

Appendix A

Text A1 Methodological approaches

Bibliographic searches

We carried out multi-level bibliographic searches to gather various types of published information and data on marsh frog invasions. To this end, we first used combinations of keywords in Google Scholar and Google, including scientific and common names of marsh frogs (in different languages) with different aspects related to invasions. For scientific names, we used all those attributed to marsh frogs i.e. the various species or subspecies these frogs correspond to in the literature (see Dufresnes et al. 2024b). We then fine-tuned the search by adding the name of geographical invaded locations at national, regional and/or local levels. Finally, we considered the published regional and national herpetological atlases of Europe. This search further involved the examination of references cited in the primary literature flagged by our initial searches. Altogether, we included articles published in scientific journals, book chapters, books and authored official reports in the review, as detailed in the reference list of the main text and in Suppl. Table 1.

Invaded administrative units and areas

We used regional and sub-regional administrative units to categorise and quantify the degree and extent of invasions in invaded countries. Each country differs in its terminology and in the number and size of subdivisions, so we chose the level of precision that was the most easily comparable across countries and for which we could derive invasion data, since the exact geographic origins were not always given (Table S2). For example, in France, these included regions and departments. Accordingly, small countries were not subdivided (e.g. Luxembourg), as their national territories were comparable of the sub-regional administrative units of neighboring countries (e.g. Luxemburg vs. provinces in Belgium; Fig. 1b). For many countries, we used the statistical regions in the European Union and partner countries (NUTS 2 and 3; 2022), completed by 2016 data for the United Kingdom and those of the territorial units in Russia, Ukraine, Belarus and Moldova. Within the natural boundaries of the range of marsh frogs, the administrative units which are highlighted as invaded (Fig. 1b) are therefore considered to include populations of both invaded and native marsh frogs.

Phylogeographic lineages

We identified the phylogeographic lineages of marsh frogs occurring in invaded and potential source ranges, based on the recent phylogeographic overview of Dufresnes et al. (2024b), which we followed the lineage delimitation, phylogenetic relationships and terminology. To this end, we re-mapped the data pertaining to the geographic distribution of lineages of *P. ridibundus* based on mtDNA, as made available by the authors at <https://doi.org/10.5281/zenodo.10423702>. Additional data on lineage identity were collected from the literature, either directly, based on the genetic information provided in publications that were not considered by Dufresnes et al. (2024b), or indirectly, based on the documented origin of some introductions which native range had been barcoded (Table S1 and Fig. 3).

Mapping

To map the native and invasive ranges of marsh frogs, we first combined the distribution shapefiles provided by the IUCN Red List that now pertain to this species (<https://www.iucnredlist.org>; last assessed on 1 November 2021). The only non-native European area distinguished by these shapefiles is the range of *P. ridibundus* in the UK. Range limits were

then modified according to: (1) the results of our literature search (see above); the phylogeographic results from Dufresnes et al. (2024b); (3) part of the occurrence data available on the GBIF platform (last accessed on 20 November 2024: www.gbif.org). Boundaries of invasions were drawn based on the distributions of alien lineages and evidence for introductions, also considering natural barriers to dispersal (mountains and major rivers). We took a conservative approach in delineating the invasive distributions, by mining information from authored published works that unambiguously discussed introductions. To show the areas of origin of alien marsh frogs, we used the centroids of the invaded sub-regional administrative units. We applied the WGS84 coordinate Reference System and drew all maps in QGIS 3.36.2.