Biology 3: Ecology and Field Biology

Lab Manual

Fall 2018

Instructions for Field Notebook

Materials
Your field notebook will only be graded if it is in a hard-cover small notebook. The notebook should be no bigger than 9.5 x 6 inches (size of paper) and no smaller than 8.5 x 5 inches. The paper inside should be college ruled notebook paper that fits that size notebook. If you type your notebook, be sure to format to the right paper size (do not cut paper to fit!). The pages in the notebook should be "loose leaved" and able to be moved around (not spiral bound!). Pages ripped out of spiral notebook pads will NOT be graded. Your entries should be printed neatly in ink.

Organization
You should have two sections in your field notebook:

1. The "Journal Section" which chronologically narrates our field trips

2. The "Species Account Section" in which each species has a page that describes it

"Journal Section"
The journal section should read like a diary. Each place we go should be entered separately and you should begin by noting the date, time, weather conditions and location.

For example:

1. Mt. San Antonio College Wildlife Sanctuary Walnut, California 2-25-13 2:00pm
Campus trip with the field biology class (Lab 1)

The weather was warm and clear. We determined the temperature to be about 73 degrees F. On this field trip we started our walk from room 7-1120 and headed across Temple Ave, down Mt SAC Way. Along the way we saw a coast live oak tree and noticed the teeth at the end of the leaves. We also spotted a red-tailed hawk soaring over Mt. SAC hill. In other words, you just give a summary of what you did. If you traveled off campus you would want to include directions on how to get to the place (in case you ever want to go back there). You would mention every organism seen in chronological order and you would also mention location (such as a brown pelican was on the bridge) but you would describe what it looks like and what it was doing in the species account section. Do not give lists of organisms in the journal section! Please write in complete sentences.

The next lab would be entered as #2 and so on. (See examples in class)

"Species Account Section"

The species account section should have a **separate page** for every species seen!

The pages should be arranged in alphabetical order by common name within each of the four sections listed below:
(these sections should be separated by tabs)

Mammalogy (Mammals)
Herpetology (amphibians and reptiles)
Ornithology (Birds)
Botany (Plants)

Every page in the species account section should have your last name followed by your first name or initial. The year should be below that in the upper left hand comer. There should be a 2 inch margin down the left side of the page (see example below). Notice in the example below that the date goes in the 2 inch margin and the location goes on the other side of the line from the date. Under the location name you describe what the organism looked like and what it was doing. The description of what it looked like should come from what you learned on the trip and using your field guide. You can include any natural history facts or characteristics you noticed, including the apparent health of the organism. When you see this species again in a different. location you would add it on the same page.

***Each species gets its own page! At the top the common name should appear with the scientific name in parentheses and underlined underneath the common name.**

For example:

Smith, Joe

Coast Live Oak
(Quercus agrifolia)

February 26, 2017

Mt. San Antonio College Wildlife Sanctuary, Walnut Ca.
This tree had pinnate leaves with teeth at the end of each leaf. We noticed a large amount of leaf litter under the tree and learned that a chemical called "tannins" is released from the decomposing leaves to keep anything from growing too close. This is an evergreen oak that produces acorns in the spring.

March 18, 2017

Rancho Santa Ana Botanic Gardens, Claremont Ca.
This tree was growing in the parking lot area of the botanic gardens. It has the pinnate leaf venation and teeth as mentioned above but I also noticed pollen dangling from it. A scrub jay was perched at the top.

Remember that in any part of your notebook, when a scientific name is used, the first word is capitalized and the second is not. Both words should be underlined or italicized. Be sure to look at the examples in class and the ones that are attached! Also, ask questions!!

1. Mt. San Antonio College Wild life Sanctuary, Walnut, California
1-13-95 9am.

Today, we went to the wildlife santuary with the Biol 3 class. It was overcast this morning around 60°C. The sanctuary is located at the corner of Temple Ave. and Grand Ave.

We started our walk from Bldg 13-9. As we walked near Bldg. 19, we came to a lemon Eukalyptus tree, which is a native species to Australia. It was called "lemon" eukalyptus because its leaves, when crushed, smell like lemon.

As we walked on, we came to a mound on the lawn near the sidewalks between the library and Bldg. 7. We learned that underneath the mound, a cold room was build there. It was used to store blue ice, which keep air conditoner on all summer.

As we walked down the isle beween Bldg 4 and Bldg 7, we saw a seagull flying overhead toward Bldg. 4. On the left, we saw a Northern mockingbird siting on a bare tree. It is in good health. It puffed up its body to keep/maintain body heat.

Finally, we reached the santuary. We entered it thru. Gate 2. Near the entrance,

Page 1

we learned that Wildlife Sanctuary was built in 1965, the idea of the chairman and President of Mt. SAC. They established the sanctuary, which is the largest and most expensive pieces of land left in Walnut. It ~~was~~ is worth 5 million dollars. Mt. SAC administration wants to develop the 10 acres of land or starting charging a fee for entrance. The people from Biol department has fought back arguing that the Sanctuary has an important role both in school and out of school. Specifically, the Sanctuary has 3 purposes 1) Outdoor Lab 2) Habitat for wildlife, and 3) Community Service.

As we walked further inside, we saw a Anna's Hummingbird's nest amongest the foliage of coast live oak. The instructor told us that last year around this time, there were eggs in the nest. However, due to frequent visitors from the human species, the mother has abandoned the nest this year. Leaving the nest empty. We also learned that indeed it was a coast live oak from the prickly leave that it has.

We then turned left on the path. The first species we encountered are sycamores. It was a native california tree. The way to tell it apart from other trees is to look for its white bark and palmate leaf.

Page 2

We came across to another Eukalypus tree. It was a native plant from Austrila. It was good for burning.

We then came to the pond. There are two mallards swimming side by side near the edge of the water at a distance away from where we were. One of the mallard is a male, characteristic of its colorful feathers. Usually it has a green head with a white ring around the neck. Another of the mallard is a female. The female are dull in color compare to the male.

As we stand on the wooden bridge, our instructor informed us that two years ago, there is a chlorine spill in the Sanctuary. The pond was totally polluted. Volunteers were recruited to remove the contaminated biomass from the bottom of the pond. It was not until recently, that everything seems to be getting back on track. In fact, big boulders were set up in the pond with an intention to introduce pond turtle into the newly-cleaned habitat. We also noticed that concentric circles are periodically being produce in the pond water. We were told that it was produced by mosquito fish.

Definition of a pond vs. swamp. Pond is usually shallow and somehow clear. Swamp

Page 3

are little bit deeper (knee-high) and murkier.

Next, we came catails. The female catails usually has a bulky substance at the end of the stalk. ~~The blade on the catails feel like a grass blade with distinctive edges~~. Whenever a catail has been spotted, it means freshwater is just near by.

The class then encountered a black crown night heron. I didnt see it. An adult black crown night heron should have a black head while a juvenile heron has a all-browned body.

As we approach the lake, we saw some bulrush. It was a tall rush or weed with a thick velvety head. We also saw duckweed in the lake. It is the smallest flowing plant. It is the food for ducks. Near the edge of the lake, we also found some wild celery. Some people crushed the leaf and said it smell like celery.

Next, we reached the stream. As we look down into the trash-filled stream, we learned that the recent storm has washed most of the trash from the street and has settled at the bottom or on the bank of the stream. The term "riparian" refered to the bank of a fresh, moving H_2O source

Page 4

not necessarily drinkable. Near the stream we also saw some Date Palms. The Date Palm are not native to the riparian. It was proposed that the Date Palm was introduced by bird through its feces.

Before we reached the stream, there are 2 species around the lake that I forgot to mention. They are black pheobe and House Finch. The black Pheobe was sting on a sign and the Finch is on a pine tree.

On the way out, we came across a methanol Eukalypus tree which is used in cough drops.

When we got back to class, we looked at the pond water which has being collected when we were at the pond. When viewed under microscopes, I saw paramesium, diatoms, amoeba and cyclops.

excellent!

Paramesium

diatom

Amoeba

Cyclops

Page 5

Species Descriptions

Page 6

Coast Live Oak
(Quercus agrifolia)

Coast Live Oak
(Quercus agrifolia)

Cristina Z.
Aug. 28

MT. SAC Wildlife Sanctuary
Walnut, CA. 10:40am

- Dark green leaves. Boatshaped leaves with dentate edges. The leaves contain the chemical Tannins that is released in the grand around the tree to inhibit growth. By inhibiting growth the tree benefits from the nutrients in the soil.
- Evergreen. Favor drier climate.
- Bark is dark brown.

Oct. 23

Rancho Santa Ana Botanical Gardens
Same description as above, it was on a oak woodland community.

NOV. 6

Eney Canyon
- oak woodland community
Nothing growing underneath.

Great Egret
(Ardea alba)

Page 9

Great Egret
(Ardea alba)

Zepeda, C.
Aug 28

Mt. SAC Wildlife Sanctuary
Walnut, CA. 10:40 am
- All white feathers. Yellow Bill.
Black legs and feet. Long thin
Neck.
Was seen flying above the lake.

Oct 4, 2017

Upper Newport Back Bay Ecological
Reserve.
- Nest in treetop colonies.
Deep croak.
Habitat: Marshes.

Page 10

Lab 1: Introduction to the Outdoors. Taxonomy and Plant Identification

*Lab modified from Life All Around Us, 4th Ed, Schmidt, Vail, Kakiba-Russell, and Revell 2010

Taxonomy is the branch of science concerned with the naming and classification of organisms. Over 1.9 million species have been discovered and classified, however it is estimated that there are 8.7 million species on earth. Many of the most biologically rich areas on earth, including coral reefs, wetlands, and temperate and tropical rainforests are being destroyed at alarming rates. The loss of organisms and the unique genetic material that they possess can have catastrophic impacts on ecosystems. Humans are currently causing the sixth great mass extinction event on earth, with it estimated that species are going extinct at a rate of 3-4 species an hour, 75 species a day, 525 a week and 27,300 a year.

The following are the major taxonomic groupings used to classify organisms. Morphological and genetic information are used to determine the classification of organisms and the evolutionary relationships between organisms.

Domain: All known organisms belong to one of three Domains: Archaea, Bacteria, Eukarya.

Kingdom: All organisms belong to one of six Kingdoms: Bacteria, Archaea, Protista, Fungi, Plantae, Animalia

Phylum: A group of similar classes

Class: A group of similar orders

Order: A group of similar families

Family: A group of similar genera.

Genus: A group of similar species.

Species: A group of interbreeding organisms that are reproductively isolated from other organisms

Example: Coyote (*Canis latrans*)

Domain: Eukarya = organisms composed of cells with membrane enclosed organelles

Kingdom: Animalia = multicellular, heterotrophic organisms

Phylum: Chordata = animals with a dorsal hollow nerve cord, notochord, pharyngeal gills slits, and post-anal tail

Class: Mammalia = endothermic animals with mammary glands and hair

Order: Carnivora = flesh-eaters with modified teeth (canines), and usually four to five clawed toes on all feet

Family: Canidae = carnivores with non-retractable claws

Genus: *Canis* = dogs, coyotes, wolves

Species: *latrans* = coyotes

Using a Dichotomous Key

A dichotomous key is a system used to identify different species by distinguishing between species based on certain visible characteristics. Dichotomous keys can be used for any type of organism, and we will be using a dichotomous key to identify various plant species within Mt. SAC's Wildlife Sanctuary. In order to use a dichotomous key effectively, users must be familiar with different morphological characteristics or the organisms in question. Below are some of the distinguishing characteristics used to identify different plants.

Parts of the Plant

Leaf: the primary photosynthetic organ of the plant consisting of the blade and petiole

Blade: the flattened portion of the leaf where most photosynthesis occurs

Petiole: the stalk of the leaf

Axillary bud: undeveloped shoots that can form new branched, leaves, or flowers

Leaflet: a smaller leaf that makes up a part of a compound leaf

Node: the point where the leaf attaches to the stem

Leaf Forms

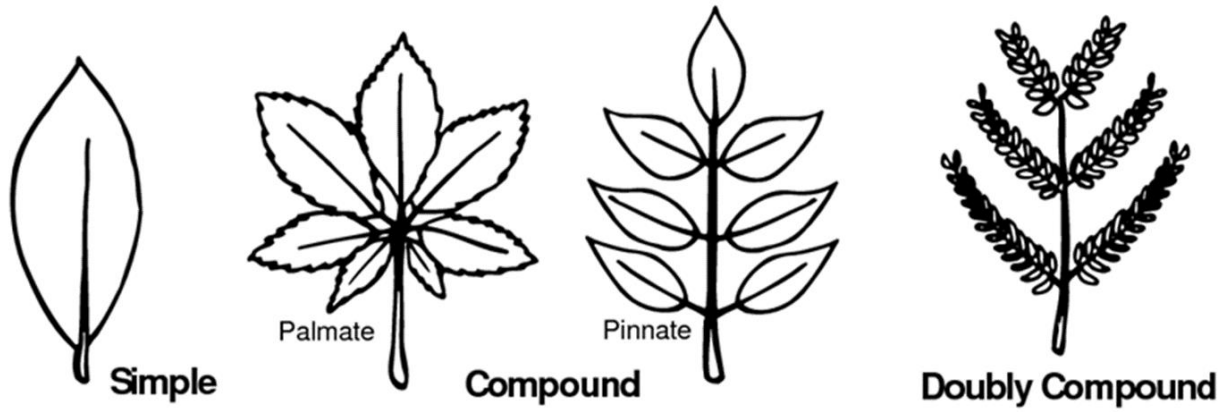
Simple leaves: unbranched leaf with only one blade-like structure. Not compound.

Compound: a leaf with two or more similar parts (leaflets) branching from a central vein

Pinnately compound: a compound leaf with leaflets arranged on either side of a common petiole

Palmately compound: a leaf having leaflets radiating from a common point

Doubly compound: leaves that are twice divided, with leaflets arranged along a secondary vein that branches off the main central vein.

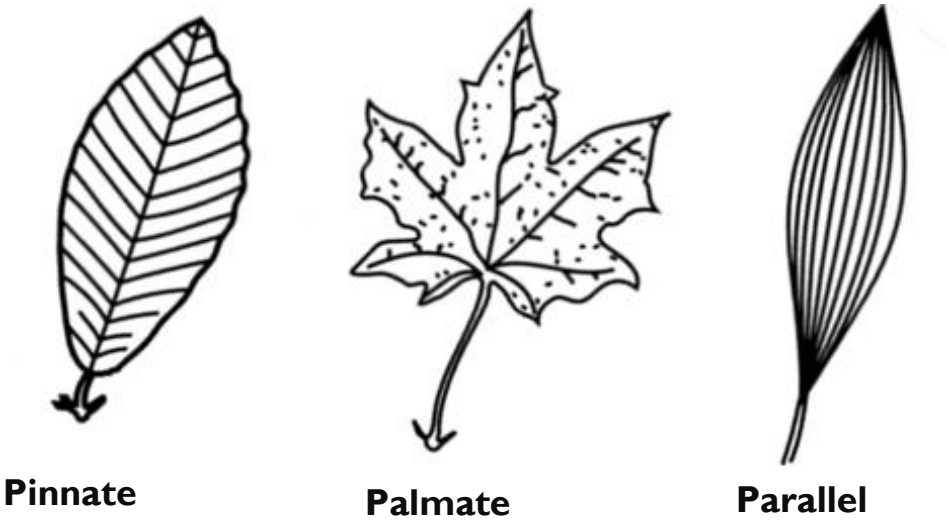


Leaf Venation

Pinnate venation: a leaf having veins arranged on each side of a main central vein

Palmate venation: a leaf having veins radiating from a main central point.

Parallel venation: a leaf having veins running parallel to each other down the length of the leaf blade



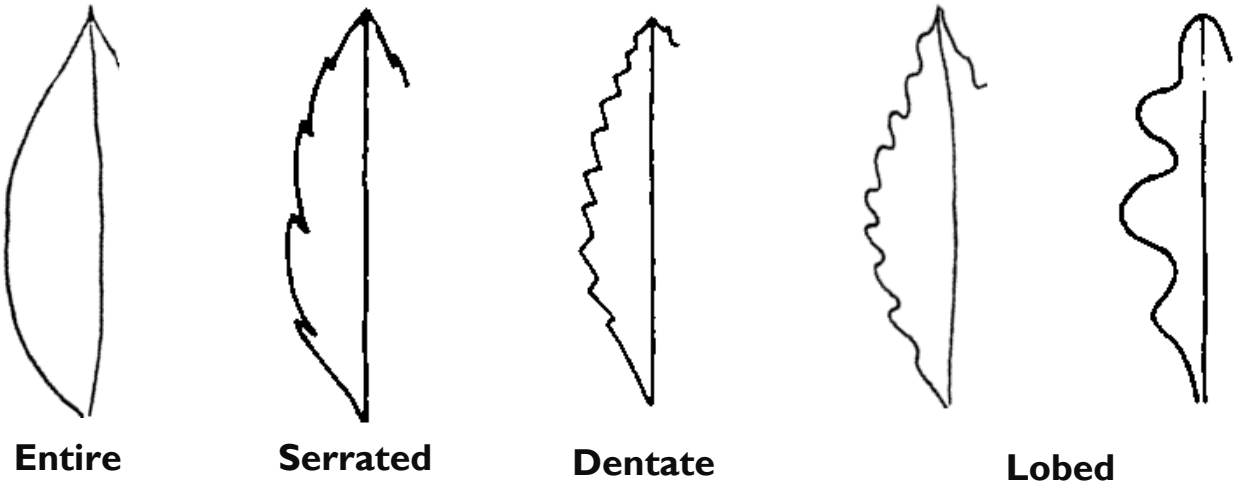
Leaf Margins

Entire: a leaf blade with a smooth edge with no teeth-like indentations

Serrated: a leaf blade with small tooth-like projections

Dentate: a leaf blade with large, often sharp tooth-like projections

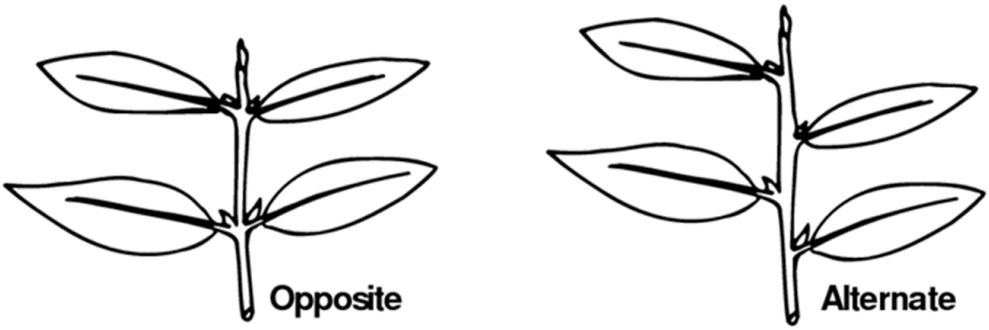
Lobed: a leaf blade with indentations toward the central vein. Indentations can be swallow or deep.



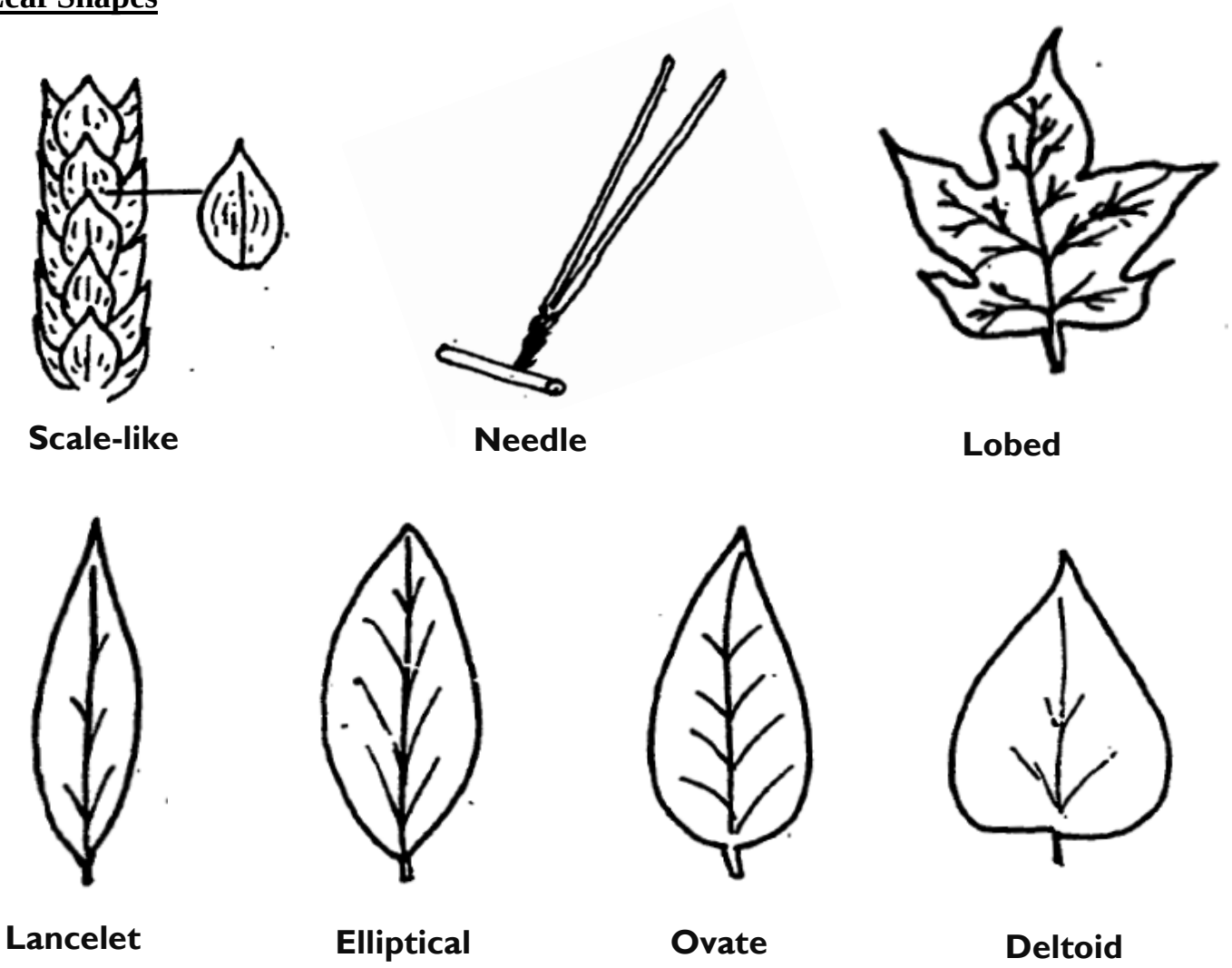
Leaf Arrangement

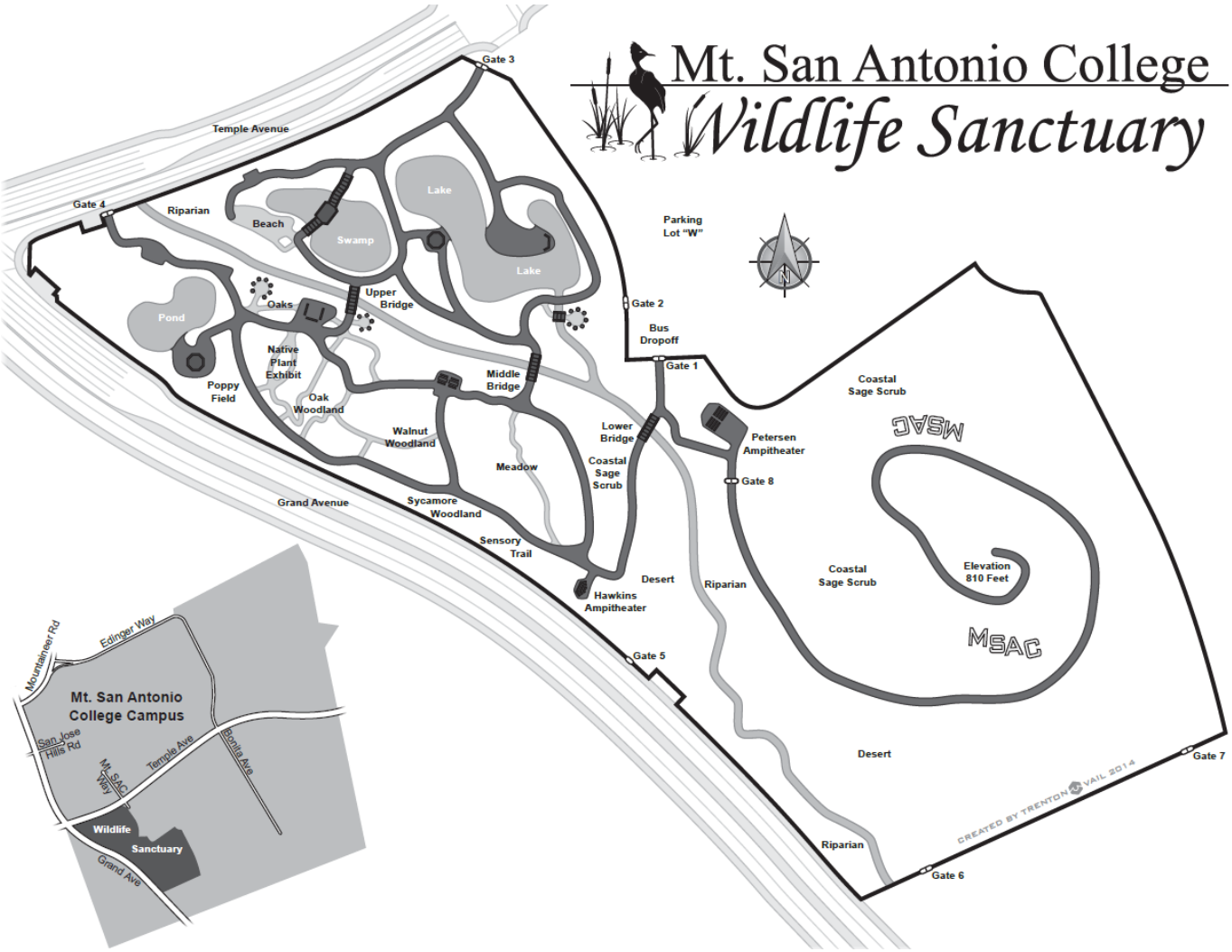
Opposite: a plant having two leaves arranged directly opposite one another at each node.

Alternate: a plant having only one leaf at each node with not wo leaves located directly opposite one another.



