

**FIELD SURVEYS FOR *CAREX ABORIGINUM*
(INDIAN VALLEY SEDGE)
IN WEST-CENTRAL IDAHO**

By

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SUMMARY

Carex aboriginum (Indian Valley sedge) is endemic to a very narrow area in Adams County and adjacent Washington County, in west-central Idaho. It was first collected in 1899 in Indian Valley, east of Cambridge and not reported again for 100 years. Prior to its re-discovery near Council in 1999, *Carex aboriginum* was presumed globally extinct. *Carex aboriginum* is currently known from eight extant occurrences, four of which were discovered during field surveys conducted in 2002. Additional sub-populations were found at two prior known occurrences in 2002. Population, habitat, threat, and other conservation information were collected at these newly discovered occurrences and sub-populations, and updated at prior known occurrences. *Carex aboriginum* grows in ephemeral moist sites at low elevations, including mesic graminoid meadows, seeps, and grass-dominated gaps within scrub-shrub riparian zones. It often grows on low alluvial terraces adjacent to intermittent creeks, but it has also been collected along ditch banks. In general, *Carex aboriginum* habitat is transitional between wet, flooded sites and dry, upland areas. In 2002, approximately 450 to 550 clusters and 700 flowering stems were observed at 19 sub-populations covering about 5,700 square m. Density within sub-populations was variable and much potential habitat adjacent to, and within, occurrence areas was unoccupied. Four occurrences are located on private land, only one of which is protected. None of the occurrences on public land are protected. Three occurrences are relatively large in numbers of plants and area of occupied habitat. However, only one of those three is located on public land. Six occurrences are potentially threatened by competition with invasive exotic species, including noxious weeds. Six occurrences are disturbed by cattle grazing; half of those are grazed intensively in the spring. Based on data collected in both 2001 and 2002, it is clear that *Carex aboriginum* remains one of Idaho's rarest and most imperiled plants. Without actions to conserve and expand current populations, this species may require protection under the Endangered Species Act.

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INTRODUCTION

Historical and Current Status

Carex aboriginum (Indian Valley sedge) is a distinctive sedge species endemic to a narrow area of west-central Idaho. Marcus E. Jones first collected it in 1899 in Indian Valley, near Salubria, in Adams County, Idaho. *Carex aboriginum* was not reported again for 100 years when it was collected near Mesa, Idaho, in 1999. In 2000, another collection was made in a roadside ditch immediately south of Council (Handley and Hartman 2001). Prior to its re-discovery, *Carex aboriginum* was presumed globally extinct because numerous botanists had failed to re-locate the species in the Indian Valley area (Moseley 1990). Moseley surveyed the Indian and Salubria valleys for *Carex aboriginum* in early July 1989 and “saw no native habitat remaining in the valley bottom.” He postulated that agricultural conversion and intensive grazing, especially on the privately owned bottomland habitats in the Little Weiser River valley, had probably led to the species’ extinction.

In 2001, the Idaho Conservation Data Center (CDC) received funding from the U. S. Fish and Wildlife Service (USFWS) to perform field surveys and assess the conservation status of *Carex aboriginum*. Prior to this survey, information regarding the biology, ecology, range, and habitat conditions of *Carex aboriginum* was lacking. During the 2001 inventory, two more *Carex aboriginum* occurrences were found (Murphy 2002). One of the new occurrences was about 4 miles south-southwest of Council. The other new site was located about 25 miles south, on lower Sheep Creek in Washington County; a major increase in the known range of the species. Results of the 2001 inventory increased our understanding of *Carex aboriginum* habitat, phenology, and conservation status. Based on this information, it was clear there were additional areas of potential habitat in need of field surveys. In addition, updated information on prior known occurrences was needed, in part to observe possible changes in population and habitat conditions. In 2002, another field survey project, also funded by the USFWS, was conducted to meet these needs.

During this year’s inventory, four new occurrences of *Carex aboriginum* were found and additional sub-populations were discovered at two prior known occurrences. All occurrences are relatively small and potentially threatened by current land uses and/or exotic weed species invasion. Four occurrences are located on private land, only one of which is protected. Three of the occurrences are clustered between Mesa and Council, Idaho. Two occurrences are now known from the Indian Valley area, while the remaining three occurrences are located in northeastern Washington County. The exact location of the original 1899 collection of *Carex aboriginum* (the Indian Valley (001) occurrence) is unknown. With only eight, small extant occurrences known, *Carex aboriginum* is one of Idaho’s most rare and imperiled plants, and a species of high conservation concern. It is currently on the Idaho Bureau of Land Management (BLM) Sensitive Species List (Bureau of Land Management 2003). It has no formal federal or state protection.

General Description, Phenology, and Habitat

See Murphy (2002) for a complete discussion of *Carex aboriginum* taxonomy, description, and habitat (especially climate and geology of the area). The following description is adapted from Cronquist (1969) and field observations. *Carex aboriginum* reproduces by both sexual and asexual means. Its stems are loosely clustered on short rhizomes. The flowering stems are up to about 1 m tall, exceeding the leaves by up to 60 cm. It has bluish-green leaves that are narrow and flat (about 2 to 4 mm wide) 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 (figure 1). The spikes are erect or ascending, their weight tending to cause the 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 is greenish when immature, but becomes coppery-tinted pale brown when mature. The perigynia is ovate to elliptic, somewhat inflated, about 5 mm long, and has a prominent beak. The perigynia are ascending to spreading, or the lower ones are reflexed. The achene is triangular, with three stigmas.

Compared to many other *Carex* species in Idaho, *Carex aboriginum* completes its reproductive cycle early in the growing season. The leaves and flowering stems grow rapidly and plants reach full vegetative height by late

Figure 1. Photo of *Carex aboriginum* flowering stems (photo courtesy of Mering Hurd, formerly of the U. S. Forest Service, Rocky Mountain Research Station). The heads in photo are approximately actual size.



May and early June. It flowers from mid-May to early June and the perigynia and achenes mature during June. A few nearly mature perigynia were observed on some plants by early June in both 2001 and 2002. However, flowering and perigynia maturation on the majority of plants was about two weeks later in 2002 than in 2001 (peaking in early June, rather than late May). Mature achenes were observed on the type specimen collected by Jones on July 12, 1899 (Moseley 1990). The best period to survey for *Carex aboriginum* is late May through mid-June, when the blue-green leaves and tall flowering stems are most visible.

Carex aboriginum grows on ephemerally moist sites with clay-rich, loamy, alluvial soil 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. Potential habitat is widely scattered, but very discontinuous within the species' range. *Carex aboriginum* grows on low alluvial terraces adjacent to intermittent creeks, in seeps and sub-irrigated meadows, and on other suitably ephemeral sites, including ditch banks. In general, habitat is transitional between wet, flooded sites and drier, upland areas. It is sometimes found on the margins of riparian or wetland areas. *Carex aboriginum* habitat often has a diverse plant species composition, especially numerous grasses, both perennial and vernal forbs, and exotic species. Vegetative production is usually high. As a result, *Carex aboriginum* habitat is often used for cattle grazing. Besides actively grazed rangeland, occurrences are known from rural-residential areas, as well as less developed areas such as intermittent stream canyons.

METHODS

The field survey project had two main goals:

- 1) To re-visit all previously known occurrences of *Carex aboriginum*, update population information, and reassess habitat conditions and threats. Baseline population and conservation data collection at the Council (005) occurrence was also a high priority.
- 2) To search public land with potential habitat for new occurrences.

In 2001, baseline-monitoring photos were taken and vegetation plots were sampled at the Mesa (002), Lower School Creek (003), and Sheep Creek/North Crane Creek Confluence (004) occurrences. The methods used for monitoring photos and vegetation plots were explained in last year's report (Murphy 2002). Monitoring was not repeated at these occurrences in 2002. No additional monitoring photos were taken or vegetation plots sampled at occurrences discovered in 2002. Based on time and budget constraints, it was decided that surveys at as many sites as possible was a higher priority for 2002. Gaining more range-wide habitat, population, and threat information was deemed necessary for designing an effective and efficient monitoring program in the future.

Survey Area Identification

During 2001 surveys, several specific areas with potential habitat for *Carex aboriginum* were mapped, but not visited, due to time constraints. These were the main sites targeted for 2002 surveys. Topographic maps, National Wetlands Inventory maps, land ownership maps, and field reconnaissance were used to determine additional areas of potential habitat for surveys. General areas targeted for 2002 surveys were:

- around Council, including the Weiser River Trail and the foothills to the east of town
- tributary canyons to the Weiser River, from Mesa to Goodrich
- foothill canyons in Shoe Peg Valley
- around Crane Creek Reservoir, southeast of Midvale
- foothill drainages in Indian Valley
- North Crane Creek basin

Field Methods

Field surveys for *Carex aboriginum* were performed between May 21 and June 27, 2002. Surveys consisted of meandering, loosely gridded transects through potential habitat. Surveys concentrated on wet meadows, seeps, and intermittent creeks with moist, grassy openings within scrub-shrub vegetation (e.g., willows and hawthorn). Flowering heads (present at all occurrences surveyed) are required for positive identification, though vegetative characteristics also prove useful. A voucher specimen was collected at the South Fork She Creek (008) occurrence. Vouchers were not collected at other occurrences because of their small population sizes.

