

# MARDON SKIPPER (*POLITES MARDON*) DISTANCE SAMPLING SURVEYS AT FOUR SENTINEL SITES IN OREGON AND WASHINGTON: YEAR 6

STATUS REPORT TO THE U.S. FOREST SERVICE, BUREAU OF LAND MANAGEMENT, AND THE INTERAGENCY SPECIAL STATUS / SENSITIVE SPECIES PROGRAM (ISSSP)



Peterson Prairie mardon skipper site, Gifford Pinchot National Forest, WA. Photo: Xerces Society/Candace Fallon, 2019.

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## SUMMARY

This report summarizes Year 6 of a multi-year monitoring effort to document population and density estimates of mardon skippers (*Polites mardon*) at four sentinel sites in Oregon and Washington. Each year, the Xerces Society provides logistical support to BLM and USFS biologists and contractors to survey mardon skipper sites at Windy Valley (Rogue River-Siskiyou National Forest, OR), the Howard Prairie site complex (Jackson County Parks, managed by Medford BLM, southern OR), and Conrad Meadows (Okanogan-Wenatchee National Forest, WA). A Xerces Society conservation biologist monitors the fourth site, Peterson Prairie (Gifford Pinchot National Forest, WA). The 2019 monitoring season took place from May through July, during which surveyors completed 6-7 visits per site to count skippers using distance sampling techniques. Data for all sites were provided to Xerces' biologists for analysis and reporting.

Population estimates for Conrad Meadows and Windy Valley trended higher in 2019 than 2018, whereas pooled population estimates dropped for the Howard Prairie Complex and Peterson Prairie (Appendix A). Population and density estimates for all sites in 2019 can be found in Table 1. Note that % CV are high and 95% CI are large at both Howard Prairie and Peterson Prairie. This is likely due to the low number of total butterfly observations at these two site complexes. See the Site Results and Discussion section for more site-specific details.

Table 1: Population and density estimates for all survey sites in 2019.

Region	Site	Estimate	2019			
			Pop. size	% CV	95% CI	
RRS	Windy Valley	Density (N/HA)	572.52	32.56	233.38	1404.50
		Population (N)	<b>508</b>	<b>32.56</b>	<b>207</b>	<b>1246</b>
S. OR Cascades	Howard Prairie	Density (N/HA)	<b>151.20</b>	<b>54.31</b>	<b>54.12</b>	<b>422.44</b>
		Population (N)	<b>874</b>	<b>54.31</b>	<b>313</b>	<b>2442</b>
	Lily Glen	Density (N/HA)	<b>18.23</b>	<b>74.54</b>	<b>4.40</b>	<b>75.53</b>
		Population (N)	<b>159</b>	<b>74.54</b>	<b>38</b>	<b>658</b>
	Pooled Estimate	Density (N/HA)	<b>71.27</b>	<b>53.48</b>	<b>26.03</b>	<b>195.15</b>
		Population (N)	<b>1033</b>	<b>53.48</b>	<b>377</b>	<b>2828</b>
GIP	Peterson Prairie North Meadow	Density (N/HA)	<b>46.36</b>	<b>69.46</b>	<b>8.85</b>	<b>243.01</b>
		Population (N)	<b>178</b>	<b>69.46</b>	<b>34</b>	<b>933</b>
	Peterson Prairie West Meadow	Density (N/HA)	n/a	n/a	n/a	n/a
		Population (N)	n/a	n/a	n/a	n/a
	Pooled Estimate	Density (N/HA)	<b>46.36</b>	<b>69.46</b>	<b>8.85</b>	<b>243.01</b>
		Population (N)	<b>97</b>	<b>69.46</b>	<b>19</b>	<b>510</b>
OKW	Conrad Meadows	Density (N/HA)	2485.5	10.47	1984.5	3113.0
		Population (N)	9571	10.47	7641	11987

**Notes:** It is possible that the same individuals were counted on multiple site visits. Numbers in **bold** have a high coefficient of variance, with large 95% Confidence Intervals. Estimates are not provided for Peterson Prairie West because no skippers were detected, which violates the assumptions of Distance Sampling. In addition, total numbers of observations for Peterson Prairie North and Lily Glen was less than 20, which likely violates these same assumptions. As such, the population estimates for these sites are unreliable, and the pooled data should be used instead of the individual site data.

The 2019 monitoring season represented the 6<sup>th</sup> year of monitoring at the four sentinel sites in Oregon and Washington. We recommend continuing annual monitoring for a minimum of ten years, although longer-term population monitoring—especially if active management is occurring at these sites—is ideal and important for developing, implementing, and adapting effective conservation and management strategies. At the beginning of each field season, we recommend that surveyors revisit the Distance Sampling protocol (Hatfield 2013) to review the assumptions of Distance Sampling and ensure that future surveys meet those assumptions. In particular, it is critical that surveyors focus on detecting 100% of butterflies on the survey transect, and, to the extent possible, monitor the population throughout the entire flight period of the butterfly. In addition to distance sampling at the four sentinel sites, we recommend continuing and/or implementing detection/no-detection surveys in a subset of historically occupied meadows (see Hatfield et al. 2013a). Development and implementation of a standardized site condition assessment form would benefit the tracking of site condition through time (see Hatfield et al. 2018a for more details).

## INTRODUCTION

Mardon skippers (*Polites mardon*) are small, stout butterflies with tawny orange wings. They are found in open meadow habitats in several disjunct areas in Washington, Oregon, and California. Similar to other members of the grass skipper family (Hesperiidae), they move in a skipping pattern, staying low to the ground. Mardon skippers are grass obligates as larvae, while adults have been documented using a variety of nectar sources. Detailed information about their life history and distribution can be found in Pyle and LaBar (2018) and previous monitoring reports (e.g. Hatfield et al. 2018b).

The small size (less than half an inch) of mardon skippers and their low flight activity results in low detectability during surveys, which makes population monitoring difficult (Potter and Olson 2012; Fallon and Hatfield 2013; Fallon and Hatfield 2014; Fallon and Hatfield 2015; Hatfield et al. 2016; Hatfield et al. 2017; Hatfield et al. 2018b). Because of this, incorporating detectability into population estimates is essential, and distance sampling methods have been shown to work well for this species, since they account for butterflies that may not have been detected during surveys.

From May through July of 2019, Xerces staff, USFS and BLM biologists, and independent contractors conducted distance sampling surveys at four sentinel sites in Oregon and Washington: Windy Valley, Howard Prairie, Peterson Prairie, and Conrad Meadows. All four of these sites have been surveyed annually using distance sampling methods since 2014. These sentinel sites were selected for several reasons:

- (1) They host some of the largest populations of mardon skippers documented on federal lands in three of the four major areas from which this species is known,
- (2) There would likely be enough skippers to conduct distance sampling (which assumes a minimum of 30 observations per site - per year),
- (3) They can serve as barometers of mardon skipper activity (including peak flight periods to inform the best time to conduct detection/no detection surveys at other mardon skipper sites nearby),
- (4) They inform population trends for each region. These six years of surveys provide robust population estimates of known mardon skipper populations in three of the four major geographical areas from which this species is known.

It is important to note that while these sentinel sites may be used as barometers for regional population trends, additional satellite sites with smaller populations should be monitored regularly to determine if they remain extant.

## METHODS

### FIELD SURVEYS

Xerces Society staff established the distance sampling transects with the program Distance (Thomas et al. 2010) in 2014 using the Mardon Skipper Rangewide Monitoring Protocol (Hatfield et al. 2013a). We adjusted the endpoints of some transects in 2014 and 2015 after surveyor feedback. Surveyors re-locate endpoints in the field each year using GPS and delineate each transect with pin flags, rebar, PVC pipes with flags, and/or wooden stakes (see Appendix B for transect coordinates).

Sites are monitored over the course of the adult flight period, which usually runs from late May to the end of July, depending on the location. As outlined in the Rangewide Monitoring Protocol, sites are visited a minimum of five times per season. Surveyors follow the general survey condition recommendations provided by Seitz et al. (2007) and modified by Hatfield (2013). Surveyors follow the distance sampling protocol outlined in Hatfield (2013).

