

Final report on Umatilla National Forest surveys for the Intermountain sulphur butterfly (*Colias occidentalis pseudochristina* = *Colias christina pseudochristina*)

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Summary

Alexa Carleton and Lori Ann Burd (Xerces Society) conducted surveys for the intermountain sulphur (*Colias occidentalis pseudochristina* = *Colias christina pseudochristina*) in May, 2012 in the Umatilla National Forest of eastern Washington (Pomeroy District). The primary objective was to determine whether *C. o. pseudochristina* occurred on U. S. Forest Service or Bureau of Land Management land in Washington. Approximately 165 field and travel person hours were spent surveying 13 sites in the Umatilla National Forest (no suitable BLM habitat was identified near historic localities). No *C. o. pseudochristina* individuals were observed during the surveys, but surveyors found one deceased specimen on private land in Wallowa County, Oregon, which is a site from which this species has recently been recorded. Many of the sites surveyed contained potentially suitable habitat but were likely visited at least 1-2 weeks too early, given their elevation and flowering phenology. Additional surveys could be conducted at these sites in mid-late June and possibly in July.

Introduction

The intermountain sulphur (*Colias occidentalis pseudochristina* = *Colias christina pseudochristina*) is found from the eastern Blue Mountains in Washington, through the Blue and Ochoco Mountains in Oregon, along the Snake River in Idaho, and south into western Utah. There are relatively few records of this subspecies in Oregon and Washington, and many of the existing populations may have been negatively influenced by habitat loss and aerial spraying of Btk (*Bacillus thuringiensis* var. *kurstaki*) for forest-defoliating moths (Hammond 2009, pers. comm. with S. Foltz). Additionally, the widespread spraying of Dimilin, pyrethroids, and organophosphates for grasshopper control occurs yearly in the range of this species (ODA 2008, Walenta 2008), and may pose further threats (Foltz 2009a).

In Washington, *C. o. pseudochristina* has been recorded in two localities of southern Asotin County: Field Springs State Park and Rattlesnake Creek Canyon along Highway 129, although the most recent records are from 1987 and 1989, respectively (Table 1). Rattlesnake Creek Canyon observers suspect that this colony was wiped out by spraying in the late 1980s; it is unknown whether *C. o. pseudochristina* still occurs at this site.

Although *C. o. pseudochristina* is presumed to be extirpated from WA (Pyle 2009, pers. comm. with S. Foltz), it is suspected on Umatilla National Forest and BLM (Vale District) land in WA, and to the best of our knowledge, these areas had not been systematically surveyed for this subspecies prior to 2012. In early May, Alexa Carleton and Sarina Jepsen (Xerces Society) visited a historic locality in WA (Field Springs State Park) and a current locality in OR (Wallowa River) while doing snail surveys nearby. Between May 28 and June 1, 2012, A. Carleton and Lori Ann Burd of the Xerces Society, joined by two U.S. Forest Service wildlife biologists, surveyed suitable habitat on federal land near the historic localities in WA.

Survey protocol

Site selection

Prior to commencing surveys, we reviewed the historic localities for the target species (Table 1). Survey locations were selected in part by proximity of suitable habitat (on BLM or Forest Service land) to historic localities and on the suspected distribution (Figure 1).

Table 1. Historic *C. o. pseudochristina* collection localities in WA

Date	State	County	Location	Habitat	Observer	Reference
6/1/86	WA	Asotin	Rattlesnake Creek Canyon	3500 ft.	B.E. Sullivan	Shepard, J. 2009. Personal communication with Sarah Foltz.
5/31/86	WA	Asotin	Rattlesnake Creek Canyon	3500 ft.	B.E. Sullivan	Shepard, J. 2009. Personal communication with Sarah Foltz.
5/23/87	WA	Asotin	Rattlesnake Creek Canyon	3500 ft.	B.E. Sullivan	Shepard, J. 2009. Personal communication with Sarah Foltz.
5/30/89	WA	Asotin	Rattlesnake Creek Canyon	3500 ft. Subsequent spraying may have decimated colony.	B.E. Sullivan	Shepard, J. 2009. Personal communication with Sarah Foltz.
6/3/87	WA	Asotin	Field Springs State Park		Nelson Curtis	Shepard, J. 2009. Personal communication with Sarah Foltz.
6/6/87	WA	Asotin	Field Springs State Park		Nelson Curtis	Shepard, J. 2009. Personal communication with Sarah Foltz.
6/7/87	WA	Asotin	State HWY 129, North of Field Spring State Park	South-facing slope	W.F. Wehling	Shepard, J. 2009. Personal communication with Sarah Foltz

