National Park Service

BIODIVERSITY FOR THE NATIONAL PARKS

ELISA VAN HOUT – JUNE 2018

Biodiversity for the National Parks

Contents

Biodiversity for the National Parks

Contents

Biodiversity for the National Parks

Introduction

This research project concerned two themes:

- **Conservation statuses of different species**: are there any patterns or themes to the types of species that become endangered?

- **Reduction of Foot and Mouth Disease at Yellowstone National Park**: how can we measure if ongoing reduction efforts are effective?

These themes were researched by analyzing readily available data from the National Park Service.

More details on the used data and analysis approach are provided per theme, later on in this presentation.

Biodiversity for the National Parks

Contents

1. Introduction

2. Conservation statuses of different species
   - Summary
   - Used Data & Approach
   - Results

3. Reduction of Foot and Mouth Disease at Yellowstone National Park
   - Summary
   - Used Data & Approach
   - Results

Conservation statuses of different species
Summary

Central question for this research was:

Are there any patterns or themes to the types of species that become endangered?

Using data from the National Park Service and statistical analysis, we have found that:

- ▶ *Animals are more likely to be endangered than plants*
- ▶ *From the animals, mammals are more likely to be endangered than reptiles*

Conservation statuses of different species
Used Data & Approach
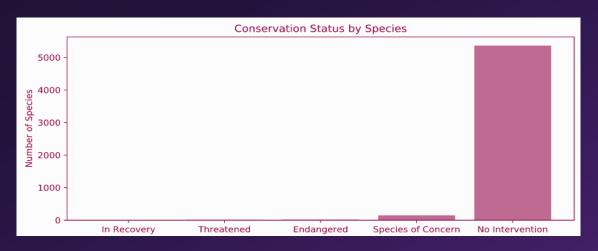
Analysis was done using a list of species, containing:

▶ The scientific name of each species

▶ The common names of each species

▶ The species category

▶ The species conservation status: "Species of Concern", "Threatened", "Endangered", "In Recovery" or none

Category	Scientific Name	Common Names	Conservation Status
Mammal	Clethrionomys gapperi gapperi	Gapper's Red-Backed Vole	
Mammal	Bos bison	American Bison, Bison	
Mammal	Bos taurus	Aurochs, Aurochs, Domestic Cattle (Feral), Domesticated Cattle	
Mammal	Ovis aries	Domestic Sheep, Mouflon, Red Sheep, Sheep (Feral)	
Mammal	Cervus elaphus	Wapiti Or Elk	
Mammal	Odocoileus virginianus	White-Tailed Deer	
Mammal	Sus scrofa	Feral Hog, Wild Pig	
Mammal	Canis latrans	Coyote	Species of Concern
Mammal	Canis lupus	Gray Wolf	Endangered
…	…	…	…

Conservation statuses of different species
Used Data & Approach

Conservation Status	No. of species
No Intervention	5363
Species of Concern	151
Threatened	10
Endangered	15
In Recovery	4

In total, 5542 unique species are listed in the data, of which 179 have a conservation status assigned.

Note: the species list contains a large number of duplicates. E.g. 'Streptopelia decaocto' appears in the list thrice. However, in our analysis we take into account only unique species, and each unique species either has a conservation status assigned or not. This way, duplicates are removed and do not affect our analysis.

For the attentive reader: the only deviation in the specific conservation statuses for a unique species is for 'Canis Lupus', which has both status "Endangered" and "In Recovery" assigned. This is why the above table adds up to 180 species, and not the mentioned 179.

Conservation statuses of different species
Used Data & Approach

To investigate if there are any patterns or themes to the types of species that become endangered, we used the category of each species.

For each category, we counted the number of species that have a conservation status, and the number that don't have such a status.

This way, we know how many species per category are protected and how many are not.

At a first glance, there seems to be quite some difference between how endangered a certain category is. Question remains if this is the result of chance, or if a certain category is in fact more likely to be endangered than another.

Category	Not Protected	Protected	% Protected
Vascular Plant	4216	46	1,08%
Nonvascular Plant	328	5	1,50%
Reptile	73	5	6,41%
Fish	115	11	8,73%
Amphibian	72	7	8,86%
Bird	413	75	15,37%
Mammal	146	30	17,05%

Conservation statuses of different species

Used Data & Approach

To see if differences in such data are significant, we use the χ^2 test (chi squared). With this test you can see if there is a significant difference in categories amongst two or more groups. E.g. are students who attended class more likely to pass than students who did not? Or in our case is a certain species category more likely to be protected than another?

To answer this question we did a pairwise comparison of the different categories, and also between animals and plants.

Category	Not Protected	Protected
Vascular Plant	4216	46
Nonvascular Plant	328	5
Reptile	73	5
Fish	115	11
Amphibian	72	7
Bird	413	75
Mammal	146	30

Category	Not Protected	Protected
Plants	4544	51
Animals	819	128

Conservation statuses of different species
Results

Comparison of animals and plants:

► The χ^2 test shows that the difference between animals and plants is significant (P value nihil: 3.20e-85); **animals are more likely to be protected than plants**.

