Report to the U.S. Forest Service, Oregon Zoo, and U.S. Fish and Wildlife Service

Summary of Mardon Skipper Coon Mountain Burn Site Occupancy Study Data from 2009, 2010 and 2011

Photograph courtesy of Brenda Devlin, USFS.

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November 2011

ABSTRACT
Xerces Society staff monitored the Coon Mountain mardon skipper (*Polites mardon*) population in 2009, 2010 and 2011 to determine the butterfly's response to a controlled burn conducted by the U.S. Forest Service in 2008. To study the effects of the burn, the site was divided into four monitoring zones. Each zone was further subdivided into burned and unburned areas, and a 150 x 30 ft. transect was set up in each, resulting in a total of eight transects across the habitat area, four each in burned and unburned areas. Xerces staff counted mardon skippers in each transect and in each zone on two independent monitoring dates in 2009, three dates in 2010 and three dates in 2011. Although mardon skipper numbers have improved in the burned sites compared to 2009, substantially fewer mardon skippers are still found in burned areas compared to unburned areas in all transects and zones.

Scott Hoffman Black, Xerces Society Executive Director met with Forest Service staff (Brenda Devlin and Sheila M. Balent) in June 2011 at the site to discuss additional management measures to improve mardon skipper habitat at the site. Some cutting of small trees within several zones was discussed and recommended. Xerces recommended that no additional controlled burns within mardon habitat should be conducted until populations rebound in the burned area, which may take several more years.

INTRODUCTION
The mardon skipper (*Polites mardon)* is a rare and declining butterfly, endemic to the Pacific Northwest (Washington, Oregon, and California) of the United States of America. It is a Washington State endangered species and a candidate species for federal listing under the U.S. Endangered Species Act. Mardon skippers are grassland and open meadow obligates. Historic mardon ranges are not known, as documentation of this butterfly is scarce and systematic population studies have only been done in recent decades (Black & Vaughan 2005). Mardon skippers were likely more widespread and abundant prior to the past 150 years of human development, which has negatively impacted their habitat via livestock grazing, fire suppression, and invasion of grassland habitat by native and non-native vegetation.

The mardon skipper is known from four geographic areas: (1) southern Puget Sound, (2) the Cascade Mountains in southern Washington, (3) the Cascade Mountains in southern Oregon, and (4) Del Norte County in north-coastal California and Curry County on the southern coast of Oregon.

Two accepted subspecies of mardon skipper have been described. Mattoon *et al*. (1998) proposed that the Oregon Cascades population be given subspecies status *Polites mardon klamathensis,* while the Washington and Northern California populations comprise the subspecies *Polites mardon mardon*. However *P. m. mardon* from Del Norte County populations have not yet been carefully compared to series of typical *P. m. mardon* from Washington and the use of the name *P. m. mardon* for Californian populations should be considered tentative (Warren 2005).

History of Mardon Skipper in California
Mardon skippers were first described by W. H. Edwards (1881) from specimens taken near Tenino, Thurston County, Washington by H. K. Morrison (Dornfeld 1980). No additional

populations were known outside of Washington State until June 1979, when Sterling and Eileen Mattoon discovered a population on High Divide Ridge in Del Norte County, California. Surveys in 2003 at the High Divide Ridge site (now called the Low Divide Road sites) identified four principal grasslands (totaling approximately 4.5 acres) in which mardon skippers were consistently observed (Haggard 2003). Three sites are in close proximity to each other (0.1 km), with the fourth being the most distant from these three (~0.3 km). Dozens of individual mardon have been detected during peak years in the 1-2 acre core area at this coastal California site (Haggard 2003). In 2004, lepidopterists found a new population in northwestern California, approximately 10 km from the closest known population (Gary Falxa, Biologist, USFWS, personal communication 2008). At the Little Bald Hills portion of Redwood National Park, Arnold (2006) observed mardon skippers in nine meadows throughout approximately 2,200 m of trails on the flank and top of the hills on May 26, 2005. Arnold (2006) surveyed dozens of other sites in the region with suitable habitat but did not find any additional populations. Surveys conducted by the Xerces Society in 2007 on 21 sites in the Six Rivers National Forest did not find additional populations. In 2008, Xerces Society staff re-surveyed several potential mardon sites on Rattlesnake Ridge and conducted new surveys of meadows at Coon Mountain (on the Six Rivers NF). Mardon skippers were discovered in the Coon Mountain meadow complex on June 10, 2008. This is believed to be the largest mardon population in California based on a one day count of 204 individuals on June 10, 2008 (Black *et al.* 2008) and follow up counts in 2009, 2010 and 2011, discussed below.

COON MOUNTAIN BURN STUDY

Fire has played an important role in many native ecosystems, and controlled burns are an increasingly common management tool. The Coon Mountain area has not had natural fire in decades and small conifers and shrubs are encroaching in the open meadow areas and negatively impacting meadow dependent species.

Fire as a management tool is based on the supposition that prairie species are adapted to wildfires, and thus can cope with regular burns (Harper *et al*. 2000; Swengel 2001) This is dependent, however, on there being adequate unburned areas that can provide sources of colonizers into the burned habitat. In habitat fragments where populations are more isolated, prescribed burning can have much more deleterious effects on the population due to a lack of colonizing capacity. For example, Harper *et al*. found that overall arthropod species richness decreased in burned prairie sites, as well as the abundance of all but one of the species measured (Harper *et al*. 2000). Their results suggest that burning a small habitat fragment in its entirety could risk extirpating some species because of limited recolonization from adjacent habitat. Rare butterflies can also be negatively impacted by prescribed burning. Swengel found that fire had consistent negative effects on prairie specialist butterfly species, and that these effects persisted for 3 – 5 years post-burning (Swengel 2001).

In September 2008, Scott Hoffman Black met with Brenda Devlin (USFS Biologist) and Gary Falxa (USFWS Biologist) to discuss modifications to the Coon Mountain burn plan that would ensure long term sustainability of the mardon skipper population at this site. Areas that should be burned and left untouched by fire were identified. In late fall 2008, a burn that impacted approximately 30-40% of the core area occupied by the mardon was conducted. A study to determine the response of the butterfly to the burn was also designed.

Scott Hoffman Black and Logan Lauvray (Xerces) met with Brenda Devlin, Gary Falxa, Sheila M. Balent and staff from the USFS fire crew on May 26, 2009. Burn staff helped delineate burned and unburned areas, which were also observable by the presence of burned shrubs. Xerces staff placed flagging at the sites to clearly demarcate burn boundaries for the surveys and recorded the coordinates (Garmin Rino GPS, NAD83).

To study the effects of the burn, the site was divided into four monitoring zones. Each zone was further subdivided into burned and unburned areas, and a 150 x 30 ft. transect was set up in each, resulting in a total of eight transects across the habitat area; four each in burned and unburned areas. Xerces staff counted mardon skippers in each transect and in each zone two times during the mardon flight season in 2009 (May 27th and June 7th), three times during the flight season in 2010 (June 21st, June 27th, and July 2nd), and three times during the flight season in 2011 (June 19th, June 23rd, and July 2nd).

SURVEY PROTOCOL

The burn site was divided into four zones. Each zone was then subdivided into burned and unburned areas.

Transect Counts

Two transects were set up in each zone, with one in burned and one in unburned habitat, for a total of eight transects across the habitat area. Flagging was placed down the center of a 150 ft. transect, and 15 feet were measured out to each side from the center to give a transect width of 30 feet. All transects were placed in the best available habitat within the zone that accommodated the desired transect size. Xerces staff (Scott Hoffman Black) walked each transect slowly and counted all butterflies within the transect areas. Each transect required ~15 minutes to survey. Butterflies were not counted if they flew in from behind the observer to avoid the possibility of counting the same individual twice.

Zone Counts

In addition to transect monitoring, counts were completed over each entire zone using a modified Pollard Walk (Pollard 1977). Xerces staff walked through each zone slowly, taking about 5 minutes to walk 100 meters, looking back and forth on either side for approximately 20 to 30 feet out. Surveyors walked a path such that all area within the zone with apparently suitable habitat was covered by this visual field.

If the surveyor left the path to look more closely at a particular butterfly, he returned to the original point where he left the path to resume monitoring. When a suspected mardon skipper butterfly was encountered, it was identified on the wing, or netted and examined to ensure identity when needed. No voucher specimens were taken at these sites. All data was recorded and particular activities such as nectaring or ovipositing were noted.

Environmental Conditions

All sites were surveyed during the following environmental conditions, which are considered optimum for mardon skipper flight activity:

Minimum temperature: Above 60°F.

Cloud cover: Partly sunny to clear. On cooler days, sunshine is very important in warming the butterflies' flight muscles and allowing them to take flight. On warmer days (above 60°F) less direct sunlight is required for skipper activity, but cloud cover should be such that a significant amount of sun comes through to help elevate the body temperature of basking butterflies.

Wind: Less than 10 MPH. On windy days, butterflies drop out of the air if they cannot maintain their direction and/or speed of flight.

