Oikos

OIK-07086

Hyeun-Ji, L., Broggi, J., Sánchez-Montes, G., Díaz-Paniagua, C. and Gomez-Mestre, I. 2020. Dwarfism in close continental amphibian populations despite lack of genetic isolation. – Oikos doi: 10.1111/oik.07086

Appendix 1

Table A1. Worldclim bioclimatic variables.

BIO1 = Annual mean temperature

BIO2 = Mean diurnal range (mean of monthly (max temp – min temp))

BIO3 = Isothermality (BIO2/BIO7)(*100)

BIO4 = Temperature seasonality (standard deviation*100)

BIO5 = Max temperature of warmest month

BIO6 = Max temperature of coldest month

BIO7 = Temperature annual range (BIO5 - BIO6)

BIO8 = Mean temperature of wettest quarter

BIO9 = Mean temperature of driest quarter

BIO10 = Mean temperature of warmest quarter

BIO11 = Mean temperature of coldest quarter

BIO12 = Annual precipitation

BIO13 = Precipitation of wettest month

BIO14 = Precipitation of driest month

BIO15 = Precipitation seasonality (coefficient of variation)

BIO16 = Precipitation of wettest quarter

BIO17 = Precipitation of driest quarter

BIO18 = Precipitation of warmest quarter

BIO19 = Precipitation of coldest quarter

Table A2. Factor loadings of principal component analysis (PCA).

	PC1	PC2
Bio_12 (Annual precipitation)	0.99	0.00
Bio_19 (Precipitation of coldest quarter)	0.99	-0.01
Bio_16 (Precipitation of wettest quarter)	0.99	-0.07
Bio_11 (Mean temperature of coldest quarter)	-0.99	-0.03
Bio_13 (Precipitation of wettest month)	0.99	-0.05
Bio_17 (Precipitation of driest quarter)	0.98	0.12
Bio_6 (Max temperature of coldest month)	-0.98	-0.14
Bio_14 (Precipitation of driest month)	0.95	-0.07
Bio_1 (Annual mean temperature)	-0.94	0.30
Bio_15 (Precipitation seasonality (coefficient of variation))	-0.94	-0.24
Bio_8 (Mean temperature of wettest quarter)	-0.91	-0.30
Bio_4 (Temperature seasonality (standard deviation*100))	0.89	0.44
Bio_7 (Temperature annual range (BIO5 - BIO6))	0.87	0.48
Bio_18 (Precipitation of warmest quarter)	0.86	0.03
Bio_2 (Mean diurnal range (mean of monthly (max temp – min temp)))	0.84	0.52
Bio_9 (Mean temperature of driest quarter)	-0.13	0.99
Bio_10 (Mean temperature of warmest quarter)	-0.27	0.96
Bio_3 (Isothermality (BIO2/BIO7)(*100))	0.44	0.78
Bio_5 (Max temperature of warmest month)	0.66	0.74
Proportion of variation explained	**0.74**	**0.21**

