APPENDIX F
INTERACTION OF TOPOGRAPHY AND FIRE ON LANDSCAPE PATTERNS

Landscape-level diversity results from non-random differences among forest stands in a landscape. Differences are the product of site conditions, disturbance history, and mechanics of recolonization. Although we probably cannot identify, let alone consciously manage for, all possible habitats, we can manage for between- and within-stand variation that is in context with physical characteristic of the land and plausible disturbance patterns. The alternative, applying a single management scheme to all stands across the landscape, will reduce contrast between stands, and in turn, reduce the range of potential habitats. Management for diversity will result in variation in stand complexity. Although more complex stands will have a greater range of niches, less complex stands will contain niches not found elsewhere.

Aspect and slope position can be used to stratify the landscape. Much naturally-occurring diversity is caused by variations in temperature, moisture and available light; all factors which are influenced by aspect and slope. Aspect and slope strongly affect fire regimes and vegetation communities, and to some extent also affect soil development.

Early entries (made at . 30-50 years old) should be designed to move a stand rapidly toward a mature forest condition. These treatments include planting, vegetation management, precommercial thinning, snag creation, and density management. They should focus on developing desirable attributes in the overstory (oldest cohort) component of the stand. Only later should the stand be managed for a more complex "old growth" appearance, using tools like a second density management entry and underburning (followed on some sites with underplanting). These later entries (made at . 70 to 80 years old) would focus on adding additional canopy layers and recruiting large structure. Characteristics found in old growth stands (like the tendency for different species to segregate into different canopy layers), and landscape-level variations (like occurrence of fan-shaped epicormic branches on south slopes and variation in stand densities in response to aspect) otherwise may be lost.

On a landscape scale, the most severe fire will kill all trees on all aspects from ridge top to creek bottom. These stand replacement fires probably are a complex of burns and reburns that occur during periods of extreme drought. Scattered trees may escape dying during such a fire but instead will die slowly over the next few decades from stress. This stress is associated with increased exposure to wind drying, sudden exposure of the entire crown to full sunlight, direct heat injury to the crown, and loss of fine roots consumed by the fire. Stress on large old trees is further accentuated by their lack of ability to regrow fine roots, replace needles, or produce protective chemicals and pitch to ward off insect and disease attacks.

Landscape diversity following such an extreme event will correspond to interaction of local physical characteristics and biological factors (such as the presence and competitiveness of stump

sprouting shrubs and hardwoods, and the seed source and aggressiveness of light-seeded pioneer species).

MODELING LANDSCAPE LEVEL PATTERNS

This model defines landscape patterns uses aspect and slope position, and their effect on wild fire. Models can be compared by diagraming the landform as a perfect cone-shaped mountain (Figure F.1). Landscape patterns are mapped as they visible from directly above by using a circle, with its center as the peak and its perimeter representing lowlands. In the following figures, each circle is oriented with north facing to the top. Variations in forest stand structural features associated with different burn severity and fire event sequences are displayed in these figures.

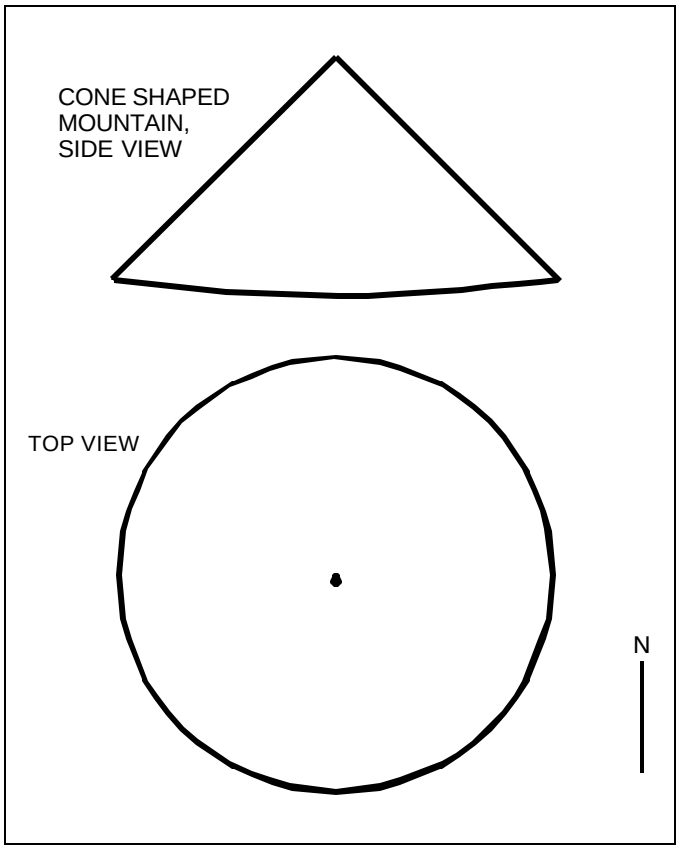

Figure F.1. Landscape-level Pattern base diagram.

