

Genetic diversity hotspots and refugia identified by mapping multi-plant species haplotype diversity in China

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Supplementary material

Table S1. Number of sampled populations and life form information for each focal species in the analysis.

No	Taxa	Family	No. of population s	Life form	References
1	<i>Acer mono</i>	Aceraceae	49	Tree	Guo et al. 2014
2	<i>Aconitum gymnandrum</i>	Ranunculaceae	20	Herb	Wang et al. 2009b
3	<i>Aconitum soongoricum</i>	Ranunculaceae	7	Herb	Jiang et al. 2014
4	<i>Ailanthus altissima</i>	Simaroubaceae	34	Tree	Liao et al. 2014
5	<i>Angelica nitida</i>	Apiaceae	13	Herb	Zhang and He 2013
6	<i>Atraphaxis frutescens</i>	Polygonaceae	26	Shrub	Xu and Zhang 2015
7	<i>Bombax ceiba</i>	Bombacaceae	11	Tree	Tian et al. 2015a
8	<i>Buddleja crispa</i>	Loganiaceae	17	Shrub	Yue et al. 2012
9	<i>Bupleurum longiradiatum</i>	Apiaceae	23	Herb	Zhao et al. 2013a
10	<i>Calligonum calliphysa</i>	Polygonaceae	10	Shrub	Wen et al. 2015
11	<i>Castanopsis eyrei</i>	Fagaceae	27	Tree	Shi et al. 2014
12	<i>Cephalotaxus oliveri</i>	Cephalotaxaceae	15	Shrub	Wang et al. 2014a
13	<i>Cercidiphyllum japonicum</i>	Cercidiphyllaceae	28	Tree	Qi et al. 2012
14	<i>Chimonanthus praecox</i>	Calycanthaceae	8	Tree	Lu et al. 2015
15	<i>Chionocharis hookeri</i>	Boraginaceae	8	Herb	Luo et al. 2016
16	<i>Chrysanthemum indicum</i>	Asteraceae	24	Herb	Fang et al. 2010
17	<i>Clematis sibirica</i>	Ranunculaceae	24	Shrub	Zhang and Zhang 2012
18	<i>Clematis songorica</i>	Ranunculaceae	30	Shrub	Zhang and Zhang 2012
19	<i>Clintonia udensis</i>	Liliaceae	18	Herb	Wang et al. 2010
20	<i>Cupressus duclouxiana</i>	Cupressaceae	11	Tree	Xu et al. 2010
21	<i>Cupressus funebris</i>	Cupressaceae	9	Tree	Xu et al. 2010
22	<i>Cyananthus delavayi</i>	Campanulaceae	9	Herb	Li et al. 2012a
23	<i>Cyclocarya paliurus</i>	Juglandaceae	39	Tree	Kou et al. 2016
24	<i>Davidia involucrata</i>	Nyssaceae	20	Tree	Chen et al. 2015a
25	<i>Dracaena cambodiana</i>	Liliaceae	7	Shrub	Zhao et al. 2013b
26	<i>Dysosma versipellis</i>	Berberidaceae	10	Herb	Qiu et al. 2009
27	<i>Ephedra equisetina</i>	Ephedraceae	6	Shrub	Qin et al. 2013
28	<i>Ephedra intermedia</i>	Ephedraceae	9	Shrub	Qin et al. 2013
29	<i>Ephedra likiangensis</i>	Ephedraceae	18	Shrub	Qin et al. 2013
30	<i>Ephedra minuta</i>	Ephedraceae	8	Shrub	Qin et al. 2013
31	<i>Ephedra saxatilis</i>	Ephedraceae	15	Shrub	Qin et al. 2013
32	<i>Eriophyton wallichii</i>	Lamiaceae	24	Herb	Luo et al. 2016
33	<i>Eurycorymbus cavaleriei</i>	Sapindaceae	15	Tree	Wang et al. 2009a
34	<i>Fagus engleriana</i>	Fagaceae	15	Tree	Lei et al. 2012
35	<i>Fagus longipetiolata</i>	Fagaceae	51	Tree	Zhang et al. 2013
36	<i>Fagus lucida</i>	Fagaceae	41	Tree	Zhang et al. 2013
37	<i>Forsythia suspensa</i>	Oleaceae	17	Shrub	Fu et al. 2014
38	<i>Ginkgo biloba</i>	Ginkgoaceae	12	Tree	Gong et al. 2008

