Management & Monitoring Plan for the Enhancement of Big Huckleberry (*Vaccinium membranaceum*) in Government Meadows Mt. Baker-Snoqualmie National Forest

Cover photos courtesy of Warren KingGeorge, Muckleshoot Indian Tribe

Department of Anthropology

Laura Potash Martin, Joyce LeCompte-Mastenbrook, Warren KingGeorge, and Tracy Fuentes. 2008. Management & Monitoring Plan for the Enhancement of Big Huckleberry (*Vaccinium membranaceum*) in Government Meadows, Mt. Baker-Snoqualmie National Forest. USDA Forest Service, Snoqualmie Ranger District, North Bend, WA

Available to the public on line at http://www.fs.fed.us/r6/mbs/projects/

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Prepared as a collaborative partnership by Laura Potash Martin[1], Joyce LeCompte-Mastenbrook[2], Warren KingGeorge[3], and Tracy Fuentes[4]

I. Project Origin, Introduction, and Setting

The Snoqualmie Ranger District of the Mt. Baker-Snoqualmie National Forest manages some of the lands traditionally used by members of the Muckleshoot Indian Tribe. In 2002, tribal elders contacted the Forest to express concerns about declining yields of big huckleberry (*Vaccinium membranaceum*), beargrass (*Xerophyllum tenax*), and other plant resources used for tribal needs. In response to concerns over declining berry yields, the Mt. Baker-Snoqualmie National Forest has initiated a pilot project to try to enhance the production of big huckleberries within selected areas. A secondary objective of the project is to provide suitable native forage for elk.

In an effort to learn as much as possible about all aspects of big huckleberry managment, the key partners (acknowledged above) organized and convened the First Annual Big Huckleberry Summit in June, 2007. The summit was a unique opportunity to bring together tribes (specifically the Muckleshoot, Umatilla, Yakima, Warm Springs, and Snoqualmie), a variety of state and federal land management and regulatory agencies, horticultural professionals, and research scientists to share knowledge about this species. The main topics of the conference addressed:

- Cultural value to indigenous peoples
- Traditional Management Practices
- Propagation of big huckleberry
- Research results of field treatments to enhance production
- Sustainable use in light of increasing harvest pressures

Based on feedback from the 80+ participants, the summit was considered an outstanding success. Proceedings are available at http://students.washington.edu/jklm/Huckleberry_Summit_2007/. Very helpful information was gained through a visit with an interdisciplinary team on the Gifford Pinchot National Forest to sites they are proposing for big huckleberry enhancement. Finally, valuable information was shared at a Huckleberry Summit sponsored by the Confederated Tribes of Warm Springs in Oregon, in June 2008. Participants in these endeavors have a commitment to share information with each other in the future so we can continue to improve upon effective management of this species.

Historically, the meadows and forest edges in the Government Meadows area (Township 19 N, Range 11 E, section 33), have been used for both recreational and subsistence gathering of big huckleberries. The purpose of this management plan is to evaluate the efficacy of treatments to increase productivity of big huckleberry on selected sites in Government Meadows.

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[1] Botany Program Manager and Project Leader, Mt. Baker-Snoqualmie National Forest. llmartin@fs.fed.us
[2] Environmental Anthropologist, University of Washington. jklm@u.washiington.edu
[3] Cultural Resources Oral Historian, Muckleshoot Indian Tribe. warren.kinggeorge@muckleshoot.nsn.us
[4] Former South Zone Botanist for Mt. Baker-Snoqualmie National Forest; current contact: tfuentes@usgs.gov

The project area is located on the Snoqualmie Ranger District of the Mount Baker-Snoqualmie National Forest, situated near the crest of the Western Cascade Mountains in Washington. The Huckleberry Enhancement stands are within the Lower Greenwater River and Upper Greenwater River subwatersheds within the White River Watershed that drains westward toward the Puyallup River near Sumner, Washington. (Figure 1). Treatments are proposed in four units that range in size from 4 acres to 23 acres (Figure 2 and Figure 3).

The units selected for huckleberry enhancement are a subset of units designated in the February 2001 Huckleberry Land Exchange Record of Decision and Forest Plan Amendment 16 (USDA Forest Service 2001). This document designates Section 33 of Government Meadows as "Management Area 8E, Greenwater Special Area" and is known elk summer range. The Record of Decision states that "the Forest Service will have the ability to maintain or create small openings for elk (and deer) forage. The majority of openings will be no larger than 15 acres and would take advantage of any existing openings and meadows". Biologists from the Mt. Baker-Snoqualmie National Forest, Muckleshoot Indian Tribe, and Washington State Department of Fish and Wildlife collaborated to determine the original unit boundaries.

From the units identified in the 2001 Record of Decision, a subset was selected for huckleberry enhancement according to the following criteria:

1. based on oral histories of tribal members, the unit has been productive in the past,
2. the unit is not too steep and thus will be relatively accessible for elders, and
3. the units were selected based on potential site productivity for big huckleberries, according to a preliminary model of plant association groups (USFS Ecology Program).

Based on these original criteria, several potential units were selected and visited in the field by all the specialists on the interdisciplinary team. Four units were selected and the boundaries of these were slightly revised based on the feasibility of successful enhancement, and to prevent potential impacts to other resources (e.g. cultural resources, watershed resources etc.).

