Lab Section: _____ **Name:** _____

Pre-lab Homework Lab 9: Food Webs in the Wild

Put your field hat on and complete the questions below before coming to lab! As always, it is expected that you have supplemented your understanding by reading about the topic of food webs in your textbook.

The bits of information that you and your classmates collect when you dissect your owl pellets are **data**. Biologists could use your data to answer many questions they have about the natural world. The types of questions they ask depend on the scale at which they work. Recall the different scales of study, from the intracellular level all the way up to studies of the biosphere. Think about how the following biologists could use data you will collect next week.

1. Dr. Arthur Boucot, a biologist at Oregon State University, studies **community ecology**. What is community ecology? Look in last week's lab manual or your textbook on ecosystems and communities.

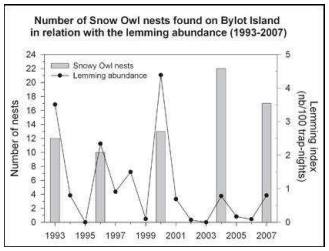
2. Review the five general categories of community interactions from table 1 of last week's lab.
   a. Which one of the 5 types of community interactions would owl pellet data help address?

   b. What is a question Dr. Boucot might be able to answer using your owl pellet data? Remember to relate this to the definition of community ecology above.

3. At Colorado State University, Dr. Bruce Wunder works as a mammalogist. He studies the A&P (**anatomy and physiology)** of small mammals (the main diet of barn owls).
   Anatomy- The study of the internal structure of organisms.
   Physiology- The study of how structures function.

What is one question your owl pellet data might answer for Dr. Wunder? Remember to relate this to mammal and/or owl anatomy and physiology.

4. Dr. Susan Haig at OSU is interested in **populations of owls and their prey**. Recall: We studied populations and population change last week. What is one question that Dr. Haig might answer using accumulating owl pellet data?



Keep in mind that Biology 101 lab students have been and will be dissecting owl pellets each year, so we could keep annual data of any prey type.

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Name: _____ **Date/Lab time:** _____

Lab 9: Hooo, Whoo, Who Eats Whom? Food Webs in the Wild

LAB SYNOPSIS:

- Dissect barn owl pellets to determine owl's ecological role.
- Use a dichotomous key to determine the types and numbers of prey.
    - Use your information to make hypotheses about predator prey interactions.

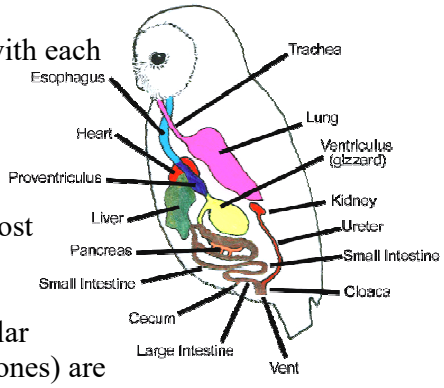
OBJECTIVES: After successfully completing this lab, a student will be able to:

- Describe an owl pellet and explain how they are formed..
- Explain how owl pellets can be used to evaluate ecological information.
- Use a dichotomous key to identify skeletal remains.
- Compare skulls and skull characteristics among mammals.

Introduction:

When predators consume their prey, not every part of the prey is digested. Digestive enzymes in the intestines can't break down some body parts, such as bones and fur. Some predators avoid eating these parts by tearing flesh away from the bones and fur. Others pass indigestible material through the digestive tract and it gets deposited in the feces of the predator. Biologists can examine feces, or "scat" found in natural areas, to identify what predators and prey are part of an area's ecosystem. This predator prey interaction is one form of community ecology.

Community ecology- the study of how populations of <u>different</u> species interact with each other in some way.



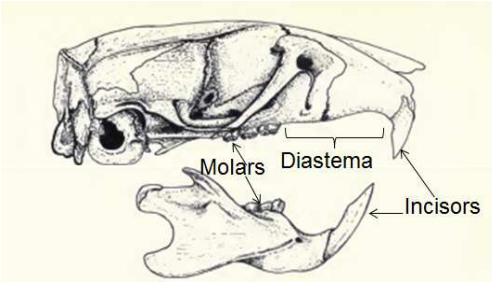
<u>Owl Pellets:</u>

Owl pellets are masses of undigested food that are regurgitated by birds of prey, such as owls. Owls, and other birds, lack teeth to chew their food. Unlike most birds however, owls lack a crop to masticate their food. Owls swallow their prey whole and digest it in their two part stomach. The first pouch, the proventriculus, secretes acids and enzymes that begin digestion. Food then moves into the muscular gizzard where it is churned and further digested. Undigestible parts (ex. fur and bones) are filtered out and compacted into a "pellet". Depending on the amount of food consumed, an owl will regurgitate an average of two pellets at their roosting site each day.