Time of year: Surveys where conducted during mardon skipper's late spring flight period. Flight season varied across the three years. In 2009 it occurred in late May and early June, and in 2010 and 2011 it occurred in late June and early July.

RESULTS

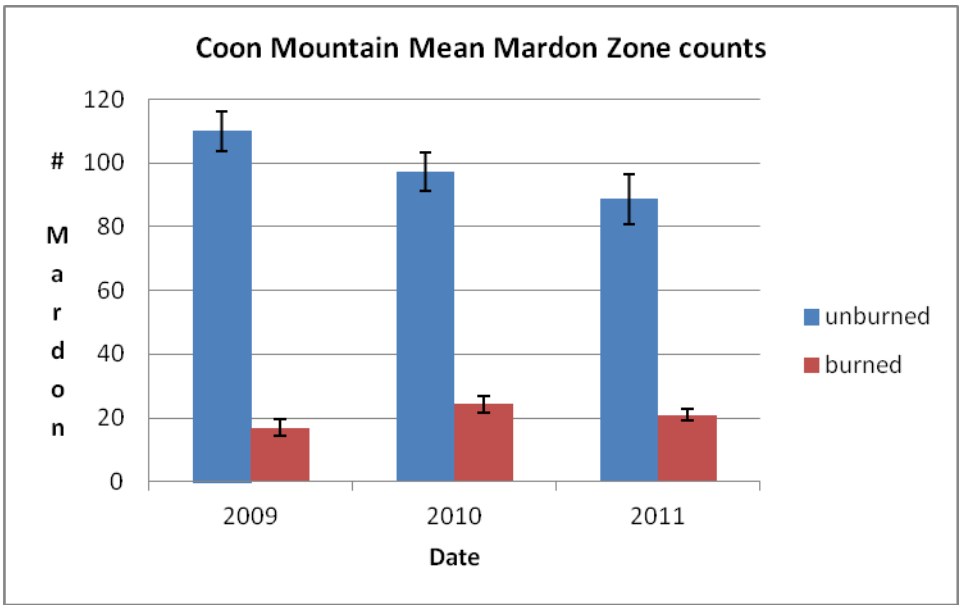
In 2009, 2010, and 2011, mardon skipper surveys revealed a clear pattern of response to burning. Without exception, mardon numbers were higher on all dates in unburned transects and zones compared to burned transects and zones within the same survey meadow. Counts for all four zones across all survey dates in 2009, 2010, and 2011 showed mardon numbers that ranged from 2.0 to 27 times higher in unburned zones compared to burned zones on the same dates (mean = 7.9 times greater for all zones, all dates; standard deviation = 6.9). Over three years of data collection, mardon numbers for all zones combined were 6.5 times greater in unburned zones (SD = 9.5) in 2009, in 2010 numbers were 4 times greater in unburned zones (SD = 6.7), and in 2011 mardon numbers were 4.2 times greater in unburned zones (SD = 3.4) (Figure 1A). Mardon skipper unburned transect counts averaged across all zones were 7.6 times higher (SD = 4.6) than the burned transects in 2009, 9.6 times higher (SD = 3.6) than burned transects in 2010, and 4.2 times higher (SD = 2) than burned transects in 2011 (Figure 1B).

For individual zones, differences between mardon numbers in unburned vs. burned zones were as follows: zone 1 = 5.5 times higher in unburned (SD = 1.5); zone 2 = 3.4 times higher in unburned (SD = 1.6); zone 3 = 9.1 times higher in unburned (SD = 8.6); and zone 4 = 13.7 times higher in unburned (SD = 7.7). Burned and unburned zones were of similar areas, although not identical in size. However, this same pattern was seen in the results of fixed-area transect surveys, with the exception of a single transect count (zone 2 transects on 5/27/2009) that showed mardon numbers in the burned zone transect 1.7 times greater than in the unburned zone transect. In the other transects surveyed on that same date, mardon numbers ranged from 1.3 to 19 times higher in unburned vs. burned transects (mean = 6.8 times higher in unburned transects; SD = 3.9). While the magnitude of the difference varied from date to date, a clear pattern of consistently reduced numbers of mardon skipper in burned habitat areas is evident. Additionally, to account for any between-zone variation related to zone size, numbers of butterflies per square meter were compared between unburned and burned zones. These results revealed that mardon numbers per unit area were on average 5.3 times higher in unburned zones (SD = 4) across all dates and zones, with the greatest difference in total mardon numbers 22 times higher in the unburned zone (6/23/2011). Overall, the difference between mean mardon numbers in unburned habitat areas were significantly different ($p < 0.05$) from mean mardon numbers in burned zones

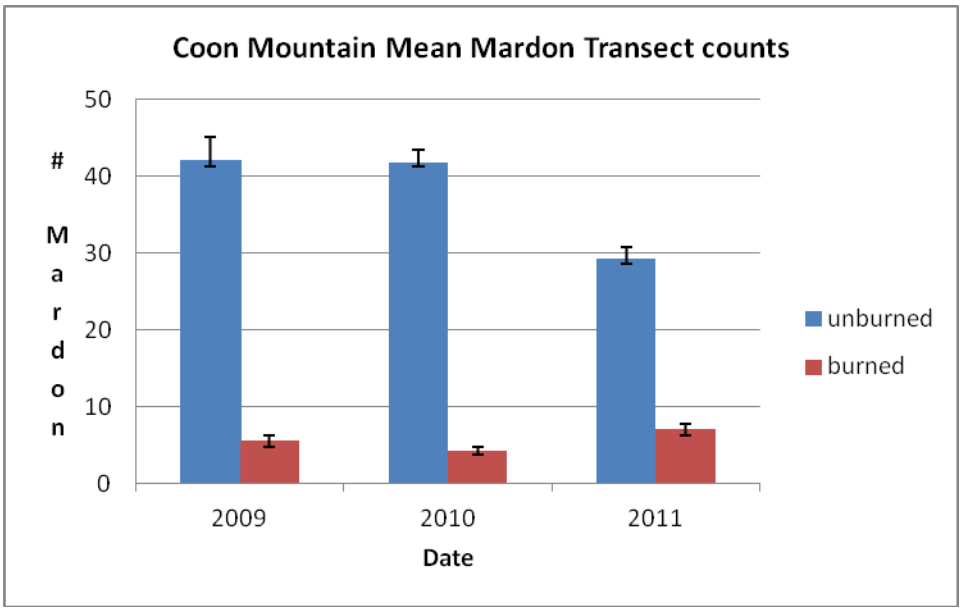
throughout the three year survey period and across all zones, indicating that at a 95% confidence level, the difference between unburned and burned survey sites cannot be attributed to chance alone. Likewise, differences in mardon numbers for unburned fixed-transect counts across all years and zones were significantly different from numbers in burned habitat areas ($p < 0.05$). Individual zone and transect counts are described below.

Figure 1. Mean mardon skipper counts, 2009, 2010, and 2011.

1A. Zone counts



1B. Transect counts



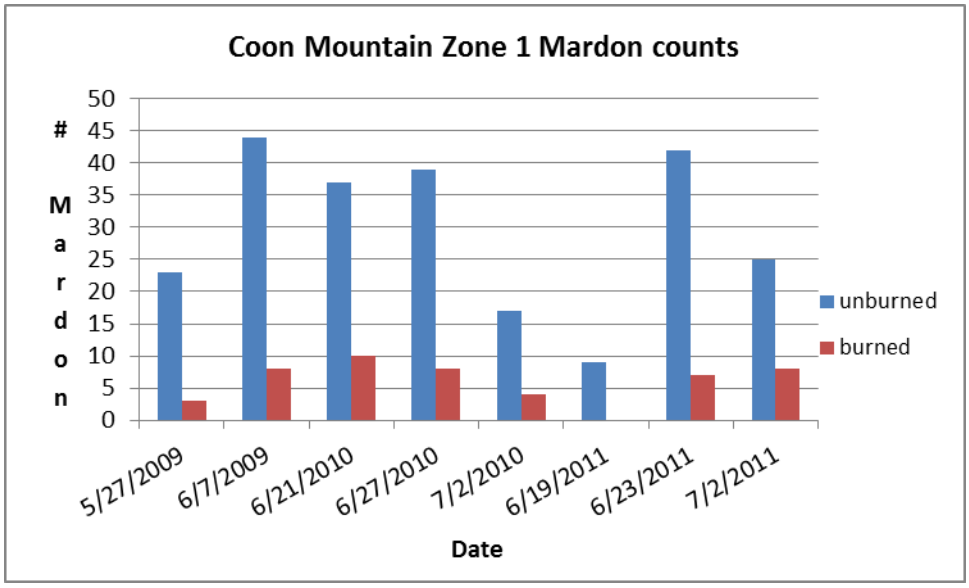
Zone 1

Zone 1 is located just to the east of road 17N07 (Appendix 1, Maps 1, 2, and 3). In 2008, this site had a relatively high density of mardon skippers based on a one-day count. In all survey years (2009, 2010, and 2011), the number of mardon skippers remained much lower in the burned area of the zone (Figure 2A and B). Mardon numbers reached a maximum of 10 in the burned zone (6/21/2010), whereas they reached up to 44 in the unburned portion of the zone (6/7/2009). The average number of mardon in unburned regions of the zone showed a decrease across three years of surveys for both total zone counts (34 in 2009, 31 in 2010, and 25 in 2011) and transect counts (13 in 2009, 12 in 2010, and 8 in 2011). The same was true of average mardon numbers in burned habitat, with the burned area of zone 1 averaging 6 mardon in 2009, 7 in 2010, and 6 in 2011, and burn transect counts averaging 2 mardon in 2009, 1 in 2010, and 2 in 2011.

