



# SPATIAL MODELING

for the Global Biodiversity Framework



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# SUSTAINING NATURE IN OUR CHANGING WORLD

## Overview

The incredible diversity of all life on our planet, or biodiversity, is under unprecedented threat in our rapidly developing world. Around 25 percent of formally assessed plant and animal groups are threatened, suggesting that around one million species face extinction, many within decades. Rapid and ill-advised human development and the resulting fragmentation of natural systems not only threaten the existence of plants and animals, but essential ecological services that are crucial to human well-being. We depend on nature for our food, medicine, energy, clean air and water, and for resilience in the face of disasters. A healthy natural world is integral to human well-being and intertwined with cultural well-being worldwide.

The global community has recognized the dire threat of biodiversity loss to humanity. In 2022, over 190 countries, organized under the United Nations Convention on Biological Diversity, adopted the Kunming-Montreal Global Biodiversity Framework (GBF). The GBF defines a plan of action for sustainability on our planet. It aligns with other sustainable development initiatives and sets out an ambitious plan to guide actions locally and around the world to transform our relationship with biodiversity by 2030, and to achieve harmony between humanity and the natural world by 2050. The goals and targets of the GBF present an opportunity for all actors working towards a more sustainable planet to organize and monitor their efforts around this carefully articulated and comprehensive framework.

## The Global Biodiversity Framework

### 2030 MISSION

“To take urgent action to halt and reverse biodiversity loss to put nature on a path to recovery for the benefit of people and planet by conserving and sustainably using biodiversity and by ensuring the fair and equitable sharing of benefits from the use of genetic resources, while providing the necessary means of implementation.”

### 2050 VISION

“The vision of the Kunming-Montreal Global Biodiversity Framework is a world of living in harmony with nature where ‘by 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people.’”

# THE KUNMING-MONTREAL GLOBAL BIODIVERSITY FRAMEWORK 2030 TARGETS

The goals outlined in the UN Kunming-Montreal Global Biodiversity Framework (GBF) focus on 23 global targets for urgent action over the decade to 2030. The targets are as follows:

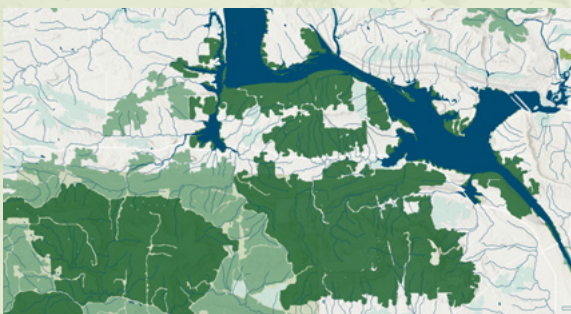
|            |   |
|------------|---|
| Target 1:  | Plan and Manage all Areas to Reduce Biodiversity Loss   |
| Target 2:  | Restore 30% of All Degraded Ecosystems  |
| Target 3:  | Conserve 30% of Land, Waters and Seas   |
| Target 4:  | Halt Species Extinction, Protect Genetic Diversity, and Manage Human-Wildlife Conflicts                                 |
| Target 5:  | Ensure Sustainable, Safe and Legal Harvesting and Trade of Wild Species   |
| Target 6:  | Reduce the Introduction of Invasive Alien Species by 50% and Minimize Their Impact                                      |
| Target 7:  | Reduce Pollution to Levels That Are Not Harmful to Biodiversity   |
| Target 8:  | Minimize the Impacts of Climate Change on Biodiversity and Build Resilience   |
| Target 9:  | Manage Wild Species Sustainably to Benefit People   |
| Target 10: | Enhance Biodiversity and Sustainability in Agriculture, Aquaculture, Fisheries, and Forestry                            |
| Target 11: | Restore, Maintain and Enhance Nature's Contributions to People  |
| Target 12: | Enhance Green Spaces and Urban Planning for Human Well-Being and Biodiversity   |
| Target 13: | Increase the Sharing of Benefits from Genetic Resources, Digital Sequence Information and Traditional Knowledge         |
| Target 14: | Integrate Biodiversity in Decision-Making at Every Level  |
| Target 15: | Businesses Assess, Disclose and Reduce Biodiversity-Related Risks and Negative Impacts                                  |
| Target 16: | Enable Sustainable Consumption Choices to Reduce Waste and Overconsumption  |
| Target 17: | Strengthen Biosafety and Distribute the Benefits of Biotechnology   |
| Target 18: | Reduce Harmful Incentives by at Least \$500 Billion per Year, and Scale Up Positive Incentives for Biodiversity         |
| Target 19: | Mobilize \$200 Billion per Year for Biodiversity from All Sources, Including \$30 Billion Through International Finance |
| Target 20: | Strengthen Capacity-Building, Technology Transfer, and Scientific and Technical Cooperation for Biodiversity            |
| Target 21: | Ensure That Knowledge Is Available and Accessible to Guide Biodiversity Action  |
| Target 22: | Ensure Participation in Decision-Making and Access to Justice and Information Related to Biodiversity for All           |
| Target 23: | Ensure Gender Equality and a Gender-Responsive Approach for Biodiversity Action   |

