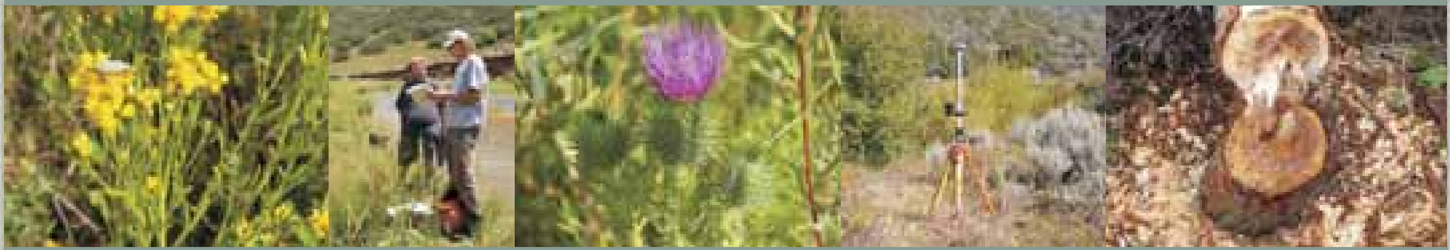
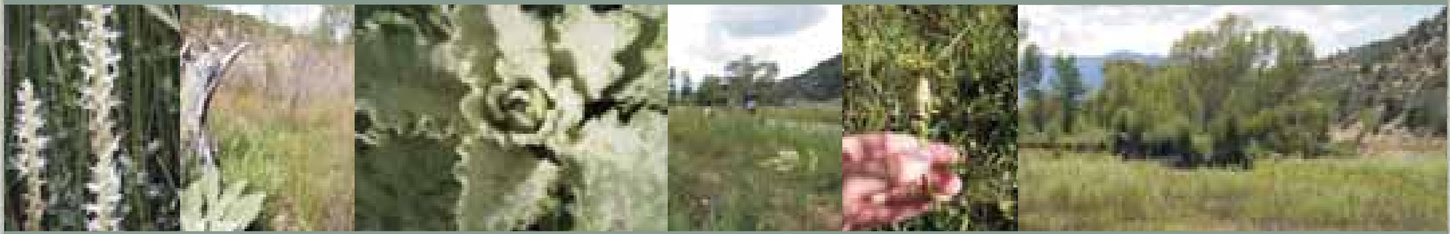


# Diamond Fork and Sixth Water Creeks Riparian Vegetation and Ute Ladies'-tresses 2007 Final Monitoring Report



**AUGUST 2008**

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# CHAPTER 1: INTRODUCTION

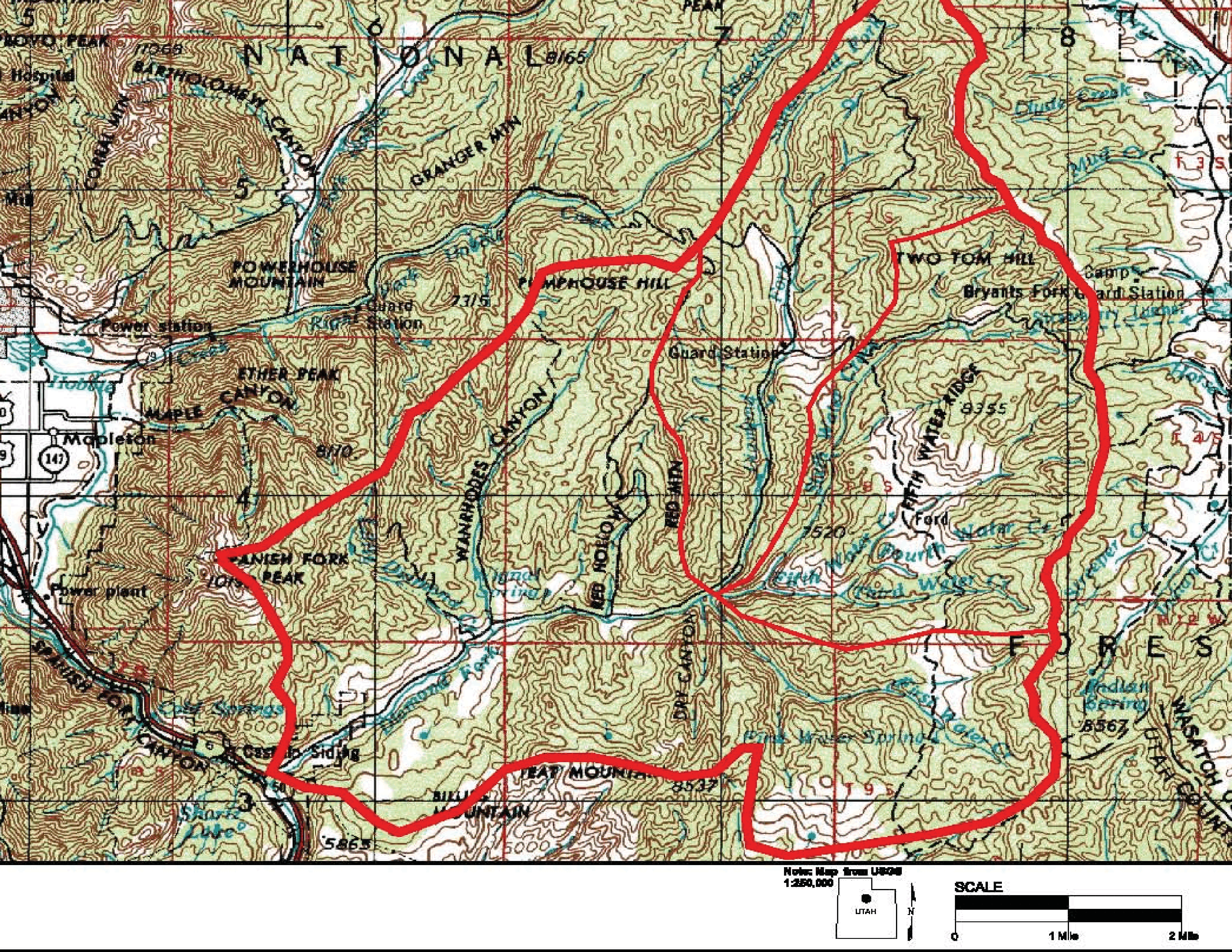
# 1.0 INTRODUCTION

Diamond Fork Creek and its tributary Sixth Water Creek are part of the Spanish Fork River Watershed (Figure 1.1). Between 1916 and 2004 these streams conveyed irrigation water diverted from Strawberry Reservoir in the Uinta Basin to the Wasatch Front. This trans-basin diversion increased peak flows in Diamond Fork Creek and Sixth Water Creek, severely impacted the stream channel and aquatic ecosystem, and created unique conditions that allowed the rare orchid, Ute ladies'-tresses (*Spiranthes diluvialis*) (ULT), to flourish and become the largest known population along the Wasatch Front. The ULT was listed as a threatened species on January 17, 1992 (USFWS 1992).

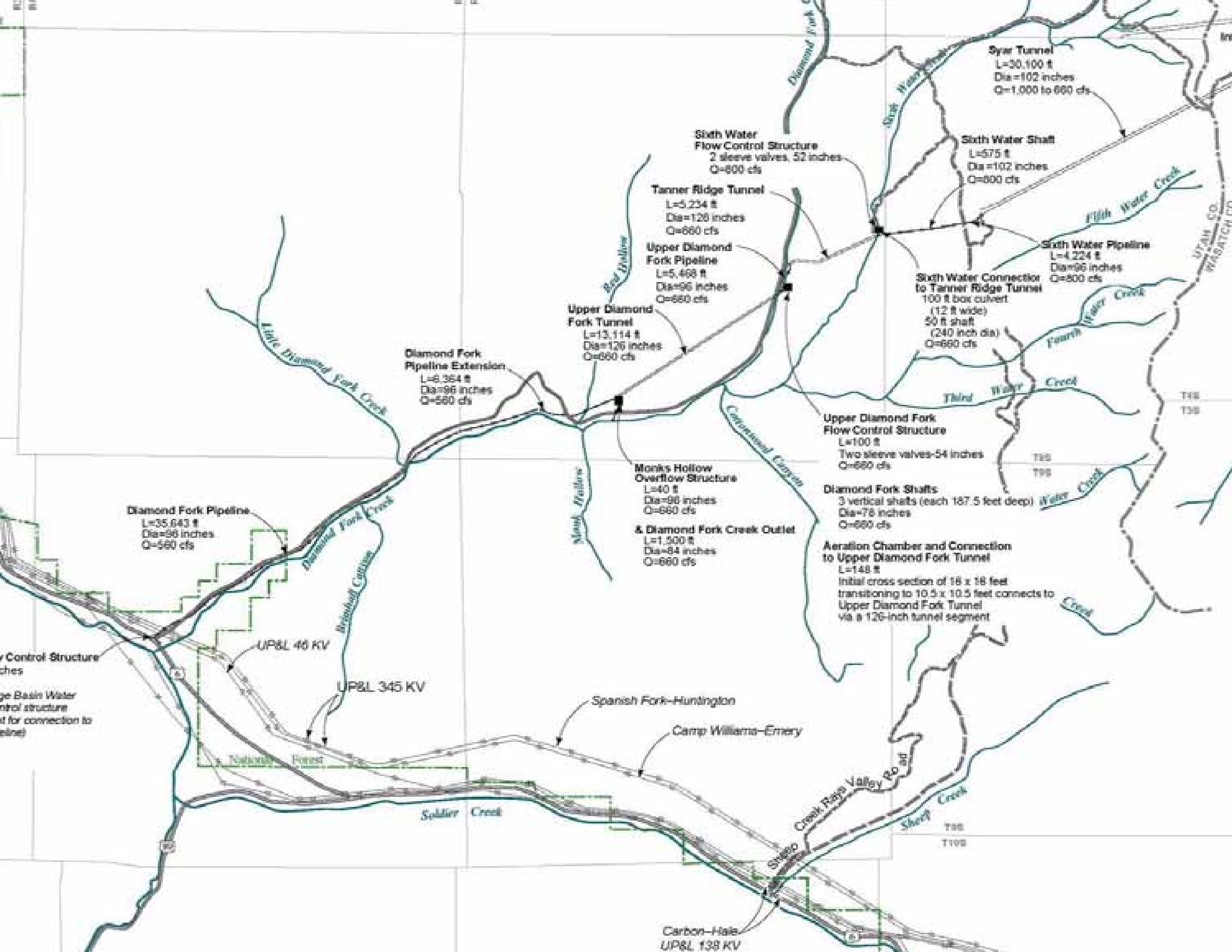
Currently, the Bonneville Unit's Diamond Fork System, completed in 2004, pipes water imported from Strawberry Reservoir directly into Spanish Fork River (Figure 1.2) and, with the exception of minimum instream flow, this imported water completely bypasses Sixth Water Creek and Diamond Fork Creek (USBOR 2005). Effects of this hydrologic change on ULT populations are largely unknown. The distribution of riparian plant species is largely driven by hydrologic and soil variables, and riparian plant communities frequently occur in relatively distinct zones along streamside elevational and soil textural gradients (Dwire et al. 2006). Vegetation zones within the riparian corridor vary in maturity due to flooding regimes and elevation. Mature sections of the corridor are composed of narrowleaf cottonwood (*Populus angustifolia*) galleries and boxelder (*Acer negundo*) with an under story of willow species, grasses, and forbs. Vegetation zones in higher elevations include common snowberry (*Symphoricarpos albus*), river birch (*Betula nigra*), and skunkbush (*Rhus trilobata*). Areas that are more regularly or newly disturbed are colonized with young willows, grasses, and forbs, and these areas support ULT populations. Previously high irrigation flows in Diamond Fork Creek deposited large amounts of sand and gravel, and produced hydrological conditions and disturbance cycles favorable for supporting unusually large ULT populations.

The Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission) initiated a long-term monitoring project, in conjunction with State and Federal agencies, in order to monitor stream channel and riparian vegetation response to the altered flow regime, address aquatic and riparian habitat restoration needs, and monitor changes within ULT colonies. This report documents the results of the riparian vegetation and ULT data collection and analysis conducted in 2007. The report is organized by topic, starting with an overall introduction and project description. This introduction is followed by chapters describing the monitoring methods and results in the following order: Chapter 2-Riparian Vegetation Cross Section Transects, Chapter 3-ULT Surveys, Chapter 4-ULT Habitat Analysis and Piezometer Measurements, and Chapter 5-Discussion.

Chapter 2 discusses methods and results of transects used to monitor the lateral extent and compositional changes of vegetation along the stream channels in response to altered hydrology. Chapter 3 describes methods and results, and discusses ULT surveys including previous and current population estimates. Chapter 4 discusses methods and results of ULT habitat analysis, results of piezometer measurements, and the connection between ground water and surface water elevations. The report concludes with Chapter 5, which presents a discussion of results, summary of findings, and recommendations for subsequent monitoring sessions.



NATIONAL
FORES
GRANGER MTN
BARTHOLOMEW CANYON
CORRAL MTN
POWERHOUSE MOUNTAIN
PUMPHOUSE HILL
Guard Station
Power station
ETHER PEAK
MAPLE CANYON
Mapleton
SPANISH FORK PEAK
Power plant
SPANISH FORK CANYON
Castilla Siding
WANRHODES CANYON
RED HOLLOW
RED MTN
DRY CANYON
TWO TOM HILL
Camp
Bryants Fork Guard Station
FIFTH WATER RIDGE
Ford
Pink Water Springs
WASATCH CO
UTAH COUNTY
Note: Map from USGS 1:250,000
UTAH
N
SCALE
0
1 Mile
2 Mile



Syar Tunnel
L=30,100 ft
Dia=102 inches
Q=1,000 to 660 cfs
Sixth Water Shaft
L=575 ft
Dia=102 inches
Q=800 cfs
Sixth Water
Flow Control Structure
2 sleeve valves, 52 inches
Q=800 cfs
Tanner Ridge Tunnel
L=5,234 ft
Dia=126 inches
Q=660 cfs
Upper Diamond
Fork Pipeline
L=5,468 ft
Dia=96 inches
Q=660 cfs
Sixth Water Pipeline
L=4,224 ft
Dia=96 inches
Q=800 cfs
Sixth Water Connection
to Tanner Ridge Tunnel
100 ft box culvert
(12 ft wide)
50 ft shaft
(240 inch dia)
Q=660 cfs
Upper Diamond
Fork Tunnel
L=13,114 ft
Dia=126 inches
Q=660 cfs
Diamond Fork
Pipeline Extension
L=6,364 ft
Dia=96 inches
Q=560 cfs
Upper Diamond Fork
Flow Control Structure
L=100 ft
Two sleeve valves-54 inches
Q=660 cfs
Monks Hollow
Overflow Structure
L=40 ft
Dia=96 inches
Q=660 cfs
& Diamond Fork Creek Outlet
L=1,500 ft
Dia=84 inches
Q=660 cfs
Diamond Fork Shafts
3 vertical shafts (each 187.5 feet deep)
Dia=78 inches
Q=660 cfs
Aeration Chamber and Connection
to Upper Diamond Fork Tunnel
L=148 ft
Initial cross section of 18 x 18 feet
transitioning to 10.5 x 10.5 feet connects to
Upper Diamond Fork Tunnel
via a 126-inch tunnel segment
Diamond Fork Pipeline
L=35,643 ft
Dia=96 inches
Q=560 cfs
UP&L 46 KV
UP&L 345 KV
Spanish Fork–Huntington
Camp Williams–Emery
Carbon–Hale
UP&L 138 KV
Sixth Water Creek
Fifth Water Creek
Fourth Water Creek
Third Water Creek
Diamond Fork Creek
Little Diamond Fork Creek
Red Hollow
Monk Hollow
Cottonwood Canyon
Brimhall Canyon
Soldier Creek
Sheep Creek
Rays Valley Road
National Forest
UTAH CO.
WASATCH CO.
T8S
T9S
T10S

## 1.1 WATERSHED DESCRIPTION

The Diamond Fork Creek Watershed, including its tributaries, covers over 150 square miles and is the largest headwater tributary of the Spanish Fork River (Mitigation Commission 2005). The streams are initiated just west of Strawberry Reservoir, and the streams in the upper portions of the watershed are initially high-gradient, confined, canyon-type streams until they reach the wider alluvial valley closer to the confluence with Spanish Fork River. Diamond Fork and Sixth Water Creeks were used as early as 1916 to divert water to the Spanish Fork River from Strawberry Reservoir through Strawberry Tunnel in order to support irrigation needs in the lower watershed area and Utah County (Mitigation Commission 2005). These streams carried a significant amount of imported water during the irrigation season, creating artificially high flows for an extended duration, causing significant changes in the sediment-transport regime, and affecting channel dimensions, pattern, and profile, as well as its interaction with the floodplain. These morphological impacts to the channel and floodplain have in turn affected water quality and the types and extent of riparian and wetland vegetation and aquatic communities. Historically, the watershed was used for agriculture, timber harvesting, livestock grazing, and recreation. Large portions of the watershed are still used for agriculture and grazing. Some of the watershed is part of the Uinta National Forest and managed by the U.S. Forest Service. Recently, Diamond Fork Creek has become a popular recreation area. The watershed has many recreational uses including both motorized and non-motorized activities.

## 1.2 HISTORY OF THE COLORADO RIVER STORAGE PROJECT ACT (CRSP), CENTRAL UTAH PROJECT (CUP), AND CENTRAL UTAH PROJECT COMPLETION ACT (CUPCA)

The Diamond Fork System is a series of tunnels and pipelines that transport water from Strawberry Reservoir in the Colorado River Basin to Spanish Fork River in the Bonneville Basin. This system is a part of the Bonneville Unit of the Central Utah Project (CUP), which develops the portion of flow from the Upper Colorado River System allocated to Utah under various interstate compacts. The CUP was authorized by Congress in 1956 through the Colorado River Storage Project Act (CRSP) of 1956 (43 U.S.C. Sec 620 et seq.). The Bonneville Unit is the largest unit of the CUP (USBOR 2005). This system of reservoirs, aqueducts, pipelines, pumping plants, and conveyance facilities enables trans-basin water diversion to occur between the Colorado River Basin (Uinta Mountains) and the Bonneville Basin. The Central Utah Water Conservation District (CUWCD) manages this water, which is allocated to municipal and industrial uses, irrigation, and instream flows for areas in Utah. Other systems in the Bonneville Unit include the Starvation Collection System, the Strawberry Aqueduct and Collection System (SACS), the Municipal and Industrial System, and the Utah Lake System.

Before the present-day Diamond Fork System was completed, imported water went directly into Sixth Water Creek. Strawberry Tunnel transported water from Strawberry Reservoir into Sixth Water Creek, a tributary to Diamond Fork Creek. The water from Strawberry Reservoir eventually reached Spanish Fork River via Diamond Fork Creek. In 1990 the Syar Tunnel was constructed to replace Strawberry Tunnel. By 1996 water from Syar Tunnel flowed through the Sixth Water Aqueduct and entered Sixth Water Creek 6 miles farther downstream than it had when Strawberry

Tunnel was the primary flow conveyance. Strawberry Tunnel is now used to convey minimum instream flows to the head of Sixth Water Creek (USBOR 2005).

In 1992 Congress passed the Central Utah Project Completion Act (CUPCA) (Title II through VI of Public Law 102-575), which authorized further construction to complete the Bonneville Unit of the CUP started in 1966. The CUPCA also mandated several modifications to the original design of the Bonneville Unit. Modifications to the Diamond Fork System consisted of constructing the Diamond Fork Pipeline to carry flow from Monks Hollow to Spanish Fork River in place of constructing the proposed Monks Hollow Dam. The legislation also established a minimum instream flow requirement. Currently, this requirement is 25 to 30 cubic feet per second (cfs) for Sixth Water Creek and 60 to 80 cfs for Diamond Fork Creek.

Under CUPCA in 1996, construction began on the Diamond Fork Pipeline, also known as Phase 1 of the Diamond Fork System of the CUP. This phase was completed in 1997 (Mitigation Commission 2000). Construction on Phase 2, the Diamond Fork Tunnel Alternative, was started in 2000 and completed in 2004. The Diamond Fork Tunnel Alternative is a pipeline and tunnel system that carries water from Syar Tunnel to the Diamond Fork Pipeline. Completing construction of Phase 1 and Phase 2 of the Diamond Fork System effectively removed all flow imports from Strawberry Reservoir to Sixth Water Creek and Diamond Fork Creek, except minimum instream flows.

The CUPCA also established the Mitigation Commission, a Federal agency responsible for mitigating impacts on fish, wildlife, and related recreation resources that resulted from construction of the Bonneville Unit. Congress also established standards for the Mitigation Commission to follow when coordinating and implementing plans for mitigation projects. The overall mitigation commitments concerning Sixth Water Creek and Diamond Fork Creek are monitoring ULT after completion of the Diamond Fork System, supporting the June Sucker Recovery Program, and monitoring stream channel responses to altered flow regimes following completion of the Diamond Fork System.

## 1.3 IMPACTS TO THE DIAMOND FORK SYSTEM

Prior to completion of the Diamond Fork System, trans-basin imports from Strawberry Reservoir increased peak flow in both Sixth Water Creek and Diamond Fork Creek, particularly during periods of high irrigation demand. These artificially high flows caused the channels to scour in order to accommodate higher and longer duration peak flows. The changes in stream geomorphology and flow regime resulted in “severely limited fish production, loss of soils, loss of riparian and wetland habitat, and reduced recreation experiences” (Mitigation Commission 2005).

Before it was used to transport water from Strawberry Reservoir, Diamond Fork Creek was most likely a single-thread, meandering channel with minor backwaters and an active floodplain estimated to be about 200 to 300 feet wide (Mitigation Commission 2005) from the mouth to Brimhall Canyon. Runoff was largely controlled by spring snowmelt, with peak flow occurring in mid May. Flows returned to baseflow by late June with periodic, short-term increases in flow caused by storms. Gage station data show annual peak flows before 1915 at 250 cfs near Brimhall Canyon and 200 cfs near Red Hollow.

Using the streams to convey imported water resulted in changes in magnitude, duration, and timing of peak flows, which in turn caused major changes to the geomorphology and adjacent riparian areas in both Sixth Water and Diamond Fork Creeks. From 1915 to 2004, the annual hydrographs of Sixth Water Creek and Diamond Fork Creek were dominated by the releases from Strawberry Reservoir. Peak flows were approximately 450 cfs sustained for the duration of irrigation season, which lasted approximately 140 days (Mitigation Commission 2005). In Sixth Water Creek bank erosion occurred and the channel incised an average of 12 to 15 feet. Compared with 1939 conditions, parts of Diamond Fork Creek have become much wider, straighter, and steeper, particularly in the lower 3 miles (Mitigation Commission 2005). Diamond Fork Creek incised an average of 2 to 4 feet where the channel is confined. In areas where the valley is wide, the channel became braided and unstable.

Removal of most of the riparian forest for agriculture in the early 1900s compounded the impacts of increased flow on the channel and riparian areas. Rapid lateral migration of the stream channel, estimated at 40 to 60 feet per year, further impacted the existing riparian forest. High summer flows altered riparian and wetland communities by increasing the duration and extent of floodplain inundation as well as artificially increasing ground water elevations. However, now that the channel is so wide, increased flows do not increase water elevations as much as the extent of innundation. Currently, the water spreads more than it rises and lowers in response to changes in flow.

A plant species of particular concern is the ULT, which was listed as threatened by the Federal government. According to recent surveys, populations of this orchid were not documented in the Diamond Fork Watershed until 1992. The Diamond Fork Watershed populations are thought to contain about 95 percent of all individuals known to occur along the Wasatch Front. The species grows in moist areas, particularly near springs and perennial streams. The plants occur primarily within the 2- to 10-year floodplain and seem to be adapted to areas disturbed by channel migration or other sources of disturbance in the floodplain. Much of current habitat for ULT in the Diamond Fork Watershed seems to have developed in areas where lateral stream migration is occurring and willows, cottonwoods, and other types of riparian vegetation have been flooded out during growing seasons. It is possible that impacts from substantially increased flows in Sixth Water Creek and Diamond Fork Creek have created conditions that are favorable for ULT establishment (Mitigation Commission 2005).

Impacts have also occurred because of Diamond Fork Tunnel Alternative construction activities. During construction, an unexpected source of hydrogen sulfide-laden water began flooding the original tunnel. This tunnel was closed and abandoned. A new tunnel with an alternative design route was constructed to complete Phase 2. The hydrogen sulfide associated with drilling of the original tunnel continues to leak into Diamond Fork Creek upstream of Three Forks, causing some water quality impacts that could affect fish and aquatic habitat. The additional hydrogen-sulfide inputs are not known to affect any ULT colonies. Other impacts related to construction of the pipeline have been mitigated with varying amounts of stream restoration and riparian area restoration.

## 1.4 VEGETATION ISSUES

Hydrologic flow regime is the major factor governing physical and biotic processes and aquatic and riparian biota in stream-riparian corridors (Poff et al. 1997, Tabacchi et al. 1998). The decreased flow in Diamond Fork Creek affects the dynamics of plant communities and species composition, altering disturbance cycles and geomorphology. Riparian areas are especially prone to establishment of exotic species because of fertile soil, water availability, and seed dissemination via water and animals—including livestock and wildlife—that heavily use and rely on riparian areas. Because of previously high disturbance rates, hydrological changes, and historical land use practices, many introduced plant species are beginning to establish in previously disturbed and drying areas. Exotic species of particular concern within ULT habitat are Canada thistle (*Cirsium arvense*) and bull thistle (*Cirsium vulgare*). These species have been found throughout the survey area within ULT habitat. Also found within areas surveyed were a small number of saltcedar (*Tamarix ramosissima*) and Russian olive (*Elaeagnus angustifolia*). Given the invasive nature of these species and their possible impacts on riparian communities, they are a particular threat to the health of the Diamond Fork Watershed riparian ecosystem.

As the amount of hydrological disturbance is reduced, plant communities have been adapting to adjusted flows and early successional species—such as grasses, forbs, and young willows—are replaced with mature woody species like coyote willow (*Salix exigua*), Booth's willow (*Salix boothii*), shining willow (*Salix lucida*), river birch, boxelder, and narrowleaf cottonwood. The ULT primarily occur in areas where the vegetation is relatively open and not overly dense or overgrown (Coyner 1989). The ULT's preference for open vegetative comminutes is also observed within the Diamond Fork Watershed, where few to no ULT individuals are found under dense willow or poplar canopies.

Another concern for ULT colonies is the continued observation that habitat once ideal for ULT colonization prior to creation of the Diamond Fork System (2004) may now be too dry to support populations. The ULT require moist soil throughout the growing season. The altered hydrology brought about from the Diamond Fork System may effect population numbers and/or survival of individual colonies. There is concern that reduced flow in Diamond Fork Creek may result in the reduction in size and or occurrences of suitable habitat and possibly the loss of existing ULT colonies within the watershed. However, there are many lower surfaces along Diamond Fork Creek that were wetter and/or seasonally inundated with water that now, with implementation of the Diamond Fork System, may be potential ULT habitat.

## 1.5 UTE LADIES'-TRESSES (ULT) ALONG DIAMOND FORK CREEK

The ULT species is a small, terrestrial, insect-pollinated orchid (Sipes and Tepedino 1995) found in wet meadows, abandoned oxbow meanders, marshes, raised bogs, and along streambanks at 4,500 to 6,900 feet (Welsh et al. 2003). Scattered populations are found throughout the west-central United States (Dressler 1981, Heidel 1997, Hildebrand 1998) including the currently known range of Idaho, Montana, Nebraska, Washington, Wyoming, Utah, Nevada, and Colorado (Fertig et al. 2005). In 1992 the ULT orchid was listed as a Federally threatened species because of relatively low population numbers, fluctuations in monitored population size, and loss of the species' riparian habitat through urban development, stream channelization, recreational development, and exotic species invasion (USFWS 1992). Historical accounts and herbarium records indicate that ULT was once much more common than its present range (Coyner 1990, Jennings 1990, Coyner 1991). Unique conditions exist along Diamond Fork Creek, created by manipulated water regimes and hydrological and geomorphological impacts, that create an ideal ecosystem for ULT populations.

