

Mapping and connecting wilderness areas in China

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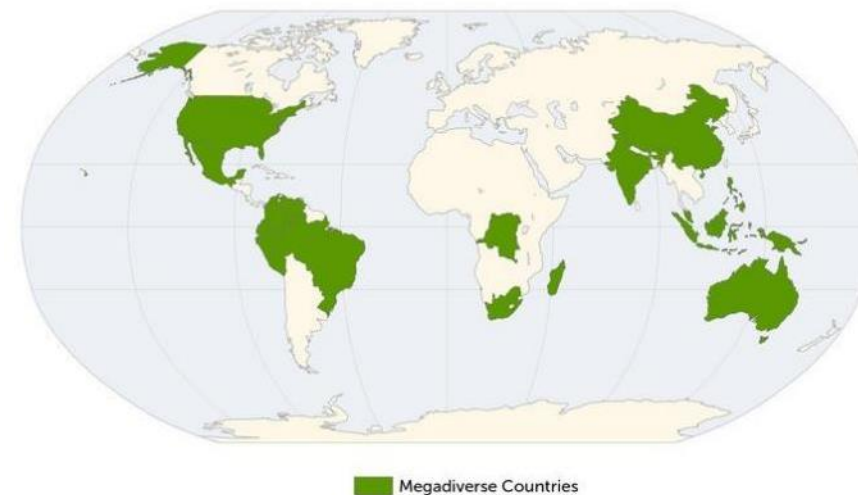


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What makes Chinese Wilderness Landscapes Different?



- History: One of the world's earliest civilizations
- Scale: One of the largest countries
- Population: World's most populous country
- Ethnic groups: 56 distinct ethnic groups
- Landscape: Diverse and mountainous
- Biodiversity: One of the megadiverse countries
- Urbanization, Economy



Conservation International identified 17 megadiverse countries in 1998





Mount Tai



Mount Wuyi

National Park Planning



Wilderness

Three-River Source



National Parks in China



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China unveils overall plan for national park system

Updated: Sep 26, 2017 9:03 PM Xinhua



BEIJING — China unveiled the overall plan for establishing its new national park system on Sept 26.

The overall plan was jointly published by the general offices of the Communist Party of China Central Committee and the State Council.

“This marks the completion of the top-level design of the national park system, and the beginning of the next stage of substantial construction” said Wang Yi, deputy head of the Institute of Science and Development at the Chinese Academy of

National Parks in China



Mapping wilderness in China

Cao, Y., Carver, S., Yang, R., 2019. **Mapping wilderness in China**: Comparing and integrating Boolean and WLC approaches. **Landscape and Urban Planning** 192, 103636.

Mapping Wilderness



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COMMENT • 31 OCTOBER 2018

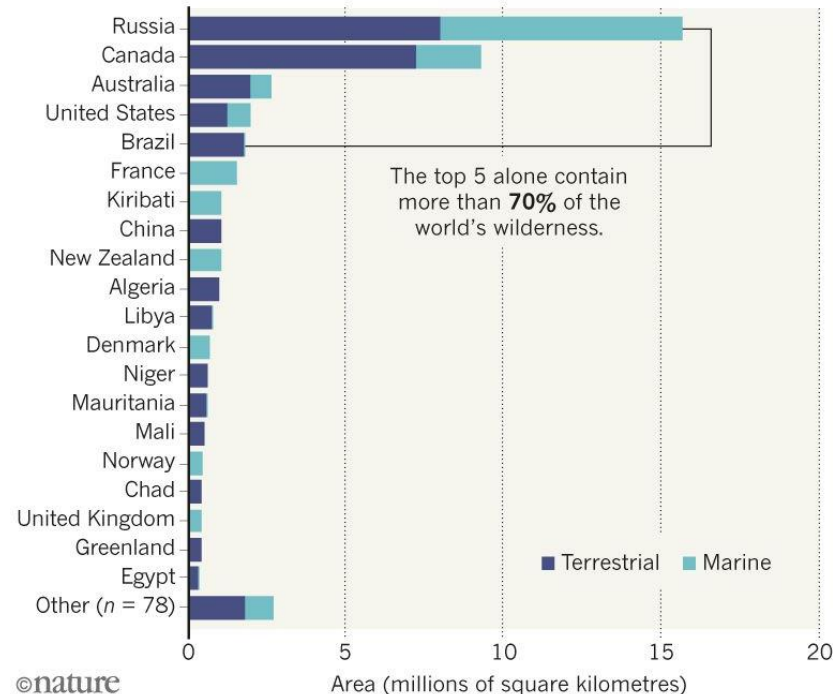
Protect the last of the wild

Global conservation policy must stop the disappearance of Earth's few intact ecosystems, warn James E. M. Watson, James R. Allan and colleagues.

James E. M. Watson, Oscar Venter, Jasmine Lee, Kendall R. Jones, John G. Robinson, Hugh P. Possingham & James R. Allan

THE WILDEST COUNTRIES

Twenty countries contain 94% of the world's wilderness, excluding Antarctica and the high seas.



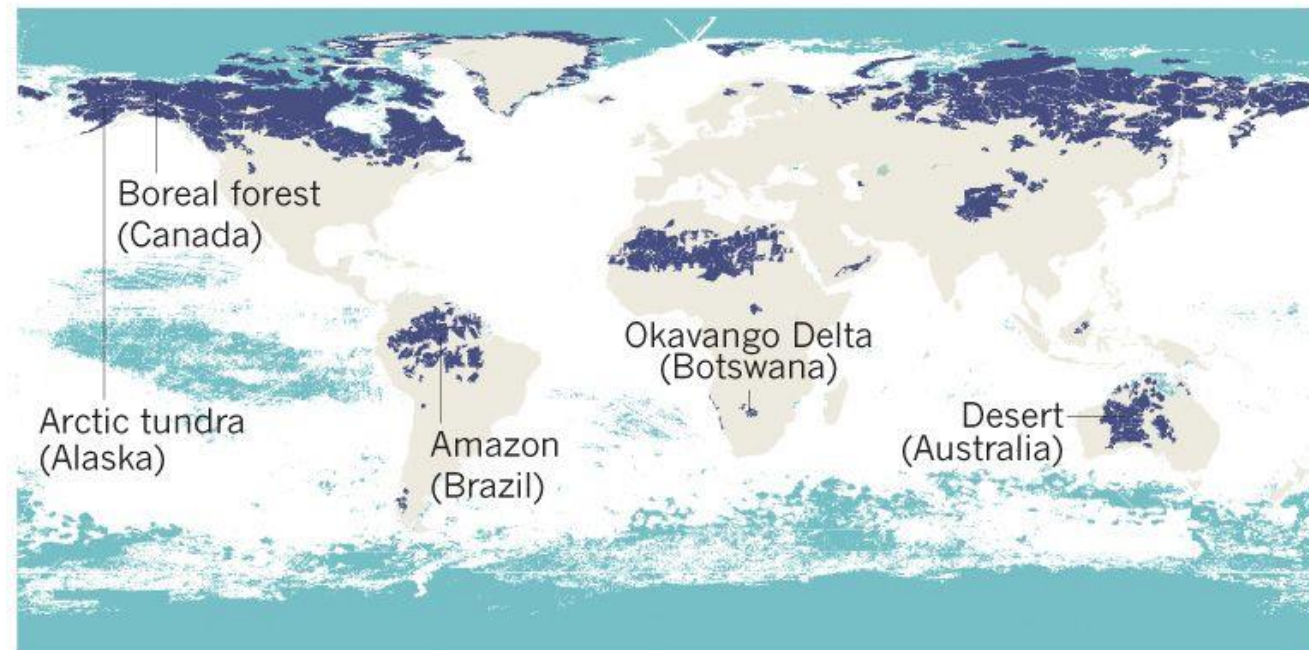
WHAT'S LEFT?

