

Ecology of Owl Pellets

Background:

The owl pellets used in this lab come from barn owls which are an endangered species found in RI.



Safety: All of the owl pellets have been sterilized. Wash hands after lab.

Materials:

Tray, toothpicks, owl pellet, glue, owl pellet bone chart, rodent skeleton diagram, ruler, construction paper.

Procedures:

1. Carefully inspect the outside of the pellet and observe its size, the materials that make it up, and any additional features. Record.

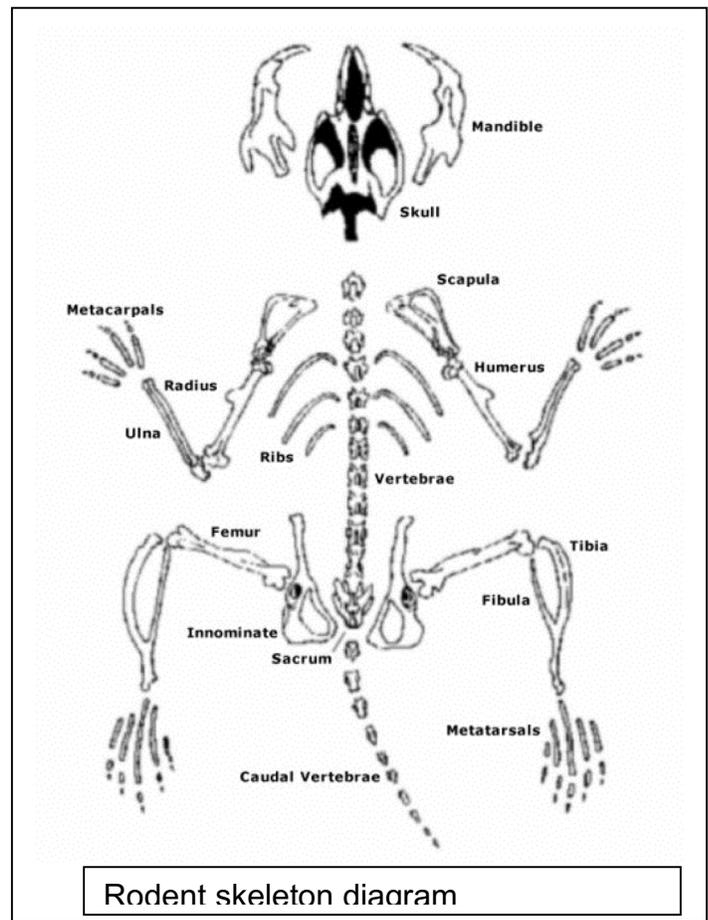
2. Gently pull apart the pellet, being careful not to break any of the bones inside it. Use toothpick or fingers to separate the bones from the fur or feathers. Take special care when removing the skulls and jawbones, since they are the best way to identify the animals that the owl ate.

3. Group similar bones together. When you've finished sorting the bones, roll the last bits of fur between your fingers to find little bones or teeth that might have been overlooked.

4. Use the owl pellet bone chart to classify the bones. The jawbones and the location of teeth will be most useful for this task. One animal that is not found on the chart is the vole. This animal has a jawbone with similar teeth placement as the rat, but the jaw is smaller.

- a) Record the number of each type of bone found on data table.
- b) Record the types of skulls found

5. Choose the skeletal remains of one animal (the one with the greatest number of bones) and piece it together. Glue as seen on rodent skeleton diagram. **Label bones.**



Data and results:

A. Description of owl pellet: Size, shape, color, consistency, make-up

B. How many of the following bones did you find?

Table #1 Title: _____

Type of Bone	Number of Bones
Skull	
Mandible (lower jaw)	
Vertebrae	
Sacrum	
Scapula (shoulder blade)	
Ribs	
Humerus (upper forelimb)	
Radius/ulna (lower forelimb)	
Innominate (pelvic bones)	
Femur (upper hindlimb)	
Tibia/Fibia (lower hindlinb)	

What types of skulls did you find?

Additional Results:

C. Food web

Use the following facts about the prey to **CREATE A FOOD WEB** that is common name of a minimum of 15 possible species. Be sure to label each component (primary producer, primary consumer, secondary consumer, etc.). **ARROWS MUST SHOW DIRECTION OF ENERGY FLOW...**Arrows point towards the predator! Include those species identified in your dissection.

