Supplementary Information for:

Optimizing biodiversity resilience: A wildlife dispersal-based framework for strategic conservation corridor design in protected area networks

Weicheng Sun[1,2], Entao Zhang[1,2], Yujin Zhao[1], Zhisheng Wu[1,2], Wenhe Chen[1,2], Yao Wang[3], and Yongfei Bai[1,4]*

[1] *State Key Laboratory of Vegetation and Environmental Change, Institute of Botany, Chinese Academy of Sciences, Beijing 100093, China*

[2] *College of Life Sciences, University of Chinese Academy of Sciences, No. 19A Yuquan Road, Beijing 100049, China*

[3] *College of Grassland Agriculture, Northwest A&F University, Yangling, Shaanxi 712100, China*

[4] *College of Resources and Environment, University of Chinese Academy of Sciences, No. 19A Yuquan Road, Beijing 100049, China*

Running head: conservation corridors enhance effectiveness of protected-area networks

***Correspondence address:**

Yongfei Bai Ph.D.

State Key Laboratory of Vegetation and Environmental Change,

Institute of Botany, the Chinese Academy of Sciences

20 Nanxincun, Xiangshan 100093

Beijing, China

Tel: (+86)-10-6283-6272

Email: yfbai@ibcas.ac.cn

Supplementary Materials include:

Supplementary Figures: S1-S8

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Supplementary Figures

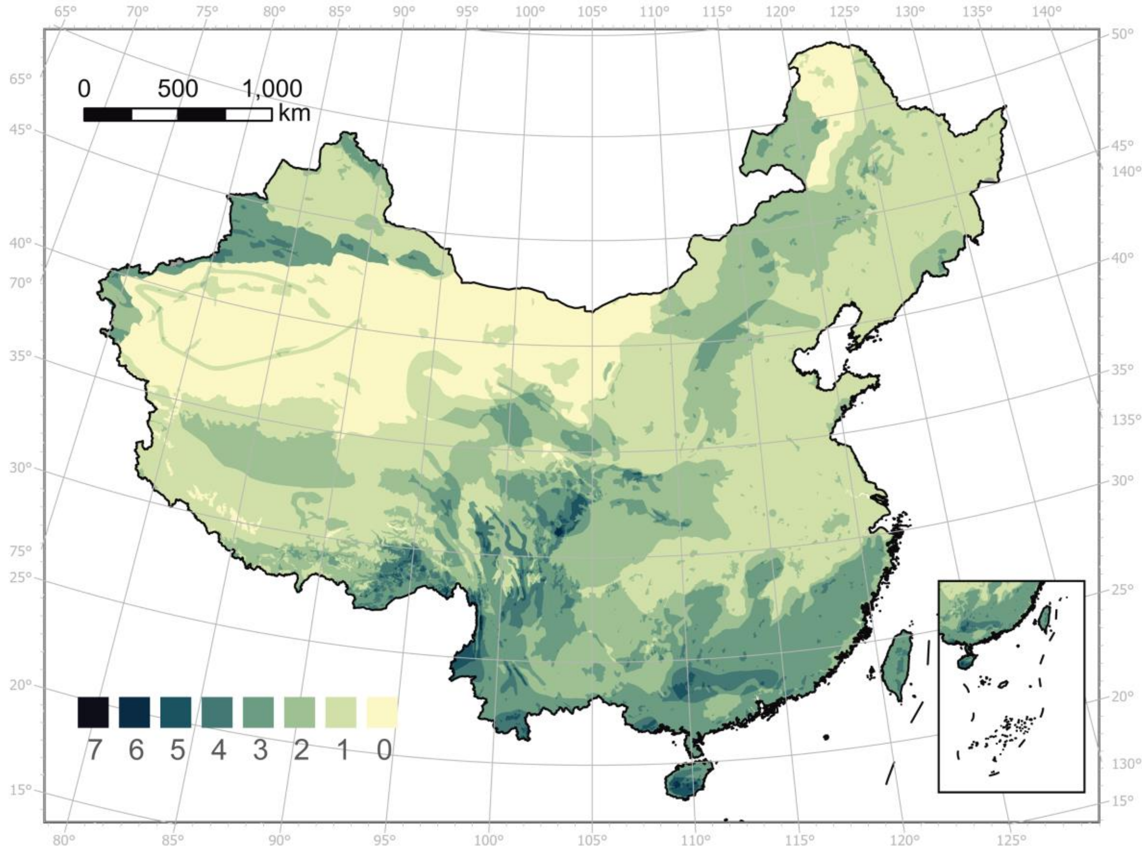

Figure S1 Map of conservation priority zones (CPZs) of biodiversity for China. A spatial overlay of seven global biodiversity prioritization templates to identify CPZs. Abbreviations: CE, crisis ecoregions[1]; BH, biodiversity hotspots[2]; EBA, endemic bird areas[3]; KBA, key biodiversity areas[4]; CPD, centers of plant diversity[5]; G200, global 200 ecoregions[6]; IFL, intact forest landscape[7]. The legend 0-7 indicates the frequency of an area being included in the seven datasets.

