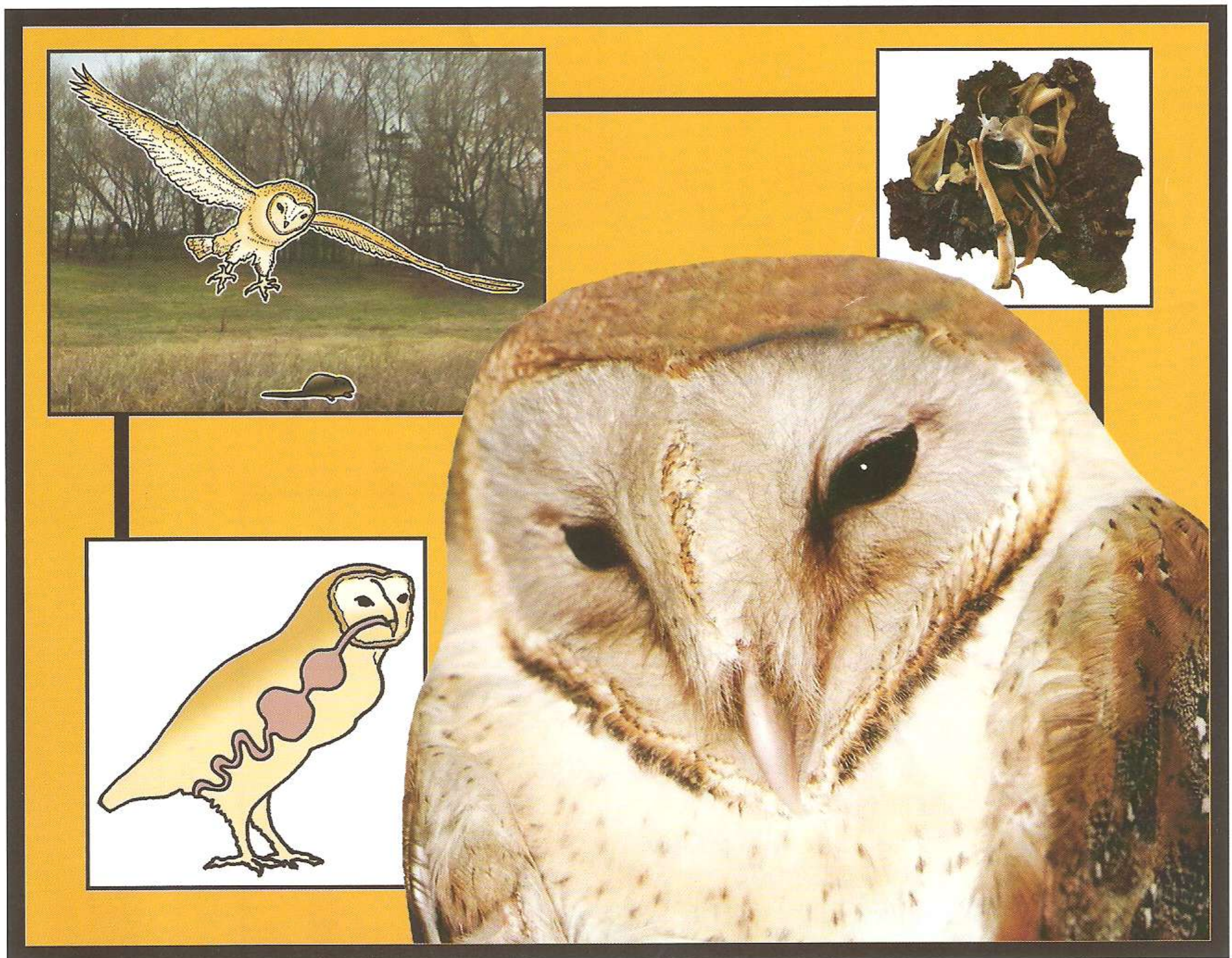


The dissection of the

Owl Pellet

featuring the Barn Owl

*A comprehensive, step-by-step dissection guide
complete with photographs & illustrations*



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How to use this guide:

This guide is intended to introduce the owl pellet and to guide the student through the dissection in a step-by-step manner. Dissection instructions are in italics. In general, the photographs may not show all structures because they are too small to be seen, but will show those that are prominent and easily identified. Illustrations are provided that will aid in identification. These figures are designed in a self-quiz manner in which the student may cover up the answers to the numbered structures.

In order to give the student a better understanding of the larger picture, the topics of barn owl ecology and predator-prey relationships are described. This guide was written for middle school students and contains two separate levels: basic and advanced. In most of the figures, the levels are clearly defined. In the text, some advanced terms may be shown in parentheses. The teacher may choose which level meets the needs of the class.

Note: The taxonomy in this guide was the most current available as of 2005. Due to discoveries in genetics, taxonomic categories may change in the future.

Barn Owl Taxonomy

Kingdom: Animalia (grouping for all animals; from sponges to humans)

Phylum: Chordata (grouping for animals with a nerve cord and notochord)

Subphylum: Vertebrata (grouping for animals with a backbone)

Superclass: Gnathostomata (grouping for animals that have a jaw)

Class: Aves (category for birds)

Order: Strigiformes (category for all owls)

Family: Tytonidae (category for barn owls)

Genus: Tyto (first part of the scientific name)

Species: alba (second part of the scientific name)

Full scientific name: Tyto alba

Common name: Barn Owl

An **owl pellet** consists of the fur, bones, feathers, and other indigestible remains of the animals that an owl eats. In order to understand the owl pellet, it is important to first explore some basics about the owl. All owls produce pellets, but the vast majority of owl pellet dissections are from the **Barn Owl** (figure 1).

figure 1 - Close-up of a compact owl pellet



figure 2 - The facial disc of a Barn Owl



General characteristics of the Barn Owl - figures 2-3

The Barn Owl is one of the most effective hunters of rodents, song birds, and other small animals. Throughout the ages, the Barn Owl has had many names, including the Yellow Owl, the Golden Owl, the White Owl, the Night Owl, Ghost Owl, the Monkey-faced Owl, the Hissing Owl, the Howlet, and the Church Owl. Its scientific name is *Tyto alba*. "Alba" is Latin for white, as illustrated by the light coloring of the body and face. The best way to identify a Barn Owl is by the white, heart-shaped **facial disc** that surrounds the small dark eyes (figure 2). Another way to recognize a Barn Owl is by the coloring of the body. The color on the back can range from a yellowish tan to a medium brown and is streaked with small, dark brown blotches. The face, belly, and legs are white or cream colored (figure 3). This pattern and coloring helps to **camouflage** the owl in its environment. The Barn Owl has a face that appears flat, long legs (for an owl), and long pointed wings when flying. The sounds that a Barn Owl can make include high pitched shrieks, hissing, tongue clicking, rasping noises, and even frog-like

figure 3 - A pair of Barn Owls (a parent with a young owl)



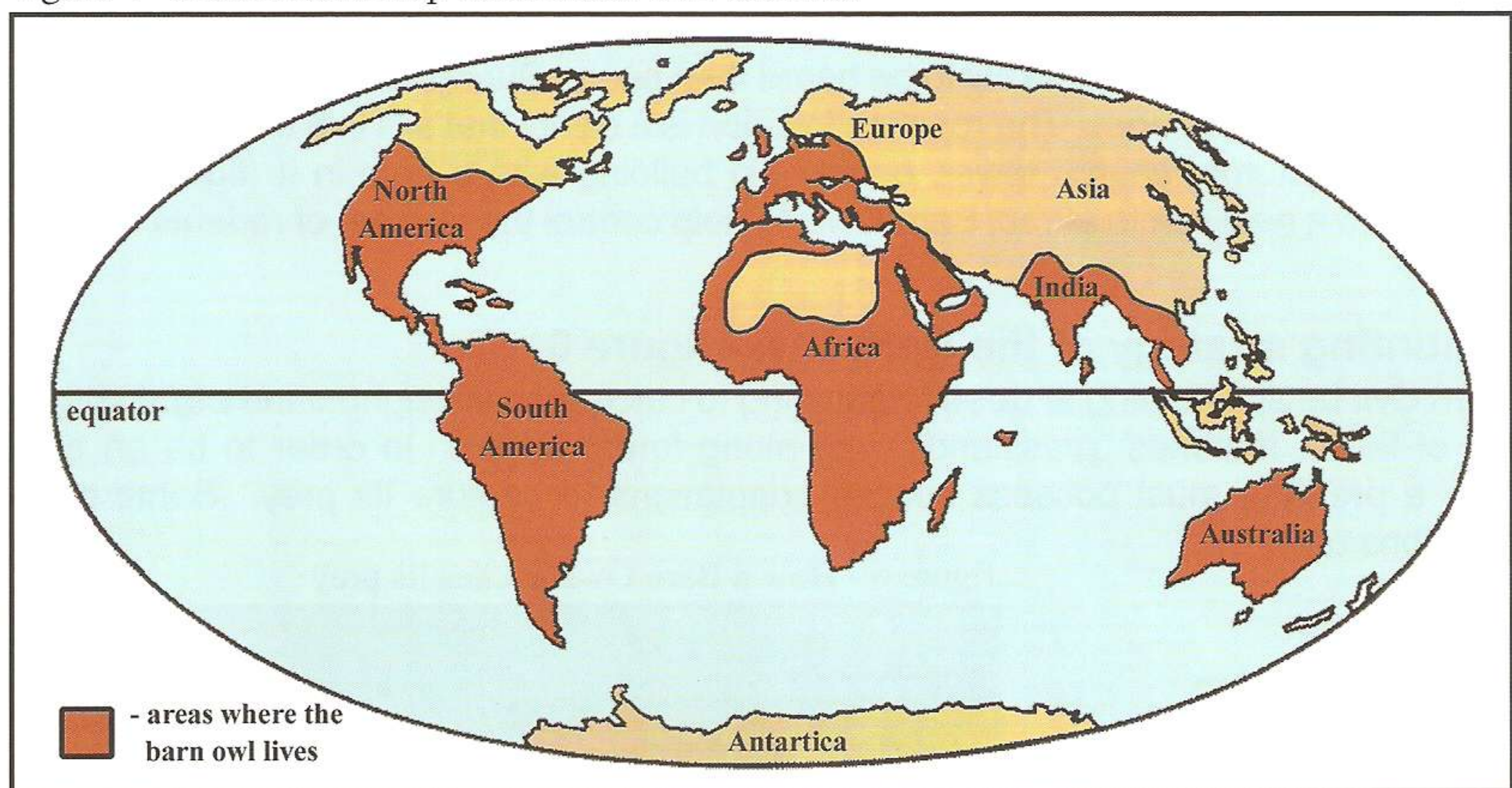
croaking. The Barn Owl does not hoot like other owls. In fact, no other owl is like the Barn Owl. The Barn Owl is so unique that it has its own category of Family Tytonidae (pronounced "tie-tawn-e-day"). All other owls are sorted in a separate group called Family Strigidae (pronounced "strig-e-day").

Barn Owls in the wild live about 2-8 years. In captivity, they can live up to 25 years. The body can reach a length of 15-16 inches with a wingspan of 42-43 inches and a weight of approximately 1 pound. Generally, the female is larger than the male. However, to look at a Barn Owl you cannot tell if it is male or female.

Life History of the Barn Owl

A pair of Barn Owls generally mate twice a year and produce two clutches of eggs. Each clutch consists of 4-7 eggs and is housed in the cavity of a tree or building. Barn Owls do not build a nest like other birds. The young emerge from the egg after 30-34 days of **incubation** by the female. Once the eggs hatch, both parents take turns in caring for the chicks, which are called **owlets**. The owlets are naked and helpless (advanced term: **altricial**) and rely completely upon the parents for warmth, protection, and food. This is in contrast to ducks and geese, whose young are covered with warm down feathers, can feed themselves, and can walk shortly after hatching (advanced term: **precocial**). After 1 ½ - 2 months of being cared for by the parents, the young leave their home region to seek mates and have their own owlets. In this way, the cycle repeats itself.

