## Subalpine Conifer (SCN)

**General Information**

**Cover Type Overview**

**Subalpine Conifer (SCN)**

* Reviewed by Marc Meyer, Southern Sierra Province Ecologist, USDA Forest Service
* Crosswalk to EVeg: Regional Dominance Type 1
  + Alpine Mixed Scrub
  + Mountain Hemlock
  + Subalpine Conifers
  + Whitebark Pine
* Crosswalk to EVeg: Regional Dominance Type 2
  + Any
* Crosswalk to Presettlement Fire Regime Type
  + Subalpine
* Crosswalk to LandFire Biophysical Settings
  + 0610330 Mediterranean California Subalpine Woodland
  + 0610440 Northern California Mesic Subalpine Woodland
  + 0610710 Sierra Nevada Alpine Dwarf-Shrubland

**Subalpine Conifer with Aspen (SCN-ASP)**

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

**Vegetation Description**

**Subalpine Conifer (SCN)** The SCN landscape is comprised of a mosaic of subalpine forests/woodlands, meadows, rock outcrops, and scrub vegetation types. These forests are open stands of conifers occurring on generally sandy soils or rocky slopes at elevations above the upper montane forest stands of *Abies magnifica*. Stand densities are low. Many, but not all, species form shrubby krummholz forms of growth near their upper elevational limits (Fites-Kaufman 2007).

*Tsuga mertensiana* is often the most common tree species and mixes with *P. contorta* ssp. *murrayana*, *A. magnifica*, *Pinus monticola*, and *Pinus albicaulis*. In some areas, *P. contorta* ssp. *murrayana* dominates post-disturbances stands. *T. mertensiana* seedlings are relatively shade tolerant compared to other subalpine conifers and do well under closed canopy conditions. *P. albicaulis* presence increases in the southern portion of the project area (Fites-Kaufman 2007, LandFire 2007a).

Treeline growth of multistemmed trees and shrubby krummholz growth of conifers varies with latitude in the Sierra Nevada. Treeline in the northern Sierra Nevada is dominated by *P. albicaulis*, which frequently occurs with a krummholz form of growth near its upper limit. Several other species may also form krummholz growth forms, including Sierra juniper, *Tsuga mertensiana, P. contorta* ssp. *murrayana*, and rarely *Pinus jeffreyi* (Fites-Kaufman 2007).

Although typically of minor importance, a shrub understory may include *Arctostaphylos, Ribes, Phyllodoce, Vaccinium,* and *Kalmia* can occur on moist sites. Herbs present may include *Lupinus, Hieracium, Arabis, Aster,* and *Erigeron. Carex* and various grasses are also common (Verner and Purcell 1988, LandFire 2007a).

**Subalpine Conifer with Aspen (SCN-ASP)** These are upland forests and woodlands dominated by *Populus tremuloides* without a significant conifer component. Conifers may be present in these systems; however, these patches of *P. tremuloides* are not typically successional to conifers. 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).

**Distribution**

**Subalpine Conifer** The elevational distribution of subalpine forest communities varies with latitude. In the northern Sierra Nevada, such stands begin around 2,450 m and extend up to treeline at 2,750 to 3,100 m (9,000 to 11,000 ft). Both upper and lower limits of subalpine species distributions are driven by a variety of factors, including soil resources, water availability, and climatic limiting factors (Fites-Kaufman 2007).

These forests are characterized by a relatively short growing season with cool temperatures. With the exception of occasional summer thunderstorms, most precipitation falls as snow. Wet years with abundant snowfall can limit growth as these may produce late-lying snowfields that reduce the length of the growing season. Winds can be severe, particularly around exposed ridges. Such wind conditions may produce snow-free winter areas that lower soil temperatures and increase plant water stress (Fites-Kaufman 2007).

Because of the solid granite parent material, areas with deeper soil accumulation can become waterlogged for much of the year. For these reasons, the length of the growing season is a function of not only early season limitation due to low temperatures and snowfields, but also late season limitations due to drought. Studies of the dynamics of alterations of treeline elevation over the past several millennia have reinforced the significance of complex interactions of both temperature and seasonal water availability in determining such changes (Fites-Kaufman 2007).