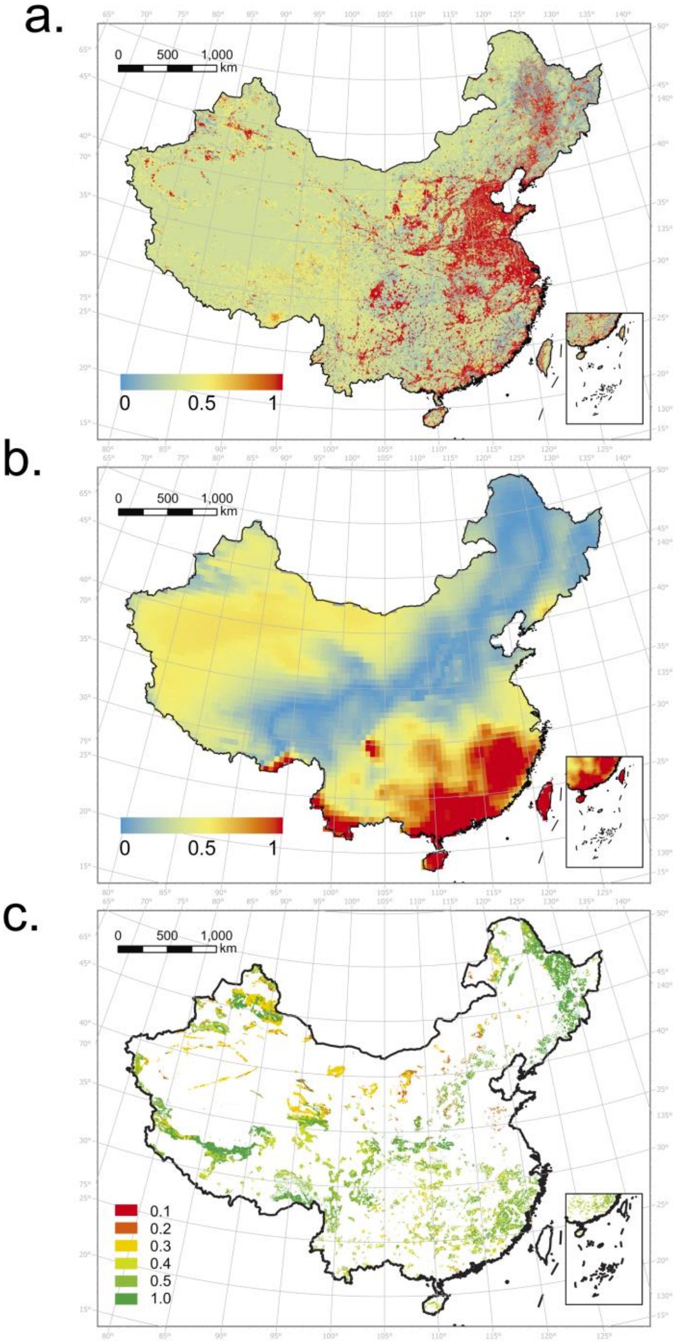

Figure S2 Spatial patterns of climate, anthropogenic activity changes and habitat representation deficiencies across the region of China. a) anthropogenic activity change. b) climate change; Each dataset is normalized to the scale of 0-1 by its distribution. The values close to 1 are colored in warmer colors to indicate higher risk. c) habitat representation deficiencies calculated by 30% coverage target in ecoregion types.

