Supplementary Material

Article

Climate and land use changes impact the future of European amphibian functional diversity

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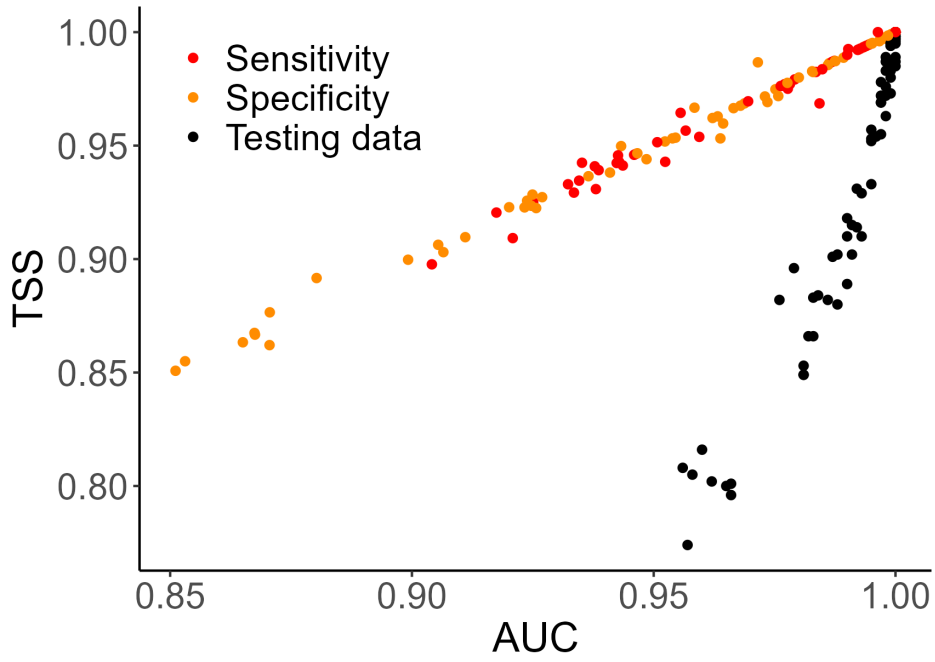


Figure S1. Scores of True Skill Statistic (TSS) and Area Under the Curve (AUC) and the respective values of Sensitivity and Specificity (rescaled to range 0-1) of European amphibian Ensemble Species distribution models. Each circle corresponds to the model scores for each species (n=73).

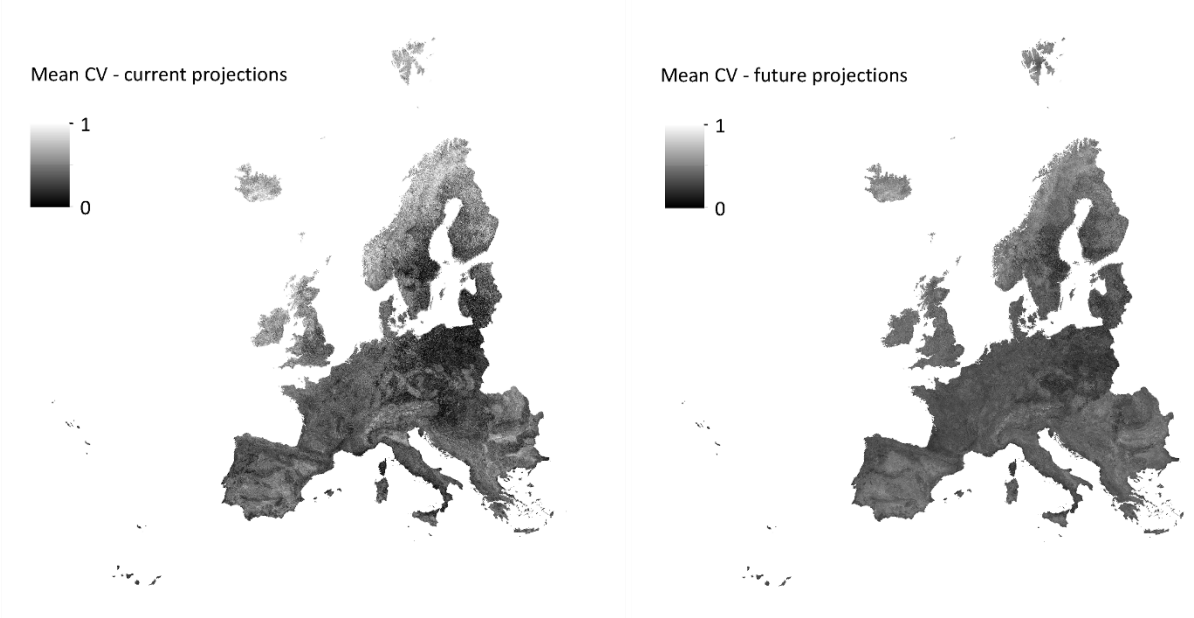


Figure S2. Mean coefficient of variation (standard deviation/mean) of the current (left) and future (right) predictions generated through ensemble species distribution modelling across 73 amphibian species. Darker colors represent higher coefficients of variation and uncertainty of prediction.

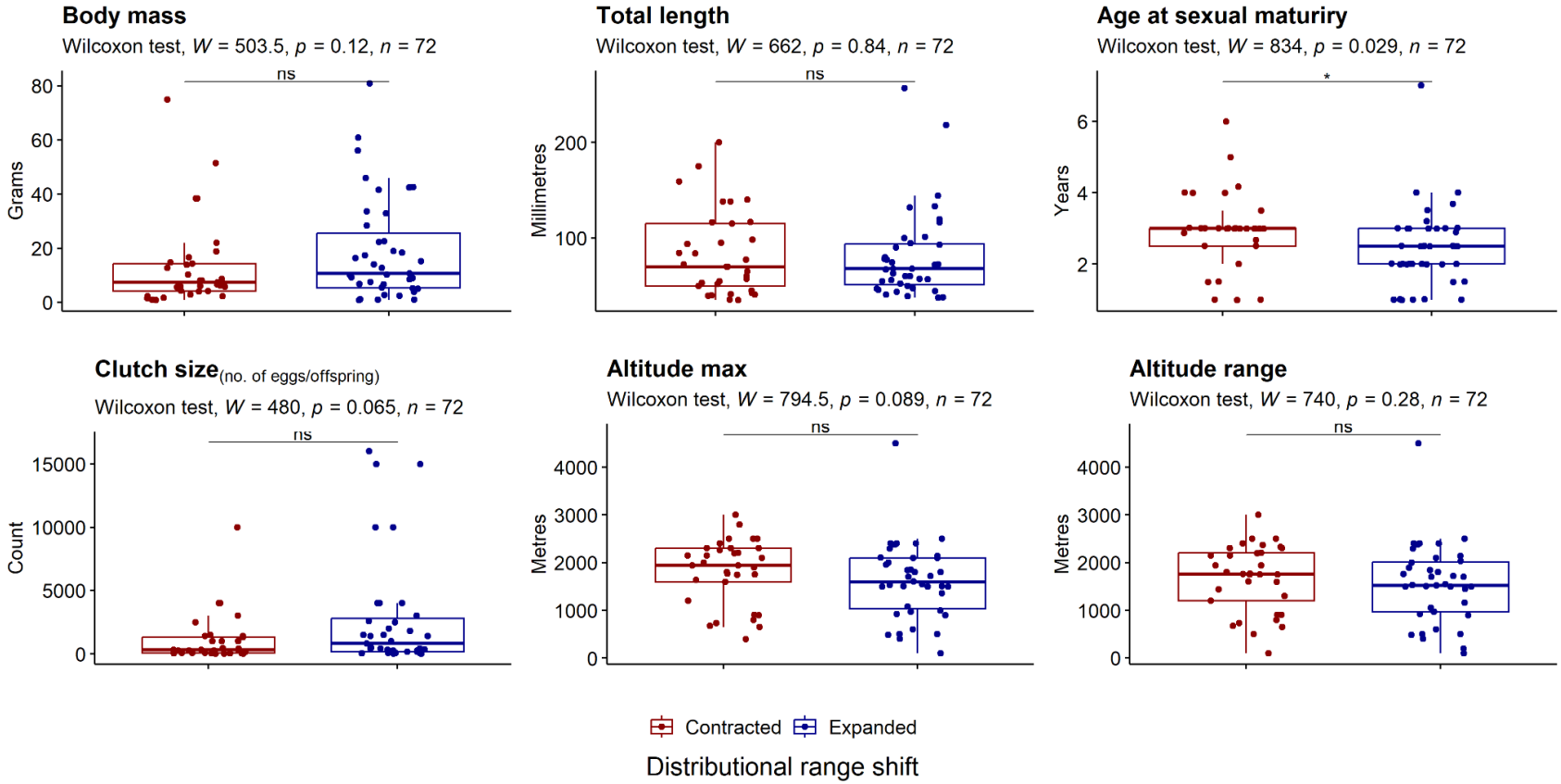


Figure S3. Wilcoxon rank-sum test results of the continuous functional trait differences between species expected to contract (n=35) or expand (n=38) their distribution range by 2050.