**Subalpine Conifer 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**

**Subalpine Conifer** Most of the SCN areas of the Sierra Nevada were subjected to repeated glaciation during the Pleistocene, and thus have thin and poorly developed soils with little organic matter. The small amounts of litter accumulation and open stand structure of subalpine forests mean that fire is rare (Fites-Kaufman 2007). It is, however, the major disturbance event of this type (LandFire 2007a). Meyer’s 2013 review suggests that historic and current fire regimes in subalpine forests are normally climate-limited and dominated by surface fires with crown fires occurring occasionally.

Data on fire return intervals (FRIs) are available from a few review papers. 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 models (2007a, 2007b).

Estimates of wildfire return interval for subalpine forests range from 57 to over 500 years (Meyer 2013). Van de Water and Safford (2011) found a mean fire return interval of 133 years, a median of 132 years, a mean min of 100 years and a mean max of 420 years for subalpine forest. The LandFire model for northern California mesic subalpine woodland predicts a mean FRI of 321 years. Replacement FRI has a mean of 500 years, while the mean mixed severity FRI is 900 years, and low severity fire is not modeled (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 500 years for high mortality fire, 923 years for low mortality fire, and 324 years for any fire.

**Subalpine Conifer 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)

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). 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 in relation to soil type modifier and the presence of *P. tremuloides*. Numbers for SCN were derived from BpS model 0610440, Van de Water and Safford (2011), Meyer (2013), and input from Safford (pers. comm. 2013), and Estes (pers. comm. 2013). Numbers for SCN-ASP were derived from BpS model 0610610 (LandFire 2007b), Meyer (2013), and input from Safford (pers. comm. 2013), and Estes (pers. comm. 2013).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variant** | **Fire Mortality** | **Mean** | **Min** | **Max** | **% of Fires** |
| SCN | High | 350 | – | – | 65 |
| Low | 500 | – | – | 35 |
| All Fires | 250 | 57 | 420 | 100 |
| SCN -ASP | High | 325 | – | – | 75 |
| Low | 450 | – | – | 25 |
| All Fires | 225 | 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.

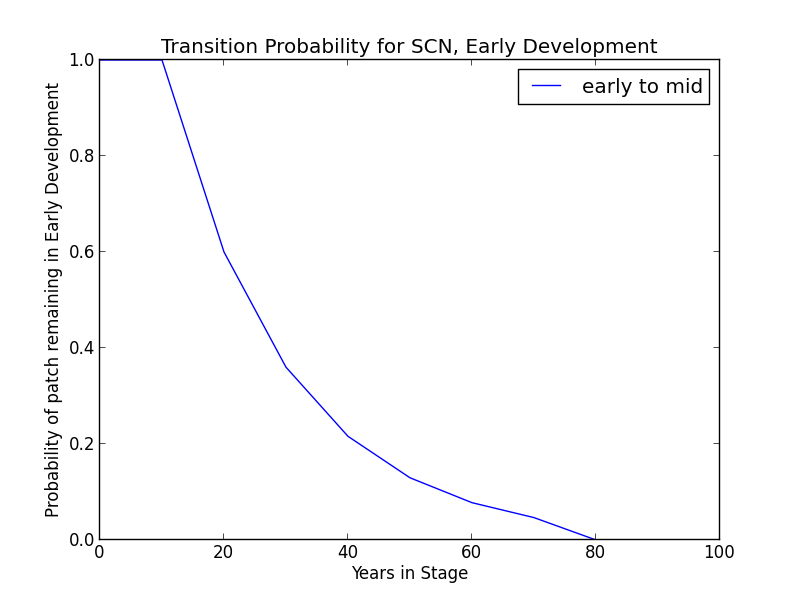
**Vegetation Condition Classes**

We 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.

We recognize five separate condition classes for SCN: Early Development (ED), Mid Development Open (MDO), Mid Development Closed (MDC), Late Development Open (LDO, and Late Development Closed (LDC). The SCN-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).

