

Investigation of NW v. SE Owl Pellets

Student Study & Analysis Sheets

This kit contains pellets produced by the Barn Owl (*Tyto alba*). Barn Owl pellets have been chosen because these owls swallow small birds and rodents whole, and the resulting pellets generally contain the complete skeletons of these prey.

Pellets begin forming within the digestive tract of an owl as soon as the prey is swallowed. Enzymatic juices break down the body tissues of the prey but leave the bony materials and hair or feathers undigested. Depending upon 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 passed from the body.

Predatory mammals such as bobcats and wolves have teeth to grind up bones and claws, and a digestive tract adapted to pass these ground parts. Owls, on the other hand, do not have teeth for grinding and cannot pass whole bone and claws through their digestive tract safely. Instead, these materials form a bolus (or pellet) which is surrounded by the hair or feathers of the prey consumed. The pellet is then orally expelled and the owl begins feeding once more.

Scientists take advantage of this adaptation by collecting these pellets and examining their contents. Since owls are not very selective feeders, these 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.

ACTIVITY 1

Dissecting Owl Pellets

Objective

To dissect one Barn Owl pellet from the Northwest U.S. and one Barn Owl pellet from the Southeast U.S.

Materials (per team of 2 students)

- 1 Northwest Owl pellet
- 1 Southeast Owl pellet
- 2 Dissecting needles

Procedure

To dissect pellets, first remove them from the aluminum foil casing. **BE SURE THAT YOU KEEP THE NORTHWEST AND SOUTHEAST PELLETS SEPARATE.** Label a sheet of clean paper with your name and the region (Northwest or Southeast) from which each owl pellet comes. Label a sheet of paper for each pellet that you dissect. One student should dissect the Northwest pellet and the other student should dissect the Southeast pellet.

Using the dissecting needle provided, begin to loosen the hair of the owl pellet. As bones are uncovered, carefully remove them and place them to the side of your sheet of paper. Extra care should be taken to keep skulls intact and associated with their respective mandibles. If you prefer, you can label a small sheet to hold the bones of each prey item that you extract. After you have removed all bones, you can begin to identify the prey.

NOTE: If you find that the pellets do not come apart easily you can soften them by soaking them briefly in warm water.

ACTIVITY 2

Using a Dichotomous Key

Objective

To use a dichotomous key to identify the skulls obtained from the raptor pellets.

Materials (per team of 2 students)

- 1 Dichotomous Key

Procedure

Pellet contents can be identified using two methods. The first of these methods is a dichotomous key. To use a dichotomous key, simply compare the first pair of statements and determine which one best fits the article you are trying to identify. After you pick one of the paired statements, you will be directed to other paired statements until you reach an answer. For example, assume that you want to identify a common U.S. coin using a dichotomous key. The key might read as follows:

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

Use the Dichotomous Key and Skull Characteristics chart to identify the skulls of small mammals found in your pellets and record the number of each type on the accompanying worksheet labeled "Pellet Contents" (Page 4). If birds, insects, etc. are found, then no further identification is needed.

Note: Undigested beetles and pillbugs are sometimes found in owl pellets. These are small animals that find expelled raptor pellets and use them as a food source and nursery for their eggs and larva. Therefore, these organisms should not be included as owl prey.

