The following supplement accompanies the article

Habitats of ten demersal species in the Gulf of Lions and potential implications for spatial management

Marie Morfin*, Nicolas Bez, Jean-Marc Fromentin

*Corresponding author: mariemorfin@hotmail.com

Marine Ecology Progress 547: 219–232 (2016)

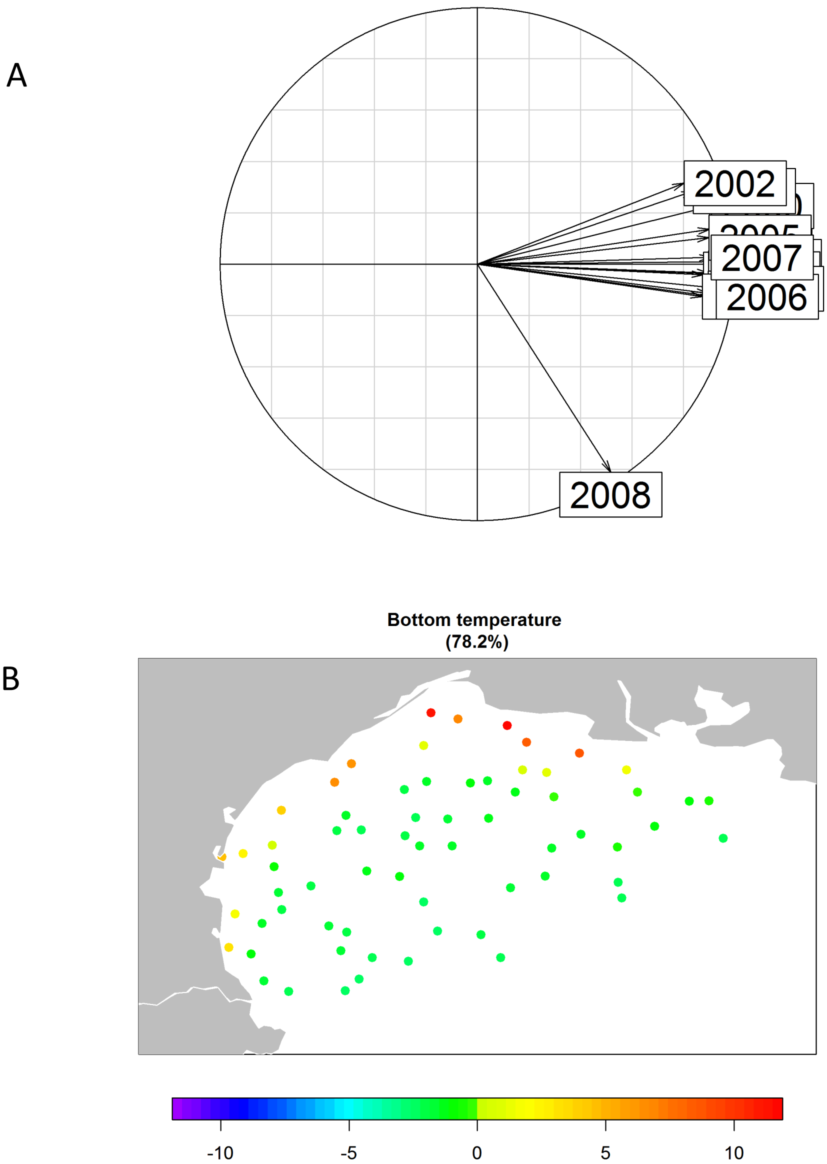


Figure S1. Empirical Orthogonal Function on *in situ* bottom temperature from 1996 to 2010, observed at the 65 stations during the hauls sampling.

According to the correlation circle (A), all the years were equally associated to the first EOF axis, except 2008. Hence the high percentage of variance explained by the first EOF (78.2%) indicates a high temporal stability of the spatial distributions of the bottom temperature over time. The variations mostly occurred in the coastal area, but the general pattern given by the projections on the first axis of the EOF persisted from year-to-year (B). We could have used these projections in our GLM analysis, but the differences are very minor, as almost all the years contributed nearly equally to this EOF axis.

