# MONITORING PLAN DEVELOPMENT AND IMPLEMENTATION FOR SELECTED SENSITIVE SPECIES ALONG CASCADE CREEK

**Prepared for:**

**South Dakota Department of**
**Game, Fish and Parks**
**Wildlife Division**
**523 East Capitol**
**Pierre, SD 57501**

**Prepared by:**

**Beth Burkhart**
**RR 1, Box 86-W**
**Custer, SD 57730**
**605-673-3159**
**e-mail: burkhart@gwtc.net**

**Elaine Ebbert**
**6603 Elk Creek Road**
**Piedmont, SD 57769**
**605-787-6114**
**e-mail: eaebbert@enetis.net**

**November 2001**

# MONITORING PLAN DEVELOPMENT AND IMPLEMENTATION FOR SELECTED SENSITIVE SPECIES ALONG CASCADE CREEK

## TABLE OF CONTENTS

## ACKNOWLEDGEMENTS

We gratefully acknowledge the following for their support in our research.

| | |
|---|---|
| South Dakota Department of Game, Fish and Parks<br>Pierre, South Dakota | Wildlife Diversity Small Grant |
| Larry Ebbert | Photography, graphics, and field support |
| Jack Frost, Landowner | Access to private property<br>Lower Cascade Creek |
| Mark Gabel, Ph.D., Department of Biology<br>Black Hills State University, Spearfish, SD | Research data |
| Jennifer Riss, Senior Biology Major<br>Black Hills State University, Spearfish, SD | Research data |
| The Nature Conservancy, Black Hills Program<br>Bob Paulson, Director | Project support and access to property |

# BACKGROUND INFORMATION

## STATUS OF FOUR SENSITIVE PLANT SPECIES ALONG CASCADE CREEK

### Historical and Current References

The Cheyenne River Canyons Conservation Initiative was established by The Nature Conservancy (TNC). The canyons consist of 42,000 ecologically bound acres that are especially rich in biodiversity and remarkably undeveloped. It is a prime example of one component of the Black Hills Ecoregion – where eastern, western, high prairie and low montane plant and animal species overlap and coexist (Paulson, 1998). The Cheyenne River Canyons site supports the only known example of an undeveloped warm spring community in the Hills. Cascade Creek and the riparian corridor provide year-round open water and support occurrences of rare species, including *Eustoma grandiflorum* (tulip gentian), *Eleocharis rostellata* (beaked spikerush), *Adiantum capillus-veneris* (southern maidenhair fern), and *Epipactis gigantea* (stream orchid) (Paulson, 1998) (Map 1).

In 1928 Dr. Arthur McIntosh, Assistant Professor of Biology at the South Dakota State School of Mines, described the biological features of the Cascade Valley in their quarterly publication, *The Black Hills Engineer.* He wrote:

"On the southern edge of the Black Hills nine miles southwest of Hot Springs, South Dakota lies a small, secluded valley. Cascade Creek, which has formed this valley, originates in a few large, bubbling springs of sparkling, warm water and flows rapidly down a narrow gorge towards the west, past Cascade village, once the rival of Hot Springs, and then turns southward through a more open valley until it mingles its clear waters with the yellowish flood of the Cheyenne River. The creek is three miles long and averages ten feet in width and three feet in depth. A mile north of the Cheyenne it tumbles over a limestone cliff forming a beautiful cascade fifteen feet high. The main, north-south valley of Cascade Creek is bounded on the east by a rocky, pine-clad ridge towering six hundred feet above the stream, while toward the west the country rises gradually to an upland underlain by sandstone, covered by the buffalo grass association, and dissected by a labyrinth of steep-sided ravines."

"A series of uplifts in past geologic ages has increased the speed of Cascade Creek to such an extent that the stream has cut down through a light yellow clay or loess-like deposit on the old valley floor to form a trench-like valley within a valley. The main valley is more than a mile wide, the smaller averages perhaps two hundred yards in width and lies from twenty to fifty feet below the main valley. In passing along the road near the rim one would hardly suspect the presence of this narrow inner valley were it not for the sound of the rushing stream or the crowns of elms and cottonwoods protruding conspicuously from below. At present the swift creek is cutting still another trench, already five feet deep, within the inner valley. A geologist could not wish for a better example of the process which he calls "rejuvenation"."

"Long ago, before the successive rejuvenations, Cascade Creek probably meandered slowly down its spacious valley and at one time or another may have formed a slough or shallow lake. Today, along the rim of the inner valley are outcroppings of a soft, porous limestone deposited by the ancient stream. This peculiar formation is composed almost wholly of petrified stonewort (Chara) and of tube-like objects that may represent fossilized worm burrows. Living Chara still flourishes along the margin of Cascade Creek and one may find it in various stages of petrification. Cascade water, like that in many places in the southern Black Hills, is richly charged with inorganic compounds, and calcium salts are doubtless very abundant. At Cascade Falls certain moist areas of the limestone escarpment are covered with an interesting moss (*Didymodon tophaceus)* also in the process of petrification."

Cascade Springs is a group of artesian springs in Fall River County, South Dakota, that contributes the majority of flow to Cascade Creek. Numerous other artesian springs occur within or near the outcrop belt of the Spearfish Formation (confining beds), between the outcrop belts of the Minnelusa Formation and the Inyan Kara Group on the margins of the Black Hills uplift. Most are believed to discharge ground water originating from the Madison and/or Minnelusa aquifers. The flow of Cascade Springs has been measured by the USGS since 1976. Flow during water years 1976-1993 averaged 19.6 cubic feet per second, with very little variability (Hayes, 1999).

**Sensitive Plant Species at Cascade Creek**

The SD Natural Heritage Program tracks the following four regionally rare species. Their only known occurrence in South Dakota is in the Cascade Creek area.

***Adiantum capillus-veneris*** (southern maidenhair-fern) historically is known to be abundant on stream banks in J.H. Keith Picnic Ground with widely scattered clumps along Cascade Creek to Cascade Falls. It occurs in tufa deposits at waters edge with *Epipactis gigantea* (stream orchid) and is mostly shaded by sparse riparian zone of Russian olive, juniper and elm (SDNHP).

The following classification scheme applies to *Adiantum capillus-veneris:*

| | | | |
|---|---|---|---|
| Kingdom: | Plantae | Order: | Pteridales |
| Division: | Polypodiophyta | Family: | Adiantaceae |
| Class: | Polypodiopsida | Genus: | Adiantum |
| Subclass: | Polypoidae | Species: | *capillus-veneris* |

Fernald (1950) divided the North American plants into var. *modestum* (Underw.) Fern. from Utah, Arizona, and New Mexico, which has small, only slightly cleft segments; and var. *protrusum* Fern. from the entire United States range excluding Arizona and New Mexico, which has larger, more deeply lobed segments. The two varieties are more sharply demarcated by geography than by morphology. Many intermediates exist, which casts doubt on the validity of Fernald's varieties (Lellinger, 1985). Dr. McIntosh (1928) described the "little maidenhair fern" at Cascade as *Adiantum modestum.*

*Adiantum capillus-veneris* is often found growing on limestone cliffs away from direct sunlight and out of the way of drying southwest winds (Petersen, 2000). The genus name, *Adiantum*, is from the Greek Adiantos, meaning "unwetted" as the leaves of this plant repel water even though the herb grows in a wet environment. Larson and Johnson (1999) note that the fern is locally common as a disjunct population along Cascade Creek where it is found growing on wet, limestone ledges and crevices along streams and springs. It is widespread in tropical and temperate regions of the world; in North America, south from Virginia, Missouri, Oklahoma, southwest Utah, southern Utah, and California, with disjunct populations in South Dakota and southern British Columbia. The fern owes its occurrence in the southern Black Hills to the warm, limey springs that feed Cascade Creek. Without the naturally warm waters of the creek, it could not survive severe winter weather (Larson and Johnson, 1999).

McIntosh (1928) noted that the maidenhair fern adorned crevices in the soft limestone in various places along the stream and that it appeared much less frequent then than at the time Dr. C. E. Bessey first described it in 1898.

In her book, *The Pteridophytes of Kansas, Nebraska, South Dakota and North Dakota, U.S.A.*, 1979, Aleta Jo Petrik-Ott offers the following historical account of *Adiantum capillus-veneris*:

Bessey (1892), upon another worker's word, reported the presence of *Adiantum pedatum* from an area near Hot Springs, South Dakota. However, during 1898 he received specimens of what was called *Adiantum pedatum* collected near Cascade, SD, and found them to be *Adiantum capillus-veneris.* To settle his curiosity concerning this confusion, Bessey set out to visit the locality. He (1898), based upon his findings, reported the "Adiantums" from the area of Cascade as *Adiantum capillus-veneris* and elaborated (1900), saying "We have found our ferns, we have vindicated the truth of the persistent report that Maiden Hair ferns grew in the Black Hills, and we have found that it is the Southern instead of the Northern species...."

This site for *Adiantum capillus-veneris*, however, seems to be quite disjunct from its more southern range although it has also been reported from as far north as British Columbia. Griggs (1940) says the following, concerning the distribution of *Adiantum capillus-veneris*: "The wind-borne spores of ferns are carried hundreds of miles with the greatest ease – witness that occurrence of the subtropical *Adiantum capillus-veneris* at a hot spring in South Dakota. Undoubtedly the spores of this species have fallen generally throughout the territory between the main body of the range and this distant outpost but only where the climate was locally mitigated by the hot water could the species gain a foothold." Bessey (1900) raises question concerning this unique distribution of *Adiantum capillus-veneris*. He asks, "Are these ferns natives of this limited region, or have they been introduced?" It is informative to bring to light, after these many years, his following statements, as he attempts to answer his question.

"It does not require a long investigation to show that if introduced, they must have been brought in a long time ago, much longer than the white man has been in the region. It is only about twenty-five years since it has been possible for white men to safely visit the Black Hills, and Cascade has been a place of resort (never much at the most) for less than ten years. The abundance of old and well-established plants extending from the springs down to where the creek opens upon the plains, is such as they preclude the supposition that they could have been brought here and transplanted by some fern-lover since the advent of white men. By what natural means they might have been introduced is a speculation upon which I do not at present care to enter. They are here, and here they maintain themselves. The warmth of the stream acts as a protection to them during the winter, and prevents their destruction by excessive cold. When the heavy snows fall they doubtless arch over the warm stream and enclose the tender ferns in a semitropical atmosphere, in which they pass the winter as safely as in a hot house. Probably for centuries these ferns have been here, and here they may continue to thrive if the hand of man does not materially change the environment."

In 1928, Dr. Arthur McIntosh noted that the ledges of the stream gorge just above Cascade Falls contained a peculiar rock formation composed of fossil stoneworts (Raventon, 1994). Stoneworts are primitive plants that grow in extensive colonies below the surface of clear-water lakes and streams. McIntosh theorized that the water in Cascade Creek, which is richly charged with inorganic compounds including calcium salts, fossilized these plants (Raventon, 1994). In the distant past, Cascade Creek meandered over a wide area slowly building up a hard pan, non-porous, calcium substrate. Shallow sloughs were created as part of this process. The heavy load of mineral salts flowing through the sloughs eventually encased dead and decaying plants solidifying them into stone. As the Black Hills uplifted, Cascade Creek slowly cut down through the rock it had created, leaving the fossilized stoneworts exposed as a ledge now some twenty feet above the present stream grade (Raventon, 1994).

The Charophyta, or stoneworts, are a small group of freshwater algae that have comprised a significant part of the submerged vegetation of streams, ponds, and lakes, at least since the Devonian (~400 million

years ago) (Kister, 1965). Of about 70 recognized living and fossil genera, only six are living today, and these include a total of 81 living species. Their wide geographic distribution and the limited geologic range of most taxa have allowed their use as stratigraphic indices in freshwater and brackish sediments (Kister, 1965). The Charophytes were regarded by Fritsch (1935) as a separate order of the green algae Chlorophyta, perhaps representing a transition from the green algae to the bryophytes and higher plants. Others consider them sufficiently distinct from both other algae and higher plants to be placed in a separate division of the plant kingdom (Kister, 1965).

The plant is wholly submerged, being attached to a muddy or sandy substrate by rhizoids that also absorb nutrients. Because charophytes are inhibited by an excess of phosphorus, they selectively occur on sandy bottoms where decaying organic matter is scarce. Some species have a limy surface encrustation, but not all species deposit lime. When present, the lime commonly is calcite, although traces of aragonite occur in some brackish water forms, and an appreciable amount of magnesium may be present (Kister, 1965).

Calcification takes place only in the living cells. Deposition progresses until nearly the entire cell substance is replaced by laminated calcite. At maturity, the cell walls break down and adjacent limy deposits fuse to form a compact lime shell. Good preservation of the lime shell is favored by an alkaline matrix, whereas the organic material is better preserved in an acidic one. Thus well-preserved lime shells have poorly preserved organic remains, and the latter are best preserved when the lime shell is partially disintegrated (Kister, 1965).

Charophytes are valuable water-clarifying agents and are among the most important food plants for waterfowl. They are also useful for cytological and physiological studies because of their freshwater habit, ease of cultivation, and extremely large cells. Charophytes are sensitive to phosphorus and will not grow in polluted waters. They are abundant only when the phosphorus level is below 20 micrograms per liter of water, other organic matter is limited, and the water is well oxygenated. They may occur in waters ranging from 5.2 to 9.8 pH, but are more characteristic of a pH near 7.0 or 8.0. Acidic waters are less favorable than alkaline ones (Kister, 1965).

Fossil charophytes are widely distributed in the non-marine limestones and calcareous shales of the Rocky Mountains area. They occur in great abundance in the limestones and associated calcareous shales of the undivided Morrison of western South Dakota, Montana, Wyoming, Colorado, Oklahoma, and New Mexico. In South Dakota, they have been found in the Morrison Formation (Upper Jurassic) in Fall River County and in the Lakota sandstone (Lower Cretaceous) in Fall River County (Peck, 1957).

**It would be valuable for more research to be done on charophyte presence in Cascade Creek, both on fossil and living organisms and remains.**

**Currently *Adiantum capillus-veneris* (southern maidenhair-fern) is still abundant on stream banks in J.H. Keith Picnic Ground (Cascade Springs). It is also abundant on stream banks in the headwaters section of the stream that is part of The Nature Conservancy's Whitney Preserve at Cascade Creek. The headwaters section refers to the creek running from USFS boundary at Cascade Springs to the northern Lamphere property boundary at Cool Creek. The Cascade Creek midsection encompasses the creek running from the southern Lamphere property boundary at the bridge to the USFS boundary at Cascade Falls. The lower section of Cascade Creek starts at the USFS boundary at Cascade Falls (southern boundary) to the mouth of Cascade Creek at the confluence with the Cheyenne River (Map 2). *Adiantum capillus-veneris* (ADICAP) is very abundant in the upstream midsection starting at the bridge and continuing downstream for approximately ¼ mile. It decreases in abundance as exposure to sunlight increases further downstream. Sunlight increases and shade decreases because there is: 1) less overhanging**

**vegetation and 2) less topographic relief of the stream bank (less steep stream banks). The decrease in ADICAP abundance and in cool, shady habitat may also be caused by different north-south orientations of the stream. There are fewer north-south and more east-west exposures as one moves down Cascade Creek. There appears to be a local increase of clumps near Cascade Falls because of an abundance of good lodging sites for free floating clumps of fern.**

**The private property below Cascade Falls was surveyed also, and ADICAP was found in widely scattered clumps. However, none was found within the last one-third mile upstream from the confluence of Cascade Creek and the Cheyenne River. Occurrences in this lower section were noted to be mainly associated with charophyte ledges and "islands" in the creek, especially near rocky waterfall areas. The ADICAP did not grow along the stream banks that were completely dominated by *Scirpus acutus* (hard bulrush), *Schoenoplectus pungens* (American three-square) or *Eleocharis rostellata* (beaked spikerush).**

***Epipactis gigantea*** (stream orchid) historically is known to occur on steep, mostly shaded stream banks of Cascade Springs and Creek. The Element Occurrence Record (EOR) from August 10, 1983, reported that between 150 and 250 plants were observed growing on moist banks and islands with *Adiantum*, and fewer than 50 plants were found on private land below the picnic area (SDNHP).

The following classification scheme applies to *Epipactis gigantea:*

| | | | |
|---|---|---|---|
| Kingdom: | Plantae | Order: | Burmanniales |
| Division: | Magnoliophyta | Family: | Orchidaceae |
| Class: | Liliopsida | Genus: | *Epipactis* |
| Subclass: | Liliidae | Species: | *gigantea* |

*Epipactis gigantea* (EPIGIG) is found on wet, seeping slopes, bluffs or ledges. It is scattered from Montana to Colorado, South Dakota, Oklahoma, Texas, Arizona, California, British Columbia, and Mexico (Kirkpatrick, 1992). Larson and Johnson (1999) note that it is uncommon and local along Cascade Creek south of Hot Springs in the southern Black Hills, growing on calcareous stream banks. It is listed as a sensitive species in the Black Hills because of its highly restricted distribution. It is one of several species whose only occurrence in South Dakota is along Cascade Creek, where warm springs enable survival of plants found nowhere else in the state or even in the region (Larson and Johnson, 1999).

The name *Epipactis* derives from a classical name used by Theophrastus (circa 350 BC) for a plant used to curdle milk. There are about 25 species worldwide, mostly in Europe and Asia. Two species are found in the US – *E. gigantea* and *E. helleborine*. *Epipactis gigantea* is virtually always found in wet places. It is found from sea level to 2600 m, always with a constant source of water at the roots, including wet cliff-faces, salty beaches, road-cuts, mountain bogs, hot springs, and sandbars in streams. One of the known pollinators is the Syrphid fly (Rach, 1998). It grows on calcareous, porous substrates or thin, partially decomposed, wet organic substrates. It is more common in the open than in the forest, and it can colonize suitable habitats quickly. It is a species of open, early successional habitats and a poor competitor later in succession (Williams, 1990).

