APPENDICES 1–13

FORAGING BEHAVIOUR OF GREAT BLACK-BACKED GULLS *LARUS MARINUS* BREEDING IN SOUTHERN NORWAY AS REVEALED BY GPS TRACKING

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APPENDIX 1 The identity (colour ring/logger ID), sex, clutch size at capture and number of fledglings ringed of Great Black-backed Gulls (= 25) fitted with a GPS transmitter. If freshly hatched chicks were present in the nest when the parent was caught, these were included in clutch size.

Bird/logger ID	Sex	Wing (mm)	Mass (g)	Head-bill (mm)	Clutch size	Fledglings
B-J51HE/243282	Female	494	1,450	130.5	3	1
B-J52HE/243262	Female	483	1,380	129.3	3	0
B-J53HE/243266	Female	483	1,420	134.0	3	2
B-J54HE/243276	Male	521	1,890	152.0	3	2
B-J55HE/243269	Male	510	1,790	148.9	3	2
B-J56HE/243272	Female	478	1,480	132.6	3	1
B-J57HE/243264	Female	469	1,460	132.4	2	2
B-J58HE/243277	Female	493	1,540	136.7	1	1
B-J59HE/243281	Female	494	1,480	135.8	3	3
B-J61HE/243279	Female	484	1,620	137.8	3	2
B-J63HE/243259	Female	489	1,430	135.4	2	0
B-J64HE/243268	Male	504	1,880	145.0	2	0
B-J65HE/243283	Female	477	1,370	133.6	3	3
B-J66HE/243274	Female	477	1,680	138.3	3	3
B-J67HE/243265	Female	482	1,630	136.0	3	1
B-J68HE/243275	Female	471	1,460	134.9	2	2
B-J69HE/243271	Male	511	1,940	145.6	2	0
B-J70HE/243278	Female	489	1,540	136.9	3	2
B-J71HE/243261	Male	524	1,720	145.2	3	1
B-J72HE/243280	Female	497	NA	134.5	3	1
B-J73HE/243273	Female	486	NA	136.6	3	2
B-J74HE/243270	Male	506	1,930	148.2	3	3
B-J75HE/243260	Female	478	1,430	135.6	3	2
B-J76HE/243263	Female	471	1,440	130.6	2	2
B-JR165/243267	Male	503	1,780	147.6	2	0

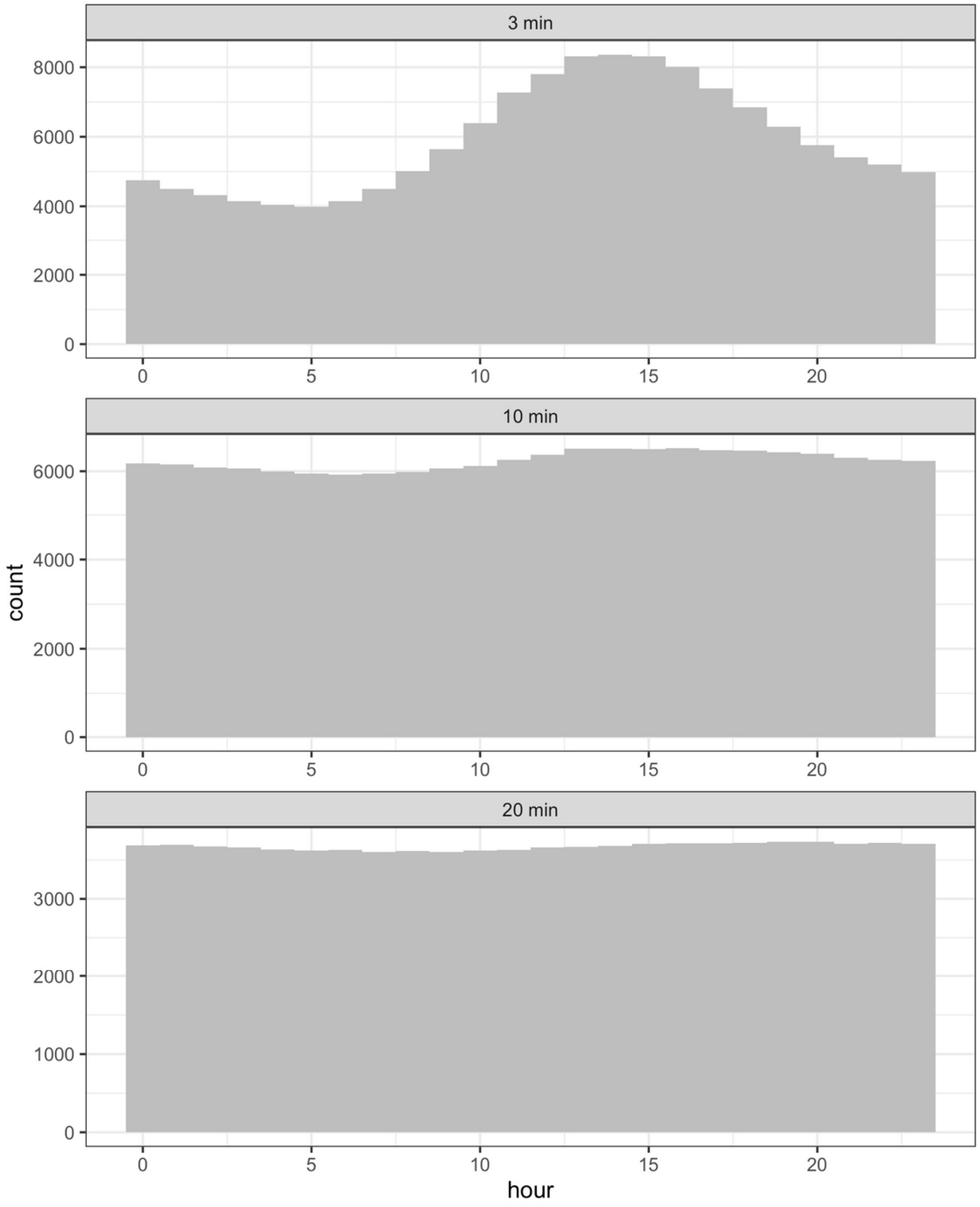
APPENDIX 2 Overview of GPS logger deployments on Great Black-backed Gulls (*n* = 25) in Norway