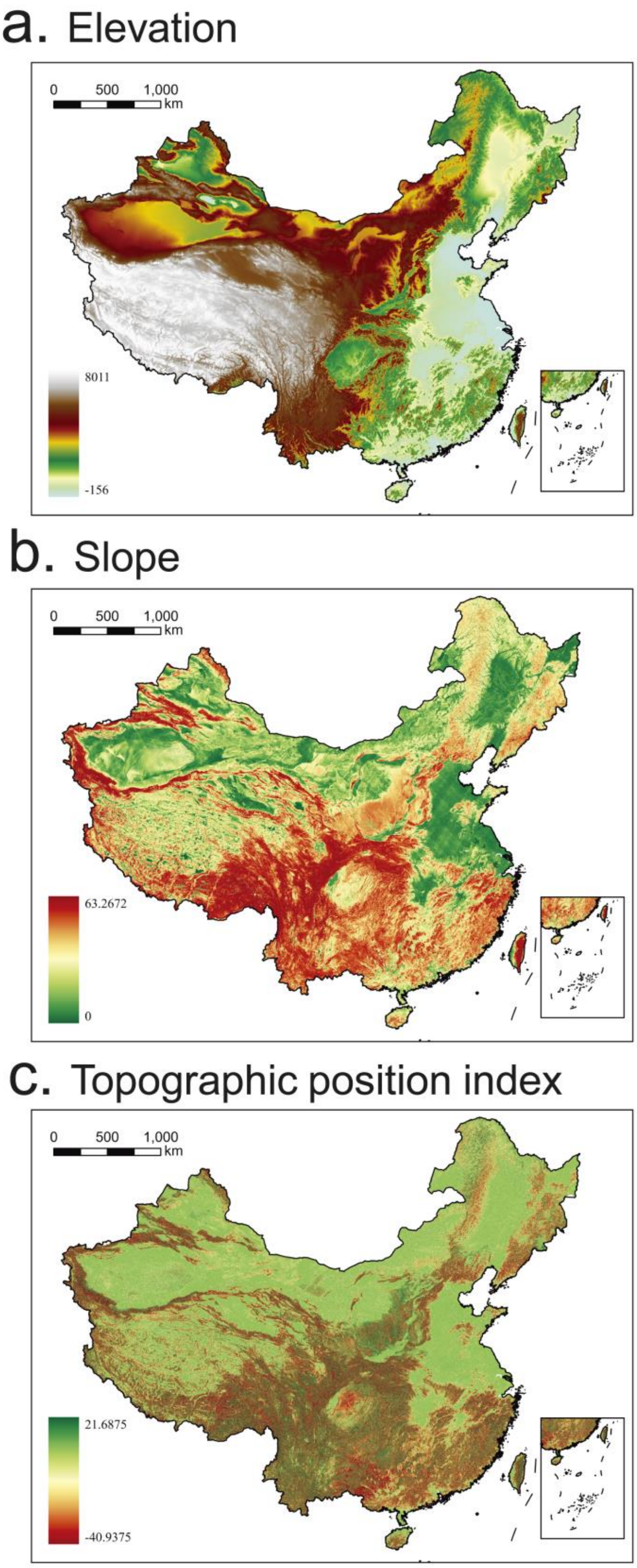

Figure S3 Global 1 km Topography. The product is based on the digital elevation model products of global 250 m GMTED2010 and near-global 90 m SRTM4.1dev[8].