The four models in the discussion below reflect progressive severity of fire effects and are not a single fire event sequence. These models were formulated based on an Oregon Coast Range setting that is entirely within the *Tsuga heterophylla* Zone, and so probably do not apply at the extreme south end of the Coast Range where tan oak is a major forest component on the south aspect.

LEVELS OF LANDSCAPE COMPLEXITY

Simple landscape

This model represents all stands regenerating following a single landscape-level stand-replacement fire and its associated reburns (Figure F.2).

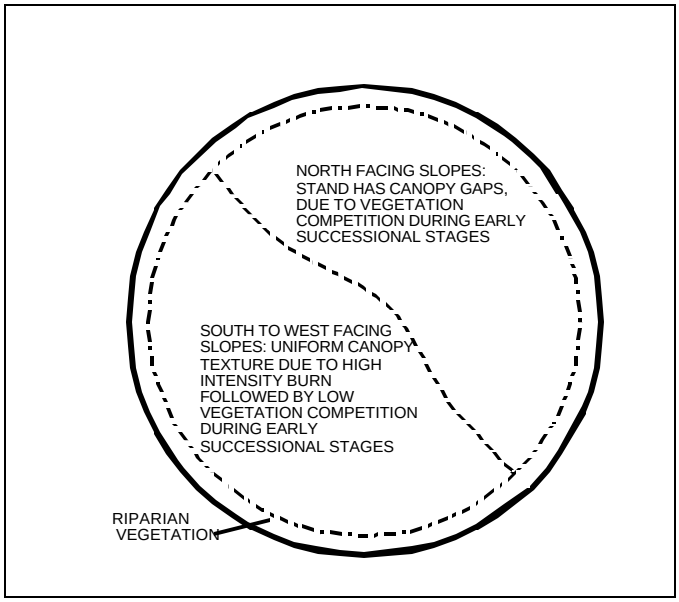

Figure F.2. Simple Landscape Pattern.

None of these stands have been modified by subsequent underburns, except for small burns on southwest-facing ridge tops. The Little North Coquille River drainage (in T26S, R10W - Section 19) contains old growth stands characteristic of the simple landscape model.

Transition Landscape

In this model, overstory trees (excepting small areas on southwest facing ridge tops), regenerated following the last landscape level stand replacement fire (Figure F.3). Low- to moderate-severity fires have lead to regeneration of a second cohort of trees, found as an understory on south to west aspects. The second cohort also may occur on upper slopes of other aspects. The North Coquille River drainage contains stands that are characteristic of a transition landscape.

Complex Landscape

In this model, the overstory on north aspects in the riparian zone (and on the lower slopes) dates from the last landscape level stand replacement fire (Figure F.4). The overstory trees on south to west aspects are younger, having regenerated following an aspect-restricted stand-replacement event. Two or more cohorts are found on north aspects. The younger cohort(s) regenerated following a low- or moderate-severity burn. If no subsequent stand-level disturbances occur, the understory cohort on the north aspect and the overstory cohort on the south aspect may have originated from the same fire event.

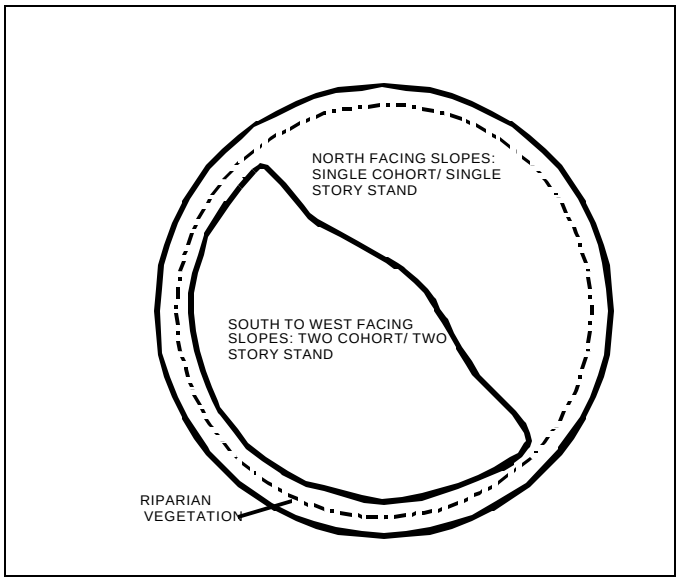

Figure F.3. Transition Landscape Pattern.