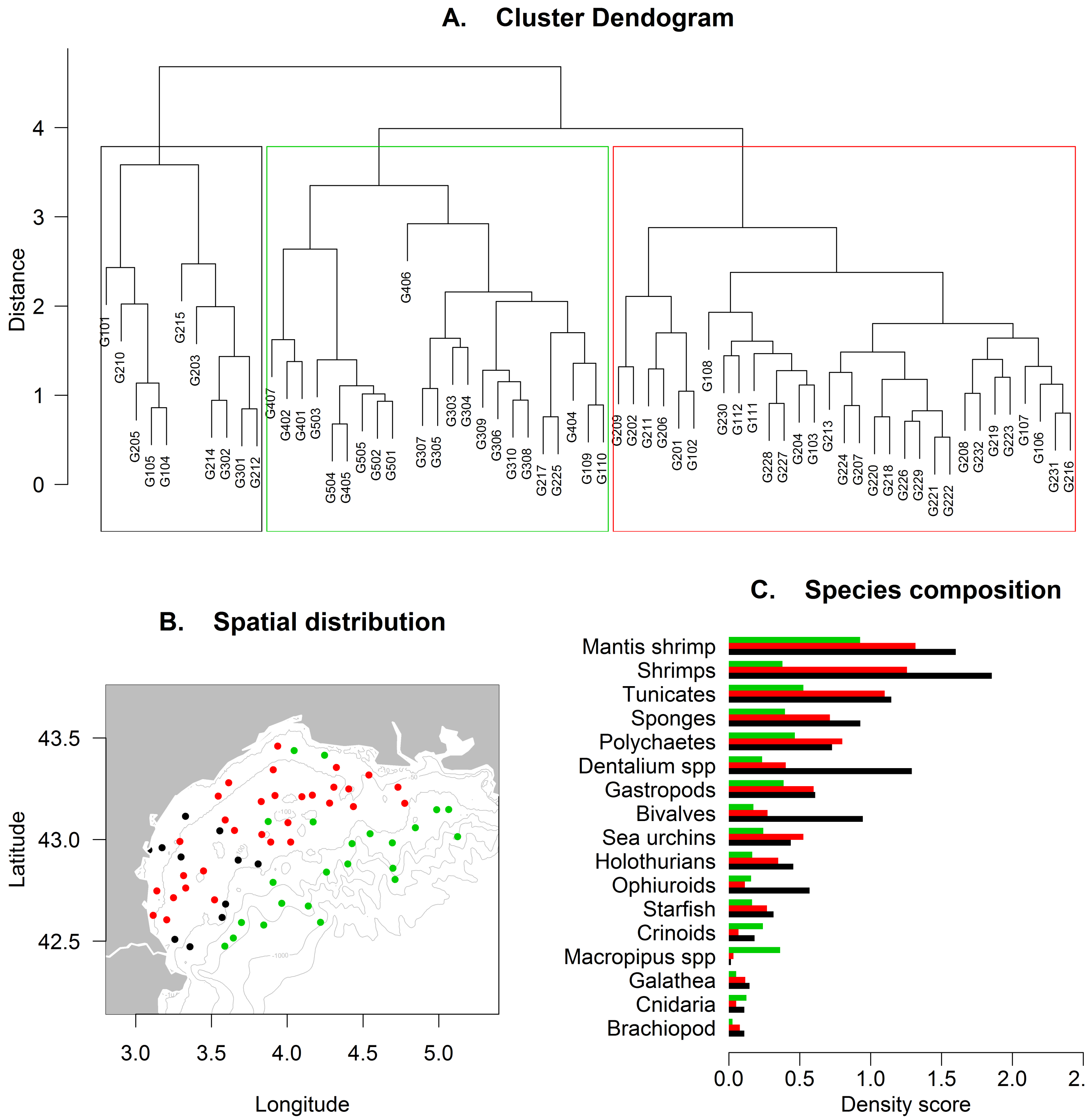


Figure S2. Benthos groups.

Data was collected by MEDITS survey, in 2000, 2001, 2002, 2004, 2006, and registered by scores of the abundance (0;]0,10];]10,30]; >30 individuals per trawl). Species were grouped into five categories (ophiuroids, sea urchins...) owing to identification issues. To reduce the number of categories, we clustered similar sites in function of their benthic composition. First, we averaged scores over the five years, and applied a Principal Component Analysis to filter outliers. The three first axes (explaining 60% of the total variance) were kept to apply a hierarchical tree procedure with complete-linkage inter-group distance (A). This metric is prone to produce balanced clusters (with equal diameter). The tree was cut according to an algorithm which optimizes the intra and inter groups distances. We finally obtained three benthos groups. Spatial distribution of the benthos groups is displayed in (B). Composition in species of each group is described in (C); for each category, averaged score in the groups was measured.