39	<i>Hippophaë neurocarpa</i>	Elaeagnaceae	21	Shrub	Kou et al. 2014
40	<i>Hippophaë rhamnoides</i>	Elaeagnaceae	44	Shrub	Jia et al. 2012
41	<i>Hippuris vulgaris</i>	Hippuridaceae	27	Herb	Chen et al. 2013
42	<i>Hydrilla verticillata</i>	Hydrocharitaceae	102	Herb	Zhu et al. 2015
43	<i>Incarvillea sinensis</i>	Bignoniaceae	38	Herb	Chen et al. 2012c
44	<i>Juglans cathayensis</i>	Juglandaceae	60	Tree	Bai et al. 2016
45	<i>Juglans mandshurica</i>	Juglandaceae	39	Tree	Bai et al. 2016
46	<i>Juniperus przewalskii</i>	Cupressaceae	18	Tree	Zhang et al. 2005
47	<i>Juniperus sabina</i>	Cupressaceae	14	Shrub	Guo et al. 2010
48	<i>Koenigia islandica</i>	Polygonaceae	16	Herb	Long et al. 2014
49	<i>Lepisorus clathratus</i>	Polypodiaceae	41	Herb	Wang et al. 2011c
50	<i>Leucomeris decora</i>	Asteraceae	8	Tree	Zhao and Gong 2015
51	<i>Ligularia tongolensis</i>	Asteraceae	9	Herb	Wang et al. 2011b
52	<i>Ligularia vellerea</i>	Asteraceae	12	Herb	Yang et al. 2012b
53	<i>Meconopsis integrifolia</i>	Papaveraceae	18	Herb	Yang et al. 2012a
54	<i>Metagentiana striata</i>	Gentianaceae	11	Herb	Chen et al. 2008c
55	<i>Myricaria paniculata</i>	Tamaricaceae	9	Shrub	Liu et al. 2009
56	<i>Myricaria squamosa</i>	Tamaricaceae	7	Shrub	Liu et al. 2009
57	<i>Nouelia insignis</i>	Asteraceae	21	Shrub	Gong et al. 2011; Zhao and Gong 2015
58	<i>Orinus thoroldii</i>	Poaceae	17	Herb	Liu et al. 2015
59	<i>Ostryopsis davidiana</i>	Betulaceae	37	Shrub	Liu et al. 2014a; Tian et al. 2009
60	<i>Oxyria sinensis</i>	Polygonaceae	23	Herb	Meng et al. 2015
61	<i>Paeonia rockii</i>	Paeoniaceae	13	Shrub	Yuan et al. 2012
62	<i>Paraquilegia microphylla</i>	Ranunculaceae	16	Herb	Luo et al. 2016
63	<i>Pedicularis longiflora</i>	Scrophulariaceae	35	Herb	Yang et al. 2008
64	<i>Picea likiangensis</i>	Pinaceae	15	Tree	Du et al. 2011; Zou et al. 2012
65	<i>Picea purpurea</i>	Pinaceae	10	Tree	Du et al. 2011; Sun et al. 2014b
66	<i>Pinus armandii</i>	Pinaceae	26	Tree	Liu et al. 2014b
67	<i>Pinus densata</i>	Pinaceae	14	Tree	Wang et al. 2011a
68	<i>Pinus massoniana</i>	Pinaceae	7	Tree	Ge et al. 2012
69	<i>Pinus tabulaeformis</i>	Pinaceae	27	Tree	Chen et al. 2008b
70	<i>Pinus tabuliformis</i>	Pinaceae	17	Tree	Wang et al. 2011a
71	<i>Pinus yunnanensis</i>	Pinaceae	10	Tree	Wang et al. 2011a
72	<i>Platycarya strobilacea</i>	Juglandaceae	25	Tree	Chen et al. 2012b
73	<i>Pomatosace filicula</i>	Primulaceae	17	Herb	Wang et al. 2014b
74	<i>Potentilla fruticosa</i>	Rosaceae	50	Shrub	Li et al. 2010; Sun et al. 2010
75	<i>Primula obconica</i>	Primulaceae	18	Herb	Yan et al. 2012
76	<i>Primula secundiflora</i>	Primulaceae	7	Herb	Wang et al. 2008b
77	<i>Primula sikkimensis</i>	Primulaceae	10	Herb	Wang et al. 2008a
78	<i>Primulina eburnea</i>	Gesneriaceae	16	Herb	Gao et al. 2015a
79	<i>Prunus pseudocerasus</i>	Rosaceae	8	Tree	Chen et al. 2015b
80	<i>Psammosilene tunicoides</i>	Caryophyllaceae	15	Herb	Zhang et al. 2011a
81	<i>Quercus glauca</i>	Fagaceae	33	Tree	Xu et al. 2015

