



# **Habitat Enhancement for Rare Butterflies on Fort Lewis Prairies**

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## **Goal : To restore and enhance components of native prairie systems that are important to four rare butterfly species.**

### **Executive Summary**

The Fort Lewis Military Installation is important in a regional context because it contains the largest remaining prairies in south Puget Sound and provides critical habitat for a number of rare and declining prairie species. Among those declining species are four butterflies: the mardon skipper (*Polites mardon*), Taylor's checkerspot (*Euphydryas editha taylori*), zerene fritillary (*Speyeria zerene bremnerii*), and the Puget blue (*Icaricia icarioides blackmorei*). The first two species, the skipper and checkerspot, are candidates for federal listing under the Endangered Species Act. Within Fort Lewis, they are currently restricted to a single locale, the Artillery Impact Area. The other two butterfly species exhibit a more widespread distribution on Fort Lewis prairies.

The distribution and abundance of the four rare butterflies is influenced by habitat conditions, especially the availability of larval and adult plant resources. The south Puget Sound prairie landscape has been dramatically altered over the last 150 years due to changes in land use practices that accompanied European settlement. Since that time, the prairies have been drastically reduced in size and fragmented, and invasive plants have further altered the remaining prairies, with the result that the historical range of landscape conditions is not available to present day prairie dependant species. In some areas, high quality native plant communities appear to be largely restricted to the more drought-prone sites, leading to a reduction in the diversity of habitat types available to butterflies in the prairie complex. Butterflies typically use resources on the open prairies and in diverse microhabitats, depending on climatic conditions. Access to a variety of habitats is likely to be especially important to adult and juvenile stage survival and fitness during extremes in weather conditions. The degradation of native resources in diverse microhabitats, especially moisture-retaining sites such as prairie edges and relatively mesic areas, is a significant concern for butterflies. Habitat diversity is important because the distribution of resources among a variety of sites can buffer the effects of unusual weather conditions on butterfly populations, thereby promoting their long-term persistence in a dynamic environment.

The purpose of this document is to identify important habitat requirements of the four target butterfly species, and propose strategies for habitat enhancements on the prairies that target those requirements. This plan constitutes the next logical step in the conservation of prairies and their fauna, following on the success of initial steps to control dense stands of Scotch broom (*Cytisus scoparius*), remove invading conifers, and plant native grasses and forbs on Puget prairies. Proposed enhancement strategies focus on three components of the prairies:

1. *Vegetation Composition* – Control of invasive species, especially Scotch broom and invasive grasses, and planting of native grasses and forbs (especially larval and adult butterfly food resources), have been, and will continue to be, the cornerstones to improving this component of the prairies for butterflies. Control of exotic grasses poses the most formidable challenge to improving the vegetation composition of the prairies for butterflies, as techniques for controlling these grasses are less well studied, especially in a butterfly conservation context.
2. *Habitat Structure* – Targeting diverse structural/edaphic features of the prairies for enhancements, in addition to open prairie sites, will promote habitat diversity. Diverse structural/edaphic features to target include:
  - Tree islands or edge habitats associated with oaks and conifers
  - Sloping topography, especially low-lying swales
  - Relatively mesic sites and prairie that grades into riparian zones.

3. *Process* – Incorporating a ‘butterfly-sensitive’ fire regime that emphasizes a regular cycle of burning on portions of the prairies, along with the creation of refugia within burned areas, should promote the *process* component of the prairies and favor butterfly populations. Restoring fire as a process on the prairies on a meaningful scale will be a challenge in the face of small, fragmented prairies, unpredictable weather, burn restrictions, and encroaching development.

Three prairies in the Fort Lewis landscape were identified as *high priority* sites on which to enhance the composition, structure and process of the prairie habitat (Figure 1). The selection was limited to three prairies to concentrate resources into high quality habitat patches in three locales, rather than scattering resources widely across multiple prairies, with fewer significant improvements. Concentrated resources increase the chances that enhanced habitat patches will be located and used, and additionally, facilitate mate location by the butterflies. The three high priority prairies, the Artillery Impact Area (AIA), the 13<sup>th</sup> Division Research Natural Area (RNA), and Johnson Prairie, were chosen based on their current and historical use by rare butterflies, availability of native prairie vegetation, the presence of diverse structural features, and compatible land uses. Within each of the three prairies, a network of three or more habitat patches were identified for potential enhancements that emphasize improving habitat elements identified as important to the rare butterflies. These habitat enhancement patches contain a combination of open prairie habitat and proximal diverse structural features. Proposed enhancements constitute an ambitious undertaking, and should be implemented slowly and with a strong research component to avoid impacts to existing butterflies and their resources. It would also be prudent to adapt existing management regimes to incorporate considerations for butterfly-sensitive management actions outlined in the plan.

Two *secondary priority* prairies, the Weir Prairie complex and Training Area 7S, were identified as sites to receive less intensive enhancement efforts (Figure 1). Strategies proposed for these sites are based on a continuation of their existing management regime, and include maintenance of Scotch broom, woody shrub and tree control efforts, with added emphasis on the prairie edges, and monitoring and treating new invasives. A longer term strategy for these secondary priority prairies includes a higher level of enhancement effort directed at non-native grass control, native species plantings, and incorporation of a butterfly-sensitive fire plan, as recommended for the short-term on high priority prairies.

Monitoring and research programs that complement the proposed enhancement strategies would be useful for improving those strategies and generally facilitate an adaptive management process. Several research areas are reviewed in the plan:

1. Measuring success toward meeting habitat enhancement objectives proposed in the plan.
2. Evaluating the response of rare butterflies to habitat enhancements.
3. Monitoring the long-term population trends of rare butterflies in relation to the greater butterfly community on Fort Lewis.
4. Gaining further understanding of a) the natural ecology of the rare butterflies and their resources, and b) prairie enhancement techniques to promote improvements in habitat management for rare species on Fort Lewis and the greater south Puget Sound region.

Evaluating the response of the mardon skipper and Taylor’s checkerspot to enhancement efforts is not possible at Fort Lewis at this time due to their limited occurrence on a restricted access site (AIA). For the purpose of gaining information on the value of select enhancement strategies proposed for these species, an off-site research program warrants consideration. Cooperating with scientific partners on local non-military lands outside of the Fort Lewis complex, where the target butterfly species occur, would allow investigation into topics that relate directly to butterfly parameters, rather than their habitat.

In addition to the conservation of biodiversity, prairie enhancement activities will support the training mission of the US army on Fort Lewis by removing dense stands of shrubs that hinder the movement of troops over the landscape during training maneuvers. Furthermore, enhancement actions will only be conducted at a time and place that does not conflict with military training activities.

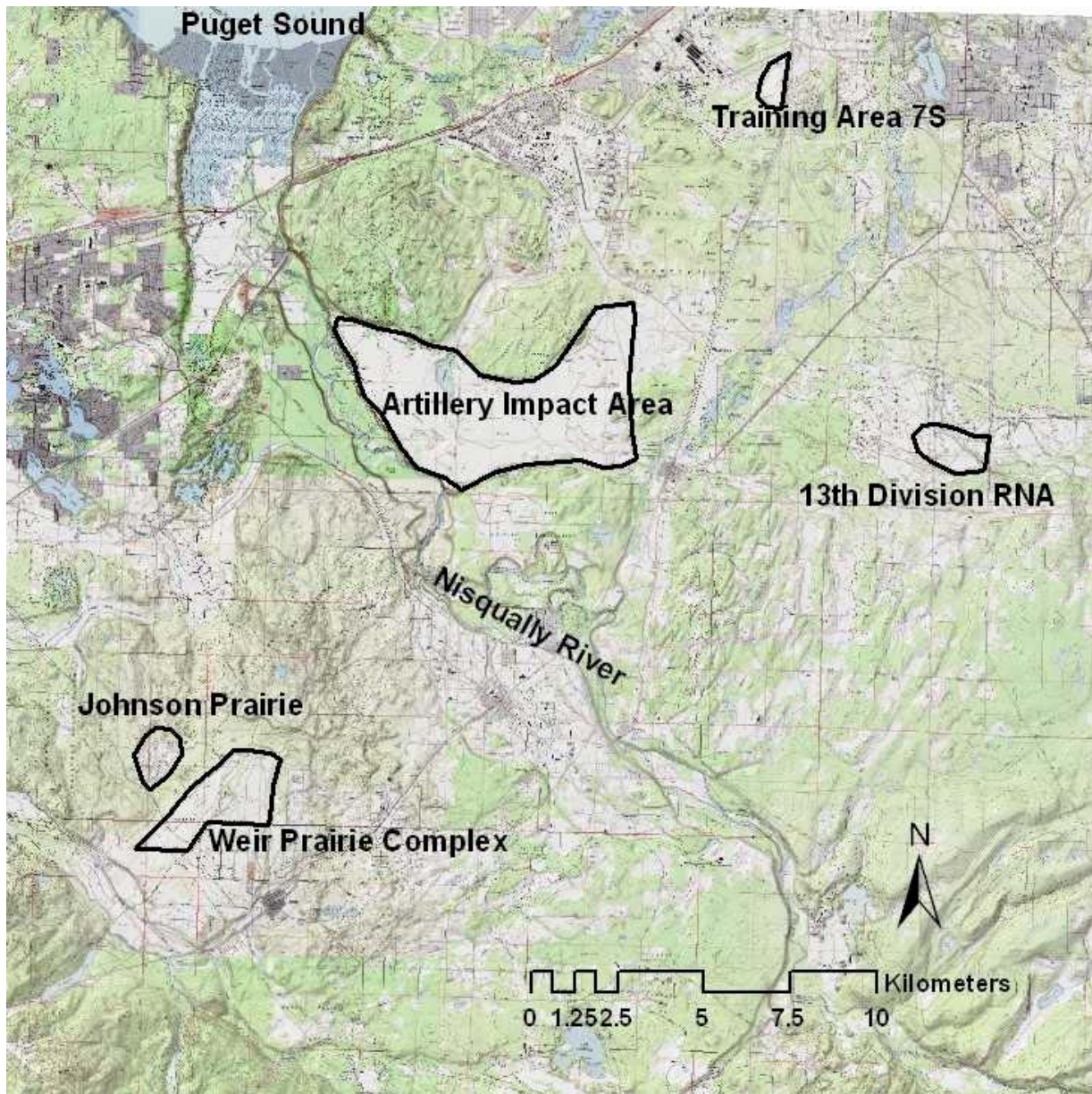


Figure 1. Map showing three high priority prairies, the Artillery Impact Area, Johnson Prairie, and the 13<sup>th</sup> Division RNA, and two secondary priority prairies, Weir Prairie Complex and Training Areas 7S targeted for habitat improvements on the Fort Lewis Military Installation.

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## 1. Introduction

Native prairies of the south Puget Sound (hereafter condensed to ‘Puget’) constitute the most endangered ecosystem in the state of Washington, and one of the most endangered ecosystems in the United States (Altman 2003). The Fort Lewis Military Installation is important in a regional context because it contains the largest remaining prairies in the Puget region, along with a significant proportion of the region’s butterfly species (Morgenweck and Dunn 2003). Four species, the mardon skipper (*Polites mardon*), Taylor’s checkerspot (*Euphydryas editha taylori*), zerene fritillary (*Speyeria zerene bremnerii*), and the Puget blue (*Icaricia icarioides blackmorei*), have become increasingly rare throughout their range in the Puget Trough - Willamette Valley ecoregion. Prairie habitat has undergone extreme changes in the last two centuries, and consequently, the butterflies are reduced to remnant populations on isolated prairies. All four species are proposed candidates for listing at the state and/or federal level (see Table 1.1). Two species, the mardon skipper and the Taylor’s checkerspot, both candidates for federal listing, were ranked by local experts as ‘very high’ in a ranking of risks to the continued existence of the species (ENSR 2001, The Nature Conservancy 2002).

Table 1.1 Special status and priority rankings by local experts for the four target butterflies (ENSR, 2001, The Nature Conservancy 2002).

Common Name	Scientific Name	Federal listing	State listing	Priority Ranking
Mardon skipper	<i>Polites mardon</i>	Candidate	Endangered	Very High
Taylor’s checkerspot	<i>Euphydryas editha taylori</i>	Candidate	Candidate	Very High
Zerene fritillary	<i>Speyeria zerene bremnerii</i>	Species of concern	Candidate	Medium
Puget blue	<i>Icaricia icarioides blackmorei</i>		Candidate	Medium

Within Fort Lewis, the mardon skipper and Taylor’s checkerspot are currently restricted to a single locale, the Artillery Impact Area (AIA). In greater western Washington, these species have highly restricted ranges in a limited number of other Puget prairies and ‘balds’. On a broader geographic scale, the mardon skipper is known from 37 sites in four areas: 1) southern Puget Sound, 2) the Mt. Adams area in southern Washington’s east Cascade Mountains, 3) the Cascade Mountains of southern Oregon, and 4) Del Norte (north-coastal) California (The Xerces Society 2002b). The Taylor’s checkerspot is believed extirpated from historical range in British Columbia, and restricted to a single locale in Oregon’s Willamette Valley (The Xerces Society 2002a).

The other two species, zerene fritillary and Puget blue, received priority rankings of ‘medium’, and are more widely distributed both on Fort Lewis and in other Puget prairies. This is especially true for the Puget Blue, which is currently found on seven prairies on Fort Lewis (Morgenweck and Dunn 2003). There is a population of zerene fritillaries on Johnson Prairie, and possibly some dispersing individuals on the Weir and 13<sup>th</sup> Division prairies (Morgenweck and Dunn 2003). Outside of the south Puget Sound region, zerene fritillaries occur on Vancouver, Gulf, and San Juan Islands (Pyle 2002), and a handful of locations in the Willapa Hills. They are presumed extirpated from their range in the Willamette Valley (Pyle 2002). Puget blue butterflies extend from Vancouver Island, south through meadows of the Olympic Mountains, and into the greater Puget Trough region (Dunn and Fleckenstein 1997, Pyle 2002).

Conservation efforts that target these four candidate species are likely to improve conditions for other prairie butterflies and organisms. Dunn and Fleckenstein (1997) conducted an analysis of the distribution of the four candidate species, state monitor species, and the total number of butterfly species in the Puget prairies. Their analysis suggested that prairies with candidate butterflies provided habitat for a wide range of butterflies, not just the specific habitat needed by the rare species. Habitat improvements that target the needs of the four candidate species, and that include the restoration of

healthy prairies in general, should result in improvements for a wide range of native prairie-associated butterflies and organisms beyond the target species of this document.

The purpose of this document is to summarize the scientific information concerning the habitat requirements of the four target butterflies and propose strategies for habitat enhancements that target prairie features likely to be important to these butterflies based on their requirements. Considerations for a complementary research program are also provided. Management strategies are proposed specifically for Fort Lewis, but the principles may be considered for wider application on Puget prairies. The two federal candidate species received a greater emphasis in the plan due to their higher priority rankings (Table 1.1). This program of enhancements constitutes the next logical step in the conservation of Puget prairies and their fauna, following on the success of initial steps to control dense stands of Scotch broom (*Cytisus scoparius*), remove invading conifers, and plant native prairie flora. The goal of this enhancement program is described as follows:

**Goal : To restore and enhance components of native prairie systems that are important to four rare butterfly species.**

If it is determined at a future date that butterfly populations will be augmented on Fort Lewis through reintroductions, then a reintroduction or recovery plan should be developed that includes a well-documented decision process for determinants of habitat suitability. The subject of the decision process associated with reintroductions of the butterflies is not treated in this plan.

Finally, along with the conservation of biodiversity, prairie enhancement activities will support the training mission of the US Army on Fort Lewis by clearing woody invasives that hinder movements of troops across the landscape.

## **2. Butterflies and the Importance of Habitat Diversity**

Most butterflies are not uniformly distributed throughout the landscape due to specific resource requirements. Each species is uniquely adapted to a suite of environmental conditions derived from intrinsic biological factors such as larval host specificity, low vagility, the need for close proximity of individuals for mating behavior, and clumped distribution of nectar resources (Arnold 1980). Despite the relatively specialist adaptations, some butterflies may change their use of host plants, habitats, or microhabitats in different seasons or years (Mason 1997). Hays et al. (2000) report that nectaring by Taylor's checkerspots shifted to areas at the grassland/conifer edge during a dry period when flowers on the open grassland had senesced, but fresh resources were available in the shade of the trees. They also describe between-year differences in the nectar resources and characteristics of habitat used by mardon skippers and zerene fritillaries in their Puget prairie study areas. The exact causes of these shifts in resource and habitat use by butterflies were not always known, but the following rationales were highlighted: variation in the availability of plant resources; responses to weather variables; and responses to changes in the habitat by management actions such as Scotch broom removal (Hays et al. 2000).

The lifecycles of many butterflies incorporate different stages with diverse habitat requirements (New 1997). The varied requirements of different butterfly life stages with limited mobility means that butterflies depend on access to diverse habitats offering a range of thermal microenvironments and resources in close proximity (Weiss and Murphy 1990).

Two of the rarest butterfly species on Puget prairies require varying habitat conditions over the course of their adult and larval development stages. The Taylor's checkerspot and mardon skipper are among the earliest butterflies to emerge as adults in early spring (Figure 2.1). These butterflies depend on early



spring conditions that allow larvae, pupae, and adults to warm up enough to move, develop, and/or feed. This is a challenge during the generally rainy and cool spring conditions on the Puget lowland prairies, which can be made colder by the strong spring winds that increase on sunny afternoons when butterflies would be most active.

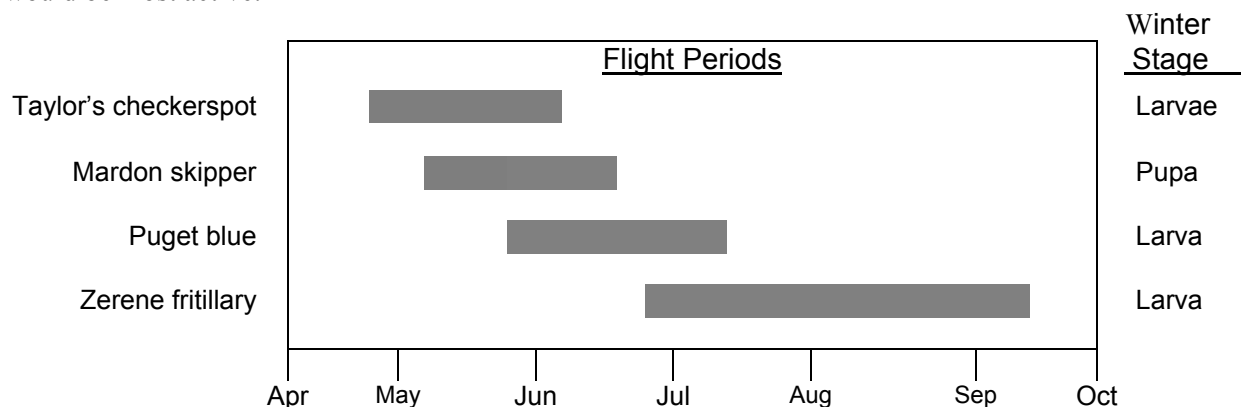


Figure 2.1 Approximate flight periods and overwinter stages for rare butterflies in the Puget region (flight times from Hinchcliff 1996 and Dunn and Fleckentstein 1997).

The rare early spring butterflies on Puget prairies require not only suitably warm conditions for growth or emergence in the cool wet spring, but also larval host resources that remain pre-senescent during the typically hot and dry northwest summers to support larval development. Summer larvae feed through mid-summer to develop sufficiently to enter their over-wintering life stages (4<sup>th</sup> instar caterpillar for Taylor's checkerspot, and pupa for mardon skipper). Research on the Bay checkerspot (*Euphydryas editha bayensis*) in California demonstrated the dependence of female reproductive success on the relative timing of adult female emergence and hostplant senescence (Cushman et al. 1994). Specifically, the larvae of eggs laid by early emerging females had the highest chance of surviving to diapause before their food resources senesced, compared to the larvae of females that emerged later (Cushman et al. 1994). The combination of conditions that favor early emergence of Taylor's checkerspot and other spring butterflies, while also allowing for mid-summer larval feeding may be important on Puget prairies also.

Moderate weather conditions that favor all phases of growth and development allow population numbers to increase. Unusual weather conditions such as an abnormally cold spring, or an early summer drought, however, may disrupt the tight phase relationship between butterfly development and resource availability (Weiss et al. 1987), leading to population declines. In times of unusual or changing weather conditions, habitat diversity in the form of topographic or structural heterogeneity becomes important, and may be key to the persistence of populations of insects that use small areas of habitat (Ehrlich and Murphy 1987). Habitat heterogeneity has the potential to buffer a population against the effects of environmental stochasticity (Hanski 2003), such as drought-induced senescence of larval host plants, through differential survival of larvae in different micro-habitats. Prairies that are structurally and compositionally diverse offer the best potential to meet the varying needs of the target butterflies over the long-term.

Open portions of the prairies are extensively used by the four rare butterflies, yet diverse structural and edaphic (pertaining to the soil or water environment) habitat features (hereafter condensed to 'structural features') of the prairies may play important roles during times of climatic extremes or at critical times of the year. Examples of diverse structural features that would be expected to enhance habitat diversity on the prairies include:

- Prairie – woodland or forest edges
- Forest 'nooks' or pockets of prairie extending into the forest or woodland matrix

- Tree islands or individual trees on the open prairie
- Low-lying swales
- Prairie grading into riparian zones
- Relatively mesic sites (i.e. sites that support prairie vegetation, but may retain moisture for longer periods of time compared to drier prairie sites)
- Mounds, or deeper soil sites.

These diverse structural features create a variety of microhabitats for butterflies and their resources, and other native fauna. They offer the potential for: protection from wind, escape cover, shading effects, moisture retention, heat retention, and differences in humidity. These differences in microclimate may be reflected in the plant species composition and their phenology, which further enhances habitat heterogeneity.

In summary, the more diverse the habitat, the better the odds that the prairie complex can support the variety of processes necessary to allow butterflies to complete their life stages in any given year, with consequent population persistence. The buffering effects of heterogeneous habitats in the face of unusual or extreme weather conditions may become more important if climate change is contributing to local population declines (McLaughlin et al. 2002).

### **3. Threats to Prairie Butterflies**

This plan is intended to guide the improvement of conditions for prairie butterflies on Fort Lewis prairies, although it is important to note that the specific reasons for the declines of these rare species are not completely understood. Extinctions and extirpations of butterflies, and biota in general, are frequently attributed to environmental change, more specifically, some combination of habitat loss (due to conversion or degradation), fragmentation, and alteration (Hanski 2003). Many insect populations normally experience large fluctuations in size (Ehrlich 1992) as a result of weather, predation or disease. These normal background fluctuations, coupled with habitat loss and alteration, can result in local extirpations, with little chance of re-colonization due to the isolated nature of the habitat patches (Hanski 2003).