At all occurrences and sub-populations updated, expanded, or discovered during surveys, the following information was documented:

- exact locations of sub-populations (utilizing a navigation grade GPS unit and topographic maps)
- population size and demographic characteristics
- physical habitat and substrate features
- associated plant communities and species (including other rare species); nomenclature for all species in the report follows the PLANTS Database (National Resources Conservation Service 2001)
- current land uses, habitat and landscape condition, and threats

BLM and Payette National Forest personnel accompanied the CDC during two field survey days in 2002. The purpose was for training agency botanists and range personnel on how to identify *Carex aboriginum* in the field. Additional training for Boise National Forest personnel is planned for 2003.

Office Methods

Location, population, habitat, condition, and threat information was entered into the CDC database to generate detailed Element Occurrence Records (Appendix 1). An occurrence is the standard database device used throughout the Natural Heritage/Conservation Data Center network for tracking rare species, or “elements” (NatureServe 2002). Occurrences represent a specific geographic location and may or may not be equivalent to the biological definition of a population. The three-digit code assigned to each occurrence corresponds to the reference number used by the CDC database. The locations of *Carex aboriginum* sub-populations were also mapped (Appendix 2).

RESULTS AND DISCUSSION

Areas Surveyed

The following is a list of areas surveyed for *Carex aboriginum* in 2002. These areas are mapped in Appendix 3. See Murphy (2002) for maps of areas surveyed in 2001.

- Frog Pond (Cold Spring Summit Quad): wetland perimeter of pond in upper North Fork Mill Creek basin, Payette National Forest; this was the highest elevation survey site at 5,300 feet
- Shingle Flat Exclosure (Cold Spring Summit Quad): *Carex*-dominated wet meadows, ephemeral meadows, willow-hawthorn scrub-shrub, and aspen groves within livestock exclosure on Shingle Creek, Payette National Forest
- Lower School Creek (Council Quad): re-surveyed willow-hawthorn and cottonwood riparian zone surveyed in 2001, from Mesa Siding to Weiser River; also surveyed moist areas within Weiser River Trail easement, from School Creek to confluence of Middle Fork Weiser and Weiser River
- South Exter Road (Council Quad): ephemerally moist roadsides from Council to near the end of paved road (halfway between Cool Creek and Lester Creek)
- Weiser River Trail (Council Quad): wetlands and ephemerally moist areas within trail easement, from Mesa Siding to Council
- Upper Road Gulch (Dodson Pass Quad): only the two seeps occupied by *Carex aboriginum* were surveyed, about 1 mile north of Dodson Pass
- Mill Creek (Fruitvale Quad): small, moist patches within a forested riparian area, around the flume and site of a proposed micro-hydropower facility
- Lower Jackson Creek (Goodrich Quad): riparian cottonwood forest and willow-hawthorn scrub-shrub of lowest 0.75 mile of Jackson Creek; also surveyed banks and moist floodplain habitat along Weiser River for about 0.5 mile upstream of Jackson Creek confluence
- Homestead Spring Creek (Goodrich Quad): riparian willow-hawthorn scrub-shrub of unnamed creek entering the Weiser River at Goodrich; this creek is fed by Homestead Spring, about 4.5 miles up from Goodrich; the survey occurred on public land, starting where the creek leaves the foothills, extending upstream for about 0.75 mile
- Roadsides, from She Creek to Camp Creek (Hog Creek Quad): ephemerally moist roadsides in She Creek basin and adjacent Camp Creek basin to south (the northern portion of Dutch Flat); this area is 4 miles northwest of Crane Creek Reservoir

- Deer Creek (Hopper Creek Quad): about 0.5 mile of riparian willow-hawthorn scrub-shrub of Deer Creek, starting about 0.5 mile upstream of where creek leaves foothills and enters Shoe Peg Valley
- Keithly Creek (Hopper Creek Quad): about 1 mile of seeps and moist openings in the forested riparian zone; survey was on public land, starting upstream of the confluence of the East Fork and main Keithly Creek; this was a cursory survey due to the low frequency of potential *Carex aboriginum* habitat
- Dry Creek Basin (Indian Valley/Granger Butte Quad): seeps and ephemeral/intermittent forks of Dry Creek, on plateau 0.5 to 0.75 mile north and east of Little Weiser River
- South Fork Grays Creek (Indian Valley Quad): 0.5 mile of unnamed stream (“South Fork Grays Creek”) riparian willow-hawthorn-syringa scrub-shrub, starting about 0.5 mile upstream of where this creek meets North Fork Grays Creek; the lower part of this area, surveyed in 2001, was referred to as “Indian Valley” in Murphy (2002)
- Buckwheat Flats Research Natural Area (Midvale Hill Quad): riparian willow-hawthorn scrub-shrub of unnamed tributary to Sage Creek within Buckwheat Flats RNA; survey continued up riparian alder forest and willow-hawthorn scrub-shrub of Sage Creek for about 0.5 mile
- Lower Sheep Creek/Road Gulch (Riley Butte Quad): suitable riparian habitat was surveyed, from the North Crane Creek confluence upstream to the road (re-survey of 2001 area), within the livestock grazing enclosure, upstream of enclosure for about 1.5 miles, and lower Road Gulch from Sheep Creek confluence up to Sheep Creek/Dodson Pass Road
- McFadden Lane Area (Riley Butte Quad): two small patches of ephemeral creek bottom on public land, one near a spring-fed cattle trough along McFadden Lane (1.75 miles east of Riley Butte Road) and the other along the Riley Butte Road 0.3 mile north of McFadden Lane
- Upper Tennison Creek Basin (Riley Butte/Coonrod Gulch Quad): portions of ephemeral tributary to Tennison Creek, including margins of cattle pond and seeps

Distribution, Ownership, and Landscape Context

Four new occurrences were discovered in 2002. *Carex aboriginum* is now known from eight extant occurrences. All occurrences are located in Adams County, and adjacent Washington County, of west-central Idaho. The total known range is about 10 miles wide by 25 miles long (Appendix 2). Occurrences are known from elevations between 2,875 and 4,445 feet. The Indian Valley (001) occurrence is the original Jones type locality. The location information for this collection is general (i.e., Indian Valley near Salubria, east of the current town site of Cambridge, Idaho) and the exact location unknown. If the collection was made in the agricultural bottomlands of Indian Valley, then it may be extirpated (Moseley 1990).

Four of the eight extant occurrences of *Carex aboriginum* are located on private land. Large blocks of private land with scattered in-holdings of BLM and Idaho state endowment lands characterize the ownership pattern within the range of *Carex aboriginum*. Much of the private land is posted no trespass and numerous roads through these properties are blocked with locked or clearly posted gates. This prevents access to public land in some instances. Time constraints prevented locating landowners necessary for gaining access through private property. Large blocks of private land north of Crane Creek Reservoir, likely to have potential habitat for *Carex aboriginum*, were not surveyed. Large blocks of BLM land are found north of Goodrich, west of Cambridge, and in the North Crane Creek basin, but these lands are predominantly dry uplands with limited potential habitat. The Payette National Forest forms the higher elevation border on the western, northern, and northeastern sides of the Weiser River basin. The Boise National Forest similarly borders a portion of the eastern side of the North Crane Creek basin. These higher elevation National Forest lands probably support minor amounts of potential *Carex aboriginum* habitat. However, the Upper Road Gulch (009) occurrence, discovered in 2002, was on the dividing ridge between North Crane Creek and Squaw Creek about 2 miles southwest of the Boise

National Forest boundary. The lower elevation National Forest lands in this area should be searched for *Carex aboriginum* in the future.

The vegetation within the range of *Carex aboriginum* falls mostly within the sagebrush-steppe zone and is dominated by *Artemisia tridentata* (big sagebrush), *Purshia tridentata* (bitterbrush), and *Pseudoroegneria spicata* (bluebunch wheatgrass). There are many inclusions of *Artemisia rigida* (rigid sagebrush), *Eriogonum* species (buckwheat), and *Poa secunda* (Sandberg's bluegrass) vegetation on scabland sites within this area, as well as mountain shrub communities on northerly canyon slopes. Within about 5 miles of all known *Carex aboriginum* sites, the sagebrush-steppe abuts the lower timberline typified by *Pinus ponderosa* (ponderosa pine) and/or *Pseudotsuga menziesii* (Douglas fir) forest and woodland.

Since settlement, large areas of sagebrush-steppe vegetation in this area have been converted to exotic grasses through the combined effects of intensive grazing, shrub clearing, and wildfire. The majority of land within the range of *Carex aboriginum* is utilized for livestock grazing. All known *Carex aboriginum* occurrences except Lower School Creek (003) are at least partially grazed by livestock. Numerous livestock-watering reservoirs have been dug in ephemerally moist drainages and at springs throughout the area, including near several occurrences. The broad and flat bottomlands of the Weiser and Little Weiser Rivers once supported a mosaic of *Populus trichocarpa* (black cottonwood), *Salix* (willow) species, *Crataegus douglasii* (black hawthorn), and mesic graminoid meadow plant communities. Remnants of this wetland vegetation remain, especially along the Weiser River. Ephemeral, intermittent, and perennial tributary streams, with either scrub-shrub or mesic graminoid riparian vegetation (depending on moisture regimes and past disturbances), are common in the area. Prior to agriculture and livestock grazing disturbances, these moist bottomlands and intermittent drainages probably supported more potential *Carex aboriginum* habitat than they do today. Prior to settlement, some bottomland was also sagebrush-steppe, but most of these areas have since been converted to irrigated agriculture. The bottomlands of the Weiser and Little Weiser River valleys are intensively farmed, mainly as irrigated hay pasture and cropland. Rural home sites and ranches are scattered throughout the range of *Carex aboriginum*. More recently, many parcels of private land between Cambridge and Council have been subdivided for housing developments.

