Advancing Endangered Species Conservation: Insights and Evidence-Based Approaches from Recent Research Studies

Molly Findley

University of Denver University College

February 19, 2023

Faculty: Fenton Kay

Director: John Hill, PhD

Dean: Michael J. McGuire, MLS

Abstract

This analysis focuses on four research articles published in credible, peer-reviewed journals that address critical issues related to the conservation of endangered species and wildlife. The studies were selected for their contributions to understanding the impacts of human activities on endangered species, evaluating the effectiveness of conservation approaches, and providing data-driven recommendations for conservation planning. These studies include a research article on using UAS and machine learning to assess the suitability of expanding natural habitats for endangered flora species, a study on the impact of environmental changes on the gut microbiome of endangered species, a research article on using SDMs and decision tools to guide surveys and translocations of endangered species, and an article on the effectiveness of protected areas in representing tropical Andean species. The analysis provides a summary of the key findings of these studies, highlighting their contributions to wildlife conservation and their implications for conservation policies and practices. Overall, the studies emphasize the need for effective and evidence-based conservation planning, including habitat conservation and management, and the importance of maintaining natural diets to support the health and survival of endangered species.

Table of Contents

Summaries

Endangered species and wildlife conservation are critical global issues that require effective and evidence-based approaches to protect biodiversity and ecosystem health. Over the past decade, a range of research studies have been published in credible, peer-reviewed journals that have focused on understanding the impacts of human activities on endangered species, evaluating the effectiveness of conservation approaches, and providing data-driven recommendations for conservation planning. Four such studies were selected for this analysis, including a study on using UAS and machine learning to assess the suitability of expanding natural habitats for endangered flora species, a research article on the impact of environmental changes on the gut microbiome of endangered species, a study on using SDMs and decision tools to guide surveys and translocations of endangered species, and an article on the effectiveness of protected areas in representing tropical Andean species. This analysis provides a summary of the key findings of these studies, highlighting their contributions to wildlife conservation and their implications for conservation policies and practices.

In "A UAS and Machine Learning Classification Approach to Suitability Prediction of Expanding Natural Habitats for Endangered Flora Species" a novel method is proposed to assess the suitability of expanding natural habitats for endangered flora species using unmanned aerial systems (UAS) and machine learning (Jurisic et al. 2022). The study focuses on the expansion of the endangered Hesperocyparis macrocarpa (Monterey cypress) habitat in California, USA. The authors used UAS imagery to collect high-resolution data on the vegetation structure, and used a machine learning algorithm to classify the habitats according to their

suitability for H. macrocarpa (Jurisic et al. 2022). The results of the study suggest that the proposed method can accurately predict the suitability of expanding natural habitats for endangered flora species. The authors believe that this method can be extended to other endangered flora species and can help inform conservation efforts and management practices.

Research published in "Gut microbiome variations in Rhinopithecus roxellanae caused by changes in the environment" investigates the impact of environmental changes on the gut microbiome of the endangered golden snub-nosed monkey (Rhinopithecus roxellanae) in China. The study analyzes the fecal microbiota of the monkeys in both wild and captive settings to determine how the microbial community varies in response to changes in diet and environmental conditions (Zhao et al. 2023). The results show that the gut microbiome of the captive monkeys is less diverse than that of the wild monkeys, with a reduction in the number of beneficial bacteria. Additionally, the gut microbiome of the captive monkeys is less adaptable to changes in diet. The authors conclude that environmental changes, such as the loss of natural habitat and the introduction of captive diets, can significantly impact the gut microbiome of endangered species like the golden snub-nosed monkey, which can have negative implications for their overall health and survival (Zhao et al. 2023).

In a recent investigation by Eyre et al., "Using species distribution models and decision tools to direct surveys and identify potential translocation sites for a critically endangered species," describes the development of a framework to guide surveys and translocations of the critically endangered mahogany glider (Petaurus gracilis) in Australia. The study utilizes species distribution models (SDMs) to identify areas that are most suitable for the gliders, and decision tools to evaluate the costs and benefits of potential translocation sites (Eyre et al. 2022). The

authors also conducted on-ground surveys to validate the results of the SDMs and identify additional potential translocation sites. The study found that the SDMs accurately predicted the distribution of the mahogany glider, and that the decision tools helped prioritize potential translocation sites based on factors such as habitat quality, proximity to existing populations, and conservation value (Eyre et al. 2022). The authors suggest that this framework can be applied to other endangered species and can help guide conservation efforts and translocation programs.

The article "The performance of protected-area expansions in representing tropical Andean species: past trends and climate change prospects" evaluates the effectiveness of protected areas in representing tropical Andean species in South America. The study analyzes the historical expansion of protected areas and models the potential impact of future climate change on species distributions (Fajardo et al. 2023). The authors found that while the number of protected areas has increased, the proportion of suitable habitat within protected areas has decreased over time. Additionally, the study projects that climate change will lead to further habitat loss and range shifts, with potential negative effects on species conservation. The authors suggest that to maintain the effectiveness of protected areas in conserving tropical Andean species, future conservation efforts should focus on connecting protected areas and expanding their coverage to include areas with high conservation value and climate change resilience (Fajardo et al. 2023).

