

# **The Floristic Relay: a game to teach plant community succession and disturbance dynamics**

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## **Background:**

One of the key concepts in ecology is succession, the changes that occur in plant communities over time. This concept is difficult to teach because it occurs over long periods of time and is very difficult to observe. I have found that most adults I speak to are unaware that plant communities, a.k.a. habitats and ecosystems, change over time and in response to changes in the environment, and that those changes are somewhat predictable. This lesson is designed to introduce students to the concept of change in plant communities.

## **Goals:**

Students will learn:

- 1) That different plants respond differently to changes in their environment.
- 2) That plants respond to each other.
- 3) Both these influencing factors can shape the way a plant community changes over time.

## **Objectives:**

Students will be able to

- 1) Diagram the changes in the imaginary plant community as a function of time, in the presence of environmental disturbances.
- 2) Predict the most likely outcome of plant succession in the imaginary plant community, in the absence of environmental disturbances.
- 3) Predict the outcome of land management strategies that increase or decrease the frequency of disturbances.

## **Description**

This lesson takes advantage of students' enthusiasm and interest in playing games. I designed a board game in which students represent imaginary plant species. Each player moves across the playing board differently based on their characteristics and the events in the environment. The events are drawn randomly from a deck of cards; this represents the unpredictability of the environment. The players also influence each other's movements across the board; this represents interspecies interactions. Students report on the changes that occur, i.e. who's ahead and who's behind, at different points in the game. The dynamics of the game were designed to represent the changes that may occur in real plant communities, and are based on current theories of plant succession. Students explore the dynamics of the game (by playing it) and are then asked to apply what they learned. To apply their new knowledge, students play land manager by controlling the events (for example, stacking the deck so some events occur more often) to achieve a specific outcome/winner.

### **How it relates to restoration ecology**

Restoration is the act of converting a parcel of land back to its original state, for example when a forest is cut for timber, restoration is the process of planting trees, and waiting for them to grow. Sometimes the process is much more difficult and the results aren't as expected. Then a scientist, called a restoration ecologist, is brought in.

The basic objective of the restoration ecologist is to understand how plant species respond to their environment and to each other, and how those two factors interact to create a dynamic plant community. We can then use the information to design a plan for the restoration.

Through playing the game, students become the restoration ecologist by studying the dynamics of the imaginary system, and then trying to manipulate the environment to achieve a desired result.

## The Floristic Relay: The Rules

Number of players: 4-6

Object of the game: First player to reach the “Finish” square wins.

Step 1: Choose a dealer.

Step 2: Dealer shuffles the three decks one at a time. All players, including dealer, choose a game piece. Place game pieces in the “Start” square.

Step 3: Dealer places Event Cards face down in Future Events spot on the playing board. Place the Interaction Cards face down in their spot, and deal one character card to each player.

Step 4: Players will play with the same character card for the duration of the game.

Step 5: The dealer chooses the first Event Card and places it face up in the Current Event spot.

Step 6: Each player then plays according to the Character card directions, starting with the dealer and going clockwise.

Step 8: After all players have their turn, check the board for players who landed on the same square. These players are interacting.

1. Interactions are played in the same order as Events (clockwise starting at the dealer)
2. Two at a time, the interacting players draw one Interaction Card.
3. Play according to the card.
4. The interaction part of the round is over when no players are sharing squares.

Step 9: Repeat Steps 5-8 until all players have left the “Start” square. Write the order of the players on the sheet titled “How did the plant community change?”. Continue with Steps 5-8 until a player wins. Write the order again at the end of the game.

Discussion Questions:

Count the Event cards that were played. How many are in each category?

Event	Game 1	Game 2	Game 3
Fire			
Landslide			
Grazing			
No Disturbance			

Which character did you play? What needs to happen in order for your character to win more often?

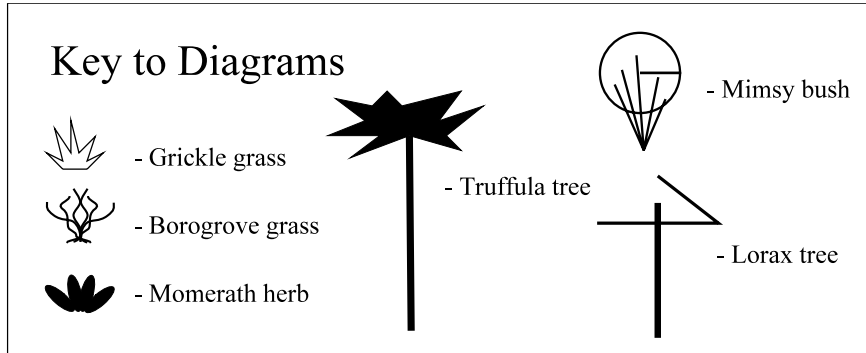
Which plant did best when there was fire? What about when there was grazing?

How would the outcome change if the events that happened less often, occurred more often?

What would happen if we took out all the Disturbance cards and only had No Disturbance cards?

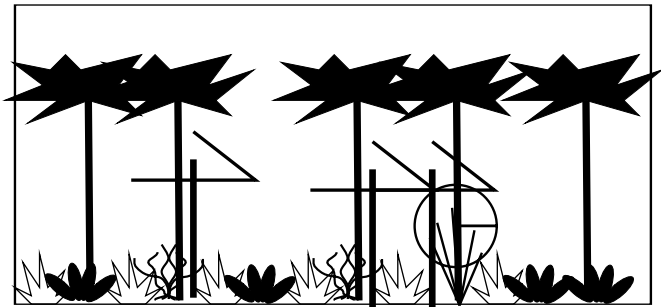
# How does the plant community change?

When all the players have left the “Start” square, write down the order of the player’s plants. At the end of the game, write down the order again. Then, diagram the community following the example below.



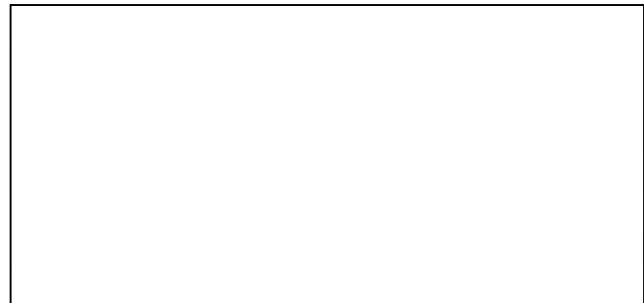
Example:

1st Place	<u>Grickle grass</u>	(6 plants)
2nd Place	<u>Truffula tree</u>	(5 plants)
3rd Place	<u>Momerath herb</u>	(4 plants)
4th Place	<u>Lorax tree</u>	(3 plants)
5th Place	<u>Borogrove grass</u>	(2 plants)
6th Place	<u>Mimsy bush</u>	(1 plant)



At the start:

