

Migratory connectivity analysis

by EURING Migration Atlas

Larus ridibundus (EURING code 05820)

1.1 Connectivity between individuals

The analysis evaluated 27479 individuals (54958 encounters) filtered from a total of 794895 records in the EURING databank which were considered for the Atlas. The species shows a significant connectivity from pattern transference (Table 05820-1; Figure 05820-1).

Table 05820-1. 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	27479	0.179	0.001	0.171	0.187	2	0.297

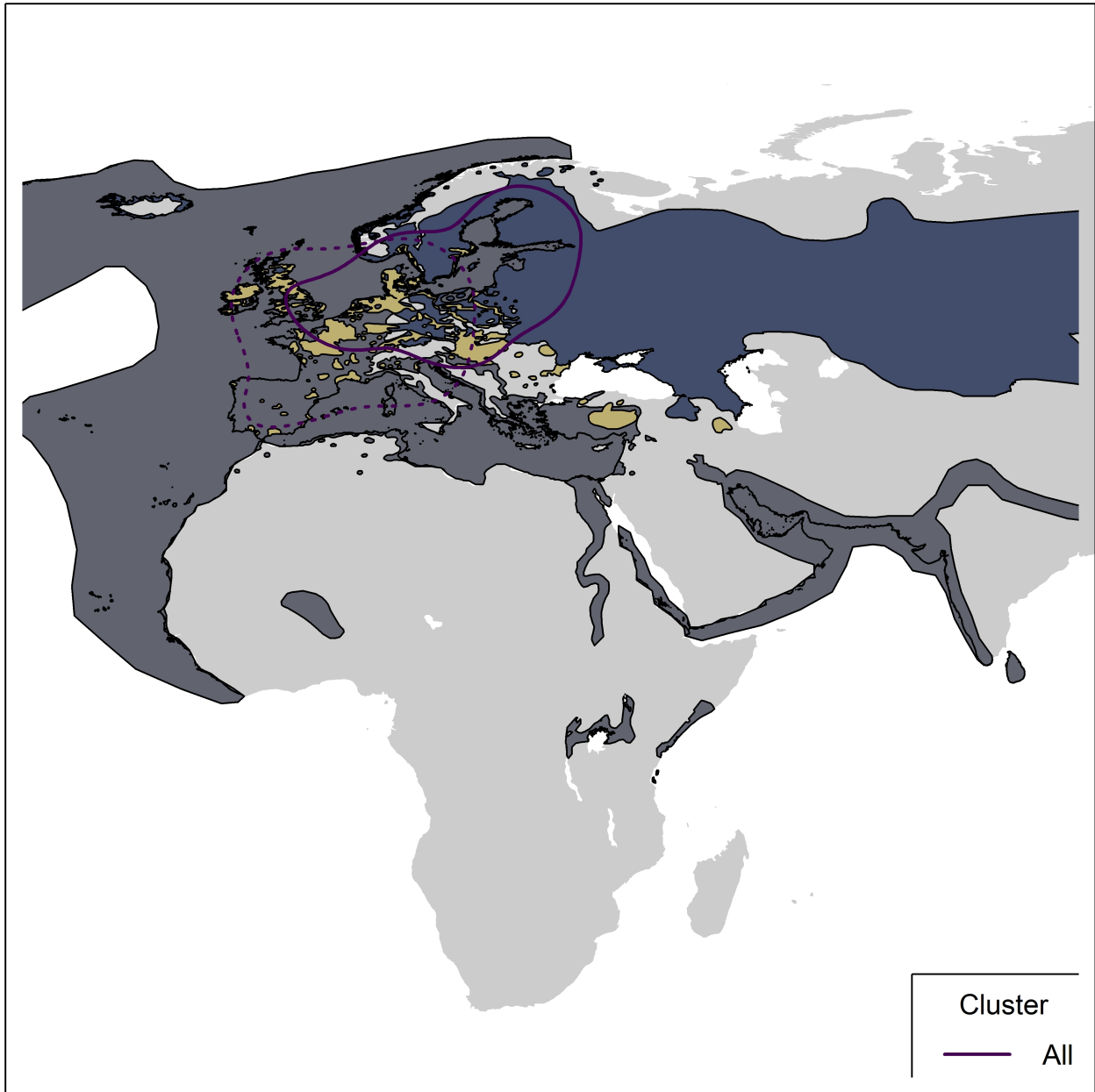


Figure 05820-1. Map showing 95% kernel contours of of first-level clusters identified by the migratory connectivity analysis, if any, or 95% kernel contours of all encounters, in case of no clustering structure. Solid lines indicate the clusters in the breeding range, dotted lines those in the non-breeding 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 05820-2) and stratified sampling of individuals within the breeding range (Figure 05820-3) and the non breeding range (Figure 05820-4). 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.

