

Supplementary Table S1

Characteristics of plant communities involving *Rhamnus erythroxylodes* subsp. *sintensisii*

Local populations	BUT-1	BUT-2	KUT	AKT
Dominants of plant communities	<i>Krascheninnikovia ceratoides</i> , <i>Rhamnus erythroxylodes</i> subsp. <i>sintensisii</i>	<i>Krascheninnikovia ceratoides</i> <i>Artemisia diffusa</i> , <i>Rhamnus erythroxylodes</i> subsp. <i>sintensisii</i>	<i>Rhamnus erythroxylodes</i> subsp. <i>sintensisii</i> , <i>Artemisia diffusa</i> , <i>Salsola arbuscula</i>	<i>Rhamnus erythroxylodes</i> subsp. <i>sintensisii</i>
Geographic data	N 42.3312 E 63.1339 h=333 m	N 42.3817 E 63.0802 h=333 m	N 40.7886 E 64.0366 h=571 m	N 41.6736 E 64.4894 h=721 m
Projective coverage, %	12.0	15.0	22.0	15.0
Species name	Species abundance (%; +<1%)			
<i>Haloxylon ammodendron</i> (C.A.Mey.) Bunge ex Fenzl	1			
<i>Rhamnus erythroxylodes</i> subsp. <i>sintensisii</i> (Rech.f.) Mabb.	3	3	8	5
<i>Salsola arbuscula</i> Pall.			3	
<i>Krascheninnikovia ceratoides</i> (L.) Gueldenst.	4	5		
<i>Artemisia diffusa</i> Krasch. ex Poljakov	2	4	6	2
<i>Ephedra intermedia</i> Schrenk & C.A.Mey.				2
<i>Acanthophyllum elatius</i> Bunge	+			
<i>Ephedra distachya</i> L.		+		
<i>Artemisia juncea</i> Kar. & Kir.			1	2
<i>Astragalus centralis</i> E.Sheld.				+
<i>Scrophularia xanthoglossa</i> Boiss.				+
<i>Anemone petiolulosa</i> Juz.			2	+
<i>Allium borszczowii</i> Regel			+	
<i>Allium kysylkumi</i> Kamelin				+
<i>Carex pachystylis</i> J. Gay.			+	
<i>Gagea bergii</i> Litv.			+	+
<i>Ixiolirion tataricum</i> (Pall.) Schult.& Schult.f.			+	
<i>Ferula karelinii</i> Bunge			+	
<i>Ferula kyzylkumica</i> Korovin				
<i>Lepidium subcordatum</i>		+	+	+

Botsch. et Vved.				
<i>Lagochilus vvedenskyi</i> Kamelin & Tzukerv.				+
<i>Rindera tetraspis</i> Pall.			+	+
<i>Stipa hohenackeriana</i> Trin. & Rupr.	+	1		+
<i>Stipa aktauensis</i> Roshev.				1
<i>Poa bulbosa</i> L.	2	1	2	2
<i>Rheum turkestanicum</i> Janisch			+	
<i>Scariola orientalis</i> (Boiss.) Sojak.			+	+
<i>Tulipa buhseana</i> Boiss.			+	+
<i>Thalictrum isopyroides</i> C.A.Mey.			+	+
<i>Peganum harmala</i> L.	+			
<i>Ranunculus falcatus</i> L.	+		+	+
<i>Eremopyrum bonaepartis</i> (Spreng.) Nevski			+	+
<i>Bromus tectorum</i> L.	+			+
<i>Diptychocarpus strictus</i> (Fisch. ex M.Bieb.) Trautv.		+		+
<i>Descurainia sophia</i> (L.) Webb ex Prantl	+			
<i>Strigosella turkestanica</i> (Litv.) Botsch.	+	+		
<i>Scandix stellata</i> Banks & Sol.	+	+		
<i>Holosteum umbellatum</i> L.	+	+	+	+
<i>Galium spurium</i> L.			+	
<i>Koelpinia linearis</i> Pall.	+	+	+	+
<i>Arnebia decumbens</i> (Vent.) Coss. & Kralik	+	+		
<i>Lappula microcarpa</i> (Ledeb.) Gürke	+	+		+
<i>Leptaleum filifolium</i> (Willd.) DC.				+
<i>Alyssum desertorum</i> Stapf.	+	+	+	+
<i>Takhtajaniantha pusilla</i> (Pall.) Nazarova		+	+	+
<i>Valerianella szovitsiana</i> Fisch. & C.A.Mey.	+	+	+	+

