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Monitoring *Carex aboriginum* (Indian Valley sedge) in west-central Idaho: 2007 - 2009 Results

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ABSTRACT

The objective of this project was to monitor population, habitat condition, and disturbances at *Carex aboriginum* (Indian Valley sedge) occurrences on private and state land. In 2004, the Idaho Conservation Data Center designed and established a monitoring program for *Carex aboriginum*. The protocol used both quantitative and qualitative methods. Detailed data was again collected from both private-land EOs intensively monitored in 2004, and new macroplots were established on 3 additional private land occurrences and 1 state land occurrence. In 2009, 2 occurrences on state land monitored in 2004 were monitored again. During 2007 monitoring, 8 new *C. aboriginum* subpopulations were found on BLM-managed land in the upper Road Gulch drainage at EO 4. A concurrent inventory project in 2007 resulted in the finding of 3 new EOs and expansion of another. After the 2009 field season, there were 10 known *C. aboriginum* EOs rangewide comprised of an estimated 1,929 plant clusters occupying approximately 0.30 ha (0.74 acres) of habitat. Of the 10 EOs, 4 support 100 or more *C. aboriginum* clusters. EO 4 is the largest known occurrence in both number of plant clusters and area occupied. It supports about 38% of the known range-wide population, and about 32% of the known occupied habitat. Most other EOs were smaller in size and vulnerable to human-related threats. *Carex aboriginum* tolerates grazing, but livestock impacts to soils and hydrology may affect the ability of the habitat to support *C. aboriginum*. The frequency and diversity of potentially competitive non-indigenous plant species was usually higher at grazed sites than ungrazed sites. At EO 3, cattle trampled the streambanks supporting *C. aboriginum*. Recent OHV and 4 x 4 truck tracks were observed within 2 m of *C. aboriginum* clusters at Subpopulation 14 in the meadow at Dodson Pass (EO 4). Monitoring information can help guide conservation efforts and decisions for *C. aboriginum*. It also provides basic ecological and life history information about this species.

KEYWORDS

Carex aboriginum, Indian Valley sedge, monitoring, rare plant, riparian, wetland

SUGGESTED CITATION

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INTRODUCTION

Carex aboriginum (Indian Valley sedge) is known only from Adams and Washington County, Idaho. The first scientific record of this species was from Indian Valley in 1899, but it was not observed again until 1999. Surveys since that time have documented 10 element occurrences (EOs) (IDCDC 2007, INHP 2008).

Nearly all occurrences are vulnerable to one or more threats, including non-indigenous plant invasions, herbicide spraying, off-highway vehicle (OHV) traffic, road and fence maintenance, housing development, livestock trampling and grazing (Murphy 2002, Murphy and Cook 2003, Murphy and Hahn 2005). Hydrologic alterations associated with stream down-cutting, bank erosion, and culverts also impact occurrences. *Carex aboriginum* has a conservation rank of G1/S1—imperiled at both the global and state levels (INHP 2008).

Ownership for the known occurrences includes private, state, and federal lands (Table 1). Four EOs are wholly on private land. One of these has public access through the Weiser River Trail easement and another through Idaho Department of Fish and Game's (IDFG) "Access Yes" program. A fifth EO is partially on private land and also within an adjacent county road right-of-way. One EO is comprised of private, state, and US Bureau of Land Management (BLM) land. One EO is on land managed by Idaho Department of Lands (ID DOL), and 2 are on the Cecil Andrus Wildlife Management Area (WMA), managed by IDFG. Another is entirely on BLM land. This ownership mix creates challenges for coordinated monitoring and conservation of *C. aboriginum*.

A monitoring program for *C. aboriginum* was initiated in 2004 using US Fish and Wildlife Service (USFWS) Section 6 funding (Murphy and Hahn 2005) (Table 1). Detailed information from 6 EOs was collected (1 on private land with access through the Weiser River Trail, 1 on private land with access permitted by the landowner, 1 on ID DOL land, and 2 on BLM land) and cursory observations made on 2 private-land EOs. The discovery of 11 additional subpopulations in Road Gulch expanded the boundaries of 2 EOs monitored in 2004 (EO 4 and 9) so that they are now combined into a single large EO (Colket et al. 2006). In 2007, 3 new EOs were found and another EO expanded. These finds were from inventory done as ground-truthing for a predictive distribution modeling project (IDCDC 2007). This inventory, guided by a map of predicted potential habitat for *C. aboriginum*, expanded the species' range 30 km west of prior known sites.

The objective of this project was to monitor trends in population size and vigor, habitat condition, and disturbances over time. In 2007 and 2008, monitoring focused on *C. aboriginum* occurrences on private land. Detailed data was again collected from both private-land EOs intensively monitored in 2004, and new macroplots were established on 3 additional private land occurrences and 1 state land occurrence. In 2009, 2 occurrences on state land monitored in 2004 were monitored again. Funding was not available for concurrent monitoring of EOs on BLM-managed land, although cursory monitoring information was collected on BLM land at portions of the Upper Road Gulch occurrence (EO 4).

STUDY AREA

The known range of *C. aboriginum* is west-central Idaho, in Washington and Adams Counties. This area is approximately triangular, with the town of Council at the north point, Dodson Pass at the south point, and the Cecil Andrus WMA at the west point. Indian Valley is near the center of the eastern edge (Figures 1 and 2).

Within the known range, potential habitat for *C. aboriginum* is widely scattered and discontinuous. *Carex aboriginum* typically occurs on ephemerally moist sites with clayey loam soils that are transitional between wetter, seasonally flooded sites and drier uplands. It occurs in grass-dominated gaps within shrubby riparian areas on terraces of intermittent streams. It also occurs in mesic graminoid-dominated meadows associated with seeps, springs, pastures, and roadside ditches. Habitats are usually gently sloped and in valley bottoms that are moist in the spring from groundwater seepage, rain and snowmelt runoff, or occasionally stream flooding. Habitats are dry by early summer. It is sometimes associated with Douglas's clover (*Trifolium douglasii*), another globally rare plant (G3).

The range of Indian Valley sedge is mostly within the sagebrush-steppe zone, dominated by big sagebrush (*Artemisia tridentata*), bitterbrush (*Purshia tridentata*), and bluebunch wheatgrass (*Pseudoroegneria spicata*). There are many inclusions of rigid sagebrush (*Artemisia rigida*), buckwheat (*Eriogonum* species), and Sandberg's bluegrass (*Poa secunda*) vegetation on scabland sites within this area, as well as mountain shrub communities on northerly-facing 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 non-indigenous grass communities dominated by bulbous bluegrass (*Poa bulbosa*), Japanese brome (*Bromus japonicus*), medusahead (*Taeniatherum caput-medusae*), intermediate wheatgrass (*Thinopyrum intermedium*), and various noxious weed species. With one exception, occurrences are within about 8 km (5 miles) of a lower timberline of ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*) woodlands.

METHODS

Monitoring included a mix of qualitative and quantitative methods described in Murphy and Hahn (2005). To ensure repeatability and objectivity of methods, indicators of *C. aboriginum* subpopulation size, reproduction and vigor, and habitat condition were measured. Descriptions of these indicators and the rationale for their inclusion are found in Murphy and Hahn (2005). Copies of data forms used for recording macroplot establishment, monitoring, and EO update data are found in Murphy and Hahn (2005).

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. All other subpopulations, comprised of discontinuous patches of plants or small contiguous patches (< 100 m^2), were monitored using either a grid design within a macroplot or a less intensive EO update method. Only cursory EO updates were done

when lack of time prevented use of more intensive methods. Table 1 summarizes the monitoring method used at each subpopulation monitored in 2007 - 2009.

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 encompassed all occupied and immediately adjacent potential habitat. Figures 4 - 11 illustrate layout of macroplots measured in 2007 - 2009.

Photo-point monitoring: Photo-points were established to view habitat changes within and immediately adjacent to the macroplot. Five photos were taken from outside the macroplot looking back toward the center.

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. At EO 8, quadrats could only be placed along one transect (i.e., the baseline) because of the linear distribution of *C. aboriginum*. Quadrats were regularly spaced along transects at intervals usually 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 3, 4, 9 and 10 illustrate the layout of quadrats at each occurrence monitored by this method in 2007 - 2009.

Line intercept 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 a closed canopy was assumed until a gap exceeded 20 cm. The height (m) and height range of each woody species were also 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 instead allow for mapping 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. Figures 5, 6, 7, 8, and 11 illustrate the layout of a macroplot grid 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 [complete methods are detailed in Murphy and Hahn (2005)]:

1. Presence or absence of both reproducing (indicated by flowering stems) and non-reproductive (vegetative) *C. aboriginum*.
2. Presence or absence of: a) all invasive and noxious non-indigenous species; b) native graminoid and forb species; and c) groundcover features.

3. Number of *C. aboriginum* flowering stems by stage development class of perigynia (aborted, immature, or mature).
4. Length (cm) of Indian Valley sedge flowering stems and height of leaves.
5. Height (cm) of herbaceous vegetation.
6. Presence or absence of wildlife sign.
7. Presence or absence of foraging by livestock and/or 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 other recent human-caused disturbances.

Small subpopulations monitored by EO update method: Small or discontinuous subpopulations not monitored with grids were monitored by an EO update method that blended qualitative and quantitative information. Information on subpopulation location, size, habitat, disturbances, and threats were recorded. Complete methods are detailed in Murphy and Hahn (2005).

Broad-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. Disturbances and threats were documented within a 50-m radius of each subpopulation monitored. The presence or absence of the following indicators was recorded:

1. streambank erosion
2. highly invasive non-indigenous and noxious weed species
3. herbicide spraying
4. OHV disturbance
5. non-motorized recreation impacts
6. other human-caused disturbances
7. fire
8. alterations of floodplain, valley bottom, and hydrology

Total population size and area occupied: To obtain another measure of relative population size, the number of plant clusters was estimated for each occurrence. Clusters were 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 methods by extrapolating *C. aboriginum* frequency results (each "hit" represented about one cluster) to the entire subpopulation's estimated occupied area.

Analysis: Data collected in the field were entered into spreadsheets. Frequency and means were calculated. For subpopulations monitored by quadrat sampling, standard errors (SE) were calculated and corrected by multiplying by the finite population correction factor (FPC = $\sqrt{[(N-n)/n]}$ where N = potential number of quadrat positions) as in Elzinga et al. (1998). Confidence intervals (95% CI) were also calculated.

Population size, combined with habitat condition and broad-scale disturbance and threat information was used to reassess the EO Ranks for each occurrence. The network of Natural Heritage Programs 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 *C. aboriginum* EOs have not been finalized. Murphy and Hahn (2005) details preliminary specifications used for ranking.

RESULTS

In 2007, we monitored 3 occurrences and private-land portions of another EO (Table 1). EO 3 in lower School Creek, located on a private open space easement with public access, was monitored. EO 5, near the town of Council, was monitored from the roadside. Landowners permitted access to monitor EO 8 in South Fork She Creek and privately owned portions of EO 4 (subpopulations 14 and 16 at Dodson Pass). EO 2 at Mesa was not monitored because high intensity cattle grazing occurred earlier than predicted. At the time of our visit, vegetation (including *C. aboriginum*) at EO 2 had been heavily utilized (stubble height was at ground level) and could not be accurately assessed. EO2 was instead monitored in 2008. Cattle grazing had occurred prior to monitoring, but vegetation was not as heavily utilized as in 2007.

During 2007 monitoring, 8 new *C. aboriginum* subpopulations were found on BLM-managed land in the upper Road Gulch drainage at EO 4 (Tables 1 and 2). Monitoring points were established at these using the EO update method. A concurrent inventory project in 2007 resulted in the finding of 3 new EOs (12, 13, and 14) and expansion of EO 7 (IDCDC 2007) (Tables 1 and 2). In addition, application of updated EO specifications in 2006 (Colket et al. 2006) and discovery of new subpopulations in 2007 resulted in the merging of EO 4 and EO 9. In 2008, a quadrat monitoring transect was established and sampled at EO 12 (Brownlee) and a grid monitoring point at EO 14 (Lower Bacon Creek). In 2009, we monitored 2 subpopulations on state land previously monitored in 2004 by the grid method (EO 4, subpopulation 1 in lower Sheep Creek, and EO 7, subpopulation 1 at South Fork Grays Creek).

<u>Population size, area occupied, reproduction, and vigor by occurrence</u>:

Mesa (EO 2)—The *C. aboriginum* population declined significantly at this occurrence between 2004 and 2008. The total population was estimated to be about 182 clusters, a decline of approximately 193 plants since 2004 (Table 2). There was a significant decline in the density of clusters (Table 2; Figures 3 and 4). Some decline may be accounted for by the difficulty in observing plants grazed by cattle prior to sampling in June 2008. The mean flowering stem length and mean leaf height of *C. aboriginum* was much less in 2008 than in 2004 (Table 4). This was due to cattle grazing. However, not all of the vegetation in Subpopulation 3 was equally utilized by cattle. It

appeared that *C. aboriginum* were missing from some less intensively grazed quadrats that had clusters in 2004 (Figures 3 and 4).

Subpopulation 1 (near the spring) and 2, located along the ephemeral drainage, (both monitored by EO update method) had also declined. As of 2004 there was a cattle-watering pond dug out at the spring adjacent to Subpopulation 1. Between 2004 and 2008, this pond was filled in by the owner and water instead piped underground from the spring to a water trough located over 75 m downstream. Although this lessened the congregation of cattle around the spring and allowed vegetation to recover, no *C. aboriginum* clusters were observed at the spring in 2008. Only 8 clusters with 4 flowering stems were observed in Subpopulation 2 along the ephemeral drainage. In contrast to *C. aboriginum*, Douglas' clover was abundant in the drainage.

Lower School Creek (EO 3)—The total area occupied at this occurrence was about 20 m^2, an observed decrease of 5 to 10 m^2 since 2004, although the number of *C. aboriginum* clusters observed was the same as 2004 (Table 2). Four subpopulations were monitored by the EO update method (Table 3). As in 2004, no *C. aboriginum* plants were observed at both Subpopulations 1 and 2. In 2002, both of these subpopulations were small, each with only one large cluster observed (Murphy and Cooke 2003). Both have experienced cattle trampling since 2002 and Subpopulation 2 had streambank erosion. Two fewer *C. aboriginum* clusters were observed at Subpopulation 3 in 2007 than 2004. Streambank erosion and cattle grazing evidence were observed, with only 1 flowering stem found ungrazed. The remaining clusters were teetering on the edge of the streambank which had been heavily trampled by cattle. A fence prevents most cattle grazing at Subpopulations 4 and 5. The number of clusters at Subpopulation 4 was one more than observed in 2004, although the number of flowering stems was 18 fewer (Table 3). The grid at Subpopulation 5, established in 2004, was re-read (Figure 5). The cumulative frequency of *C. aboriginum* was slightly higher than in 2004 (Figure 5) but the total number of flowering stems was 14 fewer (Table 4). Other indicators of *C. aboriginum* vigor (i.e., mean length of flowering stems and mean leaf height) were similar to 2004. Douglas' clover was present.

Sheep Creek - Upper Road Gulch (EO 4)—C. aboriginum at Subpopulation 1, monitored by grid method, was growing more vigorously in 2009 than in 2004 (Table 4; Figure 6). In 2009, 6 *C. aboriginum* clusters with 22 flowering stems were observed. Five clusters with only 4 flowering stems were observed in 2004. Other indicators of *C. aboriginum* vigor (i.e., mean length of flowering stems and mean leaf height) were similar to 2004. This subpopulation is grazed by cattle in the fall. No other physical habitat disturbances were observed.