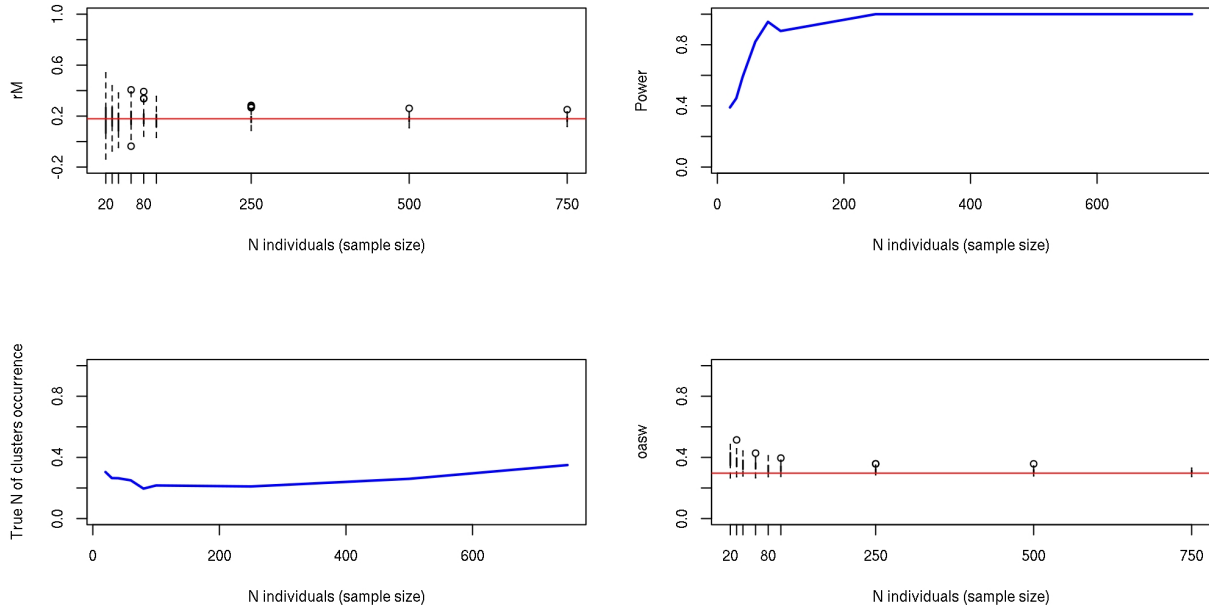


Figure 05820-2. Top left: simulated distribution (boxplots) and observed value (red line) of connectivity. Top right: Simulated power of the analysis (i.e. proportion of times the analyses on the subset of individuals was significant). Bottom left: Proportion of times the analysis provides the observed best number of cluster. Bottom right: simulated distribution (boxplots) and observed value (red line) of clustering intensity.