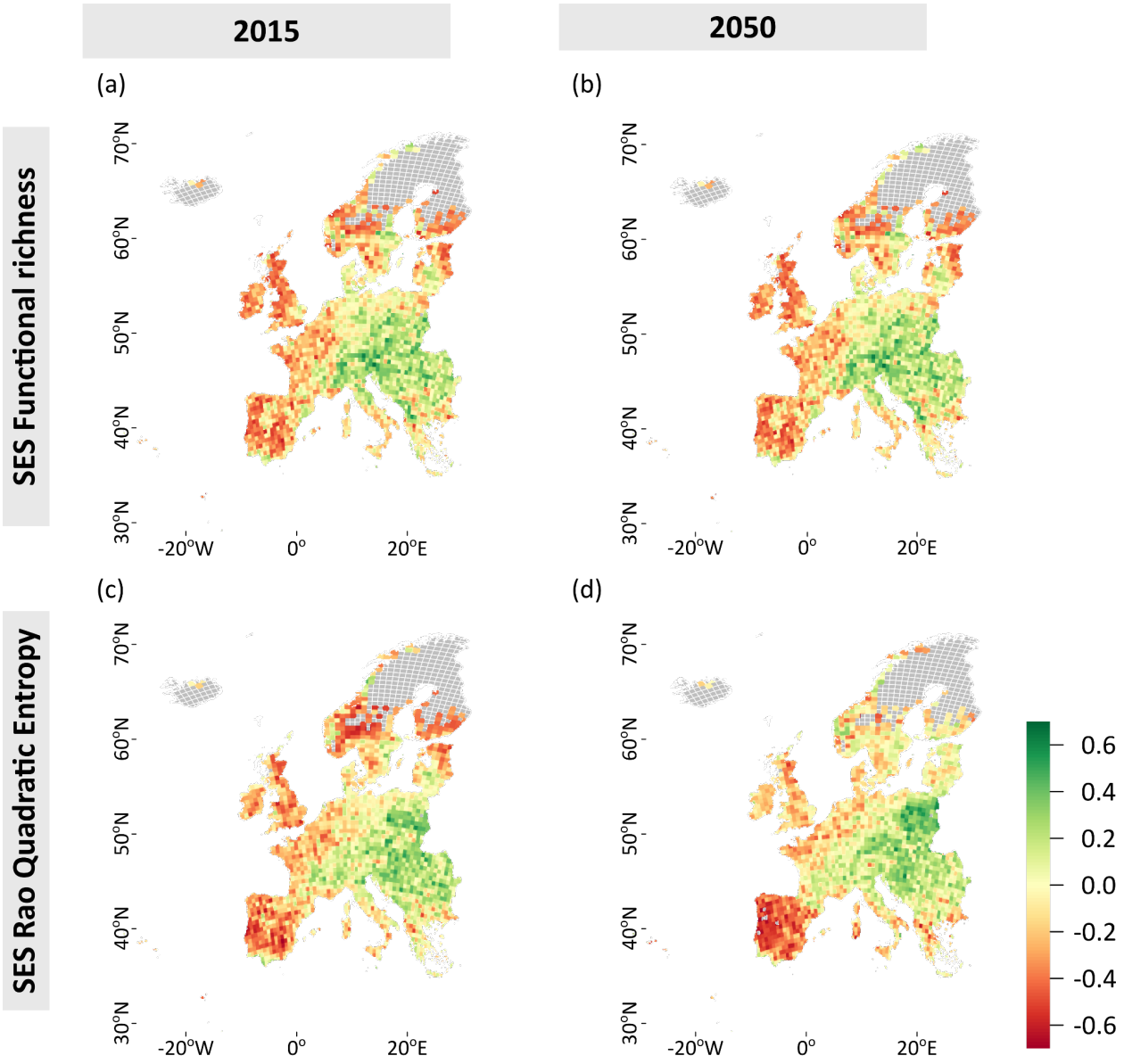


Figure S4. Standardized effect sizes (SES) for functional richness (a-b) and Rao's quadratic entropy (c-d) for current (2015) and future (2050) projections.

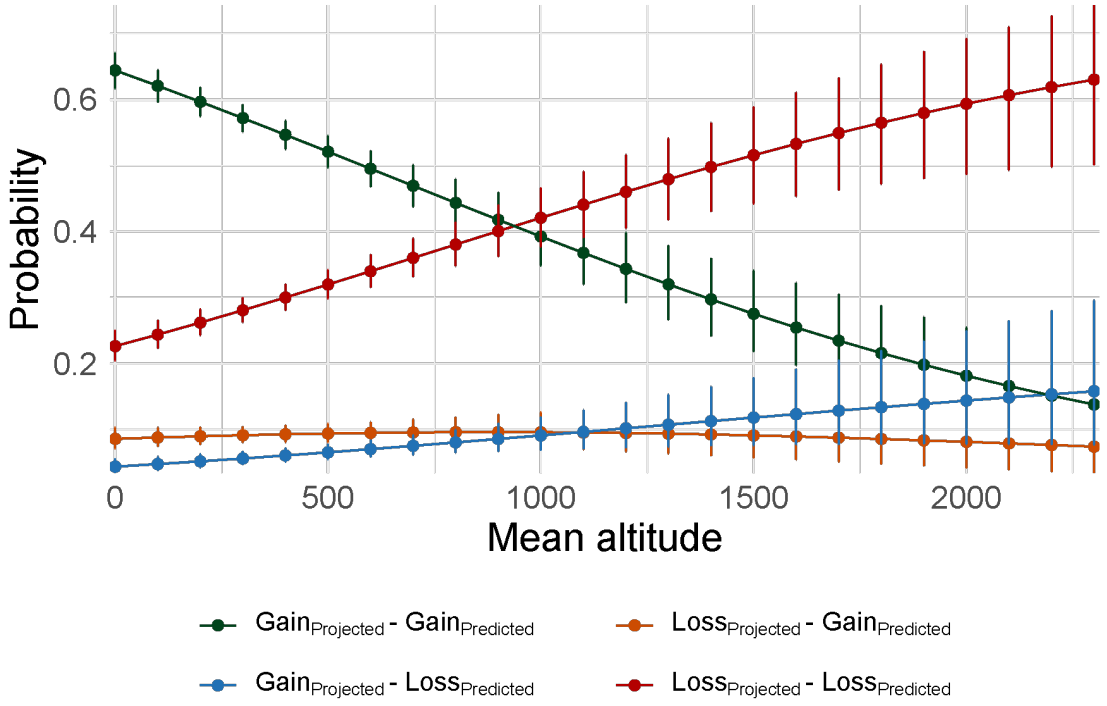


Figure S5. Predicted probability of directional shifts in functional richness estimated through ensemble species distribution models ($\Delta FRic_{projected}$) and based on differences in species richness ($\Delta FRic_{predicted}$) by 2050. Each of the four categories denote the directional (in)consistency between $\Delta FRic_{projected}$ and $\Delta FRic_{predicted}$, (i.e. $Gain_{projected}$- $Gain_{predicted}$, $Gain_{projected}$ – $Loss_{predicted}$, $Loss_{projected}$ – $Gain_{predicted}$, $Loss_{projected}$ - $Loss_{predicted}$) which was fitted as a response variable in a multinomial logistic regression model with elevation as an explanatory variable. Error bars indicate the 95% confidence interval of the estimated probability.

