Supplement

Projecting the continental accumulation of alien species through to 2050

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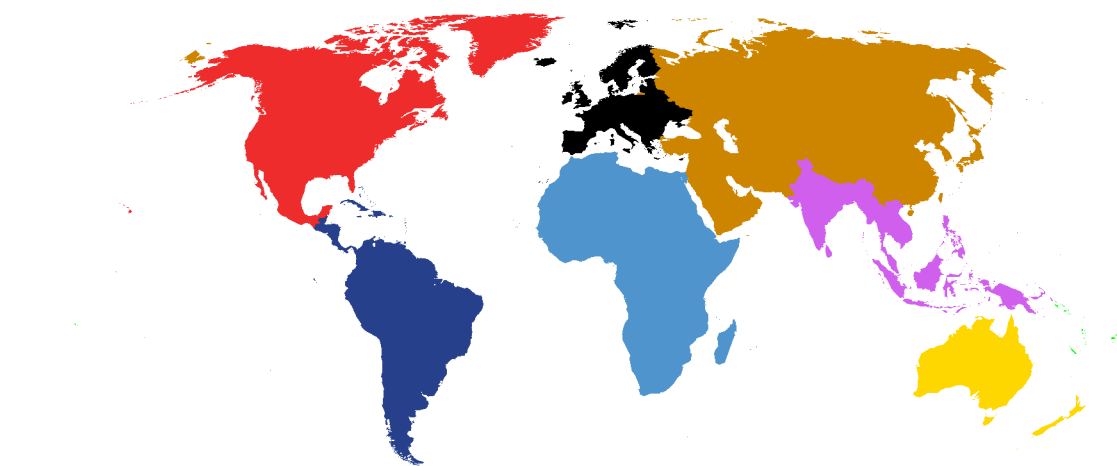[9]Institute for Environmental Protection and Research (ISPRA), Via Vitaliano Brancati 48, 00144 Rome, Italy

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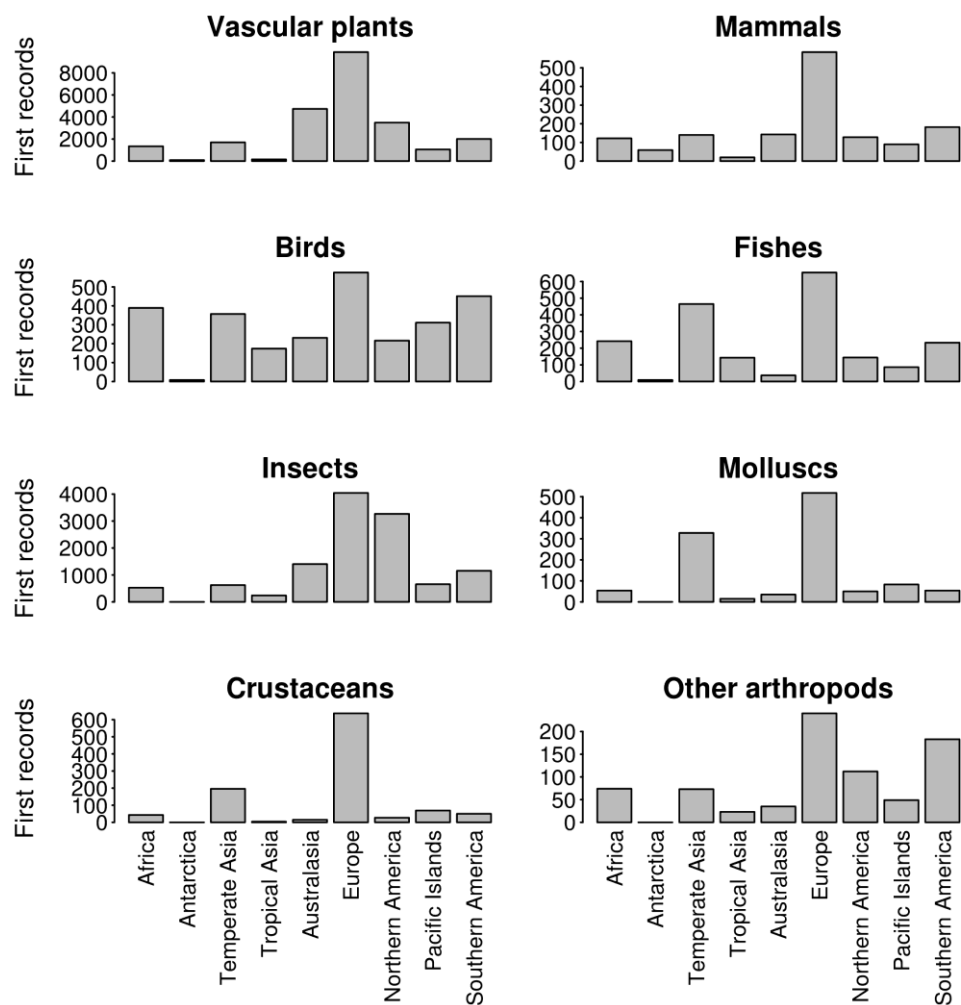