Dr. McIntosh does not mention *Epipactis gigantea* in his 1928 Cascade Valley report.

***Epipactis gigantea* (stream orchid) is very abundant at Cascade Springs. Downstream of the bridge, it continues to be very abundant along the stream bank for ¼ mile where the covering of vegetation is dense and stream banks are steep. It grows on stream banks and islands with *Adiantum capillus-***

*veneris. Epipactis gigantea* **(EPIGIG) decreases rather dramatically as the overhanging vegetation and stream bank topographic relief decreases downstream. There appears to be an increase in the number of orchids downstream this year based on a baseline botanical survey of the area conducted in the summer of 2000. One hypothesis would be that favorable climatic conditions interacting with removal of grazing allowed for greater expression of EPIGIG presence. However, there is no documentation of stem numbers for comparison. In very few places did the orchid grow without the presence of the fern. However, EPIGIG was found in low numbers virtually all the way to Cascade Falls. EPIGIG appears to be tolerant of high sunlight conditions. Its limited presence in the lower midsection may be more a result of past grazing history than inappropriate habitat.**

**An issue that requires more investigation is EPIGIG's recognized role as a colonizer of open, early successional habitats (Williams, 1990). From historical times to the present, it appears that EPIGIG has been successful at persisting in the densely shaded, later seral habitat of the Cascade Creek headwaters as well as colonizing open, early successional habitat.**

***Eustoma grandiflorum*** (tulip gentian) is historically reported as locally abundant in low, wet sandy places along Cascade Creek (SDNHD). The Element Occurrence Record (EOR) from August 10, 1983 reported 12 plants found within 25 feet of the stream bank in sandy loam, with graminoids, mostly exposed. One plant was found in 1983 at the Forest Service picnic area (SDNHD).

The following classification scheme applies to *Eustoma grandiflorum*:

| | | | |
|---|---|---|---|
| Kingdom: | Plantae | Order: | Gentianales |
| Division: | Magnoliophyta | Family: | Gentianaceae |
| Class: | Magnoliopsida | Genus: | *Eustoma* |
| Subclass: | Gentianidae | Species: | *grandiflorum* |

*Eustoma grandiflorum* (EUSGRA) is found in moist places in prairies and fields. It ranges from eastern Colorado to Nebraska, south to eastern New Mexico and Texas. *Eustoma*, from the Greek *eu* ("good") and *stoma* ("mouth"), refers to the large opening into the flower's throat where the corolla lobes join (Spellenberg, 1979). In "Rare Plants of Colorado" (Colorado Native Plant Society (CNPS), 1997) notes that this gentian was formerly found on the western half of the Great Plains from South Dakota south through Texas into Mexico but has been greatly reduced since settlement. Its habitat has been reduced to the point that it is now rare over much of its former range. It requires a fairly high water table in moist open fields and meadows underlain by sandy alluvial soils. Agricultural use, gravel mining, and urbanization have eradicated most populations near the eastern mountain front of Colorado. Whether it will continue to exist in the wild in Colorado is unclear (CNPS, 1997).

Dr. McIntosh (1928) wrote that in a wet, sandy depression near Cascade Falls "hundreds of tulip gentians (*Eustoma andrewsii*) unfurl their beautiful purple flowers."

**A slide that was taken by a volunteer photographer for The Nature Conservancy (TNC) documents the presence of *Eustoma grandiflorum* (EUSGRA) in 1998 at Cascade Springs. No other information is available regarding abundance or exact location for 1998. In 1999, Cindy Reed discovered a large number of gentians at Fargo Lake, a small lake on private land near Cascade Springs. They were not found to be growing elsewhere in the area during that time. In 2000, there were approximately 21 gentians found at Fargo Lake. On July 21, 2001 approximately 184 gentians were found growing at Fargo Lake – 44 in the known site and approximately 140 across the lake. During the monitoring survey, a new site was found right along the stream. In the midsection of Cascade Creek, two gentians were found growing very near the water, surrounded by**

**ADICAP and EPIGIG. The plants at this site were found three weeks earlier than those at Fargo Lake (June 30). Currently, these are the only two known locations of this plant – one site on TNC property and the other on private land.**

***Eleocharis rostellata*** (beaked spikerush) is a tufted perennial sedge with flattened, wiry stems 1.3 to 3.3 feet long and beaked achenes. It regenerates by seed or vegetatively by sprouting and layering. It sprouts from short shallow rhizomes, and it has elongated layering culms, which arch to the ground and root in moist soil from the apical bulbils. Beaked spikerush is an obligate wetland species and occurs in many types of alkaline wetlands, including hot spring edges. It occurs near springs and seeps in desert areas of the Southwest. It typically occurs on sand bars and along stream edges in saturated soil, occasionally in partial shade. In New York, beaked spikerush occurs in wet minerotrophic sites, nutrient-poor marl beds, and organic soils. (Marl beds are soils formed from calcium carbonate precipitates.) It is an early colonizer of marl beds by seeding into wet depressions. After colonization, the marl sites can accumulate peat and gradually become small hummocks of beaked spikerush, needle beaksedge, and moss. *Eleocharis* rostellata is a facultative seral species. It is widespread in the Americas from southern Canada south through Mexico to the West Indies, the Caribbean, and the South American Andes. Although it is widespread in the conterminous US, beaked spikerush occurs in scattered disjunct populations, and it may not be present in every state. In various states, *Eleocharis rostellata* is associated with such species as *Scirpus acutus* (hardstem bulrush), *Juncus balticus* (Baltic rush), *Phragmites australis* (common reed), and *Spartina patens* (saltmeadow cordgrass) (www.fs.fed.us/database).

Beaked spikerush occurs from sea level in Atlantic, Gulf, and Pacific coast salt marshes and tidal flats to nearly 9,000 feet elevation in Colorado. In Montana, it primarily occurs in valley and foothill zones from 3,200 to 5,500 feet elevation (www.fs.fed.us/database).

The following classification scheme applies to *Eleocharis rostellata:*

| | | | |
|---|---|---|---|
| Kingdom: | Plantae | Order: | Cyperales |
| Division: | Anthophyta | Family: | Cyperaceae |
| Class: | Monocotyledoneae | Genus: | *Eleocharis* |
| Subclass: | Cyperidae | Species: | *rostellata* |

Historically, beaked spikerush has been known in large stands along Cascade Creek from J.H. Keith Picnic Ground downstream to Cascade Falls (EOR of August 10, 1983 - SDNHP). Dr. McIntosh (1928) does not describe *Eleocharis rostellata* in his Cascade Valley publication.

***Eleocharis rostellata*** **(ELEROS) is very extensive along the majority of the length of Cascade Creek. It is less abundant at Cascade Springs on USFS property and along the headwaters of Cascade Creek. It is especially abundant along the midsection of the creek and forms large "mats" in places, especially in the area all around Cascade Falls. ELEROS was found in the lower section of the creek but was not seen for the last ½ mile upstream from the confluence of Cascade Creek and the Cheyenne River. Along the creek, it is present in larger concentrations where stream banks are gentle and a larger, flat, often wet floodplain exists with *Scirpus acutus, Phragmites australis,* and *Spartina pectinata.* ELEROS appears to be more tolerant of saturated water conditions than EPIGIG and ADICAP. However, both ADICAP and EPIGIG were found growing with ELEROS in some slightly drier sites.**

## SOIL DESCRIPTIONS

Soil map taxa identified along Cascade Creek (Map 3) were defined by the Soil Conservation Service in their survey of Fall River County, South Dakota (Kalvels, 1980). Fieldwork for this survey was performed from 1974-79. No recent soil surveys compiled for Fall River County have been identified.

**Altvan loam, 0 to 2 percent slopes (Map Unit AbA).** This well-drained, nearly level soil is on terraces. It is moderately deep over gravelly sand. Surface layer and subsoil are brown loams while underlying material is white loam. The lower part of the subsoil and the upper part of the underlying material are calcareous and have many accumulations of lime. Fertility is medium and the content of organic matter moderate. Native vegetation dominantly is western wheatgrass, green needlegrass, blue grama, and needle-and-thread. Overused areas are dominated by blue grama, needle-and-thread, and sedges.

**Bankard fine sandy loam (Map Unit Bb).** This deep, somewhat excessively drained, nearly level soil is on flood plains. It is occasionally flooded for brief periods. Surface layer is light brownish gray calcareous fine sandy loam. The underlying material is the same but stratified with thin lenses of sandy loam and sand. In some areas adjacent to the stream channel, the soil contains very coarse sand and gravel throughout. In places it is hummocky. Fertility and the content of organic matter are low in the Bankard soil. Native vegetation dominantly is sand bluestem, prairie sandreed, switchgrass, sand dropseed, sand sagebrush, and blue grama. Some areas support many cottonwoods and willows. Overused areas are dominated by sand dropseed and blue grama. After continued overuse, some areas are bare and blowouts are common.

**Boneek silt loam, 2 to 6 percent slopes (Map Unit BoB).** This deep, well-drained, gently sloping soil is on uplands. Surface layer and subsoil are brown loams; subsoil is calcareous in the lower part. Underlying material is brown calcareous loam. Accumulations of lime are in the lower part of the subsoil and the upper part of the underlying material. Native vegetation dominantly is western wheatgrass, blue grama, needle-and-thread, and green needlegrass. Overused areas are dominated by blue grama and sedges.

**Butche-Boneek complex, 3 to 15 percent slopes (Map Unit BvD).** These well drained, gently sloping to strongly sloping soils are on uplands. The shallow Butche soil is on the higher, steeper parts of the landscape. It generally has a few scattered stones on the surface. The deep Boneek soil is on the lower parts of the landscape. Areas are 55 to 70 percent Butche soil and 15 to 35 percent Boneek soil. The surface layer of the Butche soil is brown fine sandy loam, and the underlying material is brown channery fine sandy loam and hard sandstone. In some areas lime is at or near the surface; in others the soil contains more clay throughout. Surface layer of the Boneek soil is brown silt loam with firm silty clay loam in the subsoil. Underlying material is calcareous clay loam and sandstone. Included with these oils are small areas of Mathias soils and Rock outcrop. Mathias soils are on steeper south- and west-facing slopes, have many rocks and boulders throughout, and contain less clay. The Rock outcrop is on the higher, steeper parts of the landscape. Fertility and content of organic matter are low in the Butche soil. Fertility is medium and content of organic matter moderate in Boneek soil. Native vegetation dominantly on the Butche soil is little bluestem, prairie sandreed, needle-and-thread, and western wheatgrass. That on the Boneek soil dominantly is western wheatgrass, green needlegrass, needle-and-thread, and blue grama. Overused areas are dominated by blue grama and sedges.

**Colby-Norka silt loams, 6 to 15 percent slopes (Map Unit CnD).** These deep, well drained, moderately sloping and strongly sloping soils are in slightly convex areas on uplands. Strongly sloping Colby soil is on the higher, steeper ridge tops. Moderately sloping Norka soil is on side slopes. Areas are

40 to 60 percent Colby soil and 30 to 45 percent Norka soil. Surface layer of Colby soil is brown, calcareous silt loam, and below this is a transition layer of pale brown, calcareous silt loam. Underlying material is calcareous loam. Surface layer of the Norka soil is brown silt loam with subsoil of very friable silt loams. Underlying material is light gray silt loam. Fertility and content of organic matter are low in Colby soil; fertility is medium and the content of organic matter moderate in the Norka soil. Native vegetation on the Colby soil dominantly is blue grama, needlegrasses, little bluestem, sideoats grama, and western wheatgrass. That on the Norka soil dominantly is western wheatgrass, blue grama, and green needlegrass. Overused areas are dominated by needle-and-thread, sedges, and blue grama.

**Dwyer loamy fine sand, 6 to 25 percent slopes (Map Unit DwE).** This deep, somewhat excessively drained, moderately sloping to moderately steep soil is on uplands. Slopes are short and rough or broken. They generally are dissected by gullies and drainageways. Surface layer is light brownish gray loamy fine sand with underlying material of pale brown, calcareous loamy fine sand. In places lime is leached to a depth of more than 40 inches. Fertility and the content of organic matter are low. Native vegetation low terraces and flood plains. It is subject to rare flooding for very brief periods. Slopes are long and smooth. Surface layer is light brownish gray, calcareous fine sandy loam with underlying material of light brownish gray, calcareous fine sandy loam stratified with thin layers of very fine sandy loam, silt loam, and gravelly sandy loam. Fertility and content of organic matter are low. Native vegetation dominantly is sand bluestem, little bluestem, and prairie sandreed. Cottonwoods are in some of the lower areas. Overused areas are dominated by sand dropseed, needle-and-thread, blue grama, and western wheatgrass.

**Haverson loam (Map Unit Ha).** This deep, well-drained, nearly level soil is on flood plains. It is subject to rare flooding. Many areas are dissected by meandering channels. Slopes are long and smooth. Surface layer is grayish brown, calcareous loam with underlying material of grayish brown, calcareous, stratified loam, clay loam, silt loam, fine sandy loam, loamy fine sand, and loamy sand. Fertility and content of organic matter are low. Native vegetation dominantly is western wheatgrass, green needlegrass and blue grama. Overused areas are dominated by blue grama, sedges, and needle-and-thread.

**Haverson Variant loam, 3 to 9 percent slopes (Map Unit HbB).** This deep, well drained, gently undulating to gently rolling soil is on the foot slopes of steep rocky hills and mountains. It is subject to rare flooding. Areas commonly are dissected by deep gullies and channels. Slopes are short and are rough or broken. Surface layer is dark grayish brown loam with subsurface layer of calcareous gravelly loam. Underlying material is reddish brown, calcareous, stratified gravelly sandy loam and loam. Fertility and the content of organic matter are low. Native vegetation dominantly is western wheatgrass, green needlegrass and needle-and-thread. Overused areas are dominated by blue grama and sedges.

**Kyle clay, 2 to 6 percent slopes (Map Unit KyB).** This deep, well-drained, gently sloping soil is on uplands and terraces. When dry, it is characterized by cracks, which are ½ inch to 2 inches wide and several feet long and extend through the subsoil. Some areas on the lower parts of long slopes are dissected by deep drainage channels. Slopes are long and smooth. Surface layer is grayish brown clay with subsoil of grayish brown/light olive gray, very firm, calcareous clay. Underlying material is calcareous clay with common accumulations of gypsum. Fertility and content of organic matter are low. Native vegetation dominantly is western wheatgrass, green needlegrass and blue grama. Overused areas are dominated by blue grama, buffalograss, and sedges.

**Mathias-Midway-Rock outcrop complex, 15 to 30 percent slopes (Map Unit MmE).** This map unit occurs as areas of well-drained, hilly and steep soils that are closely intermingled with areas of Rock outcrop. It is on mountains. The deep Mathias soil is on the higher, steeper parts of the landscape; the shallow Midway soil is on the lower parts; and the Rock outcrop generally occurs as rimrock on the sides

of entrenched drainageways and on the upper sides of sandstone-capped ridges. Slopes generally face south or west and commonly are dissected by steep canyons. Many stones and boulders are on the surface. Areas are about 45 to 65 percent Mathias soil, 15 to 25 percent Midway soil, and 5 to 15 percent Rock outcrop. Surface layer of the Mathias soil is dark grayish brown, extremely stony, very fine sandy loam and may have mulch at the surface. Subsurface is very fine sandy loam, and subsoil is friable, very fine sandy loam. Underlying material is reddish yellow fine sandy loam. In places, a thin layer of mulch is at the surface. Surface layer of the Midway soil is pale olive, calcareous silty clay loam, and the underlying material is firm, calcareous silty clay loam. There are common shale chips throughout. The Rock outcrop is exposed sandstone in rimrock areas and on vertical cliffs and the sides of hills. Fertility and content of organic matter are low in the Mathias and Midway soils. Native vegetation on the Mathias soil dominantly is big bluestem, little bluestem, and needlegrass. That on the Midway soil dominantly is western wheatgrass, needlegrass, sideoats grama, and blue grama. Overused areas are dominated by needle-and-thread and blue grama. Some areas of the Mathias soil support sparse stands of ponderosa pine.

**Nevee silt loam, 6 to 15 percent slopes (Map Unit NeD).** This deep, well-drained, moderately sloping and strongly sloping soil is on terraces and uplands that in some areas are dissected by drainageways and small gullies. Slopes are long and smooth. Surface layer is reddish brown, calcareous silt loam with subsurface layer and underlying material both consisting of yellowish red, calcareous silt loam. Fertility and content of organic matter are low. Native vegetation dominantly is needlegrass, blue grama, little bluestem, and western wheatgrass. Overused areas are dominated by blue grama and sedges. After continued overuse, the soil is subject to gullying and erosion is a severe hazard.

**Norka silt loam, 2 to 6 percent slopes (Map Unit NoB).** This deep, well-drained, gently sloping soil is on terraces and uplands. Slopes are long and smooth. Surface layer is brown silt loam. Subsoil consists of layers of brown, very friable silt loam in the upper part; and brown and light gray, friable and very friable, calcareous silty clay loam in the lower part. Underlying material is light gray, calcareous silt loam. Fertility is medium and the content of organic matter moderate in the Norka soil. Native vegetation dominantly is western wheatgrass, blue grama, and green needlegrass. Overused areas are dominated by blue grama and sedges.

**Nunn clay loam, 2 to 6 percent slopes (Map Unit NuB).** This deep, well-drained, gently sloping soil is on terraces and uplands. Slopes are smooth. Surface layer is dark grayish brown clay loam. Subsoil is dark grayish brown and brown, firm and friable clay loam and clay; it is calcareous in the lower part. Underlying material is calcareous loam in the upper part and calcareous sandy loam in lower part. Fertility is medium and the content of organic matter moderate. Native vegetation dominantly is green needlegrass, western wheatgrass, blue grama, and buffalograss. Overused areas are dominated by blue grama and buffalograss.