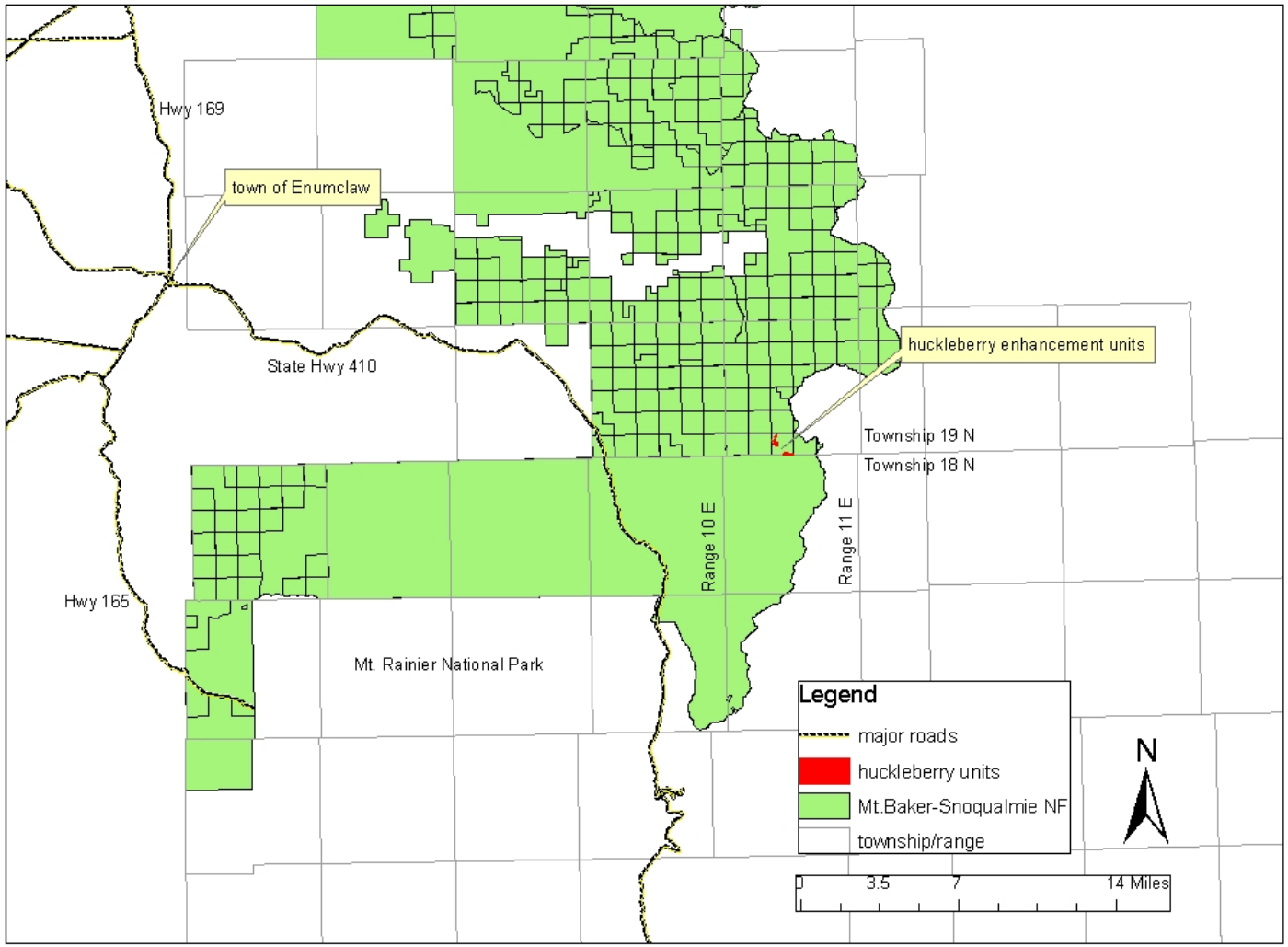


Figure 1. Vicinity map for huckleberry enhancement project.

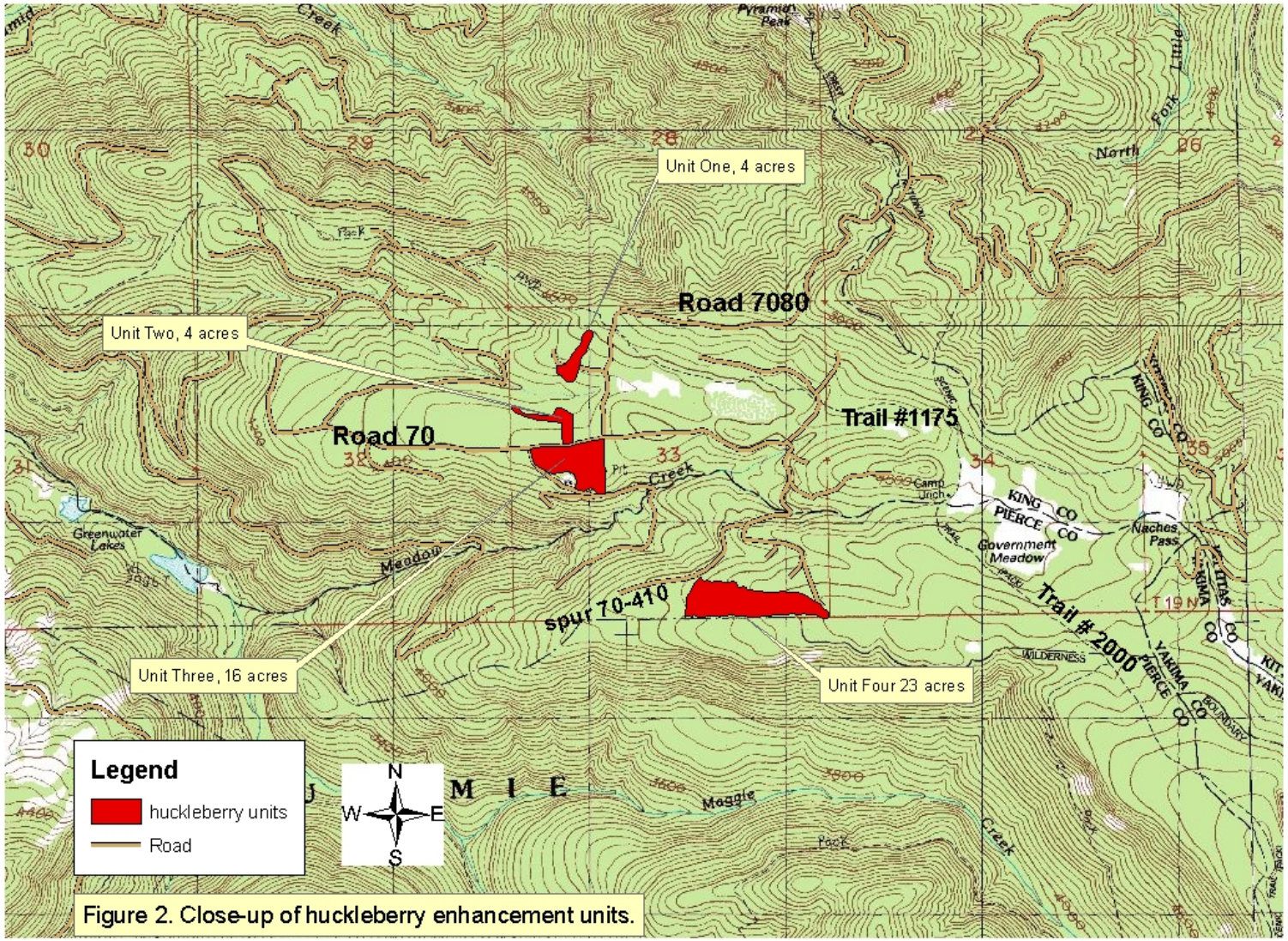
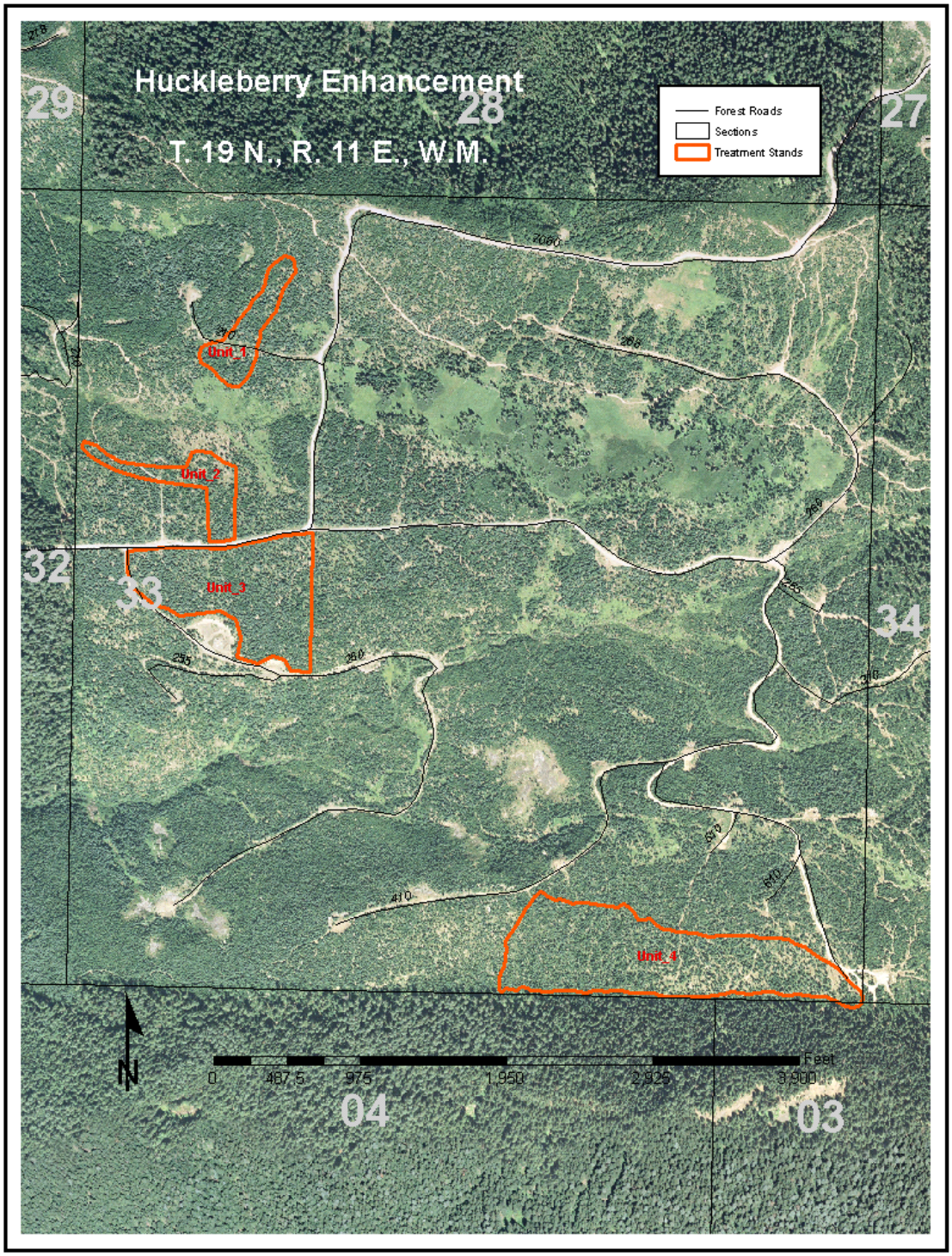


