
Year End Report for the 2021 Botanical Survey Season



Photo Caption: Apollos butterfly enjoying the plunders of the Siskiyou checkerbloom.

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Year End Report for the 2021 Botanical Survey Season

Prepared for:

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EXECUTIVE SUMMARY

Green Diamond Resource Company (GDRCo) botanical technicians surveyed a total of 39 Timber Harvest Plans (THPs) covering approximately 5945 total acres. A total of 33 plans were surveyed to completion; two plans were initiated in 2020 and completed in 2021; and six plans were initiated in 2021 and will be completed in 2022. The 2021 floristic survey season commenced on March 1st and terminated on September 3rd with an estimated 135 field days. A total of 61 new California Rare Plant Rank (CRPR) 1-2 BotID#s were generated representing 10 taxa. A total of 106 new CRPR 3-4 BotID#s representing 15 taxa were generated as part of a continued commitment to collecting spatial and habitat data for uncommon species. Two of these CRPR 3-4 species have been identified only once before on GDRCo ownership—*Wyethia longicaulis* and *Sanicula tracyi*. There were several new populations of *Bensoniella oregana*—a State listed Rare, Threatened or Endangered species—documented during the 2021 survey effort.

Within the Coastal Lagoons and Little River Botanical Management Area (CL/LR BMA), six harvest plans were reviewed. All six received partial surveys by botany staff in unique habitats and/or a brief visit to all units of the plan area to determine if other unique habitats existed. Running pine (*Lycopodium clavatum*) was the most prevalent CRPR listed species encountered in the harvest plans; however, a unique known occurrence of *Carex leptalea* (CRPR 2B.2) is growing in the footprint of an active harvest plan, as well. An agreement has been made with the California Department of Fish and Wildlife (CDFW) regarding protection provided for this population.

A summary data set for all occurrences has been prepared and submitted to the CNDDDB. This summary will include 166 field survey forms for all CRPR taxa discovered in 2021, 276 follow-up forms for 19 taxa, and the corresponding location data in ESRI File Based Geodatabase (FBGDB) format.

Monitoring for *Montia howellii* in the Salmon Creek Tract continued for an eleventh consecutive year. Surveys were conducted by two 2-person technical teams from March 3rd through March 17th for a total of 10 field days. Detections of *Montia howellii* in the ongoing study again fluctuated considerably from the previous years' results. In 2020, the occupancy by both site ID and quadrat were at a record low. This is in stark contrast to 2019, when occupancy was near record high. In 2021, the occupancy is near a record high for both site ID and quadrat. Long term results of the data continue to show a decreasing trend with a substantial amount of variability from year to year.

The botany department sets annual goals that are intended to supplement the existing botanical program, some of which are experimental in nature, and none are intended to be enforceable actions associated with CDFW's evaluation of GDRCo's botanical program. No changes are proposed to the protocols as delineated in the Sensitive Plant Conservation Plan (SPCP) and the associated Property-wide Consultations.

The goals that were set for this year are largely ones that are carrying on from the prior year and are in nature long-term and require ongoing effort. We had success in making meaningful progress on all fronts, as described in more detail in portions of this report. The following is a status update of the 2021 annuals goals:

- Investigation and development of additional Botanical Management Areas (BMAs)

1. It is the intent of the SPCP to enable sensitive plant species to persist in their preferred habitats on GDRCo lands while providing flexibility in the management of GDRCo lands for timber production using compatible management practices, plant protection measures, Property-wide Consultations, and area specific botanical resource management plans. The ultimate intent is to divide the property into BMAs that are managed under Botanical Management Plans (BMP) that rely on known existing conditions within the BMA rather than project by project surveys.

One area of the property is under intensive investigation regarding the feasibility and effectiveness of a new BMA agreement.

- Continue to refine Inter-department effort to systematically document and eradicate non-native and invasive plant species on the property.
 1. Representation in Humboldt County Weed Management Area (HCWMA)
 2. The botany department committed several days throughout the field season to document and eradicate non-native and invasive plant populations, particularly those in sensitive habitats (yellow star thistle removal in prairie/oak woodland interface; spotted knapweed removal on river flat on mainstem Mad River drainage) and those surrounding known sensitive plant populations (Scotch broom removal around *Astragalus umbraticus*).
- Moore Tract – Slater Fire
 1. Study response of known special status plant species.
 2. The botany department visited the Moore Tract of GDRCo property several times in 2021 as an ongoing effort to track and monitor the response of rare plant populations to the Slater Fire that burned the area in 2020. Results have been promising for several populations recovering post-fire.
- Oak woodland restoration silviculture
 1. Multi-year study to look at response of understory species to oak woodland restoration silviculture.
- On-going progress from 2020 goals:
 1. The Botany crew continues to monitor and maintain sensitive habitat and rare plant populations in the Christmas Prairie tract of GDRCo ownership. A significant effort was made to daylight one of the most vigorous *Thermopsis robusta* populations on the ownership in 2019 and the results are being documented annually. Spot removal of Scotch broom around Christmas Prairie Lake and a nearby *Carex arcta* population began in 2020 and continues to be monitored (and removed) annually. Results from both efforts are promising. The crew took on an additional project this year with spot removal of Scotch broom around the most robust *Astragalus umbraticus* populations on the property. There is also a dynamic and experimental habitat restoration (part of a mitigation

agreement with CDFW) occurring with pampas grass removal around a sensitive *Carex leptalea* population in the Crannell area of GDRCo ownership.

We look forward to monitoring the response in all these populations, which we anticipate being favorable. See the Habitat Improvement Projects section of this report for details.

2. On the topic of invasive plant removal on GDRCo property, the botany department worked to strengthen ties with the Intensive Forest Management (IFM) department in 2020 surrounding a coordinated effort to control invasive plants on the ownership. The Botany department has continued to correspond with the IFM department around development of more effective invasive plant mapping and removal.

RESULTS OF SPECIAL STATUS PLANT POPULATION SURVEYS

The following are the comprehensive tallies of CRPR list 1-4 species detected within THPs and outside of active harvest plans (Incidental Detections) for the 2021 field season. The Botany department also tracks occurrences of potentially rare species (those that were not identified to species level but may be rare), which are also recorded in this section of the report. For clarity, findings from plans that are still in need of complete surveys are not recorded in the tallies for this year.

From the two unfinished plans of 2020, there were several rare and sensitive plant detections found in those plans that weren't recorded in last year's annual report but will be in this annual report, as those projects are now complete.

Rare and Uncommon Species Associated with THPs

Rare Species - CRPR 1 and 2 Detections in 2021

CRPR	Scientific Name	Common Name	Code	Detections (BotID#s)	Number of Projects
1B.1	<i>Bensoniella oregana</i>	Bensoniella	BEOR	3	1
2B.1	<i>Cardamine angulata</i>	seaside bittercress	CAAN	5	3
2B.2	<i>Erythronium revolutum</i>	coast fawn lily	ERRE	18	3
1B.2	<i>Gilia capitata ssp. pacifica</i>	pacific blue field gilia	GICAPA	3	2
1B.2	<i>Iliamna latibracteata</i>	California globe mallow	ILLA	1	1
2B.2	<i>Montia howellii</i>	Howell's montia	MOHO	5	2
2B.2	<i>Monotropa uniflora</i>	ghost pipe	MOUN	19	3
2B.2	<i>Packera bolanderi var. bolanderi</i>	seacoast ragwort	PABO	1	1
1B.2	<i>Piperia candida</i>	white flowered rein orchid	PICA	2	2
1B.2	<i>Thermopsis robusta</i>	robust false lupine	THRO	1	1
Total				58	19

Uncommon Species – CRPR 3 and 4 Detections in 2021

CRPR	Scientific Name	Common Name	Code	Detections (BotID#s)	Number of Projects
4.3	<i>Chrysosplenium glechnomifolium</i>	Pacific golden saxifrage	CHGL	20	5
4.2	<i>Coptis laciniata</i>	Oregon golden thread	COLA	2	1
4.2	<i>Listera cordata</i>	heart leaved twayblade	LICO	40	10
4.1	<i>Lycopodium clavatum</i>	running pine	LYCL	5	4
4.2	<i>Mitellastrum caulescens</i>	leafy-stemmed mitrewort	MICAU	12	7
4.3	<i>Oxalis suksdorfii</i>	Suksdorf woodsorrel	OXSU	2	1
4.2	<i>Pityopus californicus</i>	California pinefoot	PICAL	7	3
4.2	<i>Pleuropogon refractus</i>	Nodding sephamore grass	PLRE	5	3
4.3	<i>Ribes laxiflorum</i>	Trailing black currant	RILA	5	3
4.2	<i>Sanicula tracyi</i>	Tracy's sanicle	SATR	2	1
4.2	<i>Sidalcea malachroides</i>	Maple leaf checker bloom	SIMA	1	1
3.2	<i>Tiarella trifoliata</i> var. <i>trifoliata</i>	Trifoliate laceflower	TITRTR	1	1
4.2	<i>Dolichousnea longissima</i>	Methuselah's beard lichen	USLO	3	2
4.3	<i>Wyethia longicaulis</i>	Humboldt County wyethia	WYLO	2	1
Total				105	43

Potentially Rare Species Detected in 2021

Populations of potentially rare species detected on GDRCo property are tracked by a GDRCo BotID#. Inability to make a positive identification is typically due to a lack of flowering individuals. This remains a constant challenge with members of the genera *Piperia* and *Erythronium*. Plants are often detected in the spring by their leaves which senesce before plants flower. Upon subsequent visits to the sites, flowers are often not present due to herbivory or immaturity. This was the case for several *Piperia* populations in surveys for four THPs this year: Boulder Bundle, Goodman Prairie/Graham creek, Snow Camp Lake 22, and North Johnson (2021).

When positive identifications are made, the unique BotID# remains with the occurrence, but the corresponding species name will be updated in GDRCo's database to reflect final taxonomic determination. If populations are confirmed to be rare, then the corresponding CNDDDB data will be submitted.

Scientific Name	Common Name	Code	Detections (BotID#s)	Number of Projects
<i>Piperia</i> sp.	Rein orchid	PISP	11	4

When floral or fruiting structures that are needed for species level identification are finally observed, a positive identification of the potentially rare species can be made. This process sometimes takes years to achieve, as many variables can alter the health of the plants and affect the plant's production of floral parts or the full development of fruiting bodies. That said, there are populations that the Botany department continues to revisit in old THPs over the years following harvest to resolve the species ID. This year we were able to make positive identifications on two populations.

A patch of *Piperia* leaves was found in accordance with a road point survey for the Boulder Creek South 2012 plan. BotID#30315 had 30 individuals that were found on a rock outcrop in 2012, but there were only dried flowers present, so the species wasn't confirmed but was thought that the petal spurs were too long to be *P. candida*. The population was revisited in 2020 with 50 individuals on the rock outcrop, 20 of which were starting to bloom, but the inflorescences weren't developed enough to make a species level ID. In the follow-up for 2021, 23 plants were found in late summer well past the peak of flowering. A note indicated that the population was in fact identified to be *Piperia elegans*, most likely during a follow-up to check on the status of the blooms in the previous year after the initial follow-up was made.

BotID#29758 in Snow Camp was found in 2009 and has two distinct patches but hadn't produced flowers until this most recent follow-up. It was previously assumed that it was *Erythronium revolutum* given its proximity to other *E. revolutum* populations (and was afforded protections as such), but upon seeing flowers for the smaller of the two patches in 2021 it was positively identified as *Erythronium californicum*. The flowers had white tepals with yellow bases and light red banding. The filaments were thin and the stigma was shallowly lobed. It is unknown if the larger patch of plants associated with the population is also *E. californicum* since it has not yet flowered. Regardless, the population is protected in a Plant Protection Area (PPA) along with a nearby *Bensoniella oregana* population. We look forward to resolving this mystery in the future!

Non-Rare Species Detected in 2021



Photo Caption: *Erythronium californicum* basking in the sun in the Boulder Bundle THP showing off its white anthers, lightly red banded tepals, and shallowly lobed stigma.

The Boulder Bundle plan in the Snow Camp area is host to many rare plant species and some non-rare relatives of those genera. *Erythronium californicum* was found plentifully along a few of the creeks in the units and along cutbanks on old seasonal roads. It was a tricky one to differentiate from *Erythronium citrinum* as the defining characteristics for the species were very similar and the plants all varied slightly in morphology across the

population. Some flowers had more yellow tepals and shallower stigmas like *E. citrinum* and then some flowers looked like *E. californicum* with strong red banding on the tepals and stigmas that had deeper lobes. It was hypothesized that there could be potential cross-hybridization between the two species as there was a small population of *E. citrinum* found on the opposite side of the creek from a very large *E. californicum* population on a rock outcrop.

Scientific name	Common name	Code	Detections (BotID#s)	Number of Projects
<i>Erythronium californicum</i>	California fawn lily	ERCAL	17	2
<i>Erythronium citrinum</i>	Lemon colored fawn lily	ERCITC	1	1
<i>Gilia capitata var. capitata</i>	Blue field gilia	GICACA	1	1
<i>Piperia transversa</i>	Green striped piperia	PITR	2	1
<i>Piperia unalascensis</i>	Alaska rein orchid	PIUN	3	1

Rare and Uncommon Species Not Associated with THPs

There are several rare and sensitive plant populations that are detected every year on various parts of the property that are not associated with THPs. The Botany department still records and submits data for these populations to the CNDDDB. The following tables summarize these findings.

Rare Species - CRPR 1 and 2 Detections in 2021

CRPR	Scientific Name	Common Name	Code	Detections (BotID#s)
1B.1	<i>Bensoniella oregona</i>	Bensoniella	BEOR	1
2B.3	<i>Carex serpenticola</i>	serpentine sedge	CASE	1
2B.2	<i>Erythronium oregonum</i>	Oregon fawn lily	EROR	1
2B.2	<i>Erythronium revolutum</i>	fawn lily	ERRE	1
2B.2	<i>Montia howellii</i>	Howell's montia	MOHO	1
1B.2	<i>Thermopsis robusta</i>	robust false lupine	THRO	1

Uncommon Species - CRPR 3 and 4 Detections in 2021

CRPR	Scientific Name	Common Name	Code	Detections (BotID#s)
4.3	<i>Chrysoplenium glechomifolium</i>	Pacific golden saxifrage	CHGL	2
4.2	<i>Cypripedium californicum</i>	lady slippers	CYCA	1
4.2	<i>Platanthera stricta</i>	slender bog orchid	PLST	1

Potentially Rare Species Detected in 2021

Scientific Name	Common Name	Code	Detections (BotID#s)

<i>Erythronium</i> sp.	fawn lily	ERSP	2
<i>Piperia</i> sp.	rein orchid	PISP	1

Non-Rare Species Detected in 2021

Scientific Name	Common Name	Code	Detections (BotID#s)
<i>Erythronium californicum</i>	California fawn lily	ERCAL	2

COASTAL LAGOONS AND LITTLE RIVER BOTANICAL MANAGEMENT PLAN STATUS

GDRCo and CDFW agreed that the long-term survey protocol for THPs within the Coastal Lagoons and Little River BMA, effective 2009, is as follows:

- RPFs shall conduct focused surveys for all THPs within the Coastal Lagoons and Little River BMA. RPFs shall be responsible for reporting the presence of any unique, high quality, sensitive plant habitat within their project area, e.g. bogs, well developed lakes or ponds, coastal prairie or large mossy boulders or rock outcrops. When Lycopodium clavatum is encountered within THP areas voluntary, non-enforceable PPMs will be applied. These PPMs include establishing ELZs for select populations and retaining non-merchantable trees. If other sensitive species are observed, the RPF will consult with GDRCo botany staff.*
- Botanical technicians shall survey unique, high quality sensitive plant habitats within THPs as identified by RPFs. If sensitive species are discovered appropriate PPMs shall be applied.*
- Botanical technicians shall monitor a subset of L. clavatum populations on a yearly basis. Initially, monitoring activities will focus on pre and post-harvest monitoring of populations protected with voluntary, internal PPMs that were implemented for plans submitted after July 8, 2008. Revisions to internal PPMs may be made based on monitoring results.*
- Botanical technicians will survey unique or high-quality habitats outside of THPs when they are identified. The intent is to find and survey areas within the BMA that have the greatest likelihood of supporting sensitive species, regardless of whether or not the habitat would ever be impacted by timber harvest operations.*

Summary of THP activity and survey coverage in the CL/LR BMA since adoption of the Botanical Management Plan (BMP) in 2008.

Year	THP acres in BMA	BMA acres surveyed	BMA acres exempt from survey
2008	3,029	1,219	1,810
2009	670	76	594
2010	3,813	109	3,704

2011	1,975	52	1,923
2012	893	1	892
2013	1,811	52	1,759
2014	2,185	137*	1,620
2015	2,625	148*	2,374
2016	1,594	109	1,485
2017	1,857	204	1,654
2018	2,344	807	1,537
2019	1,138	273	865
2020	1,262	60	1202
2021	762	95	667
Totals	25,958	3,057	22,086

Five new THPs (and one from 2020) were surveyed partially within the Coastal Lagoons and Little River BMA by the botany department in the 2021 field season to assess for potential habitat for rare plants. Surveys were focused on Sitka spruce stands and watercourses looking for habitat that could host *Moneses uniflora* or *Cardamine angulata*. A new population of *Mitellastrca caulescens* and a new population of *Lycopodium clavatum* were detected from these surveys. These populations will not receive mitigation and will be impacted by timber harvest operations. A preexisting population of *Carex leptalea* is growing along an appurtenant road for one of the THPs and will be mitigated with a 25'x10' Equipment Limitation Zone (ELZ) along with the restriction of no rock or straw being placed on that segment of road. More details of this population and associated mitigation are described in the Follow-Up Visits section of this report.

