Riparian Review

Purpose: To observe and list biotic factors that affect a given ecosystem.

Summary: In this exercise, students will identify and observe biotic factors in a riparian ecosystem, which is the green strip of vegetation alongside a waterbody; they will measure the types of vegetation at the water's edge, the function of plants as ground cover and canopy cover, and observe the wildlife in the area.

Background: Riparian areas are the transition zones between aquatic and terrestrial systems. The plants in this zone depend on high water tables and flooding patterns associated with the aquatic systems. Riparian zones cover a very small area in a watershed, but are extremely important.

Riparian Zone Functions:

- Bank stability to resist erosion
- Habitat for a diverse community of plants and animals
- Canopy cover which provides shading
- Organic materials drop from canopy cover into waterbodies
- Soils soak up water from runoff and help mitigate flooding
- Healthy riparian areas protect the land from flooding, and provide storage for a sustained summer flow

For more background information, see:

- The Riparian Zone section of the Utah Stream Team Manual which defines a riparian zone and discusses how it would change due to natural and human influences, why the riparian zone is important in an aquatic ecosystem, and how to measure and interpret the results.
- For information on Utah's wildlife, see the Utah Division of Wildlife Resources Data Center website – http://dwrcdc.nr.utah.gov/ucdc

Duration:
Classroom
20 minutes
Outdoors
50 minutes

Setting:
Classroom
Outdoors

Core Standards:
6th grade Science ILO's: 1a, 1c-1e, 1i, 2a, 4a, 5b, 6b

7th and 8th grade Science ILO's: 1a-1d, 1g, 2b, 2e, 3b, 3c, 5a

7th grade Science Standards: 5.1d, 5.2b-5.2e, 5.3c

8th grade Science standard: 1.4b, 1.4e, 2.2c

High School Science ILO's: 1a, 1f, 1g, 1i, 1j, 2b, 2c, 2e 3a, 3c, 3d, 4a-4e, 6a-6d, 6h

(continued)

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Earth Systems Science: 4.2b, 4.2c

Biology: 1.3c, 1.3d

NR Science II: 4.1a, 5.3e

6th grade math: Ratios and Proportional Relationships: 3c
Statistics and Probability: 5a, 5b

8th grade math: Number System: 3
Statistics and Probability: 1, 2

High School Math: Statistics and Probability: Making Inferences and Justifying Conclusions: 4

Geography for Life: 2.1b

Materials:

- Flagging
- Measuring tapes*
- Ocular tubes*
- Copies of the student worksheets
- Copies of the riparian zone instruction sheets
- Copies of wildlife observation instruction sheets
- Wildlife checklists (optional)
- Binoculars
- Clipboards
- Pencils
- Plant guides (optional)

* For information on equipment for loan or for purchase, contact USU Water Quality Extension at (435) 797-2580 or www.extension.usu.edu/waterquality

Classroom Activity:

1. Define the term riparian zone. *The riparian zone is the green ribbon of vegetation along a stream, and the associated animals that live in or use this area.* Talk about why a riparian zone is important to the health of an aquatic ecosystem, natural changes in the riparian zone, and also what humans do to alter the riparian zone.

2. Ask the students to list all the biotic factors they can think of in a riparian system *(e.g., types of plants, specific plants, and animals).* Ask them to think about how this community of plants and animals might be different from those found in a deep forest, in open range land, or in their backyards. How might they be similar?

3. Explain to the students that they will be going out to a stream site to evaluate the structure and function of the riparian area. These functions include both the riparian vegetation and wildlife. They will also use other techniques to observe or find evidence of animal activity.

4. Explain to them what measurements they will be taking and why. Measurements are found on the following page:

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• Greenline - they will measure the type of vegetation that grows closest to the water's edge. This is an indication of the bank stability. See Further Discussion question number 1 for more information.

• Ground Cover - they will record the width of the zone in which riparian plants grow.

• Canopy Cover - they will measure the amount of shade the riparian plants provide.

• Wildlife Signs - they will identify animals and signs of animal activity.

Because there are four sets of measurements, we strongly recommend reviewing the actual measuring procedures with the class before going into the field.

