Conservation Assessment for the

Mardon Skipper
(*Polites mardon*)

Photo Credit: Tom Kogut, U.S. Forest Service

Version 2.0
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Updates in this Conservation Assessment
Since publication of Version 1.0 of the Conservation Assessment in May 2007, additional research and surveys have resulted in new information on Mardon skipper life history, habitat characteristics and use, and location of additional Mardon skipper sites. An additional 66 new Mardon skipper sites have been discovered, although there is a possible loss of some populated sites in the southern Oregon Cascades since 2007.

This version incorporates new information from literature that arose from research needs that were identified in Version 1.0 (e.g., Beyer and Schultz 2010; Henry 2010; Beyer 2009; Beyer and Black 2007); information for site-specific management (Black et al. 2010; Henry 2010; Schultz et al. 2011); occupancy information from the Coon Mountain Burn (Black and Mazzacano 2010); as well as other updates and minor corrections.

Research projects completed since May 2007 have solidified the hypothesis that habitat structure is more important to Mardon skippers than specific bunchgrass species. Research has also shown that bunchgrass habitat structure differs between the Puget Sound and Southern Washington Cascades sites, suggesting that similar studies should be completed at southern Oregon Cascades and the northern California-southern Oregon coastal mountain sites before major habitat restoration projects are implemented in those locations. The number of oviposition and nectaring plant species used by Mardon skippers has been expanded considerably (Beyer and Schultz 2010; Beyer 2009; Beyer and Black 2007). It has also been confirmed that Mardon skipper overwinter in diapause as larvae (Henry 2010).

Management plans have been completed for southern Oregon Cascades sites on BLM lands, providing site-specific management considerations for these sites (Black et al 2010). Updates are included on potential research projects on the Gifford Pinchot National Forest and the Okanogan-Wenatchee National Forest. Updates on threats to the species have also been included.

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Disclaimer
This Conservation Assessment was prepared to compile published and unpublished information on the Mardon skipper butterfly (*Polites mardon*). This assessment does not represent a management decision by the US Forest Service (FS Region 6) or Bureau of Land Management (OR/WA BLM). Although the best scientific information available was used and subject experts were consulted in preparation of this document it is expected that new information will arise and this document may need to be updated. If you have information that will assist in conserving this species or questions concerning this Conservation Assessment, please contact the Interagency Conservation Planning Coordinator for FS Region 6, OR/WA BLM: http://www.fs.fed.us/r6/sfpnw/issssp/contactus/ .

Table of Contents

Updates in this Conservation Assessment 2
Executive Summary 5
Introduction 8
Goal 8
Scope 8
Management Status 9
Classification and Description 10
Systematics and Synonymy 10
Species Descriptions 11
Biology and Ecology 12
Life History 12
Activity Pattern and Movements 13
Food Habits 14
Range, Distribution and Abundance 15
Population Trends 19
Demography 20
Habitat 20
Ecological Considerations 21
Conservation 24
Conservation Status 24
Threats 25
Prior Management Approaches 28
Management Considerations 30
Research, Inventory and Monitoring Opportunities 35
Definitions and Terms Used 41
Acknowledgements 41
References Cited 42
Appendix A. Site-specific threats and conservation concerns for known sites 48
Appendix B. Management Status Definitions 60

Executive Summary

<u>Taxonomy:</u>
Order: Lepidoptera (butterflies and moths)
Superfamily: Hesperioidae
Family: Hesperiidae (skippers)
Subfamily: Hesperiinae (grass skippers)
Common name: Mardon skipper
Scientific name: *Polites mardon*
Taxonomic group: Butterfly

<u>Management Status</u>
The Mardon skipper (*Polites mardon*) is a Federal candidate species for listing under the Endangered Species Act (ESA). It is listed as state endangered by the Washington Fish and Wildlife Commission (WAC 232-12-014). From NatureServe, the species has a Global Heritage Status Rank of G2G3, and a United States National Heritage Status Rank of N2N3 (last reviewed May 1, 2005). The species has a state rank of S1 in Washington and California, and S2 in Oregon. The Mardon skipper is a Forest Service Region 6 Sensitive species and a BLM Special Status Species.

<u>Range, Habitat, and Abundance</u>
The Mardon skipper (*Polites mardon*) is a small, tawny-orange butterfly currently found at only four geographically disjunct areas: 1) northwest California (Del Norte County) and southwest Oregon (Curry County) coastal mountains; 2) southern Oregon Cascades; 3) southern Washington Cascades; and 4) in the south Puget Sound region of western Washington. There are 145 sites comprising 66 populations currently known from these four areas. Some previously known sites / populations have been extirpated.

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* and *Poa pratensis*, and associate with meadows with adequate nectar sources for adults (Beyer and Schultz 2010). East of the Cascades, *D. unispicata* has been found to be an important oviposition species (Joan St. Hilaire, personal communication). In the Puget Prairie, they selected strongly for small clumps of *F. roemeri* with > 50% open moss cover for oviposition, with 86 of 88 observed oviposition events on this species (Henry 2010). Detailed studies have not been done in the southern Oregon or northern California areas; however Beyer and Black (2007) recorded nectaring observations for two southern Oregon sites during a pilot study.

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; Scott Black, personal communication) and in the Okanogan-Wenatchee 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.

Extensive surveys in the southern Oregon Cascades and eastern portion of the Siskiyou ranges on both USFS and BLM lands were done between 2005 and 2008, (Black et al. 2008); no new populations were found. In 2007, surveys on BLM lands along the southern Oregon coast documented Mardon skippers on the south side of Cape Ferrelo (Ross 2007), and surveys in 2008 documented Mardon skippers in the Hunter Creek ACEC on the Coos Bay District BLM (Witt 2008). The Hunter Creek population is located approximately 42 miles (68 km) north of known sites in Del Norte County, California. Three additional sites were located on the Rogue River-Siskiyou National Forest in Curry County, Oregon; two of those "sites" were observations of only one Mardon skipper, but one supported upwards of 100 (Ross 2009, 2010). "Ross (2007) suggests that all likely habitats within the coastal fog belt (from the shoreline to the interior ridges) should be viewed as potential Mardon skipper habitat at the present time" (USFWS 2009, 10). It is unlikely that there are other extant populations outside these four disjunct areas.

Threats

Threats to Mardon skipper include direct impacts to eggs, larvae and pupae by unregulated off-road vehicle use, livestock grazing, and pesticide drift (Btk, *Bacillus thuringiensis* var *kurstaki*, a lepidopteran-specific pesticide). Habitat loss or modification through conifer encroachment, noxious weed invasion, roadside maintenance, and grassland/meadow management activities such as prescribed burning and mowing are also threats. Stochastic events also pose a risk of extirpation to sites due to highly fragmented habitat and disjunct populations. Climate change is also likely a threat.

Management Considerations

To address the threats to Mardon skipper, consider the following actions at occupied skipper sites:

- Hand remove encroaching conifers. Girdling or cutting down trees encroaching grasslands/meadows is encouraged.
- Remove noxious/invasive weeds as early as possible. Utilize all methods of available control to eliminate non-native weeds. If chemical applications are used, consider methods that will reduce spraying on non-target species.
- Limit BtK and other pesticide use within proximity to occupied sites. Utilize a no-spray buffer around occupied sites to reduce the potential for pesticide drift.
- Regulate off-road vehicle use; use boulders, berms, and other methods to deter off-road vehicle use. Consider signing occupied meadows/grasslands prohibiting off-road vehicle use of these areas.
- Limit grazing at occupied sites; where grazing is currently ongoing, consider rotational or light grazing, or restricting cattle from areas where Mardon skipper use has been noted.
- For roads between and around known occupied sites, consider not mowing roadside grasses annually, and when done, leave patches of uncut areas. Rotate placement of the uncut patches when mowing is conducted.
- Cautiously utilize prescribed fire and/or mowing as a meadow/grassland maintenance tool.
    - Consider the life history attributes of Mardon skipper when designing and conducting prescribed burns. Consider burning no more than 20% of the grassland/meadow in any given year, retaining core population areas as unburned until burned areas become recolonized to preburn levels. Design burns to benefit the species.
    - When mowing for grassland or meadow maintenance, consider life history elements of the Mardon skipper in the timing of the mowing.

- Knowledge regarding the use of fire and mowing for other butterfly species suggests consideration of the following:
    - Foster a diversity of habitat and habitat areas during any management activity
    - Utilize a diversity of methods to mitigate negative effects of any one approach
    - Use multiple strategies to enhance heterogeneity of habitat
        - Biodiversity and habitat heterogeneity may increase ecosystem resilience and help ameliorate potential effects of climate change.
    - Avoid treating all habitat in any one year
    - Develop connectivity between sites
    - Manage for both butterflies and vegetation
- Develop site-specific management plans that outline appropriate management strategies and actions needed to maintain, restore, or enhance habitat. Identify when and how to utilize more aggressive management actions such as prescribed fire and mowing.
- For any actions taken to improve or maintain grassland habitat for this species, monitor the effectiveness of those management actions, to measure and improve future success.

Research, Inventory and Monitoring Opportunities

In spring of 2005 an interagency Mardon Skipper Work Group identified and prioritized information and conservation gaps for the Mardon skipper, developed potential projects, and identified tasks and products for some of the projects. The priority gaps identified by the Work Group include:

- Research
    - Define range of habitat characteristics
    - Identify oviposition grasses, and larval host plants and food sources
    - Delineate and characterize adult use areas
    - Develop research projects to determine impacts of grassland restoration and grazing
    - Identify dispersal capabilities and dispersal modes (via habitat corridors or between “stepping stones” of suitable habitat)
    - Develop partnerships to further research on the species
- Inventory
    - Develop a survey protocol
    - Identify distribution gaps and priority areas to survey
- Monitoring
    - Develop a long-term monitoring protocol
    - Monitor restoration effectiveness

Through work by this group with Washington State University and the Xerces Society for Invertebrate Conservation, several research projects were initiated (see Beyer and Black 2007; Beyer 2009; Beyer and Schultz 2010; and Henry 2010). Considerable information on oviposition and larval host plants was gathered through these efforts.

A subgroup developed a survey protocol, identified distribution gaps, and between 2007 and 2010, the Interagency Special Status and Sensitive Species program funded surveys in these areas. Development of a monitoring protocol was begun by this group, but it was determined that more information was needed on adult and larval use areas and critical resources prior to completion of this protocol.

Introduction

Goal

The Mardon skipper (*Polites mardon*) is a small, tawny-orange butterfly currently found at only four geographically disjunct areas in Washington, Oregon and California. This species is of concern because it has a restricted distribution and exists in disjunct populations in northwest California, southern Oregon Cascades, southern Oregon coast, the southern Washington Cascades and two populations in the Puget Trough south of Seattle, Washington; four populations in the Puget Prairie area have been extirpated through habitat loss. Mardon skippers appear to have narrow habitat requirements, at least in most portions of their range. Most habitats are subject to a variety of anthropogenic disturbances such as recreation, livestock grazing, introduction of invasive weeds, various insecticides including Btk,[*] as well as natural succession (e.g., conifer encroachment in meadows) which may threaten persistence of individual sites.

The primary goal of this Conservation Assessment is to summarize existing knowledge regarding the biology and ecology of the Mardon skipper butterfly (*Polites mardon*), discuss threats to the species and identify management considerations to aid federal management for the species' conservation. This Conservation Assessment provides the most up to date information known about the species and describes actions and considerations to effectively manage sites for this species. Version 1.0 of the Conservation Assessment was published in May 2007. This version is an update on recent research, new information on the biology and status of the species, new sites, and updates on site-specific threats and management recommendations.

Federal management for this species follows FS Region 6 Sensitive Species (SS) policy and OR/WA BLM Special Status Species (SSS) policy (6840 Manual). For OR/WA BLM administered lands, SSS policy details the need to manage for species conservation. For FS Region 6 SS, policy requires the agency to maintain viable populations of all native and desired non-native wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands. Management "must not result in a loss of species viability or create significant trends toward federal listing" (FSM 2670.32) for any identified SS. Management considerations outlined below apply to FS Region 6 and OR/WA BLM lands only.

Scope

The biological and ecological information in this assessment includes the entire known and suspected range of the species from the southern Puget Sound area and southern Cascades of Washington, the southern Cascades of Oregon, and northern California. There are five OR/WA BLM and FS Region 6 administrative units which encompass the range and known sites of the species:

- In Washington, the Mount Adams and Cowlitz Valley Ranger Districts of the Gifford Pinchot National Forest; and the Naches Ranger District on the Okanogan-Wenatchee National Forest.
- In southern Oregon Cascades, the Ashland Resource Area, Medford District BLM in the vicinity of the Cascade Siskiyou National Monument; and the Ashland Ranger District of the Rogue River/Siskiyou National Forest.

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[*] *Bacillus thuringiensis* var *kurstaki* is a lepidopteran-specific insecticide

- In the southern Oregon coastal area, there are two sites on the Coos Bay District BLM, three sites on the Gold Beach Ranger District of the Rogue River-Siskiyou National Forest.

Additional known sites, not on FS Region 6 or OR/WA BLM lands include:

- In California, the Smith River National Recreation Area of the Six Rivers National Forest and Redwood National Park.
- Two populations in South Puget Sound, one on a State-managed Wildlife Area in Thurston County and one on Joint Base Lewis-McChord, a Department of Defense (DOD) base south of Tacoma, Washington.
- Significant populations and habitat are known to occur on the Yakama Indian Reservation.
- Other sites in the southern Washington Cascades include Conboy Lake National Wildlife Refuge, and a few sites on state and private lands in Klickitat County.
- One site on Oregon State Parks land along the southern Oregon coast.

The Conservation section of this Conservation Assessment applies only to those populations and habitats on OR/WA BLM and FS Region 6 lands, but may be a useful tool for other land management entities as well.

Information about the Mardon skipper was gathered from published and unpublished literature and discussions with species experts who have worked with Mardon skipper for many years. Published scientific literature specific to the Mardon skipper is limited, particularly regarding information on some aspects of the life history and biology of the species. Where information specific to Mardon skippers is not available, research on similar species is presented in this Conservation Assessment in an attempt to address data gaps and to provide possible hypotheses for further research and study. As an example, information on dispersal potential, prior management approaches, and management considerations is largely from research on other species; inference from this literature is acknowledged where appropriate.

A considerable amount of information has been gained in recent years and expansion of the known range has occurred due to increased survey efforts from 1999 through 2010. Threats and conservation concerns in this document summarize known or suspected existing threats, which may also change with time. Management considerations may be applied to localities where the species is documented and to nearby suitable habitat; larger scale issues such as population connectivity and range-wide concerns are also addressed.

Management Status

The Mardon skipper (*Polites mardon*) is a Federal candidate species under the Endangered Species Act (ESA). It is listed as a state endangered species by the Washington Fish and Wildlife Commission (WAC 232-12-014). The Global Heritage Status Rank is G2G3, the United States National Heritage Status Rank is N2N3 (June 1, 1999). The species has a state rank of S1 in Washington and S2 in Oregon. The Oregon Natural Heritage Information Center gives the species a Program Rank of List 1. The Mardon skipper is a FS Region 6 Sensitive species, and as a Federal candidate species it is also a BLM Special Status Species. (See Appendix B for definitions of Management Status designations.) The Washington Heritage Program acknowledges two subspecies (*P. m. mardon*, and *P. m. klamathensis*), giving a sub-species rank of T2T3 for Washington. The Oregon Natural Heritage Information Center does not identify a split for this species in their ranking.

