WASHINGTON NATURAL HERITAGE PROGRAM

Ranunculus triternatus (obscure buttercup)

Inventory, Monitoring, and Taxonomic Review

Prepared for
U.S. Fish and Wildlife Service
Region 1

Prepared by

Joseph Arnett

January 24, 2013

Natural Heritage
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WASHINGTON STATE DEPARTMENT OF
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(obscure buttercup)

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for
The U.S. Fish and Wildlife Service
Western Washington Fish and Wildlife Office
Region 1

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Contents

Tables

Figures

Appendices

Introduction

Ranunculus triternatus A. Gray is a buttercup species primarily known from the Columbia Hills, south of Goldendale in Klickitat County, Washington, where the type specimen was collected by Howell in 1882. The Washington Natural Heritage Program (WNHP) has assigned a state status of endangered to this taxon, and the Oregon Natural Heritage Program considers it to be critically imperiled in that state. The distribution of the species is centered on the Columbia Hills, with confirmed occurrences to the north as far as the towns of Klickitat and Wahkiacus, Washington, a distance of approximately eight miles, and into Oregon around the Dalles and Hood River. The Flora of North America (Wittemore 1997) also describes outliers in Nevada and southern Idaho (see Figure 1). Specimens from those areas have not been located (Holmgren et al. 2012), and we consider these records as most likely invalid.

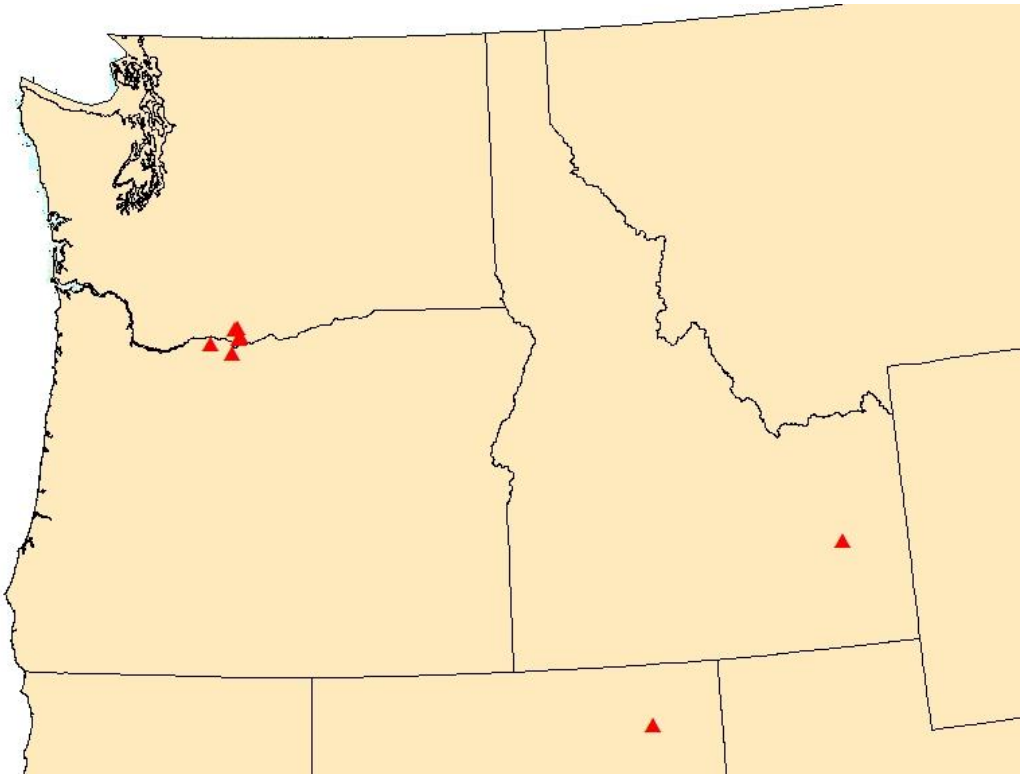

Figure 1. Global distribution of *Ranunculus triternatus*. This map is based on the distribution as mapped in the Flora of North America (Wittemore 1997). Holmgren et al. (2012) have been unable to relocate voucher specimens from Idaho and Nevada, and they consider it unlikely that *R. triternatus* occurs in these areas.

A comprehensive review of the status of *Ranunculus triternatus* in Washington had not been undertaken since 1985, and this project was intended to fill that gap by revisiting known occurrences in the state and documenting the current condition of each. Four of the six extant occurrences had not been monitored recently; three occurrences were last reported in 1986, and one occurrence in 1988. Available monitoring data suggest that the population within the Columbia Hills Natural Area Preserve has been declining (Wilderman 2012), and these changes have increased the need for evaluating other occurrences.

This project initially had four main objectives: 1) to assess the current condition of each known occurrence of *Ranunculus triternatus*, 2) to survey a broader geographic area than the species is currently known to occupy, 3) to assess the overall conservation status of the species, and 4) to support conservation planning for the species. Plants that appeared to be intermediate between *R. triternatus* and *R. glaberrimus* had previously been reported in Washington, and it was clear that these questions needed to be resolved to better assess conservation status. Consequently, the scope of this project was expanded to include review of the section of the genus in herbarium study and literature review.

Field Inventory and Database Review

Field inventory included site visits to all known occurrences of *R. triternatus* in Washington, with the exception of a few small patches above Swale Canyon that could not be accessed across private land. I also visited *Ranunculus* populations that had been reported at Canyon Creek and at Umtanum Creek north of Yakima that appeared in general appearance to resemble *R. triternatus*. Table 1 includes a summary of all site visits. Field inventories produced several additions to the WNHP database, including an expanded boundary of the *R. triternatus* population on Stacker Butte, additional locations of this taxon in Swale Canyon, and a new occurrence of the species on Columbia Land Trust, BLM, and WDFW property near Klickitat. Observations from these field observations are summarized in Appendix A. Participation in annual monitoring in partnership with the Natural Areas Program provided the opportunity to obtain additional records that had not yet been entered into the WNHP database. These additions included over forty new points and polygons on both the north and south slopes of Stacker Butte, many with precise locations and population counts. This detailed information should allow much better tracking of the species distribution and abundance in the future. Figure 2 shows the distribution of *R. triternatus* in Washington; the northern-most points on this map show a population of plants in the Canyon Creek area that resemble *R. triternatus* but that have atypical broad leaf lobes. A compilation of all the known records of *R. triternatus* is presented in Appendix B.

Ranunculus triternatus Monitoring on Stacker Butte

David Wilderman, DNR Natural Areas Ecologist, has led monitoring efforts for *Ranunculus triternatus* at five sites in the Columbia Hills Natural Area Preserve since 2003 (Wilderman 2012), and his most recent monitoring report is included in this report as Appendix C. The overall indication in this monitoring is that there is a downward trend in abundance in the macroplots where monitoring has been done; it is not known whether there are corresponding increases in other areas, counter-balancing these declines.

Table 1. Summary of areas inventoried for *Ranunculus triternatus.* (Voucher collection numbers are indicated in parentheses)

Location	Dates	Comments
Stacker Butte, WDNR	1 March 2010, 15 March 2011, 17 April 2012, 20 April 2012	Extensive known population; annual monitoring by Natural Areas Program in five areas.
Swale Canyon Klickitat Trail right-of-way on private land	2 March 2010, 18 March 2010 (lower canyon), 18 April 2012	Known population, additional subpopulations found in 2010. Adjacent private land includes extensive habitat and likely would include additional subpopulations.
Margerum Ranch area, CLT, WDFW, BLM	3 March 2010' 17March2011	Extensive new population found in 2010 and more widely delineated in 2011 (Arnett 2010-1, 2011-1).
Umtanum Creek	17 March 2010	Most plants at this site are typical *R. glaberrimus*, but scattered through the population are plants with varying degrees of triternate subdivisions of the basal leaves. The plants here do not overall resemble *R. triternatus* but have occasional leaf divisions that suggest this taxon. (Arnett 2010-2, 3, and 4)
High Prairie WDNR land, Section 36	18 March 2010	*R. triternatus* was not observed here and had not previously been known from this site.
Canyon Creek WDFW land	18 March 2010	Plants appearing intermediate between *R. triternatus* and *R. glaberrimus* (Arnett 2010-5, Carolyn Wright 2241 and 2242, Paul Slichter s.n.)
Horseshoe Bend WDNR land, Section 16	16 March 2011	*R. triternatus* was not observed here and had not previously been known from this site.
Dillacort Creek area, WDNR and CLT property	18 March 2011	*R. triternatus* was not observed here and had not previously been known from this site.
Wahkiakus and the Klickitat Trail, Klickitat Springs	19 April 2012	Extensive new population found in 2011 by Paul Slichter.

Ownerships: WDFW=Washington Department of Fish and Wildlife, WDNR=Washington Department of Natural Resources, CLT=Columbia Land Trust, BLM=Bureau of Land Management

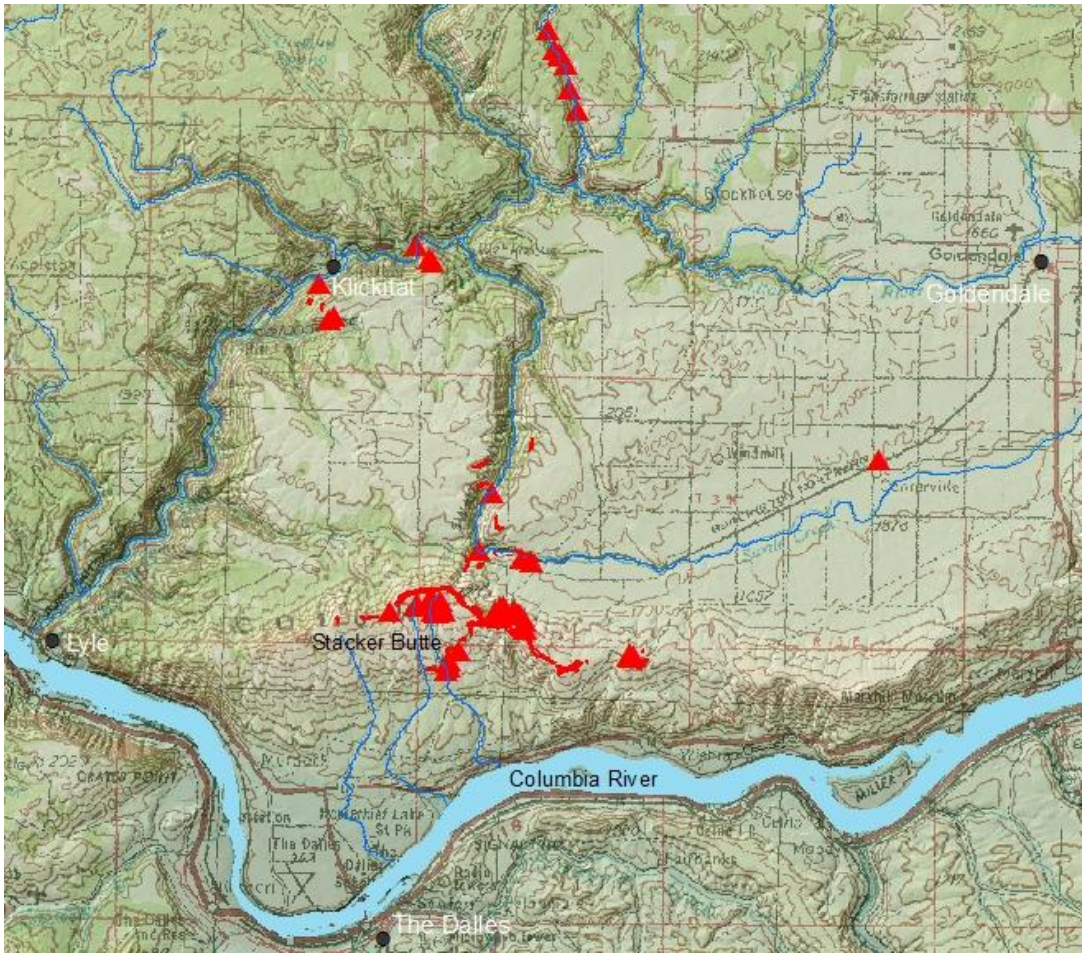

Figure 2. Distribution of *Ranunculus triternatus* in Washington. The northern-most points show the location of plants found along Canyon Creek that have been identified as *R. triternatus*, but that are atypical in leaf morphology. The eastern point is based on a 1938 collection described on the specimen label as coming from "high sagebrush hills near Centerville". Though mapped at Centerville in the WNHP database, that collection was likely from higher elevation up in the Columbia Hills.

Taxonomic review of *Ranunculus triternatus* and related taxa

In addition to field examination of *R. triternatus* throughout its range, I also examined fifty-five herbarium specimens of this species and related taxa at the University of Washington Herbarium at the Burke Museum and made notes on the morphological features most useful in identification of this section of *Ranunculus.* Notes from these examinations are included in Appendix D.

Forty-three taxa of *Ranunculus* are recorded in Washington, including 24 native species; seven of these include more than one infraspecific taxon in the state. In addition, ten non-native species are also present here. *Ranunculus triternatus* is classified within *Ranunculus* Linnaeus (subg. *Ranunculus*) sect. Epirotes (Prantl) L.D. Benson. This section is characterized by leaves that are lobed or compound (*R. glaberrimus* var. *ellipticus* can be atypical in this regard), a generally upright stature without rooting at the nodes, the presence of cauline leaves, elongate styles, thick-

walled and thick-lenticular achenes 1.2-2 times as wide as thick, and nectary scales that are joined to the petal at the base and sides (Whittemore 1997). Seven species (nine taxa including varieties) within Epirotes are known to occur in Washington; two of these species include two varieties in the state. These taxa are summarized in Table 2. Appendix E includes a summary of selected features that are most useful in identifying plants in this section.

Table 2. Species of *Ranunculus* sect. Epirotes known to occur in Washington State.

taxon	**range**
R. abortivus	Extensive in N. Am., except SW U.S.; present in NE WA; 0-3100 m.
R. cardiophyllus	Scattered in the Rocky Mts, including NE WA; 600-3400 m.
R. eschscholtzii var. *eschscholtzii*	Western N. Am. from AK south in mountains to CA, AZ, NM; usually arctic and alpine.
R. eschscholtzii var. *suksdorfii*	Rocky Mountains and Olympics; 1200-3200 m.
R. gelidus	AK, Rocky Mountains, WA Cascades; arctic and alpine.
R. glaberrimus var. *ellipticus*	Widespread in western states, 500-3600 m.
R. glaberrimus var. *glaberrimus*	Widespread in western states, 400-2000 m.
R. inamoenus var. *inamoenus*	Widespread in western states, 2000-3500 m.
R. triternatus	Mostly in southern WA and adjacent OR; disjuncts reported in ID and NV.

The presence of large flowers (petals in the range of 6-15 mm long) distinguishes *R. cardiophyllus, R. eschscholtzii, R. glaberrimus*, and *R. triternatus* from the rest of Epirotes. The presence of thicker roots (2-3 mm) and globose or depressed-globose fruiting heads set *R. triternatus* and *R. glaberrimus* apart from the rest of this section. *R. cardiophyllus* and *R. eschscholtzii* are also typically found at higher elevations at these latitudes. *R. triternatus* and *R. glaberrimus* are typically quite distinct from each other in the degree and shape of lobing in the basal leaves: *R. triternatus* has triternate leaves with linear segments (see Figure 3), while *R. glaberrimus* has broad basal leaves that are shallowly toothed (except *R. glaberrimus* var. *ellipticus*, as noted above), with entire basal leaves that are usually entire or with broad lobes ternately incised as deeply as to the middle of the blade (see Figure 4).

