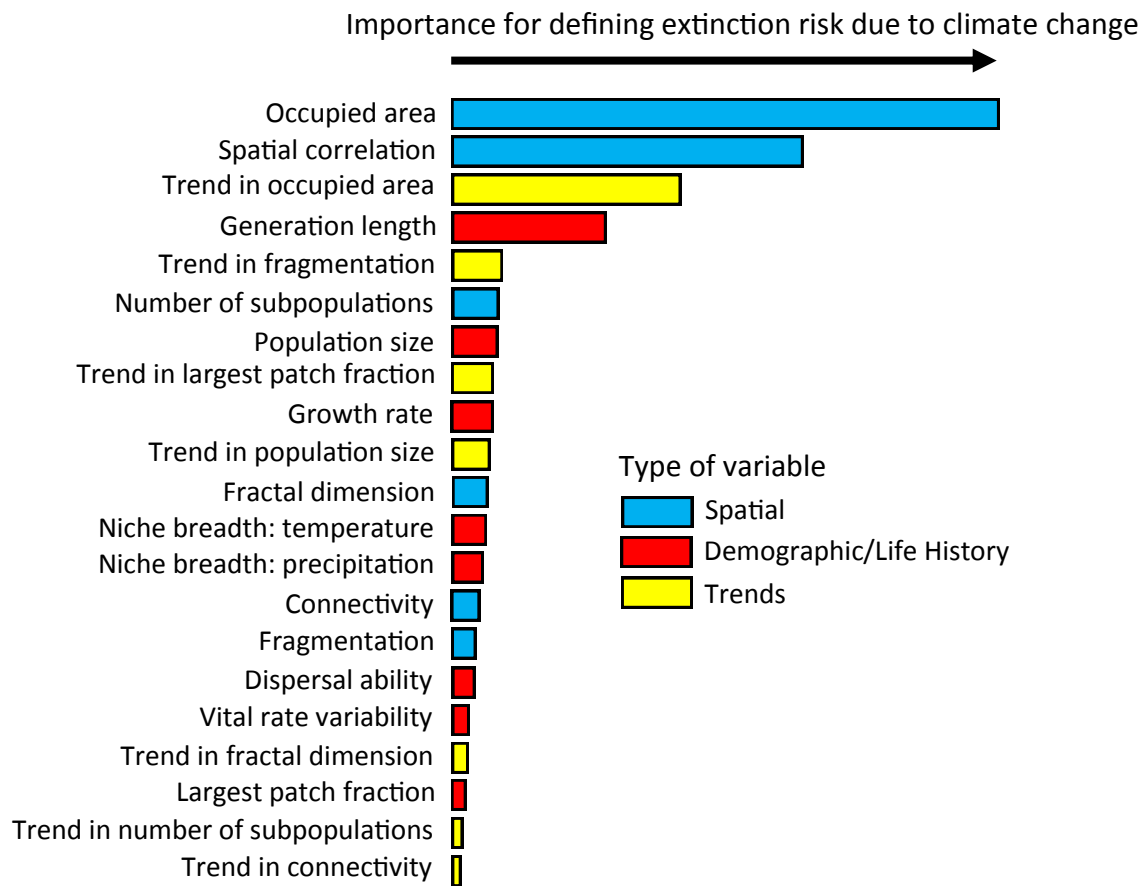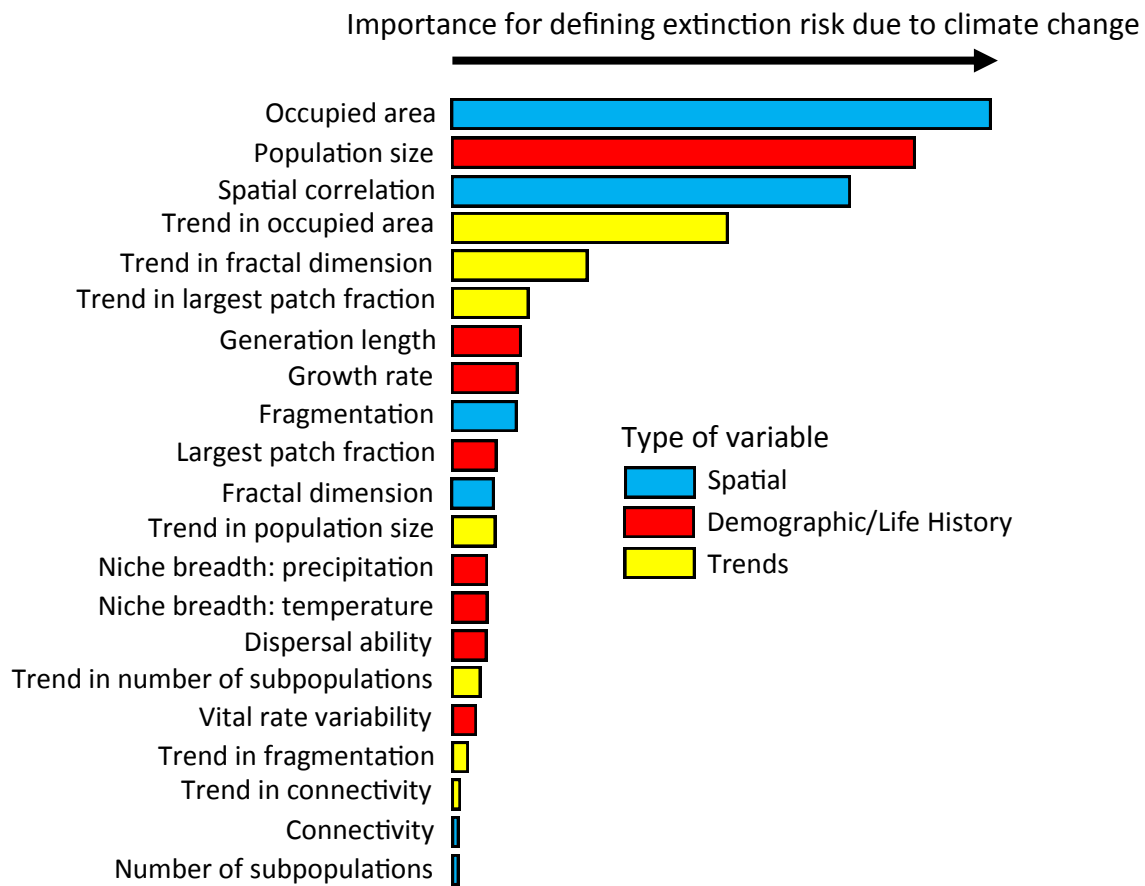**Fig. S1.** Importance of variables as predictors of extinction risk due to climate change. Importance was determined using Random Forests and the Policy climate change scenario.

