Monitoring and Conservation of Indian Valley Sedge (*Carex aboriginum*) in West-central Idaho: 2004 Results

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SUMMARY

Endemic to west-central Idaho, Indian Valley sedge (*Carex aboriginum*) is one of Idaho's rarest plant species and of high conservation concern. There are only eight known extant occurrences, comprised of 27 subpopulations. No occurrences of Indian Valley sedge are adequately protected from a series of threat factors. Livestock grazing impacts, off-highway vehicle impacts, land development, and competition from exotic species are the main threats. Because of these imminent threats and habitat disturbances, a comprehensive population and habitat-monitoring program was urgently needed. In 2004, the Idaho Conservation Data Center designed and established a monitoring program for Indian Valley sedge. Its objective is to quantify trends in population size and vigor, habitat condition, and disturbance/threat factors over time. The monitoring protocol uses three methods. At larger subpopulations, quadrats were systematically sampled along transects, while a grid method was used at selected smaller subpopulations. An Element Occurrence update method was used at other small subpopulations. Baseline monitoring information was collected in 2004. In 2004, several new localized disturbances posing serious threats to subpopulation viability were documented. Long-term monitoring data will be used to guide future conservation decisions. For immediate conservation needs, we recommend appropriate management options beneficial for long-term population persistence.

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INTRODUCTION

Until recently, Indian Valley sedge (*Carex aboriginum*) was known only from the 1899 type collection from Indian Valley, located in Adams County, Idaho. A 1989 field survey failed to relocate any populations and documented that most of potential habitat in the Indian Valley area was converted to agricultural fields or used for intensive livestock grazing (Moseley 1990). Based on this survey, Indian Valley sedge became the first Idaho endemic plant presumed to be extinct. However, a population was opportunistically discovered north of Indian Valley, near Mesa, Idaho in 1999. Another small population was found near Council, Idaho, in 2000.

With funding from the U.S. Fish and Wildlife Service (USFWS), the Idaho Conservation Data Center (IDCDC) conducted field inventories for additional populations in spring of 2001 and 2002 (Murphy 2002, Murphy and Cooke 2003). Two additional occurrences were discovered during the 2001 inventory. In 2002, four new occurrences were discovered and two known occurrences were found to be larger than previously thought. An additional subpopulation was found at another known occurrence in 2003. During these inventories, Indian Valley sedge distribution, habitat condition, phenology, and ecology information was collected. Appendix 1 summarizes the inventory and monitoring history, as well as population size prior to 2004 monitoring, for each occurrence. Indian Valley sedge remains one of Idaho's rarest plant species (NatureServe conservation rank of G1) and is of high conservation concern. There are only eight extant occurrences, comprised of 27 subpopulations, with a total range approximately 16 km wide by 40 km long (Figure 1). These occurrences support at least 800 to 1,500 plant "clusters" and cover about 2,600 m^2. Indian Valley sedge is currently on the Idaho Bureau of Land Management (BLM) Sensitive Species List (Bureau of Land Management 2003), but has no formal federal or state conservation protection.

Only one Indian Valley sedge occurrence is assessed to have good estimated long-term viability. No known occurrences are adequately protected from threats. One occurrence is located on a private land open space easement, but intensive cattle grazing, adjacent housing and road development, and exotic plant species invasion currently threaten it. Two of the three largest occurrences are on private land, one of which is intensively grazed during Indian Valley sedge growing season. Another private land occurrence is adjacent to a road in a residential area with nearby subdivision development. Three of the four occurrences on public land are small and threatened by various land use activities. Off-highway vehicle (OHV) traffic and intensive spring livestock grazing threaten the largest occurrence on public land. Appendix 2 summarizes land ownership and threats for each occurrence. While it is clear that the species tolerates some disturbance, revisiting known occurrences in 2002 revealed that the number of culms and reproductive output fluctuates year-to-year. The lack of data regarding Indian Valley sedge population dynamics and its response to habitat conditions led us to realize that a comprehensive population and habitat-monitoring program was needed. Conservation actions preventing or minimizing habitat degradation were also needed.

In 2004, the IDCDC designed and established a monitoring program that measures trends in population size and vigor, habitat condition, and disturbance/threat factors over time. The first several years are considered a pilot project, because modifications to our methodology may be made as we gain experience with the species and its habitat. Long-term monitoring data will guide future conservation decisions for Indian Valley sedge. We are also assisting federal, state, and private land managers in developing appropriate management alternatives beneficial for long-term population persistence. For example, in 2004, IDCDC botanists led two tours to show BLM personnel several occurrences. Tour participants included Four Rivers District Botanist, Mark Steiger, Idaho State Botanist Roger Rosentreter, Range Specialist Mike Burnham, and field technicians. In addition, a private landowner was also shown Indian Valley sedge and its habitat.

SPECIES DESCRIPTION, ECOLOGY, AND THREATS

Murphy (2002) and Murphy and Cooke (2003) describe Indian Valley sedge taxonomy, description, ecology, habitat (including climate and geology of the Indian Valley area), and threats to occurrences. An element occurrence (EO) is the standard database device used throughout the Natural Heritage/Conservation Data Center network for tracking rare species, or "elements" (NatureServe 2002). Element occurrences represent a specific geographic location and may include multiple subpopulations. The number assigned to each EO corresponds to the reference number used by the IDCDC database. Nomenclature for all species in the report follows the PLANTS Database (National Resources Conservation Service 2001).

Description: The following description is adapted from Cronquist (1969) and field observations. Indian Valley sedge stems are loosely clustered on short rhizomes. Individual plants form clusters, some distinct and some not, that cover from about 0.5 to 1.0 m^2. The flowering stems are typically about 40 to 65 cm long (but are occasionally up to 1 m tall, exceeding the leaves by nearly 60 cm). It has bluish-green leaves that are narrow and flat (about 2 to 4 mm wide), typically about 15 to 35 cm long, and restricted to the lower one-third of the stem. There are up to four short, cylindrical spikes (each up to 1.5 cm long) per flowering stem. The spikes are erect or ascending, their weight tending to cause the flowering stems to droop. The terminal spike is staminate, while the lateral spikes are pistillate, staminate, or mixed (staminate above pistillate). The bract subtending the lowest spike equals or exceeds the inflorescence. The pistillate scales are reddish-brown and are narrower and shorter than the perigynia. The perigynia are greenish when immature, but become coppery-tinted pale brown upon maturity. The perigynia are ovate to elliptic in shape, somewhat inflated, about 5 mm long, and have a prominent beak. The perigynia are ascending to spreading, or the lower ones may reflex. The triangular achene has three stigmas.

Reproductive Biology: Indian Valley sedge reproduces sexually and asexually, and is probably wind pollinated, like other sedge species. Vegetative propagation is by short rhizomes or rootstocks (Cronquist 1969, Hermann 1970). Both dispersed ramets and loose clusters of ramets have been observed in the field.

Indian Valley sedge completes its reproductive cycle early in the growing season compared to many other sedge species in Idaho. The leaves and flowering stems grow rapidly and plants reach full vegetative height by late May or early June. It flowers from mid-May to early June, with the fruits maturing during June. Flowering and perigynia maturation can vary year to year by at least two weeks. Mature achenes were observed on the type specimen collected by Marcus E. Jones on July 12, 1899 (Moseley 1990). Seed dispersal is probably by gravity, wind, and seasonal floods (Moseley 1990). The best period to survey and monitor for the species is late May through mid-June, when the blue-green leaves and tall flowering stems are most visible.

Mering Hurd has propagated the species from seed with methods used for other sedge species (M. Hurd, formerly with U. S. Forest Service, Rocky Mountain Research Station, pers. comm.). Plants propagated from seed grow rapidly and appear easy to transplant into suitably moist soils. Transplants have survived in a garden setting for over three years.

Life History: We lack most life history and demographic information regarding Indian Valley sedge.

Habitat: Minimal quantitative data exists on Indian Valley sedge habitat characteristics. Occurrences are known from elevations between 875 and 1355 m (2,875 to 4,445 feet). Approximately 20 to 25 inches of annual precipitation occurs within its range, about two-thirds of which falls, mostly as snow, between November and March. July and August are the driest and hottest months. The frost-free growing season is typically between mid-May and late September.

Potential habitat is widely scattered and discontinuous within its range. Indian Valley sedge is typically found on ephemerally moist sites with clay-rich loamy soils, often derived from gravelly alluvium, and underlain by basalt. Sites range from mesic graminoid meadows in broad basins to grass-dominated gaps within scrub-shrub riparian zones of narrow to moderately wide canyons. Fluvial settings include low alluvial terraces streambanks adjacent to intermittent creeks, in seeps and sub-irrigated meadows, and on other suitably ephemerally moist sites, including banks of roadside ditches. In general, habitat is transitional between wetter, seasonally flooded sites and drier, upland areas, and are usually highly productive. Indian Valley sedge habitat is often characterized by high plant diversity, especially grasses, perennial and annual vernal forbs, and exotic species. The following species are frequently associated with Indian valley sedge:

Shrubs

- arroyo willow (*Salix lasiolepis*)
- black hawthorn (*Crataegus douglasii*)
- snowberry (*Symphoricarpos albus*)
- syringa (Philadelphus lewisii)

Forbs

- camas (*Camassia quamash*)
- Carolina geranium (*Geranium carolinianum*)
- curly dock (*Rumex crispus*)
- denseflower willowherb (*Epilobium densiflorum*)
- slender cinquefoil (*Potentilla gracilis*)
- tall groundsel (*Senecio hydrophiloides*)

Graminoids

- Bolander's spikerush (*Eleocharis bolanderi*)
- bulbous bluegrass (*Poa bulbosa*)
- California oatgrass (*Danthonia californica*)
- creeping spikerush (*Eleocharis palustris*)
- Howell's rush (*Juncus howellii*)
- Japanese brome (*Bromus japonicus*)
- Kentucky bluegrass (*Poa pratensis*)
- meadow barley (*Hordeum brachyantherum*)
- redtop (*Agrostis stolonifera*)
- rush species (e.g., *Juncus confusus*, *J. tenuis*)
- sedge species (e.g., *Carex athrostachya*)

Range: The total known global range of Indian Valley sedge is about 16 km wide by 40 km long (10 by 25 miles) (Figure 1). Three occurrences are clustered between Mesa and Council, in Adams County, Idaho. Two occurrences are known from the Indian Valley area a few miles south, while the remaining three occurrences are located further to the south in northeastern Washington County.

Landscape Context: The range of Indian Valley sedge lies mostly within the sagebrush-steppe zone, dominated by big sagebrush (*Artemisia tridentata* ssp. *xericensis*), bitterbrush (*Purshia tridentata*), and bluebunch wheatgrass (*Pseudoroegneria spicata*). There are many inclusions of rigid sagebrush (*Artemisia rigida*), buckwheat (*Eriogonum* spp.), and Sandberg's bluegrass (*Poa secunda*) vegetation on scabland sites within this area, as well as mountain shrub communities on northerly canyon slopes. Likely due to the combined effects of intensive livestock grazing, shrub clearing, wildfire, and seeding, large blocks of sagebrush-steppe in Indian Valley area have been converted to exotic grass communities dominated by bulbous bluegrass, Japanese brome, medusahead (*Taeniatherum caput-medusae*) and intermediate wheatgrass (*Thinopyrum intermedium*). Within about 8 km (5 miles) of all known occurrences, the sagebrush-steppe abuts the lower timberline typified by ponderosa pine (*Pinus ponderosa*) and/or Douglas-fir (*Pseudotsuga menziesii*) woodlands.

The broad, moist bottomlands of the Weiser and Little Weiser Rivers once supported a mosaic of black cottonwood (*Populus trichocarpa*), willow (*Salix* spp.), black hawthorn, and mesic graminoid meadow plant communities. Only degraded remnants of this wetland vegetation remain, especially along the Weiser River. Ephemeral, intermittent, and perennial tributary streams, with patchy shrub or mesic graminoid riparian vegetation (depending on moisture regimes and past disturbances), are common. Before agricultural conversion, domestic livestock introduction, and subsequent exotic species invasions, these bottomlands and intermittent drainages probably supported more potential Indian Valley sedge habitat than today. Today the Weiser and Little Weiser River valleys are intensively farmed, mainly as irrigated hay pasture and cropland.

Livestock graze most land within Indian Valley sedge's range. Numerous livestock-watering reservoirs have been dug in ephemerally moist drainages and at springs throughout the area, including near several EOs. Element occurrences are also known from rural residential areas and roadsides. Recently, many parcels of private land between Cambridge and Council have been subdivided for housing development, including immediately adjacent to EOs.

Threats: Imminent, high magnitude habitat threats have been documented at each Indian Valley sedge occurrence. Appendix 2 summarizes livestock activity, weed levels, and other threats at each occurrence. The four most common categories of threats are livestock grazing disturbances, OHV impacts, land development, and competition resulting from exotic and noxious weed species. Another possible threat is woody species encroachment and shading of Indian Valley sedge habitat.

Cattle graze portions of all occurrences. Several occurrences are grazed in the spring resulting in flowering stems being eaten and a reduction in potential seed production. Intensive cattle grazing also affects habitat condition. Soil compaction and hummock formation, caused by trailing and trampling, have been observed in occupied habitat. These soil impacts can alter water infiltration, resulting in excess runoff or pooling that potentially changes the conditions required by Indian Valley sedge. In addition, cattle trampling and hoof shearing of streambanks has been observed at several occurrences. Decreased cover of deeply rooted native mesic graminoid species has resulted in streambank instability and erosion at some occurrences. Stream downcutting (indicated by active headcuts), resulting in site desiccation, has also occurred. Livestock grazing management (e.g., timing, number of Animal Unit Months, salt block placement, etc.) can influence the level of impacts.

OHV use (including 4 x 4 vehicles) within occupied habitat can result in ruts, soil compaction, and direct loss of Indian Valley sedge. The impacts to soil and hydrology are often similar to those caused by cattle. One occurrence, Upper Road Gulch (EO 9), is currently affected by OHV use. A rough two-track road bisects the population at this site.

Half the known occurrences are adjacent to roads, housing subdivisions, or other developments. Only one occurrence is in a roadless drainage basin. The main roadside threats are ditch, culvert, fence, and buried cable maintenance that directly affect occupied habitat and can alter hydrologic conditions of nearby habitat. A biking and hiking trail follows the old railroad right-of-way adjacent to subpopulations at Lower School Creek (EO 3).

