Mardon Skipper (*Polites mardon*) Site Management Plans

Gifford Pinchot National Forest Service

Cowlitz Valley Ranger District

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Cowlitz Valley Ranger District Mardon Skipper Sites

Group	Meadow	Longitude	Latitude	Area (acres)	Elevation (ft.)
Midway	Midway	121 32.0	46 21.2	8	4,313
Midway	PCT	121 31.1	46 21.1	2	4,530
Midway	115 Spur	121 30.9	46 21.0	3	4,494
Midway	Grapefern	121 30.9	46 21.5	3	4,722
Midway	7A North	121 31.4	46 21.5	2	4,657
Midway	7A South	121 31.5	46 21.4	2	4,625
Midway	7A	121 31.1	46 21.4	7	4,676
Muddy	Muddy	121 32.2	46.18.5	4	4,450
Muddy	Lupine	121 31.8	46 18.7	3	4,398
Spring Cr	Spring Cr.	121 33.5	46 20.4	unknown	3,900

Goal of the Management Plans

Maintain and improve grassland/forb habitat at known occupancy meadow sites to ensure continued occupancy by mardon skipper butterfly as well as other important pollinator species such as western bumble bee.

Introduction

On the Gifford Pinchot National Forest (GPNF), mardon skippers were first detected on the Mt. Adams Ranger District (MTA) in 2000 and on Cowlitz Valley Ranger District (CVRD) in 2002. Mardon skippers are known to inhabit ten, upland dry grassy meadows on the CVRD. Portions of the meadows are mesic and are unsuitable mardon skipper habitat. These meadows occur in 2 groupings that are approximately 3 miles apart in the Upper Cispus Watershed approximately 10 miles north of Mt Adams. The northerly group consists of 7 meadows clustered around the Midway Meadows area and the southerly group consists of 2 meadows located near Muddy Meadows. These meadows are a total of 34 acres situated near the crest of the Cascade Range at elevations ranging from approximately 4,330 to 4,800 feet. An additional site occurs at a plantation near Spring Creek where several mardon skippers were found in 2007. The amount of available habitat at Spring Creek is unknown but could be several acres and has been identified as having restoration potential, and therefore is included in this site management plan.

Due to the mardon skipper's small population, limited distribution, and recognized threats to its habitat, it is a Region 6 Sensitive species and Washington State Endangered species, in addition to Category 1 priority species for the state. Prairie, or short grass habitat, is also listed as a priority habitat by the Washington State Dept. of Fish and Wildlife (WDFW, 2008).

Figure 1: Mardon skipper, Photo credit Tom Kogut.

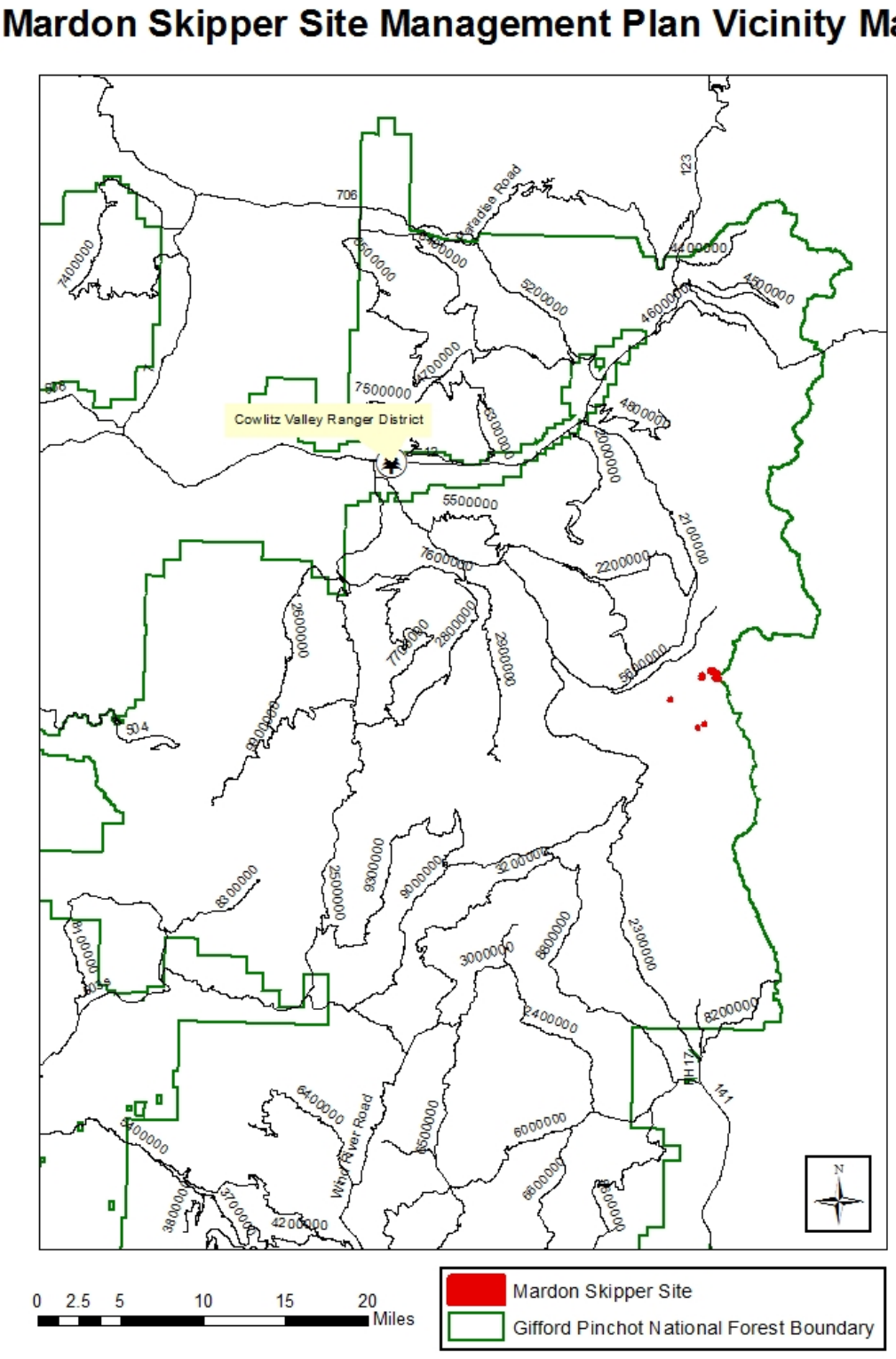

Figure 2: Cowlitz Valley Ranger District Mardon Skipper Meadows Vicinity Map.

On August 31, 2012, the U.S Fish and Wildlife Service announced that the mardon skipper butterfly (*Polites mardon*) did not warrant protection under the federal Endangered Species Act (ESA). The reason for not listing the mardon skipper included a growing number of recently documented sites on lands managed by federal and state agencies. The rationale for not listing was based on the expectation that the conservation efforts undertaken on those lands would afford the species a high level of protection without imminent risks of habitat loss through development or other impacts. The decision followed a year-long review of the best scientific and commercial information about the species, which was identified as a candidate species in 1999. It had been petitioned for listing as endangered by The Xerces Society, Gifford Pinchot Task Force, The Northwest Environmental Defense Center, Center for Biological Diversity, Oregon Natural Resources Council, Friends of the San Juans and Northwest Ecosystem Alliance in 2002.

Significant new populations have been located in the Washington Cascades and in coastal areas of California and Oregon, with some sites supporting hundreds, even thousands of individual butterflies. Between 2007 and 2010, extensive surveys in areas adjacent to known mardon skipper sites have expanded the range of the species along the northern California and southern Oregon coasts (Ross 2010), in the Wenatchee-Okanogan National Forest, and on the Yakama Reservation. On the Okanogan-Wenatchee National Forest, surveys between 2006 and 2010 located mardon skippers at 36 sites including two sites with over 900 individuals each in 2008 and 2009. On the Yakama Reservation, mardon skipper populations have been detected in 11 populations (23 sites) including one particularly notable site which covers hundreds of acres of high meadows and observed densities of approximately 50 individuals per acre.

According to the 2011 Mardon Skipper Conservation Assessment (Kerwin, 2011), mardon skippers are grassland dependent and appear to have narrow habitat requirements, at least in some portions of their range. In the southern Washington Cascades they seem to select for certain large graminoid species within meadows for oviposition, most commonly *Danthonia unispicata, Festuca idahoensis, Carex spp.* and *Poa pratensis*, and are associated with meadows with adequate nectar sources for adults (Beyer and Schultz 2010).

