Measuring the Fragmentation of China's Landscape Using Effective Mesh Size

Presented by: Ryan Boynton
rmboynton@ucdavis.edu

Primary Author: Taian Li
royal322003@gmail.com

Co-Authors: Fraser Shilling, James Thorne, Fengmin Li, Heidi Schott, Alison M. Berry, Evan Girvetz, Jochen A.G. Jaeger

Outline

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- Results/Discussion
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  - International comparison
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  - Mammal Species Richness Analysis
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China

- Number of Provinces: 34
- Number of Counties: 2,427
- Ecoregions: 48

- Mammal Species Richness: 2-205 species in a county
- Currently, China's road network is growing rapidly
  - Expansion of expressways from 652km in 1992 to 65,000km by 2010 and 85,000km by 2025

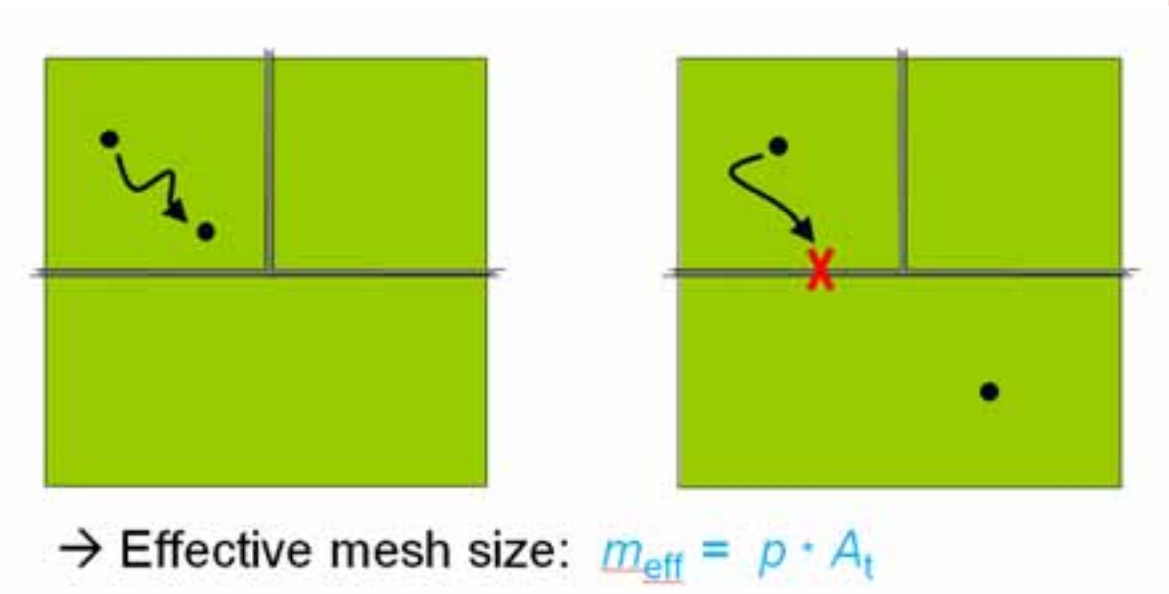
Landscape Fragmentation

- Habitat fragmentation from human land-uses can:
  - Threaten biodiversity and genetic flows
  - Enable the spread of invasive species
  - Decrease habitat patch sizes and the connectivity within and among these patches

Effective Mesh Size (M_{eff})

- The probability that any two locations in the landscape are connected (i.e. not separated by barriers)

- Can also be interpreted as the average size of the area that an animal placed randomly in the landscape will be able to access without crossing barriers




p
m
eff

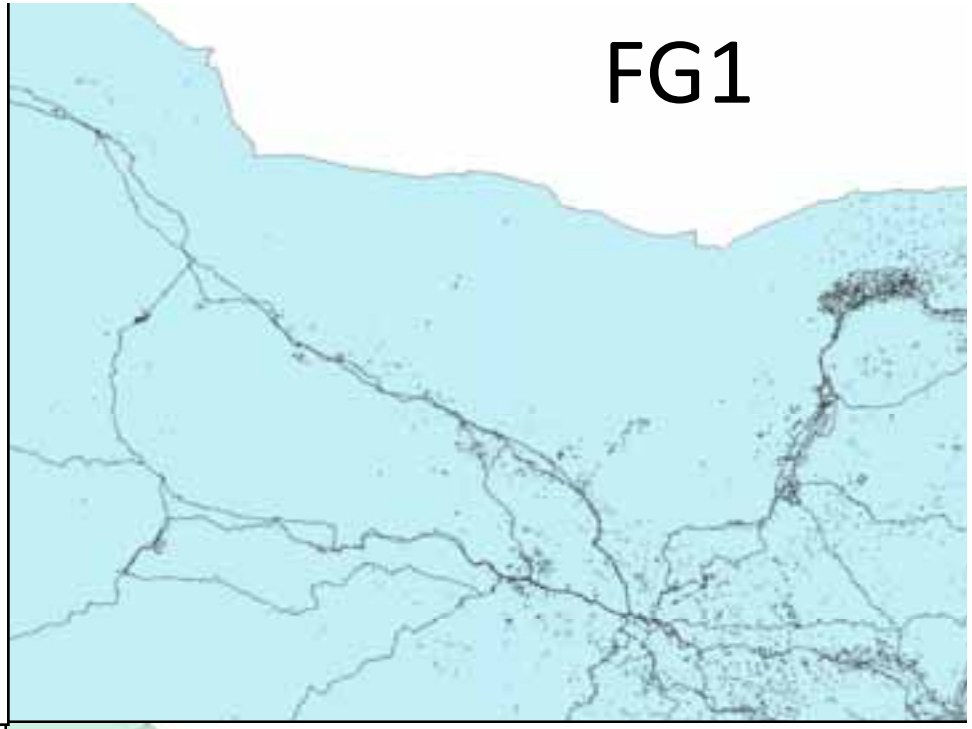
Our Study

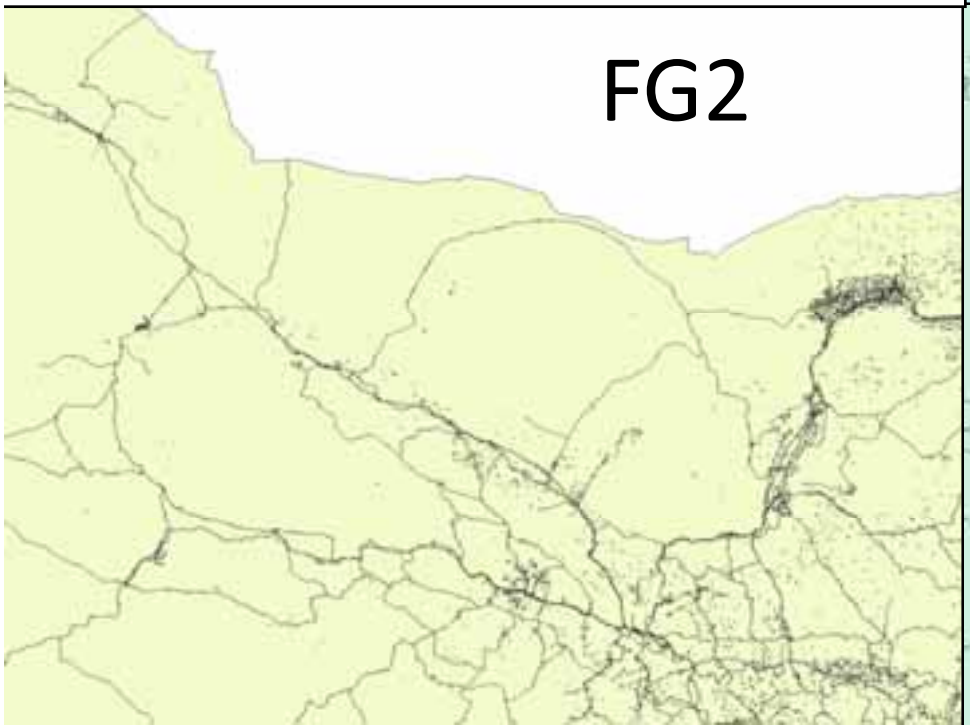
- The first assessment of landscape fragmentation by paved roads and urban areas in China
  - Provides a basis for additional systematic assessments
- The Effective Mesh Size tool in ArcGIS was used to measure the spatial distribution and degree of landscape fragmentation in China
- Sets the context for ecological conservation and transportation infrastructure planning throughout China