Earth's remaining wilderness areas are becoming increasingly important buffers against changing conditions in the Anthropocene. Yet they aren't an explicit target in international policy frameworks.

THE HUMAN FOOTPRINT

77% of land (excluding Antarctica) and 87% of the ocean has been modified by the direct effects of human activities.

REMAINING WILDERNESS: ■ Terrestrial ■ Marine



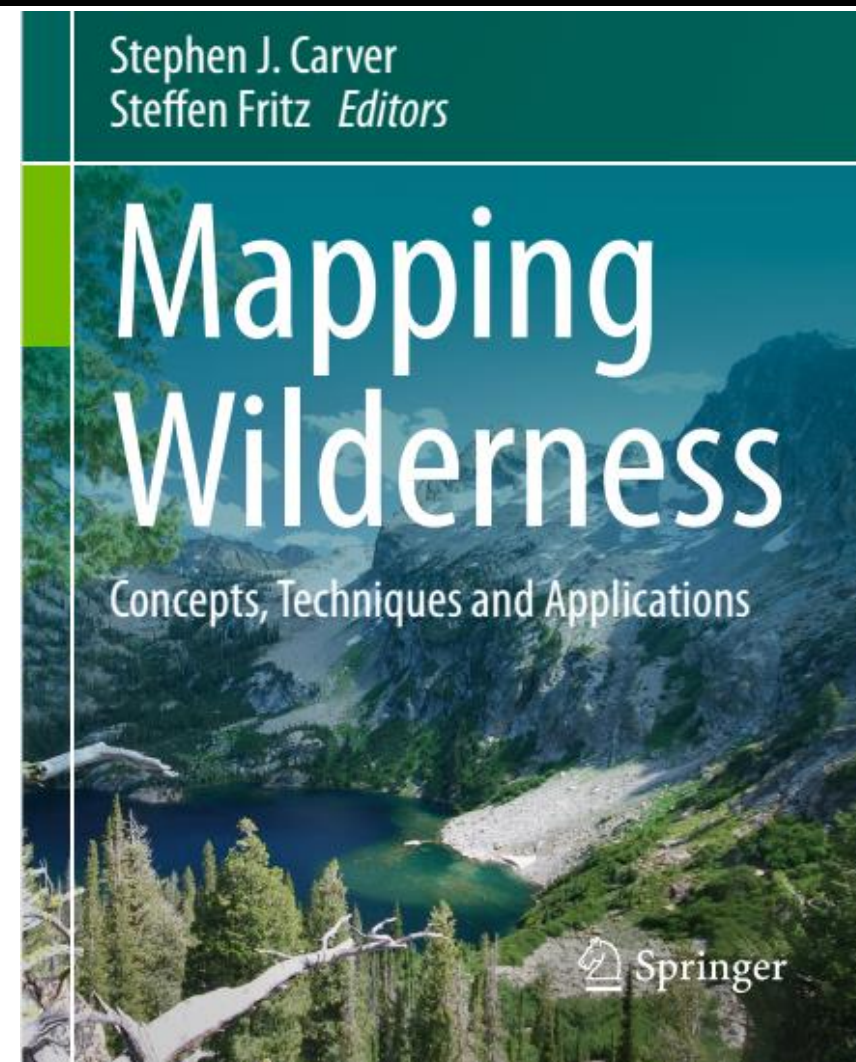
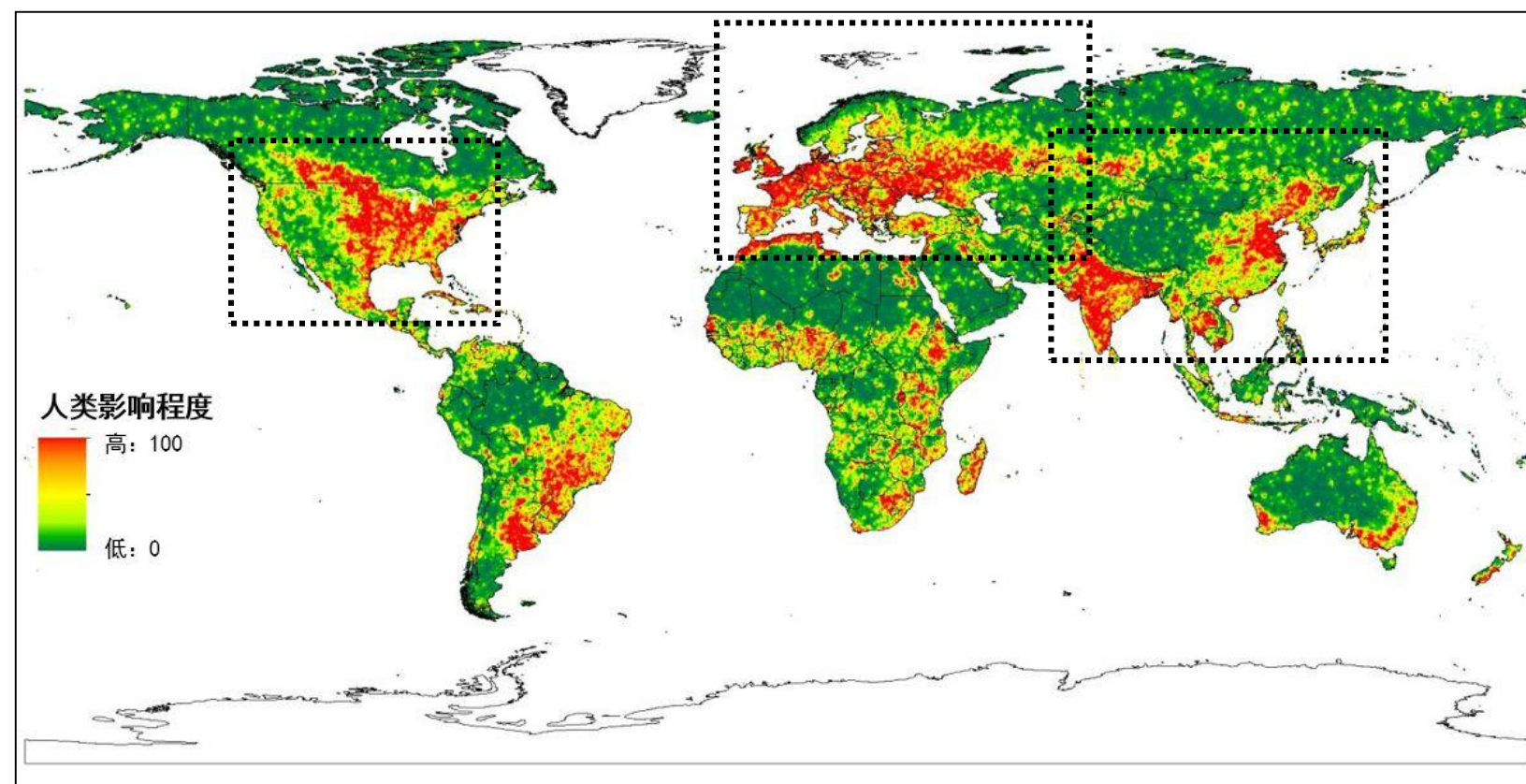
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■ Wild land exists in all landscapes at all scales (Aplet,2000)



