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Climate predicts global patterns and redistribution of predation pressure

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Supplementary information

Table S1 | Climatic and topographic predictors. This table summarizes the bioclimatic variables extracted from two publicly available databases (WorldClim v.2 and ENVIREM) and used to categorise each sampling site of Roslin et al. (2017).

Bioclimatic variables (WorldClim v.2)*	Definitions
bio1	Mean annual temperature (MAT)
bio2	Mean diurnal range (mean of monthly [maximum temperature - minimum temperature])
bio4	Temperature seasonality (standard deviation *100)
bio7	Temperature annual range (maximum temperature of warmest month - minimum temperature of coldest month)
bio12	Mean annual precipitation (MAP)
bio13	Precipitation of wettest month
bio14	Precipitation of driest month
bio15	Precipitation seasonality (coefficient of variation, CV)
ENVIREM variables (climate and topography)**	
Aridity	Thornthwaite aridity index; measures the degree of water deficit below water need
TRI	Terrain roughness index; measures the local variation in seabed terrain compared with a central pixel
topoWET	Topographic wetness; altitude above channel networks, which reflects lateral water accumulation and measures the moisture status of a particular area

Refs: * Fick and Hijmans (2017), ** Title and Bemmels (2017)

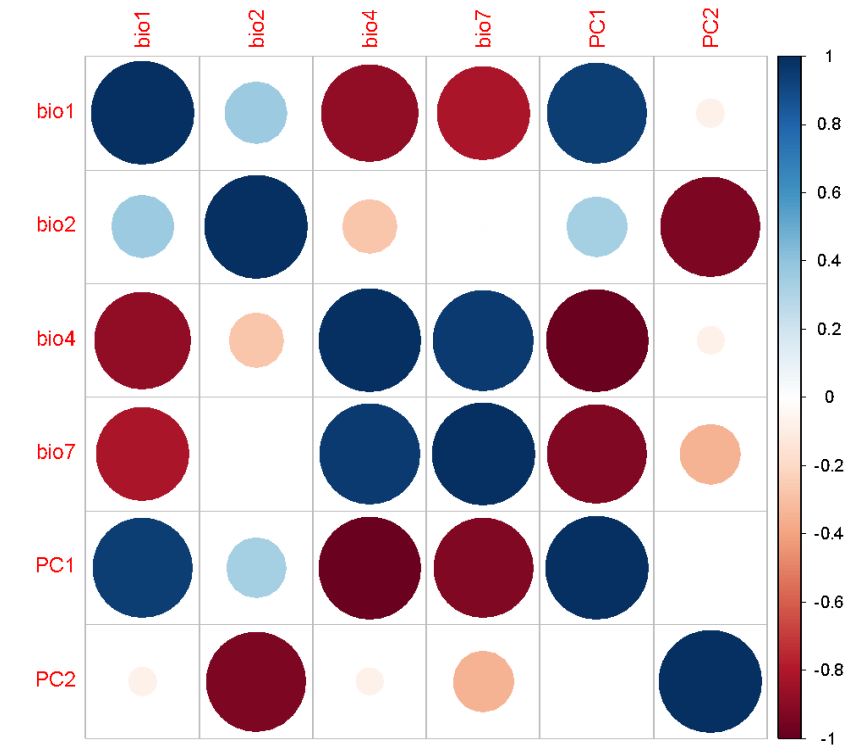
Table S2 | Evaluation of the niche models. Values of area under the curve (AUC) of receiver operator characteristic (ROC) and True Skilled Statistic (TSS) evaluating the niche models built to predict the effects of future climate change on predation pressure (attack rates) for two categories of predation rate (high, low). Values of TSS and AUC higher than 0 and 0.5 indicate models different from those generated randomly, and those higher than 0.5 and 0.7 are considered adequate, respectively. Standard deviation values (SD) indicate variation among the models, used to infer uncertainty.

