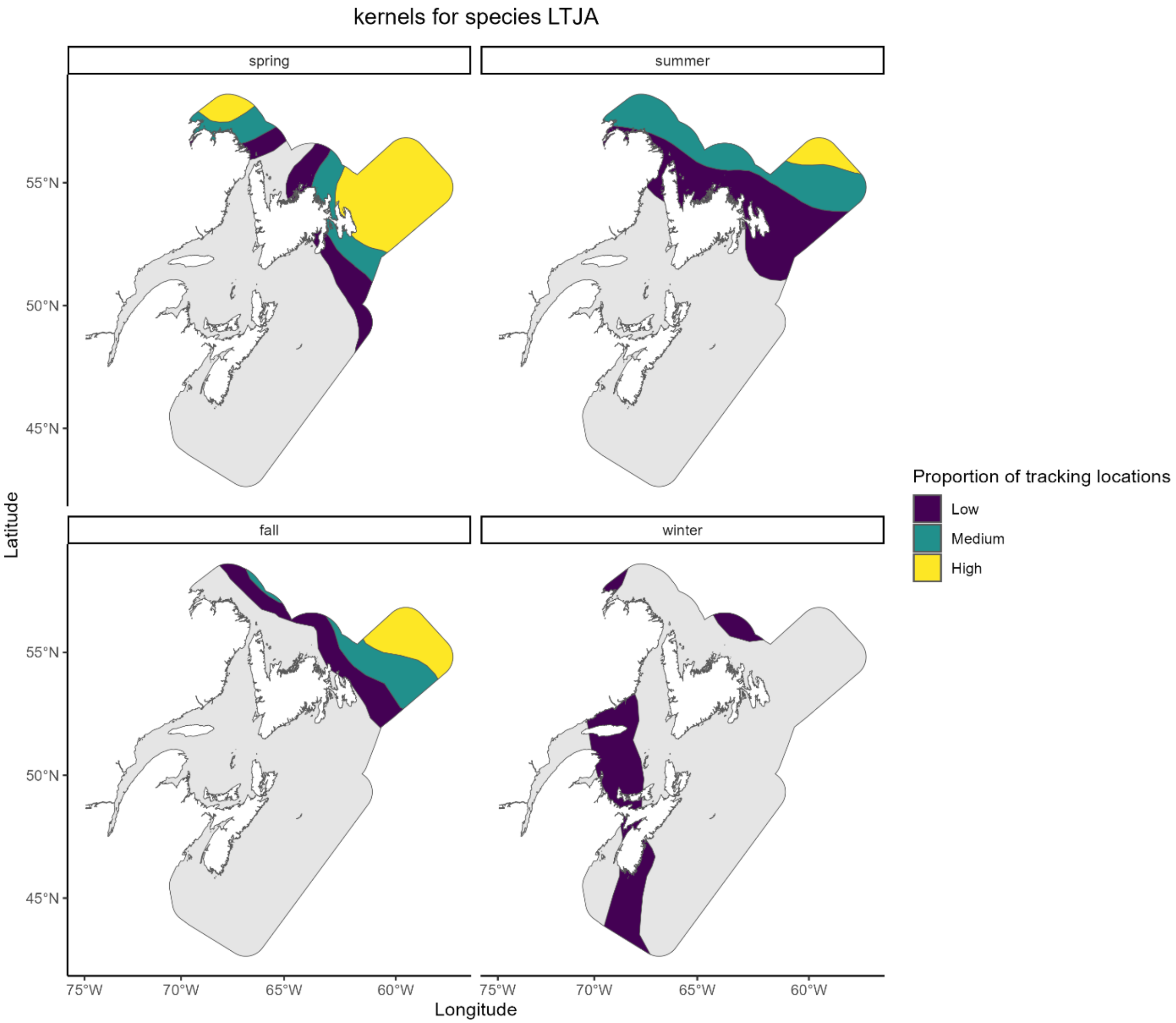
Glaucous Gull (GLGU)

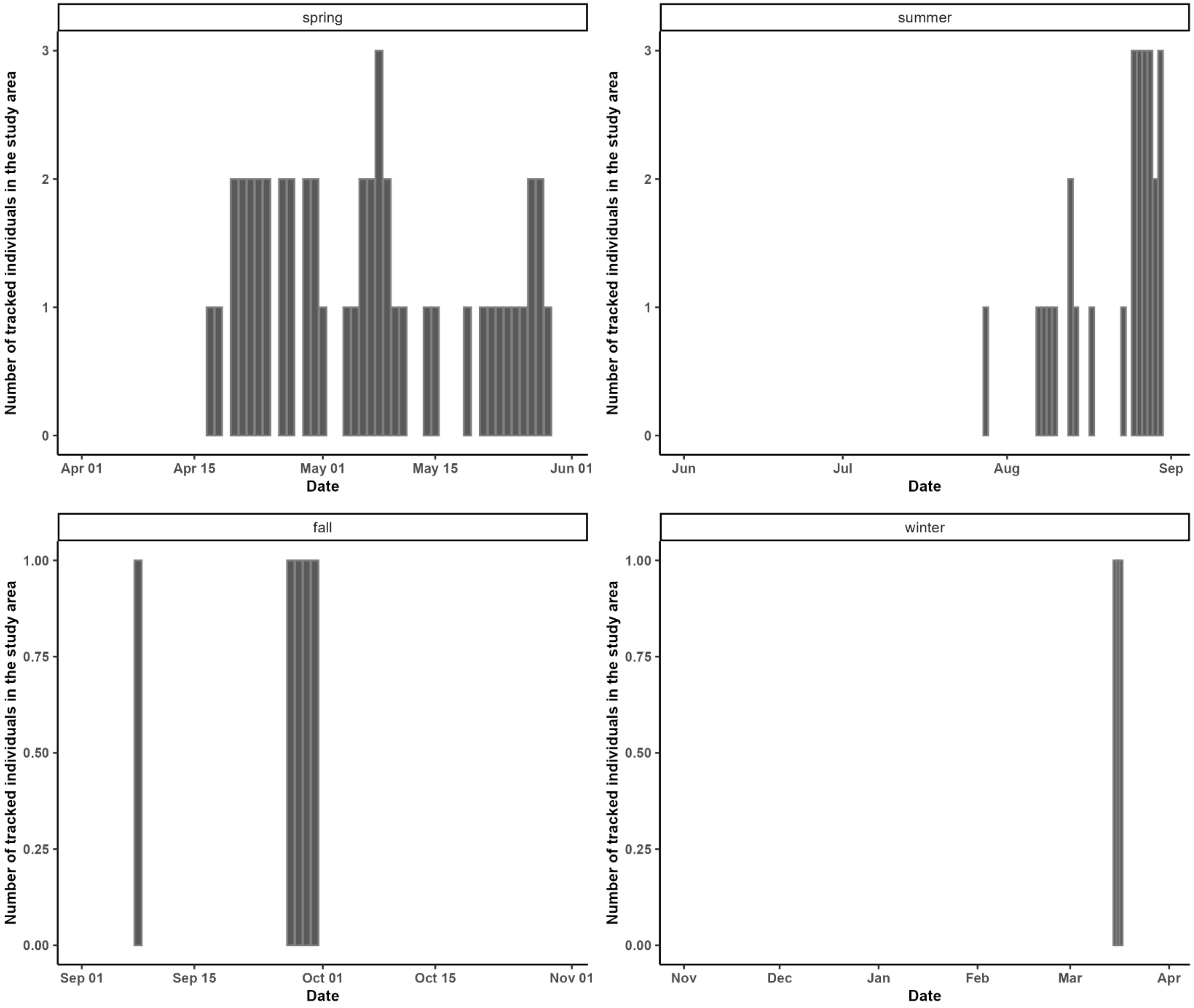



spring
Number of tracked individuals in the study area
1.00
0.75
0.50
0.25
0.00
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
0.050
0.025
0.000
-0.025
-0.050
No data available
Jun
Jul
Aug
Sep
Date
fall
0.050
0.025
0.000
-0.025
-0.050
No data available
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
1.00
0.75
0.50
0.25
0.00
Nov
Dec
Jan
Feb
Mar
Apr
Date

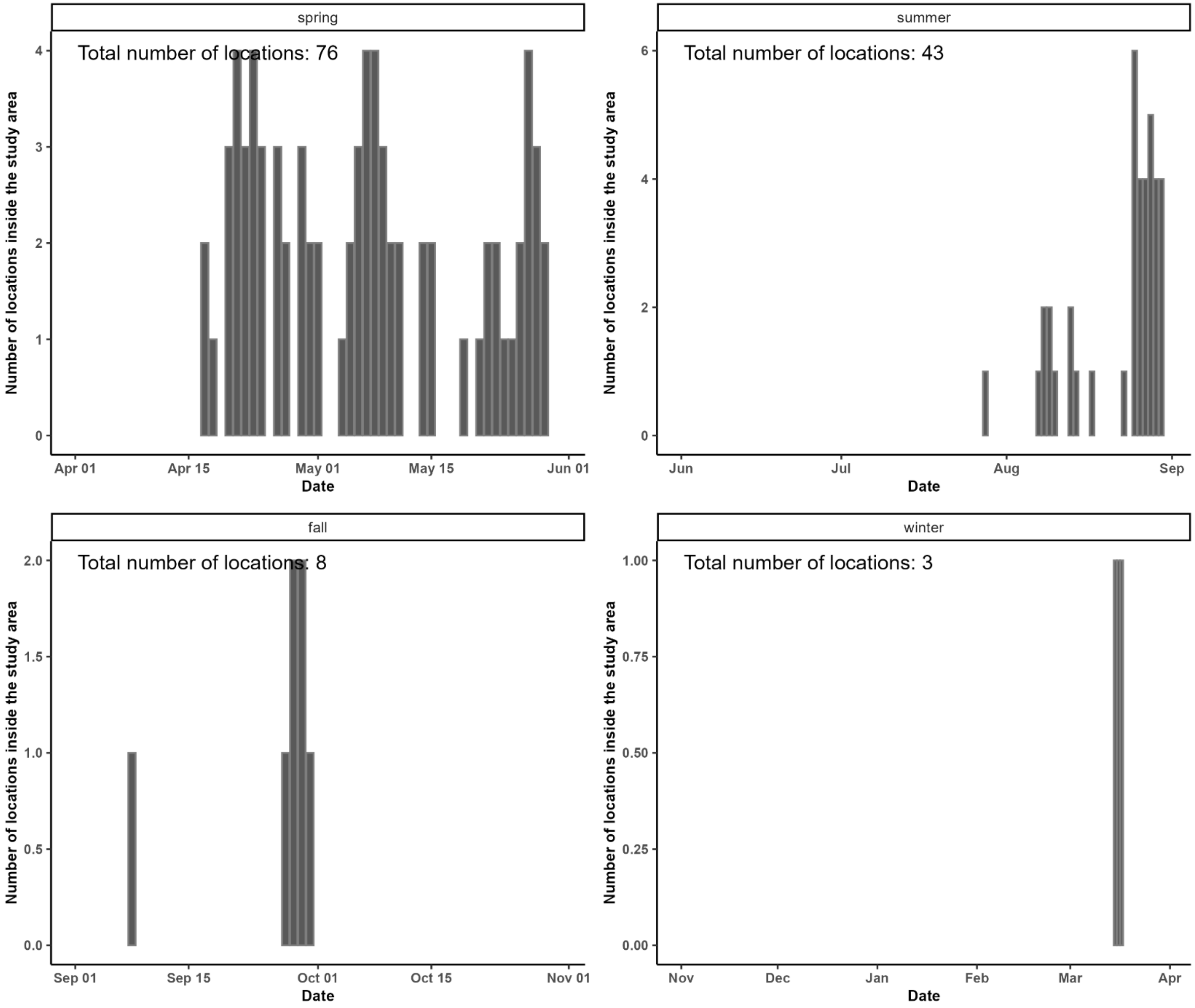

spring
Total number of locations: 1
1.00
0.75
0.50
0.25
0.00
Apr 01
Apr 15
May 01
May 15
Jun 01
summer
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Jun
Jul
Aug
Sep
fall
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
winter
Total number of locations: 12
2.0
1.5
1.0
0.5
0.0
Nov
Dec
Jan
Feb
Mar
Apr
Number of locations inside the study area
Date

Long-tailed Jaeger (LTJA)

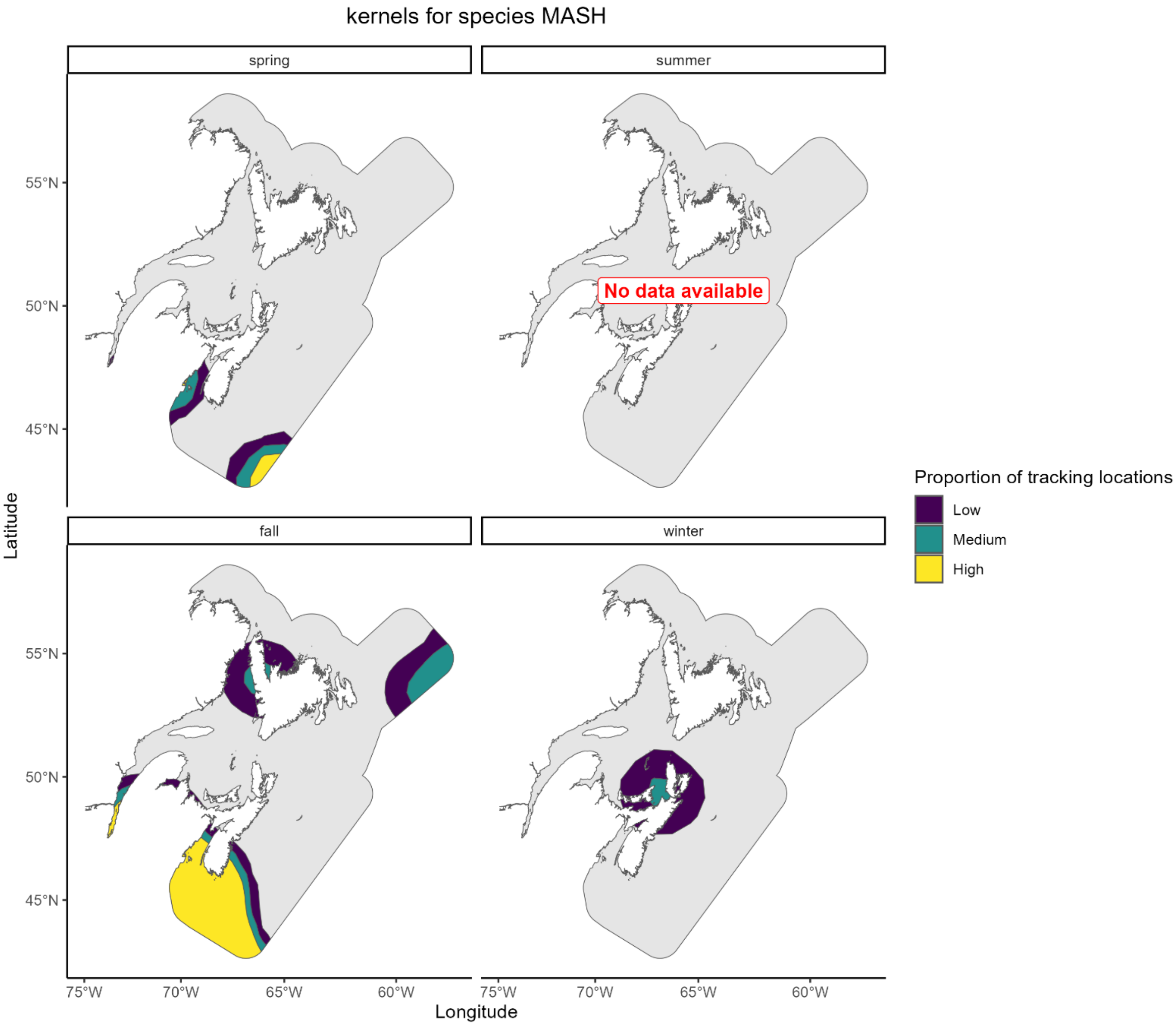


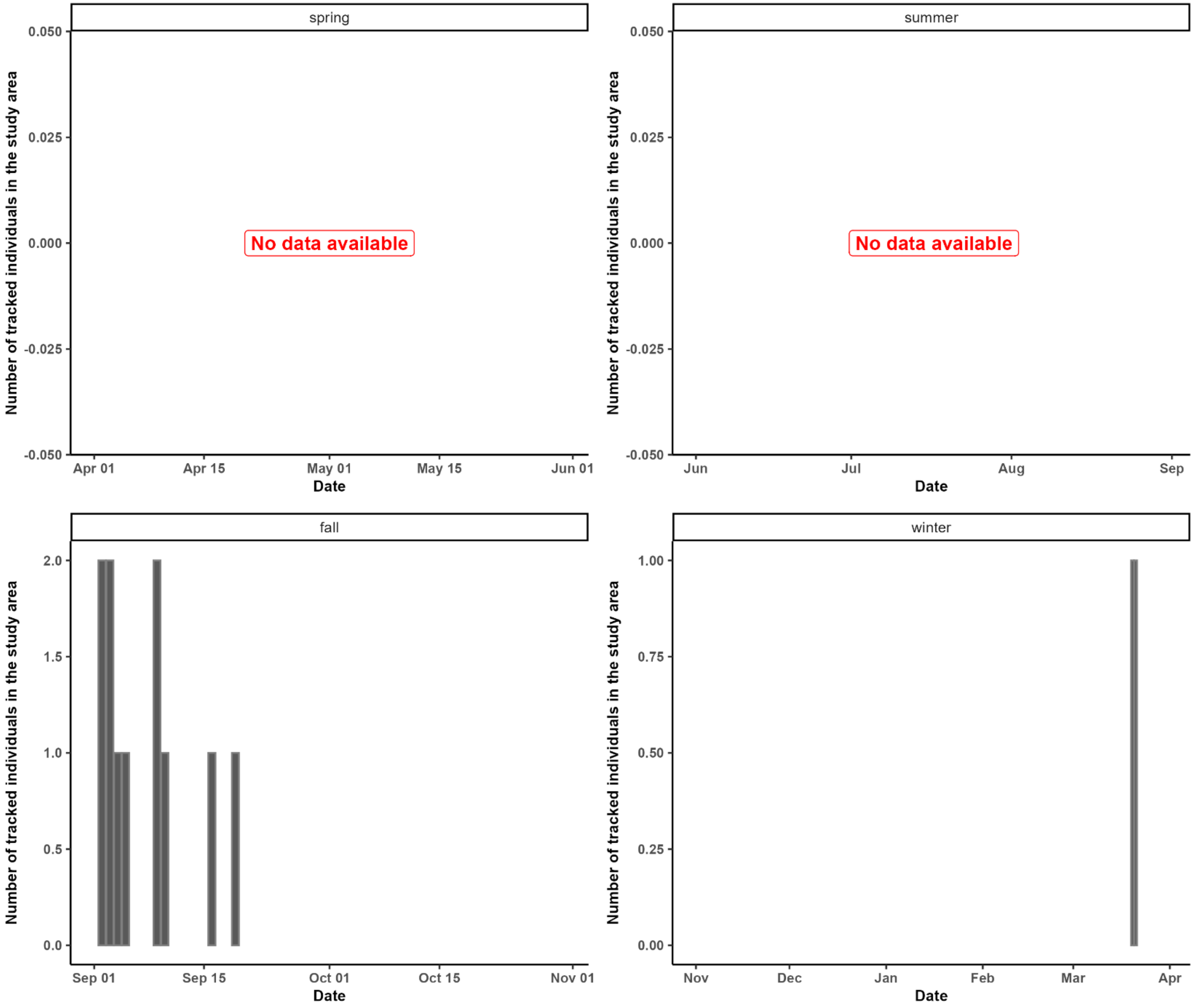


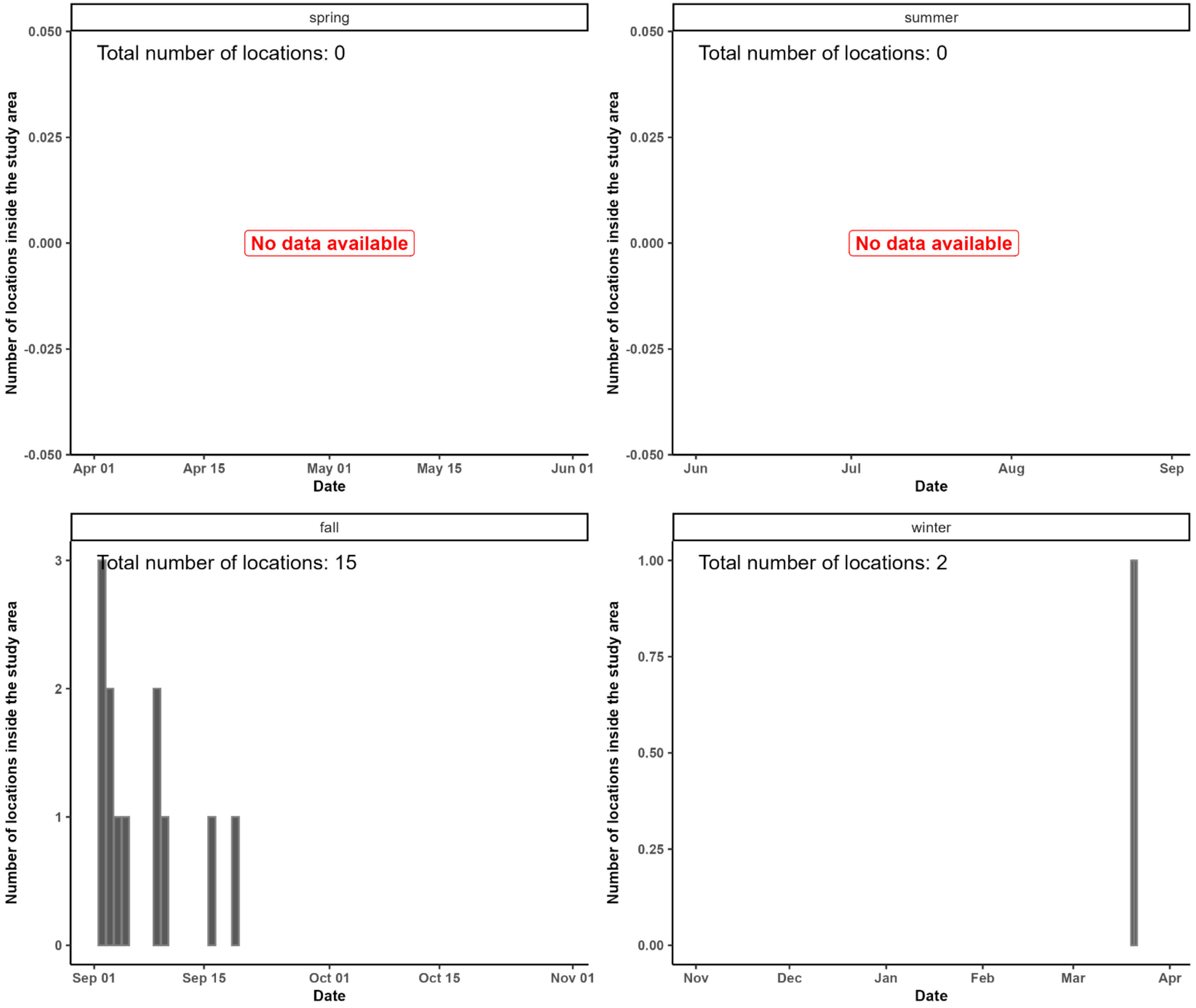
spring
summer
fall
winter
Number of tracked individuals in the study area
0
1
2
3
0.00
0.25
0.50
0.75
1.00
Apr 01
Apr 15
May 01
May 15
Jun 01
Jun
Jul
Aug
Sep
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Nov
Dec
Jan
Feb
Mar
Apr
Date


spring
Total number of locations: 76
Number of locations inside the study area
0
1
2
3
4
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 43
Number of locations inside the study area
0
2
4
6
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 8
Number of locations inside the study area
0.0
0.5
1.0
1.5
2.0
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 3
Number of locations inside the study area
0.00
0.25
0.50
0.75
1.00
Nov
Dec
Jan
Feb
Mar
Apr
Date

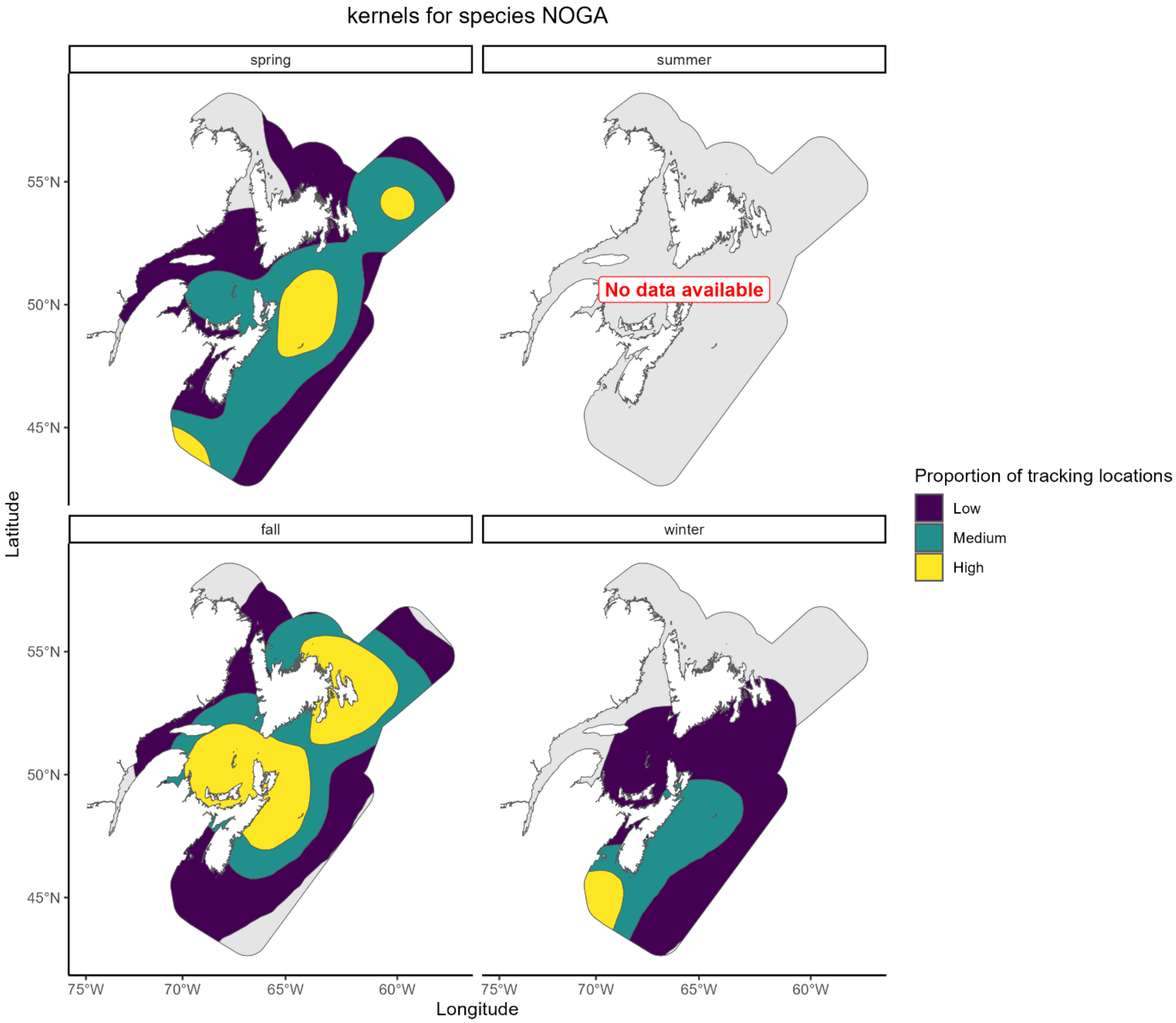
Manx Shearwater (MASH)

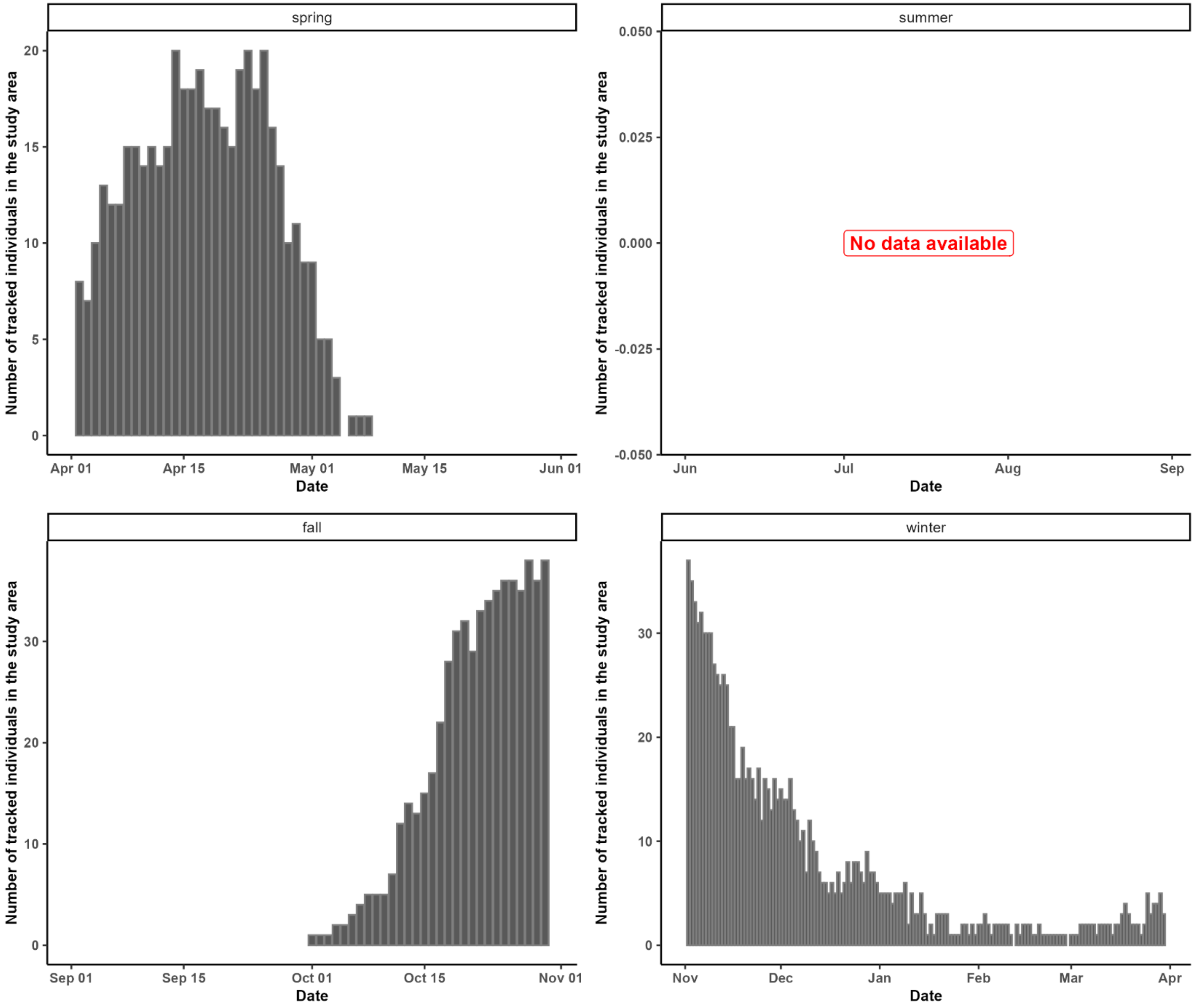


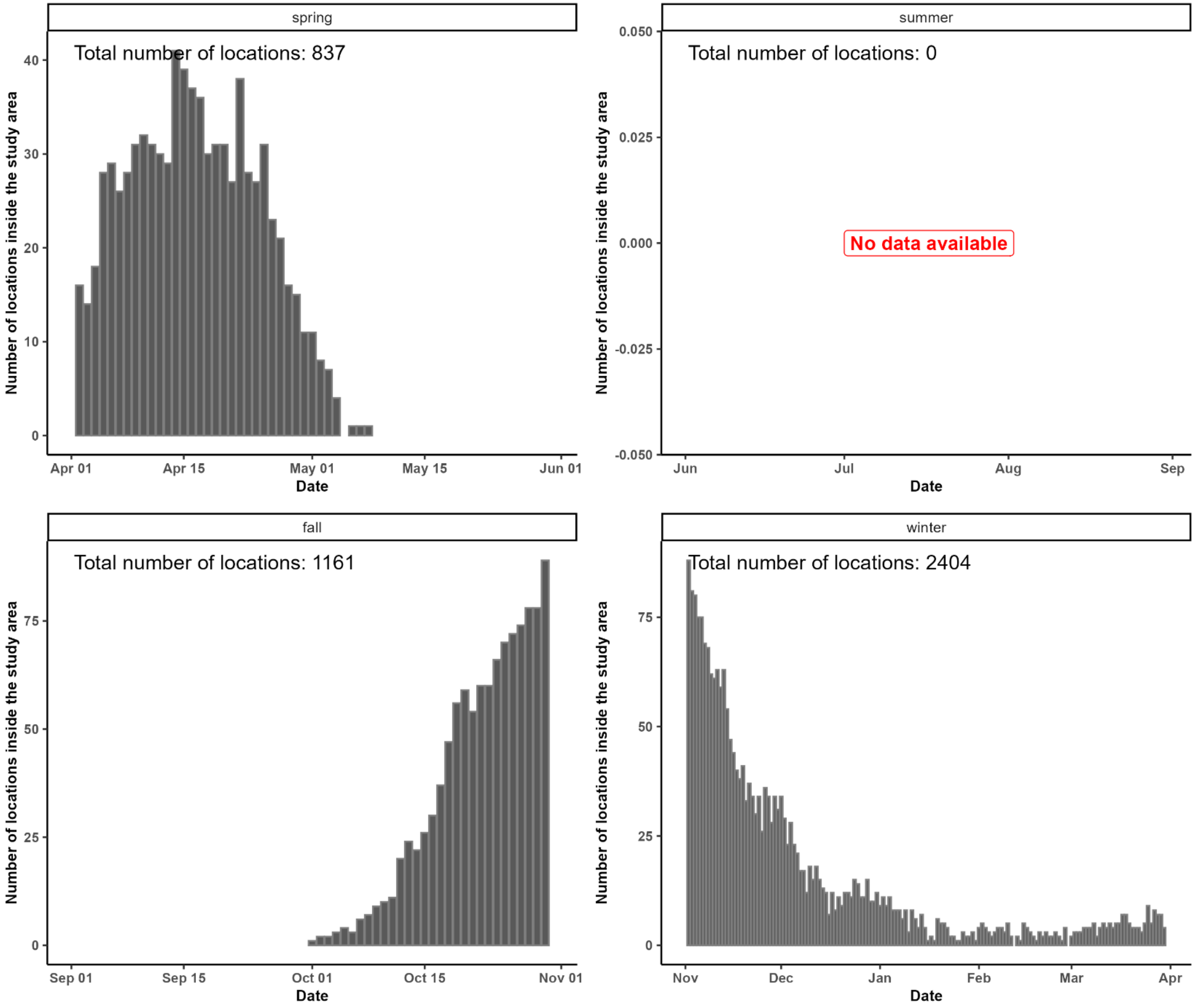

spring
summer
fall
winter
Number of tracked individuals in the study area
Date
No data available
No data available
0.050
0.025
0.000
-0.025
-0.050
Apr 01
Apr 15
May 01
May 15
Jun 01
Jun
Jul
Aug
Sep
2.0
1.5
1.0
0.5
0.0
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
1.00
0.75
0.50
0.25
0.00
Nov
Dec
Jan
Feb
Mar
Apr


spring
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
Number of locations inside the study area
summer
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Jun
Jul
Aug
Sep
Date
Number of locations inside the study area
fall
Total number of locations: 15
3
2
1
0
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
Number of locations inside the study area
winter
Total number of locations: 2
1.00
0.75
0.50
0.25
0.00
Nov
Dec
Jan
Feb
Mar
Apr
Date
Number of locations inside the study area

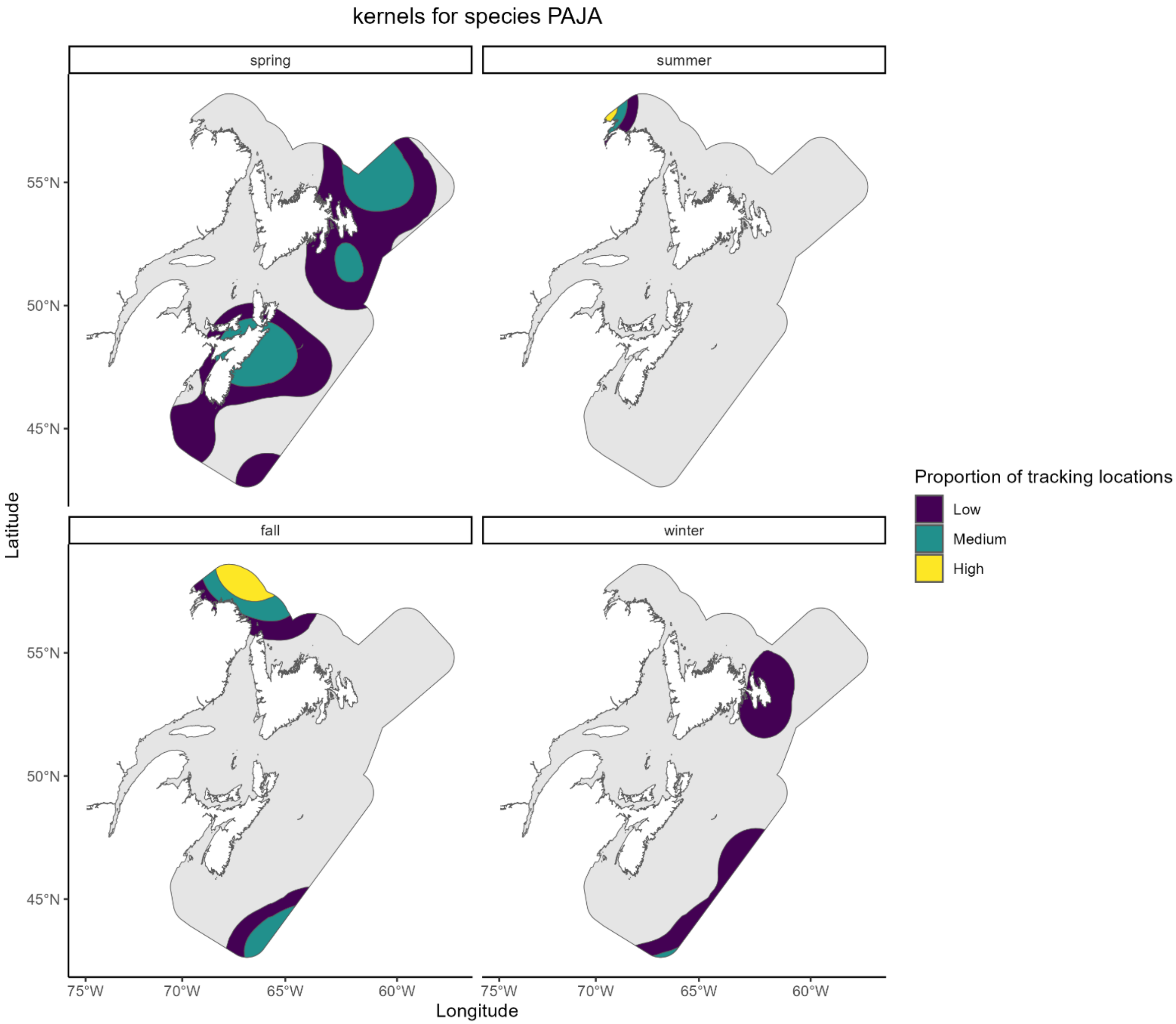
Northern Gannet (NOGA)

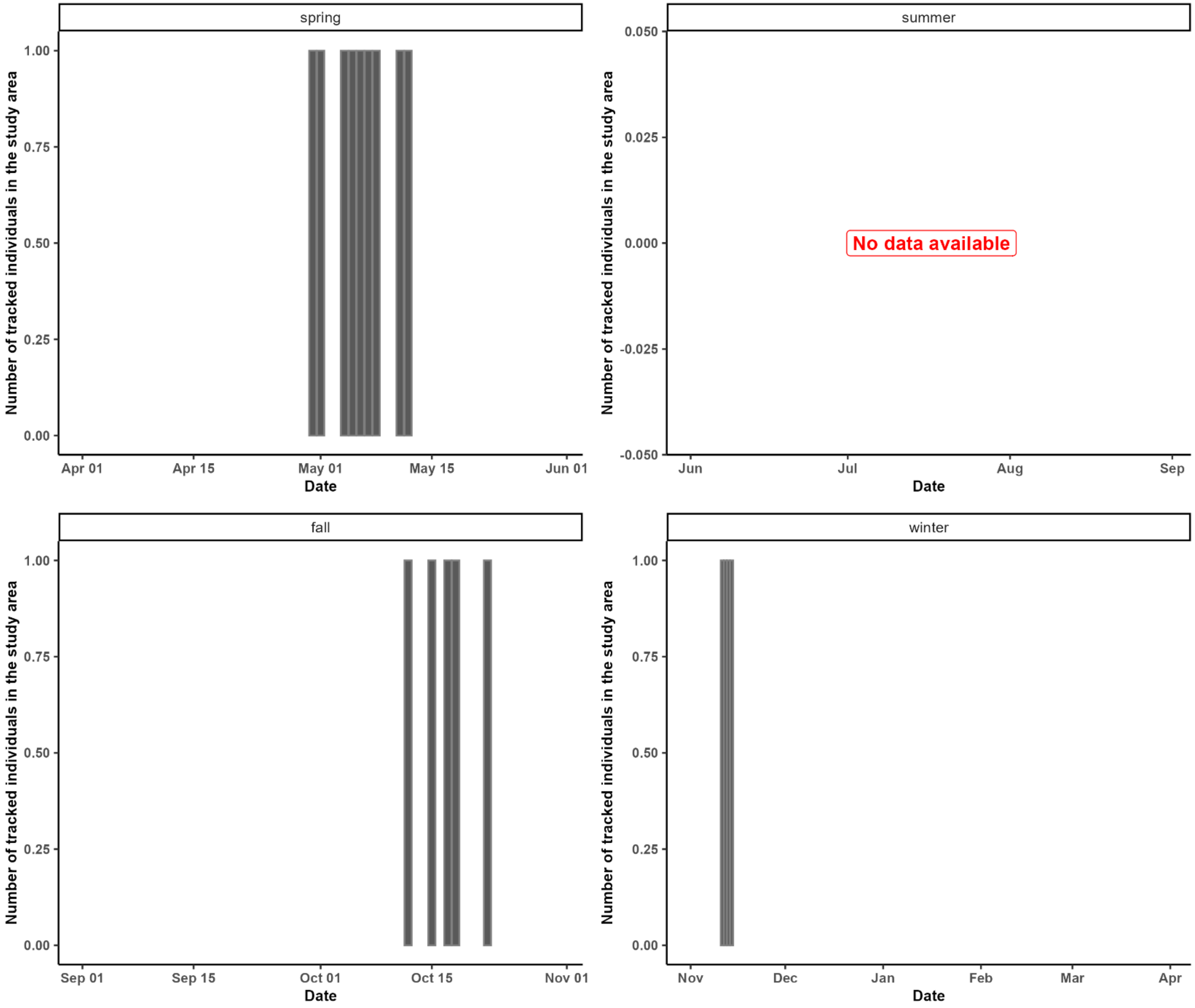


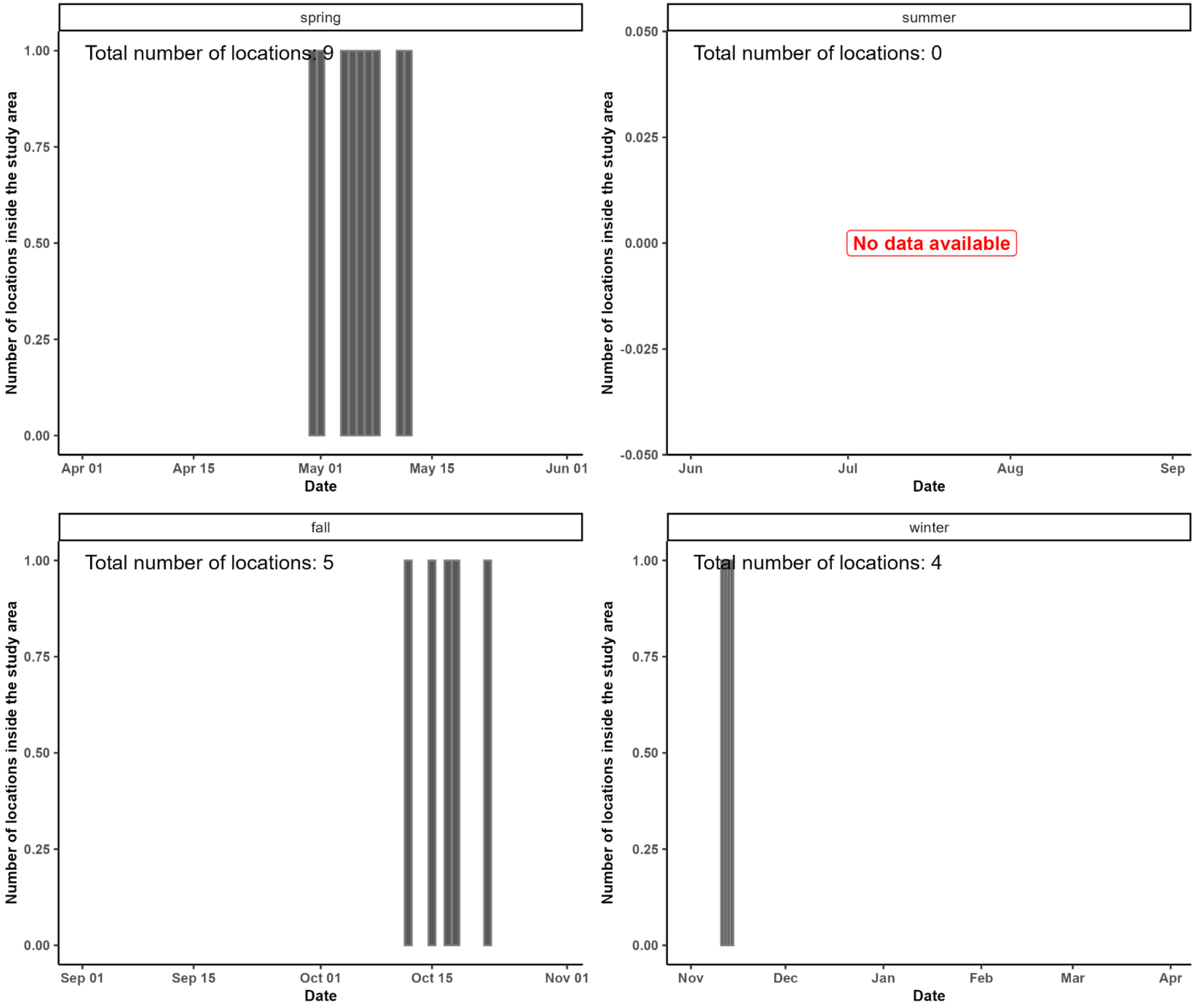

spring
summer
fall
winter
Number of tracked individuals in the study area
Date
0
5
10
15
20
Apr 01
Apr 15
May 01
May 15
Jun 01
0.050
0.025
0.000
-0.025
-0.050
No data available
Jun
Jul
Aug
Sep
0
10
20
30
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Nov
Dec
Jan
Feb
Mar
Apr


spring
Total number of locations: 837
Number of locations inside the study area
0
10
20
30
40
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 0
No data available
Number of locations inside the study area
0.050
0.025
0.000
-0.025
-0.050
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 1161
Number of locations inside the study area
0
25
50
75
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 2404
Number of locations inside the study area
0
25
50
75
Nov
Dec
Jan
Feb
Mar
Apr
Date

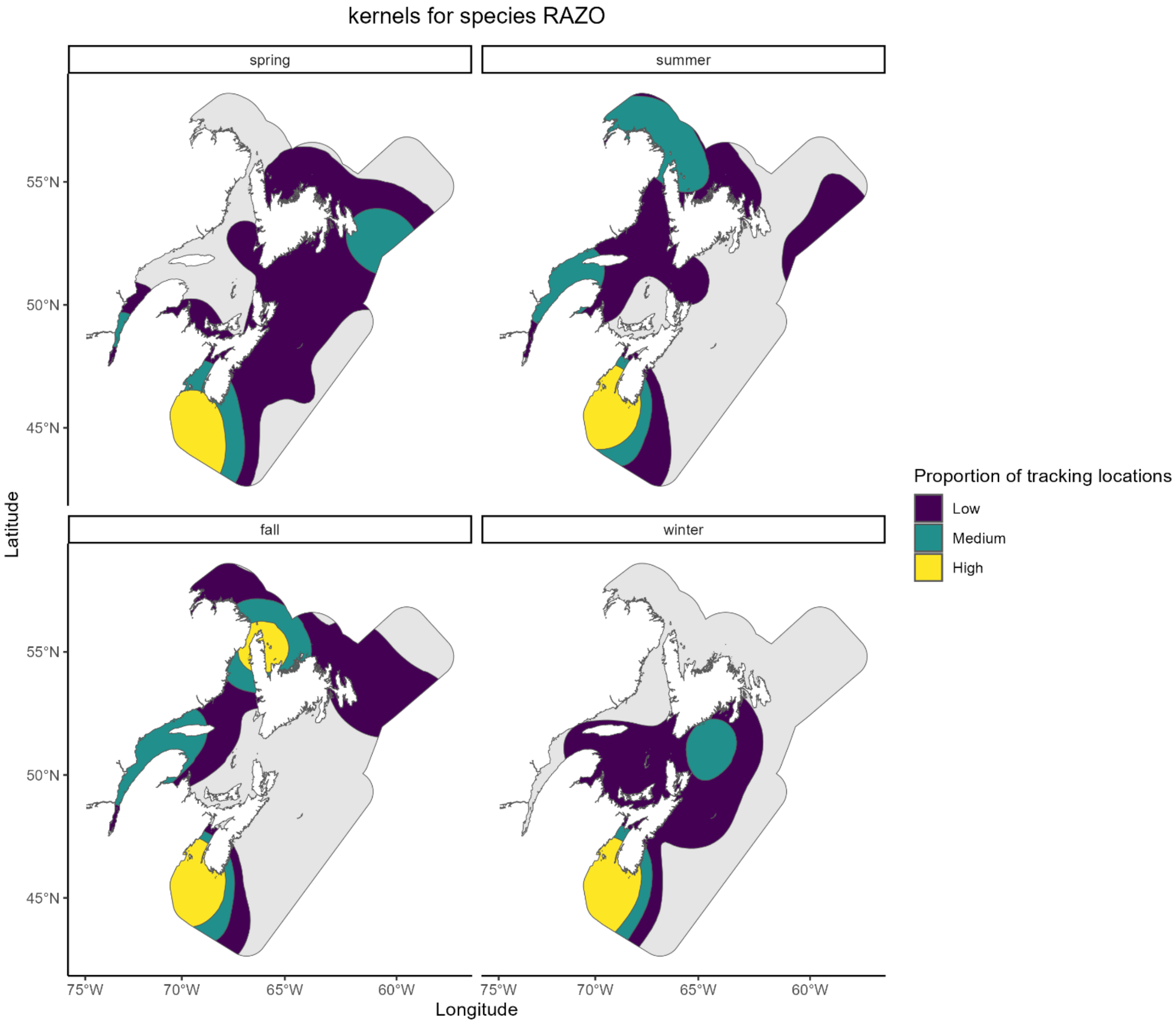
Parasitic Jaeger (PAJA)