### DATA ANALYSIS

Surveyors provide data to the Xerces staff at the end of the field season. We used Distance 7.2 Release 1 (Thomas et al. 2010) to estimate the mardon skipper abundance and density of each site. In the Results section that follows, we report several results for each sentinel site:

- 1) One-day skipper counts for each visit. These are somewhat similar to the one-day counts that have taken place in the past. However, the methodology for distance sampling is different from the modified Pollard walks, making direct comparisons difficult.
- 2) Population estimates, including estimated density (N/ha) and total population (N), as well as the Coefficient of Variation (%CV) and the 95% Confidence Intervals (95% CI) (Thomas et al. 2010). The Coefficient of Variation is a unit-less measure of error about a statistic, and thus allows a comparison of the amount of error between sites with different means (here reported as population estimates). Loosely interpreted, the 95% CI contains the mean population size (N), with 95% confidence. With similar means, a population with a larger %CV will have a broader 95% CI. Generally speaking, to detect trends in meadows with statistical significance ( $p < 0.05$ ), it would be necessary to have two means (N) with 95% CI that did not overlap. This means that detecting population trends in meadows with a high % CV, will be challenging.

The population estimates reported here are a pooled sum of the individual daily estimates of butterfly abundance. Daily population estimates are not reported here for simplicity, but those data are available from the Xerces Society upon request. The estimates provided are the best estimates of mardon skipper populations to date, and as long as the sampling protocol is followed in future monitoring efforts, the numbers reported here can be compared to future surveys. The estimates could be improved if there were accurate measures of individual butterfly survivorship, which, to our knowledge, do not exist for this species.

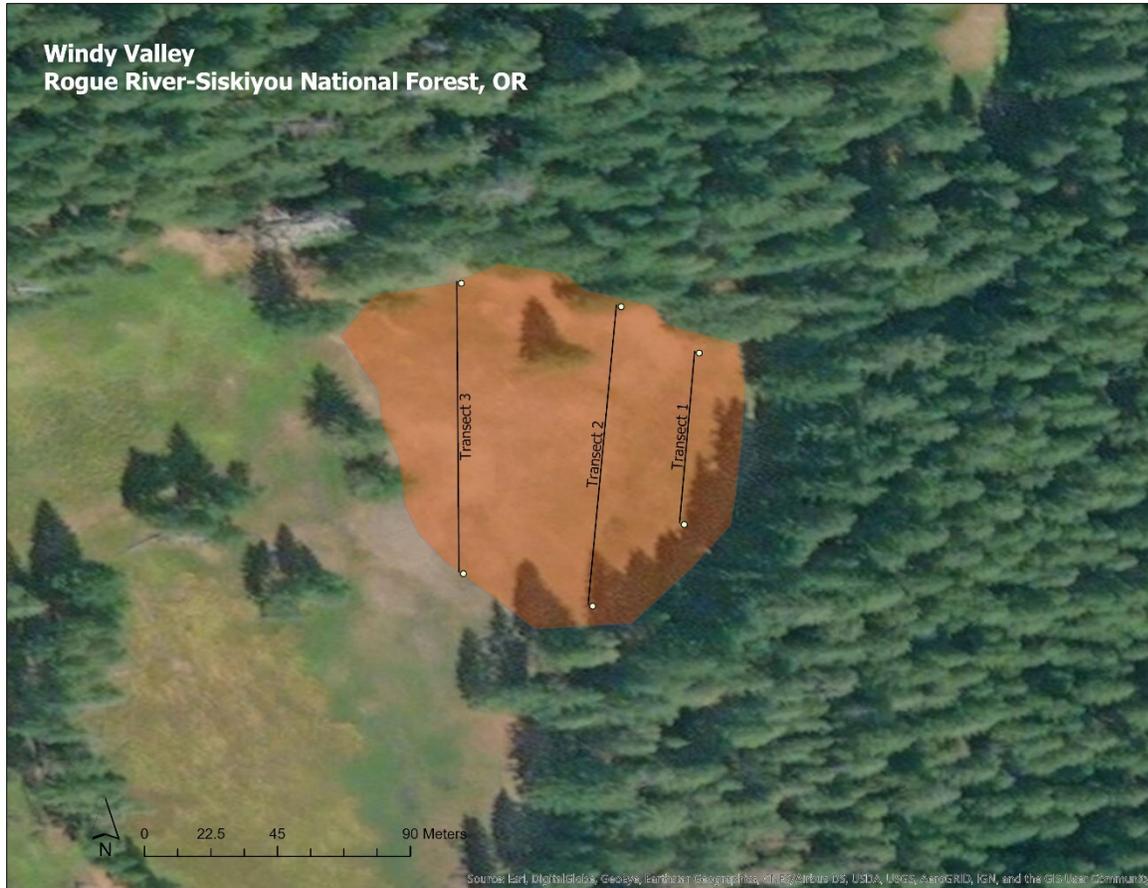
## SITE RESULTS AND DISCUSSION

### WINDY VALLEY, ROGUE RIVER-SISKIYOU NF, OR



Figure 1: Windy Valley, Rogue River-Siskiyou National Forest, OR. Photo: The Xerces Society/Candace Fallon, 2014.

The Windy Valley site (Figure 1) in southwest Oregon hosts the largest known mardon skipper population in the coastal Oregon region. Located at approximately 2,900 feet AMSL, it is composed of a seasonally wet meadow surrounded by coniferous forests. Mardon skippers continue to occupy approximately 0.89 hectares of bunch grasses and nectar plants at the northeastern edge of this meadow (see Map 1). The Chetco Bar wildfire lightly burned through this site in 2017 (Vaughn 2018, pers. comm.). During the 2019 distance sampling season, RRS field staff conducted 6 visits beginning on May 31 and ending July 8 (see Table 2).



Map 1: Windy Valley distance sampling survey site

## RESULTS

In 2019, 68 skippers were observed at the Windy Valley site. The peak count for 2019 was on June 14, with 42 individuals (Table 2). In the sampled occupied habitat, there is an estimated 572.52 mardon skippers per hectare (32.56 % CV), with a population estimate of 508 mardon skippers (32.56 % CV, habitat size of 0.887 HA, see Table 3).

Table 2: Number of skippers detected by date at Windy Valley.

Site	Area (HA)	# Transects	Total Distance of Transects (m)	5/31/2019	6/6/2019	6/14/2019	6/20/2019	6/28/2019	7/8/2019	Total Observed*
Windy Valley	0.887	3	262.33	0	8	42	15	3	0	68

\*Note: This includes all skippers detected during distance sampling (not just mardon skippers). It is possible that the same individuals were counted on multiple site visits.

Table 3: Windy Valley population estimates in 2019.

		2019			
Site	Estimate	Pop. size	% CV	95% CI	
Windy Valley	Density (N/HA)	572.52	32.56	233.38	1,404.50
	Population (N)	508	32.56	207	1246

## DISCUSSION

This is the second year of distance sampling since the Chetco Bar wildfire burned the entire occupied area in 2017. Agency botanists conducted plant surveys along the distance sampling transects this year; an updated plant list is available from the Forest. Mardon skipper counts were higher this year than in 2018, but still lower than estimates from the 2017 monitoring season (which occurred pre-fire; see Appendix A). The full flight period was captured during the six visits; no mardon skippers were detected on the first or last site visit, and a clear peak was observed on visit 3 (June 14, 2019). The detection function for this site (Figure 2) is irregular, suggesting that the Distance Sampling assumption that 100% of observations on the transect are observed with certainty may not have been met. Note that detectability drops off completely less than three meters from the transect.

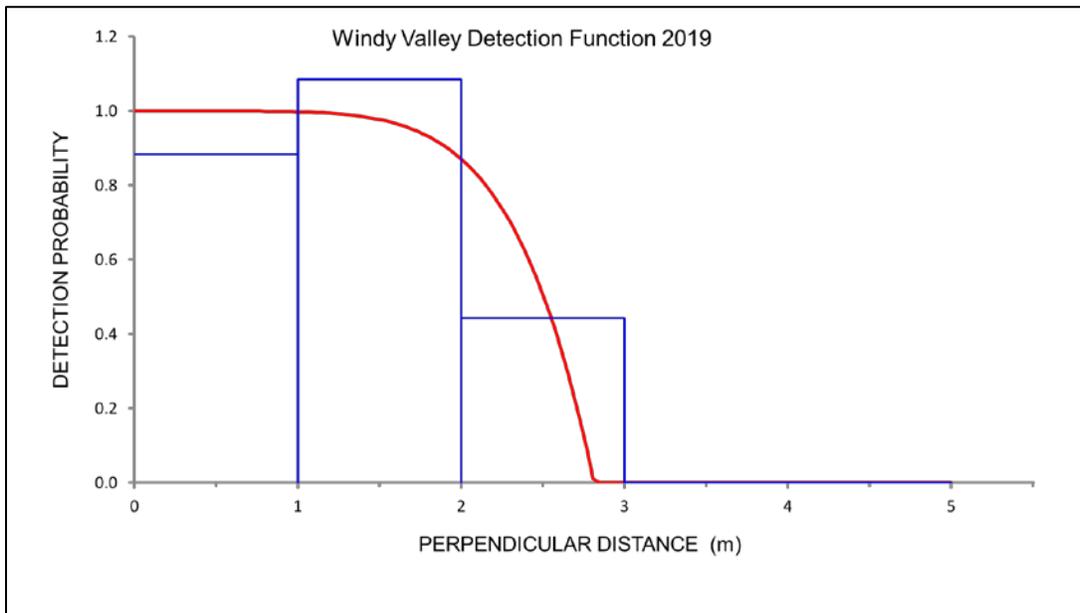


Figure 2: Windy Valley detection function

## HOWARD PRAIRIE SITE COMPLEX, OR



Figure 3: Short statured grasses allow for good visibility at Howard Prairie (left). Blooming seablush attracts nectaring mardon skippers at Lily Glen (right). Photos: Norm Barrett, 2019.



