Migratory connectivity analysis

by EURING Migration Atlas

*Coccothraustes coccothraustes* **(EURING code 17170)**

1.1 Connectivity between individuals

The analysis evaluated 571 individuals (1142 encounters) filtered from a total of 34236 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 = 7 (Table 17170-1; Figure 17170-1).

Table 17170-1. 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	571	0.782	0.001	0.733	0.830	7	0.569
1	1	149	0.944	0.001	0.886	0.990	2	0.679
2	1	106	0.642	0.001	0.509	0.785	2	0.425
3	1	39	0.565	0.001	0.120	0.848	2	0.751
4	1	58	0.175	0.018	0.023	0.408	2	0.284
5	1	53	0.789	0.001	0.227	0.939	2	0.824
6	1	45	0.777	0.001	0.610	0.888	9	0.507
7	1	121	0.988	0.001	0.940	0.995	2	0.954
11	2	119	0.904	0.001	0.736	0.995	8	0.717
12	2	30	0.706	0.001	0.362	0.971	2	0.680
31	2	36	0.053	0.245	-0.059	0.335	-	-
32	2	3	-	-	-	-	-	-
51	2	51	0.301	0.012	0.109	0.674	2	0.503
52	2	2	-	-	-	-	-	-
61	2	3	-	-	-	-	-	-
62	2	8	-	-	-	-	-	-
63	2	1	-	-	-	-	-	-
64	2	1	-	-	-	-	-	-
65	2	11	-	-	-	-	-	-
66	2	6	-	-	-	-	-	-
67	2	4	-	-	-	-	-	-
68	2	2	-	-	-	-	-	-
69	2	9	-	-	-	-	-	-
71	2	116	0.042	0.165	-0.060	0.183	-	-
72	2	5	-	-	-	-	-	-
111	3	15	-	-	-	-	-	-
112	3	9	-	-	-	-	-	-