See L, Fritz S, Perger C, et al. (2016). Mapping Human Impact Using Crowdsourcing In Carver, S.J. & Fritz, S., eds. Mapping Wilderness: Concepts, Techniques and Applications. Springer Netherlands, pp.89-101

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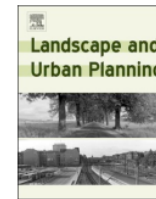
[Landscape and Urban Planning 192 \(2019\) 103636](#)



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Research Paper

Mapping wilderness in China: Comparing and integrating Boolean and WLC approaches



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ABSTRACT

Wilderness protection is increasingly important in the era of the Sixth Extinction and the Anthropocene. Mapping environmental indicators along a continuum of human modification provides key information for wilderness protection. However, uncertainty may occur in identifying wilderness areas by reclassifying wilderness continuum maps. In this study, an approach integrating both Boolean overlay and Weighted Linear Combination (WLC) is used to identify discrete wilderness patches and evaluate their relative wilderness quality. This approach is applied to China with a resolution of 1 km². The wilderness patches are first identified using Boolean overlay with discrete thresholds for land use, distance from settlements and roads. A Wilderness Quality Index is then created using a WLC model by weighting and combining six wilderness quality indicators including biophysical naturalness, population density, remoteness from settlements, remoteness from roads/railways, settlements density and roads/railways density. An integrated wilderness map is then created by combining the results from the Boolean and WLC models. It is found that China is a highly wild country in parts, containing over 86,000 wilderness patches, with varying relative wilderness qualities, which covers approximately 42% of China's terrestrial area. About 77% of the existing wilderness patches are not covered by nature reserves, indicating the obvious conservation gaps of China's wilderness areas. The wilderness maps presented here could potentially support new wilderness protected area designation, connectivity conservation, and monitoring programs. This integrated approach of wilderness mapping is potentially useful for other countries in conducting their own wilderness inventories and developing wilderness conservation policies.



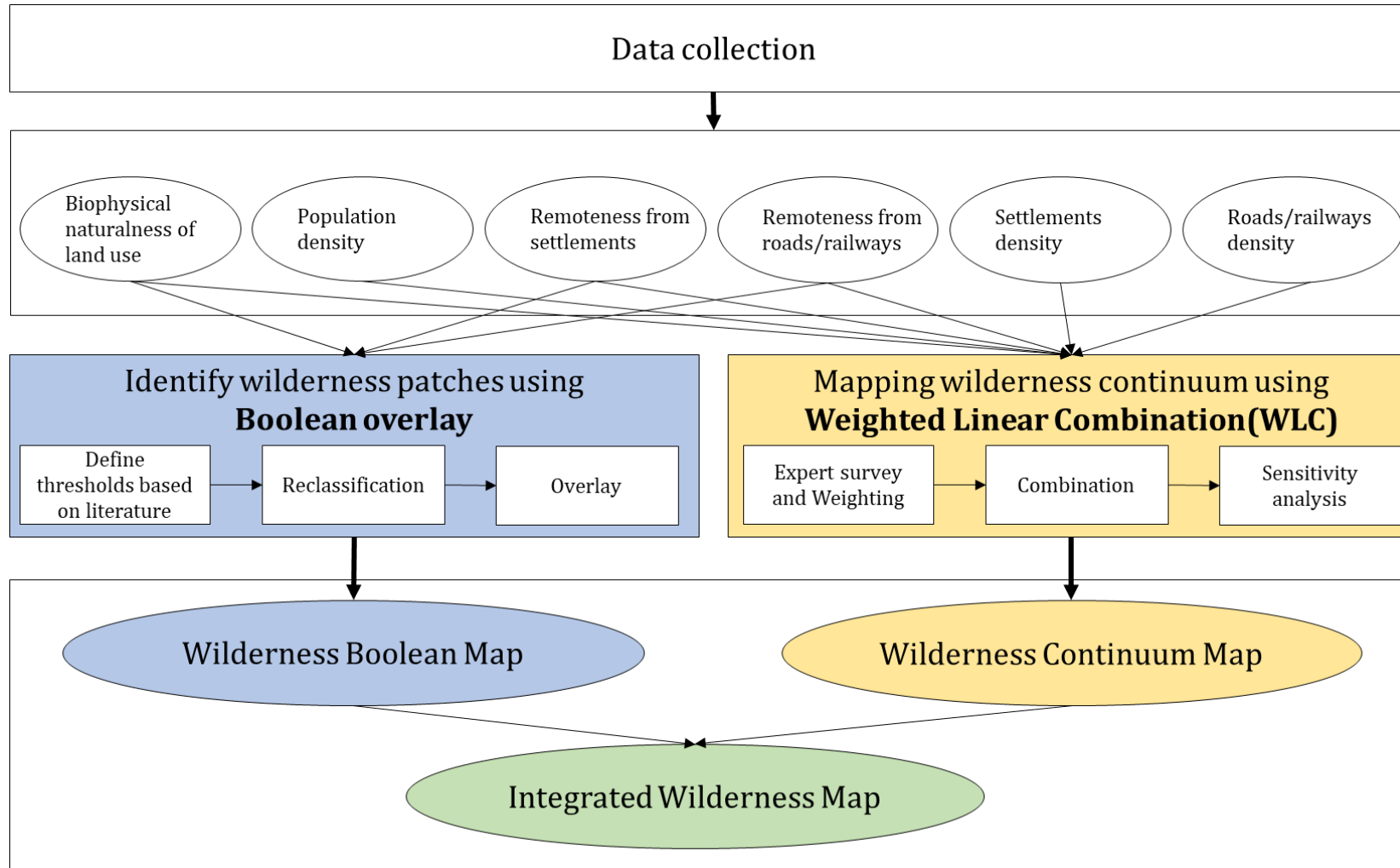
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Mapping Wilderness in China



- Boolean overlay and WLC approaches are integrated in wilderness mapping.
- The method is applied to China at 1 km resolution with high quality spatial data.



