

Figure S1. Major mode barplots among the population of *Dianthus virgineus* resulting from STRUCTURE analyses. Genetic matrix contained 654 unlinked SNP-genotypes and 184 samples, including 3 replicates of 4 individuals. Populations are arranged according to increasing elevation. Upper barplot: structure inferred for $K = 9$ (major mode 8/10; ΔK [highest] = 147.28; $\Pr[X|K] = -116491.09 \pm 8987.42$) output from the explorative analysis. Middle barplot: structure inferred for $K = 2$ (major mode 8/10; $\Delta K = 45.26$; $\Pr[X|K] = -115302.42 \pm 7.24$) output from the customized analysis. Lower barplot: structure inferred for $K = 4$ (major mode 7/10; $\Delta K = 4.91$; $\Pr[X|K]$ [highest] = -113593.69 ± 146.1) output from the customized analysis.

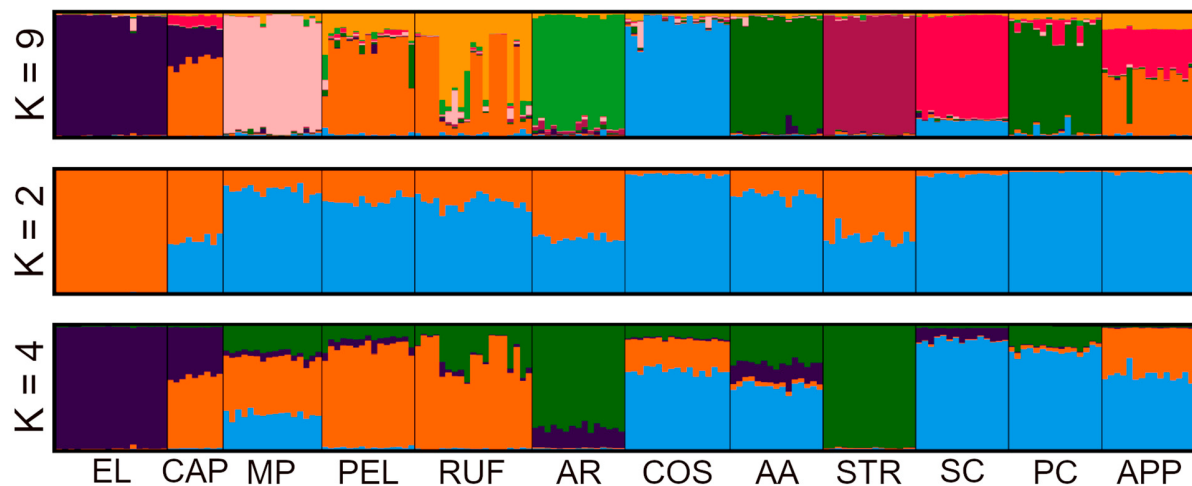


Table S1. Geographic, environmental, and sampling information of the studied populations of *Dianthus virgineus*.

