LOMATIUM ERYTHROCARPUM MONITORING and SITE REVISITS
Final Report

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Wallowa-Whitman National Forest

Introduction:
Lomatium erythrocarpum is a strict local endemic known from 11 occurrences dotted across 3 square miles in the Elkhorn Mountains of NE Oregon. This small perennial plant grows in subalpine and alpine habitats from sparsely vegetated scree communities to open subalpine fir – whitebark pine communities. Most *Lomatium erythrocarpum* sites are found on relatively steep slopes (>50%).

Threats to *Lomatium erythrocarpum* appear few. A draft conservation agreement for *Lomatium erythrocarpum* identified impacts from mountain goats and hiking trails as the two main threats to this species (USDA Forest Service 2000). Hiking trails have been constructed through 5 occurrences, although impacts to these sites appear related only to the construction and use of the trail: compacted soil of the trail has eliminated small portions of suitable habitat in four sites. Off-trail impacts from visitors are not apparent in these four sites, with the exception of one fire ring constructed near, but not within, one site. Trampling damage, grazing, and dust-wallowing by mountain goats, which were reintroduced to the Elkhorn Mountains in the 1980's, were also identified in the draft conservation agreement as a threat to this species.

In 2000, the completion of a conservation agreement for *Lomatium erythrocarpum* stalled over concerns raised by the Oregon Department of Fish and Wildlife (ODFW). The draft conservation agreement proposed removing any threats if evidence could show the source of a threat had caused the population to decline for two consecutive years and the total decline was greater than 10% (USDA Forest Service 2000). Census data collected between 1995 and 1998 at two sites had shown greatly fluctuating populations counts. ODFW questioned whether a 10% decline over two years might be within the natural range for this species. Following a joint field visit August 2005 with Forest Service and ODFW staff to *Lomatium erythrocarpum* at element Occurrence (EO) 4 the ODFW repeated an earlier request that prior to establishing a trigger for management action in the conservation agreement the Forest Service first establish the natural range of fluctuation in population abundance.

This project continues past monitoring efforts for *Lomatium erythrocarpum*. Census monitoring was begun in1995 at EOs 1 and 2 (map, Appendix A), then read annually for 4 years through 1998. Monitoring plots were then 2001, 2006. Results from the monitoring visits at EO 1 revealed wildly fluctuating counts from year to year, dropping by half from the previous year, then rebounding back to around the same number the next (Yates 2006). At EO 2, the counts had dropped precipitously from highs ranging from 200-1200 in the late 1990's to 6 in 2005 and 3 in 2006. Yates (2006) wondered if the low counts at EO2 were a consequence of visiting the population too late in the season when most plants had senesced.

Yates (2006) suggested sampling the monitoring plots, at least at EO 1, due to its relatively large population to reduce effort rather than count every individual, and further establish rules for counting individuals to ensure consistency from year to year (Elzinga, et al. 1998).

This project's primary objective is to conduct a pilot study for sampling at EO 1 and reread the monitoring plot at EO 2. A secondary objective is to assess the "status" of all sites with an emphasis on qualitative observations of impacts or imminent threats to *Lomatium erythrocarpum*. Additional monitoring visits and sampling plots would be established in summer 2013, completing the project.

Study Area:
The study area is located in the Elkhorn Mountains of northeast Oregon consisting of the range of *Lomatium erythrocarpum*, an area approximately 3 square miles along the crest of the Elkhorn Mountains, west-northwest of Baker City, Oregon (see Appendix A – Vicinity Map). The center of the study area is T 9 S, R 38 E, section 31. The area is technically subalpine. The dominant vegetation consists of subalpine fir (*Abies lasiocarpa*) and whitebark pine (*Pinus albicaulis* - a recently designated federal candidate species and Forest Service sensitive plant) in open stands surrounded by sparsely vegetated scree communities on steep slopes and glacial cirques. Two *Lomatium erythrocarpum* sites are situated in a glacial cirque; the remaining sites are located along the shoulders of the Elkhorn ridge crest and its upper slopes. Elevations range from 7700 ft. to 8500 ft.

Methods:
I reestablished the census monitoring plots at *Lomatium erythrocarpum* EO numbers 1 and 2, and established a new plot at EO 4. I counted all plants within the plot at EO 2 and EO 4 and sampled the plot at EO 1. Because EOs 2 and 4 have relatively small populations, a complete count was assumed not to be burdensome. The macroplots measure 50' x 30' (EO 1), 75' x 33' (EO 2) and 10m x 13m at EO 4.