Classification and Description

Systematics and Synonymy

The Mardon skipper, (*Polites mardon*) is a butterfly in the Order Lepidoptera (butterflies and moths), superfamily Hesperioidae, family Hesperiidae (skippers), subfamily Hesperiinae (grass skippers). It was originally described by W. H. Edwards (1881) as *Pamphila mardon* from three males and three females taken from near Tenino, Thurston County, Washington by H. K. Morrison in 1880. The type locality, stated by Edwards as Mount Hood, was later designated as small prairies near Puget Sound (Miller and Brown, 1981 cited in Mattoon et al. 1998). Most common and scientific names for butterflies come from Greek and Roman mythology (Ann Potter, personal communication); however the name Mardon is likely derived from Mardonius, an historically documented Persian general (died 479 B.C.).

Until 1979, there were few known locations for the Mardon skipper: on the Gifford Pinchot National Forest in Yakima County, Washington, Seattle and Grand Mound in Western Washington, and from Lake of the Woods, Klamath County, Oregon based on three males in the collections of the American Museum of Natural History. Newcomber (1966) documented two sites on the Yakama Indian Reservation and noted that the species had been collected at Mount Adams in 1955. In 1979 a population was discovered east of the town of Smith River in northwestern Del Norte County, California; and in 1991 a population was confirmed southwest of the Lake of the Woods area in Jackson County, Oregon (Mattoon et al. 1998). Mattoon et al. also reported that one specimen was taken near Yreka in Siskiyou County, California, but that specimen was likely collected in Oregon and mistakenly mixed with a Siskiyou County collection (Black et al. 2002). In 2004 a population was discovered by lepidopterists in the Little Bald Hills area of Redwood National Park, the southern-most known population in the range of the species. The species does not occur in any other National Park.

Mattoon et al. (1998) proposed that the Oregon population be given subspecies status *Polites mardon klamathensis* and the Washington and Northern California populations, subspecies status of *Polites mardon mardon*. Adults of *P. m. klamathensis* are described as having a consistently tawnier dorsal and ventral coloration when compared to adults from other populations (Warren 2005). A group of *P. mardon* populations exists in coastal Del Norte County in California approximately 80 air miles to the west/southwest of *P. m. klamathensis* populations in Oregon. These Del Norte County populations were called *P. m. mardon* by Mattoon et al. (1998), however the series of *P. mardon* from these Del Norte populations have not yet been carefully compared to series of *P. m. mardon* from Washington due to the small number of specimens available for evaluation (Mattoon et al. 1998), and the use of the name *P. m. mardon* for California populations should be considered tentative (Warren 2005). The geographic split of the two *P. m. mardon* populations by *P. m. klamathesis* raises questions about this subspecies classification in California. No additional work or genetic studies have been done to clarify the subspecific designations described above (Thomas Emmel, personal communication).

Species Descriptions

The Mardon skipper is generally described as a small (20-24mm; <1 in), tawny-orange butterfly with a stout, hairy body. The upper surface of forewings and hindwings is orange with broad dark borders, and underwings have a distinctive discal band pattern of light yellow to white rectangular spots. Males are smaller than females (Edwards described the males as "expands 1 inch, and females as "expands 1.1"), and have a small, dark brown, slender and branched streak (stigma) on the upper surface of the forewing. Females have a more distinct ventral hindwing pattern. As is typical of most members of the Hesperiinae, Mardon skippers have a fast, skipping flight, often described as a stone skipping across water. Also like most Hesperiinae, they have bent antennae clubs and a characteristic basking posture in which the forewings are held at a 45-degree angle and the hind wings are fully spread (Potter et al. 1999; Potter et al. 2002). The Mardon skipper is differentiated from other closely-related *Polites* species by its short, rounded wings, reduced stigmal elements, and other distinctive morphological features (MacNeill 1993, p. 179; USFWS 2010).

The Mardon skipper can be difficult to distinguish from similar skippers. The woodland skipper (*Ochlodes sylvanoides*) is widespread and its flight period overlaps with the Mardon skipper at higher elevations. In the south Puget Sound region, the Juba skipper (*Hesperia juba*) and the Sonora skipper (*Polites sonora*) have flight periods that overlap with the Mardon skipper. In the southern Cascades grasslands, the Juba skipper, the common branded skipper (*Hesperia comma* harpalus), Nevada skipper (*Hesperia nevada*), Sonora skipper, woodland skipper (*Ochlodes sylvanoides*) and the sachem (*Atalopedes campestris*) may be present during the Mardon skipper flight period (Potter et al. 2002). Each of these species has slightly different wing patterns.

Characteristics which distinguish the Mardon skipper from other skippers include:

- Forewings are more rounded – difficult to see in the field
- Borders between the orange and brown areas are generally more diffuse – difficult to see in the field
- A series of 5 or 6 lighter, adjacent spots (the macular band) on the ventral hindwing
    - The middle spot (2nd or 3rd from the top) is strongly rectangular, approximately twice the size of the others and juts out toward the perimeter of the hindwing – this is the most distinguishing characteristic (Sonoran skipper's macular band is a series of square shaped spots)
- Male stigma short and S-shaped (elongate, straight and blocky in Sonoran skippers) (Pyle 2002, Ann Potter, personal communication)

The size and orientation of the middle spot of the macular band is usually diagnostic of Mardon skipper, although distinguishing some Sonoran skippers can be problematic (Runquist 2004). While the above four characteristics provide information to distinguish the Mardon skipper from other similar species, butterfly field guides such as Pyle (2002) are probably the best source for pictorial "keys," but may be difficult to use to accurately identify adult butterflies. Field experience with experts and practice are generally required to accurately distinguish Mardon skipper from similar species.

Biology and Ecology

Life History

Mardon skippers are univoltine, completing one life cycle annually. Adults typically emerge between May and July, but possibly later at higher elevations. 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. 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 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).

The short, open structure of the native caespitose bunchgrass plant community is important to adults to allow egg deposition and access to nectar sources, as Mardon skippers seldom fly higher than one meter except during what is assumed to be courtship behavior when they will fly higher (Ann Potter, personal communication). In native vegetation communities, the spacing between the native bunchgrass clumps allows the low flying Mardon skipper access to nectar sources. Note that the preferred structure, although similar, varies between regions (Henry 2010; Beyer and Schultz 2010). Plant communities dominated by nonnative grasses and woody shrubs may restrict the Mardon skipper's ability to access nectar plants. For the Oregon silverspot butterfly (*Speyeria zerene hippolyta*), Pickering (1995) found that the structural characteristics of the grasslands affect the abundance of violets and possibly the female butterflies' ability to find them.

Beyer (2009) and Beyer and Schultz (2010) found that oviposition locations indicated a preference for low canopy cover and low tree abundance, as well as positive correlation with a larger distance to trees. As Beyer (2009) stated (p. 19):

> A high amount of tree and shrub cover reduces solar insolation and shading of habitat creates a cooler environment. As butterflies are ectotherms, they are physiologically limited to daylight hours when temperatures are high enough to enable butterfly mobility (Davies et al. 2005; Doak et al. 2006; Freese et al. 2006). Additionally, egg-laying rates are temperature dependent (Davies et al. 2006).

Henry (2010) found that Mardon skippers in Puget prairies preferred oviposition locations on widely spaced, small, green fescue bunchgrasses in areas with at least 50% open moss cover, suggesting that site-specific assessment is necessary to determine the preferred habitat characteristics for each of the four disjunct populations.

Until recently it was thought that eggs were laid on native fescue bunchgrass. A 2006 pilot study at two sites on the Gifford Pinchot National Forest and two sites on Medford District BLM has shown Mardon skippers use more than one graminoid species for oviposition (Beyer and Black 2007). Additionally, on the Gifford Pinchot National Forest, Beyer (2009), and Beyer and Schultz (2010) observed oviposition on 23 different species, eight sedges and 15 grasses. Beyer and Black found the most common oviposition plants were *Danthonia californica*, *Festuca idahoensis*, and *Carex* species. Beyer and Schultz (2010) found the most common oviposition plants were *F. idahoensis* and *Poa pratensis*. Other oviposition species included *Danthonia intermedia, Carex inops, Festuca rubra, C. deflexa, C. fracta, C. praticola*, and *C. hoodi*. These findings, along with findings by Beyer and Black (2007) that found oviposition on *F. roemeri*, *Deschampsia caespitosa*, *Bromus carinatus*, and *Stipa occidentalis* support the contention that Mardon skipper habitat use reflects their response to their respective habitats (Beyer and Schultz 2010). Between all combined studies, Beyer identified 23 different oviposition sedge and grass species, all native perennials with the exception of *Poa pratensis*, a nonnative perennial and *Muhlenbergia filiformis*, a native annual (Beyer 2009). In Beyer's work, (2009) 17 of 24 females selected a single species for oviposition, although the species varied by individual, and the remaining seven switched species between consecutive ovipositions. In Henry's work (2010), she observed 86 of 88 ovipostion locations occurred on small bunches of *F. roemeri*. Likewise, 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.

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 (Mary Linders, personal communication 2006). Henry (2010) confirmed that larva overwinter in diapause, and that captive rearing efforts appear to significantly alter larval development and diapause.

Larvae captive reared at the Oregon Zoo (Portland, Oregon) in 2004 exhibited behavior that seemed out of normal phenology. During this effort some larvae from a southern Washington Cascades population went into diapause in the larval stage, while others diapaused as pupae; survival was variable in both circumstances (Mary Linders, personal communication). Additionally the larvae pupated at a different time than usual in the wild. However, the Mardon skippers collected for the captive rearing program were collected at 4,300 feet in elevation, which may have influenced the captive breeding results obtained at the (low elevation) Oregon Zoo.

Activity Pattern and Movements

The Mardon skipper is a relatively sedentary butterfly. Mardon skippers do not migrate, rarely dispersing 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 (Ann Potter, personal communication). 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. While it is expected that Mardon skippers have limited dispersal capability, there are some unusual site locations that are difficult to explain. For example, one site on the Gifford Pinchot National Forest was an old-growth cedar stand in the early 1960s prior to clear-cut harvest. Following harvest, reforestation efforts at the site were mostly unsuccessful, and the site now supports Mardon skippers. The nearest known potential source populations are over 2 miles away and the site was colonized during the past 40 years (Vince Harke, personal communication). The colonized site occurs in a heavily roaded and clearcut landscape which appears to provide opportunities for Mardon skipper to colonize early seral habitats.

Thus, dispersal may occur (though relatively slowly), likely corresponding with metapopulation dynamics models. However, Wahlberg et al. (2002) note that distributions of data collected on dispersal distances (on checkerspot butterflies, fritillaries, and sulphurs) are highly skewed toward short distance movements, and maximum observed distances for butterflies are generally between 1 and 2 km, corresponding to the maximum observable distance in a particular study area. Dispersal patterns may also vary widely from year to year. For example, checkerspot butterflies (*Euphydryas spp*.) display increased vagility following dry winters as larval host and adult nectar plants may be sparse from lack of precipitation (Ehrlich and Murphy 1987). They also found that in one very wet year populations exploded in size and adults dispersed *en masse* from population centers.

Food Habits

Adults

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).* Mardon skippers often avoid areas with Scotch broom (*Cytisus scoparius*) (Hays et al. 2000).

Feeding by individual adults tends toward one or a few species; it appears that newly emerged adults “learn” the nectar producing species that are available upon emergence and most often feed on these species throughout their lives (Ann Potter, personal communication). Regular access to nectar plants is likely critical to survival of adults. Nectar provides carbohydrates necessary to meet energetic needs for flight and maintenance of optimal metabolic rate, and allows females to attain maximal fecundity (Murphy et al. 1983, cited in COSEWIC 2003). Nectar also provides water.

Larvae

Most butterfly larvae have very specific requirements for food plants and host plant species appear to vary by region: red fescue in the California populations, Roemer’s and Idaho fescues in the Puget Sound, and Idaho, red and an unidentified fescue species in the Mt Adams populations (Potter et al 1999, Potter & Fleckenstein 2001, Potter et al. 21002, Hagard 2003). Based on oviposition studies (Beyer and Black 2007; Beyer 2009; Beyer and Schultz 2010; Henry 2010), Mardon skipper larvae are believed to feed on a wide variety of native bunchgrass, including Idaho fescue (*Festuca idahoensis*), red fescue (*F. rubra*) and Roemer's fescue (*F. roemeri*), as well as a wide variety of other bunchgrass species (see Life History section above). Larvae have also been found on an unknown fescue cultivar (Potter et al. 1999). Mardon skippers select for larger host plants, at least in the southern Washington Cascades (Beyer and Schultz 2010), which may provide greater cover and allow larvae to switch to more favorable host plants to compensate for poor natal habitat (Albanese et al. 2007, cited in Beyer and Schultz 2010; Hellmann 2002). In the Puget Prairie area, Mardon skippers select for lower, less dense (>50% open ground (moss) cover) bunchgrasses (Henry 2010). All known southern Oregon sites are associated with fescue bunchgrasses although other species were also used for oviposition (Beyer and Black 2007). 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).

Range, Distribution and Abundance

The Mardon skipper is a little-studied species; however, the species has received considerable attention and some funding for surveys since becoming a Federal candidate species in 1999. Surveys have focused on each of the 4 disjunct population areas as well as in between and along the edges of these populations. In the south Puget Sound, grasslands have been surveyed, including large areas of Joint Base Lewis-McChord. Within forested-grassland openings in areas of the southern Cascades of Washington, areas have been surveyed on the Gifford Pinchot National Forest and Naches Ranger District of the Okanogan-Wenatchee National Forest. In the southern Oregon Cascades, surveys have been conducted on Medford District BLM, the Klamath Falls Resource Areas of the Lakeview BLM District, the eastern portion of the Rogue River-Siskiyou National Forest, and western portion of the Fremont-Winema National Forest. Surveys in between the southern Washington Cascade and southern Oregon Cascade populations have been conducted on the Columbia River Gorge National Scenic area, and the Mt Hood and Willamette National Forests with no Mardon skippers found. In the western part of the Siskiyou Mountains in Oregon to the coast, surveys have been conducted on the Rogue River-Siskiyou National Forest and Coos Bay District. Surveys have also been conducted in southern Oregon between the Cascades and Siskiyou/coastal populations with no new sites found. In Redwood National Park, the National Park Service has conducted surveys in the Little Bald Hills region since 2004, when a population was first discovered there.

Mardon skippers were likely more widespread and abundant prior to the past 150 years of human development, livestock grazing, fire suppression, and invasion of grassland habitat by native and non-native vegetation. Based on the distribution of the prairie soils of the region, prairies once covered approximately 150,000 acres in the Puget Sound region of Washington. Currently, less than 3% of that original prairie landscape remains with native prairie plant composition. The majority of the south Puget Sound prairie is degraded and is considered endangered (Noss et al. 1995; Crawford and Hall 1997 in Black et al. 2002). Grasslands were also once common across the lowland landscape from southern Vancouver Island south into the Willamette Valley of Oregon, as well as throughout the historically more open pine / fir habitats of the Cascades. Current estimates of the remaining native upland prairie in the Willamette Valley are less than 400 ha (988 ac) (Christy and Alverson 2002), and less than one percent of the estimated 409,000 ha (1,010,000 ac) of its historic extent remains. Most of this has been lost through conversion of native prairie to agricultural use and urbanization as well as through fire suppression and subsequent woodland succession (Boag 1992).