Mapping Wilderness in China



- Just over 86,000 wilderness patches were identified by Boolean overlay with a total area of just over 4 million square kilometers, which comprises approximately 42% of China's terrestrial area

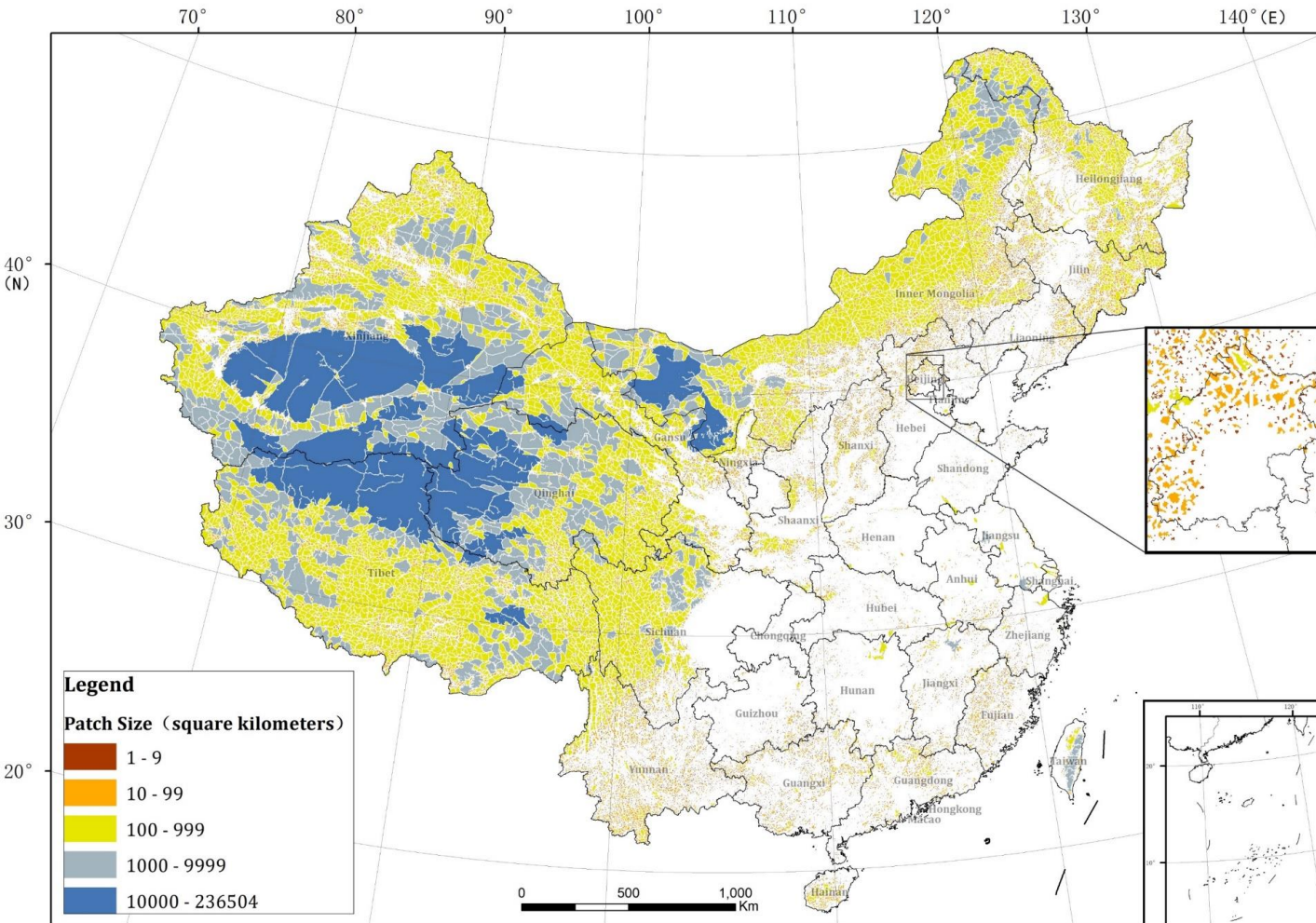


Table 3

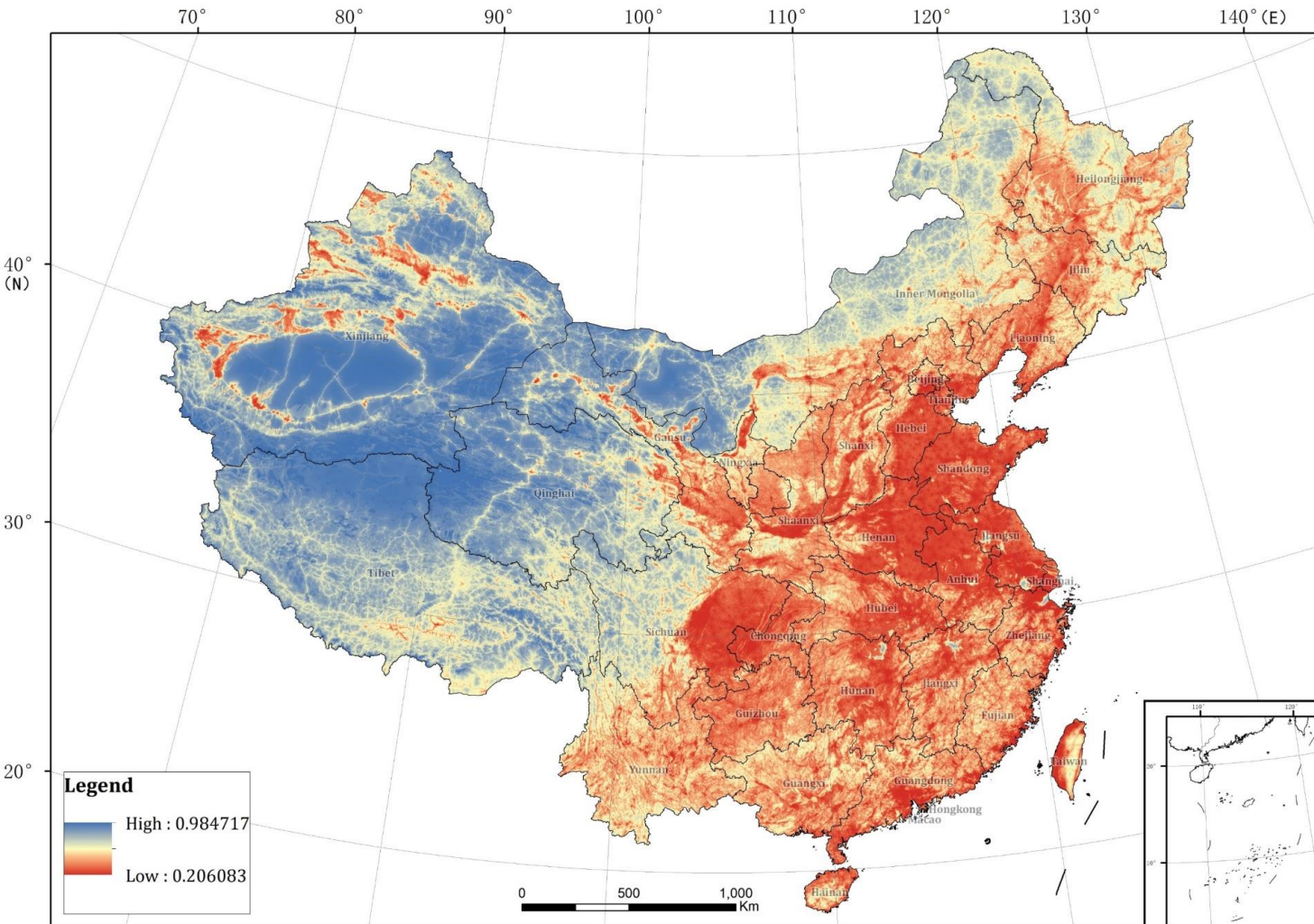
Classification of wilderness patches based on patch size.

