**Lomatium greenmanii Inventory and Monitoring**

**Final Report to the Interagency Special Status Species Program**

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**PROJECT OBJECTIVES:**  
1) Inventory suitable habitat in the Wallowa Mountains to locate new populations of *Lomatium greenmanii*;  
2) enter survey results into the U.S. Forest Service NRIS-TESP;  
3) Monitor known population on Ruby Peak and Redmont peak according to established protocol.

**Introduction**

*Lomatium greenmanii* (Greenman’s desert parsley) is endemic to subalpine meadows and rocky outcrops in the Wallowa Mountains of northeast Oregon. Currently, there are three documented populations: Mount Howard, Ruby Peak and Redmont Peak. All three occur within the Eagle Cap Ranger District of the Wallowa Whitman National Forest (WWNF). The largest population, consisting of several subpopulations, is found at the summit of Mount Howard and vicinity. Mount Howard is easily accessible by a recreational tram facility (Wallowa Lake Tramway) that transports over 30,000 visitors per year to the summit of Mount Howard. In addition to the tram facilities, numerous trails have been developed within habitat occupied by the species. Due to its extreme rarity and accessibility to humans, *L. greenmanii* is vulnerable to threats from recreational activities including trampling from hikers and operations of the Wallowa Lake Tramway.

The lack of knowledge regarding the species’ distribution and population trends, especially with respect to visitor impacts on Mt. Howard, is an identified information gap.

In 2007, a Candidate Conservation Agreement (CCA) was signed between the Wallowa-Whitman National Forest and the U.S. Fish and Wildlife service. The primary purpose of this CCA is to ensure the long-term conservation of *Lomatium greenmanii* through implementation of conservation actions and minimization of threats through an adaptive management process. These actions include continued inventory or suitable habitat and monitoring of known populations, especially at Mt. Howard, at least every two years.

In 2005, Joanna Schultz and Jeff Matthews developed a predictive model for *L. greenmanii*. This model uses geology, precipitation, slope, aspect and elevation data from known *L. greenmanii* locations to identify and rank areas with the highest probability of occurrence. This model was used in 2007 (ISSSSP funded) to survey habitat in the western portion of Wallowa Mountains. No new populations were located in 2007. This model identifies additional high potential habitat in the vicinity of East Peak, Redmont Peak and Wing Ridge and the ridges and shoulders south of Ruby Peak.
In 2010, Jerry Hustafa (during a recreational hike) observed putative *L. greenmanii* on a ridge south of Ruby Peak. It was late season for the *Lomatium* and positive identification could not be confirmed. This project revisited the suspect location and inventoried additional habitat in the vicinity. Second, monitoring was repeated at the Ruby Peak and Redmont Peak populations, according to the protocol developed by Michael Mancuso, formerly of the Idaho Conservation Data Center, as part of an agreement between the U.S. Fish and Wildlife Service and the Wallowa-Whitman National Forest. Monitoring on Mt. Howard will resume in 2012, per the agreed upon biennial schedule.

**Study Area**

*Inventory:* The study area is the system of ridges south of Ruby Peak on Traverse Ridge in the Eagle Cap Wilderness, Wallowa-Whitman National Forest.

Monitoring: On Ruby Peak, the monitoring transect was established on the largest patch of *L. greenmanii*, as shown on the attached map. The population on Redmont Peak consists of one small patch.

![Ruby Peak from Traverse Ridge. *Lomatium greenmanii* patches dot the left hand (north) ridge of Ruby Peak to just a little below the summit.](image)

![Monitoring transect on Redmont Peak, September 30, 2011. Note cured grasses and low cover of plants.](image)
Figure 1. Study Area Vicinity Map. From Mancuso (2010).
Methods

Inventory:
Inventoried areas were identified using the Schultz-Matthews model in combination with past experience in the area and knowledge of the conditions that provide suitable habitat for the species. The survey area is identified on the map appended to the report. Inventories were conducted via the intuitive controlled method, where the observer focuses survey effort in areas providing suitable habitat.

Habitat for Lomatium greenmanii is characterized by exposed slopes and open summits, areas where the duration of snow is less than that of adjacent sites. Populations have been found on all aspects and gentle to moderate slopes. Aspects have been reported from 3 to 356 degrees azimuth and slopes from 3 to 25 degrees. Associated species include bunch grasses and low perennial forbs. The altitude of the known populations ranges from 2,365 to 2,620 m (7,759 to 8,596 ft).