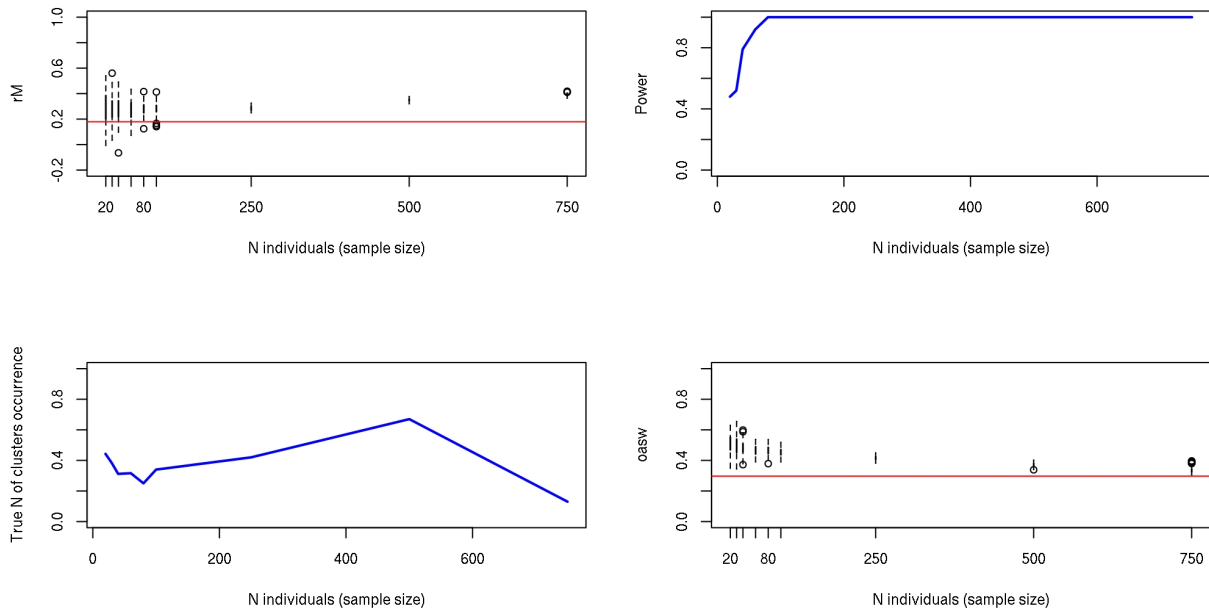


Figure 05820-3. Top left: simulated distribution (boxplots) and observed value (red line) of connectivity. Top right: Simulated power of the analysis. Bottom left: Proportion of times the analysis provides the

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

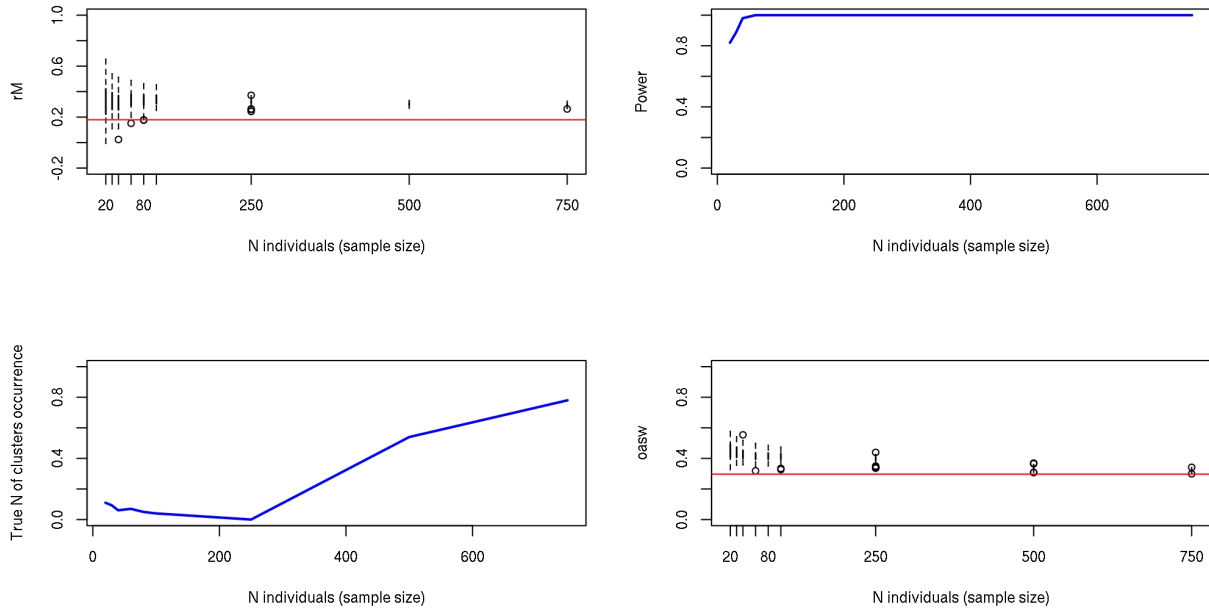


Figure 05820-4. Top left: simulated distribution (boxplots) and observed value (red line) of connectivity. Top right: Simulated power of the analysis. Bottom left: Proportion of times the analysis provides the observed best number of cluster. Bottom right: simulated distribution (boxplots) and observed value (red line) of clustering intensity.