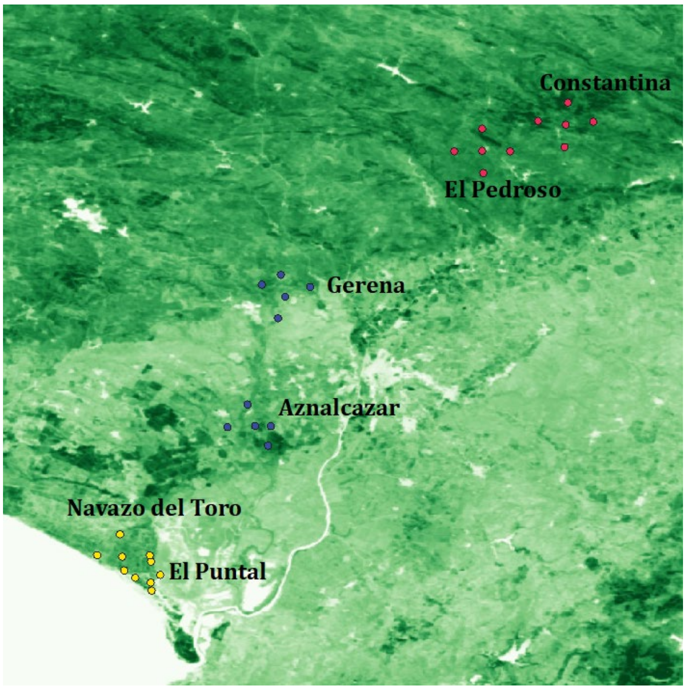


Figure A1. Figure visualizing NDVI across study populations, showing that on average the Doñana area is less densely vegetated than the Sierra Norte area.

Table A4. Loci showing significant departures from Hardy-Weinberg equilibrium (HWE). Genetic diversity estimates detailed by locus and population. n: sample size, A: number of alleles observed, %: percentage of the total number of alleles observed at a specific locus that were present in the population, AR: allelic richness, H_O and H_E: observed and expected heterozygosity, F_{IS}_Low and F_{IS}_High: lower and upper bounds of the 95% CI for F_{IS}. Only loci with p<0.001 (marked in bold) showed significant departures from Hardy–Weinberg equilibrium (HWE) after Bonferroni correction.

Navazo del Toro

	n	A	%	AR	H_O	H_E	HWE	F_{IS}	F_{IS} _Low	F_{IS} _High
Ecal4.6	27	9	90	8.05	0.59	0.83	0.144	0.288	0.068	0.515
Ecal4.14	26	11	78.57	9.99	0.69	0.88	0.069	0.213	0.02	0.417
Ecal3.29	27	6	75	5.17	0.22	0.38	0.054	0.422	-0.052	0.804
Ecal4.2	27	17	35.42	13.87	0.48	0.91	**<0.001**	0.468	0.258	0.675
Ecal3.19	21	8	72.73	7.2	0.38	0.84	0.002	0.545	0.282	0.793
Ecal4.26	27	26	48.15	19.98	0.74	0.94	**<0.001**	0.214	0.049	0.398
Ecal4.29	27	12	70.59	10.86	0.96	0.88	0.889	-0.093	-0.176	0.017
Ecal4.3	25	12	75	10.98	0.96	0.89	1	-0.08	-0.147	0.011
Ecal4.16	27	5	100	4.63	0.63	0.69	0.424	0.093	-0.183	0.359
Ecal3.26	27	15	44.12	12.58	0.52	0.88	**<0.001**	0.408	0.203	0.617
Ecal4.8	24	17	47.22	13.47	0.71	0.89	**<0.001**	0.202	0.001	0.418
Ecal4.21	26	9	75	7.97	0.62	0.82	0.227	0.248	0.037	0.472
Ecal3.4	27	7	50	6.73	0.89	0.76	1	-0.166	-0.317	0.002
Ecal4.20	27	19	79.17	15.82	0.96	0.92	0.956	-0.05	-0.105	0.032
Ecal4.18	26	9	81.82	8.43	0.88	0.83	1	-0.068	-0.216	0.097
Ecal4.24	27	11	73.33	9.96	0.93	0.87	1	-0.067	-0.159	0.053