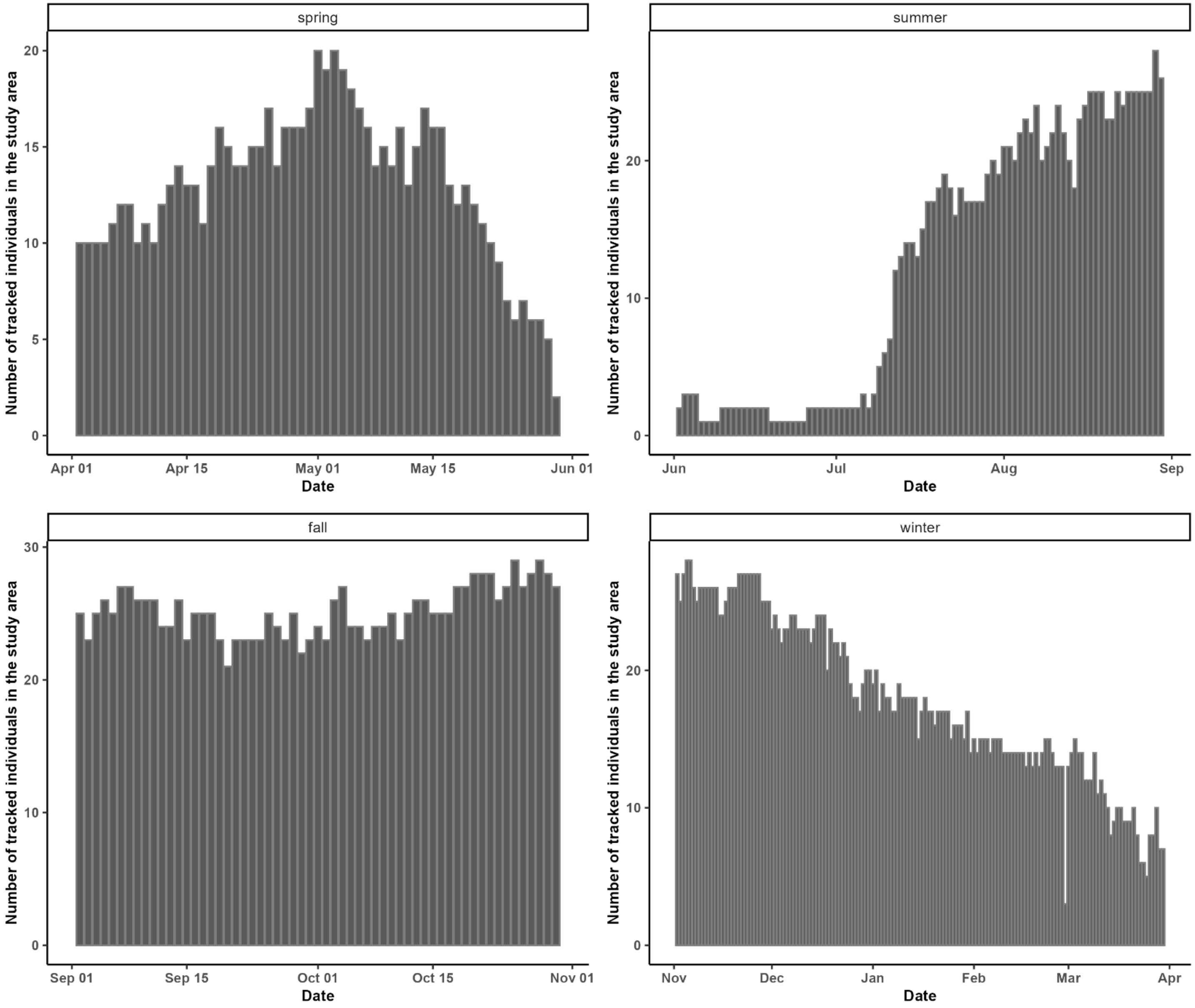


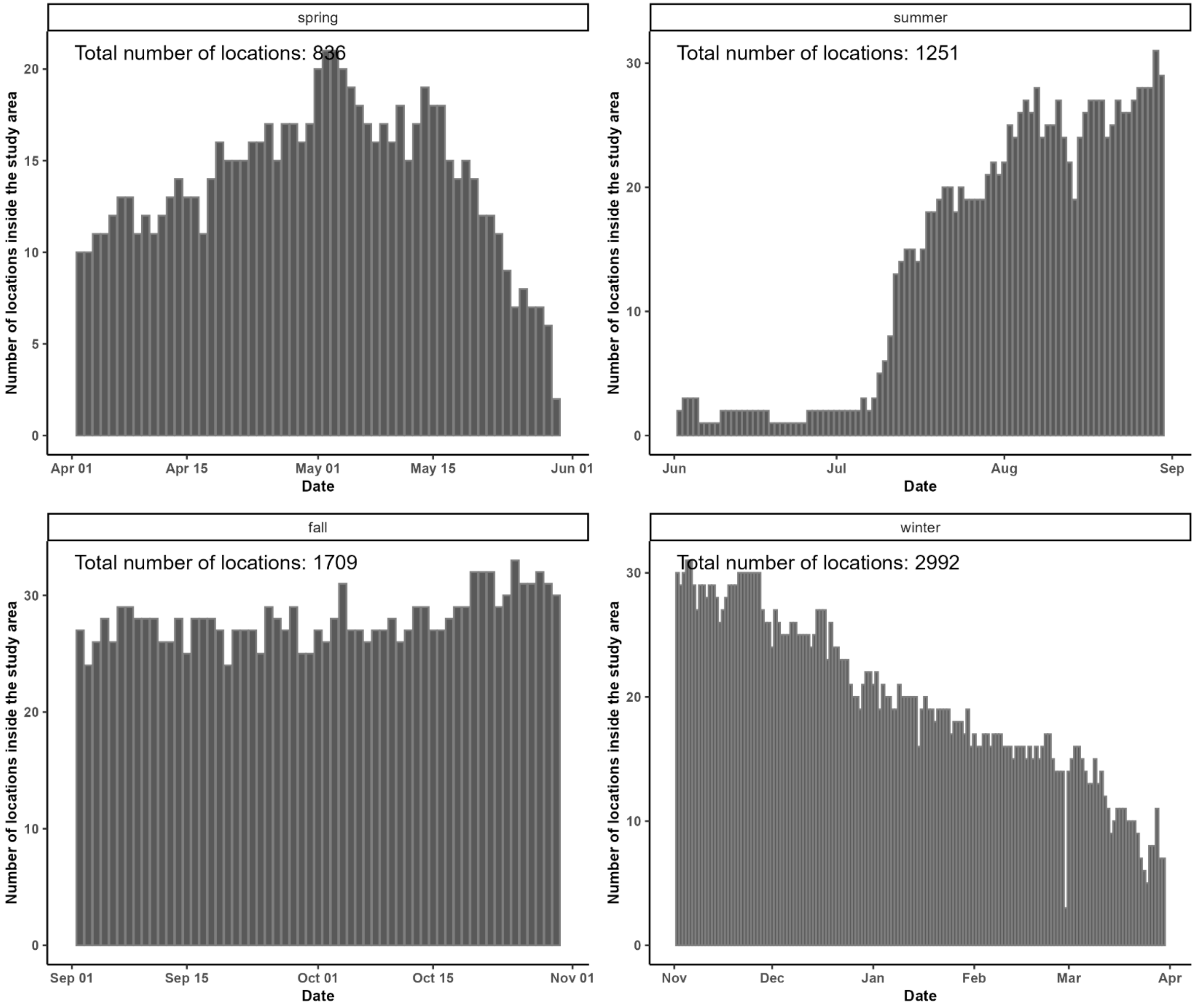

spring
summer
fall
winter
Number of tracked individuals in the study area
1.00
0.75
0.50
0.25
0.00
0.050
0.025
0.000
-0.025
-0.050
No data available
Apr 01
Apr 15
May 01
May 15
Jun 01
Jun
Jul
Aug
Sep
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Nov
Dec
Jan
Feb
Mar
Apr
Date


spring
Total number of locations: 9
Number of locations inside the study area
1.00
0.75
0.50
0.25
0.00
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 0
No data available
Number of locations inside the study area
0.050
0.025
0.000
-0.025
-0.050
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 5
Number of locations inside the study area
1.00
0.75
0.50
0.25
0.00
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 4
Number of locations inside the study area
1.00
0.75
0.50
0.25
0.00
Nov
Dec
Jan
Feb
Mar
Apr
Date

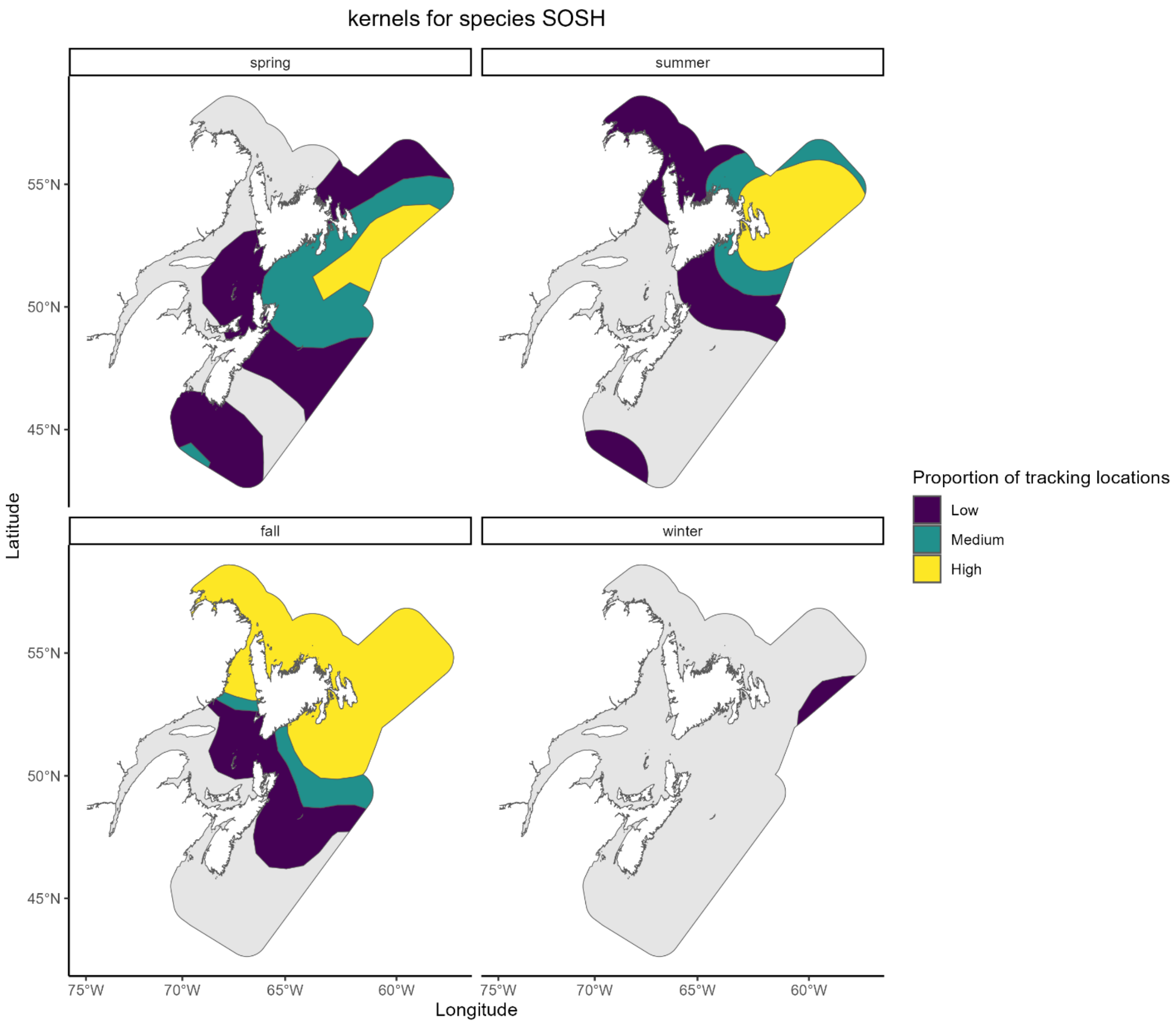
Razorbill (RAZO)

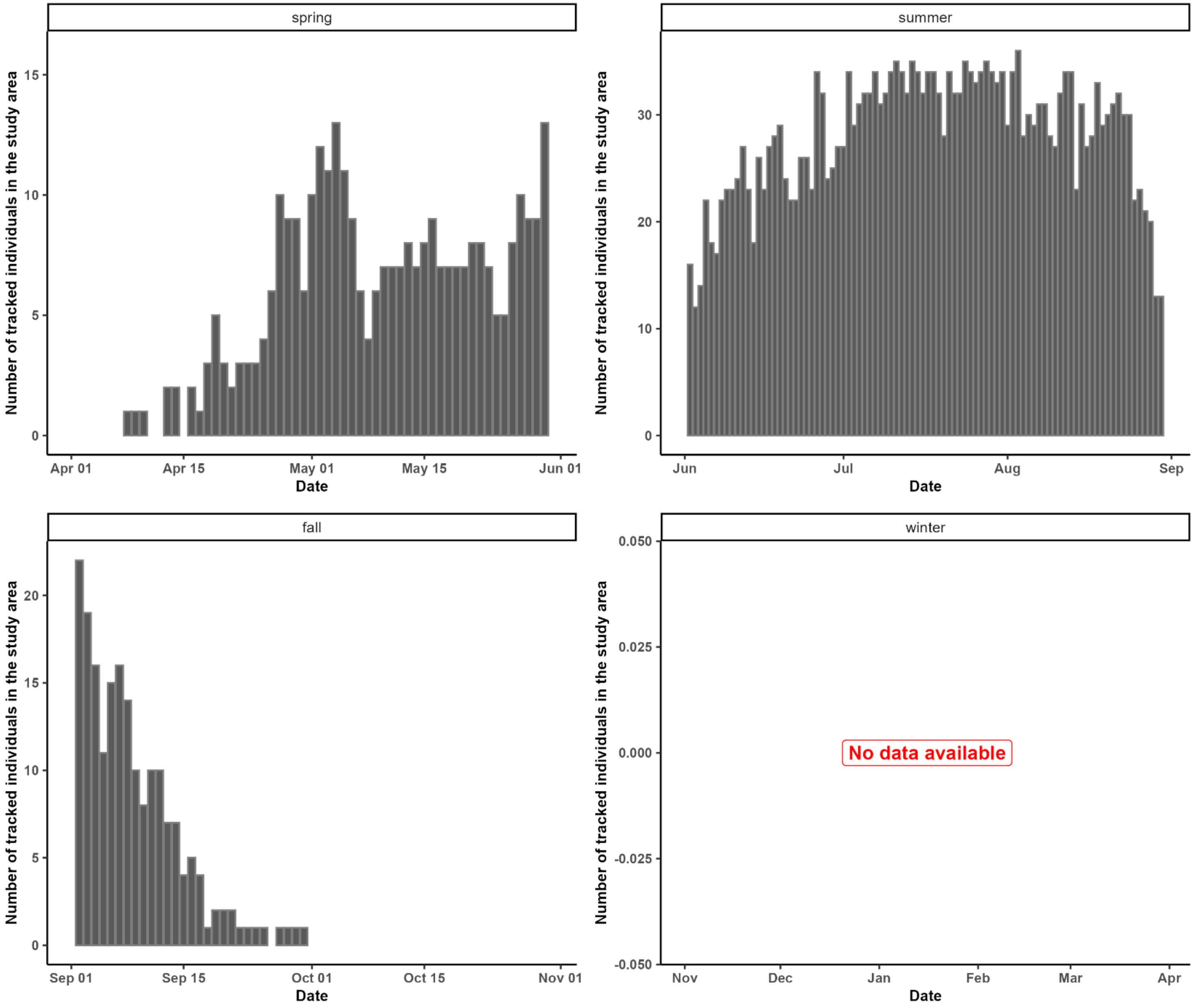


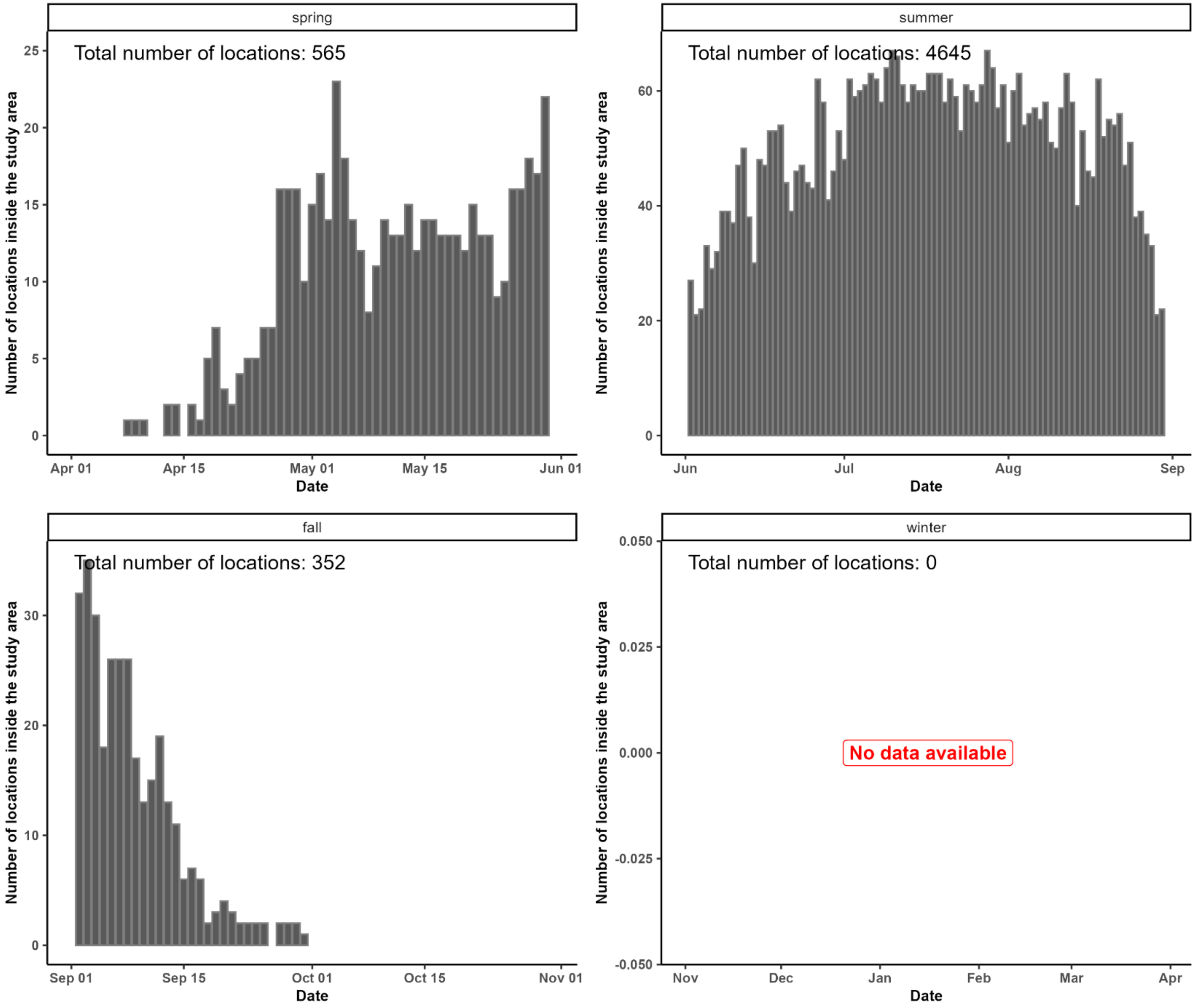

spring
summer
fall
winter
Number of tracked individuals in the study area
0
5
10
15
20
Apr 01
Apr 15
May 01
May 15
Jun 01
Jun
Jul
Aug
Sep
0
10
20
30
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Nov
Dec
Jan
Feb
Mar
Apr
Date


spring
Total number of locations: 836
Number of locations inside the study area
0
5
10
15
20
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 1251
Number of locations inside the study area
0
10
20
30
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 1709
Number of locations inside the study area
0
10
20
30
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 2992
Number of locations inside the study area
0
10
20
30
Nov
Dec
Jan
Feb
Mar
Apr
Date

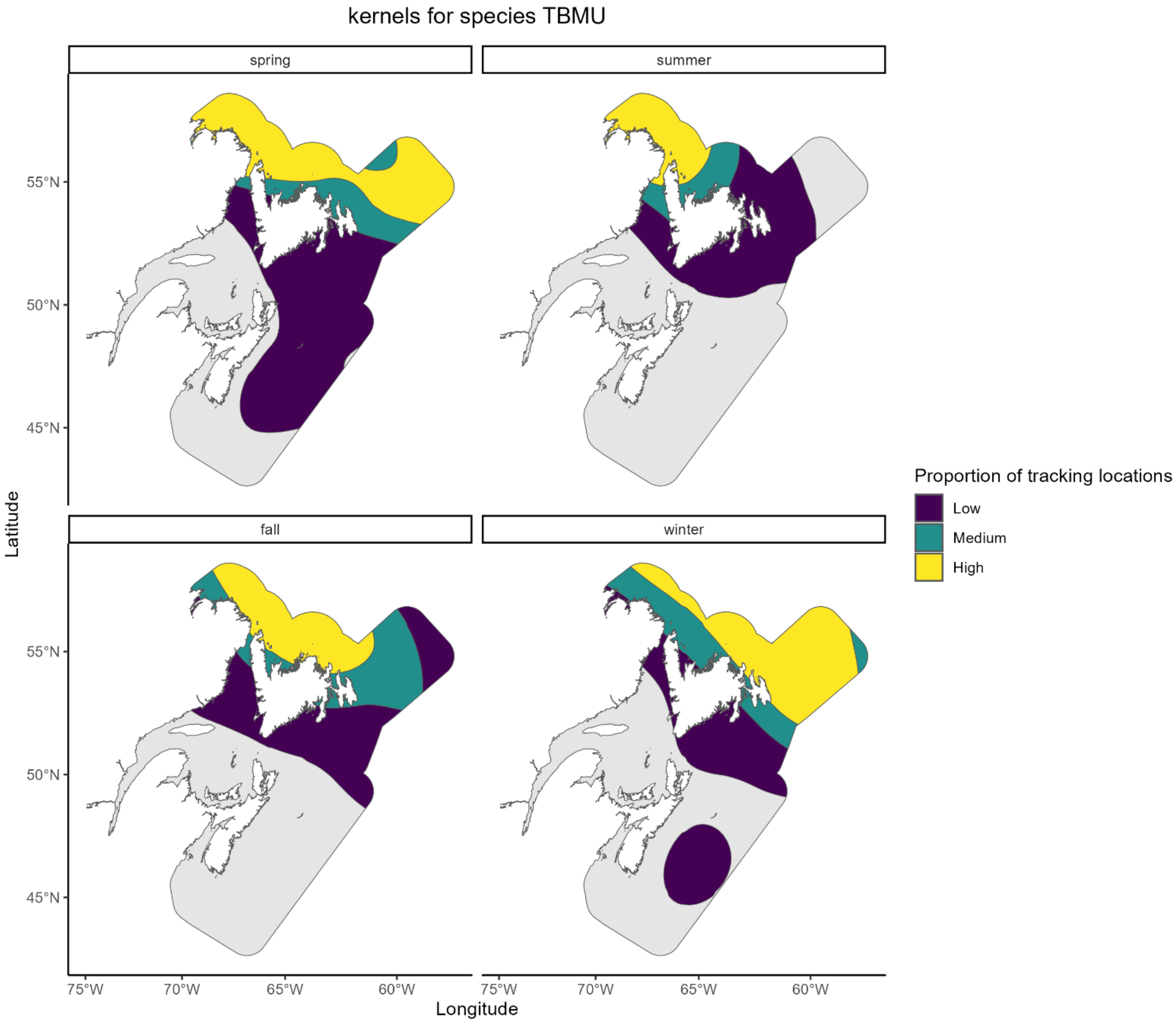
Sooty Shearwater (SOSH)

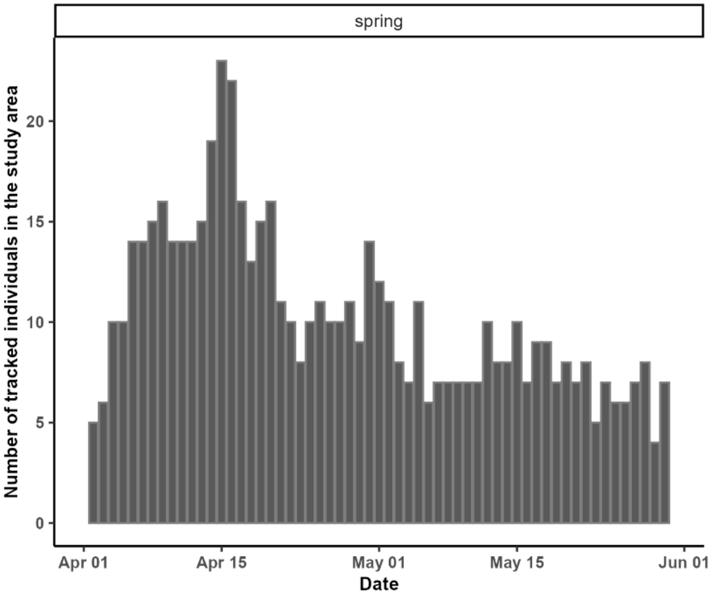


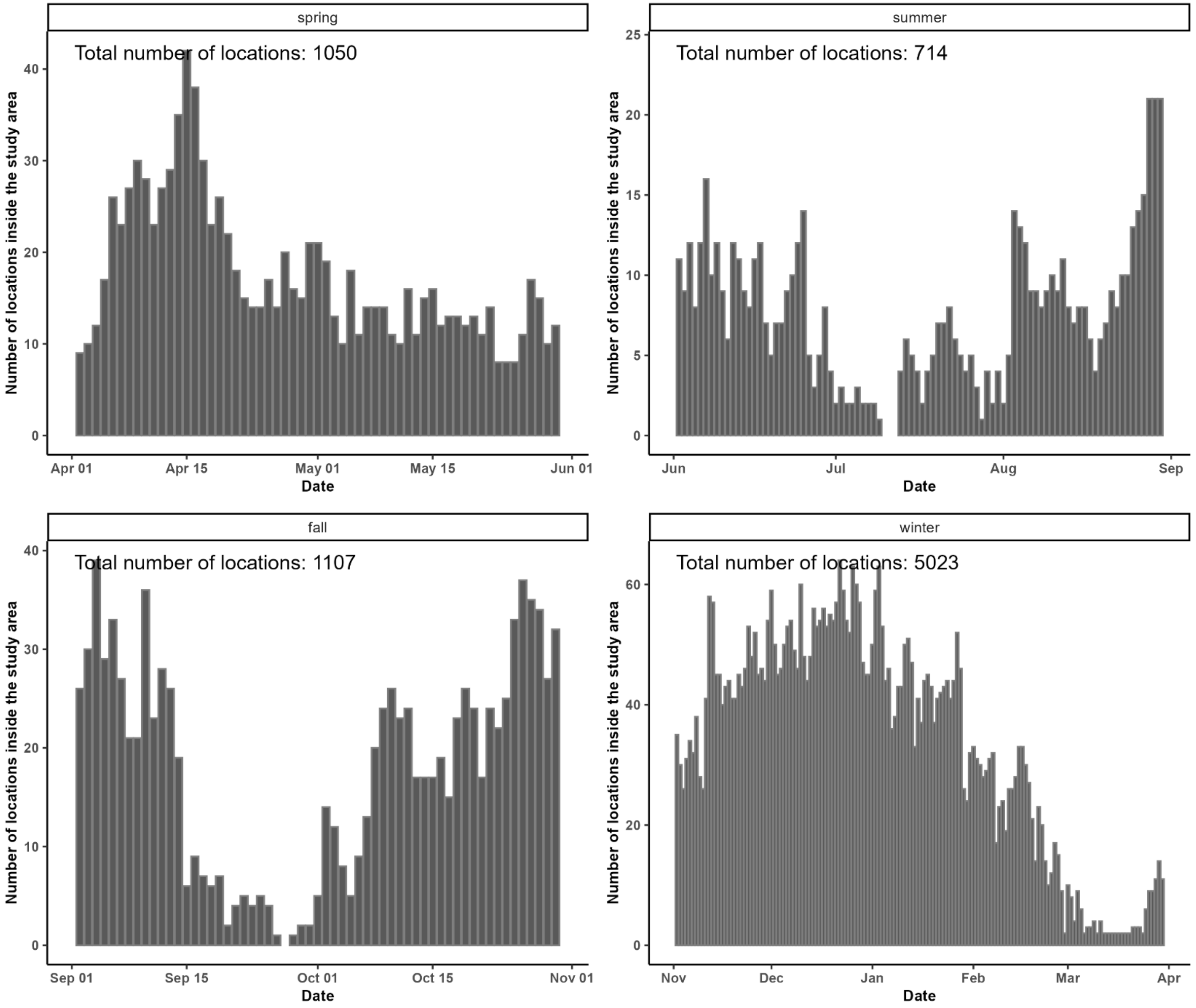

spring
summer
fall
winter
Number of tracked individuals in the study area
Date
0
5
10
15
Apr 01
Apr 15
May 01
May 15
Jun 01
0
10
20
30
Jun
Jul
Aug
Sep
0
5
10
15
20
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
0.050
0.025
0.000
-0.025
-0.050
Nov
Dec
Jan
Feb
Mar
Apr
No data available


spring
Total number of locations: 565
Number of locations inside the study area
0
5
10
15
20
25
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 4645
Number of locations inside the study area
0
20
40
60
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 352
Number of locations inside the study area
0
10
20
30
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 0
Number of locations inside the study area
0.050
0.025
0.000
-0.025
-0.050
No data available
Nov
Dec
Jan
Feb
Mar
Apr
Date

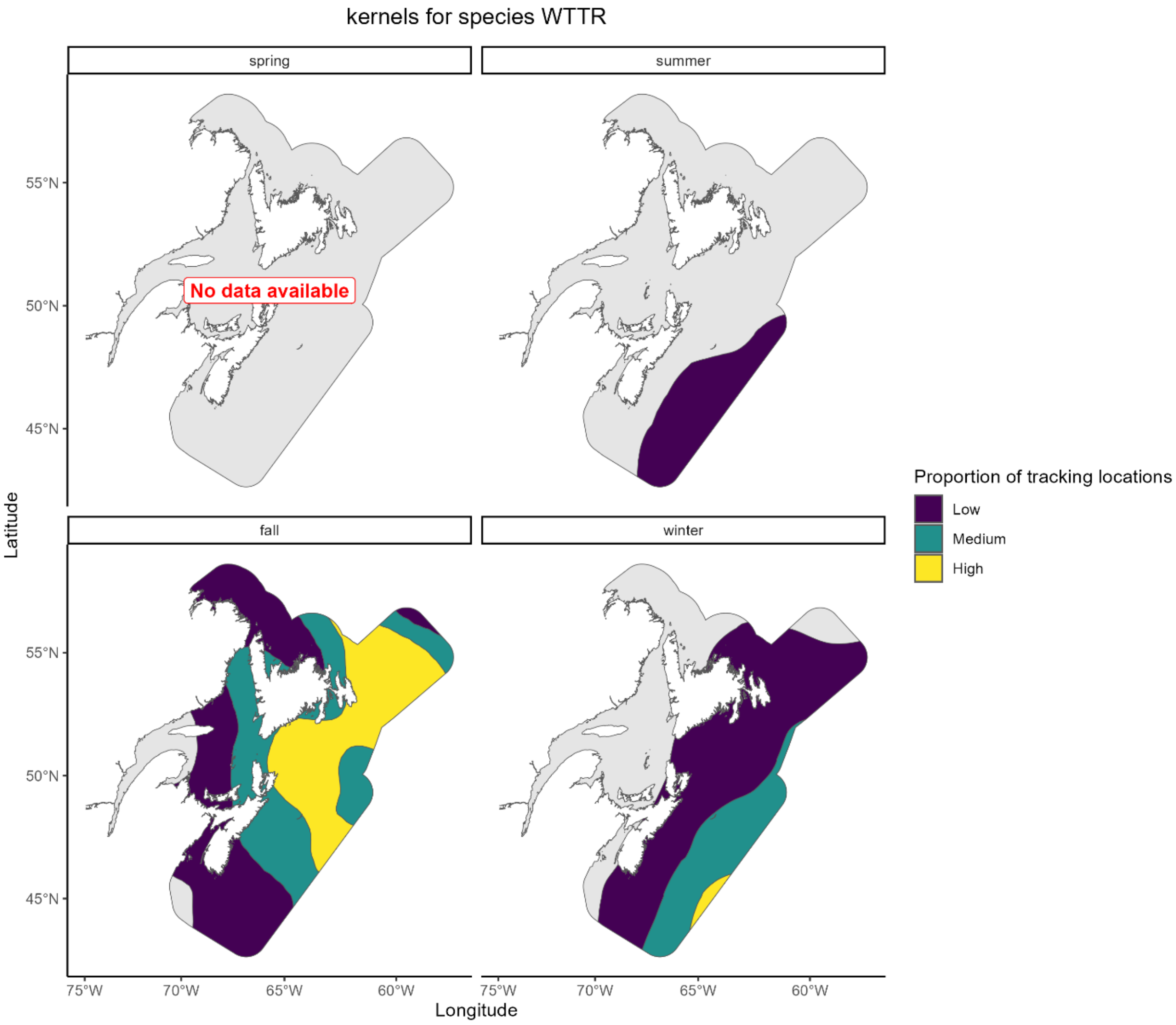
Thick-billed Murre (TBMU)

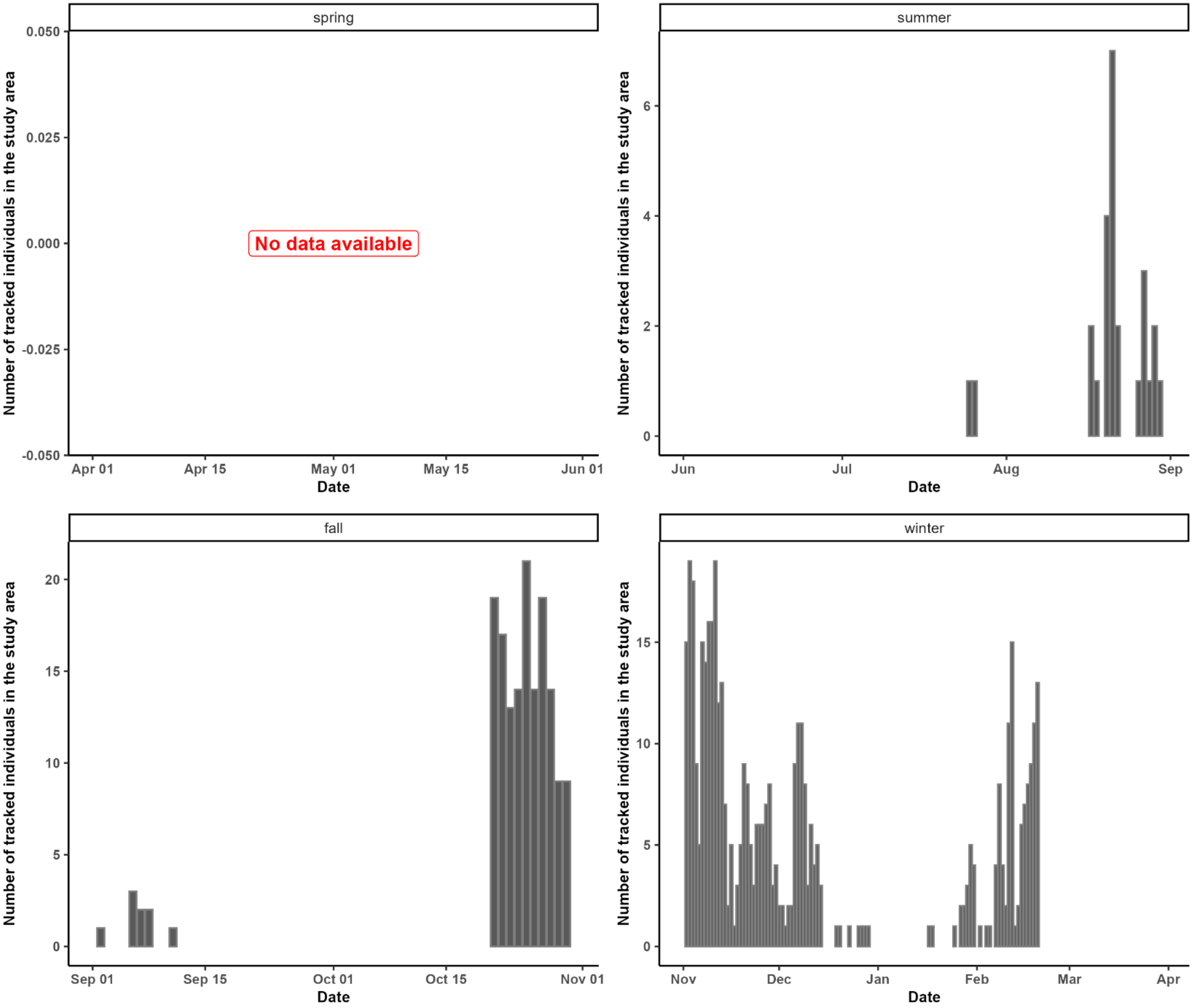


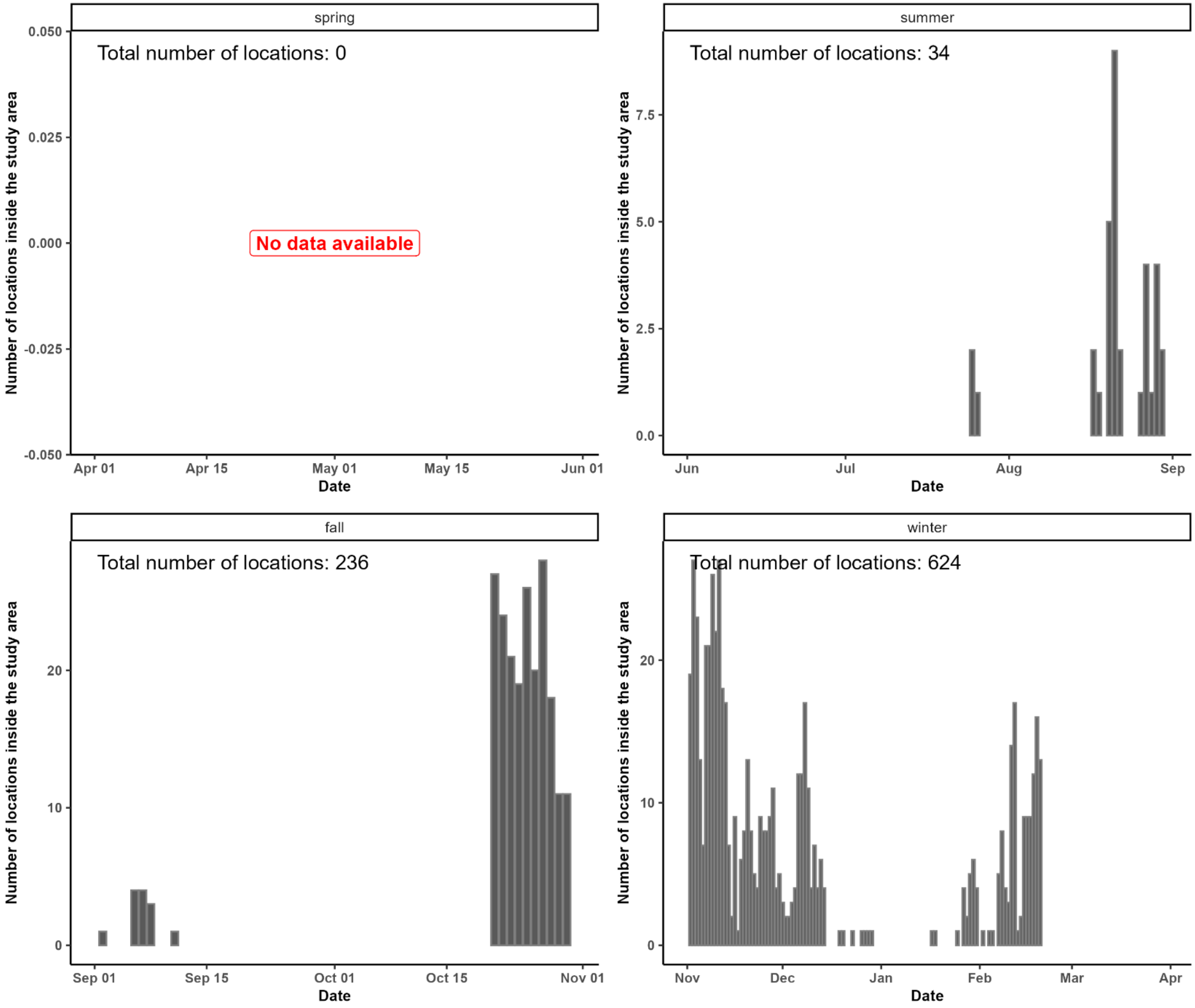

spring
summer
fall
winter
Number of tracked individuals in the study area
Date
Apr 01
Apr 15
May 01
May 15
Jun 01
Jun
Jul
Aug
Sep
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Nov
Dec
Jan
Feb
Mar
Apr
0
5
10
15
20
25
30


spring
Total number of locations: 1050
summer
Total number of locations: 714
fall
Total number of locations: 1107
winter
Total number of locations: 5023
Number of locations inside the study area
Date
0
10
20
30
40
Apr 01
Apr 15
May 01
May 15
Jun 01
0
5
10
15
20
25
Jun
Jul
Aug
Sep
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
0
20
40
60
Nov
Dec
Jan
Feb
Mar
Apr

White-tailed Tropicbird (WTTR)

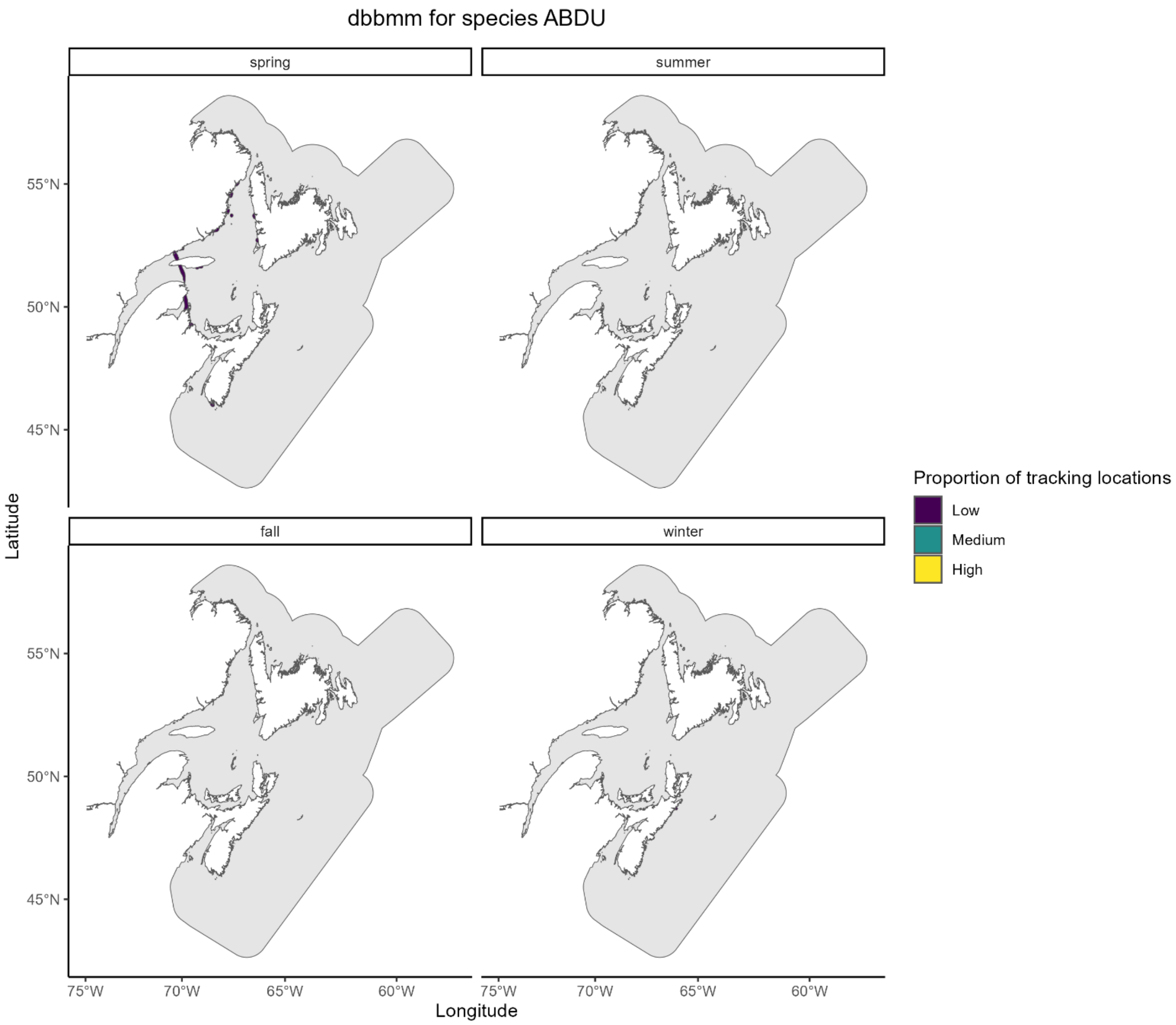


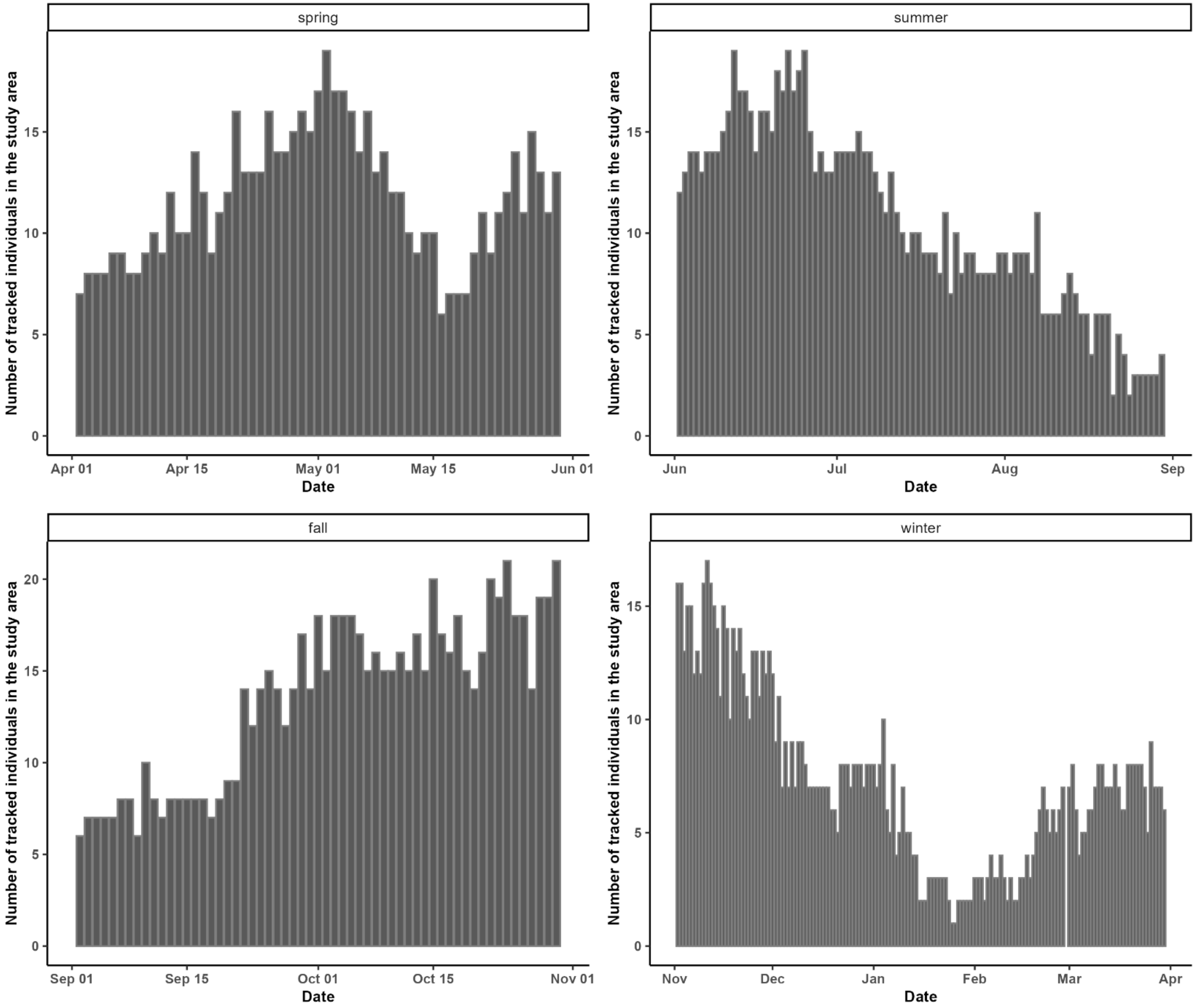

spring
summer
fall
winter
No data available
Number of tracked individuals in the study area
Date
0.050
0.025
0.000
-0.025
-0.050
Apr 01
Apr 15
May 01
May 15
Jun 01
0
2
4
6
Jun
Jul
Aug
Sep
0
5
10
15
20
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
0
5
10
15
Nov
Dec
Jan
Feb
Mar
Apr