Figure 2. Close-up of huckleberry enhancement units.

Figure 3. Close-up of Units overlaid on air photo.



II. Species General Description

Big huckleberry is a native, rhizomatous[5] shrub, 0.5- 2m tall (Hitchcock et al. 1959, Simonin 2000). Bark is grayish-brown and shredding. Leaves are alternate, yellowish-green, and ovate, with a pointed tip and finely serrate margins (Lesher and Henderson 1992). Flowers are urn-shaped, pale yellowish-pink, and are borne singly on stalks from leaf axils. Fruits are edible, sweet, purplish-black berries and ripen mid-August through September.

III. Ecological Characteristics of Big Huckleberry

Big huckleberry (*Vaccinium membranaceum*) is an early seral species and often co-occurs with beargrass *(Xerophyllum tenax)* at mid-elevations (ca. 3000-6,000 feet) throughout the Cascade Range. It is a native, somewhat shallowly rooted shrub; roots may penetrate to 100 cm (about 39 inches) of soil (Simonin 2000), but Minore (1975) reports that rhizomes usually occur within the 8-30 cm (~3-12 in.) range of the soil surface. According to Ingersoll and Wilson 1990, and Agee 1994, big huckleberry can reproduce sexually or asexually, but most reproduction is asexual, from adventitious buds on rhizomes or on the root crown. Henderson (Personal Communication) has excavated plants and observed that *V. membranaceum* has a root crown, sends down a taproot, and the other bushes in the immediate vicinity are sprouting up from branches that are growing horizontially in the duff. He notes that *V. membranaceum* does not have terminal buds, only lateral buds, so it does not have apical dominance - and that reproduction of this species is most frequently through asexual spreading of shallow roots. It is believed that individual plant colonies may be over one-hundred years old.

According to the USFS Fire Effects Information System (http://www.fs.fed.us/database/feis/plants/shrub/vacmem/all.html#FIRE%20EFFECTS), "Big huckleberry is adapted to sprout after fire and is efficient in storing nutrients released from burning. Big huckleberry sprouts after fire from shallow and deep rhizomes or root crown. Heat penetration into soil layers where rhizomes occur will affect big huckleberry's ability to produce post-fire, vegetative sprouts". *V. membranaceum* appears to fall into the "Endurer" category i.e., species that have the ability to resprout from "the root crown, lateral roots, or the aerial crown" (Agee 1993).

Although the plants remain in the understory once trees begin to mature, fruiting tends to decline as the canopy closes. However, research at the Sawtooth Berry Fields in the Gifford Pinchot National Forest suggests that a canopy cover of 30-50% on flat sites, and somewhat less on sloping sites is desirable as the trees help to retain snowpack, which protects the flowers from frost damage in spring (Mack, Personal Communication). Research on *V. membranaceum* in the intermountain west suggest that 30% to 40% shade (60% to 70% full sun) is optimal for big huckleberry production (Strik *et al*. 1993, Barney 2005, 2008).

[5] *Rhizome: a prostrate, more or less horizontally elongated stem growing partly or completely beneath the surface of the ground, usually rooted at the nodes and becoming upcurved at the apex – sometimes referred to as a rootstock (Harrington and Durrell 1957).*

IV. Habitat Types Supporting Big Huckleberry on the MBS National Forest

In Northwestern Washington, big huckleberry typically occurs between 3,500-6,000 feet, on southerly exposures with well-drained soils and moderate snowpack (Lesher and Henderson 1992). Although big huckleberry occurs in all forested series on the Mt. Baker-Snoqualmie National Forest (Henderson *et al.* 1992), it has the greatest cover in the mountain hemlock (*Tsuga mertensiana*) series, followed by the silver fir (*Abies amabilis*) series. The Plant Association Groups (PAGs) in the project area are all within the silver fir series. Within this series, big huckleberry has the highest constancy and relative cover in the cool and mesic silver fir/big huckleberry PAGs (Table 1).

Table 1. Mean relative cover values and constancy of big huckleberry (*Vaccinium membranceum*) in the silver fir (*Abies amabilis*) plant association groups and plant associations (adapted from Henderson *et al.* 1992).

Plant Association Group*	Plant Association*	Relative Mean Cover	Constancy
Cool VAME	ABAM/RHAL-VAME	16.3	100
	ABAM/VAME-VASI	27.7	100
Dry VAME	ABAM/VAME-PYSE	1.4	29
	ABAM/VAME-XETE	8.3	100
	ABAM/XETE	1.5	87
Mesic VAME	ABAM/VAME	24.0	100
	ABAM/VAME-STRO	16.2	100
	ABAM/ACTR	2.1	93
Dry VAAL	ABAM/RHAL-VAAL	3.0	100
	ABAM/VAAL	6.2	28
	ABAM/VAAL-PYSE	1.3	45
	ABAM/VAME-VAAL	15.6	100
	ABAM/VAAL-XETE	1.7	60

*ABAM = *Abies amabilis* (silver fir); ACTR = *Achlys triphylla* (vanilla leaf); PYSE = *Pyrola secunda* (sidebells pyrola); RHAL = *Rhododendron albiflorum* (white rhododendron); STRO = *Streptopus roseus* (rosy twisted-stalk); VAAL = *Vaccinum alaskaense* (Alaska huckleberry); VAME = *Vaccinium membranaceum* (big huckleberry); VASI = *Valeriana sitchensis* (Sitka valerian); XETE = *Xerophyllum tenax* (beargrass)

In determination of the criteria for unit selection, the PAG model was not a heavily weighted factor, but was taken into consideration when all other factors were equal. The plant association groups potentially occurring within the units proposed for treatment are shown in Figure 3. Further discussion of PAGs is in Section VI of this document in the section describing the silivicultural prescription.

Figure 4. Plant Association Group Model overlaid with Unit Boundaries. Where 1901 = TSHE /V. Dry; 2204 = ABAM/VAME-XETE; 2205 = ABAM/VAME-RHAL 2206 = ABAM/ACCI-ACTR; and 2271= ABAM/dry-non-forest

ABAM = *Abies amabilis* (silver fir); ACCI = *Acer circinatum* (vine maple); ACTR = *Achlys triphylla* (vanilla leaf); RHAL = *Rhododendron albiflorum* (white rhododendron); VAME = *Vaccinium membranaceum* (big huckleberry); XETE = *Xerophyllum tenax* (beargrass)

V. Management of Big Huckleberry

Due to its high yield, carbohydrate content, and sweetness, big huckleberry comprised a significant portion of the traditional diets of many aboriginal groups throughout the Pacific Northwest, and there is evidence to indicate that native peoples selectively burned portions of existing huckleberry patches to keep them in an early seral stage and enhance production (Agee 1993, French 1999, Lepofsky et al. 2005, Mack 2003, Main-Johnson 1999 and 2006, Norton et al. 1999, Richards et al. 2006, Whitlock et al. 2002).