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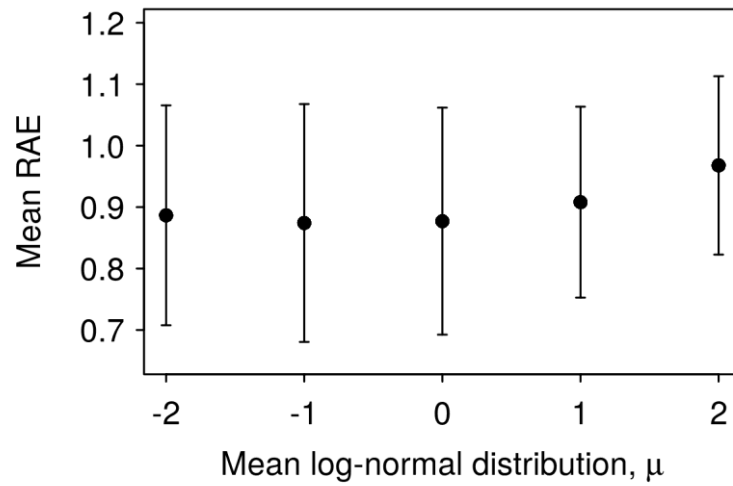
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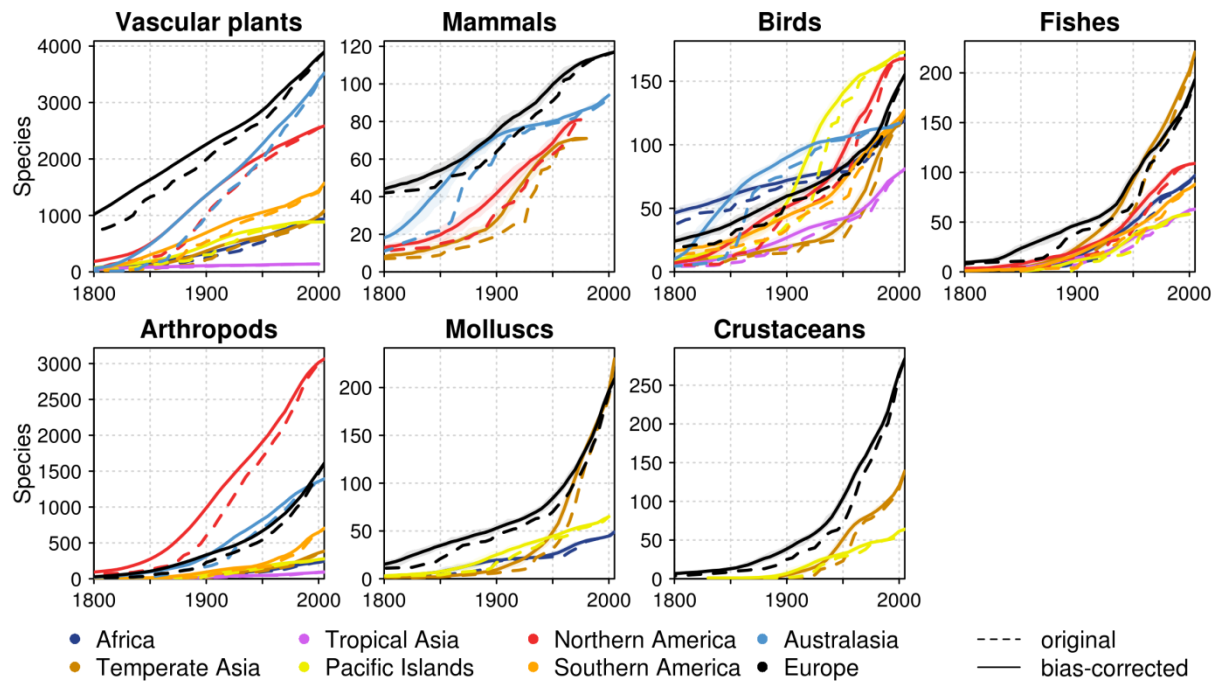
Fig. S1 Delineation of continental regions based on the Taxonomy Database Working Group (TDWG) World Geographical Scheme for Recording Plant Distributions Version 2.0 (https://www.tdwg.org/standards/wgsrpd/).