	Bioclim		Gower		Maxent		SVM	
	AUC	TSS	AUC	TSS	AUC	TSS	AUC	TSS
High predation pressure								
1	0.781	0.625	0.77	0.5	0.824	0.688	0.867	0.75
2	0.814	0.75	0.82	0.75	0.945	0.875	0.988	0.938
3	0.883	0.875	0.82	0.75	0.941	0.813	0.918	0.813
4	0.848	0.75	0.781	0.563	0.895	0.75	0.926	0.875
5	0.951	0.875	0.914	0.688	0.938	0.875	0.934	0.875
6	0.707	0.563	0.77	0.563	0.867	0.688	0.895	0.625
7	0.762	0.688	0.785	0.625	0.809	0.625	0.832	0.625
8	0.666	0.375	0.699	0.375	0.715	0.438	0.738	0.438
9	0.672	0.5	0.758	0.5	0.801	0.563	0.867	0.688
10	0.736	0.5	0.758	0.563	0.852	0.688	0.938	0.938
Mean	0.782	0.65	0.788	0.588	0.859	0.7	0.89	0.756
SD	0.093	0.167	0.056	0.119	0.074	0.138	0.069	0.163
Low predation pressure								
1	0.816	0.652	0.736	0.522	0.858	0.609	0.892	0.609
2	0.665	0.391	0.698	0.435	0.762	0.565	0.854	0.696
3	0.737	0.565	0.723	0.391	0.798	0.522	0.9	0.696
4	0.66	0.348	0.602	0.261	0.773	0.478	0.783	0.522
5	0.759	0.522	0.738	0.478	0.853	0.652	0.877	0.696
6	0.786	0.522	0.767	0.522	0.781	0.609	0.853	0.609
7	0.681	0.522	0.713	0.478	0.794	0.565	0.851	0.652
8	0.727	0.478	0.766	0.478	0.805	0.609	0.919	0.739
9	0.841	0.696	0.841	0.652	0.868	0.696	0.913	0.87
10	0.886	0.652	0.866	0.652	0.864	0.609	0.977	0.87
Mean	0.756	0.535	0.745	0.487	0.816	0.591	0.882	0.696
SD	0.077	0.112	0.074	0.116	0.041	0.062	0.052	0.11

Table S3 | Evaluation of the niche models derived at the site level, with plot-level attack rates pooled to a site-level attack rate. Values of area under the curve (AUC) of receiver operator characteristic (ROC) and True Skilled Statistic (TSS) evaluating the niche models built to predict the effects of future climate change on predation pressure (attack rates) for two categories of predation rate (high, low). Values of TSS and AUC higher than 0 and 0.5 indicate models different from those generated randomly, and those higher than 0.5 and 0.7 are considered adequate, respectively. Standard deviation values (SD) indicate variation among the models, used to infer uncertainty.

	Bioclim		Gower		Maxent		SVM	
	AUC	TSS	AUC	TSS	AUC	TSS	AUC	TSS
High predation pressure								
1	0.800	0.600	0.960	0.800	1.000	1.000	1.000	1.000
2	0.700	0.400	1.000	1.000	1.000	1.000	0.720	0.600
3	0.600	0.200	1.000	1.000	1.000	1.000	1.000	1.000
4	0.720	0.600	0.800	0.800	0.880	0.800	0.800	0.800
5	0.600	0.400	0.640	0.600	0.800	0.600	0.760	0.400
6	0.600	0.200	0.960	0.800	0.960	0.800	0.920	0.800
7	0.800	0.600	0.960	0.800	1.000	1.000	0.920	0.800
8	0.680	0.400	0.680	0.400	0.840	0.600	0.840	0.600
9	0.440	0.200	0.440	0.400	0.720	0.400	0.520	0.400
10	0.700	0.400	0.960	0.800	0.960	0.800	1.000	1.000
Mean	0.664	0.400	0.840	0.740	0.916	0.800	0.848	0.740
SD	0.108	0.163	0.193	0.212	0.101	0.211	0.154	0.232
Low predation pressure								
1	0.472	0.167	0.556	0.333	0.861	0.667	0.833	0.500
2	0.486	0.167	0.417	0.333	0.750	0.500	0.583	0.333
3	0.806	0.667	0.889	0.833	0.639	0.333	0.750	0.500
4	0.639	0.333	0.778	0.500	0.750	0.500	0.889	0.833
5	0.486	0.167	0.667	0.333	1.000	1.000	0.861	0.667
6	0.500	0.167	0.750	0.667	0.694	0.333	0.750	0.500
7	0.764	0.500	0.667	0.333	0.611	0.500	0.556	0.333
8	0.514	0.167	0.639	0.333	0.778	0.667	0.833	0.833
9	0.611	0.333	0.653	0.500	0.611	0.333	0.722	0.500
10	0.722	0.333	0.694	0.500	0.667	0.500	0.917	0.833
Mean	0.600	0.300	0.671	0.467	0.736	0.533	0.769	0.583
SD	0.127	0.172	0.127	0.172	0.122	0.205	0.123	0.196