Many of the xeric or less productive sites, formerly sagebrush and bitterbrush steppe, are now dominated by *Poa bulbosa* (bulbous bluegrass), *Bromus japonicus* (Japanese brome), *Bromus tectorum* (cheatgrass), and/or *Taeniatherum caput-medusae* (medusahead). Some of the more productive sites have been seeded with exotic perennial grasses, such as *Thinopyrum intermedium* (intermediate wheatgrass). Other invasive and noxious weeds observed in uplands adjacent to *Carex aboriginum* occurrences include: *Chondrilla juncea* (rush skeletonweed), *Cichorium intybus* (chicory), *Convolvulus arvensis* (field bindweed), *Euphorbia esula* (leafy spurge), *Hypericum perforatum* (St. John's wort), *Lactuca serriola* (prickly lettuce), *Potentilla recta* (sulphur cinquefoil), *Onopordum acanthium* (Scotch thistle), and *Salvia* species (European sage).

Location, ownership, and landscape context information is summarized by occurrence below. Also refer to Murphy (2002) for more details on the Mesa (002), Lower School Creek (003), and Sheep Creek/North Crane Creek Confluence (004) occurrences.

Mesa (002): The Mesa (002), Lower School Creek (003), and Council (005) occurrences are found along a 6-mile long line located between the towns of Mesa and Council, Idaho. This occurrence is located on private land about 2 miles northwest of the community of Mesa and about 1.5 miles south-southeast of the Middle Fork Weiser and Weiser River confluence. The landowner granted permission to access his land for both 2001 and 2002 visits. Patches of *Carex aboriginum* are distributed in a broad basin, with the main sub-population at the upper end in an ephemerally moist meadow. Livestock grazing is the primary use of this land. Exotic grasses dominate the uplands surrounding this occurrence and only remnants of the sagebrush-steppe and rigid sagebrush mosaic exist. Invasive and noxious weeds are common, but patchy, in the area. Several ranch houses, the county dump, and a busy gravel road are located within 1 mile of the occurrence. In addition, a housing development is underway on adjacent sections of land to the west. The potential of these developments to affect groundwater feeding the ephemerally moist habitats of *Carex aboriginum* is unknown.

Lower School Creek (003): This occurrence is comprised of four sub-populations scattered along lower School Creek, located 0.3 to 1 mile west-southwest of the community of Mesa Siding on Highway 95 (about 4 miles south of Council). At least three of the four sub-populations lie within the Weiser River Trail easement managed for recreation and open space protection. The easement is 100 feet on each side of the old railroad causeway in this canyon. The fourth and lowest sub-population may occur on adjacent private land. On-going housing development occurs on adjacent ridge tops. Other land on ridge tops is mostly privately owned ranches. Remnants of native vegetation are still observed on canyon slopes and in the riparian zone. Exotic species, including several noxious weed species, are widely scattered in the landscape, reflecting historic livestock grazing and other disturbances. Noxious weed spraying occurs along the railroad causeway.

Sheep Creek/North Crane Creek Confluence (004): This occurrence is located near the confluence of Sheep Creek and North Crane Creek, in Washington County, about 25 miles south of Council. The lowest sub-population, discovered in 2001, is located on the north edge of the riparian zone immediately below a powerline near the confluence. In 2002, a new sub-population was located along Sheep Creek, about 0.67 mile upstream of a livestock exclosure. These two Sheep Creek sub-populations occur on Idaho state endowment lands. Two additional sub-populations were located in lower Road Gulch, a tributary to Sheep Creek, between the Sheep Creek/Dodson Pass Road and the confluence with Sheep Creek. The Road Gulch sub-populations occur on the border of BLM and private land and ownership is unclear. Gravel roads occur within 0.5 mile of all sub-populations and have impacted riparian zones at crossings or where roads are adjacent to streams. Two 4 x 4 spur roads, ending at primitive campsites less than 250 m from occupied habitat, pose a minor threat to *Carex aboriginum*. These roads allow OHVs to access riparian habitat. Water developments for cattle have also impacted this watershed, especially between the North Crane Creek Road and the exclosure. Remnants of the former sagebrush-steppe occur on adjacent slopes and benches. Degraded *Crataegus douglasii* communities are present on toeslopes and dry terraces in the area. Exotic plant species, including noxious weeds, are common.

Council (005): Prior to 2002, this occurrence was known from one roadside collection. In 2002, three sub-populations of *Carex aboriginum* were observed adjacent to South Exeter Road, immediately south of the town of Council, on private land and road right-of-ways. Two were along the pasture fence line on the southwest side of the road, and the other was on the northeast side of the road between a ditch and a fence. The survey was restricted to the road and adjacent right-of-way ditches because landowner permission to search private land was not obtained. More sub-populations may occur in moist pastures on adjacent private lands. The landscape surrounding the occurrence includes paved roads, homes, and both irrigated and non-irrigated pastures, in a rural residential setting at the edge of town. Pastures adjacent to the occurrence are currently minimally grazed. A golf course and subdivision are located about 0.25 mile to the west. One pasture adjacent to a sub-population was for sale in 2002. Due to maintenance and construction of roads, ditches, and fences, the habitat supporting *Carex aboriginum* reflects past disturbance and is at high risk of future disturbance. Exotic species are common.

South Dry Creek Basin (006): This occurrence is at the south end of Indian Valley, in a seep basin atop benchlands located about 0.5 mile north of the Little Weiser River and 3 miles east-southeast of Ben Ross Reservoir. It is probably located on BLM land, but is very close to the border of a private land parcel. The landscape is weedy and degraded from current and historic grazing. In the Dry Creek basin, cattle tend to congregate at seeps such as this, as well as at dugout ponds. The drainages below the seep, as well as adjacent ephemeral drainages, have only narrow and broken bands of mesic graminoid vegetation bordering their channels. Riparian vegetation is degraded and weedy. Land management is complex due to the mosaic of land ownerships in the area. The nearest ranch is over 1 mile downstream.

South Fork Grays Creek (007): This occurrence is in the northeast foothills of Indian Valley, about 8 miles east of Cambridge and 3 miles northeast of the village of Indian Valley. It is 5 miles southeast of the Mesa (002) occurrence. "South Fork Grays Creek" is a tributary to North Fork Grays Creek, located north of Ross Gulch. The occurrence is on Idaho state endowment land about 1 mile upstream of a ranch road. The lower 0.5-mile of this stream was surveyed in 2001, but no *Carex aboriginum* was found in this lower reach. The landscape of the surrounding area is degraded and weedy, reflecting both past and current livestock grazing. The vegetation surrounding the occurrence is a mosaic of exotic grasses and relict sagebrush and bitterbrush-steppe. There are

cattle ponds dug at adjacent springs, about 1 mile from the occurrence. Private ranches, irrigated pastures, and roads are located 1 mile to the west, north, and south of the occurrence. The creek has been channelized in the lower watershed to minimize flooding of adjacent ranches and roads.

South Fork She Creek (008): This occurrence is somewhat of an outlier, located in Washington County about 7 miles east-southeast of Midvale, just over 3 miles northwest of Crane Creek Reservoir. It is roughly 10 miles northwest of the Sheep Creek/North Crane Creek Confluence (004), the next closest occurrence. This population occurs along an intermittent creek on private ranch land in an area of rolling uplands. It was found by slowly driving along the gravel road that crosses the intermittent creek in two places. Potential habitat along several other intermittent creeks in the area was not surveyed because all of the land is privately owned. The hills surrounding the occurrence have been cleared of sagebrush and seeded with exotic grass and alfalfa for cattle forage. Drainages are degraded from livestock trampling, erosion, and road impacts (i.e., buried cable, culverts, and ditches). Exotic species, including noxious weeds, are patchy. Private ranches occur in the area, but there are no houses in the immediate vicinity.

Upper Road Gulch (009): This occurrence is located on BLM land in the broad headwater basin of Road Gulch, about 1 mile north of Dodson Pass and 0.25 mile west of the Washington-Gem County line (i.e., the divide between the North Crane Creek and Squaw Creek basins). The occurrence is about 4 miles upstream of the lower Road Gulch sub-populations that partially comprise the Sheep Creek/North Crane Creek Confluence (004) occurrence. The sub-populations are located in seeps on an east-facing bench reached via a rough 4 x 4 road leaving the Sheep Creek Road near Dodson Pass. This 4 x 4 road traverses occupied habitat, facilitates erosion, and is the main impact in this watershed. This occurrence is about 1,000 feet higher in elevation than other known *Carex aboriginum* occurrences. The surrounding upland vegetation is intact, but riparian areas are degraded and weedy. No water developments were observed in the watershed near the occurrence. Other than road and cattle grazing impacts, the landscape surrounding this occurrence is minimally disturbed.

Population Size and Condition

Carex aboriginum is a rhizomatous species that forms loose to tight clusters. Distinguishing clusters from each other is sometimes difficult when documenting population size. In order to assess population size and condition, the area of habitat occupied, numbers of flowering stems, and numbers of clusters were estimated for all occurrences except Mesa (002) and South Fork She Creek (008). No count could be conducted at Mesa (002) because by the time the survey was made on June 21, cattle had grazed the pasture to about a two-inch stubble height, including nearly all *Carex aboriginum* (only about five flowering stems were observed in the whole population). South Fork She Creek (008) was not counted because permission to enter private land was not obtained. Totals for the Council (005) occurrence were probably an underestimate of the true population size because only clusters visible from the road were counted (permission to enter private land was not obtained).