Upland, grass/forb meadows are an uncommon but important habitat type on the Gifford Pinchot National Forest (GPNF), as well as at many other public land areas in the Pacific Northwest and elsewhere. A total of 39 meadows on the Mt. Adams and Cowlitz Valley Ranger Districts are documented locations for the mardon skipper butterfly. These grass/forb meadows also support populations of rare plants, including several species of grapeferns, such as *Botrychium pinnatum*. Like many similar meadows in the heavily-forested Northwest, they are subject to continuing threats, including conifer encroachment, off-road vehicle (ORV) use, livestock grazing, and invasive plant infestation. They are also popular for use as dispersed camping areas.

In addition to mardon skippers, many other species occur in these upland meadows, including several sympatric skipper species (ie. Sonora, arctic, juba, woodland, and western branded), as well as a wide assortment of other butterflies including checkerspots, fritillaries, sulphers, blues and swallowtails. Birds such as hermit thrush, chipping sparrow, and yellow-rumped and Townsend's warblers nest at meadow edges. Mammals such as golden-mantled ground squirrels, deer and elk are common as well, and impact meadow habitat through foraging and burrow

construction thus providing disturbance at regular intervals that contributes to habitat maintenance. In addition to coniferous forests, many of these upland meadows are bordered by wetlands, seeps and streams, which provide suitable habitat for amphibians such as Cascade frogs and western toads, and dragonflies like black petaltails and mountain emeralds (Kogut, 2007).

Figure 3: Western Bumblebee captured at the Pacific Crest trailhead near Grapefern Meadows, between Mt. Adams and the Goat Rocks Wilderness, on August 21, 2013.

The western bumblebee (Bombus occidentalis), another meadow obligate species, was found on the field visit with biologist Rich Hadfield on August 21, 2013 at the trailhead parking for the Pacific Crest Trail. The coordinates of this location are: 46.35052N/121.51717W. The detection of the western bumble bee is another recent indication that this once common pollinator species was not extirpated from the Gifford Pinchot National Forest. The significance of the detection is that it emphasizes the importance of maintaining and restoring these high mountain meadow systems for obligate species that not only include the mardon skipper but are habitat for many other species as well.

Natural History of Mardon Skipper

The mardon skipper (*Polites mardon*) is a small (less than one inch long), non-migratory, brown butterfly that is currently found at four distinct locations in Washington, Oregon, and California: (1) southern Puget Sound, (2) the Cascade Mountains in Washington, (3) the Cascade Mountains in southern Oregon, and (4) Del Norte (north-coastal) California and the southern coast of Oregon. In Washington, it occurs at a few grasslands in south Puget Sound, and in the southern Washington Cascades on the Gifford Pinchot and Wenatchee National Forests. The mardon skipper is relatively drab in appearance, and is often difficult to distinguish from other skipper species, such as the Sonora skipper (see Figure 3) and the juba skipper. The mardon skipper can be distinguished by a “V” pattern on the hindwing, formed by a series of rectangular light spots against the wing’s dark brown background (see Figure 1).

Figure 4: Sonoran skipper captured at Muddy Meadows (used by permission).

Mardon skippers emerge in June to August in the southern Washington Cascades, depending on weather conditions and elevation. Individuals live between five days and two weeks. Adults do not all emerge on the same date, so flight period duration at any given site depends in part on the number of skippers present and the local conditions. In large populations, the flight period may extend for over a month, while small populations may have adults present for only ten or fewer days. Within the same geographic area, emergence dates vary with elevation, with emergence generally occurring earlier at lower elevations. Weather influences emergence and flight period duration. Wet or cold conditions delay emergence; conversely, warm, dry conditions promote earlier emergence, and both may affect flight period (Potter et al. 2002).

Adults feed on flower nectar from a variety of sources including: early blue violet (*Viola adunca*), common vetch (*Vicia sativa*), possibly other *Vicia* species, prairie lupine (*Lupinus lepidus*), Idaho blue-eyed-grass (*Sisyrinchium idahoense*), sego lily (*Calochortus* spp.), wallflower (*Erysimum capitatum*), common camas (*Camassia quamash*), fine-leaved desert parsley (*Lomatium utriculatum*), western buttercup (*Ranunculus occidentalis*), phlox (*Phlox diffusa*), clover (*Trifolium* spp.), penstemon (*Penstemon* spp.) and hawkweed (*Hieracium* spp.) (Hays et al. 2002, Potter and Fleckenstein 2001, Pyle, 2002, Newcomber 1966 and Haggard 2003). Beyer and Black (2007) recorded nectaring observations for two Washington sites and two Oregon sites. In Washington the most nectaring was seen on vetch (*Vicia* species), and in

Oregon the most nectaring was seen on varileaf cinquefoil *(Potentilla diversifolia).* Studies have shown that use of nectaring plants seems to vary spatially and temporally, with emerging mardon skipper adults "learning" nectar sources in the area, and showing a preference for those nectar sources even if others become available during their flight period.

Beyer and Schultz (2010) found that oviposition locations were positively correlated with distance to forest edge and distance to nearest tree, indicating a preference for oviposition at larger distances from trees, perhaps due to an associated increase in solar exposure and the resultant warmer environment, which is likely more conducive to larval and pupae development. On the Gifford Pinchot National Forest, Beyer (2009), and Beyer and Schultz (2010) observed oviposition on twenty-three different species, eight sedges and fifteen grasses. Recent studies in the southern Washington Cascades have suggested that, based on the variety of oviposition plants identified, females may not always oviposit on specific host plants, but within a community of possible species that can be utilized by the larva (Beyer and Black 2007; Beyer 2009; Beyer and Schultz 2010).

In the southern Washington Cascades, larvae hatch and feed during the summer, then pupate in late summer and early fall. They are dormant until the following summer when adults emerge once again. Larvae create "nests" at the base of the oviposition plant out of little bits of grass, webbing and frass. These nests are little tube-like structures that are oriented vertically or horizontally at the base of the graminoid plant from which larvae venture out to feed and defecate. Beyer and Black (2007) located eight individual larvae that were most likely mardon skipper, and collected information on behavior and larval instar life stages up to 3rd or 4th instar. It does not appear that the larvae disperse far from the oviposition location. They did observe some larvae in tunnels lined with silk and frass that were approximately 2 cm deep.

It was believed that pupae hibernate through the winter (Potter et al. 1999, Dornfeld, 1980 and Newcomber, 1966 in Potter et al. 1999). However, Beyer and Black (2007) suggested that the species overwinters as larvae, and captive rearing showed that they may diapause as larvae. Henry (2010) confirmed that larva overwinter in diapause, and that captive rearing efforts appear to significantly alter larval development and diapause.

The non-migratory mardon skipper is a relatively sedentary butterfly (Kerwin, 2011) and rarely disperse beyond their natal meadows. However, males have been located up to 1.6 km from their original location (Runquist 2004). Males have been found some distance from females while "puddling;" a method for drinking water and obtaining minerals from small puddles or wet soil. Males have been found to travel further than females, often along corridors such as powerlines and roads with nectar resources. Potter and Fleckenstein (2001) hypothesized that when mardon skipper numbers increase in a population, some individuals disperse using habitat corridors and colonize adjacent habitat. There appear to be closed-forest barriers that potentially isolate some sites, but Potter and Fleckenstein (2001) observed mardon skippers flying along narrow gravel roads, and utilizing roadside meadows and small grassy openings bordering gravel roads.