YEAR END MITIGATION SUMMARY

Survey efforts in 2021 yielded 61 new BotID#s for confirmed CRPR List 1 and 2 species. Plant protection measures were implemented for many of these populations to avoid impacts due to timber harvest operations.

All five species for which GDRCo has a Programmatic Agreement per a Property-wide Consultation with CDFW (*Cardamine angulata*, *Erythronium revolutum*, *Monotropa uniflora*, *Montia howellii*, and *Piperia candida*) were detected during the 2021 field season. For almost all these populations, the programmatic protections were implemented. The Botany crew continues to monitor and collect data intermittently on the overall success of these plant protection measures (PPMs) for various populations of each of these species to assess the efficacy of those PPMs over time (details of these monitoring efforts can be found in the Monitoring Agreements section of

this report). We remain committed to the intent of the SPCP regarding Property-wide Consultation agreements, whose purpose is to promote long-term conservation of sensitive plants on GDRCo lands through adaptive management informed by monitoring and data-driven research.

There were also several species detected during the 2021 field season that don't have Programmatic Agreements with defined PPMs. These received a combination of different protection measures that took into consideration the biology and ecology of the species for which the mitigation was being outlined. Several received protection by Avoidance due to their affinity to riparian habitats (*Carex arcta*, *Erythronium revolutum*, *Monotropa uniflora*, *Packera bolanderi*, and *Sanguisorba officinalis*), because those riparian corridors receive a protected buffer per California Forest Practice Rules, by default. In the instance of *Gilia capitata ssp. pacifica*, which also received protection by Avoidance, these plants often grow on exposed cutbanks and/or prairie habitat on GDRCo property, both of which can easily be avoided by equipment during harvest with a buffered Equipment Exclusion Zone (EEZ) or ELZ.

There were two particularly exciting species detected during 2021 surveys: *Bensoniella oregana* and *Iliamna latibracteata*.

Table: Summary of Plant Protection Measures for 2021 Season

Code	Species	Common Name	Mitigation Used	Total Populations	Mitigated Populations
BEOR	<i>Bensoniella oregana</i>	Benson's saxifrage	Other	5	5
CAAN	<i>Cardamine angulata</i>	seaside bittercress	Programmatic	5	3
CAAR	<i>Carex arcta</i>	northern clustered sedge	Avoidance	1	1
CALP	<i>Carex leptalea</i>	bristle-stalked sedge	Other	1	1
ERRE	<i>Erythronium revolutum</i>	coast fawn lily	50 ft. buffer, Other, Avoidance	19	13
GICAPA	<i>Gilia capitata ssp. pacifica</i>	Pacific gilia	Avoidance, Other	3	3
ILLA	<i>Iliamna latibracteata</i>	California globe mallow	Other	1	1
MOUN	<i>Monotropa uniflora</i>	ghost pipe	Programmatic, Avoidance	21	13
MOHO	<i>Montia howellii</i>	Howell's montia	Programmatic	5	5
PABO	<i>Packera bolanderi</i>	seacoast ragwort	Avoidance	2	2
PICA	<i>Piperia candida</i>	white-flowered rein orchid	50 ft. buffer, Programmatic	2	2
SAOF	<i>Sanguisorba officinalis</i>	great burnet	Avoidance	1	1
THRO	<i>Thermopsis robusta</i>	robust false-lupine	Other	7	7

MONITORING AGREEMENTS

THP Monitoring Agreements

The following summaries are specifically for binding monitoring agreements that have been made with CDFW during consultation for proposed mitigations in select THPs. Voluntary monitoring efforts are described in detail in this report as well (see Follow-up Visits section of report).

Bald Mountain milkvetch (*Astragalus umbraticus*)

The following are the project names and BotID#s associated with the monitoring agreements for that project for this species.

Big Prairie (2018) THP (CDF#1-17-137H): BotID#1361, BotID#1362, and BotID#35361

Tully Creek East THP (CDF#1-17-143H): BotID#398, BotID#31592, BotID#35667, BotID#35668

Tully Thin THP (CDF#1-20-00085H): BotID#36348, BotID#36338, BotID#31584, BotID#1361, BotID#1362

Several populations of *Astragalus umbraticus* were visited in the 2021 field season as part of ongoing monitoring agreements associated with the Big Prairie (2018), Tully Creek East, and Tully Thin THPs.

Big Prairie (2018) THP

The three *Astragalus umbraticus* populations (BotID#1361, BotID#1362, and BotID#35361) associated with the Big Prairie (2018) THP (GDRCo No. 51-1702) received limited protections and unique mitigation to improve habitat for these populations. The monitoring agreement made for the populations associated with this THP are to report each population's response to impact every year for five years following harvest (2018/2019). Prior to operations, all three were declining in numbers due to encroachment of shrubs and canopy growth shading out habitat. There were individuals observed at two locations during follow up visits in 2018; however, the populations had significantly declined over the years from the time of the initial detections. The response observed in follow up monitoring in 2020 was very promising, with BotID#1361 having gone from three individuals to 410 new plants; BotID#1362 going from 500 individuals to 1000; and BotID#35361 going from no plant detections to 25 individuals. Plants were largely small, emergent seedlings that occupied the edge of the road in fresh soils. Ongoing monitoring in 2021 found higher numbers yet in two of the three occurrences. BotID#35361 had the most dramatic expansion in numbers, growing from 25 to 900 individuals. The plants were densely occupying the surface of the road that had been impacted when opening roads for harvest of the plan. Many individuals were young sprouting seedlings with an estimated single season of growth. BotID#1361 grew from 410 to 430 individuals, with the extra 20 plants also comprising emergent seedlings. BotID#1362 reduced in size from 1000 to 500, as a portion of the population was impacted again in a thinning project that occurred one year after the initial impact of the Big Prairie (2018) operations.

The response to the mitigation measures laid out for each population were largely successful and are outlined below. We anticipate seeing a continued positive response in each population in the next few years, including BotID#1362.

BotID#35361 received no protection measures and had been documented at 18 individuals in 2018, growing on an old roadbed that was brushed in and grown over. A revisit to the site in June of 2020 discovered 25 new plants growing roughly 450' down the road from the original documented population (with no plants found at the original location). It is unclear whether the seed source from the original population was transported, or the new cohort is from a distinct source. In 2021, the population expanded significantly with 900 plants observed, many of which were at the original location. Most were emergent seedlings or young plants. BotID#1361 and BotID#1362 received an avoidance ELZ and to limit side casting off the road prism during road maintenance activities to retain the seed source. Plant protection measures (PPMs) included not permitting road castings and slash piles to be deposited onto the side of the road within the ELZ and road grading was limited to only a few inches deep into the soil. As described above, the response observed was significant, with BotID#1361 having gone from 3 individuals pre-harvest operations to 430 plants in 2021. The response from BotID#1362 will be better assessed in future years since a portion was recently impacted in the Tully Thin THP described later in this section.

Tully Creek East THP

Three populations (BotID#398, BotID#31592, BotID#35667 and BotID#35668) are associated with the Tully Creek East THP (GDRCo No. 51-1706). All four populations occurred alongside appurtenant roads to the project, so the mitigation measures were to allow road maintenance activities, but to save the spoils generated from grading and bank excavation, with fill materials spread on the road surface, landings, or along the inside road edge above and below the site during the road maintenance operations associated with this plan. The intent of monitoring these populations is to assess the response to standard road maintenance operations.

Three populations occur on the BH-1900 road system: BotID#398, BotID#35667, and BotID#35668. BotID#398 was found in 2001 and has been monitored over the years, with the population initially increasing in size after detection, to rather rapidly declining in size in subsequent years. It was initially recorded at 283 individuals at the time of detection in 2001 and grew to 550 (2008). Ten years later, the population had decreased in numbers by half that size and continued to decrease in subsequent years to 250 (2019). The population was being outcompeted by overtopping shrubs and vegetation which was then cleared in 2019 by road grading operations. In 2019, post road maintenance, extensive available habitat was formed by road maintenance operations. It was hypothesized that the seed bank for this population is well established, and some disturbance might stimulate new growth. The follow-up in 2020 yielded 125 individuals. Although the number is fewer, those that were counted were primarily mature plants that had not been impacted by operations. The road was graded again in 2021 and the castings covered most of the tracks from the previous road work. It is likely that the population will regenerate in the following years if disturbance is kept to a minimum to allow the plants time to reestablish themselves. BotID#35667 has also been slowly declining over the past three years, starting at 10 individuals at the time of detection in 2018 and whittling down to five in 2021. This population was not impacted by road maintenance operations and is being encroached by surrounding vegetation. BotID#35668 is also declining for similar reasons, going from 62 plants in 2018 down to 17 plants in 2021. The population was found growing near a recently changed culvert site in preparation for logging operations in the adjacent stand. Logging opened the canopy and allowed for more sun exposure, but it has resulted in new and rapid growth of herbaceous species that have begun to choke out the population. There was no direct disturbance to the population, so seed banked has likely not been stimulated to germinate.

BotID#31592 was associated with the Annual Work Plan in 2015 on the BH-2700. It was detected in 2015 at the site of a proposed culvert installation, comprised of 35 individuals, which remained steady for several years. This road point got roped into the Tully Creek East THP in 2018. The culvert installation was not completed until 2020, which left the population at only 12 newly emergent seedling detected at the site of impact that same year. In 2021, there was a significant expansion of the population to 90 individuals, a mix of mature fruiting plants, young growth, and emergent seedlings. No protection was provided to this population and the population overall has benefited from the disturbance.

Tully Thin THP

Five populations (BotID#36348, BotID#36338, BotID#31584, BotID#1361, BotID#1362) are associated with The Tully Thin THP (GDRCo#512001). BotID#1361 and BotID#1362 are well established populations that were provided mitigation in the Big Prairie (2018) THP. Both will be monitored annually until 2023. BotID#1361 and BotID#1362 received an avoidance ELZ and to limit side casting off the road prism during road maintenance activities to retain the seed source. Plant protection measures (PPMs) included not permitting road castings and slash piles to be deposited onto the side of the road within the ELZ and road grading was limited to only a few inches deep into the soil. They are both growing along the appurtenant road system that was used to access both plans. The populations were impacted by road maintenance activities in 2018, as described in the Big Prairie (2018) section of this report. As described in this section, the response observed was significant, with BotID#1361 having gone from 3 individuals pre-harvest operations to 430 plants in 2021. The response from BotID#1362 will be better assessed in future years since a portion was recently impacted in the Tully Thin THP, which was harvested in late 2020 and early 2021. The mitigation for this population remained to limit disturbance but still allow for use of the road to access timber. The PPMs permitted designated skid trails and log decking areas along the road for access to timber as well to limit the area where logs can be passed from the unit to the road to control direct impact on the population.

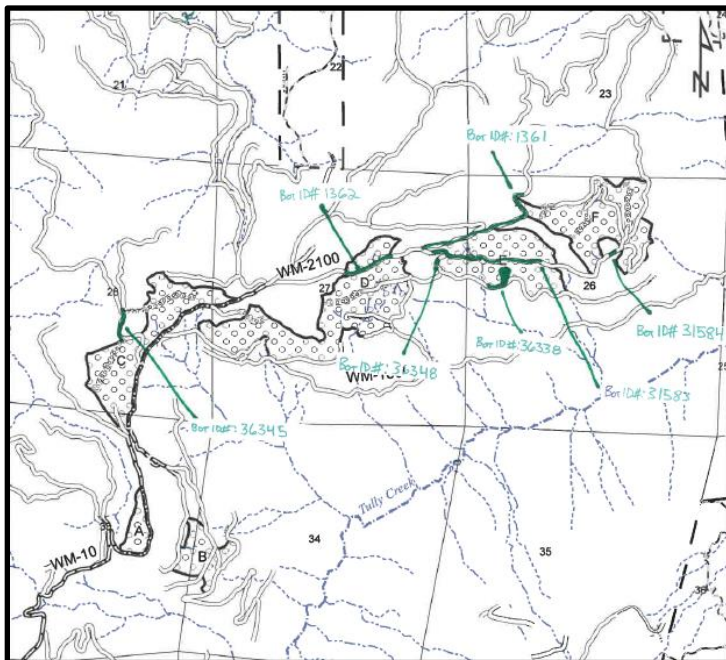


Photo caption: Survey route map showing the location and extent of each population prior to operations conducting road maintenance and forest thinning.

BotID#31583 was associated with an Annual Work Plan in 2015 to update road features. The number of individuals documented at the time of the survey was 500 mature plants, being overtopped by shrub cover. In 2020, 1500 plants were estimated to be growing at the site, with a mix of mature plants and seedlings. No protection was afforded the population during road maintenance activities, and the disturbance provided more habitat for recruitment of a new cohort and improved the habitat for the existing population by clearing out shrubs and competition.

Similarly, BotID#31584 was associated with the Annual Work Plan in 2015, but the pre-existing population here did not fare as well. The population size in 2015 was 40, with no plants recovered at this site in 2020. Road maintenance activities never occurred at this site, and the road is still overgrown with manzanita and blackberry, as well as with a thick canopy cover from roadside trees. The original population was likely shaded out in the previous years.

BotID#36348 and BotID#36338 were both detected on the same overgrown road surface at the time of surveys for the plan in 2020, one at the top of the road and one at the bottom, which also ran into the forest interior. Both will be monitored twice, post-disturbance within a five-year period. No protections were provided to these populations. The response of both to disturbance (routine road maintenance operations and forest thinning) were rather dramatic. BotID#36348 was detected at 15 mature individuals in 2020 and exploded to 150 individuals in 2021. Similarly, BotID#36338 was detected at 150 mature and young individuals in 2020 and grew to 410 plants. The majority were emergent seedlings and young growth, with roughly 60 established mature plants.



Photo caption: BotID#36338 was detected in portions of the forest interior (left) that was thinned in the Tully Thin THP in 2020 (right). The result was disturbance and increased light exposure, both of which had overwhelmingly positive results for the population.



Photo caption: The overgrown and shaded road surface where BotID#36348 was detected prior to road maintenance operations (left) and the response (right).

Overall, the response of mature and established *A. umbraticus* populations to some level of disturbance is overwhelmingly beneficial to supporting new growth of the populations by (1) clearing competing vegetation, (2) providing more habitat area for new growth to establish, and (3) stimulating germination of the seeds banked at those sites (and possibly spreading some with soil pushed around from road operations).





Photo caption: Young seedlings that sprouted in the forest interior post-harvest, associated with BotID#36338 (top left and right). The numerous young sprouting seedlings found on the road surface after operations cleared the road for access (bottom left and right).

Coastal fawn lily (*Erythronium revolutum*)

The following are the project names and BotID#s associated with the monitoring agreements for that project for this species.

Boulder Creek North 2017 THP (CDF#: 1-16-138H): BotID#35061, BotID#35063, BotID#35068, BotID#35069, BotID#35071, BotID#35073, BotID#35075, BotID#35079, BotID#35081, BotID#35092, BotID#35099, BotID#35228, BotID#35233, BotID#35234, and BotID#35241.

Boulder Creek North 2017

The Boulder Creek North 2017 THP (GDRCo#17-1602) hosted an impressive presence of *Erythronium revolutum*, with numerous populations detected along roads, in the forest interior, and largely in riparian corridors. There is prime habitat for the species in this area with copious ground of upland montane woodlands that have a slight coastal influence. The expanse of the populations were such that some populations posed immense challenges to operations, so some populations were not protected. The largest populations within the THP footprint were given full protection, with several smaller ones within the forest interior left to be directly impacted by operations. Mitigations for this THP included a monitoring agreement for 15 of the 21 populations to observe how those populations responded post-impact and prior to the THP expiring. All populations were detected in 2017 and were revisited in 2021.

Of the 15 populations, four received mitigations. Out of the 11 populations that did not receive protections, only three of them were not detected during the follow-up in 2021. BotID#35063, 35075, and 35079 were small

populations of less than 25 individuals each that were found growing in the forest interior. These three populations did not receive any protections and were not found in the most recent follow-up as it was described that there was either slash where the population would have been or there was a great deal of disturbance to the area. It is fair to say that the overall disturbance from operations has impacted these three populations and it is unclear whether the populations have been eliminated from the landscape or if they will come back in the next few years. Anecdotally, *E. revolutum* populations in THPs 13 years post-harvest recovered from impact, with the trend that the populations were in decline for about five years after operations then began to recover thereafter. Given that these plants are geophytic, they tend to be quite resilient. We look forward to seeing if these impacted populations will recover.

On the other hand, many populations survived the torment of operations with no protections provided. All but one of the populations were located within the forest interior where clearcutting would occur, yet in follow-ups they were still found amidst the slash, flowering and healthy. BotID#35081 was found in better condition than it was left as the population had a higher percentage of flowering individuals than it did before harvest. This population certainly benefited from an increase in sunlight and perhaps from some slight disturbance. The population sizes slightly fluctuated, except for BotID#35234, which had a huge increase in population size from 25 plants to 135 plants.

BotID#35228 and #35233 were very similar. Both are growing on a rocky slope with treated tanoak nearby, but there was little to no effect on the populations as both saw an increase in the number of individuals. BotID#35073 was similar as well, growing on a rock face along a road just outside of RMZ, but had no change in population size or health. There was a trend of 50% or more mature plants seen in all the populations with most of the populations producing flowers. BotID#35241 was doing well despite the road construction for the proposed road that the population was found next to. The population size decreased by half yet there were still three plants in flower. BotID#35068 was the only population to not be detected in the forest interior. Much of the population was within a RMZ and No-Harvest zone while a few meandered out. There were no protections for the plants outside the RMZ, and those plants weren't seen in the follow-up this year. Overall, the unprotected populations fared well, especially BotID#35061 which only had one individual before harvest and post-harvest it was found in full bloom. The real threat to these populations is going to be the succession of the open land with the encroachment of fast-growing plant species. Despite the official monitoring agreement being fulfilled after this most recent follow-up in 2021, the Botany crew will continue to monitor the populations in this plan to continue to inform our understanding of this species.