Field Activity:

1. Divide your students into groups of no more than six students.

Safety First!
Always consider safety factors when working near water.

2. Assign each group with a measurement (greenline, ground cover, canopy cover, or wildlife signs) and provide them with the appropriate materials.

Greenline Group
Flagging
Measuring tape
Greenline sampling instructions
Greenline worksheet

Ground Cover Group
Measuring tape
Ground cover sampling instructions
Ground cover worksheet

Canopy Cover Group
Flagging
Ocular tube
Measuring tape
Canopy cover sampling instructions
Canopy cover worksheet

Wildlife Signs Group
Binoculars
Wildlife worksheet
Wildlife observation instructions
Field checklists (optional)
Field guides (optional)

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3. Explain to the students that each group will take a different measurement and will share their data with each other back in the classroom.

NOTE: If time allows, you can have the groups do more than one of the measurements.

4. Review the sampling instructions for each particular measurement. Have the students fill out the site observations section of the student worksheets before beginning their measurements.

5. Have the students record their results onto the student worksheets. You can choose to have one record keeper per group, or have each student record all the information. You may also want to suggest to your students that they take turns conducting the measurements throughout the process.

ACTIVITY EXTENSIONS:
- Compare your results to results from other streams or other locations on the same stream.
- Sample the same station on multiple dates (fall vs. spring) to compare results.
- Use the activity What's in the Water? to collect chemical measurements in the stream. Have students hypothesize about the links between the riparian zone and the water chemistry. See discussion questions below.

Applying the Data:

- Map the stream segment - e.g., width of riparian zone, areas with canopy cover, different types of plants.
- Compare (graphically) different reaches of a river - e.g., a more developed area versus a pristine one, such as a city site versus the headwaters.
- Discuss big rivers versus small streams - how do the functions of riparian zones differ?

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Further Discussion:

1. How do the greenline measurements help us undestand how well a stream bank resists erosion?

Fast moving water can cause banks to erode. The greenline is a measure of how well the plants along the water's edge will help the banks resist erosion (bank stability). We determine stability by calculating the proportion of different vegetation types. These are sedges and rushes, shrubs and trees, grasses, forbs, (a non-woody plant that is not a grass), and bare ground. Each vegetation type has a different ability to stabilize the banks due primarily to the depth and density of the roots, and whether they are annuals (die back after one year), or perennials (live through the winter). For example, sedges are perennials that have deep, thick root masses that cling to and stabilize soils, while many annuals have shallow or sparse roots that do not contribute to bank stability.

In the field, look at the vegetation in areas where serious erosion has occurred compared to areas with stable banks. Think about how different land uses affect vegetation and therefore bank stability.

2. How does the canopy cover affect the physical properties of the stream itself?

Canopy cover provides shade and is important in keeping water temperatures low in small headwater streams. Many fish and other aquatic organisms are sensitive to high temperatures, and may disappear from streams that have lost their shade.

The canopy of a stream also represents the leaves and debris that may fall directly into the stream. This external input of material is an important source of food and shelter for the fish and other organisms living in these small streams. The relative importance of canopy cover (both for shade and for input of organic material) decreases as a river gets increasingly larger.

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3. How do humans affect the health of the riparian zone?

The riparian zone is a very small area compared to the entire land area of a watershed, and humans can have a serious impact on this important ecosystem through different types of activities.

• Clearing: Riparian areas are often cleared for agriculture, logging, or housing and other development. This can lead to destabilized banks, heavy erosion, and loss of stream and riparian functions.

• Introduced species: Many riparian areas are affected throughout the world by introduced species, which take over the riparian area and radically change the habitat. Species such as russian olive, tamarisk, and purple loosestrife may form "monocultures," replacing native plants and resulting in a serious loss of plant and animal diversity and a loss in other riparian functions such as storing and filtering wastes.

• Grazing: While grazing by cattle and other livestock has been shown to be compatible with healthy riparian areas, the type of grazing is extremely important. Most riparian areas can handle short term, "intensive" grazing, with sufficient recovery time. Continuous grazing in a riparian area can limit the plants' abilities to recover and may ultimately lead to loss of vegetation or a change in species.