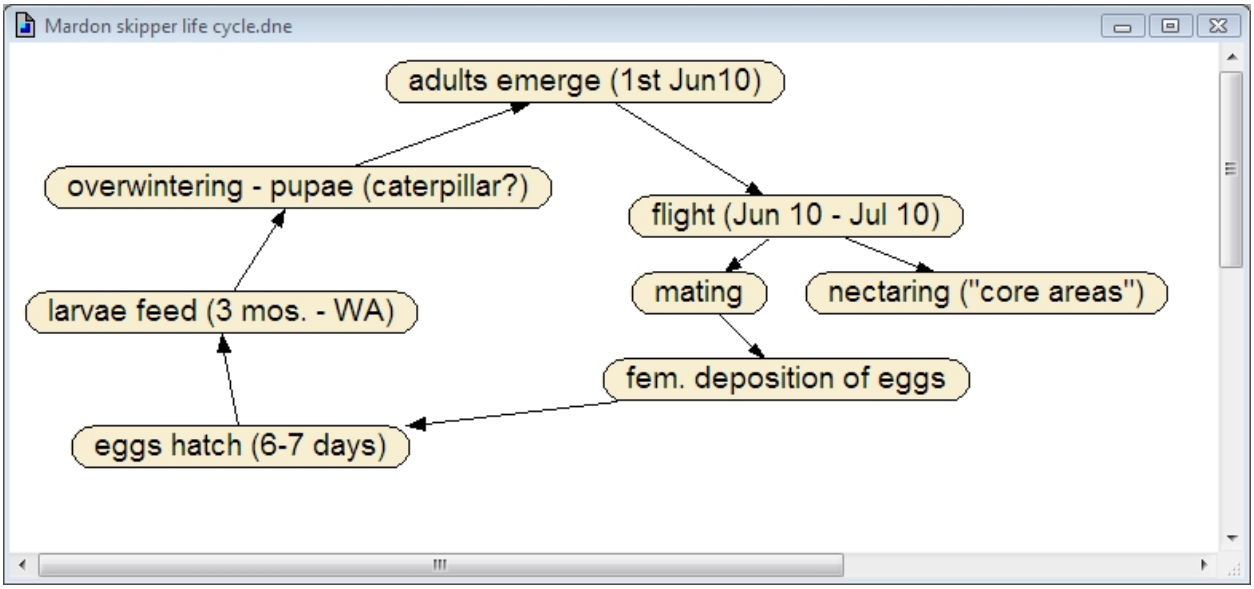

Figure 5: Mardon Skipper Life Cycle Model for S. WA Cascades, courtesy of Bruce Marcot.

Recent Monitoring Trends on Gifford Pinchot National Forest

Annual single day counts have been conducted at known sites on the Cowlitz Valley RD since they began in 2002, however due to personnel and time constraints not all sites were surveyed every year. These counts may or may not have been conducted during the peak flight period each year and likely are not reliable estimates of population size or trends.

Table 1: The highest count number obtained at known sites by year for Mardon skipper surveys on CVRD. Note that not all of sites were visited every year.

Site Name	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Midway	56	8	0	15	25	14	4	10	26	15	92	206	328	
Grapefern	53	392	402	98	373	350	83	65	60	34	14	30	116	125
7A	31	143	68	25	105	25	20-30	4	10	11	8	4	25	55
Muddy	29	n/a	25	10	18	91	22	5	7	16	8	35	50	60
115 spur	15	28		15	14	11	8	8	9	0	0	2		
7A North														
7A South								1						
PCT	8			0		25		0	6					
Lupine					45									
Spring Cr						5							10	

Monitoring of mardon skippers is planned to occur yearly for the foreseeable future to determine occupancy and assess the condition of the meadows (recreation impacts, invasive weeds, etc.). The extent of the monitoring effort will be determined by available funding but at a minimum should include at least 2 site visits during the flight period to the 4 most important meadows:

Midway, Grapefern, 7A and Muddy. Distance sampling is a monitoring technique that is more formalized and could be used in Midway Meadows.

General Threats and Management Recommendation

Mardon skipper populations face a variety of threats; including conifer, shrub, and invasive plant species encroachment, off road vehicle (ORV) use in meadows, prescribed and natural fire, recreation (including camping), applications of Btk, climate change, and issues related to small population size and stochastic events.

Small and fragmented populations are generally at greater risk of extinction from normal population fluctuations due to predation, disease, and changing food supply; as well as, from natural disasters such as droughts (*reviewed in* Shaffer, 1981). Small populations are also threatened with extinction from a loss of genetic variability and reduced fitness due to the unavoidable inbreeding that occurs in such small populations (*reviewed in* Shaffer, 1981). During adult flight, mardon skippers avoid heavily forested habitats and are assumed to have limited dispersal abilities (Beyer & Schultz 2010; Beyer & Black 2007; Runquist 2004). Therefore, there is little opportunity for the individual populations to intermix.

Due to the local (cluster of habitat patches) and regional (four disjunct populations in WA, OR and CA) distribution of mardon sites, there is considerable evidence that the mardon skipper exhibits metapopulation dynamics. Metapopulations are defined as regionally distributed populations that are interdependent over time. There are many models of metapopulations, but a central theme to all of them is frequent local extirpations of individual habitat patches and subsequent recolonization, or rescuing, from nearby successful populations. In order for metapopulations to survive over time, there must be some opportunity for connectivity between patches of habitat. Considering changes in fire regime and land use, the connectivity of the landscape has changed significantly since 1950. A 1995 study noted a 39% decrease in forest openings (meadow habitat) in the Klamath Mountains between 1944 and 1985 indicating significant forest encroachment in this time (Skinner, 1995). Much of this forest encroachment happened along meadow connections, leading to further isolation of individual forest openings. Skinner (1995) also found that the median distance to the nearest forest break had doubled between 1944 and 1985. Because of the limited dispersal abilities of mardon skippers, these changes have likely isolated remnant populations and reduced the probability of recolonization in the event of a local extirpation.

Global climate change could threaten the mardon skippers' survival. Assessment of climate change trends in North America has already revealed changes in precipitation patterns, hydrology, and plant bloom time. Overall, annual mean air temperature increased in North America from 1955-2005. The effects of global climate change are projected to include warming in the western mountains, causing snowpack and ice to melt earlier in the season (Field *et al.* 2007), which will have an impact on mardon skipper sites as all are associated with permanent, ephemeral, or subsurface water. These climactic changes may lead to drier summer conditions, particularly in arid western areas where snowmelt is important to maintaining ephemeral water sources. Spring and summer snow cover has already been documented as decreasing in the

western United States, and drought has become more frequent and intense (Intergovernmental Panel on Climate Change 2007, Saunders *et al*. 2008). Because the mardon skipper is associated with wet areas, its survival may be threatened by climate change induced habitat impairments. Moreover, since fewer seedlings and saplings will die in warmer winter and spring temperatures, and models predict an increase in fall precipitation, climate change seems to improve conditions for increased shrub and tree encroachment in open meadow habitats (Widermaier and Strong 2010). Although management at the population scale cannot directly address global climate change, providing quality habitat spread in multiple sites across the landscape is thought to insulate species from climate change.

Below we provide information on threats and general recommendations for managing conifer encroachment, prescribed fire, ORV use, and Btk applications. For information on management at specific sites, please see site specific information in Section 2 of this document.

The following discussion of guidelines for management can only be understood and implemented when used in conjunction with site specific threat information that is available in the detailed and site specific recommendations below. Mardon skippers persist in open prairie and meadow ecosystems. These ecosystems are naturally maintained by disturbance (Coop & Givinish 2007). Yet, a delicate balance is needed to create sufficient disturbance to restore and maintain the system without creating so much disturbance that the habitat is further degraded (Schultz and Crone 2008).

<u>Forest Encroachment</u>

The removal and alteration of the natural disturbance regimes (such as fire suppression), that once maintained low shrub and conifer seedling establishment rates, has led to the loss and degradation of forest-meadow ecosystems (Coop & Givinish 2007; Norman & Taylor 2005). Forest encroachment not only reduces the amount of open habitat, but closes off corridors between meadows reducing butterfly dispersal (Roland & Matter 2007). During the adult flight, mardon skippers avoid heavily forested habitats, avoid forest edges and trees during oviposition, and are assumed to have limited dispersal abilities (Beyer & Schultz *2010*; Beyer & Black 2007; Runquist 2004). Large dense shrubs likely have a similar adverse impact as encroaching trees to the habitat and behaviors of this butterfly. Conifer encroachment is negatively impacting all Forest Service sites, although some sites have higher levels of encroachment than other sites.

The lack of genetic interchange and movement of individuals between populations will likely lead to lower overall fitness and extirpations of local populations. A better understanding of the feasibility and the effects of reconnecting neighboring mardon skipper populations that have been isolated by forest and shrub encroachment is warranted (Bergman 1999; Dennis *et al.* 2006).

General Recommendations

In areas where tree and shrub encroachment are occurring, small trees and problematic shrubs should be removed as soon as possible, before they grow larger and reproduce.

A plan should be developed to remove trees using methods that incorporate sensitivity to the butterflies' life history. The plan should include the following:

In general only small trees under 4 in. diameter at breast height (DBH) should be removed from the open meadow portion of the site.