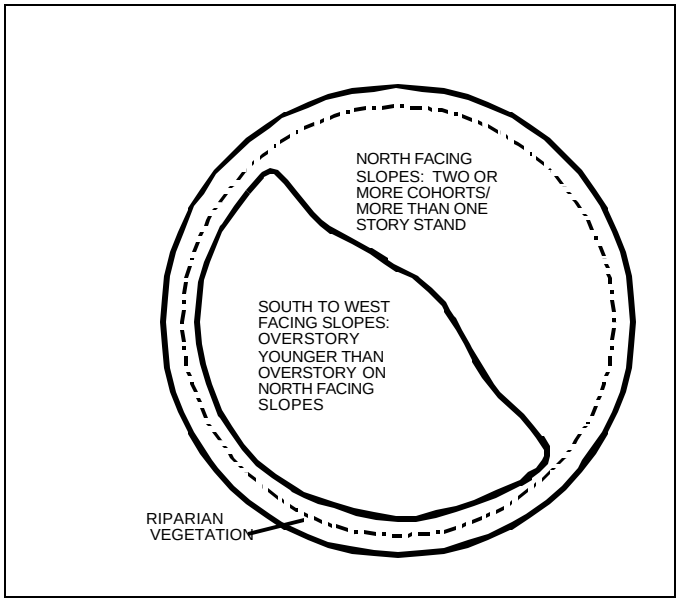

Figure F.4. Complex Landscape Pattern.

Highly Complex Landscape

This model presents a variation of the Complex Landscape model, in which stands on all aspects are modified by low- or moderate-severity fires (Figure F.5). At least two cohorts are present on all aspects and usually three or more are detectable on north aspects. Exposed southwest ridge top locations are prevented from supporting the late serial stages of stand development by frequent fire. Those southwest facing sites may be covered by open stands, or even remain in grass or shrub succession stages for decades (if not centuries). Stands around Peeve Creek and Carl Creek in the analysis area are characteristic of a highly complex landscape pattern.

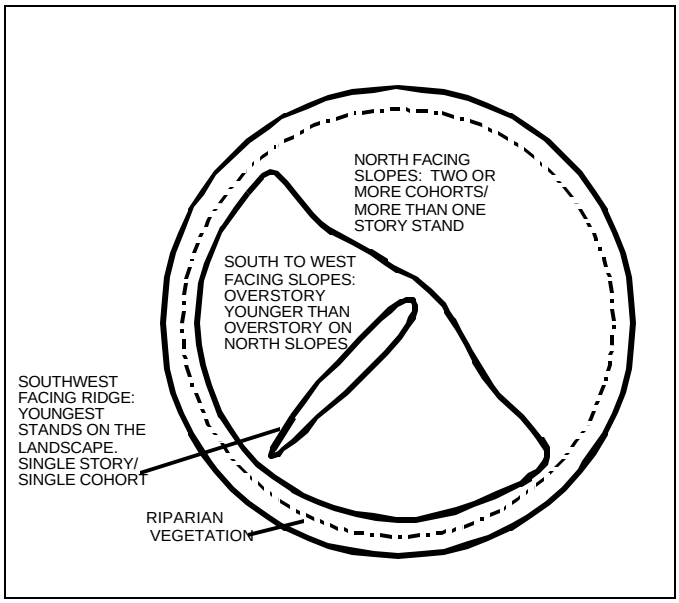

Figure F.5. Highly Complex Landscape Pattern.

LANDSCAPE COMPONENTS

Southwest-Facing Ridge Lines

Southwest-facing ridges are the most exposed sites on the landscape, and so produce the most heat and evapotranspiration stress. Warmer temperatures, lower moisture, and fire's tendency to move uphill combine to make southwest facing ridges the most fire-prone areas in the landscape. Depending on fuel and weather conditions, fire mortality may be limited to the ridge line, or the pattern may be more complex — with total kill along the ridge and partial kill on the margins. Most mortality in partial kill areas would involve fire intolerant species like hemlock.