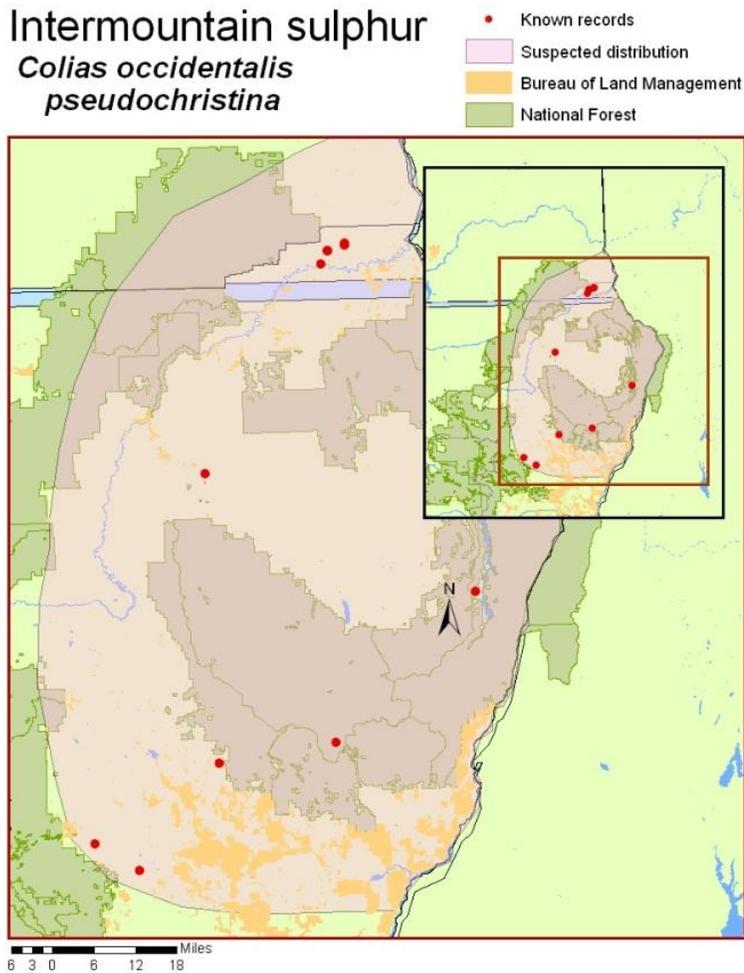


Figure 1. Known records and suspected distribution of *C. o. pseudochristina* in OR and WA. Map made by S. Foltz, 2009.

We reviewed the known habitat associations and requirements for this species across its range (summarized in Foltz 2009a). *C. o. pseudochristina* inhabits open woodland from 2600-5000 feet (Foltz 2009a; A. Carleton, pers. obs.), including meadows, roadsides, and open forest. Warren (2005) states that members of this subspecies are most often found on steep, sunny slopes at the ecotone between forest and shrub steppe or grassland habitats. Hammond (2009) describes suitable habitat as sagebrush with scattered Ponderosa pine, including both south- and east-facing slopes. The larvae feed on peavines of the genus *Lathyrus*, including *L. brachycalix*, *L. lanzwertii*, *L. pauciflorus*, and *L. nevadensis* (Hammond 2009, pers. comm. with S.

Foltz), and the Asotin County population in Washington was reported to feed on *L. pauciflorus* (reviewed in Warren 2005). Adults use a variety of plants as nectar sources (Warren 2005).

A. Carleton consulted with Holly Harris, Del Groat, and Bill Dowdy (Wildlife biologists, Umatilla National Forest), and David Bragg (a local entomologist in Pomeroy, WA) to identify areas on USFS or BLM land that may share similar habitat characteristics to those known for historic *C. o. pseudochristina* populations. Additionally, she consulted with Catherine Hovanic (WA Native Plant Society) and Mark Darrach and Joan Frazee (USFS botanists) regarding *Lathyrus* distribution in southeast WA and searched for records on the Consortium of Pacific Northwest Herbaria website (UW Herbarium 2011). M. Darrach confirmed that both *L. pauciflorus* and *L. nevadensis* occur in some abundance within the Pomeroy District (2012, pers. comm. with A. Carleton). However, no *Lathyrus* records are reported on federal land in Asotin Co. and only two records exist on or near USFS land in Columbia County (UW Herbarium 2011).

Based on these consultations, a handful of sites in the Pomeroy Ranger District (Asotin Co.) were chosen as a starting point for our surveys. These sites were north of the Grande Ronde River and within 3-16 miles of the historic locations along Highway 129. However, when we began our surveys, we expanded our survey distance to include sites in Columbia County that were up to 30 miles from historic locations.

Survey period

Depending on seasonal conditions, *C. o. pseudochristina* adults fly mostly in late May (e.g. Asotin Co., Washington, 3500 feet; Table 1). However, individuals have been collected at higher elevations through late June and early July, so the survey period for this subspecies could span May-July (Foltz 2009b). We made an effort to complete our surveys in late May/early June.

Sampling methodology

A. Carleton and S. Jepsen (Xerces Society) visited one known population (Wallowa River Wayside in Oregon) and one historic locality (Field Springs State Park in WA) in early May to obtain a search image for the habitat and, if possible, the butterfly. No *Colias* butterflies were seen at either location, but *Lathyrus* (the presumed host plant genus) was abundant at the Oregon site. Historic localities along Highway 129 in Rattlesnake Creek Canyon are on private land and were not accessible.

A. Carleton and L. A. Burd (Xerces Society) and D. Groat and B. Dowdy (USFS) conducted *C. o. pseudochristina* surveys between May 28 and June 1, 2012. While driving or hiking in each selected region, we looked for key habitat characteristics such as south- and east-facing slopes, Ponderosa pines, sagebrush, and any plants resembling *Lathyrus*. Since other *C. occidentalis* butterflies use *Lupinus* and *Vicia* plants as hosts (Warren 2005), we took note of anything in the legume/pea family (Fabaceae). If a site had any of these characteristics, we spent a minimum of 15 minutes slowly walking the area and looking for adult butterflies. The total amount of time spent varied depending on whether any butterflies were flying. We attempted to catch and identify all adult butterflies. If no butterflies were encountered, we took a photo of the site and moved on. In a few cases, the weather was too cool and we returned to the site later once the conditions had improved.

In addition to the pre-selected sites, we surveyed other sites along the way that had the key habitat features listed above. We used a Garmin Rino hand-held GPS unit to obtain geographic coordinates for each site surveyed.

Sites surveyed and survey results

A summary table of all sites surveyed is provided in Appendix I. Maps of all the sites surveyed can be found in Appendix II. Below, we provide photos and a description of each site visited.