For purposes of estimating the number of distinct populations, occupied grasslands (sites) can be considered to belong to the same population if the grasslands are within the annual dispersal distance for the species, generally assumed to be 0.5 mi (0.8 km) or less (Potter and Fleckenstein 2001). However, population delineation may be influenced by barriers to dispersal (e.g., dense forest) or other factors which could make occupied grasslands separated by less than 0.5 mi (0.8 km) not connected. Because the dispersal behavior of the species is largely unknown, the delineation of populations is a generalization of local clusters of sites within a specific geographic area. For example, at Joint Base Lewis-McCord, Washington, Mardon skippers have been monitored at three separate locations. However, because these sites are all located within the same prairie complex with no barriers to dispersal, these three sites are considered to represent a single population (Table 1). Note that in the discussion on metapopulation dynamics below, sites in this context are termed populations to be consistent with the metapopulation literature.

In 1999, the Mardon skipper was known from approximately 37 populations/sites located in four geographic areas: the south Puget Sound in western Washington, the southern Cascades of Washington, the Conboy National Wildlife Refuge east of the Gifford Pinchot National Forest, the southern Oregon Cascades, and one site in northern coastal California (Potter et al. 1999, USFWS 2004). Washington's total populations in 1999 were estimated to comprise a few hundred individuals at nine occupied sites. Populations at five historic locations, despite intensive surveys in recent years, are thought to be extirpated (Potter et al. 1999). One site on the Conboy National Wildlife Refuge may be extinct, but Mardon skippers have been documented at another location on the refuge and at three sites on adjacent private lands (Potter and Fleckenstein 2001; Potter et al. 2002). These encompass the lowest elevations sites documented in the Washington Cascades (approximately 1,800 feet) (USFWS 2010).

In the Puget Sound lowlands, the Mardon skipper is found on glacial outwash prairies, inhabiting open grasslands with Roemer's fescue interspersed with early blue violet. Additional sites (likely one metapopulation) are located at Joint Base Lewis-McChord around the 7,000 acre Artillery Impact Area, the largest remaining prairie in south Puget Prairie, which is used by the Army as an artillery range. These populations are likely maintained at a relatively low density when compared to southern Washington Cascade populations, possibly due to low availability of nectar sources, though common vetch is available as a nectar source (Mary Linders, personal communication). The more likely cause of low population densities may be the result of regular fires that occur on the Artillery Impact Area (Ann Potter, personal communication).

In Thurston County, Mardon skippers occur in two populations bisected by a forested stream and wetland within a State-managed Wildlife Area (USFWS 2010).

Survey efforts in 2000 located Mardon skippers at 19 new sites mostly within the Mt. Adams Ranger District of the Gifford Pinchot National Forest, expanding the distribution of Mardon skippers in the southern Washington Cascades, with some sites supporting relatively large populations (Potter and Fleckenstein 2001). Surveys in 2001 added two additional locations, with all 21 sites within 4 miles of known sites (Potter et al. 2002). In 2002, surveys on the Mount Adams Ranger District located 13 new sites; in 2003 and 2004, two more sites were discovered.

Since 2004, Yakama Nation biologists have conducted annual Mardon skipper surveys within the Reservation. Mardon skipper populations have been detected in 11 populations (23 sites), many of which are extensive meadow complexes; this includes one particularly notable site which covers hundreds of acres of high meadows and observed densities of approximately 50 individuals per acre.

A new population was found in 2006 on the Naches Ranger District of the Okanogan-Wenatchee National Forest, which expanded the known distribution approximately six miles north of the nearest population. Twelve to 15 individuals were documented, but the surveys may have occurred near the end of the flight period.

Twenty-eight sites are known from the Cascade Mountains in Southwest Oregon, 24 on federal lands (two new sites discovered in 2010) and four sites (status unknown) on private lands. most bordering the Cascade-Siskiyou National Monument, with populations ranging from a few to approximately 200 individuals (Potter et al. 1999 and Scott Hoffman-Black, personal communication). In 2005, four new Mardon skipper sites were located on Rogue River-Siskiyou National Forest lands 6.5 km north of Medford District BLM sites in the southern Oregon Cascades. One day counts at southern Oregon sites ranged from one butterfly to over 70 butterflies. The majority of these sites had one day counts of less than 20 (Scott Hoffman Black, personal communication.).

Surveys on the Coos Bay District BLM have located two sites (one population) on the Hunter Creek Area of Critical Environmental Concern (2008). Nearby surveys in 2009 and 2010 on the Gold Beach Ranger District located an additional two sites.

In California, surveys in 2003 at the site known since 1979 identified four principal grasslands (totaling approximately 4.5 acres) in which Mardon skipper were consistently observed (Haggard 2003). The furthest site is approximately 0.3 km from the other three, which are within 0.1 km of each other. Dozens of individuals have been detected during peak years in its 1-2 acre core area at this coastal California site (Potter et al. 1999; Haggard 2003). In 2004, lepidopterists found a new population in northwestern California, approximately 10 km from the known population (Gary Falxa, personal communication). Dozens of individuals have been observed at this site in peak years. Preliminary results from survey work and incidental observations in 2005 suggest at least one other population or metapopulation exists in the region of the other two populations and presence in other grasslands near the historic site has been documented. The U.S. Fish and Wildlife Service funded surveys in the Smith River drainage in Del Norte County to about 20 miles inland from the coast. Multiple surveys between 2003 and 2008 confirmed the three populations in this area as well as documented surveys where no Mardon skippers were located (Arnold 2006; Black et al. 2008).

Surveys into areas neighboring known populations have expanded our knowledge of the species' range from 37 known sites in 1999, to over 60 sites in 2004, to approximately 145 in 2010 (Table 1). Examples of surveys expanding our knowledge of the species' range include:

- Surveys in 2005 located approximately 11 additional sites in Oregon, and one additional site on the Cowlitz Valley Ranger District, Gifford Pinchot National Forest.
- On the Okanogan-Wenatchee National Forest, surveys between 2006 and 2010 located Mardon skippers at 36 sites including two sites documenting over 900 individuals each in

2008 and 2009. These large populations are at sites with dense mats of *Danthonia unispicata,* which may provide protected microhabitat conditions conducive to overwintering survival (USFS and WDFW 2010).

- Surveys in 2008 also located an additional site (Coon Mountain), probably the largest in northwest California (Black et al. 2008), and two sites in the Coos Bay District BLM in 2009.
- Surveys on the Rogue River-Siskiyou National Forest in Curry County located an individual male Mardon skipper at one site in 2009 (Ross 2009), and two additional sites in 2010; in one of those sites, over 100 individuals were discovered (Ross 2010).

While historical and recently discovered sites have increased the number of total sites to 145, encompassing 66 known populations, this increase is likely not due to increased habitat or expanding populations, but instead due to increased survey effort in areas not previously surveyed. Some previously known sites have been extirpated. Additional surveys in subsequent years may increase our understanding about the distribution of the species as well as to better identify connections within potential metapopulations; however, there is no connectivity between populations in the species disjunct distribution, and limited connectivity between individual sites within local populations.

Table 1. Summary of known populations of the Mardon skipper*

LOCATION	Approximate Number of Documented Sites with Species Presence (Fall 2010)	Approximate Number of Populations
South Puget Sound, WA		
Joint Base Fort Lewis-McChord	3	1
Thurston Co.	2	2
Southern Cascades, WA		
Okanogan-Wenatchee NF	36	20
Gifford Pinchot NF	43	13
Yakama Reservation	23	11
Glenwood-Goldendale	6	3
Southern Cascades, OR		
Medford District BLM	14	11
Rogue River Siskiyou NF	3	1
Private land	4	Status unknown
Oregon Coast	2	1
Northern California Del Norte Co.	9	3
TOTALS	**145 sites**	**66 populations**

* Note that different documents from other agencies or organizations may cite different numbers of sites and populations because of different definitions for these terms. Additionally, not all sites are included in this table because of lack of information on private or non-BLM/USFS lands.

Population Trends

The historic range and abundance of the species are unknown. No estimates of abundance are known to have been made at any site prior to 1980. However, Mardon skippers were likely more widespread and abundant prior to the large-scale loss and modification of grassland and prairie habitat. The number of sites, species' range, and population abundance are believed to have declined severely from historic distributions because of loss of habitats with which the species is associated (Potter et al. 1999). There has been a documented range contraction in the south Puget Sound area and the south Cascades of Washington, with some populations having been extirpated. Loss of sites has also been documented in the southern Oregon Cascades (Black et al. 2010). See the habitat section (below) for historic and current trends in habitat availability.

In the southern Oregon Cascades there are 24 current and historic sites known from Forest Service and BLM lands. Four locations on private lands are also known but the status of those sites is not known. Surveys in 2010 noted that several sites on BLM lands may have been extirpated. Additional surveys in future years are needed to confirm site status. On BLM and Forest Service lands only 12 of these 24 sites were known to be extant in 2009 (Black et al. 2010).

Surveys to estimate abundance have been conducted by systematically walking transects through a site and counting the number of adult Mardon skippers encountered (Seitz et al. 2007, Pollard and Yates 1993). However, these surveys have mostly been one-day counts so it is not known if it was early or late in the adult flight period, or if counts occurred during the peak flight period.

The timing and length of adult flight periods can vary widely. At one Washington site, Beyer and Black (2007) note that adult emergence went from zero on July 6th to 135 adults on July 9th. In general, it has been noted that insect populations fluctuate widely (Ehrlich et al. 1975 and Weiss, 1998, cited in Ehrlich, 1992); and within metapopulations, site extinctions may be a part of normal population dynamics (Ehrlich et al. 1975, 1980). Population estimates have been made for several Washington sites. However, at this point, abundance counts have not been conducted long enough, nor has there has been statistical population monitoring to determine population trends at any of the sites. Additionally, it is very difficult to conduct censuses during the entire flight period at multiple sites because of the variation in flight periods, even among sites near each other.

Mardon skipper abundance within a site, between sites and between years varies considerably. For example, surveys on the Mount Adams Ranger District in 2002-2004 show that one-day counts at each of the sites visited vary significantly; from 1 to 180 individuals in 2002, (with nine sites ranging between 10 and 55), and 3 to 62 in 2003 and 2004 (Mitch Wainwright, unpublished data). Additionally, recent surveys on the Cowlitz Ranger District (Gifford Pinchot National Forest) found populations generally ranging from 15 to 50 at five sites; however, in one four-acre meadow (Grape Fern Meadow) over 50 were detected in 2002, 392 were counted in 2003, 420 in 2004, and 65 in 2009 (Tom Kogut, personal communication). In Redwood National Park numbers have varied considerably since discovery of the Little Bald Hills population in 2004. No Mardon skippers were located in 2006; there were "too many to count" in 2008; approximately 46 in 2009; and 31 in 2010 (Kristin Schmidt, personal communication). Surveys in 2009 showed particularly low numbers across many sites, possibly in response to an unknown weather, or other factor that could have occurred anytime between late-summer of 2008 and spring of 2009; spring and early summer of 2009 was particularly cool and wet across the region.

Demography

Mardon skippers are a univoltine species, with adults having a relatively short life time, and producing one brood of eggs per year. The demography of populations is currently unknown, but as in many invertebrates, it likely varies widely from year to year depending on resource availability and previous year's reproductive output. The demographics of a population in one year can have a profound effect on the next year's breeding potential; the density of a population, particularly of a univoltine species, in one year is dependent on the density of that population in the preceding year. Stated another way, if the population is low one year, it will likely be low the following year and vice versa (Royama 1981).

Actual demographics in terms of adult population age structure have little bearing on an understanding of this species as a whole. Demographics of Mardon skipper populations (changes in numbers of different life stages) are not well understood as it is very difficult to monitor immature stages in the wild (Ann Potter, personal communication). Both exogenous (e.g., weather, habitat topography) and endogenous (previous year's reproductive success, density dependent mortality) factors must be considered when making estimates or explaining population fluctuations (McLaughlin et al. 2002).

Habitat

Mardon skippers occupy grassland habitats, the characteristics of which appear to vary by region:

- In the south Puget Sound lowlands the Mardon skipper is found on grasslands situated on glacial outwash soils, often referred to as prairies. In this habitat type, they use open grasslands with abundant *Festuca roemeri* interspersed with *Viola adunca*.
- In the southern Cascades of Washington, (elevation 549m to 1,677m (1,800 ft to 5,500 ft)) the Mardon skipper is found in warm, dry grand fir (*Abies grandis*) savannah / woodland with grassland intrusions or in small (<0.25 ha (<½ acre)) to larger grassland complexes. Forty percent of the Gifford Pinchot National Forest sites are in older clearcuts which are now dominated by fescue bunchgrasses. In the long term, fire suppression and regeneration of conifer stands may reduce the availability of suitable habitat here. Site conditions range from dry, open ridge tops to areas associated with wetlands or riparian habitats (Potter et al. 1999, 2002).
- The Okanogan-Wenatchee National Forest sites are mostly mesic meadows with a permanent water source, as indicated by the presence of false hellebore (*Veratrum californicum*). Approximately 10% of the sites are in old harvest areas or plantations. The first located site on the forest was in a grassy clearing in a post-fire woodland; however, this site appears to be atypical for this area (Joan St. Hilaire, personal communication).
- Populations in the southern Oregon Cascades occupy small (less than 0.25 to 4 ha (0.5 to 10 ac)), higher-elevation (1,372 to 1,555 m (4,500 to 5,100 ft)) grasslands within mixed conifer forests (USFWS, Candidate Notice of Review, 2005). They are usually associated with a water source, usually a small perennial or intermittent stream running through the grassland, but also with areas with shallow subsurface water. Mardon skipper adults have been observed to patchily occupy these grassland sites; distribution is rarely homogeneous across an entire site (Scott Black, personal communication). This is likely dependent upon microclimatic conditions (Ehrlich 1992), patchily distributed adult or immature resources, or the relatively small size of the populations (Davies et al. 2005), which may require

individuals to concentrate to maximize access to reproductive conspecifics within their short reproductive period.

- The three known populations in the coastal mountains of California are small serpentine grasslands or wet meadows within a complex of forest and shrublands, near the inland edge of the coastal zone subject to summer, marine-influenced fog (Mattoon et al. 1998; Scott Black, personal communication; Ross 2009 and 2010). The sites in coastal Oregon are also primarily on shallow serpentine soils in the coastal fog zone, with one site in a sedge-dominated meadow (Ross 2010).

Retention of moisture on sites also varies by region. Skippers in the southern Oregon Cascades appear to occur in the more mesic grassland sites, where the larval host plants remain green long enough to supply food for larval development. Observations in California are consistent with this hypothesis (Gary Falxa, personal communication), possibly due to their occurrence in the fog belt. Washington Puget Sound sites are on glacial outwash grasslands, and Washington southern Cascades sites vary from occurrence on high-elevation, (4,500–5,500 feet) montane meadows along ridge tops to riparian and sedge meadows. Though variable, these sites must all have adequate moisture to support adequate larval food resources until the larvae or pupae go into diapause for the winter. Therefore, the use of available habitat may vary from year to year, dependent upon climatic or microclimatic variables. Available habitat may also depend upon the local disturbance regime as some nectar plants (e.g., *V. adunca*) are early successional species.

Ehrlich (1992) found that *Euphydryas* (checkerspot butterflies) are heavily dependent on appropriate microclimates for their survival and states, “Whether or not the larvae can win the race depends on a complex phase relationship between the phenology of the host plant and the insect populations” (Singer and Ehrlich 1979). That relationship depends on the interactions between topography and habitat macroclimate which creates diverse thermal microenvironments or “topoclimates.” (Geiger 1965, Murphy and Weiss 1988 and Weiss et al. 1988, 1990 cited in Ehrlich 1992). In populations of the silver-spotted skipper (*Hesperia comma*) in Britain, the area occupied by populations increased from $2km^2$ to $10km^2$ in response to expansion of individual habitat patches (Davies et al. 2005), but also likely in response to increased population sizes within those habitat patches. In other words, the population may have expanded because of an increase in area of suitable habitat, or the population expanded into neighboring habitat that was suitable, but the population increase also led to increased dispersal because of density dependent factors and increased need for resources.

