

Migratory connectivity analysis

by EURING Migration Atlas

Fratercula arctica (EURING code 06540)

1.1 Connectivity between individuals

The analysis evaluated 193 individuals (386 encounters) filtered from a total of 103913 records in the EURING databank which were considered for the Atlas. The species shows a significant connectivity from clustering, with a number of first-level clusters = 2 (Table 06540-1; Figure 06540-1).

Table 06540-1. Results from the migratory connectivity analysis. For each cluster, the degree of connectivity (r_M), its statistical significance (p-value) and 95% confidence interval limits are shown. When the p-value is less than or equal to 0.1, the degree of clustering structure (oasw) and the best number of clusters identified are reported.

Cluster name	Level of clustering	N individuals	Migratory connectivity (r_M)	p-value	Lower 95% confidence limit	Upper 95% confidence limit	Best number of clusters	oasw
0	0	193	0.363	0.001	0.248	0.464	2	0.559
1	1	143	0.162	0.004	0.025	0.305	2	0.524
2	1	50	0.437	0.001	0.227	0.637	6	0.634
11	2	26	0.553	0.001	0.245	0.854	2	0.549
12	2	117	-0.032	0.636	-0.118	0.100	-	-
21	2	4	-	-	-	-	-	-
22	2	16	-	-	-	-	-	-
23	2	3	-	-	-	-	-	-
24	2	20	0.000	0.408	-0.068	0.296	-	-
25	2	2	-	-	-	-	-	-
26	2	5	-	-	-	-	-	-
111	3	23	0.696	0.001	0.475	0.865	8	0.505
112	3	3	-	-	-	-	-	-