El Puntal

	N	A	%	AR	H_O	H_E	HWE	F_{IS}	F_{IS} _Low	F_{IS} _High
Ecal4.6	33	8	80	7.37	0.73	0.83	0.075	0.129	-0.046	0.314
Ecal4.14	33	10	71.43	9.25	0.79	0.87	0.408	0.094	-0.054	0.255
Ecal3.29	33	6	75	5.26	0.33	0.39	0.455	0.144	-0.093	0.408
Ecal4.2	33	23	47.92	17.06	0.7	0.93	**<0.001**	0.251	0.084	0.423
Ecal3.19	22	9	81.82	8	0.32	0.86	0.005	0.629	0.387	0.851
Ecal4.26	29	25	46.3	18.98	0.97	0.94	**<0.001**	-0.025	-0.08	0.053
Ecal4.29	33	12	70.59	10.83	0.88	0.89	0.999	0.008	-0.109	0.147
Ecal4.3	32	12	75	10.57	0.88	0.86	0.998	-0.02	-0.144	0.125
Ecal4.16	33	4	80	3.98	0.48	0.66	0.014	0.265	-0.013	0.531
Ecal3.26	33	19	55.88	14.66	0.7	0.89	**<0.001**	0.22	0.056	0.39
Ecal4.8	31	22	61.11	16.43	0.9	0.91	**<0.001**	0.008	-0.104	0.132
Ecal4.21	31	9	75	7.35	0.61	0.73	0.185	0.159	-0.04	0.368
Ecal3.4	33	8	57.14	7.47	0.88	0.81	0.698	-0.084	-0.21	0.067

Ecal4.20	33	16	66.67	12.68	0.76	0.88	0.062	0.134	-0.004	0.289
Ecal4.18	33	9	81.82	8.6	0.79	0.85	1	0.069	-0.087	0.243
Ecal4.24	33	12	80	10.86	0.94	0.88	1	-0.064	-0.139	0.034

Aznalcazar

	N	A	%	AR	H_O	H_E	HWE	F_{IS}	F_{IS} _Low	F_{IS} _High
Ecal4.6	30	7	70	6.46	0.5	0.76	0.015	0.344	0.092	0.595
Ecal4.14	27	12	85.71	9.92	0.56	0.87	**<0.001**	0.364	0.155	0.578
Ecal3.29	29	7	87.5	5.68	0.48	0.55	0.156	0.127	-0.116	0.396
Ecal4.2	30	27	56.25	19.66	0.9	0.91	**<0.001**	0.014	-0.091	0.136
Ecal3.19	27	7	63.64	6.46	0.52	0.81	0.086	0.363	0.124	0.598
Ecal4.26	29	24	44.44	17.92	0.72	0.93	**<0.001**	0.217	0.052	0.393
Ecal4.29	30	13	76.47	11.21	0.93	0.87	0.668	-0.07	-0.17	0.041
Ecal4.3	30	13	81.25	11.2	0.93	0.85	0.999	-0.094	-0.183	0.013
Ecal4.16	30	4	80	3.83	0.5	0.58	0.958	0.135	-0.122	0.4
Ecal3.26	30	15	44.12	12.22	0.7	0.87	**<0.001**	0.196	0.029	0.375
Ecal4.8	28	16	44.44	12.31	0.68	0.86	**<0.001**	0.208	0.024	0.406
Ecal4.21	30	10	83.33	7.86	0.43	0.79	**<0.001**	0.449	0.236	0.661
Ecal3.4	30	8	57.14	7.33	0.77	0.77	0.964	0.005	-0.158	0.184
Ecal4.20	30	15	62.5	13.05	1	0.9	0.721	-0.116	-0.155	-0.087
Ecal4.18	30	9	81.82	7.97	0.83	0.84	0.929	0.005	-0.149	0.178
Ecal4.24	30	10	66.67	9.23	0.9	0.86	0.997	-0.051	-0.173	0.091