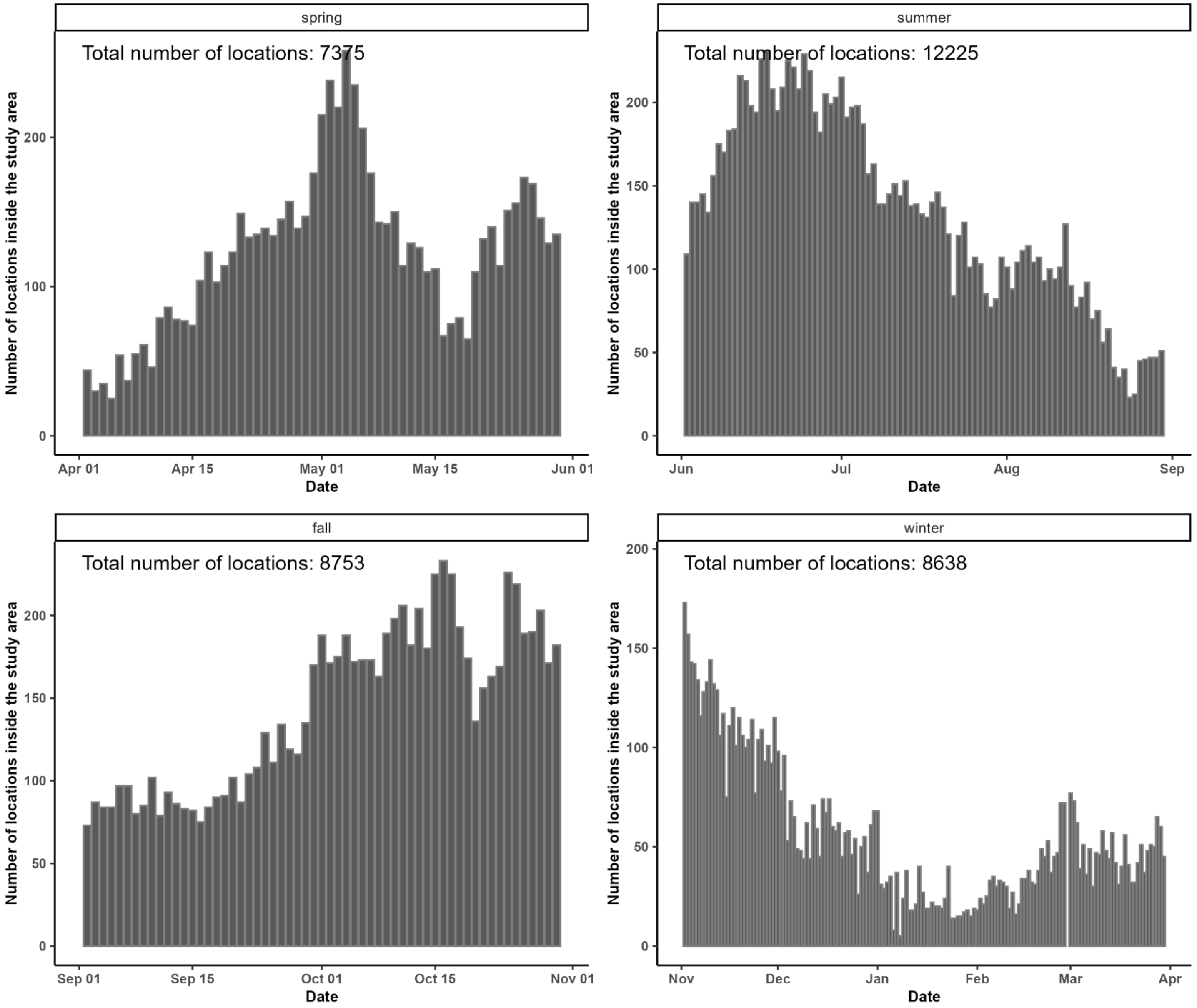

spring
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
Number of locations inside the study area
summer
Total number of locations: 34
7.5
5.0
2.5
0.0
Jun
Jul
Aug
Sep
Date
Number of locations inside the study area
fall
Total number of locations: 236
20
10
0
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
Number of locations inside the study area
winter
Total number of locations: 624
20
10
0
Nov
Dec
Jan
Feb
Mar
Apr
Date
Number of locations inside the study area

Mapping Products: Dynamic Brownian Bridge Movement Models

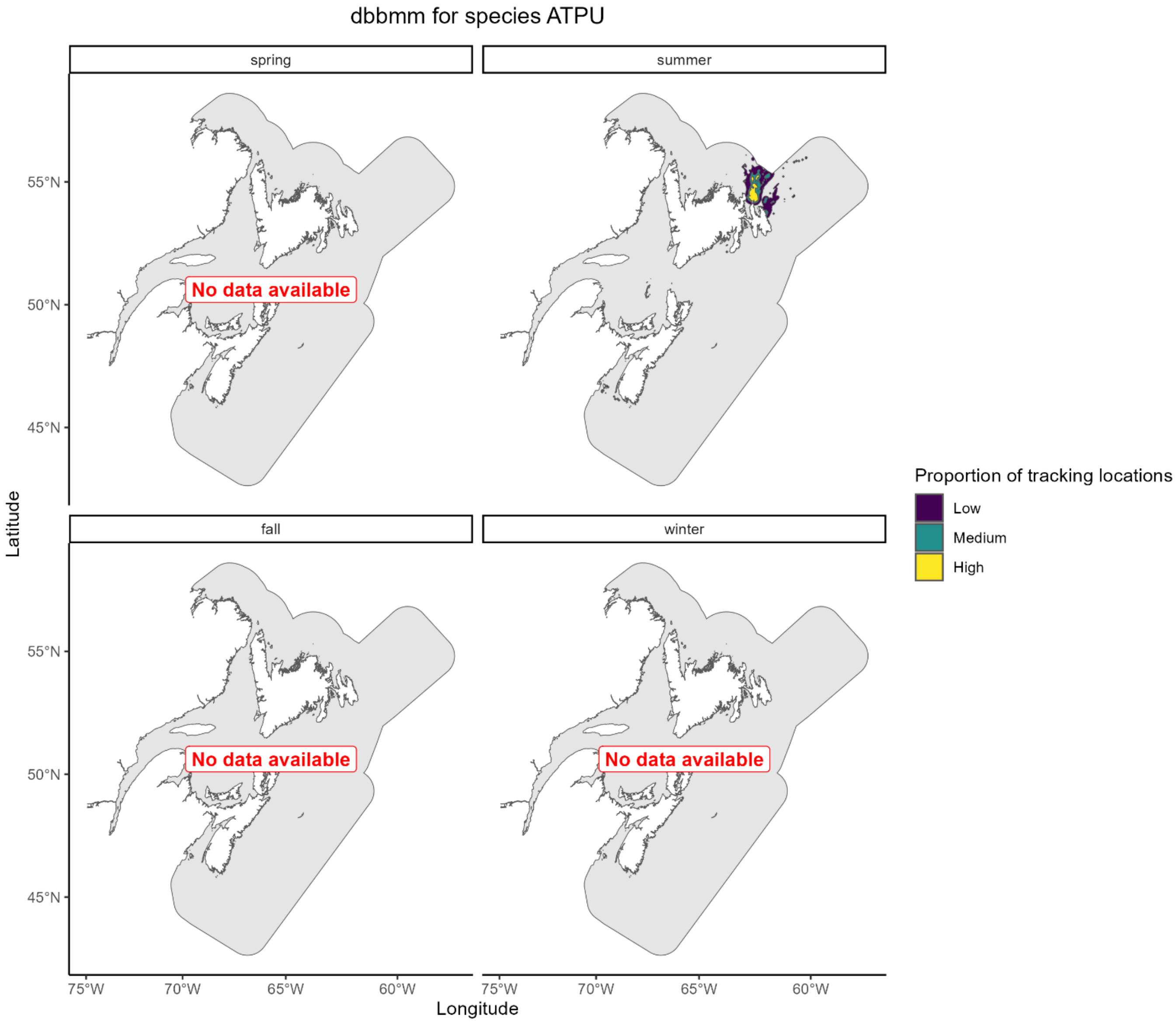
American Black Duck (ABDU)

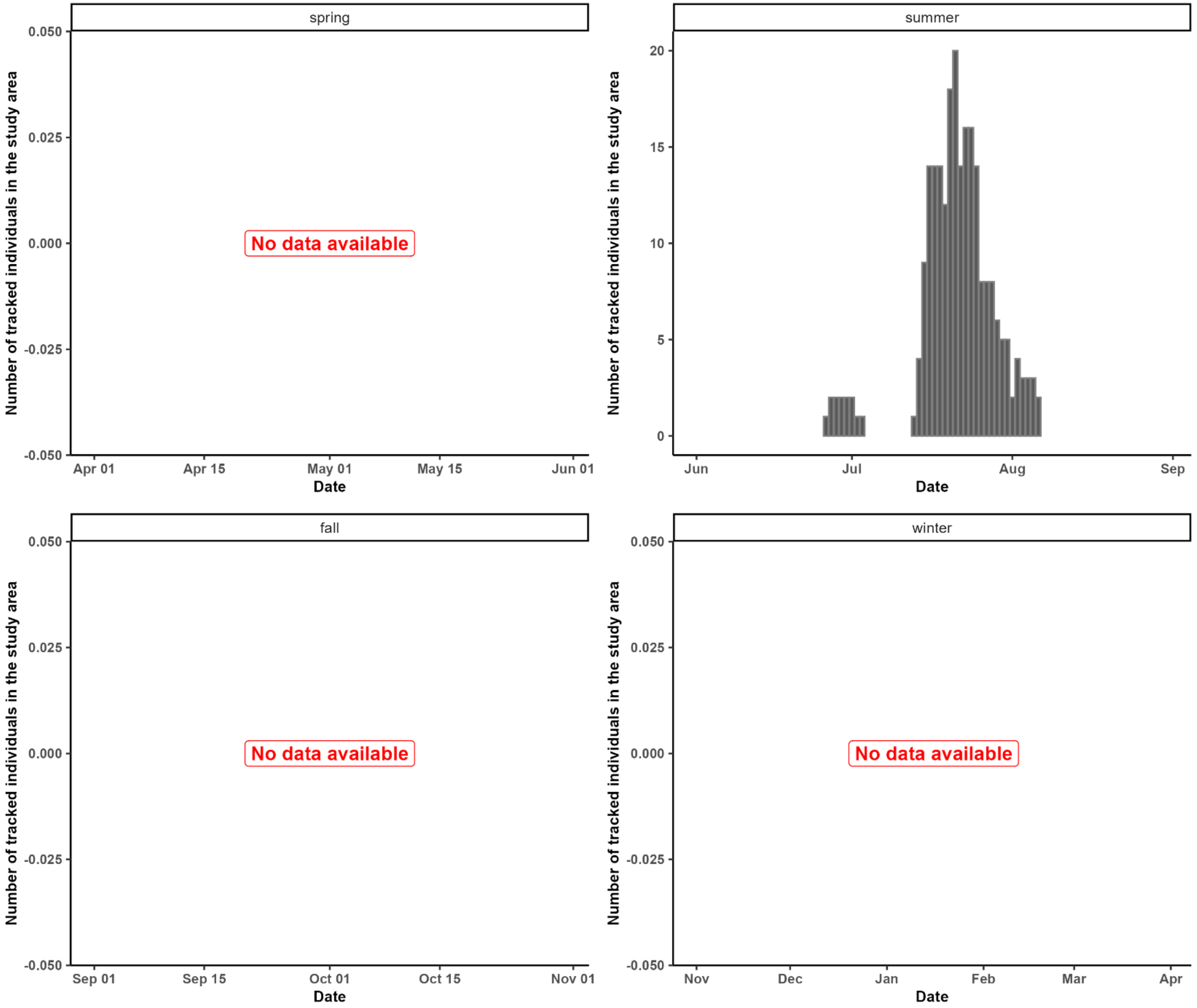


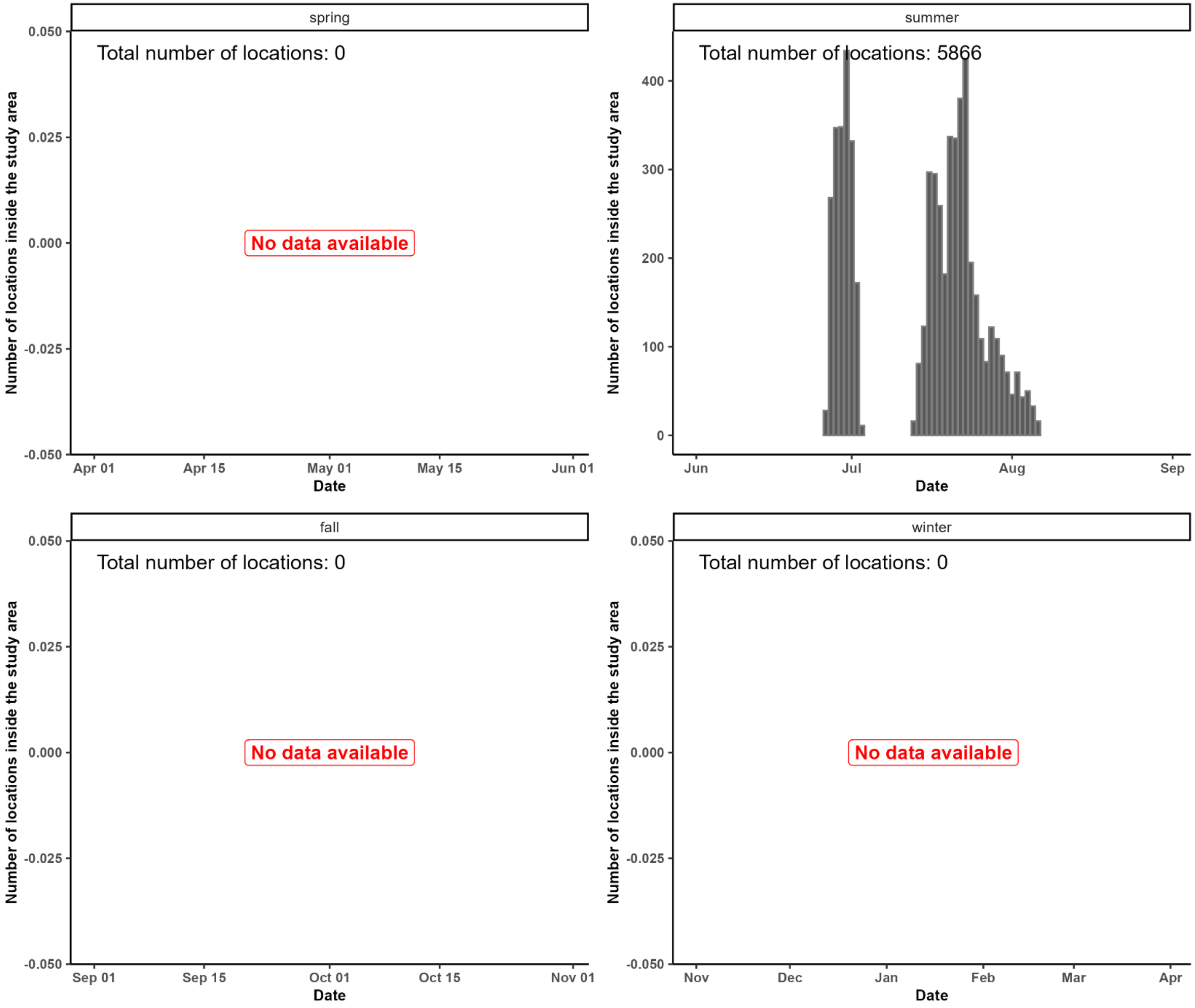

spring
summer
fall
winter
Number of tracked individuals in the study area
0
5
10
15
20
Date
Apr 01
Apr 15
May 01
May 15
Jun 01
Jun
Jul
Aug
Sep
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Nov
Dec
Jan
Feb
Mar
Apr


spring
Total number of locations: 7375
summer
Total number of locations: 12225
fall
Total number of locations: 8753
winter
Total number of locations: 8638
Number of locations inside the study area
Date
0
50
100
150
200
Apr 01
Apr 15
May 01
May 15
Jun 01
Jun
Jul
Aug
Sep
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Nov
Dec
Jan
Feb
Mar
Apr

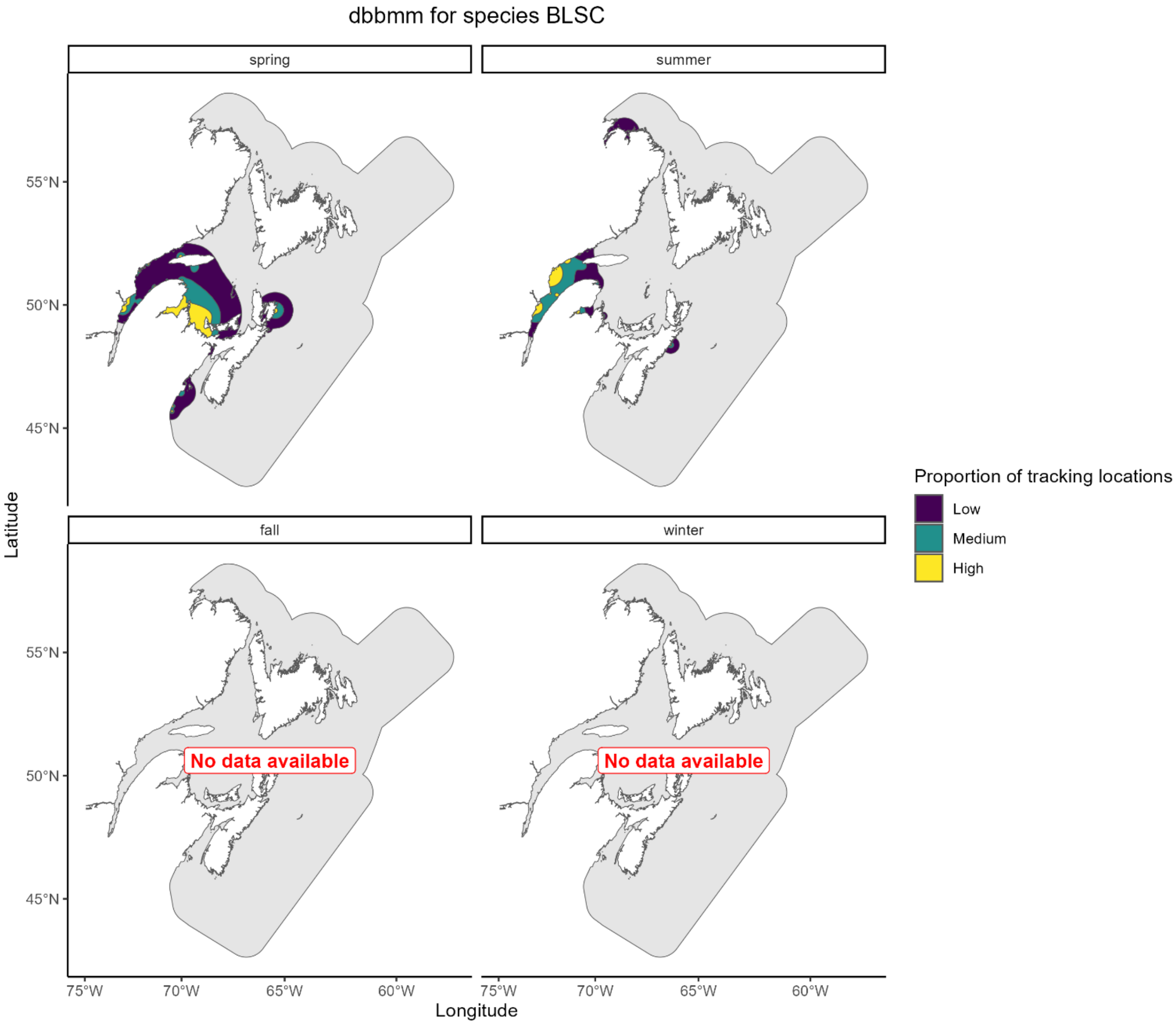
Atlantic Puffin (ATPU)

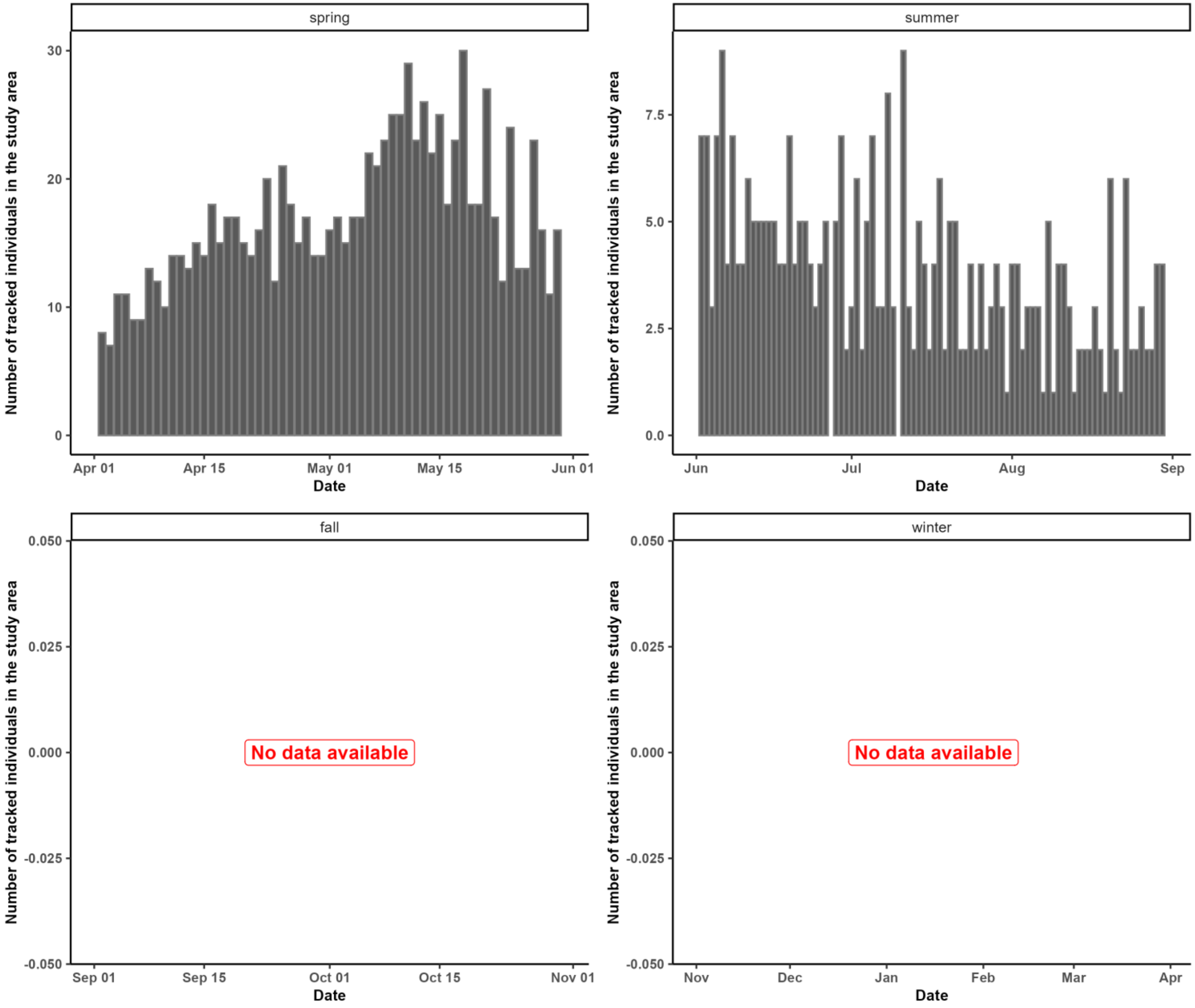



spring
Number of tracked individuals in the study area
0.050
0.025
0.000
-0.025
-0.050
No data available
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Number of tracked individuals in the study area
20
15
10
5
0
Jun
Jul
Aug
Sep
Date
fall
Number of tracked individuals in the study area
0.050
0.025
0.000
-0.025
-0.050
No data available
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Number of tracked individuals in the study area
0.050
0.025
0.000
-0.025
-0.050
No data available
Nov
Dec
Jan
Feb
Mar
Apr
Date

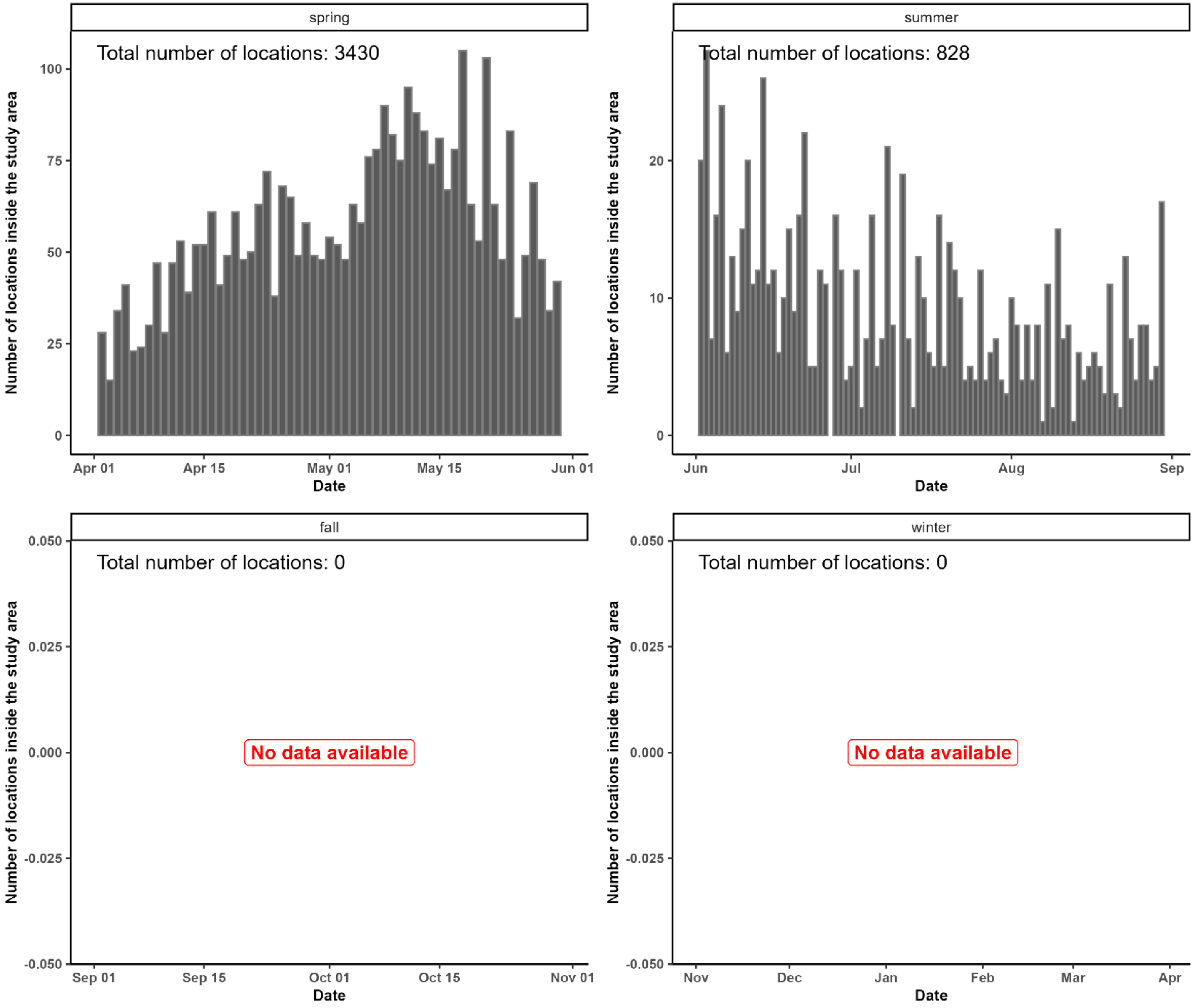

spring
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Apr 01
Apr 15
May 01
May 15
Jun 01
summer
Total number of locations: 5866
400
300
200
100
0
Jun
Jul
Aug
Sep
fall
Total number of locations: 0
No data available
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
winter
Total number of locations: 0
No data available
Nov
Dec
Jan
Feb
Mar
Apr
Number of locations inside the study area
Date

Black Scoter (BLSC)

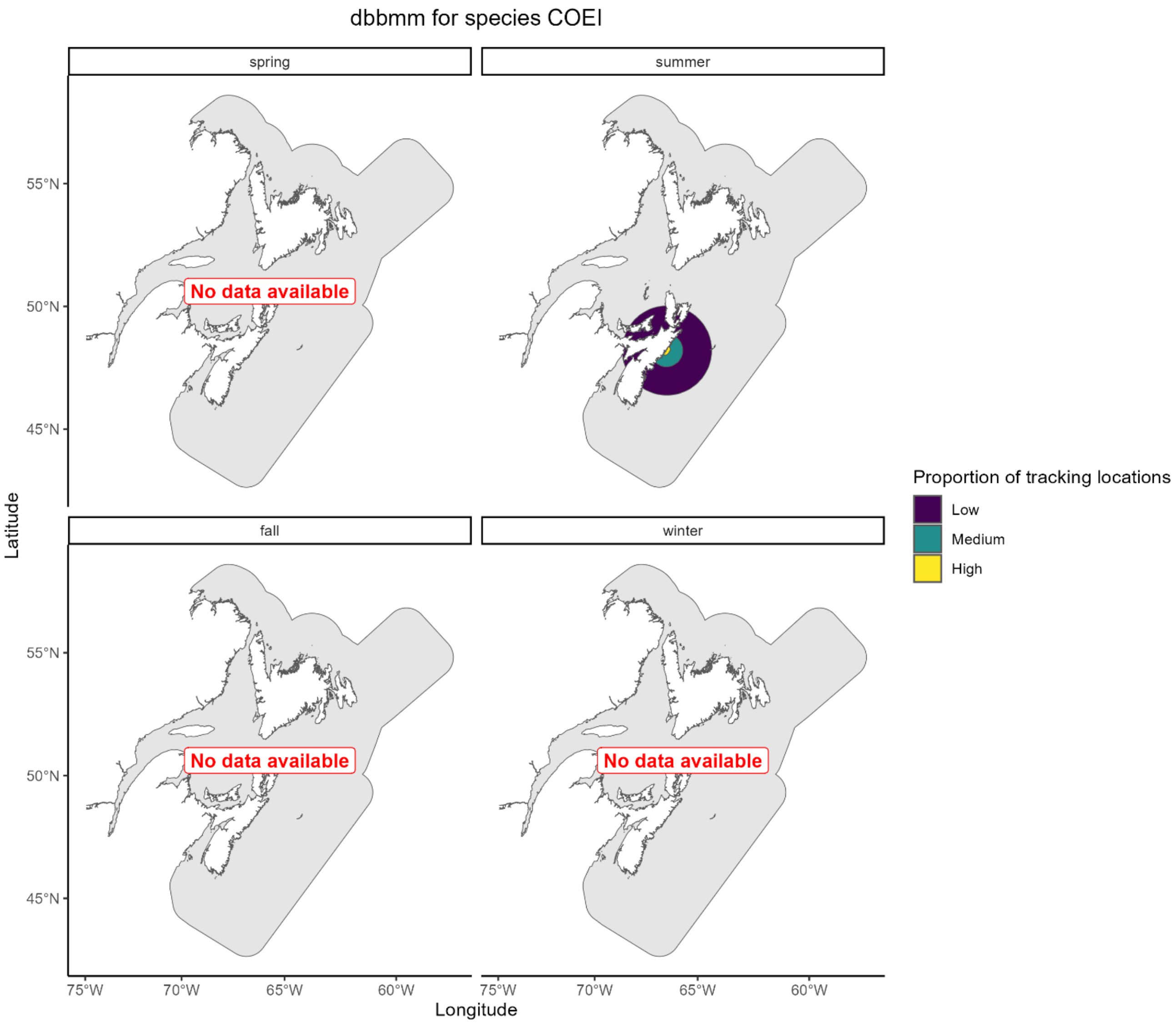


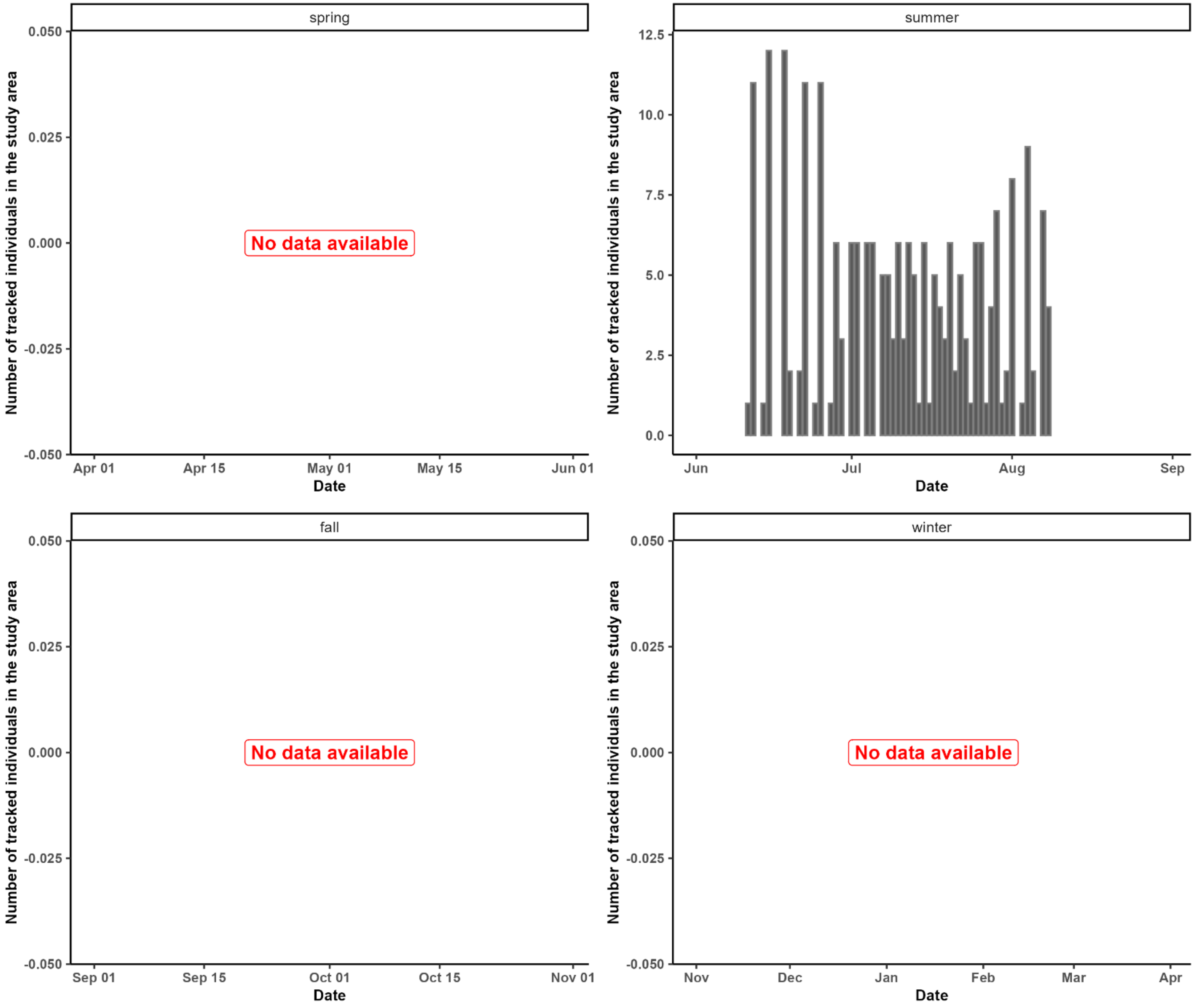


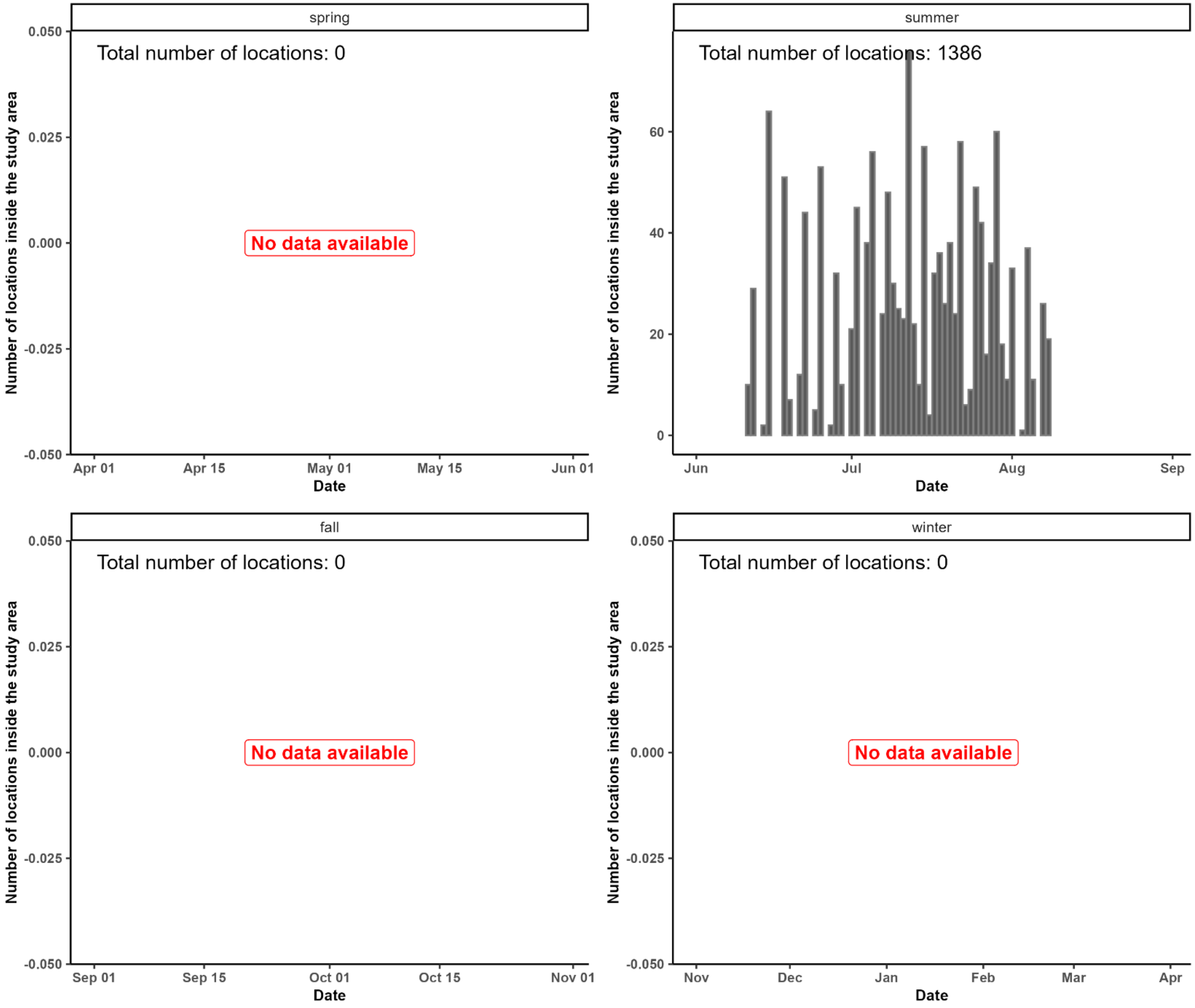
spring
summer
fall
winter
Number of tracked individuals in the study area
0
10
20
30
0.0
2.5
5.0
7.5
0.050
0.025
0.000
-0.025
-0.050
Apr 01
Apr 15
May 01
May 15
Jun 01
Jun
Jul
Aug
Sep
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Nov
Dec
Jan
Feb
Mar
Apr
Date
No data available
No data available


spring
Total number of locations: 3430
Number of locations inside the study area
100
75
50
25
0
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 828
Number of locations inside the study area
20
10
0
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 0
No data available
Number of locations inside the study area
0.050
0.025
0.000
-0.025
-0.050
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 0
No data available
Number of locations inside the study area
0.050
0.025
0.000
-0.025
-0.050
Nov
Dec
Jan
Feb
Mar
Apr
Date

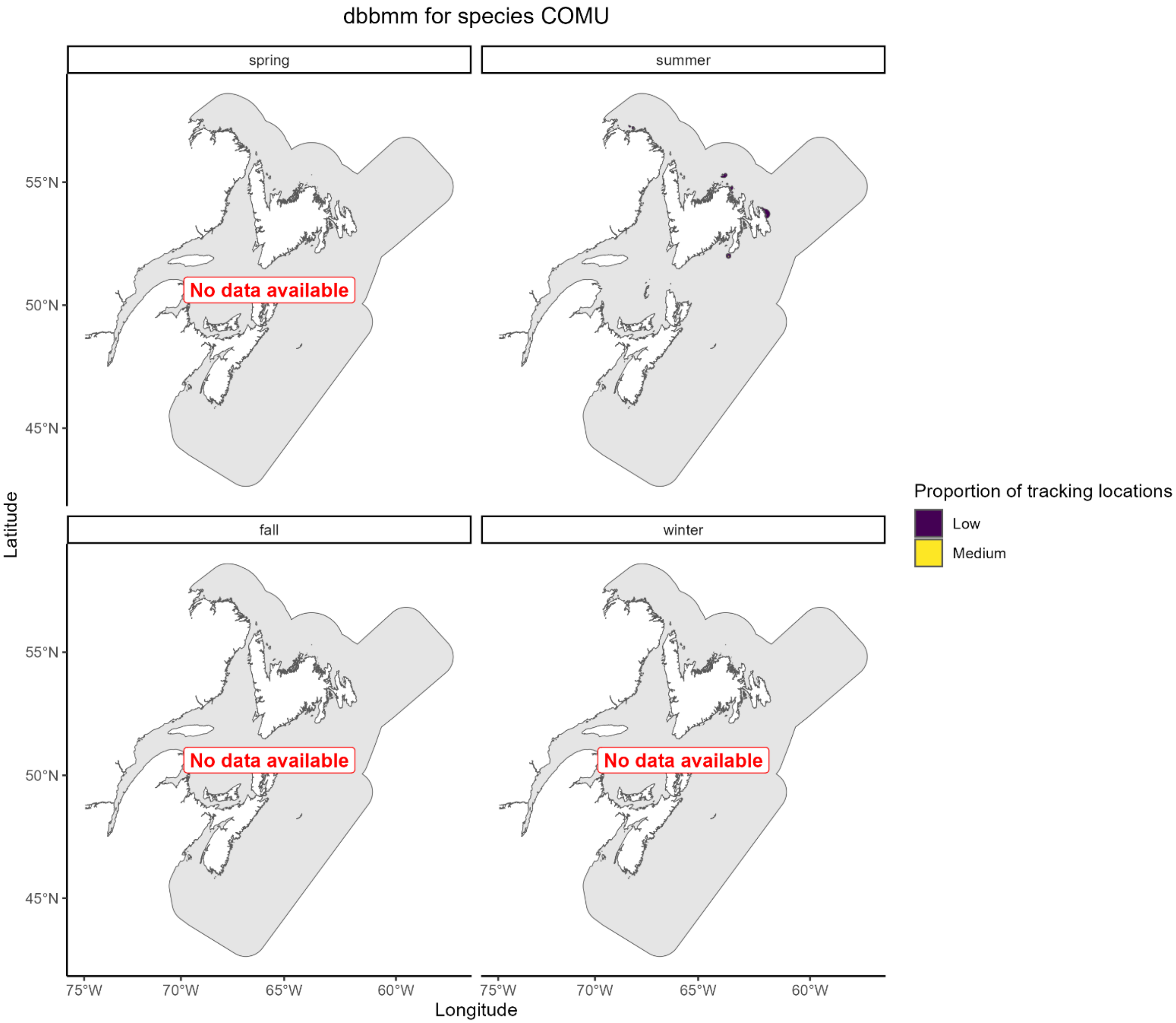
Common Eider (COEI)

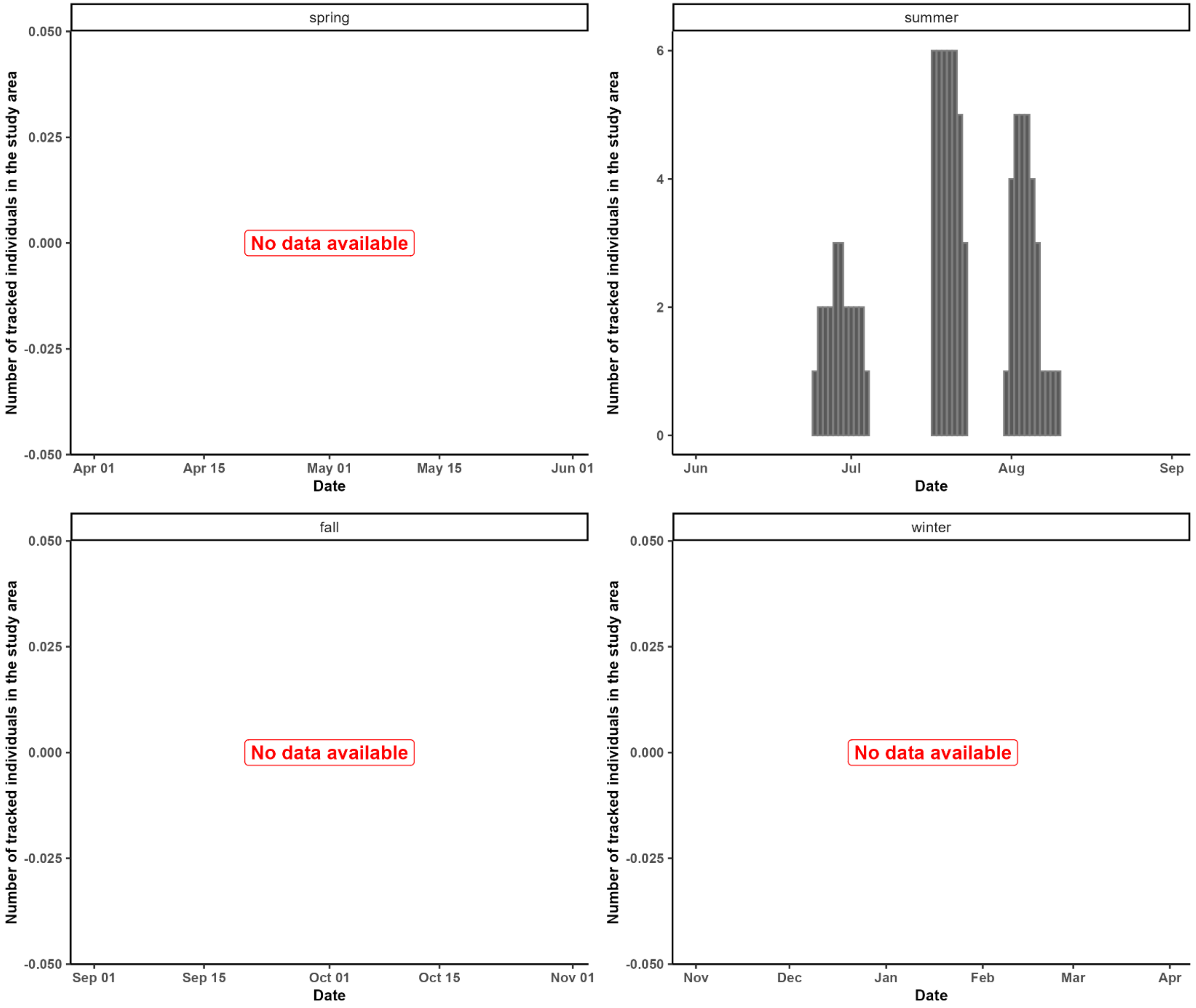


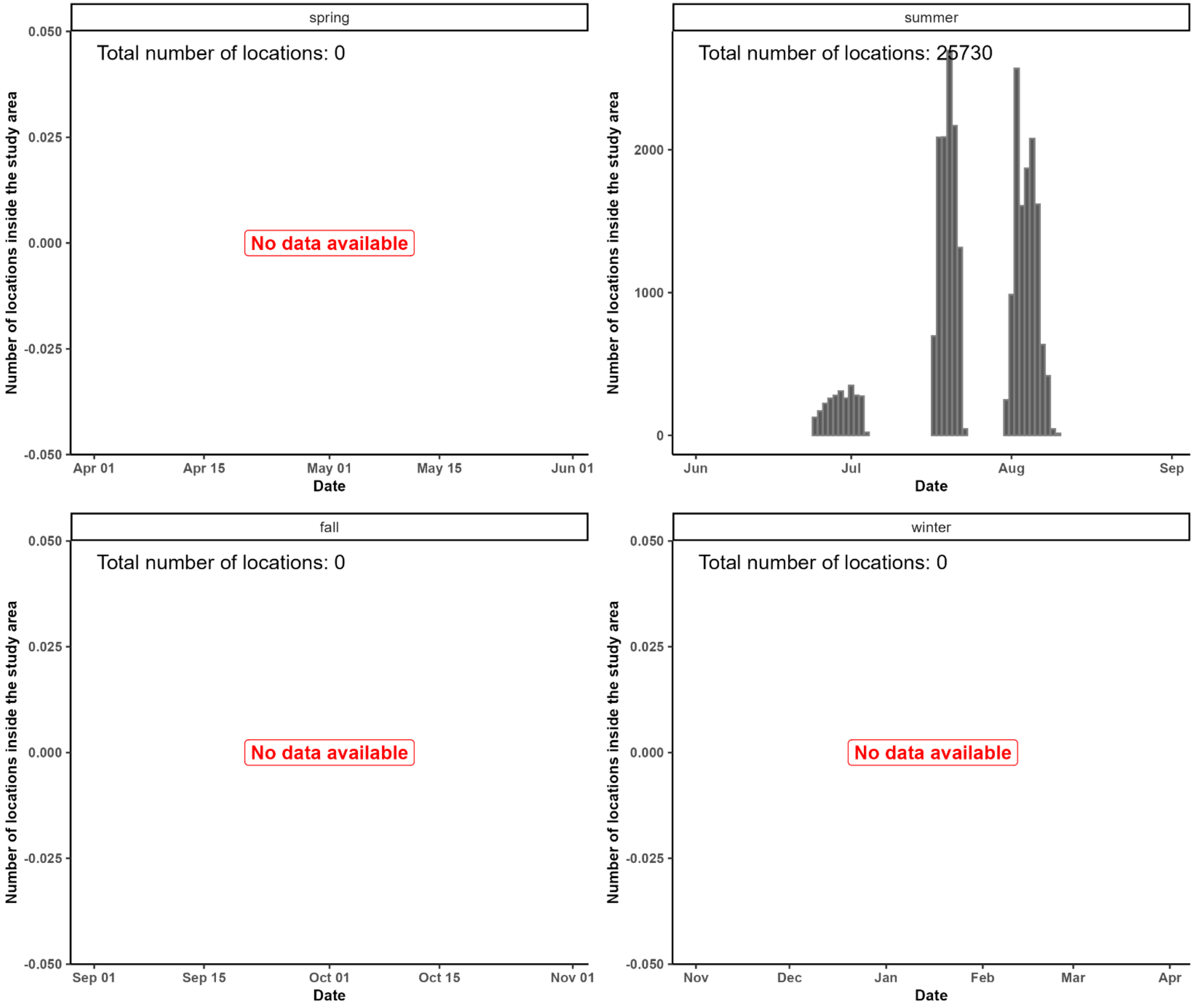

spring
summer
fall
winter
Number of tracked individuals in the study area
Date
0.050
0.025
0.000
-0.025
-0.050
No data available
Apr 01
Apr 15
May 01
May 15
Jun 01
12.5
10.0
7.5
5.0
2.5
0.0
Jun
Jul
Aug
Sep
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Nov
Dec
Jan
Feb
Mar
Apr


spring
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Number of locations inside the study area
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 1386
60
40
20
0
Number of locations inside the study area
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Number of locations inside the study area
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Number of locations inside the study area
Nov
Dec
Jan
Feb
Mar
Apr
Date