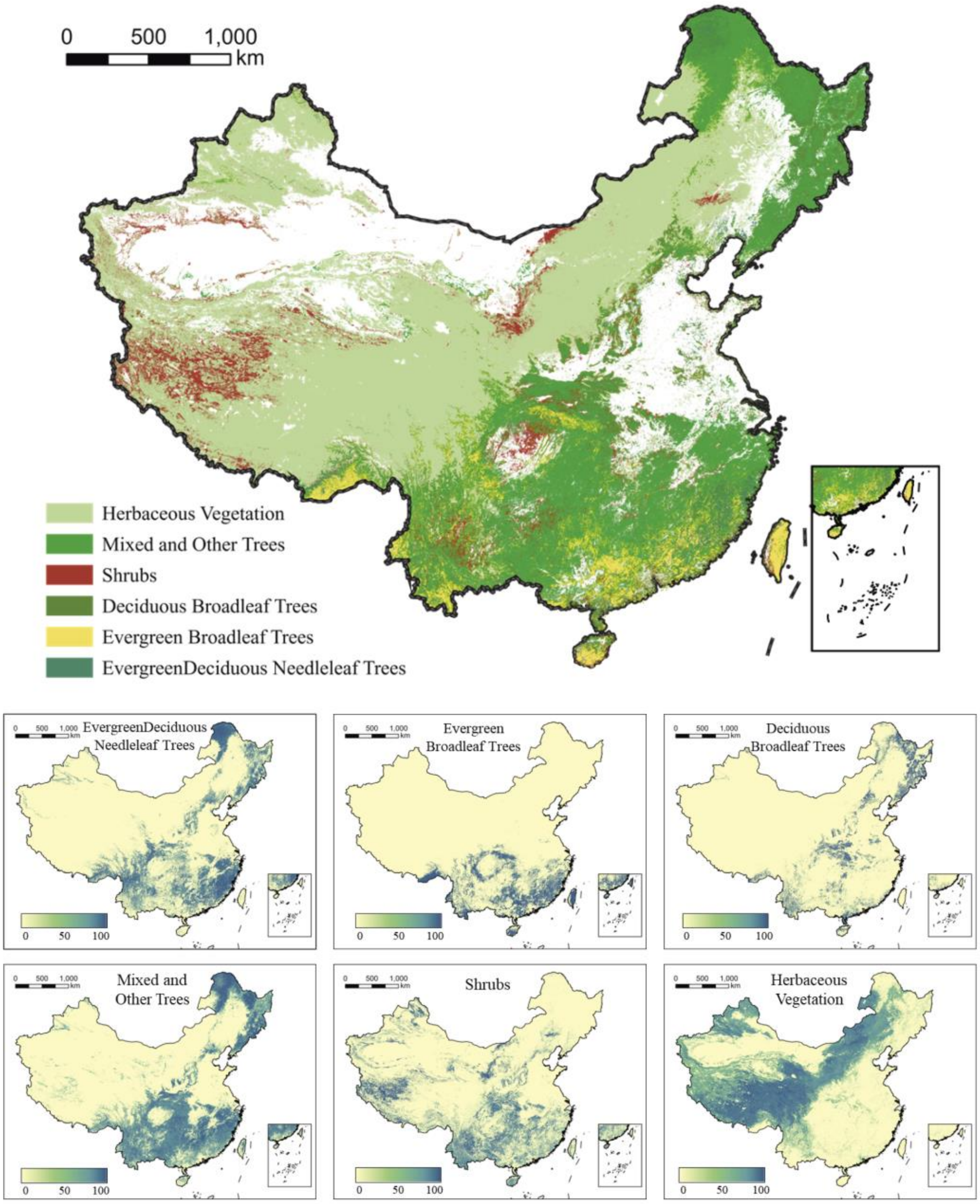

Figure S4 Global 1-km Consensus Land Cover. The dataset integrating GlobCover (2005-06; v2.2), the MODIS land-cover product (MCD12Q1; v051), GLC2000 (global product; v1.1), and DISCover (GLCC; v2)[9]. All data layers contain valid values range from 0-100, representing the consensus prevalence in percentage. All data layers have a spatial resolution of 30 arc-second per pixel (~1 km per pixel at the equator). The land cover of each natural vegetation pixel using the type with the highest consensus prevalence in percentage as the representative.

