

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

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.

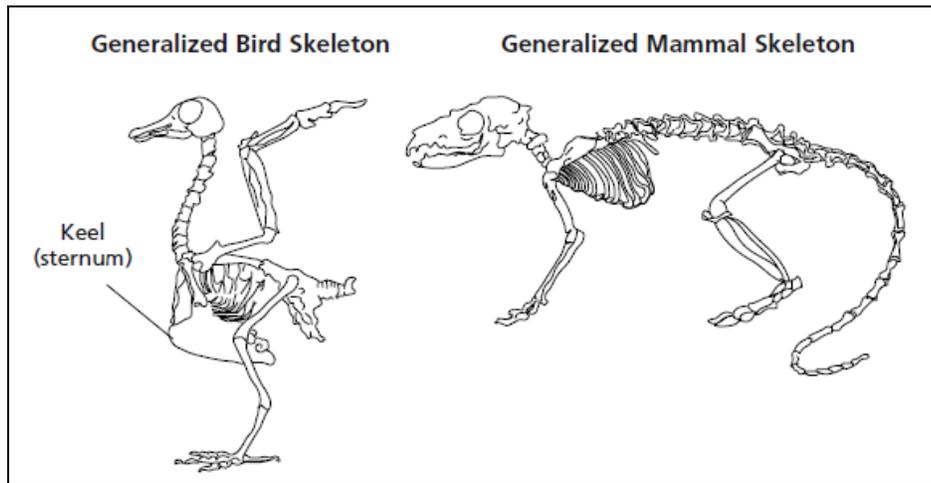
Since owls do not have teeth for grinding and cannot pass whole bones and claws through their digestive tract safely, these indigestible materials form a **bolus**, or lump, called a **pellet**. The pellet is composed of fur, feathers, bones, and other undigested parts of the consumed prey. Pellets begin 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. The contents of an owl pellet can be identified with a **dichotomous key**, a tool used to identify an object or an organism.

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.

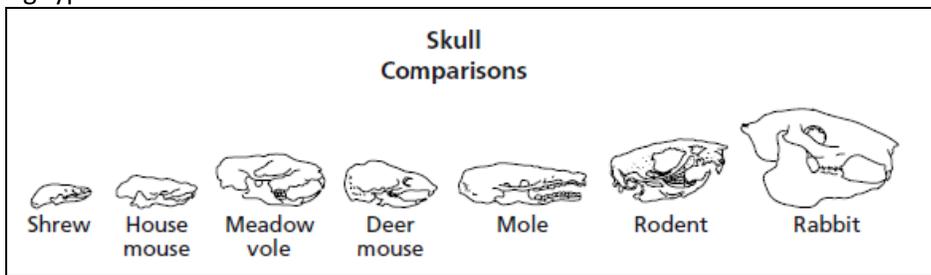
Part 1—Dissecting an Owl Pellet

CAUTION: Do not touch your hands to your face or mouth during this investigation.

1. Put on gloves and a lab apron. 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.



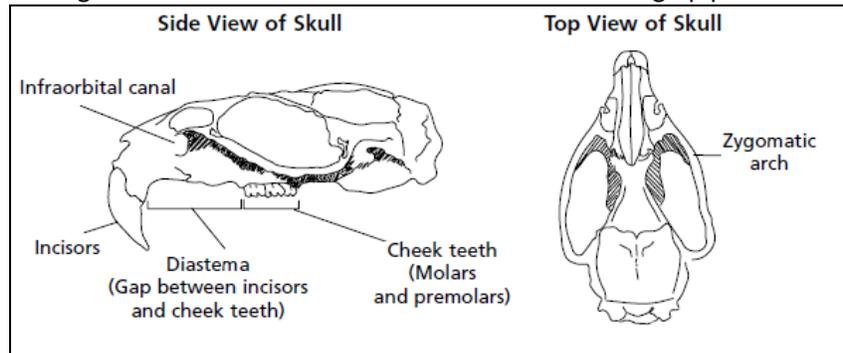
- Assemble similar bone parts to see how many prey types are represented in the pellet. Count the number of skulls to determine how many prey were in the pellet. Refer to the diagrams of the skulls shown below to aid you in identifying types of skulls.