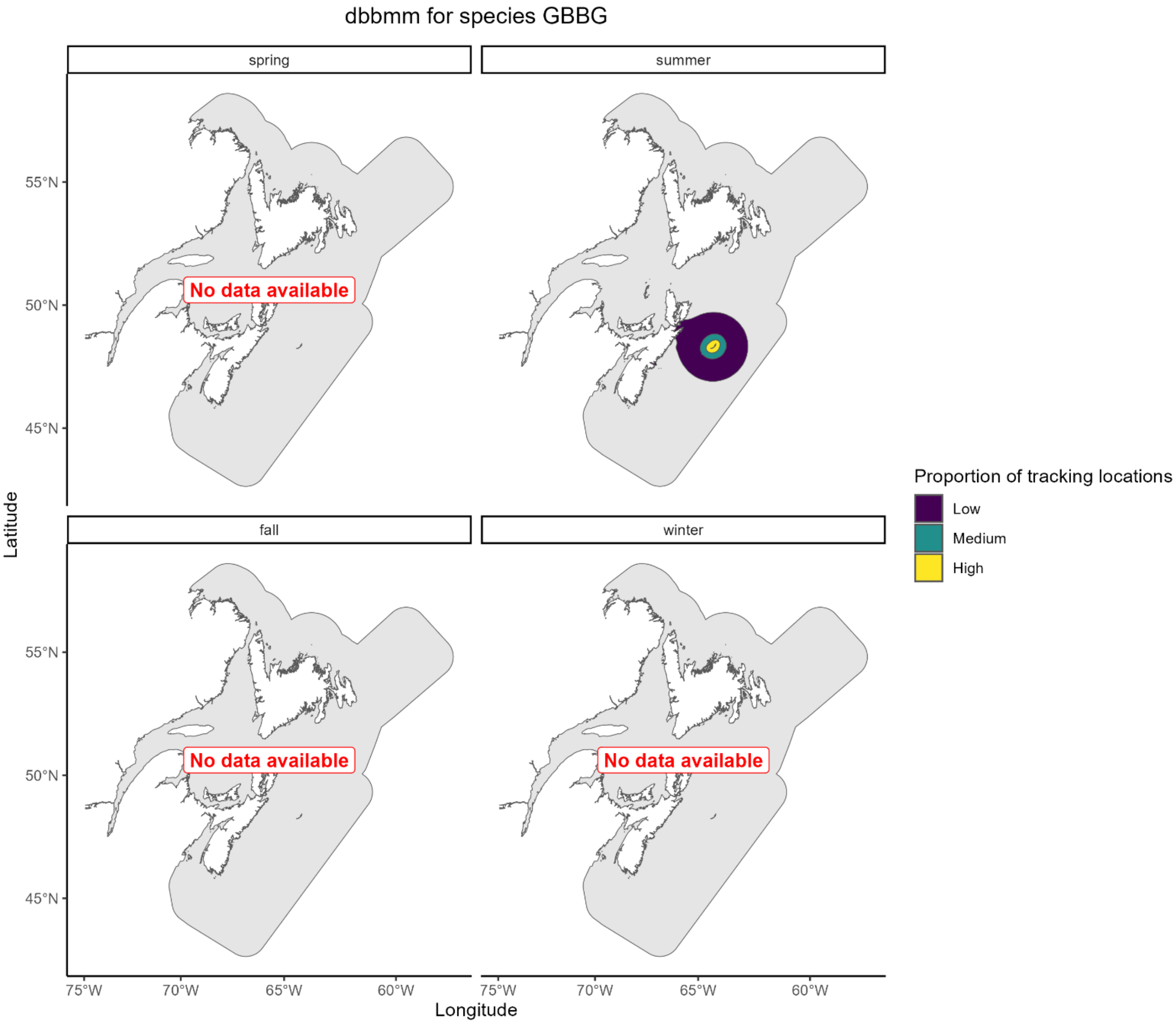
Common Murre (COMU)

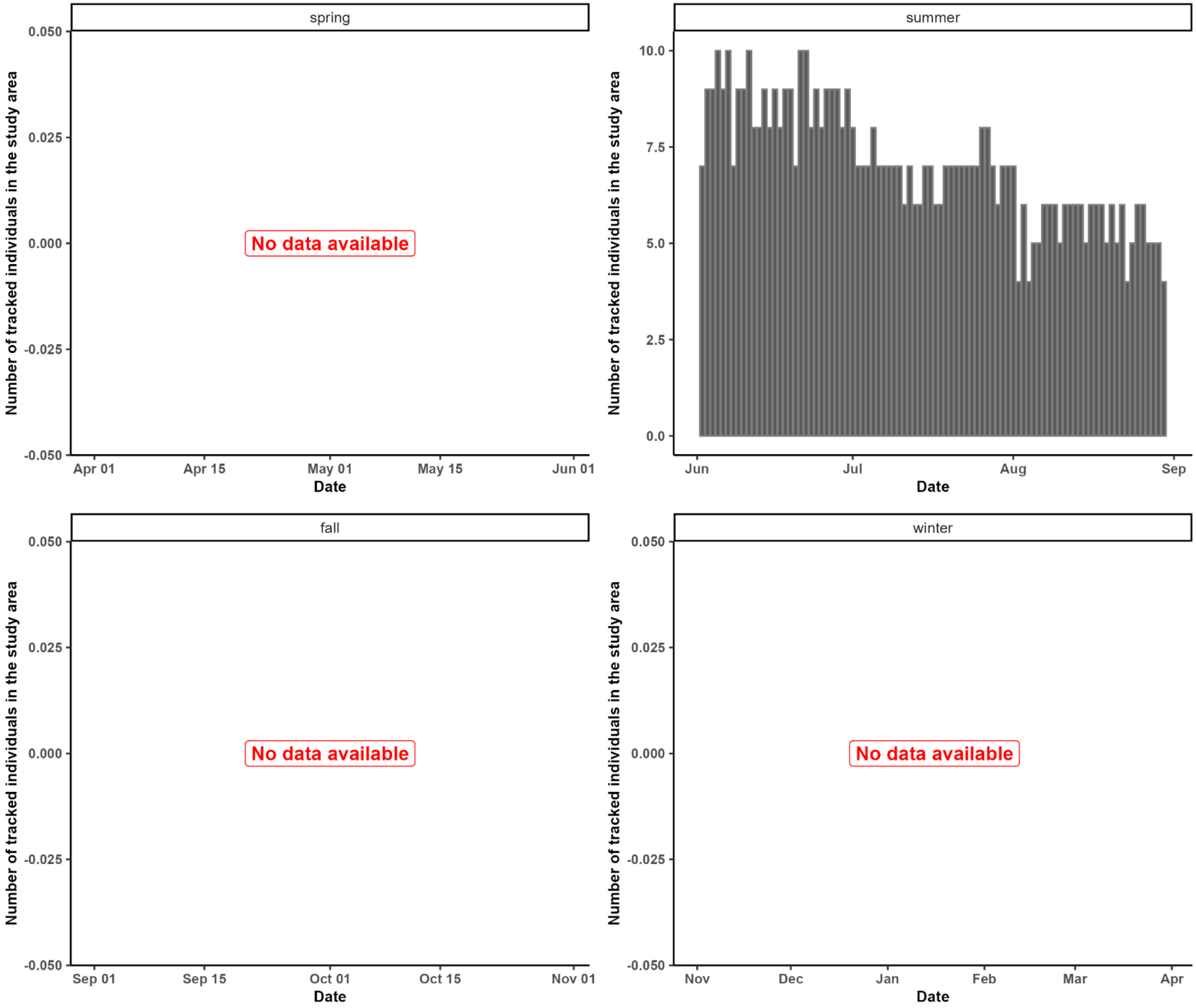


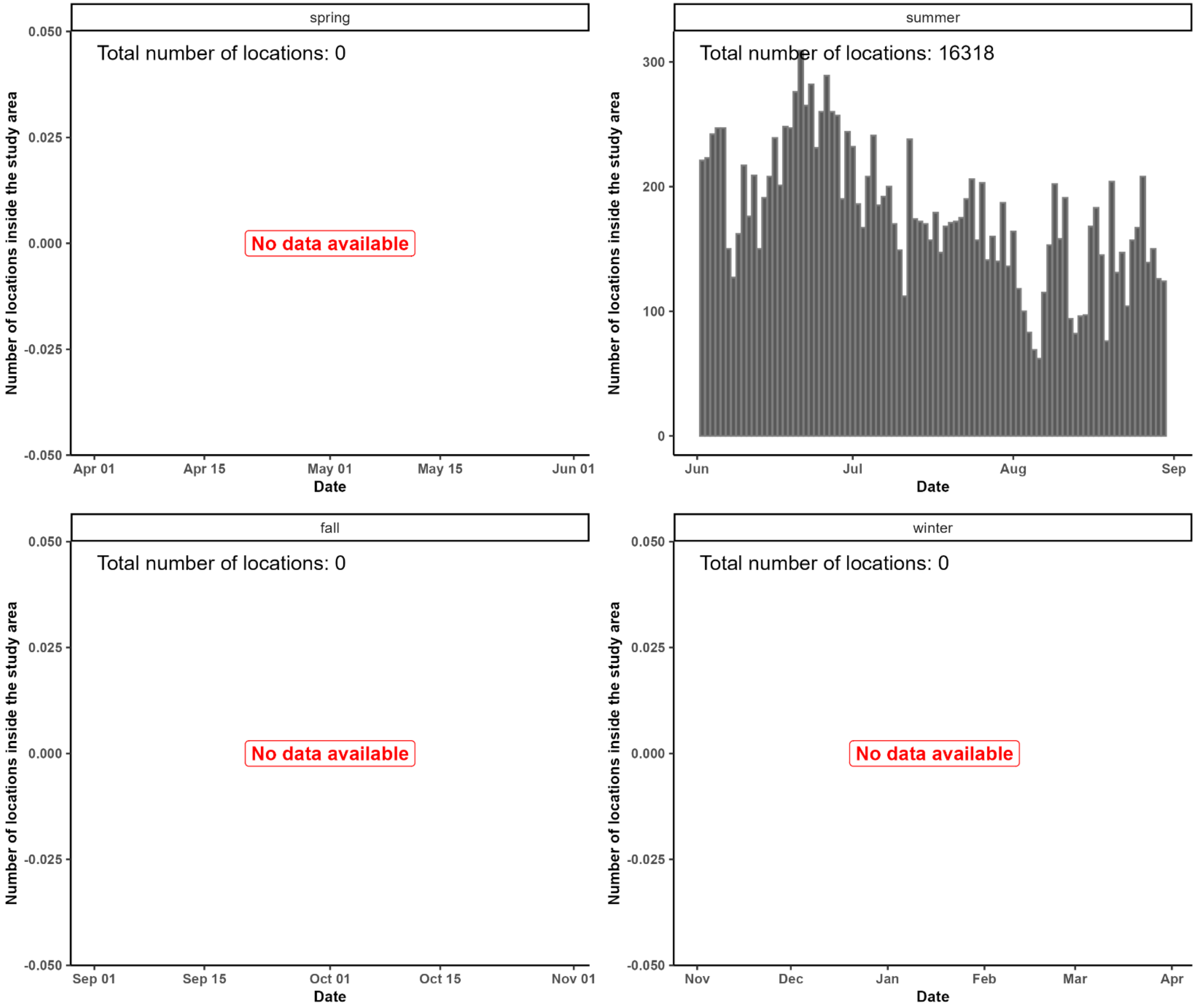

spring
summer
fall
winter
Number of tracked individuals in the study area
0.050
0.025
0.000
-0.025
-0.050
No data available
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
6
4
2
0
Jun
Jul
Aug
Sep
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Nov
Dec
Jan
Feb
Mar
Apr


spring
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Number of locations inside the study area
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 25730
2000
1000
0
Number of locations inside the study area
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Number of locations inside the study area
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Number of locations inside the study area
Nov
Dec
Jan
Feb
Mar
Apr
Date

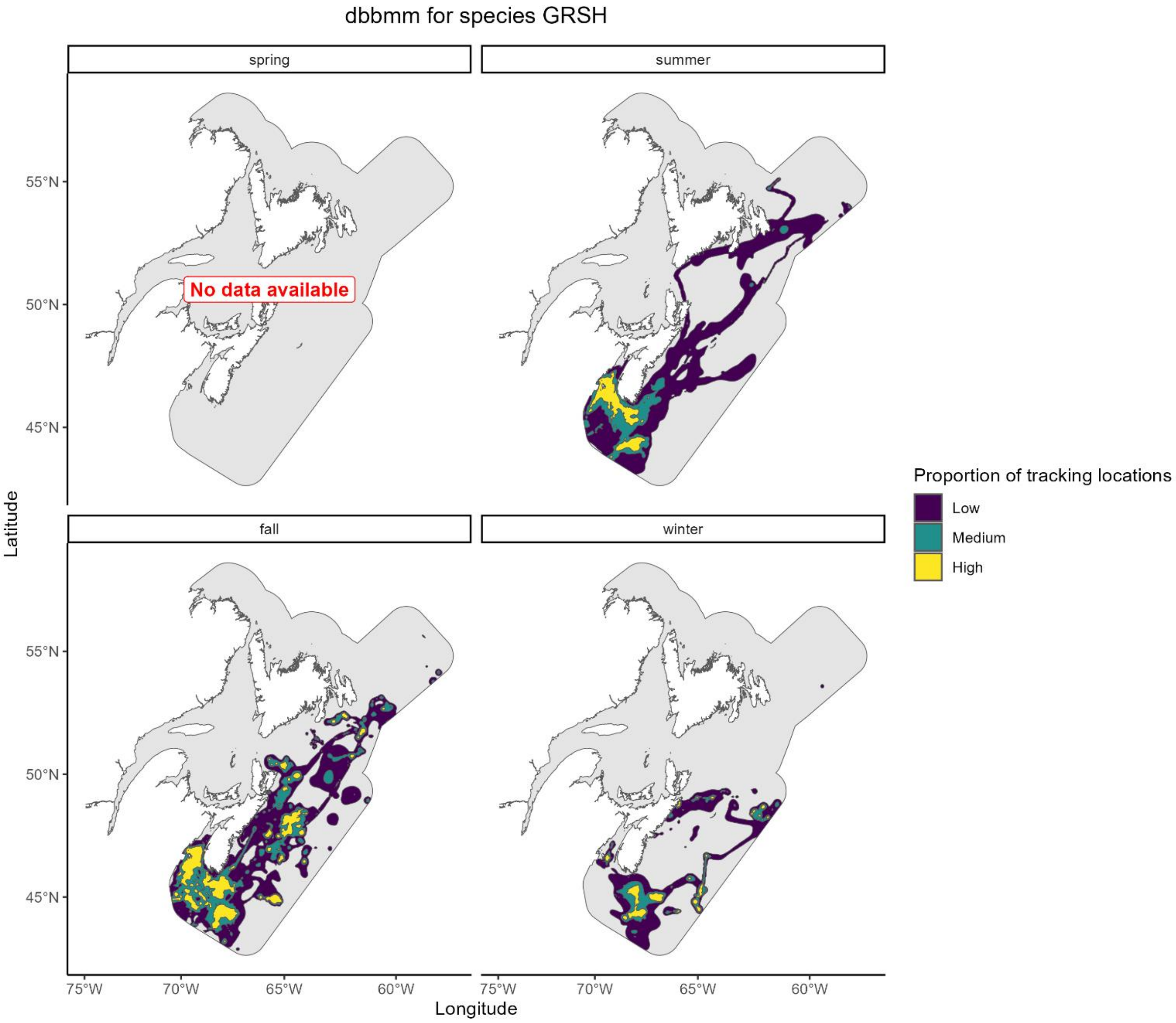
Great Black-backed Gull (GBBG)

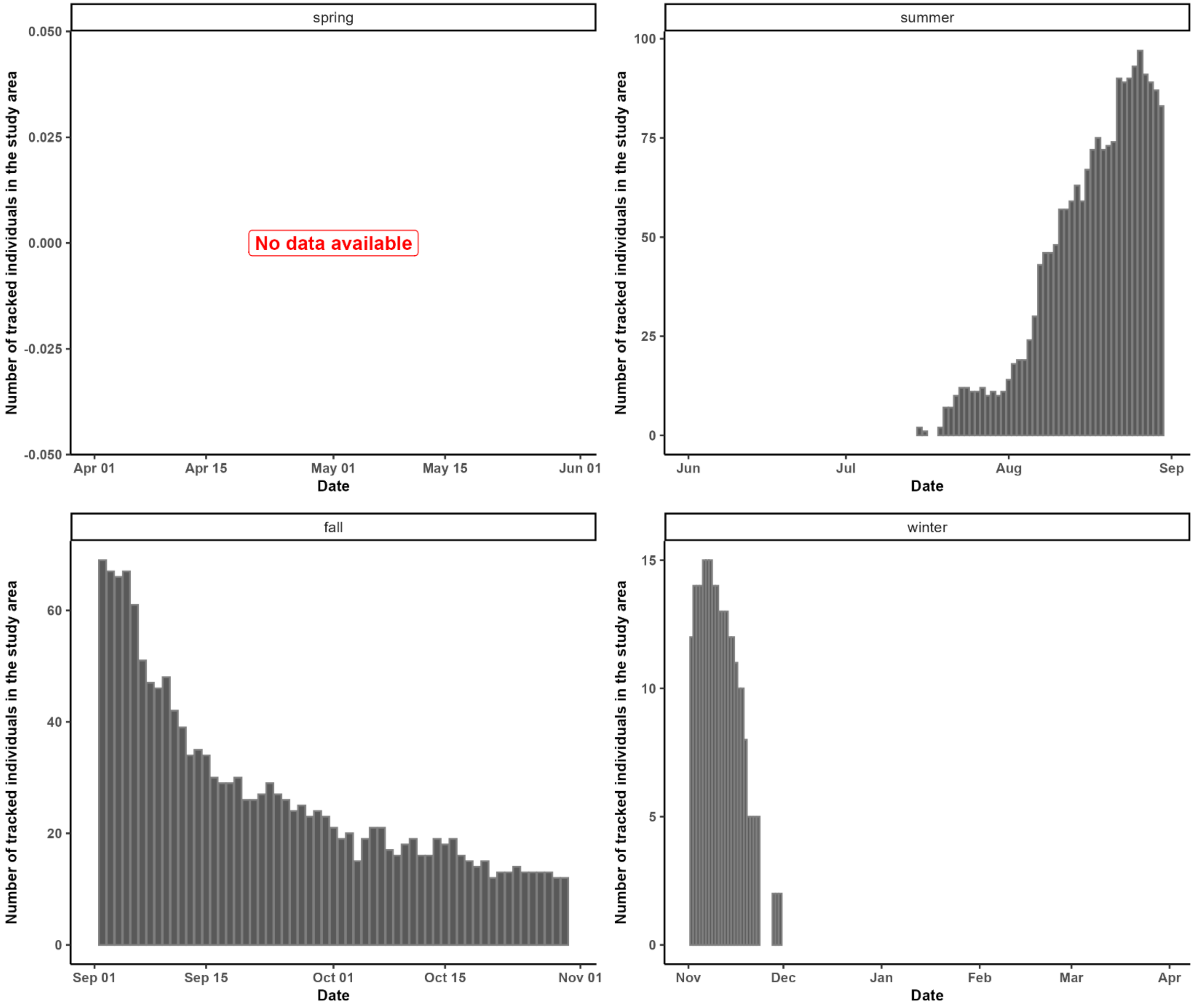


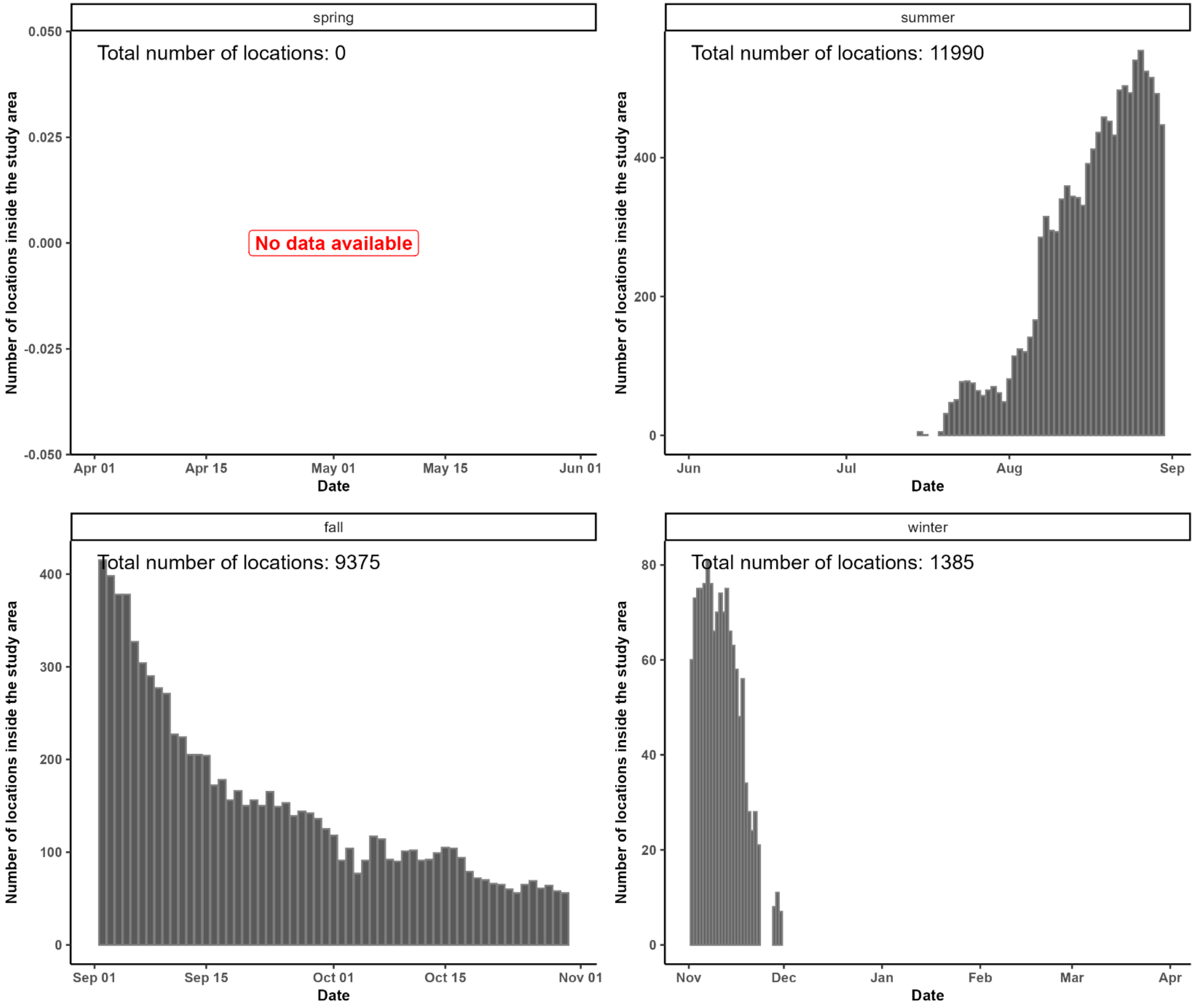

spring
summer
fall
winter
Number of tracked individuals in the study area
0.050
0.025
0.000
-0.025
-0.050
No data available
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
10.0
7.5
5.0
2.5
0.0
Jun
Jul
Aug
Sep
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Nov
Dec
Jan
Feb
Mar
Apr


spring
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Number of locations inside the study area
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 16318
300
200
100
0
Number of locations inside the study area
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Number of locations inside the study area
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Number of locations inside the study area
Nov
Dec
Jan
Feb
Mar
Apr
Date

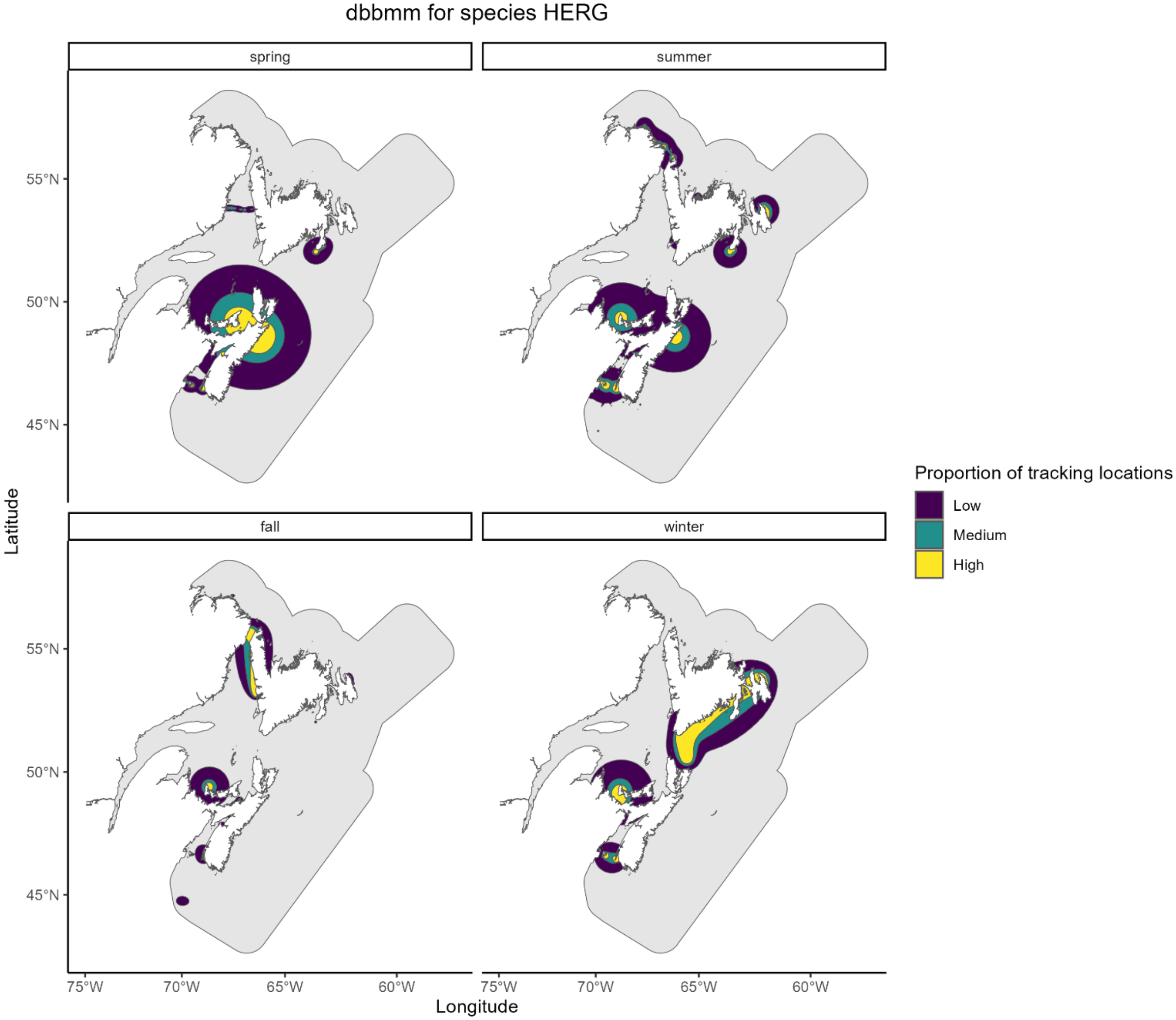
Great Shearwater (GRSH)

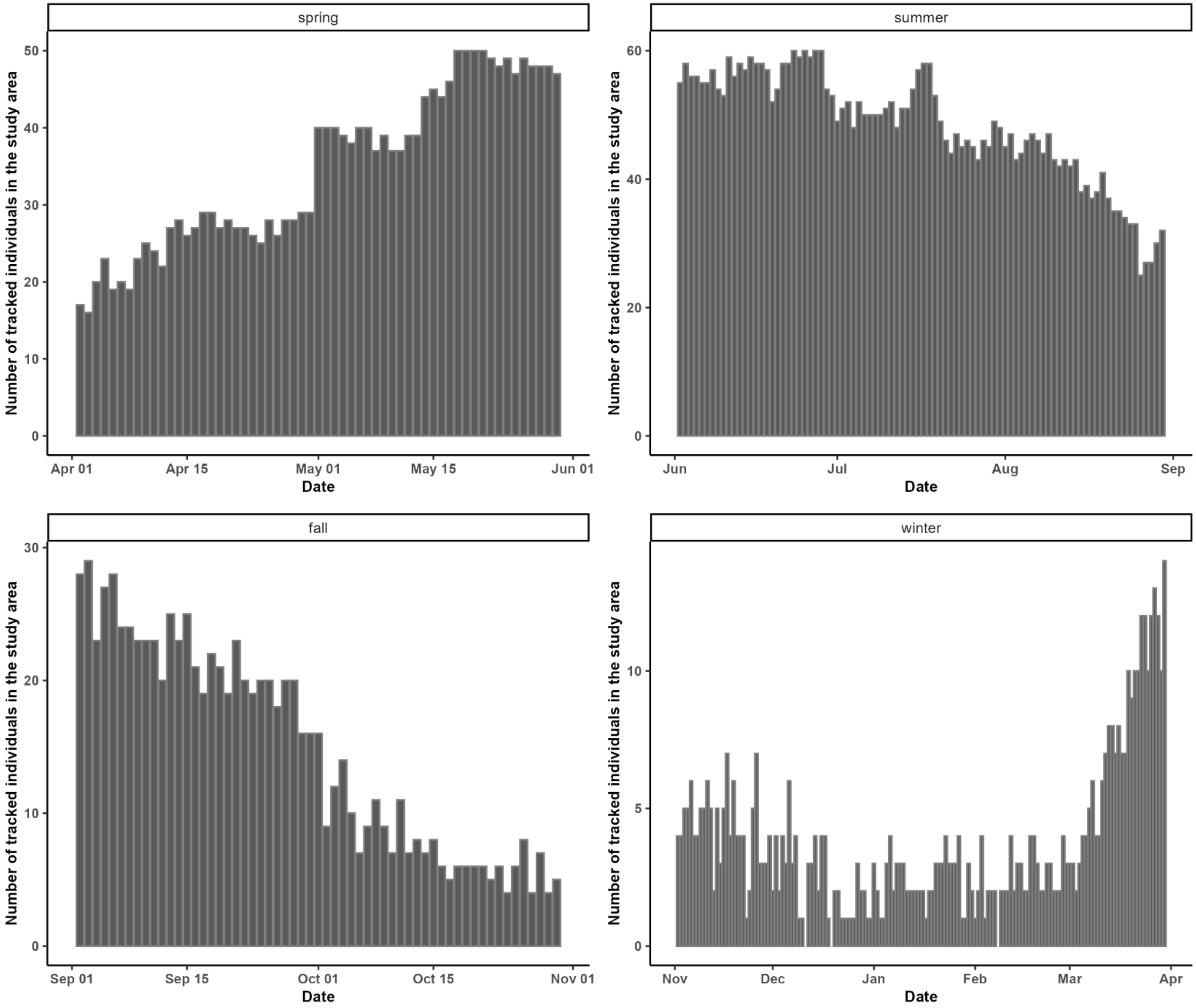


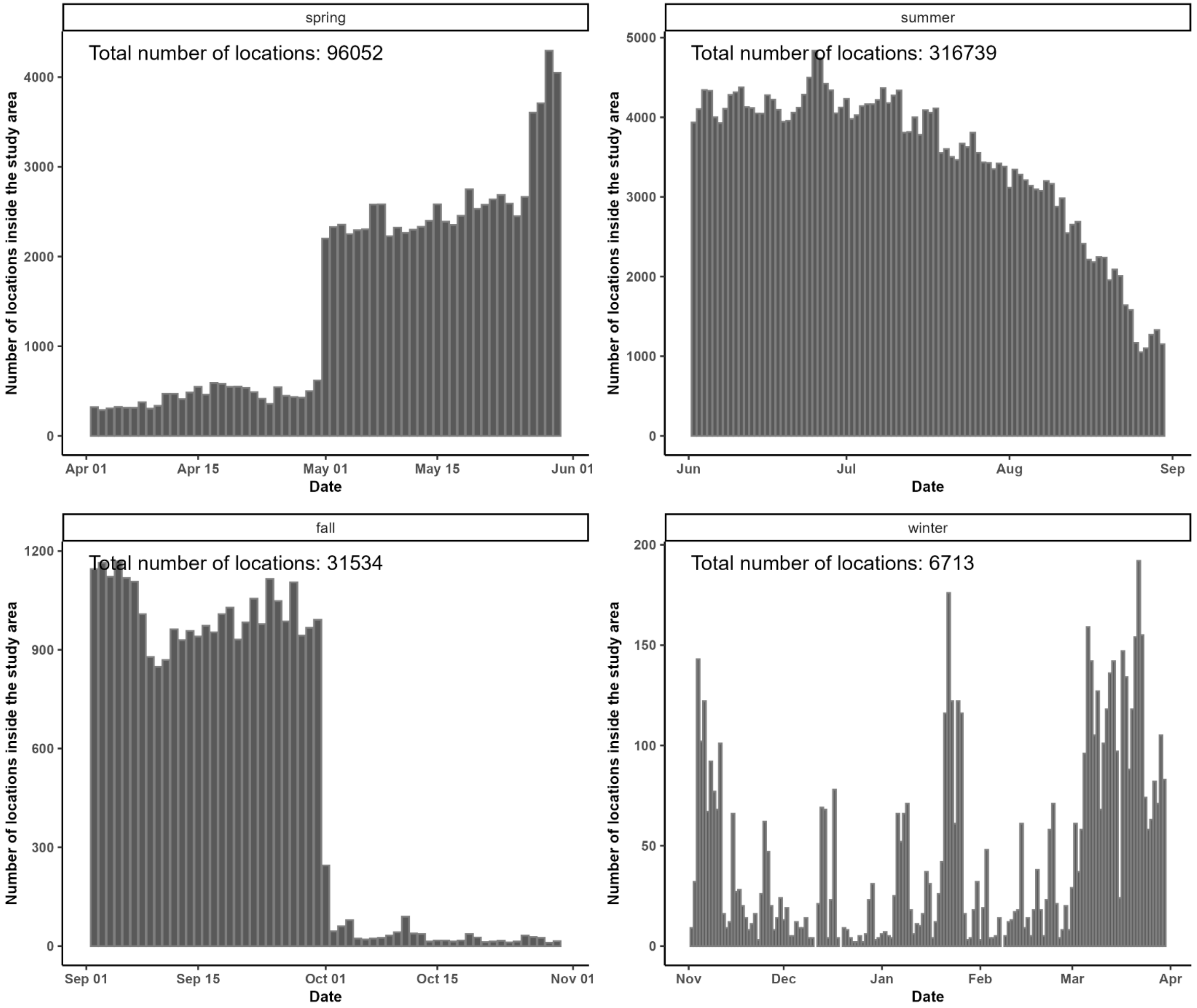

spring
Number of tracked individuals in the study area
0.050
0.025
0.000
-0.025
-0.050
No data available
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Number of tracked individuals in the study area
100
75
50
25
0
Jun
Jul
Aug
Sep
Date
fall
Number of tracked individuals in the study area
60
40
20
0
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Number of tracked individuals in the study area
15
10
5
0
Nov
Dec
Jan
Feb
Mar
Apr
Date


spring
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Number of locations inside the study area
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 11990
400
200
0
Number of locations inside the study area
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 9375
400
300
200
100
0
Number of locations inside the study area
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 1385
80
60
40
20
0
Number of locations inside the study area
Nov
Dec
Jan
Feb
Mar
Apr
Date

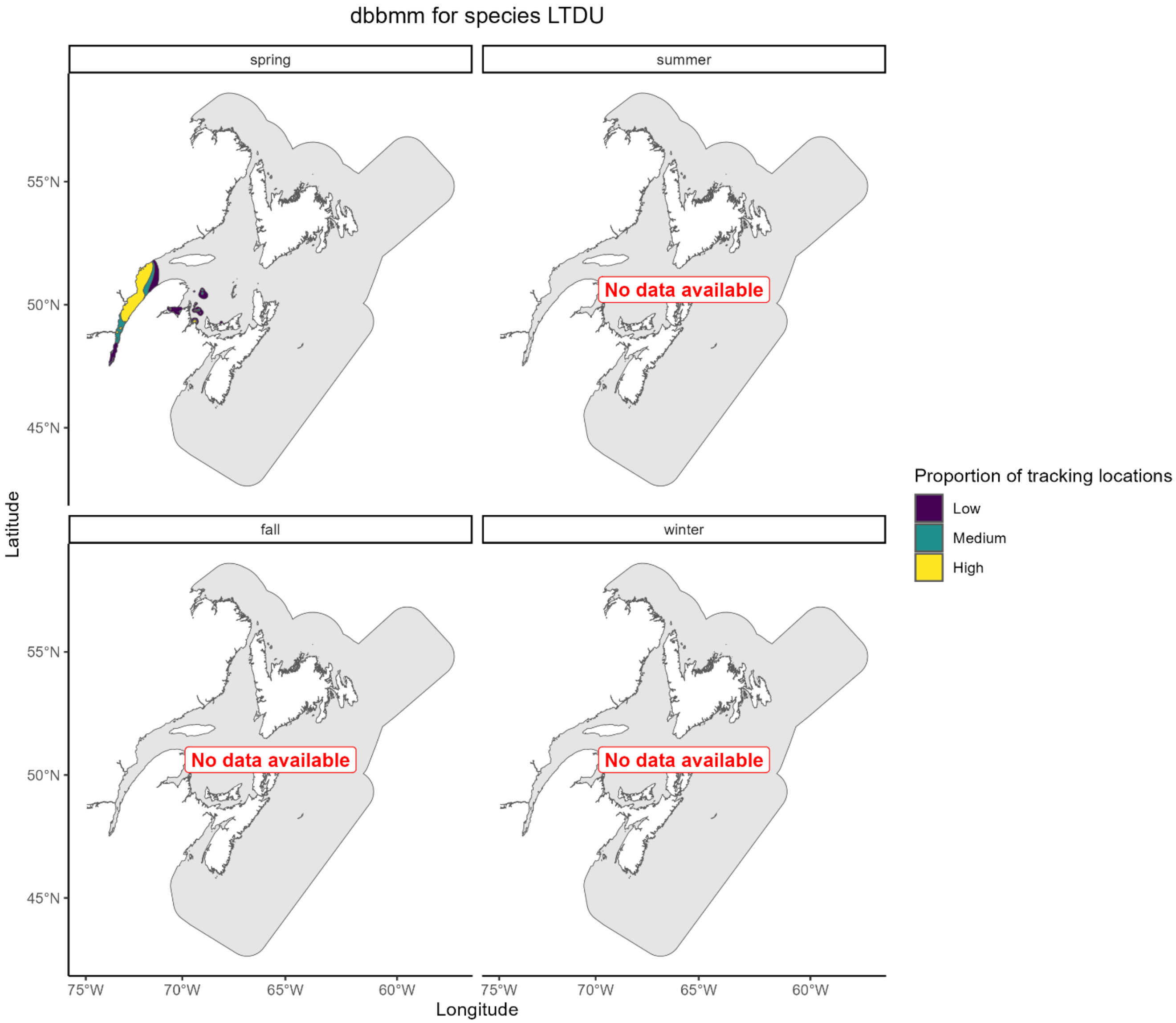
Herring Gull (HERG)

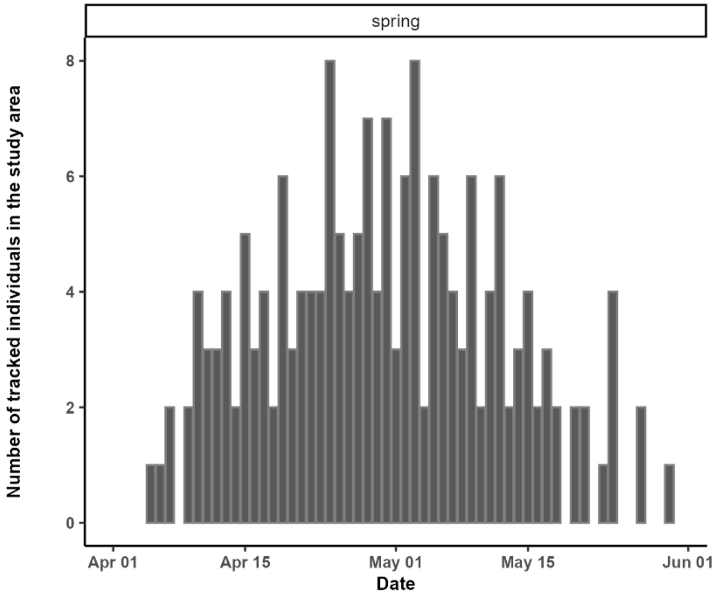


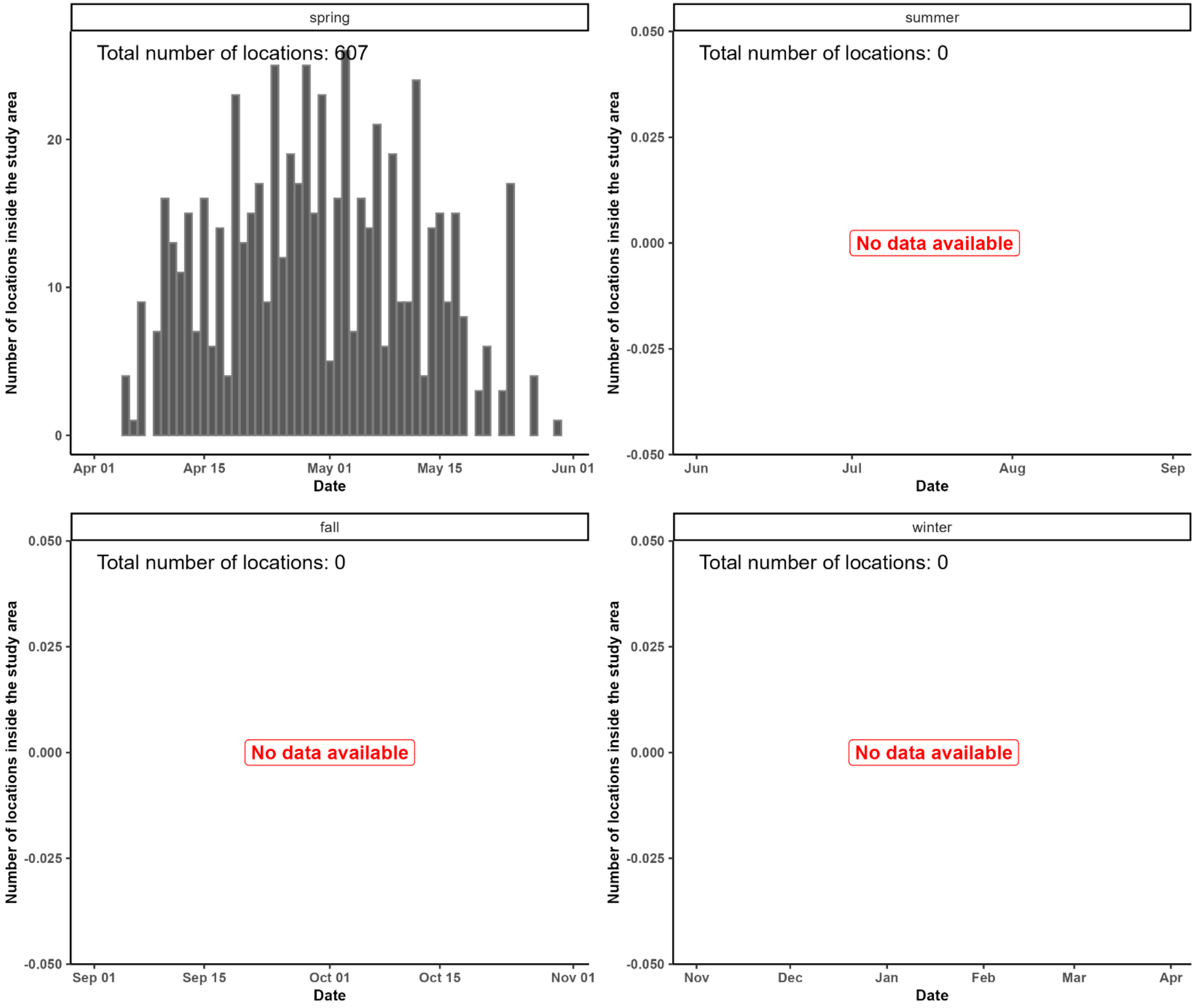

spring
Number of tracked individuals in the study area
0
10
20
30
40
50
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Number of tracked individuals in the study area
0
20
40
60
Jun
Jul
Aug
Sep
Date
fall
Number of tracked individuals in the study area
0
10
20
30
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Number of tracked individuals in the study area
0
5
10
Nov
Dec
Jan
Feb
Mar
Apr
Date


spring
Total number of locations: 96052
Number of locations inside the study area
0
1000
2000
3000
4000
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 316739
Number of locations inside the study area
0
1000
2000
3000
4000
5000
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 31534
Number of locations inside the study area
0
300
600
900
1200
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 6713
Number of locations inside the study area
0
50
100
150
200
Nov
Dec
Jan
Feb
Mar
Apr
Date

