Current extinction rate in European freshwater gastropods greatly exceeds that of the late Cretaceous mass extinction

Supplementary Information

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Supplementary Figures 1–3
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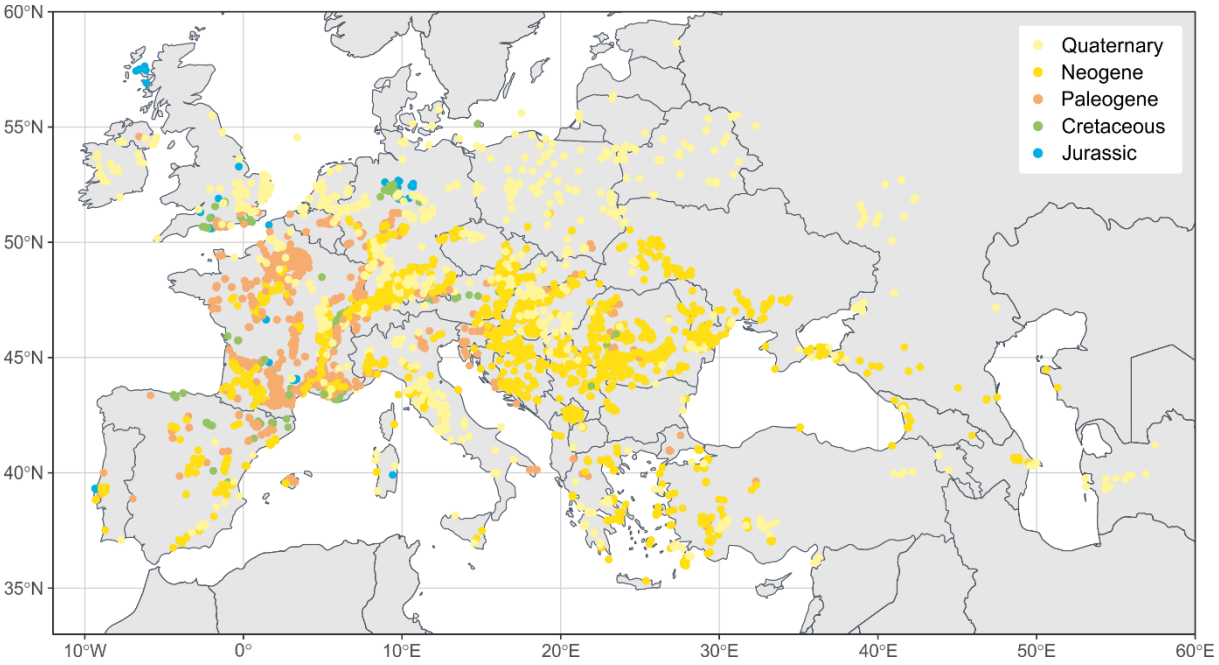
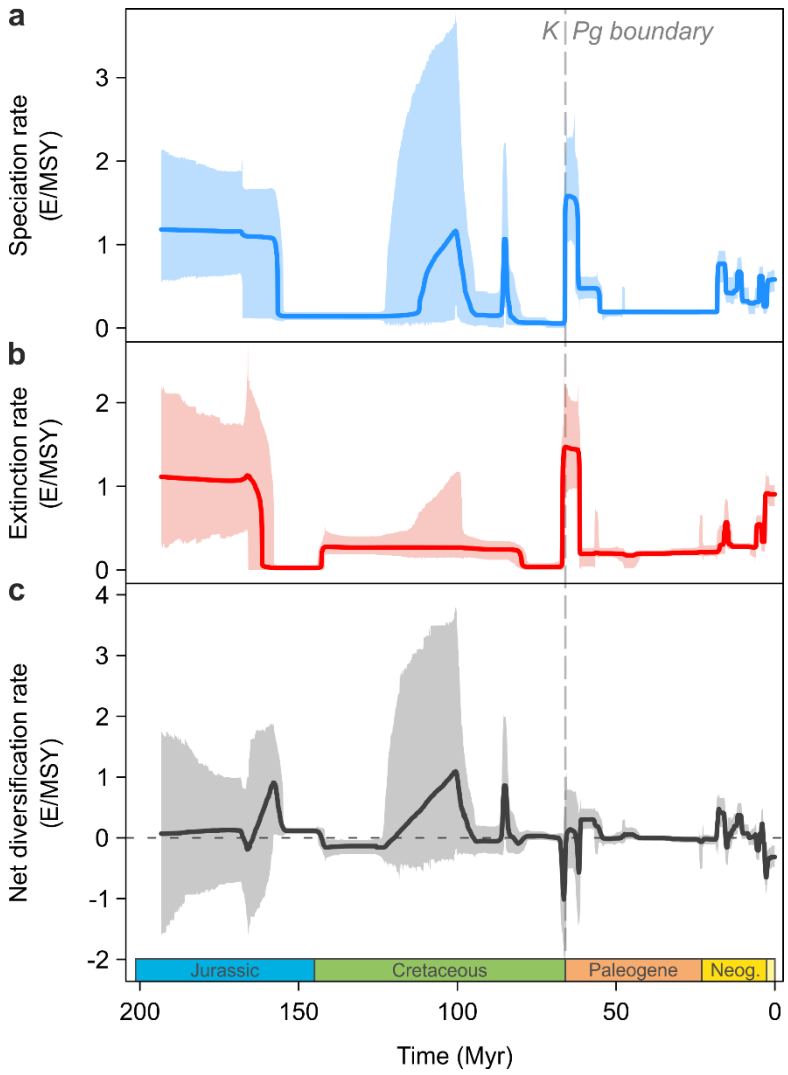
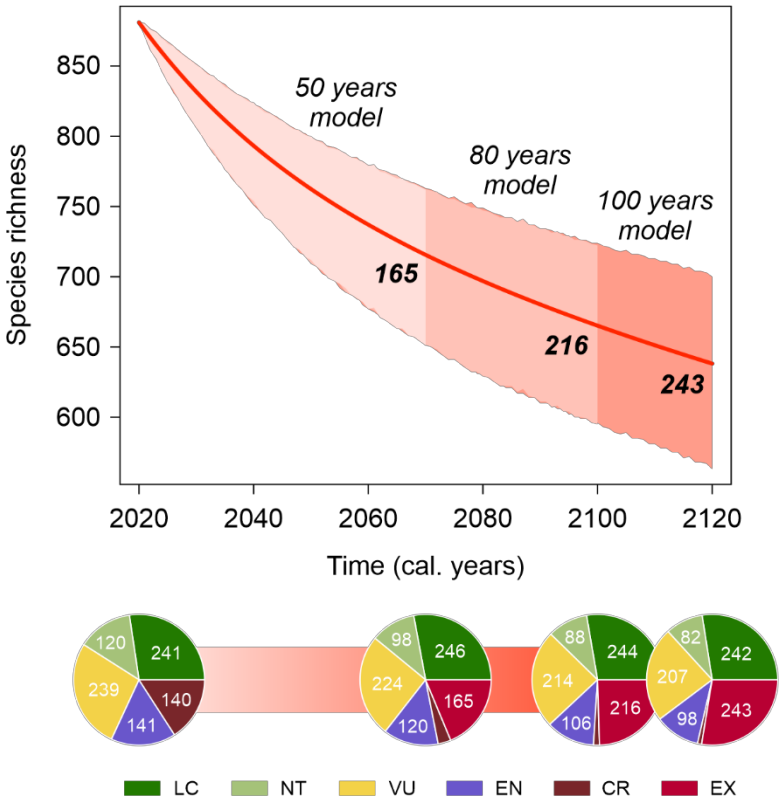