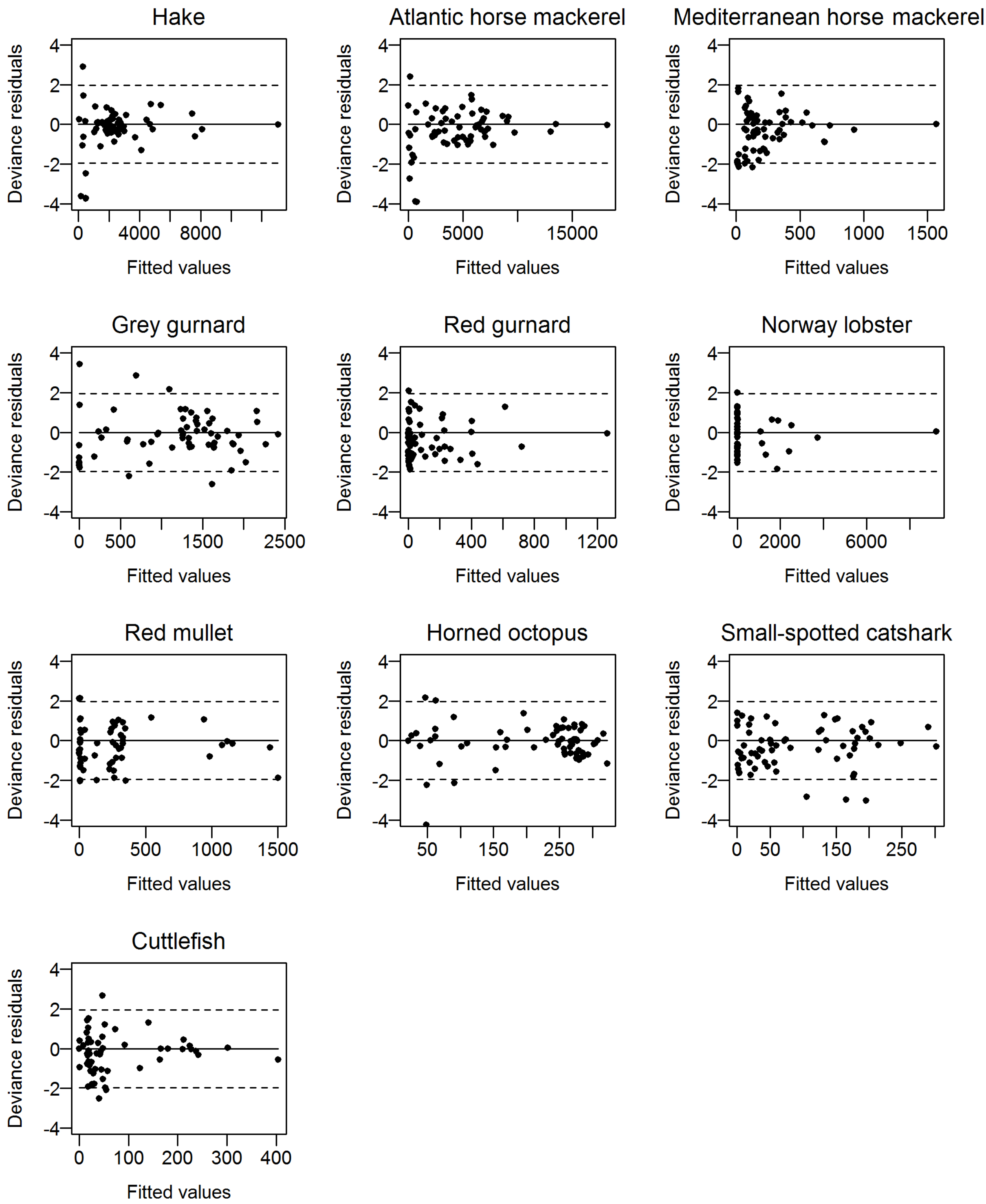


Figure S3. For each key species, deviance residuals against fitted values of the model selected by the Leave-one-out cross validation procedure.