	logger ID	sex	first fix date	first fix time	last fix date	last fix time
1	243259	F	27/05/2024	15:50:59	21/07/2024	07:40:03
2	243260	F	29/05/2024	09:41:05	31/07/2024	23:54:28
3	243261	M	28/05/2024	18:12:59	31/07/2024	23:54:43
4	243262	F	27/05/2024	10:52:05	31/07/2024	23:59:49
5	243263	F	28/05/2024	18:06:05	31/07/2024	23:58:46
6	243264	F	27/05/2024	13:23:59	31/07/2024	23:50:10
7	243265	F	27/05/2024	19:13:29	31/07/2024	23:54:19
8	243266	F	27/05/2024	11:42:23	31/07/2024	23:59:11
9	243267	M	27/05/2024	11:27:23	31/07/2024	23:56:34
10	243268	M	27/05/2024	15:43:44	31/07/2024	23:58:13
11	243269	M	27/05/2024	13:02:23	31/07/2024	23:56:12
12	243270	M	27/05/2024	19:21:55	31/07/2024	23:58:29
13	243271	M	27/05/2024	20:04:35	31/07/2024	23:55:57
14	243272	F	27/05/2024	13:05:05	31/07/2024	23:57:07
15	243273	F	28/05/2024	18:00:36	31/07/2024	23:52:44
16	243274	F	27/05/2024	19:20:35	31/07/2024	23:56:15
17	243275	F	27/05/2024	19:13:23	31/07/2024	23:59:59
18	243276	M	27/05/2024	12:52:35	31/07/2024	23:59:43
19	243277	F	27/05/2024	15:37:14	31/07/2024	23:57:32
20	243278	F	27/05/2024	15:55:53	12/06/2024	14:51:29
21	243279	F	27/05/2024	13:21:15	31/07/2024	23:59:03
22	243280	F	27/05/2024	19:22:35	31/07/2024	23:55:45
23	243281	F	27/05/2024	16:26:36	31/07/2024	23:58:02
24	243282	F	27/05/2024	08:23:29	31/07/2024	23:58:32
25	243283	F	27/05/2024	19:56:36	31/07/2024	23:59:19

APPENDIX 3 Sampling intervals for 25 GPS-tagged Great Black-backed Gulls. ID 243278 presumably died or lost its logger on 12 June 2024.



