Background and Suggested Learning Opportunities in the Finney Adaptive Management Area

What is old-growth forest restoration?

One objective of management and experiment in the Finney Adaptive Management Area (AMA) is restoration of late-successional and old-growth forests. For this discussion the following concept is used. Old-growth forests are the later successional stages of forest succession. Succession is defined as the development and organization of plant communities over time.

While most definitions of old-growth focus on size of individual trees and on gross community structure, there are many other elements that develop and change over time and become greater or more well developed as succession proceeds. A simple concept of late successional or old-growth forests that includes only tree size and structure can mask other important features that affect how these forests function. One aspect of old-growth forests that does not fit a simple concept is that old-growth forests play different roles and have different values for different organisms.

Old-growth is not just a structure, it is a changing pattern of conditions that include tree size and structure, biomass, diversity, and age. A model of restoration that has a single structural target will not restore old-growth forests. Even if a primary objective of restoration is to recover spotted owls and marbled murrelets whose limiting factor is large trees for nesting, restoring large trees in itself may not provide the ecosystem qualities that are also needed to maintain such trees. In addition to suitable nesting substrates, the old-growth forest needs to provide adequate prey and/or protection from predators to recover these species. The objective of old-growth restoration includes providing for the large number of species and processes that are dependent on late-successional forests. Providing large diameter trees or lateral branches is just one aspect of the restoration of the old-growth ecosystem.

The nature of many existing old-growth and late successional forests is influenced by the climate history. Some areas in the Pacific Silver Fir Zone (PSFZ) in the Finney AMA have remnant individuals of Douglas-fir and western white pine that are mostly 700 to 1000 years old. These trees are residuals from forests that established during the warmer and drier period of the Medieval Warm Period (about 800 to about 1300 a.d.). While the climate of the modern climatic warm period is approaching the climate of 1000 years ago, the vegetation does not yet show signs of adjusting to that climate. Restoration targets or models predicting desired future condition must take climate change into account. During the restoration period of these forests, it is likely that climate will follow similar patterns or develop under similar climatic influences as happened in the past. This historic pattern has included many and rapid climatic shifts, from warm to cold and wet to dry.

Environments and succession to old-growth

The landscape of the Finney AMA represents an environment that is colder and wetter than virtually all forest lands in the contiguous USA. Forests developed under conditions where fire was a rare occurrence. When fire occurred, it usually happened only around the warmer or drier

edges. Since the area gets high amounts of precipitation, the vegetation pattern is not typical of other areas. In the Finney AMA the Pacific Silver Fir Zone occupies about 60% of the area. The Mountain Hemlock Zone is 24 % and Western Hemlock Zone is 16% of the area. Even now, with 40% of the forested area harvested since WWII, about 50% of the current forests are over 500 years old. Prior to statehood about 90% of the forests were older than 400 years. Most of the rest of northwestern Washington forests were about 55-65% old-growth through most of the last millennium.

Pacific Silver Fir Zone forests (PSFZ) do not usually include the large sized trees or the high biomass of forests at lower elevations or in areas with less precipitation. They often have fewer Douglas-fir or western redcedar than lower elevation forests. They usually are dominated by a mix of western hemlock and Pacific silver fir, which are the early seral as well as the climax tree species. Silver fir trees, do not grow as big or as tall as Douglas-fir or western hemlock, so definitions that include large size as a major criterion can misrepresent the nature of old-growth Pacific sliver fir forests.

Succession in the Western Hemlock Zone (WHZ) is different from the PSFZ in many ways. It is warmer there and drier. There is less snow, even in very snowy winters, and summers can be drier, especially in drought years. Early seral stages can have distinctly different tree components than later stages, although in wetter areas early and later seral tree species compositions are often more similar. Red alder can occupy early stages of succession under the right conditions, and can dominate the ecosystem for up to 100 years. Douglas-fir is the most common early seral tree species. It can persist for 1000 years or more, occurring as a few scattered, large individuals in very old stands. This pattern of succession has been described many times and is relatively more predictable than the relatively unknown PSFZ succession pattern.

