Name _____

Date _____ Class _____

HOLT BIOSOURCES
LAB PROGRAM
LABORATORY TECHNIQUES

C22 Examining Owl Pellets

Skills

- observing the skeletal structure of organisms
- using a dichotomous key
- dissecting an owl pellet and separating its contents

Objectives

- *Dissect* an owl pellet.
- *Identify* the species eaten by an owl from the remains found in an owl pellet.
- *Construct* a food web containing an owl from a list of species found in owl pellets.

Materials

- gloves
- lab apron
- northwestern barn-owl pellet
- dissecting tray
- dissecting needle
- forceps
- white paper
- metric ruler
- tape or glue

Purpose

You are a field biologist for the state division of wildlife. While doing a study to determine the cause of a recent decrease in the vole population, you also noticed a decrease in the population of barn owls. You determine that the vole population is down because of the recent drought conditions in the area. You suspect that the decrease in owl population might be due to a decrease in the owl's food supply—namely voles. Your job is to dissect owl pellets collected from the area to determine whether the owls are eating voles.

Background

Owls are **raptors,** or birds of prey. They catch their prey, including small birds and rodents, and swallow them whole. Enzymatic juices in the owl's digestive system break down the body tissues of the prey but leave the bony materials, hair, and feathers undigested. Depending on the prey eaten, the undigested portions may include beaks, claws, scales, or insect exoskeletons. This type of material has little nutritional value and must be eliminated from the owl's body.

Since owls do not have teeth for grinding and cannot pass whole bones and claws through their digestive tract safely, these indigestible materials form a **bolus,** or lump, called a **pellet.** The pellet is composed of fur, feathers, bones, and other undigested parts of the consumed prey. Pellets begin forming within the digestive tract of the owl as soon as the prey is swallowed. The pellets are then coughed up, or regurgitated, and the owl begins feeding once more.

Scientists take advantage of this adaptation by collecting these pellets. Owl pellets are dried and either fumigated (treated with chemicals) or sterilized so that their contents can be examined safely. Since owls are not selective feeders, the pellets can be used to estimate the diversity of available prey. The contents are also a direct indicator of what an owl has fed on—information that is crucial for species management and protection.

The contents of an owl pellet can be identified with a **dichotomous key,** a tool used to identify an object or an organism. A dichotomous key has a series of statements or questions that compare contrasting characteristics among a group of items or organisms. For example, assume that you want to identify a common U.S. coin using a dichotomous key. The key might read as shown below. Compare the first pair of statements and determine which one best fits the coin you are trying to identify. After you pick one of the paired statements, you will be directed to another paired statement until you reach an answer.

Dichotomous Key of Coins

1.	coin edge smooth	go to 2
	coin edge grooved	go to 3
2.	coin copper in color	penny
	coin silver in color	nickel
3.	picture of Roosevelt on front	dime
	picture of Washington on front	quarter

Procedure

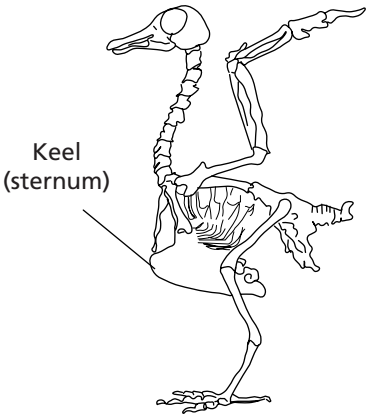
Part 1—Dissecting an Owl Pellet

1.  Put on gloves and a lab apron. **CAUTION: Do not touch your hands to your face or mouth during this investigation.** Place an owl pellet in a dissecting tray. Remove the pellet from the aluminum foil casing. Use a dissecting needle and forceps to carefully break apart the owl pellet. Remove the fur and feathers from the bones. *Note: Be careful to avoid damaging small bones while you are pulling the pellet apart.* As the bones are uncovered, use forceps to carefully place them on a sheet of paper. Take care to remove all skulls and bones from the fur mass. You will identify the animals the owl has eaten mainly by the skulls, mandibles (jaws), and teeth, so be especially careful when dissecting the pellet. Use the following diagrams of the bird and mammal skeletons to help you distinguish among types of bones.