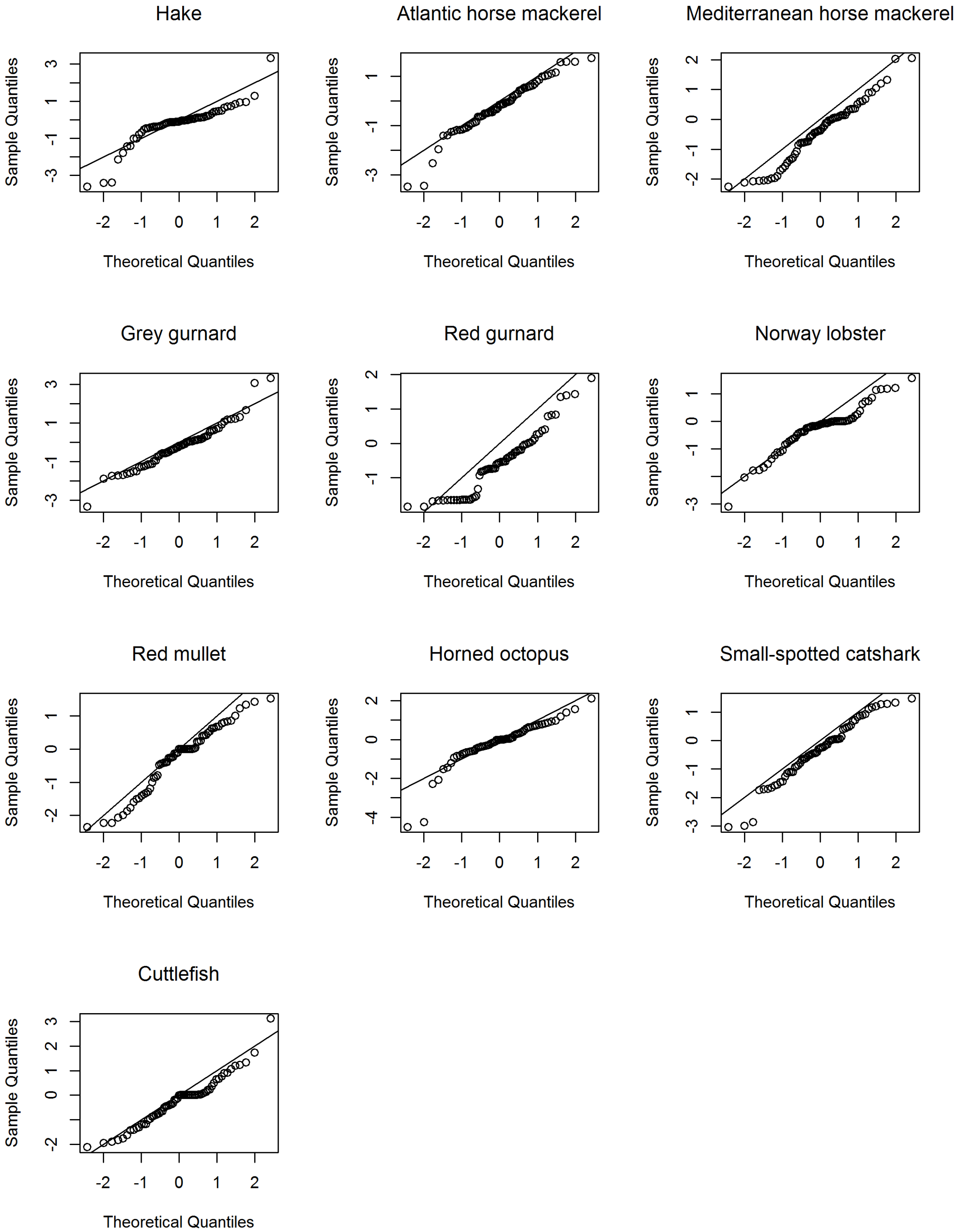


Figure S4. For each key species, quantile-quantile plot of deviance residuals from model selected by Leave-one-out cross-validation procedure against normal distribution.