Habitat quality may be much more important than its extent. As a bunchgrass specialist, if the plants for a population disappear from an area, the butterfly will not persist. Therefore, it may be very important to retain islands of quality habitat. Furthermore, the density of food plants must be high enough to permit larvae to move to a new plant when one has been devoured (Ehrlich 1992).

Ecological Considerations

<u>Metapopulations</u>

While it has not been definitively determined that Mardon skippers demonstrate metapopulation dynamics, there is considerable evidence that they do. This is based on habitat types and distribution of known sites, the expansion and contraction of known populations, and the population dynamics of other skipper species.

Metapopulations are defined as a set of populations (i.e. independent demographic units (Ehrlich 1965 cited in Harrison et al. 1988)) that are interdependent over ecological time; they are interdependent because they are linked by processes of extinction and mutual recolonization on the order of 10 to 100 generations (Harrison et al. 1988). There are two models for metapopulations. In the first model type, each habitat patch is roughly equivalent in size and habitat type or quality (Levins 1969, 1970 cited in Thomas and Harrison 1992). In this model the metapopulation is sustained as long as extinctions and recolonizations of patches remain approximately equal. The second metapopulation model is a source-sink system in which one habitat patch is usually larger and/or is of better habitat quality; this patch is assumed to be populated at all times (Harrison et al. 1988). In this second model, of interest is the distribution of the occupied peripheral patches; that is, how many patches around the source population are occupied and how this distribution varies over time. In the work of Thomas and Harrison (1992), more stable, non-transient habitats tended to have persistent populations, whereas populations in transient or rapidly changing habitats were more likely to become extinct. Metapopulation persistence is dependent on quality habitat being continuously available within fairly large areas and within colonization distance (<400m for a species with an approximate dispersal distance of <50m) (Thomas and Harrison 1992). Due to the nature of the distribution and quality of habitat, it is likely that the Mardon skipper follows this second model of metapopulations dynamics. This is also supported by the case cited above in Activity Pattern and Movements, where a clear-cut harvest area over 2 miles from the nearest known source populations became colonized and now supports Mardon skippers.

With the great distances between the regional population groupings in Washington, Oregon and California, each of these may be considered as separate metapopulations (this holds true unless other populations between these four regional groupings are identified). In any case, it is likely that there would be some genetic distinction between populations at opposite ends of the range. Based on increased surveys since 2007, this seems to hold true as no populations have been found that would provide links between extant populations. Additionally, based on the distance between sites within each regional population, it is also possible that there may be separate metapopulations within each of these regions. For example, the northernmost site in northwestern California is approximately 6 miles north of the nearest population, and the Puget Prairie populations are over 100 miles from the southern Washington Cascade populations, well beyond the surmised dispersal distance of the species.

<u>Factors in metapopulation dynamics</u>
Metapopulation dynamics are driven by a variety of causes, and both exogenous and endogenous factors should be considered when making estimates of, or explaining population fluctuations. As an example, McLaughlin et al. (2002) found that two populations of *E. e. bayensis* experienced similar climatic variables, but fluctuations in one population were less variable, likely fluctuating in response to differential reproductive success during dry years when the less topographically diverse habitat experienced greater population declines. The greater topographic diversity of the other population's habitat created a more diverse range of microclimates, providing for more persistent and possibly more diverse food plants for larvae. Additionally, greater biodiversity and more intact ecosystems produces more resilient ecosystems that are resistant to both anthropogenic and stochastic disturbance events (Thompson et al. 2009; Folke et al. 2004).

When patch number is large, metapopulation extinction (all patches become extinct at once) is unlikely to occur unless some environmental factor or catastrophe (including management) affects habitat quality on a scale that is larger than the entire area of the metapopulations (i.e., when extinctions are correlated in time and space) (Harrison & Quinn 1989; Gilpin 1990 as cited in Thomas and Harrison 1992). Harrison and Quinn (1989) conclude that, "The key to regional survival for short-lived ephemeral species may be their existence as large metapopulations spread over partly or fully independent environments."

Dispersal and colonization potential

In general, if there is adequate habitat between populations and those populations are not so distant so as to preclude dispersal, genetic exchange between populations should be possible. This statement is supported by the expansion of populations of the silver-spotted skipper butterfly (*Hesperia comma*) in Britain (Davies et al. 2005) as a result of habitat management which improved the quality and increased the availability of suitable habitat. However, the silver-spotted skipper is capable of dispersing far greater distances (approximately 15 km) than the Mardon skipper (approximately 1.6 km) (Runquist 2004). Connectivity between habitat patches is a vital factor for fragmented populations of *P. Mardon* to function as a metapopulation. For example, the Little Bald Hills population in Redwood National Park is ≥6 miles south of the nearest population on Forest Service lands and is separated from that population by the Smith River canyon and heavily forested lands on either side of the canyon (Kristin Schmidt, personal communication). It is difficult to see how dispersal could occur between these two populations if one should become extinct.

In another study on a metapopulation of butterflies in Finland, the Glanville fritillary (*Melitaea cinxia*) maintained populations in a state of multiple equilibriums (yearly extinctions and recolonizations within different sites). Habitat patches were isolated from other patches by much more than 1.5 km, and although fritillaries are strong fliers, approximately 90% of migrating butterflies moved <1.5 km, resulting in a rate of exchange of individuals at <1% (usually much less than 1%) (Hanski et al. 1995). However, Harrison et al. (1988) found that distant-dependent dispersal influences on the spatial pattern of habitat occupancy may be a phenomenon that occurs over a time scale of decades.

Based on the short dispersal capability of Mardon skippers compared with the bay checkerspot butterfly (*Euphydryas editha bayensis*), a 50% probability of habitat patches >6km apart from one another becoming occupied by Mardon skippers would require 24 years, providing suitable habitat is available at least in a stepping-stone pattern (Harrison et al. 1988). Their study also suggests that stepping-stone colonization may not work unless the stepping stone habitat patches are of adequate size and quality to support source populations themselves. Thomas and Harrison (1992) however, found that the silver-studded blue butterfly (*Plebejus argus*), a species that generally moves <50m in a year, occupied patches > 2 km away from an introduction site, showing a stepping-stone pattern of colonization. The time required to establish these colonized populations is unknown as surveys apparently occurred only in 1973 (detecting populations approximately 2 km from the introduction site) and then in 1983 and 1990 (> 2 km); the original introduction was in 1942. Thomas and Harrison (1992) concluded though, that natural recolonization of previously occupied habitat is unlikely to occur over a period of 10 to 100 years if they are farther than a few kilometers from other populations.

It is unknown what the most successful dispersal method is for Mardon skipper to connect nearby habitats or populations with others. The best method is likely dependent upon Mardon skipper behavioral patterns regarding the use of habitat, and also upon the amount and location of habitat available to the butterfly. If Mardon skippers rarely leave their host plant patches, then utilizing habitat corridors would probably be most effective dispersal method; however, if the skippers do leave host plant patches and travel faster when outside their habitat patches, then "stepping-stone" habitat patches would provide the best opportunities for dispersal, genetic exchange between populations, and recolonization of distant suitable habitat (Schultz 1997).

In a study on the Fender's blue butterfly (*Icaricia icarioides fenderi*) in the Willamette Valley of Oregon, Schultz (1997) estimated that a Fender's blue butterfly might disperse approximately 0.75 km in its 9.5 day lifetime if it stayed in lupine habitat, but more than 2 km if it dispersed between lupine habitats. While the Fender's blue butterflies in Schultz (1995) display a preference to stay within the host plant habitat, they also leave that host plant habitat at an observable rate, flying faster while outside of host plant habitat and therefore have a greater potential to migrate further within their lifetime than if they stayed solely in their host plant habitat. Since metapopulation theory suggests that many habitats are inherently patchy, and the Willamette Valley was historically a mosaic of upland and prairie habitat with lupine patches rarely more than 0.5 km apart, it follows that providing a stepping-stone of habitat patches for this species may be more effective at providing for dispersal opportunities. In light of the historical disturbance regime and inherently patchy habitat for Fender's blue, this dispersal behavior and stepping stone method may also be applicable to the Mardon skipper.

Overall it is worth noting that movement of individuals between populations does not necessarily mean that gene flow is occurring (Ehrlich and Murphy (1987); with short adult life spans, a butterfly that disperses to another population or to new habitat may have a slim chance of encountering breeding butterflies at the new site. In addition, butterfly populations have a better chance of long-term survival if they exist in a metapopulation matrix rather than in isolated populations.

Conservation

Conservation Status

Mardon skippers occur in four disjunct regions of the Pacific Northwest: 1) the Puget Sound area and 2) southern Cascades of Washington; 3) northwestern coastal California and southern coastal Oregon: and 4) the southern Oregon Cascades. The species has limited dispersal capability (generally considered to be less than 0.8 km) and habitat is fragmented around known populations by forested landscapes, and agricultural lands or other human developments. There is no likelihood of dispersal and genetic exchange between the populations in these four areas.

Mardon skippers have narrow habitat requirements. Habitat is limited to open grasslands with bunchgrasses, water available to provide for green food sources for larvae into the summer and other vegetation or structural characteristics. Habitat for adults is restricted to grasslands with adequate nectar sources. Grasslands are currently at approximately 3% of historic levels, at least in the Puget Sound region of Washington, and the extent is likely lower in other portions of the species range because of fire suppression and resultant conifer encroachment into suitable habitat.

Most populations occur outside of protective land allocations with many on lands emphasizing timber harvest, unregulated recreation activities, and other uses. Many sites, both in the Washington and Oregon Cascades, are within grazing allotments and some sites are impacted by unregulated off-road vehicle use.

Current occupied habitats appear to be relatively stable; however conifer encroachment is occurring in some occupied meadows, and grazing and off-road vehicle use may be affecting habitat quality as well as directly impacting the species in different life stages (e.g. crushing of eggs, larvae, or pupae). Better knowledge of habitat use of various life stages can help to better manage habitat to reduce the risk to populations.

Mardon skippers are univoltine species, completing one life cycle annually. Loss of reproduction in any one year can extirpate the species from that site. Stochastic events and management activities may extirpate populations with little chance of population recovery. As there is little chance for dispersal between the four regions the species is found within, and in many cases there is little likelihood of dispersal between populations within each region, recolonization of extirpated sites is unlikely or very limited.

The early seral plant food used by Mardon skippers illustrates the need to manage grasslands and meadows for early seral conditions. Maintenance of the remaining grassland habitats with extant populations of Mardon skippers (and potential habitat) will likely require active management to maintain their function and extent through time. Active management is also needed to help create new habitats, and provide linkages between populations within the four regions.

Threats

Site-specific threats to Mardon skippers and their habitat are known only in part; threats to other skippers may provide additional useful information. Threats to Mardon skipper include habitat loss and fragmentation, invasive weeds, conifer and shrub encroachment, pesticide use, off-highway vehicle use, over-collecting, overgrazing, roadside maintenance, and grassland management activities such as prescribed fire and mowing. Stochastic events, particularly wildfires may also negatively affect sites or populations due to highly fragmented habitat and disjunct populations, and climate change may have long-term consequences for the species. Site-specific threats and other conservation issues for known sites are shown in Appendix A, Table A-1. Below is a brief discussion of each potential threat.

Habitat fragmentation/loss: grassland and meadow conversion to agriculture, development

Butterfly habitats around the world have become severely fragmented, and for any species, isolation is the key cause of population decline (Prendergast & Eversham 1995), which in turn may lead to genetic isolation and inbreeding (Descimon and Napolitano 1993).

Historic landscape conditions within the range of the Mardon skippper, prior to fire suppression and extensive human habitation and consequent development, were more open and grassy (Agee 1994), conditions that facilitate Mardon skipper dispersal and possible interconnections among populations (metapopulations) (Potter et al. 2002). Grasslands likely extended from southern Vancouver Island south through western Washington and into the Willamette Valley of Oregon. Today, less than 3% of the original native-dominated grassland landscape remains (Crawford and Hall 1997 cited in Grosboll 2003). Since the 1850s, over 99% of native prairie habitat in North American has been converted to agriculturally grown crops, or plowed and converted to hay fields (Samson and Knopf 1994, cited in COSEWIC 2003).

Invasive weeds, and conifer and shrub encroachment

Invasive weeds, and conifer and shrub encroachment negatively impact suitable habitat. A long history of fire suppression and resultant conifer and shrub encroachment into meadow/grassland patches reduces the amount of habitat available for Mardon skippers, and reduces or eliminates the connections with adjacent patches. 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. Substantial loss of grassland habitat has also occurred due to invasion by nonnative vegetation including pasture grasses. Invasive weeds can out-compete native vegetation, and/or change the vegetative structural characteristics of these grasslands rendering them unsuitable for Mardon skipper use. Historically, grasslands were maintained by a variety of disturbances (Schultz et al. 2011) including regular aboriginal burning and lightning caused fires (Agee, 1994); some had been maintained by native peoples who regularly burned them to preserve and enhance them as important food sources (Norton, 1979). Native ruminant grazers also likely played a role in creating a variety of successional habitats (Ehrlich and Murphy 1987), and voles and insect herbivores may also play a role (Schultz 2001; Schultz et al. 2011).

Pesticide use

Btk *(Bacillus thuringiensis* var *kurstaki*) is a lepidopteran-specific insecticide. Pesticide drift of Btk, as well as other insecticides from use on agricultural or forest lands, may negatively affect butterfly species (Boulton 2003; Barry et al. 1993; Whaley et al. 1998). Btk has been implicated in the extirpation of a population of Mardon skipper in Washington (Anne Potter, personal communication).

Off-road vehicle use

Off-road vehicle use is an ongoing and persistent threat in some occupied Mardon skipper sites. Off-road vehicle use can result in direct mortality to eggs, caterpillars, pupae, and adults of this species and can also destroy habitat and plants, and potentially alter hydrologic regimes, which in turn can alter plant composition and vegetative structure. Off-road vehicle use may also introduce non-native weeds, further affecting habitat and host plants.

Over-collecting

Over-collecting or extensive research activities may also damage habitat (trampling, removal, introduction of noxious weeds), and more directly, eggs, larvae and pupae (Ehrlich and Murphy 1987). However, COSEWIC (2003) noted that [Dakota] skippers are generally not as popular with most collectors as some of the showier species of butterfly. Over-collecting may not be an issue for the population of Mardon skippers as a whole, but collection and research activities may lead to increased vulnerability at sites with small populations (Scott Black, personal communication).

Livestock Grazing

Tall-grass and mixed-grass prairies appear to be susceptible to the effects of overgrazing (McCabe and Post 1997, Royer and Marrone 1992, Royer and Royer 1998, cited in COSEWIC 2003), "which reduces or eliminates critical adult nectar sources and removes forage for larvae." Cattle grazing can negatively affect butterfly habitat through modification of native grasslands and can destroy eggs, larvae, pupae and adults. The physical action of cattle hooves provide continual ground disturbance. Cattle droppings add concentrated nutrients, favoring establishment of introduced grasses; areas around water sources or salt licks are often dominated by introduced grasses (Ehrlich and Murphy 1987). In a study on the Dakota skipper (*Hesperia dacotae*), Dana (1997) found that grazing cattle reduced skipper numbers in direct proportion to grazing intensity. However, grazing is not always detrimental (Dana 1991); "light or light rotational grazing in tall-grass prairies can be beneficial by creating areas of mixed-grass vegetation structure preferred by the [Dakota] skipper" (Dana 1991). Some level of grazing may also serve to reduce conifer encroachment. Grazing has been monitored on the Naches Ranger District, Okanogan-Wenatchee National Forest; however confounding variables has not allowed them to draw any firm conclusions. A research project is proposed to study the interactions of both cattle and elk grazing (St. Hilaire et al. 2010).