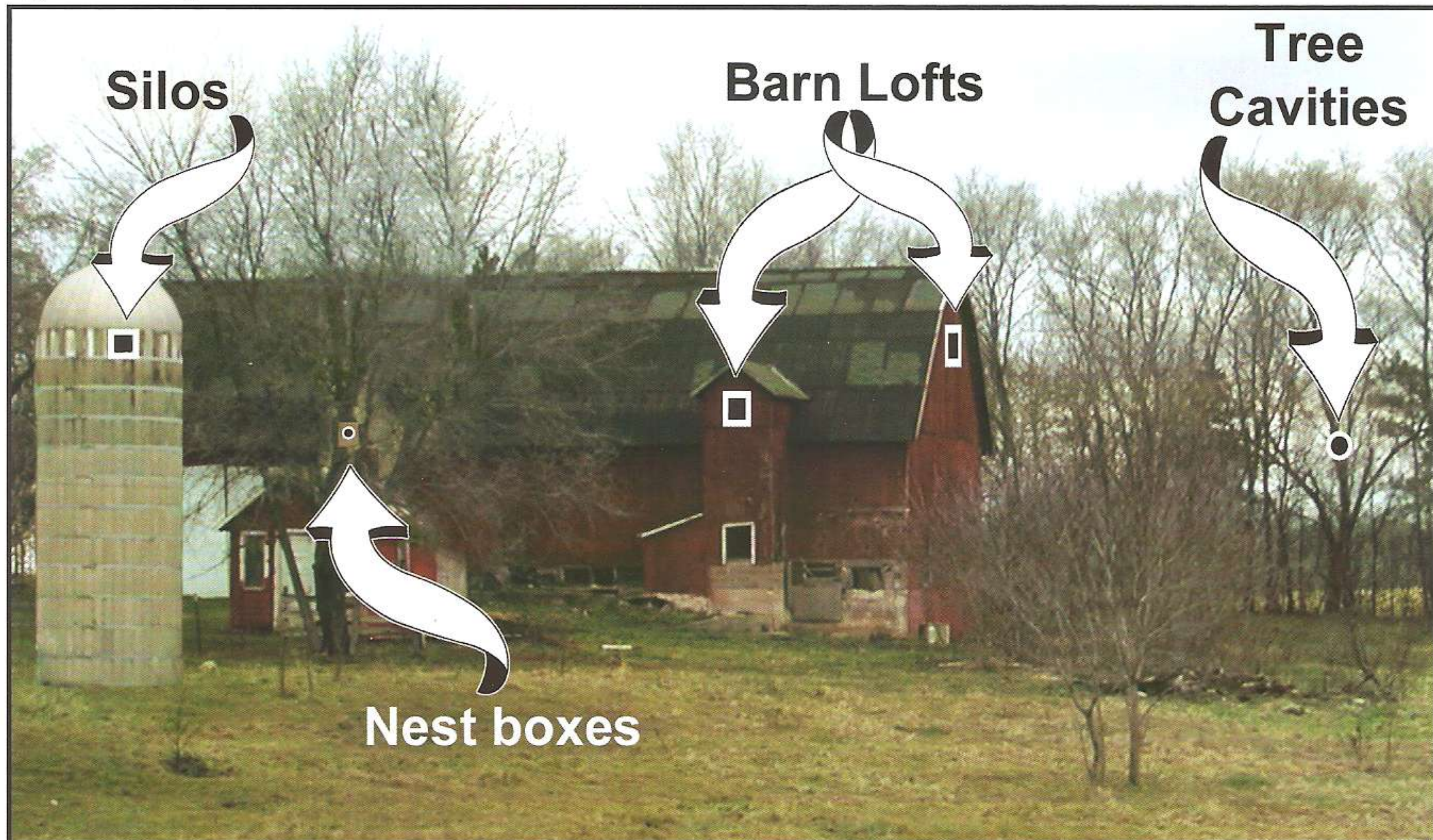
figure 4 - Distribution map of the Barn Owl's habitat



Where in the world does a Barn Owl live? - figure 4

The Barn Owl inhabits every continent except Antarctica (figure 4). You may find the Barn Owl in both North and South America, in some regions of Europe, in many areas of Africa, in India, in parts of Asia, and in Australia. Because the owl is so efficient at keeping down rodent populations, it has been introduced to areas such as Australia. The Barn Owl prefers temperate regions that have an abundance of small animals and avoids desert regions and areas that are extremely cold for long periods of time.

figure 5 - Daytime roost sites of the Barn Owl



Where could I find a Barn Owl? - figure 5

At night, a Barn Owl is more likely to be heard than seen. During the day, a Barn Owl likes to retreat to its **daytime roost**. The roosting location is a cavity that sits in a tree, rock face, barn attic, silo, old stump, church tower, or any old building with a hole in it (figure 5). Some farmers build a nest box to attract Barn Owls to help control the number of rodents in the area.

The hunting strategy of the Barn Owl - figure 6

A Barn Owl begins hunting at **dusk**, continuing to catch prey throughout the **night** over open areas of fields, marshes, grasslands, and along forest edges. In order to be an efficient hunter, a predator must possess special adaptations to capture its prey. Some of these adaptations are:

- **Silent flight**
- **Accurate hearing**
- **Sharp beak and talons**

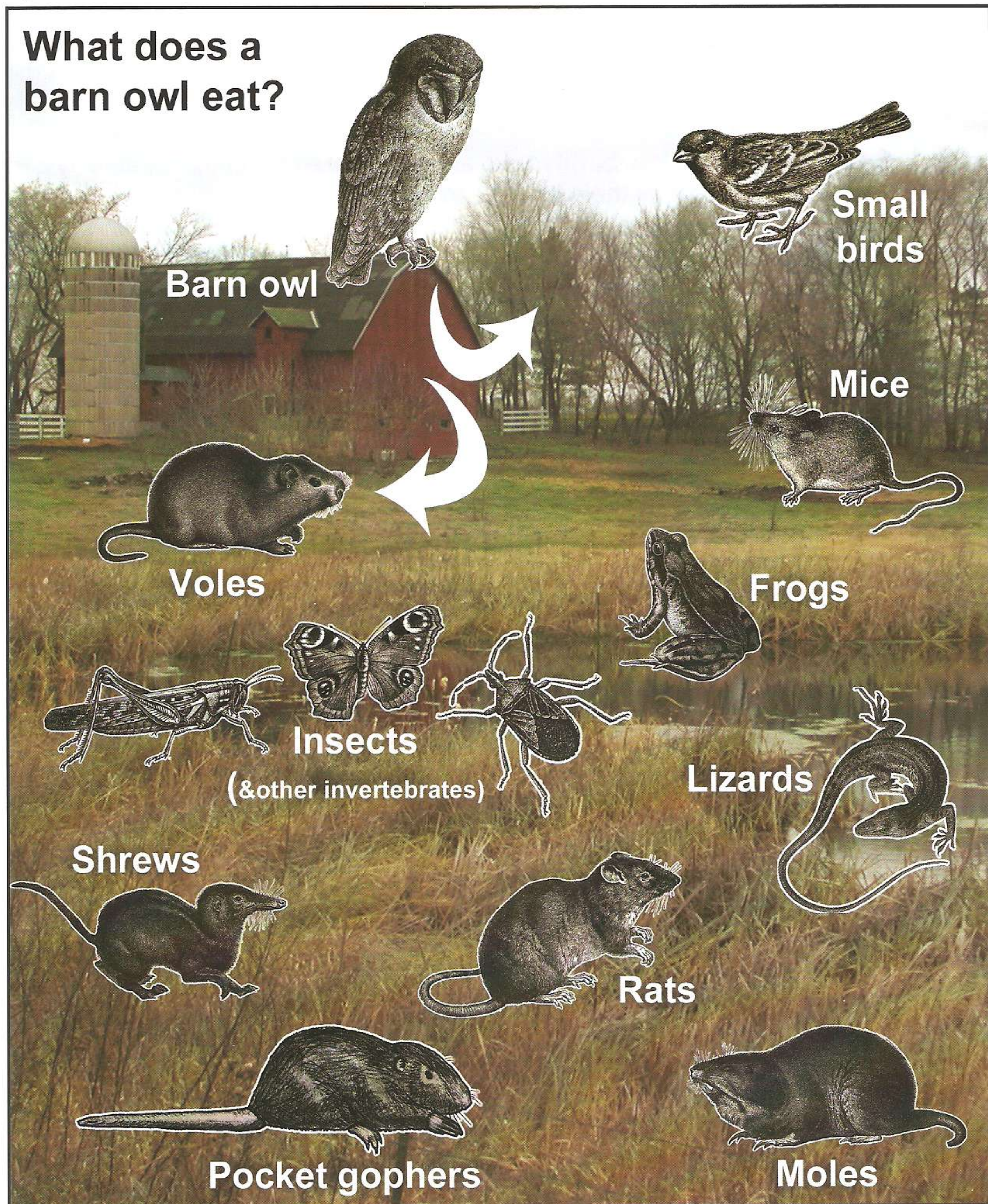
Most birds make a flapping sound when in flight. Unlike other birds, the Barn Owl has **silent flight** due to notches in the feathers that muffle sound. This helps the owl have a great deal of **stealth** when surprising the prey animal. The lack of sound in the wings

figure 6 - How a Barn Owl catches its prey



also helps the owl to hear its prey. A Barn Owl will quietly hover 5-12 feet above the ground listening for a rodent to appear. It uses its excellent **sense of hearing** to locate small animals in total darkness. When it hears something, it uses its ears to focus in on the exact position of the prey. Then the owl swoops down and uses its **sharp beak and talons** to hold the animal. With a quick bite on the back of the neck by the hooked beak, the prey is killed. It is then swallowed whole to be digested.