Comparison of plant categories:

► The χ^2 test shows that the difference between non-vascular and vascular plants is not significant(P value: 0.66)

Comparison of animal categories:

► The χ^2 test shows that the difference between mammals and reptiles is significant (P value: 0.038); **mammals are more likely to be protected than reptiles**

► The χ^2 test shows that the difference between other animal categories is not significant (P values > 0.05);

Biodiversity for the National Parks

Contents

1. Introduction

2. Conservation statuses of different species
   - Summary
   - Used Data & Approach
   - Results

3. Reduction of Foot and Mouth Disease at Yellowstone National Park
   - Summary
   - Used Data & Approach
   - Results

Reduction of Foot and Mouth Disease
Summary

Park Rangers at Yellowstone National Park have been running a program to reduce the rate of foot and mouth disease at that park. The Park's scientists want to test whether or not this program is working. In order to this this, they will have to observe the sheep for a certain amount of time.

We have been asked to determine how many sheep need to be observed in order to confidently determine the program's effect. Observations will be done in Yellowstone National Park and Bryce National Park.

Using the requirements provided by the park rangers, we have determined the following:

- **870 sheep need to be observed for confident measurements**

- Given the past sheep observations, **observation will need to last for 2 weeks at Yellowstone National Park and 4 at Bryce National Park**. They respectively have 507 and 250 observations per week

Reduction of Foot and Mouth Disease
Used Data & Approach

Analysis was done using a list of species, the same list as for the conservation status analysis, and a list of observations of species in national parks. This observations list contains:

▶ The scientific name of the observed species
  NB. These names match the scientific names used in the species list

▶ The name of the park where the species was observed

▶ The number of observations

Category	Scientific Name	Common Names	Conservation Status
Mammal	Clethrionomys gapperi gapperi	Gapper's Red Backed Vole	
Mammal	Bos bison	Am	
Mammal	Bos taurus	Au Do	
Mammal	Ovis aries	Do	
Mammal	Cervus elaphus	W	
…	…	…	

Scientific Name Species	Park Name	Observations
Vicia benghalensis	Great Smoky Mountains National Park	68
Neovison vison	Great Smoky Mountains National Park	77
Prunus subcordata	Yosemite National Park	138
Abutilon theophrasti	Bryce National Park	84
Githopsis specularioides	Great Smoky Mountains National Park	85
Elymus virginicus var. virginicus	Yosemite National Park	112
Spizella pusilla	Yellowstone National Park	228
…	…	…

Reduction of Foot and Mouth Disease
Used Data & Approach

For this specific research question, we are only interested in observations of sheep. The number of sheep observations were counted, by linking the two data files: if a certain species is of the category "Mammal", and the common name includes "sheep", the number of observations for the related scientific name is counted.
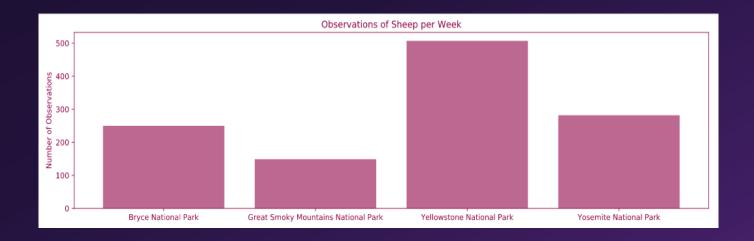
Category	Scientific Name	Common Names	Conservation Status
Mammal	**Ovis aries**	Domestic Sheep, Mouflon, Red Sheep, Sheep (Feral)	
~~Vascular Plant~~	~~Rumex acetosella~~	~~Sheep Sorrel, Sheep Sorrell~~	
~~Vascular Plant~~	~~Festuca filiformis~~	~~Fineleaf Sheep Fescue~~	
Mammal	**Ovis canadensis**	Bighorn Sheep, Bighorn Sheep	Species of Concern
…	…	…	...

Scientific Name	Park Name	Observations
Ovis aries	Yosemite National Park	126
Ovis aries	Great Smoky Mountains National Park	76
Ovis aries	Bryce National Park	119
Ovis aries	Yellowstone National Park	221
Ovis canadensis	Yellowstone National Park	219
…	…	…

Reduction of Foot and Mouth Disease
Used Data & Approach

Park Name	No. of sheep observed
Bryce National Park	250
Great Smoky Mountains National Park	149
Yellowstone National Park	507
Yosemite National Park	282

Shown above is the number of observed sheep in a week time, for each park.

This data will be used to translate the number of sheep that need to be observed (still to be calculated) to how many weeks the observation needs to last at a certain park.

Reduction of Foot and Mouth Disease
Used Data & Approach

The Yellowstone National Park's scientists want to confidently detect foot and Mouth disease reductions of at least 5 percentage points.

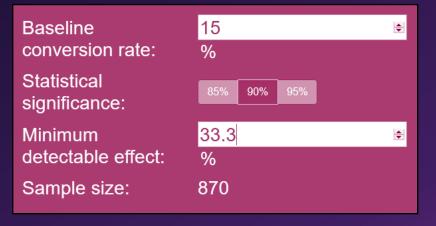Sample size is calculated using the following information:

► Significance level: 90%

► Percentage of sheep with Foot and Mouth disease at Bryce National Park (baseline): 15%

► Minimal detectable effect: 33.3%

Using a sample size calculator, we can now determine the number of sheep that need to be observed.

Reduction of Foot and Mouth Disease
Results

To meet the requirements in the previous slide:

▶ **870 sheep need to be observed for confident measurements**

▶ Given the past sheep observations, **observation will need to last for 2 weeks at Yellowstone National Park and 4 at Bryce National Park**. They respectively have 507 and 250 observations per week

Baseline conversion rate:	15 %
Statistical significance:	85% 90% 95%
Minimum detectable effect:	33.3 %
Sample size:	870

Park Name	No. of sheep observed
Bryce National Park	250
Yellowstone National Park	507