Monitoring points were established at 3 of the 4 subpopulations discovered since 2004 (Table 1). The core of Subpopulation 14, located in the north-central part of the meadow at Dodson Pass, was monitored by quadrats (Figure 7). Outlying *C. aboriginum* clusters at the upper and lower ends of the meadow (Subpopulations 14 and 16 respectively), were monitored by EO update method (Table 1). Subpopulation 14 had relatively high vigor. It supported an estimated 125 clusters with 1,193 (+/- 719)

flowering stems in the north-central part of the meadow (Table 4; Figure 7), with 3 additional outlying clusters with 72 flowering stems. In 2005, the population size was roughly estimated at about 60 clusters and 1,600 flowering stems. Low intensity sheep grazing was documented, probably resulting in reduced mean flowering stem length compared to ungrazed subpopulations monitored in 2007 (i.e., EO 3, Subpopulation 5 and EO 8, Subpopulation 2) (Table 4). Sheep grazing also reduced the mean flowering stem length and total flowering stems observed at Subpopulation 15. When this subpopulation was first documented in 2005, no livestock grazing was noted. At that time 5 clusters with 40 flowering stems were counted (versus 13 flowering stems in 2007). With the exception of Subpopulation 19, subpopulations documented for the first time in 2007 (Subpopulations 17 - 24; Table 3) were very small, ranging from 1 - 4 m^2 in area occupied and 1 - 5 plant clusters each. Subpopulation 19 was dense, with 178 clusters and 558 flowering stems observed in a discontinuous linear patch occupying approximately 80 x 2 m of an ephemeral tributary drainage to Upper Road Gulch.

Council (EO 5)—This occurrence was monitored along the roadside using the EO update method. All 3 small subpopulations were relocated (Table1). The approximate number of *C. aboriginum* clusters and area occupied was higher than in prior monitoring years (Table 2). The observed total for all 3 subpopulations was 20 clusters and 157 flowering stems in a 29-m^2 area (Table 3). In 2002 and 2004, about 15 clusters and 100-160 flowering stems were counted in a 10 to 15-m^2 area.

South Fork Grays Creek (EO 7)—Subpopulation 1 had a slightly larger population in 2009 than 2004 (Figure 8). In 2004, this occurrence had the smallest population size and area occupied, with 6 *C. aboriginum* clusters and 19 flowering stems tightly clustered in a small area of the macroplot. In 2009, the subpopulation remained small, but had 9 clusters with 13 flowering stems observed. Cattle grazing prior to monitoring had occurred in 2004 but not in 2009. Mean length of flowering stems was similar to 2004, but mean leaf height was longer due to the lack of cattle utilization (Table 4). In 2007, a second subpopulation was discovered in the next drainage to the north. This one was larger than subpopulation 1, having about 22 *C. aboriginum* clusters with 60 flowering stems over a 60 m^2 area (Table 2). Douglas' clover was also present.

South Fork She Creek (EO 8)—Prior to 2007 there had been no thorough survey of this EO. In 2007, Subpopulations 1 and 2 were monitored by quadrat method and 3 by EO update (Table 1). The arrangement of transects established for quadrat sampling were different at this EO because *C. aboriginum* was distributed in a discontinuous linear pattern along low terraces of a sinuous ephemeral stream channel rather than in a larger, wider patch. To ensure that quadrats fell in occupied and immediately adjacent unoccupied habitat, two macroplots (differing in length and width from each other) were established at each subpopulation (Figures 9). Macroplot lengths and widths were the same for each subpopulation. The macroplots were laid out end to end, but a gap of unsuitable or unoccupied habitat was omitted from sampling between each macroplot. For analysis, data from the two macroplots were combined for each subpopulation.

The estimated area of occupied habitat at EO 8 was 500 m^2 less than prior estimates, but this reduction was due to a more accurate survey rather than an actual decrease (Table 2). This occurrence probably supports the second largest area of occupied habitat and second highest total number of plants range-wide. This EO had high vigor with an estimated 356 plant clusters and 6,604 - 15,848 flowering stems in 2007 (Table 2). The density of flowering stems at Subpopulation 2 was very high (31.73 / m^2), over 7 times higher than Subpopulation 1 or any other EO monitored in 2007 (Table 4). The cumulative frequency of *C. aboriginum* was 70% at Subpopulation 2, compared to 47% at Subpopulation 1 (Figure 9). Mean flowering stem length and mean leaf height was also much higher at Subpopulation 2 when compared to 1, (Table 4). Subpopulation 3 supported 40 clusters discontinuously distributed over an estimated 175-m long reach of ephemeral stream channel (Table 3).

Brownlee (EO 12)—After establishment and reading of the quadrat monitoring macroplot in 2008, the population at this occurrence was determined to be larger than previously thought when discovered in 2007 (Table 1). About 487 *C. aboriginum* clusters were present, widely distributed over about 0.25 ha of potential habitat (Table 2). The actual occupied habitat was much less and the frequency of clusters only 0.20 (Figure 10). Flowering stem density was 1.24 / m^2, the 6th lowest of the 14 subpopulations quantitatively monitored. Other indicators of *C. aboriginum* vigor were similar to other ungrazed subpopulations.

Lower Bacon Creek (EO 14)—This occurrence is relatively small in total number of *C. aboriginum* clusters (Table 2). When discovered in 2007, 12 clusters were observed with 135 flowering stems. In 2008, about 13 clusters with approximately 360 flowering stems were observed. Two grid macroplots (A and B) were established within Subpopulation 1 in 2008 (Table 1). They were separated by about 10 m of unoccupied, but potential habitat. It was determined that a single large quadrat sampling macroplot would have had to be too large and unevenly shaped to encompass the two patches, and thus would be inefficient to sample. Subpopulation 1A supported 5 *C. aboriginum* clusters while 1B had 7 clusters (Table 2; Figure 11). Subpopulation 1B had very high flowering stem density (19.50 / m^2), the second highest of all subpopulations quantitatively sampled (Table 4). Mean flowering stem length was also relatively long, another indicator of a vigorous subpopulation. Douglas' clover was abundant at this occurrence.

<u>Associated species and invasive/noxious non-indigenous weed species by occurrence</u>:

Mesa (EO 2)—Subpopulation 3, monitored by quadrat occurs in a seep along an ephemerally wet drainage in meadow. Overall, the plant community associated with *C. aboriginum* did not greatly change between 2004 and 2009. The cover of dominant native perennial species, including California oatgrass (*Danthonia californica*), spikerush species (*Eleocharis* spp.), meadow barley (*Hordeum brachyantherum*), camas (*Camassia quamash*), and tall groundsel (*Senecio hydrophiloides*), was the same or similar (Table 6). Sedges (*Carex* spp.) and rushes, including Howell's (*Juncus howellii*) and Colorado rush (*J. confusus*), notably decreased. Some decrease is likely due to

cattle utilization. In contrast, abundant non-indigenous species, including bulbous bluegrass, prickly lettuce (*Lactuca serriola*), and curly dock (*Rumex crispus*) increased. The vernally wet, clay-rich soil regularly exposed by cattle trampling creates the ideal substrate for a large and diverse population of annual species (both native and non-indigenous) (Table 6). No noxious weeds were detected within the macroplot. No shrubs were present (Table 7).

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 overall herbaceous plant community was still a heterogeneous mix with no individual species clearly dominant (Table 5). In 2004, the most frequently occurring associated species were grass pink (*Dianthus armeria*), native perennial grass species (e.g., meadow barley), taper-leaved penstemon (*Penstemon attenuatus*), and native annual forbs characteristic of vernally moist habitats (Table 5). In 2007, grass pink was absent and several other non-indigenous forbs also noticeably decreased in frequency, including field bindweed (*Convolvulus arvensis*) (a noxious weed), prickly lettuce, and field buttercup (*Ranunculus arvensis*), possibly due in part to county weed spraying efforts. In contrast, St. John's wort (*Hypericum perforatum*), Japanese brome, medusahead, and non-indigenous bluegrass species (i.e., mostly Kentucky bluegrass [*Poa pratensis*]) all increased in frequency in 2007.

Invasive and noxious exotic weed species were common at other subpopulations. While observed non-indigenous species cover appeared similar to 2004, the species composition was slightly different. At Subpopulation 2, sulphur cinquefoil (*Potentilla recta*) was common and the noxious weed leafy spurge (*Euphorbia esula*) was observed 5 m upstream of *C. aboriginum* habitat. Leafy spurge was not observed in 2004. At Subpopulation 3, black bindweed (*Polygonum convolvulus*) was observed overgrowing a *C. aboriginum* cluster, and field bindweed was common. Black bindweed was not observed in 2004. No evidence of weed spraying was observed at Subpopulations 1 - 3. At Subpopulation 4, invasive and noxious weeds decreased in abundance and diversity. Evidence of adjacent weed spraying was observed.

At Subpopulation 5, total shrub cover was unchanged between 2004 and 2007, but dominance shifted. In 2007 there was an increase in cover of overstory arroyo willow (*Salix lasiolepis*) and a decrease in understory common snowberry (*Symphoricarpos albus*) cover compared to 2004 (Table 7). Shrub cover was similar to 2004 amounts at all other subpopulations.

Sheep Creek – Upper Road Gulch (EO 4)—The plant community at Subpopulation 1 became notably more shrub dominated between 2004 and 2009 (Table 7). Total woody species cover increased from 32 to 52%, the bulk of the increase due to growth in canopy cover and height of arroyo willow. Increased shading may be the cause of a decrease in wildrye grass (*Elymus* spp.) and Japanese brome in the understory (Table 5). *Carex aboriginum* was apparently stable in the relatively shady understory. The most notable change was an increase in Kentucky bluegrass. The plant community in the swale at the edge of the willow stand did not change much between 2004 and 2009.

Rush species and a mix of forbs dominated the herbaceous community. In general, perennial forbs increased in frequency, including the aggressive non-indigenous weed sulphur cinquefoil. Other non-indigenous species were similar between years.

The community at Subpopulations 14 - 16 was dominated primarily by native meadow species, including Nevada rush (*Juncus nevadensis*), California oatgrass, Colorado rush, camas, and native annual forbs characteristic of vernally moist habitats (Table 6). Annuals were common on barren, clay-rich soil. The most frequently occurring non-indigenous species were grasses—redtop (*Agrostis stolonifera*), bulbous bluegrass, and timothy (*Phleum pratense*). No shrubs were present in the macroplot (Table 7). No noxious weeds were observed in the macroplot or in adjacent habitat at Subpopulation 14 and 16. Subpopulation 15 had 10% cover of Wood's rose (*Rosa woodsii*).

Subpopulations 17 and 20 – 24 occur on streambanks and terraces in gaps within a shrubby riparian community in Upper Road Gulch. Arroyo willow, black hawthorn (*Crataegus douglasii*), golden currant (*Ribes aureum*), syringa (*Philadelphus lewisii*), and Wood's rose dominate the shrub community, with a fringe of bitterbrush. Shrub cover ranged from 0 to 40%, but was usually 10% or less. Abundant associated herbaceous species included a mix of native and non-indigenous species: bulbous bluegrass, California oatgrass, camas, Canada bluegrass (*Poa compressa*), Howell's rush, intermediate wheatgrass, Japanese brome, Louisiana mugwort (*Artemisia ludoviciana*), medusahead, and slender cinquefoil (*Potentilla gracilis*) on terraces and streambanks, and common spikerush (*Eleocharis palustris*) and native annual forbs in the stream channel. Field bindweed was the only noxious weed observed, observed to be common at Subpopulation 22.

Subpopulations 18 and 19 were located on the banks of a rocky spring-fed ephemeral drainage that mostly lacked shrub cover**.** The most abundant associated species were bulbous bluegrass, California oatgrass, Canada bluegrass, Colorado rush, common spikerush, Howell's rush, intermediate wheatgrass, Japanese brome, Kentucky bluegrass, Louisiana mugwort, meadow deathcamas (*Zigadenus venenosus*), native annual forbs, taper-leaved penstemon, Sandberg's bluegrass, slenderbeak sedge (*Carex athrostachya*), slender cinquefoil, and yarrow (*Achillea millefolium*). Field bindweed was the only noxious weed observed (common at Subpopulation 18).

Council (EO 5)—Associated species and non-indigenous and noxious weed species were monitored for the first time since 2002. The plant communities at this EO are the result of haygrass and legume seeding for livestock forage and the influence of ditches, irrigation, and soil disturbance. At Subpopulation 1, located in an ephemerally moist swale, the most abundant associated species were fox sedge (*Carex vulpinoidea*), Howell's rush, intermediate wheatgrass, meadow foxtail (*Alopecurus pratensis*), red clover (*Trifolium pratense*), and timothy. At Subpopulation 2, occurring on a roadside ditch bank, intermediate wheatgrass, prickly lettuce, and tall annual willow herb (*Epilobium brachycarpum*) were the most abundant species associated with *C. aboriginum*. At Subpopulation 3, in a swale receiving occasional flood irrigation, meadow foxtail and slenderbeak sedge were the most abundant associates. Other

common species at the EO included California oatgrass, tall groundsel, and sweetclover (*Melilotus officinalis*). No noxious weeds were observed.

South Fork Grays Creek (EO 7)—The plant community at Subpopulation 1 became more shrub dominated between 2004 and 2009 (Table 7). Total woody species cover increased from 29 to 49%, due to increases in canopy cover and height of syringa, chokecherry (*Prunus virginiana*), arroyo willow, and common snowberry. Although the overall community did not greatly shift between 2004 and 2009, some native perennial graminoids, including the dominant understory species California oatgrass, spikerush, Colorado rush, and Howell's rush decreased in frequency (Table 6). The frequency of several dominant native forbs (e.g., camas and tall groundsel), along with some non-indigenous species, increased between 2004 and 2009. Japanese brome, bulbous bluegrass, Canada bluegrass, Kentucky bluegrass, and sulphur cinquefoil all notably increased. Other non-indigenous species, especially hound's tongue (*Cynoglossum officinale*), crispy dock, and various annuals decreased. The amount of bare soil exposed (both due to natural processes and cattle trampling) was less in 2009, probably limiting the number of annuals that could establish. No noxious weeds were observed.

Subpopulation 2 was dominated by abundant California oatgrass, associated with tall groundsel, bulbous bluegrass, Colorado rush, meadow barley, Douglas' clover, and native annuals. Non-indigenous species cover was 5 - 25%. Occupied habitat occurs in an ephemerally moist swale in a flat valley bottom possibly fed by a seep. Other non-indigenous species include Japanese brome, crispy dock, medusahead, prickly lettuce, and the aggressive weed oxeye daisy (*Leucanthemum vulgare*).

South Fork She Creek (EO 8)—Associated species and non-indigenous species were monitored for the first time in 2007. The plant community was similar at all subpopulations, with the most frequently occurring species being California oatgrass, meadow barley, native annual forbs, prickly lettuce, rush spp. (Colorado rush and/or poverty rush [*Juncus tenuis*]), slender cinquefoil, and non-indigenous annual grasses, especially Japanese brome and medusahead (Table 6). Other common, but less frequently occurring native species included common spikerush, Nevada rush, native annual graminoids (annual hairgrass [*Deschampsia danthonioides*] and/or toad rush [*Juncus bufonius*]), and willow dock (*Rumex salicifolius*). The plant community differed between Subpopulation 1 and 2 in the number and frequency of non-indigenous species. Subpopulation 1 was grazed and had higher frequency of bare soil (100%) than 2 (63%), which was ungrazed (Table 6). Subpopulation 1 had 16 non-indigenous species sampled, compared to 11 at 2. Seven of the non-indigenous species had 30% or more frequency at Subpopulation 1, and these 7 all had higher frequency at Subpopulation 1 than 2. These species were bitter dock (*Rumex obtusifolius*), Japanese brome, medusahead, prickly lettuce, prostrate knotweed (*Polygonum aviculare*), redtop, and tall tumblemustard (*Sisymbrium altissimum*). Curly dock and the noxious weed field bindweed (observed, in one quadrat at Subpopulation 2) were the only non-indigenous species with higher frequency at Subpopulation 2 than 1. Non-indigenous species at Subpopulation 3 were similar in abundance and composition to Subpopulation 2. Shrubs were absent from the EO (Table 7).