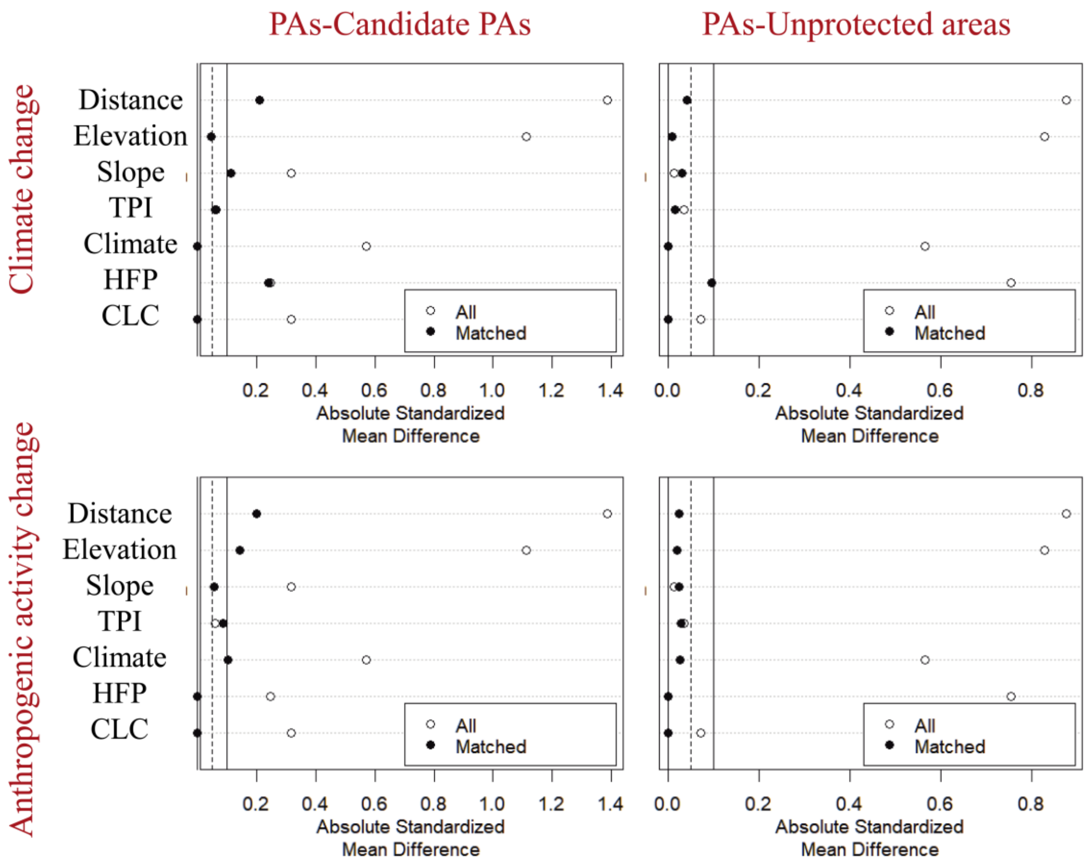

Figure S5 The similarities between treatment and control units before (All) and after (Matched). The error bands are set to 0.25 standard deviation of the caliper value. Absolute standardized mean difference (SMD) declines for all covariates and most matches are below 0.1. The matching process considered five covariates: (1) elevation; (2) slope; (3) topographic conditions (TPI index); (4) initial climate, human footprint condition; and (5) consensus land cover type (CLC)

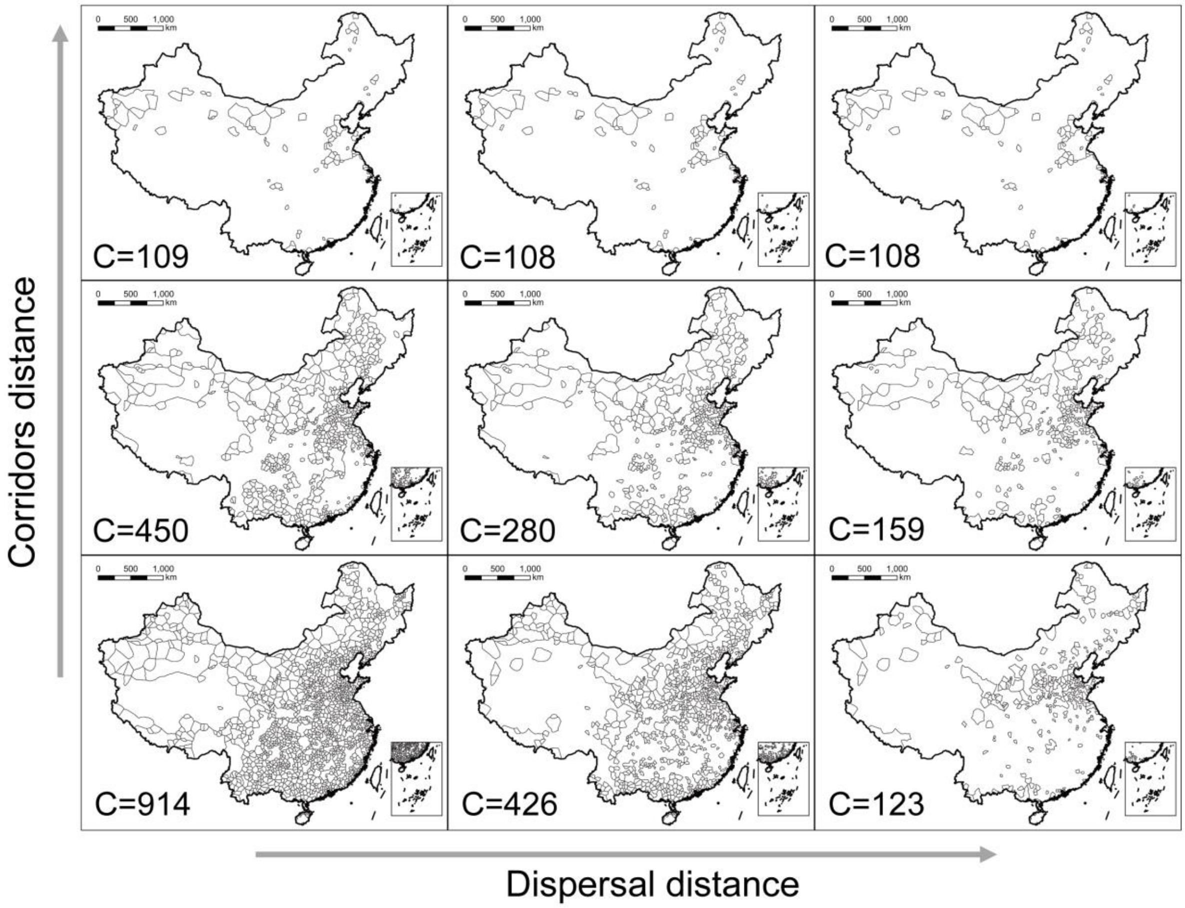

Figure S6 The isolation of the protected area networks. The isolation of protected area networks decreased with the increase of the defined dispersal distance (10km, 30km and 100km) of wildlife (horizontal axis). It means that high-motility species have a greater ability to traverse between habitat patches. After integrating the connectivity & biodiversity corridors identified at the above dispersal distance gradient into the nature conservation networks, the isolation decreases with increasing corridors distance gradients (0, 30 and 100 km) in the vertical axis. Each closed area in the map represents a separate component. That is, wildlife within this component at the corresponding dispersal distance cannot successfully traverse and communicate with outside regions.