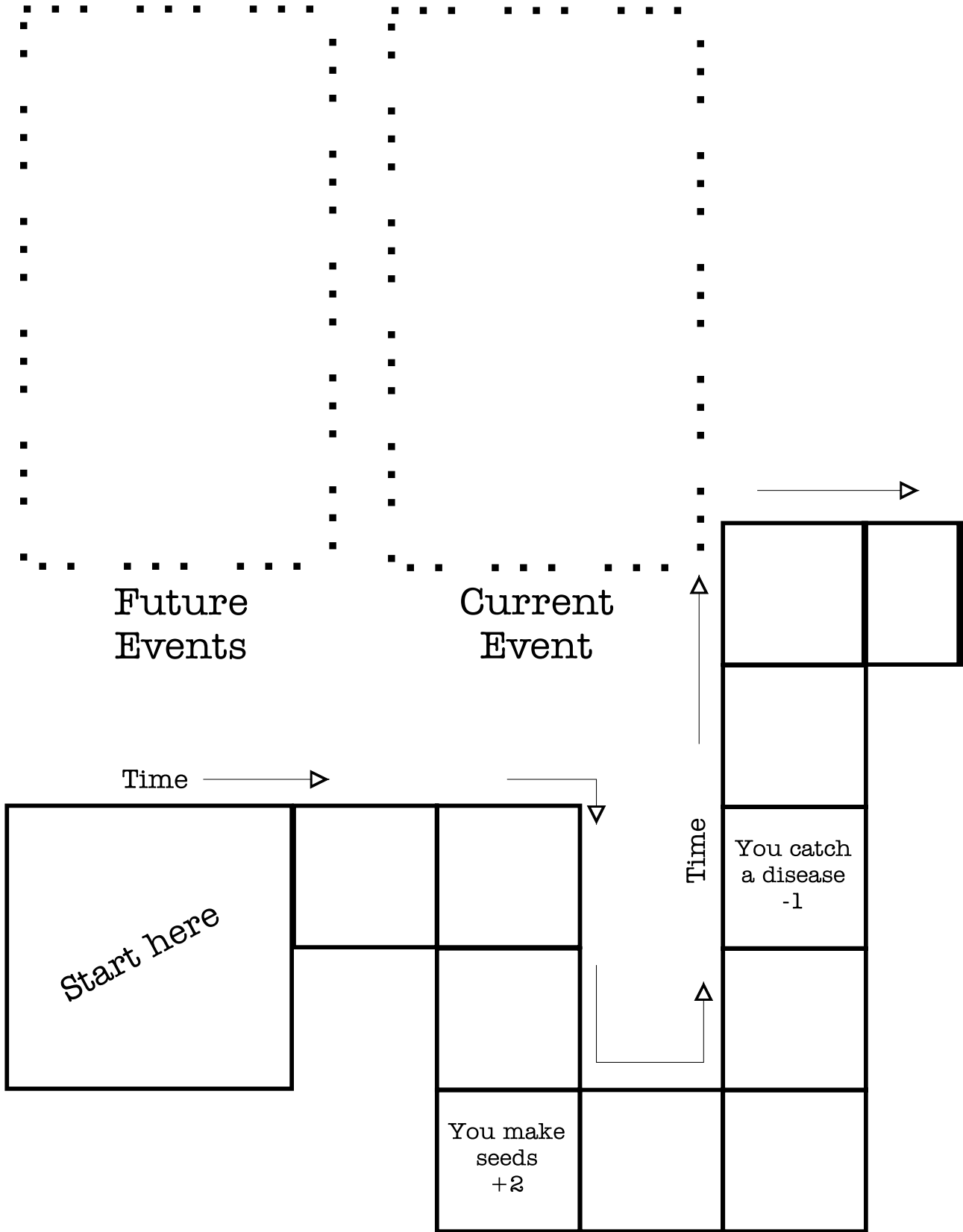
1st Place	=====	(6 plants)
2nd Place	=====	(5 plants)
3rd Place	=====	(4 plants)
4th Place	=====	(3 plants)
5th Place	=====	(2 plants)
6th Place	=====	(1 plant)

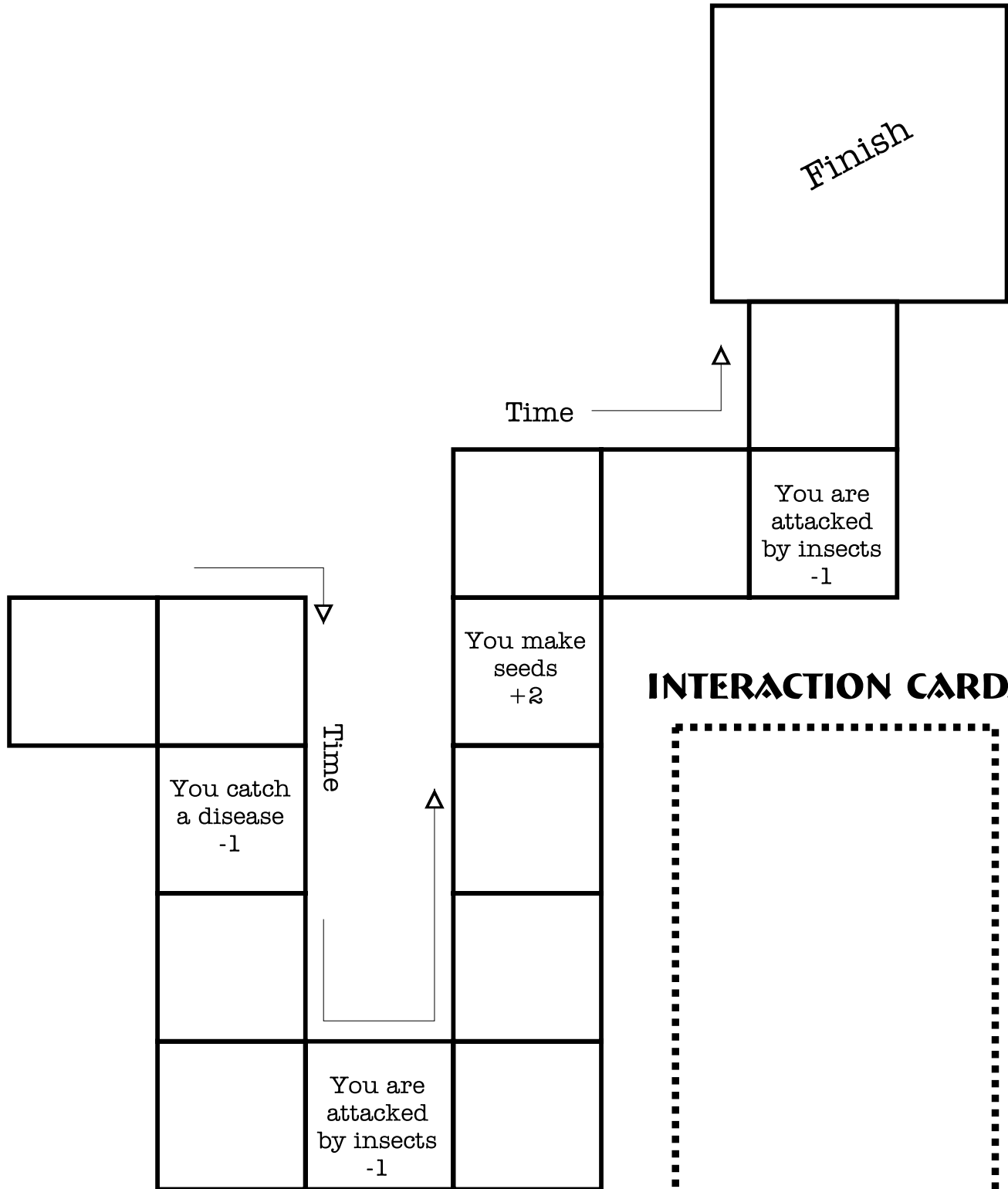


At the end:

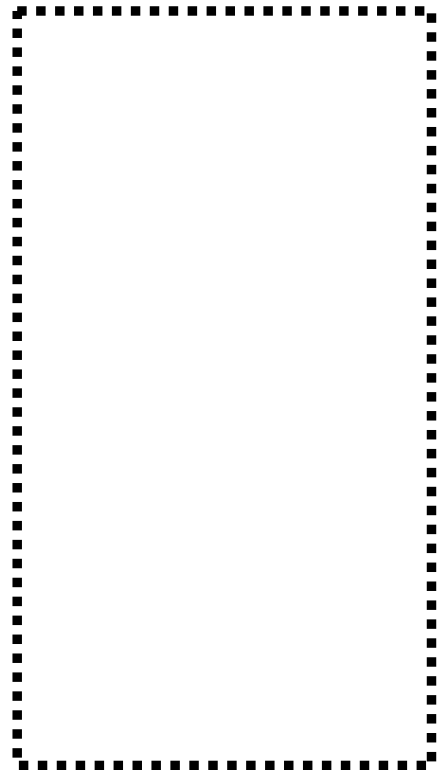
1st Place	=====	(6 plants)
2nd Place	=====	(5 plants)
3rd Place	=====	(4 plants)
4th Place	=====	(3 plants)
5th Place	=====	(2 plants)
6th Place	=====	(1 plant)







## INTERACTION CARDS



Landslide  
Event



Landslide  
Event



Wildfire  
Fire Event



Wildfire  
Fire Event



Animals grazing  
Grazing Event



Animals grazing  
Grazing Event





<p><i>Momerath herb</i></p> <p>Character Type: <b>Early Successional</b></p> <p>Fire event: go <u>forward 5</u> places</p> <p>Landslide event: go <u>forward 2</u> places</p> <p>Grazing event: <u>stay</u> in the same place</p> <p>No disturbance: go <u>back 1</u> place</p>	<p><i>Lorax tree</i></p> <p>Character Type: <b>Early Successional</b></p> <p>Fire event: <u>stay</u> in the same place</p> <p>Landslide event: go <u>forward 5</u> places</p> <p>Grazing event: go <u>forward 2</u> places</p> <p>No disturbance: go <u>back 1</u> place</p>	<p><i>Grickle grass</i></p> <p>Character Type: <b>Early Successional</b></p> <p>Fire event: go <u>forward 2</u> places</p> <p>Landslide event: <u>stay</u> in the same place</p> <p>Grazing event: go <u>forward 5</u> places</p> <p>No disturbance: go <u>back 1</u> place</p>
<p><i>Truffula Tree</i></p> <p>Character Type: <b>Late Successional</b></p> <p>Fire event: go <u>back 4</u> places</p> <p>Landslide event: go <u>back 1</u> place</p> <p>Grazing event: <u>stay</u> in the same place</p> <p>No disturbance: go <u>forward 3</u> places</p>	<p><i>Mimsy bush</i></p> <p>Character Type: <b>Late Successional</b></p> <p>Fire event: go <u>back 1</u> places</p> <p>Landslide event: go <u>back 4</u> place</p> <p>Grazing event: <u>stay</u> in the same place</p> <p>No disturbance: go <u>forward 3</u> places</p>	<p><i>Borogrove grass</i></p> <p>Character Type: <b>Late Successional</b></p> <p>Fire event: go <u>back 1</u> places</p> <p>Landslide event: go <u>back 1</u> place</p> <p>Grazing event: go <u>back 3</u> place</p> <p>No disturbance: go <u>forward 3</u> places</p>

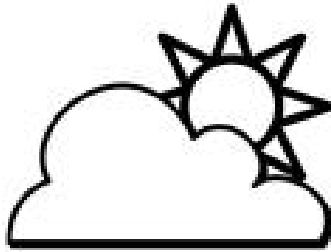
Sunny day

No Disturbance



Cloudy day

No Disturbance



Butterfly flies by

No Disturbance



Rainy day

No Disturbance



Bee buzzes by

No Disturbance



Bear eats berries

No Disturbance



<p><b>Competition</b> For Water</p> <p>Late character type has more roots &amp; uses up all the water</p> <p><u>Late move forward 2, Early move back 1</u></p> <p>If: 2 Early characters or 2 Late characters meet, then flip a coin to decide the winner</p>	<p><b>Competition</b> For Light</p> <p>Late character type shades Early character type</p> <p><u>Late move forward 2, Early move back 1</u></p> <p>If: 2 Early characters or 2 Late characters meet, then flip a coin to decide the winner</p>	<p><b>Facilitation</b> With Nutrients</p> <p>Early character type adds nitrogen to the soil</p> <p><u>Early stays in place, Late move forward 2</u></p> <p>If: 2 Early characters or 2 Late characters meet, then flip a coin to decide the winner (winner moves)</p>
<p><b>Facilitation</b> With Shade</p> <p>Early character type protects Late character from heat and drying out.</p> <p><u>Early stays in place, Late move forward 2</u></p> <p>If: 2 Early characters or 2 Late characters meet, then flip a coin to decide the winner (winner moves)</p>	<p><b>Tolerance</b></p> <p>Species tolerate each other</p> <p><u>Both stay in place</u></p>	<p><b>Tolerance</b></p> <p>Species tolerate each other</p> <p><u>Both stay in place</u></p>

## **Helpful Web Pages for Riparian Ecology**

[www.fs.fed.us/database/feis](http://www.fs.fed.us/database/feis)

This database was designed for fire ecologists, but has lots of useful information on riparian plants.

<http://plants.usda.gov>

Classification and ecological information on US plants. Click on Topics for information about Wetland Indicator Status and Invasive Species.

<http://gk12.asu.edu/>

This site is home to the GK-12 earth science education program at ASU. The site is under development but will eventually have lots of examples and lessons for earth science education. An updated version on the succession game will be posted here in a few weeks.