The bloom period for the ULT populations in the Diamond Fork Watershed occurs in late summer, generally mid August through early September, although the bloom period may come as early as late July or last through late September, depending on climate and elevation. Because ULT reproductive biology requires pollinators as well as nutrients, water, and sunlight, pollinators become an important element in the preservation of this and other rare species. The most likely cause of the decrease in ULT population abundance seems to be disturbance and fragmentation of riparian habitat (Coyner 1990), which may be related to a decrease in visiting pollinators. Rare plants may suffer depressed reproduction if they occur in small or sparse populations due to lack of mates and/or pollinator visits (Levin 1972; Feinsinger et al. 1986; Kunin 1992, 1993). In addition, the introduction of exotic species that have similar bloom periods and thus compete for pollinators may be causing further impacts. Monitoring and maintenance of large ULT populations, such as those occurring in the Diamond Fork Watershed, are important to maintaining genetic variation and survival within the species.

## 1.6 PREVIOUS STUDIES OF UTE LADIES'-TRESSES (ULT) IN THE DIAMOND FORK WATERSHED

Prior to 2006 the ULT populations in Diamond Fork Watershed were monitored by HDR Engineering, Inc. (HDR). Surveys were conducted by HDR on surfaces known to support ULT populations from 1992 to 2005, and flowering ULT individuals were counted. During the 2005 monitoring period, efforts were made to monitor flowering individuals in known and potentially occupied sites, estimate the ratio of flowering to non-flowering individuals along transects, and conduct habitat analyses and piezometer readings to measure ground water elevations at known occupied surfaces and evaluate the relationship between surface and ground water elevations. Although methods were established in 2005, implementation of those monitoring methods was incomplete and much of the data collection and analysis was inadequate to identify trends, associations, and management practices required to successfully monitor and manage this unique ecosystem and its associated plant community. Comparisons were made to previous data collected by HDR and new data collected by BIO-WEST during the 2006 and 2007 monitoring period when possible, primarily to identify coarse vegetation trends (Black and Gruwell 2005). Methodology implemented by BIO-WEST in 2006 was repeated in 2007 in order to allow comparisons of data between both monitoring years.

## 1.7 PURPOSE OF AND NEED FOR MONITORING

Mitigating impacts resulting from adjustments of the Diamond Fork System is required under CUPCA (1992). The Mitigation Commission has committed to several general areas of mitigation: (1) monitoring leatherside chub (*Gila copei*) populations, (2) monitoring water quality and stream channel responses to altered flow regimes; and (3) monitoring ULT colonies and riparian vegetation in response to altered flow regimes following the completion of the Diamond Fork System.

As adjustments are made to the Diamond Fork System, effects to riparian vegetation communities, and specifically ULT populations, should be monitored. Riparian ecosystems are unusually complex, dynamic, and diverse (Sharitz et al. 1992), making these systems key for the preservation of biodiversity (Naimen et al. 1993). Monitoring and maintaining ULT populations located along Diamond Fork Creek are important for the preservation and genetic diversity of the species. The purpose and priorities of monitoring riparian vegetation communities along Sixth Water and Diamond Fork Creeks, including continued ULT surveys, are as follows:

1. Map vegetation along the entire length of Sixth Water Creek and Diamond Fork Creek to quantify baseline conditions after construction of the Diamond Fork System (completed in 2006).

2. Measure the lateral extent of riparian vegetation communities during cross-section surveys to accurately map changes to their composition and structure as flows decrease from historically altered high flows (completed in 2006 and repeated in 2007).

3. Acquire data to accurately monitor changes over time of occupied, potentially occupied, and non-occupied habitat types, and classify plant communities found within ULT known and potentially occupied sites (ongoing).

4. Continue ULT surveys within known and potentially occupied sites to monitor changes in ULT colonies and associated vegetation communities as hydrologic and geomorphic conditions change in response to the new Diamond Fork System (ongoing).

5. Use best available scientific knowledge to ensure that the Mitigation Commission meets commitments to Sixth Water Creek and Diamond Fork Creek as set forth under CUPCA (1992) (ongoing).

## 1.8 SCOPE OF WORK FOR RIPARIAN VEGETATION MONITORING

The purpose of this monitoring is to continue to evaluate changes in riparian vegetation communities along Sixth Water Creek and Diamond Fork Creek, and continue ULT surveys at known and potentially occupied sites. The overall 2007 study area included the entire length of Sixth Water Creek and Diamond Fork Creek. These studies are a continuation of previous surveys conducted by HDR from 1992 to 2004 (Black and Gruwell 2005) and BIO-WEST (2006), and include adjustments incorporated into survey methods initiated during 2006 to streamline the ULT surveys and ensure a higher degree of precision and repeatability for surveys conducted in following years.

# CHAPTER 2:  RIPARIAN VEGETATION TRANSECTS

# 2.0 RIPARIAN VEGETATION TRANSECTS

## 2.1 INTRODUCTION

The objective of the vegetation transect surveys was to assess the response of riparian vegetation to flow alteration. In heavily altered systems, species composition, community structure, and successional processes can adjust to changes in the stream hydrology. Typical vegetative responses include encroachment into formerly active stream channel, loss of plant species richness and diversity, and invasion of the riparian zone by non-indigenous or invasive species.

In an attempt to monitor the vegetation communities' response to changes in hydrology, surveys conducted in 2006 were repeated in fall 2007, with adjustments made to data collection methodology. Cross-sectional transect data collected in 2006 were not compared with 2007 survey data because the data collected in 2006 were not detailed enough to monitor subtle changes that are likely occurring within the riparian communities or changes in species dominating the vegetative communities, particularly within the understory. Data collected in 2007 are to serve as the baseline with which subsequent data will be compared. The existing geomorphic transects were previously established in areas where potential changes in stream floodplain might occur, and future surveys are planned for these transects. The same geomorphic transects were used again for vegetation monitoring. Transects were established to represent topographic reaches along the stream. Four sites were already established for geomorphic monitoring: Sixth Water (SXW) (Figure 2.1a), Diamond Fork Campground (DFC) (Figure 2.1c), Mother (MO) (Figure 2.1d), and Oxbow (OX) (Figure 2.1e) (BIO-WEST 2006). A fifth vegetation transect site located immediately upstream of Ray's Crossing was established on Sixth Water Creek in spring 2006. The RC site (Figure 2.1b) will be used primarily for vegetation transect monitoring and not for detailed geomorphic analyses. Field surveys of riparian vegetation were conducted between July and October 2007.

The vegetation classification system used in this study is based on Monitoring the Vegetation Resources in Riparian Areas (Winward 2000). This procedure is designed to quantify the percent of each community type in a particular complex. These data may be used to indicate how much change has occurred in a particular complex (Winward 2000) in response to altered stream flow in Sixth Water and Diamond Fork Creeks.

## 2.2 METHODS

In April 2005 BIO-WEST, Inc. (BIO-WEST) established permanent transects (cross sections) in four study sites and in 2006 established permanent transects in a fifth site (RC). The five study sites are Sixth Water (Figure 2.1a), RC (Figure 2.1b), DFC (Figure 2.1c), MO (Figure 2.1d), and OX (Figure 2.1e). The SXW and MO sites each contain six transects. The DFC site contains seven transects, and the OX site contains eight transects.

Each transect is denoted by two endpoints, one on each side of the stream, which are anchored into the ground by rebar. Transect endpoints were set back several feet into non-riparian areas to account for possible expansion of riparian vegetation communities and minimize loss or damage to rebar stakes. The endpoints mark either the left endpoint (LEP) or right endpoint (REP), corresponding to

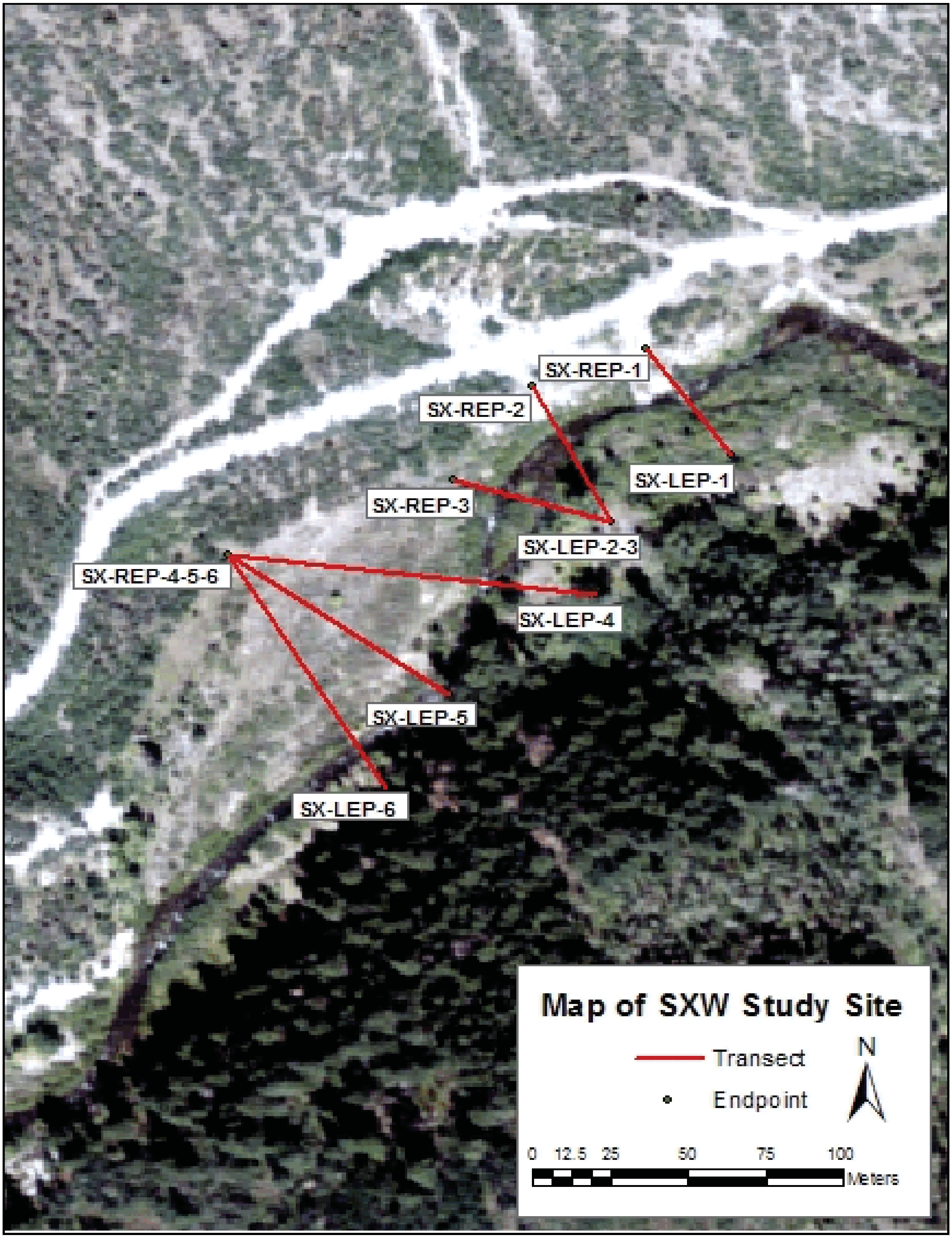



Figure 2.1a. Sixth Water Creek (SXW) study site transects.

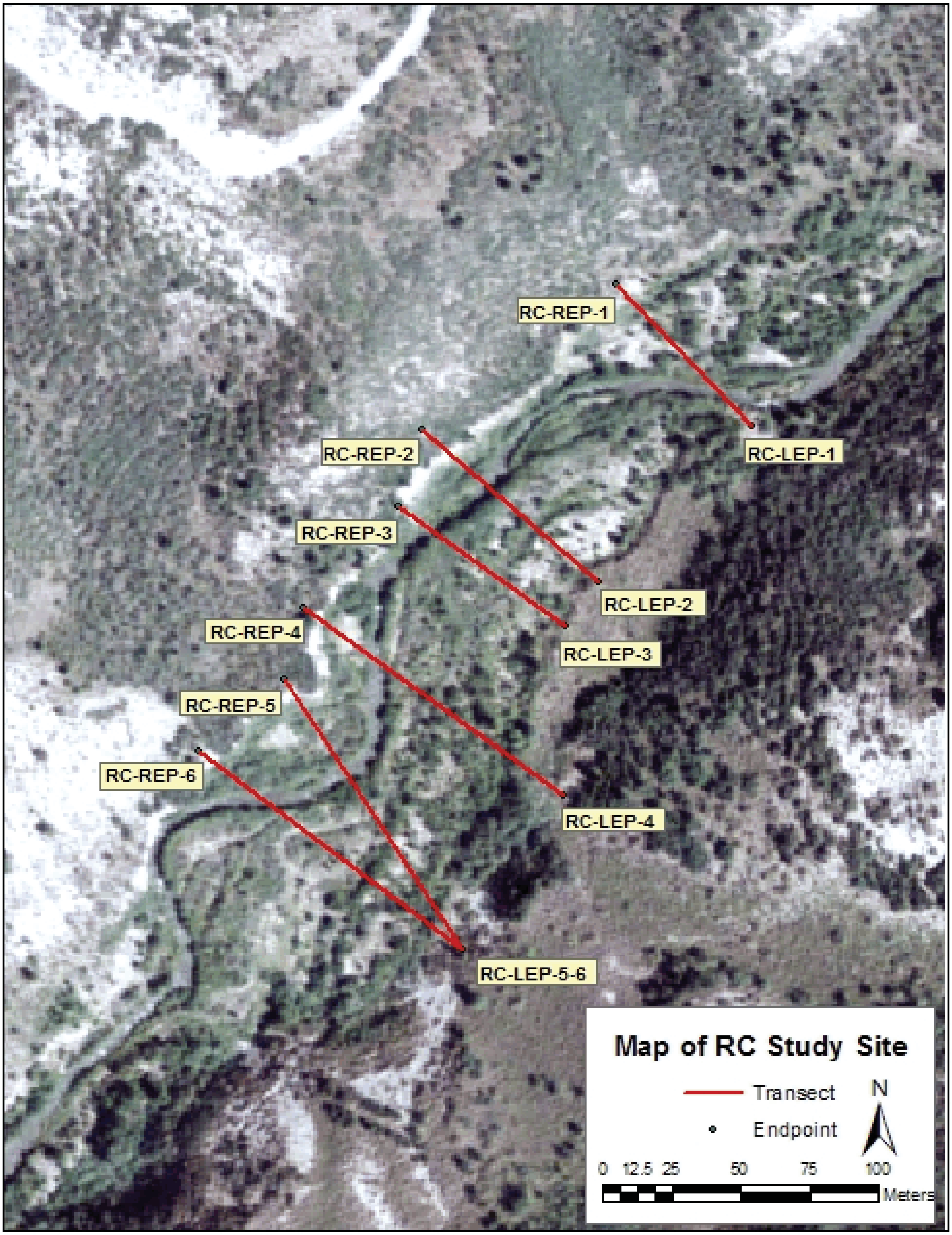



Figure 2.1b. Ray's Crossing (RC) study site transects.

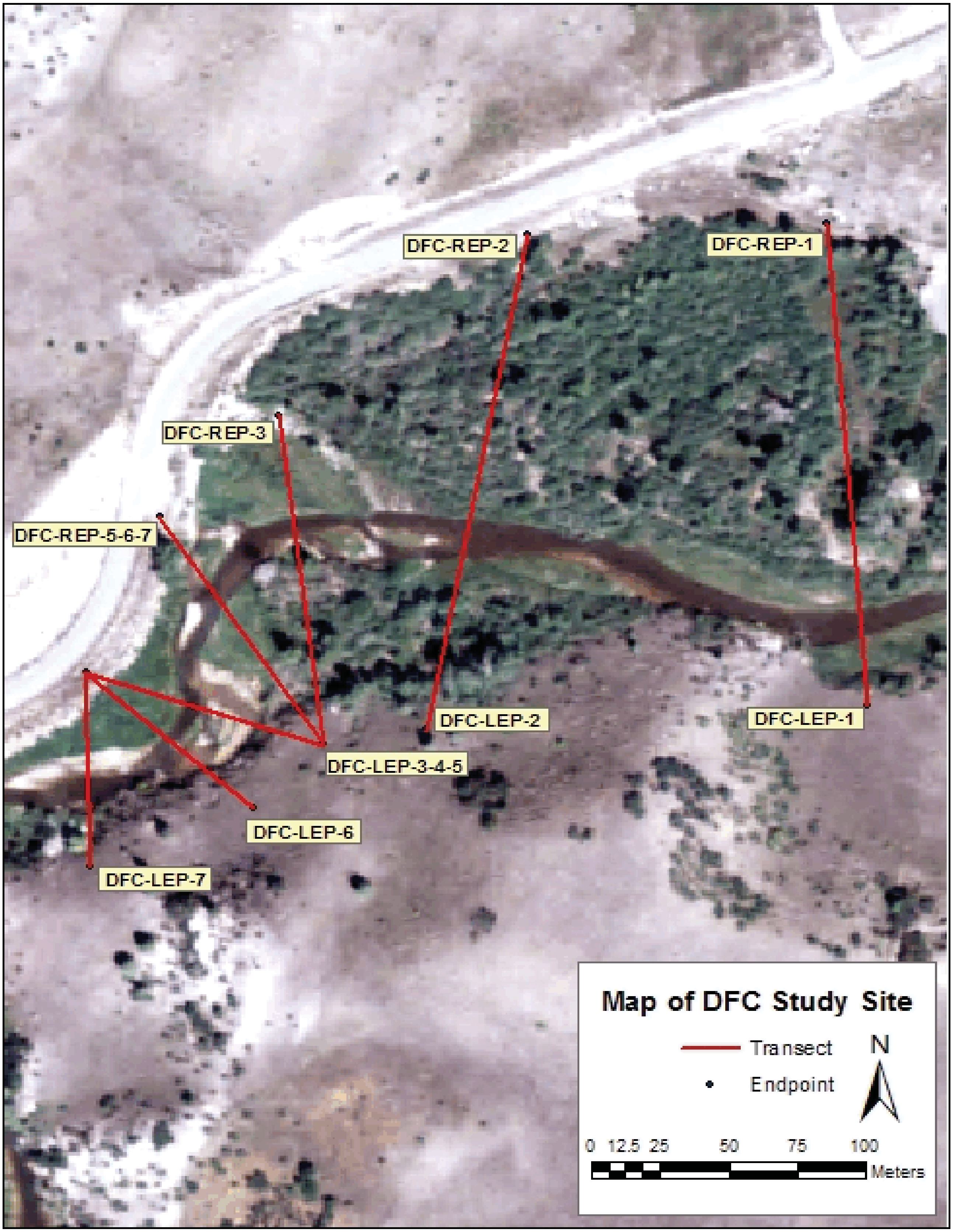



Figure 2.1c. Diamond Fork Creek (DFC) study site transects.

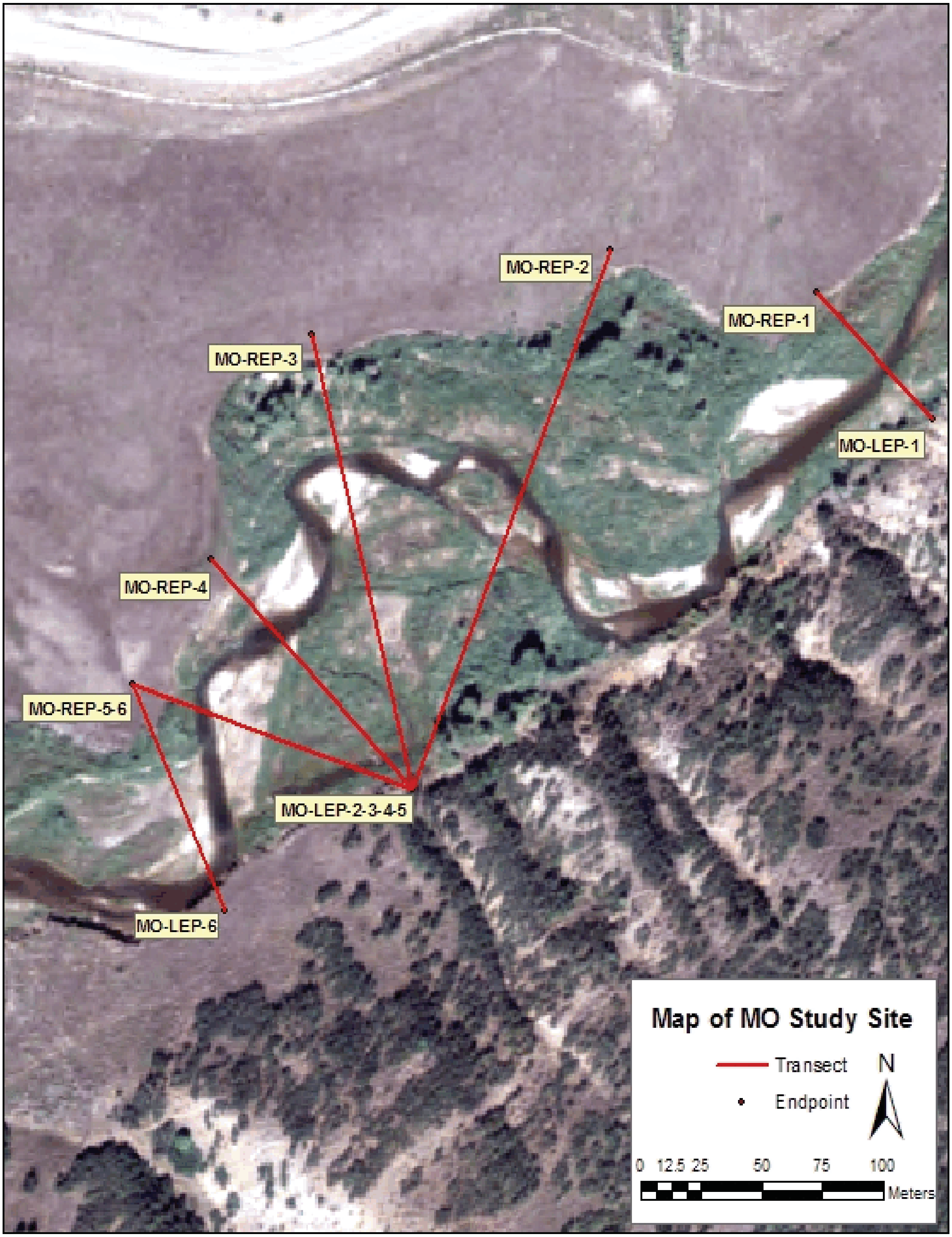



Figure 2.1d. Mother (MO) study site transects.


Figure 2.1e. Oxbow (OX) study site transects.

the side of the stream while facing downstream. The endpoint is also stamped with the study site abbreviation and transect number. Some transects share endpoints; therefore, each transect associated with an endpoint has the transect number stamped onto the cap. For example, the LEP for transects 5,6, and 7 at the DFC site is stamped as "DFC LEP 5,6,7." A submeter-grade global positioning system (GPS) was used to determine real-world horizontal coordinates in NAD83 data and elevations in NAVD 1988 feet for transect endpoints at the study sites.

In 2007 transect surveys were conducted in late fall. Sixth Water and RC site transects were surveyed October 10-11, 2007. Transects at the DFC, MO, and OX sites were surveyed October 24-26. The dates were chosen based on vegetation types and accessability. The sites were surveyed after vegetation, particularly leaves, had sufficiently dropped, since dense, leafed out-out trees often block the line of site along the transect. Sixth Water site endpoints were resurveyed with a total station in August 2006. The endpoints were tied to one set of GPS coordinates for endpoints that matched most closely with total station survey data. The updated endpoint coordinates for all reaches are presented in Appendix 2.1.

The total station was set up over one endpoint and assigned the real-world coordinates of that endpoint in the datalogger. The corresponding transect endpoint with real-world coordinates was used as the backsight. The survey data have northings and eastings relative to the two endpoint caps, thereby placing the subsequent transect survey data in the coordinate system with elevations in NAVD 1988.

To complete a transect, first the backsight endpoint cap was resurveyed with the total station to check for differences between the total station survey coordinates and the GPS coordinates for the endpoint. The rod person then placed the rod at points in a straight line (0 degrees plus or minus 5 minutes) between the two endpoints (Figure 2.2). Survey points included major changes in topography, both the left and right edges of water, the edges of backwaters, changes in vegetation, channel features such as bars and islands, presence of large woody debris, and the thalweg (deepest part of the stream at the transect).

The rod person would note in the field book which points corresponded to vegetation composition (species and percent) occurring between a given set of points. A height class (Table 2.1) was also recorded for the height of woody vegetation within a given area. Height class data collected for vegetation communities in 2007 will be compared with data from subsequent monitoring periods.

Changes in the extent of riparian species since construction of the pipeline can be assessed using cross-sectional transects of the riparian area. This study was designed to quantify the percent of vegetative community types along a cross section within geomorphic stream reaches. Data collected in 2007 will serve as the baseline data that will be compared with subsequent years' data to estimate the amount of change that has occurred within each study site. The topography and vegetation were surveyed simultaneously along the transect line to reduce the amount of effort required for each study.

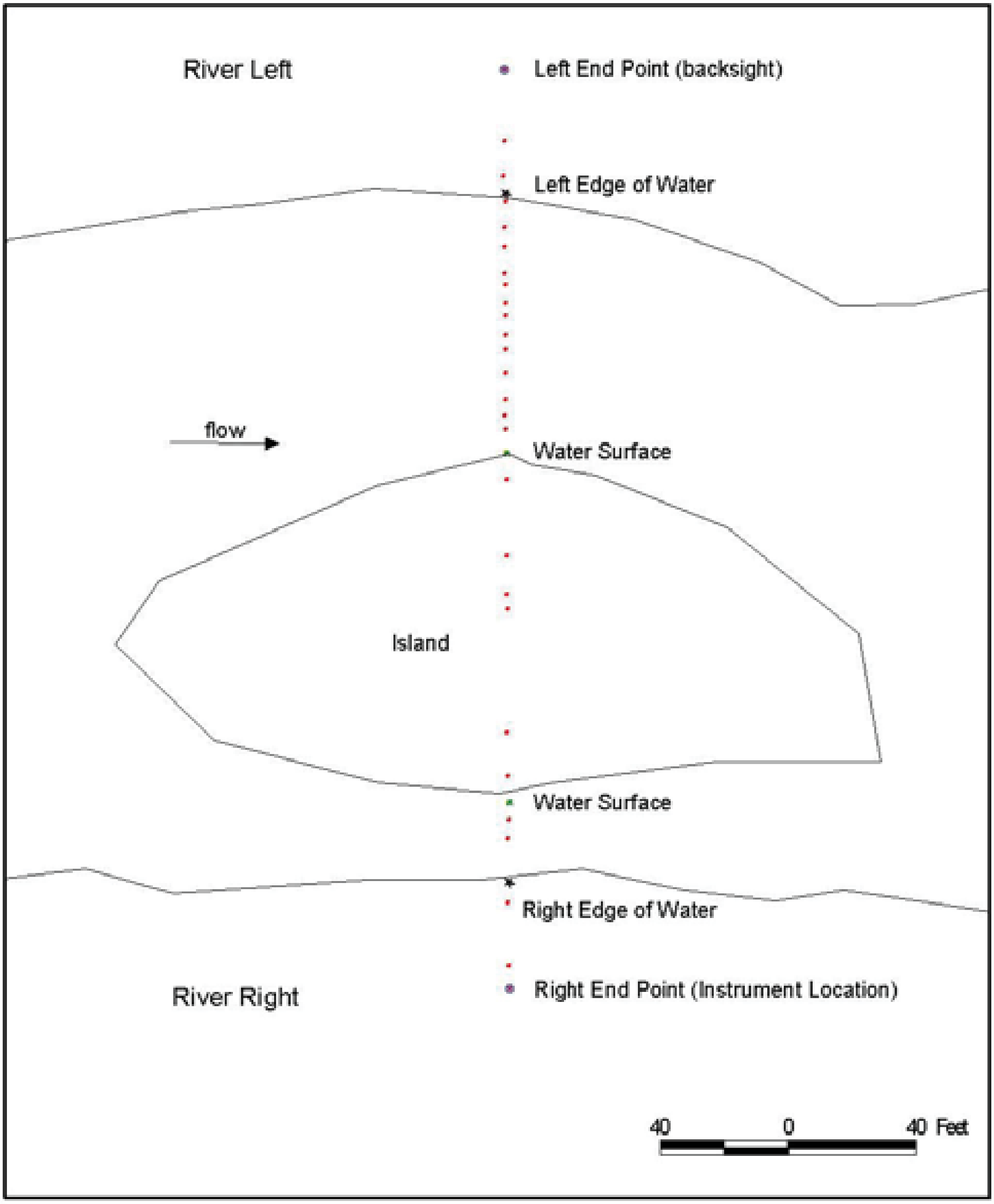



Figure 2.2. Cross-section survey methods: The instrument is set up over a permanent end point with known coordinates. The backsight is the opposite end point and also the point to which the instrument is zero-set. Survey points are taken by moving the rod and prism on line with the two endpoints, usually within +/- 5 minutes from the zero-set.

