# TEACHER'S GUIDE

This lesson plan uses a flipped learning model. Therefore, most of the lesson content is provided within the Introductory Video, the Student Pages, and the Results & Discussion Show.

By design, this lesson plan does not require teachers to know anything about wild bighorn sheep. Simply load the introductory video and begin!

**Synopsis**

Students work individually, in small research teams, and as a class to answer real-world questions using scientific data collected on wild bighorn sheep in Nevada. After watching the introductory video that provides historical, biological, and conservation/management context for the lesson, students are grouped into six research teams and each team is assigned data from, and a case study about, one Nevada bighorn sheep herd. Individually, students use real-world data to calculate missing information from a table with annual population estimates, and then they graph the data. Working collaboratively as a team, students interpret the graphs and analyze the results, answer questions from their Student Pages, create a presentation about their case study, and present findings to their peers. Working as a class, students combine information and data from all six case studies to create a list of factors that are currently affecting bighorn sheep conservation in Nevada. Then, students watch the Results & Discussion Show, which includes graphs relevant to each of the six case studies. In addition, the Results & Discussion Show presents information about the importance of balancing bighorn sheep populations with predator populations and why sustainable bighorn sheep conservation requires collaboration among bighorn sheep biologists, managers, and domestic sheep and goat operations.

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**Grade Level**: 4-6

**Next Generation Science Standards:** 4-LS1-1, 5-ESS3-1, MS-LS2-1, MS-LS2-2, MS-LS2-4;
**Common Core State Standards:** RL.4.1, RI.4.1-4.3, RF.4.4.A, SL.4.1-4.4, RL.5.1, RI.5.1-5.3, RF.5.4.A, SL.5.1-5.2, SL.5.4-5.5, RL.6.1, RI.6.1, SL.6.1-6.2, SL.6.4-6.5, RST.6-8.1-6-8.3, RST.6-8.7-6-8.8, MP.4, 5.G.A, 6.SP.B4-B5
A complete list of standards are available at the end of this Teacher's Guide

**Subjects**: Science, Math, Literacy

**Duration:** Approximately 3 class periods

**Materials for lesson:**

- Introductory Video
- Teacher Guide
- Student Pages (6 sets)
- Results & Discussion Slideshow
- Answer Key
- Short Video showing GPS Points and Movements of One Bighorn Ram

**Lesson authors:**
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Nevada Department of Wildlife

**Student Learning Targets**

1. Students will actively participate in the process of scientific discovery, using real-world data from research done on bighorn sheep herds in Nevada.

2. Students will learn that there are three subspecies of bighorn sheep in Nevada, and that the desert bighorn sheep is Nevada's state animal.

3. Students will work collaboratively to "discover" the current issues affecting wild bighorn sheep conservation in Nevada. Students will learn that disease is the primary issue affecting wild bighorn sheep. Other main conservation issues include habitat loss and fragmentation (due to suburban sprawl, dispersed recreation, and transportation corridors), feral horses and burros, excessive livestock grazing and damage to riparian areas, lack of water, and lack of separation between wild sheep and domestic sheep and goats.

4. Students will learn about the history of bighorn sheep in Nevada, including population estimates pre- and post-European settlement, why sheep numbers dropped drastically, and how sheep numbers subsequently increased.

5. Students will learn about bighorn sheep biology, bighorn sheep habitat, why Nevada's unique topography supports the largest population of bighorns in the lower 48, and which natural resource in Nevada is limiting to bighorn herds (water).

6. Students will learn about the people and organizations who worked to build the bighorn conservation program in Nevada, including NDOW biologists, sportsmen and sportswomen, conservation organizations, and volunteers.

7. Students will learn about the translocation, research, and water development programs established to help restore bighorn sheep to its historic range in Nevada.

8. Students will learn that managing wild bighorn sheep populations in the state of Nevada is a balancing act, where maintaining healthy populations of both sheep and predators (like mountain lions) is the goal.

9. Students will learn that sustainably managing wild herds of bighorn sheep requires working collaboratively and respectfully with domestic sheep and goat operations.

10. Students will learn that the bighorn sheep population is increasing, and so is the number of bighorn sheep harvested. Students will learn that regulated hunting is an important conservation tool.

11. Students will create line and bar graphs and critically evaluate/interpret graphs and tables.

12. Students will work individually and cooperatively as they solve problems, construct explanations, and hone critical thinking skills.

13. Students will hone skills in communication as they engage in a range of collaborative discussions (in teams and as a class).

14. Students will present findings to their peers, emphasizing important facts with relevant evidence.

**Acknowledgements**
To help ensure that our lesson content is science-based and balanced, we collaborated with the Nevada Department of Wildlife. Mike Cox, Big Game Staff Biologist with Nevada Department of Wildlife, provided information for the six case studies included in the Student Pages. We also incorporated information on the six case studies from the Nevada Department of Wildlife Big Game Status Report 2016-2017, specific information from this Report was written by biologists Jason Salisbury, Pat Cummings, Matthew Jeffress, and Jeremy Lutz. We are indebted to these wildlife biologists for their dedication and thoughtful, expert work to help ensure the future of wild bighorn sheep.

All data used in this lesson plan were provided by the Nevada Department of Wildlife.

Thank you also to Randy Newberg, Hunter, for generously sharing the video "Wildlife Water Guzzlers", which has been incorporated into the Introductory Video for this lesson plan.

**Brief Background Information for Teachers**
Bighorn sheep have been roaming Nevada's 314 mountain ranges for over 28,000 years. Moreover, bighorn sheep were the most numerous ungulates in Nevada prior to European settlement. It is estimated that over 30,000 wild bighorn sheep ranged throughout Nevada in 1860. By 1960, however, the number of bighorn sheep in Nevada plummeted to an estimated 3,000. Bighorn sheep were extirpated throughout much of their historic Nevada range. What happened? The decline in the number of bighorn sheep in Nevada was due to several factors including: 1) excessive ***unregulated*** hunting (which differs significantly from regulated hunting), 2) competition with domestic livestock, 3) diseases from domestic livestock (especially domestic sheep and goats), 4) loss of watering areas, and, 5) loss of habitat due to human causes.

After the dramatic decline of wild bighorns, Nevada Department of Wildlife and hunting organizations worked together to find ways to restore bighorn sheep. They began aggressive programs to stop bighorn sheep poaching and worked to ensure that bighorn sheep hunting is ***strictly regulated***. They also began a translocation program, a research program, and a habitat program:

> ***Translocation Program:*** A translocation program includes trapping healthy bighorn sheep in one location and moving them to another location. The translocation program has helped to restore bighorn sheep back to some of their historic ranges where they had been extirpated. Nevada biologists and sportsmen and sportswomen together have trapped and released over 3,380 bighorn sheep throughout Nevada.
>
> ***Research Program:*** Nevada Department of Wildlife bighorn biologists estimate how many bighorn sheep are in each herd each year. One way they do this is via aerial surveys. They've conducted thousands of hours of aerial surveys. They also catch bighorns and collect data on them (e.g., weights, body measurements, pull blood samples) to learn more about their biology, disease, and disease transmission. Then, biologists release sheep back where they were captured. Some sheep are fitted with GPS collars so biologists can track their movements.
>
> ***Habitat Program to provide water to wild bighorn sheep:*** Water is a big issue in the state of Nevada because much of the habitat is extremely dry. Over 80% of the bighorn sheep herds in Nevada are water limited, so wildlife agencies and conservation organizations have built water development (guzzlers) in areas where there's not enough water to support bighorn sheep and other wildlife. State agencies, sportsmen and sportswomen, conservation organizations, and volunteers have built over 1,000 water guzzlers for wildlife throughout the state of Nevada!

Because of the passionate, visionary, dedicated Nevada Department of Wildlife biologists who worked together with energetic sportsmen and sportswomen, and land management resource specialists, the bighorn sheep restoration effort has been a huge success. Wild sheep have been restored to many areas throughout its historic range in Nevada. Currently, there are over 12,000 bighorn sheep in the state of Nevada, which is more wild bighorns than in any other state besides Alaska!

In Nevada, there are three subspecies of wild bighorn sheep: 1) Rocky Mountain bighorn sheep, 2) Desert bighorn sheep, and, 3) California bighorn sheep. The Desert bighorn sheep is the state animal in Nevada.

The primary conservation issue affecting bighorn sheep in Nevada is disease, which is sometimes transmitted to wild bighorn sheep herds from herds of domestic sheep and goats. Therefore, it's critically important that herds of wild bighorn sheep are separated from herds of domestic sheep and goats. Other important conservation issues include habitat loss and fragmentation (due to urban sprawl, dispersed recreation, and transportation corridors), feral horses and burros, excessive cattle grazing year-round on BLM grazing allotments, damage to riparian areas, and lack of water.

Your students will use real-world data and information from case studies on six different herds of wild bighorn sheep that live in Nevada. These six herds were selected as case studies because when all six herds are evaluated collectively, they represent the entire bighorn sheep population in terms of the conservation issues that affect bighorn sheep in Nevada today.

**Materials Needed**

- Introductory Video: *Introductory Video_NV Bighorn Sheep Lesson*
- Student Pages: Nevada Bighorn Sheep: On the Edge?
  There are six sets of Student Pages, one set for members of each of the 6 student teams
- Graphing paper or graphing software such as excel
- Calculator or mathematical software such as excel
- Powerpoint or Google slides are helpful for student team presentations
- Results & Discussion Slideshow: *Results & Discussion Show_NV Bighorn Sheep Lesson*
- Short Video: *Video Showing GPS Points and Movements of One Bighorn Ram*

  This short video was created by Nevada Department of Wildlife biologists, who placed a GPS collar on a bighorn sheep ram, tracked where the ram went, documented all the GPS location points for that ram, placed the GPS location points sequentially in time in a Google Earth environment, and then created a "flyover" of all the places (GPS locations) the ram traveled.

**Procedure**

**1.** Show your students the introductory video called *Introductory Video_NV Bighorn Sheep Lesson*

**2.** At the conclusion of the introductory video, divide your students evenly into six teams. Assign each team one of the following six case study herds:

1. Team 1: Snowstorm Mountains Herd
2. Team 2: Sheep Creek Range Herd
3. Team 3: Gabbs/Gillis Valley Range Herd
4. Team 4: Bare Mountain Herd
5. Team 5: Spring Mountains Herd
6. Team 6: Muddys and Black Mountains Herd

**3.** Hand out the appropriate "Student Pages" to each member of each group (Team 1, Team 2, Team 3, Team 4, Team 5, Team 6). Each Team has an unique set of Student Pages. Hand out Student Pages to each member of each Team and allow students enough time to read the instructions, calculate their missing data, and create their graphs. As part of this activity, students in each team will then work together to answer questions specific to their case study (questions are located in their Student Pages).

**4.** Tell each team that they will be creating a presentation and then presenting their findings to the classroom. As part of their presentation, each team should include at least:

1) Brief background information about their bighorn sheep herd
2) Information about where their bighorn sheep herd lives
3) The graph or graphs that they created from their data set/s
4) A list of factors affecting the conservation of their bighorn sheep herd
5) Photos of their bighorn sheep herd and/or the area the herd occupies (photos are provided in each of the 6 sets of "Student Pages")

**5.** After all six teams have given their presentations, ask your students to work as a class to create a list of the main factors that affect the conservation of wild bighorn sheep in Nevada (combine all the factors from all six case studies).

**6.** Next, watch the Results & Discussion Slideshow, which includes graphs and results for each case study and provides additional information.

**7.** After you have watched the Results & Discussion Slideshow, have a class discussion using some of the following questions as guiding points:

A. At the end of the Results & Discussion Slideshow, you learned about ways that bighorn sheep managers, scientists, and owners of domestic sheep and goats are collaborating to ensure that bighorn sheep herds can survive while also making sure that owners of domestic animals can make a living. Can you think of other ways that bighorn sheep managers, scientists, and owners of domestic livestock and work together? Please send your ideas to: logan@beartrust.org and we will pass your ideas along to wildlife managers.

B. Many of the six bighorn sheep herds you evaluated experienced decreases in herd size. What were some of the reasons for these decreases?

C. How many of the six bighorn sheep herds experienced die-offs due to pneumonia?

D. For some bighorn sheep herds, the management goal was to keep the herd at or below carrying capacity. What does carrying capacity mean? Why is it important to keep herds at or below carrying capacity? How do managers keep bighorn sheep herds at or below carrying capacity?

E. Some of the six herds had high enough numbers of bighorn sheep to trap some individuals and translocate them to other bighorn sheep herds. Which herds?

F. What does habitat mean? What resources do bighorn sheep need?

G. Water is a limiting resource for about 80% of all bighorn herds living in Nevada, especially for desert bighorn herds because they live in regions of Nevada marked by hot summers and little annual precipitation. What is one way that Nevada Department of Wildlife biologists and hunting organizations are doing to help provide water to bighorns?

H. How does human development affect habitat for bighorn sheep?

I. Wild bighorn sheep have a low rate of reproduction. What does this mean? How does a having a low rate of reproduction make bighorn sheep particularly susceptible to die-offs from diseases?

J**.** The case study for Team 4 was the Bare Mountain Herd. Wild bighorns in this herd travel extensively in search of food and water. There are bighorns in other herds, too, that travel extensively. Show your class the short video "Video Showing GPS Points and Movements of One Bighorn Ram".

*This video was created by Nevada Department of Wildlife biologists, who placed a GPS collar on a bighorn sheep ram, tracked where the ram went, documented all the GPS location points for that ram, placed the GPS location points sequentially in time in a Google Earth environment, and then created a "flyover" of all the places (GPS locations) the ram traveled.*

Question: Although it is normal and natural for bighorn sheep to travel extensively, how can this normal activity of traveling extensively negatively impact bighorn sheep (HINT: contact with disease pathogens increases).

K. Do you think that bighorn sheep in the Nevada are "on the edge"? Why or why not?

## CURRICULUM CONNECTIONS

**NEXT GENERATION SCIENCE STANDARDS**

**Performance Expectations: 4th Grade**

4-LS1-1. Construct an argument with evidence, data, and/or a model

**Performance Expectations: 5th Grade**

5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment

**Performance Expectations: Middle School**

MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem

MS-LS2-2: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems

MS-LS2-4: Construct an argument supported by empirical evidence that changes in the physical or biological components of an ecosystem affects populations

**COMMON CORE STATE STANDARDS: ENGLIGH LANGUAGE ARTS (GRADES 4-6)**

RL.4.1: Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text

RI.4.1: Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text

RI.4.2: Determine the main idea of a text and explain how it is supported by key details; summarize the text

RI.4.3: Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text

RF.4.4.A: Read grade-level text with purpose and understanding

SL.4.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 4 topics and texts*, building on others' ideas and expressing their own clearly

SL.4.2: Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally

SL.4.3: Identify the reasons and evidence a speaker provides to support particular point
SL.4.4: Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace

RL.5.1: Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text

RI.5.1: Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text

RI.5.2: Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text

RI.5.3: Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text

RF.5.4.A: Read grade-level text with purpose and understanding

SL.5.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 5 topics and texts*, building on others' ideas and expressing their own clearly

SL.5.2: Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally

SL.5.4: Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace

SL.5.5: Include multimedia components (e.g., graphics, sound) and visual displays in presentations when appropriate to enhance the development of main ideas or themes

RL.6.1: Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text

RI.6.1: Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text

SL.6.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly

SL.6.2: Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study

SL.6.4: Present claims and findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas or themes; use appropriate eye contact, adequate volume, and clear pronunciation

SL.6.5: Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information

RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts

RST.6-8.2: Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions

RST.6-8.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks

RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually

RST.6-8.8: Distinguish among facts, reasoned judgment based on research findings, and speculation in a text

**COMMON CORE STATE STANDARDS: MATH (GRADES 4-6)**

MP.4: Model with mathematics

5.G.A: Graph points on the coordinate plane to solve real-world and mathematical problems