Succession in the Mountain Hemlock Zone (MHZ) is poorly studied and poorly known, especially in this wet and maritime environment.

Little is known about the successional development in areas as wet as the Finney AMA, particularly in the Pacific Silver Fir and Mountain Hemlock Zones (MHZ). Much of what is known about the major types of vegetation in the Finney is known from the Silver Fir Spacing Trial (SFST) or from the existing set of permanent Ecology Program benchmark/monitoring plots.

Table 1: Forest Stand Conditions in the Finney Adaptive Management Area

Seral Stage by Ecozone in acres	Mountain Hemlock Zone	Pacific Silver Fir Zone	Western Hemlock Zone	Total
Early	4,696	18,926	1,780	25,402
Mid	50	5,790	6,282	12,122
Mature	28	2,306	2,986	5,320
Old Growth	16,560	29,641	4,532	50,733

Within the Finney AMA area, there has been approximately 32,468 acres of forest activity recorded by the Forest Service including the following categories:

Destroyed By Fire, Destroyed By Flood, Broadcast Burn Or Spot Burning, Mechanical, Slash Treatment, Yarding And Burning, Clearcut, Even-Aged Regeneration, Precommercial Thinning, Partial Removal Cut, Sanitation Cut, And Salvage Cut.

Summarized by ecozone, these activities equal 6,067 acres (39 percent) of the area in the western hemlock zone, 21,838 acres (37 percent) of the area in the Pacific silver fir zone, and 4,537 acres (14 percent) of the area in the mountain hemlock zone.

Aquatic System

Fisheries

The streams draining the Finney AMA flow into either the Skagit or Stillaguamish Rivers. These rivers support all five species of Pacific salmon, cutthroat trout, bull trout, steelhead, and several species of non-game fish. Nearly all of these species have special status for a higher level of concern. Fish habitat conditions were significantly degraded as a result of timber harvests and road construction in the 1970’s, and fish populations continue to be limited to low levels. Species most directly affected by degraded conditions within the AMA are: bull trout, steelhead, coho salmon, coastal cutthroat trout, and rainbow trout. Following extensive aquatic restoration and road work over the last 20 years, streams conditions have improved somewhat, but conditions are still seriously degraded. Degraded fish habitat conditions include reduced pool frequency, reduced pool depth, increased width/depth ratios, increased sedimentation, increased stream temperatures, and reduced large wood frequency; nearly every measure of fish habitat conditions has been impacted.

Water Quality

Deer and North Fork Stillaguamish watersheds have been included on the Washington State Department of Ecology's Section 303(d) list as water quality impaired. The current 303(d) list shows Deer Creek, Little Deer Creek, and the North Fork Stillaguamish River as not meeting stream temperature standards.

Desired Conditions

Restore habitat conditions that contribute to recovery of viable populations of bull trout, Chinook salmon, and steelhead. Water quality is maintained or restored to at least state water quality standards in Deer Creek, Little Deer Creek, and the North Fork Stillaguamish River.

Watershed and Channel Processes

The three major rivers in the AMA, Finney, Deer, and North Fork Stillaguamish, are impaired with respect to peak flow hydrology and higher than natural sediment supply. Increases in coarse sediment supply tend to fill pools and aggrade channels, resulting in reduced habitat complexity,

reduced rearing capacity for some salmonids, reduced survival of incubating egg, and changed benthic invertebrate production and communities. Impaired sediment supply and peak flow hydrology can limit egg to fry survival for chinook, and likely other salmonid species.

Landslides are the primary reason for the unnaturally high sediment supply in Finney Creek and some other watersheds in the North Cascades. Landslides usually occur during rain-on-snow storms. The frequency and magnitude of sediment delivery due to landslides are increased due to the concentration of water from road surfaces and the interception of subsurface flows by road cuts that funnel water into drainage channels resulting in higher flows in creeks. Timber harvest also contributes to landslides during rain-on-snow storms by increasing melt rates of snow.

