



WOODY PLANTS OF THE MOGOLLON HIGHLANDS

A field guide and
botany companion

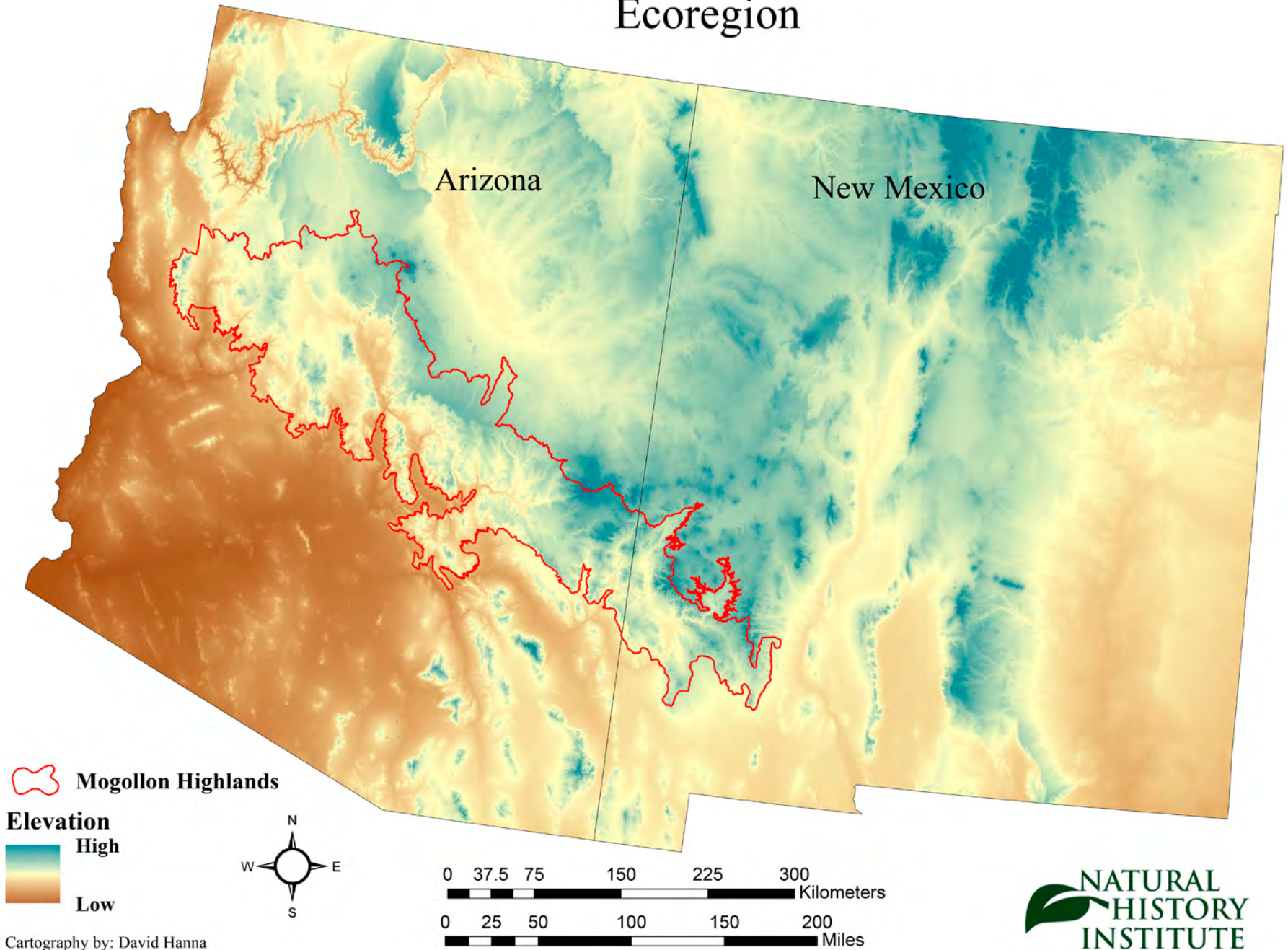
Carl and Joan Tomoff



NATURAL
HISTORY
INSTITUTE

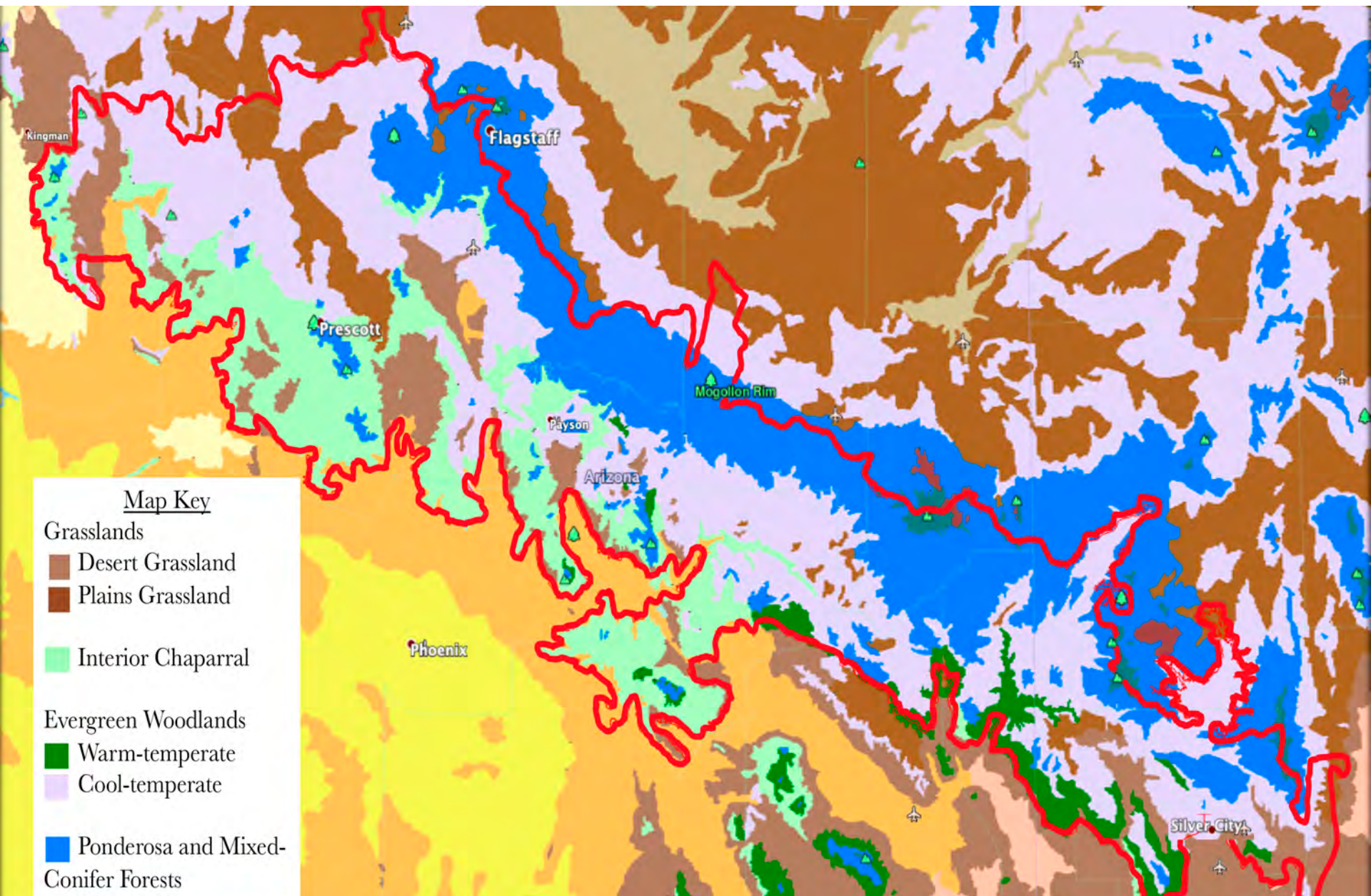


Mogollon Highlands Ecoregion



Cartography by: David Hanna

Vegetation Map



Grassland



Interior Chaparral



Evergreen Woodland



Ponderosa Pine Forest



Mixed Conifer Forest



Riparian Deciduous Woodland



Basin Effect, Slope Effect



Basics of Plant Biology - Plant Types

Differentiating between types of plants is helpful for a number of reasons. Classification helps us understand how plants are related and also how they are unique. It can shed light on genetic as well as physical qualities. Botanists group plants into **four** types:



Mosses and similar small plants: The simplest plants, they are **nonvascular**—that is, they do not have veins for transporting water and nutrients.



Ferns and simple **vascular** plants: These plants have veins and they reproduce with **spores**, unlike plants that reproduce with **seeds**.