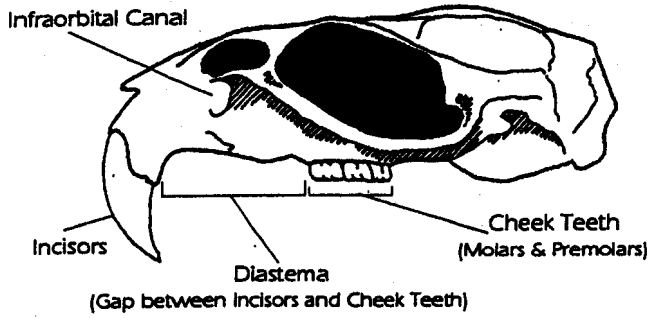
Optional Method

Required: WARD'S—NW v. SE Owl Pellet Skull Display Set 36 W 5493

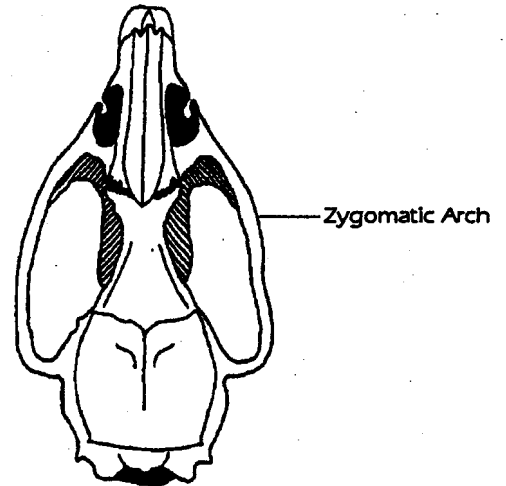
Another method of identifying raptor prey is through comparison to materials that have already been identified. Most biologists keep a set of identified skulls and hair/feather samples. These can be very useful when identifying prey remains. This can speed up the identification of large numbers of similar items by eliminating the need for a key once all of the common items have been identified.

Skull Characteristics

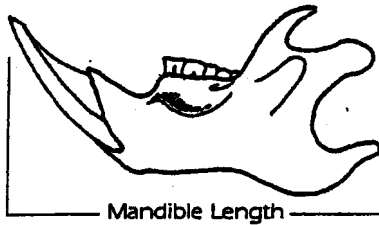
Side View of Skull



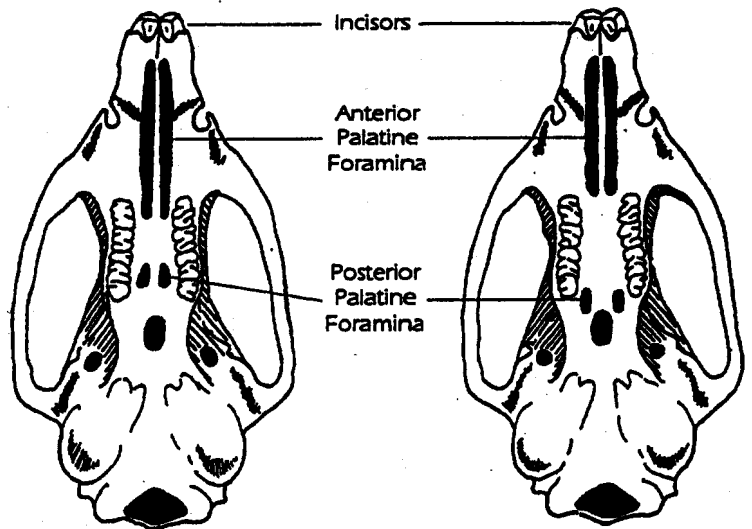
Top View of Skull



Side View of Mandible (Jaw)