# GEOGRAPHY AND THE GLOBAL BIODIVERSITY FRAMEWORK



## Everything Is Somewhere

Geography is one of the oldest sciences, used by ancient civilizations to understand and describe the world. By advancing our understanding of the places that make up our world, geography provides a framework for how location matters, and everything is spatially interconnected. In modern times, the core principles of geography have been coupled with powerful computing technology. The result is geographic information system (GIS) technology, which enables unprecedented management, visualization, analysis, and sharing of data, revealing connections and insights like never before.



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A quick review of the GBF targets reveals dozens of geographic interests, including spatial planning, areas of high importance, connectivity, area-based, pathways, traditional territories, landscapes, seascapes, and the ocean. Most of the GBF targets would be difficult or impossible to measure or quantify without considering geography. GIS allows users to not only produce maps concerning GBF topics, but also to leverage the power of spatial modeling, advanced spatial statistics, and data science to better understand, manage, and monitor key data to support the GBF targets.

## Spatial Modeling Enables

- Understand where.
- Measure the real world.
- See how places relate.
- Identify the best location and routes.
- Detect and quantify patterns.
- Make data-informed predictions.



# ACTIONABLE CONSERVATION SCIENCE FOR THE GLOBAL BIODIVERSITY FRAMEWORK

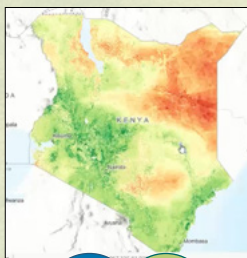
## Webinar Series

To better understand how to apply GIS and spatial modeling to your efforts towards the Global Biodiversity Framework (GBF) targets, watch these recorded webinars by experts at Esri. You'll gain insights from spatial scientists on actionable tools and workflows to establish a baseline and track your progress.



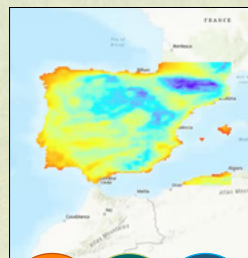
### Webinar 1

Combining and Integrating Ecological Data



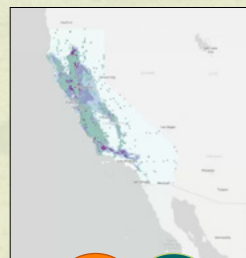
### Webinar 2

Sampling and Environmental Attribution



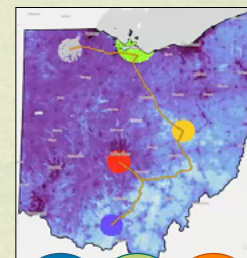
### Webinar 3

Species Distribution Modeling



### Webinar 4

Regionalization and Optimization



# LEARNING TUTORIALS

Now that you've seen in the webinars what's possible when you develop GIS skills to support your progress toward the GBF targets, it's time to build on those skills in specific tutorials. In this series of tutorials, you will access data from leading global biodiversity data providers. After completing these lessons, you will have the skills to repeat these spatial modeling approaches for your areas of interest around the world.