Sampling site	ID	Elevation (m. a.s.l.)	Latitude (WGS84 N)	Longitude (WGS84 E)	Habitat (exposition)	Morphometry (n)	Genetics (n)	Specimens collection date (dd/mm/yyyy)	Specimens collectors	Seeds collection date (dd/mm/yyyy)	Seeds collector(s)	Voucher specimens
Isola d'Elba (Livorno)	EL	39	42.751741	10.115457	Garrigue with rosemary and rock rose on siliceous maritime cliffs (SW-W)	20	14	06/06/2020	Franzoni J. & Franzoni M.	04/07/2020	Carta A.	PI 043071, 057907, 061175- 061192
Isola di Capraia (Livorno)	CAP	40	43.041384	9.844103	Garrigue on siliceous maritime cliffs (N)	2	9	10/06/2020	Franzoni J. & Peruzzi L.	29/07/2020	Franzoni J. & Giacò A.	PI 043070, 061080, 061081
Monte Pisano (Pisa)	MP	216	43.77088	10.447816	Garrigue on carbonatic rocks (SW)	20	14	03/06/2020	Astuti G. & Franzoni J.	03/07/2020	Franzoni J. & Scalzo D.	PI 061231- 061250
Poggio Pelato (Livorno)	PEL	289	43.432316	10.428041	Garrigue on ophiolitic rocks (SW)	15	15	08/06/2020	Astuti G. & Giacò A.	20/07/2020	Astuti G. & Franzoni J.	PI 061120- 06134
Monterufoli (Pisa)	RUF	473	43.240117	10.785517	Garrigue on ophiolitic rocks (SW-W)	20	15	19/06/2020	Astuti G. & Franzoni J.	13/08/2020	Franzoni J. & Franzoni M.	PI 061193- 061212
Monte Argentario (Grosseto)	AR	500	42.409876	11.152113	Holm oak forest edge on carbonatic rocks (W)	19	15	27/06/2020	Franzoni J. & Franzoni M.	16/08/2020	Franzoni J. & Franzoni M.	PI 041621, 057908, 061213- 061230
Monte Le Coste (Prato)	COS	528	43.928756	11.11943	Meadows on carbonatic rocks (E)	20	15	16/07/2020	Franzoni J. & Giacò A.	29/08/2020	Franzoni J. & Scalzo D.	PI 061155- 061174
Alpi Apuane (Lucca)	AA	585	44.092893	10.208333	Meadows on marble (E)	20	15	14/07/2020	Franzoni J. & Giacò A.	03/09/2020	Astuti G. & Franzoni J.	PI 043072, 057909, 061251- 061268
Stribugliano (Grosseto)	STR	970	42.858359	11.469196	Bare rocks and pine forest edge, on marl and jasper (SE)	20	15	28/07/2020	Franzoni J. & Franzoni M.	16/08/2020	Franzoni J. & Franzoni M.	PI 043074, 057910, 061269- 061286
Sasso di Castro (Firenze)	SC	1060	44.127587	11.296171	Bare rocks and meadows, on basaltic rocks (SE)	20	15	16/07/2020	Franzoni J. & Giacò A.	29/08/2020	Franzoni J. & Scalzo D.	PI 061135- 061154
Pania di Corfino (Lucca)	PC	1415	44.204376	10.37573	Meadows on carbonatic rocks (SW)	20	15	20/07/2020	Astuti G. & Franzoni J.	04/09/2020	Franzoni J.	PI 041622, 061101- 061119
Libro Aperto (Pistoia)	APP	1874	44.158119	10.710399	High altitude meadows on sandstone (SW)	20	15	31/07/2020	Franzoni J. & Peruzzi L.	08/09/2020	Franzoni J. & Tiburtini M.	PI 043073, 061082- 061100

Table S2. Pairwise F_{ST} among the studied populations of *Dianthus virginicus*. F_{ST} were calculated according to Nei (1987) on the genetic matrix (654 unlinked SNP-genotypes and 184 samples, including 3 replicates for 4 individuals). Population acronyms as in Table S1.

	EL	CAP	MP	PEL	RUF	AR	COS	AA	STR	SC	PC	APP
EL												
CAP	0.0617											
MP	0.0702	0.0583										
PEL	0.0574	0.0451	0.0331									
RUF	0.059	0.0559	0.0373	0.0166								
AR	0.0562	0.0511	0.0418	0.0299	0.0341							
COS	0.073	0.0697	0.0495	0.039	0.0427	0.0483						
AA	0.0593	0.0501	0.0408	0.0307	0.0365	0.0374	0.0444					
STR	0.0684	0.0648	0.0505	0.0392	0.037	0.0318	0.0542	0.0461				
SC	0.0698	0.0692	0.0539	0.0501	0.048	0.0537	0.0453	0.0484	0.0557			
PC	0.0704	0.0626	0.043	0.0392	0.0429	0.0442	0.0433	0.0288	0.051	0.038		
APP	0.0747	0.0613	0.051	0.0402	0.0458	0.0554	0.0425	0.0399	0.0542	0.0393	0.0273	

