## Yellow Pine (YPN)

**General Information**

**Cover Type Overview**

**Yellow Pine (YPN)**

* Only occurs on the east side of the Sierra crest.
* Crosswalk to EVeg: Regional Dominance Type 1
  + Eastside Pine
  + Jeffrey Pine
  + Ponderosa Pine
* Crosswalk to EVeg: Regional Dominance Type 2
  + any
* Crosswalk to Presettlement Fire Regime Type
  + Yellow Pine
* Crosswalk to LandFire Biophysical Settings
  + 0610310 California Montane Jeffrey Pine (–Ponderosa Pine) Woodland

**Yellow Pine with Aspen (YPN-ASP)**

* This type is created by overlaying the NRIS TERRA Inventory of Aspen on top of the EVeg layer. Where it intersects with YPN it is assigned to YPN-ASP.

Reviewed by:

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**Vegetation Description**

**Yellow Pine** The YPN landcover type is characterized by yellow pine species such as *Pinus ponderosa* or *Pinus jeffreyi* that occur on the east side of the Sierra crest (LandFire 2007a). Relatively pure stands of yellow pinemay occur, or they may mix with other tree species including *Abies concolor,* *Juniperus occidentalis, Pinus contorta* ssp. *murrayana,* and *Quercus kelloggi* (Fites-Kaufman et al. 2007, Fitzhugh 1988). Their understory may include both montane forest and Great Basin shrubs, including but not limited to *Ceanothus, Arctostaphylos, Symphoricarpos*, *Artemisia tridentata*, *Purshia tridentata, Ericameria nauseosa*, *Cercocarpus,* and *Holodiscus*. Herbaceous plants may include *Wyethia, Balsamorhiza sagittata, Festuca, Calamagrostis,* and *Elymus* (LandFire 2007a, Fitzhugh 1988).

Without disturbance, except for naturally occuring fire, a mosaic of uneven-aged patches develops, with open spaces and dense sapling stands (Safford 2013). *Q. kelloggi* or *Juniperus occidentalis* may form an understory, but pure stands of pine also are found. An open stand of low shrubs, and a grassy herb layer are typical. Crowns of pines are open, allowing light, wind and rain to penetrate, whereas other associated trees provide more dense foliage (Fitzhugh 1988).

**Yellow Pine with Aspen (YPN-ASP)** These are upland forests and woodlands dominated by *Populus tremuloides* without a significant conifer component, often termed “stable aspen.” The understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids or forbs. Common shrubs include *Acer*, *Amelanchier*, *Artemisia*, *Juniperus*, *Prunus*, *Rosa*, *Shepherdia*, *Symphoricarpos*, and the dwarf-shrubs *Mahonia* and *Vaccinium*. Common graminoids may include *Bromus*, *Calamagrostis*, *Carex*, *Elymus*, *Festuca*, and *Hesperostipa*. Associated forbs may include *Achillea*, *Eucephalus*, *Delphinium*, *Geranium*, *Heracleum*, *Ligusticum*, *Lupinus*, *Osmorhiza*, *Pteridium*, *Rudbeckia*, *Thalictrum*, *Valeriana*, *Wyethia*, and many others (LandFire 2007b).

**Distribution**

**Yellow Pine** This landcover type occurs on all aspects from about 1200 m to 1980 m (4000-6500 ft) in elevation, east of the Sierra Nevada crest (Fitzhugh 1988). It is usually found on volcanic and granitic substrates, in shallow soils with a frigid soil temperature regime (LandFire 2007a).

**Yellow Pine with Aspen** Sites supporting *P. tremuloides* are associated with added soil moisture, i.e., azonal wet sites. These sites are often close to streams, lakes, and meadows. Other sites include rock reservoirs, springs and seeps. Terrain can be simple to complex. At lower elevations, topographic conditions for this type tends toward positions resulting in relatively colder, wetter conditions within the prevailing climate, e.g., ravines, north slopes, wet depressions, etc. (LandFire 2007b). *P. tremuloides* stands may also be associated with lateral or terminal moraine boulder material, talus-colluvium, rock falls, or lava flows. In addition, pure stands may be found in topographic positions where snow accumulates, mostly at higher north facing elevations, where snow presence means the growing season is too short to support conifers (Shepperd et al. 2006).