Table 2.1. Height codes for Diamond Fork vegetation transect surveys.

| CODE | *HEIGHT* | EXPLANATION | HEIGHT LOW | HEIGHT HIGH |
|---|---|---|---|---|
| H1 | +25 feet | Tallest Mature Trees | 25 | |
| H2 | 15-25 | Intermediate Height Trees | 15 | 25 |
| H3 | 6-15 | Tall Shrubs and Juvenile Trees | 6 | 15 |
| H4 | 4-6 | Intermediate Shrubs and Saplings | 4 | 6 |
| H5 | 0-4 | Low Shrubs and Young Saplings | 0 | 4 |
| NA | NA | Not Applicable | 0 | 0 |

A master list of species codes recorded during cross sectional transects for Diamond Fork and Sixth Water Creeks (Table 2.2). Comprehensive lists of all native and non-indigenous species found in the Diamond Fork and Sixth Water Creeks monitoring area are presented in Appendices 2.2a and 2.2b.

Table 2.2. Vegetation codes for Diamond Fork vegetation transect surveys.

| CODE | SCIENTIFIC NAME | COMMON NAME |
|---|---|---|
| ACGR3 | *Acer grandidentatum* | Bigtooth maple |
| ACMI2 | *Achillea millefolium* | Common yarrow |
| AGGI2 | *Agrostis gigantea* | Redtop |
| ALIN2 | *Alnus incana* | Gray alder |
| ARLU | *Artemisia ludoviciana* | White sagebrush |
| ARTR2 | *Artemisia tridentata* | Big sagebrush |
| ASUT | *Astragalus utahensis* | Utah milkvetch |
| BG | Bare ground | Bare ground |
| BEOC2 | *Betula occidentalis* | Water birch |
| BRIN2 | *Bromus inermis* | Smooth brome |
| BRTE | *Bromus tectorum* | Cheatgrass |
| CABU2 | *Capsella bursa-pastoris* | Shepherd's purse |
| CANU4 | *Carduus nutans* | Musk thistle |
| CALAA | *Carex lasiocarpa var. americana* | Wooly fruit sedge |
| CANE2 | *Carex nebrascensis* | Nebraska sedge |
| CAAQ3 | *Catabrosa aquatica* | Water whorlgrass |
| CHIV8 | *Chrysothamnus viscidiflorus* | Yellow rabbitbrush |
| CIDO | *Cicuta douglasii* | Western water hemlock |
| CIAR4 | *Cirsium arvense* | Canada thistle |

| CODE | SCIENTIFIC NAME | COMMON NAME |
|---|---|---|
| CIVU | *Cirsium vulgare* | Bull thistle |
| COAR4 | *Convolvulus arvensis* | Field bindweed |
| COCA5 | *Conyza canadensis* | Canadian horseweed |
| COSE16 | *Cornus sericea* | Redosier dogwood |
| CRDO2 | *Crataegus douglasii* | Black hawthorn |
| CYOF | *Cynoglossum officinale* | Hound's tongue |
| ELAN | *Elaeagnus angustifolia* | Russian olive |
| ELPA3 | *Eleocharis palustris* | Common spikerush |
| EQAR | *Equisetum arvense* | Field horsetail |
| EUOC4 | *Euthamia occidentalis* | Western goldentop |
| FEOV | *Festuca ovina* | Sheep fescue |
| FRVE | *Fragaria vesca* | Woodland strawberry |
| GEMA4 | *Geum macrophyllum* | Largeleaf avens |
| GRSQ | *Grinelia squarrosa* | Curlycup gumweed |
| HOJU | *Hordeum jubatum* | Foxtail barley |
| JUARL | *Juncus arcticus* ssp. *littoralis* | Baltic rush |
| JUCO2 | *Juncus confusus* | Colorado rush |
| JUTO | *Juncus torreyi* | *Torrey's rush* |
| JUSC2 | *Juniperus scopulorum* | Rocky Mountain juniper |
| LELA2 | *Lepidium latifolium* | Broadleaved pepperweed |
| LEPE2 | *Lepidium perfoliatum* | Clasping pepperweed |
| LECI4 | *Leymus cinereus* | Basin wildrye |
| LIDA | *Linaria dalmatica* | Dalmatian toadflax |
| LITTER | Litter | Litter |
| MARE11 | *Mahonia repens* | Creeping barbarry |
| MEOF | *Melilotus officinalis* | Sweetclover |
| PHAR3 | *Phalaris arundinacea* | Reed canarygrass |
| PLMA2 | *Plantago major* | Common plantain |
| POMO5 | *Polypogon monspeliensis* | Annual rabbitsfoot grass |
| POAN3 | *Populus angustifolia* | Narrowleaf cottonwood |
| PSSP6 | *Pseudoroegneria spicata* | Bluebunch wheatgrass |
| PSME | *Pseudotsuga menziesii* | Douglas-fir |

| CODE | SCIENTIFIC NAME | COMMON NAME |
|---|---|---|
| PUTR2 | *Purshia tridentata* | Antelope bitterbrush |
| QUGA | *Quercus gambelii* | Gambel oak |
| RACY | *Ranunculus cymbalaria* | Alkali buttercup |
| RHTR | *Rhus trilobata* | Skunkbush sumac |
| ROCK | Rock | Rock |
| ROWO | *Rosa woodsii* | Wood's rose |
| RUCR | *Rumex crispus* | Curly dock |
| SABO2 | *Salix boothii* | Booth's willow |
| SAEX | *Salix exigua* | Coyote willow |
| SALU | *Salix lucida* | Shining willow |
| SARA2 | *Sambucus racemosa* | Red elderberry |
| SCPR4 | *Schedonorus pratensis* | Meadow fescue |
| SOCA6 | *Solidago canadensis* | Canada goldenrod |
| SPCR | *Sporobolus cryptandrus* | Sand dropseed |
| SYOR2 | *Symphoricarpos oreophilus* | Mountain snowberry |
| SYEA2 | *Symphyotrichum eatonii* | Eaton's aster |
| SYMPH4 | *Symphyotrichum species* | Aster |
| THIN6 | *Thinopyrum intermedium* | Intermediate wheatgrass |
| TRDU | *Tragopogon dubius* | Yellow salsify |
| TRRE3 | *Trifolium repens* | White clover |
| TYLA | *Typha latifolia* | Broadleaf cattail |
| URDI | *Urtica dioica* | Stinging nettle |
| VETH | *Verbascum thapsus* | Common mullein |
| VEAN2 | *Veronica anagallis-aquatica* | Water speedwell |
| WATER | Water | Water |

## 2.2.1 Data Input

Once the survey data are downloaded as text files, they are imported into Microsoft® Excel. The survey data have columns for point number, northing, easting, elevation, and description. The description column is entered into the datalogger and consists of a simple description of the point. The actual vegetation description from the field book is manually input into the Excel spreadsheet. Additional columns for scientific name, common name, height (1, 2, or 3), percent cover, growth habit (herbaceous or woody), Wetland Indicator Status, and native status were added to the spreadsheet from the vegetation description. The complete dataset for each site is shown in Appendix 2.3a and 2.3b, and example transects from each site are plotted in Appendix 2.4.

One topographical location represents a vegetation boundary. Species and percent cover were recorded in a field notebook. Cover types, such as bare ground, rock, and litter, were also recorded. Vegetation communities were assigned absolute cover to account for multiple layers of canopy. Topographical locations marked the terminus of one vegetation community and the beginning of another.

The data are sorted by northing or easting so that the LEP is the top of the transect data and the REP is at the end of the transect data (Figures 2.3 and 2.4).

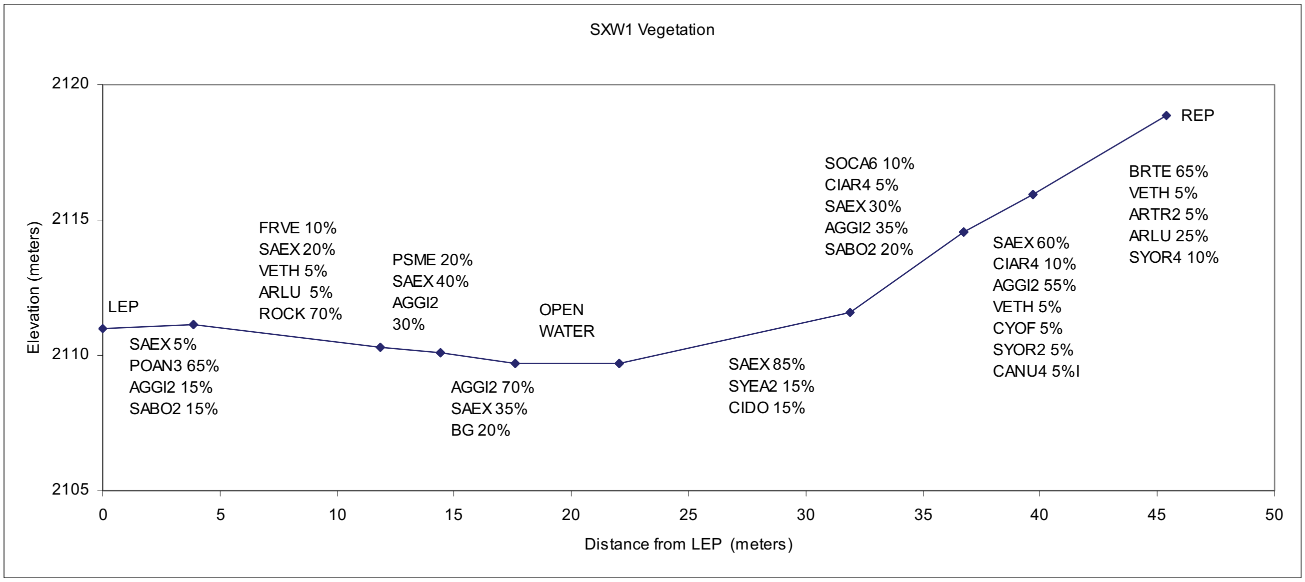



Figure 2.3. Example of a vegetation transect survey done with a total station. Each survey point marks the right endpoint of a vegetation community. Therefore, LEP to the next point along the transect recorded marks the vegetation community that is comprised of SAEX, POAN3, AGG12, and SABO2 (narrowleaf willow, narrowleaf cottonwood, redtop and Booth's willow).

## 2.2.2 Data Analysis

The species encountered were assigned classifications based on species and structure. Dominant species were then separated, and their specific vegetative traits were assessed. The lengths that each of the species occupied along the transect were calculated and compared. Lengths along the transect that contained communities dominated by more than one species were multiplied by the percent, or cover recorded, representing relative cover along that portion of the transect. Specific characteristics were assigned for all known species from the USDA NRCS PLANTS database (USDA NRCS 2007). The lengths of the transects were then totaled and averaged for the transects and reaches. The species encountered were assigned classifications based on species structure/growth form, height, wetland indicator status (UPL, FACU, FAC, FACW, FACU, OBL), and life cycle (annual, perennial, biannual). Dominant species were also classifies based on native status (indigenous, nonindigenous) as well as their specific vegetative traits including forb, grass, woody, and graminoid (sedges/rushes and grass-like species) and  assessed to provide a baseline for lateral vegetation composition.

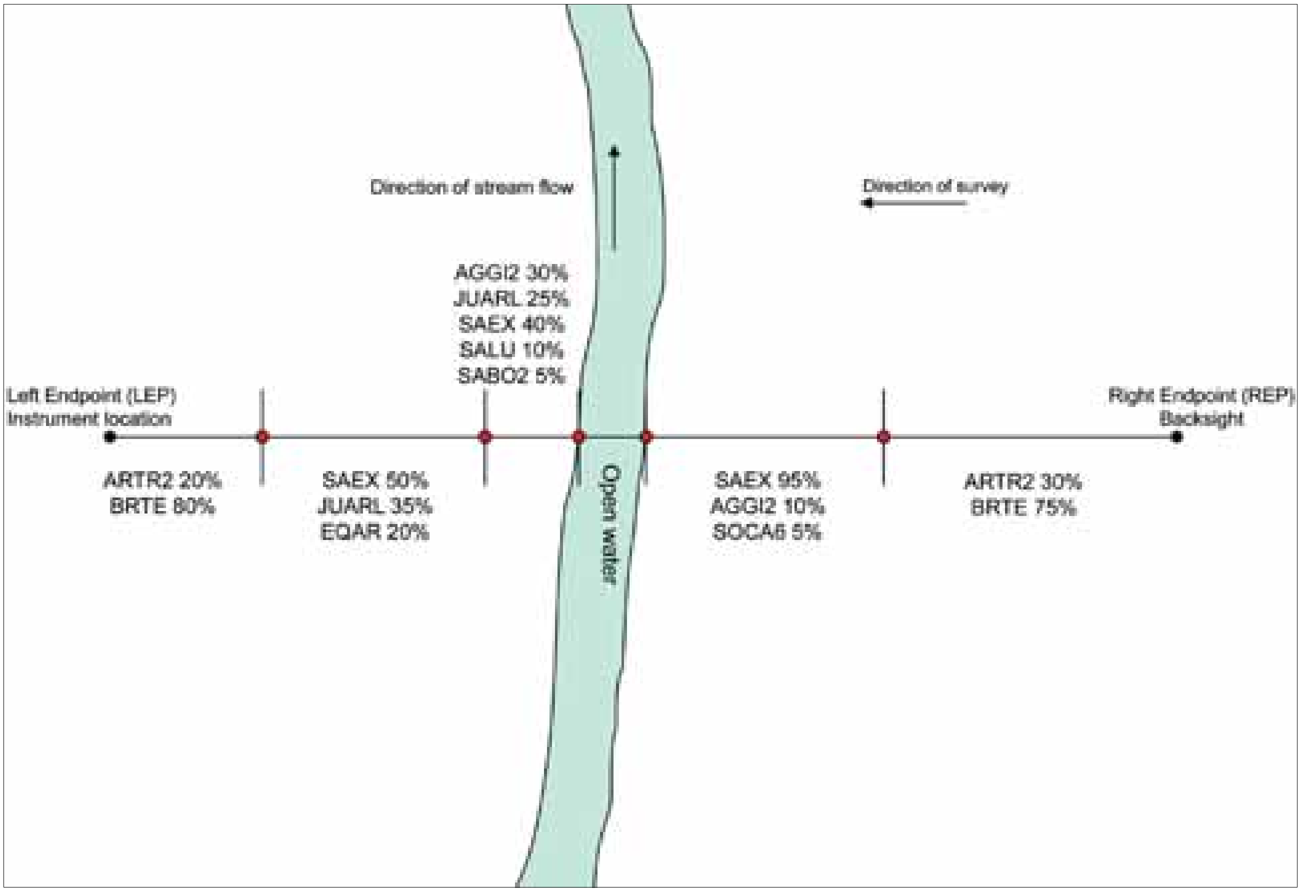



Figure 2.4. Survey method used to gather vegetation transect data.

This analysis provides information on the location, extent of riparian communities, and topographic position and can be used as a baseline for subsequent long-term monitoring.

## 2.3 RESULTS

### 2.3.1 Growth Form and Native Status

This section examines the current riparian zone characteristics including: growth habit, Wetland Indicator Status, life cycle, species composition, and native status of species. The study showed that woody vegetation composes 38 percent of absolute cover of all reaches. Herbaceous vegetation—which includes forbs, graminoids, and grass—makes up 51 percent of absolute cover when all reaches are combined (Table 2.3). Figure 2.5 shows the growth habit and native status of each reach. Woody vegetation, predominantly willow species, was the dominant cover type found within the SXW, RC, and OX reaches. The second most dominant growth habit found within these reaches were graminoid species. Graminoids, grass-like species including sedges and rushes, dominated DFC and MO. Currently, wetland vegetation dominates all reaches, and upland vegetation present along transects is primarily a function of transect end point placement that results in varying amounts of upland vegetation.

| Forb | | Sedges/Rushes | | Grass | | Woody | | Open Water | | Bare Ground | | Rock | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Distance (ft) | Percent | Distance (ft) | Percent | (Distance (ft) | Percent | Distance (ft) | Percent | Distance (ft) | Percent | Distance (ft) | Percent | Distance (ft) | Percent |
| 18.37 | 11.52% | 1.89 | 1.18% | 34.78 | 21.81% | 78.93 | 49.49% | 14.78 | 9.27% | 10.73 | 6.73% | | |
| 2.79 | 1.76% | 4.52 | 2.85% | 21.41 | 13.48% | 70.53 | 44.41% | 53.99 | 33.99% | 1.39 | 0.88% | | |
| 7.90 | 4.61% | 18.36 | 10.72% | 20.27 | 11.84% | 82.04 | 47.91% | 26.15 | 15.27% | 16.51 | 9.64% | | |
| 78.25 | 17.22% | 129.93 | 28.60% | 32.35 | 7.12% | 172.45 | 37.96% | 10.44 | 2.30% | 1.16 | 0.26% | 29.75 | 6.55% |
| 22.01 | 8.58% | 139.47 | 54.41% | 22.34 | 8.71% | 59.82 | 23.34% | 7.90 | 3.08% | 2.68 | 1.04% | 2.14 | 0.83% |
| 6.84 | 2.29% | 17.37 | 5.82% | 127.32 | 42.63% | 107.65 | 36.05% | 35.44 | 11.87% | 0.01 | 0.00% | 2.23 | 0.75% |
| **136.15** | **9.08%** | **311.54** | **20.79%** | **258.47** | **17.24%** | **571.42** | **38.12%** | **148.69** | **9.92%** | **32.49** | **2.17%** | **34.12** | **2.28%** |
| 35.98 | 12.02% | | | 41.66 | 13.92% | 173.29 | 57.91% | 34.57 | 11.55% | 10.82 | 3.62% | | |
| 34.29 | 9.43% | | | 70.11 | 19.28% | 209.11 | 57.51% | 39.27 | 10.80% | 10.79 | 2.97% | | |
| 2.95 | 1.17% | | | 44.17 | 17.55% | 180.48 | 71.73% | 24.01 | 9.54% | 0.00 | 0.00% | | |
| 37.25 | 8.19% | 2.32 | 0.51% | 70.68 | 15.54% | 286.88 | 63.10% | 20.61 | 4.53% | 23.29 | 5.12% | 13.66 | 3.00% |
| 42.89 | 9.27% | 16.35 | 3.53% | 36.09 | 7.80% | 340.43 | 73.55% | 27.08 | 5.85% | | | | |
| 2.19 | 0.47% | 0.59 | 0.13% | 67.28 | 14.51% | 340.20 | 73.35% | 46.94 | 10.12% | 6.58 | 1.42% | | |
| **155.56** | **6.78%** | **19.26** | **0.84%** | **329.98** | **14.37%** | **1,530.39** | **66.66%** | **192.47** | **8.38%** | **51.47** | **2.24%** | **13.66** | **0.59%** |
| 91.28 | 11.78% | 169.60 | 21.89% | 161.56 | 20.85% | 313.57 | 40.47% | 38.74 | 5.00% | | | | |
| 302.17 | 42.47% | 29.84 | 4.19% | 194.59 | 27.35% | 175.54 | 24.67% | 9.43 | 1.33% | | | | |
| 20.72 | 4.56% | 46.24 | 10.18% | 173.57 | 38.22% | 142.13 | 31.29% | 48.10 | 10.59% | 14.16 | 3.12% | 9.24 | 2.04% |
| 22.19 | 6.74% | 11.91 | 3.61% | 204.68 | 62.13% | 35.72 | 10.84% | 39.20 | 11.90% | 9.64 | 2.92% | 6.12 | 1.86% |
| 56.93 | 20.12% | 18.07 | 6.39% | 133.97 | 47.36% | 59.11 | 20.90% | 9.88 | 3.49% | 4.93 | 1.74% | | |
| 36.02 | 14.12% | 22.51 | 8.83% | 97.76 | 38.33% | 55.96 | 21.94% | 14.39 | 5.64% | 28.39 | 11.13% | | |
| 41.83 | 16.17% | 38.00 | 14.69% | 78.51 | 30.35% | 45.19 | 17.47% | 12.16 | 4.70% | 14.16 | 5.47% | 28.85 | 11.15% |
| **571.12** | **18.62%** | **336.17** | **10.96%** | **1044.65** | **34.07%** | **827.22** | **26.98%** | **171.89** | **5.61%** | **71.27** | **2.32%** | **44.21** | **1.44%** |
| 12.28 | 4.48% | 38.41 | 14.00% | 126.45 | 46.10% | 70.71 | 25.78% | 8.66 | 3.16% | 17.79 | 6.49% | | |
| 67.42 | 7.80% | 73.39 | 8.49% | 386.94 | 44.78% | 281.43 | 32.57% | 50.19 | 5.81% | | | | |
| 42.37 | 6.28% | 22.81 | 3.38% | 350.97 | 51.98% | 156.56 | 23.19% | 57.04 | 8.45% | 18.97 | 2.81% | 23.64 | 3.50% |
| 37.01 | 7.54% | 27.67 | 5.64% | 214.63 | 43.72% | 125.45 | 25.56% | 80.11 | 16.32% | 6.00 | 1.22% | | |
| 73.65 | 17.48% | 61.54 | 14.61% | 156.65 | 37.17% | 79.46 | 18.86% | 34.44 | 8.17% | 10.07 | 2.39% | 3.59 | 0.85% |
| 42.31 | 15.70% | 8.31 | 3.08% | 105.88 | 39.29% | 54.25 | 20.13% | 30.84 | 11.45% | 4.62 | 1.71% | 23.26 | 8.63% |
| **275.03** | **9.18%** | **232.12** | **7.75%** | **1341.52** | **44.79%** | **767.85** | **25.64%** | **261.28** | **8.72%** | **57.46** | **1.92%** | **50.49** | **1.69%** |
| 17.78 | 3.39% | 20.11 | 3.84% | 96.31 | 18.38% | 288.38 | 55.04% | 8.99 | 1.72% | 10.43 | 1.99% | 81.95 | 15.64% |
| 83.67 | 15.83% | 6.78 | 1.28% | 149.82 | 28.35% | 229.85 | 43.50% | 8.66 | 1.64% | 10.61 | 2.01% | 29.26 | 5.54% |
| 49.22 | 8.30% | 36.98 | 6.24% | 189.18 | 31.90% | 259.52 | 43.76% | 25.82 | 4.35% | 1.97 | 0.33% | 30.32 | 5.11% |
| 130.54 | 18.25% | 31.99 | 4.47% | 221.56 | 30.98% | 227.95 | 31.87% | 11.36 | 1.59% | 34.03 | 4.76% | 57.78 | 8.08% |
| 79.30 | 11.71% | 133.35 | 19.70% | 121.74 | 17.98% | 258.95 | 38.25% | 61.57 | 9.09% | 12.74 | 1.88% | 9.39 | 1.39% |
| 127.02 | 17.21% | 53.34 | 7.23% | 242.44 | 32.86% | 283.91 | 38.48% | 12.30 | 1.67% | 18.86 | 2.56% | | |
| 270.85 | 38.66% | 23.30 | 3.33% | 124.91 | 17.83% | 208.41 | 29.75% | 63.98 | 9.13% | 9.07 | 1.29% | | |
| 16.08 | 5.19% | 75.97 | 24.54% | 90.53 | 29.24% | 107.10 | 34.59% | 19.97 | 6.45% | | | | |
| **774.46** | **16.18%** | **381.82** | **7.98%** | **1,236.49** | **25.84%** | **1,864.06** | **38.95%** | **212.65** | **4.44%** | **97.71** | **2.04%** | **208.70** | **4.36%** |

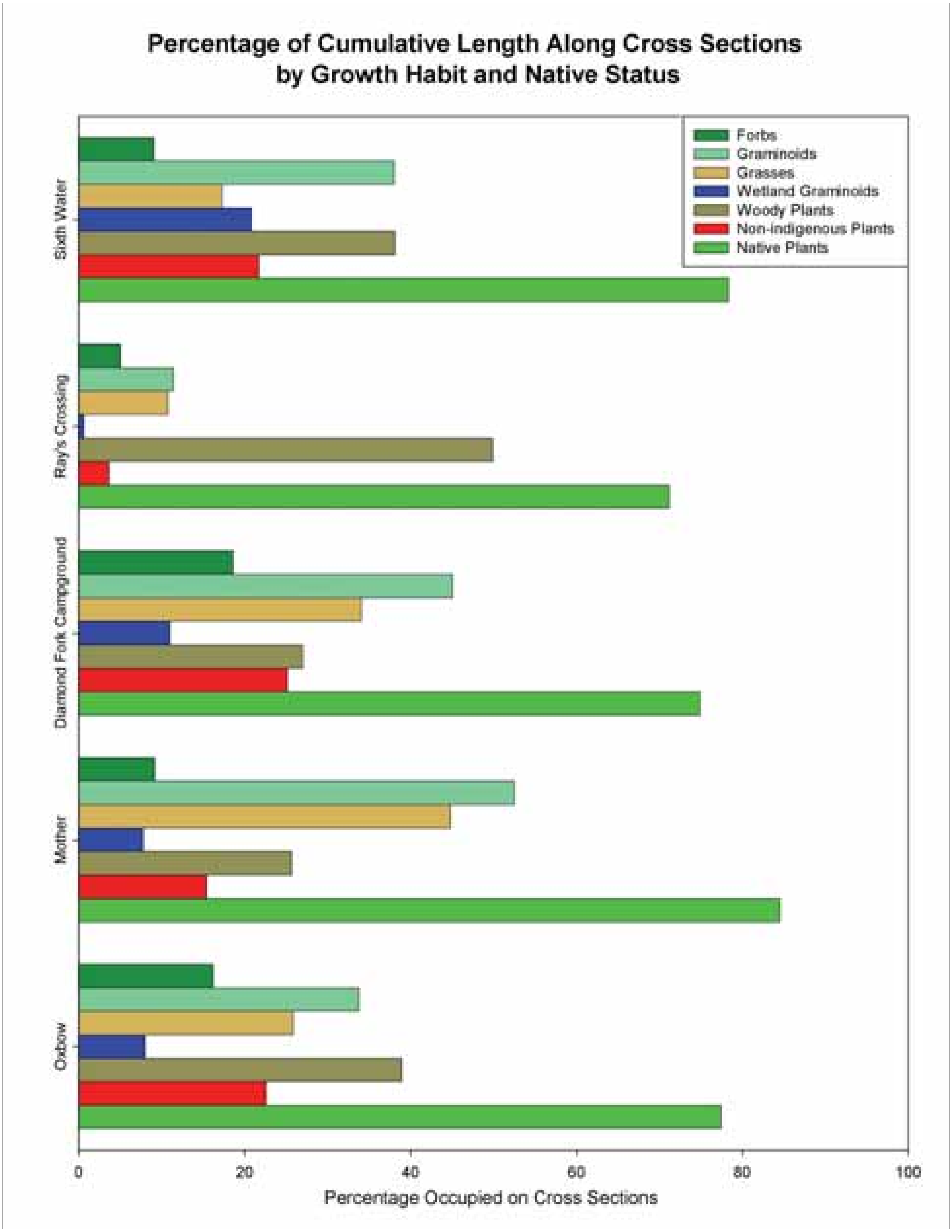



Figure 2.5. Length occupied along reach as classified by growth habit and native status.

