

Investigating the role of biological characteristics on adaptive capacity within alien and rare plant species in China

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1. Dataset - The Adaptive Capacity of Alien and Rare Species in China

The authors of this paper investigated the ability for alien plants and rare plants across China to adapt to disturbed and stressful environments. The Checklist of the Chinese Invasive Plants and the information system of the Chinese Rare and Endangered Plants were used to retrieve all alien (562) and rare (1898) species in China along with their specific invasive rank and extinction risk status. Additional data was collected from several databases, including The Flora of China, Diaspore Information Database from the Royal Botanic Gardens, and the USDA plants database, in order to categorize the biological and habitat characteristics of each alien and rare plant species. Next, adaptive capacity was calculated using the biological characteristics (reproductive strategies, dispersal strategies, and life forms) and habitat characteristics (habitat type and distribution spatial extent) of each respective plant species. The authors concluded that alien species had a higher adaptive capacity in disturbed environments while rare species had a higher adaptive capacity in stressful environments. Their specific biological and habitat characteristics also gave a potential explanation as to why the distribution of alien plants may tend to expand whereas that of rare plants tends to stay constant or shrink.

2. Hypotheses and Predictions

Overall Hypotheses

- H_0 - plant species of different invasive rank and extinction risk status do not differ in biological characteristics (dispersal strategies, reproductive strategies, life forms), habitat types, and adaptive capacity
- H_1 - plant species of different invasive rank and extinction risk status do differ in biological characteristics (dispersal strategies, reproductive strategies, life forms), habitat types, and adaptive capacity

This is a large undertaking. So supplemental hypotheses could be (*the null hypotheses can be assumed*):

- H_1 : Alien plant species of different invasive rank populate different habitat types
 - Prediction: The higher the invasive rank of the alien plant species, the more likely they are to populate habitat types that are the most disturbed
- H_2 : Rare plant species of different extinction risk status populate different habitat types
 - Prediction: The more endangered the rare plant species, the more likely they are to populate habitat types that are the most stressful

- H₃: Alien plant species of different invasive rank significantly differ in their adaptive capacity scores
 - Prediction: The higher the invasive rank of the alien plant species, the higher their adaptive capacity score
- H₄: Rare plant species of different extinction risk status significantly differ in their adaptive capacity scores
 - Prediction: The higher the extinction risk status of the rare plant species, the more extreme their adaptive capacity score
- H₅: Alien plant species differ significantly in their number of dispersal strategies and reproductive modes
 - Prediction: Alien species with more extreme invasive rank have greater numbers of dispersal strategies and reproductive modes.

3. R (*our*.. hehe get it) Game Plan

- All plants species (rare and alien) on a graph against adaptive capacity → just to see everything
 - A brief overview of data collection methods
- To answer: if there's a correlation between invasive rank in alien plants and extinction risk status in rare plants
 - For Alien Plants:
 - Group by invasive rank, summarize by mean adaptive capacity score
 - For Rare Plants:
 - Group by extinction risk status, summarize by mean adaptive capacity score
- Investigate how reproductive and dispersal strategies impact adaptive capacity, (ie. if one factors is responsible for driving more differences in adaptive capacity)
 - Test whether there is a strong relationship between reproductive strategy type and adaptive capacity
 - Perform a multivariate ANOVA?
 - WE COULD ALSO SIMPLIFY THIS BY USING REPRODUCTIVE MODE SCORE (so, a continuous independent variable rather than category) → Then we can use a simple t-test or a linear correlation
 - “Score” in this case is a column representing categorical data in numeric form
 - Test whether there is a strong relationship between dispersal strategy type and adaptive capacity
 - Perform a multivariate ANOVA?

- WE COULD ALSO SIMPLIFY THIS BY USING DISPERSAL STRATEGY SCORE (so, a continuous independent variable rather than category) --> Then we can use a simple t-test or a linear correlation
 - “Score” in this case is a column representing categorical data in numeric form
- The specific section of the dataset to analyze (e.g., which columns)
 - Dispersal strategies (and score), reproductive modes (and score), habitat type, life forms, adaptive capacity to stressful environments, and adaptive capacity to disturbed environments

4. Citation

Zhou, Q., Xin, Z., Wang, Y., Miao, R., Liu, Z., Zong, L., Li, X., Ma, Q., Liang, W., Yu, H., & Wang, L. (2022). The Adaptive Capacity of Alien and Rare Species in China. *Forests*, 13(12), 2005. <https://doi.org/10.3390/f13122005>

Marking Scheme (3 marks total)

Option 1: Hypotheses, Predictions, and Data Source

- **Hypotheses and Predictions:** 2 marks (Demonstrate effort in formulating clear and relevant hypotheses and predictions)
- **Data Source Description:** 1 mark (Identify a suitable dataset and provide a brief overview)

Grading Focus:

These components will primarily be graded on completion. The goal of this assignment is to encourage early project initiation and ensure you are on the right track.

<https://www.mdpi.com/1999-4907/13/12/2005>

To note about the paper:

- Adaptive capacity: tolerance to possible disturbed and stressful environments based on their biological and habitat characteristics (there are many biological and habitat characteristics mentioned in this paper)

“Our aim was to answer why the distribution of alien plants may tend to expand whereas that of rare plants tends to stay constant or shrink.”

- alien plants categorized into 6 invasive ranks
- rare plants categorized into 8 extinction rank statuses
- goal: answer why distribution of alien plants may tend to expand while rare plants tend to stay constant/shrink
- IDEA: we come up with new goal—> answer if there’s a correlation with rank of alien and rank of extinction in rare
- 5 dispersal strategies for alien and rare
- percentage of dispersal strategy: “the total number of each dispersal strategy to the total number of five dispersal strategies in all species”
- asexual and sexual reproduction categorized into 5 modes —> categorized # of strategies into 1,2,3,3+ —> also go a percentage
- categorized into live forms

- habitats types grouped into 10 categorized (dry to wet) —> counted to calculate adaptive capacity —> categorized # of habitats 1,2,3,3+
- total distribution calculated according to geological distribution: 4 categories