The comparison between the bootstrapped distribution of r_M values from live recaptures and dead recoveries is not significant ($p = 0.963$); Figure 05820-5).

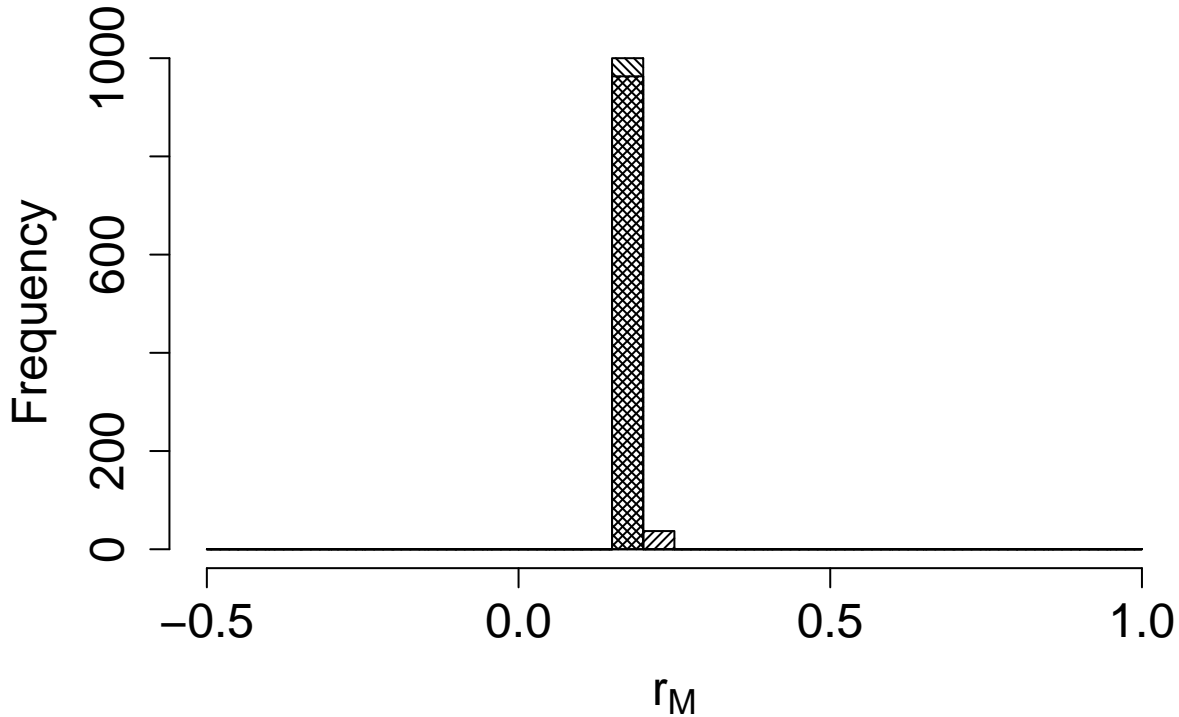


Figure 05820-5. Comparison between the bootstrapped distributions of connectivity value for alive recaptures (filling lines with angle=45°) and dead recoveries (filling lines with angle=375°).

2. Connectivity between pre-defined regions

The species shows low connectivity ($MC = 0.131$; $MC = 0.131$ when adjusted for absolute abundance) between 8 breeding regions and 11 non breeding regions (Table 05820-2; Figure 05820-6).

Table 05820-2. 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	648264	Central Europe	0.260
Central Europe	648264	North Africa	0.011
Central Europe	648264	North Europe	0.004
Central Europe	648264	North-west Europe	0.098
Central Europe	648264	South-central Europe	0.153
Central Europe	648264	South-east Europe	0.005
Central Europe	648264	South-west Europe	0.111
Central Europe	648264	West Europe	0.358
East Europe	1412874	Arabian peninsula	0.002
East Europe	1412874	Central Europe	0.291
East Europe	1412874	East Europe	0.002
East Europe	1412874	North Africa	0.005
East Europe	1412874	North Europe	0.033

