



**Taxonomic and Population
Review of
Sisyrinchium sarmentosum
(pale blue-eyed-grass)**

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

Prepared by

Joseph Arnett

March 5, 2012



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Western Washington Office
Region 1
Section 6, Segment 69

by

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Introduction

A petition was recently submitted to the U.S. Fish and Wildlife Service to list *Sisyrinchium sarmentosum* under the Endangered Species Act, prompting a reexamination of the status of the species. This project reported here was intended to summarize all existing records of *Sisyrinchium sarmentosum* in Washington, to provide a current review of the taxonomy of the species, and to collaborate with the Interagency Sensitive and Special Status Species Program (ISSSSP) of the Forest Service and Bureau of Land Management in developing a monitoring protocol.

The Washington Natural Heritage Program (WNHP) has the statewide responsibility for maintaining records of rare plant species distribution and abundance on all ownerships in Washington. At the same time, the Forest Service maintains their Natural Resource Information System (NRIS) database of sightings on National Forest System lands. In some cases the records in the two databases do not conform to each other, or are not complete or current, and WNHP has made it a priority to ensure that the statewide database, upon which conservation ranking is based, includes current Forest Service data.

Relative to taxonomy, we have had questions about the identity of plants at two sites in the Naches District of the Okanogan-Wenatchee National Forest, well north of the rest of the distribution of the species. These areas are disjunct from the other known populations of the species, and the identification of those plants had not been confirmed. There have also been observations of plants that appear to be hybrids between *S. sarmentosum* and *S. idahoense*. Resolution of the genetic relationship between *S. sarmentosum* and other members of the genus, and thereby clarifying the delineation of the species, is prerequisite to precise inventory and monitoring.

Assessing the abundance of the species and monitoring trends in population size is critical to conservation planning, species wide, and the WNHP has been supporting an effort led by the ISSSSP to develop a systematic inventory and monitoring methodology for *S. sarmentosum*. This methodology is still under development, but we will report here on the progress and challenges this project has encountered.

This work will provide the public, land management agencies, the U.S. Fish and Wildlife Service, and the scientific community with an updated review of knowledge about the distribution and abundance of this species.

Distribution of *Sisyrinchium sarmentosum* in Washington

Sisyrinchium sarmentosum is known from twelve confirmed element occurrences in Washington. Table 1 below lists those occurrences, which are mapped in Figure 1. We now regard previously reported observations from the Naches District of the Okanogan Wenatchee National Forest, and

from Yakima County near the Aiken Lava bed, included on Table 1, as mis-identifications, and they are not included in Figure 1.

Table 1. Summary of *Sisyrinchium sarmentosum* element occurrences in Washington.

EO #	EO ID	EO Rank	owner	Location	notes
3	6021	H	private	Ice Caves Road	Small population reported by D. Henderson , 12June1971.
8	5432	E	Private/ DNR	Trout Lake	Population estimates in the hundreds. Private land has not been surveyed.
9	2781	AB	USFS-GPNF	South Prairie	Large complex occurrence, 12 source features.
10	2783	BC	USFS-GPNF	Little Mosquito Lake	Many revisits since 1971. Raven reported it as declining.
12	4142	CD	USFS-GPNF	Cave Creek	Large population, apparent hybrids present.
17	1172		private	Schoolhouse Meadow	Small population, grazed and previously plowed.
18	756	E	USFS-GPNF	Little White Salmon River	Relocation unsuccessful in 2009. All plants identical in isozyme banding.
19	4910	E	USFS-GPNF	Peterson Prairie	Large population, <i>S. idahoense</i> and apparent hybrids present.
20	4908	E	USFS-GPNF	Cayuse Meadow	Plants appear more purple than usual. Isozyme analysis by Wilson et al revealed banding pattern unique to this population.
24	6303		USFS/ private	Bergen Road	Large population, Raven reports that most plants present appear to be hybrids.
25	7212	E	USFS-GPNF	Falls Creek horse camp	Large population, with lumpy distribution.
27	7360	E	USFS-OWNF	Ironstone Mountain	Henderson identified a fragmentary specimen as <i>S. sarmentosum</i> , but subsequent searches have only revealed <i>S. idahoense</i> .
28	7889	E	USFS-GPNF	Lost Meadow	Small population.
-	-		USFS-GPNF	East of Aiken lava bed	No longer in Biotics, deleted as mis-ID after numerous attempts to relocate.

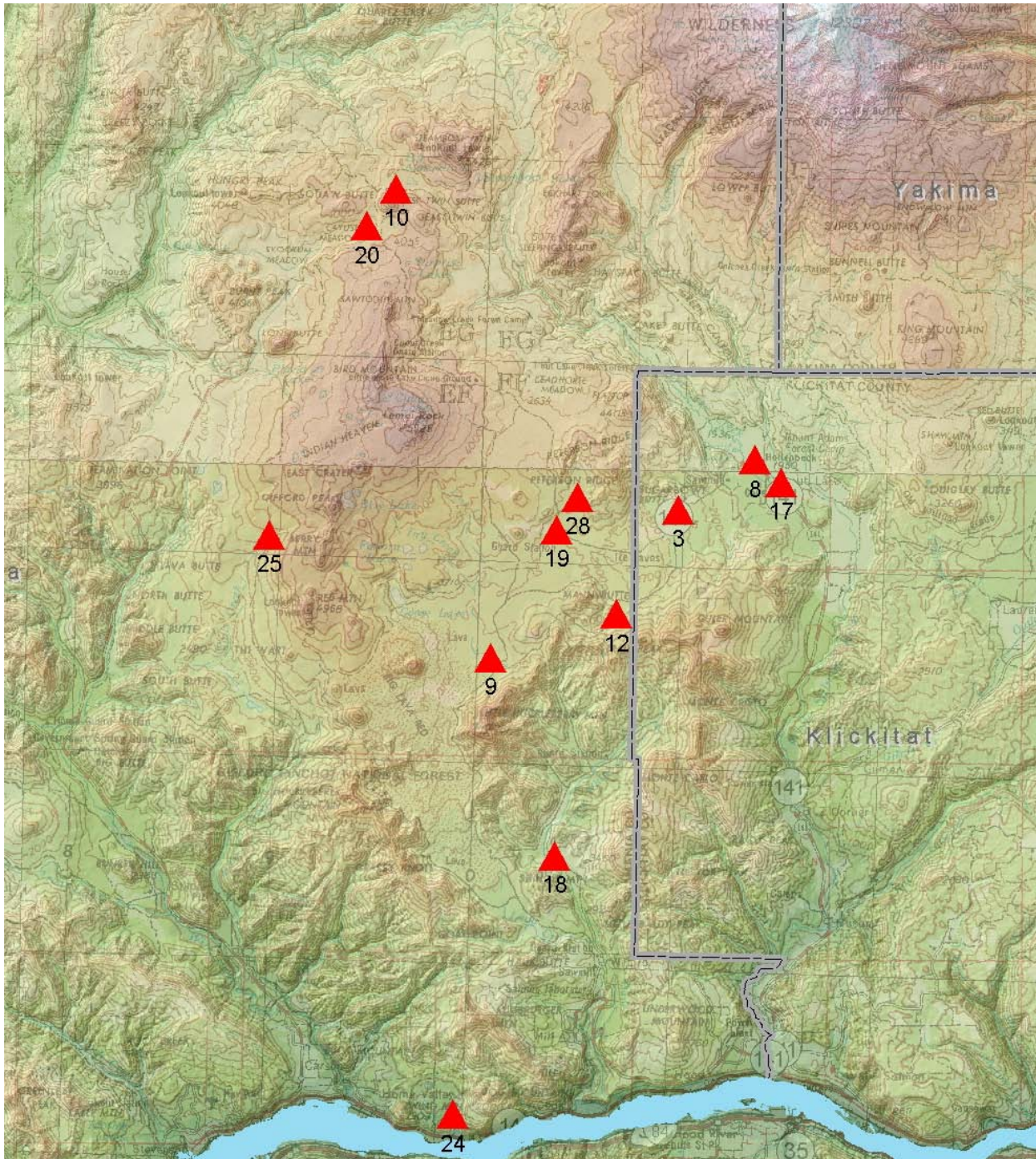


Figure 1. Overview of the distribution of *Sisyrrinchium sarmentosum* Element Occurrences (EOs) in Washington. Numbers below each triangle are EO numbers, listed in Table 1. The source features within each EO are identified in Appendix A. Populations in the Bootjack Rock and Ironstone Mountain areas of the Okanogan-Wenatchee National Forest and in Yakima County between Mt. Adams and the known distribution are currently regarded as misidentifications; they are not included on this map but are included in Table 1 and in Appendix A.

Investigation of *Sisyrinchium* in the Naches area

In the course of rare plant surveys in the Bootjack Rock and Ironstone Mountain area of the Naches District in 1994, Peter Morrison and Dana Visalli observed *Sisyrinchium* plants that they tentatively identified as *S. sarmentosum*. Though these plants were out of range and in a higher elevation habitat than the other Washington occurrences of the species, Morrison and Visalli made a best fit identification and reported their sightings to WNHP.

On July 21, 2010, I was able to visit the site of Morrison's observations near Bootjack Rock, with Jeanmarie Wheeler and Carla Jaeger from the Naches District. We found abundant *Sisyrinchium* at this site, and later in many similar habitats lower on the slopes. The color of the tepals on these plants was consistently a deep blue. I measured numerous fresh tepals, a prominent feature in the keys, and identified these plants as *S. idahoense* var. *occidentale*, based primarily on tepal length, width and color. The average length of the outer tepals of the Bootjack Rock plants, 10.5 mm (of 21 outer tepals that I measured on fresh material) is outside the range for *S. sarmentosum* (11-14 mm, according to Henderson) and within the range of *S. idahoense* var. *occidentale* (8-13 mm, according to Henderson and FNA). The Bootjack Rock plants also had winged stems, and the FNA treatment in 2002 describes the stem margins in *S. sarmentosum* as "similar in color and texture to stem body", but does not mention wings. The same statement about color and texture is made about the winged stems of *S. idahoense*. David Gibling and Anita Cholewa both later confirmed my determination at the species level. Because Morrison had not reported any other *Sisyrinchiums* from the area, we came to the conclusion that *S. sarmentosum* had been a mis-identification.

On August 9, 2011, I was able to visit Visalli's Fox Meadow site on Ironstone Mountain, with Rod Clausnitzer, Emily Driskill, and Ian Seiler of the Forest Service. As in the vicinity of Bootjack Rock, the *Sisyrinchium* plants on Ironstone Mountain keyed fairly well to *Sisyrinchium idahoense*. Plant material was collected for the molecular analysis reported later in this report.

Our general conclusion is that *Sisyrinchium sarmentosum* does not occur in the Naches District, but a question remains. On August 9, 1994, Douglass Henderson wrote to Duward Massie of the Forest Service at Naches that he had identified several *Sisyrinchium* and *Olsynium* specimens collected by Morrison and Visalli. He identified one specimen, from Fox Meadows by Visalli, as *S. sarmentosum*. Henderson noted that it was a poor specimen, without notes on date or precise location or plant parts not with the specimen. I assume the tepals had withered, which they do readily as the plants dry unless extreme care is taken. We note that in Henderson's later treatment of *Sisyrinchium*, which he co-authored with Cholewa in FNA (2002), he did not include this location in his range for the species, and Cholewa (pers. comm.) has no recollection that he mentioned it. The specimen has not been relocated.

I can't easily dismiss Henderson's earlier identification of plants from Ironstone Mountain, though he was working with fragmentary material. Other questions arise because while some of the features of the Bootjack Rock plants are outside the published dimensions of *S. sarmentosum*, they are also outside the published dimensions (in outer tepal length/width ratio) for *S. idahoense* var. *occidentale*. Henderson in 1976 stressed the importance of this ratio, and the Bootjack plants have distinctly broader tepals than those described by Henderson for either *S.*

idahoense or *S. sarmentosum*. The average length/width ratio of the 21 tepals that I measured was 2.2, far lower than what Henderson gave for either species. The FNA treatment does not mention this ratio.