Gerena

	N	A	%	AR	H_O	H_E	HWE	F_{IS}	F_{IS} _Low	F_{IS} _High
Ecal4.6	30	8	80	7.17	0.67	0.78	0.415	0.148	-0.072	0.37
Ecal4.14	29	11	78.57	10.08	0.69	0.84	0.105	0.183	0.013	0.37
Ecal3.29	30	7	87.5	6.28	0.5	0.68	0.127	0.266	-0.009	0.532
Ecal4.2	30	19	39.58	14.98	0.87	0.9	**<0.001**	0.036	-0.071	0.158
Ecal3.19	27	11	100	9.38	0.56	0.86	0.007	0.355	0.13	0.577
Ecal4.26	29	28	51.85	20.58	0.83	0.95	**<0.001**	0.125	-0.008	0.273
Ecal4.29	30	11	64.71	9.92	0.83	0.86	0.083	0.036	-0.103	0.187
Ecal4.3	29	13	81.25	11.22	0.86	0.84	0.953	-0.021	-0.149	0.123
Ecal4.16	30	4	80	3.83	0.4	0.66	0.001	0.392	0.085	0.667
Ecal3.26	28	20	58.82	15.2	0.57	0.91	**<0.001**	0.375	0.188	0.566
Ecal4.8	30	13	36.11	10.34	0.6	0.68	0.057	0.112	-0.086	0.323
Ecal4.21	29	9	75	7.82	0.59	0.78	0.16	0.253	0.032	0.478
Ecal3.4	30	6	42.86	5.23	0.8	0.71	0.532	-0.13	-0.303	0.066
Ecal4.20	30	13	54.17	11.3	0.87	0.86	**<0.001**	-0.003	-0.117	0.129
Ecal4.18	30	9	81.82	8.17	0.93	0.85	0.802	-0.093	-0.184	0.021

Ecal4.24	30	12	80	10.47	0.87	0.86	0.765	-0.005	-0.128	0.136

El Pedroso

	N	A	%	AR	H_O	H_E	HWE	F_{IS}	F_{IS} _Low	F_{IS} _High
Ecal4.6	31	7	70	6.78	0.45	0.79	0.031	0.431	0.206	0.651
Ecal4.14	30	8	57.14	7.33	0.43	0.81	0.001	0.464	0.228	0.689
Ecal3.29	30	6	75	5.12	0.37	0.49	0.294	0.258	-0.07	0.585
Ecal4.2	31	23	47.92	18.23	0.84	0.93	0.427	0.093	-0.024	0.228
Ecal3.19	26	9	81.82	7.66	0.35	0.82	**<0.001**	0.579	0.342	0.8
Ecal4.26	26	26	48.15	18.43	0.92	0.93	**<0.001**	0.008	-0.092	0.132
Ecal4.29	31	10	58.82	8.56	0.74	0.84	0.003	0.118	-0.058	0.305
Ecal4.3	31	13	81.25	11.15	0.87	0.86	0.351	-0.017	-0.13	0.112
Ecal4.16	31	4	80	3.93	0.48	0.57	0.5	0.146	-0.127	0.428
Ecal3.26	31	16	47.06	13.87	0.84	0.92	1	0.088	-0.051	0.237
Ecal4.8	31	16	44.44	13.08	0.74	0.87	**<0.001**	0.147	-0.03	0.335
Ecal4.21	31	10	83.33	8.49	0.77	0.84	0.249	0.073	-0.096	0.259
Ecal3.4	31	9	64.29	7.46	0.84	0.79	0.001	-0.065	-0.22	0.106
Ecal4.20	31	17	70.83	13.84	0.9	0.9	**<0.001**	-0.008	-0.128	0.125
Ecal4.18	31	8	72.73	7.98	0.87	0.87	1	-0.006	-0.132	0.132
Ecal4.24	31	10	66.67	9.31	1	0.86	1	-0.168	-0.21	-0.138