May 28, 2012: Mallory Ridge, Asotin County

On the first day, we surveyed the sites closest to historic localities (~4 miles northwest of the localities along Highway 129). We started at Mullin Spring (near Mallory Ridge) and moved west along W Mountain Road (NF-3404), surveying suitable habitat as we encountered it. The Mullin sites are along a ridge that partially overlooks Rattlesnake Creek Canyon and Highway 129, ~7-11 miles east of Anatone, WA, in the easternmost portion of the Umatilla National Forest in WA (Appendix II, Figure 2).

Site 1—Mullin Spring (USFS Pomeroy Ranger District)



May 28, 2012. 11:40 AM – 12:50 PM. A. Carleton and L. A. Burd searched the habitat around Mullin Spring, which included a sunny, south-facing hillside (*Lupinus* was present, but no *Lathyrus*) and a more forested area by the spring. We saw other butterflies flying, including a hairstreak, white, comma, spring azure, and snowberry checkerspot (*Euphydryas colon wallacensis*; Warren 2012, pers. comm.) but did not see any sulphurs. Mullin 2 and Mullin 3 are within two miles of Mullin Spring as we moved west along W Mountain Road (NF-4304).

Site 2—Mullin 2 (USFS Pomeroy Ranger District)



May 28, 2012. 2:00 PM – 2:40 PM. A. Carleton and L. A. Burd surveyed a south-facing slope and flat, open meadow with sagebrush and pine trees nearby. Flowering plants included *Phlox*, *Lupinus* (mostly pre-bloom), *Balsamorhiza*, *Astragalus*, and *Delphinium nuttallianum*. Butterflies spotted included a white, blue, swallowtail, and orangetip, but no sulphurs. The intermittent clouds and rain were not ideal conditions for butterflies, so we ended the survey and moved on.

Site 3—Mullin 3 (USFS Pomeroy Ranger District)



May 28, 2012. 3:40 PM – 4:15 PM. A. Carleton and L. A. Burd surveyed a flat meadow and steep sunny hillside with Ponderosa pine, sagebrush, and a variety of flowering plants (no *Lathyrus*). Butterflies observed included an Anise swallowtail, orangetip, blue, and copper (no sulphurs).

May 29, 2012: Smoothing Iron and Park Ridge, Asotin County

We were joined by Del Groat and Bill Dowdy (USFS Pomeroy District biologists), who led us to some other sites in Asotin County. Sites visited on this day were within 10-13 miles of the historic Highway 129 sites and ~22 miles southwest of Clarkston, WA (Appendix II, Figure 3).

Site 1—Black Ranch 1 (State land in Asotin Wildlife Area)



May 29, 2012. 11:30 AM – 12:00 PM. A. Carleton, L. A. Burd, D. Groat, and B. Dowdy stopped at this site along Smoothing Iron Road (NF-44) overlooking Cooper Canyon (we were within 150 meters of USFS land). We surveyed a steep slope and flat area with lots of flowers in bloom, including *Castilleja*, *Balsamorhiza*, *Astragalus*, and *Lupinus sulphureus*. We saw silvery blues and Butler’s alpines, but no sulphurs.

Site 2—Black Ranch 2 (USFS Pomeroy Ranger District)



May 29, 2012. 12:00 PM – 12:30 PM. A. Carleton, L. A. Burd, D. Groat, and B. Dowdy surveyed this steep hillside along Smoothing Iron Road (NF-44). Blooming plants included *Balsamorhiza*, *Astragalus*, and *Lupinus sulphureus*. The weather was fairly cool (50-55 degrees F), but blue butterflies were flying.

Site 3—Cook Spring (USFS Pomeroy Ranger District)



May 29, 2012. 12:45 PM – 1:00 PM. A. Carleton, L. A. Burd, D. Groat, and B. Dowdy stopped along NF-200 near Cook Spring and did a quick survey of this open, flat area with pine trees. The weather was cool (50-55 degrees F) and there was very little nectar available (lupine was present but not yet in bloom). The habitat did not appear suitable at this point in the season.

Site 4—Park Ridge (USFS Pomeroy Ranger District)



May 29, 2012. 1:55 PM – 3:00 PM. A. Carleton, L. A. Burd, D. Groat, and B. Dowdy surveyed a steep hillside and flat plateau along Park Ridge (NF-148). Flowering vegetation included *Castilleja*, *Balsamorhiza*, *Lupinus* (most was pre-bloom), and *Astragalus*. No sulphurs were seen; other butterflies included swallowtails, blues, Butler’s alpine, and an undescribed subspecies of Edith’s checkerspot (*Euphydryas editha*, NE Oregon segregate; Warren 2012, pers. comm.).

Site 5—Park Spring 1 (USFS Pomeroy Ranger District)



May 29, 2012. 3:30 PM – 3:55 PM. A. Carleton, L. A. Burd, D. Groat, and B. Dowdy surveyed a hillside near Park Spring along NF-140. There were pine trees nearby, but not many flowers in bloom (some *Lupinus* and *Delphinium nuttallianum*). Butterflies observed included blues, checkerspots, swallowtail, Butler’s alpine, orangetip, and white (no sulphurs).

Site 6—Park Spring 2 (USFS Pomeroy Ranger District)



May 29, 2012. 4:00 PM – 4:30 PM. A. Carleton, L. A. Burd, D. Groat, and B. Dowdy surveyed another hillside close to Park Spring on NF-140. This site had a lot of shrubs and not much nectar (some *Lupinus* and *Delphinium and nuttallianum*). We observed an undescribed subspecies of Edith’s checkerspot (*Euphydryas editha*, NE Oregon segregate; Warren 2012, pers. comm.) but no sulphurs.