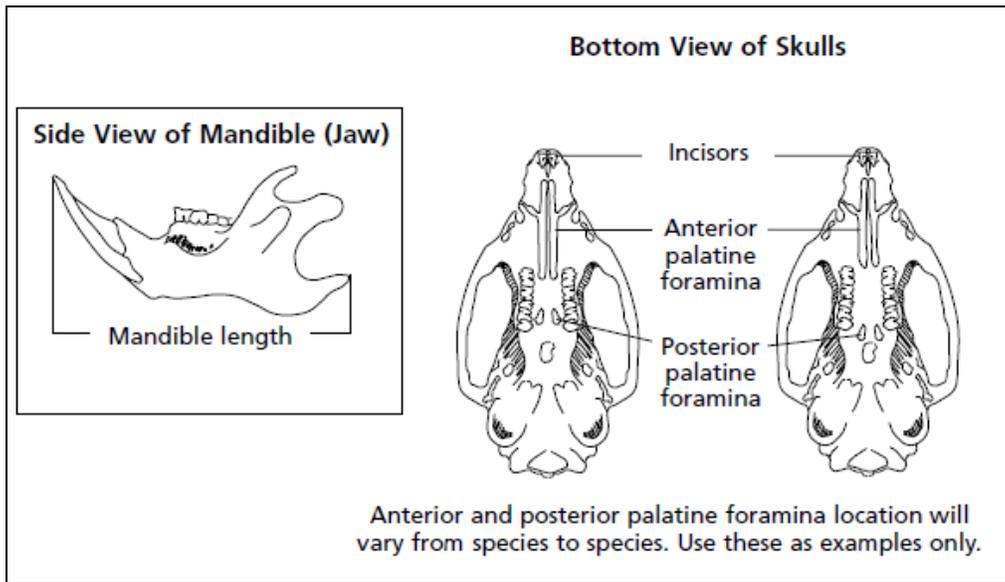
- Reassemble the skeletons by laying them out on a piece of paper with appendages arranged and spread out to the side. Glue or tape the assembled skeletons to the paper.

Part 2—Using a Dichotomous Key to Identify Prey

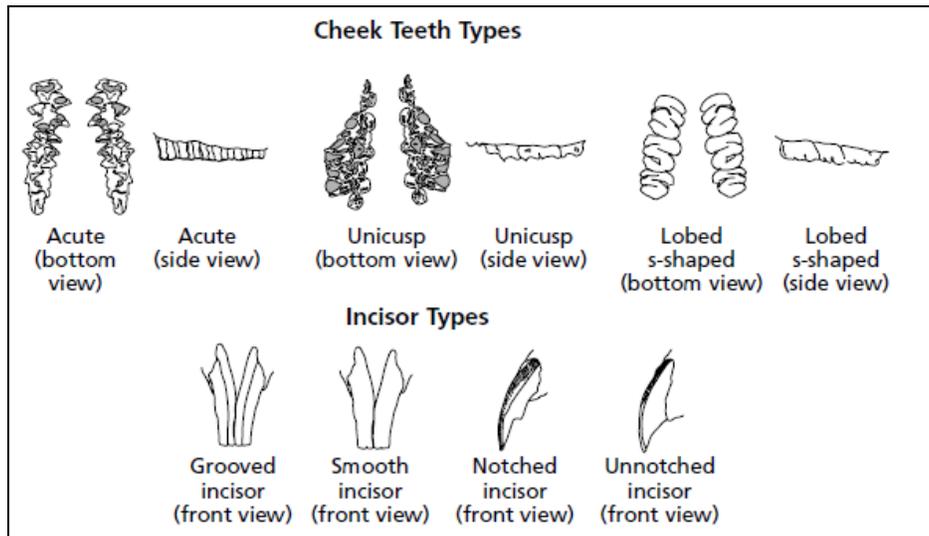
- Use the diagrams below of the side and top views of a skull to become familiar with terminology used in a dichotomous key of small mammal skulls. A gap between the incisors (front teeth) and cheek teeth (molars and premolars) is called a *diastema*. The *infraorbital canal* refers to an opening just 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.



- 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.



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



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.

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)

8. Create a data table like the one shown below to record the number of each type of skull found.

Analysis of Owl Prey

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

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

Part 3—Analyzing the Diet of a Barn Owl

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 $5 \times 150 \text{ g} = 750 \text{ g}$.
11. Calculate *Cumulative total biomass* by summing all data in the *Total biomass* column.
12. 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: $(750 \text{ g} / 5,000 \text{ g}) \times 100 = 15\%$. You can conclude that the pocket gopher contributes, on the average, about 15 percent of the biomass of a northwestern barn owl's diet.
13. 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.

<u>Prey</u>	<u>Diet</u>
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Mouse	a wide variety of plant and animal matter depending on what is available, including insects and other invertebrates, seeds, fruits, flowers, nuts, and other plant products. Deer mice sometimes eat their own feces (coprophagy).
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Mole	mostly insects and other invertebrates, including earthworms, centipedes, millipedes, snails, slugs, grubs, ants, sowbugs, termites, beetles, and crickets
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Shrew	beetles, grasshoppers, butterfly and moth larvae, ichneumonid wasps, crickets, spiders, snails, earthworms, slugs, centipedes, and millipedes. Shrews also eat small birds, mice, small snakes, and even other shrews when the opportunity presents itself. Seeds, roots, and other vegetable matter are also eaten by some species of shrews.
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Rat	typically includes seeds, nuts, grains, vegetables, fruits, meats and invertebrates.
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Bird	insects; terrestrial non-insect arthropods, seeds, grains, and nuts; fruit
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