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**SUPPORTING INFORMATION**

**Phylogenetic conservatism of species range size is the combined outcome of phylogeny and environmental stability**

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**Appendix S3** Evaluation of the robustness of species range size conservatism according to potential uncertainty in range size estimates, estimation of spatial autocorrelation of species range sizes, and phylogenetic conservatism of species range size measured on subtrees without branch length recalculation

**Robustness of species range size conservatism according to potential uncertainty in range size estimates**

To our knowledge, no method for estimating uncertainty on extent of occurrence and latitudinal range values is described in the literature focusing on range size conservatism. We therefore wrote an R program that randomly removes X% of species occurrences for the three richest subdatasets, i.e. western Tethys, MED and NWE at the scale of the entire early Pliensbachian.

The algorithm follows the successive steps:

- 5, 10 and 15% of species occurrences are removed randomly from the presence/absence matrices 1000 times

- a threshold of removal is defined in order to keep the same number of species for each iteration (otherwise the results would not be comparable): when testing for uncertainty in latitudinal range size, every species must have a minimum of two occurrences. When testing for uncertainty in extent of occurrence, every species must have a minimum of three occurrences

- Moran’s *I* is then calculated for each of the 1000 simulated datasets

- four categories of results are defined for Moran’s *I*: positive and significant, positive and non-significant, negative and significant, negative and non-significant

- a count is made on how many times out of 1000 simulations we obtain the same category of results as the original subdataset.

The results are as follows:

**Table S3.2** Evaluation of the robustness of species range size conservatism according to potential uncertainty in range size estimates

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Range variable and percentage of removed occurrences** | |  | **Spatial scale** | | | | |
|  | **MED** |  | **NWE** |  | **Western Tethys** |
| *n* |  |  | *43 sp* |  | *22 sp* |  | *117 sp* |
| *Original result of phylogenetic conservatism of extent of occurrence* | |  | **+** |  | - |  | **+** |
| -5% occurrences | |  | **1000 +** |  | **1000 -** |  | **1000 +** |
| -10% occurrences | |  | **1000 +** |  | **1000 -** |  | **1000 +** |
| -15% occurrences | |  | **1000 +** |  | **1000 -** |  | **1000 +** |
|  |  |  |  |  |  |  |  |
| *n* | |  | *66 sp* |  | *29 sp* |  | *147 sp* |
| *Original result of phylogenetic conservatism of latitudinal range* | |  | **+** |  | **+** |  | **+** |
| -5% occurrences | |  | **1000 +** |  | **534 +** 464 + 2 - |  | **1000 +** |
| -10% occurrences | |  | **999 +** 1 + |  | **458 +** 525 + 17 - |  | **1000 +** |
| -15% occurrences | |  | **997 +** 3 + |  | **467 +** 501 + 32 - |  | **1000 +** |

Abbreviations: *n*, number of species considered in the analyses; *sp*, species; MED, Mediterranean province; NWE, Northwest European province: **+** (bold), positive significant; +, positive non-significant; -(bold), negative significant; **-**, negative non-significant.

Moran’*I* remains positive and significant for the two richest sub-datasets (i.e. western Tethys and MED species), whatever the range variable tested (latitudinal range or extent of occurrence) and whatever the percentage of occurrences removed (5, 10 or 15%). For the extent of occurrence of the poorest sub-dataset (i.e. NWE species), all simulated Moran’s *I* are negative and significant instead of being negative and non-significant as for the original dataset, which does not change the interpretation of the initial results (Paradis, 2012; p. 210). Finally, results for the latitudinal range of NWE species are modified in about 50% of the 1000 iterations compared to the original dataset (they are still positive but non-significant). This shows that the phylogenetic signal of range size conservatism is less robust in the NWE province than in the MED province.