Table 2.4 illustrates the proportion of native and non-indigenous species found within each reach. Non-indigenous species were more abundant within the OX and DFC reaches. Generally, weedy vegetation was similar between reaches surveyed. Site RC showed the lowest amount of linear feet infested with non-indigenous species, only 5 percent (Table 2.4). The DFC reach had the highest rate of non-indigenous species observed at 25 percent. The SXW (22%), MO (15%), and OX (23%) reaches had similar rates of infestation. Table 2.5 lists species found along transects and the percentage and length individual species occupies by reach. Redtop (*Agrostis gigantea*) is technically listed as a non-indigenous species (USDA 2008); however, because it has become so naturalized throughout lower North America, the authors did not classify it as such.

Table 2.4. Percentage of native and non-indigenous species found within reaches.

| REACH | NATIVE STATUS | | | | GRAND TOTAL |
|---|---|---|---|---|---|
| | Native | | Non-indigenous | | |
| | Distance (ft) | Percent | Distance (ft) | Percent | |
| SXW | 1,173.95 | 78.32% | 324.90 | 21.68% | 1,498.85 |
| RC | 2,184.39 | 95.15% | 111.32 | 4.85% | 2,295.71 |
| DFC | 2,294.68 | 74.83% | 771.87 | 25.17% | 3,066.54 |
| MO | 2,533.55 | 84.59% | 461.68 | 15.41% | 2,995.22 |
| OX | 3,705.37 | 77.43% | 1,080.29 | 22.57% | 4,785.66 |
| Grand Total | 11,891.93 | 81.22% | 2,750.05 | 18.78% | 14,641.99 |

## 2.3.2 Wetland Indicator Status

The wetland status of species comprising vegetation communities varied between sites, which may be a function of transect placement, channel width, and the different vegetation community dynamics of individual reaches. Table 2.6 shows a detailed summary of Wetland Indicator Status for each transect within individual reaches. Species were classified into a National Wetland Indicator (NWI) Status Category (USFWS 1988, 1993). These indicators reflect the range of estimated probabilities of a species occurring in wetlands versus non-wetlands across the entire distribution of the species (Reed 1993). The NWI classifications are as follows:

| | |
|---|---|
| Obligate Wetland (OBL) | Occurs almost always (estimated probability 99%) under natural conditions in wetlands. |
| Facultative Wetland (FACW) | Usually occurs in wetlands (estimated probability 67-99%) but is occasionally found in non-wetlands. |
| Facultative (FAC) | Equally likely to occur in wetlands or non-wetlands (estimated probability 34-66%). |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Artemisia ludoviciana* | 49.97 | 65.38% | 7.45 | 9.75% | 15.67 | 20.50% | | | 3.34 | 4.37% | 76.4 |
| | *Artemisia tridentata* | 78.86 | 43.06% | 65.37 | 35.69% | 6.37 | 3.48% | 10.30 | 5.62% | 22.24 | 12.14% | 183. |
| | *Asclepias speciosa* | | | | | | | | | 4.13 | 100.00% | 4.1 |
| | Bare Ground | 32.49 | 10.47% | 51.47 | 16.58% | 71.27 | 22.96% | 57.46 | 18.51% | 97.71 | 31.48% | 310. |
| | *Betula occidentalis* | | | 338.37 | 89.04% | 35.01 | 9.21% | 6.65 | 1.75% | | | 380. |
| | *Carex luzulina* | | | 0.45 | 100.00% | | | | | | | 0.4 |
| | *Carex nebrascensis* | 14.98 | 35.81% | | | 20.89 | 49.93% | | | 5.96 | 14.26% | 41.8 |
| | *Carex pellita* | | | | | | | 27.81 | 100.00% | | | 27.8 |
| | *Catabrosa aquatica* | 16.32 | 100.00% | | | | | | | | | 16.3 |
| | *Chrysothamnus viscidiflorus* | | | 7.97 | 99.60% | | | | | 0.03 | 0.40% | 8.0 |
| | *Cicuta douglasii* | 2.93 | 42.03% | | | 4.04 | 57.97% | | | | | 6.9 |
| | *Conyza canadensis* | | | | | 1.74 | 38.09% | 0.77 | 16.76% | 2.07 | 45.15% | 4.5 |
| | *Cornus sericea* | | | 21.82 | 72.07% | 6.73 | 22.21% | | | 1.73 | 5.72% | 30.2 |
| | *Crataegus douglasii* | 9.74 | 39.16% | 3.08 | 12.36% | 12.06 | 48.48% | | | | | 24.8 |
| | *Eleocharis palustris* | | | 0.14 | 0.12% | | | 16.63 | 14.45% | 98.34 | 85.43% | 115. |
| | *Equisetum arvense* | | | | | 59.84 | 25.65% | 27.67 | 11.86% | 145.79 | 62.49% | 233. |
| | *Euthamia occidentalis* | | | 4.62 | 1.10% | 96.08 | 22.86% | 83.04 | 19.75% | 236.66 | 56.29% | 420. |
| | *Fragaria vesca* | 3.66 | 100.00% | | | | | | | | | 3.6 |
| | *Geum macrophyllum* | 0.71 | 100.00% | | | | | | | | | 0.7 |
| | *Grindelia squarrosa* | | | | | 140.70 | 93.09% | 6.19 | 4.09% | 4.26 | 2.82% | 151. |
| | *Hordeum jubatum* | | | | | | | 2.18 | 78.63% | 0.59 | 21.37% | 2.7 |
| | *Juncus arcticus* ssp. *littoralis* | | | 18.67 | 3.99% | 218.80 | 46.81% | 159.62 | 34.15% | 70.35 | 15.05% | 467. |
| | *Juncus confusus* | | | | | | | 0.33 | 60.94% | 0.21 | 39.06% | 0.5 |
| | *Juncus torreyi* | | | | | 0.70 | 22.34% | | | 2.44 | 77.66% | 3.1 |
| | *Juniperus scopulorum* | 1.50 | 29.89% | | | 3.46 | 68.83% | | | 0.06 | 1.27% | 5.0 |
| | *Leymus cinereus* | | | | | 1.65 | 100.00% | | | | | 1.6 |
| | *Linum lewisii* | | | | | 2.03 | 100.00% | | | | | 2.0 |
| | Litter | 5.97 | 21.22% | 2.93 | 10.41% | | | 9.47 | 33.68% | 9.75 | 34.68% | 28.1 |
| | *Mahonia repens* | | | 10.14 | 98.38% | 0.17 | 1.62% | | | | | 10.3 |
| | Open Water | 148.69 | 15.07% | 192.47 | 19.50% | 171.89 | 17.42% | 261.28 | 26.47% | 212.65 | 21.55% | 986. |
| | *Phalaris arundinacea* | 103.84 | 8.18% | | | 246.96 | 19.46% | 653.35 | 51.49% | 264.66 | 20.86% | 1268 |
| | *Polypogon monspeliensis* | | | | | | | | | 3.82 | 100.00% | 3.8 |
| | *Populus angustifolia* | 34.85 | 3.34% | 234.59 | 22.46% | 57.56 | 5.51% | 42.28 | 4.05% | 675.22 | 64.65% | 1044 |
| | *Pseudoroegneria spicata* | | | | | 17.61 | 100.00% | | | | | 17.6 |
| | *Purshia tridentata* | 3.25 | 16.80% | 16.10 | 83.20% | | | | | | | 19.3 |
| | *Quercus gambelii* | | | 52.30 | 100.00% | | | | | | | 52.3 |
| | *Ranunculus cymbalaria* | | | | | | | | | 3.03 | 100.00% | 3.0 |
| | *Rhus trilobata* | | | 42.55 | 38.54% | 67.86 | 61.46% | | | | | 110. |
| | Rock | 34.12 | 9.72% | 13.66 | 3.89% | 44.21 | 12.59% | 50.49 | 14.38% | 208.70 | 59.43% | 351. |
| | *Rosa woodsii* | 33.63 | 54.33% | 19.13 | 30.91% | 8.44 | 13.63% | 0.61 | 0.98% | 0.10 | 0.15% | 61.9 |
| | *Salix boothii* | 58.19 | 12.98% | 48.21 | 10.75% | 109.80 | 24.49% | 52.64 | 11.74% | 179.52 | 40.04% | 448. |
| | *Salix exigua* | 310.70 | 13.13% | 469.24 | 19.83% | 276.75 | 11.69% | 557.14 | 23.54% | 752.67 | 31.81% | 2366 |
| | *Salix lucida* | | | 132.45 | 19.99% | 202.67 | 30.59% | 97.80 | 14.76% | 229.54 | 34.65% | 662. |
| | *Sambucus racemosa* | 0.28 | 100.00% | | | | | | | | | 0.2 |
| | *Solidago canadensis* | 1.03 | 0.57% | | | | | 56.62 | 31.32% | 123.10 | 68.11% | 180. |
| | *Symphoricarpos oreophilus* | 40.41 | 36.77% | 69.07 | 62.84% | | | 0.43 | 0.39% | | | 109. |
| | *Symphyotrichum eatonii* | 13.25 | 23.90% | | | 28.68 | 51.74% | 0.17 | 0.31% | 13.33 | 24.05% | 55.4 |
| | *Symphyotrichum species* | | | 14.46 | 100.00% | | | | | | | 14.4 |
| | *Typha latifolia* | | | | | 7.80 | 21.25% | | | 28.90 | 78.75% | 36.7 |
| | *Urtica dioica* | 8.76 | 100.00% | | | | | | | | | 8.7 |
| | *Veronica americana* | 11.18 | 36.07% | | | 15.03 | 48.49% | 2.69 | 8.66% | 2.10 | 6.78% | 31.0 |
| ive Total | | **1173.95** | **9.87%** | **2184.39** | **18.37%** | **2294.68** | **19.30%** | **2533.55** | **21.30%** | **3705.37** | **31.16%** | **11891** |
| | *Bromus inermis* | | | | | 414.00 | 32.25% | 262.45 | 20.44% | 607.37 | 47.31% | 1283 |
| | *Bromus tectorum* | 280.24 | 86.44% | | | 24.35 | 7.51% | | | 19.60 | 6.05% | 324. |
| | *Capsella bursa-pastoris* | | | | | | | 9.51 | 100.00% | | | 9.5 |
| | *Carduus nutans* | 1.12 | 7.42% | | | 4.32 | 28.65% | 2.63 | 17.41% | 7.02 | 46.53% | 15.0 |
| | *Cirsium arvense* | 7.02 | 2.85% | 2.21 | 0.90% | 31.33 | 12.71% | 84.74 | 34.38% | 121.16 | 49.16% | 246. |
| | *Cirsium vulgare* | | | | | 1.91 | 9.82% | 3.81 | 19.57% | 13.75 | 70.61% | 19.4 |
| | *Convolvulus arvensis* | | | | | | | 3.45 | 100.00% | | | 3.4 |

| | OBL* | | FACW+ | | FACW | | FAC+ | | FAC | | FAC- | | FAC* | | FACU | | UPL | | NI | | Open Water | | Bare Gro |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ent | Distance (ft) | Percent | Distance (ft) | Percent | Distance (ft) | Percent | Distance (ft) | Percent | Distance (ft) | Percent | Distance (ft) | Percent | Distance (ft) | Percent | Distance (ft) | Percent | Distance (ft) | Percent | Distance (ft) | Percent | Distance (ft) | Percent | Distance (ft) |
| 9% | 32.56 | 20.42% | | | 31.95 | 20.04% | | | 11.39 | 7.14% | 8.72 | 5.47% | 9.57 | 6.00% | 0.08 | 0.05% | 6.85 | 4.30% | | | 14.78 | 9.27% | 10.73 |
| 8% | 0.52 | 0.33% | | | 21.41 | 13.48% | | | 0.78 | 0.49% | 22.23 | 14.00% | 12.28 | 7.73% | 1.21 | 0.76% | 8.47 | 5.33% | | | 53.99 | 33.99% | 1.39 |
| 2% | 5.00 | 2.92% | | | 20.27 | 11.84% | | | | | 0.67 | 0.39% | 3.34 | 1.95% | 1.66 | 0.97% | 0.33 | 0.20% | | | 26.15 | 15.27% | 16.51 |
| 1% | | | | | 32.35 | 7.12% | | | 14.14 | 3.11% | | | 0.14 | 0.03% | 73.86 | 16.26% | 223.38 | 49.17% | | | 10.44 | 2.30% | 1.16 |
| 5% | 0.60 | 0.24% | | | 20.42 | 7.97% | | | 4.80 | 1.87% | 2.00 | 0.78% | 1.60 | 0.62% | 21.37 | 8.34% | 152.72 | 59.58% | | | 7.90 | 3.08% | 2.68 |
| 6% | 19.51 | 6.53% | | | 28.22 | 9.45% | | | 0.65 | 0.22% | 0.02 | 0.01% | 7.92 | 2.65% | 1.86 | 0.62% | 12.07 | 4.04% | | | 35.44 | 11.87% | 0.01 |
| 3% | 58.19 | 3.88% | | | 154.63 | 10.32% | | | 31.76 | 2.12% | 33.63 | 2.24% | 34.85 | 2.33% | 100.04 | 6.67% | 403.83 | 26.94% | | | 148.69 | 9.92% | 32.49 |
| 3% | 7.68 | 2.56% | | | 94.19 | 31.48% | | | | | 9.52 | 3.18% | 8.89 | 2.97% | 41.12 | 13.74% | 30.18 | 10.09% | | | 34.57 | 11.55% | 10.82 |
| 3% | | | | | 106.50 | 29.29% | | | 3.08 | 0.85% | 3.93 | 1.08% | 28.55 | 7.85% | 28.32 | 7.79% | 45.09 | 12.40% | 5.97 | 1.64% | 39.27 | 10.80% | 10.79 |
| 0% | 13.52 | 5.37% | | | 59.31 | 23.57% | | | | | | | 60.21 | 23.93% | 2.95 | 1.17% | 12.09 | 4.81% | | | 24.01 | 9.54% | 0.00 |
| 8% | 6.14 | 1.35% | | | 180.31 | 39.66% | | | | | 5.69 | 1.25% | 21.19 | 4.66% | 54.76 | 12.04% | 21.42 | 4.71% | 35.86 | 7.89% | 20.61 | 4.53% | 23.29 |
| 8% | 20.88 | 4.51% | | | 110.18 | 23.80% | | | | | | | 44.91 | 9.70% | 53.42 | 11.54% | 36.25 | 7.83% | 15.18 | 3.28% | 27.08 | 5.85% | |
| 8% | | | | | 158.37 | 34.15% | | | | | | | 70.85 | 15.28% | 21.77 | 4.69% | 10.03 | 2.16% | | | 46.94 | 10.12% | 6.58 |
| 4% | 48.21 | 2.10% | | | 708.85 | 30.88% | | | 3.08 | 0.13% | 19.13 | 0.83% | 234.59 | 10.22% | 202.35 | 8.81% | 155.06 | 6.75% | 57.01 | 2.48% | 192.47 | 8.38% | 51.47 |
| 8% | 18.63 | 2.40% | | | 257.98 | 33.30% | 27.39 | 3.54% | 70.17 | 9.06% | | | 35.62 | 4.60% | 21.05 | 2.72% | 80.05 | 10.33% | 11.44 | 1.48% | 38.74 | 5.00% | |
| 0% | | | | | 102.10 | 14.35% | 4.93 | 0.69% | 13.98 | 1.96% | | | 6.14 | 0.86% | 290.86 | 40.88% | 79.86 | 11.22% | 11.39 | 1.60% | 9.43 | 1.33% | |
| 9% | 37.46 | 8.25% | | | 84.21 | 18.54% | 12.26 | 2.70% | | | | | 6.17 | 1.36% | 10.58 | 2.33% | 86.58 | 19.06% | 18.27 | 4.02% | 48.10 | 10.59% | 14.16 |
| 7% | 1.91 | 0.58% | | | 27.33 | 8.30% | 6.56 | 1.99% | | | 1.05 | 0.32% | | | 49.92 | 15.15% | 80.09 | 24.31% | 13.85 | 4.20% | 39.20 | 11.90% | 9.64 |
| 0% | 24.61 | 8.70% | 0.70 | 0.25% | 48.63 | 17.19% | 1.43 | 0.51% | 0.75 | 0.27% | | | 1.75 | 0.62% | 25.67 | 9.07% | 58.32 | 20.62% | 6.63 | 2.34% | 9.88 | 3.49% | 4.93 |
| 9% | 8.41 | 3.30% | | | 49.15 | 19.27% | 2.10 | 0.82% | | | | | | | 20.59 | 8.07% | 58.07 | 22.77% | 2.28 | 0.89% | 14.39 | 5.64% | 28.39 |
| 5% | 18.79 | 7.26% | | | 11.67 | 4.51% | 5.16 | 2.00% | | | 7.39 | 2.86% | 7.87 | 3.04% | 27.65 | 10.69% | 49.47 | 19.12% | 4.00 | 1.55% | 12.16 | 4.70% | 14.16 |
| 8% | 109.80 | 3.58% | 0.70 | 0.02% | 581.08 | 18.95% | 59.84 | 1.95% | 84.90 | 2.77% | 8.44 | 0.28% | 57.56 | 1.88% | 446.33 | 14.55% | 492.43 | 16.06% | 67.86 | 2.21% | 171.89 | 5.61% | 71.27 |
| 9% | 3.24 | 1.18% | | | 64.66 | 23.57% | | | | | 0.61 | 0.22% | | | 3.10 | 1.13% | 30.07 | 10.96% | | | 8.66 | 3.16% | 17.79 |
| 3% | 6.85 | 0.79% | | | 205.73 | 23.81% | 3.75 | 0.43% | | | | | 5.49 | 0.63% | 49.50 | 5.73% | 83.98 | 9.72% | | | 50.19 | 5.81% | |
| 7% | 21.37 | 3.16% | | | 89.77 | 13.30% | | | 0.17 | 0.03% | | | 36.80 | 5.45% | 76.20 | 11.29% | 81.20 | 12.03% | | | 57.04 | 8.45% | 18.97 |
| 3% | 11.22 | 2.29% | | | 62.98 | 12.83% | 11.96 | 2.44% | 0.00 | 0.00% | | | 0.00 | 0.00% | 30.28 | 6.17% | 58.94 | 12.01% | | | 80.11 | 16.32% | 6.00 |
| 5% | 6.06 | 1.44% | | | 90.04 | 21.37% | 3.99 | 0.95% | 1.44 | 0.34% | | | | | 51.32 | 12.18% | 16.40 | 3.89% | | | 34.44 | 8.17% | 10.07 |
| 8% | 3.90 | 1.45% | | | 4.90 | 1.82% | 8.31 | 3.08% | 2.37 | 0.88% | | | 2.18 | 0.81% | 33.31 | 12.36% | 15.99 | 5.94% | | | 30.84 | 11.45% | 4.62 |
| 3% | 52.64 | 1.76% | | | 518.07 | 17.30% | 28.00 | 0.93% | 3.98 | 0.13% | 0.61 | 0.02% | 44.47 | 1.48% | 243.71 | 8.14% | 286.58 | 9.57% | | | 261.28 | 8.72% | 57.46 |
| 2% | | | | | 12.97 | 2.48% | 18.09 | 3.45% | 0.35 | 0.07% | | | 159.08 | 30.36% | 9.02 | 1.72% | 76.25 | 14.55% | | | 8.99 | 1.72% | 10.43 |
| 2% | | | | | 6.55 | 1.24% | | | 66.94 | 12.67% | | | 104.50 | 19.78% | 11.10 | 2.10% | 125.04 | 23.66% | | | 8.66 | 1.64% | 10.61 |
| 6% | 4.74 | 0.80% | 1.37 | 0.23% | 49.49 | 8.34% | 9.56 | 1.61% | 1.63 | 0.28% | | | 144.67 | 24.40% | 38.89 | 6.56% | 138.93 | 23.43% | | | 25.82 | 4.35% | 1.97 |
| 6% | 5.85 | 0.82% | | | 40.07 | 5.60% | 20.40 | 2.85% | 9.48 | 1.33% | 0.10 | 0.01% | 129.73 | 18.14% | 81.35 | 11.37% | 163.00 | 22.79% | | | 11.36 | 1.59% | 34.03 |
| 4% | 30.75 | 4.54% | 0.16 | 0.02% | 95.60 | 14.12% | 31.72 | 4.69% | 9.47 | 1.40% | | | 21.98 | 3.25% | 64.58 | 9.54% | 27.37 | 4.04% | | | 61.57 | 9.09% | 12.74 |
| 4% | 38.31 | 5.19% | 1.54 | 0.21% | 84.23 | 11.42% | 44.95 | 6.09% | 10.93 | 1.48% | | | 115.26 | 15.62% | 89.97 | 12.19% | 95.42 | 12.93% | | | 12.30 | 1.67% | 18.86 |
| 6% | 99.66 | 14.23% | 2.29 | 0.33% | 56.75 | 8.10% | 7.81 | 1.12% | 2.23 | 0.32% | | | 0.59 | 0.08% | 157.59 | 22.50% | 31.83 | 4.54% | | | 63.98 | 9.13% | 9.07 |
| 5% | 0.21 | 0.07% | 0.90 | 0.29% | 34.20 | 11.05% | 13.47 | 4.35% | | | | | | | 15.62 | 5.05% | 20.44 | 6.60% | | | 19.97 | 6.45% | |
| 9% | 179.52 | 3.75% | 6.26 | 0.13% | 379.85 | 7.94% | 146.00 | 3.05% | 101.02 | 2.11% | 0.10 | 0.002% | 675.82 | 14.12% | 468.13 | 9.78% | 678.28 | 14.17% | | | 212.65 | 4.44% | 97.71 |

| | |
|---|---|
| Facultative Upland (FACU) | Usually occurs in non-wetlands (estimated probability 67-99%) but is occasionally found in wetlands (estimated probability 1-33%). |
| Obligate Upland (OBL) | Occurs in wetlands in another region, but it almost always occurs (estimated probability 99%) under natural conditions in non-wetlands in the regions specified. If a species does not occur in wetlands in any region, it is not on the National List (USFWS 1988). |
| No Agreement (NA) | The regional panel was not able to reach a unanimous decision on this species. |
| No Indicator (NI) | Insufficient information was available to determine an indicator status. |

Species classified as obligate (OBL, OBL*) or facultative wetland (FACW) were listed as a wetland species. Species classified as facultative (FAC, FAC-, FAC*, FAC+) or facultative upland (FACU) were listed as intermediate species, and species classified as upland (UPL) were listed as upland species (Table 2.7). The majority of species found within each reach are classified as OBL or FACW species, ranging between 45 and 67 percent. The SXW site was observed to have the lowest amount of wetland species present (45%), while MO had the highest proportion of wetland species present (67%). Intermediary wetland species were the second most common species classification observed, ranging from 11 to 29 percent. Upland vegetation ranged from 27 percent at SXW to 7 percent at RC.

Table 2.7. Percentage of species classified as wetland, intermediate or upland.

| REACH | WETLAND | INTERMEDIATE | UPLAND |
|---|---|---|---|
| | OBL, OBL*, FACW+, FACW | FAC, FAC-, FAC*, FAC+, FACU | UPL |
| SXW | 44.93 | 13.36 | 26.94 |
| RC | 59.42 | 19.99 | 6.75 |
| DFC | 50.93 | 21.43 | 16.06 |
| MO | 67.09 | 10.7 | 9.57 |
| OX | 45.58 | 29.06 | 14.17 |

## 2.3.3 Species Composition

Coyote willow (*Salix exigua*), redtop, and reed canary grass (*Phalaris arundinacea*) were dominant within all reaches except RC, where reed canary grass was not encountered (Figures 2.6, 2.7, 2.8, 2.9, and 2.10). The RC site contained a higher portion of woody vegetation including river birch (*Betula occidentalis*) and narrowleaf cottonwood (*Populus angustifolia*). Coyote willow was prevalent throughout the reaches surveyed, comprising between 12 and 32 percent of the total length for all transects. In most reaches willow species are the dominate woody vegetation; however, cottonwood species were also found in large amounts, especially at the OX (65%) and RC (22%)

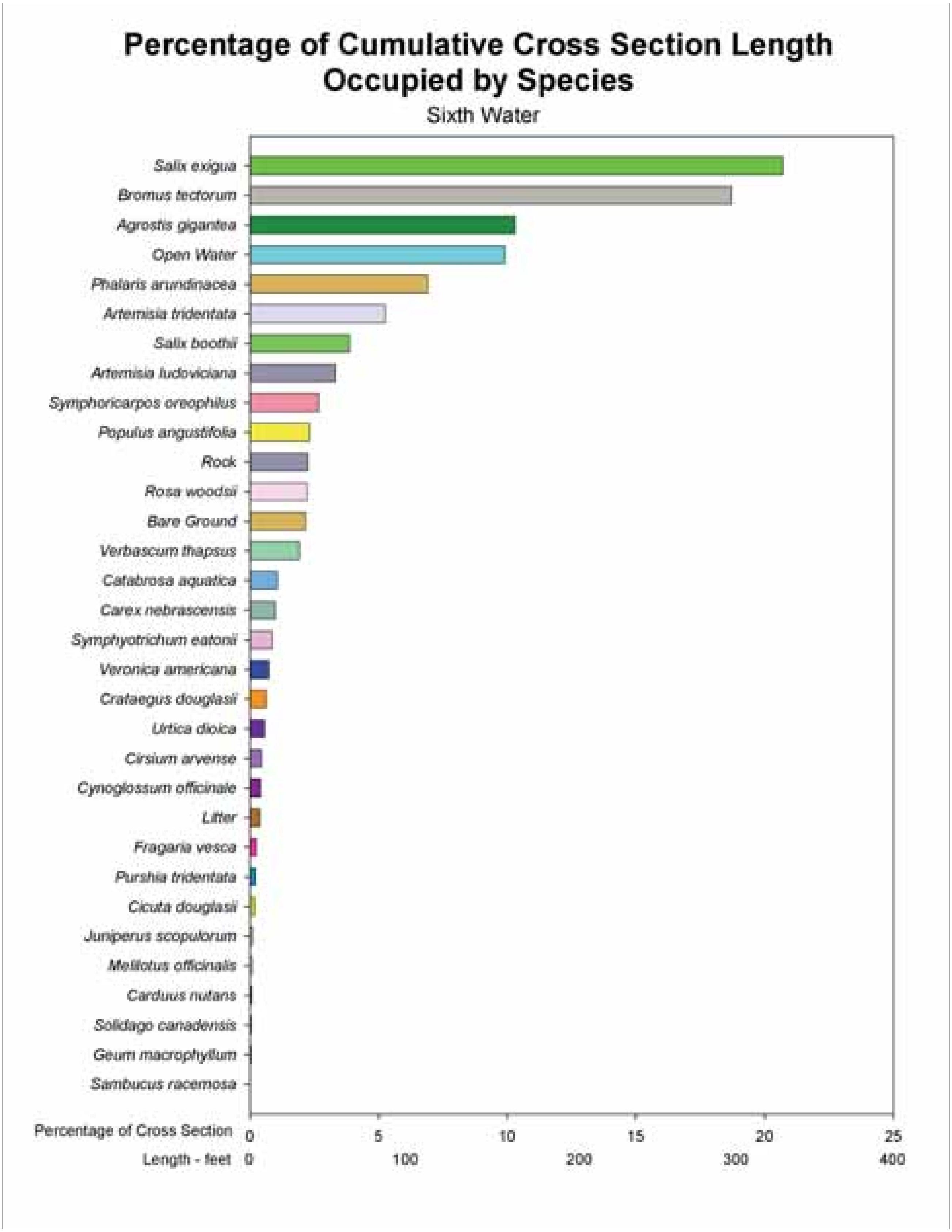



Figure 2.6. Length occupied by individual species along transects within the SXW reach.

