

# Interior and Californian Riparian Deciduous Forests and Woodlands

These winter deciduous communities are diverse, because high altitude species penetrate downslope to occur among lowland forms (Fig. 145). Originally, they occupied many of the major as well as secondary drainages in the Californian, Mohavian, sub-Mogollon (=Arizonan), Madrean, and Chihuahuan biotic provinces, where they are now greatly reduced because of reductions in stream flow. These communities are maintained along perennial or seasonally intermittent streams and springs, and may be divided into two major vegetation-types (series) — cottonwood-willow and mixed broadleaf.

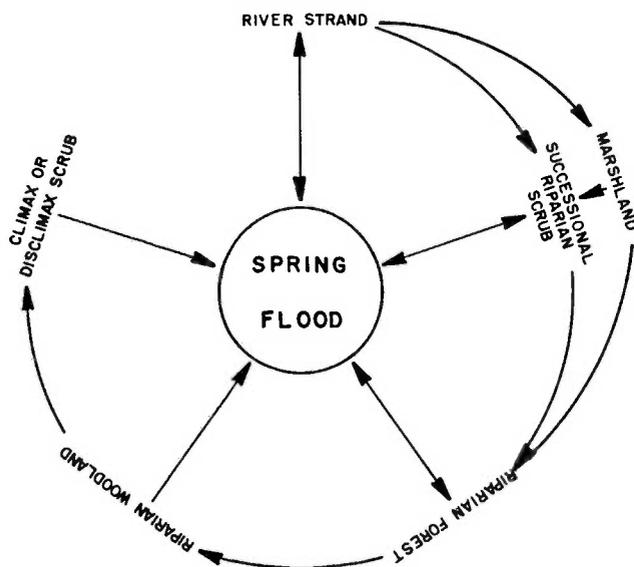
These are relictual communities. The present distributions of the two major vegetation types, particularly the mixed broadleaf, reflect a contraction of the formerly widespread, Early Tertiary mixed mesophytic forest. These riparian forests are vernaly adapted to Early Tertiary climates and have retreated to pockets where the warm temperate (ancient) climate persists.

Where streamflows are intermittent, well-developed gallery forest can be expected only where surface flow reliably occurs during winter-spring months, because the onset of the spring growing season can be expected prior to April 15 (Zimmerman, 1969; Hibbert et al., 1974). After mid-April, increased evaporation and phytotranspiration often result in only subsurface flow in all but the larger streams, at least during daytime. The Southwest's warm-temperature riparian forests and woodlands, therefore, require abundant water during March and April when most arboreal species leaf, set seed, and germinate (Zimmerman, 1969). Summer precipitation usually does not result in sustained streamflow in seasonal stream channels (Zimmerman, 1969; Hibbert, 1971; Hibbert et al., 1974), and riparian forests in the Southwest have therefore remained vernaly adapted. Probably for this reason, these forests are poorly represented and often absent from western pediments of the Sierra Madre Occidental where winter-spring precipitation and runoff is characteristically low.

Communities of cottonwood (*Populus fremontii* and others; in portions of the Chihuahuan biotic province, *P. fremontii* ssp. *mesetae*), and willows (*Salix gooddingii*, *S. exigua*, *S. bonplandiana*, and others) are characteristic stream features throughout the Southwest's warm-temperature zones. These short-lived associations are typically encountered and reach their best development in alluvial sands, clays, and gravels on flood plains. The forest canopy may be from 15 to 30 m or more in height and with open and park-like understories in mature groves, or populated by thickets of young cottonwoods or willow depending upon stage and grazing intensity.

Indications are that cottonwood-willow associations are maintained and depend on periodic spring floods (Fig. 164). Evidence for the winter-spring flood adaptation of these communities are "new" forests along undammed portions of the Verde and San Pedro rivers following spring floods in 1962 and 1967, respectively, a result of fortuitous timing of floods with the narrowly defined germination requirements of these riparian salices. Also, the presence of Californian and Mohavian cottonwood-willow fasciations would indicate that they too are vernal-adapted, and that summer precipitation and runoff is of little or no importance to their regeneration and only encourages competitors such as Saltcedar.