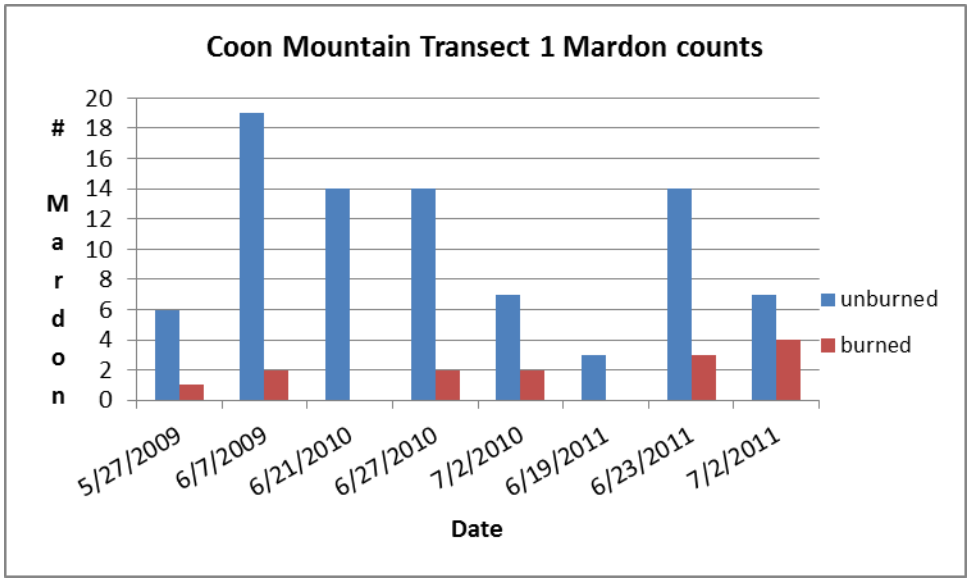
Average mardon skipper numbers were 6.7 times higher in the unburned zone in 2009, 4.4 times higher in 2010, and 4.5 times higher in 2011. This result is not due to simple differences in the total area of the burned and unburned zones. Transect counts, which are conducted on a fixed area (150 x 30 ft.), showed an even more dramatic difference, with mean mardon numbers 6.5 times higher in the unburned transect in 2009, 12 times higher in 2010, but only 4 times higher in 2011. Furthermore, accounting for variation in zone size, analysis of mardon skipper numbers per unit area for zone 1 revealed that mardon numbers were 8.5 times higher in the unburned zone in 2009, 5.5 times higher in the unburned zone in 2010, and 5.6 times higher in the unburned zone in 2011. Overall, mardon were present at extremely low numbers in the burned habitat in this zone in 2009, and had not recovered to the levels seen in unburned habitat in the following two years of data collection.

Figure 2. Zone 1 burn site mardon skipper counts, 2009, 2010, and 2011

2A. Whole zone counts



2B. Transect counts



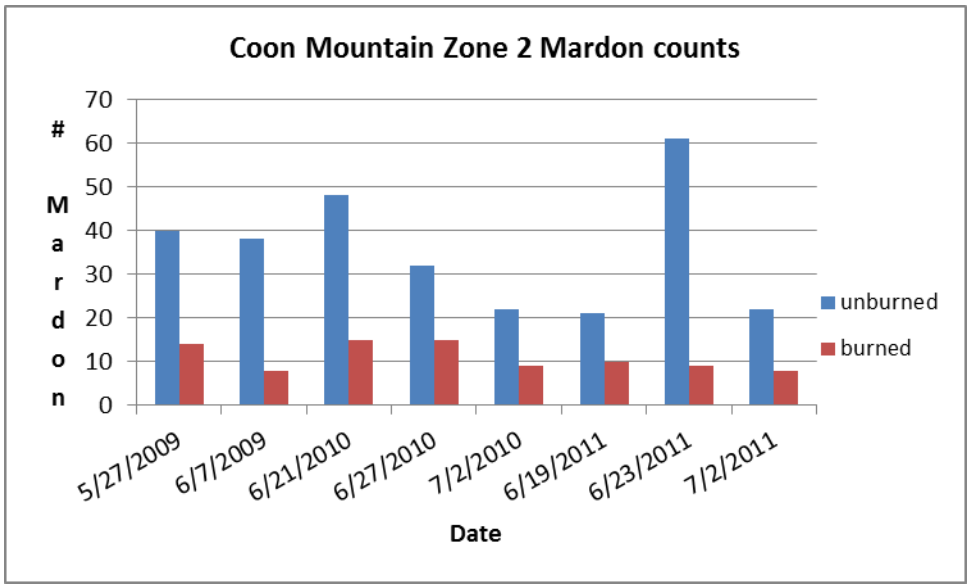
Zone 2

Zone 2 is directly east of zone 1 (Appendix 1, Maps 1, 2, and 3). Some areas within the meadow are too wet for the mardon skipper, but the majority has high quality mardon habitat and had a relatively high density of mardon skipper in the 2008 one-day count. The burned habitat in zone 2 had the highest average number of mardon among all four burned habitat zones surveyed (maximum of 15 on 6/21/2010 and 6/27/2010). However, the number of mardon in 2009, 2010, and 2011 was much lower in the burned habitat of zone 2 compared to the unburned habitat, with a maximum of 48 mardon counted in the unburned zone on 6/23/2011 (Figure 3A and B). The average number of mardon in unburned regions of the zone was similar across the three years of surveys for both total zone counts (39 in 2009, 34 in 2010, and 35 in 2011) and transect counts (9 in 2009, 12 in 2010, and 8 in 2011). Average mardon numbers in the burned area of zone 2 were almost unchanged across the three survey years (11 mardon in 2009, 13 in 2010, and 9 in 2011), while the average transect counts in the burned area were 4 times lower in 2010 and 2011 (mean = 1 mardon for both years) compared to 2009 (mean = 4 mardon).

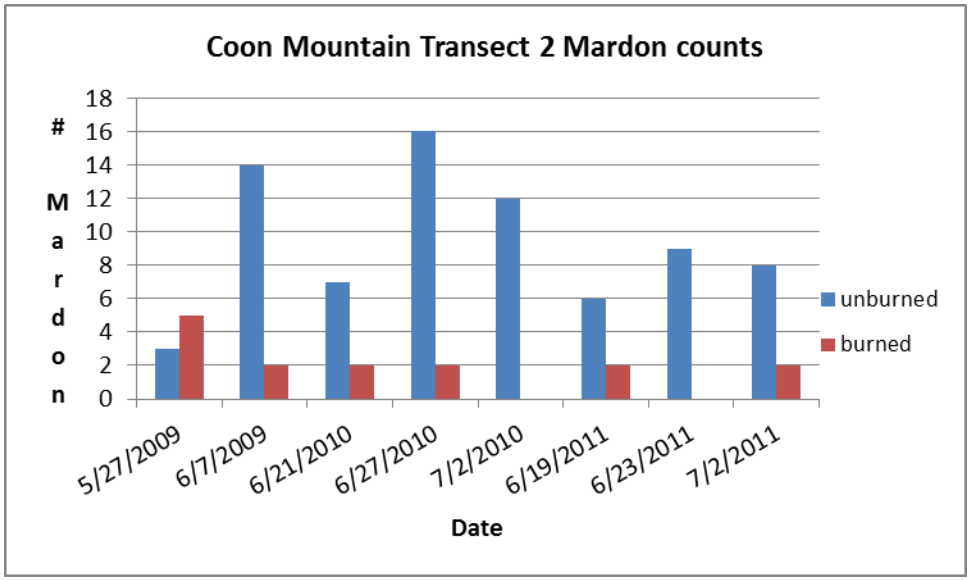
Average mardon skipper numbers were 3.5 times higher in the unburned zone in 2009, 2.6 times higher in 2010, and 3.9 times higher in 2011. The magnitude of the difference in average mardon numbers in the fixed-area transect counts was more variable, but mardon numbers were still greater on average in unburned transects in 2009 and 2011 (2.3 and 5.8 times higher in the unburned transect, respectively) and especially in 2010 (12 times higher). When mardon numbers are averaged per meter squared of unburned and burned habitat area for zone 2, differences between unburned and burned numbers for 2009 are 12.2 times higher in the unburned zone, 8.3 times higher in 2010, and 10.4 times higher in 2011. Overall, even though mardon numbers in burned habitat were highest on average in zone 2 compared to burned areas of the other three zones surveyed, the population remained smaller than in the unburned areas of the zone and had not recovered to the levels seen in unburned habitat after three years of post-burn survey efforts.