figure 7 - The diet of a Barn Owl

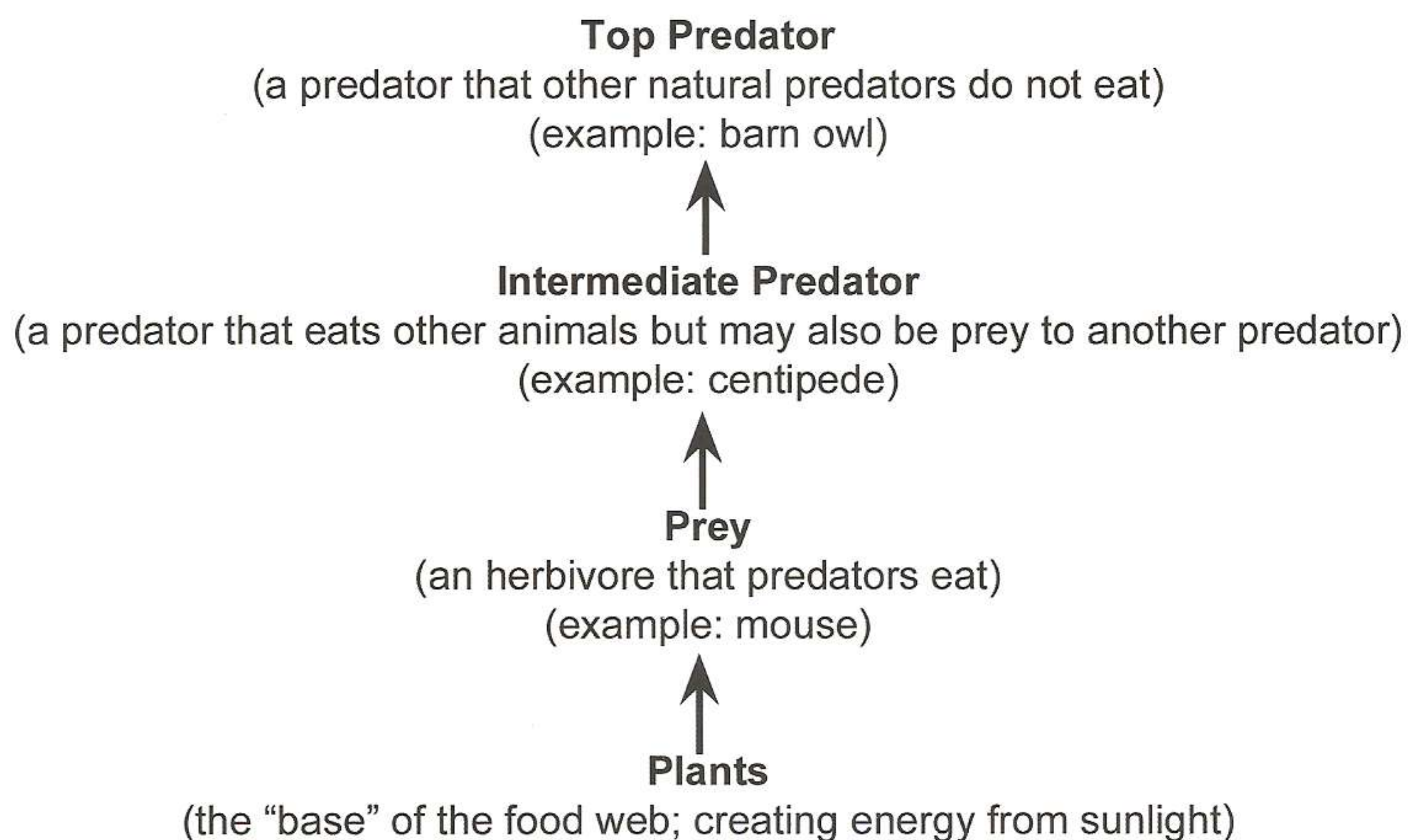


What does the Barn Owl eat and how does it fit into the ecosystem?

- figures 7-8 (figure 7 shown on previous page)

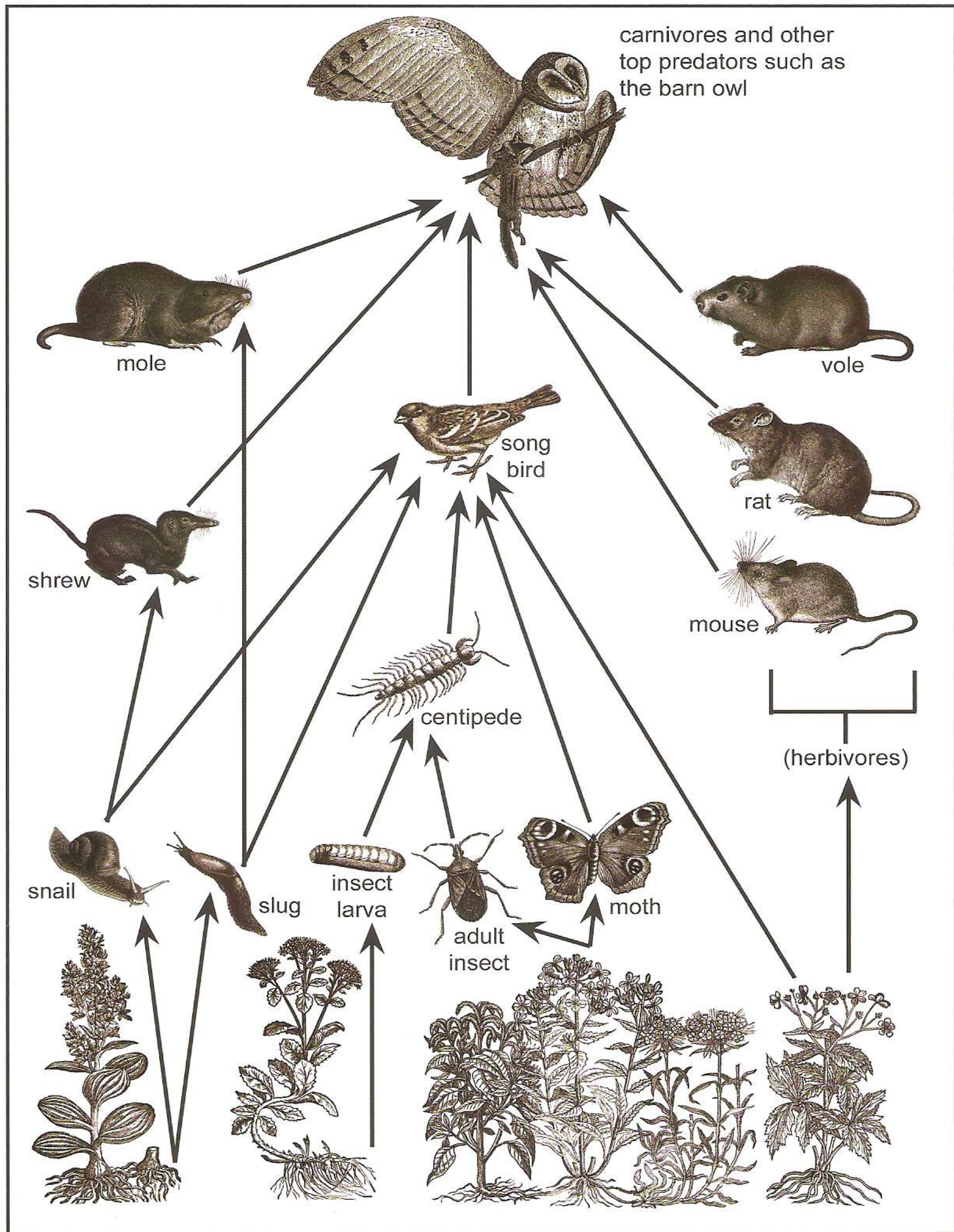
The Barn Owl is a **nocturnal predator**, hunting small animals that are active at dawn and dusk (advanced term: **crepuscular**) or are moving around during the night (nocturnal). Most of the prey animals consist of **rodents** such as **voles**, **mice**, **shrews**, **moles**, **pocket gophers**, and **rats**. The Barn Owl has been used by humans as a means of controlling rodent populations because it is such an effective hunter. When rodents aren't plentiful, a barn owl may also eat other small **mammals** (bats, weasels, and baby rabbits), **birds** (sparrows, starlings, and others), **amphibians** (frogs), small **reptiles** (lizards), and even **invertebrates** such as worms and insects (figure 7, on the previous page). A **predator** is an animal that hunts, catches, and eats other animals called **prey** for its food. A predator is also called a **carnivore**, due to its meat-only diet. In contrast, an animal whose diet consists of plant material is an **herbivore**. Many prey animals are herbivores.

The relationships between **plants**, **herbivores**, and **carnivores** are demonstrated by a **food web** (figure 8). Plants obtain their energy from the sun through a process called **photosynthesis**. The animals that eat the plants take that energy to grow and blossom. Remember, an animal that eats only plants is called an herbivore. Predators obtain their energy through eating the herbivores. The predator that has no other natural enemies to eat it is referred to as the **top predator**. The following chart summarizes the food web:



Why is a food web important? Because it can tell us about potential problems in the environment. If one part of the food web is damaged, it can hurt another part. Imagine the result if an animal eats a plant or other animal that has been sprayed with a chemical such as a **pesticide**. Some pesticides can be dangerous and stay in the body. One example is the pesticide DDT that was used extensively in the 1960's. DDT was a pesticide used to kill mosquitoes that carried diseases. It was sprayed in towns, cities, and in the country. Many small animals and birds would feed upon the insects that were full of DDT. Larger predators

figure 8 - How the Barn Owl fits into a food web



then hunted and ate the small animals and birds. In the case of DDT, the animals most affected were the **raptors**. DDT caused the eggs of many birds such as eagles, hawks, and owls, to become so thin that they would break when the mother sat upon them. Since the number of eggs that hatched was less, the populations of these birds were drastically reduced. Some species of raptors were even declared endangered species! Eventually the United States banned the use of DDT and started breeding programs to increase numbers of raptors.

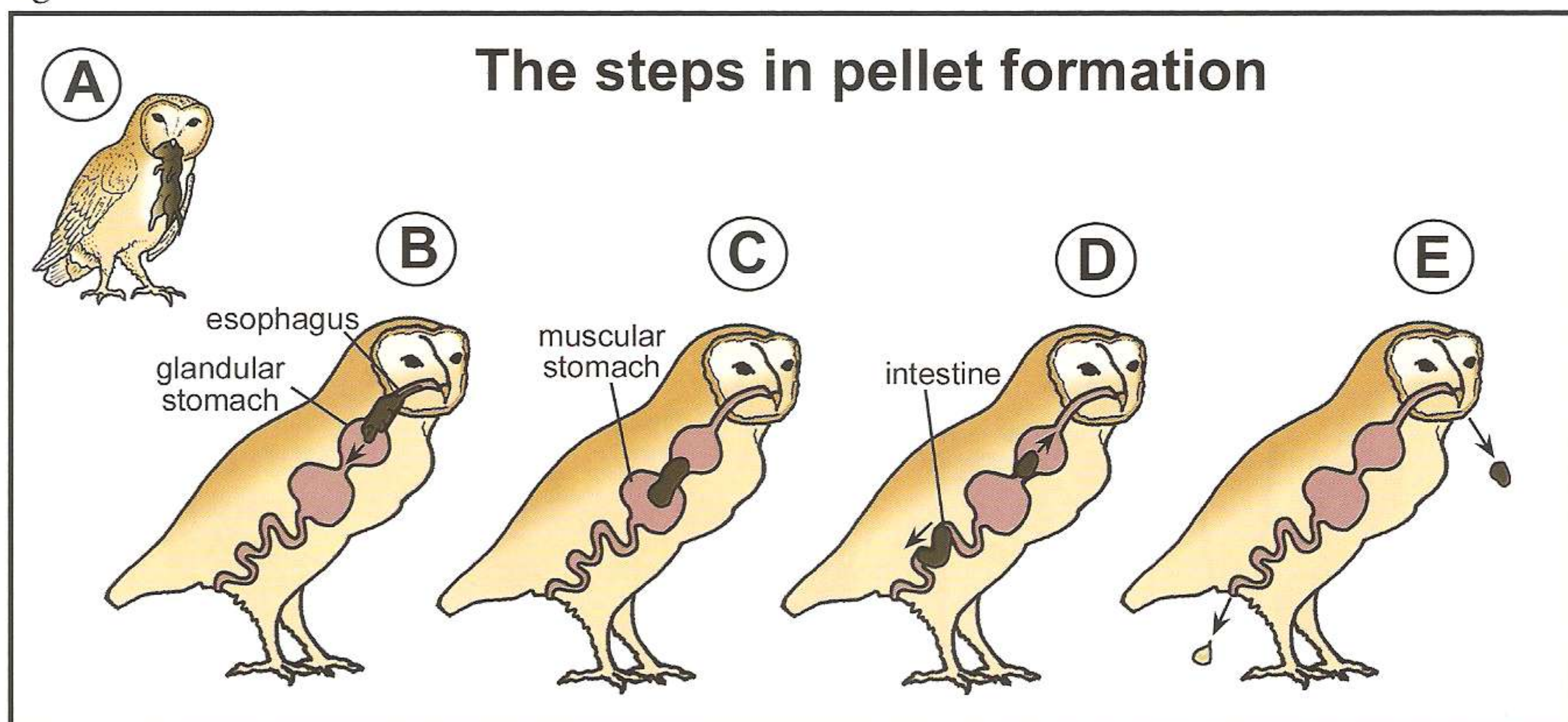
How does an owl pellet form? - figure 9

An owl pellet is a compact, hard clod that consists of the bones, teeth, fur, claws, feathers, beaks, and other parts of a prey animal that cannot pass through the digestive system. During a single night of hunting, an owl may produce 2-3 pellets, 8-10 hours after eating. Pellets are coughed up (regurgitated) at daytime roost sites or at night-time feeding stations. Owl digestion is relatively rapid and efficiently removes the needed nutrients from soft fleshy parts of the prey animal.