Brownlee (EO 12)—The meadow supporting *C. aboriginum* was dominated by native species, namely California oatgrass, Nevada rush, camas, yampah species (*Perideridia* spp.), slender cinquefoil, tall groundsel, and a suite of native vernal annuals, mixed with non-indigenous smooth brome (*Bromus inermis*) and Kentucky bluegrass (Table 6). Other forbs, including yarrow and aster species (*Symphotrichum* spp.) were also common in this diverse community. Other non-indigenous species of note included bulbous bluegrass and dandelion (*Taraxacum officinale*). A few individuals of the noxious weed leafy spurge were documented at the margin of the macroplot. Other noxious weeds included Canada thistle (*Cirsium arvense*) and field bindweed, both present in trace amounts). The macroplot occurred in a spring-fed meadow at the edge of a dense riparian black hawthorn-dominated stand. Total shrub cover was 8%, primarily black hawthorn (Table 7). A few ponderosa pine saplings were also scattered at the margins of the meadow adjacent to occupied habitat.

Lower Bacon Creek (EO 14)—Subpopulation 1 occurred in a sloped, seep-fed meadow drainage. It was dominated by sedges (*C. athrostachya*, *C. praegracilis*, and *C. sheldonii*), tall groundsel, Douglas' clover, and Kentucky bluegrass; overall, a similar mix as at Mesa (EO 2, Subpopulation 3) (Table 5). Other prominent native species associated with *C. aboriginum* included California oatgrass, Bolander's spikerush (*Eleocharis bolanderi*), Colorado rush, fringed willowherb, slender cinquefoil, and various annuals. Non-indigenous species, such as redtop, prickly lettuce, and dandelion, were also common. No noxious weeds were observed. No woody species were present (Table 7).

Habitat condition, disturbances, and threats by occurrence:

Mesa (EO 2)—The occurrence is intensively grazed by cattle every spring (less than about 10 cm stubble height). High utilization was observed in 2007 (< 5 cm stubble height) and 2008 (25 cm stubble height). Cattle sign was abundant, with 24 hoof prints / m^2 documented (Table 8). All *C. aboriginum* clusters had been grazed with varying utilization. Banks of the ephemeral stream were heavily trampled and sloughing in places. A 45 cm tall headcut was documented in the stream bottom adjacent to Subpopulation 3 (Table 9). This may have the result of lowering the water table and therefore drying the meadow habitat for *C. aboriginum*. No other disturbances or threats were observed. There was no evidence that water piped to a cattle trough at Subpopulation 1 had significantly dried the existing spring habitat. Monitoring in 2004 occurred prior to grazing.

Lower School Creek (EO 3)—Habitat condition at Subpopulations 1 - 3 continued to deteriorate between 2004 and 2007, but no major changes occurred at Subpopulations 4 and 5 compared to 2004 (Murphy and Hahn 2005). No *C. aboriginum* have been observed at Subpopulations 1 and 2 since 2002. In 2001 and 2002, no cattle grazing occurred at this occurrence. Observed in spring 2004 (Murphy and Hahn 2005) and again in 2007, grazing occurred in the downstream half of the occurrence (Subpopulations 1 - 3). Evidence of intensive grazing was observed at these

subpopulations in 2007, including trampled streambanks, trailing, and utilization of herbaceous species to 10 cm stubble height. The lack of protective vegetative cover has allowed streambanks to erode and slough into the stream. One *C. aboriginum* cluster at Subpopulation 3 was undercut by erosion and barely rooted on the terrace. It will be lost with further erosion. Within about 50 m of Subpopulation 1, cattle have trampled the streambank adjacent to a salt block location resulting in about 70 m of barren, eroding bank (no change from 2004). Cattle trails have caused bank erosion at Subpopulations 2 and 3. At Subpopulations 4 and 5, cattle sign was minimal in both 2004 and 2007, probably representing occasional strays traveling through the habitat (Table 8). In 2007, OHV tracks were observed within the grid, but no *C. aboriginum* clusters were directly impacted. The OHV might have been from county weed spraying efforts. Unstable banks also occur at Subpopulations 4 and 5. No land use changes were observed from prior visits (2004 and 2005) (Murphy and Hahn 2005). Evidence of herbicide spraying of broadleaf noxious weeds occurs within 3 m of each side of the Weiser River Trail which parallels the occurrence (Table 9). No direct impacts to occupied habitat from the trail or herbicides were observed 2007.

Sheep Creek - Upper Road Gulch (EO 4)—Although habitat disturbances and threats remain high, there were no major changes in habitat condition at the subpopulations monitored in 2007 compared to prior visits in 2004 (Murphy and Hahn 2005) and 2005. Livestock grazing, streambank erosion resulting from livestock trampling, road impacts to hydrology, noxious weed invasion, and recreation impacts were all observed threats at this EO. Subpopulation 1 did not have more than trace livestock grazing evidence in both 2004 and 2009 (Table 8). Sheep had been trailed through the occurrence during spring 2007, but the intensity of trailing and grazing varied by subpopulation. Evidence of cattle grazing from prior years was also observed, but none from 2007. Subpopulations with light trailing (no exposed soil) and light utilization of vegetation (vegetation stubble height >25 cm) by sheep were 14, 16 - 19, and 21 - 23. At Subpopulation 14, 30% of the quadrats had experienced foraging by sheep and sheep dung was widely scattered (Table 8). Subpopulations 15, 20, and 24 had moderate to intensive trailing and grazing. Unstable streambanks were observed at Subpopulations 17, 20, and 24. The road parallels most subpopulations in upper Road Gulch (Figure 8), with several road crossings and culverts, and occasional road fill impinging on the channel (e.g., Subpopulation 24) (Table 9). Sheep were trailed up the road and occasionally went down to the stream to access water and riparian vegetation. Herbicide spraying of broadleaf noxious weeds by the county occurred during monitoring. Spraying was restricted to about 2 m off the road with spot treatment of noxious weeds further off the road. It is unlikely that any *C. aboriginum* were directly impacted. Subpopulations 17, 20, 21, 23, and 24 occurred within 8 m of the road and were most at risk from road-related disturbances.

The road provides access to the occurrence for recreation activities. Recreational OHV use was observed during a prior visit in 2005. During monitoring in 2007, recent OHV tracks were observed within 10 m of *C. aboriginum* clusters at Subpopulation 14 in the meadow at Dodson Pass. In the center of the meadow, about 2 m from occupied habitat, a 4 x 4 truck had created a barren mud “donut” (about 25 m x 7 m) in 2006 (it

had some growth of vegetation on the disturbed soil). Also, a recently used campfire ring was built within 10 m of *C. aboriginum* in the meadow. There is an old 2-track road leading from the main road to the meadow. This allows for occasional camping access (during the dry season), evidenced by 3 older fire rings observed in the meadow (Subpopulations 14 and 16).

No land use changes were observed from prior visits. The discovery of additional subpopulations in 2007 makes this occurrence more secure than previously thought, but 20 of the 24 subpopulations are small and vulnerable and the Dodson Pass area is threatened by recreational impacts.

Council (EO 5)—Although the habitat condition and threats were similar to prior visits in 2004 (Murphy and Hahn 2005) and 2005, this small occurrence remains highly vulnerable to extirpation due to human activities. Maintenance of fences, irrigation ditches, and roadside ditches threaten this occurrence (Table 9). All three subpopulations occur within 5 m of roadside ditches and pasture fences. At Subpopulation 2 there was a 0.5-m^2 pile of sediment from roadside ditch dredging deposited partially on a *C. aboriginum* cluster. The hydrology is influenced by irrigation and past drainage alteration (most evident at Subpopulation 3). At Subpopulation 3, sediment from recent irrigation ditch dredging had been deposited 2 m from a *C. aboriginum* cluster. Subpopulations 1 and 3 occur within a pasture lightly grazed by horses (observed in prior years). No grazing evidence was observed in 2007. The habitat within the pasture does not appear altered by hay cultivation or plowing, but has been seeded with forage grasses and legumes in the past. Weed levels are currently low, possibly due to roadside broadleaf weed spraying, but the potential for noxious weed invasion is high, especially on soil disturbed by ditch maintenance (field bindweed occurs on roadsides near the occurrence). Pasture cultivation, and subdivision construction remain potential high magnitude threats in the area surrounding the occurrence. The irrigated pasture adjacent to the Subpopulation 2 may be too wet for home construction.

South Fork Grays Creek (EO 7)—In 2004, spring cattle grazing was the main threat to this occurrence. It 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). In 2009, only trace amounts of livestock sign were observed. Although cattle trampling was also relatively common in 2004, streambank stability was fair due to rock anchoring. At the landscape scale, an old 4 x 4 road (rarely driven, with access restricted by a locked gate) is located about 40 m south of the occurrence. An extensive wildfire occurred about 50 m up slope in the bitterbrush and sagebrush dominated uplands in late summer 2007, but the riparian habitat was not affected (Table 9). There were no major changes in habitat disturbances and threats at Subpopulation 1 since 2004. Subpopulation 2 did not have evidence of any disturbances or threats other than those related to cattle use and non-indigenous plant invasion.

South Fork She Creek (EO 8)—No major changes to habitat condition or threats were observed in 2007 compared to prior visits in 2004 (Murphy and Hahn 2005) and 2005.

Subpopulation 1 had relatively high density of recent cattle hoof prints (10 per m^2) and high levels of exposed bare soil (Table 8). Subpopulations 2 and 3 are apparently rested from cattle grazing—no evidence was observed in 2007. It has denser, more vigorous *C. aboriginum*, more stable streambanks, and less stream incision than Subpopulation 1. Cattle sometimes lightly graze Subpopulations 2 and 3, probably later in the year (some old hoof prints were observed at 3). Road crossings, ditches, buried cable, and culverts have altered drainage patterns and disturbed soil at this occurrence (Table 9). *Carex aboriginum* plants on roadside ditch banks (less than 1 m off the road) are potentially threatened by weed spraying and maintenance of ditches, fences, and buried cable. The majority of the occurrence is not affected by these activities. Erosion and stream downcutting may lead to desiccation of the terraces supporting Subpopulation 1. Non-indigenous species are common in the area surrounding the occurrence, including bulbous bluegrass, intermediate wheatgrass, Japanese brome, medusahead, and the noxious weeds field bindweed and rush skeletonweed (*Chondrilla juncea*). No land use changes were observed from prior visits (2004 and 2005).

Brownlee (EO 12)—This occurrence occurs on the Andrus Wildlife Management Area managed by Idaho Department of Fish and Game (IDFG) for wildlife habitat values and cattle grazing. The site is grazed by cattle in the spring every other year. Minimal livestock sign was recorded at the time of monitoring in June 2008 (Table 8). There was evidence of streambank trampling and churning of wet, spring-fed soils by cattle (Table 9). The result was very hummocky ground and exposed soil vulnerable to noxious weed invasion. Noxious weeds were present in potential and occupied *C. aboriginum* habitat. A headcut was observed in an adjacent ephemeral drainage. This may promote lowering of the water table and desiccation of habitat supporting *C. aboriginum*. No other habitat disturbances or threats were observed.

Lower Bacon Creek (EO 14)—No disturbances or immediate threats were observed at this occurrence (Table 8). The surrounding landscape is a mix of rural residences, ranches, roads and driveways, pastures, a reservoir (immediately upstream from the occurrence), and open rangeland (Table 9). It is unfenced to any wandering livestock, but the lack of old livestock evidence implies that current use is rare. Its proximity to a major road makes it potentially vulnerable to OHV use, but no past use was evident.

DISCUSSION

Monitoring data is valuable for developing biologically based conservation actions and management objectives for *C. aboriginum*. The goal for 2007 - 2009 monitoring, funded by USFWS Section 6, was to better understand trends in population size and vigor, habitat condition, and disturbances on private and state land. Funding for monitoring occurrences on BLM land was not available.

Monitoring and inventory (IDCDC 2007) were useful for more accurately assessing the rangewide conservation status of the species. After the 2009 field season, there were 10 known *C. aboriginum* EOs rangewide comprised of an estimated 1,929 plant clusters occupying approximately 0.30 ha (0.74 acres) of habitat (Table 2). In comparison, in 2004, there were 8 known EOs with approximately 1,240 plant clusters occupying about

0.26 ha (0.64 acres) rangewide. These results stress the importance of additional inventory for the species.

Of the 10 EOs, 4 are considered "large," each known to support 100 or more *C. aboriginum* clusters (Table 2). The 3 largest EOs (4, 8, and 12) support 81% of the range-wide population and about 73% of the known occupied area. EO 4, inclusive of the former EO 9, is the largest known occurrence in both number of plant clusters and area occupied. It supports about 38% of the known range-wide population, and about 32% of the occupied habitat area. At EO 4, which spans most of a watershed and occurs on a mix of state, federal, and private lands, the majority of *C. aboriginum* occur in 4 large subpopulations with 20 small patch subpopulations interspersed. EO 8 is wholly on private land. EO 12 occurs on IDFG land in a protected Wildlife Management Area. All other EOs are small in size and most are vulnerable to impacts related to human activities. The current conservation rank for the species (G1/S1) is appropriate.

The impacts of cattle and sheep grazing on *C. aboriginum* vigor and habitat condition are not well understood. By establishing paired monitoring transects at EO 8, one with cattle grazing and one without, insights into the impacts of cattle grazing on *C. aboriginum* vigor and habitat condition were made. *Carex aboriginum* tolerates grazing and obviously persists over time in grazed landscapes. However, the population decline at EO 2 may be correlated with annual intensive cattle grazing during the growth and reproduction period for *C. aboriginum*. Livestock impacts to soils and hydrology may affect the ability of the habitat to support *C. aboriginum*. For example, the frequency and diversity of potentially competitive non-indigenous plant species was often higher at grazed sites (i.e., Subpopulation 1 at EO 8). This may indicate colonization of soil and gravel exposed by annual trampling. Non-indigenous plant invasion may also occur on sites disturbed by OHVs and road-fill deposits. At EOs 2 and 12 stream down-cutting (often related to unstable streambanks in grazed meadows) could be lowering the water table making habitat drier and less suitable for *C. aboriginum*. At EO 3, cattle heavily trampled streambanks. This caused banks, and likely *C. aboriginum*, to collapse into the stream channel.

MANAGEMENT IMPLICATIONS AND RECOMMENDATIONS

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 and other recommendations are listed below:

1. Livestock grazed portions of all occurrences monitored during 2007. To allow adequate reproduction of *C. aboriginum*, 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. A large exclosure was recently constructed to protect

Subpopulations 7 and 8 of EO 4. The landowner at EO 2 may be open to the idea of protecting subpopulations during spring grazing with temporary exclosures.

2. To reduce streambank erosion at EO 3, grazing should be minimized or removed from riparian areas supporting *C. aboriginum*. Range-wide, salt blocks and supplements should not be located near streams, wetlands, or occupied habitat.
3. Actions should be taken to restore streambank stability and reduce streambed incision ("headcutting") at EOs 2 and 12. These are ephemeral drainages which carry brief, but potentially erosive flows during spring snow melt or large rain events. In-stream placement of large boulders or anchored large wood can sometimes effectively pool water behind them, slowing the erosive energy of flows, and allow for recovery of anchoring vegetation in such headwater streams.
4. At EO 4, the private landowner of the Dodson Pass meadow should be notified of recreational impacts and their impacts on habitat condition. To protect resources, camping should not be allowed in the meadow. The 2-track road from the main road to the meadow needs to be closed or altered to prevent OHV and 4 x 4 impacts to Subpopulations 14 and 16.
5. Control of broadleaf noxious weeds is locally effective and should continue where appropriate. Spraying within 50 m of occupied *C. aboriginum* habitat should be carefully done and only with herbicides that do not impact perennial grasses and sedges. Weed spraying crews should know occurrence locations and how to identify *C. aboriginum*.
6. Federal, state, county, and private land managers should avoid ground disturbance in occupied *C. aboriginum* habitat and immediately adjacent areas.
7. 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 *C. aboriginum* and restore its habitat.
8. The BLM and USFWS should continue to provide funding for inventory, monitoring, and conservation of *C. aboriginum* and its habitat.
9. A research program focused on better understanding the basic life history of *C. aboriginum*; the environmental characteristics of habitat; and the effects of management actions on habitat condition and population size is needed.
10. Quantitative monitoring is needed at subpopulations located on BLM-managed land. Specifically, Subpopulations at EO 4 and EO 6 should be highest priority.

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Table 1. Summary of monitoring by *Carex aboriginum* EO, subpopulation (monitoring point), and year.