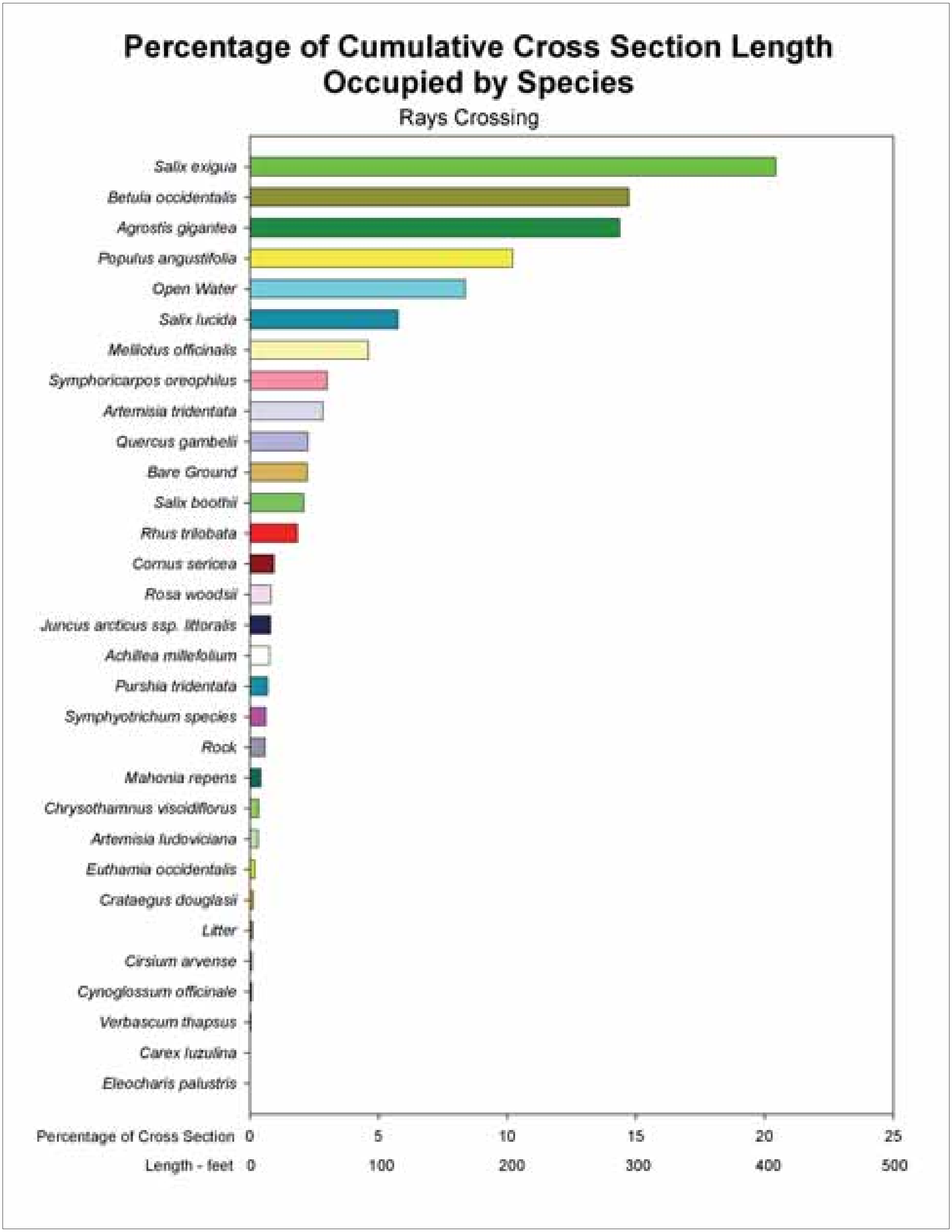



Figure 2.7. Length occupied by individual species along transects within the RC reach.

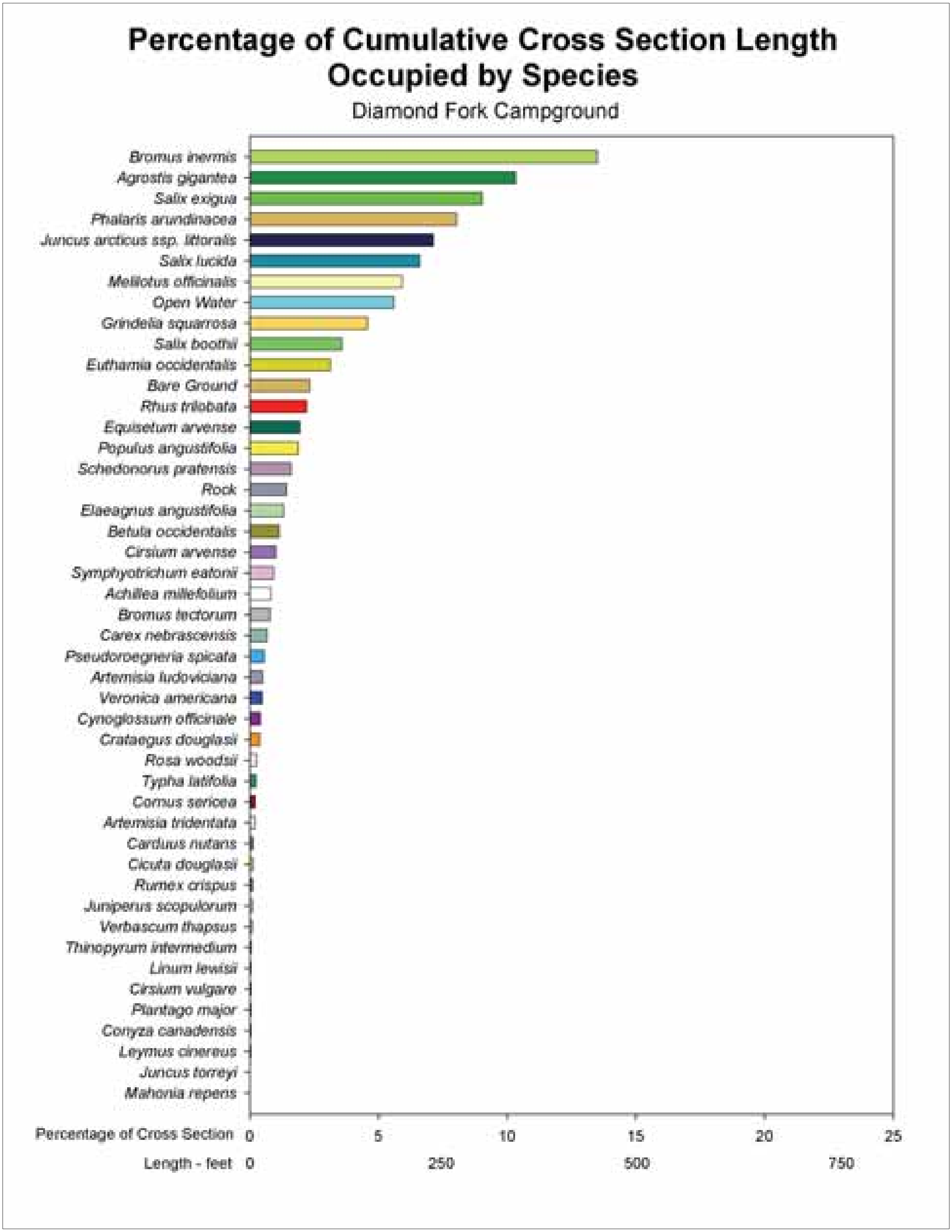



Figure 2.8. Length occupied by individual species along transects within the DFC reach.

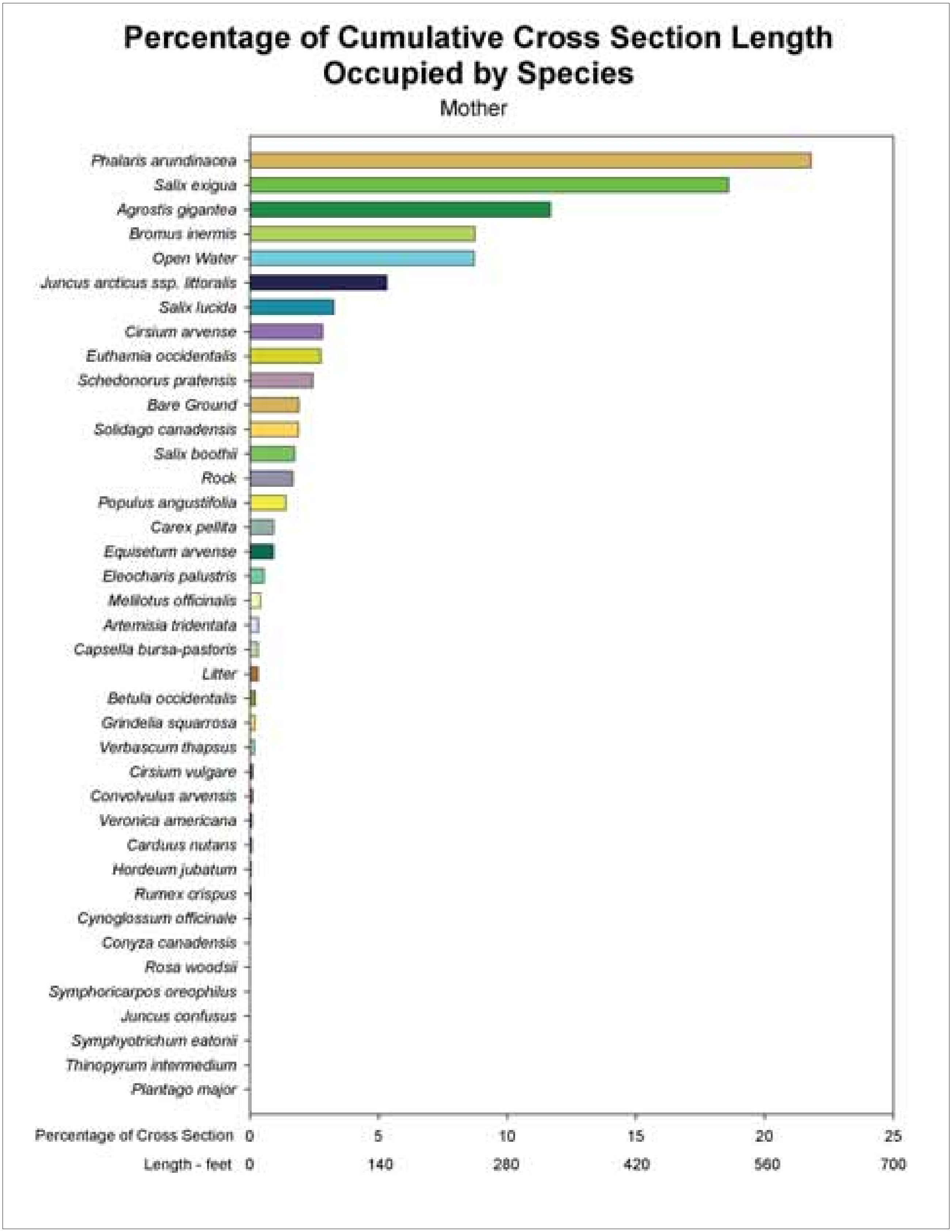



Figure 2.9. Length occupied by individual species along transects within the MO reach.

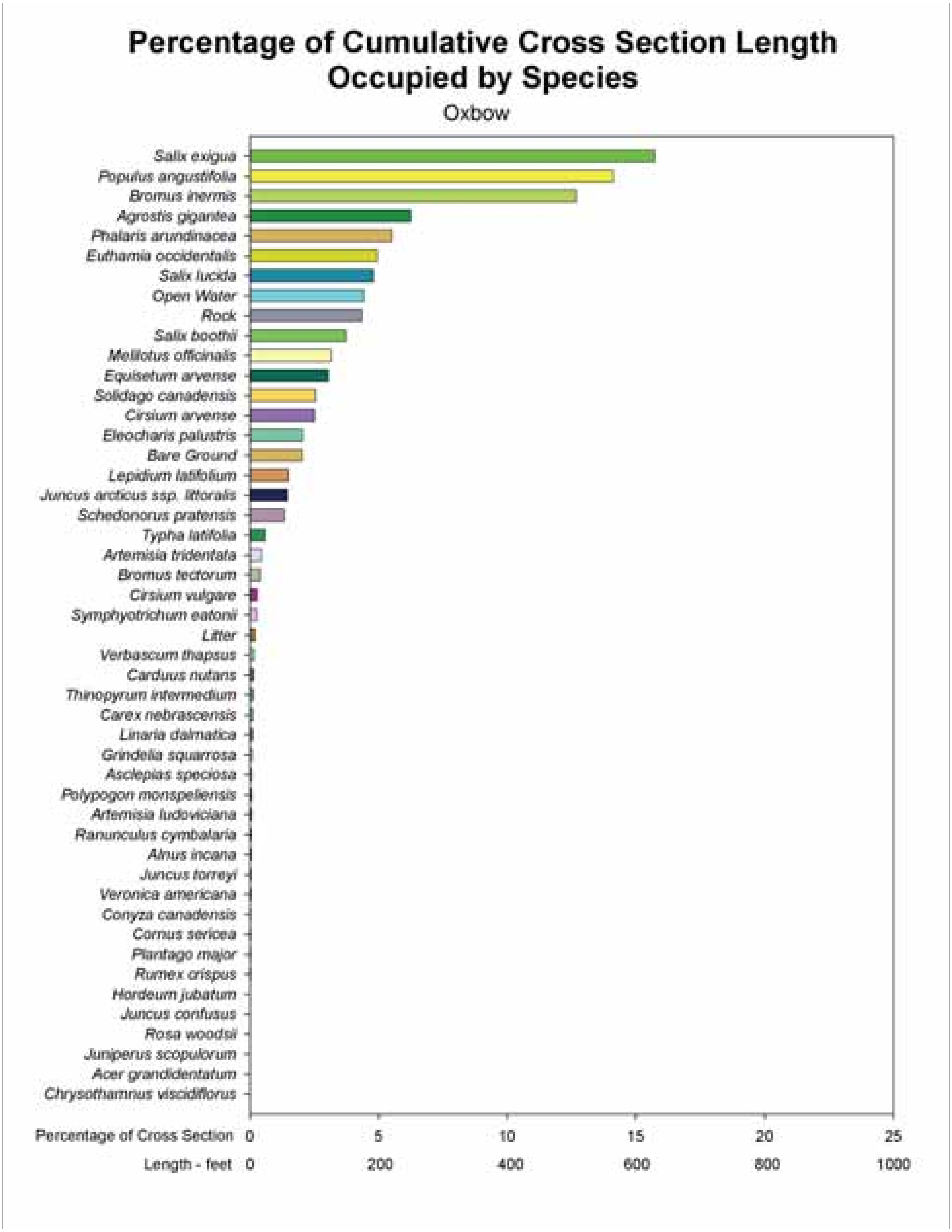



Figure 2.10. Length occupied by individual species along transects within the OX reach.

sites. Other willow species (Booth's willow [*Salix boothii*] and shining willow [*Salix lucida*]) were found at DFC and RC. Reed canarygrass, which is thought to be an aggressive native species, was prevalent in the lower reaches (MO [51%], OX [21%]), with the exception of SXW (8%) (Table 2.8). Areas of bare ground and gravel bar were relatively uniform between the sites, only ranging between 1.92 and 2.32 percent. The low percentage of bare ground and rock observed may be due to reduced disturbance regimes over the past 3 years.

## 2.4 SUMMARY AND DISCUSSION

Riparian vegetation performs many functions in natural river systems. Hydrologic and geomorphic changes following altered flow regimes can effect the physical processes that control riparian vegetation, thereby changing species distribution, abundance, and composition. The purpose of this study was to gather the data necessary to record and monitor any changes that might occur as a result of an altered flow regime.

Based on adjustments to the 2006 methodology, data gathered in 2007 are intended to serve as the baseline with which subsequent monitoring data are compared. Overall, reaches surveyed are dominated by OBL and co-dominated by FACW species. Generally, all reaches are dominated by an overstory of woody species, except for MO and DFC. It was thought during the first year of vegetation sampling along the riparian corridor that communities were dominated by early successional and disturbance-adapted species. This may be the case; however, as disturbance regimes remain relatively mild and infrequent, compared with pre-Diamond Fork System conditions, communities that are comprised of willow and cottonwood species will continue to develop, increasing canopy cover and possible reduced species diversity. Another potential consequence of reduced flows in Sixth Water and Diamond Fork Creeks is the lateral reduction of riparian vegetation communities adjacent to the channel.

A high percentage of the vegetation throughout the watershed is perennial; since the area has experienced large amounts of disturbance, a higher component of annual species was anticipated. However, annuals observed in 2006 and 2007 were almost exclusively non-indigenous species. This may be a result of monitoring timing; however, the great majority of species observed within ULT habitat monitoring areas are also classified as perennial species. Monitoring methodology implemented in 2007 provided more detailed information about the status of riparian vegetation communities occurring along Sixth Water and Diamond Fork Creeks. As monitoring is repeated in subsequent years, riparian area responses to the hydrologic modifications made by the implementation of the Diamond Fork System should become apparent within data trends. If changes are noted over time, such as reduction of wetland species in a certain area, increases in non-indigenous species, and adjustments of dominance in vegetation communities, other data aspects can be analyzed (e.g., elevation above stream or successional properties of particular species).

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| emisia tridentata | 78.86 | 43.06% | 65.37 | 35.69% | 6.37 | 3.48% | 10.30 | 5.62% | 22.24 | 12.14% | 183.14 |
| lepias speciosa | | | | | | | | | 4.13 | 100.00% | 4.13 |
| e Ground | 32.49 | 10.47% | 51.47 | 16.58% | 71.27 | 22.96% | 57.46 | 18.51% | 97.71 | 31.48% | 310.40 |
| ula occidentalis | | | 338.37 | 89.04% | 35.01 | 9.21% | 6.65 | 1.75% | | | 380.04 |
| mus inermis | | | | | 414.00 | 32.25% | 262.45 | 20.44% | 607.37 | 47.31% | 1283.82 |
| mus tectorum | 280.24 | 86.44% | | | 24.35 | 7.51% | | | 19.60 | 6.05% | 324.19 |
| osella bursa-pastoris | | | | | | | 9.51 | 100.00% | | | 9.51 |
| duus nutans | 1.12 | 7.42% | | | 4.32 | 28.65% | 2.63 | 17.41% | 7.02 | 46.53% | 15.09 |
| ex luzulina | | | 0.45 | 100.00% | | | | | | | 0.45 |
| ex nebrascensis | 14.98 | 35.81% | | | 20.89 | 49.93% | | | 5.96 | 14.26% | 41.83 |
| ex pellita | | | | | | | 27.81 | 100.00% | | | 27.81 |
| abrosa aquatica | 16.32 | 100.00% | | | | | | | | | 16.32 |
| ysothamnus idiflorus | | | 7.97 | 99.60% | | | | | 0.03 | 0.40% | 8.00 |
| uta douglasii | 2.93 | 42.03% | | | 4.04 | 57.97% | | | | | 6.97 |
| ium arvense | 7.02 | 2.85% | 2.21 | 0.90% | 31.33 | 12.71% | 84.74 | 34.38% | 121.16 | 49.16% | 246.46 |
| ium vulgare | | | | | 1.91 | 9.82% | 3.81 | 19.57% | 13.75 | 70.61% | 19.47 |
| nvolvulus arvensis | | | | | | | 3.45 | 100.00% | | | 3.45 |
| nyza canadensis | | | | | 1.74 | 38.09% | 0.77 | 16.76% | 2.07 | 45.15% | 4.58 |
| nus sericea | | | 21.82 | 72.07% | 6.73 | 22.21% | | | 1.73 | 5.72% | 30.28 |
| taegus douglasii | 9.74 | 39.16% | 3.08 | 12.36% | 12.06 | 48.48% | | | | | 24.89 |
| noglossum officinale | 6.27 | 28.21% | 2.19 | 9.86% | 12.79 | 57.50% | 0.98 | 4.42% | | | 22.24 |
| eagnus angustifolia | | | | | 40.33 | 100.00% | | | | | 40.33 |
| ocharis palustris | | | 0.14 | 0.12% | | | 16.63 | 14.45% | 98.34 | 85.43% | 115.12 |
| uisetum arvense | | | | | 59.84 | 25.65% | 27.67 | 11.86% | 145.79 | 62.49% | 233.31 |
| hamia occidentalis | | | 4.62 | 1.10% | 96.08 | 22.86% | 83.04 | 19.75% | 236.66 | 56.29% | 420.40 |
| garia vesca | 3.66 | 100.00% | | | | | | | | | 3.66 |
| um macrophyllum | 0.71 | 100.00% | | | | | | | | | 0.71 |
| ndelia squarrosa | | | | | 140.70 | 93.09% | 6.19 | 4.09% | 4.26 | 2.82% | 151.14 |
| rdeum jubatum | | | | | | | 2.18 | 78.63% | 0.59 | 21.37% | 2.77 |
| cus arcticus ssp. oralis | | | 18.67 | 3.99% | 218.80 | 46.81% | 159.62 | 34.15% | 70.35 | 15.05% | 467.43 |
| cus confusus | | | | | | | 0.33 | 60.94% | 0.21 | 39.06% | 0.54 |
| cus torreyi | | | | | 0.70 | 22.34% | | | 2.44 | 77.66% | 3.14 |
| iperus scopulorum | 1.50 | 29.89% | | | 3.46 | 68.83% | | | 0.06 | 1.27% | 5.03 |
| idium latifolium | | | | | | | | | 72.26 | 100.00% | 72.26 |
| mus cinereus | | | | | 1.65 | 100.00% | | | | | 1.65 |
| aria dalmatica | | | | | | | | | 5.73 | 100.00% | 5.73 |
| um lewisii | | | | | 2.03 | 100.00% | | | | | 2.03 |
| er | 5.97 | 21.22% | 2.93 | 10.41% | | | 9.47 | 33.68% | 9.75 | 34.68% | 28.12 |
| honia repens | | | 10.14 | 98.38% | 0.17 | 1.62% | | | | | 10.30 |
| lilotus officinalis | 1.33 | 0.29% | 105.93 | 23.35% | 181.96 | 40.11% | 12.62 | 2.78% | 151.82 | 33.47% | 453.65 |
| en Water | 148.69 | 15.07% | 192.47 | 19.50% | 171.89 | 17.42% | 261.28 | 26.47% | 212.65 | 21.55% | 986.98 |
| laris arundinacea | 103.84 | 8.18% | | | 246.96 | 19.46% | 653.35 | 51.49% | 264.66 | 20.86% | 1268.81 |
| ntago major | | | | | 1.91 | 53.08% | 0.00 | 0.00% | 1.68 | 46.92% | 3.59 |
| ypogon monspeliensis | | | | | | | | | 3.82 | 100.00% | 3.82 |
| oulus angustifolia | 34.85 | 3.34% | 234.59 | 22.46% | 57.56 | 5.51% | 42.28 | 4.05% | 675.22 | 64.65% | 1044.51 |
| udoroegneria spicata | | | | | 17.61 | 100.00% | | | | | 17.61 |
| shia tridentata | 3.25 | 16.80% | 16.10 | 83.20% | | | | | | | 19.35 |
| ercus gambelii | | | 52.30 | 100.00% | | | | | | | 52.30 |
| unculus cymbalaria | | | | | | | | | 3.03 | 100.00% | 3.03 |
| us trilobata | | | 42.55 | 38.54% | 67.86 | 61.46% | | | | | 110.41 |
| k | 34.12 | 9.72% | 13.66 | 3.89% | 44.21 | 12.59% | 50.49 | 14.38% | 208.70 | 59.43% | 351.19 |
| a woodsii | 33.63 | 54.33% | 19.13 | 30.91% | 8.44 | 13.63% | 0.61 | 0.98% | 0.10 | 0.15% | 61.91 |
| mex crispus | | | | | 3.91 | 54.84% | 1.87 | 26.16% | 1.36 | 19.00% | 7.14 |
| x boothii | 58.19 | 12.98% | 48.21 | 10.75% | 109.80 | 24.49% | 52.64 | 11.74% | 179.52 | 40.04% | 448.36 |
| x exigua | 310.70 | 13.13% | 469.24 | 19.83% | 276.75 | 11.69% | 557.14 | 23.54% | 752.67 | 31.81% | 2366.50 |
| x lucida | | | 132.45 | 19.99% | 202.67 | 30.59% | 97.80 | 14.76% | 229.54 | 34.65% | 662.46 |
| nbucus racemosa | 0.28 | 100.00% | | | | | | | | | 0.28 |

# CHAPTER 3: UTE LADIES'-TRESSES SURVEYS

# 3.0 UTE LADIES'-TRESSES SURVEYS

## 3.1 INTRODUCTION

Ute ladies'-tresses (ULT) population surveys were conducted during late summer (August through early September) to assess population trends and relative abundance of individuals located on riparian surfaces along Diamond Fork Creek. Survey methodologies used in 2006 were repeated in 2007 to maintain consistency. Data collection techniques were adapted from previous surveys done by HDR Engineering, Inc. (HDR) that occurred from 1992 to 2005 (Black and Gruwell 2005). BIO-WEST, Inc.'s (BIO-WEST's) surveys were designed to more rapidly assess population trends of ULT colonies located on surfaces they previously occupied. First, ULT individuals were counted on a sub-sample of currently occupied surfaces; second, meandering surveys were used to estimate relative abundance of individuals located on the riparian surfaces along Diamond Fork Creek. The meandering surveys were performed to capture gross trends in abundance and distribution without counting all ULT individuals. Finally, flowering and non-flowering plant counts were done along permanent transects to further understand the complex ecological processes of a species that has been inconsistent when studying emergence, flowering and non-flowering habits, and potential effects of hydrologic change within Diamond Fork Creek.

## 3.2 METHODS

### 3.2.1 Data Collection

All ULT colonies along Diamond Fork Creek were surveyed one of two ways: actual counts or abundance estimates. Based on previous ULT counts, colonies that were most indicative of overall canyon-wide population trends (with a correlation of 50 percent or more as shown in Appendix 3.1) (Rice 2006) were re-counted in 2007—including polygons 2A, 2B, 10A, 13.1, 13.2, 13.3, 14, 17A, 20, 24B, 30, and 36—as shown in the ULT polygon map located in Appendix 3.2. Colonies that showed more sporadic trends were surveyed and ranked for relative abundance: none, few, moderate, and abundant. Within each ULT colony, dominant native and any non-indigenous species observed were also recorded.