Wilderness patches type	Patch size (km ²)	Patch number	Ratio of patch number (%)	Total area	Ratio of total area (%)
Extra-small	1-9	70,223	81.57	124,328	3.08
Small	10-99	10,181	11.83	310,634	7.69
Medium	100-999	5203	6.04	1,649,980	40.85
Large	1000-9999	464	0.54	1,028,025	25.45
Extra-large	≥ 10000	19	0.02	925,773	22.92
Total	-	86,090	100	4,038,740	100

Mapping Wilderness in China



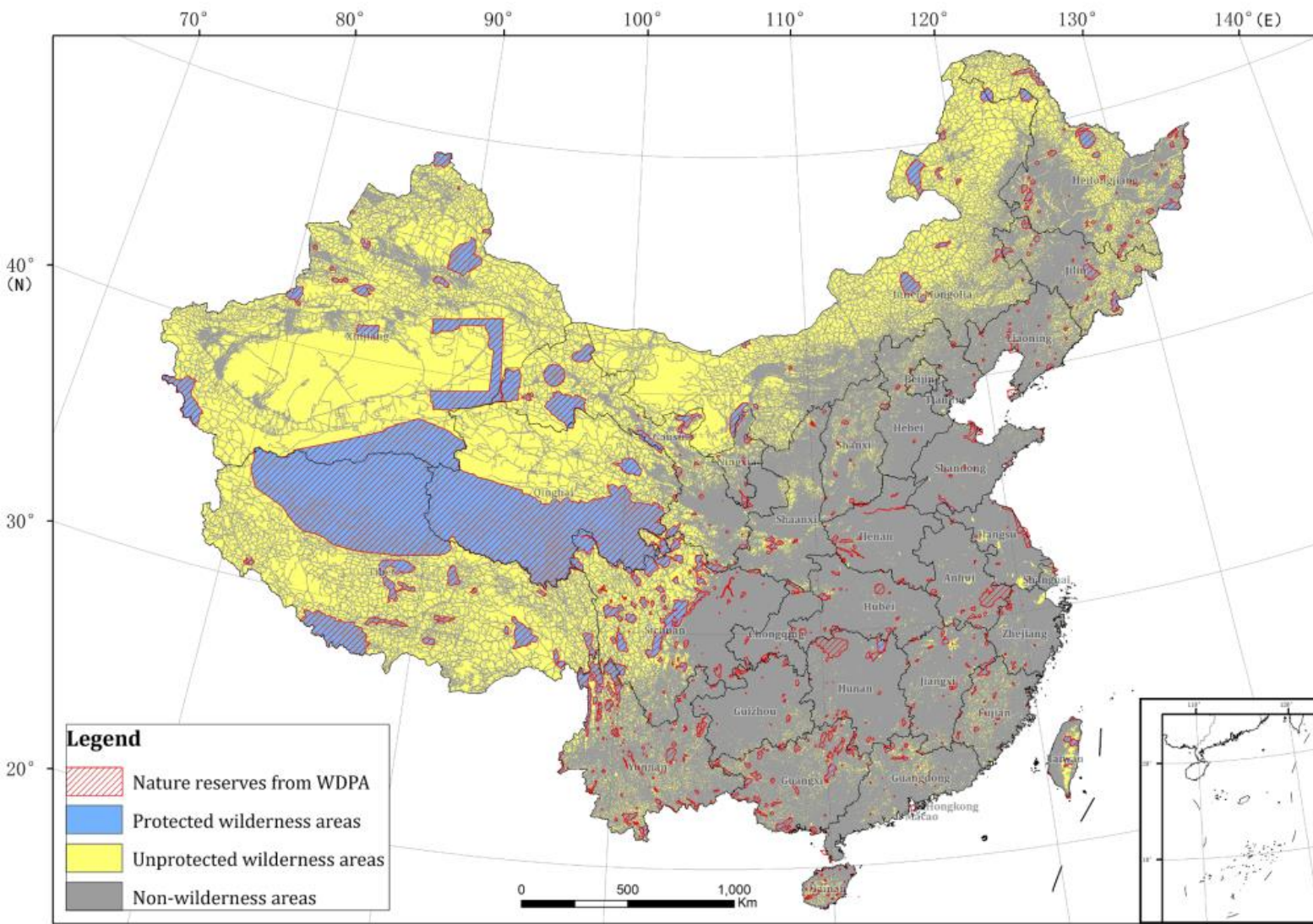
- The wilderness continuum map of China combining the six indicators with the collective expert weights using the WLC model.



Mapping Wilderness in China



- 77% of the existing wilderness areas in China are not covered by nature reserves.



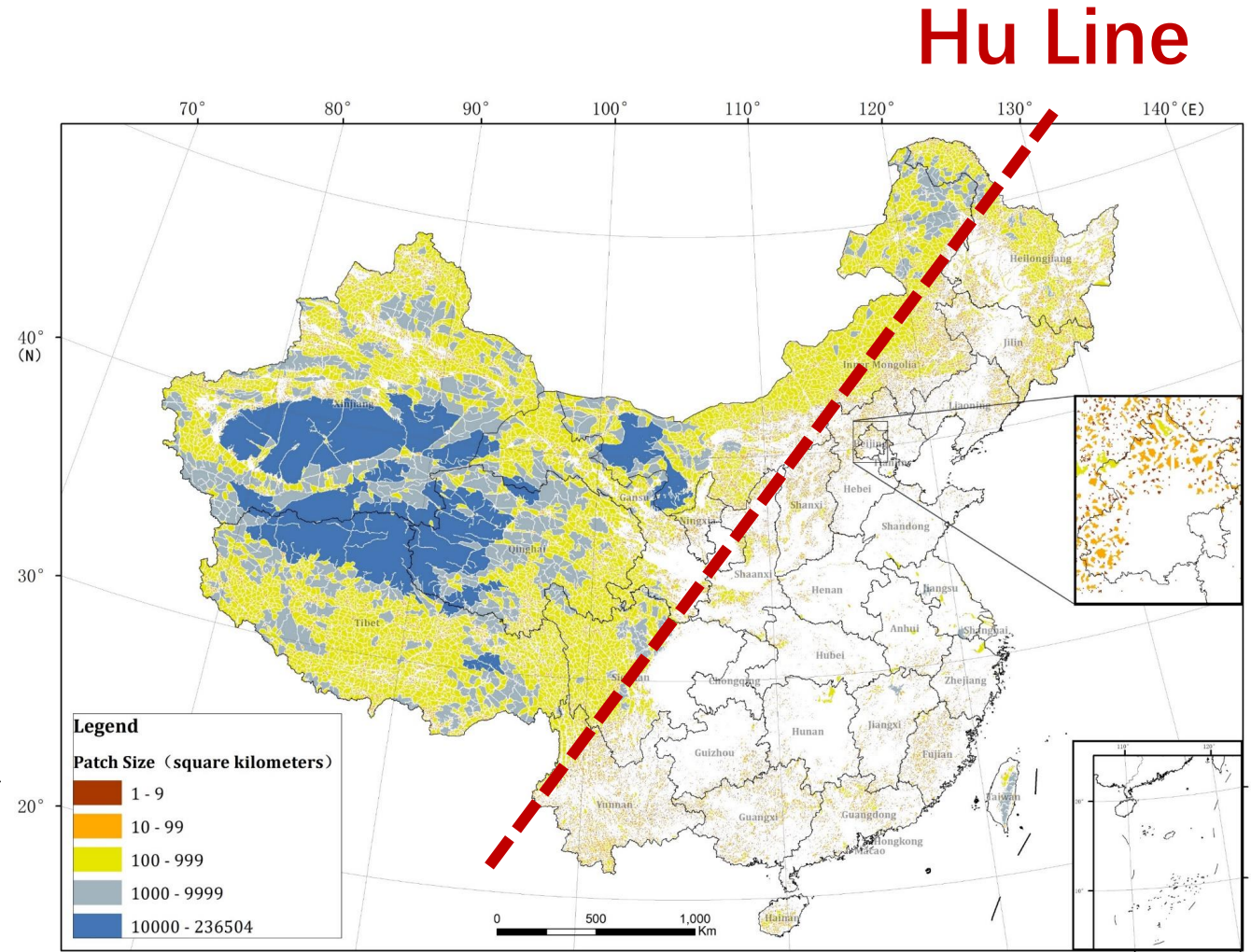
Connecting wilderness: wildland network planning