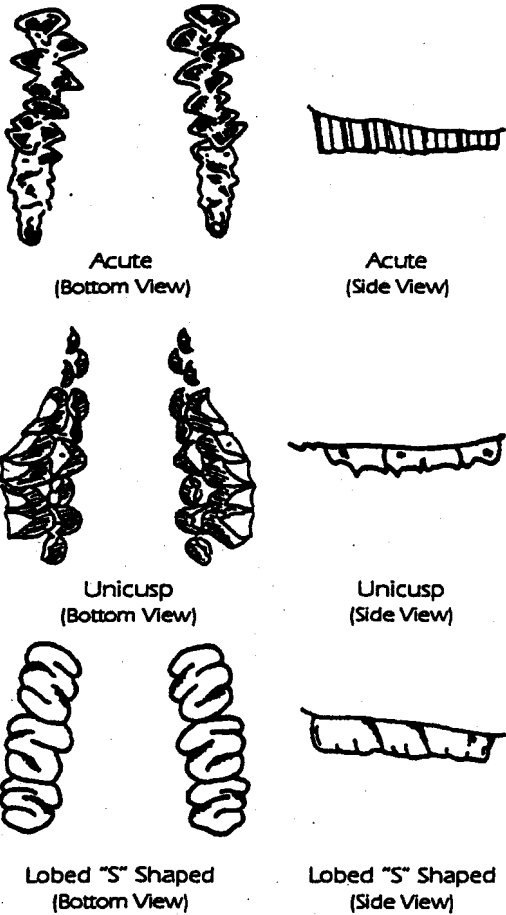


Bottom View of Skulls

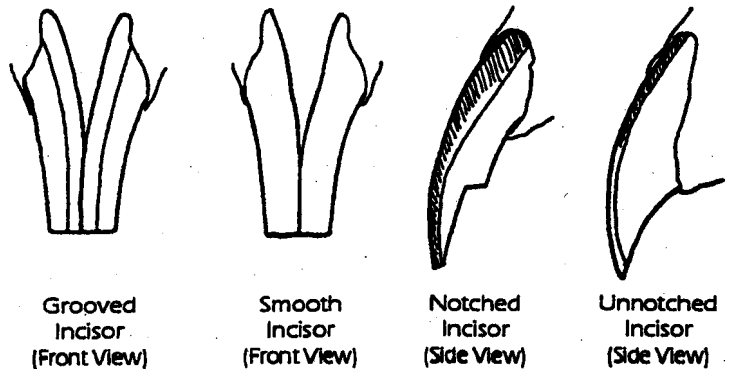


Anterior and Posterior Palatine Foramina location will vary from species to species. Use these as examples only.

Cheek Teeth Types



Incisor Types



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WARD'S

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Dichotomous Key

Skulls of Small Mammals Found in 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)

1. Zygomatic arch complete, skull flat and broad (Moles) _____ Go to 2
Zygomatic arch not complete, skull not flat and broad (Shrews) _____ Go to 3
2. Upper teeth 10 on each side; mandibular teeth 8 each _____ (SE Mole) *Scalopus*
Upper teeth 10 on each side mandibular teeth 11 on each side _____ (NW Mole) *Scapanus*
3. Skull 1.0 to 1.5cm total length; upper teeth 9 on each side _____ (Least Shrew) *Cryptotis*
Skull greater than 1.5cm total length; upper teeth 10 on each side _____ Go to 4
4. Skull robust; second and third teeth of same size and larger than fourth and fifth teeth which are also of the same size; sixth tooth minute and hidden from lateral view _____ (Short Tailed Shrew) *Blarina*
Skull delicate; second through fifth teeth not distinctly paired by size but almost uniform; sixth tooth minute but clearly visible from lateral view _____ (Shrew) *Sorex*

Order RODENTIA (Rats, voles, and mice)

1. Infraorbital canal present _____ Go to 3
Infraorbital canal not present _____ Go to 2
2. Upper incisors distinctly grooved _____ (Pocket Mouse) *Perognathus*
Upper incisors not distinctly grooved _____ (Pocket Gopher) *Thomomys*
3. Skull flat and broad; cheek teeth acutely angled and may appear as one continuous tooth _____ (Pine Vole) *Microtus*
Skull generally rounded; cheek teeth lobed or rounded and easily distinguished individually _____ Go to 4
4. Upper incisors distinctly grooved _____ (Harvest Mouse) *Reithrodontomys*
Upper incisors not distinctly grooved _____ Go to 5
5. Posterior edge of palate ending well beyond last cheek teeth _____ Go to 6
Posterior edge of palate ending even with or slightly beyond last cheek teeth _____ Go to 8
6. Upper incisors notched, anterior palatine foramina extend well beyond anterior edge of cheek teeth _____ (House Mouse) *Mus*
Upper incisors not notched, anterior palatine foramina do not extend well beyond anterior edge of cheek teeth _____ Go to 7
7. Posterior palatine foramina obvious and located just beyond last cheek teeth _____ (Rice Rat) *Oryzomys*
Posterior palatine foramina minute and located between second pair of cheek teeth _____ (Rat) *Rattus*
8. Zygomatic plate undercut and having a distinct dorsal protrusion; second and third pair of cheek teeth sigmoid or "S" Shaped _____ (Cotton Rat) *Sigmodon*
Zygomatic plate not undercut; cheek teeth not sigmoid _____ (Deer Mouse) *Peromyscus*