## **General Information on Riparian Areas**

Brinson, M.M., Swift, B.L., Plantico, R.C., and J.S. Barclay. 1981. Riparian Ecosystems: Their Ecology and Status. FWS/OBS-81/17, US Fish and Wildlife Service, Washington, DC. 151 pp. (at NAU)

Gregory, S.V., Swanson, F.J., McKee, A.J., and K.W. Cummins. 1991. An ecosystem perspective of riparian zones. *BioScience* 41: 540-551. (on microform at NAU)

Johnson, R.R., and C.H. Lowe. 1985. On the development of riparian ecology. In R.R. Johnson, C.D. Zieball, D.R. Patton, P.F. Ffolliot, and R.H. Hamre, eds. *Riparian Ecosystems and Their Management: Reconciling Conflicting Uses*. General Technical Report RM-120, Forest Service, U.S. Department of Agriculture, Washington, DC, pp. 112-116. (at NAU)

Junk, W.J., Bayley, P.B., and R.E. Sparks. 1989. The flood pulse concept in river-floodplain systems. In D.P. Dodge, ed. *Proceedings of the International Large River Symposium*. Special Issue of *Journal of Canadian Fisheries and Aquatic Sciences* 106:11-127.

Naiman, R.J., and H. Decamps. 1997. The ecology of interfaces: Riparian zones. *Annual Review of Ecology and Systematics* 28: 621-658. (at NAU)

Patten, D.T. 1998. Riparian ecosystems of semi-arid North America: Diversity and Human Impacts. *Wetlands* 18:498-512 (on-line through NAU)

Vannote, R.L., Minshall, G.W., Cummins, K.W., Sedell, J.R., and C.E. Cushing. 1980. The river continuum concept. *Canadian Journal of Fisheries and Aquatic Sciences*. 37:130-137.

### **Human disturbance esp. groundwater pumping**

LeRoy, P.N., Allan, J.D., Bain, M.B., Karr, J.R., Prestegarrd, K.L., Richter, B.D., Sparks, R.E., and J.C. Stromberg. 1997. The natural flow regime: A paradigm for river conservation and restoration. *BioScience* 47: 769-784 (on microform at NAU)

Stromberg, J., Tiller, R., and B. Richter. 1998. Effects of groundwater decline on riparian vegetation of semiarid regions: The San Pedro, Arizona. *Ecological Applications* 8: 113-131. (at NAU)

Medina, A.L. 1990. Possible effects of residential development on streamflow, riparian plant communities, and fisheries on small mountain streams in central Arizona. *Forest Ecology and Management* 33/34: 351-361.

### **Riparian Tree Ecology (cottonwood/sycamore/box elder)**

Scott, M.L., Friedman, J., and G.T. Auble. 1996. Fluvial processes and the establishment of bottomland trees. *Geomorphology* 14:327-339. (at NAU)

Auble, G.T. and M.L. Scott. 1998. Fluvial disturbance patches and cottonwood recruitment along the upper Missouri River, Montana. *Wetlands* 18:564-556 (on line through NAU)

Stromberg, J.C. 2001. Influence of stream flow regime and temperature on growth rate of the riparian tree, *Platanus wrightii*, in Arizona. *Freshwater Biology* 46: 227-239.

Kolb, T.E., Hart, S.C., Amundson, R. 1997. Boxelder water sources and physiology at perennial and ephemeral stream sites in Arizona. *Tree Physiology* 17: 151-160

Stromberg, J.C. 2001. Biotic integrity of *Platanus wrightii* riparian forests in Arizona: first approximation. *Forest Ecology and Management* 142: 251-266.

### **Succession**

Boggs, K. and T. Weaver. 1994. Changes in vegetation and nutrient pools during riparian succession. *Wetlands* 14: 98-109.

Connell, J.H., and R.O. Slatyer. 1977. Mechanisms of succession in natural communities and their role in community stability and organization. *American Naturalist* 111: 1119-1144. (at NAU)

Drury, W.H., and I.C.T. Nesbet. 1973. Succession. *Journal of the Arnold Arboretum* 54: 331-368. (at NAU)

Egler, F.E. 1954. Vegetation concepts I. Initial floristic composition, a factor in old field vegetation development. *Vegetatio* 4: 412-417.

Huston, M.A., and T.M. Smith. 1987. Plant Succession: Life history and competition. *American Naturalist* 130: 168-198. (at NAU)

Peet, R.K. and N.L. Christiansen. 1980. Succession: A population process. *Vegetatio* 43:131-140.

Pickett, S.T.A, Collins, S.L., and J.J. Armesto. 1987. Models, Mechanisms and Pathways of Succession. *The Botanical Review* 53: 335-371. (at NAU)

### **Effect of Arsenic on Plants**

Lejeune, K., Galbraith, H., Lipton, J., L.A. Kapistka. 1996. Effects of metals and arsenic on riparian communities in southwest Montana. *Ecotoxicology* 5: 297-312. (at NAU)

### **Books**

Mitsch, W.J. and J.G. Gosselink. 2000. *Wetlands*. John Wiley, New York. 3<sup>rd</sup> Edition, p. 920. (at NAU)

Elmore, F.H. 1976. *Shrubs and Trees of the Southwest Uplands*. Southwest Parks and Monuments Assoc. 214 p. (at NAU).

Arnberger, L.P. 1982. *Flowers of the Southwest Mountains*. Southwest Parks and Monument Assoc. 139 p. (at NAU)

Epple, A.O. 1995. *A field guide to the plants of Arizona*. LewAnn Publishing Co. Helena, Montana. 347 p. (at NAU)

## TREES

- ACERACEAE  
 Acer glabrum Mountain Maple  
 Acer grandidentatum Big Tooth Maple  
 Acer negundo Box-Elder
- BETULACEAE  
 Alnus oblongifolia Arizona Alder  
 Ostrya kneriifolia Hop-hornbeam
- CUPRESSACEAE  
 Cupressus arizonica Arizona Cypress  
 Juniperus scopulorum Rocky Mountain Juniper
- FAGACEAE  
 Quercus arizonica Arizona White Oak  
 Quercus chrysolepis Canyon Live Oak  
 Quercus emoryi Emory Oak  
 Quercus gambelii Gambel Oak
- JUGLANDACEAE  
 Juglans major Arizona Walnut
- OLEACEAE  
 Fraxinus velutina Velvet Ash
- PINACEAE  
 Abies concolor White Fir  
 Pinus ponderosa Ponderosa Pine  
 Pseudotsuga menziesii Douglas Fir
- PLATANACEAE  
 Platanus wrightii Arizona Sycamore
- ROSACEAE  
 Malus pumila\* Apple  
 Prunus serotina So. Western Chokecherry  
 Prunus virginiana Common Chokecherry
- SALICACEAE  
 Populus angustifolia Narrowleaf Cottonwood  
 Populus fremontii Fremont Cottonwood