Table S1. The mean functional traits of the 77 amphibian species included in the analyses, along with the IUCN status of each species (Different fonts indicate current population trend: black= increasing, red= decreasing, blue= stable, gray= unknown). Definitions for each trait are given as footnotes from Trochet et al. (2014). The main sources of trait values were the databases of Trochet et al. (2014) and AmphiBIO (Oliveira et al. 2017) (see main text). Trait values that were assigned/updated based on the literature review presented in Table S2 are marked with an * (the corresponding sources are indicated in brackets). A double asterisk (**) denotes an average trait value at the genus level based on the AmphiBIO database. Underlined values denote values adopted from closest relatives. Each species was assigned to a functional entity (n=65) in order to estimate functional redundancy (see Methods in the main text).

Species [no. of reference in Table S2 that was advised to complement traits that were missing/outdated from the database of Trochet et al. (2014) or AmphiBIO (see main text for details)]	IUCN status (Europe)	Assumed closest relative [no. of reference in Table S2]	Body mass (g)[1]	Total length (mm)[2]	Activity [3]	Age at sexual maturity (years)	Clutch size (no. of eggs/offspring)[4]	Breeding season[5]	Altitude max (m)	Altitude range (m)	Functional entity
Alytes almogavarii [2,4,37,41,44]	LC	*Alytes obstetricans almogavarii* [46]	12.78	50.00*	Nocturnal*	2.50*	80*	Prolonged*	2300*	2300*	2
Alytes cisternasii [4,35,41]	LC		5.14	37.56	Nocturnal	2.00	60	Explosive	1800	1700	12
Alytes dickhilleni [4,35,41]	EN		10.13	47.17	Nocturnal	2.00	40	Prolonged	2100	1760	13
Alytes muletensis [4,31,35,41]	EN		4.18	35.18	Nocturnal	3.00	20	Prolonged	400	100	14
Alytes obstetricans [4,35,41]	LC		10.23	47.31	Nocturnal	2.50	70	Prolonged	2400	2400	2
Bombina bombina [27,35,42,43]	LC		5.70	39.44	Diurnal	1.00	300	Prolonged	730	730	15

[1] Body mass in adults, estimated from body length-mass allometries according to Santini et al. (2018), in grams.

[2] In Anura, this measure was the snout-to-vent length. In Urodela, this measurement takes into account the tail length, which, containing veins, might also play a role in thermoregulation, thus being pertinent to the responses of functional diversity to climate change.

[3] The primary period during the day when the species is active (definition from Trochet et al. 2014).

[4] When the species is viviparous, number of offspring by female by clutch. When the species is ovoviviparous, number of eggs by female by clutch. When the species is ovoviviparous, number of offspring by female by clutch. (definition from Trochet et al. 2014).

[5] Breeding season can be prolonged or explosive (*breeding* periods of a few days to a few *weeks)* (definition of Trochet et al. 2014).

Species [no. of reference in Table S2 that was advised to complement traits that were missing/outdated from the database of Trochet et al. (2014) or AmphiBIO (see main text for details)]	IUCN status (Europe)	Assumed closest relative [no. of reference in Table S2]	Body mass (g)[1]	Total length (mm)[2]	Activity [3]	Age at sexual maturity (years)	Clutch size (no. of eggs/offspring)[4]	Breeding season[5]	Altitude max (m)	Altitude range (m)	Functional entity
Bombina variegata [27,35,37,42,43]	LC		8.53	44.71	Diurnal	1.50	170	Explosive	2100	2030	16
Bufo bufo [27,35,37,42,43]	LC		51.39	77.28	Nocturnal	3.00	10000	Explosive	2500	2500	3
Bufotes viridis [12,16,21,27,28,35,37,42,43]	LC		45.93	74.36	Both	3.00	15000	Explosive	4500	4500	18
Calotriton asper [35]	LC		6.20	116.70	Nocturnal	3.00	30	Prolonged	2500	2325	19
Chioglossa lusitanica [35]	NT		2.25	159.00	Nocturnal	4.00	20	Prolonged	1200	1200	20
Discoglossus galganoi [23]	LC		13.89	52.03	Both	4.00	1500	Prolonged	1600	1600	1
Discoglossus montalentii [12,35,44]	NT	*D. sardus* [2][6]	21.97	60.00	Both	3.00*	1000	Prolonged	1900	1600	4
Discoglossus pictus [35]	LC		14.02	52.18	Both	4.00	1500	Prolonged	1500	1500	1
Discoglossus sardus [2,12,35]	LC		16.65	55.05	Both	3.00	1000	Prolonged	1770	1770	4
Epidalea calamita [35]	LC		28.44	63.08	Nocturnal	3.00	4000	Explosive	2400	2400	3
Euproctus montanus [6,35]	LC		4.34	116.50	Nocturnal	3.00	60	Prolonged	2260	1760	21
Hyla arborea [12,27,35,37,42,43]	LC		7.68	42.61	Both	1.00	1400	Explosive	2300	2300	5
Hyla intermedia [35]	LC		6.79	40.98	Both	1.00	1400	Explosive	2300	2300	5
Hyla meridionalis [24,35]	LC		5.51	39.02	Nocturnal	1.00	1000	Explosive	965	965	22

[6] See comment in reference no. 2 (Table S2): "*Although there is a clear ecological distinction between D. montalenti and D. sardus, their biology has not been studied separately. Therefore, accounts of the biology of D. sardus may well include observations on D. montalenti*".

Species [no. of reference in Table S2 that was advised to complement traits that were missing/outdated from the database of Trochet et al. (2014) or AmphiBIO (see main text for details)]	IUCN status (Europe)	Assumed closest relative [no. of reference in Table S2]	Body mass (g)[1]	Total length (mm)[2]	Activity [3]	Age at sexual maturity (years)	Clutch size (no. of eggs/offspring)[4]	Breeding season[5]	Altitude max (m)	Altitude range (m)	Functional entity
Hyla molleri [23,24,26,33,35,44]	LC	*Hyla arborea var. molleri [46]*	5.97	40.00*	Nocturnal*	1.50*	1400*	Explosive*	2400*	2400*	23
Hyla orientalis [1,8,9,27,35,42,43,44]	LC		12.78	50.00*	Both*	2.50*	100*	Explosive*	1850*	970*	24
Hyla sarda [35]	LC		4.10	35.60	Both	1.00	1000	Explosive	1750	1750	25
Ichthyosaura alpestris [35,37,42,43]	LC		2.95	95.06	Both	3.00	260	Explosive	2500	2500	26
Lissotriton boscai [23,35]	LC		1.02	72.49	Nocturnal	3.00	250	Prolonged	1940	1940	27
Lissotriton graecus [40,42,43,37,44]	NT	*Lissotriton vulgaris graecus [46]*	0.97	100.00*	Nocturnal*	2.50*	300*	Explosive*	1842*	1842*	28
Lissotriton helveticus [35]	LC		1.20	77.24	Nocturnal	2.00	460	Explosive	2400	2400	29
Lissotriton italicus [35,44]	LC		0.89	67.28	Nocturnal	2.50**	400	Prolonged	1525	1525	30
Lissotriton maltzani [15,37,44]	LC	*Lissotriton boscai maltzani [46]*	6.72	65.00*	Nocturnal**	2.50**	250*	Prolonged*	900*	900*	31
Lissotriton montandoni [35]	LC		1.74	83.85	Both	3.00	250	Explosive	2000	1800	32
Lissotriton vulgaris [34,35,37]	LC		1.59	84.23	Both	2.88	300	Explosive	2150	2150	33
Pelobates balcanicus [17,27,29,43,37,44]	LC	*Pelobates syriacus balcanicus [46]*	33.63	67.78*	Both*	2.00*	4000*	Explosive*	920*	920*	6
Pelobates cultripes [17,23,26,35]	VU		32.90	68.04	Nocturnal	3.00	2500	Explosive	1800	1800	34
Pelobates fuscus [11,17,27,35]	LC		14.76	53.02	Nocturnal	1.50	2500	Explosive	675	675	35

