



## UNIVERSITY OF CALIFORNIA

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## FOREST STEWARDSHIP SERIES 10

# Riparian Vegetation

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Areas immediately adjacent to rivers and streams are known as riparian areas, and the vegetation that occurs there is called riparian vegetation. Riparian vegetation is often quite distinctive when compared with upland vegetation because it is comprised of plants adapted to high soil moisture (fig. 1). For example, in areas where uplands are dominated by coniferous forest or grassland, riparian vegetation may consist of

deciduous trees and shrubs including cottonwood, willow, alder, and sycamore. Riparian communities in the western United States can resemble the hardwood forest communities of the eastern and southern parts of the country.

### Objective

Understand the ecological functions of vegetation found along watercourses (riparian vegetation) in order to maintain and protect those functions on your property.

### Competencies

- Understand the ecological functions of riparian vegetation and wetlands along streams.
- Ability to use riparian buffer strips to protect ecological functions from land use impacts.
- Familiarity with the requirements for riparian buffer strips during forest management under California law.

### Related Forest Stewardship Publications

- *Forest Streams*, [ANR Publication 8239](#)
- *Fish and Fish Habitat*, [ANR Publication 8242](#)
- *Laws and Regulations Affecting Forests, Part I: Timber Harvesting*, [ANR Publication 8249](#)
- *Laws and Regulations Affecting Forests, Part II: Activities Other Than Timber Harvesting*, [ANR Publication 8250](#)

### ECOLOGICAL FUNCTIONS OF RIPARIAN VEGETATION

Riparian vegetation performs important ecological functions. These include serving as terrestrial and aquatic habitat, stabilizing stream banks, providing shade to streams, and providing large woody debris to increase complexity of in-stream fish habitat.

### Terrestrial Habitat

Healthy riparian vegetation is a critical component of habitat for many terrestrial wildlife species. For example, many birds are common visitors to riparian forests. These include songbirds that feed on insects; herons and cranes that feed on fish and frogs; and hawks, eagles, and osprey that feed on fish. Migratory birds such as waterfowl and some songbirds use riparian



**Figure 1.** Riparian vegetation is often distinctively different from surrounding upland vegetation. The boundaries of a riparian zone can be inferred from the presence of species such as willows, alders and cottonwood. *Photo:* Richard Harris.

areas for resting, feeding, and breeding habitat. Most small carnivores, such as foxes, will use the water's edge in their search for food. Riparian zones can also serve as important corridors of movement for larger wildlife such as deer and bear.

### **Aquatic Habitat**

Riparian vegetation provides habitat for insects, some of which fall in the stream and become food for fish. Plant litter derived from riparian vegetation can be the largest source of nutrients to the stream. Vegetation overhanging stream banks also provides cover for small fish. Overhanging branches or toppled trees can trap debris and can alter stream flow patterns, creating refuges for fish during high flows.

### **Stream Bank Stability**

The large and fine roots of riparian vegetation stabilize stream banks, reducing bank erosion and preventing excessive widening of the stream channel. During high stream flows, riparian vegetation may slow and dissipate the energy of floodwaters, reducing erosion from these events. Riparian vegetation may act as a filter in some locations, trapping sediment and pollutants from upslope sources.

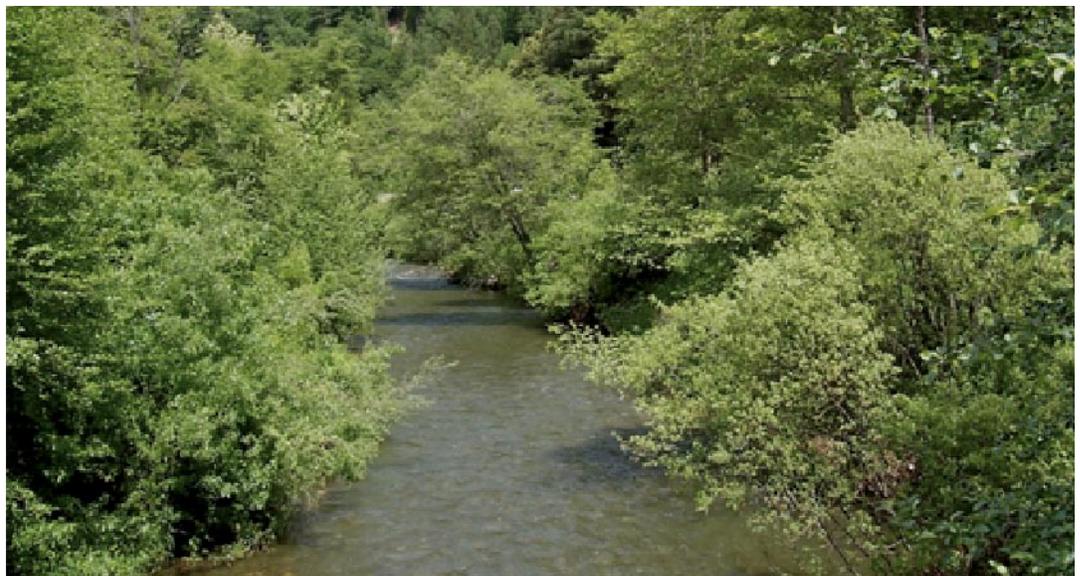
### **Shade**

The temperature of stream water varies according to season. During the summer when stream flow is low, heat from the sun (solar radiation) reaching the water surface can dramatically affect water temperature. Increased stream temperature in turn, can adversely affect coldwater fish and other aquatic life. Shade provided by riparian vegetation reduces inputs of solar radiation, helping to maintain cool water temperatures and to moderate temperature fluctuations (fig. 2).