May 30, 2012: Wenaha-Tucannon Wilderness, Columbia County

Given that we did not see any sulphurs on May 28 or 29, the USFS biologists recommended going into the Tucannon Wilderness (Columbia County) to check out some other sites. All three sites from this day were within 2 miles of William T. Wooten State Park (Appendix II, Figure 4). The first site, Hixon Creek, is a lower elevation site that is known to be a butterfly hotspot and was recommended to us by David Bragg, a local entomologist. All sites surveyed on May 30 were approximately 25-30 miles northwest of historic locations and within ~3.5 miles of historic *L. nevadensis* and *L. pauciflorus* locations (records from 1937 and 1966, respectively; UW Herbarium 2011).

Site 1—Hixon Creek (USFS Pomeroy Ranger District)



May 30, 2012. 11:00 AM – 12:20 PM. A. Carleton, L. A. Burd, D. Groat, and B. Dowdy parked on State Fish and Wildlife land along NF-160 in Hixon Canyon and walked 150 meters to USFS land. We hiked ~0.5 miles along NF-165, an old road that parallels Hixon Creek, searching the steep south-facing slope from the trail. This area had Ponderosa pines but not many other suitable habitat characteristics. Vegetation included *Lupinus* (not flowering) and *Holodiscus*. We saw a few butterflies (swallowtails, ringlets, whites, western-tailed blues, greenish blues, and spring azures), but even this lower elevation site seemed to be 1-2 weeks behind schedule in terms of flower and butterfly phenology.

Site 2—Eckler Mountain (USFS Pomeroy Ranger District)



May 30, 2012. 1:45 PM – 2:20 PM. A. Carleton, L. A. Burd, D. Groat, and B. Dowdy stopped along NF-030 to survey a steep hillside with Ponderosa pine and sagebrush. Blooming flowers included *Castilleja*, *Astragalus*, and *Lupinus sulphureus*. We saw silvery blues, swallowtails, and

checkerspots, but no sulphurs. The habitat matched descriptions on historic records of *C. o. pseudochristina*, but we may have been too early in the season (elevation was ~4300 feet).

Site 3—Maloney Mountain (USFS Pomeroy Ranger District)



May 30, 2012. 3:00 PM – 3:20 PM. A. Carleton, L. A. Burd, D. Groat, and B. Dowdy stopped along NF-013 and surveyed a flat meadow with steep slopes nearby. Flowers included *Lupinus*, *Balsamorhiza*, *Delphinium*, and *Astragalus*, although much of the lupine was pre-bloom, indicating that we might have been too early at this elevation (~4200 feet). The habitat looked promising but we saw few butterflies (blues only).

May 31, 2012: Mallory Ridge, Asotin County

After three days of surveys, we returned to the Mullin Spring area (near Mallory Ridge) that we visited on the first day (Appendix II, Figure 2). These sites had suitable habitat characteristics, but the weather had not been ideal during our first surveys there. Because many of the sites surveyed so far had been at a fairly high elevation and we were not seeing many butterflies or much nectar, our priority for this day was to survey some lower elevation sites. We spent most of the day hiking to and surveying a site along Indian Tom Creek that was recommended by USFS biologists and returned to Mullin 2 at the end of the day.

Site 1—Indian Tom Creek (USFS Pomeroy Ranger District)



May 31, 2012. At 10:00 AM, A. Carleton and L. A. Burd parked at the Indian Tom horse corral (~4 miles west of Mullin Spring on W Mountain/NF-4304). We started at ~5000 feet in elevation and began a steep descent along the Indian Tom Creek trail, which passes Indian Tom Spring and parallels Indian Tom Creek. The goal was to reach some sites in the 3500-3600 feet elevation band. We surveyed a steep hillside (~3600 feet) near Sawtooth Ridge from 12:00 PM – 12:45 PM. Flowering plants included *Castilleja*, *Lupinus* (mostly pre-bloom), *Penstemon deustus*, *Scutellaria angustifolia*, and *Eryophyllum lanatum*. We saw a handful of butterflies, including blues, swallowtails, and snowberry checkerspots (*Euphydryas colon wallacensis*; Warren 2012, pers. comm.). We also saw a large, orangeish butterfly that could have been a sulphur but was flying too fast to identify. This would be a good site to survey in the future, and there was some promising habitat with steep, south-facing slopes along the trail (if surveyors are willing to scramble). However, future surveyors should be aware that this is bear habitat (we saw tracks and fresh scat), and we were warned about rattlesnakes farther down the trail.

Site 2—Mullin 2 (USFS Pomeroy Ranger District)



May 31, 2012. 02:30 PM – 04:15 PM. We returned to Mullin 2, a site we visited on the first day of surveys (see page 9). The weather was a cool, cloudy, windy 58 degrees; we had lunch there and waited for conditions to improve, but it eventually started raining so we decided to return again the following day.

June 1, 2012: Mallory Ridge, Asotin County, and Wallowa Wayside, Wallowa County (OR)

We again returned to the Mullin Spring area that we'd visited on the first day (Appendix II, Figure 2). These sites had suitable habitat characteristics, but the weather had not been ideal during our surveys. This was our last day of surveys; however, on our way out of town, we made one more stop at the Wallowa River Wayside in Oregon (the known *C. o. pseudochristina* population that we had visited two weeks prior).

Mallory Ridge, Asotin County

Site 1—Mullin 2 (USFS Pomeroy District)

No photo (see page 9).