The populations that were protected mostly resided in RMZs or just outside of the zone, so they received a little more cushion. The PPMs for these populations consisted of a 50' ELZ with selective harvest allowed in the outer 25' of the buffer while retaining 65% canopy cover. BotID#35099 had double the number of plants than what was originally found, but there is potential that some of the plants were overlooked at the time of detection. About half of the population was flowering compared to the other populations that had only a few flowers. Similarly, BotID#35092 saw an increase in population size with roughly 20% of the population in flower. Some populations experienced a decrease in population size for a variety of reasons. BotID#35071 was buried under a Douglas fir tree that had fallen across the skid trail that the plants were growing on. The population went from 300 individuals to 50. BotID#35069 also experienced a decrease in size from 145 individuals to a mere 30. These populations were otherwise observed with a few flowers and in good health. Overall, these populations did well post-harvest and will likely recover in subsequent years.



Photo caption: Resilient Erythronium revolutum growing amidst the slash in the middle of the clearcut.

Siskiyou checkerbloom (*Sidalcea malviflora* ssp. *patula*)

The following are the project names and BotID#s associated with the monitoring agreements for that project for this species.

Goodman Prairie (2020) THP (CDF#: 1-18-176H): BotID#35799, BotID#35801, BotID#35802, BotID#35815, and BotID#35816.

Goodman Prairie (2020)

Monitoring in the Goodman Prairie (2020) THP (GDRCo#17-1802) has demonstrated that mitigations provided to *S. malviflora* ssp. *patula* populations were successful. The plan was harvested in 2019 with four out of the five populations provided PPMs. Those protected received a 50' ELZ, with the outer 25' of the buffers allowing for harvest of conifers and the inner 25' requiring a retention of 50% or more canopy coverage. Within the entire 50' ELZ, all true oaks were to be retained to the extent feasible. One *S. malviflora* ssp. *patula* population was not

protected due to its location creating operational challenges. Monitoring occurred in late June to catch the plants in their peak flowering window.

BotID#35799 received varied protection measures, as only half of the population was within the unit while the other half resided on the other side of the road adjacent to the unit. Permitted road maintenance activities were limited along the section of road where the population was growing, as feasible. This included prohibiting castings from being piled onto the population. The road was still permitted for use to access the timber stand for harvest. This road use did not impact the population, which increased in size from 85 individuals in 2020 to 195 individuals in 2021. The plants were healthy and thriving with most producing an inflorescence in both the sun and the shade.

BotID#35801 has expanded in size as well from 12 individuals in 2020 to 22 individuals in 2021. The plants were heavily shaded and only received a few hours of direct sunlight. The population was found to be only vegetative, with no sign of flowers.

BotID#35802 stayed consistent in population size and health from the original detection. All were reported looking healthy with plants flowering along the grassland interface it is growing within.

BotID#35815 has expanded from 50 individuals in 2020 to 75 individuals in 2021, with around 20 of the plants in flower. There were Douglas fir trees cleared from the surrounding oaks, likely relieving stress to the oak stand and reducing overall competition in the habitat.

BotID#35816 was the only population not provided any protections as it was in the center of the unit along a strategically proposed road. It has gone from 10 individuals in 2019 to just two individuals after harvest in 2020 to six individuals in 2021. The plants have taken a turn for the better and have recovered since operations. All the plants were flowering with one beginning to fruit. The success of this population is surprising given the complete lack of protection measures.

Robust false lupine (*Thermopsis robusta*)

High Prairie Combo 19 (CDF#: 1-20-00012H): BotID#1898.

High Prairie Combo 19

BotID#1898 has experienced a lot of fluctuations in its population size and health over the years since it was detected in 2008 with three individuals along the side of the road in the High Prairie area of GDRCo ownership. It has been in the footprint of three different THPs: High Prairie 2008 (GDRCo#:27-0802), High Prairie Thin (GDRCo#:27-1402), and High Prairie Combo 19 (GDRCo#27-1901). In the earlier THPs, the population was along an appurtenant road and was protected from impact by avoidance. For the third and most recent THP, High Prairie Combo 19, the population was located in one of the units and received more specific plant protection measures.

Six years after the initial detection (2015), there were four individuals observed, with two of them damaged by human activities and grazing. In 2019 there were only two individuals observed that were being outcompeted by surrounding overtopping shrubs and had been impacted by a slash pile left by utility workers. In 2021 there were four individuals seen after thinning operations of the High Prairie Combo 19 had occurred. The plants were

protected within an EEZ, and each plant was marked with three t-posts painted pink. Three of the plants in the follow-up in 2021 were mature individuals with one new plant found 100' down the road in a new location. This young plant was found in the disturbed ground from new road construction. We are excited to see if this disturbance will prompt the germination of additional plants.



*Photo Caption: A new *Thermopsis robusta* plant emerging after road related operations, circled in red (left). Pink T-posts mark where the mature plants are located at the original detection site (right).*

Spotted Knapweed Monitoring at Sweet Flat, Mad River

In 2013 the GDRCo botany department began collaborating with the Humboldt County Department of Agriculture to monitor and remove spotted knapweed (*Centaurea stoebe*) from the gravel bars along the Mad River near the City of Blue Lake. Spotted knapweed was initially detected in 2013 along the Mad River at three locations south of the Mad River Hatchery. One of these locations is at “Sweet Flat” which is best accessed from private GDRCo roads.

In 2014, the site was surveyed, and no plants were detected. The gravel bars along the river were surveyed to the south of the site and no other populations were detected in these regions either. The site was surveyed in 2015 and one population was detected and removed; the gravel bars along the river were surveyed to the south of the site again and no additional plants were detected. In 2016 the botany crew removed approximately 100 spotted knapweed plants and disposed of them offsite. Plants have been removed every year since with some variability in the number of plants found. Thirty plants were removed in 2017, 50 in 2018, four in 2019, six in 2020, and thirty-four were observed and removed in 2021. Additionally, there is an infestation of yellow star thistle (*Centaurea solstitialis*) at this site that was first detected in 2016 and has been variably present over the years, as with the spotted knapweed. There are several known infestations of yellow star thistle throughout the watershed. It is assumed that the low water conditions and higher than average temperatures associated with the drought cycle may be contributing to increased suitability for invasive species infestations. Due to the riparian nature of the habitat, there is no plan to use herbicides in treating this site.

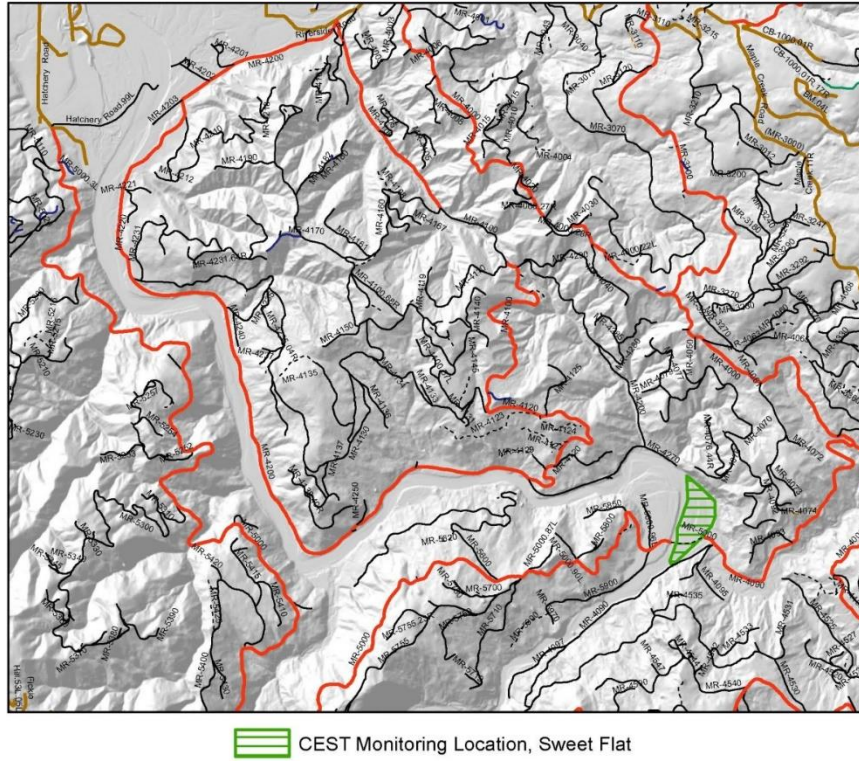


Figure 1. Location of *Centaurea stoebe* removal efforts at Sweet Flat, Mad R

FOLLOW UP VISITS

The follow-up section of this report has been expanded upon to describe in more detail some of the specific responses we have observed in a variety of species over the years. The following populations revisited are not included in formal monitoring agreements per consultation with CDFW.

Bald Mountain milkvetch (*Astragalus umbraticus*)

The following two populations were not a part of the monitoring agreement but were still visited in the 2021 season following the Tully Creek thinning project.

BotID#36338 in the Tully Thin THP (CDF#:1-20-00085H) (GDRCo#51-2001) received a thorough survey in this year’s monitoring after operations had harvested in the plan area during the winter of 2020. There was no mitigation in place for the population, which started out with 150 plants at the time of detection in 2020. In 2021 the plants were found in two distinct locations along a seasonal road that was reopened and was found scattered throughout much of the interior of the adjacent unit where it had been found sparingly in the year before. A total of 410 plants were recorded, mostly young sprouts, which is a sizeable increase from 2020.

A smaller population, BotID#36348, associated with the Tully Thin THP was also found to have increased in size following the road grading and brush clearing along the seasonal road it is growing along. In 2020, shrubs were outcompeting the population of 15 plants, which has since responded favorably to the increased light exposure and disturbance from road maintenance, growing to 150 plants in 2021. The population is primarily young plants, some freshly emerged with just a few leaves.

These responses continue to support the anecdotal evidence that certain levels of disturbance for this species are beneficial for sustaining new and continued growth of populations.



Total Known ASUM Populations on GDRCo	Populations Revisited (2021)	Populations Found to be Extant (2021)
36	10	10

Photo Caption: A mature plant growing in an area that hasn't been directly disturbed.

Benson’s saxifrage (*Benisoniella oregona*)

BotID#30329 has an interesting history. Most of the population was transplanted in 2012 out of the road surface it was found growing on. It was relocated to the outboard edge of the road to protect the plants from being

trampled by cattle or disturbed by vehicle traffic. That proved to be successful as the plants responded well in following years. In the spring of 2021, there were a record 13 plants at the site, but in late summer of 2021 the population was buried under a foot of rock as the adjacent landowner had filled in the mucky creek crossing to stabilize the road. Only four plants remain in the outboard side of the road after the incident, but the plants still appear to be healthy. The plants have received a 75' no harvest EEZ as part of mitigations in accordance with the Snow Camp Lake 22 plan (CDF#:1-21-00049H) (GDRCo#17-2002) that the population occurs in. The Botany department will continue to monitor this population for signs of recovery in the remaining habitat that is available.



Total Known BEOR Populations on GDRCo	Populations Revisited (2021)	Populations Found to be Extant (2021)
17	1	1

Photo Caption: Bensoniella oregona flourishing on the side of a seasonal road alongside Snow Camp Lake.

Flaccid sedge (*Carex leptalea*)

This population is one of very few on GDRCo ownership. BotID#30010 is growing on the road surface of an appurtenant road (CR-1000.78R) to a current plan, the CR 1000/1900 (2022) in the Cranell area of the property. This population was detected and thoroughly documented in 2011 during floristic surveys for the CR 1700 (2012) THP (CDF# 1-10-137H).

The area this population inhabits hosts a unique vegetation assemblage comprised of a mixed *Sequoia sempervirens*, *Picea sitchensis*, *Pinus muricata*, and *Pseudotsuga menziesii* stand. The shrub layer consists of *Morella californica*, *Rhododendron columbianum*, *R. macrophyllum*, *Spiraea douglasii*, and *Vaccinium ovatum*. The plants themselves are growing among an herbaceous assemblage of *Gentiana sceptrum*, *Hypericum anagalloides*, *Lycopodium clavatum*, *Spiranthes romanzoffiana*, *Sceptridium multifidum*, *Sisyrinchium californicum*, *Juncus bolanderi*, *Juncus ensifolius*, and *Juncus effusus*. The areas in which the plants are found growing are hydrologically unique, in both moisture and soil characteristics.

When detected in 2011 during surveys for the CR 1700 (2012) THP, it was documented at 20 individuals growing in a 10x20 foot area of road, primarily growing at the road margins in pooled water and/or saturated ground. At the time of this plan, it was detected at a road point, so mitigations were provided to reduce impact by

operations in the form of a 25' ELZ for the plants at the outboard edge of the road to allow for equipment to access the stand adjacent and to the east of it for operations. Operations occurred as late in the summer period as feasible to allow maximum drying prior to operations, and no rock application or graded material could be laid atop the population.

Upon revisit in 2021 during floristic surveys for the CR 1000/1900 (2022) THP, the population was discovered to have expanded in size to an approximated 63 individuals occupying a 25-foot length of road (roughly 10 feet across). The population is comprised of dense, robust bunches of plants, with the majority occupying the middle of the road surface. Those at the margins are being encroached by (and hidden under the leaf blades of) *Cortaderia jubata*. The habitat is becoming severely compromised by the encroachment.

This population will again receive a 25' ELZ along the length of road it is growing with restrictive permission to use the road for access to the plan. A part of the mitigation is to allow for brushing and removal of the pampas grass at the edges of the road, which will impact a portion of the population. However, this impact will hopefully help jumpstart the ability for the habitat to recover from invasive species encroachment. The Botany department will be formally monitoring this site post-impact to assess the efficacy of the mitigations. Complete removal of the pampas grass in this area may provide an excellent opportunity to restore habitat for this *C. leptalea* population and allow for more effective manual spot-removal of pampas grass in the following years.



Total Known CALP Populations on GDRCo	Populations Revisited (2021)	Populations Found to be Extant (2021)
3	1	1

Photo Caption: A true look at the habit of Carex leptalea, flat and splayed out as though it has been sat on.

Oregon fawn lily (*Erythronium oregonum*)

An incidental detection from 2019 found BotID#36223 along a class II creek drainage on Red Mountain. The population has decreased in size since it was first found, decreasing from 200 plants to only 50. The plants were healthy but with no blooms, just many single leaves. The population occurs in a unique, serpentine influenced area with a mixed stand of *Chamaecyparis lawsoniana*, *Pinus monticola* and *Pseudotsuga menziesii* var. *menziesii* in the overstory and *Rhododendron occidentale* shrub cover with sparse *Xerophyllum tenax* herb cover surrounding it.

Total Known EROR Populations on GDRCo	Populations Revisited (2021)	Populations Found to be Extant (2021)
7	1	1

Coastal fawn lily (*Erythronium revolutum*)

Along with the monitoring agreement for select *Erythronium revolutum* populations in the Boulder Creek North 2017 THP (CDF#: 1-16-138H) (GDRCo#17-1602), seven additional populations within the plan were revisited voluntarily. Six of the populations were provided protection with one population receiving none. Many of the populations were growing within the RMZ or were growing on a rock outcrop. A few decreased in population size, but most of the populations expanded in size. All populations were healthy with at least 50% producing flowers. BotID#35083 was the only population without any formal PPMs because of its distance from the RMZ flag line, so it was ultimately protected by default. It increased from three individuals with no flowers in 2017 to eight individuals with one flower. BotID#35086 was the only population that was not found in the follow-up monitoring, even though it was protected. It was likely buried under a windblown tanoak that was in the immediate area where the population was originally detected.

There were eight other populations revisited this year that were not part of a large monitoring effort. They were dispersed across the Korbelt area in the Maple Creek, Snow Camp, and Wiggins tracts of the property. The populations were all extant, with some having a dramatic increase in population size. All the plants were healthy and flowering or beginning to produce flowers. BotID#35255 along the RM-10 increased in size from 400 individuals in 2017 to a hefty 1,200 individuals in 2021. It's likely that a portion of the population was overlooked in the initial detection with the heavy coverage of *Polystichum munitum*, *Gaultheria Shallon* and other roadside associated species along the cutbank. Regardless, the plants were healthy, robust, and starting to develop fruits. An old population in Snow Camp, BotID#195, was originally found in 2004 with around 100 individuals and has now been estimated to have closer to 10,000 individuals as of 2021.



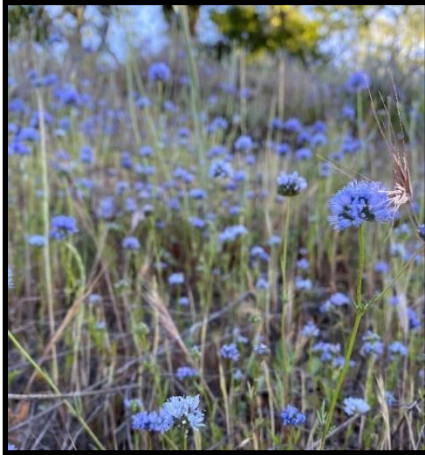
Total Known ERRE Populations on GDRCo	Populations Revisited (2021)	Populations Found to be Extant (2021)
355	29	24

Photo Caption: Classic Erythronium revolutum habitat, nestled in on a mossy rock outcrop.