| 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
113	3	52	0.991	0.001	0.990	1.000	3	0.962
114	3	19	-	-	-	-	-	-
115	3	17	-	-	-	-	-	-
116	3	3	-	-	-	-	-	-
117	3	1	-	-	-	-	-	-
118	3	3	-	-	-	-	-	-
121	3	26	0.796	0.001	0.657	0.915	2	0.677
122	3	4	-	-	-	-	-	-
511	3	43	0.527	0.002	0.318	0.952	8	0.504
512	3	8	-	-	-	-	-	-
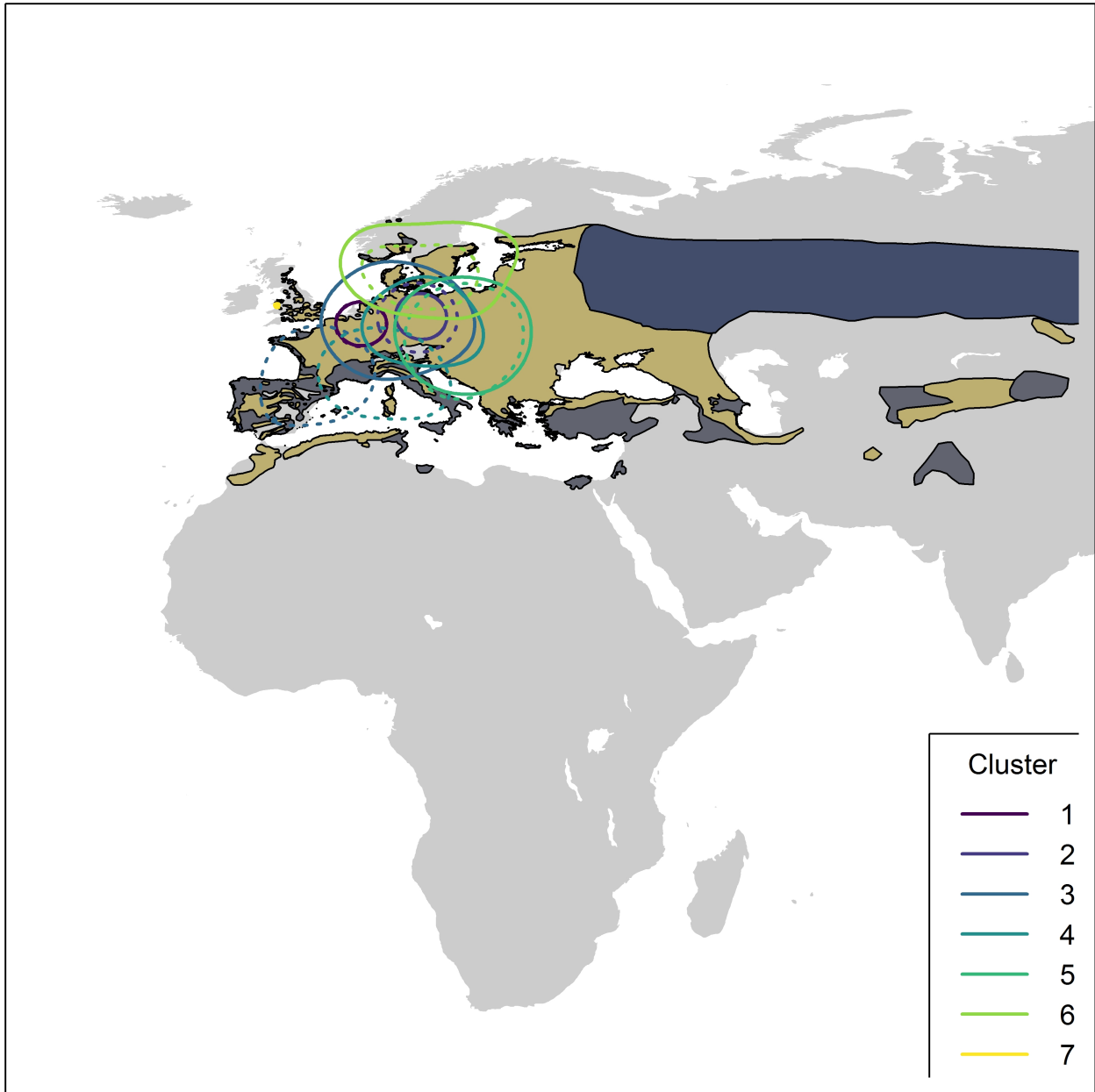
Figure 17170-1. Map showing 95% kernel contours of of first-level clusters identified by the migratory connectivity analysis, if any, or 95% kernel contours of all encounters, in case of no clustering structure. Solid lines indicate the clusters in the breeding range, dotted lines those in the non-breeding 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 17170-2) and stratified sampling of individuals within the breeding range (Figure 17170-3) and the non breeding range (Figure 17170-4). 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.
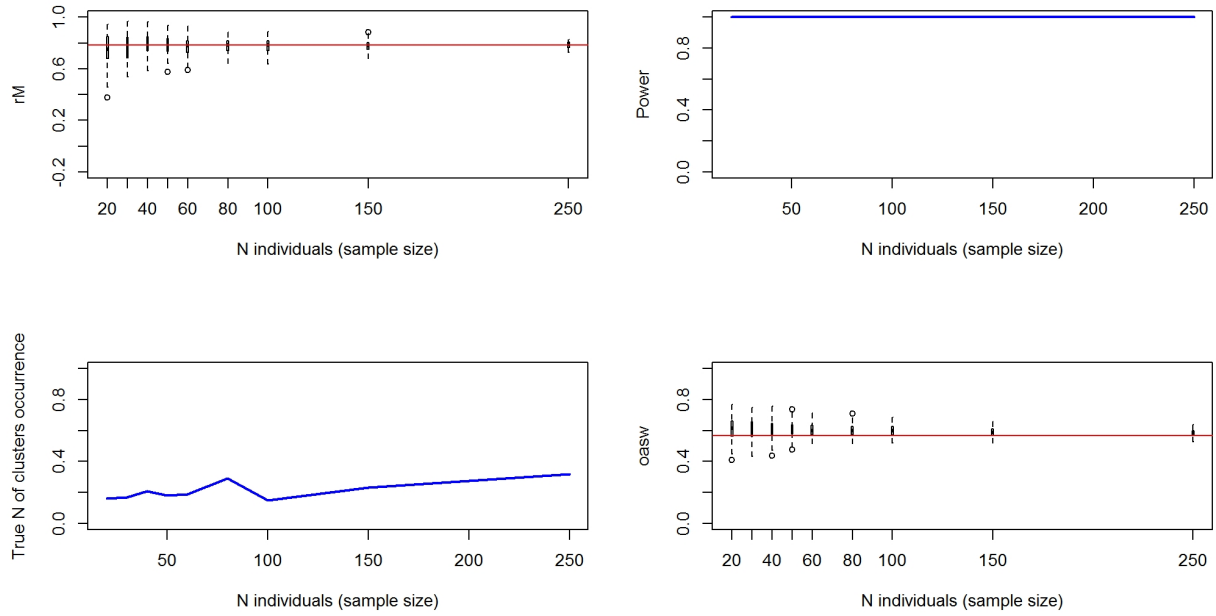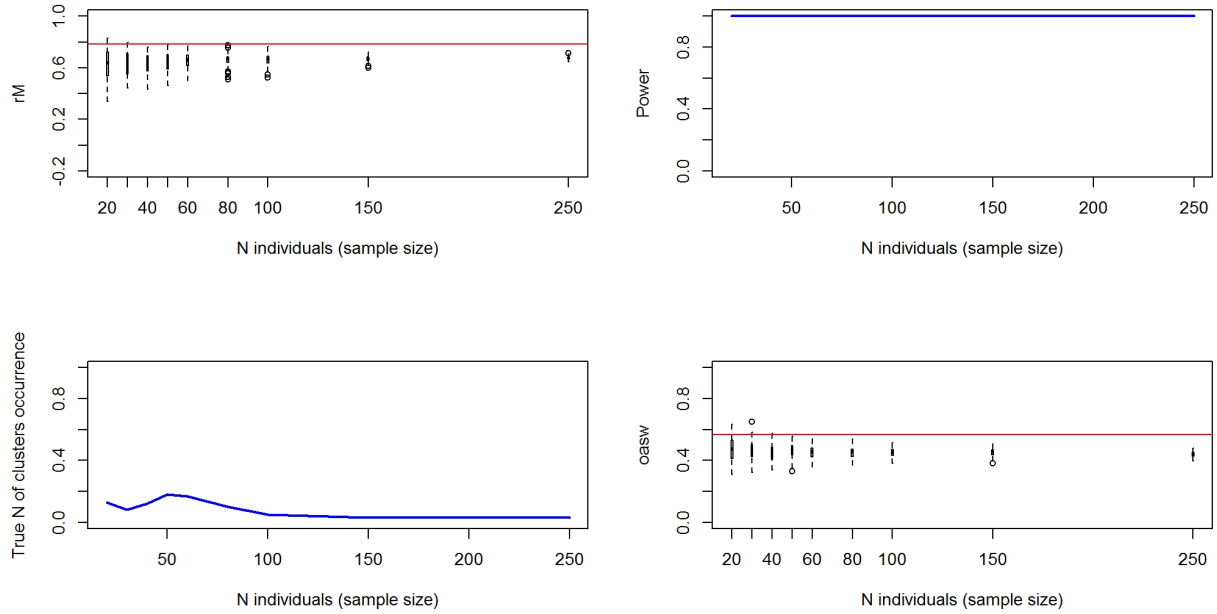