- Wherever possible, cutting should be done by hand with chainsaws or handsaws.
- All downed wood and branches from cut trees should be removed from the meadow areas.
- Care must be taken to avoid actions that could degrade habitat and kill individual skippers as a result of heavy equipment use, people trampling meadows, scattering or piling of trees or branches in meadows, or burning of piles in or adjacent to the core area of the site.
- Maintain a buffer of large trees at the edges of meadow since they may play an important role in maintaining the microclimate and hydrology of the local habitat. If thinning is needed for fuels and/or ecosystem needs, only small diameter trees should be removed. If additional tree removal is needed, consult with a butterfly habitat restoration expert.
- If openings between meadows have closed off due to encroachment, a plan should be developed to improve connectivity, especially if adjacent or nearby meadows have suitable mardon skipper habitat and/or are known occupied sites.
    - If plans for opening meadow connections are pursued, careful attention should be paid to the hydrology within and between meadows and where possible, should not be altered. A change in meadow hydrology could dramatically affect mardon skipper habitat.

Prescribed fire

Due to the importance of fire in maintaining many native ecosystems, the use of controlled burning as a management tool has become increasingly common. The effects of fire on vegetation and vertebrate communities are more widely understood than the effects of fire on invertebrates. Fire can benefit, harm, or have no significant effect on invertebrates depending on the biology of the specific taxa (Gibson *et al.* 1992). Burning of meadows with populations of butterflies, such as the mardon skipper, could extirpate the population if not done with careful consideration of butterfly behavior and life stage at time of burn, and knowledge of where the skipper population is distributed across the meadow. In addition, with isolated populations, there are often no source populations available for re-colonization once a population has been locally extirpated.

A recent study on prescribed burning and the mardon skipper in California showed substantially fewer butterflies in the burned areas of meadows compared to unburned areas after one, two, and three years following the burn event (Black *et al*. 2013). Counts for all four zones across all survey dates in 2009, 2010, and 2011 showed mardon numbers that ranged from 2 to 27 times higher in unburned zones compared to burned zones on the same dates (Black *et al*. 2013).

Figure 6: Controlled burn at a mardon skipper site in California, photo by Brenda Devlin.

Burning meadows that contain populations of mardon skippers may kill all butterflies within the fire area, as this species is thought to overwinter as a caterpillar at the base of its host plant, and is thus highly susceptible to ground fires. If controlled use of fire within a mardon skipper occupied site is feasible, and there is a management goal that can be best accomplished with controlled burning, then specific steps must be employed in order to protect the mardon skipper. To our knowledge, there are no pending plans for prescribed fire at any of the mardon skipper sites on Forest Service lands. If future prescribed burning is warranted, a detailed burn plan should be developed for each site.

General Recommendations (Note: Site specific management plans should be developed for each site before implementing a prescribed burn)

A careful and well-researched prescribed burning regimen should provide the correct combination of timing, intensity, and size that is appropriate for the management area and will result in long-term stability of mardon skipper populations.

- Future fires should not burn more than one-third of the core habitat in any given year, and less if possible.
- As a fire moves through an area it may leave small patches unburned. These skips should be left intact as potential micro-refuges.
- A comprehensive monitoring program should be put in place to accompany any plans for burns to determine the immediate and long-term impacts on mardon skipper populations.

No additional burns should be completed until there is full re-colonization of burned areas by mardon skippers.

- While implementing a burn plan, measures must be taken to avoid actions that could degrade existing habitat and kill individual mardon skippers, including heavy equipment use and additional or excessive foot traffic by burn staff in mardon meadows.

Off Road Vehicles

Mardon skipper eggs, caterpillars, pupae, and adults are killed by recreational activities such as off-road vehicle (ORV) driving (Potter *et al*. 1999). These activities can also damage native host plants and may lead to an invasion of non-native plant species. ORVs aid the dispersal of invasive non-native species deep into forestlands. One study found that in just one trip on a 10 mile course, an ORV dispersed 2,000 spotted knapweed seeds (MSU 1992). In Wisconsin, a survey of seven invasive plant species along ORV routes found at least one of these (exotic) plant species on 88 percent of segments examined (Rooney 2005).

General Recommendations

In areas with ORV traffic, we recommend closing off access to mardon skipper habitat areas and educating the public on the detrimental impacts of this form of recreation to sensitive habitats.

Use of Btk

Btk (*Bacillus thuringiensis* var. *kurstaki*), a Lepidoptera-specific insecticide, has been widely used to treat defoliators in western forests (Wagner & Miller 1995). Btk is a bacterium which, when ingested, is lethal to butterfly and moth larvae. Species such as the mardon skipper that are single-brooded with spring-active larvae, which feed during the application period for the target species are especially vulnerable to Btk (Wagner & Miller 1995). Because of the mardon skipper's current patchy distribution on isolated sites and low vagility, its populations are even more threatened by Btk applications due to the decreased probability of re-colonization.
The threat of Btk is heightened because Btk has been shown to drift at toxic concentrations for distances greater than two miles from target spray areas (Barry 1993 and Whaley et al. 1998). As a result, aerial spraying with Btk can have significant adverse effects on mardon skippers in the general area of an aerial Btk spray project.

General Recommendations

We recommend not spraying Btk on forested areas within two miles of any mardon skipper population.

Conservation Concern and Threats to Habitat on the CVRD

Shortly after mardon skippers were documented on the GPNF, it was apparent that many of the meadows were impacted by both natural succession and human-related impacts, mostly related

to conifer encroachment, illegal ORV use and noxious weed infestation. The most important threats to the mardon skipper on the Cowlitz Valley Ranger District are meadow loss through natural succession (i.e. conifer encroachment) and recreation use (both legal and illegal). Due to wildfire suppression, the existing skipper meadows are gradually being reduced in size as conifers, primarily lodgepole pine (*Pinus contorta*) become established. Eventually, the meadows will be lost entirely as they revert back to forest. To address this concern, a project was started in 2003 to remove these small (under approximately 2 inches diameter), encroaching conifers and keep the meadows in the open condition that mardon skippers, as well as many other taxa, require. Work since 2003 was focused on four meadows with the most severe conifer encroachment problems (Kogut 2007).

Another threat to the mardon skipper is recreational use of the meadows. At Midway Meadows, a combination of horse use, camping in the undesignated areas in the meadow, and illegal ORV use has impacted the habitat. Illegal ORV use has been observed at two other meadows also, as well as garbage dumping. Due to the flat, open nature of the meadows and surrounding areas, it is difficult to enforce road closures and rules prohibiting off-road vehicle traffic. A project was proposed to place large rocks at Midway Meadows to block illegal vehicle use but was never implemented. Signing of the meadow was accomplished and continual coordination with stock users is required to prevent camping in undesignated sites in the meadow.

At this time invasive weeds are a concern but are not considered to be a major problem on the North Zone mardon sites. Site visits were made by the Gifford Pinchot North Zone Botanist, Linda Swartz, on July 7th and August 21st of 2013. During site visits, *Hieracium caespitosum* (Meadow hawkweed) and *Cirsium arvense* (Canada thistle) were identified within Midway Meadow (a mardon skipper site). No invasive plant species were found within the remaining meadows where mardon skippers are known to occupy.

On August 12th, 2013 Lewis County treated per the Gifford Pinchot Site-Specific Invasive Plant Treatment Project and Forest Plan Amendment project design criteria the *Hieracium caespitosum* site and applied the herbicide, Element 3A (Triclopyr) to 0.2 acres using a spot spray method. Element 3A is a selective herbicide and was chosen to control the broadleaf weeds and spare the grasses. Monitoring of the *Hieracium caespitosum* site did occur in FY 2014 and was not detected, so no further treatment was needed. *Cirsium arvense* was hand pulled in FY 2013 and was not found in FY 2014 and therefore did not need further treatment.

Conifer Encroachment

On the Cowlitz Valley R.D., five of the meadows exhibited moderate to severe conifer encroachment in 2002. These meadows occur within a matrix of lodgepole pine (*Pinus contorta),* subalpine fir (*Abies lasiocarpa*), mountain hemlock (*Tsuga heterophylla)* and Engelmann spruce (*Picea englemannii*) forest which provide a constant and prolific seed source. The origin of the meadows is thought to be the result of past fires that were both human caused and natural events. There have been very few recent fires to provide additional habitat or maintain existing open meadow habitat free from encroaching trees. Past fires that contributed to the maintenance of open habitats include the Cispus Burn of 1902 that was very large and human caused (Fenby, 1914) and a large fire of 1918-1919 that was naturally caused and re-burned much of the Cispus Burn. The meadows were also burned over in previous fires in 1870

and 1892 which were thought to have been set by sheep herders maintaining pasture (Leve, 1922).

Prior to white settlement of the area, native people used fire in various ways to improve game habitat, facilitate travel, reduce insect pests, remove cover for potential enemies, enhance conditions for berries, and drive game, among other purposes (Zyback, 1993). American Indian bands of the Columbia Plateau maintained huckleberry fields near the Cascade crest with periodic, repeated burning (French, 1999; Mack, 2001). Fires were likely caused by both escaped campfires as well as intentional burning. Several ethnographic studies offer more evidence regarding Native American burning as a traditional cultural practice, specifically with regards to the creation and maintenance of huckleberry fields (e.g. Burke, 1979; Zyback, 1993; French, 1999; Mack, 2001).