**Disturbances**

**Wildfire**

**Yellow Pine** Wildfires are common and frequent; mortality depends on vegetation vulnerability and wildfire intensity. Low mortality fires kill small trees and consume above-ground portions of shrubs and herbs, but do not kill large trees or below-ground organs of most shrubs and herbs which promptly re-sprout. High mortality fires kill large as well as small trees, and may kill many of the shrubs and herbs as well. Fire kills the above-ground portions of the shrubs and herbs, but most shrubs and herbs resprout from surviving below-ground organs. Wildfires may trigger transitions between developmental condition classes.

The relatively long needles of yellow pines and relatively open structure of theses stands make for dry surface and ground fuels that burn readily. Thus, fires in these stands burn more frequently than those in adjacent forests (Fites-Kaufman et al. 2007). In fact, fire is an integral part of the ecology of yellow pines. Fire has allowed yellow pines to dominate sites where it is the potential climax as well as sites where it would otherwise be seral to more shade-tolerant tree species. *P. ponderosa* and *P. jeffreyi* have evolved with a thick bark and open crown structure that allows them to survive most fires. Mature trees will self-prune, leaving a smooth bole which reduces aerial fire spread. Also, fire creates favorable seedbeds for seedling establishment (Habeck 1992).

Data on fire return intervals (FRIs) are available from a few review papers. Skinner and Chang (1996) aggregated FRIs from the Sierra Nevada. Van de Water and Safford’s 2011 review paper aggregates hundreds of articles, conference proceedings, and LandFire data on fire return intervals, with an emphasis on Californian sources. We also include here data from the pertinent individual LandFire BpS model (2007a).

For yellow pine forests (not restricted to east side types), Van de Water and Safford (2011) found a mean FRI of 11 years, median of 7 years, mean min of 5 years and mean max of 40 years. Skinner and Chang (1996) examined studies of east side *P. ponderosa* forests in the southern Cascades and found median FRIs of 8-16 years, minimums of 6-8 years, and maximums of 15-32 years. For east side *P. ponderosa-A. concolor* forests in the southern Cascades, they separated pre-1850 values from the entire period of record. In that study, the median FRI was 10 years, with a minimum of 3 years and a maximum of 71 years. LandFire’s California Montane Jeffrey Pine (–Ponderosa Pine) Woodland for the northern Sierra estimated FRIs of 165 years for replacement fire, 80 years for mixed fire, 11 years for surface fire, and 9 years overall (2007a). We recalculated these numbers using condition-specific information and using only high and low mortality fire categories, which resulted in a mean FRI of 121 years for high mortality fire, 10 years for low mortality fire, and 9 years for any fire.

**Yellow Pine with Aspen** Sites supporting *P. tremuloides* are maintained by stand-replacing disturbances that allow regeneration from below-ground suckers. Replacement fire and ground fire are thought to have been common in stable *P. tremuloides* stands historically. Because *P. tremuloides* is associated with mesic conditions, it rarely burns during the normal lightning season. However, during years with little precipitation stands may be more susceptible to burning. Evidence from fire scars and historical studies show that past fires occurred mostly during the spring and fall. These are typically self-perpetuating stands (LandFire 2007b)

Van de Water and Safford (2011) found a mean fire return interval of 19 years, median of 20 years, mean min interval of 10 years and mean max of 90 years for Aspen. The LandFire model for northern Sierra Nevada “stable aspen” predicts a mean FRI of 31 years. Replacement FRI has a mean of 68 years with a range of 50-300 years, while mixed severity FRI has a mean of 57 years with a range of 20-60 years, and low severity fire is not modeled (LandFire 2007b). We recalculated these numbers using condition-specific information and using only high and low mortality fire categories, which resulted in an interval of 38 years for high mortality fire, 111 years for low mortality fire, and 29 years for any fire.