2004 EO #	2007 Revised EO #	Land Manager	2004 Subpop. #	2007 Revised Subpop. #	Quadrat Sampling	Grid	EO Update	Cursory EO Update
2	2	private (Access Yes)	1					2004 2008
		private (Access Yes)	2					2004 2008
		private (Access Yes)	3		2004 2008			
3	3	private	1				2004 2007	
		private	2				2007	2004
		private	3				2004 2007	
		private	4				2004 2007	2005
		private	5			2004 2007		
4	4	ID DOL	1			2004 2009		
		BLM	2				2004	
		BLM	3				2004	
		BLM	4				2004	
		BLM	5				2004	
		BLM	6				2004	
5	5	private	1				2007	2004 2005
		private	2				2007	2004 2005
		private	3				2007	2004 2005
6	6	BLM	1		2004			
7	7	ID DOL	1	1		2004 2009		2006
		ID DOL	n/a	**2**				2007
8	8	private	1	1	2007			2004 2005
		private	2	2	2007			2004 2005
		private	3	3			2007	2004 2005

Table 1. Continued.

2004 EO #	2007 EO #	Land Manager	2004 Subpop. #	2007 Subpop. #	Quadrat Sampling	Grid	EO Update	Cursory EO Update
9	4	BLM	1	7	2004			
		BLM	2	8	2004			
		BLM	3	9			2004	
		BLM	4	10			2004	
		BLM	5	11			2004	
		BLM	6	12			2004	
		BLM	n/a	**13**				2005
		private (Access Yes)	n/a	**14**	2008		2007	2005
		BLM	n/a	**15**			2007	2005
		private (Access Yes)	n/a	**16**			2007	2005
		BLM	n/a	**17**			2007	
		BLM	n/a	**18**			2007	
		BLM	n/a	**19**			2007	
		BLM	n/a	**20**			2007	
		BLM	n/a	**21**			2007	
		BLM	n/a	**22**			2007	
		BLM	n/a	**23**			2007	
		BLM	n/a	**24**			2007	
n/a	**12**	IDFG	n/a	**1**	2008			2007
			n/a	**2**				2007
n/a	**13**	IDFG	n/a	**1**				2007
n/a	**14**	private	n/a	**1**		2008		2007
		private	n/a	**2**				2007

EOs and subpopulations in bold = documented since 2004

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

2004 EO #	2007- 2009 EO #	2004 Total Area Occupied (approx. m^2)	2007-2009 Total Area Occupied (approx. m^2)	2004 Total Population Size (approximate)	2007-2009 Total Population Size (approximate)	2004 EO Rank	2007-2009 EO Rank
2	2	550 - 650	177 +/-	375+ clusters* 240 - 1,460+ flowering stems	182+ clusters* 9 - 575+ flowering stems	C	C
3	3	25 - 30	20 +/-	17 clusters 127 flowering stems	17 clusters 72 flowering stems	C	CD
4	4	115 +/-	no estimate	30 clusters 82 flowering stems	no new complete count	C	BC
9	4	510 +/-	no estimate	400 clusters 2,510 - 12,730 flowering stems	no new complete count	B	
n/a	4 (new subpops.)	n/a	427 +/-	n/a	330 clusters 1,209 - 2,647 flowering stems	n/a	
5	5	15 +/-	29 +/-	16 clusters 96 - 160 flowering stems	20 clusters 157 flowering stems	D	D
6	6	125 +/-	not monitored	40 clusters 86 flowering stems	not monitored	C	no new info.
7	7	8 +/-	9 +/-	6 clusters 19 flowering stems	9 clusters 13 flowering stems	C	C
n/a	7 (new subpop.)	n/a	60 +/-	n/a	22 clusters 40 flowering stems		
8	8	1,250+	700 +/-	no count	356 clusters 6,604 - 15,848 flowering stems	C	BC
n/a	12 (new EO)	n/a	485 +/-	n/a	487+ clusters 1,491 - 4,467 flowering stems	n/a	BC
n/a	13 (new EO)	n/a	250 +/-	n/a	23 clusters 17 flowering stems	n/a	C
n/a	14 (new EO)	n/a	28 +/-	n/a	12 - 13 clusters 135 - 360 flowering stems	n/a	BC

* significant decrease in number of clusters between 2004 and 2008 (paired t-test, P = 0.0307, alpha(2) = 0.05)

Table 3. Area of occupied habitat, population size, mean flowering stem (fs) length, and distribution pattern at *Carex aboriginum* subpopulations monitored using the EO update method in 2007 - 2009 and in 2004.

EO #	Subpop 2004 #	Subpop 2007-2009 #	Subpop. Area Occupied (m2) 2004	Subpop. Area Occupied (m2) 2007-2009	Subpop. Size 2004	Subp. Size 2007-2009	Mean FS Length (cm) 2004	Mean FS Length (cm) 2007-2009	Distribution Pattern
2	1	1	0	0	0 clusters	0 clusters	n/a	n/a	small patch
	2	2	not monitored	3	no estimate	8 clusters	n/a	40	discontinuous small linear patch
3	1	1	0	0	0 clusters	0 clusters	n/a	n/a	small patch
	2	2	0	0	0 clusters	0 clusters	n/a	n/a	small patch
	3	3	10	5	5 clusters 5 fs	3 clusters 1 fs	70	40	discontinuous small linear patch
	4	4	4	3	3 clusters 41 fs	4 clusters 23 fs	67	80	discontinuous small linear patch
4	2	2	30	not monitored	5 clusters 9 fs	no count	75	n/a	discontinuous small linear patch
	3	3	36	not monitored	4 clusters 18 fs	no count	78	n/a	discontinuous small linear patch
	4	4	17	not monitored	2 clusters 8 fs	no count	90	n/a	discontinuous small linear patch
	5	5	7	not monitored	7 clusters 21 fs	no count	70	n/a	discontinuous small linear patch
	6	6	20	not monitored	8 clusters 22 fs	no count	54	n/a	discontinuous small linear patch

Table 3. Continued.

EO #	Subpop 2004 #	Subpop 2007-2009 #	Subpop. Area Occupied (m2) 2004*	Subpop. Area Occupied (m2) 2007-2009	Subpop. Size 2004	Subp. Size 2007-2009	Mean FS Length (cm) 2004	Mean FS Length (cm) 2007-2009	Distribution Pattern
4 (9)	3	9	4	not monitored	9 clusters 48 fs	no count	60	n/a	small patch
	4	10	50	not monitored	18 clusters 96 fs	no count	58	n/a	discontinuous small linear patch
	5	11	56	not monitored	21 clusters 133 fs	no count	55	n/a	discontinuous small linear patch
	6	12	25	not monitored	5 – 10 clusters 75 fs	no count	56	n/a	discontinuous small linear patch
	n/a	13*	4	not monitored	10 clusters 140 fs	no count	n/a	n/a	small patch
	n/a	14 (outliers)	n/a	5	n/a	3 clusters 72 fs	n/a	56	discontinuous small patches
	n/a	15*	5	6	5 clusters 40 fs	8 clusters 13 fs	n/a	21	small patch
	n/a	16	n/a	1	n/a	1 cluster 20 fs	n/a	52	small patch

Table 3. Continued.

EO #	Subpop 2004 #	Subpop 2007-2009 #	Subpop. Area Occupied (m2) 2004*	Subpop. Area Occupied (m2) 2007-2009	Subpop. Size 2004	Subp. Size 2007-2009	Mean FS Length (cm) 2004	Mean FS Length (cm) 2007-2009	Distribution Pattern
4	n/a	17	n/a	1	n/a	3 clusters 15 fs	n/a	58	small patch
	n/a	18	n/a	4	n/a	5 clusters 6 fs	n/a	63	discontinuous small linear patch
	n/a	19	n/a	155	n/a	178 clusters 558 fs	n/a	63	discontinuous linear patch
	n/a	20	n/a	2	n/a	3 clusters 23 fs	n/a	60	small patch
	n/a	21	n/a	1	n/a	2 clusters 19 fs	n/a	59	discontinuous small linear patch
	n/a	22	n/a	1	n/a	1 cluster 3 fs	n/a	22	small patch
	n/a	23	n/a	1	n/a	2 clusters 10 fs	n/a	70	discontinuous small linear patch
	n/a	24	n/a	1	n/a	2 clusters 11 fs	n/a	63	small patch
5	1	1	not monitored	25	no count	14 clusters 80 fs	n/a	n/a	small patch
	2	2	not monitored	3	no count	5 clusters 72 fs	n/a	n/a	small patch
	3	3	not monitored	1	no count	1 cluster 6 fs	n/a	n/a	small patch
8	3	3	not monitored	175	no count	40 clusters 725 fs	n/a	69	discontinuous small linear patch

*EO 4, subpopulations 13 and 15 were last observed in 2005.

Table 4. *Carex aboriginum* flowering stem density, mean flowering stem length, and mean leaf height for subpopulations monitored by quadrat sampling and grid methods.

EO # (subpop #) Sample Size	Year	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)	2004	0.83*	1.92	850 (+/- 609)	53.6	12.12	26.4	5.77
2 (3)	2008	0.22*	1.11	226 (+/- 349)	16.3	5.5	17.4	5.9
3 (5) n = 18	2004	4.50	8.20	81	64.2	10.51	32.9	4.89
3 (5) n = 18	2007	3.72	6.00	67	64.5	16.22	42.3	7.12
4(1)	2004	0.22	0.71	4	45.0	0	24.2	6.55
4 (1)	2009	1.44	3.20	26	45.0	1.50	31.4	10.85
4 (14) n = 20	2008	7.95	10.94	1193 (+/-719)	45.5	7.47	28.7	3.43
7 (1)	2004	0.95	4.14	19	43.0	0	16.0	7.70
7 (1)	2009	0.65	1.42	13	44.8	9.52	26.9	4.07
8 (1) n =30	2007	4.37	6.51	983 (+/- 509)	45.5	8.72	22.8	3.19
8 (2) n = 30	2007	31.73	37.84	9519 (+/- 3813)	68.8	10.98	47.8	10.31
12 (1)	2008	1.24	3.22	2967 (+/- 1488)	48.1	14.27	29.4	4.73
14 (1A)	2008	4.00	7.29	48	40.5	5.68	40.0	8.56
14 (1B)	2008	19.50	40.86	312	61.2	6.91	41.0	7.41

* not a significant decrease in flowering stem density between 2004 and 2008 (paired t-test, P = 0.0975, alpha(2) = 0.05)

Table 5. Frequency of herbaceous species and ground cover attributes associated with *Carex aboriginum* subpopulations monitored by grid.

Species	2004 3 (#5) Freq.	2007 3 (#5) Freq.	2004 4 (#1) Freq.	2009 4 (#1) Freq.	2004 7 (#1) Freq.	2009 7 (#1) Freq.	2008 14 (#1A) Freq.	2008 14 (#1B) Freq.
Native Graminoids								
Carex athrostachya (slenderbeak sedge)	0.00	0.00	0.06	0.00	0.40	0.55	0.42	1.00
Carex praegracilis (blackroot field sedge)	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.25
Carex sheldonii (Sheldon's sedge)	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Danthonia californica (California oatgrass)	0.00	0.00	0.11	0.39	0.30	0.15	0.08	0.38
Deschampsia danthonioides (annual hairgrass)	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00
Eleocharis spp. (spikerush species)[1]	0.06	0.00	0.00	0.00	0.80	0.25	0.17	0.44
Elymus spp.(wildrye)[2]	0.00	0.00	0.72	0.47	0.00	0.00	0.00	0.00
Hordeum brachyantherum (meadow barley)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Juncus confusus (Colorado rush)	0.00	0.00	0.56	0.00	0.30	0.15	0.00	0.50
Juncus howelii (Howell's rush)	0.39	0.28	0.56	0.56	0.35	0.15	0.00	0.00
Juncus spp. (rush species)[3]	0.44	0.22	n/a	0.28	n/a	0.00	0.00	0.00
Juncus nevadensis (Nevada rush)	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00
Juncus tenuis (poverty rush)	0.00	0.00	0.11	0.00	0.05	0.00	0.00	0.00
native perennial grass sp. (immature)[4]	0.83	0.61	0.00	0.00	0.00	0.00	0.00	0.00
Poa secunda (Sandberg's 'Nevada' bluegrass)	0.17	0.17	0.00	0.11	0.00	0.15	0.00	0.00
unknown grass species	0.00	0.00	0.00	0.39	0.70	0.15	0.08	0.00
Native Forbs								
Achillea millefolium (yarrow)	0.39	0.72	0.61	0.44	0.25	0.20	0.08	0.00
Artemisia ludoviciana (Louisiana mugwort)	0.39	0.39	0.11	0.17	0.10	0.10	0.00	0.00
Triteleia grandiflora (largeflower triteleia)	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00
Calachortus eurycarpus (white mariposa lily)	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00
Camassia quamash (camas)	0.11	0.00	0.28	0.39	0.65	0.75	0.08	0.00
Camissonia subacaulis (diffuse eveningprimrose)	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00
Epilobium ciliatum (fringed willowherb)	0.00	0.00	0.00	0.00	0.00	0.05	0.83	0.00
Hydrophyllum capitatum (ballhead waterleaf)	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00
Lithophragma spp. (prairie starflower)	0.00	0.00	0.00	0.06	0.00	0.30	0.00	0.00
native annual forbs[5]	0.89	1.00	n/a	0.83	n/a	1.00	0.75	0.94
Penstemon attenuatus (taperleaf penstemon)	0.83	0.89	0.00	0.00	0.00	0.00	0.00	0.00
Perideridia spp. (yampah)	0.00	0.00	0.28	0.33	0.60	0.65	0.00	0.00
Potentilla arguta (tall cinquefoil)	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00
Potentilla gracilis (slender cinquefoil)	0.06	0.06	0.33	0.44	0.35	0.05	0.00	0.75
Senecio hydrophiloides (tall groundsel)	0.06	0.22	0.06	0.00	0.50	0.70	0.92	0.50
Sidalcea oregana (Oregon checker-mallow)	0.00	0.11	0.22	0.22	0.00	0.05	0.00	0.00
Symphotrichum spp. (aster species)	0.00	0.00	0.00	0.00	0.55	0.45	0.00	0.00
Trifolium douglasii (Douglas' clover)	0.06	0.00	0.00	0.00	0.10	0.00	1.00	1.00
unknown forb species	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00
Viola nuttallii (Nuttall's violet)	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00
Zigadenus venenosus (meadow deathcamas)	0.00	0.28	0.00	0.00	0.00	0.05	0.08	0.00
Ground Cover								
bare soil and gravel	0.44	0.67	0.50	0.44	0.90	0.65	0.17	0.00
rock	0.00	0.00	0.33	0.80	0.05	0.10	0.00	0.00
wood	0.33	0.00	0.67	0.94	0.50	0.50	0.00	0.00

Table 5. Continued.