<i>Veronica campylopoda</i> Boiss.			+	+
<i>Ziziphora tenuior</i> L.	+	+		

Supplementary Table S2

Soil variables in the BSE model for *Rh. erythroxylodes* subsp. *sintensis*

Variable code	Variable category	Percentage	Average (M) and standard deviation (σ) of the variables in the CAIA area (S_I) and in the econiche (S_2)				IMd
			S_I		S_2		
			M	σ^2	M	σ^2	
Characteristics of bedrock soil							
SSch_90	depth to bedrock (horizon R) up to 200 cm (BDRICM)	2,0	188,74	28,27	196,34	8,21	1,04
SSch_91	absolute depth to bedrock (in cm) BDTICM	0,7	4828,22	4818,42	3885,73	2311,16	0,80
Physical soil characteristics							
SPh_92	bulk density, kg/m ³ (BLDFIE)	0,4	1319,02	246,86	15,79	4,72	0,01
SPh_93	mass fraction of sludge (2-50 μm), in % of depth (SLTPPT)	0,3	36,27	8,01	32,24	4,02	0,89
SPh_94	rough fragments, volumetric in % of depth (CRFVOL)	1,3	12,90	9,31	15,79	7,72	1,22
Chemical soil characteristics							
SCh_95	soil ph x 10 in H ₂ O at depth (PHIHOX)	0,4	74,00	6,68	80,58	1,58	1,09
Soil types in which the development of plant root systems is difficult							
S_10	Calcic.Solonetz (SN)	0,1	0,66	0,99	1,07	0,93	1,62
S_11	Calcic.Vertisols (VR)	0,1	0,53	0,92	0,56	0,74	1,06
S_16	Gleyic.Solonetz (SN)	1,6	1,02	1,64	0,01	0,11	0,01
S_17	Gypsic.Solonchaks (SC)	7,2	1,23	2,62	0,35	0,59	0,28
S_41	Haplic.Leptosols.Eutric (LP)	15,7	1,00	1,84	1,84	1,31	1,84
S_42	Haplic.Leptosols (LP)	2,5	2,71	4,81	2,25	1,31	0,83
S_50	Haplic.Solonchaks.Sodic (SC)	0,1	0,38	0,9	0,14	0,36	0,37
S_51	Haplic.Solonchaks (SC)	0,7	3,49	4,77	2,43	1,91	0,70
S_53	Haplic.Vertisols.Eutric (VR)	0,1	0,40	0,81	0,20	0,44	0,50
S_58	Lithic.Leptosols (LP)	0,6	0,87	1,78	0,83	1,05	0,95
S_63	Mollic.Solonetz (SN)	0,1	0,83	1,32	0,17	0,44	0,20
S_65	Rendzic.Leptosols (LP)	2,2	0,65	1,39	1,48	1,33	2,28
Soils characterized by the dynamics of Fe and Al							
S_02	Aluandic.Andosols (AN)	0,3	0,17	0,61	0,01	0,09	0,06

S_06	Calcic.Gleysols (GL)	4,6	1,11	1,52	0,07	0,28	0,06
S_14	Endogleyic.Planosols (PL)	0,8	0,45	1,32	0,04	0,22	0,09
S_46	Haplic.Planosols.Eutric (PL)	0,2	0,35	0,65	0,003	0,06	0,01
S_62	Mollic.Gleysols (GL)	6,6	0,73	1,06	0,03	0,06	0,04
Soils with a well-defined accumulation of organic matter in the upper mineral horizon							
S_05	Calcic.Chernozems (CH)	0,6	0,66	1,06	0,04	0,21	0,06
S_31	Haplic.Chernozems (CH)	0,6	5,15	7,5	0,85	1,11	0,17
S_40	Haplic.Kastanozems (KS)	0,7	5,76	8,21	2,92	2,51	0,51
S_45	Haplic.Phaeozems (PH)	0,2	3,63	5,68	0,17	0,50	0,05
S_61	Luvic.Phaeozems (PH)	0,2	0,60	1,32	0,12	0,34	0,20
Soils with accumulation of moderately soluble salts or other substances							
S_07	Calcic.Gypsisols (GY)	17,3	1,36	2,22	2,40	1,60	1,76
S_23	Haplic.Calcisols.Sodic (CL)	0,5	0,09	0,36	0,02	0,12	0,22
S_24	Haplic.Calcisols (CL)	3,6	8,17	8,97	19,54	5,13	2,39
S_59	Luvic.Calcisols (CL)	1,2	1,20	1,5	1,71	1,29	1,43
S_64	Petric.Calcisols (CL)	0,8	0,44	1,05	0,82	0,93	1,86
Soils with weak or no profile differentiation							
S_21	Haplic.Arenosols.Calcaric (AR)	0,1	0,41	1,15	0,20	0,43	0,49
S_22	Haplic.Arenosols (AR)	2,9	2,59	3,96	1,36	1,55	0,53
S_03	Aric.Regosols (RG)	0,6	6,18	6,74	11,45	3,66	1,85
S_25	Haplic.Cambisols.Calcaric (CM)	0,1	2,95	2,99	5,40	2,11	1,83
S_35	Haplic.Fluvisols.Eutric (FL)	1,2	0,33	0,71	0,11	0,31	0,33
S_48	Haplic.Regosols.Dystric (RG)	0,4	0,46	1,12	0,09	0,30	0,20
S_56	Leptic.Cambisols (CM)	0,1	0,09	0,42	0,03	0,18	0,33
S_57	Leptic.Regosols (RG)	3,0	0,29	0,85	0,03	0,17	0,10

Supplementary Table S3

List of 19 bioclimatic variables used in bioclimatic envelope model development. Names and descriptions are based on WorldClim [53]

Variable	Description	Temporal Scale
bio_01	Annual Mean Temperature	Annual
bio_02	Mean Diurnal Range	Variation
bio_03	Isothermality	Variation
bio_04	Temperature Seasonality	Variation
bio_05	Maximum Temperature Warmest Month	Month
bio_06	Minimum Temperature Coldest Month	Month
bio_07	Temperature Annual Range	Annual
bio_08	Mean Temperature Wettest Quarter	Quarter
bio_09	Mean Temperature Driest Quarter	Quarter
bio_10	Temperature Warmest Quarter	Quarter
bio_11	Mean Temperature Coldest Quarter	Quarter
bio_12	Annual Precipitation	Annual
bio_13	Precipitation of Wettest Month	Month
bio_14	Precipitation of Driest Month	Month
bio_15	Precipitation Seasonality	Variation
bio_16	Precipitation of Wettest Quarter	Quarter
bio_17	Precipitation of Driest Quarter	Quarter
bio_18	Precipitation of Warmest Quarter	Quarter
bio_19	Precipitation of Coldest Quarter	Quarter