

# Migratory connectivity analysis

by EURING Migration Atlas

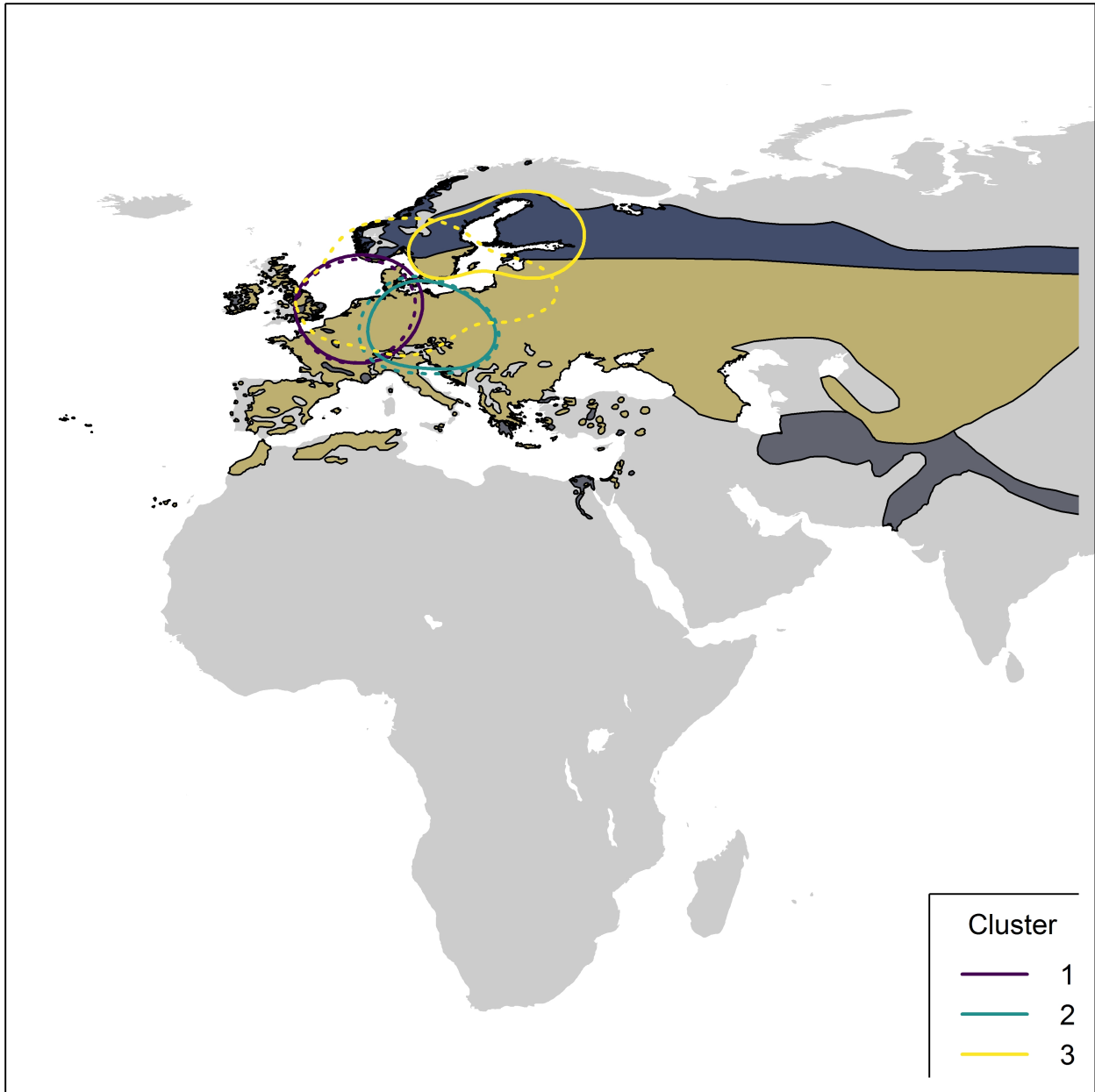
*Asio otus* (EURING code 07670)

## 1.1 Connectivity between individuals

The analysis evaluated 618 individuals (1236 encounters) filtered from a total of 18117 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 07670-1; Figure 07670-1).