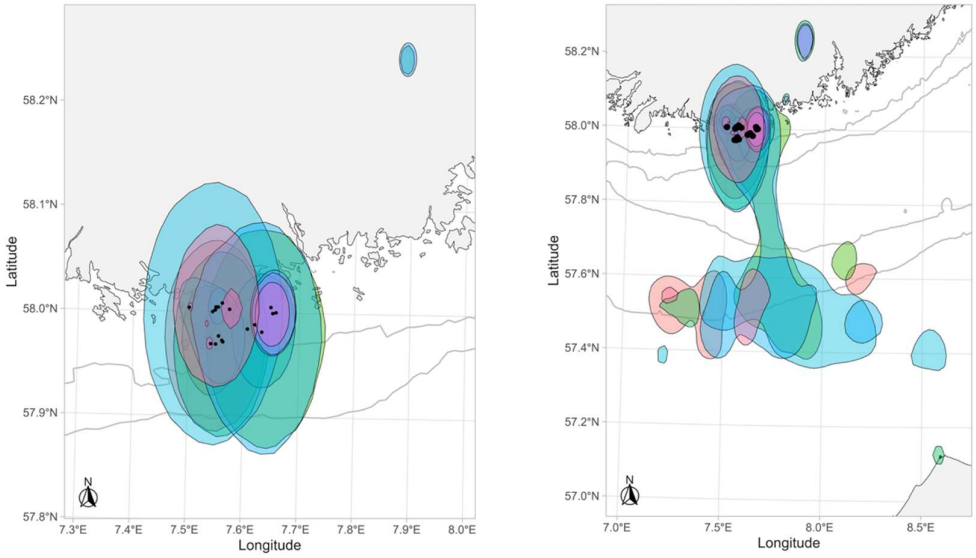
APPENDIX 4 Distribution of tracking data from Great Black-backed Gulls regularised to 3-, 10- or 20-min intervals across the day.



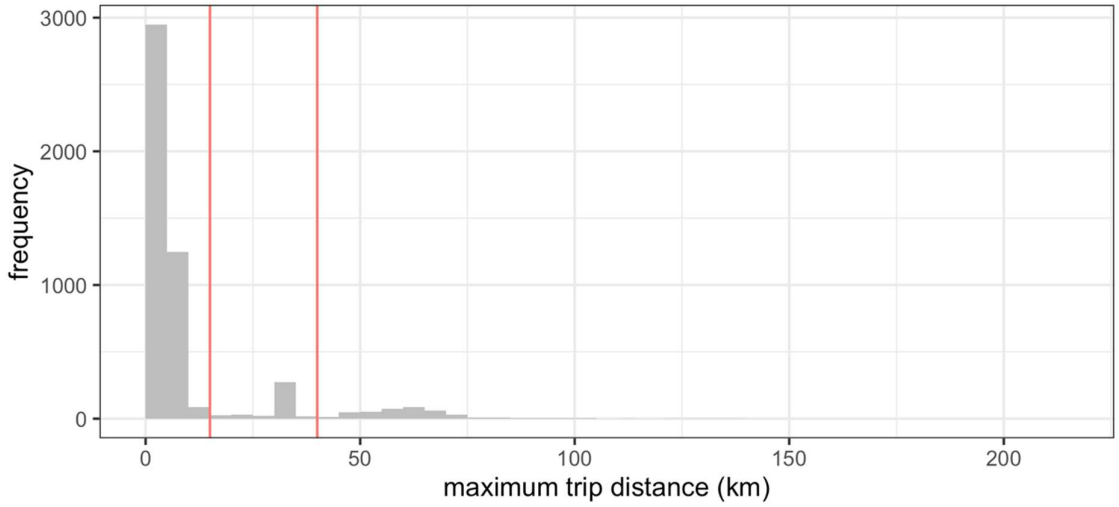
APPENDIX 5 KDE overlap (>50%) of 15 Great Black-backed Gulls tracked from a breeding colony in southern Norway.

	Logger ID	Significant count average	Overlap (%)
1	243264	12	0.667
2	243273	12	0.666
3	243260	11	0.705
4	243272	11	0.666
5	243283	11	0.727
6	243261	10	0.703
7	243270	10	0.723
8	243275	9	0.698
9	243276	9	0.702
10	243279	9	0.665
11	243281	7	0.689
12	243269	6	0.740
13	243282	5	0.662
14	243277	4	0.774
15	243266	1	0.803