Highly competitive exotic and noxious weed species are conspicuous at the majority of occurrences. Habitat disturbances often increase bare soil available for exotic plant species establishment. The effect of noxious weed competition on Indian Valley sedge populations is not clearly understood, but is presumed to be negative. Improperly planned control of noxious weed populations also potentially impacts occurrences. Herbicide over-spraying along roadsides, trails, and ditches is a possible threat at three occurrences. Exotic grass species (e.g., bluegrass species, Japanese brome, redtop) are frequently associated with Indian Valley sedge. Highly invasive exotic and noxious weed species (Idaho Department of Agriculture 2004) commonly associated with occurrences include:

- burdock (*Arctium minus*)
- Canada thistle (*Cirsium arvense*)
- Carolina geranium (*Geranium carolinianum*)
- common tansy (*Tanacetum vulgare*)
- European sage (*Salvia* species)
- field bindweed (*Convolvulus arvensis*)
- field buttercup (*Ranunculus arvensis*)
- houndstongue (*Cynoglossum officinale*)
- grass pink (*Dianthus armeria*)
- leafy spurge (*Euphorbia esula*)
- poison hemlock (*Conium maculatum*)
- prostrate knotweed (*Polygonum aviculare*)
- prickly lettuce (*Lactuca serriola*)
- rush skeletonweed (*Chondrilla juncea*)
- Scotch thistle (*Onopordum acanthium*)
- St. John's wort (*Hypericum perforatum*)
- sulphur cinquefoil (*Potentilla recta*)

METHODS

Monitoring Plan: A mix of qualitative and quantitative methodology was deemed most practical for this pilot project. The objective of this monitoring is to quantify trends in population size and vigor, habitat condition, and disturbance/threat factors over time. Baseline data will be collected during at least the first year of monitoring at each occurrence.

Before development of methods, a rough ecological model for Indian Valley sedge was conceptualized. It was based on field observations of Indian Valley sedge ecology and known disturbances and threats (Appendix 2). The ecological model helped clarify our understanding of species ecology and illustrated possible negative impacts to subpopulation size and habitat condition presumably caused by disturbances and threats (Elzinga et al. 1998). This ecological model allows us to interpret the effects of possible management options. However, this model is untested and subject to change, and minimal data regarding the effects of disturbance exist.

To develop repeatable and objective monitoring methods, our approach focused on measurable attributes that serve as logical indicators of Indian Valley sedge subpopulation size, reproduction and vigor, and habitat condition. Some of the rationale for choosing attributes is discussed below.

1. *Subpopulation Size*—Subpopulation size can be measured by Indian Valley sedge abundance and the area it occupies. For measuring abundance, determining an easily measurable counting unit for individual Indian Valley sedge plants is difficult. The stems are difficult to see within the thick mesic graminoid vegetation they are typically associated with. Individual plants vary from distinctly clustered stems to loosely clustered or isolated stems, and distinguishing between individuals is impossible without digging up rhizomes (Murphy 2002, Murphy and Cooke 2003). Although usually distinguishable from co-occurring sedge species, counting individual Indian Valley sedge stems is challenging and time consuming. Measuring changes in vegetative cover is possible, but cover measurements can be erroneous due to observer bias when estimating canopy cover of thin, dispersed sedge leaves (Elzinga et al. 1998). In addition, cover often reflects year-to-year climate variability or other difficult to quantify environmental factors. Changes in Indian Valley sedge frequency are easier to measure and can be used to assess changes in population size (Elzinga et al. 1998). For these reasons, we chose frequency to measure plant abundance. The area occupied by Indian Valley sedge is another indicator of population size. Mapping area occupied is easiest at contiguous small subpopulations, but it is more difficult at larger subpopulations or discontinuously distributed subpopulations.
2. *Reproduction and Vigor*—The flowering stems of Indian Valley sedge are conspicuous and easy to count (if they have not been grazed by livestock or native ungulates) (Murphy 2002, Murphy and Cooke 2003). For this reason, density of flowering stems was chosen as the indicator of reproduction. Height of Indian Valley sedge leaves and length of flowering stems are also easily measured and potential indicators of plant vigor. Counting flowering stems removed by livestock or native ungulates would indicate a potential decrease in reproductive output. In areas grazed by livestock during peak growth and reproduction season for the species, measuring the stubble height of vegetation would indicate intensity of grazing. Wildlife sign was tracked to assess the relative proportions of livestock and wildlife use.
3. *Habitat Condition*—Habitat condition indicators were determined from known disturbances and threats observed at occurrences (Appendix 2). Disturbance and threat indicators are described below. Changes in these indicators over time would indicate trends in habitat condition. Additionally, measurements of habitat condition indicators at a larger scale were made to document potential threats.

The monitoring program uses three methods of data collection. All large subpopulations (greater than about 100 m^2 in size) were sampled using a series of quadrats systematically spaced along transects within a permanently marked macroplot. Most other subpopulations composed of either discontinuous patches of plants or small contiguous patches (less than 100 m^2) were monitored using two different

methods. One subpopulation at each occurrence lacking a large subpopulation was monitored using a grid design within a macroplot. Remaining subpopulations were monitored with a less intensive EO update method. Only cursory element occurrence updates were done for two subpopulations at EO 2, one subpopulation at EO 3, and privately owned occurrences EO 5 and EO 8. Table 1 summarizes the monitoring method used at each subpopulation. Copies of all forms used for recording macroplot establishment, monitoring, and EO update data are found in Appendices 3 through 6.

Table 1. Monitoring methods by subpopulation and occurrence.

EO #	Subpopulation #	Quadrat Sampling	Grid	EO Update	Cursory EO Update
2	1				X
	2				X
	3	X			
3	1			X	
	2				X
	3			X	
	4			X	
	5		X		
4	1		X		
	2			X	
	3			X	
	4			X	
	5			X	
	6			X	
5	1				X
	2				X
	3				X
6	n/a	X			
7	n/a		X		
8	1				X
	2				X
9	1	X			
	2	X			
	3			X	
	4			X	
	5			X	
	6			X	

Macroplot Establishment: Though differing in size, the layout and establishment of permanent monitoring macroplots was similar for both large and small subpopulations. If possible, macroplots at each subpopulation encompassed all occupied and immediately adjacent potential habitat. If management varied across a large subpopulation (e.g., a livestock exclosure or drift fence divided the subpopulation), then a macroplot would be established in each area under a different management regime. The northeast corner of the subpopulation was chosen as the starting point for laying out the macroplot. We ran a tape from the northeast corner parallel to the longest edge of the subpopulation (in whichever direction was best to include the subpopulation) to form a baseline. Figures 2 through 8 illustrate layout of macroplots.

For large contiguous subpopulations, the baseline was a minimum 20 m long. This ensured a sufficient number of transects could be established within the macroplot to maximize the quadrat sample size. The baseline length and macroplot width corresponded with the area occupied by the subpopulation to the nearest 5 m. The width was a minimum of 10 m. For most subpopulations sampled, a rectangular macroplot adequately encompassed the occupied habitat. An exception was

at EO 2, where occupied habitat was irregularly shaped due to inclusions of less suitable habitat. To accommodate this irregularity, a 15 x 15 m extension was added to the macroplot (Figure 2). For small contiguous subpopulations, the baseline length was between 5 and 10 m (ending at the nearest meter mark). The width was a minimum of 3 m and no more than 5 m.

The northeast corner (rebar #1) and at least the endpoint (rebar #2) of the macroplot baseline were both marked for relocation by placement of orange-painted rebar. The other corners were also marked with rebar if they could be practically relocated. The corner opposite rebar #1 was called rebar #3. The location of each rebar was mapped using a navigation grade global positioning system (GPS unit). Rebar relocation will only be possible by exact triangulation from more long-lasting nearby landmarks, such as power poles, trees, rock cairns, fence posts, or other features, and with assistance of a low-cost metal detector. The precise distances and azimuths (not corrected for declination) from landmarks to the nearest two rebars were recorded. Detailed maps and directions to the macroplot and landmarks were also written. The length and azimuth (from rebar #1 to rebar #2) of the macroplot baseline, and macroplot width, were also documented.

Photo-point Monitoring: Photo-points were established to best view habitat changes within and immediately adjacent to the macroplot. Five photos were taken from outside the macroplot looking back toward the center. Starting at the northeast corner, and continuing clockwise, a photo was taken at a point 5 m diagonally out from each corner. To provide a view of the entire macroplot, one additional photo was taken from a point 10 m perpendicular out from the center of the baseline. A digital camera on automatic function, set to the widest angle without any zoom, was used. The frame number, photographer, and azimuth (without declination correction) from the photo-point to the specified corner were recorded.

Large Subpopulations Sampled by Quadrats: The sampling design was similar to that described by Elzinga et al. (1998). Macroplots were sampled using 1-m² quadrats located along a series of transects running across the macroplot perpendicular from the baseline. Quadrats were regularly spaced along transects at intervals equal to the distance between transects. Quadrats were spaced at least 2 m apart to assure independence. Transect length matched the width of the macroplot. Figures 2, 5, 7, and 8 illustrate the layout of quadrat sampling transects at each occurrence.

The line intercept method (Canfield 1941) was used to determine the percent canopy cover of all live and dead woody species along each transect. Overhanging and rooted shrubs and trees were included, and we assumed a closed canopy until the gap exceeded 20 cm. To better describe stand structure, the height (m) and height range of each woody species was estimated for each transect.

Small Subpopulations Monitored by Grid: Selected small contiguous subpopulations were monitored using a 1-m² grid system overlying the macroplot. This created a series of 1-m² quadrats that abutted each other. The entire macroplot was sampled by collecting data from each of the 1-m² quadrats comprising the grid. The quadrats are not independent samples, but they allow for mapping of the area occupied by Indian Valley sedge.

At the 1-m, 3-m, and 5-m marks along the baseline, transects running perpendicular from the baseline served as the basis for measuring line intercept of woody species. The line intercept method used in the grids was the same outlined for quadrat monitoring. Figures 3, 4, and 6 illustrate the layout of macroplot grids and transects used for measuring woody species line intercept.

Quadrat Data Collection: The same monitoring information was collected for both large subpopulations sampled by the quadrat method and small subpopulations monitored with the grid method. The following information was recorded for each 1-m² quadrat:

1. *Presence or absence of both reproducing (indicated by flowering stems) and non-reproductive (vegetative) Indian Valley sedge*. Frequency of stems rooted within nested 10 x 10 cm, 25 x 25

cm, 50 x 50 cm, and 1 x 1 m quadrats was recorded. At larger subpopulations, quadrats were placed on the right side of transects, with the bottom edge at the appropriate meter mark. The smallest nested quadrat was always placed in the lower left corner of the quadrat.

2. *Presence or absence of a) all invasive and noxious exotic weed species (in Appendix 2); b) all native perennial graminoid and forb species; and c) groundcover features, including bare soil and gravel, rock, wood (>1 cm diameter), and standing water*. The same nested frequency quadrats used for monitoring Indian Valley sedge population size were used. Plant species had to be rooted within quadrats to be counted.
3. *Number of Indian Valley sedge flowering stems by stage development class of perigynia (aborted, immature, or mature)*. The number of flowering stems removed by livestock or wildlife grazing was also recorded. Flowering stems had to be rooted within the quadrat to be counted.
4. *Length (cm) of Indian Valley sedge flowering stems and height of leaves.* Flowering stem length and leaf height is the average lengths of the longest, shortest, and median representatives.
5. *Height (cm) of herbaceous vegetation, excluding inflorescences and woody vegetation.* The height is the average lengths of the longest, shortest, and median representatives. This measurement also reflects the stubble height of grazed vegetation.
6. *Presence or absence of wildlife sign (e.g., trailing, hoofprints, scat, digging).* The specific type of wildlife sign was noted.
7. *Presence or absence of foraging (i.e., clipped vegetation) by livestock and/or wildlife.* If wildlife sign were absent and indicators of livestock grazing present, then all foraging was due to livestock grazing. If no livestock grazing had occurred, then all foraging was due to wildlife.
8. *Number of livestock hoofprints from spring grazing during the current year, and the number of livestock dung piles*.
9. *Number of recent OHV-caused tracks or ruts.*
10. *Presence or absence of recent human disturbances.* These included a) non-motorized recreation and campsite impacts (e.g., tent sites, fire rings, human trampling, etc.); b) human-caused ground disturbance (e.g., excavation, deposit of fill, placement of livestock salt blocks, firefighting sign, and construction/maintenance of fences, roads, buried cable or pipelines, etc.); c) hydrologic alteration (e.g., construction/maintenance of ditches, culverts, livestock-watering ponds, etc.). The specific types of disturbances were noted.

Small Subpopulations Monitored by Element Occurrence Update Method: Small or discontinuous subpopulations not monitored with grids were monitored by an EO update method that blended the collection of both qualitative and quantitative information. Four general types of information were recorded:

1. *Subpopulation Location*—a) specific directions to subpopulation; b) location mapped by using a GPS unit; usually, the upstream and downstream endpoints of the subpopulation were mapped.
2. *Subpopulation Size*—counts of the: a) number of Indian Valley sedge clusters (if possible to determine); number of reproductive clusters; number of non-reproductive vegetative clusters; and number of flowering stems and percent of flowering stems that had immature, mature, or aborted perigynia; b) mean flowering stem length and height of leaves (cm); c) length, width, and diagonal lengths (one for triangle, two for trapezoid) (m) of area occupied by Indian Valley sedge; d) comments on subpopulation extent, survey intensity, and presence or absence of unsurveyed potential habitat.
3. *Habitat Description*—a) comments on the general habitat; b) comments on the substrate, soil, and light regime; c) plant community type; d) estimated total percent cover of woody species within occupied habitat; d) most abundant (>5% cover) or important associated species; e) a list of invasive and noxious exotic weed species and their abundance rating (rare: <1% cover; common: 1-5% cover; or abundant: >5% cover).
4. *Subpopulation scale Habitat Disturbances and Threats*—The presence/absence or number of, and a brief description of: a) OHV tracks; b) recreation/campsite impacts; c) human-caused disturbances; d) hydrologic alteration; e) herbicide spraying; f) wildlife sign; g) livestock sign; and h) foraging. In addition, at least one photo was taken 5 m (more if necessary) out from an

edge of the subpopulation, looking toward the center so as to encompass the entire occupied habitat. The azimuth to the subpopulation center was recorded.