Breeding region	Abundance	Non breeding region	Transition probability
East Europe	1412874	North-west Europe	0.119
East Europe	1412874	South-central Europe	0.054
East Europe	1412874	South-east Europe	0.008
East Europe	1412874	South-west Europe	0.036
East Europe	1412874	West Europe	0.450
North Europe	565050	Central Europe	0.118
North Europe	565050	East Europe	0.001
North Europe	565050	North Africa	0.003
North Europe	565050	North Europe	0.183
North Europe	565050	North-west Europe	0.241
North Europe	565050	South-central Europe	0.021
North Europe	565050	South-east Europe	0.003
North Europe	565050	South-west Europe	0.044
North Europe	565050	West Africa	0.000
North Europe	565050	West Europe	0.386
North-west Europe	353636	Central Europe	0.001
North-west Europe	353636	North Africa	0.001
North-west Europe	353636	North-west Europe	0.931
North-west Europe	353636	South-west Europe	0.040
North-west Europe	353636	West Europe	0.027
South-central Europe	4002	Central Europe	0.042
South-central Europe	4002	South-central Europe	0.750
South-central Europe	4002	South-east Europe	0.042
South-central Europe	4002	South-west Europe	0.125
South-central Europe	4002	West Europe	0.042
South-east Europe	25030	Central Europe	0.067
South-east Europe	25030	South-central Europe	0.600
South-east Europe	25030	South-east Europe	0.067
South-east Europe	25030	South-west Europe	0.200
South-east Europe	25030	West Europe	0.067
South-west Europe	27983	Central Europe	0.111
South-west Europe	27983	North Africa	0.111
South-west Europe	27983	North-west Europe	0.111
South-west Europe	27983	South-west Europe	0.667
West Europe	286887	Central Europe	0.012
West Europe	286887	North Africa	0.010
West Europe	286887	North Europe	0.001
West Europe	286887	North-west Europe	0.169
West Europe	286887	South-central Europe	0.004
West Europe	286887	South-west Europe	0.184
West Europe	286887	West Europe	0.621

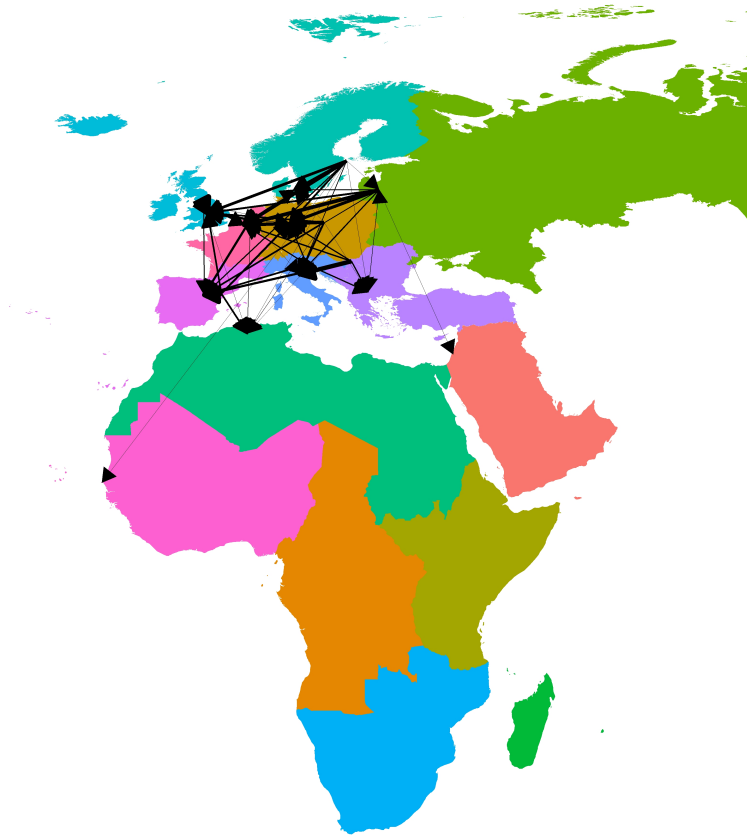


Figure 05820-6. Map showing pre-defined regions in different colours, with black arrows linking centroids of individual encounters in different regions. Arrow width is proportional to transition probability.

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>.