Less well documented is the possibility that climate change poses a direct threat to butterflies, although climate change-induced stresses have been cited as contributing factors in population declines or extirpations, (USFWS 2000, Hanski 2003). Models of Bay checkerspot (*Euphydryas editha bayensis*) population numbers and climate data show that changes in precipitation patterns associated with climate change, can amplify background population fluctuations in these checkerspots, making them more prone to local extirpations, especially in isolated populations (McLaughlin et al. 2002).

Finally, stochastic events acting on individual populations with no means for recovery due to isolation (Ehrlich and Murphy 1987), and possibly loss of genetic diversity (Ehrlich 1992, Nieminen et al. 2001), are additional factors that may contribute to population declines and extirpations. These various threats may all be contributing to some degree to the declines of the target butterfly populations on Puget prairies, although habitat modification stands out as the strongest potential contributing factor. This section of the document will focus on the changes in the Puget prairie landscape as important threats to the prairie obligate butterflies.

#### **Smaller and Fragmented Prairies**

The butterflies of the Puget Prairies evolved in a landscape that was very different than exists today. In pre-European settlement times, the prairies were far more extensive, constituting the dominant landscape feature of the Puget region (Crawford and Hall 1997). It is estimated that approximately 95% of the historical extent of prairie and savanna habitat has been lost to urban, residential, and agricultural

development, along with encroachment by Douglas-fir forest (Crawford and Hall 1997). The remaining fragmented prairies are smaller and relatively isolated compared with their historical condition.

### Invasive Species

The biological communities of these glacial outwash soils were strongly influenced by warmer and drier climatic conditions than are in effect today (Crawford and Hall 1997). Since that time, climatic conditions have become more conducive to forest cover, and the prairies have become a 'plagioclimax' community, requiring periodic disturbance to arrest succession and encroachment by conifers. A long history of high frequency, low intensity, largely anthropogenic fires, combined with periodic summer droughts and low soil fertility, served to maintain the fescue bunchgrass-dominated prairie community over large expanses of suitable soil, despite the relatively wet climatic conditions that have prevailed in recent history in western Washington (del Moral and Deardorff 1976).

Prior to European settlement in the mid-1800's, the prairies of western Washington were burned frequently, probably annually in many locales, by Native Americans (Morris 1934, Lang 1961, Norton 1979, Leopold and Boyd 1999). Cecilia Carpenter (1992) writes "... for as many years as they (our Nisqually ancestors) could remember, during the fall of each year the vast prairie areas that lay on both sides of the lower segment of the Nisqually River were burned." A less frequent burning schedule, approximately every 3 years, was used for prairie edges to encourage berry production and open the understory (Purdue 1997, Leopold and Boyd 1999). Fires were frequently extensive in size, with early visitors describing several miles of burned conditions (Lang 1961). Burning on the prairies and prairie edges by Native Americans was drastically reduced with the influx of European settlers, eventually leading to a policy of fire suppression. These same settlers also brought non-native pasture grasses for their stock, and began the introduction of many invasive plants. The changes associated with European settlement have resulted in a prairie landscape that is succeeding to conifer forest due to the absence of periodic disturbance, such as fire, and native prairie bunchgrass communities that are being replaced by invasive species. Thus, present day Puget prairies have been fragmented into smaller units, and the remaining prairie lands have been altered through the encroachment and invasion of native and non-native trees and shrubs.

### Soils

Changes are also occurring below the soil surface. The soils of Puget Sound are characterized as shallow, gravelly, well drained, low in fertility and productivity, and prone to drought (Lang 1961, Crawford and Hall 1997). The nitrogen dynamics of these prairie soils are changing due to the addition of N to the soil from:

- a) N-fixing leguminous invasive plants such as Scotch broom (Haubensak and Parker, unpub data).
- b) Atmospheric deposition of N from the global N cycle (industrial and agricultural sources) (Jeffries and Maron 1997). Atmospheric deposition of N constitutes approximately 25% of the annual N load to the Puget Sound Basin (Inkpen and Embrey 1998).

Increases in available nitrogen can favor the establishment of aggressive non-native plants that are good competitors for soil nutrients on enriched soils (Maron and Connors 1996), and crowd out native prairie plants that evolved to compete on soils with relatively low nutrient levels. In this context of enriched nitrogen soils, tall invasive grasses and conifers are becoming well established and often dominate important butterfly habitats such as relatively mesic sites and prairie edge ecotones that otherwise would have the potential to sustain butterfly larval food and nectar resources longer into the summer season. Enriched soils that favor invasive plants increase the challenges to controlling these invasives and restoring degraded prairie sites.

### Loss of Habitat Diversity

Invasions of pest plants are especially evident on many of the more structurally diverse sites such as relatively mesic areas and grassland - tree ecotones. These degraded structural features of the prairie

present challenges for controlling invasives in a cost-effective manner. They are often difficult to access with tractor mounted equipment, and are especially prone to re-invasion and establishment by woody shrubs and trees due to proximal seed sources and less droughty conditions. This results in lower habitat diversity values for the prairie complex as structurally diverse and sinuous prairie edges and ecotones are converted to straight, solid edges by woody shrubs and trees, eliminating the mosaic effects and ecotonal habitat gradients that are important to some invertebrates and other fauna. In addition, prairie habitat adjacent to the edges is often further degraded by non-native pasture grasses which form dense stands that crowd out the native grasses and forbs, further reducing the habitat diversity values. Although tall non-native pasture grasses are becoming established throughout many of the prairies, they are often especially abundant at the prairie – woodland edge, or on the deeper soils or wetter sites (personal observation). This combination of factors has led to what appears to be a disproportionate loss of high quality prairie edge and relatively mesic habitats. The result is that the high quality, native-dominated plant communities on remaining prairies may be restricted to the more drought-prone sites.

The degradation of these diverse structural features by invasive plants can seriously reduce the habitat value for butterflies in those critical moisture-retaining sites, and by extension, the greater prairie habitat complex during times of drought. This is especially true for univoltine butterflies (having one generation per year, as opposed to multiple generations per year) such as the four rare species, which require relatively long periods of time to complete their larval development, and depend on long-lasting resources to complete a single lifecycle.

#### Loss of Oak Savanna and Woodland

Deciduous trees, such as the large Oregon white oaks (*Quercus garryana*) that made up the ‘oak opening’, or oak savanna vegetation type described by surveyors for the Government Land Office in the 1850’s (GBA Forestry 2002) may have offered especially valuable habitat for the rare butterflies. They allowed light penetration for early spring plant and larval development, while supplying summer shade for persistence of host plants through the summer larval feeding period. The small and fragmented prairies remaining today contain few solitary oaks or oak woodlands with native understory vegetation, and gone are the expanses of oak savanna that were part of the prairie landscape. The loss of deciduous trees with native understory on the prairies is one more factor contributing to the degradation of the prairies, and possibly the decline of some of the rare butterflies.

#### Summary

The loss of some of the more productive habitats to invasive species often leaves largely the most drought-prone soils as the remaining native prairie habitat. Present day prairies are a relatively simplified version of a formerly complex prairie, savanna, riparian mosaic which likely contained greater proportions of native prairie vegetation in different moisture gradients such as those found in oak savannas, oak woodlands at the prairie margins, riparian areas, and relatively mesic sites, compared to the range of conditions today.

The following constitute a summary of prairie characteristics that differ in today’s prairies compared to historical conditions, and constitute potential threats to butterflies and other prairie obligate fauna.

1. Smaller, fragmented, and more isolated prairies.
2. Vegetation composition and prairie soil characteristics altered by woody and herbaceous invasives.
3. Loss of landscape structure and habitat heterogeneity, with native bunchgrass communities often restricted to the more drought-prone habitats.
4. Loss of the prairie process component – primarily a frequent, low-intensity fire regime.

## 4. Important Habitat Considerations for Rare Butterflies

An excellent investigation conducted by Hays et al. (2000) at Scatter Creek Wildlife Area and Johnson Prairie on Fort Lewis, quantitatively and qualitatively described habitat characteristics and nectar plant preferences of the four target butterfly species. Results generated from this study are very useful in the identification of habitat enhancements to promote habitat characteristics and nectar plants that should benefit the four target butterfly species.

Despite the valuable information available for the rare butterflies' nectar habitat characteristics, empirically derived definitions of more subtle, or fine-grained habitat needs associated with juvenile life stages are less well documented, as they are for most butterflies, due to time and money constraints on long-term, detail-oriented, comprehensive research programs. The habitat requirements of all the life stages of the target species play critical roles in the long-term survival of populations, and therefore are important for management considerations such as habitat restoration and reserve design (Ehrlich and Murphy 1987, Pullin 1996, Mason 1997). For example, characteristics of mate-finding habitat, sites selected for oviposition, and habitat requirements for larval and pupal development of these rare butterflies are less well understood, but would ideally be incorporated into habitat enhancements.

Natural history data are becoming increasingly harder to obtain, because the numbers of butterflies are dwindling, and intact habitats have declined. Obtaining reliable data is further complicated by the possibility that present day (and recent historic) populations of the target species may be occurring on habitat patches that would be considered marginal in an evolutionary context, and therefore do not allow the identification of the more subtle critical habitat needs for long-term persistence. This is likely true where the prairies have experienced a disproportionate loss of some of the more structurally and compositionally diverse habitat features compared with historical conditions, rendering those sites unsuitable for the butterflies. As an extension of this concept, recent extirpations may have occurred on habitat that historically acted as a population sink, and therefore does not represent a model for suitable habitat conditions for the long-term survival of the species.

These caveats are introduced to highlight the limitations to identifying all habitat requirements of these rare butterflies. In the interest of time, and the urgent need for management actions to improve conditions for these rare species, habitat enhancement actions are best not delayed for the purpose of detailed research (Ehrlich 1992). With the above qualifiers in mind, the best available information is used to describe known or scientifically sound important components of habitat for the four target species as a basis for enhancing those aspects of the habitat. Additional research is recommended to occur concurrently with enhancement actions to address information needs (section 8).

### 4.1 Important Habitat Considerations by Species

#### 4.1.1 Taylor's Checkerspot

Research and observations of the Taylor's checkerspot on Puget prairies have revealed information useful in the identification of important habitat needs for this butterfly (Table 4.1 at the end of this subsection). Local quantitative studies on this species have been limited, however, by unfavorable weather conditions and low population numbers (Hays et al 2000). The published literature contains information from long-term and detailed investigations involving other checkerspot butterflies (*Euphydryas* spp), which yield insights into some of the more subtle habitat requirements for these and other butterfly species. Many of these research findings may have application on the Puget prairies.

Abundant nectar resources have been shown to be an important habitat element for checkerspot butterflies in California, especially nectar availability late in the flight season (Murphy et al. 1983).

Abundant nectar can increase life span and egg production, both critical elements in the long-term persistence of a butterfly population where larvae are often subject to high mortality rates (Singer 1972).

Research conducted on the Bay checkerspot (*Euphydryas editha bayensis*) reveals that a critical element for this species is the availability of summer food resources for pre-diapause larvae (Singer 1972, Singer and Ehrlich 1979). Many butterfly species deposit their eggs singly in the habitat, while female checkerspots lay egg masses of 20 – 200 eggs (Cushman et al. 1994). Under favorable weather conditions, starvation of larvae is minimized, and population numbers can dramatically increase. Under conditions of extreme summer drought, the persistence of the population could depend on a few large egg masses that were deposited on host plants located in habitat with greater moisture retention capabilities compared with the more drought-prone open prairie sites. In this case, survival of eggs from just a few egg masses could maintain the population at low levels, despite high background mortality rates for eggs, larvae and pupae (Cushman et al. 1994).

In California, gopher mounds provided a microhabitat that supported checkerspot larval host resources that grew larger and remained green for longer periods into the dry season compared to other open grown resources (Singer 1972). Some *Castilleja hispida* plants (a larval host plant used by Taylor's checkerspots on the AIA) may be found on Fort Lewis prairies looking green and fresh, well after the main population of *Castilleja hispida* has senesced. Whether due to growing on gopher or mole mounds, or for other unknown reasons associated with the frequent fire regime or another factor, the deferred senescence of just a few individual larval host plants that contain egg masses, could help to explain the long-term persistence of Taylor's checkerspots on the AIA where diverse microhabitats associated with structural features of the prairie are limited. Gopher mounds may extend the availability of butterfly resources on native-dominated prairies, but where non-native species are prevalent, these same mounds may facilitate weed invasion. The community context is critical when evaluating or managing for tunneling rodents.

Large numbers of Taylor's checkerspots were observed using the relatively open habitat of the 13<sup>th</sup> Division RNA prairie in the early 1990's, and a small population continues to reside in the open conditions in the southern region of the AIA. In addition to open prairie conditions, Taylor's checkerspots were found to use a variety of habitat types on the 13<sup>th</sup> Division prairie (Hays et al. 2000), including:

- forest edges,
- wet meadows, and
- grasslands shaded by oak and Douglas-fir.

A Taylor's checkerspot expert, Ann Potter (pers. comm.) has observed adult checkerspots flying in the vicinity of coniferous trees when occurring in more open conditions, and Barry Bidwell (Morgenweck 2003) relates that he observed Taylor's checkerspots gathering on the lee side of a tree or group of trees to get out of the wind.

Ann Potter (pers. comm.) believes that trees have an important role to play in Taylor's checkerspot habitat. Most extant populations of Taylor's checkerspot in Washington and Oregon (the Bald Hills and the MacDonald Forest outside of Corvallis, Oregon), and recent extirpation (Glacial Heritage airstrip), consist of relatively small or narrow patches of prairie enclosed by coniferous and deciduous trees which probably serve to block the wind and contribute to a 'parabolic' type of heat reflectance or retention. Ann Potter (pers. comm.) has also observed that Taylor's checkerspots may be found at intact balds in western Washington, but are not found at balds where the immediately surrounding trees had been removed. The ultimate causes of these patterns are not known, but perhaps relate to: a) protection from the wind, conferring warmer temperatures for larval rearing; and/or b) greater moisture retention at tree edges, promoting prolonged flowering of nectar plants or greater vigor of larval host plants.

Taylor’s checkerspot in the Puget Sound region would be expected to benefit from heat capturing south-facing slopes, prairie ‘pockets’, or other protected structural features on the prairies that provide warm microhabitats due to their early spring larval feeding and adult emergence. The growth of post-diapause checkerspot larvae in early spring in California is influenced by local microclimatic conditions that vary with slope, exposure, and time of year (Weiss et al. 1987). These checkerspot larvae are described as ‘behavioral thermoregulators’, moving locations to raise body temperature and maximize growth rates in the warmest microhabitats (Weiss et al. 1987).

It is likely that habitats lacking structural diversity, but containing abundant plant resources can support Taylor’s checkerspot when weather conditions are favorable for the completion of their various life stages. Access to resources in more diverse habitats probably becomes more important for both adults and larvae in times of climatic stress (extremes in precipitation and temperature).

Available information argues for enhancing a combination of open sites and nearby structural features on the prairie to provide a variety of microclimates, especially sites for early spring warming, combined with moisture holding habitats to buffer the effects of drought on larval host plants in different microhabitats during the summer.

Table 4.1 Larval and Nectar plant resources used by Taylor’s checkerspot on Puget prairies and in the greater region (Hays et al. 2000, The Xerces Society 2002a).

Food Plants	Comments
<b>Larval Plants</b>	
Harsh paintbrush ( <i>Castilleja hispida</i> )	
English plantain ( <i>Plantago lanceolata</i> )	Non-native and abundant in many sites on Puget prairies.
Sea blush ( <i>Plectritis congesta</i> )	Increasingly rare on Fort Lewis, restricted to one known locale.
<b>Nectar Plants</b>	
Common camas ( <i>Camassia quamash</i> )	
Nine-leaved lomatium ( <i>Lomatium triternatum</i> )	
Spring gold ( <i>Lomatium utriculatum</i> )	
Broadpetal Strawberry ( <i>Fragaria virginiana</i> )	
Puget balsamroot ( <i>Balsamorhiza deltoidea</i> )	

Important habitat considerations for Taylor’s checkerspot are as follow:

1. The presence of at least two species of larval food resources (Table 4.1) distributed on open sites and nearby structurally diverse habitat features. In the event that one species senesces under the prevailing conditions for that year, the alternate host might remain available to larvae. *Castilleja hispida*, and *Plantago lanceolata* are the primary species to consider initially, although *Plectritis congesta* could be considered following on the necessary research (see section 8). Note that *P. lanceolata* is a non-native species that is abundant throughout our Puget prairies and should not be planted.
2. The presence of abundant nectar plants distributed on open sites and nearby structurally diverse habitat features (Table 4.1).
3. The presence of topographically/edaphically diverse sites, such as prairie pockets or forest nooks and edges, mesic areas, and grasslands shaded by oak and Douglas-fir, in enhancement areas for this species.
4. The presence of tunneling rodents (moles and gophers) that till the soil and provide sites for establishment of native plants that may persist later in the season.

#### 4.1.2 Mardon Skipper

Mardon skippers use Roemer's fescue (*Festuca roemerii*) and red fescue (*Festuca rubra* - Cascades populations) as larval host plants (The Xerces Society 2002b). Research into the silver spotted skipper (*Hesperia comma*) in Britain (Thomas 1995) shows that although the foodplant, sheep's fescue (*Festuca ovina*) is common, females lay eggs only on plants that are adjacent to bare ground. Plants in crowded conditions are ignored, perhaps due to physical obstruction or unfavorable microclimate. Interspersion of bare ground among fescue may constitute an important habitat element for mardon skippers also. Hays et al. (2000) describe observations of mardon flight behavior that emphasize the importance of the short open profile of native bunchgrass communities. When mardon skippers were observed to encounter patches of taller non-native grasses, they often flew quickly up and over these patches to forage in another area dominated by native fescue (Hays et al. 2000). The short stature and open nature of native bunchgrass prairies allows the adult butterfly to access both its oviposition sites in the fescue, which are generally close to the ground, and an important nectar plant, the blue violet (*Viola adunca*) (Potter et al. 1999, Hays et al. 2000).

Invasive plants, especially grasses such as colonial bentgrass (*Agrostis capillaris*) and the taller pasture grasses fill the interstitial spaces among the fescue and crowd out important native nectar forbs, such as *Viola adunca*. These invasive grasses not only compete with the native fescue, but block physical access to oviposition sites at the base of the plant for the butterfly. Consequently, Hays et al. (2000) highlight the importance of controlling invasive grasses in the native bunchgrass community for this butterfly. Prescribed fire may constitute an important tool to promote the presence of bare ground and short-stature vegetation characteristics that may be important for this species (see sections 5.2.3 and 7.1 for discussions of fire).

Over the course of two years, adult mardon skippers were observed foraging in high quality fescue dominated habitat (Table 4.2), along a disturbed track/trail, an area of non-native graminoids at the edge of and beneath a line of white oak trees, and a wet camas meadow at the Scatter Creek study area (Hays et al. 2000). A mardon skipper expert, Jonathon Pelham (pers. comm.) relates that "often where you find them depends on the weather conditions for that day or season". These weak-flying skippers are frequently associated with semi-drainages or low-lying swales that offer protection from wind or slightly more mesic conditions for plants (Jonathon Pelham, pers. comm.). Mardon skipper adults extensively used *Festuca* grassland along the edge of white oak stands at the Scatter Creek study area, and during the windy weather, they were often only observed in these edge habitats, in the lee of trees (Hays et al. 2000). Jonathon Pelham (pers. comm.) also relates that he has observed mardons using a wide variety of 'edge' habitats, including road edges. The disturbed track/trail at the edge of the oak stand at Scatter Creek contained a long patch of the introduced species *Vicia sativa*, which was intensively used for nectaring by mardon skippers in 1999 (Hays et al. 2000). Some disturbed habitats are characterized by low vegetation height (as in the trail or road bed itself, pers. obs.), which could facilitate their use by mardon skippers.

Dense patches of *Viola adunca* were used heavily and 'selected' for nectaring by the mardon skipper at Scatter Creek in 1998 (Table 4.3, Hays et al. 2000). An introduced plant species, *Vicia sativa*, became available in 1999 following the removal of dense Scotch broom beneath a patch of oaks, and the flowers were heavily used and 'selected for' by mardon skippers. The availability of flowers as nectar resources varied considerably between years at this site, and Hays et al. (2000) propose that the "use of areas with different species availability and phenology suggests that proximal diverse habitats may benefit the mardon skipper". In summary, it appears that the presence of short-statured native bunchgrass communities in a variety of habitat types could benefit the long-term survival of this species.



Table 4.2 High nectar use prairie site characteristics (mean percentages) for mardon skippers at Scatter Creek Wildlife Area, 1998 (Hays et al. 2000).

Roemer's Fescue	Other Native Grasses	All Native Grasses	Non-native Grasses	Native Forbs	Non- Native Forbs	Open Area
32%	2.2%	34%	15%	25%	10%	16%

Table 4.3 Mardon skipper nectar species and their characteristics at Scatter Creek Wildlife Area, 1998 and 1999 (Hays et al. 2000).

Nectar species	Density	Nearest-Neighbor Spacing
Early blue violet ( <i>Viola adunca</i> )	11 plants/m <sup>2</sup>	0.2 m spacing in high use area
Common vetch ( <i>Vicia sativa</i> ) (non-native)	0.2 – 0.5 plants/m <sup>2</sup>	0.9 m spacing / 6-17m clumps
Spring gold ( <i>Lomatium utriculatum</i> )	0.4 plants/m <sup>2</sup>	0.7 spacing
Nine-leaved lomatium ( <i>Lomatium triternatum</i> )	0.0006 plants/m <sup>2</sup>	22.8 m
Common camas ( <i>Camassia quamash</i> )	-	-
Shephard's purse ( <i>Teesdalia nudicaulis</i> )	-	-
Western buttercup ( <i>Ranunculus occidentalis</i> )	-	-

Important habitat considerations for mardon skippers are as follows:

1. The presence of abundant fescue interspersed with bare ground distributed on open sites and nearby structurally diverse habitat features.
2. The presence of an abundant and diverse community of forbs for nectar distributed on open sites and nearby structurally diverse habitat features, especially:
  - Dense patches of early blue violet (*Viola adunca*)
  - Common vetch (*Vicia sativa*) (non-native, do not plant)
  - Spring gold (*Lomatium utriculatum*)
  - Western buttercup (*Ranunculus occidentalis*)
3. The absence or low levels of invasive grasses.
4. The presence of structurally diverse habitats, including forest or disturbed edges, and relatively mesic areas or swales in enhancement areas for this species.
5. Inclusion of a 'butterfly-sensitive' fire regime (see sections 5.2.3 and 7.1) as a habitat enhancement tool to promote bare ground and short, open bunchgrass community.