Species [no. of reference in Table S2 that was advised to complement traits that were missing/outdated from the database of Trochet et al. (2014) or AmphiBIO (see main text for details)]	IUCN status (Europe)	Assumed closest relative [no. of reference in Table S2]	Body mass (g)[1]	Total length (mm)[2]	Activity [3]	Age at sexual maturity (years)	Clutch size (no. of eggs/offspring)[4]	Breeding season[5]	Altitude max (m)	Altitude range (m)	Functional entity
Pelobates syriacus [11,17,22,27,35,37,42,43]	LC		80.89	90.00	Both	2.00	4000	Explosive	500	500	6
Pelodytes atlanticus [14,23,37,44]	LC	*Pelodytes ibericus*[7]	8.71	45.00*	Nocturnal*	1.00*	1300*	Explosive*	900*	900*	36
Pelodytes ibericus [14,35]	LC		5.04	37.95	Both	1.00	350	Explosive	900	900	7
Pelodytes punctatus [14,35]	LC		9.27	45.88	Nocturnal	1.00	1500	Explosive	1500	1500	37
Pelophylax bedriagae [27,35,37,42,43]	LC		22.57	60.25	Both	2.00	10000	Prolonged	2100*	2100*	8
Pelophylax cretensis [35,37,42,43,44]	VU		42.67	72.30	Both*	2.50**	15000	Prolonged*	100*	100*	10
Pelophylax epeiroticus [35,42,43,44]	NT		56.11	78.20	Nocturnal*	1.00	2575	Prolonged**	480	480	9
Pelophylax lessonae [27,35]	LC		19.00	57.35	Both	3.00	4000	Prolonged	1550	1550	1
Pelophylax perezi [35]	LC		17.44	55.96	Both	2.00	10000	Prolonged	2380	2380	8
Pelophylax ridibundus [27,35,37,42,43]	LC		60.91	80.06	Both	2.00	16000	Prolonged	2000	2000	39
Pelophylax shqipericus [35,44]	VU		42.46	72.20	Both*	2.50**	3000	Prolonged**	500	500	40
Pleurodeles waltl [23,35]	LC		15.22	218.30	Nocturnal	1.50	1400	Prolonged	1500	1500	41
Proteus anguinus [35,45]	VU		41.51	257.00	Both	7.00	70	Prolonged	1079*	1053*	42
Rana arvalis [35]	LC		18.81	57.19	Both	3.00	3000	Explosive	800	800	43

[7] See comment in reference no. 46 (Table S2): "*Dufresnes, Pribille, Alard, Gonçalves, Amat, Crochet, Dubey, Perrin, Fumagalli, Vences, and Martínez-Solano, 2020, Heredity, 124: 423–438, discussed the evidence for species delimitation and the narrow zone of hybridization with Pelodytes ibericus.*"

Species [no. of reference in Table S2 that was advised to complement traits that were missing/outdated from the database of Trochet et al. (2014) or AmphiBIO (see main text for details)]	IUCN status (Europe)	Assumed closest relative [no. of reference in Table S2]	Body mass (g)[1]	Total length (mm)[2]	Activity [3]	Age at sexual maturity (years)	Clutch size (no. of eggs/offspring)[4]	Breeding season[5]	Altitude max (m)	Altitude range (m)	Functional entity
Rana dalmatina [27,32,35,37,42,43]	LC		18.45	56.87	Both	3.00	1800	Explosive	1720	1720	44
Rana graeca [27,35,37,42,43]	LC		16.29	54.88	Both	3.00	800	Explosive	1960	1890	45
Rana iberica [3,19,35]	VU		6.09	41.40	Both	2.00*	450	Prolonged	2200	2200	46
Rana italica [7,35]	LC		22.25	60.00	Both	2.00*	2000	Explosive*	1700	1700	47
Rana latastei [18,20,32,35]	VU		7.49	43.93	Both	1.00	400	Explosive*	400	400	7
Rana parvipalmata [37,44]	LC	*Rana temporaria parvipalmata* [46]	38.38	70.14*	Both**	3.00*	4000*	Explosive*	2200*	2200*	11
Rana pyrenaica [30,35]	EN		5.76	40.75	Both	3.00*	150	Prolonged	2100	1300	48
Rana temporaria [3,27,35,37,42,43]	LC		38.38	70.14	Both	3.00	4000	Explosive	3000	3000	11
Salamandra atra [35]	LC		8.10	115.15	Nocturnal	3.00	11	Explosive	2800	2367	49
Salamandra corsica [5,12, 15,35]	LC		10.30	200.00	Nocturnal	6.00	23	Prolonged	1800	1750	50
Salamandra lanzai [15,35]	CR		14.29	138.00	Both	5.00	6	Explosive	2300	500	51
Salamandra salamandra [15,23,35,37,42,43]	VU		74.93	175.25	Nocturnal	3.00	54	Explosive	2150	2150	52
Salamandrina perspicillata [15,35,36]	EN		1.06	92.95	Nocturnal*	4.00	60	Explosive*	1500	1450	53
Salamandrina terdigitata [15,35,39,44,45]	LC		0.86	94.00	Both	4.00*	60	Explosive	1638*	1437*	54
Speleomantes ambrosii [25,35]	CR		2.82	125.00	Both	4.00	10	Prolonged	1800	1800	55

Species [no. of reference in Table S2 that was advised to complement traits that were missing/outdated from the database of Trochet et al. (2014) or AmphiBIO (see main text for details)]	IUCN status (Europe)	Assumed closest relative [no. of reference in Table S2]	Body mass (g)[1]	Total length (mm)[2]	Activity [3]	Age at sexual maturity (years)	Clutch size (no. of eggs/offspring)[4]	Breeding season[5]	Altitude max (m)	Altitude range (m)	Functional entity
Speleomantes genei *[25,35,44]*	*VU*		2.32	98.24	Both	3.50*	10	Prolonged	650	650	56
Speleomantes italicus *[25,35]*	*EN*		2.76	94.61	Both	3.50	10	Prolonged	1600	1520	57
Speleomantes strinatii *[25,35]*	*EN*		3.92	119.50	Both	3.00	11	Prolonged	2500	2500	58
Speleomantes supramontis *[25,35]*	*EN*		4.12	116.59	Both	2.50	10	Prolonged	1360	1160	59
Triturus carnifex *[35,40]*	*VU*		8.90	144.42	Nocturnal	2.90	400	Prolonged	1000	200	60
Triturus cristatus *[35,40]*	*LC*		7.31	140.05	Both	2.67	400	Prolonged	1750	1750	61
Triturus dobrogicus *[10,35,40,44]*	*LC*		6.67	132.08	Diurnal*	3.20	250		600	600	62
Triturus macedonicus *[34,35,37,40,42,43,44]*	*EN*	*Triturus carnifex macedonicus [46]*	10.66	133.30*	Nocturnal*	3.70*	250*	Prolonged*	2140*	2140*	63
Triturus marmoratus *[13,35,40]*	*VU*		8.10	138.30	Both	4.17	400	Explosive	1940	1940	64
Triturus pygmaeus *[13,23,35,40]*	*NT*		2.43	101.07	Nocturnal	2.00	150	Prolonged	1500	1500	65

Table S2. Sources advised to complement the functional traits of species missing from the database of Trochet et al. (2014) or AmphiBIO (see main text for details).

Source	Type of Source
1. Altunişik, A.; Özdemir, N. Body size and age structure of a highland population of *Hyla orientalis* Bedriaga, 1890, in northern Turkey. *Herpetozoa* 2013, 26, 49-55.	Published paper
2. AmphibiaWeb: Information on amphibian biology and conservation (online). Accessed November 2023 at https://amphibiaweb.org.	Website
3. AnAge Database of Animal Ageing and Longevity (online). Accessed November 2023 at http://genomics.senescence.info/species/.	Website
4. Arntzen, J.W.; García-París, M. Morphological and allozyme studies of midwife toads (genus Alytes), including the description of two new taxa from Spain. *Bijdragen tot de Dierkunde* 1995, 65, 5-34.	Published paper
5. Beukema, W. Ontogenetic pattern change in amphibians: the case of *Salamandra corsica*. *Acta Herpetologica* 2011, 6, 169-174.	Published paper
6. Bovero, S.; Sotgiu, G.; Castellano, S.; Giacoma, C. Age and sexual dimorphism in a population of *Euproctus platycephalus* (Caudata: Salamandridae) from Sardinia. *Copeia* 2003, 1, 150-155.	Published paper
7. Buono, V.; Guarino, F.; Vignoli, L. Maximum body size and age distribution in the Italian Stream Frog, *Rana italica* Dubois 1987 (Amphibia: Anura). *Acta Herpetologica* 2014, 9, 231-235.	Published paper
8. Burraco, P.; Bonzom, J.M.; Car, C.; Beaugelin-Seiller, K.; Gashchak, S.; Orizaola, G. Lack of impact of radiation on blood physiology biomarkers of Chernobyl tree frogs. *Frontiers in Zoology* 2021, 18, 1-10.	Published paper
9. Stepanyan, I. New data concerning *Hyla orientalis* Bedriaga, 1890 (Anura: Hylidae) in Southern Armenia. *Herpetology Notes* 2021, 14, 325-329.	Published paper
10. Cicort-Lucaciu, A.Ş.; Dimancea, N.; Blaga-Lungulescu, R.M.; Hodişan, O.; Benkő, A. Diet composition of *a Triturus dobrogicus* (Amphibia) population from Arad County, western Romania. *Biharean Biologist* 2009, 3, 77-82.	Published paper
11. Cogălniceanu, D.; Roşioru, D.; Székely, P.; Székely, D.; Buhaciuc, E.; Stănescu, F.; Miaud, C. Age and body size in populations of two syntopic spadefoot toads (genus *Pelobates*) at the limit of their ranges. *Journal of Herpetology* 2014, 48, 537-545.	Published paper
12. Delaugerre, M., & Cheylan, M. (Eds.). 1992. *Atlas de répartition des Batraciens et Reptiles de Corse*. Parc naturel régional de	Book