Table S3. Correlation among morphometric traits in the studied populations of *Dianthus virgineus*. Above the diagonal matrix, p-values of the Pearson's correlation test; in bold p-values > 0.05. Below the diagonal matrix, the coefficient of Pearson's correlation (r); in bold r > 0.8. Variable IDs are reported in Table 1.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1		0.001	0.678	0.002	0.223	0.438	0.881	0.029	0.311	0.333	0.154	0.047	0.826	0.956	0.003	0.836	0.044	0.928	0.730	0.822	0.677	0.696	0.642	0.467
2	0.835		0.538	0.217	0.966	0.779	0.209	0.174	0.772	0.878	0.958	0.148	0.547	0.248	0.057	0.662	0.010	0.436	0.557	0.886	0.883	0.522	0.632	0.556
3	0.134	-0.198		0.329	0.121	0.783	0.498	0.227	0.627	0.705	0.569	0.218	0.253	0.381	0.950	0.432	0.794	0.600	0.753	0.711	0.614	0.607	0.395	0.051
4	0.796	0.385	0.309		0.050	0.079	0.072	0.012	0.025	0.023	0.003	0.034	0.286	0.254	0.005	0.286	0.327	0.446	0.092	0.990	0.183	0.548	0.839	0.544
5	0.380	0.014	0.472	0.577		0.025	0.012	0.363	0.001	0.034	0.010	0.506	0.032	0.011	0.633	0.365	0.956	0.535	0.148	0.612	0.627	0.430	0.636	0.640
6	0.248	-0.091	-0.089	0.525	0.641		0.002	0.013	0.000	0.021	0.000	0.069	0.038	0.010	0.327	0.178	0.999	0.617	0.007	0.928	0.239	0.067	0.952	0.368
7	0.049	-0.391	0.217	0.536	0.697	0.792		0.160	0.188	0.001	0.001	0.373	0.006	0.387	0.614	0.301	0.601	0.189	0.026	0.516	0.391	0.162	0.329	0.842
8	0.628	0.420	-0.377	0.693	0.288	0.688	0.433		0.044	0.003	0.008	0.001	0.477	0.368	0.007	0.408	0.391	0.438	0.079	0.991	0.242	0.250	0.854	0.491
9	0.320	-0.094	0.156	0.640	0.822	0.856	0.923	0.589		0.000	0.000	0.165	0.012	0.000	0.309	0.551	0.998	0.441	0.058	0.297	0.538	0.271	0.284	0.890
10	0.306	-0.050	-0.122	0.647	0.613	0.951	0.818	0.782	0.850		0.000	0.023	0.073	0.020	0.220	0.116	0.869	0.294	0.004	0.964	0.150	0.050	0.763	0.392
11	0.439	0.017	0.183	0.777	0.710	0.853	0.830	0.725	0.866	0.890		0.070	0.007	0.013	0.060	0.052	0.593	0.225	0.001	0.690	0.049	0.040	0.830	0.784
12	0.581	0.444	-0.384	0.612	0.213	0.542	0.283	0.837	0.428	0.648	0.540		0.890	0.767	0.005	0.444	0.469	0.979	0.239	0.881	0.461	0.434	0.963	0.450
13	0.071	-0.194	0.358	0.336	0.618	0.603	0.736	0.227	0.696	0.535	0.733	0.045		0.002	0.689	0.127	0.576	0.363	0.023	0.805	0.143	0.097	0.770	0.098
14	0.018	-0.362	0.279	0.357	0.700	0.705	0.911	0.286	0.868	0.660	0.690	0.096	0.787		0.954	0.517	0.597	0.166	0.180	0.260	0.909	0.568	0.261	0.545
15	0.769	0.562	-0.020	0.755	0.154	0.310	0.162	0.731	0.321	0.382	0.557	0.747	0.129	-0.019		0.564	0.042	0.816	0.261	0.681	0.229	0.593	0.421	0.624
16	0.067	-0.141	0.251	0.336	0.287	0.416	0.326	0.264	0.192	0.478	0.571	0.244	0.466	0.208	0.185		0.847	0.091	0.002	0.001	0.004	0.022	0.032	0.932
17	0.590	0.711	-0.085	0.310	-0.018	0.000	-0.168	0.273	0.001	-0.053	0.172	0.231	0.180	-0.170	0.593	-0.063		0.222	0.919	0.962	0.784	0.793	0.327	0.182
18	-0.029	-0.249	0.169	0.243	0.199	0.161	0.407	0.248	0.246	0.331	0.378	-0.009	0.289	0.427	-0.075	0.509	-0.381		0.269	0.534	0.419	0.616	0.631	0.729
19	0.111	-0.189	0.102	0.508	0.444	0.726	0.636	0.526	0.560	0.767	0.838	0.368	0.648	0.415	0.352	0.799	0.033	0.347		0.063	0.000	0.000	0.241	0.864
20	-0.073	-0.046	0.120	0.004	-0.164	-0.029	-0.208	0.004	-0.328	0.015	0.129	0.049	0.080	-0.353	0.133	0.807	0.015	0.200	0.552		0.004	0.055	0.001	0.935
21	0.135	-0.048	0.163	0.412	0.156	0.368	0.273	0.366	0.198	0.442	0.578	0.236	0.449	0.037	0.376	0.758	0.089	0.258	0.872	0.760		0.002	0.049	0.759
22	-0.126	-0.206	-0.165	0.193	0.252	0.545	0.431	0.360	0.346	0.577	0.599	0.250	0.502	0.184	0.172	0.652	0.085	0.162	0.884	0.566	0.785		0.366	0.608
23	0.150	0.154	0.271	0.066	-0.153	-0.019	-0.309	-0.060	-0.337	-0.098	0.070	0.015	0.094	-0.353	0.256	0.620	0.310	-0.155	0.367	0.825	0.579	0.287		0.744
24	0.233	0.189	0.573	0.195	0.151	-0.286	0.065	-0.221	0.045	-0.272	0.089	-0.242	0.499	0.194	0.158	0.028	0.413	0.112	-0.056	-0.026	0.099	-0.165	0.106	

