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Teaching Issues and Experiments in Ecology - Volume 7, February 2011

ISSUES : DATA SET

Exploring the population dynamics of wintering bald eagles through long-term data

Photo 1: Adult bald eagle flying in a winter sky. Photo by Tom Michalski.

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THE ECOLOGICAL QUESTION:
How does a bald eagle population change over time at a winter migratory stopover and which factors influence its abundance?

ECOLOGICAL CONTENT:
Bald eagle biology, conservation biology, endangered species, population ecology, and migration ecology (stopover)

WHAT STUDENTS DO:
Guided Approach: Students will generate questions about bald eagle numbers influenced by weather and food availability. Students will then use graphing software (JMP or Excel) to compile the data in a graphical form to answer their questions.

STUDENT-ACTIVE APPROACHES:
Brainstorming, critical thinking, concept mapping, cooperative learning, guided inquiry, and/or open-ended inquiry

SKILLS:
Generation of a hypothesis, critical thinking, experimental design, data management using a spreadsheet, graph preparation, data analysis and interpretation, and/or written or oral presentation.

ASSESSABLE OUTCOMES:
Proposal of research, figures from spreadsheet data, written interpretation of data, short or full research reports, and/or oral reports

SOURCE:
U.S. Department of the Interior, Bureau of Land Management, Coeur d'Alene Field Office, archived data.

ACKNOWLEDGEMENTS:

This data set was developed for Biology 323, Conservation Biology, at Gonzaga University and was improved by input from students in that course. We would like to thank Joe Lint for the initiation and creation of this bald eagle survey; Bureau of Land Management (BLM) employees and volunteers, Lew Brown, Terry Kincaid, and Corinne Cameron, for their years of bald eagle data collection; BLM Coeur d'Alene Field Office for the funding that made these data collections possible; Idaho Fish and Game for kokanee salmon data; Elizabeth Bart and Scott McCloskey for initial teaching ideas; Tracy Morgan for the creation of the survey site map; Ann-Scott Ettinger for aid in developing the checklist assessment tool; Carol K. Augspurger for use of the research proposal and glossary; and Ed Dole, Sheila Lyons-Sobaski, Jennifer Rubin and three anonymous reviewers for helpful comments on previous drafts.

OVERVIEW OF THE ECOLOGICAL BACKGROUND

The availability of **long-term data** on bald eagles (*Haliaeetus leucocephalus*; Photo 1) provides a unique opportunity to study the population dynamics of this culturally and ecologically important bird. In conservation biology, the bald eagle provides a unique example of a species that has overcome the imminent threats of extinction (Grier 1982). Because of its endangered status in the early 1970s (Buehler 2000), several agencies and biologists initiated long-term surveys. Some of these surveys have been implemented at a local scale, and others are nationwide, such as the Midwinter Bald Eagle Survey (Steenhof et al. 2008). Some of the data from these long-term surveys have been analyzed (Arizona *see* Grubb 2003, Western Washington *see* Dunwiddlie and Kuntz 2003, and Glacier National Park *see* McCelland et al. 1994), but other data sets have yet to be fully investigated.

Several of these long-term data sets have been gathered during the winter migration when bald eagles aggregate at stopover sites on lakes and rivers along their migration routes. In the U.S., the eagles move from their summer resident locations in the north towards the south. The primary hypothesis for this movement is that the food supply (primarily fish and, to a lesser degree, ducks) becomes less available as winter approaches and drives the eagles south (McClelland et al. 1994). Several factors influencing bald eagle populations along their migration stopovers have been studied, including weather (Grubb 2003), feeding site characteristics (Dunwiddie & Kuntz 2003; Mull and Wilzbach 2007) and human disturbance (Stalmaster and Kaiser 1998; Dunwiddie and Kuntz 2003). Long-term patterns may also differ among adult versus immature eagles (see McClelland et al. 1994; Dunwiddie and Kuntz 2003; Grubb 2003). The data sets we use in this activity come from the Bureau of Land Management in Northern Idaho. **Since 1974, they have counted migrating bald eagles every midwinter at Lake Coeur d'Alene. The eagle counts are taken on a weekly basis at several sites on the northeast end of the lake.** The adult and immature eagles are counted separately. Additional data on the kokanee salmon (*Onorhynchus nerka*) abundance in the lake, weather events, and site characteristics have been assembled.