Less visible characteristics of *R. triternatus* include concave distal margins on glabrous nectary scales and short pubescent receptacles. In contrast, *R. glaberrimus* typically has convex distal margins on sometimes ciliate nectary scales and glabrous receptacles. The shape of the scale that covers the nectary is difficult to see in dried material and seemed quite variable in the plants I examined in the field. Illustrations in Hitchcock and Cronquist (1964) show typical leaf morphology and representations of the shape of the nectary scales. Nearly all of the plants that I examined had scales with pointed lateral edges that were detached at the very tip, with ragged distal edges that were more or less truncate. I did not see nectary scales as deeply incised as those in the illustration in Hitchcock and Cronquist (1964).

While in my examinations the characteristics of the nectary scales and receptacle were less diagnostic than suggested in Hitchcock and Cronquist (1964) and Wittemore (1997), identifying plants with the typical leaf forms in the known populations of *R. triternatus* and in herbarium specimens of both species was straightforward. While similar in many regards, *R. glaberrimus*

Figure 3. Photo of *Ranunculus triternatus* from Stacker Butte. Photo by David Wilderman

Figure 4. Photograph of typical *Ranunculus glaberrimus;* these plants are from a population along Umtanum Creek.

and *R. triternatus* have not generally been confused with each other, and these examples show the distinctness of typical specimens. As Hitchcock and Cronquist (1964) referred to *R. triternatus*: "This species is very closely related to *R. glaberrimus*, but apparently never intergradient with it".

Prior to this study, however, taxonomic questions had arisen about apparently intermediate plants observed in the Canyon Creek area by Barbara Robinson and Paul Slichter. These plants are approximately five miles beyond the known range of *R. triternatus* and have triternate leaves with broad lobes (see Figure 5). The keys in both the *Flora of North America* (Wittemore 1997) and in Hitchcock and Cronquist (1973) would point a user towards *R. triternatus*, because the leaves were generally triternate; however, the leaf lobes were far wider than what would be considered to be "linear", which is the term used in both references, and far wider than *R. triternatus* plants seen or collected elsewhere. The plants from Canyon Creek appear intermediate between the illustrations depicting *R. triternatus* and *R. glaberrimus* (Hitchcock and Cronquist 1964, 1974; Wittemore 1997). An early collection (Slichter s.n.) was sent to David Giblin at the University of Washington Herbarium at the Burke Museum; he tentatively identified the specimen as *R. gelidus*, based on leaf shape. However, the specimen was lacking roots, which are a key feature distinguishing *R. gelidus* (which has fibrous roots generally around 1 mm thick) from *R. glaberrimus* and *R. triternatus*, which have thicker, fleshy roots 2 to 3 mm. thick. As Appendix E reports, the flowers of *R. gelidus* are also considerably smaller than those of either *R. triternatus* or *R. glaberrimus.*

Figure 5. Photograph of *Ranunculus* from the Canyon Creek population.

Later collections by Carolyn Wright (2241 and 2242) and Joe Arnett (2010-5) showed the thicker roots of the plants at Canyon Creek, and Slichter submitted a report on this population to the Washington Natural Heritage Program, identifying the plants there as *R. triternatus*.

Other populations of plants that resembled *R. triternatus* were also brought to our attention. A photograph of plants that were identified as *R. triternatus* was found on the internet by Lindsay Cornelius of the Columbia Land Trust as she was searching for information on *R. triternatus* after it was found on land trust property. The photograph, by Thayne Tuason, was taken along Umtanum Creek, near its confluence with the Yakima River. The photograph did indeed show a buttercup with strongly divided leaves, suggesting *R. triternatus,* but the lobes were broader than those generally found on *R. triternatus* and not usually triternate. I visited this population and found that it included typical *R. glaberrimus* (Figure 4) as well as plants with a variety of degrees of leaf lobing (see Figures 6 and 7). A second atypical *Ranunculus* in Yakima County was photographed at Bear Creek by Phelps Freeborn, who also reports that this form is found in several places in the Naches area. The leaves of these plants are deeply incised into three lobes, with narrower lobes than typical for *R. glaberrimus*; some of the lobes are again divided, though they are not triternate. I have not yet examined these plants in the field.

The presence of triternate leaves with wide lobes at Canyon Creek necessitated a more careful review of the degree of lobing and the relative width of lobes in *R. triternatus*. While the typical leaf form is with linear lobes, as illustrated by Figure 3, variation is present within the population near Klickitat and in the Stacker Butte populations. Figure 8 shows the wide end of this variation near Klickitat, on a plant from Washington Department of Fish and Wildlife (WDFW) land on the rim of Wheeler Canyon. Figure 9 shows a plant from Stacker Butte, from the primary population of *R. triternatus*. The leaf morphology of plants near Klickitat and on Stacker Butte vary in the broadness of the leaf lobes, but none of the plants that I examined in these areas had leaves anywhere near as broad as those at Canyon Creek.

After carefully examining these plants in the field, reviewing published descriptions, comparing specimens with reference collections in the herbarium, and comparing leaf morphology with photographic resources, it is apparent that these atypical plants do not fit well with existing circumscriptions of either *R. triternatus* or R. *glaberrimus.* They thus offer several taxonomic alternatives. They could be considered to be 1) within *R. triternatus*, but with extremely broad leaf segments, not precisely corresponding to the published description; 2) within *R. glaberrimus*, but with deeply dissected, sometimes triternate leaves, also not corresponding with the published description; 3) a third described taxon (the atypical plants are most similar in leaf shapes to *R. gelidus* and *R. eschscholtzii*, though they do not fit the descriptions of these species in other regards); 4) hybrids between *R. triternatus* and *R. glaberrimus*; or 5) an undescribed new taxon of *Ranunculus.*

Based on the location of the Umtanum Creek and Bear Canyon plants, and the mix of typical *R. glaberrimus* and atypical plants at Umtanum Creek, I am inclined to regard these populations as *R. glaberrimus* including individuals with a range of atypical leaf lobing. I can only speculate about the genetic source of the atypical leaf lobing, but since both *R. eschscholtzii* and *R. gelidus* occur at higher elevations in the eastern Cascades of Washington, they are worth considering.

Wide variation is known throughout the genus, and *R. eschscholtzii* includes numerous variations in this regard recognized at the taxonomic level of variety (Wittemore 1997).

After seeing the mixed population of *R. glaberrimus* var. *glaberrimus* at Umtanum Creek, I was initially inclined to interpret the Canyon Creek plants as also representing variants of this taxon, though at Canyon Creek I did not see any typical *R. glaberrimus.* The plants here appear fairly consistent in leaf morphology, at least based on the single patch that I visited and the herbarium collections by Slichter and Wright. Further examination has not enabled me to unequivocally place these plants within either *R. triternatus* or *R. glaberrimus*. The receptacles are short pubescent, consistent with the description of *R. triternatus*; the shape of the nectary scales fall within the range of specimens of that taxon examined species-wide. The shape of the leaves is the characteristic that most clearly differs from either *R. triternatus* or *R. glaberrimus;* the plants at Canyon Creek are intermediate between these two taxa, in this regard. The plants are perhaps more similar to *R. triternatus* overall because of the characteristics of the nectary scale, the shape of the fruiting head, and the pubescence of the receptacle. These intermediate plants certainly suggest hybridization between *R. triternatus* or *R. glaberrimus,* though I consider that explanation to be speculation at this point. Considering these plants to be a genetically distinct variety of *R. triternatus* is a taxonomic possibility.

Figure 6. Photograph of *Ranunculus glaberrimus* from the Umtanum Creek population.

Figure 7. Photograph of *Ranunculus glaberrimus* from the Umtanum Creek population.

Figure 8. Photograph of *Ranunculus triternatus* from Wheeler Canyon.

Figure 8. Photo of *Ranunculus triternatus* from Stacker Butte (photo by David Wilderman).

Conservation Recommendations

Most known subpopulations of *Ranunculus triternatus* occur on land already dedicated to conservation, protected by the Columbia Hills Natural Area Preserve (managed by the Washington Natural Areas Program) and the Margerum Ranch Preserve (owned and managed by the Columbia Land Trust). These areas already include conservation of *R. triternatus* as a management priority. Most of the other subpopulations are also on public land, managed by WDFW, Washington State Parks, and the Bureau of Land Management. These agencies also include conservation of rare species as part of their management guidelines, if not specifically identifying *R. triternatus* as a site specific priority. Consequently, most of the known extent of the species is on land where conservation of the species is, and will be, considered. This report will be presented to each of these agencies, to provide them with current information and to offer support of the WNHP, including site-specific recommendations, in managing for the benefit of the species.

The current trend monitoring at Stacker Butte is all occurring on open sites, and all populations have been declining through the years that monitoring has been conducted. It would be informative to monitor the trend of a large population under oak forest, such as on the Columbia Land Trust property near Klickitat, to see if the population in this different habitat is also responding to changing conditions in a way similar to the open habitat sites.

The intermediate plants in the Canyon Creek area, and to a lesser extent in Yakima County, present the challenge and opportunity to clarify the taxonomy of this group of plants.

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Appendix A: *Ranunculus triternatus* sightings, J. Arnett, WNHP, 2010-2012					
EO ID	**Source feature**		**Location**	**Date**	**Notes**
	Type	**ID**			
3397	polygon	15317	Swale Canyon	2March2010	Counted 456 plants in flower in three widely separated patches above the road
3397	point	17611	Swale Canyon, Slichter area D.	2March2010	Counted 13 plants in flower
3397	point	17611	Swale Canyon, Slichter area D.	18April2012	Counted 3 plants in fruit, no plants in flower
3397	polygon	8260	Stacker Butte	1March2010	Observed plants in flower, assisted Natural Areas staff in monitoring. Plants half in flower and half in bud, at the following points (NAD 1927 Zone 10): 646184E, 5063277N; 645913E, 5063119N; 646260E, 5063379N; 646221E, 5063343N
3397	polygon	8260	Stacker Butte	15March2011	Observed plants in flower. Plants half in flower and half in bud, at the following points (NAD 1927 Zone 10): 646184E, 5063277N; 645913E, 5063119N; 646260E, 5063379N; 646221E, 5063343N
3397	polygon	8260	Stacker Butte	17April2012	Many plants in flower and starting to set fruit. Recorded coordinates at the following points (NAD 1927 Zone 10): 648667E, 5063017N; 649008E, 5063006N.
3397	polygon	8353	Stacker Butte	20April2012	Went east along the ridge top of Stacker Butte, into this polygon, but did not see any flowering *Ranunculus.*
8181	point	17189	Margerum Ranch, Klickitat	3March2010	With Lindsay Cornelius in 2010. Under oaks near the top of steep west facing slope.
8181	polygon	17193	Margerum Ranch, Klickitat	3March2010	With Lindsay Cornelius in 2010. Open area on steep slope near top.
8181	point	17191	Margerum Ranch, Klickitat	3March2010	With Lindsay Cornelius in 2010. Near bottom of slope under oaks

8181	polygon	17192	Margerum Ranch, Klickitat	3March2010	With Lindsay Cornelius in 2010. Extensive population on broad terrace forested with oaks. Collection Arnett 2010-1.
8181	point	17190	Margerum Ranch, Klickitat	3March2010	With Lindsay Cornelius in 2010. Open area at edge of oak forest.
8181	polygon	17192	Margerum Ranch, Klickitat	17March2011	Extensive population on broad terrace forested with oaks. Likely thousands of plants, unable with time available to count or estimate. Collection Arnett 2011-2.
8181	point		BLM property near Margerum Ranch, Klickitat	17March2011	Point "A" at (NAD 1927 Zone 10): 642945E, 5074421N. One plant at edge of opening in oaks, end of flowering. Aspect WSW, 30% slope, associated with *Quercus garryana, Pseudotsuga menziesii, Olsynium douglasii, Lithophragma glabra; Carex geyeri* abundant.
8181	point		Margerum Ranch area, Klickitat	17March2011	Point "B" at (NAD 1927 Zone 10): 643326E, 5073958N. Counted 11 plants in outcropping of large boulders. NW aspect, 40% slope, associated with *Pseudoroegneria spicata, Lithophragma glabra, Lomatium columbianum*
8181	point		Margerum Ranch area, Klickitat	17March2011	Point "C" at (NAD 1927 Zone 10): 643358E, 5074003N. Counted 70 plants
8181	point		Margerum Ranch area, Klickitat	17March2011	Point "D" at (NAD 1927 Zone 10): 643417E, 5073940N. Up on the top of the slope, grassland with scattered oak. Saw one RATR plant. W aspect, 5% slope
8181	point		Margerum Ranch area, Klickitat	17March2011	Point "E" at (NAD 1927 Zone 10): 643530E, 5073261N. At the lip of Wheeler Canyon, SE aspect, 45% slope, associated with *Pseudoroegneria spicata, Lomatium columbianum.* Counted 35 plants but there are likely many more on adjacent property. Plants that I saw here were only along the canyon lip.
8181	point		WDFW above Wheeler Canyon, near Margerum Ranch property	17March2011	Point "F" at (NAD 1927 Zone 10): 643384E, 5073229N. This appears to be on WDFW property. SSE aspect, 25% slope, Lithophragma parviflora, vegetative grasses, Galium. Collection Arnett 2011-1. Lobing of leaves appears broader than usual.

8181	point		Margerum Ranch area, Klickitat	17March2011	Point "G" at (NAD 1927 Zone 10): 642937E, 5073386N. Plants throughout this opening on west facing slope, occasional below under the oaks on this slope. Time did not allow an attempt at counting.
8181	point		Margerum Ranch area, Klickitat	17March2011	Point "H" at (NAD 1927 Zone 10): 642738E, 5073700N. Ranunculus is abundant as soon as the slope lessens, under *Quercus* forest, with *Lithophragma glaberrimus, Galium.* Observed large black flies sitting on the Ranunculus flowers, apparently feeding at nectaries from buttercup to buttercup, but also just sitting.
8218	point		Canyon Creek canyon	18March2010	Along base of cliffs to the east of Canyon Creek. Plants here have divided leaves, but with much broader lobing than typical *R. triternatus*. After examination of the plants in the field and reviewing the herbarium specimens available (Arnett 2010-5, Wright 2241 and 2242, Slichter s.n.), I do not regard these plants as fitting within the the published descriptions of either *R. glaberrimus* or *R. triternatus.* This observation likely applies to all of the points along Canyon creek, though I observed plants at only one site, approximately 50 plants at (NAD 1983 Zone 10) 651268E, 5082846N.
	point		Umtanum Creek	17March2010	Plants at this site near Yakima Canyon had been identified as *R. triternatus*; I examined them in the field and in herbarium specimens (Arnett 2010-2, 2010-3, 2010-4) and consider them to be *R. glaberrimus* with atypical leaves, more divided on some plants than others, all quite distinct from *R. triternatus*.

Appendix B: Summary of all *Ranunculus triternatus* source features. A summary of the monitoring history of each known point or polygon is presented below. In the Washington Natural Heritage Program database, the Element Occurrence (EO) ID is used to track each population, and the Source Feature ID is used to track each sub-population within an EO. Maps and aerial photographs follow the table.