82	<i>Quercus variabilis</i>	Fagaceae	37	Tree	Chen et al. 2012a
83	<i>Ranunculus bungei</i>	Ranunculaceae	17	Herb	Chen et al. 2014b
84	<i>Rhodiola alsia</i>	Crassulaceae	15	Herb	Gao et al. 2009
85	<i>Rhodiola dumulosa</i>	Crassulaceae	15	Herb	Hou and Lou 2014
86	<i>Rhodiola kirilowii</i>	Crassulaceae	22	Herb	Zhang et al. 2014
87	<i>Rhododendron simsii</i>	Ericaceae	32	Shrub	Li et al. 2012b
88	<i>Rosa sericea</i>	Rosaceae	46	Shrub	Gao et al. 2015b
89	<i>Rosa soulieana</i>	Rosaceae	16	Shrub	Jian et al. 2015
90	<i>Rosa yunnanensis</i>	Rosaceae	7	Shrub	Jian et al. 2015
91	<i>Sagittaria trifolia</i>	Alismataceae	27	Herb	Chen et al. 2008a
92	<i>Sargentodoxa cuneata</i>	Lardizabalaceae	42	Liana	Tian et al. 2015b
93	<i>Saruma henryi</i>	Aristolochiaceae	12	Herb	Zhou et al. 2010
94	<i>Scrophularia ningpoensis</i>	Scrophulariaceae	12	Herb	Chen et al. 2014a
95	<i>Scutellaria baicalensis</i>	Lamiaceae	24	Herb	Yuan et al. 2010
96	<i>Sinopodophyllum hexandrum</i>	Berberidaceae	15	Herb	Li et al. 2011
97	<i>Sladenia celastriifolia</i>	Sladeniaceae	14	Tree	Lu et al. 2014
98	<i>Smilax scobinicaulis</i>	Liliaceae	17	Liana	Zhao et al. 2013c
99	<i>Smilax sieboldii</i>	Liliaceae	8	Liana	Zhao et al. 2013c
100	<i>Sophora davidii</i>	Fabaceae	31	Shrub	Fan et al. 2013
101	<i>Spenceria ramalana</i>	Rosaceae	14	Herb	Yue and Sun 2014
102	<i>Sphaeropteris brunoniana</i>	Cyatheaceae	7	Tree	Wang and Guan 2011
103	<i>Stellera chamaejasme</i>	Thymelaeaceae	22	Herb	Zhang et al. 2010
104	<i>Tacca chantrieri</i>	Taccaceae	13	Herb	Zhao and Zhang 2015
105	<i>Taiwania cryptomerioides</i>	Taxodiaceae	7	Tree	Chou et al. 2011
106	<i>Tapiscia sinensis</i>	Tapisciaceae	24	Tree	Zhang et al. 2015
107	<i>Terminalia franchetii</i>	Combretaceae	17	Tree	Zhang et al. 2011b
108	<i>Tetracentron sinense</i>	Tetracentraceae	22	Tree	Sun et al. 2014a
109	<i>Tetrastigma hemsleyanum</i>	Vitaceae	20	Liana	Wang et al. 2015
110	<i>Thalictrum squamiferum</i>	Ranunculaceae	23	Herb	Luo et al. 2016
111	<i>Tsuga chinensis</i>	Pinaceae	27	Tree	Cun and Wang 2010
112	<i>Tsuga dumosa</i>	Pinaceae	34	Tree	Cun and Wang 2010
113	<i>Zizania latifolia</i>	Poaceae	40	Herb	Xu et al. 2008
114	<i>Zygophyllum xanthoxylon</i>	Zygophyllaceae	51	Shrub	Shi and Zhang 2015