**Table 07670-1.** 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	618	0.715	0.001	0.654	0.778	3	0.542
1	1	406	0.904	0.001	0.840	0.940	9	0.430
2	1	152	0.614	0.001	0.513	0.774	3	0.448
3	1	60	0.154	0.050	-0.072	0.448	4	0.308

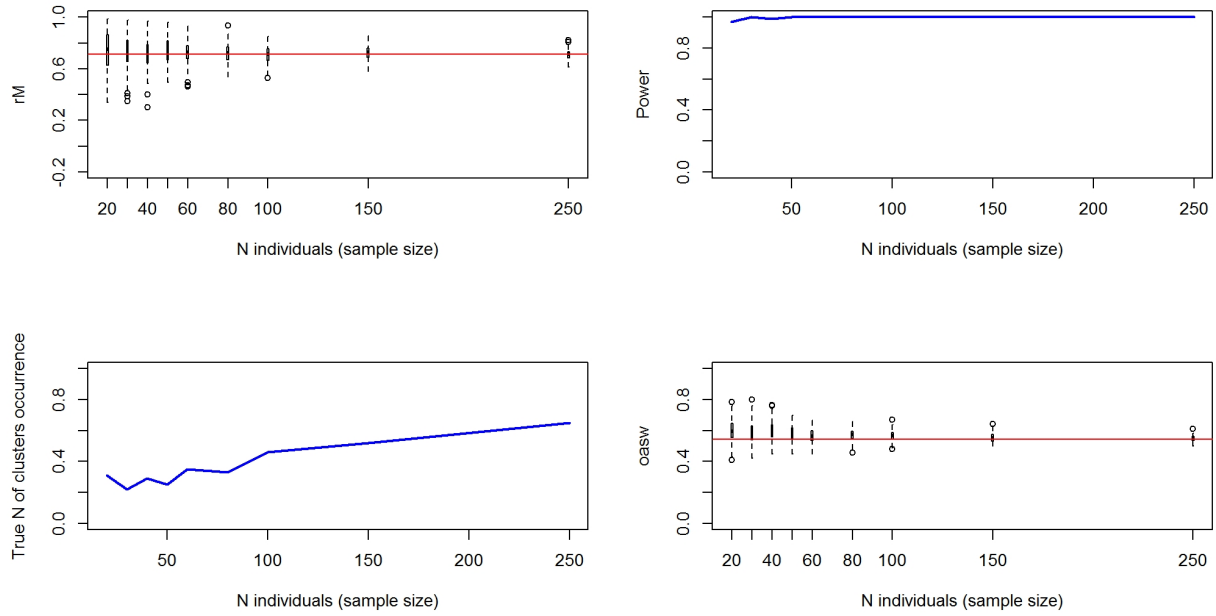


**Figure 07670-1.** Map showing 95% kernel contours of of first-level clusters identified by the migratory connectivity analysis, if any, or 95% kernel contours of all encounters, in case of no clustering structure. Solid lines indicate the clusters in the breeding range, dotted lines those in the non-breeding 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).