Pellet Contents

NORTHWEST	SOUTHEAST

ACTIVITY 4

Constructing a Food Web

Objective

To construct a food web with a barn owl at the highest trophic level, and grass and seeds at the base.

Procedure

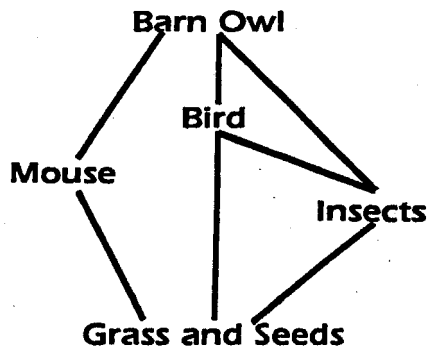
A food web is a relationship diagram showing organisms arranged by energy flow from organisms at lower trophic (feeding) levels to higher trophic levels.

Energy passes from one organism to another on a higher level through the consumption of that lower organism. With the Barn Owl, for instance, energy is passed from grass and seeds to insects, which are in turn eaten by birds, who are finally consumed by the owl. There are many different combinations in how energy is passed from one trophic level to another; several examples are shown in the diagram below.

There are usually three trophic levels found in a food web. The first is a primary consumer, which consumes photosynthetic products such as grass. Secondary consumers on the next trophic level are carnivores (meat-eaters) that also eat herbivores (plant-eaters). Tertiary consumers are carnivores that eat other carnivores, and are usually found at the top of the food chain.

Construct two food webs at the bottom of this Activity Sheet. The webs should contain a Barn Owl at the highest trophic level, and grass and seeds at the lowest. The intermediate organisms that you show should include only those prey found by your class. One food web should be constructed for the Northwest and another for the Southeast.

Here is one example of a food web:



ACTIVITY 5

Diversity and Stability

Increased diversity = increased stability. If a predator depends on one prey type then a decline in that particular prey will lead to a decline in the predator. If the prey is eradicated through disease or overhunting, then the predator will have to relocate or it may also die. On the other hand, if a predator feeds equally on five prey types, a decline in one or two may cause some stress, but the predator may still feed on the remaining types.

Diversity (and thus stability) increases as one nears the equator. For example, Alaskan owls have a very limited selection of prey types and feed almost exclusively on Lemmings (*Lemmus*). Therefore, a decline in the lemming population will seriously affect the resident owls. Owls near the equator have a large diversity of prey from which to choose and typically feed on 15-20 prey types ranging in size from insects to opossums (*Didelphis*). While a particular species of owl may feed more heavily on one of these prey than the others, a decline in any one of these prey will not likely have a major impact on overall prey availability. This principle of greater diversity toward the equator can be seen (but with less dramatic differences) by comparing pellets from the Northwestern U.S. (Washington, Oregon) to those from the Southeastern U.S. (Mississippi, Alabama, Louisiana).

Questions

1. Which region has the greatest diversity of prey?
2. Which region has the most stability?
3. Would a crash in the shrew (*Blarina*, *Cryptotis*, *Sorex*) population seriously affect either region? Why?
4. Would a crash in the vole (*Microtus*) population seriously affect either region? Why?

Optional Exercise

Barn Owls produce 2 pellets per day. Assume each pellet contains 80g of biomass. Also assume that one 40g vole can cause 50 cents of crop damage to a farm per season. If a Barn Owl family of seven (2 adults and 5 young) lives on a farm for 12 weeks and feeds entirely on voles, how much will the farmer save in crop damages?