Non-indigenous Graminoids								
Agrostis stolonifera (redtop)	0.11	0.00	0.33	0.00	0.15	0.00	0.00	0.50
Bromus inermis (smooth brome)	0.22	0.28	0.00	0.00	0.00	0.00	0.00	0.00
Bromus japonicus (Japanese brome)	0.67	0.89	0.89	0.22	0.75	0.95	0.17	0.06
Bromus tectorum (cheatgrass)	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00
Dactylis glomerata (orchardgrass)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19
Phleum pratense (timothy)	0.00	0.00	0.17	0.06	0.00	0.00	0.00	0.00
Poa bulbosa (bulbous bluegrass)	0.00	0.06	0.17	0.00	0.20	0.65	0.00	0.00
Poa compressa (Canada bluegrass)	0.00	0.00	0.11	0.17	0.40	0.65	0.00	0.00
Poa pratensis (Kentucky bluegrass)	0.00	0.00	0.67	1.00	0.50	1.00	1.00	1.00
Poa spp.[6] (bluegrass spp.)	0.56	0.89	0.00	0.00	0.00	0.00	0.00	0.00
Taeniatherum caput-medusae (medusahead)	0.00	0.44	0.00	0.28	0.00	0.35	0.00	0.00
Non-indigenous Forbs								
Conium maculatum (poison hemlock)*	0.00	0.00	0.06	0.06	0.00	0.00	0.00	0.00
Convolvulus arvensis (field bindweed)*	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cynoglossum officinale (hound's tongue)	0.00	0.00	0.00	0.00	0.45	0.15	0.00	0.00
Dianthus armeria (grass pink)	0.78	0.00	0.00	0.00	0.00	0.05	0.00	0.00
Geranium carolinianum (Carolina geranium)	0.67	0.78	0.22	0.17	0.90	0.20	0.08	0.38
Hypericum perforatum (St. John's wort)	0.06	0.50	0.11	0.00	0.00	0.10	0.00	0.00
Lactuca serriola (prickly lettuce)	0.28	0.00	0.39	0.44	0.60	0.55	0.58	0.88
Medicago sativa (alfalfa)	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00
Nepeta cataria (catnip)	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00
other non-indigenous annual/biennial forbs	0.00	0.00	n/a	0.28	n/a	0.65	0.00	0.25
Potentilla recta (sulphur cinquefoil)	0.00	0.06	0.17	0.56	0.60	0.90	0.00	0.00
Ranunculus arvensis (field buttercup)	0.33	0.06	0.00	0.00	0.00	0.00	0.00	0.00
Rumex crispus (curly dock)	0.00	0.00	0.00	0.06	0.55	0.40	0.08	0.06
Taraxacum officinale (dandelion)	0.00	0.00	0.11	0.00	0.25	0.30	0.00	0.31

[1] *Eleocharis bolanderi* (Bolander's spikerush) (e.g., at EO 14) and/or *E. palustris* (common spikerush) (e.g., at EO 7)

[2] includes *Elymus trachycaulus* (slender wheatgrass) and *Elymus glaucus* (blue wildrye)

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

[4] immature *Hordeum brachyantherum* (meadow barley) or *Pascopyrum smithii* (western wheatgrass)

[5] includes 14 species

[6] primarily *Poa pratensis* (Kentucky bluegrass) with lesser amounts of *Poa compressa* (Canada bluegrass)

* Idaho noxious weed (Idaho Department of Agriculture 2010)

Table 6. Frequency of herbaceous species and ground cover attributes associated with *Carex aboriginum* subpopulations monitored by quadrat sampling.

Species	2004	2008	2008	2007	2007	2008
	2 (#3)	2 (#3)	4 (#14)	8 (#1)	8 (#2)	12 (#1)
	Freq.	Freq.	Freq.	Freq.	Freq.	Freq.
Native Graminoids						
Carex athrostachya (slenderbeak sedge)	n/a	n/a	0.00	0.03	0.00	0.25
Carex petasata (Liddon sedge)	0.00	0.00	0.00	0.00	0.00	0.05
Carex douglasii (Douglas' sedge)	0.00	0.00	0.00	0.23	0.13	0.00
Carex spp. (sedge species)[1]	0.51	0.20	0.00	0.00	0.00	0.00
Danthonia californica (California oatgrass)	0.83	0.83	0.70	0.87	0.77	0.70
Danthonia unispicata (onespike oatgrass)	0.00	0.05	0.00	0.00	0.00	0.05
Eleocharis spp. (spikerush)[2]	0.56	0.61	0.00	0.37	0.40	0.15
Elymus trachycaulus (slender wheatgrass)	0.00	0.00	0.00	0.07	0.13	0.00
Hordeum brachyantherum (meadow barley)	0.42	0.44	0.00	0.47	0.47	0.00
Juncus howelii (Howell's rush)	0.22	0.05	0.00	0.00	0.00	0.00
Juncus nevadensis (Nevada rush)	0.00	0.00	1.00	0.03	0.37	0.50
Juncus spp. (rush species)[3]	0.81	0.56	0.55	0.60	0.33	0.35
Koeleria macrantha (prairie junegrass)	0.00	0.00	0.00	0.03	0.00	0.00
native annual graminoids[4]	n/a	n/a	0.05	0.37	0.33	0.00
Poa secunda (Sandberg's 'big' bluegrass)	0.00	0.00	0.00	0.07	0.00	0.00
Poa secunda (Sandberg's 'Nevada' bluegrass)	0.00	0.02	0.05	0.00	0.00	0.15
unknown grass sp. (immature)	0.00	0.00	0.00	0.00	0.00	0.25
Native Forbs						
Achillea millefolium (yarrow)	0.00	0.00	0.00	0.07	0.00	0.50
Agoseris sp. (agoseris species)	0.00	0.02	0.35	0.03	0.00	0.00
Arnica sororia (twin arnica)	0.00	0.00	0.00	0.00	0.00	0.10
*Calochortus eurycarpus (*white mariposa lily)	0.00	0.00	0.10	0.00	0.07	0.00
Camassia quamash (camas)	0.95	0.78	1.00	0.00	0.07	0.55
Epilobium ciliatum (fringed willowherb)	0.00	0.00	0.45	0.00	0.00	0.30
Grindelia squarrosa (curlycup gumweed)	0.00	0.00	0.15	0.00	0.00	0.00
native annual forbs[5]	n/a	0.98	1.00	1.00	0.93	0.90
Nothocalais sp.(false dandelion)	0.00	0.00	0.00	0.00	0.00	0.05
Osmorhiza berteroi (sweet cicely)	0.00	0.00	0.00	0.00	0.00	0.10
Penstemon attenuatus (taper-leaved penstemon)	0.00	0.00	0.00	0.00	0.00	0.25
Perideridia spp.(yampah)	0.00	0.00	0.30	0.07	0.03	0.65
Potentilla gracilis (slender cinquefoil)	0.05	0.02	0.00	0.27	0.57	0.85
Ranunculus uncinatus (woodland buttercup)	0.00	0.00	0.00	0.00	0.00	0.35
Rumex salicifolius (willow dock)	0.00	0.00	0.05	0.40	0.07	0.00
Senecio hydrophiloides (tall groundsel)	0.32	0.32	0.00	0.00	0.00	1.00
Sidalcea oregana (Oregon checker-mallow)	0.00	0.00	0.00	0.07	0.03	0.35
Solidago missouriensis (Missouri goldenrod)	0.00	0.00	0.00	0.13	0.03	0.00
Symphotrichum spp. (aster species)	0.00	0.00	0.00	0.00	0.00	0.50
Trifolium douglasii (Douglas' clover)	0.39	0.10	0.00	0.00	0.00	0.00
Wyethia amplexicaulis (mule-ears)	0.00	0.00	0.00	0.07	0.10	0.00
Wyethia helianthoides (sunflower mule-ears)	0.00	0.00	0.00	0.00	0.03	0.10
Zigadenus venenosus (meadow deathcamas)	0.00	0.00	0.00	0.00	0.00	0.20

Table 6. Continued.

Ground Cover						
bare soil and gravel	0.90	1.00	0.80	1.00	0.63	0.65
rock	0.00	0.02	0.20	0.00	0.00	0.05
wood	0.00	0.00	0.00	0.10	0.03	0.10
water	0.02	0.00	0.00	0.00	0.00	0.25
Non-indigenous Graminoids						
Agrostis stolonifera (redtop)	0.00	0.00	0.90	0.40	0.10	0.10
Bromus inermis (smooth brome)	0.00	0.00	0.00	0.00	0.00	0.40
Bromus japonicus (Japanese brome)	0.02	0.15	0.05	1.00	0.93	0.00
Bromus tectorum (cheatgrass)	0.00	0.00	0.00	0.13	0.03	0.00
Phleum pratense (timothy)	0.00	0.00	0.35	0.00	0.00	0.00
Poa bulbosa (bulbous bluegrass)	0.78	0.85	0.35	0.23	0.13	0.20
Poa compressa (Canada bluegrass)	0.17	0.17	0.05	0.27	0.00	0.05
Poa pratensis (Kentucky bluegrass)	0.00	0.32	0.05	0.00	0.00	0.60
Polypogon monspeliensis (annual rabbitsfoot grass)	0.00	0.00	0.00	0.10	0.00	0.00
Taeniatherum caput-medusae (medusahead)	0.00	0.00	0.00	0.70	0.33	0.00
Thinopyrum intermedium (intermediate wheatgrass)	0.00	0.00	0.00	0.03	0.03	0.00
Non-indigenous Forbs						
Amaranthus retroflexus (redroot amaranth)	0.00	0.00	0.00	0.07	0.00	0.00
Cichorium intybus (chicory)	0.93	0.63	0.00	0.00	0.00	0.00
Cirsium arvense (Canada thistle)*	0.00	0.00	0.00	0.00	0.00	0.05
Convolvulus arvensis (field bindweed)*	0.00	0.00	0.00	0.00	0.03	0.10
Lactuca serriola (prickly lettuce)	0.34	0.54	0.15	0.37	0.27	0.00
Myosotis stricta (strict forget-me-not)	n/a	0.12	0.00	0.13	0.07	0.15
Polygonum aviculare (prostrate knotweed)	0.00	0.34	0.10	0.30	0.00	0.00
Ranunculus arvensis (field buttercup)	0.00	0.00	0.00	0.03	0.00	0.00
Rumex crispus (curly dock)	0.32	0.66	0.00	0.00	0.30	0.00
Rumex obtusifolius (bitter dock)	0.00	0.00	0.00	0.30	0.00	0.00
Sisymbrium altissimum (tall tumblemustard)	0.00	0.00	0.00	0.37	0.03	0.00
Taraxacum officinale (dandelion)	0.00	0.00	0.00	0.00	0.00	0.35
Thlaspi arvense (field pennycress)	0.00	0.00	0.00	0.10	0.00	0.05
Tragopogon dubius (yellow salsify)	0.00	0.00	0.05	0.00	0.00	0.00
Trifolium spp. (non-indigenous clover species)	n/a	0.15	0.00	0.00	0.00	0.05
Xanthium strumarium (cocklebur)	0.39	0.41	0.00	0.00	0.00	0.00

[1] includes *Carex sheldonii* (Sheldon's sedge) and *Carex praegracilis* (blackroot field sedge)

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

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

[4] includes *Deschampsia danthonioides* (annual hairgrass) and *Juncus bufonius* (toad rush)

[5] includes 14 species

* Idaho noxious weed (Idaho Department of Agriculture 2010)

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

Species			EO # (Monitoring Point #)											
	2004	2008	2004	2007	2004	2009	2007	2004	2009	2007	2007	2008	2008	2008
	2 (#3)	2 (#3)	3 (#5)	3 (#5)	4 (#1)	4 (#1)	4 (#14)	7 (#1)	7 (#1)	8 (#1)	8 (#2)	12 (#1)	14 (#1A)	14 (#1B)
	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover	% Cover
Amelanchier alnifolia (serviceberry)	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0
Crataegus douglasii (black hawthorn)	0	0	2.2	3.3	0	0	0	0	0	0	0	7.1	0	0
Philadelphus lewisii (syringa)	0	0	0	0	0	0	0	14.3	18.8	0	0	0	0	0
Prunus virginiana (chokecherry)	0	0	0	0	0	0	0	3.7	13.3	0	0	0	0	0
Ribes aureum (golden currant)	0	0	2.2	0	6.8	2.4	0	0	0.0	0	0	0	0	0
Rosa woodsii (Wood's rose)	0	0	0	0	1.7	0	0	3.5	3.3	0	0	0.5	0	0
Salix exigua (coyote willow)	0	0	2.8	2.2	0	0	0	0	0.0	0	0	0	0	0
Salix lasiolepis (arroyo willow)	0	0	15.6	23.9	23.3	50	0	0	4.2	0	0	0	0	0
Symphoricarpos albus (common snowberry)	0	0	39.7	33.7	0	0	0	7.6	9.2	0	0	0.1	0	0
dead shrub spp.	0	0	9.7	2.8	41.3	18.3	0	4.2	5.8	0	0	0.7	0	0
total live woody spp. cover	0	0	62.4	63.1	31.8	52.4	0	29.1	48.8	0	0	7.7	0	0
mean woody spp. height (cm)	n/a	n/a	86	92	130	197	n/a	104	144.0	n/a	n/a	280	n/a	n/a
height range (cm)	n/a	n/a	30 - 210	10 - 180	n/a	48 - 220	n/a	n/a	60 - 200	n/a	n/a	32 - 450	n/a	n/a

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

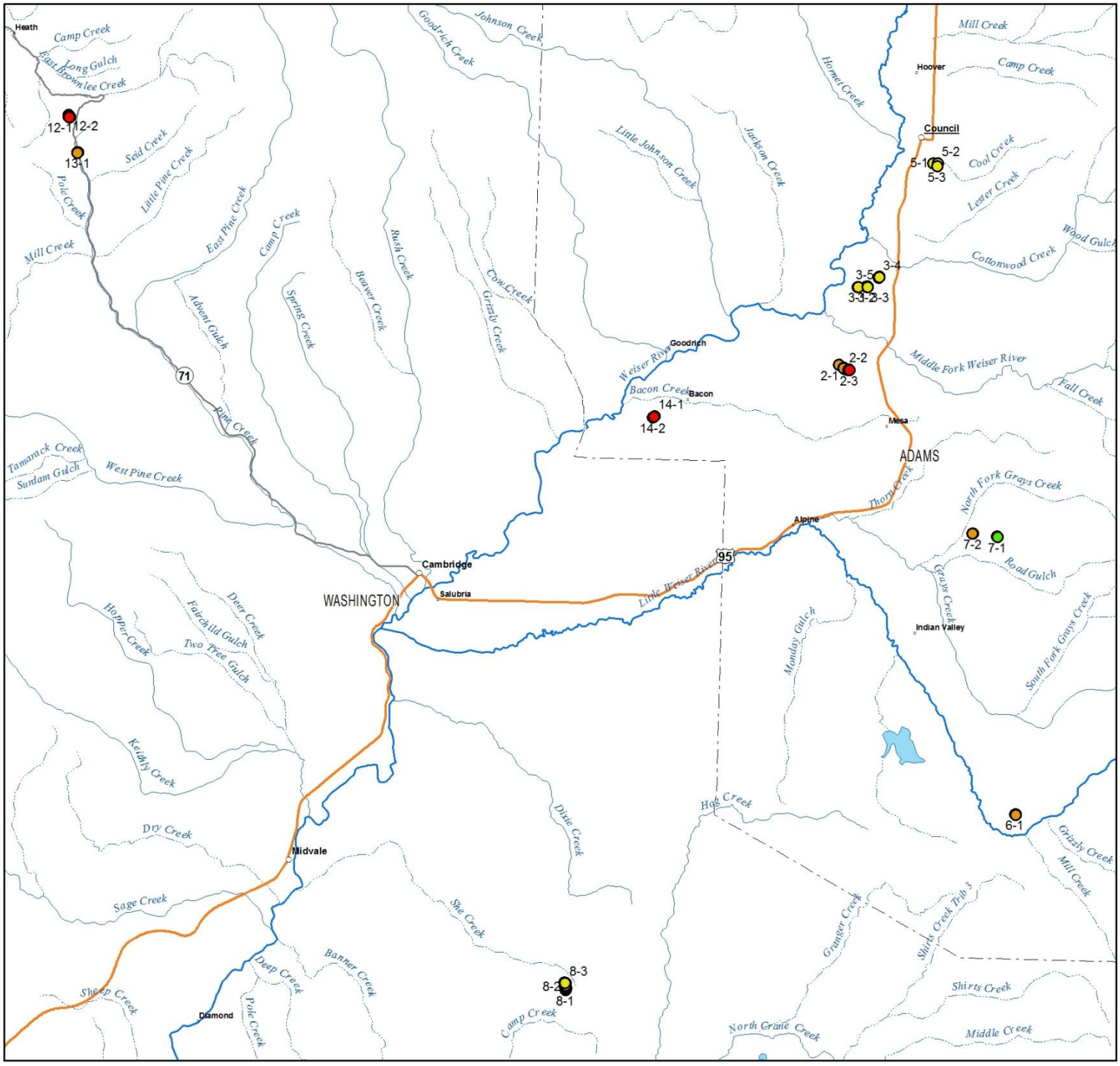
EO # (subpop #) Sample Size	Year	OHV Disturbance		Livestock Grazing Sign				Other Habitat Disturbances			
		Density (tracks/m^2)	SD	Density (dung piles/m^2)	SD	Density (hoof-prints/m^2)	SD	Foraging Frequency	SE	Wildlife Sign Frequency	SE
2 (3)	2004	0	0	0.10	0.30	0	0	0	0	0.02	0.02
2 (3)	2008	0	0	0.37	0.94	24.22	11.17	1.00	0	0	0
3 (5) n = 18	2004	0	0	0	0	0.06	0.23	0.22	n/a	0.28	n/a
3 (5) n = 18	2007	0.33	0.58	0	0	1.44	2.17	0	n/a	0.06	n/a
4 (1)	2004	0	0	0	0	0	0	0.39	n/a	0	n/a
4 (1)	2009	0	0	0.06	0.23	0	0	0	n/a	0	n/a
4 (14) n = 20	2008	0	0	0.80	1.29	0.05	0.22	0.30	0.10	0	0
7 (1)	2004	0	0	1.05	1.99	4.10	3.52	0	n/a	0.05	n/a
7 (1)	2009	0	0	0.10	0.44	0	0	0.05	n/a	0.10	n/a
8 (1) n =30	2007	0	0	0.33	0.55	10.23	4.38	0	n/a	0	n/a
8 (2) n = 30	2007	0	0	0	0	0	0	0	n/a	0.07	0.09
12 (1)	2008	0	0	0.10	0.45	0	0	0.10	0.07	0	0
14 (1A)	2008	0	0	0	0	0	0	0	n/a	0	n/a
14 (1B)	2008	0	0	0	0	0	0	0	n/a	0	n/a

Table 9. Livestock impacts, invasive non-indigenous and noxious weed species, and other threats at *Carex aboriginum* occurrences monitored in 2007 - 2009.