Cao Y, Yang R, Carver S., Linking wilderness mapping and connectivity modelling: A methodological framework for wildland network planning. **Biological Conservation**, 2020, 251:108679.

Connecting Wilderness in China



- In fact, wildland network planning is urgently needed by policymakers and local practitioners in addressing concerns over habitat fragmentation, isolation and species decline.
- Taking China as an example, the fragmentation of wilderness areas in the eastern half of the country may be some of the worst in the world due to intensified agriculture, settlement and infrastructure construction, which can be seen clearly from the Chinese wilderness maps (Cao et al., 2019).



Connecting Wilderness in China



■ A conceptual framework for the wildland networks

■ Components:

1. Core wild areas (wilderness areas)
2. Ecological corridors between core wild areas

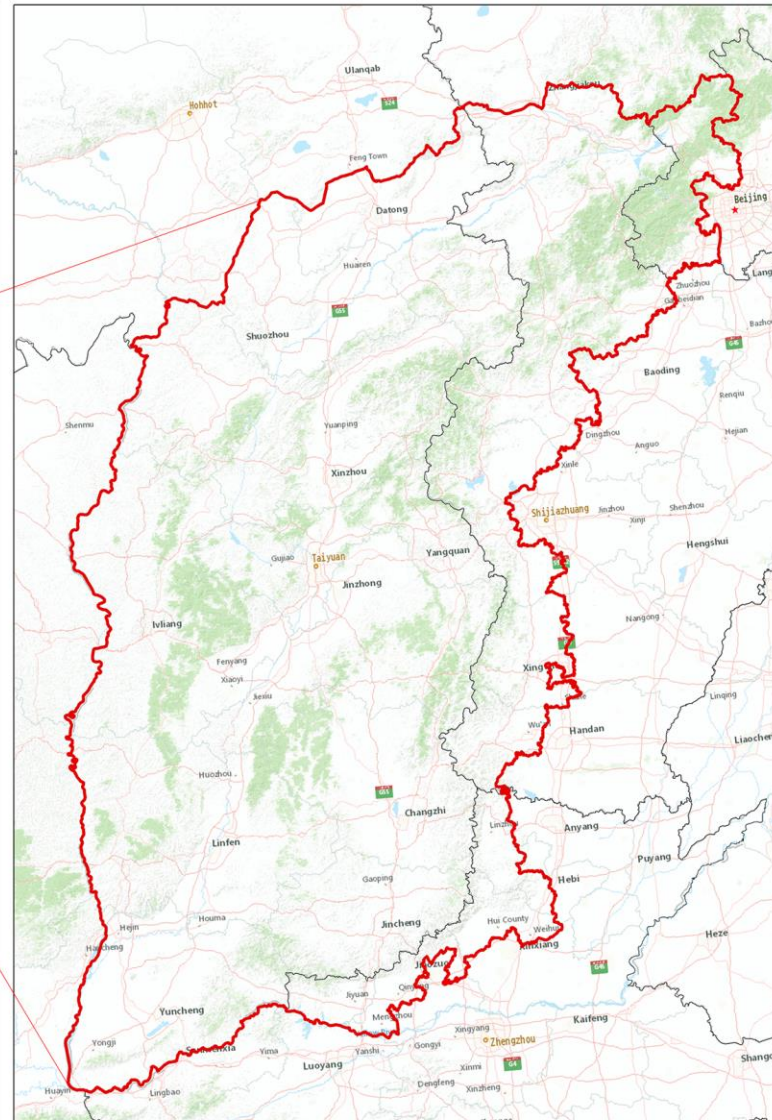
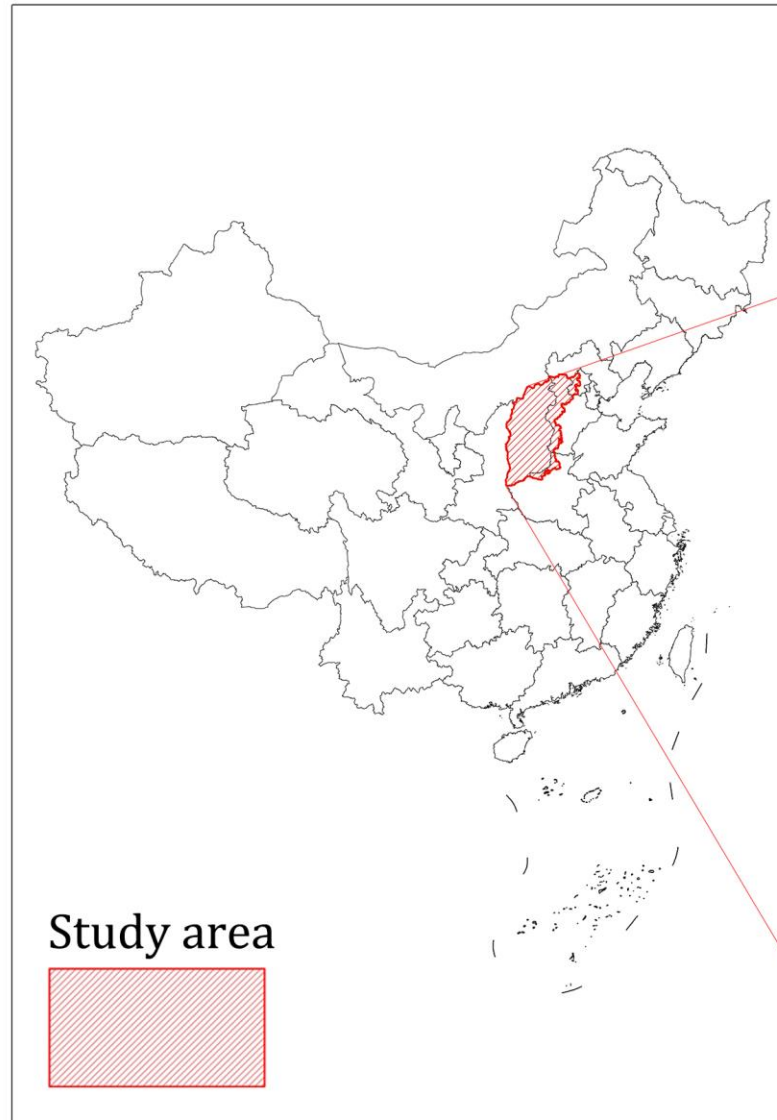
■ Components:

1. Difference between wildland networks and protected area networks
2. Difference between wildland networks and habitat networks.