#### 4.1.3 Zerene Fritillary

Zerene fritillaries use violets as their larval host (Pyle 2002), and have been observed ovipositing on or near *Viola adunca* on Puget prairies (Hays et al. 2000). Research on another zerene fritillary subspecies, the Oregon silverspot (*Speyeria zerene hippolyta*) at Cascade Head in Oregon, revealed that females oviposited in areas of higher violet density (> 20 plants/m<sup>2</sup>), that were characterized by lower thatch depth (2.25 – 3.5 cm), and lower vegetation height (< 30 cm) compared with surrounding areas (Pickering et al. 1992). *Viola adunca* are poor competitors (Bierzuchudeck 2003) that are found on dry sites and wet meadows (Pojar and Mackinnon 1994). Invasive species, including non-native grasses, pose a problem for this low-growing forb by increasing thatch density and vegetation height, competing for resources, and reducing open space for germination (Pickering 1997a, Pickering et al. 2000).

Experimental manipulations with *Viola adunca* show that fire stimulates seed germination (Pickering et al. 2000, Bierzychudeck 2003). Violets respond well to burning in some instances, and fire is being used as a management tool to enhance habitat for zerene fritillaries at Cascade Head (Pickering 1997a, 1997b). Fire would also be expected to produce favorable results for zerenes on Puget prairies by stimulating violet germination, reducing thatch density and depth and vegetation height, and potentially, the cover of some woody and grass invasives.

Zerene fritillaries are one of the later flying species on the prairies (Figure 2.1), and fly at a time when there are relatively few prairie species flowering, especially during the latter half of their flight period. Research on zerene fritillaries in the Puget prairies revealed that they nectared exclusively and ‘selected for’ the non-native Canada thistle (*Cirsium arvense*) during a hot and dry year (*Erigeron speciosus* senesced early), and then ‘selected for’ showy fleabane (*Erigeron speciosus*) the following year characterized as cool and wet (Hays et al. 2000). Other nectar resources recorded for this species in the Puget prairies include *Solidago spathulata* (perhaps actually *Solidago missouriensis*), *Aster curtus* (syn: *Sericocarpus rigidus*), *Chrysanthemum leucanthemum*, *Hypochaeris radicata*, *Senecio jacobaea*, *Leontodon nudicaulis* (Hays et al. 2000). Summer weather conditions largely determine which species are available for nectar late in the summer, and thus, the availability of flowering resources varies among years. An important consideration for zerene fritillaries is the availability of a variety of late season nectar resources growing in a variety of structurally diverse habitats and ecotones, especially moisture-retaining habitats, to assure that flowers are available somewhere in their habitat during the typically warm and dry mid to late summer on Puget prairies. Furthermore, the presence of non-native thistles in zerene habitat should not be discouraged unless the thistle population is threatening native vegetation. It may be useful to investigate the potential for promoting late-flowering native thistles, such as *Cirsium undulatum*, which has limited occurrence on Fort Lewis (LCTA 2003).

Zerene fritillaries are known to make use of open prairies, but are also associated with prairie edges and ecotones (Morgenweck 2003, Morgenweck and Dunn 2003), and wooded nooks where adults “loaf, nectar and court” (Pyle, 2002). The 1998 ‘high use’ nectaring area for zerene fritillaries in the Puget prairie study was the most degraded area with the lowest cover of native grasses and forbs compared to habitat used by the other three rare butterfly species studied by Hays et al. (2000) (Table 4.4). This is not surprising, as they were nectaring on a species (*Cirsium arvense*) that is described for Fort Lewis as ‘common’ in poor quality prairie (dominated by non-native grasses), especially wet prairies (LCTA 2003). This species is a strong flier compared to the other rare butterfly species, and can range more widely over the prairie, accessing different habitat types. The ‘entire’ areas used for nectaring in 1998 and 1999 exhibited higher quality prairie characteristics (higher cover values for native grasses and forbs, and correspondingly lower values for non-native grasses and forbs, Table 4.4) (Hays et al. 2000). Zerene fritillaries on Puget prairies do not appear to require native dominated grassland for nectaring sites. They appear to require late season nectar sources, native or non-native, where access is not hindered by woody shrubs. At the same time, zerenes require higher quality habitat that is suitable for patches of *Viola adunca*, characterized by low vegetation height and low thatch depth (Pickering et al. 2000). This combination of requirements would argue for enhancement of a combination of open prairie, prairie edge, and moisture-retaining habitats on the prairies to promote violets and nectar resources listed in Table 4.5 and other late-season forbs.

Table 4.4 ‘High Nectar Use’ and ‘Entire Sample Area’ (bold font) prairie site characteristics (mean percentages) for zerene fritillaries at Scatter Creek Wildlife Area, 1998 and 1999 (Hays et al. 2000).

Roemer’s Fescue	Other Native Grasses	All Native Grasses	Non-native Grasses	Native Forbs	Non- Native Forbs	Open Area
0%	15%	15%	51%	9%	17%	7%
<b>5 – 11%</b>	<b>4 – 12%</b>	<b>16 – 23%</b>	<b>16 – 27%</b>	<b>10 – 15%</b>	<b>7 – 15%</b>	<b>24 – 45%</b>

Table 4.5. Zerene fritillary nectar species and their characteristics at Scatter Creek Wildlife Area, 1998 and 1999 (Hays et al. 2000).

Nectar species	Density	Spacing
Canada thistle ( <i>Cirsium arvense</i> ) (non-native)	3.5 plants/m <sup>2</sup>	0.3 m spacing in high use
Showy fleabane ( <i>Erigeron speciosus</i> )	0.002 plants/m <sup>2</sup>	13.4 m spacing
Spikelike goldenrod ( <i>Solidago spathulata</i> )*	0.001 plants/m <sup>2</sup>	16.5 m spacing

\*Hays et al. (2000) list spikelike goldenrod as a nectar source, but on Fort Lewis prairies, this species is rare and flowers around June, and would not likely be available as a nectar source. Missouri goldenrod (*Solidago missouriensis*) is more common and tends to bloom later in the season (LCTA 2003, Rod Gilbert, pers. comm.), and therefore would more likely be available during the zerene fritillary flight season. For this reason, #2 below, and enhancement plantings proposed for zerene fritillaries (Table 5.3), include *Solidago missouriensis* rather than *Solidago spathulata*.

Important habitat considerations for zerene fritillaries are as follows:

1. The presence of patches of dense concentrations of violets (*Viola adunca*  $\geq 20$  plants/m<sup>2</sup>) in habitat characterized by:
  - low thatch depth (2.25 – 3.5 cm), and
  - low vegetation height (< 30 cm).
2. The presence of an abundant and diverse community of late season forbs for nectar distributed in open sites and nearby structurally diverse features, especially:
  - Showy fleabane (*Erigeron speciosus*)
  - Canada thistle (*Cirsium arvense*) (non-native, do not plant)
  - Native thistles, (e.g. *Cirsium undulatum*)
  - Missouri goldenrod (*Solidago missouriensis*)
  - White-top aster (*Sericocarpus rigidus*).
3. The inclusion of structurally diverse habitats, including mesic areas, forest nooks/prairie pockets, swales, tree islands, and prairie edge components in enhancement areas for this species.
4. Inclusion of a ‘butterfly-sensitive’ fire regime (see sections 5.2.3 and 7.1) as a habitat enhancement tool to promote violets and associated desirable habitat characteristics.

#### 4.1.4 Puget Blue

Puget blue butterflies are known to use sickle-keeled lupine (*Lupinus albicaulis*) for mating, ovipositing, larval feeding, and nectaring (Hays et al. 2000). These butterflies are “completely dependant upon lupines” (Pyle 2002). Puget blues are highly associated with *L. albicaulis* on Fort Lewis and other Puget prairies, and high use site characteristics reflect relatively high quality prairie conditions (Table 4.6). The anomaly is Training Area 7S, where they are known from the recent past, but were not detected during the 2003 butterfly surveys (Morgenweck and Dunn 2003), despite an abundance of *L. albicaulis* and other forbs at this prairie. *Lupinus albicaulis* is an early successional species that relies on disturbance factors such as fire to persist (Guppy and Shepard 2001), and thus prescribed burns would likely be helpful in promoting this plant species.

A variety of plant species were used for nectaring by Puget blues in the 1998 and 1999 years of the Hays et al. (2000) study (Table 4.7), although there was a clear preference both years for feeding from unopened flowers of *L. albicaulis*. Although the exact feeding mechanism on these unopened flowers is not known, there may be an association between aphids and *L. albicaulis* flowers, where the aphids produce honeydew that is attractive to butterflies (Morgenweck 2003). This topic should receive further attention to better understand the relationship between Puget blues and this important resource. Hays et al. (2000) also observed ants ‘tending’ and defending Puget blue larvae. Ant – butterfly associations are known from other Lycaenid species (Pyle 2002), and further details of the relationship between ants and

Puget blues would be helpful for understanding habitat needs and improving enhancement actions (see section 8 for further research).

Table 4.6 High nectar use prairie site characteristics (mean percentages) for Puget blues at Johnson Prairie, 1998 (Hays et al. 2000).

Roemer's Fescue	Other Native Grasses	All Native Grasses	Non-native Grasses	Native Forbs	Non- Native Forbs	Open Area
16%	4%	20%	15%	42%	19%	3%

Table 4.7 Puget blue nectar species and their characteristics at Scatter Creek Wildlife Area and Johnson Prairie, 1998, 1999 (Hays et al. 2000).

Nectar species	Density	Spacing
Sickle-keeled lupine ( <i>Lupinus albicaulis</i> )	0.05 - 1.8 plants/m <sup>2</sup>	0.5 – 1.9 m spacing
Common vetch ( <i>Vicia sativa</i> ) (non-native)	0.001 - 14.1 plants/m <sup>2</sup>	0.2 – 14.4 m spacing
Nine-leaved lomatium ( <i>Lomatium triternatum</i> )	0.002 – 0.03 plants/m <sup>2</sup>	3.3 – 11.6 m spacing
Oregon sunshine ( <i>Eriophyllum lanatum</i> )	1.6 - 12 plants/m <sup>2</sup>	0.1 – 0.4 spacing
Manroot ( <i>Marah oreganus</i> )	0.0005 plants/m <sup>2</sup>	24.6 m spacing
Graceful cinquefoil ( <i>Potentilla gracilis</i> )	0.09 - 0.2 plants/m <sup>2</sup>	1.1 – 1.6 m spacing

Important habitat considerations for Puget blues are as follows:

1. The presence of dense concentrations of *Lupinus albicaulis* for larval feeding and adult nectaring.
2. The presence of an abundant and diverse community of forbs for nectar (Table 4.7)
3. The inclusion of a ‘butterfly-sensitive’ fire regime (see sections 5.2.3 and 7.1) as a habitat enhancement tool to promote lupines and other forbs.

## 4.2 Scotch Broom in Butterfly Habitat

Scotch broom is a non-native invasive plant that degrades butterfly habitat on the Puget prairies. Hays et al. (2000) summarize their data on Scotch broom cover and height with the following generalizations:

1. Scotch broom cover was below 20% in all sample areas in habitat used by butterflies in the study.
2. Areas with higher butterfly densities generally had lower coverage of Scotch broom.
3. The density, coverage, and height of Scotch broom were less in high use areas than in entire sample areas.

Furthermore, mardon skippers and Puget blue butterflies avoided (no or low use relative to abundance in the habitat) Scotch broom flowers as a nectar resource in their habitat.

## 4.3 Summary of Important Habitat Considerations

This section synthesizes important habitat considerations for the rare species butterfly community, or subsets of this community, identified through the butterfly habitat research conducted by Hays et al. (2000), the published literature, and local experts. This summary emphasizes hostplant and nectar resources as important habitat elements because butterfly population size has been shown to be strongly associated with resource availability (Schultz and Dlugosch 1999).

A summary of important habitat considerations for the rare butterfly community includes the following:

1. The absence or low height and cover of Scotch broom and other woody invasives on prairies and their structurally diverse habitat features.
2. The absence or low cover of non-native invasive grasses in important butterfly habitats on prairies and their structurally diverse habitat features.
3. The presence of diverse native prairie vegetation communities on prairies and their structurally diverse habitat features.
4. The presence of a diversity and abundance of forbs in different prairie habitat types that flower at different times throughout the season, with particular attention to late season nectar resources (including non-native species) which are limited on Puget prairies.
5. The presence of dense concentrations of larval host plants for the target butterflies, including *Castilleja hispida*, *Lupinus albicaulis*, and/or *Viola adunca*, in high quality prairie interspersed with *Festuca roemerii* and some bare ground in different prairie habitat types.
6. The implementation of a ‘butterfly-sensitive’ fire regime (see section 5.2.3) to promote prairie habitat characteristics that benefit rare butterflies.
7. The implementation of management activities conducted “a) with knowledge of rare butterfly locations and habitat (resource) use, and b) at a scale that will not adversely affect rare butterfly populations” (Hays et al. 2000).

## 5. Habitat Enhancement Strategies

Section 4 above highlights important habitat considerations for the four rare butterfly species on Puget prairies. This section describes proposed strategies for translating important habitat considerations into enhancement actions, including *where*, *what*, and *how* to enhance.

### 5.1 *Where?* - Spatial scales

Enhancement strategies were developed to guide enhancement actions across the Fort Lewis landscape, and within individual prairies. The strategies for these two spatial scales are elaborated below.

#### 5.1.1 *Landscape Scale*

The majority of the enhancement actions recommended in this plan focus on three *high priority* prairies (Figure 1). The rationale for this approach is to concentrate resources into high quality habitat patches on a few prairies, rather than scattering resources widely across multiple sites with fewer significant improvements. Concentrated resources increase the chances that these resources will be located by adult butterflies, and consequently, facilitate mate location, and at the same time minimize larval dispersal out of a resource patch. Historically, the three high priority prairies have displayed the highest butterfly diversity on Fort Lewis (Morganweck 2003). The selection of prairies as high priority for enhancement was based primarily on the current and recent historical presence of rare butterflies, with consideration of additional criteria outlined in Table 5.1.

Table 5.1. Criteria for choosing high priority and secondary priority prairies for butterfly enhancements. T=Taylor’s checkerspot, M=mardon skipper, Z=zerene fritillary, P=Puget blue and +=above average, compared with these and other prairies.

Decision Criteria	AIA	Johnson	13 <sup>th</sup> RNA	Weir	TA7S
Current use by butterflies	T, M, P	Z, P	P	P	
Historical use by butterflies		T	T, Z		T, P
Diverse structural features and microsites		+	+		+
Compatible land use, RNA’s & Seibert areas.		+	+	+	+
Native prairie vegetation	+	+	+	+	+
Potential to support metapopulation dynamics	+		+	+	

### High Priority Prairies

- Artillery Impact Area Currently supports the only known populations of Taylor’s checkerspots and mardon skippers on Fort Lewis. Also supports a population of Puget blue butterflies. Contains a diverse and abundant fire-maintained native forb community, including a population of *Castilleja hispida*.
- Johnson Prairie Historically supported a population of Taylor’s checkerspots, and currently supports the most diverse and abundant butterfly population on Fort Lewis, including zerene fritillaries and Puget blues. Also contains an abundant and diverse native forb community, including a population of *Castilleja hispida*. Contains diverse structural features including swales, tree islands, and oak woodlands.
- 13<sup>th</sup> Division RNA Currently supports a population of Puget blue butterflies. Historically supported a large population of Taylor’s checkerspots, a population of zerene fritillaries, and a relatively diverse butterfly community. Currently contains some high quality native prairie vegetation along with important structural features, especially riparian habitat. Protected by RNA status and Seibert stakes.

In addition to the high priority sites, two *secondary priority* prairies (Figure 1) are recommended to receive less intensive enhancement actions such as a) woody vegetation control and b) monitoring and treating new invasive species, on open grasslands, adjoining oak woodlands, and prairie edges. A long-term strategy could include increased enhancement efforts on these two prairies, including greater control of invasive species (especially grasses), and enhancement plantings, as recommended for the high priority prairies, to increase the overall potential for long-term persistence of the four target taxa. This will be especially important for the Weir Prairie Complex, which, together with nearby Johnson Prairie, could form a potentially larger network of high quality prairies to support metapopulation dynamics.

### Secondary Priority Prairies

- Weir Prairie Complex The lower and upper Weir prairies, together with South Weir, support a population of Puget blues. This prairie complex contains abundant native fescue bunchgrass, although the abundance and diversity of native forbs on these prairies are relatively limited compared with the other prairies mentioned previously. Diverse structural features are also relatively limited, although upper Weir prairie contains considerable sections of oak woodlands, and the southern portion has a large swale. The Weir prairies are afforded limited protected by RNA status, and Weir prairie south of

Rainier Road (South Weir) constitutes the northern extension of a potential conservation area adjacent to Fort Lewis.

- Training Area 7S Historically supported a population of Taylor's checkerspot. Recently supported a population of Puget blues. Contains a relatively abundant and diverse native forb community, including a population of *Castilleja hispida*, and diverse structural features such as forest edges, oak woodlands, and terraces. Large portions of this prairie have been converted to a gravel pit. A portion is protected by Seibert stakes.

### 5.1.2 Prairie Scale

For each of the three high priority prairies mentioned above, improvements for butterflies would be served by enhancing *three components* of prairie habitat: a) vegetation composition, b) habitat structure, and c) process. Each of these three components will be treated in further detail in section 5.2.

Enhancements are not likely to be distributed continuously across each prairie due to constraints in financial, labor, and plant propagation resources. Instead, a strategy is proposed that concentrates enhancements, and especially outplantings of butterfly plants, into a network of three or more *habitat enhancement patches*, each a minimum of 2 ha in size (see 'Patch Size' below), in each prairie. These *habitat enhancement patches* would ideally contain one or more patches of concentrated plant resources for butterflies (*butterfly resource patches*) as conditions allow (i.e. where appropriate, according to butterfly and plant species-specific requirements). Thus, *butterfly resource patches* (separated by  $\leq 50$  m) combine to make up a *habitat enhancement patch* that is at least two ha in size. Prairie wide, it would be best if the three or more, 2+ ha size *habitat enhancement patches* were separated by no more than 200 m (see 'Distance Between Habitat Patches' below, and section 5.3.3 for further discussion) where possible, eventually closing the gap to 100 m in future phases of butterfly enhancement planning. The exception is the Artillery Impact Area, where the potential to undertake management activities is limited due to restricted access and safety concerns. This prairie site is perhaps the most important due to the presence of mardon skippers and Taylor's checkerspots, and therefore warrants special efforts to include enhancements compatible with the site's limitations (see section 7.2.1).

### Patch Size

Ideally, enhanced habitat patches should be large and closely spaced, although limited resources constrain the actualization of this model. Alternatively, the optimal size and arrangement of enhanced butterfly habitat patches should be based on knowledge of the dispersal characteristics and population demographics of the target butterfly species. Unfortunately, data for these parameters are lacking for the four rare butterfly species. In this case, inferences may be drawn from the treatment of these questions for other butterflies.

Crone and Schultz (2003) treat the question of minimum patch size for the persistence of populations of the Fender's blue butterfly (*Icaricia icarioides fenderi*). Using computer models that incorporated field data for this species, they determined that minimum patch sizes of 2 – 6 ha for isolated patches were necessary for the long-term persistence of this butterfly, depending on the variability of the population growth rates. Bagueette et al. (2000) determined that habitat patches ~ 1 ha in size yielded less emigration and immigration than smaller patches (0.3 – 0.6 ha) for three butterfly species (two Pierids and one Lycaenid in Belgium). In the absence of specific data derived directly from our target species, it appears reasonable to incorporate information from these butterflies, and start with patches that are approximately 2 ha in size, as three of our four butterflies are relatively small and use dense patches of resources, and are relatively weak fliers. Each of the three high priority prairies on Fort Lewis is large enough to accommodate a network of patches of this size. The value of these habitat patches to the

butterflies is increased where they are incorporated in a network and spaced within potential dispersal distance, as opposed to being isolated patches.

### Distance Between Habitat Patches

The distance between enhanced habitat patches on the prairie should be no greater than the dispersal capabilities of the target butterfly species to allow movements among patches. Long distance movements for mardon skippers are estimated at 400 m (Runquist 2003). Research on the Bay checkerspot in California reveals that directed dispersal is not likely beyond 50 m, although individuals are capable of travel up to 5.6 km in less than 24 hours over flat open terrain (Harrison 1989). Arnold's (1980) research on six Lycaenid butterfly species revealed that adult movements of these relatively weak fliers averaged less than 37 m, yet some adults dispersed 100 – 200 m to peripheral patches of their foodplant in adjacent grassland. Schultz (1998) describes a mark-recapture study where a limited number of Fender's blue butterflies dispersed between habitat patches separated by 150 m. The Taylor's checkerspot, mardon skipper, and Puget blue butterflies are all considered to be weak fliers, and consequently, relatively poor dispersers (Char and Boersma 1995). In the absence of dispersal distance data for the four butterfly species on Puget prairies, a rule of thumb could be to space habitat patches at intervals of  $\leq 200$  m, and closer to 100 m where possible (Ann Potter, pers. comm.), with relatively open prairie habitat (non-forest) stretching between patches, to facilitate movement among the different habitat patches within a prairie.

## 5.2 *What?* - Three components of the prairie

An earlier discussion (section 3) described primary threats to Puget prairies and their butterflies. Based on the threats identified in that section, three components of the prairies will be targeted to ameliorate those threats, and enhance conditions for prairie butterflies:

1. Vegetation Composition
2. Habitat Structure, and
3. Process.

### 5.2.1 *Vegetation Composition*

Control of invasive species and planting of native grasses and forbs, especially larval and adult food resources, have been and will continue to be the cornerstones to improving the vegetation composition of the prairies for butterflies. Scotch broom removal has been a primary activity on the Fort Lewis prairies to date, and this important activity will continue to form the foundation of prairie restoration efforts, upon which more specific butterfly enhancements can build. Enhancements proposed to improve vegetation composition are based on the following considerations:

- High quality prairie vegetation composition parameters (cover estimates by plant category) for the butterfly community could serve as baseline targets for general butterfly enhancement actions (Table 5.2).
- Butterfly species-specific resource targets (section 6) could be considered for habitat enhancement patches where enhancement actions target a specific butterfly species.
- Enhancements that emphasize augmentation of known larval host plants for the rare species, and close interspersions of nectar plants among the larval hosts, are likely to considerably improve butterfly habitat (Schultz and Dugosh 1999).
- In some cases, enhancement plantings could include not only important butterfly resources, but also the more common species that characterize high quality native vegetation on the prairies and in the oak woodland - savanna understory to promote a healthy and functional prairie. See tables 5.4 and 5.5 in section 5.3.3 for lists of species that characterize these two communities.