## TUTORIAL: MODEL CONSERVATION SUITABILITY





In this tutorial, you will take on the role of a Kenyan conservation professional using spatially informed decision-making tools to prioritize areas for conservation to reach 30x30—a global initiative aimed at protecting 30 percent of Earth's land and ocean areas by the year 2030—in Kenya.

You will use layers from ArcGIS® Living Atlas of the World to determine how much area is currently conserved and how much more needs to be conserved to meet that goal. Once you have done so, you will use the Suitability Modeler in ArcGIS Pro to analyze multiple data layers and determine high-priority areas for conservation in order to meet GBF targets.

TARGET  
2


TARGET  
3

TopicsTutorials



# Model conservation suitability

Work toward the 30x30 goal as a conservation planner, using Living Atlas data and Suitability Modeler in ArcGIS Pro.



Author

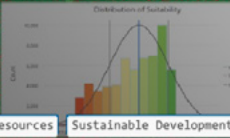
Bob Booth

Duration

1hr(s)

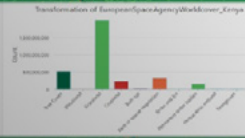
Difficulty

Intermediate



Legend

| Value | Category  | Suitability    |
|-------|-----------|----------------|
| 1     | Very Low  | Low            |
| 2     | Low       | Medium         |
| 3     | Medium    | High           |
| 4     | High      | Very High      |
| 5     | Very High | Extremely High |



Transformation of Suitability

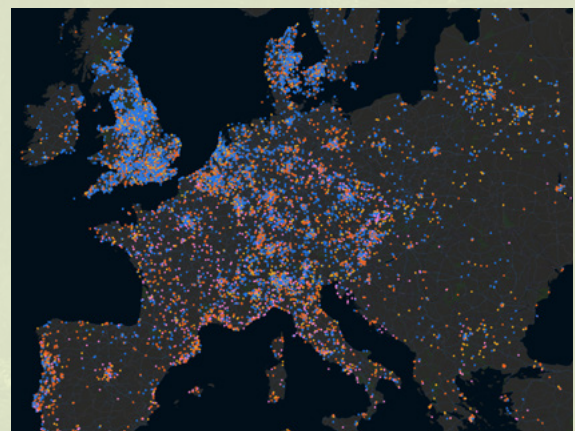
| Category  | Count   |
|-----------|---------|
| Very Low  | 1000000 |
| Low       | 2000000 |
| Medium    | 3000000 |
| High      | 4000000 |
| Very High | 5000000 |

Spatial Analysis & Data ScienceGovernmentNatural ResourcesSustainable Development

6

## TUTORIAL: PREPARE DATA FOR SPECIES DISTRIBUTION MODELING

In this tutorial, you'll acquire and prepare data for species distribution modeling of the European badger, including presence data, environmental factors, and pseudo-absence points. You'll learn to generate pseudo-absence points using random generation to complement presence data, improving model accuracy. Lastly, you'll extract environmental data to analyze the badger's habitat preferences, such as well-drained soils, vegetation cover, and mid-elevation areas.