6.SP.B.4: Summarize and describe distributions

6.SP.B.5: Summarize numerical data sets in relation to their context

# Student Pages: Nevada Bighorn Sheep: On the Edge?

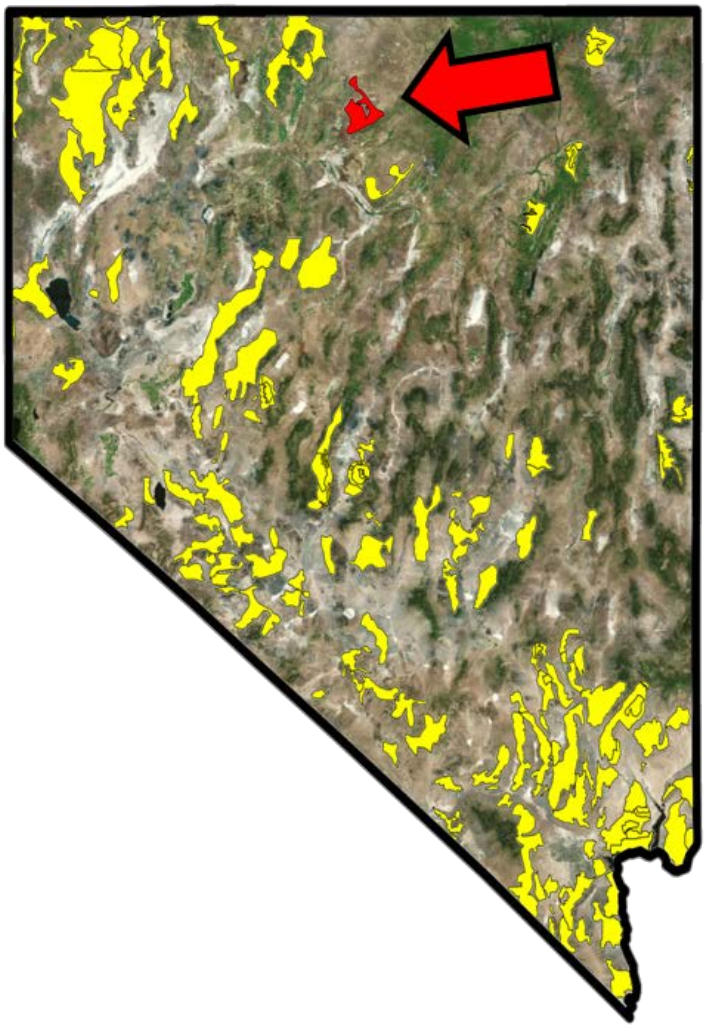
**Team 1** **Your bighorn sheep herd name is SNOWSTORM MOUNTAINS HERD**

**Instructions for this Activity**

You should be in one of 6 teams. Individually, read through the Background Information thoroughly, calculate the missing data in the Table 1-1, and create your graph. Then, work as a team to answer the questions and create a list of factors (things) that affect the conservation of your bighorn sheep herd. Then, as a team create a presentation that you will give to the rest of the class. At the end of these Student Pages, you will find a list of things you should include in your presentation.

**BACKGROUND INFORMATION**

The Snowstorm Mountains Herd is located north of Battle Mountain, Nevada and occupies about 125,000 acres.



**Bighorn Sheep Subspecies**

The subspecies of bighorn sheep in the Snowstorm Mountains Herd is the California bighorn sheep.

**History and Habitat**

Beginning in 1985, the Nevada Department of Wildlife began transplanting wild bighorn sheep INTO the Snowstorm Mountains area to help re-establish the herd. During 1985-1986, 15 bighorn sheep were translocated into the Snowstorm Mountains Herd from a wild bighorn sheep herd in Idaho. In 1988, 12 bighorn sheep were translocated into the Snowstorm Mountains Herd from a wild bighorn sheep herd in Idaho. In 1994, 13 bighorn sheep were translocated into the Snowstorm Mountains Herd from a wild bighorn sheep herd in British Columbia and 2 bighorn sheep were translocated into the Snowstorm Mountains Herd from a sheep herd in Nevada. In 1998, 14 bighorn sheep were translocated into the Snowstorm Mountains Herd from a wild bighorn sheep herd in northern Nevada. The herd grew steadily up until year 2011. During August 2011, bighorn sheep began dying from a bacteria pathogen called ***Mycoplasma ovipneumoniae***, which causes pneumonia in wild bighorns.

The bacteria ***Mycoplasm ovipneumoniae*** can be present in domestic goats and domestic sheep. Interestingly, even when domestic goats and domestic sheep carry this bacteria, the domestic goats and domestic sheep typically do not get pneumonia. However, if a wild bighorn sheep comes into contact with a domestic goat or sheep that has this bacteria, then the wild bighorn sheep can be exposed to the bacteria and subsequently get infected with pneumonia. Moreover, the newly infected wild bighorn sheep can then bring the bacteria back to its herd and infect the entire herd with pneumonia.

Since 2011, recruitment in the Snowstorm Mountains Herd has been very low.

Nevada Department of Wildlife is collaborating with South Dakota State University, Washington State University, and Idaho Fish and Game on research to better understand disease transmission in wild bighorn sheep herds. Research efforts include trapping, collaring, and testing bighorns in the Snowstorm Mountains Herd. Each year, bighorn sheep in the Snowstorm Mountains Herd are tested to determine whether they have the bacteria called ***Mycoplasma ovipneumoniae.***

The habitat in the Snowstorm Mountains is primarily dominated by sagebrush steppe shrublands with an understory of perennial, non-native annual grasses, and quite a lot of flowers. There are several buttes and ridge tops with dissecting drainages, with many aspen stringers large enough to provide habitat for Northern Goshawks. This area represents some of the most picturesque and typical Great Basin habitats in Nevada.

Water in the Snowstorm Mountains is relatively abundant with about 10 small creeks that flow year round, and several natural springs and meadows.

## Wild Bighorn Sheep Translocation Program in Nevada

As of February 2019, Nevada biologists have translocated 3,380 bighorn sheep in Nevada!

**The following wild bighorn sheep were translocated INTO the Snowstorm Mountains Herd:**

1985 – 9 bighorns, came from a different bighorn herd in Idaho
1986 – 6 bighorns, came from a different bighorn herd in Idaho
1988 – 12 bighorns, came from a different bighorn herd in Idaho
1994 – 13 bighorns, came from a different bighorn herd in British Columbia
1994 – 2 bighorns, came from a different bighorn herd in Nevada
1998 – 14 bighorns, came from a different bighorn herd in Nevada

## Factors Affecting the Conservation of the Snowstorm Mountains Herd

Disease is the primary issue for the Snowstorm Mountains Herd. Because the 2011 die-off was caused by a bacterial pathogen that causes pneumonia, managers are working to minimize the possibility of domestic sheep and goat interactions with the Snowstorm Mountains Herd to reduce the threat of disease transmission.

Traffic and human disturbance are also issues for this herd because one of the largest open pit gold mines is located within 5 miles of the Snowstorm Mountains in the valley directly to the west. This means that the Snowstorm Mountains Herd is subjected to 24-hour traffic, noise, and lights. In addition, more than 500 feral horses occupy the area between the Dry Hills and Snowstorm Mountains, which means bighorn sheep compete for food and water resources with a large feral horse herd. Although cattle grazing operations are well managed at higher elevations, competition exists between cattle and bighorn at lower elevations where much of the native perennial grass component has been lost to wildfires. There is also competition between cattle and bighorns for water at degraded spring sources. In the Snowstorm Mountains, helicopters are used in spring to conduct golden eagle nest surveys, which has the potential to place newborn lambs at risk (they might fall or be abandoned) when the herd runs from the helicopters. Finally, there are some predators of bighorn sheep here, including mountain lions, bobcats, coyotes, and golden eagles.

## Graph It!

Using Table 1-1 on the following page, do the following:

1. Calculate the **Total Number of Bighorn Sheep Each Year** (HINT: add the Number of EWES yearlings, Number of RAMS yearlings, Number of EWES 2+ years old, and the Number of RAMS 2+ years old) for each year and put the answers in the column marked **Total Number of Bighorn Sheep Each Year** (the yellow shaded column).

2. After you have filled in all the missing data, create a graph showing the **Total Number of Bighorn Sheep Each Year**. Put **Year** on the x-axis and **Total Number of Bighorn Sheep Each Year** on the y-axis.

Table 1-1. Annual Population Estimate of Bighorn Sheep in the Snowstorm Mountains Herd, 1985-2018

| YEAR | Number of EWES Yearlings | Number of RAMS Yearlings | Number of EWES 2+ years old | Number of RAMS 2+ years old | Total Number of Bighorn Sheep Each Year |
|---|---|---|---|---|---|
| 1985 | 2 | 0 | 3 | 3 | 8 |
| 1986 | 1 | 1 | 8 | 2 | |
| 1987 | 1 | 3 | 8 | 3 | |
| 1988 | 1 | 1 | 16 | 7 | |
| 1989 | 5 | 2 | 15 | 7 | |
| 1990 | 3 | 3 | 18 | 8 | |
| 1991 | 3 | 3 | 20 | 9 | |
| 1992 | 5 | 5 | 20 | 10 | |
| 1993 | 2 | 2 | 22 | 16 | |
| 1994 | 4 | 4 | 22 | 13 | |
| 1995 | 6 | 6 | 38 | 16 | |
| 1996 | 8 | 7 | 40 | 19 | |
| 1997 | 6 | 6 | 42 | 21 | |
| 1998 | 8 | 8 | 42 | 23 | |
| 1999 | 12 | 12 | 53 | 26 | |
| 2000 | 14 | 12 | 59 | 28 | |
| 2001 | 18 | 18 | 65 | 33 | |
| 2002 | 9 | 9 | 73 | 42 | |
| 2003 | 12 | 12 | 73 | 39 | |
| 2004 | 7 | 7 | 75 | 45 | |
| 2005 | 11 | 10 | 72 | 44 | |
| 2006 | 8 | 8 | 75 | 43 | |
| 2007 | 17 | 17 | 75 | 39 | |
| 2008 | 10 | 10 | 81 | 44 | |
| 2009 | 13 | 13 | 82 | 41 | |
| 2010 | 18 | 18 | 86 | 43 | |
| 2011 | 9 | 9 | 50 | 25 | |
| 2012 | 0 | 0 | 54 | 15 | |
| 2013 | 1 | 2 | 48 | 14 | |
| 2014 | 0 | 0 | 31 | 14 | |
| 2015 | 4 | 4 | 26 | 10 | |
| 2016 | 1 | 1 | 25 | 11 | |
| 2017 | 2 | 2 | 15 | 13 | |
| 2018 | 2 | 2 | 14 | 9 | |

**QUESTIONS (answer these as a team)**

1. How many total bighorn sheep have been translocated INTO this herd between 1985-1998? Where did these translocated wild bighorn sheep come from?

2. What happened to this herd in 2011?

3. Do you think the bighorn sheep herd has recovered from whatever happened in 2011?

4. How is the pathogen that causes pneumonia in wild bighorn sheep often transmitted to bighorn sheep herds?

5. Why would traffic, noise, and lights affect bighorn sheep?

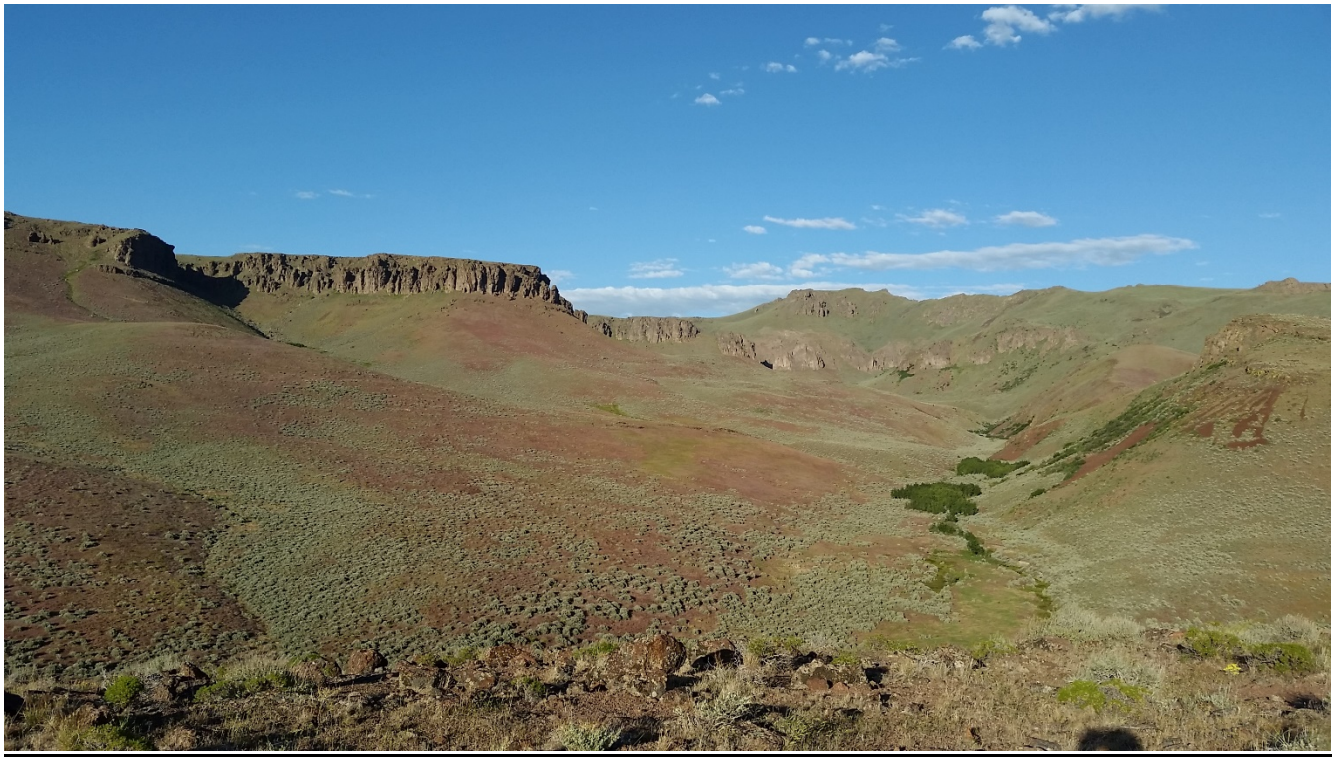
6. How do feral horses affect the habitat for wild bighorn sheep?

## INSTRUCTIONS FOR CREATING YOUR PRESENTATION

Work as a team to put together a presentation that you will give to the rest of the class. Your presentation should include at least the following:

1) the subspecies of bighorn sheep in your herd
2) where your bighorn sheep herd lives
3) brief background information about the history of this herd and the habitat it occupies, including information about the water availability in the Snowstorm Mountains
4) the graph you created
5) information about how many wild bighorn sheep have been translocated into the Snowstorm Mountains Herd during years between 1985-1998
6) information about what happened to this herd in 2011
7) a list of factors affecting the conservation of this herd
8) include photos of the Snowstorm Mountains, provided below

Photos of the Snowstorm Mountains area are provided by Mike Cox, Nevada Department of Wildlife:



# Student Pages: Nevada Bighorn Sheep: On the Edge?

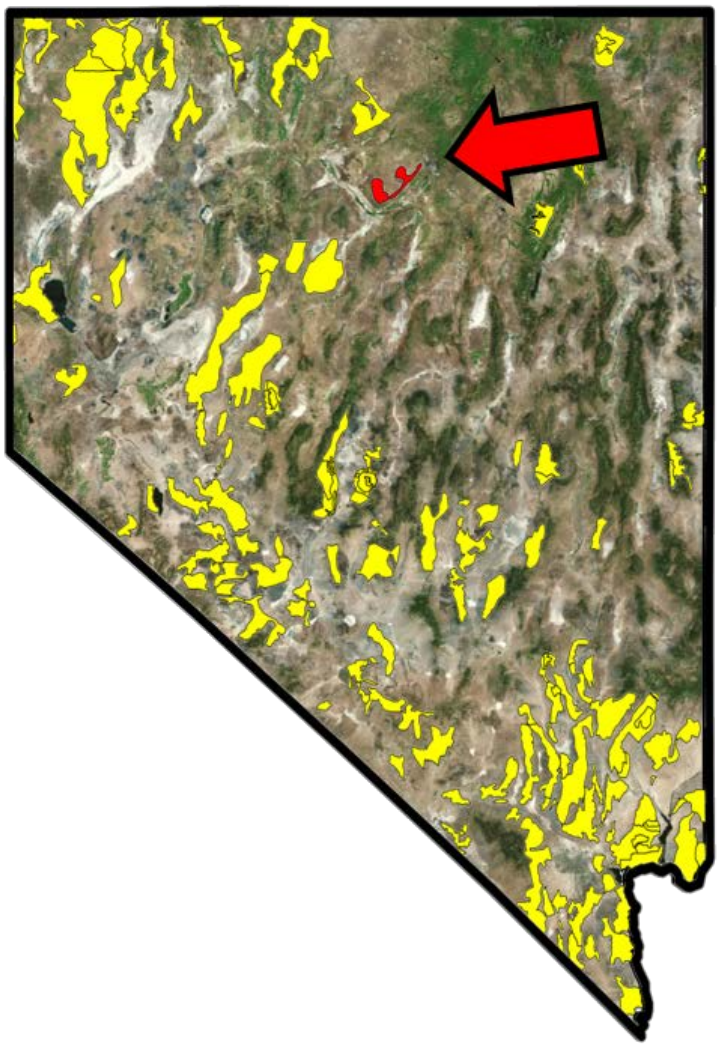
**Team 2** **Your bighorn sheep herd name is SHEEP CREEK RANGE HERD**

**Instructions for this Activity**

You should be in one of 6 teams. Individually, read through the Background Information thoroughly, calculate the missing data in the Table 1-2, and create your graph. Then, work as a team to answer the questions and create a list of factors (things) that affect the conservation of your bighorn sheep herd. Then, as a team create a presentation that you will give to the rest of the class. At the end of these Student Pages, uou will find a list of things you should include in your presentation.