Due to active fire suppression since the 1918 burn, no large fires have burned in the area around the meadow complex and the process of natural succession has resulted in a gradual loss of meadow habitat. The ceding of Indian lands and National Forest Service policy prohibited traditional burning practices beginning in the early 1900s (Fisher, 1997). Lack of fire and other disturbances have led to the encroachment by conifers into open meadow habitats.

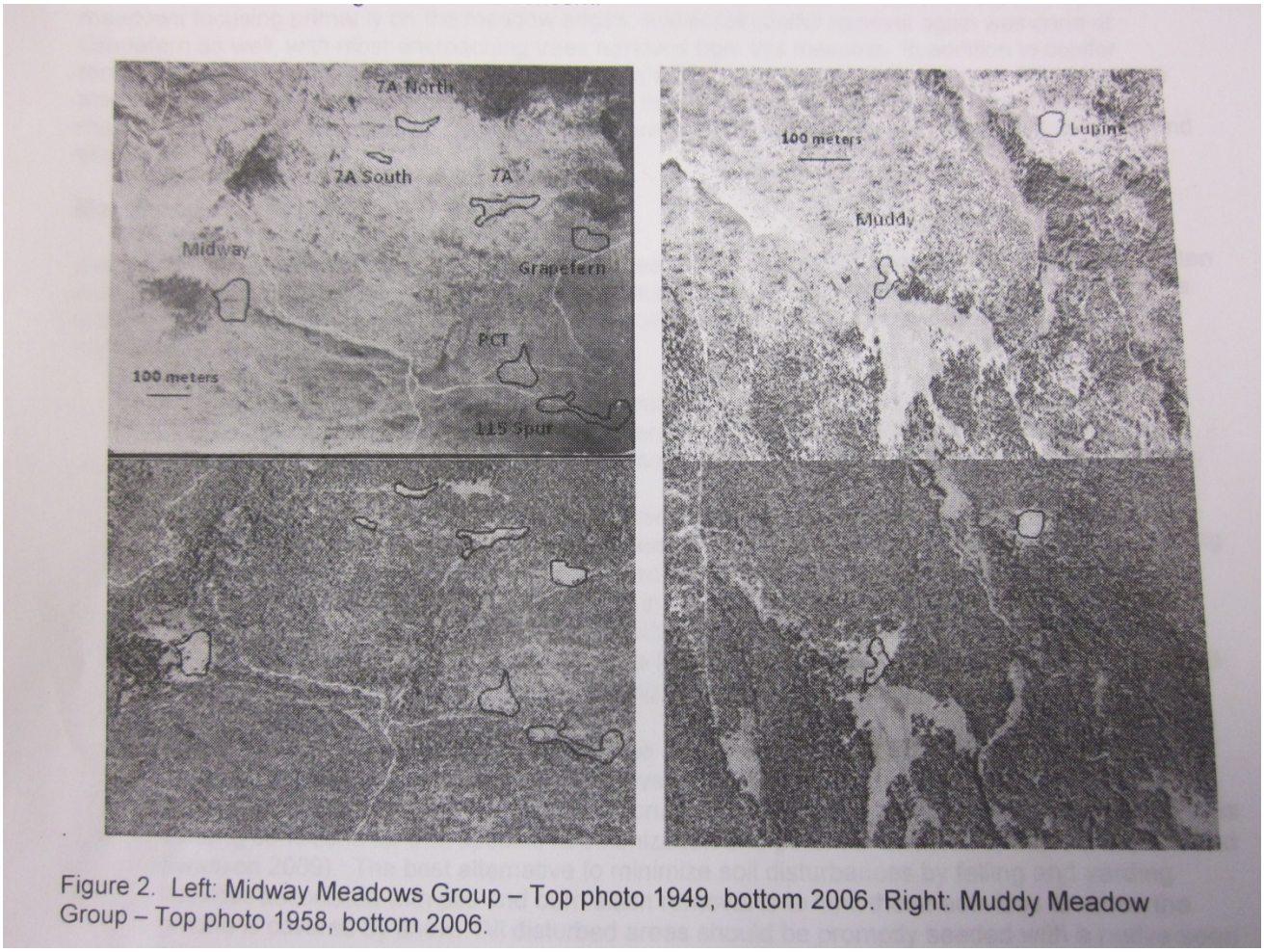

Figure 2. Left: Midway Meadows Group – Top photo 1949, bottom 2006. Right: Muddy Meadow Group – Top photo 1958, bottom 2006.

Figure 7: Comparison of historical versus present day habitat in mardon skipper meadows.

The above figure (excerpted from Foster, 2010) shows in particular the dramatic increase in conifer encroachment in the mardon skipper meadow complex on the Cowlitz District. Currently the total acres of meadow habitat are a small fraction of the area that existed in these photos from a half century earlier.

Dry meadows such as the mardon skipper meadow complex on the Cowlitz District are unique habitats in the west cascades. According to a recent report entitled Early Seral Forest in the Pacific Northwest: A Literature Review and Synthesis of Current Science *"In general, naturally structured early seral forest in the Pacific Northwest is important for many ecosystem services and species (including obligates and near-obligates), but has declined from historic landscape proportions"(*Swanson, 2012). Fire is cited as the most important agent for the creation of early seral habitat in this report.

The 2002 Washington Dept. of Fish and Wildlife (WDFW) South Rainier elk herd plan (WDFW 2002) cites forest encroachment in high elevation meadows as a threat to critical elk habitat and refers to an analysis conducted that showed 20% of the high elevation meadows in the southern part of the range had been taken over by conifers from 1959 to 1990.

Restoration Strategy Options

Grapefern Meadows: The site management recommendation for Grapefern Meadows is to continue past restoration work of removing small invading conifers from encroaching into the meadow. The objective is to maintain the area of open habitat in the meadow at the current level which is approximately 3 acres. This work should be done every 3 to 4 years and can be accomplished by hand-pulling the seedlings or with loppers. It is a good project for the Discovery Team or with other volunteer groups.

Specific Recommendations:

- Remove all trees under 4 inches in diameter from the open meadow portion of the site.
    - Wherever possible, cutting should be done by hand with chainsaws or handsaws.
    - All downed wood and branches from cut trees should be removed from the meadow areas.
    - Care must be taken to avoid actions that could degrade habitat and kill individual skippers as a result of heavy equipment use, people trampling meadows, scattering or piling of trees or branches in meadows, or burning of piles in or adjacent to the occupied, or potentially occupied portion of the site.
- A plan should be developed to girdle larger trees near the perimeter of the meadow to open up the habitat and reduce shading of mardon skipper habitat.
    - Maintain a buffer of large trees at the edges of meadow since they may play an important role in maintaining the microclimate and hydrology of the local habitat. If thinning is needed for fuels and/or ecosystem needs, only small diameter trees should be removed. If additional tree removal is needed, consultation with a butterfly habitat restoration expert would be needed.
- Careful attention should be paid to the hydrology within and between meadows and where possible, should not be altered. A change in meadow hydrology could dramatically affect mardon skipper habitat.
- The boulder placement to block spur road access to the PCT and Grapefern Meadows is working. The spur road is becoming overgrown with small conifers and that is preventing the use of the spur road by ORV users. Yearly monitoring of the boulder placement to determine effectiveness is part of the long term strategy.

Midway Meadows: Management options include the closure of the spur road that accesses the meadow (shown in the figure below branching off of the #117 road). This road only goes to the meadow and does not reach any other destination, and is used by people to camp in the meadows. However, use is primarily concentrated around Labor Day during elk hunting season. Closing the road would be highly controversial and very unpopular with the elk hunters that camp in Midway Meadows.

If closing the road is not possible given current recreational use, the current strategy of maintaining law enforcement presence during the high use season to prevent the use of non-designated sites for camping should be continued. Some ORV use in the meadow is still

occurring despite the signage so this needs to be monitored to determine if the intensity and frequency of this activity is within acceptable levels or damaging to mardon skipper habitat.