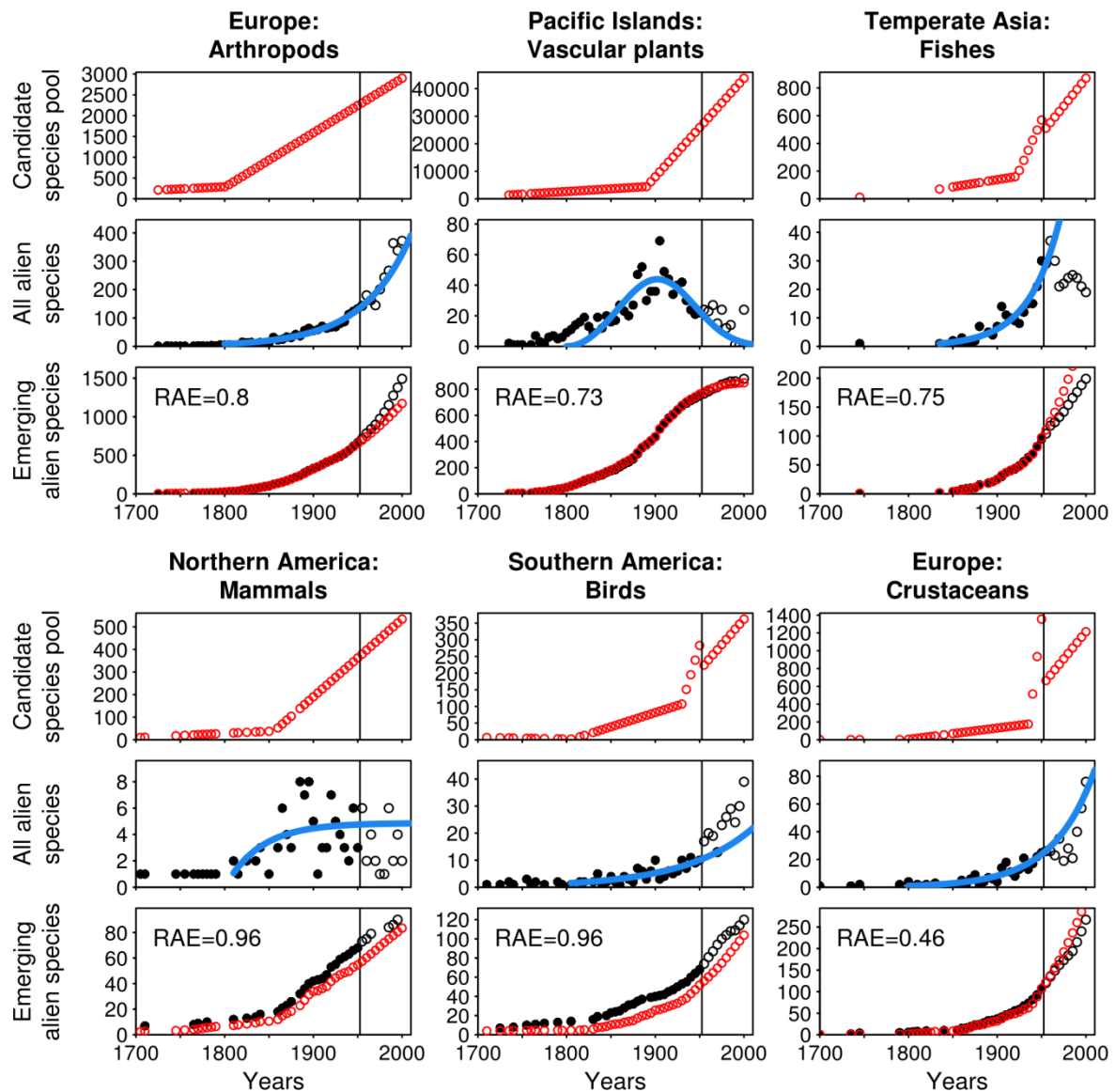
Fig. S2 Number of available first records per continent and taxonomic group.
