

Ecography

ECOG-03414

Pironon, S., Villegas, J., Thuiller, W., Eckhart, V. M., Geber, M. A., Moeller, D. A. and García, M. B. 2017. The 'Hutchinsonian niche' as an assemblage of demographic niches: implications for species geographic ranges. – Ecography doi: 10.1111/ecog.03414

Supplementary material

Appendix Captions

Appendix 1: Locations of the monitored populations. (A) Map representing the distribution of the “precipitation of the driest month” variable (from low values in white, to high values in green) across the range of *P. coronopus* (extracted from Pironon et al. 2015). Our 11 monitored populations are represented by light blue dots. Unsuitable areas are represented in black, and Oceans and Seas in dark blue. (B) Location of the study area of *C. xantiana* within California, United States (extracted from Eckhart et al. 2011). (C) Map representing the distribution of the “spring temperature” variable (from low values in white to high values in green) across the range of *C. xantiana* (extracted from Eckhart et al. 2011). Our 20 monitored populations are represented by light blue dots. Unsuitable areas are represented in black, and the Isabella Lake in dark blue.

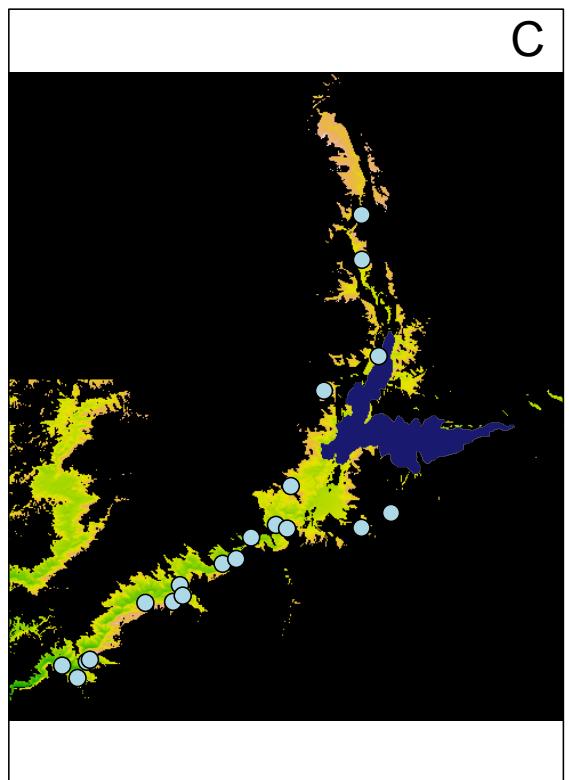
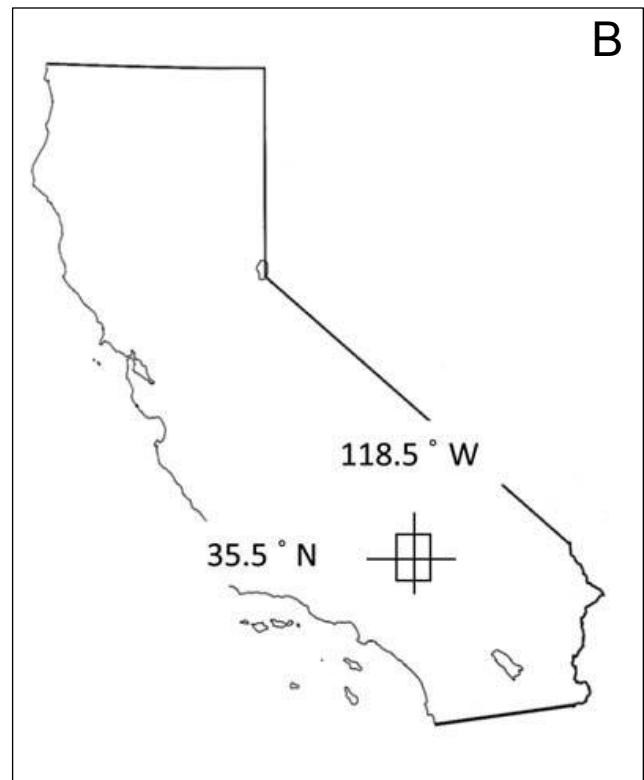
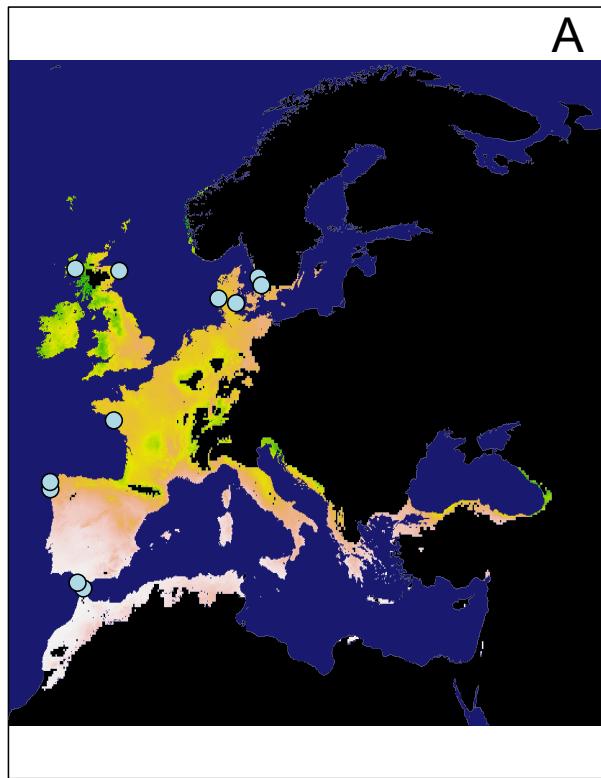
Appendix 2: Canonical correlation between environmental variables and the first two axes of the OMI analyses for the two species. The highest coefficients are given in bold.