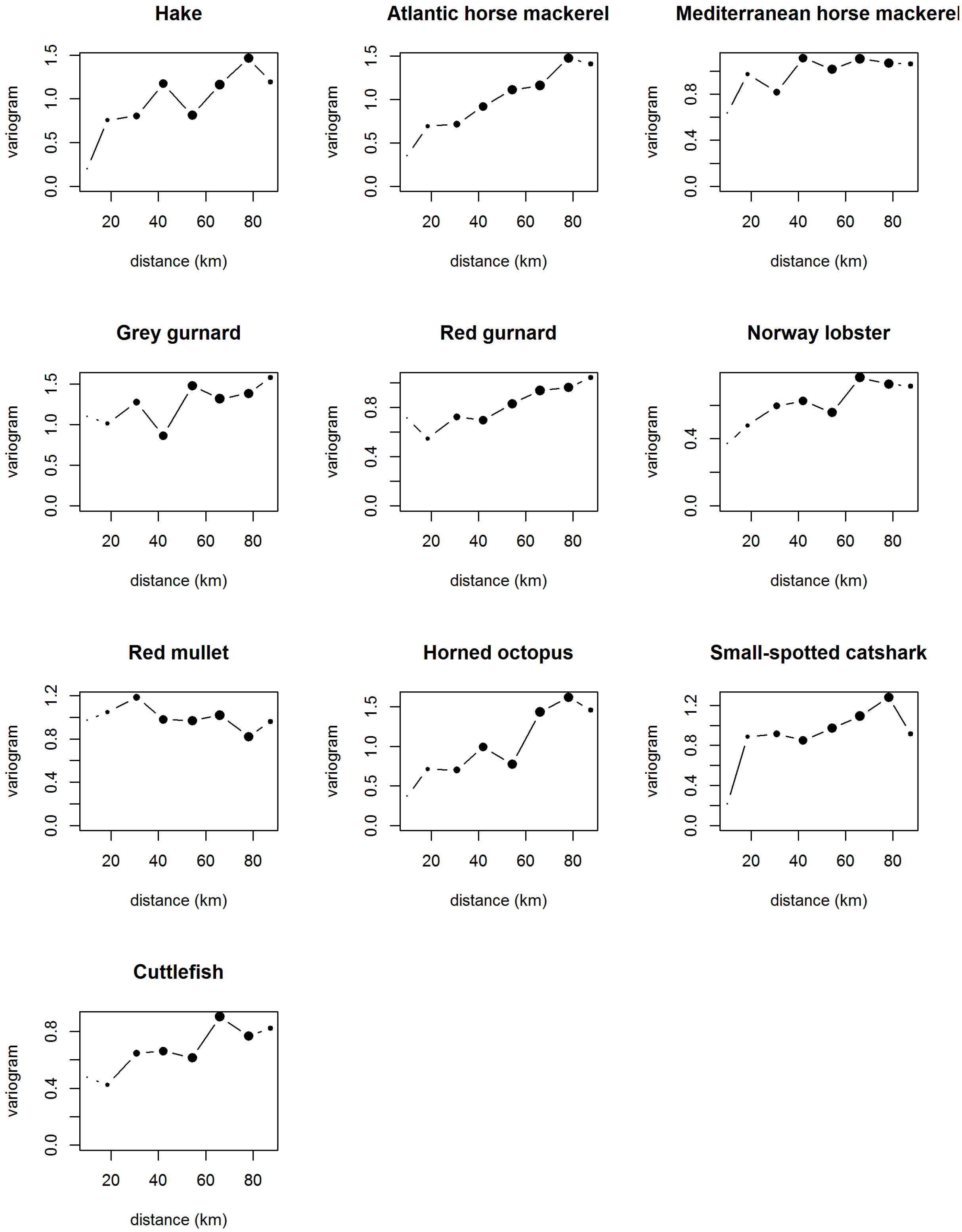
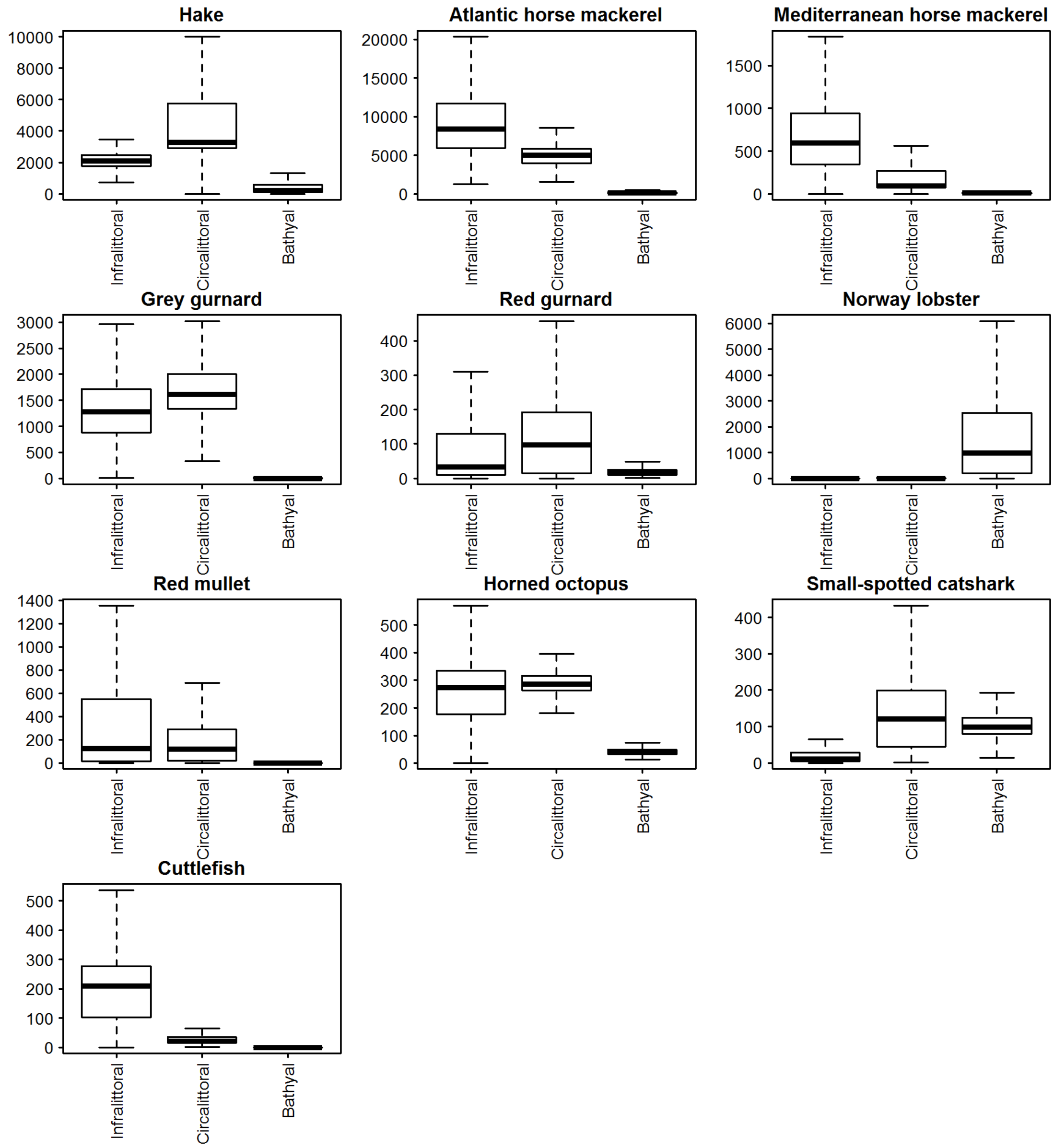


Figure S5. For each key species, variogram of deviance residuals from model selected by Leave-one-out cross-validation procedure. Size of the points is proportional to the number of observations used to calculate the corresponding value.



<u>Figure S6.</u> Model interpretation: marginal effects.

Marginal response in species density depending on biological zones, as predicted by the model selected by Loo procedure. Distributions of the marginal response were estimated by bootstrap.