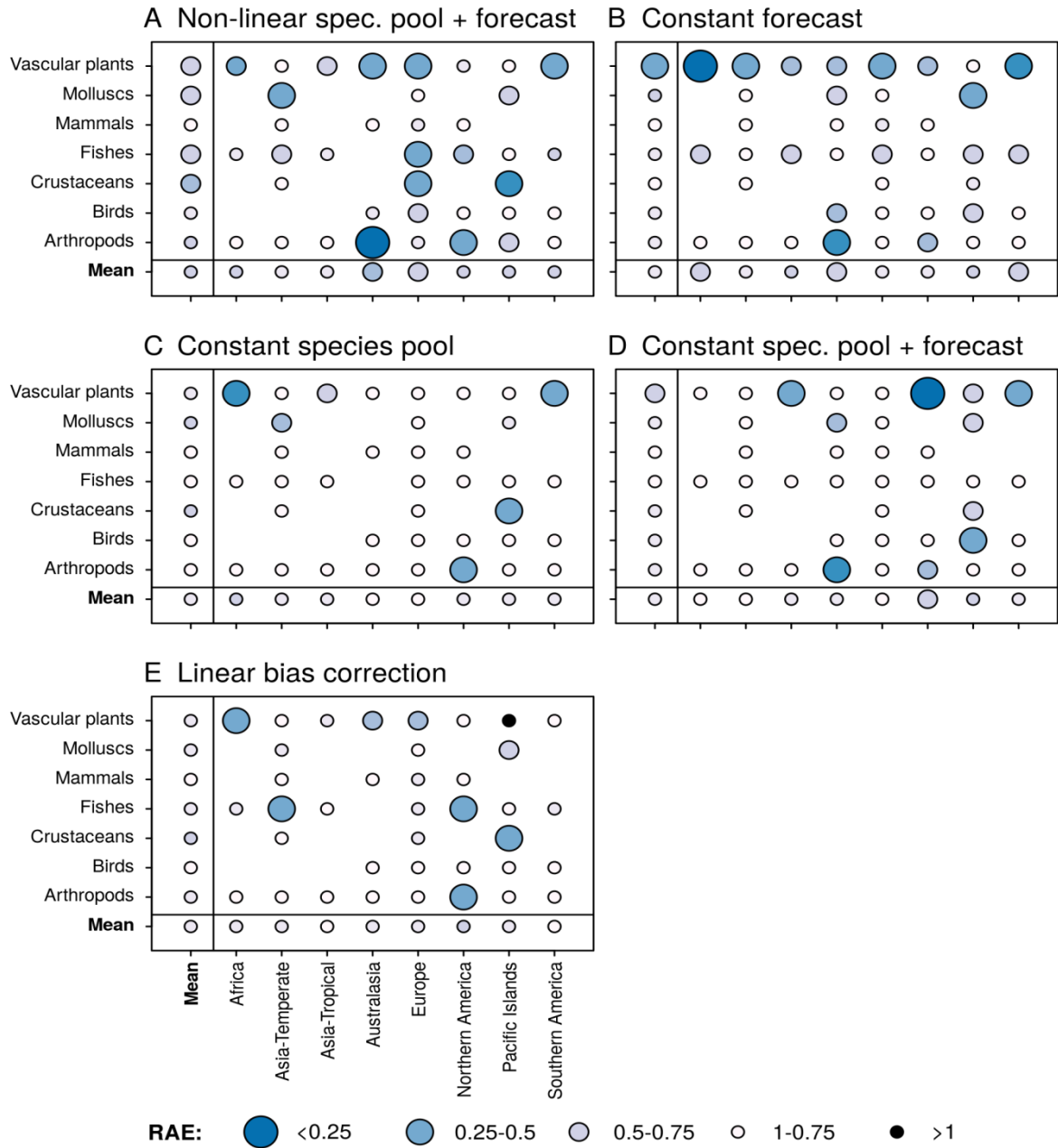
Fig. S3 Mean and standard deviation of relative absolute errors (RAEs) of simulations of all possible taxon-continent combinations for varying values of the mean log-normal distribution, μ, which determines the shape of the candidate source pools. Overall, values around -1 and 0 provided best model performance, although the difference to model performances using other values was low.

Fig. S4 Changes in emerging alien species numbers for different taxonomic groups and continental regions until the year 2005. Trajectories are shown for original data (dashed lines) and for mean species numbers after correcting for temporal sampling bias (solid lines). Bias correction was done separately for each of the 100 model runs with the mean shown here.