Source	Type of Source
Corse-Ecole pratique de Hautes Etudes.	
13. Díaz-Paniagua, C. Reproductive dynamics of a population of small marbled newts (*Triturus marmoratus pygmaeus*) in South-Western Spain. *Herpetological Journal* 1998, 8, 93-98.	Published paper
14. Diaz-Rodriguez, J.; Gehara, M.; Marquez, R.; Vences, M.; Goncalves, H.; Sequeira, F.; Martinez-Solano, I.; Tejedo, M. Integration of molecular, bioacoustical and morphological data reveals two new cryptic species of *Pelodytes* (Anura, Pelodytidae) from the Iberian Peninsula. *Zootaxa* 2017, 4243, 1-41.	Published paper
15. Dubois, A.; Raffaëlli, J. A new ergotaxonomy of the family Salamandridae Goldfuss, 1820 (Amphibia, Urodela). *Alytes* 2009, 26, 1-85.	Published paper
16. Dufresnes, C.; Mazepa, G.; Jablonski, D.; Oliveira, R.C.; Wenseleers, T.; Shabanov, D.A.; Auer, M.; Ernst, R.; Koch, C.; Ramírez-Chaves, H.E.; Mulder, K.P. Fifteen shades of green: the evolution of *Bufotes* toads revisited. *Molecular Phylogenetics and Evolution* 2019, 141, 106615.	Published paper
17. Dufresnes, C.; Strachinis, I.; Tzoras, E.; Litvinchuk, S.N.; Denoël, M. Call a spade a spade: taxonomy and distribution of *Pelobates*, with description of a new Balkan endemic. *ZooKeys* 2019, 859, 131-158.	Published paper
18. Edgar, P.; Bird, D. R. (2005). Action plan for the conservation of the Italian agile frog (*Rana latastei*) in Europe. *Strasbourg: Convention on the Conservation of European Wildlife and Natural Habitats, 25th meeting.*	Convention proceedings
19. Esteban, M.; Sanchiz, B. Differential growth and longevity in low and high altitude *Rana iberica* (Anura, Ranidae). *Herpetological Journal* 2000, 10, 19-26.	Published paper
20. Guarino, F.M.; Lunardi, S.; Carlomagno, M.; Mazzotti, S. A skeletochronological study of growth, longevity, and age at sexual maturity in a population of *Rana latastei* (Amphibia, Anura). *Journal of Biosciences* 2003, 28, 775-782.	Published paper
21. Hemmer, H.; Kadel, B.; Kadel, K. The Balearic toad (*Bufo viridis balearicus* (Boettger, 1881)), human bronze age culture, and Mediterranean biogeography. *Amphibia-Reptilia* 1981, 2, 217-230.	Published paper
22. Kalayci, T.E.; Gül, S.; Özdemir, N. Age structure and body size of the eastern spadefoot toad *Pelobates syriacus* Boettger, 1889 (Anura: Pelobatidae) from Afyonkarahisar, Turkey. *Acta Zoologica Bulgarica* 2019, 71, 189-193.	Published paper
23. LIFE Charcos (online). Accessed November 2023 at http://lifecharcos.lpn.pt.	Website
24. LLusia, D.; MáRquez, R.; MoReiRa, C.N.; Arias, A. Seasonal and diel temperature variation of breeding microhabitat in *Hyla*	Published

Source	Type of Source
molleri and *H. meridionalis*: comparison between Iberian populations at thermal extremes. *Bulletin de la Société herpétologique de France* 2013, 145, 73-89.	paper
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26. Martínez-Gil, H.; Sánchez-Montes, G.; Montes-Gavilán, P.; Ugarte, G.; Martínez-Solano, Í. Fine-scale functional connectivity of two syntopic pond-breeding amphibians with contrasting life-history traits: an integrative assessment of direct and indirect estimates of dispersal. *Conservation Genetics* 2023, 24, 361-374.	Published paper
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35. Speybroeck, J.; Beukema, W.; Bok, B.; Van Der Voort, J. 2016. *Field guide to the amphibians and reptiles of Britain and*	Published paper

Source	Type of Source
Europe. Bloomsbury publishing.	
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42. Atlas of Amphibians and Reptiles of Greece (in Greek, online). Accessed November 2023 at http://herpatlas.gr.	Website
43. Reptiles and Amphibians of Greece (online). Accessed November 2023 at www.herpetofauna.gr/.	Website
44. Frost, D. Amphibian Species of the World 6.2, an Online Reference (online). Accessed November 2023 at https://amphibiansoftheworld.amnh.org/	Website
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Table S3. Land type aggregation of the GLOBIO4 land use maps.

GLOBIO4 land use Code	GLOBIO4 Name	Aggregation number	Aggregation name
1	Urban	1	Urban
2	Cropland	2	Croplands
3	Pasture	3	Pastures and rangelands
4	Rangeland	3	Pastures and rangelands
5	Forestry	4	Forestry
6	Secondary vegetation	5	Secondary vegetation
7	Undefined	0	No Data
50	Tree cover broadleaved evergreen closed to open (>15%)	6	Forests
60	Tree cover broadleaved deciduous closed to open (>15%)	6	Forests
61	Tree cover broadleaved deciduous closed (>40%)	6	Forests
62	Tree cover broadleaved deciduous open (15-40%)	6	Forests
70	Tree cover needleleaved evergreen closed to open (>15%)	6	Forests
71	Tree cover needleleaved evergreen closed (>40%)	6	Forests
72	Tree cover needleleaved evergreen open (15-40%)	6	Forests
80	Tree cover needleleaved deciduous closed to open (>15%)	6	Forests
81	Tree cover needleleaved deciduous closed (>40%)	6	Forests
82	Tree cover needleleaved deciduous open (15-40%)	6	Forests
90	Tree cover mixed leaf type (broadleaved and needleleaved)	6	Forests
100	Mosaic tree and shrub (>50%) / herbaceous cover (<50%)	6	Forests
110	Mosaic herbaceous cover (>50%) / tree and shrub (<50%)	7	Grasslands
120	Shrubland	7	Grasslands
121	Shrubland evergreen	7	Grasslands
122	Shrubland deciduous	7	Grasslands
130	Grassland	7	Grasslands
140	Lichens and mosses	7	Grasslands
150	Sparse vegetation (tree shrub herbaceous cover) (<15%)	7	Grasslands
151	Sparse tree (<15%)	7	Grasslands
152	Sparse shrub (<15%)	7	Grasslands
153	Sparse herbaceous cover (<15%)	7	Grasslands
160	Tree cover flooded fresh or brakish water	6	Forests
170	Tree cover flooded saline water	6	Forests
180	Shrub or herbaceous cover flooded fresh/saline/brakish water	7	Grasslands
200	Bare areas	8	Bare areas
201	Consolidated bare areas	8	Bare areas
202	Unconsolidated bare areas	8	Bare areas
210	Water bodies	9	Water bodies
220	Permanent snow and ice	10	Rock and ice
230	Cropland – low intensity	2	Croplands
231	Cropland – high intensity	2	Croplands

Table S4. The area covered by each aggregated land cover type in 2015 and 2050.