All known populations of Lomatium greenmanii occur on soils derived from specific geologic types. These include volcanic and metavolcanic rock from the upper Triassic, ultramafic and mafic intrusive rocks and serpentinized equivalents from the Triassic and Paleozoic (Mount Howard and vicinity), Grande Ronde Columbia River Basalt Group (Redmont Peak) and Columbia River Basalt Group and related flows from the Miocene (Ruby Peak).

Plants occur mostly in open areas, with rocks ranging from small, gravel sized particles to larger, shale-like pieces. The habitat resembles alpine tundra, with dwarfed plants and exposed rocks. Some plants have been found within small openings and along edges of Pinus albicaulis (whitebark pine) galleries.

Monitoring:
The new monitoring program has been designed to provide trend information at the site-specific and rangewide scales. The following description is from Michael Mancuso (2010), who developed the protocol under a joint partnership project between U.S. Fish and Wildlife Service and the Wallowa-Whitman National Forest.

[The monitoring design] collects quantitative information regarding (1) Greenman’s desert-parsley abundance and basic plant attributes, such as reproductive status and herbivory, (2) associated plant community composition, and (3) ground disturbance factors. The program includes sampling at all three known Greenman’s desert-parsley occurrences – Mt. Howard, Ruby Peak, and Redmont Peak. Monitoring is based on nested frequency sampling and photo point photographs at permanently marked transects. The sampling objective is to be 90% certain of detecting a 20% change in Greenman’s desert-parsley frequency or other measured attributes.

Monitoring transects
Monitoring transect locations were determined after conducting a reconnaissance to delineate patches of Greenman’s desert-parsley in a selected area. In most cases, selected areas represented locations of Greenman’s desert-parsley monitoring sites.
used in previous, subsequently abandoned monitoring studies (Kaye and Meinke 1993, Kagan 1999). Old rebar stakes and/or descriptive maps documented the general location of these former plot locations. Transects were either 25 or 50 meters long, with the start and end points monumented using an approximately 12 inch length of angle iron or a 12 inch metal spike. A third stake, at or near the mid-length was added for some of the transects. Transect lengths of 25 meters were used for small, and 50 meters for larger patches of Greenman’s desert-parsley. The transect is a metric tape stretched between the start and end points. A random choice determined whether to sample the right or left side of the transect tape.

**Nested frequency sampling**

Frequency data were collected for five plot sizes nested within a 0.5 meter x 0.5 meter microplot frame: 10 cm², 100 cm², 500 cm², 1000 cm², and 2000 cm². These sizes equate to square measurements inside the frame of 3.16 cm, 10.00 cm, 22.36 cm, 31.62 cm, and 44.72 cm, respectively. Frequency data were obtained by placing the plot frame along the transect with the 10 cm² corner flush with the appropriate meter tic mark on the tape. Frequency data were collected for all vascular plant species, as well as ground cover, ground disturbance, and animal pellet attributes. Ground cover attributes included bare soil, litter, biological crust (moss/lichen), gravel (<8 cm [3 in] diameter), rock (>8 cm [3 in] diameter), and wood. Ground disturbance attributes included trails or other recreational user impacts, animal tracks and digging, etc. Animal pellets were recorded by species when identification was certain. Frequency was recorded for the smallest nested plot size in which the plant species or other measured attribute occurred. For Greenman’s desert-parsley, any part of the plant within the frame counted as a “hit” (including pieces of leaf or stem). This followed a sampling rule originally devised by Kagan (1999) in response to the difficult determination of the rooting point of individual Greenman’s desert-parsley in dense clusters of multiple plants. All other plant species had to be rooted in the frame to be counted.

Frequency data were recorded at a minimum of 25 microplot frames/transect. Twenty-five meter long transects were sampled every meter, starting at the 1 meter point, for a total of 25 samples. Transects 50 meters in length were sampled a little differently. Greenman’s desert-parsley, ground disturbance, and animal pellet frequency was sampled every meter, starting at the 1 meter point, for a total of 50 samples. All other vascular plant species and ground cover attributes were sampled every other meter point starting at the 1 meter point, for a total of 25 samples. This helped reduce the time needed to sample the 50 meter long transects.