**Nunn clay loam, 6 to 9 percent slopes (Map Unit NuC).** This deep, well-drained, moderately sloping soil is on terraces and uplands. Slopes are short and smooth. Surface layer is dark grayish brown clay loam. Subsoil consists of layers of dark grayish brown and brown, firm and friable clay loam and clay. It is calcareous in the lower part. Underlying material is grayish brown, calcareous loam in the upper part and pale brown, calcareous sandy loam in the lower part. Fertility is medium and the content of organic matter moderate. Native vegetation dominantly is green needlegrass, western wheatgrass, blue grama, and buffalograss. Overused areas are dominated by blue grama and buffalograss.

**Paunsaugunt-Boneek complex, 6 to 15 percent slopes (Map Unit PaD).** These well drained, gently rolling and rolling soils are on mountains and uplands. The shallow Paunsaugunt soil is in convex areas on the tops of ridges and knolls. The deep Boneek soil is in concave areas on the lower parts of the

landscape. Areas are 40 to 55 percent Paunsaugunt soil and 25 to 40 percent Boneek soil. Surface layer and subsurface layers of the Paunsaugunt soil are grayish brown, calcareous gravelly loam with many coarse fragments. Underlying material is calcareous channery loam and bedrock is hard limestone. Surface layer of the Boneek soil is brown silt loam, and the subsoil is firm silty clay loam. Underlying material is calcareous clay loam. Sandstone is deeper. Fertility and the content of organic matter are low in the Paunsaugunt soil. Fertility is medium and the content of organic matter moderate in the Boneek soil. Native vegetation on the Paunsaugunt soil dominantly is a sparse stand of ponderosa pine and an understory of sedges and mid grasses. That on the Boneek soil is western wheatgrass, blue grama, needle-and-thread, and green needlegrass. Overused areas of this soil are dominated by blue grama and sedges.

**Paunsaugunt-Vanocker-Rock outcrop complex, 9 to 60 percent slopes (Map Unit PbF).** This map unit occurs as areas of well drained, strongly sloping to very steep soils that are closely intermingled with areas of Rock outcrop. It is on mountains. The shallow Paunsaugunt soil dominantly is on ridges. The deep Vanocker soil is on side slopes below the Rock outcrop. The Rock outcrop consists of ledges of limestone or sandstone on the rims of drainageways, on the top of canyon walls, and on steep mountain peaks. Areas are 45 to 55 percent Paunsaugunt soil, 35 to 45 percent Vanocker soil, and 15 percent Rock outcrop. Surface layer and subsurface layers of the Paunsaugunt soil are grayish brown, calcareous gravelly loam with many coarse fragments. Underlying material is calcareous channery loam and bedrock is hard limestone. About 3 inches of organic litter is typically at the surface of the Vanocker soil. The surface layer is dark grayish brown, calcareous gravelly loam. Subsoil is brown, very friable, calcareous gravelly and channery loam; underlying material is calcareous channery loam. The Rock outcrop is exposed hard limestone or calcareous sandstone. Fertility and content of organic matter are low in the Paunsaugunt soil. Fertility is medium and the content of organic matter moderate in the Vanocker soil. Most of the acreage is forested with Ponderosa pine and used for limited grazing. The Paunsaugunt soil is poorly suited to range and woodland. The Vanocker soil is fairly well suited to woodland and poorly suited to range. A few sparsely timbered spots having an understory of grass are throughout the mapped areas. . Native vegetation on the Paunsaugunt soil dominantly is a thin stand of stunted ponderosa pine and an understory of shrubs and sparse grasses. The Vanocker soil supports a denser stand of ponderosa pine and grass.

**Pierre-Samsil clays, 6 to 25 percent slopes (Map Unit PsE).** These well drained, moderately sloping to moderately steep soils are on uplands. Deep channels dissect some of the steeper areas. Moderately deep Pierre soil is on the lower, less sloping parts of the landscape. The shallow Samsil soil is on the higher ridges and on hilltops. Areas are 40 to 50 percent Pierre soil and 40 to 50 percent Samsil soil. Surface layer of the Pierre soil is grayish brown clay, and subsoil is brownish gray, very firm calcareous clay with many accumulations of lime in the lower part. Underlying material is calcareous shaly clay. In some areas the soil is acid throughout, and in places it has visible salt crystals throughout. Surface layer of Samsil soil is brownish gray, calcareous clay with underlying material of calcareous shaly clay. In some areas the soil is acid throughout, and in places it has less clay throughout. Fertility is medium in the Pierre soil and low in the Samsil soil. Content of organic matter is low in both. Native vegetation on the Pierre soil dominantly is green needlegrass, blue grama, and western wheatgrass. That on the Samsil soil dominantly is little bluestem, western wheatgrass, and sideoats grama. Overused areas are dominated by blue grama and sedges. Many small gullies form after continued overuse.

**Rekop-Tilford-Gystrum complex, 6 to 15 percent slopes (Map Unit ReD).** These well drained, moderately sloping and strongly sloping soils are in areas on uplands where slopes are rough and broken. The shallow Rekop soil is on the tops of ridges and knolls. The deep Tilford soil is in the lower concave areas. The moderately deep Gystrum soil is on mid slopes and in the less sloping areas on side slopes. Areas are 20 to 25 percent Rekop soil, 20 to 35 percent Tilford soil, and 15 to 25 percent Gystrum soil.

matter moderate in the Eckley soil. These soils are poorly suited to native grasses because they are droughty. Native vegetation dominantly is blue grama, sedges, and needle-and-thread. Western wheatgrass is common on the Eckley soil in addition. Overused areas are dominated by sedges, blue grama, and weeds. After continued overuse, bare areas are common on the Schamber soil.

**Tilford silt loam, 6 to 9 percent slopes (Map Unit TaC).** This deep, well-drained, moderately sloping soil is on terraces and uplands. Slopes are smooth. Surface layer is reddish brown silt loam. Subsoil is reddish brown, red, and light red, very friable silty clay loam and silt loam. It is calcareous in the lower part. Underlying material is red, calcareous silt loam. In some areas carbonates are leached to a depth of 10 inches or more. Fertility is medium and the content of organic matter moderate. The native vegetation dominantly is little bluestem, blue grama, green needlegrass, and western wheatgrass. Overused areas are dominated by blue grama and sedges.

**Zigweid-Nihill complex, 6 to 20 percent slopes (Map Unit ZnE).** These deep, gently rolling to hilly soils are in areas on ridges, fans, and terrace escarpments where slopes are short and convex. The well-drained Zigweid soil is on the lower parts of the landscape and in saddles between the ridges. The excessively drained Nihill soil is on the ridges and terrace escarpments. In many areas scattered rocks and pebbles are on the surface. Areas are 40 to 50 percent Zigweid soil and 40 to 50 percent Nihill soil. Surface area of the Zigweid soil is brown, calcareous clay loam. Subsoil is very friable, calcareous clay loam with common accumulations of lime in the lower part. Underlying material is light gray, calcareous loam. Surface layer of Nihill soil is brown, calcareous gravelly loam. Underlying material is calcareous very gravelly loam. Lime coatings are on the undersides of the pebbles. Fertility and content of organic matter are low in both soils. The native vegetation dominantly is blue grama, needle-and-thread, western wheatgrass, and sedges. Overused areas are dominated by blue grama and sedges.

## REFERENCES


Colorado Native Plant Society. 1997. Rare plants of Colorado. Falcon Press Publishing Company, Inc., Helena, Montana. 105 pp.

Dorn, Robert D. 1992. Vascular plants of Wyoming. Mountain West Publishing, Cheyenne, Wyoming. 340 pp.

Guennel, G. K. 1995. Guide to Colorado wildflowers, plains & foothills. Westcliffe Publishers, Inc., Englewood, Colorado. 336 pp.

Hays,T.S. 1999. Episodic sediment-discharge events in Cascade Springs, Southern Black Hills, South Dakota. USGS Water-Resources Investigations Report 99-4168. 34 pp.

Horn af Rantzein, H. 1951. On the fossil charophyta of Latin America. Svensk Botanisk Tidskrift. BD 45, Il. 4. 1951.

Kalvels, John. 1980. Soil Survey of Fall River County, South Dakota. National Cooperative Soil Service, United States Department of Agriculture & Soil Conservation Service. 192 pp.

Kirkpatrick, Z.M. 1992. Wildflowers of the Western Plains. University of Texas Press, Austin, Texas. 240 pp.

Kister, Rene. 1965. The living organism. Encyclopedia of the life sciences. Doubleday & Company, Inc. Pages 913-941.

Lamphere, Marc. 2000. Personal communication.

Larson, G.E. 1993. Aquatic and wetland vascular plants of the northern Great Plains. Gen. Tech. Rep. RM-238. Fort Collins, Colorado: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 681 pp.

Larson, G.E. and J.R. Johnson. 1999. Plants of the Black Hills and Bear Lodge Mountains. South Dakota State University, Brookings, South Dakota. 608 pp.

Lellinger, D.B. 1985. A Field Manual of the Ferns & Fern-Allies of the United States & Canada. Smithsonian Institution Press, Washington, D.C. 389 pp.

Marriott, H.J. and D. Faber-Langendoen. 2000. Riparian and wetland plant communities of the Black Hills. The Nature Conservancy, Midwest Conservation Science Center and Association for Biodiversity Information, Minneapolis, Minnesota. 178 pp.

McGregor, R.L., T.M. Barkley, R.E. Brooks, and E.K. Schofield. 1986. Flora of the Great Plains. University Press of Kansas, Lawrence, Kansas. 1402 pp.

McIntosh, A.C. 1928. "Biological features of Cascade Valley and vicinity." The Black Hills Engineer: Hot Springs Number Jan.1928: 68-83.

Paulson, Bob. 2000. Personal communication.

Peck, R.E. 1957. North American mesozoic charophyta. USGS PP 294-A, GPO. Paper 44 pp., 8 pl., 7 figs.

Peterson, Duane. 1998. *Adiantum capillus-veneris* (Southern Maidenhair Fern). Southwestern Fern Society. Online. Internet. 1998.

Petrik-Ott, Aleta Jo. 1979. The Pteridophytes of Kansas, Nebraska, South Dakota and North Dakota, U.S.A. J. Cramer, FL-9490 VADUZ.

Rach, N. 2000. *Epipactis gigantea* Doug. ex Hooker – General information and cultural notes. Houston Orchid Society. Online. Internet. 6 July 2000.

Raventon, Edward. 1994. Island in the Plains: A Black Hills Natural History. Johnson Books: Boulder. 272 pp.

South Dakota Natural Heritage Program. 2001. Element Occurrence Records for *Adiantum capillus-veneris, Eleocharis rostellata, Epipactis gigantea,* and *Eustoma grandiflorum.*

Spellenberg, Richard. 1979. The Audubon field guide to North American Wildflowers: Western Region. Alfred A. Knopf, Inc., New York. 862 pp.

Stickler, D. 1993. Wayside wildflowers of the Pacific Northwest. The Flower Press, Columbia Falls, Montana. 272 pp.

TNC (The Nature Conservancy, Northern Great Plains Steppe Ecoregional Conservation Team). 1999. Ecoregional conservation in the Northern Great Plains Steppe. The Nature Conservancy, Midwest Regional Office, Minneapolis, MN. 76 pp.

TNC (The Nature Conservancy, Northern Great Plains Steppe Ecoregional Conservation Team). 2000 DRAFT. Ecoregional conservation in the northern great plains steppe. The Nature Conservancy, Midwest Regional Office, Minneapolis, MN. 238 pp

Van Bruggen, T. 1996. The vascular plants of South Dakota. University of South Dakota Press, Vermillion, SD. 293 pp.

Williams, T.Y. 1990. *Epipactis gigantea*. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2001, October). Fire Effects Information System, (Online). www.fs.fed.us/database/feis/plants/forb/epigig/all.html

www.fs.fed.us/database. 2001. *Eleocharis rostellata*: distribution and occurrence.

www.fs.fed.us/database. 2001. *Eleocharis rostellata*: botanical and ecological characteristics.

# SCIENTIFIC REPORT

## ABSTRACT

A monitoring design was developed to gather data to monitor two sensitive species: Stream orchid (*Epipactis gigantea* - EPIGIG) and Southern maidenhair fern (*Adiantum capillus-veneris* – ADICAP), on The Nature Conservancy (TNC) property along Cascade Creek in southwestern South Dakota (Map 1). The monitoring was designed to provide data/analysis that would assist the preserve manager in achieving four management goals – maintenance of populations of EPIGIG and ADICAP along Cascade Creek headwaters section and increase in populations of EPIGIG and ADICAP along Cascade Creek mid -section. The design was implemented in a pilot study in 2001 with placement of 54 permanent plots in the Cascade Creek midsection (Map 3). Density data was collected in 2001. Eight of 54 plots captured EPIGIG plants in them with numbers of stems varying from 1 to 23. Nine of 54 plots captured ADICAP presence with numbers varying from 20 to 100 cm of fern along the stream bank. No statistical analysis on population change will be done until a second round of monitoring data is collected for comparison with 2001 data. Issues to be resolved before continuing monitoring beyond this pilot study include: 1) increasing the percent of stream monitored from 2% to a level minimizing variability between sampling sites, 2) deciding on a best design for data collection (e.g. monitoring different partial sets of plots each year for several years versus redesign to a smaller sampling population and more intensive sampling), and 3) choosing an appropriate cycle for monitoring analysis. Although the means for supporting and accomplishing a long-term monitoring program on Cascade Creek are not clear, the major value of this project will be derived from many years of monitoring and appropriate adaptive management.


## INTRODUCTION

A monitoring design was developed to gather data to monitor two sensitive plant species (EPIGIG and ADICAP) on TNC property along Cascade Creek with respect to four management goals – to maintain populations of EPIGIG and ADICAP along Cascade Creek headwaters section and increase populations of EPIGIG and ADICAP along Cascade Creek midsection (Map 2).

Implementation of the design, involving placing and collecting density data from 54 permanent plots along Cascade Creek midsection and 20 permanent plots along Cascade Creek headwaters, was begun in summer of 2001 (Map 4).

Our conclusions on the design of this pilot study to date are: 1) permanent plots are preferable over temporary plots in this study to capture population change with minimum manpower, 2) a one-meter square plot is an appropriate sample size/shape for the midsection but may need to be reevaluated for the headwaters section, 3) monitoring two percent of the creek length is not adequate to reflect either species' distribution.

To continue the monitoring effort begun in the pilot project implemented this summer:

1) monitoring plots must be put in place in the headwaters section next spring (to complete the pilot project)
2) a decision must be made on how to continue this monitoring project – the two most likely possibilities are:
    a) keeping the existing sampling population and using a phased series of plots monitored over several (three) years or
    b) development of a smaller sampling area within the first with more intensive sampling
3) a decision must be made on what the cycle for monitoring will be on Cascade Creek

We believe the establishment of monitoring for EPIGIG and ADICAP is essential to conserving these rare species in South Dakota. Although our long-term goal of having a single, coordinated monitoring plan for the entire Cascade Creek area (with different strategies for individual species, as appropriate, and for individual landowner goals) is still far in the future, we feel the pilot design we've implemented is a good start to investigating the issues and constraints involved with setting up a viable monitoring program for these two sensitive species on Cascade Creek. Although the means for supporting and accomplishing a

long-term monitoring program are not clear, the major value of this project will be derived from many years of monitoring and appropriate adaptive management.

This report is being provided to The Nature Conservancy's Black Hills Program Director for TNC's use on the Whitney Preserve at Cascade Creek. TNC should be the decision-maker regarding the questions posed above to continuing monitoring for sensitive plant species along Cascade Creek within the Whitney Preserve.

**MATERIALS AND METHODS**

MATERIALS:

Flotation tubes
Permanent plot markers (rebar 18 inch lengths)
Hammer (for placing markers)
GPS unit
30 meter tape measure
Pin flags
Data sheets
Plot frame (1x1 m, copper)
Clipboard
Plastic bags to keep data sheets, etc. dry

METHODS:

Do reconnaissance of stream to gain subjective experience on populations and distribution; survey private section below Cascade Falls to confluence with Cheyenne River for presence/absence
Determine different stream sections for stratified sampling
Measure length of stream sections on map
Generate random numbers for 2% of the stream length
Determine distance from section starting point to points downstream
Determine randomly if plot is on right or left bank
Locate section starts by waypointing to map coordinates
Measure distances downstream by tape measure
Record population data at each point with a one-meter square plot for ADICAP (cm along stream bank) and EPIGIG (number of stems)
Analyze quality of data

We defined our study area to include the portion of Cascade Creek owned by The Nature Conservancy (TNC): Cascade Creek below Keith Park (Cascade Springs, US Forest Service (USFS) ownership) to private land owned by Marc Lamphere/Cindy Reed, and then below the Lamphere property to Cascade Falls (USFS ownership). The total length of creek owned by TNC is two and one-half miles. We also received permission to survey Cascade Creek for EPIGIG and ADICAP on private property below Cascade Falls to the confluence of Cascade Creek and the Cheyenne River.

We reviewed existing information on EPIGIG and ADICAP in the Black Hills. Species Assessments for these species on national forest land in the Black Hills were completed in 2000 and shared with us by the Black Hills National Forest (BHNF) (Deanna Reyher, Forest Ecologist). We didn't develop stand-alone ecological models for EPIGIG and ADICAP as suggested in our main guidance document (Elzinga et. al.,

2001) but used the information in the species assessments to understand each species' life history, possible interactions with management activities, and develop our objectives and sampling design.

The life history patterns (expressions in the environment) of these two species are different, even though they share an unusual habitat (warm springs ecosystem) and are both primarily rhizomatous. Although there are three potential modes of reproduction in ADICAP (sexual reproduction by outcrossing involving production of new fronds from gametes/spores of different individuals; reproduction involving production of new fronds from gamets/spores developed from a single individual (selfing); and rhizomatous spread through clonal growth), it is inferred from limited information (largely from *Adiantum pedatum* - ADIPED), that sexual reproduction is most likely not common (Crook, 2000). Because of its rhizomatous life history pattern and small stem size, it's difficult to distinguish genets or ramets of individuals or count stems of ADICAP, which can be found growing along the banks of Cascade Creek in long stretches in suitable habitat. Because of this difficulty, we decided to adopt the convention from the BHNF surveys to measure presence of ADICAP by measuring inches/cm of fern along the stream bank where found.