Pacific blue field gilia (*Gilia capitata* ssp. *pacifica*)

A large population of *Gilia capitata* ssp. *pacifica*, BotID#29678, is growing on the eastern bank of the road at the junction of Bald Hills Road and Snow Camp Road. The population has doubled in size from 1,500 plants in 2008 to now 3,000 plants in 2021. The extent of the population has expanded down the road over the years, as well as a small patch occupying a new site across the road, so it is fair to summarize that the population is thriving.

BotID#30337 is growing on the cutbank of a season road in the Snow Camp area of GDRCo property. This road became appurtenant to a current plan (Snow Camp Lake 22 plan (CDF#:1-21-00049H) (GDRCo#17-2002)) and is growing on the edge of one of the units. The population has grown over the years from 75 plants in 2012 to 200 plants in 2021 and will be receiving a 25' No-Harvest buffer into the unit and an EEZ along the stretch of road it resides on to protect it from impact.



Total Known GICAPA Populations on GDRCo	Populations Revisited (2021)	Populations Found to be Extant (2021)
13	2	2

Photo Caption: Gilia capitata var. pacifica blooms in full swing, looking bright in the morning shadows.

Running pine (*Lycopodium clavatum*)

Lycopodium clavatum receives voluntary PPMs typically in the form of a 25' ELZ drawn from the edge of the population extent or are provided protection through riparian buffers or Habitat Retention Areas (HRAs). A large effort was made to check on some populations in the BMA in plans that had been recently harvested. Most populations were mitigated, or they were within another no harvest feature like a RMZ or HRA.

There were a total of 13 populations that were found during monitoring. Three populations had no protections but were found to be doing well and were healthy. BotID#31455 was located during the follow-up but the plants were all dead for unknown reasons as the mitigation buffer was intact and there was no disturbance seen nearby. Populations that received protection by a 25' ELZ were found thriving with new growth and sporophyte structures after harvest operations came through, demonstrating that the ELZ buffer was effective.

Five populations weren't relocated post-impact. They were all provided 25' ELZ buffers or were avoided during operations, but these protections were not effective for these populations. It is possible that disturbance from timber harvest operations altered the micro-habitat beyond suitability for the species.

Total Known LYCL Populations on GDRCo	Populations Revisited (2021)	Populations Found to be Extant (2021)
985	18	13

Howell's montia (*Montia howellii*)

Ten populations of *M. howellii* were revisited in 2021. Two populations of these populations (BotID#30022 and BotID#30024) were originally detected in the Goodman Prairie 2010 plan (CDF#:1-10-055H) (GDRCo#17-1002). Both populations experienced a major decrease in population size since the original findings in 2010. BotID#30022 decreased from 113 individuals to 37. BotID#30024 started with a hefty 208 individuals and dwindled down to only two, yet the habitat in the surrounding area was excellent for the species. It is unclear why the populations have depleted over the years, but we hypothesize that it could largely be encroachment of weedy species or just loss of the wet, silty substrate the plants need to thrive. An incidental detection from 2019, BotID#36222, on the MRS-2000 was observed with opposite results from the other two populations. It went from 50 individuals in 2019 to 100 individuals in 2021. The habitat was ideal mucky substrate on the road edge with the plants growing from old machine tracks.



Total Known MOHO Populations on GDRCo	Populations Revisited (2021)	Populations Found to be Extant (2021)
36	10	8

Photo Caption: Happy and healthy Montia howellii flourishing in the silty muck.

Ghost pipe (*Monotropa uniflora*)

A large effort is made annually to monitor a range of *M. uniflora* populations. GDRCo has a Programmatic Agreement for the species that provides a 100' ELZ for populations, with the inner 66' No-Harvest and the outer 33' selective harvest. Of the 52 populations monitored this year, 35 of them received programmatic protections. Twenty-one of those protected were found during monitoring while the remaining 14 were not detected. Of the 17 populations that did not receive protections, eight populations were found and nine were not. Some of the unprotected populations survived the impacts of timber harvesting and changes to the micro-climate thereafter.

Since the species is involved in a mycorrhizal association with other species, it is very possible that the response observed in populations over time is only a small snapshot of what is happening in the bigger picture. Each population is linked to the health of its mycorrhizal associate and its host tree(s)/shrub(s), and as such, there is a dynamic number of variables that can be influencing any one of them and as a result, each other. For example, if the host tree is impacted, the main nutrient source is impacted which may influence the mycorrhizal associate and in turn, the growth pattern of *Monotropa uniflora* populations plugged into that network. Even if the host plant is not directly impacted, the change in the micro-climate may impact any of the players and influence the pattern of growth in each population.

Total Known MOUN Populations on GDRCo	Populations Revisited (2021)	Populations Found to be Extant (2021)
939	52	29



Photo Caption: Monotropa uniflora beginning to emerge in the middle of summer with the help of the fog drip (right). Not as commonly seen is the emergence of flowers in the same location as the previous year, indicated by the old fruiting stalks (left).

Woodnymph (*Moneses uniflora*)

BotID#35321 is a population of *Moneses uniflora* growing in a CalTrans right away along the southbound 101 that is immediately adjacent to Green Diamond property. This population is used primarily as a reference site for phenology and habitat characteristics. The area is not managed for timber, so it is an undisturbed area with a mixed stand of *Picea sitchensis*, *Pseudotsuga menziesii* var. *menziesii* and *Tsuga heterophylla*. The area where the plants are growing is unique, but the habitat change is abrupt. The understory opens up in a circular patch where *Menziesia ferruginea* and *Vaccinium parvifolium* replace the dense *Vaccinium ovatum* in the surrounding stands. *Struthiopteris spicant* becomes the dominant fern and the forest floor has a well-established mat of moss intermixed with fine woody debris and needle litter. This habitat is not often seen on the property, although this reference site serves as an excellent example of what habitat to target and thoroughly survey when present in a plan area.



Photo Caption: Healthy Moneses uniflora plants shedding its petals as the ovary begins to swell with maturing fruit (left). Large, very healthy leaves of the woodnymphs that didn't flower (right).

Total Known MOUNI Populations on GDRCo	Populations Revisited (2021)	Populations Found to be Extant (2021)
0	1	1

Siskiyou checkerbloom (*Sidalcea malviflora* ssp. *patula*)

The beautiful Siskiyou checkerbloom is known from a few locations on GDRCo property with only 15 populations occurring mostly in the greater Wiggins and Fulton Ranch areas. This year there were two projects monitored, where the highest concentration of *Sidalcea malviflora* ssp. *patula* occurs. The populations in the Goodman Prairie THP are part of a formal monitoring agreement (see Monitoring Agreement section of report for details). The populations in the Elk Habitat Improvement project in Fulton Ranch are not.

The Fulton Ranch is a part of the Big Lagoon Private Land Management (PLM) plan. In 2020 there were restoration efforts made for habitat improvement in roughly 100 acres of the Oregon white oak woodlands (*Quercus garryana*) by removing small diameter Douglas firs (*Pseudotsuga menziesii* var. *menziesii*). The trees were cut by chainsaws and hand tools, while several larger trees were girdled. This effort prevents the encroachment of quick growing conifers in the true oak woodlands, preserving the landscape and improving habitat for many plant and animal species that depend on the oak stands.

The initial survey for the project was conducted in 2013 and five populations of *S. malviflora* ssp. *patula* were detected along the edge of the oak woodlands and margins of open grasslands. Another follow up visit to the populations in 2018 found that most of the plants were not flowering as they were still too heavily shaded by conifer canopy, but the population sizes had grown since their initial finding in 2013. BotID#30633 and #30636 have increased in size in the last few years with both having several plants in bloom. BotID#36037 and #360634 occur within the same slope, one stayed the same in size while the other expanded greatly. There were a few

flowers seen, but the populations mostly resided in the shade and were vegetative. BotID#30635 has decreased in size ever so slightly, but nonetheless was still flowering. Overall, the populations are looking healthy and are increasing in numbers. The percentage of blooming individuals is increasing following the restoration efforts.

Total Known SIMAPA Populations on GDRCo	Populations Revisited (2021)	Populations Found to be Extant (2021)
15	10	10



Photo Caption: Magenta Sidalcea malviflora ssp. patula flowers glowing in the sun and in the shade.

Robust false lupine (*Thermopsis robusta*)

The Christmas Prairie tract of GDRCo ownership (Bald Mountain area) hosts excellent habitat for *Thermopsis robusta*. There are 29 distinct populations on GDRCo property, of which eight are in this part of the property. The clay rich soils and unique forest composition provide the right ingredients for success and—to the surprise of some—mechanical disturbance from timber operations can be the binding agent that sustains and supports old and new populations alike. The history of the species might be complicated in that regard. Many online sources state that timber harvest operations and road maintenance/use are threats to this species. On the contrary, anecdotal evidence from tracking and monitoring GDRCo populations over time have provided a different picture. Below are several examples from monitoring efforts that provide context for this claim.

Several *T. robusta* populations in the Christmas Prairie tract of GDRCo ownership were targeted for habitat restoration several years ago when it was noted that many of the populations were suffering from vegetative competition and shading from overtopping vegetation as the surrounding forest regenerated. BotID#692 has been tracked over the years since its discovery in 2002 when it was observed at a hefty 100 individuals. It's population numbers crept higher in the years following when in 2018 there was a record 250 plants observed, all growing roadside (or close to) amongst encroaching shrubs that were beginning to suppress the plants. In 2019 and 2020, the Botany crew used hand tools to remove surrounding shrubs and small tree limbs that were shading out plants. Concurrently, in 2020 the road was brushed during maintenance activities for a nearby THP on the surrounding stretches of road that the plants were growing along (but not impacting the stretches containing plants). The response has been extremely effective. The plants were receiving more light, were blooming, and had stopped "stretching" their limbs to reach light. In 2021, new emergent seedlings were observed at this site among the robust, mature flowering individuals.

Total Known THRO Populations on GDRCo	Populations Revisited (2021)	Populations Found to be Extant (2021)
29	3	3



Photo caption: Young plants sprouting (left) among a thriving Thermopsis robusta population (right) whose habitat has been improved by a combination of routine road maintenance and hand removal of shrubs.

Another notable and impressive (unexpected) response occurred after the harvest of a plan in 2016. In Fall 2019, an employee was walking an appurtenant seasonal road used for access to a unit in the plan area and noticed an expansive population of young *T. robusta* plants had germinated along the road surface and into the surrounding clear-cut. This population (BotID#36686) has been monitored in the prior two years as the plants have matured and an impressive 150 plants have sprouted and grown to maturity in the wake of the disturbance, primarily along a decommissioned temp road but also into the footprint of the clear-cut unit surrounding it. New emergent seedlings were still being observed in 2021. Most of these plants are associated with new road construction, which might suggest that this species needs seed scarification for successful germination. The blading and grading of the soil to construct the road likely disturbed and scarified the seeds banked in the soil on site. This scarification, combined with canopy removal, created ideal habitat that is now supporting an expansive population. It does not seem like a stretch that this might be the case, as other relatives

in the Fabaceae family are disturbance adapted and early successional species (e.g., *Cytisus scoparius* and *Astragalus umbraticus*). Many plants are four or five feet tall, and equally as wide. It is exciting and interesting to see these positive responses to standard management practices on the landscape.



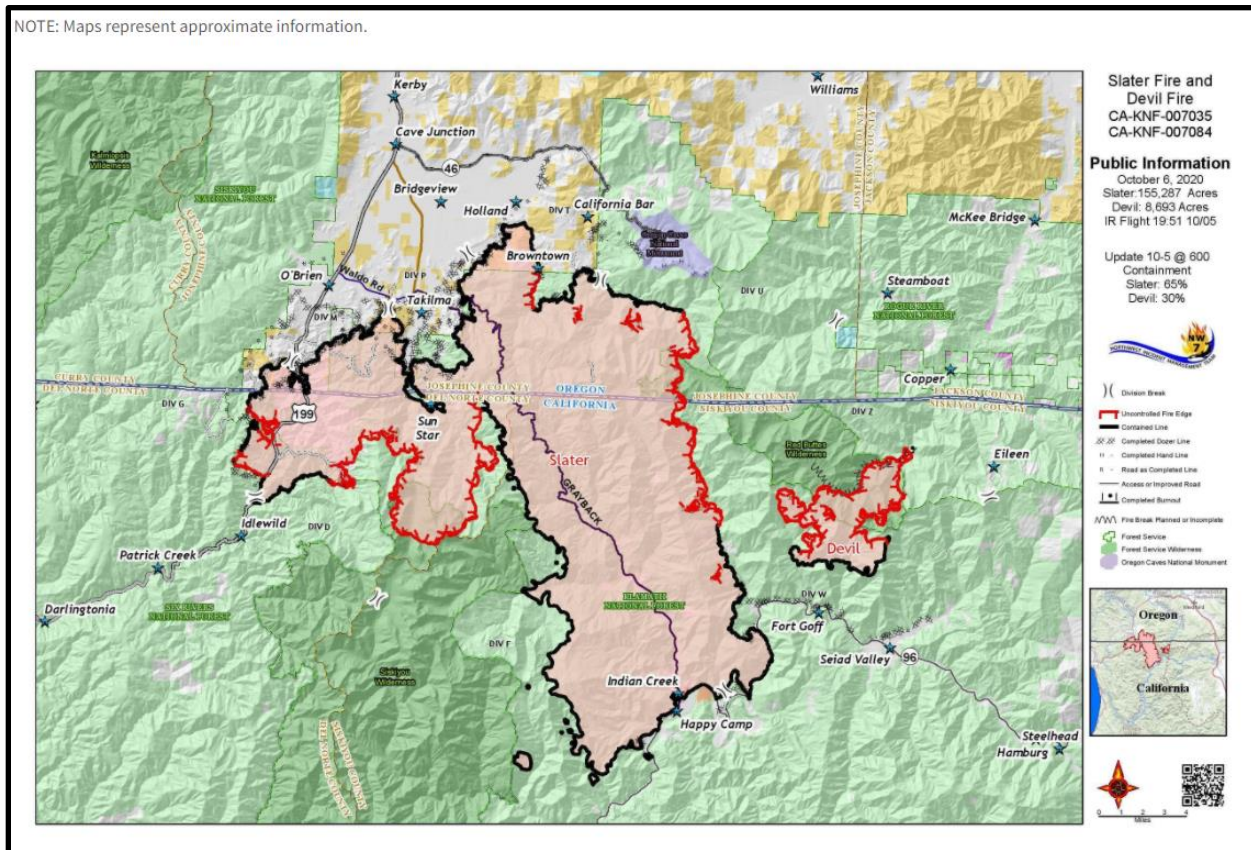
*Photo caption: An intimate moment captured on the bright inflorescence of a *T. robusta* plant, with a sea of inflorescences in the background (left). Another sea of individuals are growing along the surface of the abandoned seasonal road and extending down into the clear-cut unit to the right of the photo edge (right).*

Another notable example is a new population detected this year during surveys for the Christmas Carroll THP (CDF# 1-21-00046H) (GDRCo#27-2001). This population (BotID#36703) was found along one of the appurtenant roads for the plan adjacent to a unit from the Upper Lupton THP (CDF# 1-14-043H) (GDRCo#27-1401) harvested in 2016. Plants occur on the road prism, the road margin, and in the regenerating clear-cut. There were no pre-existing populations in the area at the time of the Upper Lupton surveys, so the population stemmed from the new road construction and harvest operations. The seeds must have been banked in the soil for at least the last 30 years or more, given the history of the land and the last time it was harvested.

We look forward to continuing to monitor the response of these populations over time, as well as closely monitoring the footprint of recent operations in this area for new explosions of plants.

Moore Tract: Species Return Post Fire

NOTE: Maps represent approximate information.



Map Source: InciWeb, Slater/Devil Fires

The 2020 fire season was devastating for the Pacific Northwest. By late September of 2020, over five million acres had burned in California, Oregon, and Washington, setting record highs for the cumulative number of fire detections in the prior 20 years. (Migliozi, 2020) The Slater Fire was among those considered a “large incident” (100 acres or larger in timber) (Northwest Interagency Coordination Center, 2021), and indeed it was. The Slater Fire originated in the Klamath National Forest in northern California on September 8, 2020 and burned through 157,270 acres of National Forest and private land before being 100% contained in early December 2020 (U.S. Forest Service, 2020). It should not go without noting that among the devastation to land were communities, homes, and lives lost. Wildfires in the Northwest United States will continue to be harrowing events to prepare for and overcome into the future.

A portion of the private land that the Slater Fire burned through is GDRCo ownership in an area called the Moore Tract. The fire burned a total of 4,052 acres out of the total 4,995 acres owned. Hazardous conditions were left in the aftermath of the fire in the form of unstable soils and dead, standing trees along roadways and trails. Within the area burned were numerous populations of sensitive and rare plants: *Coptis laciniata*, *Iris bracteata*, *Piperia candida*, *Arctostaphylos nortensis*, *Asarum marmoratum*, *Listera cordata*, *Erythronium howellii*, *Lilium kelloggii*, and *Prosartes parvifolia*.



Photo caption: View of the burned timber in the Moore Tract.

The area was granted Emergency Notice Harvest permits to salvage log some of the area impacted in the Moore Tract in late 2020-2021. The Botany department was able to make a few visits to this part of the property immediately after the fire and again in the 2021 field season visit as many rare plant populations as was feasible to assess the impact. Unfortunately, the number of populations accessible were few, as the roads and conditions are still being recovered. However, there were promising finds. Regeneration is underway. Among the flora found regenerating in the burned soils were the vegetation (and some flowers) of fire weed, tan oak sprouts, bracken ferns, violets, vanilla leaf, trillium, irises, and rose flowered lotus.

We look forward to continuing to visit and monitor the regeneration of the site as it recovers from the impact of fire.



Photo caption: The green and bright pops of colored blossoms stand in stark contrast to the barren, rocky burned soils around them.