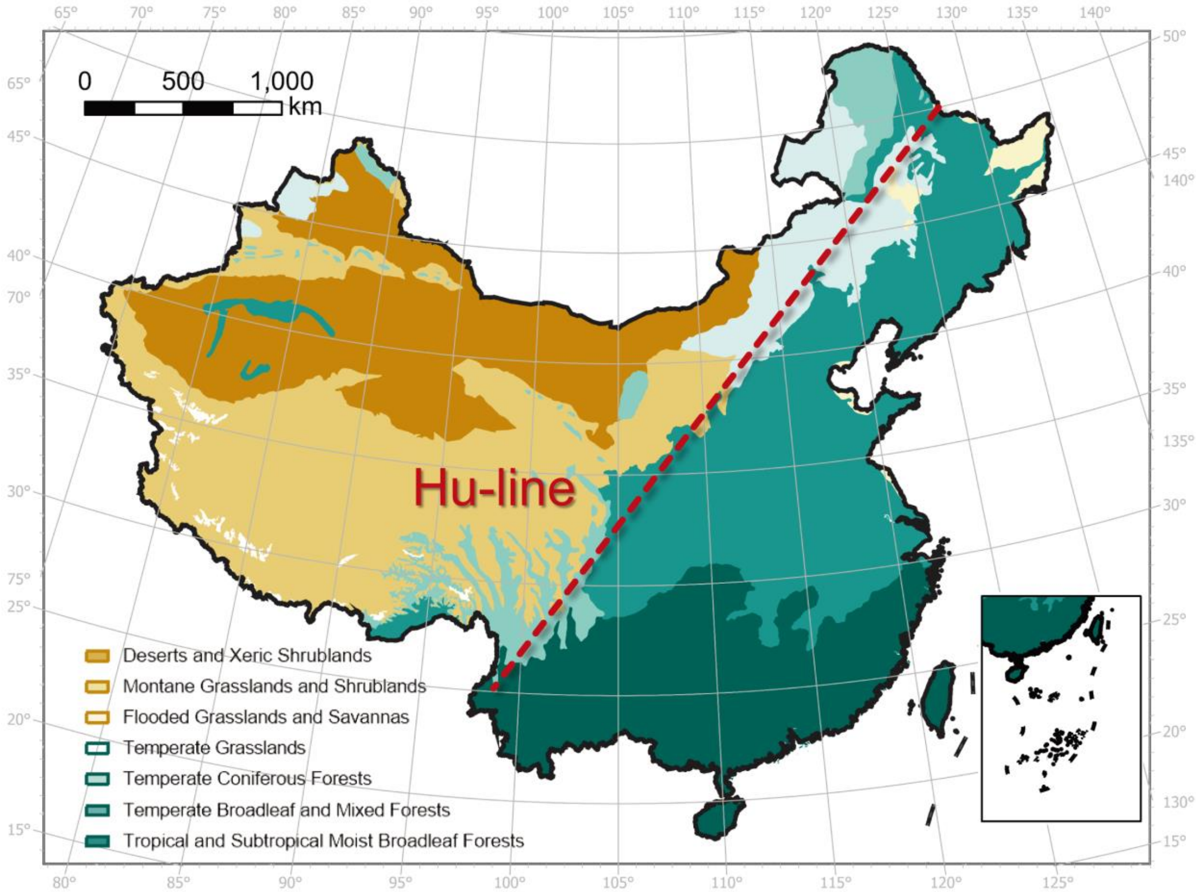

Figure S7 Distribution pattern of biomes in China. The gradation of colors from green to yellow represents seven different biomes. The dashed red line is the Hu-line, which represents the divisions between population development and the social economic pattern in China.