Conifers or **gymnosperms**: These plants produce their seeds in cones. "Gymnosperm" literally means "naked seeds," referring to the fact that the seeds are not protected by an enclosing fruit.



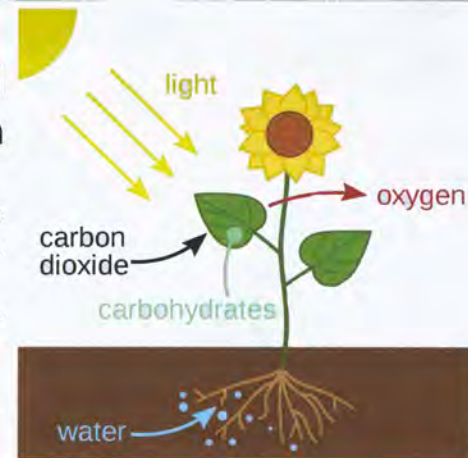
Flowering plants or **angiosperms**: "Angiosperm" means "enclosed seeds." These plants produce flowers, parts of which develop into fruits that form a protective enclosure for the seeds.

Note: All the plants in this book are **gymnosperms** or **angiosperms**.

How Plants Work: Photosynthesis and Cellular Respiration

How do plants get the energy they need to survive? The short answer is that they use sunlight to make their own food. The green pigment found in leaves, **chlorophyll**, converts radiant energy from the sun into chemical energy in the form of carbohydrates. This process is called **photosynthesis**—literally,

"light creation." When the sun shines on a leaf, tiny gateways in the leaf epidermis called **stomata** open in response to the light intensity. Most broad-leaved plants have stomata only on the protected undersides of their leaves. Open stomata take in carbon dioxide and release oxygen. Plants take in water through their roots and release it through open stomata in a process called transpiration, which helps cool the plant. The most common photosynthesis pathway is known as **C₃** because an important intermediate chemical in the path from carbon dioxide (CO₂) and water (H₂O) to sugar (C₆H₁₂O₆) is a three-carbon compound. The general photosynthesis equation is:

$$6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$$


When the air is cool and moist, stomata can remain open all day without incurring significant water loss while photosynthesis takes place. Therefore, most plants use the **C₃** pathway. Desert plants, however, have to face hot, dry environments, so they use a special process called **C₄ photosynthesis**. You can learn more about this on p. 81, and another desert adaptation called **CAM photosynthesis** on p. 110.

Photosynthesis first appeared in simple marine bacteria. Over geologic time, these bacteria and later plants produced enough oxygen to make the evolution of animals possible. The chemical reverse of photosynthesis is **cellular respiration**: $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{energy}$. This is the most efficient process that living things use to convert chemical energy and oxygen into activities essential for life, like growth, reproduction, and movement.

To Begin Identifying a Plant

1. What is its growth form?

Trees are woody plants that can grow over 13 feet (4 m) tall, usually with a single erect stem (the trunk) and lateral branches bearing foliage (the crown).



Shrubs are woody plants that usually grow to less than 13 feet (4 m) tall and have several stems that arise at or just above ground level.



Vines are plants with long stems. Woody vines are called **lianas**. Vines and lianas grow along the ground or climb supports, usually trees.



Succulent plants store water in fleshy stems or leaves.



Forbs are herbaceous (nonwoody) plants that are not grasses.

Grasses are herbaceous narrow-leaved plants that have flowers without petals.

(Note: Forbs and grasses are not included in this book.)

2. If the plant is a tree, shrub, or liana, is it evergreen or deciduous?

Evergreen trees and shrubs retain leaves all winter. Often the old leaves fall and new leaves grow at the same time, so the plant is never bare. Often we think of evergreens as gymnosperms like pine trees, but many evergreens are angiosperms.

Deciduous woody plants lose all their leaves in a short time, typically in the fall, leaving the plant barren of leaves during winter. New leaves grow in the spring. Some plants are drought-deciduous and grow new leaves when they get enough water. All the deciduous trees, shrubs, and lianas in this area are angiosperms.

3. Are the leaves scales, needles, or blades?

Scales are very small and overlapping.



scales

Needles often grow in bundles or packets.



needles

Blades attach to the stem with **petioles**. They characterize some evergreen and nearly all deciduous species in this book.



petiole

blade

4. If the leaves are blades, are they simple or compound?

Simple leaf blades are undivided. Their margins might be **entire** (smooth), **toothed** (serrated), or **lobed** (with rounded portions).



entire



toothed



lobed

Compound leaves are divided into leaflets, each on its own stalk attached to the central vein.