Leaf Shapes




Mt. San Antonio College
Wildlife Sanctuary
Gate 3
Temple Avenue
Gate 4
Riparian
Beach
Swamp
Lake
Lake
Pond
Oaks
Upper Bridge
Native Plant Exhibit
Poppy Field
Oak Woodland
Walnut Woodland
Middle Bridge
Meadow
Grand Avenue
Sycamore Woodland
Sensory Trail
Parking Lot "W"
Gate 2
Bus Dropoff
Gate 1
Lower Bridge
Coastal Sage Scrub
Hawkins Amphitheater
Desert
Riparian
Gate 5
Petersen Amphitheater
Gate 8
Coastal Sage Scrub
MSAC
Elevation 810 Feet
Coastal Sage Scrub
Desert
Riparian
Gate 6
Gate 7
CREATED BY TRENTON VAIL 2014
Mt. San Antonio College Campus
Mountaineer Rd
Edinger Way
San Jose Hills Rd
Mt. SAC Way
Temple Ave
Bonita Ave
Wildlife
Sanctuary
Grand Ave

KEY TO COMMON TREES AND SHRUBS OF THE MT. SAN ANTONIO COLLEGE WILDLIFE SANCTUARY

1a. Tree...2
1b. Shrub ...Go to Shrub Key #21

2a. Leaves small, needlelike or scale-like...3
2b. Leaves broad, more than 2 mm wide ...4

3a. Leaves scale-like or narrowly triangular… *Calocedrus decurrens* (Incense cedar)
3b. Leaves needle-like or narrow and flattened...*Pinus sp.* (Pine)

4a. Leaves simple...5
4b. Leaves compound...11

5a. Leaves palmately veined, pubescent, with grey and white peeling bark...*Platamus racemose* (Western sycamore)
5b. Leaves pinnately veined...6

6a. Petioles strongly flattened, deltoid (heart shaped) leaves, dentate margins...*Populus fremontii* (Fremont cottonwood)
6b. Petioles not flattened...7

7a. Leaf margin entire...8
7b. Leaf margin not entire...9

8a. Lower leaf blade narrow and lighter in color than upper blade...*Salix sp* (willow)
8b. Lower and upper leaf blade the same color, bright colored flowers… *Eucalyptus sp.* (Blue gum)

9a. Leaf margin serrate… *Alnus rhombifolia* (White alder)
9b. Leaf margin dentate...10

10a. Hair on the bottom of older leaves in axils the leaf veins…*Quercus agrifolia* (Coast live oak)
10b. Lower leaf surface lacks pubescence...*Prunus ilicifolia spp. Lyonii* (Catalina cherry)

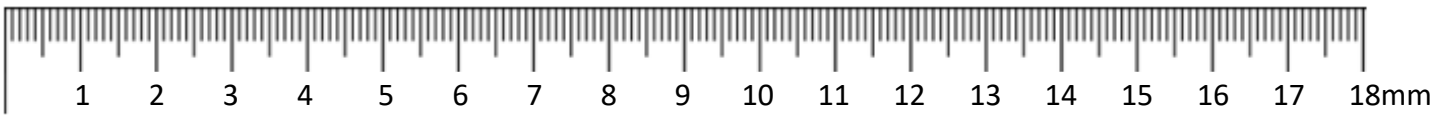
11a. Leaves opposite...13
11b. Leaves alternate...12

12a. Leaflets 5-8mm at widest point, pinnate leaves, small red berries… *Schinus terebinthifolius* (Brazilian pepper)
12b. Leaflets > 8mm at widest point, pinnate leaves ...*Juglans californica* (California black walnut)

13a. Leaflets palmately compound with five leaflets… *Aesculus californica* (California buckeye)
13b. Leaflets pinnately compound...14

14a. Small, wide leaflets that make leaves appear fernlike... *Lyonothammus floribundus* (Catalina ironwood)
14b. Large (5-15mm long) leaflets…15

15a. Leaves 20-35mm long, 7-9 ovate leaflets with fine toothed margins ... *Fraxinus americana* (White ash)
15b. Leaves 12-25mm long, 5-11 elliptical leaflets with fine toothed margins…*Sambucus mexicana* (Elderberry)



21a. Leaves compound…22
21b. Leaves simple…23

22a. Three small leaflets with entire margins, pungent odor… *Isomeris arborea* (Bladder pod)
22b. Three serrated leaflets usually present, but sometimes 5 or 1, prickles on stem ... *Rubus ursinus* (California blackberry)

23a. Leaves alternate...24
23b. Leaves opposite...34

24a. Leaves revolute (leaf margins rolled under)…25
24b. Leaves not revolute...26

25a. Small leaves clustered in fascicles (bundles), branching inflorescence…*Eriogonum fasciculatum* (California buckwheat)
25b. Thin leaves often with three lobes. Aromatic. Slender, flexible stems…*Artemisia californica* (California sagebrush)

26a. Leaf not lobed...27
26b. Leaf with 3 lobes, fuzzy texture-modified hairs (trichomes)... *Fremontodendron californicum* (Flannel bush)

27a. Leaf margins entire...28
27b. Leaf margins not entire...30

28a. Ovate leaves…29
28b. Elliptical leaves, strongly folded with red margins...*Malosma laurina* (Laurel sumac)

29a. Waxy leaves, often wavy. Small, hard red fruits forming stalks...*Rhus ovata* (Sugar bush)
29b. Light green, chalky leaves. Red bark on mature stems…*Arcrostaphylos glauca* (Big leaf manzanita)

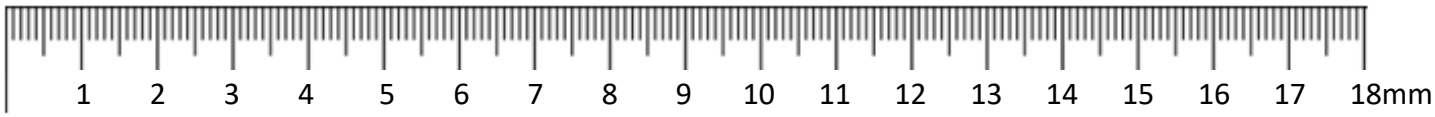
30a. Elliptical leaves > 7cm in length...31
30b. Ovate leaves < 7cm in length...32

31a. Large shrub. Stiff leaves with dentate margins. Red "berries" present in fall… *Heteomeles arbutifolia* (Toyon)
31b. Long, straight unbranched stems. 3 main veins on serrated leaves…*Baccharis salicifolia* (Mulefat)

32a. Finely serrated leaf margins. Reddish bark on stems. Cherry-like berries…*Frangula californica* (Coffee berry)
32b. Serrated leaf margins. Fuzzy corn nut-like fruits, sweet to taste…*Rhus integrifoilia* (Lemonade berry)

33a. Round stem. Small, ovate leaves often vertically oriented…*Simmondsia chinensis* (Jojoba)
33b. Squared stems…34

34a. Chalky, white lanceolate leaves…*Salvia apiana* (White sage)
34b. Dark green, lanceolate leaves with tiny wrinkles…*Salvia mellifera* (Black sage)



Part I: Plant Identification

Name:_____

List of trees and shrubs and two distinguishing characteristics for each plant

Common name of plant	Characteristics
1. _____	_____
	_____
2. _____	_____
	_____
3. _____	_____
	_____
4. _____	_____
	_____
5. _____	_____
	_____
6. _____	_____
	_____
7. _____	_____
	_____
8. _____	_____
	_____
9. _____	_____
	_____
10. _____	_____
	_____
11. _____	_____
	_____
12. _____	_____
	_____
13. _____	_____
	_____
14. _____	_____
	_____

Part II: Biodiversity

We are going to compare the biodiversity of animal species on the developed campus with the Wildlife Sanctuary. Write a hypothesis regarding which area you think will have the greatest biodiversity, the developed campus or the Wildlife Sanctuary.

Hypothesis: _____

_____

_____

Results

Data Table I: Invertebrates

Invertebrate Species Observed (Insects, spiders, ants, butterflies, etc.)	**Number observed on Campus**	**Number observed in the Wildlife Sanctuary**
Total number or individuals		
Total number of species		

Data Table II: Mammals

Mammal Species Observed	Number observed on Campus	Number observed in the Wildlife Sanctuary
Total number or individuals		
Total number of species		

Data Table III: Fish, Amphibians and Reptiles

Fish/Amphibian/Reptile Species Observed	Number observed on Campus	Number observed in the Wildlife Sanctuary
Total number or individuals		
Total number of species		

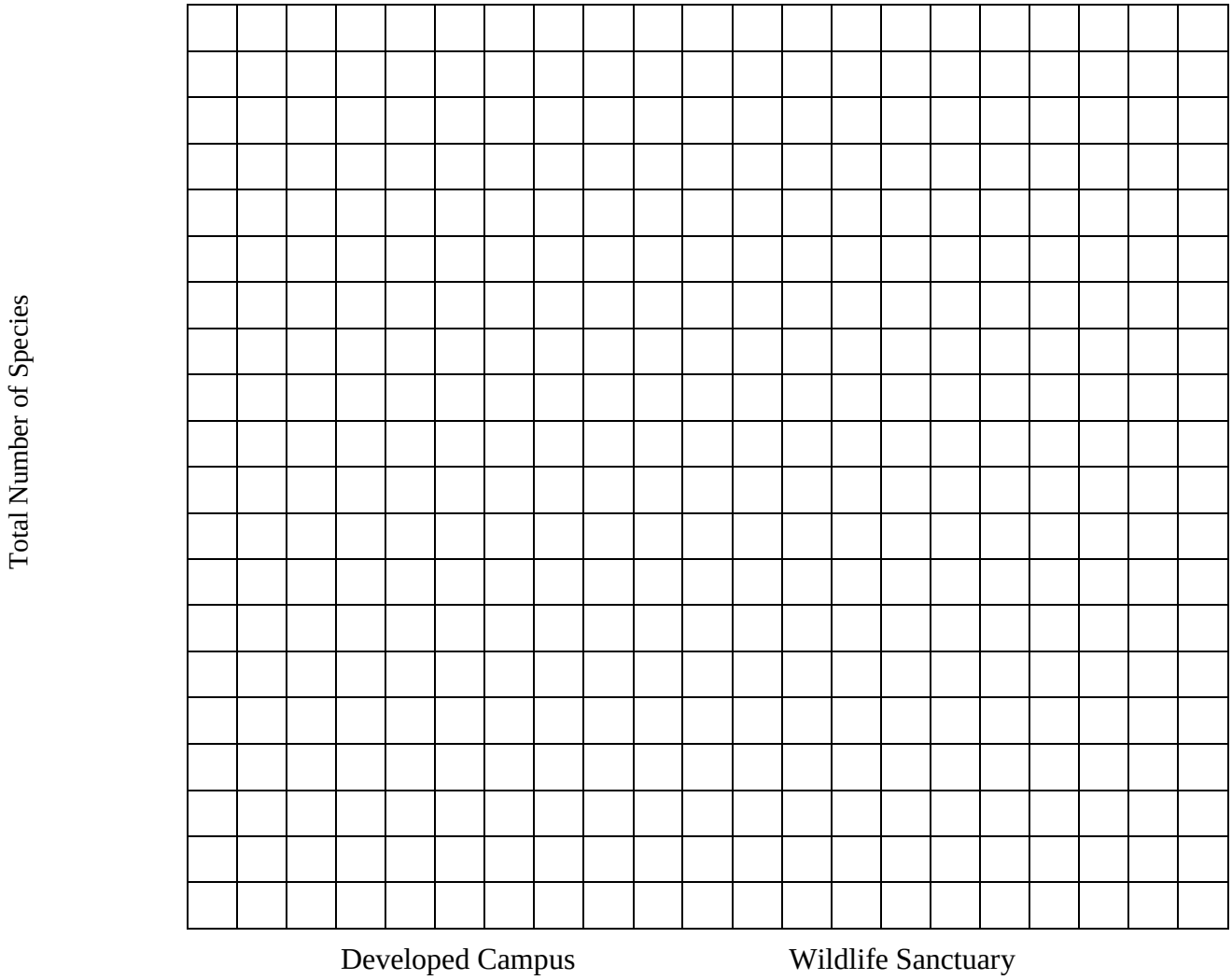
Data Table IV: Birds

Bird Species Observed	Number observed on Campus	Number observed in the Wildlife Sanctuary
Total number or individuals		
Total number of species		

Data Table V: Total Number of Species for Developed Campus and Wildlife Sanctuary

Totals	Number observed on Campus	Number observed in the Wildlife Sanctuary
Invertebrates		
Mammals		
Fish, Amphibians and Reptiles		
Birds		
Total number of species		

Construct a bar graph for the total number of species observed in each area



Review Questions:

1. Why is the appearance of an organism commonly used to identify it? _____

_____

2. What is an advantage to using common names over scientific names? _____

_____

3. What is an advantage to using scientific names over common names? _____

_____

4. What is the value of a dichotomous key? _____

_____

5. Why didn't we use a dichotomous key that included all of the plant species found on campus and in the wildlife sanctuary? _____

_____

6. Describe some of the differences between the wildlife observed on the developed campus to the wildlife observed in the Wildlife Sanctuary. _____

_____

_____

_____

7. Why are some species more common on the developed campus while others are more common in the Wildlife Sanctuary? _____

_____

_____

8. An acre of clear-cut forest has been replanted with 100 ponderosa pines, which are all 20 years old. An acre of old growth forest contains only 60 trees, however there are 15 different tree species within the acre of old growth forest. Which forested area is likely to support the greatest diversity of animal species? Why? _____

_____

_____

_____

_____

Lab 2: Evey Canyon Field Trip

*Lab written by Dr. Cindy Shannon

WARNING- THIS AREA CONTAINS A LARGE AMOUNT OF POISON OAK DO NOT TOUCH PLANTS UNLESS INSTRUCTED TO DO SO BY YOUR INSTRUCTOR, AND TAKE CAREFUL NOTE OF DANGEROUS PLANTS THAT ARE IDENTIFIED FOR YOU!! IT ALSO CONTAINS RATTLESNAKES SO BE CAREFUL WHERE YOU STEP!

Evey Canyon is located on the edge of the Angeles National Forest. In the 1950's the owner, who was a man named Gardner, became ill. He was offered millions for this property, but he sold it for $1.00 to the Pomona-Claremont Colleges with the stipulation that it would never be developed. His intention was for this area to be used for instructional purposes, so users are required to have a permit. However, you will probably see evidence such as graffiti, fires and trash, of people abusing the area. It has been said that Evey Canyon is one of the most relaxing places in our area and also one of the most diverse. The elevational differences in the canyon allow a number of different vegetation types to exist. As you know where plants go, usually animals follow!

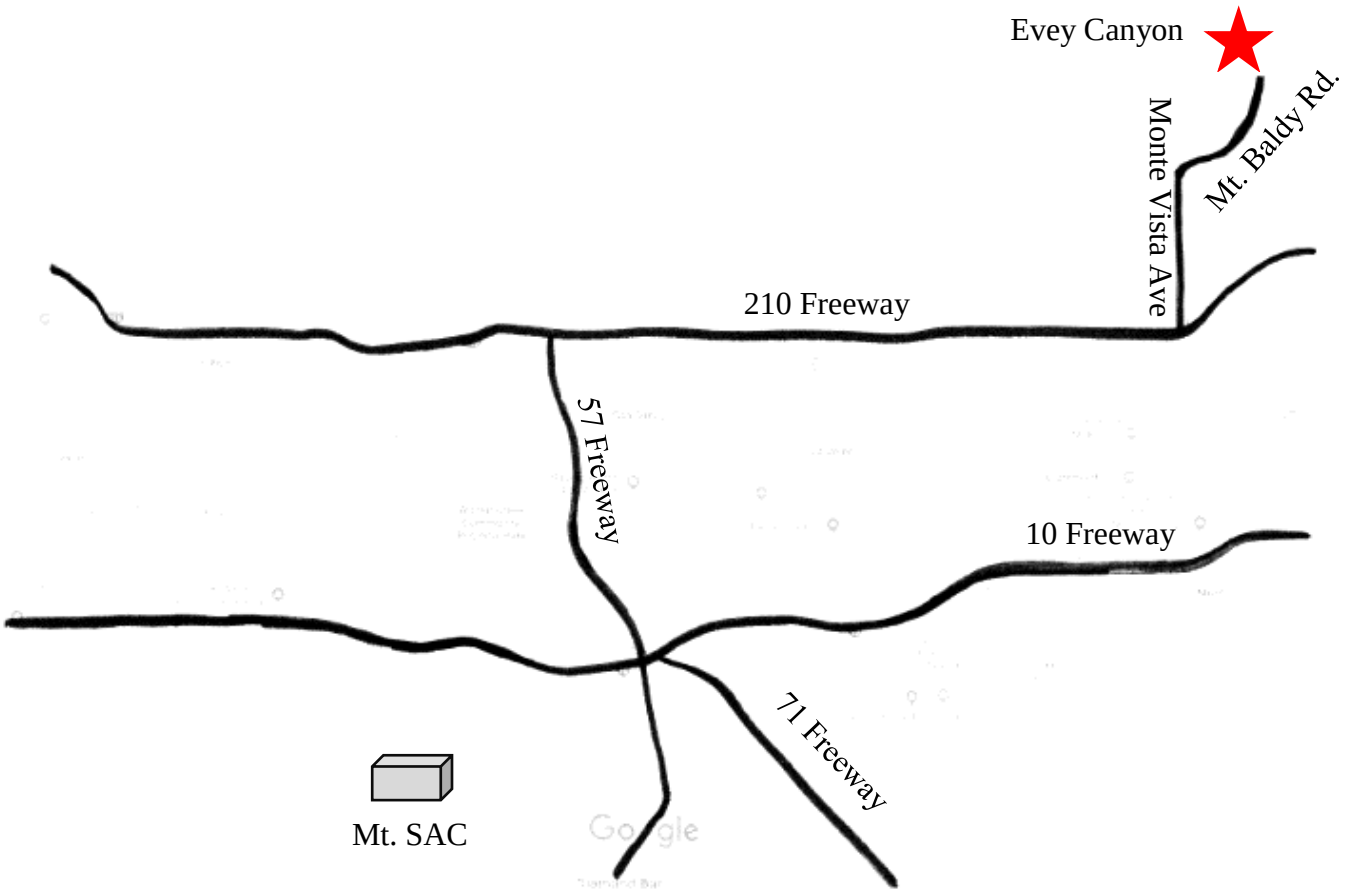
In fact, in the southwestern United States, changes in plant communities with elevation result in somewhat distinct belts of vegetation. The changes in elevation found in Evey canyon allows for the occurrence of many different habitats: including coastal sage scrub, chaparral, riparian and mountain habitats just to name a few!. At the entrance to Evey Canyon a variety of plants may greet you, such as Scrub Oak (found in coastal sage scrub), Spanish Broom which has a yellow flowers and Coulter Pines. Also near the entrance are Solanum which contains purple flowers with yellow anthers and produces a green fruit. This plant is in the nightshade family (a group of deadly plants) which bears tiny tomato-like fruits that originally gave tomatoes a bad name, since some Solanum fruits are deadly! Near the entrance you may also see brome grass, rye grass and mustard (also with yellow flowers). Having walked past the yellow gate you should notice a coastal sage scrub hillside containing such plants as Black Sage, Coastal Sagebrush, "White Sage and Buckwheat. Coastal Sage Scrub plant taxa such as those just mentioned are drought deciduous species with light brittle stems and typically fibrous shallow root systems. Coastal sage scrub tends to be found at elevations below 600-900m, in a climate with low rainfall, severe water stress and a short growing season. At higher elevations a type of habitat called chaparral may be found. Chaparral may contain some of the same species as are found in coastal sage scrub, however the predominant plants tend to be chamise, Ceanothus and mountain mahogany. These plants are more evergreen schlerophyllous species with root systems that are deeper. We will find chaparral plants later as we increase in elevations in our walk up the canyon. Near the coastal sage scrub hill a plant called Miner's lettuce may be found, this plant indicates disturbed areas and it is often found right next to the trail. Laurel Sumac is also another prominent plant in coastal sage scrub. Birds that have been seen in this area include: Scrub Jays, Rufous-sided Towhees, Anna's Humming-bird, Robins, House Finch, Bushtits and Mourning Doves. The ecology and field biology class (Bio 3) has also seen Western Rattlesnakes and Racers in this area.

As you work your way into the stream area large amounts of poison oak can usually be found. Remember the rhyme: "leaves of three -leave it be!" A plant called Mugwort is often found growing along with poison oak. Mugwort is used as an antidote to poison oak. Poison Hemlock resembles a carrot because it is in the carrot family. However, it is found here and it is deadly to us. One thing to remember here is many of the poisonous organisms that have been mentioned so far are easily eaten by other animals -just not by us and are integral parts of the ecosystem. The stream area is called a riparian area. This means it contains moving fresh (not necessarily drinkable) water. Most of the tall trees here are California Alders. In and around this stream are California Newts, Tree Frogs, Moss, Centipedes, Western Blind snakes, Gopher Snakes Fence Lizards, Alligator Lizards, Ring necked snakes and many more!

Continuing up the trail you should see some Rip Gut Brome, a type of grass that cattle would eat and then die because it would tear up their stomach. On the hillside are Mariposa (or soap) Lily, the bulb of which was used by Native Americans for soap. In this area we have seen Cooper's Hawks, Wrentits, Black-chinned sparrows and Great Horned Owls. The trail takes you up into the canopy or top of the forest, which is an excellent place for bird watching!

Bracken Ferns can be seen in the under story, some people eat the young ones called fiddle heads. You may find Mistletoe in the oaks and alders here. This is also very good black bear habitat: oaks, dead wood and grubs (insect larvae)! You may find Sycamores, and a tree that looks like a sycamore but is really a Big Leaf Maple. A little farther up the trail three different species of oaks can all be found in the same area: Canyon Oak, Coast Live Oak and Interior Live Oak. Birds seen here are Black-headed Grosbeaks and Mountain Quail. We can find plants representative of mountain habitats such as Incense Cedar, Choke Cherry and "White Fir.

In October of 2003, the "Grand Prix Fire" burned most of Evey Canyon. The white alders near the riparian area have been drastically reduced in number. A layer of forbs and wildflowers emerged in spring of 2004, as the area recovered. Typically, a low -growing layer of weedy species called forbs emerges post-fire when trees and shrubs have been removed. In the absence of fire, the trees and shrubs would normally shade out the forbs. Many coastal sage scrub and chaparral exhibit crown-sprouting, where new growth emerges from the top of the roots. Often these plants are fire-adapted and even store food reserves in their roots just for post-fire growth. The pre-fire understory of bracken ferns and poison oak was greatly reduced, but many of the coast live oaks re-sprouted. However, many other coast live oaks are in the process of dying. The flora and fauna of this area was definitely changed as a result of the fire. Although fire is a natural part of this ecosystem, fire management that allowed buildup of underbrush has likely taken the water from conifers, such as coulter pines. This created a more severe burn situation. The transition zone plants such as coulter pines, and the Canadian Hudsonian zone plants such as incense cedar and white fir have all but disappeared.



Checklist for Plants and Animals Observed at Evey Canyon

Birds:

1. ___ Acorn Woodpecker (*M.elanerpes furmicivorus*)
2. ___ American Robin (*Turdus migratorius*)
3. ___ Annas Hummingbird (*Calypte anna*)
4. ___ Black-headed Grosbeak (*Pheucticus melanocephalus*)
5. ___ Black Phoebe (*Sayornis nigra*)
6. ___ Bush tits (*Psaltriparus minimus*)
7. ___ Cactus Wren (*Campylorhynchus brunneicapillus*)
8. ___ California Towhee (*Pipilo fuscus*)
9. ___ Cooper's Hawk (*Accipiter cooperii*)
10. ___ Downy Woodpecker (*Picoides pubescens*)
11. ___ Great-homed owl (*Bubo virginianus*)
12. ___ Hooded Oriole (*Icterus cucullatus*)
13. ___ House Finch (*Carpodacus mexicanus*)
14. ___ Mourning Dove (*Zenaida macroura*)
15. ___ Northern Flicker (*Collaptes auratus*)
16. ___ Nutall's Woodpecker (*Picoides borealis*)
17. ___ Red-tailed Hawk (*Buteo jamaicensis*)
18. ___ Ruby-crowned Kinglet (*Regulus calendula*)
19. ___ Sharp-shinned Hawk (*Accipiter striates*)
20. ___ Spotted Towhee (*Pipilo erythrophthalmus*)
21. ___ Steller's Jay (*Cyanocitta stelleri*)
22. ___ Western Scrub Jay (*Aphelocorna coerulescens*)
23. ___ Western Tanager (*Piranga ludoviciana*)
24. ___ Wrentit (*Chamaea fasciata*)
25. Others: _____ _

Amphibians:

1. ___ Treefrogs (*Hyla regilla*)
2. ___ Western Toad (*Bufo boreas*)

Reptiles:

1. ___ Striped Racer (*Masticophis lateralis*)
2. ___ Western Fence Lizard (*Sceloporous occidentalis*)
3. ___ Western/Pacific Rattlesnake (*Crotalus viridis*)
4. ___ Others: _____

Mammals:

1. ___ Black Bear (*Ursus americanus*)
2. ___ Gray Fox (*Urocyon cinereoargenteus*)
3. ___ Pacific Kangaroo Rat (*Dipodomys agilis*)
4. ___ Mule Deer (*Odocoileus hemionus*)
5. ___ Western Gray Squirrel (*Sciurus griseus*)
6. ___ Others: _____

Invertebrates:

1. ___ Water Striders (Order Hemiptera)
2. ___ Beetles (Order Coleoptera)
3. ___ Grasshopper (Order Orthoptera)
4. ___ Dragonfly (Order Odonata)
5. ___ Butterflies (i.e. Painted Lady) Order Lepidoptera
6. ___ Velvet Ant (Order Hymenoptera)

Plants:

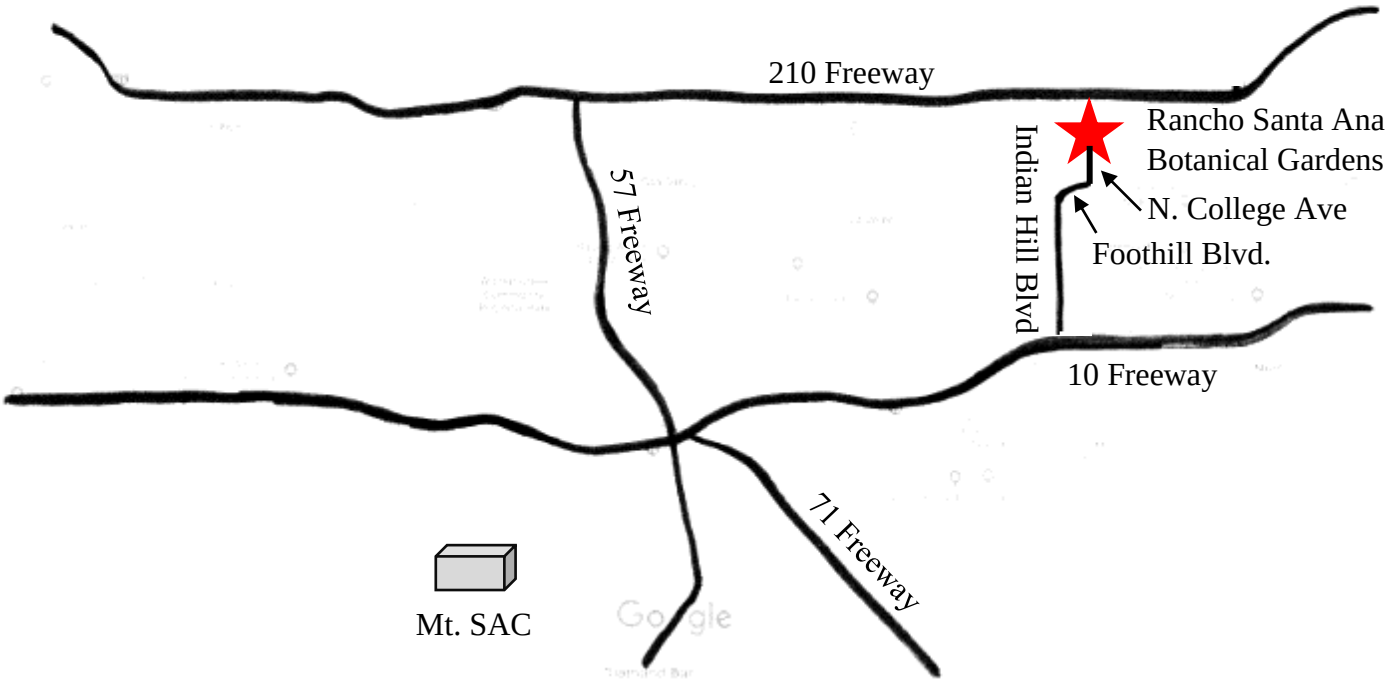
1. ___ Baby Blue Eyes (*Nemophila menziesii*)
2. ___ Big Leaf Maple (*Acer macrophyllum*)
3. ___ Black Sage (*Salvia mellifera*)
4. ___ Bracken Fern (*Pteridium aquilinum pubescens*)
5. ___ Bromegrass (*Bromus sp*.)
6. ___ Buckwheat (*Eriogonum fasciculatum*)
7. ___ California Blackberry (*Rubus ursinus*)
8. ___ California Black Oak (*Quercus kelloggii*)
9. ___ California Bells (*Phacelia minor*)
10. ___ Canyon Oak (*Quercus chrysolepis*)
11. ___ Chamise (*Adenostoma fasciculatum*)
12. ___ Chokecherry (*Prunus virginiana*)
13. ___ Coast Live Oak (*Quercus agrifolia*)
14. ___ Coastal Sagebrush (*Artemesia californica*)
15. ___ Columbines (*Aquilegia sp*.)
16. ___ Coulter Pine (*Pinus coulteri*)
17. ___ Dudleya (*Dudleya sp*.)
18. ___ Fushia-flowered Gooseberry (*Ribes speciosum*)
19. ___ Gooseberry (*Ribes sp*.)
20. ___ Horehound (*Marrubium vulgare*)
21. ___ Incense Cedar (*Calocedrus decurrens*)
22. ___ Indian Paintbrush (*Castilleja sp*.)
23. ___ Interior Live Oak (*Quercus wislizenii*)
24. ___ Laurel Sumac (*Rhus laurina*)
25. ___ Lupine (*Lupinus sp*.)
26. ___ Mariposa-Lily (Soap Lily) (*Calochortus sp*.)
27. ___ Miner's Lettuce (*Claytonia perfoliata*)
28. ___ Mistletoe (*Phoradendron sp*.)
29. ___ Monkey Flower (*Mimulus sp*.)
30. ___ Morning Glory (*Calystegia sp*.)
31. ___ Mountain Mahogany (*Cercocarpus betuloides*)
32. ___ Mountain Lilac (*Ceanothus sp*.)
33. ___ Mugwort (*Artemesia douglasiana*)
34. ___ Mulefat (*Baccharis glutinosa*)
35. ___ Mustard (*Brassica sp*.)
36. ___ Nutall's Larkspur (*Delphinium nuttallianum*)
37. ___California Everlasting (*Gnaphalium californicum*)
38. ___ Poison Hemlock (*Conium maculatum*)
39. ___ Poison Oak (*Toxicodendron diversilobum*)
40. ___ Rip Gut Brome (*Bromus diandrus*)
41. ___ Scrub Oak (*Quercus dumosa*)
42. ___ Nightshade (*Solanum sp*.)
4 3. ___ Spanish Broom (*Spartium junceum*)
44. ___ Stork's Bill (*Erodium sp*.)
45. ___ Western Sycamore (*Platanus racemosa*)
46. ___ Telegraph Weed (*Heterotheca grandiflora*)
47. ___ Toyon (*Heteromeles arbutifolia*)
48. ___ White Alder (*Alnus rhombifolia*)
49. ___ White Fir (*Abies concolor*)
50. ___ White Sage (*Salvia apiana*)
51. ___ Wild Cucumber (*Marah sp*.)
52. ___ Wild Sweet Pea (Lathyrus vestitus)
53. ___ Violets (*Viola sp*.)
54. ___ Yucca (Spanish Bayonet) (*Yucca whipplei*)
55. ___ Others: _____ _

Misc.:

1. ___ Lichen
2. ___ Moss (Division Bryphyta in Kingdom Plantae)

Lab 3: Rancho Santa Ana Botanical Gardens

Rancho Santa Ana Botanic Garden is the largest botanic garden dedicated to California native plants, promoting botany, conservation and horticulture to inspire, inform and educate the public and scientific community about California's native flora. The Garden is a living museum with curated collections of more than 22,000 California native plants, some of which are rare or endangered. Spread across 86 acres in Claremont, California, the Garden is located approximately 35 miles east of Los Angeles. The Garden displays about 2000 taxa of California plants and includes those native to the California Floristic Province.