The following describes the process of pellet formation and corresponds with figure 9:

- A. The prey animal is captured, killed, and **swallowed whole**. Barn owls have no teeth with which to chew their food.
- B. The prey animal enters the digestive system through the **esophagus** and enters into the **glandular stomach**. Chemicals, called **enzymes**, begin to break down and separate the fleshy parts of the animal from the bones and fur.
- C. The bones and fur are isolated from the fleshy parts by the action of the **muscular stomach**.
- D. The fleshy food parts continue through the digestive tract. The nutrients are absorbed as it passes through the **intestine**. The bones and fur are compressed into an oval ball called the **pellet**.
- E. The owl pellet is coughed up (regurgitated). Digested waste is expelled into the external environment.

figure 9 - Pellet formation



Why is the owl pellet important?

The owl pellet can tell scientists a lot about the relationships between an owl and the animals it preys upon. Owl pellets are resistant to decay, so they remain in the environment for a long time. They give clues to an owl's diet and general habits. Pellets are found at the daytime roosts and at the night-time feeding stations. The number of pellets found can indicate how many owls there are in a given area. Identifying the bones of the prey animals in the pellet can tell a biologist what types of animals are numerous. In this manner, owl pellets serve as indicators of small mammal populations. Owl pellets are studied to determine the impact an owl has upon the ecosystem as a beneficial predator.

The Dissection

General dissection hints: Take your time when doing a dissection. Work through it by carefully proceeding in layers and follow the instructions.

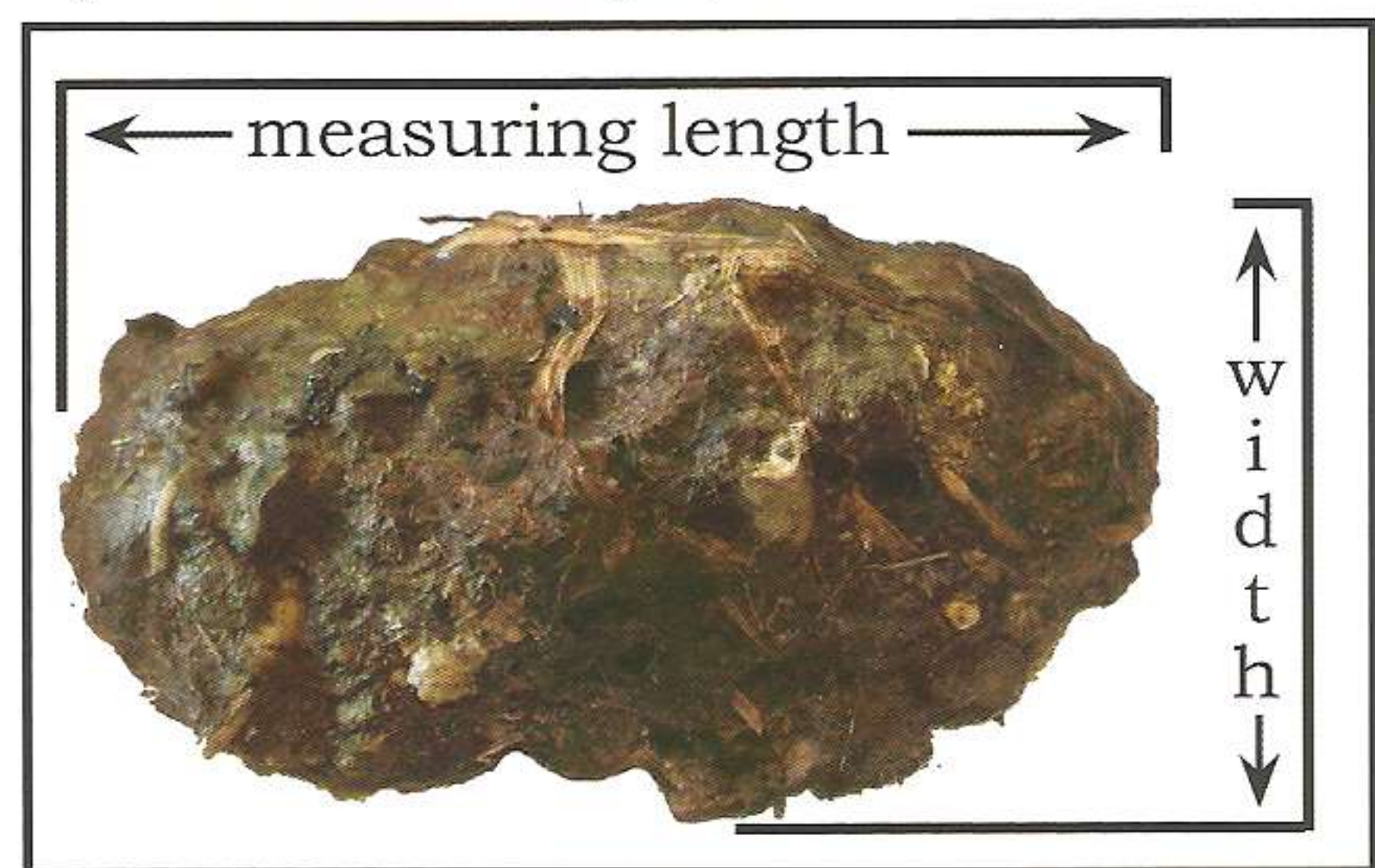
Materials needed:

- * Owl pellet
- * Forceps or toothpick
- * Sharp probe or toothpick
- * Plastic baggies
- * Drawing paper
- * Pencil or pen
- * Ruler
- * Weight scale
- * Glue
- * Small container such as a small tub or a deep petri dish (for wet dissection)
- * Dissection tray or other working surface such as a paper plate
- * Skeleton, skull, and bone diagrams (included in this guide)
- * Skull identification key (included on page 15)
- * Magnifying glass or dissection microscope (if available)

Note: You may find small, black pin-sized spheres in your pellet. Moth larvae often feed upon the pellets and leave behind their droppings (the black spheres).

There are two ways to dissect an owl pellet: the dry dissection technique and the wet dissection technique.

figure 10 - Measuring a pellet



Dry dissection:

Step-by-step instructions:

1. Obtain an owl pellet and the other materials listed above. It is recommended that you work in pairs for this lesson.
2. Measure the length and width of your pellet (figure 10). Measure the weight of your pellet.

Length _____ Width _____ Weight _____

3. Using your forceps (or toothpick), carefully separate the bones and fur within the pellet. Make two piles: one with fur (or feathers), the other with bones.
4. Sort the bones into type, using the blank bone sorting chart on page 17. Look at your bones pile and determine if there is more than one animal present. If you have more than one animal, try to put the bone pieces with the skull that corresponds with it. Note: Many of the bones may be broken. Simply look at the pieces and try to put the ones that are alike together.
5. Proceed to identify the prey animals from the bones you have sorted. Begin by measuring the length of the skull and lower jaw bone (mandible). Note: On the skull the brain case (cranium) may be broken. When measuring, estimate the length as shown in figure 16 on page 16.

Skull: Length _____ Width _____

Lower jaw: Length _____ Width _____

6. Now look at the skulls more closely using a magnifying glass or dissecting microscope (if available). Compare the features of the skull with the skull diagrams on pages 14, 16, 18 and 19.
7. Use the skull key on page 15 to determine the prey animal that was in the pellet.
8. Optional: Re-create the skeleton of your prey animal by pasting (using glue) the bones on a piece of paper and referencing the skeletal diagrams in this guide.
9. Optional: Draw the bones of your prey animal and label them.
10. Remember! Clean-up is a part of lab class. When you are finished with your dissection, clean and dry your tools, return them to their proper place, and put the bones and fur from your owl pellet into plastic baggies (if you are storing them for later use). Make sure to wipe down your lab table and wash your hands before leaving.

Wet dissection – instructions:

Follow steps #1-2 from the dry dissection instructions. Before you proceed to step #3, take your pellet and soak it in water for a few hours in a small container. Once the pellet has been softened through the soaking process, set it on a paper towel and carefully pull apart the pellet. Go on to step #4 and follow the rest of the steps from the dry dissection instructions. Optional technique: Instead of using only water, use 50 grams of NaOH crystals dissolved in water to eliminate the fur. Stir the pellets in this solution for several hours. When done, use a screen or filter to wash the remaining bones.