Importance for defining extinction risk due to climate change

Occupied area
Spatial correlation
Trend in occupied area
Generation length
Trend in fragmentation
Number of subpopulations
Population size
Trend in largest patch fraction
Growth rate
Trend in population size
Fractal dimension
Niche breadth: temperature
Niche breadth: precipitation
Connectivity
Fragmentation
Dispersal ability
Vital rate variability
Trend in fractal dimension
Largest patch fraction
Trend in number of subpopulations
Trend in connectivity

Type of variable
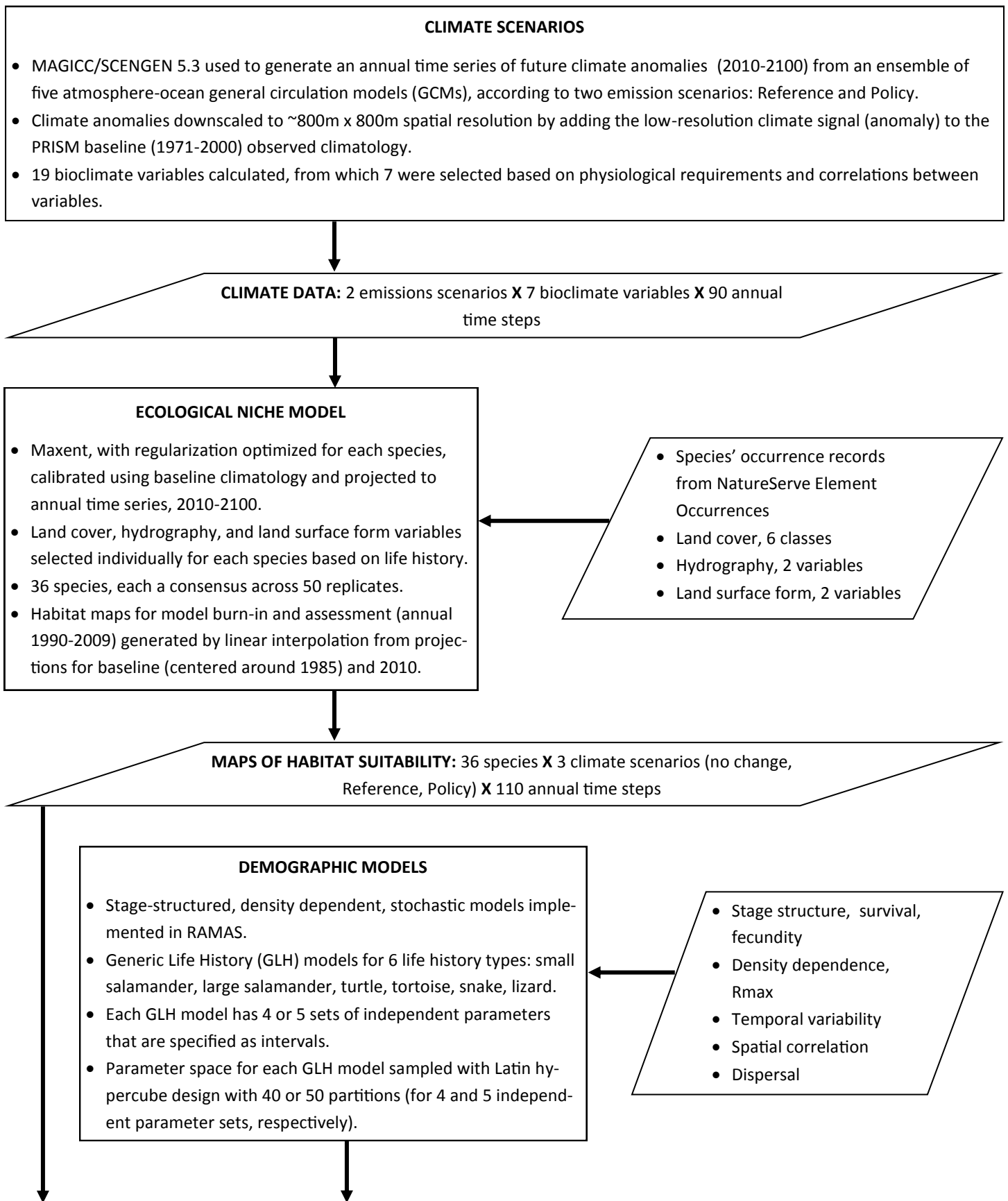Spatial
Demographic/Life History
Trends

Fig. S2. Importance of variables as predictors of extinction risk due to climate change. Importance was determined using Boosted Regression Trees and the Reference climate change scenario.

Importance for defining extinction risk due to climate change

Occupied area
Population size
Spatial correlation
Trend in occupied area
Trend in fractal dimension
Trend in largest patch fraction
Generation length
Growth rate
Fragmentation
Largest patch fraction
Fractal dimension
Trend in population size
Niche breadth: precipitation
Niche breadth: temperature
Dispersal ability
Trend in number of subpopulations
Vital rate variability
Trend in fragmentation
Trend in connectivity
Connectivity
Number of subpopulations