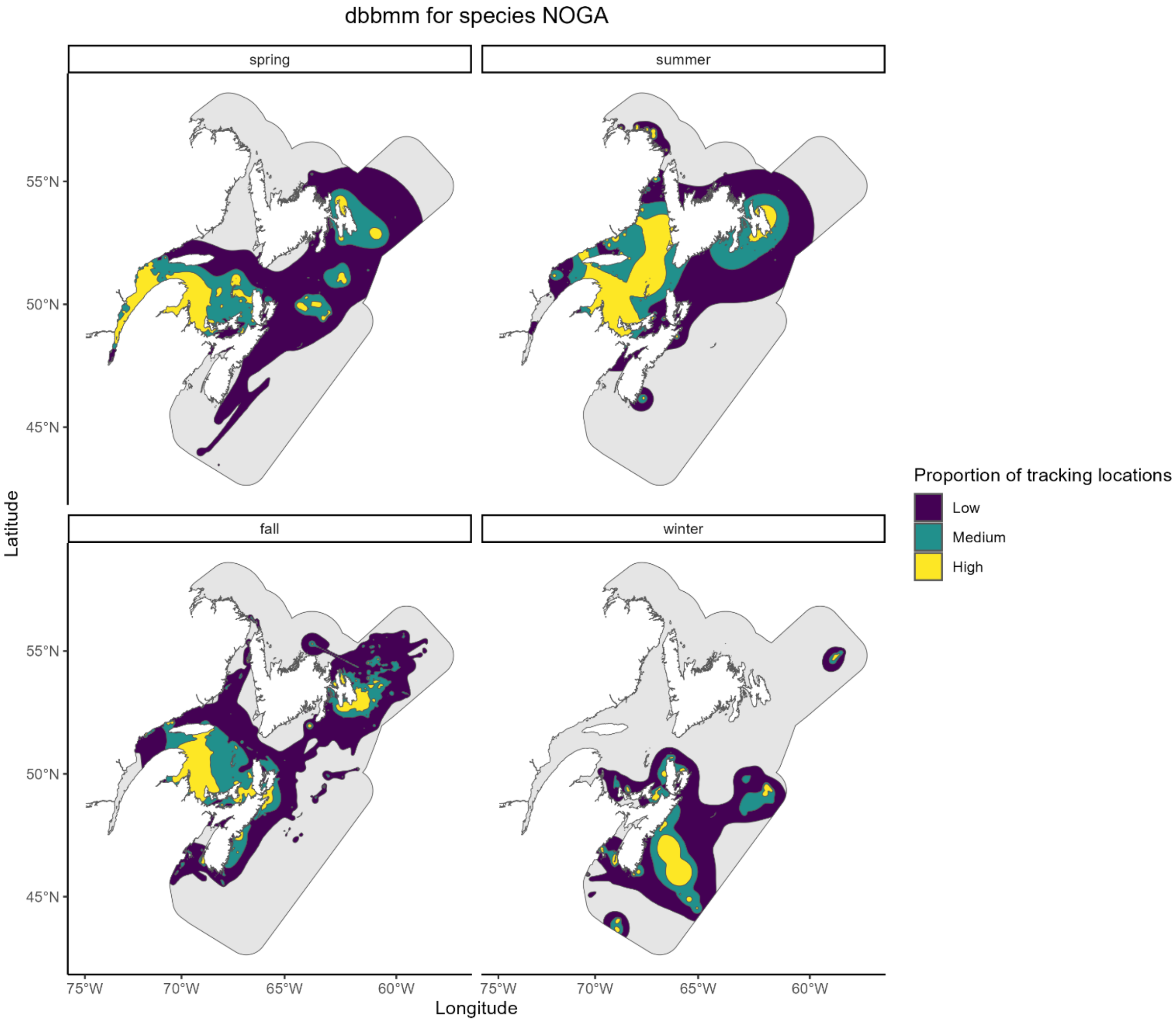
Long-tailed Duck (LTDU)

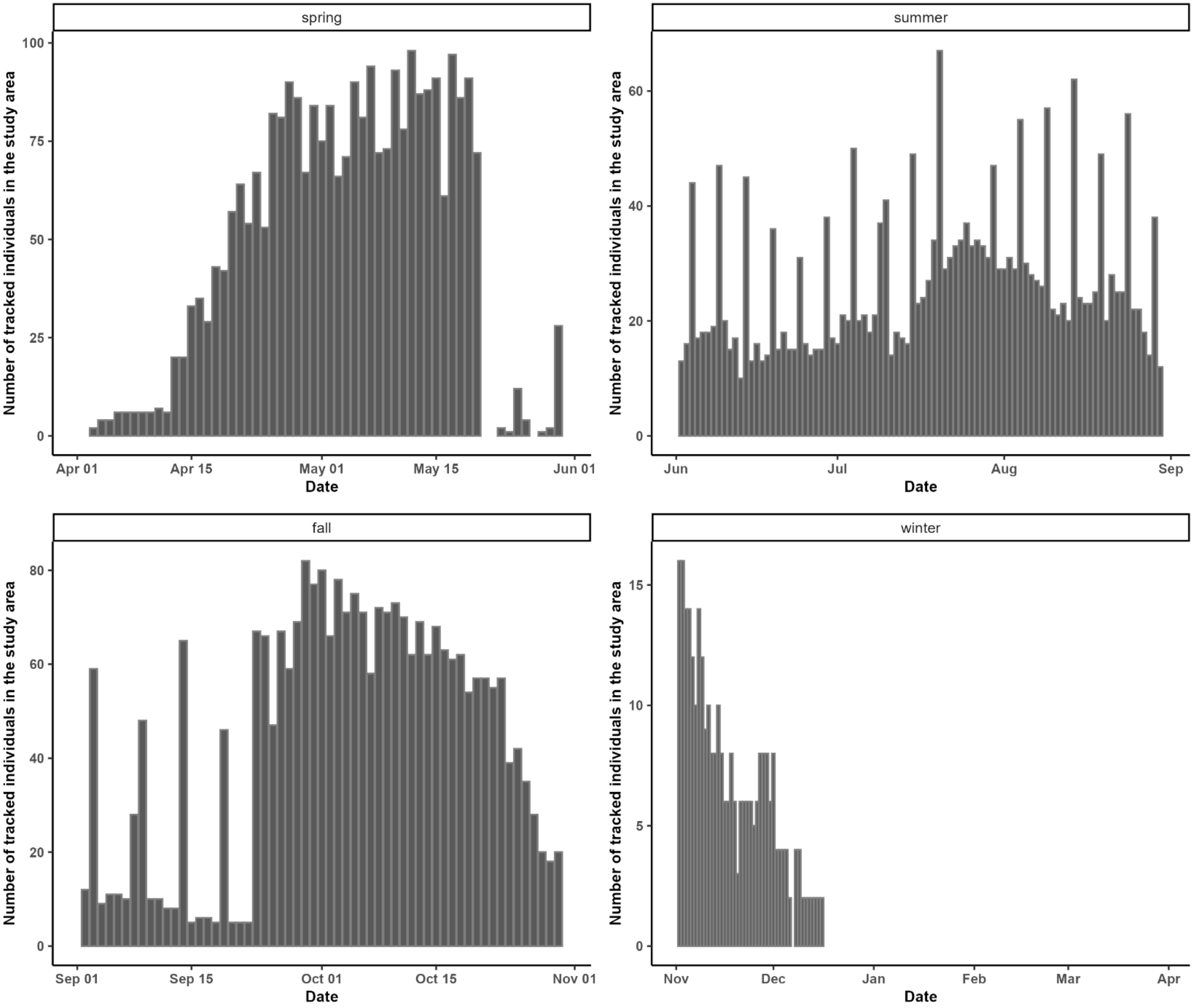


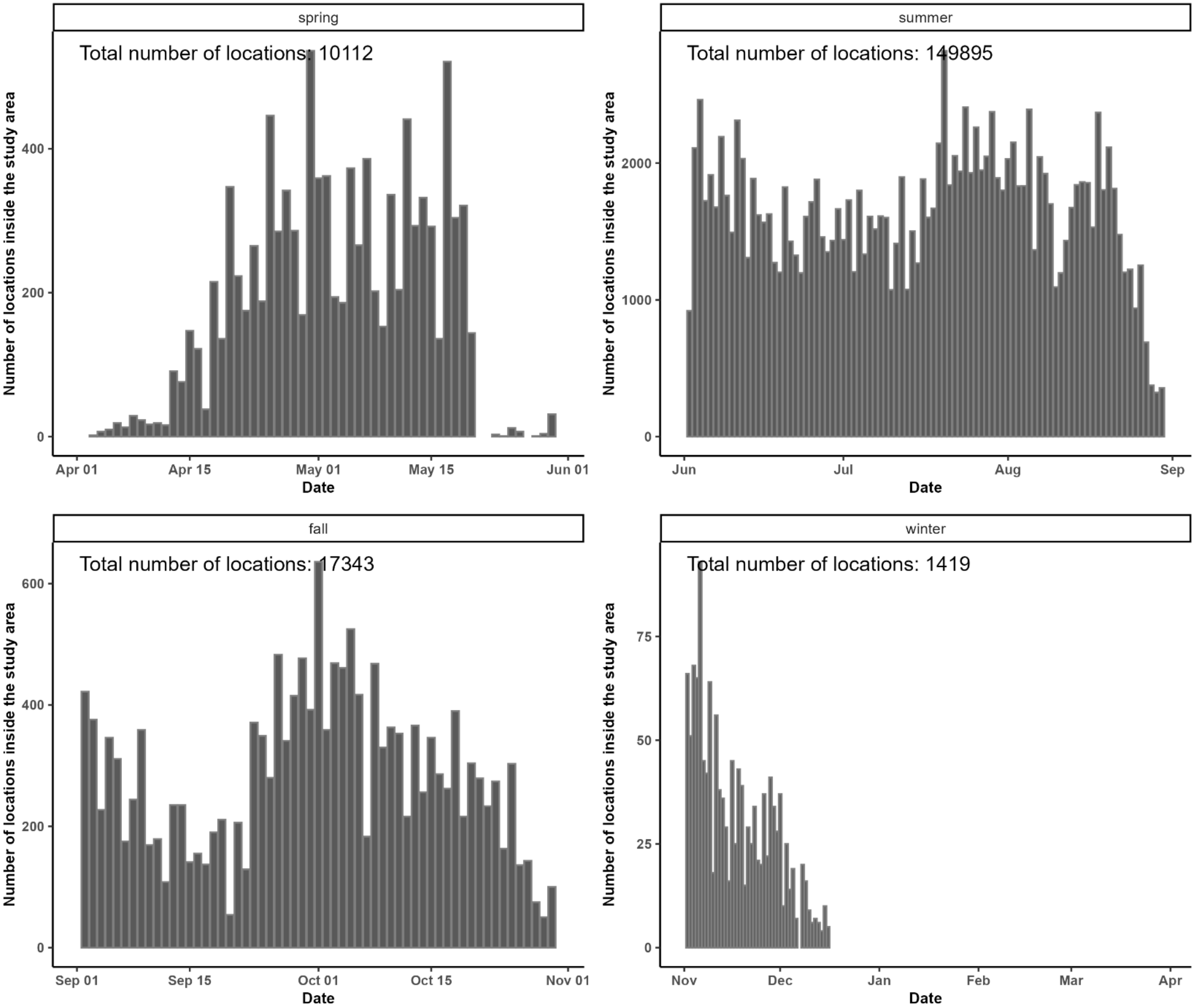

spring
summer
fall
winter
Number of tracked individuals in the study area
8
6
4
2
0
0.050
0.025
0.000
-0.025
-0.050
Apr 01
Apr 15
May 01
May 15
Jun 01
Jun
Jul
Aug
Sep
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Nov
Dec
Jan
Feb
Mar
Apr
Date
No data available
No data available
No data available


spring
Total number of locations: 607
Number of locations inside the study area
0
10
20
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 0
No data available
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 0
No data available
Nov
Dec
Jan
Feb
Mar
Apr
Date

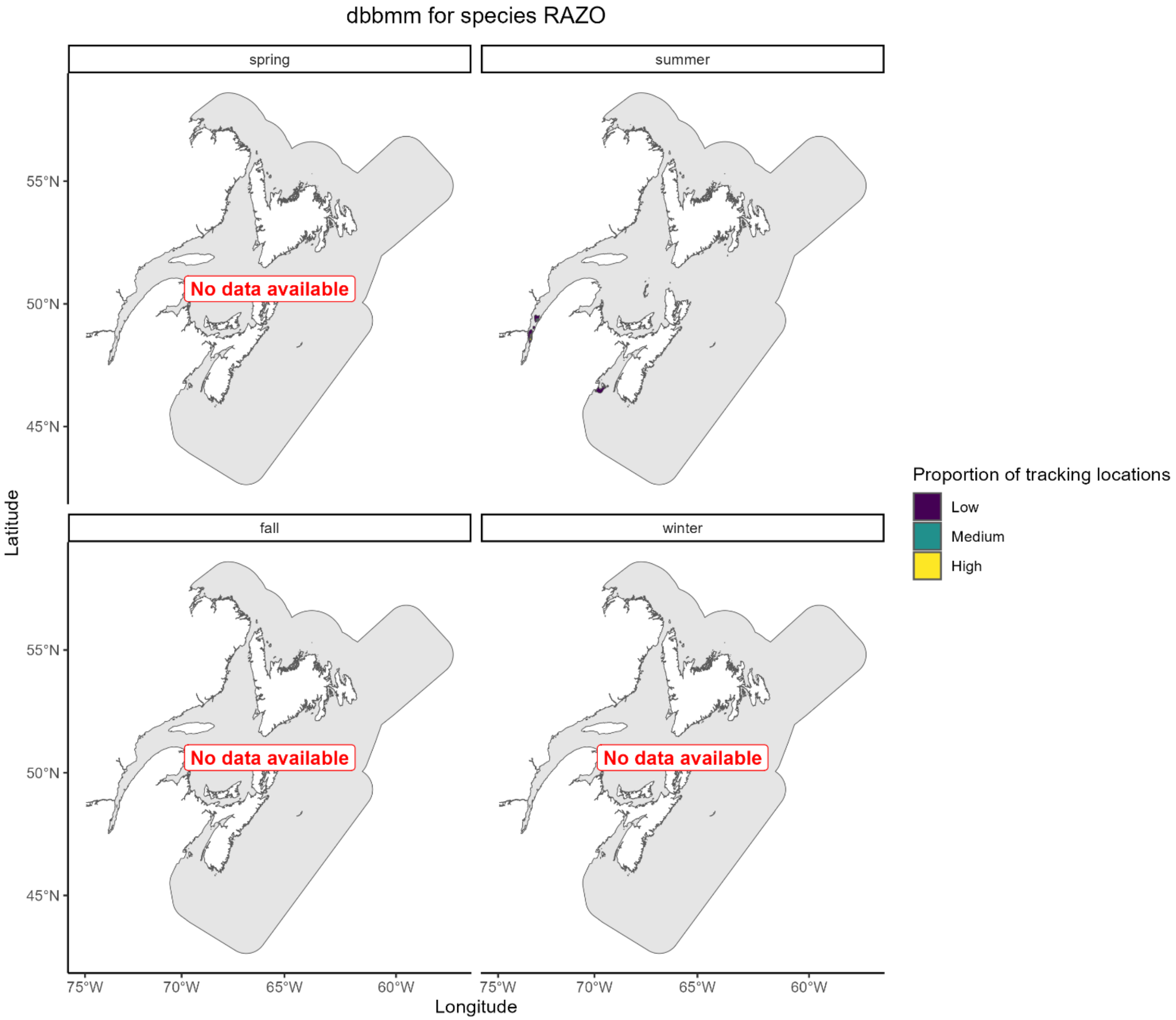
Northern Gannet (NOGA)

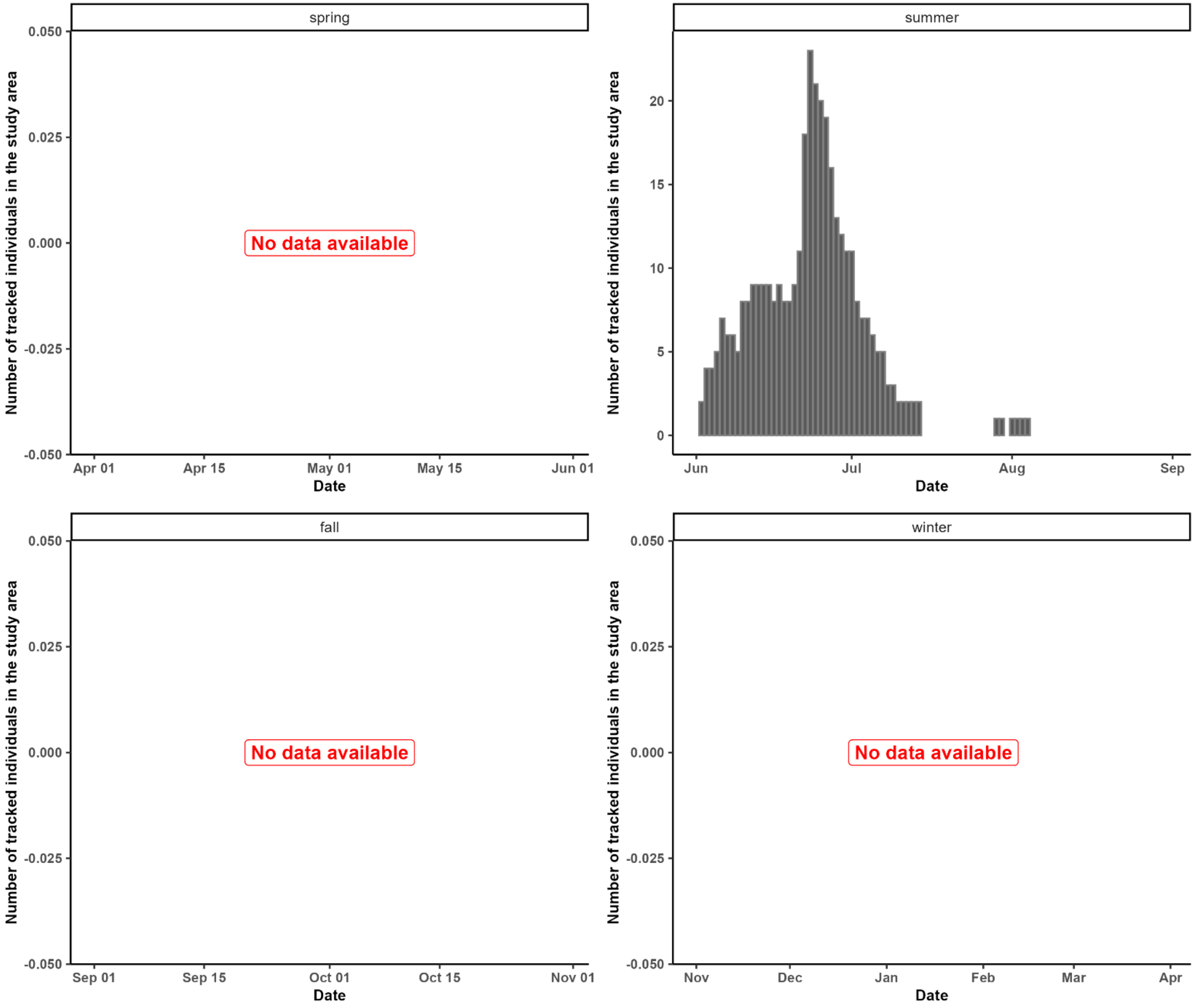


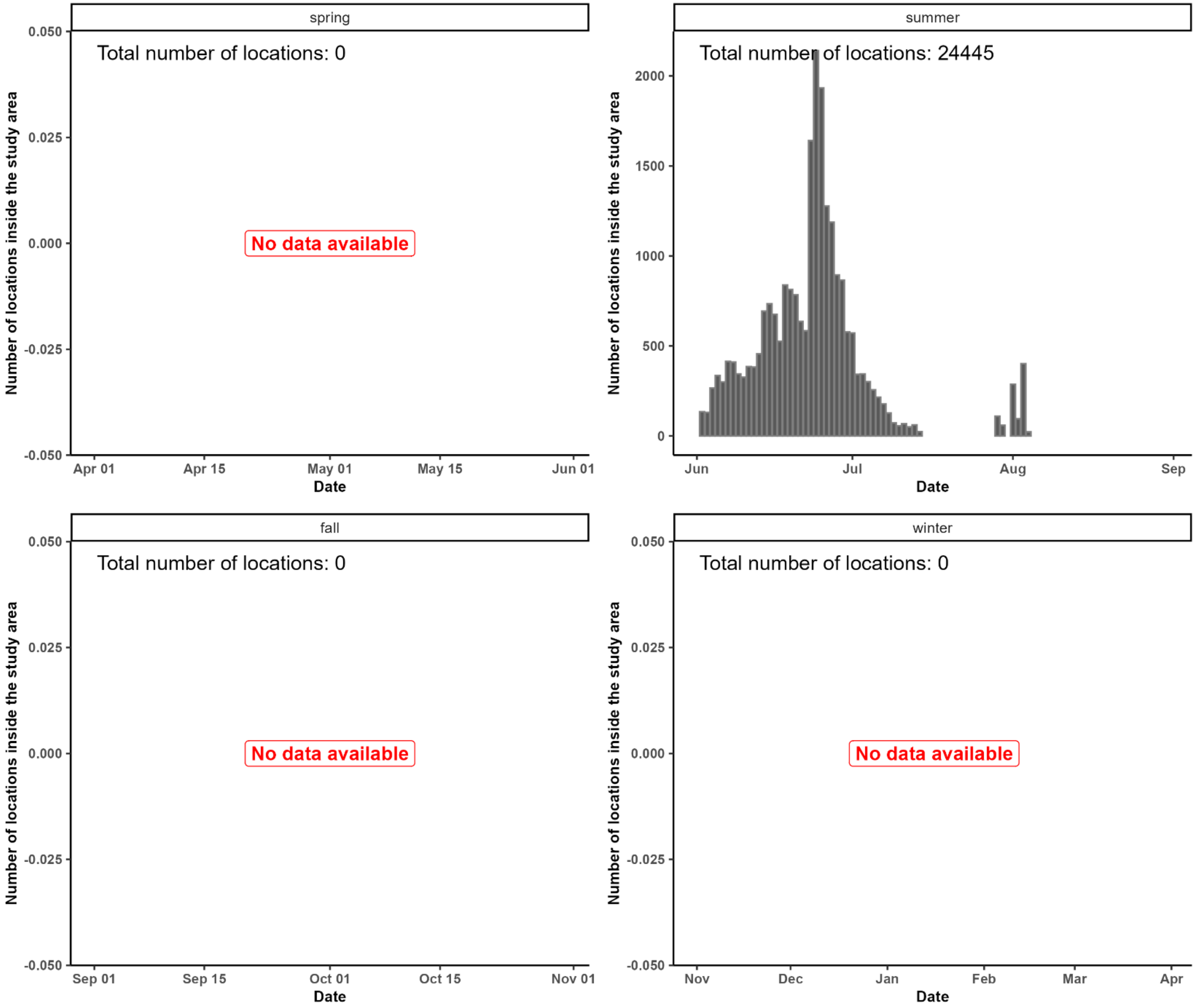

spring
summer
fall
winter
Number of tracked individuals in the study area
Date
100
75
50
25
0
Apr 01
Apr 15
May 01
May 15
Jun 01
60
40
20
0
Jun
Jul
Aug
Sep
80
60
40
20
0
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
15
10
5
0
Nov
Dec
Jan
Feb
Mar
Apr


spring
Total number of locations: 10112
Number of locations inside the study area
0
200
400
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 149895
Number of locations inside the study area
0
1000
2000
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 17343
Number of locations inside the study area
0
200
400
600
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 1419
Number of locations inside the study area
0
25
50
75
Nov
Dec
Jan
Feb
Mar
Apr
Date

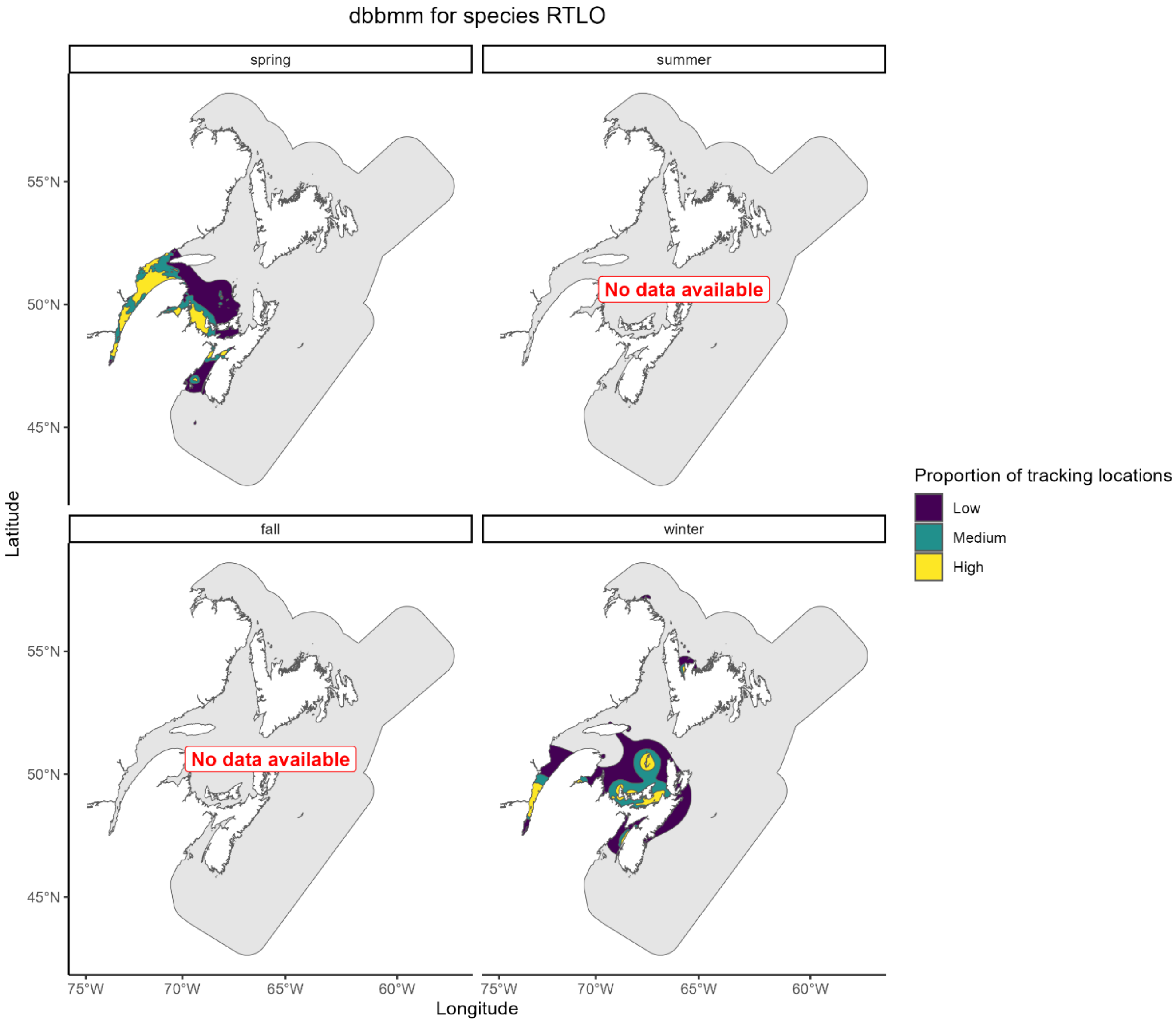
Razorbill (RAZO)

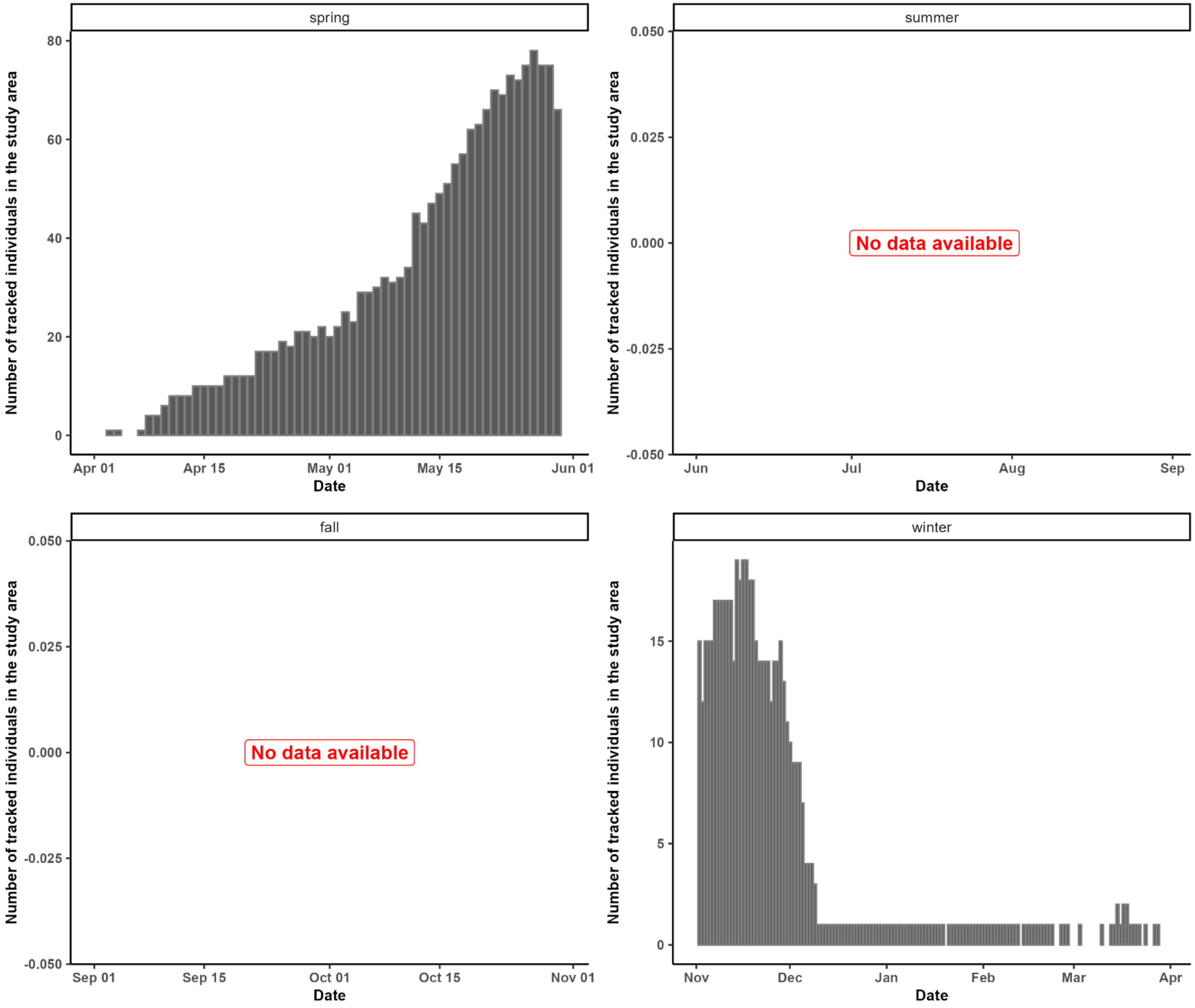


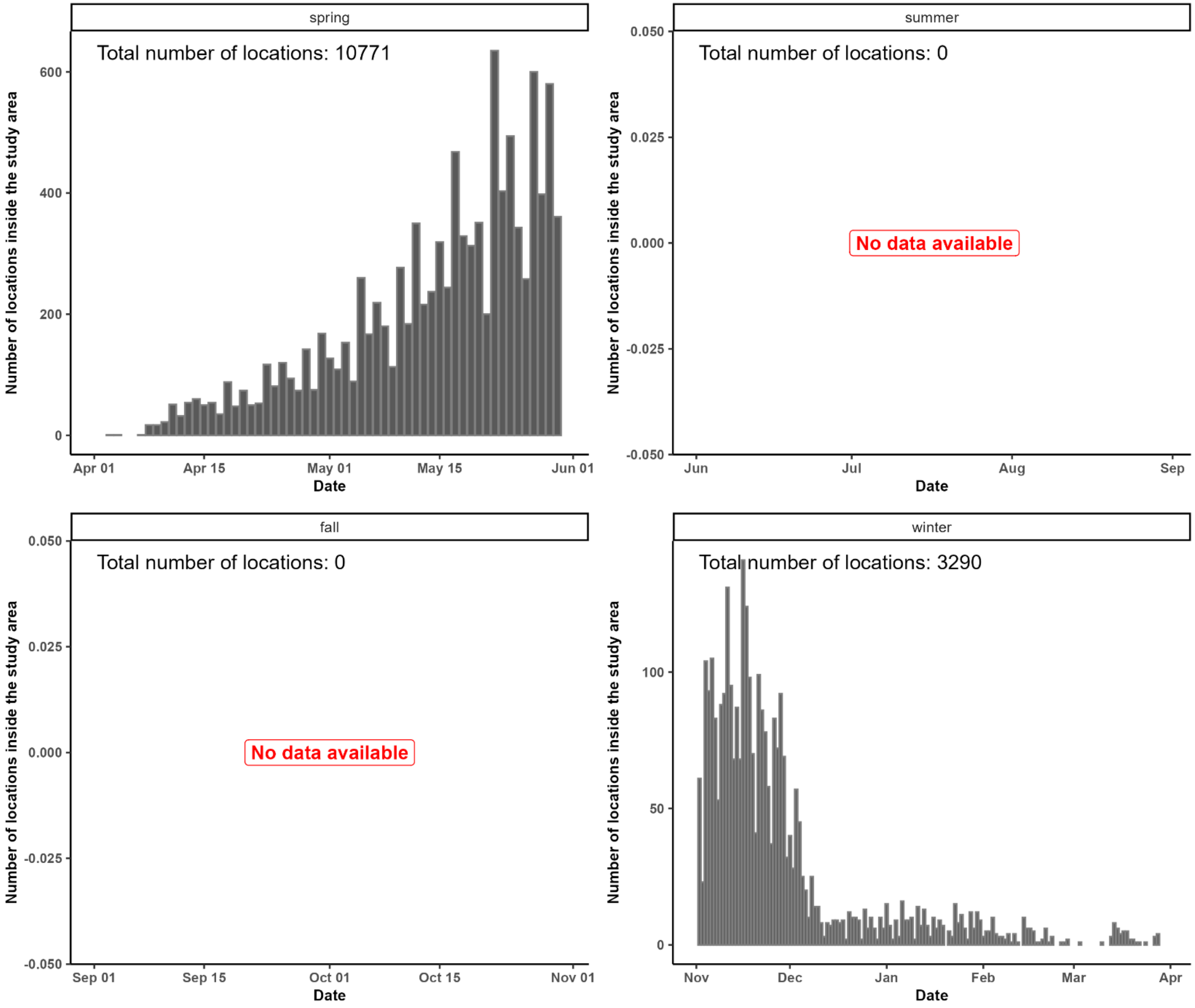

spring
summer
fall
winter
Number of tracked individuals in the study area
0.050
0.025
0.000
-0.025
-0.050
No data available
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
20
15
10
5
0
Jun
Jul
Aug
Sep
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Nov
Dec
Jan
Feb
Mar
Apr


spring
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
Number of locations inside the study area
summer
Total number of locations: 24445
2000
1500
1000
500
0
Jun
Jul
Aug
Sep
Date
Number of locations inside the study area
fall
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
Number of locations inside the study area
winter
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Nov
Dec
Jan
Feb
Mar
Apr
Date
Number of locations inside the study area

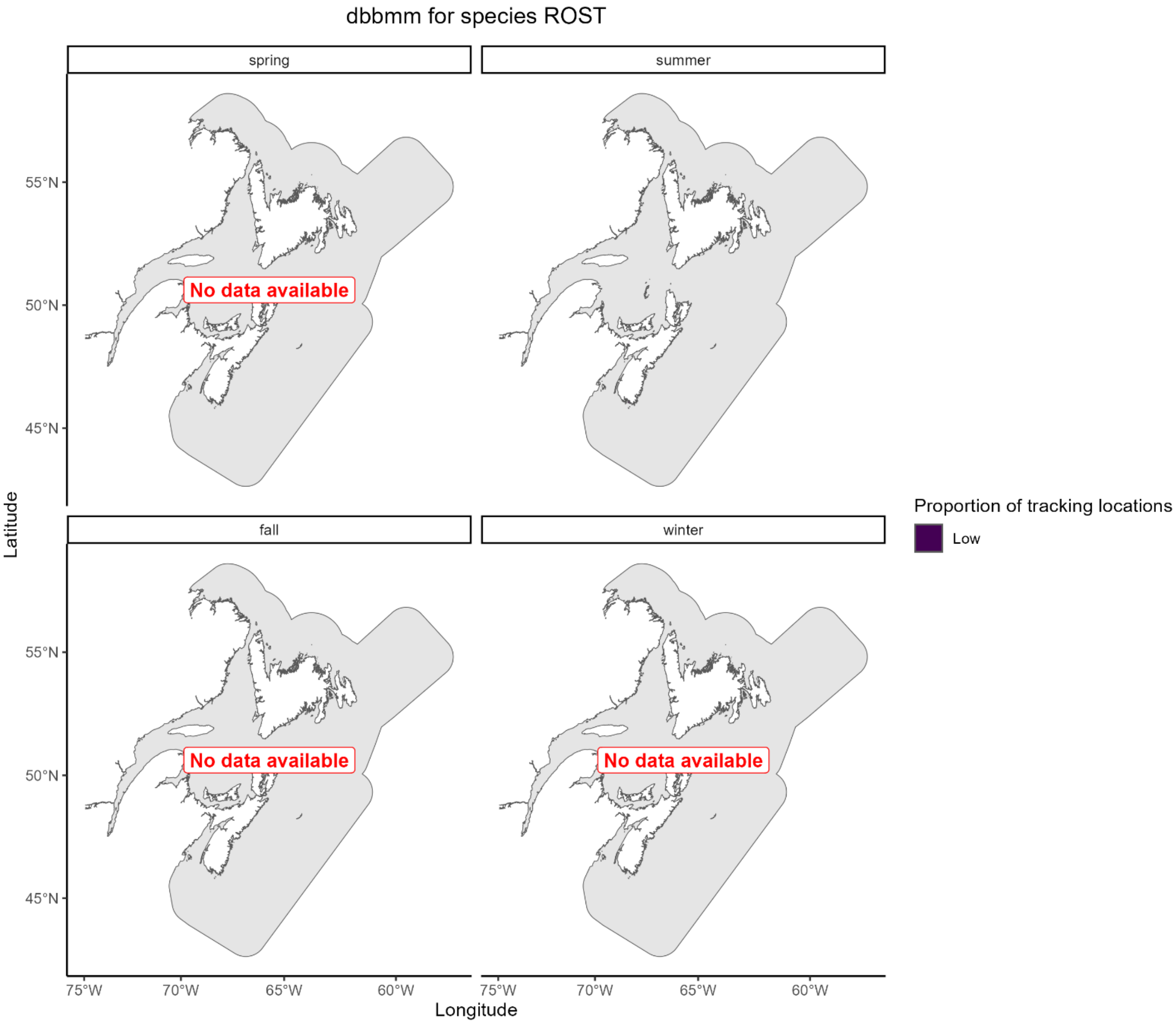
Red-throated Loon (RTLO)

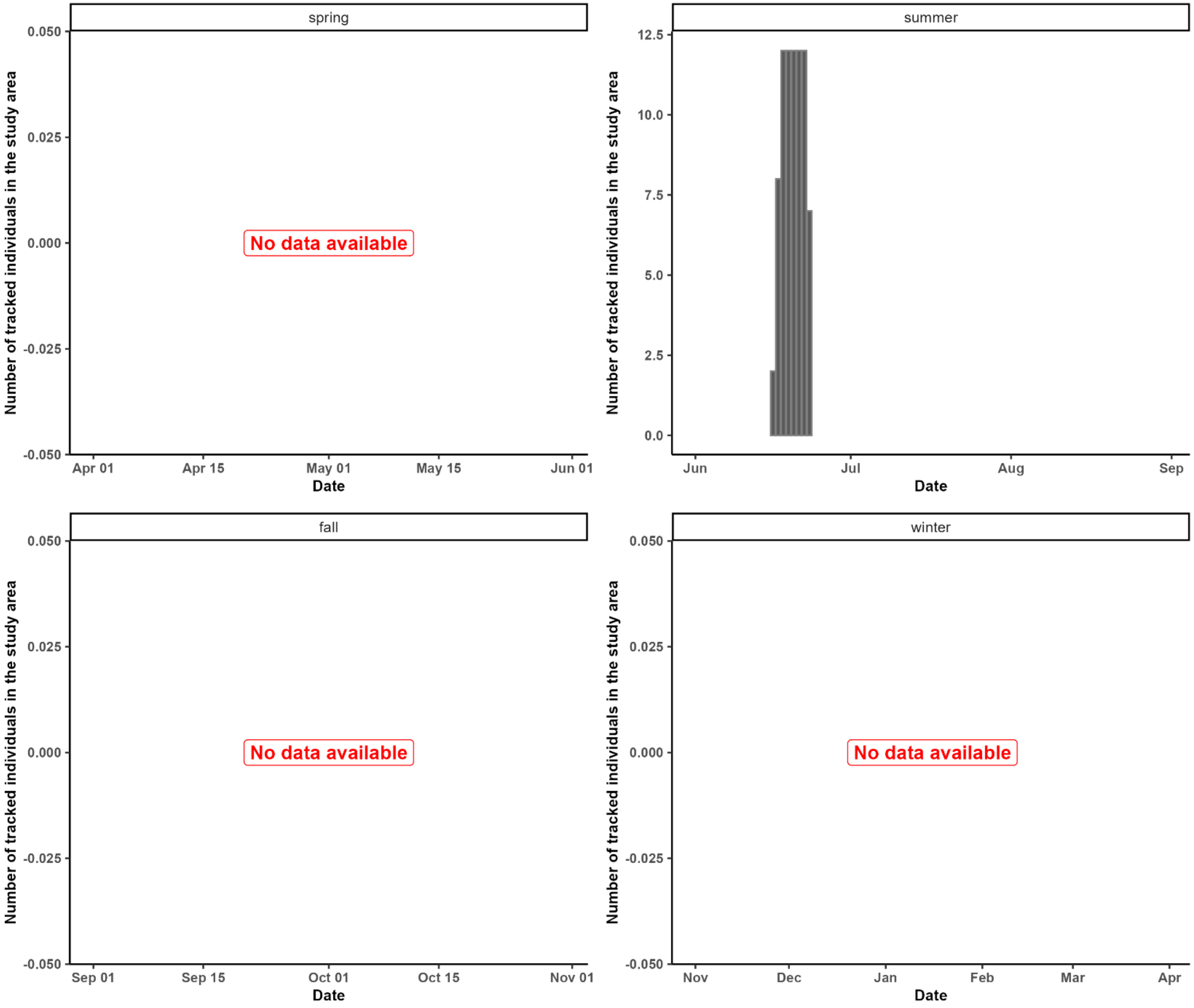


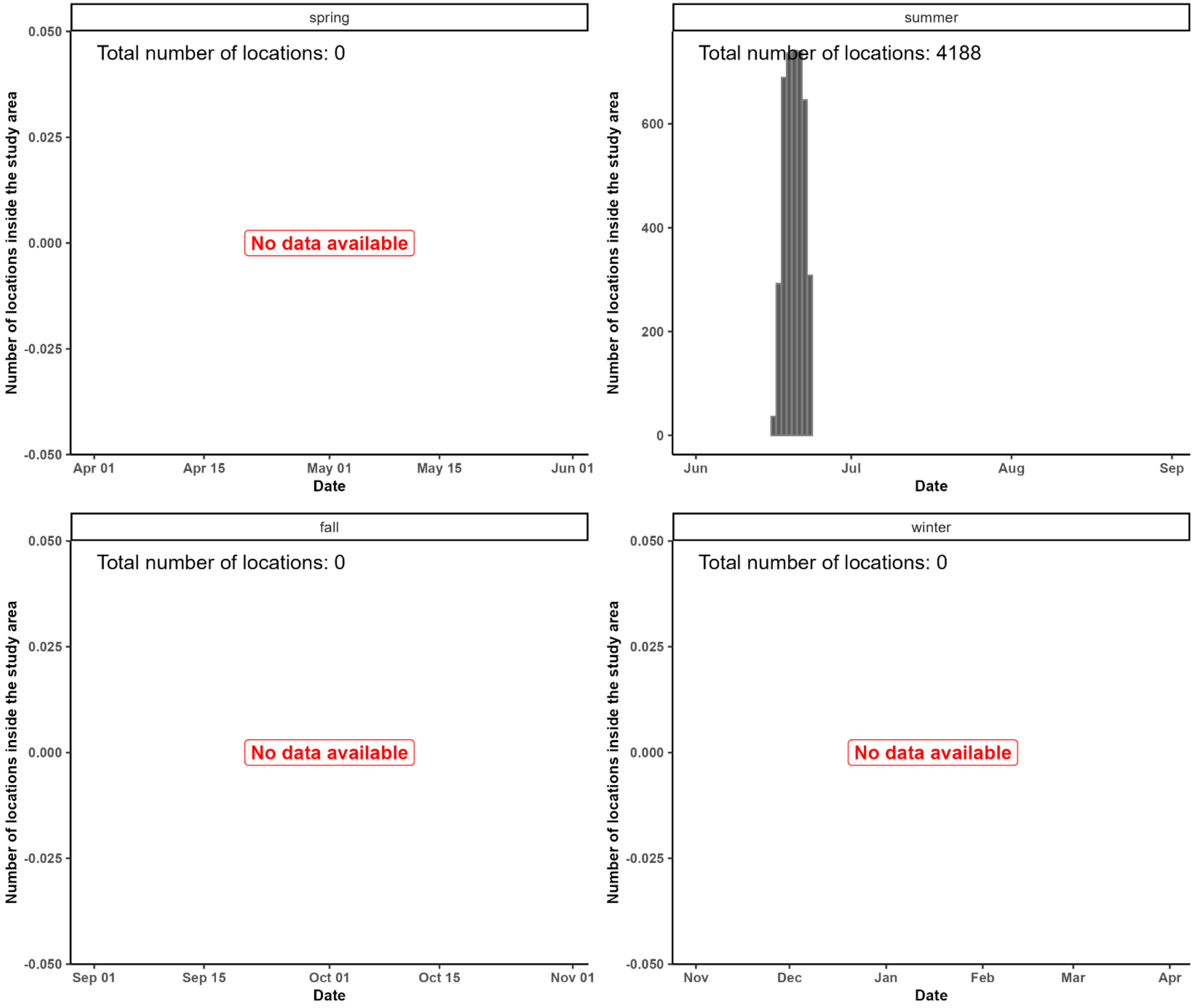

spring
summer
fall
winter
Number of tracked individuals in the study area
Date
80
60
40
20
0
Apr 01
Apr 15
May 01
May 15
Jun 01
0.050
0.025
0.000
-0.025
-0.050
Jun
Jul
Aug
Sep
No data available
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
No data available
15
10
5
0
Nov
Dec
Jan
Feb
Mar
Apr


spring
Total number of locations: 10771
Number of locations inside the study area
600
400
200
0
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 0
No data available
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 3290
100
50
0
Nov
Dec
Jan
Feb
Mar
Apr
Date

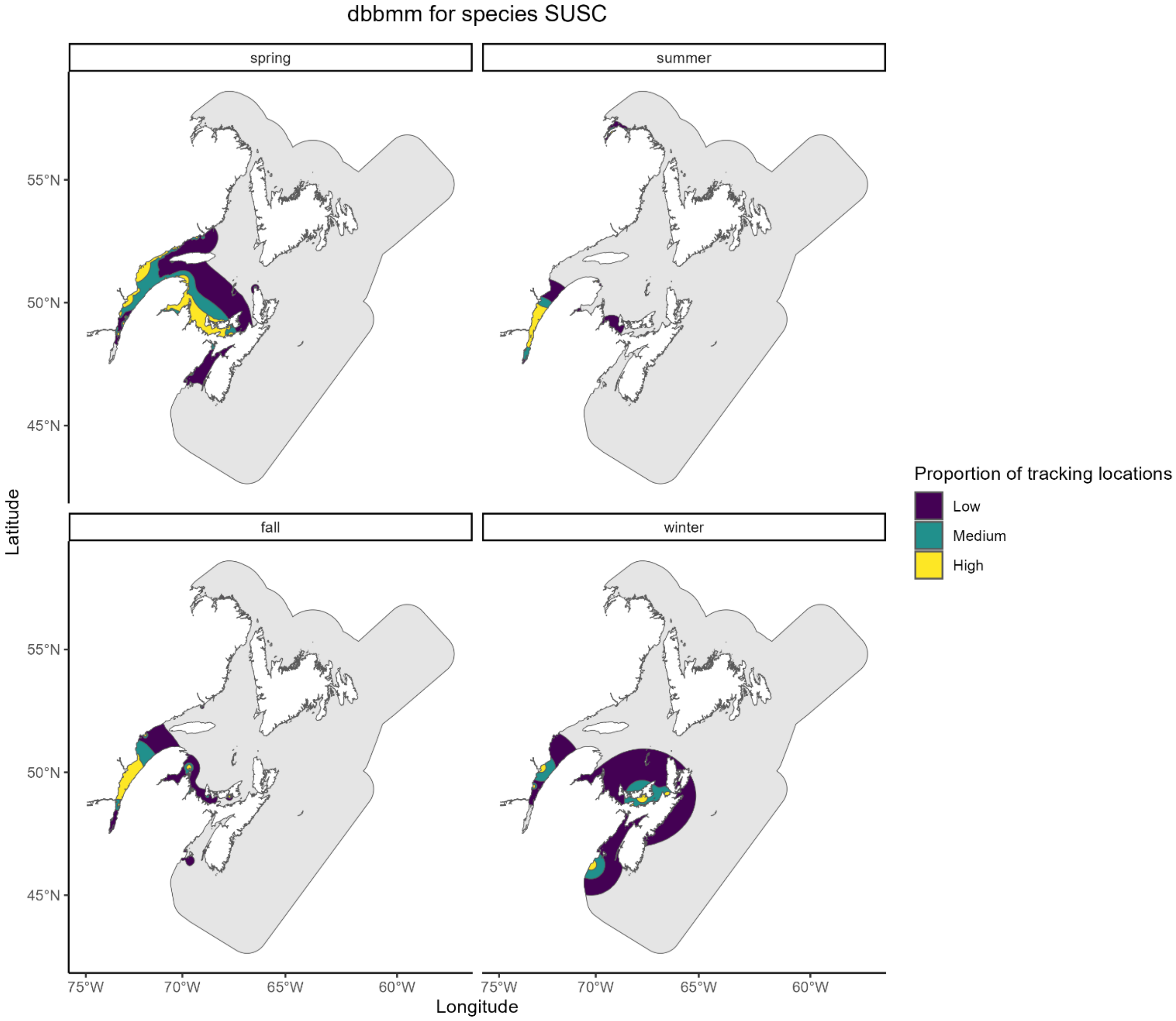
Roseate Tern (ROST)