Appendix 3: The internal demographic niche structures of *P. coronopus* and *C. xantiana*. The environmental hyperspaces are defined by the climatic, land use and geological variables described in the Methods. The most important variables are displayed on the two axes of the OMI analyses (canonical coefficients in Appendix 2). The positions of the monitored populations are represented by black dots. The different demographic niches are represented by 1.5 inertia ellipses and

their centroids by squares. The size of the squares is proportional to the contribution of the vital rates to the population growth rate (L) and remains constant for population growths (L). The population growth niches (L) are represented in blue, fecundities (f) in pink, growths (g) in brown, survivals (s) in green, and recruitments (r) in purple (more details on the vital rates in the Methods).

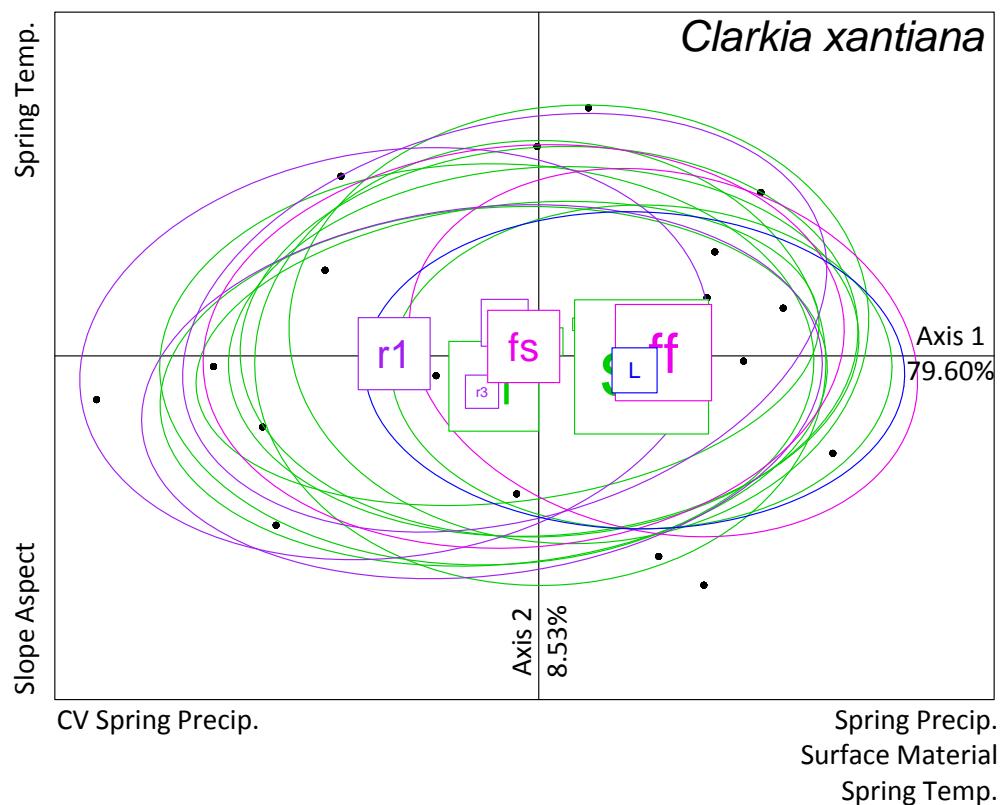
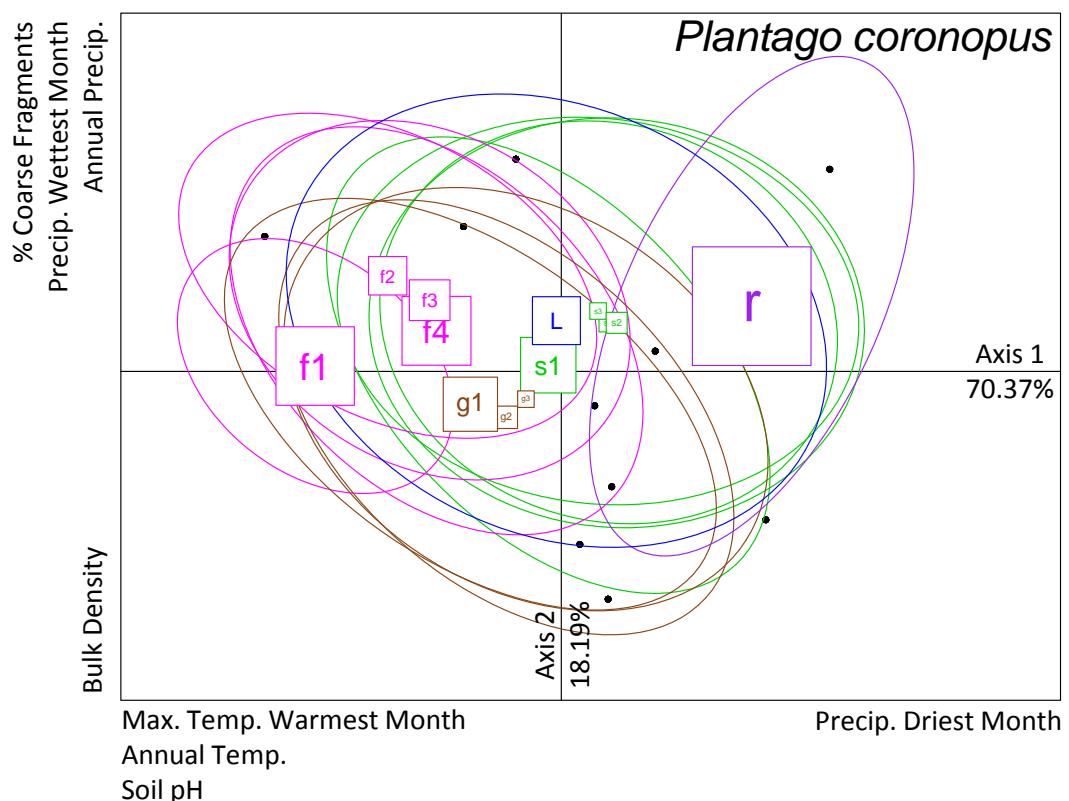
Appendix 4: Multiple linear regression models predicting the effects of the OMI axes on the demographic rates. Significant values ($P<0.05$) are represented in bold. Survival, growth, fecundity, and recruitment rates having the highest contributions to the population growth rate are highlighted in grey.

Appendix 5: Modeled demographic responses of *P. coronopus* and *C. xantiana* within their niches and distributions. For each demographic rate, low values are represented in yellow and high values in red. Colors fluctuate across niches and distributions for significant models (f1, g1, and r for *P. coronopus*; ff, s1, r1 and L for *C. xantiana*), but remain constant for the non-significant models (s1 and L for *P. coronopus*). Detailed results of the multiple linear models for all the demographic rates are given in Appendix 4. The width of the ellipses is proportional to the contribution of the vital rates to differences in population growth rates (the width of the ellipse of population growth rate being constant). For clarity, we displayed only the survival, growth, fecundity, and recruitment rates having the highest contributions (f1, g1, s1, r for *P. coronopus*; ff, s1, r1 for *C. xantiana*). Unsuitable areas are represented in black, and Oceans and Seas in dark blue.