**BACKGROUND INFORMATION**

The Sheep Creek Range Herd is located northeast of Battle Mountain, NV and occupies about 74,959 acres.



**Bighorn Sheep Subspecies**

The subspecies of bighorn sheep in the Sheep Creek Range Herd is the California bighorn sheep.

**History and Habitat**

The Sheep Creek Range Herd was re-established during 1991 when 21 bighorn sheep were translocated into the Sheep Creek Range area. The 21 sheep came from a wild bighorn herd in Idaho. In 1993, another 25 wild bighorn sheep were translocated into the Sheep Creek Range area, the bighorns came from a wild herd in Idaho. In 1995, 7 additional bighorns were translocated into the Sheep Creek Range Herd, the bighorns came from a wild bighorn sheep herd in British Columbia.

The Sheep Creek Range area also serves as winter range for several hundred deer, antelope, and elk. In addition, a large number of cattle graze on BLM land in the Sheep Creek Range area.

The habitat in Sheep Creek Range used to be a beautiful sagebrush steppe plant community, with diverse plant species including perennial grasses and forbs. In the late 1880s, invasive annual plants were brought over with livestock. These invasive plants began to outcompete the perennial grasses, in part because of the way cattle have overgrazed the habitat for the past 100 years. Then, in 1980, wildfire began to burn the area. The area has been burned 3-4 times since 1980.

This means that the habitat in the Sheep Creek Range has changed due to a combination of: 1) cattle overgrazing, 2) invasive annual plants outcompeting native perennial plants, and 3) wildfire. The sad result is this -> what used to be a diverse, rich sagebrush steppe community has changed into a monotypic (one type of) plant community of invasive annual plants (dominated by cheatgrass and tansy mustard). This has resulted in lower quality habitat for bighorn sheep, which means the carrying capacity of the Sheep Creek Range area is lower now than it was 100 years ago.

Even though the habitat quality and carrying capacity have decreased in the Sheep Creek Range area, the number of cattle grazing on this habitat has remained the same. As food resources decrease, it would make sense to decrease the number of animals using those food resources. Due to extensive cattle overgrazing (i.e., the number of cattle grazed here has not been reduced even though the food resources here have been declining), there simply isn't enough food for all the bighorn sheep and all the cattle anymore.

So, in 2013-2014, biologists at Nevada Department of Wildlife decided to do the responsible thing and reduce the size of bighorn sheep herd. They feared that a severe winter could bring high mortality for bighorn sheep if the bighorns went into the winter lean. Therefore, in 2013-2014 they captured 38 bighorn sheep and translocated them to other wild bighorn herds. During 2014, they also started a ewe hunt to help reduce the bighorn sheep herd so that the herd size matched its lowered carrying capacity.

Attempts to restore the native sagebrush in the Sheep Creek Range habitat have so far been unsuccessful, but a non-invasive small shrub, *Forage kochia*, was introduced into the habitat to provide high quality forage for wild bighorn sheep, migratory herds of wintering pronghorn, and mule deer that share the mountain range.

**Carrying capacity** is the maximum size of a biological population that the environment can sustain indefinitely without degrading the environment for future generations. When a population is at carrying capacity, then the # of births = the # of deaths. The carrying capacity of the Sheep Creek Range was lowered due to cattle overgrazing, invasive annual plants outcompeting native perennial plants, and wildfire.

Water is limited in the Sheep Creek Range area, with only 4 known springs. Two water developments were built to help provide water to bighorn sheep and other wildlife.

## Wild Bighorn Sheep Translocation Program in Nevada

As of February 2019, Nevada biologists have translocated 3,380 bighorn sheep in Nevada!

**The following wild bighorn sheep were translocated INTO the Sheep Creek Range Herd:**

1991: 21 bighorns, came from a different bighorn herd in Idaho
1993: 25 bighorns, came from a different bighorn herd in Idaho
1995: 7 bighorns, came from a different bighorn herd in Idaho

**The following wild bighorn sheep were trapped FROM the Sheep Creek Herd and translocated to other wild bighorn sheep herds:**

2012: 23 bighorns trapped from the Sheep Creek Herd and translocated to a different NV bighorn herd
2014: 15 bighorns trapped from the Sheep Creek Herd and translocated to a different NV bighorn herd

## Factors Affecting the Conservation of the Sheep Creek Range Herd

The primary issue affecting the conservation of the Sheep Creek Range Herd is excessive cattle grazing year-round on BLM grazing allotments within the Sheep Creek Range area. The entire mountain has lost its healthy native vegetation and the annual plants that dominate the landscape are not sufficient to support both native ungulates (bighorn sheep, mule deer, and pronghorn) and domestic livestock numbers.

Another issue affecting this herd is maintaining separation between wild bighorn sheep and domestic goats to avoid transmission of diseases. A herd of domestic goats exists on private land near the Sheep Creek Range Herd. A bacteria called ***Mycoplasma ovipneumoniae*** can be present in domestic goats. ***Mycoplasma ovipneumoniae*** causes pneumonia in wild bighorn sheep.

Interestingly, even when domestic goats carry this bacteria, the domestic goats typically do not get pneumonia. However, if a wild bighorn sheep comes into contact with a domestic goat that has

this bacteria, then the wild bighorn sheep can be exposed to the bacteria and subsequently get infected with pneumonia. Moreover, the newly infected wild bighorn sheep can then bring the bacteria back to its herd and infect the entire herd with pneumonia.

The goat herd owner "rents" out his goats to farmers where the goats eat weedy plants on agricultural lands. When the goats are not working on agricultural lands, the goats live in the pastures at the base of a mountain near the area occupied by the Sheep Creek Range Herd, and they pose a disease risk to the bighorn herd. Talks were started a few years ago to come to an agreement to remove the goats or build a fence that would restrict wild bighorn sheep from interacting with the weed goats. The fence has yet to be built, but discussions continue with the private landowner (where the goats live when they are not "rented" out to farmers) and the goat operator who leases the pastures from the private landowner.

To a lesser degree, predators are a conservation issue. Predators of bighorn sheep in the Sheep Creek Range Herd include mountain lions, bobcats, coyotes, and golden eagles.

## **Graph It!**

UseTable 1-2 on the next page to do the following:

1. Calculate the **Total Number of Bighorn Sheep Each Year** (HINT: add the Number of EWES yearlings, Number of RAMS yearlings, Number of EWES 2+ years old, and the Number of RAMS 2+ years old) for each year and put the answers in the column marked **Total Number of Bighorn Sheep Each Year** (the yellow shaded column).

2. After you have filled in all the missing data, create a graph showing the **Total Number of Bighorn Sheep Each Year**. Put **Year** on the x-axis and **Total Number of Bighorn Sheep Each Year** on the y-axis.

Table 1-2. Annual Population Estimate of Bighorn Sheep in the Sheep Creek Range Herd, for Years 1991-2018

| YEAR | Number of EWES Yearlings | Number of RAMS Yearlings | Number of EWES 2+ years old | Number of RAMS 2+ years old | Total Number of Bighorn Sheep Each Year |
|---|---|---|---|---|---|
| 1991 | 0 | 16 | 2 | 2 | **20** |
| 1992 | 3 | 15 | 3 | 3 | |
| 1993 | 5 | 36 | 4 | 8 | |
| 1994 | 6 | 37 | 7 | 11 | |
| 1995 | 9 | 45 | 9 | 15 | |
| 1996 | 9 | 48 | 9 | 21 | |
| 1997 | 6 | 49 | 6 | 27 | |
| 1998 | 5 | 47 | 6 | 29 | |
| 1999 | 5 | 44 | 6 | 28 | |
| 2000 | 8 | 41 | 8 | 27 | |
| 2001 | 8 | 42 | 8 | 27 | |
| 2002 | 10 | 43 | 11 | 28 | |
| 2003 | 10 | 46 | 11 | 33 | |
| 2004 | 17 | 49 | 18 | 35 | |
| 2005 | 13 | 57 | 14 | 44 | |
| 2006 | 10 | 62 | 10 | 49 | |
| 2007 | 15 | 63 | 15 | 51 | |
| 2008 | 17 | 69 | 17 | 54 | |
| 2009 | 14 | 75 | 15 | 58 | |
| 2010 | 18 | 79 | 19 | 60 | |
| 2011 | 28 | 86 | 28 | 65 | |
| 2012 | 23 | 84 | 23 | 74 | |
| 2013 | 10 | 93 | 9 | 79 | |
| 2014 | 11 | 76 | 10 | 71 | |
| 2015 | 9 | 66 | 10 | 64 | |
| 2016 | 16 | 61 | 16 | 58 | |
| 2017 | 9 | 61 | 9 | 58 | |
| 2018 | 8 | 59 | 8 | 51 | |

**QUESTIONS (answer these as a team)**

1. How many sheep were translocated TO this herd during 1993-1995 to re-establish it, and where did these translocated sheep come from?

2. What other animals besides wild bighorn sheep use the habitat in the Sheep Creek Range?

3. What three things happened that lowered the habitat quality and carrying capacity of the Sheep Creek Range area? What does carrying capacity mean?

4. How did Nevada Department of Wildlife reduce the size of this bighorn sheep herd so that the size of the herd would better match the lowered carrying capacity?

5. Why is it better to have a diverse habitat with native plant species rather than a monotypic habitat with mostly non-native plants?

6. Do you think it is a good idea to use domestic goats to control weeds in areas near bighorn sheep herds? Why or why not?

## INSTRUCTIONS FOR CREATING YOUR PRESENTATION

Work as a team to put together a presentation that you will give to the rest of the class. Your presentation should include at least the following:

1) the subspecies of bighorn sheep in your herd
2) where your bighorn sheep herd lives
3) brief background information about the history of this herd and information about its habitat
4) the graph you created
5) information about how many wild bighorn sheep have been translocated TO the Sheep Creek Range Herd and how many sheep have been trapped FROM the Sheep Creek Range Herd and translocated to other wild herds
6) information about how the habitat has changed in the Sheep Creek Range area
7) definition of carrying capacity
8) a list of factors affecting the conservation of this herd
9) photos of the Sheep Creek Range, provided below

Photos of the Sheep Creek Range area are provided by Mike Cox, Nevada Department of Wildlife:

# Student Pages: Nevada Bighorn Sheep: On the Edge?

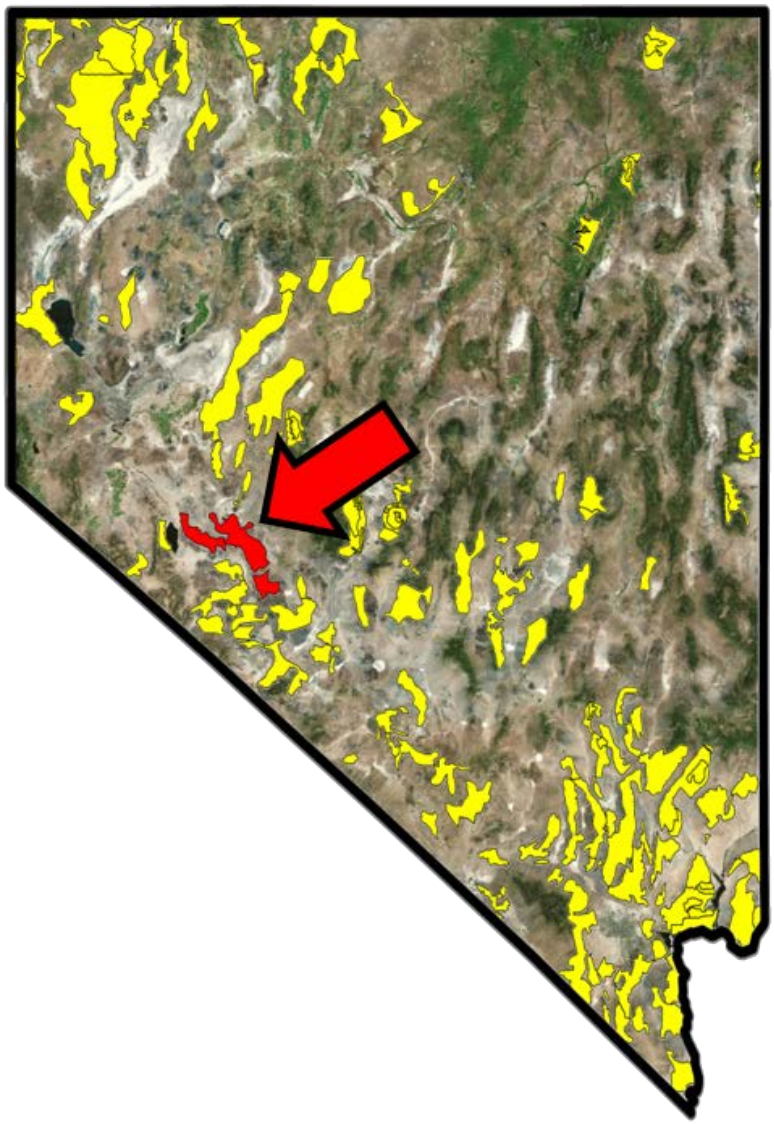
**Team 3** **Your bighorn sheep herd name is GABBS/GILLIS VALLEY RANGE HERD**

**Instructions for this Activity**

You should be in one of 6 teams. Individually, read through the Background Information thoroughly, calculate the missing data in the Table 1-3, and create your graph. Then, work as a team to answer the questions and create a list of factors (things) that affect the conservation of your bighorn sheep herd. Then, as a team create a presentation that you will give to the rest of the class. At the end of these Student Pages, you will find a list of things you should include in your presentation.

**BACKGROUND INFORMATION**

The Gabbs/Gillis Valley Range Herd is located southeast of Carson City, Nevada and occupies about 280,195 acres.



## Bighorn Sheep Subspecies

The subspecies of bighorn sheep in the Gabbs/Gillis Valley Range Herd is the desert bighorn sheep.

## History and Habitat

The Gabbs/Gillis Valley Range Herd was re-established during 1988-1993 when 57 bighorn sheep were translocated to this area → 29 of the 57 wild bighorns translocated to the Gabbs/Gillis Valley Range Herd came from the Muddy and Black Mountains Herd. In 1998, another 21 bighorn sheep were translocated to the Gabbs/Gillis Valley Range area, the wild bighorns came from other wild bighorn sheep herds in Nevada. To supplement this herd, another 21 bighorns were translocated to the Gabbs/Gillis Valley Range Herd in 1998.

Since 1994, this bighorn sheep herd has sometimes served as a source stock, which means that biologists trap wild bighorn sheep FROM the Gabbs/Gillis Valley Range Herd and translocate them TO other wild bighorn sheep herds.

The habitat in the Gabbs/Gillis Valley Range area is primarily dominated by sagebrush and scattered pinyon pine at higher elevations. At mid to lower elevations, the dominant plant species are spiny hopsage, saltbrush, and shadescale, with an understory of some perennial grasses like Indian rice grass, Galleta grass, and desert needle grass.

Water availability in the Gabbs/Gillis Valley Range area include several seeps and springs, but some are unreliable in the heat of the summer and others are not well distributed in the steep and rugged habitat that bighorn sheep prefer. Ten water developments (guzzlers) were built to augment the natural distribution of springs to help provide water for bighorn sheep during the summer months. Bighorn sheep are dependent on these guzzlers from April-October each year.