I visited EO 2 on July 18, 2012, about 2 weeks earlier than the 2006 visit, in the hope of confirming my suspicion that late phenology was responsible for the strikingly low counts in 2005 and 2006. The plot at EO2 was censussed, not sampled, due to its apparent small size. I counted all individuals, using three size classes or maturity classes: seedling-juvenile, vegetative and flowering-fruiting. Seedling-juvenile class is defined as having an intact or unshed wall of the mericarp, cotyledons, or a simple, pinnately-lobed to once-pinnate leaf. The seedling and juvenile stages were combined to reduce error in distinguishing well developed seedlings from underdeveloped second-year juvenile plants. The vegetative class is defined by having no flowering or fruiting structures and at least one leaf that is partly bi-pinnate, i.e., at least one pair of leaflets are pinnate (Figure 1). The flowering-fruiting class includes plants with aborted fruits.

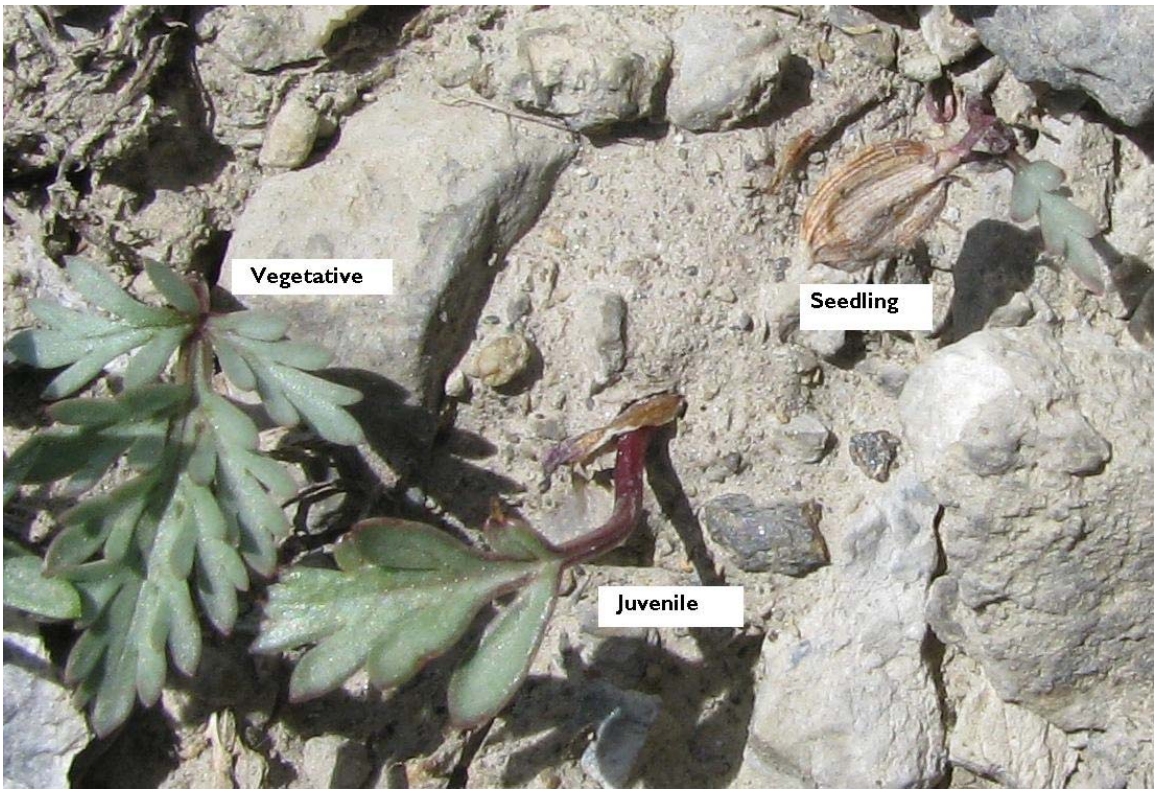


Figure 1. *Lomatium erythrocarpum* seedling, juvenile and vegetative maturity classes.

To increase the accuracy of counts, I divided the macroplot into manageable 3-foot wide belt transects along the long axis of the plot. I established the belts with a measuring tape and yellow cord. I counted each stem emerging from the soil as one genet, regardless of the distance separating stems. Meinke and Constance (1984) report that *Lomatium erythrocarpum* stems arise "from a simple or very rarely 2-3-branched caudex." By counting each stem arising from the soil some genets may have been "very rarely" double or triple counted.