General Channel Conditions

Lower Finney Creek (below falls and downstream of federal land)

Accelerated sedimentation, an unconfined valley bottom, and the removal of large wood from the riparian area, have resulted in a channel with little complexity or structure (wide and shallow). The extreme aggradation of the channel has caused increased meandering of the stream that has undercut the toe slopes and added to an already elevated sediment supply.

Channel widening, which has increased by 77%, decreases pool depths and frequencies, reduces stream shading, and results in fewer side channels that serve as refugia for aquatic organisms during floods. Tributary pool area loss, channel widening in the main stem, and summer temperatures exceeding 65 degrees F (18 degrees C), have created habitat conditions are below their potential for all species.

Upper Finney Creek

The singular most impacting mechanism in the upper basin is from shallow landslides becoming debris torrents/dam breaks. These failures deposit sediment, temporarily blocking portions of upper Finney Creek. These blockages lend themselves to dam break floods, delivering stored sediment to the lower Finney Creek basin.

North Fork Stillaguamish River

Similar channel conditions and processes occur in this watershed as in the Finney watershed. A large number of higher gradient stream channels (particularly within the North Fork) have been scoured as a result of debris torrents. Sediment waves have filled and widened reaches of the main stem river over the years, most notably between Rollins Creek and Boulder River.

Restoration

Watershed restoration on National Forest System land began in the mid 1980's following the 1983 storm which saw 37 major landslide failures in Finney/Deer . Since 1986 the Forest Service has developed and installed a variety of drainage structures such as the vented concrete fords or "Texas Crossings" as well as performed substantial conventional drainage improvement and fill stabilization. For example, since 1986 forty three miles of road in the Deer Creek Watershed have

been treated to improve aquatic processes and habitats. Correcting road deficiencies in the Finney Creek and Deer Creek are fairly complete. In the North Fork Stillaguamish watershed, about 30% of known road deficiencies have been remedied.

Wildlife Resources

Northern Spotted Owl

Two wildlife species in the Finney AMA are the federally listed marbled murrelet and northern spotted owl. The nesting habitat of both of these species is closely associated with structural characteristics found in old growth forests. The recovery efforts for these two species include maintaining existing habitat across the landscape and the restoration of late-successional forest components.

The Finney block contains proposed critical habitat for the recovery of the spotted owl in a Managed Owl Conservation Area (MOCA) 1. MOCA 1s are designated to support 20 pairs of northern spotted owls. The Finney area is also one of the western most blocks of National Forest lands to the Puget lowlands. Within the Finney AMA, an important limiting factor for the northern spotted owl is limited suitable nesting habitat. In the Western Washington Cascades province the draft spotted owl recovery plan prescribes that 70 percent of the habitat-capable acres would be suitable habitat. Spotted owl recovery may also be impacted by competition with barred owls.

Marbled Murrelet

On the Mount Baker-Snoqualmie National Forest, murrelet activity associated with nesting occurs primarily within the western hemlock zone and silver-fir zone, within 40 to 45 miles of salt water. Within the Finney AMA, potential limiting factors or areas of uncertainty for the populations of marbled murrelets include:

- Lack of suitable nesting habitat due to previous timber harvest. Most of the harvesting was in the western hemlock zone leaving approximately 20 to 30 percent of the western hemlock zone in older forest (200 plus years-of-age)
- Lack of optimal, suitable habitat due to a large percentage of the area in Pacific Silver-fir and mountain hemlock forest association zones.
- Low juvenile survival from nest failures.

Learning Opportunities

Potential AMA Research Themes (Silviculture)

Opportunity 1: Late and Old-growth Forest Restoration

One approach to restoration of old-growth for either the PSFZ or the WHZ is to either facilitate the natural processes of succession or to remove barriers to such normal development. Experimentation would therefore need to be based on an assessment that stands are not normally progressing toward old-growth conditions and that there are steps that could be taken to assure a more acceptable rate of successional development. A range of treatments from natural or existing conditions and beyond natural or currently prescribed conditions could be used to test for stocking effects on community development and ecosystem processes, on stand growth and biomass accumulation, soil development, fungi, birds and mammals abundance and forest structural conditions that form the normal community development pathway. Existing plot installations and plot protocols used in the SFST and the Ecology Program permanent plots program could be used to monitor conditions and response.

