11520

California Montane Riparian Systems

BpS Model/Description Version: Aug. 2020

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| --- | --- | --- | --- |
| **Modelers** |  | **Reviewers** |  |
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Reviewers: Olivia Duren, Janet Fryer

Vegetation Type

Mixed Upland and Wetland

Map Zones

2, 3, 7

Geographic Range

This Biophysical Setting (BpS) is found in the central and inner northern Coast Ranges of California and north into the Klamath Mountains.

Biophysical Site Description

This BpS is found within a broad elevation range from ~600m (2,000ft) to >1,500m (5,000ft). It includes springs, seeps, and perennial and intermittent streams in serpentine substrates and non-serpentine substrates. These woodlands and shrublands require periodic flooding and bare, moist substrates for reestablishment. They are found in low-elevation canyons and draws, on floodplains, in steep-sided canyons, or in narrow V-shaped valleys with rocky substrates. In steep-sided canyons, perennial streams typically have mid to high gradients and bands of riparian forest are narrow, whereas forests along low-gradient streams with well-developed floodplains can be quite broad. Sites are subject to temporary flooding during spring runoff. In many areas, hydrology is controlled by snowmelt from high elevation areas, so flows are variable with higher flows in spring diminishing to spring-fed summer flows (ODEQ 2008). Logs in freshets may cause considerable damage to tree boles. Periodic floods may result in some bank erosion and tree loss, particularly along larger-order streams, but many species are well adapted to this disturbance and resprout. Beavers crop younger cottonwood, willows, and other species in the smaller waterways and frequently dam side channels occurring in these stands. Natural disturbances of varying intensity and frequency often result in stands of complex and patchy age structures and species compositions. The surface is flooded during spring runoff and remains saturated for variable periods.

Soils are typically alluvial deposits of sand, clays, silts, and cobbles that are highly stratified with depth due to flood scour and deposition. Most bottomland and alluvial fan soils are well drained but pockets of shrink-swell clays also occur (Franklin and Dyrness 1988). Underlying gravels may keep the water table just below ground surface, and are favored

Vegetation Description

This system often occurs as a mosaic of multiple communities that are tree-dominated with a diverse shrub component. Canopy closure/cover tends to be high and understory vegetation dense. The variety of plant associations connected to this system reflects elevation, stream gradient, floodplain width, and flooding events.

Dominant trees may include *Alnus rhombifolia*, *A. rubra* (in Coast Ranges), *Acer negundo*, *A. macrophyllum*, *Populus fremontii*, *P. trichocarpa*, *Salix laevigata*, *S. gooddingii*, *Fraxinus latifolia*, *Pseudotsuga menziesii*, *Platanus racemose*, *Quercus agrifolia*, *Q. kelloggii*, and *Prunus virginiana*.

Dominant shrubs include *Salix* spp. (e.g., *S. exigua*, *S. lasiolepis*, *S. lasiandra*), *Amelanchier alnifolia*, *Berberis aquifolium*, *Cornus sericea*, *Crataegus douglasii*, *Philadelphus lewisii*, *Physocarpus capitatus*, *Ribes* spp., *Rosa* spp., *Sambucus mexicana*, *Spiraea douglasii*, *Symphoricarpos albus*, *Toxicodendron diversilobum*, and *Vitis californica*.

Herbaceous layers are often dominated by species of *Carex* and *Juncus* and perennial grasses and mesic forbs such as *Bromus carinatus*, *Elymus glaucus*, *Stachys* spp., *Equisetum* spp., and ferns.

Species tend to be stratified along a gradient from the water inland or depending on water availability. In narrower floodplains, species associated with more xeric conditions, such as *Quercus garryana* and *Pinus ponderosa*, can also occur within the riparian forest. At lowest elevations, the riparian areas may contain madrone, tanoak, California laurel, dogwood, maple, and ash. Willow species are common throughout, with species changing as elevation increases. At the highest riparian areas in the Klamath region, the vegetation has a more Sierran appearance.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| SABR2 | *Salix breweri* | Brewer's willow |
| HESA17 | *Hesperocyparis sargentii* | Sargent's cypress |
| FRCA12 | *Frangula californica* | California buckthorn |
| UMCA | *Umbellularia californica* | California laurel |
| STAL | *Stachys albens* | Whitestem hedgenettle |
| POBAT | *Populus trichocarpa* | black cottonwood |
| ACMA3 | *Acer macrophyllum* | Bigleaf maple |

Species names are from the NRCS PLANTS database. Check species codes at http://plants.usda.gov.