Source feature ID	Feature type	Location (Figures on which this feature is found are in parentheses)	Notes or dates of observations
Swale Canyon, EO ID 3397			
3634	polygon	Lower Swale Canyon, on the east side above steep slopes (B-9).	Gamon 1986 (estimated several hundred)
3635	polygon	Swale Canyon, large polygon above the steep slopes on the west side of the canyon, mostly in Section 8 (B-9).	Gamon 1986 (estimated at least several hundred)
8351	polygon	Swale Canyon, polygon on upper slopes on the west side, mid-canyon in Section 17 (B-9).	Gamon 1986 (estimated several hundred)
8642	polygon	Swale Canyon, large polygon on more gradual slopes above the east rim of the canyon (B-8, B-9).	Gamon 1986 (estimated several hundred)
15317	polygon	Swale Canyon, large polygon north of the creek by the RR bridge (B-8, B-9).	Robinson 2006 Arnett 2010 (counted 456 in three patches; Slichter 2010 (counted 1519 throughout the polygon)
15318	polygon	Uppermost RATR in Swale Canyon, on the north side of the creek, upstream from the RR bridge (B-8).	Robinson 2006, Slichter 2010 (counted 170)
17194	point	Swale Canyon, roadside at the bend in the canyon (B-8, B-9).	Arnett 2010 (counted 1)
17195	point	Swale Canyon, canyon sides east of the creek (B-9).	Arnett 2010 (partial count of 95; plants continuing upslope on private land.
17608	polygon	South of the creek, the western-most polygon in the east-west portion of Swale Canyon (B-8, B-9).	Slichter and Enz 2010 (counted 389)
17609	polygon	South of the creek in Swale Canyon, above steep slopes; Slichter Site G (B-8).	Slichter 2010 (approximated 12 by binoculars)

Source feature ID	Feature type	Location, identifier	Notes or dates of observations
17610	point	Swale Canyon, Slichter Site F, south of the creek by the RR bridge (B-8).	Slichter 2020 (counted 41)
17611	point	Swale Canyon, Slichter Site D (B-8).	Arnett 2010 (counted 13), Slichter 2010 (counted 32), Arnett (counted 3 in fruit)
17612	polygon	Swale Canyon, Slichter Site E (B-8).	Slichter 2010 (counted 806)
Centerville Road near Stacker Canyon, EO ID 3397			
8352	polygon	East of Stacker Canyon (B-8).	Augenstein 1985 (estimated 100+)
3644	polygon	Stacker Canyon (B-8).	Augenstein 1985 (plants observed, no estimates or counts); Chapin 1988 (plants observed, no estimates or counts)
3643	polygon	West of Stacker Canyon (B-8).	Augenstein 1985 (plants observed, no estimates or counts)
Stacker Butte, EO ID 3397. This part of this table includes source features on the summit ridge and the north and south faces of Dalles Mountain, but features on the Centerville Road and in Swale Canyon are treated in separate parts of this table.			
2307	polygon	Beyond 8-mile creek, above road up to Stacker Butte (B-1).	Davis, Kallinene, and Fimbel 2000 (est. 200-500 plants); Taylor, Lenon, and Lenon 2002 (4 plants observed, vegetative and in fruit).
3648	polygon	East end of the ridge of Stacker Butte, south of road (B-2).	Chamberlain 1980 (small patch of plants observed); Kemp 1982 (plants observed); Chapin 1985 (100+); Chapin 1986)300-400; Chapin 1988 (~500).
3649	polygon	Ridge immediately east of Stacker Butte (B3).	Kemp 1982 (plants observed)
3650	polygon	East end of Stacker Butte ridge, north of road (B-2).	Kemp 1982 (plants observed)
8260	polygon	Summit ridge of Stacker Butte. This large polygon includes Natural Area monitoring sites #1 and #2 (B-4, B-5, B-6, B-7).	Kemp 1982 (plants observed); Taylor, Lenon, & Lenon 2002 (plants observed); Wilderman 2010 (plants observed in three monitoring plots, numbers down from previous years).
8261	polygon	Beyond 8-mile creek, above road up to Stacker Butte (B-1, B-4).	Taylor, Lenon, and Lenon 2002 (flowering plants observed).
8262	point	points circling radio facility (B-2).	Kemp 1982 (plants observed)

Source feature ID	Feature type	Location, identifier	Notes or dates of observations
8263	point	points circling radio facility (B-2).	Kemp 1982 (plants observed)
8264	point	points circling radio facility (B-2).	Kemp 1982 (plants observed)
8265	point	points circling radio facility (B-2).	Kemp 1982 (plants observed)
8266	point	points circling radio facility (B-2).	Kemp 1982 (plants observed)
8350	polygon	Summit ridge of Stacker Butte, near the west end, west of the road down on the north side (B-6).	Kemp 1981 (~ 200 plants); Arnett 1March2010.
8353	polygon	Ridge immediately east of Stacker Butte. This feature includes Natural Area monitoring site #4 (B-3, B-4, B-7).	Kemp 1982 (plants observed); Nelson & Blackburn 1985 (scattered individuals observed); Wilderman 2010 (plants observed in two monitoring plots, numbers down from previous years); Arnett 2010 (assisting with monitoring, 2011, 2012.
8354	polygon	Ridge immediately east of Stacker Butte (B-3).	Kemp 1982 (plants observed); Nelson & Blackburn 1985 (scattered individuals observed).
8648	polygon	Summit ridge of Stacker Butte, western-most polygon of RATR (B-6).	Hitchcock 1938 (collection #3307); Kemp 1981 (~ 200 plants).
14146	polygon	West of oaks along 8-mile creek above the road up to Stacker Butte (B-1).	Taylor and Lenon 2003 (est. 30-50 flowering plants).
15882	point	Along 8-mile creek, above road up to Stacker Butte (B-1).	Beck and Arnett 2003 (35 plants, past flowering).
15883	point	Along creek just west of 8-mile Creek, above road up to Stacker Butte (B-1).	Beck and Arnett 2003 (est. 50 plants, past flowering).
15884	point	Beyond 8-mile creek, above road up to Stacker Butte (B-1).	Taylor, Lenon, and Lenon 2002 (flowering plants observed).
15885	point	Beyond 8-mile creek, above road up to Stacker Butte (B-1).	Taylor, Lenon, and Lenon 2002 (flowering plants observed).
15886	point	Along 8-mile creek, just above road up to Stacker Butte (B-1).	Doan and Doan 2004 (flowering plants observed); Wilderman 2010 (monitoring in Natural Areas monitoring site #4, numbers down from previous years.
19121	point	West end of Stacker Butte along road down the north side (B-6).	Pls observed, WNAP, 15April2010. May include a monitoring plot.
19122	point	North side of Stacker Butte, near the road down (B-7).	Pls observed, WNAP, 19April2010. May include a monitoring plot.

Source feature ID	Feature type	Location, identifier	Notes or dates of observations
19123	point	North side of Stacker Butte, near the road down (B-7).	6 pls., WNAP, 16March2010
19124	point	North side of Stacker Butte, near the road down (B-7).	2 pls., WNAP, 16March2010
19125	point	North side of Stacker Butte, near the road down (B-7).	1 pls., WNAP, 16March2010
19126	point	North side of Stacker Butte, east of the road down (B-7).	2 pls., WNAP, 16March2010
19127	point	North side of Stacker Butte, east of the road down (B-7).	1 pl., WNAP, 16March2010
19128	point	South side of Stacker Butte below the ridge (B-5).	27 pls., WNAP, 17March2010
19129	point	South side of Stacker Butte below the ridge (B-5).	1 pl., WNAP, 17March2010
19130	point	South side of Stacker Butte below the ridge (B-5).	9 pls., WNAP, 17March2010
19131	point	South side of Stacker Butte below the ridge (B-5).	1 pl., WNAP, 17March2010
19132	point	South side of Stacker Butte below the ridge (B-5).	30 pls., WNAP, 17March2010
19133	point	South side of Stacker Butte below the ridge (B-5).	14 pls., WNAP, 17March2010
19134	point	South side of Stacker Butte below the ridge (B-5).	17 pls., WNAP, 17March2010
19135	point	South side of Stacker Butte below the ridge (B-5).	74 pls., WNAP, 17March2010
19136	point	South side of Stacker Butte below the ridge (B-5).	150 pls., WNAP, 17March2010
19137	point	South side of Stacker Butte below the ridge (B-5).	300 pls., WNAP, 17March2010
19138	point	South side of Stacker Butte below the ridge (B-5).	400 pls., WNAP, 17March2010
19139	point	South side of Stacker Butte below the ridge (B-5).	300 pls., WNAP, 17March2010

Source feature ID	Feature type	Location, identifier	Notes or dates of observations
19140	polygon	South side of Stacker Butte below the ridge (B-5).	500+ pls., WNAP, 17March2010
19141	polygon	South side of Stacker Butte below the ridge (B-5).	200 pls., WNAP, 17March2010
19142	polygon	South side of Stacker Butte below the ridge (B-5).	300 pls., WNAP, 17March2010
19143	polygon	South side of Stacker Butte below the ridge (B-5).	300 pls., WNAP, 17March2010
19144	polygon	South side of Stacker Butte below the ridge (B-4).	Natural Areas Program; assume to have been delineated in 2005.
19145	polygon	South side of Stacker Butte, small polygon spanning the road up (B-4).	Natural Areas Program; assume to have been delineated in 2005.
19146	polygon	Near 8-Mile Creek (B-1).	Natural Areas Program; assume to have been delineated in 2005.
19147	polygon	East on Stacker Butte ridge (B-3).	Natural Areas Program; assume to have been delineated in 2005.
19148	polygon	East on Stacker Butte ridge (B-3).	Natural Areas Program; assume to have been delineated in 2005.
19149	polygon	East on Stacker Butte ridge (B-3).	Natural Areas Program; assume to have been delineated in 2005.
19150	polygon	Saddle of ridge above Oak Spring (B-4, B-7).	Natural Areas Program; assume to have been delineated in 2005.
19151	polygon	North slope of Stacker Butte, east of the road (B-7).	Natural Areas Program; assume to have been delineated in 2005.
19152	point	North slope of Stacker Butte, west of the road (B-7).	300 pls., WNAP, 16March2010
19153	point	North slope of Stacker Butte, east of the road (B-7).	6 pls., WNAP, 16March2010
19154	point	North slope of Stacker Butte, west of the road (B-7).	23 pls., WNAP, 16March2010
19155	point	North slope of Stacker Butte, west of the road (B-7).	8 pls., WNAP, 16March2010
19156	point	North slope of Stacker Butte, west of the road (B-7).	14 pls., WNAP, 16March2010
19157	point	North slope of Stacker Butte, along the road (B-7).	Natural Areas Program; assume to have been delineated in 2010.

Source feature ID	Feature type	Location, identifier	Notes or dates of observations
19158	point	North slope of Stacker Butte, west of the road (B-7).	Natural Areas Program; assume to have been delineated in 2010.
19159	polygon	Oak stand on north slope of Stacker Butte (B-4, B-7).	285 pls., WNAP, 16March2010
19160	polygon	North slope of Stacker Butte (B-7).	128 pls., WNAP, 16March2010
19161	polygon	North slope of Stacker Butte (B-7).	234 pls., WNAP, 16March2010
19162	polygon	North slope of Stacker Butte (B-7).	299 pls., WNAP, 16March2010
19163	polygon	North slope of Stacker Butte (B-7).	100+ (300) pls., WNAP, 16March2010
19164	point	North slope of Stacker Butte (B-7).	163 pls., WNAP, 16March2010
19165	point	North slope of Stacker Butte (B-7).	12 pls., WNAP, 16March2010
19166	polygon	Stacker Butte, near the middle of the ridge (B-4, B-5).	
Margerum Ranch property and adjacent area, EO ID 8181			
17192	polygon	Extensive population on broad shelf under oak forest (B-10).	Arnett and Cornelius 2010, Arnett 2011. Collections Arnett 2010-1, 2011-2
17193	polygon	Open area on steep slope near top (B-10).	Arnett and Cornelius 2010
19116	point	Arnett point A (B-10).	Arnett 2011
19117	polygon	Polygon including Arnett points B, C, and D (B-10).	Arnett 2011
19118	point	Arnett point E (B-10).	Arnett 2011
19119	point	Arnett point F (B-10).	Arnett 2011
Klickitat Springs area, EO ID 8664			
19109	point	Near bottom of the slope (B-11).	P. Slichter, S&L Enz, 18March2011, 17 pls.
19110	polygon	Large open slope (B-11).	P. Slichter, S&L Enz, 18March2011, 90 pls.
19111	polygon	Along the edge of the woods (B-11).	P. Slichter, S&L Enz, 18March2011, 268 pls.
19112	point	Point near the lip of large open slope (B-11).	P. Slichter, S&L Enz, 18March2011, 4 pls., 2 locations.
19113	point	Upper part of large open slope (B-11).	P. Slichter, S&L Enz, 18March2011, 3 pls., 2 locations

Canyon Creek area, EO ID 8218			
Source feature ID	**Feature type**	**Location, identifier**	**Notes or dates of observations**
17322	point	Along base of cliffs to the east of the creek (B-12).	Considered as *R. glaberrimus* with somewhat divided leaves.
17323	point	Along base of cliffs to the east of the creek (B-12).	Triternate leaves with very broad lobing, possibly best considered to be a variety of *R. triternatus*.
17324	point	Along base of cliffs to the east of the creek (B-12).	Triternate leaves with very broad lobing, possibly best considered to be a variety of *R. triternatus*.
17325	point	Along base of cliffs to the east of the creek (B-12).	Collections Arnett 2010-5, Wright 2241, 2242, Slichter s.n. Triternate leaves with very broad lobing, possibly best considered to be a variety of *R. triternatus.*
17326	point	Along base of cliffs to the east of the creek (B-12).	Triternate leaves with very broad lobing, possibly best considered to be a variety of *R. triternatus*.
17327	point	Along base of cliffs to the east of the creek (B-12).	Triternate leaves with very broad lobing, possibly best considered to be a variety of *R. triternatus*.
17328	point	Along base of cliffs to the east of the creek (B-12).	Triternate leaves with very broad lobing, possibly best considered to be a variety of *R. triternatus*.