Approximately 225 *Carex aboriginum* clusters, with slightly over 300 flowering stems, were observed in 2001. The total number of clusters and flowering stems observed in 2002 was about 450 to 550 clusters and 700 flowering stems; over twice as many as in 2001. In 2001, about eight sub-populations covering up to about 3,000 square m were observed. Surveys in 2002 resulted in a total of 19 sub-populations covering up to about 5,700 square m. Density within sub-populations was variable and much potential habitat adjacent to, and within, occurrence areas was unoccupied. See Murphy (2002) for complete discussion of 2001 population data. Population size and condition for 2002 is summarized in Table 1 and by occurrence below.

Mesa (002): In 2001, this occurrence supported the largest known population of *Carex aboriginum*, with approximately 190 to 200 plant clusters and over 220 flowering stems. The total occupied habitat was over 0.5 acre, mostly comprised of the large sub-population in the upper basin meadow. As discussed above, no population count was conducted in 2002. Future population assessments should be made prior to the release of cattle onto the site (typically the last week in May).

Lower School Creek (003): The total number of *Carex aboriginum* clusters observed in 2001 was approximately 13, with at least 63 flowering stems. In 2002, only 8 clusters, with a total of 44 flowering stems, were observed.

Table 1. *Carex aboriginum* occurrences discovered or updated during 2002 inventory.

Occurrence (#)	2002 Survey Status	# of sub-pops.	Population Size (approximate)		Population Area
			2001	2002	
Mesa (002)	updated	3	190-200 clusters 220+ flowering stems	no count	2000-4000 sq. m
Lower School Creek (003)	updated	4	13 clusters 63+ flowering stems	8 clusters 44 flowering stems	30-40 sq. m
Sheep Ck./North Crane Ck. Confluence (004)	expanded (3 new sub-populations)	4	11 clusters 19 flowering stems	16 clusters 28 flowering stems	20-25 sq. m
Council (005)	first survey	3	no count	15 clusters 100 flowering stems	10-15 sq. m
South Dry Creek Basin (006)	new	1	n/a	2 clusters 7 flowering stems	1 sq. m
South Fork Grays Creek (007)	new	1	n/a	6 clusters 17 flowering stems	<10 sq. m
South Fork She Creek (008)	new	1	n/a	no count (large population)	1250+ sq. m
Upper Road Gulch (009)	new	2	n/a	400-500 clusters 550+ flowering stems	350+ sq. m

The decrease in clusters may reflect both the merging of clusters counted in 2001, as well as the possibility of missing clusters hidden under tall, dense shrubs and grass. All clusters observed in 2002 had flowering stems, but the number of flowering stems was clearly less than in 2001. No new sub-populations were observed in 2002. Plants were still found in four distinct sub-populations distributed along about 0.5 mile of the creek bottom. No change from 2001 was observed at the lowest sub-population, still with only one cluster. Compared to six clusters observed at the middle two sub-populations in 2001, only two large clusters were observed in 2002. The upper sub-population had six clusters in 2001 and five in 2002. No changes in the area covered by sub-populations were noticed in 2002.

Sheep Creek/North Crane Creek Confluence (004): Three additional sub-populations were discovered at this occurrence in 2002. A total of 16 clusters, with 28 flowering stems, were observed at the four sub-populations. About 25% of the clusters were vegetative, while the remainder had flowering stems. The four sub-populations were scattered over an area of about 580 square m, but plants were discontinuously distributed within this area, making the actual occupied habitat only about 20 to 25 square m. At the lowest sub-population, only 4 clusters with 14 flowering stems were observed in 2002, compared to about 11 clusters with 19 flowering stems in 2001. This probably reflected the merging of clusters counted as separate clusters in 2001. All the newly discovered sub-populations were small. The other Sheep Creek sub-population consisted of 8 clusters and 7 flowering stems scattered in three small groups. The actual population may be slightly larger because some *Carex aboriginum* plants had been grazed by cattle. The two lower Road Gulch sub-populations consisted of 4 clusters with 7 flowering stems. At least seven flowering stems appeared to have aborted during fruit development.

Council (005): This occurrence consisted of three small sub-populations with a total of about 15 clusters and 100 flowering stems. The total population size was about 10 to 15 square m. The majority of distinguishable *Carex aboriginum* clusters were vigorously reproducing, with 6 to 10 flowering stems per cluster. The sub-population in the swale on the northeast side of the road had the most flowering stems (over 60). The two sub-

populations at the margins of the pasture on the southwest side of the road totaled about 10 clusters and over 30 flowering stems. The actual population size at this occurrence is probably larger because only plants observable from the fence and roadside were counted during a cursory survey.

South Dry Creek Basin (006): This occurrence consisted of only 2 clusters, with 7 flowering stems, loosely clumped in the middle of a small seep area. Both clusters produced flowering stems that had developing and mature perigynia at the time of the survey. There was also one flowering stem that aborted during fruit development. There may be a few more clusters in this seep, but heavy grazing made their detection difficult. This occurrence has the most precarious viability of all known *Carex aboriginum* occurrences.

South Fork Grays Creek (007): Six clusters, with 17 flowering stems, were found in about a 10 square m area of habitat. The majority of clusters were reproductive. Several clusters were difficult to distinguish from each other. Cattle grazed two of the clusters, including some of the flowering stems. Several patches of unoccupied potential habitat were observed downstream of the occurrence. More potential habitat may occur upstream on private land.

South Fork She Creek (008): Because this occurrence is on private land, the number of clusters and flowering stems was not counted in 2002. Based on cursory observations, *Carex aboriginum* is nearly continuously distributed and locally dense in the northern half of the occurrence and discontinuously distributed in the southern half. The majority of clusters had some flowering stems, including some with many flowering stems. The population area covers approximately 250 m of the 5 m wide floodplain of an intermittent creek. This is probably one of the densest of any known occurrences.

Upper Road Gulch (009): Two large sub-populations were observed, with an estimated total of 400 to 500 clusters and at least 500 flowering stems. The northern sub-population had about 100 to 150 clusters, with about 100 flowering stems. The southern sub-population had 300 to 400 clusters and over 400 flowering stems. The number of clusters was estimated by extrapolating from density counts in the densest areas of each sub-population. The average cluster size was about 0.5 square m. In the absence of heavy grazing, clusters could eventually merge and may decrease in number. *Carex aboriginum* was densest in the middle of each sub-population, but numerous outliers occurred over a wider area at each sub-population. About 75% of the clusters were reproductive. About 90% of the perigynia were mature, turning brown, and beginning to disperse. The site should be revisited in the spring before cattle grazing occurs to obtain a better estimate of the population size. This is by far the largest population known on public land.

Habitat, Moisture Regime, and Soils

Detailed descriptions of *Carex aboriginum* habitat were made at all new occurrences found in 2002, as well as at Council (005) and new sub-populations at Sheep Creek/North Crane Creek Confluence (004). Table 2 summarizes the environmental characteristics of habitat supporting *Carex aboriginum*. Below is a summary of the habitat and soils at each occurrence.

Mesa (002): *Carex aboriginum* grows in an ephemeral moist, sub-irrigated meadow located within a broad, shallow basin. Plants also occur on the low terraces and banks of a narrow and incised, intermittent stream channel. Another sub-population is on the margin of a seep. The mottled soils are ephemeral moist to seasonally saturated. The clay-rich soil hardens upon drying in late spring or early summer. The soil is gravelly, silty clay loam at least 0.75 m thick. There are no associated shrubs. *Carex aboriginum* grows on ground that is wetter than adjacent *Danthonia californica* (California oatgrass) meadow, but drier than adjacent saturated sites.

Lower School Creek (003): In contrast to the meadow habitat at Mesa (002), *Carex aboriginum* grows in partially sunny, grass and forb-dominated gaps within the scrub-shrub riparian zone at this occurrence. It also occurs within or on the edge of shrub thickets adjacent to these gaps. *Carex aboriginum* grows on low alluvial terraces of intermittent to temporarily flooded creek channels that cut a canyon through a basaltic plateau. Multiple narrow (1.5 to 3 m wide) channels are present in the floodplain that occupies most of the 30 to 40 m wide canyon bottom. These channels are entrenched 0.2 to 0.75 m deep, reflecting both historical impacts from

Table 2. Summary of environmental characteristics at *Carex aboriginum* occurrences.