• Recreation: Recreationalists flock to riparian areas, but may "love them to death." Trampling, multiple trails, wood removal for campfires, and littering all can impair riparian areas.

4. Why would a stream area be a good habitat for wildlife?

The diversity of plant species (from small annuals to dense sedges to tall trees) provides food and shelter for a wide diversity of animals, ranging from insects to birds to mammals. One function of riparian areas that people sometimes neglect is their use as a "corridor" for wildlife, providing connecting routes across otherwise dry or uninhabitable landscapes. These corridors are important not only for migration, but also for connecting different breeding populations.

Greenline Worksheet

Name: _____ Group #: _____
Date: _____ Site ID: _____

SITE OBSERVATIONS:
Type of waterbody (e.g., stream, lake, wetland):_____
Water appearance (e.g., clear, brown, foamy, milky):_____
What type of land uses are in the immediate area?_____
What type of land uses are in the surrounding area?_____

	Vegetation Categories				
	Deep Rooted Plants		**Shallow Rooted Plants**		
	Sedges & Rushes	Shrubs & Trees	Grasses	Forbs	Bare Ground
Row 1: Record each observation as a slash mark in the appropriate box.					
Row 2: Total number of observations for each category.					
Row 3: Total number of observations for the entire greenline (sum of all observations in Row 2).					
Row 4: Proportion of each category (divide row 2 vlaues by total in row 3).					
Row 5: Multiply each value in row 4 by the factor in each category. Record in row 6.	X 10	X 8	X 6	X 3	X 1
Row 6: Score for each category.					

Total Score (add up all scores in Row 6):_____

Site Scores
7 - 10 healthy banks
4 – 7 semi healthy banks
0 – 4 unhealthy banks

The higher the score, the more the stream banks will resist erosion.

Worksheet

Canopy Cover

Name: _____ Group #: _____
Date: _____ Site ID: _____

SITE OBSERVATIONS:
Type of waterbody (e.g., stream, lake, wetland):_____
Water appearance (e.g., clear, brown, foamy, milky): _____
What types of land uses are in the immediate area?_____
What types of land uses are in the surrounding area?_____

	"Miss" (Open sky)	**"Hit" (Vegetation)**
Row 1: At each step along the water's edge, record with a slash whether you see a "miss" (open sky) or a "hit" (vegetation) in your ocular tube.		
Row 2: Total # of slash marks for each category.		
Row 3: Total number of observations		
Percent canopy cover. Divide total "hits" (Row 2) by total observations (Row 3) and multiply by 100.		

The more covered area available, the more shading the stream receives. This keeps the water cool, provides food for aquatic organisms, and woody debris that falls into the stream provides fish habitat.

Ground Cover

Name: _____ Group #: _____
Date: _____ Site ID: _____

SITE OBSERVATIONS:
Type of waterbody (e.g., stream, lake, wetland):_____
Water appearance (e.g., clear, brown, foamy, milky):_____
What types of land uses are in the immediate area?_____
What types of land uses are in the surrounding area?_____

At each step along the transect record. with a slash mark, the type of ground cover you see. Add the slash marks for each row and record in the Category Total column. Because there are 100 observations, the total will equal the percent.

	Transects Perpendicular to the stream (20 paces per transect)					
	1	2	3	4	5	Category Total (percent of total)
Live vegetation						=
Litter (dead vegetation or sticks)						=
Rocks						=
Bare ground						=

The percentage of each category above may vary depending on where the site is. A mixture of cover types is ideal because each provides a different service. Although bare ground does nothing, vegetation functions well as a filter and also buffers against erosion. Rock does little to filter pollutants, but does protect against erosion. Litter serves both functions.