Lab 4: Plant Collection and Preservation

A **herbarium** is a collection of plant samples and associated data that are preserved for future study. Plant samples can include dried plants, seeds, bark, flowers, fruits, pollen, wood, DNA, and microscope slides of different anatomical portions of the plant. Herbaria (plural for herbarium) are often associated with museums, botanical gardens, and university libraries. The Swedish naturalist Carl Linnaeus, who developed the taxonomic system of classifying and naming organisms still used today, was an avid plant collector and is credited for developing the modern herbarium method of preservation we are going to use today. Linnaeus's collection of pressed plant specimens are housed in vaults in the Linnaean Society in London and are still used by researchers today. Herbaria are often used in plant systematics, which is the classification of plants based on morphological and genetic similarities and differences, however they can be used in a variety of other disciplines. The Florida Museum of Natural History describes the following examples of herbaria by various disciplines.

Anthropology/Archeology - identify seed, wood and other plant remains from archeological sites; document plants used by people (ethnobotany)

Ecology - locate and document plant communities or individual species; identify and document invasive species

Entomology - locate food plants and habitats for insects; document pollination ecology

Environmental Regulation - identify plants in an area in order to define the habitat and designate an environmentally and legally appropriate use for the site

Forensics - identify plant fragments that might yield evidence in legal cases; in some cases plant fragments may be used to determine if a person was in a certain place

Forestry - locate wild plants that have potential as new crops; document plants used as forage; locate and identify relatives of cultivated species for use in breeding programs; identify and document the spread of weeds

History - retrace itineraries of early naturalists; track down early place names; determine historic plant ranges

Horticulture - identify native and cultivated plants; find plant locations; document cultivars

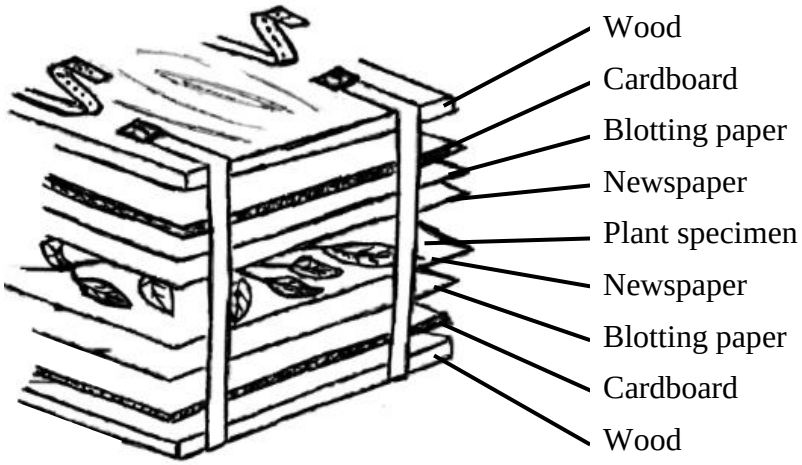
Pharmaceutical Research - locate wild plants as possible source of medicines

Poison Control and Medical Care - identify plants in cases of ingestion

Veterinary Science - identify forage and poisonous plants

Zoology - identify animal food plants; locate animal habitats

In today's lab plant specimens will be preserved using a plant press, which consists of a wooden frame, corrugated cardboard, blotter paper, and newspaper. The corrugated cardboard provides ventilation, the blotter paper absorbs moisture, and the newspaper contains the plant while it is being pressed. The purpose of the plant press is to extract all moisture from the plant tissue, while preserving the morphological structure and characteristics of the plant specimen.



Procedure

1**. Collect your specimen**: Each specimen should consist of the stem, and leaves, but may also include the roots, flowers, and fruits when possible. The specimen must fit on an 11” x 16” sheet of paper so make sure the sample you collect is representative of the entire plant, but also small enough to fit on the blotting paper. When in the field collecting your specimen, each plant specimen should be placed in a separate bag or container and the data sheet should be filled out (ON LOCATION) and placed in the bag with the specimen. Ten data sheets are provided. For best results, plant specimens should be planted the same day they are collected, although a moist paper towel can be placed in the bag to prevent the plant from wilting.

2. **Prepare your specimen for pressing**: Before placing the plant on the newspaper, make sure the plant is clean of any debris or dirt by brushing off any loose soil or non-plant material. After the plant is clean and dry, place the specimen on the newspaper. The plant material should be carefully arranged so that leaves, stems, flowers and fruits are spread out on the paper and do not overlap. Be sure to place the identification tag in the folded newspaper with the plant specimen. After all the layers of plant specimens are in place the top and bottom pieces of wood will be tightened down with the straps to being extracting the moisture from the plant tissue.

3. Finalizing plant specimen: After the plant specimen has been pressed for several weeks, the specimen should be dry and ready for final mounting. Remove the specimen from the newspaper and place it on a fresh piece of blotting paper. Small amounts of glue can be used to secure the specimen in place. You can either glue the data sheet to the lower corner of the paper or clearly write the information from the sheet on the lower corner of the paper.

Possible Plants for Plant Collection

1. Coastal (California) Sagebrush (*Artemesia californica*) p. 116
2. California Buckwheat (*Eriogonum fasciculatum*) p. 143
3. Horehound (*Marrubium vulgare*)
4. Mulefat (*Baccharis salicifolia*)
5. Coast Live Oak (*Quercus agrifolia*) p. 108
6. Elderberry (*Sambucus mexicana*) p. 122
7. Toyon (*Heteromeles arbutifolia*) p. 127
8. Sugarbush (*Rhus ovata*) p. 120 ·
9. Monkey Flower (*Mimulus aurantiacus*) p. 167
10. Black Sage (*Salvia mellifera*)
11. White Sage (*Salvia apiana*) p. 157
12. Deerweed (*Lotus scoparius*) p. 160
13. Black Mustard (*Brassica nigra*) p. 158
14. Tree Tobacco (*Nicotiana glauca*) p. 124
15. Coyote Brush (*Baccharis pilularis*)
16. Curly Dock (*Rumex crispus*)
17. Jimsonweed (*Datura stramonium*) p. 159
18. Miner's Lettuce (*Claytonia perfoliata*) p. 165
19. Wild Cucumber (*Marah macrocarpus*) p. 150

Scientific Name: ____________________________
Common Name: ____________________________
Habitat: ___________________________________
Date: _____________________ No. _______
Collector: ________________________________

Scientific Name: ____________________________
Common Name: ____________________________
Habitat: ___________________________________
Date: _____________________ No. _______
Collector: ________________________________

Scientific Name: ____________________________
Common Name: ____________________________
Habitat: ___________________________________
Date: _____________________ No. _______
Collector: ________________________________

Scientific Name: ____________________________
Common Name: ____________________________
Habitat: ___________________________________
Date: _____________________ No. _______
Collector: ________________________________

Scientific Name: ____________________________
Common Name: ____________________________
Habitat: ___________________________________
Date: _____________________ No. _______
Collector: ________________________________

Scientific Name: ____________________________
Common Name: ____________________________
Habitat: ___________________________________
Date: _____________________ No. _______
Collector: ________________________________

Scientific Name: ____________________________
Common Name: ____________________________
Habitat: ___________________________________
Date: _____________________ No. _______
Collector: ________________________________

Scientific Name: ____________________________
Common Name: ____________________________
Habitat: ___________________________________
Date: _____________________ No. _______
Collector: ________________________________

Scientific Name: ____________________________
Common Name: ____________________________
Habitat: ___________________________________
Date: _____________________ No. _______
Collector: ________________________________

Scientific Name: ____________________________
Common Name: ____________________________
Habitat: ___________________________________
Date: _____________________ No. _______
Collector: ________________________________

Lab 5: Measuring Plant Species Diversity

* Lab written and designed by Dr. Cindy Shannon

Learning Objectives:

1. To acquire an understanding of some basic principles of ecology.
2. To expand the student's vocabulary to include the following ecological terms:

Ecology	Community
Ecosystem	Resources
Abiotic	Ecological Niche
Biotic	Vegetation Sampling
Habitat	Diversity

3. To develop an appreciation for the complex structure of an ecosystem, by observing the distribution of a plant community.
4. To learn to identify plants!

Introduction:

Ecology is the study of interrelationships between organisms and their environment. The word comes from the Greek "oikos", meaning home. Thus, the term ecology literally translates into the "study of home", reminding us that the planet Earth is the only home we have. This also reminds us that the students which use these lab techniques out in the field, are in someone's home, and the areas they work in should be treated as such~ We should try to disturb the environment in which we work as little as possible, and we should never take anything out with us that we didn't bring in or leave anything (such as litter) behind in the environment.

An **ecosystem** is any dynamic system of life, interacting with its biotic and abiotic factors, and the assemblages of organisms within it. A **biotic** factor is a biological environmental factor, such as the impact of other organisms competing for the same resources. An **abiotic** factor is a physical environmental factor effecting an organism's survival, such as temperature, climate, soil composition, and light. The availability of resources also influences the distribution of species. Resources can vary in differing habitats, which may have different" soil compositions, slope, and water availability.

The **habitat** refers to a specific environment in which an organism lives, and the **ecological niche** refers to the specific role that an organism plays in the environment. For example, the niche of a bullfrog is feeding on insects that fly over or land on the pond (its habitat) in which the frog lives. The ecological niche of a coast live oak tree would be extensive vertical growth, resulting in the ability to capture light energy for photosynthesis. Whereas, another species of plant which is more of a low growing "scrubby" species (such as California sage), would cover a larger horizontal surface in which photosynthesis would occur.

A **community** is the co-occurrence of different populations of different species in a particular habitat. The **diversity** of a community includes both the number of species in a community (richness), and the number of individuals of each species (abundance). In the early days of ecology, observation and description were considered adequate for recording the various aspects of a community. However, the need for quantitative data has made various sampling techniques necessary, since all members of a community usually cannot be measured or counted. We will use the line-intercept method to obtain relative frequency and relative density rankings for two different types of plant communities.

Procedure for Vegetation Sampling:

To compare the plant communities between two areas, we need to survey the plants found in each area. Vegetation surveys will be conducted using the line transect method. For this lab we will be surveying two coastal sage scrub habitats and collecting data in your field notebooks. Data will be analyzed later during lab 7.

Write a hypothesis stating which habitat will have the greatest plant diversity: _____
_____
_____

Write a hypothesis for which habitat will have the greatest density of native species: _____
_____
_____

Procedure:

1. Working in groups of 4-6, stretch a 15-meter tape between two group members, from a point that is picked randomly by your instructor in the study area once you arrive there.
2. The other members of the group, will record on the data sheet a tally of the number of individuals of each species which intercept (or come in contact with) the tape.
3. Once the data are recorded for one 15-meter length of tape, have the two group members holding each end of tape walk approximately five meters either to the left or right of the original line, so that they are now holding a second line transect parallel to the original one.
4. After these data are recorded, repeat this one more time so that you have data for three 15-meter lines in your habitat.
5. We will split up the class groups so that some class groups measure disturbed coastal sage scrub (CSS), and the others measure restored coastal sage scrub. Then we will combine our data in the form of a summary sheet, when we return to the lab room.

Name: _____

Section: _____

Line Transect Data Sheet

Date: _____ Observers: _____

Habitat: _____ Location: _____ Transect Number: _____

Plant Species	Number of Individuals Contacting Transect
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____
10. _____	_____
11. _____	_____
12. _____	_____

Trees
1. California Walnut (*Juglans californica)*
2. Coast Live Oak (*Quercus agrifolia*)
3. Elderberry (*Sambucus mexicana*)
4. Toyon (*Heteromeles arbutifolia*)
5. Tree Tobacco (*Nicotiana glauca*)

Shrubs
6. Buckwheat (*Eriogonum fasciculatum*)
7. Black Sage (*Salvia mellifera*)
8. Coastal Sagebrush (*Artemesia californica*)
9. Coyote Brush (*Baccharis pilularis*)
10. Deerweed (*Lotus scoparius*)
11. Monkey Flower (*Mimulus sp*.)
12. Mulefat (*Baccharis salicifolia*)
13. Pearly Everlasting (*Anaphalis margaritacea*)
14. Poison Oak (*Toxicodendron diversilobum*)
15. Prickly Pear Cactus (*Opuntia littoralis*)

Shrubs cont.
16. Scrub Oak (*Quercus dumosa*)
17. Nightshade (*Solanum sp*.)
18. Sugarbush (*Rhus ovata*)
19. White Sage (*Salvia apiana*)
20. Wild Cucumber (*Marah sp*.)
21. Bush Mallow (*Malacothamus fasciculatus*)

Forbs
22. Blue Dick (*Dichelostemma pulchella*)
23. Bull Thislte (*Cirsium vulgare*)
24. Grasses (Family Poaceae) includes oats (*Avena sp*.), rye (*Elymus sp*.) and bromegrass (*Bromus sp*.)
25. Horehound (*Marrubium vulgare*)
26. Miner's Lettuce (*Claytonia perfoliata*)
27. Mustard (*Brassica sp*.)
28. Stork's Bill (*Erodium sp*.)
29. Star Thistle (*Centaurea sp*.)

Name: _____

Section: _____

Line Transect Data Sheet

Date: _____ Observers: _____

Habitat: _____ Location: _____ Transect Number: _____

Plant Species	Number of Individuals Contacting Transect
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____
10. _____	_____
11. _____	_____
12. _____	_____

Trees
1. California Walnut (*Juglans californica*)
2. Coast Live Oak (*Quercus agrifolia*)
3. Elderberry (*Sambucus mexicana*)
4. Toyon (*Heteromeles arbutifolia*)
5. Tree Tobacco (*Nicotiana glauca*)

Shrubs
6. Buckwheat (*Eriogonum fasciculatum*)
7. Black Sage (*Salvia mellifera*)
8. Coastal Sagebrush (*Artemesia californica*)
9. Coyote Brush *(Baccharis pilularis*)
10. Deerweed (*Lotus scoparius*)
11. Monkey Flower (*Mimulus sp*.)
12. Mulefat (*Baccharis salicifolia*)
13. Pearly Everlasting (*Anaphalis margaritacea*)
14. Poison Oak (*Toxicodendron diversilobum*)
15. Prickly Pear Cactus (*Opuntia littoralis*)

Shrubs cont.
16. Scrub Oak (*Quercus dumosa*)
17. Nightshade (*Solanum sp*.)
18. Sugarbush (*Rhus ovata*)
19. White Sage (*Salvia apiana*)
20. Wild Cucumber (*Marah sp*.)
21. Bush Mallow (*Malacothamus fasciculatus*)

Forbs
22. Blue Dick (*Dichelostemma pulchella*)
23. Bull Thislte (*Cirsium vulgare*)
24. Grasses (Family Poaceae) includes oats (*Avena sp*.), rye (*Elymus sp*.) and bromegrass (*Bromus sp*.)
25. Horehound (*Marrubium vulgare*)
26. Miner's Lettuce (*Claytonia perfoliata*)
27. Mustard (*Brassica sp*.)
28. Stork's Bill (*Erodium sp*.)
29. Star Thistle (*Centaurea sp*.)

Name: _____

Section: _____

Line Transect Data Sheet

Date: _____ Observers: _____

Habitat: _____ Location: _____ Transect Number: _____

Plant Species	Number of Individuals Contacting Transect
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____
10. _____	_____
11. _____	_____
12. _____	_____

Trees
1. California Walnut (Juglans californica)
2. Coast Live Oak (*Quercus agrifolia*)
3. Elderberry (*Sambucus mexicana*)
4. Toyon (*Heteromeles arbutifolia*)
5. Tree Tobacco (*Nicotiana glauca*)

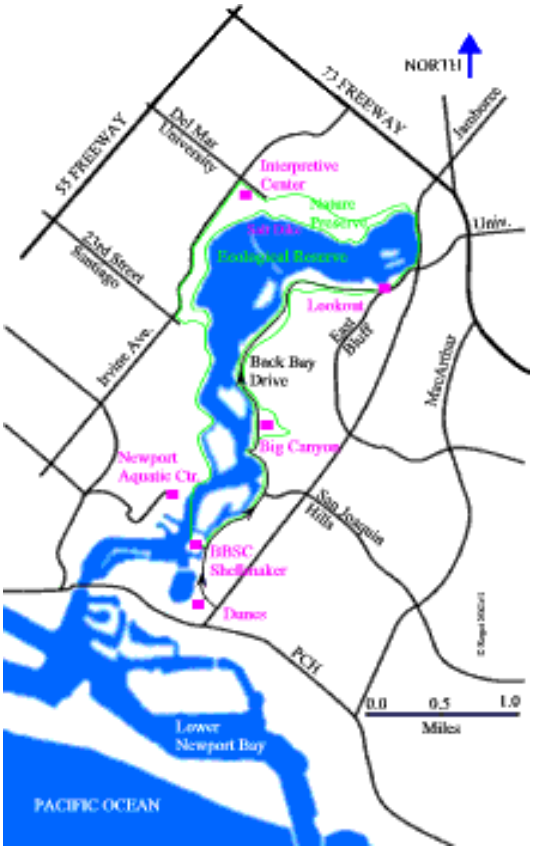
Shrubs
6. Buckwheat (*Eriogonum fasciculatum*)
7. Black Sage (*Salvia mellifera*)
8. Coastal Sagebrush (*Artemesia californica*)
9. Coyote Brush (*Baccharis pilularis*)
10. Deerweed (*Lotus scoparius*)
11. Monkey Flower (*Mimulus sp*.)
12. Mulefat (*Baccharis salicifolia*)
13. Pearly Everlasting (*Anaphalis margaritacea*)
14. Poison Oak (*Toxicodendron diversilobum*)
15. Prickly Pear Cactus (*Opuntia littoralis*)

Shrubs cont.
16. Scrub Oak (*Quercus dumosa*)
17. Nightshade (*Solanum sp*.)
18. Sugarbush (*Rhus ovata*)
19. White Sage (*Salvia apiana*)
20. Wild Cucumber (*Marah sp*.)
21. Bush Mallow (Malacothamus fasciculatus)

Forbs
22. Blue Dick (Dichelostemma pulchella)
23. Bull Thislte (*Cirsium vulgare*)
24. Grasses (Family Poaceae) includes oats (*Avena sp*.), rye (*Elymus sp*.) and bromegrass (*Bromus sp*.)
25. Horehound (*Marrubium vulgare*)
26. Miner's Lettuce (*Claytonia perfoliata*)
27. Mustard (*Brassica sp*.)
28. Stork's Bill (*Erodium sp*.)
29. Star Thistle (*Centaurea sp*.)

Newport Back Bay and Corona Del Mar Field Trip

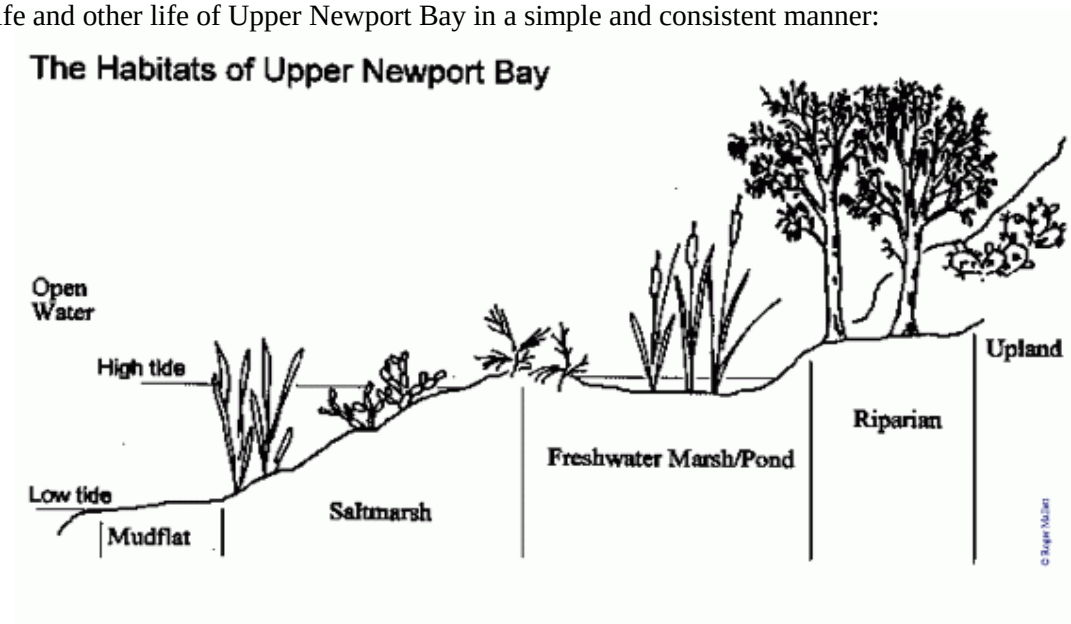
Upper Newport Bay (UNB) in Newport Beach is an estuary - a place where fresh and salt water meet and mix. It is one of only a few remaining estuaries in Southern California and is the home of nearly 200 species of birds, including several endangered species, as well as numerous species of mammals, fish, other critters and native plants. The Bay is an important stopover for migrating birds on the Pacific Flyway and up to 30,000 birds can be seen here on any day during the winter months. Its close proximity to the 73 Freeway makes Upper Newport Bay easily accessible to residents of Orange County and beyond. Many people come here to hike, cycle, canoe, kayak, fish or simply enjoy nature.



The UNB Ecological Reserve was created in 1975 as result of the purchase of 527 acres of land in and around the bay from the Irvine Company and the transfer of 214 acres of tidal wetlands from the County of Orange to the State. An additional 11 acres of land in Big Canyon was added in 1982 bringing the total acreage of the Ecological Reserve to 752 acres. It is managed by the California Department of Fish and Game (DFG). In 1990 the County of Orange acquired 140 acres of bluffs on the north and north-west sides of the bay for the creation of a Regional Park. The Regional Park was rededicated as the UNB Nature Preserve in 2000. It is managed by the County of Orange Department of Harbors, Beaches and Parks (HBP).

A habitat is a type of place where a particular animal or plant or group of animals and plants is most at home. In this type of place the general combination of food, water, shelter and space allows these plants and animals to thrive. Within any one geographical area there may be several habitats. The classification of habitats is a subject of much debate among naturalists. Some bird watchers, for instance, feel that as few as five habitats are sufficient to define where birds are seen at Upper Newport Bay. On the other hand some botanists have defined as many as 13 different habitats and as many as 21 distinct plant communities here at the Bay.

The set of six habitats shown below has been found to be of most benefit in categorizing the plants, birds, marine life and other life of Upper Newport Bay in a simple and consistent manner:



Open Water – The bay itself as distinct from the bottom or the shores of the bay. Fish swim in open water and seabirds are seen overhead. The water is teeming with plankton. Seaweeds (algae) and submerged marine plants such as eel grass may be present.

Mudflat – The areas of the shore exposed at low tide. As the name implies these areas are generally muddy and flat. Plant life is limited to algae. Worms, mollusks and other marine critters are found in abundance in the mud and shore birds are seen pecking at the surface or probing below the surface of the mud for food.

Saltmarsh – The area of the shore from the mud flats to the high tide line. The plants in this area are adapted to being submerged in water and growing in salty soils. Cord grass thrives from the mid tide region upwards. Pickleweed is found in abundance in the high tide region and adjacent dry land which has salty soil.