figure 11 - Pellet containing bird (avian) prey

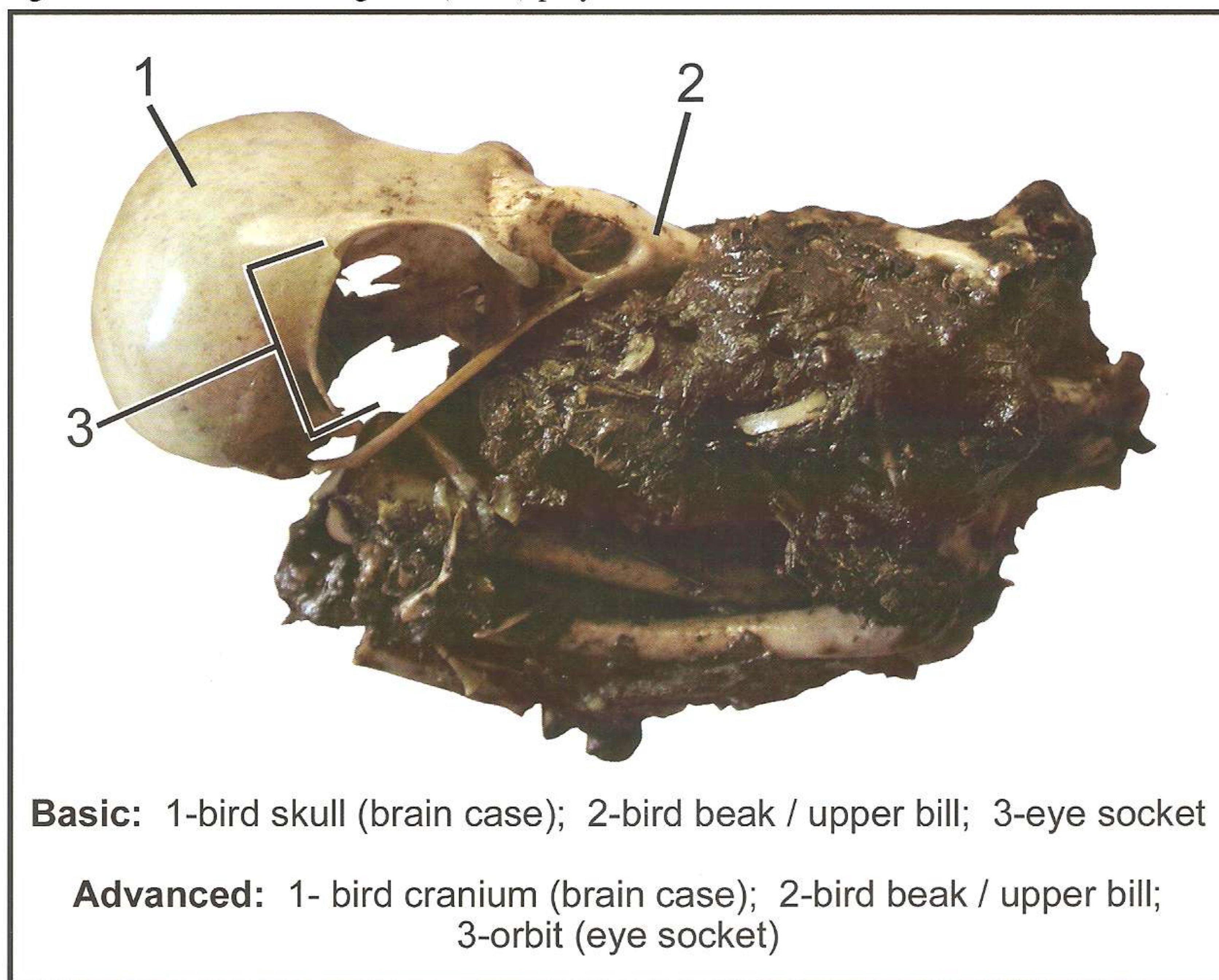
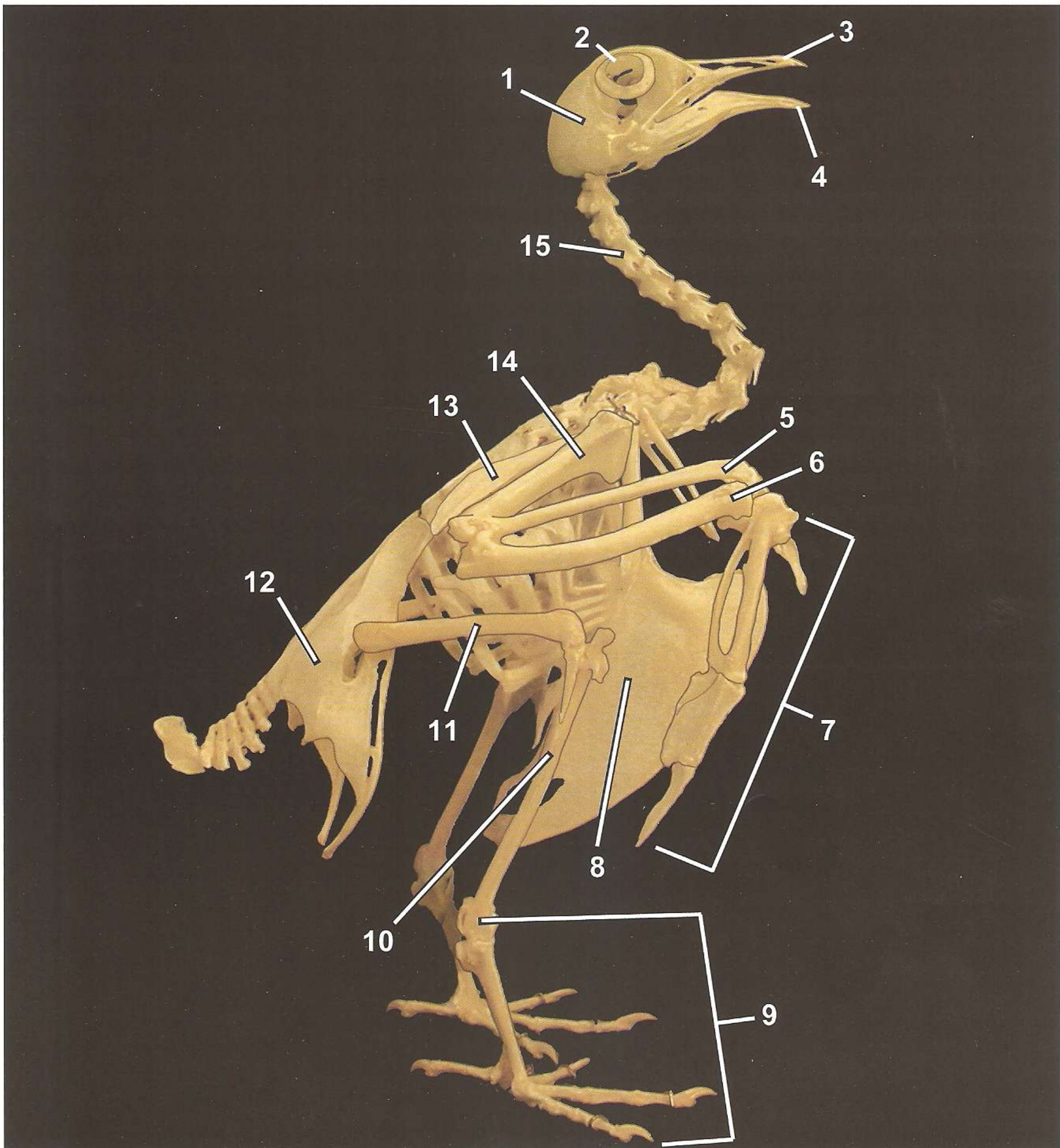


figure 12- Major bones on a bird



Basic bird skeleton: 1- skull (brain case); 2-eye socket; 3-upper bill; 4-lower bill; 5-lower wing bone; 6-lower wing bone; 7-bones of the tip of the wing; 8-breast bone; 9-bones of the foot; 10-lower leg bone; 11-upper leg bone; 12-pelvis (hip bone); 13-shoulder blade; 14-upper wing bone; 15-neck bones

Advanced bird skeleton: 1-skull (cranium); 2-orbit (eye socket); 3-upper bill; 4-mandible; 5-radius; 6-ulna; 7-bones of the tip of the wing; 8-sternum; 9-bones of the foot; 10-fibula; 11-femur; 12-pelvic bone; 13-scapula; 14-humerus; 15-cervical vertebrae (neck bones)

figure 13 - Owl pellet containing rodent prey

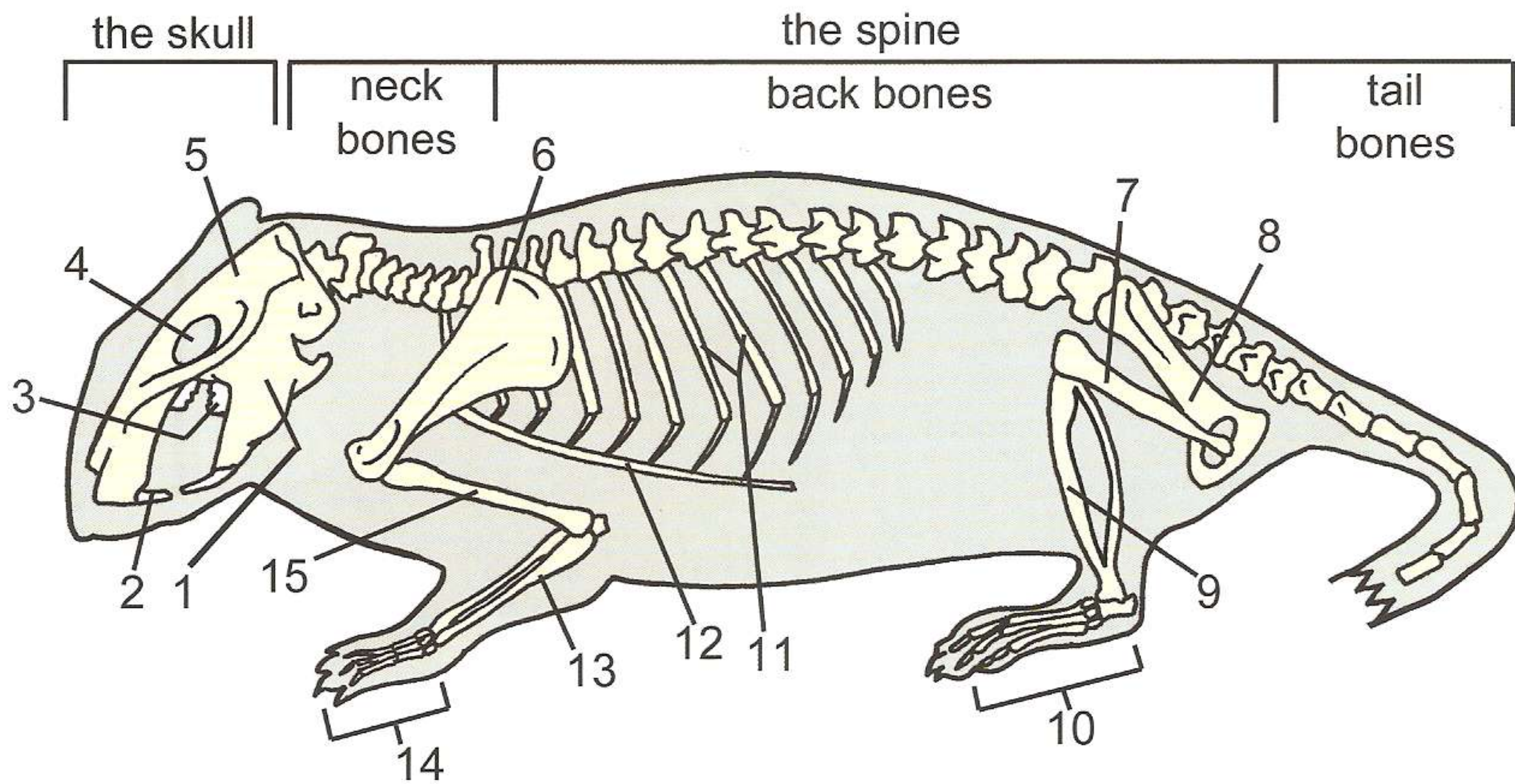


Basic: 1-skull (of a rodent); 2-shoulder blade;
3-upper leg bone; 4-skull (of a rodent); 5-lower jaw bone

Advanced: 1-skull (of a vole); 2-scapula; 3-femur;
4-skull (of a vole); 5-mandible (of a vole)