EPIGIG reproduces by either aerially dispersed microscopic seeds or vegetatively by rhizomatous shoots (Hornbeck, 2001). Germination rates for the seeds are low and may depend on an endomycorrhizal symbiont. Although it is difficult to distinguish genets from ramets, it is easy to count EPIGIG stems. We chose to count stems in monitoring EPIGIG to capture trend on population expansion or decrease and ignored the question of number of individuals.

We developed objectives for our project and shared them with TNC's Whitney Preserve manager and TNC Black Hills Program Director, but no additions were suggested (see Table 1).

**Table 1. Goals for management of Cascade Creek, Whitney Preserve relative to two sensitive species (EPIGIG and ADICAP)**

| | |
|---|---|
| | ***Definitions***: Cascade Creek headwaters=creek from USFS boundary to Lamphere property boundary<br>Cascade Creek midsection=creek from Lamphere property boundary to USFS boundary at Cascade Falls<br>Cascade Creek lower section=creek from USFS boundary at Cascade Falls (southern boundary) to mouth of Cascade Creek at confluence with Cheyenne River |
| 1 | Maintain *Adiantum capillus-veneris* (ADICAP) along Cascade Creek headwaters |
| 2 | Maintain *Epipactis gigantea* (EPIGIG) along Cascade Creek headwaters |
| 3 | Decrease Canada thistle (CIRARV) and Russian olive (ELEANG) along Cascade Creek headwaters |
| 4 | Increase EPIGIG along Cascade Creek midsection where possible (e.g. may not be possible along streambanks stabilized by *Eleocharis rostellata* (ELEROS) |
| 5 | Increase ADICAP along Cascade Creek midsection where possible (e.g. ADICAP seems to prefer steep, overhanging banks or charophyte ledges) |
| 6 | Decrease Canada thistle and Russian olive along Cascade Creek midsection |
| 7 | Control grazing along Cascade Creek midsection to prevent impacts to EPIGIG and ADICAP |
| 8 | Control/avoid sediment loads added to Cascade Creek on all creek sections |
| 9 | Control recreation impacts to streamside where EPIGIG and ADICAP are located on all creek sections |

To keep the pilot study manageable, we developed objectives to monitor four of these goals this first year:

Goals 1 and 2 - Objective = monitor existing EPIGIG and ADICAP on the headwaters and midsection of Cascade Creek

Goals 4 and 5 - Objective = monitor for new recruitment of EPIGIG and ADICAP along the midsection of Cascade Creek

To set up our sampling design, we decided that the biological populations of interest were the populations of EPIGIG and ADICAP along the entire stretch of Cascade Creek from the springs to the confluence of the Cascade Creek and Cheyenne Rivers. The target populations of the study, however, were set to be all plants within TNC ownership in the above area. We decided the sampled population would be the same as the target population, thinking that the length of stream involved would be reasonable for the study design (see Discussion). In our original design, we considered the midsection to be the entire area below Lamphere private property to Cascade Falls (1.5 mi or 2.4 km). However, after we reconnoitered the creek in person (roughly 24 hours, over three days) and became aware of a significant population distribution difference between the upper and lower stretches of this reach, we decided that a stratified random sampling design would be more appropriate and broke the midsection into upper and lower sections. The upper midsection is 851 meters length, and the lower midsection is 1601 meters length (Map 2). We then randomly generated plot locations for sampling of existing populations in the headwaters areas, and for existing populations and new recruitment in each section of the midsection.

We debated the use of temporary or permanent plots in our study design. Our monitoring guide (Elzinga et. al., 2001) promotes the use of permanent plots where possible since the statistical tests for detecting change from one period to the next are much more powerful than tests used on temporary sampling units. This advantage translates into reducing the number of sampling units that have to be sampled to detect a certain magnitude of change. After making rough estimates of plot numbers, we decided the use of permanent plots would help make the type of design we could apply with two people much more effective.

The monitoring guide puts a good deal of emphasis on determining the appropriate size and shape for sampling plots. The prime objective when selecting a sampling unit size and shape is to try and reduce the variability between sampling units while maintaining a size and shape that's practical in the field. Due to the common clumping nature of many plants and responses to environmental gradients, the monitoring guide makes the case that long, narrow plots are often most effective for vegetative sampling. Since the species we are monitoring are generally found in a narrow band along the creek margin that doesn't have much gradient for environmental conditions, we determined that a plot size/shape of one square meter should still be appropriate to encourage minimum variability between sampling units (see Discussion).

We located plots by setting a Global Positioning System (GPS) reference point at the beginning of each section or subsection (Map 4). We randomly generated distances downstream covering the total length of the section or subsection and randomly generated whether the plot should be on right bank or left bank (facing downstream). In our early design stages, we decided that monitoring five percent of the section distance would be desirable. However, we determined that 120 plots in the midsection and 20 plots in the headwaters were not reasonable for the time frame of the pilot study. We decided to set up plots covering 2 percent of the midsection area (50 plots). We are undecided at this time whether to do 5 percent or 2 percent of the headwaters section. We decided to schedule initial monitoring on the headwaters section for spring 2002, when the poison ivy and Canada thistle aren't overpowering yet EPIGIG and ADICAP will be visible. After collecting data on the midsection at the two-percent level, our conclusion is that the two-percent level is not adequate to capture the presence accurately of either species in the midsection (see Discussion).

We waypointed to the starting GPS locations and measured distances to plots downstream with a tape measure. In the upper section of the midsection, we could walk 99% of the stream (exceptions were a

couple of water falls). In the lower section of the midsection, we used flotation devices (developed for fishing on still water). During our original reconnaissance of the stream, we discovered we had to travel long stretches without being able to even see the stream due to deep water in the pool preventing instream-walking and streamside vegetation preventing foot travel along the adjacent streamside (e.g. *Scirpus acutus* monocultures). Using the floats was essential to placing all the plots, although taking the floats over the occasional but regular charophyte falls was often a bruising experience!

At each plot location, we took a GPS reading and placed a permanent marker (rebar). The plot was laid out using a collapsible copper tube frame, with the upstream edge touching the rebar. In some places, the rebar was placed up to a meter away from the stream, depending on where solid ground for pounding in the marker securely could be found.

At each plot, we counted the number of EPIGIG stems found in the one square meter plot, counted the length of ADICAP along the stream bank within the plot (in cm), and took notes on other species in the plot, particularly the presence of ELEROS and EUSGRA.

We estimate it took us 24 hours (over 3 days of work) to locate and read the 54 plots.

**RESULTS**

The plot location data is in Appendix B and plot data for the sampling on the midsection is in Appendix C. No statistical analyses have been made at this point. This is baseline data, and analysis will be possible when a second round of monitoring data has been collected that can be compared to the 2001data.

Table 2 presents a summary of the 2001 plot data. Eight of the 54 plots captured EPIGIG plants in them with numbers varying from 1 to 23 stems. Nine of the 54 plots captured presence of ADICAP with numbers varying from 20 to 100 cm. Almost half of the plots with ADICAP had the full plot length covered with fern.

We don't feel the eight and nine plots showing presence properly represents the presence of either of these species along Cascade midsection and is leading us to reconsider the 2% level of sampling in our design (see Discussion). In contrast, 43 of 54 plots captured ELEROS. Although we noted presence of ELEROS qualitatively, this will still provide a good baseline for ELEROS presence.

**Table 2. Summary of 2001 plot data: EPIGIG = *Epipactis gigantea*; ADICAP = *Adiantum capillus-veneris*; ELEROS = *Eleocharis rostellata***

| Permanent plot number | Cascade Creek Section | EPIGIG - number stems | ADICAP - length along stream | Comments |
|---|---|---|---|---|
| CCM-001 | midsection | 5 | 0 | ELEROS abundant on stream bank |
| CCM-002 | midsection | 0 | 32 cm | ELEROS abundant on stream bank |
| CCM-003 | midsection | 5 | 0 | |
| CCM-004 | midsection | 8 | 1 m | |
| CCM-005 | midsection | 0 | 0 | ELEROS on stream bank |
| CCM-006 | midsection | 1 | 1 m | |
| CCM-007 | midsection | 1 | 1 m | |
| CCM-008 | midsection | 0 | 0 | ELEROS on streambank |
| CCM-009 | midsection | 0 | 0 | ELEROS 95%cover |
| CCM-010 | midsection | 23 | 45 cm | ELEROS narrowly on streambank |

| Permanent plot number | Cascade Creek Section | EPIGIG - number stems | ADICAP - length along stream | Comments |
|---|---|---|---|---|
| CCM-011 | midsection | 0 | 0 | ELEROS abundant on streambank |
| CCM-012 | midsection | 0 | 0 | |
| CCM-013 | midsection | 0 | 0 | ELEROS on streambank |
| CCM-014 | midsection | 0 | 0 | |
| CCM-015 | midsection | 0 | 0 | some ELEROS on streambank |
| CCM-016 | midsection | 4 | 1 m | |
| CCM-017 | midsection | 0 | 0 | ELEROS on streambank |
| CCM-018 | midsection | 0 | 0 | ELEROS on streambank |
| CCM-019 | midsection | 9 | 0 | ELEROS on streambank |
| CCM-020 | midsection | 0 | 25 cm | ELEROS on streambank |
| CCM-021 | midsection | 0 | 0 | ELEROS abundant on streambank |
| CCM-022 | midsection | 0 | 0 | ELEROS abundant on streambank |
| CCM-023 | midsection | 0 | 0 | ELEROS abundant on streambank |
| CCM-024 | midsection | 0 | 0 | ELEROS abundant on streambank |
| CCM-025 | midsection | 0 | 0 | ELEROS abundant on streambank |
| CCM-027 | midsection | 0 | 0 | ELEROS present |
| CCM-028 | midsection | 0 | 0 | ELEROS present |
| CCM-029 | midsection | 0 | 0 | ELEROS abundant on streambank |
| CCM-030 | midsection | 0 | 0 | ELEROS abundant on streambank |
| CCM-031 | midsection | 0 | 0 | ELEROS understory to SCIACU |
| CCM-032 | midsection | 0 | 0 | ELEROS present |
| CCM-033 | midsection | 0 | 0 | ELEROS abundant on streambank |
| CCM-034 | midsection | 0 | 0 | ELEROS present |
| CCM-035 | midsection | 0 | 0 | ELEROS present |
| CCM-036 | midsection | 0 | 0 | ELEROS present |
| CCM-037 | midsection | 0 | 0 | ELEROS under SCIACU |
| CCM-038 | midsection | 0 | 0 | ELEROS under SCIACU |
| CCM-039 | midsection | 0 | 0 | |
| CCM-040 | midsection | 0 | 0 | ELEROS abundant on streambank |
| CCM-041 | midsection | 6 | 0 | ELEROS minimal; ADICAP on opposite bank |
| CCM-042 | midsection | 0 | 0 | ELEROS abundant on streambank |
| CCM-043 | midsection | 0 | 0 | ELEROS abundant on streambank |
| CCM-044 | midsection | 0 | 0 | ELEROS abundant on streambank |
| CCM-045 | midsection | 0 | .5 m | ELEROS present |
| CCM-046 | midsection | 0 | 20 cm | ELEROS abundant on streambank |
| CCM-047 | midsection | 0 | 0 | ELEROS under SCIACU |
| CCM-048 | midsection | 0 | 0 | ELEROS abundant on streambank |
| CCM-049 | midsection | 0 | 0 | ELEROS abundant on streambank |
| CCM-050 | midsection | 0 | 0 | |
| CCM-051 | midsection | 0 | 0 | ELEROS present |
| CCM-052 | midsection | 0 | 0 | ELEROS abundant on streambank |
| CCM-053 | midsection | 0 | 0 | |
| CCM-054 | midsection | 0 | 0 | Very little ELEROS |

The plant communities found along Cascade Creek are a mosaic of Cottonwood – Peach-leaf Willow Floodplain Woodland (*Populus deltoides* – (*Salix amygdaloides*)/*Salix exigua*, CEGL000659) and Great Plains Cattail – Bulrush Marsh (*Typha* spp. – *Scirpus* spp. – Mixed Herbs Great Plains Herbaceous Vegetation, CEGL002228). These community types are described in detail in Riparian and Wetland Plant Communities of the Black Hills (Marriott and Faber-Langendoen, 2000). The cattail – bulrush type is coarsely patchy in itself, with patches along Cascade Creek of Hard bulrush *(Scirpus acutus),* American three-square *(Schoenoplectus pungens*), Beaked spikerush (*Eleocharis rostellata*), and Broad-leaved cattail (*Typha latifolia*). Prairie cordgrass (*Spartina pectinata*) is also present in relatively small stands along the length of the creek. It's uncertain without more investigation if it is most accurate to describe the situation as a riparian mosaic including the cordgrass community (Prairie Cordgrass – Sedge Wet Meadow (*Spartina pectinata – Carex* spp. Herbaceous Vegetation) or as a mosaic of the Cottonwood – Peach-leaf Willow Floodplain Woodland and Great Plains Cattail – Bulrush Marsh containing remnant stands of prairie cordgrass from an earlier seral stage.

The most common non-native species in the floodplain are *Phragmites australis* (Common reed or elephant grass) that is present in large patches, and *Eleagnus angustifolia* (Russian olive). In slightly drier habitat further back from the stream, *Cirsium arvense* (Canada thistle) can be found in large patches.

Common native herbaceous species include *Nasturtium officinale* (watercress), *Asclepias incarnata* (Swamp milkweed), *Asclepias speciosa* (Showy milkweed), *Helianthus maximilianii*, (Maximilian's sunflower), *Lobelia siphilitica* (Blue cardinal flower), *Mentha arvensis* (Field mint ), *Parthenocissus vitacea* (Woodbine), *Polypogon monspeliensis* (Rabbitfoot grass), *Solidago canadensis* (Canada goldenrod), and *Verbena stricta* (Hoary vervain). Common native shrub species include *Ribes* spp. (Currants) and *Shepherdia argentea* (Silver buffaloberry). It is extremely difficult to map riparian community mosaics accurately. Although we stated in the project proposal we would provide a map of plant communities along Cascade Creek, we decided that a detailed map would not add much to this monitoring project and our time would be more profitably spent designing and implementing the monitoring plan. We provide the above description of the vegetation in lieu of a community map.

## DISCUSSION AND CONCLUSIONS

This has been a challenging and educational project. We both learned a great deal about setting up a monitoring project and expect to learn more as we continue. We both intellectually knew the kind of rigor required to set up a sampling design that would provide data that can be statistically analyzed with confidence levels for determining population change. We were not aware what that would mean for time committed until we developed this sampling plan and tried to carry it out.

Our conclusions on the design of this pilot study to date are: 1) permanent plots are preferable over temporary plots in this study to capture population change with minimum manpower, 2) a one-meter square plot is an appropriate sample size/shape for the midsection but may need to be reevaluated for the headwaters section, 3) monitoring two percent of the creek length is not adequate to reflect either species' distribution.

Although our data was highly variable from plot to plot, we believe the one square meter plot size is still appropriate. More data collection will provide better confidence on this determination, but the pattern of the species' distribution relative to the stream (found physically very close) is such we believe it would not benefit the project to change to a different shape. We may need to reevaluate this on the headwaters section where EPIGIG populations can be quite high (hundreds of stems) and extend up steep streambanks for quite a distance.

As our data shows, we did not accomplish the goal of minimizing variability between sampling sites. We had a clear majority of plots with no EPIGIG and no ADICAP. When we hit the few random sites with

what we felt were more representative population levels, the numbers are highly variable. Our conclusion is that the two-percent level of monitoring is not adequate. We feel it's extremely unlikely, however, that any volunteer would have the time to implement the five percent or more level on the chosen sampling population in a single summer.

A couple of possibilities exist. Firstly, we haven't decided yet what the best time interval for the next monitoring cycle should be. Usually population change data is not collected and analyzed every year (unless drastic changes are already occurring on a landscape). It's most likely that large changes on Cascade Creek won't happen every year. Perhaps a three-year cycle should be put in place, where roughly 50 different plots are monitored every year (a total of 150 over three years – resulting in over five percent level of stream length monitored). Then, the data would be compared and analyzed with respect to the population data from the previous cycle.

Another possibility would be to change the sampling design by choosing an area to sample that is a smaller subset of the target populations. We weren't comfortable with doing this in the initial design since we come from field backgrounds (accustomed to looking at the maximum area on the ground as possible) rather than statistical backgrounds. However, if the design is to rely on statistics for confidence levels on determining population change, perhaps we need to define a smaller sampling area and a design that a small crew can accomplish with the rigor needed for meaningful statistical analysis. If that is done, deciding on the appropriate sampling population will be a critical point.

In summary, to continue the monitoring effort begun in the pilot project implemented this summer:

4) monitoring plots must be put in place in the headwaters section next spring (to complete the pilot project)
5) a decision must be made on how to continue this monitoring project – the two most likely possibilities are:
    a) keeping the existing sampling populations and using a phased series of plots monitored over several (three) years or
    b) development of a smaller sampling area within the first with more intensive sampling
6) a decision must be made on what the cycle for monitoring will be on Cascade Creek

We believe the establishment of monitoring for EPIGIG and ADICAP is essential to conserving these rare species in South Dakota. Although our long-term goal of having a single, coordinated monitoring plan for the entire Cascade Creek area (with different strategies for individual species, as appropriate, and for individual landowner goals) is still far in the future, we feel the pilot design we've implemented is a good start to investigating the issues and constraints involved with setting up a viable monitoring program for these two sensitive species on Cascade Creek. Although the means for supporting and accomplishing a long-term monitoring program are not clear, the major value of this project will be derived from many years of monitoring and appropriate adaptive management.

This report is being provided to the Black Hills Program of The Nature Conservancy for their use at the Whitney Preserve at Cascade Creek. TNC should be the decision-maker regarding the questions posed relative to continuing monitoring of the sensitive plant species EPIGIG and ADICAP along Cascade Creek within Whitney Preserve.