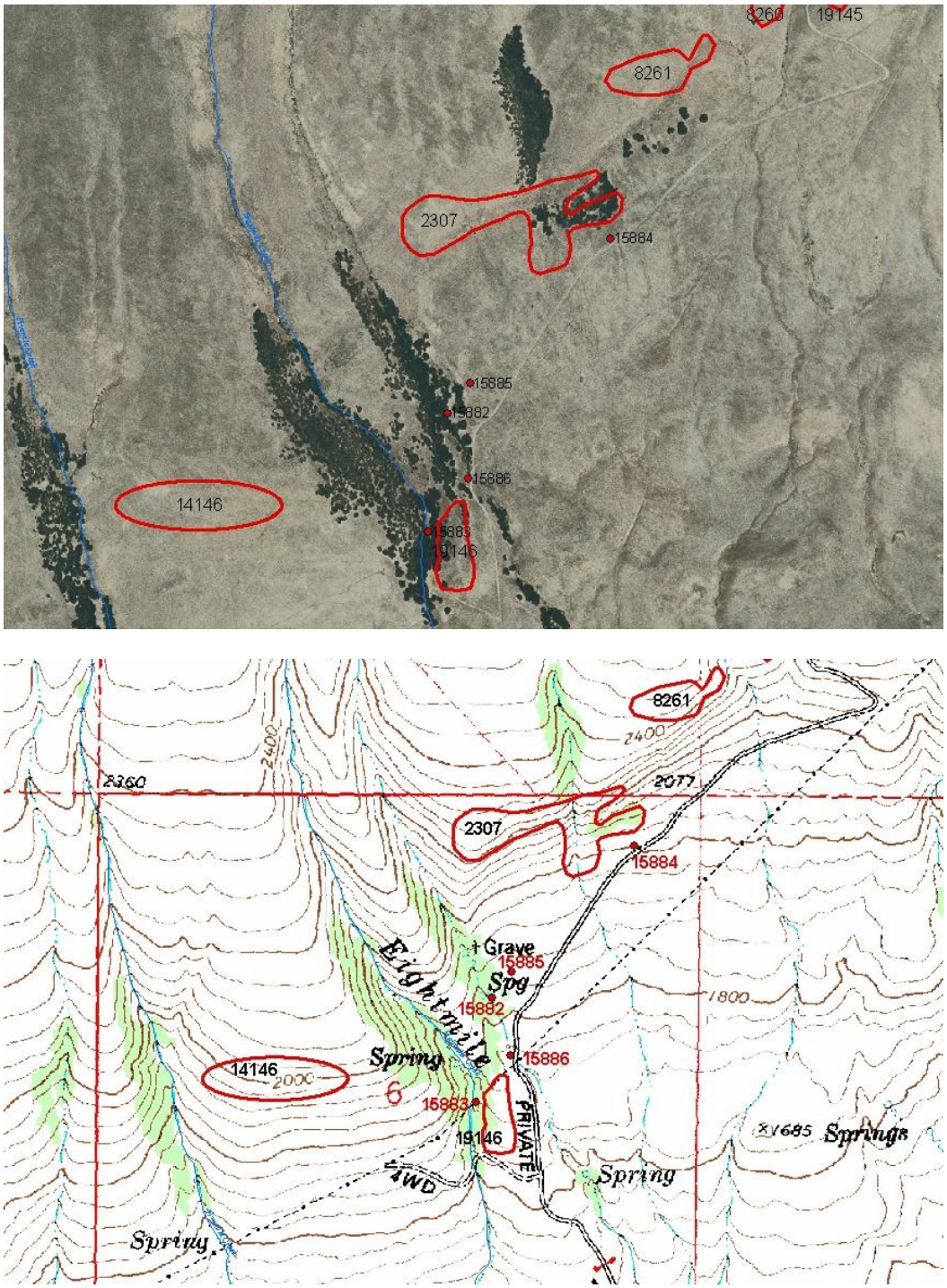

Figure B-1. *Ranunculus triternatus* source features in the vicinity of Eightmile Creek on Stacker Butte.

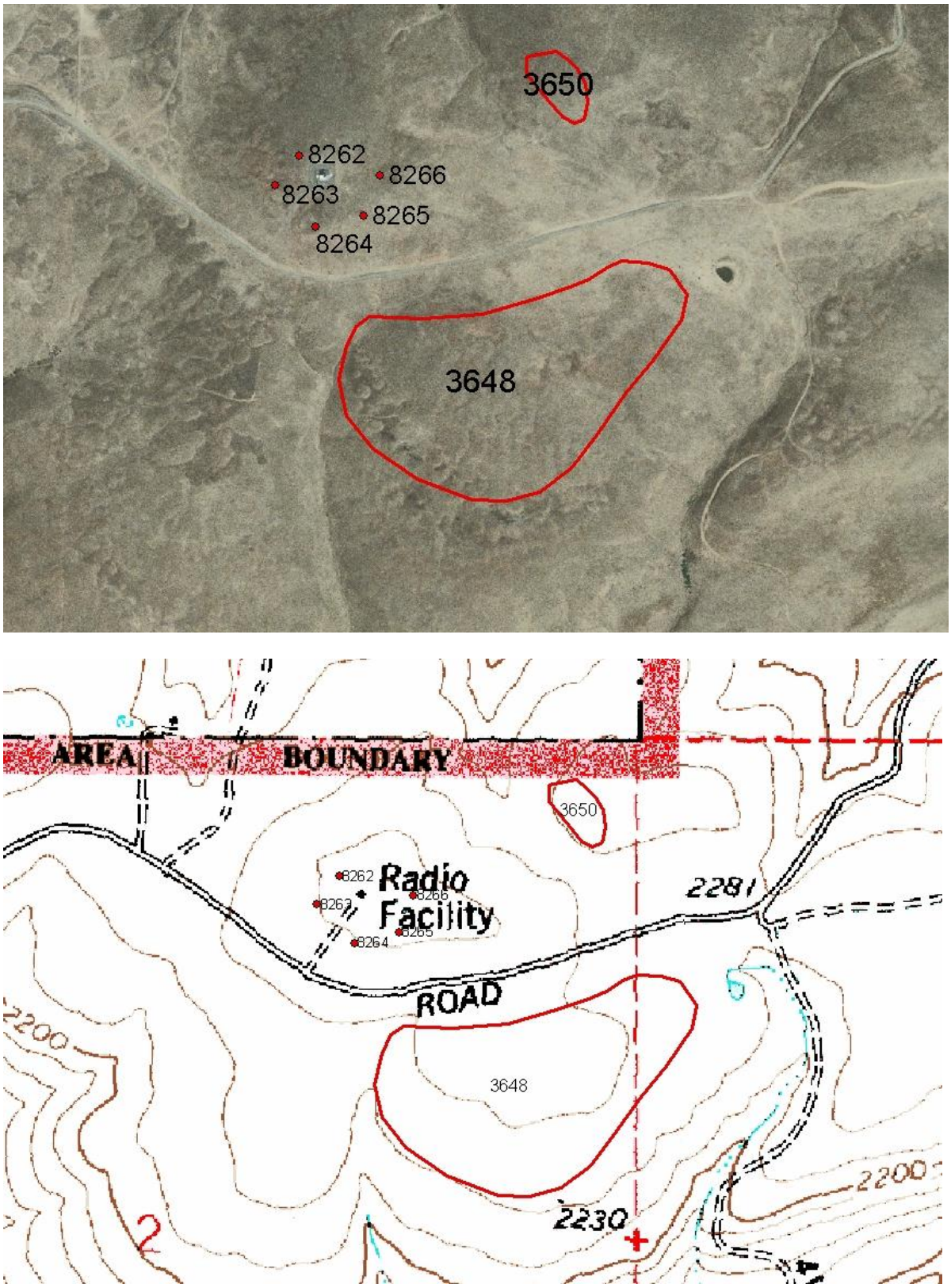

Figure B-2. *Ranunculus triternatus* source features at the far east end of Stacker Butte.

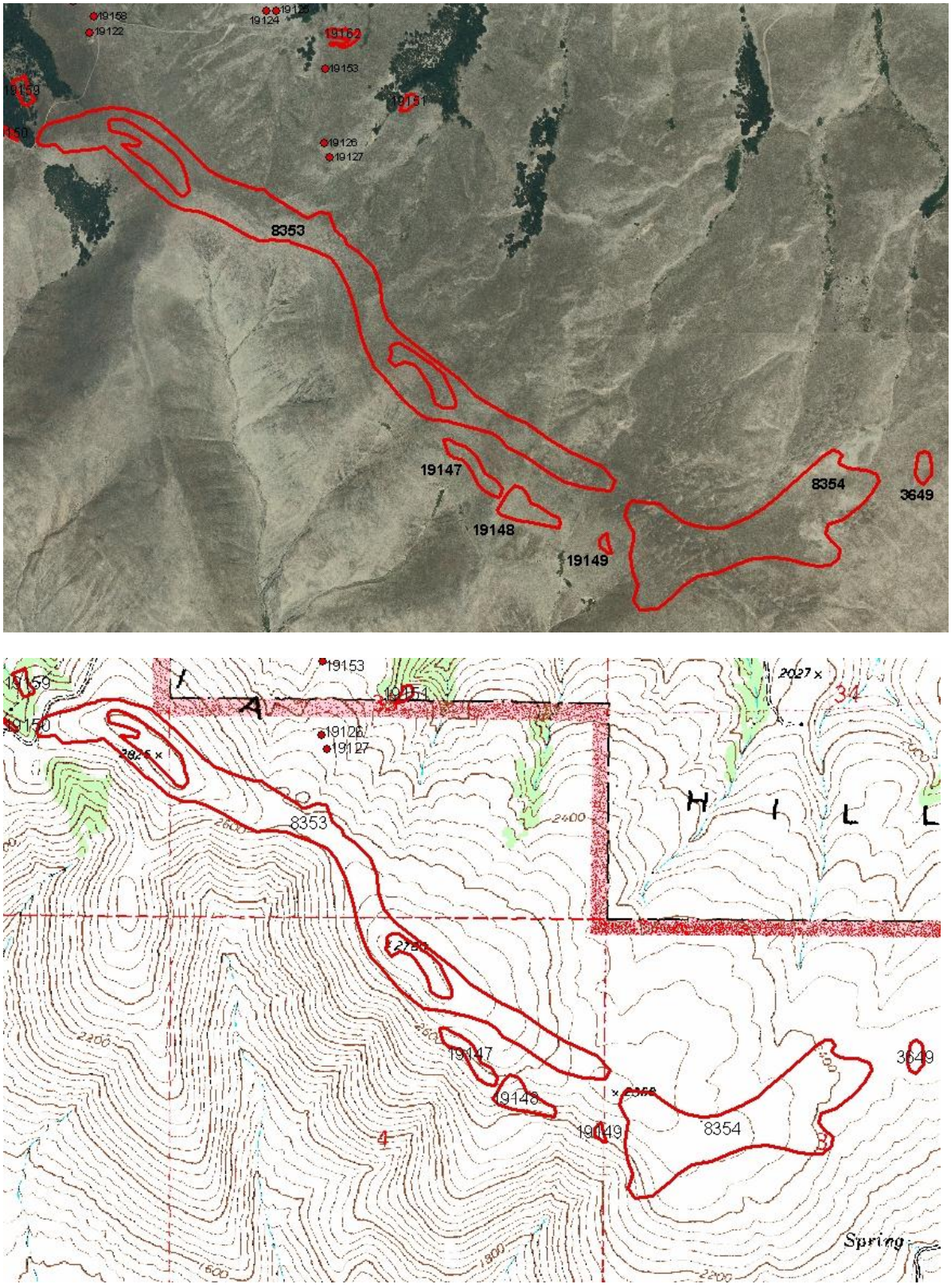

Figure B-3. *Ranunculus triternatus* source features toward the eastern end of the ridge of Stacker Butte.

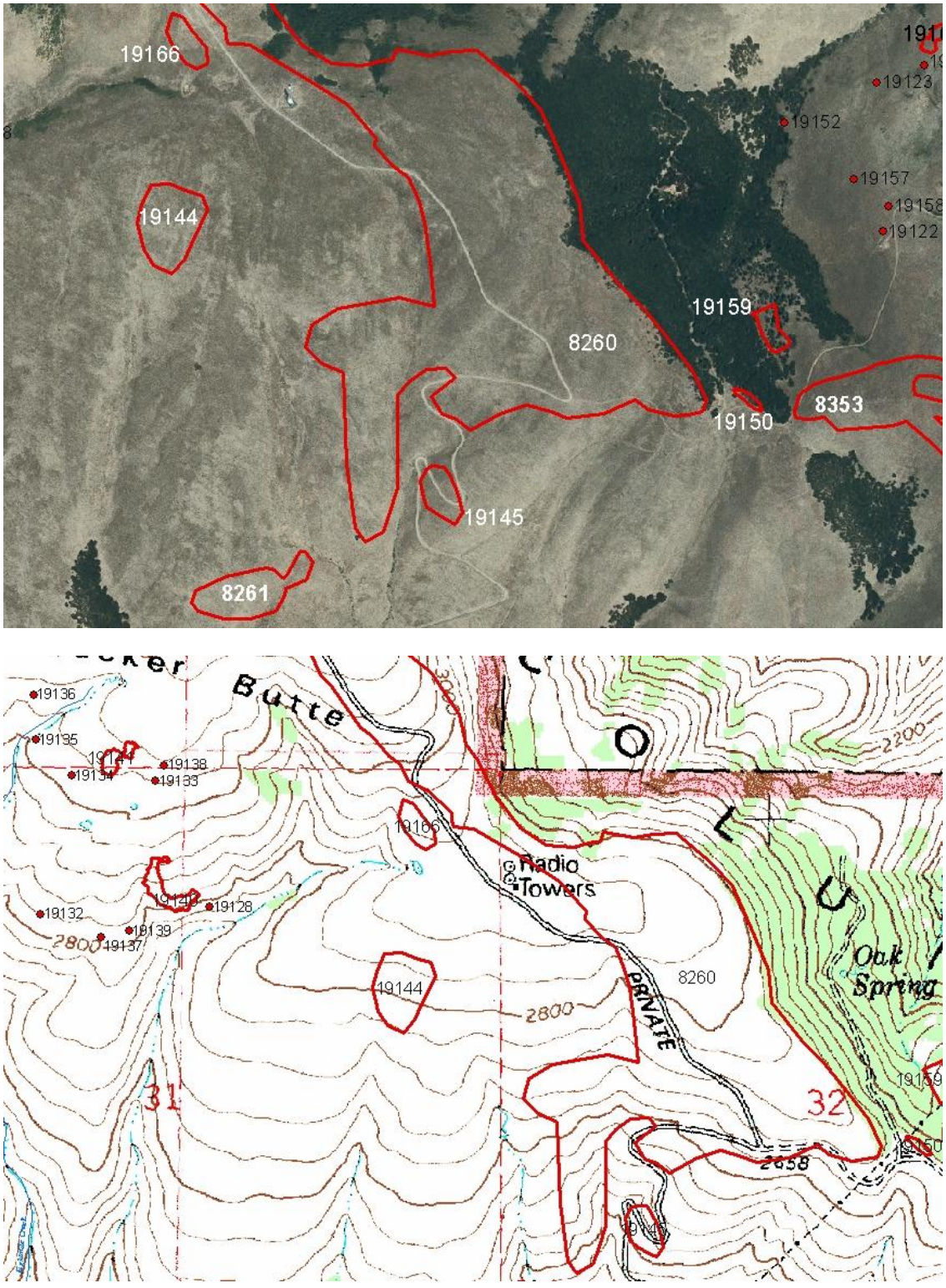

Figure B-4. *Ranunculus triternatus* source features on Stacker Butte near Oak Spring.