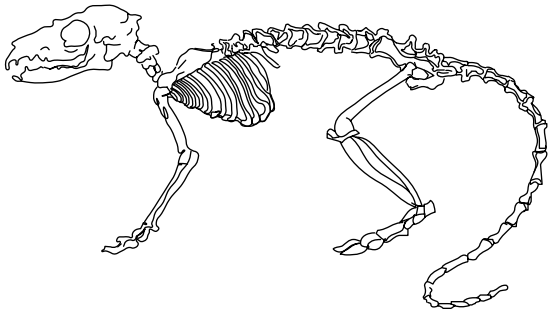
   Sometimes, undigested beetles and pill bugs are found in owl pellets. They are small animals that find the expelled pellets and use them as a food source and nursery for their eggs and larvae. Therefore, these organisms should not be included as owl prey.

   ♦ In what way might the formation of owl pellets increase an owl's chances of survival in an ecosystem?

Generalized Bird Skeleton

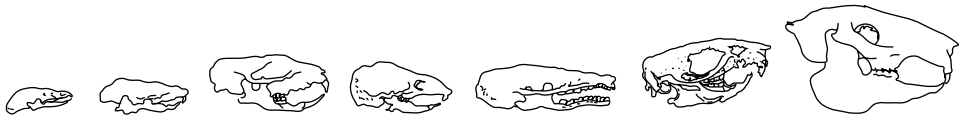


Generalized Mammal Skeleton



2. Assemble similar bone parts to see how many prey types are represented in the pellet. Count the number of skulls to determine how many prey were in the pellet. Refer to the diagrams of the skulls shown below to aid you in identifying types of skulls.

Skull Comparisons



- What are some ways you can predict which species of animals you might find in an owl pellet?

- How can you distinguish between vertebrate and invertebrate material? between birds and mammals?

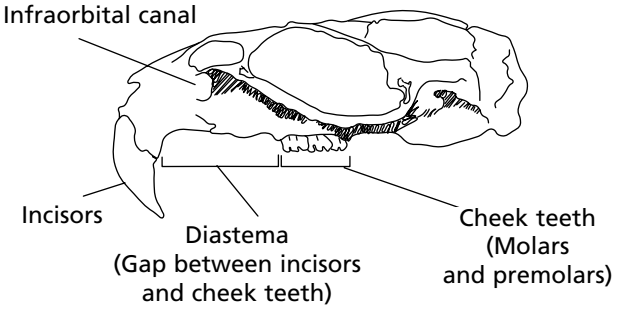
3. Reassemble the skeletons by laying them out on a piece of paper with appendages arranged and spread out to the side. Glue or tape the assembled skeletons to the paper.

♦ How many skeletons were you able to assemble from your owl pellet?

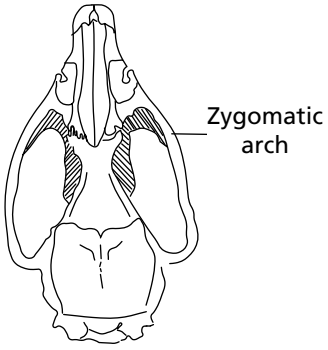
Part 2—Using a Dichotomous Key to Identify Prey

4. Use the diagrams below of the side and top views of a skull to become familiar with terminology used in a dichotomous key of small mammal skulls. A gap between the incisors (front teeth) and cheek teeth (molars and premolars) is called a *diastema*. The *infraorbital canal* refers to an opening just below the eye socket. The *zygomatic arch* is a ridge of bone located on the side of the skull making up part of the cheekbone.