*Table 5.2. High quality habitat characteristics synthesized from high quality habitat conditions described by Hays et al. (2000) for areas used by butterflies on Puget prairies, and Dorner's (1999) research on prairie quality on Fort Lewis.*

<b>Plant Category</b>	<b>Characteristic</b>
Scotch broom	< 6% cover, and < 0.26 m in height
Native grasses, dominated by fescue	> 35% - 60% cover
Native forbs	> 25% cover
Non-native grasses and forbs	< 35% cover

To improve the vegetation composition for specific butterflies, a first approach would be to expand existing high quality resource patches for the four butterfly species in each of the three high priority prairies. Secondly, establishing butterfly resource patches in close proximity ( $\leq 50$  m) to the existing resource patches would improve habitat. At the same time, habitat enhancement patches (section 5.1.2) identified for the three high priority prairies (section 7) could receive enhancements and plantings to create one or more butterfly resource patches within the habitat enhancement patch.

### 5.2.2 Habitat Structure

Diverse structural features of the prairies should be targeted for enhancements in addition to open prairie sites to promote habitat diversity. Controlling invasives, and increasing the native plant composition of structural features described below will increase the diversity of habitat types and microsites available to the butterflies, and the ecological community as a whole.

Diverse structural features to target include:

- Tree islands and edge habitats, especially oak woodlands, and prairie pockets that extend into the forest or woodland matrix
- Sloping topography, especially low-lying swales
- Riparian zones and relatively mesic sites.

### 5.2.3 Process

#### Fire

Fire played an important role in the history of Puget prairies. Prior to European settlement in western Washington, fires were frequent, relatively low in intensity, and burned extensive areas of the prairie landscape, including prairie edges and adjacent woodlands and forest (Morris 1934, Lang 1961, Norton 1979, Leopold and Boyd 1999). The regularity of these fires (annual burning on Nisqually prairies [Carpenter 1992]) was an important process that favored prairie vegetation and helped to arrest forest succession on the prairies (Boyd 1999). Fire suppression is the current policy in the region, although prescribed burns conducted by Fort Lewis personnel are implemented on portions of the prairies during the summer or fall. Tveten and Fonda (1999) examined the effects of the military's prescribed burning program, and found that both frequent burning, and the absence of burning, favored different suites of non-native species over native grasses and forbs in prairies and oak woodlands. The authors concluded that, compared with 'frequent burning', and 'no burning' fire regimes, "fire intervals shorter or longer than the 3 – 5 year fire rotation now employed on Fort Lewis are detrimental to fescue prairie and oak woodland." It is important to note that this observation should be considered in a general sense, as the authors did not conduct controlled experiments to specifically test different fire return intervals. It is reasonable, however, to consider that frequent burning and no-burning fire regimes would be deleterious to prairie habitat, while a regime of repeat burning at some moderate interval could be beneficial.

Fire has numerous effects on the physical, chemical and biotic components of grasslands that influence the functioning of prairie systems in general, and butterfly habitat in particular. Specifically, fire has the potential to impact the following positive and negative attributes of the prairie soil and vegetation community:

- Reduce moss and thatch layers.
- Increase the bare ground component of the prairies, which:
  - allows butterfly access to the base of plants for oviposition,
  - creates nesting sites for ground nesting invertebrates such as bees (e.g. bumblebees pollinate *Castilleja* spp.)
  - provides germination sites for native plants and non-natives – depending on context.
- Reduce woody shrub cover (Clark and Wilson 2001).
- Increase the availability of nitrogen in the immediate pre-burn phase, which favors non-native grasses (Wan et al. 2001)
- Over time, reduce the total nitrogen pool, thereby favoring native plants (probably requires repeat burns, Wan et al. 2001).
- Reduce the cover of some invasive grasses (Grace et al. 2001) and native perennial grasses (Corbin et al. in review)
- Enhance forb germination and abundance (Schuller 1997, Maret and Wilson 2000).
- Promote short-stature prairie vegetation (through the combination of reducing grass cover [Tveten and Fonda 1999], and nitrogen levels).

The impacts of a prescribed burn on the vegetation community would depend on the context, including the fire's characteristics and the existing pre-burn vegetation. Where pre-burn vegetation is dominated by native species, fire would be expected to have little negative effect on the vegetation. Where pre-burn vegetation includes an abundance of non-native plants and their propagules, fire has the potential to increase non-native vegetation.

At the same time, fire would be expected to result in some mortality of butterflies, and therefore requires careful consideration when used in habitat containing isolated populations of rare butterflies. An analysis by Schultz and Crone (1998) examined the tradeoffs of short-term negative effects vs. long-term positive effects of fire on a population of Fender's blue butterflies (*Icaricia icarioides fenderi*) in the Willamette Valley of Oregon. Their work revealed that the theoretically best fire strategy was to burn one-third of the habitat every year or two. This would result in a fire return interval of approximately every three to six years. A review of research related to prescribed burns and prairie insects highlights the value of a mosaic of burn stages in promoting insect diversity, and the importance of patchy burn patterns that promote an interspersion of burned and unburned habitat for rapid recolonization of burned sites (Reed 1997). It is likely that the judicious use of fire to create a mosaic of burned and unburned patches would be beneficial for enhanced butterfly habitat in the context of Puget prairies also.

It is not possible, nor is it necessarily desirable, to duplicate the historic fire regime in the current context of small populations of rare butterflies distributed among isolated and fragmented prairies with increased fuel loads. At the same time, fire is an important process and tool for maintenance of a diverse prairie landscape, and enhancement efforts for butterflies would benefit from further investigations into strategies to maximize habitat improvements through the use of fire, while minimizing potentially harmful impacts. The development and implementation of a 'butterfly-sensitive' fire regime that incorporates a strong research component may provide the best approach to evaluating the tradeoff in the costs and benefits to butterflies and their habitat. The 'butterfly-sensitive' fire plans should be designed in the very near future for each high priority prairie (other than the AIA), followed by the second priority prairies. These plans should be designed through collaboration among partners that include fire, butterfly, and community ecology experts (see section 7.1 for elaboration of considerations for a 'butterfly-sensitive' fire regime).

## Wildlife

Pocket gophers (*Thomomys mazama*) historically contributed to the prairie *process* component. Their tilling and mound forming habits influence plant germination and phenology dynamics. Their

herbivorous diet consists of roots, bulbs, and tubers, along with the above ground portions of plants, which could serve to locally thin out prairie plants. Large native ungulates such as elk (*Cervus elaphus*) also may have played a greater role historically in the prairie and prairie-ecotone processes than they do today. Elk can form large herds, and they probably had seasonal influences on prairie processes in specific locales through their grazing and trampling actions. In the current context of widespread non-native weeds, the soil disturbing processes of tunneling rodents and large ungulates could have negative effects on native prairie communities by facilitating weed invasion. Given the lack of definitive information to guide the incorporation of these faunal elements in the prairie process component, this plan will not provide further treatment of these topics. It would be useful to explore these topics however, through future research (section 8).

### Native Americans

Local Native American tribes gathered much of their dietary carbohydrates and vegetable protein, along with medicines, from the Puget prairies (Lombardi 1997). Their gathering activities included primarily: a) the use of digging sticks to till and aerate the soil and dig out camas bulbs, and b) thinning of plants (Norton 1979). Regular use of the prairies in this way by native peoples would have had an effect on the soil and vegetation of the prairies, and could be considered another *process* that was influential in shaping the historical condition of the prairies. The extent and effects of digging and thinning activities, and their implications in the present context of invasive species, are not well described, and therefore will not be treated further in the plan, but constitute good subjects for further investigation (section 8).

### European Settlers

Settling of the prairies by Europeans resulted in the direct loss of habitat through development and the indirect loss through cessation of frequent burning (see Fire above). The condition of the prairies were further altered by changes in land use such as cultivation for agriculture, heavy grazing by livestock, and cutting oak for firewood. These processes permanently altered the composition and structure of the native vegetation and soils. Although rural settlement processes have contributed to the degradation of the greater prairie landscape over the years, they are no longer operating on Fort Lewis prairies, and will not be addressed further in this document.

### Current Use

Current processes operating on Fort Lewis prairies include recreational activities, military training, natural resource management activities, and protection via designated research and natural areas. Civilians frequently use Fort Lewis prairies for recreational purposes such as horseback riding, dog training, model airplane flying, pheasant hunting, occasional large events, and unauthorized motorcycle/ORV use. While most of these activities have limited impacts on the prairies, horseback riding can degrade native habitat by introducing non-native pasture grasses through their feed hay and manure. Recreational vehicle traffic disturbs the soil and vegetation, and creates conditions favorable to weed invasion.

Military use of the prairies varies over time according to the training needs of the U.S. Army, but can be generalized in the following four categories: 1) impacts from projectiles, 2) vehicle maneuvers, 3) foot traffic, and 4) excavation (Altman 2003). These activities typically result in damage to soil, vegetation, and wildlife through soil compaction and contamination, release of toxic chemicals, noise disturbance to wildlife, habitat loss and degradation, and introduction and spread of invasive weed seeds on transport and other training equipment (Altman 2003). A potentially positive effect of military training on butterfly habitat is the initiation of wildfires resulting from exploding munitions, especially on the Artillery Impact Area.

Active management by Fort Lewis personnel and partners to enhance the condition of the prairies has been in effect for several years. Management activities include area-specific rehabilitation efforts and projects that target rare species. Invasive species control is widely practiced on the prairies with the aid

of mowers and herbicides. Prescribed fire is currently used as a management tool to enhance habitat and reduce fuel loads on prairies and their edges.

Research Natural Areas and Seibert staked areas afford protection to prairies by limiting activities in high quality habitats. Specific areas of select prairies are delineated by Seibert stakes that signal restricted access. No vehicles, bivouacs or digging activities are permitted inside the staked area. These areas are used primarily for protection of special status species, high quality sites, rehabilitation efforts, or cultural sites.

The above uses contribute to both the degradation and enhancement / protection of butterfly habitat. Current uses that complement enhancement efforts are encouraged (special protection status to limit access by vehicles and horses, invasive species control), while those known to degrade habitat are discouraged (destructive recreational and military uses) in areas targeted for habitat enhancement activities on the high and secondary priority prairies. It may also be useful to include a brief introduction to prairie conservation in training courses for Fort Lewis personnel.

### **5.3 How ? – Enhancement Techniques**

Management actions recommended in this plan emphasize the enhancement of native prairie and prairie-woodland ecotone features through the control of invasive species and subsequent planting of native grasses and forbs in a variety of microhabitats. Strategies for controlling invasive species, and seeding or planting of native species are complex subjects and generally rest outside of the intent for this document. Some aspects of these restoration strategies are treated below by way of cursory overviews of considerations that are important to butterflies and their habitat, and some of the gaps in our knowledge of these strategies. Where possible, restoration strategies should be implemented in a way that facilitates learning opportunities through careful research to allow application of lessons learned in future restoration efforts. Specific considerations for rendering some enhancement techniques (fire, mowing, herbicides) safer for butterflies are provided in section 7.1.

#### *5.3.1 Controlling Woody Invasives*

Efforts to reduce the threat of Scotch broom have been underway for several years on Puget prairies, and have met with considerable success in reducing the cover and height of this woody invasive. Scotch broom is difficult to eliminate, however, and thus maintenance efforts are ongoing to control the re-growth, re-establishment, and spread of this species. Control efforts incorporate a variety of tools, including fire, mowing, brush-cutting, hand-pulling, and herbicides. Considerable attention has been devoted to this problem area (Dunn 2003), and thus will not be elaborated in this plan, other than to emphasize butterfly-sensitive considerations for use of these tools reviewed in section 7.1. Other woody shrubs that require periodic control on the prairies or prairie ecotones include the non-native Himalayan blackberry (*Rubus discolor*), and the native snowberry (*Symphoricarpos albus*).

It is also important to arrest or reverse the encroachment of Douglas-fir saplings and trees on the prairies. Occasional trees or tree islands contribute to habitat diversity, but where Douglas-fir overtop oaks, or contribute to a substantial reduction in prairie habitat, conifer saplings and trees should be removed. The use of hand-held brush cutters, chain saws, or fire could be useful in controlling the invasion of conifers on the prairie.

#### *5.3.2 Controlling Herbaceous Invasives*

Non-native forbs, especially hairy cat's ear (*Hypochaeris radicata*), are very prevalent on the prairies, although they do not appear to degrade the prairies to the extent that other woody and grass invasives do. Furthermore, non-native forbs may provide important resources for butterflies. Taylor's

checkerspots have used the non-native *Plantago lanceolata* as a larval food on the Puget prairies, and non-native thistles, including *Cirsium arvense*, are important nectar resources for zerene fritillaries (Hays et al. 2000). Control of non-native forbs will not be treated further in this plan, although the role of non-native forbs in butterfly habitat constitutes a topic for future research (section 8).

Non-native grasses appear to be far more problematic than non-native forbs on the high priority prairies, especially in relatively mesic sites and areas of the prairie that grade into riparian zones. In some of these sites, tall aggressive pasture grasses dominate and have converted the once short-statured bunch grass or sedge-dominated prairie vegetation to ‘hayfields’ of 1m+ tall grasses. Tall grasses that dominate structural features of the prairies pose a considerable threat to butterfly habitat because they: a) block access to native plants, and b) out-compete and eliminate native vegetation in these important habitats, rendering them unusable to butterflies that rely on native resources. Shorter grasses such as colonial bentgrass (*Agrostis capillaris*) also pose serious threats to butterfly habitat because they compete for space with native species, and are widespread on some prairies, which limits control options. A cursory review of control options for invasive grasses and their implications for butterfly conservation is presented below.

### Mowing

Annual spring mowing has the potential to reduce the vigor of some invasive grasses (Wilson and Clark, 2001), but the effects of mowing on Puget prairie grasses are unknown. Where species differ in height, mowing may be a useful tool to target taller species, while not harming shorter species that are below the cutting height. In the case of Puget prairies, mowing has the potential to be most effective at controlling invasive grasses that are taller than the native fescue and danthonia (*Danthonia californica*), such as tall oat grass (*Arrhenatherum elatius*), but would probably have little potential for controlling shorter invasives such as colonial bentgrass, which is closer to the native fescue in height. Use of mowing to control invasive grasses in a butterfly habitat improvement context would be controversial because:

- a) This strategy requires mowing in the spring, which could be lethal to some individual butterfly larvae, pupae and adults, which are more likely to be active higher up on plant stems at that time of year compared to their sedentary phase in the duff layer during the fall or winter.
- b) Mowing is non-selective, and spring mowing could be detrimental to desirable native forb butterfly resources, along with the target grasses.

The use of mowing as a tool to control invasive grasses may be useful in some sites, but less desirable in the context of butterfly habitat enhancement where rare butterflies are present. The efficacy of mowing to control invasive grasses is currently being investigated on Puget prairies by Scott Pearson of the Department of Natural Resources.

### Herbicides

The judicious use of grass-specific herbicides has the potential to considerably reduce the cover of non-native grasses, while avoiding harmful impacts to the forb community. These herbicides are applied at the critical growth stage when root resources have been depleted, and the grasses are translocating resources (and the herbicide) to their roots, just prior to flowering (typically late April – early May). One such herbicide, sethoxydim, kills grasses but has little or no impact on broadleaf herbs, woody plants (Tu et al. 2001), or fine-leaved fescues. Whereas the native fescue and forbs may not be harmed by these chemicals, other native grasses such as *Koeleria cristata* and *Danthonia californica* may be affected (Robohm 1997), and it may be necessary to re-plant native grasses following herbicide application on native plant communities. The chemical sethoxydim was used in a trial at the 13<sup>th</sup> Division Prairie, where it killed colonial bentgrass within one week of application, while the fescue remained unharmed (Robohm 1997). The bentgrass produced new growth at the site later that season, however, and it is recommended that these herbicides be applied two times in a season, (e.g. spring and after the fall rains) to be effective at killing pasture grasses with a well-established root network.

Grass-specific herbicides have the potential to control invasive grasses with fewer direct or indirect impacts on native fauna and flora compared with mowing and prescribed grazing (see below). Over the long term, herbicides may require fewer applications on the landscape compared with annual mowing, with the result that the direct impacts of tractor movements on the prairies could be reduced through the use of herbicides. The efficacy of herbicides to provide long-term (three or more years) control of non-native grasses has not been empirically tested on Puget prairies, however, nor have the direct and indirect impacts to the prairie vegetation and butterfly communities been comprehensively investigated. The same is true of all the methods described here for invasive grass control in this section, and it would be useful to proceed with a pilot program of herbicide application to address these information gaps.

### Fire

Adaptation to fire by grasses is variable, and while some may respond to fire by decreasing, others can increase (Robohm 1997, Grace et al. 2001). Grasses are best controlled if burned during their vulnerable stage, and it is likely that repeat applications of fire would be most efficacious in controlling non-native grasses (Tu et al 2001). Fire may be an important tool for the control of native grasses, but its use should be pursued with the following cautions in mind.

Fire is likely to kill juvenile stages of butterflies, and thus needs to be used at a limited scale and at an appropriate time (season). Fire has the potential to be maladaptive in the current context of invasive plants due to the short-term increase in available N following the burn, and an increase in open sites for invasive plant germination. Furthermore, fuel loads on some prairies and in their margins are high due to the limited burning in recent history. High fuel loads may cause fires to burn at temperatures higher than those to which the prairie community is adapted, and could be more detrimental to prairie flora and fauna than helpful. In the case of high fuel loads, these sites could undergo fuel reduction through some form of biomass removal, such as mowing or brush-cutting. As an alternative, the initial prescribed burn could be implemented under moist or cool season site conditions, which should result in less extreme heat.

Finally, implementation of a fire regime that includes annual burning is likely to be difficult to execute on schedule due to the vagaries of the weather, coupled with regulatory restrictions (burn bans). In the event that a prescribed fire is cancelled for the year due to unfavorable conditions or other reasons, several other management activities may serve as short-term substitutes for fire. Mowing or applying herbicide on woody shrubs or invasive grasses in the target area should serve to reduce the extent and biomass of these pest species. In the case of mowing, it would probably be best to use a bagger to remove the cut biomass from the site to remove a source of nitrogen to more closely mimic the volatilization of nitrogen that would occur with fire. One option would be to conduct carefully controlled 'trash-can' type contained burns on very small sections of the target area (e.g. patches of violets) to influence the bare ground, moss, and thatch characteristics that would be difficult to affect without the use of fire.

### Grazing

Uncontrolled or excessive grazing is generally injurious to native habitats (Guppy and Shepard 2001). The judicious use of grazing by cattle or sheep, however, has the potential to enhance butterfly habitat by reducing the cover of invasive grasses, thereby favoring forb diversity and abundance. Cattle grazing has been instrumental in the control of invasive grasses in California, with some benefits to checkerspot populations (Weiss 1999), while historical grazing by sheep is believed to be instrumental in the maintenance of habitat for Taylor's checkerspot and zerene fritillary in British Columbia (Guppy and Shepard 2001). Light grazing is proposed as a management recommendation for Taylor's checkerspot butterflies in Washington (Larsen et al. 1995), and therefore should be considered as a potential tool for controlling invasive grasses.

Marty Chaney (pers. comm.) has observed that under well managed grazing regimes, cattle prefer to graze the more succulent invasive grasses rather than the native fescue grass and forbs. Potter et al. (1999), however, relate that cattle favor the native fescues as forage, and suggest that cattle grazing may be detrimental to populations of mardon skippers.

Carefully managed grazing has the potential to control non-native grasses while benefiting the native fescue and forbs. In this regard, it would be preferable to mowing as a tool to control invasive grasses because of its selective nature. It also has the potential to reduce thatch depth, and hoof action may break up the existing thatch layer. At the same time, cattle could have deleterious effects on the prairie system such as increasing nitrogen through the deposition of urine and feces, and their hoof action could compact soil and/or facilitate weed invasion by creating additional germination sites.

As with other techniques described above, grazing should be most injurious to the non-native grasses during the spring growth phase, and then again in the fall after the rains initiate the fall flush of vegetative growth. Spring is also the active phase of many of our Puget butterflies, and therefore grazing has the potential to be harmful to individual butterflies during this season through trampling or inadvertent consumption.

The logistics of managing cattle grazing on native prairies would be complex, labor intensive, and costly. Cattle should be moved frequently using temporary electric fencing in the target zone to avoid depleting the invasive grass forage and switching to native fescue and forbs. A disadvantage unique to Fort Lewis is that the animals may 'spook' or otherwise react to the sounds of exploding munitions, helicopters, or other training activities. The use of grazing as a habitat enhancement tool to control invasive grasses would not be without controversy. In summary, the use of prescribed grazing, if considered as a management tool, should proceed cautiously as a pilot project, and on a limited spatial scale with a strong research component.

### Summary

A multi-pronged approach, combining mowing, herbicides, and fire, may be necessary to reduce the extent and vigor of non-native grasses on the prairies. Prescribed grazing using cattle also has the potential to selectively target invasive grasses if managed correctly, but the logistics of this option may preclude its application in a meaningful way. The use of any of these options should proceed cautiously as pilot projects, and with strong research components that include collaboration or input from regional scientists. In the interest of furthering butterfly conservation efforts as outlined in this plan, it may be useful to institute some pilot projects to test combinations of mowing, herbicides and/or fire on the most heavily degraded areas of 13<sup>th</sup> Division Prairie, and to a lesser extent, the western arm of Johnson Prairie. **Despite the cautions and concerns raised, aggressive control actions are warranted because the full range of enhancement strategies in this plan cannot be accomplished without control of invasive grasses in the more heavily invaded structural features such as relatively mesic and edge habitats.**

### 5.3.3 *Planting Native Species*

Direct seeding and transplanting 'plugs' of native grasses and forbs are techniques that have been used for restoring patches of native species on Puget prairies (Dunn 1998). Seeds typically require the presence of a disturbance mechanism to create bare soil for successful establishment, whereas nursery plugs facilitate the survival and vigor of transplants into existing vegetation. Transplanting nursery grown plugs into holes created with the use of a dibble planting bar, although more costly and labor intensive than direct seeding, is the preferred method for establishing or augmenting specific resources in existing prairie while avoiding large scale soil disturbance. Many species (eg. *Erigeron speciosus*) exhibit better survival when planted out from a larger container than nursery plugs (Dave Hays, pers. comm.), although the effort to grow and outplant larger individuals will require considerably more

monetary and labor resources than those required for plugs. Where safety concerns dictate that sub-surface soil not be disturbed due to the possible presence of unexploded munitions, as on the Artillery Impact Area, direct seeding without disturbance is recommended to augment native species populations.