Andrea Ruchty, in her Conservation Strategy for *S. sarmentosum* (2010), refers to rhizomes, which Bootjack Rock plants appeared to lack, at least on the collection I made. The FNA treatment says ...”rhizomes scarcely discernible”, and Henderson refers to the plants as caespitose. I don’t know if Ruchty based the presence of rhizomes on her own observations or on the FNA descriptions.

Because Henderson is no longer alive, I wrote to Anita Cholewa, the co-author of the FNA treatment, and she has offered to look at specimens, including the excellent specimens prepared by Jeanmarie Wheeler from collections in the same general area. Since this taxon is being considered for federal listing, it would be prudent to be as certain about the Bootjack Rock and Ironstone plants as possible.

Dr. Cholewa was able in February of 2011 to look at specimens from the Naches District (collected by Jeanmarie Wheeler) from Cash Prairie, just a few miles from the recorded specimen of *S. sarmentosum*, and very similar, according to Jeanmarie, to the plants we looked at by Bootjack Rock. Here are excerpts from Dr. Cholewa, Feb 18, 2011:

“They are all *S. idahoense*. Almost all the specimens show evidence of being grazed and this tends to produce much smaller flowers than typical. ...*S. idahoense* is the most variable of all the species in the Pacific Northwest – it is the “dog species”. Tepal apex varies from rounded to truncate to emarginated but shape of bracts (especially inner bract apex) and tepals along with the color are good characters, subtle but good and they all have to be considered as a whole, no one character can be singled out in this genus...I did not know of Henderson’s letter regarding the Fox Meadows population –but it is interesting that he did not include this when we prepared the FNA treatment. I wonder if he had second thoughts about its identification.”

My impression was that the Bootjack flowers were darker blue than the *S. sarmentosum* that I have seen; the photos below (Figures 2 and 3) support this observation, but differences in exposure may account for some of the difference. The broad outer tepals on the Bootjack Rock plants are most striking.

Development of a *Sisyrinchium sarmentosum* monitoring protocol

A working group formed in late 2010 to develop a monitoring protocol for *S. sarmentosum*. Team members included Jim Alegria and Carol Apple, Region 6 Forest Service statisticians; Joe Arnett, WNHP rare plant botanist; Andrea Ruchty, South Zone botanist for the Gifford Pinchot National Forest; and Kelly VanNorman, Inventory Coordinator for ISSSSP. Phone conference calls were made in November and December 2010, and January through June, 2011, and a draft monitoring protocol was developed by Jim Alegria in January 2011. This plan included a fairly precise method of recording of the perimeters of each occurrence, permanently marking the vertices of each polygon, and then sampling within each polygon to determine

Sisyrinchium densities within each. The protocol was quite labor intensive, and it assumed that polygon boundaries would not change appreciably year to year. The method, as drafted, would require using metal detectors to relocate rebar markers, and survey grade gps equipment, possibly done by engineering staff rather than the field botanists.

In the summer of 2011, efforts were made to implement the plan at a few selected sites; WNHP staff participated in the visit to Peterson Prairie, but the method proved to be impractical in the field, primarily because of the cryptic appearance of the species under most conditions. It is extremely difficult to see when not flowering, which is transitory, and the flowers open and close in response to sunlight during the course of a day. An additional complication is that *S. sarmentosum* and *S. idahoense* cannot readily be distinguished from each other unless they are flowering. The difficulties in 2011 were compounded by the extremely wet year and lingering snowpack. In the process of attempting to monitor *S. sarmentosum*, additional or “satellite” occurrences were found in several areas, indicating that the distribution of the species was not as well-known as had been assumed.

The response to attempts to monitor *S. sarmentosum* has been to shift to a focus for 2012 to developing a habitat model and then working on field verification. The first objective is a more complete inventory of potential habitat for the species. The model is being prepared by Richard Helliwell, a Forest Service modeler, using MaxEnt software.



Figure 2. *Sisyrinchium idahoensis* var. *occidentale* from Bootjack Rock area.



Figure 3. *Sisyrinchium sarmentosum* from South Prairie Bog



Figure 4. *Sisyrinchium idahoense* from Boistfort, Lewis County, WA.

Taxonomy of *Sisyrinchium* in Washington

“*Sisyrinchium* is a complex polyploidy taxon in which the species are not always easily distinguished”.

Cholewa and Henderson 2002

Hitchcock and Cronquist (H&C) (1973) treated *Sisyrinchium* in a broad sense, including plants that have more recently been segregated into the genus *Olsynium* (Henderson and Cholewa 2002). *Sisyrinchium* and *Olsynium* (or the corresponding section of *Sisyrinchium* in H&C) are distinguished, according to these two references, by the following characteristics:

***Olsynium*:** Leaves centric, somewhat inflated; stem simple; seeds brown, angular (FNA); filaments connate only 1/3 to 1/2 length, perianth (white) reddish-purple (H&C). Two taxa occur in WA: *O. douglasii* var. *douglasii* (*S. douglasii* in H&C) and *O. douglasii* var. *inflatum* (*S. inflatum* in H&C).

***Sisyrinchium*:** Leaves plane; stem simple or branched; seeds blackish, globose, with broad concave indentation in chalazal area (FNA); filaments connate to near the tip, perianth more bluish than reddish.

Henderson (1976) reviewed and reorganized *Sisyrinchium* in the Pacific Northwest and recognized 37 species. Nine taxa (6 species) are documented to occur in Washington; they are included on the list below. The species in bold font are tracked by WNHP. *S. bellum* and *S. halophilum* are regarded on the Washington Flora Checklist (WFC) as misapplied in Washington to *S. idahoense* var. *idahoense*. Henderson retains these species in his FNA treatment, but does not report them as occurring in Washington.

S. californicum, golden-eyed grass. Coastal B.C. to CA. 2n=32, 34, 36

S. idahoense var. *idahoense*, Idaho blue-eyed grass. 12 collections at the University of Washington Herbarium at the Burke Museum (WTU), from the coast to Spokane. This variety appears sympatric with *S. sarmentosum*. Plants sampled in by Meinke in western Oregon were 2n=96. Henderson and Cholewa report 2n=64, 96

S. idahoense var. *macounii*, Macoun's blue-eyed grass. Juan County and adjacent BC, Protection Island, Cattle Pt., Day Lake on Orcas, W of Friday Harbor. 2n=64

S. idahoense var. *occidentale*, western blue-eyed grass. 22 collections as WTU, all over WA. 2n=64

S. idahoense var. *segetum*, prairie or cornfield blue-eyed grass. 10 collections at WTU, from Thurston, Grays Harbor, Weir Prairie, Mt. Constitution, Tenino, Rocky Prairie, Mud Creek,

Pierce Co, Olympia. WFC gives the range as NW WA and adjacent BC (perhaps meaning var. *macounii*). 2n=64

S. littorale, shore or Alaska blue-eyed grass. 16 collections at WTU, all coastal, had been erroneously referred to *S. segetum*. 2n=96

***S. montanum* var. *montanum*, strict blue-eyed grass.** 2 collections at WTU, from Douglas County. Not included in the Washington Flora Checklist. 2n=96

***S. sarmentosum*, pale blue-eyed grass.** We have not been able to relocate a specimen identified as this species by Henderson from Fox Meadow, collected by Visalli in 1994. Many plants from that area appear to be *S. idahoense*, and Visalli does not remember seeing more than one species. 2n=96. Figure 1 shows an overview of the distribution of *S. sarmentosum* in Washington, not including the Fox Meadow occurrence, which we are now regarding as a mis-identification.

***S. septentrionale*, northern blue-eyed grass.** 8 collections at WTU, from NE WA. 2n=32

Hybridization in *Sisyrinchium*

Cholewa and Henderson (2002) refer to *Sisyrinchium* hybridization studies; ploidy number appears to be a strong barrier to hybridization. Cholewa (pers. com.) has not seen hybrids in the field, though she and Henderson made crosses in the lab, and she said that ploidy level is a strong barrier to hybridization. *S. sarmentosum* is n=48, and most *S. idahoense* is n=32. However, Groberg et al. (2010) reported *S. idahoense* var. *idahoense* in western Oregon as n=48; FNA (Cholewa and Henderson 2002) also report that *S. idahoense* var. *idahoense* can be n=48 as well as n=32. *S. idahoense* is extremely variable.

Raven (2003) reported on Henderson's work (1972, 1976) performing hand pollinations in the greenhouse showing hybrids between *S. sarmentosum* and *S. idahoense*. Field observations suggest hybridizations in nature, based on flower color. Apparent hybrids were observed at Cave Creek, Little White Salmon, Peterson Prairie, and Bergen Road. Apparent hybrids at Little White Salmon flowered earlier than typical *S. sarmentosum*.

DeWoody and Hipkins (2006) performed isozyme analysis of three WA and one Oregon *S. sarmentosum* (or unknown?) populations, plus two distinct *S. idahoense* populations. Their analyses did not distinguish between *S. sarmentosum* and *S. idahoense*; RAPD analysis revealed more variation among the populations and identified a distinct marker for *S. sarmentosum* but not for *S. idahoense*. Plants from Peterson Prairie appeared most similar to South Prairie; Little White Salmon plants were genetically distinct but more similar to *S. sarmentosum* than to *S. idahoense*.

The ISSSSP, in discussions of this question, initiated a genetic study with four purposes: 1) to verify that *S. sarmentosum* is a distinct species, 2) to determine whether hybridization is occurring in nature between *S. sarmentosum* and its close relative *S. idahoense*, 3) to determine whether hybridization, if it is occurring, poses a threat to the genetic integrity of *S. sarmentosum*, especially in sites where both species are present, and 4) to characterize the genetic differences and similarities among *S. sarmentosum* populations, to determine whether this information might be considered in conservation planning for the species. A broader purpose of the genetic study is

also to contribute to the understanding genetic relationships within *Sisyrinchium*, placing *S. sarmentosum* in a broader taxonomic context. The genetic study was with the guidance of Andy Bower, Forest Service geneticist, with support from Valerie Hipkin at the National Forest Genetics Laboratory (NFGEN) in Placerville, California.

Material was collected from several outliers, as well as the core populations, and from areas where color variation suggested hybridization had occurred. These specimens were sent as fresh material to NFGEN, and DNA has been successfully extracted. Analysis is planned but has not yet been conducted.

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- Wilson, B.L., D.L. Doede, and V.D. Hipkins. 2000. Isozyme variation in *Sisyrinchium sarmentosum* (Iridaceae). *Northwest Science* 74(4): 346-354.

Table 2. Locations of *Sisyrinchium* collections for molecular analysis.

Species	Site	Number	Area	State	Notes
<i>S. idahoense</i>	Camas Prairie WIL	25	Sweet Home RD, Willamette NF	OR	
<i>S. idahoense</i>	Frog Creek Tributary	20	Mt Hood NF, Hood River District	OR	
<i>S. idahoense</i>	Camas Prairie MTH	20	Mt Hood NF, Barlow RD	OR	
<i>S. idahoense</i>	North Fork, Rock Creek	20	Mt Hood NF, Barlow RD	OR	
<i>S. idahoense</i>	Rock Creek	21	Siuslaw NF	OR	
<i>S. idahoense</i>	Lava Lake	24	SHWNF	OR	
<i>S. idahoense</i>	Peterson prairie	24	GP	WA	hybrids present
<i>S. idahoense</i>	Forbes Point	20	Forbes Point, Whidbey Is., Island Co.	WA	
<i>S. idahoense</i>	Lozier	20	Lozier Prairie Preserve, Lewis County	WA	
<i>S. idahoense</i>	Conboy	10*	Conboy NWR, Klickitat Co.	WA	
<i>S. idahoense</i>	Boistfort	20	Lewis County	WA	
<i>S. idahoense</i>	Lost Meadow	25	GP	WA	
<i>S. idahoense</i>	Andy Creek	14	OKWNF	WA	
<i>S. idahoense</i>	Iron Stone Mt	10*		WA	
<i>S. sarmentosum</i>	Clackamas Lake, North Shore	20	Mt Hood NF, Zig Zag District	OR	hybrids present; DNA already at NFGEL from 2005 collection
<i>S. sarmentosum</i>	Little Crater Meadow	30	Mt. Hood	OR	
<i>S. sarmentosum</i>	Lost Meadow	30	GP	WA	hybrids present
<i>S. sarmentosum</i>	Peterson prairie	24	GP	WA	hybrids present
<i>S. sarmentosum</i>	Falls Creek Horse Camp	15 (14?)	GP	WA	DNA already at NFGEL from 2005 collection
<i>S. sarmentosum</i>	South Prairie	30	GP	WA	
suspected hybrid	Falls Creek Horse Camp	9 (10?)	GP	WA	

*Because of the small sample size, these sites may not be included in the analyses, or additional samples may be collected in 2012.