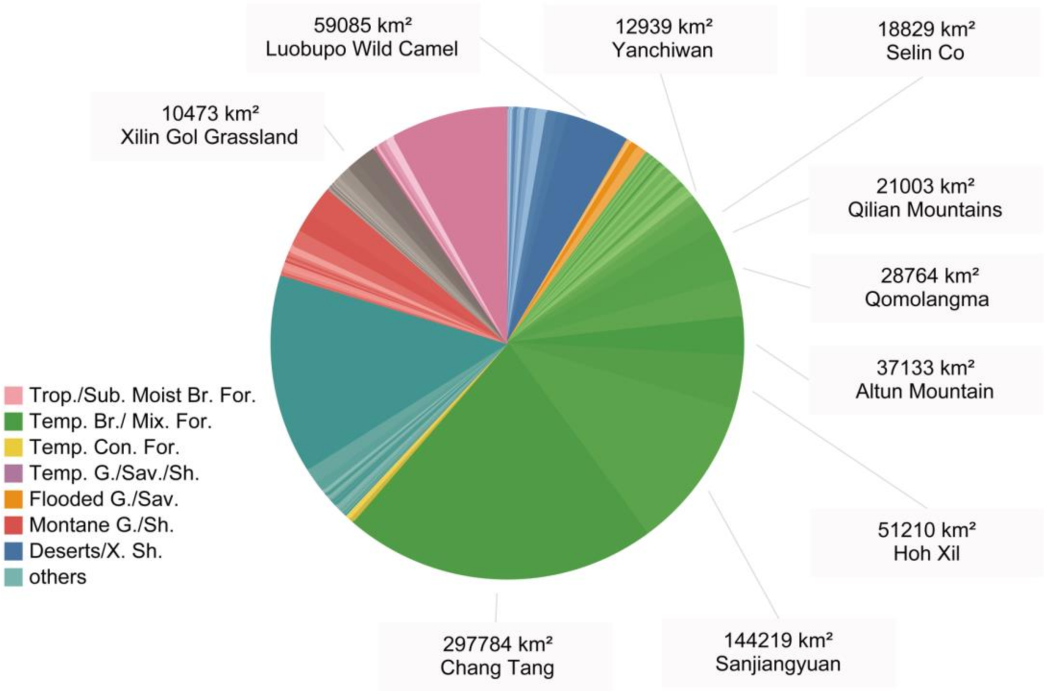

Figure S8 Size of each protected area in China. The sector map is used to show the size of each protected area (PA). Different color schemes represent various biomes. The top ten largest PAs of grassland, scrub, and desert ecosystems are marked with labels. For ease to show, PAs less than 100 km^2 are grouped by biomes.

Supplementary Tables

Table S1. Summary of the numbers, areas, and coverage of corridors under different connectivity & biodiversity corridors (CBCs) scenarios. The probability of connectivity (PC) and the percentage of protected and connected land covered (ProtConn) for three types of dispersal distances under each CBCs scenario, respectively.

Scenarios	Dispersal distance (km)	Corridors number	Coverage (%)	Areas (km^2)	PC	ProtConn (%)	Total coverage (%)
Current PAs	10	-	-	1325785	0.005	6.9	14.0
	30				0.005	7.3	14.0
	100				0.006	7.9	14.0
10km-CBCs	10	1549	7.6	2042258	0.011	10.3	21.6
	30				0.011	10.7	21.6
	100				0.013	11.6	21.6
30km-CBCs	10	3356	20.0	3218451	0.022	15.0	34.0
	30				0.026	16.2	34.0
	100				0.029	17.0	34.0
100km-CBCs	10	6389	47.8	5848174	0.325	57.0	61.8
	30				0.326	57.1	61.8
	100				0.327	57.2	61.8

Table S2. The proportion of current protected areas, future protected areas, and nature conservation networks in various biomes.

Biomes	National land areas				CPZs				Overlapped with CPZs		
	Land areas (km^2)	Current PA Networks (%)	Future PA Networks (%)	Nature conservation networks (%)	CPZs (km^2)	Current PA Networks (%)	Future PA Networks (%)	Nature conservation networks (%)	Current PA Networks (%)	Future PA Networks (%)	Nature conservation networks (%)
Tropical and Subtropical Moist Broadleaf Forests	1472389	8.1	31.5	75.4	1472158	8.1	31.5	75.4	100.0	100.0	100.0
Temperate Broadleaf and Mixed Forests	2345790	9.3	33.5	63.3	2304529	9.4	34.0	64.4	99.8	99.9	100.0
Temperate Coniferous Forests	537701	15.1	40.7	64.7	376069	19.2	55.7	89.9	88.9	95.5	97.2
Temperate Grasslands, Savannas, and Shrublands	637097	8.3	21.1	54.7	637003	8.3	21.1	54.7	100.0	100.0	100.0
Flooded Grasslands and Savannas	106668	17.0	34.3	66.2	106522	17.0	34.3	66.3	99.9	99.9	99.9
Montane Grasslands and Shrublands	2493421	28.3	47.9	76.7	2188316	28.5	50.9	83.7	88.5	93.1	95.7
Deserts and Xeric Shrublands	1734587	6.7	21.2	31.8	528049	5.1	52.5	87.1	23.3	75.4	83.5
Others	134227	6.5	11.9	16.9	63106	12.6	24.4	34.5	90.6	96.4	96.1
Total	**9461880**	**14.0**	**34.0**	**61.8**	**7675752**	**14.8**	**39.6**	**73.8**	**85.9**	**94.3**	**96.8**

Table S3. The achievement of habitat representation based on biomes.