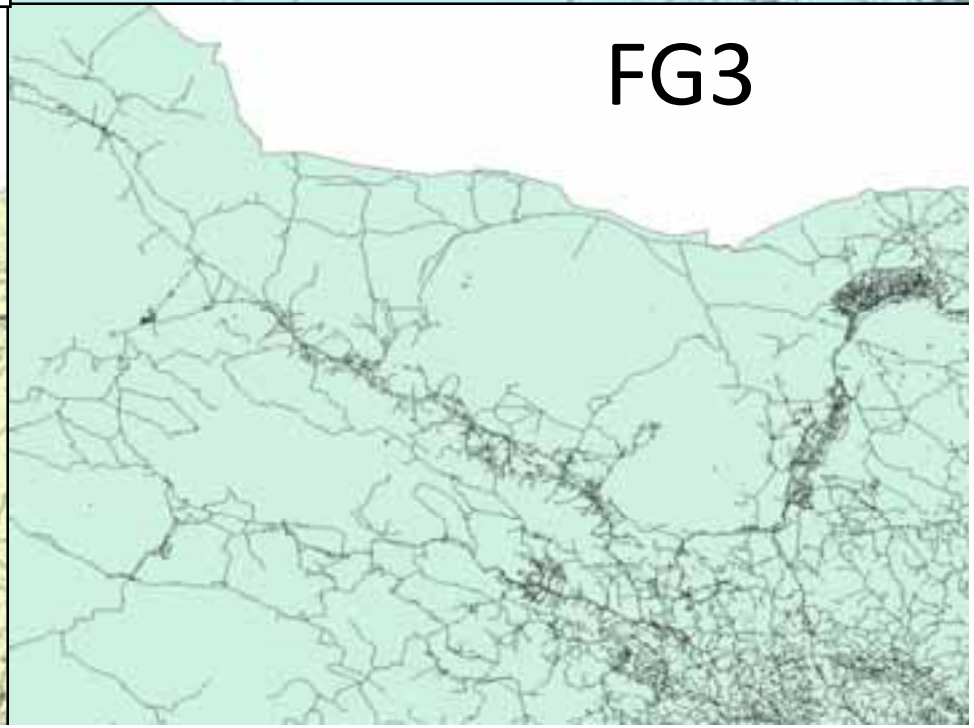
Fragmentation Geometries (FGs)

- We defined 3 levels of FGs for China:
  - FG1 = Urban Areas, National Roads*, Railways*

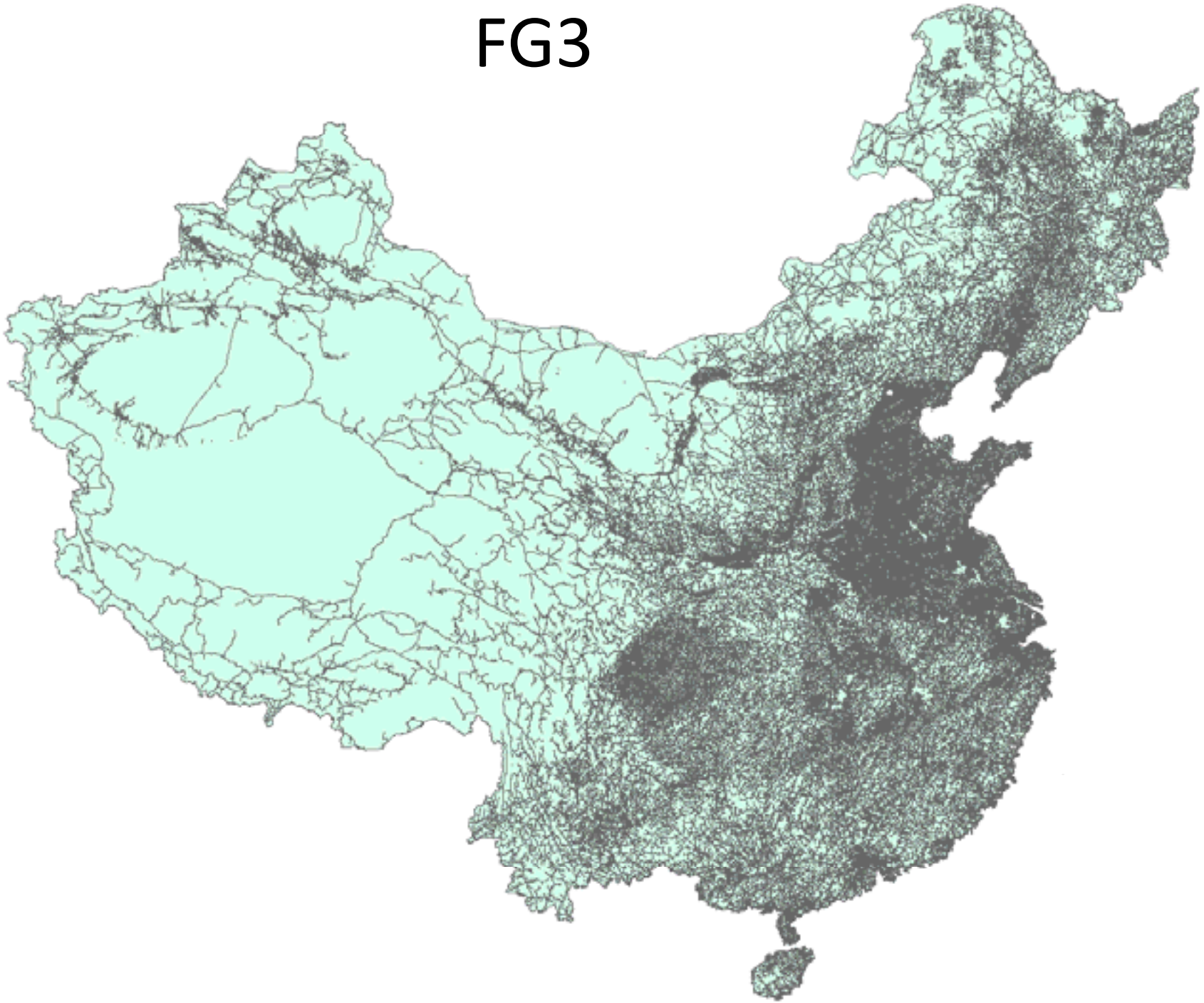
    *Buffered by 100m
  - FG2 = FG1 + Provincial Roads buffered by 60m
  - FG3 = National Roads, Railways, Provincial Roads, and County Roads buffered by 30m and then added to the urban areas layer