Appendix A

Atlas of *Sisyrinchium sarmentosum* occurrences in Washington

Table A-1 presents a summary of all Washington populations of *Sisyrinchium sarmentosum*. The maps that follow the table show the current Biotics records for each Source Feature within each Element Occurrence and show the position of each point or polygon indicated by Source Feature ID.

Table A-1 presents a summary of all Washington populations of *Sisyrinchium sarmentosum*

EO #	EO ID	Source Feature ID	EO Rank	Owner	Location	Notes
3	6021	10806	H	private	Ice Caves Road	D. Henderson sighting of a small population. Last observation: 12June1971.
8	5432	3154	E	Private / DNR	Trout Lake	Several hundred originally, 200 in 1981. Private land has not been surveyed. Last observation: 14June1988 by K. Thie. Last visit 27June2000 (negative survey) by F. Caplow and T. Kaye.
8	5432	14067	E	DNR	Trout Lake	Last observation: 15July1981 by G. Pearson. Plants not in flower.
8	5432	17453	E	DNR	Trout Lake	Last observation: 2July2010 by C. Wright; incomplete survey, 5-10 plants.
9	2781	1757	AB	USFS-GPNF	South Prairie	Last observation: 25June2003 by J. Scott, 50+ plants.
9	2781	1758	AB	USFS-GPNF	South Prairie	Last observation: 17July1990 by J. Gamon; 17 clumps in flower and fruit.
9	2781	1759	AB	USFS-GPNF	South Prairie	Last observation: 17July1990 by J. Gamon; 16 plants observed in 1985.
9	2781	1760	AB	USFS-GPNF	South Prairie	Last observation: 17July1990 by J. Gamon; 32 plants observed in 1985.
9	2781	1761	AB	USFS-GPNF	South Prairie	Last observation: 25June2003 by J. Scott; 349+ individuals.
9	2781	1762	AB	USFS-GPNF	South Prairie	Last observation: 17July1990 by J. Gamon; plants observed.
9	2781	1763	AB	USFS-GPNF	South Prairie	Last observation: 17July1990 by J. Gamon; plants observed in flower and fruit.
9	2781	1764	AB	USFS-GPNF	South Prairie	Last observation: 24July1997 by S. Clagget and M. Waggy. 5 clumps in 4 square meters.
9	2781	1765	AB	USFS-GPNF	South Prairie	Last observation: 19July1990 by J. Gamon, several hundred, in approx. 2 acres.
9	2781	14079	AB	USFS-GPNF	South Prairie	Last observed 25June2003 by J. Scott; 30+ individuals.
9	2781	14080	AB	USFS-GPNF	South Prairie	Last observed 25June2003 by J. Scott; 20+ individuals.
9	2781	14081	AB	USFS-GPNF	South Prairie	Last observed 25June2003 by J. Scott; 150+ individuals.

9	2781	14082	AB	USFS-GPNF	South Prairie	Large population, 24,000-27,000 plants (Raven). DeWoody & Hipkins and Wilson et al. used in analyses; Wilson found plants here dimorphic for two enzymes, most similar to Peterson Prairie. Estimated 10,000 on 3Aug2006 by E. & T. Doan.
10	2783	9668	BC	USFS-GPNF	Little Mosquito Lake	Raven reported it as declining. Last observed: 24Aug2001 by J. Scott, approx. 25 plants in 20' x 30' area.
10	2783	14083	BC	USFS-GPNF	Little Mosquito Lake	Last observed 17July2003 by J. Scott; 50-100 plants.
12	4142	1754	CD	USFS-GPNF	Cave Creek	7,500 to 10,000 in 2000 by A. Raven: apparent hybrids present. Wilson et al. included in isozyme analysis.
12	4142	1755	CD	USFS-GPNF	Cave Creek	
17	1172	9837	D?	private	Schoolhouse Meadow	Small population, grazed and previously plowed. Last observed 20June1986 by J. Gamon.
18	756	9842	E	USFS-GPNF	Little White Salmon River	A. Raven: Apparent hybrids appear to flower much earlier than typical SISA. Most plants present appear to be hybrids. DeWoody & Hipkins and Wilson et al. used in analyses, distinct from South and Peterson Prairies. All plants identical in isozyme banding. Last visit on 12June2009 by M. Miller (RareCare), hybrids observed.
19	4910	11130	E	USFS-GPNF	Peterson Prairie	A. Raven: 1,000 plants, apparent hybrids present, 1/4 to 1/3 of plants examined. DeWoody & Hipkins and Wilson et al. used in analyses. Appears to have <i>S. idahoensis</i> . Last observed on 16June2003 by J. Scott. At least 200 flowering, may more vegetative and in fruit.
19	4910	11131	E	USFS-GPNF	Peterson Prairie	
20	4908	9667	E	USFS-GPNF	Cayuse Meadow	Plants appear more purple than usual. Isozyme analysis by Wilson et al revealed banding pattern unique to this population. 100+ plants on 17June2004, all vegetative, by J. Scott and A. Raven.
24	6303	3909		USFS/private	Bergen Road	2,000 to 3,000. A. Raven: most plants present appear to be hybrids. Last observed in 2003.
25	7212	14069	E	USFS-GPNF	Falls Creek horse camp	1,000+ clumps, 25% in flower on 18Aug1999. Last observed on 20July2004, mostly in fruit, by J. Scott.
25	7212	14070	E	USFS-GPNF	Falls Creek horse camp	
25	7212	14071	E	USFS-GPNF	Falls Creek horse camp	
28	7889	16522	E	USFS-GPNF	Lost Meadow	30 plants, blooming and fruiting, on 30June2004 (NRIS) by A. Ruchty.

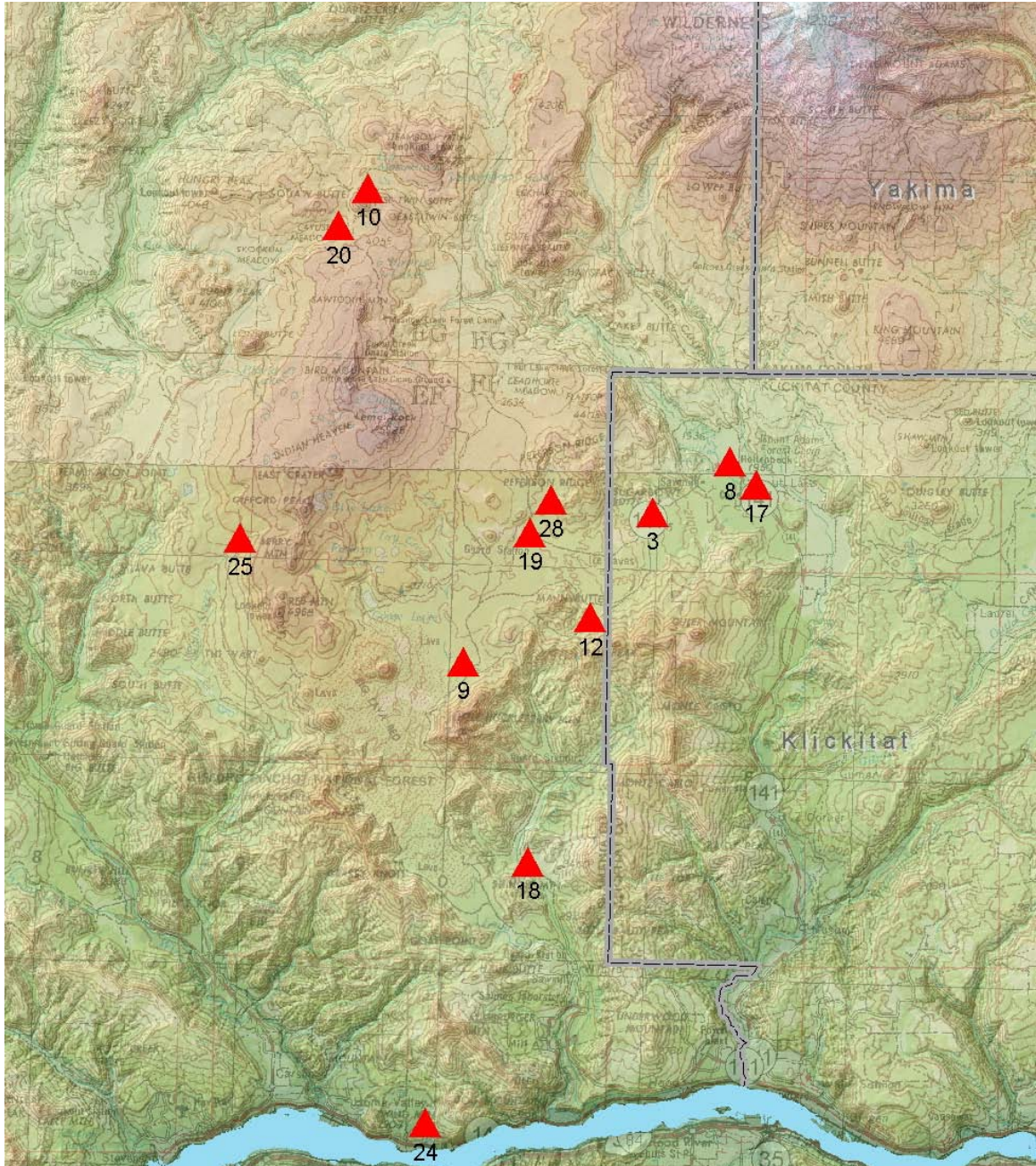


Figure A-1. Overview of the distribution of *Sisyrinchium sarmentosum* in Washington. Numbers below each triangle are Element Occurrence (EO) numbers.

In the following site maps, red triangles are Forest Service points, green polygons are from the National Forest Natural Resource Information System (NRIS), and yellow stars and yellow or blue polygons are from the WNHP Biotics database. Numbers labeling points and polygons are the Source Feature ID numbers included in Table A-1.