## REFERENCES


Crook, R.W. 2000. Species assessment of *Adiantum capillus-veneris* L. in the Black Hills National Forest. USDA Forest Service, Black Hills National Forest, Custer, South Dakota. 26 pp.

Elzinga, C.L., D.W. Salzer, and J.W. Willoughby. 1998. Measuring & monitoring plant populations. BLM Tech.Reference 1730-1. Denver, Colorado: U.S. Department of the Interior, Bureau of Land Management. 492 pp.

Elzinga, C.L., D.W. Salzer, J.W. Willoughby, and J.P. Gibbs. 2001. Monitoring plant and animal populations. Blackwell Science, Inc., Malden, Massachusetts. 360 pp.

Faber-Langendoen, D. (editor). March 1999 DRAFT. Terrestrial vegetation of the Midwestern United States, South Dakota portion. From, International Classification of Ecological Communities: Terrestrial Vegetation of the United States, The Nature Conservancy, 1815 N. Lynn Street, Arlington, VA. USA.

Faber-Langendoen, D., editor. 2001. Plant communities of the Midwest: Classification in an ecological context. Association for Biodiversity Information, Arlington, VA. 61 pp. + appendix (705 pp.).

Hornbeck, J.H. 2001. Species assessment of *Epipactis gigantea* Dougl. ex Hook. in Black Hills National Forest. USDA Forest Service, Black Hills National Forest, Custer, South Dakota. 51 pp.

Larson, G.E. and J.R. Johnson. 1999. Plants of the Black Hills and Bear Lodge Mountains. South Dakota State University, Brookings, South Dakota. 608 pp.

Marriott, H.J., D. Faber-Langendoen, A. McAdams, D. Stutzman and B. Burkhart. 1999. The Black Hills community inventory: Final report. The Nature Conservancy, Midwest Conservation Science Center, Minneapolis, MN. 175 pp.

Marriott, H.J. and D. Faber-Langendoen. 2000. The Black Hills community inventory. Volume 2: Plant community descriptions. The Nature Conservancy, Midwest Conservation Science Center and Association for Biodiversity Information, Minneapolis, MN. 326 pp.

Marriott, H.J. and D. Faber-Langendoen. 2000. Riparian and wetland plant communities of the Black Hills. The Nature Conservancy, Midwest Conservation Science Center and Association for Biodiversity Information, Minneapolis, MN. 178 pp.

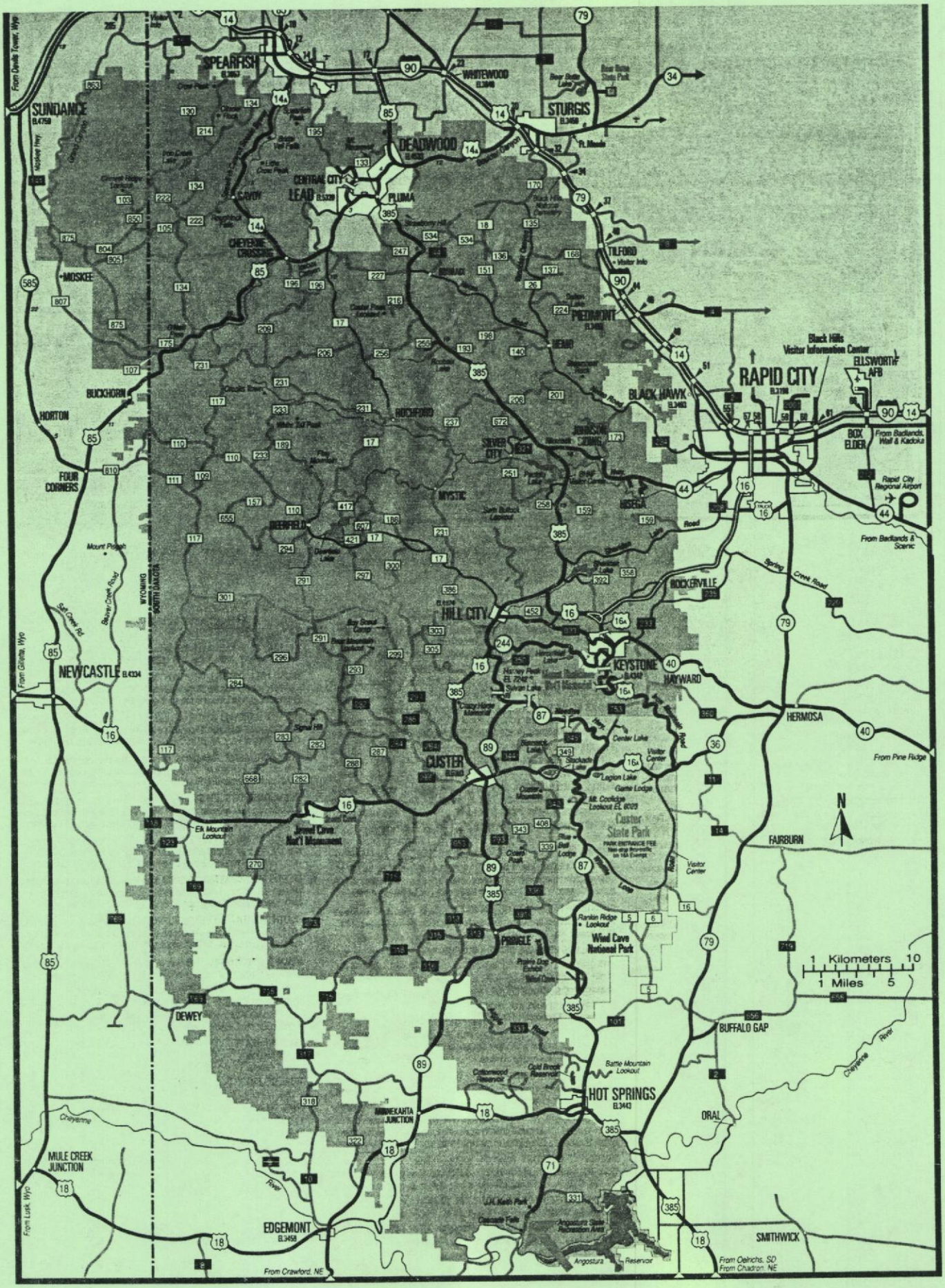
# APPENDICES

# APPENDIX A

# MAPS

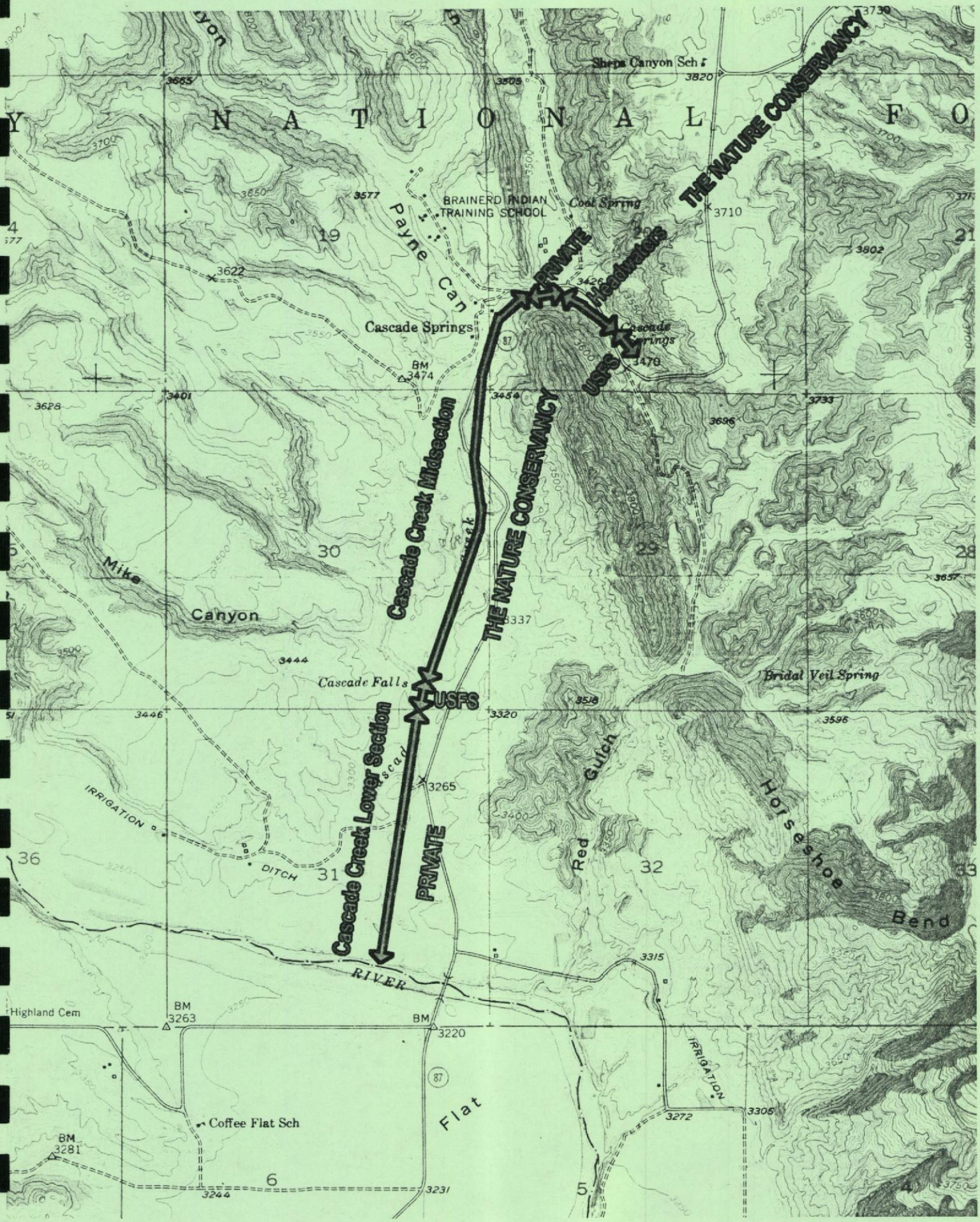
# CASCADE CREEK LOCATION

MAP 1



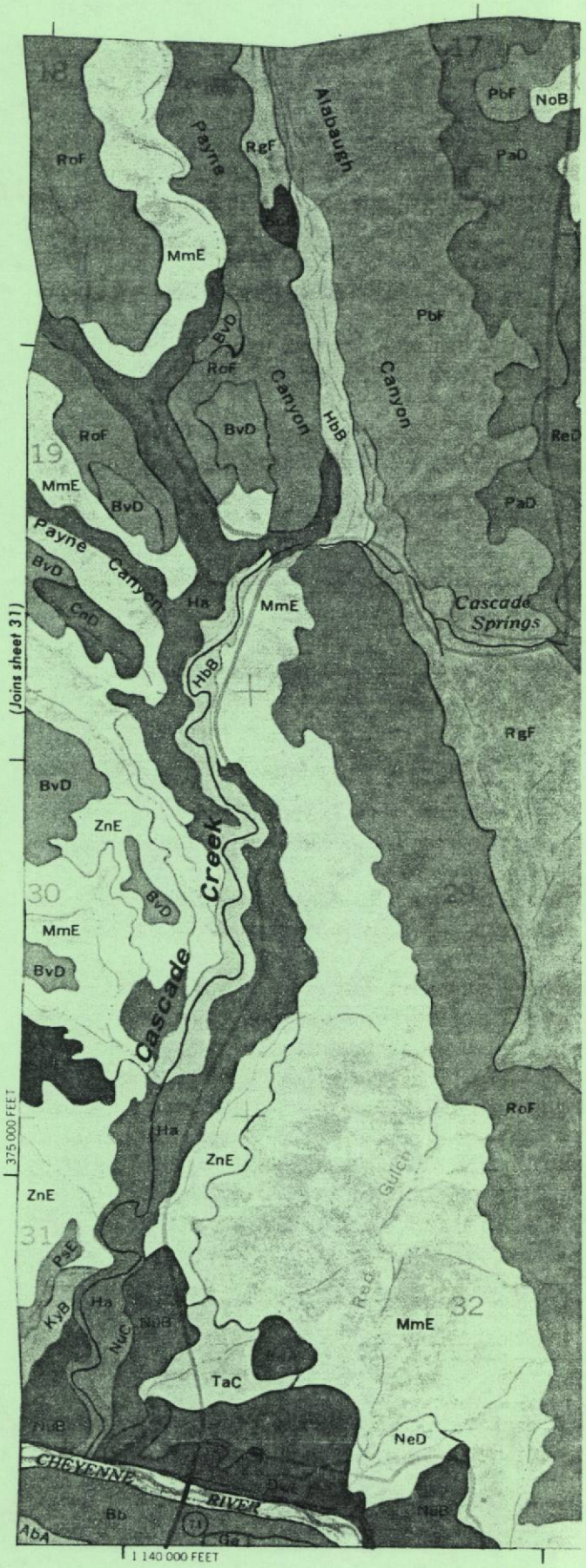
# CASCADE CREEK OWNERSHIP

MAP 2



# CASCADE CREEK SOILS

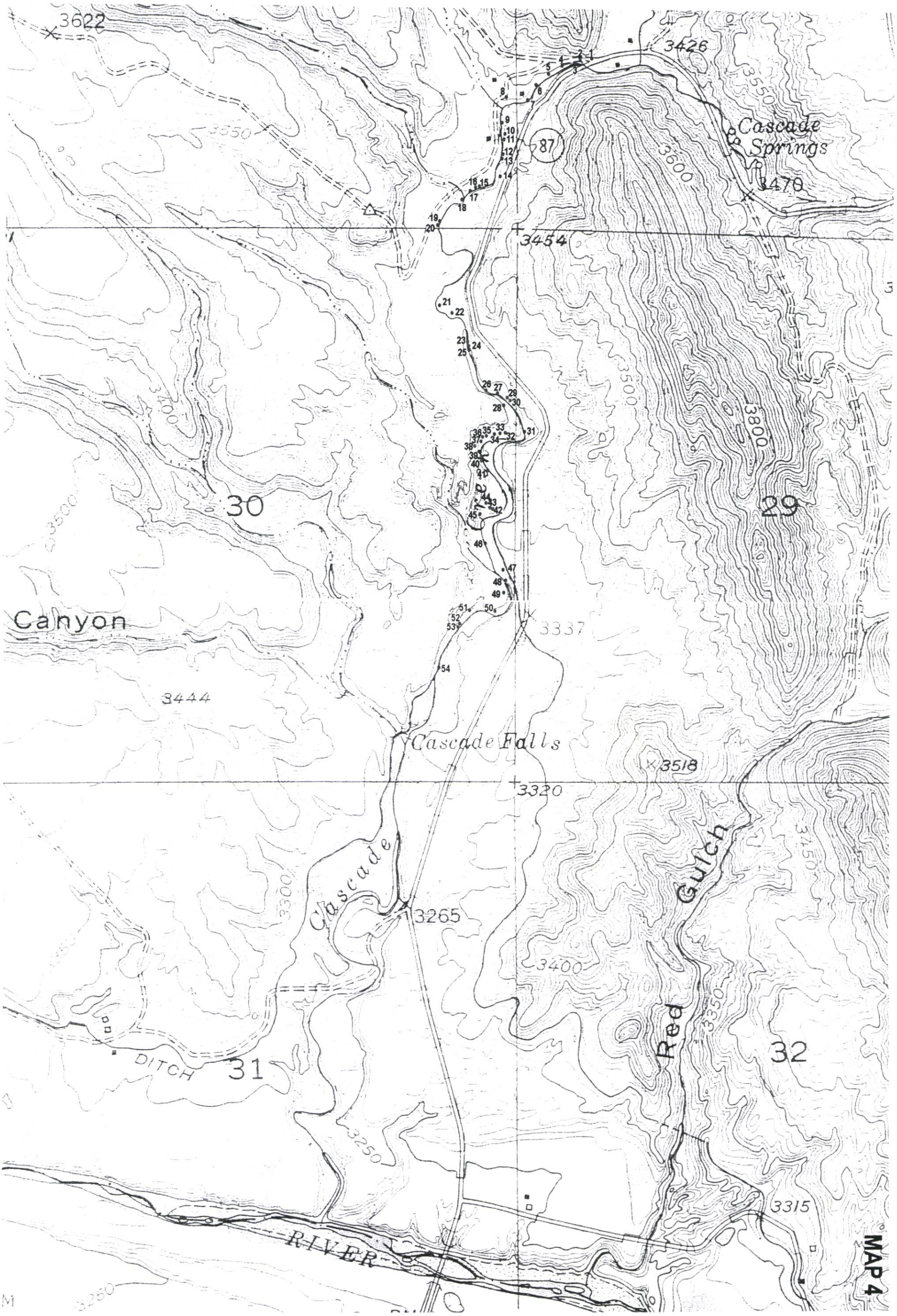
MAP 3




| | | |
|---|---|---|
| | AbA | Altvan loam, 2-6% slopes Well-drained, gently sloping soil on terraces |
| | Bb | Bankard fine sandy loam Deep, excessively drained, nearly level soil on flood plains |
| | BoB | Boneek silt loam, 2-6% slopes Deep, well-drained, gently sloping soil on uplands |
| | BvD | Butche-Boneek complex, 3-15% slopes Well-drained, sloping soils on uplands |
| | CnD | Colby-Norka silt loams, 6-15% slopes Deep, well-drained sloping soils on uplands in slightly convex areas |
| | DwE | Dwyer loamy fine sand, 6-25% slopes Deep, excessively drained, gently sloping soils on uplands |
| | Ga | Glenberg fine sandy loam Deep, well drained, nearly level, calcareous soil on low terraces and flood plains |
| | HA | Halvorson Loam Deep, well-drained, nearly level soil on flood plains- typically grayish-brown calcareous loam |
| | HbB | Halverson Variant loam, 3-9% slopes Deep, well drained, gently undulating soil on the foot of steep rocky hills |
| | KyB | Kyle clays, 2-6% slopes Deep well drained, gently sloping soil on uplands and terraces |
| | MmE | Mathias-Midway-Rock outcrop complex, 15-30%slopes well drained, hilly and steep soils |
| | NeD | Nevee silt loam, 6-15% slopes Deep, well drained, moderatelysloping soil on terraces and uplands |
| | NoB | Norka silt loam, 2-6% slopes Deep, well drained, gently sloping soil on terraces and uplands |
| | NuB | Nunn clay loam, 2-6% slopes Deep, well drained, gently sloping soil on terraces and uplands |
| | NuC | Nunn clay loam, 6-9% slopes Deep, well drained, moderately sloping soil on terraces and uplands |
| | PaD | Paunsaugunt-Boneek complex, 6-15% slopes Well drained, gently rolling soils on uplands |
| | PbF | Paunsaugunt-Vanocker-Rock outcrop complex, 9-60% slopes Well drained, strongly sloping to very steep soils |
| | PsE | Pierre-Samsil clays, 6-25% slopes Well drained, moderately sloping soils on uplands |
| | ReD | Rekop-Tilford-Gystrum complex, 6-15% slopes Well drained, moderately sloping soils on uplands- broken slopes |
| | RgF | Rock outcrop-Gystrum complex, 9-50% slopes Moderately deep, well drained, very steep soil |
| | RoF | Rock outcrop-Mathias-Butche complex 30-75% slopes, generally facing south and west. |
| | SmE | Schamber-Eckley complex, 9-40% slopes Strongly sloping, steep soils on high terraces |
| | TaC | Tilford silt loam, 6-9% slopes Deep, well drained, moderately sloping soil on terraces and uplands |
| | ZnE | Zigweid-Nihill complex, 6-20% slopes Deep, gently rolling to hilly soils on ridges, fans, and terrace escarpments |