Landscape scale Habitat Disturbance and Threat Information Collection: Potential or indirect disturbances and threats to subpopulation habitat were assessed at a scale larger than the immediate occurrence (i.e., the "landscape" scale). Disturbances and threats were documented within a 50-m radius of each subpopulation monitored. If two or more subpopulations were within 100 m of each other, then only one landscape scale assessment was made for these subpopulations. Assessments were made by pacing 50 m from the subpopulation center to make thorough and accurate estimates of disturbances and threats. The following information was recorded:

1. *Streambank Erosion*—The percent of streambank experiencing recent erosion, shearing, or collapse was estimated. In addition, the number and height (in cm) of active stream headcuts within 50 m downstream of a subpopulation was recorded. Descriptive comments of the type and extent of erosion, its apparent causes, and streambank stability were also made.
2. *Highly Invasive Exotic and Noxious Weed Species*—The species present were listed, and the relative abundance of each estimated. Abundance ratings were: rare: <1% cover; common: 1-5% cover; or abundant: >5% cover.
3. *Herbicide Spraying*—Presence or absence of herbicide spraying was recorded. Comments on the proximity to occupied habitat, extent of spraying, and type of spraying were included.
4. *OHV Disturbance*—The number of roads or track sets were counted. Their extent within 50 m of the subpopulation was also estimated.
5. *Non-motorized Recreation Impacts*—The number of fire rings or other campsite impacts and the length and width of any obvious human-caused trails or trampling was estimated.
6. *Other Human-caused Disturbances*—The presence or absence of human-caused disturbances and comments on the type, location, extent, number, and severity of impact to habitat.
7. *Fire*—Presence or absence of sign and comments on location, extent, and severity.
8. *Alteration of Floodplain, Valley Bottom, and Hydrology*—The presence or absence of disturbances, distance to disturbance from subpopulation center, and comments on the direct and indirect effects were documented.
9. Any outlying Indian Valley sedge plants within 50 m were recorded. These plants sometimes represent new subpopulations or extensions of known subpopulations. The number of clusters (if possible to discern) and flowering stems were counted and locations mapped with GPS units.

Total Population Size and Area Occupied: To obtain another measure of relative population size, the number of plant clusters was estimated for each occurrence. In 2004, cluster numbers were only counted (if they were possible to distinguish) at subpopulations monitored by the EO update method. They were roughly estimated at subpopulations monitored by quadrat sampling and the grid method by extrapolating Indian Valley sedge frequency results (each "hit" represented about one cluster) to the entire subpopulation. The area occupied was also estimated. For small subpopulations and one larger subpopulation (EO 6) it was possible to accurately measure the area occupied. At other larger subpopulations, the area occupied was estimated by extrapolating frequency results (each "hit" represented about 1 m^2 of occupied habitat) to the entire subpopulation.

***Analysis*:** Data collected in the field were entered into spreadsheets. Frequency and means (including standard deviations) were calculated. For subpopulations monitored by quadrat sampling, standard errors (SE) were calculated and corrected by multiplying by the finite population correction factor (FPC = square root of (N-n)/n where N = potential number of quadrat positions) as in Elzinga et al. (1998). Confidence intervals (95% CI) were also calculated. Frequency data will be analyzed for significant change by using either chi-square or McNemar's test. A paired t-test will be used to analyze for significant changes in mean density. The first year data set will be used to adjust the number of samples where necessary for statistical purposes.

Population size, combined with habitat condition and landscape scale disturbance and threat information was used to reassess the EO Ranks for each occurrence. The network of Natural Heritage Programs and Conservation Data Centers use EO Ranks for conservation planning (NatureServe 2002). EO Ranks represent the estimated viability (or probability of persistence at least 20 years into the future) of occurrences based on current habitat condition, population size, and landscape context. An 'A' rank equals excellent estimated viability; a 'B' rank equals good; a 'C' rank equals fair; and a 'D' rank equals poor.

Specifications for ranking Indian Valley sedge EOs have not been finalized. For preliminary ranking, 'A' or 'B' ranked occurrences had a large population size (i.e., total habitat occupied by Indian Valley sedge must be greater than 100 m^2, preferably comprised of two or more subpopulations, and support a minimum of about 75 Indian Valley sedge clusters and/or 200 flowering stems). An 'A' ranked occurrence would have no imminent, high magnitude threats and no recent major habitat disturbances within or immediately adjacent to occupied habitat. Potential threats would not be imminent and the occurrence would be located in a landscape where natural ecological processes and native vegetation are intact. A 'B' ranked occurrence would have one or two imminent, high magnitude threats and two or less potential imminent threats. It would also be located in a landscape where natural ecological processes and native vegetation are intact. Any disturbances (at any scale) have minimally compromised the ecological integrity of habitat. A 'C' ranked occurrence would not meet the population size criteria or the habitat condition and landscape context criteria required for a 'B' ranked occurrence. A 'D' ranked occurrence would fail to meet any of the above criteria but may still be valuable for short-term conservation (e.g., seed source, genetic material banking, restoration).

RESULTS AND DISCUSSION

In 2004, we monitored a total of six occurrences (Table 1). All four occurrences on public land (EOs 4, 6, 7, and 9) were monitored. EO 3, located on a private open space easement with public access was monitored. EO 2 was also monitored because the private landowner granted us permission to do so. EOs 5 and 8, both on private land, were not monitored in 2004. However, cursory roadside observations were made so that EO database records could be updated.

Baseline data collected in 2004 is summarized below. Frequency data is reported only for 1-m^2 quadrats. Table 2 summarizes total area of habitat occupied by Indian Valley sedge, total population size, and EO Rank by occurrence. Table 3 summarizes Indian Valley sedge flowering stem density, mean flowering stem length, and mean leaf height for subpopulations monitored by quadrat sampling and the grid method. Table 4 summarizes area of occupied habitat, size, and Indian Valley sedge distribution pattern at subpopulations monitored using the EO update method. Tables 5 and 6 summarize the frequency of important associated herbaceous species and ground cover attributes, and Table 7 summarizes the percent cover of associated woody species, at subpopulations monitored by quadrat sampling and the grid method. Table 8 summarizes the density of OHV disturbance and livestock grazing sign, and frequency of foraging and wildlife sign, at subpopulations monitored by quadrat sampling and the grid method. Figures 2 through 8 show quadrats sampled, quadrats with Indian Valley sedge present, and the reproductive, vegetative, and cumulative frequencies of Indian Valley sedge in each macroplot monitored.

Population Size, Area Occupied, Reproduction, and Vigor by Occurrence:
Mesa (EO 2)—This occurrence supports the third largest Indian Valley sedge population and the second largest area of habitat occupied (Table 2). The 2001 estimate of total area occupied at Subpopulation #3 was probably too high. The 2001 estimate included large patches of unoccupied habitat. In 2004, the area occupied at this subpopulation was estimated to be 375 m^2 (Table 2).

The largest subpopulation (Subpopulation #3) was monitored using quadrats, while only cursory walk-through observations were made at Subpopulations #1 and #2. No Indian Valley sedge plants were

observed at Subpopulation #1 in 2004. This small subpopulation is heavily impacted by cattle grazing and trampling due to its close proximity to a dug out cattle-watering pond. In contrast, many clusters and flowering stems were observed at Subpopulation #2. This subpopulation is difficult to monitor because it occurs as several small patches discontinuously distributed along a relatively long stretch of ephemeral stream channel. The cumulative Indian Valley sedge frequency at Subpopulation #3 (Figure 2) was slightly less than the cumulative frequency sampled at large subpopulations at EO 9. Based on density of flowering stems sampled at Subpopulation #3, an estimated 850 flowering stems (+/- 609 with a 95% CI) were present (Table 3). Overall, vigor at this subpopulation was lower than both large subpopulations monitored at EO 9, but higher than at EO 6. The mean length of flowering stems was the most of all large subpopulations monitored (Table 3).

Table 2. Total area of occupied habitat, total population size, and EO Rank by occurrence.

EO #	Total Area Occupied[1] (approximate m^2)	Total Population Size[2] (approximate)	2004 EO Rank[3]
2	550–650	375+ clusters 240–1,460+ flowering stems	C
3	25–30	17 clusters 127 flowering stems	C
4	115 +/-	30 clusters 82 flowering stems	C
5	10–15	no count (similar to 2002)	D
6	125 +/-	40 clusters 86 flowering stems (before cattle grazing)	C
7	8 +/-	6 clusters 19 flowering stems	C
8	1,250+	no count (similar to 2002)	C
9	510 +/-	400 clusters 2,510–12,730 flowering stems	B

[1] = At small subpopulations and a few larger subpopulations the area of habitat occupied was measurable. At most large subpopulations, the area occupied was estimated by extrapolating frequency results (each "hit" represented about 1 m^2 of occupied habitat) to the entire subpopulation.
[2] = Cluster numbers were counted at subpopulations monitored by EO update method. Cluster numbers were roughly estimated at subpopulations monitored by quadrat sampling and the grid method by extrapolating frequency results (each "hit" represented about one cluster) to the entire subpopulation. Cluster numbers should only be used for determining relative population size.
[3] = An 'A' EO rank equals excellent estimated viability; a 'B' rank equals good; a 'C' rank equals fair; and a 'D' rank equals poor.

Lower School Creek (EO 3)—The total area occupied at this occurrence was 25 to 30 m^2 (Table 2). Subpopulation #5, newly discovered in 2004, was the only one at this occurrence monitored using the grid method. Not only was it the most vigorous of all subpopulations at this occurrence, it was also the most vigorous of all small subpopulations monitored with the grid method. Both the cumulative frequency of Indian Valley sedge and frequency of flowering stems (Figure 3) were the highest of all small subpopulations monitored. The mean length of flowering stems was also longer than other small subpopulations (Table 3). A total of 81 flowering stems were counted (Table 3). This was also much higher than other small subpopulations monitored by the grid method.

Three of the four other subpopulations at this occurrence were monitored by the EO update method (Table 4). No Indian Valley sedge plants were observed at either Subpopulations #1 and #2. In 2002, both of these subpopulations were very small, each with only one large cluster observed (Murphy and

Cooke 2003). Both have experienced cattle trampling since 2002 and Subpopulation #2 had evidence of streambank erosion.

Table 3. Indian Valley sedge flowering stem density, mean flowering stem length, and mean leaf height for subpopulations monitored by quadrat sampling and grid methods.

EO # (Subpop #) Sample Size	Flowering Stems (FS)					Leaves	
	Density FS/m^2	SD	Total FS (+/-95% CI if applicable)	Mean FS Length (cm)	SD	Mean Leaf Height (cm)	SD
2 (# 3) n = 41	0.83	1.92	850 (+/- 609)	53.6	12.12	26.4	5.77
3 (# 5) n = 18	4.50	8.20	81	64.2	10.51	32.9	4.89
4 (# 1) n =18	0.22	0.71	4	45.0	0	24.2	6.55
6 n = 28	0.43	1.37	86 (+/- 99)	37.6	24.09	17.3	7.93
7 n =20	0.95	4.14	19	43.0	0	16.0	7.70
9 (# 1) n = 28	14.04	24.30	5263 (+/- 3399)	38.8	5.54	28.3	3.97
9 (# 2) n = 35	3.80	8.57	2280 (+/- 1713)	42.0	7.76	20.7	5.60

Sheep Creek/North Crane Creek Confluence (EO 4)—Estimating the total area occupied at this occurrence was difficult because Indian Valley sedge clusters were widely scattered and interspersed by patches of unoccupied potential habitat. The total area occupied by Indian Valley sedge was about 115 m^2 (Table 2). Subpopulation #1 was monitored with the grid method. With only 4 flowering stems observed, this subpopulation was not vigorously reproducing in 2004 (Figure 4 and Table 3).

In 2004, two new subpopulations were discovered along Sheep Creek, just below the confluence with Road Gulch. These and two known subpopulations were monitored by the EO update method. All four subpopulations had relatively low numbers of clusters and flowering stems (Table 4). With the exception of Subpopulation #6, the mean flowering stem lengths were the longest of any subpopulations monitored.

Council (EO 5)—A cursory roadside visit was made in 2004. All three small subpopulations were relocated. The approximate number of Indian Valley sedge clusters and flowering stems, and area occupied, was similar to the 2002 visit, when about 15 clusters and 100 flowering stems were counted in a 10 to 15-m^2 area (Table 2).

South Dry Creek Basin (EO 6)—In 2002, this occurrence was thought to consist of only one subpopulation with 2 clusters and 7 flowering stems, loosely clumped in the middle of a small seep that was heavily grazed and trampled by cattle (Murphy and Cooke 2003). In 2004, we made a cursory visit before cattle grazing (on May 26) and found the occurrence to be larger. Most plants were observed around the southern end of the seep. The total area occupied by Indian Valley sedge was about 125 m^2 (Table 2). We were able to accurately measure the dimensions of occupied habitat and the total number and average length of flowering stems during this visit, but had to return to complete monitoring. By the time we returned to complete monitoring (on June 4), cattle had grazed and trampled the occurrence.

The cumulative Indian Valley sedge frequency, and frequency of vegetative and flowering stems (Figure 5), was the lowest of all large subpopulations monitored. One aborted flowering stem was also recorded. Based on density data, an estimated 86 flowering stems (+/- 99 with a 95% CI) were

present (Table 3), matching the count of flowering stems made before livestock grazing. This occurrence had the lowest vigor of any large subpopulation. Both the sampled mean length of flowering stems and height of Indian Valley sedge leaves were the least of all large subpopulations (Table 3). The mean leaf height was also the lowest of all large subpopulations. Cattle grazing prior to sampling caused this result. Before grazing, the mean length of flowering stems was about 58 cm, while after grazing the mean length was 38 cm.

Table 4. Area of occupied habitat, size, mean flowering stem length, and Indian Valley sedge distribution pattern at subpopulations monitored using the EO update method.

EO #	Subpop. #	Subpop. Area Occupied (m^2)	Subpopulation Size	Mean Flowering Stem Length (cm)	Distribution Pattern
3	1	1	0	n/a	small patch
	3	10	5 clusters 5 flowering stems	70	discontinuous small linear patch
	4	4	3 clusters 41 flowering stems	67	small patch
4	2	30	5 clusters 9 flowering stems	75	discontinuous small linear patch
	3	36	4 clusters 18 flowering stems	78	discontinuous small linear patch
	4	17	2 clusters 8 flowering stems	90	discontinuous small linear patch
	5	7	7 clusters 21 flowering stems	70	discontinuous small linear patch
	6	20	8 clusters 22 flowering stems	54	discontinuous small linear patch
9	3	4	9 clusters 48 flowering stems	60	small patch
	4	50	18 clusters 96 flowering stems	58	discontinuous small linear patch
	5	56	21 clusters 133 flowering stems	55	discontinuous small linear patch
	6	25	5 to 10 clusters 75 flowering stems	56	discontinuous small linear patch

South Fork Grays Creek (EO 7)—This occurrence has the smallest Indian Valley sedge population size and area occupied. The area occupied was 8 m^2 (Table 2). The frequency of flowering stems was very low (Figure 6), although density was relatively higher because 19 flowering stems were tightly clustered in a small area of the macroplot (Table 3). The mean height of leaves was the lowest of all subpopulations monitored. Cattle grazing prior to monitoring had occurred.

South Fork She Creek (EO 8)—A cursory roadside visit was made in 2004. Both of the large, linear subpopulations were relocated. Compared to 2002, there were no apparent changes in population size, vigor, or area occupied. This occurrence remains relatively large and in fair ecological condition. This occurrence probably supports the largest area of occupied habitat (Table 2).