Figure 17170-2. Top left: simulated distribution (boxplots) and observed value (red line) of connectivity. Top right: Simulated power of the analysis (i.e. proportion of times the analyses on the subset of individuals was significant). Bottom left: Proportion of times the analysis provides the observed best number of cluster. Bottom right: simulated distribution (boxplots) and observed value (red line) of clustering intensity.
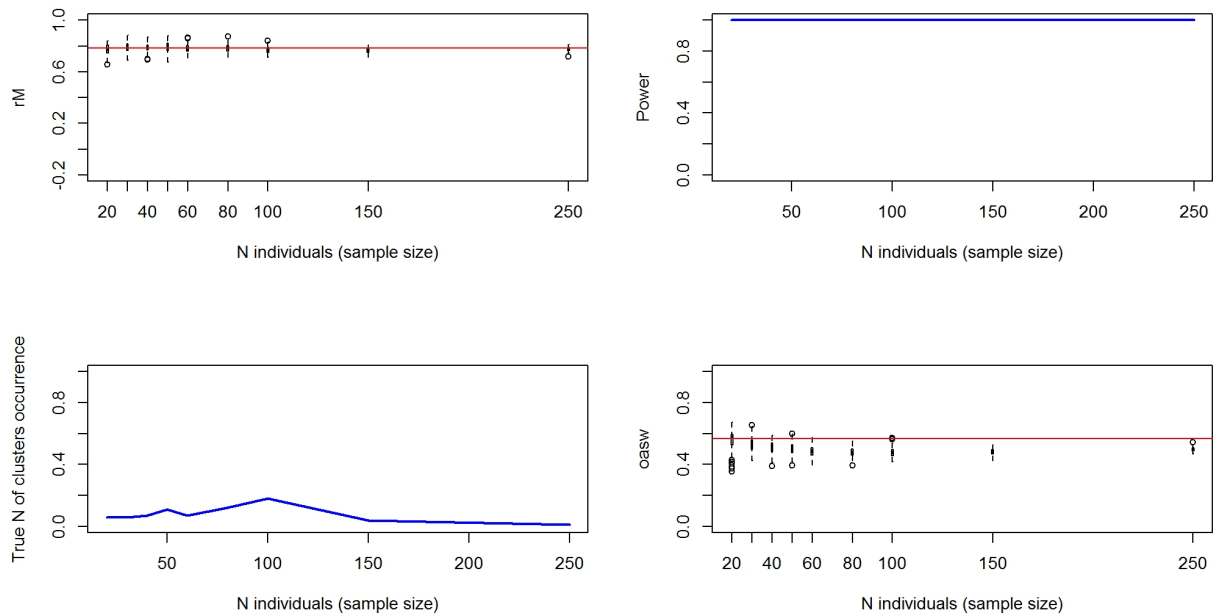