Where native vegetation is relatively abundant, specific butterfly plant resources may be transplanted into existing native vegetation to enhance the site's potential as butterfly habitat. In potentially important structurally diverse habitat sites, such as tree edges, prairie pockets, and relatively mesic areas where invasives often predominate, strong measures to remove or control the invasives are warranted, followed by the establishment of diverse suites of native plants emphasizing important butterfly resources. Outplantings are likely to require considerable follow up 'maintenance' to reduce competition from non-native grasses and forbs to ensure long-term survival and establishment (Dave Hays, pers. comm.). Seeds for direct seeding and transplanting should be derived from Fort Lewis prairie sources where possible to assure that plants are adapted to local conditions.

### Site Preparation

Enrichment plants should not be transplanted into areas that are dominated by invasive species. Some of the habitat enhancement patches identified for improvements in this plan (section 7) contain structural features that are potentially important to butterflies, but are dominated by invasives. In these enhancement patches, site preparation should consist of controlling invasive species and their seed banks, if possible. Alverson's (2002) observations from upland prairie restoration efforts in the Willamette Valley of Oregon led to this opinion that "site conditions (i.e. the more complete removal of weed seed) are a more important factor in native plant establishment than the quantity of seed that is applied". This opinion applies to direct seeding, but might also be considered relevant for transplanting plugs into existing prairie dominated by weedy species. Planting trials of fescue plugs in degraded Puget prairies invaded by colonial bentgrass revealed that the combination of applying a grass-specific herbicide and a layer of mulch around the plugs to control competition from invasives had significant positive effects on the growth of the fescue plugs (Robohm 1997).

In highly degraded but potentially important butterfly microhabitats, where invasives form the dominant cover type and threaten to outcompete the transplants (eg. where prairie grades into the riparian zone on 13<sup>th</sup> Division Prairie RNA), drastic measures may be warranted to effect the removal of the entire herbaceous layer along with its weed seed bank. One method to consider is solarization, a site preparation technique that captures radiant heat energy from the sun to kill weeds and weed seeds located under clear plastic sheeting. This energy causes physical, chemical, and biological changes in the soil. These changes lead to reductions of soilborne plant pathogens such as fungi, bacteria, and nematodes, along with any vegetation and seeds present. This site preparation technique requires large quantities of plastic, which is costly and not environmentally friendly when disposed of, and would only be suitable for sites dominated by non-native vegetation and lacking native species. Solarization might be most effective in preparing a weed and weed seed-free site if used in conjunction with a spring application of herbicide to kill much of the existing vegetation first (Alverson 2003). A combination of techniques including herbicides, tilling, and solarization offers potential for establishing a community of native plants with low levels of invasives (Alverson 2003).

In summary, site preparation (and maintenance) to promote survivorship and vigor of outplantings is critical to the success of habitat enhancements for butterflies. The plantings recommended in this plan often include suites of species to be distributed across varying habitat conditions, and pose a considerable challenge for implementers of the plan to prepare sites that are relatively free of competition for the transplants. The identification of site preparation techniques suitable for a range of conditions will likely require considerable attention to research trials, combined with long-term monitoring.



## Planting Amendments

Idaho fescue is highly amenable to transplantation, and requires no additional amendments (Dunn 1998). First year results of an outplanting trial for *Viola adunca* indicate that this prairie forb exhibits high first year survival. First year results of a *Castilleja hispida* trial on Fort Lewis suggest that these plants benefited from the addition of fertilizer, and thus 2.5 ml (0.5 tspn) of a 19:6:12 slow release fertilizer is recommended for addition in the dibble hole at the time of planting (Grosboll and Fimbel 2003). Addition of fertilizer should be localized to the transplanted plug to avoid general fertilization of the prairie vegetation, particularly invasive species, which are adapted to compete well for nutrients. The secondary effects of planting amendments in general, and fertilizer in particular, on invasive plants can reduce the overall effectiveness of the amendments for the target species (Dunn 1998), unless applied very carefully. As a general rule, planting amendments are not recommended.

## Planting Strategy

*Habitat enhancement patches* (described in section 5.1.2) are too large to receive 100% coverage of plantings. Instead, one, or a combination of, the three planting strategies described below should provide concentrations of butterfly resources (*butterfly resource patches*) within the *habitat enhancement patches* (Figure 5.1). First priority for a planting strategy is to identify existing resource patches for a particular butterfly, and then plant seeds or nursery plant plugs within 50 m of those existing resource patches. This will require mapping existing larval and important nectar resources of the four butterfly species (see section 7.1 for a listing of some of these resources) for each of the high priority prairies.

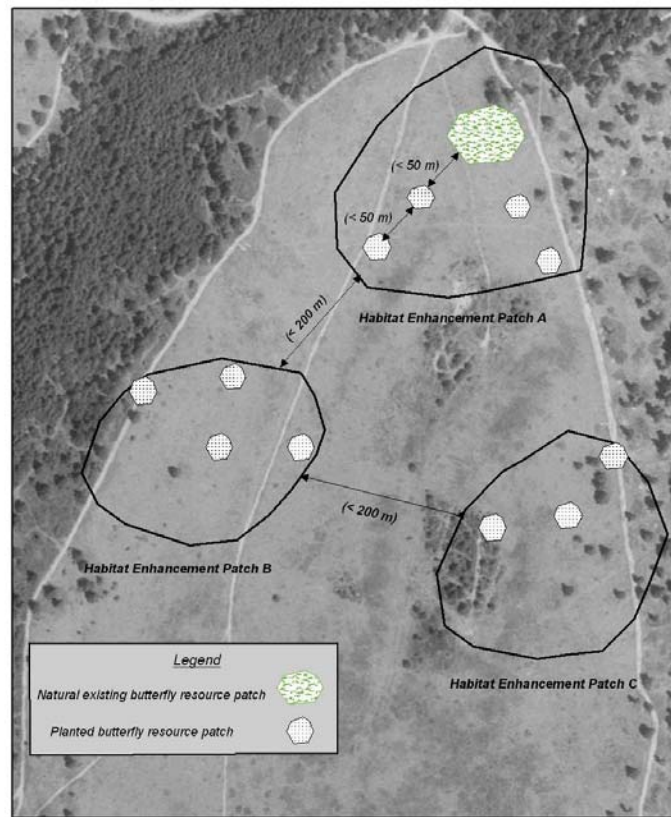


Figure 5.1 Schematic showing hypothetical prairie with three habitat enhancement patches (A, B, and C). The proposed planting strategy emphasizes initially planting butterfly resource patches (eg. butterfly enrichment plots, described below) within 50 m of a natural existing resource patch, and then expanding outward.

To avoid disturbance to butterflies and their existing resources, avoid planting where resources already exist. Eventually, the aim is for *butterfly resource patches* (natural, or planted using one or more of the three planting strategies below) to expand beyond the initial *habitat enhancement patches* to create a more widespread coverage such that the larger *habitat enhancement patches* are separated by  $\leq 100$  m (Ann Potter, pers. comm.).

It will be important to **monitor** the general survivorship of outplantings to determine if they are available to butterflies (section 8, question 1). Many of the plants may not survive in the short or long-term. Quantities of plantings proposed in this document assume mortality rates of  $\leq 25\%$ . Transplanted Roemer's fescue plugs are likely to exhibit relatively low mortality and are not expected to require substantial re-plantings. Some forbs, however, are likely to exhibit high rates of mortality within the first few years, and will probably exceed the 25% mortality assumption. In these cases where mortality exceeds 25%, dead plants will need to be replaced. Plantings are also likely to require substantial maintenance efforts to promote suitable conditions for long-term survival of transplants. Monitoring and research (section 8) will be an important component of a successful planting program to identify suitable site preparation, planting, and maintenance methods and techniques for a variety of plant species in a variety of site conditions.

### Three Planting Strategies

1. Where native vegetation is relatively abundant, one or more plant species may be seeded or planted to augment specific resources for butterfly species targeted in that habitat enhancement patch.
2. Where native vegetation is relatively abundant, but generally lacking in butterfly plant resources, a 'butterfly enrichment plot' targeting a specific butterfly species may be planted (Table 5.3). Butterfly enrichment plots emphasize concentration of larval resources and some adult resources for specific butterflies in approximately 8 m radius circles (200 m<sup>2</sup>). The circle shape was chosen to minimize edge effects and consequently the potential for dispersal by butterflies outside of the resource patch. A circular plot is also easy to install with a single stake and a string. Butterfly enrichment plots should be located in the habitat to take advantage of naturally occurring structural features such as swales and tree/woodland edges. In the event that a site does not accommodate an approximate circle shape, the larval resources should be distributed in a clumped fashion appropriate to the shape of the site. These butterfly enrichment plots constitute the primary means of improving quantities of resource plants for butterflies.

Table 5.3 Species for planting in ~8 m radius (200 m<sup>2</sup>) ‘butterfly enrichment plots’ to target a specific butterfly species. *Viola adunca* v. *adunca* plantings for mardon skipper and *zerene fritillary* to be concentrated in center ~16 m<sup>2</sup> of plot (2.25 m radius or 4m x 4m square) to yield 12.5 plants/m<sup>2</sup> for mardon skipper and 25 plants/m<sup>2</sup> for *zerene fritillary*. Species listed are local to Fort Lewis (LCTA 2003).

Butterfly	Enrichment Plantings	Management Considerations
Taylor’s checkerspot	300 <i>Castilleja hispida</i> ssp. <i>Hispida</i> (larval host) 300 <i>Camassia quamash</i> v. <i>azurea</i> 100 <i>Lomatium utriculatum</i> 50 <i>Lomatium triternatum</i> v. <i>triternatum</i> 100 <i>Fragaria virginiana</i> ssp. <i>Platypetala</i> 50 <i>Balsamorhiza deltoidea</i>	
Mardon skipper	* <i>Festuca roemerii</i> (laval host) 200 <i>Viola adunca</i> v. <i>adunca</i> (plant in center 2.25 m radius) 50 <i>Lomatium utriculatum</i> 50 <i>Lomatium triternatum</i> v. <i>triternatum</i> 200 <i>Camassia quamash</i> v. <i>azurea</i> 50 <i>Ranunculus occidentalis</i> v. <i>occidentalis</i>	<ul style="list-style-type: none"> <li>• Fescue to be interspersed with bare ground (bare ground cover at 10 – 20%)</li> <li>• Maintain low vegetation height (~ height of fescue and violets)</li> </ul>
Zerene fritillary	400 <i>Viola adunca</i> v. <i>adunca</i> (larval host) (plant in center 2.25 m radius) 200 <i>Sericocarpus rigidus</i> 50 <i>Erigeron speciosus</i> v. <i>speciosus</i> (plant distant from violets) 50 <i>Solidago missouriensis</i> v. <i>tolmieana</i> (plant distant from violets to maintain low vegetation height)	<ul style="list-style-type: none"> <li>• Low thatch depth (2.25 – 3.5 cm)</li> <li>• Low vegetation height (&lt; 30 cm)</li> </ul>
Puget blue	200 <i>Lupinus albicaulis</i> v. <i>albicaulis</i> (larval host) 100 <i>Lomatium triternatum</i> v. <i>triternatum</i> 200 <i>Eriophyllum lanatum</i> v. <i>achillaeoides</i> 100 <i>Potentilla gracilis</i> v. <i>gracilis</i>	

\* = As needed to bring cover value to 30% - 60%.

- Where native vegetation is sparse, and invasive vegetation has been controlled, ‘basic prairie planting blocks’ or ‘edge planting blocks’, incorporating suites of butterfly resources and relatively common native prairie plants, are recommended to aid in the restoration of a more complex and healthy community of native prairie vegetation. These blocks are 5m x 5m, and consist of suites of plants (Tables 5.4 and 5.5) in a systematic planting array (Figure 5.2). These planting blocks would be most applicable in the case of a site recently cleared of dominating shrubs or trees, and/or heavily burned areas where there are opportunities for restoring a more complete native prairie community. These planting blocks are relatively small in size (25 m<sup>2</sup>) and are to be used as ‘building blocks’ that contribute toward the restoration of native prairie, while allowing for the interspersion of single resource plantings or butterfly enrichment plots among the planting blocks to emphasize enhancement of the site for specific butterfly species.

Although plant resources are normally clumped and irregularly spaced in the landscape, a systematic planting strategy is recommended for the basic prairie and edge planting blocks. The planting strategy described below incorporates planting blocks and centers as artificial constructs to facilitate the planning and distribution of the plants during the planting process, and also to facilitate the future location and monitoring of the success of the restoration plantings. This planting strategy includes regular spacing of fescue (two fescue spacings, 0.5 m and 0.33 m, are recommended to test the efficiency of meeting the habitat enhancement objectives, section 6), with clumpings of native forbs and other graminoids in the interstitial spaces among the fescue. The primary caveat for this planting protocol, however, is that when outplanting in the future, plants should be distributed in the landscape in a manner consistent with their natural distribution, wherever known or possible.

Species recommended for use in the planting blocks are listed in tables 5.4 and 5.5. Forbs are categorized as high, medium, and low density targets to reflect their relative abundance in the planting mix based on their importance to butterflies and their relative abundance in native prairie communities. High and medium density targets emphasize important butterfly resources and those plant species that are most common on the prairies (Chappel and Crawford 1997), whereas low density targets are species that are still commonly found on Puget prairies, but not known to be used by butterflies. *Specialty plants* are relatively large and shrub-like, or typically require special site considerations.

### Basic Prairie Planting Block

Purpose: baseline planting block suited to open prairie site where native vegetation is sparse and invasive vegetation has been controlled, to restore elements of native prairie vegetation community with emphasis on butterfly resources (Table 5.4). The block is composed of regularly spaced fescue plugs, with forb planting centers in the interstitial spaces among the fescue. Forb planting centers may incorporate a single individual, or several individuals, of a species.

- 5 m x 5 m block with one of two different spacings:
  - a) 121 fescue at 0.5 m spacing (Figure 5.2)
  - b) 256 fescue at 0.33 m spacing
- 50% fescue plugs : 50% forb and non-fescue graminoid plants
- composition of forb and non-fescue graminoid plants for interstitial spaces (planting centers):
  - a) 0.5 m fescue spacing - 8 planting centers for each high density species, 5 planting centers for each medium density species and non-fescue graminoids, and 4 planting centers for each low density species.
  - b) 0.33 m fescue spacing – 16 planting centers for each high density species, 11 planting centers for each medium density species and non-fescue graminoids, and 8 planting centers for each low density species.
- Four lupines (3 *L. albicaulis*, and 1 *L. lepidus*) and 4 *Balsamorhiza deltoidea* to be planted at the exterior of each planting block because they have the potential to become large and shrubby, and can dominate the local microsite.
- Spreading dogbane (*Apocynum androsaemifolium*) to be planted along road edges or sites with little to no interspecific competition.

### Edge Planting Block

Purpose: Same as baseline planting block above, except for use under and adjacent to oak trees, or conifer trees or in relatively mesic conditions (Table 5.5). Graminoids are spaced at regular intervals, with forb planting centers in the interstitial spaces among the graminoids.

- 5 m x 5 m block, with 0.5 m or 0.33 m graminoid spacing as above.
- (50%) graminoids : (50%) forbs
- composition of graminoids and forb to consist of:
  - a) 0.5 m spacing – 73 *Carex inops*, 24 *Elymus glaucus*, 16 *Festuca roemerii*, 8 *Danthonia californica*, and 20 planting centers for each high density forb species: 7 planting centers for each low density forb species.
  - b) 0.33 m spacing – 146 *Carex inops*, 50 *Elymus glaucus*, 40 *Festuca roemerii*, 20 *Danthonia californica*, and 40 planting centers for each high density forb species: 18 planting centers for each low density forb species.

*Note: Plectritis congesta* has been identified as an important larval food and adult nectar resource for Taylor's checkerspot at the Bald Hills site in western Washington. This annual also occurs on Fort Lewis, but its distribution and abundance is very limited and has recently declined to just a few known

occurrences (LCTA 2003). This species is described as occurring in ‘vernally moist meadows and open rocky slopes and bluffs’ (Pojar and MacKinnon 1994). These habitats are not prevalent on our lowland Puget prairies, and therefore, this species may not be a robust candidate for augmentation on Fort Lewis. It is worth investigating, however, conditions that would favor the establishment of this species, given its potential importance to Taylor’s checkerspot butterflies. This species is not currently included on the list of enhancement plantings due to a lack of local seed source and knowledge of site requirements. The potential and suitability of this species as a Taylor’s checkerspot resource on Fort Lewis is included as a subject for future research (section 8).

Butterfly Habitat Enhancement on Fort Lewis

Table 5.4. Prairie plant species for use in 'basic prairie planting blocks' (described above) by density target categories. Species listed are local to Fort Lewis (LCTA 2003). Category designation based on: a) the species' importance to butterflies and b) abundance (constancy and cover, Chappell and Crawford 1997) in the native landscape. Specialty plants include species to be planted outside of planting blocks. L = larval host, N = nectar resource.

Common name	Scientific name	Constancy	% Cover	Mardon Skipper	Taylor's Checkerspot	Zerene Fritillary	Puget Blue
<b>Graminoids</b>							
Roemer's fescue	<i>Festuca roemerii</i>	100	45	L			
Long-stolon sedge	<i>Carex inops</i> ssp. <i>Inop</i>	93	2				
California danthonia	<i>Danthonia californica</i>	79	2				
<b>Forbs</b>							
<u>High density targets</u>							
Common camas	<i>Camassia quamash</i> v. <i>azurea</i>	86	6	N	N		
Oregon sunshine/woolly sunflower	<i>Eriophyllum lanatum</i> v. <i>achillaeoides</i>	93	2				N
Early blue violet	<i>Viola adunca</i> v. <i>adunca</i>	64	4	N		L	
Harsh paintbrush	<i>Castilleja hispida</i> ssp. <i>Hispida</i>	-	-		L		
Spring gold	<i>Lomatium utriculatum</i>	43	<1	N	N		N
Nine-leaved lomatium	<i>Lomatium triternatum</i> v. <i>triternatum</i>	-	-	N	N		
<u>Medium density targets</u>							
Houndstongue hawkweed	<i>Hieracium cynoglossoides</i>	86	4			N?	
White-top aster	<i>Sericocarpus rigidus</i>	71	4			N	
Broadpetal strawberry	<i>Fragaria virginiana</i> ssp. <i>Platypetala</i>	64	4	N	N		
Missouri goldenrod	<i>Solidago missouriensis</i> v. <i>tolmieana</i>	64	2			N	N
Western buttercup	<i>Ranunculus occidentalis</i> v. <i>occidentalis</i>	64	2	N	N		N
Slender cinquefoil	<i>Potentilla gracilis</i> var. <i>gracilis</i>	57	2				N
Showy fleabane	<i>Erigeron speciosus</i> v. <i>speciosus</i>	-	-			N	
<u>Low density targets</u>							
Cutleaf microseris	<i>Microseris laciniata</i> ssp. <i>Laciniata</i>	71	<1				
Henderson's shooting star	<i>Dodecatheon hendersonii</i> ssp. <i>Hendersonii</i>	50	<1				
Bluebells of Scotland	<i>Campanula rotundifolia</i>	29	<1				
Prairie junegrass	<i>Koeleria macrantha</i>	29	2				
Selfheal	<i>Prunella vulgaris</i> ssp. <i>Lanceolata</i>	64	<1				
Yarrow	<i>Achillea millefolium</i> v. <i>occidentalis</i>	64	<1				
<u>Specialty plants</u>							
Prairie lupine	<i>Lupinus lepidus</i>	64	2	N			
Sickle-keeled lupine	<i>Lupinus albicaulis</i> v. <i>albicaulis</i>	-	-				L N
Puget balsamroot	<i>Balsamorhiza deltoidea</i>	21	3		N		
Spreading dogbane	<i>Apocynum androsaemilifolium</i>	-	-			N	

Table 5.5. Plant species for use in 'edge planting blocks' (described above) at tree-prairie ecotones or relatively mesic sites. Species listed are local to Fort Lewis (LCTA 2003). Constancy and cover values from native-dominated herbaceous vegetation plots in the Oregon white oak/long stolon sedge-camas community (Chappell and Crawford 1997).

Common name	Scientific name	Constancy	% Cover
<b>Graminoids</b>			
Long-stolon sedge	<i>Carex inops</i> ssp. <i>Inop</i>	100	22
Blue wildrye	<i>Elymus glaucus</i> ssp. <i>Glaucus</i>	60	13
Roemer's fescue	<i>Festuca roemeri</i>	60	6
California danthonia	<i>Danthonia californica</i>	50	3
<b>Forbs</b>			
<u>high density</u>			
Common camas	<i>Camassia quamash</i> v. <i>azurea</i>	60	5
Early blue violet	<i>Viola adunca</i> v. <i>adunca</i>	70	<1
Oregon sunshine/woolly sunflower	<i>Eriophyllum lanatum</i> v. <i>achillaeoides</i>	20	6
Spring gold	<i>Lomatium utriculatum</i>	20	4
Harsh paintbrush	<i>Castilleja hispida</i> ssp. <i>Hispida</i> (observed under oaks at Bald Hill)	-	-
<u>low density</u>			
Yarrow	<i>Achillea millefolium</i> v. <i>occidentalis</i>	70	4
Western buttercup	<i>Ranunculus occidentalis</i> v. <i>occidentalis</i>	60	2
Showy fleabane	<i>Erigeron speciosus</i> v. <i>speciosus</i> (late season nectar source)	-	-

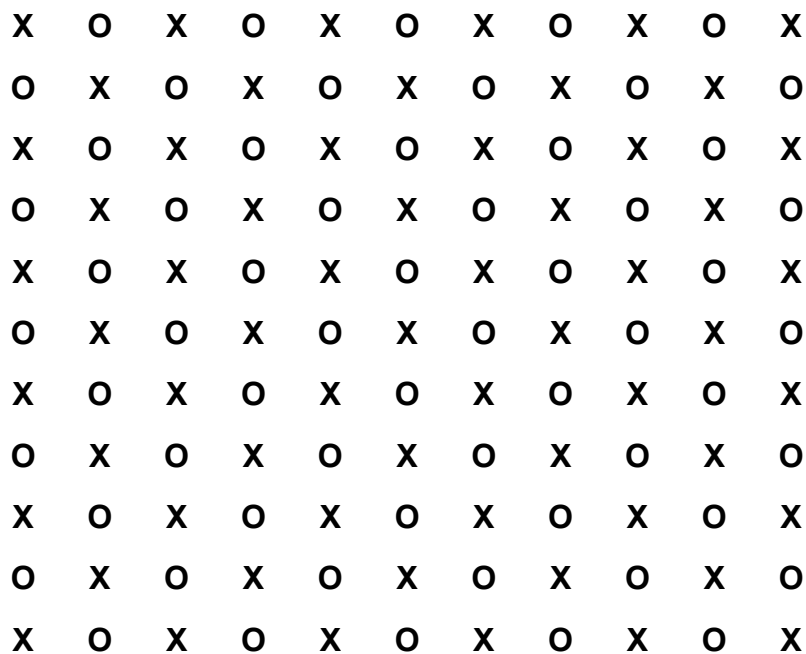


Figure 5.2 A portion of a basic prairie planting block, 5 m x 5 m (0.0025 ha) showing partial array of 11 x 11 = 121 planting centers. Fescue (X's) to be planted at 0.5 m or 0.33 m spacing, with forbs or non-fescue graminoid (O's) in interstitial spaces.