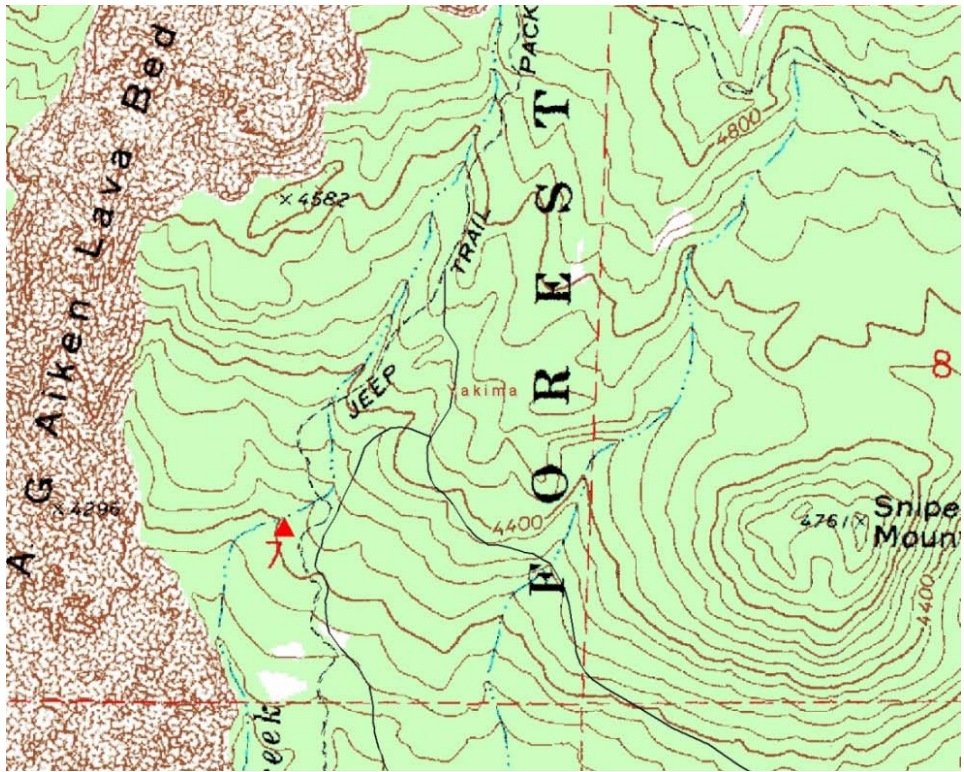


Figure A-2. Map of the location of an additional population of *Sisyrrinchium* (the red triangle) north of Cave Creek that had been identified as *Sisyrrinchium sarmentosum*. This site is regarded by the Forest Service as a mis-identification (Andrea Ruchty, pers. comm.).

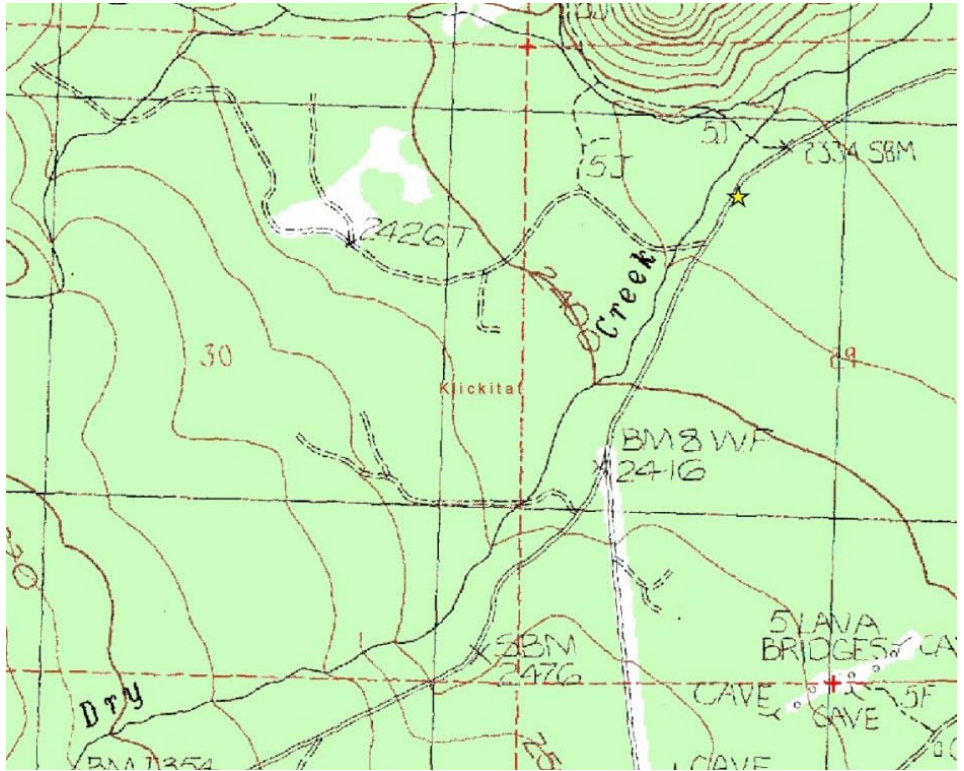


Figure A-3. Vicinity map of *Sisyrrinchium sarmentosum* #3, Ice Caves Road.



Figure A-4. Source feature of *Sisyrinchium sarmentosum* #3, Ice Caves Road.

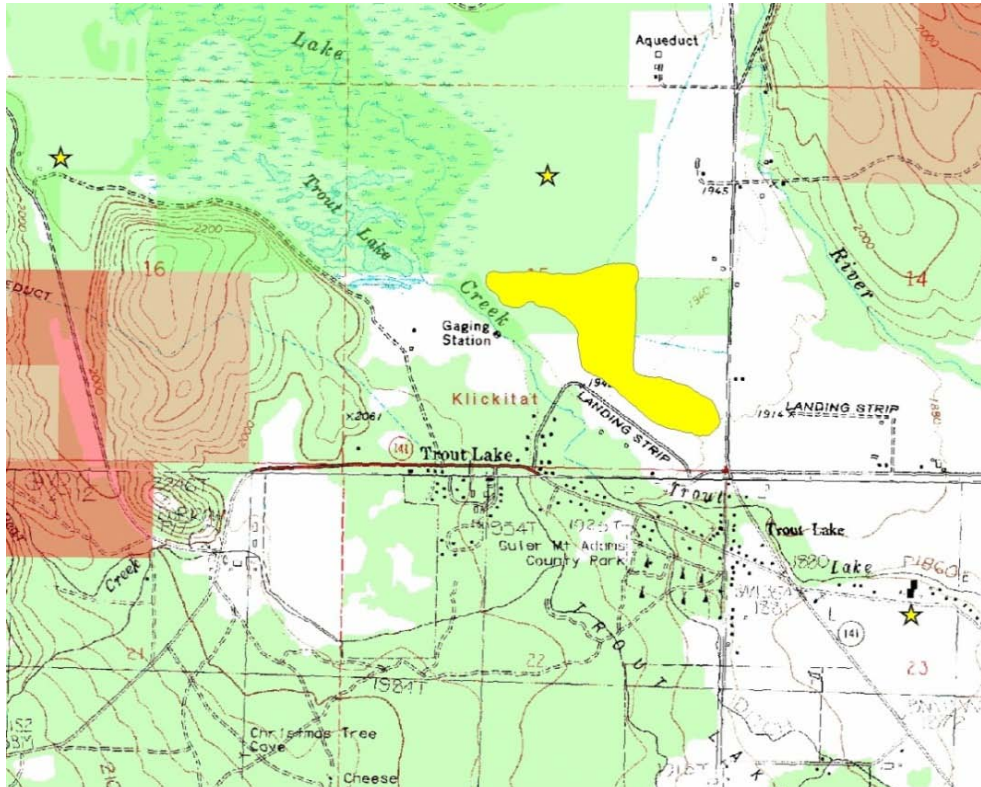


Figure A-5. Vicinity map of *Sisyrinchium sarmentosum* #8, Trout Lake; and #17, Schoolhouse Meadow (the southeast star).

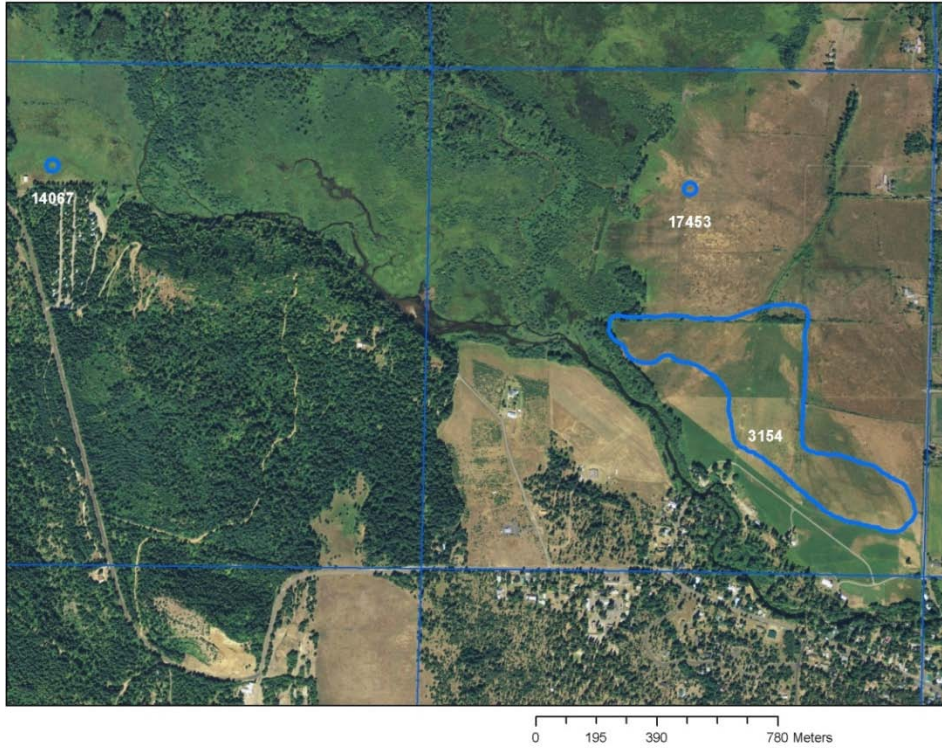


Figure A-6. Aerial photograph of source features of *Sisyrrinchium sarmentosum* #8, Trout Lake.

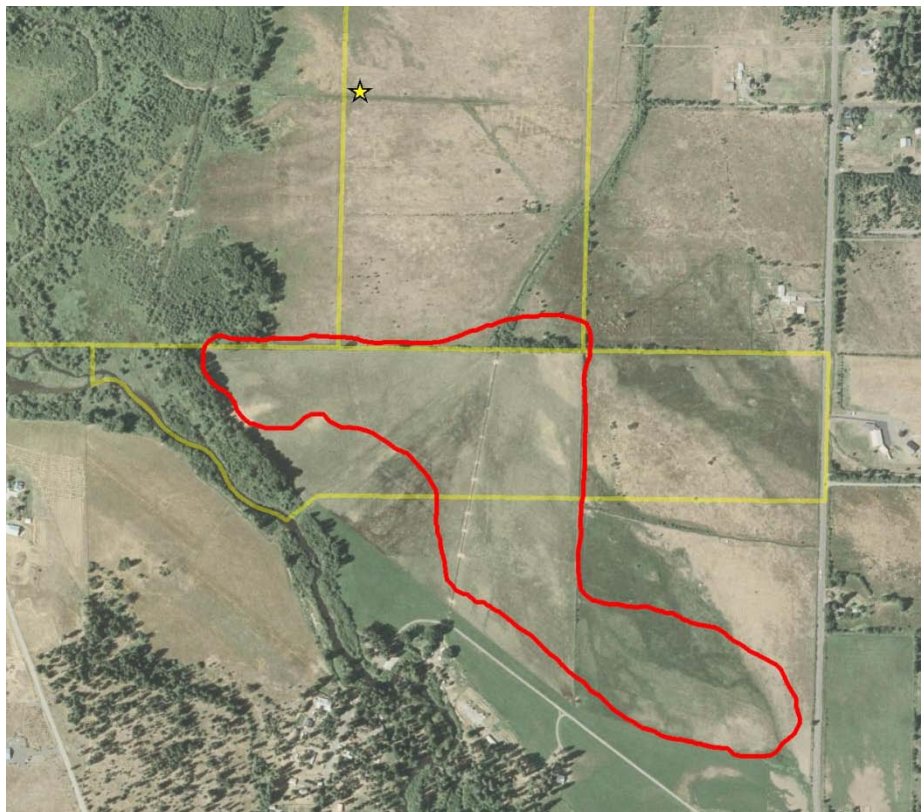


Figure A-7. Aerial photograph of the main polygon of *Sisyrrinchium sarmentosum* #8, at Trout Lake. The yellow line is the Natural Area Preserve Boundary. Property below that line is private.