Upper Road Gulch (EO 9)—The largest Indian Valley sedge population size is at EO9. The area occupied was estimated to be 510 m^2, the third largest of all occurrences (Table 2). Both large subpopulations were monitored using quadrats. At Subpopulation #1, all three categories of Indian

Valley sedge frequency (Figure 7) were the highest of any large subpopulation monitored. This subpopulation supports the most flowering stems of any subpopulation, with an estimated 5263 flowering stems (+/- 3399 with a 95% CI) (Table 3). The estimated area occupied at this subpopulation was at least 150 m^2. At Subpopulation #2, both the cumulative frequency and frequency of vegetative stems (Figure 8) were only slightly less than at Subpopulation #1, but the frequency of flowering stems was much less. The number of flowering stems was 2280 (+/- 1713 with a 95% CI) (Table 3). Both the frequency and density of flowering stems was the second highest of all large subpopulations. The area occupied was estimated to be at least 225 m^2. It is unknown how many Indian Valley sedge clusters were removed by OHV tracking that created a barren patch in a portion of the subpopulation.

Other subpopulations at the occurrence were monitored using the EO update method. All had high vigor high vigor (Table 4). Subpopulations #4, #5, and #6 were newly discovered in 2004. Subpopulation #6 had 6 or more flowering stems grazed off by either cattle or wildlife.

Associated Species and Invasive/Noxious Exotic Weed Species by Occurrence:
Mesa (EO 2)—At Subpopulation #3, the community supporting Indian Valley sedge had high frequency of both native and exotic species, with several important forbs but a larger number of important graminoid species (Table 5). The most frequently occurring associated species were bulbous bluegrass, California oatgrass, camas, and chicory. The frequency of associated species was not monitored at Subpopulations #1 and #2.

Chicory is a tall perennial exotic forb, but it is not considered highly invasive. Bulbous bluegrass is another exotic species also well adapted to colonization of disturbed clay soils. It matures early in the growing season and produces large numbers of propagules. Several other exotic species were present, including prickly lettuce and cocklebur. No noxious weeds were present. Exposed soil and gravel, another indicator of disturbed ground, occurred with 90% frequency. At the landscape scale, three noxious weeds, field bindweed, rush skeletonweed, and sulphur cinquefoil, were common.

Lower School Creek (EO 3)—Subpopulation #5, monitored by grid, occurs between a shrubby riparian community and a weedy opening located on a terrace about 5 m from School Creek. The most frequently occurring associated species were grass pink (an annual exotic species), meadow barley, and taper-leaved penstemon (Table 6). Numerous other exotic species commonly occurred at this subpopulation, including two noxious weeds, field bindweed and St. John's wort.

Invasive and noxious exotic weed species were common at other subpopulations. At Subpopulation #1, field bindweed was common and field buttercup was abundant. At Subpopulation #3, field bindweed, houndstongue, St. John's wort, and sulphur cinquefoil were all common. At Subpopulation #4, sulphur cinquefoil was common. At the landscape scale, several additional invasive and noxious exotic weed species were present within 50 m of subpopulations. These were burdock, European sage, and common tansy (all rare), and leafy spurge and rush skeletonweed, both common. Cattle trampling and road-fill deposits (between the riparian area and a newly constructed road) have created bare soil sites suitable for colonization by exotic weed species.

At Subpopulation #5, there was 62% shrub cover consisting of a tall stratum dominated by arroyo willow and a shorter stratum dominated by common snowberry (Table 7). Shrub cover was also important at all of the other subpopulations monitored at this occurrence. Shrub cover ranged from 10% at Subpopulation #1 to 65% at Subpopulations #3 and #4. Dominant shrub species included arroyo willow, black hawthorn, common snowberry, and golden currant.

Table 5. Frequency of important herbaceous species and ground cover attributes at subpopulations monitored by quadrat sampling.

Species	EO # (Subpopulation #)							
	2 (#3)		6		9 (#1)		9 (#2)	
	Frequency	SE	Frequency	SE	Frequency	SE	Frequency	SE
Native Graminoids								
Achnatherum columbiana (Columbia needlegrass)	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.06
Carex spp. (sedge species)[1]	0.51	0.08	0.39	0.09	0.14	0.07	0.09	0.05
Danthonia californica (California oatgrass)	0.83	0.05	0.04	0.03	0.36	0.09	0.66	0.08
Eleocharis spp. (spikerush species)[2]	0.56	0.08	0.68	0.08	0.21	0.08	0.43	0.08
Hordeum brachyantherum (meadow barley)	0.42	0.08	0.64	0.09	0.18	0.07	0.20	0.07
Juncus howelii (Howell's rush)	0.22	0.07	0.29	0.08	0.04	0.03	0.06	0.04
Juncus spp. (rush species)[3]	0.81	0.06	0.71	0.08	0.93	0.05	0.89	0.05
Native Forbs								
Achillea millefolium (yarrow)	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.07
Artemisia ludoviciana (Louisiana mugwort)	0.00	0.00	0.00	0.00	0.04	0.03	0.17	0.06
Camassia quamash (camas)	0.95	0.03	0.00	0.00	0.25	0.08	0.03	0.03
Grindelia squarrosa (curlycup gumweed)	0.00	0.00	0.68	0.08	0.07	0.05	0.14	0.06
Penstemon attenuatus (taper-leaved penstemon)	0.00	0.00	0.00	0.00	0.43	0.09	0.09	0.05
Potentilla gracilis (slender cinquefoil)	0.05	0.03	0.00	0.00	0.64	0.09	0.37	0.08
Senecio hydrophiloides (tall groundsel)	0.32	0.07	0.04	0.03	0.04	0.03	0.00	0.00
Trifolium spp. (clover species)[4]	0.39	0.08	0.57	0.09	0.00	0.00	0.00	0.00
Ground Cover								
bare soil and gravel	0.90	0.05	0.89	0.06	0.64	0.09	0.91	0.05
water	0.02	0.02	0.29	0.08	0.11	0.06	0.11	0.05
Exotic Graminoids								
Agrostis stolonifera (redtop)	0.00	0.00	0.46	0.09	0.64	0.09	0.37	0.08
Bromus japonicus (Japanese brome)	0.02	0.02	0.32	0.08	0.14	0.07	0.37	0.08
Poa bulbosa (bulbous bluegrass)	0.78	0.06	0.82	0.07	0.93	0.05	0.80	0.07
Poa compressa (Canada bluegrass)	0.17	0.06	0.11	0.06	0.11	0.06	0.23	0.07
Exotic Forbs								
Cichorium intybus (chicory)	0.93	0.04	0.00	0.00	0.00	0.00	0.00	0.00
Geranium carolinianum (Carolina geranium)	0.00	0.00	0.04	0.03	0.00	0.00	0.11	0.05
Lactuca serriola (prickly lettuce)	0.34	0.08	0.50	0.09	0.18	0.07	0.26	0.07
Polygonum aviculare (prostrate knotweed)	0.00	0.00	0.04	0.03	0.00	0.00	0.00	0.00
Rumex crispus (curly dock)	0.32	0.07	0.61	0.09	0.04	0.03	0.03	0.03
Xanthium strumarium (cocklebur)	0.39	0.08	0.00	0.00	0.00	0.00	0.00	0.00

[1] includes *Carex sheldonii* (Sheldon's sedge) only at 002; mostly *Carex athrostachya* (slenderbeak sedge) elsewhere

[2] includes *Eleocharis bolanderi* (Bolander's spikerush) and/or *Eleocharis palustris* (common spikerush)

[3] includes *Juncus confusus* (Colorado rush) and/or *Juncus tenuis* (poverty rush)

[4] mostly *Trifolium longipes* (longstalk clover)

Table 6. Frequency of important herbaceous species & ground cover attributes at subpopulations monitored by grid.

Species	EO # (Subpopulation #)		
	3 (#5)	4 (#1)	7
	Frequency	Frequency	Frequency
Native Graminoids			
Carex athrostachya (slenderbeak sedge)	0.00	0.06	0.40
Danthonia californica (California oatgrass)	0.00	0.11	0.30
Eleocharis spp. (spikerush species)[1]	0.06	0.00	0.80
Elymus glaucus (blue wildrye)	0.00	0.72	0.00
Hordeum brachyantherum (meadow barley)	0.83	0.00	0.00
Juncus confusus (Colorado rush)	not surveyed	0.56	0.30
Juncus howelii (Howell's rush)	0.39	0.56	0.35
Juncus spp. (rush species)[2]	0.44	not surveyed	not surveyed
Juncus tenuis (poverty rush)	not surveyed	0.11	0.05
Poa secunda (Sandberg's 'Nevada' bluegrass)	0.17	0.00	0.00
unknown grass species	0.00	0.00	0.70
Native Forbs			
Achillea millefolium (yarrow)	0.39	0.61	0.25
Artemisia ludoviciana (Louisiana mugwort)	0.39	0.11	0.10
Aster spp. (aster species)	0.00	0.00	0.55
Camassia quamash (camas)	0.11	0.28	0.65
Penstemon attenuatus (taper-leaved penstemon)	0.83	0.00	0.00
Perideridia spp. (yampah)[3]	0.00	0.28	0.60
Potentilla gracilis (slender cinquefoil)	0.06	0.33	0.35
Senecio hydrophiloides (tall groundsel)	0.06	0.06	0.50
Sidalcea oregana (Oregon checker-mallow)	0.00	0.22	0.00
Trifolium spp. (clover species)[4]	0.06	0.00	0.10
Ground Cover			
bare soil and gravel	0.44	0.50	0.90
rock	0.00	0.33	0.05
wood	0.33	0.67	0.50
Exotic Graminoids			
Agrostis stolonifera (redtop)	0.11	0.33	0.15
Bromus inermis (smooth brome)	0.22	0.00	0.00
Bromus japonicus (Japanese brome)	0.67	0.89	0.75
Phleum pratense (timothy)	0.00	0.17	0.00
Poa bulbosa (bulbous bluegrass)	0.00	0.17	0.20
Poa compressa (Canada bluegrass)	0.33	0.11	0.40
Poa pratensis (Kentucky bluegrass)	0.28	0.67	0.50
Exotic Forbs			
Conium maculatum (poison hemlock)*	0.00	0.06	0.00
Convolvulus arvensis (field bindweed)*	0.28	0.00	0.00
Cynoglossum officinale (hound's tongue)	0.00	0.00	0.45
Dianthus armeria (grass pink)	0.78	0.00	0.00
Geranium carolinianum (Carolina geranium)	0.67	0.22	0.90
Hypericum perforatum (St. John's wort)*	0.06	0.11	0.00
Lactuca serriola (prickly lettuce)	0.28	0.39	0.60
Potentilla recta (sulphur cinquefoil)*	0.00	0.17	0.60
Ranunculus arvensis (field buttercup)	0.33	0.00	0.00
Rumex crispus (curly dock)	0.00	0.00	0.55
Taraxacum officinale (dandelion)	0.00	0.11	0.25

* Idaho noxious weed (Idaho Department of Agriculture 2004)

[1] includes *Eleocharis bolanderi* (Bolander's spikerush) and/or *Eleocharis palustris* (common spikerush)

[2] includes *Juncus confusus* (Colorado rush) and/or *Juncus tenuis* (poverty rush)

[3] mostly *Perideridia gairdneri* (Gairdner's yampah)

[4] mostly *Trifolium longipes* (longstalk clover)

Table 7. Percent cover of woody species at subpopulations monitored by quadrat sampling and grid methods.

Species	EO # (Subpopulation #)						
	2 (#3)	3 (#5)	4 (#1)	6	7	9 (#1)	9 (#2)
	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover
Crataegus douglasii (black hawthorn)	0	2.2	0	0	0	0	0
Philadelphus lewisii (syringa)	0	0	0	0	14.3	0	0
Prunus virginiana (chokecherry)	0	0	0	0	3.7	0	0
Ribes aureum (golden currant)	0	2.2	6.8	0	0	0	0
Rosa woodsii (Wood's rose)	0	0	1.7	0	3.5	0	0.8
Salix exigua (coyote willow)	0	2.8	0	0	0	0	0
Salix lasiolepis (arroyo willow)	0	15.6	23.3	0	0	0	0
Symphoricarpos albus (common snowberry)	0	39.7	0	0	7.6	0	0
dead shrub spp.	0	9.7	41.3	0	4.2	0	0
% Cover of Live Woody Spp. for Macroplot	0	62.4	31.8	0	29.1	0	0.1
Mean Woody Spp. Height (cm)	n/a	86	130	n/a	104	n/a	30
Height Range (cm)	n/a	30 - 210	n/a	n/a	n/a	n/a	n/a

Sheep Creek/North Crane Creek Confluence (EO 4)—Subpopulation #1, monitored by grid, occurs at the edge of a shrubby riparian community. The most frequently occurring associated species were graminoids, including blue wildrye, Japanese brome, and Kentucky bluegrass (Table 6). Common exotic forbs were prickly lettuce, redtop, and Carolina geranium. Exotic species may indicate colonization of soil and gravel exposed by annual cattle trampling. Several noxious weed species were also present and may pose a competitive threat, but frequency of each was low. They included poison hemlock, St. John's wort, and sulphur cinquefoil. These three species were also present (with varying cover) at the other subpopulations monitored using the EO update method. In addition, poison hemlock occurred at Subpopulation #6. At the landscape scale, several additional noxious weed species were documented. Rush skeletonweed and Scotch thistle were both rare near Subpopulation #1. Poison hemlock and rush skeletonweed were rare near Subpopulations #2, #5, and #6. Rush skeletonweed was common and Scotch thistle was rare near Subpopulations #3 and #4.

Subpopulation #1 had 32% shrub cover, mainly due to arroyo willow (Table 7). A dead shrub was also present in the macroplot, contributing much downed wood (Table 6). Shrub cover was moderate to high at all other subpopulations. Shrub cover ranged from 25% at Subpopulation #2, to 45% at Subpopulation #5, to between 50 and 70% at both Subpopulations #4 and #6. Dominant shrub species included arroyo willow, black hawthorn, golden currant, and Wood's rose.

Council (EO 5)—Associated species and exotic species were not monitored in 2004. No obvious changes from 2002 were noted.

South Dry Creek Basin (EO 6)—The community supporting Indian Valley sedge had high frequency of both native and exotic species, mostly comprised of graminoids (Table 5). Several weedy forbs were also important. The most frequently occurring associated species were bulbous bluegrass, curlycup gumweed, meadow barley, rush spp., and spikerush species. Exotic species, including curly dock, Japanese brome, prickly lettuce, and redtop, were also frequently occurring. Soil and gravel exposed by deep cattle hoofprints (i.e., pugging) had high frequency. The habitat remains wet into the summer, possibly preventing establishment of noxious weed species intolerant of saturated soil. No noxious weeds were present at either the subpopulation or landscape scale. No woody species were present.