June 1, 2012. 10:50 AM – 11:30 AM. A. Carleton and L. A. Burd returned to Mullin 2 and surveyed the same flat, open meadow with sagebrush and pine trees nearby and steep south- and east-facing slopes. The weather was better this time (there were wind gusts but no rain). We saw swallowtails and commas but no sulphurs.

Site 2—Mullin Spring (USFS Pomeroy District)

No photo (see page 8).

June 1, 2012. 11:30 AM – 12:15 PM. A. Carleton and L. A. Burd returned to a site visited on Day 1 and surveyed the same sunny, south-facing hillside and spring. The weather was much better (72 degrees F) and we saw a handful of butterflies: blues, whites, commas, orangetips, and snowberry checkerspots (*Euphydryas colon wallacensis*; Warren 2012, pers. comm.), but no sulphurs.

Site 3—Mullin 4 (USFS Pomeroy District)



June 1, 2012. 12:20 PM – 12:35 PM. A. Carleton and L. A. Burd stopped at one more site along W Mountain Road (NF-4304), ~1 mile east of Mullin Spring. The habitat looked suitable from the road but did not have much in bloom, and no butterflies were spotted.

Wallowa River Wayside, Wallowa County (OR)

Site 1—Wallowa River Wayside (private land)



June 1, 2012. 03:20 PM – 04:20 PM. A. Carleton and L. A. Burd stopped at a known *C. o. pseudochristina* locality along the Wallowa River in Wallowa County, Oregon to see if butterflies were flying at lower elevation (~2600 feet). We searched two patches of suitable habitat on the steep hillside north of the road (pictured above). Not much nectar was available, but *Lathyrus* spp. plants were present (most post-bloom). A few sulphurs were flying across the highway between the hillside and the river. They were too fast to catch, but a dead individual collected from the road (pictured above) was later confirmed as *C. o. pseudochristina* by Andy Warren (2012, pers. comm. with A. Carleton).

Potential future survey work

We recommend future surveys for *C. o. pseudochristina* in the USFS Pomeroy District in mid-late June and possibly July, depending on elevation and seasonal conditions. Once we began our surveys, we found it quite difficult to find accessible sites in the 3500-4000 feet elevation band, so most of our sites were over 4000 feet. Given that *C. o. pseudochristina* was flying at the Wallowa Wayside site (2600 feet) on June 1, it is likely that if any populations exist in the areas we surveyed, the adults would be active later in the season (at least 1-2 weeks, and maybe later depending on the season). Our USFS collaborators, D. Groat and B. Dowdy, spotted *Colias* sp. butterflies (probably *C. alexandra edwardsii*; Warren, pers. comm.) in the Pomeroy District on June 4 (1 mile up Charley Creek) and on July 13 (South Fork of Asotin Creek, near our Park Ridge survey site).

Although we did not see any *Lathyrus* plants at our survey sites, we found otherwise-suitable habitat with Fabaceae plants (*Lupinus* and *Astragalus*). It is possible that we overlooked *Lathyrus* if it was in low abundance and not flowering; Joan Frazee (Okanogan-Wenatchee National Forest botanist) has offered to join us in the field and help locate *Lathyrus* plants if any future surveys take place (pers. comm. with A. Carleton). We recommend follow-up surveys of the following sites in Asotin County: Mullin Spring and surrounding habitat along the NF-4304 ridge (particularly Mullin 2), Indian Tom Creek (beware of bears and rattlesnakes), Park Ridge, and Black Ranch. Sites in Asotin County should be prioritized given their proximity to historic populations, but we also recommend surveys of Eckler and Maloney Mountain in Columbia County (25-30 miles from historic localities).

Given the presumed sensitivity of this butterfly to herbicides and pesticides, areas that have not been managed/treated with chemicals should be given priority when choosing survey sites.

Acknowledgments

We gratefully acknowledge Del Groat, Bill Dowdy, and Holly Harris (Forest Service), David Bragg (WSU Extension), and Melissa Yzquierdo (BLM) for their help in selecting survey sites. We are especially grateful to Del and Bill for sharing their local expertise and spending two days driving us to sites all over Asotin and Columbia counties. We additionally thank Catherine Hovanic (WA Native Plant Society), Mark Darrach (Umatilla National Forest botanist), and the UW Herbarium for providing information about *Lathyrus* distribution, as well as Joan Frazee (Okanogan-Wenatchee National Forest botanist) for assistance with plant identification and Andy Warren (McGuire Center for Lepidoptera and Biodiversity) for butterfly identification.

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Appendix 1: Table of sites surveyed