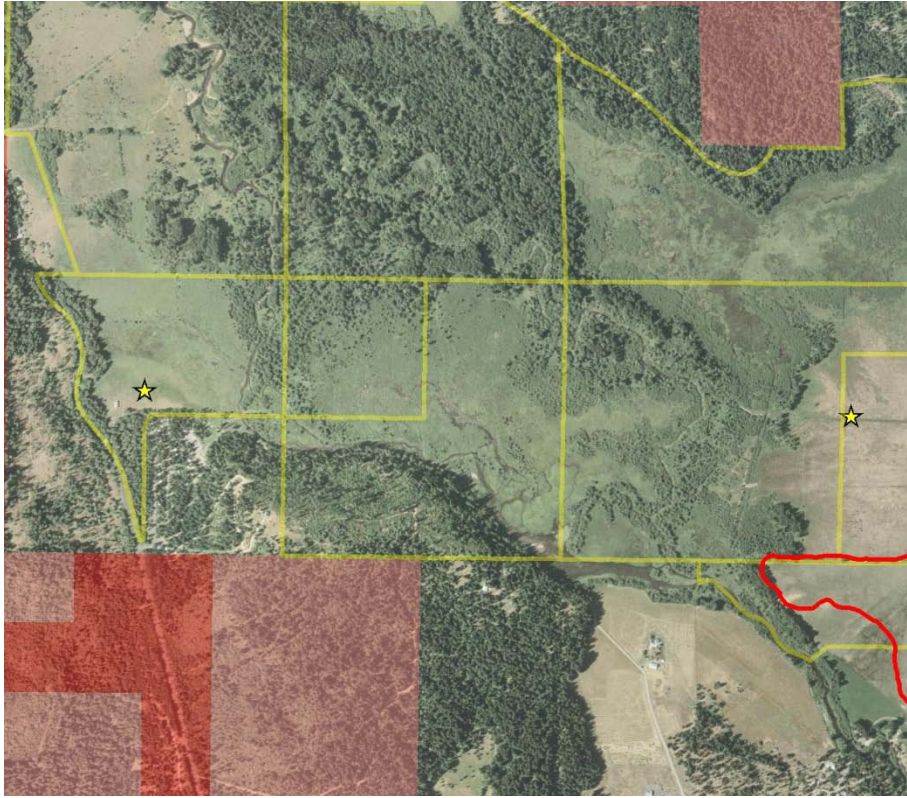


Figure A-8. Aerial photograph of the peripheral locations of *Sisyrrinchium sarmentosum* #8, at Trout Lake. The yellow line is the Natural Area Preserve boundary, the reddish areas are other DNR lands.

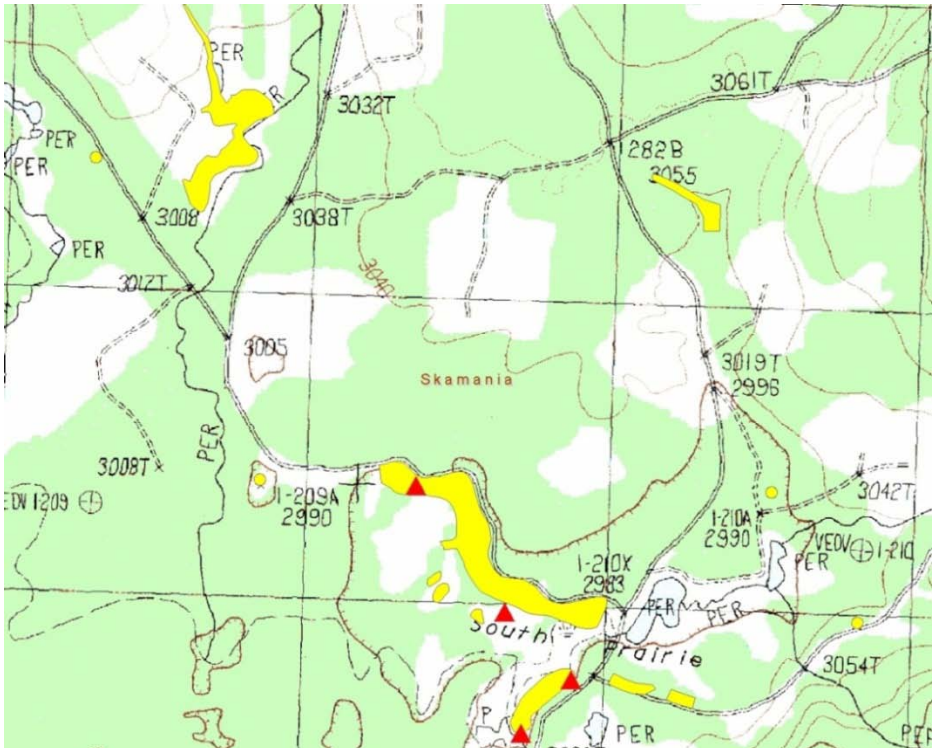


Figure A-9. Vicinity map of *Sisyrrinchium sarmentosum* #9, South Prairie.

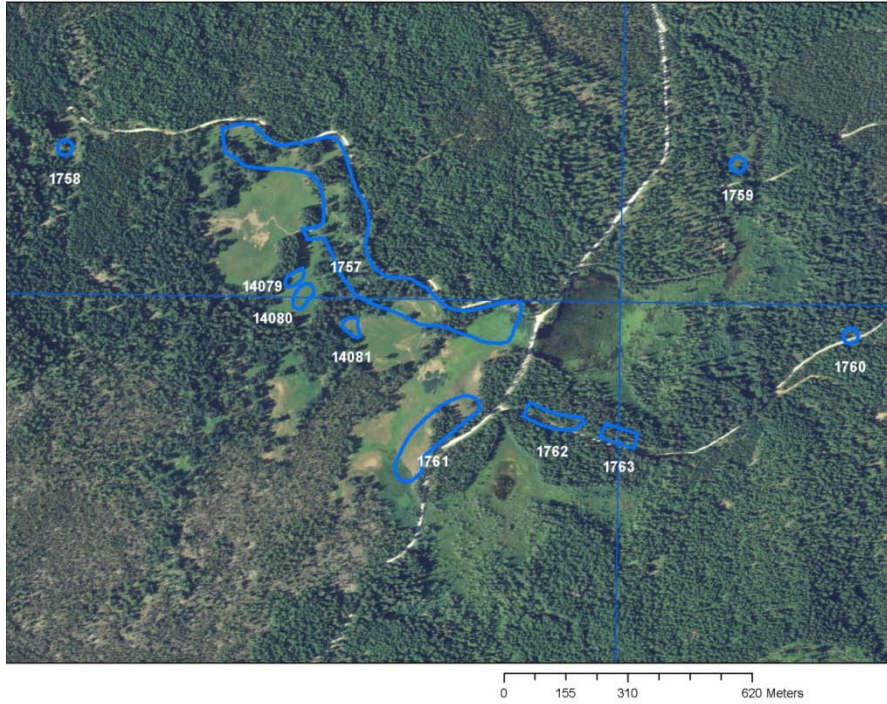


Figure A-10. Map of source features in the central portion of *Sisyrrinchium sarmentosum* #9, South Prairie.

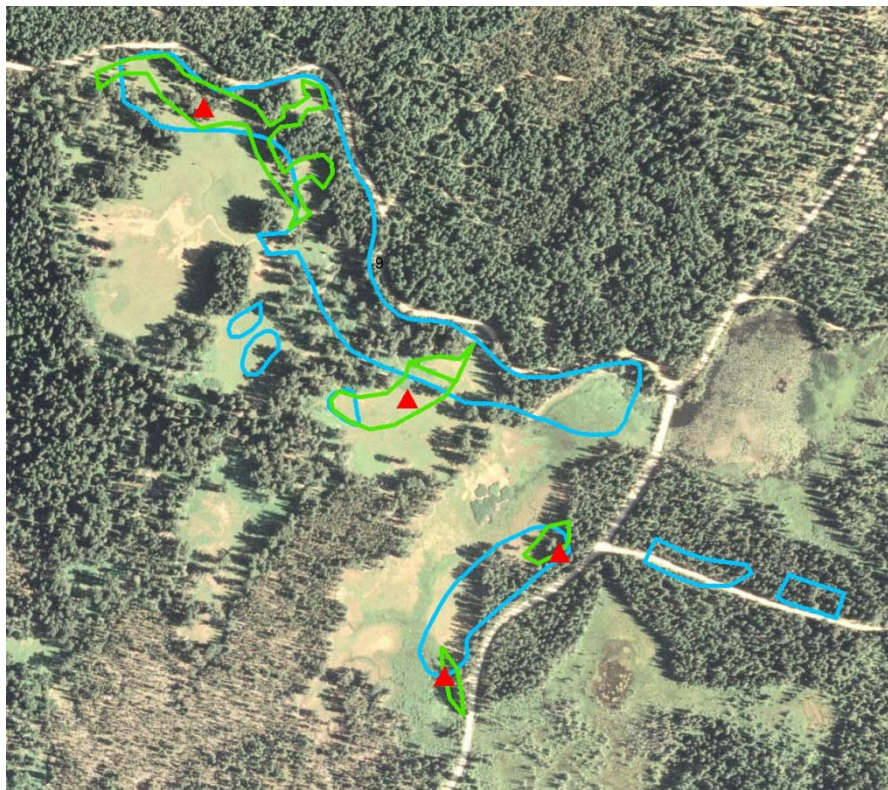


Figure A-11. Map of the central portion of *Sisyrrinchium sarmentosum* #9, South Prairie. The blue polygons are from Biotics, the green polygons are from NRIS, the red triangles are from a Forest Service shape file to be used in calibrating the model.



Figure A-12. Source features in the northwest portion of *Sisyrinchium sarmentosum* #9, South Prairie.



Figure A-13. Source feature in the northeast portion of *Sisyrinchium sarmentosum* #9, South Prairie.

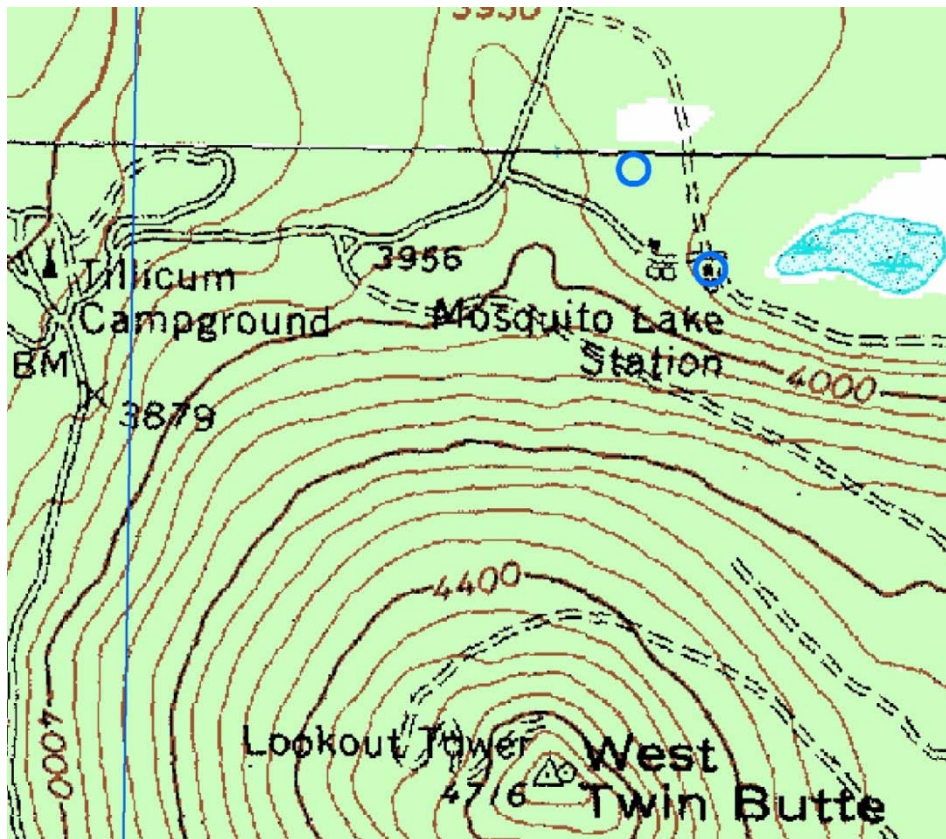


Figure A-14. Vicinity map of *Sisyrinchium sarmentosum* #10, at Little Mosquito Lake.