**Subalpine Conifer Variant**

**Early Development (ED)**

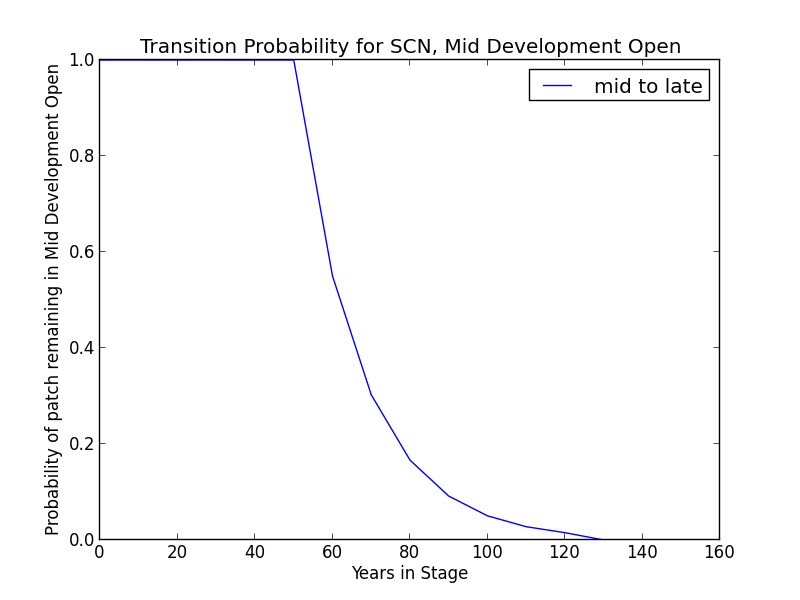
**Description** The first few years following stand-replacing wildfire are characterized by bare ground, herbs, shrubs, and varying densities of tree seedlings (presumably dependent on seed sources). Dominant species include coniferous tree seedlings, resprouting grasses and shrubs, and invading herbs. Shrubs include *Ribes* spp. Herbs and grasses include *Aster*, *Pedicularis*, *Hieracium*, *Arabis*, *Erigeron*, *Carex*, *Luzula*, and *Poa* (LandFire 2007a).

**Succession Transition** In the absence of disturbance, this condition will begin transitioning to mid development after 20 years at a rate of 0.4 per time step. Transition to either MDC or MDO can occur, although transition to MDC occurs 90% of the time. At 80 years, all stands will have succeeded.

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

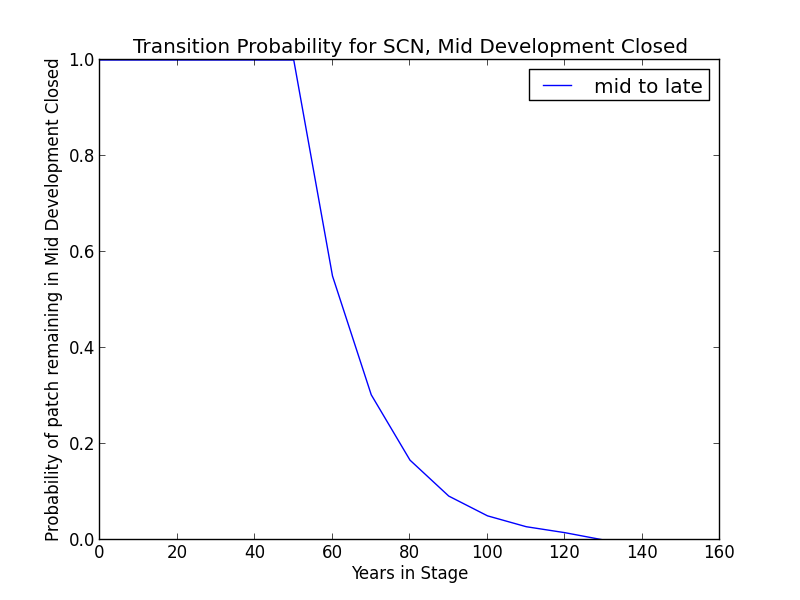
**Mid Development - Open (MDO)**

**Description** This condition represents delayed tree regeneration and long-term domination by shrubs and herbs. Shrubs include *Ribes* spp. Herbs and grasses include *Aster*, *Pedicularis*, *Hieracium*, *Arabis*, *Erigeron*, *Carex*, *Luzula*, and *Poa*. Trees are represented by seedlings and saplings of *T. mertensiana, P. contorta* ssp. *murrayana*, and other species (LandFire 2007a).