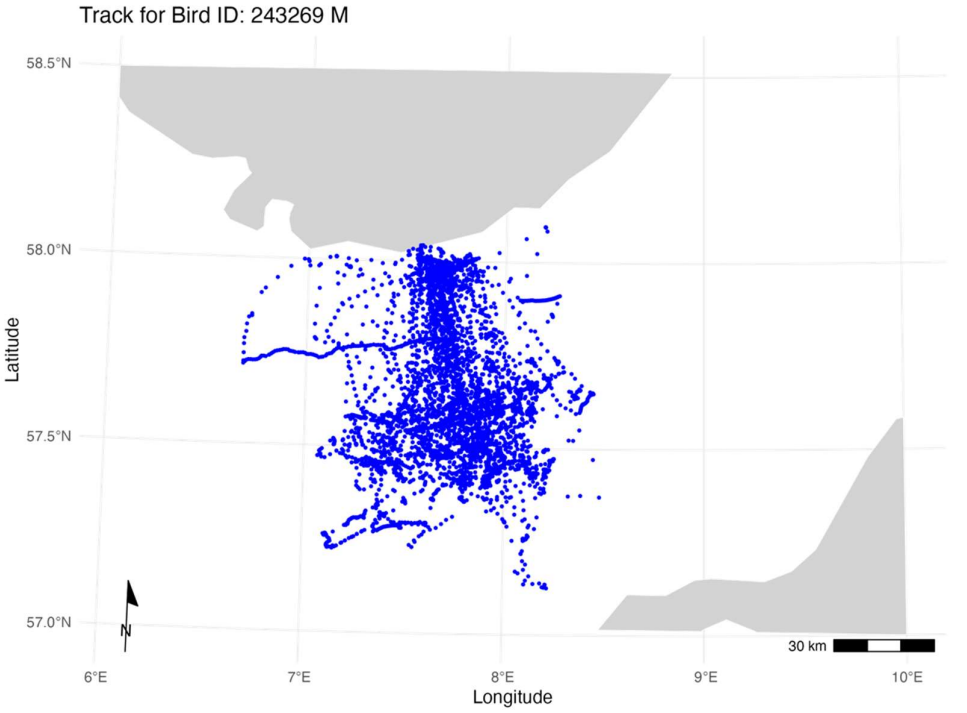
APPENDIX 6 Kernel density plots (left: 50% and right: 75% KDE) showing main foraging areas of Great Black-backed Gulls with >50% overlap (*n* = 15) tracked from a breeding colony in southern Norway. Each colour represents one individual. Grey areas are southern Norway and north-western Denmark. Black dots are the birds' nesting sites. Grey lines denote bathymetry.