## Wild Bighorn Sheep Translocation Program in Nevada

As of February 2019, Nevada biologists have translocated 3,380 bighorn sheep in Nevada!

### The following wild bighorn sheep were translocated INTO the Gabbs/Gillis Valley Range Herd:

1988 – 22 bighorns, came from a different Nevada bighorn sheep herd
1989 – 3 bighorns, came from a different Nevada bighorn sheep herd
1990 – 12 bighorns, came **from the Muddys and Black Mountains Herd in Nevada**
1993 – 17 bighorns, came **from the Muddys and Black Mountains Herd in Nevada**
1993 – 3 bighorns, came from a different bighorn sheep herd in Nevada
1998 - 21 bighorns, came from a different bighorn sheep herd in Nevada

**The following wild bighorn sheep were trapped FROM the Gabbs/Gillis Valley Range Herd and translocated INTO other wild bighorn sheep herds:**

1994 – 1 bighorn trapped from Gabbs/Gillis Range Herd and translocated to a different NV bighorn herd
1998 – 20 bighorns trapped from Gabbs/Gillis Range Herd and translocated to a different to TX bighorn herd
2001 – 22 bighorns trapped from Gabbs/Gillis Range Herd and translocated to a different NV bighorn herd
2015 – 15 bighorns trapped from Gabbs/Gillis Range Herd and translocated to a different NV bighorn herd

## Factors Affecting the Conservation of the Gabbs/Gillis Valley Range Herd

The primary factor affecting this herd is competition with an excessive number of feral horses. There are over 700 feral horses that live in the Gabbs/Gillis Valley Range area! Feral horses compete with wild bighorns for water at springs and seeps. Sometimes feral horse studs are unwilling to allow bighorn sheep to drink from springs. Bighorn sheep are very timid and noncombative, so they simply quit going to a spring if a feral horse is consistently defending it.

To a much lesser degree, some predators also affect this herd. Predators include mountain lions, bobcats, and coyotes.

## Graph It!

Using Table 1-3 on the following page, do the following:

1. Calculate the **Total Number of Bighorn Sheep Each Year** (HINT: add the Number of EWES yearlings, Number of RAMS yearlings, Number of EWES 2+ years old, and the Number of RAMS 2+ years old) for each year and put the answers in the column marked **Total Number of Bighorn Sheep Each Year** (the yellow shaded column).

2. After you have filled in all the missing data, create a graph showing the **Total Number of Bighorn Sheep Each Year**. Put **Year** on the x-axis and **Total Number of Bighorn Sheep Each Year** on the y-axis.

Table 1-3. Annual Population Estimate of Bighorn Sheep in the Gabbs/Gillis Valley Range Herd, for Years 1984-2018

| YEAR | Number of EWES Yearlings | Number of RAMS Yearlings | Number of EWES 2+ years old | Number of RAMS 2+ years old | Total Number of Bighorn Sheep Each Year |
|---|---|---|---|---|---|
| **1984** | 3 | 1 | 13 | 4 | **21** |
| **1985** | 5 | 4 | 15 | 5 | |
| **1986** | 5 | 4 | 18 | 9 | |
| **1987** | 5 | 5 | 20 | 12 | |
| **1988** | 4 | 4 | 38 | 16 | |
| **1989** | 5 | 8 | 36 | 23 | |
| **1990** | 6 | 8 | 42 | 30 | |
| **1991** | 10 | 10 | 44 | 32 | |
| **1992** | 7 | 7 | 50 | 34 | |
| **1993** | 14 | 14 | 62 | 34 | |
| **1994** | 21 | 22 | 69 | 35 | |
| **1995** | 23 | 22 | 81 | 44 | |
| **1996** | 28 | 27 | 94 | 52 | |
| **1997** | 16 | 15 | 110 | 61 | |
| **1998** | 24 | 23 | 112 | 62 | |
| **1999** | 31 | 28 | 120 | 69 | |
| **2000** | 25 | 24 | 135 | 76 | |
| **2001** | 25 | 24 | 144 | 80 | |
| **2002** | 32 | 31 | 132 | 83 | |
| **2003** | 19 | 20 | 145 | 90 | |
| **2004** | 29 | 29 | 143 | 86 | |
| **2005** | 36 | 36 | 148 | 93 | |
| **2006** | 36 | 38 | 161 | 104 | |
| **2007** | 40 | 40 | 167 | 115 | |
| **2008** | 40 | 42 | 177 | 126 | |
| **2009** | 39 | 40 | 186 | 136 | |
| **2010** | 48 | 49 | 197 | 146 | |
| **2011** | 54 | 55 | 216 | 157 | |
| **2012** | 48 | 49 | 237 | 173 | |
| **2013** | 53 | 54 | 255 | 175 | |
| **2014** | 67 | 67 | 275 | 185 | |
| **2015** | 45 | 45 | 304 | 206 | |
| **2016** | 66 | 66 | 295 | 204 | |
| **2017** | 73 | 74 | 321 | 213 | |
| **2018** | 78 | 78 | 350 | 220 | |

**QUESTIONS (answer as a group):**

1. How many bighorns have been translocated TO the Gabbs/Gillis Valley Range Herd between 1988-1993?

2. How many wild bighorns have been trapped FROM the Muddys and Black Mountains Herd and translocated TO the Gabbs/Gillis Valley Range Herd?

3. How many sheep have been trapped FROM the Gabbs/Gillis Valley Range Herd and translocated TO other wild bighorn sheep herds?

4. Based on the population data you graphed, do you think the efforts to re-establish this herd have been successful? Why or why not?

5. How many water guzzlers have been created in the Gabbs/Gillis Valley Range area? Why is it important to create water guzzlers for bighorn sheep?

6. Feral horses are beautiful and majestic animals, but do you think really LARGE herds of non-native feral horses belong on habitats that support native wildlife species like wild bighorn sheep? Why or why not?

**INSTRUCTIONS FOR CREATING YOUR PRESENTATION**

Work as a team to put together a presentation that you will give to the rest of the class. Your presentation should include at least the following:

1) the subspecies of bighorn sheep in your herd
2) where your bighorn sheep herd lives
3) brief background information about the history of this herd and its habitat
4) the graph you created
5) information about how many wild bighorns were translocated TO the Gabbs/Gillis Valley Range Herd between 1988-1993. Include information about how many of these bighorns came FROM the Muddys and Black Mountains Herd in Nevada.
6) information about how many wild bighorn sheep have been trapped from the Gabbs/Gillis Valley Range Herd and translocated to other wild herds
7) information about how feral horses compete for resources with wild bighorn sheep
8) a list of factors affecting the conservation of this herd
9) include photos of the Gabbs/Gillis Valley Range area, provided below

Photos of the Gabbs/Gillis Valley Range area provided by Mike Cox, Nevada Department of Wildlife:

# Student Pages: Nevada Bighorn Sheep: On the Edge?

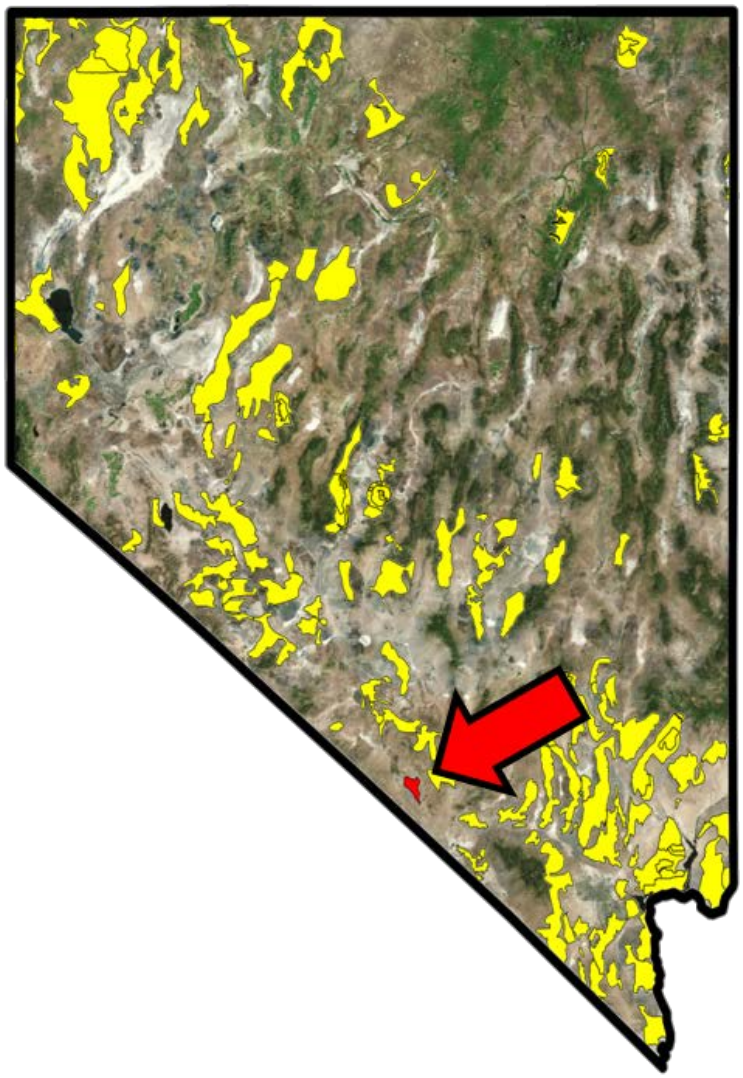
**Team 4** **Your bighorn sheep herd name is BARE MOUNTAIN HERD**

**Instructions for this Activity**

You should be in one of 6 teams. Individually, read through the Background Information thoroughly, calculate the missing data in the Table 1-4, and create your graph. Then, work as a team to answer the questions and create a list of factors (things) that affect the conservation of your bighorn sheep herd. Then, as a team create a presentation that you will give to the rest of the class. At the end of these Student Pages, you will find a list of things you should include in your presentation.

**BACKGROUND INFORMATION**

The Bare Mountains Herd is located southeast of Beatty, Nevada and occupies about 30,599 acres.



**Bighorn Sheep Subspecies**

The subspecies of bighorn sheep in the Bare Mountain Herd is the desert bighorn sheep.

**History and Habitat**

The Bare Mountain Herd was re-established beginning in 1991 when 20 bighorn sheep were translocated TO the Bare Mountain area. These 20 wild bighorn sheep were trapped FROM the Muddys and Black Mountain Herd. In 1993, another 18 wild bighorn sheep were translocated TO the Bare Mountains area. These 18 wild bighorn sheep were also trapped FROM the Muddys and Black Mountains Herd. In 1995, another 5 bighorn sheep were translocated TO the Bare Mountain area, the 5 bighorn sheep came FROM another wild sheep herd in Nevada.

The size of the Bare Mountains Herd steadily increased over time. In 2014, the size of the herd was larger than the water resources in the Bare Mountains could support (the limited water supply was drying up). To manage this herd sustainably, the Nevada Department of Wildlife established an ewe hunt in 2014. They stopped the ewe hunt in 2018 because the bighorn herd size was decreasing due to a pneumonia outbreak.

More about the pneumonia outbreak: in 2014 the Bare Mountain Herd was exposed to ***Mycoplasma ovipneumoniae***, which is a bacteria that causes pneumonia in wild bighorn sheep. By 2016-2017, pneumonia began to take its toll on the herd, as fewer lambs survived and fewer adults survived, too.

The bacteria ***Mycoplasma ovipneumoniae*** can be present in domestic goats and domestic sheep. Interestingly, even when domestic goats and domestic sheep carry this bacteria, the domestic goats and domestic sheep typically do not get pneumonia. However, if a wild bighorn sheep comes into contact with a domestic goat or sheep that has this bacteria, then the wild bighorn sheep can be exposed to the bacteria and subsequently get infected with pneumonia. Moreover, the newly infected wild bighorn sheep can then bring the bacteria back to its herd and infect the entire herd with pneumonia.

Research is being conducted on the Bare Mountain Herd. Biologists capture wild bighorns and sample their blood to monitor disease. Then, captured bighorns are released back into their habitat. Biologists also capture some bighorns in the Bare Mountain area and attach GPS collars on them, and then release the bighorns back into their habitat. With GPS collars, biologists can track bighorn sheep movements to understand how pneumonia spreads across the landscape. Biologists also use GPS data to better understand where bighorn sheep go and how wild bighorn sheep use resources on the landscape.

The habitat in the Bare Mountain area is primarily dominated by creosote bush, white bursage, and black brush. There is an understory of limited perennial plants, desert needle grass, some flowers, and a few cactus species like barrel, beavertail, and cholla. At the very highest elevations in the Bare Mountain area, there is typical Great Basin habitat including sagebrush.

There is not much water in the Bare Mountain area. There's only one known spring, Specie Springs, which was once a well flowing and productive spring. Now Specie Springs is dry much of the year due to continued overuse and damage by an overabundance of feral burros. Four water developments were built

specifically to help provide water for bighorn sheep. These four water developments are fenced off so feral burros can't use them. Bighorn sheep are dependent on these water developments from April – October. Interestingly, there is a small active gold mine in the Bare Mountain area and the owners of the gold mine are very supportive of the bighorn herd. The gold mine workers have maintained two water troughs for over ten years to help provide a vital water source to the bighorn sheep herd.

The Bare Mountain is connected to a larger series of mountainous terrain and canyons, which are off limits to the public. This large area is co-managed by the Department of Defense and Energy and is occupied by bighorn sheep that have a history of extensive movement. It is normal for bighorn sheep to move extensively when a landscape provides relatively sparse foods and water. On these types of landscapes, bighorn sheep might travel extensively searching for food and water. Unfortunately, extensive travel also means that wild bighorn sheep might come in contact with animals (wild or domestic) that have the bacteria ***Mycoplasma ovipneumoniae***. This can increase the chances that wild bighorn sheep might contract pneumonia. This is exactly what happened in 2014 to this herd.

## Wild Bighorn Sheep Translocation Program in Nevada

As of February 2019, Nevada biologists have translocated 3,380 bighorn sheep in Nevada!

**The following wild bighorn sheep were translocated INTO the Bare Mountain Herd:**

1991 – 20 bighorns, came from the Muddys and Black Mountains Herd in Nevada
1993 – 18 bighorns, came from the Muddys and Black Mountains Herd in Nevada
1995 – 5 bighorns, came from a different Nevada bighorn sheep herd

**The following wild bighorn sheep were trapped FROM the Bare Mountain Herd and translocated INTO other wild bighorn sheep herds:**

2011 – 25 bighorns trapped from the Bare Mountain Herd and translocated to a different NV bighorn herd
2013 – 50 bighorns trapped from the Bare Mountain Herd and translocated to a different NV bighorn herd

## Factors Affecting the Conservation of the Bare Mountain Herd

The primary factors affecting the Bare Mountains Herd include disease and competition with an excessive number of feral burros.

Disease → Pneumonia continues to be an issue for this herd. Since 2015, almost no lambs have survived during the last few years.

Feral Burros → There are over 300 feral burros that live in the Bare Mountain area. These feral burros overgraze the small, relatively sparsely vegetated mountain and damage the limited and critical riparian areas.
Fortunately, the Bureau of Land Management (BLM) conducted a feral burro gather in 2017 and removed many of the feral burros, which will help the struggling bighorn sheep herd on the Bare Mountain.

Lack of water continues to be an issue. Also, there is some human disturbance to this herd: a desert road race occurs every year through the northern end of Bare Mountain with thousands of dune buggy type vehicles and motorcycles. Finally, there are a limited number of bobcats and coyotes. Predation is a relatively minor issue for the Bare Mountain Herd.

**Graph It!**

Using Table 1-4 on the following page, do the following:

1. Calculate the **Total Number of Bighorn Sheep Each Year** (HINT: add the Number of EWES yearlings, Number of RAMS yearlings, Number of EWES 2+ years old, and the Number of RAMS 2+ years old) for each year and put the answers in the column marked **Total Number of Bighorn Sheep Each Year** (the yellow shaded column).

2. After you have filled in all the missing data, create a graph showing the **Total Number of Bighorn Sheep Each Year**. Put **Year** on the x-axis and **Total Number of Bighorn Sheep Each Year** on the y-axis.