Figure 3. Zone 2 burn site mardon skipper counts, 2009, 2010, and 2011

3A. Whole zone counts



3B. Transect counts



Zone 3

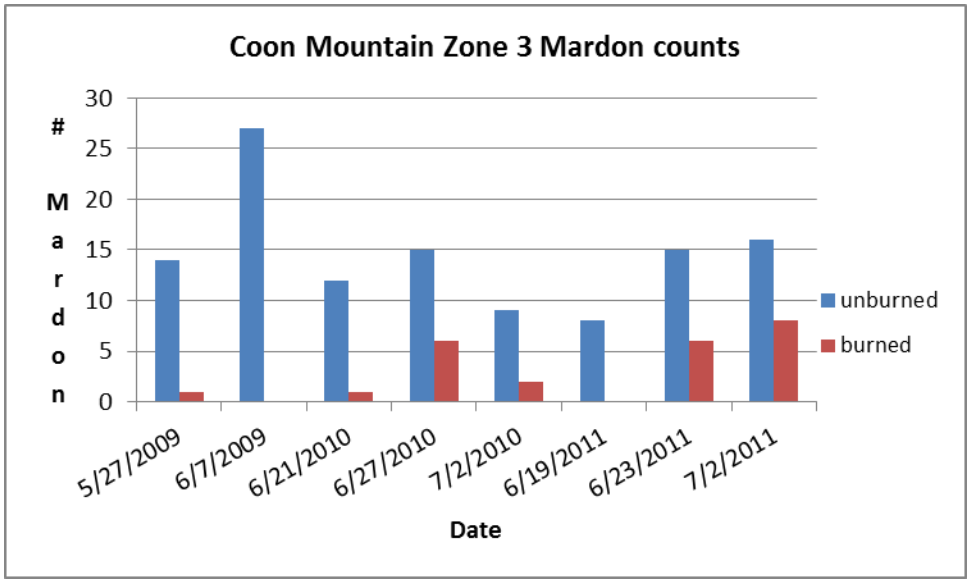
Zone 3 is located just to the south of zone 1 (Appendix 1, Maps 1, 2, and 3). It is a linear habitat area that is much smaller than zones 1 or 2, although the burned and unburned zones are of a comparable area to each other. The habitat in the non-burn area had more fescue and nectar sources than the habitat in the burned portion of the site, although mardon were found in moderate numbers throughout this area in the 2008 surveys. For all survey years, 2009, 2010, and 2011, the number of mardon skippers remained much lower in the burned zone. Mardon

numbers never exceeded a maximum of 8 in the burned zone on any date surveyed; this maximum zone count occurred on a single date (7/2/2011), and on all other survey dates the zone counts ranged from only 6 to no mardon at all (Figure 4A and B). In contrast, even though the unburned zone 3 habitat consists of a smaller area than zone 1 or 2, the maximum number of mardon counted during a single zone survey was of the same order of magnitude as the maximum numbers in the larger zones (27 in the unburned portion of zone 3 on 6/7/2009). The average number of mardon in unburned regions of the zone varied more across years for the total zone counts (21 in 2009, 12 in 2010, and 13 in 2011) compared to the fixed-area transect counts (mean = 8 in 2009 and 2010, and 7 in 2011). Mardon numbers in burned habitat increased slightly on average across the survey period, with the burned area of zone 3 averaging 0.5 mardon in 2009, 3 in 2010, and 5 in 2011. Likewise, transect counts in the burned area increased two-fold between survey years 2009 to 2010 (from 0.5 to 1, respectively) and from 2010 to 2011 (from 1 to 2, respectively).

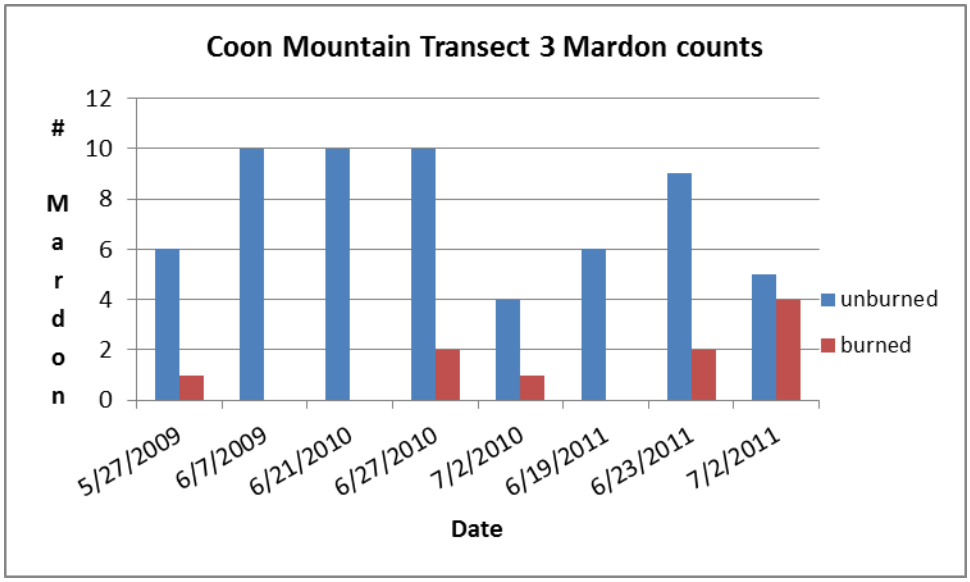
Average mardon skipper numbers were 42 times higher in the unburned zone in 2009, 4 times higher in 2010, and 2.8 times higher in 2011. Fixed-area transect counts showed a similar trend, with mean mardon numbers 16 times higher in the unburned transect in 2009, 8 times higher in 2010, and 3.3 times higher in 2011. Mardon skipper numbers averaged per square meter of unburned and burned habitat area for zone 3 in 2009 were 14.2 times higher in the unburned zone, 4.4 times higher in 2010, and 3.1 times higher in 2011. Overall, mardon were present in lower numbers in the burned habitat in this zone in all three survey years, but there are slight indications that the population may be beginning to recover.

Figure 4. Zone 3 burn site mardon skipper counts, 2009, 2010, and 2011.

4A. Whole zone counts



4B. Transect counts



Zone 4

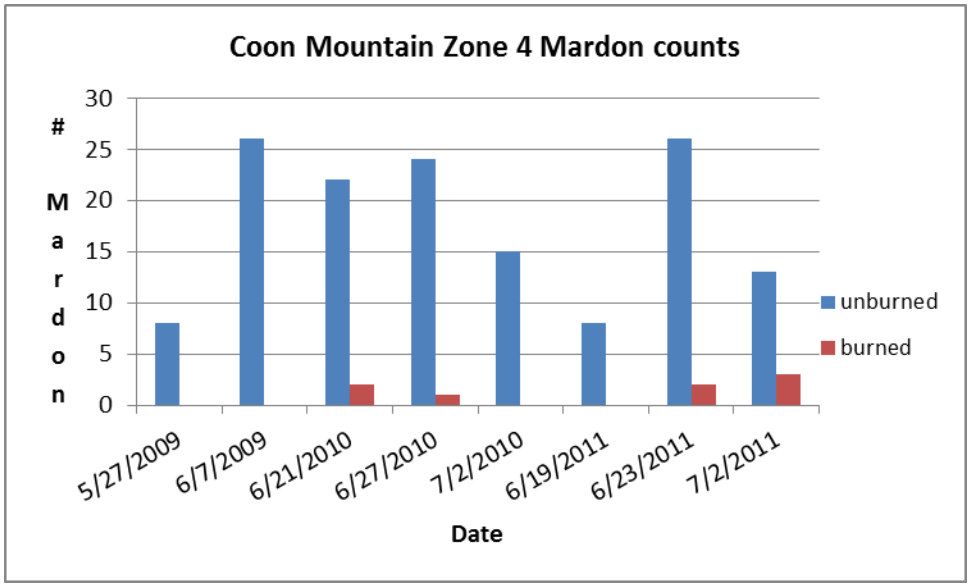
Zone 4 includes the southern-most meadow in this complex and is located southeast of zone 3 (Appendix 1, Maps 1, 2, and 3). The habitat in the non-burn area has more fescue and nectar sources than the habitat in the burned portion of the site, although mardon were found in moderate numbers throughout this area in our 2008 survey. This meadow had the smallest numbers of mardon in the burned habitat among all four zones surveyed for both whole-zone and transect counts. Mardon numbers never exceeded a maximum of 3 during any survey in the zone 4 burned habitat, and half of the survey dates yielded no mardon sightings. While it is true that zone 4 is another small area of habitat, similar to zone 3, numbers of mardon in the unburned area were much higher, with a maximum of 26 counted in the unburned zone (6/7/2010 and 6/23/2011) (Figure 5A and B). The mean number of mardon in unburned regions of the zone was similar across the three years of surveys for total zone counts (17 in 2009, 20 in 2010, and 16 in 2011), but decreased slightly from 2009 to 2011 for transect counts (13 in 2009, 10 in 2010, and 7 in 2011). In contrast, the burned habitat surveyed in zone 4 completely lacked mardon in 2009. In 2010 and 2011, mardon were present but at very low numbers (1-3 total for zone or transect counts), and on the final survey date in 2010 and first survey date in 2011, mardon were again absent from this burned zone.

