

Migratory connectivity analysis

by EURING Migration Atlas

Emberiza citrinella (EURING code 18570)

1.1 Connectivity between individuals

The analysis evaluated 1280 individuals (2560 encounters) filtered from a total of 79924 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 = 3 (Table 18570-1; Figure 18570-1).

Table 18570-1. 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	1280	0.933	0.001	0.909	0.953	3	0.532
1	1	484	0.886	0.001	0.813	0.954	7	0.460
2	1	526	0.989	0.001	0.977	0.998	2	0.603
3	1	270	0.752	0.001	0.630	0.853	3	0.544
21	2	371	0.964	0.001	0.925	0.998	5	0.545
22	2	155	0.996	0.001	0.992	1.000	2	0.858
31	2	30	0.757	0.002	0.073	0.918	2	0.737
32	2	103	0.955	0.001	0.911	0.986	9	0.643
33	2	137	0.881	0.001	0.794	0.946	9	0.506
211	3	24	0.417	0.041	0.052	1.000	2	0.678
212	3	150	0.979	0.001	0.934	0.999	4	0.555
213	3	82	0.928	0.001	0.915	0.996	9	0.683
214	3	86	0.986	0.001	0.965	0.999	4	0.547
215	3	29	0.969	0.001	0.204	0.996	2	0.873
221	3	137	0.999	0.001	0.998	1.000	9	0.809
222	3	18	-	-	-	-	-	-
311	3	29	0.142	0.062	0.016	0.494	2	0.344
312	3	1	-	-	-	-	-	-
321	3	9	-	-	-	-	-	-
322	3	43	0.784	0.001	0.630	0.998	2	0.795
323	3	11	-	-	-	-	-	-
324	3	4	-	-	-	-	-	-
325	3	4	-	-	-	-	-	-
326	3	6	-	-	-	-	-	-
327	3	10	-	-	-	-	-	-
328	3	12	-	-	-	-	-	-
329	3	4	-	-	-	-	-	-

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
331	3	3	-	-	-	-	-	-
332	3	21	0.927	0.001	0.852	0.997	2	0.840
333	3	24	0.775	0.001	0.375	0.998	9	0.629
334	3	19	-	-	-	-	-	-
335	3	10	-	-	-	-	-	-
336	3	4	-	-	-	-	-	-
337	3	24	0.947	0.001	0.394	0.996	2	0.903
338	3	15	-	-	-	-	-	-
339	3	17	-	-	-	-	-	-