- CORNACEAE  
 Cornus sericea (C. stolonifera) DOGWOOD FAMILY  
 Red Osier Dogwood
- ERICACEAE  
 Arctostaphylos pringlei Pringle's Manzanita
- FABACEAE  
 Robinia neomexicana LEGUME FAMILY  
 New Mexico Locust
- FAGACEAE  
 Quercus turbinella BEECH FAMILY  
 Shrub Live Oak
- GARRYACEAE  
 Garrya flavescens SILK-TASSEL FAMILY  
 Silktassel Bush
- GROSSULARIACEAE  
 Ribes inermis GOOSEBERRY FAMILY  
 Common Gooseberry  
 Ribes pinetorum Orange Gooseberry  
 Ribes wolfii Rothrock Currant
- HYDRANGAEAE  
 Hydrangea FENDLERBUSH FAMILY  
 Cliff Fendlerbush  
 Philadelphus microphyllus Mock Orange
- HYDROPHYLLACEAE  
 Eriodictyon angustifolium WATERLEAF FAMILY  
 Yerba-Santa
- RHAMNACEAE  
 Rhamnus californica BUCKTHORN FAMILY  
 Coffeeberry
- ROSACEAE  
 Anemone utahensis ROSE FAMILY  
 Utah Serviceberry  
 Cercocarpus montanus Mountain Mahogany  
 (C. breviflorus)  
 Holodiscus discolor Rock Spirea  
 Petrophyllum caespitosum Rock Mat  
 Rosa woodsii v. ultramontana Arizona Rose  
 (R. arizonica)  
 Rubus leucodermis Western Raspberry  
 Rubus neomexicanus New Mexican Raspberry  
 Rubus procerus\* Himalaya-Berry  
 Rubus strigosus American Red Raspberry
- RUTACEAE  
 Ptelea trifoliata CITRUS FAMILY  
 Hop Tree  
 (P. angustifolia & P. pallida)
- SALICACEAE  
 Willow FAMILY  
 Willow  
 Salix exigua Coyote Willow  
 Salix gooddingii Goodding's Willow  
 Salix lasiolepis Red Willow  
 Salix lasiolepis Arroyo Willow

- OPUNTIA  
 Opuntia macrorhiza Prickly Pear sp.  
 Opuntia phaeacantha Brownspine Prickly Pear
- VINES**
- CONVOLVULACEAE  
 Ipomoea cristulata MORNING GLORY FAMILY  
 Scarlet Creeper  
 (I. coccinea, I. heterifolia)
- MORACEAE  
 Humulus lupulus MULBERRY FAMILY  
 American Hop  
 (H. americanus)
- RANUNCULACEAE  
 Clematis ligusticifolia BUTTERCUP FAMILY  
 White Virgin's Bower
- VITACEAE  
 Parthenocissus vitacea GRAPE FAMILY  
 Virginia Creeper  
 Vitis arizonica Arizona Grape

## HERBACEOUS PLANTS

- AMARANTHACEAE  
 Amaranthus blitoides\* AMARANTH FAMILY  
 (A. graccians)  
 Prostrate Pigweed  
 Amaranthus powellii Powell Amaranth.
- APIACEAE  
 Cicuta maculata PARSLEY FAMILY  
 Water Hemlock  
 (C. douglasii)  
 Ligusticum porteri Osha  
 Osmorhiza chilensis Sweetroot sp.  
 Pastinaca sativa\* Parsnip
- APOCYNACEAE  
 Apocynum cannabinum DOGBANE FAMILY  
 Indian Hemp  
 Apocynum x floribundum Dogbane sp.  
 (A. medium)
- ARALIACEAE  
 Aralia racemosa GINSENG FAMILY  
 Spikenard
- ASCLEPIADACEAE  
 Asclepias tuberosa MILKWEED FAMILY  
 Butterfly Weed
- ASTERACEAE  
 Achillea millefolium SUNFLOWER FAMILY  
 Western Yarrow  
 (A. lanulosa)  
 Ageratina herbacea Ageratina  
 (Eupatorium herbaceum)  
 Ambrosia psilostachya Western Ragweed  
 Anaphalis margaritacea Pearly Everlasting  
 Antennaria marginata Rocky Mtn. Pussytoes  
 Avicennaria parvifolia Pussytoes sp.  
 Artemisia canadensis Sagebrush sp.  
 Artemisia dracunculoides False Tarragon  
 Artemisia ludoviciana Prairie Sagebrush  
 Aster falcatus Aster sp.  
 (A. commutatus)  
 Aster lancolatum Siskiyou Aster  
 (A. hesperius)  
 Bahia dissecta Yellow Ragweed  
 Brickellia grandiflora Tassel Flower

## CACTUS AND SUCCULENTS

- AGAVACEAE  
 Agave parryi AGAVE FAMILY  
 Parry's Agave  
 Nolina microcarpa Beargrass  
 Yucca baccata Banana Yucca
- CACTACEAE  
 Echinocereus coccineus CACTUS FAMILY  
 Claret Cup Cactus

## SHRUBS

- ANACARDIACEAE  
 Rhus glabra Smooth Sumac  
 Toxicodendron rydbergii Poison Ivy
- ASTERACEAE  
 Brickellia californica SUNFLOWER FAMILY  
 California Brickelbush
- BERBERIDACEAE  
 Mahonia repens BARBERRY FAMILY  
 (Berberis repens) Creeping Mahonia
- CAPRIFOLIACEAE  
 Sambucus glauca HONEYSUCKLE FAMILY  
 Blueberry Elder  
 Symphoricarpos rotundifolius Roundleaf Snowberry
- CELASTRACEAE  
 Pachystima myrsinites BITTERSWEET FAMILY  
 Mountain Lover

Arizona Thistle  
 Bull Thistle  
 Horsetweed  
 Fleabane sp.  
 Fleabane sp.  
 Fleabane sp.  
 Fleabane sp.  
 Wright's Cudweed  
 Clammy Cudweed  
 Common Sunflower  
 Narrowleaf Sunflower  
 Camphorweed  
 Hairy Golden Aster  
 Fendler's Hawkweed  
 Wright Beeflower  
 Blue Lettuce  
 Prickly Lettuce  
 Hoary Aster  
 (*Aster canescens* & *A. leptoides*)  
*Packera multilobata*  
 (*Senecio multilobatus*)  
*Packera neomexicana*  
 (*Senecio neomexicanus*)  
*Packera quercetorum*  
 (*Senecio quercetorum*)  
*Perrille ciliata*  
*Rudbeckia laciniata*  
*Senecio arizonicus*  
*Solidago missouriensis*  
*Solidago canadensis* v. *scabra*  
*Solidago*  
 (*S. altissima*)  
*Solidago velutina*  
 (*Solidago sparsiflora*)  
*Solidago virgiti*  
*Sonchus asper*\*  
*Taraxacum laevegatum*\*  
*Taraxacum officinale*\*  
*Tragopogon dubius*\*  
*Tragopogon porrifolius*\*  
 BORAGINACEAE  
*Lithospermum multiflorum*  
*Macromeria viridiflora*  
 MUSTARD FAMILY  
*Arabis glabra*  
*Arabis hirsuta*  
*Arabis perennans*  
*Capsella bursa-pastoris*\*  
*Chorispora tenella*\*  
*Draba asprella*  
*Erysimum capitatum*  
*Erysimum wheeleri*  
*Lepidium densiflorum*  
*Rorippa nasturtium-aquaticum*\*  
 (*Nasturtium officinale*)  
*Rorippa obtusa*  
*Schoenocrambe linearifolia*  
 (*Sisymbrium linearifolium*, *Thelypodopsis* L.)  
*Sisymbrium altissimum*\*  
*Thlaspi montanum*  
 (*T. fendleri*)