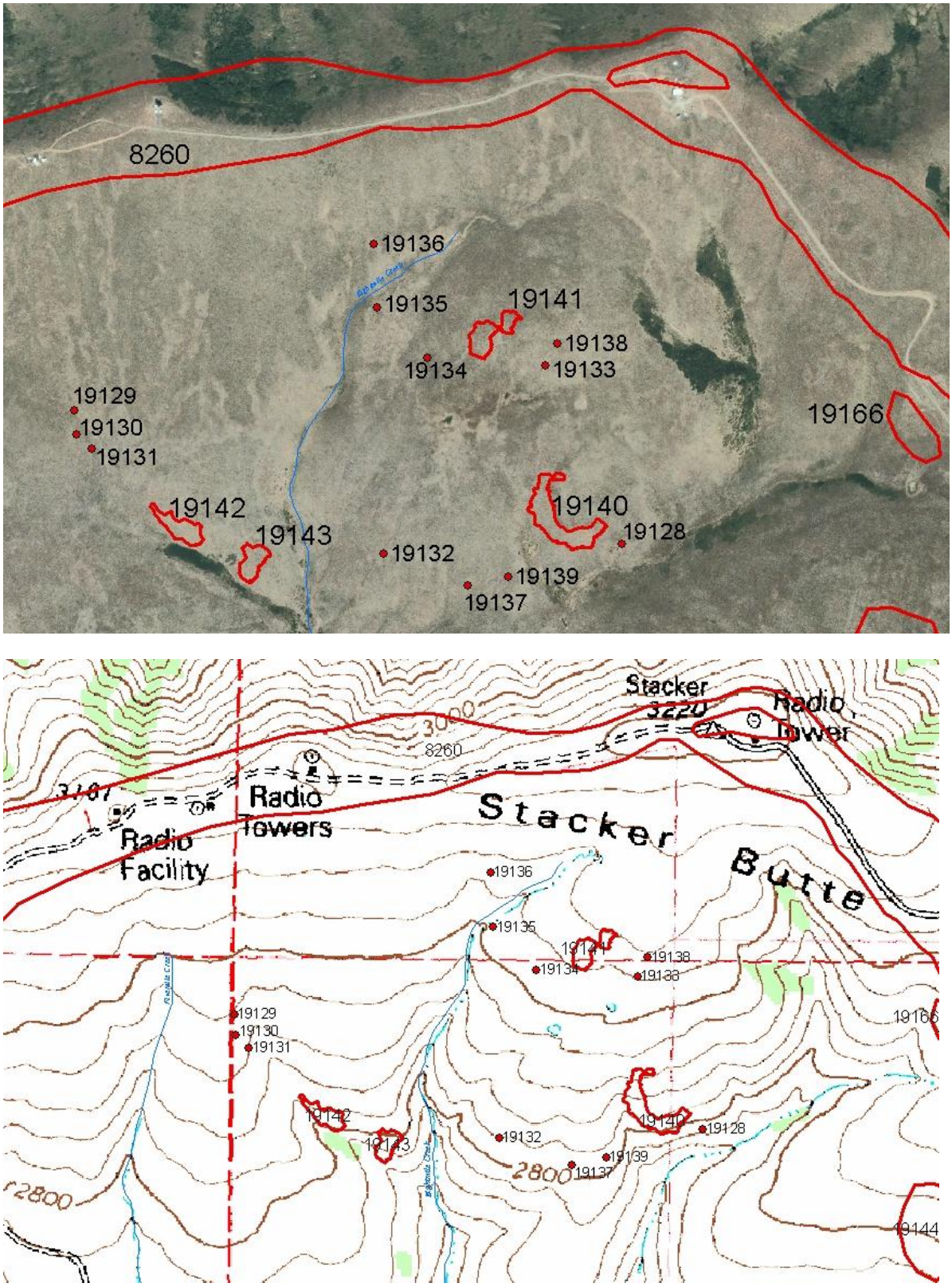

Figure B-5. *Ranunculus triternatus* source features around the summit and on the south face of the upper part of Stacker Butte.

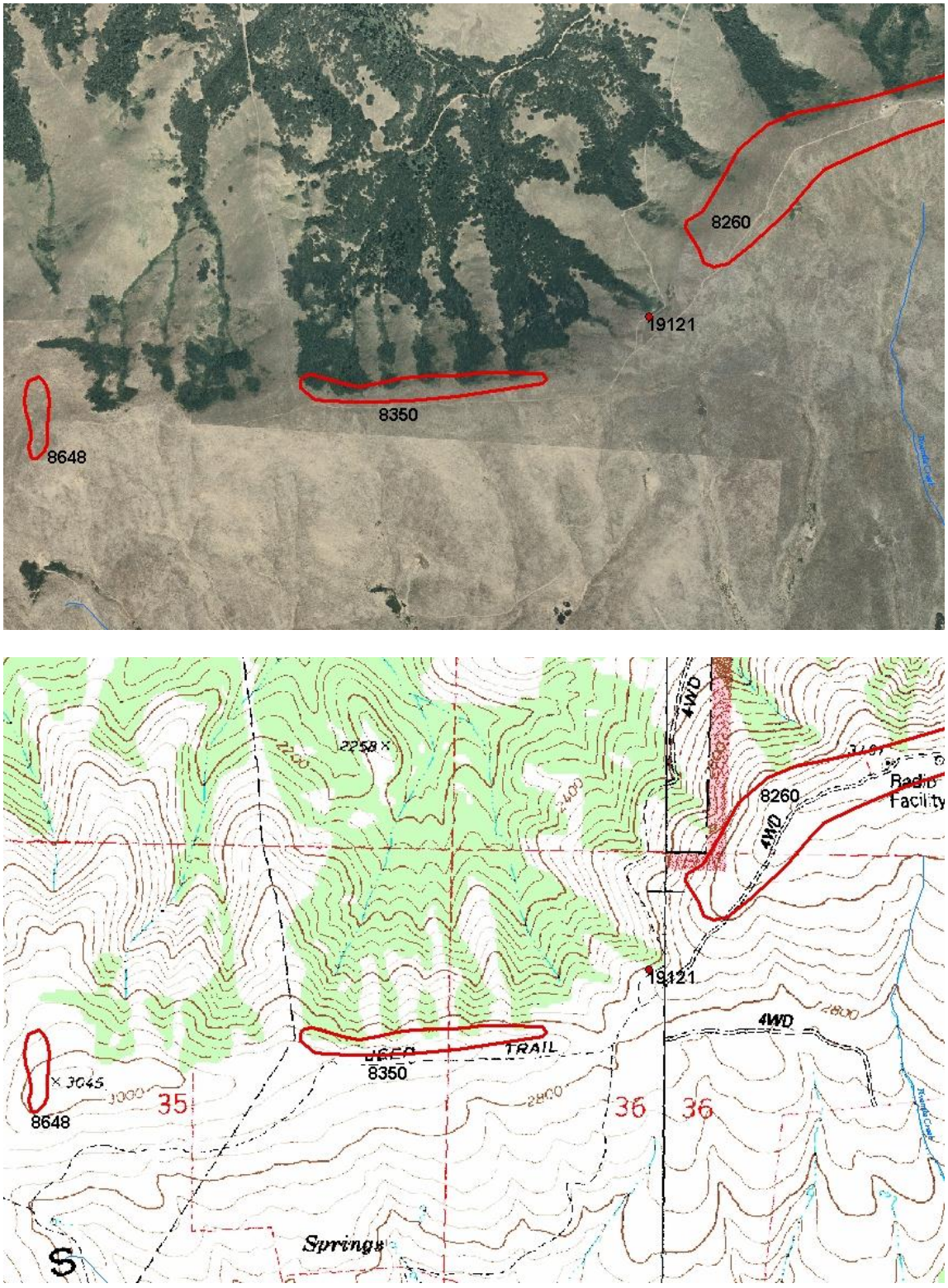

Figure B-6. *Ranunculus triternatus* source features on the west end of Stacker Butte.

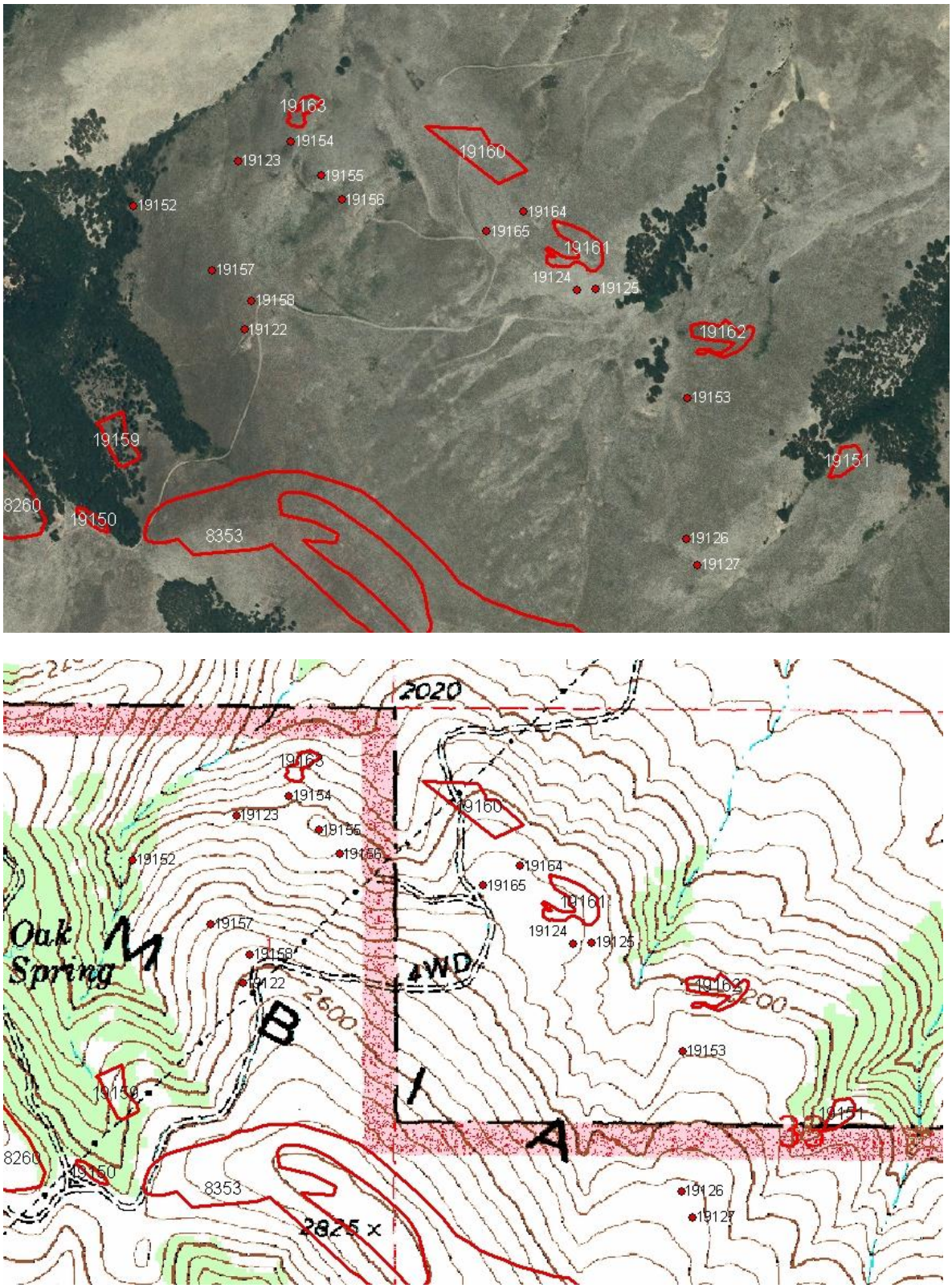

Figure B-7. *Ranunculus triternatus* source features on the north side of Stacker Butte

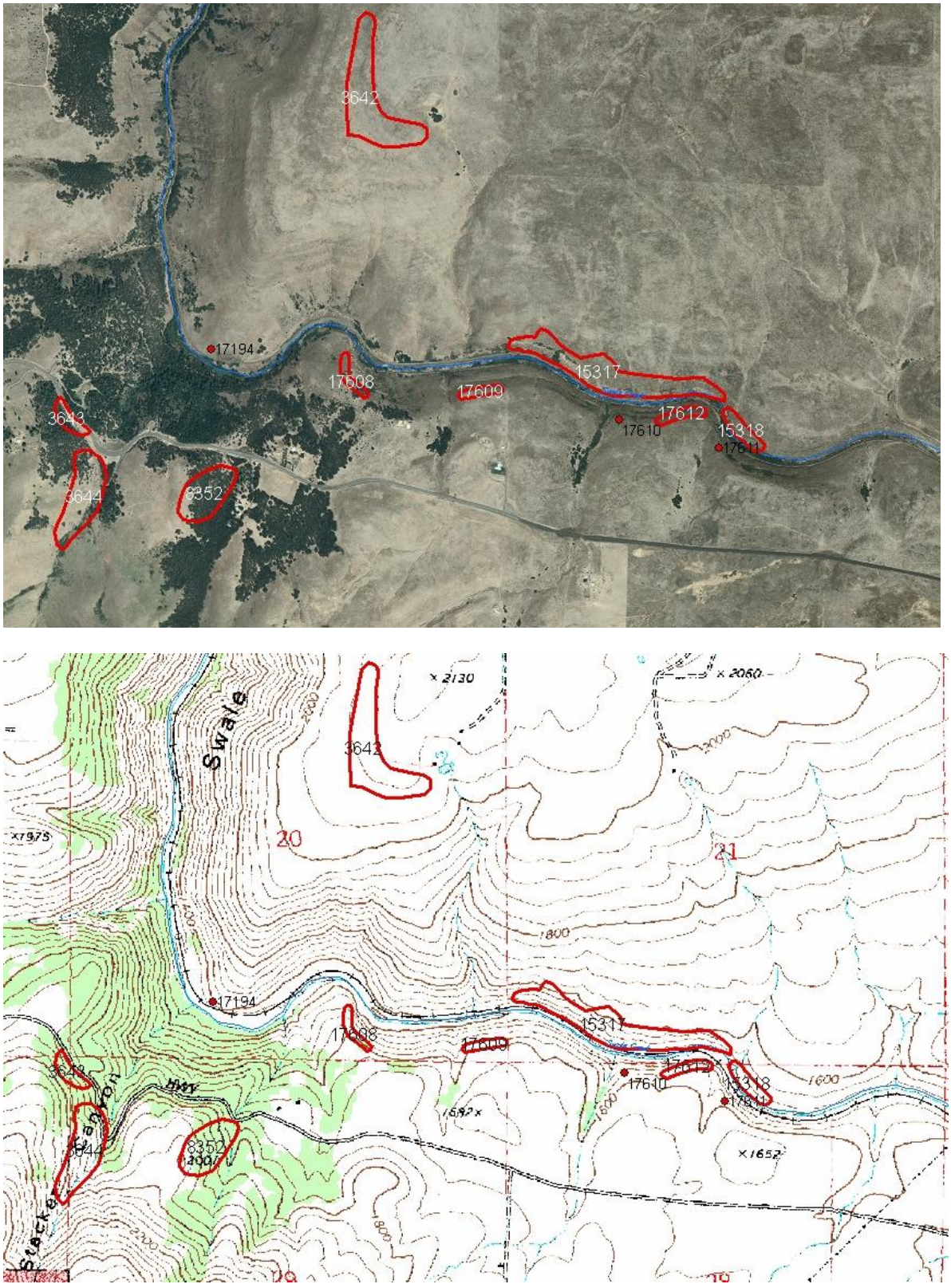

Figure B-8. *Ranunculus triternatus* source features in upper Swale Canyon and near the Centerville Road.