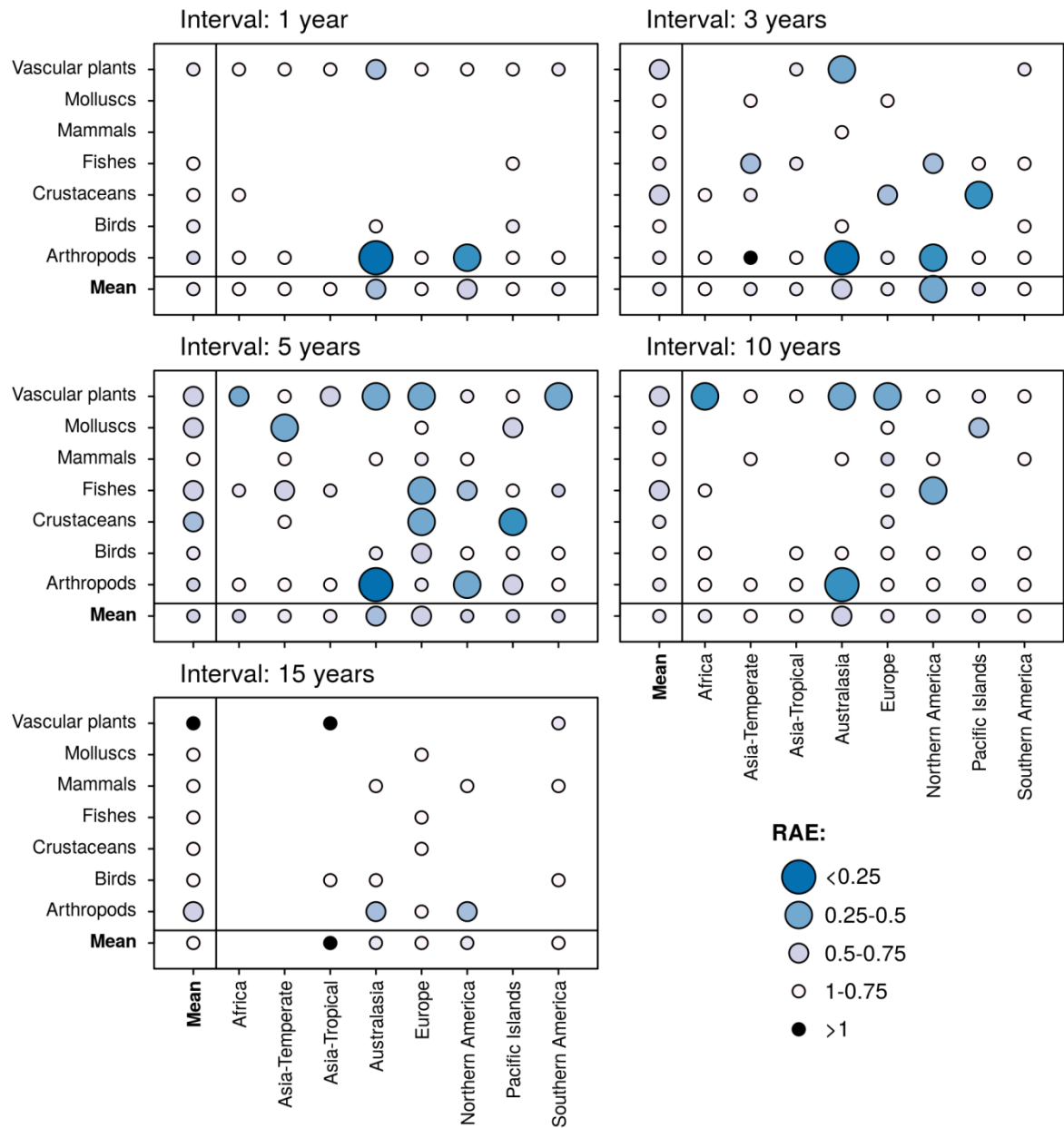
Fig. S5 Examples of single model runs for a random selection of taxon-continent pairs, showing observed time series of first records until 1950 (black dots), fit and extrapolations of first record rates (blue lines) and model predictions until 2005 (red circles). Top panels show the estimated sizes of the candidate species pools until 1950, which were linearly extrapolated until 2005. Middle panels highlight the first-record rates of all alien species until 1950, which were extrapolated until 2005 using one out of six functional forms (blue lines), which described the dynamics since 1800 best. Observed first-record rates from 1950-2005 are shown for comparison (black circles). Bottom panels show the observed (black) and predicted (red) accumulations of emerging alien species. The model fit is indicated by the relative absolute error (RAE).
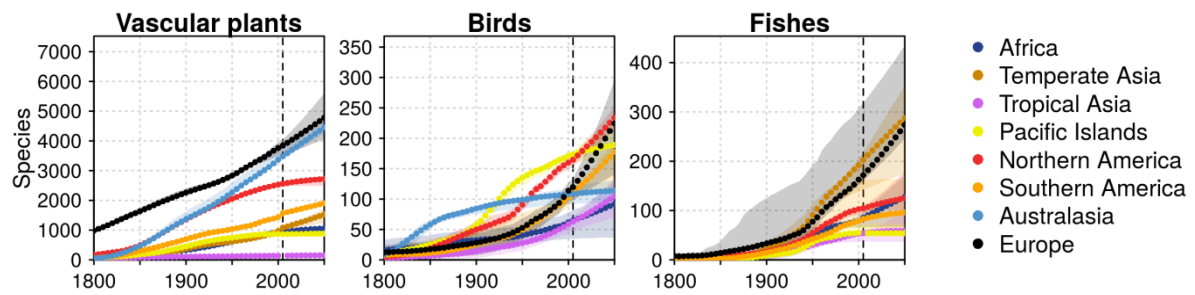
Fig. S6 Model performance of all model versions and all simulation runs (up to 100 runs each) for each taxonomic group and continent. Performance was tested by applying the model to first records until 1950 to predict dynamics from 1950 to 2005. Model performance was measured using the relative absolute error (RAE) between observed and predicted rates of emerging alien species. Size of bubbles and colours indicate the median RAE averaged over 100 model runs for each combination of taxa and continent. Lower values of RAE denote better model performance. Gaps indicate taxon-continent combinations, where resulting time series of first records did not fulfil our minimum requirements for calculating simulations (step 5 in methods).
