LEsson 14  Artificial Nest Predation Investigation

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Overview
Students design an investigation to evaluate the effects of land use or land management on the predation of ground-nesting birds using artificial eggs to simulate the eggs of ground-nesting bird species.

Objectives
At the end of the lesson, students will be able to:
1. Create a map of a study area.
2. Identify places birds commonly lay eggs, and compare the relative advantages of each.
3. Set up a field experiment by first posing a hypothesis, and then designing an experiment to answer test it.
4. List potential predators of bird eggs.
5. Collect and analyze data.

Teacher Background
Roads cover six million kilometers of land in the contiguous United States. Previous studies on songbirds have suggested that nest predation increases with road width and traffic use, but decreases with distance from the road. Increasing numbers of roads, habitat fragmentation, loss of songbird habitat due to commercial and residential development, and increased human activity are all aspects of community growth. The presence of a diverse songbird population contributes to a community’s natural biodiversity and residents’ quality of life.

One way that scientists can assess the environmental impact of community growth is by designing artificial nest predation studies to measure changes in nesting success due to increased likelihood of being eaten by predators. Scientists make artificial eggs out of plasticine or clay and place them in a fake nest on the forest floor and observe what happens over time. Predators, such as mice, squirrels, raccoons are tricked into thinking that the clay eggs are a potential food source.

Some Possible Study Questions Using “Artificial” Eggs

Questions that relate to development:
• Do predation rates vary in an open field v. forest?
• Do predation rates vary in an edge habitat v. interior forest
• Are predation rates higher along a human-caused edge (trail, road) vs. a natural edge (river)?
• Is predation higher in a town park vs. a natural grassland or interior forest?
• Are predation rates higher in smaller forests (fragments) vs. larger forests?
• Do predation rates vary an urban area vs. an agricultural area?
• Do predation rates vary by road type (paved, unpaved) or distance from a road?

*Other questions:*

• Do predation rates vary in coniferous vs. deciduous forests?
• Are certain egg colors more attractive to predators?
• Do predation rates vary in wetland vs. interior forest habitats?

Any variable that can be divided into two levels may be studied: housing density, edge effect, type of edge, road type, habitat type, etc. The possibilities are endless!

**Where Do Birds Nest?**

When the snow begins to melt in the spring, many birds begin their long migratory journey North to their summering grounds. Why do birds fly North for the summer?

- Warmer temperatures signal the increased availability of food— insects, arthropods, and plants.
- Mate and lay eggs.

Life as a bird is not easy when it comes to reproduction. Birds not only have to find good locations to place their nests but they also have to protect these nests from all kinds of predators. How many have seen bird nests before? Where were the nests? Trees, nests, houses, on the ground

Why is the ground a good place for some birds to lay their eggs? How can birds and their nests keep from getting eaten? *Ground nesters tend to have cryptically colored plumage that helps them to “fit-in” and conceal their nest.*

Why might the ground not be such a good place to lay eggs?
- More easily stepped on
- Eaten by predators

Some common forest ground-nesting bird species include: *Oven bird, Hermit thrush, Veery*

What kinds of animals in the forest might find and eat bird eggs on the ground?
- Mammals: mice, chipmunk, skunk, bear, raccoon
- Reptiles: snakes
- Raptors or other predatory birds: owls, hawks, jays, crows

**Procedure**

**Part I – Design Artificial Nest Study**

Either as a class or in small groups of 3 students, select a question to investigate and design their study. *Optional:* Research information on your study question. Identify the appropriate location to carry out your study.
Scientists often set-up studies using transects. A transect is a straight line that can be run east/west, north/south, etc. on the ground along which observations or measurements are made at certain distances. Why do you think scientists use transects?

- Easy to follow
- Easy to set-up
- Easier to find sample sites

Show students various study design. For example, show how to locate two transects, i.e. one next to a road and one next to a trail. One possible study design is to use one row of nests spaced 5 meters from the flag trees, which are 25m apart along the transect. See the sample study design illustrated below.

**Sample Study Design** (draw onto study design grid map)

![Sample Study Design Diagram]

**Part II – Draw Map of the Study Design**

Next, distribute the Study Design Grid Map. Instruct students to draw their nest placement lay-out on the Study Design Grid Map. Make a KEY or map legend that shows your symbol for the nests, transects, and flag trees. Use a distance of 25 steps (meters) or more between nests. You may use only one set of nests along a transect, or several as shown above.

Demonstrate how to make a simple map and include key components:

i. Legend (key), symbols
ii. Scale bar
iii. North arrow
iv. Study design
Part III – Make Artificial Eggs

1. Distribute plasticine or clay, plastic/rubber gloves, and ziploc bags. (Students must wear gloves to make sure they do not put their “scent” on the eggs….human scents can discourage natural predators or attract predators that normally would not eat bird eggs, altering our results.)