This approach would also test the use of intermediate treatments in stands that are progressing normally toward old-growth conditions, but are densely stocked, to provide for some characteristics of late and old-forests as they progress towards later seral stages. Treatments would be designed to enhance old forest habitat function to some degree by creating new layers in the tree canopy and increased development of forest floor vegetation layer through reduction in canopy cover and creation of canopy openings. Treated areas are expected to have increased growth of individual trees by thinning that may facilitate progression of the stand towards late old forest structure to large trees, large diameter snags, and large down logs sooner than if stands were left unthinned. In the process of thinning, tree species which are minor components of the stands, such as hardwoods and western redcedar, could be favored to reflect old forest-related habitat needs as well. In general these treatments would be designed to introduce greater diversity in species and structure to homogeneous stands to improve its function as habitat for old forest-related species whose habitat requirements include canopy differentiation and understory vegetation.

Thinning too widely in the western hemlock zone can result in forest floor domination by a large amount of western hemlock seedlings that compete with other plant species and overstory trees for resources such as light, water and nutrients. This phenomenon has occurred on the Mount Baker-Snoqualmie National Forest in certain plant associations as the result of thinning overstory trees. Because this could set back the development of old forest structure in managed stands, recommendations in stand stocking guidelines from area ecologists would be used avoid these undesired results.

In general, treatments which decrease stand stocking to avoid high height-to-diameter ratios (> 70) and reduced tree growth may also add some complexity to currently simple stands in terms of species composition and canopy layers for some amount of time. While not shifting the stands

directly from one-canopy conditions into an old forest structure, making the habitat more complex for some period of time while not stunting the development of old forest, may improve LSR condition and provide wood products in the short term.

Several large scale silviculture experiments (LSSEs) are on-going in the western Cascade mountains to test silvicultural methods to accelerate the development of late-successional forest structure in young, even-aged forests. However, these studies do not include forests in the Pacific Silver Fir forest zone.

Strategy for learning in the Western Hemlock Forest Zone

Select stands from 30 to 100 years old that have stocking greater than 55% of maximum stand density index (SDI) for the particular tree species present and test stand responses to thinnings ranging from 35% SDI to 55 % SDI in different plant associations. Treatments would occur with and without skips and gaps of varying sizes and using species preferences to enhance minor species such as hardwoods and western redcedar. Stand exam data is very limited (only a few stands have been sampled), as well as ecoplot data which can be used to estimate stand density across some stands in the Finney AMA, however, full coverage of stand information is needed for this area. Use guidelines for thinning from the Late Successional Reserve Assessment (MBS, 2001) and plan for responses to changing light conditions with the ability to manage the understory post harvest with non-commercial thinning if necessary. Overstory, midstory, and understory vegetation, mosses, lichens, bryophytes, fungi, snags, woody debris, wood production, tree growth, hydrology, and forest floor composition are all possible response variables.

Strategy for learning in the Pacific Silver Fir Forest Zone

Select stands from 30 to 100 years in the silver fir zone to mimic other ongoing large-scale silvicultural management studies in the Pacific Northwest. Appropriate stands would be those with high stand densities (greater than 55% maximum SDI). Test the same types of treatments as above using density guidelines being derived from Mount Baker-Snoqualmie ecoplot data for this purpose. Use the same response variables as above. Data on the development of forests in the Pacific Silver Fir forest zone is currently being analyzed as was done for the Western Hemlock/Swordfern PAG in the Late Successional Reserve Assessment. This analysis will provide more specific direction on tree stocking levels to predict and test stand responses.

In both the western hemlock zone and the silver fir zone, criteria for stand selection should not be limited to stands 80 years and younger, but rather individual stand characteristics for density and structural development. If stands greater than 80 years-old are proposed for treatment, a site specific Forest Plan amendment will be required.