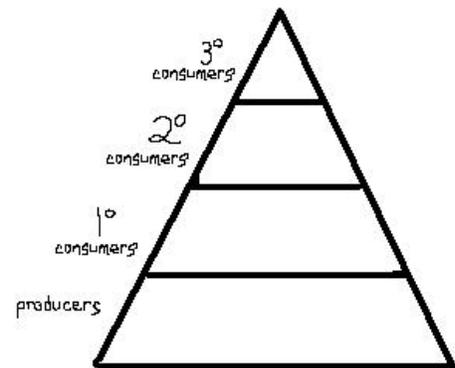
Useful website: http://www.fws.gov/ninigret/complex/wildlife_lists.html

Prey	Diet
Mouse	It eats 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).
Mole	A mole's diet is mostly insects and other invertebrates, including earthworms, centipedes, millipedes, snails, slugs, grubs, ants, sowbugs, termites, beetles, and crickets
Shrew	Food habit studies have revealed that shrews eat 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
Rat	The rat's diet typically includes seeds, nuts, grains, vegetables, fruits, meats and invertebrates. They consume about one-third of their weight in food every 24 hours. Because of their inability to vomit, rats are very hesitant to try new foods that may be poisonous. They will take a small nibble and wait to see if they feel sick and, if so, will avoid that food in the future.
Bird	Insects; terrestrial non-insect arthropods, seeds, grains, and nuts; fruit

Ecological Pyramids

The amount of energy or matter in an ecosystem can be illustrated by a drawing called an ecological pyramid. In this activity you will construct three types of ecological pyramids: a number pyramid, a biomass pyramid and an energy pyramid.

Each pyramid you construct will consist of **four trophic levels**. The top of each will relate to your owl, the only tertiary consumer (3^o). The next level down will relate to the owl's prey, the secondary consumers (2^o). For the purposes of this activity, assume that all of the prey found in the owl pellets are secondary consumers. The next trophic level down will relate to the organisms eaten by the owl's prey, the primary consumers, (1^o). The base of each pyramid will relate to the organisms eaten by the primary consumers, the producers.



Use the information obtained from your owl pellet dissection to complete the data tables and construct the ecological pyramids below.

D. Number Pyramid, for one 24 hour period

A number pyramid is an ecological pyramid that indicates the *total number of organisms* in each trophic level

Create and fill in a chart on your paper – Please note that a vole is 'equivalent' to a mouse
 Table #2 Title: _____

Prey	Length (cm)	Number Found	Number eaten per day	Number eaten per week	Number eaten per year
Mouse	6.5 – 9.5				
Mole	12 – 14				
Shrew	8				
Rat	40				
Bird	15				
				Total	

CREATE A NUMBERS PYRAMID for the owl based on the **number eaten per year** with one owl on the top with total annual number of all prey below. Use the assumption that an owl produces an average of 2.5 pellets per day.

1. Draw your pyramid, labeling the number of 3^o, 2^o and 1^o consumers. (Reminder: There is only 1 owl, which is the 3^o consumer, and you have calculated the number of prey found in each pellet).
2. Determine the ratio, R, of the number of 2^o consumers to the number of 3^o consumers.

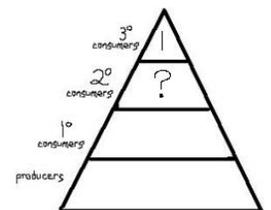
$$R = \frac{\# \text{ 2}^{\circ} \text{ consumers}}{\# \text{ 3}^{\circ} \text{ consumers}}$$

3. Use your ratio, R, to calculate the number of 1^o consumers by multiplying the number of 2^o consumers by R. Label your pyramid with the number of 1^o consumers.

$$\# \text{ 1}^{\circ} \text{ consumers} = R (\# \text{ 2}^{\circ} \text{ consumers})$$

4. Calculate the number producers by multiplying the number of 1^o consumers by the ratio, R. Finish your pyramid by labeling it with the number of producers.

$$\# \text{ producers} = R (\# \text{ 1}^{\circ} \text{ consumers})$$



E. Biomass Pyramid, for a 2.5 year lifespan

A biomass pyramid is an ecological pyramid that indicates the *total mass of organisms* in each trophic level

E. Create and fill in the following chart on your paper.

Date table #3 title: _____

Prey	Number per year	Mass (g)	Mass of Prey (g)	Mass of Prey (kg)	Annual Food (kg) Eaten/ kg of prey	Biomass eaten
Mouse		20			45.6 kg	
Mole		55			365 kg	
Shrew		5			1168 kg	
Rat		240			12.8 kg	
Bird		20			127 kg	
		Total per pellet (H =			Total per pellet (P =	
		2.5 x H			2.5 x P	

Total biomass of prey (kg) =

F. Use your data to **CREATE A BIOMASS PYRAMID**. For the **top carnivore level** the mass of one owl is about **0.6 kg**.