*A delicate bloom and the characteristic mottled leaves of *Erythronium howellii* (BotID#30738) emerging from the charred soils (top left). (Top right) Waxy, marbled emerging leaves of *Asarum marmoratum* (BotID#30739). A bright pink trillium makes a statement (bottom left).*

Howell's fawn lily (*Erythronium howellii*)

The only occurrence of this species on the property, BotID#30738, has survived the extreme heat of the Slater fire of 2019 that blazed through the Moore tract, leaving nothing but bare soil and blackened tree stems. This population was last recorded to have 50 plants in 2011 upon its finding and it now was recorded to have 60 plants. The population must have slowly grown over the years and even after the fire it still had an increased population size, though it is likely that a few individuals were lost to the fire. The plants were very small and heavily mottled, likely because of the full sun exposure they were now receiving. *Achlys triphylla* and *Viola sp.* were all that was seen growing around the population, the vegetation for those plants was also smaller than normal. Overall, the population looked healthy and is likely to make a strong recovery.



Total Known ERHO Populations on GDRCo	Populations Revisited (2021)	Populations Found to be Extant (2021)
1	1	1

Photo Caption: A real trooper. The only population of Erythronium howellii known on the property was still able to produce a flower even after an intense fire came through and left nothing behind just the year before.

Marbled wild ginger (*Asarum marmoratum*)

BotID#30739, the only recorded occurrence of the species on the property, was found in 2011 along the MT-10 road in the Moore tract in accordance with the proposed N #587 THP (GDRCo#: 87-1101) plan that was never harvested. The five individuals were found growing on a cutbank near a small creek along the *Pseudotsuga menziesii var. menziesii* dominant inland forest. The cutbank was composed of tan colluvial soil with sparse vegetation. In 2018 there were seven individuals reported. All were healthy but may have been slightly impacted by recent roadwork. In 2021 there were three individuals that had regenerated after the Slater fire of 2020. The plants looked healthy, vibrantly green in the early season despite the severity of the fire. The plants were buffered in accordance with the salvage logging in 2021 and road reconstruction.

Total Known ASMA Populations on GDRCo	Populations Revisited (2021)	Populations Found to be Extant (2021)
1	1	1

Salmon Creek Howell's *Montia* Monitoring

Based on the results of the power analysis that West Inc. conducted on the 2011 through 2013 monitoring data for *Montia howellii* in Salmon Creek, the monitoring protocol was revised to focus on detecting trends of occupancy in 2015. This has subsequently resulted in a change to the sampling protocol and much of the data collection has been simplified. In 2019, the protocol for sampling competing cover was also updated and changed. The current monitoring protocol is as follows:

Objectives:

1. Determine if the trend in occupancy of *Montia howellii* (MOHO) growing along the mainline Salmon Creek road system is increasing, decreasing or stable over time.
2. Determine if MOHO occupancy is correlated with covariates that can be altered through management.
 - A. Road surface type as percent cover of dirt and percent cover of rock (cumulatively equal to 100%).
 - B. Percent cover of competing vegetation – we will measure cover of plants at ground level other than MOHO, including straw mulch or logging slash

Sampling Plan:

1. The sampling universe includes the GDRCo Salmon Creek tract mainline road system on the north side of Salmon Creek, with the exception of one road that crosses to the south side of Salmon Creek. That road is included until it reaches the GDRCo property line. The roads that are classified as mainline roads for the purpose of this study are the main roads that are projected to be used and maintained over the next ten years (2011-2020). For the most part the roads included provide an access loop through the extent of the property on the north side of Salmon Creek. The significance of this continuity is that it should allow us to account for plants anywhere they may have migrated along the mainline. The majority of the mature timber in this tract has already been harvested and the main area left to harvest is at the northeastern portion of the sampling universe. The mainline road accessing this area has been reconstructed and newly constructed in recent years and while MOHO has not been found on this road yet, it does contain potential habitat. There are other roads included that to date have not supported MOHO, as well as roads that have supported large numbers of MOHO until they were rocked a few years ago. Some of the roads included may get more or less use than others over the course of the study. The sampling universe contains road segments with both natural and rocked surfaces. Additional rocking may occur in the years to come. We anticipate that the habitat quality along roads or portions thereof will fluctuate throughout the course of the study.
2. The roads in the sampling universe were designated as routes with beginning and end points and then routes were ordered in space and divided into 50 foot segments that will serve as sample plots. The width of the road varies and plants are often found at the margins and in the middle, so the plots will not have a fixed dimension across the width of the road. Each 50 foot segment was given a permanent route ID and segment ID with fixed start/stop UTM coordinates that can be loaded into GPS units.
*There are three road segments that are shorter than 50 feet, but longer than 25 feet so we will keep them. There are a total of 1551 road segments.
3. Stage 1 consists of determining presence or absence of MOHO in the sample plots or road segments (SID). Sample plots selected by a generalized tessellation stratified (GRTS) sample of 50-foot road segments to ensure sample plots are spatially balanced (interspersed) throughout the population with few if any adjacent to one another. The GRTS sample will consist of a specially randomized list of road segments that preserves spatial balance in adjacent sets of segments. The first 110 segments on this list

were formerly placed in a group called Panel 1. All of Panel 1 was sampled on an annual basis for the first 4 years of the study. The subsequent groups of 20 segments were assigned to panels numbered 2 through 73. Road segments in panels 2 through 73 were to be sampled twice every 5 years on a rotating basis. During the first five years of the study, a total of $n = 130$ sites were being sampled (Panel 1 plus one of Panel 2 through 6). After Year 5 of the study, a total of $n = 150$ segments were to be sampled (Panel 1 plus a previously unvisited panel plus a previously visited panel). After four years of conducting the study under this sampling regime, it was determined that the effort required to complete the number of sites was too great to remain sustainable for the long term. The proposed revisions to the sampling protocol are outlined below.

Revision to Sampling:

The goal for revising the sampling protocol is to have two groups of surveyors complete the work in two weeks, or 10 sample days. To achieve this goal, we propose that the sample number be reduced and that the survey protocol be simplified. By estimating that each group will be able to complete five sites per day, this makes 100 SIDs over the 10 sampling days. This seems reasonable and achievable. There is some concern regarding destructive sampling to the 110 permanent sites. It would be ideal to be able to give some of these sites a rest period. In addition to this, having faster replication of the 80 (Panels 2-5) that have been sampled already could also be beneficial. There will still be sampling of new sites as well under the following scheme:

- a) Panel 1, which consists of 110 SIDs, gets divided into three panels: Panel 1, Panel 2 and Panel 3. Two of these will have 37 SIDs and one will have 36. In order to give some of these permanent sites a resting period, a two year on and one year off strategy will allow us to do this without losing how a prior year at a SID directly impacts the following year (since they are annual plants). This strategy would look like this:
Year 1: Panel 1, 3
Year 2: Panel 1, 2
Year 3: Panel 2, 3
Year 4: Panel 3, 1
Year 5: Panel 1, 2 (Etc.)
 - b) Panels 2-6, which each consist of 20 SIDs, but collectively make 100 SIDs, will remain the same. Their panel numbers will change since Panel 1 has been divided into three new panels. Their new panel numbers will be 4-8. These panels of 20 will cycle and repeat every five years e. g. 4, 5, 6, 7, 8, 4, 5, 6, 7, 8, etc.
 - c) If we take two of the panels from the first group (Panels 1-3), this will make 74 SIDs. If we add one of the other panels from the second group (Panels 4-8), this will make 94 SIDs. We will always sample eight new sites, and since the number of permanent SIDs we sample can vary slightly year to year, some years we will survey 101 total SIDs and some years we will survey 102 ($36+37+20+8=101$; $37+37+20+8=102$).
4. Stage 2 consists of determining patch size in the selected sample plots. Each sampled plot will be divided **into five 10-foot quadrats** that extend across the entire width of the road. Presence or absence of MOHO will be recorded for each of the **five quadrats** in the sampled plot. To estimate probability of detecting MOHO assuming it is there, two surveyors will make independent presence/absence observations and record their data separately and discretely. When complete the two surveyors will compare their P/A to make the P/A union. When there are discrepancies the two surveyors will visually check the quadrat to see if there was a true miss by one surveyor, a misidentified plant or if the plant could not be relocated. If it was a misidentified plant or could not be relocated, a note is made on the datasheet, since this leads to cases where their union is not a simple addition of P/A1 and P/A2.

Boundaries of the quadrats will be delineated using stakes/spikes at ten foot intervals at both edges of the plot (outside road margins).

Each surveyor will make visual estimates of the percent cover of rock to the nearest whole percent (0-100) in each quadrat while they are doing the P/A survey. Each surveyor will also make a visual (ocular) estimate of the percent cover to the nearest whole percent (0-100) of competing vegetation in each quadrat. Once the surveyors have completed the segment, they will come to agreement on their independent assessments to determine the union value for the environmental variables.

A cursory analysis of the occupancy data from 2011-2021 was completed and is presented below in Figure 3. The results from each year's survey are shown in Figures 5-14 and the overall harvest activity is shown in Figure 4. The total numbers for 2019 show a significant increase in occupancy from 2017 and 2018, which brought the trendline to nearly flat. In years 2012 and 2015 the population showed declining occupancy numbers then upward trends in 2013, 2014, 2016, 2018, and 2019. In contrast to the high occupancy in 2019, 2020 occupancy was at record low. In 2021, occupancy bounced back to near high levels. We hypothesize that this dramatic variability in occupancy can largely be attributed to the sample draw. Long term results of the data continue to show a decreasing trend with a substantial amount of variability from year to year.

2021, the evolution continues:

During data review and initial analysis of our 2018 data, it became apparent that many of the ocular estimates for percent vegetation and rock cover among surveyors were highly variable and seemingly inconsistent. To calculate the significance of these discrepancies and make our data more useful, we implemented an additional vegetation sampling protocol in 2019. The point intercept method was used following the protocols outlined in Coulloudon et al. 1999. This protocol involves systematic estimation of percent cover of both rock and vegetation in all plots.

In our application, the point intercept method involves stringing a transect across the middle of each quadrat in the segment, with the transect oriented perpendicular to the road. The vegetation and rock cover was assessed every half-foot along the transect line using the point intercept method. See Figure 2 for a diagram of the plot/transect layout.

After reviewing and comparing our ocular estimates and point-intercept estimates on the 2019 plots, we discovered that there was no consistency or significant pattern between our ocular estimate data and the point-intercept data. Given the proven precision and accuracy of the point intercept method (Coulloudon et al. 1999), we can only assume that the ocular estimate data is both inaccurate and imprecise. While this is a somewhat disheartening realization, it is useful to get some clarity on the effectiveness of our methods. In 2020, we omitted the ocular estimation of vegetative cover and rock cover from the protocol, and used only the point-intercept estimation. This will be the norm moving forward with this project.

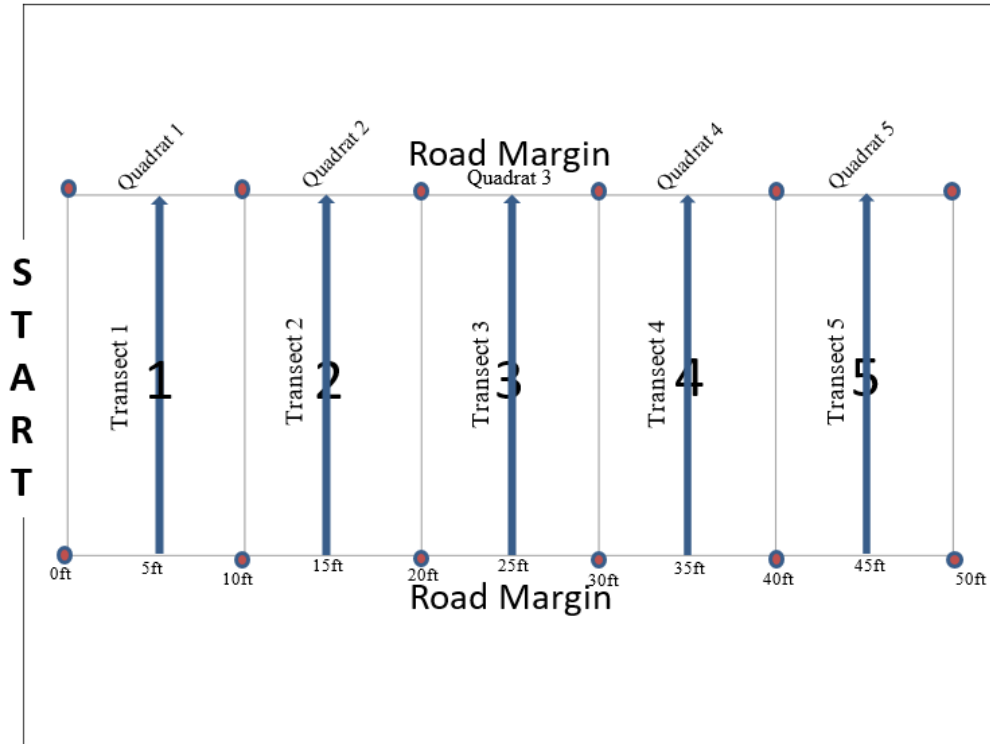


Figure 2. Point-intercept transect layout on MOHO segment.

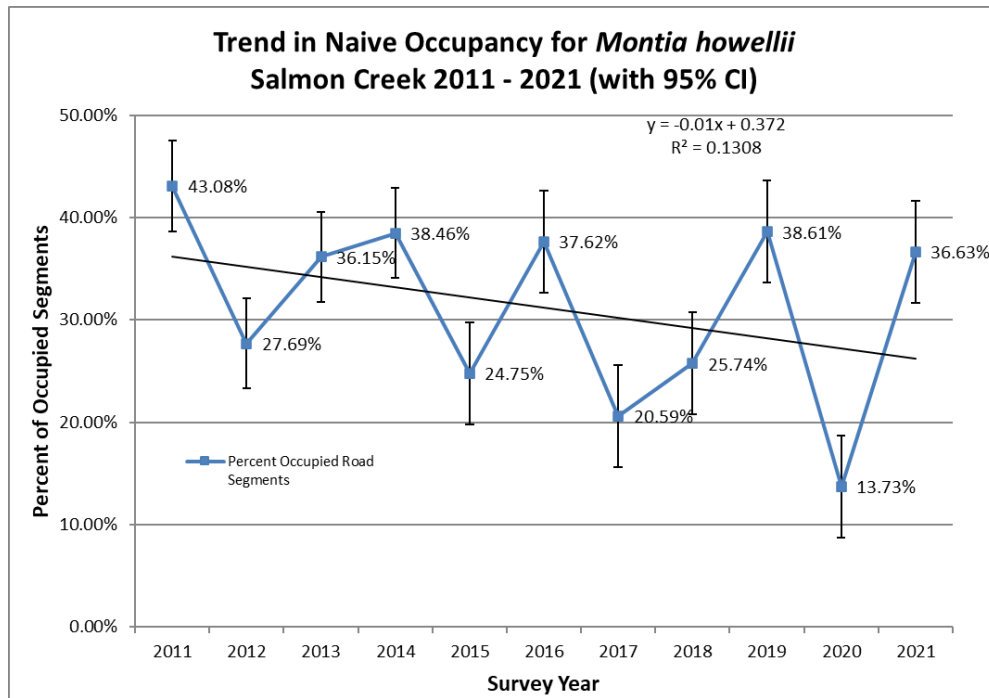


Figure 3. Howell's montia eleven-year occupancy trend.

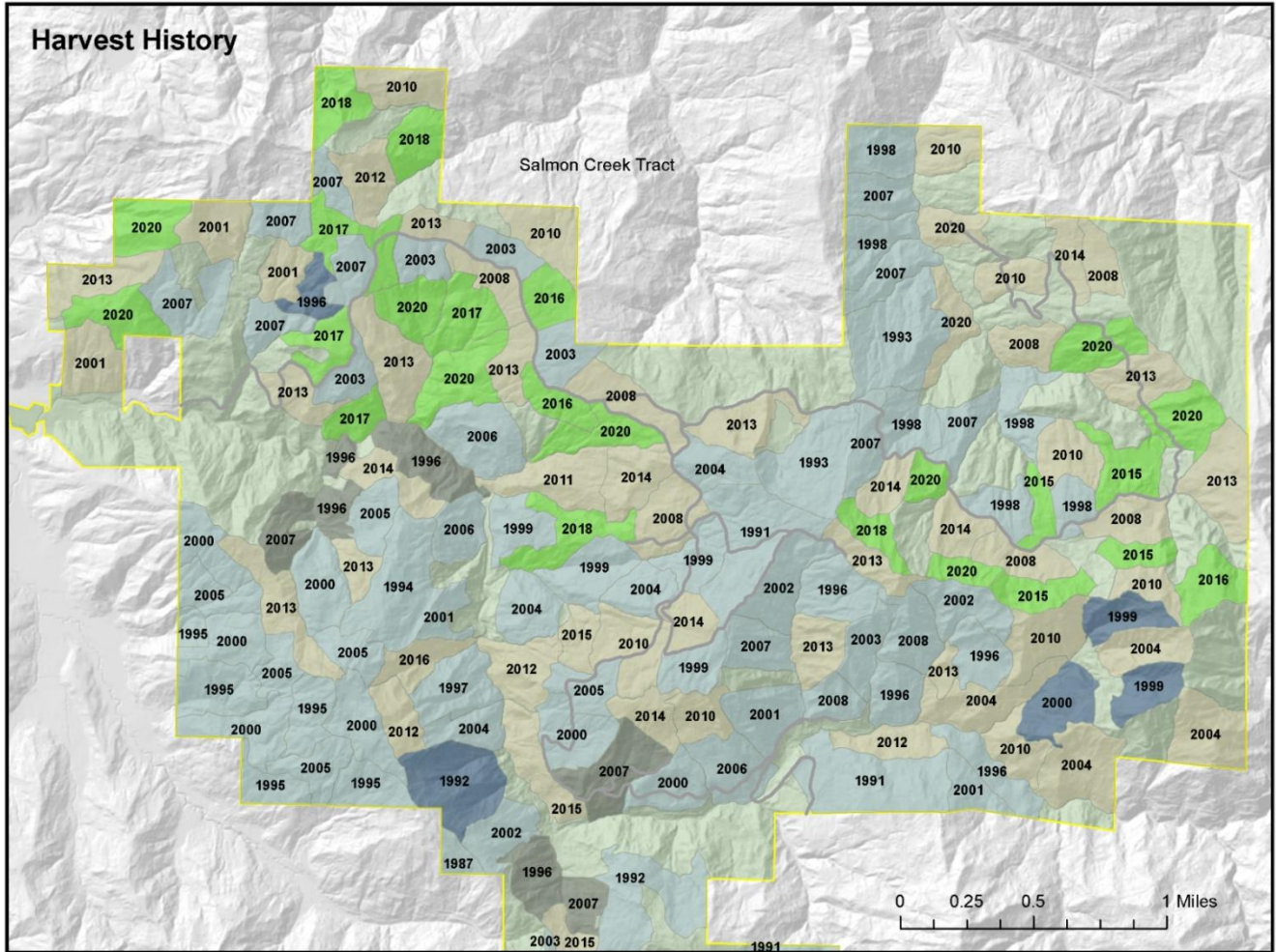


Figure 4. Harvest history and future harvest within the Salmon Creek MOHO sampling universe. Highlighted units were recently harvested.

