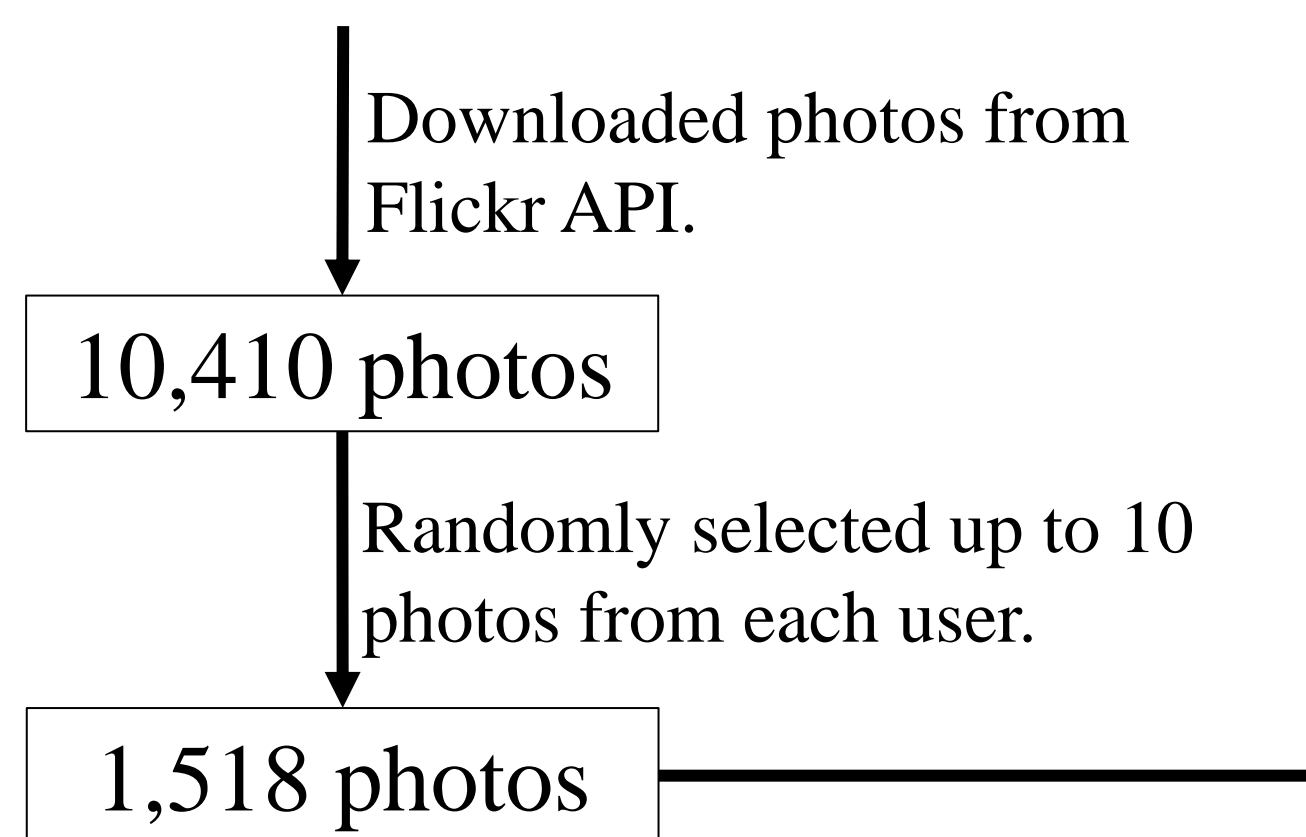


## Abstract

Cultural Ecosystem Services (CES) serve as a crucial link between humans and nature and are closely related to tourism development, thereby impacting the local economy. However, research has been sparse in evaluating CES values on Lyudao, despite the crucial economic role played by tourism on this island. This study aims to assess the distribution of CES categories on Lyudao through social media images analysis, with a focus on understanding the relationships among different CES categories, and establishing reference standards for CES categories evaluation in tourism-oriented islands. Our findings reveal that the predominant values of CES on Lyudao are outdoor recreation and landscape aesthetics, aligning with the island's tourism-oriented image. Analysis shows strong positive correlations between CES values with temporal and spatial grouping. In correlation analysis grouped by month, the strongest correlation was observed between landscape aesthetics value and cultural identity value. When grouped by location, the strongest correlation was found between outdoor recreation value and landscape aesthetics value. Moreover, heatmaps show clumped distribution for most CES values, while the dispersion of existence value reflects the scattered distribution of flora and fauna on Lyudao. Furthermore, we found low levels of spiritual and religious value, and since this value represents similar topics to cultural identity, it would be beneficial for future research to consider integrating these categories when studying CES on Lyudao.