Stabilized flows from storage reservoirs and summer flooding in today's wider channels facilitates dissemination of Salt-



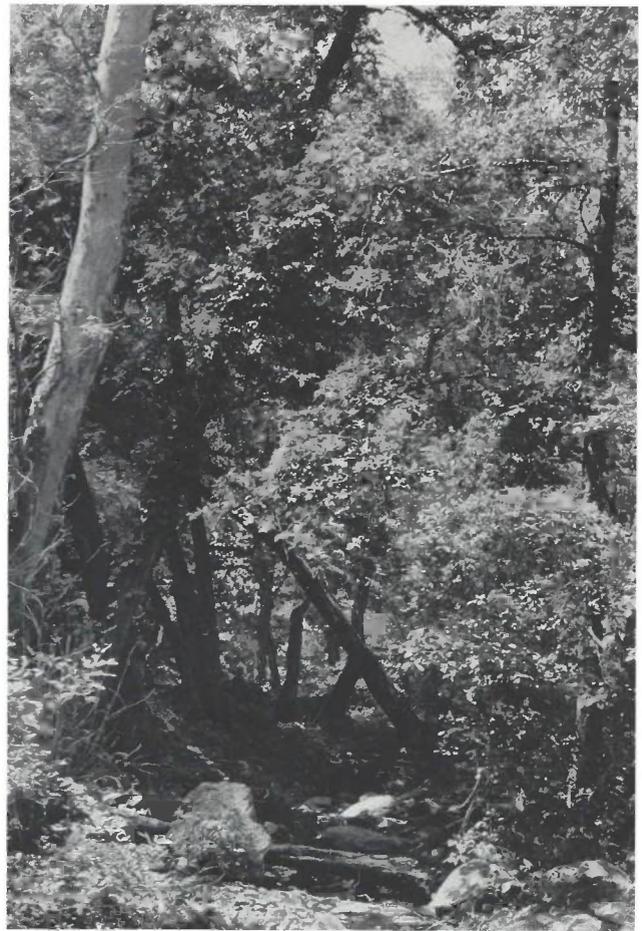
**Figure 164.** Hypothetical successional cycle of Southwestern riverine wetlands based on and around the natural flooding phenomena of the region.

cedar, allowing that species to complement or replace cottonwood and willow along many miles of the Rio Grande, Pecos, upper Gila, and other rivers where such conditions now occur. Stabilized flow below dams seems especially to result in decadent stands of native trees in which reproduction is lacking. Unlike other riparian trees, such as sycamores (*Platanus* spp.) that reproduce almost entirely by sprouting into clones, cottonwood and willow are mainly disseminated by seed. Studies by Horton et al. (1960) and Zimmerman (1969) have shown that these species germinate in spring, and that seeds remain viable for less than 7 weeks. If receding waters fail to provide a suitable seed bed, little or no reproduction of these short-lived species will occur.

Saltcedar produces seed from March through October in the Southwest, and may colonize seed beds similar to those used by cottonwood and willow (Horton, 1977). Summer flooding therefore, may enhance that species, except in canyon-bound rivers where the violence of scour appears to exclude it (Minckley and Clark, 1979; Turner and Karpiscak, 1980). Wider places in stream channels provide ameliorating effects on such flooding, so that only major channel-straightening events (Burkham, 1972) can remove dense Saltcedar cover and allow germination and successful recolonization by native trees. The advent of extensive water storage with attendant regulation of streamflow and reduction of floods, coupled with invasion of Saltcedar, have resulted in a great reduction of interior cottonwood-willow communities. Intensity of livestock predation along many stream channels adds another factor often alone sufficient to preclude survival of the limited numbers of seedlings.