Occurrence (#)	Elevation (feet)	Alluvial Landform & Moisture Regime	Soil Texture ¹	Plant Communities
Mesa (002)	3,000 to 3,035	*wetland meadow in broad basin; low terraces & banks of narrow, incised channel *intermittent, seasonally flooded & sub-irrigated	mottled silty clay loam	*mesic graminoid meadow (<i>Danthonia californica</i> , <i>Hordeum brachyantherum</i> , <i>Poa pratensis</i> , <i>Carex</i> spp., <i>Camassia quamash</i>)
Lower School Creek (003)	2,875 to 2,910	*low terraces, undercut banks, & floodplain of moderately entrenched stream channel & flood overflow channels *intermittent, temporarily flooded with occasional vernal pools	sandy to silty loam, with gravel	* <i>Salix lasiolepis</i> /bench * <i>Crataegus douglasii</i> / <i>Rosa woodsii</i> * <i>Populus trichocarpa</i> / <i>Crataegus douglasii</i>
Sheep Creek/North Crane Creek Confluence (004)	3,415 to 3620	*low terraces, stable banks, & swales of shallowly entrenched stream channel & flood overflow channels *intermittent, seasonally flooded with occasional vernal pools	silty clay loam, with rocks, gravel, & sand	* <i>Salix lasiolepis</i> /bench * <i>Salix lasiolepis</i> / <i>Rosa woodsii</i>
Council (005)	2975 to 3005	*swales, shallow channels, & upper ditch banks; areas between temporarily flooded ditches, irrigated pastures, & drier scabland *ephemerally moist receives overland runoff & sub-irrigation	clay loam with gravel?	*mesic graminoid meadow (<i>Danthonia californica</i> , <i>Hordeum brachyantherum</i> , <i>Poa pratensis</i> , <i>Carex sheldonii</i> , <i>Juncus</i> spp., <i>Senecio hydrophiloides</i> , annuals)
South Dry Creek Basin (006)	3465	*gently sloped, hummocky seep in broad drainage basin *ephemerally wet, saturated below surface in late spring	clay loam, with organic matter	*mesic graminoid meadow (<i>Poa pratensis</i> , <i>Eleocharis</i> spp., & <i>Juncus</i> spp.)
South Fork Grays Creek (007)	3170	*low terrace, flood overflow swale *intermittent, seasonally flooded with occasional vernal pools	clay loam, minimal gravel & rock	* <i>Philadelphus lewisii</i> (with <i>Symphoricarpos albus</i>)
South Fork She Creek (008)	3295 to 3300	*low terraces, sloped banks, & floodplain of moderately entrenched stream channel; upper ditch banks *intermittent, seasonally flooded	clay loam, with gravel	* <i>Danthonia californica</i> meadow (with <i>Hordeum brachyantherum</i>)
Upper Road Gulch (009)	4445	*gently sloped, hummocky seep on basalt shelf toeslope in broad basin; between dry shrubs & ephemeral drainage/vernal pools *ephemerally moist, sub-irrigated	clay loam, with rocks & organic matter	*mesic graminoid meadow (<i>Danthonia californica</i> , <i>Hordeum brachyantherum</i> , <i>Juncus confusus</i> , & <i>Poa bulbosa</i>)

¹ all soils are derived from gravelly alluvium of weathered basalt origin

livestock grazing (e.g., bank shearing) and down cutting from occasional large flood events. *Carex aboriginum* grows on stable sites immediately adjacent to channels, but also up to 10 m away on the floodplain. These sites are about 0.1 to 0.75 m above the average high water line of the creek and are flooded during high-flow runoff events. *Carex aboriginum* is also occasionally perched on steep undercut banks. The fine-textured loamy soil is ephemerally moist during spring runoff. The soil varies from only about 0.25 m to 0.75 m thick, over alluvial cobble and gravel. *Carex aboriginum* does not grow within the rocky stream channel or on the margins of vernal pools found below high water line.

Sheep Creek/North Crane Creek Confluence (004): Similar to Lower School Creek (003), *Carex aboriginum* grew in grass-dominated gaps within riparian scrub-shrub vegetation, with occasional plants observed on the edges of shrub thickets. Sub-populations occurred on the floodplains of intermittent/seasonally-flooded, low gradient creeks within narrow (10 to 30 m wide) valleys. Multiple flood channels are sometimes present in the floodplain. The creek channels range from 1 to 3 m wide and 10 to 50 cm deep. The channels are slightly entrenched (about 0.2 to 0.3 m deep). *Carex aboriginum* was observed on relatively stable banks, low terraces, and in swales along both the main creek and flood overflow channels. The terrace and bank habitats flood during high-flow events and are usually situated about 10 to 20 cm above the average annual high water line.

The soil is ephemerally moist, sub-irrigated by flood flows, but apparently not wet for long periods. The soil is generally gravelly loam, with variable amounts of clay, sand, and rock intermixed. The soil is about 0.50 to 0.75 m deep over mixed rocky and gravelly alluvium. The loamy alluvial soils of creek bottom occurrences such as this one, seem to have less clay than seep-fed meadow occurrences, such as Mesa (002) or South Dry Creek Basin (006). Small vernal pools are occasionally present in creek channels, as well as cattle-watering reservoirs and beaver ponds, but *Carex aboriginum* apparently does not grow on pool margins.

Council (005): *Carex aboriginum* occurs on transitionally moist areas between periodically flooded roadside ditches (with obligate wetland species) and wet, irrigated pasture and drier hay pasture (on deeper soil) or dry *Poa bulbosa* scablands. The habitat includes gently sloping (less than 5%) upper banks ditches, swales, and shallow ephemeral channels. One sub-population occurs in a swale between ditch dredging deposits and wetter pasture, while the other two sub-populations occur along fencelines on the margins of a pasture currently used for horse grazing. *Carex aboriginum* grew in full sun and shrubs were lacking. Soils are ephemerally moist, probably clay-rich, gravelly, and loamy. The habitat is likely sub-irrigated by naturally high groundwater combined with moisture from pasture irrigation and seasonal overland runoff.

South Dry Creek Basin (006): Similar to portions of the Mesa (002) occurrence, *Carex aboriginum* grows in a mesic graminoid dominated seep. The seep was small (only 10 m by 20 m), elliptical shaped, and gently sloped (less than 5%). Also like Mesa (002), this seep occurred in a broad drainage basin surrounded by much drier upland grass and shrub vegetation. *Carex aboriginum* grew on 10 cm-tall hummocks situated between the drier margin (dominated by *Danthonia californica*) and the wettest portion of the seep (dominated by *Eleocharis* (spikerush) species). The dark gray loamy soil is moist at the surface and saturated just below the surface during late spring. The soil is rich in both clay and organic matter, of basalt origin, and has traces of sand, gravel, and stones intermixed. Shrubs were absent in this habitat.

South Fork Grays Creek (007): The habitat was most similar to the Sheep Creek/North Fork Crane Creek Confluence (004) occurrence. *Carex aboriginum* occupied a flood overflow swale on a low-lying "island" terrace between two rocky channels of a braided intermittent creek. Channels are 3 to 5 m wide, 30 to 60 cm deep, and at least 20 cm entrenched. Channels carry water during peak runoff and snowmelt periods, with only small pools and a rocky channel bottom present in late spring. The terrace supporting *Carex aboriginum* is over 20 cm above the average high water line and floods infrequently. The soil is dark brownish-red, clay loam with trace amounts of gravel and rock intermixed, and is about 60 to 75 cm thick (over rocky alluvium). *Carex aboriginum* occurs in a mesic graminoid and forb-dominated gap between patches of riparian scrub-shrub vegetation, in partial to full sun.

South Fork She Creek (008): This habitat is most similar to sub-populations along the intermittent creek channel at Mesa (002). At this occurrence, *Carex aboriginum* occupies mesic graminoid dominated low terraces and sloped banks in the floodplain of a meandering intermittent creek. The creek only flows during peak runoff events and during snowmelt. The creek channel is mostly gravel, 1 to 3 m wide, 30 to 50 cm deep, and slightly entrenched. A few *Carex aboriginum* clusters were observed growing on the channel bottom, as well as on an ephemerally moist roadside ditch bank at the two road crossing points. The clay loam soil averaged about 50 cm thick over gravelly alluvium (with trace cobble and sand intermixed). Shrubs were lacking in this habitat.

Upper Road Gulch (009): *Carex aboriginum* occupies moist areas of seeps in the broad headwater basin of Road Gulch. The seeps occur on an easterly facing 5% toeslope perched atop a basalt shelf. The microtopography is undulating due to natural erosion patterns, "biscuit and swale" topography, and disturbances related to grazing and a 4 x 4 road that crosses this population. The soil is sub-irrigated clay loam that dries hard by summer. The soil has occasional colluvial stones and boulders embedded and has an organic surface layer. The seeps drain into ephemeral drainages, swales, and a vernal pool, all supporting drier (but ephemerally moist) vegetation on scabland soils. In the seeps, *Carex aboriginum* occurs in a mesic graminoid meadow in full sun. Shrubs, such as *Rosa woodsii* (Wood's rose), are confined to the transitional border with *Artemisia tridentata*-*Purshia tridentata* vegetation. Although this habitat is seep-fed like several other occurrences, it is the only one known that is sloped and perched on a rocky shelf. At 4,445 feet, it is the highest elevation occurrence,

over 800 feet higher than the sub-populations located in lower Road Gulch (part of the Sheep Creek/North Crane Creek Confluence (004) occurrence).

Plant Communities

Mesa (002): *Carex aboriginum* occurs in a mesic graminoid meadow dominated by *Danthonia californica*, *Hordeum brachyantherum* (meadow barley), *Poa pratensis* (Kentucky bluegrass), *Carex* species, and *Camassia quamash* (camas). This community was difficult to classify due to its heterogeneous composition. The species composition is most similar to the *Hordeum brachyantherum* community type described for southwestern Idaho (Jankovsky-Jones et al. 2001). The co-dominance by *Danthonia californica* may reflect grazing disturbance or a transitional moisture regime between wetter *Carex*-dominated vegetation and drier meadow. Patches dominated by various *Carex* and *Juncus* (rush) species, with *Eleocharis palustris* (common spikerush), occur on adjacent saturated soil. *Danthonia californica* dominates adjacent drier soils.