### 3.2.2 Habitat Known to be Occupied by Ute Ladies'-tresses

Surfaces within the Diamond Fork Watershed have historically been surveyed and monitored with an emphasis on obtaining exact counts of flowering ULT individuals. Total counts were time intensive, and the number of ULT individuals found varied between years. During BIO-WEST's initial survey in 2006, surfaces were selected by the Utah Reclamation Mitigation and Conservation Commission (Mitigation Commission) (Rice 2006) that were known to have ULT and showed count trends somewhat representative of ULT colonies found throughout the watershed. The same surfaces were surveyed again in 2006 and 2007. Surveys were performed along arbitrary transect lines, with surveyors spaced no more than 5 feet apart. This method provided effective detection of flowering individuals (Figure 3.1) and minimized the possibility of overlap counting. All flowering ULT individuals were counted, and data were compared with HDR's data collected during previous years (Black and Gruwell 2005) as well as data collected by BIO-WEST in 2006 in order to extrapolate

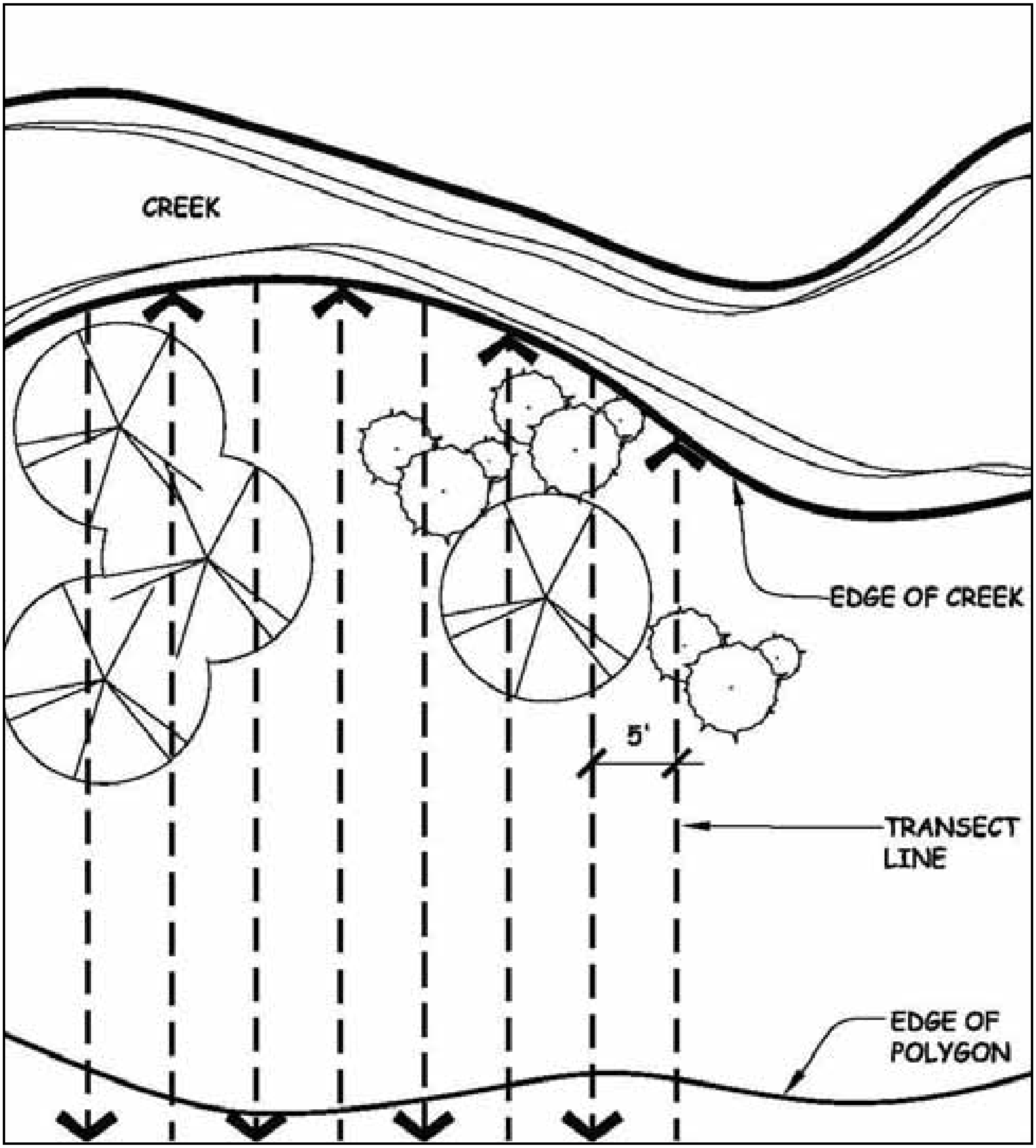



Figure 3.1. Method used for actual plant counts on known Ute ladies'-tresses-occupied sites.

possible trends. Data gathered before and after Diamond Fork System construction were summarized to clarify potential effects to the Diamond Fork ULT population as a result of construction.

Meandering surveys were conducted on remaining known ULT colony surfaces to rapidly determine relative abundance in a consistent and efficient manner (Figure 3.2). Particular attention was paid to areas of potential ULT habitat, as well as dense willow stands, to get an accurate representation of the surface. Rough counts were made, and abundance was rated by comparing numbers and overall surface sizes. Surfaces were ranked and characterized by color according to relative abundance: none, few, moderate, and abundant (Appendix 3.3).

### 3.2.3 Habitat Suitable for Ute Ladies'-tresses Occupation

As hydrology and geomorphology change within the Diamond Fork System, new surfaces with conditions ideal for ULT have begun to develop along Diamond Fork Creek. New surfaces with ecological conditions favorable for establishment of ULT will be identified during flowering plant surveys. As colonies are found, they will be mapped, rated for abundance, and monitored in subsequent years.

### 3.2.4 Flowering and Non-flowering Ute Ladies'-tresses

Surveys conducted to assess the ratio of flowering to non-flowering ULT individuals were performed on surfaces known to be occupied by ULT and potentially occupied sites. Data were collected in circular plots to assess the ratio of flowering to non-flowering ULT plants. Permanent transects were established by HDR in 2005 (Black and Gruwell 2005) and resurveyed again in 2006 and 2007 on surfaces where ULT individuals had been found or habitat was predicted to be ideal as hydrology changed (Appendix 3.4). Transects were placed deliberately in micro-topography, particularly in areas slightly wetter than where ULT individuals are normally found (Figure 3.3). It is estimated that the permanent transects established in 2005 were set in wetter areas in anticipation that these areas would dry as a result of reduced flows in Diamond Fork Creek, which would make conditions in these areas more suitable for ULT.

Surveys to determine flowering and non-flowering ratios began on the upstream end of the transects and subsequently ran downstream in the direction of water flow. Each circular plot was 1 meter in diameter and placed on center every 5 meters along the transect. Within each circular plot the number of ULT flowering and non-flowering individuals were enumerated. Any observations of herbivory of or pollinators on ULT individuals were noted.

### 3.2.5 Occupied and Suitable Ute Ladies'-tresses Habitat

During individual ULT counts and relative abundance surveys, dominant plant species and non-indigenous species were recorded for each surface. Also included in the data collection were general observations including health of the vegetative community (e.g., drying, extent of non-indigenous species infestations).

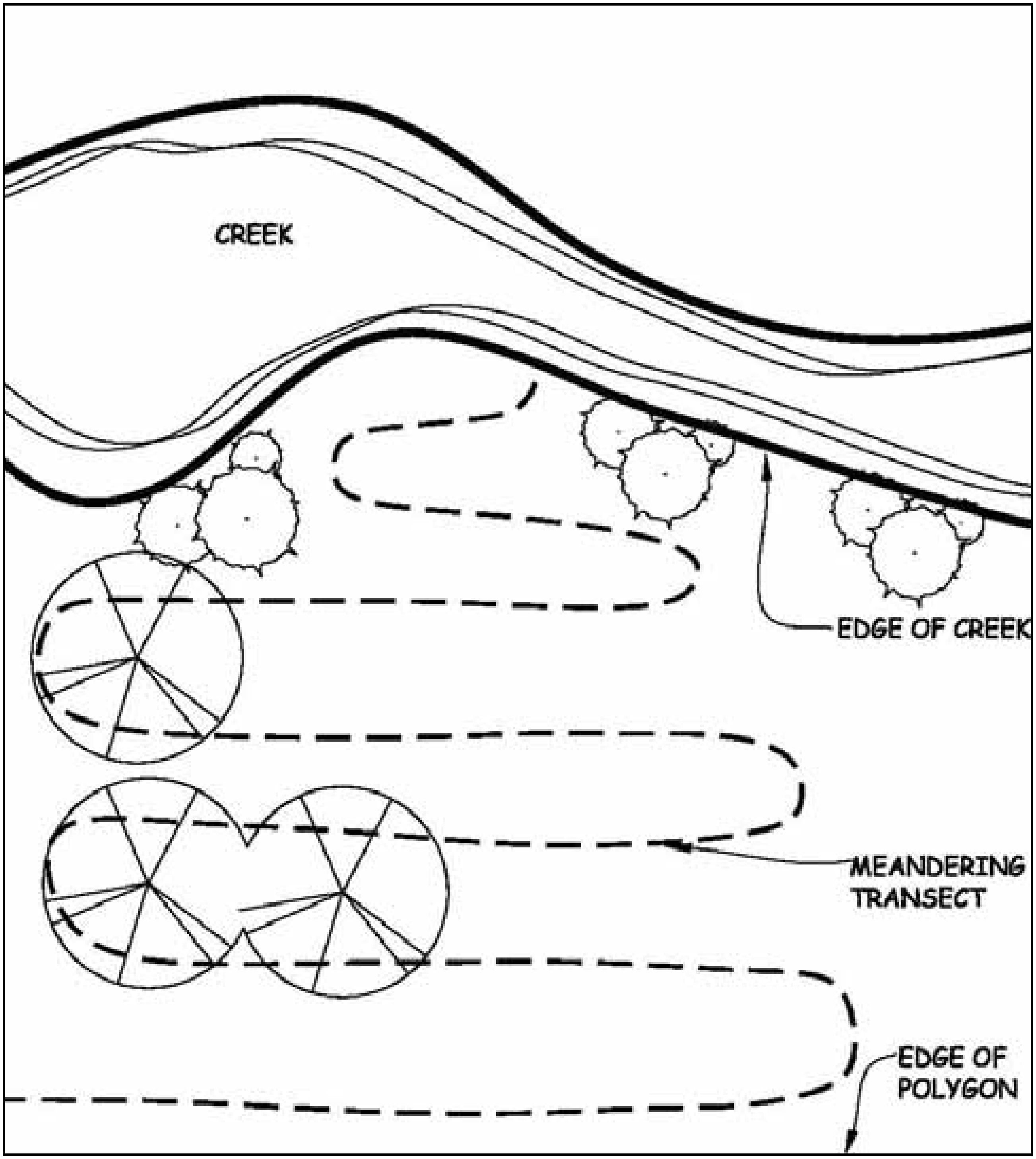



Figure 3.2. Method used for meandering Ute ladies'-tresses relative abundance estimates on known colony surfaces.

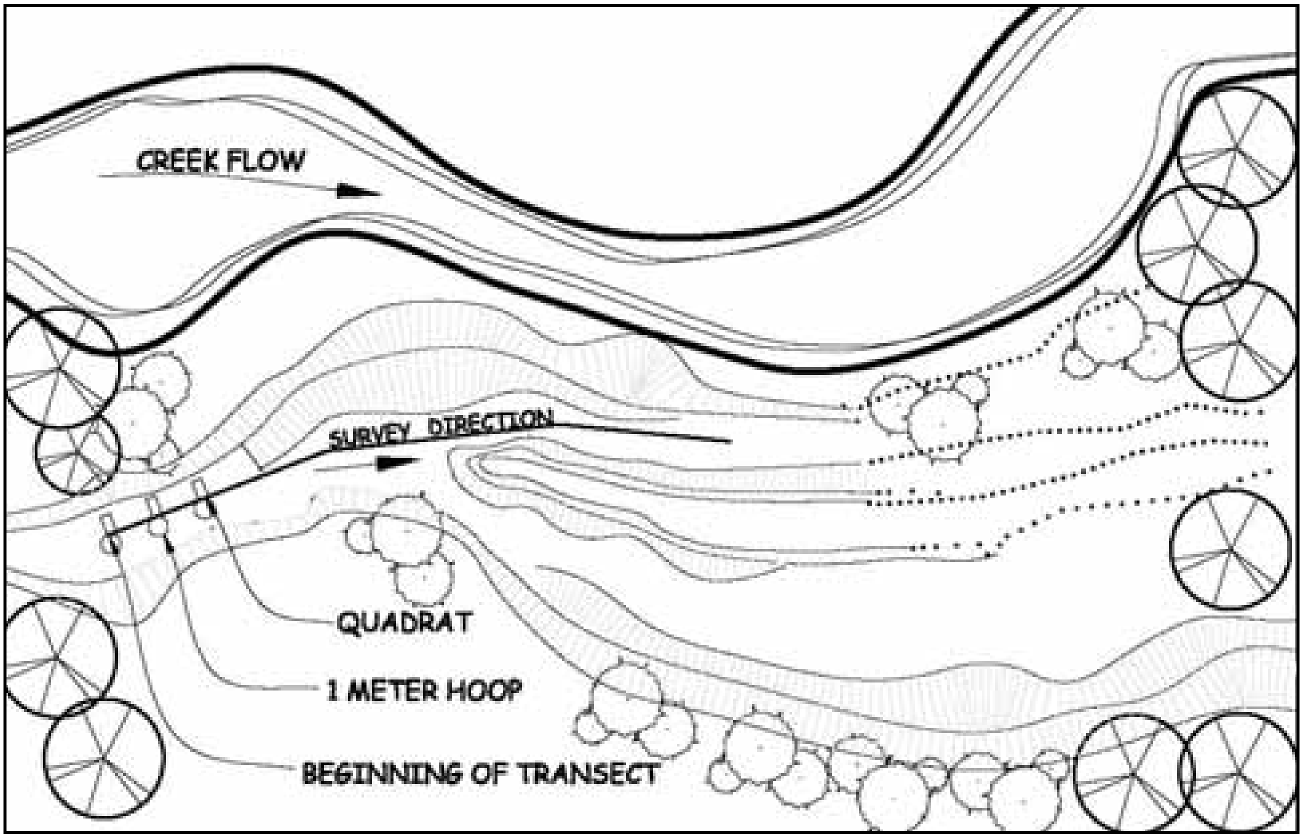



Figure 3.3. Diagram showing permanent transect placement and survey methodology.

# 3.3 RESULTS

## 3.3.1 Known Ute Ladies'-tresses Surfaces

### *3.3.1.1 Counts of Flowering Ute Ladies'-tresses Individuals*

Counts of flowering ULT individuals on the 10 representative surfaces ranged from 0 to 128, a significant decrease from observations in 2006 that ranged from 0 to 879 (Table 3.1). The number of flowering individuals recorded since 1992 (Black and Gruwell 2005) indicates that ULT numbers generally deceased in 2002, 2003, 2004, and 2005. Counts recorded in 2006 on the 10 representative surfaces indicated no significant change in most colonies, except for 14, 30, and 24B, where numbers had increased significantly (Figure 3.4), and colony 20, where numbers had decreased significantly and were the lowest on record for that particular site. However, in 2007, colonies 14, 30, and 24B all showed a significant decrease of ULT individuals compared with numbers of individuals observed during 2006 surveys. The number of ULT found during the 2007 surveys was more consistent with what was observed by HDR in 2002, 2003, 2004, and 2005 (Black and Gruwell 2005). Colonies 10A, 2B, 13.2 14, 20, 24B, 30, and 36 all showed a decrease in the number of ULT found. On surfaces that contained colonies 2A, 13.1, 13.3, 17A, and 2D, no ULT were found during the 2006 or 2007 surveys. All of the colonies for which actual counts were conducted either decreased (in many cases significantly) or continued to contain no ULT individuals (Table 3.1 and Figure 3.4). Climatic patterns in 2007 were hotter and drier than normal and many of the surfaces

Table 3.1. Ute ladies'-tresses counts of flowering individuals on representative surfaces.

| COLONY ID | 1992 | 1993 | 1994 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2A | NA[a] | NA | NA | NA | 6 | 0 | 40 | 63 | 14 | 4 | 1 | 0 | 0 | 0 |
| 2B | NA | NA | NA | NA | 45 | 19 | 432 | 380 | 118 | 28 | 0 | 5 | 2 | 0 |
| 10A | NA | NA | NA | 96 | 58 | 34 | 339 | 523 | 482 | 1 | 0 | 64 | 297 | 114 |
| 13 | NA | 67 | 0 | 1 | 52 | 17 | 83 | 79 | 1 | 0 | 0 | 2 | | |
| 13.1 | | | | | | | | | | | | 0 | | 0 |
| 13.2 | | | | | | | | | | | | 0 | 3 | 0 |
| 13.3 | | | | | | | | | | | | 0 | | 0 |
| 14 | NA | 97 | 200 | 957 | 96 | 440 | 638 | 663 | 111 | 23 | 18 | 58 | 879 | 57 |
| 17A | NA | NA | NA | 47 | 21 | 25 | 39 | 42 | 53 | 2 | 0 | 34 | 0 | 0 |
| 20 | 28 | 804 | 91 | 1,888 | 236 | 122 | 990 | 863 | 480 | 17 | 34 | 290 | 4 | 0 |
| 24B | NA | NA | NA | 1,409 | 38 | 341 | 795 | 952 | 565 | 8 | 91 | 155 | 872 | 5 |
| 30 | NA | 8 | GI* | 0 | 89 | 23 | 54 | 474 | 289 | 43 | 6 | 451 | 680 | 128 |
| 36 | NA | 141 | 138 | 382 | 162 | 22 | 25 | 84 | 61 | 5 | 2 | 70 | 104 | 68 |
| Average | 28 | 223 | 107 | 597 | 80 | 104 | 343 | 412 | 217 | 13 | 15 | 113 | 284 | 37 |

Note: Filled cells indicate remnants of a larger colony that has subsequently been fragmented.
[a] NA - Flowering plants had not yet been identified at this location.
[b] Grazing impacts, no data collected.

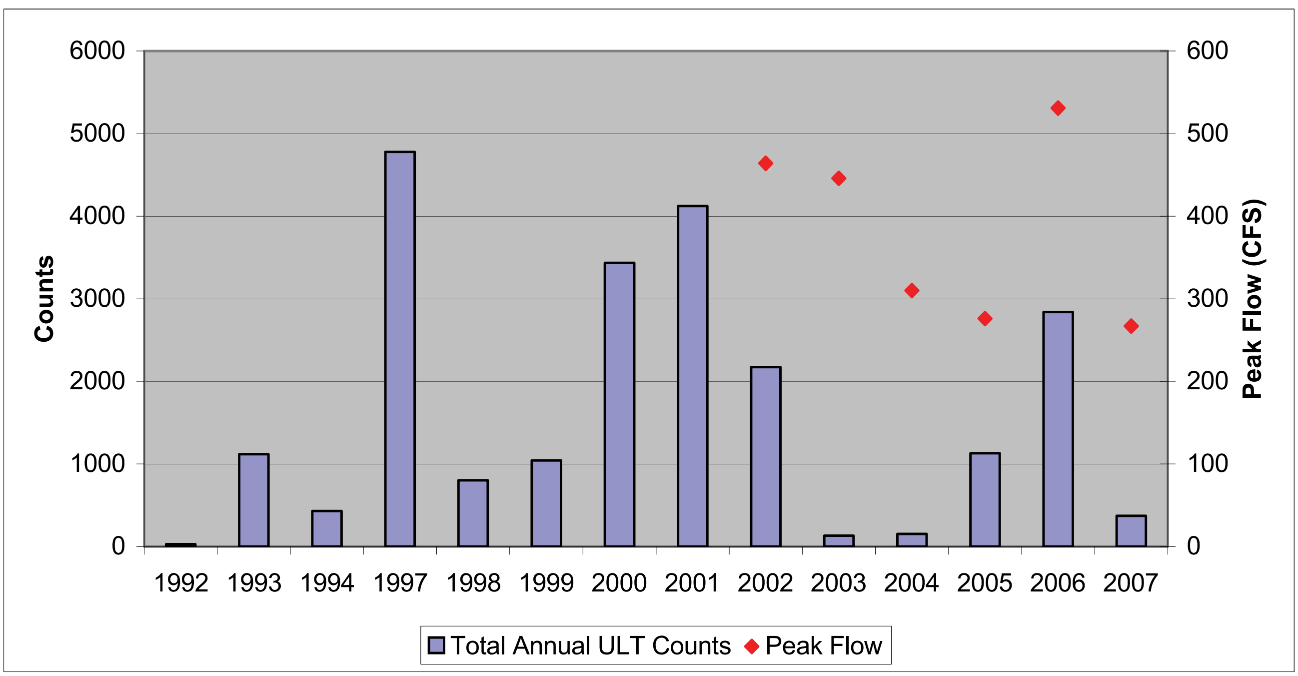



Figure 3.4. Time series counts of flowering Ute Ladies'-tresses individuals on the 10 representative sites and peak cfs. (*The 2007 peak cfs is provisional.)

where ULT colonies exist had been heavily grazed, which likely contributed to the lower number of flowering individuals. Because ULT numbers have followed no significant trends in past surveys, no discernable patterns can be detected in the new data.

Figure 3.4 includes peak discharge measurements from 2002 to 2007 (USGS 2008) for Diamond Fork Creek above Red Hollow gage. The peak discharge measurement for 2007 is provisional. When comparing numbers of actual ULT counted within this period of time, there appears to be a relationship between high peak flows in Diamond Fork Creek and higher ULT counts. Conversely, years of lower peak flows seem to relate to lower ULT counts. A discussion about the relationship between stream flow and depth to ground water at the occupied surfaces is further explored in Chapter 4. These data further indicate that peak flows within Diamond Fork Creek may impact ULT counts.

Adding to the confounding patterns of ULT counts observed from year to year is the possibility of dual peaks within ULT colonies. During the 2007 actual count surveys, three surfaces were surveyed twice, once in early August (August 6, 2007) and again in mid August (August 18, 2007). During the initial survey 114 ULT were found on surface 10A, whereas roughly 2 weeks later an excess of 500 flowering ULT were observed. Four other surfaces were resurveyed including 13.1, 13.2, and 13.3. No blooming ULT were found on those surfaces during the initial survey. There were no flowering ULT observed on surfaces 13.1 and 13.2. However, surveyors counted an excess of 500 flowering ULT individuals on surface 10A and 35 flowering ULT individuals were counted on surface 13.3 during the second survey (Table 3.2). These observations further confound the understanding of ULT flowering trends from year to year.

Table 3.2. *Ute ladies'-tresses counts comparisons within the 2007 field season.*

| Colony | August 6, 2007 | August 18, 2007 |
|---|---|---|
| 10A | 114 | 500+ |
| 13.1 | 0 | 0 |
| 13.2 | 0 | 0 |
| 13.3 | 0 | 35 |

### *3.3.1.2 Relative Abundance Estimates*

The relative abundance of flowering ULT individuals on known ULT surfaces ranged from none to abundant (Table 3.2 and Appendix 3.3). Abundance estimates were assigned by roughly counting individual ULT found on each surface and related the numbers to surface size. If no ULT were found it was rated as none, when 1 to 10 were found the surface was rated to contain few. Surfaces which contained 10 through 89 were rated as moderate, and surfaces with 90 or more ULT were rated as abundant. Patterns observed during 2007 surveys appear to indicate that overall counts have decreased since 2006 and were very similar to counts observed in 2002, 2003, 2004, and 2005. In 2006 some surveyed surfaces contained the highest number or abundance ranking recorded. Abundance estimates on surfaces 27A, 36B, 8A, 8B, 8C, and 4B were at the highest recorded level for those particular colonies. Abundance at colonies 1 and 23A had also significantly increased

(Black and Gruwell 2005). Other decreases or slight increases observed in particular colonies may be attributed to annual fluctuations in numbers similar to those found during previous surveys. Only one surface, 24C, had a significant drop in ULT numbers. During HDR surveys (Black and Gruwell 2005), 889 flowering ULT individuals were found on this surface. During the 2006 surveys, no flowering individuals were recorded for this surface and most of the obligate vegetation on the site was drying and dying back. This appears to be a recent phenomenon as replacement species, either non-indigenous or upland, have yet to establish in this area. Table 3.3 lists surface number and relative abundance estimates recorded during 2007 surveys.

Table 3.3. Ute ladies'-tresses actual counts from representative surfaces 2006 and 2007.

| SITE | ABUNDANCE 2006 | COUNT 2006 | ABUNDANCE 2007 | COUNT 2007 |
|---|---|---|---|---|
| 1 | Abundant | 400+ | Moderate | 38 |
| 1A | None | 0 | Few | 12 |
| 1B | None | 0 | None | 0 |
| 2.1 | None | 0 | Few | 3 |
| 2.2 | Few | 2 | None | 0 |
| 2.3 | Moderate | 13 | None | 0 |
| 2C | None | 0 | None | 0 |
| 2D | None | 0 | None | 0 |
| 2E | None | 0 | None | 0 |
| 3 | Few | 6 | None | 0 |
| 3A | Abundant | 90 | Abundant | 118 |
| 3B | None | 0 | None | 0 |
| 3C | None | 0 | None | 0 |
| 4 | Abundant | 114 | None | 0 |
| 4A | None | 0 | None | 0 |
| 4B | Abundant | 96 | Abundant | 290 |
| 4C | None | 0 | None | 0 |
| 5 | Moderate | 29 | Few | 7 |
| 5A | | | Few | 2 |
| 6 | Moderate | 47 | None | 0 |
| 6A | Few | 6 | Abundant | 100 |
| 7 | None | 0 | None | 0 |
| 8 | Few | 9 | Few | 10 |
| 8A | Few | 17 | Moderate | 55 |
| 8B | Abundant | 152 | Abundant | 110 |
| 8C | Abundant | 105 | Moderate | 35 |
| 9 | None | 0 | Moderate | 55 |

| SITE | ABUNDANCE 2006 | COUNT 2006 | ABUNDANCE 2007 | COUNT 2007 |
|---|---|---|---|---|
| 11 | Few | 8 | None | 0 |
| 11A | None | 0 | None | 0 |
| 12 | Few | 2 | None | 0 |
| 12A | None | 0 | Moderate | 27 |
| 14 | None | 0 | Moderate | 35 |
| 14A/New Find | | | Moderate | 30 |
| 15 | None | 0 | None | 0 |
| 15A-1 | None | 0 | None | 0 |
| 15A-2 | None | 0 | None | 0 |
| 15B | None | 0 | None | 0 |
| 16 | None | 0 | None | 0 |
| 16A | None | 0 | None | 0 |
| 16B | None | 0 | None | 0 |
| 17 | None | 0 | None | 0 |
| 17B | None | 0 | None | 0 |
| 18 | Few | 4 | None | 0 |
| 18A | None | 0 | Few | 3 |
| 19 | None | 0 | None | 0 |
| 19A | None | 0 | None | 0 |
| 20B | Moderate | 40 | Moderate | 25 |
| 20C | Abundant | 400+ | Moderate | 21 |
| 20D | None | 0 | Few | 12 |
| 21 | Abundant | | Few | 2 |
| 21A | Few | 10 | None | 0 |
| 21B | None | 0 | None | 0 |
| 21C | None | 0 | Few | 1 |
| 23 | None | 0 | None | 0 |
| 23A | Few | 2 | None | 0 |
| 24 | None | 0 | Few | 2 |
| 24A | None | 0 | Few | 1 |
| 24C | None | 0 | Few | 2 |
| 24D | Few | 5 | Few | 7 |
| 25 | Abundant | 520+ | Abundant | 973+ |
| 25A | None | 0 | Moderate | 73 |
| 25B | Few | 20 | Few | 1 |

| SITE | ABUNDANCE 2006 | COUNT 2006 | ABUNDANCE 2007 | COUNT 2007 |
|---|---|---|---|---|
| 26 | Abundant | 425 | Abundant | 485 |
| 27 | Moderate | 12 | None | 0 |
| 27A | Abundant | 245 | Moderate | 55 |
| 28 | Moderate | 77 | Moderate | 60 |
| 28A | None | 0 | None | 0 |
| 29 | None | 0 | None | 0 |
| 29A | None | 0 | Few | 2 |
| 33 | Abundant | 173 | Abundant | 122 |
| 33A | None | 0 | None | 0 |
| 34 | None | 0 | None | 0 |
| 34A | None | 0 | None | 0 |
| 35 | Abundant | 300 | Abundant | 362 |
| 35A | Few | 10 | Moderate | 55 |
| 35B | None | 0 | None | 0 |
| 36A | None | 0 | Few | 8 |
| 36B | Moderate | 82 | Abundant | 135 |
| 37A | None | 0 | Few | 5 |
| 37B | Moderate | 39 | Few | 3 |
| 37C | None | 0 | Few | 2 |
| 37D | Few | 18 | Moderate | 25 |
| 37E | Few | 3 | None | 0 |

Of the surfaces surveyed, 46 percent contained no ULT individuals, 24 percent contained few, 18 percent contained a moderate number, and 11 percent contained an abundant number of flowering ULT individuals, compared with 2006 when 51 percent of surfaces surveyed contained no ULT individuals, 20 percent contained few, 11 percent contained a moderate number, and 16 percent contained an abundant number of flowering ULT individuals (Table 3.4). Overall abundance estimates in 2007 indicated a more tempered flowering season, which may be caused by the drier-than-normal climatic conditions combined with the reduced flow in Diamond Fork Creek post Diamond Fork Pipeline operation.

Abundance estimates for the majority of ULT colonies surveyed showed no discernable differences year to year in population trends within the Diamond Fork Watershed. The variability of counts from year to year is so great that there are no apparent trends with these data. Appendix 3.3 contains maps illustrating abundance for individual surfaces surveyed in 2007.

Table 3.4. Abundance estimates for surfaces surveyed; percentage of surfaces ranked as none, few, moderate, or abundant.

| ABUNDANCE RATING | PERCENTAGE OF SURFACES | |
|---|---|---|
| | 2006 | 2007 |
| None | 51% | 46% |
| Few | 21% | 24% |
| Moderate | 11% | 18% |
| Abundant | 17% | 11% |

## 3.3.2 New Ute Ladies'-tresses-Occupied Sites

The locations of each new surface occupied by ULT are illustrated in Appendix 3.5. New surface occupation could be a result of changed hydrology, but it is likely that these colonies were missed during previously conducted surveys. Surfaces identified as new finds in 2006 were revisited. With the exception of two surfaces, there were no ULT found during the 2007 surveys.