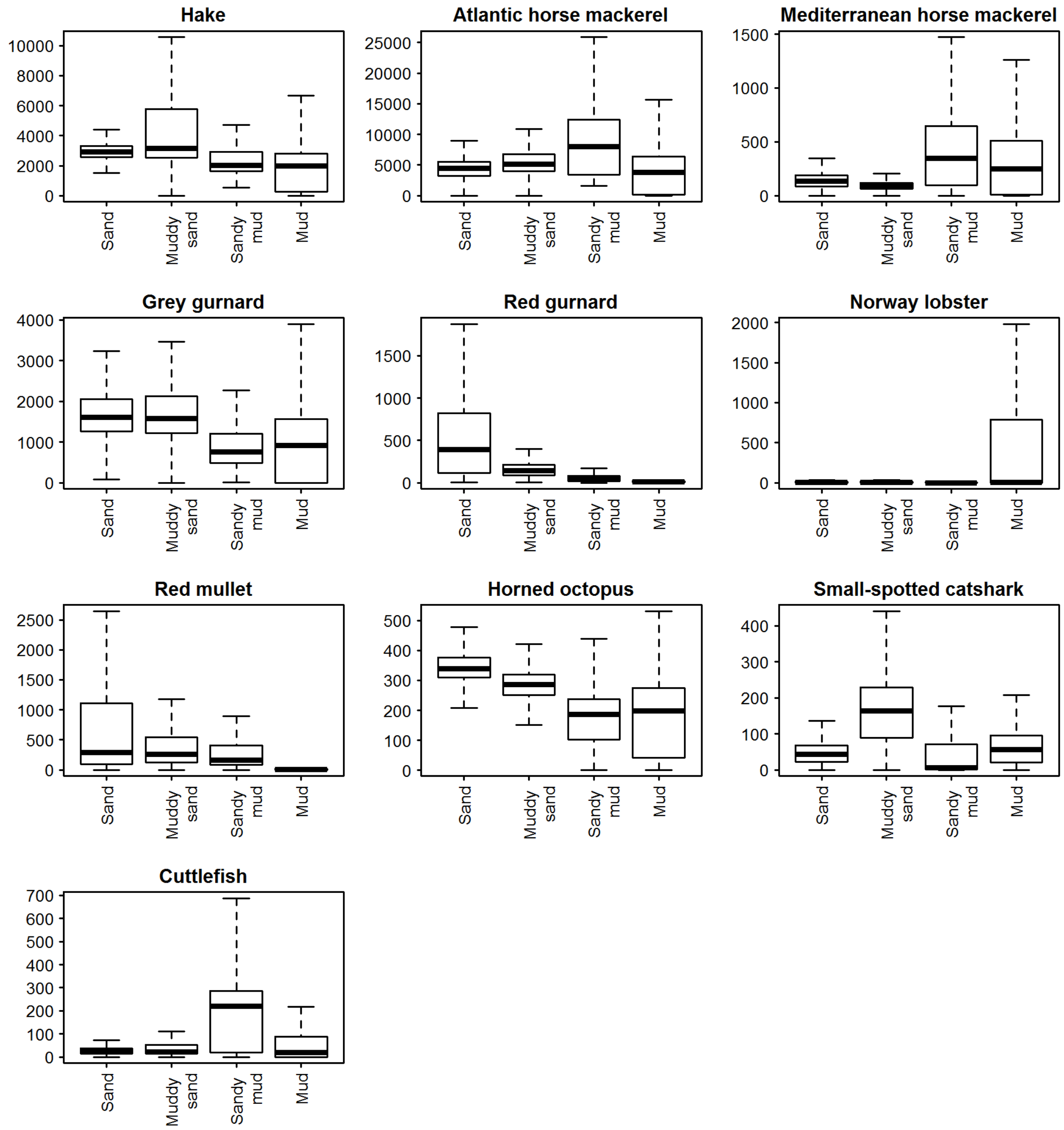
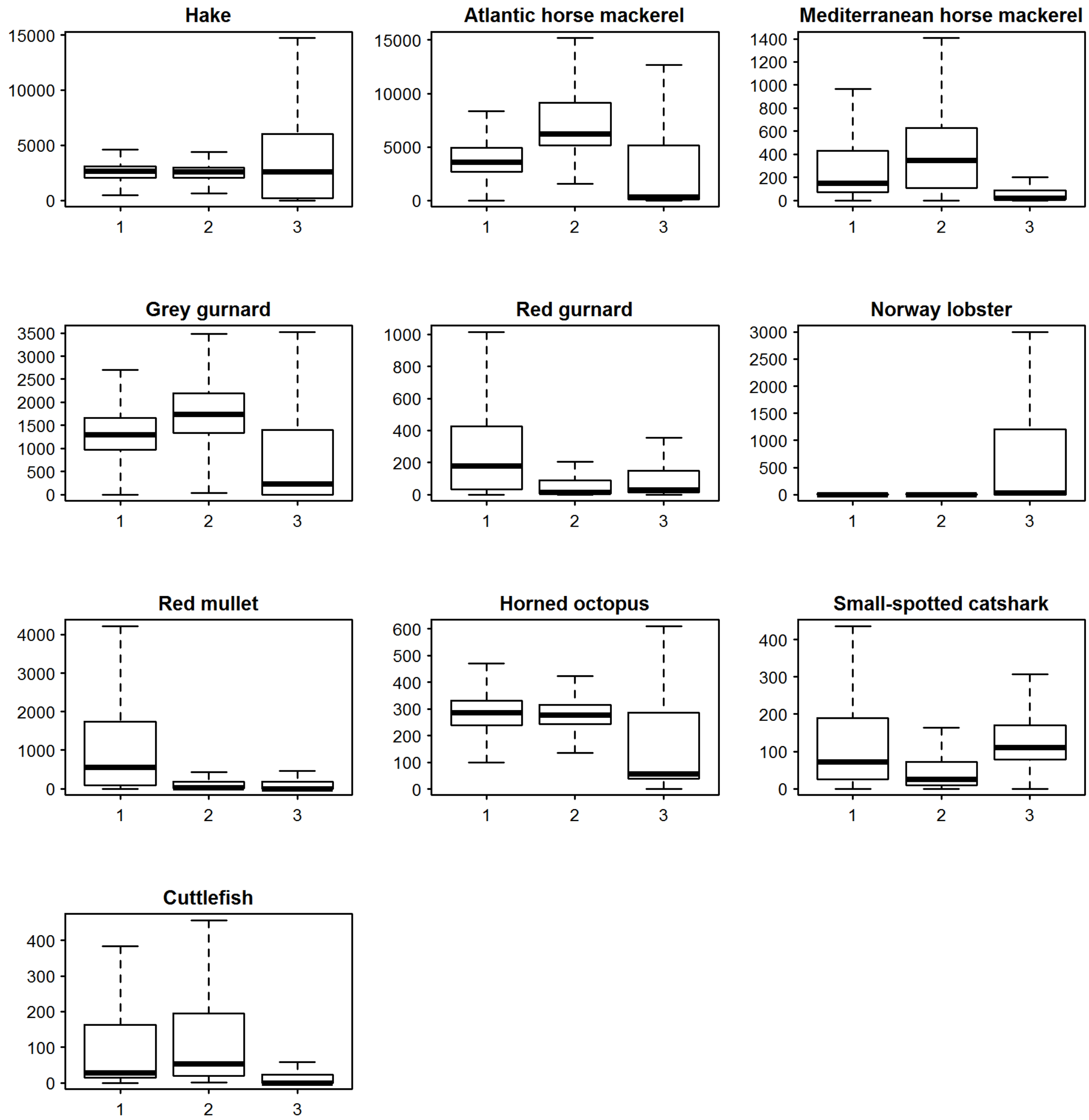