Prescribed burning is not currently being considered for treatment purposes in the four units in Government Meadows primarily because the trees are too small to effectively support a broadcast burn (Starkovich, Personal Communication). The following account (compiled by Mastenbrook 2006) is included here both for historical perspective, and to provide insight for potential future projects on the Mt. Baker-Snoqualmie National Forest, where prescribed burning could potentially be implemented as one of the treatment options to enhance productivity of big huckleberry.

The most detailed accounts of actual burning practices come from the ethnographic record. The following accounts are from the northern end of the Fraser river valley, to southwest Washington. Taken together, they provide some valuable generalizations with regard to native burning techniques, while at the same time they represent a broad range of locally specific practices that are not necessarily interchangeable from one place to another (Figure 5).

Among the Gitxsan and Wet'suwet'en of northern British Columbia, individual berry patches were owned by matrilineal kin, or house groups. The chief of each house group controlled access to the resource, although house groups, by common consent would frequently open berry patches near village sites to all villagers, who would acknowledge this "by making small public gifts to the chief of the owning group" (Main-Johnson 1999). It was also the responsibility of the chief to determine when the berry patches would be burned, and the responsibility of the men in the house group to do the burning, although groups of women sometimes burned patches as well. Burning was "traditionally done by the 'father's side' and the service was paid for with a feast" (ibid.). Gitxsan informants mention late August or early September as the appropriate time to burn patches.

In Sto:lo territory, near the Canadian-US border, prescribed burns were carefully controlled and monitored, and were the responsibility of particular individuals within the group. According to Lawrence Hope, a Sto:lo tribal member, "special people…burned it, they knew the weather" (qtd. in Lepofsky, et. al 2005). The nature of the fire varied depend[ed] upon the species of berry: "[There was] one way of doing it for the blueberry [*Vaccinium ovalifolium, V. deliciosum, and V. alaskaense*] and one way of doing it for black huckleberry [a.k.a. big huckleberry, *Vaccinium membranaceum*]. Black huckleberry you pretty near had to burn all the trees down. It's got to be a very hot fire" (ibid.). At higher elevations and on thin soils, the Sto:lo would clip back invading heather species rather than burning. Prescribed fires tended to be set on south-facing slopes, a practice which appears to have been common among several groups in western British Columbia (ibid. 225).

Figure 5. Huckleberry drying with smoking log (Filloon 1952).

Patches were burned approximately every three years in the early fall, when the leaves were beginning to drop from the bushes, and just before an anticipated rain.

The dried leaves provided an added source of combustion to carry the flame. In addition to burning the fields for purposes of plant regeneration and to maintain the shrubs in an early-seral state and control encroaching conifers, the Sto:lo also burned as a form of pest management.

The Wascoe and Wishram are linguistically related to the Chinook and occupied a territory from the confluence of the Columbia and Sandy rivers in western Oregon, to outside the Dalles on the

east. Their burning practices were documented by David French in the early 20th century. Huckleberry patches with declining yields were burned in late fall, presumably at the end of the harvest season. The Wasco and Wishram would commonly ignite these fires by means of a burning log that had been used to dry the harvested berries.

A few men were responsible for monitoring and maintaining the vigor of the patches, and one or two of these would stay behind after the harvest and wait for appropriate weather conditions to light the fire. These men had special knowledge with regard to both the fields and "could read the signs of the coming weather" (French 1999). The goal was to light a fire that would be sufficient to burn the patches without setting the adjoining forest on fire. These conditions can be inferred as the point at which live moisture levels are quite low, winds are moderate, and a drenching rain or snow that will extinguish the fire is anticipated.

Over the past one hundred years or so, fire suppression policies have resulted in the encroachment of trees into former huckleberry patches throughout the region, and thus a decline in resource abundance. Although a significant amount of interest is emerging with regard to the reintroduction of fire as a management tool to enhance berry production, there are several reasons why there have been few attempts to do so on public lands to date, including: lack of success in past experiments (Minore 1979); inability to burn during the fall season due to an elevated risk of wildfire; air quality concerns from burning; and relative success using other means of enhancement, such as tree-girdling (ibid.) and yarding over snow (Jimenez, Personal Communication). In addition, although big huckleberry roots appear to be able to withstand low to moderate intensity burns, high intensity burns can kill the roots, and even lower intensity burns may inhibit berry production for several years afterward.

Researchers concur that because the roots of big huckleberry are also sensitive to compaction, extreme care should be exercised on sites where commercial thinning is employed as a tool to enhance berry production (Minore 1979, Strik *et al*. 1993, Barney 2005, 2008).

SILVICULTURE

Please see Appendix B for a detailed prescription that will be used to accomplish the treatment objectives for this project.

FIRE

As mentioned above, prescribed burning is not currently being considered for treatment purposes in the four units in Government Meadows primarily because the trees are too small to effectively support a broadcast burn (Starkovich, Personal Communication). However, when trees are removed (by hand) to open up the overstory canopy, any materials that are not used for firewood or boughs will be burned in small piles, according to the prescription below.

Wildfires (and prescribed burns) do not only affect plants by changing the light regime – fire also changes a suite of other ecological characteristics, and comparisons in productivity between burned vs. unburned areas have been studied for other species in the same family (Potash 1989). Container stock of big huckleberry (that are being propagated from sources local to the project area) may be planted in the areas that were burned and immediately adjacent to the burned area,

to document (albeit anecdotally given the small sample size) observations of the possible differences in productivity of big huckleberry between the burned and unburned areas

Fuel generated by the cutting of trees and other vegetation (slash) to enhance big huckleberry production, shall be treated to a level which reduces fire hazard and improves ungulate forage and migration through the treatment units.

Thinning slash will be treated by hand-piling and prescribed burning of the piles. Piles will not be larger than 6 feet wide, 6 feet long and 6 feet tall and will include material smaller than 8 inches in diameter. Broadcast burning of the huckleberry treatment units is an option if fuel conditions are conducive to burning. This treatment may also enhance huckleberry vigor and stimulate rhizome sprouting. Handpiles should be covered with clear polyurethane sheeting to ensure piles are dry when optimum pile-burning conditions are prevalent after adequate fall precipitation has fallen to reduce the probability of an escaped prescribed burn. Handpiles shall be limited to slash less than 8" in diameter, which reduces residence time of the burning pile, reducing negative effects to the soil and leaves adequate firewood available to the public for campfires.

PLANTING

This project also includes planting of big huckleberry, mountain ash, and Oregon boxwood plants (*Vaccinium membranaceum*, *Sorbus sitchesis*, and *Pachystima myrsinites*) grown from plant materials originating near the project area. In consideration of the secondary objective of this project – to provide elk forage, these species were targeted because they have been shown to be "selected" by elk in other research conducted in the Cascades (Davis et al. 2003), or because, within the treatments units, they were observed to be very heavily browsed. In 2007, berries and cuttings were collected from all three species in the vicinity of the project area and are currently being grown out under contract into 1000 one-gallon containers, which will be out-planted in 2009 or 2010. Propagation of these species requires patience – Figure 7 shows big huckleberry seedlings, only about 1 or 2 cm tall, about 9 months after sowing.

Figure 6. Seedlings of *V. membranaceum* from berries collected near the treatment units.