Although both the burned and unburned habitat in zone 4 comprise only a small area, the mardon population in the unburned area appears stable and similar in average size to that seen in other, larger survey zones. However, both zone and transect counts indicated that no mardon were present in the burned habitat in zone 4 in 2009. Although mardon appear to have returned to this habitat in 2010 and 2011, the population remained extremely small, with mean mardon numbers 20 and 9.4 times higher in the unburned zone, respectively and 14 and 5.3 times higher in the unburned fixed-area transect in 2010 and 2011, respectively. Mardon skipper numbers averaged per square meter of unburned and burned habitat area for zone 4 were 6.3 times higher in the unburned zone in 2009, 6.2 times higher in 2010, and 4 times higher in 2011. Overall, mardon

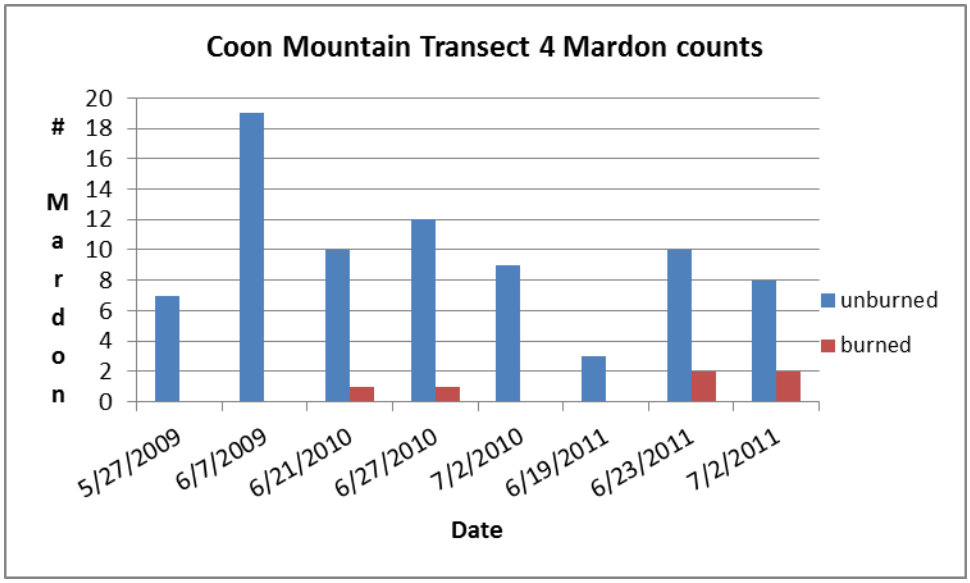
were present in extremely low numbers following the burn in the burned habitat; three years of surveys indicate that they are either not recovering compared to the levels seen in unburned habitat or recovering extremely slowly.

Figure 5. Zone 4 burn site mardon skipper counts, 2009, 2010, and 2011.

5A. Whole zone counts



5B. Transect counts

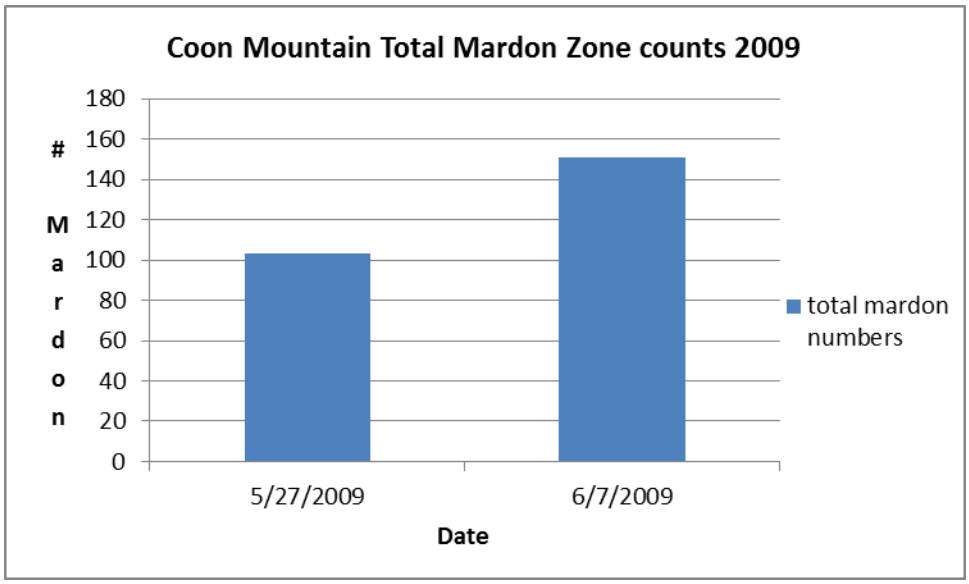


TOTAL POPULATION COUNTS AT COON MOUNTAIN

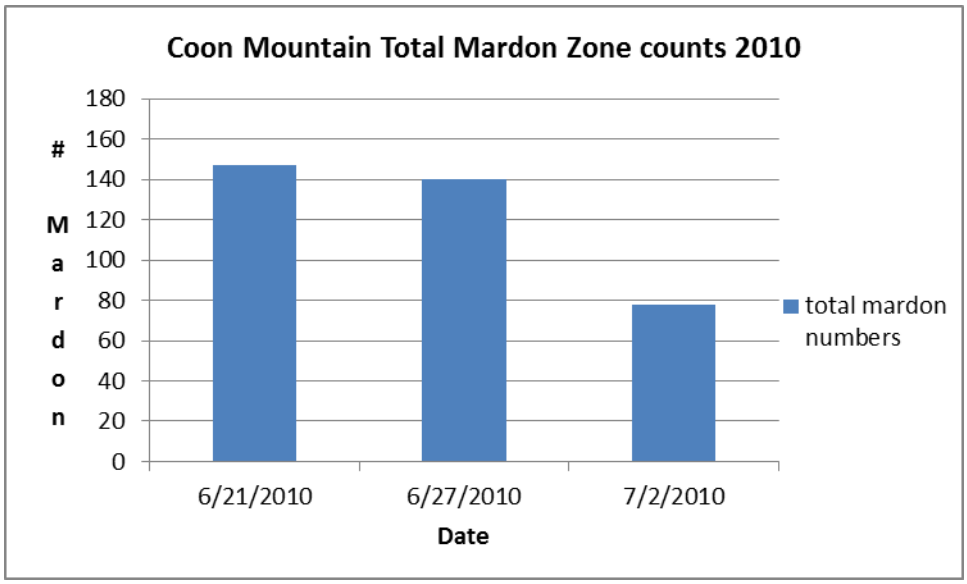
Mardon were discovered in the Coon mountain meadow complex on June 10, 2008. This is believed to be the largest population in California based on a one-day count of 204 individuals on June 10, 2008 (Black *et al.* 2008). Total mardon population numbers across all four zones and for burned and unburned zone counts were combined to show the number of total butterflies throughout the flight period during all three survey years (Figure 6A, 6B, and 6C). The highest one-day count was 151 in 2009, 147 in 2010, and 168 in 2011. The population across this area seems stable and is still considered the largest population in California.

Figure 6. Total mardon skipper zone counts, unburned and burned combined.