Type of variable
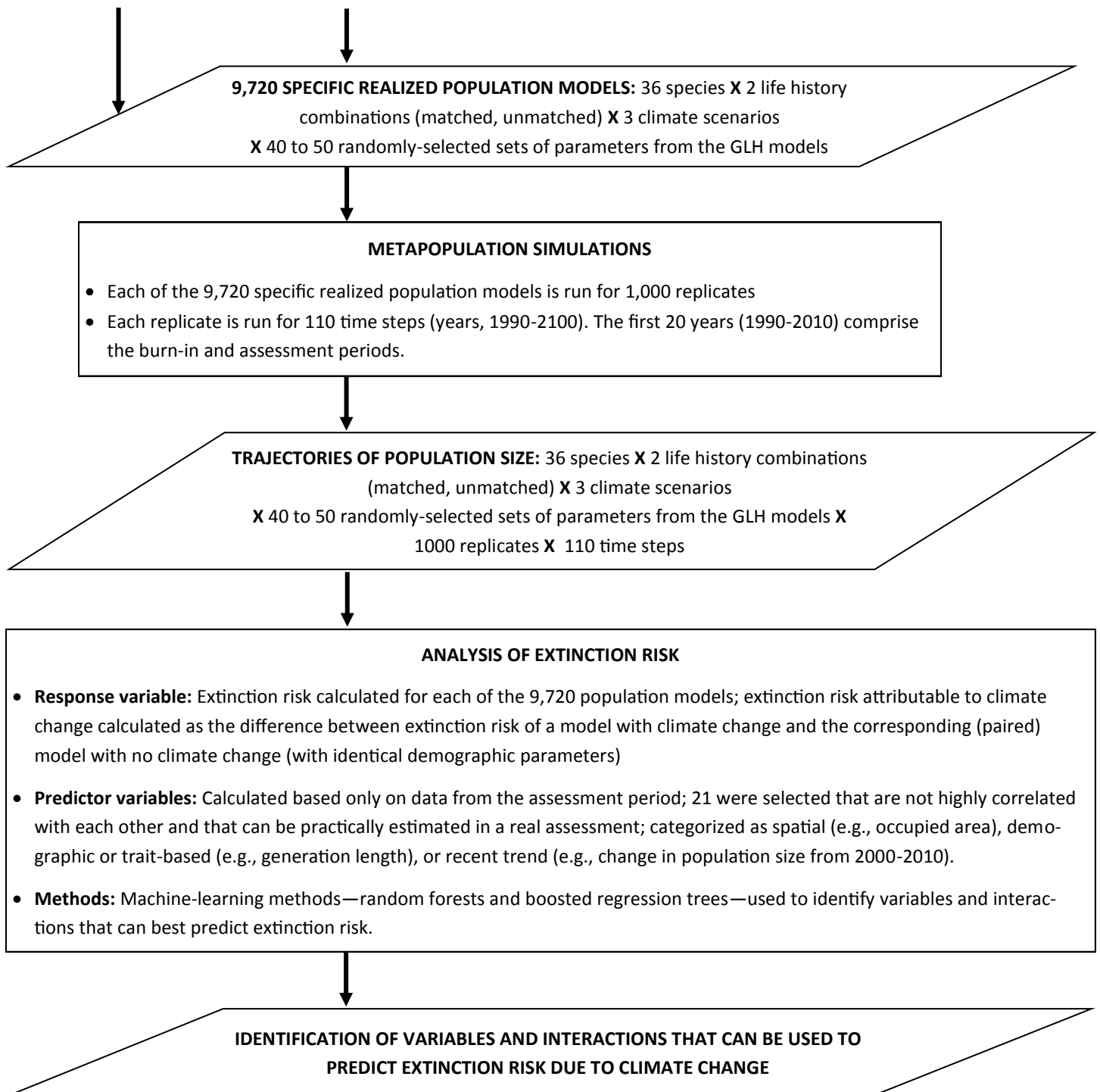- Spatial
- Demographic/Life History
- Trends