References:

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STUDENT INSTRUCTIONS

This data set explores factors affecting the population numbers of bald eagles (*Haliaeetus leucocephalus*) surrounding Lake Coeur d'Alene, Idaho. The Bald eagle is a large bird of prey that demands our attention by its physical features, its history of near extinction, and its dynamic population seen today.

Background Information:

The population trend of the bald eagle during the past 70 years provides a history with several important lessons. After World War II, the insecticide, dichlorodiphenyl-trichloroethane (DDT), was allowed for widespread agricultural use. Despite its effectiveness in killing insect pests on crops, the chemical accumulated in the body tissues of bald eagles (through biomagnification), making the birds unhealthy and causing them to lay thin-shelled eggs that broke as soon as the parents sat on them to begin incubation. The numbers of bald eagles in the contiguous United States, which were already declining due to hunting, plummeted as a result. The bald eagle was listed as endangered under the Endangered Species Act of 1973, and this protection, combined with the national ban of DDT in 1972, is credited with leading to the recovery of these magnificent birds.

Bald eagle numbers not only vary over historical time, but they also vary across the landscape with changes in the seasons. Like many birds, most bald eagles migrate in the winter in search of food. The primary food source for bald eagles is fish, and the eagles need open water to access the fish, which in many locations consists of spawning salmon at the shallow edges of lakes and streams. Once the lakes and streams freeze over, the eagles have to use an alternative food source (i.e., carrion such as dead deer or elk) or go elsewhere. Bald eagles will also feed on ducks, although not as frequently as fish. During the migration the eagles follow a route with several stopovers at lakes and streams along a southward corridor. The bald eagles travel individually, and although a given eagle may spend only a week or two at a stopover, collectively the eagles may be present for several months. Although the birds travel as individuals, once at a stopover, they will roost together in the evening (i.e., location were eagles gather to sleep for the night) and perch together in the same or adjacent trees.

Because of its endangered status in the early 1970s, several agencies and biologists initiated long-term surveys. Some of the surveys are ongoing nationwide surveys, such as the Midwinter Bald Eagle Survey, and others are local surveys such as the data set that is the focus of this activity.

Since 1974, just two years after the ban on DDT, the Bureau of Land Management in Northern Idaho has counted migrating bald eagles every winter. The bald eagle counts are taken on a weekly basis at eleven sites around Wolf Lodge Bay on Lake Coeur d'Alene in the Pacific Northwest (Figure 1). The eagles stop at Lake Coeur d'Alene because of the availability of kokanee salmon, which is a land-locked strain of sockeye salmon (*Onorhynchus nerka*). The salmon live to about three years of age and then spawn in November or December, dying immediately after spawning and leaving a large number of carcasses in the shallow water for the eagles to feed on. The biologists go out by car and count the number of eagles on perch trees or flying at these sites. The

adult and immature eagles are counted separately. The sites are usually visited once per week in the morning from mid-November to the beginning of February with the highest numbers of eagles usually being present during December. In addition, the biologists record weather conditions, human activity at each site, salmon abundance, and various other factors that could influence the counts of migrating eagles.