1. Draw your pyramid and label the total biomass of the 3° consumer, assuming the owl's biomass is 600 g (0.6 kg). Label the biomass of the 2° consumers. (Reminder: You have already calculated the biomass eaten over a year. Multiply this by 2.5 → the average lifespan in years)

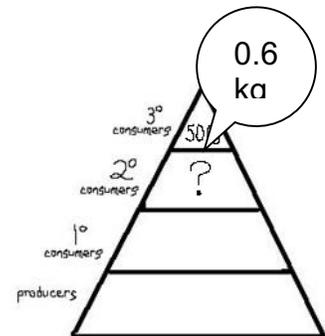
2. Determine the new ratio, R, of the total biomass of the 2° consumers to the total biomass of the 3° consumers.

$$R = \frac{\text{biomass of 2° consumers}}{\text{biomass of 3° consumers}}$$

3. Use your ratio, R, to calculate the total biomass of the 1° consumers by multiplying the total biomass of the 2° consumers by R. Label your pyramid with the total biomass of the 1° consumers.

$$\text{biomass of 1° consumers} = R (\text{biomass of 2° consumers})$$

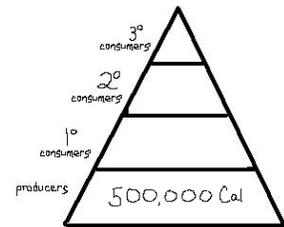
4. Calculate the total biomass of the producers by multiplying the total biomass of the 1° consumers by R. Do you see a pattern in your calculations? Finish your pyramid by labeling it with total biomass of the producers.



F. Energy Pyramid

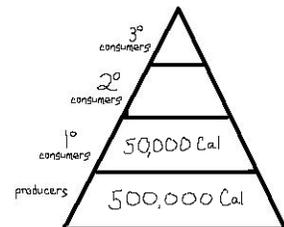
An energy pyramid is an ecological pyramid that indicates the *amount of energy* in each trophic level. According to the terms of thermodynamics, only about 10% of the energy available within one trophic level is transferred to organisms at the next trophic level.

1. Assume that the producers in this pyramid, plants, contain a total of 500,000 Calories of food energy. Label the base of your pyramid with this value.



2. Calculate the amount of energy for the 1° consumers by multiplying the food energy of the producers by 0.10. Write this value in your pyramid.

3. Complete your energy pyramid by calculating and labeling the energies for the top two trophic levels.



Analysis Questions:

1. Using the classification system (kingdom, etc.), which groups are **shared** by owls and rodents? What are the specific names of the groups shared by both?
2. Each vertebra of the rodent has an opening in the middle. Why? How does the function of the vertebrae relate to the rodent's classification (look at the name of the phylum)? Describe the skeleton of a rodent as seen in the pellet (teeth, ball and socket versus hinge joints)
3. Why do the ends of the limb bones end in a ball? Why do the shoulder and pelvis have rounded depressions? Explain how they are related.
4. Describe the complete diet of a barn owl in RI.
5. How many and what type of animals did your specific owl eat?
6. What is the trophic level of an owl? A rodent? Explain your answer in terms of the food web you researched and created.
7. Would you expect to find more rodents or owls in an ecosystem? Explain why in terms of **energy pyramids** and **biomass pyramids**. Define both of these terms in your answer.
8. Describe the habitat of a barn owl in RI.
9. Are barn owl numbers increasing or decreasing in RI? What could be some reasons for this change?
10. What impacts have humans had on barn owl numbers in RI? Describe. (**Hint: "Humans don't eat owls" OR "humans don't interact with owls" is incorrect**)
11. Do barn owls have an impact on the human population? Explain your answer. **Hint: "Humans don't eat owls" OR "humans don't interact with owls" is incorrect**)
12. What could be done to increase their numbers? Describe a plan to increase the numbers of barn owls in RI. Be specific?