## 6. Habitat Enhancement Objectives

To satisfy the goal of enhancing habitat for four rare butterfly species on Fort Lewis, objectives were developed to guide:

1. An overarching strategy for the Fort Lewis *landscape* as a whole,
2. enhancement actions at the *prairie* level, and
3. *species*’ level objectives for each of the four butterflies targeted in this plan.

These objectives are based on the best available ecological data presented in earlier sections of this document, and are derived largely from the study of local populations by Hays et al. (2000).

### *Landscape Objective*

Three high priority prairies meet prairie level objectives outlined below (see section 5.1.1 for further background).

### *Prairie Objectives*

- 1) For each high priority prairie,  $\geq 3$  habitat enhancement patches ( $\geq 2$  ha in size each) meet the following high quality vegetation composition targets for the butterfly community, synthesized from Hays et al. (2000) and Dorner (1999) (see Table 5.2 and section 5.1.2 for further background):
  - Scotch broom < 6% cover, and < 0.26 m in height
  - Native grasses, dominated by fescue 30% - 60% cover
  - Native forbs > 25% cover
  - Non-native grasses and forbs < 35% cover
- 2) At least half of the habitat enhancement patches include diverse structural features other than flat open prairie habitat.

### *Butterfly Objectives*

For each of the four rare butterfly species, two prairies contain  $\geq 3$  habitat enhancement patches ( $\geq 2$  ha in size each) per prairie, that meet species’ level objectives (elaborated below). For example, objectives relating to the Taylor’s checkerspot include meeting criteria ‘a’ – ‘c’ below in each of three or more habitat enhancement patches on each of two prairies highlighted in this plan.

#### Taylor’s Checkerspot

- a) Two larval resource species, *Plantago lanceolata* (non-native, do not plant) and *Castilleja hispida* ( $\geq 200$  plants) established and reproducing.
- b) Three or more nectar resource species (*Camassia quamash* is the most important) established and reproducing, especially:
  - *Camassia quamash*
  - *Lomatium utriculatum*
  - *Lomatium triternatum*
  - *Fragaria virginiana*
- c) At least 2 habitat enhancement patches per prairie enhanced for Taylor’s checkerspot incorporate diverse structural features (e.g. swales, relatively mesic areas, or tree edges) other than flat open prairie.

#### Mardon Skipper

- a) Abundant fescue ( $\geq 30\%$  cover) interspersed with bare ground present at 10-20% cover.
- b) Three or more nectar resource species established and reproducing, including
  - *Viola adunca* (presence of clusters containing  $\geq 11$  plants/m<sup>2</sup>)



- *Vicia sativa* (where present do not control, clusters extending 6 – 17 m in size)
- *Lomatium utriculatum* (presence of clusters approximating 0.4 plants/m<sup>2</sup> or ~0.7 m spacing)
- c) At least 2 habitat enhancement patches per prairie enhanced for mardon skippers incorporate diverse structural features (e.g. swales, mesic areas, or tree, trail, or road edges) other than flat open prairie.

#### Zerene Fritillary

- a) Abundant violets (*Viola adunca* clusters with  $\geq 20$  plants/m<sup>2</sup>) in habitat characterized by
  - low thatch depth (2.25 – 3.5 cm), and
  - low vegetation height (< 30 cm).
- b) Two or more nectar resource species established and reproducing, especially:
  - *Erigeron speciosus*
  - *Cirsium arvense* (non-native, do not plant, do not control unless large patches threaten landscape)
  - *Solidago missouriensis*,
  - *Sericocarpus rigidus* (syn: *Aster curtus*)
- c) At least 2 habitat enhancement patches per prairie enhanced for zerene fritillaries incorporate diverse structural features (e.g. swales, mesic areas, tree edges, or forest nooks / pockets) other than flat open prairie.

#### Puget Blue

- a) Abundant *Lupinus albicaulis* (density 0.1 – 2 plants/m<sup>2</sup>) for larval feeding and adult nectaring.
- b) Two or more additional nectar resource species (in addition to the lupines which also serve as a nectar resource) established and reproducing, especially:
  - *Lomatium triternatum*
  - *Eriophyllum lanatum*
  - *Potentilla gracilis*
  - *Vicia sativa* (non-native, do not plant).

## 7. Prairie Enhancement Strategies

Strategies for enhancing butterfly habitat in each of the five prairies covered by this plan are presented on the following pages. In some cases, details are offered to facilitate both the planning and implementation phases of the enhancement work. Despite the level of detail, the reader should not confuse precision for accuracy in determining the correct path to meaningful enhancements for prairie butterflies. These strategies reflect application of the best available ecological information, and should be considered more as *guidelines* than a *recipe*. Implementers of the plan will need to remain flexible in the face of dynamic natural systems, and willing to incorporate new information, try new approaches, and generally modify the proposed strategies to improve results as a response to quantitative and qualitative research results and observations of progress made. Timely incorporation of results from complementary research projects will facilitate the adaptive management process. Additionally, a review of progress made in meeting the habitat enhancement objectives (section 6) in year three (end of 2006) would allow a formal opportunity for an assessment of the need to modify approaches recommended in the plan.

Prairies are grouped as ‘high priority’ or ‘secondary priority’ (see section 5.1.1), although baseline enhancement actions were developed for application on all prairies. Strategies for high priority prairies

emphasize greater enhancement efforts, including more aggressive invasive grass control and native species plantings. Implementation of these enhancement actions should be conducted with special provisions to minimize impacts to rare butterflies and their resources (considerations for ‘butterfly-sensitive’ management techniques are provided in section 7.1). Butterfly enhancements must be conducted in a manner that promotes the continued existence of these rare butterflies where they currently occur. Caution is warranted because isolated populations that are significantly reduced or extirpated are not likely to re-establish naturally.

Several habitat enhancement patches in high priority prairies contain sites that are dominated by woody and herbaceous invasives. Removal of invasives that dominate a site is the first step to enhancing these areas. Specific planting recommendations for these sites should be developed after removal or control of the invasives and examination of the condition of the underlying grass and forb layer. Enhancement actions, especially those pertaining to control of invasives, should be considered more as maintenance efforts to be repeated as needed, rather than single application management actions.

The exact location of plantings within a habitat enhancement patch is generally not specified in the proposed strategies, but resources should generally be clumped to facilitate their use by butterflies. To this end, a first approach would be to expand existing high quality resource patches. Secondly, new or enhanced resource patches should be established in close proximity ( $\leq 50$  m) to the existing patches. An additional consideration is that plants should be distributed among a variety of habitat types or structural features, and in a manner that is consistent with the plant species’ ecology, where possible.

Finally, the number and type of plantings proposed for each of the high priority prairies (elaborated in section 7.2 by prairie) were determined by an initial review of the quality and abundance of existing vegetation and suitability for the butterfly species targeted. Proposed quantities are subject to revisions based on future field observations of available resources and survivorship of enrichment plantings.

#### Baseline Recommendations Common to High and Secondary Priority Prairies

1. Maintain Scotch broom and woody invasives control across all high and secondary priority prairies, while increasing efforts in the prairie-tree ecotones. It is important to continue to control Scotch broom to avoid ‘losing ground’ on the progress made to date at keeping this woody invasive at a manageable level. Activities to monitor and treat new invasives are important to control non-native species before they become serious problems. Management actions that target woody plant control should include considerations provided for ‘butterfly-sensitive’ strategies outlined in section 7.1 below.
2. Implement fire regimes as comprehensive ‘butterfly-sensitive’ fire plans that include research components are developed for two high priority sites. In the interim, high and secondary priority prairies could receive a program of limited prescribed burns that include considerations for a ‘butterfly-sensitive’ fire strategy outlined in section 7.1 below.
3. Control conifer tree invasions into prairies and oak woodlands where applicable, through the use of fire, cutting, and/or girdling of trees at prairie margins, and where warranted, the central prairie area. Maintain some standing dead trees as snags for wildlife.
4. Consider as an emergency measure, watering important habitat patches (dense concentrations of larval and/or nectar plant resources) under cases of extreme drought, for the purpose of deferring senescence of important larval or nectar plant resources. This emergency measure is justified on the basis that the fragmented and degraded prairies no longer provide a ‘minimum dynamic area’ for many species that would seek out more mesic habitats, and therefore active management such as emergency watering (perhaps with the Forestry Department’s water tenders) may be warranted.

## 7.1 Considerations for Implementing Management Actions

Enhancements proposed in this plan represent an ambitious undertaking. The proposed plantings alone could require a minimum of three years to implement, depending on availability of resources. As a general rule, it would be prudent to implement enhancements slowly over a period of several years to avoid impacting large areas of existing prairie at any one time. A period of approximately three years is anticipated for the short-term implementation of proposed enhancements (section 9).

Implementation of enhancement activities should be most conservative on sites occupied by rare species. This would include scheduling activities to avoid seasons of high vulnerability of the rare butterflies and their important plant resources. As a general rule, it would be safest to implement management activities in rare butterfly habitat that are likely to be harmful to active butterflies or their resources, such as mowing or burning, during the quiescent stage of the butterfly life cycle (mid/late September – mid April). Managers should strive to minimize combining multiple management actions (i.e. mowing and fire) at a single site within an annual cycle. Combinations of management actions may produce unpredictable synergistic effects on the butterflies or their habitat, and also confound interpretation of research results.

In the interest of maintaining an active restoration crew year round, or if a management activity requires implementation during larval feeding or adult flight periods, activities such as mowing could be conducted in highly degraded sites or other areas where rare butterflies are not likely to occur (e.g. monodominant stands of tall Scotch broom, or dense stands of invasive grasses). In this case, targeted surveys could be conducted to confirm the absence of rare butterflies before implementation of the management activity during the spring or summer active periods.

When management actions are required in rare butterfly habitat during feeding or flight periods, the trade-offs in terms of costs and benefits to rare butterflies should be evaluated by managers in consultation with butterfly ecology experts. If the management action is deemed to have a potentially net positive effect for butterflies, considerations outlined below could be incorporated, along with conducting the management action at a reduced scale of application, and incorporating a strong monitoring and/or research component for the butterflies and their resources.

Similarly, if through annual monitoring, rare butterfly populations are observed to be declining, or are determined to be especially low, biologists from the Washington Department of Fish and Wildlife should be consulted to develop an appropriate course of action on habitat occupied by rare butterflies.

Finally, to reduce potentially harmful impacts on rare butterflies from management actions such as burning, mowing, and application of herbicides, it is important to conduct these actions at an appropriate scale that includes consideration of the distribution of adult and larval stages of the rare butterflies and their plant resources. Specific considerations for implementing management actions in a ‘butterfly-sensitive’ manner were developed with input from Ann Potter (pers. comm.) and are included in the strategies outlined below. Complementary research (section 8), including cost-benefit analyses, would be useful to evaluate and refine these considerations through an adaptive management process.

### Considerations for a ‘butterfly-sensitive’ fire strategy:

- Evaluate fuel loads present, and consider measures to control high fuel loads to avoid generating extremely high temperatures.
- Map the distribution of: a) adult target butterflies (may include declining species beyond the four rare species identified in this plan) and concentrations of their nectar plants or high use areas and b) larval resources of target butterflies (i.e. map the actual distribution of adults, and the potential distribution of larval stages of the target butterflies, see figure 7.1 for a hypothetical example). Larval resources to map include:

Taylor's checkerspot – *Castilleja hispida* plants within 100 m of another treated as one resource patch. *Plantago lanceolata* plants within 100 m of another treated as one resource patch (do not consider plants located in a trail or road setting).

Mardon skipper – dense, short stature fescue patches near patches of nectar resources such as *Viola adunca* or *Vicia sativa*.

Puget blue – *Lupinus albicaulis* patches containing  $\geq 0.5$  plants/m<sup>2</sup>, patches within 100 m of another treated as one resource patch.

Zerene fritillary - *Viola adunca* patches containing  $\geq 2$  plants/m<sup>2</sup> (most visible in May and June), patches within 200 m of another treated as one resource patch.

- In any single year, burn  $\leq \frac{1}{4}$  of **each** ‘butterfly patch’ (adult use area and/or larval resource patch), totalling approximately  $\leq \frac{1}{4}$  of the prairie (yielding a burn interval of approximately 4 – 6 years).
- Avoid burning during the flight season. Post larval diapause (dry- season) burning includes August, September and October for mardon skipper, Taylor's checkerspot and Puget blue butterflies. Where zerene fritillaries may be present, avoid burning before September 20th.
- Promote a shifting mosaic burn pattern to include irregularly shaped burn patterns harboring unburned refugia within burn patches.
- Include prairie – woodland/forest ecotones in the prescribed fire target area to enhance habitat under and near trees.
- Implement the burn in a way that facilitates learning opportunities through a strong research component that includes replicates and controls (see section 8, question # 4, topic #4, for further elaboration of research topics applicable to the use of fire). Incorporate annual monitoring of butterflies and their resources to contribute to a better understanding of the impacts of fire (the scale of monitoring will need to match the scale of the fire application to interpret meaningful results concerning fire impacts). Pre-treatment monitoring data should be gathered prior to implementation of prescribed burns to complement the post-treatment monitoring data.

Considerations for a ‘butterfly-sensitive’ mowing strategy:

- Map primary areas occupied or used by adult target butterflies (as above).
- Where rare butterflies are present, schedule mowing outside of the flight period: mow from late July/August – late March for Taylor's checkerspot, mardon skipper and Puget blue.
- Where zerene fritillaries are present, their flight period overlaps with the most effective time to control Scotch broom. Therefore, if mowing during July/August/September in areas occupied by zerene fritillaries, identify and delineate high use areas and nectar patches for zerene fritillaries and mow  $\leq \frac{1}{4}$  of each use area/nectar patch in a single year and during conditions that allow escape flight ( $\geq 60^\circ$  F, wind  $\leq 15$  mph, enough sun to cast distinct shadows, and between 0900 – 1600 h).
- Include prairie – woodland/forest ecotones in the mowing target area to enhance habitat under and near trees. Locate and flag oak and other native hardwood seedlings and saplings to alert mowing personnel to their presence.
- Implement some mowing in a way that facilitates learning opportunities through a strong research component that includes replicates and controls. Incorporate annual monitoring of butterflies and their resources to contribute to a better understanding of the impacts of mowing (the scale of monitoring will need to match the scale of the mowing application to interpret meaningful results concerning mowing impacts). Pre-treatment monitoring data should be gathered prior to mowing to complement the post-treatment monitoring data.

Considerations for a ‘butterfly-sensitive’ herbicide strategy:

- Map primary areas occupied or used by rare butterflies, and their resources, as described for fire above.

## Butterfly Habitat Enhancement on Fort Lewis

- In any single year, herbicide application not to exceed  $\frac{1}{4}$  of each 'butterfly patch' (adult use area and/or larval resource patch), totaling no more than  $\frac{1}{4}$  of the prairie.
- Apply herbicides outside of the flight period (Figure 2.1) in areas occupied by target butterflies.
- The flight period of Taylor's checkerspot overlaps with the most effective time to control invasive grasses with herbicide. If an herbicide needs to be applied during the flight period of a target butterfly, additional caution is warranted such that herbicide should only be applied during conditions that allow escape flight ( $\geq 60^\circ$  F, wind  $\leq 15$  mph, enough sun to cast distinct shadows, and between 0900 – 1600 h).
- Include prairie – woodland/forest ecotones in the herbicide target area to enhance habitat under and near trees.
- The herbicide treatment should be implemented in a way that facilitates learning opportunities through a strong research component that includes replicates and controls (see section 8 , question #4, topic #3, for further elaboration of research topics applicable to the use of herbicides). Incorporate annual monitoring of butterflies and their resources to contribute to a better understanding of the impacts of herbicides (the scale of monitoring will need to match the scale of the herbicide application to interpret meaningful results concerning herbicide impacts). Pre-treatment monitoring data should be gathered prior to the herbicide application to complement the post-treatment monitoring data.

Finally, habitat enhancement actions should only be conducted at a time and place that is not in conflict with military training activities.

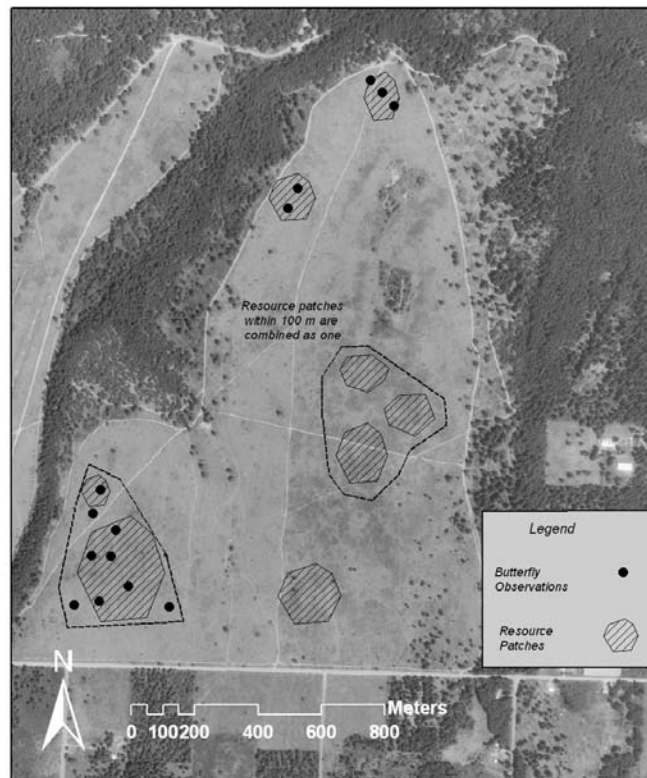


Figure 7.1, An example of a prairie, for demonstration purposes, showing five hypothetical butterfly patches made up of observations of adults, and/or larval and nectar plant resource patches (butterfly resource patches may be naturally occurring or planted). Identified resource patches facilitate the planning process for prescribed burns or other management actions having the potential to harm individual butterflies or their resources.

## 7.2 Prairie Specific Enhancement Strategies

### *High Priority Prairies*

#### 7.2.1 *Artillery Impact Area*

The opportunity to conduct management actions is very limited at this site because of its use as an artillery practice range. Options for habitat enhancement are limited to activities in safe areas, and activities that do not disturb subsurface soil due to the potential danger of unexploded munitions.

Known populations of rare butterflies occur primarily in the southwest portion (Taylor's checkerspot and mardon skipper), and along the southern boundary (mardon skipper) of the AIA. Exploration for additional populations of butterflies or potential habitat has been very limited due to restricted access. This prairie is extremely important because it is the only place on Fort Lewis that supports populations of the federal candidate species: Taylor's checkerspots and mardon skippers. These two populations are highly vulnerable to stochastic events, as they appear to be small in number and restricted in space. Therefore, considerable attention should be directed to this prairie in the future to determine the extent of the distribution of existing populations of these and other rare species, along with a determination of potential suitable habitat. The peripheral regions of the AIA are likely to provide some opportunities for expanding, and/or enhancing butterfly habitat because the impact target range is primarily in the middle of the AIA, leaving the periphery area relatively free of large artillery impacts, and also relatively free of land training impacts. The periphery area is also subject to periodic burning, which may help to promote some habitat characteristics that are favorable for butterflies. These same burns also pose a potential risk factor, especially during the active phases of the two rare butterflies. Considerable emphasis should be placed on expanding and enhancing habitat for Taylor's checkerspot and mardon skippers at the AIA.

#### Populations of Rare Butterflies

- Currently supports the only known population of the state and federal candidate species, Taylor's checkerspot, on Ft. Lewis. This population is also the only extant low elevation population of Taylor's checkerspot remaining in Washington.
- Currently supports the only known population of the state endangered and federal candidate species, mardon skipper, on Ft. Lewis, which constitutes one of three extant populations in the Puget Sound.
- Currently supports Puget blue butterflies.

#### Important Butterfly Habitat Considerations

- Military training activities (other than artillery practice) are limited at this site because of its use as an artillery range.
- Supports a large population of *Castilleja hispida*, an important larval food plant for Taylor's checkerspot.
- Subject to occasional early season (spring and early summer) burns which may kill checkerspot and skipper larvae, pupae, or adults, which are more active and potentially more vulnerable at this time than other seasons (late summer or fall), and impact their larval and adult plant resources.
- Subject to periodic burns, and therefore contains vegetation composition and structure characteristics associated with frequent burning such as:
  - abundant and diverse native forb community
  - relatively low moss cover
  - relatively abundant bare ground, creating open spaces among fescue and forbs to allow butterflies access to oviposition sites and food plants

## Butterfly Habitat Enhancement on Fort Lewis

- absence or low level of woody invasives (esp. Scotch broom)
- low cover of tall non-native perennial pasture grasses that exclude native forbs and grasses.

### Habitat Enhancement Activities (Figure 7.2)

#### Woody Invasives

Enhancement Patch A (outside of but adjacent to the AIA) – control Scotch broom in the enhancement patch and surrounding greater triangle west of the road.

#### Non-native grass control

Control non-native grasses in enhancement patch A (directly adjacent to the AIA) - consider the use of a grass-specific herbicide to avoid harm to native forb community and to prepare sites for native plantings.

#### Plantings

First priority is to augment and expand existing resource patches (section 5.1.2). Secondly, new or enhanced resource patches should be established in close proximity ( $\leq 50$  m) to the existing resource patches. Some habitat enhancement patches have been identified for this prairie (figure 7.2) based on the presence of native vegetation, structural features, and/or location in the landscape.

Habitat Enhancement Patch A - directly adjacent (exterior to) the west side of the AIA. There is some high quality vegetation here, and Puget blue butterflies have been observed at this site. The current priority for this patch is the Puget blue butterfly, although this area should be evaluated in the future regarding the potential for extending habitat for Taylor's checkerspot and mardon skipper, following on results of additional investigations mentioned above.

- Plant 2 Puget blue 'butterfly enrichment' plots (this patch is outside of AIA boundaries)

Habitat Enhancement Patch B - large swale where mardon skippers observed historically. Judging from nearby swale habitat in Patch C, the fescue and forb cover may be limited.