## Data Collection and Analysis

Photos on Flickr that are located within the boundaries of Lyudao, and uploaded between the years 2000 and 2022.

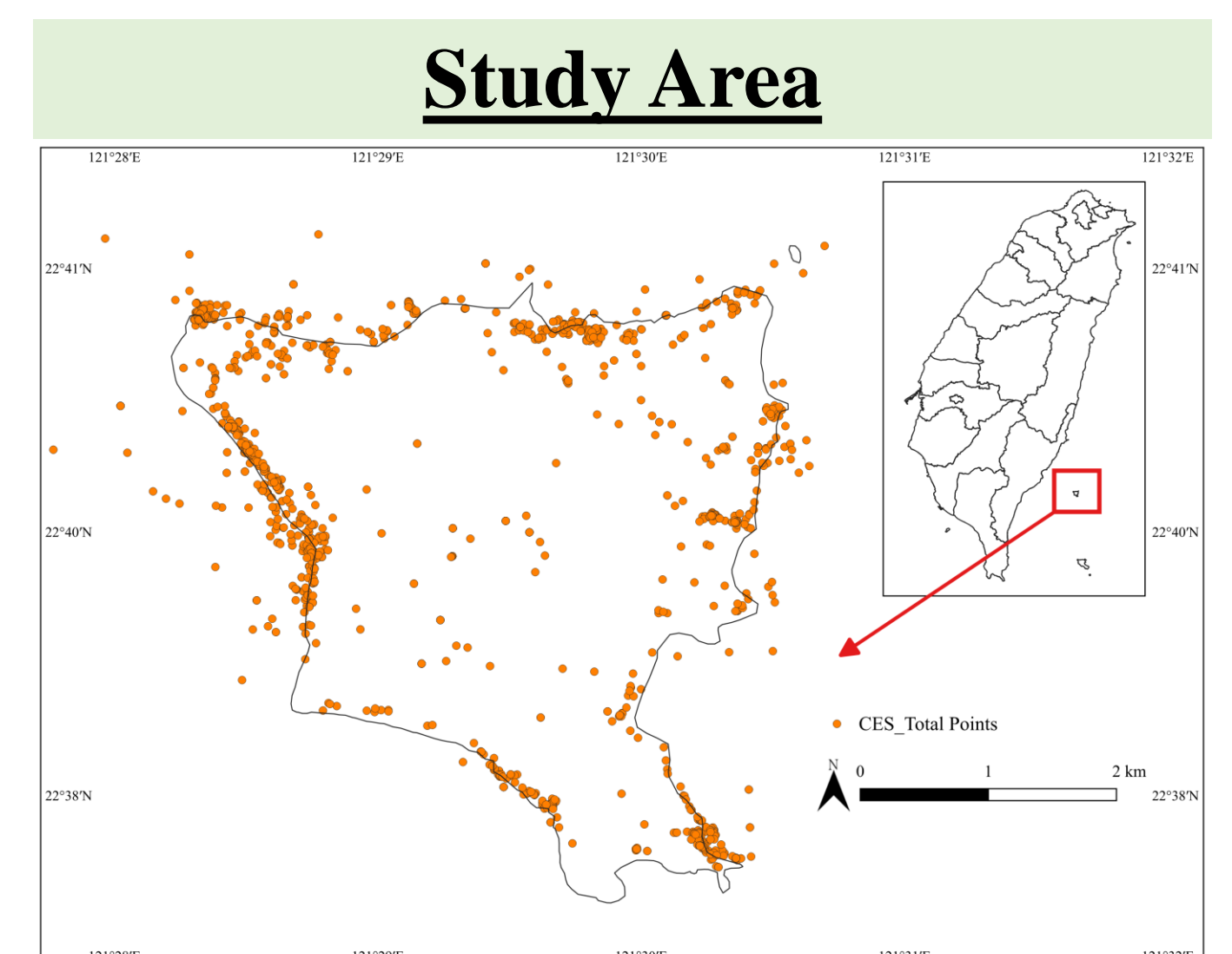


Categorized photos based on CES classification. (Table 1.)