General survey locality	Survey site	Date	Elevation (feet)	County	Land ownership	Lat/Long	UTM (Zone 11)
Mallory Ridge	Indian Tom Creek	5/31/12	3603	Asotin	USFS (Pomeroy District)	N46.09934; W-117.36361	471895 E, 5105149 N
	Mullin Spring	5/28/12, 6/1/12	4800	Asotin	USFS (Pomeroy District)	N46.10499; W-117.29119	477495 E, 5105754 N
	Mullin 2	5/28/12, 5/31, 6/1/12	4971	Asotin	USFS (Pomeroy District)	N46.10634; W-117.29765	476996 E, 5105906 N
	Mullin 3	5/28/12	5006	Asotin	USFS (Pomeroy District)	N46.11307; W-117.33037	474471 E, 5106664 N
	Mullin 4	6/1/12	4778	Asotin	USFS (Pomeroy District)	N46.10167; W-117.27370	478825 E, 5105384 N
Smoothing Iron and Park Ridge	Black Ranch 1	5/29/12	4062	Asotin	State land (Asotin Wildlife Area)	N46.21999; W-117.36162	472110 E, 5118554 N
	Black Ranch 2	5/29/12	4344	Asotin	USFS (Pomeroy District)	N46.20795; W-117.38466	470327 E, 5117225 N
	Cook Spring	5/29/12	4537	Asotin	USFS (Pomeroy District)	N46.19186; W-117.37915	470743 E, 5115435 N