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Table S2. Hotspots of genetic diversity (with their geographic ranges) identified by the top 10% of grid cells with the highest scores, and, for comparison, the hotspots recognized by Zhang *et al.* (2016), Huang *et al.* (2012) and López-Pujol *et al.* (2011), and refugia identified by Menget *et al.* (2015), Qiu *et al.* (2011) and Liu *et al.* (2012).

Hotspot No.	Cell No.	Province	Hotspot Name	Main ranges (Summit (m asl))			Hotspots			Refugia	
					<i>H</i>	<i>Hu</i>	Zhang <i>et al.</i> 2016	Huang <i>et al.</i> 2012	López-Pujol <i>et al.</i> 2011	Qiu <i>et al.</i> 2011; Liu <i>et al.</i> 2012	Meng <i>et al.</i> 2015
1	F-14	Xinjiang	N Xinjiang	Altai Mountains and Quasi algor Basin	+		+			+	+
	G-15	Xinjiang				+					
	G-16	Xinjiang				+					
	H-13	Xinjiang			+						
	H-14	Xinjiang			+	+					
	H-15	Xinjiang				+					
2	J-10	Xinjiang	N Xinjiang	Poluokenu Mountains		+	+			+	+
	K-9	Xinjiang				+					
3	K-12	Xinjiang	N Xinjiang	Tianshan Mountains	+						
4	K-17	Xinjiang	N Xinjiang	Bogeda Mountains	+	+	+				
5	K-21	Xinjiang	N Xinjiang	Bogeda Mountains	+	+				+	+
6	O-34	Ningxia/inner Mongolia	N Ningxia/S inner Mongolia	Helan Mountains		+	+				+
7	O-47	Hebei	E Hebei	near to the Bohai Sea	+						
8	P-27	Gansu/inner Mongolia	N Qinghai	Qilian Mountains, Datong Mountains, Qinghainan Mountains	+	+					
	Q-25	Qinghai			+						
	Q-26	Qinghai			+	+					
9	R-28	Qinghai	E Qinghai	Qinghainan Mountains, Animaqin Mountains,	+			+		+	
	S-27	Qinghai			+						
	T-26	Qinghai			+						

	U-24	Qinghai		Bayankala Mountains	+						
	U-25	Qinghai/Sichuan				+					
10	R-36	Gansu/Shanxi	SE Gansu/Shanxi	Huanglong Mountains	+					+	
	S-36	Gansu/Shanxi			+						
11	R-48	Shandong	NE Shandong	Wuliashan Mountains	+		+				
12	T-20	Qinghai	SW Qinghai	the upper watershed region of the Yangtze River		+				+	
13	T-29	Gansu/Qinghai	SE Qinghai/SW Gansu/N Sichuan	Animaqin Mountains, Qinling Mountains and Minshan Mountains	+			+		+	
	U-30	Gansu/Sichuan			+						
14	T-32	Gansu	SE Gansu/SE Shanxi	Qinling Mountains, Liupan Mountains	+	+					
	T-33	Gansu			+						
	T-34	Gansu/Shanxi			+		+	+	+		
	U-33	Gansu/Shanxi			+						
15	U-37	Shanxi/Hubei	SE Shanxi/NW Hubei	the intermountain valley located between Qinling Mountains and Wudang Mountains		+	+		+	+	
16	V-8	Xizang	W Xizang	Gangdisi Mountains	+						
17	W-24	Qinghai/Xizang	NE Xizang	Nyainqentanglha Mountains and Taniantaweng Mountains		+	+	+	+	+	
	X-23	Xizang			+						
18	W-29	Sichuan	NW Sichuan	Daxue Mountains		+		+		+	