Worksheet

Wildlife Signs

Name: _____ Group #: _____
Date: _____ Site ID: _____

SITE OBSERVATIONS:
Type of waterbody (e.g., stream, lake, wetland):_____
Water appearance (e.g., clear, brown, foamy, milky):_____
What types of land uses are in the immediate area?_____
What types of land uses are in the surrounding area?_____

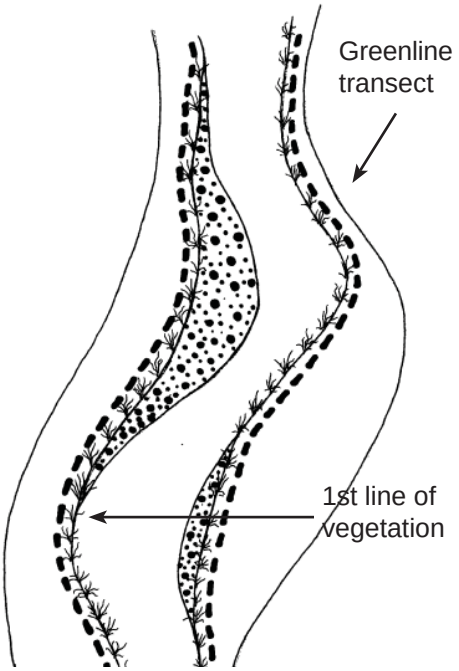
COMMON NAME	How is it using the riparian area?	TYPE OF OBSERVATION
e.g., American Dipper	e.g., food, shelter, traveling through	e.g., V, O

Types of Observations
V = saw animal
T = track
S = scat
B = bones
O = other sign such as burrow, teeth marks, nests

Greenline

Time – 30 minutes
Persons – 2
Materials –
- Flagging
- Measuring tape
- Greenline worksheet
- Plant guide (optional)

The Greenline Transect



1. Measure a 100 foot stretch along the stream. Place a flag near the water at the beginning and end points.

2. Standing at the first flag, note the vegetation type that is closest to the water and record it in row 1 of the worksheet.

3. Take one pace toward the other flag and stop A pace is a normal stride you would take while walking. Look toward the water and record the vegetation type closest to the water by placing a slash mark in the appropriate box. See the Teacher Resource page for definitions of vegetation types.

4. Repeat these steps until you reach the other flag.

5. Tally the number of slash marks in each box and record this for each category in row 2.

6. Add up all the observations and record that total in row 3.

7. For each vegetation category, divide the number in row 2 by the number in row 3, and record in row 4. This will give the proportion of the greenline that is made up of that vegetation category.

8. For each vegetation category, multiply the number in row 4 by the factor in row 5 and record in row 6. This will give you the "site score" for each vegetation category. Because sedges and rushes have the strongest roots and prevent erosion the best, they receive the highest factor - "10." Bare ground doesn't prevent erosion so it receives the lowest factor - "1."

9. Add the individual site scores in row 6 to get the "total site score" for that stretch of stream.

10. Compare the site score to the "Site Scores" box on the worksheet to determine the health of the greenline.

Canopy Cover

Time – 30 minutes
Persons – 2
Materials –
- Ocular tube
- Measuring tape
- Canopy cover worksheet
- Flagging

1. Measure a 100 foot stretch along the stream. Place a flag near the water at the beginning and end points or use the same measurements set out by the greenline group.

2. Standing at the first flag, point the ocular tube straight into the air (90 degree angle) and look through it with one eye. Your partner who is recording data can tell you how to adjust the tube until it is pointing as straight up as possible.

3. Tell the recorder whether the "X" at the end of the tube points at sky (a "miss") or a part of a tree or bush (a "hit"). Record this in the first row on the canopy cover worksheet.

4. Take one pace toward the other flag and stop. A pace is a normal stride you would take while walking. Again, point the ocular tube straight into the air and record a hit or a miss.

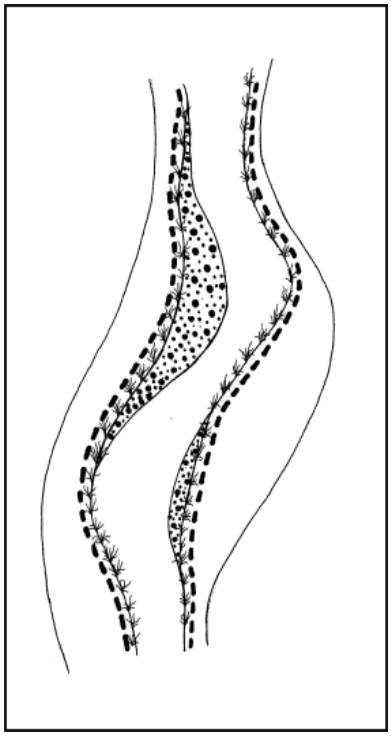
5. Repeat these steps until you reach the other flag.