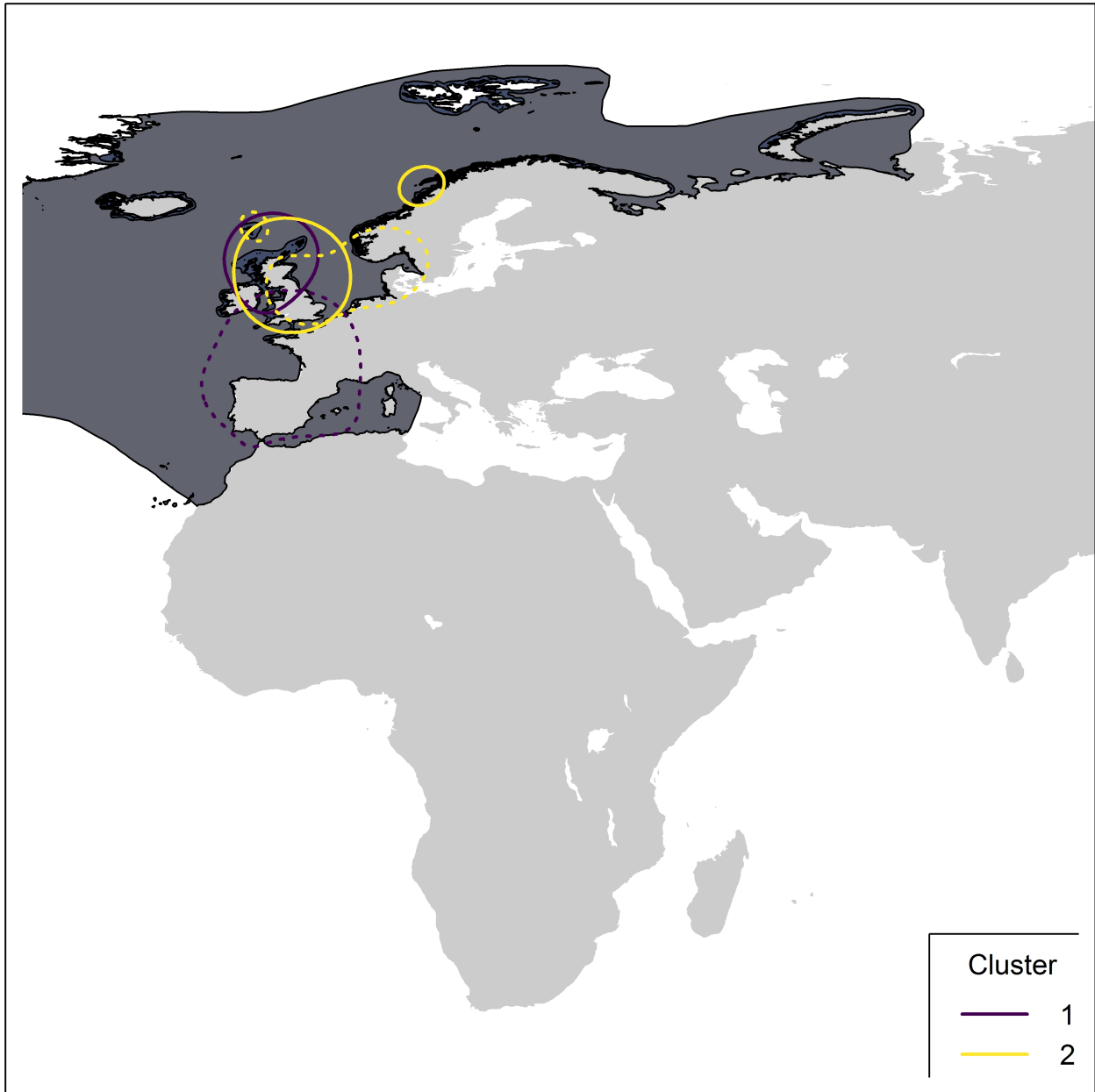


Figure 06540-1. Map showing 95% kernel contours of of first-level clusters identified by the migratory connectivity analysis, if any, or 95% kernel contours of all encounters, in case of no clustering structure. Solid lines indicate the clusters in the breeding range, dotted lines those in the non-breeding range. Different contour colours correspond to different clusters, as reported in legend. The species distribution range is also shown (breeding range: blue; non-breeding range: dark grey; resident range: beige; from BirdLife International, 2019).

1.2 Sensitivity analysis

Results of power analysis and validation. Analyses at the species level were re-run on subsamples of individuals of decreasing size (100 repetitions per subsample size), according to simple random sampling of individuals (Figure 06540-2) and stratified sampling of individuals within the breeding range (Figure 06540-3) and the non breeding range (Figure 06540-4). For stratified sampling, we selected individuals with a

probability inversely proportional to the number of observation in each country. Figures below report the results of the procedure.

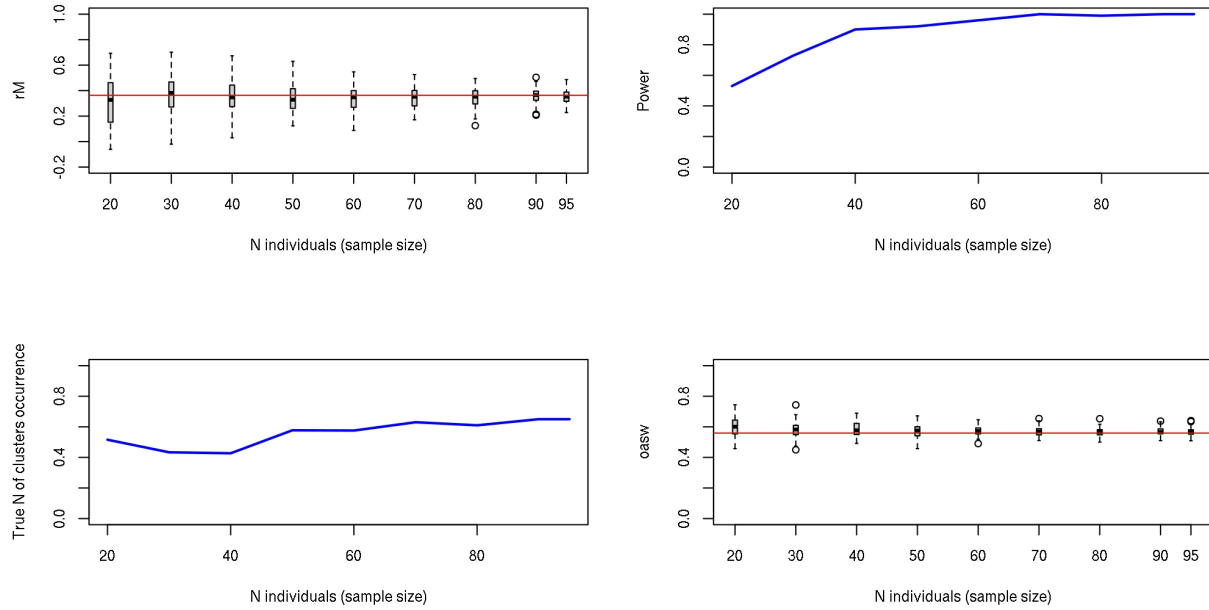


Figure 06540-2. Top left: simulated distribution (boxplots) and observed value (red line) of connectivity. Top right: Simulated power of the analysis (i.e. proportion of times the analyses on the subset of individuals was significant). Bottom left: Proportion of times the analysis provides the observed best number of cluster. Bottom right: simulated distribution (boxplots) and observed value (red line) of clustering intensity.