CAMPANULACEAE  
*Campanula parryi*  
*Lobelia cardinalis*  
*Triodanis perfoliata*  
 CAPRIFOLIACEAE  
*Lonicera arizonica*  
 CARYOPHYLLACEAE  
*Arenaria lanuginosa*  
*Cerastium vulgatum*\*  
*Silene antirrhina*  
*Silene scouleri*  
*Stellaria jamesiana*  
 CHENOPODIACEAE  
*Chenopodium album*\*  
*Chenopodium denticatum*  
*Chenopodium fremontii*  
*Chenopodium graveolens*  
*Salsola tragus*\*  
 (*S. iberica*, *S. kali*)  
 CLUSIACEAE  
*Hypericum scouleri*  
 (*H. formosum*)  
 COMMELINACEAE  
*Commelina dianthifolia*  
*Tradescantia occidentalis*  
 EUPHORBACEAE  
*Achlypha neomexicana*  
*Chamaesyce hyssopifolia*  
 (*Euphorbia hyssopifolia*)  
*Euphorbia dentata*  
*Tragia ramosa*  
 (*T. stylaris*)  
 FABACEAE  
*Lathyrus lansuvertii*  
 (*L. arizonicus*)  
*Lotus wrightii*  
*Lupinus argenteus*  
*Medicago lupulina*\*  
*Medicago miramina*\*  
*Medicago sativa*\*  
*Melilotus alba*\*  
*Melilotus officinalis*\*  
*Thermopsis montana*  
 (*T. pinetorum*)  
*Trifolium repens*\*  
*Vicia americana*  
 FUMARIACEAE  
*Corydalis aurea*  
 GENTIANACEAE  
*Frasera speciosa*  
 (*Suaeda radiata*)  
 GERANIACEAE  
*Erodium cicutarium*\*  
*Geranium caespitosum*  
*Geranium richardsonii*  
 GERANIUM FAMILY  
*Filaree*  
 Purple Geranium  
 Richardson's Geranium

HYDROPHYLLACEAE  
*Hydrophyllum occidentale*  
*Phacelia megellanica*  
 MINT FAMILY  
*Agastache pallidiflora*  
*Clinopodium vulgare*\*  
*Halepna diffusa*  
*Lamium amplexicaule*\*  
*Mentha spicata*\*  
*Monarda menthaefolia*  
*Nepeta cataria*\*  
*Prunella vulgaris*\*  
 LILIIACEAE  
*Allium* sp.  
*Disporum trachycarpum*  
*Fritillaria atropurpurea*  
*Mainanthenum racemosum*  
 (*Smilicina racemosa*)  
*Mainanthenum stellatum*  
 (*Smilicina stellata*)  
*Zigadenus elegans*  
 MALVACEAE  
*Malva neglecta*\*  
*Sidalcea neomexicana*  
*Sphaeralcea* sp.  
 NYCTAGINACEAE  
*Mirabilis comata*  
 (*Oxybaphus comatus*)  
 ONAGRACEAE  
*Chaenarrhon angustifolium*  
 (*Epilobium angustifolium*)  
*Circaea alpina*  
*Epilobium canum*  
 (*Zauschneria californica*)  
*Epilobium ciliatum*  
 (*E. adenocaulon*)  
*Epilobium halleanum*  
*Gaura hexandra*  
 (*G. gracilis*)  
*Oenothera elata*  
 (*O. hookeri*)  
*Oenothera flava*  
 (*inc. O. taraxacoides*)  
*Oenothera laciniata*  
*Oenothera neomexicana*  
*Oenothera villosa*  
 (*O. procer*)  
 ORCHIDACEAE  
*Corallorhiza maculata*  
*Eppactis gigantea*  
*Goodyera oblongifolia*  
*Platanthera sparsiflora*  
 (*Habenaria sparsiflora*)  
 OXALIDACEAE  
*Oxalis alpina*  
 (*O. metcalfei*)  
*Oxalis stricta*\*  
 WATERLEAF FAMILY  
 Waterleaf  
 Varileaf Phacelia  
 LAMIACEAE  
 Pale Giant Hyssop  
 Wild Basil  
 Mock Penuryoyal sp.  
 Herbit  
 Spearmint  
 Bee Balm  
 Catnip  
 Self-Heal  
 LILY FAMILY  
 Onion sp.  
 Fairybells  
 Fritillary sp.  
 False Solomon's Seal  
 (*Smilicina racemosa*)  
 Starry Solomon's Seal  
 (*Smilicina stellata*)  
 Death Camas  
 MALLOW FAMILY  
 Common Mallow  
 N. Mexico Checker-Mallow  
 Globe Mallow sp.  
 FOUR O'CLOCK FAMILY  
 Four O'Clock sp.  
 EVENING-PRIMROSE FAMILY  
 Fireweed  
 Enchanters Nightshade  
 Hummingbird Trumpet  
 Willow Weed sp.  
 Willow Weed sp.  
 Slender Gaura  
 Hooker Evening Primrose  
 Shortfin Evening Primrose  
 Cutleaf Evening Primrose  
 Evening Primrose sp.  
 Evening Primrose sp.  
 ORCHID FAMILY  
 Coralroot sp.  
 Giant Helleborine  
 Rattlesnake Plantain sp.  
 Rein Orchid sp.  
 WOODSORREL FAMILY  
 Woodsorrel sp.  
 Yellow Woodsorrel

BELLFLOWER FAMILY  
 Parry Bellflower  
 Scarlet Lobelia  
 Venus Looking Glass  
 HONEYSUCKLE FAMILY  
 Arizona Honeysuckle  
 PINK FAMILY  
 Sandwort  
 Common Chickweed  
 Sleepy Catchfly  
 Scouler's Catchfly  
 Starwort  
 GOOSEFOOT FAMILY  
 Lamb's Quarters  
 Narrowleaf Goosefoot  
 Goosefoot sp.  
 Goosefoot sp.  
 Russian Thistle  
 ST. JOHN'S WORT FAMILY  
 St. John's Wort  
 SPIDERWORT FAMILY  
 Dayflower  
 Western Spiderwort  
 SPURGE FAMILY  
 Three-seeded Mercury  
 Hyssop Spurge  
 Spurge sp.  
 Noseburn  
 LEGUME FAMILY  
 Arizona Pea  
 Wright's Lotus  
 Silverstem Lupine  
 Black Medic  
 Small Bur Clover  
 Alfalfa  
 White Sweet Clover  
 Yellow Sweet Clover  
 Golden Pea  
 White Clover  
 American Vetch  
 FUMITORY FAMILY  
 Golden Corydalis  
 GENTIAN FAMILY  
 Deers Ears  
 GERANIUM FAMILY  
 Filaree  
 Purple Geranium  
 Richardson's Geranium



POLYDIACEAE POLYPODY FAMILY  
*Polypodium hesperium* Western Polypody

PTERIDIACEAE MAIDENHAIR FERN FAMILY  
*Adiantum aleuticum* Western Maidenhair Fern  
 (*Adiantum pedatum*)

SELAGINELLACEAE SPIKE MOSS FAMILY  
*Selaginella underwoodii* Selaginella sp.