2. Demonstrate how to make egg (roll in hands until right size/shape of bird species’ egg you select.) Each student should make 3 eggs per nest; 10 nests per transect (exact number depends upon study design), times the number of transects.

3. When finished, place the eggs into Ziploc bag to transport to the study site.

Part IV – Lay Out Nests

Now we are ready to go outside to set up our study and lay-out our nests. Students will need to bring: eggs, plastic gloves, clipboard, Study Design Map and Artificial Nest Location data form, pencil, compass, and flagging (GPS units optional).

Locate the start of the transect and first flag tree. Walk the desired number of paces using pre-cut yarn lengths or meter tape along the transect (along the road, trail or river) to your first flag tree. Mark the flag tree with flagging and label with nest location: Transect # - Nest # Example: 1-1. Describe the flag tree (trunk diameter, species) on your Artificial Nest Location data form. The flagging is not placed immediately next to the nest location, so as not to discourage or attract predators.

Walk 5 meters perpendicular from the flag tree away from the road, trail, or river. Look for a good nest location where ground-nesting birds would typically put their eggs (good hiding places!):

- Under small trees
- Alongside logs
- Under brush

Scrape/clear-out a small spot for the nest (small, rounded depression), and gently place eggs in nest. BE SURE to WEAR GLOVES when making nests and placing eggs to minimize human scent on the eggs/nest. The teacher may demonstrate by making first a nest and placing 3 eggs in the nest.

On the Artificial Nest Location data form, record a description of the flag tree and the location of your nest from the flag tree using your compass (and GPS unit). The teacher may need to demonstrate how to use the compass or GPS unit. If using a compass: find North, then point the directional arrow toward the nest while standing at the flag tree. Record the direction in degrees on the data form. Next, record the direction to the nest from another object. Add any other descriptive information, such as species and diameters of nearby trees, etc. to help you find the next location when you return. This is critical!! If you can't find the nest again, you don't get any data!!

Sample description recorded in data form:

<table>
<thead>
<tr>
<th>Transect # - Nest #</th>
<th>GPS Lat. &amp; Long.</th>
<th>Description of Flagged Tree</th>
<th>Description of Nest Location (from flagged tree)</th>
<th>Describe Nest Location from another Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nest 1-1</td>
<td></td>
<td>6” diam. Maple tree</td>
<td>5 m-320° from Flag Tree at base of 1” diam. Beech tree. 3 blue eggs</td>
<td>.5’ from downed maple trunk</td>
</tr>
</tbody>
</table>

Go to the next flag tree by taking the desired amount of paces. Place flagging on the flag tree and repeat nest placement procedure and record location information in data form. One-by-one, have students lay out nests, or give student groups the necessary time to place their eggs according to their study design plan.
Assign students within each team to the following tasks, or if students are younger, teacher will direct students to do the following tasks:

Task #1: Measures distance to each flag tree. Mark flag tree with flagging and label with Transect # - Nest #. Draw flag tree location on Study Design Grid Map. Number nests on map the same as what is on the flag!

Task #2: Find location on ground for next, 5 m from flag tree. Make nest depression by scraping away debris. Place eggs.

Task #3: Record description of flag tree and nest location on data form. Note trees, rocks, and other objects that will help you find the nest next week.

Part V – Checking Nests

Students may return at intervals of three, six and twelve days, etc. depending upon the study design, to check their nests. Students should bring their Artificial Nest Location data form, Study Design Grid Map, and their Artificial Nest Observation data form.

Discuss with students how they will determine if a nest or egg has been predated upon:
- Will see bite marks in eggs.
- Eggs are missing.

When retrieving eggs, place bitten eggs into a Ziploc bag labeled with the nest location and bring back to classroom for analysis. *Handle eggs carefully, just picking up eggs can sometimes smear out any bite marks! Note number of missing eggs on the Artificial Nest Observation Data Form. Be careful not to step on the eggs!!!! On your last visit, retrieve all flagging and eggs--we don't want to litter the forest!

Part VI – Analyze the Data

Bring eggs back to classroom. Have students assess eggs and determine which ones were really bitten (some eggs may have marks on them from sticks/leaves). Over time, you may want to assemble a reference collection of example eggs that have marks from mice, chipmunks, raccoons, deer, and birds.

Clues to which predator disturbed the artificial egg:
- Birds have a triangular shape mark with no distinct teeth marks.
- The size of the egg will rule out certain predators.
- Mammals all have distinct teeth marks and the best way to identify these is to match them to a skull (if available). Teeth marks are usually the incisors or the molars. For the incisors, look at the number of incisors and the width of the teeth (mice<chipmunk<skunk or raccoon). Eggs with molars marks are generally from mammals like skunks or raccoons.