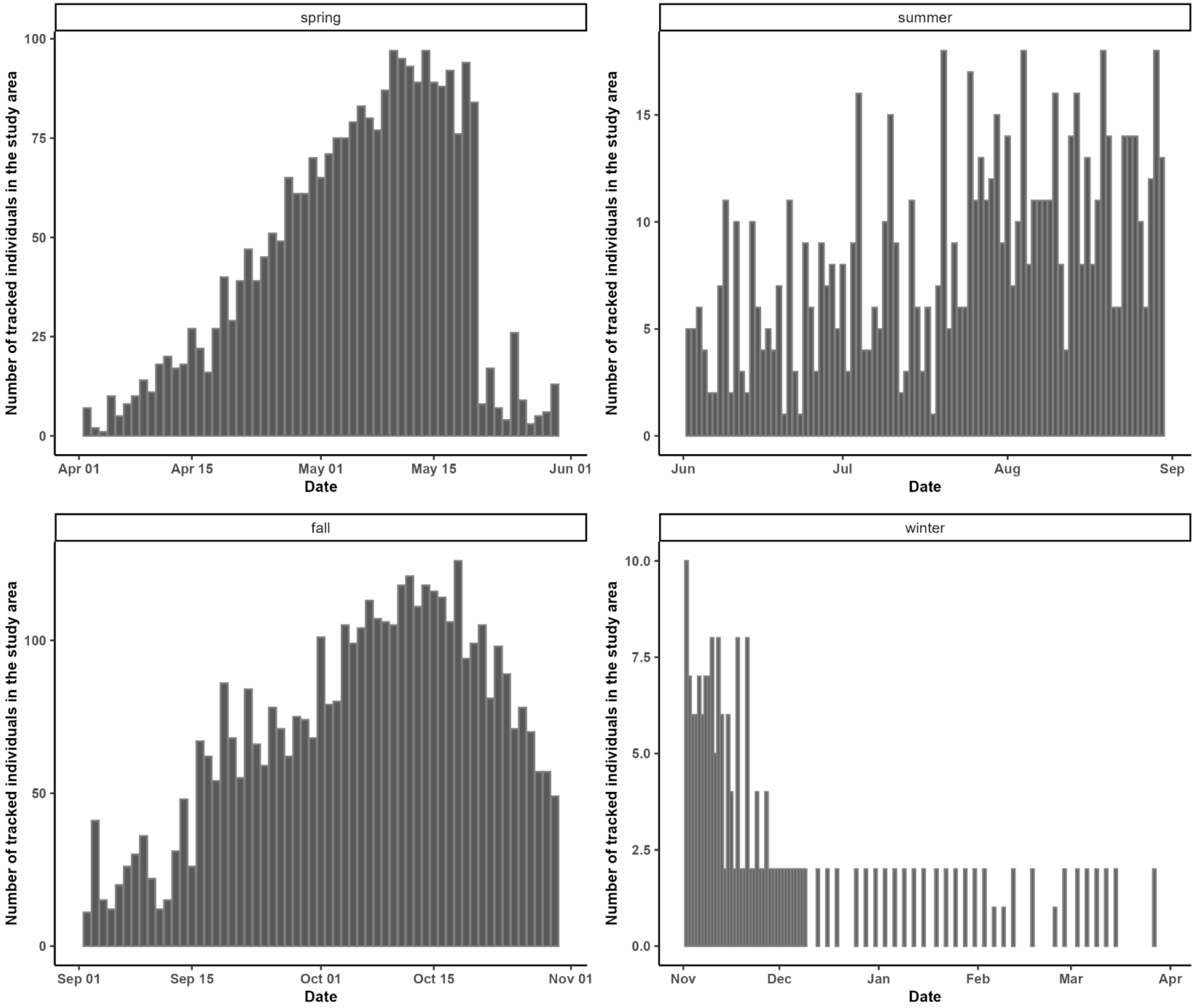


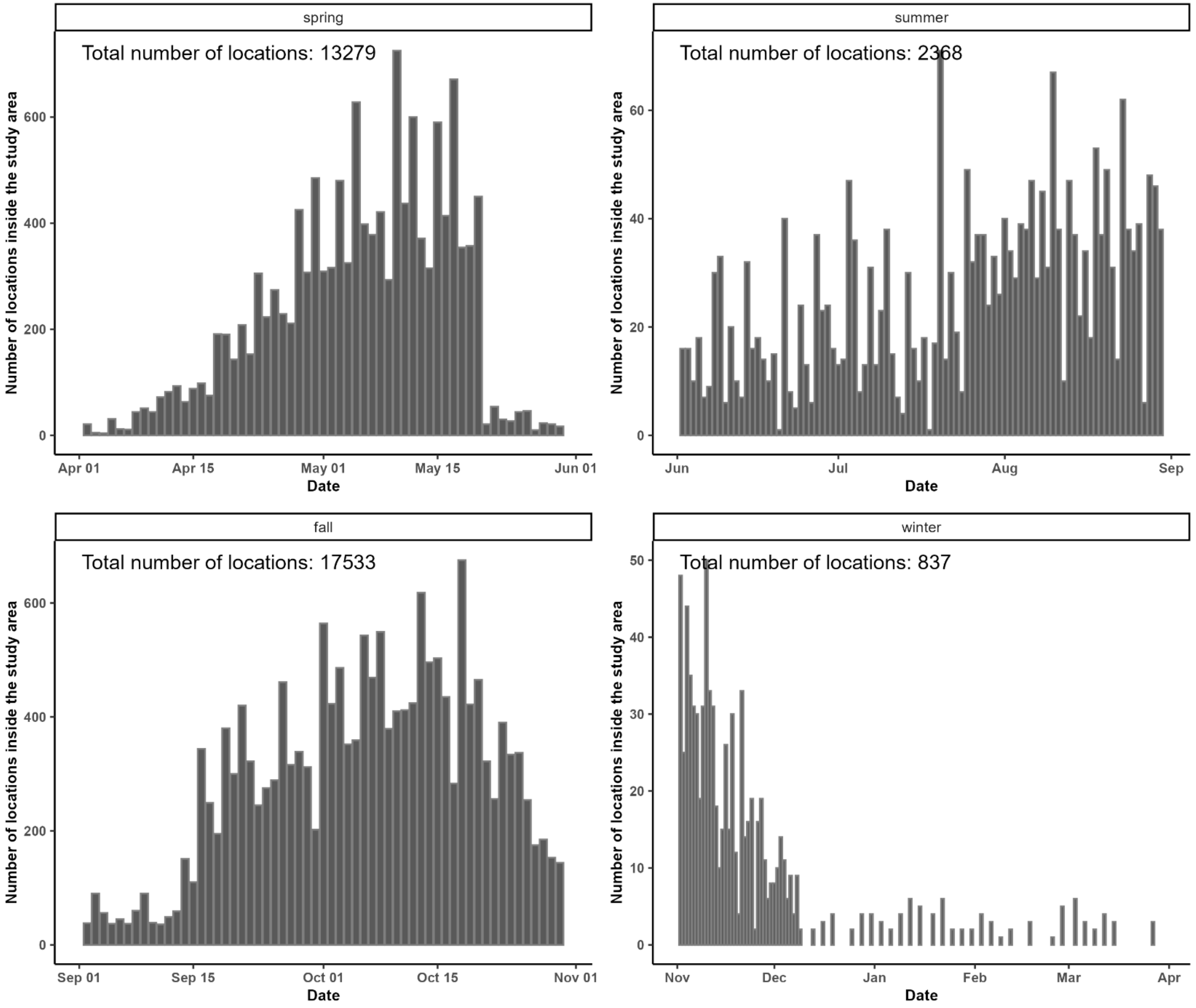

spring
summer
fall
winter
Number of tracked individuals in the study area
Date
0.050
0.025
0.000
-0.025
-0.050
Apr 01
Apr 15
May 01
May 15
Jun 01
No data available
12.5
10.0
7.5
5.0
2.5
0.0
Jun
Jul
Aug
Sep
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
No data available
Nov
Dec
Jan
Feb
Mar
Apr
No data available


spring
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Number of locations inside the study area
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 4188
600
400
200
0
Number of locations inside the study area
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Number of locations inside the study area
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 0
No data available
0.050
0.025
0.000
-0.025
-0.050
Number of locations inside the study area
Nov
Dec
Jan
Feb
Mar
Apr
Date

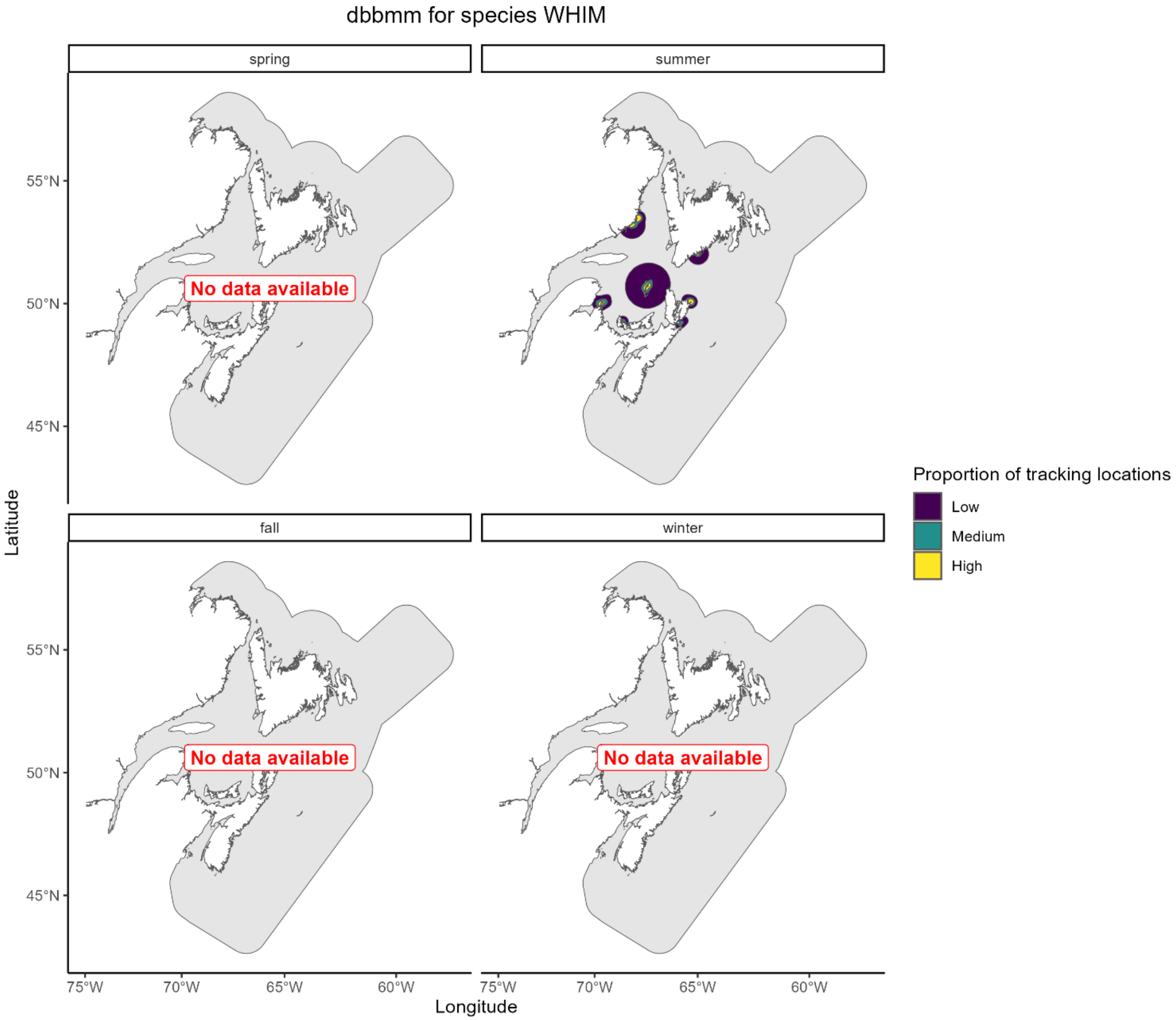
Surf Scoter (SUSC)

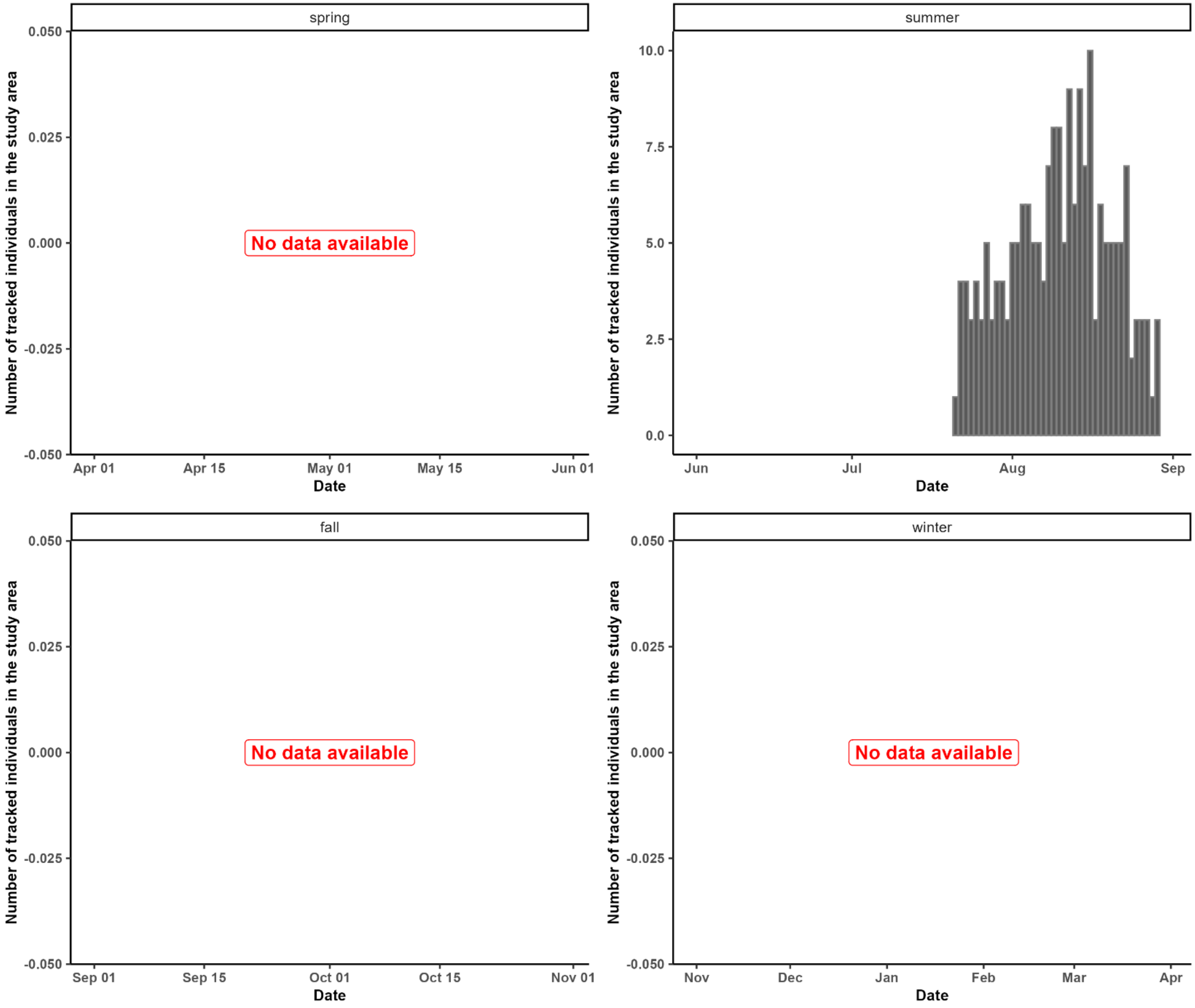


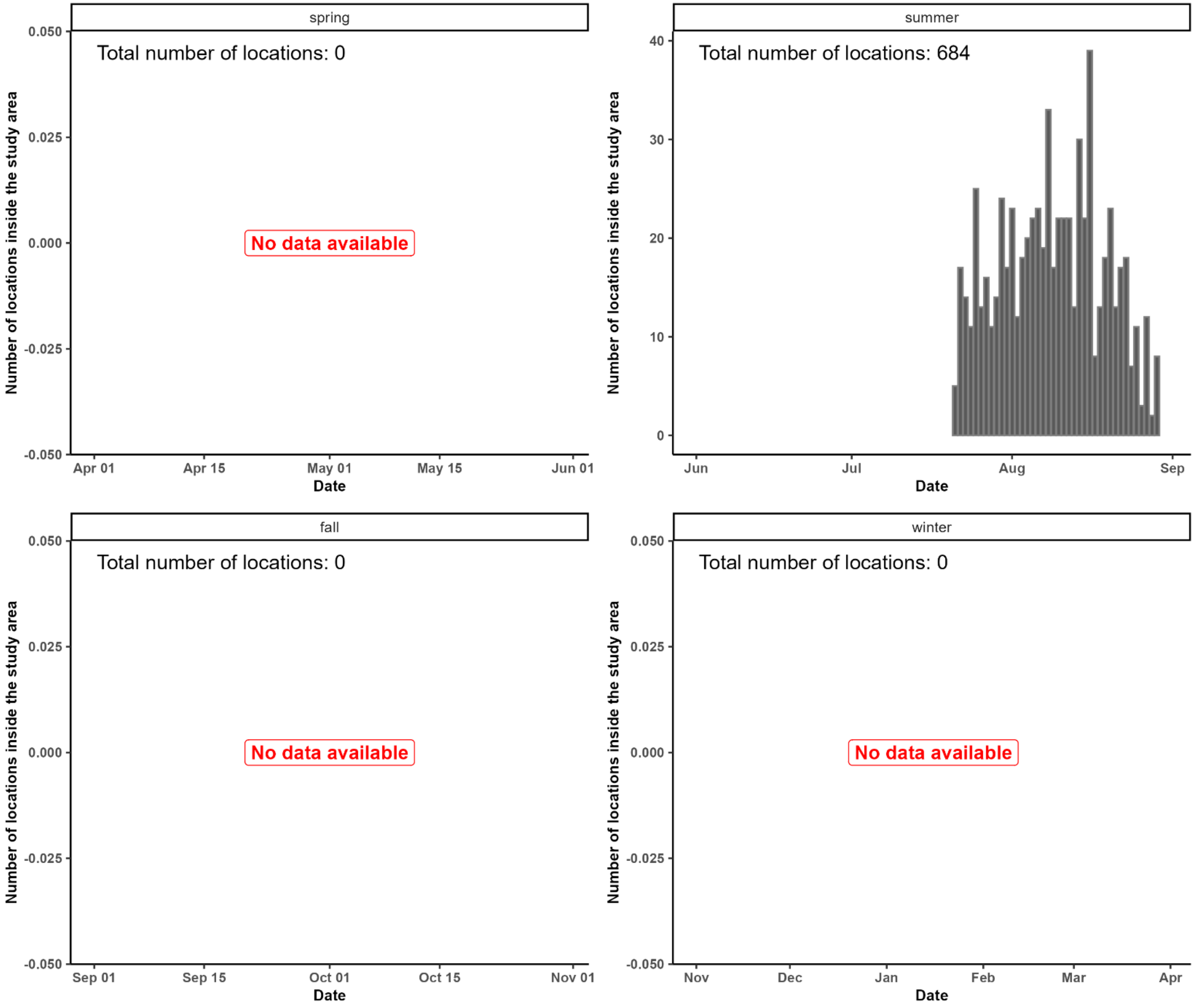

spring
summer
fall
winter
Number of tracked individuals in the study area
Date
0
25
50
75
100
Apr 01
Apr 15
May 01
May 15
Jun 01
0
5
10
15
Jun
Jul
Aug
Sep
0
50
100
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
0.0
2.5
5.0
7.5
10.0
Nov
Dec
Jan
Feb
Mar
Apr


spring
Total number of locations: 13279
Number of locations inside the study area
0
200
400
600
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 2368
Number of locations inside the study area
0
20
40
60
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 17533
Number of locations inside the study area
0
200
400
600
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 837
Number of locations inside the study area
0
10
20
30
40
50
Nov
Dec
Jan
Feb
Mar
Apr
Date

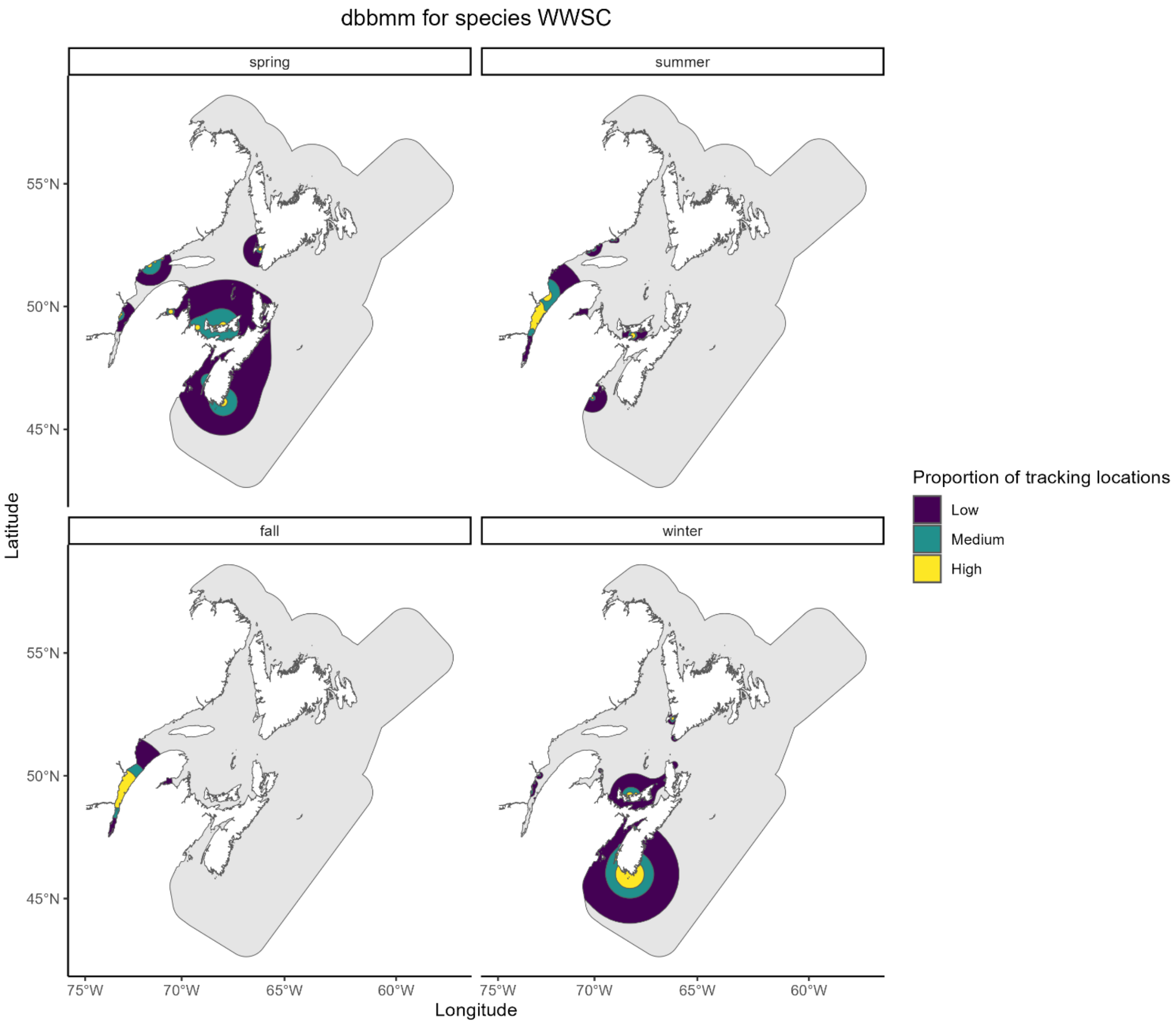
Whimbrel (WHIM)

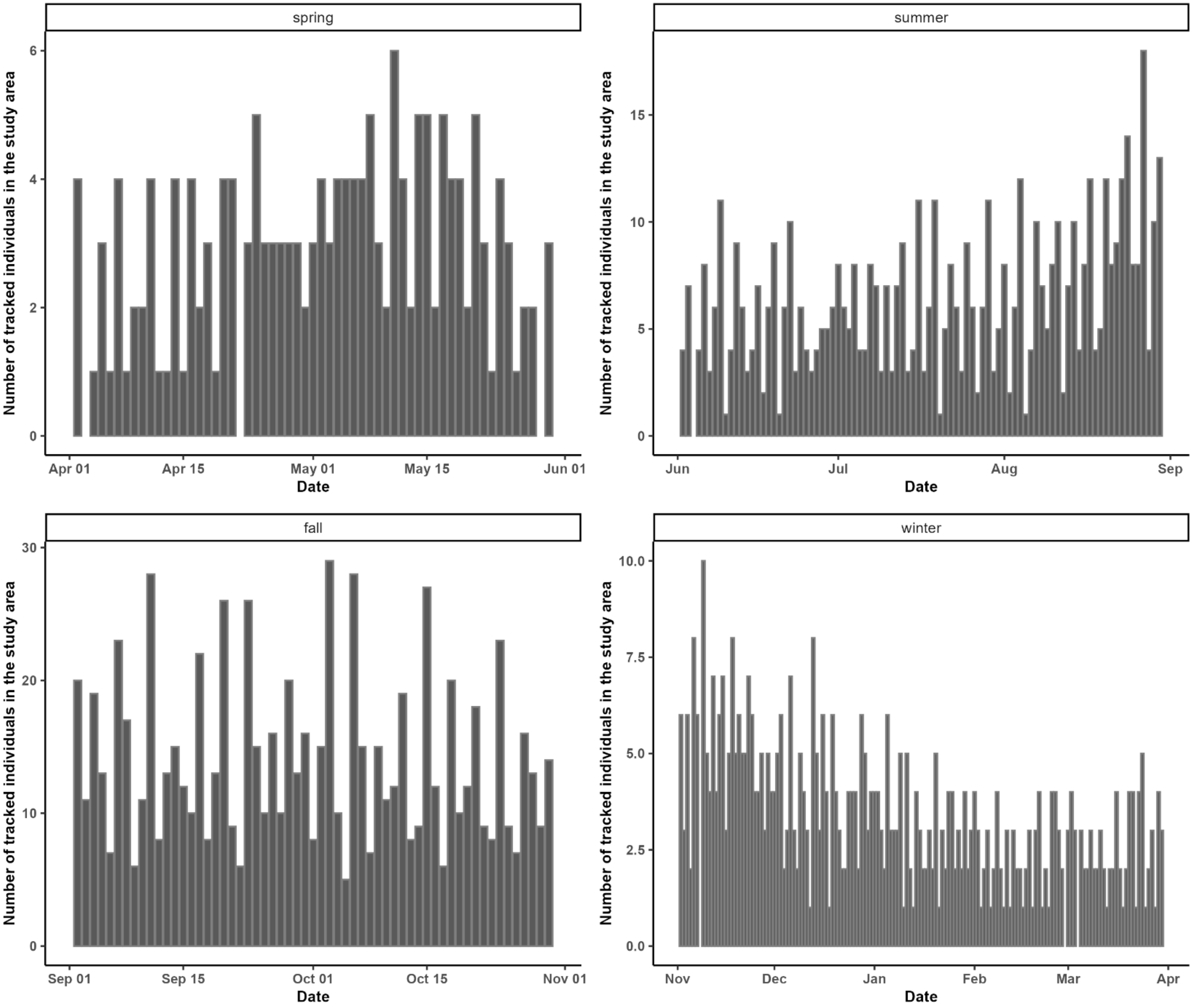


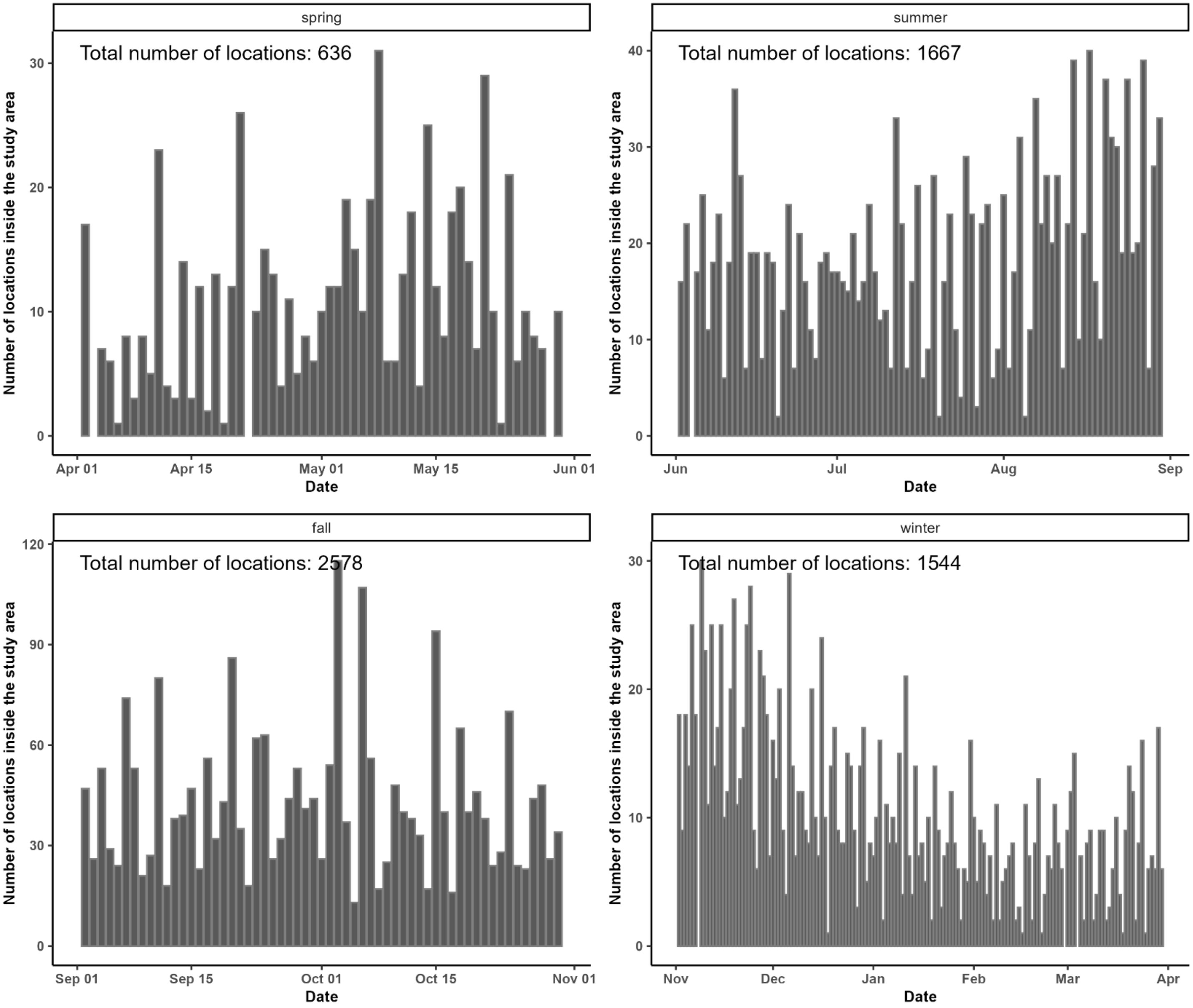

spring
0.050
0.025
0.000
-0.025
-0.050
Number of tracked individuals in the study area
No data available
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
10.0
7.5
5.0
2.5
0.0
Number of tracked individuals in the study area
Jun
Jul
Aug
Sep
Date
fall
0.050
0.025
0.000
-0.025
-0.050
Number of tracked individuals in the study area
No data available
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
0.050
0.025
0.000
-0.025
-0.050
Number of tracked individuals in the study area
No data available
Nov
Dec
Jan
Feb
Mar
Apr
Date


spring
Total number of locations: 0
No data available
Number of locations inside the study area
0.050
0.025
0.000
-0.025
-0.050
Apr 01
Apr 15
May 01
May 15
Jun 01
Date
summer
Total number of locations: 684
Number of locations inside the study area
40
30
20
10
0
Jun
Jul
Aug
Sep
Date
fall
Total number of locations: 0
No data available
Number of locations inside the study area
0.050
0.025
0.000
-0.025
-0.050
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Date
winter
Total number of locations: 0
No data available
Number of locations inside the study area
0.050
0.025
0.000
-0.025
-0.050
Nov
Dec
Jan
Feb
Mar
Apr
Date

White-winged Scoter (WWSC)




spring
summer
fall
winter
Number of tracked individuals in the study area
Date
0
2
4
6
Apr 01
Apr 15
May 01
May 15
Jun 01
0
5
10
15
Jun
Jul
Aug
Sep
0
10
20
30
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
0.0
2.5
5.0
7.5
10.0
Nov
Dec
Jan
Feb
Mar
Apr

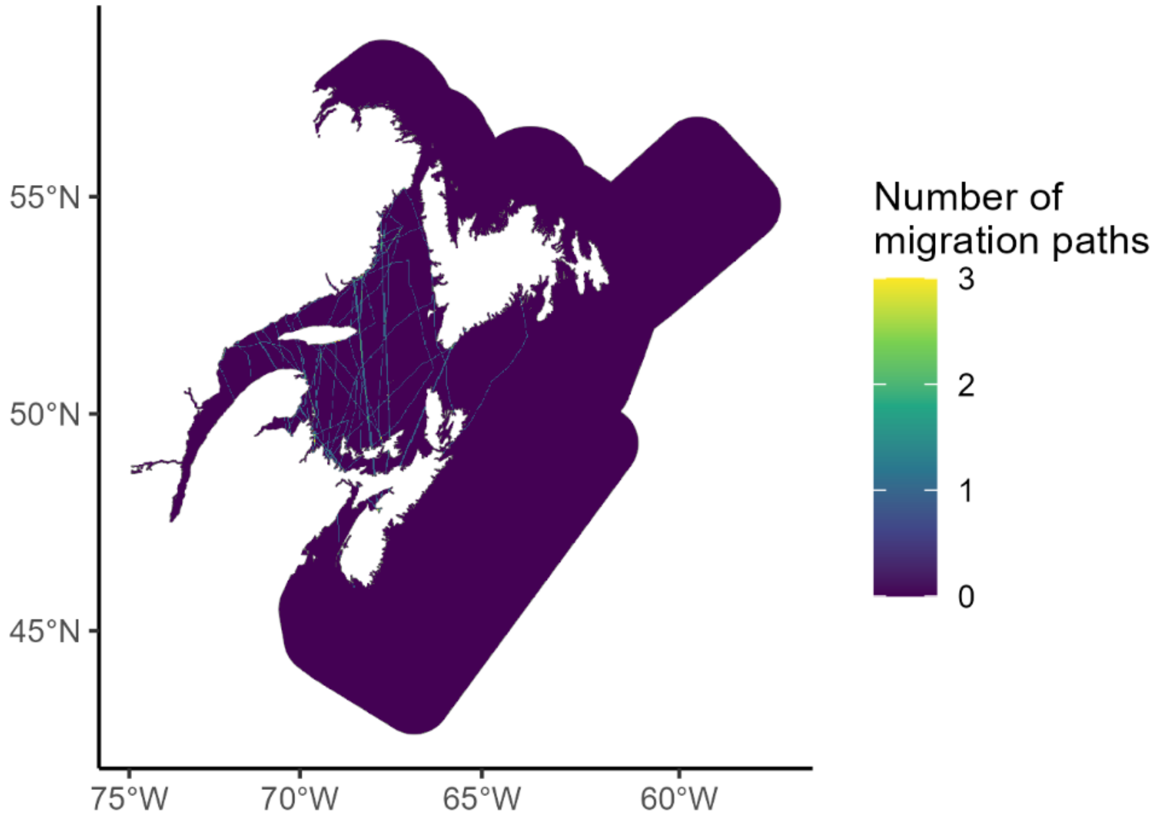

spring
Total number of locations: 636
summer
Total number of locations: 1667
fall
Total number of locations: 2578
winter
Total number of locations: 1544
Number of locations inside the study area
Date
0
10
20
30
40
60
90
120
Apr 01
Apr 15
May 01
May 15
Jun 01
Jun
Jul
Aug
Sep
Sep 01
Sep 15
Oct 01
Oct 15
Nov 01
Nov
Dec
Jan
Feb
Mar
Apr

Appendix D: Migration Paths and Movement Tracks

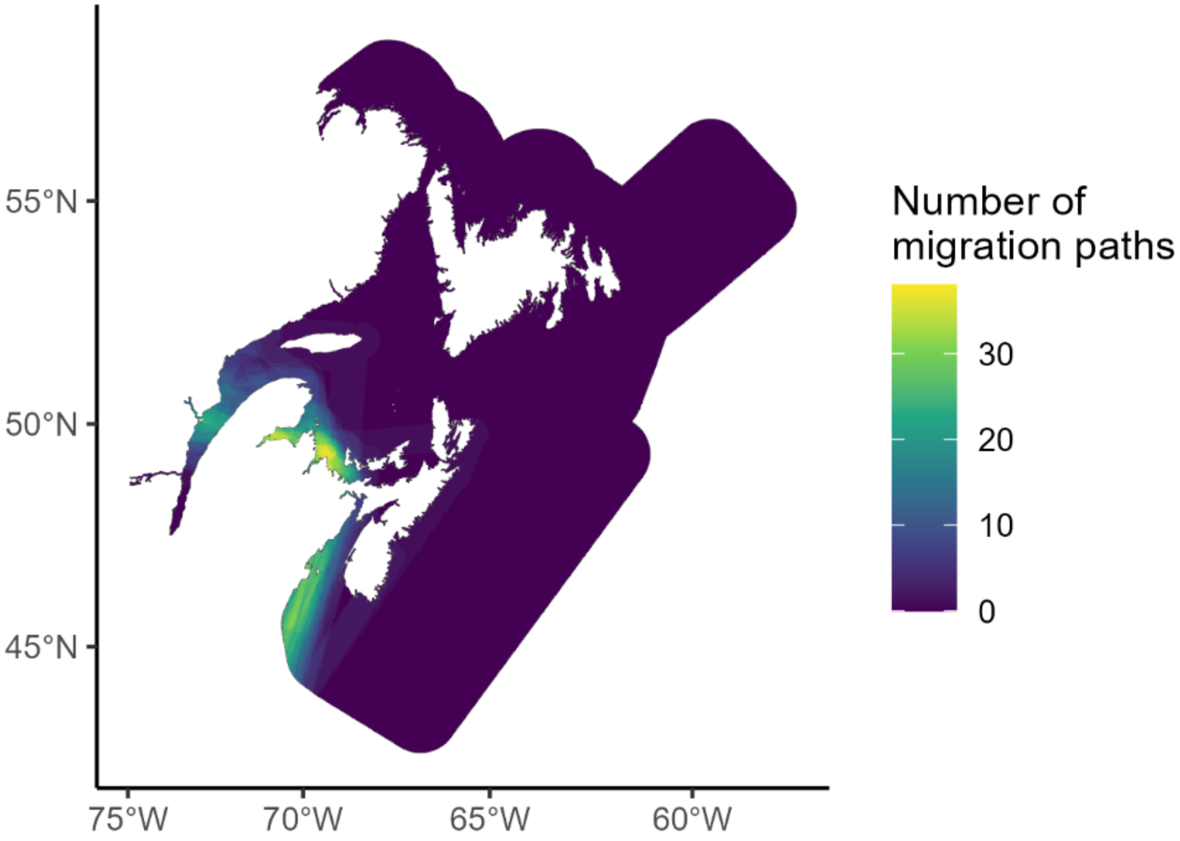
Migration Paths

Spring Error Mean Migration Corridors

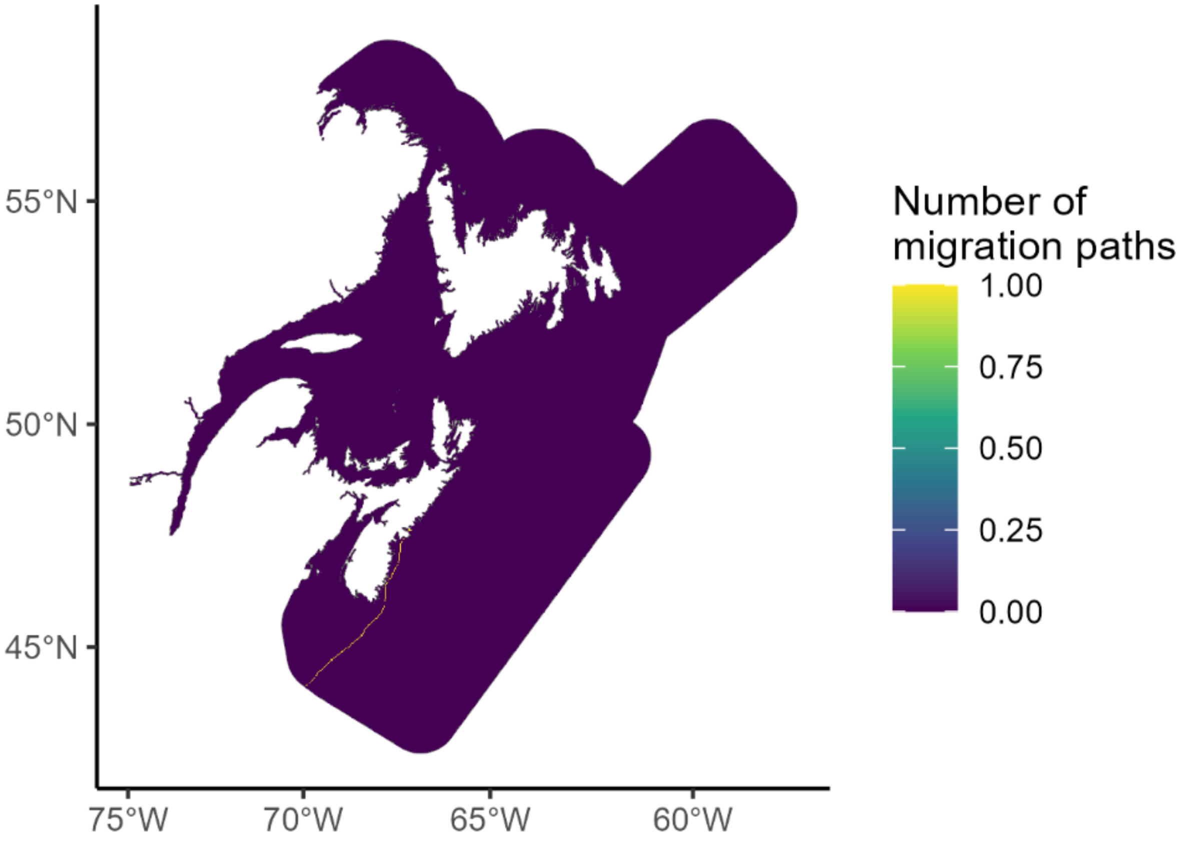
American Black Duck (ABDU)



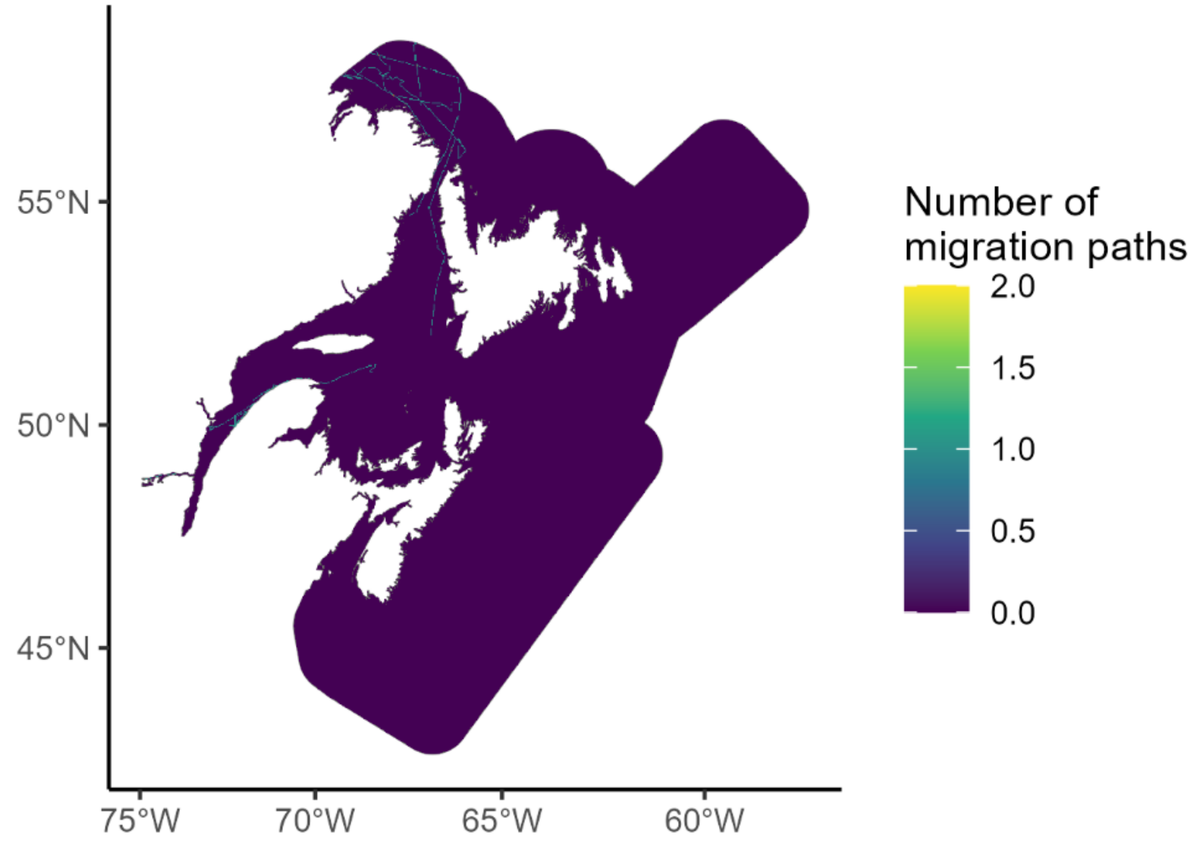
Black Scoter (BLSC)



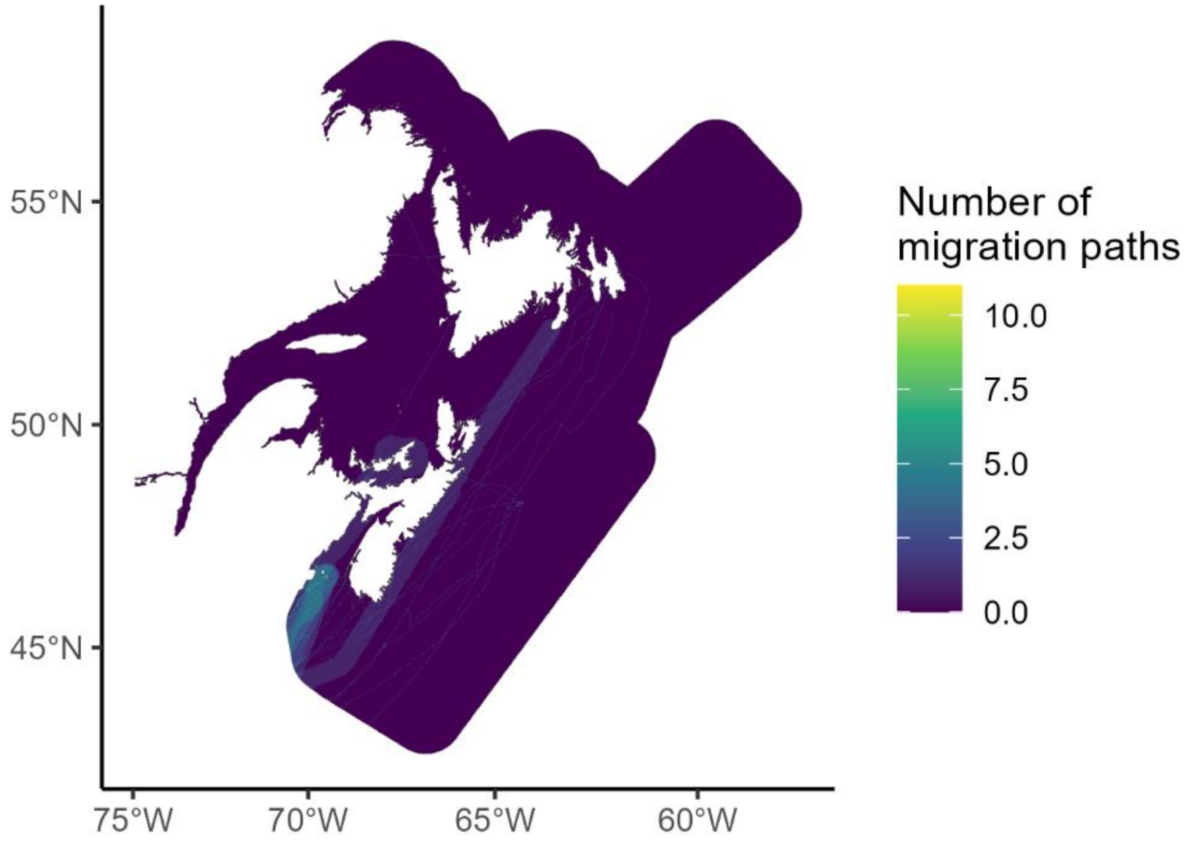
Great Black-backed Gull (GBBG)