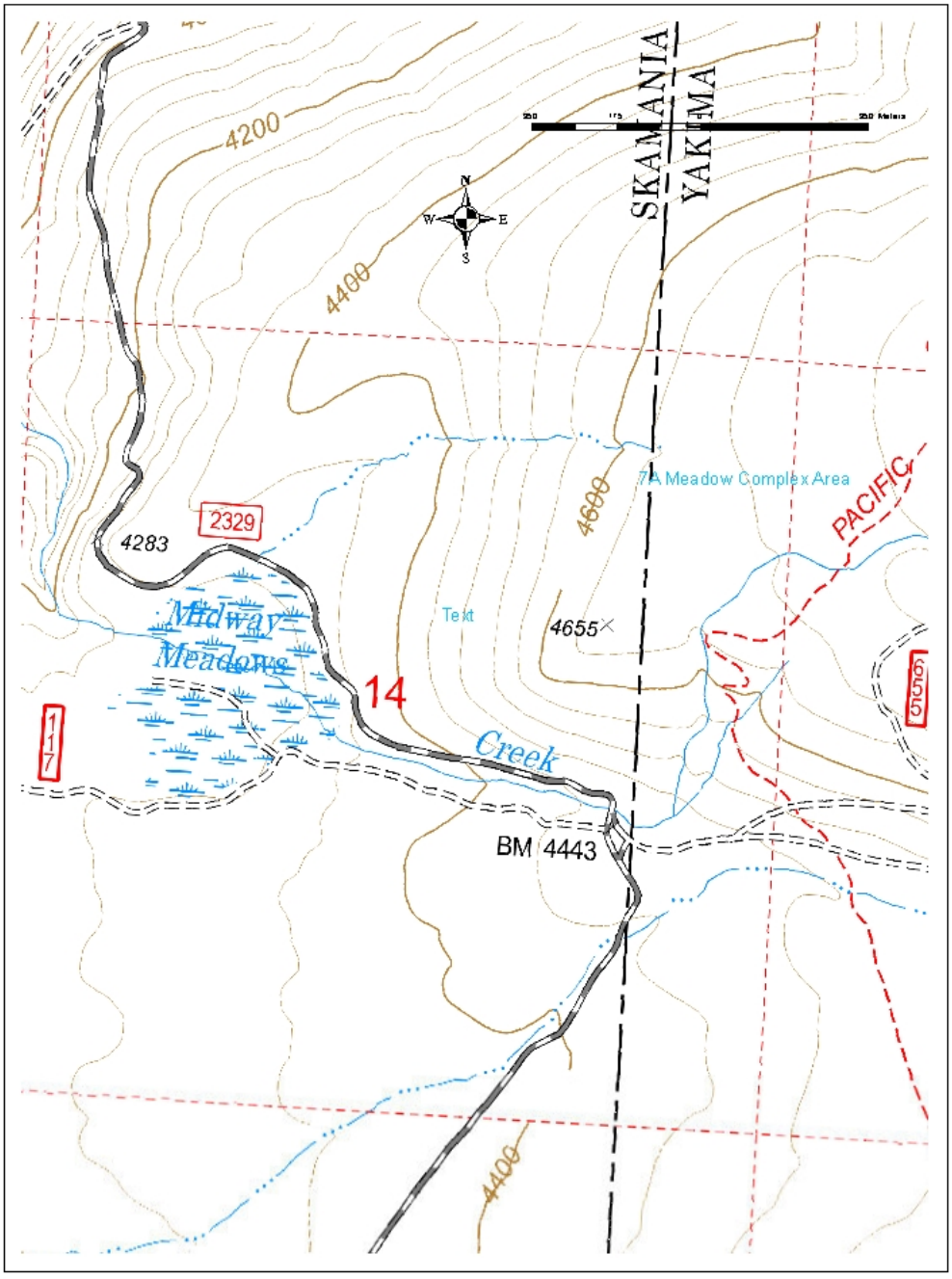

Figure 8: Midway Meadows showing spur road into meadows that allows motorized access.

Non-native weeds are not a major concern at Midway Meadows so far but are occasionally present. Recently Canada thistle was found near the stream in the meadows and was eradicated. Another noxious weed, meadow hawkweed, was treated with herbicide in an eradication effort in the meadow. Treatment was prescribed per the Project Design Criteria in the Gifford Pinchot Site-Specific Invasive Plant Treatment Project and Forest Plan Amendment for mardon skipper habitat and monitoring will occur on an annual basis to determine the effectiveness of the treatment.

Conifer encroachment is also a potential threat to the habitat at Midway but due to the larger size and distance from forest edge is not as immediate a threat as it is in the smaller meadows. However, conifer encroachment needs to be monitored and treated as needed.

Specific Recommendations:

Actively and aggressively control for invasive plant species before they spread throughout the meadow and into mardon skipper habitat. Use herbicide applications that are specific enough to avoid spraying non-target forage plants and host plants. If possible time the application for fall when caterpillars are not active. If large areas of the meadow must be treated only treat a percentage (less than 25%) of the meadow each year.

- Remove all trees under 4 in. Diameter at Breast Height (DBH) from the open meadow portion of the site.
    - Wherever possible, cutting should be done by hand with chainsaws or handsaws.
    - All downed wood and branches from cut trees should be removed from the meadow areas.
    - Care must be taken to avoid actions that could degrade habitat and kill individual skippers as a result of heavy equipment use, people trampling meadows, scattering or piling of trees or branches in meadows, or burning of piles in or adjacent to the core area of the site.

Muddy Meadows: The suggested management strategy for Muddy Meadows is to monitor and remove encroaching conifers in the northeast part of the meadows. Muddy has a limited area of dry, short grass habitat. It has consistently had good Mardon counts over the years and is important habitat. Additionally, it is isolated from the meadow systems near Midway Meadows and if the population was lost natural re-colonization may be difficult.

Specific Recommendations:

- Remove all trees under 4 in. Diameter at Breast Height (DBH) from the open meadow portion of the site.
    - Wherever possible, cutting should be done by hand with chainsaws or handsaws.
    - All downed wood and branches should be removed from the meadow areas.
    - Care must be taken to avoid actions that could degrade habitat and kill individual skippers as a result of heavy equipment use, people trampling meadows,

scattering or piling of trees or branches in meadows, or burning of piles in or adjacent to the core area of the site.

Figure 9: Muddy Meadows, July 2013, showing extensive wet meadow habitat, Mt. Adams in background.

7A Complex: The stringer meadows that form the 7A complex have the highest potential for a large-scale restoration project that could significantly expand the area of suitable habitat for mardon skippers. Restoration would remove a substantial amount of the conifer cover between the stringer meadows, including removal of trees up to 7 inches in diameter. The larger trees over 7 inches in diameter could be girdled to create snags. The proposed work would include a total of approximately 15 acres in existing meadows 7A, 7A North and 7A South, and the area of early seral forest that exists between the meadows. The objective would be to reverse the trend of conifer encroachment in the meadows and significantly expand the area of potential habitat.

Specific Recommendations:

- Remove all trees under 7 in. Diameter at Breast Height (DBH) from the marked area in Figure 10.
    - Wherever possible, cutting should be done by hand with chainsaws or handsaws.
    - All downed wood and branches from cut trees should be removed from the meadow areas.
    - Care must be taken to avoid actions that could degrade habitat and kill individual skippers as a result of people trampling meadows, scattering or piling of trees or branches in meadows, or burning of piles in or adjacent to occupied, or potentially occupied habitat.
    - Conduct the tree removal in late fall when access is still possible, but mardon skipper larva are in diapause. This will also minimize disturbances to herbaceous vegetation and protect the overall habitat.
- Within the marked area on Figure 10, girdle all trees greater than 7 inches in diameter.
    - Maintain a buffer of large trees at the edges of meadow since they may play an important role in maintaining the microclimate and hydrology of the local habitat. If thinning is needed for fuels and/or ecosystem needs, only small diameter trees should be removed. If additional tree removal is needed, consult with a butterfly habitat restoration expert.
    - Careful attention should be paid to the hydrology within and between meadows and where possible, should not be altered. A change in meadow hydrology could dramatically affect mardon skipper habitat.

The work would be conducted by crews walking in and using chain saws to fall and buck the smaller trees, and girdle the larger trees over 7 inches in diameter. The resulting conifer slash would be hand piled and burned a year or 2 later. The project would best be implemented during the late fall period when access is still possible with 4-wheel drive vehicles and there is some snow cover, less than one foot, to minimize disturbance to herbaceous vegetation and impacts to over-wintering mardon skipper larva.

Contract costs for falling conifers and piling slash are estimated to be $1,000 per acre (because hand piling is very expensive), so approximately $15,000 for the 7A complex. The slash would be pulled back out of the existing meadows and piled out of sight of the trails in the area between the meadows that is currently early seral forest. Prescribed burning costs approximately $300 per acre so that would add another $5,000 to the cost of implementation.