VII. Huckleberry Monitoring Design

The basic strategy is to compare berry production in a series of small plots within the unit slated for treatment to a series of very similar "control" plots nearby, but outside the proposed treatment area. The baseline sample will be completed in 2008 before any treatments occur.

Plots inside the units will be sampled along the longest possible axis running through the approximate center of unit, and a second axis running perpendicular to that (See Figure 8). The plots will be placed at predetermined intervals, resulting in approximately 1 plot per acre. The same number of plots will be installed outside the unit – near enough so the habitat is the same, but far enough from the unit (at least ½ the average tree height) to avoid the edge effect.

To avoid bias in selection of plot placement, the exact location of the plots was determined by using Hawth's tools, an add-on to ArcGIS that is specifically designed for monitoring. Once the minimum and maximum x/y coordinates are determined (by looking at the unit boundaries), Hawth's tools is used to generate even spacing along the treatment transects, and generates points along a corresponding transect (for the control plots) parallel to the treatment transects. The only modification will be that in Unit 3, all control plots situated along the east-west axis (C3e through C3j) were moved due south (180 degrees) by 100 feet, to avoid placing them in the middle of a roadbed. The original UTMs were located in the field and then the new plot location was determined by measuring out 100 feet with a tape measure. Then the new UTMs were taken as a waypoint in the field.

Figures 8, 9, and 10 show the plot locations within the units, and Tables 2, 3, and 4 and 5 show the current UTMs (after adjusting C3e through C3j) for the center of each plot. Each plot has a unique identifier, labeled as follows: T or C for Treatment or Control, Unit number, and consecutive lower case letter.

Figure 7. Unit 1, showing Treatment and Control plot locations.

Figure 9. Units 2 and 3, showing Treatment and Control plot locations. Controls along the east-west axis in Unit 3 were modified as described in the text above.

Figure 10. Unit 4, showing Treatment and Control plot locations.

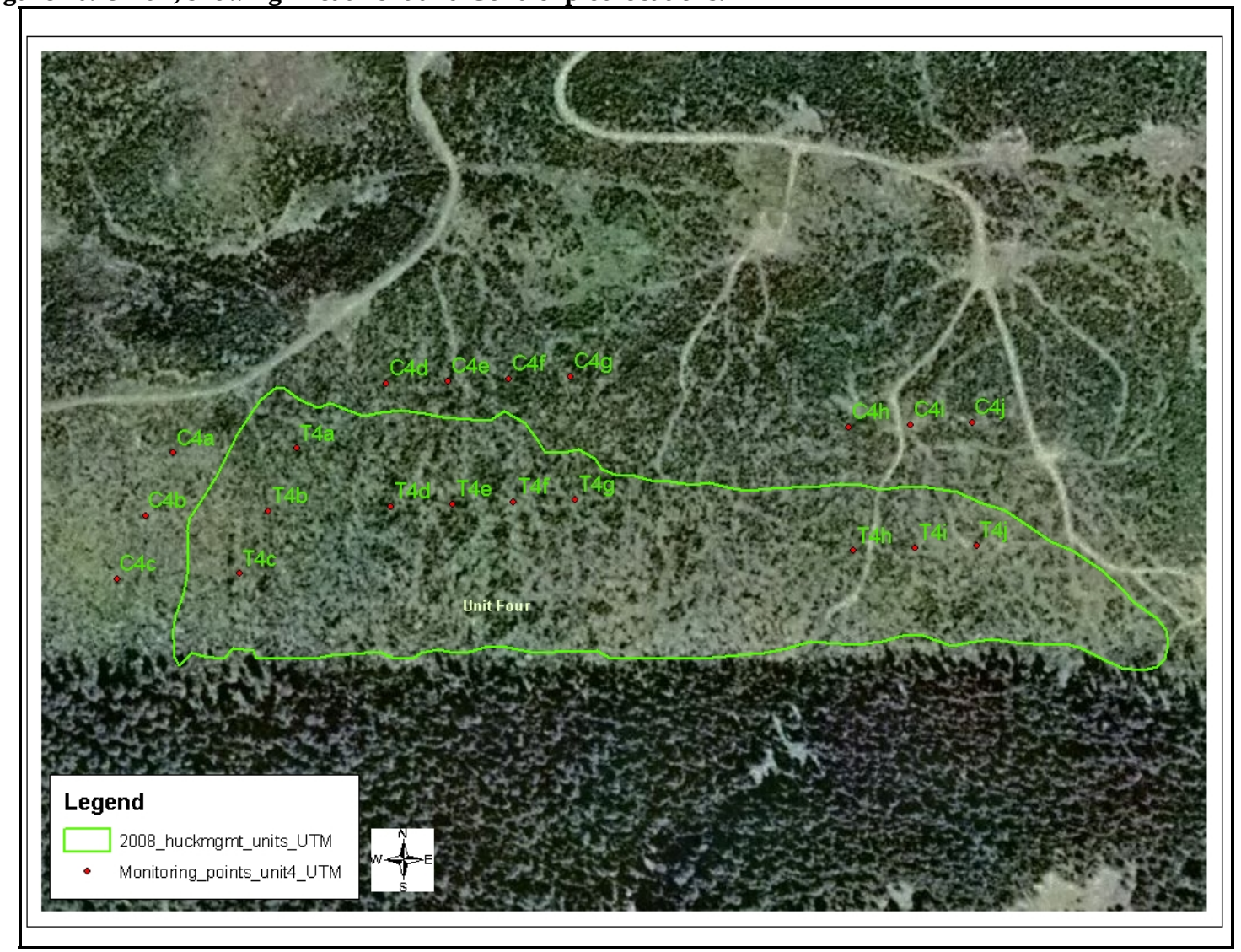


Table 1. UTMs for plot locations in Unit 1.

Plot_Name	Y (northing)	X (easting)
C1a	5217150	619985
C1b	5217104	619964
C1c	5217058	619943
C1d	5217012	619922
C1e	5216966	619901
T1a	5217147	619894
T1b	5217101	619873
T1c	5217055	619852
T1d	5217008	619831
T1e	5216962	619810

Table 2. UTMs for plot locations in Unit 2.

Plot_Name	X (easting)	Y (northing)
C2a	619660	5216678
C2b	619705	5216680
C2c	619839	5216730
C2d	619841	5216685
C2e	619843	5216639
T2a	619658	5216723
T2b	619703	5216725
T2c	619794	5216728
T2d	619796	5216683
T2e	619797	5216638

Table 3. UTMs for plot locations in Unit 3. Controls along the east-west axis in Unit 3 were modified as described in the text above.

Plot Name	Y (northing)	X (easting)
C3a	5216505	619551
C3b	5216461	619576
C3c	5216416	619600
C3d	5216372	619624
C3e	5216295	619650
C3f	5216296	619694
C3g	5216301	619735
C3h	5216307	619774
C3i	5216306	619829
C3j	5216319	619926

T3a	5216509	619687
T3b	5216512	619733
T3c	5216515	619778
T3d	5216516	619824
T3e	5216517	619869
T3f	5216517	619915
T3g	5216560	619799
T3h	5216471	619847
T3i	5216427	619872
T3j	5216382	619897

Table 4. UTMs for plot locations in Unit 4.