Supplementary Figure 1 | Geographic overview of the dataset. Shown are the 5,564 localities yielding Jurassic to Pleistocene freshwater gastropods included in the dataset. Color codes conform to the International Chronostratigraphic Chart 2020 (freely available from https://stratigraphy.org/chart).



Supplementary Figure 2 | Rates of diversification of European freshwater gastropods. a, Speciation rate. **b**, extinction rate. **c**, net diversification rate, calculated as speciation minus extinction rate (complete version of Figure 2). Shown are the median rates and the 95% highest posterior density quantifying the uncertainty in rates. Net diversification is calculated as speciation minus extinction rate. In addition to those in the studied interval (Figure 2), there are notable peaks in the speciation and extinction rate in the Neogene and Pleistocene. The Neogene diversification pattern is likely a result of the major radiations in several long-lived lakes in the Miocene, which is also mirrored in the extraordinarily high diversity during this time period[1] (Figure 1). The high extinction rate at the Plio–Pleistocene transition reflects the disappearance of these environments and faunas; the Pleistocene plateau in the extinction rate is likely due to the massive climatic change during the glacial cycles[1]. The high rates inferred for the Jurassic may be a result of limited sampling. E/MSY, events per million species years.



Supplementary Figure 3 | Extinction risks of extant European freshwater gastropods. Predicting the number of extinct species and conservation status change of the complete European freshwater gastropod fauna (including spring, subterranean, cave and karstic species) over the next 50, 80 and 100 years based on current species conservation status as derived from the IUCN Red List[2] using the recently developed program iucn_sim[3]. The results of the analysis are provided in the Supplementary Tables 5–7.

Supplementary References

1. Neubauer, T. A., Harzhauser, M., Georgopoulou, E., Kroh, A. & Mandic, O. Tectonics, climate, and the rise and demise of continental aquatic species richness hotspots. *Proc. Natl. Acad. Sci. USA* **112**, 11478–11483 (2015).
2. IUCN. *The IUCN red list of threatened species. Version 2020-1*. https://www.iucnredlist.org (2020).
3. Andermann, T., Faurby, S., Cooke, R., Silvestro, D. & Antonelli, A. iucn_sim: a new program to simulate future extinctions based on IUCN threat status. *Ecography* **44**, 162–176 (2021).