# PERMANENT MONITORING PLOTS

MAP 4



# APPENDIX B

# PLOT GPS LOCATION DATA

| PLOT # | L or R | mtrs from start | mtrs from last | Expected coordinates - N | Actual | Expected coordinates - W | Actual |
|---|---|---|---|---|---|---|---|
| 0 | R | | | N43 20' | 13.9" | W103 33' | 25.2 |
| 1 | R | 30 | --- | N43 20' 13.10" | 14 | W103 33' 27.9" | 25.8 |
| 2 | L | 52 | 22 | N43 20' 12.85" | 14 | W103 33' 28.8" | 26.6 |
| 3 | L | 78 | 26 | N43 20' 12.42" | 13.5 | W103 33' 29.9" | 27.4 |
| 4 | R | 117 | 39 | N43 20' 11.71" | 13.2 | W103 33' 31.3" | 28.9 |
| 5 | R | 166 | 49 | N43 20' 10.55" | 12.5 | W103 33' 32.7" | 30.9 |
| 6 | L | 214 | 48 | N43 20' 9.64" | 11.4 | W103 33' 34.2" | 32.6 |
| 7 | L | 267 | 53 | N43 20' 9.23" | 10.1 | W103 33' 36.5" | 33.6 |
| 8 | L | 334 | 67 | N43 20' 7.43" | 10.3 | W103 33' 36.83" | 36.6 |
| 9 | L | 424 | 90 | N43 20' 4.31 | 7.8 | W103 33' 36.9" | 37.1 |
| 10 | R | 458 | 34 | N43 20' 3.29" | 6.8 | W103 33' 37.6" | 36.9 |
| 11 | R | 473 | 15 | N43 20' 2.82" | 6.3 | W103 33' 37.6" | 36.9 |
| 12 | R | 526 | 53 | N43 20' 1.65" | 4.8 | W103 33' 38.9" | 37 |
| 13 | R | 534 | 8 | N43 20' 1.53" | 4.4 | W103 33' 39.2" | 37.1 |
| 14 | L | 591 | 57 | N43 20' 0.74" | 2.7 | W103 33' 41.4" | 37.4 |
| 15 | R | 662 | 71 | N43 20' 0.00" | 1.7 | W103 33' 43.8" | 40.2 |
| 16 | R | 669 | 7 | N43 20' 0.00" | 1.7 | W103 33' 44.1" | 40.5 |
| 17 | L | 688 | 19 | N43 19' 58.75" | N43 20' 1.3 | W103 33' 44.5" | 41.3 |
| 18 | L | 724 | 36 | N43 19' 57.67" | N43 20' 0.5 | W103 33' 45.0" | 42.4 |
| 19 | L | 848 | 124 | N43 19' 55.47" | 58.3 | W103 33' 42.4" | 45.5 |
| 20 | L | 851 | 3 | N43 19' 55.48 | 58.2 | W103 33' 42.4" | 45.5 |
| 21 | L-"new start | "80 | 229 | N43 19' 50.37" | 50.4 | W103 33' 45.4" | 45.3 |
| 22 | L | 128 | 48 | N43 19' 49.48" | 49.8 | W103 33' 43.9" | 43.6 |
| 23 | L | 266 | 138 | N43 19' 46.25" | 47 | W103.33' 41.1" | 41.4 |
| 24 | L | 277 | 11 | N43 19' 45.91" | 46.6 | W103 33' 41.0" | 41.3 |
| 25 | R | 285 | 8 | N43 19' 45.65" | 46.4 | W103 33' 40.9" | 41.3 |
| 26 | R | 420 | 135 | N43 19' 41.99" | 42.4 | W103 33' 38.1" | 38.9 |
| 27 | R | 451 | 31 | N43 19' 41.62" | 42.2 | W103 33' 36.8" | 37.4 |
| 28 | R | 483 | 32 | N43 19' 40.98" | 41.1 | W103 33' 35.7" | 36.5 |
| 29 | L | 490 | 7 | N43 19' 40.83" | 41.7 | W103 33' 35.5 | 36 |
| 30 | R | 496 | 6 | N43 19' 40.67" | 41.5 | W103 33' 35.3 | 35.7 |
| 31 | L | 604 | 108 | N43 19' 37.58" | 38.6 | W103 33' 33.8" | 33.7 |
| 32 | R | 675 | 71 | N43 19' 37.68" | 38.5 | W103 33' 36.9" | 36.2 |
| 33 | R | 687 | 12 | N43 19' 37.60" | 38.6 | W103 33' 37.5" | 36.6 |
| 34 | R | 691 | 4 | N43 19' 37.52" | 38.6 | W103 33' 37.6" | 36.8 |
| 35 | R | 727 | 36 | N43 19' 37.16" | 38.2 | W103 33' 39.1" | 38.4 |
| 36 | L | 734 | 7 | N43 19' 36.96" | 38.1 | W103 33' 39.2" | 38.6 |
| 37 | R | 740 | 6 | N43 19' 36.79" | 38.1 | W103 33' 39.4" | 38.9 |
| 38 | L | 765 | 25 | N43 19' 35.98" | 37.6 | W103 33' 39.3" | 39.6 |
| 39 | R | 819 | 54 | N43 19' 34.51" | 36.1 | W103 33' 38.0" | 39.7 |
| 40 | L | 823 | 4 | N43 19' 34.42" | 36.2 | W103 33' 37.9" | 39.6 |
| 41 | R | 872 | 49 | N43 19' 33.08" | 34.8 | W103 33' 36.8" | 38.5 |
| 42 | R | 1045 | 173 | N43 19' 29.07" | 31.3 | W103 33' 39.3" | 37.9 |
| 43 | R | 1049 | 4 | N43 19' 28.93" | 31.4 | W103 33' 39.3" | 38.1 |
| 44 | L | 1062 | 13 | N43 19' 28.54" | 31.8 | W103 33' 39.2" | 38.8 |
| 45 | L | 1109 | 47 | N43 19' 27.13" | 30.7 | W103 33' 38.4" | 39.5 |
| 46 | L | 1190 | 81 | N43 19' 24.84" | 28 | W103 33' 36.8" | 38.8 |
| 47 | L | 1273 | 83 | N43 19' 22.44" | 25.5 | W103 33' 35.5" | 36.4 |
| 48 | R | 1301 | 28 | N43 19' 21.69" | 24.5 | W103 33' 36.1" | 36 |
| 49 | L | 1346 | 45 | N43 19' 21.24" | 23.3 | W103 33' 37.9" | 36.3 |
| 50 | L | 1426 | 80 | N43 19' 20.94" | 21.5 | W103 33' 41.1" | 37.6 |
| 51 | R | 1524 | 98 | N43 19' 18.5" | 21.6 | W103 33' 43.9" | 41 |
| 52 | L | 1571 | 47 | N43 19' 17.13" | 20.4 | W103 33' 44.8" | 42.3 |
| 53 | R | 1585 | 14 | N43 19' 16.69" | 20.1 | W103 33' 44.9" | 42.6 |
| 54 | L | 1601 | 16 | N43 19' 16.18" | | W103 33' 45.1" | |

# APPENDIX C

# MONITORING PLOT DATA

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 20' 14.0" W103 33' 25.8" |
| PERMANENT PLOT NO.: | CCM-001 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_x_ falls__ lower___ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X___ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

ACTUAL GPS start: N43 20'13.9" W103 33'25.2"

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB,EE | 5<br>IN FRUIT | 0 | ELEROS in abundance on shoreline<br>Other species: HELMAX, SOLCAN |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 20'14.0" W103 33'26.6" |
| PERMANENT PLOT NO.: | CCM-002 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB,EE | 0 | 32 cm<br>also, 36 cm in from bank (scattered inland with MELOFF, HELMAX) | ELEROS on streambank<br>ADICAP growing mixed with SCIsp, HELMAX |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG:both |
| GPS NO.: | N43 20'13.5" W103 33'27.4" |
| PERMANENT PLOT NO.: | CCM-003 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_x_ 1m along streamside_x_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB,EE | 5 IN FRUIT | 0 | RHUTOX, JUSC overhanging, PARVIT, Phragmites, PRUAME |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 20'13.2 W103 33'28.9" |
| PERMANENT PLOT NO.: | CCM-004 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB,EE | 8 IN FRUIT | 1M | RIBAUR, CLELIG, RHUTOX, ASTsp, SPAPEC, in shade of POPDEL |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 20'12.5" W103 33'30.9" |
| PERMANENT PLOT NO.: | CCM-005 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_x_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_x_ 1m along streamside_x_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB, EE | 0 | 0 | ELEROS along streambank, POAsp, HELMAX, ASTLAE, PANVIR |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 20'11.4" W103 33'32.6" |
| PERMANENT PLOT NO.: | CM-006 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB, EE | 1 IN FRUIT | 1M | ASTLAE, PRUAME, RIBsp, RHUTOX, VITRIP, AGRSTO |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 20'10.1" W103 33'33.6" |
| PERMANENT PLOT NO.: | CCM-007 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB, EE | 1 WELL CHEWED | 1M | SOLCAN, ASTLAE, SYMOCC, PARVIT, PRUAME, RHUTOX, SPAPEC, AMOFRU |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| SPECIES: | ADICAP or EPIGIG: both |
|---|---|
| GPS NO.: | N43 20'10.3" W103 33'36.6" |
| PERMANENT PLOT NO.: | CCM-008 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB, EE | 0 | 0 | ELEROS on streambank; ASTLAE, SOLCAN, RHUTOX, SPAPEC, MENARV, EQULAV |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 20'07.8 W103 33'37.1" |
| PERMANENT PLOT NO.: | CCM-009 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB, EE | 0 | 0 | ELEROS constitutes 95% cover, ASTLAE 1-5% |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 20'06.8" W103 33'36.9" |
| PERMANENT PLOT NO.: | CCM-010 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-venerls*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB, EE | 23<br>WELL CHEWED | 45 cm | PANVIR, ASTsp, SOLCAN, SPAPEC<br>ELEROS narrowly on streambank<br>ADICAP sparse along streambank |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 20'06.3 W103 33'36.9" |
| PERMANENT PLOT NO.: | CCM-011 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB, EE | 0 | 0 | AGRSTO, SPAPEC, PANCAP, EUPMAC<br>ELEROS on streambank heavily<br>SCIsp, ELYsp, PUCsp?, BROJAP |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| SPECIES: | ADICAP or EPIGIG: both |
|---|---|
| GPS NO.: | N43 20'04.8 W103 33'37.0" |
| PERMANENT PLOT NO.: | CCM-012 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB, EE | 0 | 0 | LOBSIL, HELMAX, SOLCAN, SPAPEC<br>ELEROS on streambank<br>PANCAP, EUPMAC |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 20'04.4 W103 33'37.1 |
| PERMANENT PLOT NO.: | CCM-013 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB, EE | 0 | 0 | HELMAX, ASTsp, SCIsp, SOLCAN, AMOFRU<br>ELEROS on streambank |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 20'02.7 W103 33'37.4" |
| PERMANENT PLOT NO.: | CCM-014 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB, EE | 0 | 0 | lots POAsp, SCIsp, NASOFF - grassy point |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| SPECIES: | ADICAP or EPIGIG: both |
|---|---|
| GPS NO.: | N43 20'01.7 W103 33'40.2" |
| PERMANENT PLOT NO.: | CCM-015 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB, EE | 0 | 0 | SCIsp, PUCsp?, ASTLAE, POAsp, PRUAME, MENARV<br>some ELEROS along streambank |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 20'01.7" W103 33'40.5 |
| PERMANENT PLOT NO.: | CCM-016 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB, EE | 4<br>IN FRUIT | 1M<br>ALL ALONG LEDGE | ASTLAE, PANVIR, SPAPEC, LOBSIL, SOLCAN |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 20'01.3 W103 33'41.3" |
| PERMANENT PLOT NO.: | CCM-017 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB, EE | 0 | 0 | ASTLAE, PANVIR, SPAPEC, SCIsp, EQULAE, BROJAP, LOBSIL, SOLCAN<br>Juncus sp<br>ELEROS along streambank |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 20'0.5" W103 33'42.4 |
| PERMANENT PLOT NO.: | CCM-018 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB, EE | 0 | 0 | ELEROS on streambank<br>ASCINC, ROSsp, RHUTOX, Phragmites, HELMAX, RIBAUR, NASOFF |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| SPECIES: | ADICAP or EPIGIG: both |
|---|---|
| GPS NO.: | N43 19'58.3" W103 33'45.5" |
| PERMANENT PLOT NO.: | CCM-019 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB, EE | 9<br>IN FRUIT | 0<br>(ADICAP just upstream of plot, ca 18") | CIRARV, SPAPEC, ASTFAL, SOLCAN<br>ELEROS along bank |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N 43 19'58.2 W103 33'45.5" |
| PERMANENT PLOT NO.: | CCM-020 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 8/25/01 | BB, EE | 0 | 25 cm (ADICAP extends down-stream out of plot longer than 1M) | ROSsp, AMOFRU, SPAPEC, CIRARV, SOLCAN, PARVIT ELEROS along streambank |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 19'50.4" W103 33'45.3" |
| PERMANENT PLOT NO.: | CCM-021 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | ELEROS 1m deep on streambank, entire plot<br>ASCINC, SCIsp |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N 43 19'49.8" W103 33'43.6" |
| PERMANENT PLOT NO.: | CCM-022 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_x_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_x_ 1m along streamside_x_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | ELEROS for whole 1x1M, extending in from bank ca 2 more meters<br>SCHPUN |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 19'47.0" W103 33'41.4" |
| PERMANENT PLOT NO.: | CCM-023 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | ELEROS IN 1X1M, also ca 2m inland<br>ASTLAE, SCIACU |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N 43 19'46.6" W103 33'41.3" |
| PERMANENT PLOT NO.: | CCM-024 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | ELEROS full 1x1m and ca 2m inland<br>SCIACU, PANCAP |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N 43 19'46.4" W103 33'41.3" |
| PERMANENT PLOT NO.: | CCM-025 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | ELEROS in full 1x1m<br>SCHPUN, VERSTR |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N 43 19'42.4" W103 33'38.9" |
| PERMANENT PLOT NO.: | CCM-026 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | SCHPUN, SOLCAN, POAPRA, ASTFAL |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 19'42.2" W103 33'37.4" |
| PERMANENT PLOT NO.: | CCM-027 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | SCHPUN, ARTLUD, BROJAP, POAsp, ELEROS, Rumex sp, SOLCAN, BROTEC, Epilobium sp, ASCSPE, PARVIT |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 19'41.1" W103 33'36.5" |
| PERMANENT PLOT NO.: | CCM-028 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | SCIACU, ELEROS, POLMON, POAsp<br>2 unk forbs (yellow flowerPicra and ADICAP-looking forb)<br>1 unk grass/sedge?Luzula? |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 19'41.7 W103 33'36.0" |
| PERMANENT PLOT NO.: | CCM-029 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | ELEROS along bank for entire 1x1m<br>CIRARV, ASCINC, GAUPAR, Epilobium sp |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 19'41.5" W103 33'35.7" |
| PERMANENT PLOT NO.: | CCM-030 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | ELEROS total 1x1m, also big flat of ELEROS<br>SPAPEC, CIRARV |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 19'38.6" W103 33'33.7" |
| PERMANENT PLOT NO.: | CCM-031 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | ELEROS understory to SCIACU<br>NASOFF |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 19'38.5" W103 33'36.2" |
| PERMANENT PLOT NO.: | CCM-032 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | ELEROS, Epilobium sp, SPAPEC, SCHPUN, POLMON unk forb(Picra) |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 19'38.6" W103 33'36.6" |
| PERMANENT PLOT NO.: | CCM-033 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | ELEROS entire 1x1m<br>SCHPUN, SPAPEC, PANCAP, POLMON |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 19'38.6" W103 33'36.8" |
| PERMANENT PLOT NO.: | CCM-034 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | ELEROS on stream edge, more SCHPUN than ELEROS inland<br>POLMON, SPAPEC<br>unk forb (Picra) |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 19'38.2" W103 33'38.4" |
| PERMANENT PLOT NO.: | CCM-035 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | ELEROS along streambank, SPAPEC inland SCHPUN, SPAPEC, POLMON |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 19'38.1" W103 33'38.6" |
| PERMANENT PLOT NO.: | CCM-036 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | ELEROS along shoreline<br>SCIACU, Epilobium sp |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 19'38.1" W103 33'38.9" |
| PERMANENT PLOT NO.: | CCM-037 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | ELEROS under SCIACU<br>Epilobium sp, mint? |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 19'37.6" W103 33'39.6" |
| PERMANENT PLOT NO.: | CCM-038 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | ELEROS under canopy of SCIACU MENARV |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 19'36.1" W103 33'39.7" |
| PERMANENT PLOT NO.: | CCM--039 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | VERSTR, POAsp, SPAPEC, SOLCAN, OENBIE, ASTLAE, SCHPUN |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 19'36.2" W103 33'39.6" |
| PERMANENT PLOT NO.: | CCM-040 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/2/01 | BB, EE | 0 | 0 | ELEROS in abundance<br>POAsp, SCIACU |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG:both |
| GPS NO.: | N43 19' 34.8" W103 33' 38.5" |
| PERMANENT PLOT NO.: | CCM-041 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_x_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_x_ 1m along streamside_x_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/9/01 | BB,EE | 6 | 0 | ADICAP on LEFT side - pretty continuous patches from point 40 (below bulrush) to here<br>ELEROS minimal on bank;<br>PARVIT, SOLCAN, RIBsp, SALEXI, Phragmites |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG:both |
| GPS NO.: | N43 19' 31.3" W103 33' 37.9" |
| PERMANENT PLOT NO.: | CCM-042 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_x_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_x_ 1m along streamside_x_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/9/01 | BB,EE | 0 | 0 | ELEROS along bank in force - ca 10 ft in from bank, SCIACU scattered within<br>Lots ADICAP clumps along the 173 m between this point and last |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG:both |
| GPS NO.: | N43 19' 31.4' W103 33' 38.1" |
| PERMANENT PLOT NO.: | CCM-043 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_x_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_x_ 1m along streamside_x_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/9/01 | BB,EE | 0 | 0 | ELEROS abundant, ca 10 ft in from bank<br>SCIACU scattered, PANCAP |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG: both |
| GPS NO.: | N43 19' 31.8" W103 33' 38.8" |
| PERMANENT PLOT NO.: | CCM-044 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/9/01 | BB,EE | 0 | 0 | ELEROS thick, in from bank 10-12 ft;<br>scattered SCIACU<br>MENARV |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG:both |
| GPS NO.: | N43 19' 30.7" W103 33' 39.5" |
| PERMANENT PLOT NO.: | CCM-045 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/9/01 | BB,EE | 0 | .5m | Not a straight streambank - charophyte winds around streambank and keeps going downstream;<br>ELEROS entire plot; few SCIACU<br>NOTE: 1 EPIGIG plant in ca 15 ft from bank; lots of ADICAP in among ELEROS - old stream channel with charophyte? |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG:both |
| GPS NO.: | N43 19' 28.0" W103 33' 38.8" |
| PERMANENT PLOT NO.: | CCM-046 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/9/01 | BB,EE | 0 | ca 20 cm - sparse, overhung by ELEROS | ELEROS entire plot, ca 20 ft in from stream<br>SCIACU and SALEXI more than 20 ft from streambank<br>SHEARG loaded with berries<br>Lots of ADICAP patches between points 46 and 45 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| SPECIES: | ADICAP or EPIGIG:both |
|---|---|
| GPS NO.: | N43 19' 25.5" W 103 33' 36.4" |
| PERMANENT PLOT NO.: | CCM-047 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_x_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_x_ 1m along streamside_x_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/9/01 | BB,EE | 0 | 0 | ELEROS under canopy of SCIACU HELANN, SOLCAN, Epilobium sp. |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG:both |
| GPS NO.: | N43 19' 24.5" W103 33' 36.0" |
| PERMANENT PLOT NO.: | CCM-048 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/9/01 | BB,EE | 0 | 0 | ELEROS 20 ft in from bank<br>Phragmites, scattered SCIACU, MENARV |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG:both |
| GPS NO.: | N43 19' 23.3 W103 33' 36.3" |
| PERMANENT PLOT NO.: | CCM-049 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_x_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_x_ 1m along streamside_x_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/9/01 | BB,EE | 0 | 0 | ELEROS abundant<br>LOBSIL, ASTFAL, SCIACU, ASTLAE, SOLCAN, Epilobium sp, leathery leaf/basal rosette? |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG:both |
| GPS NO.: | N43 19' 21.5" W103 33' 37.6" |
| PERMANENT PLOT NO.: | CCM-050 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/9/01 | BB,EE | 0 | 0 | PARVIT, VITRIP, SCIACU, SPAPEC, CLELIG, Epilobium sp. |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG:both |
| GPS NO.: | N43 19' 21.6" W103 33' 41.0" |
| PERMANENT PLOT NO.: | CCM-051 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/9/01 | BB,EE | 0 | 0 | Plot just above falls<br>ELEROS, SCIACU, MENARV, unknown forb |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG:both |
| GPS NO.: | N43 19' 20.4" W103 33' 42.3" |
| PERMANENT PLOT NO.: | CCM-052 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_x_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_x_ 1m along streamside_x_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/9/01 | BB,EE | 0 | 0 | Lots ELEROS, SOLCAN, MENARV, Epilobium sp SCHPUN and SCIACU scattered |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG:both |
| GPS NO.: | N43 19' 20.1" W103 33' 42.6" |
| PERMANENT PLOT NO.: | CCM-053 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_X_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_X_ 1m along streamside_X_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/9/01 | BB,EE | 0 | 0 | MELALB, MENARV, CIRARV, LACSER, ARTFRI, Poa sp, ASCINC, SALAMY?, ASTFAL, AGRSTO, Potentilla sp, TRADUB, CONCAN<br><br>Plot on huge charophyte bank |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**CASCADE CREEK MONITORING PROJECT**
**LOCATION:** TNC WHITNEY PRESERVE