Palmately compound leaves have leaflets arising from a common point, like fingers of a hand.

Stalks of **pinnately compound** leaves are attached to the central vein in opposite pairs or alternating to the tip.

Some plants have **bipinnately compound leaves** with each primary leaflet divided into secondary leaflets.

HOW TO USE THIS BOOK

We have organized our guide using a few key principles:

1. Plants are placed into sections by the plant community where they are most commonly found. The order of sections is as follows: Riparian Deciduous Woodlands, Grasslands, Interior Chaparral, Evergreen Woodlands, Ponderosa Pine Forest, and Mixed Conifer Forest. The first two sections are found at variable elevations, and the rest are arranged from low to high elevation.

2. Plants are arranged according to their growth forms. Within each section, we start with trees and move to shrubs, lianas and vines, and finally succulents. On each page, you will find comparable information: whether the tree is evergreen or deciduous, its typical size, its bark texture and color, and information about its leaves. Use the introduction and glossary if you need help understanding any plant vocabulary or botany concepts. **Commonly confused plants, or plants that are frequently found together, are often placed on opposing pages.**

3. For more information on every plant, you can flip to the text section found after each group of plates. There you will find an alphabetized list of species accounts that contains details on each plant's family, elevation, flowers, fruits, ethnobotanical uses, and other interesting facts.

4. On some of the plant plates, you may find a note that looks something like this:

Hinckley Cottonwoods are **hybrids** of other cottonwood species. See p. 57 to learn about hybrids.

These notes signal that there is a special botany lesson associated with the species. Flip to the designated page to learn more about the relevant concept or term.

We hope you have fun exploring!



palmately compound pinnately compound bipinnately compound

To distinguish between a **leaf** and a **leaflet**, find the attachment point of the petiole to the stem. A leaf will have a **bud** at this intersection. Leaflets do not have individual buds.

5. Are the leaves attached singly, alternating along the stem? Or do they emerge in pairs opposite each other?



We recommend asking these five questions in this sequence each time you approach a plant you want to study. This process is orderly and efficient, and it reflects your experience with each plant. As you approach, you can often see whether a plant is evergreen or deciduous before you can determine the type or arrangement of its leaves. Closer, you can often see whether the leaves are simple or compound, alternating along the stems or arranged in pairs. Even closer examination reveals their shapes and other characteristics.

Variations in leaf size, shape, and other characteristics challenge the curious naturalist. These differences occur on individual plants as well as among members of local populations. Look for features that remain consistent amidst this variation, such as whether the leaves are simple or compound, alternate or opposite.



Fremont Cottonwood

Populus fremontii



This **deciduous tree** grows up to **100 feet** (30 m) tall with a **broad rounded crown**. Bark is smooth and light gray, becoming darker and deeply furrowed with age.

Leaves are **alternate** and **simple**, somewhat triangular, with **wavy toothed margins**, shiny green above and somewhat paler beneath. Petioles are flat and nearly as long as the blade.

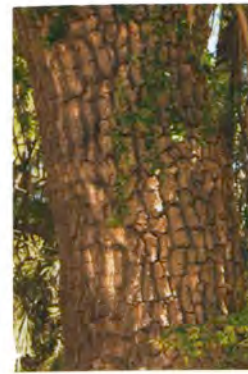


female



Narrowleaf Cottonwood

Populus angustifolia



This **deciduous tree** grows up to **50 feet** (15 m) tall with upright branches and a narrow pyramidal crown. Bark is smooth and light yellow-green, becoming pale gray and deeply furrowed with age.

Leaves are **alternate** and **simple**, at least twice as long as they are wide, with **finely toothed margins**, medium green above and paler beneath. Petioles are flattened at the base.



Hinckley Cottonwood

Populus x hinckleyana



Hinckley cottonwoods are **hybrids** of other cottonwood species. See page 57 to learn about hybrids.

Native to: American Southwest

Habitat: Along washes and roadsides from deserts to foothills, in sunshine. Desert-willow thrives with less than 30 inches (76 cm) of annual precipitation but requires a reliable source of underground water.

Flowers: Abundant, showy tubular flowers, white to lavender and very fragrant and long lasting, bloom at new branch tips from April to August. Hummingbirds and native bees visit the flowers for nectar and pollen.