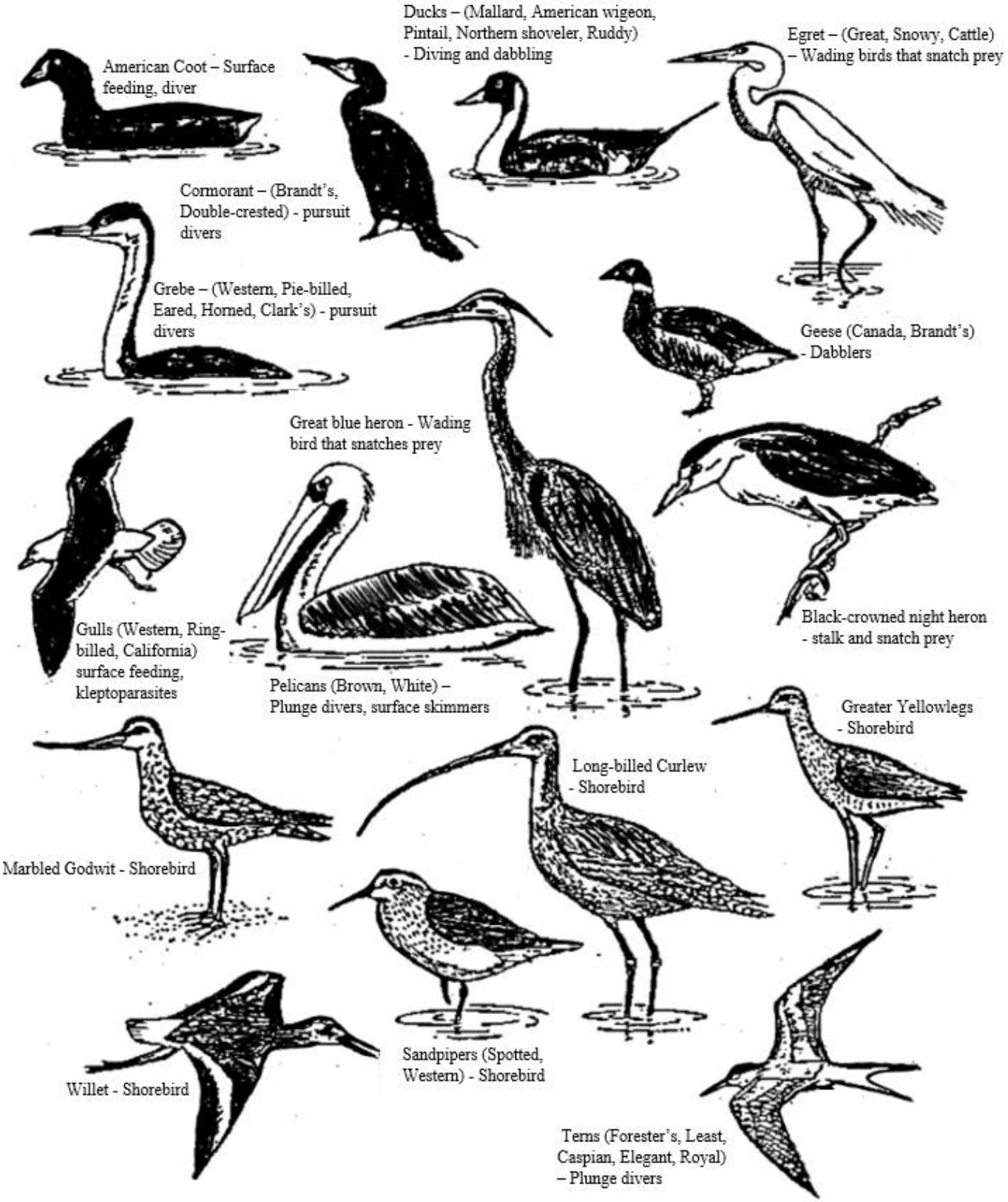
Freshwater Marsh/Pond – Water-loving plants such as cattails and sedges grow in and around the water. Many of these plants can tolerate mild to moderate salinity. Freshwater fish, crayfish and other critters live here. Numerous ducks will be found here, particularly in winter.

Riparian – The area along side a river or stream or on the banks of a lake or pond. The plants in this area like moist soil but do not necessarily grow in the water. Willows are common. Cottonwoods and other trees and large shrubs are found. Bushtits, finches and hummingbirds will be seen here.

Upland – The bluffs, cliffs and undeveloped mesas around the bay make up the upland habitat. The dry slopes abound with sagebrush and drought-resistant succulents such as ice plant and cactus are found. Turkey vultures and other birds of prey are at home here. They are seen soaring effortlessly in the upward currents of warm air along the bluffs.

Many plants and animals may be found in more than one habitat and the boundary between two habitats is not necessarily well-defined. In particular, because Upper Newport Bay is an estuary, the distinction between saltwater and freshwater marsh is not always clear. There is a region where the seawater coming in from the ocean and the freshwater entering from San Diego Creek mix. Here the water is moderately saline (salty). It is said to be brackish. This brackish region changes as a result of both the twice-daily ebb and flow of the tide and the big seasonal difference in flow along the creek.

One of the things that makes Upper Newport Bay so interesting and exciting is the ability to experience so many different habitats on a short nature walk. At Big Canyon algae, cord grass, pickleweed, salt grass, cattail, willow and cactus can all be seen in a quarter of a mile hike. Terns, sandpipers, ducks, songbirds, hawks and many more birds are found there.


American Coot – Surface feeding, diver
Ducks – (Mallard, American wigeon, Pintail, Northern shoveler, Ruddy) - Diving and dabbling
Egret – (Great, Snowy, Cattle) – Wading birds that snatch prey
Cormorant – (Brandt's, Double-crested) - pursuit divers
Grebe – (Western, Pie-billed, Eared, Horned, Clark's) - pursuit divers
Geese (Canada, Brandt's) - Dabblers
Great blue heron - Wading bird that snatches prey
Black-crowned night heron - stalk and snatch prey
Gulls (Western, Ring-billed, California) surface feeding, kleptoparasites
Pelicans (Brown, White) – Plunge divers, surface skimmers
Greater Yellowlegs - Shorebird
Long-billed Curlew - Shorebird
Marbled Godwit - Shorebird
Sandpipers (Spotted, Western) - Shorebird
Willet - Shorebird
Terns (Forester's, Least, Caspian, Elegant, Royal) – Plunge divers

Species Checklist for Newport Back Bay

Species	When	Where
GREBES		
__Pied-billed Grebe (b)	W	OW
__Eared Grebe	W	OW
__Western Grebe	W	OW
__Clark's Grebe	W	OW
PELICANS		
__Brown Pelican	W	OW
__White Pelican	W	OW
CORMORANTS		
__Double-crested Cormorant	Y	OW
HERONS & BITTERNS		
__Great Blue Heron	Y	TF,SM
__Great Egret	Y	TF,SM
__Snowy Egret	Y	TF,SM
__Green Heron	Y	TF,SM
__Black-crowned Night Heron	Y	FW,TF,SM
DUCKS		
__Green-winged Teal	W	SM,TF
__Mallard (b)	Y	SM,TF,FW
__Northern Pintail	W	SM,TF
__Blue-winged Teal	W	SM,TF,FW
__Cinnamon Teal (b)	Y	SM,TF,FW
__Northern Shoveler	W	SM,TF,FW
__American Wigeon	W	SM,TF,FW
__Canvasback	W	OW,FW
__Lesser Scaup	W	OW
__Surf Scoter	W	OW
__Bufflehead	W	OW
__Ruddy Duck	W,S	FW
GULLS & TERNS		
__Ring-billed Gull	Y	OW,TF
__California Gull	Y	OW,TF
__Western Gull (b)	Y	OW,TF
__Caspian Tern (b)	Y	OW,TF
__Elegant Tern (b)	S	OW,TF
__Forster's Tern (b)	Y	OW,TF
__Least Tern, California (b)	S	OW,TF
SKIMMERS		
__Black Skimmer (b)	Y	OW,TF

Species	When	Where
RAILS & COOTS		
__Ridgeway's Rail (b)	Y	SM
__Sora	W	SM,FW
__American Coot (b)	Y	OW,SM,TF
PLOVERS		
__Black-bellied Plover	Y	TF,SM
__Semipalmated Plover	W	TF
__Killdeer (b)	Y	TF
STILTS & AVOCETS		
__American Avocet (b)	Y	TF
SANDPIPERS		
__Willet	Y	FW,TF
__Greater Yellowlegs	W	TF
__Spotted Sandpiper	Y	FW,TF
__Whimbrel	Y	FW,TF
__Long-billed Curlew	Y	FW,TF
__Marbled Godwit	W	TF
__Dunlin	W	TF
__Western Sandpiper	W	TF
__Least Sandpiper	W	TF
__Short-billed Dowitcher	W	TF
__Long-billed Dowitcher	W	TF
VULTURES		
__Turkey Vulture	Y	UP,SM
HAWKS		
__Northern Harrier (b)	Y	SM,UP
__Red-shouldered Hawk (b)	Y	SM,UP
__Red-tailed Hawk (b)	Y	SM,UP
__Osprey (b)	Y	SM
FALCONS		
__American Kestrel (b)	Y	SM,UP
__Peregrine Falcon	Y	SM,UP
__White-tailed Kite	Y	SM,UP
OWLS		
__Great Horned (b)	Y	UP
__ Barn Owl (b)	Y	UP

Species	When	Where
SHRIKES		
__Loggerhead Shrike (b)	Y	UP
PIGEONS & DOVES		
__Rock Pigeon (b) (i)	Y	UP
__Mourning Dove (b)	Y	SM,UP
HUMMINGBIRDS		
__Anna's Hummingbird (b)	Y	UP
SWIFTS		
__White-throated Swift	Y	TF,SM
TYRANT FLYCATCHERS		
__Black Phoebe (b)	Y	TF,SM
__Say's Phoebe	W	SM,FW
SWALLOWS		
__No. Rough-winged Swallow (b)	S	UP
__Cliff Swallow (b)	S	UP
__Barn Swallow (b)	S	FW
CROWS & JAYS		
__American Crow (b)	Y	FW,UP
__ Raven (b)	Y	UP
BUSHTITS		
__Bushtit (b)	Y	FW,UP
WRENS		
__Marsh Wren (b)	Y	FW
__Cactus Wren (b)	Y	UP
GNATCATCHERS		
__California Gnatcatcher (b)	Y	UP
MOCKINGBIRDS		
__Northern Mockingbird (b)	Y	UP
PIPITS		
__American Pipit	W	TF
STARLINGS		
__European Starling (b) (i)	Y	TF,UP
WOOD WARBLERS		
__Orange-crowned Warbler	W	FW
__Yellow-rumped Warbler	W	TF,UP
__Common Yellowthroat (b)	Y	TF
__Wilson's Warbler	S,F	UP

Species	When	Where
SPARROWS		
__California Towhee	Y	UP
__Savannah Sparrow, Belding's (b)	Y	TF,SM
__Savannah Sparrow, (other sub-species)	W	UP
__Song Sparrow (b)	Y	FW,UP
__Lincoln's Sparrow	W	FW,UP
__Golden-crowned Sparrow	W	UP
__White-crowned Sparrow	W	UP
BLACKBIRDS & ORIOLES		
__Red-winged Blackbird (b)	Y	FW
__Western Meadowlark (b)	Y	UP
__Brewer's Blackbird (b)	Y	UP
__Brown-headed Cowbird (b)	Y	UP
__Hooded Oriole	SU	UP
FINCHES		
__House Finch (b) (i)	Y	UP
WEAVER FINCHES		
__House Sparrow (b)	Y	UP

Legend

S = Spring (Mar-May) Su = Summer (June – Aug)

F = Fall (Sep – Nov) W = Winter (Dec – Feb)

Y = Year round FW = Fresh Water Up = Uplands

OW = Open water TF = Tidal flats SM = Salt Marsh

(b) = Breeds at reserve or nearby (i) = Introduced

Plants:

1.___ *Baccharis emoryi*
2.___ Beach-Bur (*Ambrosia chamussonis*)
3.___ Beach Evening Primrose (*Camissonia cheirantbifolia*)
4.___ Bulrush (*Scirpus sp*.)
*5.*___ Cattails (*Typha sp*.)
6.___ Cocklebur (Xantbium s.pinosum)
7.___ Coyote Brush <Baccharis pilularis)
8.___ Dodder (Cuscuta sp.)
9.___ Fennel (Foeniculum wlgare)
10.___ Ice-Plant (Gasoul crystallinum)
11.___ Mule Fat (Baccharis glutinosa)
12.___ Pickleweed (Salicornia bigelovii)
13.___ Nightshade (Solanum elaeagnifolium)
14.___ Saltbush (Atriplex s.p.)
15.___ Saltgrass (Distichlis spicata)
16.___ Sand Verbena (Abronia maritima)
17.___ Sea Rocket (Cak:ile maritima)
18.___ Toyon (Heteromeles arbutifolia)
19.___ Telegraph Weed (Heterotheca grandiflora)
20.___ Tree Tobacco (Nicotiana glauca)

Mammals:

l.___ Califormia Ground Squirrel (Spermophilus beecheyi)
2.___ Desert Cottontail (Sylvilcigus audubonii)
3.___ Harbor Seal (Phoca vitulina)
4.___ other: _____

Herps:

1.___ Side-blotched Lizard (Uta stansburiana)
2.___ Western Fence Lizard (Sceloporous occidentalis)
3.___ other: _____

Misc. (You can just put these in the journal section):

Gnats, Gray Smoothhound Shark, Green Algae (Enteromorpha), Mosquito fish, Sardines, Round Stingray. As you write your species account sections, you may want to study over the ones that appear in the "Nature of California" text.

The Rocky Intertidal

The coastline of Los Angeles-Orange Counties is a series of rocky shores and sandy beaches interspersed with bays, harbors and estuaries. Rocky shores are areas of shoreline where exposed rocks make up the substrate. In southern California, the rocky shores are usually bordered by large cliffs and sandy beaches border these areas. Beaches with sections of rocky shoreline in southern California include Corona Del Mar, Laguna Beach, and Dana Point. Sandy beaches are the areas of shoreline covered with sand, which is most of our local beaches including Newport Beach and Huntington Beach. Bays and harbors are coastal inlets that are typically sheltered from intense wave action. In southern California we have the LA and Long Beach Harbor which together make up one of the largest Harbors in the world and the busiest container shipping port in the United States. Estuaries are coastal inlets where fresh water runoff from coastal drainages meets the salt water from the ocean. Southern California estuaries include Upper Newport Back Bay, and Bolsa Chica Ecological Reserve.

Tides play a critical role in intertidal communities with the periodic exposure brought on by the changing tides leading to various adaptations in intertidal organism. In southern California there are two tidal cycles every day high tides and low tides peaking about every 6 hours. Tides are created by gravity, which holds the water int eh ocean basins, and by the gravitational pull from celestial bodies (sun and moon). The gravitational pull of the sun and moon depends on size and distance of the object with the m being small but very close, resulting in a large effect, while the sun is large but far away, which results in less of a tidal effect. The greatest tides occur when the gravitational pull of the sun and moon are in alignment, which are called spring tides. Spring tides occur during full and new moons and can be 3 times greater than neap tides. Neap tides are less extreme and occur when the sun, earth, and moon are not in direct alignment. Neap tides occur during first and last quarter moons. The lunar cycle results in a changing tidal cycle with a set of spring tides occurring every 2 weeks, with a set of neap tides occurring the week between the spring tides.

One of the things we will be studying while at Corona Del Mar is the zonation within he rocky intertidal. Zonation is arrangement of different marine organisms in horizontal bands or zones along the shoreline. The intertidal zones differ in their elevation above sea level, and thus, their exposure during the different periods of the tidal cycle. The four recognized intertidal zones in southern California include:

a. Spray (Splash) Zone – 5.0 feet and above sea level
b. High Tide Zone – 2.5 to 5.0 feet above sea level
c. Middle Tide Zone – 0.0 to 2.5 feet above sea level
d. Low Tide Zone – Below sea level

Intertidal organisms are typically found in one or two of these zones, but not all of the zones. Often limits of the intertidal zone are often defined by the presence or absence of particular organisms. The differences in the intertidal zones have to do with the variation in the amount of exposure each zone receives, and the other environmental conditions encountered by the organisms in each zone.

Although the rocky intertidal zone is an incredibly diverse ecosystem, it is also one of the more challenging environments on earth for organisms live. Intertidal organisms have to deal with the constant wave action, periods of exposure that can lead to desiccation (drying out), changes in temperature and salinity within the tide pools, competition for space and food, and the threat of predators. All of these environmental challenges have led to the evolution of various adaptations within intertidal organisms. The reason for our visit to the rocky intertidal community is because there is arguably no other habitat in southern California where we can see such diverse phyla, and also observe the various adaptations organisms have evolved to survive in their environment.

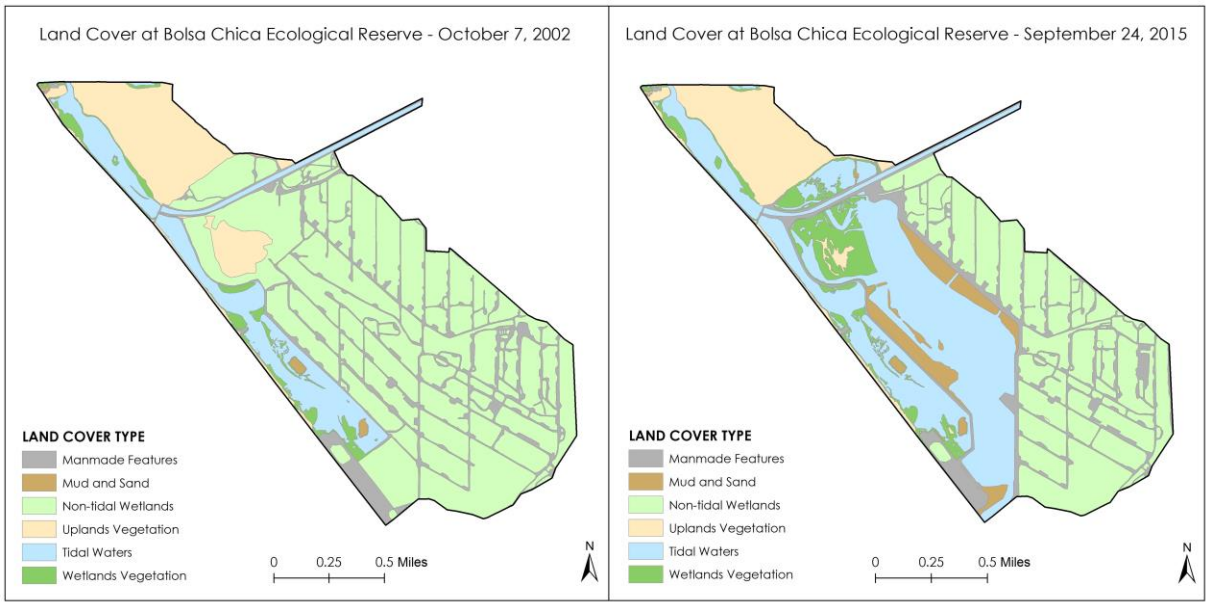
Lab 6: Bolsa Chica Ecological Reserve Field Trip

The Bolsa Chica Ecological Reserve (BCER) is approximately 1,449 acres of coastal estuary located in Huntington Beach, California. It is the largest saltwater marsh between Monterey Bay and Tijuana River Estuary. The ecological reserve has several different habitats including open water, mudflats, salt marsh, coastal dunes, seabird nesting islands, riparian, and freshwater marsh, which are home to a variety of different species. The reserve is an important migratory stop and nesting site for many bird species, with more than 350 bird species recorded at the reserve. The reserve is also home to some federally and/or state protected species the California Least Tern (*Sternula antillarum browni*), Western Snowy Plover (*Charadrius nivosus nivosus*), California Clapper Rail (*Rallus longirostris obsoletus*), and Belding's Savanna Sparrow (*Passerculus sandwichensis beldingi*), which are listed as either threatened or endangered by California Department of Fish and Wildlife or the U.S Department of Fish and Wildlife.

Humans have occupied the area in and around the Bolsa Chica Ecological Reserve for around 8,000 years, which is an estimate based on the discovery of cogged stones in the area. Cogged stones are round disks with grooves or notches around the edges, which are believed to have been used in Native American ceremonies. Various Native American tribes occupied the area until the Spanish colonized the area in the 1700's. Spanish colonization and the foreign diseases they brought with them led to the death of most of the Native Americans in the area.

In the late 1800's a hunting club built a dam across the inlet to prevent salt water from entering the wetlands so they could create fresh water ponds to attract ducks. The addition of the dam drastically altered the ecology of the wetland for over a hundred years. The discovery of oil in Huntington Beach in 1920 also transformed the coastal landscape with addition of hundreds of oil derricks along the coast.

In 1972 California passed the Coastal Act which led to the designation of the Bolsa Chica Ecological Reserve in 1973. Since then, community organizations and government agencies have worked to expand the preserve and restore the Bolsa Chica wetland to its original splendor. As part of the restoration effort, an inlet was created to allow salt water to flow into areas of the wetland that were blocked by the construction of the dam some hundred years earlier. He formation of the full tidal basin has allowed many marine species to use the reserve as a nursery, while also expanding the number of nesting sites for birds.



Species	When	Where
GREBES		
__Pied-billed Grebe (b)	W	OW
__Eared Grebe	W	OW
__Western Grebe	W	OW
__Clark's Grebe	W	OW
PELICANS		
__Brown Pelican	W	OW
__White Pelican	W	OW
CORMORANTS		
__Double-crested Cormorant	Y	OW
HERONS & BITTERNS		
__Great Blue Heron	Y	TF,SM
__Great Egret	Y	TF,SM
__Snowy Egret	Y	TF,SM
__Green Heron	Y	TF,SM
__Black-crowned Night Heron	Y	FW,TF,SM
DUCKS		
__Green-winged Teal	W	SM,TF
__Mallard (b)	Y	SM,TF,FW
__Northern Pintail	W	SM,TF
__Blue-winged Teal	W	SM,TF,FW
__Cinnamon Teal (b)	Y	SM,TF,FW
__Northern Shoveler	W	SM,TF,FW
__American Wigeon	W	SM,TF,FW
__Canvasback	W	OW,FW
__Lesser Scaup	W	OW
__Surf Scoter	W	OW
__Bufflehead	W	OW
__Ruddy Duck	W,S	FW
GULLS & TERNS		
__Ring-billed Gull	Y	OW,TF
__California Gull	Y	OW,TF
__Western Gull (b)	Y	OW,TF
__Caspian Tern (b)	Y	OW,TF
__Elegant Tern (b)	S	OW,TF
__Forster's Tern (b)	Y	OW,TF
__Least Tern, California (b)	S	OW,TF
SKIMMERS		
__Black Skimmer (b)	Y	OW,TF

Species	When	Where
RAILS & COOTS		
__Ridgeway's Rail (b)	Y	SM
__Sora	W	SM,FW
__American Coot (b)	Y	OW,SM,TF
PLOVERS		
__Black-bellied Plover	Y	TF,SM
__Semipalmated Plover	W	TF
__Killdeer (b)	Y	TF
STILTS & AVOCETS		
__American Avocet (b)	Y	TF
SANDPIPERS		
__Willet	Y	FW,TF
__Greater Yellowlegs	W	TF
__Spotted Sandpiper	Y	FW,TF
__Whimbrel	Y	FW,TF
__Long-billed Curlew	Y	FW,TF
__Marbled Godwit	W	TF
__Dunlin	W	TF
__Western Sandpiper	W	TF
__Least Sandpiper	W	TF
__Short-billed Dowitcher	W	TF
__Long-billed Dowitcher	W	TF
VULTURES		
__Turkey Vulture	Y	UP,SM
HAWKS		
__Northern Harrier (b)	Y	SM,UP
__Red-shouldered Hawk (b)	Y	SM,UP
__Red-tailed Hawk (b)	Y	SM,UP
__Osprey (b)	Y	SM
FALCONS		
__American Kestrel (b)	Y	SM,UP
__Peregrine Falcon	Y	SM,UP
__White-tailed Kite	Y	SM,UP
OWLS		
__Great Horned (b)	Y	UP
__ Barn Owl (b)	Y	UP

Species	When	Where
SHRIKES		
__Loggerhead Shrike (b)	Y	UP
PIGEONS & DOVES		
__Rock Pigeon (b) (i)	Y	UP
__Mourning Dove (b)	Y	SM,UP
HUMMINGBIRDS		
__Anna's Hummingbird (b)	Y	UP
SWIFTS		
__White-throated Swift	Y	TF,SM
TYRANT FLYCATCHERS		
__Black Phoebe (b)	Y	TF,SM
__Say's Phoebe	W	SM,FW
SWALLOWS		
__No. Rough-winged Swallow (b)	S	UP
__Cliff Swallow (b)	S	UP
__Barn Swallow (b)	S	FW
CROWS & JAYS		
__American Crow (b)	Y	FW,UP
__ Raven (b)	Y	UP
BUSHTITS		
__Bushtit (b)	Y	FW,UP
WRENS		
__Marsh Wren (b)	Y	FW
__Cactus Wren (b)	Y	UP
GNATCATCHERS		
__California Gnatcatcher (b)	Y	UP
MOCKINGBIRDS		
__Northern Mockingbird (b)	Y	UP
PIPITS		
__American Pipit	W	TF
STARLINGS		
__European Starling (b) (i)	Y	TF,UP
WOOD WARBLERS		
__Orange-crowned Warbler	W	FW
__Yellow-rumped Warbler	W	TF,UP
__Common Yellowthroat (b)	Y	TF
__Wilson's Warbler	S,F	UP

Species	When	Where
SPARROWS		
__California Towhee	Y	UP
__Savannah Sparrow, Belding's (b)	Y	TF,SM
__Savannah Sparrow, (other sub-species)	W	UP
__Song Sparrow (b)	Y	FW,UP
__Lincoln's Sparrow	W	FW,UP
__Golden-crowned Sparrow	W	UP
__White-crowned Sparrow	W	UP
BLACKBIRDS & ORIOLES		
__Red-winged Blackbird (b)	Y	FW
__Western Meadowlark (b)	Y	UP
__Brewer's Blackbird (b)	Y	UP
__Brown-headed Cowbird (b)	Y	UP
__Hooded Oriole	SU	UP
FINCHES		
__House Finch (b) (i)	Y	UP
WEAVER FINCHES		
__House Sparrow (b)	Y	UP

Legend

S = Spring (Mar-May) Su = Summer (June – Aug)

F = Fall (Sep – Nov) W = Winter (Dec – Feb)

Y = Year round FW = Fresh Water Up = Uplands

OW = Open water TF = Tidal flats SM = Salt Marsh

(b) = Breeds at reserve or nearby (i) = Introduced

Lab 7: Data Analysis and Graphing

Background:

Species diversity within a biological community is an important measure when determining the health and resilience of the ecosystem. When considering species diversity, one must consider two different components of diversity: (1) species richness and (2) species evenness. Species richness is defined as the total number of species within a given community, whereas the species evenness is a measure of the relative abundance of each species in a community in relation to the abundance of all other species in that community. For example, a community with 10 different species, each representing 10% of the total abundance, would result in a community with high evenness. Conversely, a community with 10 different species where 9 species each make up 1% of the community and one species makes up the remaining 91% of the community, would signify a community with low evenness or high dominance (dominance is the inverse of evenness). There are a number of different indices used to measure species richness and evenness, however, for this lab we will be using the Shannon-Wiener Diversity Index (H'), which provides a measure of both species richness and evenness. The Shannon-Wiener Index is perhaps the most commonly used index for determining the diversity of biological communities. To determine the level of evenness within the community we will be using another index known as the Simpson's Index of Dominance (D). For this exercise we will be taking the reciprocal of the Simpson's Index to aid in interpretation later. After determining the H' values for each community, we will use a statistical test known as a Hutcheson's t-test which was developed to determine if there is a significantly different in the diversity between the two communities.

Objectives:

- Analyze the plant transect data
- Analyze survey data from the field trips
- Learn how to create formulas and graphs in Excel

Procedure:

Plant transect data

As a class, create a species list for the two habitat types on the board starting with native species followed by non-native species. Representatives from each survey group will fill in the data table on the board with the data collected during the plant surveys so that the entire class can use the combined data set. Working in groups of 2 or 3 (from your survey group), check out a laptop from the lab cabinet and login to the computer using the Login: student; Password: student. Open the Microsoft Excel sheet titled Bio 3 Data Analysis. Using the "Plant transects" sheet, fill in the data tables marked Disturbed CSS and Restored CSS with the data on the board. In order to compare the plant diversity between the two sites we need to summarize the data using the following calculations.

Calculations:

1. **Abundance** = number of individuals of each species that intercept the line.

- These are the raw data values entered into the data table

2. **Total Abundance** = the total number of individuals of each species found within a given habitat.

- To determine total abundance of each species enter the formula =sum("range of values") at the end of the first row for the first species. After obtaining the correct value, drag down to populate the rest of the cells.

