BACKGROUND, HYPOTHESES, PREDICTIONS

There are 8 species of bears worldwide: American black bear, Asiatic black bear, brown bear, giant panda bear, polar bear, sloth bear, spectacled bear, and sun bear. Of these 8 species, 6 are listed as Endangered or Vulnerable (not endangered, but facing high rate of extinction in the wild) by the International Union for Conservation of Nature (IUCN). Only the American black bear and brown bear are considered species of Least Concern globally.

For this lesson plan, you will be using real-world data from the **first** bear capture study ever done in Taiwan on wild Formosan black bears (*Ursus thibetanus formosanus*), an endangered subspecies of the Asiatic black bear (*Ursus thibetanus*). During 1998-2000, Dr. Mei-Hsiu Hwang and her research team trapped, collared, and tracked wild Formosan black bears to determine whether or not Yushan National Park, the largest national park in Taiwan at the time of this study, was large enough to support the resident Formosan black bears. Dr. Hwang also wanted to evaluate habitat use by these wild bears.

In Taiwan, protected areas are considered critical to conserving endangered species like the Formosan black bears. Yushan National Park is an ecologically protected area where hunting is not permitted. Very little human activity occurs inside the Park. Although it is illegal to hunt Formosan black bears anywhere in Taiwan, bears that travel outside the boundaries of Yushan National Park face relatively greater risk of mortality due to poaching.

Before Dr. Hwang did her research, no one really knew if Yushan National Park was big enough to support the endangered bears. Protected areas will only be effective if they can provide the habitat and spatial needs of the animals you are trying to conserve. In this particular case, if Yushan National Park did not provide all the resources that Formosan black bears needed, then bears might travel outside the park where mortality risk is higher due to poaching.

Major Threats to Asiatic Black Bears: Illegal hunting and trade of bear parts, along with habitat degradation, are the two primary threats to the persistence of these bears. Although it is illegal to hunt, capture, or kill these bears in most places, it's difficult to enforce regulations owing to lack of funding, lack of conservation commitments among some managers and the public in some areas, and low accessibility of bear habitat for patrolling.

SIZE OF THE DATA SET
It's important to mention that the data set on Formosan black bears you will be using is small relative to many data sets from research studies on bears in the US and Europe (e.g., American black bears, brown bears, polar bears). Research funding for bear species found in US and in Europe, and for giant panda bears, has been relatively more abundant than that for bear species like Asiatic black bears, spectacled bears, sun bears, and sloth bears. The four latter bear species are all listed as vulnerable owing to fragmented, small population sizes and decreasing numbers due to continuous human-caused threats. For most vulnerable species, their populations occur in low densities, animals are wary, and they live in remote places that are difficult for scientists to access. For these reasons, it is extremely difficult to collect data on most vulnerable species, including the Formosan black bears in Taiwan.

For the study that you are evaluating, Dr. Hwang and her crew were able to capture 15 bears. For 5 of these bears, Dr. Hwang was not able to collect adequate location data for analyses. Why? Several reasons, including possible collar breakage, possibility of bears moving out of receiver range, and possibility of mortality by illegal hunting.

Dr. Hwang was able to use bear location data from 10 bears for her analyses. You will evaluate 5 of those 10 bears. Many North American scientists strive to collect data on at least 30 individuals of a population to meet statistical assumptions. In this particular study, Dr. Hwang and her crew were limited by several constraints:

1) the Formosan black bears have a very low population density so it is difficult to even find them
2) the Formosan black bears are very wary so it's difficult to catch them
3) the rugged terrain makes it very difficult to hike into bear habitat and then track bears when they are collared

The bottom line is this: it is extremely difficult to capture and track Formosan black bears. Just to hike into the study area took 3-4 days. That Dr. Hwang captured any bears at all is an amazing feat!

Conservation of vulnerable and endangered species for which populations are very small and difficult to track is complex. Dr. Hwang is dedicated to the conservation of Asiatic black bears. To this aim, one of her goals is to use the best science available to learn about habitat needs of these bears. The hope is that if we better understand habitat and spatial needs, we will be better able to conserve these amazing animals.

You will be scientifically evaluating the real-world data collected by Dr. Hwang and her field crew. So……you will 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, scientists, and the public

Unfortunately, we don't have time to design field studies, determine statistical estimators, and tromp around in the mountains of Taiwan to collect these data. Dr. Mei-Hsiu Hwang and her research team already did that fun stuff! Lucky for us, Dr. Hwang has shared her data with you, so you can participate in Steps 1, 2, 5, 6, and 7.

Let's get started with hypotheses:

Hyp 1A: Yushan National Park is large enough to support the resident Formosan black bears

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

Hyp 1B:
_____

Great! Okay, let's go back to Hypothesis 1A. If Hypothesis 1A is correct, what prediction would you make about the data?

(to get you started, we'll provide this prediction for you…see below):

Prediction 1A: Home ranges for bears will exist completely WITHIN Yushan National Park

If Hypothesis 1B is correct, what prediction would you make about the data?

Prediction 1B:
_____

_____

Let's look at the other set of hypotheses:

Hyp 2A: Because bears use different foods during different seasons, and because bear foods are found seasonally at different elevations, bears will use different elevations seasonally

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

Hyp 2B:
_____

_____

Great! Okay, let's go back to Hypothesis 2A. If Hypothesis 2A is correct, what prediction would you make about the data? (again, we'll provide the first prediction for you)

Prediction 2A: Habitat use for different elevations by bears will differ among seasons

If Hypothesis 2B is correct, what prediction would you make about the data?

Prediction 2B:

_____

_____

Okay, it's time to move on to data analyses. Download "STUDENT PAGES: Instructions for Analyzing Data" and work through these instructions.

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