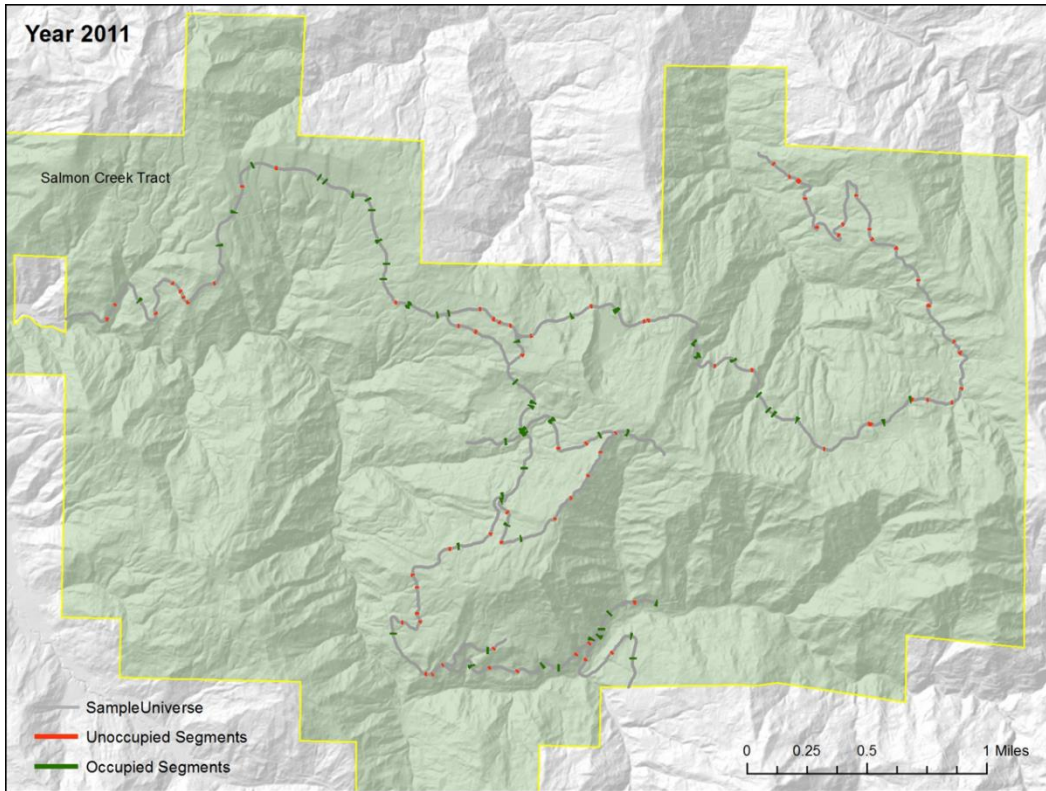


Figure 5. Sampling results 2011.

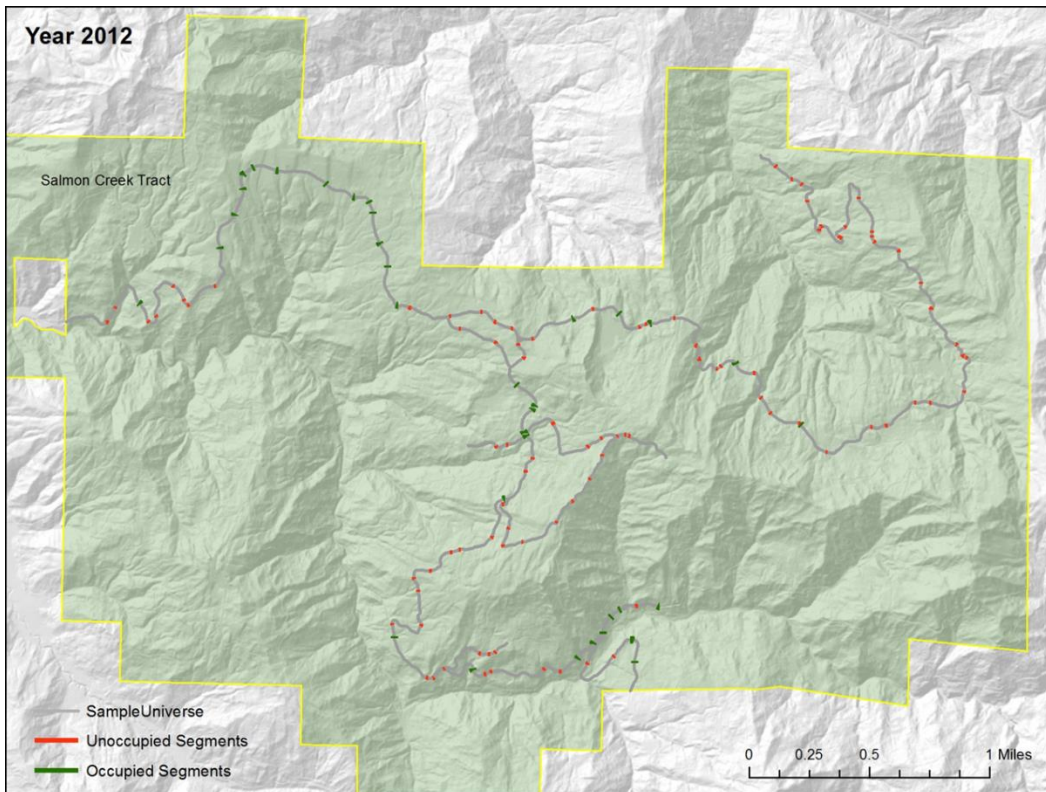


Figure 6. Sampling results 2012

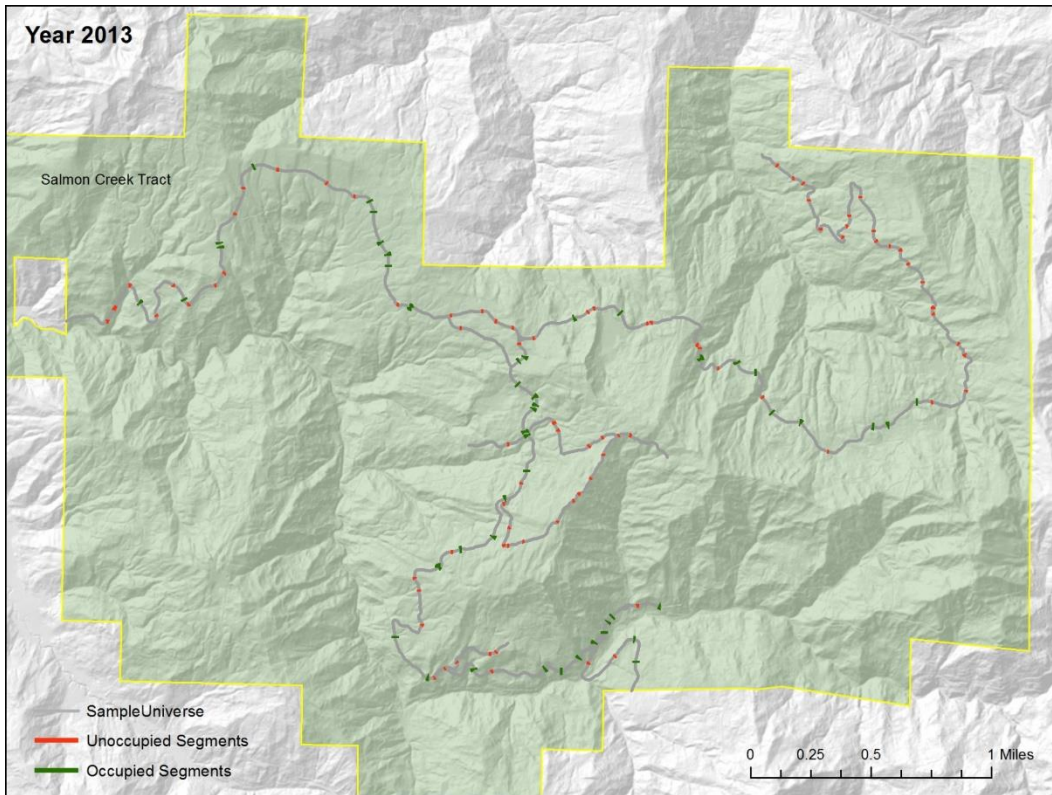


Figure 7. Sampling results 2013.

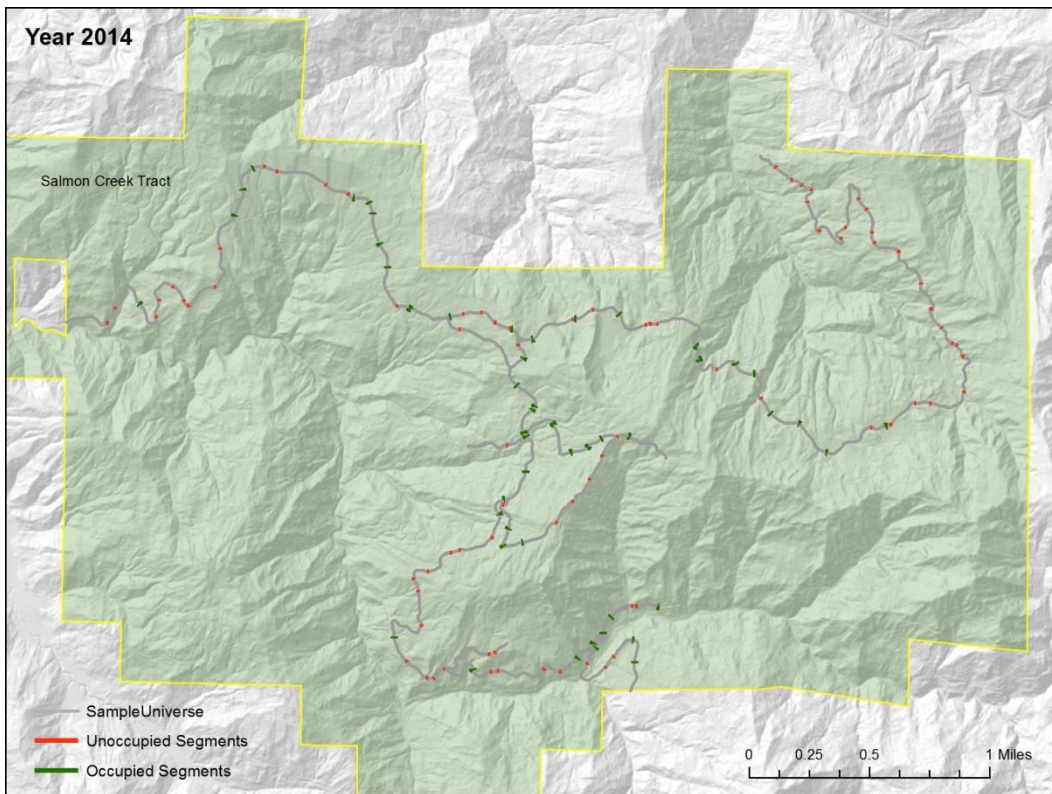


Figure 8. Sampling results 2014.

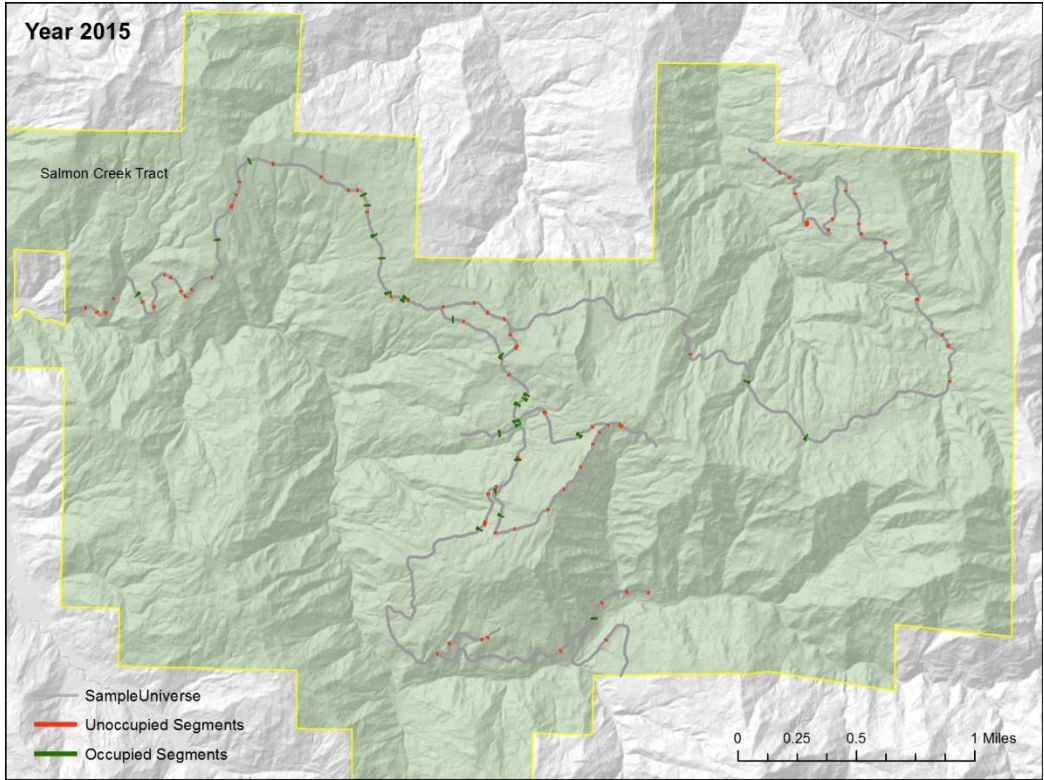


Figure 9. Sampling results 2015.

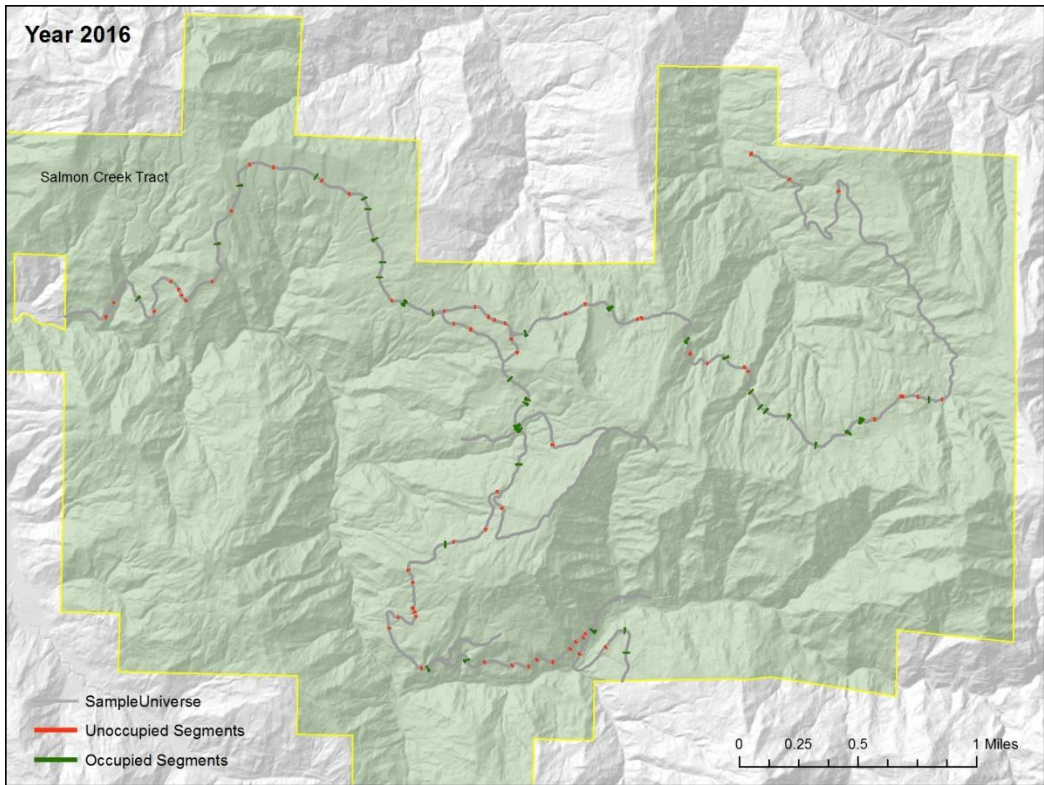


Figure 10. Sampling results 2016.