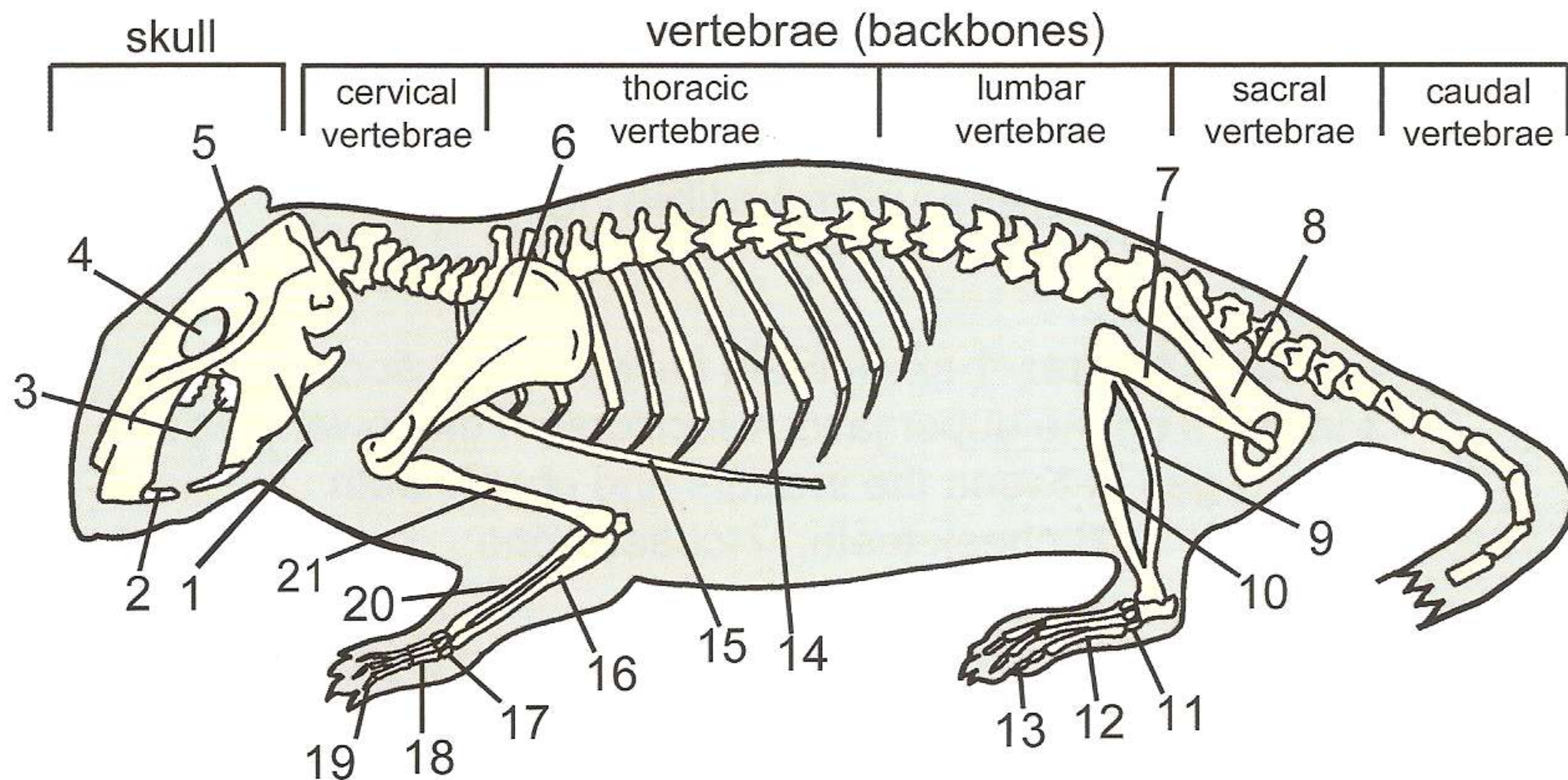
figure 14 - Major bones in a rodent

Basic Rodent Skeleton



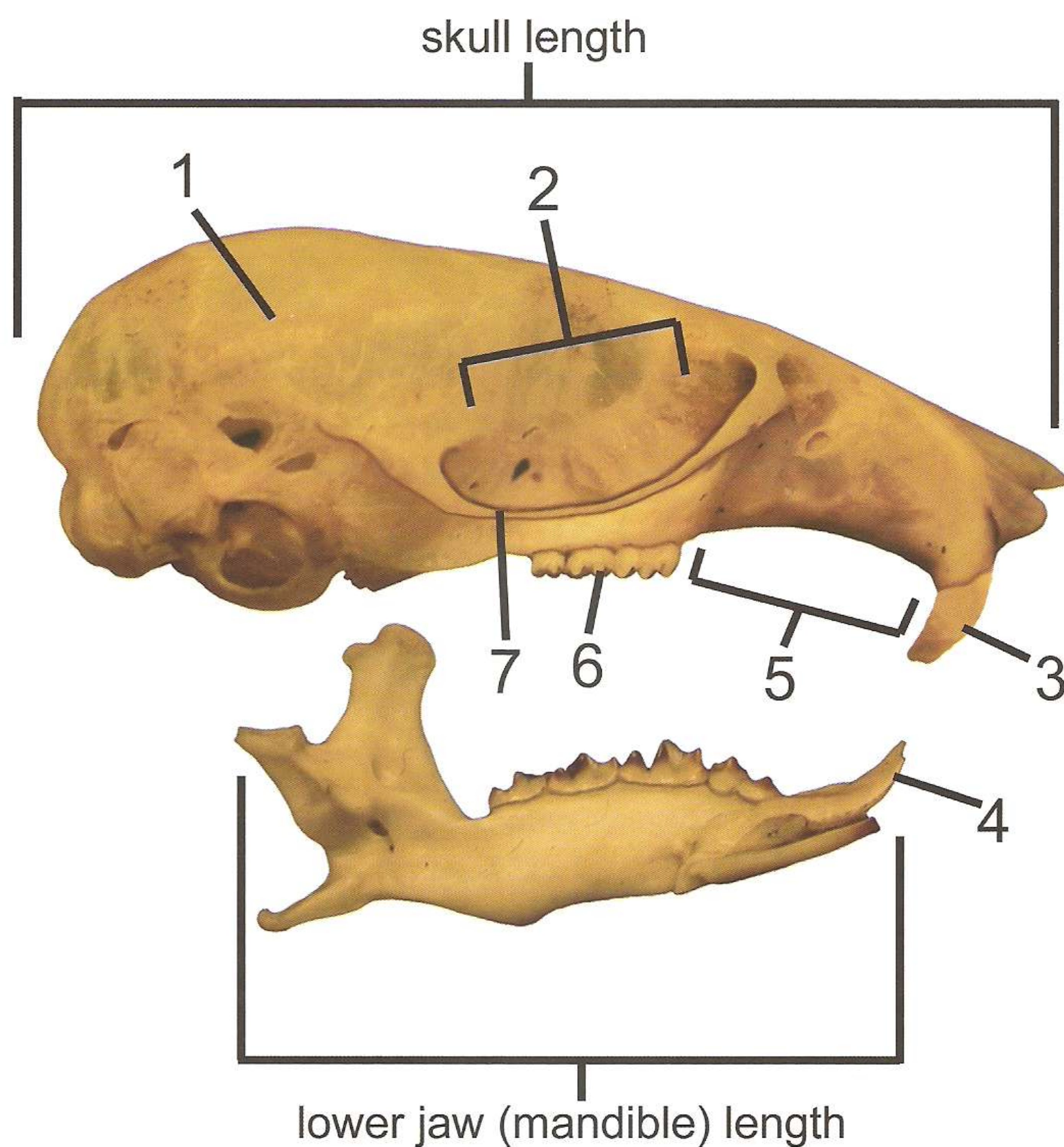
- 1-lower jaw; 2-incisor; 3-cheek teeth (molars); 4-eye socket; 5-skull (brain case);
 6-shoulder blade; 7-upper leg bone (back leg); 8-hip bone (pelvis);
 9-lower leg bones (back leg); 10-bones of the back foot; 11-ribs; 12-chest bone;
 13-lower leg bones (front leg); 14-bones of the front foot; 15-upper leg bone (front leg)

Advanced Rodent Skeleton



- 1-mandible (lower jaw bone); 2-incisor; 3-molars; 4-orbit (eye socket);
 5-cranium (brain case); 6-scapula; 7-femur; 8-pelvis; 9-fibula; 10-tibia;
 11-tarsals; 12-metatarsals; 13-phalanges (with claws); 14-ribs; 15-sternum; 16-ulna;
 17-carpals; 18-metacarpals; 19-phalanges (with claws); 20-radius; 21-humerus

figure 15 - The anatomy of a skull (rodent shown)



Basic terms: 1-skull (brain case); 2-eye socket;
3-incisors on the upper jaw; 4-incisors on the lower jaw;
5-gap between the incisors and cheek teeth;
6-cheek teeth; 7-cheek bone

Advanced terms: 1-skull (cranium); 2-orbit (eye socket);
3-incisors on the upper jaw; 4-incisors on the mandible;
5-diastema; 6-molars; 7-zygomatic arch

Skull Key – The way to identify skulls

Keys are used extensively in biology to identify plants, animals, and other organisms. Using a key is like following a map to get to a destination. It consists of a series of questions that eventually lead to an answer.

How to use this key:

Each step has two questions: part a and part b. Answer the question that goes best with the skull you are working with. Use figure 15 to learn the names of the parts of the skull. The answer to the question will tell you the name of the animal that possesses the skull or will tell you what step to proceed to in order to find the answer. When working with this key, you may want to refer back to the measurements you made in the dissection instructions portion of this guide.

Step #1

- a) Skull has a bill (beak) and no teeth.....– **It is a bird**
- b) Skull has teeth.....– Go to step #2

Step #2

- a) If the upper jaw has a gap (diastema) between the teeth (incisors) and the back teeth (molars).....– Go to step #3
- b) If there is no gap (diastema)..... – Go to step #6

Step #3 – Using a pair of tweezers (forceps), carefully remove one of the cheek teeth (molars) and inspect it using a magnifying glass or dissecting microscope.

- a) If the tooth has no roots and a rounded shape.....– Go to step #4
- b) If the tooth has individual roots on the bottom and has sharp corners.....– Go to step #5

Step #4

- a) If the length of the skull is 25mm or more and the lower jaw (mandible) is 17-30mm.....– **It is a rat**
- b) If the length of the skull is less than 25mm and the lower jaw (mandible) is 9-16mm.....– **It is a mouse**

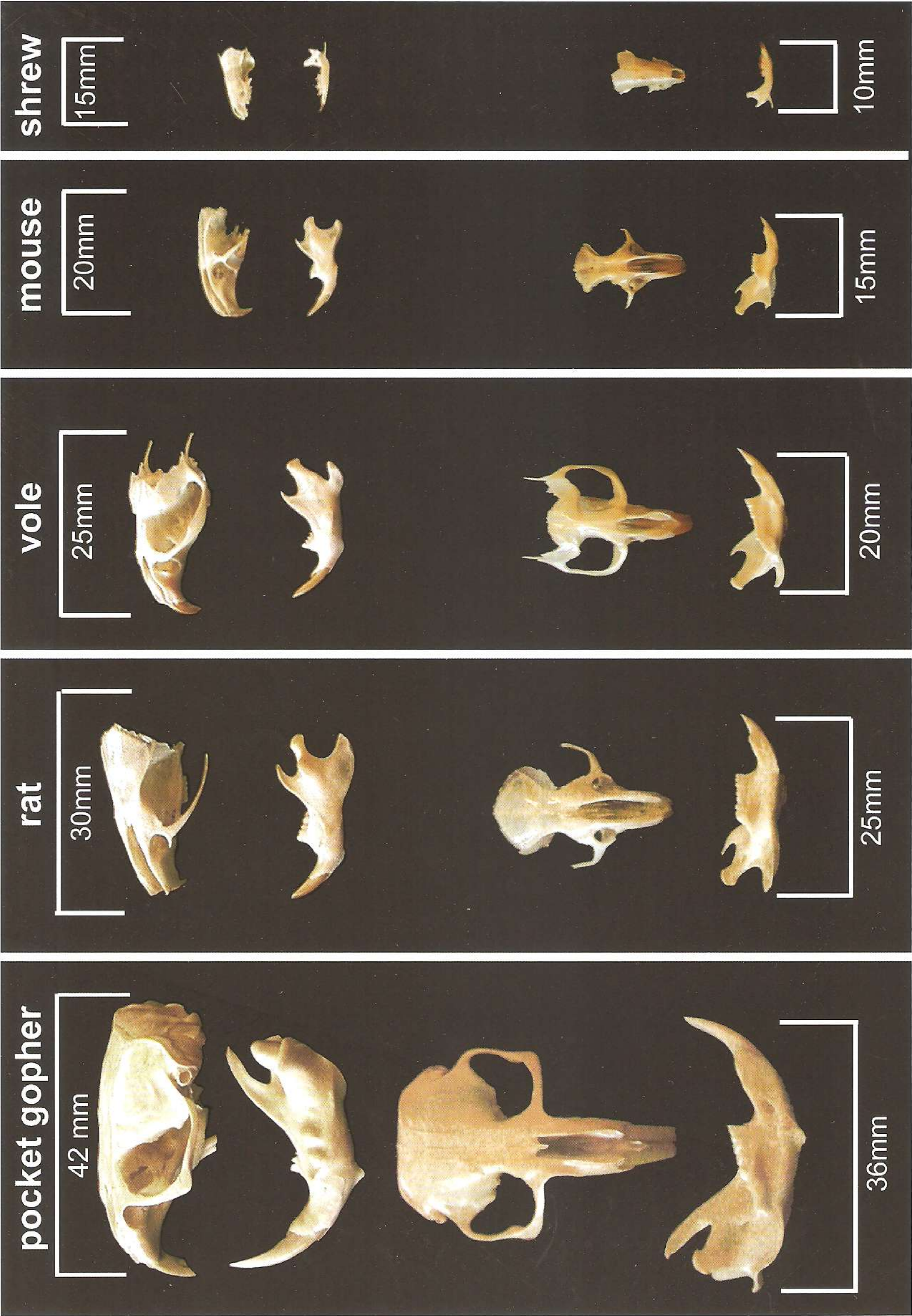
Step #5

- a) If the top of the cheek teeth (molars) are pointed, and the skull length is 20-25mm and the lower jaw (mandible) length is 15-20mm.....– **It is a vole**
- b) If there are 4-5 cheek teeth (molars) that are not pointed and the skull length is 30-42mm and the lower jaw (mandible) length is 25-36mm.....– **It is a pocket gopher**