Lower School Creek (003): *Carex aboriginum* occurs in gaps dominated by *Poa pratensis* within a *Salix lasiolepis* (arroyo willow)/bench community. *Camassia quamash*, *Carex* spp., *Juncus* spp., *Senecio hydrophiloides* (tall groundsel), and a variety of weedy species also occur in these gaps. This community is similar to the *Salix lasiolepis* dominance type described for southwestern Idaho (Jankovsky-Jones et al. 2001), but includes the “bench” modifier to indicate the terrace position (as in Manning and Padgett 1995). In addition, *Carex aboriginum* grew in a gap within a *Crataegus douglasii*/*Rosa woodsii* community. This habitat is very similar to the *Crataegus douglasii*/*Rosa woodsii* community described by Jankovsky-Jones et al. (2001). *Carex aboriginum* also grew on the periphery of an open *Populus trichocarpa*/*Crataegus douglasii* stand. This forested riparian community is not well documented in Idaho (Jankovsky-Jones et al. 2001).

Sheep Creek/North Crane Creek Confluence (004): *Carex aboriginum* grows in microsites dominated by *Poa pratensis*, associated with *Artemisia ludoviciana* (Louisiana mugwort), *Danthonia californica*, *Juncus* spp., *Potentilla gracilis* (slender cinquefoil), and a variety of weedy species. These microsites occur on stand margins and in gaps of *Salix lasiolepis*/*Rosa woodsii* and *Salix lasiolepis*/bench communities. *Crataegus douglasii*, *Philadelphus lewisii* (syringa), and *Ribes aureum* (golden currant) are commonly associated shrubs, but have low cover. These community types have been described by Manning and Padgett (1995) in Nevada, but are also similar to the *Salix lasiolepis* dominance type described for southwestern Idaho (Jankovsky-Jones et al. 2001).

Council (005): *Carex aboriginum* grows on the weedy margins of a *Danthonia californica*-dominated meadow/pasture, as well as in a roadside swale. *Carex sheldonii* (Sheldon’s sedge), *Hordeum brachyantherum*, *Poa pratensis*, and/or *Senecio hydrophiloides* are all locally co-dominant. The plant community was difficult to classify due to its heterogeneous and weedy composition. The species composition is similar to the *Hordeum brachyantherum* and *Danthonia californica* community types (Jankovsky-Jones et al. 2001).

South Dry Creek Basin (006): *Carex aboriginum* was found in a mesic graminoid-dominated meadow occurring in a moist seep. The plant community was difficult to classify, due to the highly disturbed vegetation. The community was co-dominated by *Poa pratensis*, *Eleocharis bolanderi* (Bolander’s spikerush), and *Eleocharis palustris*, with lesser amounts of *Juncus* spp., vernal annuals, and exotic species also present.

South Fork Grays Creek (007): *Carex aboriginum* grew in a gap dominated by mesic graminoids (mainly *Poa pratensis*, *Carex deweyana*, and *Danthonia californica*), and a wide array of forbs. Species diversity was very high, but only *Poa pratensis* and *Senecio hydrophiloides* had more than 10% cover. The gap was at the edge of a *Philadelphus lewisii* community, with *Symphoricarpos albus* (common snowberry) and *Salix lasiolepis* intermixed. A *Prunus virginiana* (chokecherry) stand was adjacent. The community was somewhat similar to the *Philadelphus lewisii* dominance type described for southwestern Idaho (Jankovsky-Jones et al. 2001).

South Fork She Creek (008): The community was best classified as *Danthonia californica*, although *Hordeum brachyantherum* was locally dominant (Jankovsky-Jones et al. 2001). Perennial forbs, especially *Potentilla gracilis* and *Wyethia amplexicaule* (yellow mule’s ear), and annual forbs, such as *Epilobium brachycarpum* (tall

annual willowherb), were also common. Although the environmental setting and plant community resembled the Mesa (002) occurrence, this community lacked the diverse mix of *Carex* spp. and mesic perennial forbs.

Upper Road Gulch (009): *Carex aboriginum* occurs in a mesic graminoid meadow dominated by *Danthonia californica*, *Hordeum brachyantherum*, *Juncus confusus* (Colorado rush), and *Poa bulbosa*. Various other exotic perennial grasses, as well as native forbs (e.g., *Potentilla gracilis*, *Senecio hydrophiloides*, and vernal annuals), characterized this seep community. Except for its lack of other *Carex* spp., this community's composition was somewhat similar to the Mesa (002) and Council (005) occurrences. The vegetation is closely related to the *Hordeum brachyantherum* and *Danthonia californica* community types described for southwestern Idaho (Jankovsky-Jones et al. 2001).

Associated Species

The following lists of associated species were generated from habitat information collected in 2001 and 2002. The following species were observed within occupied *Carex aboriginum* habitat at greater than 50% of the occurrences. A community with at least several of the following high constancy species is indicative of potential habitat for *Carex aboriginum*. These species are sometimes also the most abundant:

- *Camassia quamash*
- *Danthonia californica*
- *Eleocharis bolanderi*
- *Eleocharis palustris*
- *Hordeum brachyantherum*
- *Juncus howellii* (Howell's rush)
- *Poa pratensis*
- *Potentilla gracilis*
- *Rumex crispus* (curly dock)
- *Senecio hydrophiloides*

The following species were associated at 25 to 50% of the occurrences. With the exception of a few shrubs and several annual forbs species, these species usually had low cover in *Carex aboriginum* habitat:

- *Achillea millefolium* (yarrow)
- *Agrostis stolonifera* (redtop)
- *Artemisia ludoviciana*
- *Artemisia* species (wormwood)
- *Bromus japonicus*
- *Carex athrostachya* (slenderbeak sedge)
- *Carex deweyana* (Dewey's sedge)
- *Carex sheldonii*
- *Castilleja tenuis* (hairy owl's clover)
- *Convolvulus arvensis*
- *Crataegus douglasii*
- *Deschampsia danthonioides* (annual hairgrass)
- *Elymus glaucus* (blue wildrye)
- *Epilobium brachycarpum*
- *Epilobium densiflorum* (denseflower willowherb)
- *Erigeron annuus* (eastern daisy)
- *Galium aparine* (annual cleavers)
- *Geranium carolinianum* (Carolina geranium)
- *Gnaphalium palustre* (western marsh cudweed)
- *Grindelia squarrosa* (curlycup gumweed)
- *Juncus bufonius* (toad rush)
- *Juncus confusus*
- *Juncus tenuis* (poverty rush)
- *Lactuca serriola*
- *Mimulus* spp. (monkeyflower)
- *Montia* spp. (miner's lettuce)
- *Myosotis stricta* (strict forget-me-not)
- *Navarretia intertexta* (needleleaf navarretia)
- *Perideridia* spp. (yampah)
- *Philadelphus lewisii*
- *Phleum pratense* (timothy)
- *Plagiobothrys scouleri* (Scouler's popcornflower)
- *Poa bulbosa*
- *Poa compressa* (Canada bluegrass)
- *Polygonum aviculare* (prostrate knotweed)
- *Potentilla recta*
- *Prunus virginiana*
- *Ribes aureum*
- *Rosa woodsii*
- *Salix lasiolepis*
- *Sidalcea oregana* (Oregon checkerbloom)
- *Symphoricarpos albus*
- *Taraxacum officinale* (dandelion)
- *Thinopyrum intermedium*
- *Trifolium longipes* (longstalk clover)
- *Triteleia hyacinthina* (white brodiaea)
- *Veronica perigrina* (hairy speedwell)
- *Zigadenus venenosus* (death camas)

Land Uses and Threats

Threats to occupied *Carex aboriginum* habitat were observed at each occurrence. Livestock grazing impacts (e.g., streambank degradation, soil compaction, etc.) and noxious weed invasion were high magnitude, imminent threats to the majority of occurrences. Current land uses and threats are described below by occurrence. Table 3 also summarizes livestock activity, weed levels, other threats at each occurrence.

Mesa (002): This occurrence is located on land managed for livestock grazing. According to the landowner, a large cattle herd grazes the mesic meadow habitat for about three weeks in the spring each year. The herd is usually released on to the site during the last weekend in May. By June 21, when the site was visited in 2002, cattle had grazed the pasture down to about a two-inch stubble height, including nearly all *Carex aboriginum* clusters. Only a few less palatable exotic forbs were left ungrazed. *Carex aboriginum* has persisted on the site under this grazing regime for years. There is no information on whether short duration, intensive spring cattle grazing has positive or negative effects on the population. Overall, no changes from 2001 land uses or threats were observed in 2002. See Murphy (2002) for details on exotic species and the potential impacts of livestock grazing and water developments on soils, hydrology, and weed invasion.

Lower School Creek (003): The upper three sub-populations at Lower School Creek (003) are within the Weiser River Trail easement. This easement is owned by a private non-profit organization that manages the land for recreation use and open space protection. A biking and hiking trail follows the old railroad right-of-way adjacent to lower School Creek. Other than for maintenance and weed control purposes, motorized vehicle use is prohibited from the trail. According to the Friends of the Weiser River Trail organization, the canyon bottom is excluded from livestock grazing. No trespass livestock grazing was observed in 2002. No impacts from trail maintenance or construction were observed in 2002. *Euphorbia esula* occurs only 5 m from *Carex aboriginum* sub-populations and poses a serious threat unless immediately controlled. *Euphorbia esula* has thoroughly choked some drainages in nearby areas. To control noxious weeds, herbicide spraying occurs along the railroad causeway and trail, only about 3 to 4 m away from occupied habitat. No evidence of over-spraying was observed in 2002. A flood went through the site during a rapid late April snowmelt, but erosion in lower School Creek was minor. Riparian scrub-shrub vegetation anchored the terrace soil and no damage to *Carex aboriginum* habitat was evident. In general, no changes from 2001 land uses or threats were observed in 2002. See Murphy (2002) for last year's details.