Table S4. Significantly different morphometric variables among the studied populations of *Dianthus virgineus*. Significant threshold was set at 0.01. Above the diagonal matrix, the number of significantly different variables between each population pair is reported, the darker the color the higher the number of variables. Below the diagonal matrix the number IDs (Table 1) representing the variables are reported. Bold variable ID indicates significant differences resulting from Bonferroni corrected Mann-Whitney U test (Levene test $p < 0.05$). Non bold variable ID indicates significant differences resulting from Tukey post hoc test (Levene test $p > 0.05$). ns = not significant differences. Population acronyms as in Table S1.

	EL	CAP	MP	PEL	RUF	AR	COS	AA	STR	SC	PC	APP
EL		1	3	3	4	5	6	9	5	4	4	5
CAP	10		1	2	2	2	2	7	2	4	3	3
MP	1, 2, 4	6		2	3	5	2	8	2	3	8	11
PEL	1, 4, 15	6, 10	5, 15		0	1	1	5	1	2	8	9
RUF	1, 2, 4, 15	6, 10	5, 15, 19	ns		4	1	6	6	5	8	11
AR	1, 2, 4, 5, 24	6, 10	1, 10, 19, 22, 24	5	5, 7, 9, 12, 13		3	11	4	4	9	11
COS	1, 2, 4, 12, 15, 23	6, 10	15, 19	19	5	12, 13, 23		5	7	4	8	8
AA	1, 2, 6, 16, 19, 20, 21, 22, 23	6, 10, 13, 16, 19, 20, 22	10, 11, 16, 19, 20, 21, 22, 23	16, 19, 20, 21, 23	12, 16, 19, 20, 21, 23	1, 4, 5, 7, 11, 13, 16, 19, 20, 21, 23	12, 15, 16, 19, 20, 21, 23		11	9	8	11
STR	1, 2, 4, 15, 17	6, 10	15, 17	17	5, 9, 13, 19, 21, 22	1, 17, 19, 22	13, 17, 19, 22, 23	7, 11, 13, 15, 16, 17, 19, 20, 21, 22, 23		6	14	12
SC	4, 6, 13, 23	6, 10, 12, 13	2, 8, 13	1, 15	1, 2, 12, 15, 17	1, 2, 17, 24	1, 2, 8, 15	1, 2, 16, 17, 19, 20, 21, 22, 23	2, 15, 17, 19, 21, 24		3	6
PC	6, 10, 19, 23	6, 10, 19	1, 5, 6, 9, 10, 11, 19, 21	1, 4, 6, 10, 15, 19, 21, 23	1, 2, 4, 6, 10, 12, 15, 23	1, 4, 5, 6, 7, 9, 11, 15, 23	1, 4, 6, 8, 9, 10, 12, 15	1, 4, 6, 9, 16, 19, 20, 21	1, 4, 6, 7, 9, 10, 15, 17, 18, 19, 21, 22, 23	6, 10, 24		2
APP	6, 10, 16, 20, 23	6, 10, 19	1, 2, 5, 6, 8, 10, 11, 16, 19, 20, 22	1, 2, 4, 8, 10, 15, 16, 19, 20	1, 2, 4, 6, 7, 8, 10, 11, 12, 15, 17	1, 2, 4, 5, 8, 9, 11, 15, 16, 17, 23	1, 2, 4, 8, 10, 11, 12, 15	1, 2, 4, 7, 8, 16, 17, 19, 20, 21, 23	1, 2, 6, 8, 10, 11, 15, 17, 19, 20, 21, 22	1, 2, 8, 10, 13, 24	7, 21	

Table S5. Spearman's correlation test results between morphometric variables and elevation in the studied populations of *Dianthus virgineus*. Results are ordered from the highest to the lowest absolute r values.