<i>Plantago coronopus</i>	OMI	
Environmental Variables	Axis 1	Axis 2
Annual Mean Temperature	-0.32	0.10
Temperature Seasonality	0.08	-0.25
Mean Maximum Temperature of the Warmest Month	-0.35	-0.01
Mean Minimum Temperature of the Coldest Month	-0.26	0.14
Annual Precipitation	0.16	0.30
Precipitation of the Wettest Month	-0.07	0.32
Precipitation of the Driest Month	0.32	-0.02
Precipitation Seasonality	-0.29	0.12
Evergreen/Deciduous Needleleaf Trees	0.03	-0.14
Deciduous Broadleaf Trees	-0.01	0.07
Mixed/Other Trees	0.19	0.15
Shrubs	0.17	0.20
Herbaceous Vegetation	0.12	0.13
Cultivated and Managed Vegetation	-0.08	-0.05
Regularly Flooded Vegetation	0.21	0.10
Barren	-0.26	-0.09
Bulk Density	-0.07	-0.31
Cation Exchange Capacity	-0.10	0.16
Clay Content	-0.18	0.24
Percentage of Coarse Fragments	0.08	0.46
Soil Organic Carbon Concentration	0.29	0.17
Soil pH	-0.31	0.02
Silt Content	-0.08	0.26
Sand Content	0.13	-0.26

<i>Clarkia xantiana xantiana</i>	OMI	
Environmental Variables	Axis 1	Axis 2
Mean February-June ("spring") Temperature	0.41	0.42
Mean February-June ("spring") Precipitation	0.51	-0.25
Coefficient of Variation of February-June ("spring") Precipitation	-0.41	-0.09
Mean November-January ("winter") Precipitation	-0.17	0.00
Coefficient of Variation of November-January ("winter") Precipitation	-0.27	0.29
Slope Inclination	0.32	0.12
Slope Aspect	0.05	-0.81
Surface Material	0.44	0.01

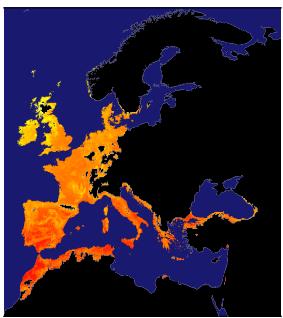


<i>Plantago coronopus</i>	Intercept					OMI axis 1					OMI axis 2					Model			
	Parameter Estimate	Standard Error	t-value	P-value	Parameter Estimate	Standard Error	t-value	P-value	Parameter Estimate	Standard Error	t-value	P-value	d.f.	F-value	R ²	P-value			
Demographic Rates																			
Survival (s1)	0.473	0.116	4.08	0.003	-0.012	0.042	-0.29	0.779	0.005	0.047	0.11	0.915	8	0.057	0.014	0.945			
Survival (s2)	0.436	0.062	7.02	0.001	0.064	0.022	2.85	0.021	0.070	0.025	2.81	0.023	8	6.689	0.626	0.020			
Survival (s3)	0.473	0.073	6.43	0.001	0.052	0.026	1.98	0.083	0.087	0.030	2.95	0.018	8	5.367	0.573	0.033			
Survival (s4)	0.521	0.077	6.72	0.001	0.067	0.028	2.40	0.043	0.083	0.031	2.65	0.029	8	5.345	0.572	0.034			
Growth (g1)	0.424	0.070	6.04	0.001	-0.092	0.025	-3.64	0.007	-0.057	0.028	-2.03	0.077	8	7.506	0.652	0.015			
Growth (g2)	0.406	0.079	5.11	0.001	-0.058	0.029	-2.04	0.075	-0.062	0.032	-1.95	0.087	8	3.324	0.454	0.089			
Growth (g3)	0.410	0.099	4.16	0.003	-0.038	0.035	-1.06	0.320	-0.039	0.040	-0.97	0.360	8	0.862	0.177	0.458			
Fecundity (f1)	0.126	0.074	1.69	0.129	-0.068	0.027	-2.54	0.034	-0.013	0.030	-0.45	0.665	8	3.237	0.447	0.093			
Fecundity (f2)	0.210	0.059	3.57	0.007	-0.071	0.021	-3.33	0.010	0.037	0.024	1.58	0.153	8	8.189	0.672	0.012			
Fecundity (f3)	0.284	0.066	4.26	0.003	-0.072	0.024	-3.02	0.016	0.037	0.027	1.39	0.202	8	6.635	0.624	0.020			
Fecundity (f4)	0.335	0.070	4.77	0.001	-0.086	0.025	-3.38	0.010	0.017	0.028	0.60	0.567	8	6.574	0.622	0.020			
Recruitment (r)	0.170	0.058	2.95	0.018	0.077	0.021	3.70	0.006	0.046	0.023	2.00	0.080	8	7.690	0.658	0.014			
Population Growth (L)	0.428	0.010	4.29	0.003	0.006	0.036	0.17	0.870	0.059	0.040	1.47	0.180	8	1.084	0.213	0.383			