3. **Relative Abundance** = number of individuals of one species as a percentage of the total number of individuals of all species

- The basic formula is as follows: $\frac{\text{Number of individuals of each species}}{\text{Total number of individuals of all species}} \times 100$

- In Excel, first determine the total number of individuals in each habitat by sing the formula =sum("range of values") at the base of the column labeled Total. After the total number of individuals has been determined, use the formula =("total of each species/total individuals for each habitat)*100
-
- Before populating all the remaining cells, add the $ symbol in front of the column and cell number to ensure Excel will always refer to that exact cell when determining the relative abundance values for the remaining species.
    - i.e. =(L4/$L$18)*100; where L4 is the total individuals of coastal sage scrub in disturbed CSS, and L18 is the total number of individuals of all species within disturbed CSS

3. **Relative Frequency** = number of occurrences of one species as a percentage of the total number of occurrences of all species

- The basic formula is as follows: $\frac{\text{Number of transects each species occurs in}}{\text{Total number of transects}} \times 100$

- In Excel, use the formula =(COUNTIF("range of values,">0")/total number of transects)*100. The COUNTIF function will only count the transects where the species was present (> 0).
    - i.e. =(COUNTIF(C4:K4,">0")/9)*100

4. **Shannon-Wiener Diversity Index (H')** = an index that represents the species richness and evenness of a given community

- The basic formula is as follows: $H' = -\Sigma\ [(p_i)(\ln p_i)]$
    - where p_i = (# of individuals of each species/ total # of individuals in each community)

- In Excel, use the formula = (total individuals of each species/ total individuals of all species within a community) for determining p_i.
    - i.e. p_i of buckwheat =L5/$L$18

- To determine the natural log of pi, use the formula =ln(p_i)
    - i.e. ln(pi) of buckwheat = ln(L5)

- To calculate the pi x the ln(pi) of each species, use the formula =(pi)*(ln(pi))
    - i.e. =O4*Q4

- Finally, to determine H' use the formula = -(sum(range of all (pi)*ln(pi) values)
    - i.e. =-(sum(R4:R17))

5. **Simpson's Index of Dominance (D)**: an index that represents the evenness of the diversity within a biological community

- The basic formula is as follows: $D = \Sigma(p_i)^2$, and the formula for the reciprocal inverse of $D = 1/\ \Sigma(p_i)^2$
- In Excel, determine p_i^2 use the formula =(pi of a given species)^2
- To determine D use the formula =1/(sum(range of p_i^2 values)

6. **Hutcheson's t-test:** a statistical test used to compare the differences in the diversity of two communities based on the Shannon-Wiener Diversity Index

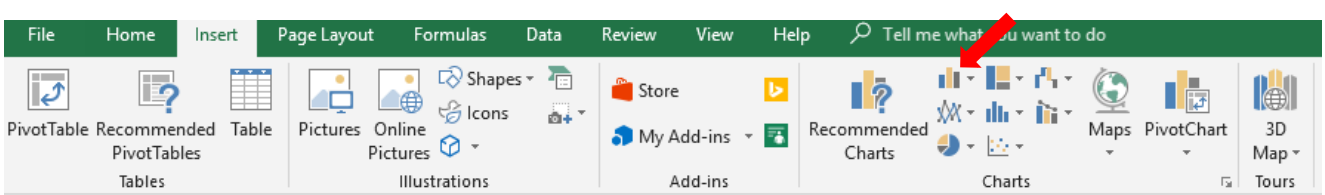
- The basic formula is as follows: $t = \dfrac{H_a - H_b}{\sqrt{S^2H_a + S^2H_b}}$
  - Where H_a and H_b represent the Shannon-Wiener Diversity Indices for the two communities, and S^2H represents the variance for the two indices.
  - The formula for S^2H in as follows: $S^2H = \dfrac{\Sigma\, p_i(\ln p_i)^2 - (\Sigma\, p_i \ln p_i)^2}{N} + \dfrac{(S-1)}{2N^2}$
    - Where S = species richness (total number of species in each community) and N = the total number of individuals in each community.
- For all calculations relating to the Hutcheson's t-test, please use the preset formulas within the spreadsheet. The instructor will help you with these calculations once you get to this part of the calculations.

Results:

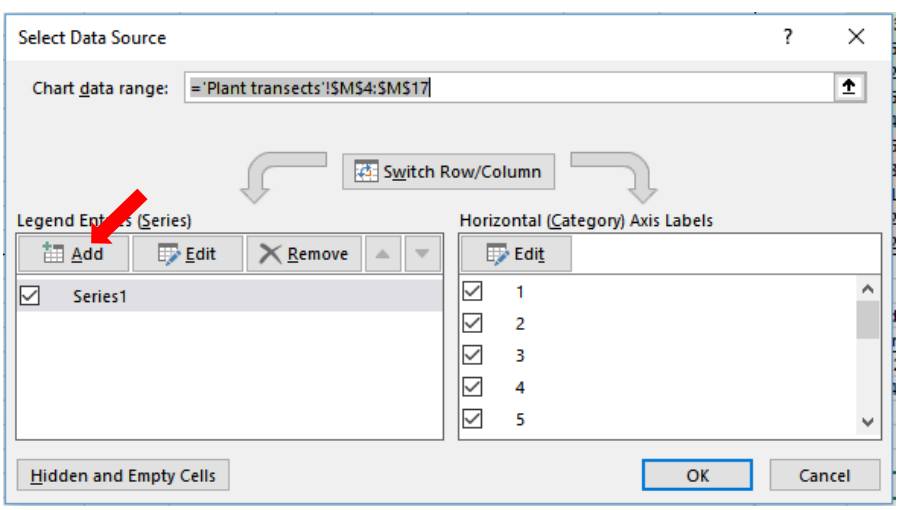
The results of your calculations are often expressed using figures or tables. Follow the directions below to construct figures representing your calculations for the two communities.

Part I. Create a figure showing the relative abundance of the different plant species within the two plant communities.

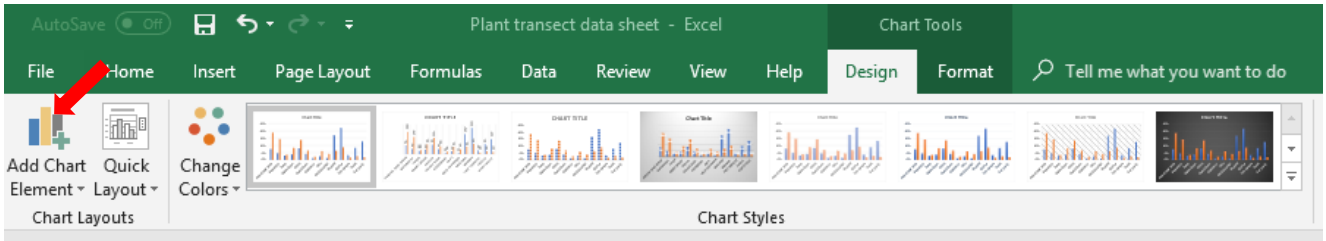
1. Highlight the relative abundance of all species within the disturbed CSS
2. Once highlighted select the Insert tab then click on the bar graph icon, then select the Clustered Column under the 2D Column options.



3. Once the figure appears click on the plot area, then right click to get a scroll down menu. In the menu choose the select data option
4. Once the Select Data Source window opens, select the Add button under the Legend Entries (Series)

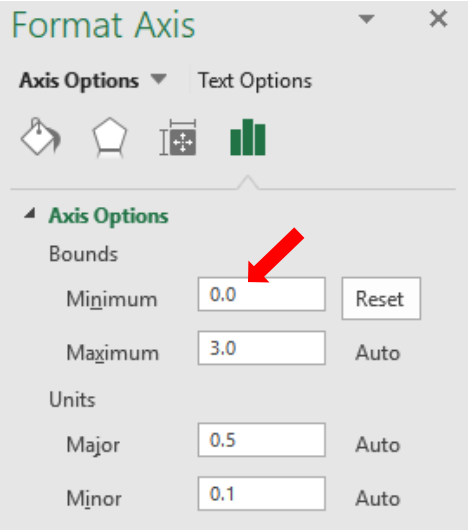


5. Once the Edit Series window opens enter Restored CSS in the Series name section, then select the range of relative abundance values for the species in the restored CSS table for the series values.
6. After adding the Restored CSS abundance data select the edit button for Series 1 and change the series name to Disturbed CSS.
7. Add the species names as the x-axis labels by selecting the edit button under the Horizontal (Category) Axis Labels box. Once the Axis Labels window opens select the range of different species within either table (they should be the same).
8. After adding the data to the table, add a chart title, axis labels and a legend using the Add Chart Element tab under the Design ta within Chart Tools.



Part II. Create figures comparing the Shannon-Wiener Diversity Index and Simpson's Index of Dominance for each plant community.

1. Highlight the data and headings for the Shannon-Wiener Diversity Index values, then select the Insert tab and 2-D Clustered Column Graph.
2. After the graph is created adjust the scale of the y-axis value by selecting on the y-axis, then right clicking the mouse to revel the scroll down menu. In the scroll down menu select the format axis option.
3. In the axis options window, adjust the minimum value in the bounds category to 0.



After the bar graph for the Shannon- Wiener Diversity Index is created, create another graph for the Simpson's Index of Dominance.

Interpretation and Discussion:

The discussion section is where researchers evaluate their findings and address their original hypotheses. As part of your final assignment you will be asked to submit a paper with your original hypotheses, a description of the transect methods, your results (figures described above), and a discussion section where you consider your findings.

Interpreting your Indices

The Shannon-Wiener Diversity Index (H') assumes that all species within a given community are represented in your sampling data, and that all sampling was done at random. Can you think of any issues with these assumptions? The Shannon-Wiener Diversity Index is a single value that represents both the richness and evenness within a community. While this is a strength of the index, it is also a weakness because it makes it difficult to compare communities that differ greatly in richness. Values for the Shannon-Wiener Diversity Index typically range from 1.5 to 3.5, with greater index values indicating increases of both richness and evenness within a community.

The Simpson's Index of Dominance (D) is based on the probability that if two individuals are drawn at random from the same community, then they will belong to the same species. One issue with the index is that it will gives more weight to common or dominant species within a community, while rare species within a community will not affect the diversity value. Can you see how these assumptions may be an issue? By taking the inverse of index, the greater the value for D the greater the diversity evenness of the community with the maximum number equaling the total number of species within the community.

Answer the following questions to help you in writing your discussion section.

1. Look at your group's relative abundance and relative frequency values, what are the dominant plants in each area? What species are rare within each area? _____

_____

_____

2. Do your findings support or refute your hypotheses? Explain. _____

_____

_____

3. What plant community had the greatest species diversity? Which had the greatest evenness? _____

_____

_____

4. What factors might account for any differences between the two plant communities? Explain. _____

_____

_____

5. How do you think knowing the diversity and distribution of species in an environment, helps ecologists understand the interactions that occur there between organisms in their environment? _____

_____

_____

6. How do you think this knowledge of interaction might aid in preserving our environment? (For example, consider the rapid development of hillsides similar to those surrounding Mt. SAC). _____

_____

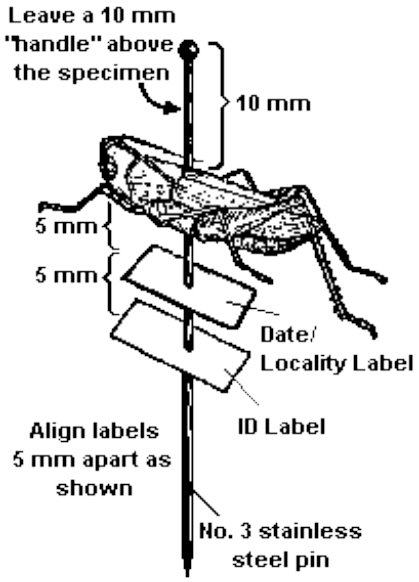
_____

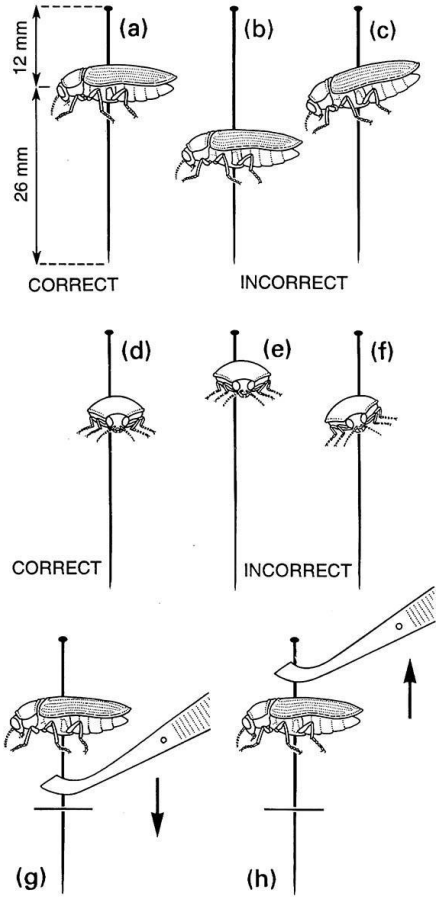
Lab 8: Insect Collection and Preservation

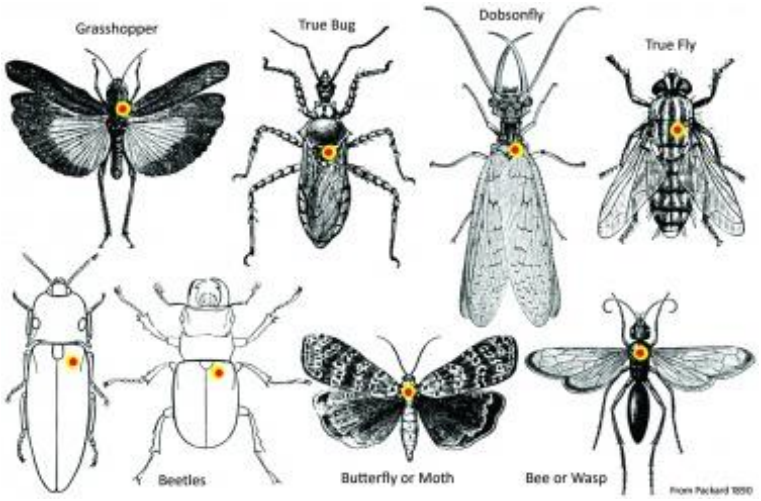
Similar to the collection and preservation of plants, the collection and preservation of animals, including insects, are an important to the study and understanding of diversity and adaptation among living things. For this lab we will tour the wildlife sanctuary and campus to collect local insect species using a collection net and collection jar. We will return to lab to pin the insects we collect although each student will be required to collect a minimum of five different insect species. Students will also have time to finish pining insects during lab time in the following weeks. Use the dichotomous key for common insect orders to begin the identification of the insects you collect. Students will be expected to know the following list of insect orders introduced in the dichotomous key. Use the insect labels and guidelines provided to complete you insect collection.

Insect Orders you need to know:

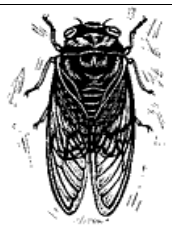
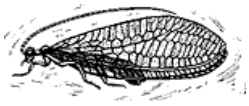
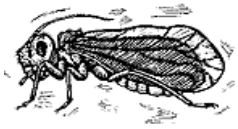
Diptera	Isoptera
Lepidoptera	Coleoptera
Homoptera	Hemiptera
Blattodea	Odonata
Hymenoptera	Orthoptera

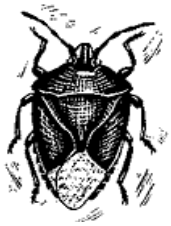


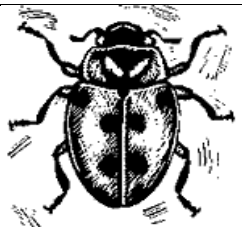




STEP	CHARACTERS	ORDER / CLASS
1a	One pair of wings. . . . . go to 2	
1b	Two pairs of wings. . . . . go to 3	
2a	Hind wings reduced to tiny knobs (halteres), tip of abdomen without 2-3 thread-like tails	 **DIPTERA** (Flies)
2b	Hind wings not reduced to tiny knobs, tip of abdomen with 2-3 thread-like tails **(caudal filaments)**	 **EPHEMEROPTERA** (Mayflies)
3a	Front and hind wings have similar texture. . go to 4	
3b	Front wings a rigid or leathery covering for clear hind wings. . .go to 14	
4a	Wings covered with powdery scales, mouthparts usually a coiled tube **(proboscis)** for sucking	 **LEPIDOPTERA** (Moths / Butterflies)
4b	Wings not covered with powdery scales, mouthparts not a coiled tube. . . . . go to 5	
5a	Wings slope downwards (rooflike) from the center at rest. . . .go to 6	
5b	Wings not held rooflike at rest. . . . go to 9	
6a	Wings covered with hair	 **TRICHOPTERA** (Caddisflies)
6b	Hairless wings. . . . go to 7	

7a	Sucking mouthparts in the form of a rigid beak, often short and bristley antennae, body may look like a thorn	 **HOMOPTERA** (Hoppers)
7b	Mouthparts not in the form of a rigid beak, antennae not short and bristley, body never looks like a thorn. . . . go to 8	
8a	Wings with many cross veins	 **NEUROPTERA** (Lacewings)
8b	Wings without many cross veins	 **PSOCOPTERA** (Bark lice)
9a	Front and hind wings similar in size and shape. . . . go to 10	
9b	Front and hind wings not similar in size and shape. . . .go to 12	
10a	Antennae always short and bristley	 **ODONATA** (Dragonflies & Damselflies)
10b	Antennae never short and bristley. . . .go to 11	
11a	Wings held flat over abdomen when at rest, last abdominal segment not enlarged, usually found in colonies	 **ISOPTERA** (Termites)

11b	Wings not held flat over abdomen when at rest, males with the last abdominal segment enlarged like a scorpion's stinger and held over the body, not found in colonies	 **MECOPTERA** (Scorpionflies)
12a	Body very soft, without a narrow "waist". . .go to 13	
12b	Body not exceptionally soft, often with a narrow "waist"	 **HYMENOPTERA** (Bees & Wasps)
13a	Hind wings wider than front wings, folded underneath like a fan	 **PLECOPTERA** (Stoneflies)
13b	Hind wings much smaller than front wings, not folded underneath like a fan	 **EPHEMEROPTERA** (Mayflies)
14a	Sucking mouthparts in the form of a rigid beak, front wings with clear tips **(hemelytra)**, overlapping at rest, revealing a triangular panel on the back **(scutellum)**	 **HEMIPTERA** (True Bugs)
14b	Chewing mouthparts, front wings without clear tips. . . go to 15	

15a	Rigid front wings **(elytra)** meet in a straight line down the middle of the back	 **COLEOPTERA** (Beetles)
15b	Front wings not as above. . . .go to 16	
16a	Head visible from above. . . . .go to 17	
16b	Head hidden from above by a hoodlike structure **(pronotum)**	 **BLATTODEA** (Cockroaches)
17a	Front legs strong with prominent spines for grasping prey, hind legs long and slender	 **MANTODEA** (Mantids)
17b	Front legs without spines or with weak spines, the femora of the hind legs are enlarged for jumping	 **ORTHOPTERA** (Grasshoppers & Crickets)

Insect Collection Labels

Scientific Name: _________________
Common Name: _________________
Habitat: ________________________
Date: _____________ No. ______
Collector: ______________________

Scientific Name: _________________
Common Name: _________________
Habitat: ________________________
Date: _____________ No. ______
Collector: ______________________

Scientific Name: _________________
Common Name: _________________
Habitat: ________________________
Date: _____________ No. ______
Collector: ______________________

Scientific Name: _________________
Common Name: _________________
Habitat: ________________________
Date: _____________ No. ______
Collector: ______________________

Scientific Name: _________________
Common Name: _________________
Habitat: ________________________
Date: _____________ No. ______
Collector: ______________________

Scientific Name: _________________
Common Name: _________________
Habitat: ________________________
Date: _____________ No. ______
Collector: ______________________

Scientific Name: _________________
Common Name: _________________
Habitat: ________________________
Date: _____________ No. ______
Collector: ______________________

Scientific Name: _________________
Common Name: _________________
Habitat: ________________________
Date: _____________ No. ______
Collector: ______________________

Scientific Name: _________________
Common Name: _________________
Habitat: ________________________
Date: _____________ No. ______
Collector: ______________________

Scientific Name: _________________
Common Name: _________________
Habitat: ________________________
Date: _____________ No. ______
Collector: ______________________

Lab 9: Introduction to Amphibians, Reptiles, and Mammals

* Lab created by Dr. Cindy Shannon and modified by Tyler Flisik

Objective: To learn the basic characteristics of amphibians, reptiles and mammals to learn how to identify local examples.

AMPHIBIANS & REPTILES

The study of amphibians and reptiles is called herpetology. Therefore, the term "herps" is often used to refer to these organisms.

Amphibians are classified in the kingdom system as follows:

Kingdom: Animalia

Phylum: Chordata

Class: Amphibia

Order: Anura = frogs and toads

Order: Urodela = newts and salamanders

Examples of amphibians would include frogs, toads, salamanders and newts. Their characteristics include a "double life." Which refers to their 2-phase life style. They are usually aquatic while developing from egg to juvenile, and semi-terrestrial as a juvenile and adult. Metamorphosis refers to a change in body form, so that the young form looks different than the adult. Most amphibians undergo metamorphosis from aquatic larvae that breathe using gills, to a terrestrial adult that breathes using lungs. Amphibians have no amniotic layer around their egg (instead the egg is often surrounded by jelly layers), so the egg must be laid in water. Amphibians practice cutaneous respiration (skin breathers) to obtain oxygen in addition to gills as larvae and lungs as adults. Some also use buccal respiration (respiration through the mouth and pharynx.

Unlike reptiles, amphibians lack scales, so the skin of amphibians is smooth, moist and slippery, and they have mucus glands to keep their skin from drying out. The mucus secreted from the mucus glands also makes them hard to hold onto for predators. Many amphibians also produce toxins that can be secreted from specialized poison glands when they are attacked. Amphibians do not have true nails or claws, although some have a modified projection of the epidermis, but it is not a true claw. Their teeth are homodont (all the same), except toads, which are toothless. Similar to most reptiles, amphibians have a three-chambered heart (2 atria, 1 ventricle), while birds, crocodiles and mammals have a four chambered heart (2 atria, 2 ventricles). Amphibians have a brain with 10 cranial nerves, which send information received by the sensory receptors to the brain. This differs from reptiles, birds, and mammals which have 12 cranial nerves. Most amphibians have enlarged pelvic and pectoral girdles, which allows them to better support their body weight on land. All amphibians are ectotherms, so their body temperature depends on heat derived externally. Furthermore, amphibians are not as good at body temperature regulation as reptiles, so amphibians tend to have body temperatures about 20-22 degrees Celsius (68-72 degrees F) and compared to the reptiles which range from 25-40 degrees Celsius (77-104 degrees F).

Reptiles are classified in the kingdom system as follows:

Kingdom: Animalia

Phylum: Chordata

Class: Reptilia

Order: Testudines = turtles and tortoises

Order: Squamata = lizards and snakes

Order: Crocodilians = crocodiles and alligators

Examples of reptiles include lizards, snakes, turtles, crocodiles and alligators. Reptiles, birds, and mammals have an egg encased within amniotic fluid (amniotic egg), which allows them to lay their eggs outside of the water. Some reptiles and most mammals retain the egg and develop the fetus internally, then give birth to live young (viviparity). Another characteristic, which was key to their invasion of land, is the keratinized scales that cover the skin of reptiles. These scales are homologous with the hair of mammals and the feathers of birds. The cornified portion (dead cells) of the epidermis is frequently shed in healthy reptiles and resulting in new growth. If the reptile is in poor health, it tends to have difficulty shedding due to the amount of energy require to produce new scales. Most reptiles have true claws made of keratin, with some snakes having a single claw or spur on each side of their anal opening, which are the vestigial hind limbs once present in snake ancestors. Unlike amphibians, reptiles do not have an aquatic larval stage, so all reptiles have lungs, although there are some turtles and sea snakes that practice cutaneous respiration to extend the length of their dives. Most reptiles have a three-chambered heart (2 atria, 1 ventricle) except the crocodilians, which have a four-chambered heart. While turtles and crocodilians have a single erectile penis, male snakes and lizards have a pair of reproductive organs known as a hemi-penis. Reptiles tend to have more teeth than amphibians, with most reptiles having homodont dentition, although some lizards are heterodont and crocodilians are thecodont (teeth are in sockets). Similar to amphibians, reptiles are ectothermic, relying on the external environment to control their internal body temperature.

HERPETOLOGY LAB SPECIMENS

AMPIBIANS

Salamanders:

1. California Newt
2. California Slender Salamander

Frogs & Toads:

1. Spadefoot toad
2. Western Toad
3. Leopard Frog
4. California Treefrog
5. Pacific Treefrog
6. Bullfrog

REPTILES

Turtles

1. Desert Tortoise

Lizards:

1. Western Whiptail
2. Desert Homed Lizard (NOT a horny toad!!)
3. Collard Lizard
4. Desert Iguana
5. Alligator Lizard

Lizards cont.

6. Zebratail Lizard
7. Western Fence Lizard
8. Side-blotched Lizard
9. Western Skink
10. Spiny Lizard
11. Chuckwalla

Snakes:

1. Rosy Boa
2. Striped Racer
3. Racer
4. Coachwhip
5. Long-nosed Snake
6. Common Kingsnake
7. Ringneck Snake
8. Spotted Leaf-nosed Snake
9. Gopher Snake
10. Western Rattlesnake
11. Red Diamondback Rattlesnake
12. Sidewinder
13. Western Blind Snake

Name: _____

HERPATOLOGY LAB QUESTIONS

1. Why do amphibians need to live near water? _____

_____

2. Describe 5 evolutionary advances that reptiles have over amphibians:

1._____
2._____
3._____
4._____
5._____

3. What is the difference between a frog and a toad? _____

_____

4. How is a salamander different from a lizard? _____

_____

5. What is the spade on a spadefoot toad for? _____

6. How do you tell a western toad from a spadefoot toad? _____

_____

7. Describe a leopard frog's spots: _____

8. What two characteristics will help you tell a treefrog from any other frog? _____

_____

9. Describe the physical characteristics of a bullfrog: _____

_____

10. Which lizard has a mottled or marbled appearance, and a VERY long tail? _____

11. Which lizard has a row of enlarged or raised scales down the middle of its back? _____

12. Which lizard has distinct blackish crossbands on its back, and a fold down the side of its body with short stubby legs?_____

13. Describe the following lizards:

Side-blotched: _____

Western fence: _____

Western whiptail: _____

14. Describe the rosy boa: _____

_____

15. Which snake is reddish, has a black patch on the neck and looks like a braided whip? What do you notice about the eyes on this snake? _____

_____

16. How can you tell the striped racer, long-nosed snake and common kingsnake apart? _____

_____

17. Which of the snakes in the previous question eats other snakes? _____

18. Which snake hisses and rustles in leaves like a rattlesnake, but is nonvenomous? _____

What do you think this snake eats? _____

19. What is the difference between a poisonous animal and a venomous animal? _____

_____

19. What 3 traits should you look for to identify a rattlesnake:

1. _____
2. _____
3. _____

20. Describe the following rattlesnakes:

Western: _____

Red Diamond: _____

Sidewinder: _____

21. What is the best course of action for a venomous snake bite?_____

_____

_____

MAMMALOGY

The study of mammals is called mammalogy A wide variety of mammals occur in California including opossums, moles, squirrels, bats, rabbits, beavers, bears, coyotes, deer, seals, dolphins, whales. and many more!