19	W-33	Sichuan	Sichuan Basin/SW Chongqing/NE Guizhou	Sichuan Basin, Huaqian Mountains and Dalou Mountains	+			+	+	+	
	X-33	Sichuan/Chongqing			+						
	Y-34	Chongqing				+					
	Z-34	Guizhou/Chongqing			+						
	Z-35	Guizhou/Chongqing				+					
20	W-39	Hubei	NW Hubei	between Daba Mountains and Wudan Mountains	+			+	+		
21	W-44	Anhui	E Anhui	Dabie Mountains		+	+				
22	W-47	Anhui/Jiangsu	S Jiangsu/E Zhejiang	Tianmu Mountains, Xianxialing Mountains	+		+	+	+	+	
	X-47	Anhui/Zhejiang				+					
	Y-47	Zhejiang				+					
	Z-47	Zhejiang				+					
23	Y-12	Xizang	S Xizang	the intermountain valley in the upper watershed of the Yarlung Zangbo River	+		+	+			
24	Z-15	Xizang	S Xizang	Laguigangri Mountains		+					
25	A1-17	Yadong, Xizang	Yadong, Xizang	Himalayas		+		+			
26	A1-27	Yunnan	NW Yunnan	Yunling Mountains		+	+	+	+	+	
	B1-28	Yunnan				+					
27	Z-32	Sichuan/Yunnan	NE Yunnan and SE Sichuan	Wulianfeng Mountains	+			+	+		
28	Y-39	NW Hunan/S Hubei	NW Hunan	Wuling Mountains, Xuefeng Mountains		+		+	+		

	Z-38	Hunan				+						
29	Y-41	Hubei/Hunan	NE Hunan/SE Hubei	Dongting Lake and the Middle-Lower Yangtze Plain		+						
30	D1-26	Yunnan	S Yunnan	Nushan Mountains, Ailao Mountains, Wuliang Mountains	+		+	+	+	+	+	
	D1-27	Yunnan			+							
	D1-28	Yunnan			+							
	D1-31	Yunnan			+	+						
	E1-27	Yunnan			+							
	E1-29	Yunnan			+	+						
	E1-30	Yunnan			+							
	F1-30	Yunnan				+						
31	C1-33	Guizhou	SW Guizhou	Miaoling Mountains		+		+	+	+		
32	C1-39	Hunan/Guangxi	S Hunan/N Guangdong	Nanling Mountains, Luoxiao Mountains		+		+		+		
	C1-40	Hunan/Guangdong				+						
	C1-41	Hunan/Guangdong				+						
33	C1-46	Fujian	E Fujian	Daiyunshan Mountains		+						
34	E1-41	Guangdong	C Guangdong	Julian Mountains, Luofu Mountains	+			+	+			
35	E1-48	Taiwan	E Taiwan	Taiwan Mountains		+		+		+		
36	G1-29	Yunnan	Xishuangbanna, Yunnan	Mekong Valley	+	+	+	+				
Number of hotspots in common							12	unknown	13	16	5	
Percentage of hotspots shared with those identified in our study							60.00%	unknown	65.00%	88.90%	83.30%	