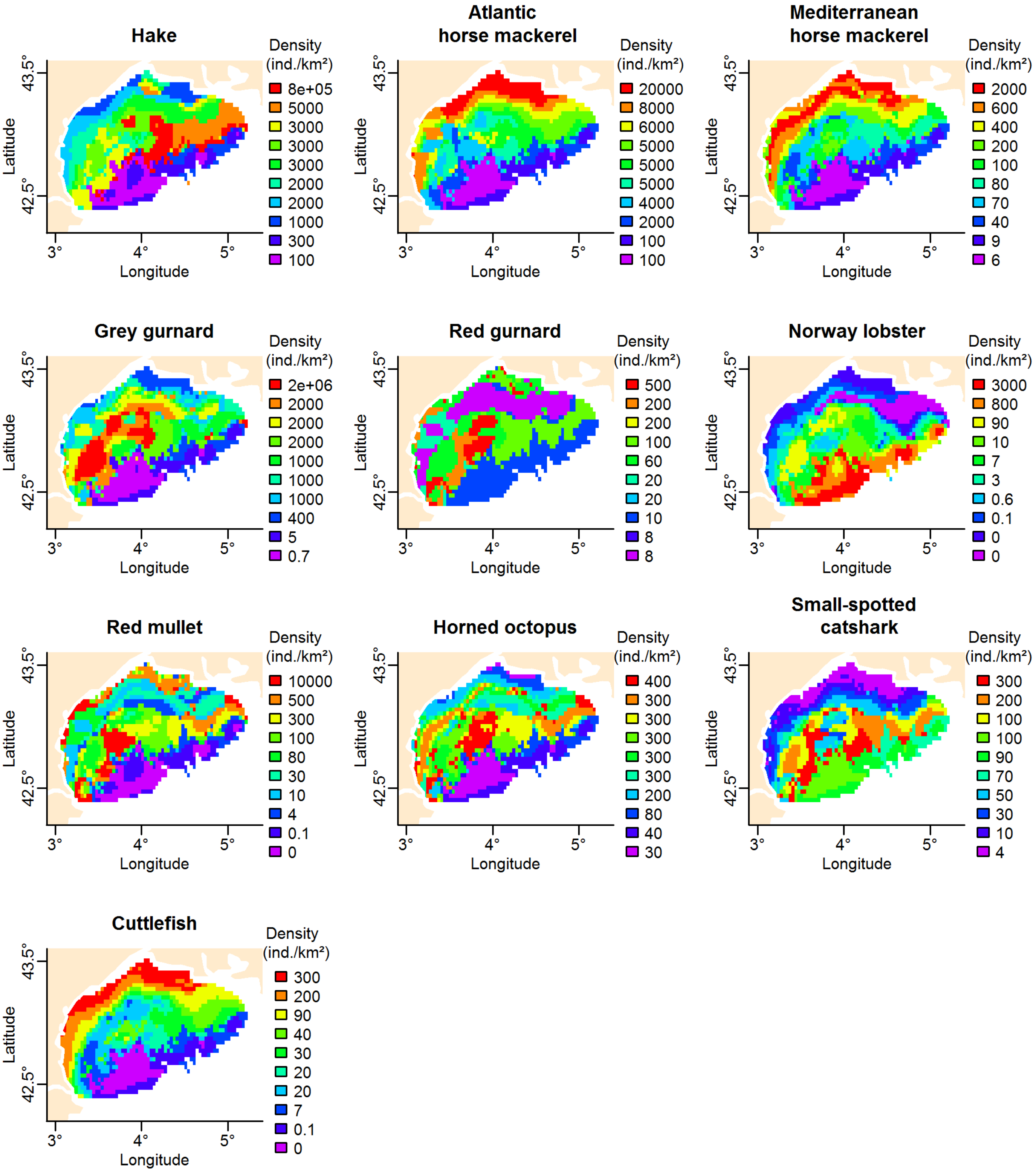
Figure S7. Model interpretation: marginal effects.