## 3.3.3 Ute Ladies'-tresses Flowering and Non-flowering Ratio

The data that were gathered along the ULT transects includes counts of flowering and non-flowering individuals within circular plots. When these counts were analyzed, a normal distribution was not observed. In addition, the ratios for each hoop were widely variable and often contained just one individual. Hoops with low numbers of flowering, no flowering, or non-flowering ULT individuals skewed the data considerably. Since there was also no known density-dependent relationship of flowering to non-flowering ratios for ULT, data analyses were carried out cumulatively for all the individuals counted. This allows for a more direct analysis since these data are binomial: Each individual can either be classified as flowering or non-flowering. The number of samples needed to estimate the mean of the population was then carried out using the equation (Krebs 1989) shown on page 3-13. Table 3.5 shows the sample number required to achieve a margin of error of $d$ and a confidence level of $\alpha$.

Table 3.5. Sample number for various values of $\alpha$ and *d*.

| *d* = margin of error | $\alpha$ = .05 | $\alpha$ = .01 |
|---|---|---|
| 0.05 | 384 | 665 |
| 0.02 | 2,349 | 4,157 |
| 0.01 | 9,597 | 16,629 |

Using the equation below, we assumed that the sampled individuals were from the same populations. However, this assumption is situationally problematic. It is reasonable to suspect that ULT found at different locations might be genetically separate populations and thus may show different flowering ratios. There is also reason to suspect that ULT found in various habitats may exhibit different phenology, and possibly even different flowering ratios, depending on environmental factors. Determination of the proper sample size is complicated by the biology of the species and may require a more complex, stratified, and rigorous sampling design than was used in this study.

$$n = \frac{t^2{}_{\alpha} \ \hat{p}\hat{q}}{d^2}$$

| | | |
|---|---|---|
| $n$ | - | The number of samples for: |
| $t$ | - | Student's t-value for α (the alpha level / probability that the mean is not within the margin of error) |
| $\hat{p}$ | - | proportion of one state (flowering) estimate |
| $\hat{q}$ | - | proportion of other state (non-flowering) estimate |
| $d$ | - | margin of error desired |

With data from sampling: $383 = \frac{1.96^2{}_{\alpha = .05} \ (0.528 * \ (1 - 0.528))}{0.05^2}$

The ratio of flowering to non-flowering ULT individuals was highly variable and did not follow a normal distribution (Figure 3.5). Data from a total of 290 hoops were recorded along transects located in surfaces with known ULT colonies and surfaces that may be occupied in the future. Of the hoop data gathered, only 39 hoops contained flowering or non-flowering ULT individuals. The majority of hoops surveyed (251) contained no flowering or non-flowering ULT individuals.

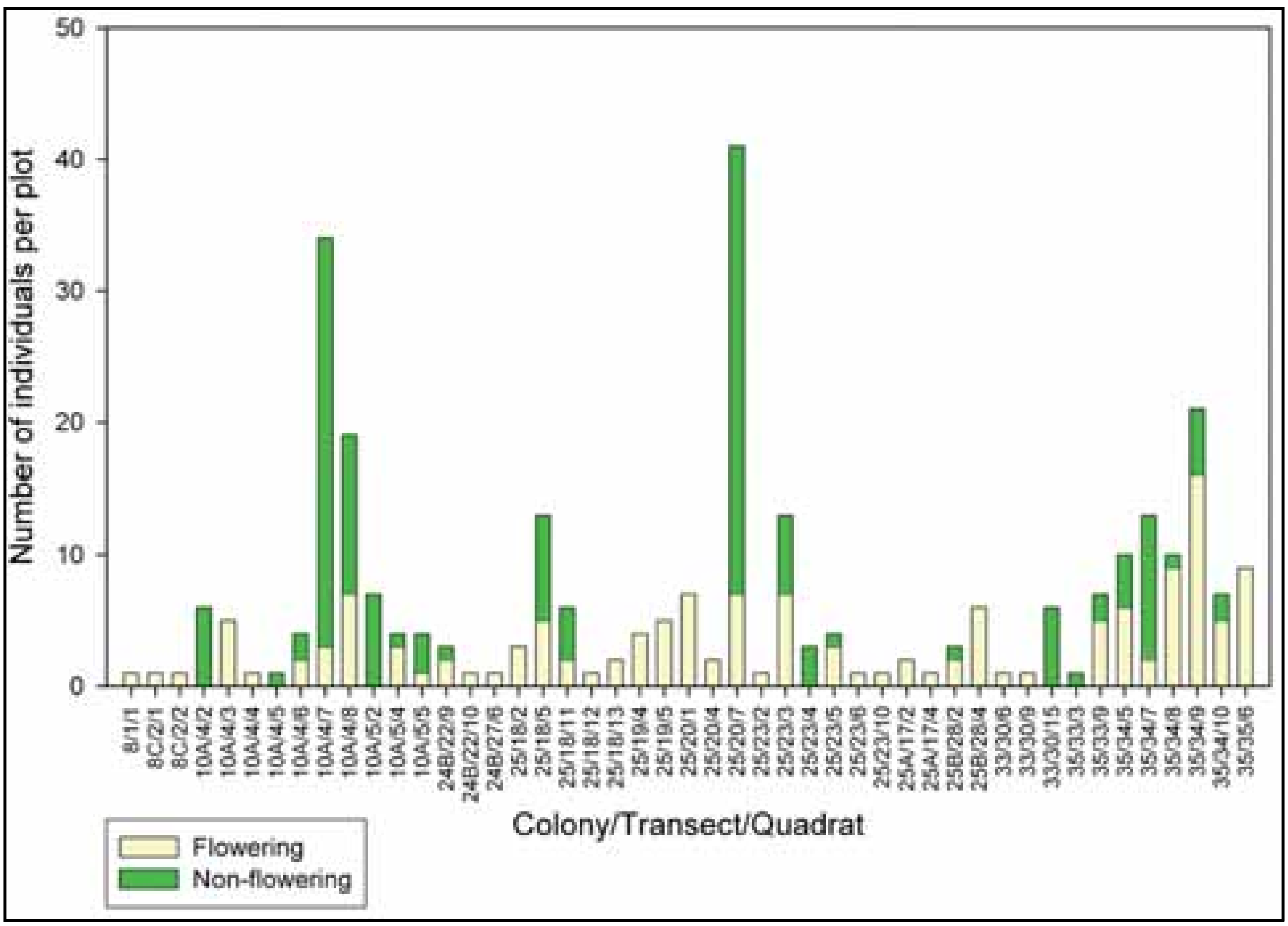



Figure 3.5 Ute-ladies'-tresses flowering and non-flowering ratio histogram.

The lack of ULT individuals within hoop surveys created a data set that, when analyzed, skewed the results considerably and didn't allow for development of a ratio of flowering to non-flowering individuals. When data were analyzed excluding hoops containing no ULT, a more reasonable conclusion for flowering to non-flowering ratios could be made.

Within a 95 percent confidence interval, the percentage of flowering to non-flowering ULT individuals in 2006 fell between 52.6 and 41.8 percent, with a mean of 47.2 percent. The ratio of flowering to non-flowering individuals is 1 to 1.119, indicating that for every flowering ULT individual there is one non-flowering individual. Originally, it was suspected that the year-to-year differences of the ratio are also likely be highly variable, as are historical counts of flowering ULT individuals. However, the percentage of flowering to non-flowering ULT individuals in 2007 falls between 54.5 and 42.8 percent, with a mean of 48.6 percent (Appendix 3.6). The ratio of flowering to non-flowering individuals is 1 to 1.055, again indicating that for every flowering ULT individual there is one non-flowering individual. The ratio observed in 2007 was surprisingly similar to the ratio observed in 2006. To determine a meaningful estimate of the ratio of flowering to non-flowering ULT individuals within a reasonable confidence interval would require enormous effort; that ratio may not be applicable in the context of this project.

$$\hat{p} \pm \left[ \left( z_\alpha \sqrt{1-f} \sqrt{\frac{\hat{p}\hat{q}}{n-1}} \right) + \frac{1}{2n} \right]$$

$\hat{p}$ = Estimated proportion of flowering plants (X types)

$z_\alpha$ = Standard normal deviate (1.96 for 95% confidence interval)

$f$ = Sampling fraction - Number of samples/population (25,000)

$\hat{q}$ = proportion of non-flowering plants (Y or other types)

$n$ = sample size

The 95% confidence interval of the proportion of flowering plants is: (0.545, 0.428)

$$.486577 \pm \left[ \left( 1.96 \sqrt{1 - .01192} \sqrt{\frac{.486577 * .513423}{297}} \right) + \frac{1}{2*298} \right]$$

## 3.4 DISCUSSION

Currently, the best method for assessing ULT populations is counting flowering individuals annually in representative colonies and determining abundance estimates for colonies with more variable historical counts. By counting flowering individuals on representative surfaces it provides managers with information that may be pertinent to population health and a vigor. Another function of monitoring flowering ULT individuals is to assess the number of colonies within a population, which may be another indicator of how current management is affecting ULT numbers. It may be appropriate in subsequent years to compare ULT abundance estimates observed before and after construction of the Diamond Fork System.

The year-to-year variability of ULT counts has made it difficult to identify patterns and extrapolate trends for flowering individuals. During the 2007 field season, observations of multiple peaks in flowering individuals further indicate that ULT counts conducted once annually may be inadequate for the assessment of the ULT population health and vigor along Sixth Water and Diamond Fork Creeks. Observed actual counts, as well as abundance estimates, may be as much a function of annual variability as they are variability of flowering within the bloom period that occurs from late July through early September. The varied bloom times may be a function of climatic conditions, population genetic variance between colonies, elevation, and/or changes in competition of other vegetative species year to year.

Impacts to ULT populations in the Diamond Fork Watershed may be attributed to changes in vegetation rather than changes in water levels. Mechanisms changing vegetation composition include: competition from non-indigenous plant species, changes in disturbance regimes, vegetation structure (transition from young willows to mature stands), and establishment of late successional species. Ute ladies'-tresses are typically found in areas that are heavily vegetated by early successional species or species that are in early stages of establishment or development.

# CHAPTER 4: UTE LADIES'TRESSES HABITAT ANALYSIS

# 4.0 UTE LADIES'-TRESSES HABITAT ANALYSIS

## 4.1 INTRODUCTION

Ute ladies'-tresses (ULT) are endemic to moist areas and occur in the following habitats: along riparian edges, gravel bars, old oxbows, and high-flow channels; in moist-to-wet meadows along perennial streams in apparently stable wetlands and seeps associated with established landscape features; within historical floodplains of major rivers; and in the eastern Great Basin in wetlands and seeps near freshwater lakes or springs (USFWS 1992). These areas are highly dynamic ecosystems sensitive to fluctuations in hydrology. As flows in Sixth Water Creek and Diamond Fork Creek were reduced in 2004, after implementation of the Diamond Fork System, attention to changes within the riverine ecosystem and its associated ULT habitat has increased.

In 2005 HDR attempted to establish a baseline for monitoring changes within ULT habitat. This was done by monitoring ground water hydrology as well as plant communities where ULT colonies were found. However, the course scale of those efforts—as well as incomplete data sets—made it difficult to establish a baseline to track changes such as species composition and vegetation coverage within ULT habitat (Black and Gruwell 2005).

Potential impacts to ULT populations in the Diamond Fork Watershed may be attributed to changes in water levels in addition to changes in vegetation. Mechanisms changing vegetation composition include competition with non-indigenous plant species, changed disturbance regimes, and establishment of late successional species. Because of vegetational changes, such as species composition and subsequent successional processes, a baseline ULT habitat analysis was established in order to track vegetational changes through time.

Ground water monitoring was conducted as part of the riparian monitoring and ULT surveys. Conducting ground water monitoring in conjunction with recording surface water levels may help explain the relationship, if any, between the flow in the Diamond Fork Creek and ground water elevations at various geomorphic surfaces where unique vegetation communities, including ULT colonies, have established.

BIO-WEST, Inc. (BIO-WEST) began vegetation and ground water monitoring in 2006 at existing transects and piezometers, examining compositional changes and ground water fluctuations within ULT habitat in closer detail. Quadrats located along existing transects were used to establish baseline data to track vegetation composition changes. During the 2007 monitoring season, the methods used in 2006 were repeated, using the same transects and quadrat hoop methodology. The intent of these surveys was to identify correlations between ULT and accompanying species, compare correlations found between ULT and accompanying species from 2006 surveys to those found in 2007, and examine whether or not habitat found on potentially occupied sites are trending toward habitat found on sites occupied with ULT. Also, the occurrence of non-indigenous species in 2007 was compared with data collected from 2006.

# 4.2 METHODS

## 4.2.1 Survey Methods

In 2005 HDR established permanent transects on surfaces where ULT individuals had been found or where habitat was predicted to be ideal for colonization as hydrology changed. Many transects were placed deliberately in micro-topography, particularly in areas slightly wetter than where ULT individuals are normally found (Black and Gruwell 2005) (Figure 4.1). These areas, prior to construction of the Diamond Fork System, likely could not support ULT establishment because high flows would have inundated these sites with water during the growing period. It is probable that permanent transects were set up in wetter areas with the anticipation that reduced flow in Diamond Fork Creek would eventually cause these areas to dry slightly, making conditions more suitable for ULT. The same transects used to assess the ratio of non-flowering and flowering ULT were used in 2006 and again in 2007 for habitat assessments.

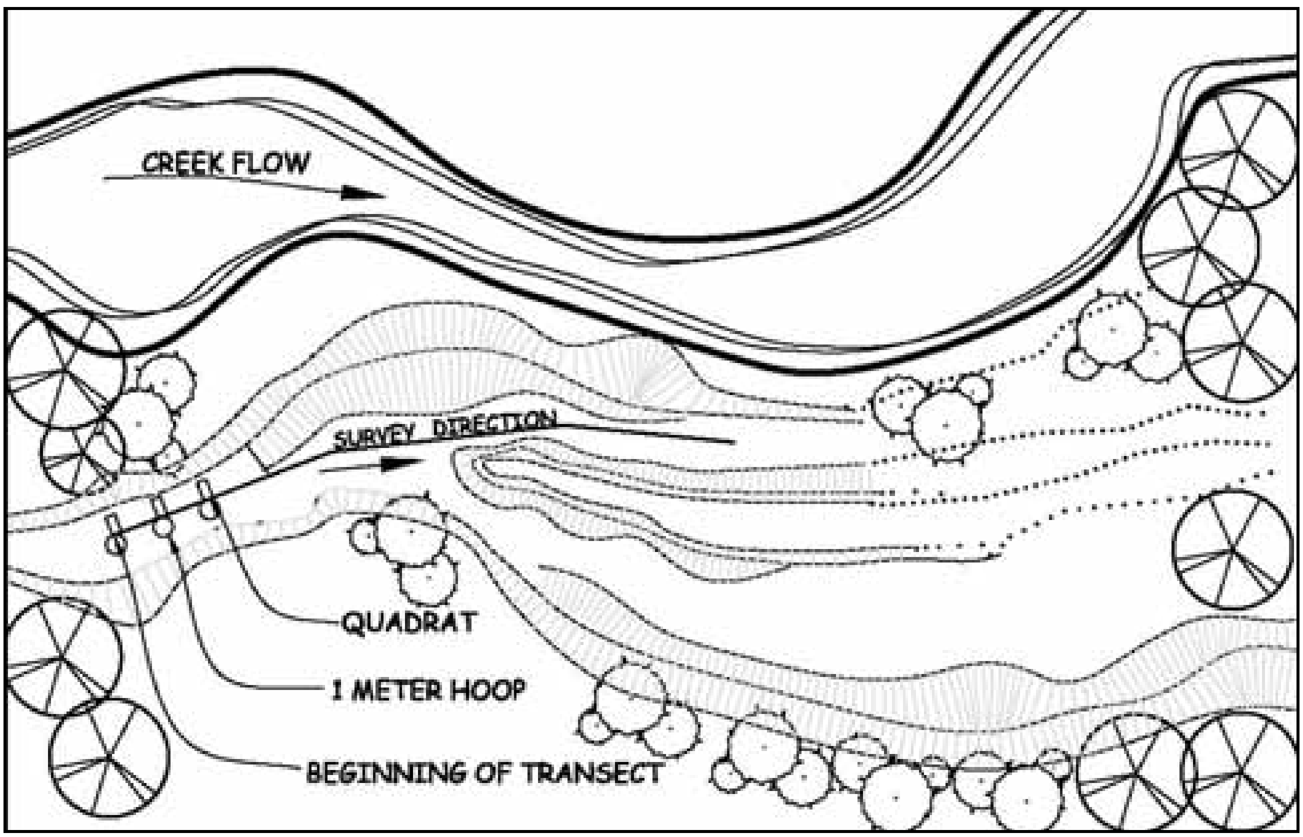



Figure 4.1. Transect placement within microtopography.

## 4.2.2 Transect Quadrats and Hoops

The permanent transects used for BIO-WEST's 2006 surveys were also used during 2007 surveys. Each site contained a total of 30 quadrats or more, which were re-established and sampled. Quadrats were placed along transects, placing the top corner on the transect and spacing quadrats every 5 meters. Within each quadrat, the absolute cover of vegetation (by species of grasses, forbs, and shrubs less than 0.5 meter tall), moss, bare ground, litter, and rock was visually estimated. Every species found within the quadrat was recorded, and percent cover was estimated. All flowering ULT individuals found within the quadrats were counted and recorded.

Hoops were also placed along transects, centering the hoop at the corner of adjacent quadrat (Figure 4.1). Within each hoop, the total number of flowering and non-flowering ULT were counted and recorded.

### 4.2.3 Piezometer Measurements

Piezometers were installed in 2005 by HDR at three locations within the three lower geomorphic monitoring sites, Diamond Fork Creek (DFC) (Surface 10), Mother (MO) (Surface 25), and Oxbow (OX) (Surface 35) on Diamond Fork Creek (Black and Gruwell 2005). In November 2006 each piezometer's location and elevation were surveyed using a total station and known real-world coordinates from cross-section endpoints used for geomorphic monitoring (BIO-WEST 2005). At each piezometer the top of the well casing and the ground surface were surveyed (Table 4.1).

Table 4.1. Location of the top of piezometers used for 2007 ground water monitoring.

| SITE | PIEZOMETER NAME | COLONY NUMBER | NORTHING (UTM METERS) | EASTING (UTM METERS) | ELEVATION (NAVD 1988 METERS) | ELEVATION (NAVD 1988 FEET) |
|---|---|---|---|---|---|---|
| DFC | Well 1 top of casing | 10A | 4,435,457 | 462,680.2 | 1,577.07 | 5,172.79 |
| | Well 1 ground | | 4,435,456 | 462,680.3 | 1,576.96 | 5,172.43 |
| DFC | Well 2 top of casing | 10A | 4,435,463 | 462,665.3 | 1,576.95 | 5,172.40 |
| | Well 2 ground | | 4,435,463 | 462,665.4 | 1,576.77 | 5,171.80 |
| DFC | Well 3 top of casing | 10A | 4,435,453 | 462,642.3 | 1,576.63 | 5,171.35 |
| | Well 3 ground | | 4,435,452 | 462,642.3 | 1,576.48 | 5,170.85 |
| MO | Well 1 top of casing | 25 | 4,432,709 | 459,629.8 | 1,522.59 | 4,994.10 |
| | Well 1 ground | | 4,432,709 | 459,629.9 | 1,522.36 | 4993.34 |
| MO | Well 2 top of casing | 25 | 4,432,735 | 459,618 | 1,522.68 | 4994.40 |
| | Well 2 ground | | 4,432,735 | 459,618 | 1,522.48 | 4,993.73 |
| MO | Well 3 top of casing | 25 | 4,432,772 | 459,600.7 | 1,522.23 | 4,992.91 |
| | Well 3 ground | | 4,432,772 | 459,600.8 | 1,522.09 | 4,992.45 |
| OX | Well 1 top of casing | 35 | 4,432,219 | 458,314.8 | 1,525.622 | 5,004.04 |
| | Well 1 ground | | 4,432,219 | 458,314.8 | 1,525.398 | 5,003.30 |
| OX | Well 2 top of casing | 35 | 4,432,172 | 458,302.1 | 1,525.239 | 5,002.78 |
| | Well 2 ground | | 4,432,172 | 458,302.1 | 1,525.134 | 5,002.44 |
| OX | Well 3 top of casing | 35 | 4,432,192 | 458,309.3 | 1,525.243 | 5,002.87 |
| | Well 3 ground | | 4,432,172 | 458,302.1 | 1,525.134 | 5,002.44 |

The proposed sampling schedule included measurements at seven times during the year. These sampling periods included the following:

- April or May during base flow,
- during peak runoff,
- 3 weeks after peak runoff,
- early July,
- end of July,
- mid August, and
- the end of September.

However, in 2007 measurements occurred slightly more frequently in order to more accurately characterize the influence stream flow has on ground water elevation at the occupied surfaces. Therefore, there are 10 sets of water level measurements for 2007. Two additional measurements were taken during the receding limb of run-off as the alluvial aquifer had an immediate response to peak flows.

Water-level measurements for each piezometer included depth of ground water from the top of the piezometer and the elevation of the water surface in Diamond Fork Creek near the piezometer (perpendicular to flow in the creek). A tape was used to measure the depth of the ground water from the top of the piezometer. Rebar was installed near the streambank to gage stream elevation from a set point above the stream.

Because the piezometer locations were surveyed, ground water elevations could be adjusted to real-world elevations with the following simple subtraction:

> Top of casing (NAVD 1988 elevation) - Depth of water from top of well casing = Elevation of ground water (NAVD 1988 elevation)

In order to calculate the elevations of the surface water as real elevations, the change in elevation from the top of the casing to the water surface was subtracted from the elevation at the top of the well casing. The average daily flow in Diamond Fork Creek was noted from the U.S. Geological Survey (USGS) gage 10149400 Diamond Fork Above Red Hollow through the USGS website for days when piezometer measurements were taken. All data were plotted as a time series with the measurement date on the X axis, ground water elevation on the primary Y axis, and steam flow on the secondary Y axis.

### 4.2.4 Data Analysis

All vegetation data were compiled in a database (Microsoft® Access) and organized by transect. Correlation analyses were conducted on the quadrat vegetal cover data in a pair-wise manner with ULT densities measured for each transect for 2006. In 2007 there were not enough ULT found on transects to assign densities within the quadrats. Therefore, data collected in 2007 did not show strong correlations. Ute ladies'-tresses density was collected by placing a 1-meter hoop opposite each quadrat (Figure 4.1). These data were then averaged for each transect, and this value was used as the correlation value for the coverage amount of each species and other cover-type parameters measured. In addition, species were grouped into categories for analysis: forb, graminoid (grass-like plants including sedges and rushes), grass, non-grass gramninoids (only sedges, rushes, and spikerushes), woody plants, and non-indigenous plants.

For both 2006 and 2007, a Kruskal-Wallis test was then conducted on the data (SYSTAT 2006). Although some of the species or species category data did seem normally distributed, most did not appear to meet this criteria. Analysis of variance (ANOVA), a standard method used to compare population means between groups, assumes normality of data, which could lead to inaccurate estimates of p-values if used where data are not normally distributed. However, to compare all the data consistently, the Kruskal-Wallis test was used. The Kruskal-Wallis test is a non-parametric test that does not assume normality, ranks the vegetal cover data, and tests the null hypothesis: 'There is no difference between the mean ranks of vegetal covers based on habitat type.' Some information is lost with this technique; however, it is a statistically robust test for this type of data and is considered a standard method in ecological studies. Three surface groups were described based on transect placement: occupied surfaces, potentially occupied surfaces, and unoccupied surfaces. Occupied surfaces are surfaces that contain ULT colonies where transects were placed directly within microsites containing previously identified colonies. Potential ULT surfaces are areas that have ULT individuals located somewhere on the surface but not necessarily within the microsites where the transects were placed. Unoccupied surfaces are surfaces that have vegetation and hydrologic characteristics similar to occupied sites but where no ULT plants have been found during previous studies. The Kruskal-Wallis test was conducted for the coverage amount of each species and other cover-type parameters measured, as well as for the groups of species developed for the correlation analysis. Comparisons were also made between transects for 2006 and 2007. Data were tabulated, and basic statistical calculations were run for each transect for both 2006 and 2007. Means were calculated for areal coverage by transect for species groups, wetland indicator status, and indigenous status (Table 4.3). Bar graphs for these data were then created. Complete statistical analyses and results are located in Appendices 4.1 and 4.2. Appendix 4.1 contains quadrat data collected during habitat analysis. Appendix 4.2 contains box plots for ULT habitat data.

## 4.3 RESULTS

### 4.3.1 Vegetation Cover and Composition

Cover types used for the ULT habitat analysis were total vegetal cover, bare ground, rock, and litter. Occupied, potentially occupied, and unoccupied sites were all analyzed independently. Figures 4.2 and 4.3 show significance of total cover categories in 2006 and 2007, respectively. Figures 4.3 and 4.4 show significance of species cover groups found in 2006 and 2007, respectively. The P-values are not a result of paired comparisons between any two habitat types; these values simply illustrate that there are significant differences between habitat types in species found and cover categories. The results from 2006 indicated that occupied and potentially occupied sites had higher vegetal cover with smaller standard deviations than unoccupied sites, which were similar in 2007. Bare ground areal cover was significantly higher at the unoccupied sites than at the occupied and potentially occupied sites. However, in 2007 bare ground areal cover was significantly reduced within the unoccupied sites and more similar to the occupied and potentially occupied sites. Occupied sites had less rock areal cover than the potentially occupied sites and much less rock areal

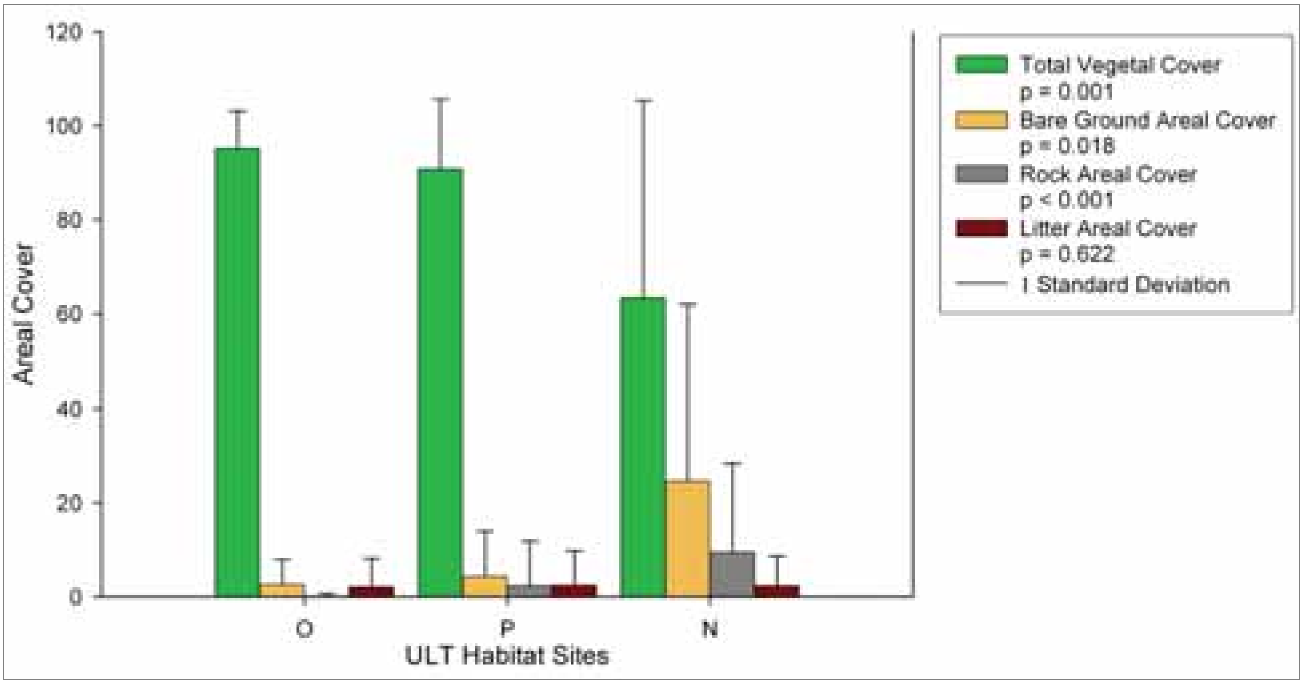



Figure 4.2. Cover categories in ULT habitat sites in 2006.