**Greenman’s desert-parsley sampling**

Information specific to Greenman’s desert-parsley was obtained simultaneously with the collection of nested frequency data at each frame on the transect. This included life stage class, and evidence of herbivory or disease. Reproductive, non-reproductive, or seedling life stage class was assigned and recorded for the Greenman’s desert-parsley plant located closest to the top, left-hand corner of the nested frequency frame. This individual could be inside or outside the frame, but had to be within 1 meter of the
frame corner. This constraint minimized researcher time collecting the information, and disturbance walking around in search of a Greenman’s desert-parsley plant. Reproductive plants contained one or more umbels. Tiny plants consisting of a single small leaf were scored as seedlings. Individuals larger than seedlings and without reproductive structures comprised the non-reproductive life stage class. To provide an idea of relative reproductive output, the number of umbels on reproductive individuals was recorded.

Herbivory and/or disease were recorded as “present” if observed on one or more Greenman’s desert-parsley plants in a nested frequency frame. Evidence of herbivory included nipped stems, leaves, or inflorescences. Disease evidence included tissue discoloration, or other morphological anomalies. Greenman’s desert-parsley herbivory and disease determination occurred simultaneously with the collection of nested frequency data.

**Photo points**

Photographs taken over time from the same marked point provide a visual, time-lapse record of the vegetation and other habitat characteristics (Hall 2001). Photo point photographs were taken using a digital camera set to wide angle. A minimum of six photographs comprise the photo point series, including 2 of the nested frequency transect, and four providing a panorama of the surrounding landscape. One transect photo is taken along the transect azimuth while standing 3 meters behind the start stake. Another photo is taken along the back azimuth while standing 3 meters behind the end stake. Photos taken while standing at the transect mid-point at 0º, 90º, 180º, and 270º give a panoramic overview of the general area. Additional photos to show disturbances, overviews of the site, and other features of conservation concern were optional.

**Results and Discussion**

**Inventory:**

About 300 acres were inventoried for the project (NRIS Survey ID 06160550015) over four days between August 15 and August 18, 2011. The initial suspect site, discovered in 2010, turned out to be *Lomatium oreganum*. This species, once tracked by ORBIC, was detected at several locations during the survey. One “new” site of *Lomatium greenmanii* was discovered on the north ridge of Ruby Peak located between mapped patches of the plant. This patch may have been detected in the past, but was not mapped in the Forest Service NRIS-TESP GIS application. A perusal of ORBIC and Forest Service site reports do not make clear whether this location had been detected earlier. The small patch, about 0.2 acres, sits on the ridge and its uppermost west shoulder at 8650 ft., with an estimated population of 100. It is located about 100 meters south (and 50 ft. higher in elevation) from the nearest accurately mapped patch, so may indeed be a new patch discovery. It is part of a larger element occurrence, PDAP11B1C0.2, a site comprised of 7 discrete patches along the north ridge of Ruby Peak, from 8000 to 8800 ft. in elevation. Although the highest elevation patch of *L. greenmanii* is mapped just off the summit of Ruby Peak at 8800 ft., this patch was not observed during the inventory. In 1999, Paula Brooks and Jimmy Kagan also did not observe this patch, and Shultz and Matthews (2004) similarly have
not discovered *L. greenmanii* near the summit. The legacy mapping of *L. greenmanii* near the summit may be an error.

The survey did detect one vegetative plant, over 1 mile disjunct from the Ruby Peak that we suspect to be *L. greenmanii* but could not positively confirm. We conducted a thorough search of the vicinity around this plant but found no others. We took a waypoint of the site for future reference.

In addition to the “new” patch discovery of *Lomatium greenmanii* on Ruby Peak, we discovered new occurrences of *Carex micropoda* and *Carex vernacula* in the glacial cirque surrounding Silver Basin to the west of Ruby Peak, near our campsite. Characteristically for the species, patches were small, especially for *Carex vernacula*, which was comprised of ten small clumps in less than 0.1 acre at the very base of the boulder field adjacent seasonal drainage. *Carex micropoda* was scattered among granitic boulder talus in several patches, with a total population estimate of 100.