Connecting Wilderness in China



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Identification of core wild areas

- 1. Boolean wilderness patches (Core patches type A)
- 2. Areas with the highest wilderness quality index (Core patches type B)
- 3. Nature reserves protecting habitat for north Chinese leopard (Core patches type C)

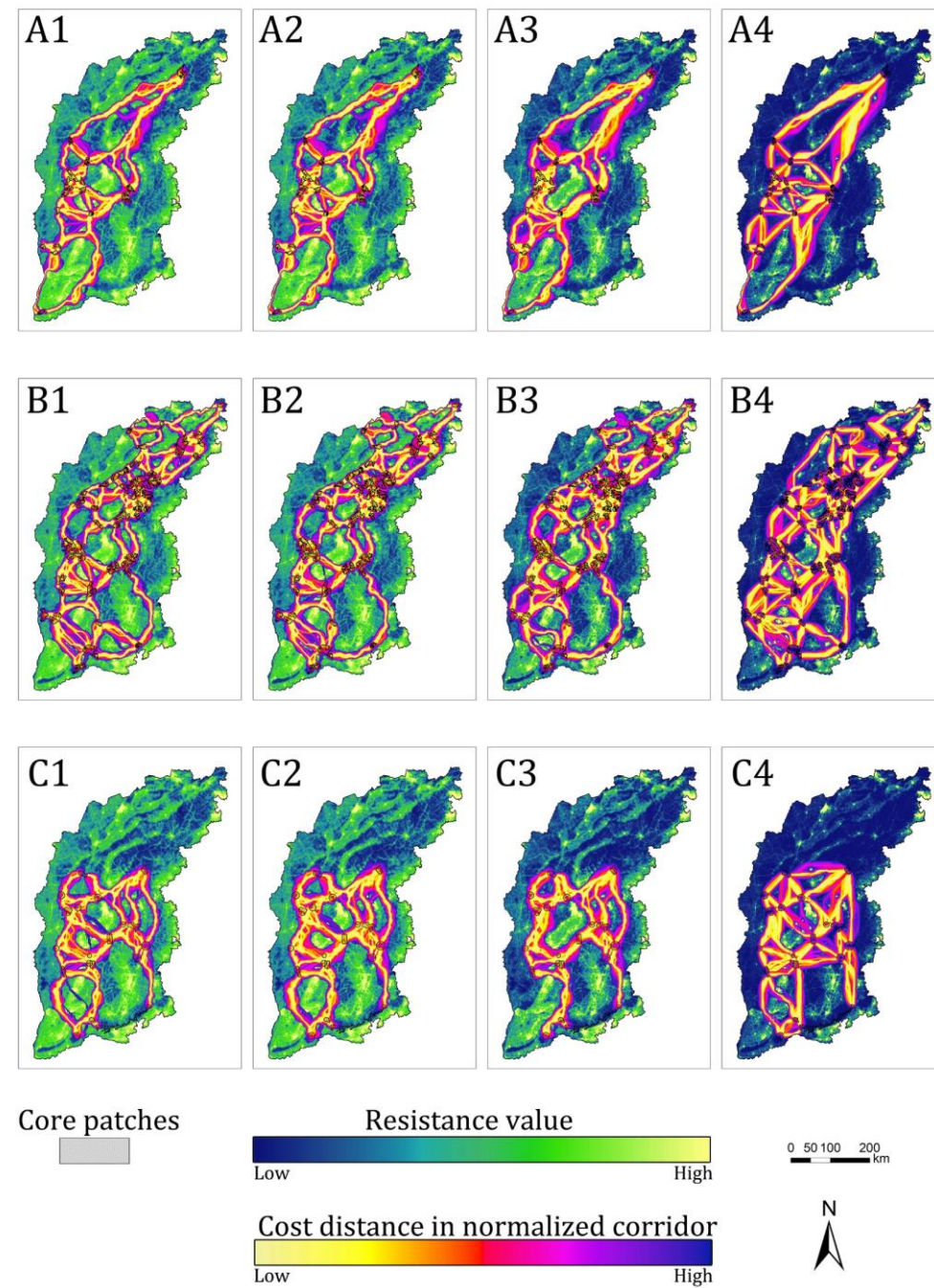
Creation of resistance surfaces

Table 1
The code of 12 networks (A1-A4, B1-B4, C1-C4). Core patches type A, B, C represent Boolean wilderness patches, areas with highest wilderness quality index, and nature reserves protecting habitat for north Chinese leopard, respectively. Resistance type 1 represents negative linear transformation and resistance type 2,3,4 represent negative exponential transformation when $c = 1,4,8$ respectively.

	Resistance type 1	Resistance type 2	Resistance type 3	Resistance type 4
Core patches type A	A1	A2	A3	A4
Core patches type B	B1	B2	B3	B4
Core patches type C	C1	C2	C3	C4

