Vegclass and Cover Type Descriptions
Source: Yospin et al. in review

Vegetation state and transition model

We created a customized STM to describe both current and potential future vegetation for the study area at a level of detail that would allow us to simulate the successional trajectories of plant communities within the study area. We reduced diverse species and species assemblages by grouping species that were ecologically related into eight cover types defined by dominant and subdominant tree species, relying on previous fieldwork (Day, 2005; Sonnenblick, 2006; Murphy, 2008; Yospin et al., 2012) and knowledge of these communities. Based on the projections of potential vegetation from previous work with MC1, we added four cover types to the STM (ponderosa pine (*Pinus ponderosa* Lawson & C. Lawson) savanna, ponderosa pine woodland, Pacific madrone (*Arbutus menziesii* Pursh) woodland and forest, and Pacific madrone and Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) forest that are present but not dominant in the current landscape but that could become dominant under changing climate (Table 1). New species could migrate into our study area (or escape from horticultural plantings), but we assumed that the timeframe of our simulations (93 years) was too short to allow for the immigration and emerging dominance of new tree species.

We used 111 discrete states in 12 cover types and linked each cover type to the potential vegetation types from MC1 (Table 1). To define states, we used four parameters: dominant species, quadratic mean stem diameter, canopy closure, and canopy layering. Quadratic mean diameter is a weighted mean that emphasizes larger trees in a stand.

To assign states to the initial landscape, we collected descriptions of vegetative cover from five data sources as described below. These sources were necessary to generate lists of trees, grouped by species, size-class, canopy closure, and canopy layering, that describe extant vegetation, especially prairie and oak savanna habitats of limited current distribution.

Ponderosa pine (*Pinus ponderosa* Lawson & C. Lawson) and Pacific madrone (*Arbutus menziesii* Pursh) occur in current forests in our study area in scattered locations at low abundances but are never community dominants. We describe each current and future community type using species that already occur in the study area and appear to be likely potential components of future communities. The distribution of Pacific madrone includes subtropical climate zones, and Ponderosa pine is representative of a conifer in a continental climate. A unique feature of our study area is its location near the confluence of three different climatic regions: maritime temperate, continental temperate, and subtropical. This location makes the increasing prominence of madrone and ponderosa pine plausible over the coming century.

In order to rectify the often-conflicting spatial distributions and descriptions of vegetation in the available data sets, we used a logical rule-set that gave us one state for each IDU on the landscape. We created a 30-m grid representation of each data source and then prioritized them to assign a vegetation state to each pixel based on our on-the-ground knowledge of which were most accurate in particular situations (Day, 2005; Sonnenblick, 2006; Murphy, 2008; Yospin et al., 2012) and consultation with regional ecologists. We then aggregated the grid cells into their respective IDUs, and assigned to each IDU the plurality state of its constituent 30-m cells. We validated our results for several subareas of the study area using detailed field data from The Nature Conservancy that had been mapped in GIS. (See supplemental materials for a more detailed description of the states.)

To assign states to the initial landscape, we collected descriptions of vegetative cover from multiple data sources, including the Gradient Nearest Neighbor (Ohmann and Gregory, 2002), Oregon Gap Analysis Program (Existing Vegetation: NW ReGAP, 2011), Land Use Land Cover (Hulse et al., 2002), Northwest Habitat Institute ("Northwest Habitat Institute," 2011), 1851 Vegetation (Hulse et al., 2002). These sources were necessary to generate lists of trees, grouped by species, size class, canopy closure, and canopy layering, that describe extant vegetation, especially prairie and oak savanna habitats of limited current distribution. Although the Gradient Nearest Neighbor dataset was the only one that specified each of the required four parameters, it was not developed for the fine-scale vegetation

assignments that we implemented in this project and required substantial reclassification from other data sources to better reflect existing vegetation.

QMD classes were: no QMD, trees < 1.37 m tall; 0-12.7 cm diameter at breast height (DBH, 1.37 m); 12.7-25.4 cm DBH; 25.4-50.8 cm DBH, and >50.8 cm DBH. Canopy closure categories were < 25%, 25-60%, and > 60%. We defined the canopy to have either one or two layers.

Cover Type Classification

OA: Open broadleaf deciduous communities of drought-tolerant species, typically oaks. May include other related genera, but must have canopy cover below 25%. This group includes most prairie and savanna.

OW: Broadleaf deciduous woodland of principally drought-tolerant species, typically oaks. May include other related genera. Must have canopy cover between 25% and 60%.

OD: Woodlands of drought-tolerant trees, dominated by broadleaf deciduous trees rather than needleleaf evergreen trees. Trees must have quadratic mean diameter (QMD) of at least 25.4 cm. If the QMD is less than 25.4 cm, these communities are usually described as DO.

DO: Woodlands and low-density forests of needleleaf evergreen trees growing above drought-tolerant broadleaf deciduous trees.

DD: Less mesic needleleaf evergreen woodlands and forests. These may contain a wide variety of species, but Douglas-fir typically dominates.

BM: Mesic broadleaf deciduous forest, bigleaf maple usually dominates in upland locations but may include species of alder, cottonwood and ash in riparian zones. This may include a substantial component of mesic needleleaf evergreen trees.

DM: Mesic mixed needleleaf evergreen and broadleaf deciduous forest. The typical needleleaf evergreen species is Douglas-fir, but there may be a grand fir component. The typical broadleaf deciduous species is bigleaf maple. The needleleaf evergreen component must be dominant over the broadleaf deciduous component.

DG: Mesic needleleaf evergreen forest. Douglas-fir is the dominant species, with grand fir as the subdominant species. There may also be substantial quantities of bigleaf maple.

M: Systems dominated by evergreen broadleaf species, typified by madrone. This must not include a substantial Douglas-fir component.

MD: Systems dominated by evergreen broadleaf species, with a substantial component of Douglas-fir .

P: Systems dominated by xeric evergreen species, typified by ponderosa pine. This includes prairie, savanna and woodland systems.

The ctss (cover type, structural stage) description of an STM state is a concatenation of five components.

First is the cover type:

oa	Open deciduous oak habitat
ow	Deciduous oak woodland
od	Deciduous oak over Douglas-fir
do	Douglas-fir over oak
dd	Less mesic Douglas-fir
bm	Bigleaf maple
dm	More mesic Douglas-fir
dg	Douglas-fir and grand fir
m	Madrone
md	Mixed madrone and Douglas-fir
p	Ponderosa pine

Next is size class:

gfp	Grass-forb, post-disturbance
gf	Grass-forb
y	young (< 12.7 cm diameter-at-breast-height [dbh])
p	pole (12.7 – 25.4 cm dbh)
s	small (> 25.4 – 50.8 cm dbh)
l	large (> 50.8 cm dbh)

Canopy closure is next, although it is only included for size classes p, s and l:

o	Open canopy (<25% canopy cover)
m	Medium closure (25 – 60% canopy cover)
c	Closed canopy (>60% canopy cover)

An exception to this rule is the dd cover type, for which open is defined as ≤ 60% canopy cover, and medium canopy closure is > 60% canopy cover.

Next is the canopy layering, included only for sizes s and m:

1	Single canopy layer
2	More than one canopy layer

Finally, there may be "rf" appended, indicating a managed state with reduced fuels, or a "p" indicating a post-disturbance state that persists for only a single year to allow PVT affects on stand regeneration to be implemented. In its current implementation, the STM in CV-STM includes a total of 111 unique states, although the current design could support up to 396 states.