**Succession Transition** This condition will maintain under low mortality disturbance, but after 60 years without fire it begins transitioning to LDO at a rate of 0.45 per time step. Succession to LDO may occur once the age since transition to an MD condition for that patch is at least 60 years, even if the patch has shifted between the MDC and MDO condition classes. After 130 years, all stands will have succeeded. Succession to MDC is not modeled.

**Wildfire Transition** High mortality wildfire (60% of fires) recycles the patch through the Early Development condition. Low mortality wildfire (40%) maintains the patch in MDO.

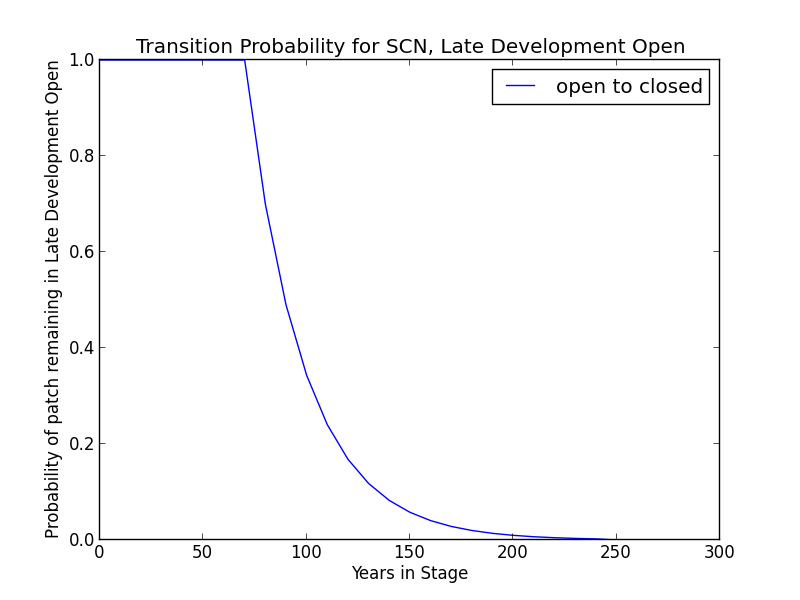
**Mid Development - Closed (MDC)**

**Description** This condition class represents rapid regeneration by *P. contorta* ssp. *murrayana*, with additional conifers coming in, including *T. mertensiana, A. magnifica,* and *P. monticola.* Shrubs include *Ribes* spp. Herbs and grasses include *Aster*, *Pedicularis*, *Hieracium*, *Arabis*, *Erigeron*, *Carex*, *Luzula*, and *Poa*. (LandFire 2007a).

**Succession Transition** After 60 years without a wildfire-triggered transition, this condition will begin transitioning to LDC at a rate of 0.45 per time step. Patches moving between MDC and MDO begin transitioning after 60 years since transition to mid development. After 130 years, all stands will have succeeded.

**Wildfire Transition** High mortality wildfire (66.7% of fires) recycles the patch through the Early Development condition. Low mortality wildfire (33.3%) triggers a transition to MDO.

**Late Development - Open (LDO)**

**Description** This condition class represents late-successional stands with large individuals (greater than 20” DBH) of *T. mertensiana* and other species. The open stand structure is maintained by mixed severity fire and insect-caused tree mortality (the latter not modeled at this time). Shrubs include *Ribes* spp. Herbs and grasses include *Aster*, *Pedicularis*, *Hieracium*, *Arabis*, *Erigeron*, *Carex*, *Luzula*, and *Poa*. (LandFire 2007a).

**Succession Transition** In the absence of any fire, succession to LDC occurs after 80 years at a rate of 0.3 per timestep.

**Wildfire Transition** High mortality wildfire (60% of fires) recycles the patch through the Early Development condition. Low mortality wildfire (40%) maintains the patch in LDO.