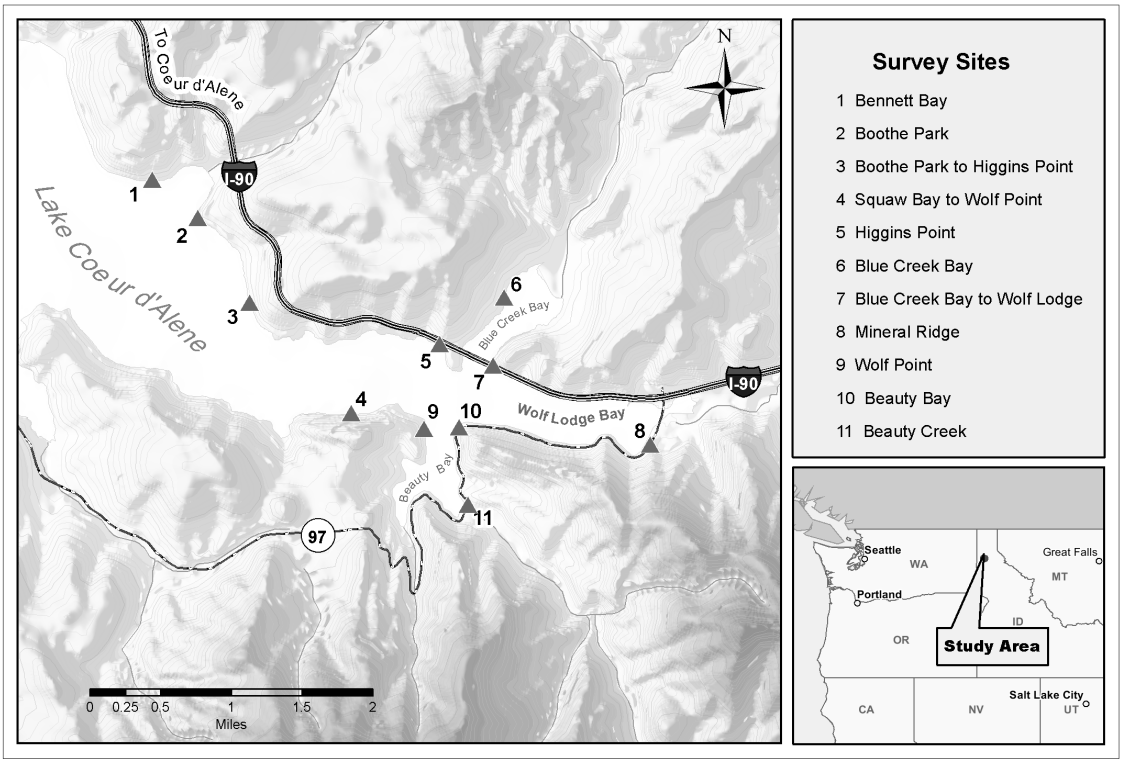

Figure 1: Map of the study area in the Pacific Northwest (United States) and the bald eagle winter survey sites along Lake Coeur d'Alene, Idaho.

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Part I: How does the bald eagle population at a winter stopover change over three decades?

1. Look over the terms in the glossary and the proposal worksheet (provided by your instructor). For example, what is the difference between the dependent variable versus the independent variable? Open the Excel file with the data for the guided approach (provided by your instructor) and examine the data. Are the data continuous or categorical?

2. How does a bald eagle population change across three decades at a winter migratory stopover? Your explanation for your prediction is your hypothesis. Some scientists will combine the prediction and hypothesis into one "If-then" hypothesis. The **"if" clause contains the hypothesis** and the **"then" clause contains the prediction that is to be tested**. When making a hypothesis you are making assumptions for factors that will not vary with your treatments. For example, you are assuming that the eagles will migrate along a similar path each year. Combine your prediction and hypothesis into one "If-then" hypothesis and write it below.

3. Graph the data from the provided Excel file (provided by your instructor). Which statistical analysis will you use? What does your graph *say* or what is the pattern that your data shows? What does your graph *mean* or what is your interpretation of the data pattern? Was your prediction accurate? Do the data support your hypothesis?

Part II: How do salmon abundance and December temperatures influence bald eagle numbers?

1. Do salmon numbers influence the bald eagle abundance? Explain your hypothesis below and state your independent and dependent variables. Explain the relationship between bald eagles and salmon abundance after performing your analysis in Excel. Do the data support your hypothesis?

2. Do cold air temperatures influence bald eagle abundance? Explain your hypothesis below and state your independent and dependent variables. Explain the relationship between bald eagles and December air temperatures at Lake Coeur d'Alene. Do the data support your hypothesis?