- Make site visit to determine condition of swale and enhancement potential for mardon skippers.
- If determined suitable for enhancement, direct seed *Festuca roemerii* and *Viola adunca* v. *adunca* as appropriate as a minimum, and potentially *Lomatium utriculatum* and *Lomatium triternatum* v. *triternatum* if forb component lacking. Add more seed in succeeding years if germination is not successful.

Habitat Enhancement Patch C - supports generally high quality vegetation and supports the only known population of Taylor's checkerspot. Mardon skippers have been observed in the swale in the south of this patch. The swale does not contain high quality vegetation, and appears to be dominated by non-native low growing grasses (*Aira* sp.) and forbs (*Lotus* sp.). Taylor's checkerspot should be the priority for the northern and central portion of this patch, while the mardon skipper should be the priority for the swale and the generally southern portion.

- For Taylor's checkerspot, expand the distribution of its important larval resource by direct seeding *Castilleja hispida* ssp. *Hispida* (~ 100,000 seed [expect < 1% germination] ) in two patches ~50m from current *C. hispida* populations. Add more seed in succeeding years if germination is not successful. Evaluate timing of seeding in relation to fire to achieve highest potential germination results (section 8, question #4, topic #5).

## Butterfly Habitat Enhancement on Fort Lewis

- For mardon skipper, direct seed *Festuca roemerii*, *Viola adunca* v. *adunca*, *Lomatium utriculatum* and *Lomatium triternatum* v. *triternatum* in the swale in the southern portion of the habitat patch where mardon skippers have been observed. Add more seed in succeeding years if germination is not successful.

### Other Actions

1. Explore options for expanding enhancement efforts beyond the boundaries of the habitat enhancement patches outlined on the map, emphasizing edge areas along the south and east of the Artillery Impact Area where mardon skippers were observed in the spring of 2003 (Morganweck and Dunn 2003).
2. Explore the need and options to minimize impacts of spring and summer burns on rare butterflies and their resources by creating an intermittent fire-break to the north and west of the current high use butterfly site (Enhancement Patch C). Options to consider might include the following:
  - Apply herbicide in a 3-5 m wide band ~100 – 200 m (allowing space for expanding butterfly resources) outward from the exterior of the perimeter of the high use butterfly zone (high quality prairie) to eliminate fire fuels, thereby slowing the advance of early season burns.
  - Maintain tree line break to the east and south of patch C and maintain berm to the east, as these features are likely to be instrumental in protecting patch C from fires.

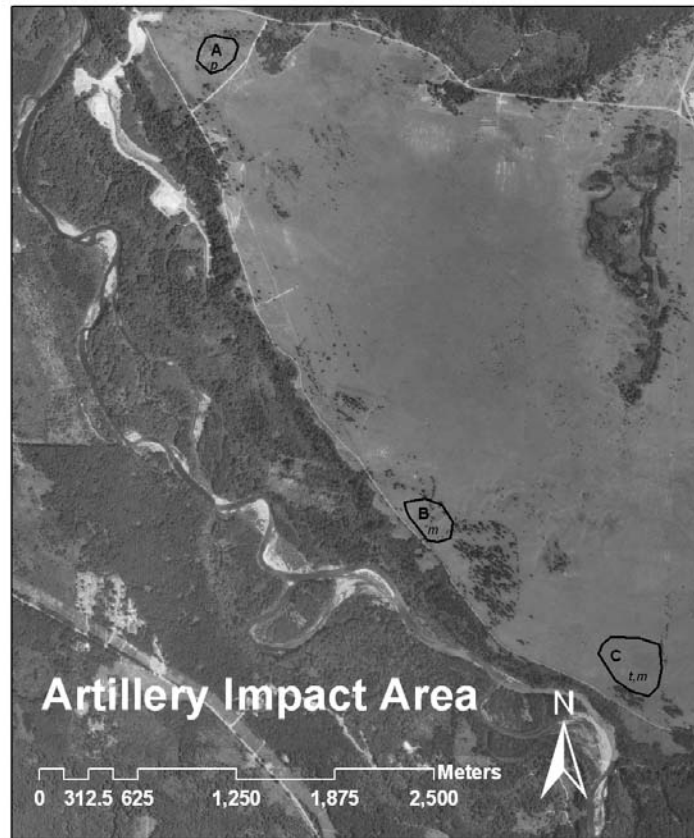


Figure 7.2 Artillery Impact Area on Fort Lewis showing outlines of proposed butterfly habitat enhancement patches A, B, and C. Small case letters in italics indicate butterfly species targeted by enhancements: *m* = mardon skipper, *p* = Puget blue, and *t* = Taylor's checkerspot.



### 7.2.2 Johnson Prairie

Johnson Prairie is a relatively forb rich prairie distinguished by large swales. This prairie has a history of supporting a diverse assemblage of butterflies, including rare species. Enhancements proposed below should proceed slowly over several years to avoid impacting existing populations of zerene fritillaries and Puget blue butterflies and their resources. The vegetation ranges from relatively tall and dense concentrations of forbs and fescue, to relatively short stature open fescue dominated prairie. Short and tall non-native grasses are prevalent, as are patches of Scotch broom. This would be a good site to test the suitability of native thistles (*Cirsium undulatum* v. *undulatum*) as a zerene fritillary nectar source. The combination of vegetation and structural features appears to be most suitable for the species currently and formerly known to occupy this prairie, the Puget blue, zerene fritillary, and Taylor's checkerspot.

#### Populations of Rare Butterflies

- Currently supports a Puget blue population.
- Currently supports a zerene fritillary population.
- Historically supported a Taylor's checkerspot population.

#### Important Butterfly Considerations

- Highest documented abundance and diversity of butterflies compared to other Fort Lewis prairies (Morgenweck and Dunn 2003).
- Supports a small population of *Castilleja hispida*
- Supports an abundant and diverse forb community.
- Includes diverse prairie structural features, including swales, oak woodlands, tree edges and tree islands.
- The presence of pocket gophers (*Thomomys mazama*) has been documented on this prairie.

#### Habitat Enhancement Activities (Figure 7.3)

##### Woody Invasives

Control Scotch broom and invasive woody shrubs prairie-wide as needed, with special attention to edge areas under oak woodlands and conifer edges. Enhancement patches containing high quality native vegetation such as D and G (especially patch D which contains a population of *Castilleja hispida*), or that support rare butterfly species such as patches A, B, and D, should be considered for the use of low-impact or hand operated equipment that minimizes damage to sensitive species. Large Scotch broom plants should be removed from the grasslands after being cut where possible to reduce nitrogen and fuel levels. Remove encroaching Douglas-fir seedlings, especially those that threaten to overtop oaks. Some (perhaps ~ 50%) of the large Douglas-fir trees in enhancement patch A could be removed to control succession in this portion of the prairie.

##### Non-native Grasses

Control non-native grasses in enhancement patches, especially A and D. Consider the use of a grass-specific herbicide (see section 7.1) to avoid harm to native forb community and prepare sites for native plantings.

##### Fire

Implement butterfly-sensitive fire regime upon completion of a plan. In the interim, adapt the existing fire regime to incorporate considerations for a butterfly-sensitive fire regime, as outlined in section 7.1.

## Plantings

First priority is to augment and expand existing resource patches (section 5.1.2). Secondly, new or enhanced resource patches should be established in close proximity ( $\leq 50$  m) to the existing resource patches. Some habitat enhancement patches have been identified for this prairie (figure 7.3) based on the presence of native vegetation, structural features, and/or location in the landscape.

Habitat Enhancement Patch A – a small portion of prairie that is succeeding to conifer forest.

This area offers considerable protection from winds, and is generally open to the south, promoting relatively warm conditions for the early spring butterfly, Taylor's checkerspot. At the same time, there is shade provided by conifer trees and topography with northerly and easterly aspects in some areas, likely promoting some moisture retention. Zerene fritillaries were observed in this patch in 2003, although nectar plants were not in evidence. This area may be capable of supporting nectar resources relatively late in the season due to portions having the potential for higher than average moisture retention. This patch could be improved by removing some conifers, the Scotch broom, controlling tall invasive grasses, and reducing the moss build up. Enhancements in this patch target Taylor's checkerspot and zerene fritillary.

- 10 edge planting blocks, (adjust number after evaluation of site condition following removal of dense broom)
- forb component of 8 prairie planting blocks (fescue prevalent, but few forbs)
- 4 Taylor's checkerspot enrichment plots (north-central and south central portions)
- 4 zerene fritillary enrichment plots (north-east and south-central portions)

Habitat Enhancement Patch B – bordered by conifers on three sides, with a generally southern exposure. The site is currently dominated by Scotch broom and bracken fern, and is frequented by zerene fritillaries, great spangled fritillaries, and Puget blue butterflies. There is a patch of dogbane that was flowering during the zerene fritillary flight season in 2003. Enhancements in this patch target Taylor's checkerspot, zerene fritillary, and the Puget blue butterfly (southern portion of the enhancement patch).

- 4 edge planting blocks, (adjust number after evaluation of site condition following dense broom removal)
- 4 basic prairie planting blocks, (adjust number after evaluation of site condition following dense broom removal)
- 2 Taylor's checkerspot enrichment plots
- 2 zerene fritillary enrichment plots
- 2 Puget blue enrichment plot (southern portion of habitat enhancement patch)
- 100 *Apocynum androsaemifolium*.to expand the current patch along the roadway.

Habitat Enhancement Patch C – supports relatively short stature fescue-dominated vegetation with relatively few forbs. The conifers to the west offer protection from some winds and some afternoon shade. Enhancements in this patch target Taylor's checkerspot, zerene fritillary, and the Puget blue butterfly.

- forb component of 4 basic prairie planting blocks (fescue abundant, but few forbs)
- 2 Taylor's checkerspot enrichment plots
- 2 zerene fritillary enrichment plots.

Habitat Enhancement Patch D – includes 2 swales and an open patch of conifer trees. Zerene fritillaries use this site, and *Erigeron speciosus* was abundant during the 2003 flight season, although violets were not evident. The vegetation on the west side of this patch is relatively short and open, while the vegetation in the southeast tends to be tall and

forb rich. The west side of this patch may be suitable for *Viola adunca* establishment. This patch also supports the main population of *Castilleja hispida* on Johnson Prairie, and this population should be expanded. Enhancements in this patch target Taylor's checkerspot, zerene fritillary, and the Puget blue butterfly.

- 8 edge planting blocks, (adjust number after evaluation of site condition following dense broom removal)
- 3 zerene fritillary enrichment plots, but may not need to plant *Erigeron speciosus* or *Sericocarpus rigidus*, which are already abundant in this habitat patch.
- 3 Taylor's checkerspot enrichment plots
- 2 Puget blue enrichment plot.

Habitat Enhancement Patch E – includes a low lying portion on both sides of the road in the eastern portion of the habitat patch, which appears to retain more moisture than surrounding prairie. The western portion is relatively short stature, open vegetation. Enhancements in this patch target Taylor's checkerspot, zerene fritillary, and the Puget blue butterfly.

- 8 edge planting blocks (for relatively mesic conditions in eastern portion of patch)
- 3 Taylor's checkerspot enrichment plots
- 2 zerene fritillary enrichment plots
- 2 Puget blue enrichment plot

Habitat Enhancement Patch F – includes a swale and some large trees. This habitat enhancement patch supports some relatively short stature vegetation and limited forbs. Enhancements in this patch target Taylor's checkerspot, zerene fritillary, and the Puget blue butterfly.

- 3 Taylor's checkerspot enrichment plots
- 3 zerene fritillary enrichment plots
- 3 Puget blue enrichment plots

Habitat Enhancement Patch G - includes a swale in the southern portion and some large trees. This habitat enhancement patch supports some relatively short stature vegetation in the northern portion, and is forb rich (especially lupine) in the southern portion. Enhancements in this patch target Taylor's checkerspot, zerene fritillary, and the Puget blue butterfly.

- 3 Taylor's checkerspot enrichment plots
- 3 zerene fritillary enrichment plots
- 2 Puget blue enrichment plot.

Habitat Enhancement Patch H - includes a swale in the southern portion and some large trees. This habitat enhancement patch contains abundant forbs. Enhancements in this patch target Taylor's checkerspot, zerene fritillary, and the Puget blue butterfly.

- 2 Taylor's checkerspot enrichment plots, perhaps only *Castilleja hispida* necessary, as nectar forbs may be abundant.
- 2 zerene fritillary enrichment plots
- 2 Puget blue enrichment plots (perhaps plant or promote dense concentration of *Lupinus albicaulis* only, as nectar forbs were abundant in 2003).

Habitat Enhancement Patch I – edge habitat with extensions into forest matrix ('Forest nooks'). Formerly dominated by tall and dense concentrations of Scotch broom, recently mowed in the fall, 2003. Enhancements in this patch target Taylor's checkerspot, and zerene fritillary butterflies.

## Butterfly Habitat Enhancement on Fort Lewis

- 8 edge planting blocks, (adjust number following evaluation where dense broom removed)
- 2 Taylor's checkerspot enrichment plots
- 2 zerene fritillary enrichment plots

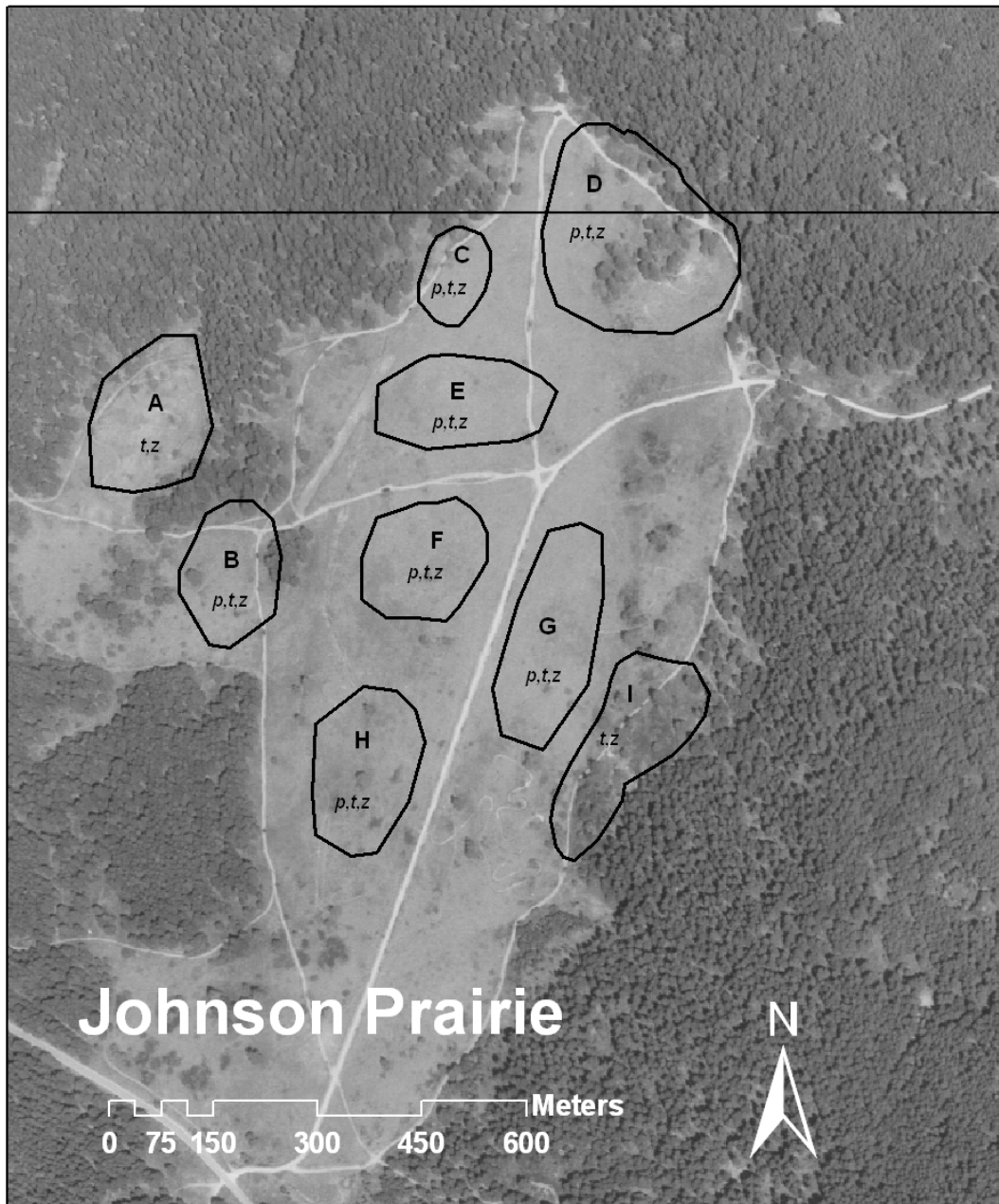


Figure 7.3 Johnson Prairie on Fort Lewis showing outlines of proposed butterfly habitat enhancement patches A through I. Small case letters in italics indicate species targeted by enhancements: p = Puget blue, t = Taylor's checkerspot, and z = zerene fritillary.

### 7.2.3 13<sup>th</sup> Division Prairie RNA

The 13<sup>th</sup> Division Prairie RNA and some associated prairie supports a combination of relatively short stature open native vegetation, and relatively mesic sites dominated by dense stands of tall invasive grasses that grade into riparian zones along the two creeks present. The combination of vegetation and structural features appears to provide opportunities for enhancing habitat for all four rare butterfly species.

#### Populations of Rare Butterflies

- Currently supports a small Puget blue population.
- Recently supported a large Taylor's checkerspot population.
- Historically supported zerene fritillaries.

#### Important Butterfly Considerations

- Includes Siebert staked and fenced areas that afford protection from many high impact training activities.
- Supports natural and planted populations of *Castilleja hispida*.
- Supports high quality prairie areas with moderate forb densities.
- Includes diverse structural features including riparian corridors, deciduous and coniferous tree edges and tree islands.

#### Habitat Enhancement Activities (Figure 7.4)

##### Woody Invasives

Control Scotch broom and woody shrubs prairie-wide as needed, with particular attention to removal of woody shrubs at tree edges along South and Muck Creeks and under oaks in the fenced areas of the triangle. Large Scotch broom plants should be removed from the grasslands after being cut, where possible, to reduce nitrogen and fuel levels. Scotch broom mowing occurred in August, 2003. Remove encroaching Douglas-fir seedlings, especially those that threaten to overtop oaks.

##### Non-native Grasses

Control non-native grasses in enhancement patches - consider the use of a grass-specific herbicide (see section 7.1) to avoid harm to native forb community and to prepare sites for native plantings.

*Special attention should be given to prairie - tree ecotones, especially under oaks in the triangle area (enhancement patches D and E). The tall grasses in the relatively mesic sites adjacent to the riparian zones along the two creeks in enhancement patches B, D, E, and F will require, and warrant, aggressive control efforts.*

##### Fire

Implement butterfly-sensitive fire regime upon completion of a plan. In the interim, adapt the existing fire regime to incorporate considerations for a butterfly-sensitive fire regime, as outlined in section 7.1.

##### Plantings

First priority is to augment and expand existing resource patches (section 5.1.2). Secondly, new or enhanced resource patches should be established in close proximity ( $\leq 50$  m) to the existing resource patches. Some habitat enhancement patches have been identified for this prairie (figure 7.4) based on the presence of native vegetation, structural features, and/or location in the landscape.

Habitat Enhancement Patch A – just west of the airstip, this patch supports one of the largest patches of *Castilleja hispida* on Fort Lewis. This patch is characterized by relatively short stature, open vegetation incorporating a large population of forbs. The native fescue is not abundant here. This patch also supports a population of the streaked horned lark (*Eremophila alpestris strigata*), which also is of conservation concern. Management actions for butterflies should be conducted in a manner consistent with management recommendations for this streaked horned lark. Recommendations for this species include avoiding disturbance (mowing, vehicle traffic, gatherings of people) during the breeding season from early March until early August (Pearson 2003). Pearson (2003) also recommends maintaining relatively short grasses and forbs (0 – 10”) and a relatively high percent (7 – 15%) of bare ground. Enhancements in this patch target Taylor’s checkerspot butterflies.

- 5,000 fescue plugs (being careful to maintain bare ground specified above) as a prairie base
- 2 Taylor’s checkerspot enrichment plots within 50 m of existing *Castilleja hispida* (*Lomatium* spp. abundant at this site, not necessary to plant if still abundant)

Habitat Enhancement Patch B – includes relatively short stature open vegetation and relatively mesic sites, the latter dominated by tall non-native grasses which require aggressive measures for their control before plantings occur. Enhancements in this patch may be distributed among the different site conditions to target Taylor’s checkerspot, mardon skipper, zerene fritillary, and Puget blue butterflies.

- 15 edge planting blocks in relatively mesic zone grading into north riparian edge
- 4 Taylor’s checkerspot enrichment plots
- 4 mardon skipper enrichment plots
- 4 zerene fritillary enrichment plots
- 4 Puget blue enrichment plots
- 10 *Quercus garryana* (to increase hardwood tree structural diversity)

Habitat Enhancement Patch C – includes some topographical diversity and conifer tree islands and forest edge. Currently supports scattered *Erigeron speciosus*. Vegetation is variable due to variety of site conditions, although native forbs are generally not very abundant. Enhancements in this patch may be distributed among the different site conditions to target Taylor’s checkerspot, zerene fritillary, and Puget blue butterflies.

- 2 Taylor’s checkerspot enrichment plots
- 2 zerene fritillary enrichment plots
- 2 Puget blue enrichment plots

Habitat Enhancement Patch D – constitutes the western portion of the protected triangle area between the confluence of Muck and South Creeks. This patch contains relatively short stature open vegetation in the central northern portion. There is a row of oaks along the northern boundary, and the understory contains an abundance of non-native grasses. The southern portion of this patch grades into a riparian zone, and is dominated by tall non-native grasses. The relatively mesic conditions in the southern portion could provide longer lasting resources for butterflies if they could be converted to native vegetation (in the relatively mesic areas that would support prairie forbs, not the wet riparian zone). This southern area requires aggressive non-native grass control. Enhancements in this patch may be distributed among the different site conditions to target Taylor’s checkerspot, mardon skipper, and zerene fritillary butterflies.

- 10 edge planting blocks under the oaks

## Butterfly Habitat Enhancement on Fort Lewis

- 10 edge planting blocks in relatively mesic zone grading into southern riparian zone
- 3 Taylor's checkerspot enrichment plots
- 3 mardon skipper enrichment plots
- 3 zerene fritillary enrichment plots

Habitat Enhancement Patch E - constitutes the eastern portion of the protected triangle area between the confluence of Muck and South Creeks. This patch contains relatively short stature open vegetation in the central northern portion. There is a row of oaks along the northern boundary, and the understory contains an abundance of non-native grasses. The southern portion of this patch grades into a riparian zone, and is dominated by tall non-native grasses. The relatively mesic conditions in the southern portion could provide longer lasting resources for butterflies if native vegetation (in the relatively mesic areas that would support prairie forbs, not the wet riparian zone) were restored to this area. This southern area requires aggressive non-native grass control. Enhancements in this patch may be distributed among the different site conditions to target Taylor's checkerspot, mardon skipper, zerene fritillary, and Puget blue butterflies.