South Fork Grays Creek (EO 7)—The community supporting Indian Valley sedge was diverse and dominated by exotic species, with forbs especially prominent (Table 6). The most frequently occurring exotic species were Carolina geranium, curly dock, Japanese brome, Kentucky bluegrass, prickly lettuce, and sulphur cinquefoil. The most frequently occurring native species were Aster spp., camas, spikerush spp., tall groundsel, and yampah. The high diversity and frequency of exotic species may indicate colonization of soil and gravel exposed by annual cattle trampling. At the landscape scale, no noxious weed species were documented. Total shrub cover was 29%, with the canopy height averaging 104 cm. Syringa was the dominant shrub (Table 7).

South Fork She Creek (EO 8)—Associated species and exotic species were not monitored in 2004. No obvious changes from 2002 were noted.

Upper Road Gulch (EO 9)—At Subpopulation #1, graminoid species dominated the community supporting Indian Valley sedge. The most frequent species were bulbous bluegrass and rush spp. (Table 5). Redtop was another frequently occurring exotic species. Depressions occasionally held water, some of which were caused by cattle pugging. Subpopulation #2 was similar to #1, with rush spp., bulbous bluegrass, and California oatgrass being the most frequently occurring species (Table 5). Japanese brome, redtop, and prickly lettuce were also important. Exposed soil and gravel, reflecting annual disturbance by cattle, was common at both subpopulations. Exotic grasses and prickly lettuce are probably colonizing bare soil microsites. Recent OHV tracks and a 4 x 4 road at the edge of the subpopulation are also ideal sites for colonization by exotic species. At the landscape scale, no noxious weed species were documented near any subpopulations.

No shrubs were present at Subpopulation #1 and Wood's rose had trace cover at Subpopulation #2 (Table 7). Shrubs, especially black hawthorn, common snowberry, and Wood's rose, were important at Subpopulations #4 (25% cover), #5 (15 to 20% cover), and #6 (40% cover).

Habitat Condition, Disturbances, Threats, and EO Rank Assessment: At both the landscape and subpopulation scales, no non-motorized recreation disturbances were observed at any occurrences monitored in 2004. At the subpopulation scale, no human-caused ground disturbance, hydrologic alteration, or herbicide spraying were observed.

Mesa (EO 2)—Cattle grazing during the period of growth and reproduction of Indian Valley sedge remains the main disturbance at this occurrence. Habitat monitoring occurred prior to the release of cattle on the site (typically late May). Minimal cattle sign was recorded (Table 8).

At the landscape scale, there was one 15 cm tall headcut in the stream 50 m downstream of Subpopulation #3 that threatens to lower the water table and promote site desiccation. Streambank sloughing and instability caused by cattle trampling was evident. In addition, a new powerline was planned for construction during summer 2004. It would span the site, but no supporting structures or access roads were planned within about 300 m of occupied habitat.

Since 2002, there have been no major changes in the types or magnitude of habitat disturbances and imminent threats at either the subpopulation or landscape scales. No change to the EO Rank of 'C' was made.

Lower School Creek (EO 3)—In 2001 and 2002, no cattle grazing was observed at this occurrence. In spring 2004, grazing occurred in the downstream half of the occurrence. At Subpopulation #5, cattle sign was minimal (Table 8). Pocket gopher digging was the main disturbance. Subpopulation #1 was the most intensively grazed subpopulation. Within about 50 m of Subpopulation #1, a cattle salt block had been placed on a terrace 6 m from School Creek. Cattle severely trampled the streambank adjacent to the salt block, resulting in about 70 m of barren, eroding bank. Cattle trails have caused

bank erosion at several spots within 50 m of Subpopulations #2 and #3. Unstable banks also occur at Subpopulations #4 and #5, although cattle trampling is minimal. Subpopulation #4 had no cattle sign.

At the landscape scale, the lower watershed has been degraded by recent subdivision development. Since 2002, a new dirt road was constructed along the toe of the northern canyon slope. It led to a new home adjacent to the riparian zone about 225 m downstream of Subpopulation #1. The road was about 10 to 15 m of Subpopulation #2 and 25 to 30 m of Subpopulation #3. The road was 50 to 65 m of Subpopulations #1, #4, and #5. About 10 m from Subpopulation #2, coarse rock and dirt fill from road construction covered about 2 m of the riparian zone. In addition, another home was constructed about 300 m upstream of Subpopulation #5 and an undeveloped building lot was within about 70 m. The Weiser River trail (a non-motorized recreation trail) occurs on the old railroad grade within 50 to 75 m of all subpopulations. Herbicide spraying of noxious weeds occurs within 3 m of each side of the trail. No direct impacts to occupied habitat from the trail or herbicide spraying were observed.

Of all occurrences monitored in 2004, this one experienced the largest decrease in habitat condition. Although a small new subpopulation was discovered in 2004, new habitat disturbances and increases in threat severity merited lowering the EO Rank from 'B' to 'C.'

Table 8. Density of OHV disturbance and livestock grazing sign, and frequency of foraging and wildlife sign at subpopulations monitored by quadrat sampling and grid methods.

EO # Subpop # Sample Size	OHV Disturbance		Livestock Grazing Sign				Other Habitat Disturbances			
	Density (tracks/m^2)	SD	Density (dung piles/m^2)	SD	Density (hoof-prints/m^2)	SD	Foraging Frequency	SE	Wildlife Sign Frequency	SE
2 (# 3) n = 41	0	0	0.10	0.30	0	0	0	0	0.02	0.02
3 (# 5) n = 18	0	0	0	0	0.06	0.23	0.22	n/a	0.28	n/a
4 (# 1) n =18	0	0	0	0	0	0	0.39	n/a	0	n/a
6 n = 28	0	0	0.64	1.62	12.11	5.32	1.00	0	0.04	0.03
7 n =20	0	0	1.05	1.99	4.10	3.52	0	n/a	0.05	n/a
9 (# 1) n = 28	0	0	0.75	0.97	0.29	0.86	0	0	0	0
9 (# 2) n = 35	1.20	1.32	0.20	0.76	2.80	4.05	0.20	0.07	0.06	0.04

Sheep Creek/North Crane Creek Confluence (EO 4)—At Subpopulation #1 no cattle sign was recorded. The frequency of foraging was relatively high due to grazing by native ungulates (Table 8). Cattle grazed all other subpopulations at this occurrence, but intensity varied across the occurrence. The main cattle impact was trailing and streambank instability and erosion at the landscape scale. Herbicide spraying of Scotch thistle occurred about 15 m upslope of Subpopulation #4, below the main road (located about 50 m upslope). In addition, since 2002, beaver have built a new dam about 75 m upstream of Subpopulation #1, but no obvious downstream effects were noticeable.

Although habitat disturbances and threats remain high, there were no major changes at either the subpopulation or landscape scales from 2002. The discovery of additional subpopulations in 2004 makes this occurrence more secure than previously thought, but all subpopulations are still small and vulnerable. No change to the EO Rank of 'C' was made.

Council (EO 5)—Livestock grazing, fence construction and maintenance, and roadside ditch maintenance all threaten this occurrence. Two subpopulations occur within a horse pasture. All three subpopulations occur within 5 m of roadside ditches and pasture fence lines. The hydrology is influenced by irrigation and past drainage alteration. The habitat within the pasture does not appear altered by hay cultivation, plowing, or seeding. The pasture is only lightly grazed, but may have been more heavily grazed in the past. Weed levels are currently low, but the potential for field bindweed invasion is high. Pasture cultivation, roadside weed spraying, and subdivision construction are potential high magnitude threats. The pasture adjacent to the northern sub-population was for sale in 2002, but it may be too wet for home construction. No obvious changes from 2002 were noted during our 2004 visit. However, this small occurrence is highly vulnerable to extirpation due to human activities. For these reasons, an EO Rank of 'D' was most suitable.

South Dry Creek Basin (EO 6)—Habitat monitoring took place after cattle grazing. The density of cattle dung piles was the third highest of any subpopulation monitored by quadrat or the grid method, and the density of cattle hoofprints was the highest (Table 8). Cattle foraging was recorded in every quadrat. There were no disturbances or threats noted at the landscape scale. Although there was no change in population or landscape scale disturbances and threats since 2002, due to the expansion in population size, the EO Rank was raised from 'D' to 'C.'

South Fork Grays Creek (EO 7)—Spring cattle grazing remains the main threat to this occurrence. This was the most intensively grazed of any small subpopulations monitored. The density of cattle dung piles was the highest of any subpopulation monitored (Table 8). Although cattle trampling was also relatively common, streambank stability was fair due to rock anchoring. At the landscape scale, an old 4 x 4 road (recently driven, but with access restricted by a locked gate) is located about 40 m south of the occurrence. There were no major changes in habitat disturbances and threats at either the occurrence or landscape scales. The EO Rank of 'C' was not changed. However, because this is the smallest known occurrence, any decrease in habitat condition or population size would drop the EO Rank to 'D.'

South Fork She Creek (EO 8)—Road crossings, ditches, buried cable, and culverts have altered drainage patterns and disturbed soil at this occurrence. Indian Valley sedge plants on roadside ditch banks (less than 1.0 m off the road) are imminently threatened by weed spraying and maintenance of ditches, fences, and buried cable. The majority of the occurrence is not affected by these activities. The northern subpopulation is apparently rested from grazing. It has thicker mesic graminoid cover, denser Indian Valley sedge, more stable streambanks, and less stream incision than the southern population. Cattle graze the southern subpopulation, probably later in summer or fall (no grazing was observed in 2004). Erosion and stream downcutting may lead to desiccation of the terraces supporting this subpopulation. Exotic species are common in the area, including noxious weeds such as field bindweed and rush skeletonweed. No obvious changes from 2002 were noted in 2004. No change to the EO Rank of 'C' was made.

Upper Road Gulch (EO 9)—Because we timed our monitoring to occur before large numbers of cattle congregated at the occurrence, overall grazing sign was low to moderate (Table 8). Cattle are released in the site near June 1 each year. Frequency of foraging, by both cattle and/or wildlife was very low. A cattle-watering reservoir occurs about 150 to 175 m upstream of Subpopulation #3 and a similar distance down slope from Subpopulations #1 and #2. Cattle trails leading to this reservoir and loafing areas traverse the stream bottom within 2 m of Subpopulation #3 and 10 m of Subpopulation #4. Streambank instability caused by inadequate cover of deeply rooted species was observed. Occasional cattle trampling is the main threat to Subpopulation #4. Although minimal cattle grazing sign was observed during monitoring, Subpopulations #5 and #6 both had evidence of past trampling.

This was the only occurrence with OHV impacts recorded at the subpopulation scale (Table 8). A rough dirt road (about 6 m wide and with up to three parallel sets of tracks) traverses the edge of both

Subpopulations #1 and #2, allowing OHVs and 4 x 4 vehicles easy access. In 2004, OHVs created a barren mud "donut" (about 12 m in diameter) adjacent to the road. At least 5 to 10 m^2 of occupied habitat at Subpopulation #2, and a much larger area of potential habitat, was severely damaged. The OHV disturbance occurred between our visit on May 21 and another visit on May 25. This allowed us to obtain pre- and post disturbance photographs (Figure 9).

Because of its large population size, lack of noxious weeds, and location on BLM land in a minimally developed watershed, this occurrence has the best viability. However, impacts from OHVs and cattle grazing remain imminent, high magnitude threats. The EO Rank of 'B' was unchanged in 2004.

Monitoring Assessment: After preliminary analysis of monitoring data collected by quadrat sampling in 2004, it is clear that standard deviations and standard errors were too large to obtain the precision necessary for detecting changes over time. In 2004, our quadrat sample sizes (varying from n = 28 to 41) were possibly too small. More analysis of 2004 data must occur so we can set meaningful minimal detectable change thresholds and determine the proper quadrat sample size necessary for increasing statistical power (Elzinga et al. 1998). The 1-m^2 quadrat usually obtained frequency values for Indian Valley sedge close to what is needed for detecting change (between 30 and 70%, Elzinga et al. 1998). The smaller quadrats nested within the 1-m^2 quadrat were too small to obtain about 30% frequency of Indian Valley sedge. The frequency of highly invasive exotic and noxious weed species was more variable, both above and below 30%. Because of high standard deviations, it is possible that the 1-m^2 quadrat is insufficient for recording density data. A rectangular quadrat may be more efficient. In general, sampling quadrats was more time consuming than expected. The added value of using nested quadrats for detecting frequency changes might be less than the additional time required for reading each quadrat. The grid method was slightly less time consuming, mainly due to the smaller number of quadrats sampled and ease of laying out the small macroplot. Due to its blend of qualitative and quantitative data collection, the EO update method proved to be rapid.

CONCLUSIONS AND RECOMMENDATIONS

Recommended Conservation Actions: Specific management objectives for each occurrence should be developed and implemented by the appropriate land management agency (Elzinga et al. 1998). As monitoring information is gathered, conservation actions can be revised and progress toward meeting management objectives assessed. Short-term conservation actions based on monitoring data are listed below:

1. Cattle grazed portions of all occurrences monitored during 2004. To allow adequate reproduction of Indian Valley sedge, grazing could be conducted after seeds mature (e.g., summer) or before the growing season (e.g., winter). Alternatively, exclosures or cages could be erected around subpopulations. Range managers for both the BLM and Idaho Department of Lands have expressed interest in taking such measures. The landowner at EO 2 is also open to the idea of protecting subpopulations during spring grazing with temporary exclosures, but materials and labor for erecting and removing exclosures would not be supplied.
2. To reduce impacts from cattle trampling, the salt block near Subpopulation #1 at EO 3 should be removed from the stream bottom. Salt blocks and supplements should not be located in stream bottoms, wetlands, or nearby occupied Indian Valley sedge habitat.
3. The cattle-watering reservoir at EO 9, located above Subpopulation #3, is filling with silt and should be removed or at least not maintained (R. Rosentreter, pers. comm.). This would decrease cattle trailing through occupied and potential habitat in the stream bottom.
4. The 4 x 4 road going through EO 9 needs to be closed or altered to prevent OHV impacts to Subpopulations #1 and #2.
5. Weed control actions are needed at EO 3 and EO 4, where noxious weed invasion was most serious. No broadcast herbicide spraying should occur within 50 meters of any occupied Indian Valley sedge habitat. Spraying within 50 meters should be done with a spot spray method or

avoided. Chemicals targeting perennial graminoid species should be avoided within 50 meters of occupied habitat. Weed spraying crews should know occurrence locations and how to identify the species.