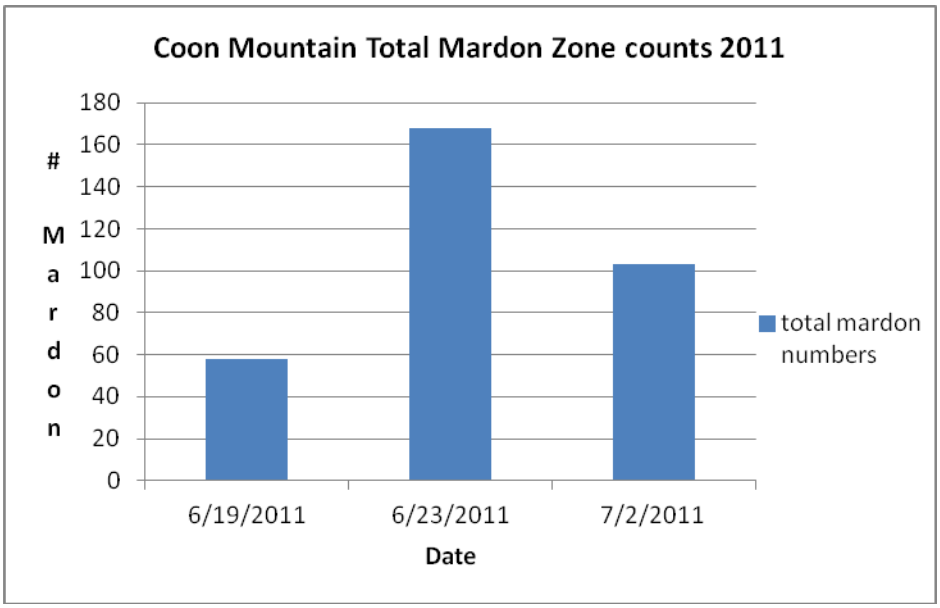
6A. 2009 total zone counts



6B. 2010 total zone counts



6C. 2011 total zone counts



DISCUSSION

The results of this study consistently show substantially fewer butterflies in the burned areas of Coon Mountain meadows compared to unburned regions after one, two, and three years following the burn event. Without exception, mardon numbers were higher at all dates in unburned transects and zones compared to burned transects and zones within the same survey meadow. Counts for all four zones across all survey dates in 2009, 2010, and 2011 showed mardon numbers that ranged from 2 to 27 times higher in unburned zones compared to burned zones on the same dates.

Prescribed fire

As stated above, fire suppression can lead to invasion and maturation of shrubs and trees and an increase and ultimately loss and degradation of forest-meadow ecosystems (Black *et al*. 2011, Coop & Givinish 2007; Norman & Taylor 2005). Eventually, continued succession results in the degradation and loss of the grasslands (Schultz & Crone 1998; Panzer 2003). Prescribed burning is therefore a useful tool for restoring and maintaining grassland habitat but a balance should be struck between improving habitat with fire and the impact prescribed burning has on non-target insects.

Fire as a management tool is based on the supposition that prairie species are adapted to wildfires, and thus can cope with regular burns (e.g., Harper *et al*. 2000; Swengel 2001; Panzer 2002; Hartley *et al*. 2007). This is dependent, however, on there being adequate unburned areas adjacent that can provide sources of colonizers into the burned habitat. In small fragments where populations are more isolated, prescribed burning can have much more deleterious effects on the population due to a lack of colonizing capacity. For example, Harper *et a*l. (2000) found that overall arthropod species richness decreased in burned prairie sites, as well as the abundance of all but one of the species measured. Their results suggest that burning a small habitat fragment in its entirety could risk extirpating some species because of limited recolonization from adjacent habitat.

Fire can have serious impacts on population levels and unless there are adequate refuges from the fire or adjacent habitat, recolonization of a burned site may not be feasible (Black *et al*. 2009, 2011). Timing of burns is also critical and should not be carried out when target pollinators are in a larval or critical foraging stage.

To ensure a healthy population of mardon skipper, burned areas must be recolonized by butterflies flying in from unburned parts of the meadow. During adult flight, mardon skippers are assumed to have limited dispersal abilities (Beyer & Schultz 2010; Beyer & Black 2007; Runquist 2004). Also, areas with smaller core populations may take longer to colonize than other areas with larger population sizes.

Forest Encroachment

Forest encroachment not only reduces the amount of open habitat, but closes off corridors between meadows reducing butterfly dispersal (Roland & Matter 2007). During the adult flight, mardon skippers avoid heavily forested habitats, avoid forest edges and trees during oviposition, and are assumed to have limited dispersal abilities (Beyer & Schultz 2010; Beyer & Black 2007; Runquist 2004). Large dense shrubs likely have a similar adverse impact as encroaching trees to the habitat and behaviors of this butterfly.

Based on observations of the site over the last three years it is likely that conifer encroachment is still negatively impacting mardon habitat at Coon Mountain. Some areas of the burn did not eliminate the small trees and they are encroaching into meadow habitat, especially in zone 2 (Figure 7).

Figure 7. Tree encroachment at Coon Mountain. By Scott Hoffman Black

RECOMMENDATIONS

A careful and well-researched prescribed burning regimen should provide the correct combination of timing, intensity, and size that is appropriate for the management area and will result in long-term stability of mardon skipper populations. Knowledge of how butterflies respond to fire is integral to designing an effective fire management strategy. The Xerces Society makes the following recommendations:

- No additional burns in mardon meadows should be implemented until surveys indicate that mardon have completely re-colonized the previous burn areas.
- Future fires should not burn more than one-third of the core habitat in any given year, and less if possible.
- As a fire moves through an area it may leave small patches unburned. These skips should be left intact as potential micro-refuges.
- A comprehensive monitoring program should be put in place to accompany any plans for continuing burns to determine the immediate and long-term impacts on mardon populations.

- While implementing a burn plan, measures must be taken to avoid actions that could degrade existing habitat and kill individual skippers, including heavy equipment use and additional or excessive foot traffic by burn staff in mardon meadows.
- The mardon skipper monitoring program at Coon Mountain should be continued, in order to understand the rate and timing of full re-colonization of burned areas by skippers.

The Xerces Society recommends doing limited small tree removal in the Coon Mountain mardon area. These areas include zones 2 and 3, where small trees and problematic shrubs should be identified and removed. A plan should be developed that removes trees using methods that incorporate sensitivity to the butterflies' life history. The plan should include the following:

- In general only small trees under 4 in. Diameter at Breast Height (DBH) should be removed from the open meadow portion of the site.
- Wherever possible, cutting should be done by hand with chainsaws or handsaws.
- All downed wood and branches should be dragged out of the meadow areas.
- Care must be taken to avoid actions that could degrade habitat and kill individual skippers as a result of heavy equipment use, people trampling meadows, scattering or piling of trees or branches in meadows, or burning of piles in or adjacent to the core area of the site.
- The Xerces Society would be willing to help delineate areas where this treatment is needed.

LITERATURE CITED

Arnold, R. A. 2006. Report on 2005 mardon skipper surveys in Del Norte County, CA. Entomological Consulting Services, Ltd. Pleasant Hill, CA 18 pp.

Beyer, L. and S. H. Black. 2007. Site utilization by adults and larvae of mardon skipper butterfly (*Polites mardon*) at four sites in Washington and Oregon. Final Report to the Forest Service and BLM from the Xerces Society.

Beyer, L. J., Schultz, C.B. 2010. Oviposition selection by a rare grass skipper *Polites mardon* in montane habitats: Advancing ecological understanding to develop conservation strategies. *Biological Conservation* 143: 862-872.

Black, S.H., M. Shepherd, and M. Vaughan. *In press*. Rangeland Management for Pollinators. Society for Range Management. June 2011.

Black, S.H., Shepherd, M., Vaughan, M., LaBar, C., Hodges, N. 2009. *Yolo County Heritage Program (KCP/NCCP) Pollinator Conservation Strategy*. Xerces Society for Invertebrate Conservation. Portland OR/Sacramento CA.

Black, S. H., and D. M. Vaughan. 2005. Species Profile: *Polites mardon*. *In*: Shepherd, M. D., D. M. Vaughan, and S.H. Black (eds), *Red List of Pollinator Insects of North America*. CD-ROM Version 1 (May 2005). The Xerces Society for Invertebrate Conservation, Portland, OR.

Black, S. H., S. Jepsen, and L. Lauvray. 2008. Report to the U.S. Fish and Wildlife Service, Surveys for *Polites mardon* in Del Norte County of Northern California. The Xerces Society for Invertebrate Conservation, Portland, OR.

Coop, J. D., and T. J. Givinish. 2007. Spatial and temporal patterns of recent forest encroachment in montane grasslands of the Valles Caldera, New Mexico, USA. *Journal of Biogeography* 34: 914-927.

Dornfeld, E. J. 1980. Butterflies of Oregon. Timber Press, Forest Grove, Oregon.

Haggard, J. 2003. Status report: Mardon skipper (*Polites mardon mardon*) in Del Norte County, CA. Haggard Wildlife Consulting, Fieldbrook, CA. 22 pp.

Harper, M. G., C. H. Dietrich, R. L. Larimore, and P. A. Tessene. 2000. Effects of prescribed fire on prairie arthropods: An enclosure study. *Natural Areas Journal* 20(4):325-335.

Hartley, M. K., W. E. Rogers, E. Siemann, and J. Grace. 2007. Responses of prairie arthropod communities to fire and fertilizer: balancing plant and arthropod conservation. *American Midland Naturalist* 157(1):92-105.

Mattoon, S. O., J. F. Emmel, and T. C. Emmel. 1998. The distribution of *Polites mardon*

(Lepidoptera: Hesperiidae) in North America, and description of a new subspecies from southern Oregon. Pages 767-774 *in* T. C. Emmel, (ed.), *Systematics of western North American butterflies*. Mariposa Press, Gainesville, Florida. 878 pp.

Norman, S. P., and A. H. Taylor. 2005. Pine forest expansion along a forest-meadow ecotone in northeastern California, USA. *Forest Ecology and Management* 215: 51-68.