Remove the data with Value = 8.  
Conducted correlation analysis based on grouping by month and location.  
To create a heatmap using Kernel Density Estimation, the Scott's rule of thumb was used to determine the appropriate bandwidth, and estimation was performed with a quartic kernel shape.

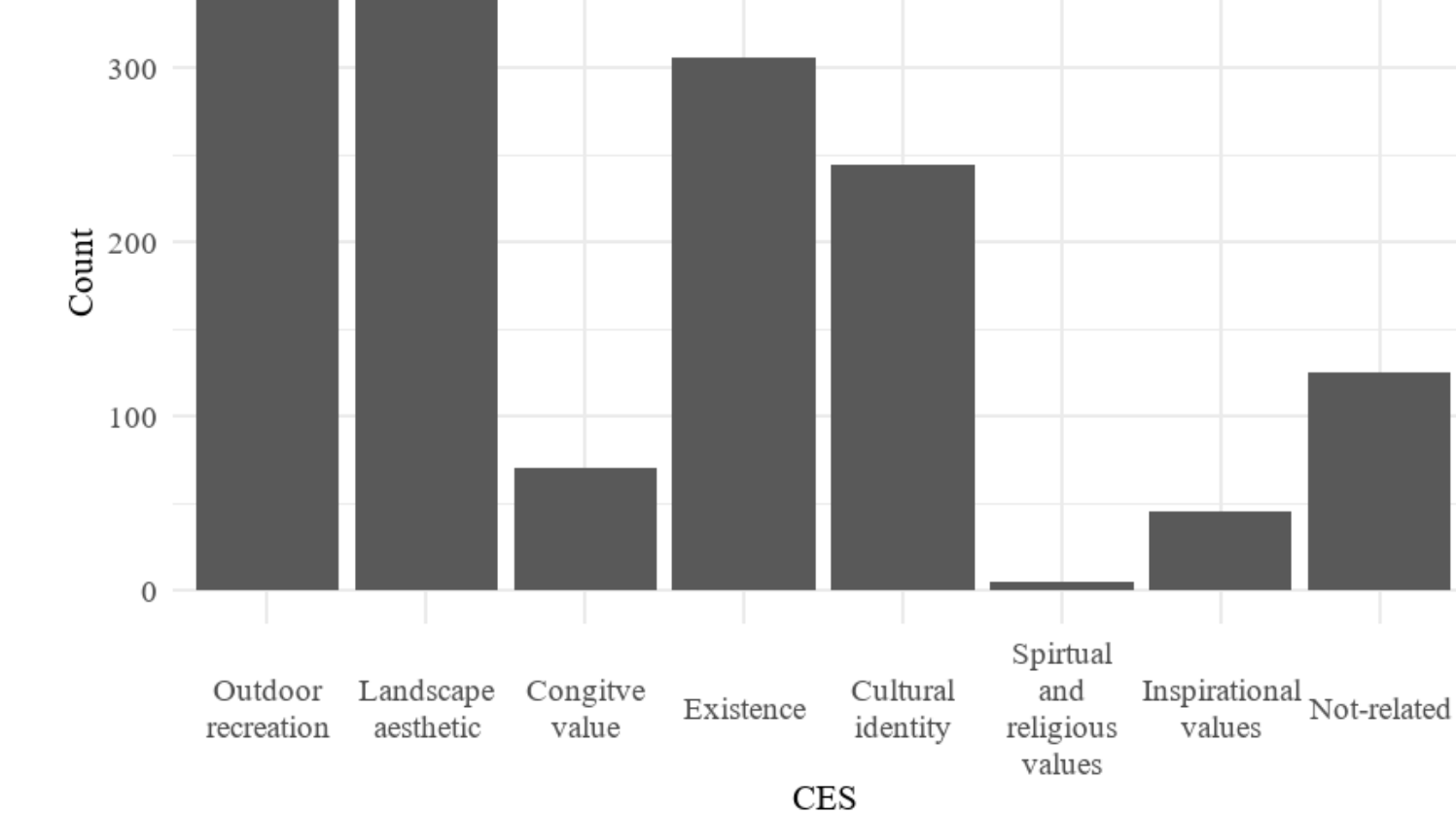
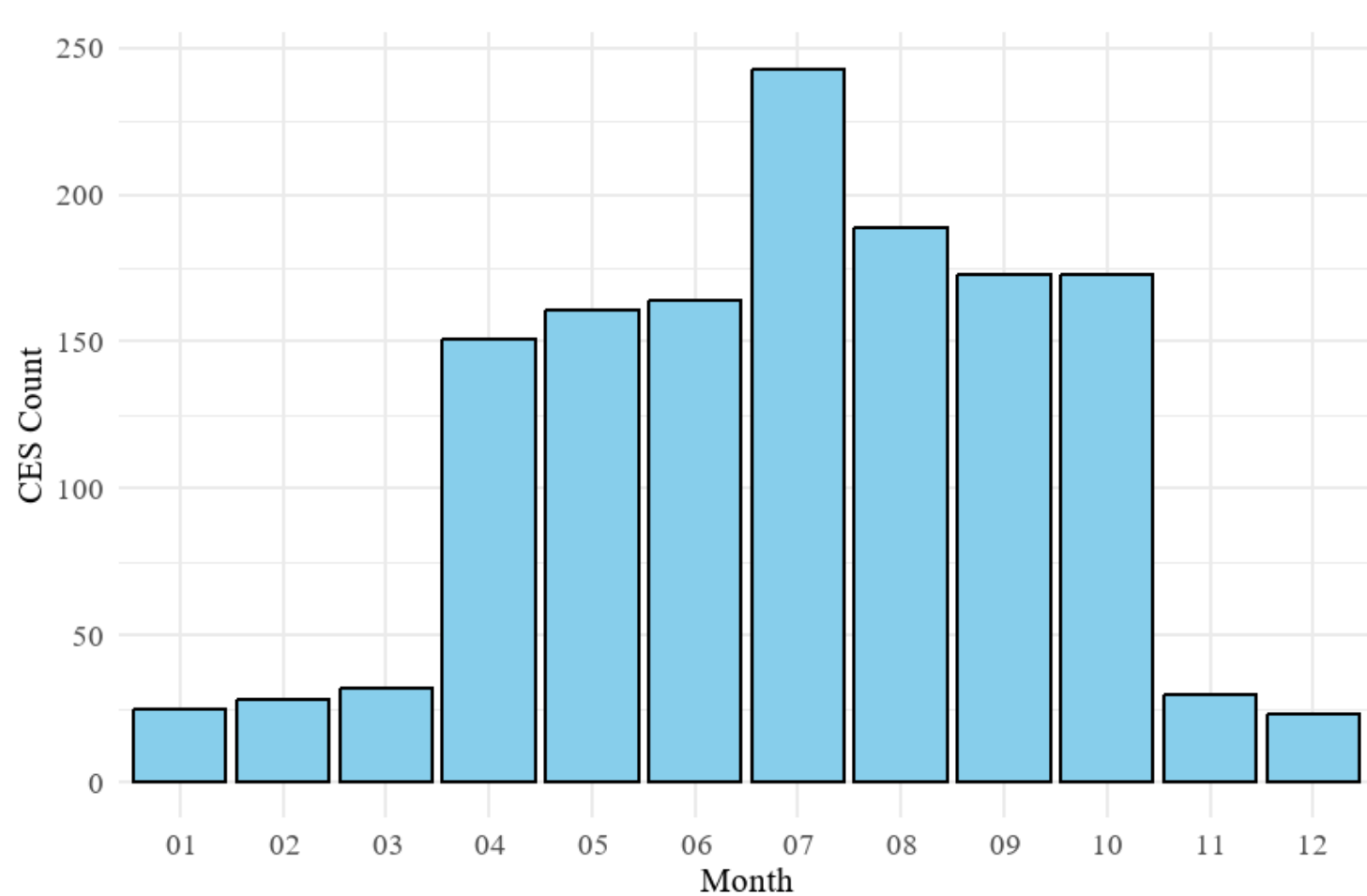
Table 1. Categories for CES values based on CICES (v 5.2)

VALUE	CES category
1	Outdoor recreation
2	Landscape aesthetic
3	Cognitive value
4	Existence
5	Cultural identity
6	Spiritual and religious value
7	Inspirational value
8	Not-related