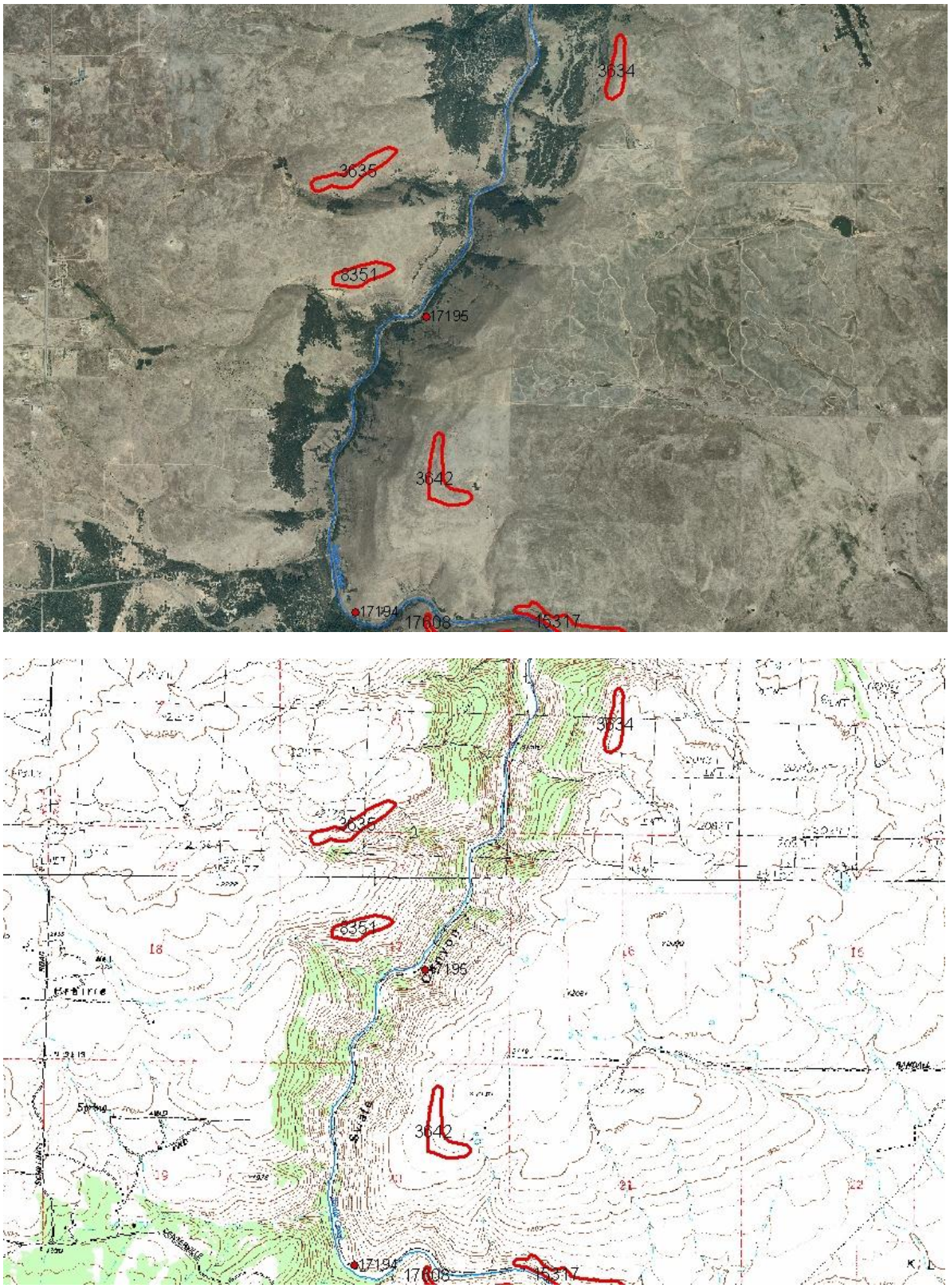

Figure B-9. *Ranunculus triternatus* source features in lower Swale Canyon.

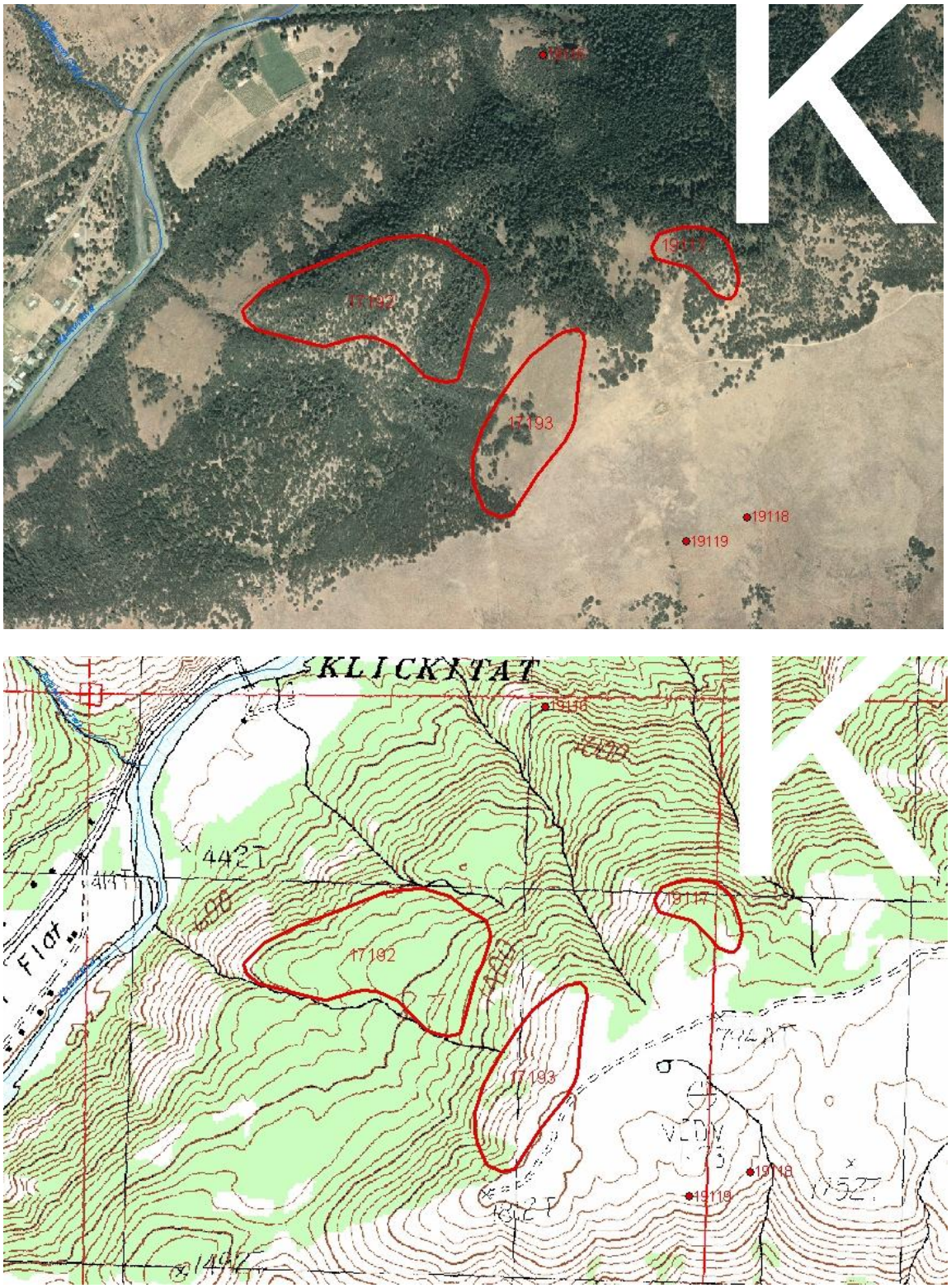

Figure B-10. *Ranunculus triternatus* source features near Margerum Ranch.

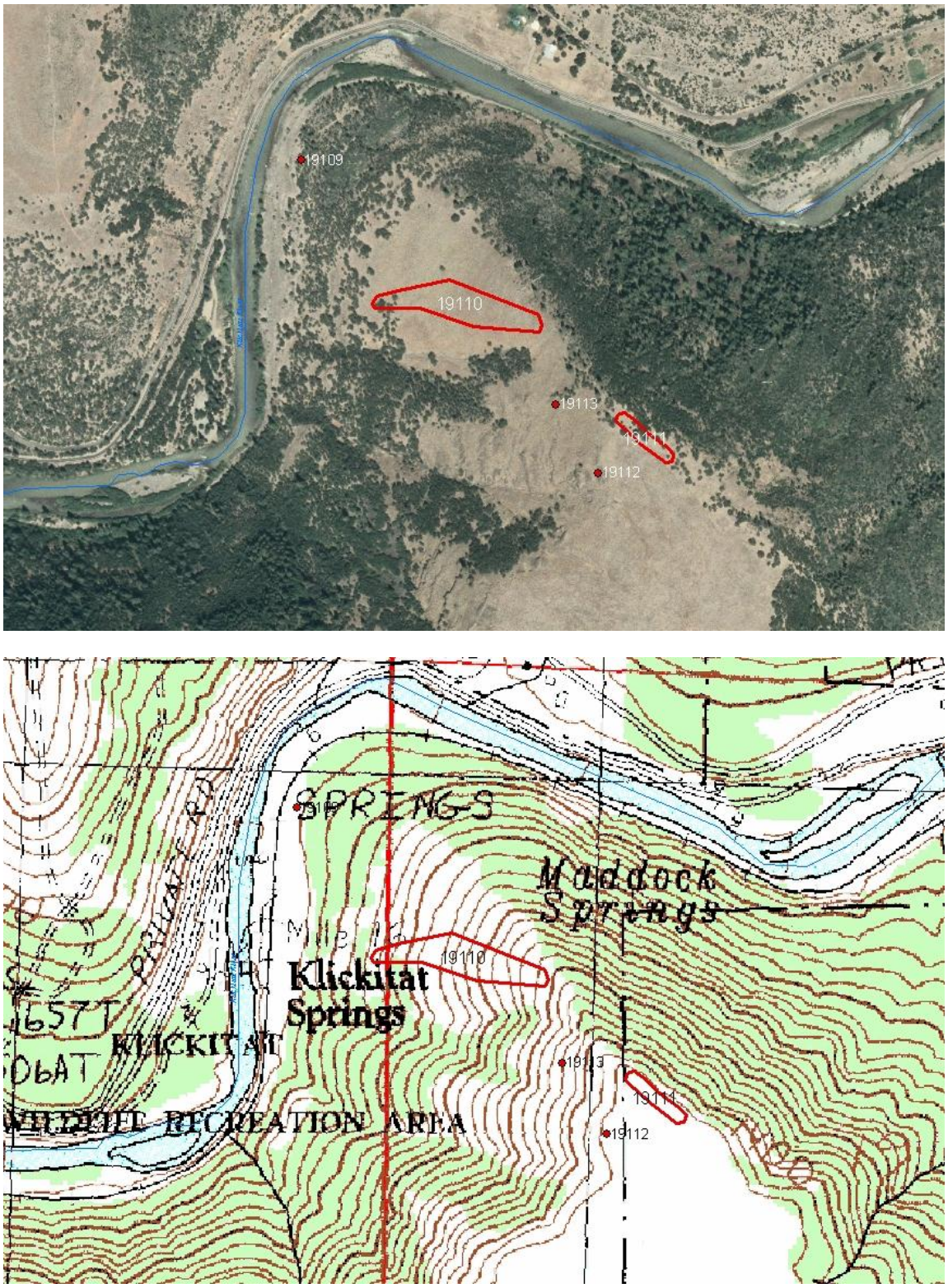

Figure B-11. *Ranunculus triternatus* source features near Klickitat Springs.

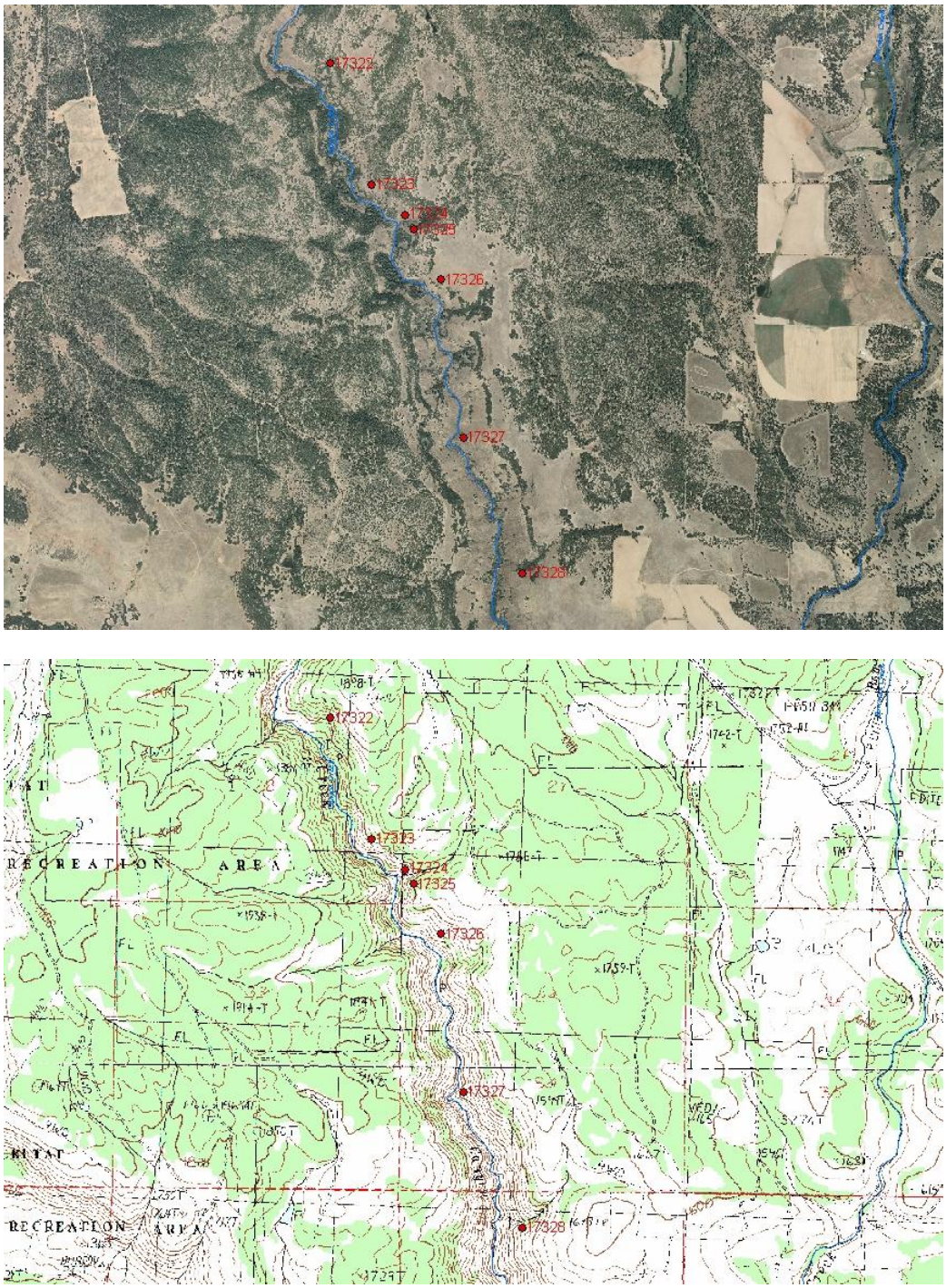

Figure B-12. *Ranunculus* source features at Canyon Creek. Currently kept in the WNHP database as R. triternatus, the leaves on these plants are outside of the characteristics of the published description.

Appendix C

Ecological Monitoring Report

Obscure buttercup (*Ranunculus triternatus*)

Columbia Hills NAP/Columbia Hills State Park

David Wilderman, DNR Natural Areas Ecologist

December 16, 2012

ECOLOGICAL MONITORING REPORT

Natural Feature/Element: Obscure buttercup (*Ranunculus triternatus*)

Site: Columbia Hills NAP/Columbia Hills State Park

Prepared by: David Wilderman, DNR Natural Areas Ecologist **Date:** 12/16/12

1.0 Background

Within the Pacific Northwest, obscure buttercup is known only from the eastern end of the Columbia River Gorge, primarily along a small stretch of the Columbia Hills in Washington. It is classified as Endangered in Washington and is a federal Species of Concern. The vast majority of its range is a band approximately ½ mile wide and 7 ½ miles long in the Columbia Hills, extending east from the western end of the Columbia Hills NAP. One other occurrence is known from north of the NAP, and there are two small populations across the Columbia River in Oregon. The concentration of plants contained within the Columbia Hills NAP and Columbia Hills State Park is estimated to include 75% of the known individuals of the species in the Pacific Northwest, and is by far the largest occurrence of the plants within a designated protected area.