Fig. S3. Importance of variables as predictors of extinction risk due to climate change. Importance was determined using Boosted Regression Trees and the Policy climate change scenario.
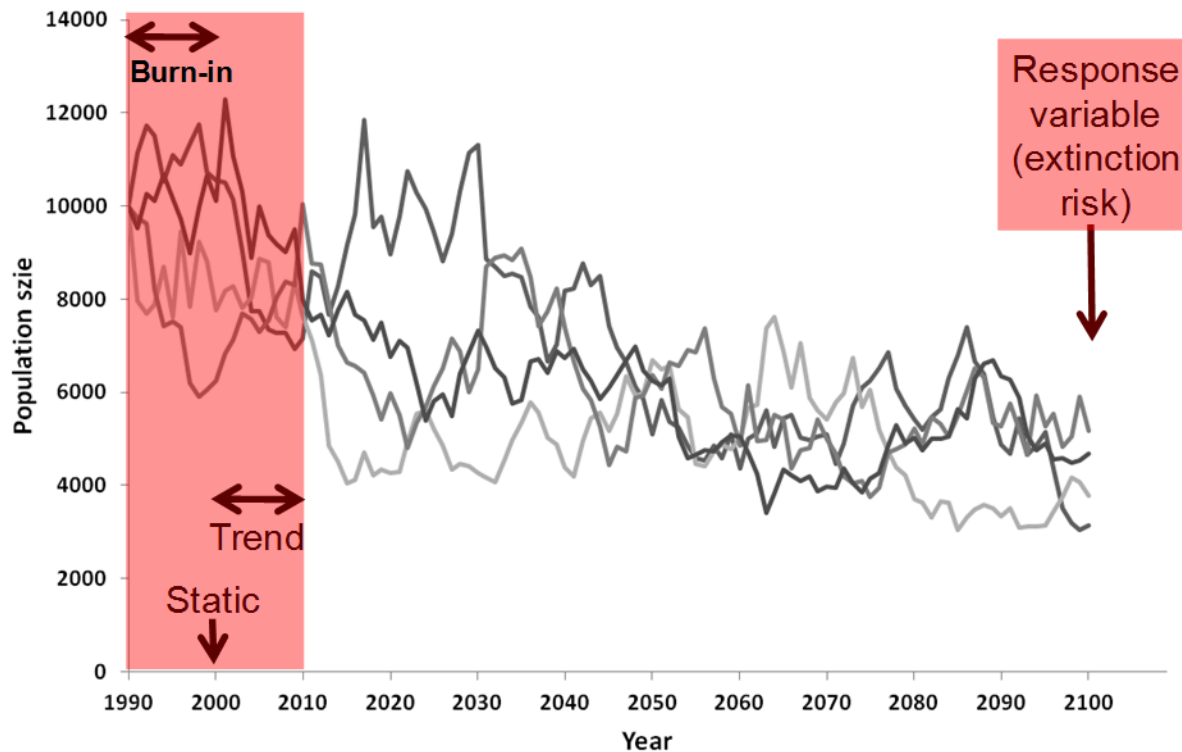
Fig. S4. Flowchart detailing the main steps carried out in the study. Processing steps are shown as rectangles; data inputs/outputs are shown as parallelograms.

CLIMATE SCENARIOS

- MAGICC/SCENGEN 5.3 used to generate an annual time series of future climate anomalies (2010-2100) from an ensemble of five atmosphere-ocean general circulation models (GCMs), according to two emission scenarios: Reference and Policy.
- Climate anomalies downscaled to ~800m x 800m spatial resolution by adding the low-resolution climate signal (anomaly) to the PRISM baseline (1971-2000) observed climatology.
- 19 bioclimate variables calculated, from which 7 were selected based on physiological requirements and correlations between variables.

CLIMATE DATA: 2 emissions scenarios **X** 7 bioclimate variables **X** 90 annual time steps

ECOLOGICAL NICHE MODEL

- Maxent, with regularization optimized for each species, calibrated using baseline climatology and projected to annual time series, 2010-2100.
- Land cover, hydrography, and land surface form variables selected individually for each species based on life history.
- 36 species, each a consensus across 50 replicates.
- Habitat maps for model burn-in and assessment (annual 1990-2009) generated by linear interpolation from projections for baseline (centered around 1985) and 2010.

- Species' occurrence records from NatureServe Element Occurrences
- Land cover, 6 classes
- Hydrography, 2 variables
- Land surface form, 2 variables

MAPS OF HABITAT SUITABILITY: 36 species **X** 3 climate scenarios (no change, Reference, Policy) **X** 110 annual time steps

DEMOGRAPHIC MODELS

- Stage-structured, density dependent, stochastic models implemented in RAMAS.
- Generic Life History (GLH) models for 6 life history types: small salamander, large salamander, turtle, tortoise, snake, lizard.
- Each GLH model has 4 or 5 sets of independent parameters that are specified as intervals.
- Parameter space for each GLH model sampled with Latin hypercube design with 40 or 50 partitions (for 4 and 5 independent parameter sets, respectively).

- Stage structure, survival, fecundity
- Density dependence, Rmax
- Temporal variability
- Spatial correlation
- Dispersal

(continued on next page)

(Fig. S1, continued from previous page)

9,720 SPECIFIC REALIZED POPULATION MODELS: 36 species **X** 2 life history combinations (matched, unmatched) **X** 3 climate scenarios **X** 40 to 50 randomly-selected sets of parameters from the GLH models

METAPOPULATION SIMULATIONS

- Each of the 9,720 specific realized population models is run for 1,000 replicates
- Each replicate is run for 110 time steps (years, 1990-2100). The first 20 years (1990-2010) comprise the burn-in and assessment periods.