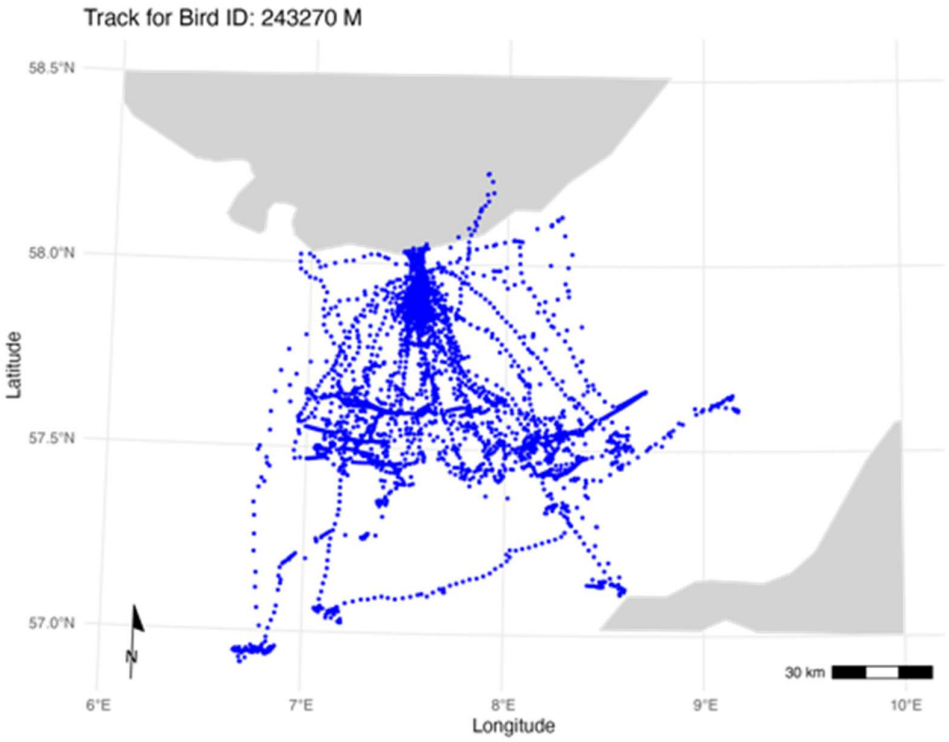


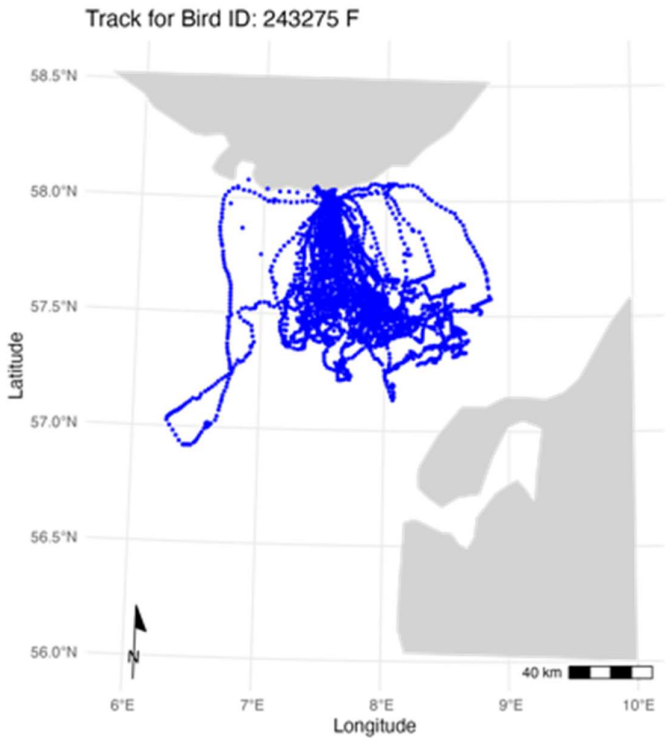
APPENDIX 7 Histogram of maximum trip distance of 20 Great Black-backed Gulls based on GPS tracking data. Red vertical lines indicate distances of 15 and 40 km; boundaries between trips that were classified as ‘short’, ‘medium’ and ‘long’.

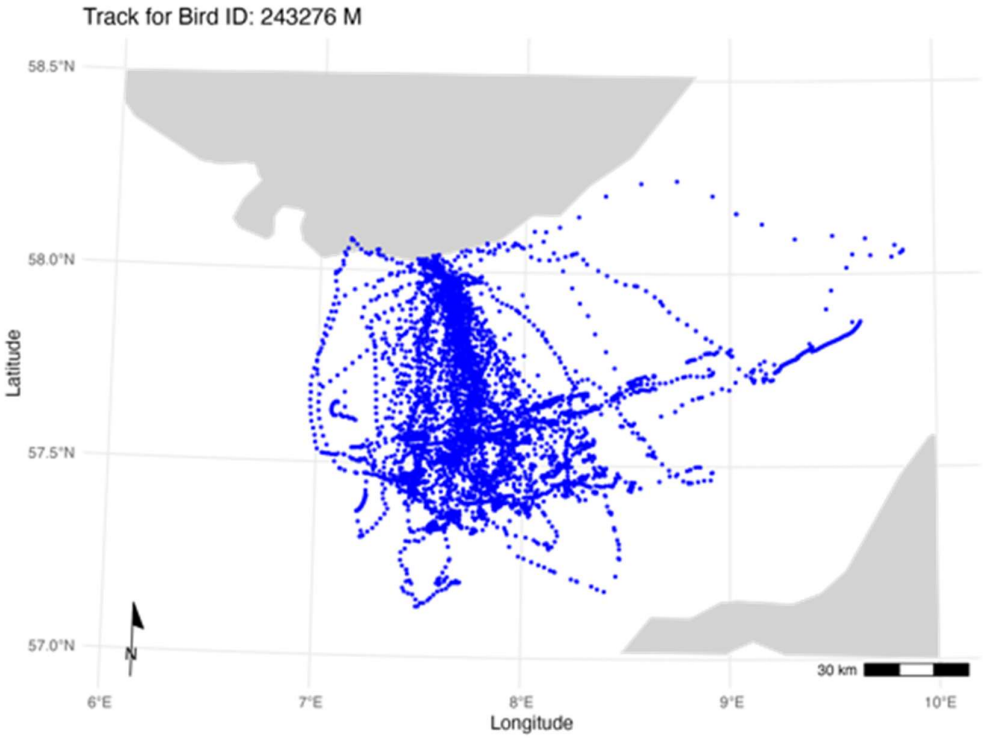


APPENDIX 8 Maps of four Great Black-backed Gulls that undertook foraging trips of more than 100 km from the nest.