Analysis

The evidence presented in the four articles can support various conservation approaches. For example, the study on using UAS and machine learning classification to assess the suitability of expanding natural habitats for endangered flora species can inform conservation efforts by providing accurate predictions of the suitability of habitats for species conservation (Jurisic et al. 2022). Similarly, the research on the impact of environmental changes on the gut microbiome of endangered species highlights the need for habitat restoration and maintenance of natural diets to support the health and survival of endangered species (Zhao et al. 2023). The study on using SDMs and decision tools to guide surveys and translocations of endangered species can provide a framework for effective conservation planning and translocation programs (Eyre et al. 2022). Finally, the article on the effectiveness of protected areas in representing tropical Andean species highlights the need for continued expansion and connection of protected areas to maintain their effectiveness in conserving endangered species (Fajardo et al. 2023). All of the articles focus on the habitats of species and how to better improve their surroundings for their survival.

The present analysis highlights the ways in which habitat protection is conceptualized across four peer-reviewed articles. While the studies vary in their foci and methodologies, two broad approaches to habitat protection emerge. Specifically, the research article on Unmanned Aerial Systems (UAS) and Species Distribution Models (SDMs) emphasize the utility of leveraging technology to advance species conservation. Given the growing prominence of technology in many domains of contemporary life, it is imperative that these tools are effectively deployed in the service of conservation goals. Indeed, by utilizing UAS and SDMs,

researchers are able to effectively monitor and identify habitats that are well-suited for species survival. Conversely, the research articles on gut microbiomes and expanding protected areas emphasize the importance of effective ecosystem management within habitats to promote species success. These studies underscore the need to address broader ecological factors that impact species health and survival, and highlight the potential benefits of expanding protected areas to support biodiversity and ecosystem health.

In general, the class agreed that the evidence presented in the articles highlights the importance of accurate data and effective conservation planning for the protection of endangered species. The studies showed that a range of methods, including UAS imagery, machine learning, SDMs, and decision tools, can be used to assess habitat suitability, guide surveys, and translocations, and prioritize conservation efforts. Additionally, the studies emphasized the need for habitat conservation and management, as well as the importance of maintaining natural diets to support the health and survival of endangered species. Overall, the articles were seen as supporting the goals of the ESA to "conserve species and ecosystems through the prohibition of federal and private activities that destroy species and their habitats" (Czech and Krausman 2001, 50).

However, as we've seen in discussions, the ESA is not accomplishing their goals as quickly and effectively as it aspired. While steps are taken to preserve and conserve species, species are added more quickly than the act can enable enough protection to remove them. All of the recommendation in these articles pertain to endangered species and thus have been listed by the ESA. The findings from the articles elaborate on processes that could be used by ESA to better identify species for protection and how to ensure they will have a viable habitat.

The studies reviewed in this analysis provide valuable insights into the challenges of conserving endangered species and wildlife, and they offer evidence-based approaches to address these challenges. By leveraging technological innovations such as UAS and machine learning, researchers are finding new ways to assess habitat suitability and guide conservation efforts. Moreover, studies that examine the impact of environmental changes on the gut microbiome of endangered species have important implications for conservation practices, particularly in terms of the need to maintain natural diets for these species. In addition, studies that utilize species distribution models and decision tools to guide surveys and translocations of endangered species offer valuable data-driven recommendations for conservation planning. Finally, the study on the effectiveness of protected areas in representing tropical Andean species highlights the importance of preserving and managing natural habitats to support biodiversity and ecosystem health. Collectively, these studies draw the attention to the importance of developing evidence-based conservation strategies that are tailored to the unique needs of individual species and ecosystems.

References

Czech, Brian and Paul R. Krausman. 2001. The Endangered Species Act: History, Conservation, Biology, and Public Policy. 1st Edition Johns Hopkins University Press.

Eyre, Arabella C., Natalie J. Briscoe, Dan K. P. Harley, Lindy F. Lumsden, Leo B. McComb, and Pia E. Lentini. 2022. "Using Species Distribution Models and Decision Tools to Direct Surveys and Identify Potential Translocation Sites for a Critically Endangered Species." *Diversity & Distributions* 28, no. 4: 700–711. https://doi.org/10.1111/ddi.13469.

Fajardo, Javier, Janeth Lessmann, Christian Devenish, Elisa Bonaccorso, Ángel M. Felicísimo, Fernando J. M. Rojas-Runjaic, Haidy Rojas, Miguel Lentino, Jesús Muñoz, and Rubén G. Mateo. 2023. "The Performance of Protected-Area Expansions in Representing Tropical Andean Species: Past Trends and Climate Change Prospects." *Scientific Reports* 13, no. 1: 966. https://doi.org/10.1038/s41598-022-27365-7.

Jurišić, Mladen, Dorijan Radočaj, Ivan Plaščak, and Irena Rapčan. 2022. "A UAS and Machine Learning Classification Approach to Suitability Prediction of Expanding Natural Habitats for Endangered Flora Species." *Remote Sensing* 14, no. 13: 3054. https://doi.org/10.3390/rs14133054.

Zhao, Gang, Mingpu Qi, Qiankun Wang, Changmin Hu, Xiang Li, Yingyu Chen, Jingyuan Yang, Huiliang Yu, Huanchun Chen, and Aizhen Guo. 2023. "Gut Microbiome Variations in Rhinopithecus Roxellanae Caused by Changes in the Environment." *BMC Genomics* 24, no. 1: 62. https://doi.org/10.1186/s12864-023-09142-6.