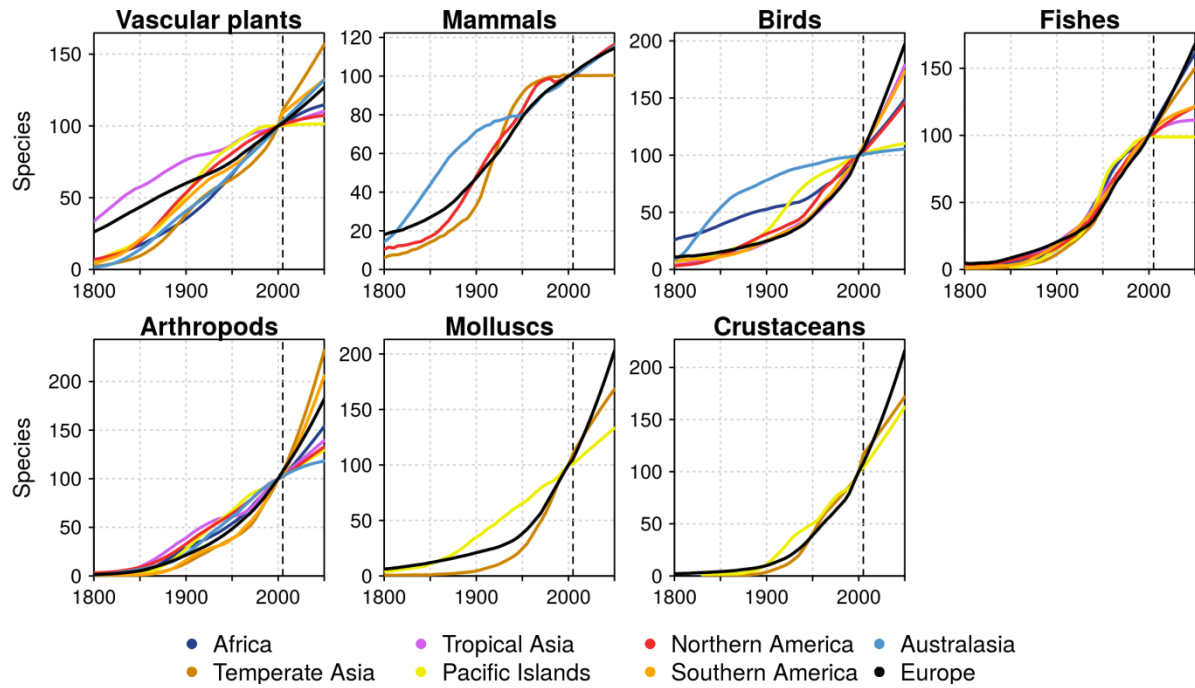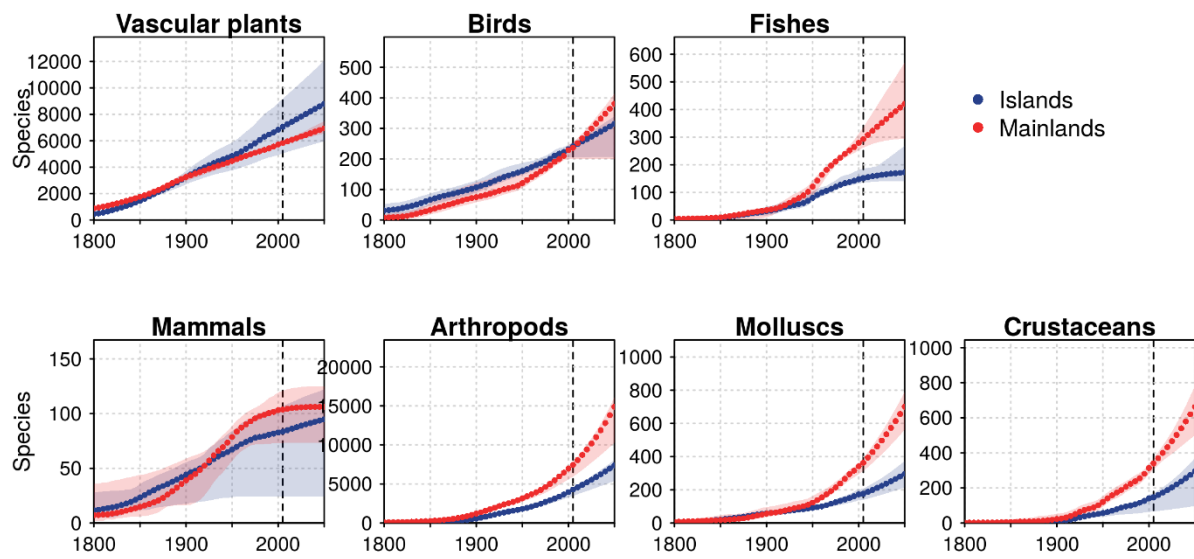
Fig. S7 Model performance using different bin sizes to aggregate first records from 1 to 15 years. Model performance is shown for all simulation runs (up to 100 runs each) for each taxonomic group and continent. Performance was tested by applying the model to first records until 1950 to predict dynamics from 1950 to 2005. Model performance was measured using the relative absolute error (RAE) between observed and predicted rates of emerging alien species. Size of bubbles and colours indicate the median RAE averaged over 100 model runs for each combination of taxon and continent. Lower values of RAE denote better model performance. Gaps indicate taxon-continent combinations where resulting time series of first records did not fulfil our minimum requirements for calculating simulations (step 5 in methods).