Side View of Skull

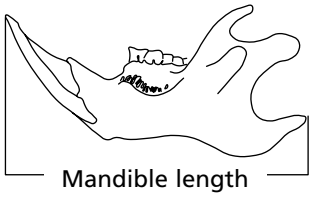


Top View of Skull

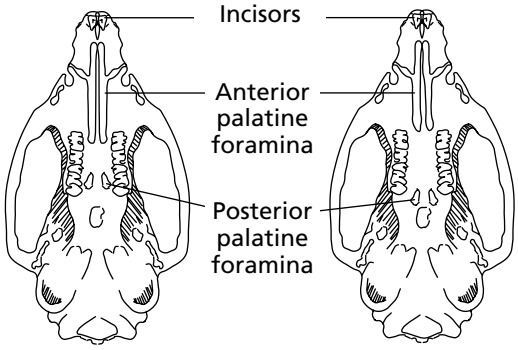


5. Use the diagrams below to aid you in determining the length of the mandible, or lower jaw. The bottom view of the skull is actually a view of the roof of the mouth. When determining the posterior edge of the palate, look for the position of the *posterior palatine foramina*. The palate ends beyond the posterior palatine foramina. The skull on the left shows the posterior edge of the palate ending even with the last cheek teeth. The right-hand skull shows the palate ending beyond the last cheek teeth.

Side View of Mandible (Jaw)



Bottom View of Skulls



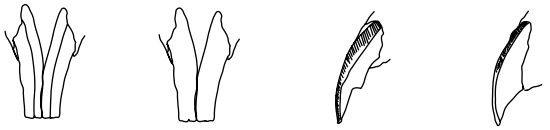
Anterior and posterior palatine foramina location will vary from species to species. Use these as examples only.

6. To determine cheek teeth types or incisor types, refer to the diagrams below.

Cheek Teeth Types

Acute (bottom view) | Acute (side view) | Unicusp (bottom view) | Unicusp (side view) | Lobed s-shaped (bottom view) | Lobed s-shaped (side view)

Incisor Types



Grooved incisor (front view) | Smooth incisor (front view) | Notched incisor (front view) | Unnotched incisor (front view)

7. Use the dichotomous key below and the diagrams above and on the preceding page to identify the skulls of small mammals found in your owl pellet. Record the number of each type of skull found in the Analysis of Owl Prey data table on the next page.

Dichotomous Key

Skulls of Small Mammals Found in Northwestern Barn-owl Pellets

No gap (diastema) between incisors and cheek teeth. . . . . Order: Insectivora
Gap (diastema) between incisors and cheek teeth. . . . . Order: Rodentia

Order Insectivora (moles and shrews)

Zygomatic arch complete; skull flat and broad . . . . . *Scapanus* (mole)
Zygomatic arch not complete; skull not flat and broad . . . . . *Sorex* (shrew)

Order Rodentia (rats, voles, and mice)

1. Infraorbital canal not present . . . . . Go to 2
Infraorbital canal present. . . . . Go to 3

2. Upper incisors distinctly grooved . . . . . *Perognathus* (mouse)
Upper incisors not distinctly grooved . . . . . *Thomomys* (pocket gopher)

3. Skull flat and broad; cheek teeth acutely angled and may appear as one continuous tooth . . . . . *Microtus* (vole)
Skull generally rounded; cheek teeth lobed or rounded and easily distinguished individually . . . . . Go to 4

4. Upper incisors distinctly grooved. . . . . *Reithrodontomys* (harvest mouse)
Upper incisors not distinctly grooved . . . . . Go to 5

5. Posterior edge of palate ending even with or only slightly beyond last cheek teeth; cheek teeth not capped with enamel . . . . . *Peromyscus* (deer mouse)
Posterior edge of palate ending beyond last cheek teeth; cheek teeth capped with enamel . . . . . Go to 6