Mixed broadleaf series of Interior and Californian riparian deciduous forest occur along rubble-bottomed perennial and near-perennial streams. In the interior Southwest (sub-Mogollon Arizona and New Mexico, northwestern Chihuahua and northeastern Sonora; Figs. 165, 166), boreal constituents may be admixtures of stands of regional species or ecotypes of such Holarctic genera, as Arizona Sycamore (*Platanus wrightii*), Velvet Ash (*Fraxinus pennsylvanica* var. *velutina*), Fremont Cottonwood, Arizona Alder, Arizona Walnut (*Juglans major*) and willows (*Salix exigua* and others). At some of the higher elevations (ca. 1,400 to 1,800 m), Boxelder, Bigtooth Maple, Narrowleaf Cottonwood, and cherries (*Prunus* spp.) may make their appearance and even dominate locally. At lower elevations (1,100 to 1,500 m), a number of trees of more southern distribution are often present: e.g., Western Soapberry (*Sapindus saponaria* var. *drummondii*), Texas Mulberry (*Morus microphylla*), Netleaf Hackberry (*Celtis reticulata*), and Mexican Elder (*Sambucus mexicana*). Arizona Cypress (*Cupressus arizonica*) is not uncommon, and the forest or woodland often contains oaks (*Quercus gambelii*, *Q. emoryi*, *Q. arizonica*) and conifers (*Pinus ponderosa*, *Juniperus deppeana*) from upstream and adjacent uplands. Near settlements and locally elsewhere, such exotic trees as the Tree-of-heaven (*Ailanthus altissima*), Catalpa (*Catalpa bignoniodes*), Osage-orange (*Maclura pomifera*), and even fruit trees may be present. Some of the more noticeable understory species include Bracken Fern (*Pteridium aquilinum*), Smooth Sumac (*Rhus glabra*), Poison-ivy (*Rhus toxicodendron*) and several deciduous vines, especially Canyon Grape (*Vitis arizonica*).

Californian mixed broadleaf forests and woodlands (Figs. 167, 168) have much the same appearance and share many of the same species and genera as their interior counterparts.



**Figure 165.** Summer aspect of Interior riparian deciduous forest (mixed broadleaf series) along Gap Creek, Yavapai County, Arizona. A "gallery" forest of the interior riparian "big six"—sycamore (*Platanus wrightii*), alder (*Alnus oblongifolia*), willows (*Salix gooddingii*, *S. bonplandiana*), walnut (*Juglans major*), ash (*Fraxinus pennsylvanica* var. *velutina*), cottonwood (*Populus fremontii*)—and other winter deciduous trees along a boulder-bottomed, perennial stream. Elevation ca. 1,200 m.

While the sycamore and alder here are *Platanus racemosa* and *Alnus rhombifolia*, the widespread *Populus fremontii*, *Fraxinus pennsylvanica* var. *velutina*, *Sambucus mexicana*, *Salix gooddingii*, and *Salix nigra* are represented in both fasciations. Canyon Live Oak (*Quercus chrysolepis*) and Coast Live Oak (*Q. agrifolia*) are often important arboreal constituents and Poison Oak (*Rhus toxicodendron*) is an important understory component in southern California and northern Baja California del Norte riparian communities, as is California Blackberry (*Rubus vitifolius*).

As in cottonwood-willow associations, lowered streamflow has reduced a number of mixed broadleafed forests and woodlands to scattered individual trees, opening the canopy and reducing its desirability for some species of wildlife. Because of previous watershed practices, flash flooding of a destructive nature now too often destroys many miles of these streamside forests. Timbering practices and grazing by livestock has further reduced and affected the forest understory by curtailing or eliminating some forest-associated species.



**Figure 166.** Mature broadleaf series of Interior riparian deciduous forest along Cajón Bonito, northern Sonora, Mexico. Species present are the same as for Gap Creek (excluding alder; Fig. 165). Elevation ca. 1,100 m; photograph by Dean A. Hendrickson, June, 1978.

Numerous wildlife species are totally or largely dependent on these riparian deciduous communities and many others reach their greatest densities there. Two tree squirrels, Arizona Gray Squirrel (*Sciurus arizonensis*) and Apache Fox Squirrel (*S. nayaritensis*), are largely confined to mixed broadleaf forests within their respective Mogollon and Madrean provinces. The Western Gray Squirrel (*S. griseus*) and introduced Fox Squirrel (*S. niger*) use analogous broadleaf forests in California. Now extremely rare, the River Otter (*Lutra canadensis*) was at one time found in the interior Southwest within warm temperate streams. This species, like the beaver, is more a stream obligate than in need of forest per se.