### **Large Woody Debris**

Large woody debris (LWD) includes tree stems, roots, and branches that enter the stream as a result of tree mortality, bank erosion, wind throw, or large floods. Large wood provides fish with cover to escape from predators, serves as a refuge during high stream flows, and creates rearing habitat. Large wood in streams obstructs and diverts flows in complex patterns, slowing water and changing its depth, helping to form pools (fig. 3).

**Figure 2.** Shade provided by riparian canopy overhanging a stream helps maintain lower water temperatures during the summer and fall and benefits resident fish and other aquatic life. *Photo:* Richard Harris.



Large woody debris also creates storage sites for sediment in all types of stream channels. In smaller streams, single pieces of large wood spanning the channel can be the primary factor keeping sediment from moving downstream. In larger streams, LWD is transported downstream and often accumulates in debris “jams.” These jams act as escape cover for fish and storage sites for sediment, which can provide spawning gravel for fish. LWD on floodplains and gravel bars on large streams provide escape habitat for fish at high flows when floodplains are inundated, and they also promote streamside forest development.

### **HUMAN-INDUCED CHANGES IN RIPARIAN VEGETATION**

Although change occurs naturally in riparian communities, many human activities have caused dramatic and widespread changes well beyond the norm. Agriculture, livestock grazing, mining, forestry, and urban and residential development near water bodies can all lead to removal or reduction of riparian vegetation and the impairment of its ecological functions.

Once riparian vegetation is removed, it no longer serves to shade water, provide food for aquatic organisms, maintain stream banks, provide a source of large woody debris, or slow or filter runoff to streams. The result is degraded water quality and fish habitat. For those reasons, maintenance of riparian vegetation is a critical element of almost any type of land use.

### **ECOLOGICAL FUNCTIONS OF WETLANDS**

Wetlands are distinguished from riparian vegetation primarily because they are mostly comprised of herbaceous plants such as sedges, rushes, and grasses. Trees and shrubs that are present are adapted to a permanent high water table and saturated soils.

**Figure 3.** Large woody debris (LWD) helps stabilize stream channels, create habitat for fish and other creatures, and store sediment. Accumulations such as the one in the figure are especially important because they tend to provide beneficial functions for a long time.  
*Photo: Richard Harris.*



Wetlands can be associated with stream systems or may be found in upland areas with no obvious connection to streams. The mountain meadow is a common example of a wetland often associated with a stream. Spring-fed wetlands or bogs are usually not associated with streams.

Vernal pools (shallow pools that form only during the rainy season) are a special type of wetland that is found in grassland, oak woodland, and prairie landscapes with little topographic relief. They are essentially depressions in otherwise flat terrain. They are uncommon in most forests and will not be discussed further here.

Wetlands along streams are inundated at high flows (fig. 4). These wetlands slow floodwaters, allowing sediments and pollutants to settle out. Vegetation in wetlands can assimilate nutrients, including some toxins, thereby protecting downstream water quality. Wetlands intercept, delay, and store surface water runoff and reduce the severity of downstream flooding. Wetlands are often dependent on groundwater and are indicative of underlying aquifers. Wetlands also discharge water to streams during periods of low flow, extending the season of stream flow during dry summer months. Because wetlands are able to store water and make it available in the dry summer months, they provide critical habitat to many aquatic and terrestrial wildlife species.

## CHANGES IN RIPARIAN VEGETATION AND WETLANDS

Riparian vegetation naturally changes over time and may establish in new areas under favorable conditions. For example, newly deposited gravel and sand bars may be colonized

**Figure 4.** Spring-fed and other wetlands are common on many forested lands and are protected under current forest practice rules during timber harvesting operations. The occurrence and size of mountain meadows such as the one shown have been reduced due to a combination of hydrologic impacts, grazing, fire exclusion, and invasion by conifers. *Photo:* Gary Nakamura.



by willows or other plants that may gradually capture sediment from floodwaters, causing the bar to get larger and higher above the stream. As the willows get older, other plants such as sycamore or oak may establish and eventually overtop the willows. In heavily forested regions such as the North Coast, vegetation changes over time (i.e., succession) may lead to the establishment of a riparian community dominated by conifers like redwood.

Floodwaters can sweep away entire riparian communities, leaving bare gravel or sand bars. When this happens, the development of the plant community from pioneer plants such as willows to later-successional species like cottonwood, oak, or redwood begins again.