6. Upper incisors notched, mandible length less than 16 mm . . . *Mus* (house mouse)
Upper incisors not notched, mandible length greater than 18 mm. . . . *Rattus* (rat)

Analysis of Owl Prey

Prey	Occurrence	Number found in sample	Prey biomass (in grams)	Total number in all samples	Total biomass
Pocket Gopher *Thomomys*	+++		150 g		
Rat *Rattus*	+		150 g		
Vole *Microtus*	+		40 g		
Mice *Peromyscus* *Mus* *Reithrodontomys* *Perognathus*	 ++ +++ ++ ++		 40 g 18 g 12 g 25 g		
Mole *Scapanus*	+		55 g		
Shrew *Sorex*	++		4 g		
Other Prey bats birds insects	 ++ ++ ++		 7 g 15 g 1 g		
Cumulative total biomass					

Key: +++ = common, ++ = occasional, + = rare

Part 3—Analyzing the Diet of a Barn Owl

8. As you have seen from the dichotomous key on the previous page, there are many genera of prey that occur in the northwestern region of the United States. Any other animal remains you find in your pellet will be from a bird, bat, or insect. List them as "other prey" in the data table above.

♦ How many different species of animals did you find in the owl pellet?

_____

9. Your teacher will gather class totals for each type of prey. Record these in the *Total number in all samples* column in your data table.

10. To calculate the total biomass, multiply the numbers in the *Total number in all samples* column by the numbers listed in the *Prey biomass* column. For example:

If five pocket gophers *(Thomomys)* were recorded as the *Total number in all samples,* and from the chart the prey mass is 150 g, then

$$5 \times 150 \text{ g} = 750 \text{ g}$$

Compute totals in this way for all species found, and enter your answers in the column headed *Total biomass*. Calculate *Cumulative total biomass* by summing all data in the *Total biomass* column.

11. It is now possible to get a good idea what each prey species contributes to the diet of the northwestern barn owl population that the owl pellets represent. To calculate percentage (in biomass) of owl diet, divide each number in the *Total biomass* column by the *Cumulative total biomass* and multiply your answer by 100 to give a percentage. For example, assuming a cumulative total biomass of 5,000 g and using the pocket gopher example:

$$\frac{750\ \text{g}}{5{,}000\ \text{g}} \times 100 = 15\%$$

You can conclude that the pocket gopher contributes, on the average, about 15 percent of the biomass of a northwestern barn owl's diet.

♦ What was the total biomass from all species found in your class's owl pellets?

Part 4—Constructing a Food Web

12. In the space below, construct a food web with the owl at the highest trophic level. *Note: Be sure to include producers (green plants) and decomposers in your food web.* The intermediate organisms should include the prey found in your owl pellets in class.

♦ How many different trophic levels are represented in your food web?

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13.  Dispose of your materials according to the directions from your teacher.

14.  Clean up your work area and wash your hands before leaving the lab.

Analysis

15. If an owl needs 120 g of food per day, how many *Sorex* would it need to capture? How many *Microtus*?

16. Were the remains of any voles found in the owl pellets?

Conclusions

17. How would a sudden decrease in the shrew population affect the barn-owl population?

18. How would a sudden decrease in the vole population affect the barn-owl population?

19. Assume an owl eats 100 1-gram insects and 1 100-gram rat. Did the insects or rat contribute more to the owl's diet? How does foraging time affect this outcome?

20. Is quantity or quality of prey more important?

Extensions

21. Predators such as owls are subjected to poisons that have been concentrated through the food chain. Some species of owls are considered endangered, threatened by pesticides and heavy metals that contaminate the foods eaten by their prey. Do library research, and write a report on this topic. Explain how a grain crop contaminated with a compound containing lead can affect the owl population.

22. *Wildlife biologists* study and help manage wildlife populations in state and federal parks and preserves. They conduct research on predator-prey relationships, interactions among species, and effects of pollution and human intervention on population changes. Find out about the training and skills required to become a wildlife biologist.