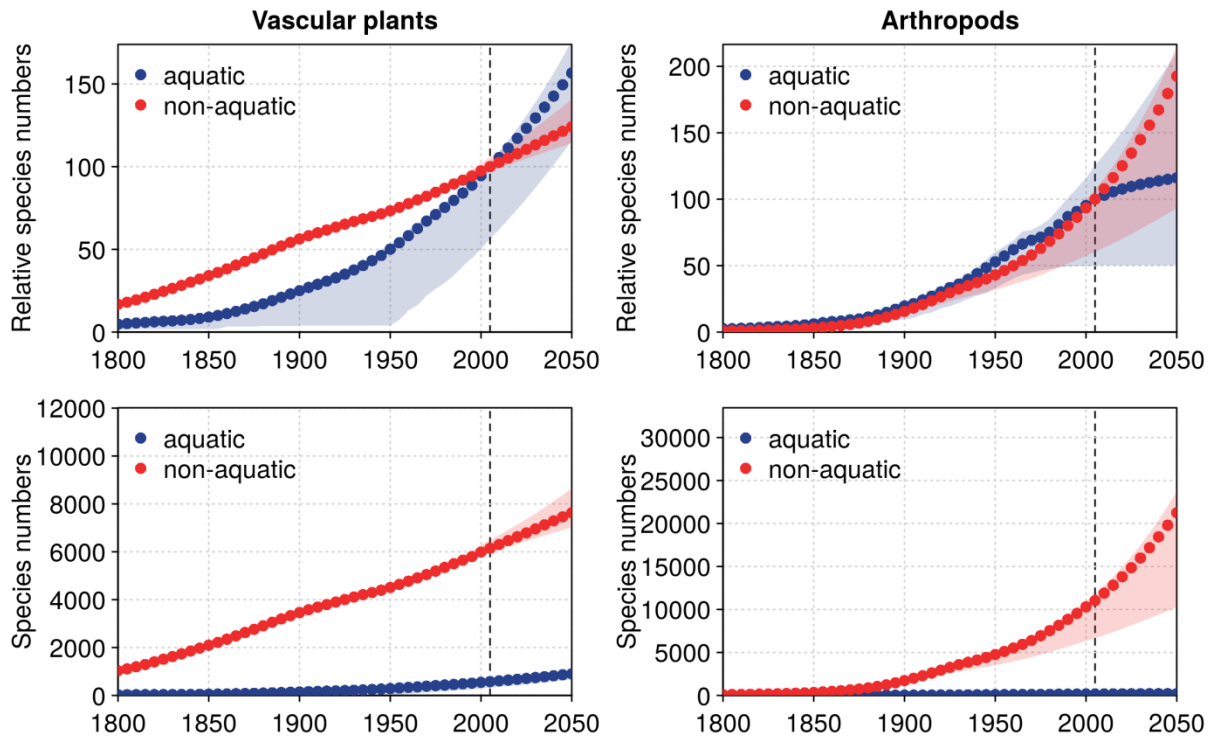
Fig. S8 Uncorrected projections of alien species accumulations on different continents until 2050 for alien vascular plants, birds and fishes. The projections are the same as in Fig. 2, but without correcting for spatial variation in sampling intensity. The dots represent means of up to 100 model runs, while the full range of all predicted trajectories is indicated by shaded areas.