<u>Roadside maintenance</u>

Roads are mainly used as dispersal routes for this species, serving as linear connectors with other potential or occupied grasslands or meadows. Roadside maintenance such as mowing or spraying herbicides may make site conditions unsuitable for Mardon skipper dispersal, potentially directly impacting the nectar food source for dispersing adults, or altering the vegetative structure to point where the habitat becomes unsuitable.

<u>Grassland maintenance management actions-prescribed fire, mowing</u>

Management actions to maintain or improve grassland habitat may pose a threat to Mardon skippers and their habitat. Effects of many of the management practices used for meadow maintenance on the Mardon skipper are largely unknown; however, effects to other skippers provide a useful starting point for assessing threats to the Mardon skipper.

Mardon skippers, with their current small, isolated populations, may be particularly susceptible to management practices such as mowing or fire; inappropriate management can cause extirpations (New et al. 1995; Thomas 1984 as cited in Pickering 1995). Pre-historic fire regimes would have impacted the Mardon skipper, however, the butterfly's assumed historic distribution would likely have allowed it to re-colonize sites affected by fires from neighboring unburned areas. Grassland / forest (conifer and oak) complexes extended from the southern Cascades of Washington into Northern California. Some of these grassland complexes may have existed, without the influence of fire, as true or natural grasslands (as defined by Vogl 1974, as cited in Pickering 1995) "in areas where edaphic and/or climatic conditions limited the growth of woody vegetation." However, most grasslands, particularly in forest / grassland complexes, require a recurring disturbance to maintain them in an open condition.

Prescribed fire is often used in meadow/prairie restoration to maintain native grassland structure and floral complexes. However, these burns often differ from wildfires and Native American burning practices. They are often done when wildfires would not normally occur and in prescribed burns, meadows are often burned more thoroughly and not in a mosaic pattern as would generally occur under a more natural fire regime. Burning of meadows with populations of butterflies, such as the Mardon skipper, could extirpate the population if not done carefully and with consideration of butterfly behavior and life stage at time of burn. Because most Mardon skipper populations are isolated, there are often no source populations available for recolonization once a population has been locally extirpated. Reduced numbers of Mardon skippers were also found at a burned site on the Six Rivers National Forest (Black and Mazzacano (2010). In work on the Dakota skipper, significantly lower abundances of skippers and other butterfly habitat specialists were observed at sites that had been burned compared to sites that had been mowed (Swengel 1996, 1998). Prescribed fire may also lead to an introduction or increase in the spread of invasive weeds (Pickering et al. 2000).

Mowing may make site conditions unsuitable for Mardon skipper reproduction, potentially directly impacting larvae or pupae, reducing the larval food source necessary to support larvae to pupation, or affecting microhabitat conditions to a level that would negatively affect either of these two life stages.

<u>Climate Change</u>

Effects of climate change on Mardon skippers are uncertain; however, assessment of climate change in North America has already revealed changes in precipitation patterns, plant bloom time, and bird migration timing. Climate change in the Pacific Northwest is projected to increase rainfall, decrease snowpacks, and lead too drier, hotter summers, all of which could have an impact on Mardon skipper habitat.

Prior Management Approaches

While limited work has been done to improve habitat for Mardon skippers, a number of management approaches have been undertaken to improve habitat for other species of butterflies. These approaches have had varying levels of success and some have highlighted important issues to consider when Mardon skipper habitat management is proposed. Inappropriate management, weather, habitat fragmentation, limited adult nectar sources, and egg and larval mortality have all been identified as some of the more common factors in limiting butterfly population sizes (Dempster and Hall 1980; Williams 1988; Duffey 1968 and Thomas 1984 as cited in Pickering 1995).

<u>Grassland maintenance management actions-prescribed fire, mowing</u>

Prescribed fires have several advantages but also some major disadvantages for use in Mardon skipper habitat. While not used as a management tool specifically to maintain or improve skipper habitat, the likely extirpation of a population of Mardon skipper in Washington was caused by prescribed fire (Grosboll 2003). On the positive side, burning may increase the abundance of flowering plants and reduce or halt shrub and forest encroachment. However, prescribed fire may also kill eggs, larvae or pupae, depending on the season of the burn.

A prescribed burn was conducted in 2008 on the Six Rivers National Forest in California on the Coon Mountain Mardon skipper site, which encompasses the largest known population of this species in California. The prescribed burn affected 30 to 40% of the core population area. To study the effects of the burn, the burn area was divided into four monitoring zones with each further subdivided into burned and unburned areas. Monitoring transect surveys were conducted in 2009 and 2010, with fewer Mardon skipper appearing in the burned area in 2009. Numbers were higher in 2010, but still lower than in unburned areas, demonstrating a relatively slow recolonization rate. This supports the management recommendations for burning only small areas of habitat in a site, and allowing the site to recover before burning other areas (Black and Mazzacano 2010).

Experimental burns have been conducted in Oregon silverspot butterfly habitat. One study resulted in increased violet density, and although the fire intensity was too low to kill established conifers, the fire did keep the area clear of new conifer regeneration for several years (Pickering 1995). Due to limitations in previous burn studies and because of concerns about killing diapausing larvae, The Nature Conservancy began a new study in 1995 to study the effects of burning and mowing of

Oregon silverspot habitat. Initial findings have shown that prescribed burning may lead to an increase in nonnative, invasive weeds (Pickering 2000). The Nature Conservancy is investing more time in research before starting a full scale management program, pursuing studies of the butterfly's population dynamics and behavior.

Because of concerns about killing diapausing larvae of the Oregon silverspot, "the Siuslaw National Forest prohibits burning in the best habitat and limits burning to a small portion of the area in a given year" (Pickering 1995). For the past 10 years, the Siuslaw National Forest has utilized mowing rather than burning on a majority of their Oregon silverspot habitat. This is mainly due to concerns over mortality of larvae and invasion of undesired species after burning as well as the immediate threat of loss of populations without immediate management (Pickering 1995). The Siuslaw National Forest is partnering with The Nature Conservancy to develop a more long term management approach for this federally listed threatened species (Pickering, Personal communication).

Prescribed fire can also exacerbate problems if not used carefully. Prescribed fire which resulted in a patchy burn in Karner blue butterfly (*Lycaeides melissa samuelis*) habitat resulted in survival of larvae while more complete combustion resulted in no evidence of larvae on the Indiana Dunes National Lakeshore (Swengel 1995). Prescribed fire management of historically fire-maintained prairie, marsh and savanna habitats at the Indiana Dunes National Lakeshore has shown that determination of presence of the Karner blue butterfly is necessary prior to burning to avoid elimination of populations (Kwilosz and Knutson 1999). Kwilosz and Knutson recommend avoiding burning in areas with significant numbers of butterflies to increase survival of eggs and larvae. Exclusion of prescribed fire from these areas may shorten the timeframe for recolonization of the adjacent burned area. Karner blue butterflies exhibit movement distances similar to Mardon skippers, generally traveling less than 100m for more than 75% of recorded butterfly movements (Knutson et al. 1999 cited in Kwilosz and Knutson 1999).

In a study by Erhardt (1985) in Switzerland, a variety of management regimes were assessed for effects to butterfly diversity. In general he found that regular, light disturbance enhanced both numbers and diversity of butterfly species. Meadows that were regularly mowed or heavily grazed showed lower diversity of Lepidoptera species as these practices left few areas undisturbed, destroyed nectar flowers used by adults, and killed many of the young stage larvae and eggs. Erhardt also found that early stages of abandoned (no longer managed) grassland were dominated by grasses and herbs, and exhibited the highest richness of butterflies of all vegetation types. This was attributed to the richness of plant species and the lack of disturbance, thereby allowing butterfly larvae to complete their life cycles. These sites, with very shallow humus layers, were stable habitats and provided a warm microclimate favorable to butterflies.

A habitat restoration experiment for the Fender's blue butterfly, a federally listed endangered species, identified four important issues to consider for habitat restoration (Schultz 2001):

- Conduct restoration efforts at multiple sites, which can help generalize potential restoration techniques across the range of the species.
- An experimental approach, using multiple restoration methods, is very useful to determine strategies for habitat restoration.
- Research should link resource needs of rare species to restoration of their habitat.
- For successful restoration efforts, resources need to be provided for all butterfly life stages.

Captive rearing

The Washington Department of Fish and Wildlife and The Oregon Zoo worked cooperatively on a Mardon skipper captive rearing project using methods developed by Dave Nunnalee in 2002 (Grosboll 2003). Efforts in 2003 and 2004 resulted in minimal success with 2004 resulting in only one or two surviving pupae, with no pupae eclosing (Grosboll 1999; Mary Linders personal communication.; David Shephardson, personal communication.) During these efforts larvae and pupae exhibited uncharacteristic phenology and most died during diapause. Some larvae from a south Washington Cascades population went into diapause in the larval stage, while others diapaused as pupae (Mary Linders, personal communication). One adult eclosed in 2005. Differences in diapause may be attributed to the lower elevation at the Oregon Zoo (~1,000 ft) compared to the 4,300 ft elevation of the southern Washington Cascades where the Mardon skippers were collected. It has recently been confirmed that, at least in the Puget Prairie, Mardon skippers overwinter as larvae in diapause and do not pupate until late March (Henry 2010), acknowledging that there does appear to be regional differences in Mardon skipper ecology (Henry 2010; Beyer and Schultz 2010; Beyer and Black 2007).

Management Considerations

General considerations

Butterflies appear to be very sensitive to changes in the vegetative species composition and structural characteristics of their preferred habitat (Erhardt 1985), which varies for the Mardon skipper between different regions (Henry 2010; Beyer and Schultz 2010). Top priority for management and conservation should focus on identifying and maintaining reservoir populations (Ehrlich and Murphy (1987). Maintenance and restoration of the bunchgrasses and graminoid species on which the Mardon skipper appears to depend is vital to the persistence of the species. A prelisting recovery strategy was developed for the Dakota skipper (*Hesperia dacotae*) which identified sites having the highest priority for supporting viable populations of the species within Minnesota. Sites were characterized in terms of landform and topography, soils, vegetation and land use. Further characterization of the Dakota skipper populations included history of information, distribution within the site, habitat preferences, population size and dynamics, threats and a prognosis for each site (Dana 1997). Site-specific management plans have been developed for southern Oregon Cascades BLM sites (Black et al. 2010), and management recommendations were included in Henry's thesis (2010) for her study area in the Puget Sound area of Washington.

An extensive review of the conservation of prairie-oak butterflies in Oregon, Washington, and British Columbia was recently completed (Schultz et al. 2011). Among other topics, this review looked at three key threats (habitat loss and fragmentation, invasive species, and lack of appropriate disturbance) to prairie-oak habitat, and four management approaches (fire, herbicides, mowing, and habitat restoration) that could be relevant to Mardon skippers. The three sites in the Puget prairie are the only Mardon skipper sites in this habitat type; however, the threats and management approaches are relevant for most Mardon skipper sites. Their conclusions emphasize restoration of key, historical disturbance processes as important for conservation management of butterfly habitat, processes that historically maintained prairies, reduced invasive species and tree or shrub encroachment, and increased patch connectivity. These processes include natural and Native American-set fires, ungulate grazing, localized camas harvesting, and the activity of fossorial rodents as likely influences on plant communities, soil characteristics and nutrient cycling.

Swengel (1998) found significantly increased abundance of habitat specialist butterflies associated with less frequent or less intrusive management practices. However, she also noted that leaving habitat entirely unmanaged was not optimal. Grassland habitats with extant populations of Mardon skippers will likely require active management to maintain their function and extent through time. However, active management will require careful planning as the species dependent upon these grasslands may be negatively impacted by these disturbances (Swengal 1992 as cited in Pickering 1995), particularly if management is strictly designed for the benefit of the plant communities (Schlicht and Saunders 1995).

Schlicht and Saunders (1995) outlined a series of recommendations for management of the Dakota skipper (*Hesperia dacotae*) in prairie / grassland habitat which can be applied to the Mardon skipper. These recommendations emphasized:

- managing for animals rather than strictly for vegetation
- managing small populations of invasive weeds for elimination
- burning with specific objectives
- do not manage with fire in small habitat patches
- managing at a scale smaller than the smallest suitable habitat area at any site
- managing using multiple strategies to enhance heterogeneity of habitat

The Gifford-Pinchot National Forest had implemented considerable meadow restoration efforts for Mardon skippers. They implemented a series of standard practices to minimize effects of conifer removal in meadow habitats:

- hand cutting only with heavy duty loppers or hand saws
- carrying, not dragging trees to piling locations on meadow edges
- cutting trees flush with the ground to minimize visual impacts
- performing work in the fall, following skipper adult emergence and egg deposition, and subsequent larval emergence
- restoration work in large meadows should occur over several years to distribute impacts
- maintenance should occur every 3 to 4 years (Kogut 2008)

Specific management considerations

In light of the threats and prior management approaches outlined above, consider the following when managing sites of this species. These recommendations are based on information on site-specific management recommendations (Henry 2010 (Puget prairies); Black et al. 2010 (southern Oregon Cascades); Kogut 2008 (Washington Cascades)) and on the general recommendations outlined above. As site conditions and habitat requirements vary across the range of the species, site-specific assessment is necessary to determine the appropriate management action(s) to be implemented. For example, applying results of Beyer and Schultz's (2010) work in the southern Washington Cascades at Puget prairie sites could result in enhancement of habitat structure that would be detrimental to Puget prairie populations (Henry 2010).

<u>Habitat fragmentation or loss: grassland and meadow conversion to agriculture and development</u>

Reduce the loss or modification of grassland and meadows systems. Assess the benefits of grassland and meadow habitats for Mardon skipper in parcels proposed for land exchanges.

Invasive weeds and conifer and shrub encroachment

Conduct hand removal of encroaching conifers. Girdling and cutting of encroaching conifers to maintain or increase meadow/grassland opening size is encouraged. Avoid trampling of the meadow during implementation. Carry cut material rather than dragging it across meadows. Burn piles away from the core area of the site. Remove invasive weeds as soon as noticed; where possible, utilize hand control methods. If chemical applications are necessary, protect non-target vegetation. Avoid the use of heavy equipment to prevent killing individual skippers of any life stage. Avoid actions that could degrade habitat or kill individuals.

Pesticide use

Delineate no-spray buffers around occupied Mardon sites or time spraying to avoid coinciding with the larval stage (Boulton 2003). Identify adequate buffers to eliminate the potential for drift into the site; Black et al. (2010) recommended a buffer distance of 2 miles from any occupied site. Pesticide drift has been found to exceed 3,000 meters in mountainous terrain (Barry et al. 1993; Whaley et al. 1998). Consider topographic features when modeling drift.

Off-road vehicle use

Block illegal off-highway vehicle use through boulders, tank traps, gates, or other effective closure devices. Sign occupied meadows as off limits for off-road vehicles, and to discourage camping or other intensive uses. Include educational material on signs to inform the public about sensitive habitats.