a) Correlation plot



b) PCA biplot

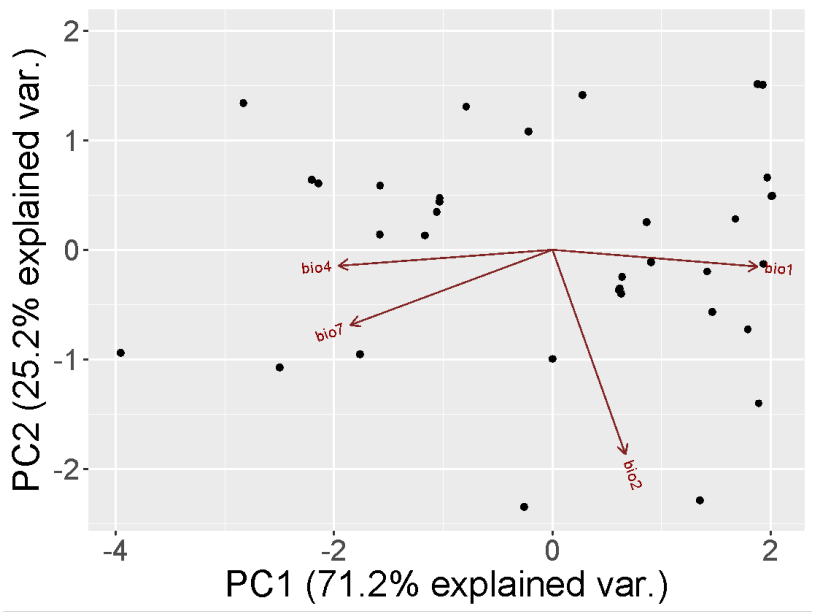


Fig. S1 | Evaluation of the climatic components of temperature. a, Correlation among individual temperature variables (bio1 – bio7; Table S1) and the first two axes of a Principal Component Analysis (PCA); colour intensity and the size of the circle are proportional to the correlation coefficients. **b**, Principal component bi-plot showing that bio1 contributes to positive values for PC1, whereas bio4 and bio7 contribute to negative value of PC1. Definitions of climatic components of temperature are provided in Table S1 (see Methods for details).

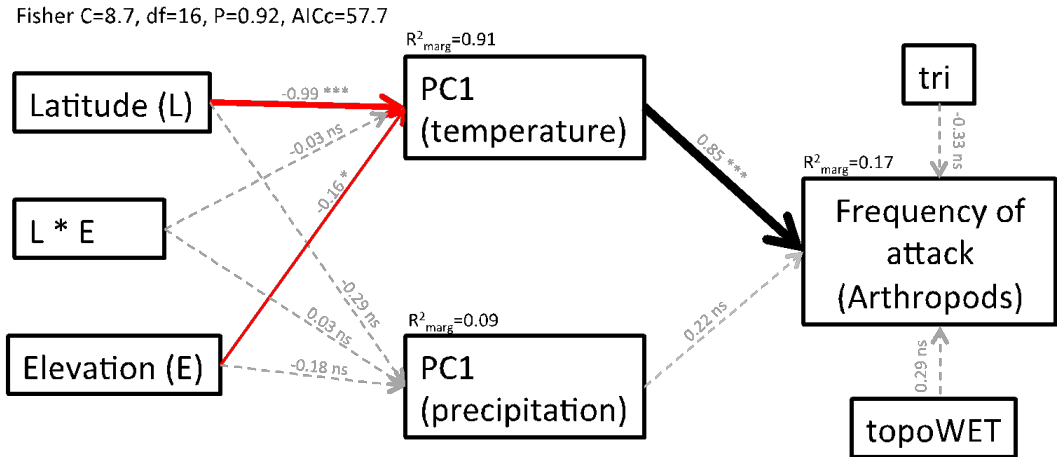


Fig. S2. Causal relationships determined by structural equation model (SEM), including components of topography (tri and topoWET, see Table S1). Here, we dissect the causal effect of latitude (L), elevation (E), interactions between L and E, and two components of topography (TRI and topoWET), on separate components of temperature and precipitation (first axis of a principal component analysis, PCA), and the predation pressure by arthropod on model caterpillars (data from Roslin et al. 2017). Red, black and grey lines represent negative, positive and non-significant adjusted paths of a piecewise SEM, respectively, with marginal R^2 for endogenous variables. Model fit components are presented at the top of the figure. * P<0.05, *** P<0.001.