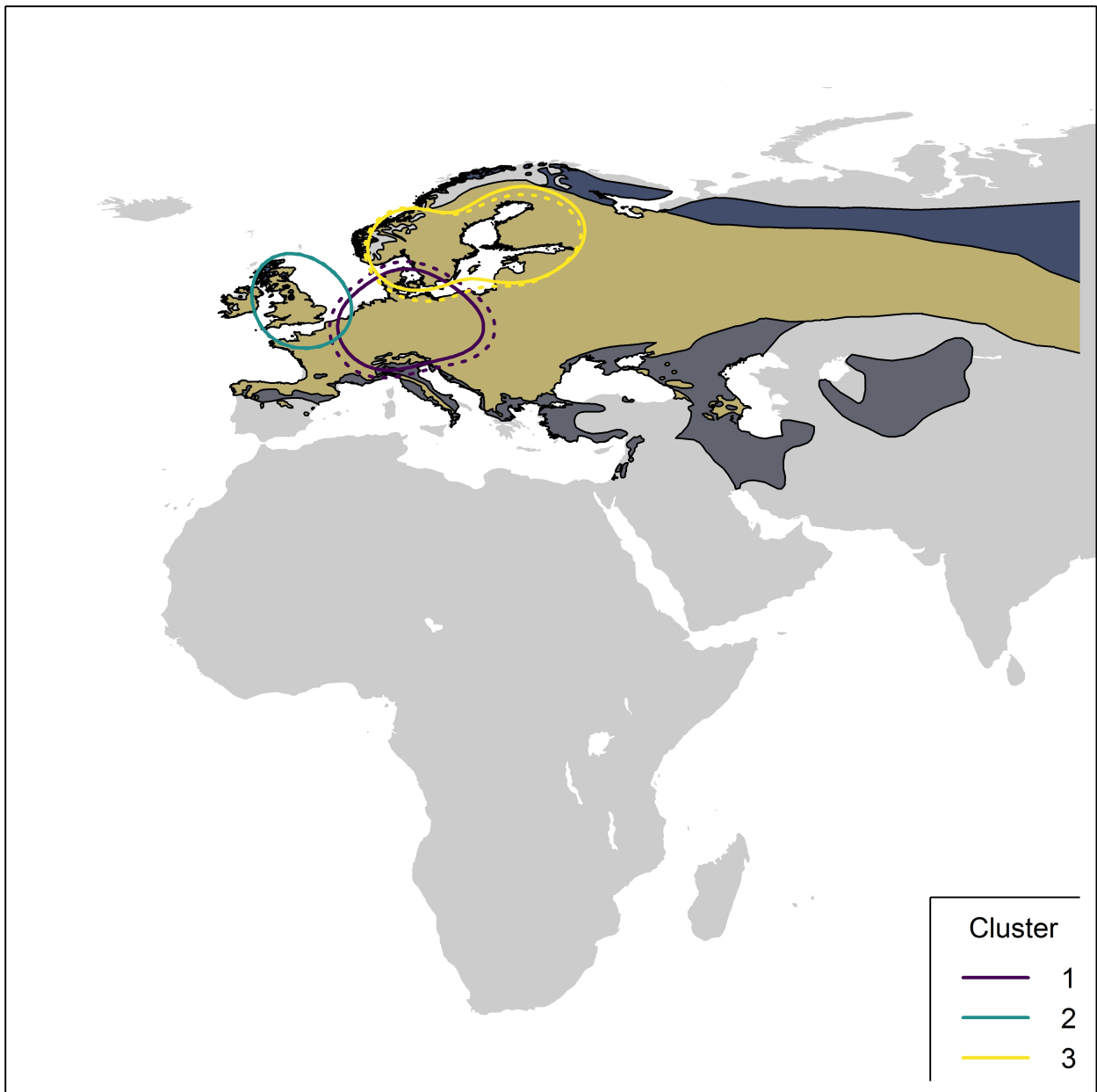


Figure 18570-1. Map showing 95% kernel contours of of first-level clusters identified by the migratory connectivity analysis, if any, or 95% kernel contours of all encounters, in case of no clustering structure. Solid lines indicate the clusters in the breeding range, dotted lines those in the non-breeding 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 18570-2) and stratified sampling of individuals within the breeding range (Figure 18570-3) and the non breeding range (Figure 18570-4). 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.