**Late Development - Closed (LDC)**

**Description** This condition class represents late-successional stands with large individuals (greater than 20in DBH) of *T. mertensiana* and other species, and advanced regeneration of *T. mertensiana* and other shade tolerant species. Shrubs include *Ribes* spp. Herbs and grasses include *Aster*, *Pedicularis*, *Hieracium*, *Arabis*, *Erigeron*, *Carex*, *Luzula*, and *Poa*. (LandFire 2007a).

**Succession Transition** This condition class will maintain in the absence of disturbance.

**Wildfire Transition** High mortality wildfire (66.7% of fires) recycles the patch through the Early Development condition. Low mortality wildfire (33.3%) maintains the patch in LDC.

**Aspen Variant**

**Early Development – Aspen (ED–A)**

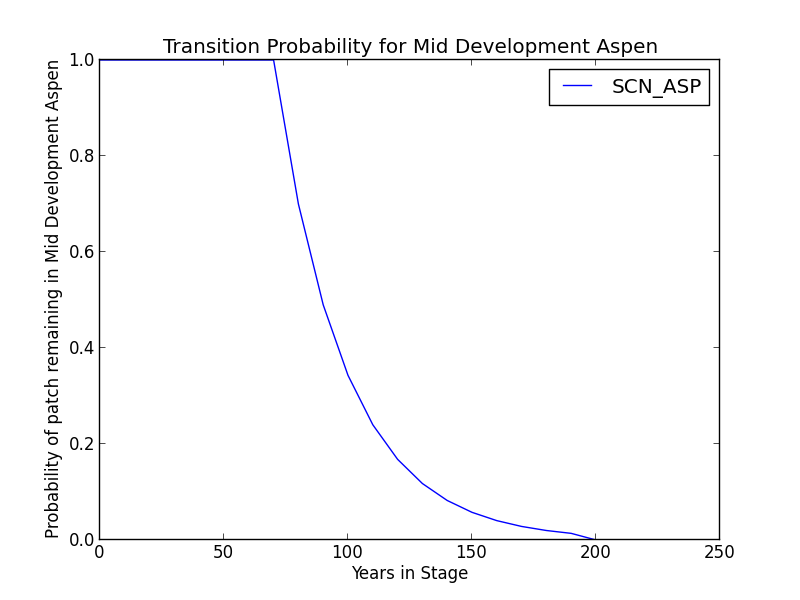
**Description** Grasses, forbs, low shrubs, and sparse to moderate cover of tree seedlings/saplings (primarily *P. tremuloides*) with an open canopy. This condition is characterized by the recruitment of a new cohort of early successional, shade-intolerant tree species into an open area created by a 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 ED–A condition persists for 10 years, at which point it transitions to MD-A.

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

**Mid Development – Aspen (MD–A)**



**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** MD-A persists for at least 80 years in the absence of fire, after which stands begin transitioning to MD-AC at a rate of 0.3 per timestep. After 200 years since entering MD-A, any remaining patches transition to MD-AC.

**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 – Conifer with Aspen (LD–CA)**

**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 eventually overtop the aspen (LandFire 2007).

**Succession Transition** This class will maintain in the absence of 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 SCN. 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.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Cover Condition | Overstory Tree  Diameter 1 (DBH) | Overstory Tree  Diameter 2 (DBH) | Total Tree  CFA (%) | Conifer  CFA (%) | Hardwood  CFA (%) |
| Early All | null | any | any | any | any |
| Early All | 0-4.9” | any | any | any | any |
| Mid Open | 5-19.9” | any | null | null | null |
| Mid Open | 5-19.9” | any | <50 | any | any |
| Mid Open | 5-19.9” | any | null | <50 | null |
| Mid Closed | 5-19.9” | any | >50 | any | any |
| Mid Closed | 5-19.9” | any | null | >50 | any |
| Late Closed | 20”+ | any | >50 | any | any |
| Late Closed | 20”+ | any | null | >50 | any |
| Late Open | 20”+ | any | null | null | null |
| Late Open | 20”+ | any | <50 | any | any |
| Late Open | 20”+ | any | null | <50 | null |

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

**Draft Model**

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

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