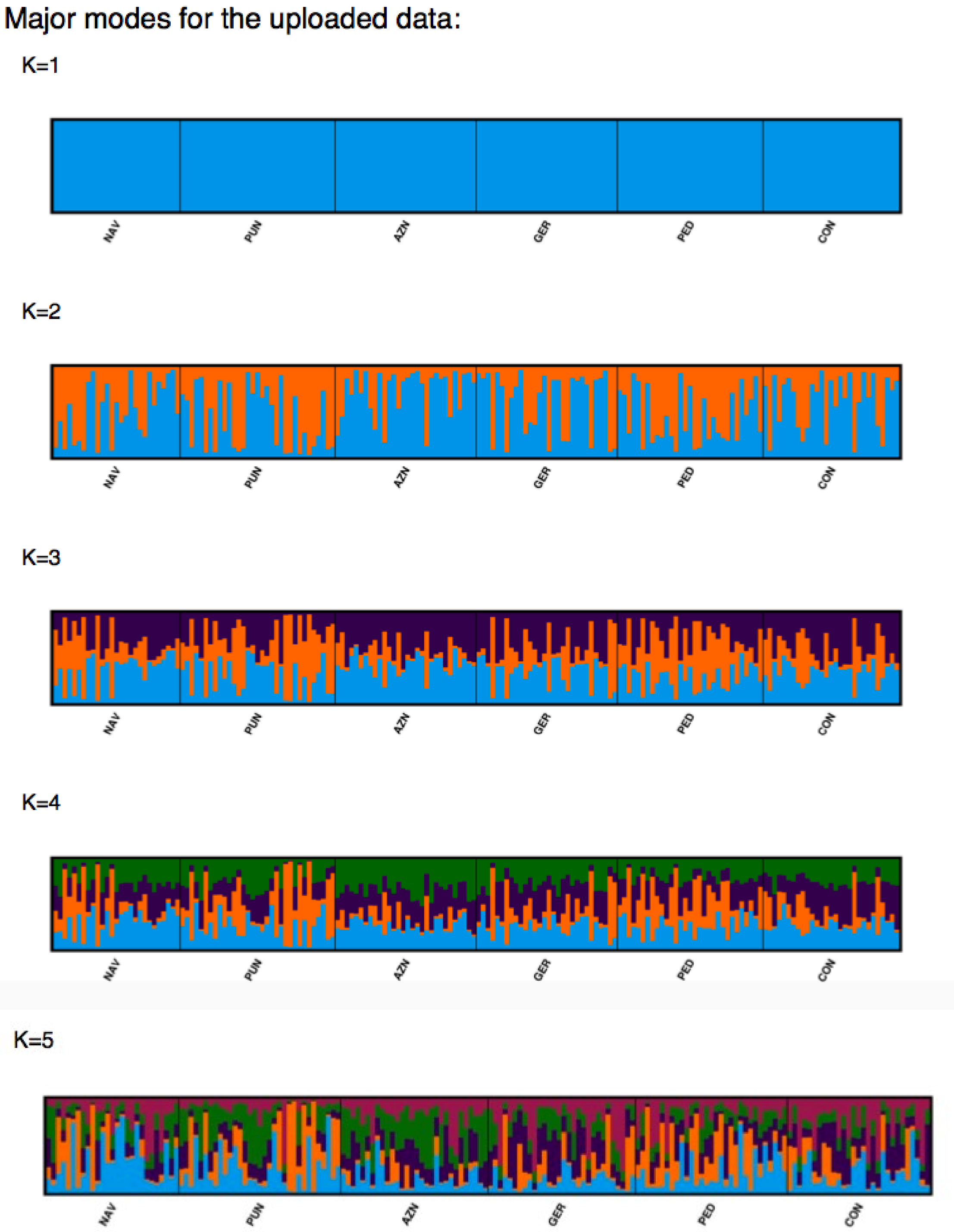
Constantina

	N	A	%	AR	H_O	H_E	HWE	F_{IS}	F_{IS} _Low	F_{IS} _High
Ecal4.6	29	8	80	7.69	0.66	0.77	0.67	0.145	-0.066	0.373
Ecal4.14	28	10	71.43	9.28	0.64	0.87	0.958	0.259	0.064	0.471
Ecal3.29	29	5	62.5	4.81	0.48	0.57	0.133	0.158	-0.15	0.463
Ecal4.2	29	21	43.75	16.79	0.83	0.93	**<0.001**	0.109	-0.027	0.26
Ecal3.19	23	10	90.91	8.58	0.48	0.85	0.013	0.435	0.191	0.678
Ecal4.26	26	23	42.59	17.43	0.77	0.93	**<0.001**	0.171	-0.002	0.357
Ecal4.29	29	8	47.06	7.41	0.76	0.82	0.973	0.069	-0.117	0.266
Ecal4.3	28	10	62.5	9.63	0.79	0.85	1	0.079	-0.079	0.26
Ecal4.16	29	5	100	4.5	0.45	0.6	0.115	0.252	-0.024	0.537
Ecal3.26	27	14	41.18	11.49	0.85	0.85	**<0.001**	-0.004	-0.148	0.16
Ecal4.8	29	17	47.22	13.68	0.83	0.85	0.005	0.029	-0.115	0.187
Ecal4.21	29	7	58.33	6.46	0.62	0.74	0.561	0.166	-0.056	0.389
Ecal3.4	29	8	57.14	7.12	0.72	0.78	0.081	0.077	-0.112	0.277
Ecal4.20	29	21	87.5	16.85	0.93	0.92	**<0.001**	-0.01	-0.094	0.1
Ecal4.18	29	8	72.73	7.44	1	0.83	0.2	-0.203	-0.259	-0.167
Ecal4.24	29	12	80	10.68	0.93	0.88	0.437	-0.057	-0.147	0.057

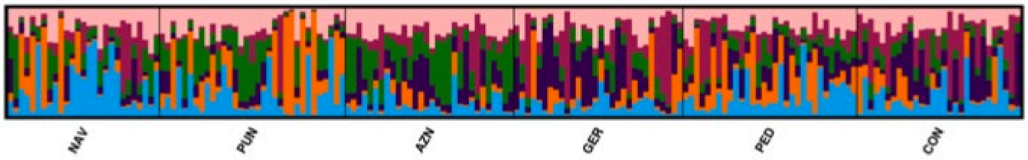