Fruit: Long, narrow, brown capsules ripen in late summer and stay on the plant until the following spring. The seeds have a fringe of fine white hairs that aid in wind dispersal.

Comments: Desert-willow is a long-lived component of stable desert wash communities. It tolerates flooding, often growing in the center of the watercourse. In addition to growing from seeds, Desert-willow also reproduces by root sprouting.

Etymology: *Chilopsis* means "resembling lips" and refers to the shape of the calyx, the outer flower tissue, which is green in most flowers but tan in Desert-willow. *Linearis* means "line-like," referring to the long, narrow leaves.

Fremont Cottonwood (*Populus fremontii*)

Family: Salicaceae

Elevation: 2500 to 6000 feet (750-1800 m)

Habitat: Riparian areas in the southwestern United States to central Mexico

Flowers: Male and female flowers are produced in catkins on separate trees before the leaves emerge from March to May. Wind disperses the pollen.

Fruit: Capsules release abundant and hairy seeds, which are disseminated by wind.

Comments: In this area, Fremont Cottonwood is the most common indicator of perennial water. It roots easily from cuttings and is planted along irrigation ditches. Fremont Cottonwood forests add diversity to arid and semiarid habitats of the Southwest. They provide protection as well as forage and nest sites for a great variety of birds and other wildlife. Beavers eat the bark and build with the branches. Native Americans chewed the inner bark to prevent illnesses caused by vitamin C deficiency. Pueblo peoples used the wood for drums and carve Kachina dolls, a type of ceremonial figure, out of the roots.

Etymology: John Charles Fremont was a mid-nineteenth century army officer, politician, and explorer who briefly studied plant collection and preservation with George Engelmann of the Missouri Botanical Garden before making several expeditions to the Great Basin and Oregon Territory.

Hybrids

Hybridization occurs when individuals from two genetically distinct populations produce viable offspring. Plants hybridize more often and with greater success than animals because their pollen is widely dispersed and lands randomly, and there is enough variability in plant forms that intermediate forms often have high likelihood of success. This happens so frequently in nature that common hybrids have names. For example, when a pollen grain of Fremont Cottonwood lands on and fertilizes a flower of Narrow-

leaf Cottonwood, it produces a seed that grows into Hinckley Cottonwood. Other common hybridizing woody plants in our area are oaks. Oaks produce so many hybrids that individual plants are often difficult to classify. However, hybrids of Gambel Oak with Scrub Oak or Arizona White Oak (or their hybrids) are fairly easy to recognize because their leaves have shallow lobes and are between their parents in size. These hybrids are called Wavy-leaf Oak.

Goodding Willow (*Salix gooddingii*)

Family: Salicaceae

Elevation: up to 7000 feet (2150 m)

Native to: Southwestern United States and northern Mexico

Habitat: Along lakes and streams in a variety of habitats

Flowers: Tiny flowers appear with the leaves from March to May, male and female catkins on separate trees, and are pollinated by insects.

Fruit: A tiny capsule with a swollen bottom and tapered top splits to release hairy seeds that are dispersed by the wind.

Comments: Like other willows, Goodding Willow is used for stream bank stabilization and erosion control and provides shade for fish and other wildlife. It tolerates flooding but not shade. Indigenous people used infusions of leaves and bark to cure various ailments.

Etymology: Leslie Goodding was an early 20th century botanist, one of the first to explore southern Arizona.

Himalaya Blackberry (*Rubus discolor*)

Family: Rosaceae

Elevation: 4000 to 6400 feet (1200-1950m)

Habitat: Hillsides, along waterway, and in disturbed areas, growing in dense thickets of arching canes

Native to: Eurasia; cultivated and naturalized

Flowers: Five white or pale pink petals and numerous stamens and carpels

Fruit: Fleshy aggregate of numerous little drupelets that turn red before they ripen and are sweet when nearly black.

Comments: When you pick a blackberry, the receptacle comes with it; when you pick a raspberry, the receptacle stays on the plant, leaving the fruit with a hollow core. People have been eating blackberries for millennia and have developed many cultivated varieties. They grow all over Europe and were probably cultivated in North America before European settlement. Patches of wild blackberries and raspberries in the forest may indicate the existence of an earlier human settlement. Their perennial root systems produce biennial canes, often with flat surfaces. The first year, the cane grows to its full length. The second year, it produces lateral branches with smaller leaves and terminal clusters of flowers and fruits.

Etymology: *Discolor* means to change color; perhaps in reference to the different leaf surface colors above and below.



