

**11550**

## **North American Warm Desert Riparian Systems**

BpS Model/Description Version: Aug. 2020

| <b>Modelers</b> |                    | <b>Reviewers</b> |      |
|-----------------|--------------------|------------------|------|
| Janet Grove     | jgrove@fs.fed.us   | None             | None |
| Holly Richter   | hrichter@fs.fed.us | None             | None |
| Jony Cockman    | jcockman@blm.gov   | None             | None |

### **Vegetation Type**

Woody Wetland

### **Map Zone**

15

### **Model Splits or Lumps**

This biophysical setting (BpS) is split into multiple models. BpS 11550 was split between 11550, which is dominated by mid to large perennial rivers where Native American use was possible, and 11552, which represents smaller riparian stringers with either intermittent water or subsurface groundwater flow (washes, canyon corridors, small streams) imbedded in the creosote and paloverde matrix.

### **Geographic Range**

Perennial and intermittent desert drainages in central and southwestern Arizona.

### **Biophysical Site Description**

Riparian systems occur primarily along perennial streams/rivers along the Lower Colorado, Lower Salt, Lower Verde, Lower Gila, Big Sandy, Bill Williams, Santa Maria, Hassayampa, and Lower Santa Cruz corridors adjacent to Sonoran Desert scrub.

### **Vegetation Description**

The vegetation is a diverse mosaic of riparian forests, shrublands, streamside marshes, and barren alluvial surfaces. Larger river systems were dominated by gallery forests. Dominant species are *Salix gooddingii*, *Populus fremontii*, *Distichlis spicata*, *Scirpus* spp., *Typha* spp., *Prosopis* spp., *Baccharis salicifolia*, and *Muhlenbergia rigens*. Vegetation is dependent upon periodic flooding. Native Americans also had a strong influence on vegetation composition and structure by favoring edible plants (e.g., mesquite), collecting fuel wood, and burning to flush animals and increase accessibility to open water and agricultural fields.

### **BpS Dominant and Indicator Species**

| <b>Symbol</b> | <b>Scientific Name</b>                   | <b>Common Name</b> |
|---------------|------------------------------------------|--------------------|
| POFR2         | <i>Populus fremontii</i>                 | Fremont cottonwood |
| PLSE          | <i>Pluchea sericea</i>                   | Arrowweed          |
| ATLEB         | <i>Atriplex lentiformis ssp. breweri</i> | Quailbush          |
| SAEX          | <i>Salix exigua</i>                      | Narrowleaf willow  |
| TYAN          | <i>Typha angustifolia</i>                | Narrowleaf cattail |
| DISTI         | <i>Distichlis</i>                        | Saltgrass          |

|       |                              |                     |
|-------|------------------------------|---------------------|
| WAFI  | <i>Washingtonia filifera</i> | California fan palm |
| PROSO | <i>Prosopis</i>              | Mesquite            |

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

### Disturbance Description

This BpS is a flood-dependent ecosystem. The entire range of flood magnitudes contributes to ecological processes such as nutrient cycling, recruitment, and species composition. Two- to 10-yr events primarily impact herbaceous vegetation, 7- to 50yr events result in patchy removal of shrubs and saplings, 50-yr+ events remove stands of larger trees. Cottonwood returns to pole size within 10yrs of disturbance. Cottonwood is considered mature around 60yrs.

New mud/silt flats created by flooding were cultivated for corn, bean, and squash by Native Americans. Farming was a stand-replacing events that prevented cottonwood and willow seedling establishment.

Fuel characteristics and fire behavior are extremely variable due to the wide range of vegetation types that characterize the riparian zone and due to Native American manipulations. In general, fuels are typically continuous and fuel loads are high, but fuel moisture content is also often high. Wildfires may not carry except under extreme fire-weather conditions (average fire return interval [FRI] for replacement fire, 500-1,000yrs). For stands not recently tended by Native Americans, greater fuel loads allow for more frequent fire than in areas of an intense collection of fuel wood and prescribed burning for hunting and agricultural purposes.

Native Americans had a profound influence on these systems with the development of irrigation ditches, crop production on silt/mud flats deposited by yearly floods, the burning of willows for basketry (only first-year willow can be used for weaving) and to maintain open irrigation ditches and agricultural fields, and burning to facilitate access and flush jackrabbits, game birds, and deer. Fire was applied in the fall when fuels would be cured and dry. Thus, the historical fire regime is characterized by small to moderate, complete, high-intensity passive crown fires, and small moderate-intensity fires set frequently by Native Americans. The fire regime group of this BpS is difficult to identify. In the absence of native burning, the fire regime is dominated by infrequent but stand-replacing fires.

Willow resprout more vigorously from fire than cottonwood. Woodland dominants such as Fremont cottonwood (*Populus fremontii*), honey mesquite (*Prosopis glandulosa*), and willow (*Salix* spp.) typically resprout after being top-killed. However, resprouting individuals and seedlings are susceptible to mortality during recurring fires.