Plot Name	X (easting)	Y (northing)	
C4a	620391.62	5215861.52	
C4b	620370.65	5215815.33	
C4c	620349.68	5215769.14	
C4d	620548.75	5215912.86	
C4e	620594.13	5215914.58	
C4f	620639.51	5215916.30	
C4g	620684.89	5215918.01	
C4h	620890.83	5215880.42	
C4i	620936.22	5215882.13	
C4j	620981.60	5215883.85	
T4a	620482.39	5215864.95	
T4b	620461.42	5215818.76	
T4c	620440.44	5215772.57	
T4d	620552.18	5215822.20	
T4e	620597.56	5215823.92	
T4f	620642.95	5215825.64	
T4g	620688.33	5215827.35	
T4h	620894.27	5215789.76	
T4i	620939.65	5215791.47	
T4j	620985.04	5215793.19	

The plots will be circular to minimize edge effect. The plots will be 1/200th acre in size, which is an 8.3 foot (i.e. 8 feet 4 inches) radius. This plot size is a compromise because it will be more realistic in terms of time needed for sampling than collecting all the berries in a 1/100th acre plot, and will have less chance of getting zeros (no huckleberries) than installing a series of 1/300th acre plots.

Ideally, in order to get enough degrees of freedom to make statistically valid inferences, a minimum of 30 plots will be established in the treated areas and 30 in the control areas. This assumes all the units will receive the same treatment (to have replicates).

What will be measured/documented in each plot

1. Weight of berries (to nearest 1/10th ounce) (*all* berries within plot boundaries will be harvested, whether ripe or green).
2. % cover of *V. membranaceum* in each plot
3. % cover of tree canopy in each plot (using visual estimate)
4. Plant association (as per Henderson *et al*. 1992) in each plot
5. Observations about phenology (% already fallen to the ground, ripe, green, flowering)
6. % slope
7. Aspect (degrees)
8. Digital photo taken from southern border of plot looking due north through plot center.

VIII. Data Analysis and Management Implications

Container stock of big huckleberry may be planted in the areas that were burned and immediately adjacent to the burned area, to document (anecdotal) observations of the possible differences in productivity of big huckleberry between the burned and unburned areas.

For the thinning treatments within the units - effectiveness will be assessed by seeing if there is a significant difference between:

Weight of berries in pre-treatment plots (2008) compared to post treatment plots - beginning in 2010 (one year after thinning treatments)and continuing every 5 years until 2050. Weights will be recorded

- Per individual plot
- per sum of plots per unit,
- per sum of all treatment plots.

The controls will be used as a frame of reference not only to compare to the treated plots but also to compare control plot weights in 2008 vs. control plot weights in 2010 and beyond. The berries will be weighed:

- Per individual plot
- per sum of plots per unit,
- per sum of all treatment plots.
-

IX. Estimated timeline

- 2008: Pretreatment monitoring of both treatment and control plots to establish a baseline.

- 2009: Initial thinning via bough and Christmas tree sales, including treatment of slash.

- 2009: Planting out of nursery stock in burned and adjacent unburned areas (newly planted areas will be clearly marked to avoid disturbance in future bough/tree sale contracts)

- 2010 and every 5 years thereafter until 2050: Post treatment huckleberry monitoring

- 2010 and every 5 years thereafter until 2050: Post treatment forest stand monitoring

X. Conclusions and Acknowledgements

We hope to infer that the treatment was effective if there is a significant increase between pre and post-treatment weights, *and* the corresponding control plots do not show the same relative amount of increased weight. In addition, we hope to learn if there is a correlation between productivity and the amount of: tree canopy, relative cover of big huckleberry, plant association, slope, or aspect. Management treatments outside of this pilot study area will be, at least in part, based on the findings of this study.

This management and monitoring plan was completed through the collective efforts of many people. The primary collaborators were Laura Potash Martin, Botany Program Manager, Mt. Baker-Snoqualmie National Forest, Joyce LeCompte-Mastenbrook, Environmental Anthropologist, University of Washington, Warren KingGeorge, Cultural Resources Oral Historian, Muckleshoot Indian Tribe, and Tracy Fuentes, Former South Zone Botanist for Mt. Baker-Snoqualmie National Forest. The USFS interdisciplinary team (Laura Martin, Jim Franzel, Barry Gall, Jan Hollenbeck, Shirley Lorentz, Sonny Paz, Doug Schrenck, Anthony Starkovich, Mary Coughlin, Lee Redmond, and Stephanie Swain) provided environmental analysis and recommendations on how to achieve project objectives in consideration of all other resources and concerns. All those cited as Personal Communication provided extremely helpful advice and suggestions, and all the presenters in the 2007 Big Huckleberry Summit provided invaluable information (see http://students.washington.edu/jklm/Huckleberry_Summit_2007/) We look forward to continuing the sharing of information and working with all interested parties to achieve sustainable management of this species.

The completion of this plan would not have been possible without funding, in 2006 and 2007, from Title II, Secure Rural Schools and Community Self Determination Act of 2000.

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PLEASE PRINT

Plot Name[1] _____

Observer, First and Last Name: _____

Date: _____

Weight of Berries[2] (to nearest 1/10thounce):_____

% cover of *V. membranaceum*[3]:
_____

% cover of tree canopy using visual estimate _____

Plant association (per Henderson *et al*.) :_____

Aspect (degrees): _____

Slope (%) and vertical plot radius[4]:_____

Phenology[5]:_____

Digital Photo Number[6]
_____

[1] Each plot has a unique identifier, labeled as follows: T or C for Treatment or Control, Unit number, and consecutive lower case letter.
[2] All berries in the plot will be weighed, whether ripe or green. Weight of ziplock will be accounted for if necessary.
[3] Visual estimate; use table for radii within 1/200th acre plot (Table 1, next page)
[4] On flat ground, plot radius is 8' 4". As % slope increases, horizontal radius remains 8'4" but vertical radius increases (use Table 2, next page)
[5] Your observations on ripeness, e.g. % green, % ripe, % already fallen to the ground,
[6] Digital photo should taken from southern border of plot looking due north through plot center.

Table 1. Radii for visual estimates of % cover within a 1/200th acre plot.

PERCENT COVER	Radius as calculated (feet)	Radius to measure in the field (in feet & inches, rounded to nearest inch)
1 %	0.83	10 inches
5 %	1.85’	1’ 10”
10 %	2.62’	2’ 7”
20 %	3.71’	3’ 9”
25 %	4.15’	4’ 2”
30 %	4.55’	4’ 7”
40 %	5.25’	5’ 3”
50 %	5.87’	5’ 10”
60 %	6.43’	6’ 5”
70 %	6.94’	6’ 11”
100 %	8.3’	8’ 4”

Table 2. Radius for a 1/200th acre plot with correction for some different percent slopes[1]. Horizontal radius will always be 8 feet 4 inches. Vertical radius will change as follows.

Percent of Slope	*Correction* **Factor**	**Feet and inches to measure in the field**	*Percent of* **Slope**	**Correction Factor**	**Feet and inches to measure in the field**
0 to 9	1.00	8’ 4”	78 to 79	1.27	10’ 7”
10 to 17	1.01		80	1.28	
18 to 22	1.02		81 to 82	1.29	
23 to 26	1.03	8’ 7”	83	1.30	10’ 10”
27 to 30	1.04		84 to 85	1.31	
31 to 33	1.05		86	1.32	
34 to 36	1.06	8’10”	87 to 88	1.33	11’ 1”
37 to 39	1.07		89	1.34	
40 to 42	1.08		90 to 91	1.35	
43 to 44	1.09	9’ 1”	92	1.36	11’ 4”
45 to 47	1.10		93 to 94	1.37	
48 to 49	1.11		95	1.38	
50 to 51	1.12	9’ 4”	96 to 97	1.39	11’ 8”
52 to 53	1.13		98	1.40	
54 to 55	1.14		99 to 100	1.41	
56 to 57	1.15	9’ 7”	101	1.42	n/a for this project
58 to 59	1.16		102	1.43	n/a for this project
60 to 61	1.17		103 to 104	1.44	n/a for this project
62 to 63	1.18	9’ 10”	105	1.45	n/a for this project
64 to 65	1.19		106 to 107	1.46	n/a for this project
66 to 67	1.20		108	1.47	n/a for this project
68 to 69	1.21	10’1”	109	1.48	n/a for this project
70	1.22		110 to 111	1.49	n/a for this project
71 to 72	1.23		112	1.50	n/a for this project
73 to 74	1.24	10’ 4”	113	1.51	n/a for this project
75	1.25		114 to 115	1.52	n/a for this project
76 to 77	1.26		116	1.53	n/a for this project

[1] 8’4” or 100 inches x correction factor, then converted back to feet and inches. Alternatively, in a small plot like this, slope can be quickly accounted for by stretching an 18’8” line over the plot, held low at the uphill end and high at the downhill end so the line is level.