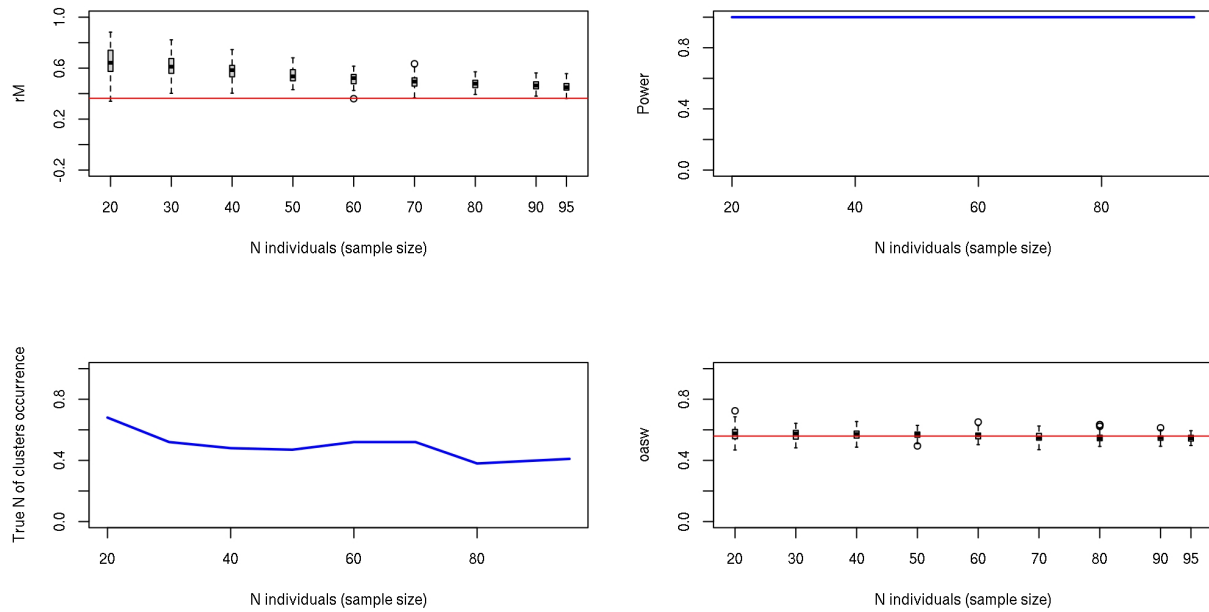


Figure 06540-3. Top left: simulated distribution (boxplots) and observed value (red line) of connectivity. Top right: Simulated power of the analysis. Bottom left: Proportion of times the analysis provides the

observed best number of cluster. Bottom right: simulated distribution (boxplots) and observed value (red line) of clustering intensity.