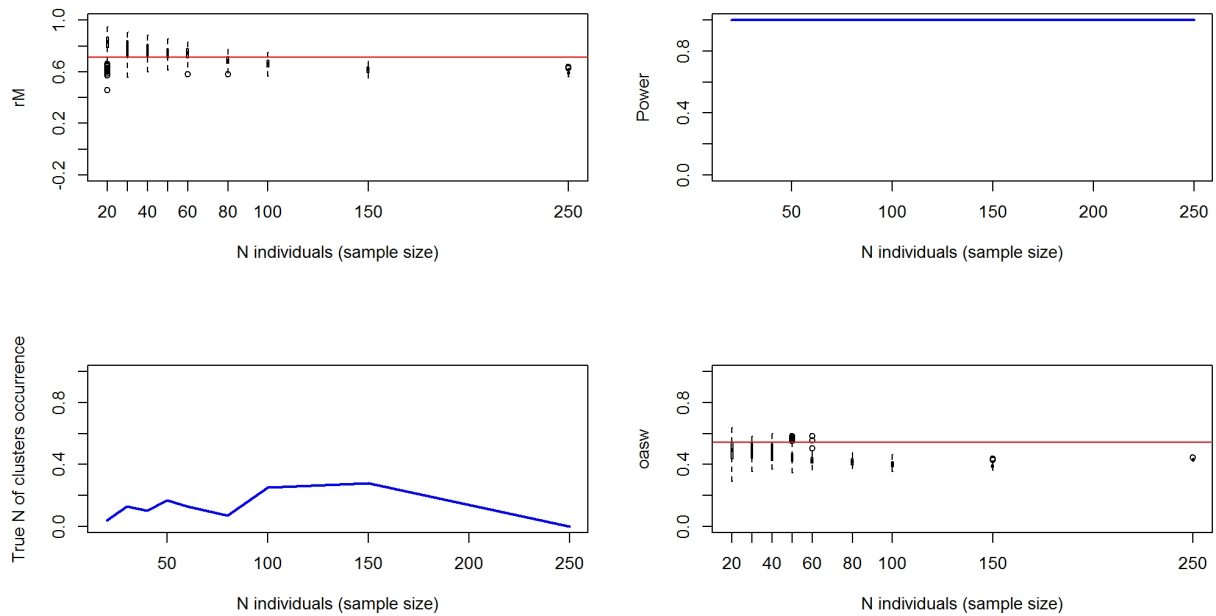
## 1.2 Sensitivity analysis

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 07670-2) and stratified sampling of individuals within the breeding range (Figure 07670-3) and the non breeding range (Figure 07670-4). 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.

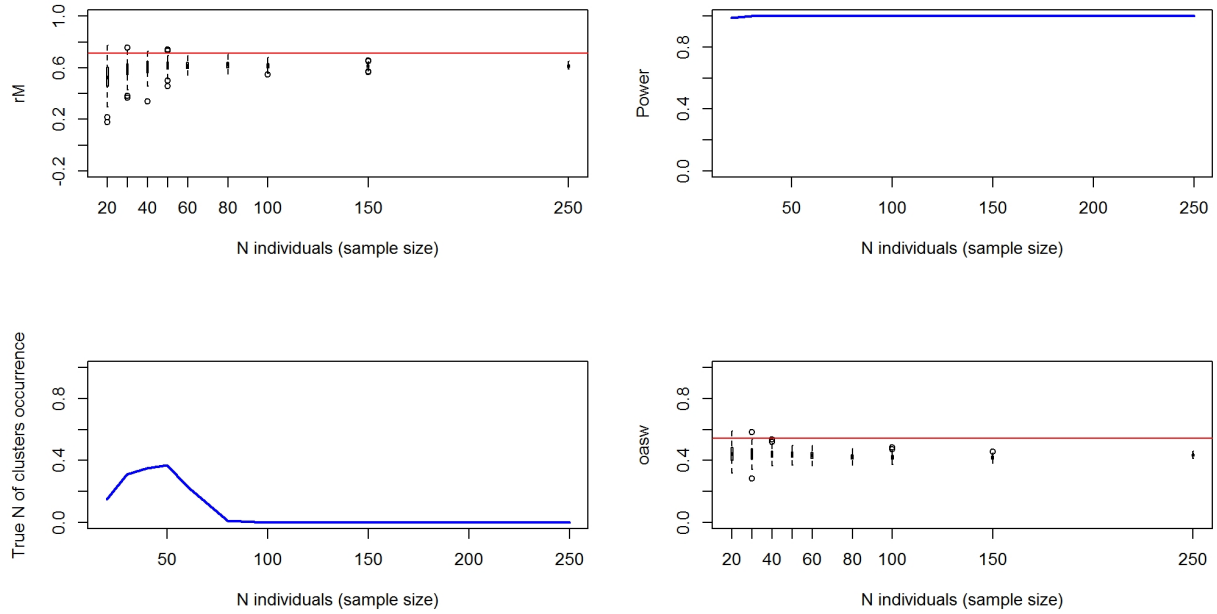


**Figure 07670-2.** Top left: simulated distribution (boxplots) and observed value (red line) of connectivity. Top right: Simulated power of the analysis (i.e. proportion of times the analyses on the subset of individuals was significant). Bottom left: Proportion of times the analysis provides the observed best number of cluster. Bottom right: simulated distribution (boxplots) and observed value (red line) of clustering intensity.