Mammals are classified in the kingdom system as follows:

Kingdom Animalia

Phylum Chordata

Class Mammalia

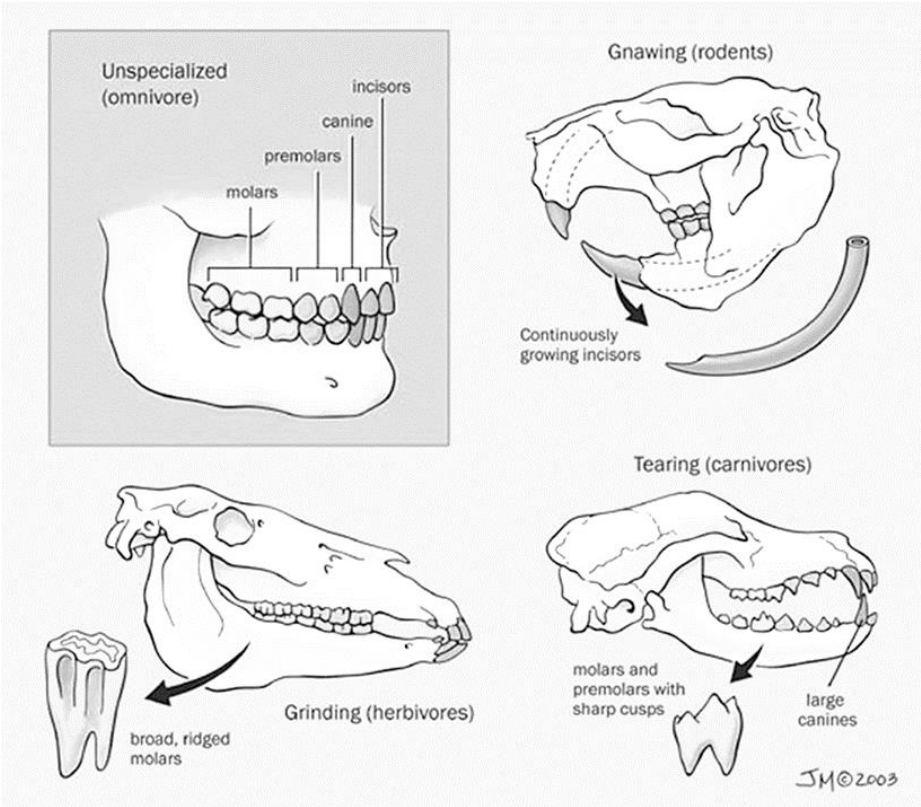
Order: Monotremata = egg laying mammals (platypus, echidna)

Infraclass: Marsupalia = marsupial mammals (koala, kangaroo, opossum)

Infraclass: Eutharia = placental mammals (rodents, cetaceans, dogs, cats, ungulates)

Mammals have multiple shared, derived characteristics that define mammals. First, all mammals have mammary glands (milk glands), which is where the taxonomic group gets its name. Milk is a lipid rich nutrient source for developing offspring and is one of the reasons for the high survival rates of most mammals. Most mammals have hair or fur, often over the whole body. This insulates them and allows them to have a fairly constant body temperature (homeotherms). Some mammals found in warm climates, like elephants, rhinos and hippos, have very little hair covering their bodies, but have very thick skin and other adaptations for cooling. Whales and porpoises are hairless, and instead rely on blubber for insulation. Other mammal characteristics include muscular diaphragm that separates the abdominal cavity from the chest cavity, and single lower jaw bone called a mandible, three inner ear bones and red blood cells without a nucleus. All mammals have a 4-chambered heart (2 atria, 2 ventricles) and a left aortic arch. Mammals have herterdont dentition, which means they have different teeth that serve different functions. Most mammals also have diphodont dentition, which means they have a first set of teeth that are later replaced by a second and final set of teeth. Like crocodilians, mammals also have teeth set in sockets, which is known as thecodont dentition. Mammals have a hard palate, which is a bony palate separates the mouth from the nasal cavity allowing mammals to breathe while eating. Mammals are endothermic homoeotherms that generate their own body temperature internally and maintain a relatively constant body temperature. Almost all mammals give live birth (viviparity), with the exception of the platypus and echidnas with lay an egg like reptiles (oviparity). Mammals have a large cerebral cortex portion of the brain, which is responsible for interpretation of sensory information and higher reasoning. At the base of the skull where the spinal vertebrate articulate with the skull, mammals have two projections known as occipital condyles. This characteristic separates them from bird and reptiles which only have a single occipital condyle.

Mammals are typically divided into three major groups based on their form of reproduction. Monotremes, which include the platypus and echidna, lay eggs externally like a bird or reptile. Similar to reptiles the mammal eggs have a leathery shell, rather than a hard shell like that of birds. Monotremes lack nipples and instead secrete milk from their mammary glands. All monotremes are limited to Australia and New Guinea. Marsupials give live birth to underdeveloped young that finish their development in a marsupium or pouch. The only marsupial native to North America is the Virginia opossum (*Didelphis virginiana*). Eutherian mammals give birth to live young that a fully developed within a placenta. Eutherian mammals are by far the largest group of mammals, with world wide distribution. Eutherians are divided into numerous taxonomic orders including rodentia (rodents), chiroptera (bats), carnivora (dogs, cats, bears, weasals, pinnipeds), afrotheria (elephants, manatees, hyrax), lagoorpha (rabbits and hares), perissidacyla (horses, rhinos) and cetartiodactyla (bovine, camels, pigs, deer, cetaceans).



MAMMALOGY LAB SPECIMENS

MARSUPIAL
1. Opossum (marsupial)

EUTHERIANS
2. Armadillo
3. California Mole (insectivore)

Rodentia:
4. Pocket Gopher
5. California Ground Squirrel
6. Western Gray Squirrel
7. White-tailed Antelope Ground Squirrel
8. Northern Flying Squirrel
9. Chipmunk
10. Brush Mouse
11. California Mouse
12. Deer Mouse
13. California Pocket Mouse
14. House Mouse
15. Harvest Mouse
16. Meadow Mouse
17. Desert Kangaroo Rat (K-Rat)
18. Pacific Kangaroo Rat (K-Rat)
19. Woodrat
20. Norway Rat

Chiroptera:
21. Western Pipistrelle Bat
22. Pallid Bat

Carnivora:
23. River Otter/Sea Otter
24.Beaver
25. Mountain Beaver
26. Long-tailed Weasel
27. Coyote
28. Domestic Dog
29. Housecat
30. Mountain Lion
31. Black Bears

Lagomorphs:
32. Desert Cottontail
33. Black-tailed Jackrabbit

Cetartiodactyla:
34. Mule Deer (Black-tailed deer)
35. White-tailed Deer
36. Pronghorn
37. Bighorn sheep

Name: _____

MAMMALOGY LAB QUESTIONS

1. Provide four characteristics unique to mammals:

1. _____
2. _____
3. _____
4. _____

2. Name some mammals that have little or no hair/fur: _____

_____

3. Compare the size of the eyes and ears on the mole, gopher and deer mouse. Explain why these characteristics may differ between these rodents._____

_____

4. How can you tell a chipmunk from a squirrel? _____

_____

5. Which mammal has front feet that are broader than they are long, a naked nose, no external ears and pin size eyes? How might these characteristics reflect the life style of this mammal? _____

_____

6. Which rodent has tiny ears and eyes and very long incisors? How might these characteristics reflect the life style of this mammal? _____

_____

7. How can you tell a California ground squirrel from a western-gray squirrel? _____

_____

8. Describe the morphology of the white-tailed antelope ground squirrel: _____

_____

9. What do you notice about the size of the eyes on the northern flying squirrel? How might this characteristic reflect the life style of this mammal? _____

_____

10. Compare the morphology of the California mouse and deer mouse:

Which has a tail that is shorter than its body?_____

Which has very large ears?_____

11. Compare the woodrat, Norway rat and kangaroo rats:

Which has a tuft of hair on the end of the tail? _____

Which has a naked tail? _____

Which has a long tail that is lightly furred with no tuft at the end? _____

Which has very large hind legs in comparison to the front legs?_____

Which is also known as a "packrat"? _____

12. Describe the following:

California Pocket Mouse: _____

House mouse: _____

Harvest mouse: _____

13. How can you tell a desert cottontail from a black-tailed jackrabbit? _____

_____

14. How does the fur of the beaver differ from that of the coyote? Why? _____

_____

15. Beaver, like all rodents, have continuously growing incisors, however the incisors of the beaver also contain high level s of iron giving them their orange color. Why might the beaver and not other rodents have high levels of iron in their incisors? _____

_____

16. Are both bears in the museum black bears? How do you know? _____

_____

17. What are some other names for a mountain lion? _____

18. How is the tragus of the two kinds of bats on display different? _____

_____

19. Which ungulate has "true horns"' instead of antlers? _____

20. Which deer has antlers that branch equally? Which deer’s antlers branch from a main beam? _____

_____

21. Which mammal has armor? _____

22. Which mammal has grayish fur, a white face, a rat-like tail and a pouch? _____

23. Which ungulate is from Africa and would only be seen in California in a zoo? _____

Lab 10: Introduction to Birds

*Lab created by Dr. Cindy Shannon, with portions from “Life All Around Us” by Schmidt, Vail, Kakiba-Russell and Revell.

Objective: To learn the basic characteristics of birds, and to learn how to identify local examples.

INTRODUCTION

The study of birds is called ornithology. Birds are the most studied of all vertebrates, because most are diurnal (active during the day) and they are conspicuous. There are over 600 different bird species recorded in California so learning the anatomical features of birds will help you in identifying the various species. It is important to understand the terms for the different parts of the bird, including the crown, nape, breast, rump, flank and vent, as these are commonly used in bird descriptions for identification. Two important characteristics in identifying the ecological niche of a particular bird species is to consider the bill shape and the location and habitat you observed the bird in. We will review different bill shapes and their functions as part of this lab.

Birds are classified in the kingdom system as follows:

Kingdom: Animalia

Phylum: Chordata

Class: Reptilia

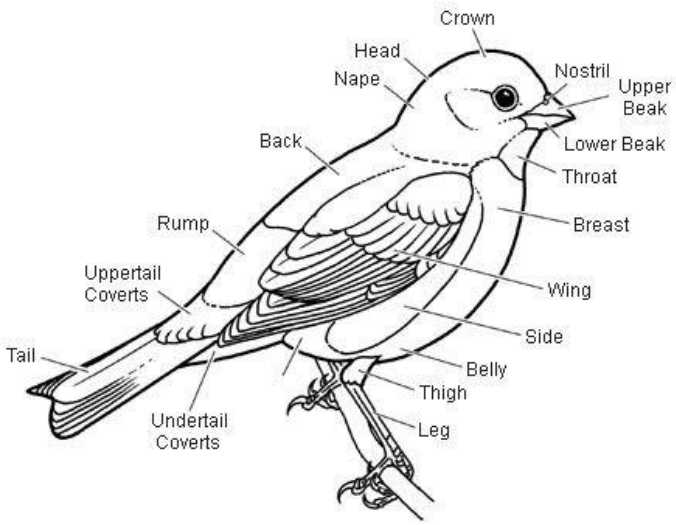
Clade: Aves

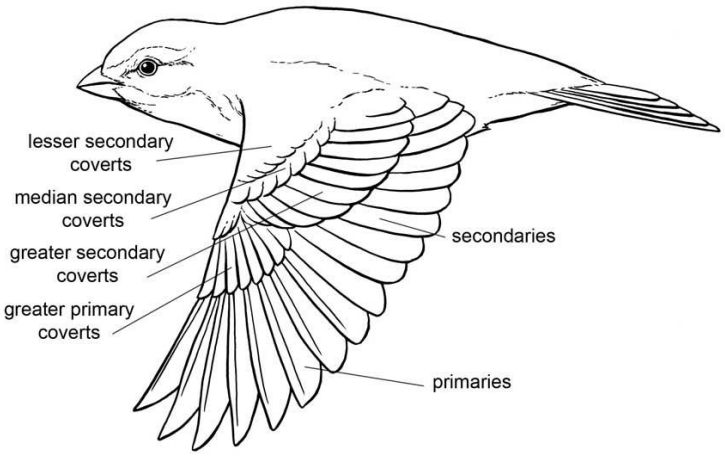
A shared, derived characteristic (synapomorphy) for all birds is the presence of feathers. It is hypothesized that feathers likely evolved as a thermoregulatory benefit, but then became coadapted for flight. The forelimb bones of birds have been reduced and modified into wings, while their hind limbs are adapted for walking, swimming or perching. Similar to their reptile ancestors, birds have scales present on their feet, however, unlike most reptiles bird lack teeth. The skeleton of birds is adapted for flying, with lightweight bones, many of which have been fused together for weight reduction and increased strength. Similar to mammals and crocodiles, birds have a 4-chambered heart, but birds have a right aortic arch instead of a left aortic arch present in mammals. Other adaptations for flight include the presence of extensive air sacs throughout their body and the lack of a urinary bladder. All birds are oviparous, with female birds laying eggs outside the mother's body. Like mammals, birds are endothermic homeotherms that generate their own body heat internally and also maintain a relatively constant body temperature. Unlike mammals, birds lack sweat glands which aid in evaporative cooling. Birds have a uropygial gland at the base of the tail which secretes an oily substance that birds use to preen and waterproof their feathers. Birds have a single occipital condyle for articulation of the skull with the vertebrate, which allows them to rotate their head 180 degrees. Owls have additional adaptations that allow them to rotate their heads 240 degrees. Similar to reptiles and monotreme mammals, birds have a single opening for expelling waste (uric acid) and semen, known as a cloaca. Uric acid requires much less water to produce than urine, which is one reason why mammals are not active in the desert when birds are active. Bird beaks vary in shape according to what a bird eats and how it eats. A sparrow's bill is conical in shape for crushing seeds, while a warbler's bill is pointed for eating insects, while shorebirds may have long, thin bills used to probe in the mud for invertebrates. Many birds have different "plumages" for different times of year, mainly breeding and nonbreeding seasons. In some species the male and female plumages look different (sexual dimorphism), but in others it is the same.

ORNITHOLOGY LAB SPECIMENS

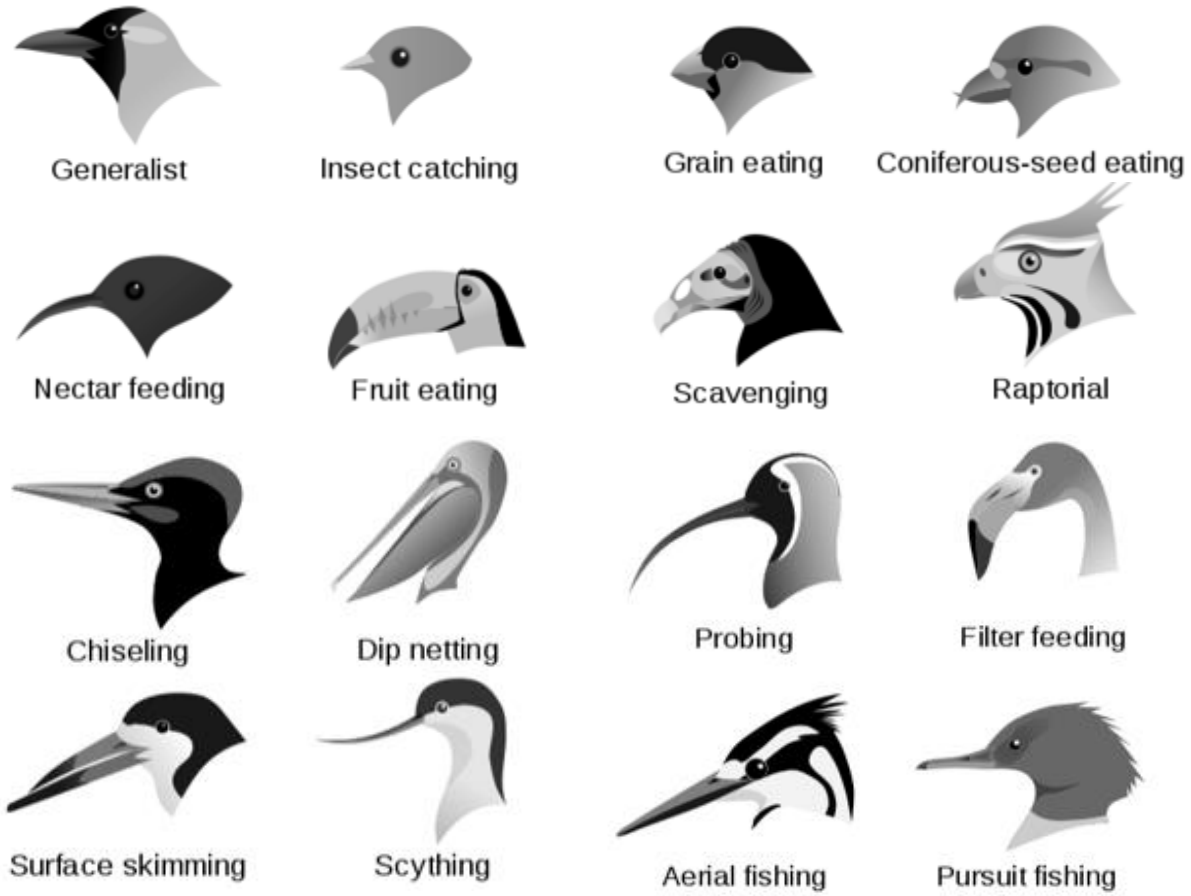
1. Brown Pelican
2. Ring-necked Pheasant
3. Great Homed Owl
4. Merganser
5. Mallard
6. Mourning Dove
7. Barn Owl
8. Golden Eagle
9. Western Meadowlark
10. Cooper's Hawk
11. Band-tailed Pigeon
12. California Thrasher
13. Cedar Waxwing
14. Brewer's Blackbird
15. Western Kingbird
16. Yellow-rumped Warbler
17. Hooded Oriole
18. Cactus Wren
19. Ash-throated Flycatcher
20. Brown-headed Cowbird
21. Red-winged Blackbird
22. Belted Kingfisher
23. Black-tailed Gnatcatcher
24. Western Scrub Jay
25. Northern Oriole
26. Wilson's Warbler
27. Bewick's Wren
28. House Wren
29. Spotted Towhee
30. California Towhee
31. Black-headed Grosbeak
32. American Kestrel
33. Mountain Bluebird
34. European Starling
35. Western Tanager
36. Say's Phoebe
37. Black Phoebe
38. Burrowing Owl
39. American Crow
40. Bushtit
41. American Robin
42. Northern Flicker
43. Acorn Woodpecker
44. Nutall's Woodpecker
45. White-breasted Nuthatch
46. White-crowned Sparrow
47. White-headed Woodpecker
48. Anna's Hummingbird
49. Loggerhead Shrike
50. Forster's Tern
51. Dowitcher
52. Gambel's Quail
53. California Quail
54. Killdeer
55. Roadrunner
56. House Sparrow
57. Mountain Chickadee
58. Western Bluebird
59. Red-tailed Hawk
60. Northern Mockingbird
61. Eared Grebe
62. Vermillion Flycatcher
63. House Finch
64. American Goldfinch
65. Black-necked Stilt
66. Barn Swallow

External Anatomy of Birds





Beak Shape and Diet Type



Wing Shape and Type of Flight

Active Soaring Wings
Long and narrow. Excellent for soaring (flying without flapping) over water as long as wind currents are favorable.

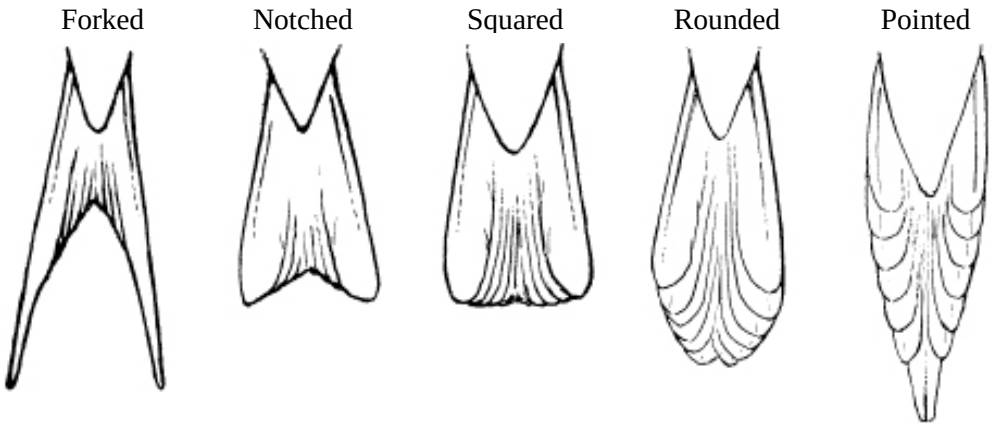
Passive Soaring Wings
Long and broad wings ending in long primary feathers with wide gaps in between. These slots help the bird take advantage of columns of rising hot air, allowing it to soar without reliable wind currents.

Elliptical Wings
Optimized for bursts of fast, tightly controlled flight. Excellent at taking off quickly, maneuvering through branches, and avoiding predators. Ordinary flight is slow and usually requires flapping.

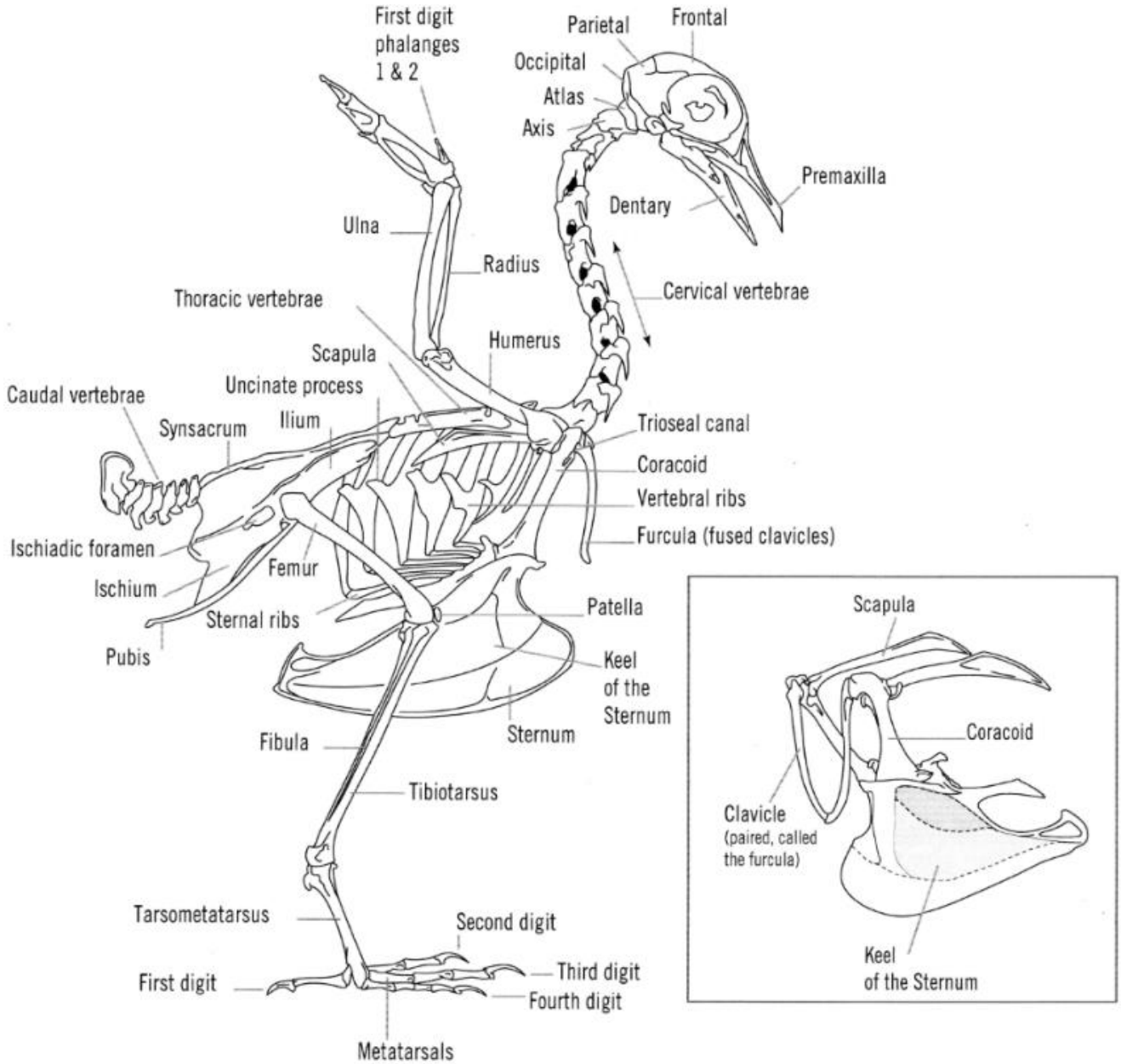
High-Speed Wings
Medium-long and narrow, optimized for sustained speed.

Hovering Wings
Small relative to body size. Excellent for tightly controlled flight and hovering. Articulates mostly at the shoulder rather than the wrist.

Tail Shape



Skeleton of a Rock Dove (Pigeon)



Name: _____

QUESTIONS

1. Provide three characteristics found in all birds.

   1. _____
   2. _____
   3. _____

2. Besides feathers and wings, provide two adaptations that evolved in birds to help birds them achieve flight.

   1. _____
   2. _____

3. Looking at the fossil of *Archaeopteryx*, a transitional form between birds and reptiles, identify two reptile features and two bird features found in the fossil.

