Supplementary material for Pompe et al. Using ecological and life-history characteristics for projecting species' responses to climate change. ***Frontiers of Biogeography*** **6(3)**

Table S1. (a) 38 bioclimatic variables computed from average monthly values for baseline 1961-1990 (New et al. 2002) and extreme scenario (GRAS ~ +3.8°C; corresponding to IPCC SRES A1FI, HadCM3 model run) 2051-2080 (Fronzek et al. 2012, Spangenberg et al. 2012), spring: March-May, summer: June-August, autumn: September-November, winter: December-February, (b) four land use classes: forest, grassland, cropland and urban landscape for baseline 2000 and 2080 (Mücher et al. 2000, Rounsevell et al. 2006), (c) percentages of eleven soil characteristics (European soil database 2004), data were provided for the grid systems of the Atlas Florae Europaeae (50km × 50km, 'AFE') and the national grid resolution (10' longitude × 6' latitude, www.floraweb.de). N=Number of variables of each type. We applied a principal component analysis (PCA) on the bioclimatic variables, and a correspondence analysis (CA) on the soil data to avoid multi-collinearity. Six principal components (variance accounted for: 93%) and six CA axes (variance accounted for: 56%) were subsequently used as model predictors (cf. Pompe et al. 2008, Pompe et al. 2010).

Description	Unit	N
(a) climatic variables		
mean annual temperature	°C	1
mean monthly temperature (Jan, Apr, Jul, Oct)	°C	4
diurnal temperature range (Jan, Apr, Jul, Oct)	°C	4
growing degree days above 5°C (annual; spring, summer, autumn, winter) (Kauppi and Posch 1988, Fronzek and Carter 2007)	°C	5
mean temperature of the coldest month	°C	1
mean temperature of the warmest month	°C	1
temperature range (annual; spring, summer, autumn, winter)	°C	5
equilibrium evapotranspiration (cf. Prentice et al. 1993)	mm	1
precipitation (annual; spring, summer, autumn, winter)	mm	5
index of aridity (temperature of July/annual pre, cf. Ellenberg 1991)		1
water deficit (cf. Ohlemüller et al. 2006)	mm	1
isothermality ((dtr/(tmx-tmn) for Jan, Apr, Jul, Oct, cf. Nix 1986)		4
precipitation range (annual; spring, summer, autumn, winter)	mm	5

Continuation of **Table S1**

Description	**Unit**	**N**
(b) land-use variables		
forest	%	1
cropland	%	1
urban landscape	%	1
grassland	%	1
(c) soil variables		
texture of the surface	%	1
base saturation	%	1
available water capacity	%	1
cation exchange capacity	%	1
depth to gleyed horizon	%	1
depth to rock	%	1
slope	%	1
organic carbon content	%	1

Table S2: Estimates of range loss and range gain (mean±standard deviation (median) [%]) for the selected categorical traits: life form, ecological strategy type (seven classes: competitors c, competitors/ruderals cr, competitors/stress-tolerators cs, competitors/stress-tolerators/ruderals csr, ruderals r, stress-tolerators s, stress-tolerators/ruderals sr), leaf persistence, pollen vector (see Table 1 for further explanations, trait information from Klotz et al. 2002 and references therein). N=Number of species per group.

Trait	***Loss [%]***	***Gain [%]***	***N***
Life form			
therophyte	22±23 (11)	33±71 (0.80)	32
geophyte	40±37 (35)	3±5 (2.10)	8
hemicryptophyte	39±31 (36)	30±98 (0.86)	70
chamaephyte	51±41 (48)	46±130 (1.26)	17
phanerophyte	44±39 (45)	18±50 (0.17)	40
two forms	28±25 (22)	83±419 (0.43)	28
Life strategy			
c	42±37 (35)	32±102 (0.11)	53
cr	17±25 (4)	42±80 (2.41)	16
cs	45±35 (37)	13±34 (0.90)	28
csr	38±32 (39)	58±304 (0.74)	55
r	34±25 (33)	17±52 (0.40)	22
s	39±39 (24)	72±172 (1.26)	9
sr	18±18 (10)	4±7 (0.96)	12
Leaf persistence			
persistent green	45±34 (47)	21±68 (0.75)	52
overwintering green	25±24 (16)	94±420 (0.46)	28
spring green	31±30 (26)	3±5 (0.09)	8
summer green	36±34 (27)	31±93 (0.91)	107
Pollen vector			
insects	41±34 (36)	31±99 (0.86)	104
selfing	33±30 (33)	60±322 (0.54)	48
wind	26±34 (12)	32±65 (3.56)	28
two forms	36±32 (37)	3±7 (0.03)	15