Science can learn a lot by studying owl pellets. They can teach us physiology of owl digestion, anatomy of prey species and the ecology of the owl and their prey. For example, the relative number and ratio of prey caught over time/season tell about owl feeding preference as well as the types of prey in the ecosystem.

Today in lab we will analyze pellets from the Barn Owl, *Tyto alba* to:

1. Determine the types and numbers of prey consumed, and then
2. Use this information to estimate the numbers of each prey consumed per year.



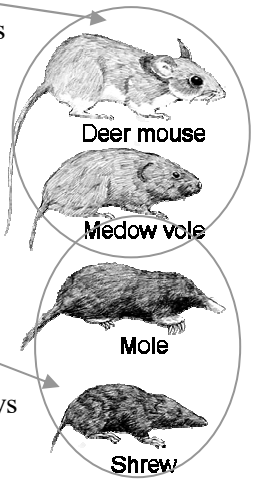
<u>Prey identification:</u>

To identify prey, we will be using a <u>skull</u> dichotomous key (see supply tray). Mammals will have skulls with teeth. Generally, mammals have **incisors** in front, **canines** on each side of the incisors, and **molars** in the back of the mouth.

The skulls you find may belong to a rodent (a vole, mouse or rat (fig. 1)) or they may belong to a shrew.

Order Rodentia: Teeth can tell a lot about an animal. Rodents are primary consumers. The incisors of these herbivores are good for cutting vegetation like grasses and stems. Their incisors grown continuously, replacing these teeth as they wear down. Rodents lack canines and instead have a gap called a **diastema** (fig. 1). If your skull has a diastema, you have a rodent. Rodents also have wide, flat molars that are good for grinding vegetation.

Order Soricomorpha: If your skull has canines, you probably have a shrew or a mole. Canines are usually sharp and long and are good for tearing apart animal bodies. Shrews and moles also have sharp, pointy molars that are good at crunching insect skeletons and grinding their flesh. These secondary consumers are carnivores eating mostly insects and worms.



Exercise 1: Trophic Levels

Each group of two students will be given one owl pellet. These pellets were collected from various barn owl roosts in the vicinity of White Salmon, Washington. White Salmon is a small farming community on the Columbia River, about 60 miles east of Portland. Our pellets come from a science supply company and have been sterilized.

Complete the trophic level table below. For each organism, determine what trophic level it plays in its community and indicate why you think it plays this role. Use only these terms: **producer, primary consumer, secondary consumer or tertiary consumer. .** (Hint: the information in the introduction to the lab is full of hints about this!)

Organism	Trophic Level	Reasoning
grass		
vole		
shrew		
barn owl		
mouse		
We need one more organism!		

What type of organisms is necessary to breakdown dead organisms and recycle chemical nutrients like nitrogen and phosphorus within an ecosystem?

⇨ _____

In the box, assemble a simple food web that contains all of the organisms from the table above. Include arrows showing the direction of food energy. Add any additional organisms that might be found in the owl's environment.

How might losing one of the species effect this food web?

Exercise 2: Owl Pellet Dissection

Recall the steps of the scientific method

1 2 3 4 5 6 7

Observation → Question (Problem) → Hypothesis → Test → Analyze Results → Conclusions → Document/Peer Review

Procedure:

1. Science begins with observations. Unwrap your owl pellet and observe it. What do you see? How big is it (measure it!)? How much does it weigh? What do you think you will find in the pellet, etc.? List your observations below (prior to dissection!).

2. Question- what's inside of an owl pellet?

3. Hypothesize how many animals and how many different species you will find in the owl pellet.

Hypothesized number of prey animals _____ Hypothesized number of different species _____

4. Test of hypothesis- Dissect your owl pellet:
   Use a dropper to moisten the pellet (do not saturate the pellet!). Use tweezers and probes to **GENTLY** loosen the hair and/or feathers and then remove any interesting material. Gently separate and place bones on a clean paper towel. You will concentrate on the skulls and jaws for identification of prey. In addition to skulls, two jaws, left and right equal one prey. Use the supplied dichotomous key to identify your prey. Identifying skulls can be a difficult process, so take your time dissecting the pellet and do a good job.
   Additional aids in identification include charts and keys provided on the prep counter and photos in the back of the Peterson's Field Guide to Mammals.