Table 4: Number of skippers detected by site and date at the Howard Prairie complex.

Site	Area (HA)	# Transects	Total Distance of Transects (m)	(5/30/2019)	(6/4/2019)	(6/10/2019 – 6/11/2019)	(6/18/2019)	(6/25/2019)	(7/2/2019)	(7/10/2019)	Total Observed*
Howard Prairie	5.78	4	1,084.5	0	0	12	23	18	3	0	56
Lily Glen	8.71	6	1,887.0	4	5	4	2	1	n/a	n/a	16
Pooled	14.49	10	2,971.5	4	5	16	25	19	3	0	72

\*Note: This includes all skippers detected during distance sampling (not just mardon skippers). It is possible that the same individuals were counted on multiple site visits.

Table 5: Howard Prairie and Lily Glen population estimates in 2019. Note that the total number of observations (N=10) for Lily Glen are too low to provide a reliable population estimate for that individual site. Instead, we recommend using the pooled estimate for these two sites. Note the high % CV for all of these estimates.

Site	Estimate	2019			
		Pop. size	% CV	95% CI	
Howard Prairie	Density (N/HA)	151.2	54.31	54.118	422.44
	Population (N)	874	54.31	313	2,442
Lily Glen	Density (N/HA)	18.228	74.54	4.399	75.533
	Population (N)	159	74.54	38	658
Pooled Estimates	Density (N/HA)	71.27	53.48	26.028	195.15
	Population (N)	1,033	53.48	377	2,828

## DISCUSSION

We removed a percentage of the data at Howard Prairie and Lily Glen based on the proportion of mardon skippers observed in post-sampling netting surveys and survey notes. The provided estimates in Table 5 account for this. Pooled population estimates for the Howard Prairie complex are lower in 2019 than in 2018 (see Appendix A). However, these estimates should be interpreted with caution due to a large % CV and the fact that the total number of observations (after adjustments had been made to account for butterflies counted during distance sampling that may not have been mardon skippers) at Lily Glen (n=10) was too low to provide an accurate population estimate for that site. Because of the low number of observations at Lily Glen, detection functions for each site were not generated; a pooled detection function (Figure 4) was calculated instead. As these two sites are different, detectability is also likely quite different (e.g., the plant community at Howard Prairie tends to be short and sparse, which may lead to higher detectability). As such, the pooled detection function may provide inaccurate population estimates, but these are the best available estimates with the number of mardon skippers observed in 2019. Pooled detection functions have been generated for all years except 2014 (the first year of monitoring) and may provide the best population estimates for this site complex.

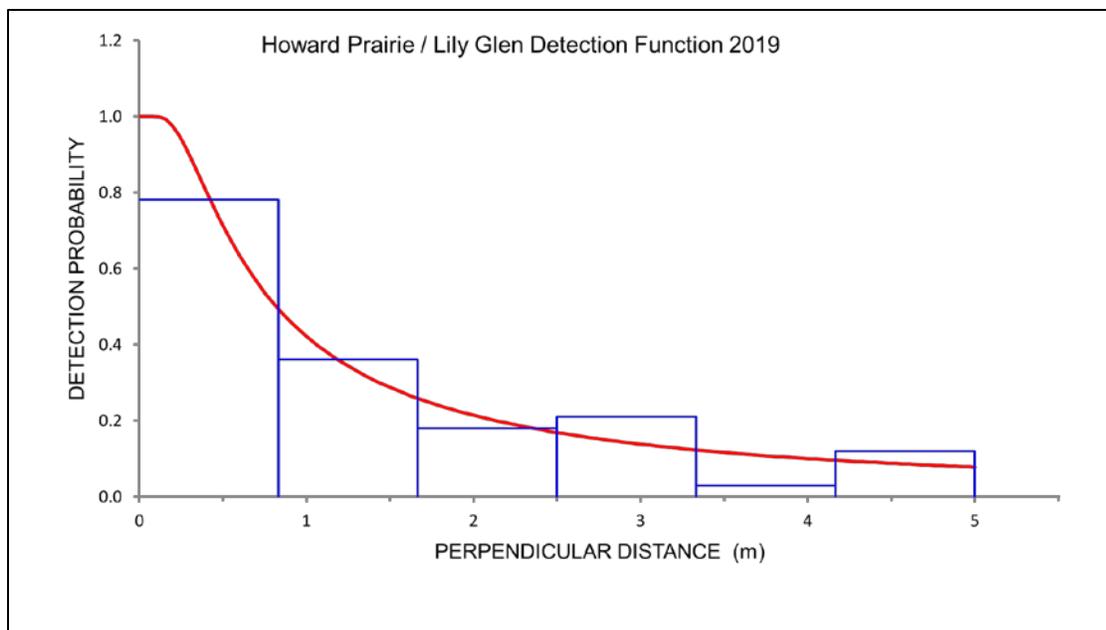


Figure 4: Pooled Howard Prairie complex detection function

Water availability at the Howard Prairie site complex may be an issue for mardon skipper populations. Despite a winter with above average snow depths with high water content, repair work on the nearby reservoir led to low water levels during the 2019 monitoring season (Barrett 2019). This appears to be affecting the water table of the mardon skipper sites; dry conditions during the flight period appeared similar to drought conditions.

Howard Prairie is a large open meadow with two large trenches that carry water through the site. The site appears to dry out earlier than most other sites in the region and as a result may have a slightly earlier flight season. It also tends to have relatively few nectar sources during the flight period, although there is an abundance of host plants to support mardon skipper larvae. A cool May resulted in a shortened 2019 bloom period for the few flowering plants found in the meadow (Barrett 2019). Early season flowering is usually dominated by camas lily, but in 2019 less than 10% of the camas blossomed and almost all had wilted and dried up by the middle of May (Barrett 2019). No other flowering plants bloomed in sufficient quantity to support mardon skipper nectaring this year. Mardon skipper activity at this site was predominantly along transect 1 early in the season and then drifted to Transects 3 and 4 by the end of the season.

Lily Glen is a large meadow located just east of Howard Prairie with a permanent stream that bisects the site from NE to SW. There is a vernal pool habitat on the east side of the stream, which supports abundant *Plectritis congesta* (a known nectar plant) and mardon skippers. Most of the remainder of the meadow is a mix of fescue, forbs, and bare ground. 2019 was the shortest flight season recorded at Lily Glen during the six years of monitoring. Similar to Howard Prairie, flowering plants at Lily Glen experienced a shorter blooming period during the 2019 monitoring season (Barrett 2019). This was especially true for seablush (*Plectritis congesta*), which mardon skippers use early in their flight season for nectar. For additional site details, see Barrett (2019).



Figure 5: Camas (*Camassia quamash*) in Peterson Prairie's North Meadow. Photo: Xerces Society/Candace Fallon, 2019.

Peterson Prairie is comprised of two xeric natural grass and forb meadows without a permanent water source; a low swale runs diagonally from NW to SE through the North Meadow, which retains moisture later into the summer. A Region 6 sensitive species, *Sisyrinchium sarmentosum* (pale blue-eyed grass) is found in and near this swale. There is a small aspen (*Populus tremuloides*) grove in the center of the West meadow. The North Meadow (Figure 5) measures 3.84 hectares; the West Meadow 2.1 hectares (see Map 3). This site complex is located at approximately 3,000 feet AMSL.