Table 1. Fire return intervals (years) and percentage of high versus low mortality fires. Numbers for YPN were derived from BpS model 0610581 (LandFire 2007a), Skinner and Chang (1996) and Safford (pers. comm. 2013). Numbers for YPN-ASP were derived from BpS model 0610110 (LandFire 2007b) and Safford (pers. comm. 2013).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variant** | **Fire Mortality** | **Mean** | **Min** | **Max** | **% of Fires** |
| YPN | High | 200 | – | – | 5 |
| Low | 10 | – | – | 95 |
| All Fires | 9 | 3 | 71 | 100 |
| YPN–ASP | High | 38 | – | – | 12 |
| Low | 111 | – | – | 88 |
| All Fires | 18 | 20 | 300 | 100 |

**Other Disturbance**

Other disturbances are not currently modeled, but may, depending on the condition affected and mortality levels, reset patches to early development, maintain existing condition classes, or shift/accelerate succession to a more open condition.

**Vegetation Condition Classes**

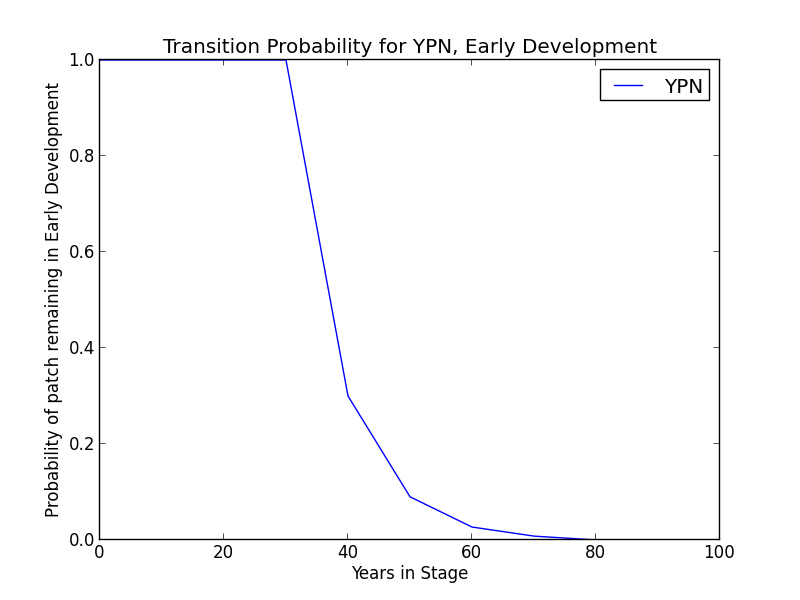
We recognize five separate condition classes for YPN: Early Development (ED), Mid Development Open (MDO), Mid Development Closed (MDC), Late Development Open (LDO, and Late Development Closed (LDC). The YPN -ASP variant is assigned to three condition classes: Early Development – Aspen (ED-A), Mid Development – Aspen (MD-A), and Late Development – Conifer with Aspen (LD-CA).

We use condition classes not in the sense of fire regime condition classes, but as an alternative to “successional” classes that imply a linear progression of states and tend not to incorporate disturbance. The condition classes identified here are derived from a combination of successional processes and anthropogenic and natural disturbance, and are intended to represent a composition and structural condition that can be arrived at from multiple other conditions described for that landcover type. Thus our condition classes incorporate age, size, canopy cover, and vegetation composition as well as relative seral stages. In general, the delineation of stages has originated from the LandFire biophysical setting model descriptive of a given landcover type; however, condition classes are not necessarily identical to the classes identified in those models.