6. Mature seed should be collected from each occurrence to form a conservation seed bank. This could be done in cooperation with the Berry Botanic Garden (Portland, Oregon), who can provide seed collection protocol and seed storage facilities.
7. Indian Valley sedge has been successfully propagated and transplanted in a garden setting. An experimental propagation and re-introduction program may be a useful long-term conservation tool for this species. Until the genetic diversity across all known occurrences has been studied, care should be taken in designing reintroduction to prevent crosses that may decrease the inherent adaptive fitness of the species.
8. Federal, state, county, and private land managers should avoid ground disturbance in occupied Indian Valley sedge habitat and immediately adjacent areas.
9. EO 2 and EO 8 (both on private land) represent two of the three largest occurrences and are very valuable for the long-term persistence of Indian Valley sedge. Existing USFWS and Natural Resources Conservation Service programs should be utilized to provide funding and incentives for the landowners to conserve Indian Valley sedge and restore its habitat.
10. The BLM and USFWS should continue to provide funding for monitoring and conservation of Indian Valley sedge.

Recommended Research: Indian Valley sedge research should focus on three general areas: 1) the basic life history of Indian Valley sedge; 2) the environmental characteristics of habitat; and 3) the effects of management actions on habitat condition and population size. Several related research projects might include:

1. analysis of intra- and inter-population genetic variability
2. collection of soil data (e.g., texture, depth, moisture, organic matter, nutrient availability, temperature, etc.) in Indian Valley sedge habitat
3. collection of hydrologic data (e.g., water table depth, groundwater level changes throughout the growing season, flood regime, etc.) in Indian Valley sedge habitat
4. study of the long-term effects of short duration, intensive, spring grazing on occurrences; exclosures or small utilization cages could be used to compare population and habitat trends in areas open to cattle grazing with those closed to grazing (R. Rosentreter, pers. comm.)

Recommended Monitoring Actions: Several monitoring needs were identified. Quantitative monitoring is needed at Subpopulation #2 of EO 2. At least one grid macroplot could be established. Quantitative monitoring by quadrat sampling or grids (whichever is most applicable) is needed in both subpopulations at EO 8. Permission from the landowner would be required at this occurrence. Additional small subpopulations at EO 4 and EO 9 should be monitored by the grid method.

To collect the most meaningful data, future monitoring should occur at roughly the same time each year. At EO 2 and EO 6, Indian Valley sedge and associated species monitoring would preferably occur prior to the release of large numbers of cattle that quickly utilize most of the forage. However, the later in the growing season that monitoring can occur, the easier it is to identify plant species and measure the impacts of cattle grazing.

Monitoring data is valuable for developing biologically based conservation actions and management objectives for Indian Valley sedge. Funding and implementing monitoring, research, and conservation should be cooperative when possible. To facilitate implementation and funding of conservation actions, opportunities for coordination between federal and state agencies, county weed control, and private landowners should be pursued. Volunteers from Idaho Department of Fish and Game, Idaho Native Plant Society, Friends of the Weiser River Trail, and elsewhere could be recruited to assist and broaden community involvement in Indian Valley sedge conservation.

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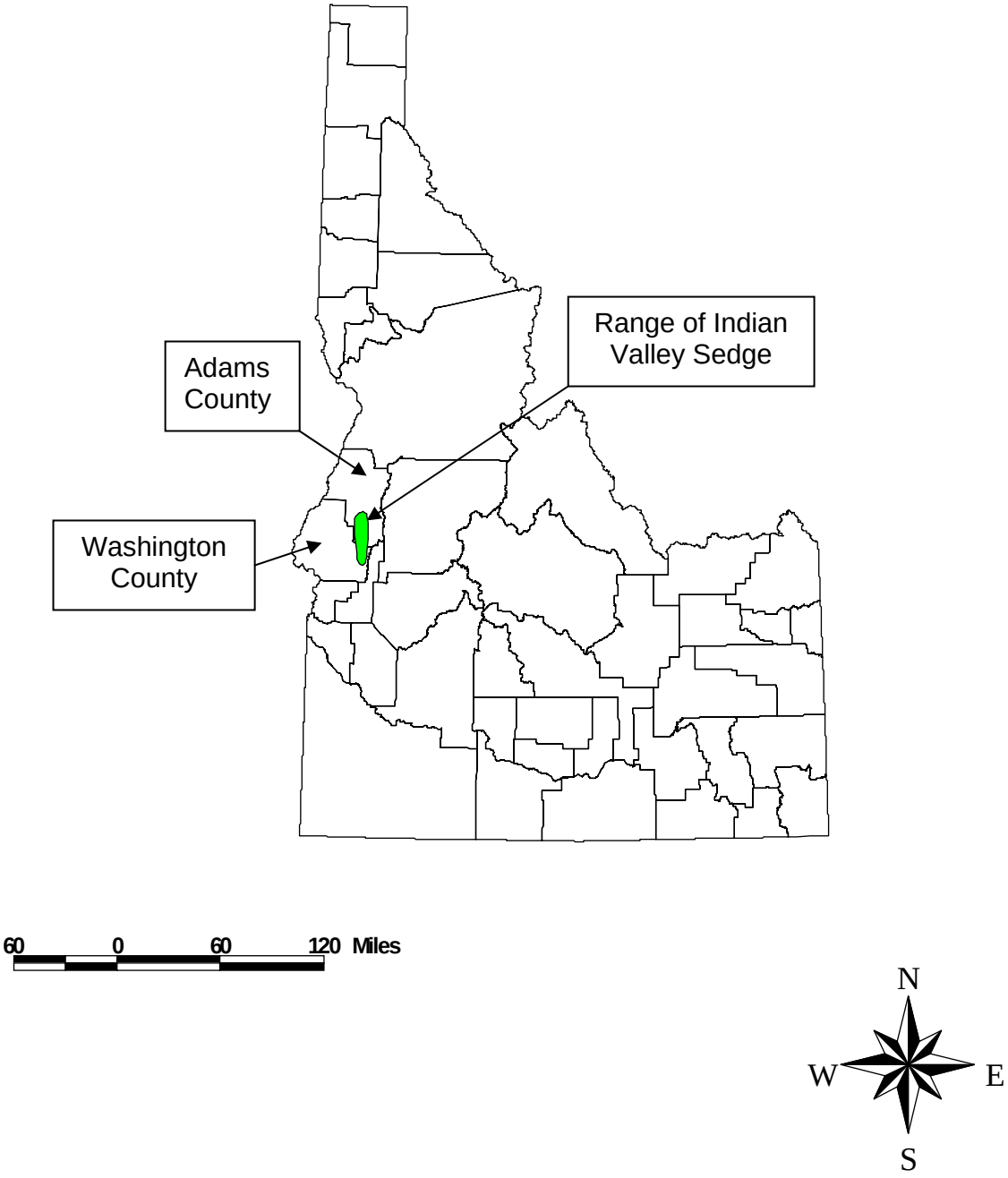
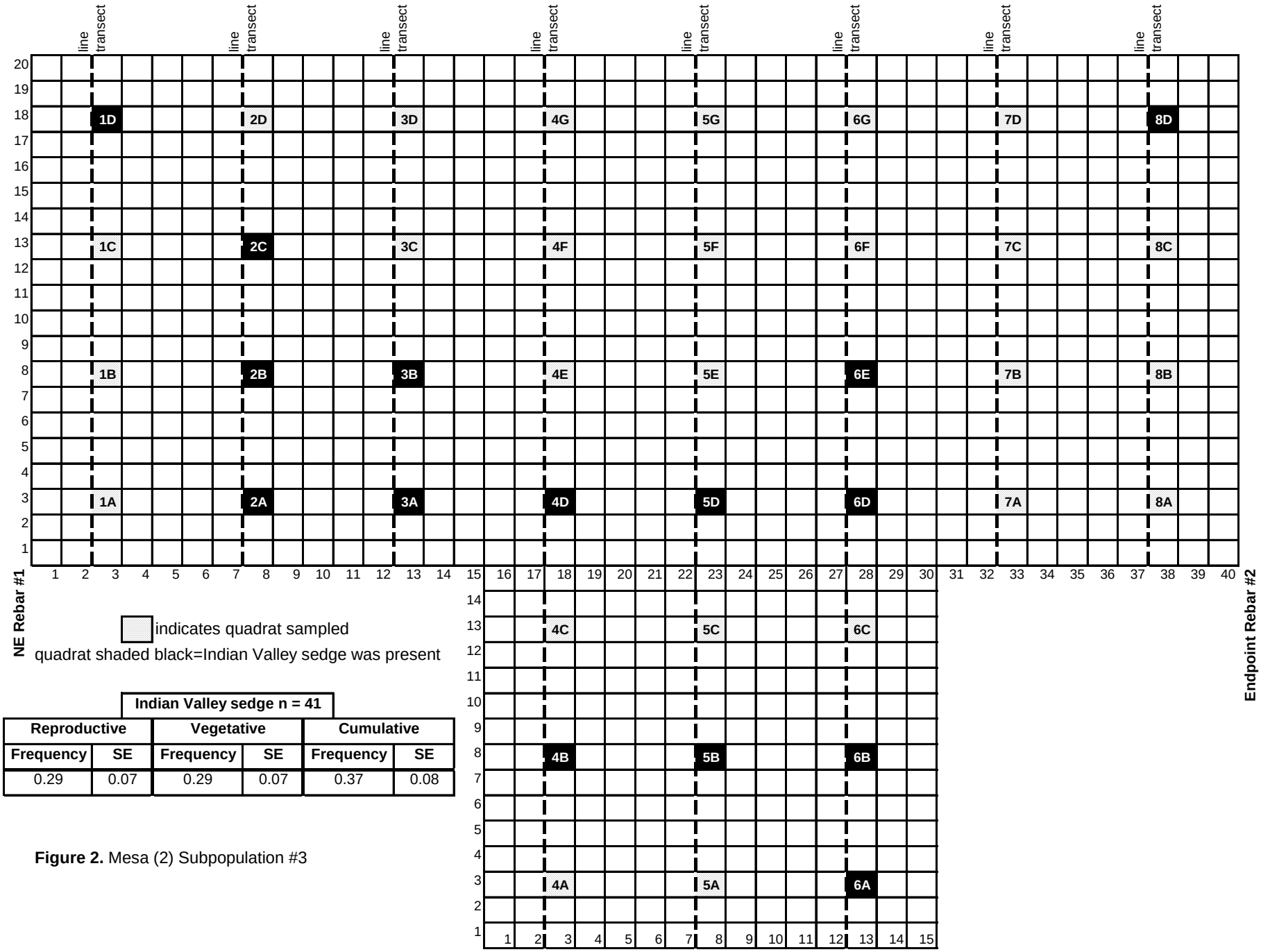
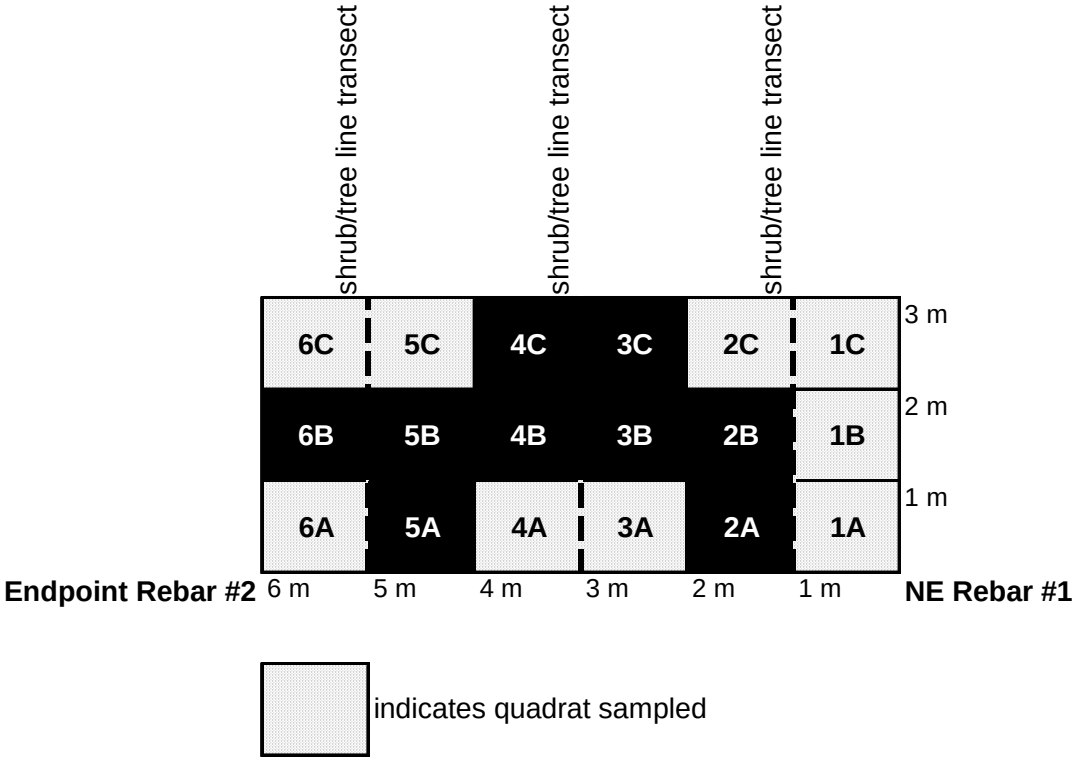


Figure 1. Range of Indian Valley sedge



Indian Valley sedge n = 41					
Reproductive		Vegetative		Cumulative	
Frequency	SE	Frequency	SE	Frequency	SE
0.29	0.07	0.29	0.07	0.37	0.08

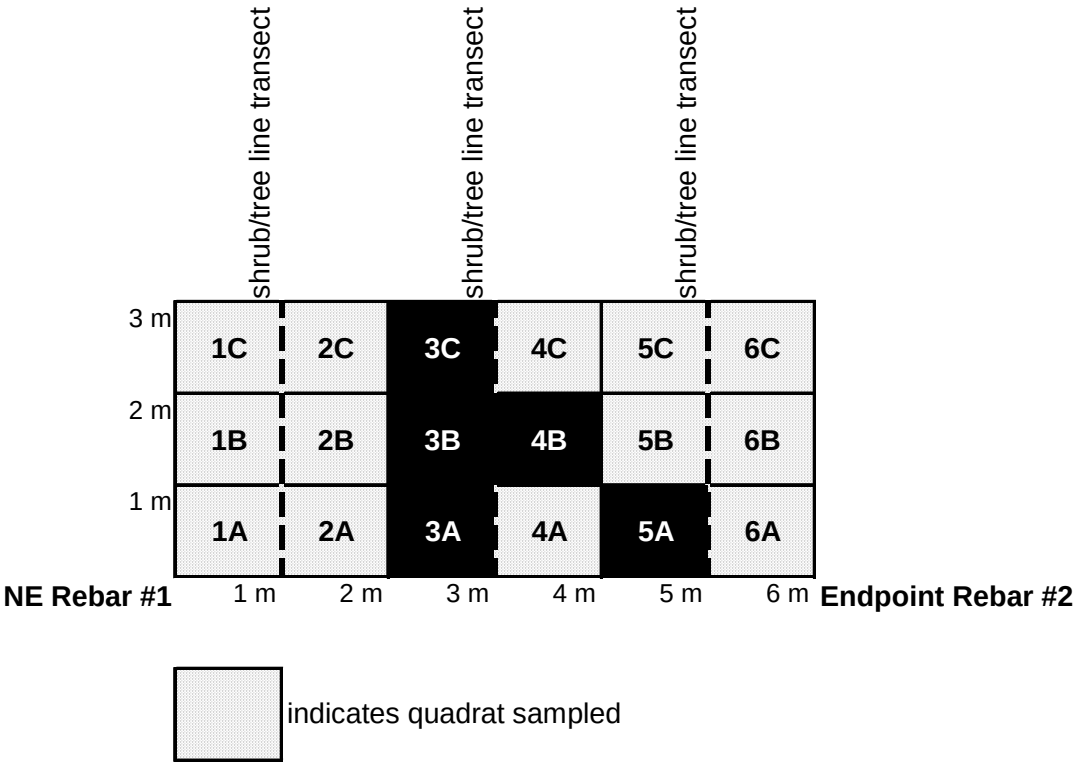
Figure 2. Mesa (2) Subpopulation #3



quadrat shaded black = Indian Valley sedge was present

Indian Valley sedge n = 18		
Reproductive Frequency	**Vegetative Frequency**	**Cumulative Frequency**
0.50	0.39	0.50