Figure A-15. Source features of *Sisyrinchium sarmentosum* #10, Little Mosquito Lake Road.



Figure A-16. Map of *Sisyrinchium sarmentosum* #10, Little Mosquito Lake Road. The green polygons are from NRIS; the yellow stars are the points in Biotics.

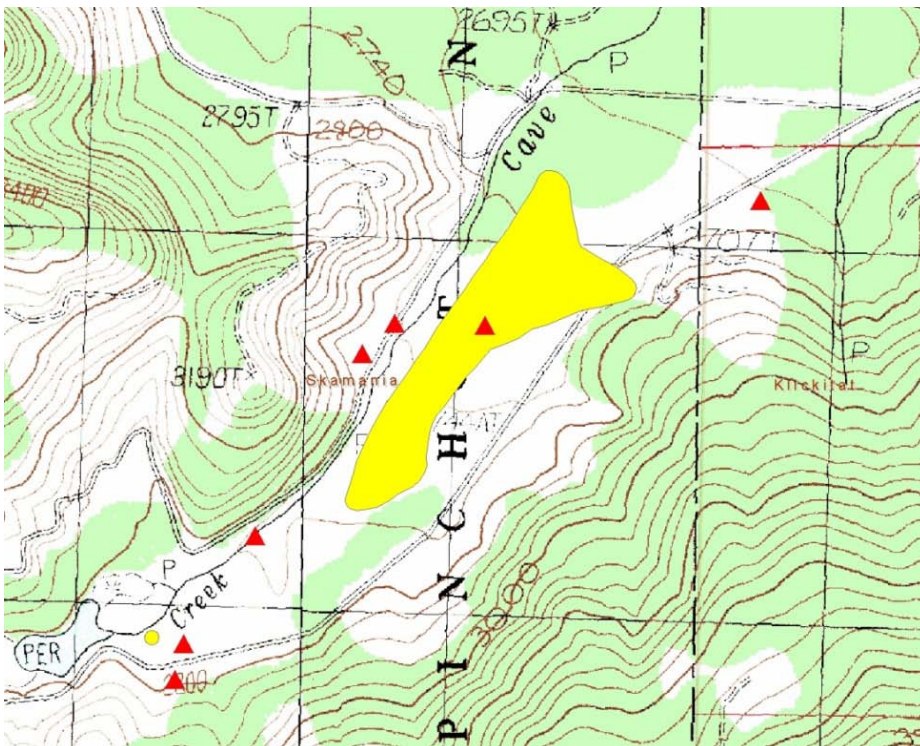


Figure A-17. Vicinity map of *Sisyrinchium sarmentosum* #12, Cave Creek.

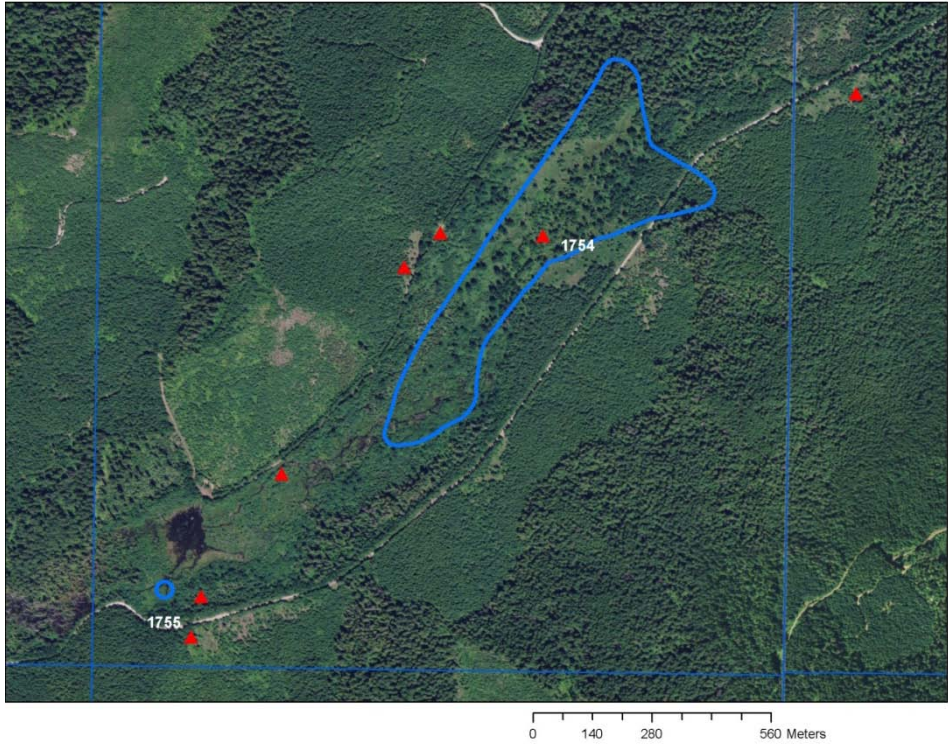


Figure A-18. Map of *Sisyrrinchium sarmentosum* #12, Cave Creek. Source Feature ID numbers pertain to the blue polygons.

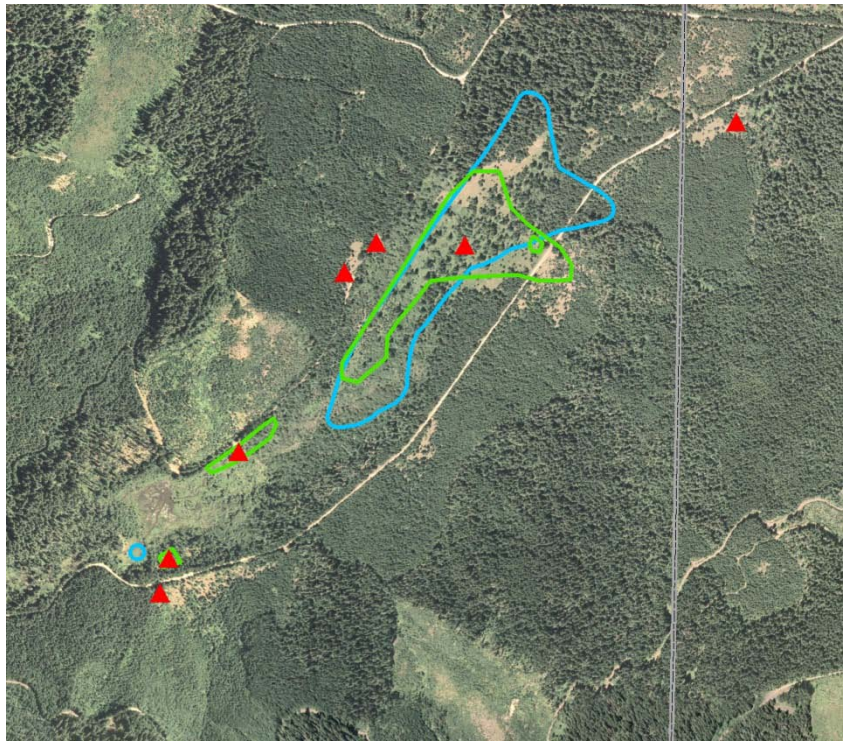


Figure A-19. Map of *Sisyrrinchium sarmentosum* #12, Cave Creek. The blue polygons are from Biotics, the green polygons are from NRIS, the red triangles are from a Forest Service shape file to be used in calibrating a habitat model.



Figure A-20. Source feature of *Sisyrinchium sarmentosum* #17, Schoolhouse Meadow. For the vicinity map, see Figure A-5.

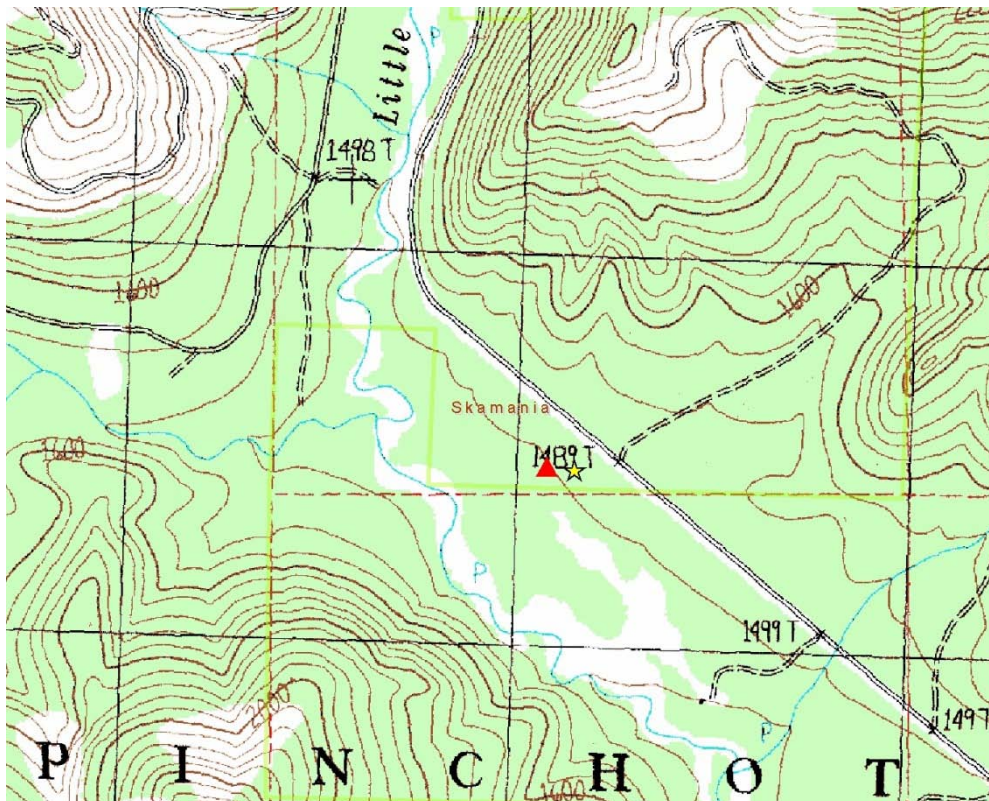


Figure A-21. Vicinity map of *Sisyrinchium sarmentosum* #18, Little White Salmon.

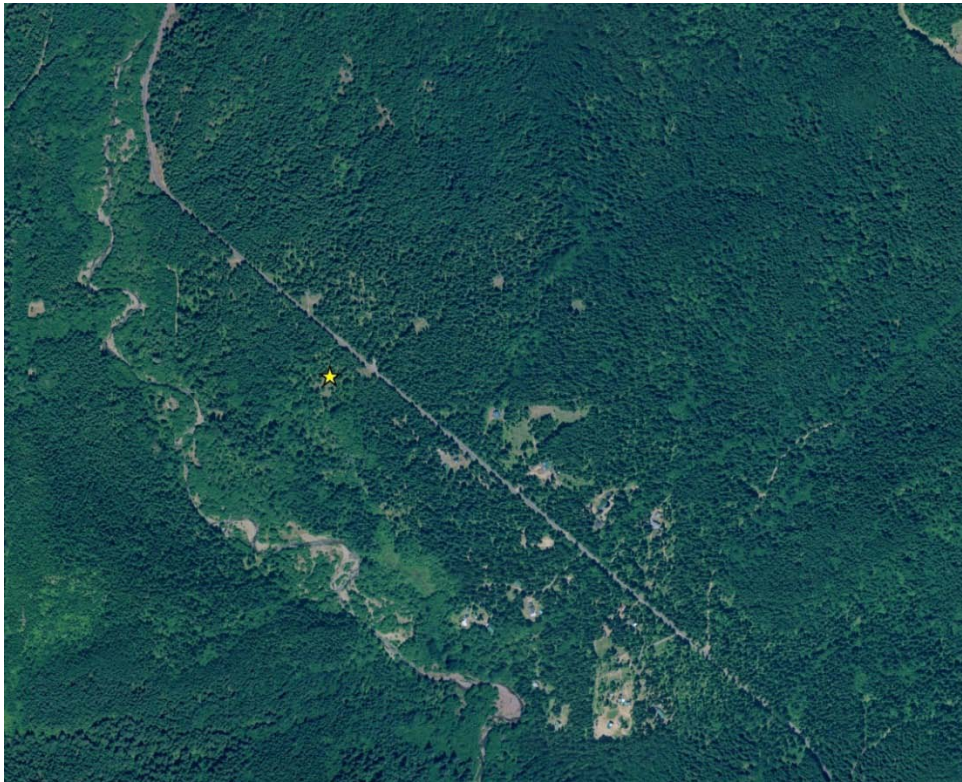


Figure A-22. Aerial photo of *Sisyrinchium sarmentosum* #18, Little White Salmon.