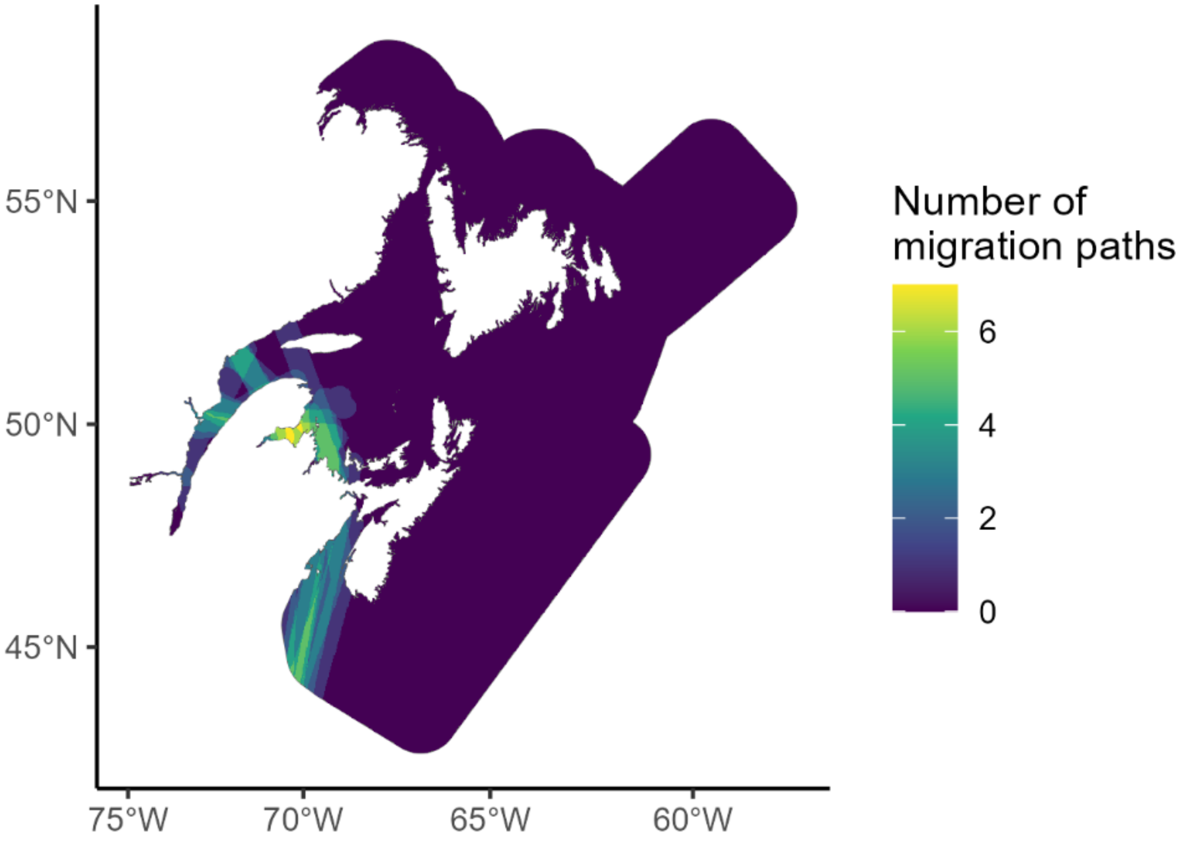
Glaucous Gull (GLGU)



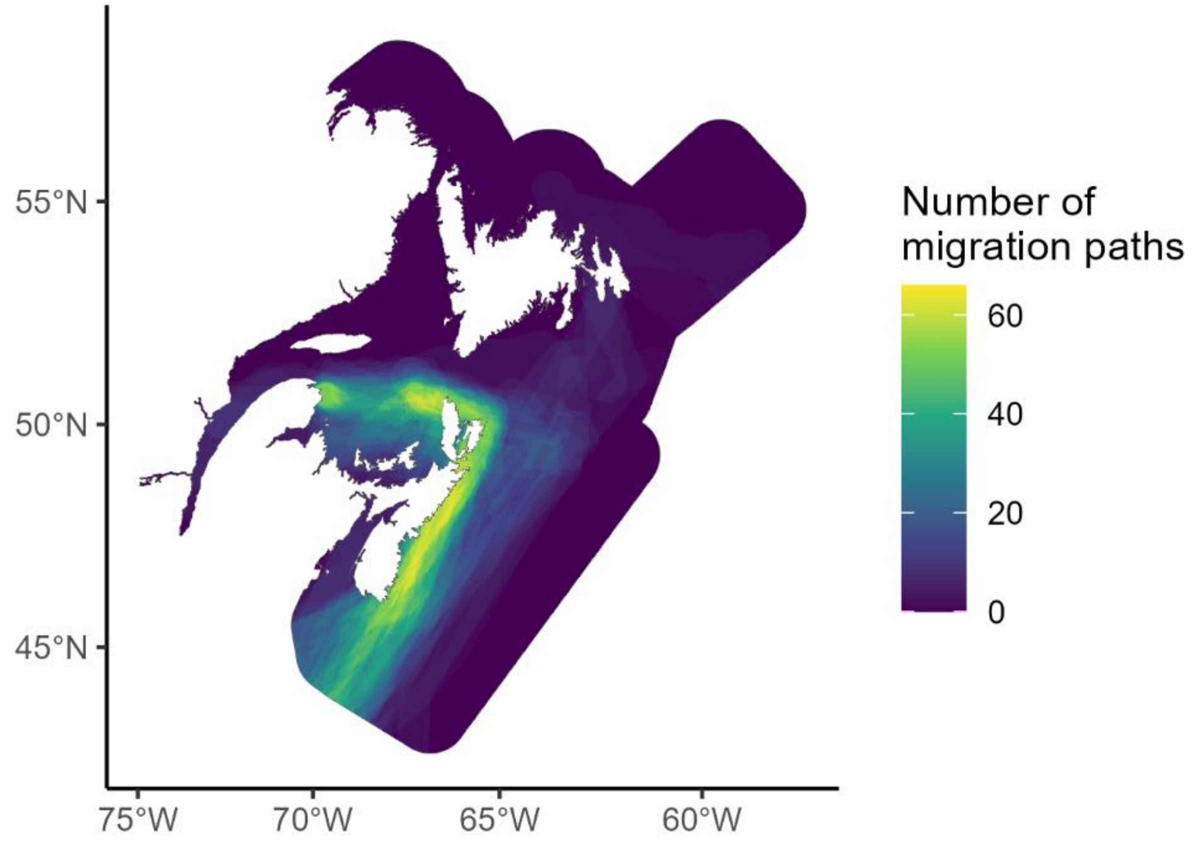
Herring Gull (HERG)



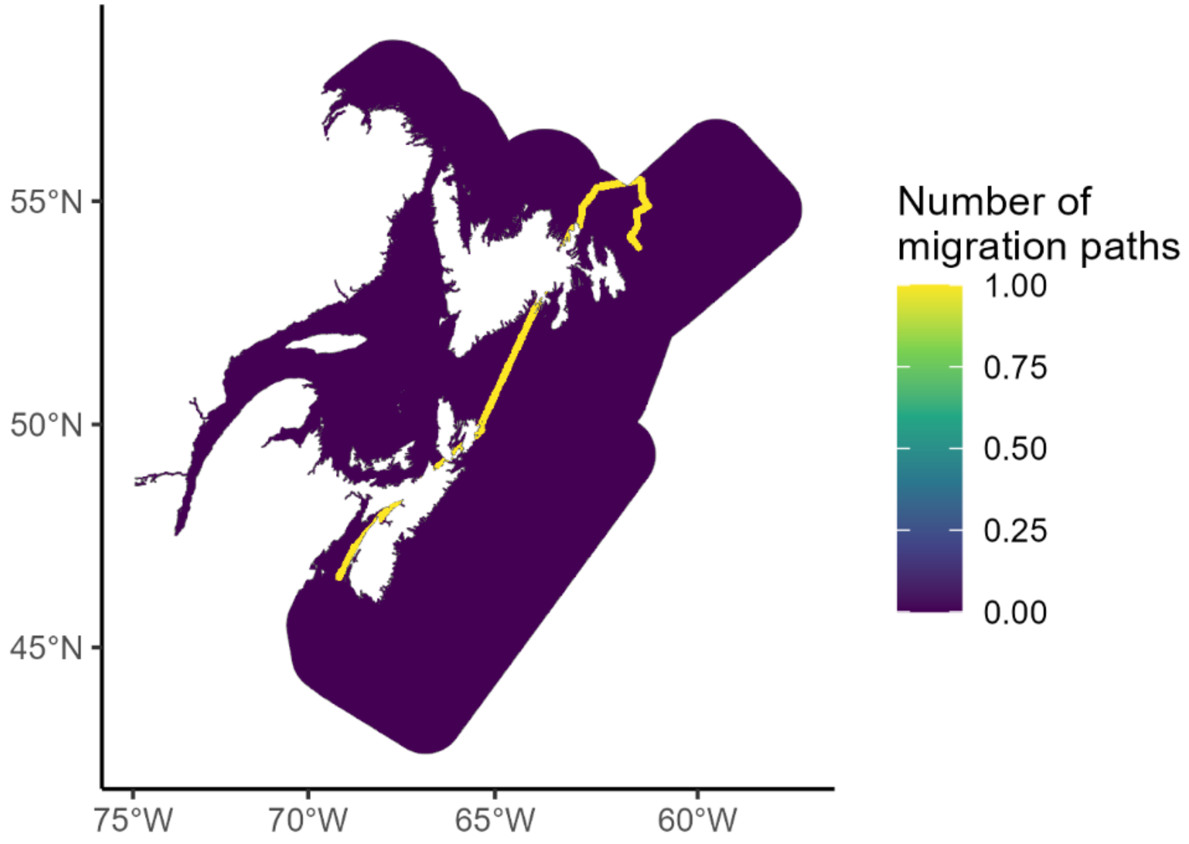
Long-tailed Duck (LTDU)



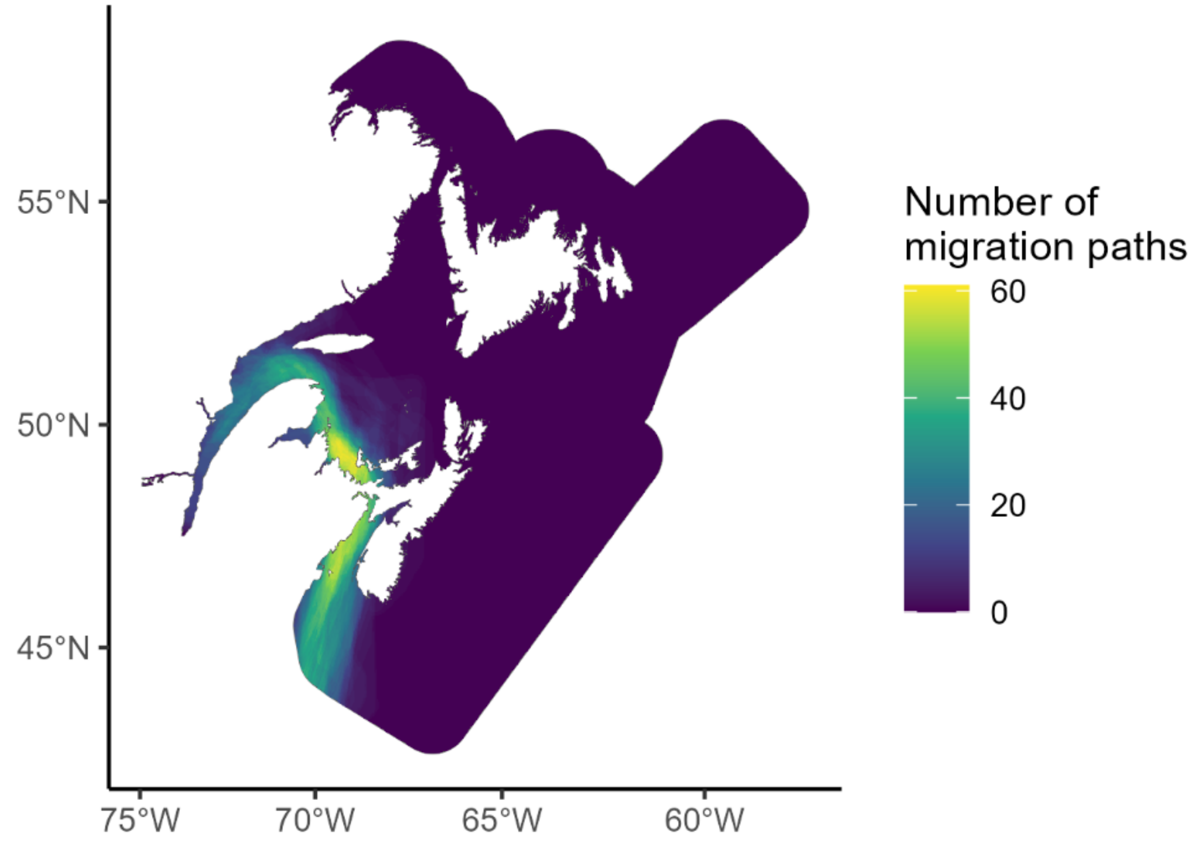
Northern Gannet (NOGA)



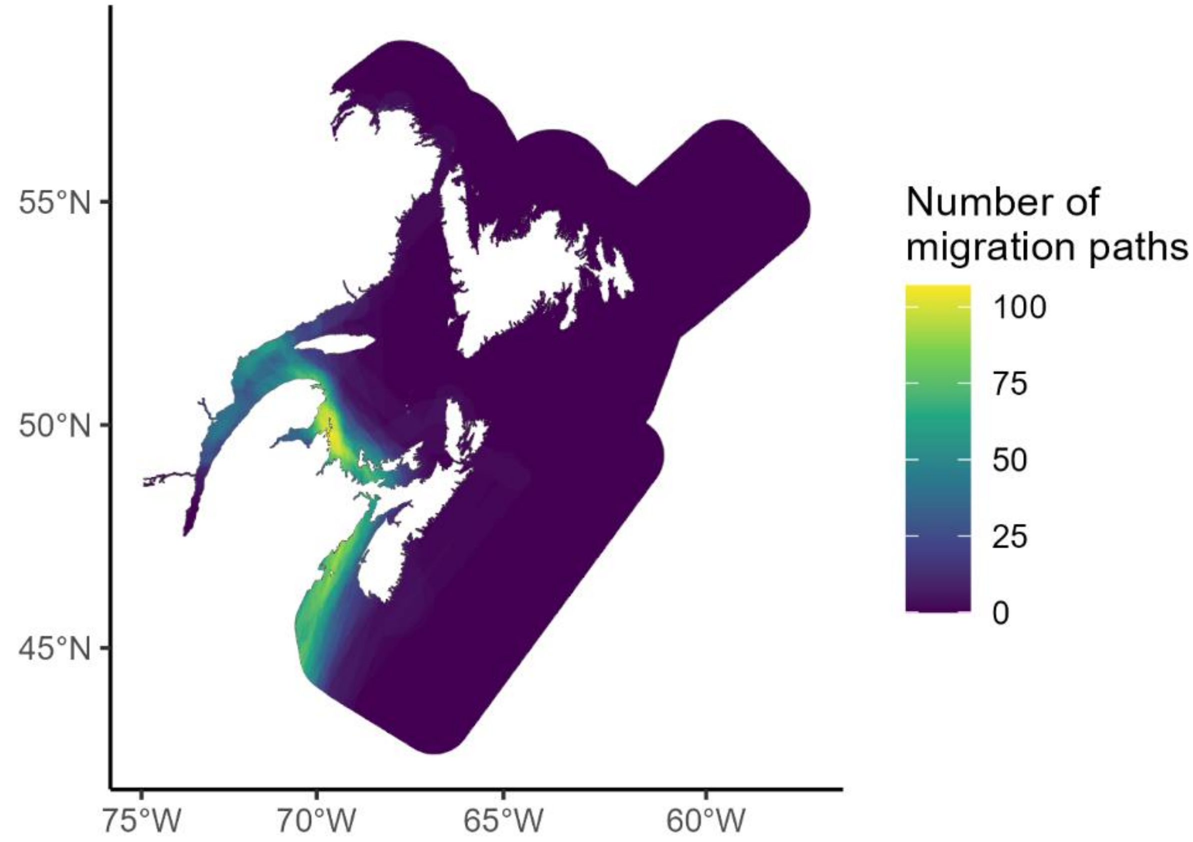
Pectoral Sandpiper (PESA)



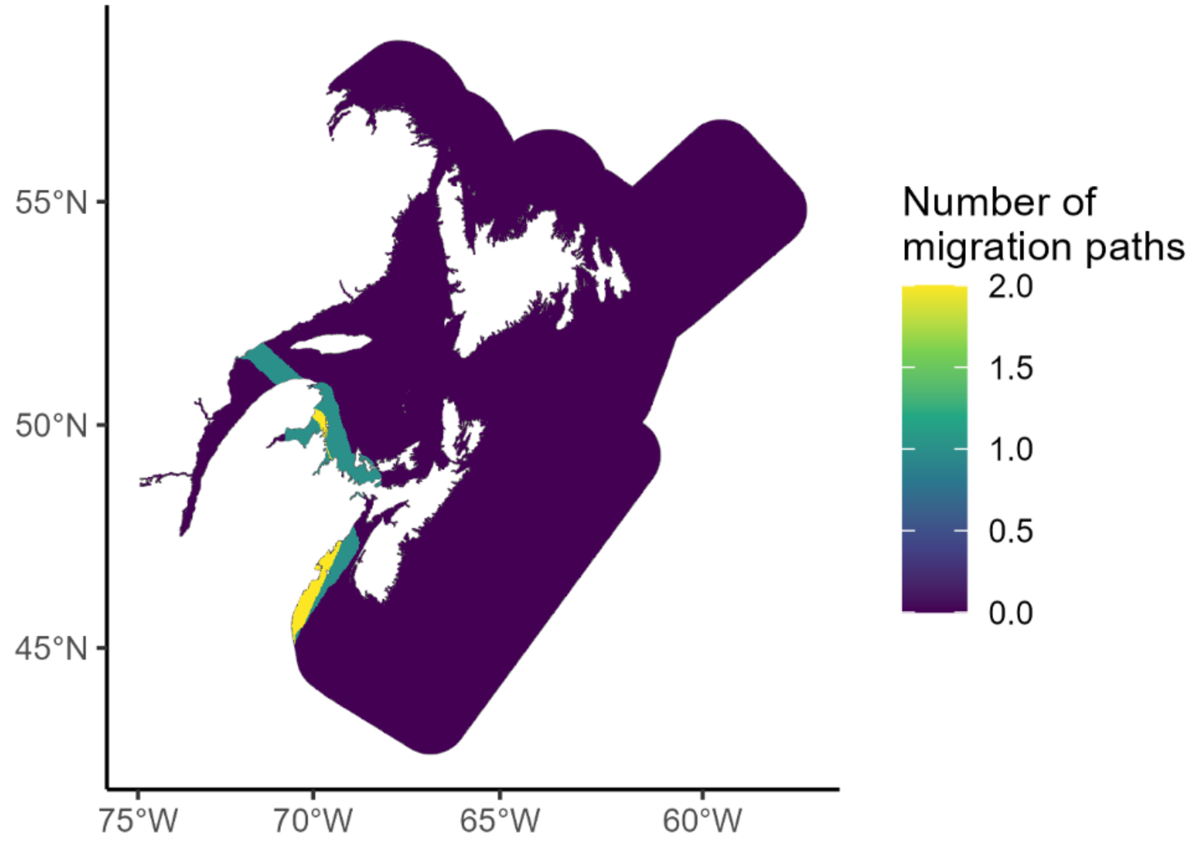
Red-throated Loon (RTLO)



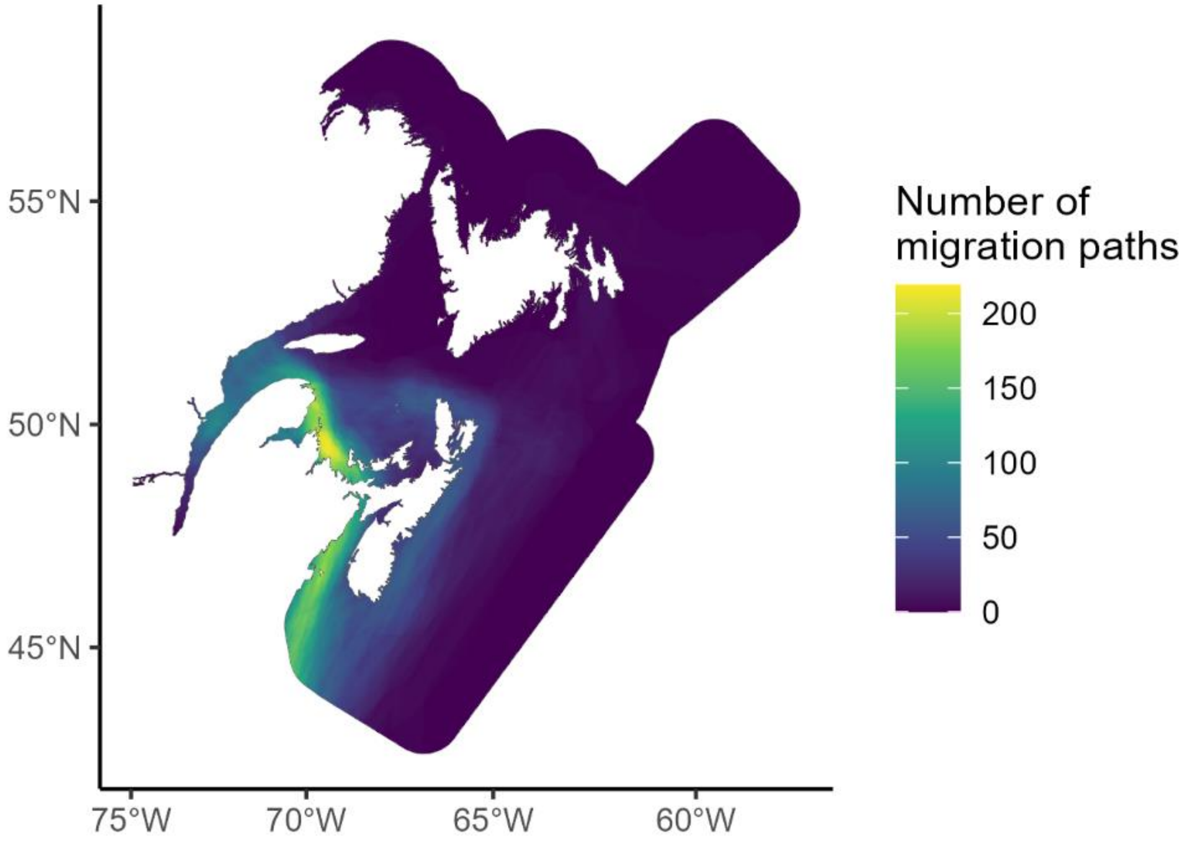
Surf Scoter (SUSC)



White-winged Scoter (WWSC)

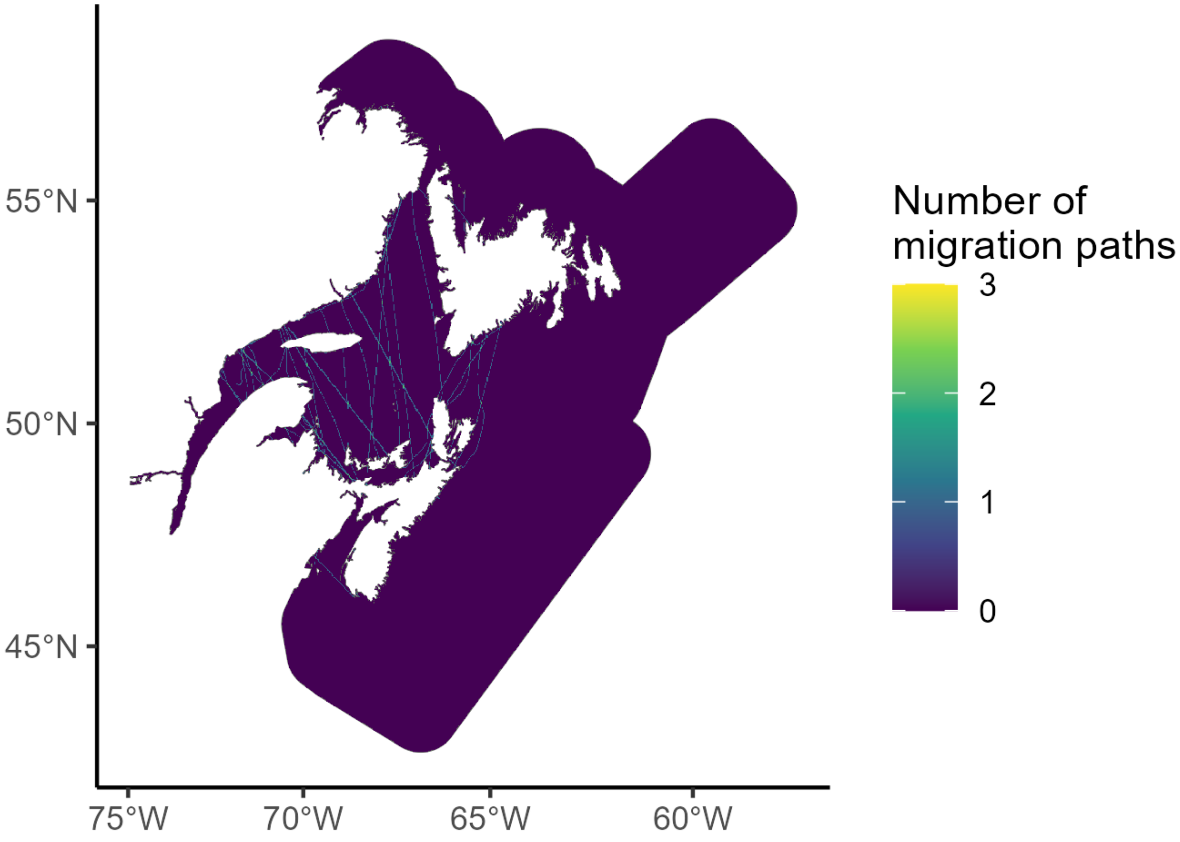


All Spring Error Mean Migration Corridors

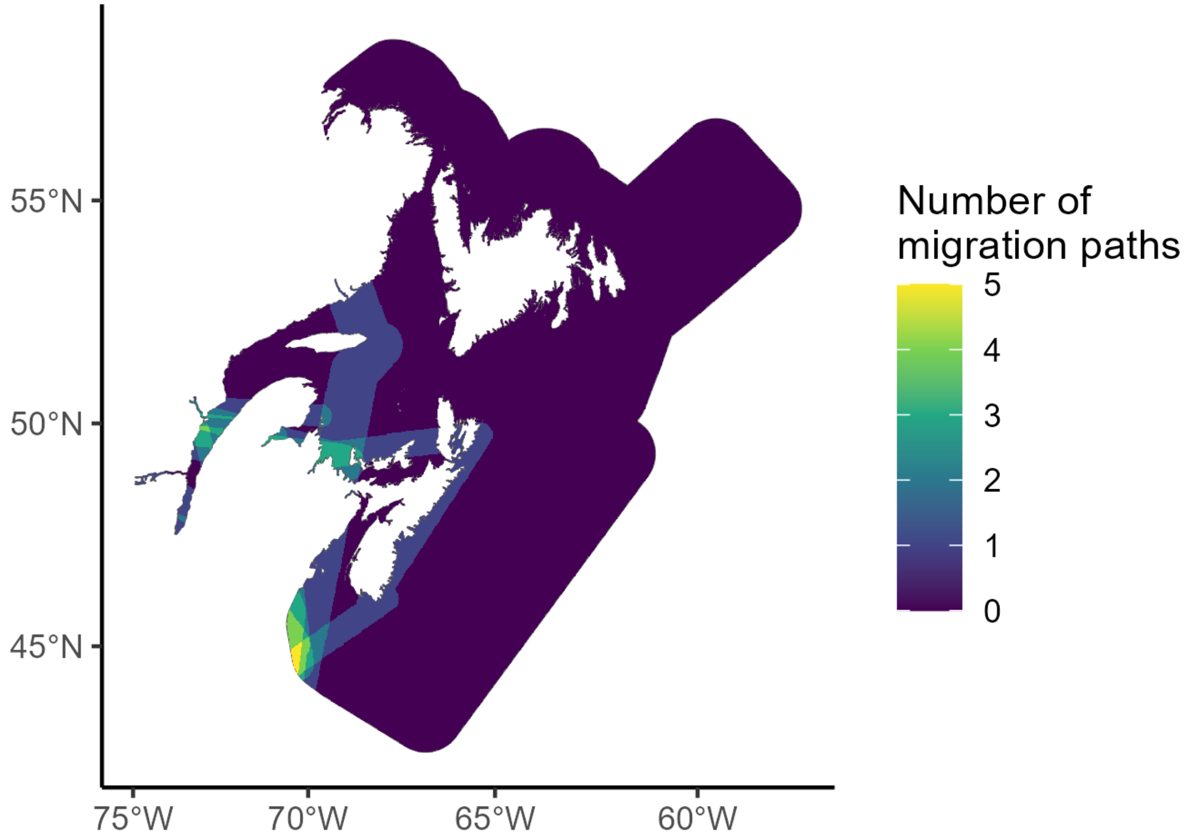


Fall Error Mean Migration Corridors

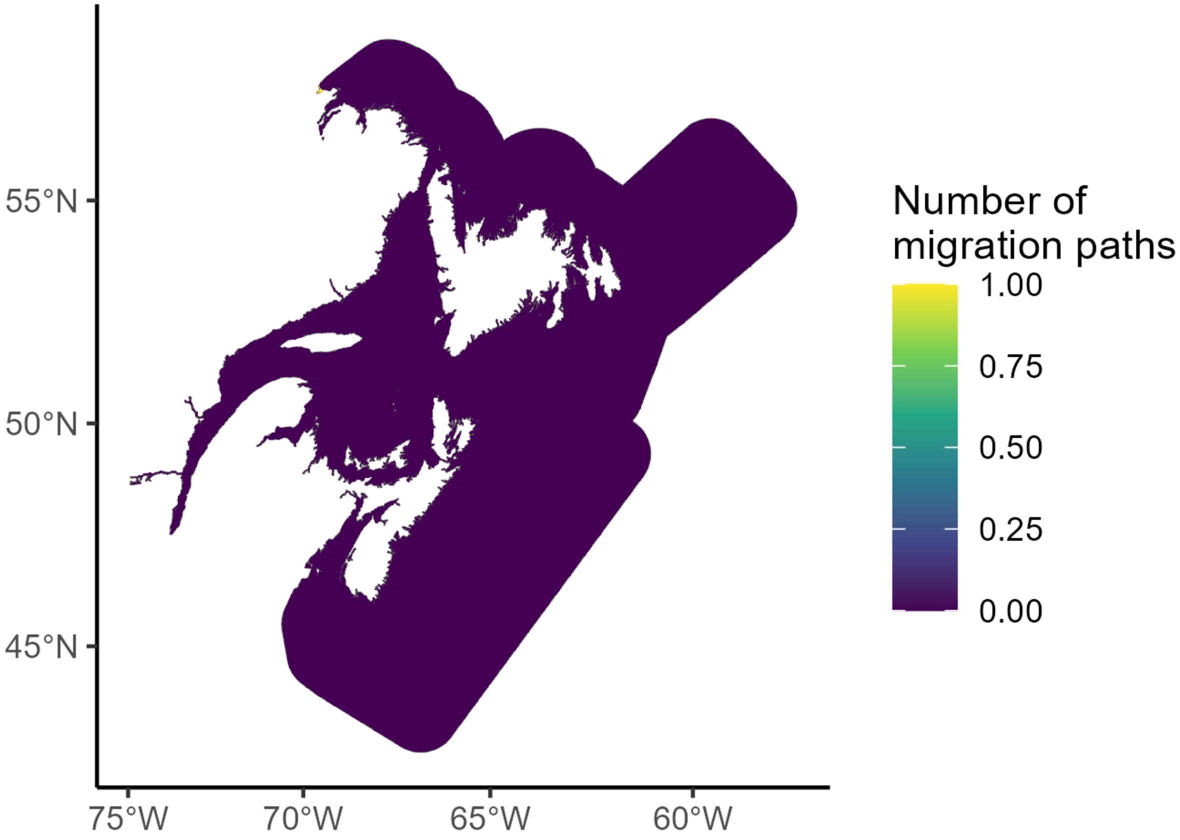
American Black Duck (ABDU)



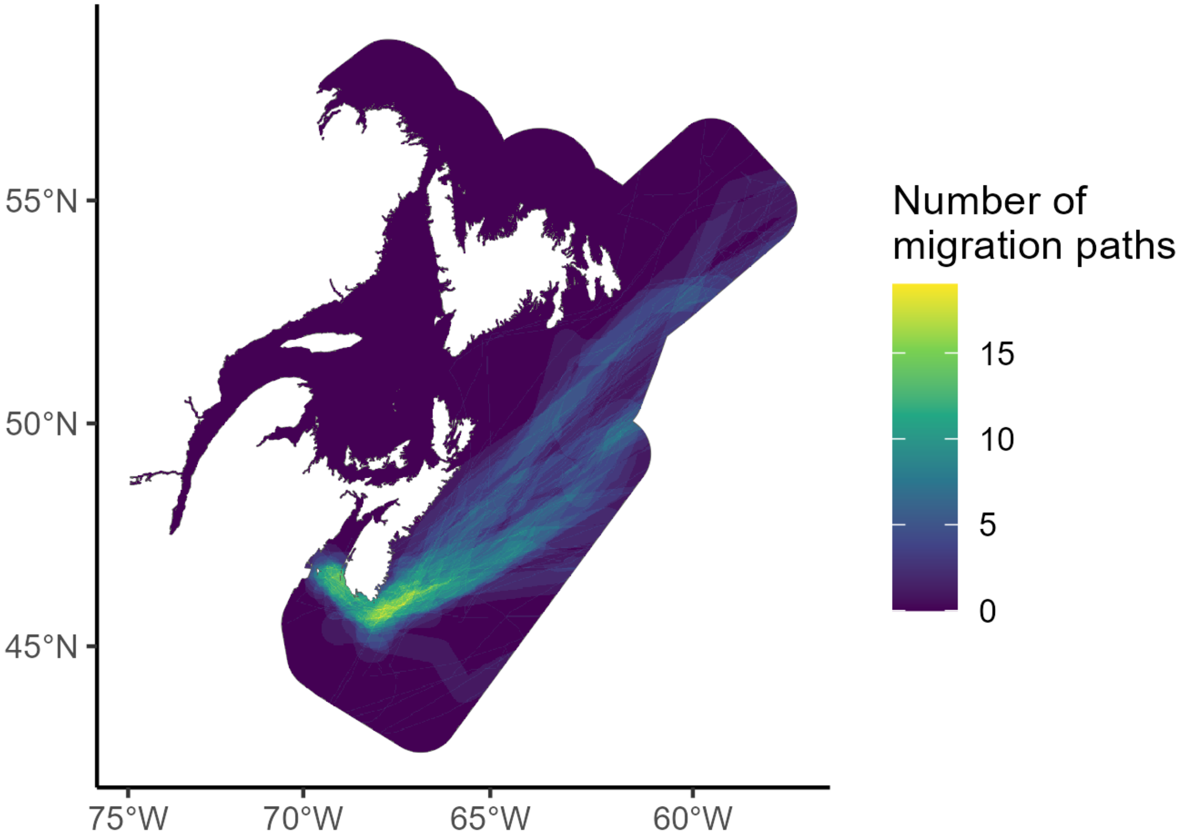
Black Scoter (BLSC)



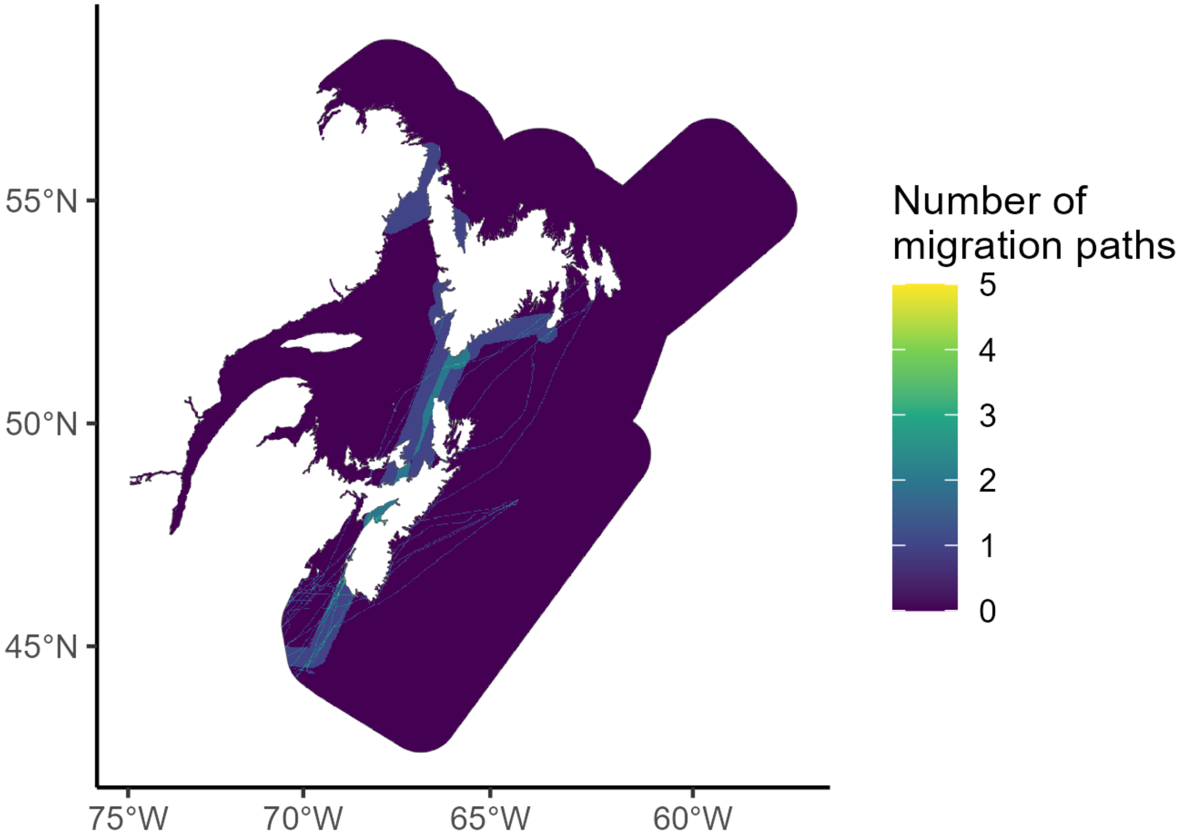
Common Eider (COEI)



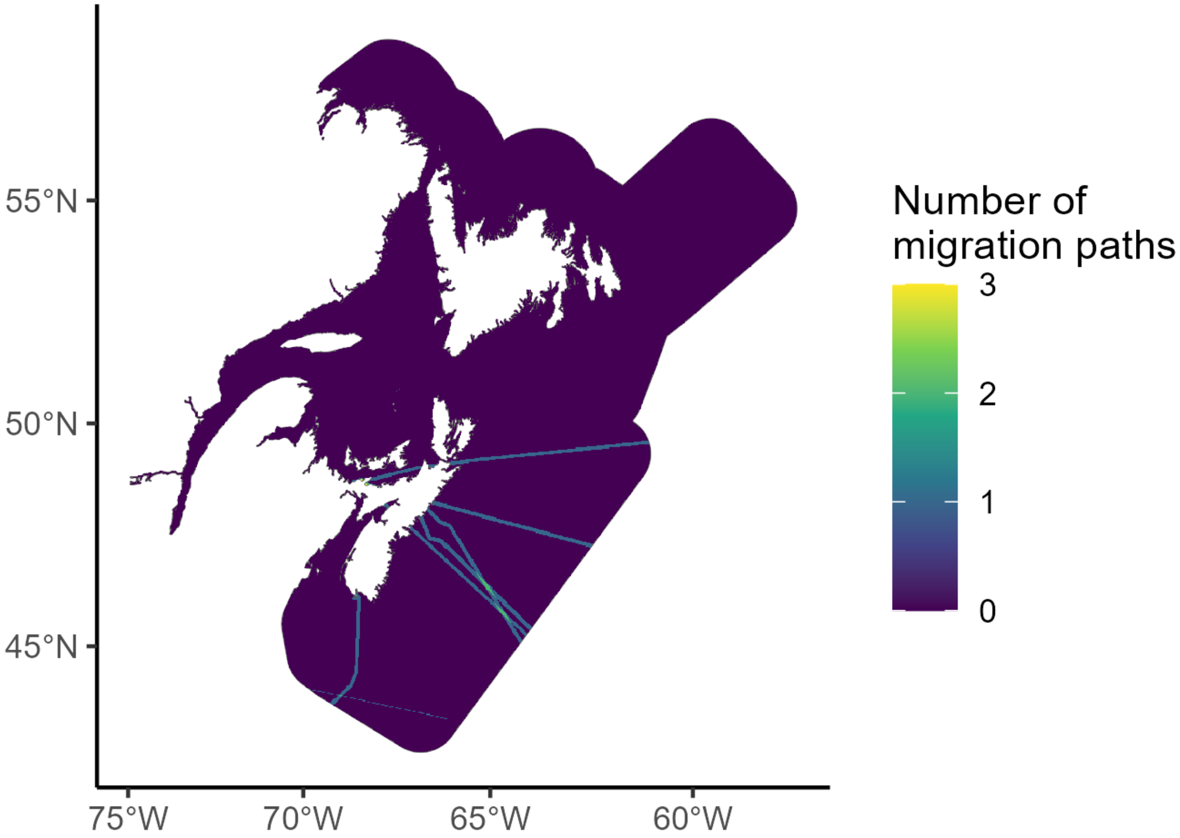
Great Shearwater (GRSH)



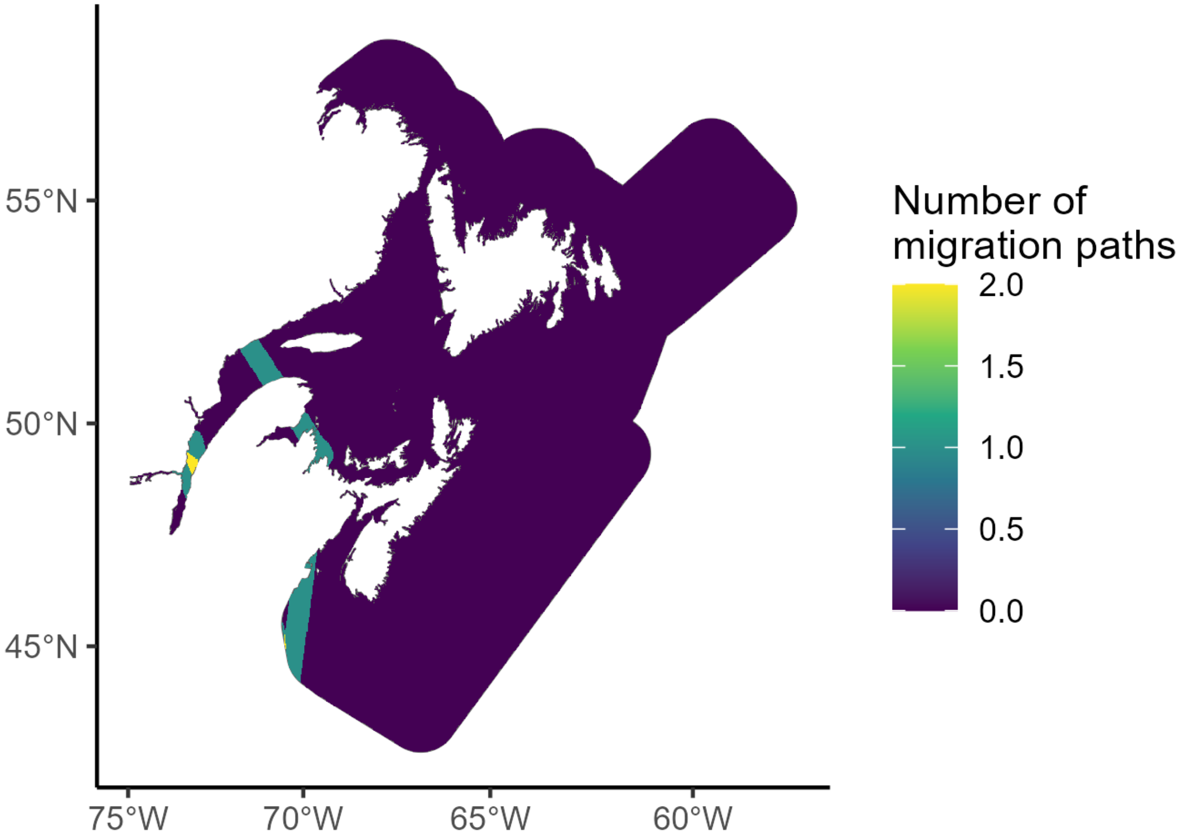
Herring Gull (HERG)



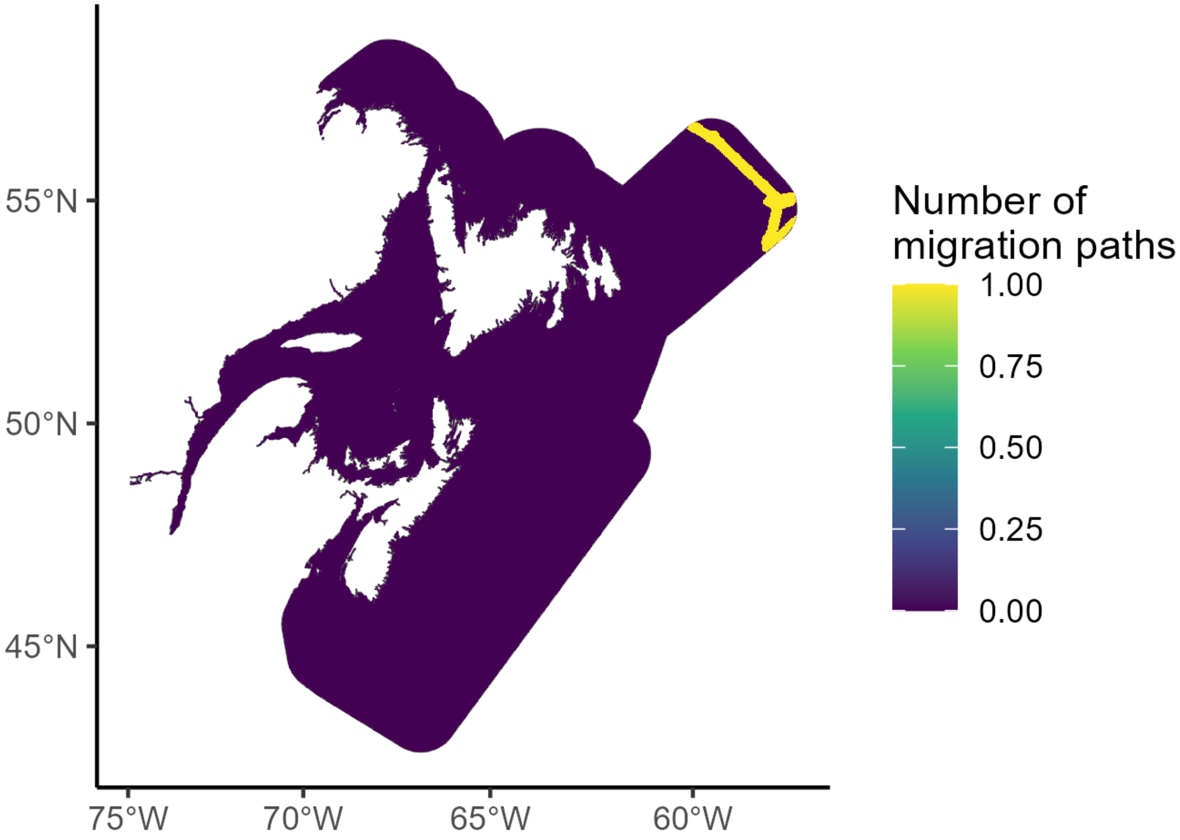
Lesser Yellowlegs (LEYE)



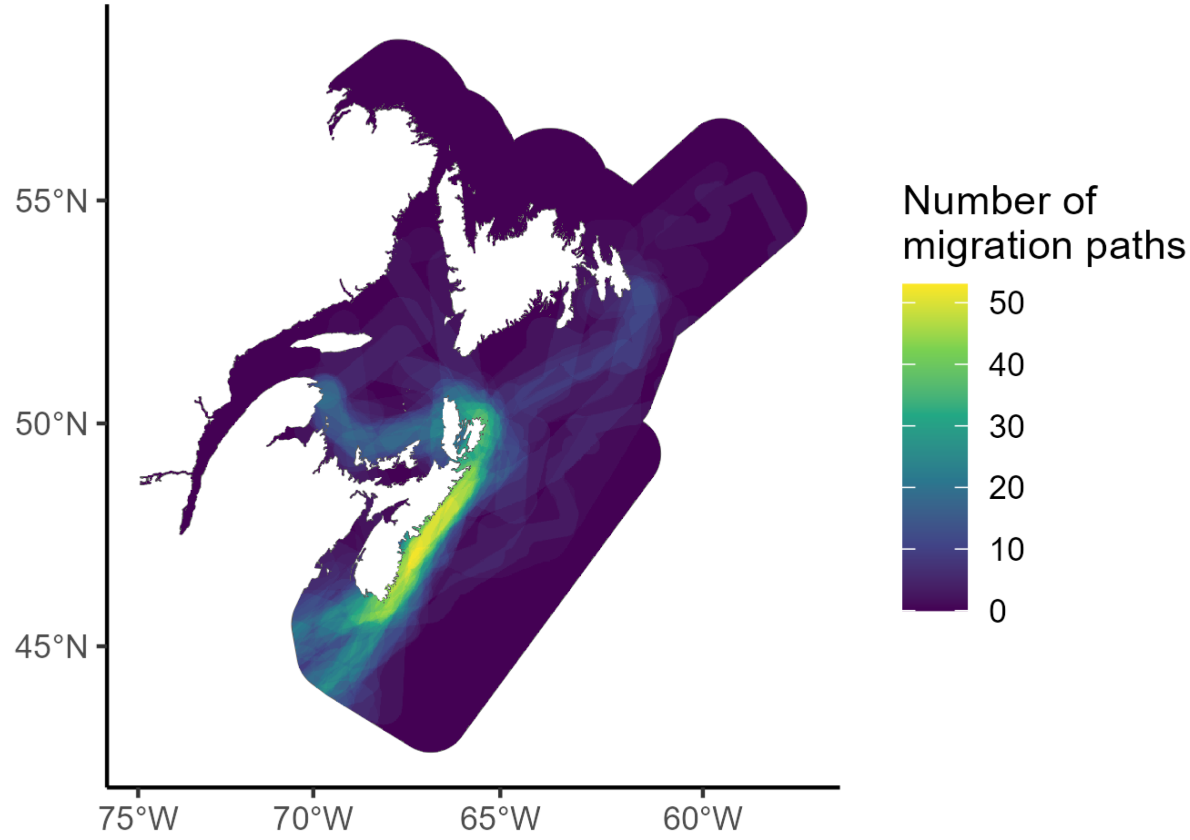
Long-tailed Duck (LTDU)