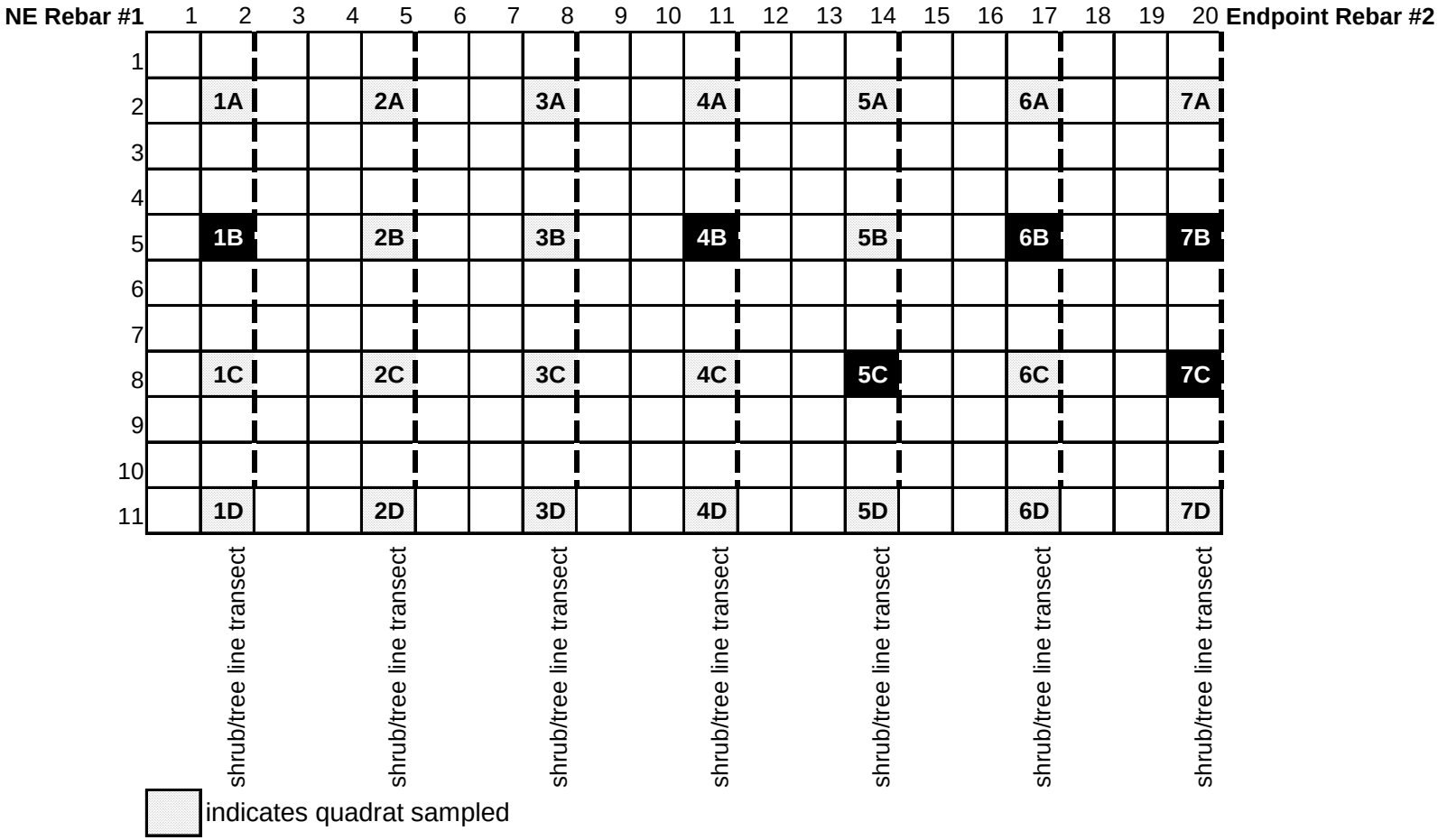
Figure 3. Lower School Creek (3) Subpopulation #5



quadrat shaded black = Indian Valley sedge was present

Indian Valley sedge n = 18		
Reproductive Frequency	**Vegetative Frequency**	**Cumulative Frequency**
0.06	0.28	0.28

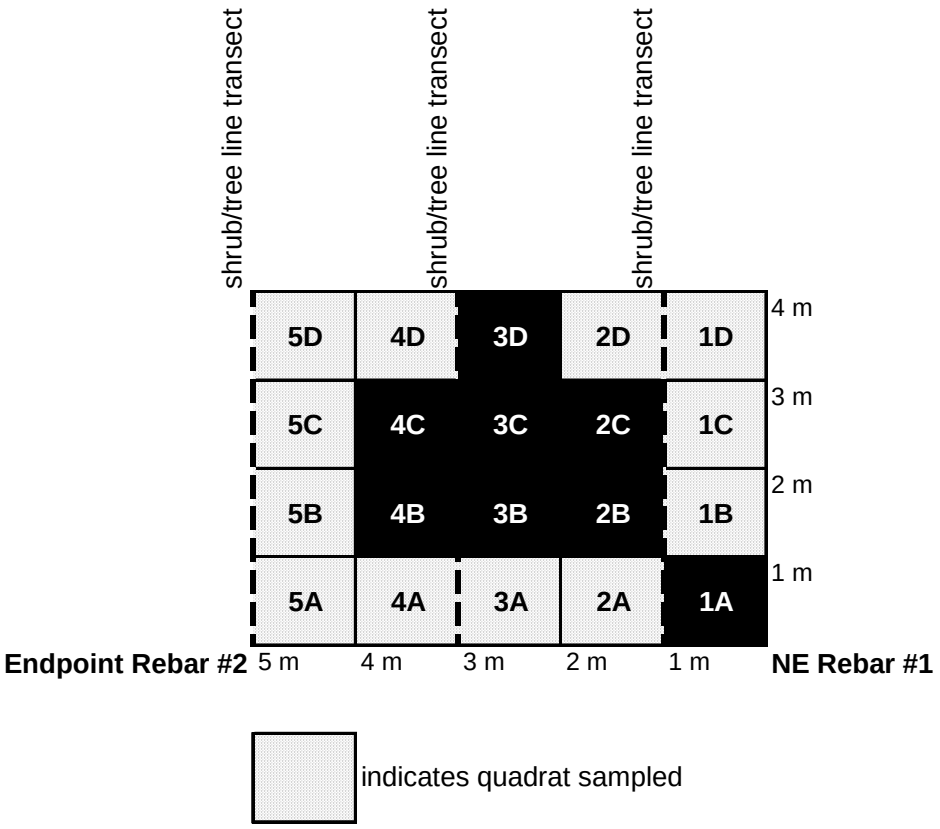
Figure 4. Sheep/North Crane Creek Confluence (4) Subpopulation #1



Indian Valley sedge n = 28					
Reproductive		Vegetative		Cumulative	
Frequency	SE	Frequency	SE	Frequency	SE
0.11	0.06	0.18	0.07	0.21	0.07

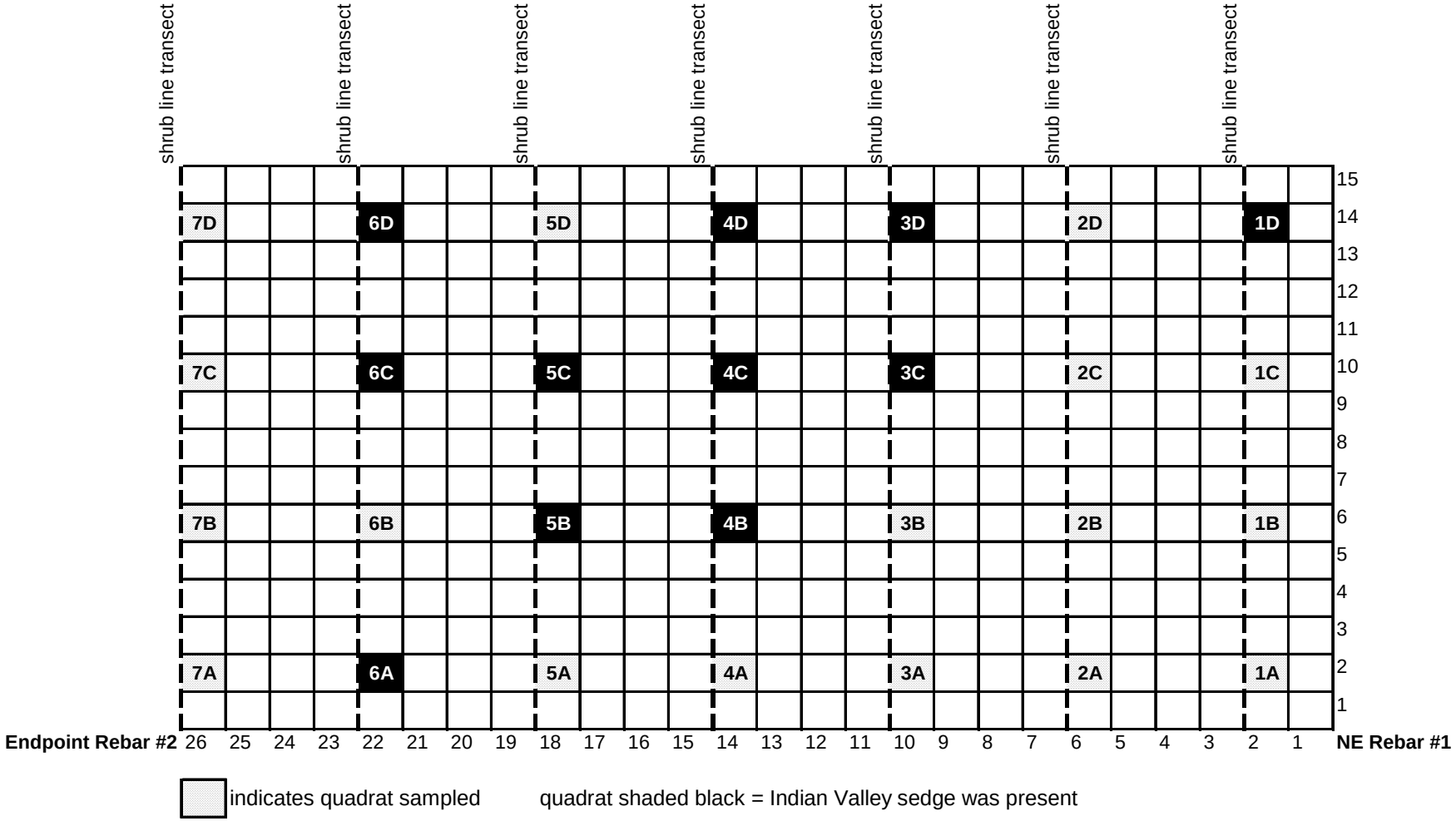
quadrat shaded black = Indian Valley sedge was present

Figure 5. South Dry Creek Basin (6)



Indian Valley sedge n = 20		
Reproductive Frequency	**Vegetative Frequency**	**Cumulative Frequency**
0.05	0.40	0.40

Figure 6. South Fork Grays Creek (7)



Indian Valley sedge n = 28					
Reproductive		Vegetative		Cumulative	
Frequency	SE	Frequency	SE	Frequency	SE
0.32	0.09	0.39	0.09	0.39	0.09

Figure 7. Upper Road Gulch (9) Subpopulation #1

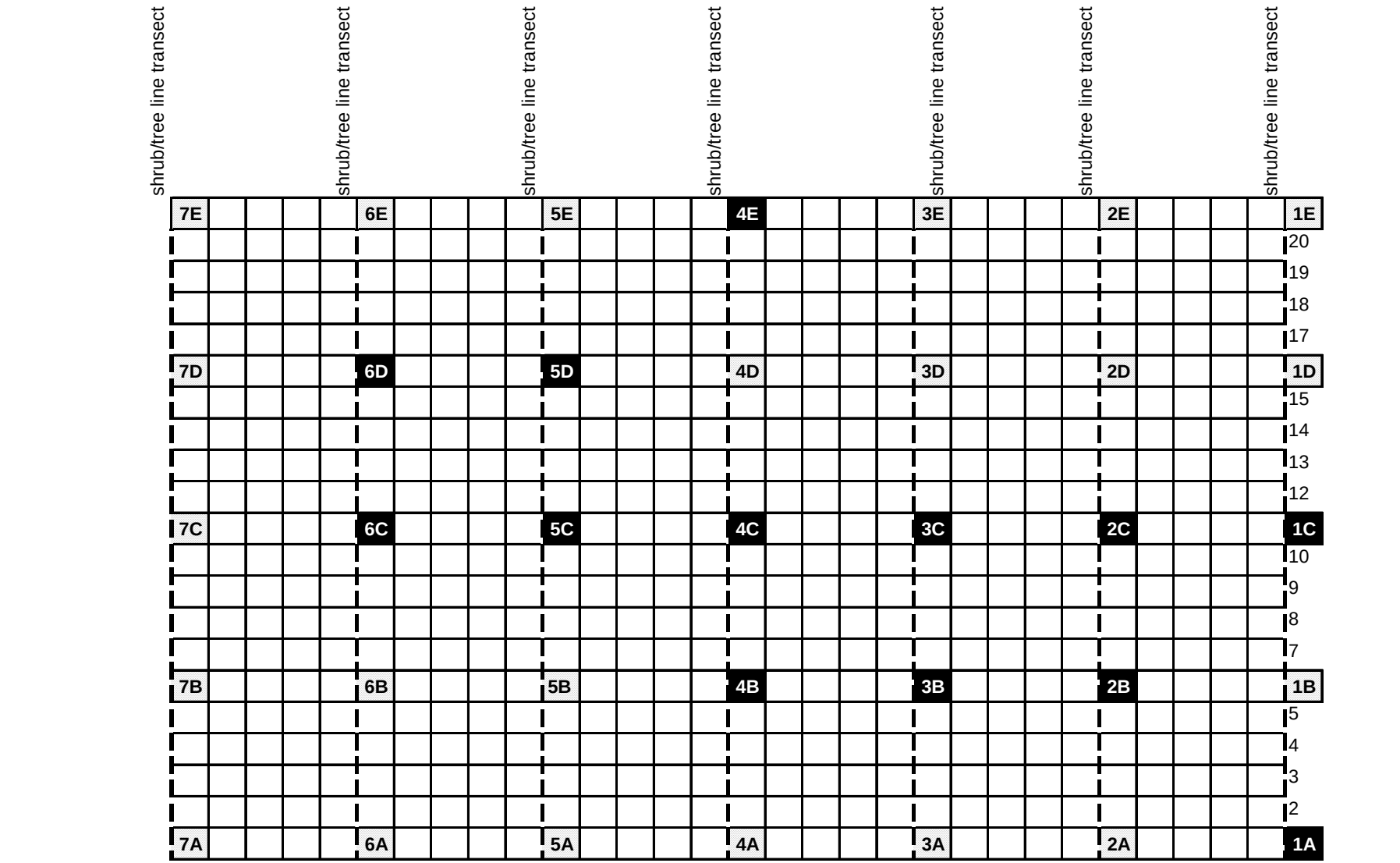


Figure 8. Upper Road Gulch (9) Subpopulation #2

Indian Valley sedge n = 35

Reproductive		Vegetative		Cumulative	
Frequency	**SE**	**Frequency**	**SE**	**Frequency**	**SE**
0.29	0.08	0.37	0.08	0.37	0.08