Table S3: Analysis of covariance of the effects of species characteristics on range loss and range gain under climate change scenarios in Germany for 195 selected species (minimum adequate model derived using error probabilities). Range loss: R^2 adjusted = 0.22, R^2 multiple = 0.29 (p<0.001). (arcsin square-root transformation of response variable range loss); range gain: R^2 adjusted = 0.29, R^2 multiple = 0.30 (p<0.001), (log10 transformation of response variable range gain).

	Degrees of freedom	*Sum of Squares*	*F-value*	*p-value*
Range loss				
Intercept	1	1.314	8.393	**0.004**
Range size	1	1.779	11.358	**<0.001**
Life form	5	2.069	2.642	**0.025**
Number of floristic zones	1	1.262	8.057	**0.005**
Ellenberg indicator value moisture	1	0.001	0.004	0.948
Ellenberg indicator value continentality	1	0.874	5.578	**0.019**
Ellenberg indicator value soil reaction	1	1.022	6.523	**0.012**
Number of floristic zones × Ellenberg indicator value moisture	1	0.800	5.107	**0.025**
Life form × Ellenberg indicator value moisture	5	2.185	2.790	**0.019**
Residuals	178	27.876		
Range gain				
Intercept	1	4.260	5.013	**0.026**
Range size	1	56.576	66.576	**<0.001**
Ellenberg indicator value temperature	1	6.478	7.623	**0.006**
Ellenberg indicator value moisture	1	5.500	6.467	**0.012**
Ellenberg indicator value temperature × Ellenberg indicator value moisture	1	5.610	6.601	**0.011**
Residuals	190	161.461		

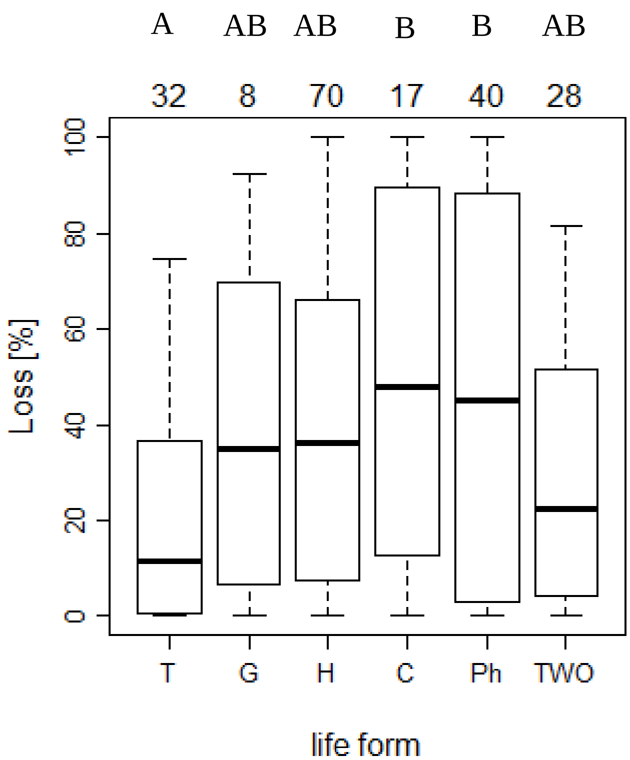

Fig. S1: Boxplot illustrating the range loss for different life forms under climate change scenario (+3.8°C up to 2080, n=195). Numbers above represent the sample size, large letters above show significant differences after Post-hoc test ($p<0.05$). T therophyte; G geophytes; H hemicryptophyte; C chamaephyte ; P Phanerophyte; TWO species related to two life-forms were summarized into one category to explain potential versatility (Krumbiegel, pp. 93–118 in Klotz et al. 2002, Table 1).