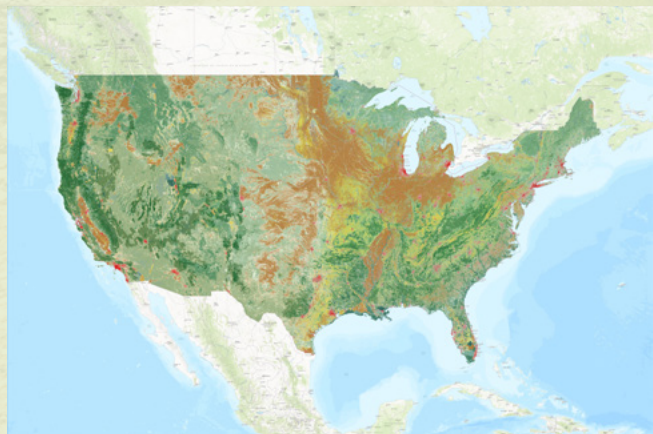
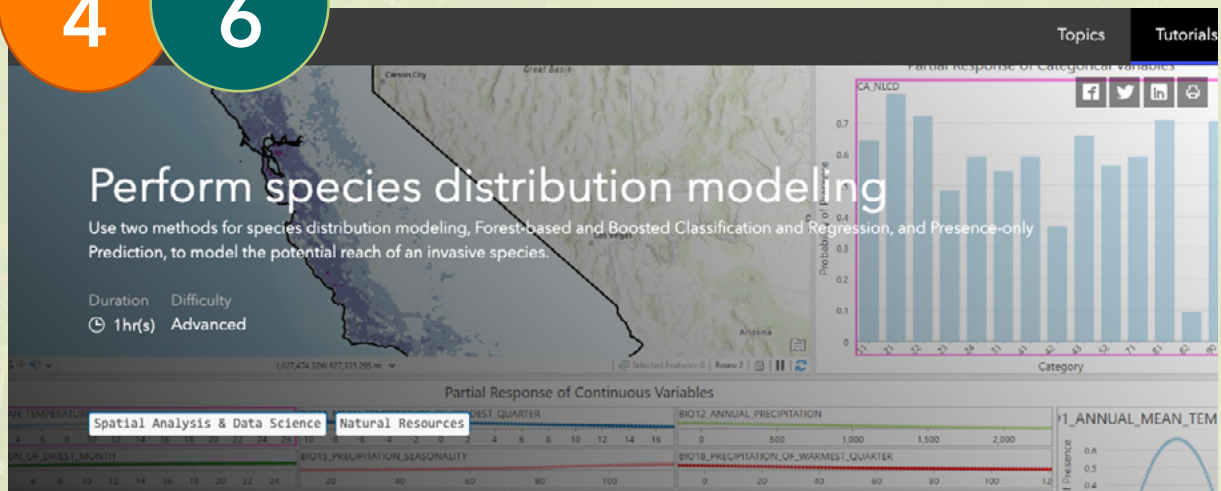
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## TUTORIAL: PERFORM SPECIES DISTRIBUTION MODELING

In this tutorial, you'll explore species distribution modeling for feral swine, an invasive species that threatens biodiversity, agriculture, and public health. It covers two modeling methods—Forest-based Classification and Regression, and Presence-only Prediction—that can be used independently or together to assess and predict swine distribution. The approach outlined in this tutorial is intended to demonstrate some of the methods available for species distribution modeling. It is not intended to prescribe a workflow or singular approach to the topic.

TARGET  
4

TARGET  
6



## TUTORIAL: IDENTIFY REGIONS USING BIOCLIMATIC DATA AND MULTIVARIATE CLUSTERING

This tutorial guides you through identifying bioclimatic regions in Puerto Rico's El Yunque National Forest using bioclimatic data and multivariate clustering to support GBF targets. You'll explore how environmental factors drive species distributions and the importance of understanding habitats' complexity, spatial extent, and rarity for effective conservation. The tutorial demonstrates tools and data for regionalization, offering a flexible approach that can be tailored to specific conservation goals and locations.