At EO 5 I established a 10m x 13m plot, subdividing the plot into 3m wide belts to improve accuracy of the count.

At EO 1, a pilot study was developed with the following sampling objective: be 90% certain of detecting a 25% change in population between visits, and willing to accept a 10% chance of making a false-change error. The plot measures 30ft. by 50ft. The sampling unit (quadrat) measured 2ft. by 3ft. In the 50ft by 30ft plot there are 250 possible sampling units. Thirty quadrats total were placed in a systematic arrangement along 6 30-ft. transects (5 quadrats per transect), spaced 5 ft. apart. A random number between 0 and 3 was chosen along the baseline to place the first transect. A separate random number between 0 and7 was chosen for the starting point for quadrats placed at 10-foot intervals along each transect.

Total counts (the sum of all stages, seedling-juvenile, vegetative, and reproductive counts) were plotted over time to discern trend.

For site revisits population counts were taken at sites with fewer than 100 individuals; population estimates were made at larger sites. Data were collected and recorded for the required fields on NRM TESP EO forms for all visited sites. Field data was entered into NRM TESP-IS. Population boundaries were mapped using recreational grade Garmin GPS Map 60CSx with accuracy at less than 20 ft. To accomplish this, the observer walks throughout the known population area and beyond, recording waypoints as plants are encountered. The observer continues walking in a somewhat systematic manner, to ensure the entire known area is covered, marking waypoint locations for plants, then beyond until the target species is no longer encountered. The resulting point shapefile may then used as a back cover to delineate the population boundary - as a polygon in NRM TESP-IS - as closely to the outer boundary created by the points in the shapefile. With this technique, changes in the population boundary, at the accuracy of the GPS hardware in use, can be tracked over time. It is also very simple to map multi-part polygons using this approach. For survey area, I saved the track files daily, and use these to create survey polygons in NRM TESP-IS. In my experience I have found this method to be more accurate compared to mapping boundaries and survey routes directly on aerial photos.

Results:

Census monitoring results, *Lomatium erythrocarpum* Element Occurrence Nos. 1, 2, 4

Table 1 and Figure 2 display the results of census monitoring at *Lomatium erythrocarpum* EOs 1 and 2 between 1995 and 2012 and EO 4 in 2012. Gaps in time indicate years where monitoring was not conducted. Census data for years 1995 – 2001 were reported by Murray (2001).

Table 1. *Lomatium erythrocarpum* EO 1, EO2 & EO4 Census Monitoring Results: 1995–2012

	1995	**1995**	**1997**	**1998**	**2001**	**2005**	**2006**	**2012**
EO 1	8/5/1995	8/26/1995	8/13/1997	7/29/1998	7/16/2001	2005	7/23/2006	8/02/2012
Veg	359	707	341	775	340		695	1987
Reprod	194	332	225	295	165		711	271
Total	553	1039	566	1070	505		1406	2258
EO 2								**07/17/2012**
Veg	443	88	298	468	112	3	2	
Reprod	130	108	464	752	18	3	1	
Total	573	196	762	1220	130	6	3	508
EO 4								**7/13/2012**
								631