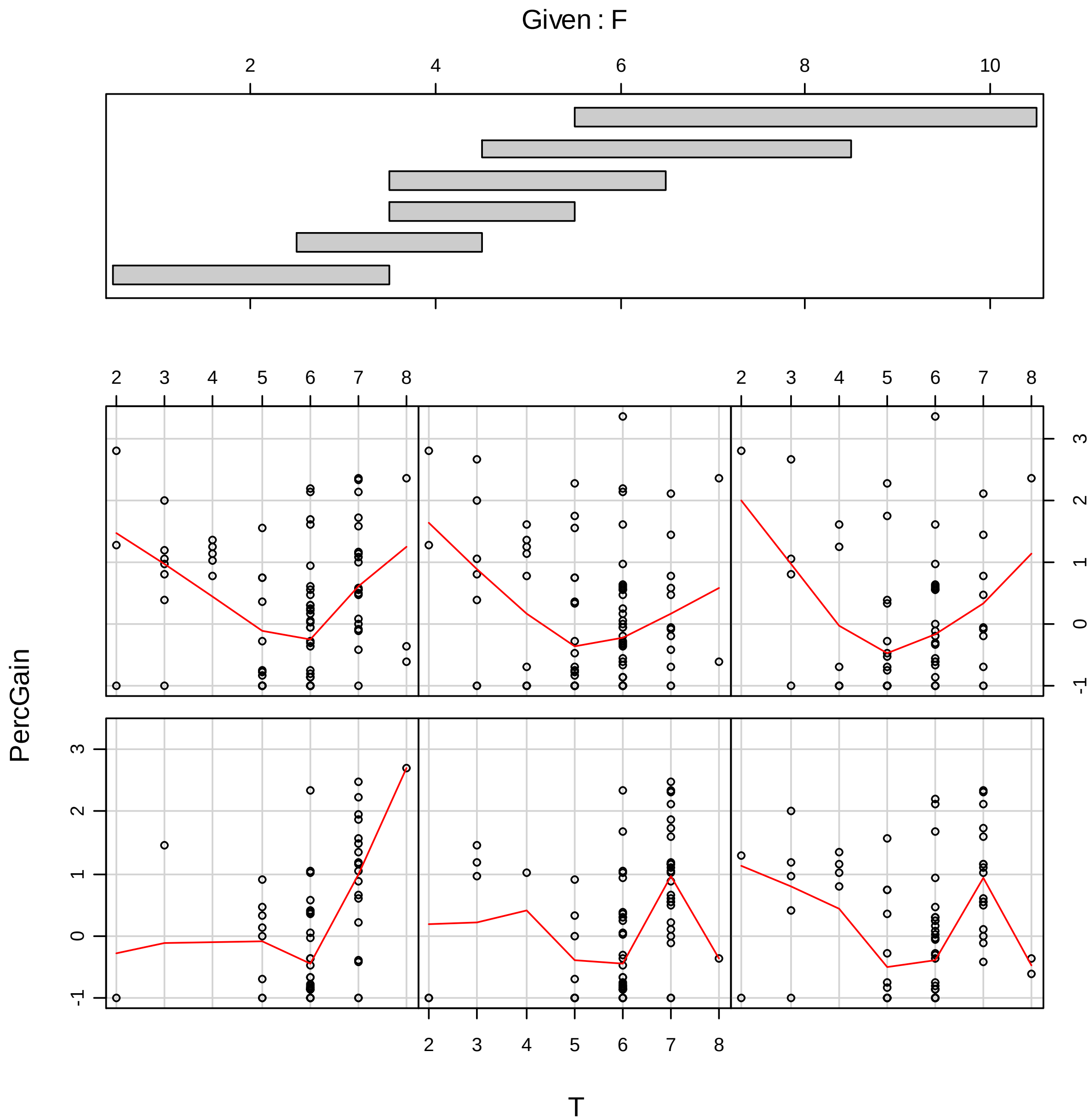

Fig. S2: Conditioning plot illustrating interactions; we look at the variations of gain rate (log10 transformation) as a function of temperature indicator value (T) at different values of moisture indicator values (F) based on Ellenberg et al. (1991). Each scatter plot of temperature indicator values shows the data points for only a certain range of moisture indicator values in the top panel.

Separate univariate regressions were performed to test the effect of indicator values (F, T) on range gain. Range gain was positively related to temperature (R^2=0.0004, $F_{1,193}$=0.069) and negatively related to moisture (R^2=0.018, $F_{1,193}$=3.617) but not significant (p>0.05).

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