Student Pages: Group Activity

Grizzly Bear Science Team 3

For this activity, your group is the "Grizzly Bear Science Team #3". Your team is responsible for scientifically evaluating whether or not the GYE grizzly bear population has met **Demographic Recovery Criterion #3**.

To do this, we should take another look at **Demographic Recovery Criterion #3**:
"For independent females (at least 2 years old), the current annual mortality limit, not to be exceeded in **2 consecutive years** and including all sources of mortality, is **9 percent** of the total number of independent females. For independent males (at least 2 years old), the current annual mortality limit not to be exceeded in **3 consecutive years** and including all sources of mortality, is **15 percent** of the total number of independent males. For dependent young (less than 2 years old), the current annual mortality limit, not to be exceeded in **3 consecutive years** and including only known and probable human caused mortalities, is **9 percent** of the total number of dependent young."

Your team needs to scientifically evaluate this Demographic Recovery Criterion. So, you need to use the scientific process, which includes at least the following steps:

1. Develop Hypotheses
2. Use hypotheses to develop predictions
3. Design a scientific study to rigorously evaluate predictions
4. Collect data
5. Analyze and evaluate data
6. Use results from data evaluation to draw conclusions, and to inform new hypotheses
7. Share findings with peers and the public

Unfortunately, we don't have time to design field studies, determine statistical estimators, and tromp around in the mountains following grizzly bears to collect data. The IGBST gets to do all that fun stuff! Lucky for us, the IGBST has shared their data, so your team CAN participate in Steps 1, 2, 5, 6, and 7.

Let's get started with hypotheses:

Hyp 1: The grizzly bear population has met Demographic Recovery Criterion #3

There's a competing alternative hypothesis, what is it?

Hyp 2:

Great! Okay, let's go back to Hypothesis 1. If Hypothesis 1 is correct, what predictions would you make about the data you evaluated in Datasets 5 and 6?

Example of one prediction:

Prediction 1A: The annual mortality of independent females (at least 2 years old) has not exceeded 9% of the total number of independent females in 2 consecutive years.

What would prediction 1B be (hint: it has something to do with independent males)

Prediction 1B:

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_____

What would prediction 1B be (hint: it has something to do with dependent young)

Prediction 1C:

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_____

If Hypothesis 2 is correct, what predictions would you make about the data you evaluated in Datasets 5-6?

Prediction 2A:

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Prediction 2B:

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Prediction 2C:

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Okay, it's time for Step 5 of the Scientific Process (i.e., Analyze and Evaluate Data).

Hmmmmmmm.....some of the information in Datasets 5 and 6 might not be completely clear, and this might make it difficult to evaluate your predictions. In the following paragraphs, you will find some information that should help:

First....why does the IGBST care so much about understanding grizzly bear mortality? Because the primary threat to continued grizzly bear recovery in the GYE is human-caused mortality.

What does "sustainable mortality" mean? Sustainable mortality establishes the upper limit on the grizzly deaths that can occur yet still maintain a healthy population.

Demographic Recovery Criterion #3 specifically states mortality limits for independent females, independent males, and dependent young. So, why does Dataset 5 include a 4% human-caused mortality limit during years 1991-2006?
In 2007, the IGBST updated the mortality limits based on the best science available. Prior to 2007, the IGBST used a mortality limit that was based on the best science available *at that time.*

So, in Dataset #5 the IGBST used a human-caused mortality threshold equal to 4% of the "Minimum Population Estimate". This means that AT THE MOST, 4% of the grizzly bear population could be killed by humans without negative impact to the sustainability of the population. What does "Minimum Population Estimate" mean? Team #1 will be telling you during their presentation.

What were the mortality limits during 2007-2014?
In 2007, new science emerged that offered better ways to estimate the population size and the mortality limits. Specifically, the IGBST used new science to evaluate population segments (i.e., independent females, dependent young, and independent males). They estimated size of these population segments and they also estimated mortality thresholds for each segment.