Opportunity 2: Balanced Age Class Distribution

Another approach would identify the need for replacement ages and a more balanced distribution of forest ages and conditions in the landscape could be used to develop a long-term plan for harvest and treatments to provide for a sustained amount of old-growth and late seral conditions. This landscape model would test the idea that a landscape can be managed or tended to provide a

critical amount of old-growth in perpetuity, while at the same time providing for replacement stands in the case of disturbance, or climate change, and the needs of a broader range of organisms and human needs. Treatments would then facilitate other experimental needs as they are developed but also test the implementation of such a landscape model over a long period of time.

Potential AMA Research Themes (Aquatics)

Opportunity 1: Stand manipulation to restore altered rain-on-snow hydrology.

Watershed restoration activities have treated many of the hydrologic modification and slope stability issues relating to roads and road drainage. However, forest stand characteristics that slow runoff from forested hillslopes have not returned and are slow to develop. Air movement and snow retention by canopies are important in the snowmelt processes and delivery of water to the soil. The parameters that are most important are the stand structure that controls the rain drip and snow retention characteristics (limb size, canopy closure, multi-layers) and the transmission of wind through the stand during storms (multi-storied, multi-layered). The characteristics of the understory and litter layer are also important due to a “sponge effect” during storms that afford longer water retention and for erosion reduction.

A research theme would explore the possible stand manipulations that would help restore the processes of snow accumulation and melt. Considerable research was conducted to describe the changes in the snow accumulation and melt from clear cut harvest. The science allows us to make predictions and projections of those effects on watershed processes and peak flows, but there is no sound way to describe how long those effects persist nor how the practice of thinning a stand that is in some phase of recovery effects rain-on-snow processes. Being able to better determine when snow melt/runoff recovery occurs during stand development and what impacts partial harvest would have on changes in water delivery are important to determine the degree of risk of hydrologic disruption posed by selective tree harvest.

A component of this research would look at soil and litter conditions following harvest, post-harvest burning, and from natural fire on the development of the resulting stand. To what degree do altered soil and litter conditions affect stand development and the water content of the soil and litter? The study could be accomplished through instrumentation of sample plots (including replications) to look at forest stand development and soil/litter moisture characteristics for a variety of stands and stand treatments.

Opportunity 2. Riparian Area and Stream Condition

There is considerable work being done in Riparian Reserves with the objective to restore riparian conditions that maintain and restore multiple resource goals as defined in the Aquatic Conservation Strategy (ACS) Objectives. Local climate, aspect, elevation, landforms, stream gradient, geology, and soils all affect the type of treatment that would best restore physical aquatic habitat features and stream temperatures.

This research theme would explore the question of whether management intervention in Riparian Reserves is helpful in meeting our objectives, by creating or accelerating the development of desired characteristics. The study would expand on existing monitoring of instream structures and their effect on channel morphology and include combined riparian and inchannel treatments versus untreated sites. It would also attempt to quantify what riparian vegetation characteristics should be using landform mapping of riparian areas in the AMA. By comparing the landform mapping results to conditions in reference watersheds in the North Cascades National Park, a more solid basis to determine what treatments, if any, are most appropriate to restore riparian processes/conditions in the AMA would be determined.

The study components under this theme could allow the evaluation of actions/treatments that would result in measurable (amount and rate) improvement in conditions/processes above what would occur without intervention.

Potential AMA Research Themes (Wildlife)

Opportunity 1. Management of second growth stands toward old forest characteristics

- Are there stand or tree characteristics that can be promoted for murrelet nesting: such as large diameter branches with canopy protection?

Opportunity 2.Analyze habitat use and resource portioning of sympatric barred owls and spotted owls.

Manage the effect of barred owls on spotted owls.

- determine how the two species use their habitat and resources, including prey
- identify habitat, if any, which favor spotted owls over barred owls
- determine how use of habitats by barred owls change as the barred owl population changes.