Disturbance Description

Riparian portions of this system are disturbance-driven and require limited flooding, scour, and deposition for seed germination and maintenance of seral vegetation

There are few fire history studies of this BpS. Montane riparian zones of California experience surface fires, mixed fires, and crown fires (Bendix and Cowell 2010; Kobziar and McBride 2006; Murphy et al. 2007). Olson (2000) characterized the fire regime of riparian forests in the Steamboat drainage of the North Umpqua as moderate severity and reported a mean fire return interval (MFRI) for large and small stream riparian forests of 38yrs (range: 3-167yrs). She noted that fire frequency in upslope forests was slightly more frequent but not significantly different from riparian forests. Skinner (2002, 2003) found an MFRI of 25yrs (range: 4-71yrs) in the Klamath Mountains. Skinner (1997) reported that fire frequency was less (about double the MFRI) in perennial riparian zones than in the adjacent uplands but that the range of intervals was comparable. He reported median fire return intervals of 33 (range: 7-65), 16 (range: 5-56), 21 (range: 12-71), and 42 (range: 9-52) years at riparian sites within the Klamath Mountains. Messier and others (2012) found a range of 50-60yrs in the Rogue River Basin.

Shrub communities that are wet throughout the year, such as willow scrub, usually burn less frequently than adjacent upland communities (Luce et al. 2012). However, Skinner suggested there is more variability in fire frequency and severity in forested riparian areas than in uplands (Skinner 2002, 2003). Because riparian areas are moister than upland areas, some fires may leave no scars on riparian trees. Consequently, fire histories using fire scars may underestimate fire frequency in riparian zones (Skinner 2002). Taylor and Skinner (1998) reported that fires in steep upper reaches of intermittent streams have frequent, severe fires. Perennial riparian zones appear to stop the spread of some fires and thus contribute to spatial and temporal diversity of landscapes beyond what their relative area would suggest.

High fuel loads in riparian areas can increase fire spread and severity by acting as "wicks." Fuel loads higher than those of surrounding vegetation may be due to natural succession, fire exclusion, tree harvesting, or fuel treatments in uplands (Luce et al. 2012). During the 2007 Angora Fire on the Tahoe National Forest, for example, heavy dead woody debris in the Angora Creek stream-riparian corridor helped fuel a mixed surface and active crown fire that raced down the corridor and up Angora Ridge (Murphy et al. 2007).

North American beaver (*Castor canadensis*) crop younger cottonwoods (*Populus* spp.), willows (*Salix* spp.), and other species and frequently influence the hydrologic regime through construction of dams, etc. Beaver will move from areas where tree availability is depleted.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 64 | 55 |  |  |
| Moderate (Mixed) | 79 | 45 |  |  |
| Low (Surface) |  |  |  |  |
| All Fires | 35 | 100 |  |  |

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Percent of all fires is the percent of all fires modeled in that severity class. Minimum and Maximum FIs show the relative range of fire intervals as estimated by model contributors, if known.

Scale Description

This system can exist as small to large linear features in the landscape (e.g., Klamath, Eel, Matole rivers). In larger, low-elevation riverine systems, it may exist as mid to large patches. Fire disturbance patch size varies from 1-100ac, but uncertainty exists about fire size and behavior in these riparian systems.

Adjacency or Identification Concerns

Fire exclusion may have had some impact on the levels of fuels and amount of shading in riparian areas (Skinner 1997). Available research in local headwater streams found fire exclusion effects similar to those seen in upland areas, including higher tree density, increased numbers of Douglas-fir and true fir, slower tree growth rates, and a loss of less shade-tolerant hardwoods in these riparian area (Messier et al. 2012). Along larger, perennial streams, fires were probably historically less common and had less effect than along smaller streams (Frost and Sweeney 2000), and presumably there would have been less vegetation change related to fire suppression in riparian areas of larger streams. Fire exclusion has altered stand structure and plant species composition and increased fuel loads in many montane riparian corridors (Luce et al. 2012; Safford et al. 2009). Heavy fuel accumulation is particularly common in early post-fire and late-seral riparian forests (Spies and Cline 1988).