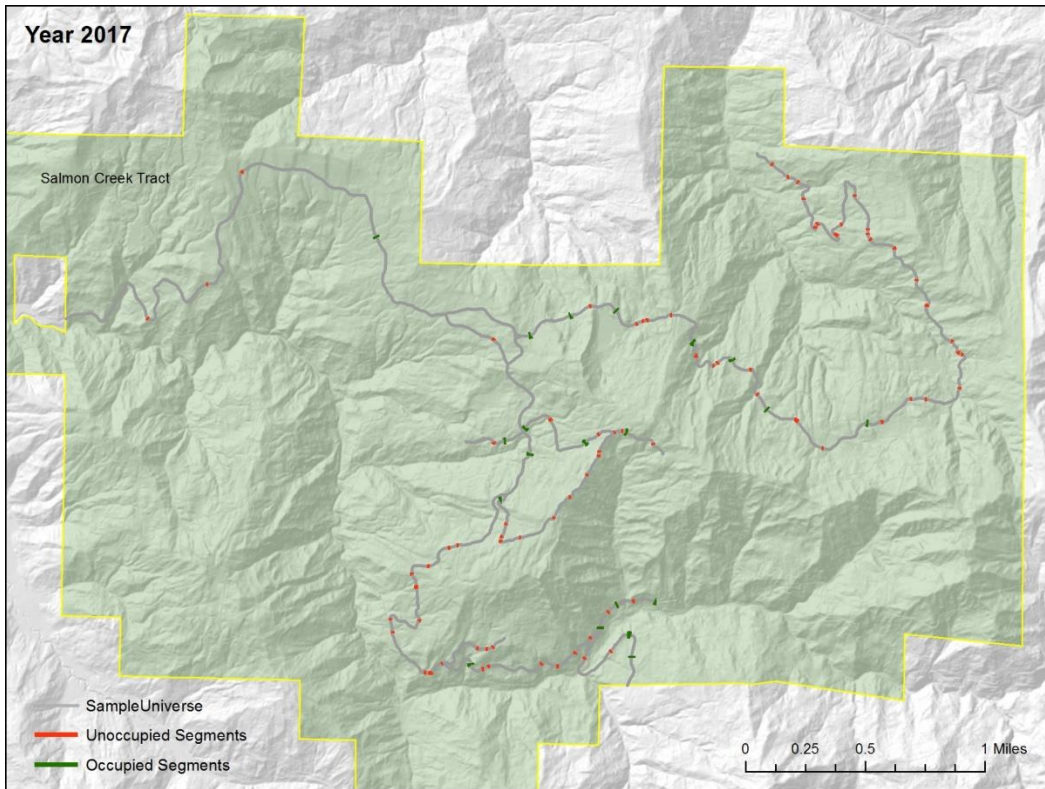


Figure 11. Sampling results 2017.

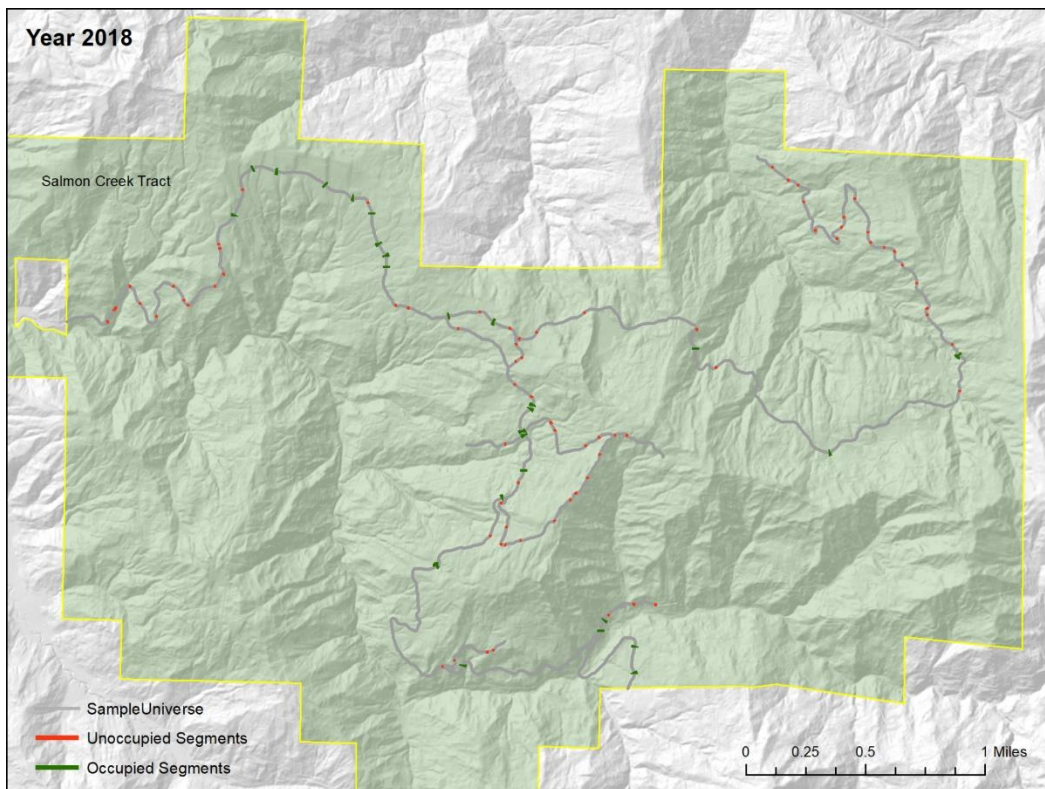


Figure 12. Sampling results 2018.

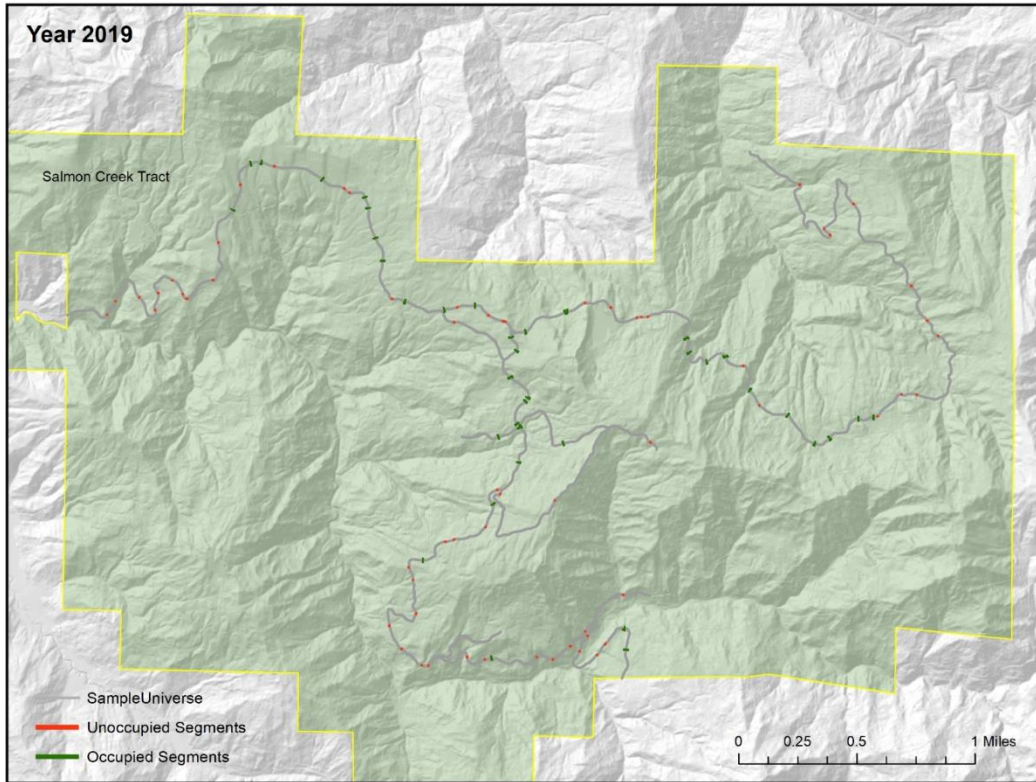


Figure 13. Sampling results 2019.

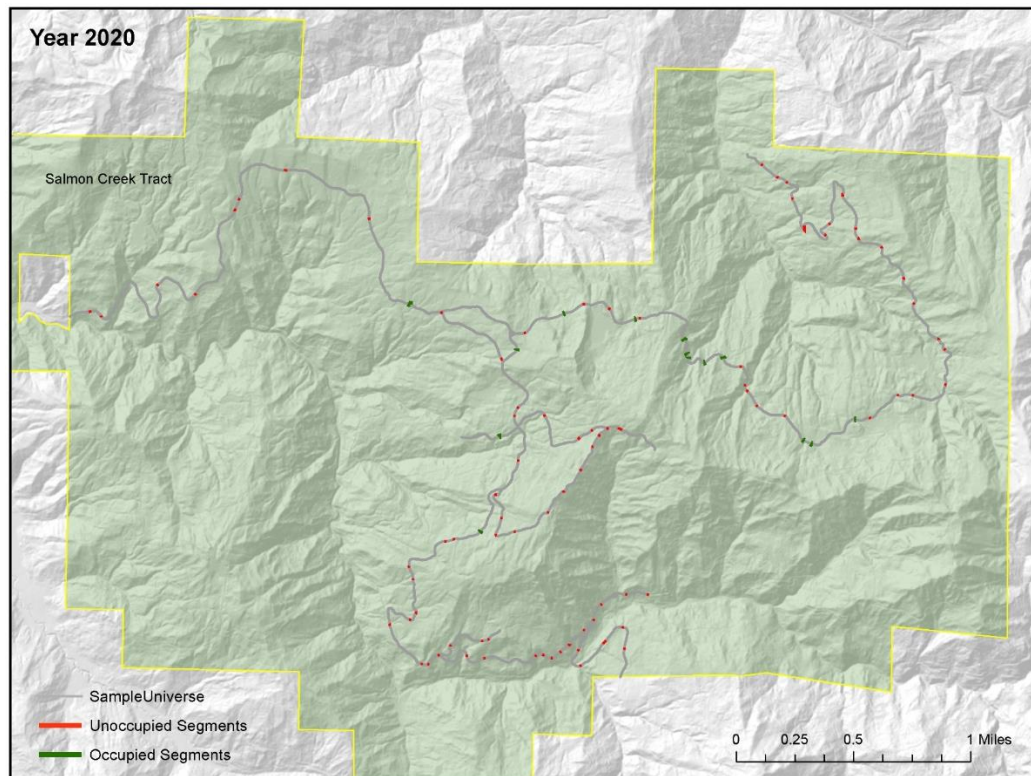


Figure 14. Sampling results 2020

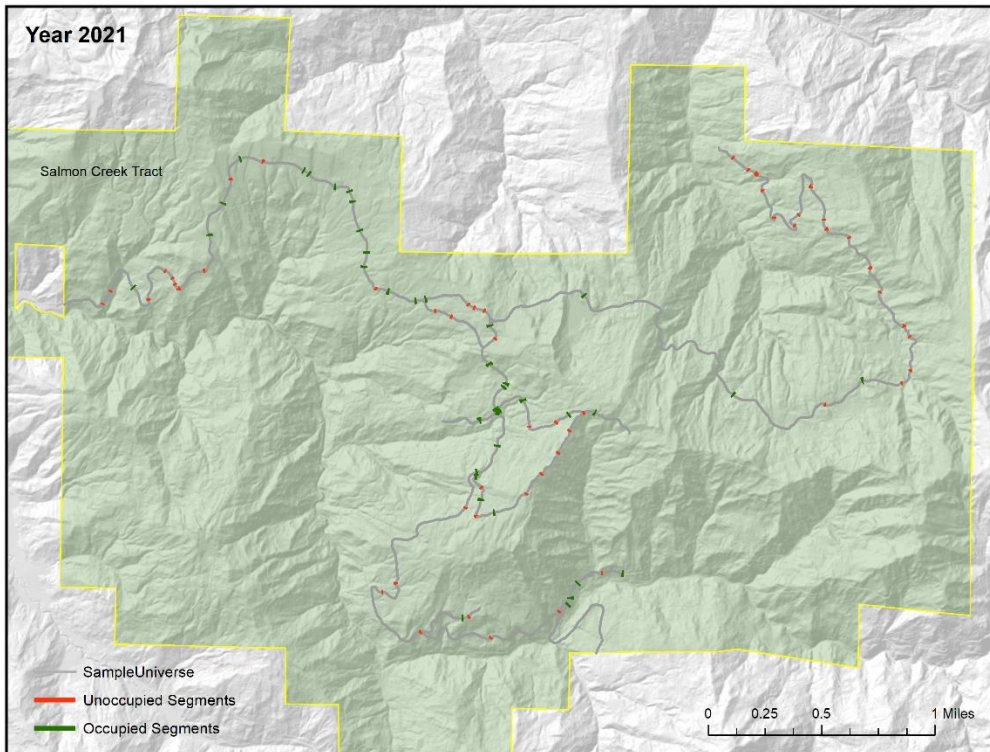


Figure 15. Sampling results 2021

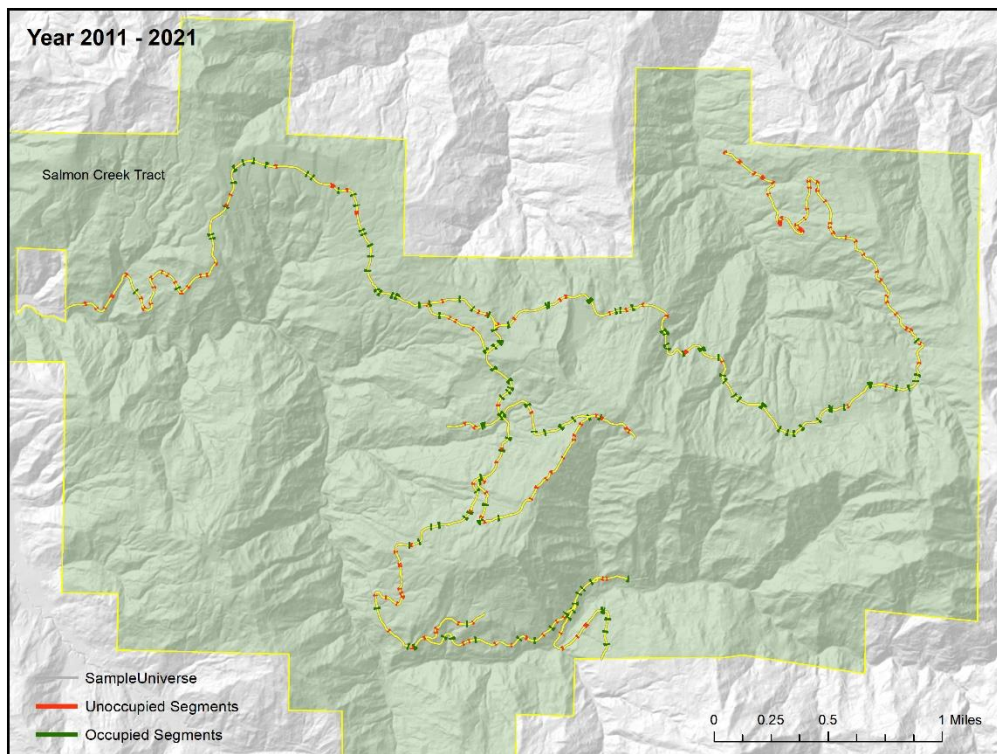


Figure 16. Combined sampling results 2011-2021.

HABITAT IMPROVEMENT PROJECTS

Scotch Broom (Cytisus scoparius) Removal



Photo Caption: Scotch broom removal with the use of weed wrenches (left) on the WM-10 road system. (Right) Photo of the same area after removal, which had a dense patch of well-established individuals.

Scotch broom is a nuisance non-native flowering shrub in North America. It is believed to have been introduced to the United States by European settlers as an ornamental or possibly for livestock feed (U.S. Department of Agriculture, 2020). It is currently reported growing in 30 states, with the density of positive reports in Oregon and California (EDDMapS, 2022). It is an exotic invasive species, uniquely suited to outcompete native vegetation through a few key life history traits: (1) it survives in a wide variety of soil conditions and thrives in full sunlight (e.g. forest clearings, road, waterways, pastures, etc.); (2) the photosynthetic stems of this plant allow it to grow year-round (no dormancy period); (3) it's roots host nitrogen-fixing bacteria (a trait of genera in the family Fabaceae), which help it establish in nutrient-poor soils; and, (4) it is a prolific producer of seed that banks in the soil and remains viable for many years (Reeves, 2010). This plant occurs abundantly on the North Coast of California, and everywhere it becomes established is at risk for the formation of dense stands of this species that crowds out native species and consequently destroys wildlife habitat. GRDCo's ownership is not immune to this invader. There are currently multi-department efforts underway at GDRCo to bolster our mapping and eradication of this plant on the property. A predicament that we have found with native plant conservation—and native sensitive plant conservation in particular—is that a common (and effective) strategy for eradicating large populations of Scotch broom is to treat them with herbicide. Herbicide treatments are prohibited near watercourses and around rare plant resources (i.e. sensitive habitats), per state regulations. Given this restriction, the Botany department has made robust efforts in the prior few years to manually remove (through hand tools and hand weeding) Scotch broom plants that are growing around sensitive plant

populations and/or in sensitive habitats on GRDCo property. The following are two projects that were started in the 2020-2021 field seasons to remove Scotch broom around sensitive plant populations and in unique habitat to help alleviate further spread and encroachment.