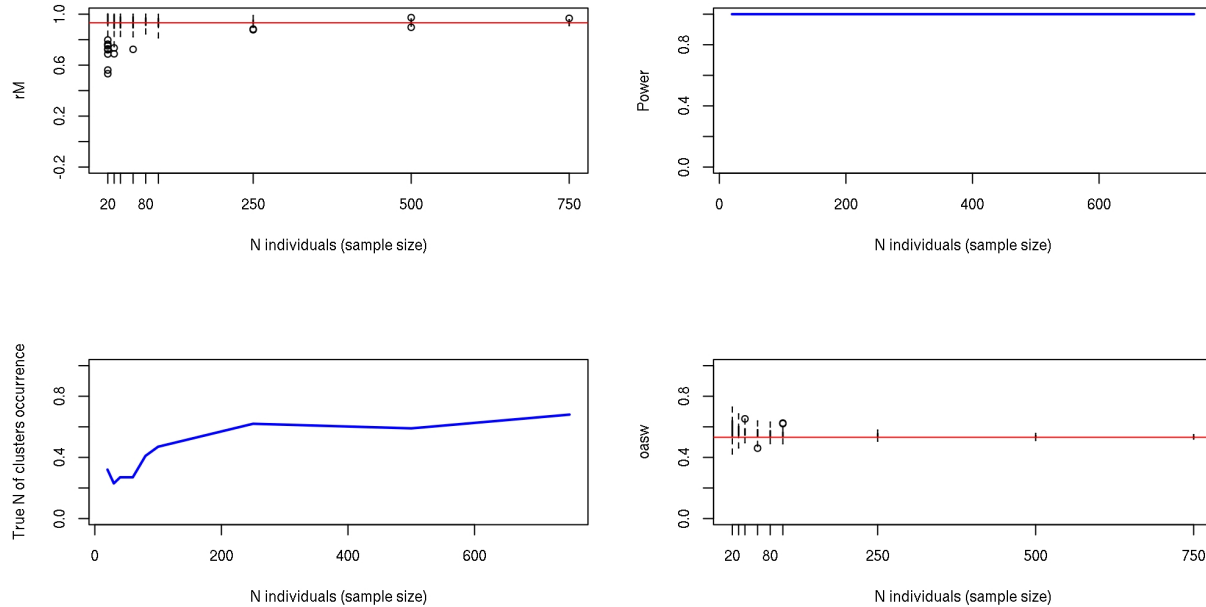


Figure 18570-2. Top left: simulated distribution (boxplots) and observed value (red line) of connectivity. Top right: Simulated power of the analysis (i.e. proportion of times the analyses on the subset of individuals was significant). Bottom left: Proportion of times the analysis provides the observed best number of cluster. Bottom right: simulated distribution (boxplots) and observed value (red line) of clustering intensity.