Where fires modify vegetation and stand structures, southwest-facing ridges will tend to support the earliest seral stages. Extreme forms may produce a fire-maintained prairie or a brush field. In other landscapes, stand development on southwest facing ridges may be arrested repeatedly before trees reach maturity, producing periodic pulses of small-diameter snags. Depending on the severity of fire and the maturity of surrounding stands, burns may also result in large-diameter snag recruitment on the margins of the affected area. This pattern will be most evident where low- to moderate-severity fires burn repeatedly. The east half of the Middle Creek subwatershed is an example.

South to West Facing Slopes and All Exposed Upland Ridges

This is the second most frequently burned area. Here, overstory timber can reach. High-severity burns on southwest-facing ridges may be accompanied by low- or moderate-severity burns on south to west facing slopes. The low- to moderate-severity burns will kill most (and sometimes all) fire-intolerant species while killing few (or none) of the Douglas-fir. This burning pattern creates "natural shelterwoods," by favoring regeneration of even-aged understories dominated by hemlock. Some Douglas-fir also may be recruited. The proportion of Douglas-fir in the understory will

depend on the size of the hemlock seed source, the amount of shade from the overstory, and whether there are overstory gaps. Repeated low- to moderate-severity burns will tend to remove all evidence of previous hemlock stands, but some Douglas-fir may survive. Because these sites are prone to summer drought, stand-replacement fires occur at a higher rate than on north-facing slopes.

North-Facing Slopes and All Lowland Slopes

Only the riparian zone burns at a lower frequency than these areas. Since these sites are cooler and moister than south to west facing slopes, when conditions dry sufficiently to produce a stand-replacement fire, it also will have produces stand-replacement events on all other aspects. Fires here that do not result in stand replacement will cause a more severe burn on the south to west facing slopes (when the fire event is large enough to encompass more than one aspect). Therefore, a single event can produce a low- to moderate-severity fire on north aspect and a stand replacement fire on south to west aspects.

Protected Riparian Zones

These are the least likely areas to burn. When fire does enter, it may be no more than a creeping ground fire. These protected areas dry out sufficiently to carry a stand replacement fire only under conditions of extreme and prolonged drought. Obviously, if a fire is severe enough to destroy the riparian trees, it probably also has killed all other trees on the landscape. Floodplains and riparian sites are subject to debris torrents and avalanches, and so are strongly affected by disturbances other than fire (see Section III.9).

A GUIDE TO MANAGING STANDS

STANDS <30 YEARS OLD

During regeneration, stand establishment, and precommercial thinning phases of stand development, treatments should be selected that fit the simple landscape model. It is appropriate manage for a predominance of shade-intolerant trees (Douglas-fir) on open sites and shade-tolerant trees (hemlock and cedar) where there is overhead shade. Specific recommendations are:

- Tolerate vegetation competition to the extent that it breaks up uniform distribution of conifers on moist sites but not to the extent that establishing a future conifer stand is compromised.

- Use precommercial thinning to accelerate the growth of future dominant and co-dominant overstory trees, while at the same time providing growing space for natural fill-in that will constitute future intermediate and suppressed trees in the overstory.

- Culture stump-sprouting hardwoods so that they produce relatively few stems per stump.

C Consider leaving scattered red alders (up to 40 per acre) when present on sites where local experience shows they are unlikely to spread by seed. The alders will act as "place holders" and will leave overstory gaps when they die.

C Retain hardwoods to the extent that they diversify the future stand but not to the extent that they compromise establishing the conifer component of that future stand.

STANDS 30-80 YEARS OLD ON SOUTH ASPECT UPLAND SITES

Manage for relatively uniform stands consisting of mostly co-dominant trees on south aspects. If density management is applied around age 30-50, design the stand treatment to fit in the simple landscape pattern. Specific recommendations are:

C Target spacing to achieve . 40% crown length at age 80-100 years.

C Include sufficient site disturbance to allow a small seed catch of hemlocks and cedars. To emulate natural stands only a few hemlock and cedar (roughly five or less per acre) will be needed.

Note that failure to establish understory trees can be appropriate in this setting, as that is within the natural range of variation.

STANDS 30-80 YEARS OLD ON NORTH ASPECT UPLAND SITES

Manage for stands with gaps and high crown-class variability. This can be achieved by the following density management actions:

C Leave stringers and patches of alders next to draws and wet areas.