Step #6

- a) If the teeth are white and the skull has a cheek bone (zygomatic arch)..... – **It is a mole**
- b) If the teeth are stained reddish brown on the tips and the skull has no cheek bone (zygomatic arch)..... – **It is a shrew**

figure 16 - Skulls obtained from owl pellets (some have a broken cranium / brain case)



Note: The measurements shown are not exact and merely reflect the average length of the skull or jaw bone (mandible).

figure 18 - Bone comparison chart: the bones of the body

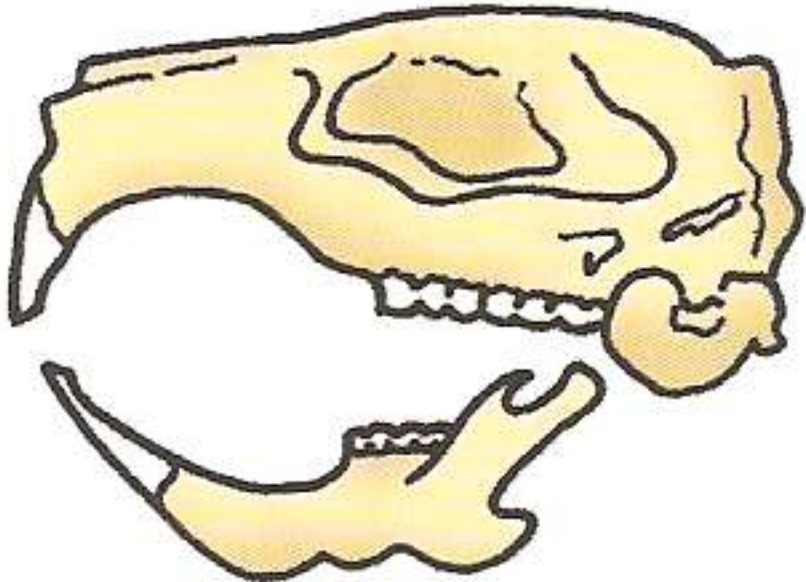
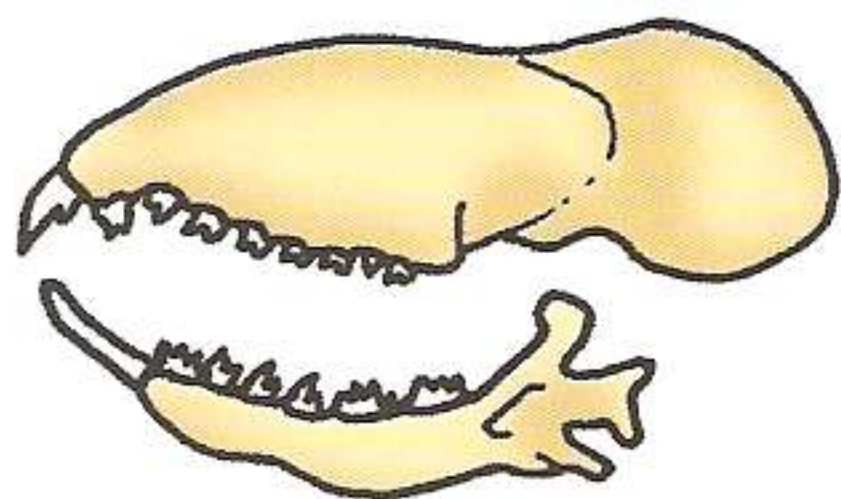
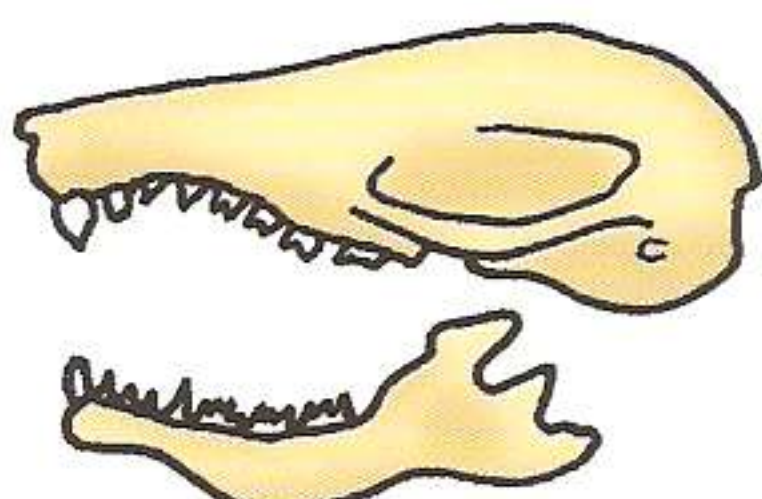
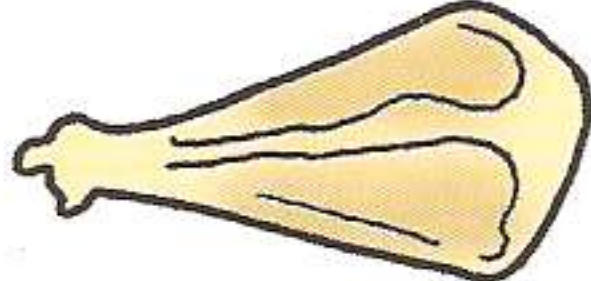
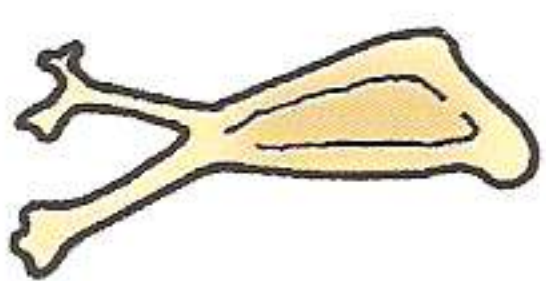
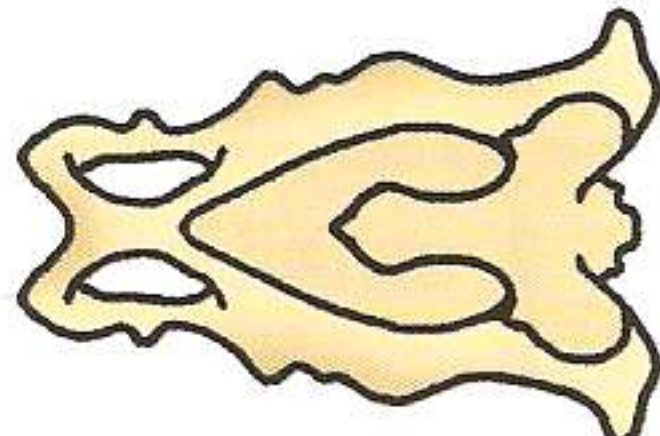
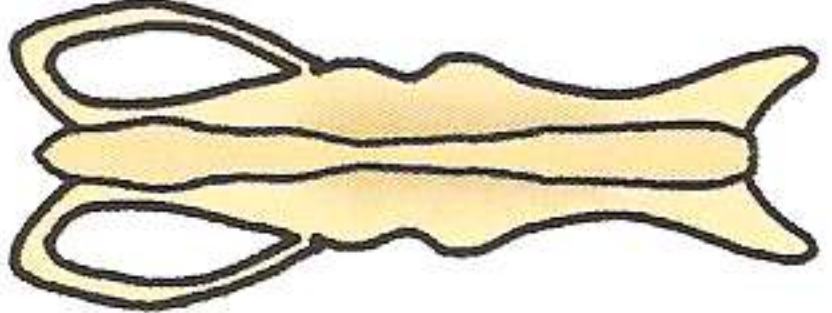
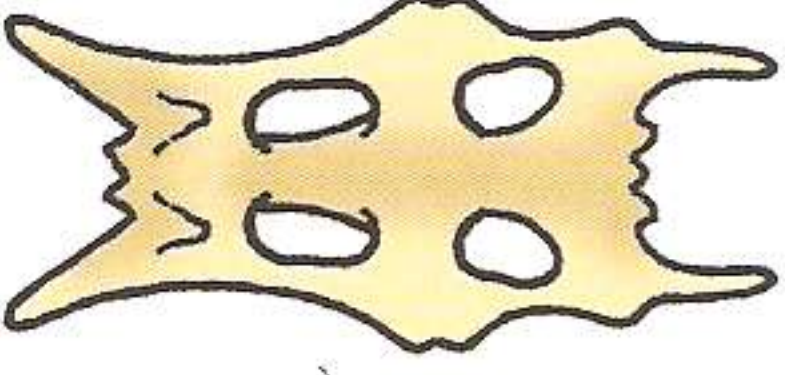
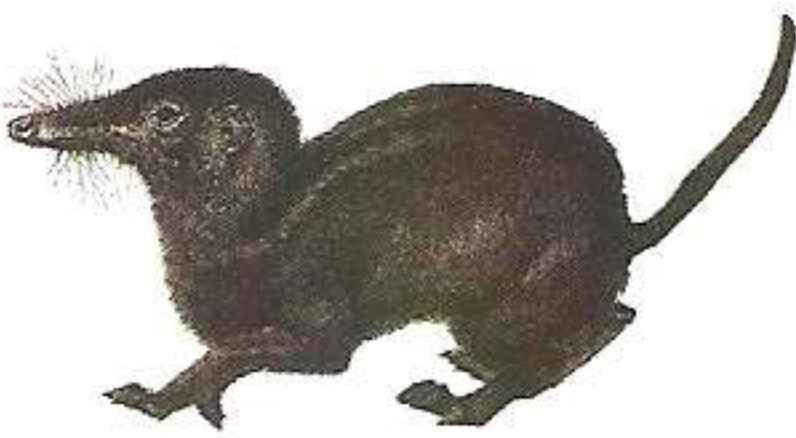
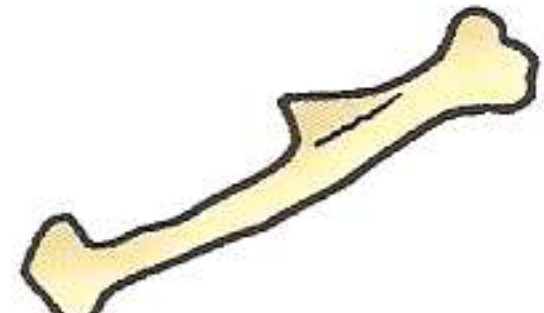
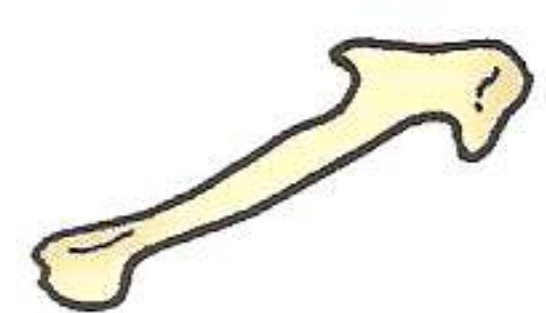
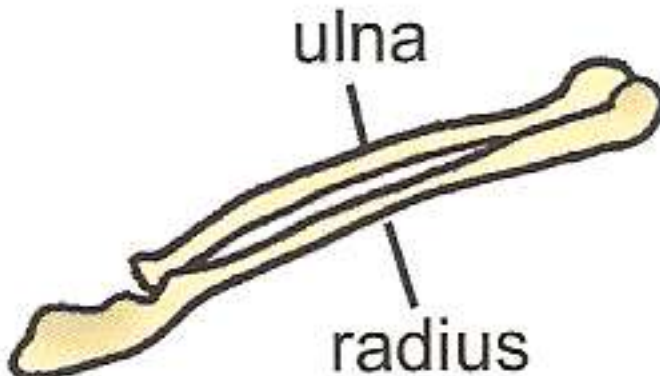
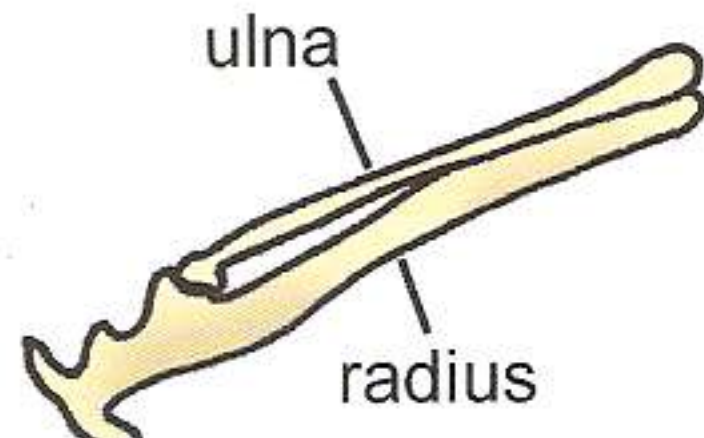
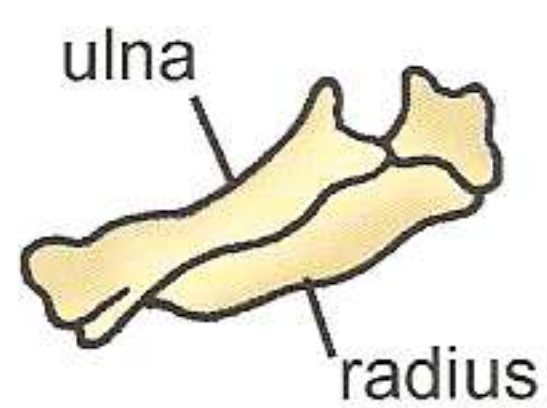
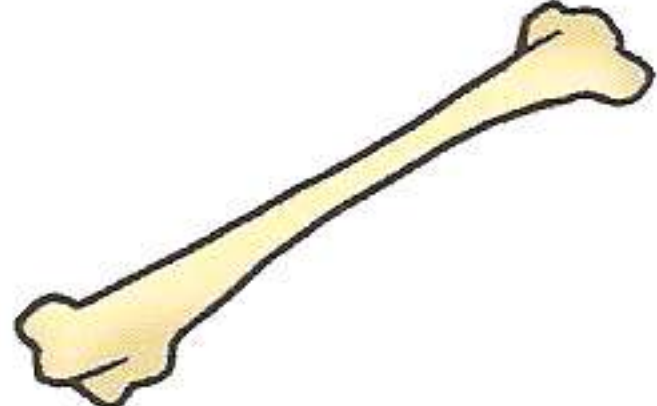
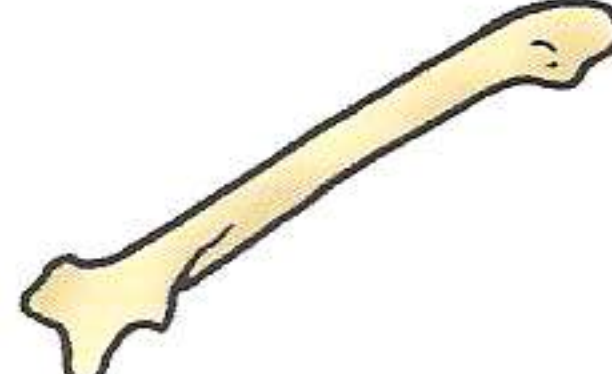
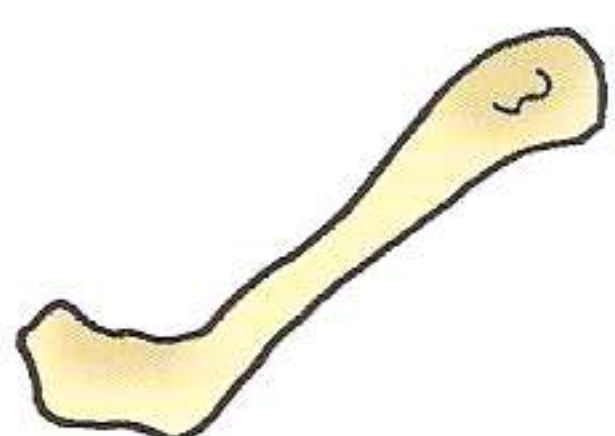
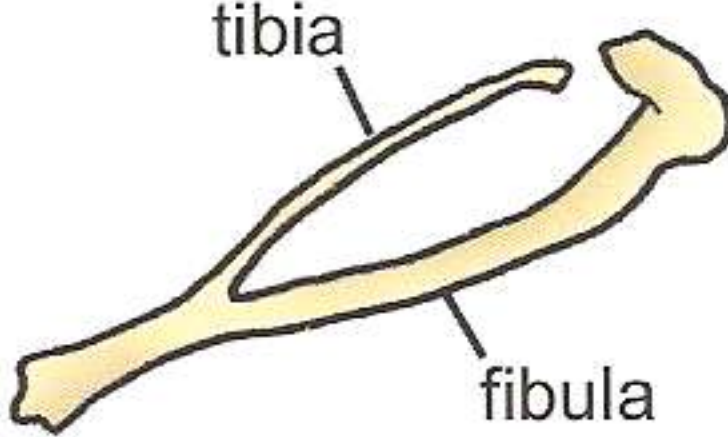
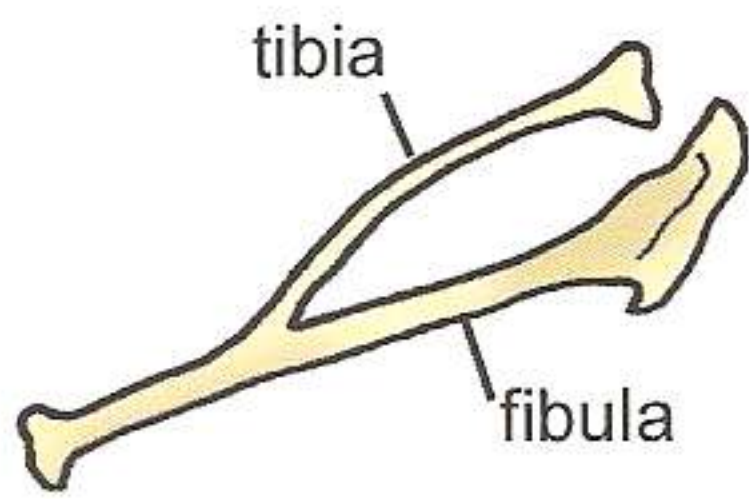
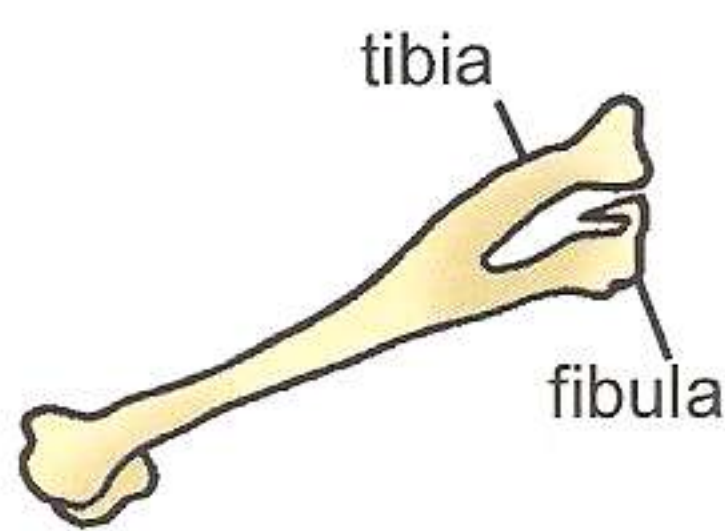
	 vole	 shrew	 mole
skull			
shoulder blade (scapula)			
hip bone (pelvis)			