Fire exclusion also affects debris accumulation in aquatic ecosystems. Parenti (2002) suggested that with fire exclusion in the Sierra Nevada, the frequency of large woody debris deposition into streams, pool frequency, and pool volume is reduced compared to historical levels. When fire does occur in suppression areas, post-fire deposition of large woody debris and sediment is often greater than historical levels. Parenti hypothesized that 1st-order streams have sufficient stream power to transport increased fuel and sediment loads; however, mid-elevation (~5,000ft [1,500m]) alluvial stream channels cannot transport these loads efficiently because their stream power is too low. As a result, pool volumes are decreased from historical levels as sediment from 1st-order streams is transported and deposited into alluvial streams (Parenti 2002).

In the Klamath Mountains, gold mining beginning in the 1850s in and adjacent to streams resulted in diverted water and excavated streambeds, changing sediment loads and substrates needed for native plant recruitment and possibly widening stream channels with associated loss of forest (e.g., LaLande 1995). Large bottomland forests may have occurred in large patches, but following Euro-American settlement, most have been cut over or cleared for agriculture, principally grazing and hay production. Riparian forests are generally narrower and more closely confined to the stream channel than historically. As floodplains have been developed, complexity associated with lower-gradient streams, such as side channels and oxbows, has been lost with a concurrent simplification of riparian forest structure and species diversity.

Many of California's riparian plant communities have undergone dramatic changes in species composition due to non-native plant invasions (Bossard and Randall 2007; Dudley 1998), and highly flammable nonnative species may increase fuel biomass, continuity, and fire severity (Verkaik et al. 2013). Exotic trees such as *Ailanthus altissima* and *Eucalyptus* spp. and exotic herbs such as *Arundo donax* occur. Some invasive species, particularly *Rubus bifrons* (Himalayan blackberry) and reed canarygrass (*Phalaris arundinacea*), have attained high enough cover to suppress native tree and shrub regeneration in many unmanaged forests (unpublished reference site survey data available from The Freshwater Trust). In Yosemite National Park, invasives were significantly more abundant in burned riparian areas compared to burned upland areas (Kaczynski 2007).

Issues or Problems

Uncertainty exists about the effects of American beaver activity and historic fire in these systems.

Native Uncharacteristic Conditions

Comments  
It is unclear how well this model and description apply to the northern part of map zones (MZs) 02 and 07, especially within the Willamette Valley and the West Cascades ecoregions. A reviewer stated that the riparian zones of the western Cascades are much wetter and presumably have less frequent fire than the Klamath region. Future review and local modeling efforts should consider the need for model revisions in these areas. One reviewer felt that the fire return interval (FRI) was more frequent than modeled, but this was not adjusted because the modeled FRI was within the range of those reported by Skinner (1997, 2002, 2003) and Olson (2000).

During the 2016 model review period, this model was reviewed and descriptive changes made by Olivia Duren (olivia@thefreshwatertrust.org) and Janet Fryer (jfryer@fs.fed.us). As a result of review, beaver clear cutting was removed as a disturbance in the Early class because a reviewer noted that the trees were too small for beaver to bother with at that stage. Max Bennet also offered review comments.

LANDFIRE National Comments:

This model was originally developed as 181154 by Don Major (dmajor@tnc.org) and Louis Provencher (lprovencher@tnc.org). John Foster incorporated dynamics and parameters values from BpS 181154 into BpS 031152. Model 021152 and 0711520 were imported from MZ03. Foster removed ice scour and modified the biophysical description and species composition. The FRI was derived from composite of the available upland types in the Klamath and California Coast Range, then doubling the FRI in accordance with Skinner (1997). The flooding disturbance regime was refined to reflect values of intensity for the California northern Coast Range. Expert input on hydrologic cycle is needed.