	ID	Spearman's rs	p-value
Basal leaf width (mm)	6	-0.8601399	5.97E-04
Calyx length (mm)	16	-0.8391608	0.001192
Lower stem leaf width (mm)	10	-0.7762238	0.00466
Upper stem leaf width (mm)	8	-0.6503497	0.02591
Number of epicalyx scales	12	-0.6070213	0.03634
Corolla diameter (mm)	19	-0.59441	0.04575
Number of flowers per stem	11	-0.5649158	0.05564
Ovary length (mm)	23	-0.5454545	0.07068
Petal length (mm)	20	-0.4965035	0.1041
Petal limb width (mm)	22	-0.4475524	0.1472
Lower stem leaf length (mm)	9	-0.3706294	0.2367
Upper epicalyx scales length (mm)	13	-0.3636364	0.2463
Petal limb length (mm)	21	-0.3636364	0.2463
Upper internode length (mm)	4	-0.3286713	0.2969
Basal leaf length (mm)	5	-0.2867133	0.5273
Upper epicalyx scales mucro length (mm)	14	-0.2867133	0.3664
Plant height (cm)	1	-0.2237762	0.4849
Upper epicalyx scales width (mm)	15	-0.2167832	0.4991
Calyx teeth length (mm)	18	-0.1888112	0.5578
Number of internodes	2	-0.1225921	0.7043
Calyx width (mm)	17	-0.1118881	0.7328
Upper stem leaf length (mm)	7	-0.04195804	0.9037
Lower internode length (mm)	3	0.1258741	0.6967
Anther length (mm)	24	0.4285714	0.2992

Table S6. Morphometric distance among the studied populations of *Dianthus virgineus*. Pairwise distances were calculated as Euclidean distances of a standardized dataset without highly correlated variables ($r > 0.8$) and variable that did not show significant differences among populations. Population acronyms as in Table S1.

	EL	CAP	MP	PEL	RUF	AR	COS	AA	STR	SC	PC	APP
EL												
CAP	6.712											
MP	2.892	4.9156										
PEL	4.4524	5.6664	3.0183									
RUF	4.4136	6.5143	3.5145	2.5913								
AR	5.7018	5.3357	4.0668	3.6835	4.1548							
COS	4.9742	5.8458	3.4818	3.1801	2.4609	4.521						
AA	6.0985	8.8457	5.6814	6.3346	5.1969	6.4487	4.984					
STR	4.8723	5.9136	4.194	3.6272	3.2764	3.3829	4.4443	6.2776				
SC	3.3063	6.9444	2.6213	3.9677	4.1811	5.581	3.9117	5.1833	5.6974			
PC	4.8613	7.9757	4.4383	5.1304	5.6952	5.984	5.6396	5.4961	6.4124	4.3198		
APP	3.9363	7.8481	4.1867	5.2307	5.5202	5.8544	5.4685	5.0583	5.9544	3.8275	2.7721	

Table S7. Elevation distance among sampling sites of the studied populations of *Dianthus virgineus*. Pairwise distances were calculated in meters. Population acronyms as in Table S1.

	EL	CAP	MP	PEL	RUF	AR	COS	AA	STR	SC	PC	APP
EL												
CAP	1											
MP	177	176										
PEL	250	249	73									
RUF	434	433	257	184								
AR	461	460	284	211	27							
COS	489	488	312	239	55	28						
AA	546	545	369	296	112	85	57					
STR	931	930	754	681	497	470	442	385				
SC	1021	1020	844	771	587	560	532	475	90			
PC	1376	1375	1199	1126	942	915	887	830	445	355		
APP	1835	1834	1658	1585	1401	1374	1346	1289	904	814	459	

Table S8. Geographic distance among sampling sites of the studied populations of *Dianthus virgineus*. Pairwise distances were calculated in kilometers. Population acronyms as in Table S1.

	EL	CAP	MP	PEL	RUF	AR	COS	AA	STR	SC	PC	APP
EL												
CAP	43.70											
MP	117.54	104.16										
PEL	82.18	77.51	37.13									
RUF	91.39	106.38	69.05	44.79								
AR	120.61	160.35	167.99	137.54	99.39							
COS	170.06	171.28	76.27	93.79	83.85	165.96						
AA	147.33	122.11	44.11	76.33	113.10	211.66	102.37					
STR	150.19	180.87	150.71	131.15	86.36	60.23	123.10	194.10				
SC	199.27	199.82	101.62	122.47	112.23	188.26	29.22	120.39	139.84			
PC	161.73	140.38	48.13	84.74	114.85	214.23	87.61	22.18	190.47	102.16		
APP	167.47	155.39	51.38	85.35	100.75	197.25	51.73	55.99	164.95	64.88	37.36	