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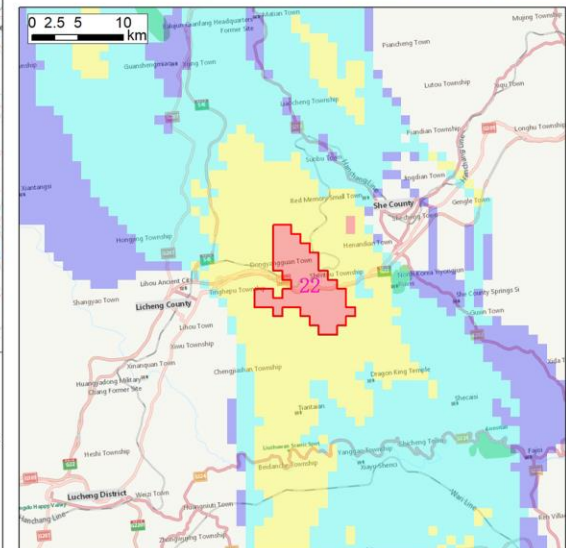
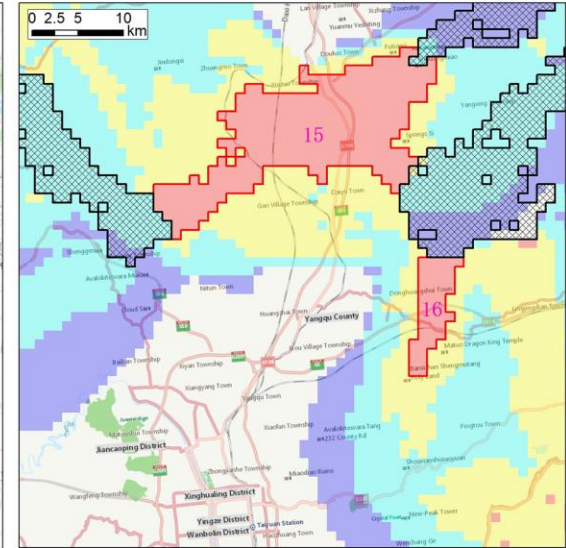
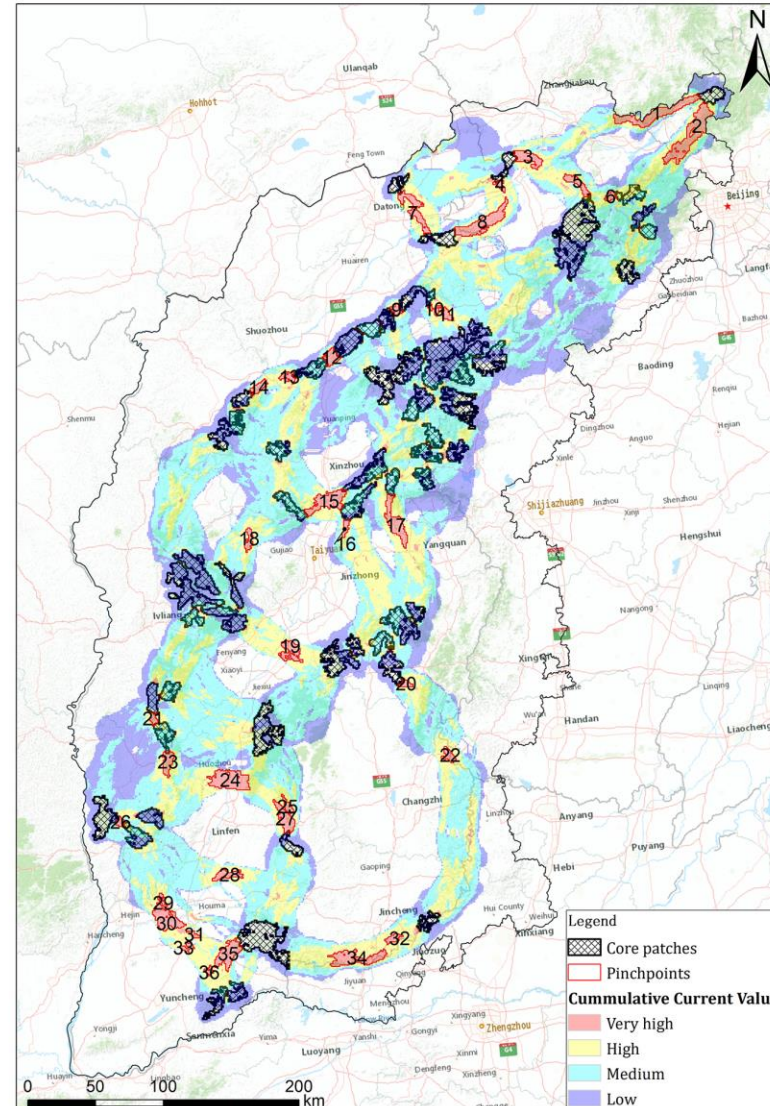
Least-cost corridors between the core patches (Scenario A, B and C).



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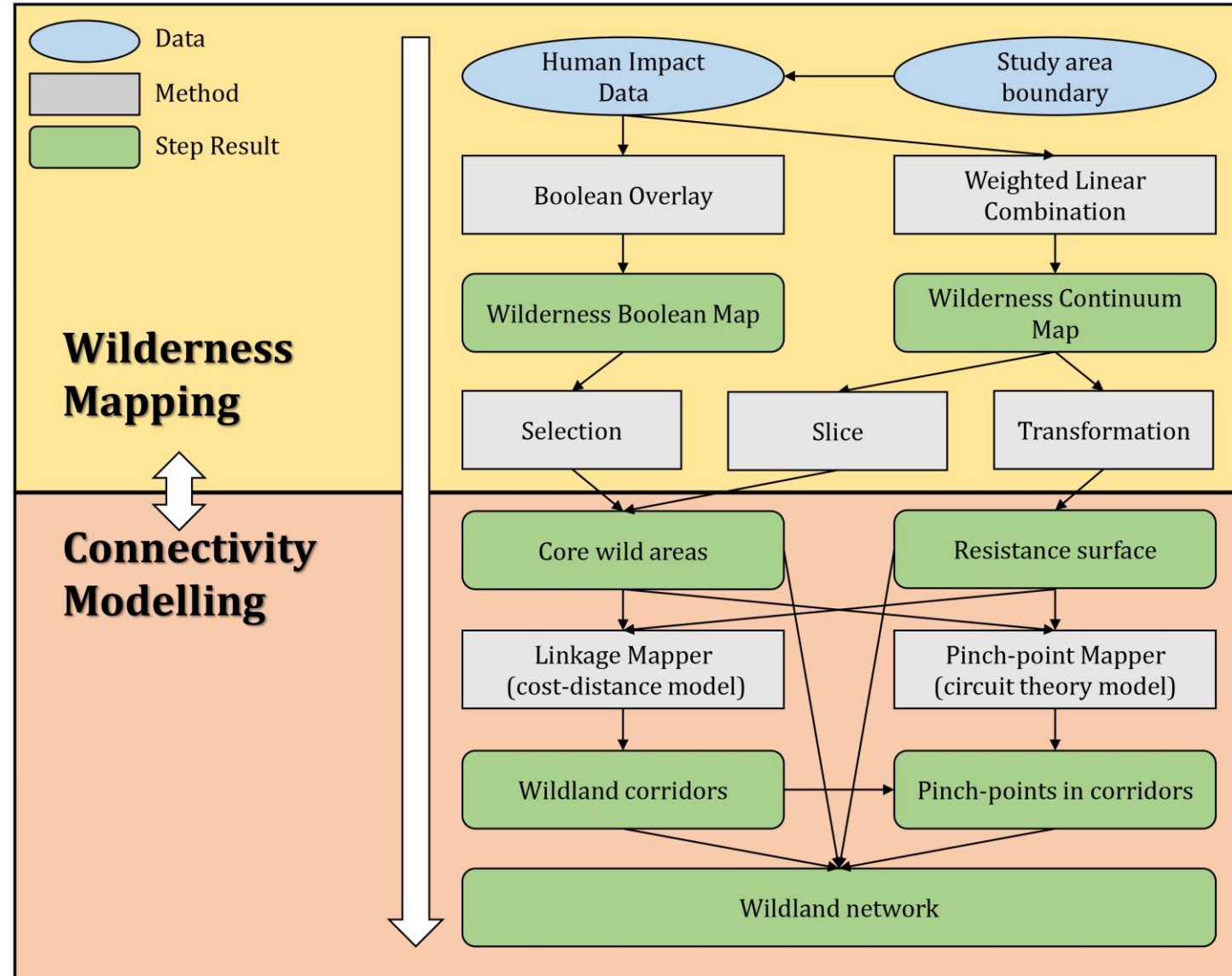
Pinch-points in resulting corridors (scenario B3).
Pinch-points are areas with high cumulative current values and most important to connectivity conservation and restoration.



Connecting Wilderness in China



A methodological framework for wildland network planning, which links wilderness mapping and connectivity modelling.



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THANK YOU

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