**Yellow Pine Variant**

**Early Development (ED)**

**Description** Grasses, forbs, low shrubs, and sparse to moderate cover of trees (primarily *P. ponderosa* or *P. jeffreyi*) seedlings/saplings with an open canopy. This condition is characterized by the recruitment of a new cohort of early successional, shade-intolerant tree species into an open area created by a stand-replacing disturbance. Following such disturbance, some sites are dominated by dense shrub stands composed of *P. tridentata, Arctostaphylos,* and/or *Ceanothus*, depending on location. Other postfire sites are more open and dominated by dense pine seedlings, bunchgrasses and forbs.

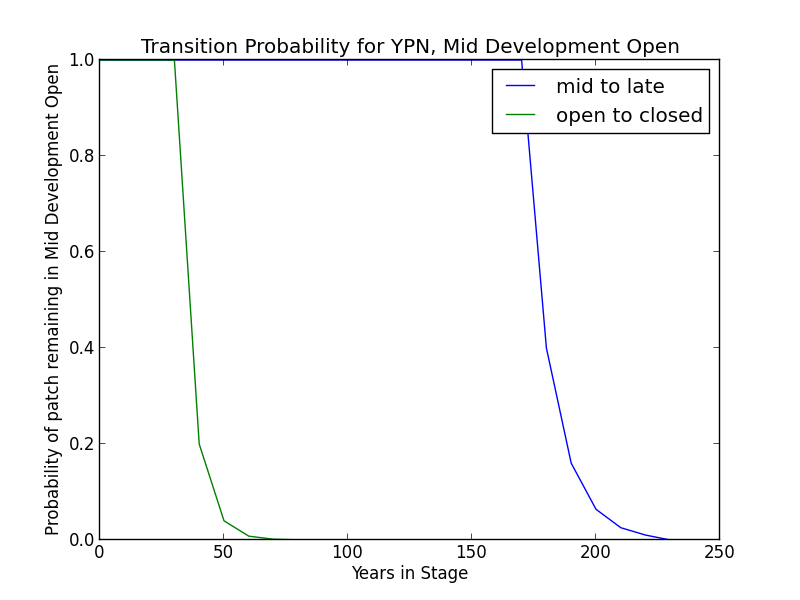


**Succession Transition** In the absence of disturbance, patches in this condition will begin transitioning to MDC or MDO after 40 years at a rate of 0.7 per timestep. The transition to MDO is twice as likely as transition to MDC. At 80 years, all remaining patches will succeed to either MDC or MDO.

**Wildfire Transition** High mortality wildfire (100% of fires in this condition) recycles the patch through the ED condition, regardless of soil type. Low mortality wildfire is not modeled for this condition.

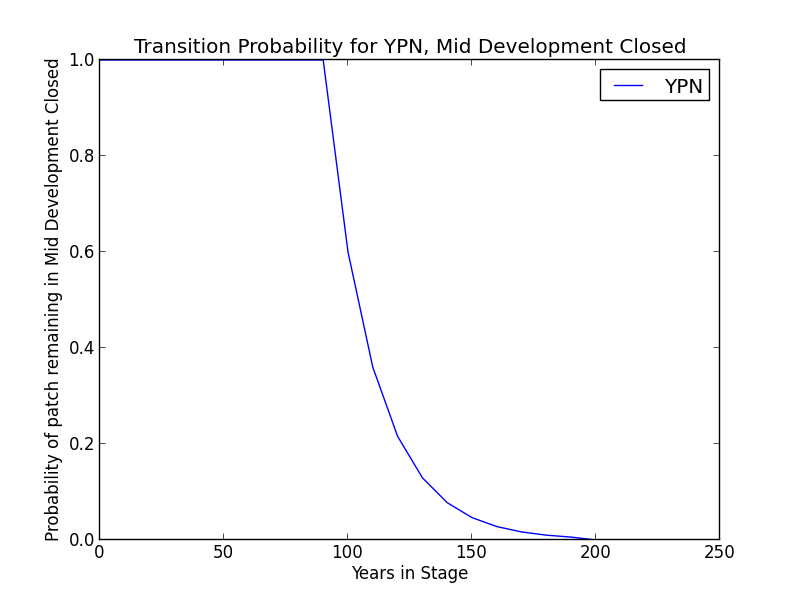
**Mid Development - Open (MDO)**

**Description** Open mid-development forest with diverse herbaceous understory and scattered woody shrubs. Conifers, primarily *P. ponderosa* or *P. jeffreyi*, are medium sized. Herbs and other species gradually decline as growing trees begin to shade understory. Maintained by frequent burning. Canopy cover is less than 40% (LandFire 2007a).