TRAJECTORIES OF POPULATION SIZE: 36 species **X** 2 life history combinations (matched, unmatched) **X** 3 climate scenarios **X** 40 to 50 randomly-selected sets of parameters from the GLH models **X** 1000 replicates **X** 110 time steps

ANALYSIS OF EXTINCTION RISK

- **Response variable:** Extinction risk calculated for each of the 9,720 population models; extinction risk attributable to climate change calculated as the difference between extinction risk of a model with climate change and the corresponding (paired) model with no climate change (with identical demographic parameters)

- **Predictor variables:** Calculated based only on data from the assessment period; 21 were selected that are not highly correlated with each other and that can be practically estimated in a real assessment; categorized as spatial (e.g., occupied area), demographic or trait-based (e.g., generation length), or recent trend (e.g., change in population size from 2000-2010).

- **Methods:** Machine-learning methods—random forests and boosted regression trees—used to identify variables and interactions that can best predict extinction risk.

IDENTIFICATION OF VARIABLES AND INTERACTIONS THAT CAN BE USED TO PREDICT EXTINCTION RISK DUE TO CLIMATE CHANGE

Fig. S5. Schematic representation of the burn-in, assessment, and simulation periods. The gray lines are four replicate trajectories of one model. The burn-in period was the first 10 years of the simulations (see text for explanation). The assessment period was the second 10 years. All response variables were calculated based only on data after the assessment period. Extinction risk (the response variable we focus on in this study) is calculated at the end of the simulation period. All predictor variables are calculated from data in the assessment period. Static predictor variables (such as population size) are calculated at the start of the assessment period; predictor variables that are trends (such as Trend in population size) are calculated from data during the assessment period.
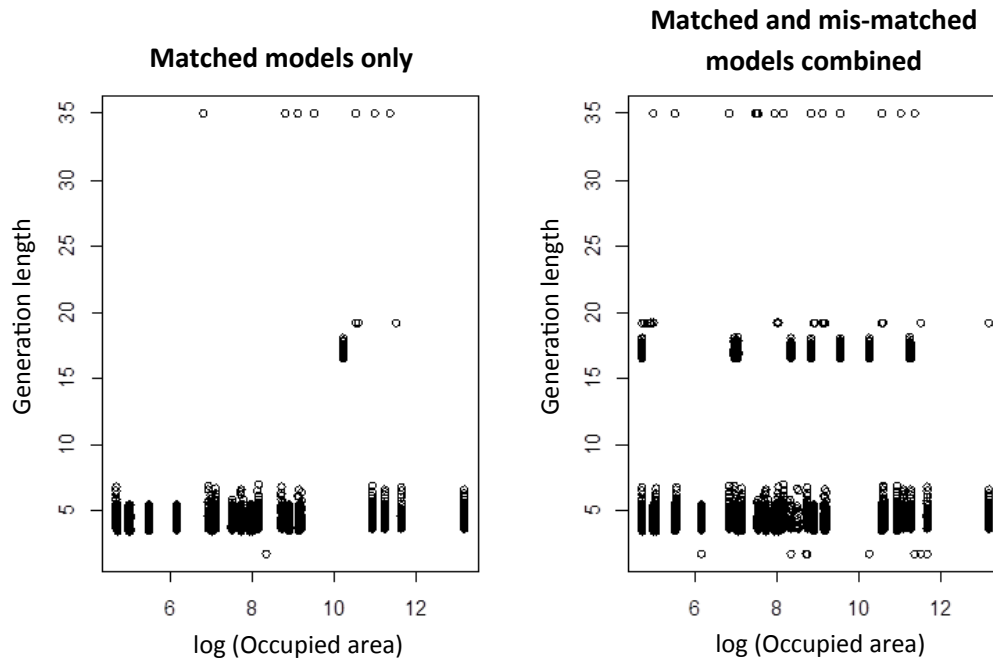
Fig. S6. Sampling of parameter space for a spatial variable and a demographic variable with mis-matched models excluded **(A)** and included **(B)**. Inclusion of mis-matched models results in more of the parameter space being filled, facilitating more effective estimation of interactions. Inclusion of mis-matched models also substantially reduces collinearity among these two variables (Pearson r reduced from 0. 36 to 0.05).
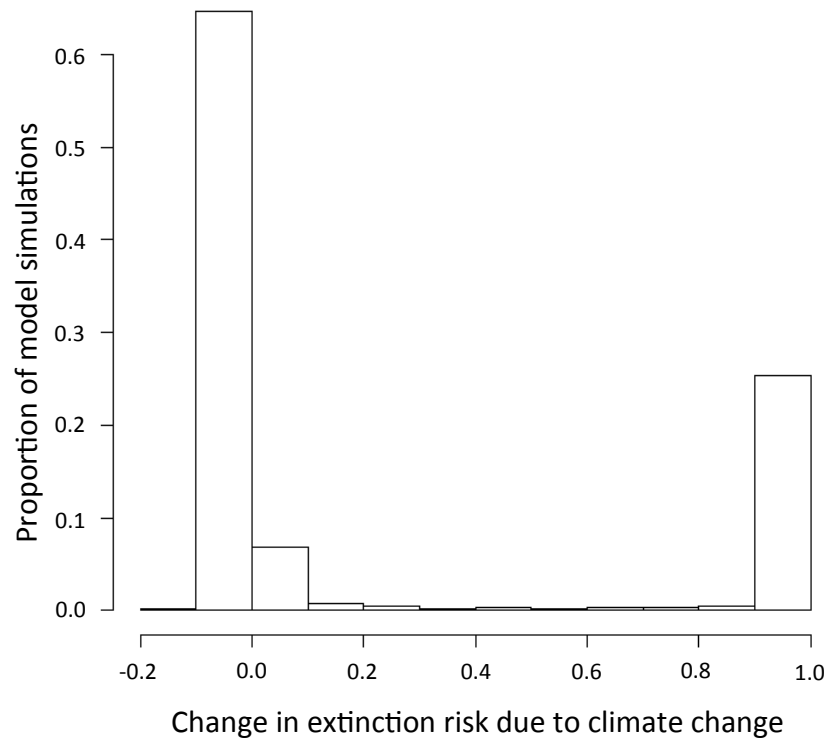
Figure S7. Histogram showing the bimodal distribution of change in extinction risk due to climate change. Data are for Random Forests under the Reference climate change scenario.