Xerces staff set up transects on May 27, 2019, and conducted an additional seven site visits from June 3, 2019, through July 16, 2019 (see Table 6). Xerces staff also conducted detection/no detection surveys at three other known mardon skipper sites (Bunny Hill, Flog Meadow North, and King Mountain) on the Gifford Pinchot NF on July 5, 2019. These were originally planned as modified peak counts (see protocol description in Hatfield 2013), and Xerces staff expected to use mardon skipper estimates from Peterson Prairie to time these peak counts. However, Peterson Prairie never had a noticeable peak in 2019, so it is unknown whether these counts occurred during the peak flight period for the region.



Map 3: Peterson Prairie distance sampling survey sites

## RESULTS

No skippers were observed during distance sampling surveys in the West Meadow during the 2019 season, and only 19 were observed in the North Meadow (Table 6). The peak count of 6 skippers for the 2019 season occurred on July 8 (see Table 6).

Table 6: Number of skippers detected by site and date at Peterson Prairie in 2019.

Site	Area (HA)	# Transects	Total Distance of Transects (m)	6/3/2019	6/9/2019	6/13/2019	6/21/2019	7/1/2019	7/8/2019	7/16/2019	Total Observed*
West Meadow	2.1	4	697.58	0	0	0	0	0	0	n/a	0
North Meadow	3.84	5	1209.74	0	0	3	5	5	6	0	19
Pooled	5.94	9	1907.32	0	0	3	5	5	6	0	19

\*Note: It is possible that the same individuals were counted on multiple site visits. When conducting the analysis for Peterson Prairie, a single skipper observation was removed from June 3, as it appears from the notes and the other detection data that this was unlikely to be *Polites mardon*. No distance sampling was conducted at the West Meadow on 7/16/2019.

Table 7: Peterson Prairie population estimates in 2019.

Site	Estimate	2019			
		Pop. size	% CV	95% CI	
Peterson Prairie West Meadow	Density (N/HA)	n/a	n/a	n/a	n/a
	Population (N)	n/a	n/a	n/a	n/a
Peterson Prairie North Meadow	Density (N/HA)	<b>46.362</b>	<b>69.46</b>	<b>8.845</b>	<b>243.01</b>
	Population (N)	<b>178</b>	<b>69.46</b>	<b>34</b>	<b>933</b>
Pooled Estimate	Density (N/HA)	<b>46.362</b>	<b>69.46</b>	<b>8.845</b>	<b>243.01</b>
	Population (N)	<b>97</b>	<b>69.46</b>	<b>19</b>	<b>510</b>

In the sampled occupied habitat, there is a pooled estimate of 46.362 mardon skippers per hectare (69.46% CV), with a population estimate of 97 skippers (69.46% CV, habitat size of 5.9 HA, see Table 7). The population estimate for the North Meadow is 178 butterflies (69.46% CV). Population estimates for the North Meadow are lower than estimates made in all prior monitoring years except 2015, when the estimate was 151 butterflies (however, note the high % CV and large 95% confidence intervals this year). Because no butterflies were detected in the West Meadow, only the pooled data should be used for future comparisons.

Only three mardon skippers were observed during the detection/no detection surveys—one male and two of unknown sex at Flog Meadow North (Figure 6). No mardon skippers were detected at Bunny Hill and King Mountain. Because it was difficult to determine the peak flight period in this area, the low number of detections at this site and the lack of any detections at the other two sites should be interpreted with caution.



Figure 6: Flog Meadow North, Gifford Pinchot National Forest, WA. Mardon skippers were observed nectaring on the lupine seen in this photo. Photo: Xerces Society/Candace Fallon, 2019.

## DISCUSSION

Pooled population estimates for Peterson Prairie in 2019 were lower than estimates from all prior years, but also have the largest % CV, likely due to the low overall number of detections ( $n < 20$ ) (see Table 6). Because there were no detections in the West Meadow (see Table 6), we present only a pooled detection function (Figure 7). Despite what may be a stable population in the North Meadow, skipper detections continue to drop in the West Meadow, with no skippers observed since 2017 (Table 8).

Table 8: Population (N) estimates at Peterson Prairie West Meadow, 2014-2019. Note high % CV for data in bold italics.

Year	Pop. size	% CV	95% CI	
2014	255	18.3	174	255
2015	<b>14</b>	<b>49.87</b>	<b>5</b>	<b>37</b>
2016	<b>93</b>	<b>49.83</b>	<b>27</b>	<b>322</b>
2017	<b>14</b>	<b>93.03</b>	<b>1</b>	<b>171</b>
2018	n/a	n/a	n/a	n/a
2019	n/a	n/a	n/a	n/a

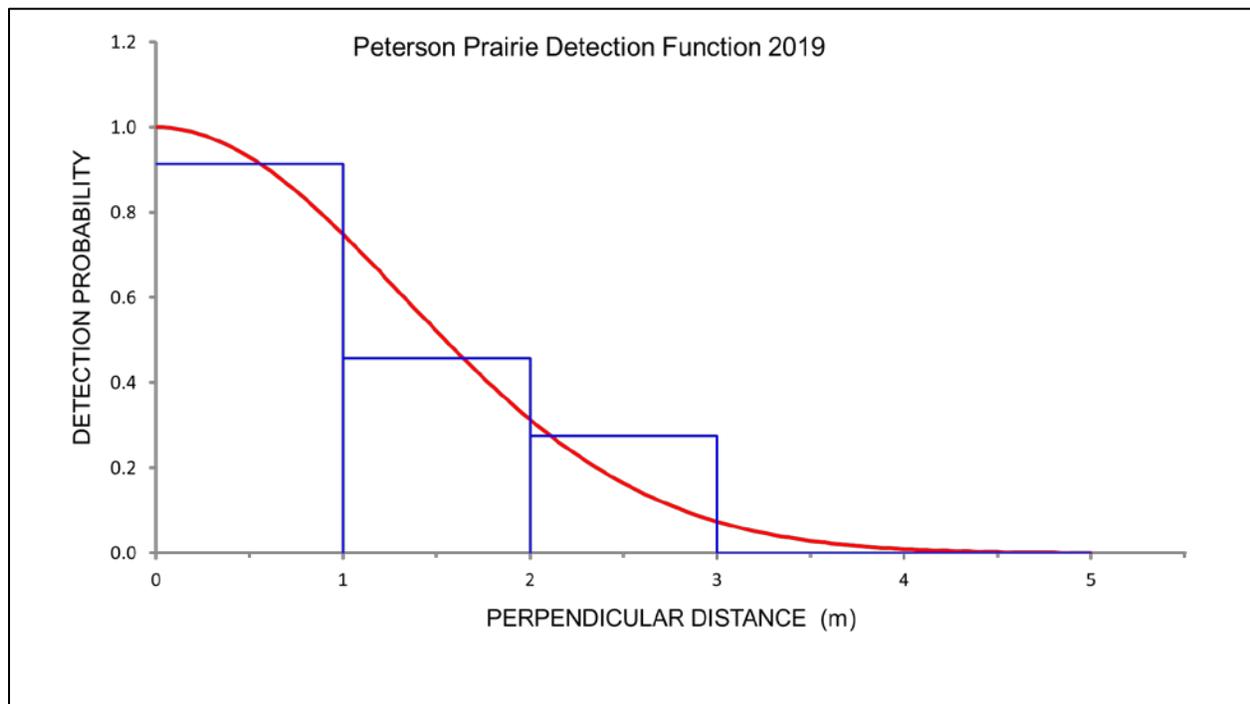


Figure 7: Pooled Peterson Prairie detection function

Moisture availability may be affecting mardon skippers at Peterson Prairie. The West Meadow does not have a swale to retain soil moisture later into the flight period like the North Meadow. Even with the swale, the North Meadow appears to be drying out. Wet meadow habitat in southwest Washington is expected to decrease under a warmer climate because of projected changes in hydrology, which may in turn lead to tree establishment and a shift from wet meadow to dry meadow habitats (Hudec et al. 2019). This can have a negative effect on mardon skippers, which require open, wet meadows. In 2019, surveyors noted several specific areas of concern, including ongoing shrub and aspen encroachment in the West Meadow (Figure 8), which has not had any skipper detections

in the past two years of monitoring. Active management of this site, including control of encroaching aspen and conifer trees and provision of earlier season nectar sources, may benefit mardon skipper populations