Table A5. Genetic differentiation (showing all 16 loci). Square matrix showing pairwise genetic differentiation among the six populations using all 16 loci. Upper triangular: Hedrick's G_{ST}, lower triangular: Jost's D, with 1000 bootstrapped 95% confidence intervals (95% CI). Estimates significantly different from zero (i.e. with 95% CI not including zero) are marked in bold.

	Navazo del Toro	El Puntal	Aznalcazar	Gerena	El Pedroso	Constantina
Navazo del Toro		0.031 (0-0.089)	**0.066 (0.013-0.126)**	**0.097 (0.038-0.173)**	**0.057 (0.005-0.124)**	0.044 (0-0.110)
El Puntal	0.006 (0-0.058)		**0.082 (0.028-0.148)**	**0.130 (0.073-0.195)**	**0.081 (0.029-0.148)**	**0.108 (0.052-0.170)**
Aznalcazar	0.039 (0-0.102)	**0.058 (0.007-0.118)**		**0.072 (0.017-0.141)**	**0.069 (0.021-0.132)**	**0.066 (0.015-0.127)**
Gerena	**0.052 (0.002-0.113)**	**0.069 (0.019-0.132)**	0.036 (0-0.095)		**0.077 (0.024-0.148)**	**0.076 (0.020-0.149)**
El Pedroso	0.022 (0-0.084)	0.044 (0-0.101)	0.041 (0-0.098)	0.044 (0-0.106)		0.048 (0-0.104)
Constantina	0.011 (0-0.070)	**0.068 (0.018-0.122)**	0.036 (0-0.088)	0.045 (0-0.109)	0.023 (0-0.074)	

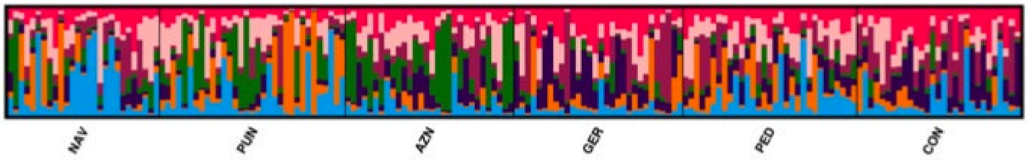
Table A6. Bayesian clustering analysis results, showing that there is no genetic clustering among populations regardless of K.