Aggregation number	Aggregation name	Area in 2015 (ha)	Area in 2050 (ha)
1	Urban	18301685	20399591
2	Croplands	321194431	318944403
3	Pastures and rangelands	174554097	179612870
4	Forestry	70738023	70652896
5	Secondary vegetation	0	0
0	Heterogenous/Undefined	48039	62099
6	Forests	148045917	135352361
7	Grasslands	79756934	69563297
8	Bare areas	184327807	173272313
9	Water bodies	1505589208	1505587808
10	Rock and ice	28925388	28925388

Table S5. The Variance Inflation Factor (VIF) of the 15 climatic and land use variables included for Ensemble Species Distribution Modelling.

Category	Variables	VIF
Climate	Mean annual air temperature	5.42
Climate	Precipitation seasonality	1.25
Climate	Mean monthly precipitation amount of the warmest quarter	2.49
Climate	Mean monthly precipitation amount of the coldest quarter	2.38
Climate	Mean diurnal air temperature range	2.08
Climate	Temperature seasonality	2.63
Land use	Urban	1.08
Land use	Pastures	1.38
Land use	Forestry	1.33
Land use	Secondary vegetation	1.72
Land use	Forests	1.97
Land use	Grasslands	1.57
Land use	Bare areas	1.19
Land use	Water bodies	2.23
Land use	Rock and ice	1.00

Table S6. The models used for the ensemble modeling and the associated parameter settings.

Model	Parameter settings
GLM	type = 'quadratic', interaction.level = 0, myFormula = NULL, test = 'AIC', mustart = 0.5, control = glm.control(epsilon = 1e−08, maxit = 50, trace = FALSE)
GAM	algo = 'GAM_mgcv', type = 's_smoother', k = 3, interaction.level = 0, myFormula = NULL, family = binomial(link = 'logit'), method = 'GCV.Cp', optimizer = c('outer','newton'), select = FALSE, knots = NULL, paraPen = NULL, control = list(nthreads = 1, irls.reg = 0, epsilon = 1e−07, maxit = 200, trace = FALSE, mgcv.tol = 1e−07, mgcv.half = 15, rank.tol = 1.49011611938477e – 08, nlm = list(ndigit = 7, gradtol = 1e−06, stepmax = 2, steptol = 1e−04, iterlim = 200, check.analyticals = 0), optim = list(factr=1e + 07), newton = list(conv.tol = 1e−06, maxNstep = 5, maxSstep = 2, maxHalf = 30, use.svd = 0), outerPIsteps = 0, idLinksBases = TRUE, scalePenalty = TRUE, efs.lspmax = 15, efs.tol = 0.1, keepData = FALSE, scale.est = fletcher, edge.correct = FALSE)
RF	do.classif = TRUE, ntree = 500, nodesize = 5, maxnodes = NULL
MAXENT	memory_allocated = 512, maximumiterations = 200, linear = TRUE, quadratic = TRUE, product = FALSE, threshold = TRUE, hinge = TRUE, lq2lqptthreshold = 80, l2lqthreshold = 10, hingethreshold = 15, beta_threshold = -1, beta_categorical = -1, beta_lqp = -1, betamultiplier = 1, defaultprevalence = 0.5, regmult = 1

Table S7. The projected range size of each species and the relative change compared to the range size in 2015.

Species	IUCN status (Europe)	Range size in 2015 (ha)	Range size in 2050 (ha)	Percentage Loss	Percentage Gain	Percentage Stable	Range change compared to 2015 (%)
Species projected to expand their range							
Rana latastei	VU	11240673	68875917	15.14	545.95	84.86	512.74
Alytes dickhilleni	EN	1238497	5430380	4.17	349.55	95.83	338.47
Pelophylax epeiroticus	NT	38290	145755	18.69	302.18	81.31	280.66
Pelophylax shqipericus	VU	170091	623454	2.84	270.00	97.16	266.54
Hyla intermedia	LC	25714722	93119761	11.03	290.53	88.97	262.13
Pelobates balcanicus	LC	4337153	14956334	7.86	239.40	92.14	244.84
Triturus carnifex	VU	21731536	54016340	7.41	162.11	92.59	148.56
Proteus anguinus	VU	3793338	8790370	9.75	146.87	90.25	131.73
Hyla orientalis	LC	50128052	107739504	10.92	149.62	89.08	114.93
Salamandrina perspicillata	EN	16664381	35424909	41.95	170.66	58.05	112.58
Lissotriton graecus	LC	16607333	35293224	1.89	119.00	98.11	112.52
Speleomantes italicus	EN	9931376	19022178	30.22	139.12	69.78	91.54
Rana graeca	LC	40659936	77237190	5.35	105.98	94.65	89.96
Lissotriton italicus	LC	33298777	63106185	24.77	127.51	75.23	89.52
Discoglossus pictus	LC	11165764	20910204	37.96	132.66	62.04	87.27
Rana italica	LC	31660243	55513943	29.49	121.95	70.51	75.34
Triturus macedonicus	VU	1509947	2577732	28.70	100.84	71.30	70.72
Pelobates fuscus	LC	49977405	81324193	39.54	117.57	60.46	62.72
Speleomantes supramontis	EN	67609	109961	46.43	110.71	53.57	62.64
Triturus dobrogicus	LC	9940903	14868251	59.17	115.60	40.83	49.57
Speleomantes ambrosii	CR	8741	12696	80.71	123.57	19.29	45.25
Hyla meridionalis	LC	56926510	81760830	19.04	69.04	80.96	43.63
Pelodytes ibericus	LC	23808915	33008946	1.66	41.31	98.34	38.64
Pelophylax cretensis	VU	3431126	4733421	6.22	45.32	93.78	37.96
Alytes almogavarii	LC	1665890	2262400	52.08	88.43	47.92	35.81
Pelophylax ridibundus	LC	70736187	95857322	22.31	64.75	77.69	35.51

Pelophylax bedriagae	LC	10252025	13218120	50.49	93.68	49.51	28.93
Bufotes viridis	LC	66646408	83128570	24.97	49.13	75.03	24.73
Lissotriton helveticus	LC	91940445	111248026	13.30	39.32	86.70	21.00
Alytes cisternasii	LC	36773287	43580669	3.63	22.82	96.37	18.51
Pelobates syriacus	LC	2687829	3141066	30.74	50.01	69.26	16.86
Pelodytes punctatus	LC	44240932	49992917	23.94	39.34	76.06	13.00
Pelodytes atlanticus	LC	2758099	3111984	14.74	29.17	85.26	12.83
Bombina bombina	LC	45757579	50488986	50.71	75.81	49.29	10.34
Speleomantes strinatii	EN	12448121	13585920	52.57	76.32	47.43	9.14
Chioglossa lusitanica	NT	10296792	10646587	15.46	20.60	84.54	3.40
Pelophylax perezi	LC	68491692	70448186	9.14	13.04	90.86	2.86
Rana arvalis	LC	66783709	67235811	38.73	52.27	61.27	0.68
Species projected to suffer a range contraction							
Pelobates cultripes	VU	54818090	54608088	18.09	18.65	81.91	-0.38
Alytes obstetricans	LC	94913106	94310480	19.92	22.53	80.08	-0.63
Pleurodeles waltl	NT	25203669	24860925	14.81	13.88	85.19	-1.36
Pelophylax lessonae	LC	71372605	67793915	43.84	46.35	56.16	-5.01
Triturus marmoratus	VU	68127031	64056506	37.52	38.54	62.48	-5.97
Bombina variegata	LC	85558949	79829251	24.20	19.00	75.80	-6.70
Triturus pygmaeus	NT	19579013	17966705	24.00	16.28	76.00	-8.23
Salamandrina terdigitata	LC	9366857	8491779	29.62	22.42	70.38	-9.34
Rana dalmatina	LC	57441886	51274926	50.95	41.91	49.05	-10.74
Rana pyrenaica	EN	2552808	2276360	36.00	25.57	64.00	-10.83
Discoglossus galganoi	LC	67794200	59432554	15.87	3.75	84.13	-12.33
Lissotriton montandoni	LC	8418002	6704702	59.45	55.85	40.55	-20.35
Salamandra salamandra	VU	105013112	78507936	34.06	10.72	65.94	-25.24
Epidalea calamita	LC	80565642	58321087	47.47	23.09	52.54	-27.61
Discoglossus sardus	LC	5547410	3970568	42.84	36.91	57.16	-28.42
Lissotriton boscai	LC	27247924	19128419	36.46	7.67	63.54	-29.80
Hyla sarda	LC	13900575	9756036	44.70	28.44	55.30	-29.82
Rana iberica	VU	16414644	11065412	36.49	4.70	63.51	-32.59