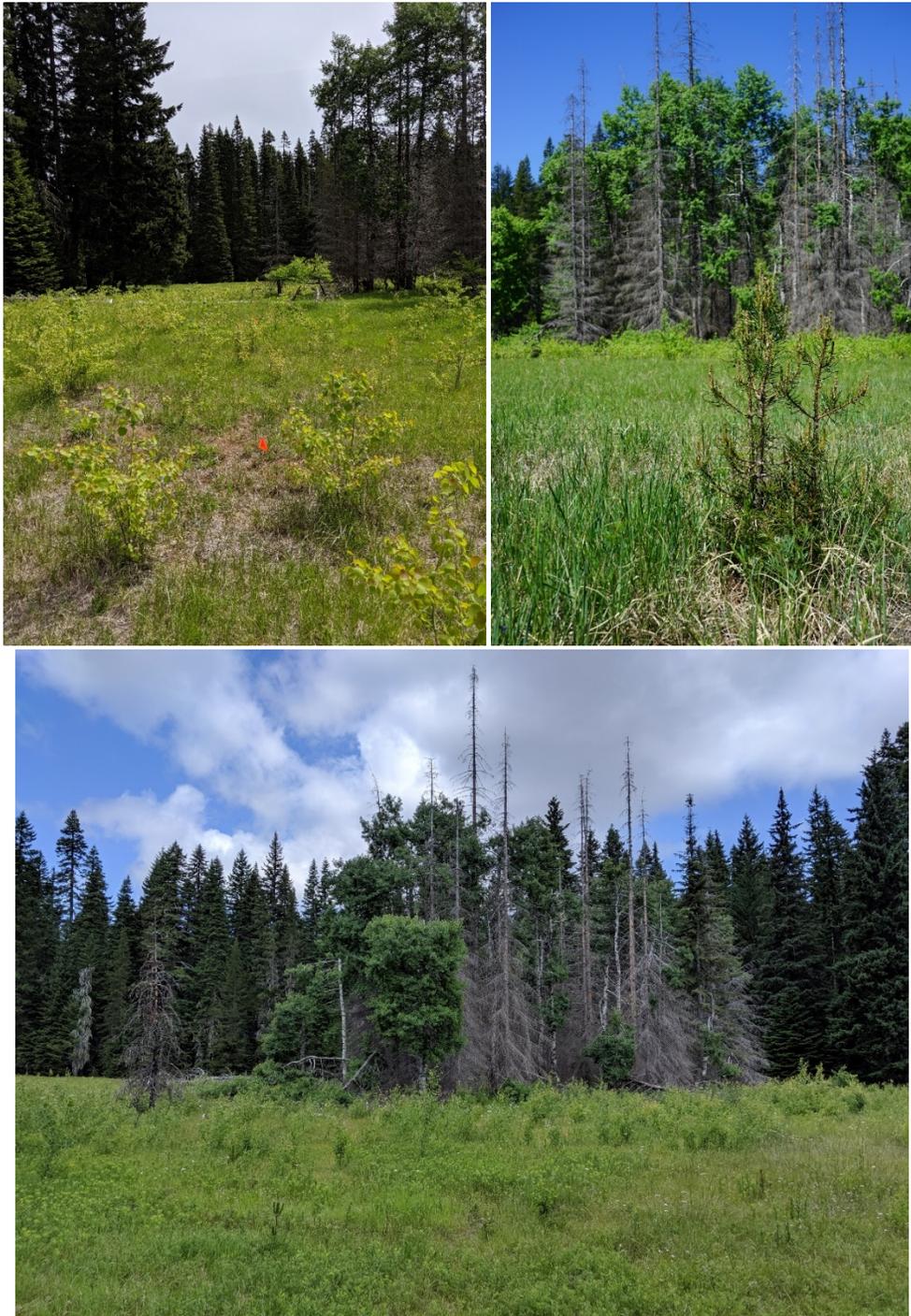


Figure 8: Aspen and conifer encroachment in Peterson Prairie West. Photos: Xerces Society/Candace Fallon, June - July 2019.

Similar to previous years, the most abundant nectar sources in 2019 were dusky horkelia (*Horkelia fusca*), camas (*Camassia quamash*), and purple violets (*Viola* spp.). Other blooming plants observed during the survey season included cinquefoil (*Potentilla* sp.), yarrow (*Achillea millefolium*), mariposa lilies (*Calochortus subalpinus*),

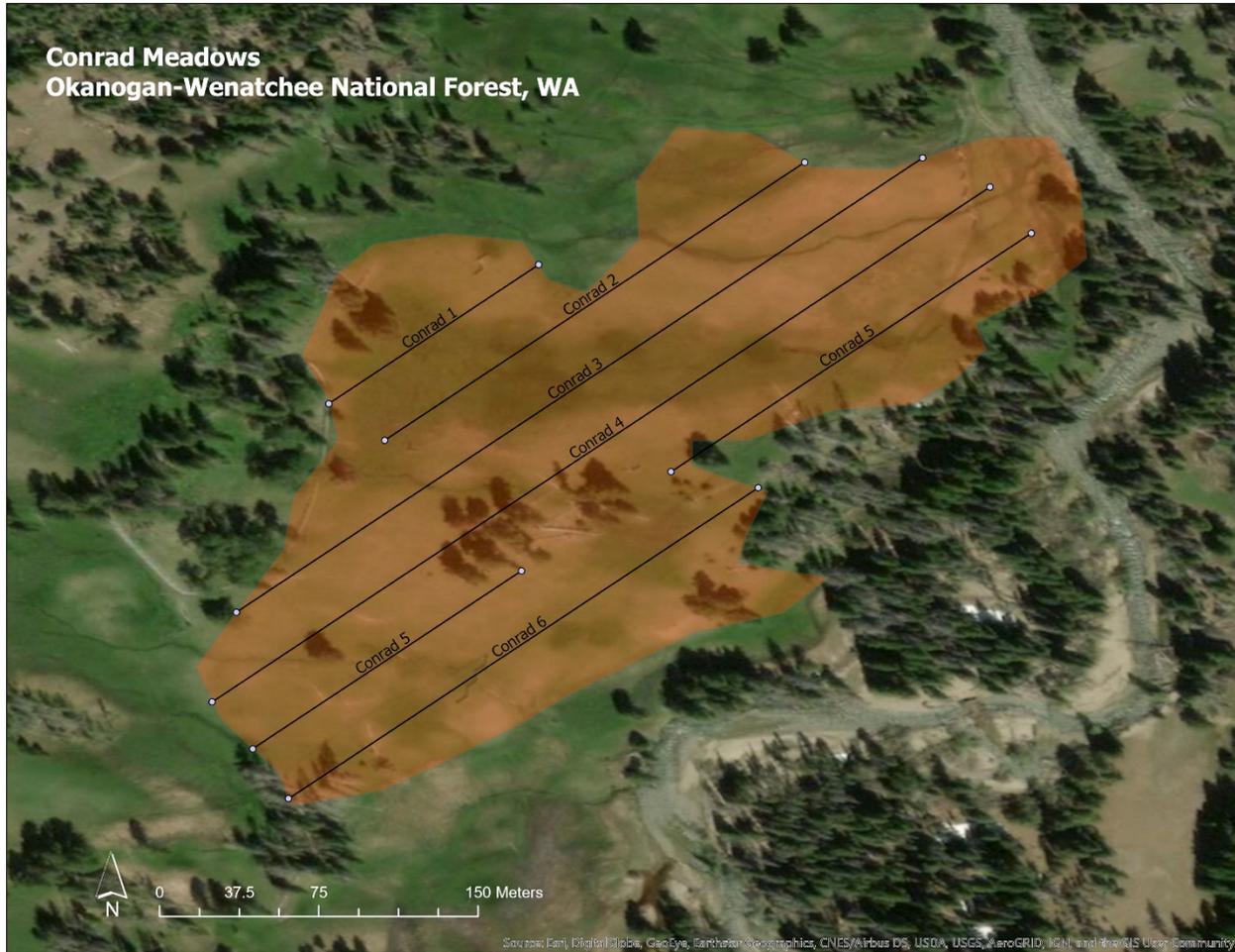
paintbrush (*Castilleja* sp.), tiger lilies (*Lilium columbianum*), blue-eyed grass (*Sisyrinchium* spp.), a purple iris (*Iris* sp.), checkermallow (*Sidalcea* sp.), Oregon sunshine (*Eriophyllum* sp.), strawberry (*Fragaria* sp.), vetch (*Vicia* sp.), pearly everlasting (*Anaphalis margaritacea*), blue-eyed mary (*Collinsia* sp.), goldenrod (*Solidago* sp.), purple owl clover (*Orthocarpus* sp.), purple asters, and spreading phlox (*Phlox diffusa*). As in years past, numerous butterfly and bumble bee species were observed in the two meadows. On June 9, a single putative western bumble bee (*Bombus occidentalis*) queen was observed on a transect in the North Meadow.