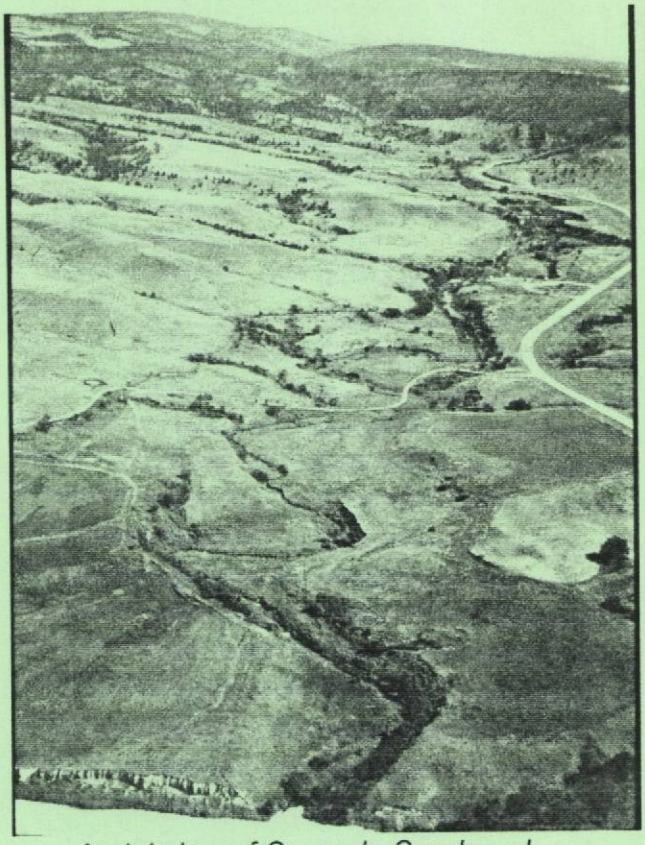
| | |
|---|---|
| SPECIES: | ADICAP or EPIGIG:both |
| GPS NO.: | N43 19' 16.18" (?) W103 33' 45.1(?) Est not actual? |
| PERMANENT PLOT NO.: | CCM-054 |
| SECTION: (Circle one) | springs__ headwaters__ midsection_x_ falls__ lower__ |
| PLOT DIMENSION: | 1m x 1m_x_ 1m along streamside_x_ |

NOTE: ADICAP= *Adiantum capillus-veneris*
EPIGIG= *Epipactis gigantea*

| DATE | OBSERVER | NUMBER OF EPIGIG STEMS | INCHES OF ADICAP ALONG STREAM | COMMENTS: (include associated species, condition/vigor, weed coverage, presence of *Eleocharis rostellata* or *Eustoma grandiflorum*, etc.) |
|---|---|---|---|---|
| 9/9/01 | BB,EE | 0 | 0 | ELEROS - very little<br>CIRARV, LACSER, EUPSER, PARVIT, Ambrosia sp (hairy), VERSTR, EUPDEN, PANVIR, Poa sp, ARTFRI, HELMAX, PROJAP, SCHPUN,GLABIP |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

# APPENDIX D

# PHOTOGRAPHS



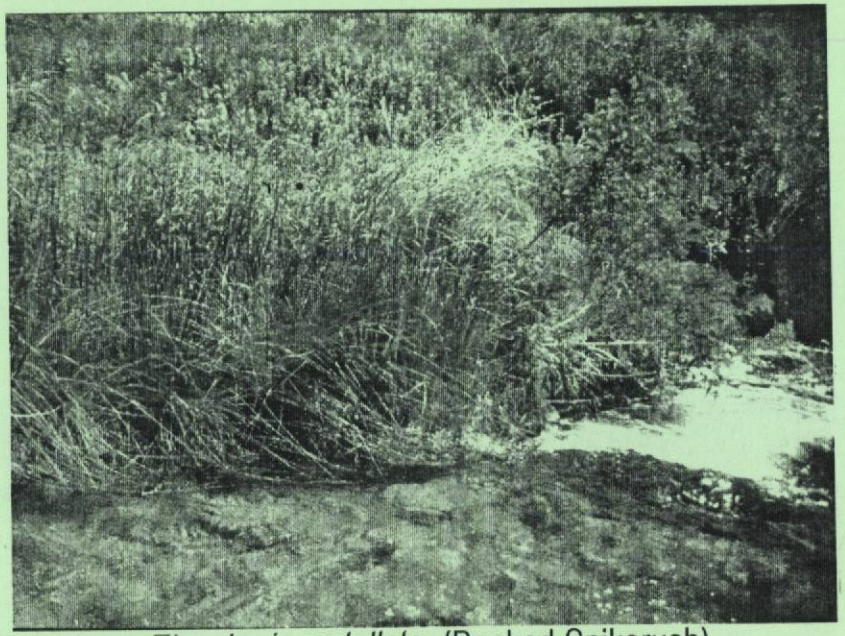
*Aerial view of Cascade Creek and confluence with the Cheyenne River*

*Adiantum capillus- veneris* (Southern Maidenhair Fern) at Cascade Springs

*Epipactis gigantea* (Stream Orchid) at Cascade Springs

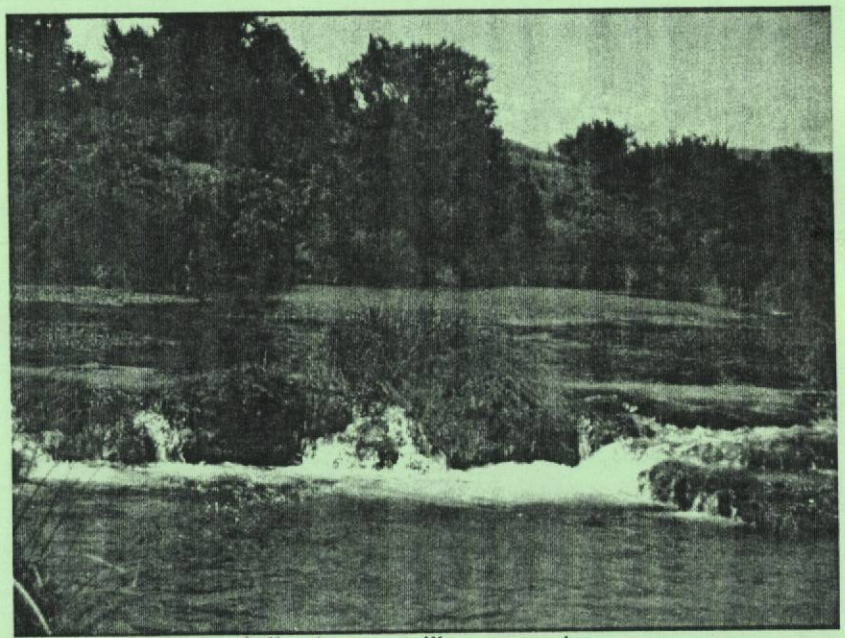
*Eustoma grandiflorum* (Tulip Gentian), *Adiantum capillus-veneris, Epipactis gigantea* Cascade Creek Midsection

*Eleocharis rostellata* on stream bank below
Cascade Falls, Cascade Creek Midsection



*Eleocharis rostellata* (Beaked Spikerush)
Cascade Creek Lower Section

*Adiantum capillus-veneris* below Cascade Falls
Cascade Creek Midsection



*Adiantum capillus-veneris*
below Cascade Falls, Cascade Creek Midsection

*Adiantum capillus-veneris* on charophyte rock
Cascade Creek Midsection

*Adiantum capillus-veneris & Eleocharis rostellata*
Cascade Creek Midsection

*Adiantum capillus-veneris* on charophyte rock
Cascade Creek Midsection

*Adiantum capillus-veneris & Eleocharis rostellata*
Cascade Creek Midsection

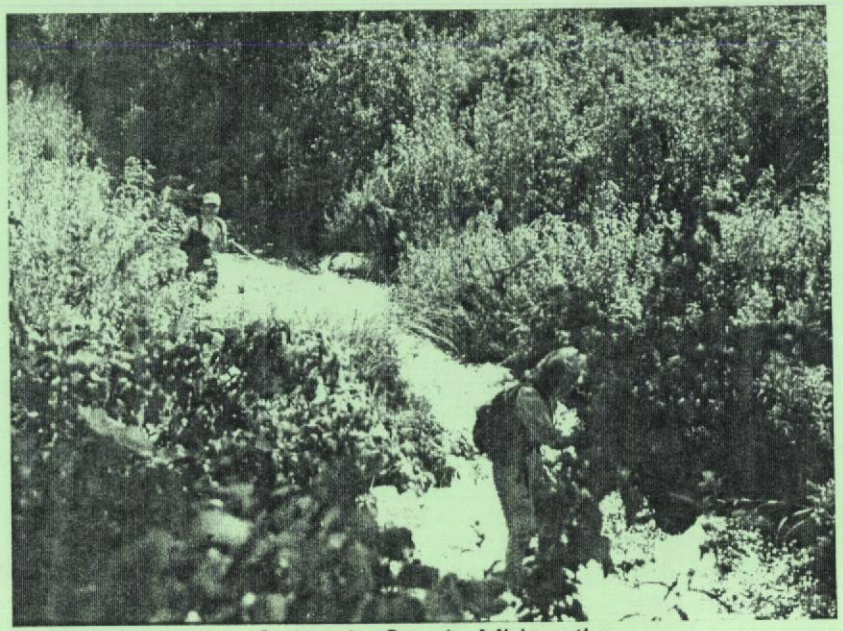
Cascade Creek Midsection

Cascade Creek Midsection- looking Northwest

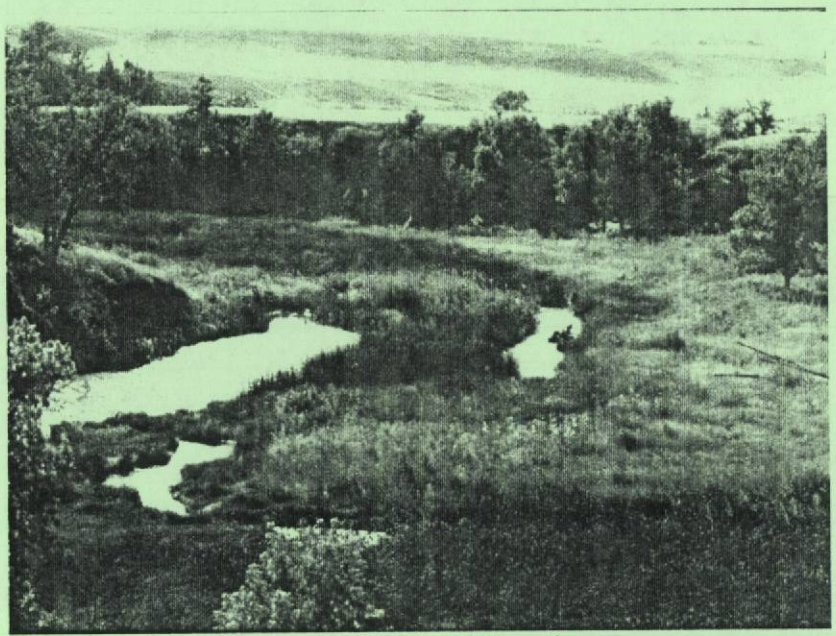
Recording GPS Data- Cascade Creek Midsection