Other tree-requiring species found in riparian deciduous forests are the Raccoon, and, in California, the introduced Opossum (*Didelphis marsupialis*). Cliffs typically associated with warm temperate canyon streams support small carnivores such as the Ringtailed Cat (*Bassariscus astutus*) and skunks (*Mephitis* spp., *Spilogale putorius*). In drier places, burrowing mammals such as pocket gophers (*Thomomys* spp.) may also be largely restricted to this mesic zone. Numerous bats roost in riparian trees (e.g., Red Bat, *Lasiurus borealis*), or in crevices and holes in cliffs (*Myotis* spp., *Pipistrellus hesperus*), preying on the rich aquatic and riparian insect fauna.

Several nesting birds are obligate to either riparian deciduous trees, cliffs, or the streams themselves. Warm-temperate-inhabiting examples in the interior Southwest include Summer Tanager (*Piranga rubra*), Mississippi Kite (*Ictinia mississippiensis*), Zone-tailed Hawk (*Buteo albonotatus*), and Black Hawk (*Buteogallus anthracinus*); the White-tailed Kite (*Elanus leucurus*) nests in Californian riparian deciduous forest, while the Yellow Warbler, Yellow-billed Cuckoo (*Coccyzus americanus*), Bullock's Oriole (*Icterus bullocki*), and numerous other insectivores such as the Cliff Swallow (*Petrochelidon pyrrhonota*) are common to both biomes. Many others are well represented, and the Madrean fasciations often are host to several neotropical raptors, numerous hummingbirds, [i.e., Blue-throated [*Lampornis clemenciae*], Violet-crowned [*Amazilia verticalis*], Lucifer [*Calothorax lucifer*] and Broad-billed [*Cyananthus latirostris*]], and songbirds e.g., Sulphur-bellied Flycatcher (*Myiodynastes luteiventris*), Rose-throated Becard (*Platypsaris aglaiae*), and Coppery-tailed Trogon (*Trogon elegans*). These last and some sub-Mogollon communities also provide important habitats for common game species, as the White-tailed Deer, Black Bear (*Ursus americanus*), and Wild Turkey, also found in Eastern deciduous forests.

Riparian deciduous forests and stream channels are of equal importance to cold-blooded life forms, including the



**Figure 167.** Exterior view of Californian riparian deciduous forest (*Platanus racemosa*, *Salix gooddingii* series) along Arroyo San Rafael, Baja California del Norte, Mexico. The change in life-form height between this linear wetland community and the adjacent upland chaparral is readily apparent. Note the extensive but discontinuous areas of coastal scrub on hillsides, which are subclimax here to chaparral and the result of recent fires. Elevation ca. 1,350 m.

California Newt (*Taricha torosa*), Ensatina (*Ensatina eschscholtzi*), Pacific and California Slender Salamanders (*Batrachoseps pacificus*, *B. attenuatus*), and California Toad (*Bufo boreas holophilus*). Also present are the arboreal or boulder-inhabiting Pacific Treefrog and California Treefrog (*H. cadaverina*); Canyon Treefrog and Arizona Treefrog (*H. wrightorum*) are in the interior. Species of the *Rana pipiens* complex also are common in the interior, and in Mexico the Tarahumara Frog (*Rana tarahumarae*) and stream-adapted Tarahumara Salamander (Collins, 1979) are present at warm-temperate elevations.

Leaf litter along streams may provide habitat for alligator lizards, *Gerrhonotus multicarinatus* in California and *G. kingi* in the interior. Where suitable loose soils are present along Californian streams one may find the California Legless Lizard (*Anniella pulchra*). Numerous snakes such as king-snakes (*Lampropeltis* spp.) are well represented in streamside environments, and some, such as Ringnecked Snake (*Diadophis punctatus*), are most often found within riparian forest and woodland. In Madrean fasciations one may encounter the Green Rat Snake (*Elaphe triaspis*), Vine Snake (*Oxybelis aeneus*), and Huachuca Blackhead Snake (*Tantilla wilcoxi*)

*wilcoxi*). Streams provide hunting grounds and escape areas for several species of the more or less aquatic garter snakes, depending on biotic province and microhabitat characteristics.