Figure A-23. Source feature of *Sisyrinchium sarmentosum* #18, Little White Salmon.

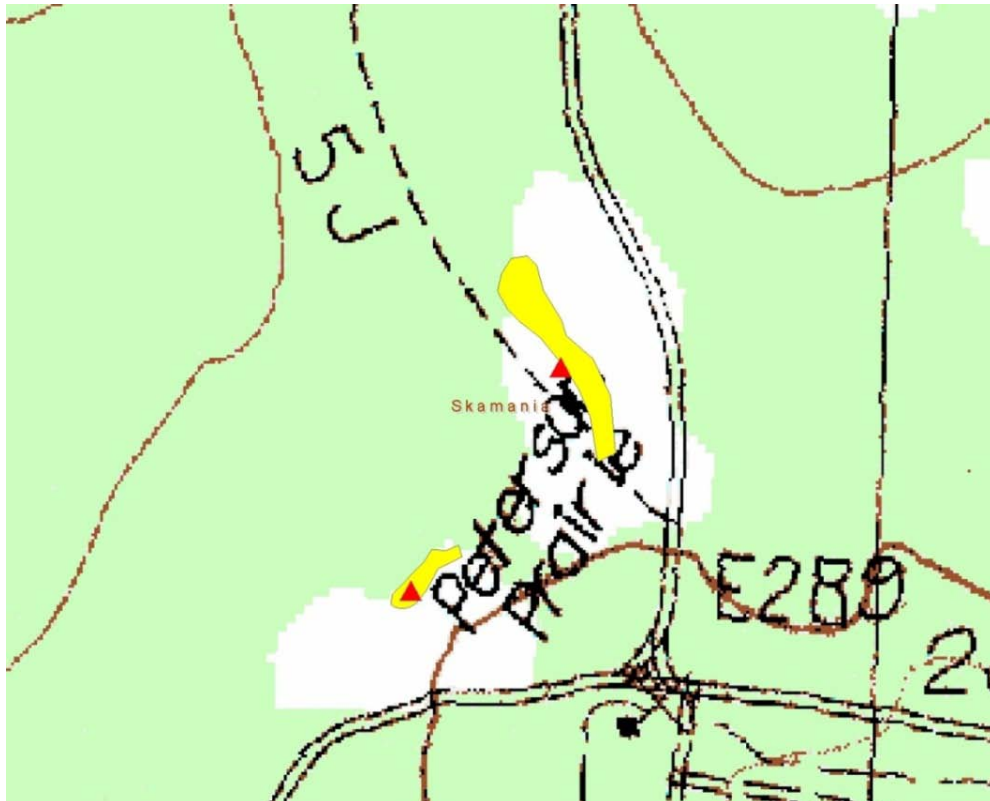


Figure A-24. Vicinity map of *Sisyrinchium sarmentosum* #19, Peterson Prairie.



Figure A-25. Source features of *Sisyrinchium sarmentosum* #19, Peterson Prairie.

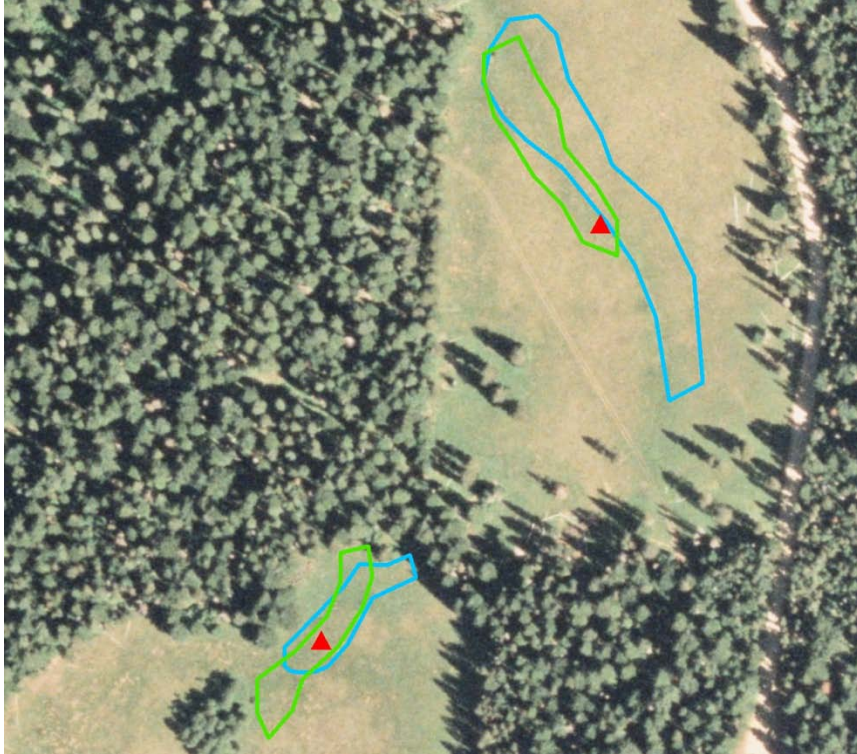


Figure A-26. Map of *Sisyrrinchium sarmentosum* #19, Peterson Prairie. The blue polygons are from Biotics, the green polygons are from NRIS, the red triangles are from a Forest Service shape file to be used in calibrating the model.

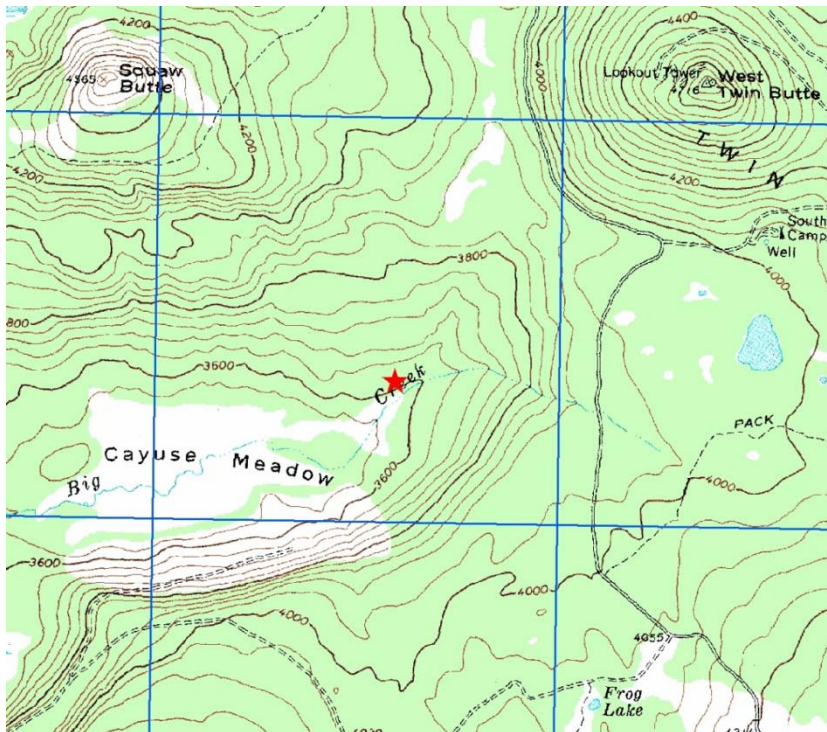


Figure A-27. Location of *Sisyrrinchium sarmentosum* #20, Cayuse Meadow. NRIS and Biotics record the same point.



Figure A-28. Source feature of *Sisyrinchium sarmentosum* #20, Cayuse Meadow.

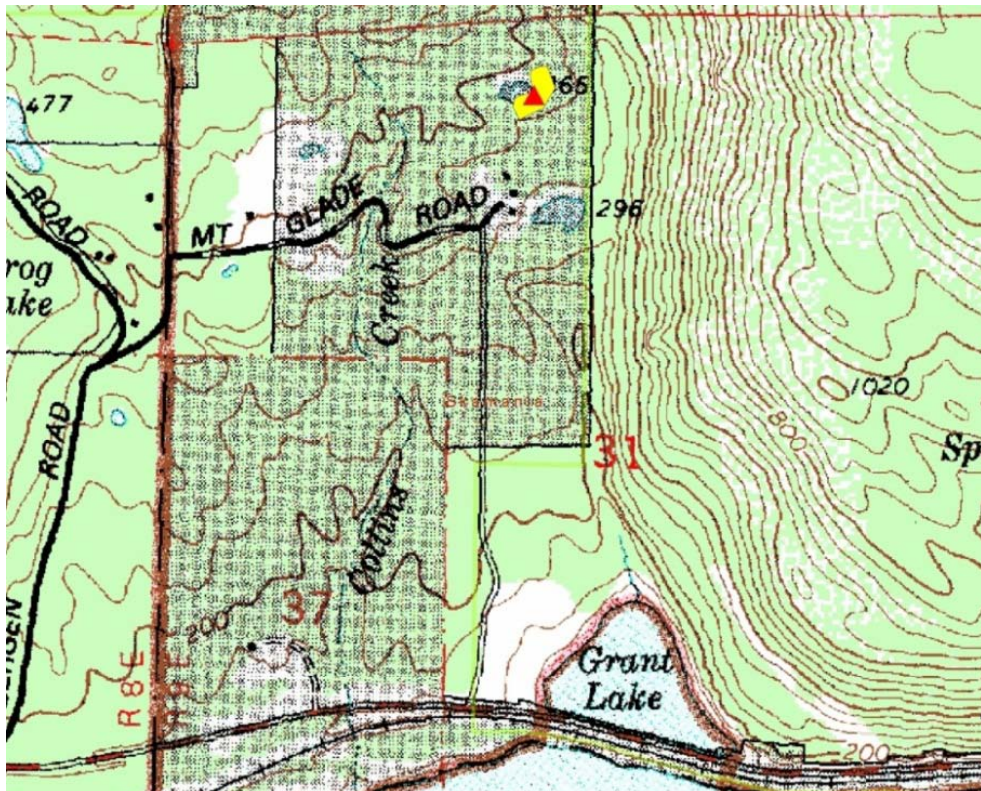


Figure A-29. Map of *Sisyrinchium sarmentosum* #24, Bergen Rd. pond turtle site.



Figure A-30. Map of *Sisyrinchium sarmentosum* #24, Bergen Rd. pond turtle site.



0 15 30 60 Meters

Figure A-31. Source feature of *Sisyrinchium sarmentosum* #24, Bergen Rd. pond turtle site.



Figure A-32. Map of *Sisyrinchium sarmentosum* #24, Bergen Rd. pond turtle site. The blue polygon is from Biotics, the green polygon is from NRIS, the red triangle is from a Forest Service shape file to be used in calibrating the model.