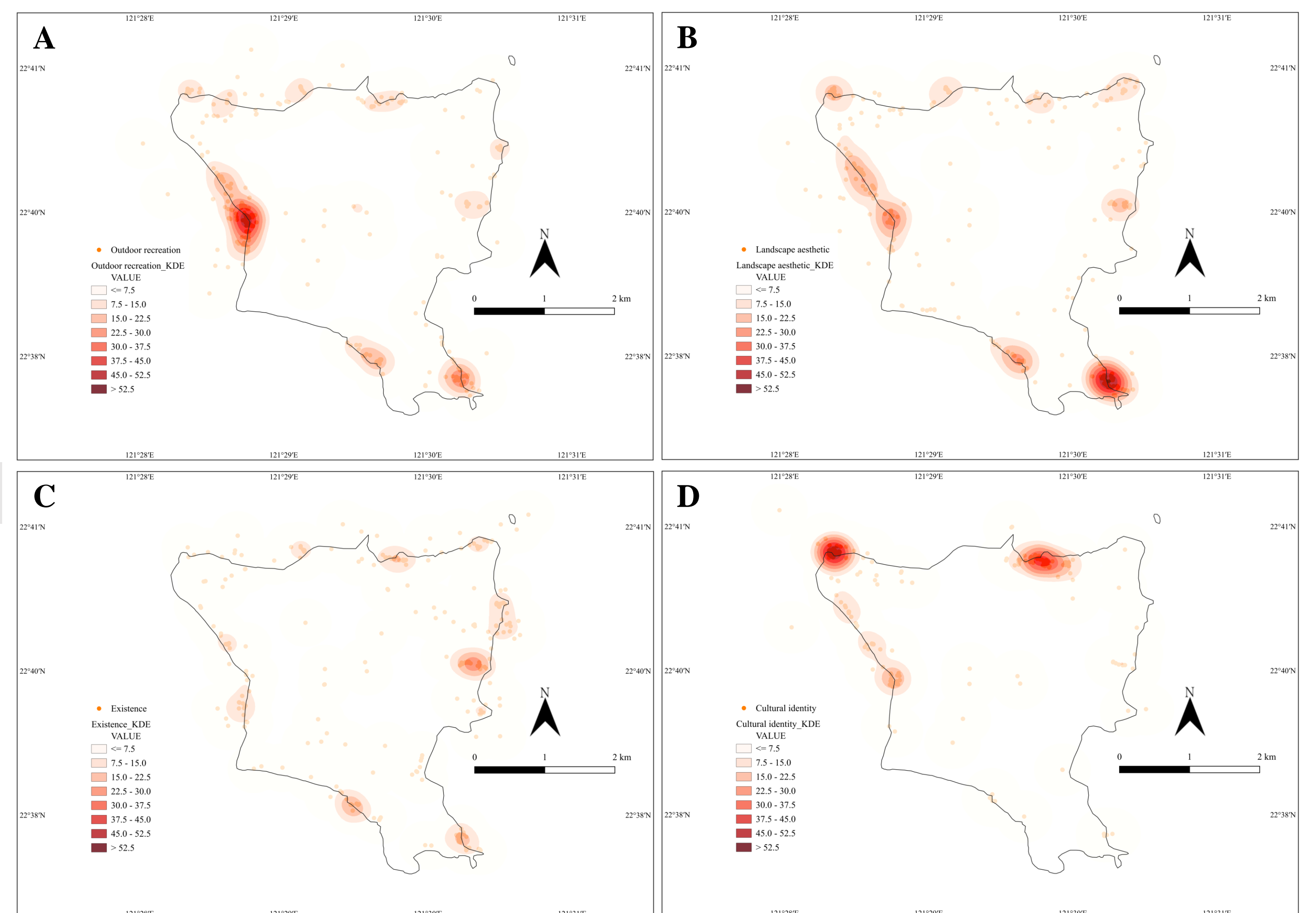


## Results

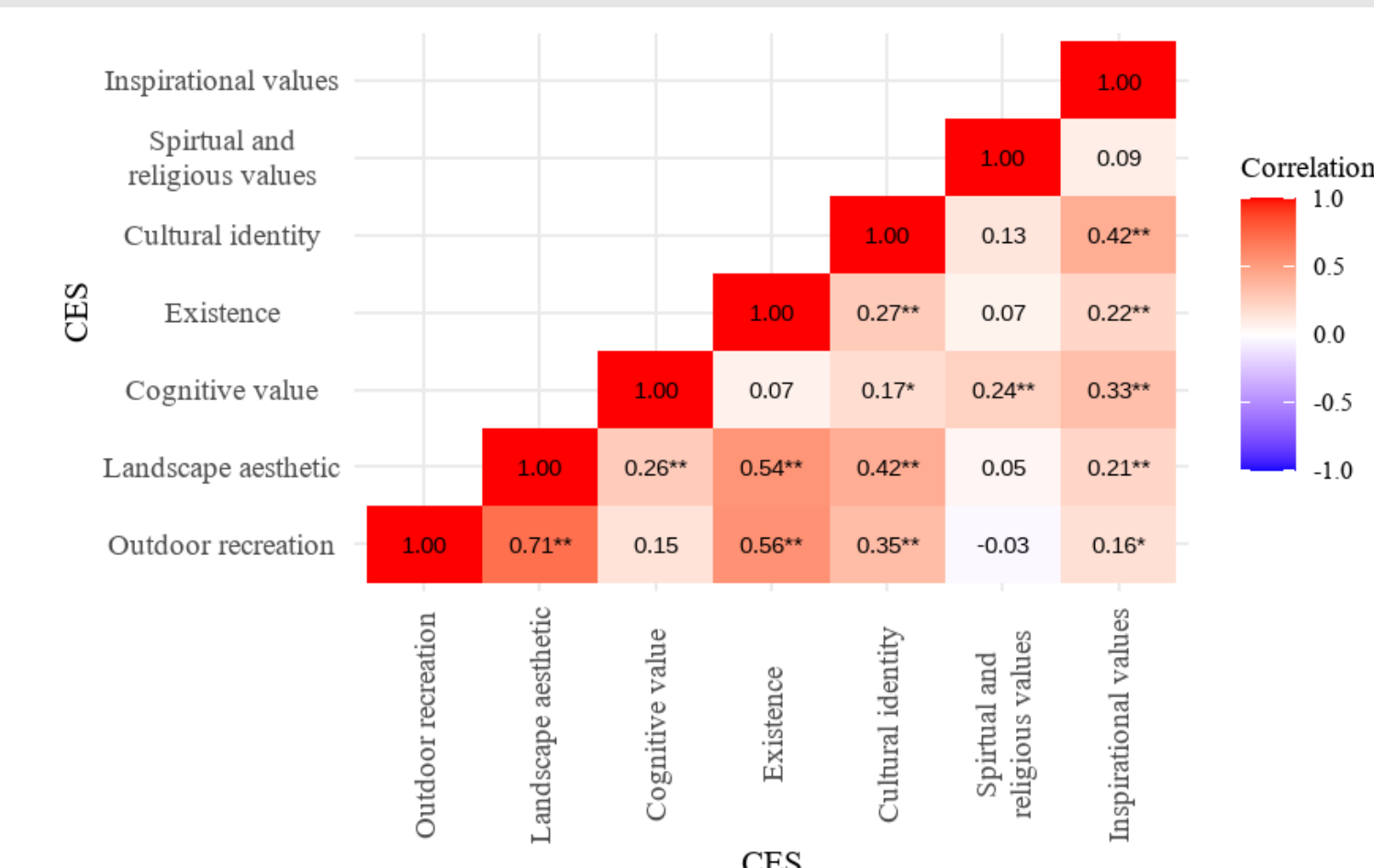
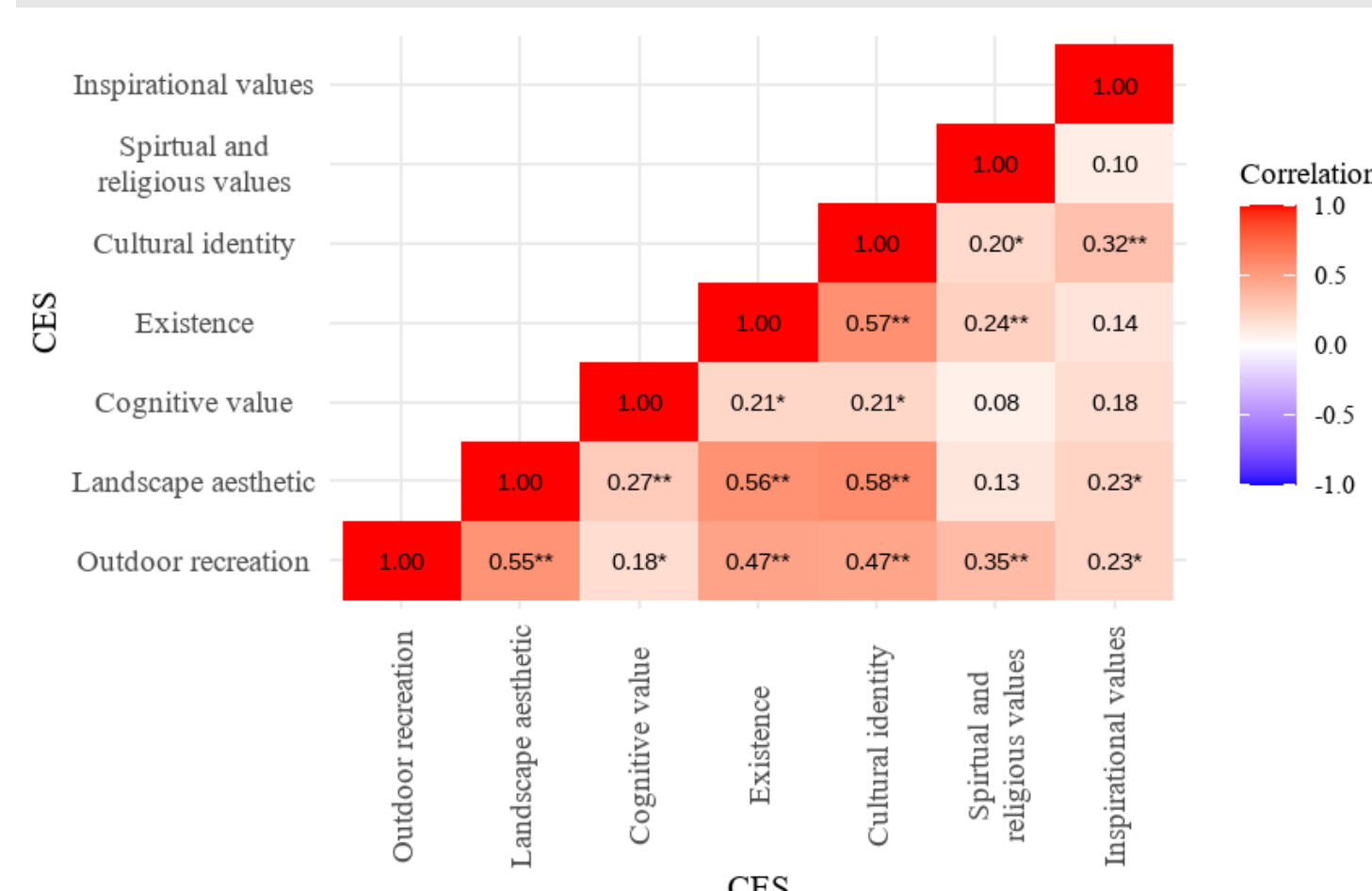
### Data Distribution



### Kernel Density Estimation Heatmap



### Correlation Analysis



## Discussions

- For Lyudao, outdoor recreation and landscape aesthetics are the predominant CES values, aligning with our expectations for a tourism-oriented island.
- The samples for spiritual and religious value are relatively scarce and, in terms of definition, are similar to those in the cultural identity category. Future studies in Lyudao could consider merging them.
- Regardless of whether grouped by month or location, most CES values are positively correlated. This may be due to the fact that variations in months (such as tourism off-seasons and peak seasons) and environmental characteristics of specific locations exert similar influences on multiple CESs.
- In the correlation analysis grouped by month, the strongest correlation was found between landscape aesthetics value and cultural identity value, likely because we included photos of distinct geological formations in cultural identity category, which closely aligns with landscape aesthetics category.
- When grouped by location, the strongest correlation was found between outdoor recreation value and landscape aesthetics value, which may suggest that these two categories overlap in terms of location. This overlap indicates that areas valued for their landscape aesthetics are often the same locations where outdoor recreational activities are popular.
- Existence category appears more dispersed on the heatmap, likely because flora and fauna on Lyudao are not concentrated in specific areas.

## Appendix