Pollard, E. 1977. A method for assessing changes in the abundance of butterflies. Biological Conservation 12: 115-134.

Panzer, R. 2002. Compatibility of prescribed burning with the conservation of insects in small, isolated prairie reserves. Conservation Biology 16:1296-1307.

Panzer, R. 2003. Importance of *in situ* survival, recolonization, and habitat gaps in the postfire recovery of fire-sensitive prairie insect species. *Natural Areas Journal* 23(1):14-21.

Roland, J., and S. F. Matter. 2007. Encroaching forests decouple alpine butterfly population dynamics. *Proceedings of the National Academy of Sciences* 104: 13702-13704.

Runquist, E. 2004. Unpublished report and presentation: Workshop on the ecology and status of the mardon skipper (*Polites mardon*), an unusual Pacific Northwest butterfly. Ashland, Oregon.

Schultz, C. B., and E. E. Crone. 1998. Burning prairie to restore butterfly habitat: a modeling approach to management tradeoffs for the Fender's blue. *Restoration Ecology* 6(3):244-252.

Swengel, A.B. 2001. A literature review of insect responses to fire, compared to other conservation managements of open habitat. *Biodiversity and Conservation.* 10:1141–1169.

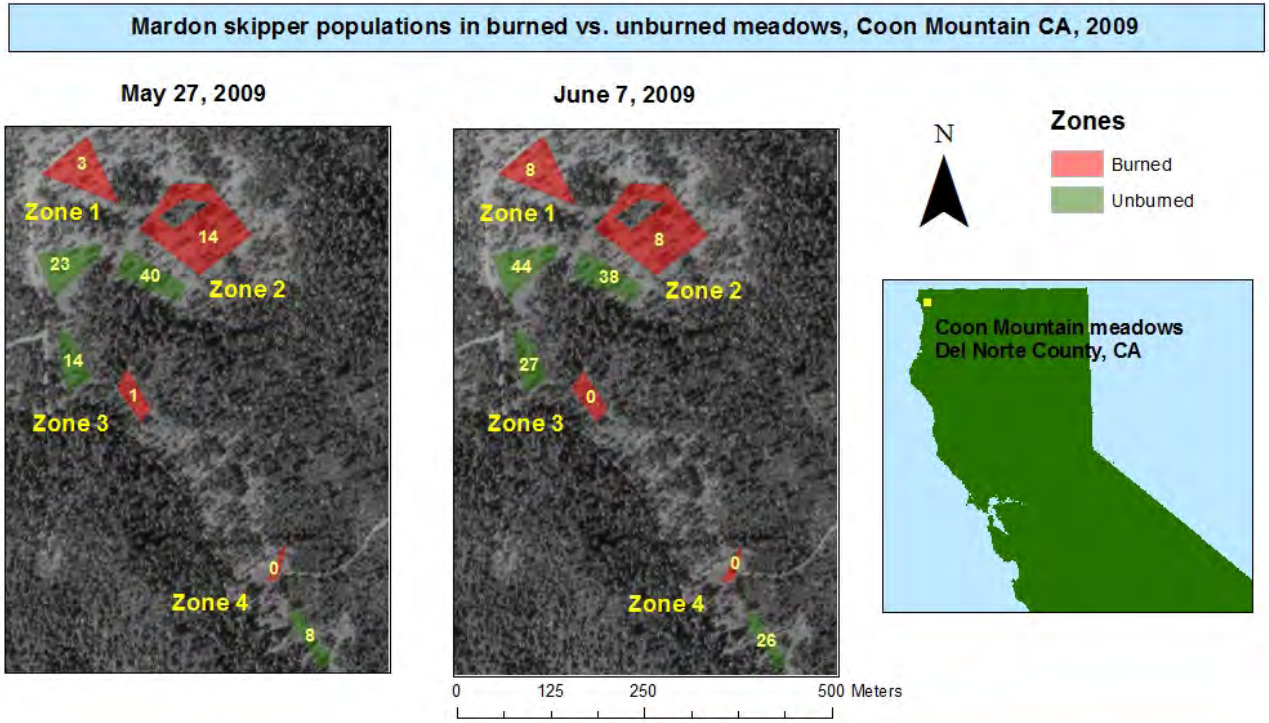
Warren A. D. 2005. Lepidoptera of North America 6. Butterflies of Oregon, Their Taxonomy, Distribution and Biology. C. P. Gillette Museum Of Arthropod Diversity. Colorado State University. Fort Collins, CO.

PERSONAL COMMUNICATION

Gary Falxa, Biologist, USFWS 2008

APPENDIX 1: MAPS

Map 1

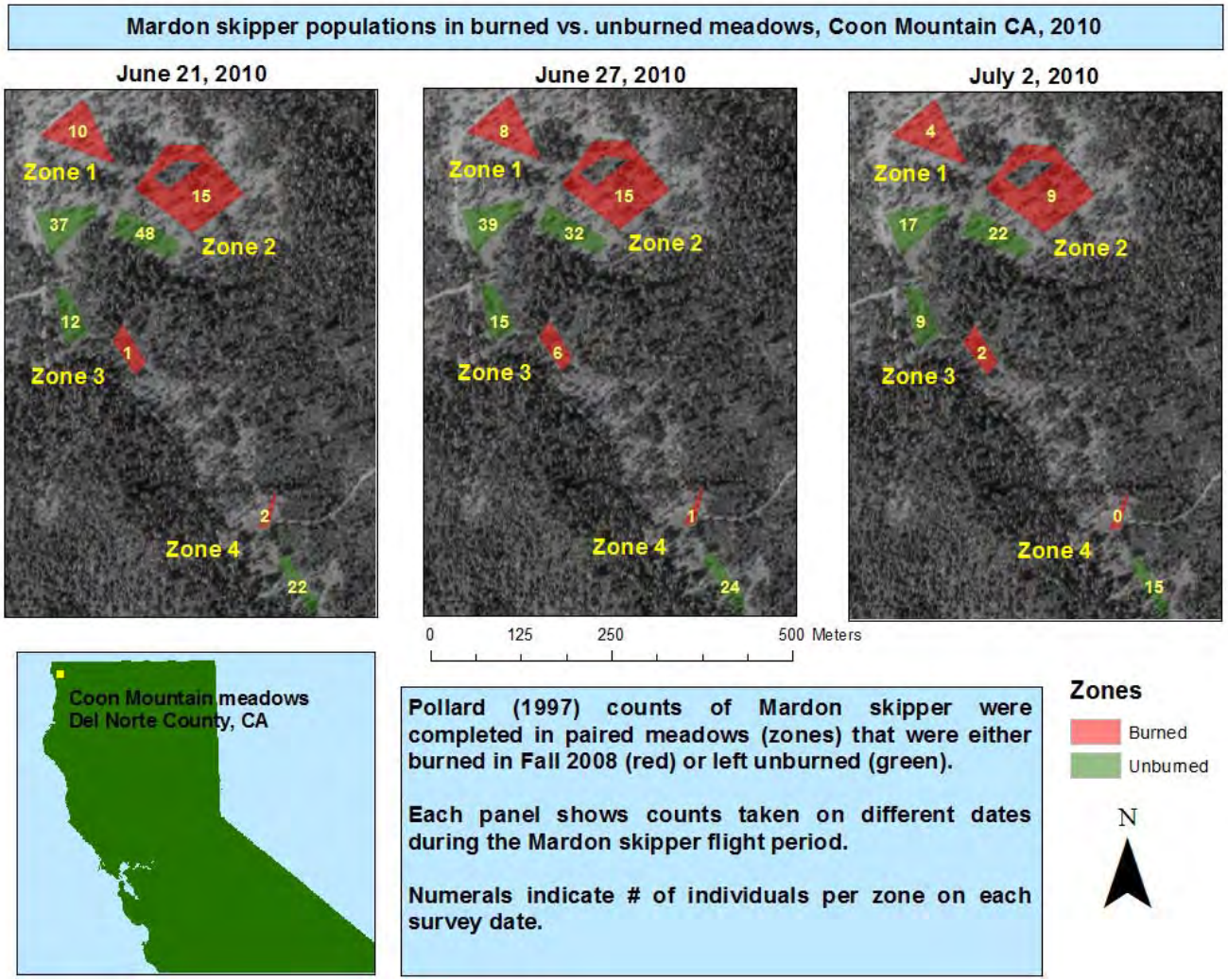


Pollard (1997) counts of Mardon skipper were completed in paired meadows (zones) that were either burned in Fall 2008 (red) or left unburned (green).