Biomes	Habitat representation		
	Current PAs	Future PAs	Nature conservation networks
Tropical and Subtropical Moist Broadleaf Forests	8.1	31.5	75.4
Temperate Broadleaf and Mixed Forests	9.3	33.5	63.3
Temperate Coniferous Forests	15.1	40.7	64.7
Temperate Grasslands, Savannas, and Shrublands	8.3	21.1	54.7
Flooded Grasslands and Savannas	17.0	34.3	66.2
Montane Grasslands and Shrublands	28.3	47.9	76.7
Deserts and Xeric Shrublands	6.7	21.2	31.8
Mean Target Achievement	**30% target**	**30% target**	**50% target**
	38.9%	92.6%	95.4%

Table S4. The achievement of habitat representation based on ecoregions.

Ecoregions	Habitat representation		
	Current PAs	Future PAs	Nature conservation networks
Alpine cushion vegetation	53%	71%	86%
Alpine sparse vegetation	21%	45%	68%
Alpine tundra	13%	63%	93%
Annual herb deserts	2%	17%	37%
Bamboo forests and scrubs in subtropical and tropical zones	15%	63%	91%
Broadleaf deciduous forests in subtropical zone	18%	56%	88%
Broadleaf deciduous forests in temperate zone	13%	58%	83%
Broadleaf evergreen and deciduous mixed forests in subtropical zone	26%	65%	92%
Broadleaf evergreen and deciduous scrubs in subtropical and tropical zones	9%	32%	75%
Broadleaf evergreen forests in subtropical zone	14%	50%	79%
Cold-temperate and temperate marshes	15%	40%	57%
Cushion nano-semi-shrub high-cold deserts	41%	49%	52%
Deciduous scrubs in temperate zone	10%	40%	76%
Dwarf semi-arboreous deserts	4%	50%	77%
Evergreen xeromorphic succulent thorny scrubs in subtropical and trpical zones	8%	15%	65%
Grass and forb halophytic meadows	7%	27%	45%
Grass and forb meadows	10%	44%	73%
Grass, Carex and forb swamp meadows	14%	32%	60%

Grass, Carex spp. high-cold steppes	50%	70%	88%
High-cold marshes	36%	68%	97%
Kobresia spp., forb high-cold meadows	23%	40%	77%
Microphyllous deciduous woodlands in temperate zone	10%	19%	45%
Needeleleaf, evergreen and deciduous broadleaf mixed forests on mountains in subtropical zone	22%	37%	53%
Needleleaf and deciduous broadleaf mixed forests in temperate zone	19%	93%	98%
Needleleaf forests in cold-temperate zone and on mountains in temperate zone	11%	42%	51%
Needleleaf forests in subtropical zone	9%	41%	83%
Needleleaf forests in temperate zone	9%	20%	50%
Needleleaf forests in tropical zone	66%	98%	98%
Needleleaf forests on mountains in subtropical an tropical zones	26%	64%	92%
Sclerophyllus broadleaf evergreen forests in subtropoical zone	13%	43%	87%
Semi-shrub and dwarf semi-shrub deserts	6%	22%	37%
Shrub deserts	6%	22%	27%
Steppe shrub deserts	5%	16%	22%
Subalpine broadleaf deciduous scrubs	21%	37%	77%
Subalpine needleleaf evergreen scrubs	12%	23%	72%
Subalpine sclerophylla broadleaf evergreen scrubs	19%	48%	91%
Subtropical and tropical grasslands	7%	28%	76%
Subtropical and tropical marshes	13%	48%	70%
Succulent halophytic dwarf semi-shrub deserts	2%	11%	26%
Temperate grass, forb meadow steppes	6%	23%	59%
Temperate grasslands	10%	41%	84%
Temperate tufted grass steppes	8%	17%	52%
Temperate tufted low grass, nano-semi-shrub desert steppes	11%	29%	67%
Tropical mangroves	4%	10%	43%
Tropical monsoon forests	18%	47%	80%
Tropical rain forests	19%	34%	53%
Mean Target Achievement	**30% target**	**30% target**	**50% target**
	47.7%	89.0%	94.9%

List of data sources

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