#### CONRAD MEADOWS, OKANOGAN-WENATCHEE NF, WA



Figure 9: Surveyors at Conrad Meadows with the Goat Rocks Wilderness in the background. Photo: USFS/Joan St. Hilaire, 2019.

Conrad Meadows (Figure 9) is part of a large complex of grass meadows near the edge of the Goat Rocks Wilderness (Map 4) at approximately 4,100 feet AMSL. Mardon skipper-inhabited areas are dominated by native onespoke oatgrass (*Danthonia unispicata*), with various species of *Poa* and *Carex* scattered throughout. In 2019, seven surveys were conducted at Conrad Meadows, with surveys beginning on June 5 and ending on July 17. No mardon skippers were detected on the first monitoring visit, indicating that the beginning of the flight period was successfully included in the monitoring period this year.



Map 4: Conrad Meadows distance sampling survey site

## RESULTS

Throughout the 2019 season, 1,951 skippers were observed in Conrad Meadows. The peak count of 728 butterflies occurred on June 24, 2019 (see Table 9). In the sampled occupied habitat, there is an estimated density of 2,485.5 mardon skippers per hectare (10.47% CV), and a population estimate of 9,571 mardon skippers (10.47% CV, habitat size of 3.85 HA, see Table 10). Note the low % CV for this site.

Table 9: Number of skippers detected by date at Conrad Meadows.

Site	Area (HA)	# Transects	Total Distance of Transects (m)	6/5/2019	6/13/2019	6/17/2019	6/24/2019	7/1/2019	7/8/2019	7/17/2019	Total Observed*
Conrad Meadows	3.85	6	1,435.39	0	38	384	728	472	286	43	1,951

\*Note: This includes all skippers detected during distance sampling (not just mardon skippers). It is possible that the same individuals were counted on multiple site visits.

Table 10: Conrad Meadows population estimates in 2019.

		2019			
Site	Estimate	Pop. size	% CV	95% CI	
Conrad Meadows	Density (N/HA)	2,485.50	10.47	1,984.50	3,113.00
	Population (N)	9,571	10.47	7,641	11,987

## DISCUSSION

Population estimates of mardon skippers continue to increase at Conrad Meadows. In 2019, detection of mardon skippers dropped below 50% after two meters, and although they were rare, detections continued beyond nine meters from the transect. This is significantly different from the other three sentinel sites, although consistent with detection functions at this site from years past, which likely reflects the relatively large mardon skipper population at this site (Figure 10). Because there were still mardon skippers flying on the last day of surveys, the annual estimate here should be interpreted as the low end as the length of the flight season is somewhat uncertain.

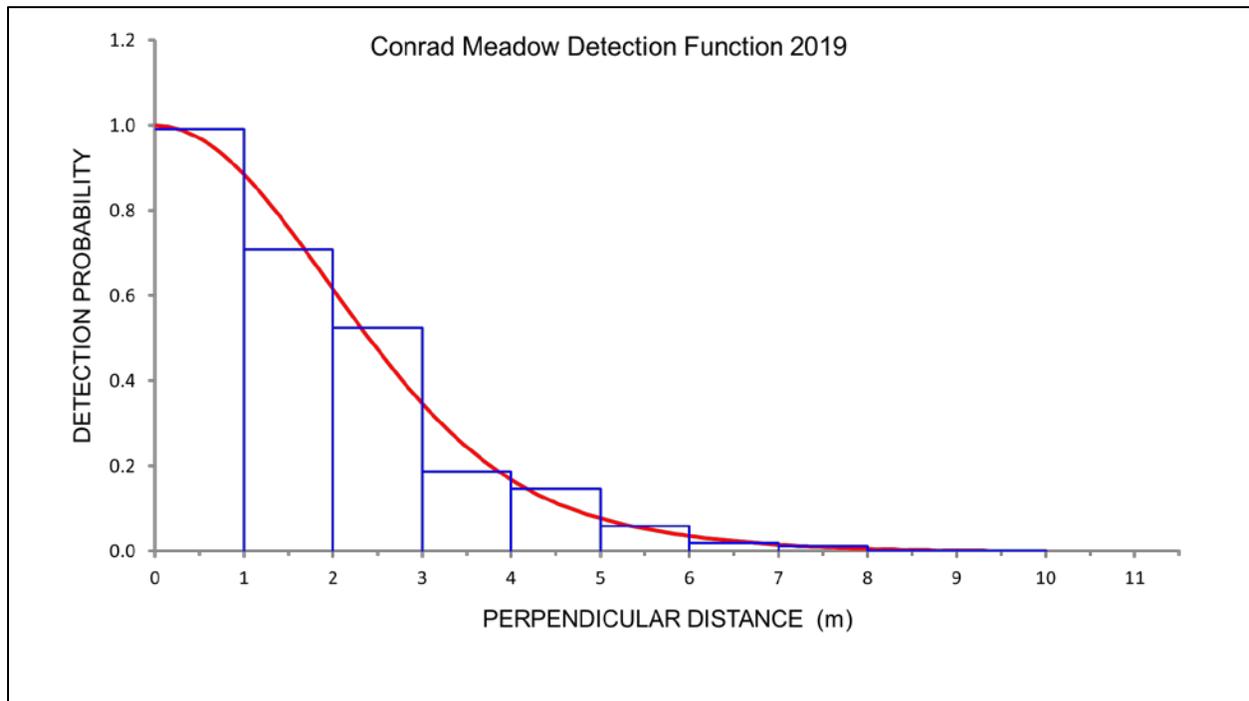


Figure 10: Conrad Meadows detection function

## ACKNOWLEDGEMENTS

We are grateful for the Interagency Special Status Sensitive Species Program’s continued interest in and financial support of this project. Long term monitoring efforts are invaluable for detecting changes in populations and informing management actions at both occupied and potentially occupied sites. For this sixth year of monitoring, distance sampling surveys were conducted by Elizabeth Hooper (Windy Valley, RRS), Norman Barrett (Lily Glen and Howard Prairie), Joan St. Hilaire (Conrad Meadows, OKW), and Candace Fallon (Peterson Prairie, GIP). We thank Trevor Sheffels (Conboy Lake NWR) for letting us know when skippers were flying at Conboy so we could time the Peterson Prairie surveys accordingly. At the Peterson Prairie site, we are grateful for additional help from Corey

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## REFERENCES

Allison, B., J. Dubuque, H. Witt, L. Miller. 2015. Mardon skipper (*Polites mardon*) management plan, Windy Valley Meadow. Rogue River-Siskiyou National Forest, Gold Beach Ranger District. Prepared for the Forest Service and Bureau of Land Management, Interagency Special Status/Sensitive Species Program (ISSSSP). 23 pp. Available from <https://www.fs.fed.us/r6/sfpnw/issssp/species-index/fauna-invertebrates.shtml> (accessed 27 November 2019).

Barret, N. 2019. Unpublished 2019 mardon skipper annual report summary to the Xerces Society. Independent Contractor, Shady Cove, OR.

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.

Black, S.H., L. Beyer, S. Jepsen, C.A. Mazzacano, M. Shepherd, A. Minnerath. 2010. Management plans for all Southern Oregon Cascade mardon skipper (*Polites mardon klamathensis*) sites on BLM lands. Prepared for the USDA Forest Service Region 6 and USDI Bureau of Land Management, Interagency Special Status/Sensitive Species Program. 72 pp. Available from <https://www.fs.fed.us/r6/sfpnw/issssp/species-index/fauna-invertebrates.shtml> (accessed 27 November 2019).

[BLM] Bureau of Land Management. 2019. OR-IM-2019-003 Transmittal of State Director Special Status Species List, with attachments. Available from <http://www.fs.fed.us/r6/sfpnw/issssp/agency-policy/> (accessed 27 November 2019).

Fallon, C., and R.G. Hatfield. 2013. Mardon skipper (*Polites mardon*) surveys at Conboy Lake National Wildlife Refuge. Final report to the U.S. Fish and Wildlife Service, Mid-Columbia River National Wildlife Refuge Complex. The Xerces Society.

Fallon, C. and R.G. Hatfield. 2014. Mardon skipper (*Polites mardon*) distance sampling surveys at four sentinel sites in Oregon and Washington. Final report to the U.S. Forest Service, Bureau of Land Management, and the Interagency Special Status/Sensitive Species Program (ISSSSP). The Xerces Society, Portland, OR. 31 pp.