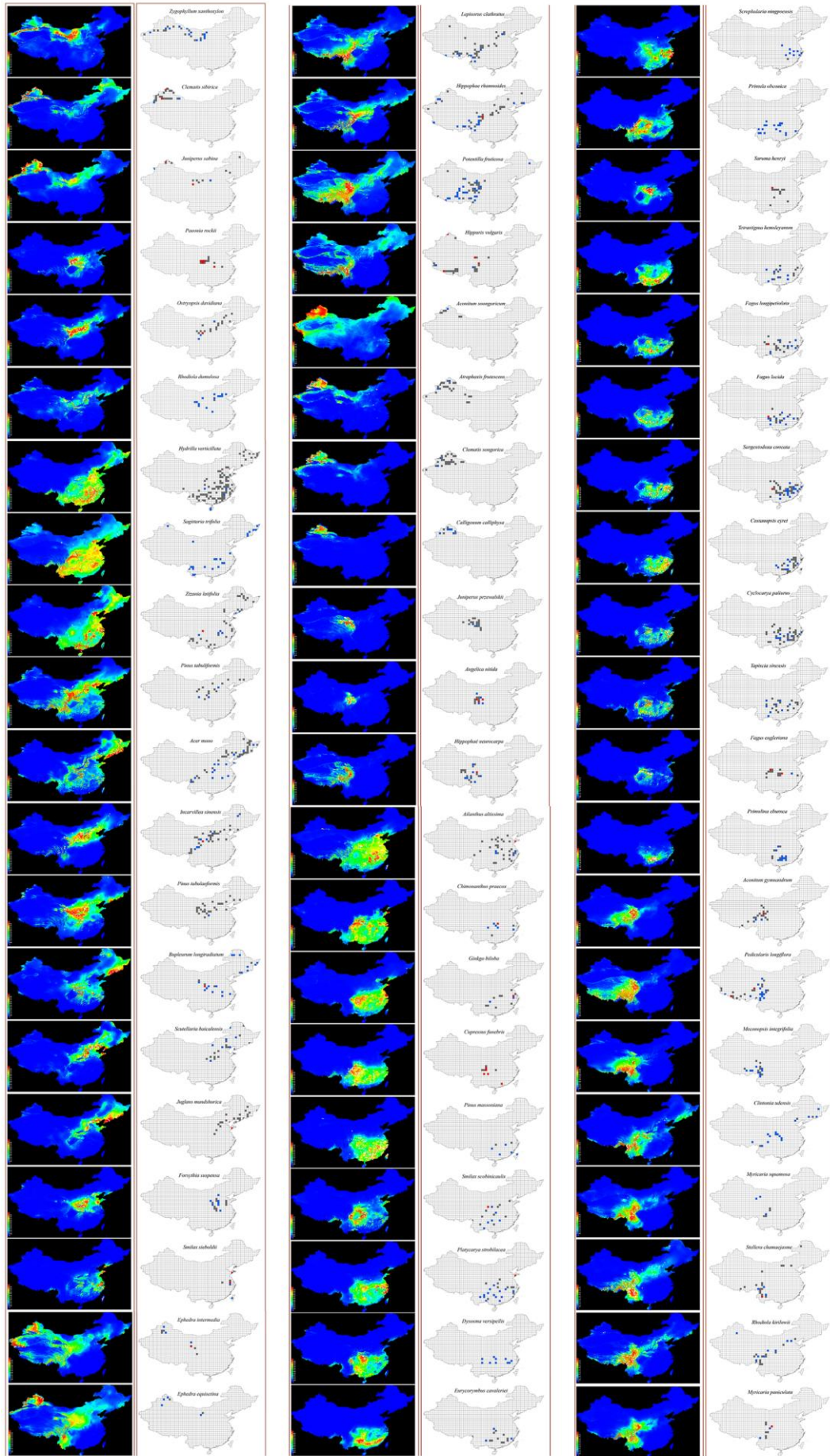


Figure S1. Haplotype uniqueness Hu mapped onto a $1^\circ \times 1^\circ$ latitude/longitude grid map of China for 116 species (right) arranged by similarities of predicted by SDM species ranges (left). The cells with $Hu = 0$ and $Hu > 0$ have grey and blue color, respectively. The cells in red are those identified as genetic hotspots.