C Gaps may be enlarged by concentrating snag creation efforts on the perimeter of existing gaps, or by marking all but the largest co-dominant and the dominant Douglas-firs for removal on the edges of existing gaps and decreasing the distance between leave trees proportional to their distance from the gap. If few (or no) hemlocks or cedars are found beside the gaps, site preparation and planting around gap edges (and 50-75 ft. into the stand) will produce areas within the range of observed natural variability.

C Manage hardwoods as a component of the overstory during sapling and pole stages of stand development. Allow the difference in growth rates between hardwoods and conifers to produce multiple stratums over time.

STANDS 80+ YEARS OLD ON SOUTH ASPECT UPLAND SITES

As these stands approach 80-100 years old, management should shift stand character from a simple to transition landscape pattern. Specifically:

C Either an underburn or treatments that emulate an underburn will be needed to prepare for regenerating an understory and recruiting snags. Apply this treatment working from the ridge top down. Break-off the first underburns where the sclerophyllous shrubs give way to a plant association characterized by swordfern, oxalis, or salmonberry (or at the Riparian Reserve boundary, should this be necessary to meet ACS objectives). For safety reasons the boundary for the underburn must be put in a logical location. A safe, defendable burn boundary takes precedence over boundaries keyed to plant association.

Underburn objectives include:

- C recruiting snags;
- C creating small gaps;
- C preparing a seed bed for recruiting understory trees;
- C reducing vegetation competition so understory trees can become established, and;
- C improving browse quality.

There needs to be sufficient overstory stocking following treatment so stand function will be maintained and so additional underburn can be conducted 50-75 years in the future.

C Carry out underburn treatments so new snags are recruited every year somewhere in the landscape. Most naturally-occurring underburns either were isolated on a ridge top or covered large continuous areas along the top and south face of large ridge systems. Some underburns should be located next to previous treatments so that they will become large continuous blocks of similar habitats[1].

C A different approach may be prudent for stands on poor sites on southwest-facing ridge tops. Wide spacing is recommended to reduce stress from root competition and to emulate effects of frequent fire.[2]

STANDS 80+ YEARS OLD ON NORTH ASPECT UPLAND SITES

Although it is possible that underburns may be used in future management of north-facing slopes, for the foreseeable future we do not recommend prescribed underburning (beyond those incidental inclusions of north slopes found on predominantly south to west facing underburn project areas). In

[1] An analysis of patch size associated with low- to moderate-severity burns in the Tioga Creek subwatershed suggests that density management and/or underburning to open the canopy (with the objective of regenerating an understory and recruiting snags from the overstory) should strive for the following objectives, to stay within the range of natural variability: Treat about 2,000 ac. over the next 20 years in that subwatershed. Leave between 20% and 75% canopy closure immediately after treatment (anticipating additional mortality will drop live canopy closure to between 15 and 70%). Approximately 75% of the treatment units should be less than 80 ac. with most of the units falling in the 20 ac. and less or in the 40-70 ac. ranges. Approximately 65% of the treated acres should be in units containing at least 100 contiguous acres. This does not preclude additional acres of treatment but those treatments should not be sufficiently severe as to leave a signature that will be visible on aerial photos 30 years after treatment.

[2] Under wild conditions, poor sites on exposed southwest-facing ridges only may have infrequently supported late-successional forest. Such sites support flowering plants like fawn lily, and Indian paint brush. Although they are relatively common plants in other locations throughout Oregon, they are rarely found on the Coos Bay District. They thereby serve as indicators of a locally-scarce habitat, and prescribed fire may be a necessary tool in managing these sites.

wild landscapes, underburns on north facing slopes occurred as part of a larger burn pattern, producing the complex and highly complex landscape patterns described above.

It should be noted that fully implementing either the complex or highly complex model inside an LSR would require stand replacement disturbances on south-facing slopes, and therefore would be in conflict with current planning for these reserves.

HARDWOODS

Hardwoods should be managed as a component of landscape patterns described above. Specifically:

- Manage long-lived hardwoods (bigleaf maple, myrtle etc.) so they are retained as an understory component.

- Retain or reestablish long-lived hardwood on sites where they previously were favored by frequent disturbance (such as where fire on southwest aspects and valley side sites once maintained oaks, madrones, or myrtles).

- In riparian zones subject to frequent flooding or debris torrents, mange for myrtles, bigleaf maples, willow, ash or cottonwood on their respective sites.