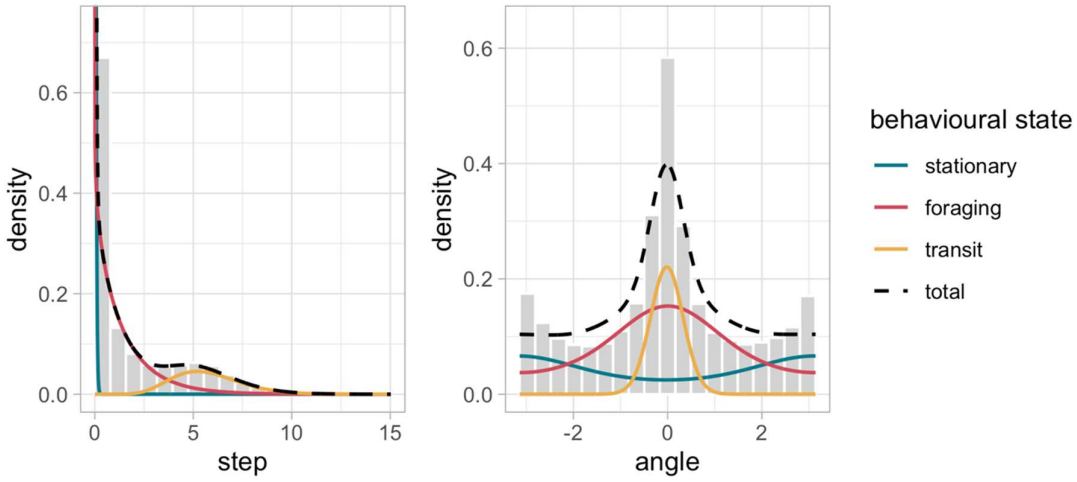


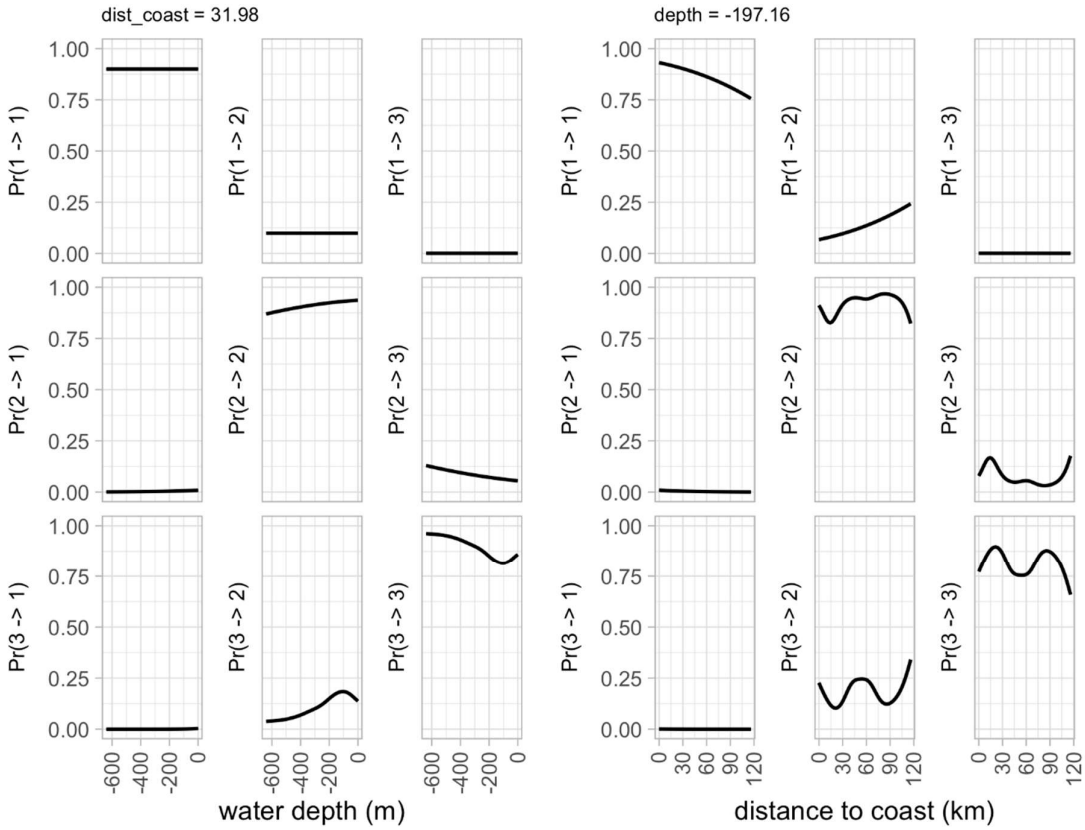



Track for Bird ID: 243275 F
58.5°N
58.0°N
57.5°N
57.0°N
56.5°N
56.0°N
Latitude
N
40 km
6°E
7°E
8°E
9°E
10°E
Longitude