Catclaw Acacia

Acacia greggii



This **deciduous**, spreading shrub or **small tree** grows up to **30 feet** (9 m) tall, with the main trunk up to a foot (30 cm) across. Quarter-inch (6 mm) thick bark becomes cracked and scaly with age. Branches are armed with **stout, single, curved, quarter-inch** (6 mm) prickles.

Alternate, bipinnately compound leaves, up to two inches (5 cm) long, have **one to three pairs of primary leaflets**, each with four to seven pairs of secondary leaflets.



Catclaw Mimosa

Mimosa aculeaticarpa



This **deciduous, thicket-forming shrub** grows up to **eight feet** (2.4 m), but is usually only **three feet** (1 m) tall. The slender, straight or zig-zagged, brown-barked hairy stems are armed with **stout, curved, quarter-inch** (6 mm) prickles, usually in pairs.

Alternate, bipinnately compound leaves, up to **two inches** (5 cm) long, have **up to seven pairs of primary leaflets** and up to 13 pairs of tiny secondary leaflets on each primary leaflet.



Legumes like acacias and mimosas form symbiotic relationships with bacteria in the genus *Rhizobium* to perform **nitrogen fixation**. Visit p. 82 to learn more about this crucial biological process.



Narrowleaf Yucca

Yucca angustissima



Evergreen, sharp, flexible, nearly linear, gray-green leaves grow in a **hemispherical rosette up to two feet (60 cm) high**. The leaves have yellow-brown margins that release **curling white threads**.



Beargrass

Nolina microcarpa



Beargrass is a **semi-succulent shrub** with **evergreen, tough, flexible, grass-like** leaves up to **three feet (1 m) long**, growing in a clump from an underground, branched, woody base.

The leaves have **finely toothed margins** with tips that split into **long, loose fibers**.





Scrub Oak

Quercus turbinella



male



This **evergreen shrub** or **small tree** grows up to **15 feet** (4.5 m) tall. Bark is gray, becoming fissured with age.

Leaves are **alternate, simple**, small, and leathery, bluish green with a powdery bloom above, paler and slightly hairy beneath, **margins** usually with **small spiny teeth**.



female



male



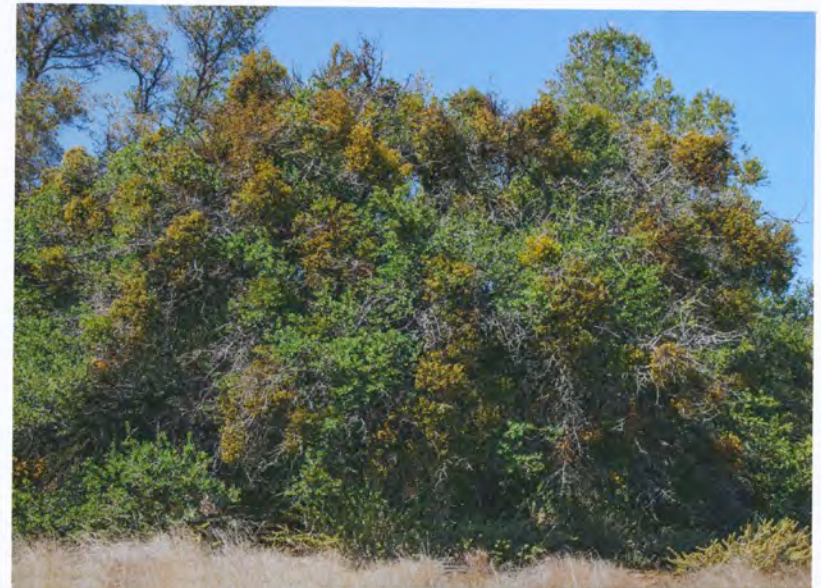
Oak Mistletoe

Phoradendron serotinum



Oak Mistletoe is an **evergreen** that grows on oaks (like the one below), sending roots (haustoria) up to **two feet** (60 cm) long into the host plant.

Opposite leaves perform photosynthesis and provide most of the mistletoe's food, but the host provides water, minerals, and some nutrients. Because this mistletoe makes most of its own food, it is considered a **hemiparasite**.







Needle Bundles





Alligator Juniper

Juniperus deppeana



This slow-growing **evergreen tree** grows up to **50 feet** (15 m) tall with a **broad, rounded crown** and is usually distinguished from other junipers by its gray bark that divides into squarish plates that resemble alligator skin.