The goal of this monitoring is to provide a quantitative estimate of the overall population status and trends on the NAP and State Park. Other monitoring techniques that have been used on the NAP, including demographic monitoring and GPS-located presence/absence plots scattered throughout the area, have provided useful information but were either not designed to address site-wide population status or were too labor-intensive to be continued long-term. The design developed here, while focused on a small number of locations, is intended to provide quantitative data that are efficient to collect, can be collected primarily by volunteers, and represent the major habitat types in which the species is found within the NAP/State Park landscape. In addition to this, subpopulations throughout the NAP and State Park are mapped periodically, providing more qualitative observations from the across the entire area. The combination of these two methods should provide a useful assessment of the overall population status.

2.0 Design and Monitoring Locations

In 2003, macroplots were established at three sites (Sites #1-3) were established for collection of nested frequency data. The nested frequency methodology was chosen because it is relatively fast and simple, easy to learn, and data consistency between observers is high. These attributes make it suitable for volunteers to collect data and allow multiple areas to be sampled in a short amount of time. In 2004, macroplots were established at two additional sites (Sites #4-5).

While the NAP and State Park support a large number of plants distributed over a large area, it was only practical to monitor a small number of subjectively-chosen locations. In order to maximize the usefulness of the data and efficiency of data collection, the following criteria were used in selecting monitoring locations: a) sites must contain dense enough concentrations of the plant for data collection to be feasible; b) the sites should include

representation of a significant amount of the habitat variation in the area; c) the sites should be as well-distributed through the NAP and State Park as possible; and d) the sites must be readily accessible for volunteers. Locations selected included the following:

Site 1) A relatively dense subpopulation immediately east of Exclosure #2, at the sharp bend in the main gravel road. This is a relatively dense subpopulation occurring in typical grassland habitat on the upper south-facing slope of the main ridge.

Site 2) The subpopulation in Macroplot 2616, previously used for demographic monitoring. This is a dense subpopulation located in typical grassland habitat on a east-northeast facing, steep slope near the top of the main ridge.

Site 3) A subpopulation just south of where the main gravel road crosses Eight Mile Creek, on State Parks. This subpopulation is somewhat low-density but is significantly lower in elevation than other known subpopulations on the south-facing side of the Columbia Hills ridge. It also has some plants growing under an open oak overstory.

Site 4) A subpopulation in the saddle approximately 1 mile east of the Oak Spring road (follow old road tracks up the ridge east of Oak spring road and then down into the saddle)

Site 5) The subpopulation in and around Exclosure #3 (Macroplot 2615 for demographic monitoring), southwest of the first communication tower along the gravel road.

3.0 Methods

3.1 Sampling Design

The monitoring objectives were to estimate the percent frequency of obscure buttercup in each macroplot, with a 90% chance of detecting a minimum 20% change between years. It was estimated that a minimum sample size of 100 frequency quadrats would be necessary to meet these objectives. Because no estimates of frequency were available to help determine the appropriate quadrat size, a nested quadrat frame was used for the first two rounds of data collection for each macroplot (2003-2005) consisting of three sizes: 1m x 1m; 1m x 2m; and 2m x 2m. Quadrats were placed along transects within each macroplot. Transect and quadrat spacing were determined by dividing the total macroplot area by 100, resulting in an average area per quadrat. Therefore, transect and quadrat spacing differed for each macroplot, depending on the total area of the macroplot. Beginning in 2006, only the 2m x 2m frame was used based on results from the first round of data collection at all five macroplots.

3.2 Macroplot Design

Each macroplot was designed to encompass at least 90% of the subpopulation found at the sampling location. As a result the size and shape of each macroplot varied somewhat. For each macroplot, a baseline was established along one side of the macroplot and marked with rebar. Transects were then run perpendicularly to this baseline. Following are descriptions of the macroplots established at each location:

Site 1) 115m baseline running 10° mag. N. Starts just above the lower bend of road and ends approximately 35m above the upper bend in the road. The baseline runs more or less parallel to the east side of Exclosure #2 and is about 15m east of the Exclosure. Baseline marked with 3' rebar at 0m, 40m, 80m, and 115m. Transects run 100° mag. N for varying lengths. Between 0m-30m (approx.) transects are ca. 88m (to road). From 30m-40m, transects are ca. 110m (cross road and go to end of habitat). From 40m-115m, transects are ca. 120m (go to rock line = edge of habitat). Total area of macroplot approx. 12,500 m^2. Transect spacing 11m, quadrat spacing 10m.

Site 2) Rectangular macroplot 75m x 50m. Baseline is existing 2616 baseline, 60m long at 335° mag. N. Transects run 50m at 245° mag. N. Transect spacing 7m, quadrat spacing 5m.

Site 3) Rectangular macroplot 100m x 52m. Baseline on west side, running 100m at 175° mag. N. Transects run 52m at 265° mag. N. Transect spacing 10m. Quadrat spacing 5m. Total area 5200 m^2.

Site 4) Macroplot is roughly rectangular but has transects of varying lengths. The baseline is on the south side of the saddle, running 110m at 120° mag. N. Transects run at 30° mag. N and vary in length from 35m at the east end to 112m at the west end, depending on the extent of suitable habitat. Suitable habitat is generally defined by the sharp slope break running along the north side of the saddle, although in places this is less obvious than others. Look for presence of plants 5-10m beyond the actual lip to determine the extent of suitable habitat. Transect spacing 10m. Quadrat spacing 9m.

Site 5) 145m baseline runs 0° mag. N, parallel to west edge of Exclosure #3 and about 5m west of it. Baseline extends ca. 20m above and 40m below the Exclosure. Transects run 90° mag. N for 100m, all the same length. Transect length determine by edge of subpopulation. Total area of macroplot 9425 m^2. Transect spacing 12m, quadrat spacing 12m.

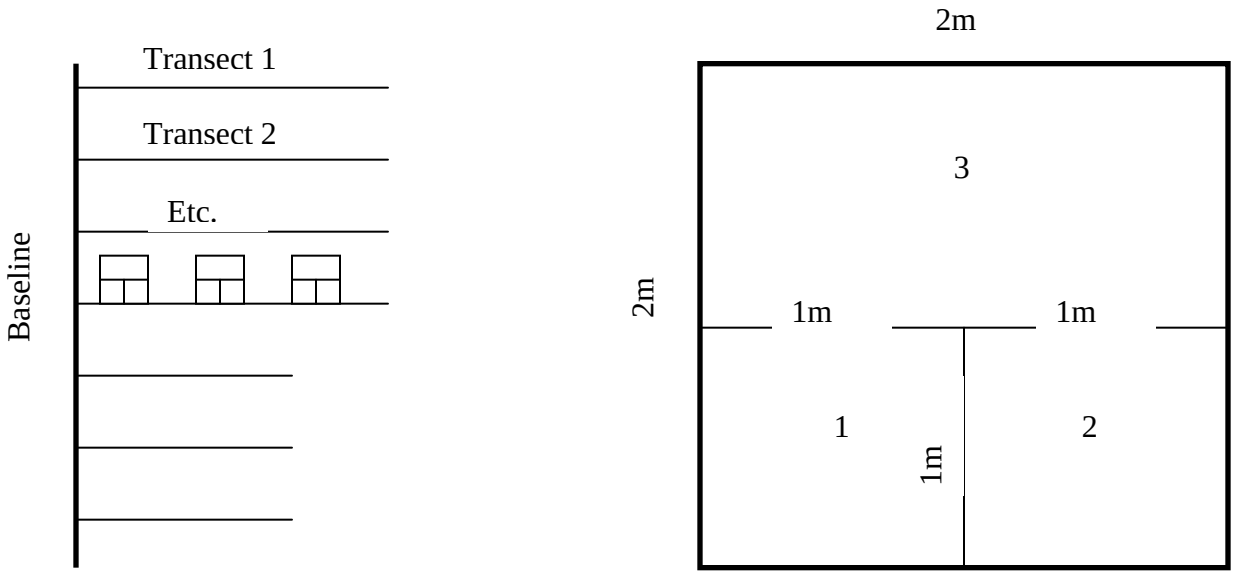

Figure 1. Example of macroplot layout (left) and nested quadrat design (right).

For each macroplot, a random starting point was generated for transects, after which the appropriate transect spacing was used. Random starting points were also generated for the quadrat locations on each transect, followed by the appropriate quadrat spacing.

3.3 Data Collection

Data were collected between 2003 and 2012 for each macroplot, as follows:

Site	2003	2004	2005	2006	2010	2011	2012
1	X		X		X		X
2	X		X		X		X
3	X		X		X		X
4		X		X		X	
5		X		X		X	

Table 1. Data collection years for each macroplot.

In 2003, 2004 and 2005, each nested quadrat was thoroughly searched for obscure buttercup individuals, vegetative or reproductive, beginning with the 1m x 1m frame. If any plants were found rooted within this frame, a '1' was recorded for that quadrat. If

no plants were found, the second 1m x 1m frame was searched and a '2' recorded if the species was present. If no plants were found in this frame, the remainder of the quadrat was searched and a '3' recorded if the species was present. If no plants were found anywhere in the quadrat, a '0' was recorded. Plants rooted immediately under the frame edge, i.e. "on the line", were recorded as "in".

Beginning in 2006 when only the 2m x 2m quadrat was used, the same methodology was followed for this single quadrat size.

Figure 2. Volunteers and staff collecting data from a 2mx2m quadrat.

4.0 Results

Each of the sites has declined significantly within the 2m x 2m quadrats over the monitoring period (Table 2, Figure 3). Relative to starting frequency values, Site 1 declined by 57%, Site 2 by 39%, Site 3 by 63%, Site 4 by 43%, and Site 5 by 76%. Most of these declines took place between 2006 and 2010, except for Site 2 which declined the most between 2010 and 2012.

Site	2003	2004	2005	2006	2010	2011	2012
1	30% ab		31% a		19% bc		13% c
2	71% a		72% a		61% a		43% b
3	30% a		27% a		5% b		11% b
4		21% ab		23% a		12% b	
5		21% a		21% a		5% b	

Table 2. Percent frequency of *Ranunculus triternatus* within 2mx2m quadrats in each macroplot. Different letters indicate statistically significant differences between values for a given macroplot (Chi-square $p \leq 0.05$).

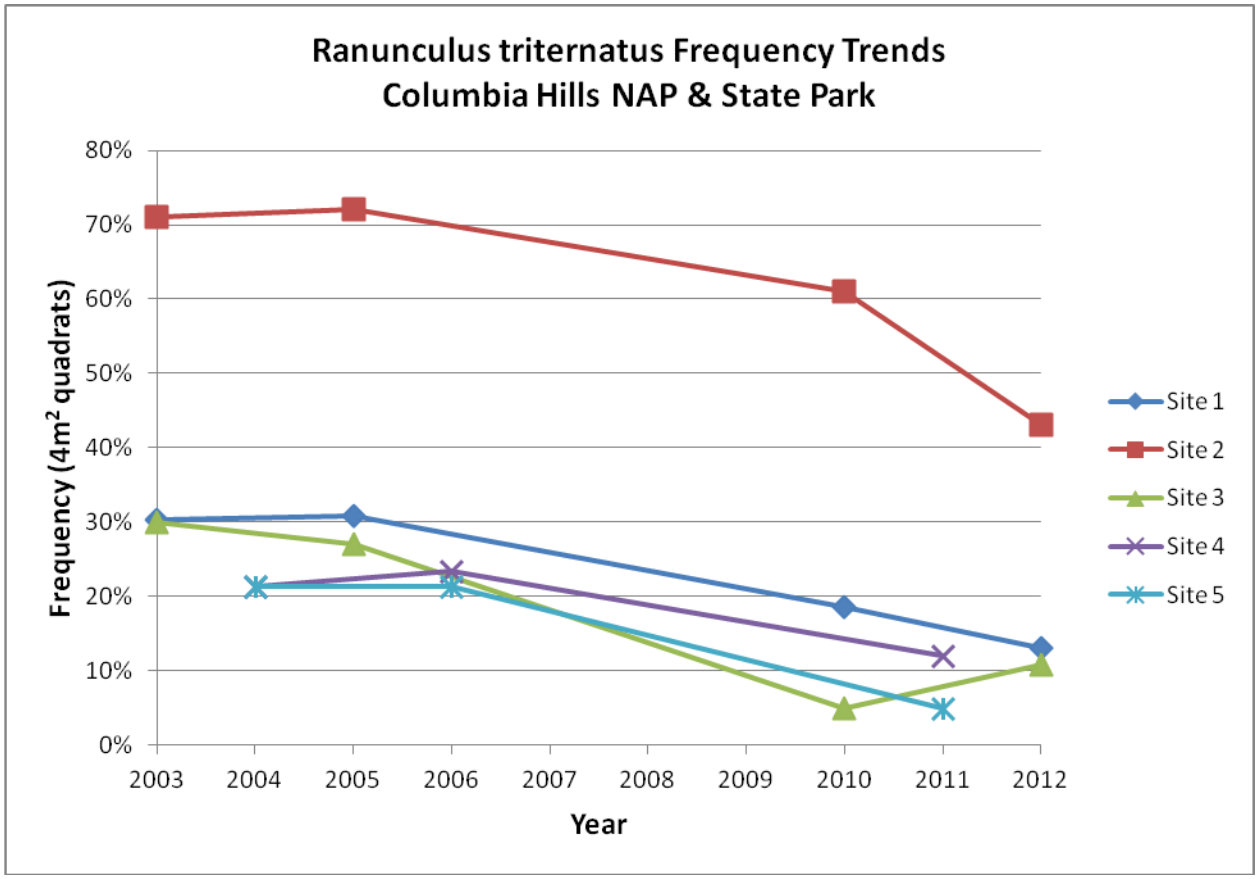

Figure 3. Graph showing frequency data trends over time for each monitoring site.