Table S1. Species, their generic life history traits, number of occurrence records, and ENM test statistics.

Species	Common Name	Generic Life History Traits	Occurrence records per replicate†	ENM test AUC (mean, min, max)
Ambystoma bishopi	Reticulated Flatwoods Salamander	Small Salamander	27	0.966, 0.961, 0.969
Ambystoma californiense	California Tiger Salamander	Small Salamander	889	0.915, 0.914, 0.918
Ambystoma cingulatum	Frosted Flatwoods Salamander	Small Salamander	75	0.973, 0.967, 0.977
Batrachoseps robustus	Kern Plateau Salamander	Small Salamander	17	0.981, 0.962, 0.987
Batrachoseps wrightorum	Oregon Slender Salamander	Small Salamander	226	0.922, 0.920, 0.923
Clonophis kirtlandii	Kirtland's Snake	Snake	105	0.914, 0.908, 0.919
Cryptobranchus alleganiensis	Hellbender	Large Salamander	364	0.947, 0.942, 0.948
Desmognathus aeneus	Seepage Salamander	Small Salamander	50	0.922, 0.904, 0.932
Drymarchon couperi	Eastern Indigo Snake	Snake	347	0.929, 0.923, 0.931
Emydoidea blandingii	Blanding's Turtle	Turtle	1723	0.893, 0.891, 0.894
Eurycea tonkawae	Jollyville Plateau Salamander	Small Salamander	14	0.979, 0.936, 0.991
Farancia erytrogramma	Rainbow snake	Snake	13	0.736, 0.712, 0.759
Gambelia sila	Blunt-nosed Leopard Lizard	Lizard	170	0.966, 0.964, 0.967
Glyptemys insculpta	Wood Turtle	Turtle	1546	0.901, 0.899, 0.903
Glyptemys muhlenbergii	Bog Turtle	Turtle	595	0.954, 0.954, 0.955
Gopherus agassizii	Agassiz's desert tortoise	Tortoise	768	0.936, 0.933, 0.938
Gopherus morafkai	Morafka's desert tortoise	Tortoise	438	0.928, 0.925, 0.931
Gopherus polyphemus	Gopher Tortoise	Tortoise	1689	0.857, 0.855, 0.858
Graptemys barbouri	Barbour's Map Turtle	Turtle	31	0.938, 0.927, 0.947
Graptemys nigrinoda	Black-knobbed Map Turtle	Turtle	145	0.983, 0.980, 0.985
Heterodon simus	Southern Hog-nosed Snake	Snake	280	0.942, 0.939, 0.945
Lampropeltis extenuata	Short-tailed Snake	Snake	16	0.901, 0.833, 0.930
Lampropeltis zonata	California Mountain Kingsnake	Snake	21	0.932, 0.900, 0.960
Pantherophis gloydi	Eastern Foxsnake	Snake	28	0.953, 0.946, 0.964
Pituophis melanoleucus	Pinesnake	Snake	681	0.927, 0.926, 0.928
Pituophis ruthveni	Louisiana Pinesnake	Snake	73	0.978, 0.974, 0.981
Plethodon elongatus	Del Norte Salamander	Small Salamander	132	0.934, 0.931, 0.938
Plethodon nettingi	Cheat Mountain Salamander	Small Salamander	39	0.994, 0.992, 0.995
Plethodon ouachitae	Rich mountain Salamander	Small Salamander	15	0.985, 0.978, 0.990
Plethodon punctatus	White-spotted Salamander	Small Salamander	25	0.983, 0.974, 0.990
Plethodon stormi	Siskiyou Mountains Salamander	Small Salamander	114	0.937, 0.936, 0.940
Plethodon welleri	Weller's Salamander	Small Salamander	30	0.968, 0.960, 0.982
Pseudemys alabamensis	Alabama Red-bellied Cooter	Turtle	59	0.991, 0.980, 0.994
Sistrurus catenatus	Massasauga	Snake	457	0.936, 0.934, 0.937
Terrapene ornata	Ornate Box Turtle	Turtle	48	0.830, 0.814, 0.858
Thamnophis gigas	Giant Gartersnake	Snake	183	0.973, 0.971, 0.976