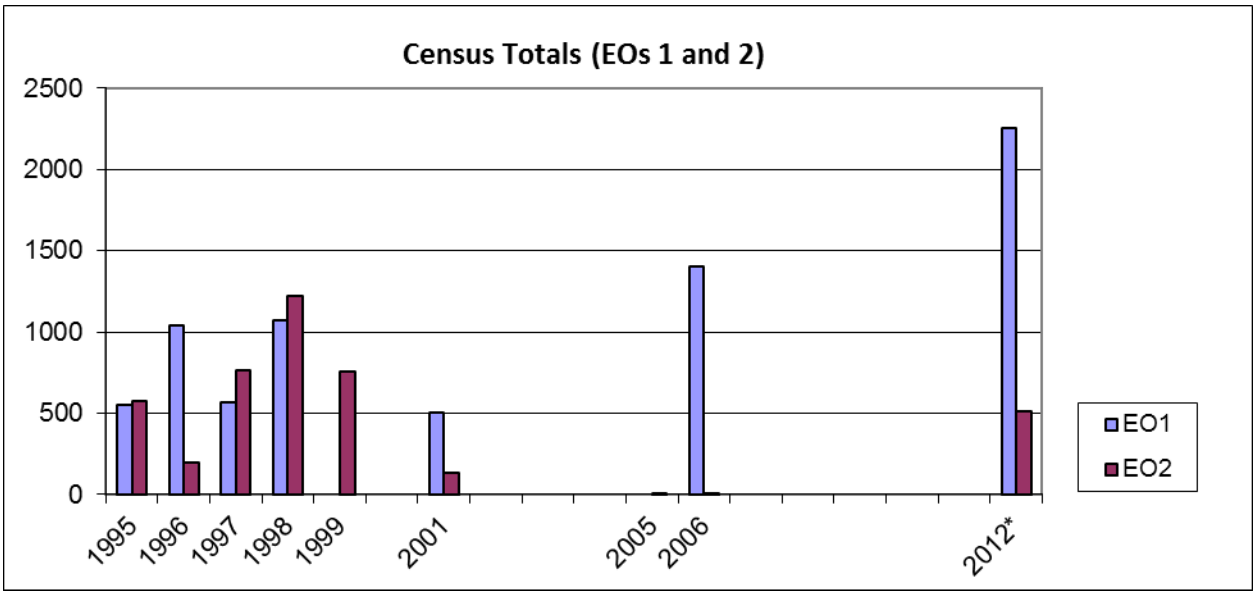


Figure 2. Census totals for *Lomatium erythrocarpum*, EO 1 and EO2: 1995-2012. Gaps in years indicate census not taken.*2012: Sampled EO1: 90% confidence interval ± 650 plants.

1c. Population Counts or Estimates for *Lomatium erythrocarpum* Element Occurrence Numbers 3 - 11.

Table 2 below summarizes population counts at EO's 3-11.

Table 2: Summary of *Lomatium erythrocarpum* Element Occurrence population counts or estimates over time

	***Lomatium erythrocarpum* Genets counted or estimated by year**										
	1986	**1992**	**1995**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2012**	**2013**
EO 3			145						342	NV	NV
EO 4	1900-e				100-e				300-e	1000-e	
EO 5	30				NF*	NF	NF	NF	NF*	NF	
EO 6			100-e						750-e	NV	NV
EO 7		500-e							1000-e	2000-e	
EO 8			85						NV*	NF	NF
EO 9			118		NC*				60		NV
EO 10				125					60-e		100-e
EO 11				100					NC*	500-e	

*NV: Not Visited, NC: Visited but Not Counted; e: estimated count; NF: Not Found

Discussion: Explain the significance of the results. Also discuss lessons learned about any aspect of the study.

Census Monitoring at EO 1: Census monitoring at Element Occurrence 1 reveals that this *Lomatium erythrocarpum* population fluctuates considerably from year to year. In 1995, the first year of the census, 553 total genets (the sum of reproductive and vegetative individuals) were counted. The next year, 1996, 1039 genets were counted. The following year, 1997, the total genet count dropped to 556, and then in 1998 the genet count again climbed up to 1070 individuals. The census was not taken in 1999 or 2000. In 2001, 505 genets were counted, and then following a 4-year hiatus, the census was taken in 2006 with 1406 genets counted. At a glance, this population, although fluctuating, appears stable. In 2012, the monitoring plot at EO 1 was sampled to save time compared with counting every individual. While this method proved efficient, the pilot study did not yield statistically satisfactory results. The mean number plants per quadrat equals 9 (n=30); the standard deviation is 8.9. The total number of plants in the plot was calculated at 2258 with the 90% confidence interval of +- 650 plants. 2012 appears to be an increase above prior visits, but cannot be said with much certainty. One difference in 2012 is I noticed an abundance of seedlings. The presence of seedlings has not been reported in the past for any of the EOs. This may be due to visiting the plot at just the right point in the season or *Lomatium erythrocarpum* may exhibit episodic germination.

Census Monitoring at EO 2: I was relieved to encounter in 2012 several hundred plants at EO2. The monitoring plot covers nearly the entire extent of this site. 508 plants were counted within the plot; the total occurrence population was estimated at 600. The past two visits resulted in few plants counted. Hundreds of plants were counted in the initial years of monitoring (see table 2 above), but only 3 plants were counted in 2006 and 6 plants in 2005. The low counts were likely due to visiting the EO2 too late in the 2005-2006 seasons. Still, the 2012 count is half the highest count on record, 1220 plants in 1988, but similar to other counts during the 1990s.