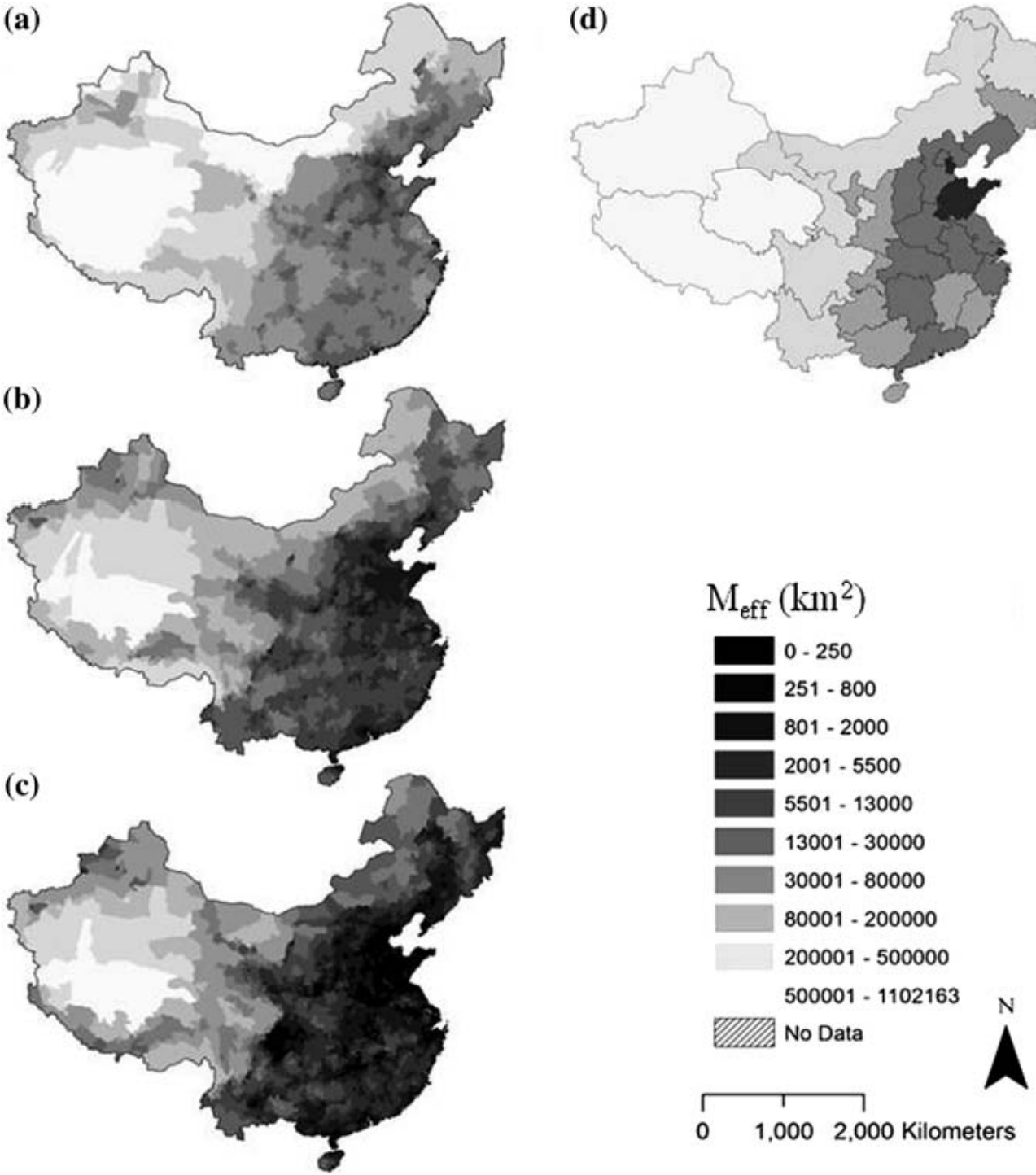

FG1


FG2


FG3

FG3



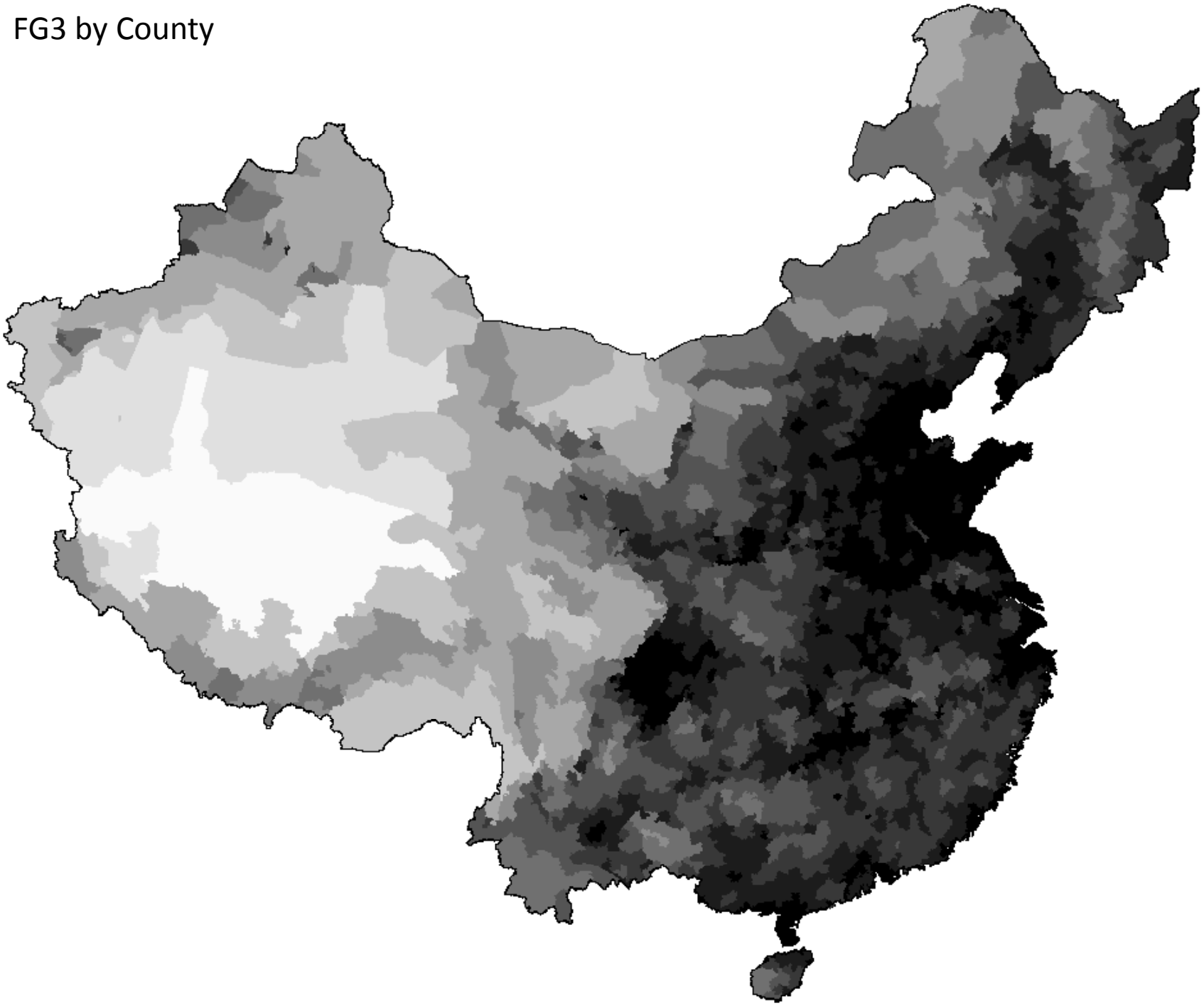


M_{eff} Outputs

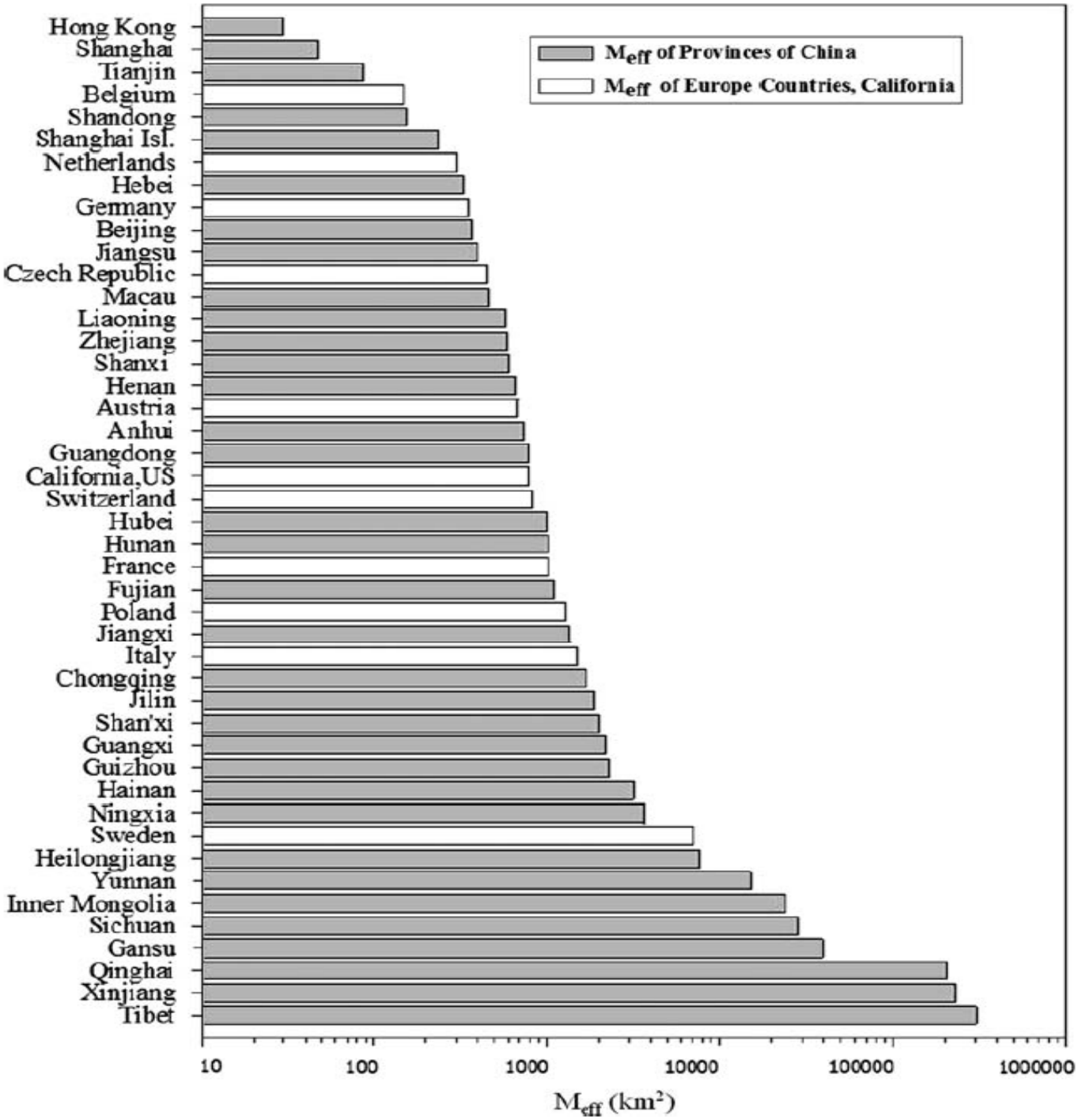
- a = FG1
  - National Highways, Railways, and Urban Areas
- b = FG2
  - FG1 + Provincial Roads
- c = FG3
  - FG2 + County Roads
- d = FG3