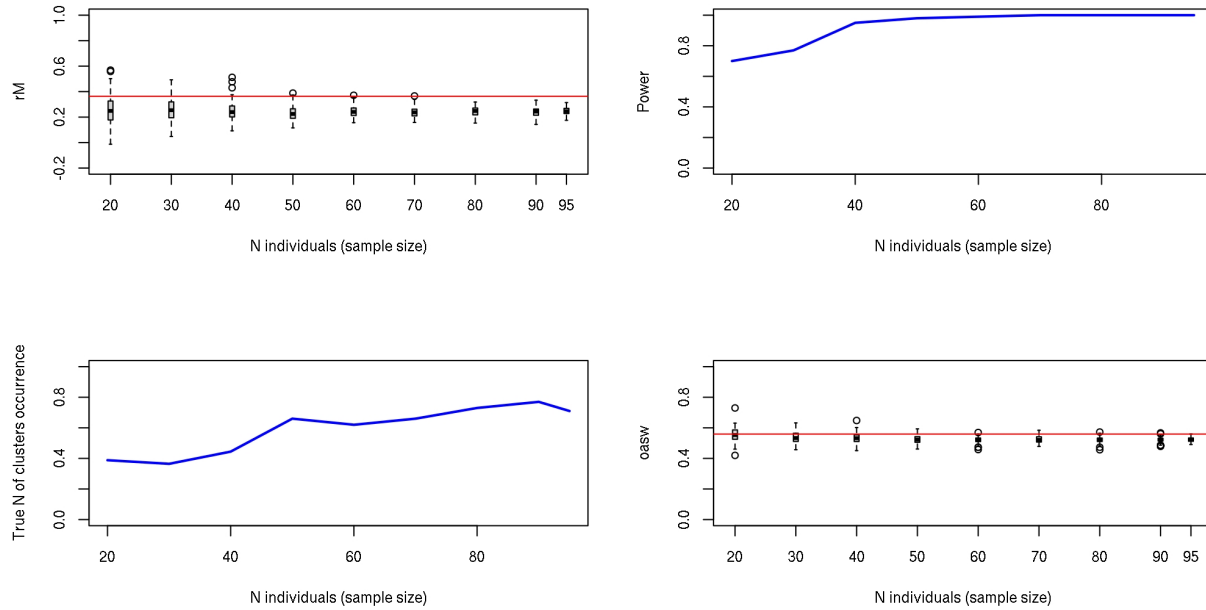


Figure 06540-4. Top left: simulated distribution (boxplots) and observed value (red line) of connectivity. Top right: Simulated power of the analysis. Bottom left: Proportion of times the analysis provides the observed best number of cluster. Bottom right: simulated distribution (boxplots) and observed value (red line) of clustering intensity.

2. Connectivity between pre-defined regions

The species shows moderate connectivity ($MC = 0.435$; $MC = 0.431$ when adjusted for absolute abundance) between 3 breeding regions and 6 non breeding regions (Table 06540-2; Figure 06540-6).

Table 06540-2. Transition probabilities between pre-defined regions. Estimated abundance (number of individuals) in each breeding region is also reported.

Breeding region	Abundance	Non breeding region	Transition probability
North Europe	4340000	North Europe	0.375
North Europe	4340000	North-west Europe	0.625
North-west Europe	6202424	Central Europe	0.011
North-west Europe	6202424	North Africa	0.049
North-west Europe	6202424	North Europe	0.104
North-west Europe	6202424	North-west Europe	0.120
North-west Europe	6202424	South-west Europe	0.148
North-west Europe	6202424	West Europe	0.568
West Europe	351	South-west Europe	1.000

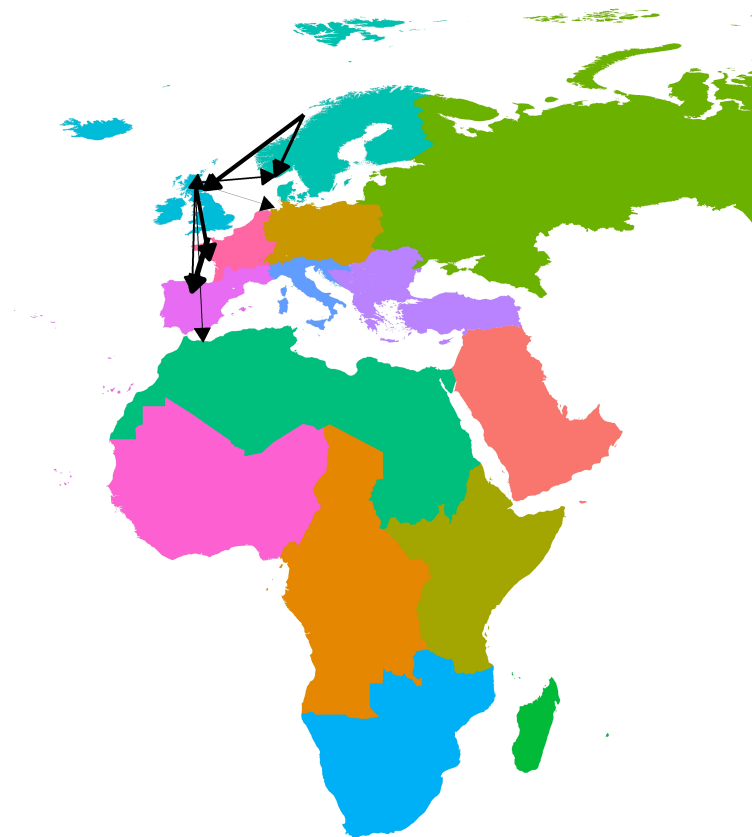


Figure 06540-6. Map showing pre-defined regions in different colours, with black arrows linking centroids of individual encounters in different regions. Arrow width is proportional to transition probability.

Reference

BirdLife International and Handbook of the Birds of the World (2019). Bird species distribution maps of the world. Version 2019.1. Available at <http://datazone.birdlife.org/species/requestdis>.