Giant Panda Habitat Distribution Across its Entire Geographic Range: A Preliminary Assessment

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Summary
The world-famous endangered giant pandas (Ailuropoda melanoleuca) depend on forested areas as shelter and understory bamboo as staple food. Although giant pandas had a wide geographic distribution in the past, they are currently restricted to five major mountainous regions in China. To understand the distribution of giant panda habitat across its entire geographic range, we have acquired relevant field and remotely sensed data. The spatial locations of panda evidence (tracks, scats, and bamboo shoots) were recorded in the field using global positioning system receivers. These were used to develop presence/availability models by means of Ecological Niche Factor Analysis, using time series of different vegetation indices (obtained from MODIS) as predictor variables. We assessed the performance of the models created with each of the predictor data sets using two different validation procedures (Minimal Predicted Area and Prediction Success). In addition, a series of landscape metrics were calculated for each mountain region in order to evaluate the degree of fragmentation of the habitat for the pandas. Preliminary analyses reveal that the habitats for the giant panda in its entire geographic range exhibits a high degree of fragmentation, particularly in the southern part of the geographic range. In addition, the temporal variability of vegetation indices provides a phenological characterization of the landscape that represents a suitable predictor of panda habitat quality. These results suggest that MCDIS data has considerable potential for endangered wildlife species habitat mapping and management.

Habitat Modeling
Model based only on Topography (Topographic Potential)
From an Elevation Model (obtained by the Shuttle Radar Topography Mission):
- Elevation: 1200 – 3800 m
- Slope: < 30°

Model based on Topography and the 2004 MODIS Time Series of Canopy Biophysical Characteristics
Ecological Niche Factor Analysis (ENFA)

Presence/Avoidance Model (Hiezel et al., 2002):
- Global n-volume (Defined by the total area extent)
- Panda n-volume (Defined by the pixels with panda occurrence)

Habitat Suitability (HS) for each pixel in the global n-volume is inversely proportional to the distance to the centroid of the Panda n-volume.

Validation
Traditional validation techniques based on contingency tables cannot be applied due to the use of presence-only data. Therefore we used:

Prediction Success (Boyle et al., 2002):
- Frequency of cross-validation plots is calculated in four HS bins
- Spearman-rank correlation coefficient is calculated for the frequency of cross-validation plots in each bin vs. bin rank
- A good model should have high Spearman-rank correlation coefficient

Minimal Predicted Area (Engler et al. 2004):
A good HS map should predict the smallest potential habitat area that comprises 90% of the panda occurrences (rule of parsimony).

Landscape Metrics
FRAGSTATS was used to calculate a series of landscape metrics on the panda habitat obtained using both the topographic potential and the ENFA model, per mountain region:
- Fragmentation (e.g., number patches, patch density, perimeter/area, shape index)
- Connectivity (e.g., patch cohesion, patch aggregation)
- Complexity (e.g., fractal dimension)

As a measure of the degree of habitat fragmentation and isolation, we calculated (per mountain region) the Euclidean Distance, in the multi-dimensional space of landscape metrics, between the topographic potential and the results from the ENFA model.

Preliminary Conclusions
- Time series of canopy biophysical characteristics (derived from MCDIS) constitute a useful environmental predictor for giant panda habitat modeling.
- The current area of panda habitat constitutes around half of the topographic potential.
- All mountain regions exhibit a high degree of habitat fragmentation and complexity, as well as high degree of isolation (i.e., low connectivity).
- Current habitat in Qinghai is closer to the topographic potential (in terms of landscape metrics) than in any other mountain region.

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Literature Cited