Conclusions from Census Monitoring: If anything can be concluded, since the population attribute measured consists of a complete count of genets within the macroplot (that is, the entire statistical population was counted, not sampled) it is that population numbers vary considerably from year to year. With 7 years of counts done over an 18-year period, population fluctuations of ±50% may be normal for this *Lomatium erythrocarpum*, at least at the two censussed element occurrences. Or the differences in counts may be due to timing of the visits. *L. erythrocarpum* has a short growth cycle, senescing soon after fruit dispersal, leaving no trace of its presence. If visits are not carefully timed to occur at the same moment of phonological development, particularly if the visit is toward the end of the plants seasonal development, many plants may have senesced, avoiding detection. Calculating a running mean over a 5 or 10 year period may better account for the annual fluctuations in population.

EOs 1 & 2 showed little to no evidence of trampling damage to habitat or the *L. erythrocarpum.* At this point is its difficult to establish a biologically significant change in population over time for *L. erythrocarpum*. But managers should be concerned if declines are sustained over several years.

Population counts/estimates/and habitat integrity observations at EOs 7 & 11:

EO7 is a large site flanking a spur ridge extending north by northeast from the main crest of the Elkhorn Mountains. Trampling, trailing, and digging impacts by mountain goats were again observed at EO7 in 2012. The amount of impacted ground has increased; few *L. erythrocarpum* were observed growing in the areas of impact. These impacts are somewhat mitigated by the large area occupied by *L. erythrocarpum* at EO7. This population's aerial extent was enlarged in 2012, a result of additional inventory along its southerly extent and is now conservatively estimated to contain 2000 individuals (Figure 3). The reason for the change in population area is unknown. The additional area discovered in 2012 may have been overlooked in the past, or the site may have expanded into new territory. I suspect the former.

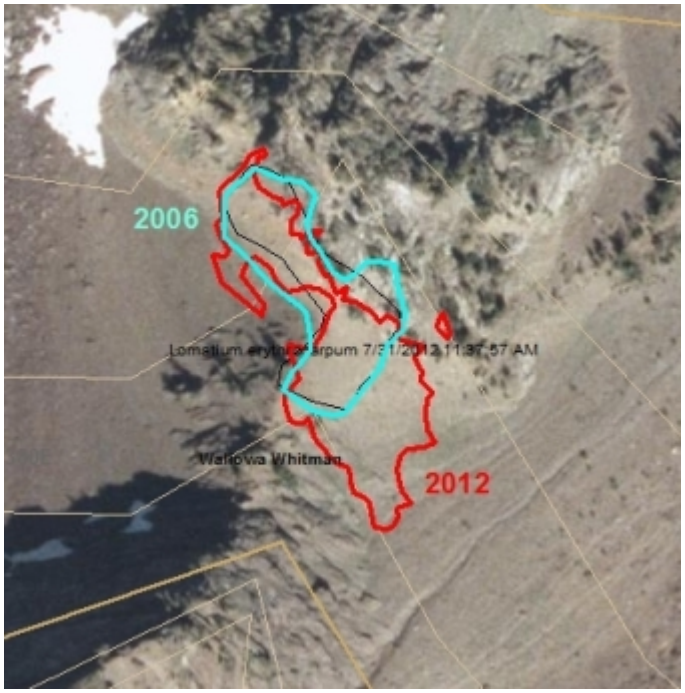


Figure 3. *Lomatium erythrocarpum* EO-7: Population mapping showing the aerial boundary changes from 2006 (aqua) to 2012 (red).

In 2006, the proportion of impacted soil surface at EO 7 was less estimated at less than 5%. In 2012, the percent impacted soil surface is not likely higher than was estimated in 2006, even though the total amount of impacted surface has apparently increased. Even so, there remains concern for the long term viability of *L. erythrocarpum* at EO7 from impacts caused by mountain goat behavior.

Element occurrence number 10 was visited in 2013 and its extent again mapped via GPS. I estimated the population size at around 100 plants. This is likely a very conservative estimate. The population was visited on July 22, but in 2013, due to the hot dry weather all summer, this was already a bit too late to record all plants. Many plants had already shed fruits. Following dispersal, *Lomatium erythrocarpum* quickly senesces, leaving no trace behind. Therefore, the 2013 population estimate is likely inaccurate. Even so, this estimate appears within the range of past estimates. In 2001, the population was estimated at 125; in 2006 the estimate dropped to 60. The population area boundary

was extended downslope to the south by some 50 meters. The population is patchy, and in 2013 was mapped as a multi-part polygon in NRM-TESP-IS. Figure 4 displays the change in population boundary from 2006-2013. This change is due to the range extension and more accurate mapping of plant clusters in 2013, resulting in a multi-part polygon, a step not taken earlier. In 2006, the population was mapped as a single polygon, which did not capture the finer detail of the population's patchy distribution.