6. Add the total hits and misses and record in the second row.

7. Add the two scores recorded in row 2. This will tell you the "total number of observations" you took along the transect (the greenline). Record this total in row 3.

8. Divide the number of "hits" in row 2 by the total observations in row 3 and multiply by 100. This will give you the percentage of canopy cover for the transect.

Canopy Cover Transect

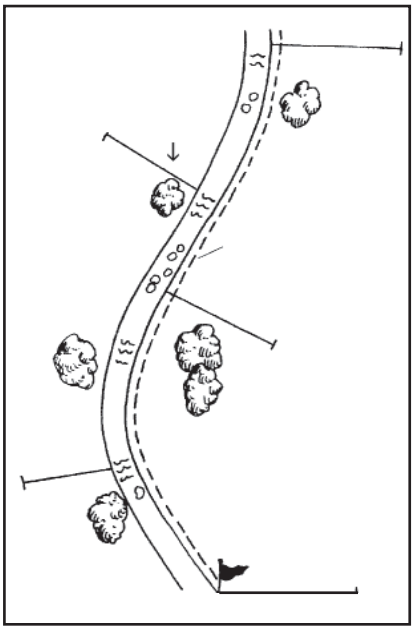


Ground Cover

Time – 35 minutes
Persons – 2
Materials –
- Measuring tape
- Ground cover worksheet

Note: Riparian ground cover transects start at the stream edge and extend 20 paces away from the stream, into the riparian vegetation.

Ground Cover Transect



1. You will collect data along five separate transects in your stream stretch, spaced out at approximately equal distances along your stream reach. If possible, you should run two transects on one side of the stream and three on the other to get a better picture of the total riparian zone. Refer to the figure to the right for help locating these transects.

2. Begin at your first transect. Starting at the stream's edge, take one pace away from the stream. Touch your finger to the ground at the tip of your front foot.

3. Note the ground cover type that your finger touches. The categories are: live vegetation, litter (dead vegetation or sticks), rocks, or bare ground. Record the type with a slash in the appropriate box on the ground cover worksheet. Note that each column on the data chart is for a separate transect.

4. Repeat steps 2 – 3 for 20 paces. Then move on to the second transect. Repeat for all 5 transects.

5. When you've finished with all five transects, add the totals for each row (cover type). This will give you the percentage of each type of ground cover in the riparian zone. To check your math, add your percentages for each ground cover type. They should total 100%.

The percentage of each ground cover type provides a measure of ground cover that can be compared to other sites or used to compare changes over time (between different years or seasons). As a general rule, though, a healthy riparian zone will be covered by a mixture of litter, rock and vegetation. Important exceptions to this are desert streams, which have very sandy banks.

Wildlife Signs

Time – 35 minutes
Persons – 2
Materials –
- Binoculars
- Wildlife worksheet
- Field guides
- Field checklists (optional)
- Magnifying glasses (optional)

Note: Wildlife and birds are shy and may be hard to observe. You may want to send your wildlife observers directly upstream or downstream of your transect so the noise and activity of the vegetation survey won't interfere with their observations. Only do this if it is safe and practical.

1. Slowly walk a 100 foot length along the stream's edge. Look carefully for tracks, scat or other animal signs. Also watch for birds, mammals, reptiles, or amphibians as you walk. Record all species that can be identified by sight or sound on the wildlife signs worksheet. Also note how the wildlife may have been using the riparian area, and the type of observation.

2. Return to approximately the middle of the length of stream you just walked, and walk 20 paces away from the stream's edge. Stand quietly, watching and listening for two minutes. Record all species that can be identified.

3. Slowly walk back toward the stream, looking for tracks, scat or other animal signs. Once you have reached the stream, listen and watch for another two minutes. Repeat this procedure at three points (more if time allows) along the stream.