† Number of point occurrence records sampled from NatureServe Element Occurrences for each of 50 replicates.

Table S2. ENM variables included for each species.

Species	Land cover variables						Hydrography variables		Land surface form variables	
	Urban	Barren	Forest	Grassland, Shrubland	Agriculture	Wetlands	Standing water	Moving water	South-facing slopes	North-facing slopes
Ambystoma bishopi	**		**	**	**	**	**			
Ambystoma californiense	**		**	**	**	**	**			
Ambystoma cingulatum	**		**	**	**	**	**			
Batrachoseps robustus	**		**	**	**			**		**
Batrachoseps wrightorum	**		**		**			**		**
Clonophis kirtlandii	**			**	**	**	**	**		
Cryptobranchus alleganiensis	**		**		**			**		
Desmognathus aeneus	**		**		**		**	**		
Drymarchon couperi	**		**	**	**	**	**	**		
Emydoidea blandingii	**			**	**	**	**	**		
Eurycea tonkawae	**				**			**		**
Farancia erytrogramma	**		**		**	**	**	**		
Gambelia sila	**	**		**	**					
Glyptemys insculpta	**	**	**	**	**	**		**		
Glyptemys muhlenbergii	**		**		**	**	**	**		
Gopherus agassizii	**	**		**	**					
Gopherus morafkai	**	**		**	**					
Gopherus polyphemus	**	**	**	**	**					
Graptemys barbouri	**		**		**		**	**		
Graptemys nigrinoda	**		**		**	**	**	**		
Heterodon simus	**	**	**	**	**					
Lampropeltis extenuata	**		**	**	**			**		
Lampropeltis zonata	**		**	**	**			**	**	
Pantherophis gloydi	**	**		**	**		**	**		
Pituophis melanoleucus	**	**	**		**					
Pituophis ruthveni	**	**	**		**					
Plethodon elongatus	**		**		**			**		**

Species										
Plethodon nettingi	**		**		**			**		**
Plethodon ouachitae	**		**		**			**		**
Plethodon punctatus	**		**		**			**		**
Plethodon stormi	**		**		**			**		
Plethodon welleri	**		**		**			**		
Pseudemys alabamensis	**				**	**	**	**		
Sistrurus catenatus	**			**	**	**	**	**		
Terrapene ornata	**		**		**	**	**	**		
Thamnophis gigas	**				**	**	**	**		

** Variable was included in the ENM.