**Succession Transition** Patches in this condition will maintain under low mortality disturbance, but after 40 years without fire it begins transitioning to MDC at a rate of 0.8 per time step. Succession to LDO occurs once the patch has been in mid development for 170 years. The rate of succession per time step is 0.6. After 230 years, all patches will have succeeded.

**Wildfire Transition** High mortality wildfire (5.8% of fires in this condition) recycles the patch through the Early Development condition. Low mortality wildfire (94.2%) maintains the patch in MDO.

**Mid Development - Closed (MDC)**

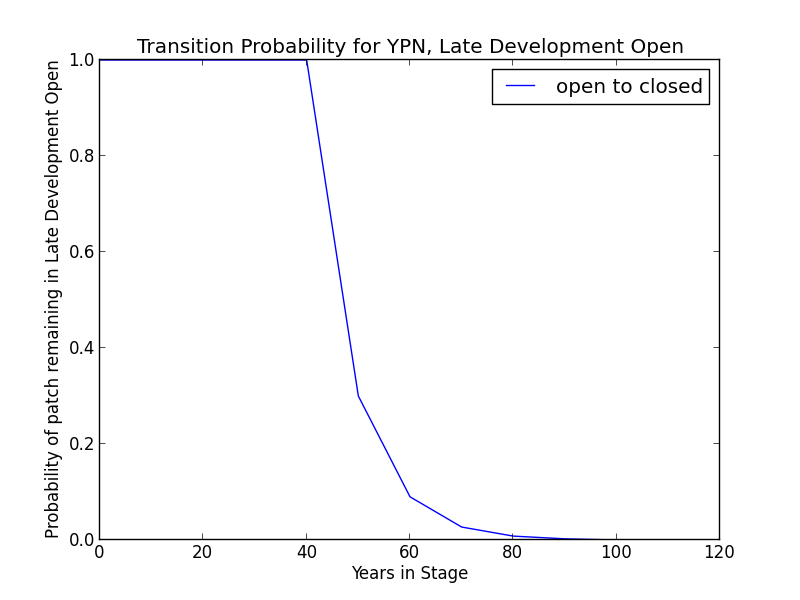
**Description** Dense mid-development forest. “Overstocked” pole to large pole size trees, primarily *P. ponderosa* or *P. jeffreyi,* susceptible to stagnation. Marginal understory associated with limited site resources. Develops where fire frequency is too low to thin small trees. Canopy cover is over 40% (LandFire 2007a).

**Succession Transition** At 100 years since succession to a mid development condition, these patches will begin transitioning to LDC. The rate of succession per time step is 0.4. After 200 years, all patches will have succeeded.

**Wildfire Transition** High mortality wildfire (14.8% of fires in this condition) recycles the patch through the Early Development condition. Low mortality wildfire (85.2%) opens the stand up to MDO 51.9% of the time; otherwise, the patch remains in MDC.

**Late Development - Open (LDO)**

**Description** Open late-development forest with large and very large trees, primarily *P. ponderosa* or *P. jeffreyi*. Trees grow in often widely spaced clumps and the understory is open and often diverse. Surface fuels are limited due to frequent burning. Canopy cover is less than 40% (LandFire 2007a, Safford 2013).

**Succession Transition** Patches in this condition will maintain under low mortality disturbance, but after 50 years without fire, these patches succeed to LDC at a rate of 0.7 per timestep.

**Wildfire Transition** High mortality wildfire (1.1% of fires in this condition) recycles the patch through the Early Development condition. Low mortality wildfire (98.9%) maintains the patch in LDO.