As noted before, diversity in fishes is high at intermediate elevations in warm temperate habitats. Most characteristic in the Gila River Basin are Roundtail Chub, Longfin Dace (*Agosia chrysogaster*), Sonoran Sucker (*Catostomus insignis*), and Desert Mountain-sucker (*Pantosteus clarki*). Spikedace (*Meda fulgida*) and Loach Minnow (*Tiaroga cobitis*), each a member of a monotypic genus endemic to the Gila River, may also occur, as may Speckled Dace in cooler, well-shaded streams or in large rivers at intermediate elevations. This same assemblage, less the two Gila River endemics, also is present in the Bill Williams River, tributary to the lower Colorado River mainstream.

The north-flowing Río Conchos, originating in the rugged and inaccessible Sierra Madre Occidental of western Mexico, is occupied by a few fishes of Plains origins, e.g., Longnose Dace (*Rhinichthys cataractae*) and Fathead Minnow. However, Mexican Stoneroller (*Campostoma ornatum*) replaces Plains Stoneroller, and Mexican species with little relationships to the north are dominant, e.g., Chihuahuan Shiner (*Notropis*

*chihuahua*), Ornate Minnow (*Codoma ornata*), and others (Table 32). The influence of the Plains fauna in the Río Conchos drainage diminishes rapidly to the West, as does overall faunal diversity. The fathead minnow is native to the basin of Lago de Guzmán. The Beautiful Shiner (*Notropis formosus*) found there is a close relative of the Red Shiner. All other species are of the "old" fauna, e.g., Chihuahua Chub (*Gila nigrescens*) and a mountain-sucker (*Pantosteus plebeius*), or are of Mexican origins.

The Río Yaqui watershed is a composite of sub-basins derived from the Río Casas Grandes, Río Conchos, Gila River, and drainages to the south and west (Hendrickson et al., 1981). Colorado River fishes such as Roundtail Chub appear here, but species characteristic of north-central Mexico, Ornate Minnow, Mexican Stoneroller, Mesa del Norte Chub (*Gila pulchra*), etc., mostly prevail. The coarse-scaled Yaqui Sucker (*Catostomus bernardini*) occurs from mountains through deserts, and is scarcely separable from the Conchos Sucker (*C. conchos*) to the east or the Sonoran Sucker (*C. insignis*) of the Gila River basin to the north (Miller 1976). The Longfin Dace, a minnow adapted to severe conditions of the Sonoran Desert (Minckley and Barber, 1971), but also moving into tropical and temperate habitats, also is shared by the Río Yaqui and Gila River, as is the Sonoran Topminnow (*Poeciliopsis occidentalis*).

To the west, coastal drainages of southern California have few native fishes, and those that persist are under severe pressure from human population growth and use of existing water. The omnipresent Speckled Dace occurs there along with Arroyo Chub (*Gila orcutti*) and Santa Ana Mountain-sucker (*Pantosteus santaanae*) in tributaries to the Los Angeles Basin, implying by their presence a former connection of that drainage with the Colorado River system (Smith, 1966). The only native fishes to occupy all coastal drainages in southern California are those able to disperse through sea water, e.g., Threespine Stickleback (*Gasterosteus aculeatus*) and California Killifish (*Fundulus parvipinnis*) (Moyle, 1976). In the interior, the Death Valley system contains only remnants of fluviatile fishes persisting in springs and marshes connected by short reaches of flowing water; these relicts of wetter times are discussed later.



**Figure 168.** Interior view of Californian riparian deciduous forest (mixed broadleaf series) of alder (*Alnus rhombifolia*) along South Fork of San Felipe Creek, San Diego County, California. It is early spring and the alders are just leafing out; immediately downstream was a mixture of such typical Californian riparian species as sycamore (*Platanus racemosa*), cottonwood (*Populus fremontii*), willow (*Salix gooddingii*) and Canyon Live Oak (*Quercus chrysolepis*) Elevation ca. 1,375 m.