Measuring distance to next random plot site
Cascade Creek Midsection

Plot frame- 1 meter square
Cascade Creek Midsection

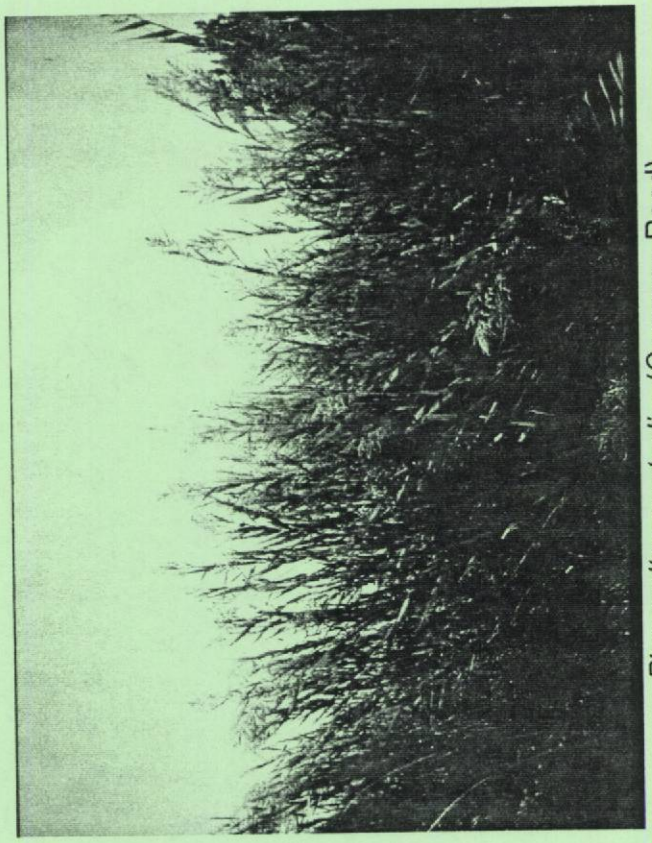


Cascade Creek Midsection

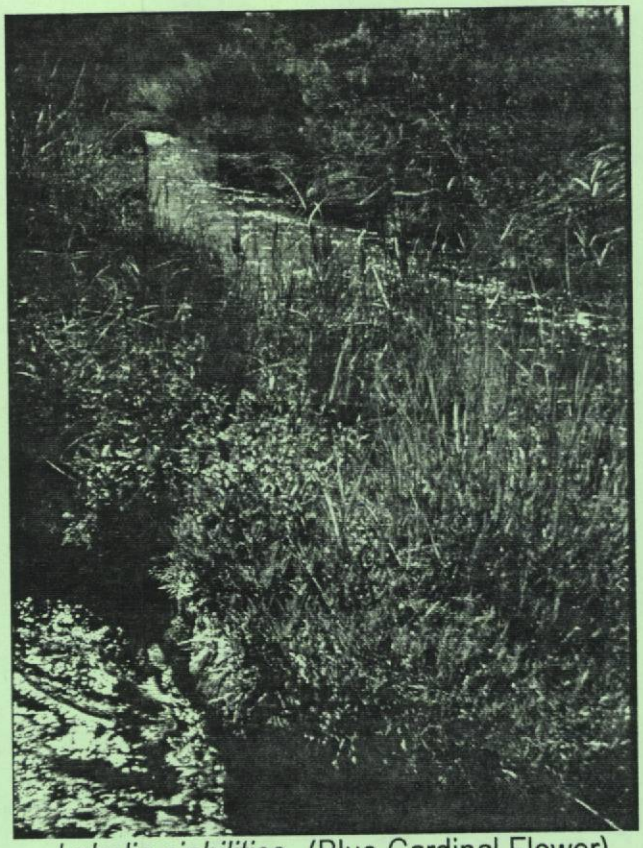


Cascade Creek Midsection

Cascade Creek Midsection

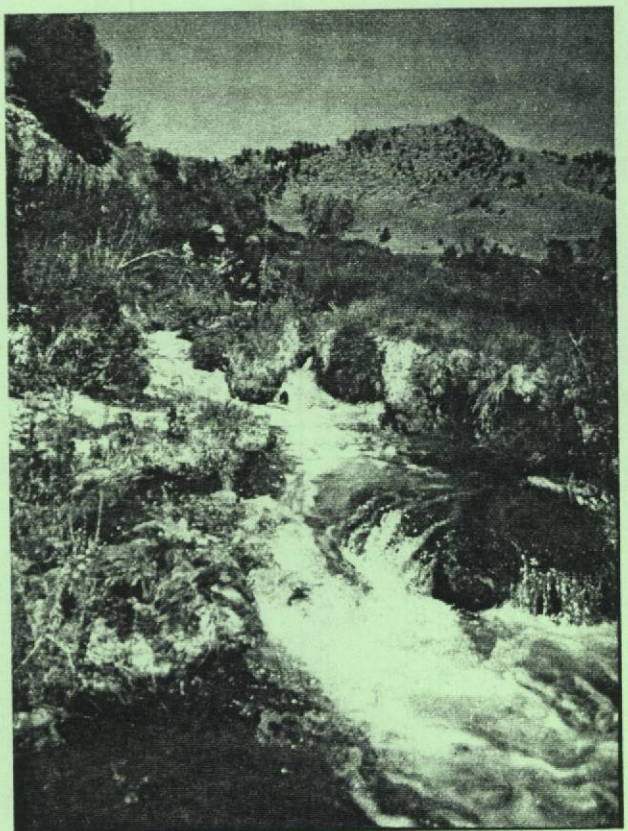


*Phragmites australis* (Common Reed)
Cascade Creek Midsection



*Lobelia siphilitica* (Blue Cardinal Flower)
Cascade Creek Midsection

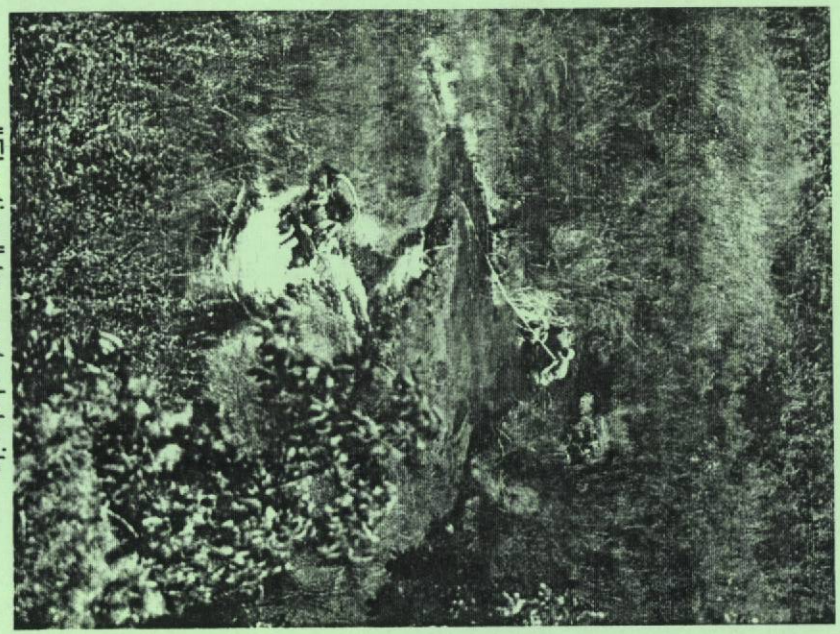
Cascade Creek Midsection, looking Southwest



Cascade Creek Midsection, looking Northeast

Recording plot species data Cascade Creek Midsection

Cascade Creek Midsection



"Floating" to next plot site
Cascade Creek Midsection

Setting up permanent plot Cascade Creek Midsection

After emerging from the bullrushes Cascade Creek Midsection

Setting up permanent plot Cascade Creek Midsection

Cascade Creek Midsection, looking North

Working our way through the bullrushes
Cascade Creek Midsection

# APPENDIX E

# SMALL GRANT PROPOSAL

**2001**
**SOUTH DAKOTA DEPARTMENT OF GAME, FISH AND PARKS**
**WILDLIFE DIVISION**
**SMALL GRANTS PROGRAM APPLICATION**


| | | |
|---|---|---|
| **Date:** | February 20, 2001 | |
| **Names:** | Elaine A. Ebbert | Beth Burkhart |
| **Mailing Address:** | HC 80, Box 645<br>Piedmont, SD 57769 | RR 1, Box 86-W<br>Custer, SD 57730 |
| **E-Mail:** | eaebbert@enetis.net | burkhart@gwtc.net |
| **Phone:** | (605) 787-6114 | (605) 673-3159 |
| **SSN:** | 503-62-6244 | 273-46-2128 |


**Project Title**: Monitoring Plan Development and Implementation for Selected Sensitive Species Along Cascade Creek

## PROJECT DESCRIPTION:

A monitoring plan will be designed and implemented for two selected sensitive species, *Adiantum capillus-veneris* (southern maidenhair fern) and *Epipactis gigantea* (stream orchid), along Cascade Creek on properties of The Nature Conservancy, U.S. Forest Service, and private landowners. The entire length of Cascade Creek (approximately 3.5 miles) will be included in the monitoring plan. Slide photography will provide documentation of the species and their habitats. Two other sensitive species, *Eustoma grandiflorum* (tulip gentian) and *Eleocharis rostellata* (beaked spikerush), will be inventoried. Classification and mapping of the plant associations will be completed. The final report will include the monitoring plan, results of the pilot study, and mapping of the plant associations.

## PROJECT NEED:

### Justification.

The Cheyenne River Canyons Conservation Initiative was established by The Nature Conservancy (TNC). The canyons consist of 42,000 ecologically-bound acres that are especially rich in biodiversity and remarkably undeveloped. It is a prime example of one component of the Black Hills Ecoregion - where eastern, western, high prairie and low montane plant and animal species overlap and coexist (Paulson, 1998).

The Cheyenne River Canyons site supports the only known example of an unimpacted warm spring community in the Hills. Cascade Creek and the riparian corridor provide year-round open water and support occurrences of rare species, including *Eustoma grandiflorum* (tulip gentian), *Eleocharis rostellata* (beaked spikerush), *Adiantum capillus-veneris* (southern maidenhair fern), and *Epipactis gigantea* (stream orchid) (Paulson, 1998).

There is little concern at the present time that the abundant populations of *Epipactis gigantea* (G4-S1) and *Adiantum capillus-veneris* (G5-S1) along Cascade Creek are in danger of disappearing. However, there is also little research on the complete life histories of these species and what factors most impact their viability success in the warm water ecosystem at Cascade Springs and along Cascade Creek. As a result, these species are vulnerable to changes in management that might occur by the various owners of stretches of Cascade Creek (TNC, U.S. Forest Service, and private landowners). If we don't know whether population trends are stable, increasing, or decreasing, and how current management is impacting these species, we will not be able to plan effective and protective management in the future.

In the project, we will adhere to the definition of monitoring in *Measuring and Monitoring Plant Populations* (BLM Technical Reference 1730-1): the collection and analysis of repeated observations or measurement to evaluate changes in condition and progress toward meeting a management objective. We plan to follow the guidelines in this text and a new reference (*Monitoring Plant and Animal Populations: A Handbook for Field Biologists* (C. Elzinga et al., 2001, Blackwell Science Publishers) to develop strategies for monitoring *Epipactis gigantea* and *Adiantum capillus-veneris*.

Developing monitoring strategies will involve background tasks such as determining appropriate scale and intensity for resources available; developing some simple ecological models; developing objectives for the monitoring, including identifying some management goals; and setting some timeframe for management response. Developing the monitoring design will be very important. The design must be statistically defensible and answer specific questions. In addition, the design must be appropriate based on life history, ecology, and other factors.

The U.S. Forest Service has recognized the need to track *Epipactis gigantea* and *Adiantum capillus-veneris* on their properties along Cascade Creek and initiated an inventory project in summer 2000. We have contacted Black Hills National Forest staff, and they are willing to share with us the techniques they used and the data they collected. One of our short-term goals is to design monitoring strategies that will be able to include any data collected by the U.S. Forest Service. Our long-term goal is to have a single, coordinated monitoring plan for the entire Cascade Creek area (with different strategies for individual species, as appropriate) covering multiple landowners and potentially different management goals.

We consider the implementation of this monitoring project in the summer of 2001 to be a pilot study. A pilot period is important for testing the feasibility of the proposed monitoring approach and identifying improvements. Although we do not see the means for accomplishment at this time, the major benefits of this monitoring project will come over many years of monitoring and

subsequent adaptive management. We believe the importance of putting some good quality monitoring in place is essential to conserving these species that are among the most uncommon in South Dakota.

**Funding Needed.**

- Travel expenses to Cascade Creek
- Slide film/film developing for documentation of sensitive species and habitat
- Materials for setting up plots

**PROJECT OBJECTIVES:**

- To develop monitoring strategies for *Adiantum capillus-veneris* (southern maidenhair fern), and *Epipactis gigantea* (stream orchid)

- To implement this monitoring plan with a pilot study during the summer 2001

- To inventory for *Eustoma grandiflorum* (tulip gentian) and *Eleocharis rostellata* (beaked spikerush)

- To classify and map the plant associations along Cascade Creek as a baseline for the monitoring project

- To complete slide photography of all species monitored or inventoried and provide a set of slides to the South Dakota Natural Heritage Program (SDNHP)

- To submit all data to the South Dakota National Heritage Program (SDNHP)

**PROJECT METHODS:**

The monitoring procedures will be developed in May and June. The monitoring will take place in June, July, and August.

Slides will be taken of specimens and habitats. This will be accomplished with Nikon N6006 cameras and AF Micro Nikkor 60mm lens (provided by applicants).

Communities will be classified according to the *Black Hills Community Inventory* (Marriott and Faber-Langendoen, 2000) and the *Terrestrial Vegetation of the Midwestern United States* (Faber-Langendoen (editor), 1999 DRAFT). *Measuring and Monitoring Plant Populations* (BLM Technical Reference 1730-1) and *Monitoring Plant and Animal Populations: A Handbook for Field Biologists* (C. Elzinga et al., 2001, Blackwell Science Publishers) will be used for developing monitoring methods. Permission will be obtained to complete survey work on adjoining Cascade Creek property.

## EXPECTED RESULTS:

A monitoring plan for *Adiantum capillus-veneris* (southern maidenhair fern) and *Epipactis gigantea* (stream orchid) will be developed, and baseline first year monitoring results will be completed. Survey information for *Eustoma grandiflorum* (tulip gentian) and *Eleocharis rostellata* (beaked spikerush) will be included. The data will be submitted to the South Dakota Natural Heritage Program (SDNHP).

A vegetation map of the plant associations and sensitive species along Cascade Creek properties will be prepared.

Slide photography will provide documentation of monitoring methods used, plant associations and habitat condition of Cascade Creek properties. A set of slides will be provided to the SDNHP.

## QUALIFICATIONS OF APPLICANTS:

Elaine Ebbert will graduate with a BS in Biology from Black Hills State University in May 2001. Projects completed by the applicant during the Summer of 2000 include: 1) Baseline inventory of the plants at the Nathaniel and Mary Whitney Preserve at Cascade Creek; 2) Ecological survey of the McKenna Ranch for The Nature Conservancy; and 3) Survey of the Mushrooms and other Fleshy Fungi of the Black Hills. Elaine has done field work with botanists Hollis Marriott, Beth Burkhart, and Terri Hildebrand. Elaine has worked for three summers with Dr. Audrey Gabel, mycologist at Black Hills State University, on a project for collecting, identifying and photographing fungi in the Black Hills of South Dakota (another project funded by SDNHP).

Beth Burkhart is currently employed by the U.S. Forest Service as a botanist/range conservationist on the Buffalo Gap National Grassland, Fall River Ranger District. She received her M.S. in Botany-Floristics from the University of Wyoming in Laramie in 1998. Her thesis was *A Floristic Survey of South-central Wyoming* (1998), field work supported by BLM. Beth worked for the Black Hills National Forest in the summer of 1999 to kick off a project relating vegetation mapping with soils mapping in Lawrence County. She also worked for The Nature Conservancy in the summer of 1998 in the final year of the Black Hills Community Inventory project and is one of the coauthors of the *Black Hills Community Inventory Final Report* (1999). Prior to obtaining her Master's Degree, Beth had 15 years of work experience as a Natural Resource Management Specialist with the National Park Service, Bureau of Reclamation, Corps of Engineers, and U.S. Department of Energy.

**LITERATURE CITED**:


Elzinga, C., D. Salzer, and J. Willoughby. 1998. *Measuring and Monitoring Plant Populations* (BLM Technical Reference 1730-1). 477 pp.

Elzinga, C., et al. 2001. *Monitoring Plant and Animal Populations: A Handbook for Field Biologists.* Blackwell Science Publishers.

Faber-Langendoen (editor), Don. 1999. *Terrestrial Vegetation of the Midwestern United States*, South Dakota Portion. March 1999 DRAFT.

Hayes, Timothy. 2000. *Episodic Sediment-Discharge Events in Cascade Springs, Southern Black Hills, South Dakota.* U.S. Geological Survey Water-Resources Investigations Report 99-4168. 34 pp.

Marriott, Hollis and D. Faber-Langendoen. 2000. *Black Hills Community Inventory*, December 2000. 326 pp.

Marriott, Hollis and D. Faber-Langendoen. 2000. *Riparian and Wetland Plant Communities of the Black Hills*, December 2000. 178 pp.

Marriott, Hollis, D. Faber-Langendoen, A. McAdams, D. Stutzman, and B. Burkhart. 1999. *Black Hills Community Inventory*, December 1999. 175 pp.

Paulson, Bob. 1998. The Nature Conservancy of the Dakotas Newsletter. Fall 1998.

## PROJECT TIME TABLE

| | |
|---|---|
| May 14 | Project Starting Date |
| May 14 - June 30<br>1 day every<br>other weekend | Researching U.S. Forest Service monitoring for *Epipactis gigantea* and *Adiantum capillus-veneris*<br>Develop monitoring objectives and plan<br>On-site work to refine plans<br>Preliminary classification of habitat and plant associations |
| July 1 - Sept. 8<br>1 day every<br>weekend | Implement monitoring protocols<br>Survey for additional species<br>Map plant associations and document habitat conditions |
| October 30 | Final Report Submission |

## BUDGET

**Travel Expenses** $1015

75 miles one way/150 miles per trip (Elaine)
50 miles one way/100 miles per trip (Beth)
14 trips minimum

**Supplies**

| | |
|---|---|
| Slide film | 25 |
| Photographic developing | 50 |
| Materials-measuring tape, flagging, compass, stakes | 100 |

**Total Funds Requested** **$1190**

**Donated Time/Expenses**

The applicants will donate 1day every other weekend from May 14 to June 30 and 1 day every weekend from July 1 to September 8 to complete the project during the summer of 2001.