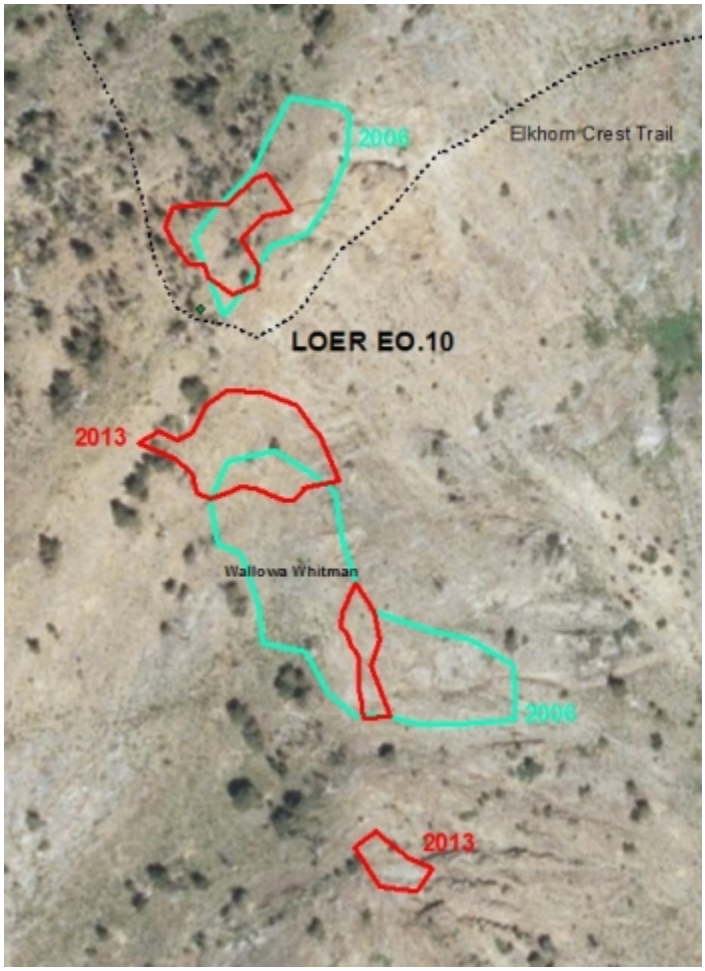


Figure 4. *Lomatium erythrocarpum* EO-10: Population mapping showing the aerial boundary changes from 2006 (aqua) to 2013 (red).

Element occurrence number 11 is the most northerly occurrence of *L. erythrocarpum*. This population was estimated to contain 500 plants, larger than prior estimates, although its extent was mapped much smaller than the polygon that was drawn in 2000, the year it was discovered (Figure 5). I cannot find a reason for the discrepancy in mapping this population's areal extent between visits. The initial observers make no note of how mapping was accomplished, although the extent would have been drawn on topographic maps or perhaps aerial photographs. The 2000 boundary appears to be broadly delineated.

Element occurrence number 11 grows largely within an alpine fleeceflower community (*Polygonum phytolaccifolium*) with ample lupines (*Lupinus caudatus*) and extends into a mountain big

sagebrush-Geyer sedge community. These communities are among the most densely vegetated communities that *Lomatium erythrocarpum* inhabits. Continued development of the fleeceflower community toward the more stable mountain big-sagebrush community will, at some point in the future, not provide suitable habitat necessary to support *Lomatium erythrocarpum*, which appears to prefer an early successional environment, or at least ground with scant cover or competition from other plant species. There is also evidence of trampling and digging by mountain goats at EO 11, but the vast majority of the population does not appear impacted.