EO # Land-owner	Livestock activity and impacts	Highly invasive non-indigenous and noxious weed species observed in and adjacent to occupied habitat	Other threats
2	*intensive cattle grazing during growth and reproduction period of *C. aboriginum* *streambank sloughing and instability caused by cattle trampling	*Bromus japonicas, Chondrilla juncea*, *Cichorium intybus, Poa bulbosa, Poa pratensis, Lactuca serriola, Polygonum aviculare, Potentilla recta, Rumex crispus, Xanthium strumarium*	*45 cm tall headcut in ephemeral stream adjacent to Subpop. 3 threatens to lower water table and promote site desiccation
3 (private easement)	*not grazed in 2001 or 2002 (occasional cattle grazing with minor trailing) *intensive spring cattle grazing in 2004 and 2007 *heavy trailing; severe streambank trampling; streambank erosion; salt block site in riparian zone	*Arctium minus*, *Bromus japonicus*, *Convolvulus arvensis*, *Cynoglossum officinale*, *Euphorbia esula*, *Hypericum perforatum*, *Poa bulbosa*, *Poa pratensis*, *Potentilla recta*, *Polygonum convolvulus*, *Ranunculus arvensis*, *Salvia* spp., *Tanacetum vulgare*, *Taeniatherum caput-medusae*	*access road construction; culverts *housing development *herbicide over-spraying along trail right-of-way *erosion of alluvial terraces and streambanks
4 (state, BLM, & private)	*two pastures: 1) light spring cattle grazing & short duration, intensive fall grazing; 2) riparian pasture (cattle), variable timing, intensity, & duration *sheep trailing; streambank trampling *soil compaction; pugging; hummock formation; hydrologic alteration (decreased water infiltration resulting in excess runoff & pooling)	*Bromus japonicus*, *Chondrilla juncea*, *Cirsium arvense*, *Conium maculatum*, *Convolvulus arvensis*, *Dianthus armeria*, *Erodium cicutarium, Hypericum perforatum*, *Lactuca serriola, Onopordum acanthium*, *Phleum pretense*, *Poa bulbosa*, *Potentilla recta*, *Ranunculus arvensis, Rumex crispus, Sisymbrium altissimum, Taeniatherum caput-medusae*, *Thinopyrum intermedium, Verbascum blatteria*	*erosion of alluvial terraces, unstable banks *stream downcutting & site desiccation *hydrologic alteration (culverts) *OHV and 4 x 4 tracking in occupied habitat; bare soil & altered hydrology (decreased water infiltration & excess pooling) *campsites
5 (private)	*no current livestock grazing in 2007 *minimal noticeable impacts	*Alopecurus pratensis*, *Thinopyrum intermedium*, *Lactuca serriola*, *Melilotus officianalis*	*roadside herbicide spraying, ditch digging, road & fence maintenance *hydrologic/irrigation alteration *potential housing development

7	*no recent cattle grazing in spring of 2009; old evidence present	*Agrostis stolonifera, Bromus japonicus, Bromus tectorum, Chondrilla juncea*, *Cynoglossum officinale, Lactuca serriola, Leucanthemum vulgare, Poa bulbosa, Poa compressa, Poa pratensis*, *Potentilla recta, Rumex crispus, Taeniatherum caput-medusae*	*no immediate threats or habitat disturbances observed *nearby 2-track road rarely used
8 (private)	*two pastures: Subpopulation 1—spring cattle grazing, intensity unknown; Subpopulation 2—not recently grazed *streambank trampling; soil compaction	*Chondrilla juncea*, *Convolvulus arvensis*, *Polygonum aviculare*, *Sisymbrium altissimum*, *Taeniatherum caput-medusae*	*roadside herbicide spraying, ditch digging, road & culvert, fence, & buried cable maintenance *erosion of alluvial terraces
12	*site grazed by cattle in spring every other year *streambank trampling; ground very hummocky where wet due to spring	*Agropyron intermedium, Agrostis stolonifera, Bromus inermis, Bromus japonicus, Cardaria draba, Cirsium arvense, Euphorbia esula, Poa bulbosa, Poa pratensis*, *Lactuca serriola, Thlaspi arvense*	*headcut in ephemeral stream adjacent to Subpop. 3 threatens to lower water table and promote site desiccation
14	*no recent livestock grazing evident	*Agropyron intermedium, Alopecurus pratensis, Agrostis stolonifera, Bromus japonicas, Dactylis glomerata, Lactuca serriola, Poa pratensis, Sisymbrium altissimum*	*no immediate threats or habitat disturbances observed *landscape has a mix of roads, rural residents, seeded pasture, and grazed rangeland

Figure 1. Distribution of *Carex aboriginum* monitoring points in west-central Idaho (northern part of study area, excluding EO 4).

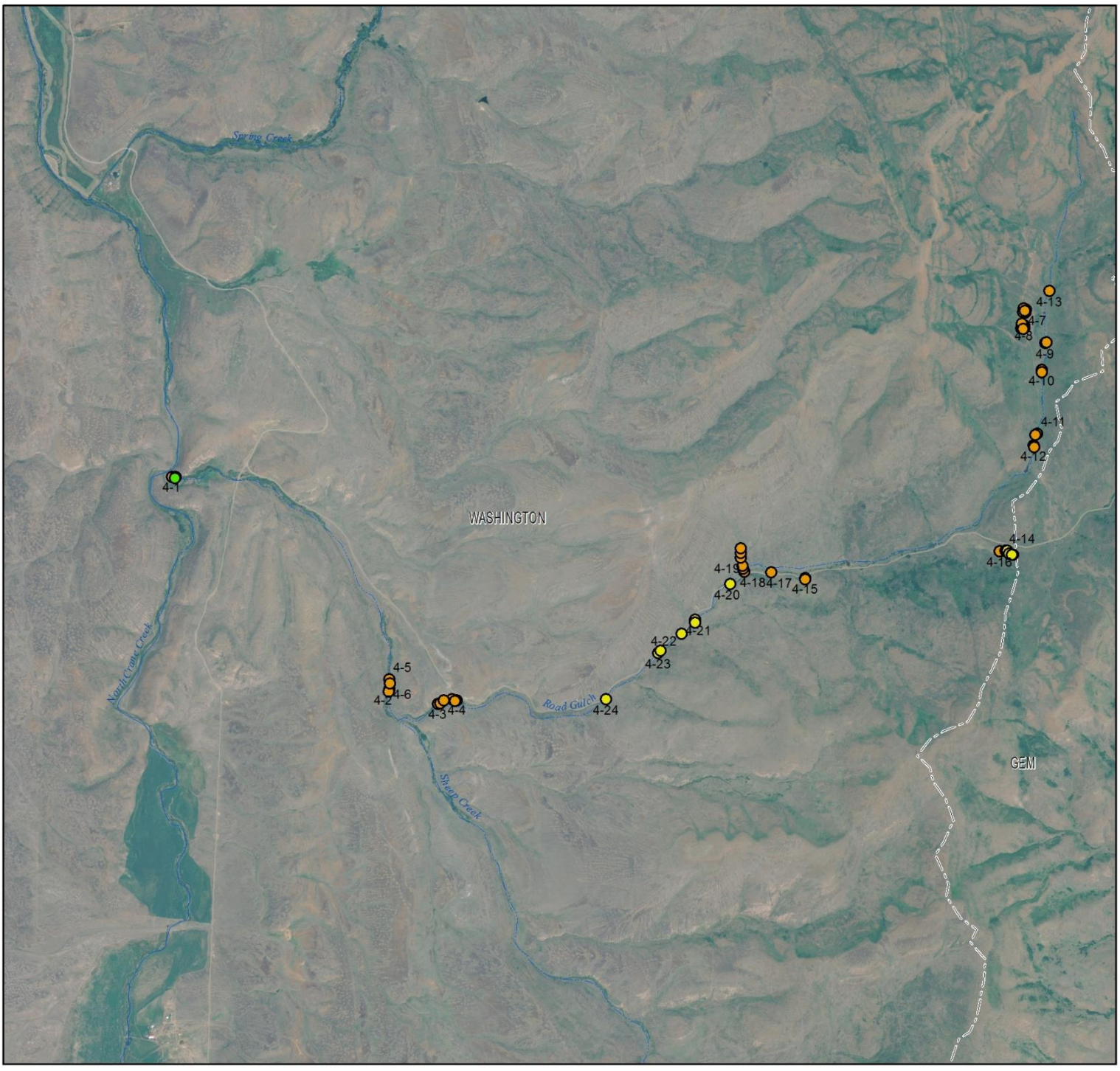


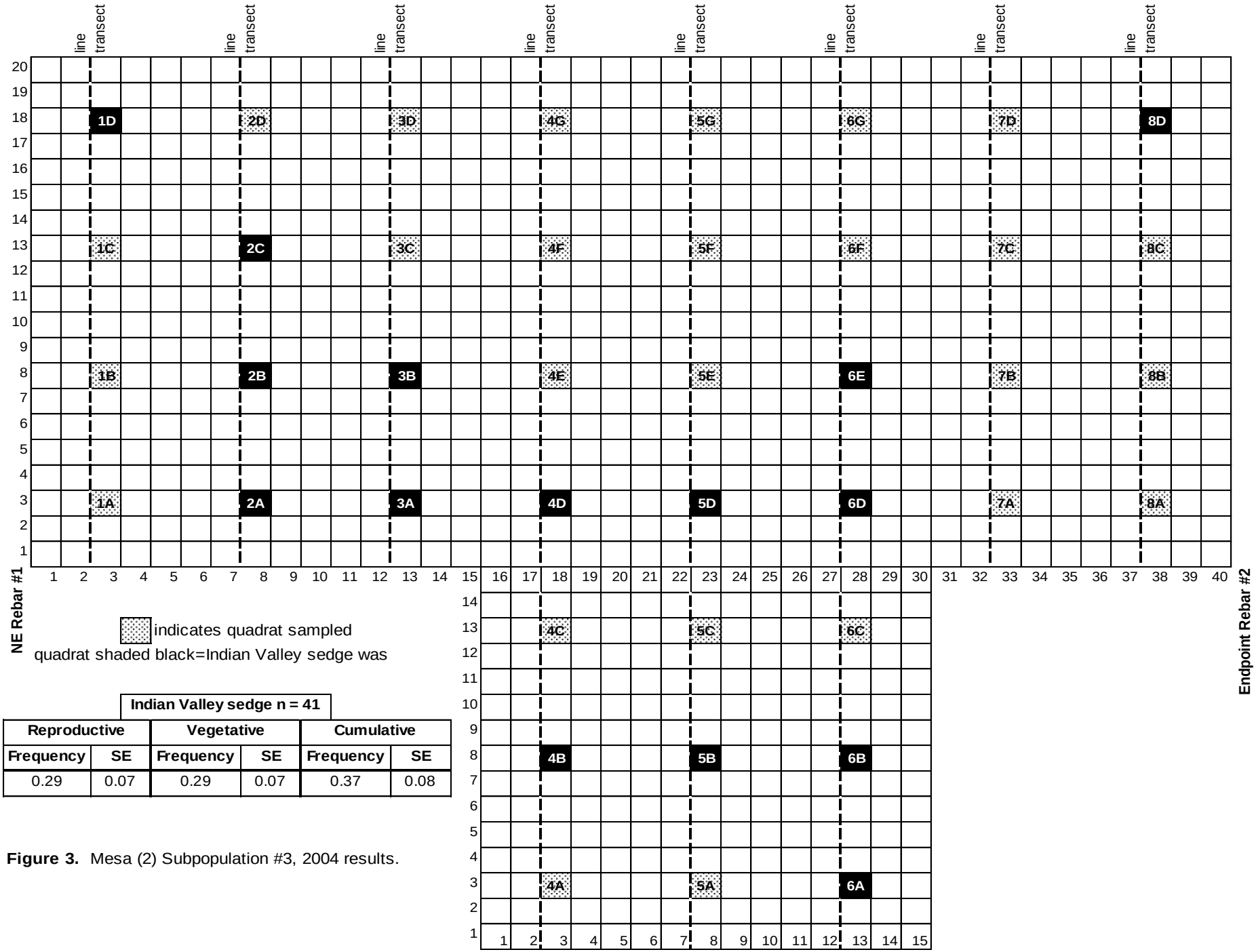
- 2007 Monitoring Points
- 2008 Monitoring Points
- 2009 Monitoring Points
- Not Monitored 2007 - 2009

N

0 3,500 7,000 14,000 Meters

Figure 2. Distribution of Carex aboriginum monitoring points at EO 4.