Marginal response in species density depending on substrate categories, as predicted by the model selected by Loo procedure. Distributions of the marginal response were estimated by bootstrap.



<u>Figure S8.</u> Model interpretation: marginal effects.

Marginal response in species density depending on benthos groups, as predicted by the model selected by Loo procedure. Distributions of the marginal response were estimated by bootstrap.



<u>Figure S9.</u> Species distribution maps.

Predictions of species distributions over the Gulf of Lions by models selected by Loo procedure. Colours are implemented according to the percentiles of species density distributions (individuals per km²).

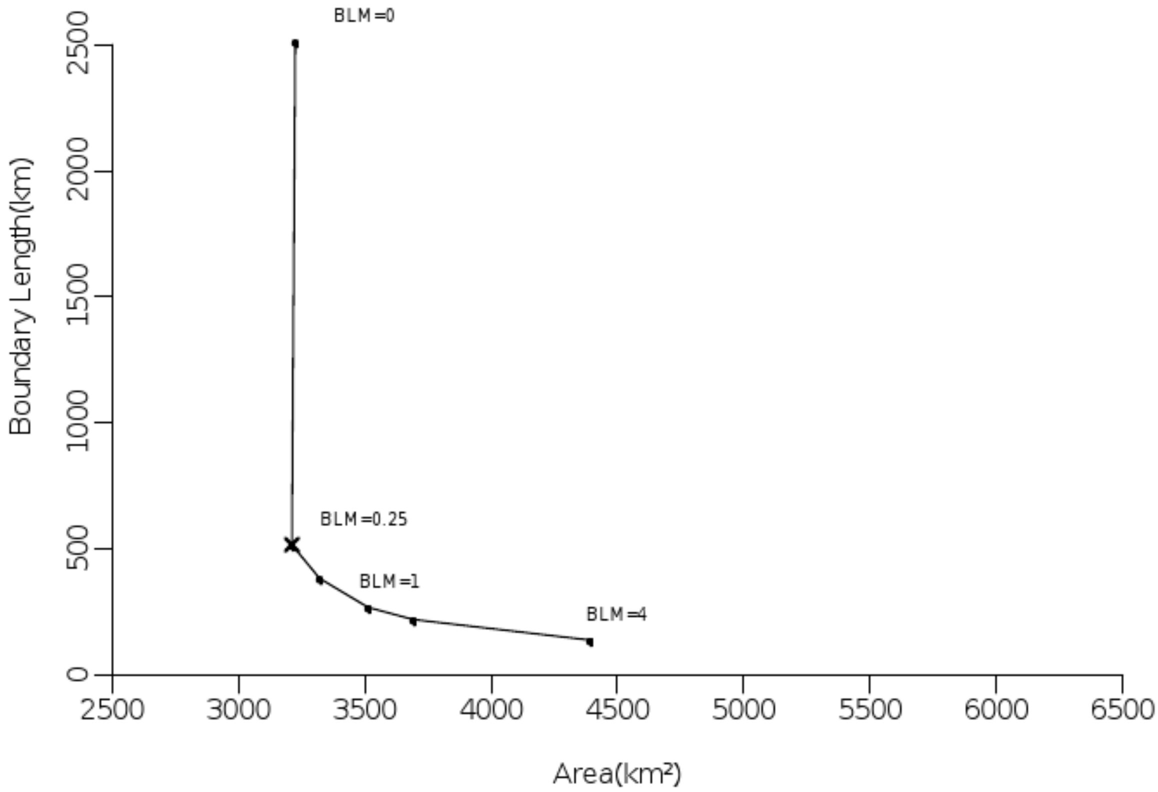


Figure S10. Boundary Length Modifier.

Total boundary length of the protected zones versus their total area, for different values of the Boundary Length Modifier (BLM). The higher the value of the BLM, the lower the total boundary length. The optimal value of BLM was considered as those which realized the best trade-off between the boundary length and the area.