Triturus cristatus	LC	91367528	60301988	43.07	13.34	56.93	-34.00
Lissotriton maltzani	LC	603721	384339	38.49	1.93	61.51	-36.34
Bufo bufo	LC	194638490	120741878	47.80	14.05	52.20	-37.97
Hyla molleri	LC	32810848	19328667	43.98	3.58	56.02	-41.09
Calotriton asper	LC	4484583	2547571	69.47	26.81	30.54	-43.19
Euproctus montanus	LC	4275049	2395289	65.25	65.72	34.75	-43.97
Salamandra atra	LC	20394091	11138118	48.01	3.27	51.99	-45.39
Rana temporaria	LC	166573602	84164640	53.16	7.04	46.84	-49.47
Discoglossus montalentii	NT	1965024	961613	55.93	6.02	44.07	-51.06
Rana parvipalmata	LC	3966707	1916302	56.17	5.73	43.83	-51.69
Hyla arborea	LC	68835194	28187236	74.66	17.89	25.34	-59.05
Alytes muletensis	EN	32491	13177	99.60	40.44	0.40	-59.44
Ichthyosaura alpestris	LC	84060526	33028348	61.93	1.80	38.07	-60.71
Salamandra Corsica	LC	3122050	985631	71.20	4.40	28.80	-68.43
Lissotriton vulgaris	LC	80304224	21990133	76.25	5.24	23.75	-72.62
Salamandra lanzai	CR	3533325	945664	73.44	0.18	26.56	-73.24
Speleomantes genei	VU	244685	2948	99.00	0.19	1.00	-98.80

Table S8. The relative contribution of climatic variables and land-use related variables to projected species distributions (rescaled to sum up to 100), along with the IUCN status per species. Different fonts indicate current population trend: black= increasing, red= decreasing, blue= stable, gray= unknown.

	Climate						Land uses								
Species	T	T Seaso-nality	Prec. Wettest Quarter	Prec. Seaso-nality	Diurnal Range	Prec. Coldest Quarter	Forests	Grasslands	Pastures	Hetero-genous	Forestry	Water bodies	Bare Areas	Rock & ice	Urban
Alytes almogavarii	1.72	25.08	16.02	11.77	36.50	1.64	2.50	0.45	2.39	0.00	1.18	0.10	0.20	0.00	0.45
Alytes cisternasii	9.57	5.33	26.98	25.04	20.23	6.33	3.26	0.47	0.74	0.31	1.22	0.43	0.09	0.00	0.00
Alytes dickhilleni	10.41	1.88	25.93	2.11	24.82	4.04	17.82	5.84	2.75	0.09	2.31	0.14	1.38	0.49	0.00
Alytes muletensis	35.47	3.02	10.81	8.86	20.93	1.64	11.97	0.53	0.73	1.25	1.19	1.31	2.27	0.00	0.00
Alytes obstetricans	14.94	31.59	11.71	5.08	19.00	5.24	0.64	2.21	2.03	6.15	1.04	0.26	0.11	0.00	0.00
Bombina bombina	29.37	17.67	7.67	7.94	17.66	13.42	0.61	2.01	1.05	0.30	0.31	1.92	0.06	0.00	0.00
Bombina variegata	22.54	13.79	26.40	3.09	18.37	7.04	2.10	4.58	0.54	0.50	0.51	0.01	0.52	0.02	0.00
Bufo bufo	26.05	22.10	9.24	15.20	11.39	7.26	1.68	1.21	1.59	1.72	1.61	0.45	0.17	0.29	0.02
Bufotes viridis	37.26	14.18	6.92	4.60	10.39	10.50	1.68	0.66	1.16	11.03	1.05	0.55	0.00	0.00	0.00
Calotriton asper	5.23	26.02	7.94	10.05	33.57	7.20	5.51	2.59	0.69	0.02	1.06	0.00	0.11	0.00	0.00
Chioglossa lusitanica	17.41	36.20	6.84	8.16	6.53	19.58	1.67	0.62	0.94	0.22	1.44	0.20	0.19	0.00	0.00
Discoglossus galganoi	5.58	29.32	25.06	17.28	17.02	3.58	0.21	0.14	0.50	0.15	0.87	0.20	0.09	0.00	0.00
Discoglossus montalentii	2.78	5.34	26.23	16.86	4.00	12.72	13.14	10.14	3.72	0.05	1.36	0.06	3.59	0.00	0.00
Discoglossus pictus	41.82	27.70	7.81	6.76	2.03	8.19	0.57	1.19	0.48	1.42	1.20	0.44	0.40	0.00	0.00
Discoglossus sardus	5.00	9.37	25.86	31.04	5.40	4.32	6.42	4.85	3.93	0.58	1.69	0.45	1.06	0.00	0.00
Epidalea calamita	22.35	37.52	7.22	7.70	13.71	6.75	0.59	0.42	1.16	0.88	1.24	0.26	0.11	0.07	0.00
Euproctus montanus	4.52	11.93	25.22	24.99	2.54	9.49	8.81	6.12	3.58	0.25	1.07	0.10	1.38	0.00	0.00
Hyla arborea	33.17	19.13	11.05	11.74	14.04	7.10	0.67	0.54	1.10	0.48	0.55	0.17	0.16	0.10	0.00
Hyla intermedia	53.66	10.22	12.37	7.28	4.50	4.84	1.44	0.48	0.40	0.99	2.44	0.56	0.81	0.00	0.00
Hyla meridionalis	39.16	18.87	8.40	13.43	4.14	6.37	1.63	1.84	3.10	1.19	0.53	1.00	0.34	0.00	0.00
Hyla molleri	4.73	24.83	20.45	14.59	17.78	7.90	1.39	0.64	0.55	0.37	3.09	3.02	0.64	0.00	0.00
Hyla orientalis	28.14	22.06	14.68	6.29	14.29	4.59	1.00	1.48	0.98	1.87	1.77	2.59	0.23	0.02	0.00