## GRASSES AND THEIR RELATIVES

CYPERACEAE SEDGE FAMILY  
*Carex abrotachya* Sedge sp.  
*Carex occidentalis* Sedge sp.  
*Carex senta* River Sedge  
*Carex vulpinoidea* Sedge sp.  
*Cyperus fendlerianus* Flat Sedge sp.  
*Scirpus microcarpus* Panicle Bulrush

JUNCACEAE RUSH FAMILY  
*Juncus ensifolius* Rush sp.  
 (*Juncus saximontanus*)  
*Juncus tenuis* Slender Rush

POACEAE GRASS FAMILY  
*Agrostis gigantea\** (A. alba\*) Rectop  
*Avena fatua\** Wild Oat  
*Bouteloua curtipendula* Side Oats Gramma  
*Bouteloua gracilis* Blue Gramma  
*Bromus carinatus* California Brome  
*Bromus ciliatus* Fringed Brome  
*Bromus diandrus\** (B. rigidus\*) Rippogt Grass  
 (*B. rigidus*\*)  
*Bromus frondosus* Brome sp.  
*Bromus inermis\** Smooth Brome  
*Bromus japonicus\** Japanese Brome  
*Bromus marginatus* Mountain Brome  
*Bromus polyanthus* Great Basin Brome  
*Bromus porteri* Nodding Brome  
 (*B. anomalus*)  
*Bromus tectorum\** Downy Brome  
*Chloris virgata* Feather Fingergrass  
*Dactylis glomerata\** Orchard Grass  
*Dichanthelium oligosanthos* Grass sp.  
 (*Panicum scribnerianum*)  
*Digitaria sanguinalis\** Common Crabgrass  
*Echinochloa crusgalli\** Barnyard Grass  
*Elymus canadensis* Canada Wild Rye  
*Elymus elymoides* Squireltail  
 (*Sitanion hystrix*, S. longifolium)  
*Elymus glaucus* Blue Wild Rye  
*Elymus trachycaulis* (Agropyron subsecundum)  
 (*Agropyron subsecundum*)  
*Eragrostis curvula\** Weeping Lovegrass  
*Eragrostis intermedia* Plains Lovegrass  
*Eragrostis mexicana* Mexican Lovegrass  
*Festuca pratensis\** (F. elatior) Meadow Fescue  
*Festuca rubra\** Fescue sp.  
*Glyceria striata* Fowl Manna Grass  
*Holcus lanatus\** Velvet Grass  
*Hordeum jubatum* Foxtail Barley

SAXIFRAGACEAE SAXIFRAGE FAMILY  
*Alumroot sp.* Alumroot sp.  
*Alumroot sp.* Alumroot sp.  
*Parnassia palustris* Grass of Parnassus  
 (*P. parviflora*)  
*Saxifraga rhomboides* Diamondleaf Saxifrage

SCROPHULARIACEAE FIGWORT FAMILY  
*Castilleja applegatii* Desert Paintbrush  
 (*C. chromosa*)  
*Linaria dalmanica\** Dalmatian Toadflax  
*Mimulus carolinensis* Common Monkey Flower  
*Mimulus guttatus* Common Monkey Flower  
*Mimulus rubellus* Monkeyflower sp.  
*Pedicularis centranthera* Wood Betony  
*Penstemon barbatus* Southwestern Penstemon  
*Penstemon pseudospectabilis* Arizona Penstemon  
*Penstemon rostriflorus* Bridge's Penstemon  
 (*P. bridgesii*)  
*Scrophularia parviflora* Figwort  
*Verbascum thapsus\** Common Mullein  
*Veronica anagallis-aquatica* Speedwell sp.

SOLANACEAE NIGHTSHADE FAMILY  
*Datura wrightii* Sacred Datura  
 (*Datura meteloides*)  
*Solanum douglasii* Nightshade sp.  
*Solanum xanti* Purple Nightshade

VALERIANACEAE VALERIAN FAMILY  
*Valeriana arizonica* Arizona Valerian  
*Valeriana edulis* Common Valerian

VERBENACEAE VERVAIN FAMILY  
*Glandularia gooddingii* Gooding Verbena  
 (*Verbena gooddingii*)

VIOLACEAE VIOLET FAMILY  
*Viola canadensis* Canada Violet  
*Viola nephrophylla* Violet sp.

ZYGOPHYLLACEAE CALTROP FAMILY  
*Tribulus terrestris\** Puncture Vine

## FERNS AND THEIR RELATIVES

ASPLENIACEAE SPLEENWORT FAMILY  
*Asplenium trichomanes* Maidenhair Spleenwort

DENNSTAEDTIACEAE BRACKEN FAMILY  
*Peridium aquilinum* Western Bracken

DRYOPTERIDACEAE WOOD FERN FAMILY  
*Cystopteris bulbifera* Bladder Fern  
*Cystopteris reevesiana* Southwestern Brittle Fern  
 (*C. fragilis* var. *tenuifolia*)  
*Dryopteris filix-mas* Male Fern

EQUISETACEAE HORSETAIL FAMILY  
*Equisetum arvense* Meadow Horsetail  
*Equisetum hiemale* Common Scouringrush  
*Equisetum laevigatum* Smooth Scouringrush

PLANTAGINACEAE PLANTAIN FAMILY  
*Plantago lanceolata\** Buckhorn Plantain  
*Plantago major\** Common Plantain

POLEMONIACEAE PHLOX FAMILY  
*Gilia flavocincta* Gilia sp.  
*Ipomopsis aggregata* Skyrocket  
 (*Gilia aggregata*)  
*Ipomopsis multiflora* Many-flowered Gilia  
 (*Gilia multiflora*)  
*Linanthus nuttallii* Nuttall's Linanthus  
*Phlox gracilis* Slender Phlox  
 (*Microsteris gracilis*)  
*Polemonium foliosissimum* Jacob's Ladder sp.

POLYGONACEAE BUCKWHEAT FAMILY  
*Eriogonum alatum* Winged Buckwheat sp.  
*Eriogonum pinnuacoides* Wild Buckwheat sp.  
*Eriogonum polycladon* Wild Buckwheat sp.  
*Polygonum aviculare\** Common Knotweed  
*Polygonum convolvulus\** Black Bindweed  
*Polygonum lapathifolium* Willow Weed  
*Polygonum persicaria\** Lady's Thumb  
*Rumex crispus\** Curlyleaf Dock  
*Rumex obtusifolius\** Bitter Dock  
*Rumex altissimus* Dock sp.