Fallon, C. and R.G. Hatfield. 2015. Mardon skipper (*Polites mardon*) distance sampling surveys at four sentinel sites in Oregon and Washington: Year 2. Final report to the U.S. Forest Service, Bureau of Land Management, and the Interagency Special Status/Sensitive Species Program (ISSSSP). The Xerces Society, Portland, OR. 36 pp.

Hatfield, R. 2013. Mardon skipper (*Polites mardon*, W.H. Edward, 1881) rangewide monitoring protocol. The Xerces Society for Invertebrate Conservation.

Hatfield, R.G., S. H. Black, and S. Jepsen. 2013a. Range-wide strategy and monitoring protocol for the mardon skipper (*Polites mardon*, W. H. Edwards, 1881). The Xerces Society for Invertebrate Conservation.

Hatfield, R.G., S. H. Black, and S. Jepsen. 2013b. Management plans for mardon skipper (*Polites mardon* ssp. *klamathensis*) sites on Lily Glen and Howard Prairie. Prepared for the USDA Forest Service Region 6 and USDI Bureau of Land Management, Interagency Special Status/Sensitive Species Program. 26 pp. Available from <https://www.fs.fed.us/r6/sfpnw/issssp/species-index/fauna-invertebrates.shtml> (accessed 27 November 2019).

Hatfield, R.G., C. Fallon, and M. Blackburn. 2016. Mardon skipper (*Polites mardon*) distance sampling surveys at four sentinel sites in Oregon and Washington: Year 3. Final report to the U.S. Forest Service, Bureau of Land Management, and the Interagency Special Status/Sensitive Species Program (ISSSSP). The Xerces Society, Portland, OR. 44 pp.

Hatfield, R.G., C. Fallon, and M. Blackburn. 2017. Mardon skipper (*Polites mardon*) distance sampling surveys at four sentinel sites in Oregon and Washington: Year 4. Final report to the U.S. Forest Service, Bureau of Land Management, and the Interagency Special Status/Sensitive Species Program (ISSSSP). The Xerces Society, Portland, OR. 41 pp.

Hatfield, R.G., C. Fallon, and M. Blackburn. 2018a. Mardon skipper rangewide distance sampling protocol: A four year report on trends, analyses, and suggested next steps. Report from the Xerces Society to the Interagency Special Status/Sensitive Species Program (ISSSSP). The Xerces Society, Portland, OR. 19 pp.

Hatfield, R.G., C. Fallon, and M. Blackburn. 2018b. Mardon skipper (*Polites mardon*) distance sampling surveys at four sentinel sites in Oregon and Washington: Year 5. Final report to the U.S. Forest Service, Bureau of Land Management, and the Interagency Special Status/Sensitive Species Program (ISSSSP). The Xerces Society, Portland, OR. 31 pp.

Hudec, J.L., J.E. Halofsky, D.L. Peterson, J.J. Ho (Eds.). 2019. Climate change vulnerability and adaptation in southwest Washington. Gen. Tech. Rep. PNW-GTR-977. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station. 249 pp.

Kerwin, A. E. 2011. Conservation assessment for the mardon skipper (*Polites mardon*). Version 2.0. Interagency Special Status/Sensitive Species Program, USDA Forest Service Region 6, and USDI Bureau of Land Management, Oregon and Washington. 60 pp.

[ORBIC] Oregon Biodiversity Information Center. 2019. Rare, Threatened, and Endangered Species of Oregon. Institute for Natural Resources, Portland State University, Portland, Oregon. 133 pp.

Pollard, E. and T. J. Yates. 1994. Monitoring butterflies for ecology and conservation: the British butterfly monitoring scheme. Springer.

Potter, A. and G. Olson. 2012. Monitoring mardon skipper (*Polites mardon*) on the Scatter Creek Wildlife Area. Washington Department of Fish and Wildlife.

Potter, A., J. Fleckenstein, and J. Feen. 2002. Mardon skipper range and distribution in Washington in relation to state and federal highways with a habitat description and survey method guidelines. Final report to Washington Department of Transportation.

Pyle, R.M. and C. LaBar. 2018. Butterflies of the Pacific Northwest. Timber Press Field Guide. 461 pp.

Seitz, R., A. Potter, K. Van Norman, N. Barrett, and M. Wainwright. 2007. Survey protocol for the Mardon skipper (*Polites mardon*), version 1.1. USDA Forest Service Region 6 and USDI Bureau of Land Management, Oregon and Washington, Portland, Oregon. 30 pp.

St. Hilaire, J. 2012. Mardon skipper (*Polites mardon*) management plans for Okanogan-Wenatchee National Forest, South Fork Tieton Subwatershed sites on Forest Service lands. Prepared for the USDA Forest Service Region 6 and USDI Bureau of Land Management, Interagency Special Status/Sensitive Species Program. 87 pp. Available from <https://www.fs.fed.us/r6/sfpnw/issssp/species-index/fauna-invertebrates.shtml> (accessed 27 November 2019).

St. Hilaire, J. 2017. Restoration and management report of mardon skipper sites on the Okanogan-Wenatchee National Forest 2017. Prepared for the USDA Forest Service Region 6 and USDI Bureau of Land Management, Interagency Special Status/Sensitive Species Program. 16 pp. Available from <https://www.fs.fed.us/r6/sfpnw/issssp/species-index/fauna-invertebrates.shtml> (accessed 27 November 2019).

Thomas, L., S. T. Buckland, E. A. Rexstad, J. L. Laake, S. Strindberg, S. L. Hedley, J. R. B. Bishop, T. A. Marques, and K. P. Burnham. 2010. Distance software: design and analysis of distance sampling surveys for estimating population size. *Journal of Applied Ecology* **47**:5–14.

[USFS] US Forest Service. 2019. Transmittal – Regional Forester Special Status Species List, with enclosures. Available from <http://www.fs.fed.us/r6/sfpnw/issssp/agency-policy/> (accessed 27 November 2019).

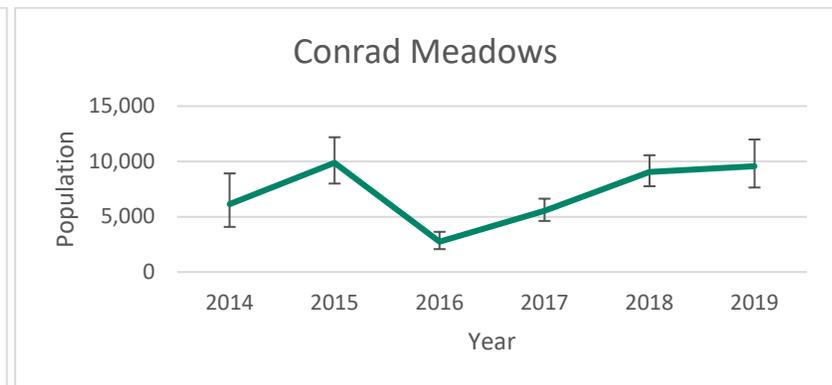
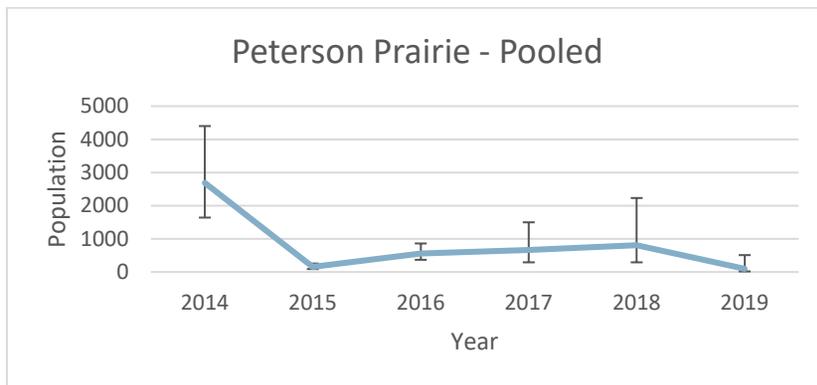
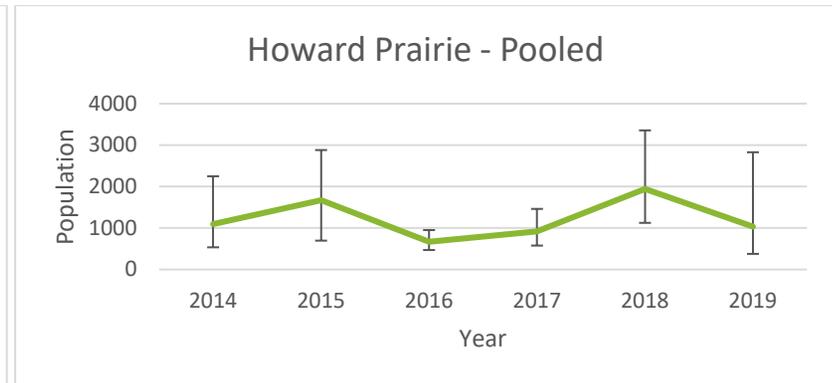
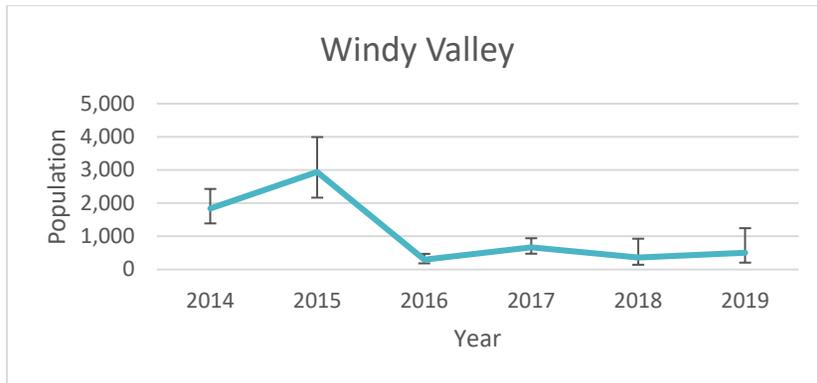
Vaughn, R. 2018. Personal communication with the Mardon Skipper Work Group annual conference call. Wildlife Biologist, Rogue River-Siskiyou National Forest, Powers and Gold Beach Ranger District. February 28.