Livestock Grazing

With fire suppression and the encroachment of conifers and invasion of non-native grasses, some low level, rotational grazing may be beneficial in restoring these habitats; however, this hypothesis needs to be tested. Discourage or eliminate grazing within at least a portion of the occupied grassland/meadow. Consider using light or rotational grazing which “in tall-grass prairies can be beneficial by creating areas of mixed-grass vegetation structure preferred by the (Dakota) skipper” (Dana 1991). Black et al. (2010) recommended not allowing grazing during the adult flight period and maintaining short grazing periods with long recovery periods in suitable habitat. Consider fencing out habitat, particularly habitat where livestock appear to congregate or consistently pass through.

Roadside maintenance

If possible, for roads between and around known occupied sites, consider not mowing roadside grasses annually and leaving strips and patches of uncut areas, to allow for dispersal/use of these corridors. Uncut patches should be less than 0.1 km apart and could alternate in location in subsequent years. In addition, consider varying mowing timing. Mowing was found to be beneficial to the Dakota skipper if it was done from September into October, and mowed in alternate years (McCabe 1981, Skadsen 1997, cited in COSEWIC 2003).

Grassland maintenance management actions-prescribed fire, mowing

More aggressive management to maintain or enhance habitat for Mardon skipper may be needed. These actions should be utilized with caution and site-specific considerations, until effects specific to Mardon skippers are well understood. With fire suppression and the encroachment of conifers and invasion of non-native grasses, some more aggressive/active management actions such as mowing or burning may be beneficial in restoring these habitats; however, this hypothesis needs to be tested.

Grassland management – mowing
Consider varying mowing timing and retention of uncut areas as described in the section on roadside maintenance above.

Grassland management – prescribed fire
Prescribed burns in Mardon skipper habitat should be conducted in a carefully prescribed manner to avoid extirpating the species from sites where presence has been confirmed. The approach taken to avoid extirpation of the Karner blue butterfly (Kwilosz and Knutson 1999) could be adopted within Mardon skipper habitat. Alternatively, an approach suggested by Black et al. (2010) in management recommendations for southern Oregon Cascades sites could also be effective. This approach proposes to burn only a small portion of the occupied habitat followed by monitoring to determine effects, and implementing an adaptive management approach based on monitoring results. These two approaches as well as recommendations from another study are outlined below. Site-specific conditions would need to be considered to determine the best approach. In all cases, management plans should be developed for each site prior to any prescribed burning.

Adaptive management approach (Black et al. 2010)
If prescribed burning is planned, develop a site-specific burn plan which incorporates the ecology of the species.

- Burn no more than 20% of the site in any one year
- Burn during cool periods
- Encourage a patchy, mosaic burn, maintaining unburned areas within the fire perimeter
- Avoid trampling meadows during implementation.
- Develop a comprehensive monitoring plan to determine short and long term effects to Mardon skippers, including pre-treatment monitoring.

Pickering (1995) recommended seven considerations when planning prescribed fire management of habitat at sites of the Oregon silverspot butterfly.

- Avoid burning all habitat of any one site in any one year
- Unburned habitat at a site should be of sufficient size to provide a refuge for the population until the burned habitat is suitable for recolonization
- Timing, intensity and completeness of burn need to be considered in light of life stage of the butterfly, and habitat remaining after the burn is complete
- Low intensity and patchy burns are thought to pose a smaller threat to invertebrates (Dana 1991; Moffat and McPhillips 1993)
- Patchiness can be encouraged by mowing or wetting patches within the burn unit, possibly around patches of host plants
- A diversity of methods (fire, mowing, removal of encroaching vegetation) may mitigate the negative impacts of any one approach and address logistical constraints
- Monitoring results are essential to measure and improve success

<u>Karner blue butterfly recommendations (Kwilosz and Knutson 1999) applicable to Mardon skipper</u>
Prescribed burns could be done in an area within the species' dispersal distance, but not within documented egg deposition sites, or where adult activity was focused during spring/summer flight times. After the area has recovered and bunchgrasses or other larval host-plants have resprouted, and if skippers occupy these sites, the original site could be managed with prescribed fire while

ensuring the availability of butterflies to recolonize burned units. Burning during cool periods would result in a more patchy burn, resulting in a mosaic of burned areas, and unburned habitat which is still suitable for the species – low intensity and patchy burns would pose a lower threat to invertebrates (Dana 1991).

Climate Change

Effects of climate change on Mardon skippers are largely unknown; however, phenology of bird migration, butterfly and other insect emergence in other areas, and effects on species because of changes in phenology (e.g., bird migration and food availability) supports climate change as an important issue to consider for conservation of sensitive species. Butterflies are moving upward in elevation and northward (Parmesan 2007). It is known that climate and microclimatic conditions can affect butterflies (Henry 2010; Schultz et al. 2011), and of critical importance is the timing of emergence of the butterflies, and larval host and adult nectar species (Parmesan 2007). Conservation and enhancement of suitable habitat as well as connections between habitat patches at higher elevations may be critical as species move up in elevation. Additionally, shifts in populations northward may be impossible without anthropogenic assistance because of fragmented habitat (Schultz et al. 2011). In any case, in light of climate change, it is critical to provide suitable habitat into which Mardon skippers can disperse.

Metapopulation considerations

Ehrlich and Murphy (1987) recommended a four step approach to manage for viable metapopulations of *Euphydryas spp*., which can be considered for Mardon skipper.

- As habitat variability may be an important factor to allow skippers to vary their locations to suit yearly variations in weather patterns, it is important to conserve a series of demographic units selected for their diversity of habitats.
- Corridors among sites should be established so as not to preclude recolonization in the event of stochastic extinctions of demographic units.
- Double our best guess about habitat area required to preserve the species to reach a minimum recommended reserve size, and to provide for minimum viable metapopulations as opposed to populations.
- Sample groups must be studied over the long term to understand population variability, and to understand the response after observing populations under different climatic regimes and in different ecotypes.

After considerable success with expanding populations of the silver-spotted skipper (*Hesperia comma*) in Britain, Davies et al. (2005) recommended four approaches to promote further expansion of the species:

1) ensure conservation management actions are taken within 50% of the maximum dispersal recolonization distance;
2) manage habitat to increase population sizes to provide for more migrant individuals being available to establish new populations;
3) manage large habitat networks to provide for “long-distance” dispersal through a stepping-stone network of suitable habitat; and
4) reintroduce the species in suitable habitat.

The fourth recommendation is the least preferred and would likely lead to minimal gains for recovery of the species. Reintroduction could be considered after habitat manipulations have been completed and there is a need to reduce the risk of loss of small isolated populations.

Genetic considerations for reintroductions and augmentation
Lack of genetic exchange between populations may contribute to possible inbreeding. Additionally, lack of genetic interchange and migration / dispersal between populations may make it impossible for an extirpated population to become reestablished.

Some butterfly species may be suitable for artificial introductions (Brookes et al. 1997), providing genetic studies show there is an irretrievable loss of alleles without introductions from different populations. As selection can restore perturbed gene frequencies (Brookes et al. 1997), if genetic studies show a predominance of certain alleles, but do not preclude rare alleles, artificial introductions may not be necessary. This is because if frequency of rare alleles does not depart from natural variation or normal distribution of genes within the population, these alleles are not precluded from becoming manifest in phenotypes.

Even though it may be possible to reestablish connections between sites, there is no guarantee that dispersal and/or genetic exchange will occur between populations. Individuals arriving late at a site, such as would likely occur with dispersers, may not be able to successfully reproduce unless their arrival coincides with emergence of the local population. Therefore, even if populations intermix, genetic exchange may not occur, or only occur very slowly over a period of many years; however, emergence is likely due to environmental influences, so in subsequent years emergence of Mardon skippers from different populations would likely occur simultaneously. This also has implications for reestablishment of suitable habitat in which populations have become extirpated (Ehrlich and Murphy 1987).

Research, Inventory and Monitoring Opportunities

In spring of 2005 an interagency Mardon Skipper Work Group was convened by the Interagency Special Status/Sensitive Species Program for Region 6 Forest Service and Oregon/Washington Bureau of Land Management (BLM) to assist in the development of the Conservation Assessment for this species. Participants in the Work Group included representatives from the U.S. Forest Service and BLM field and Regional offices, the US Fish & Wildlife Service, the Washington Department of Fish & Wildlife, and the USDA Forest Service Pacific Northwest Experimental Research Station. The Work Group identified and prioritized information and conservation gaps for the Mardon skipper, developed potential projects, and identified tasks and products for some of the projects. Some of these projects have been implemented, at least in part (Seitz et al. 2007; Beyer and Black 2007; Beyer 2009; Beyer and Schultz 2010; Black et al. 2010). Information from these projects have been incorporated throughout this updated Conservation Assessment.

The priority information and conservation gaps identified by the Work Group are included in three themes, research, inventory, and monitoring. These are detailed below along with a synopsis of completed work and publications.

- Research
  - Define range of habitat characteristics
  - Identify oviposition grasses and larval host plants and food sources
  - Delineate and characterize adult use areas
  - Develop research projects to determine impacts of grassland restoration and grazing

  - Identify dispersal capabilities and dispersal modes (via habitat corridors or between "stepping stones" of suitable habitat)
  - Develop partnerships to further research on the species
- Inventory
  - Develop a survey protocol
  - Identify distribution gaps and priority areas to survey
- Monitoring
  - Develop a long-term monitoring protocol
  - Monitor restoration effectiveness

Tasks were funded in FY05-07 to address some of these gaps. Efforts by the Mardon skipper Working Group, in conjunction with Washington State University and the Xerces Society for Vertebrate Conservation, resulted in initiation of several research and site management plan projects (see Beyer and Black 2007, Beyer 2009, Beyer and Schultz 2010, Black et al. 2010, and Henry 2010). Included below is a more in-depth discussion of these information and conservation gaps, and progress made to date.

<u>Research</u>

Much about Mardon skipper life history and habitat needs is unknown. The Mardon skipper is considered to be fairly sedentary, and it is not known how far, by what mode, or where, the adults disperse. Based on work in Washington, it was thought that eggs are laid on fescue bunchgrass (Potter et al. 1999, Dornfeld, 1980 and Newcomber, 1966 in Potter et al. 1999). Based on work from 2006 to 2009 (Beyer and Black 2007; Beyer 2009; Beyer and Schultz 2010; Henry 2010), oviposition on fescue, as well as other species, was confirmed. Females generally lay one egg per oviposition site, but it is not known how many eggs per year a female will lay. Adult use of grasslands appears to be restricted to small areas (Ann Potter, personal communication), and it now appears that habitat structure is the primary determining factor in oviposition location (Beyer and Black 2007; Beyer 2009; Beyer and Schultz 2010; Henry 2010); however, this structure appears to differ between different areas or altitudes (Henry 2010). A series of data gaps was identified that would aid in answering these questions to enable USFS and BLM wildlife biologists and managers to apply special status and sensitive species policy for Mardon skipper habitat.

The following six gaps were identified by the Work Group as high and moderate priority tasks for research.

1. Define range of habitat characteristics

A beginning step in identifying habitat is to accumulate what is already known about general habitat characteristics at different sites and interpret this information to determine the best indicators of Mardon skipper habitat. A preliminary Bayesian belief model was developed to organize habitat information. Primary habitat characteristics identified by this model can be tested by field research and/or surveys, then used to assess grassland and meadows to identify potential Mardon skipper habitat. Oviposition studies (Henry 2010; Beyer 2009; Beyer and Schultz 2010; Beyer and Black 2007) had led to a greater understanding of habitat needs for oviposition, and importantly, how preferred habitat structure, and oviposition species, varies by region and within regions. Henry (2010) and Beyer and Schultz (2010) emphasized the importance of maintaining native meadow ecosystems with consideration of local habitat preferences. This habitat use information is an important foundation necessary before aggressive restoration and monitoring activities can occur.

2. Identify oviposition grasses and larval host plants and food sources
Mardon skippers have been observed to oviposit on fescue bunchgrasses (Ann Potter, personal communication). In 2006, The Xerces Society undertook a pilot study of oviposition plants and locating larvae for the BLM and USFS in the southern Washington Cascades and in southwestern Oregon (Beyer and Black 2007). Beyer (2010) and Beyer and Schultz (2010) continued this work in 2007 in the southern Washington Cascades with funding through a Cooperative Ecosystems Study Unit (CESU) agreement between the BLM and Washington State University-Vancouver. They identified a variety of different oviposition plants with Beyer and Schultz (2010) identifying 23 different oviposition species, with a preference within meadows, but not between meadows. Primary oviposition species were *Poa praetensis* and *Festuca idahoensis* Contrarywise, in research by Henry (2010), she identified *F. roemeri* as the primary oviposition plant in the Puget Prairie, with 86 of 88 ovipositions on this single species. Interestingly, in work at high-altitude sites in the southern Washington Cascades (Beyer and Schultz 2010), preference was for larger graminoid species, while work in the low-altitude Puget prairies (Henry 2010) preference was for smaller bunch grasses with over 50% open, moss-covered ground.

3. Delineate and characterize adult use areas
Similar to identifying immature habitat, the habitat used by adults for nectar, water, and courtship is important information. Such information may also lead to discovery about dispersal distance and under what conditions dispersal occurs. In addition, it may help us understand what the limiting resources are for this species. The Xerces Society collected nectaring species data in 2006 (Beyer and Black 2007), but characterization of adult use areas and dispersal is still needed.

4. Develop research projects to determine impacts of grassland restoration and grazing
The Work Group identified a variety of specific research projects to determine impacts of meadow restoration and grazing. Most of the suggested projects are on the Gifford Pinchot National Forest, because wildlife biologists there have consistently conducted site revisits and relative abundance counts at a handful of meadows over the last 5 to 8 years (Table 2). This table has been updated to include work completed to date at these sites (Mitch Wainwright, personal communication 2010; Kogut 2007).

A grazing project on the Okanogan-Wenatchee National Forest on the Naches Ranger District is also suggested. Their sites encompass some of the largest populations of Mardon skippers and experience considerable cattle and elk grazing. Additionally, all sites are within a grazing allotment. Forest biologists have conducted plant species and grass height studies (2009 and 2010). These sites may also lend themselves to a paired study of cattle and elk grazing as well as grazing impacts on Danthonia *unispicata*, a seemingly key plant species to support Mardon skippers in this area. There are similar questions and opportunities on BLM and USFS lands in southwestern Oregon and northern California.

The response of the skipper to these projects could be monitored over time (see Monitoring section). While monitoring of completed projects should provide some useful information, collection of baseline data for projects that have not been implemented would be very important to assist in determining cause-effect relationships of the project actions.

Table 2. Potential Research Projects on the Gifford Pinchot National Forest	
Gifford Pinchot Site	**Suggested Project**
Mount Adams* 15 (aka Gotchen Meadow)	Low numbers of Mardon skippers. The site is heavily grazed by cattle in the late summer and has also been encroached by conifers. A fence was constructed in 2005 to exclude cattle from the meadow; the fence is being maintained by the USFS. All conifers < 10" DBH were removed within the meadow; this project was completed in 2009. Mardon skippers have been seen in the meadow, but no formal surveys have been done since the trees were removed The other objective for this project is maintaining an aspen stand in the meadow.
Mount Adams 11 (aka Cave Creek Meadow)	High numbers of Mardon skippers. This site is within a grazing allotment; however, grazing has not occurred in the allotment for the past three seasons; it is likely that the permit will be waived back to the USFS in 2011. The entire meadow is infested with Canada thistle and hound's tongue. Studies of herbicide treatments for Canada thistle occurred in 2009 and 2010. This meadow is a high priority for treatment and weed treatment will continue.
Mount Adams 20 (aka Lost Meadow)	Low to moderate numbers of Mardon skippers. This site is within a grazing allotment; however, grazing has not occurred in the allotment for the past three seasons; it is likely that the permit will be waived back to the USFS in 2011. The meadow appears to be recovering and habitat has improved. No additional management is planned at this time.
Cowlitz Valley ** Meadows	Encroaching conifers have been removed from several meadows on the Cowlitz Valley Ranger District that support moderate to high number of Mardon skippers. This work has continued and also includes removal of noxious weeds and blocking of OHV access through boulder placement.
Mount Adams 33 (adjacent to Lost Meadow)	Conifer encroachment is closing in the meadow. NEPA for conifer removal will be completed in 2012 and work may occur in 2012 as well. Treatment would include the removal of conifers, and maintenance work to impede further encroachment.
Mount Adams 21 & 22 (aka Peterson Prairie)	This site has two separate meadows which support low to moderate number of Mardon skippers. This site is within a grazing allotment; however, grazing has not occurred in the allotment for the past three seasons; it is likely that the permit will be waived back to the USFS in 2011. The meadow appears to be recovering and habitat has improved. No additional management is planned at this time, but measures may need to be taken in the future to prevent vehicle access to the meadow.