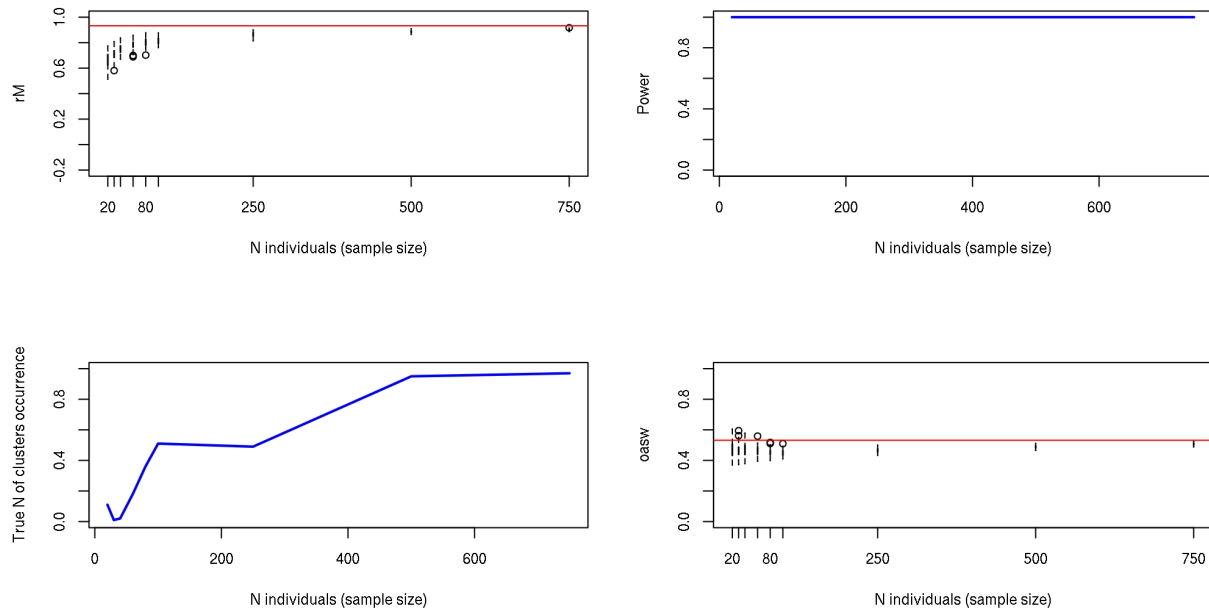


Figure 18570-3. Top left: simulated distribution (boxplots) and observed value (red line) of connectivity. Top right: Simulated power of the analysis. Bottom left: Proportion of times the analysis provides the observed best number of cluster. Bottom right: simulated distribution (boxplots) and observed value (red line) of clustering intensity.

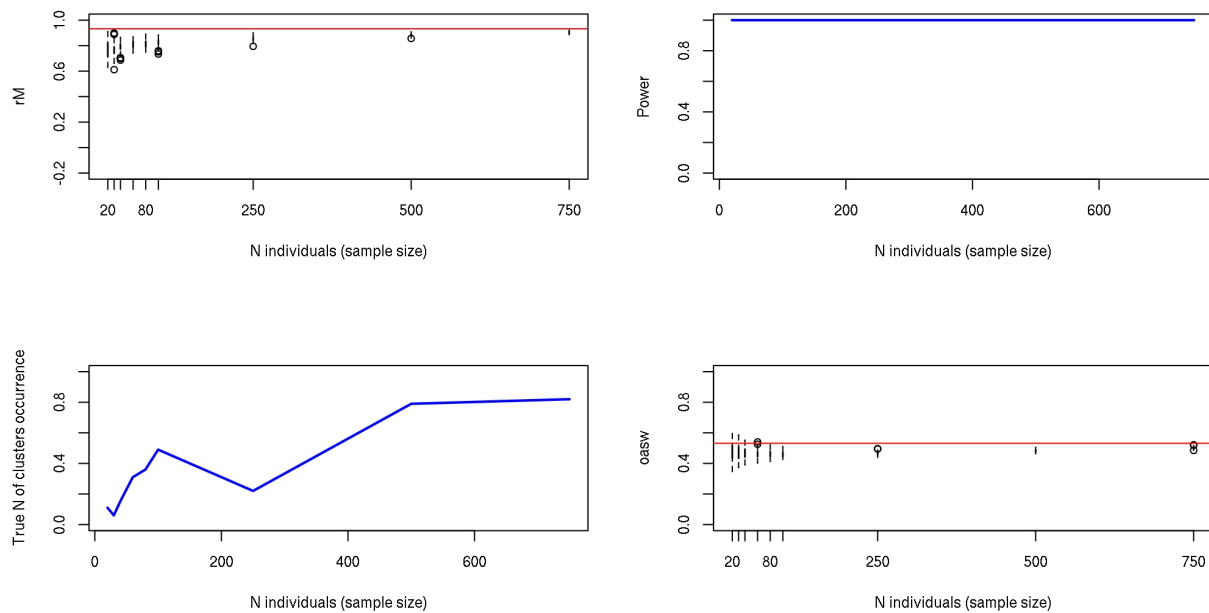


Figure 18570-4. Top left: simulated distribution (boxplots) and observed value (red line) of connectivity. Top right: Simulated power of the analysis. Bottom left: Proportion of times the analysis provides the observed best number of cluster. Bottom right: simulated distribution (boxplots) and observed value (red line) of clustering intensity.

The comparison between the bootstrapped distribution of r_M values from live recaptures and dead recoveries is significant ($p < 0.001$); Figure 18570-5).