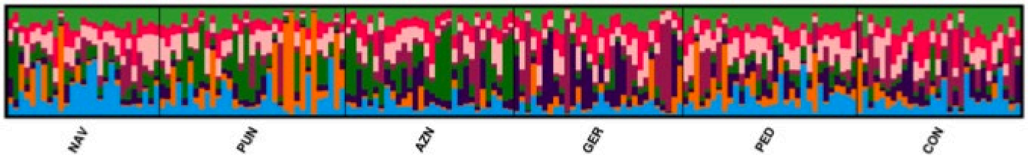
K=6



K=7

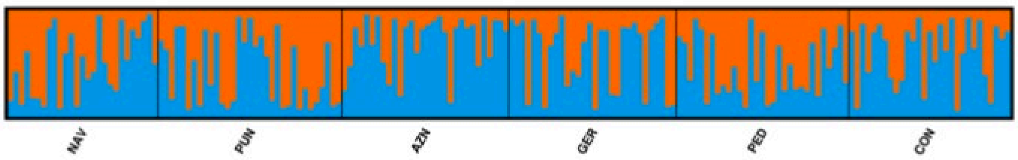


K=8

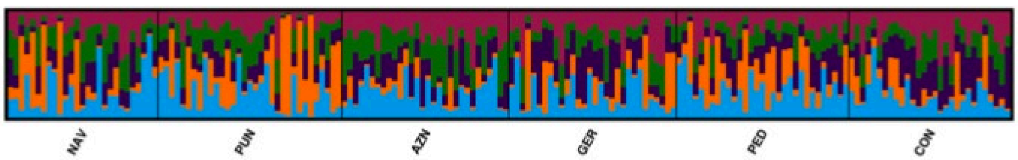


Minor modes for the uploaded data:

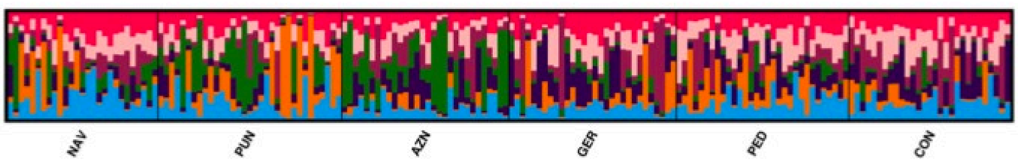
K=2 MinorCluster1



K=5 MinorCluster1



K=7 MinorCluster1



Division of runs by mode:

K=1	5/5
K=2	3/5, 2/5
K=3	5/5
K=4	5/5
K=5	3/5, 2/5
K=6	5/5
K=7	3/5, 2/5
K=8	5/5

Table A7. Snout-to-vent length and body mass of metamorphs.

Population	SVL (mm)	Body mass (g)
Constantina	9.01	0.00564
El Puntal	9.62	0.00673
El Pedroso	9.73	0.00784
Gerena	9.99	0.00893
Aznalcazar	10.12	0.00817
Navazo del Toro	10.58	0.00870

Table A8. Kolmogorov–Smirnov test results.
Each value indicates the p-value of the Kolmogorov-Smirnov test, indicating whether two populations differ from each other in age structure.

	NAV	PUN	AZN	GER	PED	CON
NAV		0.002	1	0.006	0.6	0.003
PUN	0.002		0.004	0.6	0.05	0.7
AZN	1	0.004		0.01	0.3	0.005
GER	0.006	0.6	0.01		0.09	0.9
PED	0.6	0.05	0.3	0.09		0.05
CON	0.003	0.7	0.005	0.9	0.05	

Table A9. Von Bertalanffy growth curves parameters. (L_{inf} = mean asymptotic SVL, K = growth coefficient, t_0 = hypothetical age at size 0)

	L_{inf}	K	t_0
Navazo del Toro	64.86	2.88	-0.06
El Puntal	60.90	2.11	-0.08
Aznalcazar	67.91	2.45	-0.07
Gerena	73.79	1.83	-0.08
Pedroso	70.26	1.43	-0.10
Constantina	68.57	2.27	-0.06