* Mt. Adams Ranger District
** Cowlitz Valley Ranger District

5. Identify dispersal capabilities and dispersal modes

In order to craft habitat restoration projects to enhance successful dispersal between habitat patches, it is important to understand the population or metapopulation dynamics of the species. There is a need to determine how Mardon skippers disperse and colonize unoccupied habitat, via habitat corridors or between "stepping stones" of suitable habitat.

6. Develop partnerships to further research on the species
The USFS and BLM have been in contact with potential partners who share an interest in Mardon skippers. When possible and where efficient, agreements or other structures for research opportunities will continue to be established.

Inventory
The Mardon skipper working group identified two priority needs for inventory or surveys of the species. A subgroup of the Working Group developed a survey protocol (USDA, USDI 2007); identified distribution gaps; and between 2007 and 2010, the Special Status Species program funded surveys in these areas.

1. Develop a survey protocol
Few are skilled at recognizing Mardon skippers in the field and verifying identification. Mardon skipper surveys require familiarity with butterfly identification and the ability to concentrate on small details as one surveys potential habitat. Potter et al. (2002) developed a Mardon skipper survey protocol that provides a general approach to Mardon skipper surveys. The Mardon Skipper Work Group modified and further developed that survey protocol with an emphasis on surveys conducted on BLM and FS lands, especially in areas where Mardon skipper presence is unknown (Seitz et al. 2007).

2. Identify potential habitat within distribution gaps and priority areas to survey
There is a large gap in the distribution of this species, between the southern Washington and the southwestern Oregon Mardon skipper populations. Another gap exists to the north of the northwestern California populations to Curry and Coos Counties in Oregon, as well as between the northern California/southern coastal Oregon and southern Oregon Cascade populations. The extent and location of previous surveys for Mardon skippers in these gaps is largely unknown. A combination of approaches was used to identify potential habitat in the gaps to survey including identifying grasslands, especially grasslands where Sonoran skippers have been found (Scott Black and Ann Potter, personal communications). In addition, the regional strategy has been to radiate out surveys from the nearest known sites. For example, in 2005, 2007, and 2008, surveys were conducted on the Rogue River-Siskiyou National Forest and Klamath Falls BLM Resource Area near the Medford District BLM's known sites, documenting four new sites on the Rogue River-Siskiyou National Forest in 2005. The Winema National Forest conducted nearby surveys in 2006 and the Willamette National Forest conducted surveys in 2007 and 2008 (Ross 2008); no Mardon skippers were located in either forest. At the northern end of the distribution gap, surveys were also conducted in 2006 on the Columbia River Gorge National Scenic Area and the Mt. Hood National Forest. The U.S. Fish and Wildlife Service funded surveys in the Smith River drainage in Del Norte County to about 20 miles inland from the coast. Multiple surveys between 2003 and 2008 confirmed three populations in this area as well as documented surveys where no Mardon skippers were located (Arnold 2006; Black et al. 2008). Additional surveys have been completed and the only new area in which Mardon skippers were located was along the southern Oregon coast (Ross 2008, 2009, and 2010); surveys also extended the extent of this region's population approximately 7 miles further south along the California coast. Surveys have also expanded the known sites on the Naches Ranger District of the Okanogan-Wenatchee National Forest and the Yakama Reservation.

A component of the new survey protocol directs field units to fully document when and where areas are surveyed even if the species is not detected and to input this information into the FS and BLM corporate databases.

<u>Monitoring</u>
To determine long range population trends and effectiveness of treatments, two monitoring needs were identified.

1. Develop a long-term monitoring protocol
An important question is to determine how FS and BLM management actions are influencing Mardon skipper populations. A successful monitoring strategy must be statistically sound and repeatable. A monitoring sub-Work Group met to develop a monitoring protocol for this species, but realized that additional information about immature and adult habitat is needed before determining which habitat parameters to monitor. Methods have been established for butterfly abundance indices (Pollard and Yates 1993). A modified relative abundance count method has been developed based on Pollard and Yates (1993), and used at a number of Mardon skipper sites (Ann Potter, personal communication; Beyer and Black 2007), but it is not a statistically designed index. With additional information gained through recent research (see particularly Beyer and Schultz 2010; Henry 2010; Beyer and Black 2007), we may have enough information to begin to develop this monitoring protocol and identify more detailed information needs.

2. Monitor restoration effectiveness
Restoration efforts specifically designed for this species should have monitoring incorporated into the project to help determine how effective various restoration efforts are. The Gifford-Pinchot National Forest has done considerable restoration work and monitors sites as resources and time allow, but population monitoring has not been completed in a systematic manner. Emphasizing the importance of monitoring, the Gifford-Pinchot National Forest has documented that conifers can reestablish in treated meadows at a surprising speed (Kogut 2008).

<u>Other</u>
Habitat-associated dispersal behavior (either corridor or stepping-stone methods) is an important determinant in establishing habitat restoration objectives. A behavioral study (Schultz 1997) could provide important information on restoration of habitat, as well as the best approach to enhancing dispersal among extant populations or metapopulations, or recolonization of suitable habitat.

Beyer and Schultz (2010) and Henry (2010) identified additional research questions including the following:

- Is habitat choice in Puget Prairies due to microclimate parameters or predatory pressures, or another factor?
- Focus future studies on resource needs as well as structural landscape factors to determine habitat components important to all life stages of the Mardon skipper.
- Studies need to be completed in different regions to determine region-specific habitat characteristics.

In addition, species taxonomy and genetic relationships is considered by many to be an important research topic that needs attention.. The subspecies designations for *Polites mardon mardon* and

Polites mardon klamathensis are questionable and have not been confirmed by genetic analysis, peer review, or a thorough taxonomic review.

Definitions and Terms Used

Caespitose: having a densely clumped growth form with flowers held above the clump

Density dependence: Density dependent mortality is: “Mortality inflicted on the members of a population, the magnitude of which increases as the current density of the population increases and which decreases promptly as the current density of the population declines” (Van Driesche, R. G. and T. S. Bellows, Jr. 1996. Biological control. (Population Dynamics, General Considerations) Chapman and Hall, New York. 539 pp.

Diapause: a suspension of development that can occur at the embryonic, larval, pupal, or adult stage

Eclose: the process of a butterfly emerging from its chrysalis

Graminoid: grass or grass-like

Metapopulation: a set of populations (i.e. independent demographic units) which are interdependent over ecological time

Site: a specific, defined area in which Mardon skippers have been documented

Population: one or several sites that are within the surmised dispersal distance of the species.

> Note: populations and sites are synonymous is the metapopulation dynamics section of this document to keep the discussion of populations-within-metapopulations consistent with the literature.

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Appendix A. Site-specific threats and conservation concerns for known sites[1]

Site Name	Administrative Unit	Site-specific threats					Comments
		Primary Threat	Threat Level*	Secondary Threat	Threat Level*	Other	
High Cascades RD 1	High Cascades RD Rogue River/ Siskiyou NF	Grazing	2				Grazing impacts are low on this site but high on nearby sites. Site is in excellent condition.
High Cascades RD 2	High Cascades RD Rogue River/ Siskiyou NF	Grazing	2	conifer encroachment	3		Grazing impacts are low on this site but high on nearby sites. Site is in excellent condition.
High Cascades RD 3	High Cascades RD Rogue River/ Siskiyou NF	conifer encroachment	4	Grazing	3		Serious conifer encroachment already. Grazing sign is light. This is the northernmost site known in Oregon. Good population numbers.
Cowlitz 1	GPNF ** Cowlitz Valley RD	Off-road vehicles	3	Grazing (elk)	2		ORV use a major problem at this meadow due to flat terrain and heavy adjacent recreation use with easy access. Signing has occurred and appears to be helping.
Cowlitz 2	GPNF Cowlitz Valley RD	conifer encroachment	3	ORVs/camping	3		Meadow has been rehabbed via removal of encroaching conifers, but encroachment is an ongoing threat.
Cowlitz 3	GPNF Cowlitz Valley RD	conifer encroachment	3	Off-road vehicles	3		Meadow scheduled for rehab in summer, 2005, to remove small, encroaching conifers. Access roads to meadow were blocked in 2004, and signing has occurred.

[1] Note that this table includes the majority of sites on federal lands. It does not include all known sites for the species.

Site Name	Administrative Unit	Site-specific threats					Comments
		Primary Threat	Threat Level*	Secondary Threat	Threat Level*	Other	
Cowlitz 4	GPNF Cowlitz Valley RD	conifer encroachment	3	ORVs, camping	3		Meadow was rehabbed in 2004 by removing small, encroaching conifers. Access roads to meadow were also blocked with boulders in 2004, and signing has occurred.
Cowlitz 5	GPNF Cowlitz Valley RD	conifer encroachment	3	rec use (camping)	3		Meadow was rehabbed in 2003 and 2004 by removing small, encroaching conifers. Access is via hiking trails, and occasional camping occurs in meadow.
Cowlitz 6	GPNF Cowlitz Valley RD	conifer encroachment	3	rec use (camping)	2		Meadow scheduled for rehab in 2005 by removing small, encroaching conifers. High recreational use area; ORV use is not a serious threat; picnicking and trampling are potential problems.
Cowlitz 7	GPNF Cowlitz Valley RD	Conifer encroach ment	3	none			Meadow located in remote area bordering Mt. Adams Wilderness.
Cowlitz 8	GPNF Cowlitz Valley RD	Conifer encroachment	3	none			Regenerating pine/fir plantation with open patches containing fescue and strawberry. Tallest trees are 25 feet high. Overall marginal habitat for mardons that will not last much longer.
Cowlitz 9	GPNF Cowlitz Valley RD	Conifer encroachment	3	none			Small meadow north of 7A Trail meadow, moderate conifer encroachment which is scheduled for treatment in 2010

Site Name	Administrative Unit	Site-specific threats					Comments
		Primary Threat	Threat Level*	Secondary Threat	Threat Level*	Other	
Cowlitz 10	GPNF Cowlitz Valley RD	Conifer encroachment	3	none			Small meadow west of 7A Trail meadow, moderate conifer encroachment which is scheduled for treatment in 2010.
Cowlitz 11 (formerly Mt. Adams 3)	GPNF, Mount Adams RD	Unknown					Upland meadow
Gold Beach RD 1	Gold Beach R.D./ Rogue River/ Siskiyou NF	4WD Truck Use	3	Conifer Encroachment	3		Small meadow appears to be part of a larger complex of loosely connected serpentine-bunchgrass meadows. Recent 4WD truck and ATV use appears to be a major threat to this site along with conifer encroachment.
Gold Beach RD 2	Gold Beach R.D./ Rogue River/ Siskiyou NF	Conifer encroachment	3	Noxious weeds	2		100+ individuals found in 2010. Prime native grass meadow habitat located inside Biscuit Fire (2002) perimeter.
SH Boardman State Park 1	Samuel H. Boardman State Park						Single male Mardon skipper located in 2007
Mt. Adams 1	GPNF, Mount Adams RD	Unknown					Upland meadow
Mt. Adams 2	GPNF, Mount Adams RD	Encroachment	U				Old harvest unit.
Mt. Adams 4	GPNF, Mount Adams RD	Road Maintenance	U	Grazing	U		Roadside
Mt. Adams 5	GPNF, Mount Adams RD	Road Maintenance	U	Grazing	U		Roadside
Mt. Adams 6	GPNF, Mount Adams RD	Road Maintenance	U	Grazing	U		Roadside

Site Name	Administrative Unit	Site-specific threats					Comments
		Primary Threat	Threat Level*	Secondary Threat	Threat Level*	Other	
Mt. Adams 7	GPNF, Mount Adams RD	Encroachment	U	Grazing	U		Old harvest unit
Mt. Adams 8	GPNF, Mount Adams RD	Encroachment	3	Grazing	2		Open bunchgrass slope.
Mt. Adams 9	GPNF, Mount Adams RD	Encroachment	U	Grazing	U		Old harvest unit
Mt. Adams 10	GPNF, Mount Adams RD	Encroachment	U	Grazing	U		Old harvest unit
Mt. Adams 11	GPNF, Mount Adams RD	Weeds	4				Cattle grazing has been discontinued in this allotment in 2010. The allotment is closed
Mt. Adams 12	GPNF, Mount Adams RD	Road Maintenance	U	Grazing	U		Roadside
Mt. Adams 13	GPNF, Mount Adams RD	Grazing	3				High elevation open bunchgrass slope (5600').
Mt. Adams 14	GPNF, Mount Adams RD	Encroachment	3				Old harvest unit. Site surveyed in 2011. Rapid conifer growth has reduced open grass habitat in this unit significantly, likely to transition to non-suitable within the next 10 years.
Mt. Adams 15	GPNF, Mount Adams RD	Encroachment	4	Grazing	4	Weeds	Grass/forb meadow/pasture, exclosure fence being constructed in 2005
Mt. Adams 16	GPNF, Mount Adams RD	Encroachment	U				Old harvest unit
Mt. Adams 17	GPNF, Mount Adams RD	Encroachment	U	Grazing	U		Old harvest unit.
Mt. Adams 18	GPNF, Mount Adams RD	Encroachment	U				Old harvest unit.

Site Name	Administrative Unit	Site-specific threats					Comments
		Primary Threat	Threat Level*	Secondary Threat	Threat Level*	Other	
Mt. Adams 19	GPNF, Mount Adams RD	Encroachment	U	Grazing	U		Old harvest unit. Cattle grazing has discontinued in this allotment in 2011. The allotment has been closed.
Mt. Adams 20	GPNF, Mount Adams RD	Grazing	4	Weeds	3		Grass/forb meadow adjacent to old harvest unit. Cattle grazing has discontinued in this allotment in 2011. The allotment has been closed.
Mt. Adams 21	GPNF, Mount Adams RD	Grazing	3	Encroachment	3		Grass/forb meadow. Cattle grazing has discontinued in this allotment in 2011. The allotment has been closed.
Mt. Adams 22	GPNF, Mount Adams RD	Grazing	3	Encroachment	3		Grass/forb meadow. . Cattle grazing has discontinued in this allotment in 2011. The allotment has been closed.
Mt. Adams 23	GPNF, Mount Adams RD	Unknown					Talus meadow
Mt. Adams 24	GPNF, Mount Adams RD	Unknown					Talus meadow
Mt. Adams 25	GPNF, Mount Adams RD	Road Maintenance	U	Grazing	U		Roadside
Mt. Adams 26	GPNF, Mount Adams RD	Encroachment	2				Fescue meadow, not grazed by livestock.
Mt. Adams 27	GPNF, Mount Adams RD	Encroachment	U	Grazing	U		Old harvest unit.
Mt. Adams 28	GPNF, Mount Adams RD	Encroachment	U	Grazing	U		Old harvest unit.
Mt. Adams 29	GPNF, Mount Adams RD	Encroachment	U	Grazing	U		Old harvest unit.
Mt. Adams 30	GPNF, Mount Adams RD	Encroachment	U	Grazing	U		Old harvest unit.
Mt. Adams 31	GPNF, Mount Adams RD	Unknown					Fescue meadow.