Appendix D: *Ranunculus* specimens examined at the University of Washington during this study						
Collector	**Collection number**	**Species (original name on the label or subsequent annotation)**	**Date of collection**	**Collection site**	**Date of examination**	**Notes**
Arnett, J.	2010-1	*R. triternatus*	3March2010	Margerum Ranch, Klickitat Canyon	19October2012	Leaf lobes mostly ca. 1 mm, some to 1.5 or even rarely to 2 mm.
Arnett, J.	2010-2	*R.* cf. *glaberrimus*	17March2010	Umtanum Creek	19October2012	More typical *R. glaberrimus* leaves also present
Arnett, J.	2010-3	*R.* cf. *glaberrimus*	17March2010	Umtanum Creek	19October2012	Small ternate basal leaves
Arnett, J.	2010-4	*R.* cf. *glaberrimus*	17March2010	Umtanum Creek	19October2012	Flowers 18 and 25 mm across, petals 10 x 7 mm; basal leaf segments 3-5 mm, some more or less triternate
Arnett, J.	2010-5	*Ranumculus* species	18March2010	Canyon Creek	19October2012	Leaves triternate in some places but some lobes as wide as 5 or 6 mm. Narrowest lobes 2 mm.
Arnett, J.	2011-1	*R. triternatus*	17March 2011	Wheeler Canyon	19October2012	Ternate leaves with lobes to 3 mm wide, large population on the other side of the ridge of typical *R. triternatus* , but these leaves have markedly wider lobes. Beaks on the achenes are more or less straight, some dried and curved.
Arnett, J.	2011-2	*R. triternatus*	17March 2011	Margerum Ranch, Klickitat Canyon	19October2012	Plants growing on an extensive bench forested with oaks. Narrow leaf lobes, ca. 1 mm wide.
Beck, K.	201025	*R. glaberrimus* var. *ellipticus*	8June2010	Buckhorn Mt, Ok Co.	19October2012	Most basal leaves broadly elliptic, not lobed. Stem leaves deeply 3-lobed, middle lobe longest.
Biven	08-05	*R. eschscholtzii* var. *eschscholtzii*	16August2008	Heather Pass	8November2012	Fls to 15 mm across, roots somewhat narrower than *R. triternatus* or *R. glaberrimus* , more abundant, to ca. 1 mm thick
Bliss, L	sn	*R. gelidus*	30June1965	Elk Mt., ONP	15November2012	Basal lvs deeply 3-parted and again lobed, rounded lobes, fls to 9 or 10 mm across, petals to ca. 4 mm long and 3 mm wide, nearly rotund, pedicel glab, roots to 1.2 mm, most 1 mm, calyx and back of petals somewhat pub. Pl around 10 cm

Doss, Diane	06-69	*R. eschscholtzii* var. *eschscholtzii*	18July2006	MRNP	8November2012	Fls to 19 mm across, small plants with small basal leavesand narrow roots
Douglas, G.W.	3162?	*R. gelidus*	20August1971	Crater Mt	15November2012	Basal lvs deeply 3-parted and again lobed, rounded lobes, fls 8 or 9 mm across, petals to ca. 4.5 mm long and 3 mm wide, pedicel sparsely pub, roots slender, to 0.75 mm, calyx and back of petals somewhat pub. Pl to around 20 cm. recepticle elongating to be cylindric with maturing fruit. Achenes with short hooked beak
Fiker, Chas. B.	1280	*R. glaberrimus* var. *ellipticus*	19June1933	Rock Mt., Ok Co.	19Oct2012	
Flett, J.B.	2177	*R. gelidus*	31July1903	Mt Tacoma	15November2012	Plants with typical basal leaves, fls to around 9 mm across as pressed, petals around 4 mm
Gale, Nettie P		*R. triternatus*		Open slopes opposite the Dalles	19Oct2012	TOPOTYPE. No collection date, but identified in 1915. Leaves with lobes 1 and 1.5 mm wide
Giblin, David	405	*R. glaberrimus* var. *glaberrimus*	17May2006	Coluckum Wildlife Area	8November2012	A few basal leaves broadly elliptical, but nearly all three-lobed, the middle lobe slightly longer. Petals 5-7 mm, roots 2mm thick and tapering, fr sparsely short hairy, beak 1mm, curving
Giblin, David	03-18	*R. glaberrimus* var. *glaberrimus*	11April2003	Umptanum Creek	8November2012	Basal leaves shallowly 3-lobed, fls to 10 mm across. Fat achenes had narrow curving beak, imm fr had broad, triangular beak
Giblin, David	802B	*R. glaberrimus* var. *ellipticus*	20April2007	WNF, Taneum Rd.	19October2012	Basal leaves with three lobes, the middle lobe longer. Some achene beaks straight, some hooked
Gross, David	509	*R. triternatus*	28Feb2010	Centerville Highway	19October2012	Most leaf lobes 1 mm, occ. to 1.5
Gwozdz, Rich	05-12	*R. eschscholtzii var. eschscholtzii*	23July2005	Basin S of Rennie Peak	8November2012	Elongate recepticle, cluster of fruits to 5x10mm, achenes glab with narrow straight beak 1mm+, basal lvs deeply divided int three, then again deeply lobed or toothed.

Habegger, E.	RC9	*R. glaberrimus* var. *glaberrimus*	30April1997	Rock Creek, Klickitat Co	8November2012	One basal lf almost scalloped, blade 24 mm wide x 17 mm long, root nearly 3 mm wide, tapering gradually
Hahn, Steve	07-03	*R. eschscholtzii* var. *eschscholtzii*	4August2007	Copper Ridge	8November2012	Fls to 20 mm across, typical leaves and roots
Harris, S.W.	21	*R. glaberrimus* var. *glaberrimus*	5May1950	S Fk Palouse R	8November2012	Basal lvs all unlobed, broadly ovate, small, 9x12 mm; roots to 2.5 mm, tapering, fls to 19 mm across. St lvs have 3 narrow lobes
Hitchcock, C.L.	3307	*R. triternatus*	30April1938	Just below summit on the north side, high hills opposite the Dalles	19October2012	With V.L. Marsh
Hitchcock, C.L.	8296	*R. glaberrimus* var. *ellipticus*	25May1944	Blue Mts south of Pomeroy	19October2012	With Muhlick. Broadly elliptic basal leaves, some lobes with longer middle lobe.
Holmgren, Noel H.	5573	*R. adoneus*	22July1971	Caribou Range, ID	8November2012	Narrowly dissected leaves, lobes linear, fls to 22mm across, roots 1mm thick, imm fr with narrow straight beak ca 1.2mm. Had first been identified as *R. reconditus*
Holms, Russ	10-14	*R. glaberrimus* var. *ellipticus*	12May2010	Ross Lake NRA	19October2012	Leaves all elliptic, without lobes.
Hunn, E.	14-May	*R. glaberrimus* var. *ellipticus*	27March1977	Lyle	19October2012	Typical elliptic basal leaves, stem leaves deeply 3-lobed, middle lobe much longer and broader,
Kemp, Lois	82006	*R. triternatus*	16March1982	3 miles SE of Stacker Butte	19October2012	typical narrow lobes
Kemp, Lois	82006-a	*R. triternatus*	20April1982	3 miles SE of Stacker Butte	19October2012	
Knoke	240	*R. eschscholtzii*	10August2002	Pelton Basin	8November2012	Fls to 17 or 18 mm across, basal lvs with numerous broad lobes, prob var. *eschscholtzii*
Knoke	1168	*R. eschscholtzii* var. *eschscholtzii*	26August2006	SW of Circle Lake, Kittitas Co	8November2012	Elongate receptacle, narrow fibrous roots

Naas, Ralph and Dorothy	5441	*R. glaberrimus* var. *ellipticus*	16June1988	Tiffany Meadow, Conconully, Ok Co.	19October2012	Broadly elliptic basal leaves, no lobes; beaks on achenes short, somewhat hooked. Occ stem leaves are lobed.
Pickett, F.L.	224	*R. glaberrimus* var. *glaberrimus*	1April1915	S. of Pullman	8November2012	Basal lvs large, blade to 20 x 40 mm, most broadly obovate in outline, shallowly 3-lobed, middle lobe longest. A few lvs without lobes. Petals to 11 mm
Pickett, F.L.	1546	*R. cymbalaria*	2June1934	Ewan, Whitman Co	8November2012	Elongate recepticle is distinctive, though some basal leaves more or less resemble small toothy versions of *R. glaberrimus*
Rodman, James (det. Knoke)	543	*R. glaberrimus* var. *glaberrimus*	2May2009	Grant Co., channeled scablands	8November2012	Robust, blade of basal leaves to 25 mm wide x 30 mm. Fat fruit with narrow curved beak, head to 15 mm across. Roots over 3 mm wide, bluntly tapering
Rogers, H.T.	766	*R. glaberrimus* var. *ellipticus*	9April1941	Flathead Co. MT	19October2012	Basal leaves deeply lobed with middle lobe larger
Slichter, Paul	sn	*R. gelidus*	23April2009	Canyon Creek canyon, Klickitat Co	15November2012	This specimen lacks roots, is from the same population as specimens by Carolyn Wright (2241, 2242) and Arnett (2010-5)
Suksdorf	627	*R. glaberrimus* var. *glaberrimus*	2May1884	Klickitat River near Mt Paddo	8November2012	Leaves nearly rotund in outline, three lobed, middle lobe slightly longer. Roots 2 mm bluntly tapered. Fls 12 mm across, fat achenes with 1 mm long curved narrow beaks,
Suksdorf	4142	*R. gelidus*	30August1904	Mt Paddo [Adams]	15November2012	Small plants, and small basal leaves (to 13 mm across) but typical shape. Fls around 9 mm.
Suksdorf	4142	*R. gelidus*	30August1904	Mt Paddo [Adams]	15November2012	second sheet of same collection number, specimen with typical leaves and flowers, in poor condition
Thompson, J.W.	sn	*R. gelidus*	1August1951	Wen Mts bet Hardscrabble and 4th Creeks	15November2012	Basal lvs deeply 3-parted and again lobed, rounded lobes, fls 8 or 9 mm across, petals to ca. 4 mm long and 4mm wide, nearly rotund, pedicel glab, roots to 1 mm, most 0.75 mm, calyx and back of petals somewhat pub. Pl to around 20 cm. Nectary when visible seemed like an open v, without scale

Thompson, J.W.	7776	*R. gelidus*	31July1931	Mt Stuart	15November2012	Mature fruits present, in elliptical head. Bulging on achene visible. Specimen from 8500 ft. Pressed fls around 8 mm across, roots slender, less than 1 mm., pls near 20 cm tall.
Thompson, J.W.	11055	*R. gelidus*	21July1934	Iron Mt, Jefferson Co	15November2012	Basal lvs deeply 3-parted and again lobed, rounded lobes, fls to 8 to 10 mm across, petals to ca. 4 mm long and 3 mm wide, pedicel glab, roots slender, to 1 mm, calyx glb to sparsely pub. Pl to around 10 cm.
Thompson, J.W.	11415	*R. triternatus*	27April1935	High hills opposite the Dalles	19October2012	Some leaf lobes more clavate than linear, up to 2 mm wide
Thompson, J.W.	14272	*R. triternatus*	14May1938	High sagebrush hills near Centerville	19October2012	Some leaf lobes more or less clavate, up to 3 mm wide
Thompson, J.W.	14497	*R. glaberrimus* var. *glaberrimus*	15April1940	Cleman Mt	8November2012	Basal broad, some broader than long, three lobed, some fls double to 34 mm across
Thompson, J.W.	15046	*R. gelidus*	15July1940	Mt. Aix, Yakima Co	15November2012	Basal lvs deeply 3-parted and again lobed, rounded lobes, fls to 9 or 10 mm across, petals to ca. 4.5 mm long and 3.5 mm wide, pedicel glab, roots slender, to 0.75 mm, calyx glb to sparsely pub. Pl to around 15 cm. recepticle elongating to be cylindric with maturing fruit. Achenes with short hooked beak
Wallace-Senft	4	*R. gelidus*	23July2005	Reynolds Peak area	15November2012	Fls to ca 8 mm across. Petals to 4.5 x 4.5 mm, pedicels and calyx back glab to sparsely pub., pls 12 cm tall
Wallace-Senft	5	*R. gelidus*	23July2005	Reynolds Peak area	15November2012	Mature fruits present, in elliptical head. Faint bulging on achene somewhat visible, or maybe just imagined. Pressed fls around 8 mm across, roots slender, less than 1 mm., pls ca 15 cm tall. Beaks on fruit are hooked at tip, though may not have been before drying.
Ward, G.W.	258	*R. glaberrimus* var. *glaberrimus*	19April1946	Colockum Pass Rd	8November2012	Basal leaves three-lobed, fls to 20 mm across, roots to 2.5 mm, bluntly tapered

Wood, Jean	271	*R. glaberrimus* var. *ellipticus*	23May1995	Little Pend Oreille River	19October2012	
Wright, Carolyn	2241	*Ranunculus* species	1April2009	Canyon Creek canyon, Klickitat Co	19October2012, 11November2012	Most developed leaves are triternate, with ultimate lobes ca. 3.5 mm across. Flowers are 20, 25, and 30 mm across; beaks on immature fruit are broadly triangular
Wright, Carolyn	2242	*Ranunculus* species	3May2009	Canyon Creek canyon, Klickitat Co	19October2012, 11November2012	Leaves are triternate with ultimate lobes 2-4 mm across.
Zika	14875	*R. glaberrimus* var. *glaberrimus*	29March2009	Lime Hill	8November2012	Lvs three lobed, fls to 20 mm across; achenes with narrow curving beak

Appendix E: Comparison of selected morphological characteristics of *Ranunculus* sect. Epirotes, according to Wittemore (1997) and Douglas et al. (1999).

taxon	basal leaf					root thickness (mm)	petals (mm)	nectary scale	shape of head in fruit	receptacle	range
	shape	segmentation	base	segment shape	segment tip						
R. abortivus	reniform or orbiculate	typically undivided, innermost may be 3-parted	shallowly to deeply cordate	very broad lobes if divided	rounded to rounded-obtuse	0.5-1.5	1.5-3.5 x 1-2	glabrous	ovoid	pilose to very sparsely pilose	Extensive in N. Am., except SW U.S.; present in NE WA; 0-3100 m.
R. cardiophyllus	ovate or elliptic	undivided or innermost 3-5-parted	cordate to broadly obtuse	serrate with broad	rounded to broadly acute	1.3-2	6-13 x 4-13	usu. ciliate	ovoid or cylindric	canescent	Scattered in the Rocky Mts, including NE WA; 600-3400 m.
R. eschscholtzii var. *eschscholtzii*	reniform or cordate	3-parted with lateral segments again lobed	truncate or cordate	broad segments half as wide as long	rounded-obtuse or broadly rounded-acute	0.4-1.6	6-12 x 4-16	glabrous	cylindric or ovoid	glabrous to pilose	Western N. Am. from AK south in mountains to CA, AZ, NM; usually arctic and alpine.
R. eschscholtzii var. *suksdorfii*	reniform	3-parted with all segments again lobed	truncate or cordate	segments half as wide as long	acute or acuminate	0.4-1.6	7-11	glabrous	cylindric or ovoid	glabrous to pilose	Rocky Mountains and Olympics; 1200-3200 m.
R. gelidus	cordate or reniform	3-parted, segments again lobed	truncate or nearly cordate	lobes as wide as long	rounded	0.5-1	3-6 x 1-5	glabrous	cylindric to ovoid-cylindric	glabrous or pubescent	AK, Rocky Mountains, WA Cascades; arctic and alpine.
R. glaberrimus var. *ellipticus*	ovate or elliptic to narrowly elliptic	margins entire or rarely with 3 distal crenae	obtuse to attenuate	broad shallow crenae if divided	acute to rounded	1-3	8-13 x 5-12	glabrous or ciliate	globose	glabrous	Widespread in western states, 500-3600 m.
R. glaberrimus var. *glaberrimus*	elliptic to oblong or reniform	entire to deeply 3-crenate	obtuse to truncate	broad apical crenae	rounded	1-3	8-13 x 5-12	glabrous or ciliate	globose	glabrous	Widespread in western states, 400-2000 m.
R. inamoenus var. *inamoenus*	ovate, obovate, or orbiculate, rarely reniform	undivided or innermost with 2 clefts near apex	acute to rounded	generally not divided	rounded	0.6-1.2	4-9 x 2-5	glabrous	cylindric	pilose or glabrous	Widespread in western states, 2000-3500 m.
R. triternatus	rhombic to deltate or reniform	30-4 dissected	obtuse	linear	narrowly rounded	2-3	6-15 x 4-10	glabrous	depressed-globose	short pubescent	Southern WA and adjacent OR