Leaves are blue-green, **scaly**, and **pointed**, a **sixteenth of an inch** (1-2 mm) long, with a conspicuous gland.



seed cone



pollen cones



This **coniferous evergreen tree** grows up to **60 feet** (18 m) tall with a short main trunk and nearly horizontal branches that form a **conical crown**. Bark is smooth, reddish-brown, and shreddy, becoming gray and furrowed with age.

Leaves are small and **scalelike** with keels, gray-green to silvery, and they grow in **opposite** pairs close to the twig, making it appear square.



Arizona Cypress

Cupressus arizonica



pollen cones

Arizona Cypress can sometimes be damaged by **bark beetles**. To learn more, visit p. 127.





Gambel Oak

Quercus gambelii



female flowers



male catkins

This **deciduous shrub or tree** grows up to **50 feet** (15 m) tall with a **rounded crown**. Bark is brownish, becoming gray with flat ridges.

Gambel Oak is **deciduous**, whereas most other southwestern oaks are evergreen. Leaves are **alternate, simple**, lustrous dark green above and velvety pale green beneath. The leaves are also **lobed**, the only lobed oak leaves in this area.



Fendler Ceanothus

Ceanothus fendleri



This mostly **evergreen shrub** is usually **3 feet** (1 m) tall. Young bark is gray-green, and the twigs have thorns.

Leaves are **alternate simple ovals** with **three main veins** and hairless to pubescent undersides.





Douglas-fir

Pseudotsuga menziesii

These **evergreen trees** grow up to **200 feet** (60 m) tall and can live as long as 400 years. The crown is **conical**, broadening with age, and the branches droop. Young bark is red-dish-brown and smooth, becoming darker brown, thick, and deeply furrowed. Pointed conical buds have red-brown scales.

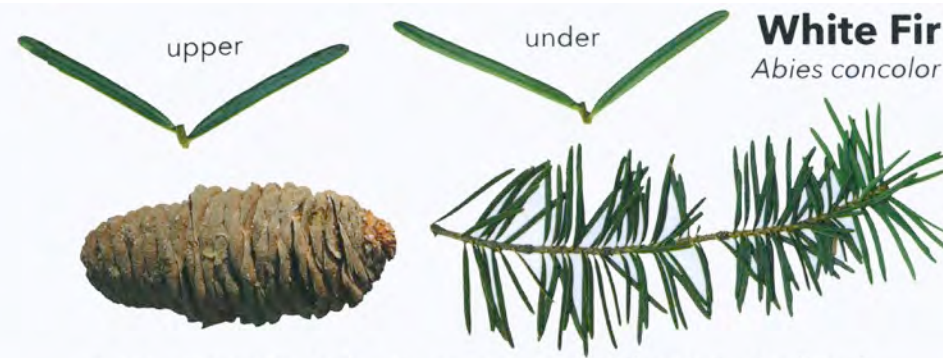
Needles grow **spirally around the twig**, are **flat, one to 2.5 inches** (2.5–6.5 cm) long, and green with two whitish bands of stomata on the lower surface.