Table 1-4. Annual Population Estimate of Bighorn Sheep in the Bare Mountain Herd, for Years 1992-2018

| YEAR | Number of EWES Yearlings | Number of RAMS Yearlings | Number of EWES 2+ years old | Number of RAMS 2+ years old | Total Number of Bighorn Sheep Each Year |
|---|---|---|---|---|---|
| **1992** | 1 | 0 | 13 | 5 | **19** |
| **1993** | 2 | 2 | 26 | 8 | |
| **1994** | 5 | 5 | 25 | 10 | |
| **1995** | 4 | 4 | 28 | 19 | |
| **1996** | 5 | 5 | 30 | 21 | |
| **1997** | 8 | 8 | 32 | 24 | |
| **1998** | 6 | 6 | 37 | 30 | |
| **1999** | 3 | 3 | 39 | 34 | |
| **2000** | 6 | 6 | 38 | 33 | |
| **2001** | 6 | 6 | 38 | 32 | |
| **2002** | 6 | 7 | 38 | 32 | |
| **2003** | 5 | 5 | 39 | 30 | |
| **2004** | 9 | 9 | 38 | 30 | |
| **2005** | 11 | 11 | 43 | 31 | |
| **2006** | 13 | 13 | 48 | 37 | |
| **2007** | 10 | 10 | 55 | 40 | |
| **2008** | 6 | 6 | 70 | 47 | |
| **2009** | 13 | 13 | 81 | 53 | |
| **2010** | 10 | 10 | 85 | 54 | |
| **2011** | 14 | 14 | 89 | 55 | |
| **2012** | 35 | 35 | 92 | 55 | |
| **2013** | 24 | 25 | 118 | 83 | |
| **2014** | 28 | 28 | 101 | 90 | |
| **2015** | 22 | 15 | 114 | 98 | |
| **2016** | 13 | 12 | 115 | 99 | |
| **2017** | 15 | 15 | 97 | 92 | |
| **2018** | 12 | 12 | 90 | 86 | |

**QUESTIONS (answer these as a group)**

1. How many bighorn sheep were translocated TO this herd to establish it during 1991-1995, and where did these translocated sheep come from?

2. Based on the data you graphed for the number of total sheep observed, would you say that this herd has recovered from what happened in 2014? Why or why not?

3. Research is being done on this herd, what are biologists trying to find out with their research?

4. Sometimes human development like gold mining can negatively impact the conservation of wild animals. In the Bare Mountain area, there is one gold mine owner who is doing something good for wild bighorn sheep. What is this gold mine owner doing?

5. Bighorn sheep in the Bare Mountain area travel extensively looking for food and water. Although traveling extensively is natural and normal for wild bighorns, can you think of one negative thing that can happen as bighorns travel so extensively?

6. Feral burros are really cool animals, but when there are so many feral burros in one wild area it can be problematic. Why?

## INSTRUCTIONS FOR CREATING YOUR PRESENTATION

Work as a team to put together a presentation that you will give to the rest of the class. Your presentation should include at least the following:

1) the subspecies of bighorn sheep in your herd
2) where your bighorn sheep herd lives
3) brief background information about the history of this herd and its habitat
4) the graph you created
5) information about how many wild bighorn sheep have been translocated TO the Bare Mountain Herd, specifically include the number of wild bighorn sheep that came from the Muddys and Black Mountains Herd in Nevada
6) information about what happened to the Bare Mountain Herd in 2014
7) a list of factors affecting the conservation of this herd
8) include photos of the Bare Mountain area, provided below

Photos of the Bare Mountain area provided by Mike Cox, Nevada Department of Wildlife:

4x4
OFF ROAD

N

# Student Pages: Nevada Bighorn Sheep: On the Edge?

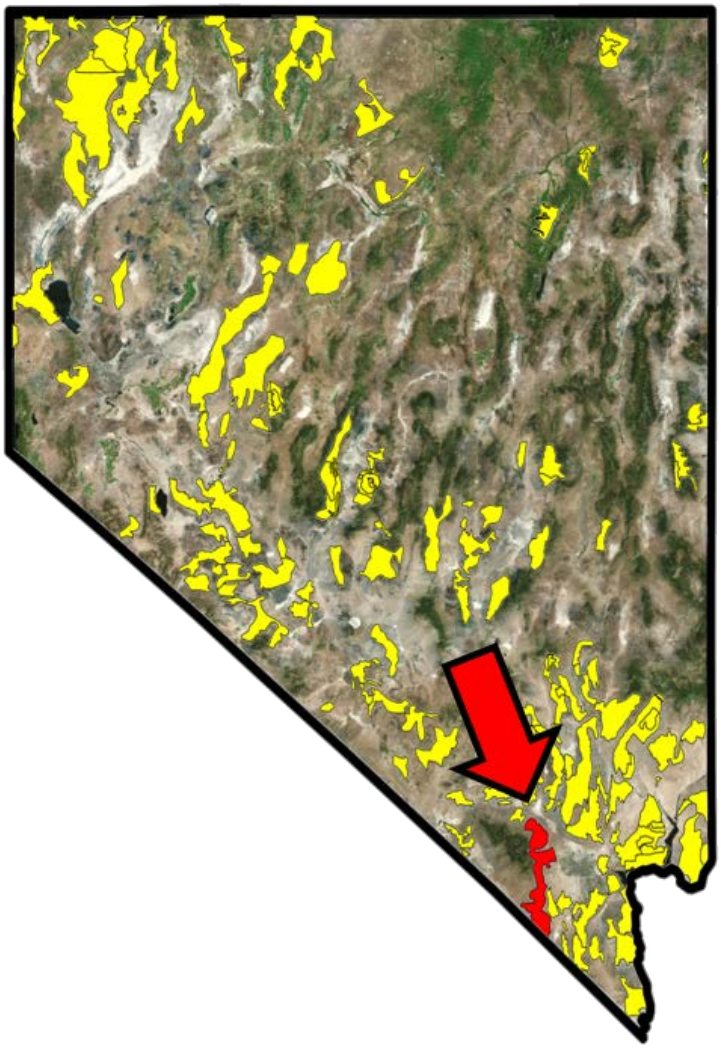
**Team 5** **Your bighorn sheep herd name is SPRING MOUNTAINS HERD**

**Instructions for this Activity**

You should be in one of 6 teams. Individually, read through the Background Information thoroughly, calculate the missing data in the Table 1-5, and create your graph. Then, work as a team to answer the questions and create a list of factors (things) that affect the conservation of your bighorn sheep herd. Then, as a team create a presentation that you will give to the rest of the class. At the end of these Student Pages, you will find a list of things you should include in your presentation.

**BACKGROUND INFORMATION**

The Spring Mountain Herd is located west of Las Vegas, Nevada and occupies about 258,049 acres.



## Bighorn Sheep Subspecies

The subspecies of bighorn sheep in the Spring Mountains Herd is the desert bighorn sheep.

## History and Habitat

The Spring Mountains Herd is a native herd. The Spring Mountains area provides plenty of water with more than 25 natural springs. An additional 4 water developments (guzzlers) were built in this area to allow bighorn sheep the opportunity to broaden their distribution into the more rugged bighorn habitat (where springs are not available).

The habitat in the Spring Mountains area is primarily dominated by creosote bush, white bursage (*Ambrosia dumosa*), and black brush (*Coleogyne ramosissima*) with an understory of perennial Galleta grass, fluff grass (Erionueron spp), desert needle grass, and a rich flower component with peak bloom in late March/early April. In this area, there is a diversity of cactus species including barrel, beavertail (*Optunia* spp.), cholla, and others. At higher elevations of the Spring Mountains area, there is a diverse shrub component with more than enough forbs for wild bighorn sheep. Spring Mountains has the fifth highest mountain peak in the state, the mountain is almost 12,000 feet high! The mid to high elevations of the Spring Mountains area are forested, and bighorn sheep do not occupy this forested area. The very highest elevations of this mountain generates its own weather patterns, which helps provide added moisture to the lower elevations of the mountain range. This added moisture helps provide water and food for bighorn sheep at lower elevations. Because of all this, the Spring Mountains are considered a "sky island" in the Mojave Desert.

In June 2005, lightning strikes in the higher elevations near Potosi Peak ignited the Goodsprings Fire. The Goodsprings Fire consumed plants across 33,484 acres along a 3,940-foot elevation gradient.

In 2013 and through 2015, the Spring Mountains Herd was exposed to ***Mycoplasma ovipneumoniae***, which is a bacteria that causes pneumonia in wild bighorn sheep. The source of the exposure to this bacteria is unknown, but pneumonia killed up to 20% of the adult wild bighorn sheep in this herd and pneumonia continues to cause poor lamb survival today. To monitor disease in this herd, Nevada Department of Wildlife biologists are currently conducting research. Biologists capture wild bighorns and sample their blood to determine whether sheep have the bacteria that causes pneumonia.

## Wild Bighorn Sheep Translocation Program in Nevada

As of February 2019, Nevada biologists have translocated 3,380 bighorn sheep in Nevada!

NO bighorn sheep have been translocated into the Spring Mountains Herd.

## Factors Affecting the Conservation of the Spring Mountains Herd

Disease is a primary factor affecting the Spring Mountains Herd. Beginning in 2013 and through 2015, the herd experienced two separate pneumonia outbreaks from an unknown source.

Suburban sprawl is also a factor. The Spring Mountains area is close to Las Vegas so human disturbance is a conservation issue and causes habitat degradation, habitat fragmentation, and habitat loss. For example, several square miles of historic bighorn sheep habitat has been lost due to suburban sprawl near Las Vegas. The development of subdivisions in this area presents numerous problems including potential stress to wintering and lambing sheep, direct mortality from dogs and fences, loss of landscape connectivity, and direct loss of habitat.

Dispersed recreation is another factor affecting the conservation of this bighorn sheep herd. Within the Spring Mountain area, there is the Red Rock Natural Conservation Area, which draws tens of thousands of visitors from Las Vegas each year. Red Rock Natural Conservation Area is a rock climbing mecca, there are many hiking trails, and there is an extensive system of mountain bike trails. Some climbing routes and trails are very intrusive to bighorn sheep and some climbing routes and trails are close to critical spring resources that bighorn sheep need.

In the Spring Mountains area, there is also a very large number of feral horses and burros, which compete with wild bighorn sheep for food and water.

Wildfire has also affected the habitat in the Spring Mountains area.

Predators are also a factor. In the Spring Mountains area there are mountain lions, bobcats, and coyotes. Mule deer and elk herds share the Spring Mountains with bighorn sheep, so mountain lions are year-round residents in the Spring Mountains area. Mountain lions often prey on mule deer and elk, but mountain lions will opportunistically "prey switch" to bighorn sheep.

## Graph It!

Using Table 1-5 on the following page, do the following:

1. Calculate the **Total Number of Bighorn Sheep Each Year** (HINT: add the Number of EWES yearlings, Number of RAMS yearlings, Number of EWES 2+ years old, and the Number of RAMS 2+ years old) for each year and put the answers in the column marked **Total Number of Bighorn Sheep Each Year** (the yellow shaded column).

2. After you have filled in all the missing data, create a graph showing the **Total Number of Bighorn Sheep Each Year**. Put **Year** on the x-axis and **Total Number of Bighorn Sheep Each Year** on the y-axis.

Table 1-5. Annual Population Estimate of Bighorn Sheep in the Spring Mountains Herd, for Years 1980-2018

| YEAR | Number of EWES Yearlings | Number of RAMS Yearlings | Number of EWES 2+ years old | Number of RAMS 2+ years old | Total Number of Bighorn Sheep Each Year |
|---|---|---|---|---|---|
| 1980 | 14 | 20 | 144 | 90 | 268 |
| 1981 | 31 | 32 | 140 | 87 | |
| 1982 | 27 | 27 | 148 | 93 | |
| 1983 | 26 | 26 | 148 | 96 | |
| 1984 | 24 | 25 | 148 | 95 | |
| 1985 | 25 | 26 | 148 | 96 | |
| 1986 | 24 | 24 | 148 | 95 | |
| 1987 | 22 | 22 | 147 | 95 | |
| 1988 | 23 | 24 | 145 | 92 | |
| 1989 | 36 | 39 | 141 | 90 | |
| 1990 | 22 | 23 | 138 | 99 | |
| 1991 | 19 | 19 | 133 | 98 | |
| 1992 | 21 | 21 | 127 | 96 | |
| 1993 | 19 | 19 | 124 | 95 | |
| 1994 | 22 | 22 | 124 | 91 | |
| 1995 | 21 | 21 | 126 | 91 | |
| 1996 | 21 | 21 | 125 | 89 | |
| 1997 | 26 | 26 | 117 | 87 | |
| 1998 | 22 | 22 | 114 | 87 | |
| 1999 | 35 | 35 | 117 | 86 | |
| 2000 | 22 | 22 | 130 | 97 | |
| 2001 | 12 | 12 | 131 | 92 | |
| 2002 | 21 | 21 | 122 | 76 | |
| 2003 | 34 | 34 | 123 | 77 | |
| 2004 | 34 | 34 | 136 | 88 | |
| 2005 | 26 | 26 | 146 | 99 | |
| 2006 | 24 | 24 | 150 | 102 | |
| 2007 | 29 | 29 | 151 | 101 | |
| 2008 | 21 | 21 | 157 | 103 | |
| 2009 | 25 | 25 | 153 | 102 | |
| 2010 | 25 | 25 | 154 | 98 | |
| 2011 | 13 | 13 | 154 | 95 | |
| 2012 | 25 | 25 | 141 | 84 | |
| 2013 | 15 | 15 | 142 | 88 | |
| 2014 | 19 | 19 | 134 | 79 | |
| 2015 | 12 | 12 | 127 | 74 | |
| 2016 | 3 | 3 | 113 | 62 | |
| 2017 | 6 | 6 | 95 | 46 | |
| 2018 | 9 | 9 | 81 | 38 | |

**QUESTIONS (answer these as a team)**

1. What happened in this area in 2005?

3. What happened in 2013 and 2015 that made the number of sheep in this herd decline?

4. Has this herd recovered from what happened during 2013 and 2015?

5. What is a "sky island"?

6. The Spring Mountains Herd occupies an area very close to Las Vegas, where there's lots of people. In what ways do humans cause issues for bighorn sheep conservation in the Spring Mountain area?

7. Feral horses are beautiful, majestic animals and feral burros are cool. However, do you think really LARGE herds of non-native feral horses and feral burros belong on habitats that support native wildlife species like wild bighorn sheep? Why or why not?

## INSTRUCTIONS FOR CREATING YOUR PRESENTATION

Work as a team to put together a presentation that you will give to the rest of the class. Your presentation should include at least the following:

1) the subspecies of bighorn sheep in your herd
2) where your bighorn sheep herd lives
3) brief background information about the history of this herd and its habitat
4) the graph you created
5) information about how many wild bighorn sheep have been translocated into the Spring Mountains Herd (if no sheep have been translocated into this herd, then state that)
6) information about what happened to this area in 2005
7) information about what happened to this herd in 2013 and 2015
8) a list of factors affecting the conservation of this herd
9) include photos of the Spring Mountains area, provided below

Photos of the Spring Mountains area are provided by Mike Cox at Nevada Department of Wildlife:

# Student Pages: Nevada Bighorn Sheep: On the Edge?

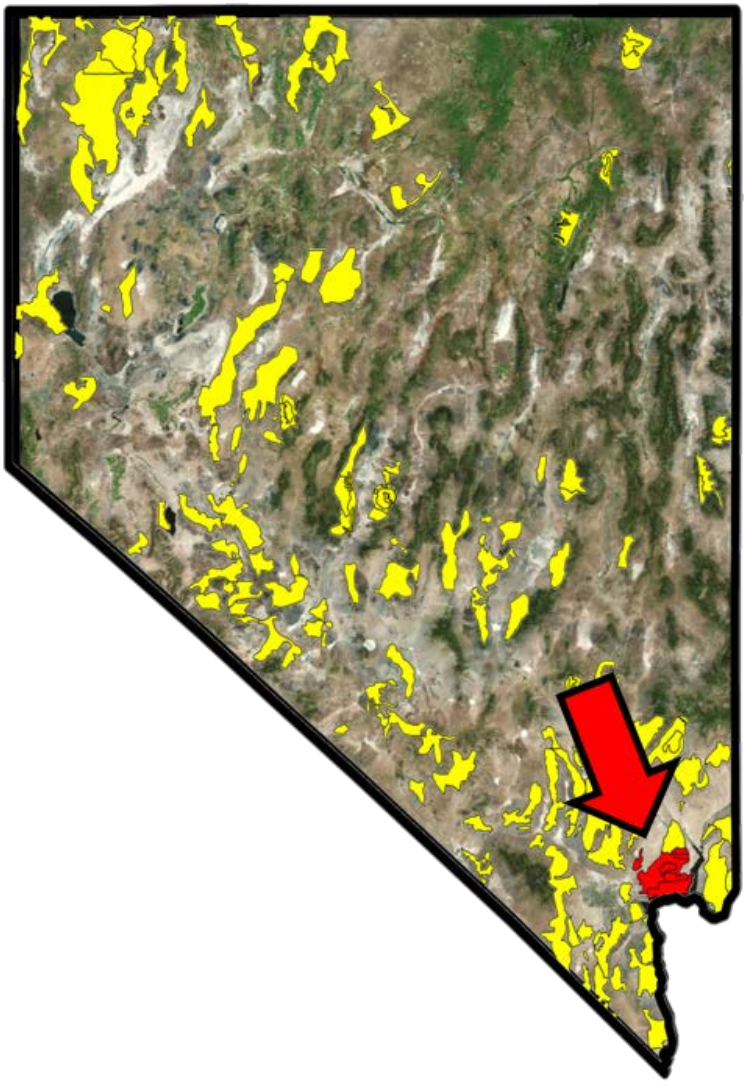
**Team 6** **Your bighorn sheep herd name is MUDDY AND BLACK MOUNTAINS HERD**

## Instructions for this Activity

You should be in one of 6 teams. Individually, read through the Background Information thoroughly, calculate the missing data in the Table 1-6, and create your two graphs. Then, work as a team to answer the questions and create a list of factors (things) that affect the conservation of your bighorn sheep herd. Finally, as a team create a presentation that you will give to the rest of the class. At the end of these Student Pages, you will find a list of things you should include in the presentation.