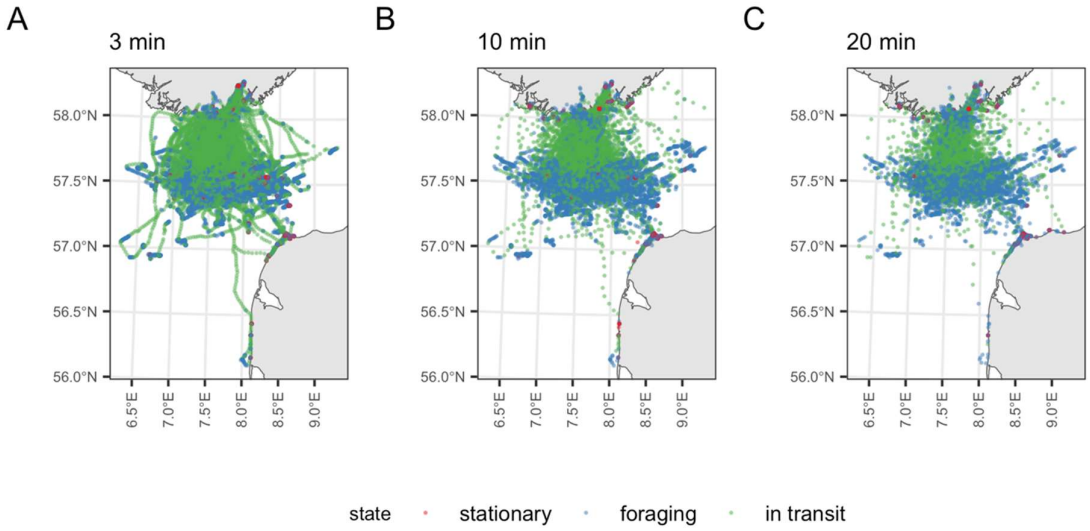

Track for Bird ID: 243276 M
58.5°N
58.0°N
57.5°N
57.0°N
Latitude
N
30 km
6°E
7°E
8°E
9°E
10°E
Longitude

APPENDIX 9 Distribution of (left) step lengths and (right) turning angles of the three behavioural states for data regularised to 10-min intervals.