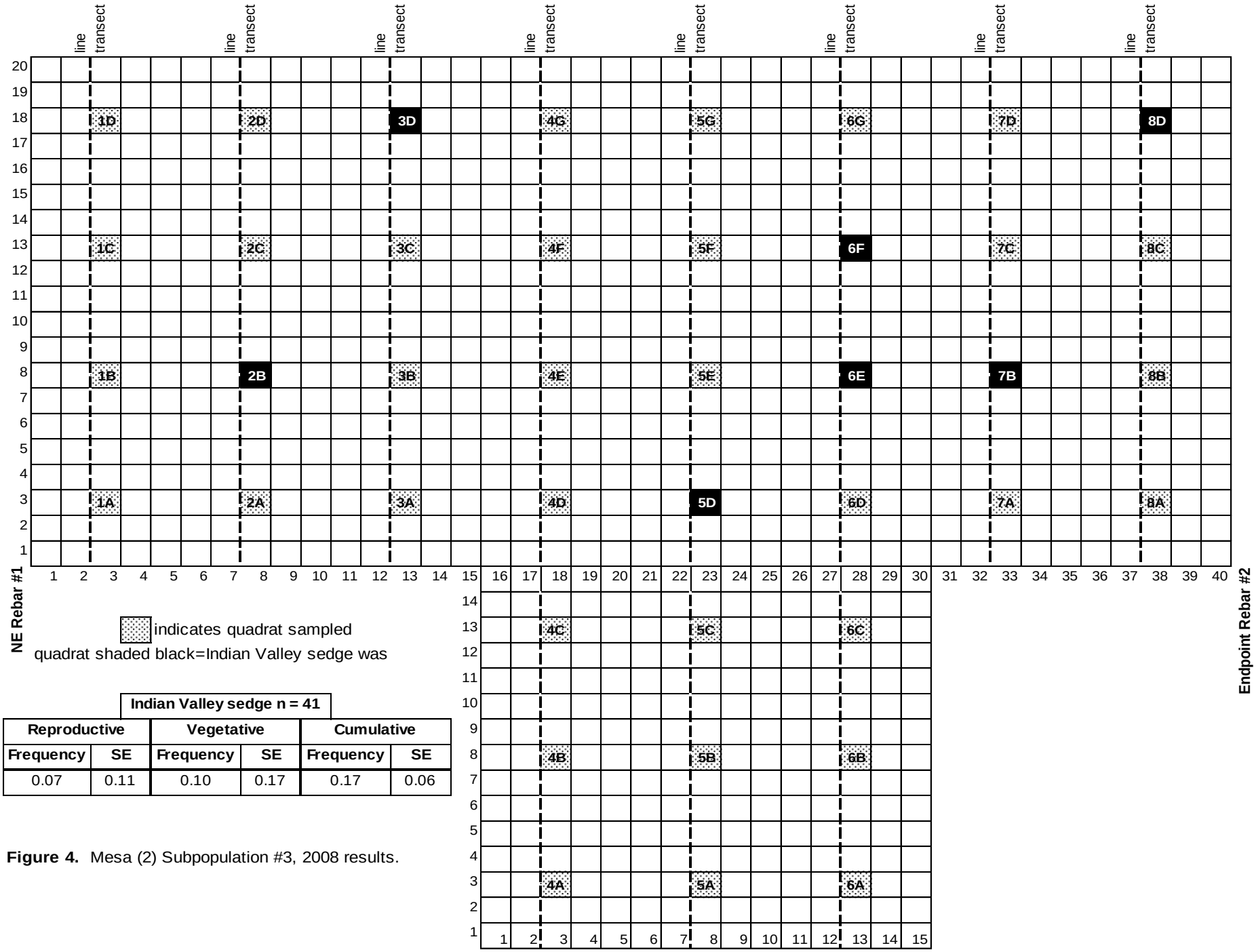
indicates quadrat sampled

quadrat shaded black=Indian Valley sedge was

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

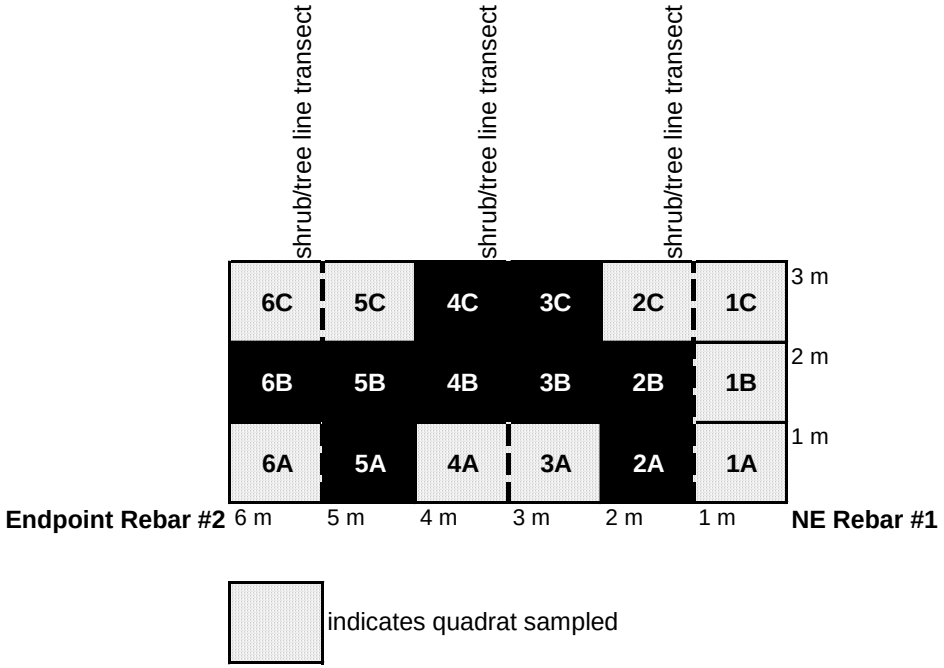
Figure 3. Mesa (2) Subpopulation #3, 2004 results.



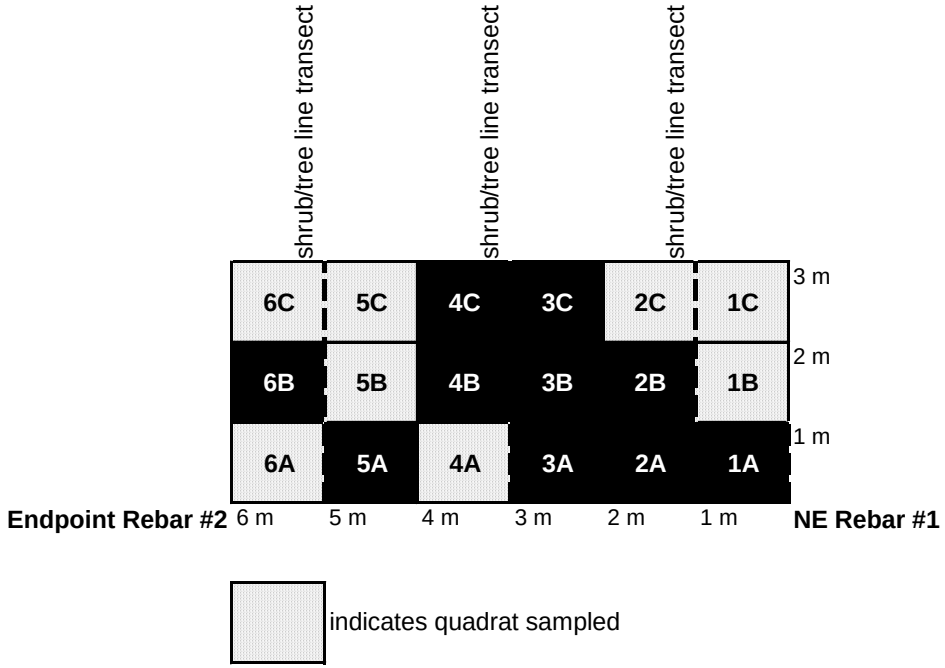
Indian Valley sedge n = 41

Reproductive		Vegetative		Cumulative	
Frequency	SE	Frequency	SE	Frequency	SE
0.07	0.11	0.10	0.17	0.17	0.06

Figure 4. Mesa (2) Subpopulation #3, 2008 results.

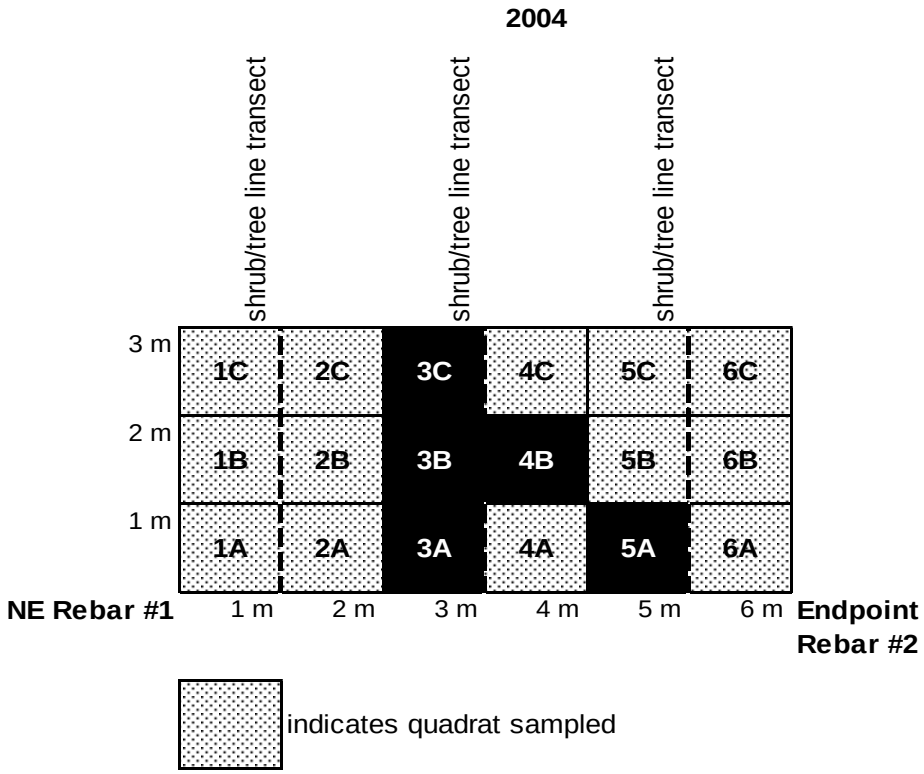


Indian Valley sedge n = 18		
Reproductive Frequency	Veg. only Frequency	Cumulative Frequency
0.50	0.00	0.50

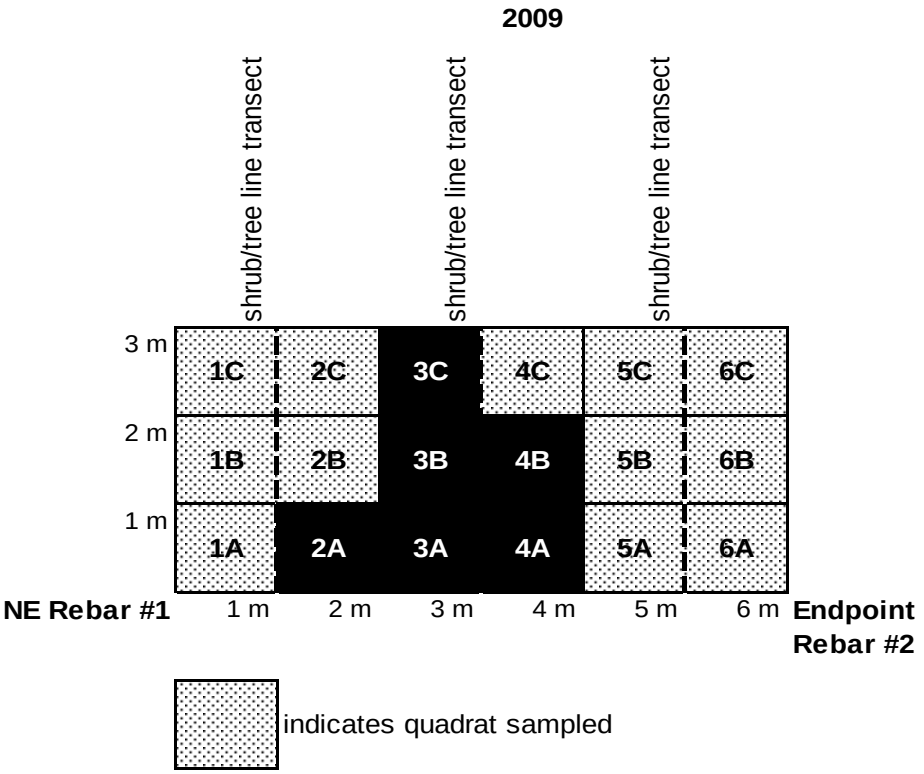


Indian Valley sedge n = 18		
Reproductive Frequency	Veg. only Frequency	Cumulative Frequency
0.44	0.11	0.56

Figure 5. Lower School Creek (003) Subpopulation #5 (2004 results in left figure; 2007 results in right figure).

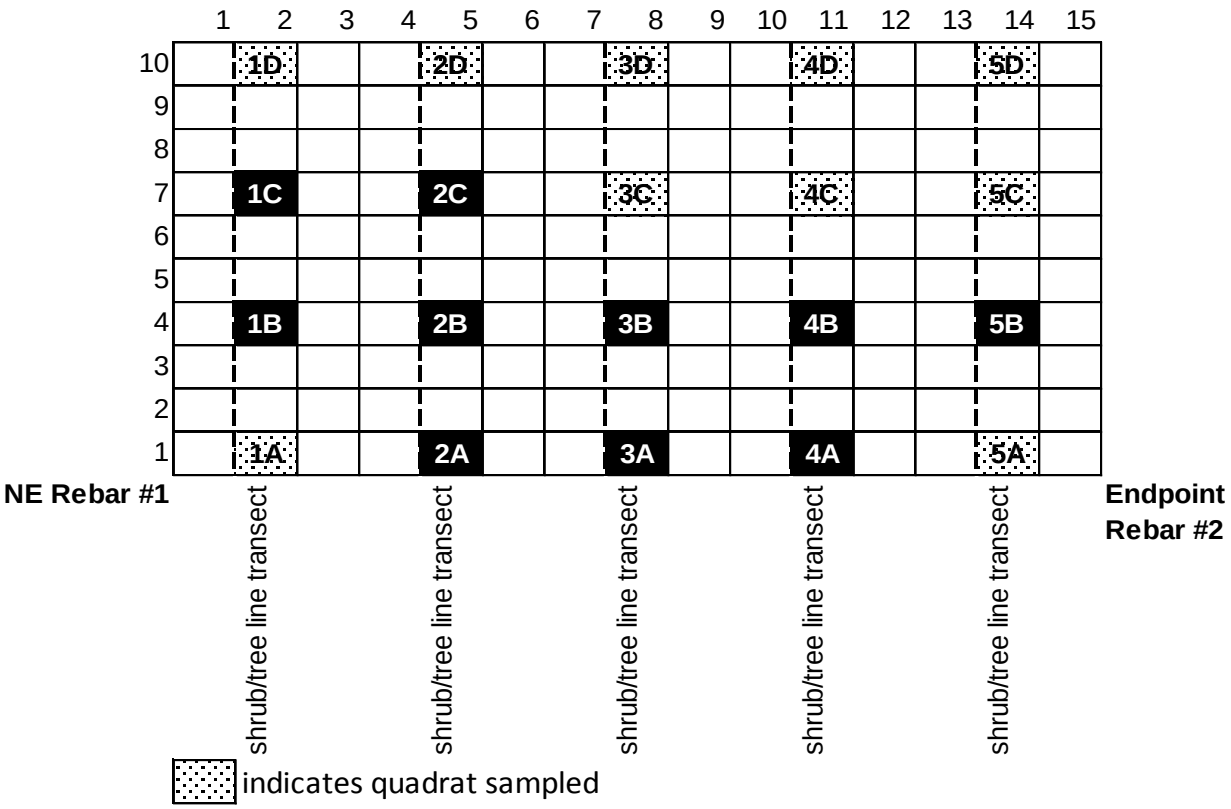


Indian Valley sedge n = 18		
Reproductive Frequency	Vegetative Frequency	Cumulative Frequency
0.06	0.28	0.28



Indian Valley sedge n = 18		
Reproductive Frequency	Vegetative Frequency	Cumulative Frequency
0.22	0.11	0.33

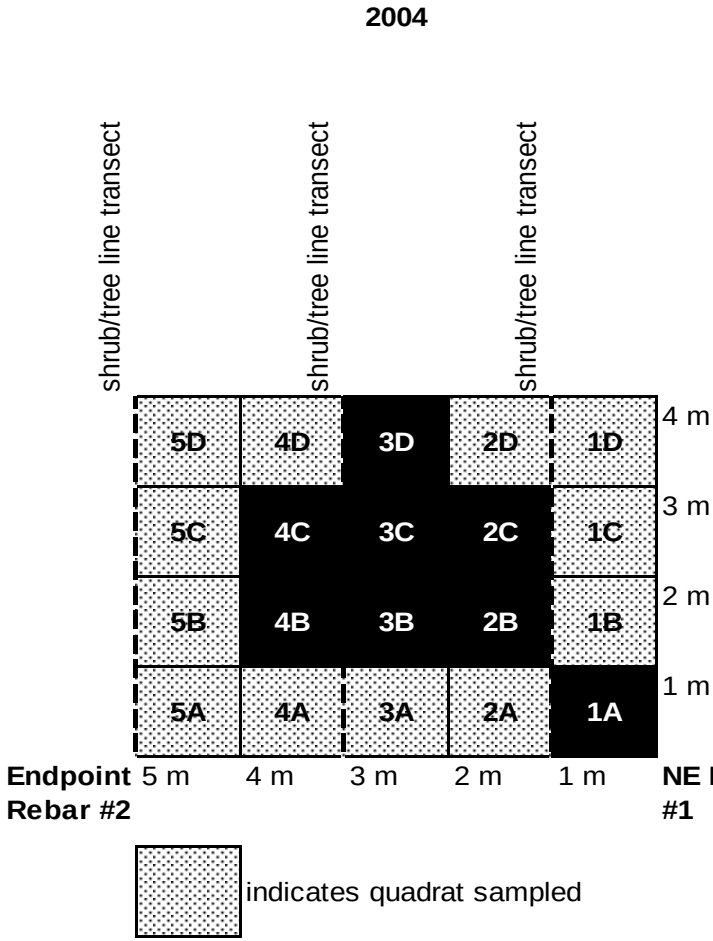
Figure 6. Sheep/North Crane Creek Confluence (4) Subpopulation #1 (2004 results in left figure; 2009 results in right figure)