- Reporting Unit
  - a,b,c = County
  - d = Province

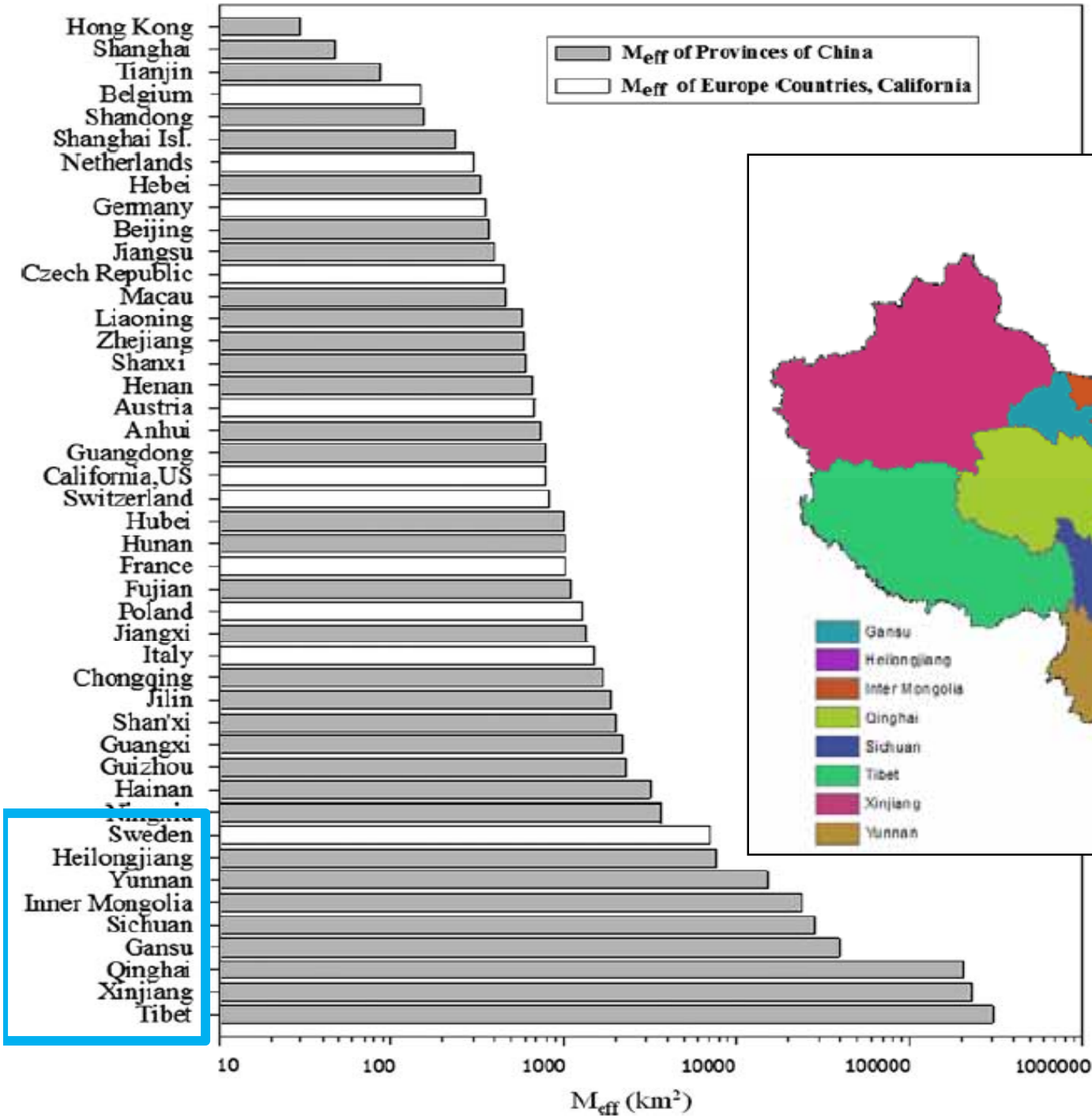
FG3 by County



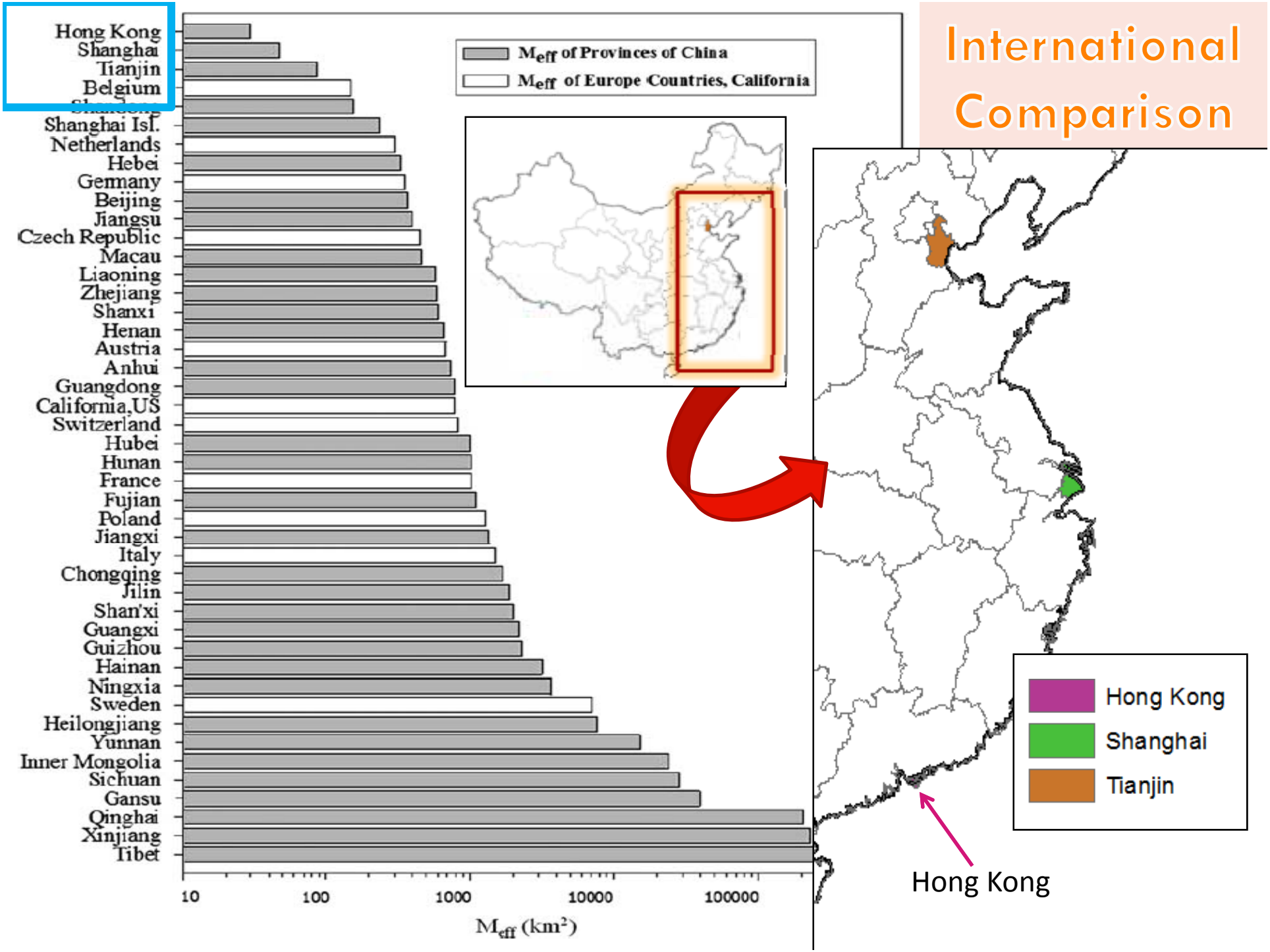
International Comparison



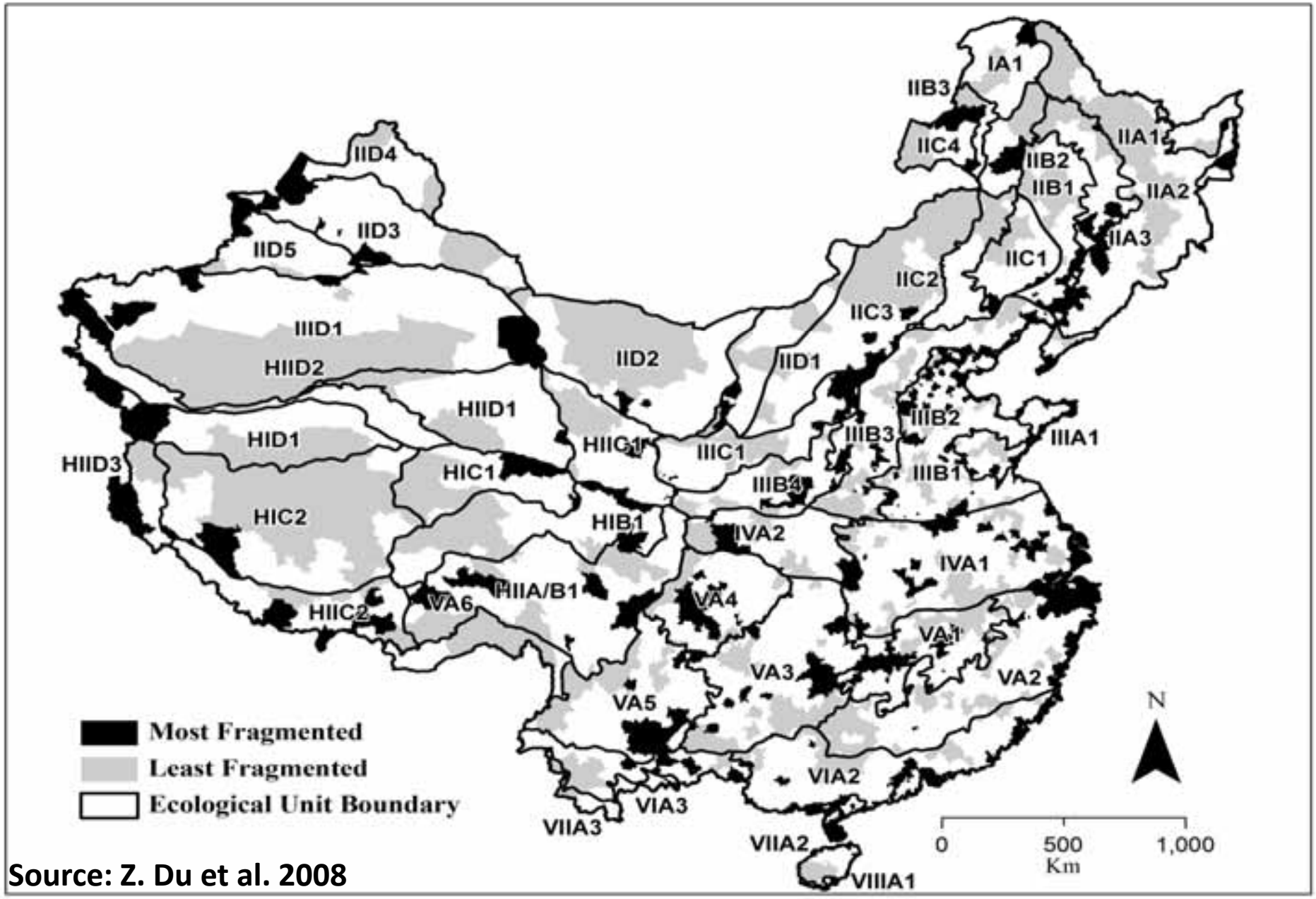
International Comparison



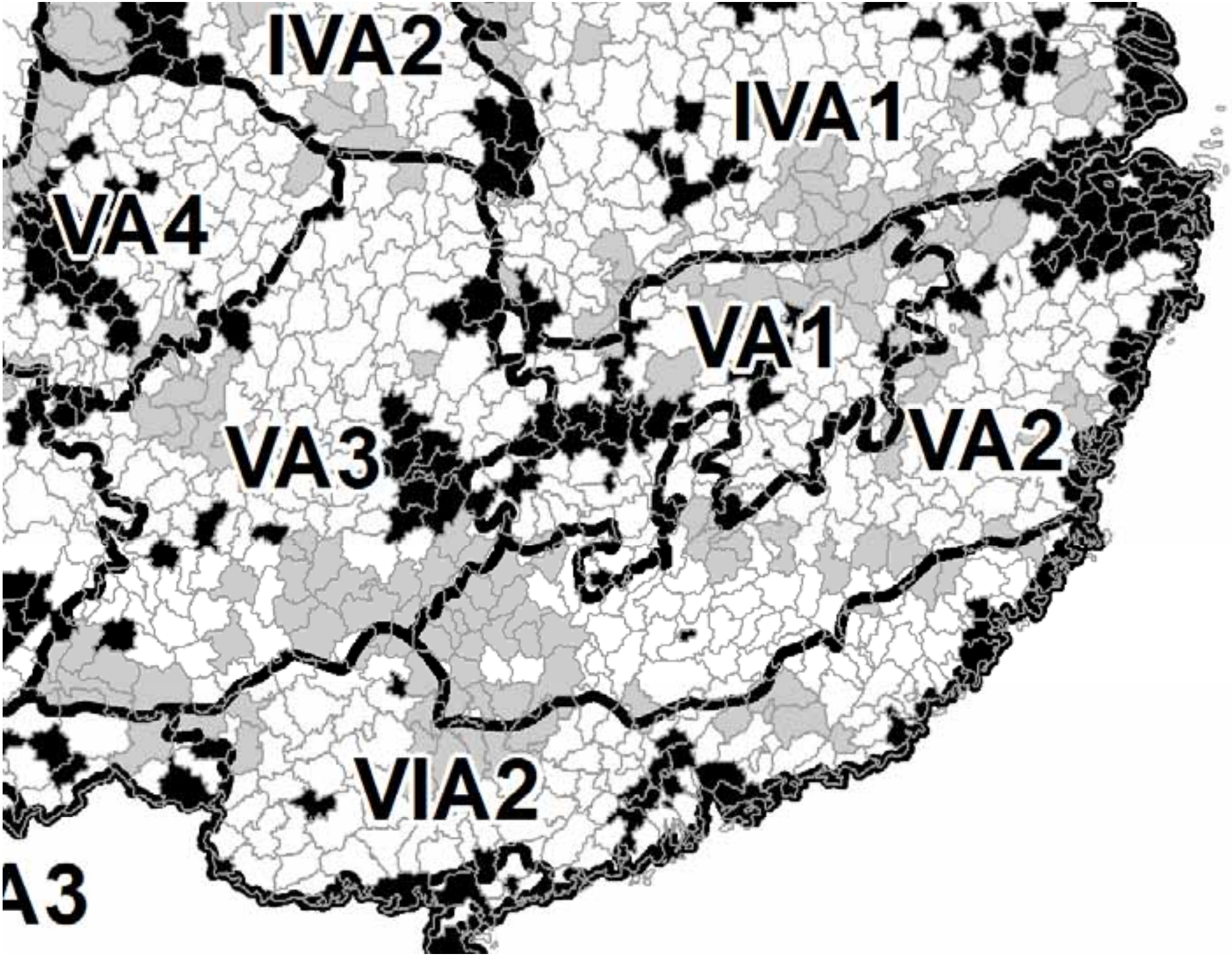
International Comparison



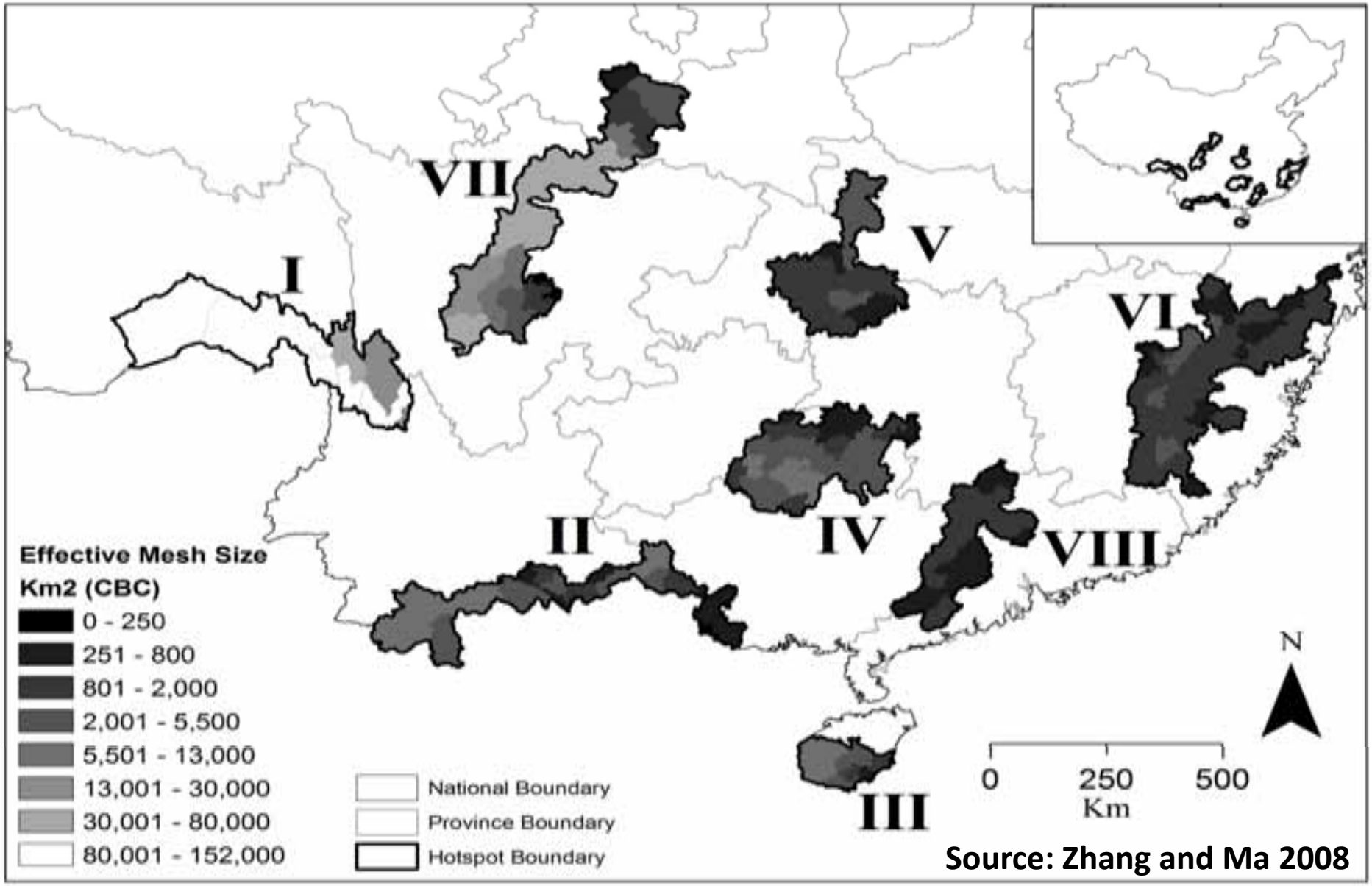
Ecoregion Analysis



Source: Z. Du et al. 2008

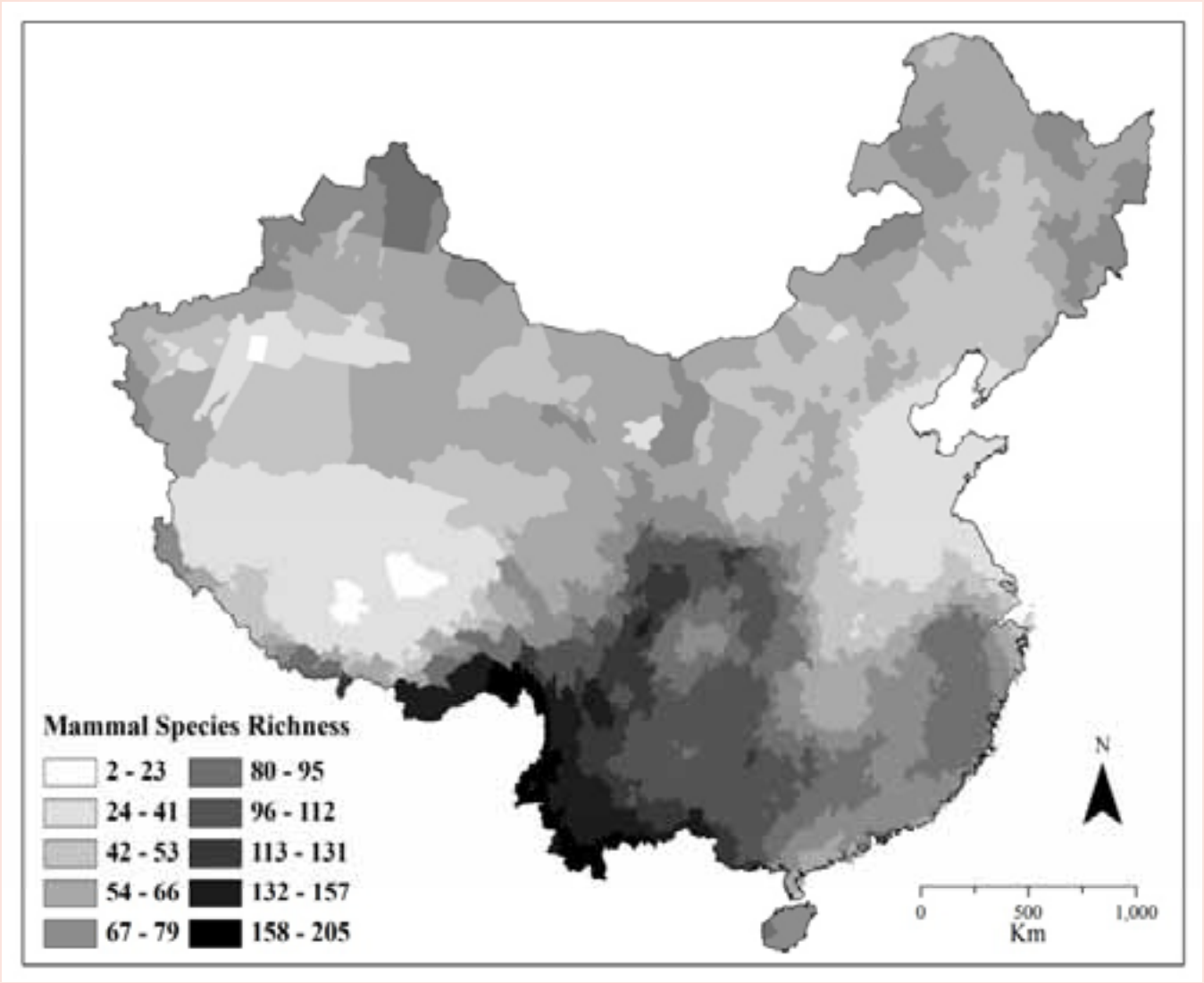

IVA2
IVA1
VA4
VA1
VA3
VA2
VIA2
A3

Threatened Plant Hotspot Analysis