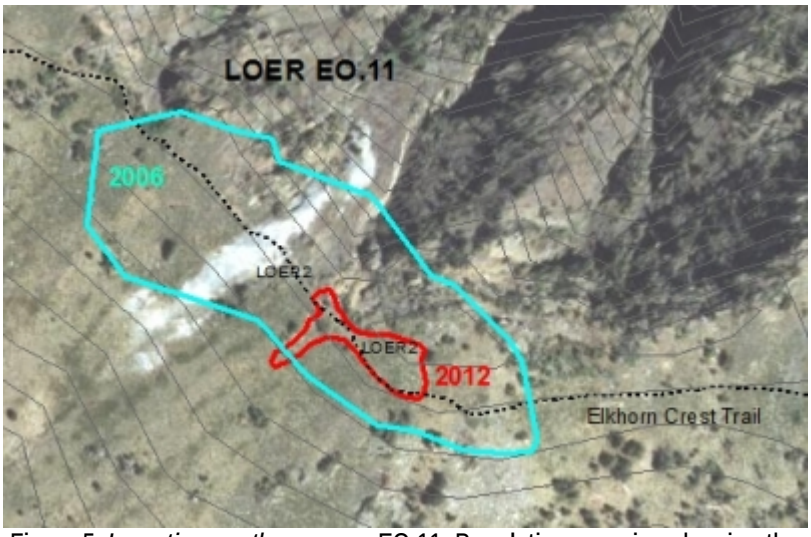


Figure 5. *Lomatium erythrocarpum* EO-11: Population mapping showing the aerial boundary changes from 2006 (aqua) to 2012 (red).

One new small patch of 30 plants was found about 500 m NW of EO 10. This site was associated with EO 10 in NRIS TESP.

Element occurrence numbers 3, 6 and 9 were not visited. We have not relocated EO 5, a small patch of 30 plants, since its discovery in 1986. The new small site noted above is over 1 mile from the mapped location of EO 5, and despite their similarity in size, should not be considered a candidate for the lost population of EO 5. If EO 5 is relocated, it would be merged with EOs 4 as a single element occurrence of multiple-polygons due to their reported proximity, less than one quarter mile.

Recommendations:

The census monitoring scheme for *Lomatium erythrocarpum* was designed in 1995. The draft conservation agreement included a monitoring objective, but not a clearly articulated management objective (address the cause of a 10% decline in the running mean from one year to the next). If formal quantitative monitoring is to continue, both a management and monitoring objective should be clearly articulated. At EO1, the number of sampling quadrats could be doubled or perhaps even better would be to have fewer long slender quadrats extending upslope the full length of the plot. Doing so would make reading plots a bit more difficult but likely reduce variation between quadrats, and still use less time than a complete census. Given the increased effort with additional sampling and subsequent data analysis, it might be easier to revert to the complete census that was initiated in the late 1990s. Given the large fluctuations in census counts, frequency may be a better attribute to

monitor, but I do not recommend departing from using census because we now have data reaching back nearly 15 years.

The presence of ongoing impacts within *Lomatium erythrocarpum* habitat argues for quantitative monitoring of the species rangewide. However, apparent impacts from wildlife (or even hikers) may not require formal quantitative monitoring to trigger management action. Severe acute impacts, such as trampling, digging – readily visible physical damage to habitat - should provide sufficient notice to managers to warrant changes in management without the need for statistically valid population trend data. Qualitative monitoring at EO7 and EO11, which have observable impacts, should be conducted more frequently, perhaps every 2 or 3 years. This monitoring could be augmented with a method designed to monitor the change in the amount of impacted habitat (namely ground disturbance from mountain goats) over time.

Population boundary mapping using recreational grade GPS should be conducted at the time of census monitoring or site revisits. This is an effective method to map changes in the population area over time. To better estimate population size and extent, it is imperative to revisit sites at the phenologically appropriate time of year. This period occurs from the onset of fruiting to mature fruit development but before fruits dehisce. (I find the plants are easier to detect in fruit compared to flower, because the scape lengthens during fruit development.) Census monitoring at EOs 1, 2, and 4 could be accomplished in a single season, at 5 or 6 year intervals. The remaining EOs, could be revisited in alternate years, spreading visits over 2 or 3 years, to reduce effort that would be called upon to visit all sites in a single year. Even with its small range, attempting to monitor all element occurences of *Lomatium erythrocarpum* in a single season is impractical.