Figure 9. Pre- and post-OHV disturbance photos, in a portion of Subpopulation #2, EO 9. For reference, the arrows point to the same hawthorn tree in each photo. The dashed ovals represent the nearly the same area of occupied and potential habitat in each photo.

Top: Pre-OHV disturbance, May 21, 2004, zoomed in. Indian Valley sedge is prominent within the oval (especially in the right half of the oval). The pre-existing 4 x 4 road and old OHV tracks are also visible. Some Indian Valley sedge plants are also located on the left side of the 4 x 4 road.

Middle: Same area, post-OHV disturbance, May 25, 2004. Width of disturbance is about 12 m.

Bottom: Same area, post-OHV disturbance, May 25, 2004, zoomed out.

Appendix 1. Indian Valley sedge occurrence inventory and monitoring histories, and population sizes recorded during 2001 and 2002 surveys.

Occurrence Name EO #	Inventory & Monitoring History			Population Size	
	2001	2002	2004	2001	2002
Mesa 2	first survey; 18 photos	updated	monitored	190 –200 clusters 220+ flowering stems	no count
Lower School Creek 3	new; 11 photos	updated	monitored; expanded (1 new subpop.)	13 clusters 63+ flowering stems	8 clusters 44 flowering stems
Sheep/North Crane Creek Confluence 4	new; 5 photos	expanded (3 new subpop.)	monitored; expanded (2 new subpop.)	11 clusters 19 flowering stems	16 clusters 28 flowering stems
Council 5	not surveyed	first survey	updated	no count	15 clusters 100 flowering stems
South Dry Ck. Basin 6	--	new 2 photos	monitored	--	2 clusters 7 flowering stems*
South Fork Grays Ck. 7	--	new	monitored	--	6 clusters 17 flowering stems
South Fork She Ck. 8	--	new	updated	--	no count (large population)
Upper Road Gulch 9	--	new	monitored; expanded (3 new subpop.)	--	400–500 clusters 550+ flowering stems

*survey occurred after intensive cattle grazing

Appendix 2. Livestock impacts, invasive exotic and noxious weed species, and other threats at Indian Valley sedge occurrences.

EO # Land-owner	Livestock Activity and Impacts	Highly Invasive Exotic and Noxious Weed Species Present	Other Threats
2 (private)	*short duration, intensive (heavy utilization), spring cattle grazing *trampling around cattle-watering pond & streambanks; increased bare soil	*Chondrilla juncea*, *Convolvulus arvensis*, *Potentilla recta*, *Salvia* spp.	*headcut present; stream downcutting & site desiccation *expansion of cattle trampling zone around pond
3 (private easement)	*not grazed in 2001 or 2002 (occasional trespass cattle grazing with minor trailing) *intensive spring cattle grazing in 2004 (also 2003?) *heavy trailing; severe streambank trampling; streambank erosion; salt block in riparian zone	*Arctium minus*, *Convolvulus arvensis*, *Cynoglossum officinale*, *Euphorbia esula*, *Hypericum perforatum*, *Potentilla recta*, *Ranunculus arvensis*, *Salvia* spp., *Tanacetum vulgare*	*access road construction; culverts (new in 2003) *housing development (two new homes in 2003; one undeveloped homesite) *herbicide over-spraying along trail right-of-way *erosion of alluvial terraces and streambanks
4 (state & BLM)	*two pastures: 1) light spring grazing & short duration, intensive fall grazing; 2) riparian pasture, variable timing, intensity, & duration *trailing; streambank trampling	*Chondrilla juncea*, *Cirsium arvense*, *Conium maculatum*, *Convolvulus arvensis*, *Dianthus armeria*, *Hypericum perforatum*, *Onopordum acanthium*, *Potentilla recta*	*erosion of alluvial terraces, unstable banks *headcut present; stream downcutting & site desiccation *herbicide spraying within 50 m of subpopulation *hydrologic alteration (culverts)
5 (private)	*light grazing at two sub-populations by two horses in 2002 *minimal noticeable impacts	*Convolvulus arvensis*	*roadside herbicide spraying, ditch digging, road & fence maintenance *hydrologic/irrigation alteration *potential housing development
6 (BLM)	*intensive spring cattle grazing at seep *soil compaction; deep pugging; hummock formation; increased bare soil; hydrologic alteration (decreased water infiltration resulting in excess runoff & pooling)	none observed	none observed
7 (state)	*intensive spring cattle grazing *trailing; streambank trampling; soil pugging	*Cynoglossum officinale*, *Potentilla recta*	*potential erosion of alluvial terraces & unstable streambanks
8 (private)	*two pastures: 1) summer/fall cattle grazing, intensity unknown; 2) not recently grazed *streambank trampling; soil compaction	*Chondrilla juncea*, *Convolvulus arvensis*	*roadside herbicide spraying, ditch digging, road & culvert, fence, & buried cable maintenance *erosion of alluvial terraces
9 (BLM)	*intensive spring cattle grazing *soil compaction; pugging; hummock formation; hydrologic alteration (decreased water infiltration resulting in excess runoff & pooling)	none observed	*severe OHV damage resulting in 12 m wide area of bare soil & altered hydrology (decreased water infiltration & excess pooling) *rutted 4 x 4 road in occupied habitat, associated campsites

Appendix 3.

Carex aboriginum Macroplot and Transect Establishment Form

EO Name_____EO#_____Subpop #_____
Observers_____Date_____

GPS Waypoints:
Rebar #1 (NE Corner): UTM zone____Datum____N_____E_____WP____Error_____

Rebar #2: UTM zone_____Datum_____N_____E_____WP_____Error_____

Rebar #3: UTM zone_____Datum_____N_____E_____WP_____Error_____

Rebar #4: UTM zone_____Datum_____N_____E_____WP_____Error_____

Macroplot dimensions: length (m)_____width (m)_____additions_____
Total area_____Baseline distance (between Rebar #1 - #2) (m)_____
Transect starting points (m marks along baseline)_____

Landmark Description:
_____
_____

Distance from landmark to rebar #1 (m)_____landmark to rebar #2_____
Azimuth (uncorrected) from landmark to rebar #1_____Azimuth from landmark to rebar #2_____
Baseline Azimuth (from rebar #1 to #2)_____

Directions (detailed with landmarks, distances, etc.):

Sketch a map showing roads/trails, distances, landmarks, bearings, and other details that will help relocate the transect in the future. Include a drawing of the macroplot, its dimensions, and transect locations:

Appendix 4.

Carex aboriginum **Data Form (front)**

EO Name: EO #: Subpop #:

1=10x10cm 2=25x25cm 3=50X50cm 4=1x1m Date: Page of

Species/ Attribute	Quadrat																					
Bare soil																						
Rock																						
Wood																						
Water																						
CARABO R																						
CARABO NR																						
CARABO FS I/M																						
CARABO FS A																						
CARABO Fl ht																						
CARABO Lf ht																						
AGRSTO																						
BROJAP																						
DANCAL																						
Eleocharis spp																						
HORBRA																						
JUNHOW																						
Juncus spp																						
PHLPRA																						
POABUL																						
POACOM																						
POAPRA																						
ACHMIL																						
ARTLUD																						
CAMQUA																						
CICINT																						
CYNOFF																						
GERCAR																						
Grindelia spp																						
HYPPER																						
LACSER																						
Penstemon spp																						
Perideridia spp																						
POTGRA																						
POTREC																						
Polygonum spp																						
RUMCRI																						
SENHYD																						
TAROFF																						
Trifolium spp																						
XANSTR																						

Carex aboriginum **Data Form (back)**

EO Name: EO #: Subpop #:

Observers: Date: Page of

HABITAT DISTURBANCE:

Attribute	Quadrat (1x1m)																				
OHV tracks																					
Campsite impacts																					
Antro gr disturb																					
Hydro alteration																					
Herb spraying																					
Wildlife sign (y/n)																					
Forage sign (y/n)																					
Cattle scat (#)																					
Cattle prints (#)																					
Avg veg ht (cm)																					

SHRUB LINE INTERCEPT:

Species	Transect Starting Meter Mark on Baseline									
DEAD SHRUB										
CRADOU										
PHILEW										
PRUVIR										
RIBAUR										
ROSWOO										
SALLASIO										
SYMALB										
Totals										
Transect length										
% Cover										
shrub ht range										
Aver shrub ht										

PHOTOS:

frame #	photographer	comments

COMMENTS:

Appendix 5. ***Carex aboriginum*** **Subpopulation EO Update Form**

Observers:_____Date of Observation:_____

Location Information –

EO Name:_____EO #:_____Subpop #:_____

Directions (be specific):

UTM zone_____Datum_____

N_____E_____WP_____Error_____
N_____E_____WP_____Error_____
N_____E_____WP_____Error_____
N_____E_____WP_____Error_____

Do you feel you mapped the full extent of the subpopulation? (circle one) Yes / No / Unsure

Is there more potential habitat in the area that hasn't been surveyed? (circle one) Yes / No / Unsure

The survey was (circle one): very thorough / fairly thorough / cursory / incidental observation

Subpopulation Information – (please fill in this section with information for the entire subpopulation)

Total number of CARABO plant clusters (if possible to distinguish):_____

Total number of reproductive CARABO (with flowering stems present) clusters:_____

Total number of non-reproductive/vegetative CARABO clusters:_____

Total number of CARABO flowering stems: % immature:_____% mature:_____% aborted:_____

Average flowering stem length (cm):_____Average CARABO leaf height (cm):_____

Subpopulation measurements (m): length:_____width:_____diagonal:_____diagonal:_____

Additional subpopulation comments:

Habitat Description –

General habitat description:

Fluvial position and hydrology description:

Substrate/soil description:

Plant community type:

Total estimated % woody species cover:_____

Associated abundant species include (underline the most important):

Noxious/highly invasive exotic spp. & abundance code: **R**are(<1% cover) **C**ommon(1-5% cover) **A**bundant(>5% cover)

Subpopulation Scale Habitat Disturbances – (circle yes for present, no for absent)

4 x 4/OHV tracks: Yes / No Description: # of tracks:

Non-motorized recreation/campsite impacts: Yes / No Description of types: # or extent:

Human-caused ground disturbances (excavation/fill; firefighting sign; housing development; fence, cable, roadside ditch construction and maintenance, etc.): Yes / No Description of types: # or extent:

Hydrologic alteration (beaver dams, levees, rip-rap, bridges, diversions, ditches, culverts, etc.):
Description of types & indirect or direct effects: # or extent:

Herbicide spraying: Yes / No Description: Distance to occupied habitat:

Wildlife sign: Yes / No Description:

Livestock grazing sign: Yes / No Description: Intensity or extent:

Foraging sign: Yes / No Description:

Comments on threats and disturbances to subpopulation:

Photos – (take at least one overview photo 5 m from subpopulation edge)

Frame #'s:_____Photographer:_____Azimuth (photo-point to subpopulation):_____Comments:

Appendix 6.

***Carex aboriginum* Landscape Scale Disturbance and Threat Information Form**

EO Name: EO #: Subpop #:

Observers: Date:

BANK EROSION: streambank experiencing shearing or collapse & distance to closest bank erosion within 50 m

estimated % of bank eroding: distance to closest bank erosion:

# of head cuts: height of headcuts (cm):

comments on erosion type, extent, apparent causes, bank stability, etc.:

INVASIVE PLANTS: list of species and abundance rating of each: **R**are (<1%), **C**ommon (1-5%), **A**bundant (>5%)

HERBICIDE SPRAYING: present / absent

Describe extent, type, and distance to nearest spraying:

4 x 4/OHV DISTURANCE:

# of roads or track sets: length 50 m: width 50 m:

known CARABO on opp side of road/track?: Y / N comments:

NON-MOTORIZED RECREATION IMPACTS:

fire rings (#):

trampling length: trampling width:

comments on the type, location, extent, number, and severity of impact to habitat:

OTHER HUMAN DISTURBANCES: fences, powerlines, houses, excavation, filling, heavy equipment, firefighting, etc…

comments on the type, location, extent, number, and severity of impact to habitat:

FIRE: evidence of past fire, fire scar on trees and shrubs, burnt stumps Y / N describe extent, severity:

ALTERATION OF FLOODPLAIN: beaver dam, levees, rip-rapping, culverts, bridges, diversions, other developments

disturbance types:

distance to disturbance:

comments on direct or indirect effects:

***CAREX ABORIGINUM*:** outliers within 50 m of perimeter

fl stems:

GPS: N: E: error: wp #:

GPS: N: E: error: wp #:

comments:

Submitted by:

_____

Chris Murphy
Riparian Ecologist
Idaho Conservation Data Center
Idaho Department of Fish and Game

Approved by:

_____

Kevin Church
Program Coordinator
Idaho Conservation Data Center
Idaho Department of Fish and Game