Sheep Creek/North Crane Creek Confluence (004): Livestock grazing is the predominant land use in this area. Cattle paths occur immediately adjacent to two of the four sub-populations. There is a livestock enclosure on lower Sheep Creek with recovering riparian vegetation inside, but *Carex aboriginum* was not observed within the enclosure. Livestock grazing is managed with two pastures, each under different regimes. At the lowest sub-population (near the confluence with North Crane Creek), cattle grazing is incidental during the spring, but heavy in the fall. In contrast, the upper three sub-populations are grazed with variable timing and intensity throughout the year. Several clusters of *Carex aboriginum* observed on May 21 in the upper sub-populations were grazed to less than 10 cm stubble height by June 12. Other cattle grazing impacts, such as bank shearing, soil compaction, loss of native riparian vegetation, and noxious weed invasion, were observed in both 2001 and 2002. In addition, the grassy terraces and banks supporting *Carex aboriginum* are unstable and susceptible to erosion, especially due to the large amount of weak-rooted *Poa pratensis*. The riparian scrub-shrub vegetation sufficiently anchored the soil during a flood that went through the site during a rapid late April snowmelt. However, a small headcut was observed about 75 m downstream of the upstream sub-population in Sheep Creek. Down cutting and subsequent drying of terraces may eventually disrupt the soil moisture regime favorable for *Carex aboriginum* persistence. Noxious weeds, including *Chondrilla juncea*, *Cirsium arvense*, *Conium maculatum* (poison hemlock), *Convolvulus arvensis*, and *Onopordum acanthium*, have invaded terraces in lower Sheep Creek and Road Gulch. *Conium maculatum* and *Onopordum acanthium* occur within 5 m of *Carex aboriginum* at two sub-populations and may pose a competitive threat unless controlled. Control of noxious weeds should be done by a spot spray method to prevent accidental spraying of *Carex aboriginum*.

Table 3. Threats and impacts in occupied habitat at all *Carex aboriginum* occurrences.

Occurrence (#)	Livestock Activity and Impacts	Highly Invasive Exotic Species and Noxious Weeds	Other Threats	EO Rank*
Mesa (002)	*short duration, intensive (heavy utilization), spring cattle grazing *trampling around stock-watering pond & streambanks	<i>Chondrilla juncea</i> , <i>Potentilla recta</i> , <i>Salvia</i> spp.	*expansion of cattle trampling zone around stock pond *depletion of groundwater from adjacent housing development	C
Lower School Creek (003)	*not grazed (occasional trespass cattle grazing with minor trailing)	<i>Arctium minus</i> , <i>Convolvulus arvensis</i> , <i>Cynoglossum officinale</i> , <i>Euphorbia esula</i> , <i>Hypericum perforatum</i> , <i>Tanacetum vulgare</i>	*over-spraying of noxious weed herbicides along trail right-of-way *erosion of alluvial terraces	B
Sheep Creek/North Crane Ck. Confluence (004)	*two pastures: 1) light spring grazing & short duration, intensive fall grazing; 2) riparian pasture, variable timing, intensity, & duration *trailing & trampling of streambanks	<i>Chondrilla juncea</i> , <i>Cirsium arvense</i> , <i>Conium maculatum</i> , <i>Convolvulus arvensis</i> , <i>Hypericum perforatum</i> , <i>Onopordum acanthium</i> , <i>Potentilla recta</i>	*erosion of alluvial terraces, unstable banks *headcut present; down cutting & site dessication *hydrologic alteration (culverts)	C
Council (005)	*currently, light grazing at two sub-populations by two horses *minimal impacts	<i>Convolvulus arvensis</i>	*herbicide spraying, ditch digging, road & fence maintenance *hydrologic/irrigation alteration *housing development	C
South Dry Creek Basin (006)	*heavy, intensive spring cattle grazing at seep *soil compaction, deep pugging, hummock formation	none observed	*hydrologic alteration (decreased soil infiltration resulting in excess runoff & pooling)	D
South Fork Grays Creek (007)	*light to moderate intensity spring cattle grazing *trailing, trampling & soil pugging	<i>Potentilla recta</i>	*erosion of alluvial terraces & unstable streambanks	C
South Fork She Creek (008)	*two pastures: 1) summer/fall cattle grazing, intensity unknown; 2) not recently grazed *bank trampling, soil compaction	<i>Chondrilla juncea</i> , <i>Convolvulus arvensis</i>	*herbicide spraying, ditch digging, road & culvert maintenance, fence & buried cable maintenance *erosion of alluvial terraces	C
Upper Road Gulch (009)	*heavy intensive spring cattle grazing *soil compaction, pugging, hummock formation	none observed	*rutted 4 x 4 road in occupied habitat, associated campsites *hydrologic alteration (decreased soil infiltration & excess runoff)	B

* “Element Occurrence Ranks” (EORs) were assigned for each new occurrence and reassessed for prior known occurrences. The network of Natural Heritage Programs and Conservation Data Centers use EORs for conservation planning (NatureServe 2002). EORs represent the estimated viability, or probability of persistence, 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.

Council (005): Livestock grazing, fence construction and maintenance, and roadside ditch maintenance have all disturbed this occurrence in the past. All three sub-populations occur within 5 m of roadside ditches and pasture fence lines. Sub-populations are located on both sides of fences, within the horse pasture and outside the pasture between ditches and fences. The hydrology is influenced by current irrigation and past drainage alteration, probably both creating and eliminating *Carex aboriginum* habitat. Future hydrologic alteration may be a threat to this occurrence. The habitat is mostly dominated by native species, although weedy and colonizing species are common on soil disturbed by past ditch maintenance. The habitat within the pasture does not appear altered by hay cultivation, plowing, or seeding. The pasture is only lightly grazed by two horses, but may have been more heavily grazed in the past. Weed levels are currently low, but the potential for invasion by *Convolvulus arvensis* is high. Pasture cultivation, roadside weed spraying, and possibly subdivision construction, are high magnitude threats. The pasture adjacent to the northern sub-population was for sale in 2002, but it may be too wet for subdivision construction. It is not currently grazed, but may have been grazed in the past.

South Dry Creek Basin (006): Intensive spring cattle grazing is an imminent threat to this occurrence. Although livestock grazing in the surrounding landscape is only light to moderate, cattle congregate in the moist and lush seep supporting *Carex aboriginum*. Trampling has caused major damage of the saturated soil, including deep pugging, hummock formation, soil compaction, and exposure of bare soil. Hydrologic conditions have been altered by excess runoff on compacted soil and excess pooling in areas of pugging. The amount of potential *Carex aboriginum* habitat is probably reduced as a result. There is a high likelihood of cattle directly dislodging the few *Carex aboriginum* clusters occurring in the seep. Direct grazing of clusters was also observed. As the summer progresses, the clay-rich soils supporting *Carex aboriginum* become dry, hard, and less impacted by cattle hooves. Summer drought probably limits the re-growth and reproduction of *Carex aboriginum* after June. Thus, short duration, intensive spring cattle grazing while *Carex aboriginum* is growing and flowering will likely limit its reproduction and promote compaction of the moist soils. Exotic species, such as *Bromus japonicus*, *Poa bulbosa*, *Poa pratensis*, *Rumex crispus*, and *Taraxacum officinale* were common, but no noxious weeds were observed.

South Fork Grays Creek (007): Cattle grazing intensity is currently light to moderate in the habitat supporting *Carex aboriginum*. Grazing is locally heavy in the surrounding area and has had noticeable effects. For example, cattle trampling has sheared terrace banks and exposed soil, increasing the chance of erosion of *Carex aboriginum* habitat. Streambank stability is further decreased because of weakly rooted *Poa pratensis*. Although noxious weeds were not observed, competition from other exotic species may be a threat. Exotic species included: *Lactuca serriola*, *Poa bulbosa*, *Poa pratensis*, *Potentilla recta*, *Rumex crispus*, and *Taraxacum officinale*.

South Fork She Creek (008): Road crossings, ditches, cable burying, and culverts have altered drainage patterns and disturbed soil at this occurrence, both creating and destroying *Carex aboriginum* habitat. *Carex aboriginum* clusters on roadside ditch banks (only 0.5 to 1.0 m off road) are imminently threatened by weed spraying, ditch clearing, fence maintenance, and maintenance of buried cable. The majority of the occurrence is not affected by these activities. The northern portion of the occurrence is apparently rested from grazing, has thick mesic graminoid cover and denser *Carex aboriginum*, stable streambanks, and less down cutting in the creek. Cattle graze the southern portion of the occurrence, probably later in summer or fall (no grazing was observed during survey). There was noticeably less mesic graminoid cover and patchier *Carex aboriginum*, more soil erosion, and less vegetated streambanks. Erosion and down cutting may lead to drying of the terraces supporting *Carex aboriginum*. Exotic species are common in the area, including noxious weeds *Chondrilla juncea* and *Convolvulus arvensis*.