Reptile features	Bird features
_____	_____
_____	_____

4. Use the yellow-rumped warbler specimen to answer the following questions

   1. What color are the primaries on the yellow-rumped warbler? _____
   2. What color is the throat of the yellow-rumped warbler? _____
   3. What color are the lesser secondary coverts on the yellow-rumped warbler? _____
   4. What color is the crest of the yellow-rumped warbler? _____
   5. What color is the breast of the yellow-rumped warbler? _____

5. Provide the common names of three birds that likely eat seeds based on their bill shape.

   1. _____
   2. _____
   3. _____

6. Provide the common names of three birds that likely eat insects based on their bill shape.

   1. _____
   2. _____
   3. _____

7. Which of the bird species in lab feed on nectar? _____

8. What do you think that scrub jay eats based on its bill shape? _____

9. What is a "raptor"? Provides the common names of two birds considered raptors. _____

_____

10. Describe the differences between the acorn woodpecker and the Nuttall's woodpecker. _____

_____

11. How do woodpeckers protect their brain from the impact of chiseling wood? _____

_____

12. Describe now the woodpeckers feet differ from those of the California towhee? _____

_____

13. What is a "shorebird"? Provide an example of a shorebird _____

_____

14. Describe the differences in the bill of the Black-necked Stilt and Dowitchers and explain how this relates to the fitness of both species _____

_____

15. Which of the birds in lab are considered nest parasites? _____

16. Describe why loggerhead shrikes got the nickname butcher birds? _____

_____

17. How do burrowing owls differ from most other owls? _____

_____

18. Why have owls evolved to rotate their heads up to 240 degrees? _____

_____

19. Which of the bird species in lab are non-native to California? _____

_____

20. What type of tail does the barn swallow have? _____

Lab 10: Comparative Vertebrate Anatomy

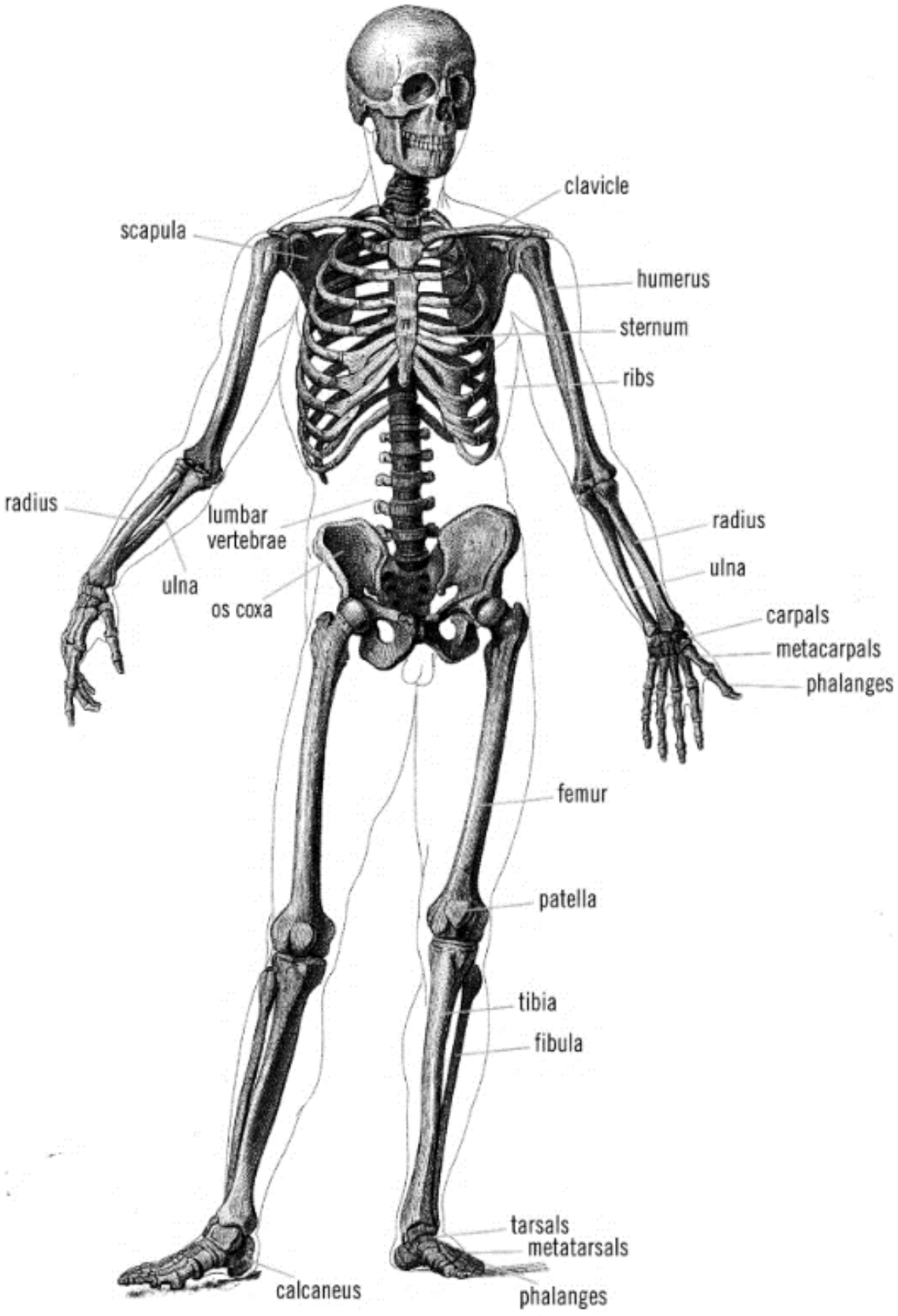
Objective: The primary objective is to establish the degree of relationship between. vertebrates using skeletons and external anatomy for comparison. This will provide a dramatic example of evolution, as well as emphasize the meaning and significance of the concepts of homology and analogy.

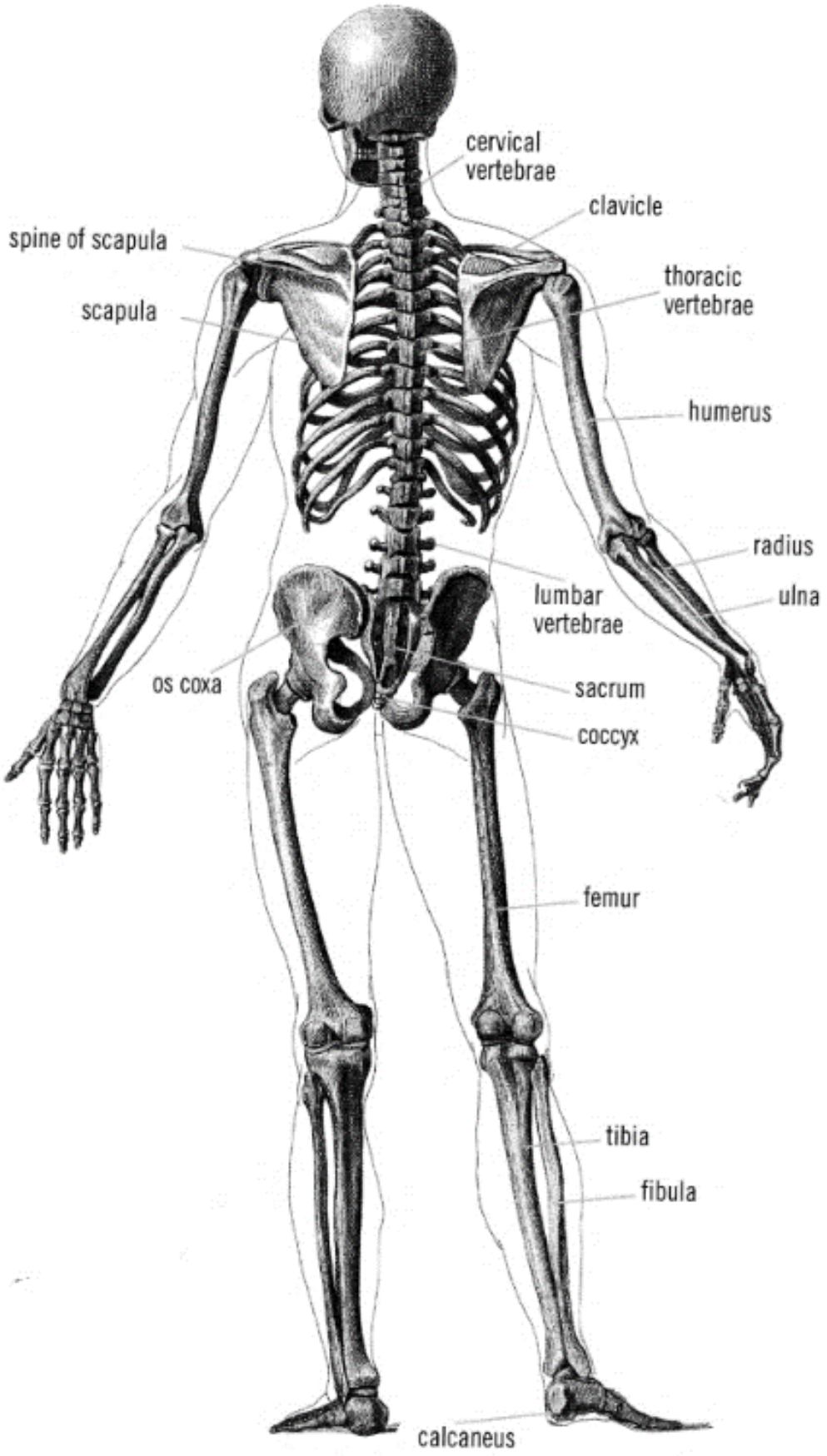
Introduction

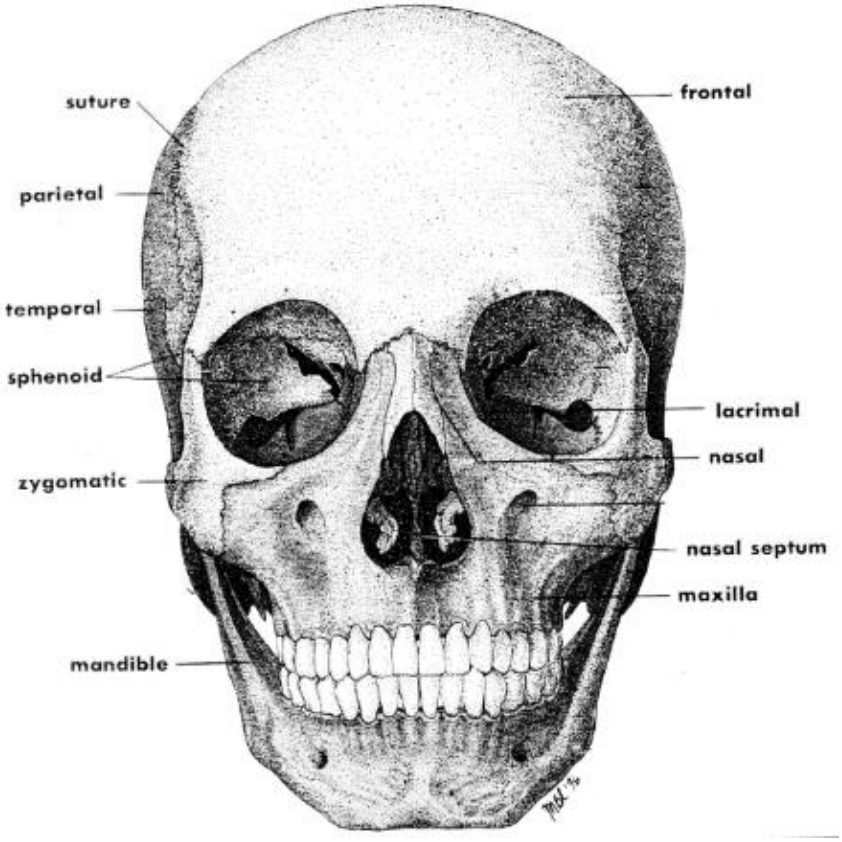
The goal of taxonomy is to identify organisms and determine the degree of evolutionary relatedness among species. In examining evolutionary relationships, similarities and differences are evaluated. To simplify, the more similar two organisms are, the more closely related in evolutionary origin, we assume them to be. Of course, the ultimate judge of relatedness is comparison of DNA. However, in many cases, we can get a reasonable idea of relatedness by looking at physical characteristics. When judging similarity, it is important to look at structure and not function. For example, two persons would not be regarded as related simply because they are equally good accountants. Two persons must look alike in their structural features before we can infer a close family relationship. These considerations hold true for the natural world as well. Animal characteristics are said to be **homologous** if they have similar structural components or embryonic origin. They are said to be **analogous** if they have similar function but not similar structure. If homology is established, close evolutionary relationship would likely be supported through DNA analysis. For example, regardless of the different function of human and gray whale forelimbs, the structures are virtually identical in fundamental architecture and embryonic origin. However, if only analogy can be established, then a close evolutionary relationship is likely not to exist. For example, regardless of the very similar function of insect and bird wings, the structure of these two types of wings is very different.

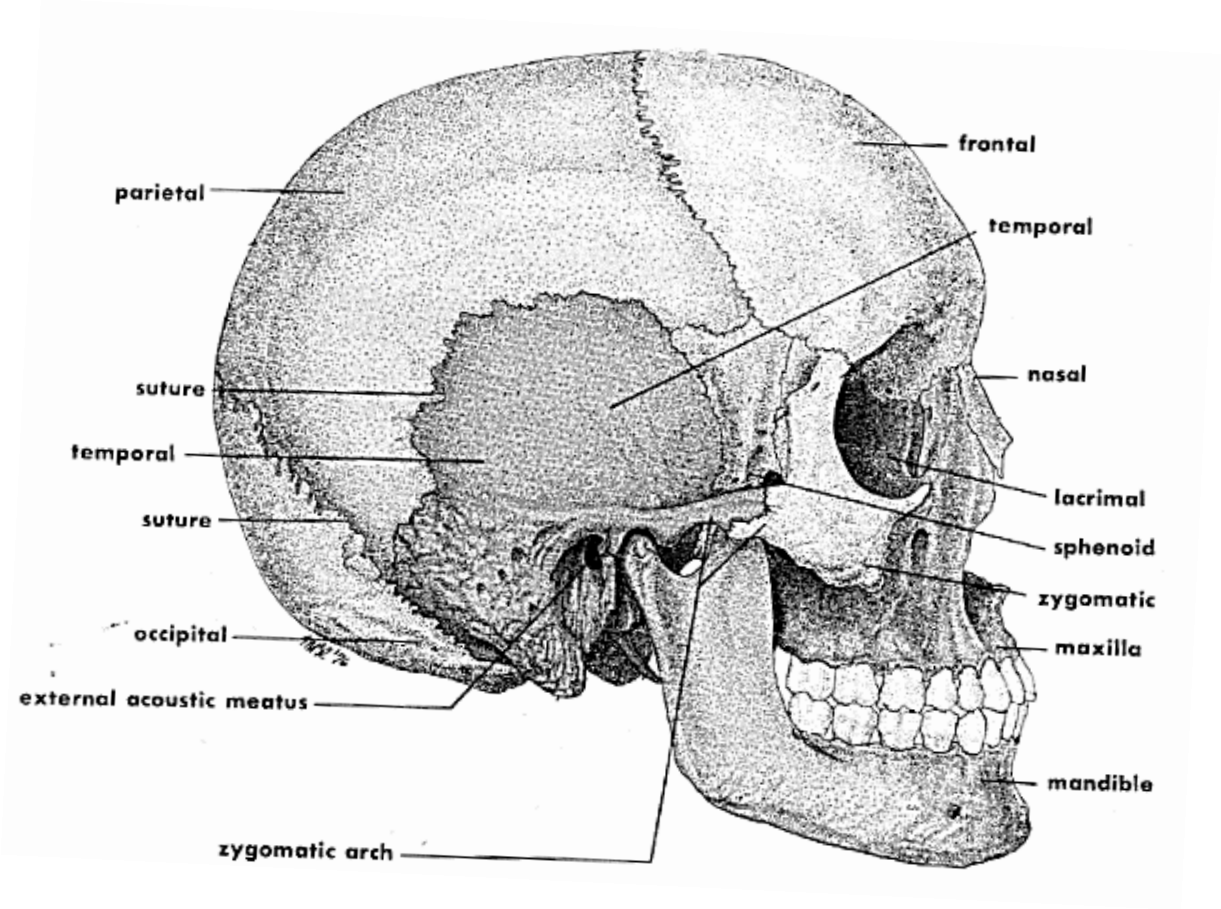
VERTEBRATES
Vertebrates are animals with backbones.
Phylum: Chordata
    Subphylum: Vertebrata
        Class: Agnatha = jawless fishes
        Class: Chondrichthyes = sharks, skates and rays
        Class: Sarcopterygii = lobe-finned fishes
        Class: Actinopterygii = ray-finned fishes
        Class: Amphibia = amphibians
        Class: Reptilia = Reptiles
        Class: Aves = Birds
        Class: Mammalia = mammals

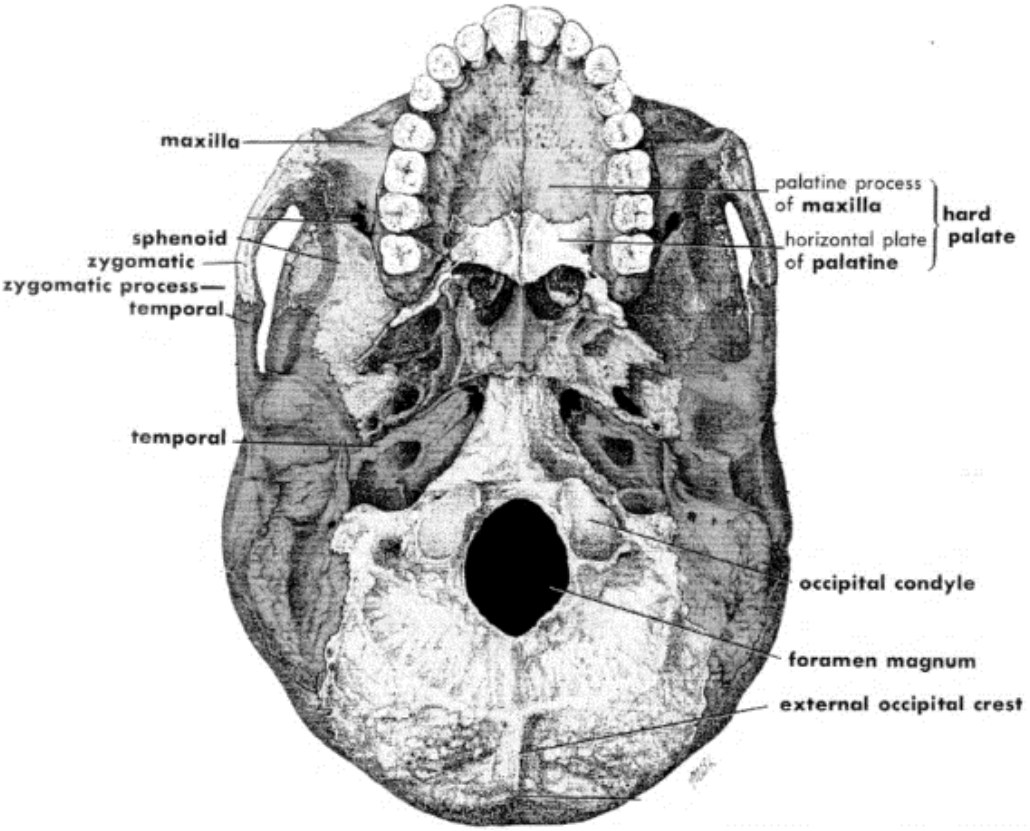
In today' s lab you will study similarities and differences between these animals by examining skulls, limbs and other skeletal parts, as well as, comparing the external anatomy of various animals. Before comparing the skeletons of non-human animals, you will first learn the basic anatomy of vertebrates by studying the skeletal system of humans.

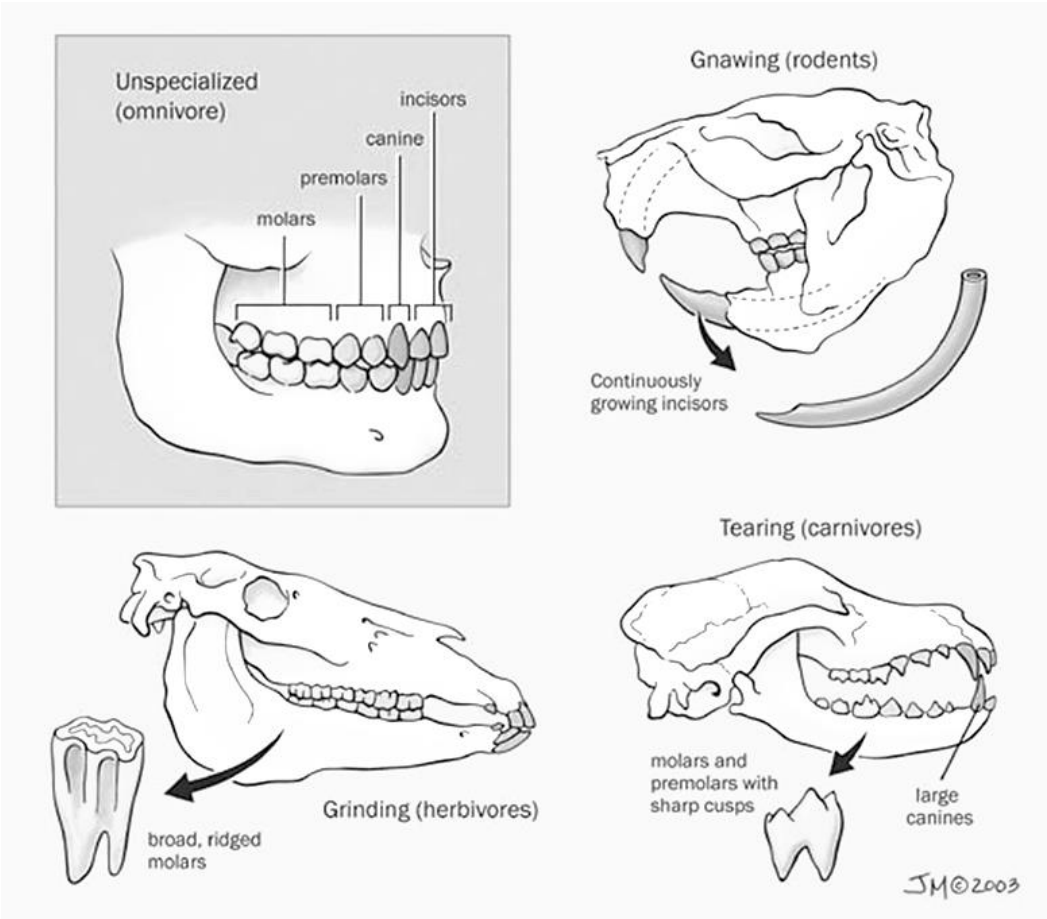

clavicle
scapula
humerus
sternum
ribs
radius
lumbar
vertebrae
ulna
os coxa
radius
ulna
carpals
metacarpals
phalanges
femur
patella
tibia
fibula
tarsals
metatarsals
calcaneus
phalanges


cervical
vertebrae
clavicle
spine of scapula
thoracic
vertebrae
scapula
humerus
radius
lumbar
vertebrae
ulna
os coxa
sacrum
coccyx
femur
tibia
fibula
calcaneus


suture
frontal
parietal
temporal
sphenoid
lacrimal
nasal
zygomatic
nasal septum
maxilla
mandible

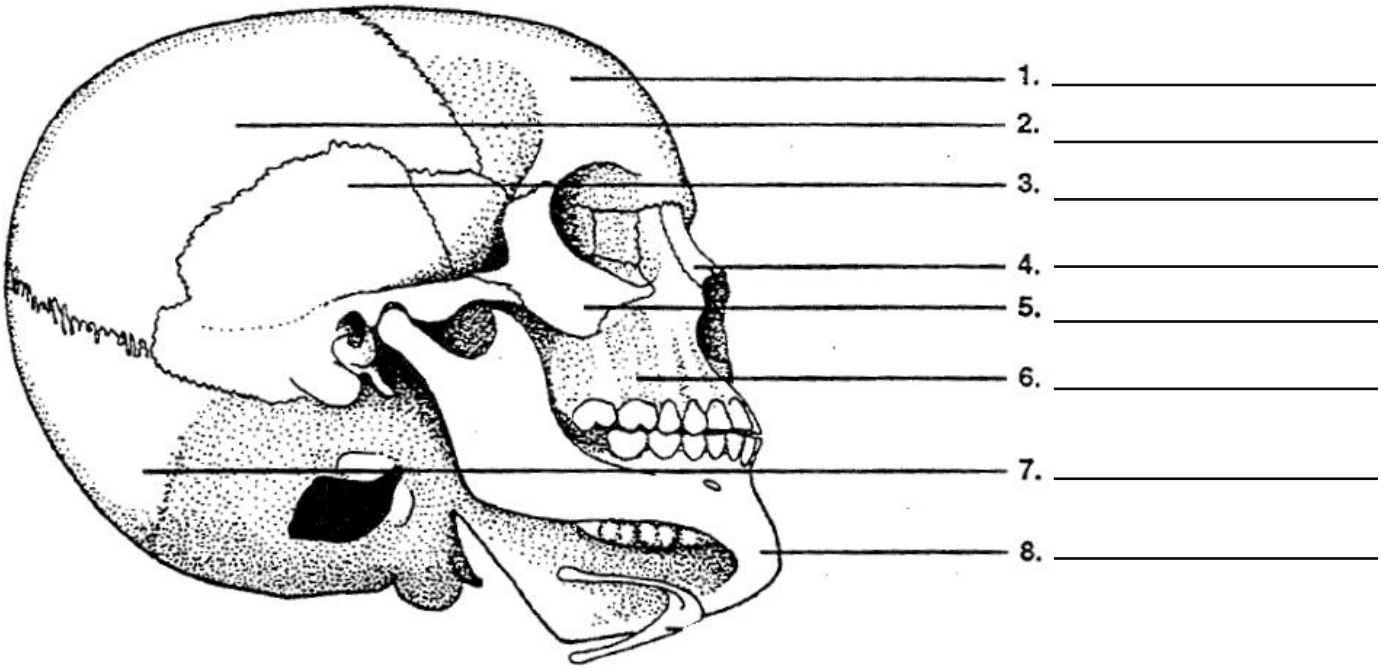

frontal
parietal
temporal
nasal
suture
temporal
lacrimal
suture
sphenoid
zygomatic
occipital
maxilla
external acoustic meatus
mandible
zygomatic arch


maxilla
sphenoid
zygomatic
zygomatic process
temporal
temporal
palatine process of maxilla
horizontal plate of palatine
hard palate
occipital condyle
foramen magnum
external occipital crest


Unspecialized (omnivore)
incisors
canine
premolars
molars
Gnawing (rodents)
Continuously growing incisors
Tearing (carnivores)
molars and premolars with sharp cusps
large canines
Grinding (herbivores)
broad, ridged molars
JM©2003

Name: _____

Label the different skull bones in the diagram below



Refer to the human skull for the following questions:

1. Which bone bears the external auditory meatus? Hint: This opening leads to inward parts of the ear.) _____

_____

2. Which bone bears the foramen magnum? (Hint: This opening is where nerve fibers from the brain pass out of the skull and become the spinal cord.)_____

3. What is the common term for the zygomatic arch? _____

Refer to the human skeleton for the following questions:

4. What is the correct name for the collar bone on the human skeleton? _____

5. What is the correct name for the shoulder blade? _____

6. Name the bones that make up the fingers: _____ hands: _____ wrist: _____

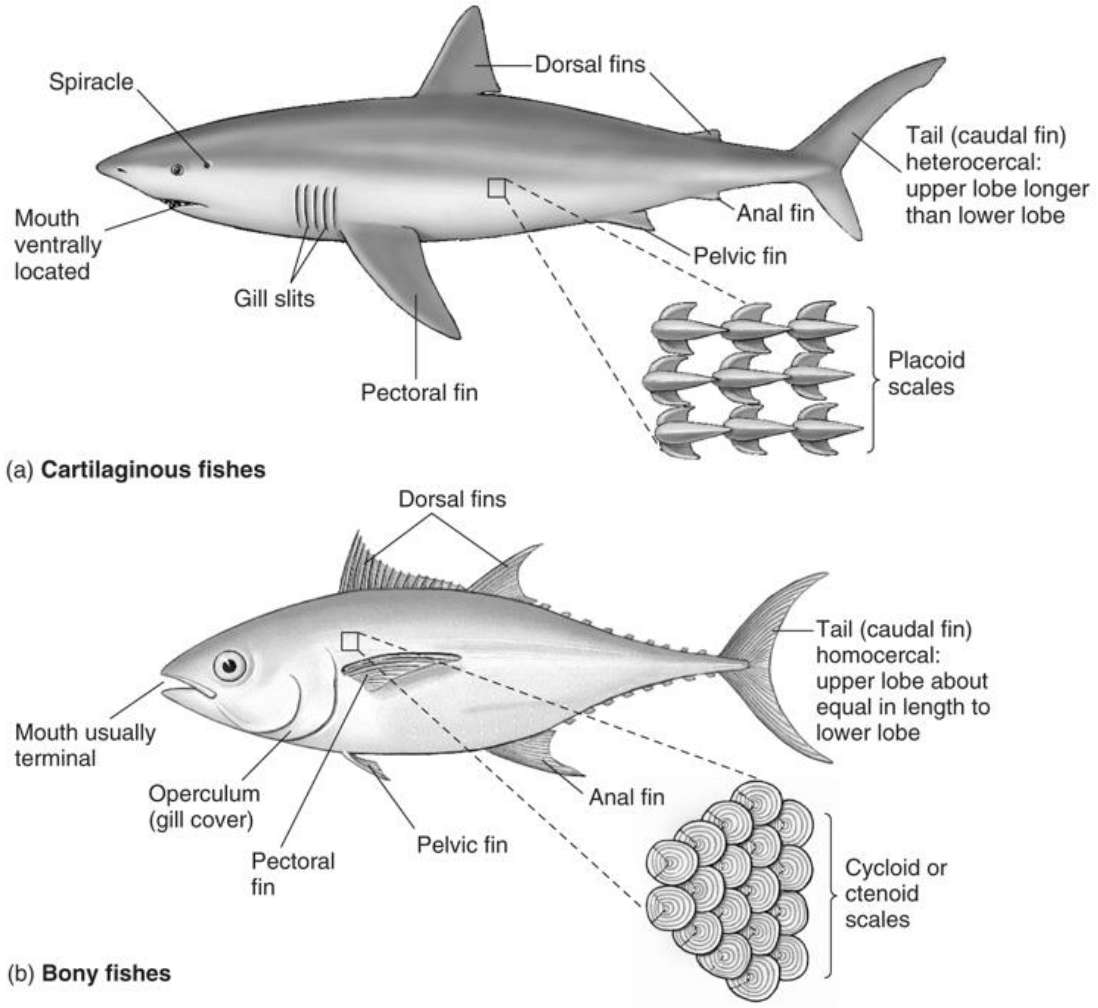
7. Which is larger, the radius or the ulna? _____