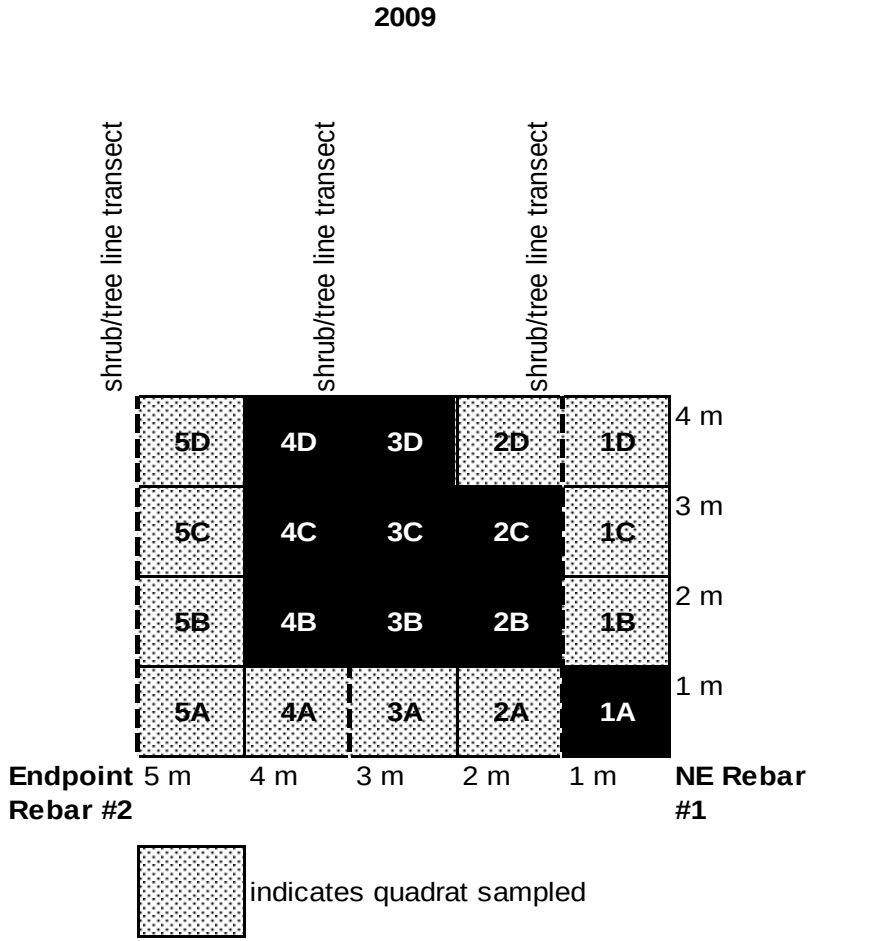
Indian Valley sedge n = 20					
Reproductive		**Vegetative**		**Cumulative**	
Frequency	**SE**	**Frequency**	**SE**	**Frequency**	**SE**
0.50	0.12	0.00	n/a	0.50	0.12

quadrat shaded black = Indian Valley sedge was present

Figure 7. Upper Road Gulch (Dodson Pass) (4 #14)



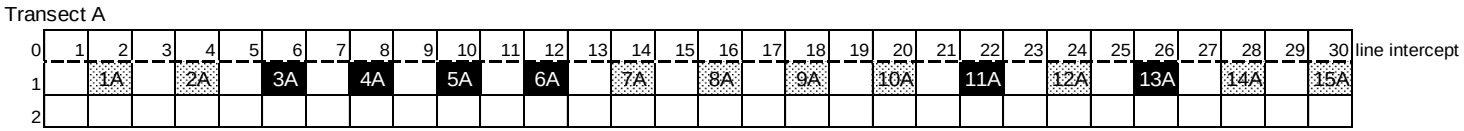
Indian Valley sedge n = 20		
Reproductive Frequency	Vegetative Frequency	Cumulative Frequency
0.05	0.40	0.40

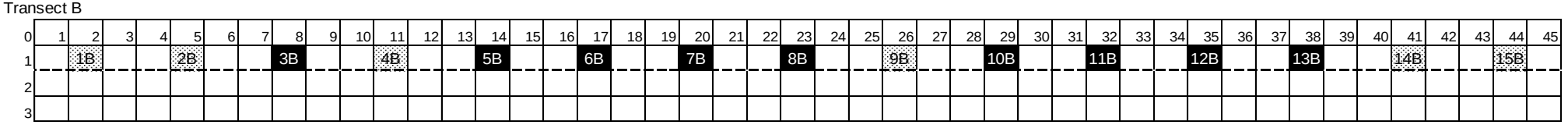


Indian Valley sedge n = 20		
Reproductive Frequency	Vegetative Frequency	Cumulative Frequency
0.20	0.25	0.45

Figure 8. South Fork Grays Creek (7) Subpopulation #1 (2004 results in left figure; 2009 results in right figure)

South Fork She Creek (8) Subpopulation 1



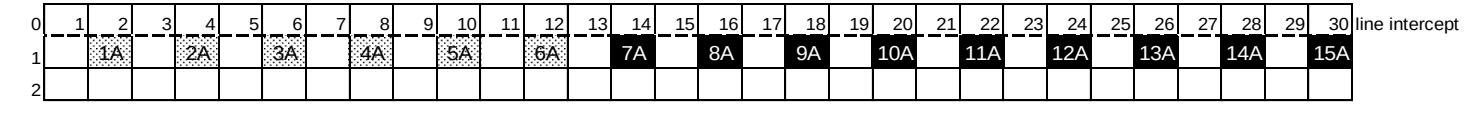


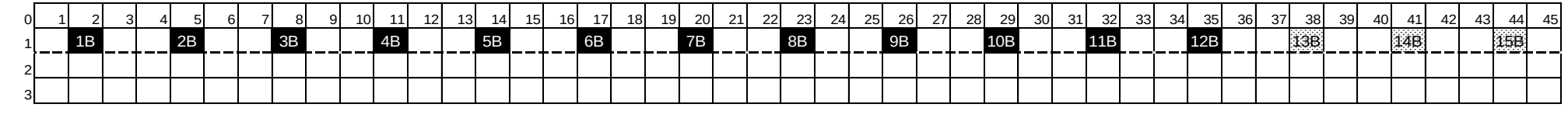
indicates quadrat sampled

quadrat shaded black = Indian Valley sedge was present

Indian Valley sedge n = 30					
Reproductive		Vegetative		Cumulative	
Frequency	SE	Frequency	SE	Frequency	SE
0.47	0.09	0.03	0.03	0.50	0.09

South Fork She Creek (8) Subpopulation 2



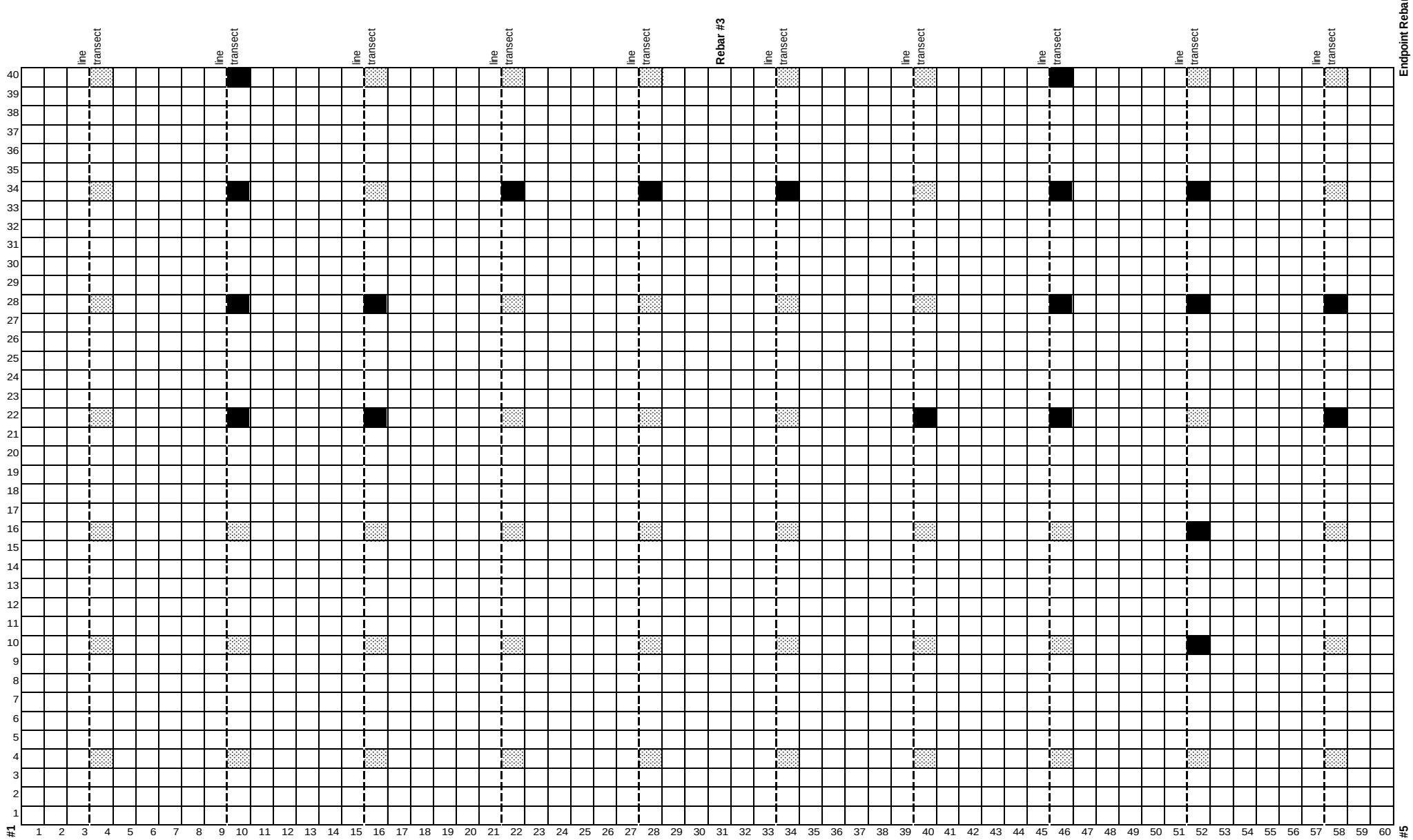


indicates quadrat sampled

quadrat shaded black = Indian Valley sedge was present

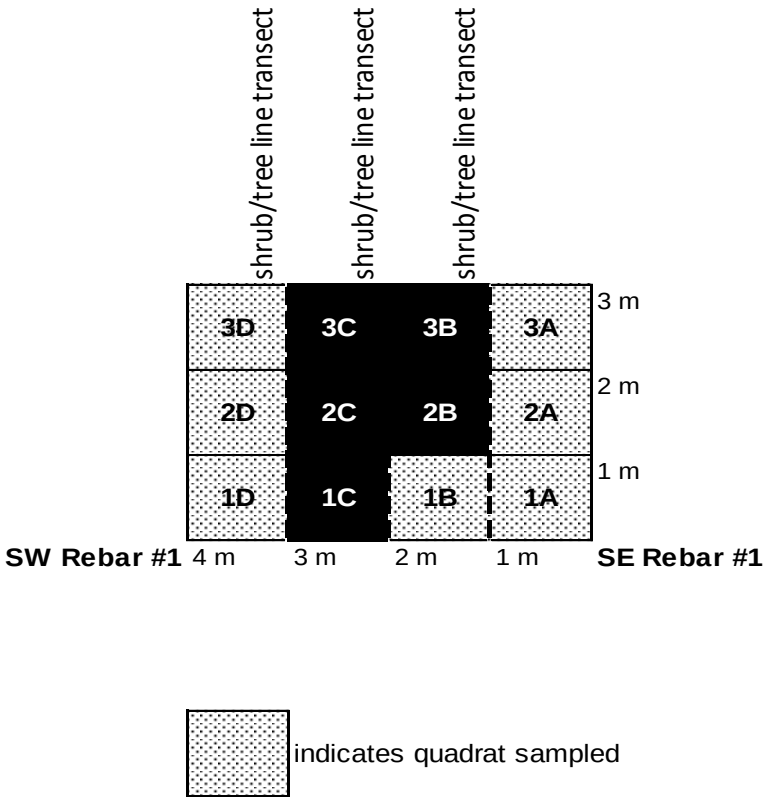
Indian Valley sedge n = 30					
Reproductive		Vegetative		Cumulative	
Frequency	SE	Frequency	SE	Frequency	SE
0.70	0.08	0.00	0.00	0.70	0.08

Figure 9. South Fork She Creek (8) Subpopulation 1 (top) and Subpopulation 2 (bottom).



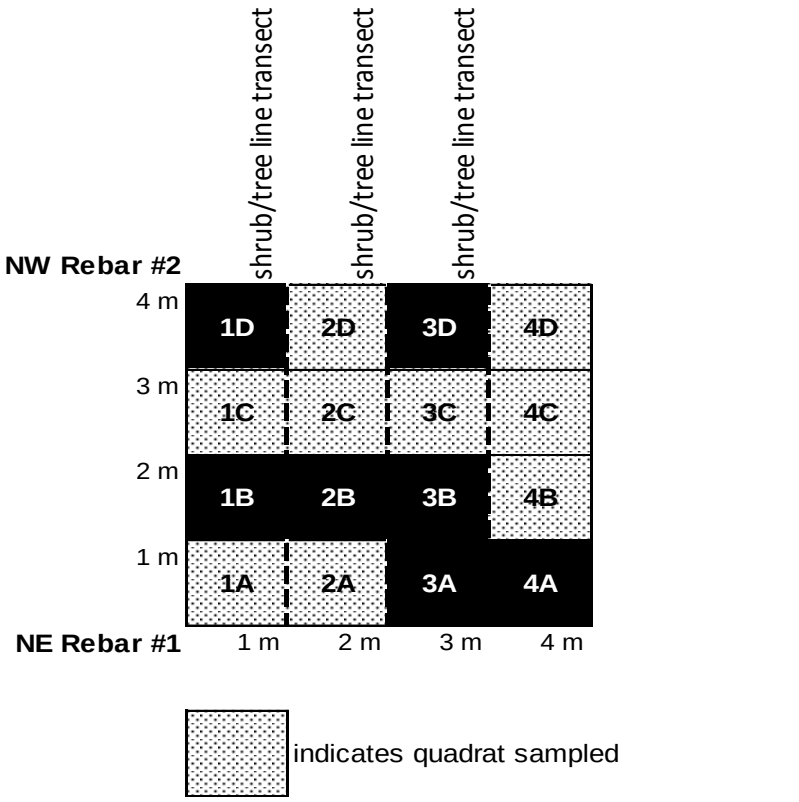
Indian Valley sedge n = 98					
Reproductive		Vegetative		Cumulative	
Frequency	SE	Frequency	SE	Frequency	SE
0.17	0.13	0.03	0.06	0.20	0.05

Figure 10. Brownlee (12) Subpop. #1, 2008 results.



quadrat shaded black = Indian Valley sedge was present

Indian Valley sedge n = 12		
Reproductive Frequency	Vegetative Frequency	Cumulative Frequency
0.06	0.28	0.28



quadrat shaded black = Indian Valley sedge was

Indian Valley sedge n = 16		
Reproductive Frequency	Vegetative Frequency	Cumulative Frequency
0.05	0.40	0.40

Figure 11. Lower Bacon Creek (14), Subpopulation #1A (left figure) and #2A (right figure).