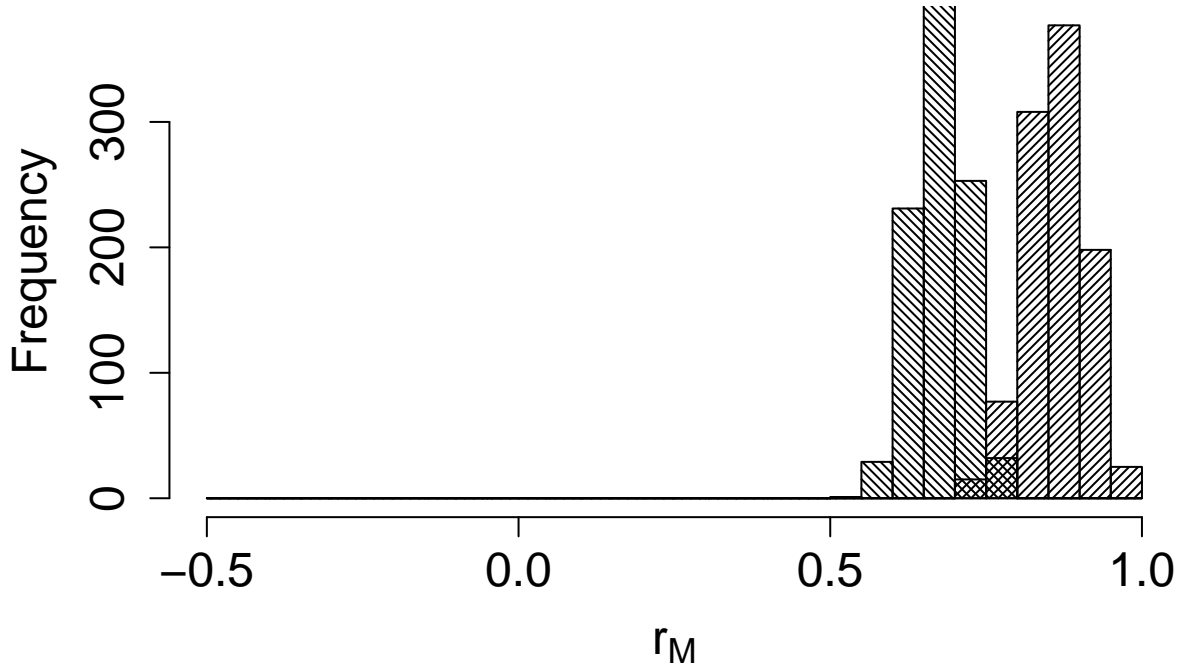
**Figure 07670-3.** Top left: simulated distribution (boxplots) and observed value (red line) of connectivity. Top right: Simulated power of the analysis. Bottom left: Proportion of times the analysis provides the

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



**Figure 07670-4.** 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 ( $p = 0.047$ ); Figure 07670-5).



**Figure 07670-5.** 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 = 0.474; MC = 0.473 when adjusted for absolute abundance) between 7 breeding regions and 7 non breeding regions (Table 07670-2; Figure 07670-6).

**Table 07670-2.** 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	152010	Central Europe	0.838
Central Europe	152010	East Europe	0.005
Central Europe	152010	North Europe	0.005
Central Europe	152010	North-west Europe	0.005
Central Europe	152010	South-central Europe	0.010
Central Europe	152010	South-west Europe	0.015
Central Europe	152010	West Europe	0.122
East Europe	586500	Central Europe	0.750
East Europe	586500	East Europe	0.250
North Europe	43100	Central Europe	0.233
North Europe	43100	East Europe	0.082
North Europe	43100	North Europe	0.521
North Europe	43100	North-west Europe	0.055

Breeding region	Abundance	Non breeding region	Transition probability
North Europe	43100	South-west Europe	0.014
North Europe	43100	West Europe	0.096
North-west Europe	11987	North-west Europe	1.000
South-central Europe	47000	South-central Europe	1.000
South-west Europe	36070	South-west Europe	1.000
West Europe	58497	Central Europe	0.038
West Europe	58497	North-west Europe	0.006
West Europe	58497	West Europe	0.956



**Figure 07670-6.** 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>.