The first locality the department targeted is at the margins of Christmas Prairie Lake in 2019. This is a very special inland lake (approx. 2300 feet elevation) that hosts a rich and unique assemblage of species at its margins, which can be classified as a sphagnum bog. The margins are saturated, vernaly inundated sphagnum type soils that host dense tufts of sedges and rushes, with patchy thickets of *Vaccinium caespitosum* and *Spiraea douglasii*, dotted by creeping groundcover of *Hosackia gracilis*. Species such as *Sanguisorba officinalis* (BotID#30452) and *Carex arcta* (BotID#30228) are in the vicinity of the lake margins, with the *C. arcta* population specifically being encroached by small Scotch broom plants from a nearby source population. Other isolated, dense thickets of Scotch broom were identified at the margin of the lake in a few locations and removed in 2019. Follow ups in 2020 discovered small seedlings emerging and several smaller plants that had been overlooked in 2019. These were removed and piled nearby to dry out. This effort remained ongoing in 2021 and will continue in the following years, both to monitor the sites that have been treated and to delineate other problem areas that can be targeted for removal. To date, it has proven to be a successful endeavor as the treated populations are slowly receding and new detections in these areas are young sprouts.



Photo Caption: Christmas Prairie Lake (left). A brown mass of Scotch broom plants removed from bog, piled and left to desiccate (right).

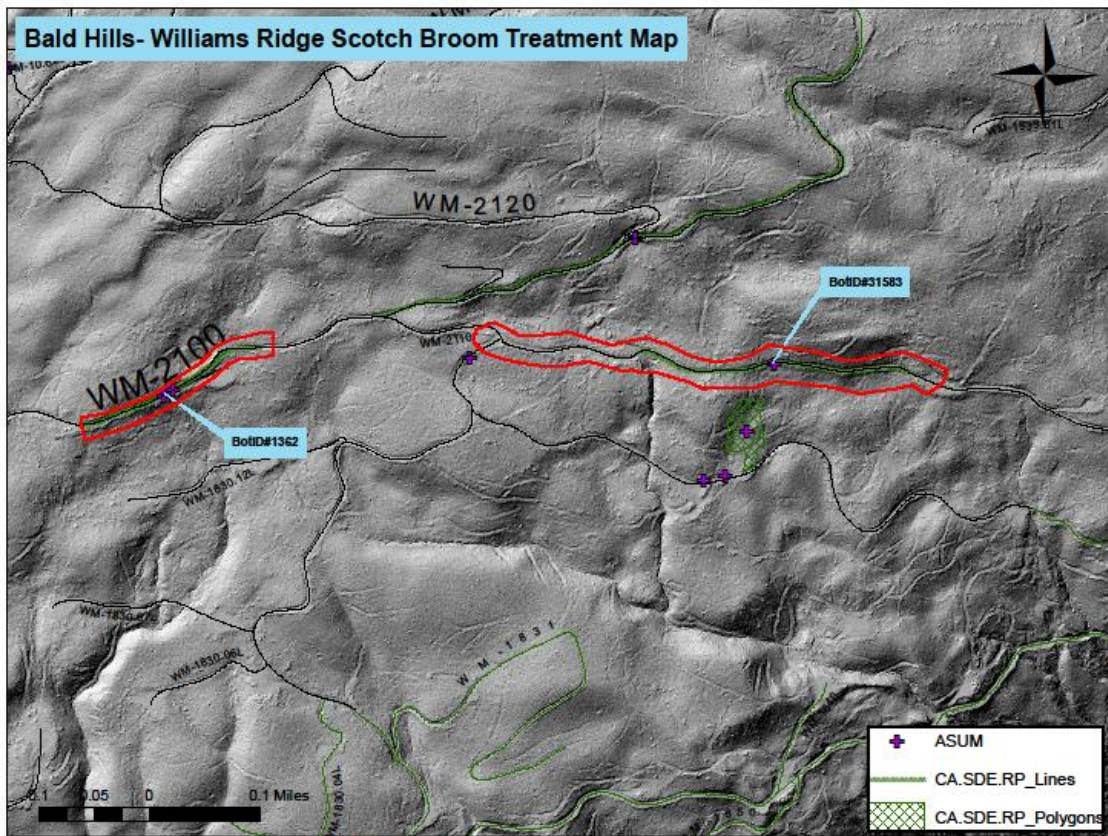
The second treatment site is along the Williams Ridge road system in an area of GDRCo property where the CRPR 2B.3 species *Astragalus umbraticus* (Bald mountain milk vetch; ASUM) is prevalent. Of the 36 unique BotIDs of *A. umbraticus* on GDRCo property, 19 are associated populations that are on the WM-10 roads system. Bald mountain milk vetch is endemic to southwestern Oregon, but its range extends down into the western Klamath Range (w KR) and North Coast Outer Range of Humboldt County (n NoCoRO) in California (Jepson eFlora). Its preferred habitat is dry, open woodlands, ridges, and burned areas (Oregon State University, 2022).

While there is a dearth of research for *A. umbraticus* specifically, a study conducted in 2010-2012 by Oregon State University's Meinke lab group investigated a close relative—*A. agnicidus* (Humboldt milk vetch; ASAG)—and found that both ASAG and ASUM are early seral species that have seeds adapted for long-term storage, a strategy that allows the copious seeds banked from these highly fecund plants to germinate all at once one to several years post-disturbance. The seed viability of ASAG is high, with seeds that readily germinate with brief exposure to low temperatures. Threats to ASAG are the lack of disturbance at a site and any action that interferes with seed production during its reproductive phase (Meinke et al, 2013). Anecdotally, ASUM responds similarly on GDRCo property. The typical habitat these populations are found in are on the cutbanks of the roads, sometimes inhabiting the road prism. It seems likely that the disturbance regime of timber operations in this area of the property (and the road work associated with accessing the timber stands) has been a driving force in stimulating the germination and vigor of many of these populations. Given the favorable response to disturbance that *A. umbraticus* demonstrates in its life history, it is no surprise that some of the populations are now co-mingling with Scotch broom, another relative of the Fabaceae family with similar life history traits.

In summer of 2021, the Botany crew used weed wrenches and shovels to manually remove a troublesome and well-established population of Scotch broom growing along the road system where BotID#31583 and BotID#1362 are located. Both ASUM populations are extensive and are growing roadside for over 1,000 feet each. This road system received maintenance and upgrading in 2020 in preparation for stands in this area to be thinned and mitigations for these populations (among other ASUM populations in this area) received a combination of disturbance and no disturbance. This site seemed to be a perfect candidate to receive habitat maintenance and restoration, as the ASUM populations in this area are being closely monitored for their response to the disturbance. The response of the ASUM populations was overwhelmingly favorable (see Follow Up Visits section for details). We look forward to continuing to monitor this site for new growth of both ASUM and Scotch broom, with intent to continue eradicating new growth and well-established Scotch broom plants that are competing for habitat with ASUM.



*Photo Caption: (Left) before and (right) after removal of Scotch broom along a segment of the WM-10 road system with a Plant Protection Area where *A. umbraticus* is growing.*



Scotch Broom Treatment Area

Star Thistle (Centaurea solstitialis) Removal

As part of GDRCo’s early detection and rapid response policy, in 2021 the botany group formally mapped and began treatment of yellow star thistle in the Bald Hills area. This infestation has been treated by the IFM group in the past, but herbicide application limitations have allowed plants to persist. The botany group spent considerable time hand pulling this population. Going forward, this will be a multi-year endeavor that will likely need to involve both mechanical and chemical treatments.



Photo Caption: Map showing the recorded occurrences of star thistle on Williams Ridge Road.



Photo Caption: The Botany crew hand pulling star thistle from a section of infested roadside (left) and a photo of another segment of road that had yet to be treated (right).

PROPERTY-WIDE SUMMARY TABLE FOR THPS SURVEYED IN 2021

THP Name	GDRCO THP #	CalFire THP #	IN CL/LR BMA?	Quad	Elevation (ft)	Survey Acres	2021 Field Work Date(s)	Field Survey Hours	Survey Rate (ac/hr.)	CRPR 1-2, Rare/Sensitive Sp. (mitigated)	CRPR 3-4 Uncommon Species
Hancorne 1000 '21	512002	1-21-00015HUM	No	Holter Ridge, Johnsons	1440-2260	76.5	3/23, 4/19, 7/23	23.5	3.3	PICA	THGR, LICO
North Johnson '21	561903	1-21-00001HUM	No	Johnsons, Holter Ridge	600-2150	25	3/30, 4/1	9	2.8	PICA, PISP	LICO
Ah Pah 1800 '21	562001	1-21-00023HUM	No	Ah Pah Ridge	500-1400	145.5	5/19, 5/24, 7/14, 7/15	21.75	6.7	CAAN	MICAU, PICAL
West Tectah	562002	1-20-00213HUM	No	High Divide	1300-2600	259	4/21, 4/23, 5/10	30.5	8.5	Negative	COLA, LICO
North Tectah	562101	1-21-00087HUM	No	Bald Hills, Holter Ridge	1200-2200	234.5	5/11, 5/12, 5/18	31	7.6	Negative	LICO, RILA
CL North/1000	562102	1-21-00168HUM	No	Ah Pah Ridge, Holter Ridge	400-1600	209.5	5/28, 6/3, 6/7, 6/10, 6/15	31	6.8	Negative	PICAL
The Dump Thin	672001	1-21-00089DEL	No	Requa, Fern Canyon	28-960	389	6/16, 6/21, 6/23, 6/28	54.25	7.2	CAAN	CHGL, MICAU, PLRE, RILA
Salt Creek	702001	1-21-00005DEL	No	Requa	40-800	183	6/30, 7/1, 7/6	21	8.7	CAAN	CHGL
H-500	712101	1-22-00004DEL	No	Can't Hook Mountain & Klamath Glen	1500-2500	234.5	7/26, 7/29, 7/30, 8/2	28.25	8.3	Negative	Negative
W-160	712102	1-21-00166DEL	No	Requa	25-100	188	7/8, 7/9, 7/12, 7/13	30.5	6.2	MOUN	MICAU, PICAL
Hunter West	712103	1-21-00189DEL	No	Requa, Child's Hill	240-1600	94.5	8/16, 8/23, 8/24	11.5	8.2	MOUN	Negative

Lower Hunter '22	732101	1-21-00192DEL	No	Requa	40-1160	157	7/13, 7/14, 7/19, 7/22	32	4.9	MOUN	CHGL, PICAL, MICAU
Dogbox	732102	1-21-00195DEL	No	Klamath Glen	0-80	90	8/24	11.75	7.7	Negative	Negative
Tip of Tepo	732103	-	No	Requa	120-1320	127	8/18, 8/23	21	6	MOUN	Negative
Nasty Jack	852002	1-21-00146DEL	No	Klamath Glen	440-2800	156.5	5/17, 5/18, 5/24, 8/2, 8/6, 8/9	32.25	4.9	ERRE	RILA
Morrison 200	902001	1-21-00102DEL	No	High Divide, Smith River	100-1200	115	7/20	16	7.2	Negative	Negative
Rod and Gun Club	932101	1-21-00141DEL	No	High Divide	100-1200	139	7/21, 7/27	24	5.8	MOUN	OXSU
The Jim Adams	932102	1-21-00165DEL	No	High Divide	100-1200	277.5	8/3, 8/5, 8/11, 8/17	51.75	5.4	MOUN	CHGL
Tsarnas	022101	-	No	Myers Flat	400-1080	184	6/9, 6/10	20	9.2	PICA	None
Spread Stevens	092001	1-21-00011HUM	No	Owl Creek	1160-1760	126	4/7, 6/8	18.5	6.5	PABO	LICO, TITRTR
Gas Wells Thin	142002	1-21-00134HUM	No	Fortuna, Fields Landing	140-958	210	5/20, 5/28, 6/1, 6/3, 6/4	13.25	15.8	Negative	LICO
Jacoby 22	152001	1-21-00022HUM	No	Arcata South	300-1100	180	4/7, 4/8, 4/12	37	4.9	Negative	LYCL, CHGL
Goodman Prairie/Graham Creek	172001	1-20-00222HUM	No	Mad River Buttes	1180-2640	121	3/22, 4/14, 4/15, 4/16	40.25	3	ERRE, PISP, MOHO	Negative
Snow Camp Lake 22	172002	1-21-00049HUM	No	Mad River Buttes, Maple Creek, Grouse Mountain Board Camp Mountain	3500-4680ft	163.8	5/5, 5/6, 5/13, 6/11	35	4.7	BEOR, ERRE, PISP	Negative

Boulder Bundle	182001	1-20-00207HUM	No	Mad River Buttes	3500-4800	163.2	7/21, 7/23, 5/3, 5/4, 5/13	61.25	2.7	GICAPA, ERRE, PICA	ERCITC, PLRE, USLO, WYLO
McKay Deuce 2022	192101	1-21-00067HUM	No	Arcata South, McWhinney Creek	200-740	67	4/20, 5/25	11.5	5.8	Negative	SIMA
Fickle Hill 1100	222001	1-21-00124HUM	No	Arcata South	720-2200	195	4/13, 4/16, 4/20, 7/2	33	5.9	Negative	CHGL, LICO, MICAU
Maple Bear	242001	1-21-00016HUM	No	Korbel, Maple Creek	520-1140	272.5	3/18/2022	51	5.3	MOHO	LICO, MICAU
Long Prairie '21	262002	1-21-00019HUM	No	Blue Lake, Lord Ellis Summit	475-2220	237.9	4/1, 4/5, 4/6, 4/12	38	6.3	GICAPA	CHGL, LICO, MICAU, USLO
Christmas Carroll	272001	1-21-00046HUM	No	Lord ellis summit	2000-2700	196	4/28, 4/29, 5/24	18.5	10.6	THRO	Negative
Noisy Springs (formerly Noisy Creek '22)	272101	-	No	Maple Creek	1200-2800	173	5/25/21, 5/27/21	18.25	9.5	ERSP	LICO, TITRTR
Canyon Creek 22	422002	1-21-00091HUM	Yes/No	Blue Lake	740-1800	276	3/29, 4/9, 4/12, 4/23, 4/26, 4/29, 4/30, 5/18	48	5.8	Negative	LICO, LYCL
Little Beach Thin	452001	1-20-00162HUM	Yes	Crannell	120-1200	10	3/26	5	2	Negative	MICAU
Big Diamond	472004	1-21-00099HUM	Yes	Rodger's Peak	0-1900	15	6/18, 6/24	6.5	2.3	Negative	Negative
BL 1800/1900	472101	1-21-00147HUM	Yes	Rogers's Peak, Crannell	1355-2300	5	6/24	3	1.7	Negative	Negative
Baby Lagoon	472102	1-21-00088HUM	Yes	Rodger's Peak, Crannell	1000-2100	5	6/24	1	5	Negative	Negative
CR 1000/1900 '22	472103	1-21-00143HUM	Yes	Crannell	760-1200	25	7/28	5.75	4.3	CALEP	LYCL
South McDonald	472104	1-21-00120HUM	Yes	Rodger's Peak	760-1760	35	6/18, 6/24	6	5.8	Negative	Negative

Light green highlight: surveys initiated in 2020 and completed in 2021. Light grey highlight: surveys initiated in 2021 and status pending results of 2022 surveys.

Key to species abbreviations and CRPR Status		
ARNO: <i>Arctostaphylos nortensis</i> (CRPR 4.3)	ERRE: <i>Erythronium revolutum</i> (CRPR 2B.2)	MOUNI: <i>Moneses uniflora</i> (CRPR 2B.2)
ASUM: <i>Astragalus umbraticus</i> (CRPR 2B.3)	GICAPA: <i>Gilia capitata</i> ssp. <i>pacifica</i> (CRPR 1B.2)	PICAL: <i>Pityopus californicus</i> (CRPR 4.2)
BEOR: <i>Bensoniella oregona</i> (CRPR 1B.1)	IRBR: <i>Iris bracteata</i> (CRPR 3.3)	PLRE: <i>Pleuropogon refractus</i> (CRPR 4.2)
CAAN: <i>Cardamine angulata</i> (CRPR 2B.1)	LICO: <i>Listera cordata</i> (CRPR 4.2)	PLST: <i>Plantanthera stricta</i> (CRPR 4.2)
CHGL: <i>Chrysosplenium glechomifolium</i> (CRPR 4.3)	LYCL: <i>Lycopodium clavatum</i> (CRPR 4.1)	RILA: <i>Ribes laxiflorum</i> (CRPR 4.3)
COCAN: <i>Cornus canadensis</i> (CRPR 2B.2)	MICAU: <i>Mitellastrum caulescens</i> (CRPR 4.2)	SIMA: <i>Sidalcea malachroides</i> (CRPR 4.2)
COLA: <i>Coptis laciniata</i> (CRPR 4.2)	MOHO: <i>Montia howellii</i> (CRPR 2B.2)	THGR: <i>Thermopsis gracilis</i> (CRPR 4.3)
EROR: <i>Erythronium oregonum</i> (CRPR 2B.2)	MOUN: <i>Monotropa uniflora</i> (CRPR 2B.2)	TITRTR: <i>Tiarella trifoliata</i> var. <i>trifoliata</i> (CRPR 3.2)

PROGRAM GOALS FOR 2022

- (1) Develop a Botanical Management Area in the County Line region.
- (2) Perform consistent and comprehensive updates to the GDRCo herbarium in CCH2 and internally.
- (3) Foster more engagement with the local botanical community by organizing field trips and participating in events with the local CNPS chapter, local community college, and local state university.

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