Hyla sarda	9.75	20.09	17.90	30.67	4.51	3.14	2.37	3.61	0.58	0.44	4.63	1.06	1.23	0.00	0.00
Ichthyosaura alpestris	6.78	18.80	21.07	15.24	15.09	4.99	3.16	0.35	1.49	11.01	1.49	0.14	0.25	0.14	0.00
Lissotriton boscai	10.32	22.12	11.46	20.03	14.36	18.57	0.72	0.41	0.97	0.50	0.34	0.13	0.06	0.00	0.00
Lissotriton graecus	20.13	13.99	17.78	5.75	13.13	19.63	1.23	0.67	2.63	2.79	1.66	0.44	0.15	0.01	0.00
Lissotriton helveticus	19.52	29.02	8.04	10.78	10.99	6.75	4.16	1.34	1.47	6.32	1.10	0.34	0.12	0.04	0.00
Lissotriton italicus	21.46	11.14	13.14	7.74	5.16	12.97	7.28	3.56	5.60	1.84	5.70	2.56	1.83	0.00	0.01
Lissotriton maltzani	8.45	29.85	15.54	22.70	1.97	3.83	3.93	2.32	1.30	3.97	3.19	0.45	1.42	1.09	0.00
Lissotriton montandoni	11.89	13.05	14.17	11.34	5.34	15.06	3.08	5.57	12.83	1.78	4.32	1.12	0.44	0.00	0.00
Lissotriton vulgaris	27.79	14.16	9.21	13.55	23.21	5.20	0.97	0.65	1.94	2.08	0.73	0.30	0.07	0.14	0.00
Pelobates balcanicus	19.12	19.47	21.70	5.82	14.18	3.62	3.46	6.19	1.25	2.72	0.21	1.12	0.94	0.21	0.00
Pelobates cultripes	21.06	12.75	14.98	29.28	10.00	5.29	1.37	1.28	1.13	0.55	1.45	0.54	0.31	0.00	0.00
Pelobates fuscus	31.31	13.38	6.68	10.19	23.14	9.30	0.92	0.49	1.01	1.25	1.48	0.81	0.02	0.01	0.00
Pelobates syriacus	18.47	14.83	17.99	8.58	14.37	6.29	2.42	5.57	5.31	1.77	1.38	1.93	0.85	0.25	0.00
Pelodytes atlanticus	6.33	33.78	12.77	21.76	5.34	3.67	4.05	1.47	2.48	3.20	2.10	1.60	1.45	0.00	0.00
Pelodytes ibericus	18.76	9.40	15.37	36.22	9.01	6.07	0.21	0.51	0.76	1.03	1.62	0.65	0.39	0.00	0.00
Pelodytes punctatus	15.74	25.87	15.48	10.61	8.13	9.32	1.39	2.77	5.41	0.92	2.42	1.71	0.22	0.00	0.00
Pelophylax bedriagae	28.67	6.58	11.81	18.52	18.36	7.81	0.82	1.34	0.32	3.28	1.15	0.22	1.13	0.00	0.00
Pelophylax cretensis	3.02	1.25	18.04	47.10	2.43	15.32	1.71	4.44	3.11	1.75	0.28	0.43	1.13	0.00	0.00
Pelophylax epeiroticus	28.33	0.35	6.44	17.53	41.92	2.60	0.00	0.93	0.06	0.91	0.00	0.00	0.92	0.00	0.00
Pelophylax lessonae	21.48	21.10	8.57	7.11	20.16	10.33	0.83	1.31	2.02	3.29	0.78	2.68	0.32	0.02	0.00
Pelophylax perezi	17.55	32.18	9.03	17.02	14.02	3.15	1.51	0.35	1.33	1.48	2.15	0.21	0.01	0.00	0.00
Pelophylax ridibundus	47.01	14.28	5.06	7.01	7.01	8.24	0.45	0.92	1.35	4.85	1.05	2.51	0.27	0.00	0.00
Pelophylax shqipericus	33.54	11.58	2.07	5.59	8.96	27.70	1.71	3.70	2.68	0.77	0.83	0.84	0.04	0.00	0.00
Pleurodeles waltl	11.19	8.16	37.14	18.67	9.98	10.93	0.96	0.31	0.85	0.43	0.47	0.39	0.51	0.00	0.00
Proteus anguinus	21.28	12.56	16.68	10.70	5.92	12.20	5.99	3.40	4.75	1.22	3.63	1.05	0.60	0.04	0.00
Rana arvalis	19.39	19.67	5.84	10.33	26.01	12.12	0.95	0.57	1.19	1.19	0.68	1.59	0.42	0.05	0.00
Rana dalmatina	32.50	18.62	10.04	12.09	13.89	6.14	3.10	0.65	1.21	0.96	0.63	0.13	0.03	0.00	0.00
Rana graeca	15.35	22.20	7.27	7.24	6.76	22.52	7.26	1.19	6.41	0.14	0.99	1.23	1.45	0.00	0.00
Rana iberica	3.07	22.36	14.41	29.82	7.10	19.87	1.10	0.31	0.51	0.19	1.22	0.02	0.01	0.00	0.00
Rana italica	17.62	21.42	10.42	10.54	4.25	23.22	6.81	1.13	1.08	0.83	1.94	0.21	0.50	0.00	0.02
Rana latastei	48.74	10.68	16.35	8.23	2.96	7.50	0.47	2.46	0.31	0.44	1.14	0.22	0.50	0.00	0.00

Rana parvipalmata	4.33	33.18	10.17	11.17	7.99	18.03	3.54	2.97	5.03	0.75	2.30	0.51	0.03	0.00	0.00
Rana pyrenaica	4.71	12.27	11.51	14.86	31.05	20.28	1.04	0.69	1.54	0.19	1.07	0.07	0.52	0.20	0.00
Rana temporaria	21.84	27.43	16.14	9.02	7.46	7.56	2.35	1.60	2.62	1.17	1.41	0.37	0.29	0.74	0.00
Salamandra atra	5.38	7.08	58.69	1.90	16.24	4.93	0.38	2.13	0.51	1.07	0.86	0.08	0.62	0.12	0.00
Salamandra corsica	7.74	16.56	22.59	10.52	3.19	20.32	5.52	2.20	6.21	0.30	3.07	0.86	0.91	0.00	0.00
Salamandra lanzai	32.16	7.72	2.55	3.99	32.29	5.74	1.41	8.00	1.28	0.10	1.15	0.26	1.10	2.24	0.00
Salamandra salamandra	13.82	21.49	7.84	10.06	29.43	10.85	2.88	0.44	1.33	0.71	0.82	0.12	0.11	0.10	0.00
Salamandrina perspicillata	21.16	20.65	11.55	10.14	4.02	13.93	8.99	2.29	1.20	2.22	2.18	0.83	0.85	0.00	0.00
Salamandrina terdigitata	8.64	6.23	24.63	5.42	1.24	28.66	14.92	2.83	3.31	0.99	1.83	0.79	0.43	0.09	0.00
Speleomantes ambrosii	5.05	0.30	5.78	21.97	20.29	4.79	37.03	0.65	0.16	0.00	3.98	0.00	0.00	0.00	0.00
Speleomantes genei	7.35	5.94	45.03	15.64	1.92	12.34	4.07	0.80	1.10	0.58	4.71	0.24	0.26	0.01	0.00
Speleomantes italicus	14.62	12.45	8.19	9.99	7.04	9.77	22.36	3.07	3.31	3.55	3.55	1.92	0.18	0.00	0.00
Speleomantes strinatii	1.98	22.75	13.68	26.78	1.85	13.65	12.11	2.14	1.80	1.21	1.37	0.06	0.49	0.12	0.00
Speleomantes supramontis	9.36	1.52	31.40	14.19	19.95	1.25	4.88	5.08	3.49	0.35	1.14	1.36	5.69	0.32	0.00
Triturus carnifex	32.20	6.19	35.63	6.72	3.85	5.47	5.16	0.43	1.00	2.16	0.66	0.14	0.37	0.00	0.00
Triturus cristatus	17.03	28.95	8.85	10.82	14.72	9.82	1.10	0.68	2.35	3.70	0.84	0.80	0.09	0.27	0.00
Triturus dobrogicus	18.40	12.63	6.32	8.30	12.21	18.11	5.16	6.71	5.17	3.22	2.34	1.42	0.00	0.00	0.00
Triturus macedonicus	7.05	14.36	12.55	4.60	16.39	27.73	2.86	5.31	3.59	0.49	2.94	0.60	0.83	0.71	0.00
Triturus marmoratus	19.60	36.24	15.36	5.86	7.36	9.07	3.00	0.64	0.79	0.86	0.86	0.22	0.15	0.00	0.00
Triturus pygmaeus	10.62	5.50	26.24	34.72	7.44	7.71	3.55	0.55	0.68	0.77	2.13	0.09	0.00	0.00	0.00

Table S9. The estimated effect of elevation on temporal shifts in projected and predicted functional richness (i.e. $\Delta FRic_{projected}$ calculated through ensemble species distribution models and $\Delta FRic_{predicted,}$ based on differences in species richness, respectively) estimated through multinomial logistic regression. Each of the four categories denotes the directional (in)consistency between $\Delta FRic_{projected}$ and $\Delta FRic_{predicted}$, (i.e. $Gain_{projected} - Gain_{predicted}$, $Gain_{projected} - Loss_{predicted}$, $Loss_{projected} - Gain_{predicted}$, $Loss_{projected} - Loss_{predicted}$) which was fitted as a response variable in a multinomial logistic regression model with elevation as an explanatory variable. "Probability" denotes the slope of the relationship between each category and elevation (i.e. mean altitude in Fig. S5). For example, a 1-meter change in mean altitude is associated with a 2.44e-04 decrease in the probability of observing a gain in either projected or predicted temporal shift in functional richness (ΔFRic; see also Fig. S5).

Projected-predicted temporal difference in functional richness	Probability (s.e.)	p-value	95% confidence interval	
			Lower bound	Upper bound
$Gain_{projected} - Gain_{predicted}$	-2.44e-04 (2.91e-05)	<0.001	-3.01e-04	-1.87e-04
$Gain_{projected} - Loss_{predicted}$	4.38e-05 (1.17e-05)	0.005	2.10e-05	6.67e-05
$Loss_{projected} - Gain_{predicted}$	1.41e-05 (1.67e-05)	0.38	-1.86e-06	5.69e-05
$Loss_{projected} - Loss_{predicted}$	1.86e-04 (2.49e-05)	<0.001	1.37e-04	2.34e-04