## BACKGROUND INFORMATION

The Muddy and Black Mountain Herd is located east of Las Vegas and occupies about 263,369 acres.



**Bighorn Sheep Subspecies**

The subspecies of bighorn sheep in the Muddy and Black Mountains Herd is the desert bighorn sheep.

**History and Habitat**

The Muddy and Black Mountains Herd is a native herd. The Muddy Mountains is adjacent to the Black Mountains. The habitat in the Muddy Mountains is primarily dominated by creosote bush, white bursage (*Ambrosia dumosa*), and black brush (*Coleogyne ramosissima*) with an understory of limited perennial fluff grass and desert needle grass. There are also a lot of flowers, with a peak bloom in late March/early April. There is a diversity of cactus species in this area, with barrel, beavertail, cholla, and others. The plant community in the Black Mountains is not as diverse as that in the Muddy Mountains. However, water is more available in the Black Mountains compared to water availability in the Muddy Mountains.

Before the Hoover Dam was built on the Colorado River near Boulder City, the Muddy Mountains served as winter range for bighorn sheep. Historically, there were about 700 bighorns that lived in the Muddy and Black Mountains area before the Hoover Dam was built.

Importantly, the Muddy Mountains area has a scattered distribution of two small shrubs called screwbean mesquite (*Prosopis pubescens*) and catclaw acacia (*Acacia greggii*) that stay green and bear their fruits longer during drought periods than any other shrub or plant. These two shrubs provide critical food sources for bighorn sheep when drought conditions exist. These two vitally important shrubs supplement the bighorn diet when all other plants are dried and desiccated, which allows desert bighorns here to survive better than most other desert bighorn sheep herds.

**Wild Bighorn Sheep Translocation Program in Nevada**

As of February 2019, Nevada biologists have translocated 3,380 bighorn sheep in Nevada!

No bighorn sheep have been translocated INTO the Muddy and Black Mountains Herd.

However, since 1981 this bighorn sheep herd has served as a source stock, which means sometimes wild bighorn sheep have been trapped FROM the Muddy and Black Mountains Herd and translocated TO other wild bighorn sheep herds.

## Factors Affecting the Conservation of the Muddy and Black Mountain Herd

Relative to most bighorn habitat in Nevada, the Muddy Mountain area is not well-watered. This area has less than 10 known natural spring sources. Bighorns are dependent on these springs from April-October each year. Bighorn sheep here also compete with a small number of feral horses and burros for water at the limited natural springs. To help conserve this herd, Nevada Department of Wildlife and many conservation organizations have built water guzzlers to help provide water.

Dispersed recreation is also a conservation issue. The Muddy and Black Mountains area is part of the Lake Mead National Recreation Area and Valley of Fire State Park, both of which receive high

amounts of dispersed recreation. The Muddy and Black Mountains Herd has acclimated to high rates of sightseeing helicopter flyovers from Las Vegas to the Grand Canyon.

Keeping the Muddy and Black Mountains Herd at or below carrying capacity is a management goal. This bighorn sheep herd is doing very well. In fact, this herd has done so well that hundreds of sheep have been trapped FROM the Muddy and Black Mountains Herd and translocated TO other bighorn sheep habitat throughout Nevada and even to other states to re-establish other bighorn sheep herds or to supplement small herds. Even today, the herd continued to grow despite the fact that many sheep had been translocated FROM this herd TO other herds.

It's important to keep this herd at or below carrying capacity to control the herd in relation to its availability of resources. To help keep the bighorn herd at or below carrying capacity, managers use at least two strategies: 1) regulated hunting (where the number of sheep allowed to be hunted is calculated based on scientific information), and, 2) trapping some individuals FROM the Muddy and Black Mountains Herd and transplanting them TO other wild bighorn sheep herds. Regulated hunting is an important conservation tool for wildlife managers.

**Carrying capacity** is the maximum size of a biological population that the environment can sustain indefinitely without degrading the environment for future generations. When a population is at carrying capacity, then the # of births = the # of deaths.

**Graph It!**

Now, it's time to do some graphing. There are two tables below, follow the instructions for each table.

Using Table 1-6 on the next page, do the following:

1. Calculate the **Total Number of Bighorn Sheep Each Year** (HINT: add the Number of EWES yearlings, Number of RAMS yearlings, Number of EWES 2+ years old, and the Number of RAMS 2+ years old) for each year and put the answers in the column marked **Total Number of Bighorn Sheep Each Year** (the yellow shaded column).

2. After you have filled in all the missing data, create a line graph showing the **Total Number of Bighorn Sheep Each Year**. Put **Year** on the x-axis and **Total Number of Bighorn Sheep Each Year** on the y-axis.

Table 1-6. Annual Population Estimate of Bighorn Sheep in the Muddy and Black Mountains Herd, for Years 1985-2018

| YEAR | Number of EWES Yearlings | Number of RAMS Yearlings | Number of EWES 2+ years old | Number of RAMS 2+ years old | Total Number of Bighorn Sheep Each Year |
|---|---|---|---|---|---|
| 1985 | 77 | 76 | 377 | 294 | 824 |
| 1986 | 64 | 56 | 353 | 293 | |
| 1987 | 58 | 56 | 334 | 273 | |
| 1988 | 59 | 58 | 356 | 262 | |
| 1989 | 81 | 78 | 363 | 254 | |
| 1990 | 53 | 52 | 383 | 265 | |
| 1991 | 45 | 43 | 362 | 248 | |
| 1992 | 46 | 45 | 359 | 236 | |
| 1993 | 70 | 69 | 334 | 219 | |
| 1994 | 77 | 74 | 339 | 225 | |
| 1995 | 56 | 55 | 336 | 226 | |
| 1996 | 57 | 53 | 343 | 218 | |
| 1997 | 36 | 36 | 362 | 211 | |
| 1998 | 57 | 56 | 332 | 195 | |
| 1999 | 69 | 70 | 333 | 202 | |
| 2000 | 53 | 51 | 349 | 215 | |
| 2001 | 29 | 26 | 340 | 208 | |
| 2002 | 53 | 51 | 297 | 175 | |
| 2003 | 25 | 24 | 288 | 173 | |
| 2004 | 68 | 65 | 288 | 160 | |
| 2005 | 79 | 79 | 329 | 192 | |
| 2006 | 87 | 84 | 362 | 217 | |
| 2007 | 93 | 90 | 396 | 235 | |
| 2008 | 73 | 71 | 415 | 265 | |
| 2009 | 84 | 84 | 411 | 283 | |
| 2010 | 49 | 50 | 441 | 308 | |
| 2011 | 43 | 42 | 448 | 304 | |
| 2012 | 109 | 108 | 412 | 287 | |
| 2013 | 68 | 65 | 460 | 320 | |
| 2014 | 109 | 110 | 450 | 316 | |
| 2015 | 104 | 106 | 448 | 334 | |
| 2016 | 69 | 69 | 483 | 365 | |
| 2017 | 93 | 92 | 469 | 357 | |
| 2018 | 80 | 79 | 480 | 376 | |

Using Table 2-6 below (on this page), create a BAR graph showing the number of sheep translocated FROM the Muddy and Black Mountains Herd each year. Put **Year** on the x-axis and **Number of Sheep Trapped FROM the Muddy and Black Mountains Herd** on the y-axis.

**Table 2-6. Number of Bighorn Sheep Trapped FROM the Muddy and Black Mountains Herd and translocated TO Other Bighorn Sheep Herds During 1981-2014.**

| Year | Number of bighorn sheep trapped FROM the Muddy and Black Mnts Herd |
|---|---|
| 1981 | 20 |
| 1982 | 0 |
| 1983 | 57 |
| 1984 | 19 |
| 1985 | 50 |
| 1986 | 112 |
| 1987 | 74 |
| 1988 | 0 |
| 1989 | 26 |
| 1990 | 41 |
| 1991 | 38 |
| 1992 | 0 |
| 1993 | 55 |
| 1994 | 36 |
| 1995 | 58 |
| 1996 | 20 |
| 1997 | 0 |
| 1998 | 30 |
| 1999 | 20 |
| 2000 | 20 |
| 2001 | 26 |
| 2002 | 0 |
| 2003 | 10 |
| 2004 | 0 |
| 2005 | 0 |
| 2006 | 0 |
| 2007 | 25 |
| 2008 | 41 |
| 2009 | 20 |
| 2011 | 51 |
| 2012 | 25 |
| 2013 | 50 |
| 2014 | 71 |

**Important information to remember about Table 2-6:**
During 1990, of the 41 bighorn sheep trapped FROM the Muddy and Black Mountains herd, 12 of those trapped bighorns were then translocated TO the Gabbs/Gillis Range Herd.

During 1991, of the 38 bighorn sheep trapped FROM the Muddy and Black Mountains Herd, 20 of these bighorn sheep were then translocated TO the Bare Mountain Herd.

During 1993, of the 55 bighorns sheep trapped FROM the Muddy and Black Mountains Herd, 17 of these bighorn sheep were then translocated TO the Gabbs/Gillis Range Herd and 18 of these bighorn sheep were translocated TO the Bare Mountain Herd.

**QUESTIONS (answer these as a team)**

1. How many sheep were trapped FROM the Muddy and Black Mountains Herd during 1993?

2. In 1993, some of the bighorns that were trapped FROM the Muddy and Black Mountains Herd were translocated to two other bighorn sheep herds in Nevada. Name those two herds.

2. What does carrying capacity mean?

3. Why is it important to keep a wild bighorn herd at or below carrying capacity? How do managers keep the Muddy and Black Mountains Herd below or at carrying capacity?

4. How does regulated hunting differ from unregulated hunting? (Hint: which one is based on science?)

5. Why are screwbean mesquite and catclaw acacia so important to this herd?

6. How many total bighorn sheep have been trapped FROM the Muddy and Black Mountains Herd and translocated TO other bighorn sheep herds? (Hint: add all the numbers in the orange column in Table 2-6).

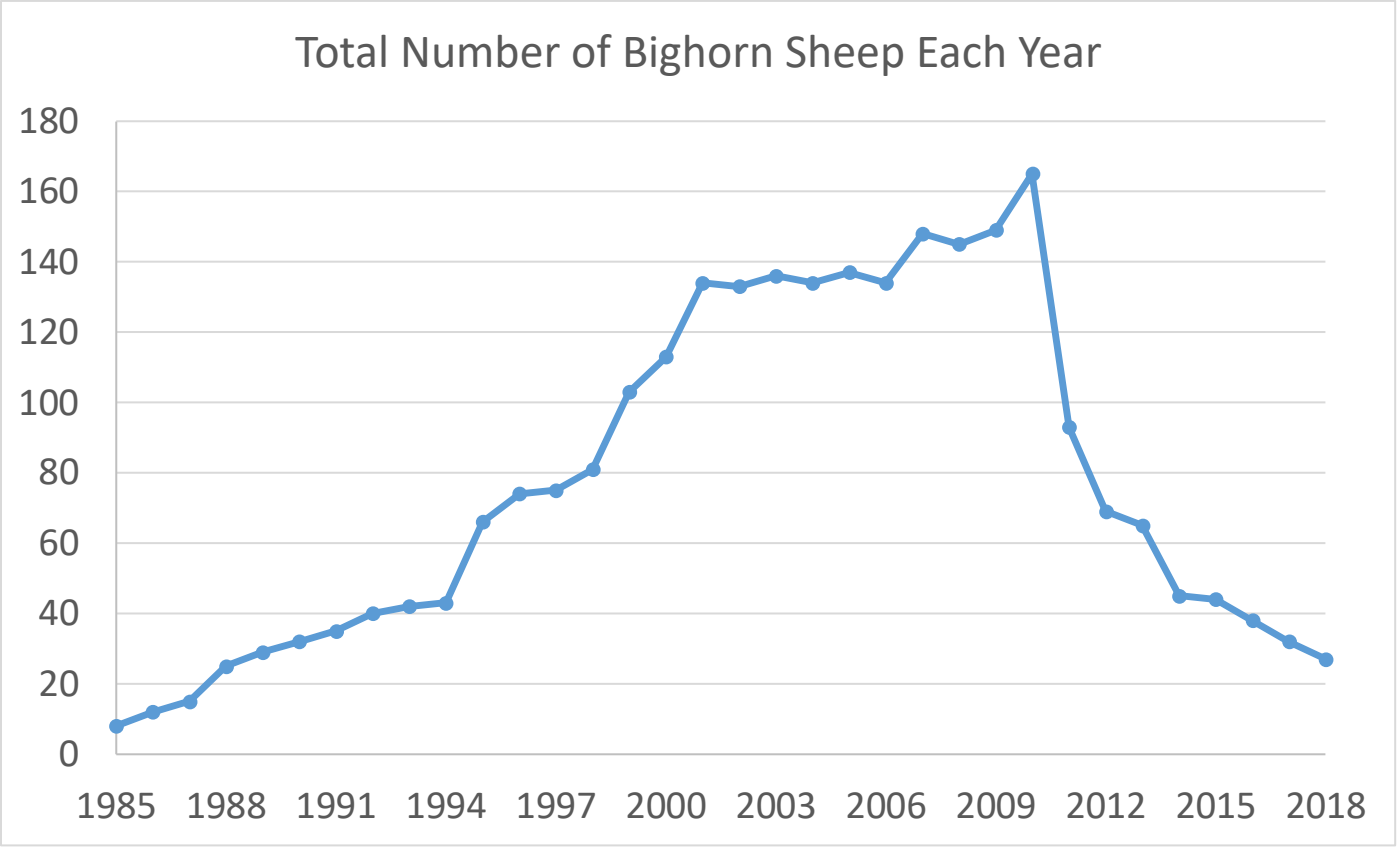
## INSTRUCTIONS FOR CREATING YOUR PRESENTATION

Work as a team to put together a presentation that you will give to the rest of the class. Your presentation should include at least the following:

1) the subspecies of bighorn sheep in your herd
2) where your bighorn sheep herd lives
3) brief background information about the history of this herd and the habitat it occupies, include information about how many guzzlers have been built here and why screwbean mesquite and catclaw acacia are so important to this herd
4) the graphs you created
5) information about how many wild bighorn sheep have been trapped FROM the Muddy and Black Mountains Herd and translocated to other wild herds
6) information about how many bighorns have been trapped FROM the Muddy and Black Mountains Herd and translocated to the Gabbs/Gillis Range Herd and information about how many bighorns have been trapped FROM the Muddy and Black Mountains and translocated to the Bare Mountains Herd
6) a list of factors affecting the conservation of this herd
7) a definition of **carrying capacity**
8) photos of the Muddy and Black Mountains area and sheep, provided below

