

*Geographic Information Technology Training Alliance (GITTA) presents:*

# **Case Study: Mountain goats and bighorn sheep in Yellowstone National Park**

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# 1. Case Study: Mountain goats and bighorn sheep in Yellowstone National Park

## Introduction: Bighorn sheep under threat

In Yellowstone National Park, there is concern about the native bighorn sheep. Some of the reasons for this concern are competition from and diseases carried by mountain goats.

In order to prevent the species from going extinct in Yellowstone National Park, the park administration is considering to relocate some bighorn sheep into suitable habitats that are less likely to be used by mountain goats.

To assist the park administration, your tasks are

1. To identify suitable bighorn sheep and mountain goat habitats in Yellowstone National Park
2. Based on this, to select potential areas for the relocation scheme
3. To give a presentation on your approach and findings
4. To make recommendations to the park administration

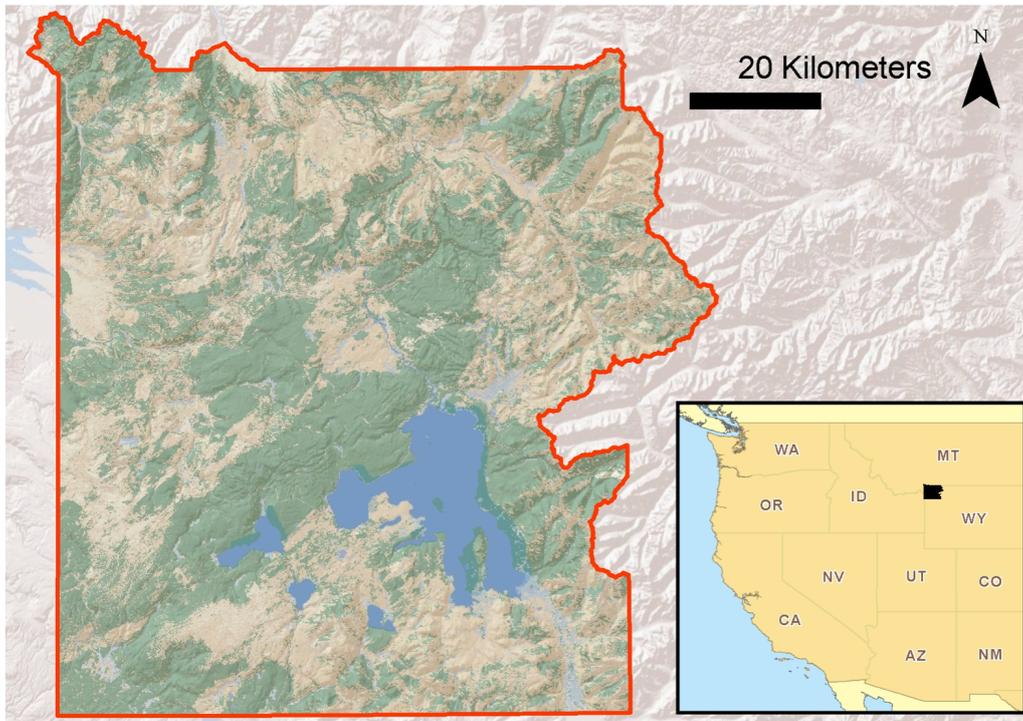
## Learning Objectives

- Developing a strategy for the analysis
- Operationalizing quantitative and qualitative information
- Processing and analysis of raster- and vector data
- Presentation of results

## 1.1. Task

### 1.1.1. Background and problem description

Established in 1872, the Yellowstone National Park is not only the oldest but also one of the most famous national parks in the world. The Park is located in the U.S. states of Wyoming, Montana and Idaho and covers an area of 8,987 square km. It is, amongst others, home to 67 species of mammals and 322 species of birds.



*Yellowstone National Park* (National Park Service 2012)

However, some of this biodiversity is under threat. One example for a species at risk are bighorn sheep, which are native to this area. Bighorn sheep used to roam the western United States in their millions before almost being exterminated by skin hunters by 1900. Today, a few hundred individuals live in Yellowstone National Park (National Park Service 2012). One of the threats their population is faced with is the spread of mountain goats, a species considered to be non-native in Yellowstone National Park. Introduced to the area for sport hunting some decades ago, mountain goats have been making their way into the park where they are feared to outcompete the bighorn sheep with regard to fodder and to carry diseases that may kill bighorn sheep (Gross 2001).

One possible conservation strategy for bighorn sheep that has been relatively successful in the past are relocation of animals to new habitats (Gross et al. 2000). In view of the high translocation cost – a 1999 estimate gave 3000 US\$ per relocated mountain goat (Zeigenfuss et al. 2000) – good planning is vital. Your task is to provide a rational, scientific basis for such a relocation scheme for the park authorities.