Site Name	Administrative Unit	Site-specific threats					Comments
		Primary Threat	Threat Level*	Secondary Threat	Threat Level*	Other	
Mt. Adams 32	GPNF, Mount Adams RD	Road Maintenance	U	Grazing	U		Roadside
Mt. Adams 33	GPNF, Mount Adams RD	Encroachment	3				Roadless area
Mt. Adams 34	GPNF, Mount Adams RD	Encroachment	3	Weeds			Small meadow opening in old harvest unit.
Mt. Adams 35	GPNF, Mount Adams RD	Encroachment	3	Weeds			Small meadow opening in old harvest unit.
Mt. Adams 36	GPNF, Mount Adams RD	Encroachment	3	Weeds			Small meadow opening in old harvest unit.
Mt. Adams 37	GPNF, Mount Adams RD	Encroachment	3	Weeds			Small meadow opening in old harvest unit.
Wenatchee 1	OKWNF[†] Naches RD	Grazing	U	Conifer encroachment	4		Old harvest unit
Wenatchee 2	OKWNF Naches RD	Grazing	U				Fall cattle grazing
Wenatchee 3	OKWNF Naches RD	Conifer Encroachment	4	Grazing	U	3	Old harvest unit invasive weed, fall cattle grazing
Wenatchee 4	OKWNF Naches RD	Grazing	U				fall cattle grazing
Wenatchee 5	OKWNF Naches RD	Grazing	U	Conifer Encroachment	3		Old harvest unit
Wenatchee 6	OKWNF Naches RD	Grazing	U	Road maintenance	3		near side of 1204 rd, backdrop old harvest unit,
Wenatchee 7	OKWNF Naches RD	Grazing	U	Conifer Encroachment	3		Old harvest unit
Wenatchee 8	OKWNF Naches RD	Conifer Encroachment	3	Grazing	U		Old harvest unit
Wenatchee 9	OKWNF Naches RD	Grazing	U	Conifer Encroachment	4		Old harvest unit, cattle exclosure present
Wenatchee 10	OKWNF Naches RD	Conifer Encroachment	4	Invasive weeds	3		Old harvest unit,
Wenatchee 11	OKWNF Naches RD	Conifer Encroachment	4	Grazing	U		Old harvest unit, cattle exclosure present
Wenatchee 12	OKWNF Naches RD	Vehicles/ camping	4				Landing from old TS harvest, dispersed camping site

Site Name	Administrative Unit	Site-specific threats					Comments
		Primary Threat	Threat Level*	Secondary Threat	Threat Level*	Other	
Wenatchee 13	OKWNF Naches RD	Conifer encroachment	3	Grazing	U		Old harvest unit
Wenatchee 14	OKWNF Naches RD	Conifer encroachment	4	Grazing	U		Old harvest unit
Wenatchee 15	OKWNF Naches RD	Conifer encroachment	4	Grazing	U		Old harvest unit
Wenatchee 16	OKWNF Naches RD	Conifer encroachment	4	Grazing	U		Old harvest unit
Wenatchee 17	OKWNF Naches RD	Conifer encroachment	4	Grazing	U		Old harvest unit
Wenatchee 18	OKWNF Naches RD	Grazing	U				wild ungulate grazing only during the spring, dispersed camping site
Wenatchee 19	OKWNF Naches RD	Grazing	U				cattle and elk exclosures present
Wenatchee 20	OKWNF Naches RD	Grazing	U	Rec use-trails	3		Large Meadow on private and FS lands, along popular horse and foot trail that access wilderness
Wenatchee 21	OKWNF Naches RD	Grazing	U	Rec use- trails	3		on private and FS lands, along popular horse and foot trail that access wilderness
Wenatchee 22	OKWNF Naches RD	Grazing	U	Rec use- trails	3		Private land, popular horse & foot trails access the wilderness
Wenatchee 23	OKWNF Naches RD	Grazing	U	vehicle use	3		Along popular horse and foot trail in wilderness, pvt land-cabin site
Wenatchee 24	OKWNF Naches RD	Grazing	U	Conifer Encroachment	3		Along popular horse and foot trail in wilderness
Wenatchee 25	OKWNF Naches RD	Conifer Encroachment	2	Rec use- trails	3		Along popular horse and foot trail in wilderness
Wenatchee 26	OKWNF Naches RD	Conifer Encroachment	3	Rec use- trails	3		Along popular horse and foot trail in wilderness
Wenatchee 27	OKWNF Naches RD	Conifer Encroachment	2	Rec use- trails	3		Along popular horse and foot trail in wilderness

Site Name	Administrative Unit	Site-specific threats					Comments
		Primary Threat	Threat Level*	Secondary Threat	Threat Level*	Other	
Wenatchee 28	OKWNF Naches RD	Conifer Encroachment	2	Rec use- trails	3		Along popular horse and foot trail in wilderness
Wenatchee 29	OKWNF Naches RD	Conifer Encroachment	2	Rec use- trails	3		Along popular horse and foot trail in wilderness.
Wenatchee 30	OKWNF Naches RD	Conifer Encroachment	2	Rec use- trails	3		Along popular horse and foot trail in wilderness.
Wenatchee 31	OKWNF Naches RD	Conifer Encroachment	2	Rec use- trails	3		Along popular horse and foot trail in wilderness
Wenatchee 32	OKWNF Naches RD	Conifer Encroachment	2	Rec use- trails	3		Along popular horse and foot trail in wilderness
Wenatchee 33	OKWNF Naches RD	Rec use- trails	3				Jeep trail runs through the middle of the meadow. Large ruts in a portion of the meadow.
Wenatchee 34	OKWNF Naches RD	Grazing	U				Small meadow located adjacent to Conrad meadow. Cattle/game trail leads to meadow. Moderate to heavy grazing levels.
Wenatchee 35	OKWNF Naches RD	Conifer Encroachment	2	Grazing	U		This is an old timber sale unit that had natural wet areas (false hellebore present). Moderate levels of grazing, Conifer encroachment well established.
Wenatchee 36	OKWNF Naches RD	Invasive Plants	4	Rec use-trails	3		Small meadow with a popular horse trail through it.
Conboy 1	Conboy Lake National Wildlife Refuge	Conifer Encroachment					Extensive camas/fescue meadow on margin of Conboy Lake.
Conboy 2	Conboy Lake National Wildlife Refuge	Conifer Encroachment					Short-grass area located on margin of Conboy Lake.

Site Name	Administrative Unit	Site-specific threats					Comments
		Primary Threat	Threat Level*	Secondary Threat	Threat Level*	Other	
Conboy 3	Conboy Lake National Wildlife Refuge	Conifer Encroachment					New site documented in 2011. Short-grass area located on margin of Conboy Lake.
Conboy 4	Conboy Lake National Wildlife Refuge	Conifer Encroachment		Invasive Weeds			Riparian meadow, in close proximity to Conboy NWR Laurel site.
Conboy 5	Conboy Lake National Wildlife Refuge	Conifer Encroachment					
Conboy 6	Conboy Lake National Wildlife Refuge	Conifer Encroachment					Clearing in front of Flying L Ranch, maintained as a meadow by owners.
Conboy 7	Conboy Lake National Wildlife Refuge	Conifer Encroachment					Old airstrip clearing on Flying L. Property, no longer maintained as an airstrip. Conifers encroaching.
Conboy 8	Conboy Lake National Wildlife Refuge	Conifer Encroachment					Extensive upland complex, large area with potential mardon habitat.
Conboy 9	Conboy Lake National Wildlife Refuge	Conifer Encroachment					Extensive upland complex, large area with potential mardon habitat.
California 1	Six Rivers National Forest, Smith River National Recreation Area	Conifer encroachment	3 / 4	Off-road vehicle damage	3		Conifer encroachment due to fire suppression, lack of disturbance. Boulders placed in 2008 to block vehicle access to habitat.

Site Name	Administrative Unit	Site-specific threats					Comments
		Primary Threat	Threat Level*	Secondary Threat	Threat Level*	Other	
California 2	Redwood National Park	Conifer encroachment	3				Conifer encroachment due to fire suppression, lack of disturbance.
California 3	Six Rivers NF, Smith River Nation Recreation Area	Conifer encroachment	3				Conifer encroachment due to fire suppression, lack of disturbance. Part of habitat treated with a managed burn in fall 2008.
BLM Ashland 1	Medford District BLM, Ashland RA	Grazing	2 / 3	Conifer Encroachment; noxious weeds	2 / 3		Non-native grasses
BLM Ashland 2	Medford District BLM, Ashland RA	Grazing	2 / 3	Conifer Encroachment; noxious weeds	2 / 3		Non-native grasses
BLM Ashland 3	Medford District BLM, Ashland RA	Grazing	2 / 3	Conifer Encroachment; noxious weeds	2 / 3		Private land. Non-native grasses
BLM Ashland 4	Medford District BLM, Ashland RA	Grazing	2 / 3	Conifer Encroachment; noxious weeds	2 / 3		Corner of four sections; Partially on private land. Non-native grasses
BLM Ashland 5	Medford District BLM, Ashland RA	Grazing	2 / 3	Conifer Encroachment; noxious weeds	2 / 3		Private land Non-native grasses
BLM Ashland 6	Medford District BLM, Ashland RA	Grazing	2 / 3	Conifer Encroachment; noxious weeds	2 / 3		Non-native grasses
BLM Ashland 7	Medford District BLM, Ashland RA	Grazing	2 / 3	Conifer Encroachment; noxious weeds	2 / 3		Partially on private land. Non-native grasses
BLM Ashland 8	Medford District BLM, Ashland RA	Grazing	U	Conifer Encroachment; noxious weeds	2 / 3		Hobart Peak Complex Exclosure around meadows; noxious weeds and non-native grasses

Site Name	Administrative Unit	Site-specific threats					Comments
		Primary Threat	Threat Level*	Secondary Threat	Threat Level*	Other	
BLM Ashland 9	Medford District BLM, Ashland RA	Grazing	U	Conifer Encroachment; noxious weeds	2 / 3		Hobart Peak Complex Exclosure around meadows; noxious weeds and non-native grasses
BLM Ashland 10	Medford District BLM, Ashland RA	Grazing	U	Conifer Encroachment; noxious weeds	2 / 3		Hobart Peak Complex Exclosure around meadows; noxious weeds and non-native grasses
BLM Ashland 11	Medford District BLM, Ashland RA	Grazing	U	Conifer Encroachment; noxious weeds	2 / 3		Hobart Peak Complex Exclosure around meadows; noxious weeds and non-native grasses
BLM Ashland 12	Medford District BLM, Ashland RA	Grazing	2 / 3	Conifer Encroachment; noxious weeds	2 / 3		Non-native grasses
BLM Ashland 13	Medford District BLM, Ashland RA	Grazing		Conifer Encroachment; noxious weeds			
BLM Ashland 14	Medford District BLM, Ashland RA	Grazing		Conifer Encroachment; noxious weeds			
BLM Ashland 15	Medford District BLM, Ashland RA	Grazing		Conifer Encroachment; noxious weeds			
BLM Ashland 16	Medford District BLM, Ashland RA	Grazing		Conifer Encroachment; noxious weeds			
BLM Ashland 17	Medford District BLM, Ashland RA	Grazing		Conifer Encroachment; noxious weeds			
BLM Ashland 18	Medford District BLM, Ashland RA	Grazing		Conifer Encroachment; noxious weeds			

Site Name	Administrative Unit	Site-specific threats					Comments
		Primary Threat	Threat Level*	Secondary Threat	Threat Level*	Other	
BLM Coos Bay 1	Coos Bay District BLM Myrtlewood RA	Conifer encroach-ment	3	Grazing	2		Meadow restoration (cutting small conifer, pile & burn) completed in 2007.
BLM Coos Bay 2	Coos Bay District BLM Myrtlewood RA	Conifer encroach-ment	3	Grazing	2		No restoration; possibly in the future.
Joint Base Lewis-McChord 1	Joint Base Lewis-McChord	Artillery fire	3 / 4	Wildfire resulting from artillery fire	3 / 4		Population is around the periphery of a 7,000 acres meadow which serves as a bombing range.
Joint Base Lewis-McChord 2	Joint Base Lewis-McChord	Artillery fire	3 / 4	Wildfire resulting from artillery fire	3 / 4		Population is around the periphery of a 7,000 acres meadow which serves as a bombing range.
Joint Base Lewis-McChord 3	Joint Base Lewis-McChord	Artillery fire	3 / 4	Wildfire resulting from artillery fire	3 / 4		Population is around the periphery of a 7,000 acres meadow which serves as a bombing range.
Puget 1	WA DFW††	Invasive Weeds	3/4				Site is being actively managed by WDFW to control invasive weeds and restore native prairie species
Puget 2	WA DFW	Invasive Weeds	3/4				Site is being actively managed by WDFW to control invasive weeds and restore native prairie species

* Threat Level: U = Unknown; 1 = Threat not present; 2 = Threat present, no degradation observed; 3 = Threat present, little degradation detected; 4 = Habitat seriously degraded; 5 = Habitat lost, butterflies extirpated
** Gifford Pinchot National Forest † Okanogan-Wenatchee National Forest †† Washington Department of Fish and Wildlife

Appendix B. Management Status Definitions

For reference, the Mardon skipper is ranked as follows:
Federal Candidate
Washington State endangered species by the Washington Fish and Wildlife Commission
Global Heritage Status Rank of G2G3
United States National Heritage Status Rank is N2N3
BLM Special Status Species
U.S. Forest Service Region 6 Sensitive species
Polites mardon klamathensis in southern Oregon has a Global Heritage Status Rank of G2G3 and a rounded Global Heritage Status Rank of T1

The information on the Heritage Rankings is from the Oregon Biodiversity Information Center website: http://orbic.pdx.edu/

Ranks are developed for different portions of a species range.

- The first and most critical rank describes the species status globally, and best describes the risk of extinction. This is called the Global Rank and begins with a "G".
- National Ranks describing the species status in the United States, was developed. These begin with the letter "N".
- If the taxon has a trinomial (a subspecies, variety or recognized race), this is followed by a "T" rank indicator.

The number following the letter designation shows the relative rarity of occurrences.
1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences.

2 = Imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction (extirpation), typically with 6-20 occurrences.

3 = Rare, uncommon or threatened, but not immediately imperiled, typically with 21-100 occurrences.

BLM and U.S. Forest Service Special Status and Sensitive Species programs are based on national policies and seek to further the objectives of the Endangered Species Act by avoiding federal actions that may contribute to future listings of species as threatened or endangered. Each policy requires coordination with state and other federal agencies to achieve conservation goals of species. The objectives of the Forest Service's program also include compliance with National Forest Management Act regulations requiring diversity of plant and animal communities, and management to maintain viable populations of existing native and desired nonnative vertebrate species.

Washington State Endangered Species is defined in WAC 232-12-297, Section 2.4, to include "any wildlife species native to the state of Washington that is seriously threatened with extinction throughout all or a significant portion of its range within the state."
(http://wdfw.wa.gov/wlm/diversty/soc/definitn.htm)