**Table 1.**

<table>
<thead>
<tr>
<th>NRIS Site ID</th>
<th>Species</th>
<th>Population Estimate</th>
<th>Element Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>06160598765</td>
<td><em>Lomatium greenmanii</em></td>
<td>100</td>
<td>PDAPI1B1C0.2</td>
</tr>
<tr>
<td>0616050602</td>
<td><em>Carex micropoda</em></td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>0616050603</td>
<td><em>Carex vernacula</em></td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

**Monitoring Results:**

Results are presented in the tables below for frequency results in both 2010 and 2011 at Redmont Peak and Ruby Peak.

**Redmont Peak frequency results for nested quadrats in 2010 and 2011 (quadrat count)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Nest 1 (10 cm²)</th>
<th>Nest 2 (100 cm²)</th>
<th>Nest 3 (500 cm²)</th>
<th>Nest 4 (1000 cm²)</th>
<th>Nest 5 (2000 cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>07/19/2010</td>
<td>(17) 34%</td>
<td>(31) 62%</td>
<td>(44) 88%</td>
<td>(48) 96%</td>
<td>(49) 98%</td>
</tr>
<tr>
<td>09/30/2011</td>
<td>(6) 12%</td>
<td>(22) 44%</td>
<td>(39) 78%</td>
<td>(43) 86%</td>
<td>(48) 96%</td>
</tr>
</tbody>
</table>

**Ruby Peak frequency results for nested quadrats in 2010 and 2011 (quadrat count)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Nest 1 (10 cm²)</th>
<th>Nest 2 (100 cm²)</th>
<th>Nest 3 (500 cm²)</th>
<th>Nest 4 (1000 cm²)</th>
<th>Nest 5 (2000 cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>08/05/2010</td>
<td>(10) 20%</td>
<td>(30) 60%</td>
<td>(42) 84%</td>
<td>(44) 88%</td>
<td>(45) 90%</td>
</tr>
<tr>
<td>08/17/2011</td>
<td>(7) 14%</td>
<td>(23) 46%</td>
<td>(37) 74%</td>
<td>(42) 84%</td>
<td>(48) 96%</td>
</tr>
</tbody>
</table>

**Discussion:**

At Redmont peak, frequency measurements varied in 2011 from 12% to 96% depending on the quadrat size. In 2010 frequency varied from 34% to 98%. Results from Ruby peak displayed similar ranges in frequency between quadrat size, ranging from 14% to 96% in 2011, and 20% to 90% in 2010. Because frequency measurements are ideally obtained between 30 and 70 percent (Elzinga, et al. 1998), quadrat nest 2 (100 cm²) was used to analyze the change between years using the chi-square statistic. The chi-square analysis was used because, even though the transect placement was permanent, quadrat
placement along the transect was not. Quadrat location was systematically randomized in both 2010 and 2011.

Contingency tables for frequency measurements are arranged below. Expected values were calculated using the formula:

$$\text{Expected value} = \frac{(\text{row total} \times \text{column total})}{\text{total}}$$

### Table 3. Frequency contingency table between 2010 and 2011 – Redmont Peak

<table>
<thead>
<tr>
<th></th>
<th>2010 Observed</th>
<th>2010 Expected</th>
<th>2011 Observed</th>
<th>2011 Expected</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>31</td>
<td>26.5</td>
<td>22</td>
<td>26.5</td>
<td>53</td>
</tr>
<tr>
<td>Absent</td>
<td>19</td>
<td>23.5</td>
<td>28</td>
<td>23.5</td>
<td>47</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

### Table 4. Frequency contingency table between 2010 and 2011 – Ruby Peak

<table>
<thead>
<tr>
<th></th>
<th>2010 Observed</th>
<th>2010 Expected</th>
<th>2011 Observed</th>
<th>2011 Expected</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present</td>
<td>30</td>
<td>26.5</td>
<td>23</td>
<td>26.5</td>
<td>53</td>
</tr>
<tr>
<td>Absent</td>
<td>20</td>
<td>23.5</td>
<td>27</td>
<td>23.5</td>
<td>47</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