### Fire Frequency

| Severity         | Avg FI | Percent of All Fires | Min FI | Max FI |
|------------------|--------|----------------------|--------|--------|
| Replacement      | 763    | 10                   | 500    | 1000   |
| Moderate (Mixed) | 82     | 90                   |        |        |
| Low (Surface)    |        |                      |        |        |
| All Fires        | 74     | 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

These systems can exist as small to large linear features in the landscape. In larger, low-elevation riverine systems, this system may exist as mid-large patches.

### **Adjacency or Identification Concerns**

Exotic trees of *Tamarix* spp. and *Bromus rubrum*, *Bromus tectorum*, and Bermudagrass are common in some stands.

Water diversion and groundwater pumping have greatly modified hydrologic regimes and water levels, perhaps permanently.

Livestock grazing can be a major influence in the alteration of structure, composition, and function of the community.

In riparian woodlands, the invasives saltcedar, *Tamarix* spp., *Bromus rubrum*, *Bromus tectorum*, and Bermudagrass are common in some stands and create contiguous fuels that allow fire to spread. After an initial fire, these invasives may recover quickly and surpass their pre-fire dominance, promoting increasingly more frequent and intense fires, which can eventually displace native plants.

### **Issues or Problems**

### **Native Uncharacteristic Conditions**

Canopy cover can reach 100%.

### **Comments**

In June 2020 TNC changed the code for this BpS from 11551 to 11550.

Model assumptions include the following:

- A mixed-severity FRI of 10-20yrs was assumed, respectively, for late development (not in mesquite bosque, Class E) and mid development, and was calculated by assuming that Native Americans burned every year but affected only 10% to 5%, respectively, of the floodplain per year (probability/yr, 0.1-0.05). It was also assumed that older stands received more burning than younger stands, which provided less fuel wood.
- Intense collection of fuel wood was assumed to occur on 30% of the area in the Late-Development cottonwood class (Class D).
- Cultivation of mud/silt flats created by flooding was assumed at a level of 10% utilization of Early-Development vegetation class/yr to imitate 50% utilization during the first of 5yrs.

For LANDFIRE National, this model was based on the model for the same BpS in map zone 14. Modelers of 1411550 also include Brooke Gebow (bgebrow@tnc.org). BpS 1411550 was created by substantially revising BpS 1311550. Many changes were made. Floods causing stand-replacing events were more frequent (5-50yrs and 50yrs+, for respectively, Mid- and Late-Development classes). Classes C and D in 1311550 were merged into Class C (still accounting for Native American influences). And Class D is mesquite bosque, which is the last successional phase in the floodplain (not in the Mojave Desert), with 500-yr flood-replacement events and

replacement fire every 250yrs on average. Although Native American influences were maintained, the importance of mixed-severity fire was implicitly reduced by removing time-since-disturbance from BpS 1311550.

For BpS 1311550, Native American burning was introduced as a very plausible disturbance; however, no data or expertise were available. Consultation with ethnobiologist Kay Fowler resulted in modifications to the original model and description. The Native American influence was greater than initially thought, with farming of mud flats (not in late-development stands as initially modeled), irrigation, massive fuel wood collection, and extensive small-scale burning for willow control, basketry, general access, and hunting. Therefore, very frequent mixed-severity fire was added by Louis Provencher to the Mid-Development Closed and Late-Development Closed classes, time-since-disturbance was shortened from 50yrs to 15yrs, and farming and fuel collection were added, respectively, as model parameters in Early- and Late-Development Open classes. Mixed-severity fire and fuel wood collection were added to the Late-Development Closed class to represent Native Americans utilization of neglected or virgin stands. These last parameters had a large influence on model results.

Suggested reviewers: Dave Gori (TNC Arizona), Julie Stromberg (Arizona State University) Dan Robinette (NRCS Tucson), and Richard Felger (rfleger@ag.arizona.edu).

## 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       | D                | D     | D     | D     | D     | D     | D     | D     | D     | D      |
| 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

|                |           |                                             |
|----------------|-----------|---------------------------------------------|
| <b>Class A</b> | <b>20</b> | <b>Early Development 1 - All Structures</b> |
|----------------|-----------|---------------------------------------------|

Indicator Species

| Symbol | Scientific Name    | Common Name               | Canopy Position |
|--------|--------------------|---------------------------|-----------------|
| SAGO   | Salix gooddingii   | Goodding's willow         | Upper           |
| POFR2  | Populus fremontii  | Fremont cottonwood        | Upper           |
| BASA   | Baccharis salicina | Great Plains false willow | Upper           |

Description

Immediate post-disturbance responses are dependent on pre-disturbance vegetation composition. Species composition varies with fire (*Salix gooddingii* favored) or flood magnitude (*Salix gooddingii* and *Populus fremontii* favored). This class is typically shrub/seedling dominated, but grasses may co-dominate. This class also exists as recently deposited mud/silt flats that may be farmed for corn, squash, and beans. Farming was applied to new mud flats and it prevented germination of cottonwood and willow.