Figure 17170-3. Top left: simulated distribution (boxplots) and observed value (red line) of connectivity. Top right: Simulated power of the analysis. Bottom left: Proportion of times the analysis provides the

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

Figure 17170-4. 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 17170-5).
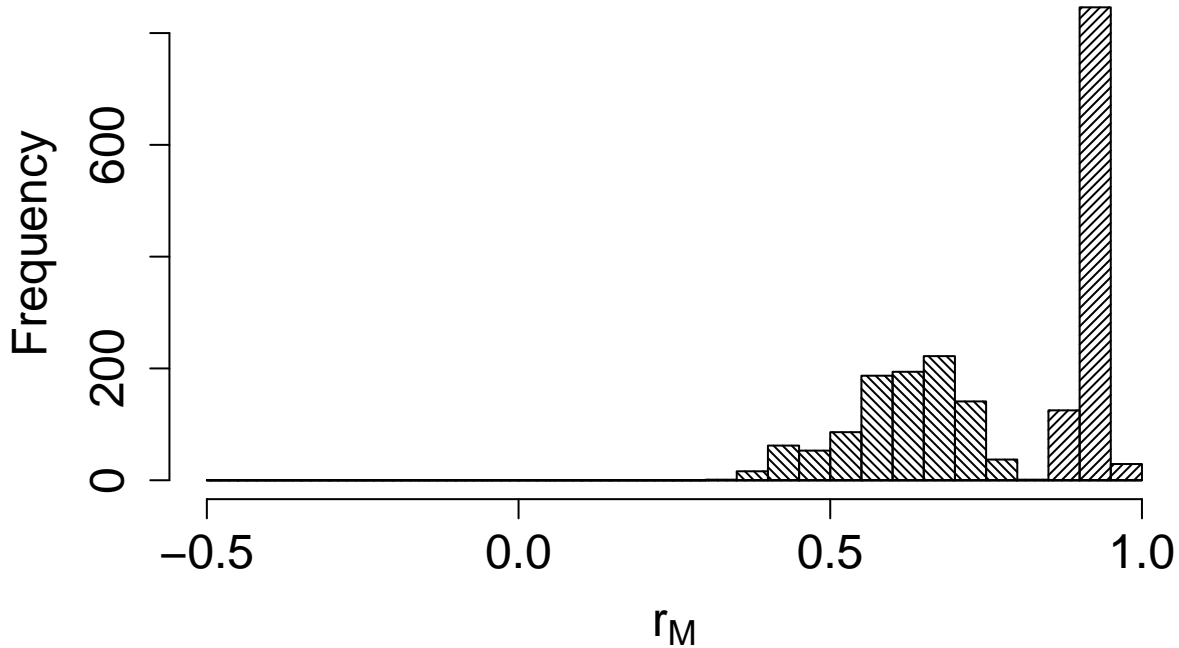
Figure 17170-5. Comparison between the bootstrapped distributions of connectivity value for alive recaptures (filling lines with angle=45°) and dead recoveries (filling lines with angle=375°).