	Park Spring 1	5/29/12	4265	Asotin	USFS (Pomeroy District)	N46.18726; W-117.35602	472526 E, 5114915 N
	Park Spring 2	5/29/12	4354	Asotin	USFS (Pomeroy District)	N46.18642; W-117.35987	472228 E, 5114823 N
	Park Ridge	5/29/12	4281	Asotin	USFS (Pomeroy District)	N46.18330; W-117.34686	473231 E, 5114472 N
Wenaha-Tucannon Wilderness	Eckler Mountain	5/30/12	4382	Columbia	USFS (Pomeroy District)	N46.22263; W-117.78072	439790 E, 5119080 N
	Hixon Creek	5/30/12	2678-3000	Columbia	USFS (Pomeroy District)	N46.23895; W-117.68939	446756 E, 5121081 N
	Maloney Mountain	5/30/12	4195	Columbia	USFS (Pomeroy District)	N46.28811; W-117.72144	444428 E, 5126312 N
Historic locality (WA)	Field Springs State Park	5/17/12	3987	Asotin	State land (Parks and Recreation)	N46.08365; W-117.17549	486432 E, 5103357 N
Current locality (OR)	Wallowa Wayside	6/1/12	2682	Wallowa	Private land	N45.62749; W-117.67255	447575 E, 5052880 N

Appendix II: Maps of sites surveyed

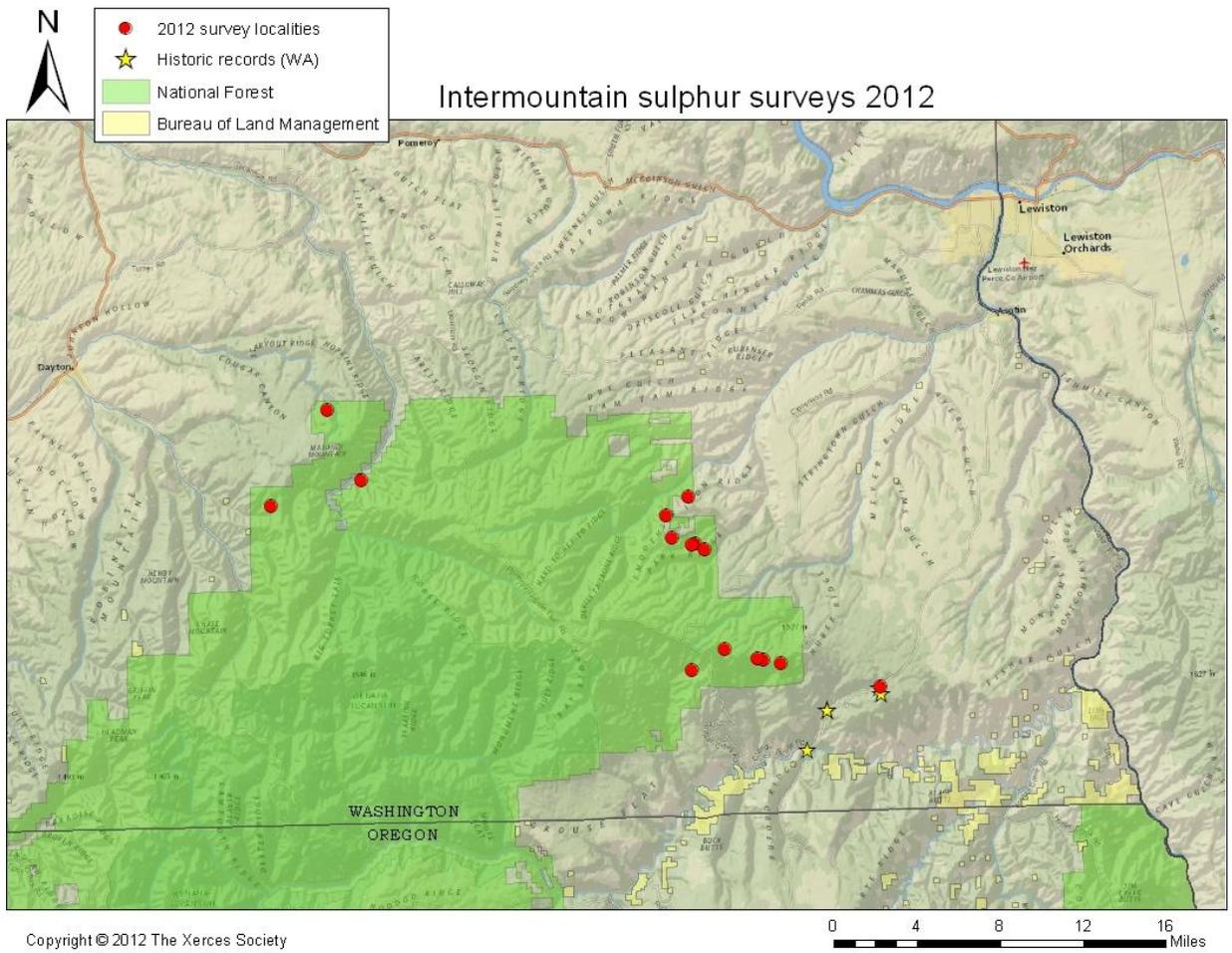
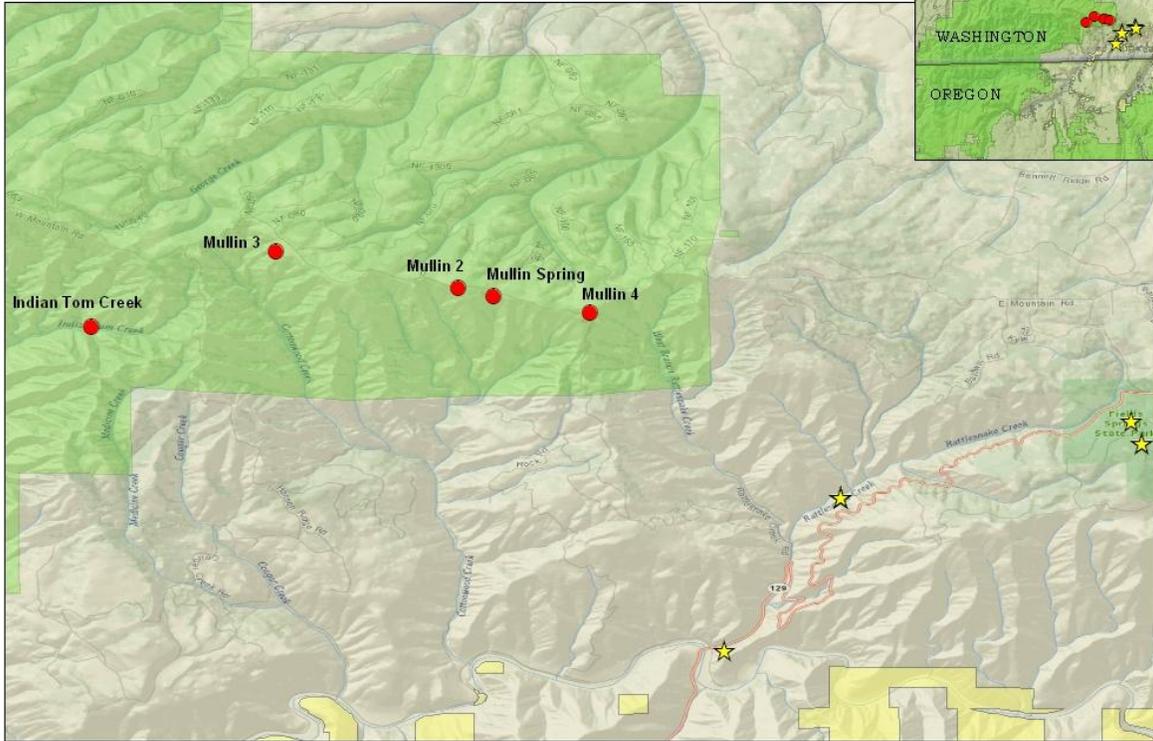
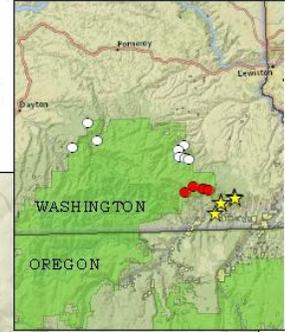