In Dataset #6, the IGBST used the following mortality limits:

- Independent females: the mortality limit is 9% of all independent females (all mortalities are used to calculate this threshold)
- Independent males: the mortality limit is 15% of all independent males (all mortalities are used to calculate this threshold)
- Dependent young: the mortality limit is 9% of all dependent young (only human-caused mortalities are used against this threshold)

So, the information about mortality in Dataset 5 is for years 1991-2006 when the older scientific methods were used. The information about mortality in Dataset 6 is for years 2007-2014 when the newer scientific methods were used.

Today, the IGBST is **once again** in the process of updating how the sustainable mortality limits should be determined, based on the best science today (which is always changing and improving). Specifically, the IGBST is recommending that the percentages that represent annual mortality limits for each population segment should be dynamic; they should change EACH year to reflect new data.

IMPORTANT: While the general biological intent of this proposed revision regarding mortality limits is identical to the current Demographic Recovery Criterion #3 (i.e., to establish mortality limits that prevent population decline), there is one important difference. **The new mortality rates that are being proposed by the IGBST are calculated based on a goal of grizzly bear population stability instead of grizzly bear population growth.** No population can grow forever, since the resources it requires are finite. When a population grows too large for its environment to support continued growth, it is said to be at "carrying capacity."

What's Carrying Capacity?
It's the maximum size of a population that the environment can sustain indefinitely without degrading the environment for future generations. Carrying capacity in wild species that are habitat generalists like grizzly bears varies from year to year and even from day to day, which makes it more appropriate to regard carrying capacity as a band covering a range of population sizes, rather than a clearly defined, constant value. Accordingly, population growth may be positive or negative in any given year **but over a longer time series, it will be approximately zero**.

Why use a 6-year running average in Dataset 5? The breeding and cub cycle of grizzly bears is, on average, once every three years. So the 6-year running average includes 2 normal cycles that an independent female could produce cubs. This 6-year running average has value when looking at long-term trends in reproduction, survival, and **mortality**. There is always information that is unknown. The 6-year average helps smooth out high and low counts of females, adult females, and all bears and gives a more accurate sense of how females are surviving and **dying**.

Okay, you should have enough information now to complete Step 5 of the Scientific Process (i.e., Analyze and evaluate the data) and complete Step 6 (i.e., Use results from data evaluation to draw conclusions). Which predictions did the data from Datasets 5 and 6 refute?

Based on the scientific data you have, has Demographic Recovery Criterion #3 been met or has Demographic Criterion #3 NOT been met?

Time to work on Step 7 of the Scientific Process (i.e., share findings with your peers).

Your team will now prepare a presentation about Demographic Criterion #3 and your findings related to this criterion. Your team will give this presentation to the rest of the class (i.e., Grizzly Bear Science Team 1 and Grizzly Bear Science Team 2).

In this presentation, make sure to include AT LEAST the following:

1. What is Demographic Recovery Criterion #3?
2. Why do we care so much about grizzly bear mortality in the GYE?
3. What are your hypotheses and predictions?
4. What does sustainable mortality mean? What was the human-caused **mortality limit** for the entire GYE grizzly bear population during years 1991-2006?
5. What was the mortality limits for each population segment of the GYE grizzly bear population during years 2007-2014?
6. Why did the IGBST change the mortality limits beginning in 2007? How does the mortality limit for years 1991-2006 DIFFER from the mortality limits for years 2007-2014?
7. Team #1 presented a graph showing lambda for each consecutive 2-year period during 1991-2014. Did this graph indicate that the GYE population has grown, declined, or remained relatively stable during years 2008-2014? What does carrying capacity mean?
8. Present the graph you made that shows "4 % of Minimum Population Estimate" and "Human-Caused Mortality" for **All Bears** during years 1991-2006 (from Dataset 5). What does this graph indicate?
9. Present the graph you made that shows "6-year running averages for human-caused mortality" for adult females (from Dataset 5). Explain to your classmates why the IGBST used a 6-year running average.
10. Present the 3 graphs you made from Dataset 6. Has the estimated mortality for independent females exceeded the mortality limit during 2 consecutive years during 2007-2014? Has the estimated mortality for independent males exceeded the mortality limit during 3 consecutive years during 2007-2014? Has the estimated mortality for dependent young exceeded the mortality limit during 2 consecutive years during 2007-2014?
11. Which predictions did your data support?
12. What are your conclusions regarding the grizzly bear population in GYE with respect to Demographic Criterion #3?

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