To evaluate the data using the chi-square analysis, we calculated the degrees of freedom necessary to obtain a critical $x^2$ value from a chi-square table. For a 2x2 comparison, the degrees of freedom value = 1. [df = (r-1)(c-1); r = rows in comparison, c = columns in comparison] With our $P$-threshold set at 0.10 (recall, the sampling objective is to be 90% certain of detecting a 20% change in Greenman’s desert-parsley frequency) and degrees of freedom = 1, the chi-square critical value from a table or chi-square calculator equals 2.706. To confirm the null hypothesis, that there is no difference in frequency measurements between 2010 and 2011, then the calculated chi-square value from the experimental data would be less than 2.706. If the chi-square value is greater than 2.706 we may reject the null hypothesis and conclude that there is an observed difference in frequency. The Chi-square value was calculated using the formula:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

Where:
- $\chi^2$ = the chi square statistic (calculated value)
- $\Sigma$ = sum of the variables
- $O$ = Observed Value
- $E$ = Expected Value

For Redmont Peak, the calculated chi-square value is 3.25; for Ruby Peak, the value is 1.97. Thus, at Ruby peak, the null hypothesis is confirmed ($1.97 < 2.706$), and the drop in measured frequency (from
60% in 2010 to 46% in 2011) would not be considered significant. For Redmont Peak, however, the calculated chi-square value is 3.25, which is greater than 2.706, so we may reject the null hypothesis and conclude the measured drop in frequency from 62% in 2010 to 44% in 2011 is significant. The result is within our threshold of 90% certainty a real change in frequency occurred.

One possible explanation for a drop in frequency at Redmont Peak is that the plot was read over 10 weeks later in the season (September 30) in 2011 compared to 2010 (July 19). By this late date, many Lomatium plants were in late fruit or senescing; smaller individuals may have dehisced and been carried away by the wind. Herbivory by rodents, noted at other Lomatium greenmanii sites, may have been more pronounced later in the season compared to earlier in the summer, thus reducing abundance and frequency. And differences in climate or weather may have influenced abundance in 2011 at this site. Arrangement of the quadrats along the transect were different in 2011, and though we might expect to obtain a different frequency by doing so, even in the same year, the chi-square analysis is designed to correct for non-permanent, random quadrat placement.

**Recommendations:**

**Inventory:**
Additional suitable habitat is present south of the Traverse Ridge vicinity. Additional habitat also exists on Brown Mountain that lies west of Minam Lake deeper in the Wallowa Mountains. These areas should be inventoried for the presence of Lomatium greenmanii.

**Monitoring:**
1. Monitoring plots should be read at approximately the same time of year in subsequent years. Make quadrat locations permanent to obtain greater sensitivity to change (McNemar’s test) vs. chi-square analysis.
2. Consider using permanently marked quadrat locations. This would enable use of McNemar’s Test, which would improve statistical power. Given the quadrat size is small, the feasibility of making quadrat locations permanent should first be attempted and analyzed for practicality as well as accuracy.
3. For monitoring Lomatium greenmanii frequency, the quadrat size of 100 cm² (nest 2) should be used. The remaining nests could be dropped. This would increase the speed of reading plots. Perhaps for the first 5-6 years, until “natural” variation in frequency is established, we might recommend reading the 3 smallest nests, then select the most appropriate size for longer term monitoring. Given the results, there is no reason to continue reading the two largest quadrats, where frequencies exceed 90 percent.
4. Monitor Lomatium greenmanii frequency annually for 5 years to get a baseline trend of biological variation in LOGR2 frequency. Following this period, monitoring may be reduce to every 2nd year in accordance with the conservation agreement.
5. Reduce frequency Vegetation community monitoring to every 6th year, which would be consistent with the area ecology long-term monitoring protocols. This would reduce time and cost associated with monitoring Lomatium greenmanii. If unusual changes in LOGR2 frequency
were noted, or a disturbance, such as a fire, occurred, monitoring vegetation would resume the first season following the fire or disturbance, then return to the 6 year interval.

References


Lomatium greenmanii Inventory - 2011
Wallowa-Whitman National Forest

Legend
- Element Occurrence Poly Survey
- Survey Name
  - Greenman's Lomatium 2007
  - Lomatium_greenmanii-2011

Ruby Peak Monitoring Site
Lomatium greenmanii patch - expansion of 50
Potential Lomatium greenmanii Discovery

Carex micropoda and Carex variegata