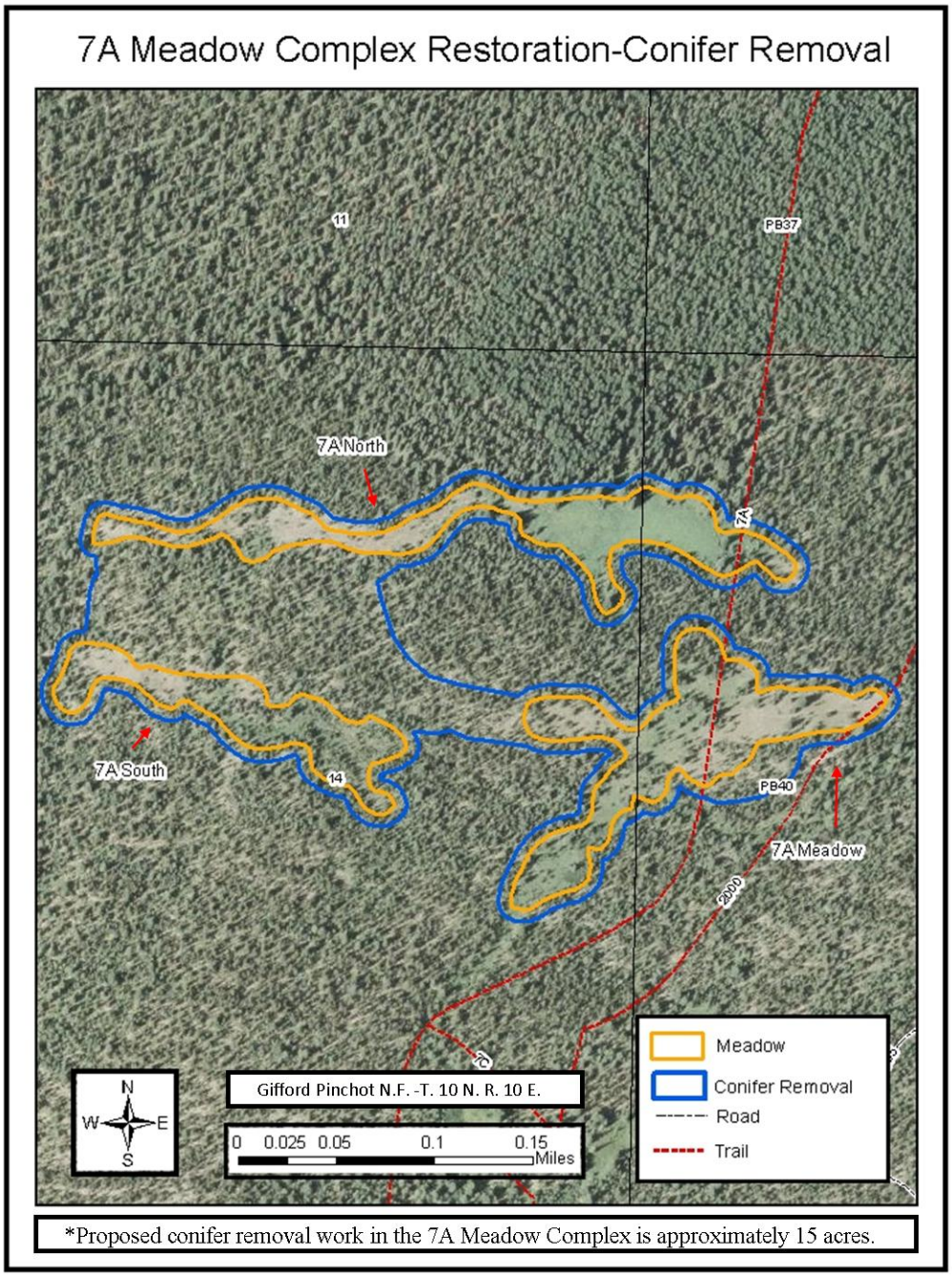

Figure 10: Proposed conifer removal at 7A meadow complex.

Figure 11: Conifer encroachment in 7A South meadow.

115 Spur Meadow: A similar treatment as the 7A complex with conifer removal could be an option for the 115 Spur Meadow.

Spring Creek Plantation: At this site Vince Harke (US Fish and Wildlife Service) located 5 mardon skippers in July of 2007. This site is a regenerating pine/fir plantation with open patches containing fescue and strawberry. The site is marginal habitat for mardons that will not last much longer without restoration action. A site visit in the summer of 2014 was conducted and 10 mardon skippers were observed.

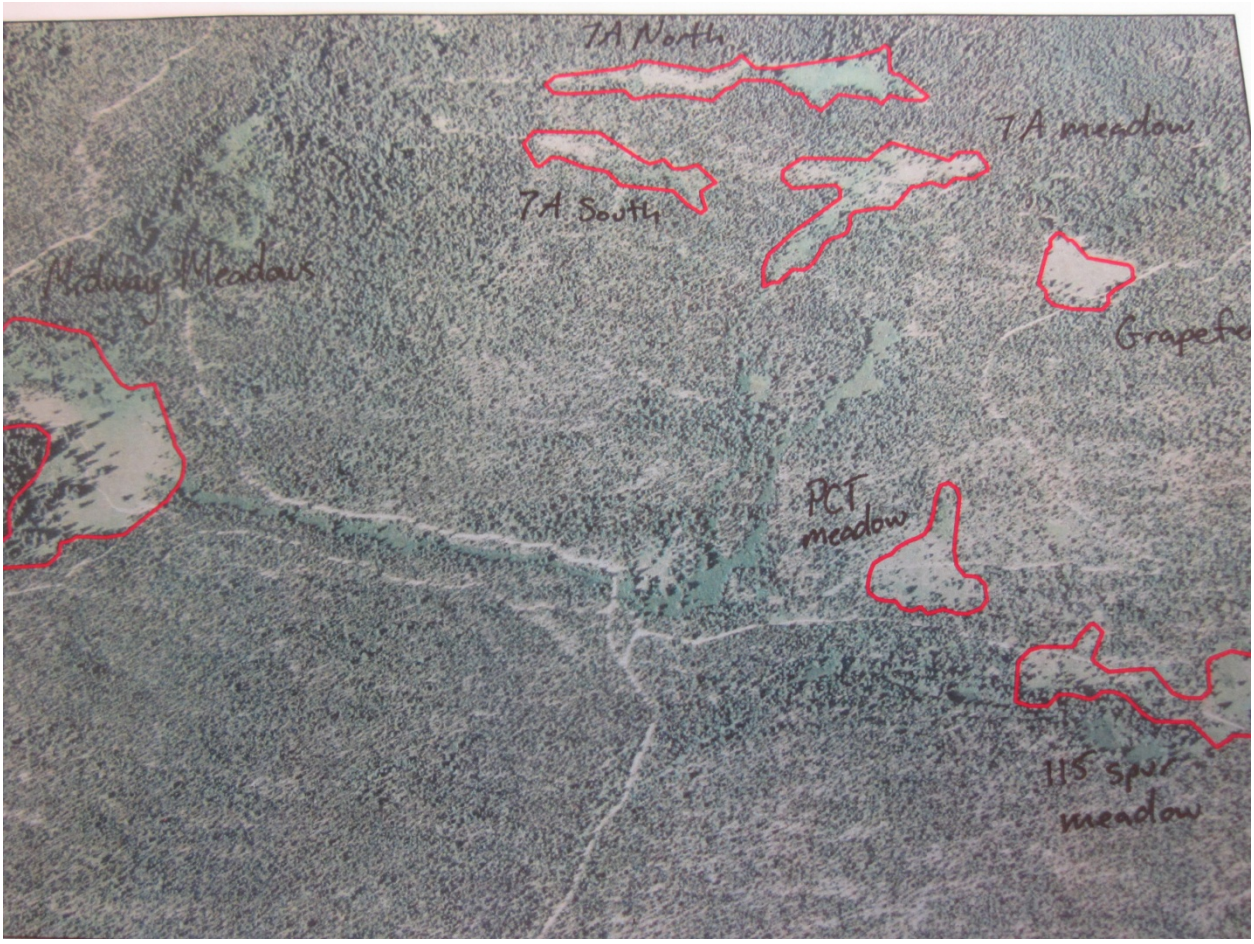

Figure 12: Photo of mardon meadows on CVRD and potential restoration sites.