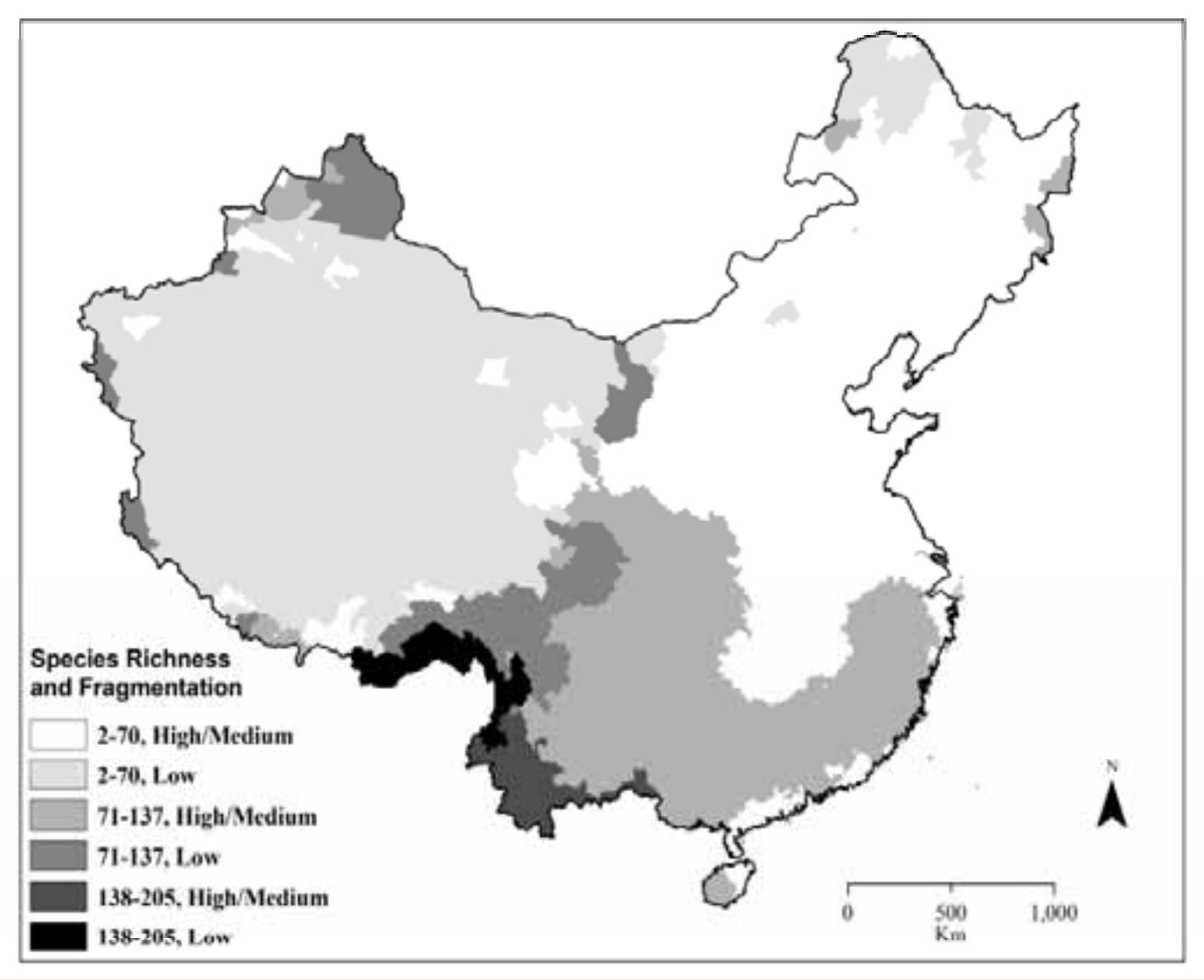
Source: Zhang and Ma 2008

Mammal Species Richness Analysis

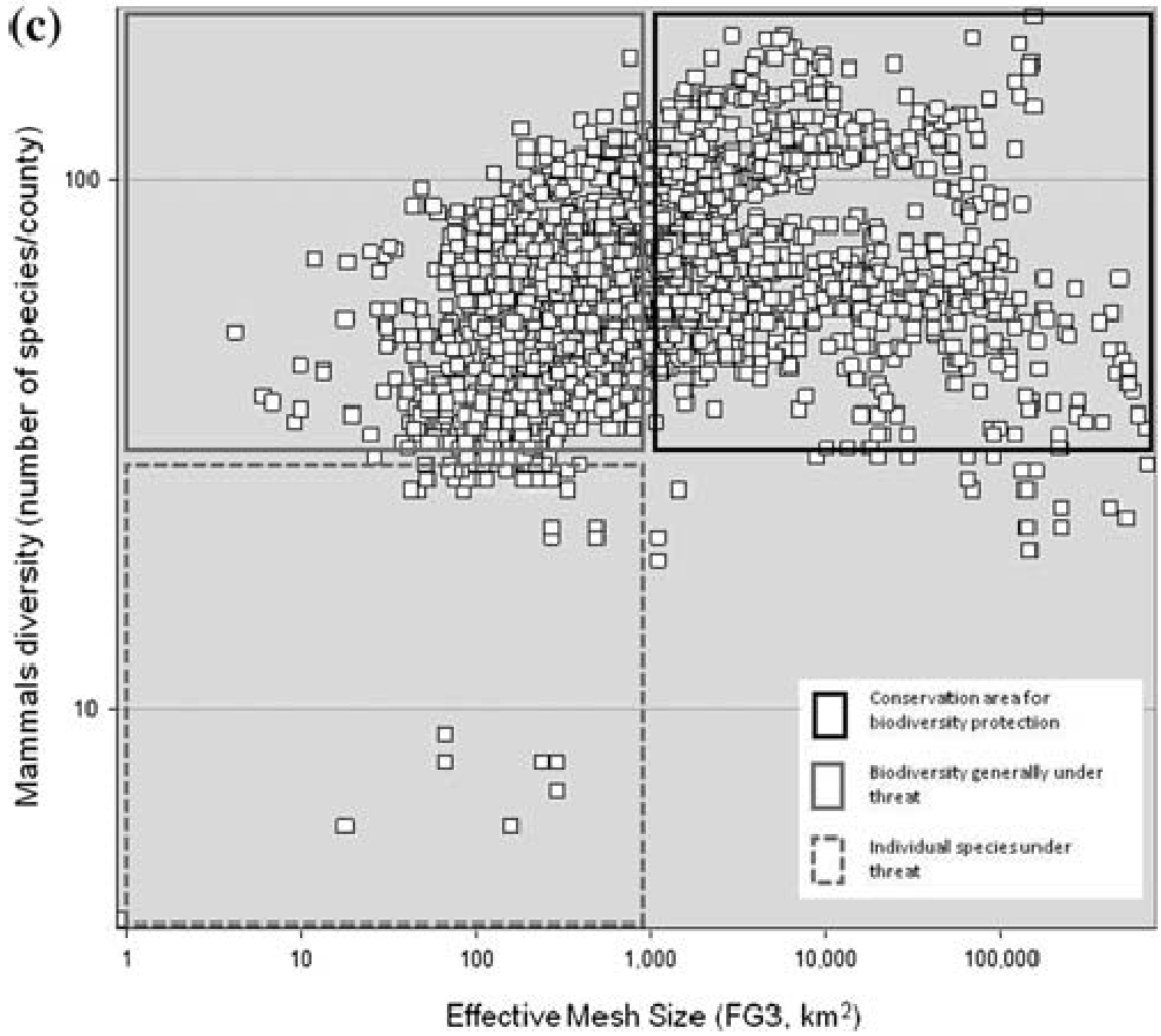


Source: IUCN

Mammal Species Richness Analysis



- A simple three-tier classification of richness against either low, medium, or high levels of fragmentation


(c)
Mammals diversity (number of species/county)
100
10
1
10
100
1,000
10,000
100,000
Effective Mesh Size (FG3, km2)
Conservation area for biodiversity protection
Biodiversity generally under threat
Individual species under threat

Conclusions

- Evaluation of ecological fragmentation be integrated into road system planning at various scales
  - Ranging from the national scale to the smallest planning units

- When planning a transportation corridor, the structure of the road network and the corresponding fragmented landscape requires the planner to **think at a landscape scale** and not just the project scale

- If a structured program of connectivity evaluation can be applied to all the roads planning, design, and maintenance, this may reduce future fragmentation pressure on China's landscape. Based on the M_{eff} analysis we did, planners should:
  - Carefully align roads in the west, taking action to conserve the existing non-fragmented areas
  - Amplify the value of less-fragmented areas in the east and the south of China by improving connectivity within and among them
  - Avoid any further fragmentation of existing natural areas, such as woodlands, wetlands, and other existing connected habitats in China