Table 3. Field Equiment List. Each monitoring team will need to have a complete set of the following gear unless otherwise noted.

1	Nail to engrave plot number into wooden stake
2	Data sheets
3	GPS set for UTMs in Zone 10, NAD 1983, with 2 extra batteries
4	Two ropes, each 16 feet 8 inches long, for quickly laying out plot boundaries[1]
5	Ziplock bags, quart size, minimum of 60 bags
6	Sharpies
7	Replacement flagging for plot center: blue/white flagging *and* red/white flagging
8	A few replacement wooden stakes for ones that are missing or broken
9	Digital camera
10	Henderson's key to plant associations of the Mt. Baker-Snoqualmie National Forest
11	Compass with declination set
12	USFS handheld radio, with 9 extra batteries
13	Laminated color photos of each unit showing plot names and their UTMs
14	Mosquito repellent and mosquito suit for Unit 1 ☺
15	60 datasheets (distributed amongst the teams)
16	Scale, accurate to nearest 1/10th ounce (only one scale needed).
17	Spreadsheet with volunteer contact information
18	Copies of Appendix A of this monitoring plan
19	Clinometer
20	Rite-in-the-Rain® field notebook
21	Pencils
22	Ten Essentials. Tell volunteers to see: http://www.mountaineers.org/scriptcontent/default.cfm?insert=essentials
23	Volunteer release forms

[1] Each plot has 8' 4" radius or 16'8" diameter. The ropes are stretched horizontally and vertically due N,S,E, and W, forming the boundaries of the circular plot, dividing into quarters. The middle of the rope and both ends should be marked with bright flagging. This is very helpful for estimating % cover. Note: diameter of the vertical axis on steep slopes will be longer than 16' 8" to account for slope. See Table 2 on the previous page.

APPENDIX B
SILVICULTURAL PRESCRIPTION

The following is an excerpt of the prescription prepared by Shirley Lorentz, Mt. Baker-Snoqualmie National Forest Silviculturist. The portions pertaining to the treatments *per se* are included here; potential impacts (or lack thereof) to other resources are described in the Decsion Memo that accompanies this management and monitoring plan.

Introduction and Summary
This silvicultural prescription describes historical and environmental settings, biotic and abiotic conditions and proposed treatments to increase huckleberry production in four forest stands. These stands were chosen for analysis due to site productivity, age, location and species composition. Typical of upper-elevation regenerated slopes on the Snoqualmie Ranger District, they include planted Noble fir and Pacific silver fir trees along with some Douglas-fir and western hemlock intermixed. To enhance the health and productivity of huckleberry plants in the understory, an effort to increase light and decrease tree competition has led to this prescription. Various resource specialists provided guidance for this prescription.

Setting
The area has hosted several harvests over the decades. Regeneration harvest was the typical method and while part of a checkerboard private ownership pattern, all forested areas of section 33 were harvested around 1980. Neighboring federally-owned sections were not harvested as heavily as privately-owned land in this region.

Abiotic Conditions – Soils, Climate, Topography
The project area lies on volcanic rocks, largely dark andesites which are mixtures of ash and rock fragments from past eruptions of Mt. Rainier that formed as mudflow deposits and formed agglomerates. Two soil unit types occur within the four proposed vegetation management units. Unit 1 has soil type 46, while units 3 and 4 have type 36, and unit 2 has both. The units have varying amounts of volcanic ash in the soil. These soil types are sandy or loamy sands with gravels, averaging 3-4 feet in depth down to bedrock. They are very permeable, not prone to compaction or cementation and stable. Surface erosion potential is moderate for these soils, while the erosion potential of subsoils is estimated to be low to moderate. They have the potential for limited fertility and moisture retention capacity (Gall, 2008, Hydrologist report).

The climate of the surrounding area is influenced by marine air masses moving across the region from the southwest to the northeast. It receives an average annual precipitation of approximately 100 inches falling mainly as snow during the period from October through March. Springs are cool and moist through mid-June. Summers are typically warm from mid-June through early September. Daily temperatures rarely exceed 70 degrees F. There are also frequent episodes of rain-on-snow events in the late-fall and late-spring, which are responsible for many of the peak annual flow events. Annual spring snowmelt produces large flows in almost all years.

These stands are situated on gentle rolling ridge-tops. Aspects are variable from flat to south, north, and east. Steepness ranges from 0 percent slope where the stand leaves the ridge, to 20 percent and elevations range from 4400 to 4600 feet. The exception is the western edge of Unit 4, which has a southerly aspect with slopes of about 45%.

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Biotic Conditions – Vegetation, Harvest History, Pathology and Entomology
According to records from the time of the Huckleberry Land Exchange, the stands were regeneration-harvested under a clearcut prescription in 1980 before the Mount Baker-Snoqualmie National Forest acquired them. Planting occurred, but regeneration records are unavailable. Currently, they include healthy sapling-sized trees of mainly Noble fir (*Abies procera*), and Pacific silver fir (*Abies amabilis*), with scattered Douglas-fir (*Pseudotsuga menziesii*) and western hemlock (*Tsuga heteropylla*).

Records from the Mount Baker-Snoqualmie National Forest Geographic Information System (GIS) show that the following plant association groups characterize the stands. Unit 1 = 2205 & 2204 , Unit 2 = 2206 & 2204, Unit 3 = 2206, 2204, 1901, and Unit 4 = 2205, 2204, and 2271. ABAM/VAME-XETE (Pacific silver fir / Big Huckleberry-Beargrass) plant association is the primary association for all four stands. That association is within the VAME-XETE (Big Huckleberry-Beargrass) plant association group (PAG). All sites considered in this project are capable of supporting forage species for elk and deer, including big huckleberry (*Vaccinium membranaceum*). Forage openings would be created in these stands by removing enough trees to leave 30-50 percent canopy cover with the intention of increasing light to huckleberry plants in the understory, and maintaining an optimal amount of light to the huckleberry plants over time to perpetuate a healthy stand.

Commonly on cold, dry sites of moderate snowpack, and south aspects, this plant association has low timber productivity. Silver fir and western hemlock are considered climax tree species. Regeneration of trees is difficult, especially Douglas-fir, and big huckleberry can be a competition problem. Generally, trees are approximately 6-8 inches DBH and 15-30 feet tall. Canopy cover is irregular and varies from 0 to 85 % throughout the stands. Preliminary analysis was done in 2005 on this area to describe stand conditions. This report uses the same information, acknowledging that some changes such as growth or attrition have occurred since that time, but are not expected to be significant at this for this level of analysis. Insects and disease are not at significant levels in these stands, though the potential for *Armillaria* and *Annonsus* root diseases is high.

Table 1. Estimated current stand conditions (per Unit).

Stand (Unit #)	Average Tree Age	Elevation (feet)	Basal Area	Trees Per Acre	# of Dead	# of Live	%Douglas Fir	%Western Hemlock	%Noble Fir	%Silver Fir	%Cover
1	30	4500	75	240	25	215	5	5	25	65	55
2	33	4400	90	280	30	255	5	5	65	25	65
3	33	4500	90	280	30	255	5	5	65	25	65
4	33	4600	90	370	40	330	5	5	65	25	85

Management Considerations
The Huckleberry Enhancement stands fall within the Management Area 8E – Greenwater Special Area in the Mount Baker-Snoqualmie National Forest Land Resource Management Plan.