8. What are the two bones that make up the elbow joint? _____

9. The elbow is a projection off what bone?_____

10. Which bone in the leg is the shin bone? _____

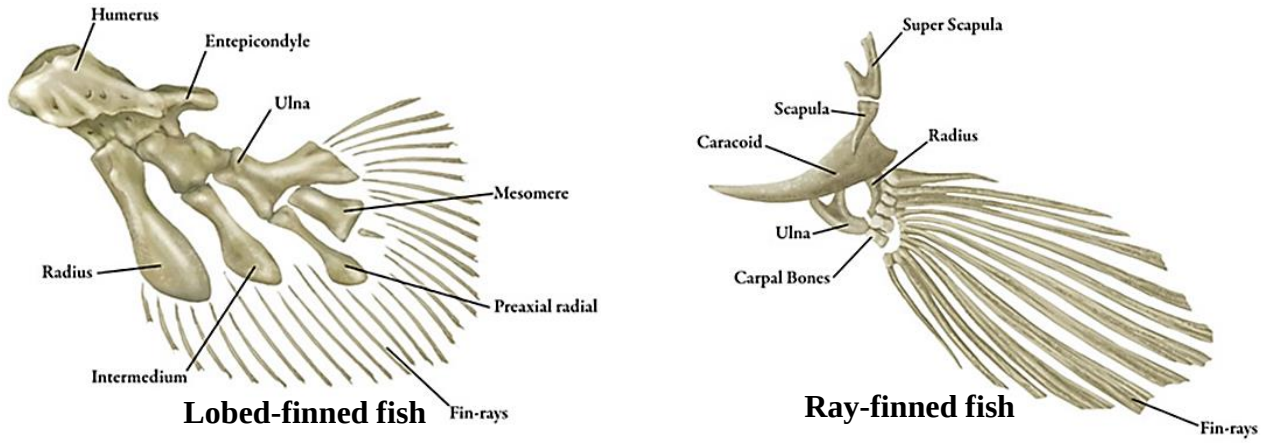
11. What bones represent the ankle: _____foot: _____ toes: _____



12. Describe at least four differences between the anatomy of cartilaginous fish and bony fish. _____

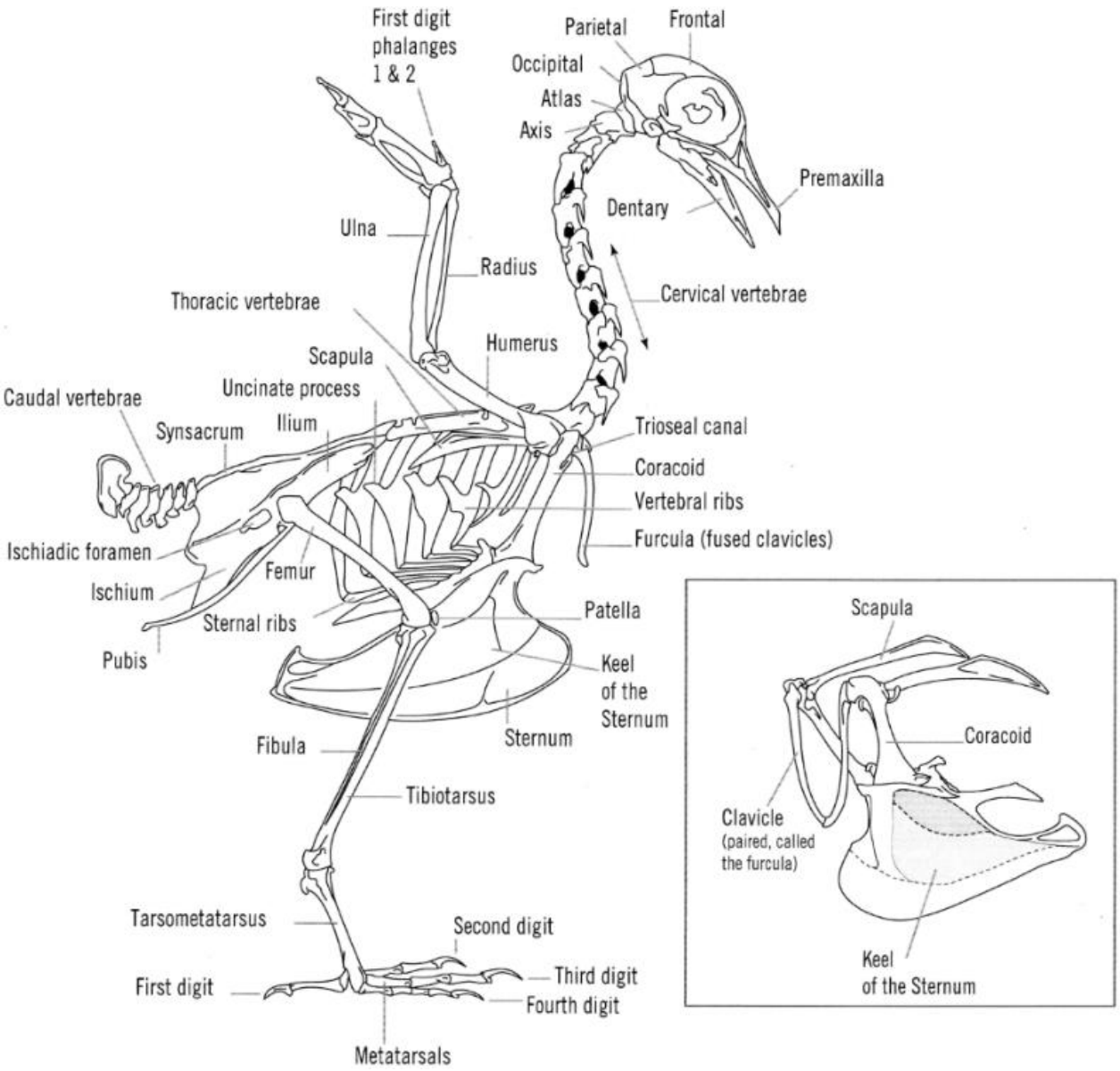
_____

_____



13. In looking at the pectoral fin anatomy of lob-finned fish (Sarcopterygii) and ray-finned fish (Actinopterygii) which group of fish do you think tetrapods (four limbed animals) evolved from? Why? _____

_____



Refer to the bird skeleton above to answer the following questions.

14. What is the function of the large keeled sternum found in birds? _____

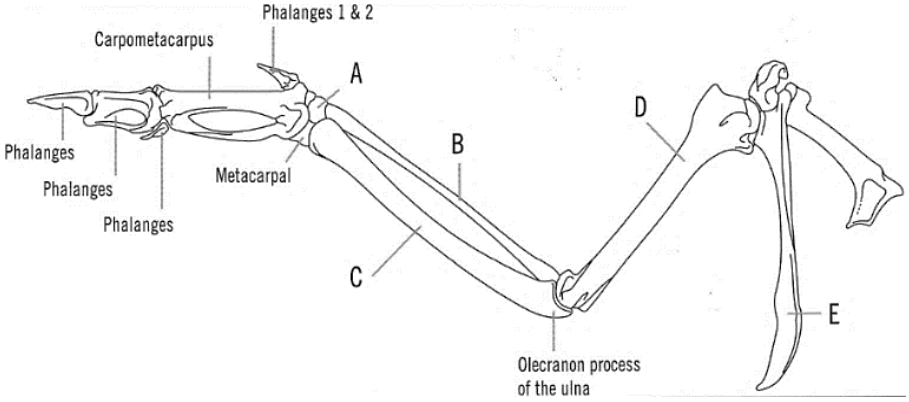
_____

15. Would you expect all birds to have a keeled sternum? Why or why not? _____

_____

16. How might the fused clavicle bones, called the furcula, be beneficial to birds? _____

_____



17. Provide the names of the bones in the bird wing on the left.

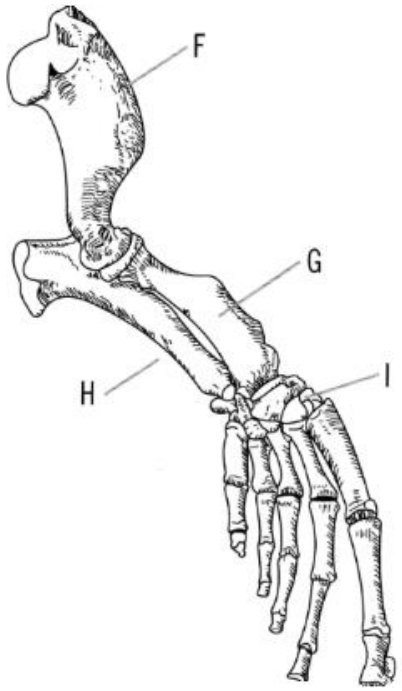
A. _____

B. _____

C. _____

D. _____

E. _____



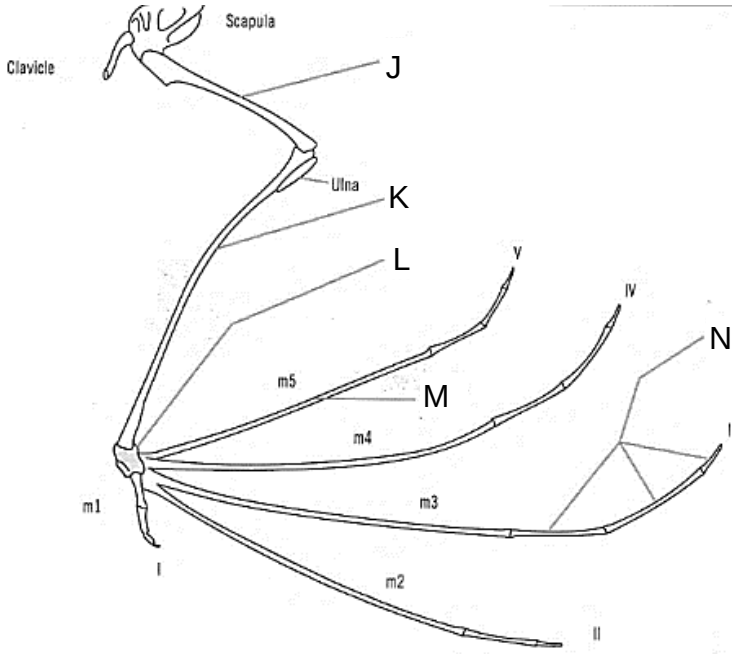
18. Provide the names of the bones in the sea lion fore limb on the left

F. _____

G. _____

H. _____

I. _____



19. Provide the names of the bones in the bat wing on the left.

J. _____

K. _____

L. _____

M. _____

N. _____

Use the diagrams of the bird wing, sea lion fore limb, and bat wing to answer the following questions.

20. Describe the differences between the anatomy of the bird wing and the bat wing. _____

_____

21. Would you consider the bird wing and the bat wing homologous or analogous structures? Why? _____

_____

22. How does the structure of the sea lion fore limb coincide with its lifestyle? _____

_____

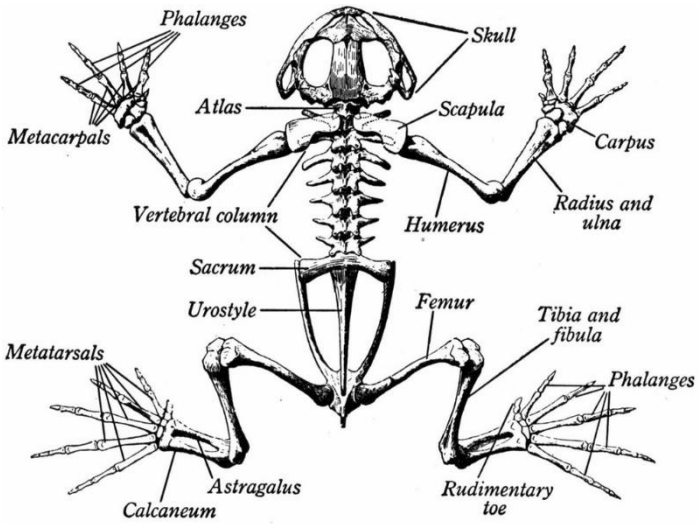
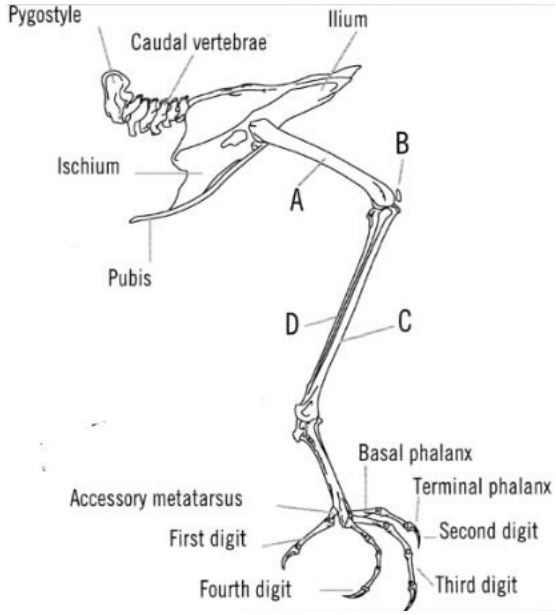


FIG. 400. *Skeleton of Frog.* Modified, after Jammes



23. Provide the names for the hind limb bones of the bird

A. _____

B. _____

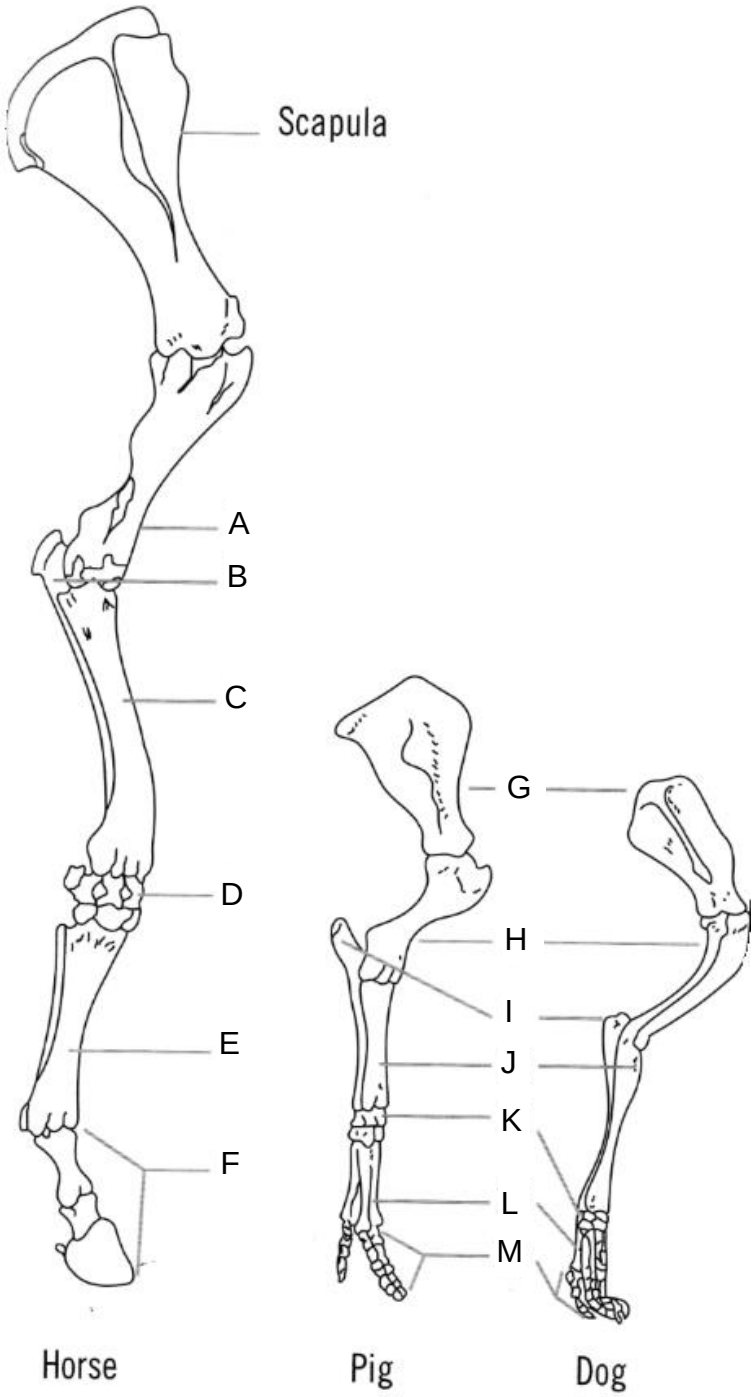
C. _____

D. _____

24. Describe some of the differences between the hind limb bones of the frog, and how these differences relate to their lifestyle. _____

_____

25. Provide the names for the horse, pig and dog, forelimbs shown to the left.



A. _____

B._____

C. _____

D. _____

E. _____

F. _____

G. _____

H. _____

I. _____

J. _____

K. _____

L. _____

M. _____

26. Which of the three animals shown above walk on their nails (unguligrade)? _____

27. Which of the animals above walk on their toes (digitigrade)? _____

Use the skulls of the various vertebrate to answer the following questions.

28. Using the bear skull, locate the following tooth types and describe their function in the bear.

A. Incisors: _____

B. Canines: _____

C. Premolars and molars: _____

29. Compare the teeth of the horse, deer, bear, coyote, and bobcat. How do the teeth indicate if the animal is a carnivore (meat eater), herbivore (plant eater), or omnivore (eats both meat and plants)? Describe the relationship between the types of teeth present, shape of the teeth, and diets of these organisms.

Horse: _____

Deer: _____

Bear: _____

Coyote: _____

Bobcat: _____

30. Which type of tooth is reduced or missing in the deer and horse? Why? _____

_____

31. Look at the skull of the inappropriately named crabeater seal. How are the teeth of the crab eater seal different from those of the harbor seal? _____

_____

32. Most seals eat fish, however, the crabeater seal specialize in eating a small shrimp like crustacean called krill, which they eat by filter feeding krill using their specialized teeth. Explain why the crabeater seal would have evolved this adaptation to eat krill. _____

_____

_____

33. In looking at the snake skull, notice that the lower jaw is freely divided in the center. Why do you think the lower jaw of the snake has this characteristic? _____

_____

34. Look at the skull of the cat, human, and turtle. Which of these skulls possess a complete har palate separating the nasal cavity from the mouth? _____

35. Birds and mammals are endothermic, which means they have a high metabolic rate to generate heat internally. Animals with high metabolic rates also require a lot of oxygen for metabolic processes (cellular respiration). Fish, amphibians, and reptiles are ectothermic, which means they are dependent on the external environment for their body temperature. Ectotherms do not rely on metabolic processes to maintain their body temperature, and thus, ectotherms tend to have much lower oxygen requirements. Is there a relationship between the presence of a hard palate and endothermy? What possible advantage is gained by the presence of a hard palate? _____

_____

_____

36. The foramen magnum is the hole at the base of the skull where the spinal cord connects to the brain. Compare the position of the foramen magnum in the bear to that of the human. How does the position of the foramen magnum relate to the animal being bipedal (walks upright) or quadrupedal (walks on four feet)?

_____

_____

37. The eye socket is called the orbit. The size of the orbit is often a clue to whether an animal is active during the day (diurnal) or active at night (nocturnal). The orientation of the orbits can also indicate if an animal has good binocular vision or good peripheral vision. If both orbits are facing forward it indicates that the animal has binocular vision and good depth perception. If the orbits are facing towards the sides then then animal has poor depth perception but better peripheral vision (wide field of view).

A. Compare the size of the orbit in the cat skull (relative to the size of the skull), to that of the deer. Based on the size of the orbit, would you expect the cat to be nocturnal or diurnal? _____

_____

B. Compare the orientation of the orbit in the horse, deer, cat, and bear. How does the position of the orbit indicate the animal's position in the food chain? _____

_____

C. Look at the skull of the tree-dwelling wooly monkey. How might the orientation of the monkey's orbits reflect the life style of the wooly monkey? _____

_____

Names: _____

LAB 12: CARRYING CAPACITY AND FOOD WEB ACTIVITY

Background: Coast live oaks (*Quercus agrifolia*) are endemic to the coastal regions of California and northern Baja California. Coast live oaks produce acorns, which are a main food source for acorn woodpeckers, gray squirrels, wood rats, scrub jays, black bears, mule deer, California ground squirrels, raccoons and skunks.

Purpose: To estimate the number of western gray squirrels that can be supported by the coast live oak trees in the wildlife sanctuary and to access the ecology of the wildlife sanctuary.

Procedure: Working in pairs you will locate and measure the circumference of coast live oak trees in the wildlife sanctuary.

1) Measure the circumference at breast height of 20 Coast live oak trees in the Mt. SAC wildlife sanctuary. Record your data and return to class.

2) Use the formulas: $d = \frac{c}{\pi}$, where c = circumference and d= diameter to calculate the diameter of the trees. Use Table 1 to determine the kilogram yield of acorns per tree based on tree diameter.

3) Convert kilograms of acorns to kcal a unit of energy. Use 1 kg of acorns = 4,500 kcal of energy.

4) After calculating the acorn yield of each oak tree, add up the yield from all trees to get the total production of all trees in the sanctuary.

5) Assuming that a tree squirrel needs 37 kcal per day, and 365 days in a year,

   calculate the number of squirrels the oak woodland at the sanctuary can support annually (carrying capacity).

6) After completing Table 2, answer the review questions using complete sentences.

Table 1. Average annual acorn yield (in kilograms) of California coast live oaks based on diameter at breast height (cm)

Diameter of tree (cm) at DBH	< 15	15-25	25-35	35-45	45-55	55-65	65-75	75-85	85-95	95-105	> 105
Acorn yield (kg)	0.77	1	1.3	1.5	1.8	2.1	2.3	2.6	2.9	3.3	3.7

Table 2. Tree measurement and acorn yield data.

Tree #	Tree circumference (cm)	Tree diameter (cm)	Acorn yield (kg)	Energy from acorns (kcal)	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
					Total kcal/yr for all trees
					Total squirrels the sanctuary can support

Review Questions: Answer the following using complete sentences.

1. Define carrying capacity. What factors determine carrying capacity? _____

_____

_____

2. It would be correct to predict the carrying capacity is actually less than what your team calculated. Explain why this is so. _____

_____

_____

3. a. Calculate the yield on two large trees and the yield on five of the smaller trees.

_____ = Yield of two large live oaks

_____ = Yield of five smaller live oaks

b. Is the carrying capacity greater with many small trees or a few large diameter ones? _____

_____

4. As much as 25 – 50% of the diet of black bears, scrub jays, acorn woodpeckers, and mule deer are acorns. What would happen to the carrying capacity of the squirrels in the sanctuary if any of these animals were present? **Explain.** _____

_____

_____

5. Use the list of species below to construct a food web for the wildlife sanctuary. Label the trophic levels

Plants: bunch grass, coast live oak, buckwheat, toyon, wildflowers, black walnut, western sycamore

Animals: mule deer, black bear, coyote, brush rabbit, raccoon, red-tailed hawk, California ground squirrel, dusky-footed wood rat, gopher snake, western fence lizard, caterpillar

6. Eucalyptus trees were introduced to California from Australia in the 1860's. Eucalyptus trees grow can grow up to 12 feet a year and regenerate quickly after a fire. These fast growing non-native trees have been replacing many oak woodlands throughout California, which has lead to their classification as an invasive species. Species native to California did not evolve with the eucalyptus tree, and thus, few native animals consume any product of the eucalyptus tree. Furthermore, chemicals given off by the leaf litter of eucalyptus trees prevents any native plant growth in its understory. Predict what will happen to the sanctuary food web if eucalyptus trees replace the coast live oaks in the sanctuary.

_____

_____

_____

_____

7. Assume the population of squirrels on campus has been stable for some time. After a fire in the nearby hills all the squirrels from that area move into our campus sanctuary. Describe what will happen to the population of squirrels. Sketch a graph of squirrel population over time. Your graph should include the time before and after the fire occurred. Indicate on the graph when the fire occurred. Show the carrying capacity according to the results of your lab (step 5 of procedure) on the graph with a dotted line and label it.

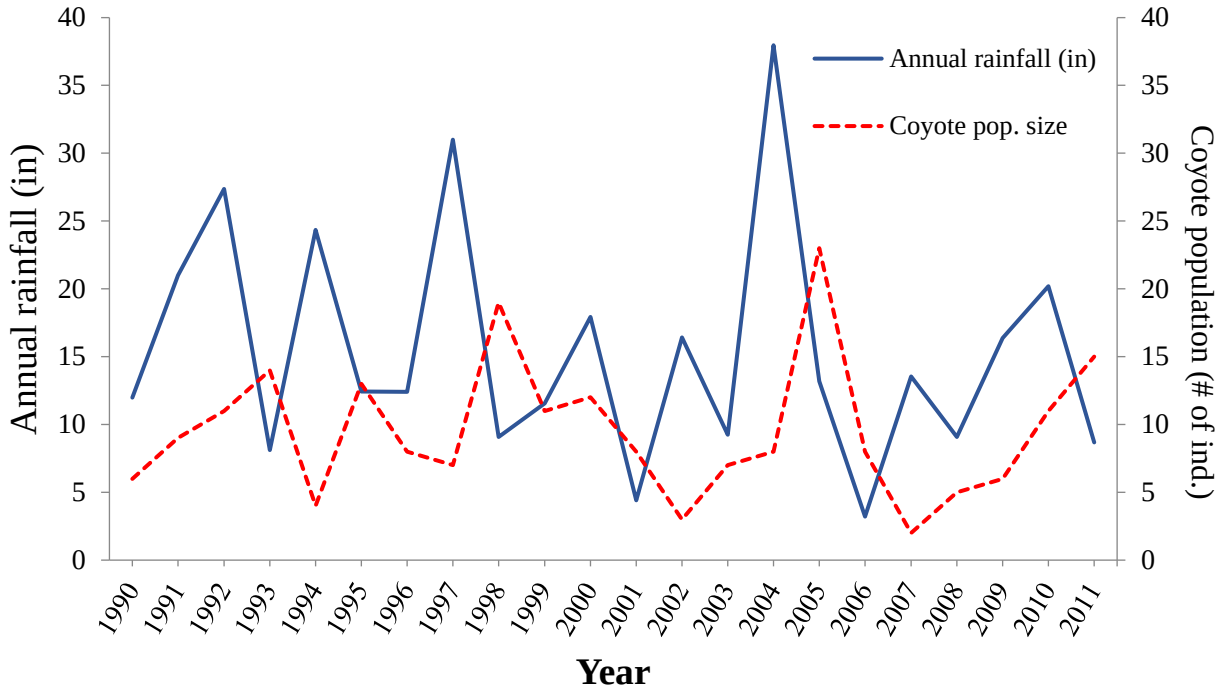
_____

_____

_____

_____

Studies have discovered a correlation between average annual rainfall and annual acorn production in coast live oaks. The following figure shows the annual rainfall for the City of Walnut along with the coyote population in the wildlife sanctuary. Use the figure to answer the following review questions.



8. How would you explain the time lag between rainfall and coyote population numbers?

_____

_____

_____

_____

9. Do climatic conditions have an effect on a species carrying capacity? How might shifts in climatic conditions (more or less frequent rainfall, extreme temperatures) resulting from global climate change affect the wildlife sanctuary food web.

_____

_____

_____

_____