4. After sampling, spend any extra time investigating the entire site looking for animals or signs of them.

How to Make an Ocular Tube

An ocular tube is used to sample canopy cover. It is a very simple device, but it removes bias from field sampling canopy cover.

Materials

- 6 in. of 1 in. wide PVC or other material such as a cardboard tube.
- 2 paper clips
- Duct tape

Directions

1. Cut a 6 in. length of tube.

2. Make four notches every 90 degrees on one end.

3. Straighten paper clips and lay into notches. Bend excess length over the outside of the tube.

4. Duct tape around the ends of the paper clips to hold them in place. Use duct tape over the edges of the viewing end of the tube to make a smooth surface.

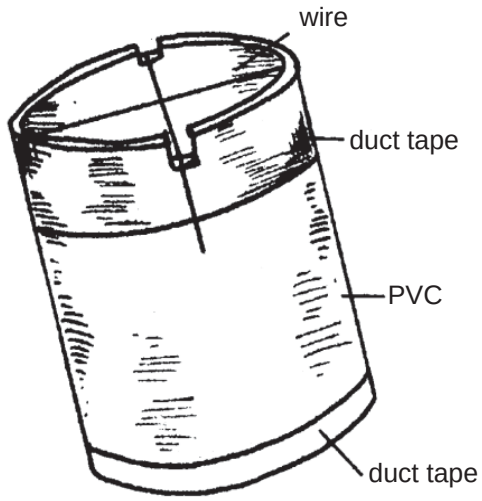


Illustration: Holly Broome-Hyer

Field Checklist for Mammals

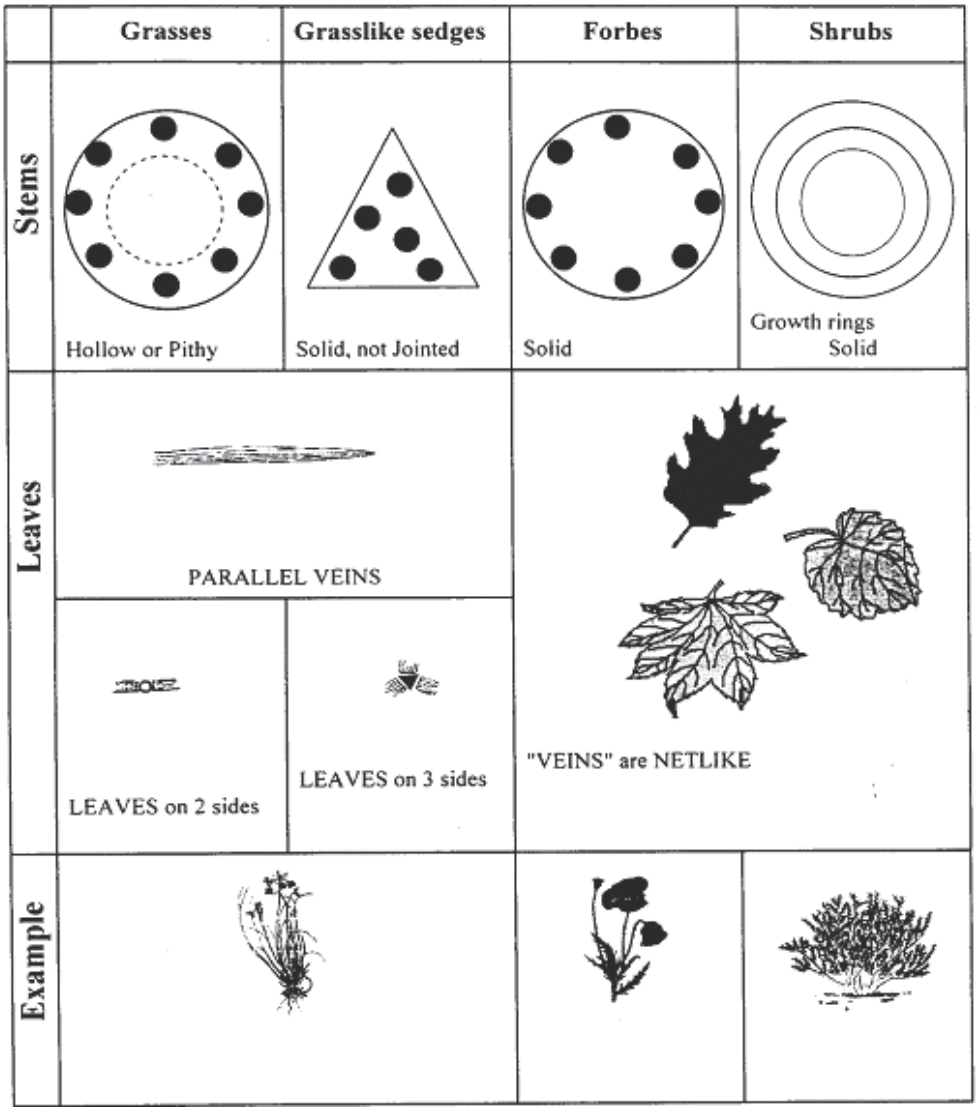
✓	Common Name	Scientific Name
	Masked Shrew	*Sorex cinereus*
	Dusky Shrew	*Sorex obscurus*
	Northern Water Shrew	*Sorex palustris*
	Black Bear	*Ursus americanus*
	Raccoon	*Procyon lotor*
	Longtail Weasel	*Mustela frenata*
	Mink	*Mustela vison*
	River Otter	*Lutra canadensis*
	Striped Skunk	*Mephitis mephitis*
	Coyote	*Canis latrans*
	Red Fox	*Vulpes fulpa*
	Mountain Lion	*Felis concolor*
	Bobcat	*Lynx rufus*
	Yellowbelly Marmot	*Marmota flaveventis*
	Northern Pocket Gopher	*Thomomys talpoides*
	Beaver	*Castor canadensis*
	Meadow Vole	*Microtus pennslvanicus*
	Muskrat	*Ondantra zibethica*
	Porcupine	*Erethizon dorsatum*
	Mountain Cottontail	*Sylvilagus nutalli*
	Elk	*Cervus elaphus*
	Mule Deer	*Odocoileus hemionu*
	Moose	*Alces alces*
	Pronghorn	*Antilocapra Americana*
	Douglas' Squirrel	*Tamiasciurus douglasii*