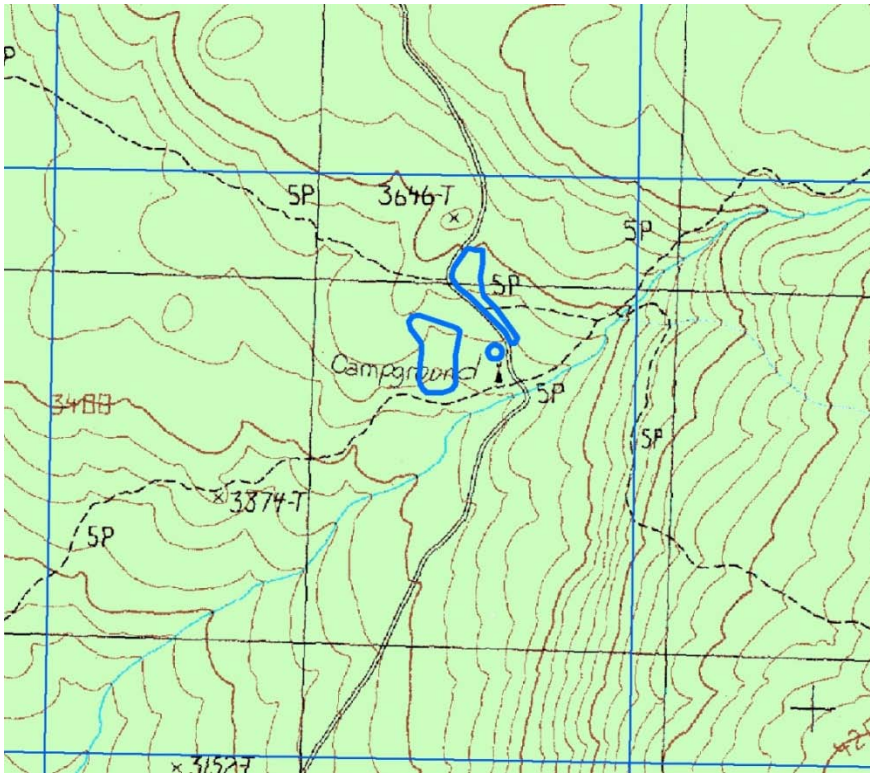


Figure A-33. Vicinity map of *Sisyrinchium sarmentosum* #25, Falls Creek Horse Camp.

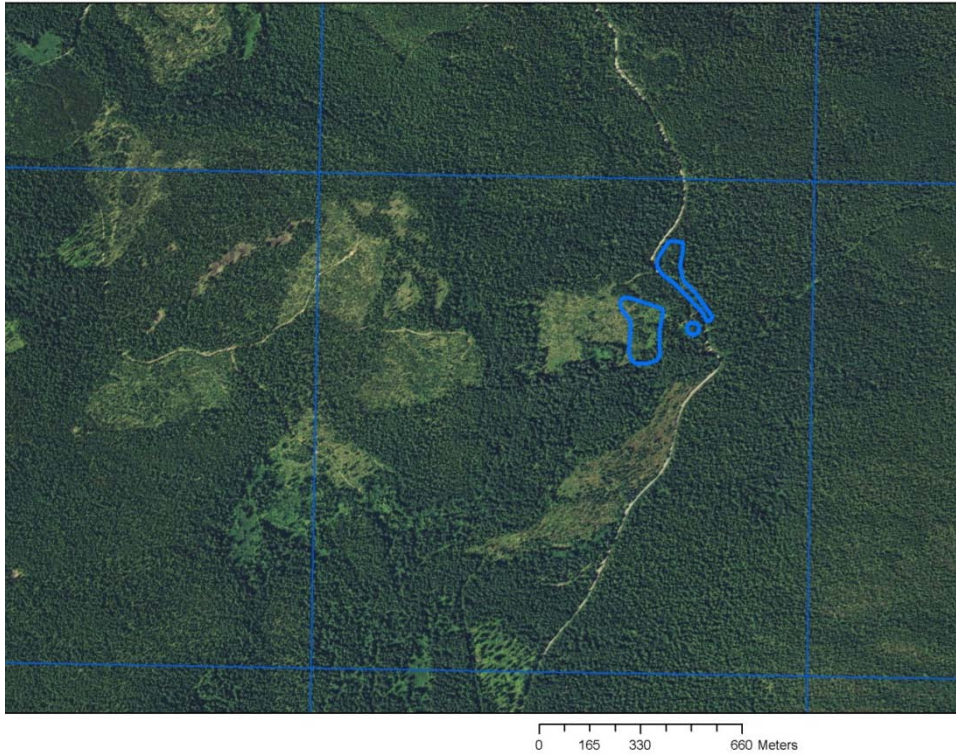


Figure A-34. Aerial photo showing the vicinity of *Sisyrinchium sarmentosum* #25, Falls Creek Horse Camp.

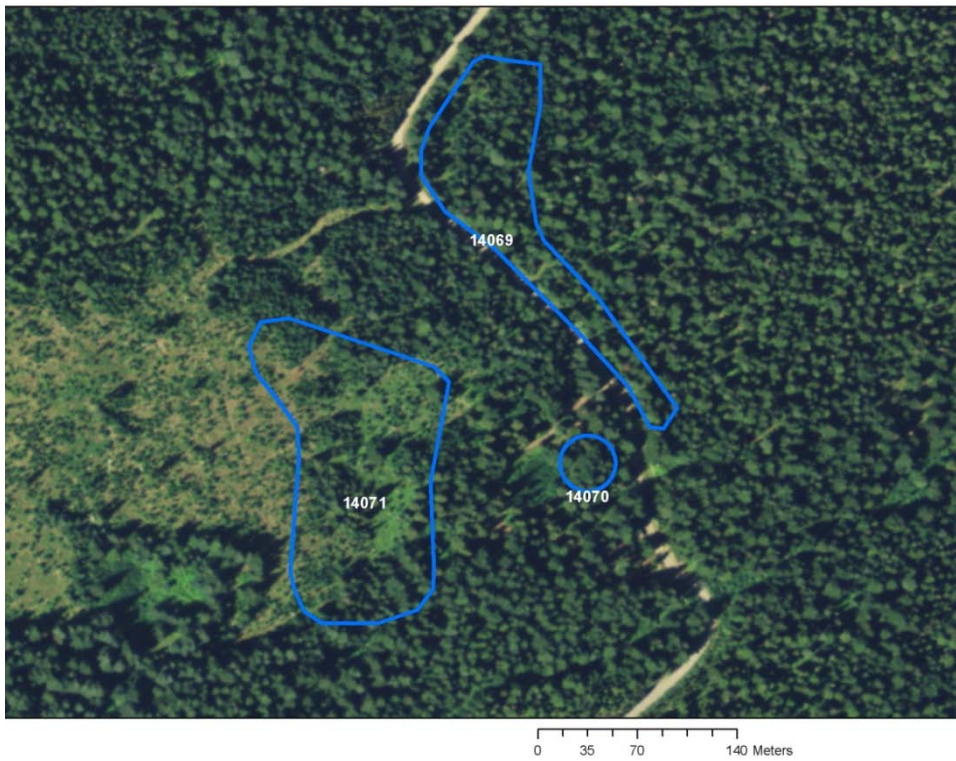


Figure A-35. Aerial photo showing source features of *Sisyrinchium sarmentosum* #25, Falls Creek Horse Camp.

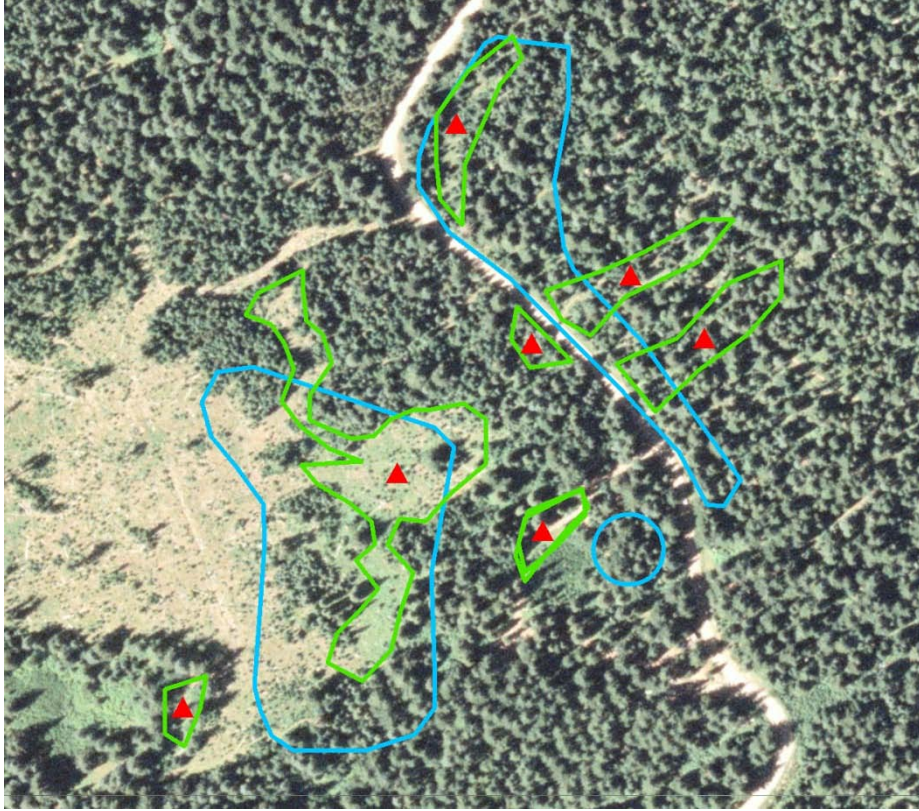


Figure A-36. Aerial photo showing *Sisyrinchium sarmentosum* #25, Falls Creek Horse Camp. The blue polygons are from Biotics, the green polygons are from NRIS, the red triangles are from a Forest Service shape file to be used in calibrating the model.

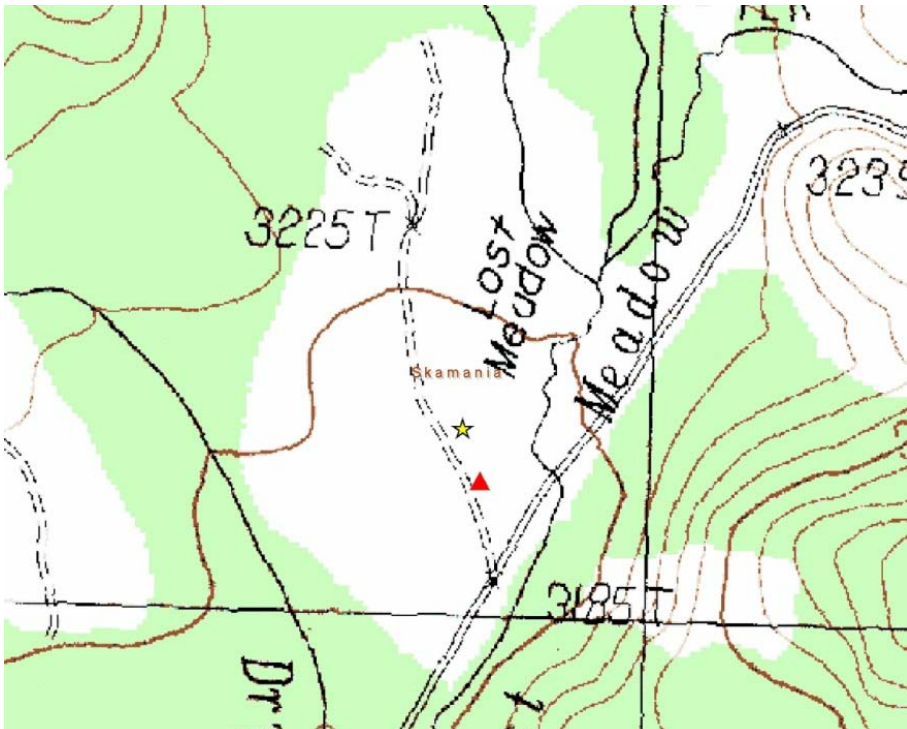


Figure A-37. Vicinity map of *Sisyrinchium sarmentosum* #28, Lost Meadow.



Figure A-38. Aerial photo showing the vicinity of *Sisyrinchium sarmentosum* #28, Lost Meadow.



Figure A-39. Source feature of *Sisyrinchium sarmentosum* #28, Lost Meadow.