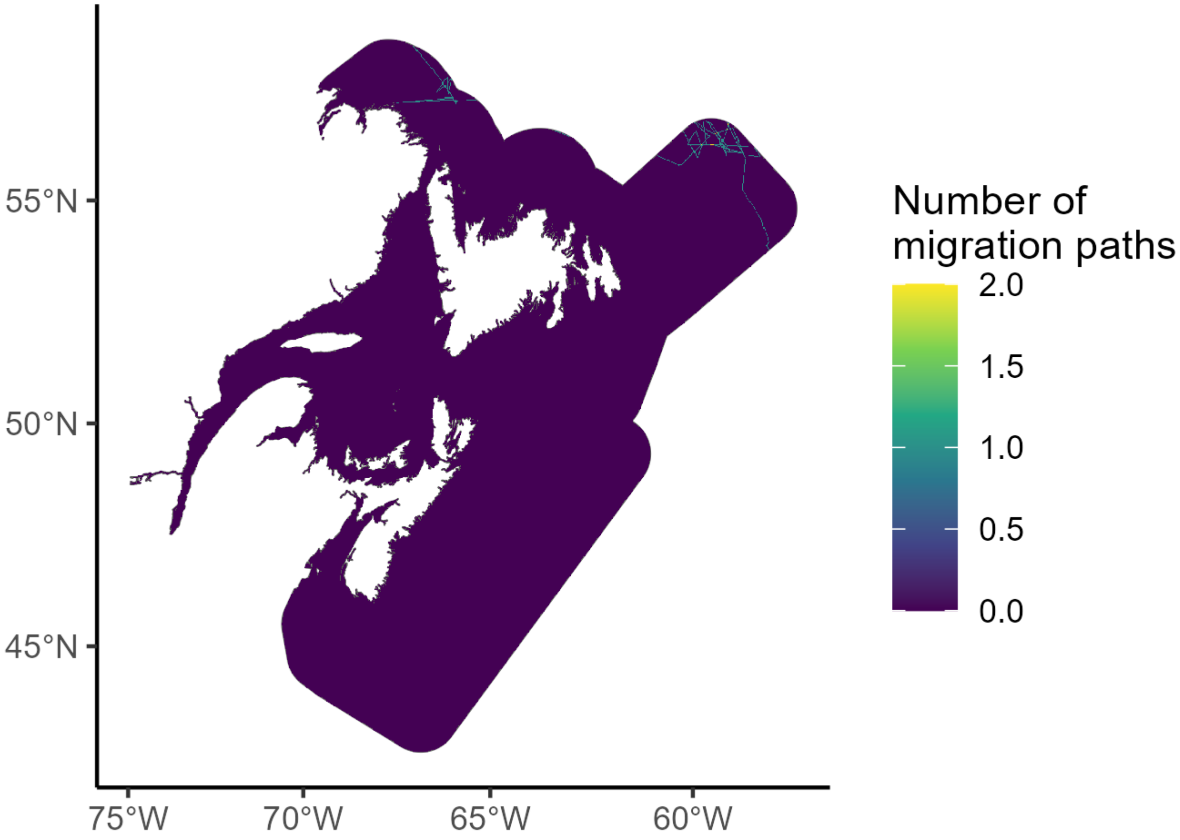
Long-tailed Jaeger (LTJA)



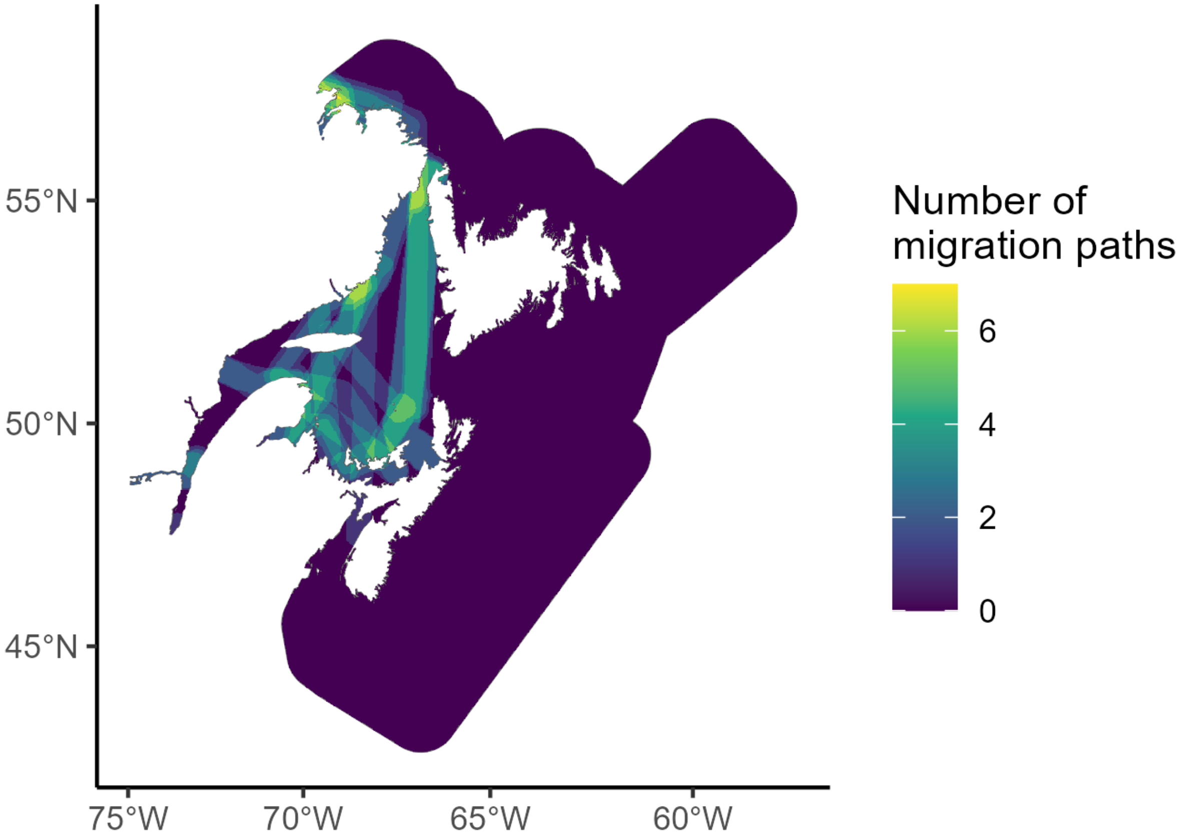
Northern Gannet (NOGA)



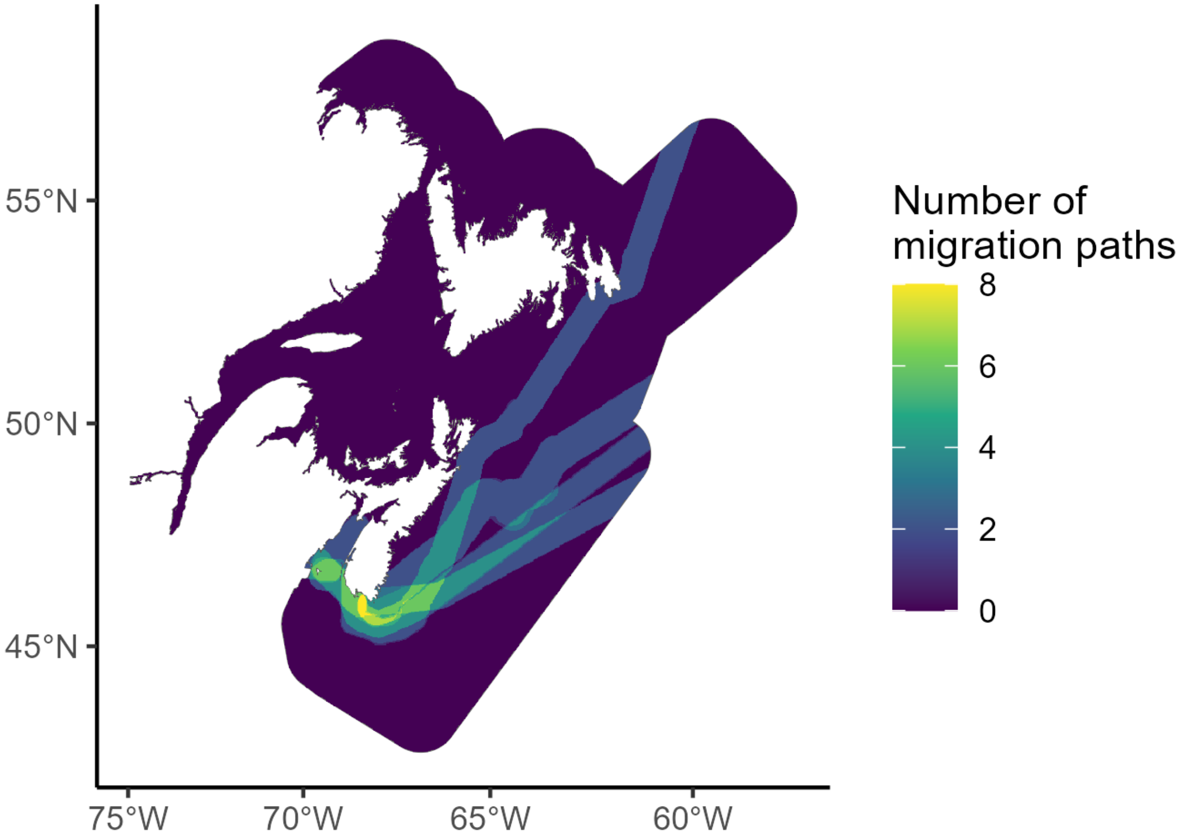
Parasitic Jaeger (PAJA)



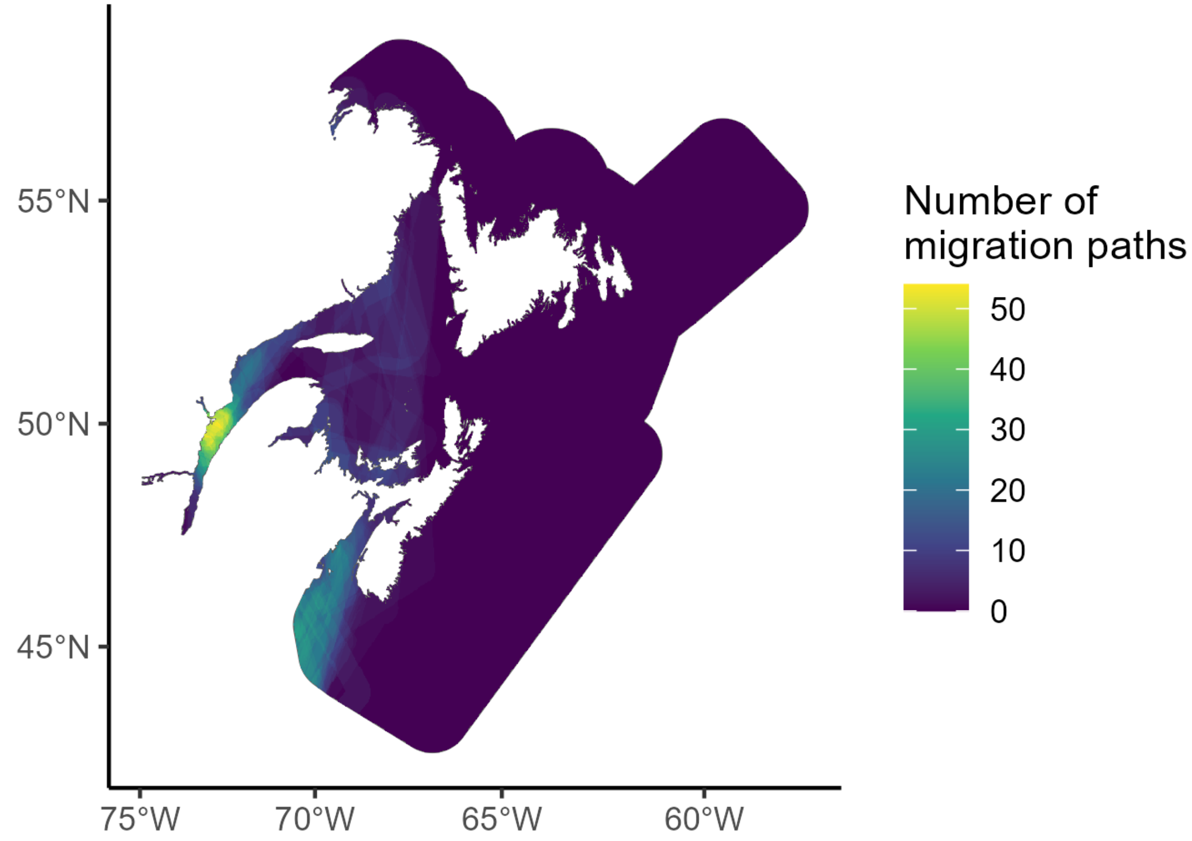
Red-throated Loon (RTLO)



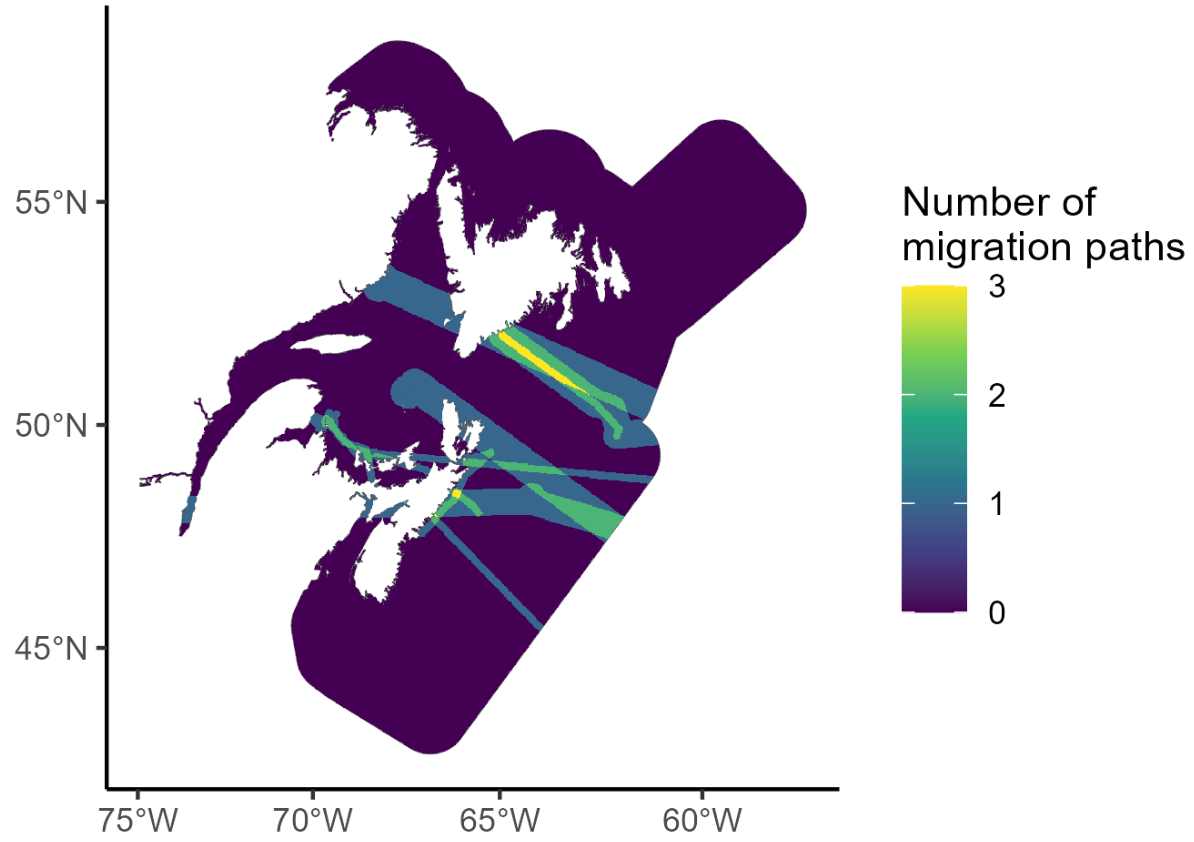
Sooty Shearwater (SOSH)



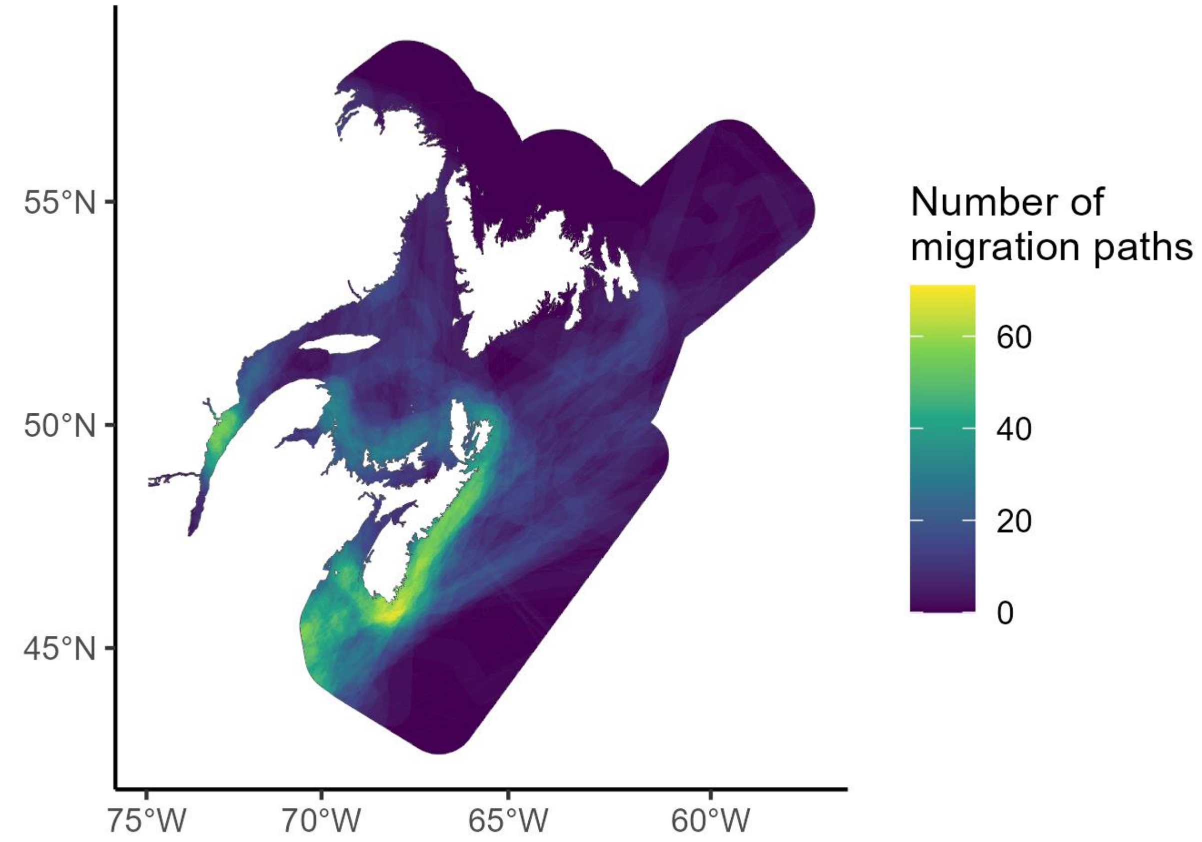
Surf Scoter (SUSC)



Whimbrel (WHIM)

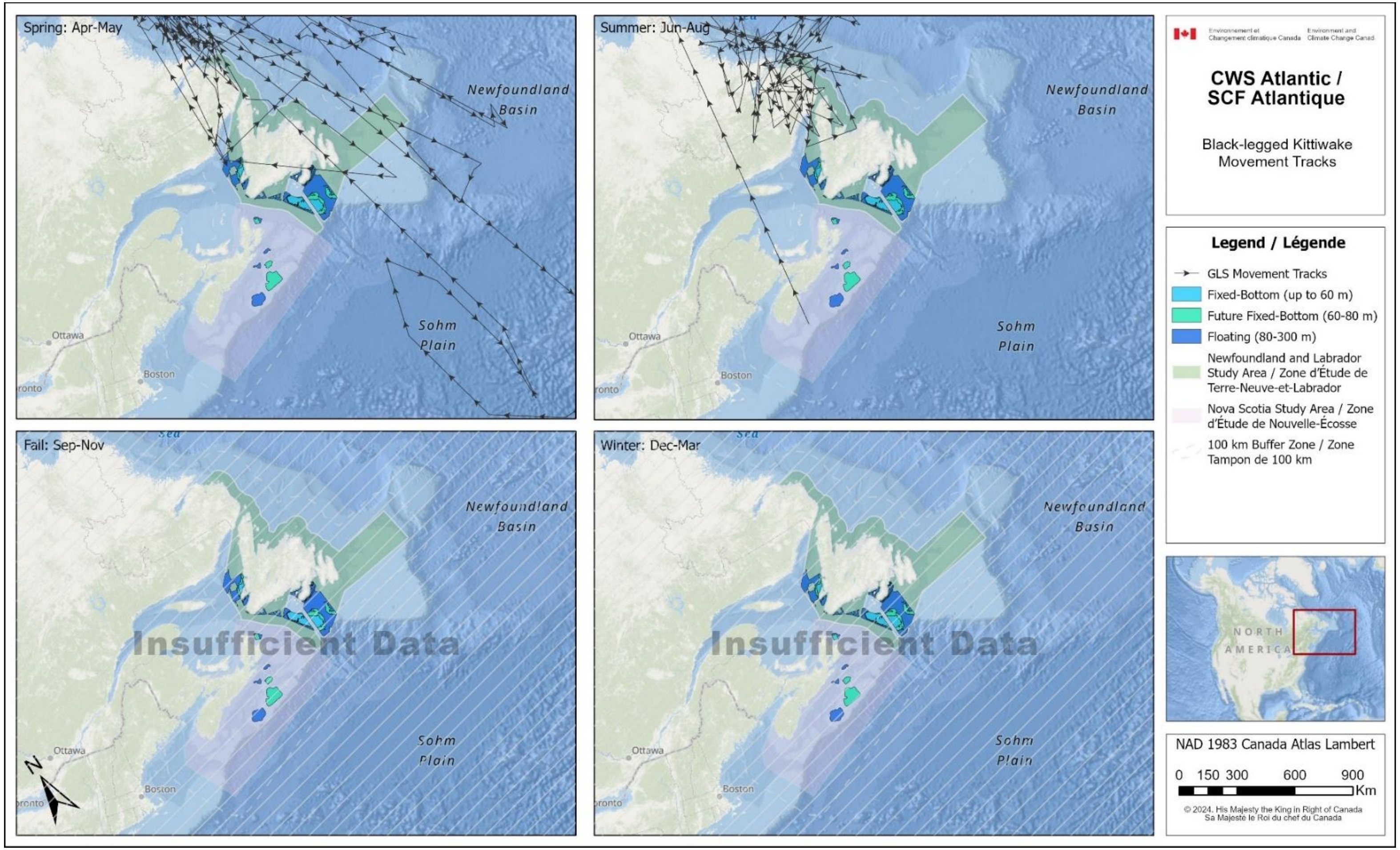


All Fall Error Mean Migration Corridors

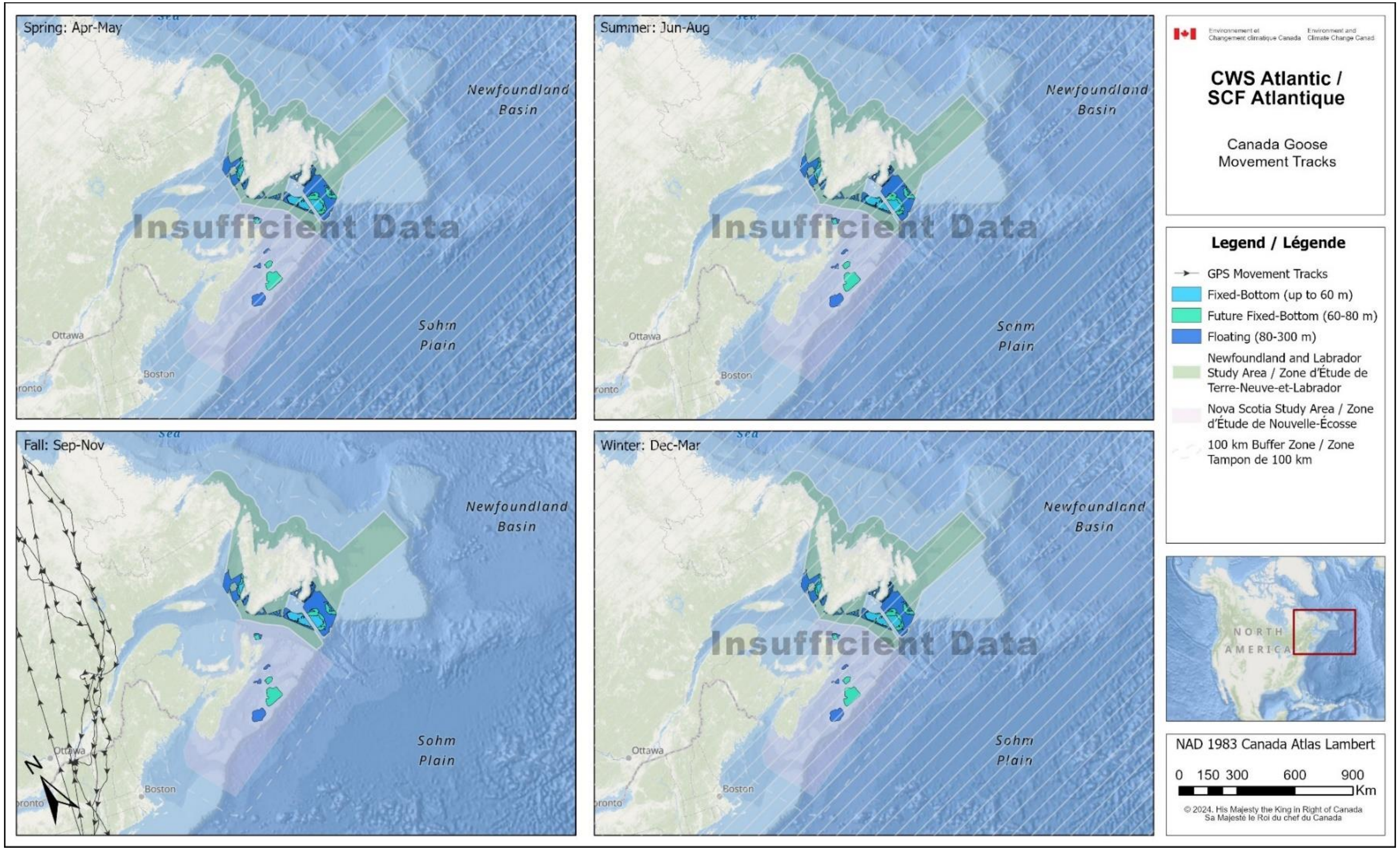


Movement Tracks

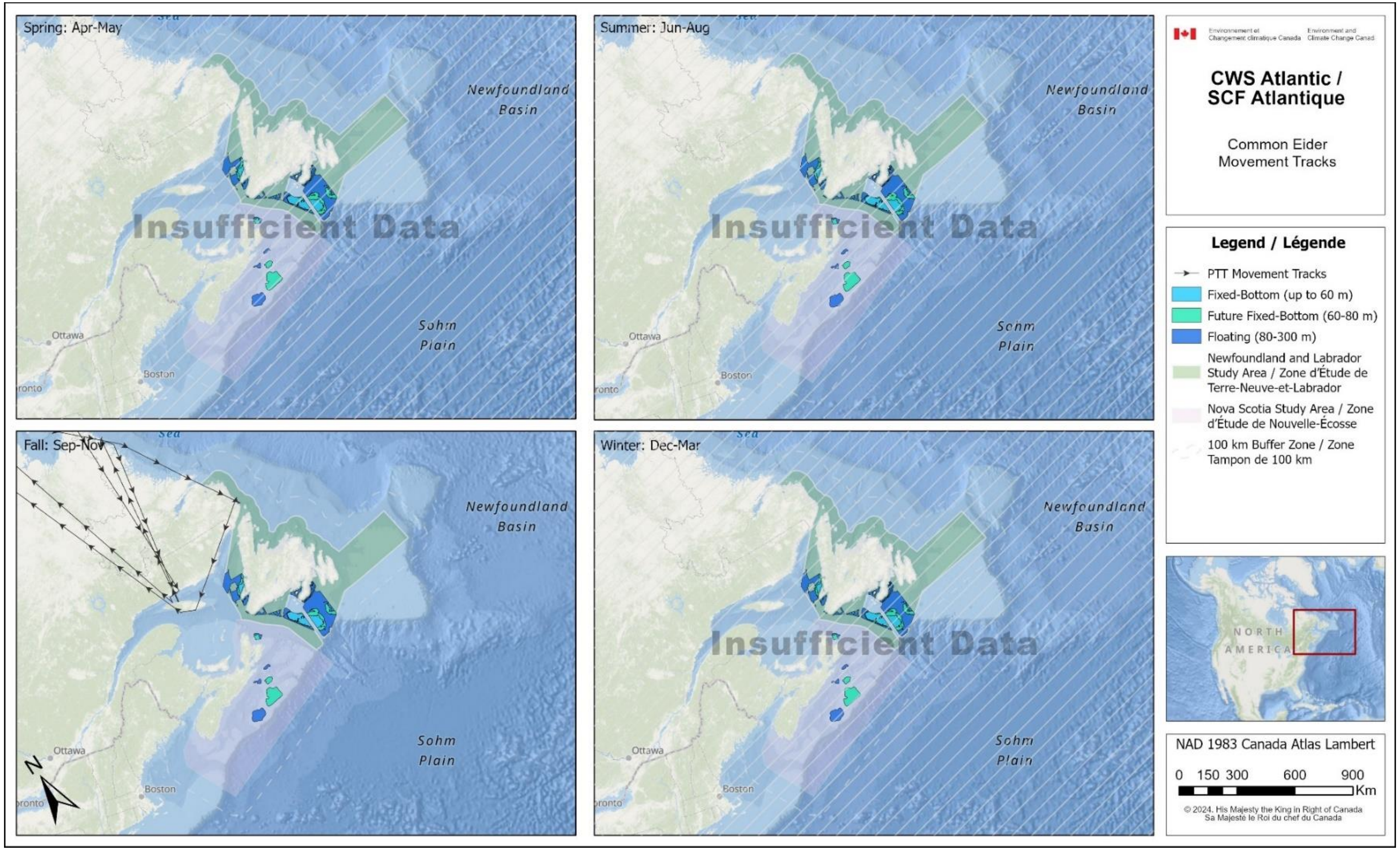
Black-legged Kittiwake (BLKI)



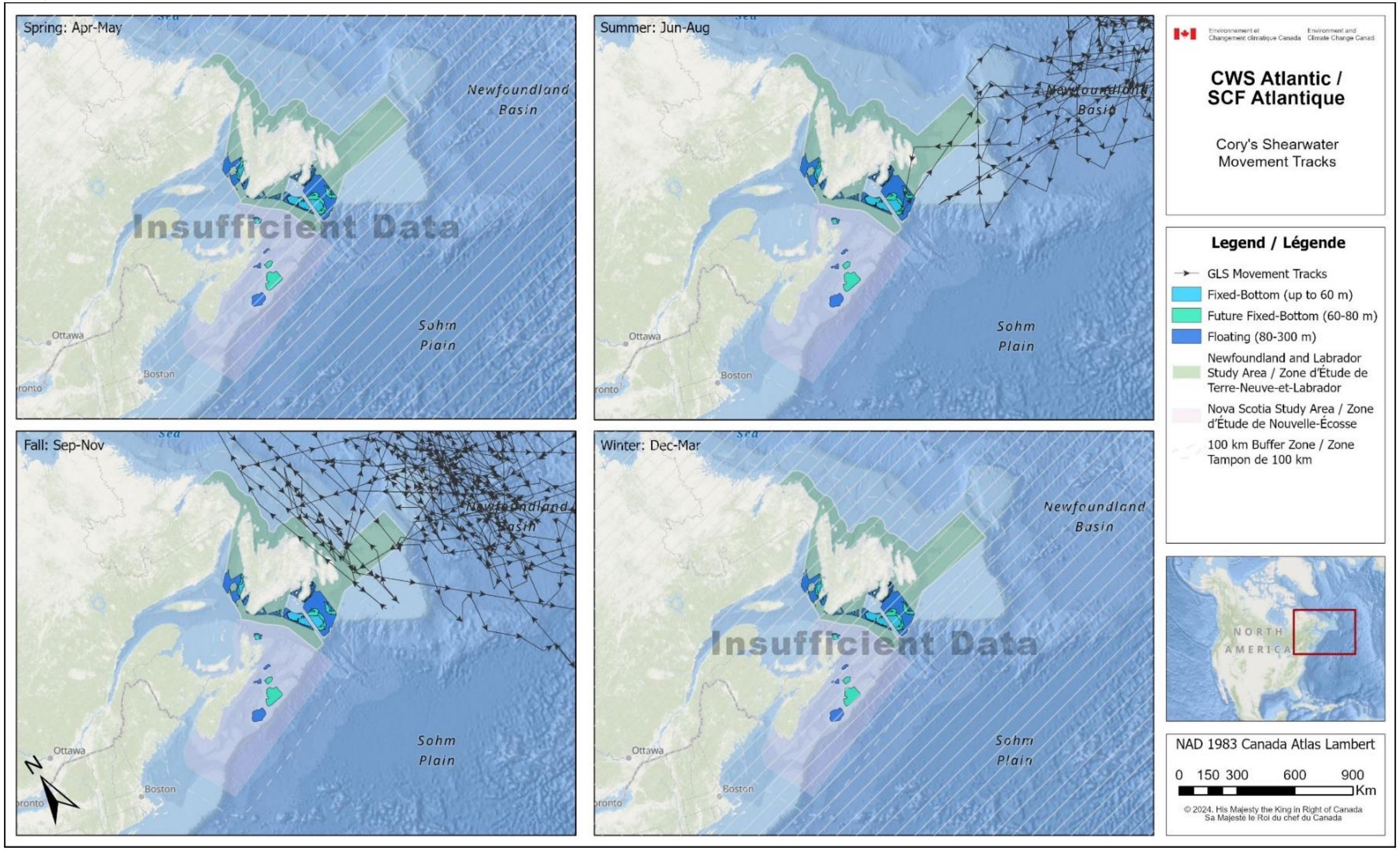
Canada Goose (CCGO)



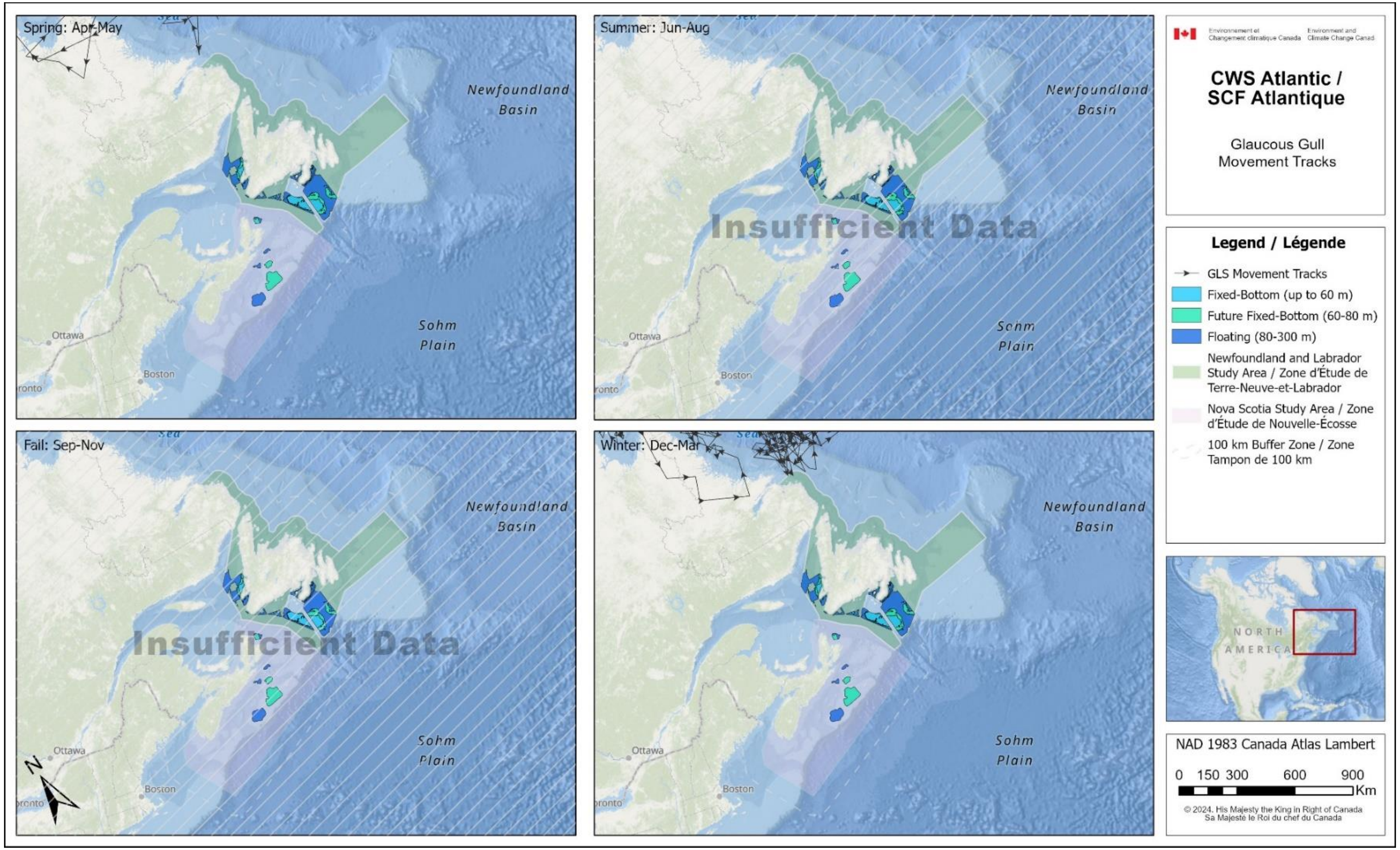
Common Eider (COEI)



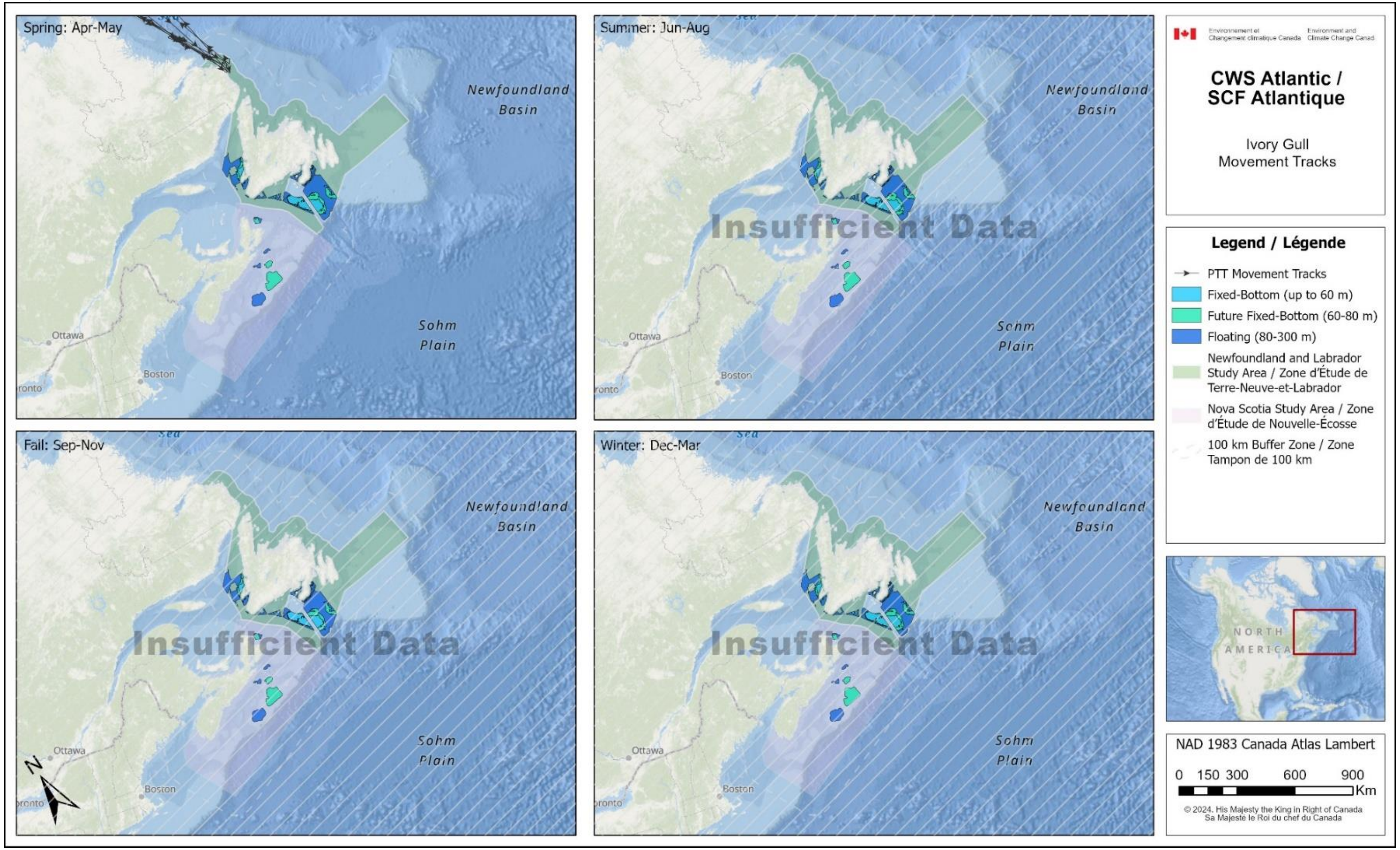
Cory's Shearwater (CORS)



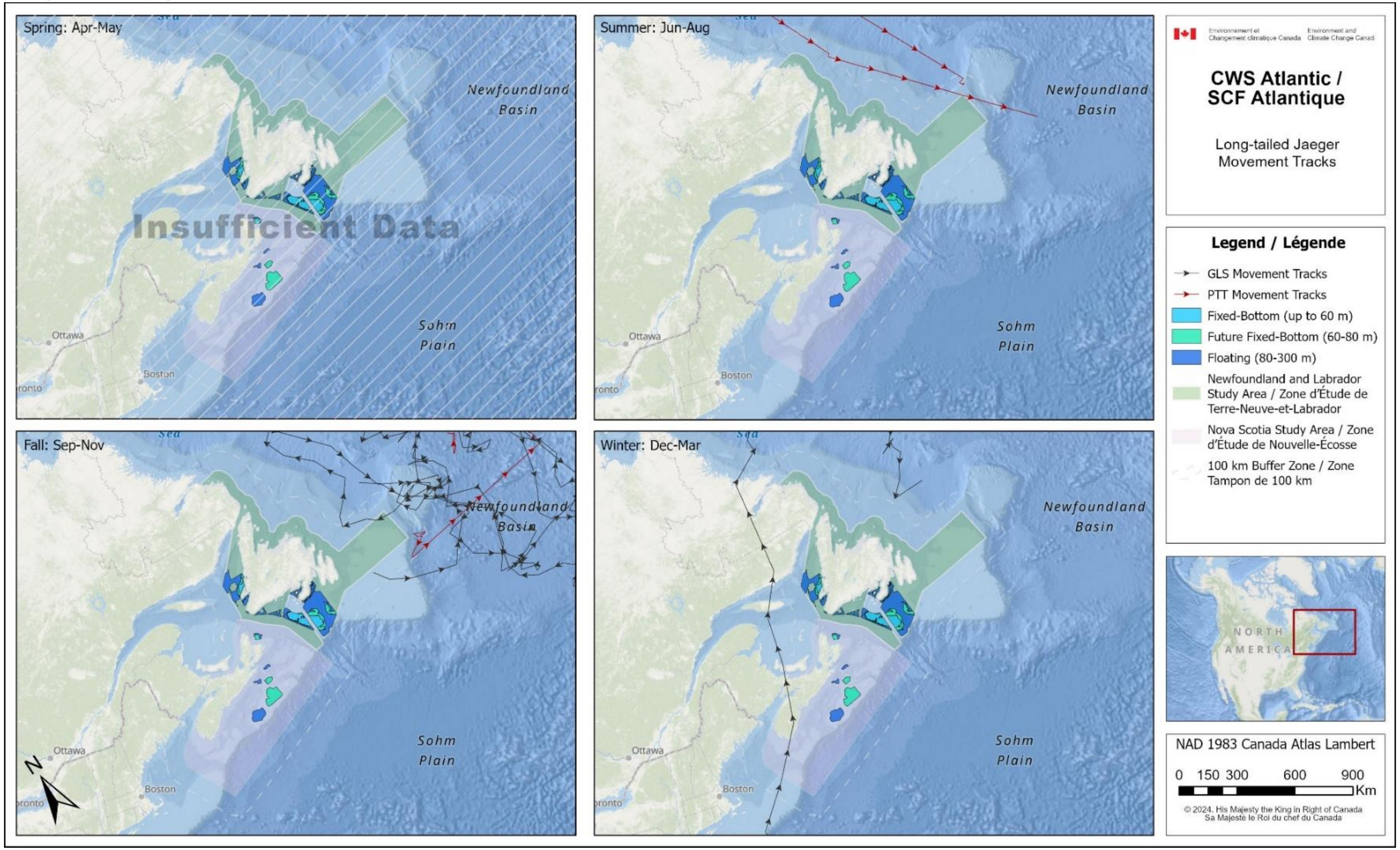
Glaucous Gull (GLGU)



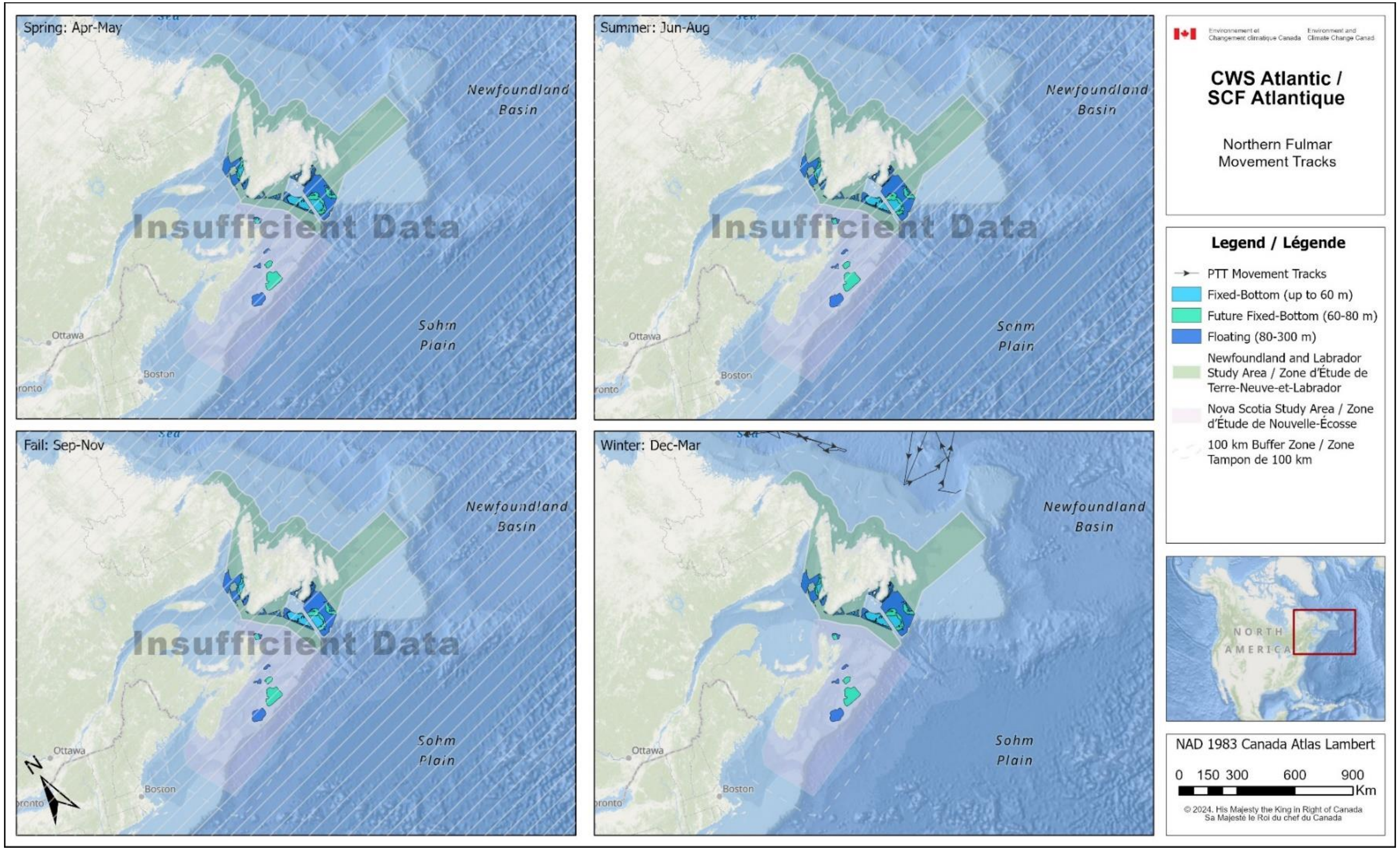
Ivory Gull (IVGU)



Long-tailed Jaeger (LTJA)



Northern Fulmar (NOFU)



Parasitic Jaeger (PAJA)