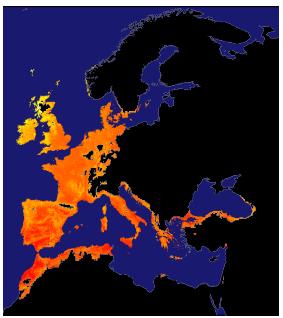
<i>Clarkia xantiana</i>	Intercept					OMI axis 1					OMI axis 2					Model			
	Parameter Estimate	Standard Error	t-value	P-value	Parameter Estimate	Standard Error	t-value	P-value	Parameter Estimate	Standard Error	t-value	P-value	d.f.	F-value	R ²	P-value			
Demographic Rates																			
Survival (s0)	0.569	0.050	11.29	0.001	0.013	0.027	0.50	0.624	0.052	0.043	1.19	0.251	17	0.859	0.092	0.441			
Survival (s1)	0.397	0.058	6.79	0.001	0.104	0.031	3.31	0.004	-0.035	0.050	-0.70	0.493	17	5.631	0.398	0.013			
Survival (s2)	0.328	0.070	4.69	0.001	-0.026	0.037	-0.69	0.499	0.007	0.060	0.12	0.909	17	0.242	0.028	0.787			
Survival (s3)	0.594	0.075	7.91	0.001	0.003	0.040	0.08	0.939	-0.028	0.065	-0.43	0.675	17	0.093	0.011	0.912			
Survival (s4)	0.417	0.060	6.98	0.001	0.040	0.032	1.25	0.146	0.083	0.051	1.61	0.127	17	2.160	0.203	0.146			
Survival (s5)	0.627	0.076	8.26	0.001	-0.081	0.041	-2.00	0.062	-0.029	0.065	-0.44	0.664	17	2.130	0.200	0.149			
Survival (s6)	0.626	0.060	10.35	0.001	0.007	0.032	0.22	0.824	0.017	0.052	0.34	0.740	17	0.086	0.010	0.918			
Survival (s1)	0.472	0.056	8.40	0.001	-0.051	0.030	-1.70	0.107	-0.089	0.048	-1.85	0.081	17	3.296	0.279	0.062			
Fecundity (ff)	0.389	0.060	6.48	0.001	-0.122	0.032	-3.80	0.001	0.001	0.052	0.00	0.999	17	7.225	0.460	0.005			
Fecundity (fs)	0.716	0.047	15.14	0.001	-0.028	0.025	-1.11	0.281	0.046	0.041	1.12	0.277	17	1.201	0.124	0.325			
Recruitment (r1)	0.382	0.032	12.05	0.001	-0.139	0.017	-8.20	0.001	0.015	0.027	0.55	0.592	17	33.65	0.798	0.001			
Recruitment (r2)	0.430	0.063	6.87	0.001	-0.039	0.034	-1.17	0.258	0.095	0.054	1.76	0.096	17	2.153	0.202	0.147			
Recruitment (r3)	0.288	0.057	5.03	0.001	-0.039	0.031	-1.29	0.216	-0.064	0.049	-1.30	0.210	17	1.750	0.171	0.204			
Population Growth (L)	0.324	0.045	7.13	0.001	0.079	0.024	-3.25	0.005	-0.036	0.039	-0.91	0.374	17	5.591	0.397	0.014			

Plantago coronopus

Fecundity
(f_1)



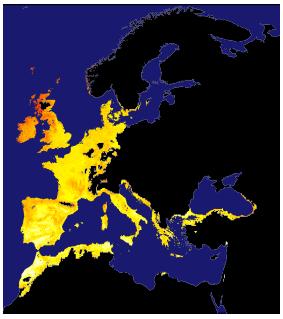
Growth
(g_1)



Survival
(s_1)



Recruitment
(r)

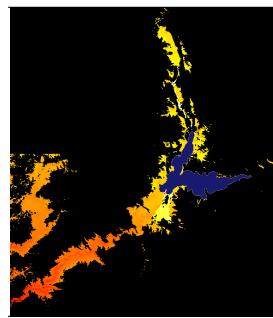


Population
Growth (L)



Clarkia xantiana

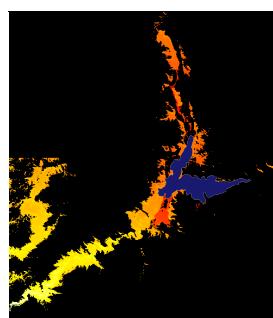
Fecundity
(ff)



Survival
(s_1)



Recruitment
(r_1)



Population
Growth (L)