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Direction in this area is to manage for elk forage production by converting forested land. This is expected to occur through the creation of openings from 1 to 40 acres in size, within a mosaic of even-aged and uneven-aged stands. Forage species should be favored, and forest fuels should be light (<15 tons per acre) to limit the risk of wildfires. Prescribed fire may be used.

Northwest Forest Plan Mount Baker-Snoqualmie National Forest Plan Amendment
All timber sales on the Mount Baker-Snoqualmie N.F. fell under the direction of these standards for riparian and wildlife management in 1994. The surrounding stands are to be managed as Late Successional Reserve as described in the Northwest Forest Plan.

Stand Objectives
Tiering to the Forest Plan, the watershed assessment, and the Huckleberry Land Exchange EIS, the objectives with measurable criteria for the Huckleberry Enhancement stands are as follows:

1. **Provide huckleberry-picking opportunities for people.**
   Increase the amount of productive huckleberry stands along open forest roads.
2. **Improve wildlife habitat by creating canopy openings of elk and deer forage.**
   Increase browse species in volume and numbers of plants from current levels.

Implementation and Stand Monitoring Plan
Stands will be thinned through the cutting of trees with chainsaws using a spacing guide. Each microsite should be evaluated individually for its potential and its current condition. The objective is to create and maintain a forest stand that leaves approximately 30 percent canopy cover while meeting other management objectives. This is accomplished through general density control and species composition. Noble fir boughs will be cut simultaneously to provide some funding for monitoring and future activities such as burning, monitoring and other thinning entries. The stocking level should be reduced from above to an average of 45 sq ft/acre. It is not necessary that every acre be stocked at these target levels. Favor noble fir for future bough sales and discriminate against other species. Stocking can fluctuate 25 percent with the location of desirable trees. The goal is a canopy cover of 30 percent average across the area, not necessarily in all locations. All snags should be retained.

Treatment Plan
This stand will be thinned non-commercially from above using leave tree spacing. Noble fir boughs will be cut for commercial sale prior to or simultaneously with thinning. Cut material not included in bough sales will be left on site. Hand pile residual slash to reduce fire hazard. Piling and burning of slash material will be accomplished by hand piling small piles (6’ x 6’), avoiding damage to leave trees and huckleberry plants as much as possible. Burn piles or broadcast burn during moist soil conditions if possible.

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Table 2. Projected post treatment stand conditions. The desired future condition is for years 2010 to 2050.

Stand (Unit #)	Elevation	Basal Area	Trees Per Acre	Spacing	%Douglas Fir	%Western Hemlock	%Noble Fir	%Silver Fir	%Cover
1	4500	45	165	16' x 16'	0	0	33	67	30
2	4400	45	170	16' x 16'	0	0	98	2	30
3	4500	45	170	16' x 16'	0	0	98	2	30
4	4600	45	170	16' x 16'	0	0	100	0	30

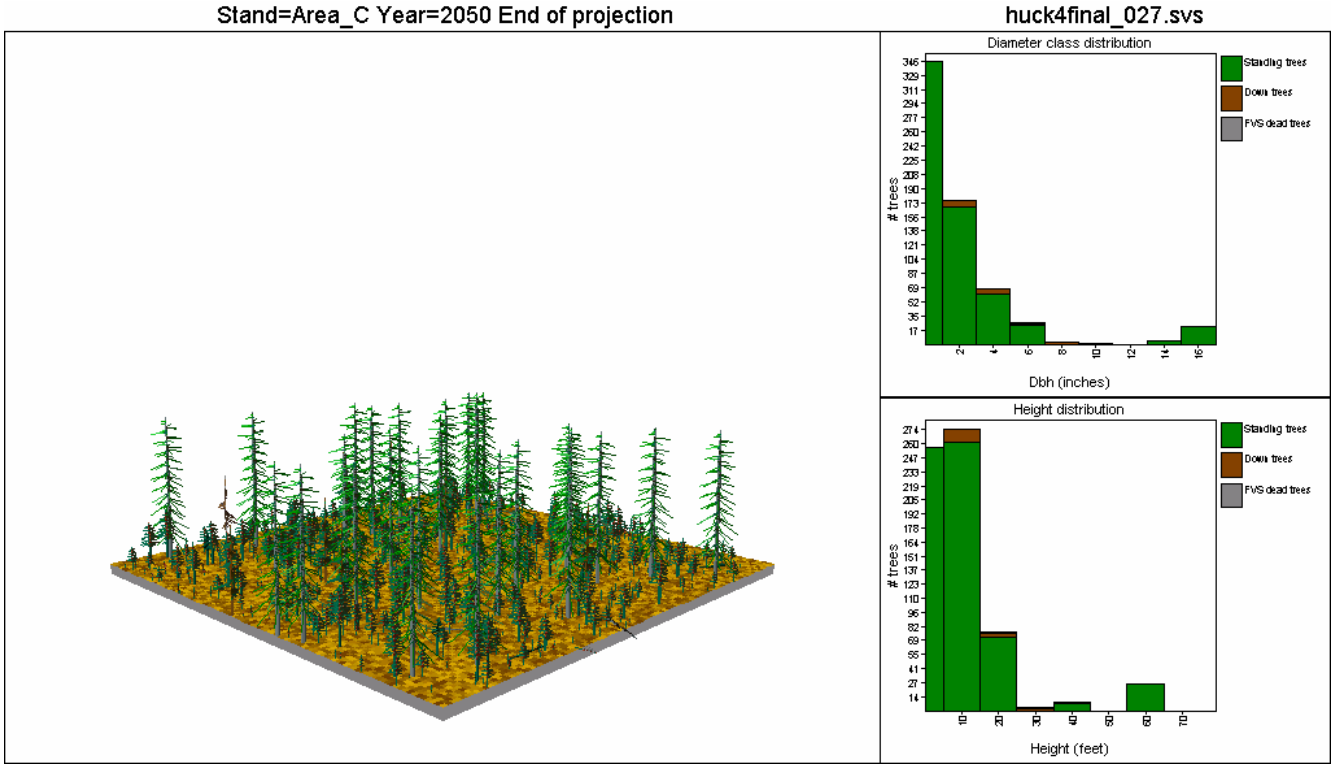

Figure 1. Graphical representation of post-treatment stand conditions.

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Silvicultural Monitoring

Growth of leave trees and natural regeneration will be monitored in the stands after the prescribed treatment. Guidelines for huckleberry monitoring will come from the Huckleberry Enhancement Management Plan and are described below in this document. As necessary, continued entries of hand cutting and bough sales will occur over time to maintain an acceptable amount of shade and sunlight for huckleberry vigor. Monitoring should be considered an important aspect of stand treatment throughout all operations. Objectives should be clear to all those involved in stand treatment: contractors, sale administrators, burners, and monitors. The following is a table of monitoring and contingency strategies for carrying out the stand objectives.

Table 3. Forest Stand Monitoring Tentative Schedule

Year	Activity	Objective	Method	Adaptation
2008	Pre-treatment huckleberry monitoring (described below)	Establish baseline	(see below)	
2009	Thinning & Bough sales	Desired future condition 30-50% canopy cover	Contract Administration	Ensure compliance with contract
2010	Slash Treatment	Reduce wildfire risk	Review stand prior to burning	Alter burn plan as needed
2010 thru 2050	Monitor canopy cover and huckleberry health	Maintain healthy stocking of huckleberry stands	Monitoring plot measurements	Schedule future thinnings to achieve desired canopy cover.