Photos of the Muddy and Black Mountains Herd and area provided by Mike Cox, Nevada Department of Wildlife:

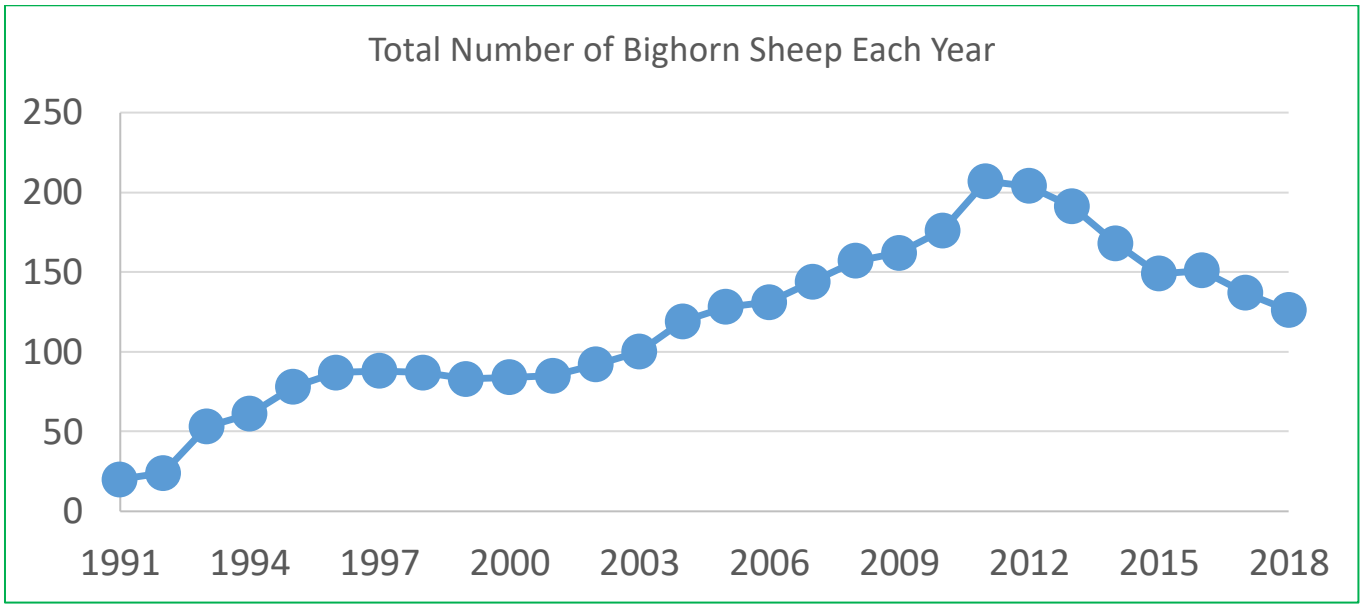
Answer Key
Team 1
Snowstorm Mountain Herd



# Answer Key
# Team 1

| YEAR | Number of EWES Yearlings | Number of RAMS Yearlings | Number of EWES 2+ years old | Number of RAMS 2+ years old | Total Number of Bighorn Sheep Each Year |
|---|---|---|---|---|---|
| 1985 | 2 | 0 | 3 | 3 | **8** |
| 1986 | 1 | 1 | 8 | 2 | **12** |
| 1987 | 1 | 3 | 8 | 3 | **15** |
| 1988 | 1 | 1 | 16 | 7 | **25** |
| 1989 | 5 | 2 | 15 | 7 | **29** |
| 1990 | 3 | 3 | 18 | 8 | **32** |
| 1991 | 3 | 3 | 20 | 9 | **35** |
| 1992 | 5 | 5 | 20 | 10 | **40** |
| 1993 | 2 | 2 | 22 | 16 | **42** |
| 1994 | 4 | 4 | 22 | 13 | **43** |
| 1995 | 6 | 6 | 38 | 16 | **66** |
| 1996 | 8 | 7 | 40 | 19 | **74** |
| 1997 | 6 | 6 | 42 | 21 | **75** |
| 1998 | 8 | 8 | 42 | 23 | **81** |
| 1999 | 12 | 12 | 53 | 26 | **103** |
| 2000 | 14 | 12 | 59 | 28 | **113** |
| 2001 | 18 | 18 | 65 | 33 | **134** |
| 2002 | 9 | 9 | 73 | 42 | **133** |
| 2003 | 12 | 12 | 73 | 39 | **136** |
| 2004 | 7 | 7 | 75 | 45 | **134** |
| 2005 | 11 | 10 | 72 | 44 | **137** |
| 2006 | 8 | 8 | 75 | 43 | **134** |
| 2007 | 17 | 17 | 75 | 39 | **148** |
| 2008 | 10 | 10 | 81 | 44 | **145** |
| 2009 | 13 | 13 | 82 | 41 | **149** |
| 2010 | 18 | 18 | 86 | 43 | **165** |
| 2011 | 9 | 9 | 50 | 25 | **93** |
| 2012 | 0 | 0 | 54 | 15 | **69** |
| 2013 | 1 | 2 | 48 | 14 | **65** |
| 2014 | 0 | 0 | 31 | 14 | **45** |
| 2015 | 4 | 4 | 26 | 10 | **44** |
| 2016 | 1 | 1 | 25 | 11 | **38** |
| 2017 | 2 | 2 | 15 | 13 | **32** |
| 2018 | 2 | 2 | 14 | 9 | **27** |

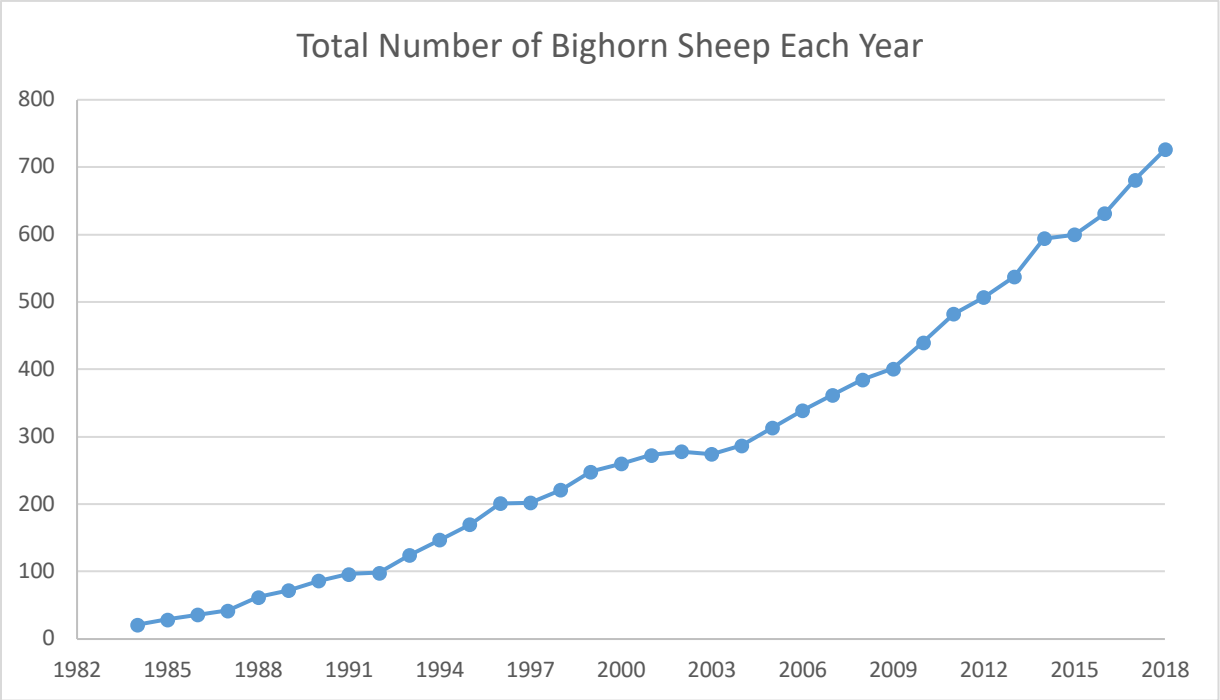
Answer Key
Team 2
Sheep Creek Range Herd



Answer Key
Team 2
Sheep Creek Range Herd

| YEAR | Number of EWES Yearlings | Number of RAMS Yearlings | Number of EWES 2+ years old | Number of RAMS 2+ years old | Total Number of Bighorn Sheep Each Year |
|---|---|---|---|---|---|
| **1991** | 0 | 16 | 2 | 2 | **20** |
| **1992** | 3 | 15 | 3 | 3 | **24** |
| **1993** | 5 | 36 | 4 | 8 | **53** |
| **1994** | 6 | 37 | 7 | 11 | **61** |
| **1995** | 9 | 45 | 9 | 15 | **78** |
| **1996** | 9 | 48 | 9 | 21 | **87** |
| **1997** | 6 | 49 | 6 | 27 | **88** |
| **1998** | 5 | 47 | 6 | 29 | **87** |
| **1999** | 5 | 44 | 6 | 28 | **83** |
| **2000** | 8 | 41 | 8 | 27 | **84** |
| **2001** | 8 | 42 | 8 | 27 | **85** |
| **2002** | 10 | 43 | 11 | 28 | **92** |
| **2003** | 10 | 46 | 11 | 33 | **100** |
| **2004** | 17 | 49 | 18 | 35 | **119** |
| **2005** | 13 | 57 | 14 | 44 | **128** |
| **2006** | 10 | 62 | 10 | 49 | **131** |
| **2007** | 15 | 63 | 15 | 51 | **144** |
| **2008** | 17 | 69 | 17 | 54 | **157** |
| **2009** | 14 | 75 | 15 | 58 | **162** |
| **2010** | 18 | 79 | 19 | 60 | **176** |
| **2011** | 28 | 86 | 28 | 65 | **207** |
| **2012** | 23 | 84 | 23 | 74 | **204** |
| **2013** | 10 | 93 | 9 | 79 | **191** |
| **2014** | 11 | 76 | 10 | 71 | **168** |
| **2015** | 9 | 66 | 10 | 64 | **149** |
| **2016** | 16 | 61 | 16 | 58 | **151** |
| **2017** | 9 | 61 | 9 | 58 | **137** |
| **2018** | 8 | 59 | 8 | 51 | **126** |

Answer Key
Team 3
Gabbs-Gillis Range Herd



Answer Key

Team 3: Gabbs-Gillis Range Herd

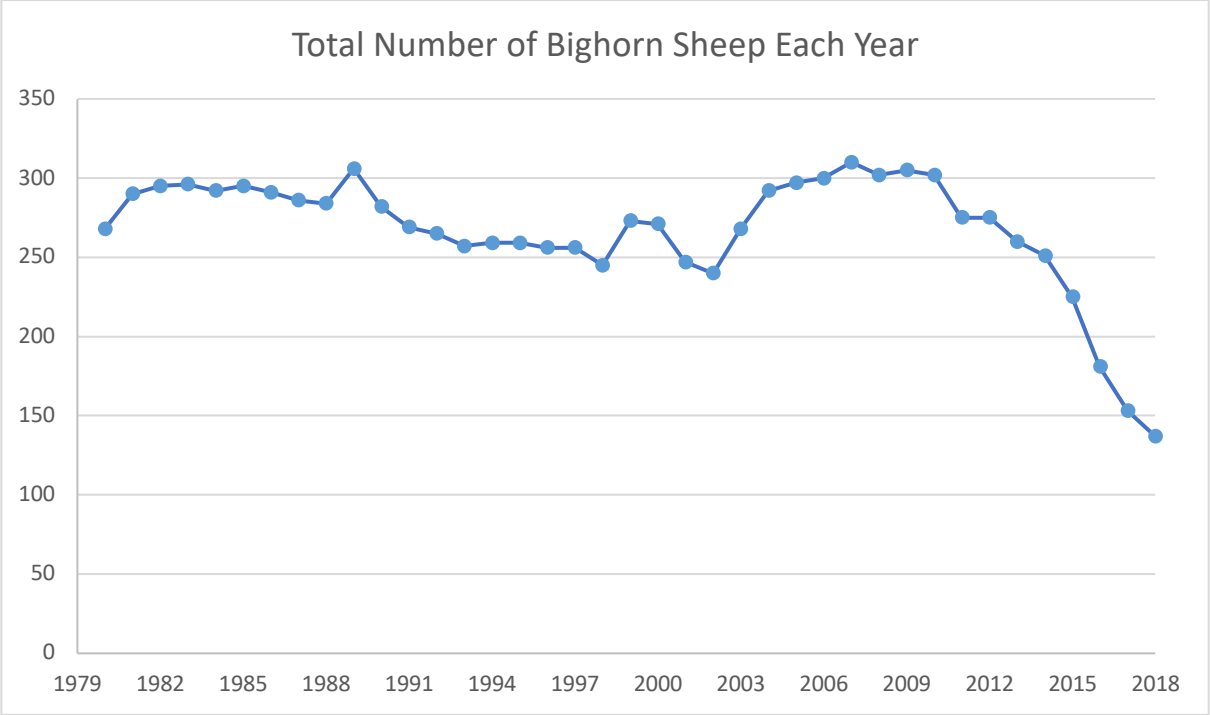
| YEAR | Number of EWES Yearlings | Number of RAMS Yearlings | Number of EWES 2+ years old | Number of RAMS 2+ years old | Total Number of Bighorn Sheep Each Year |
|---|---|---|---|---|---|
| **1984** | 3 | 1 | 13 | 4 | **21** |
| **1985** | 5 | 4 | 15 | 5 | **29** |
| **1986** | 5 | 4 | 18 | 9 | **36** |
| **1987** | 5 | 5 | 20 | 12 | **42** |
| **1988** | 4 | 4 | 38 | 16 | **62** |
| **1989** | 5 | 8 | 36 | 23 | **72** |
| **1990** | 6 | 8 | 42 | 30 | **86** |
| **1991** | 10 | 10 | 44 | 32 | **96** |
| **1992** | 7 | 7 | 50 | 34 | **98** |
| **1993** | 14 | 14 | 62 | 34 | **124** |
| **1994** | 21 | 22 | 69 | 35 | **147** |
| **1995** | 23 | 22 | 81 | 44 | **170** |
| **1996** | 28 | 27 | 94 | 52 | **201** |
| **1997** | 16 | 15 | 110 | 61 | **202** |
| **1998** | 24 | 23 | 112 | 62 | **221** |
| **1999** | 31 | 28 | 120 | 69 | **248** |
| **2000** | 25 | 24 | 135 | 76 | **260** |
| **2001** | 25 | 24 | 144 | 80 | **273** |
| **2002** | 32 | 31 | 132 | 83 | **278** |
| **2003** | 19 | 20 | 145 | 90 | **274** |
| **2004** | 29 | 29 | 143 | 86 | **287** |
| **2005** | 36 | 36 | 148 | 93 | **313** |
| **2006** | 36 | 38 | 161 | 104 | **339** |
| **2007** | 40 | 40 | 167 | 115 | **362** |
| **2008** | 40 | 42 | 177 | 126 | **385** |
| **2009** | 39 | 40 | 186 | 136 | **401** |
| **2010** | 48 | 49 | 197 | 146 | **440** |
| **2011** | 54 | 55 | 216 | 157 | **482** |
| **2012** | 48 | 49 | 237 | 173 | **507** |
| **2013** | 53 | 54 | 255 | 175 | **537** |
| **2014** | 67 | 67 | 275 | 185 | **594** |
| **2015** | 45 | 45 | 304 | 206 | **600** |
| **2016** | 66 | 66 | 295 | 204 | **631** |
| **2017** | 73 | 74 | 321 | 213 | **681** |
| **2018** | 78 | 78 | 350 | 220 | **726** |