Recall experimental variables: (independent, dependent and standardized)

5. After you have completed your examination, record your data and answer the questions on the next page

   Pellet Contents Data: List the types of prey and the number of each type that you were able to identify in the owl pellet. Be as specific as possible and identify every different animal you find!

Actual prey species identified?	Number of this prey species?

QUESTIONS on owl pellets:

1. Compare your pellet data to that of a few other groups. How are their pellets different from yours? How can you explain these differences? Make a hypothesis!

2. What is the average number of skulls in an owl pellet? Remember that to find the average, you add up the total found in many groups and divide by the number of groups; you will have to talk to other groups to get this information!

3. Estimate the number of prey your owl eats in a day, a month, and a year (based on your average!). Recall: owls produce about 2 pellets per day.

4. Your examination is the new experimental group. Recall experiments should have a control group for comparison. Our control group is published data (1969) on from Pacific Northwest barn owls. This data showed each pellet on average contains; 2.5 voles, 0.7 shrews, 0.1 others[1]. How do the data compare to your class data? What might be reasons for any differences?

[1]Doerksen, George Peter. (1969). An analysis of barn owl pellets from Pitt Meadows, British Columbia. *The Murrelet*. 50(1), 4-8. http://archive.org/stream/canadianfieldnat1978otta/canadianfieldnat1978otta_djvu.txt

Exercise 3: Populations of Predator and Prey

Now that you know what barn owls prey upon here in the Pacific Northwest, let's look at the role owls and small mammals play in their community.

Deer mice, *Peromyscus maniculatus,* can be pests to humans: they often enter cabins, houses, tents, etc. in search of shelter, nesting sites and food. Once they find a nesting site, females will bear a litter of about four young. They breed throughout the year, from February through November. They have an average of three litters per year. Female young grow up and are ready to reproduce at six weeks of age.

Suppose your one-acre lot has twelve breeding pairs of deer mice. Without predation, how many mice would you have in three years? Assume half the young are females, and these females produce 12 young per year.

First year:
12 breeding pairs x 12 young per pair = _____ new baby mice + the 24 parents = _____ total mice first year

Second year:
(Total mice from first year (parents and offspring) ÷ 2) x 12 young per pair = _____ new baby mice + the total mice from first year = _____ total mice second year

Third year:
(Total mice from second year (parents and offspring) ÷ 2) x 12 young per pair = _____ new baby mice + the total mice from second year = _____ total mice

1. Predation is the highest cause of death for small mammals such as deer mice. Would you welcome a pair of nesting barn owls on your property? Why or why not?

2. Which do you suppose is a more affective way of controlling rodent populations: snap traps or barn owls?

Why?

3. a. The number of rodents like mice can influence the number of owls that can live in an area. Populations of mice in some areas increase and decrease over time quite drastically in a process sometimes called a "boom-bust cycle". What do you think would happen to populations of owls in an area where mouse populations are fluctuating like this? (This is your prediction!)

   b. Why do you think that this would happen to owl populations? This is your hypothesis! Notice that we have put these questions (a and b) in an odd order. Of course you must have already had your hypothesis to make your prediction in the first place, but often thinking about a hypothesis after your prediction, in terms of first what will happen (your prediction) then why (your hypothesis), can help you tell the two apart.

   c. How could you use owl pellets to test this prediction?

   d. What are some limitations of relying only on owl pellets to test this prediction?

   e. How else could you test this prediction?

4. On your supply tray, find a copy of a data sheet from a survey of another species of owl, the Tawny owl *Strix aluco*. This owl feeds on field mice and voles near Oxford, England. Do these data support or refute your hypothesis from #3a above? Explain what this is telling you about how these owls survive.

5. Owls are generalist predators (they eat a wide variety of food). Look over the data sheet for populations of lynx and hare in the western U.S (on your supply tray). What do these data tell you about the differences between generalist vs. specialist predators? Explain.

6. Owls are raptors like hawks and eagles. Both hawks and eagles also produce pellets. No skulls are found in the pellets form hawks or eagles, only small bits of bone and some hair/feathers are found. What are <u>two</u> reasons that hawk and eagle pellets would be so different from those of owls? (think about the feeding habits of these birds)