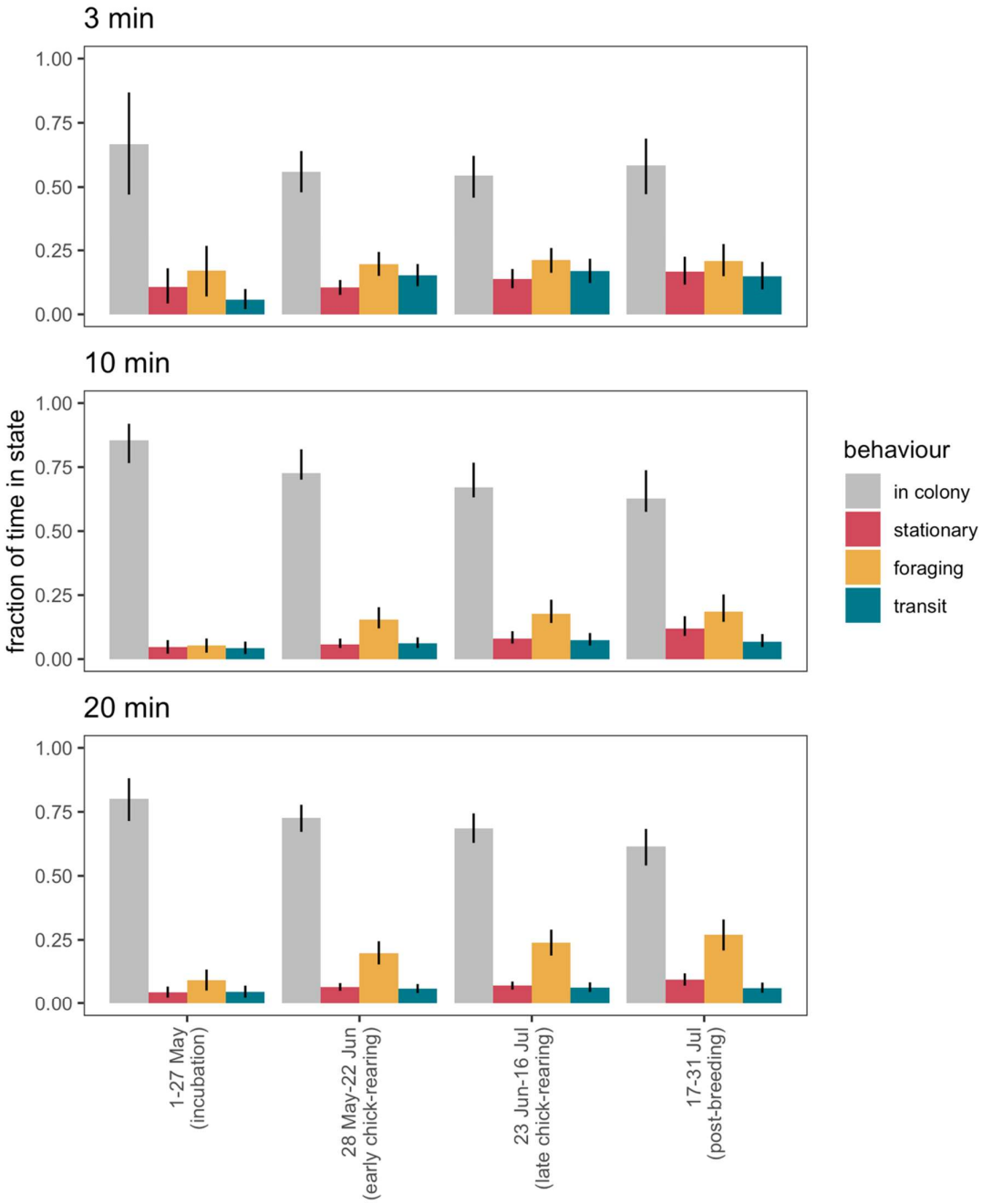




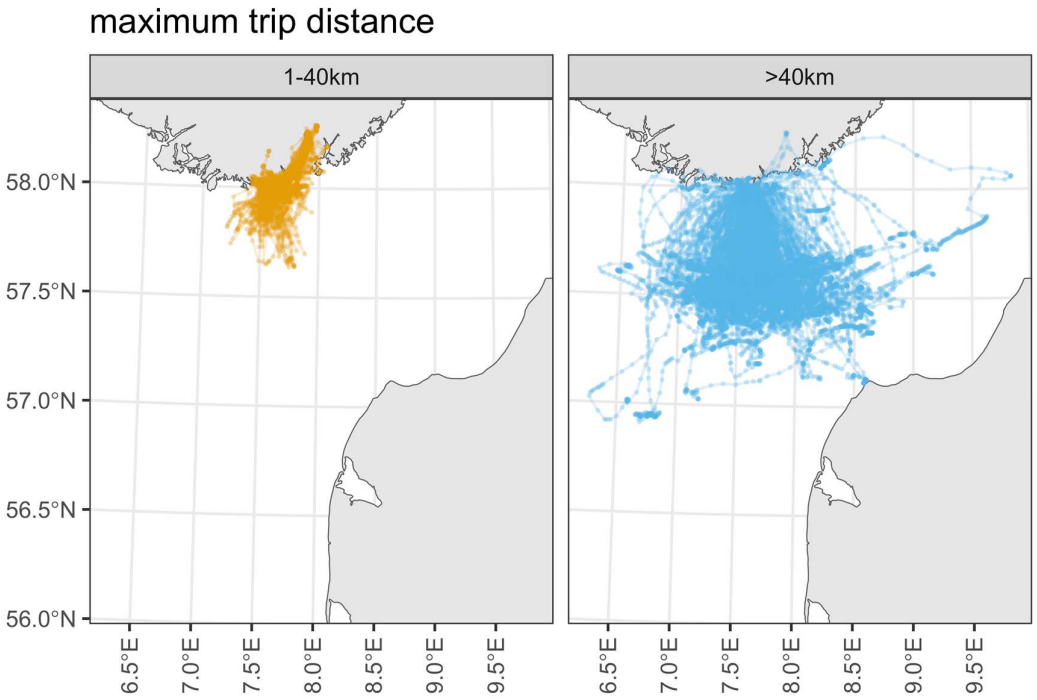
APPENDIX 10 *Conditional effects of water depth (left) and distance to the coast (right) on transition probabilities (i.e. the probability of switching from one behavioural state to another) in a three-state Hidden Markov Model. Values at the top of each figure represent the mean of the covariate held constant in the model while examining the effect of the other covariate on the probability of switching to another behavioural state. State 1 = stationary, 2 = foraging, state 3 = in transit.*



APPENDIX 11 *Maps showing three behavioural states based on Hidden Markov Models using tracking data regularised to A. 3-, B. 10- or C. 20-minute intervals.*



APPENDIX 12 *Time in states based on tracking data regularised to 3-, 10- or 20-minute intervals.*



APPENDIX 13 *GPS positions of Great Black-backed Gulls (n = 20), recorded during chick-rearing, of short and long trips. GPS fixes were resampled to 10-minute intervals. Grey areas are southern Norway, where the gulls breed, and north-western Denmark.*