Bring in animal skulls and skins typical of local wildlife, so students can see what kinds of predators may have bitten or eaten their eggs. Use skulls to make “mock” bite marks so students can compare to their eggs. Wildlife identification books will also be helpful.
Discuss the results. Possible discussion questions include:

- Describe ways in which humans alter the environment. *Roads, housing, commercial development.*
- Describe common ecological relationships between and among species and their environments.
- Explain the ecological effect of increased nest predation on the forest ecosystem. How will increased nest predation affect the food chain/web? How will increased nest predation affect our enjoyment of the forest? Forest biodiversity?
- What do our study results tell us about the effect of urban development on avian reproduction and survival rate.
- What is our conclusion?
- Is this adequate data to draw conclusions? What other studies might we conduct?
- How could the study design have been improved?

**Part VII - Graph the Data**

Have students make a bar graph to display their data. Be sure to label the axis:

- Location (x-axis) – numbered nests along the transect.
- Number of eggs predated (y-axis)

**Assessment**

- Study Design Grid Maps show flag trees, numbered nest locations, legend, scale, North arrow.
- Artificial Nest Location data form is completed with good descriptions.
- Artificial Nest Observation form describes number and condition of eggs.
- Student can draw conclusions from their data.
- Students are able to display their data correctly in an appropriate graphic form.

**Michigan Content Standards Addressed**

**Social Studies**

*Strand II. Geographic Perspective*
- **Standard II.2 Human/Environment Interaction**
  - All students will describe, compare, and explain the locations and characteristics of ecosystems, resources, human adaptation, environmental impact, and the interrelationships among them.
- **Standard V.2 Inquiry**
  - Construct an answer to the question posed and support it with evidence.

**Science**

*Strand III.5 Life Sciences ~ Ecosystems* All students will analyze how humans and the environment interact.
- **Standard III.5.6MS Describe ways in which humans alter the environment.**
- **Standard III.5.1 HS Describe common ecological relationships between and among species and their environments.**
- **Standard III.5.6 HS Explain the effects of agriculture and urban development on selected ecosystems.**

**Math**

*Strand III. Data Analysis and Statistics*
- **Standard III.1 Collection, Organization and Presentation of Data**
  - Students collect and explore data, organize data into a useful form, and develop skill in representing and reading data displayed in different formats.
- **Standard III.2 Description and Interpretation**
  - Students examine data and describe characteristics of a distribution, relate data to the situation from which they arose, and use data to answer questions convincingly and persuasively.
- **Standard III.3 Inference and Prediction**
  - Students draw defensible inferences and make predictions.
REFERENCES

Web Resources
National Bird Identification Information Center

www.Enature.com
http://animal.discovery.com/guides/mammals/mammals.html
http://www.birds.cornell.edu/programs/AllAboutBirds/BirdGuide/

Educator’s guide to Bird Study
http://www.birds.cornell.edu/schoolyard/Research/index.html

Scientific Journals available at most University Libraries
Zoology, Canadian Field-Naturalist, American Midland Naturalist

Talk with local scientists
Universities or Colleges
State offices
Organizations and clubs, ex. Audubon Society

Field Guides
National Geographic Society Field Guide Field Guide to the Birds of North America
4th Edition, 2002. Comprehensive, covering the rarities, including species found in such places as the
western Aleutians of Alaska and the Dry Tortugas of Florida. And although it's fairly large for a field
guide, it's still manageable in the field. Some beginning birders may be overwhelmed with the great
amount of information available in this field guide.

Sibley Guide to Birds The Sibley field guide to North American birds is the most exciting field
guide to come out since Roger Tory Peterson first invented the field guide in the early years of the 20th
century. This book has 6600 beautiful pictures of American birds in lifelike poses. It's a big book, with
over 500 large pages.

Stokes, Donald and Lillian Stokes. Stokes Field Guide to Birds: Eastern Region
The Stokes’ guides are probably the easiest one for beginning birders to get started. The authors have
gone a long way to make a complex body of information accessible to the beginner.

Some people think it's still the best field guide North America has ever had.
Ehrlich, Paul and David Dobkin, Darryl Wheye. *The Birder’s Handbook: A Field Guide to the Natural History of North American Birds (Including All Species That Regularly Breed North of Mexico)* Compact and yet filled with information, this portable encyclopedia of North American bird behavior is a complement to field guides. Learn more about the species you see in the field, and--when in doubt--use this handy reference as another.


Kays, Roland W. and Don E. Wilson. *Mammals of North America* Most comprehensive and up-to-date field guide to the mammals of North America. Written by two leading authorities, no other reference covers all resident species north of Mexico, mammals large and small. With full-color illustrations for every one of the 442 species

Poole, A. and Gill, F. (eds). *The Birds of North America*. Academy on Natural Science and American Ornithologists’ Union. Contains species accounts that cover natural history, status, conservation issues, and many other topics
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<thead>
<tr>
<th>Name:</th>
<th>Location:</th>
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