Answer Key
Team 4
Bare Mountain Herd

Answer Key
Team 4
Bare Mountain Herd

| YEAR | Number of EWES Yearlings | Number of RAMS Yearlings | Number of EWES 2+ years old | Number of RAMS 2+ years old | Total Number of Bighorn Sheep Each Year |
|---|---|---|---|---|---|
| **1992** | 1 | 0 | 13 | 5 | **19** |
| **1993** | 2 | 2 | 26 | 8 | **38** |
| **1994** | 5 | 5 | 25 | 10 | **45** |
| **1995** | 4 | 4 | 28 | 19 | **55** |
| **1996** | 5 | 5 | 30 | 21 | **61** |
| **1997** | 8 | 8 | 32 | 24 | **72** |
| **1998** | 6 | 6 | 37 | 30 | **79** |
| **1999** | 3 | 3 | 39 | 34 | **79** |
| **2000** | 6 | 6 | 38 | 33 | **83** |
| **2001** | 6 | 6 | 38 | 32 | **82** |
| **2002** | 6 | 7 | 38 | 32 | **83** |
| **2003** | 5 | 5 | 39 | 30 | **79** |
| **2004** | 9 | 9 | 38 | 30 | **86** |
| **2005** | 11 | 11 | 43 | 31 | **96** |
| **2006** | 13 | 13 | 48 | 37 | **111** |
| **2007** | 10 | 10 | 55 | 40 | **115** |
| **2008** | 6 | 6 | 70 | 47 | **129** |
| **2009** | 13 | 13 | 81 | 53 | **160** |
| **2010** | 10 | 10 | 85 | 54 | **159** |
| **2011** | 14 | 14 | 89 | 55 | **172** |
| **2012** | 35 | 35 | 92 | 55 | **217** |
| **2013** | 24 | 25 | 118 | 83 | **250** |
| **2014** | 28 | 28 | 101 | 90 | **247** |
| **2015** | 22 | 15 | 114 | 98 | **249** |
| **2016** | 13 | 12 | 115 | 99 | **239** |
| **2017** | 15 | 15 | 97 | 92 | **219** |
| **2018** | 12 | 12 | 90 | 86 | **200** |

Answer Key
Team 5
Spring Mountain Herd



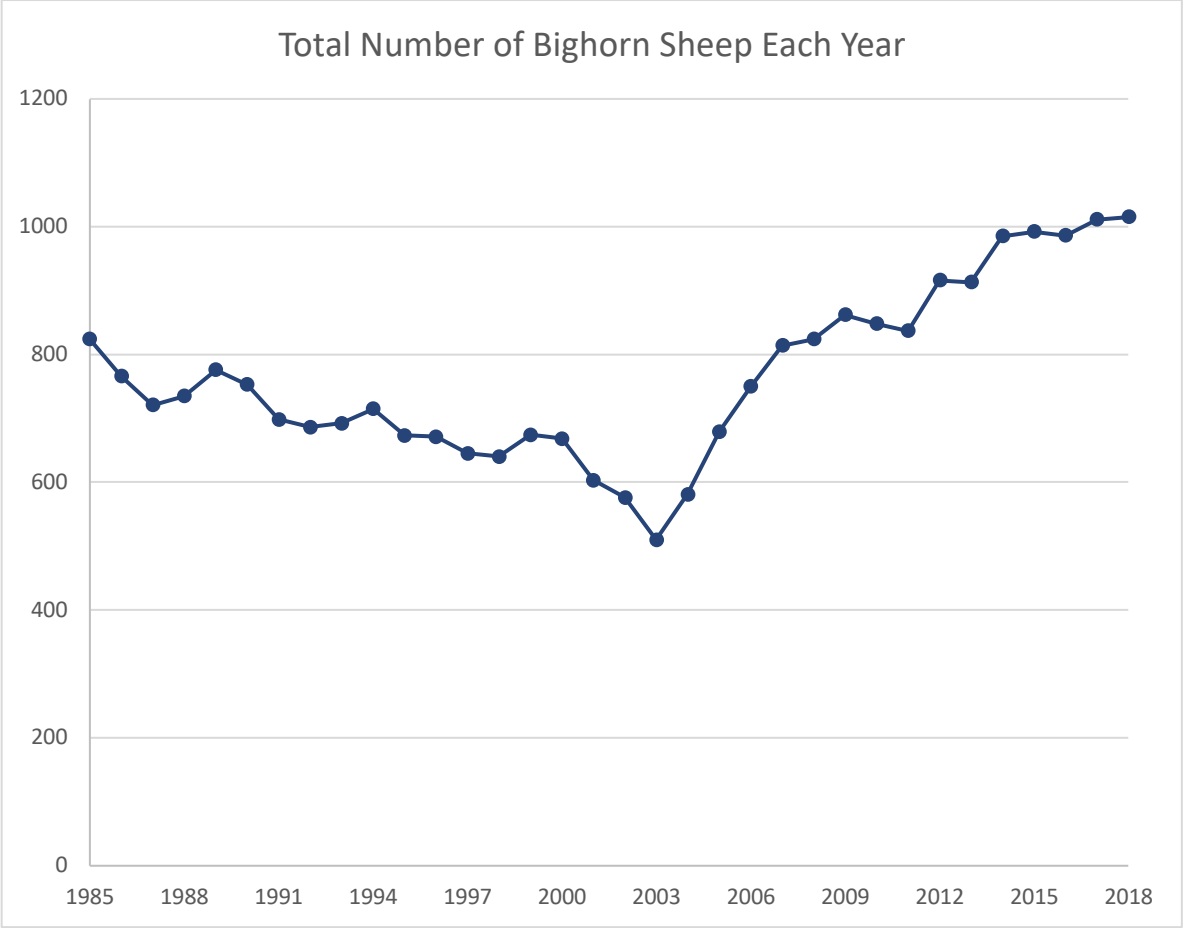
Answer Key
Team 5
Spring Mountain Herd

| YEAR | Number of EWES Yearlings | Number of RAMS Yearlings | Number of EWES 2+ years old | Number of RAMS 2+ years old | Total Number of Bighorn Sheep Each Year |
|---|---|---|---|---|---|
| 1980 | 14 | 20 | 144 | 90 | 268 |
| 1981 | 31 | 32 | 140 | 87 | 290 |
| 1982 | 27 | 27 | 148 | 93 | 295 |
| 1983 | 26 | 26 | 148 | 96 | 296 |
| 1984 | 24 | 25 | 148 | 95 | 292 |
| 1985 | 25 | 26 | 148 | 96 | 295 |
| 1986 | 24 | 24 | 148 | 95 | 291 |
| 1987 | 22 | 22 | 147 | 95 | 286 |
| 1988 | 23 | 24 | 145 | 92 | 284 |
| 1989 | 36 | 39 | 141 | 90 | 306 |
| 1990 | 22 | 23 | 138 | 99 | 282 |
| 1991 | 19 | 19 | 133 | 98 | 269 |
| 1992 | 21 | 21 | 127 | 96 | 265 |
| 1993 | 19 | 19 | 124 | 95 | 257 |
| 1994 | 22 | 22 | 124 | 91 | 259 |
| 1995 | 21 | 21 | 126 | 91 | 259 |
| 1996 | 21 | 21 | 125 | 89 | 256 |
| 1997 | 26 | 26 | 117 | 87 | 256 |
| 1998 | 22 | 22 | 114 | 87 | 245 |
| 1999 | 35 | 35 | 117 | 86 | 273 |
| 2000 | 22 | 22 | 130 | 97 | 271 |
| 2001 | 12 | 12 | 131 | 92 | 247 |
| 2002 | 21 | 21 | 122 | 76 | 240 |
| 2003 | 34 | 34 | 123 | 77 | 268 |
| 2004 | 34 | 34 | 136 | 88 | 292 |
| 2005 | 26 | 26 | 146 | 99 | 297 |
| 2006 | 24 | 24 | 150 | 102 | 300 |
| 2007 | 29 | 29 | 151 | 101 | 310 |
| 2008 | 21 | 21 | 157 | 103 | 302 |
| 2009 | 25 | 25 | 153 | 102 | 305 |
| 2010 | 25 | 25 | 154 | 98 | 302 |

| | | | | | |
|---|---|---|---|---|---|
| 2011 | 13 | 13 | 154 | 95 | 275 |
| 2012 | 25 | 25 | 141 | 84 | 275 |
| 2013 | 15 | 15 | 142 | 88 | 260 |
| 2014 | 19 | 19 | 134 | 79 | 251 |
| 2015 | 12 | 12 | 127 | 74 | 225 |
| 2016 | 3 | 3 | 113 | 62 | 181 |
| 2017 | 6 | 6 | 95 | 46 | 153 |
| 2018 | 9 | 9 | 81 | 38 | 137 |

Answer Key
Team 5
Spring Mountain Herd

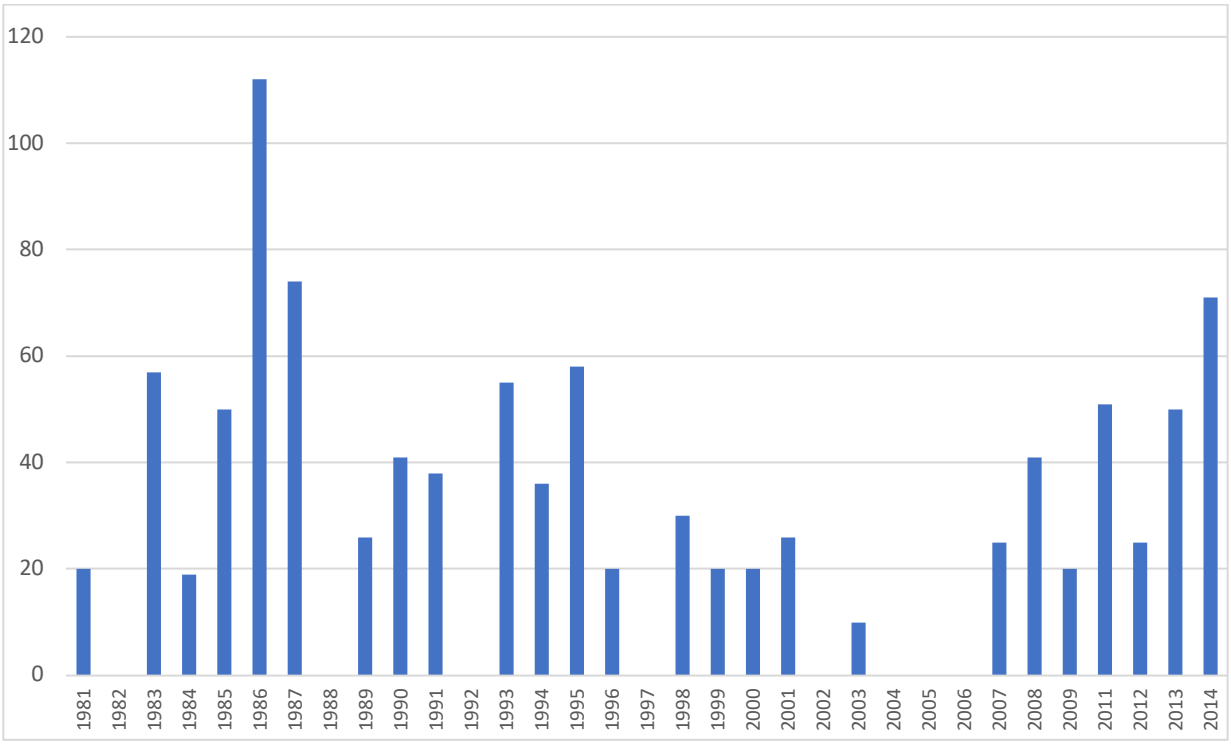
Answer Key
Team 6
Muddys and Black Herd



Answer Key
Team 6
Muddys and Black Herd

| YEAR | Number of EWES Yearlings | Number of RAMS Yearlings | Number of EWES 2+ years old | Number of RAMS 2+ years old | Total Number of Bighorn Sheep Each Year |
|---|---|---|---|---|---|
| 1985 | 77 | 76 | 377 | 294 | 824 |
| 1986 | 64 | 56 | 353 | 293 | 766 |
| 1987 | 58 | 56 | 334 | 273 | 721 |
| 1988 | 59 | 58 | 356 | 262 | 735 |
| 1989 | 81 | 78 | 363 | 254 | 776 |
| 1990 | 53 | 52 | 383 | 265 | 753 |
| 1991 | 45 | 43 | 362 | 248 | 698 |
| 1992 | 46 | 45 | 359 | 236 | 686 |
| 1993 | 70 | 69 | 334 | 219 | 692 |
| 1994 | 77 | 74 | 339 | 225 | 715 |
| 1995 | 56 | 55 | 336 | 226 | 673 |
| 1996 | 57 | 53 | 343 | 218 | 671 |
| 1997 | 36 | 36 | 362 | 211 | 645 |
| 1998 | 57 | 56 | 332 | 195 | 640 |
| 1999 | 69 | 70 | 333 | 202 | 674 |
| 2000 | 53 | 51 | 349 | 215 | 668 |
| 2001 | 29 | 26 | 340 | 208 | 603 |
| 2002 | 53 | 51 | 297 | 175 | 576 |
| 2003 | 25 | 24 | 288 | 173 | 510 |
| 2004 | 68 | 65 | 288 | 160 | 581 |
| 2005 | 79 | 79 | 329 | 192 | 679 |
| 2006 | 87 | 84 | 362 | 217 | 750 |
| 2007 | 93 | 90 | 396 | 235 | 814 |
| 2008 | 73 | 71 | 415 | 265 | 824 |
| 2009 | 84 | 84 | 411 | 283 | 862 |
| 2010 | 49 | 50 | 441 | 308 | 848 |
| 2011 | 43 | 42 | 448 | 304 | 837 |
| 2012 | 109 | 108 | 412 | 287 | 916 |
| 2013 | 68 | 65 | 460 | 320 | 913 |
| 2014 | 109 | 110 | 450 | 316 | 985 |
| 2015 | 104 | 106 | 448 | 334 | 992 |
| 2016 | 69 | 69 | 483 | 365 | 986 |
| 2017 | 93 | 92 | 469 | 357 | 1011 |
| 2018 | 80 | 79 | 480 | 376 | 1015 |

Answer Key
Team 6
Extra Graph/Table




| Year | # of Bighorns transplanted from Muddys/Black Mnt Herd to other NV herds | # of Bighorns transplanted from Muddys/Black Mnt Herd to other herds OUTSIDE Nevada |
|---|---|---|
| 1981 | 20 | 0 |
| 1982 | 0 | 0 |
| 1983 | 42 | 15 |
| 1984 | 17 | 2 |
| 1985 | 29 | 21 |
| 1986 | 77 | 35 |
| 1987 | 74 | 0 |
| 1988 | 0 | 0 |
| 1989 | 26 | 0 |
| 1990 | 22 | 19 |
| 1991 | 38 | 0 |
| 1992 | 0 | 0 |
| 1993 | 55 | 0 |

| | | |
|---|---|---|
| 1994 | 16 | 20 |
| 1995 | 36 | 22 |
| 1996 | 0 | 20 |
| 1997 | 0 | 0 |
| 1998 | 30 | 0 |
| 1999 | 20 | 0 |
| 2000 | 0 | 20 |
| 2001 | 26 | 0 |
| 2002 | 0 | 0 |
| 2003 | 10 | 0 |
| 2004 | 0 | 0 |
| 2005 | 0 | 0 |
| 2006 | 0 | 0 |
| 2007 | 25 | 0 |
| 2008 | 41 | 0 |
| 2009 | 0 | 20 |
| 2011 | 51 | 0 |
| 2012 | 0 | 25 |
| 2013 | 0 | 50 |
| 2014 | 0 | 71 |
| **TOTAL** | **655** | **340** |

| Year | Number of bighorn sheep transplanted FROM the Muddys/Black Mnts Herd |
|---|---|
| 1981 | 20 |
| 1982 | 0 |
| 1983 | 57 |
| 1984 | 19 |
| 1985 | 50 |
| 1986 | 112 |
| 1987 | 74 |
| 1988 | 0 |
| 1989 | 26 |
| 1990 | 41 |
| 1991 | 38 |
| 1992 | 0 |
| 1993 | 55 |
| 1994 | 36 |
| 1995 | 58 |

Answer Key
Team 6
Extra Graph/Table

| | |
|---|---|
| 1996 | 20 |
| 1997 | 0 |
| 1998 | 30 |
| 1999 | 20 |
| 2000 | 20 |
| 2001 | 26 |
| 2002 | 0 |
| 2003 | 10 |
| 2004 | 0 |
| 2005 | 0 |
| 2006 | 0 |
| 2007 | 25 |
| 2008 | 41 |
| 2009 | 20 |
| 2011 | 51 |
| 2012 | 25 |
| 2013 | 50 |
| 2014 | 71 |
| **TOTAL** | 995 |

Answer Key
Team 6
Extra Graph/Table