Figure 1. All sites surveyed in 2012. Note: Wallowa Wayside site in OR not shown.

- 2012 survey localities (Mallory Ridge)
- Other 2012 survey localities (not displayed)
- ★ Historic records (WA)
- National Forest
- Bureau of Land Management

Intermountain sulphur surveys 2012: Mallory Ridge



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Figure 2. Sites surveyed near Mallory Ridge, Asotin County, WA.

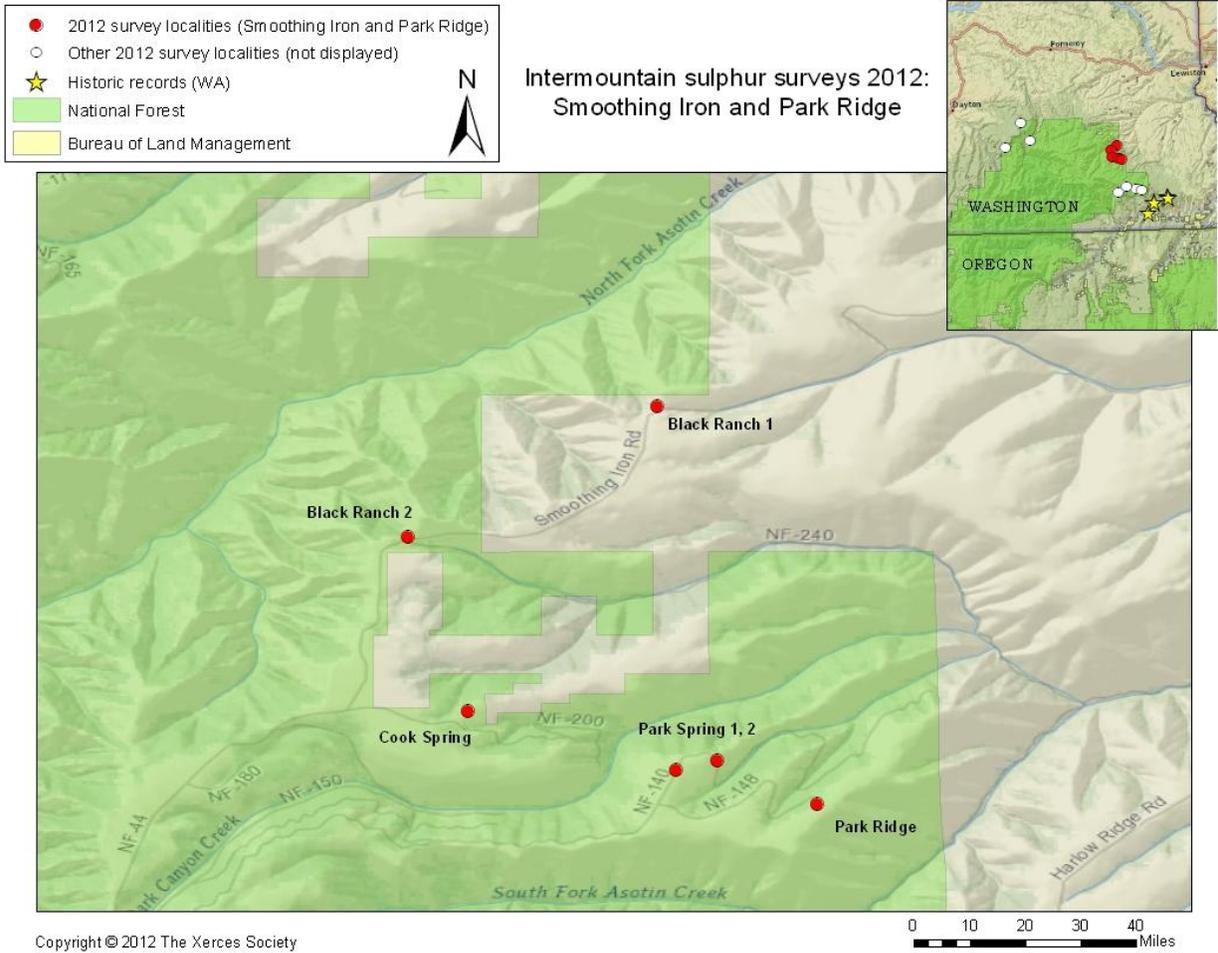


Figure 3. Sites surveyed near Smoothing Iron Ridge and Park Ridge, Asotin Co., WA.

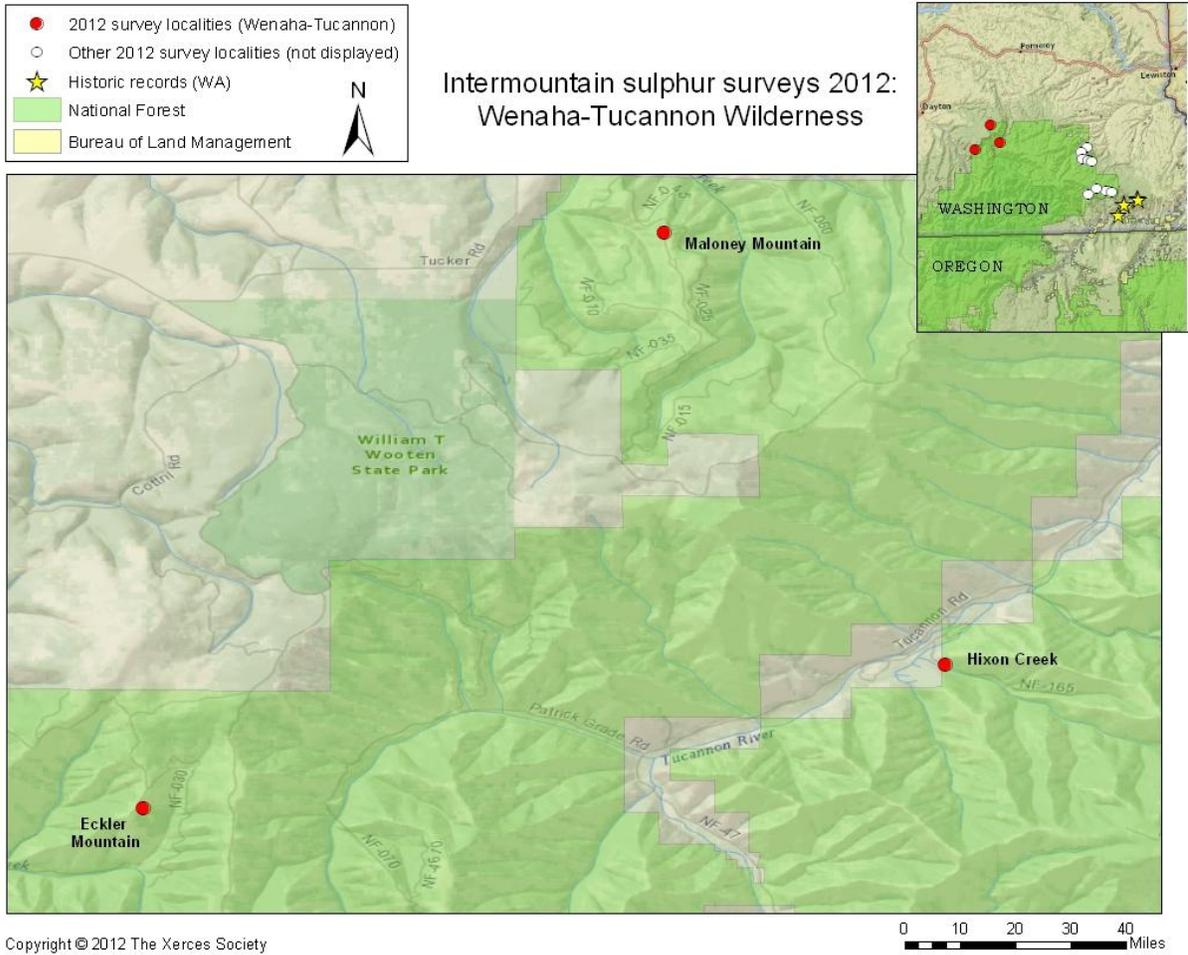


Figure 4. Sites surveyed in the Wenaha-Tucannon Wilderness, Columbia Co., WA.