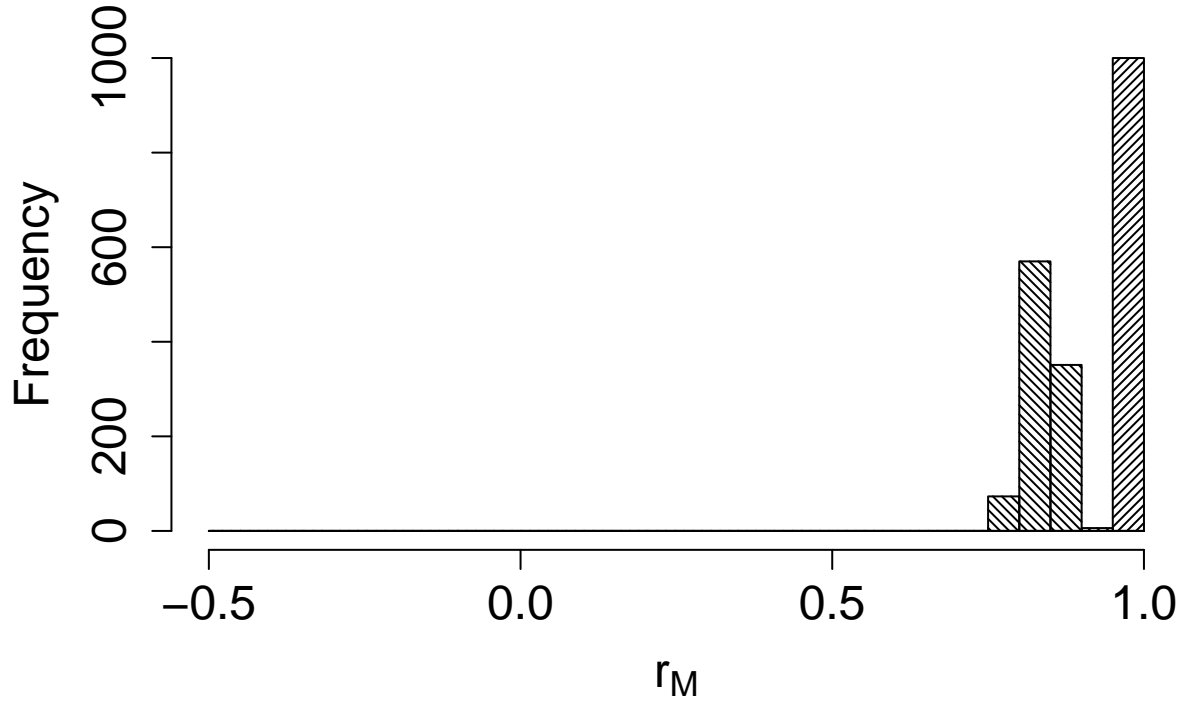


Figure 18570-5. Comparison between the bootstrapped distributions of connectivity value for alive recaptures (filling lines with angle=45°) and dead recoveries (filling lines with angle=375°).

2. Connectivity between pre-defined regions

The species shows moderate connectivity ($MC = 0.49$; $MC = 0.489$ when adjusted for absolute abundance) between 6 breeding regions and 8 non breeding regions (Table 18570-2; Figure 18570-6).

Table 18570-2. 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
Central Europe	21685200	Central Europe	0.981
Central Europe	21685200	East Europe	0.003
Central Europe	21685200	South-west Europe	0.008
Central Europe	21685200	West Europe	0.008
East Europe	13925997	Central Europe	0.333
East Europe	13925997	East Europe	0.444
East Europe	13925997	South-central Europe	0.111
East Europe	13925997	South-east Europe	0.111
North Europe	4120000	Central Europe	0.009
North Europe	4120000	North Europe	0.988

Breeding region	Abundance	Non breeding region	Transition probability
North Europe	4120000	West Europe	0.003
North-west Europe	1805737	North-west Europe	1.000
South-central Europe	675000	South-central Europe	1.000
West Europe	1046309	Central Europe	0.011
West Europe	1046309	North Europe	0.011
West Europe	1046309	South-west Europe	0.054
West Europe	1046309	West Europe	0.925



Figure 18570-6. 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>.