### 1.1.2. Case material

#### Geodata

You will get the geodata for this Case Study from the teacher of this course. Non-GITTA members interested in this Case Study are welcome to contact the GITTA coordinator ([coordinator@gitta.info](mailto:coordinator@gitta.info)).

Data type	Data format
Digital elevation model	Raster
Forest cover	Raster
Land cover	Raster
Park boundary	Vector
Roads	Vector

#### Habitats requirements

Download habitat information sheets for bighorn sheep and mountain goats here

Download: [Habitats.zip](#)

#### Additional information and literature

See list of references ([bibliography](#)).

### 1.2. Suggestions for work on the Case Study

Don't forget that you are required to write a learning diary from this phase onwards. Please use the Learning Diary template. Download: [Learning diary](#).

Besides making your approach to the Case Study transparent for your teacher and allowing you to reflect on your learning process, the learning diary as well as the task plan and the workflow diagrams (see below) can help you to structure and plan your work.

#### 1.2.1. First Steps

1. Carefully read both habitat information sheets
2. List the habitat requirements of mountain goats bighorn sheep
3. Spend some time to have a look at all available geodata
4. Read the metadata for all geodata

Remember: there is not *one* correct solution to this Case Study. Instead, various approaches are possible.

#### 1.2.2. Planning

##### Task plan

Organize and plan your work sequence – from planning to presentation – using a task plan. Set milestones and estimate the time required for each task. At the end of each phase, compare the time it took to complete the task to your target time. Please use the Task Plan template. Download: [Task plan](#).

##### Workflow diagrams

Set up two workflow diagrams for GIS data processing (one per animal species). First develop a rough sketch for your workflow diagrams which includes at least the following information:

1. Input data
2. How the input data are combined (your solution strategy)
3. Output data and results

This first draft is not meant to be a perfect solution scheme but your main idea and solution strategy should become clear.

You will present your task plan and your workflow diagram to your class and discuss them with your classmates. After successfully completing this phase (green light from your supervisor) you can begin the implementation phase.

The trial-and-error experience during the implementation phase will help you to continuously refine your workflow diagram and eventually to come up with detailed diagrams showing your approach and the corresponding process steps.

#### 1.2.3. Implementation

Proceed with your data preparation and analysis according to your task plan and workflow diagrams. Refine your diagrams step by step to document your approach in a traceable way.

The expected results for this phase are:

- Translating quantitative and qualitative information about habitat requirements into a GIS analysis

- Processing and analysis of raster and vector data
- Refinement of your workflow (and the corresponding workflow diagram)
- Production of figures for the final presentation

### **1.2.4. Information exchange**

During the final event you will give a 10 minute presentation on your approach and your results. Following the presentation there will be a discussion.

Since different solution strategies are possible, this phase will allow you to get to know and discuss the strategies used by your fellow students.

### **1.2.5. Evaluation**

The evaluation of your work will be based on:

- Your preparation of a task plan, a workflow diagram and a learning diary
- Your conversion of habitat requirements into a GIS analysis
- The presentation of your findings
- Your participation during the sessions (discussions)

### 1.3. Bibliography

- **DeCesare, N. and D. Pletscher**, 2006. Movements, Connectivity, and Resource Selection of Rocky Mountain Bighorn Sheep. *Journal of Mammalogy*, 87 (3), 531–538.
- **Gross, J.**, 2001. Evaluating Effects of an Expanding Mountain Goat Population on Native Bighorn Sheep: a Simulation Model of Competition and Disease. *Biological Conservation*, 101 (2), 171-185.
- **Gross, J., F. Singer, and M. Moses**, 2000. Effects of Disease, Dispersal, and Area on Bighorn Sheep Restoration. *Restoration Ecology*, 8 (4S), 25-37.
- **Gross, J., M. Kneeland, D. Reed, and R. Reich**, 2002. GIS-based Habitat Models for Mountain Goats. *Journal of Mammalogy*, 83 (1), 218-228.
- **Laundré, J.**, 1994. Resource Overlap Between Mountain Goats and Bighorn Sheep. *Western North American Naturalist*, 54 (2), 114–121.
- **Lemke, T.**, 2004. Origin, Expansion, and Status of Mountain Goats in Yellowstone National Park. *Wildlife Society Bulletin*, 32 (2), 532–541.
- **National Park Service** (2012). *Bighorn Sheep - Yellowstone National Park* [online]. Available from: <http://www.nps.gov/yell/naturescience/bighorn.htm> [Accessed 2013-02-18].
- **Poole, K., K. Stuart-Smith, and I. Teske**, 2009. Wintering Strategies by Mountain Goats in Interior Mountains. *Canadian Journal of Zoology*, 87 (3), 273-283.
- **Zeigenfuss, L., F. Singer, and M. Gudorf**, 2000. Test of a Modified Habitat Suitability Model for Bighorn Sheep. *Restoration Ecology*, 8 (45), 38-46.