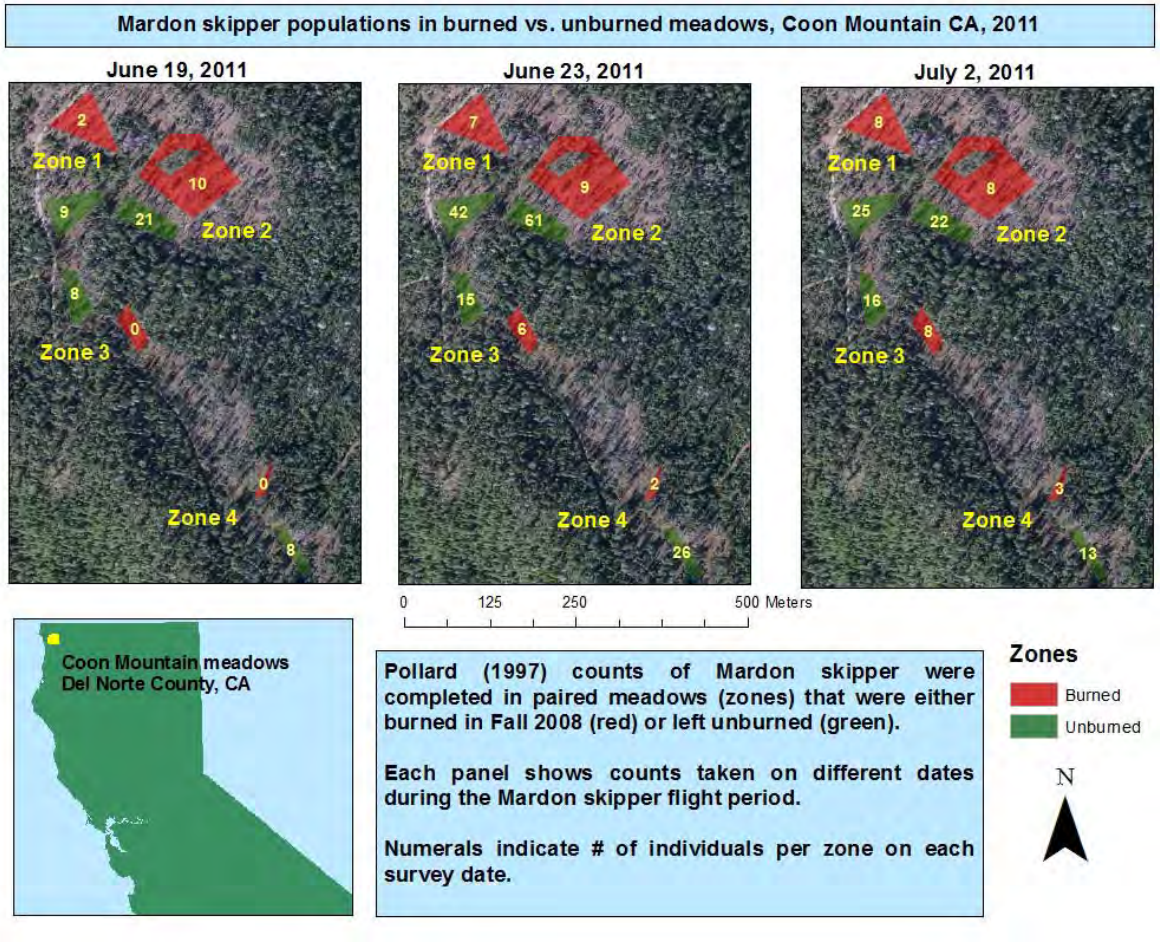
Each panel shows counts taken on different dates during the Mardon skipper flight period.

Numerals indicate # of individuals per zone on each survey date.

Map 2


Mardon skipper populations in burned vs. unburned meadows, Coon Mountain CA, 2010
June 21, 2010
June 27, 2010
July 2, 2010
Zone 1
Zone 2
Zone 3
Zone 4
10
15
37
48
12
1
2
22
8
15
39
32
15
6
1
24
4
9
17
22
9
2
0
15
0
125
250
500 Meters
Coon Mountain meadows
Del Norte County, CA
Pollard (1997) counts of Mardon skipper were completed in paired meadows (zones) that were either burned in Fall 2008 (red) or left unburned (green).
Each panel shows counts taken on different dates during the Mardon skipper flight period.
Numerals indicate # of individuals per zone on each survey date.
Zones
Burned
Unburned
N

Map 3


Mardon skipper populations in burned vs. unburned meadows, Coon Mountain CA, 2011
June 19, 2011
June 23, 2011
July 2, 2011
Zone 1
Zone 2
Zone 3
Zone 4
2
10
9
21
8
0
0
8
7
9
42
61
15
6
2
26
8
8
25
22
16
8
3
13
0
125
250
500 Meters
Coon Mountain meadows
Del Norte County, CA
Pollard (1997) counts of Mardon skipper were completed in paired meadows (zones) that were either burned in Fall 2008 (red) or left unburned (green).
Each panel shows counts taken on different dates during the Mardon skipper flight period.
Numerals indicate # of individuals per zone on each survey date.
Zones
Burned
Unburned
N

APPENDIX 2: TABLES

Table 1. Mardon skipper habitat zone and transect locations.

Survey region	Polygon coordinates[1]	Transect coordinates[2]
Zone 1 unburned	1. N 41.77428 W 123.97115 2. N 41.77369 W 123. 97084 3. N 41.77423 W 123.97008 4. N 41.77440 W 123.97001	Start: N 41 46.459 W 123 58.205 End: N 41.774117 W 123.970467
Zone 1 burned	1. N 41.77483 W 123.96980 2. N 41.77487 W 123.96979 3. N 41.77570 W 123.97035 4. N 41.77523 W 123.97112	Start: N 41.774750 W 123.969767 End: N 41.775100 W 123.970150
Zone 2 unburned	1. N 41.77401 W 123.96990 2. N 41.77434 W 123.96973 3. N 41.77386 W 123.96866 4. N 41.77367 W 123.96883	Start: N 41.774050 W 123.969517 End: N 41.774283 W 123.969967
Zone 2 burned	1. N 41.77399 W 123.96848 2. N 41.77448 W 123.967641 3. N 41.77513 W 123.96835 4. N 41.77513 W 123. 96893	Start: N 41.775167 W 123.968833 End: N 41.774800 W 123.969167
Zone 3 unburned	1. N 41.77274 W 123.97016 2. N 41.77256 W 123.97057 3. N 41.77335 W 123.97076 4. N 41.77333 W 123.97058	Start: N 41.772817 W 123.970483 End: N 41.773250 W 123.970567
Zone 3 burned	1. N 41.77221 W 123.96941 2. N 41.77 239 W 123.96923 3. N 41.77288 W 123.96966 4. N 41.77266 W 123.96985	Start: N 41.772833 W 123.969733 End: N 41.772383 W 123.969483
Zone4 unburned	1. N 41.76994 W 123.96706 2. N 41.77003 W 123.96691 3. N 41.76936 W 123.96628 4. N 41.76927 W 123.96645	Start: N 41.769800 W 123.966700 End: N 41.769417 W 123.966533
Zone 4 burned	1. N 41.77035 W 123.96718 2. N 41.77032 W123.96740 3. N 41.77084 W 123.96705 4. N 41.77073 W 123.96705	Start: N 41.770717 W 123.967200 End: N 41.770333 W 123.967250

[1]Coordinates indicate the corners of zone polygon. Note that the coordinates given for the zone 2 burned survey area do not indicate a small "donut hole" of unsuitable habitat at the northeast end of the polygon that was omitted from surveying. See maps in Appendix 1 for additional detail.

[2]Coordinates indicate the start and endpoints of the center line of the transect. Surveys were conducted along 15 feet on either side of the midpoint.

Table 2. Mardon skipper counts, 2009, 2010, & 2011

Mardon skipper counts, total zone numbers									
		Date							
Zone	**condition**	**5/27/2009**	**6/7/2009**	**6/21/2010**	**6/27/2010**	**7/2/2010**	**6/19/2011**	**6/23/2011**	**7/2/2011**
	unburned	23	44	37	39	17	9	42	25
Zone 1	burned	3	8	10	8	4	0	7	8
	unburned	40	38	48	32	22	21	61	22
Zone 2	burned	14	8	15	15	9	10	9	8
	unburned	14	27	12	15	9	8	15	16
Zone 3	burned	1	0	1	6	2	0	6	8
	unburned	8	26	22	24	15	8	26	13
Zone 4	burned	0	0	2	1	0	0	2	3
Mardon skipper, transect counts[1]									
		Date							
Transect[1]	**condition**	**5/27/2009**	**6/7/2009**	**6/21/2010**	**6/27/2010**	**7/2/2010**	**6/19/2011**	**6/23/2011**	**7/2/2011**
	unburned	6	19	14	14	7	3	14	7
Zone 1	burned	1	2	0	2	2	0	3	4
	unburned	3	14	7	16	12	6	9	8
Zone 2	burned	5	2	2	2	0	2	0	2
	unburned	6	10	10	10	4	6	9	5
Zone 3	burned	1	0	0	2	1	0	2	4
	unburned	7	19	10	12	9	3	10	8
Zone 4	burned	0	0	1	1	0	0	2	2

[1] Each count indicates the number of mardon in a 150 x 30 ft. fixed-area survey. Individual transects were marked and counted within the burned and unburned habitat areas of each numbered zone.