upper



under

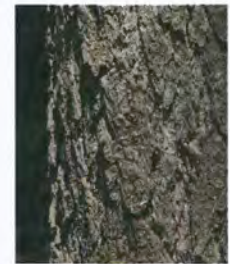


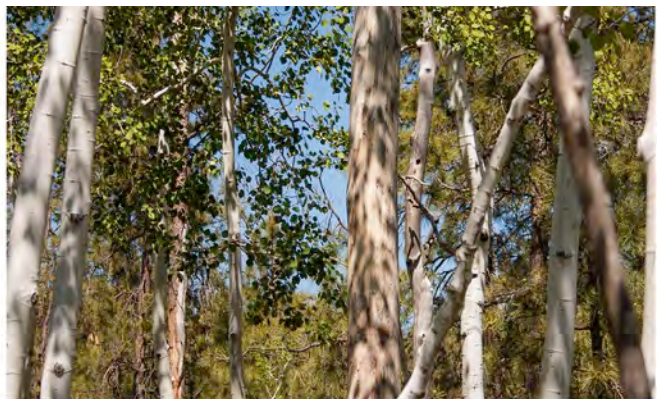
White Fir

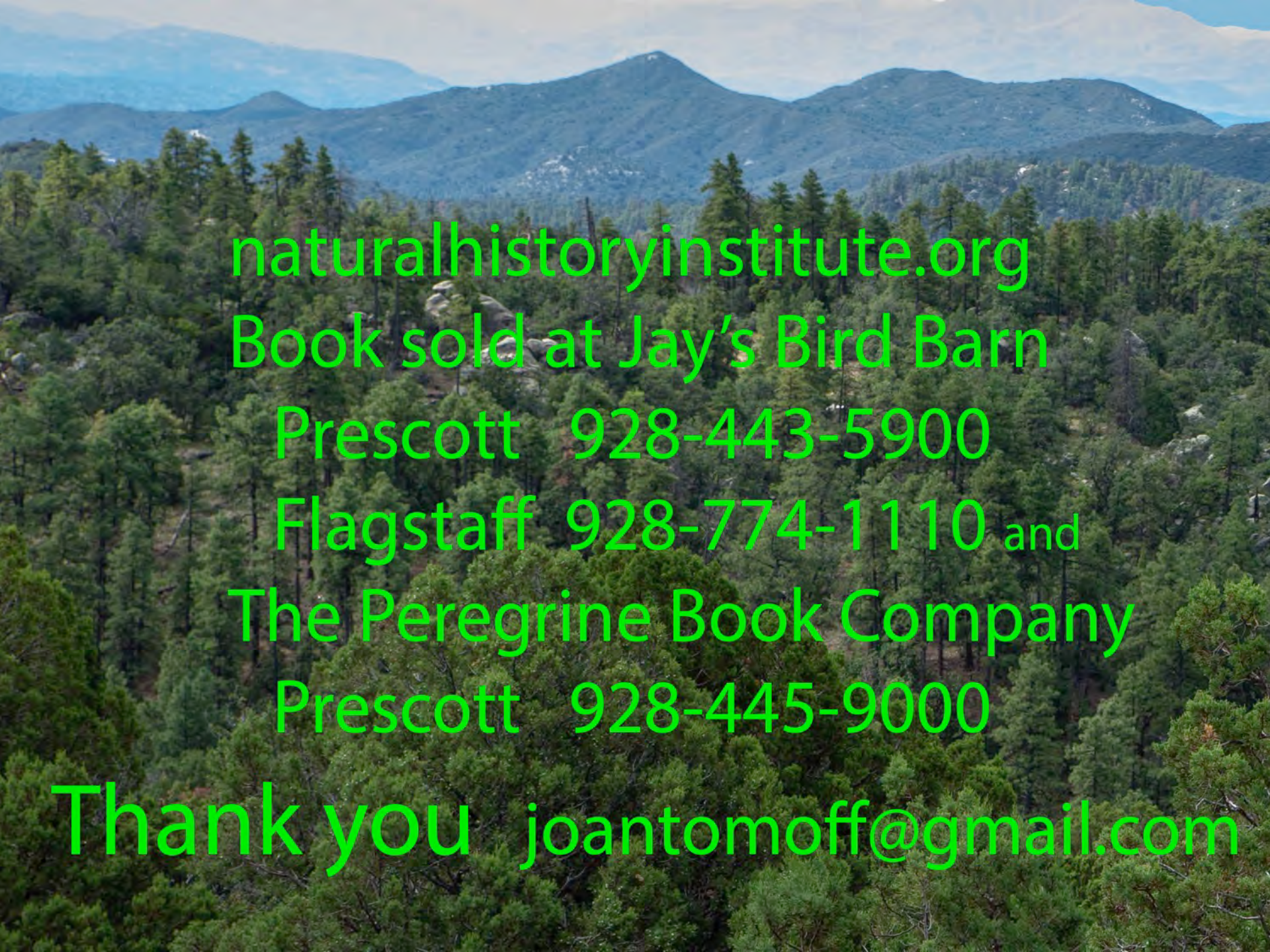
Abies concolor

These **evergreen trees** can grow up to **150 feet** (46 m) tall and can live as long as 300 years. When there is enough space, the branches nearly touch the ground, but when the trees are more crowded, up to half of the trunk is bare. The crown is **spirelike**, rounding with age, and the branches grow perpendicular to the trunk. Young bark is gray and smooth with resin blisters, becoming ashy gray, thick, and deeply furrowed on mature trees.

Rounded buds have light brown scales. **Needles** grow **straight out from all sides of the twig**, are **flat, two to three inches** (5–8 cm) long, and silvery-blue-green with white lines of stomata on both surfaces and a pungent odor.







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