Upper Road Gulch (009): At the time of surveys, cattle grazed the seeps supporting *Carex aboriginum*. Grazing was locally heavy, with nearly complete utilization of mesic graminoids in places. Cows had broken off or grazed flowering stems of numerous *Carex aboriginum* clusters. An occasionally used 4 x 4 road bisects the southern sub-population and forms the upper border of the northern sub-population. The road has deep ruts and compacted soil that cause excess water runoff out of the habitat. The road has likely destroyed *Carex aboriginum* habitat in the past and contributes to current site degradation by allowing 4 x 4 vehicles and cattle

easy access to the habitat. There were primitive campsites in the area, including one fire ring in occupied habitat. Despite impacts from cattle and vehicles, noxious weeds were not observed.

Noxious Weeds and Exotic Species

Poa pratensis, an exotic sod-forming perennial grass, was present at nearly all sub-populations of *Carex aboriginum* visited in 2001 and 2002, and is often co-dominant. It appears that *Carex aboriginum* can effectively compete with *Poa pratensis* (as well as other vigorous riparian and wetland species)—at least where *Poa pratensis* does not form dense monoculture stands. In addition to *Poa pratensis*, the following exotic weed species were observed growing either within or immediately adjacent to occupied *Carex aboriginum* habitat:

- *Agrostis stolonifera*
- *Arctium minus* (burdock)
- *Bromus japonicus*
- *Chondrilla juncea*
- *Cichorium intybus*
- *Conium maculatum*
- *Convolvulus arvensis*
- *Cynoglossum officinale* (hound's tongue)
- *Euphorbia esula*
- *Geranium carolinianum*
- *Hypericum perforatum*
- *Lactuca serriola*
- *Myosotis stricta*
- *Onopordum acanthium*
- *Phleum pratense*
- *Poa bulbosa*
- *Poa compressa*
- *Polygonum aviculare*
- *Potentilla recta*
- *Rumex crispus*
- *Taeniatherum caput-medusae*
- *Tanacetum vulgare* (common tansy)
- *Taraxacum officinale*
- *Thinopyrum intermedium*
- *Verbascum blatteria* (moth mullein)
- *Xanthium strumarium* (cocklebur)

Of these species, *Chondrilla juncea*, *Conium maculatum*, *Convolvulus arvensis*, *Onopordum acanthium*, and *Euphorbia esula* are legally designated as “noxious” by the Idaho Department of Agriculture (2003). These five noxious weeds do not currently have high cover or density within habitat occupied by *Carex aboriginum*. However, they have completely shaded native plants and taken over many drainages within the range of *Carex aboriginum*. Within and adjacent to occupied *Carex aboriginum* habitat, control of noxious and invasive weeds should be done by hand-pulling or with a spot spray method to prevent accidental spraying of populations.

CONSERVATION ASSESSMENT AND MANAGEMENT RECOMMENDATIONS

Carex aboriginum is known from only eight extant occurrences. Six occurrences are potentially threatened by competition with invasive exotic species, including noxious weeds. Cattle grazing disturbs six occurrences; half of those are heavily grazed in the spring during the time of *Carex aboriginum* reproduction. Only three occurrences have relatively large numbers of plants and large areas of occupied habitat. However, only one of these is located on public land. Based on data collected in both 2001 and 2002, it is clear that *Carex aboriginum* remains one of Idaho's rarest and most imperiled plant species. Within the range of *Carex aboriginum*, housing development and highway construction may become serious, high magnitude threats. Without actions to conserve and expand current populations, this species may qualify for listing under the Endangered Species Act. The conservation status of each occurrence is summarized below.

Mesa (002): This is the third largest occurrence in number of *Carex aboriginum* clusters, but it is probably the largest known area of occupied habitat. Intensive spring grazing results in grazing most to nearly all *Carex aboriginum* clusters and prevents much reproduction. The landowner is open to the idea of protecting populations during spring grazing with temporary exclosures.

Lower School Creek (003): This population is small, but the habitat is probably the best protected of any known occurrence. The most upstream sub-population is vulnerable to accidental over-spraying of herbicides along the old railroad causeway. The other sub-populations are minimally threatened, but monitoring of weed invasion or other habitat changes should occur at these sub-populations.

Sheep Creek/North Crane Creek Confluence (004): With the discovery of additional sub-populations, this occurrence is more secure than previously thought. However, all of the sub-populations are very small. These sub-populations are vulnerable to competition with noxious weeds, as well as to direct and indirect impacts from cattle grazing (e.g., shearing of streambanks, erosion, soil compaction, etc.). A headcut in Sheep Creek, between the enclosure and the upper sub-population, indicates that the stream is at risk of more erosion, down cutting, and loss of riparian vegetation. Range managers for both the BLM and Idaho Department of Lands have expressed interest in taking measures to better protect these sub-populations.

Council (005): This was one of the most reproductively vigorous of all occurrences in 2002. However, it is probably the most vulnerable to loss due to human activities, including land development, noxious weed spraying, fence maintenance, roadside ditch digging, and hydrologic alteration.

South Dry Creek Basin (006): This is the smallest known occurrence in both numbers of clusters and occupied habitat. It is probably the least viable occurrence known. Without immediate actions to protect the seep from heavy cattle grazing and trampling, this occurrence may soon be extirpated.

South Fork Grays Creek (007): This is a small occurrence located in a heavily grazed, degraded landscape. It is the second smallest occurrence known. While weed invasion is not currently a problem, other indirect threats related to soil disturbance, such as streambank erosion, could become a problem.

South Fork She Creek (008): This is a relatively large occurrence. A few clusters are vulnerable to roadside weed spraying and ditch and culvert maintenance. Erosion and cattle grazing may be impacting the southern half of the population.

Upper Road Gulch (009): This is the largest known occurrence, in terms of numbers of *Carex aboriginum* clusters, and by far the largest on BLM land. This occurrence also has the lowest degree of exotic species invasion; no noxious weeds were observed. The 4 x 4 road and intensive spring cattle grazing are imminent, high magnitude threats. These threats could be mitigated with management changes.

Recommendations

Management Actions:

1. Federal and state land managers should avoid planning any ground disturbing projects (e.g., road building, hydrologic alterations, livestock water developments, fence construction, etc.) in, or adjacent to, occupied *Carex aboriginum* habitat.
2. The long-term effects of short duration, intensive, spring grazing on the viability of the Mesa (002) and Upper Road Gulch (009) populations is not well understood. To allow adequate *Carex aboriginum* reproduction at these occurrences, cattle grazing could be conducted after seeds mature (e.g., summer) or prior to the growing season (e.g., winter). Alternatively, enclosures could be erected around seeps and meadows supporting *Carex aboriginum*, while still allowing use of cattle ponds and adjacent forage.
3. No broadcast herbicide spraying should occur within 50 m of *Carex aboriginum* habitat. Any spraying within 50 m should be done with a spot spray method. Chemicals targeting graminoid species should not be used within 50 m of occupied *Carex aboriginum* habitat. Noxious weed control needs to occur, but it should be done carefully so as to avoid harm to *Carex aboriginum* populations.
4. Because they are the largest known populations, the Mesa (002), South Fork She Creek (008), and Upper Road Gulch (009) occurrences are very valuable for the long-term persistence of *Carex aboriginum*. The USFWS should work with the landowners at Mesa (002) and South Fork Sheep Creek (008), and the BLM at Upper Road Gulch (009), to develop a conservation agreement for *Carex aboriginum*.

5. The USFWS or Natural Resources Conservation Service could provide incentives for landowners at Mesa (002), Council (005), and South Fork She Creek (008) to conserve *Carex aboriginum*. For example, parcels of land may be suitable for conservation through the Wetlands Reserve Program. Under the Wetlands Reserve Program, private property owners can receive financial incentives to restore and protect wetland habitat in exchange for retiring marginal agricultural land. Rangelands and pastures, where the hydrology has been significantly altered but can still be restored, may qualify. Landowners can request permission to cut hay, graze livestock, or perform other activities if these uses are fully compatible with the protection and enhancement of the wetland.
6. BLM, U. S. Forest Service, Idaho Department of Lands, Friends of the Weiser River Trail, and county weed control personnel should be made aware of known sub-populations and the potential for additional *Carex aboriginum* occurrences around Council, North Crane Creek, and elsewhere. Personnel should be trained on how to identify *Carex aboriginum* in the field.

Research:

1. *Carex aboriginum* seed should be collected from each occurrence to form a conservation seed bank. This should be done in cooperation with the Berry Botanic Garden, who can provide seed collection protocol and seed storage facilities. *Carex aboriginum* has been successfully propagated from seeds and seedlings have been successfully transplanted into properly moist garden settings. An experimental propagation and re-introduction program may be a useful conservation tool for this species.
2. A genetic study should be conducted to understand intra- and inter-population genetic variability. This information is necessary for developing an appropriate, biologically based reintroduction program.
3. A monitoring program should be initiated to increase our understanding of *Carex aboriginum* ecology and population dynamics, as well as the effects of disturbances and land management on populations. Population size, fecundity, area of occupied habitat, and habitat conditions should be monitored at each sub-population on public land and on private land occurrences if landowner permission is granted. Livestock enclosures could be used to compare population trends in areas open to cattle grazing with those closed to grazing.

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Appendix 1

Element Occurrence Records for *Carex aboriginum*

Appendix 2

Maps of *Carex aboriginum* Locations

Appendix 3

Maps of Surveyed Areas

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