Succession Classes

**Mapping Rules**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Upper Layer Lifeform** | **Height (m)** | **Canopy Cover (%)** | | | | | | | | | |
| **0-10** | **11-20** | **21-30** | **31-40** | **41 - 50** | **51-60** | **61-70** | **71-80** | **81-90** | **91-100** |
| Herb | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Herb | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Herb | >1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 1.0-3.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | >3.0 | A | A | A | A | A | A | A | A | A | A |
| Tree | 0-5 | B | B | B | B | B | B | B | B | B | B |
| Tree | 5-10 | B | B | B | B | B | B | B | B | B | B |
| Tree | 10-25 | C | C | C | C | C | C | C | C | C | C |
| Tree | 25-50 | C | C | C | C | C | C | C | C | C | C |
| Tree | >50 | C | C | C | C | C | C | C | C | C | C |

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leafform distinction where a qualifier is added to the class letter: Brdl (broadleaf), Con (conifer), or Mix (mixed conifer and broadleaf). UN refers to uncharacteristic native or a combination of height and cover that would not be expected under the reference condition. NP refers to not possible or a combination of height and cover which is not physiologically possible for the species in the BpS.

**Description**

Class A 16 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| SALIX | Salix | Willow | Upper |
| ALNUS | Alnus | Alder | Upper |
| POPUL | Populus | Cottonwood | Upper |

Description

Immediate post-disturbance responses are dependent on pre-disturbance vegetation composition, as many species resprout. Typically tree-dominated, but shrubs may co-dominate (*Salix* and *Alnus* are shrubs at this stage). Composition highly variable. Flooding events were modeled as wind/weather/stress.

*Maximum Tree Size Class*  
None

Class B 42 Mid Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| SALIX | Salix | Willow | Middle |
| POPUL | Populus | Cottonwood | Upper |
| ALNUS | Alnus | Alder | Upper |

Description

Highly dependent on the hydrologic regime. Vegetation composition includes tall trees and shrubs.

*Maximum Tree Size Class*  
Pole 5-9" DBH

Class C 42 Late Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| POPUL | Populus | Cottonwood | Upper |
| ALNUS | Alnus | Alder | Mid-Upper |

Description

This class represents the mature, large cottonwood, alder, etc., woodlands. *Salix* species are still present, but other trees are taller and bigger. Tree height can exceed 75ft.

*Maximum Tree Size Class*  
Large 21-33" DBH

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Mid1:ALL | 4 |
| Mid1:ALL | 5 | Late1:CLS | 24 |
| Late1:CLS | 25 | Late1:CLS | 999 |

Probabilistic Transitions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Disturbance Type** | **Disturbance occurs In** | **Moves vegetation to** | **Disturbance Probability** | **Return Interval (yrs)** | **Reset Age to New Class Start Age After Disturbance?** | **Years Since Last Disturbance** |
| Replacement Fire | Early1:ALL | Early1:ALL | 0.02 | 50 | Yes | 0 |
| Wind or Weather or Stress | Early1:ALL | Early1:ALL | 0.1 | 10 | Yes | 0 |
| Wind or Weather or Stress | Mid1:ALL | Early1:ALL | 0.01 | 100 | Yes | 0 |
| Mixed Fire | Mid1:ALL | Mid1:ALL | 0.02 | 50 | No | 0 |
| Replacement Fire | Mid1:ALL | Early1:ALL | 0.02 | 50 | Yes | 0 |
| Optional 1 | Mid1:ALL | Mid1:ALL | 0.025 | 40 | No | 0 |
| Optional 1 | Mid1:ALL | Early1:ALL | 0.025 | 40 | Yes | 0 |
| Wind or Weather or Stress | Mid1:ALL | Mid1:ALL | 0.2 | 5 | No | 0 |
| Optional 1 | Late1:CLS | Mid1:ALL | 0.001 | 1000 | Yes | 0 |
| Wind or Weather or Stress | Late1:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Wind or Weather or Stress | Late1:CLS | Mid1:ALL | 0.005 | 200 | Yes | 0 |
| Mixed Fire | Late1:CLS | Mid1:ALL | 0.01 | 100 | Yes | 0 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.01 | 100 | Yes | 0 |

Optional Disturbances

Optional 1: American beaver

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