TARGET

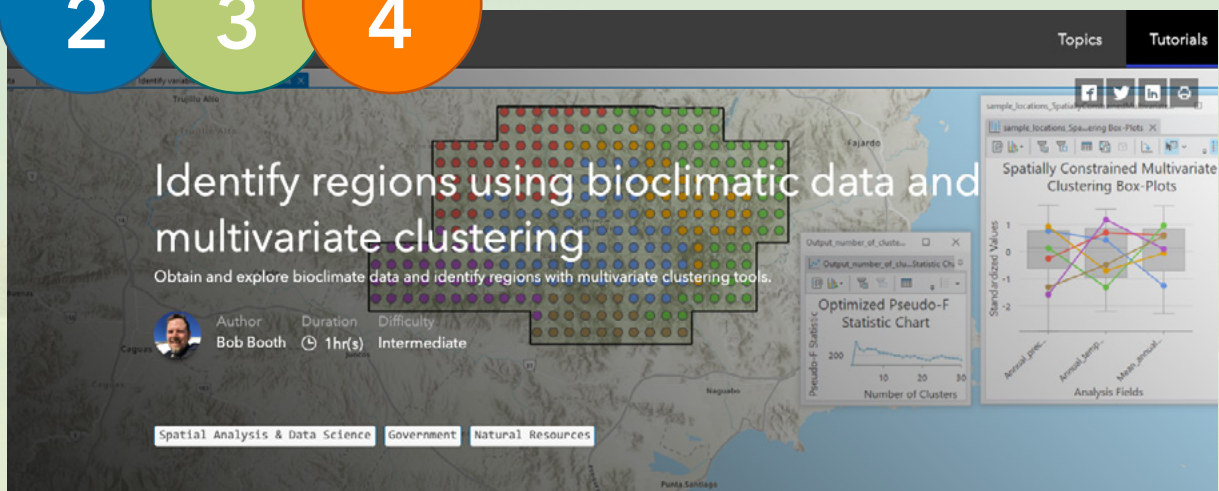
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TARGET

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TARGET


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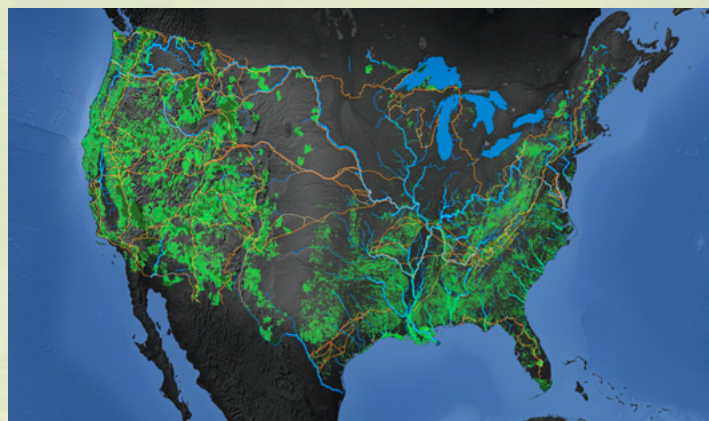
## TUTORIAL: IDENTIFY AND CONNECT AREAS TO PROTECT RARE SPECIES

In this tutorial, you will take on the role of a conservation planner in Ohio. As part of the efforts to meet targets of the Global Biodiversity Framework, your goal is to protect areas that are home to rare species and total 5,000 square kilometers, and to define connecting pathways between these areas.



|   | Author    | Duration | Difficulty   |
|---|-----------|----------|--------------|
|  | Bob Booth | 30mins   | Intermediate |

Spatial Analysis & Data Science   Natural Resources



# GLOBAL BIODIVERSITY DATA PROVIDERS

In this collection of webinars and learning materials, you have seen how biodiversity data was utilized by leading global partners whose networks and systems provide some of the best representations of global biodiversity. Through our collaboration with these institutions, users can directly access biodiversity data in ArcGIS Living Atlas of the World. Esri wishes to express our gratitude to these organizations for their willingness to work with us in the development of these materials. We encourage you to visit these organizations' websites to learn more about data and technical resources they offer to support those mapping the world's biodiversity.





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