Maximum Tree Size Class

No data

---

|                |           |                                   |
|----------------|-----------|-----------------------------------|
| <b>Class B</b> | <b>24</b> | <b>Mid Development 1 - Closed</b> |
|----------------|-----------|-----------------------------------|

Indicator Species

| Symbol | Scientific Name   | Common Name        | Canopy Position |
|--------|-------------------|--------------------|-----------------|
| SAGO   | Salix gooddingii  | Goodding's willow  | Upper           |
| POFR2  | Populus fremontii | Fremont cottonwood | Upper           |

Description

Highly dependent on the hydrologic regime. Vegetation composition includes tall shrubs and small trees (willow and cottonwood). Native mixed-severity burning in the fall for acquiring supplies for basketry, clearing irrigation ditches, and hunting was conducted. Shrubs resprouted vigorously the year after burning.

Maximum Tree Size Class

Pole 5-9" DBH

---

|                |           |                                    |
|----------------|-----------|------------------------------------|
| <b>Class C</b> | <b>35</b> | <b>Late Development 1 - Closed</b> |
|----------------|-----------|------------------------------------|

Indicator Species

| Symbol | Scientific Name   | Common Name        | Canopy Position |
|--------|-------------------|--------------------|-----------------|
| POFR2  | Populus fremontii | Fremont cottonwood | Upper           |
| SAGO   | Salix gooddingii  | Goodding's willow  | Upper           |
| PROSO  | Prosopis          | Mesquite           | Middle          |

Description

This class is represented by mature, large cottonwood and willow riparian woodlands. Mesquite increases in importance in the mid-story and lower canopy. When Native Americans used this class, the mid-story shrub component was tended and open, but the tree canopy was generally unaffected. Native American burning was most likely to flush jackrabbit and deer, and to control willow encroachment near waterways (irrigation ditches or side channels) and agricultural fields situated on nearby alluvial deposits. Fuel collection was an important activity resulting in understory thinning and fuel load reduction.

#### Maximum Tree Size Class

Large 21-33" DBH

---

**Class D      21      Late Development 2 - Closed**

---

#### Indicator Species

| Symbol | Scientific Name | Common Name     | Canopy Position |
|--------|-----------------|-----------------|-----------------|
| PROSO  | Prosopis        | Mesquite        | Upper           |
| CEPA8  | Celtis pallida  | Spiny hackberry | Middle          |

#### Description

Mesquite dominates the riparian floodplain. *Salix goodingii* and *Populus fremontii* are a minor component in this class.

#### 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:CLS    | 4             |
| Mid1:CLS   | 5              | Late1:CLS   | 19            |
| Late1:CLS  | 20             | Late2:CLS   | 109           |
| Late2:CLS  | 110            | Late2: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 |
|---------------------------|-----------------------|---------------------|-------------------------|-----------------------|-----------------------------------------------------|------------------------------|
| Optional 1                | Early1:ALL            | Early1:ALL          | 0.1                     | 10                    | Yes                                                 | 0                            |
| Wind or Weather or Stress | Early1:ALL            | Early1:ALL          | 0.13                    | 8                     | Yes                                                 | 0                            |
| Mixed Fire                | Mid1:CLS              | Mid1:CLS            | 0.05                    | 20                    | No                                                  | 0                            |
| Wind or Weather or Stress | Mid1:CLS              | Early1:ALL          | 0.067                   | 15                    | Yes                                                 | 0                            |
| Replacement Fire          | Late1:CLS             | Early1:ALL          | 0.00133                 | 752                   | Yes                                                 | 0                            |

|                           |           |            |       |     |     |   |
|---------------------------|-----------|------------|-------|-----|-----|---|
| Wind or Weather or Stress | Late1:CLS | Early1:ALL | 0.02  | 50  | Yes | 0 |
| Wind or Weather or Stress | Late2:CLS | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Replacement Fire          | Late2:CLS | Early1:ALL | 0.004 | 250 | Yes | 0 |

### Optional Disturbances

Optional 1: Farming

### References

Brooks, M. L. and R. A. Minnich. In Press. Fire in the Southeastern Desert Bioregion. Chapter 16 in: N.G. Sugihara, J.W. van Wagtenonk, J. Fites-Kaufman, K.E. Shaffer and A.E. Thode, ed). Fire in California ecosystems. University of California Press, Berkeley.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. Data current as of 10 February 2007.

Richter, H.E. 1992. Development of a conceptual model for floodplain restoration in a desert riparian system. *Arid Lands* 32: 13-17.

Stromberg, J. 1992. Element Stewardship Abstract for Mesquite (*Prosopis* spp.). The Nature Conservancy, Arlington, VA.