- 15 edge planting blocks under the oaks
- 15 edge planting blocks in relatively mesic zone grading into southern riparian zone
- 4 Taylor's checkerspot enrichment plots
- 4 mardon skipper enrichment plots
- 4 zerene fritillary enrichment plots
- 4 Puget blue enrichment plots
- 10 *Quercus garryana* (to increase hardwood structural diversity)

Habitat Enhancement Patch F - contains relatively short stature, open vegetation in the central southern portion, grading into tall non-native grasses as conditions become more mesic near the riparian zone at the northern boundary. There is a row of hardwoods in the riparian zone. The relatively mesic conditions in the northern portion could provide longer lasting resources for butterflies if native vegetation (in the relatively mesic areas that would support prairie forbs, not the wet riparian zone) were restored. This northern area requires aggressive non-native grass control. Enhancements in this patch may be distributed among the different site conditions to target Taylor's checkerspot, mardon skipper, zerene fritillary, and Puget blue butterflies.

- 10 edge planting blocks in the relatively mesic zone
- 3 Taylor's checkerspot enrichment plots
- 3 mardon skipper enrichment plots
- 3 zerene fritillary enrichment plots
- 3 Puget blue enrichment plots

Habitat Enhancement Patch G – has been logged and burned in recent history, providing relatively favorable conditions for planting. This patch is generally level with large conifers. Vegetation is relatively sparse, including a mix of native and non-native grasses and forbs. Enhancements in this patch target Taylor's checkerspot, mardon skipper, and zerene fritillary butterflies.

- 20,000 fescue plugs
- 20 basic prairie planting blocks
- 10 edge planting blocks
- 3 Taylor's checkerspot enrichment plots
- 3 mardon skipper enrichment plots

## Butterfly Habitat Enhancement on Fort Lewis

- 3 zerene fritillary enrichment plots

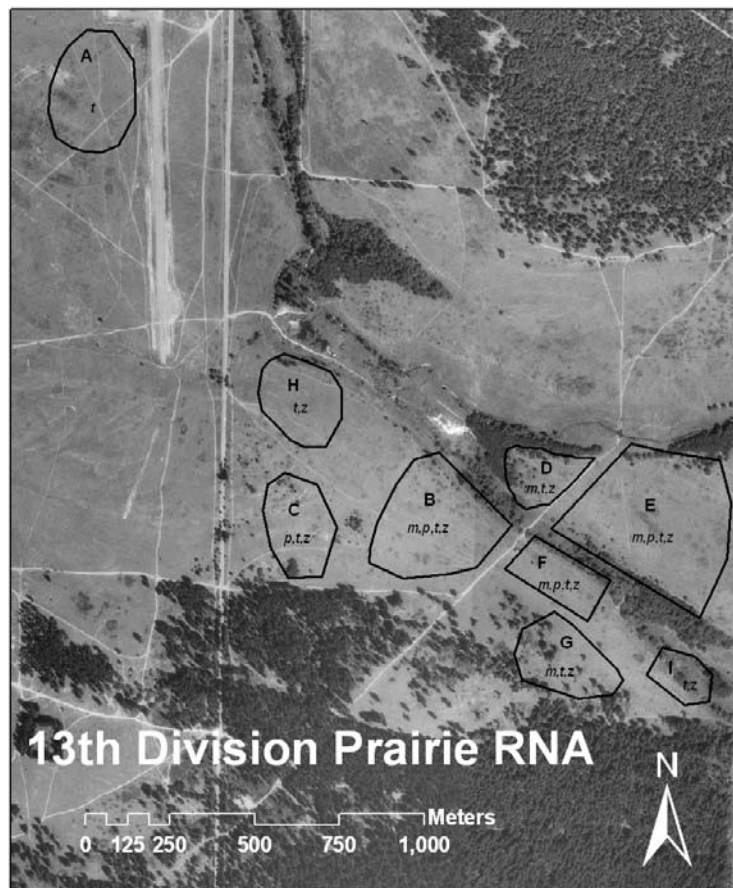
Habitat Enhancement Patch H – is relatively level and featureless, but extends habitat westward toward patch A primarily for Taylor’s checkerspot. Enhancements in this patch target Taylor’s checkerspot, and zerene fritillary butterflies.

- 3 Taylor’s checkerspot enrichment plots
- 2 zerene fritillary enrichment plots

Habitat Enhancement Patch I – is relatively low-lying and mesic as it grades into the riparian zone on the northern portion of the patch. The relatively mesic area is dominated by tall non-native grasses which should be removed before adding plantings.

Enhancements in this patch target Taylor’s checkerspot, and zerene fritillary butterflies.

- 10 edge planting blocks for mesic area
- 2 Taylor’s checkerspot enrichment plots
- 2 zerene fritillary enrichment plots



**Figure 7.4** 13<sup>th</sup> Division Prairie RNA and associated ‘Pacemaker’ area showing outlines of proposed butterfly habitat enhancement patches A, through I. Small case letters in italics indicate species targeted by enhancements: *m* = mardon skipper, *p* = Puget blue, *t* = Taylor’s checkerspot, and *z* = zerene fritillary.



## ***Secondary Priority Prairies***

### ***7.2.4 Weir Prairie Complex***

The Weir prairie complex includes Upper, Lower, and South (south of Rainier Rd.) Weir Prairies. These prairies have retained considerable coverage of fescue dominated vegetation, although the forb populations and butterfly resources appear to be less abundant compared with the high priority prairies. The Weir prairies also contain considerable populations of the introduced grass, *Agrostis capillaris*. The combination of these three prairies offers the advantage of a large geographical area, taken together with nearby Johnson Prairie, to provide the opportunity for a higher level meta-population, compared with other prairies.

#### Populations of Rare Butterflies

- Currently supports a zerene fritillary population
- Currently supports a Puget blue population

#### Important Butterfly Considerations

- Some protection from training activities afforded by Research Natural Area status.
- Supports high quality native prairie area with abundant fescue.
- Forbs present in moderate abundance on Upper Weir, but relatively limited on Lower and South Weir.
- Includes some structural features such as coniferous and oak tree edges.
- South Weir constitutes the northern extension of a potential conservation area adjacent to Fort Lewis.

#### Habitat Enhancement Activities

Control Scotch broom and invasive woody shrubs prairie wide as needed, with special attention to edge areas under oak woodlands and conifer edges. Remove large Scotch broom plants from the prairie where possible following cutting, as they may increase local nitrogen and fuel levels. Remove encroaching Douglas-fir seedlings, especially those that threaten to overtop oaks. Monitor and treat new invasive species. Adapt the existing fire regime to incorporate considerations for a butterfly sensitive fire regime, as outlined in section 7.1.

### ***7.2.5 Training Area 7S***

This prairie has been severely impacted by the development of a gravel pit on the lower tier. There is an upper tier of the prairie that continues to offer high quality vegetation, but this habitat is threatened by future expansion of the gravel pit. This prairie is distinguished by the inclusion of a ponderosa pine savanna and numerous structural features that offer a high level of structural diversity, despite the relatively small size. Butterfly surveys in 2003 revealed for the first time, the absence of the historical population of Puget blue butterflies that occupied this site.

#### Populations of Rare Butterflies

- Formerly supported a Taylor's checkerspot population.
- Status of Puget blue population uncertain – historically present, but not detected in 2003 survey.

#### Important Butterfly Considerations

- Includes a Siebert staked area that affords protection from many high impact training activities.
- Supports a population of *Castilleja hispida*, an important larval food plant for Taylor's checkerspot.
- Supports a high quality prairie area with abundant forbs.

- Includes diverse prairie structural features including terraces, deciduous and coniferous tree edges and tree islands.
- Supports abundant *Vicia sativa* under the oaks, which could serve as a nectaring source for mardon skippers.
- Supports ponderosa Pine savanna, and mardon skippers are known to use this habitat type elsewhere.

### Habitat Enhancement Activities

Control Scotch broom and invasive woody shrubs prairie wide as needed, with special attention to edge areas under oak woodlands and conifer edges. Large Scotch broom plants should be removed from the grasslands where possible after being cut, to reduce nitrogen and fuel levels. Remove encroaching Douglas-fir seedlings, especially those that threaten to overtop oaks. Monitor and treat new invasive species. Adapt existing fire regime to incorporate considerations for a butterfly-sensitive fire regime, as outlined in section 7.1.

## **8. Research and Monitoring to Guide Enhancement Actions**

It is important to implement monitoring and research activities in conjunction with the enhancement activities to address several questions that could lead to improvements in habitat management for rare butterflies. These questions are addressed below.

### Question #1. Are the prairie enhancement strategies suitable for meeting the habitat enhancement objectives outlined in the plan?

Measuring the *ultimate* success of enhancement efforts to promote the long-term persistence of rare butterflies is not possible at Fort Lewis at this time due to the limited occurrence of the rare butterfly species there. It *is* possible, however, to monitor and evaluate the success of enhancement efforts in meeting the *habitat* enhancement objectives recommended for Fort Lewis in this plan (section 6). In addition, ‘off-site’ (outside of the Fort Lewis military complex) experimental approaches to enhancement in habitat occupied by the rare butterflies would allow testing of effects of the enhancements directly on the target butterflies themselves (see Question #2 below for further development of this topic).

The success of habitat enhancement actions on Fort Lewis to achieve the habitat objectives outlined in this plan may be evaluated through vegetation monitoring and sampling in enhanced areas. It is important to track the survivorship of outplantings to determine if the resources are available to butterflies. If mortality of transplants exceeds 25%, dead plants should be replaced. Other parameters to consider measuring would be the percent cover by plant species or plant group, frequency or density of plant species or plant groups, and other specific vegetation or site characteristics identified in the objectives (section 6), including vegetation height, thatch depth, and amount of bare ground. These measurements should commence in 2005 or 2006, to allow plants to establish and grow to a sufficient size to be measured, and monitoring should continue for a minimum of five years to evaluate the long-term success (Dave Hays, pers. comm.).

### Question #2. What is the response of the rare butterflies to habitat enhancements?

Fort Lewis

Opportunities for measuring the response of rare butterflies to habitat enhancements at Fort Lewis:

- Taylor’s checkerspot and mardon skipper responses to very limited enhancements on the Artillery Impact Area (AIA).

- Zerene fritillary responses to enhancements at Johnson Prairie.
- Puget blue responses to enhancements at the AIA, Johnson Prairie, and the 13<sup>th</sup> Division Prairie RNA.

In the areas outlined above, monitoring populations during their flight periods will provide documentation of use in enhanced areas and population trends through time. These monitoring activities could overlap with the *rare species* butterfly monitoring program discussed in question #3 below, so that rare species monitoring data may be used to address both questions #2 and #3, where the technique yields detailed and comprehensive data.

On a finer scale, adult and/or larval use of resources (especially larval host and nectar plants) in the enhanced habitat patches should be documented through direct observation, or indirectly through the use of ‘sign’, such as larval feeding damage on host plant leaves. Investigations of this nature will be most limited for the two highest conservation priority species, the Taylor’s checkerspot and mardon skipper due to restrictions on habitat enhancements and limited access in the AIA. More comprehensive assessments could eventually occur if mardon skippers and Taylor’s checkerspots are reintroduced to the enhanced priority prairies in the future.

#### ‘Off-Site’

In the interim, for the purpose of gaining information on the value of select enhancement actions proposed in this plan, an off-site research program warrants consideration. Cooperating with scientific partners on local non-military lands outside of the Fort Lewis complex, where the target butterfly species occur, would allow investigation into topics that relate directly to the butterflies themselves (as opposed to their habitat characteristics). For example, this approach would be especially useful in investigating questions relating to the use of improved edge habitat, or the use of concentrated violet plantings by mardon skippers at the Scatter Creek Wildlife Area.

#### Question # 3. What are the long-term population trends of rare butterflies in relation to the general butterfly community on Fort Lewis?

It is important to monitor populations of rare butterfly species on Fort Lewis to track long term population trends. At the same time, it is important to track changes in the general butterfly community in the larger context of the Fort Lewis prairie complex through a broad-base, coarse-level butterfly monitoring program. A program that emphasizes monitoring for *rare species* should be integrated with the monitoring program for the *greater community* of butterflies on Fort Lewis. The topic of long-term monitoring is raised in the context of this enhancement plan because it is important to track trends in abundance of the rare butterflies, along with the butterfly community, to assess the long-term impacts of enhancement or other management actions on all butterflies. This monitoring program could complement the finer scale, directed research topics raised in question #2 above. A monitoring program to address both rare species and the greater butterfly community is scheduled to be developed in the future.

#### Question # 4. How can enhancement and management efforts be improved for rare butterflies?

Further research is needed to address the gaps in knowledge about the ecology of the rare butterflies, their habitat requirements, and the proposed enhancement techniques. Several topics of inquiry are identified below as important research subjects to guide current and future enhancement actions, although this list is by no means exhaustive. Components of these research topics should be incorporated into the implementation and evaluation of enhancement actions described in section 7.2 for the high priority prairies where applicable.

## Important Research Topics

1. Greater understanding of the distribution and habitat use by the four target species, especially Taylor's checkerspot and mardon skipper populations at the Artillery Impact Area and other 'off-site' Puget prairies. Some of the questions identified below represent an extension of the research conducted by Hays et al. (2003), or were previously highlighted as topics for further research by the authors.

*Purpose* – To guide enhancement actions for the four rare butterfly species at the AIA, Fort Lewis and Puget region in general.

*Approach* - Research to investigate:

- Distribution, abundance, and use of different components of the habitat (nectar and larval resources, structural features) by these species:
    - on the AIA and surrounding habitat (especially the mardon skipper and Taylor's checkerspot)
    - other Puget prairies
  - The relationship between fire and Taylor's checkerspot and mardon skippers at the Artillery Impact Area, including the past history of the impact of fires on the butterflies and their plant resources at the AIA. As an extension, explore the need for protection of critical habitat from spring and early summer burns.
  - Differential survival/mortality of eggs, larvae and pupae as a function of habitat type (open prairie, conifer tree edge, deciduous tree edge, swale, riparian or mesic site, etc.) under varying weather conditions.
  - Population demographics of the rare butterflies.
  - Determinants of dispersal and colonization abilities among habitat patches.
  - Documentation of the phenologies of butterfly life cycles in relation to the phenologies of their food and nectar plants in different habitats and different years.
  - Vegetation composition and structure of high vs. low use sites (plant stature, densities, spacing, bare ground, edaphic features, etc.).
  - Nectar and larval host preferences in different years and sites, use vs. availability, and response to enhancement measures and plantings.
  - Feeding mechanisms of Puget blue butterflies on unopened *L. albicaulis* flowers.
  - The relationship between Puget blue butterfly larvae and ants.
  - Exploration of additional late season nectar resources, including native and non-native forbs, especially thistles.
  - Exploration of the role of non-native forbs as butterfly resources.
2. Investigation into planting techniques, including site preparation and planting amendments, and control of invasives, that are most effective at promoting the establishment and maintenance of a diverse native plant community.

*Purpose* – To guide planting and invasive species control protocols that are efficacious in establishing and maintaining native plant communities with few invasive plants.

*Approach* – Research to investigate the most effective and efficient site preparation and planting techniques in a variety of field conditions from existing native prairie to highly degraded prairie, including applications of direct seeding and transplanting of nursery plugs to establish and maintain diverse native communities while controlling invasive plants. Research to include replicated designs within the context of Fort Lewis, as well as other Puget prairies.
  3. Greater understanding of the role of grass-specific herbicides as prairie restoration tools to control invasive grasses in butterfly enhancement sites.

*Purpose* – To guide restoration actions in enhancement sites where invasive pasture grasses dominate.

*Approaches* – Investigate the application of a grass-specific herbicide at an enhancement site containing a mixture of native and non-native vegetation (especially tall grasses and colonial bentgrass), combined with a laboratory investigation to evaluate the effects on lepidopteran larvae. Specific topics to investigate:

- Efficacy of a grass-specific herbicide in controlling the target invasive grasses in the short-term (1 year) and long-term (3 years).
- Impacts of the herbicide on non-target vegetation (native grasses and forbs).
- Impacts of the herbicide on butterfly larvae (test on common butterfly or moth species through collaboration with environmental toxicologist at Puyallup laboratory).

Field testing of a grass-specific herbicide would be especially useful at the 13<sup>th</sup> Division Prairie RNA where there are extensive areas of habitat dominated by tall pasture grasses, and other areas with considerable colonial bentgrass cover, as well as a mixture of native grasses and forbs. These mixed conditions would allow investigation of the herbicide's effects on both target and non-target species.

4. Greater understanding of the role of fire as a prairie process, and also as a restoration tool to enhance butterfly habitat in the prairies and prairie edges.

*Purpose* – To guide the use of fire in prairie enhancement actions on Fort Lewis and other Puget prairies.

*Approach* – Collaborate with fire ecology experts to design and execute long-term studies to complement a 'butterfly –sensitive' fire plan (section 5.2.3 and 7.1 for characteristics to consider), for the purpose of addressing the following topics:

- The optimum fire intensities, return intervals, and burning techniques to achieve the following desired butterfly habitat characteristics:
  - low moss cover and thatch depth
  - presence of bare ground component of the prairies
    - allows access to base of plants for oviposition,
    - nesting sites for ground nesting invertebrates such as bees (eg bumblebees pollinate *Castilleja* spp.)
    - germination sites for plants (advantage and disadvantage at the same time)
  - low woody shrub cover
  - low invasive grass cover
  - high forb abundance
  - short-stature prairie vegetation
- The identification of non-native plants that increase and decrease with fire, and site and burn conditions that may influence those responses.
- The effects of different burn/non-burn patch configurations and densities on floral and faunal composition of burned prairies and the creation of burn refugia (e.g. multiple small burns vs. patchiness within a single large burn... the SLOSS debate as applied to burn refugia).
- Techniques to incorporate diverse habitat features such as prairie edges and mesic areas in burn regimes.
- The use of burned areas compared with unburned areas, by butterflies.
- Mortality rates for butterflies as a direct or indirect result of fire.

5. Greater understanding of the natural ecology and germination and growth requirements of larval resources for the rare butterflies: *Festuca roemerii*, *Castilleja hispida* ssp. *Hispida*, *Plectritis congesta*, *Viola adunca* v. *adunca*, and *Lupinus albicauli* v. *albicaulis*.

*Purpose* – To guide enhancement actions that include management for these species as larval host plants for rare butterflies.

*Approach* - Research to investigate:

- Population demographics

- Response to fire (germination, growth, and survivorship)
  - Pollination
  - Hemiparasitism for *Castilleja hispida* ssp. *Hispida*
  - Senescence patterns in different microhabitats
  - Site requirements – potential for establishment along moisture and light gradients.
  - Site requirements, propagation, and seeding potential for establishing large patches of the annual forb, *Plectritis congesta*, with subsequent determination of factors necessary to maintain a substantial population, with an overall evaluation of its suitability as a Taylor’s checkerspot resource.
6. Greater understanding of the wind, temperature, and moisture variables associated with prairie structural features, including prairie ‘pockets’, prairie-tree edges, ‘swales’ and relatively mesic areas, compared with open prairie sites.  
*Purpose* – To guide enhancement actions that target improvements in prairie *structure*.  
*Approach* – Collaborate with environmental science experts to design research to investigate: wind, temperature, and moisture variables associated with open prairie habitat and diverse structural features during post-diapause larval feeding and adult flight phases (early spring through summer).
7. Greater understanding of the historical condition and processes of the Puget prairies in general, and the prairies targeted for enhancement on Fort Lewis, in particular.  
*Purpose* – To develop a model of historic conditions and processes in the local prairie landscape to guide prairie restoration actions on Fort Lewis and the Puget region  
*Approach* - Consult historical resources, including GLO land survey maps and survey notes to describe historical vegetation conditions and site features, including the extent and configuration of mesic sites, springs, or riparian zones where possible, while describing the extent and distribution of vegetation types, including grassland, oak and/or ponderosa pine savanna, woodlands, and conifer forest. Investigate the historical influence of Native Americans and wildlife on the process component of the Puget prairies. Investigate the effects of soil N enrichment as a present day process vs. historical context, on the invasion of native communities by non-native species.

## 9. Timeline

Short-term and long-term strategies are proposed for implementation of the enhancement activities.

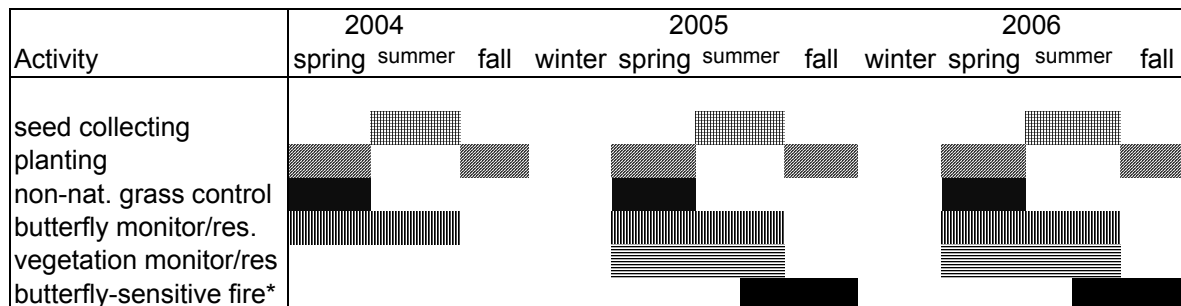
### Short-term strategy (2004 - 2006)

A short-term strategy includes the implementation of prairie specific enhancement and research activities proposed for the three high priority prairies over a three year period, adapting and improving enhancement objectives and activities as new information becomes available. Also for the short-term could be the implementation of ‘butterfly-sensitive’ burning regimes with research components on two prairies by the end of the short term (Figure 9.1).

### Long-term strategy (2007+)

A longer-term strategy could incorporate a continuation and expansion of prairie enhancement and research activities on the high priority prairies and at new sites. Other sites to be considered for further butterfly habitat enhancement could include:

1. new habitat patches on the high priority prairies,
2. prairie habitat adjacent to the Artillery Impact Area, and
3. increasing efforts on the secondary priority Weir prairie complex and Training Area 7S, if deemed appropriate at that time.



\* Incorporate considerations for a butterfly-sensitive fire regime provided in section 7.1 pending the completion of a butterfly-sensitive fire plan.

Figure 9.1 Timeline of short-term activities for this enhancement plan.

### Acknowledgements

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