NEPA Requirements

A Categorical Exclusion (CE) is expected to be completed by September 30, 2015 for the restoration work in the 7A meadow complex, and it will cover some conifer removal in the PCT meadow and Spring Creek plantation as well. Preparation of the CE has required several days of specialists time to conduct botanical, heritage, and other resource surveys in addition to the preparation of the document. Recreation specialists will be involved in project design because of the proximity to the Pacific Crest Trail and 7A trail system.

Monitoring/Site Revisits and Adaptive Management:

The treated areas will be monitored after treatments are completed to determine if the actions were implemented as planned, and to determine the effectiveness of the treatments. It is

expected that invasive weeds will need to be treated on an ongoing basis. Small conifers will need to be removed by lopping or hand pulling every few years. This work could be done by volunteers.

Summary Table for Site Restoration Strategy and Treatment Needs:

Site Name	Monitoring Strategy and Restoration Needs	Estimated Cost
Midway	Annual Invasive Weed monitoring and Treatment Monitor effectiveness of signage and need to close road	$700/year $400.00/year for compliance monitoring
Grapefern	Small conifer removal every 5 years	$700/every 5 years
7A Complex (includes 7A, 7A North and South)	Enlarge meadow complex by removing small conifers and piling slash or prescribed burning,	Approximately $20,000 for implementation and $16,000 for NEPA
115 Spur	Monitor for conifer encroachment, conduct removal if needed	$700/ every 5 years
PCT	Include some conifer removal in CE for meadow restoration. Monitor for effectiveness of ORV boulders on annual basis	Could be included in contract for 7A Meadow complex or accomplished with Forest Service personnel, cost estimated < $500.
Muddy	Annual monitoring for invasive weeds	$200/year, could be combined with Midway treatments/surveys
Midway, Muddy, Grapefern and 7A	Annual monitoring of Mardon skippers	$1300/year
Lupine	Monitor every 4 to 5 years for conifer encroachment and Mardon skipper presence	$600/1 day
Spring Cr.	Conduct conifer removal as covered under CE for meadow restoration.	Could be included in contract for 7A Meadows or accomplished with Forest Service personnel, cost estimated < $500.

Past Restoration Efforts

The following section is a summary of past restoration and management of upland meadows on the Cowlitz Valley Ranger District. This report, prepared by the former district biologist, Tom Kogut, summarizes the efforts undertaken by the GPNF over the period from 2003 to 2009 to address both natural and human-caused meadow impacts. This section includes some strategies and tactics that may be beneficial to others considering similar actions.

Figure 13: White Pass High School Discovery Team restoring "PCT Meadow", Cowlitz Valley Ranger District.

Figure 14: Encroaching lodgepole pines, 7A Trail meadow, prior to restoration.

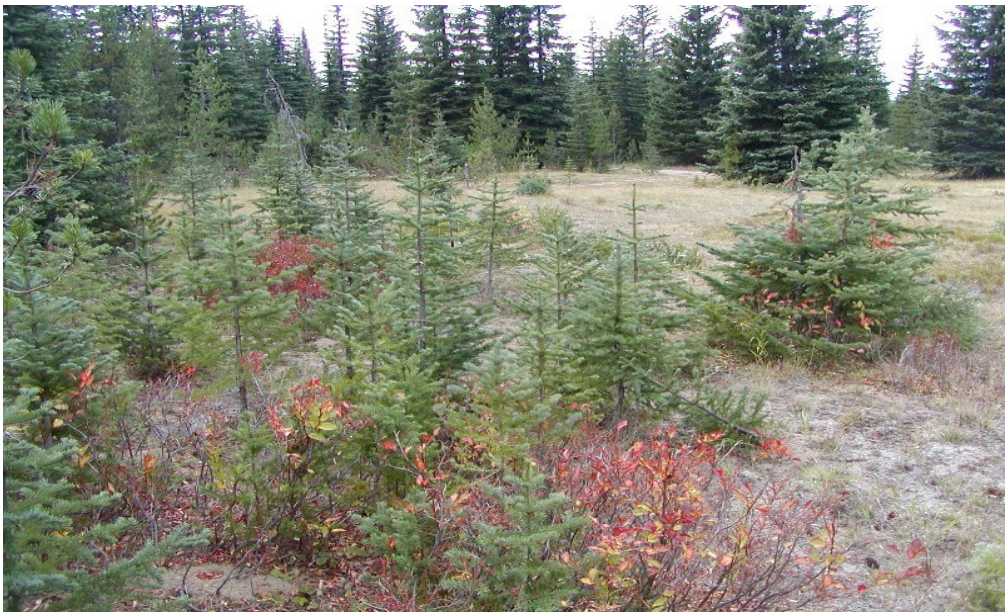

Figure 15: Encroaching conifers, edge of Grapefern meadow, prior to rehab.

The first meadow rehabilitation effort occurred at CVRD in 2003 at the 115 Spur and 7A Trail meadows following the completion of a NEPA analysis (i.e. Categorical Exclusion), both heavily encroached sites featuring lodgepole pine and Engelmann spruce saplings 3 to 15 feet in height. Work was accomplished via "force account" by District staff, with additional assistance generously provided by personnel from the U.S. Fish and Wildlife Service, Lacey, Washington. To minimize disturbance impacts to Mardon skippers and meadow vegetation, as well as on recreation and aesthetics along trails and roads, rehabilitation restoration sideboards included:

- hand cutting only with heavy duty loppers or hand saws
- dragging of cut trees was not allowed; trees were carried to piling locations on meadow edges
- trees were cut flush with the ground to minimize visual impacts
- Work was performed in the fall, following skipper adult emergence and egg deposition and subsequent larval emergence.

In addition, a decision was made to perform work at the large (12 acre) 7A Trail meadow in stages, to distribute rehabilitation impacts over a time span of 3 years, thus allowing a recovery period for treated areas.

In 2004, further assistance became available from the White Pass High School Discovery Team, a summer conservation program for students, which resulted in a much larger workforce. Restoration work was delayed until the last week of the program in August to avoid the adult Mardon skipper flight period. Work focused again on the 7A Trail meadow, with constant monitoring and supervision of crew activities to avoid unacceptable meadow damage caused by dragging trees to pile sites, or excessive trampling. Additional rehabilitation work was done later in 2004 via force account at Grapefern meadow, which contains the highest density of adult Mardon skippers on the Forest, with over 100 adults per acre during peak emergence in mid-July.

Figure 16: US Fish and Wildlife Service personnel cutting encroaching conifers, 7A Trail meadow, September, 2003.

Figure 17: Rehabilitated 7A Trail meadow, September, 2003.

The White Pass Discovery Team was scheduled again in 2005 for more rehab work at the PCT meadow, which had not been treated previously. In 2006 it was observed that since initial rehab efforts in 2003, thousands of conifers had seeded back into the 7A trail and 115 spur meadows, which prompted several days of "touch up work" with lightweight loppers of 6-18 inch seedlings. Although obviously much easier than the initial rehab project, it displays how rapidly the meadows can initiate a successional process back to a forested condition in the absence of constant rehabilitation vigilance.

Illegal Off-road vehicle use: In addition to conifer encroachment, a serious management problem that is equally threatening to meadow habitat, and considerably more difficult to address, is illegal off-road vehicle use. Many of the meadows are accessible by ORV's to varying degrees. These range from Midway meadow, a flat, eight acre site which is easily accessed by ORVs via a spur road which bisects the lower part of the meadow, to other sites where quads and four-wheel drive trucks find openings between roadside trees or boulders to access the meadows. Vehicles also drive up closed spur roads, wood tracks, or even the Pacific Crest Trail and other linear features to access the meadows and points beyond. These sites are relatively remote and enforcement of closures is difficult considering the low number of enforcement officers.

Figure 18: ORV tracks at Midway Meadow, June, 2007.

Several measures have been instituted to address the ORV problem:

1) Signs have been erected at meadow approach roads and along meadow edges to notify the public that driving (along with camping and fires) in meadows is not permitted.

Figure 19: Meadow protection sign, Midway meadow.

2) Existing road closures and open, meadow edge "vehicle corridors" were enhanced with boulders to greatly increase the difficulty of accessing meadows.
3) Backcountry horsemen and hunters at Midway meadow, which is a popular campsite during the summer and fall, were contacted and encouraged to report violations to Forest Service personnel, including law enforcement officers. Although reports often arrive several days "after the fact", they do provide descriptions and license plate numbers for subsequent investigation, and also help to document the frequency and magnitude of violations.
4) Increased monitoring and photographic documentation of vehicular damage was instituted for several meadows to determine the extent of the problem and also to determine the effectiveness of the above deterrent strategies.

Figure 20: Boulder placements to block spur road access to PCT and Grapefern meadows.

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