## RIPARIAN BUFFER STRIPS

Buffer strips are areas of vegetation left beside a stream or lake to protect against land use impacts. For example, a fence may be installed at the landward edge of a riparian community to create a buffer between the stream and livestock. Buffer strips are also used to protect streams during forest harvesting operations. Whether or not harvesting is permitted within the buffer strip, well-designed and managed buffers can contribute significantly to the maintenance of aquatic and riparian habitat and the control of pollution. Riparian buffer strips are designed to protect the ecological functions associated with riparian vegetation. In addition, they help protect aquatic and riparian plants and animals from upland sources of pollution by trapping or filtering sediments, nutrients, and chemicals from forestry, agricultural, and residential activities.

On private forestland in California, legal requirements are imposed during timber harvesting to protect the ecological functions associated with riparian vegetation and to maintain water quality. The California Forest Practice Act requires maintenance of riparian vegetation in buffer strips called watercourse and lake protection zones (WLPZs). How WLPZs are defined and maintained must be specifically described in a written timber harvest plan filed by a Registered Professional Forester (RPF) with the California Department of Forestry and Fire Protection (CAL FIRE).

California defines four classes of watercourses (I, II, III, and IV) on the basis of the watercourse's use (see box). WLPZ width is determined by the watercourse class and the steepness, or slope, of the adjacent land draining to the watercourse.

### Watercourse Class Description

- I Perennial streams that contain fish or are domestic water supplies.
- II Perennial streams that do not contain fish but do contain other aquatic life or are within 1,000 feet (305 m) of a Class I stream.
- III Watercourses that do not support aquatic life but have the potential to deliver sediment to a Class I or II stream.
- IV Human-made streams for domestic, agricultural, or hydroelectric supply or for other beneficial use.

As of 2007, WLPZs for Class I watercourses ranged from 75 to 150 feet (23 to 46 m) on each side of the watercourse, depending on slope and region of the state. On Class II watercourses, WLPZs ranged from 50 to 100 feet (15 to 30 m). Along Class III and IV streams, equipment exclusion zones (EEZs) or equipment limitation zones (ELZs) are required to prevent equipment from operating near the watercourse. Buffers are established on a case-by-case basis for these watercourses. Alternative prescriptions for Class I and II watercourse WLPZs are allowed on a site-specific basis if they provide at least as much protection as the standard WLPZ.

The specific WLPZ requirements for timber harvesting are subject to change, and it is always advisable to consult with an RPF or the CAL FIRE to determine current regulatory requirements. Because of the importance of the streamside zone, regulations are stringently enforced.

In California, there is no state law equivalent to the Forest Practice Act for protecting riparian zones from infringement by other uses. Consequently, regulatory controls are left up to local jurisdictions, primarily counties. Agricultural uses, including rangeland grazing in riparian zones, are regulated in only a few counties.

## RESOURCES

Several educational and cost-share programs promote riparian protection as it applies to agricultural uses. Educational programs are offered through the University of California Cooperative Extension (UCCE). The California Department of Fish and Game (DFG) and the Natural Resource Conservation Service (NRCS) administer cost-share programs for landowners seeking to protect and restore riparian zones by excluding livestock and other measures. To find out about these and other programs, contact your local UCCE, DFG, or CAL FIRE offices.

### Riparian Forest Restoration

While few people agree on just how much large woody debris is needed in a stream, many biologists feel that most California streams need more. The present deficit is in large part a result of past policies advocating the clearance of LWD from streams. Currently, most clearing of wood from streams is limited to that required to prevent damage to roads and stream crossings.

Riparian forests are critical for supplying new LWD to streams. However, many riparian forests have few large trees because of conversion of timberland to agricultural and residential use, as well as timber harvesting conducted before the current forest practice rules were instituted.

To reverse LWD deficiencies, a landowner can manage the riparian forest to promote recruitment of LWD. Most LWD falling into streams comes from within 100 to 200 feet of the stream. Depending on the size of the stream, you may want your riparian LWD recruitment zone to be equal in width (on each side of the stream) to the height of the tallest tree that might realistically fall into the watercourse. Growing large trees as potential sources of LWD may require active management, such as planting conifers, controlling competition, and thinning. Actively managing riparian zones must be done with caution to minimize soil disturbance and leave a good shade canopy intact. Indiscriminate removal of LWD from streams or floodplains can destabilize streams and reduce habitat values, so this should be avoided.

In the long term, creative management of riparian forests offers the most promise for improving conditions. However, on some streams, reintroduction or placement of logs in the channel may provide a short-term solution until natural recruitment processes recover. The novice should not attempt to do this. Your local DFG staff can provide advice and guidelines for placing wood in streams. Cost-sharing programs are often available for these projects.

Rural residential uses are prevented from adversely affecting riparian zones in some counties by ordinance and in all counties through implementation of the California Environmental Quality Act (CEQA). Before engaging in activities that may affect riparian zones, a landowner should contact the local county planning department.

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