**Table S3.3** Spatial autocorrelation of species range sizes estimated using Moran's *I* as implemented in the function *gearymoran* of the package ade4 (Dray et al., 2007) in R (v.3.0.2.; R Development Core Team, 2010). NB: all results are non-significant

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Temporal interval** | **Range variable** | **Spatial scale** | | |
| **NWE** | **MED** | **Western Tethys** |
| **Early Pliensbachian** | *n* | *43 sp* | *22 sp* | *117 sp* |
| *Extent of occurrence* | -0.1206 | -0.0917 | 0.1324 |
| *n* | *66 sp* | *29 sp* | *147 sp* |
| *Latitudinal range* | -0.3013 | -0.2319 | -0.0304 |
|  |  |  |  |  |
| **DAVOEI** | *n* | *14 sp* | *5 sp* | *33 sp* |
| *Extent of occurrence* | -0.2679 | -0.2248 | -0.3332 |
| *n* | *17 sp* | *7 sp* | *38 sp* |
| *Latitudinal range* | -0.2166 | 0.1404 | -0.7399 |
| **IBEX** | *n* | *22 sp* | *11 sp* | *57 sp* |
| *Extent of occurrence* | -0.0718 | 0.0181 | -0.5462 |
| *n* | *29 sp* | *13 sp* | *66 sp* |
| *Latitudinal range* | -0.0526 | 0.0128 | -0.0330 |
| **JAMESONI** | *n* | *33 sp* | *12 sp* | *67 sp* |
| *Extent of occurrence* | -0.9813 | 0.0818 | 0.0262 |
| *n* | *49 sp* | *16 sp* | *87 sp* |
| *Latitudinal range* | -0.8376 | 0.1816 | -0.3966 |

Abbreviations: *n*, number of species considered in the analyses; *sp*, species; MED, Mediterranean province; NWE, Northwest European province. Note: \*\*\*p < 0.001, \*\*p < 0.01, \*p < 0.05, no symbol = not significant.

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| **Table S3.4** Phylogenetic conservatism of species range size as measured by Moran’s *I*. Analyses were conducted on subtrees containing only the species occurring in each chronozone and geographical area considered but inter-species phylogenetic distances are the same as those of the early Pliensbachian phylogenetic tree (Fig. 2) | | | | |
| **Temporal interval** | **Range variable** | **Spatial scale** | | |
| **MED** | **NWE** | **Western Tethys** |
| **Early Pliensbachian** | *n* | *43 sp* | *22 sp* | *117 sp* |
| *Extent of occurrence* | **0.0052\*\*\*** | -0.045 | -0.005 |
| *n* | *66 sp* | *29 sp* | *147 sp* |
| *Latitudinal range* | **0.0118\*\*** | **0.027\*** | **0.004\*\*** |
|  |  |  |  |  |
| **DAVOEI** | *n* | *14 sp* | *5 sp* | *33 sp* |
| *Extent of occurrence* | -0.071 | -0.225 | -0.061 |
| *n* | *17 sp* | *7 sp* | *38 sp* |
| *Latitudinal range* | **0.105\*** | -0.159 | -0.008 |
| **IBEX** | *n* | *22 sp* | *11 sp* | *57 sp* |
| *Extent of occurrence* | **0.059\*** | -0.180 | 0.010 |
| *n* | *29 sp* | *13 sp* | *66 sp* |
| *Latitudinal range* | **0.216\*\*\*** | **0.156\*\*** | 0.008 |
| **JAMESONI** | *n* | *33 sp* | *12 sp* | *67 sp* |
| *Extent of occurrence* | **-0.0036\*\*\*** | -0.110 | -0.017 |
| *n* | *49 sp* | *16 sp* | *87 sp* |
| *Latitudinal range* | **-0.0065\*\*** | -0.053 | **-0.009\*** |
| Abbreviations: *n*, number of species considered in the analyses; *sp*, species; MED, Mediterranean province; NWE, Northwest European province. Note: \*\*\*p < 0.001, \*\*p < 0.01, \*p < 0.05, no symbol = not significant. | | | | |
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