Literature Cited

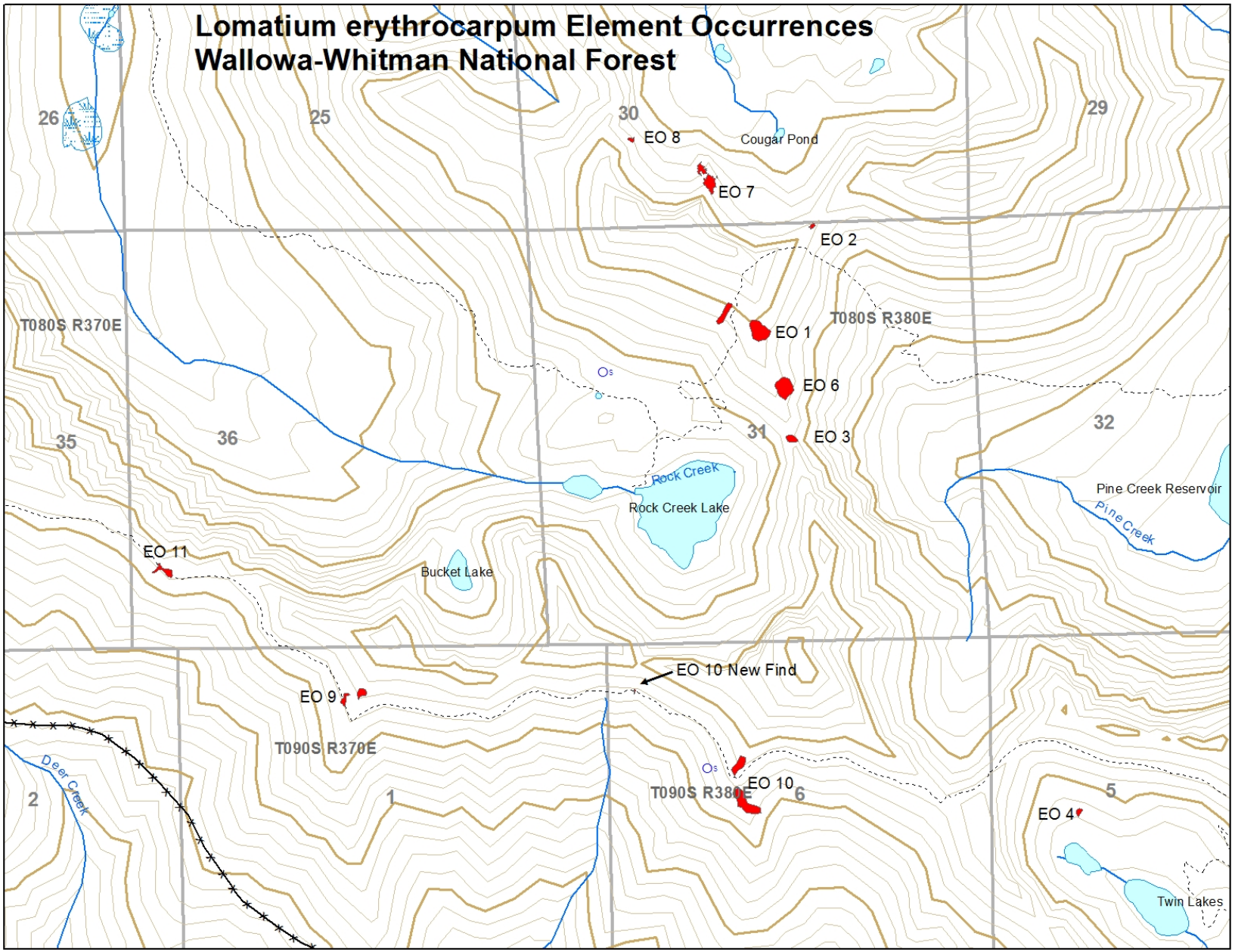
Elzinga, Caryl L., Salzer, Daniel W.; and John H. Willoughby. 1998. Measuring and Monitoring Plant Populations. BLM Technical Reference 1730-1, U.S. Department of Interior, Bureau of Land Management, 477 pp.

Meinke, Robert J. and Lincoln Constance. 1984. A new subalpine species of *Lomatium* (Umbelliferae) from eastern Oregon., Bull. Torrey Bot. Club, v. 111 (2), pp. 222-226.

Murray, Michael P. 2001. Red-fruited Lomatium (*Lomatium erythrocarpum*) Monitoring and Survey. Report to Wallowa-Whitman National Forest, Baker City, Oregon.

USDA Forest Service. 2000. Draft conservation agreement for *Lomatium erythrocarpum*,Wallowa-Whitman National Forest, Baker City, Oregon.

Yates, Gene. 2005. *Lomatium erythrocarpum* Survey. Final Report to Interagency Special Status and Sensitive Species Program. Wallowa-Whitman National Forest, Baker City, OR. http://www.fs.fed.us/r6/sfpnw/issssp/documents/inventories/inv-rpt-va-loer-waw-surveys-2005-10.pdf

Yates, Gene. 2006. *Lomatium erythrocarpum* Monitoring. Final Report to Interagency Special Status and Sensitive Species Program. Wallowa-Whitman National Forest. http://www.fs.fed.us/r6/sfpnw/issssp/documents/inventories/inv-rpt-va-loer-waw-monitoring-2006-09.pdf

Appendix A. Element Occurrence Locator Map