Field Checklist for Birds

✓	**Riparian Species of Utah *=southern Utah species**
	Ring-necked Pheasant
	Wild Turkey
	Great Blue Heron
	Cooper's Hawk
	Red-tailed Hawk
	American Kestrel
	Yellow-billed Cuckoo
	Western Screech-owl
	Great Horned Owl
	Black-chinned Hummingbird
	Belted Kingfisher
	Downy Woodpecker
	Willow Flycatcher
	Cassin's Kingbird
	Eastern Kingbird
	Bell's Vireo *
	Plumbeous Vireo
	Brown Creeper
	Bewick's Wren

	House Wren
	American Dipper
	Swainson's Thrush
	American Robin
	Gray Catbird
	European Starling
	Cedar Waxwing
	Yellow Warbler
	Wilson's Warbler
	Yellow-breasted Chat
	Spotted Towhee
	Abert's Towhee *
	Fox Sparrow
	Song Sparrow
	Lincoln's Sparrow
	Black-headed Grosbeak
	Blue Grosbeak
	Lazuli Bunting
	Brown-headed Cowbird
	Bullock's Oriole
	Lesser Goldfinch *

Plant Identification



Grasses – These have hollow stems that are jointed and leaves with parallel veins. The leaves come off the stem in opposite directions.
Grass-like sedges – These resemble grasses but have solid, triangular stems with no joints. The leaves have parallel veins but they come off the stem in three directions. This group also includes rushes which have round, hollow stems with very small or no leaves.
Forbs – These generally have broad leaves with net-like veins. The stems are solid or spongy and they die back to the ground every year.
Shrubs and trees – These have woody stems that remain alive all year. The leaves tend to have net-like veins. Rarely do shrubs grow taller than 13 feet. Trees are similar to shrubs in that they generally have a single woody stem but grow taller than 13 feet.

Notes