2. Connectivity between pre-defined regions

The species shows low/moderate connectivity (MC = 0.355; MC = 0.353 when adjusted for absolute abundance) between 7 breeding regions and 9 non breeding regions (Table 17170-2; Figure 17170-6).

Table 17170-2. 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	2317080	Central Europe	0.656
Central Europe	2317080	North Africa	0.004
Central Europe	2317080	North Europe	0.004
Central Europe	2317080	South-central Europe	0.113
Central Europe	2317080	South-east Europe	0.007
Central Europe	2317080	South-west Europe	0.156
Central Europe	2317080	West Europe	0.060
East Europe	2000735	Central Europe	0.333
East Europe	2000735	East Europe	0.333
East Europe	2000735	South-east Europe	0.167
East Europe	2000735	West Europe	0.167
North Europe	68000	Central Europe	0.051
North Europe	68000	North Europe	0.846

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Breeding region	Abundance	Non breeding region	Transition probability
North Europe	68000	South-central Europe	0.051
North Europe	68000	South-west Europe	0.051
North-west Europe	1800	North-west Europe	1.000
South-central Europe	831112	South-central Europe	0.667
South-central Europe	831112	South-west Europe	0.333
South-west Europe	386088	South-west Europe	1.000
West Europe	113520	South-west Europe	0.009
West Europe	113520	West Europe	0.991
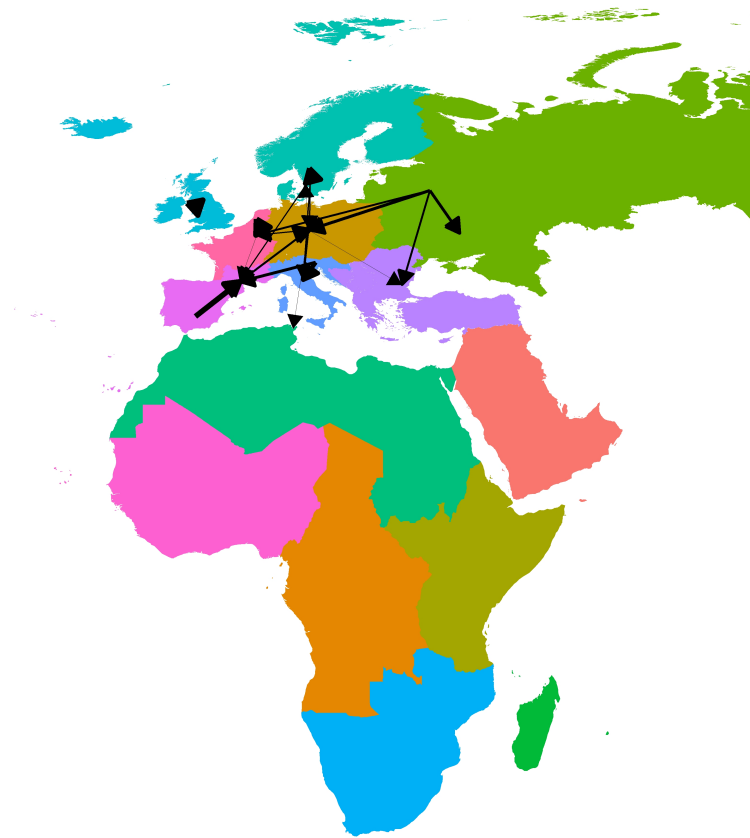
Figure 17170-6. Map showing pre-defined regions in different colours, with black arrows linking centroids of individual encounters in different regions. Arrow width is proportional to transition probability.

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.