figure 19 - Bone comparison chart: the bones of the limbs (appendages)

	 vole	 shrew	 mole
front leg: upper leg bone (humerus)			
front leg: lower leg bone (radius and ulna)	 ulna radius	 ulna radius	 ulna radius
back leg: upper leg bone (femur)			
back leg: lower leg bone (fibula and tibia)	 tibia fibula	 tibia fibula	 tibia fibula

Key terms

The definitions of the following terms are basic and only described as they pertain to the information in this guide. For further explanations, refer to a biology dictionary or textbook.

- **Altricial** – The advanced term for a young mammal or bird that is naked and helpless at birth. Compare with precocial.
- **Amphibian** – The term for a group of animals that includes frogs, toads, salamanders, and caecilians.
- **Carnivore** – The term used for an animal whose diet consists of meat. Compare with herbivore.
- **Clutch** – A nest of eggs.
- **Crepuscular** – Most active at dawn and dusk.
- **Dusk** – The term used for the time period just before nighttime.
- **Ecosystem** – The term used to describe the community of animals, plants, and smaller organisms (bacteria, etc.) within the environment.
- **Facial disc** – The term used to describe the unique heart-shape of the Barn Owl's face.
- **Herbivore** – The term for an animal whose diet consists of plants. Compare with carnivore.
- **Incubation** – The process performed by birds that consists of sitting upon eggs to keep them warm.
- **Invertebrate** – The term used for an animal that does not possess an internal skeleton made of bone.
- **Mammal** – The term used for a group of animals that possesses hair and nourishes their young by means of mammary glands.
- **Nocturnal** – Most active at night.
- **Owlet** – The term used for a young owl.
- **Pesticide** – A chemical used to kill harmful insects.
- **Precocial** – The advanced term for a young mammal or bird that is able to walk and is well developed at birth. Compare with altricial.
- **Predator** – Refers to an animal that hunts to obtain its food.
- **Prey** – Refers to an animal that is hunted.
- **Raptor** – The term used to describe a group of birds that have sharp, hooked beaks and talons. Includes owls, hawks, eagles, and falcons.
- **Reptile** – The term for a group of animals that includes snakes, lizards, turtles, crocodiles, and alligators.
- **Roost** – A perch on which a bird will rest or sit. This place can be a tree branch, rooftop, or any other place above the ground.
- **Stealth** – Secretive behavior that involves moving without being discovered.