Wainwright, M. 2012. Site management plans for Lost Meadow, Peterson Prairie North and West, Cave Creek Meadow, and Lost Creek Meadow mardon skipper (*Polites mardon*) sites on Mount Adams Ranger District, Gifford Pinchot National Forest. Prepared for the USDA Forest Service Region 6 and USDI Bureau of Land Management, Interagency Special Status/Sensitive Species Program. 28 pp. Available from <https://www.fs.fed.us/r6/sfpnw/issssp/species-index/fauna-invertebrates.shtml> (accessed 27 November 2019).

[WNHP] Washington Natural Heritage Program. 2017. Animal Species with Ranks. Available online at [https://www.dnr.wa.gov/publications/amp\\_nh\\_animals\\_ranks.pdf](https://www.dnr.wa.gov/publications/amp_nh_animals_ranks.pdf) (accessed 2 November 2018).

## APPENDIX A: POPULATION ESTIMATES FROM 2014 TO 2019

Population estimates for all survey sites from 2014 through 2019. Pooled estimates are shown for Howard Prairie and Peterson Prairie. Note that it is possible that the same individuals were counted on multiple site visits. Error bars represent the 95% CI.



## APPENDIX B: ENDPPOINTS FOR DISTANCE SAMPLING TRANSECTS

Coordinate endpoints for distance sampling transects. Coordinates are NAD 1983, Zone 10. Note that the Howard Prairie endpoints are different from those used in 2014.

Site	Points	UTM E (X)	UTM N (Y)
Windy Valley		<b>Transect 1</b>	<b>1</b>
	<b>Start</b>	405329.4	4687206.3
	<b>End</b>	405334.0	4687264.1
		<b>Transect 2</b>	<b>2</b>
	<b>Start</b>	405306.1	4687179.0
	<b>End</b>	405314.6	4687280.0
		<b>Transect 3</b>	<b>3</b>
	<b>Start</b>	405285.1	4687186.2
<b>End</b>	405253.7	4687284.4	
Howard Prairie		<b>Transect 1</b>	<b>1</b>
	<b>Start</b>	545512.4	4679411.2
	<b>End</b>	545653.7	4679552.5
		<b>Transect 2</b>	<b>2</b>
	<b>Start</b>	545534.7	4679362.8
	<b>End</b>	545796.2	4679624.3
		<b>Transect 3</b>	<b>3</b>
	<b>Start</b>	545569.7	4679327.1
<b>End</b>	545778.3	4679535.7	
	<b>Transect 4</b>	<b>4</b>	
<b>Start</b>	545604.7	4679291.3	
<b>End</b>	545760.2	4679446.8	
Lily Glen		<b>Transect 1a</b>	<b>1a</b>
	<b>Start</b>	546641.5	4679833.1
	<b>End</b>	546824.6	4680016.3
		<b>Transect 1b</b>	<b>1b</b>
	<b>Start</b>	546641.7	4679762.6
	<b>End</b>	546879.8	4680000.8
		<b>Transect 2a</b>	<b>2a</b>
	<b>Start</b>	546641.7	4679762.6
	<b>End</b>	546879.8	4680000.8
		<b>Transect 2b</b>	<b>2b</b>
	<b>Start</b>	546910.6	4680031.6
	<b>End</b>	547064.7	4680185.8

Site	Points	UTM E (X)	UTM N (Y)
Lily Glen continued		<b>Transect 3</b>	<b>3</b>
	<b>Start</b>	546696.1	4679746.3
	<b>End</b>	547178.5	4680228.8
		<b>Transect 4</b>	<b>4</b>
	<b>Start</b>	547057.6	4680037.2
	<b>End</b>	547097.6	4680077.2
		<b>Transect 5</b>	<b>5</b>
	<b>Start</b>	547055.5	4679964.4
	<b>End</b>	547230.5	4680139.4
		<b>Transect 6</b>	<b>6</b>
<b>Start</b>	547105.0	4679943.1	
<b>End</b>	547213.7	4680051.7	
Peterson Prairie North		<b>Transect 1</b>	<b>1</b>
	<b>Start</b>	603607.9	5091704.6
	<b>End</b>	603622.5	5091984.8
		<b>Transect 2</b>	<b>2</b>
	<b>Start</b>	603632.6	5091699.4
	<b>End</b>	603647.4	5091982.2
		<b>Transect 3</b>	<b>3</b>
	<b>Start</b>	603657.4	5091694.3
	<b>End</b>	603670.1	5091937.0
		<b>Transect 4</b>	<b>4</b>
	<b>Start</b>	603682.2	5091689.2
	<b>End</b>	603692.7	5091890.4
	<b>Transect 5</b>	<b>5</b>	
<b>Start</b>	603583.1	5091709.7	
<b>End</b>	603597.6	5091987.3	
Peterson Prairie West		<b>Transect 1</b>	<b>1</b>
	<b>Start</b>	603500.1	5091641.5
	<b>End</b>	603568.3	5091653.6
		<b>Transect 2</b>	<b>2</b>
	<b>Start</b>	603380.4	5091595.0
	<b>End</b>	603588.0	5091631.7

Site	Points	UTM E (X)	UTM N (Y)
Peterson Prairie West continued		<b>Transect</b>	<b>3a</b>
	<b>Start</b>	603369.6	5091567.8
	<b>End</b>	603455.4	5091582.9
		<b>Transect</b>	<b>3b</b>
	<b>Start</b>	603479.7	5091587.2
	<b>End</b>	603587.6	5091606.2
		<b>Transect</b>	<b>4</b>
	<b>Start</b>	603368.9	5091542.3
<b>End</b>	603586.4	5091580.6	
Conrad Meadows		<b>Transect</b>	<b>1</b>
	<b>Start</b>	631231.9	5151253.8
	<b>End</b>	631298.6	5151320.5
		<b>Transect</b>	<b>2</b>
	<b>Start</b>	631250.4	5151237.0
	<b>End</b>	631384.0	5151370.5
		<b>Transect</b>	<b>3</b>
	<b>Start</b>	631204.0	5151155.2
	<b>End</b>	631422.2	5151373.3
		<b>Transect</b>	<b>4</b>
	<b>Start</b>	631197.1	5151112.9
	<b>End</b>	631444.3	5151360.1
		<b>Transect</b>	<b>5a</b>
	<b>Start</b>	631210.7	5151091.1
	<b>End</b>	631296.2	5151176.6
		<b>Transect</b>	<b>5b</b>
	<b>Start</b>	631343.7	5151224.2
	<b>End</b>	631458.3	5151338.7
		<b>Transect</b>	<b>6</b>
	<b>Start</b>	631222.9	5151068.0
<b>End</b>	631372.2	5151217.2	