**Late Development - Closed (LDC)**

**Description** Dense late-development forest, primarily *P. ponderosa* or *P. jeffreyi* with large and very large trees, sometimes with significant within-stand mortality. Substantial surface fuel accumulation and ladder fuels. Canopy cover exceeds 40% (LandFire 2007a).

**Succession Transition** Patches in this condition will maintain in the absence of disturbance.

**Wildfire Transition** High mortality wildfire (26.9% of fires in this condition) recycles the patch through the Early Development condition. Low mortality wildfire (73.1%) opens the stand up to MDO 31.2% of the time; otherwise, the patch remains in MDC.

**Aspen Variant**

**Early Development – Aspen (EDA)**

**Description** Grasses, forbs, low shrubs, and sparse to moderate cover of tree seedlings/saplings (primarily *P. tremuloides*) with an open canopy. This condition is characterized by the recruitment of a new cohort of early successional, shade-intolerant tree species into an open area created by a stand-replacing disturbance.

Following disturbance, succession proceeds rapidly from an herbaceous layer to shrubs and trees, which invade together (Verner 1988). *P. tremuloides* suckers over 6ft tall develop within about 10 years (LandFire 2007b).

**Succession Transition** Unless it burns, a patch in the early condition persists for 10 years, at which point it transitions to MD-A.

**Wildfire Transition** High mortality wildfire (100% of fires in this condition) recycles the patch through the ED-A condition. Low mortality wildfire is not modeled for this condition.

**Mid Development – Aspen (MDA)**

**Description** *P. tremuloides* trees 5-16” DBH. Canopy cover is highly variable, and can range from 40-100%. These patches range in age from 10 to 110 years. (LandFire 2007b).

**Succession Transition** Patches in the MD-A condition persist for at least 80 years in the absence of any fire, after which they begin transitioning to LD-CA at a rate of 0.6 per timestep. After 130 years without fire all remaining MD-A patches transition to LD-CA.

**Wildfire** **Transition** High mortality wildfire (100% of fires in this condition) recycles the patch through the ED-A condition. Low mortality wildfire is not modeled for this condition.

**Late Development – Aspen with Conifer (LDAC)**

**Description** These stands have been protected from fire since the last stand-replacing disturbance. *P. tremuloides* trees are predominantly 16” DBH and greater. Conifers are encroaching and can theoretically eventually overtop the aspen, but it is unlikely that conifers will comprise dominant portion of the stand (LandFire 2007b).

**Succession Transition** Patches in this condition will maintain in the absence of stand-replacing disturbance.

**Wildfire Transition** High mortality wildfire (45.5% of fires in this condition) returns the patch to ED-A. Low mortality wildfire (54.5%) maintains the patch in LD-CA.

**Condition Classification**

Table 2. Classification of cover condition for YPN. Diameter at Breast Height (DBH) and Cover From Above (CFA) values taken from EVeg polygons. DBH categories are: null, 0-0.9”, 1-4.9”, 5-9.9”, 10-19.9”, 20-29.9”, 30”+. CFA categories are null, 0-10%, 10-20%, … , 90-100%. Each row in the table below should be read with a boolean AND across each column of a row.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Cover Condition | Overstory Tree  Diameter 1 (DBH) | Overstory Tree  Diameter 2 (DBH) | Total Tree  CFA (%) | Conifer  CFA (%) | Hardwood  CFA (%) |
| Early All | 0-4.9” | any | any | any | any |
| Mid Open | 5-19.9” | any | <40 | any | any |
| Mid Closed | 5-19.9” | any | >40 | any | any |
| Late Open | 20”+ | any | <40 | any | any |
| Late Closed | 20”+ | any | >40 | any | any |

LPN-ASP conditions were assigned manually using NAIP 2010 Color IR imagery to assess condition.

**Draft Model**

(See PDF) Disturbance-Succession model for YPN and YPN–ASP.

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