PORTULACACEAE PURSLANE FAMILY  
*Claytonia perfoliata* Miner's Lettuce  
 (*Montia perfoliata*)  
*Claytonia rosea* Spring Beauty  
 (*C. lanceolata*)  
*Portulaca oleracea\** Common Purslane

POTAMOGETONACEAE PONDWEED FAMILY  
*Potamogeton nodosus* Pondweed sp.

PRIMULACEAE PRIMROSE FAMILY  
*Androsace septentrionalis* Fairy Candelabra

PYROLACEAE PYROLA FAMILY  
*Chimaphila umbellata* Pipsissewa

RANUNCULACEAE BUTTERCUP FAMILY  
*Aconitum columbianum* Monkshood  
*Anemone cylindrica* Anemone sp.  
*Aquilegia chrysantha* Yellow Columbine  
*Cimicifuga arizonica* Arizona Bugbane  
*Delphinium geraniifolium* Larkspur sp.  
*Delphinium scaposum* Barestem Larkspur  
*Thalictrum fendleri* Fendler's Meadowrue

ROSACEAE ROSE FAMILY  
*Agrimonia gryposepala* Agrimony sp.  
*Potentilla glandulosa* Sticky Cinquefoil  
*Potentilla thurberi* Red Cinquefoil

RUBIACEAE Madder Family  
*Gadium triflorum* Fragrant Bedstraw  
*Gadium wrightii* Bedstraw sp.  
*Houstonia wrightii* (Hedysotis pygmaea) Pygmy Blueets  
 (*Hedysotis pygmaea*)  
*Kelloggia galioides* Kelloggia

SANTALACEAE SANDALWOOD FAMILY  
*Conantra umbellata* (C. pallida) Bastard Toadflax  
 (*C. pallida*)

# THE WEST FORK OF OAK CREEK

## OF AND CALL OF THE CANYON TRAILS

### PLANT CHECKLIST

Coconino National Forest

Red Rock Country

Sedona

Arizona



The list is organized by currently accepted Scientific, or Latin names, as given by the USDA Plant Database website. Former synonyms follow (in parentheses). Common names may vary; these are taken first from A Catalogue of Arizona Flora by Lehr, and then from the USDA database where Lehr listed none. This list covers most of the species one might encounter in the first 4-5 miles along the trail in West Fork; over 500 species have been identified within the entire 14 mile Wilderness Area boundary.

The West Fork of Oak Creek Canyon, in addition to being one of the most scenic hikes in Northern Arizona, also contains an incredible botanical diversity for its relatively restricted area. The canyon's narrow walls, combined with a spring-fed perennial stream, create a particular microclimate that allows many species of plants to thrive that otherwise would not be found in the Sedona Red Rocks Area.

West Fork contains four of the eight major plant communities found in the overall region. As its name implies, vegetation in the Ponderosa Pine-Fir Woodland is dominated by tall Ponderosa Pines, Douglas Fir, and White Fir. This community is more widespread on the rim country above and to the north. The cool, shaded, moist canyon mimics a higher elevation climate and allows these trees to grow here. Bracken fern and a number of herbaceous perennials grow on the forest floor beneath the towering pines.

The Chaparral community dominates the drier south facing slopes above the canyon floor, and is composed of a group of almost impenetrable shrubs, dominated by Scrub Live Oak, Manzanita, Silk-tassel Bush, and Mountain Mahogany. This community intergrades with the Evergreen Oak Woodland on the lower benches just above the Pines and Firs, and in slightly more protected drainages to the sides of the main channel. Canyon Live Oak, Gambel Oak, and several other species of oaks are found in these sections of the Canyon, along with New Mexico Locust, Hoptree, Coffeeberry, Serviceberry, and Bigtooth Maple. You will encounter fingers of this community along the main trail up West Fork, but the Chaparral will be observed mainly at a distance above.

The Upper Riparian Zone is associated directly with the West Fork stream waters and its perennial seeps and springs. An incredible variety of vegetation thrives here. Arizona Alder, Box Elder, Velvet Ash, and several Willows are trees that all require constant water. These are interwoven with understory thickets of Wild Rose, Arizona Grape, Virginia Creeper, Red Osier Dogwood, New Mexico Raspberry, and Red Raspberry, along with many different herbaceous wildflowers, grasses, and ferns. The earliest flowers begin blooming before the snows are gone in March, and a steady progression follows on into October and even November depending on frost and the arrival of early Winter storms.

- Hordeum murinum\* Hare Barley
- (H. leporinum\*, H. glaucum\*)
- Lolium perenne\* Perennial Ryegrass
- Lycurus setosus Wolf-tail
- (L. phleoides)
- Melica porteri Porter Melic
- Muhlenbergia aridina Fox-tail Muhly
- Muhlenbergia polycanalis Cliff Muhly
- Muhlenbergia racemosa Marsh Muhly
- Muhlenbergia virescens Screw-leaf Muhly
- Panicum bulbosum Bulb Panicum
- Paspalum smithii Western Wheatgrass
- (Agropyron smithii)
- Phalaris arundinacea\* Reed Canary Grass
- Phleum pratense\* Common Timothy
- Polygonum monspeliensis\* Rabbit-foot Grass
- Poa compressa\* Canada Bluegrass
- Poa fendleriana Muttongrass
- Poa pratensis\* Kentucky Bluegrass
- Schizachyrium scoparium Little Bluestem
- (Andropogon scoparius)
- Sporobolus cryptandrus Sand Dropseed
- Vulpia myuros\* Fox-tail Fescue
- (Festuca myuros)

TYPHACEAE CATTAIL FAMILY  
 Typha latifolia Broad-Leaved Cat-Tail

### DOMESTIC PLANTS

(persisting from early settlement in the vicinity of the trailhead and Mayhew's Lodge ruins)

- Ailanthus altissima\* Tree of Heaven
- Campsis radicans\* Trumpet Vine
- Chaenomeles sp.\* Quince
- Hedera sp.\* Ivy
- Iris sp.\* Domestic Iris
- Malus pumila\* Apple
- Prunus sp.\* Cherry
- Pyrus communis\* Pear
- Syringia sp.\* Lilac
- Vinca major\* Perywinkle

Introduced Plants are identified in the list by an asterisk\* after the scientific name. Many of these are found primarily in the Call of the Canyon area and along the main Oak Creek channel where the land has been disturbed by both earlier settlement patterns and more current construction projects. Some of these have become naturalized throughout the whole canyon system, however. Kentucky Bluegrass, Common Tommothy, Orchard Grass, Redtop, and several of the Brome Grasses are now key components of the West Fork riparian zone, along with Black Medic, several Clovers, Dandelions, Chickweed, Plantain, Lady's Thumb, Self-Heal, Horseweed, and Sow Thistle.

One other introduced plant that has achieved Noxious Weed status in Northern Arizona is Bull Thistle. It has been slowly spreading through the Canyon, and can be identified by its very spiny, dark green stems and leaves, and deep purple flower heads. Native thistles are not a problem, however; the Arizona Thistle has more grey-green foliage, non-spiny stems, and bright red, narrow flowers, and does not grow right in the riparian area, unlike Bull Thistle.