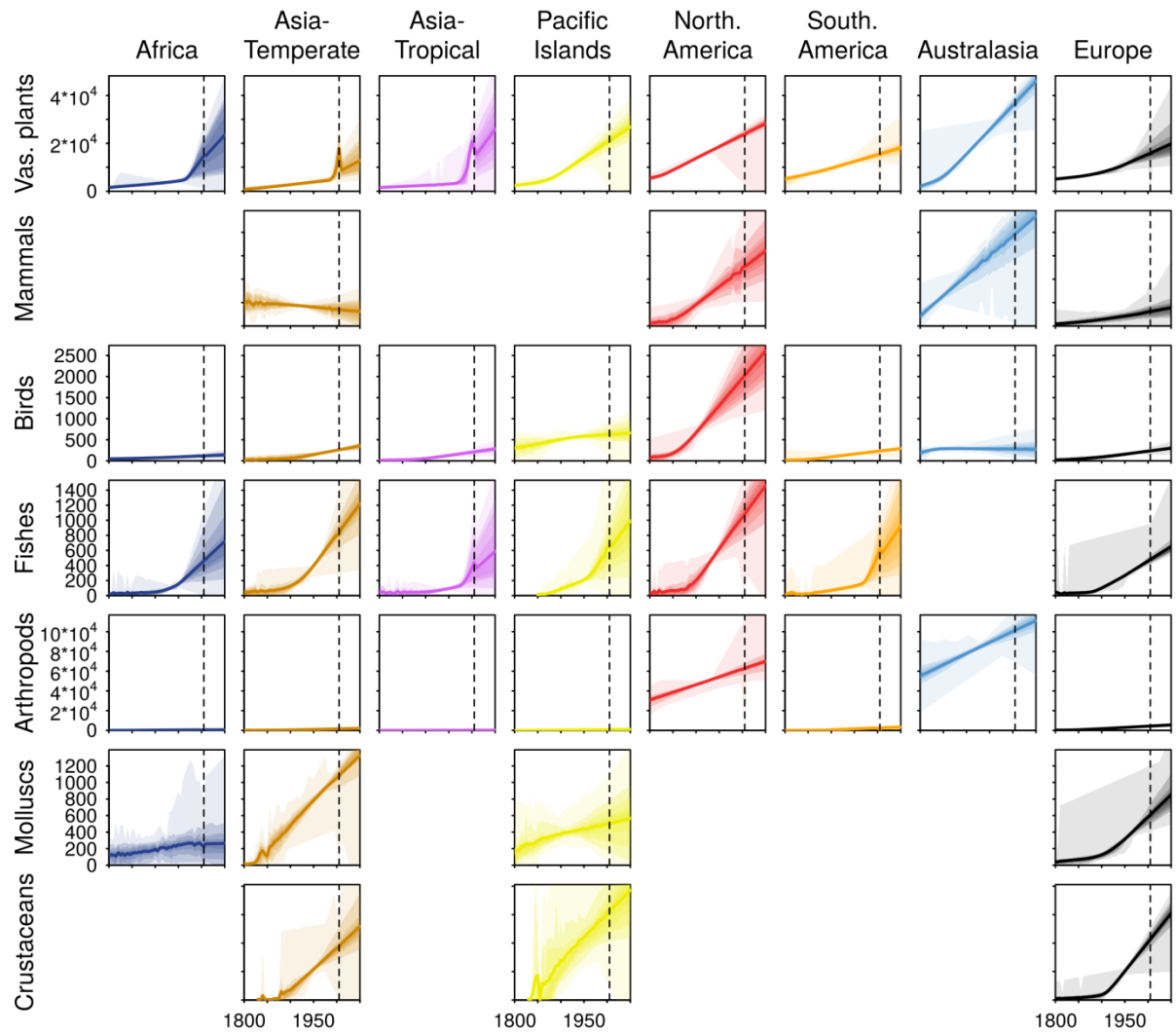
Fig. S9 Projections of relative alien species accumulations on different continents for seven taxonomic groups. The time series are rescaled to a value of 100 at 2000 to highlight relative increases in alien species numbers per continent and taxon. The lines represent means of 100 model runs.

Fig. S10 Predicted developments of alien species numbers on islands and mainlands for seven taxonomic groups until 2050. The dots represent means of up to 100 model runs, while the full range of all predicted trajectories is indicated by shaded areas.

Fig. S11 Predicted developments of aquatic and terrestrial alien species numbers for vascular plants and insects until 2050 in relative (upper panels) and absolute (lower panels) numbers. The dots represent means of up to 100 model runs, while the full range of all predicted trajectories is indicated by shaded areas. Relative accumulation trends are normalised so that the value of species numbers at 2005 equals 100.

Fig. S12 Predicted temporal developments of the sizes of candidate species pools shown separately for each taxon-continent combination. The mean of all simulation runs are shown as lines. Quantiles of simulation runs in 10% steps are indicated by bands.