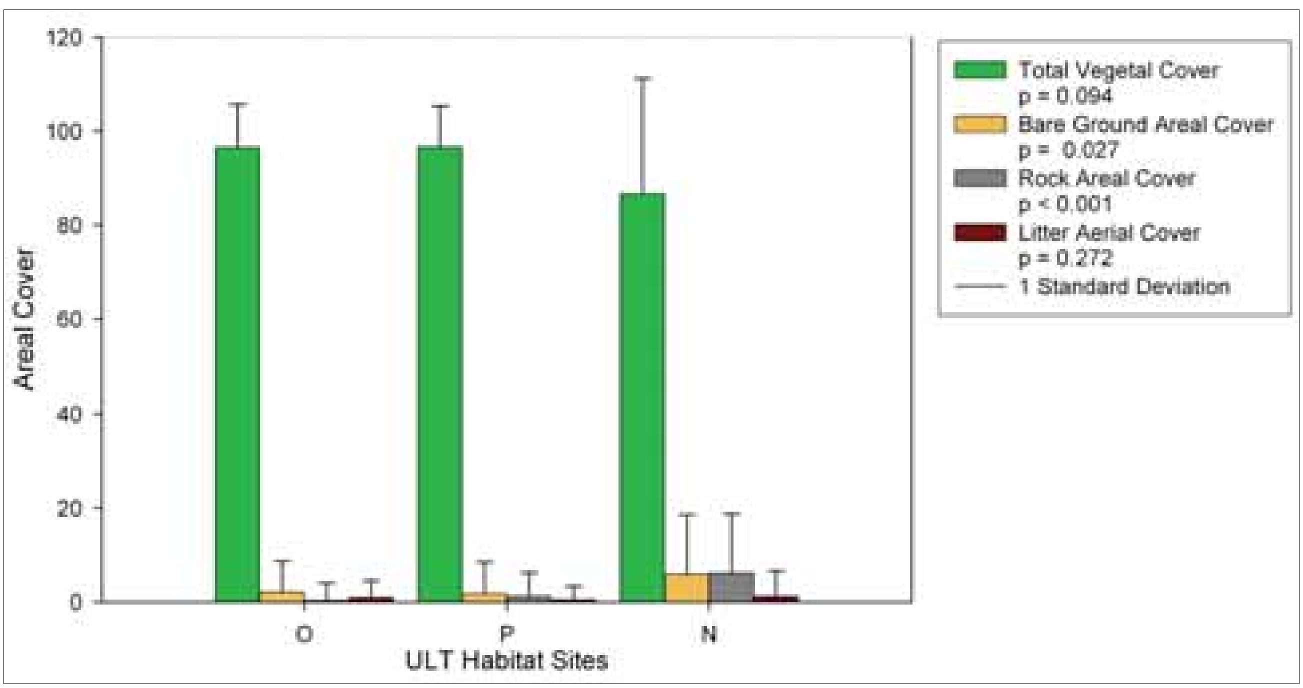



Figure 4.3. Cover categories in ULT habitat sites in 2007.

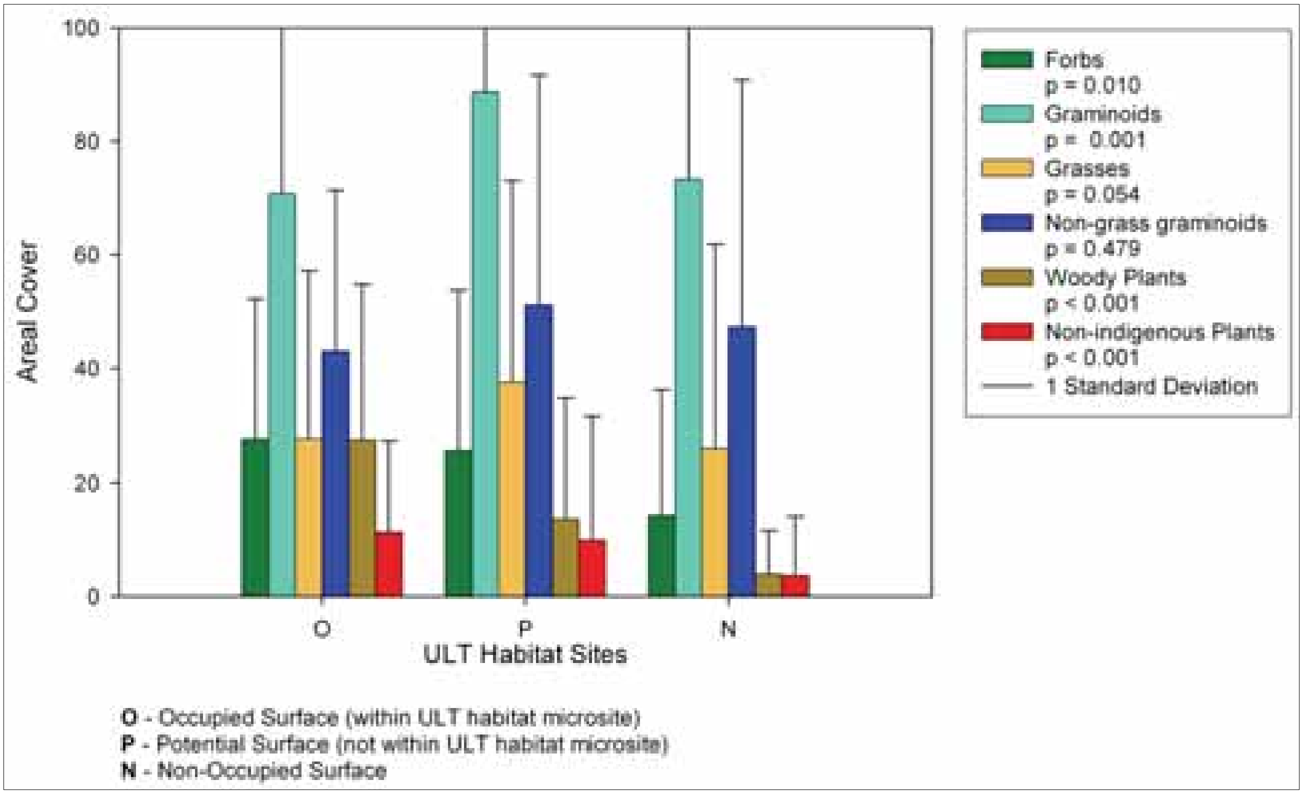



Figure 4.4. Species group coverage of ULT habitat sites in 2006.

cover than the unoccupied sites in both 2006 and 2007. There was no difference between 2006 and 2007 in litter cover between sites.

Results from 2006 showed that total vegetal cover was highest in occupied sites, as shown in Figure 4.2, with a P-value of 0.001. In other words, there was a significant statistical difference in total vegetal cover between sites. Results from 2007 show that total vegetal cover found in occupied and potentially occupied sites were nearly identical (Figure 4.3). There were no significant statistical differences of vegetal cover observed between any of the habitat types. The percentage of bare ground was much higher in the unoccupied sites with a low P-value (<0.001), also indicating a statistically significant difference between sites in 2006. However, in 2007 the percentage of bare ground in the unoccupied sites was much lower. The reduction in bare ground observed in 2007 may be because surfaces were not washed out by higher flows because of reduced flows in Diamond Fork Creek and drier climatic conditions.

Species found within quadrats were placed in one of the following groups: forb, graminoid, grass, non-grass graminoid, woody plant, or non-indigenous plant (Figures 4.4 and 4.5). In 2006 and 2007, the number of woody plant individuals was significantly higher at the occupied sites than at the potentially occupied or unoccupied sites. However, the differences between the habitat types and the percentage of woody species found were not as drastic in 2007, suggesting that more woody species are beginning to establish in the non-occupied sites. Non-indigenous plant numbers were highest in the occupied sites in 2006. A contrasting observation in 2007 showed that non-indigenous species were significantly higher in the non-occupied sites and had increased in the occupied and potentially occupied sites. A general observation made on the majority of surveyed surfaces was that there was

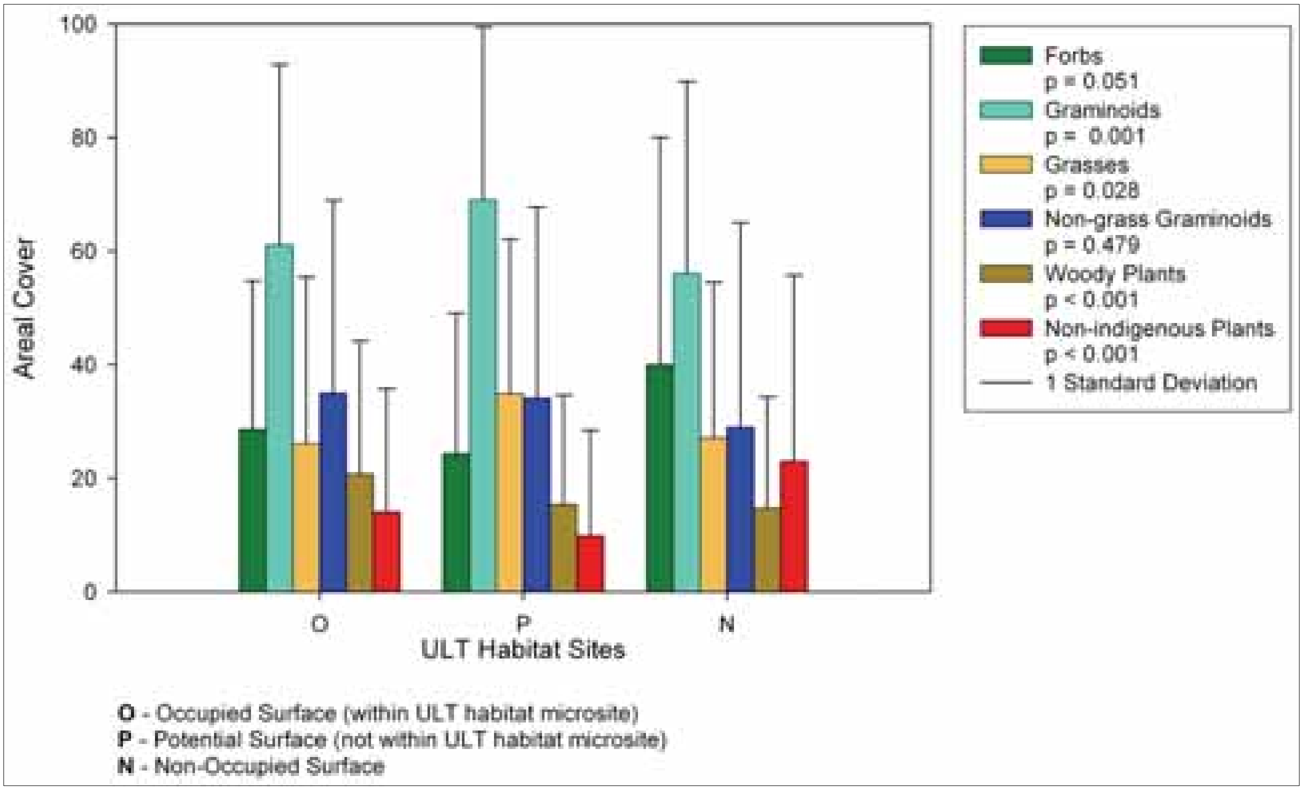



*Figure 4.5. Species group coverage of ULT habitat sites in 2007.*

a marked proliferation of yellow sweetclover (*Melilotus officianalis*). This may account for the overall trend of increased non-indigenous species found within all habitat types. Woody plant species, as well as non-indigenous species, showed a highly significant relationship with P-values of <0.001 in 2006 as well as 2007. Since ULT and most non-indigenous plants are disturbance-adapted species, this is not unexpected. However, the occurrence of a higher rate of woody plants associated with ULT individuals is less intuitive. Woody plant species, mainly willows, generally did not have a high percentage of vegetal cover at the occupied sites and were still in early developmental stages. When mature willow thickets were sampled, no ULT plants were found. The low-to-moderate cover of woody species seems to indicate a moderate-disturbance regime along Diamond Fork Creek to which the ULT species is adapted.

The quadrat data were also analyzed in 2006 and 2007 according to selected species found within each of the ULT habitat types (Figure 4.6 and Figure 4.7). Although many more species existed in the data set, the species shown in Figures 4.6 and 4.7 were those that showed a high correlation with P values that were highly significant or significant when comparisons were made between sites. A comprehensive list of species found within all quadrats during the 2007 surveys can be found in Appendix 4.3. A set of species was selected for further analysis based on whether the species was found within each habitat type. Each species was then compared by ULT habitat type, and Kruskal-Wallis tests were performed for each. The P-values (Appendix 4.3) describe differences of species and cover types between habitat types: occupied, potentially occupied, and non-occupied.

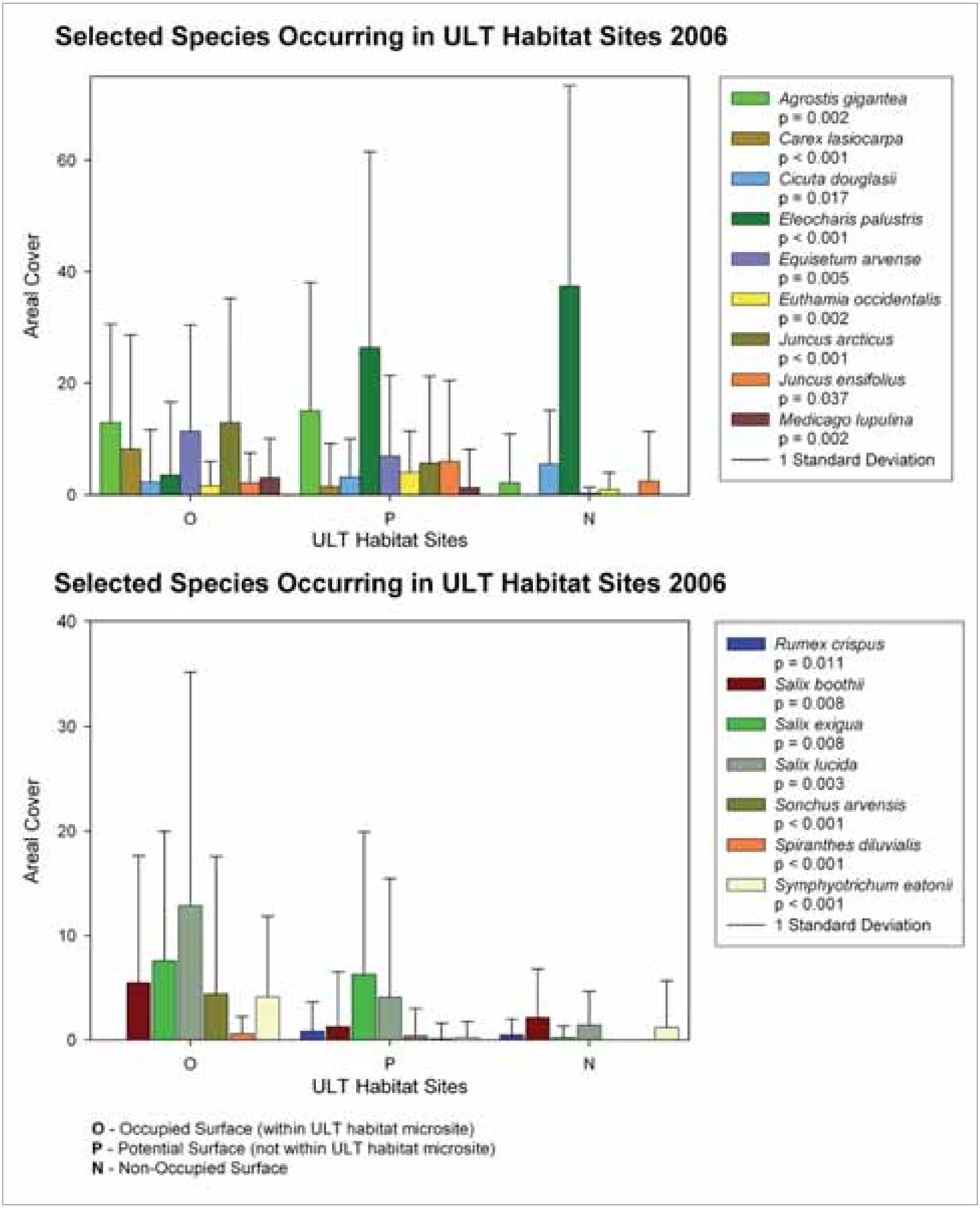



Figure 4.6 Significance of species groups cover within ULT habitat sites observed in 2006.

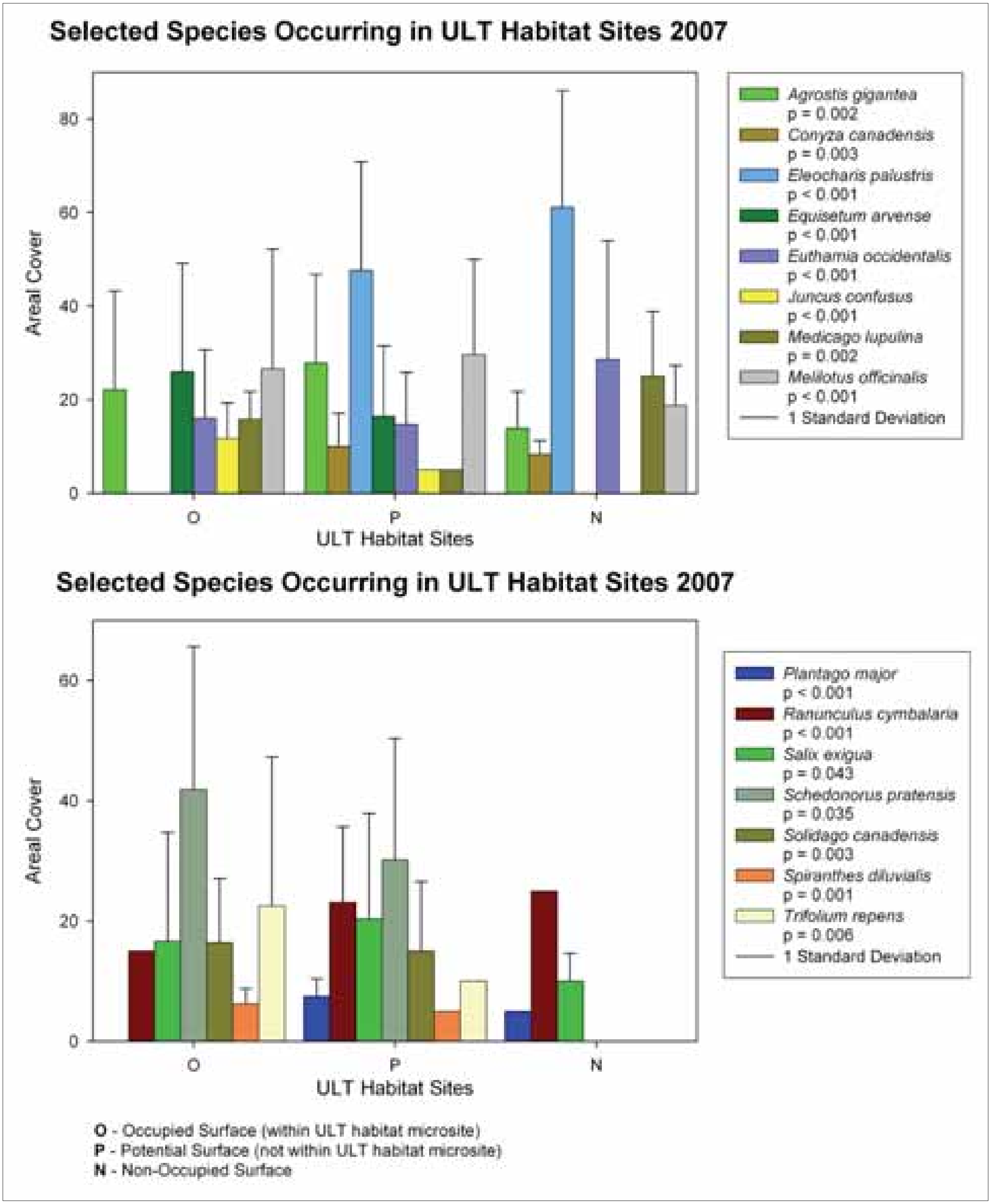



Figure 4.7 Significance of species groups cover within ULT habitat sites observed in 2007.

Correlations between the density of ULT plants on a transect and vegetal parameters recorded within the quadrats were not strong in 2006. A large majority of the hoop sections surveyed along established transects, even within the occupied sites, contained no ULT individuals. The method used to attribute ULT densities from the transect to the quadrats may have influenced the lack of correlation, but other factors associated with the size and shape of occupied micro-habitats may also have confounded the results. Since the correlation analysis assumes a linear relationship between the data and a normal distribution of parameters, deviations from these assumptions can largely influence the correlation results. The fact that the data were collected in a pre-determined, non-random manner, using hoop sections that many times contained no ULT plants may also have influenced these analyses, resulting in an inadequate number of ULT to show strong enough correlations during 2007 surveys.

### 4.3.2 Vegetation Cover, Composition, and Wetland Indicator Status 2006 and 2007

Comparisons of transect data from 2006 and 2007 were made, in addition to quadrat comparisons, to better compare changes occurring within occupied, potentially occupied, and non-occupied habitat types. Between years species groups, as well as individual species, were classified into a National Wetland Indicator Status Category (USFWS 1988, 1993). These classifications include the following:

| | |
|---|---|
| Obligate Wetland (OBL) | Occurs almost always (estimated probability 99%) under natural conditions in wetlands. |
| Facultative Wetland (FACW) | Usually occurs in wetlands (estimated probability 67-99%), but is occasionally found in non-wetlands. |
| Facultative (FAC) | Equally likely to occur in wetlands or non-wetlands (estimated probability 34-66%). |
| Facultative Upland (FACU) | Usually occurs in non-wetlands (estimated probability 67-99%), but is occasionally found in wetlands (estimated probability 1-33%). |
| Obligate Upland (OBL) | Occurs in wetlands in another region, but it almost always occurs (estimated probability 99%) under natural conditions in non-wetlands in the regions specified. If a species does not occur in wetlands in any region, it is not on the National List. |
| No Agreement (NA) | The regional panel was not able to reach a unanimous decision on this species. |
| No Indicator (NI) | Insufficient information was available to determine an indicator status. |

A few species were classified for this project that either had no regional classification or were classified as NI, which is not useful for assessing the distribution pattern of the species in relation to wetland conditions. Personal experience on numerous projects throughout the region was used to make these designations (S. Ripple and B. Atkin, botanists, BIO-WEST, Inc., 2007 personal observations) (Table 4.2). While these designations are not intended to assign wetland status, they do represent an indication of wetland conditions, especially when several species are pooled.

Table 4.2. Species National Wetland Indicator (NWI) status designation by authors in 2007.

| SPECIES CODE | SCIENTIFIC NAME | COMMON NAME | NWI STATUS | REASON |
|---|---|---|---|---|
| AGGI2 | *Agrostis gigantea* | redtop | FACW | Species is listed as A. stolonifera (in part) in NWI |
| BRIN2 | *Bromus inermis* | smooth brome | UPL | Experience |
| CANU4 | *Carduus nutans* | musk thistle | UPL | Experience |
| CAREX | *Carex species* | sedge | OBL | All other Carex in area are OBL |
| GUMI | *Gutierrezia microcephala* | threadleaf snakeweed | UPL | Experience |
| MESA | *Medicago sativa* | alfalfa | UPL | Experience |
| SPDI6 | *Spiranthes diluvialis* | Ute lady's tresses | OBL | Only found in Wetlands |
| TRDU | *Tragopogon dubius* | yellow salsify | UPL | Experience |
| VETH | *Verbascum thapsus* | common mullein | UPL | Experience |

After wetland indicator classifications were assigned to all species, 2006 and 2007 data were tabulated and basic statistical calculations were completed for each transect (Table 4.3). Species groups, Wetland Indicator Status, and non-indigenous status were used as the data values. Bar graphs of these data were also created (Figures 4.8 and 4.9).

Data from quadrats were organized based on transect and habitat type and habitat types, occupied, potentially occupied, and non-occupied, were compared between 2006 and 2007. Comparisons between the years include cover categories, species groups, and wetland indicator status (Figures 4.8, 4.9, and 4.10). When comparisons were made for transects between years, there was an overall decrease of obligate species occurring in all habitat sites in 2007 (Figure 4.8). Minimal changes were detected between 2006 and 2007 in species designated FACW and there was an increase in all habitat types of FACU designated species. There were not significant changes in upland species found, which is likely because there are not many upland species found within quadrats.

There was a general trend in 2007 that showed an increase in total vegetal cover, a decrease in bare ground areal cover, rock and litter cover (Figure 4.9). This may be due to the reduced spring run-off, lower annual precipitation, and lower flows in Diamond Fork Creek throughout the year, reducing the overall disturbance of surface areas adjacent to the creek. Figure 4.10 shows species groups

| TS | FLOWERING | | FLOWERING | | SET TOTAL | | COVER | | GROUND | | ROCK | | LITTER | | FORBS | | RUSHES | | GRASSES | | GRAMINOIDS | | VEGETATION | | SPECIES | | FAC | | FAC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 07 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 | 2007 | 2006 |
| 3 | 1.59 | 0.71 | 3.86 | 2.07 | 5.45 | 2.78 | 83.13 | 98.75 | 5.63 | 0.63 | 0.00 | 0.00 | 11.25 | 0.63 | 0.34 | 0.55 | 0.42 | 0.27 | 0.12 | 0.09 | 0.30 | 0.18 | 0.25 | 0.20 | 0.15 | 0.53 | 0.38 | 0.12 | 0.06 |
| 9 | 0.12 | 0.14 | 0.08 | 0.39 | 0.20 | 0.53 | 93.13 | 88.33 | 1.88 | 3.89 | 0.00 | 3.89 | 5.00 | 3.89 | 0.20 | 0.28 | 0.42 | 0.62 | 0.00 | 0.19 | 0.42 | 0.43 | 0.52 | 0.19 | 0.12 | 0.24 | 0.12 | 0.18 | 0.05 |
| 7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 92.86 | 100.00 | 7.14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.24 | 0.04 | 0.57 | 0.66 | 0.42 | 0.66 | 0.15 | 0.00 | 0.25 | 0.31 | 0.09 | 0.03 | 0.09 | 0.01 | 0.00 |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 90.00 | 96.00 | 7.00 | 2.00 | 0.00 | 2.00 | 3.00 | 0.00 | 0.28 | 0.18 | 0.76 | 0.65 | 0.09 | 0.26 | 0.67 | 0.39 | 0.37 | 0.18 | 0.02 | 0.06 | 0.07 | 0.00 | 0.01 |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 99.00 | 100.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.24 | 0.05 | 1.05 | 0.85 | 0.23 | 0.15 | 0.82 | 0.70 | 0.04 | 0.08 | 0.00 | 0.01 | 0.00 | 0.00 | 0.04 |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 78.00 | 100.00 | 16.00 | 0.00 | 0.00 | 0.00 | 6.00 | 0.00 | 0.13 | 0.09 | 1.14 | 0.80 | 0.53 | 0.36 | 0.60 | 0.44 | 0.17 | 0.12 | 0.18 | 0.04 | 0.18 | 0.00 | 0.00 |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 82.50 | 100.00 | 3.33 | 0.00 | 0.00 | 0.00 | 14.17 | 0.00 | 0.34 | 0.15 | 0.89 | 0.66 | 0.66 | 0.62 | 0.23 | 0.04 | 0.15 | 0.20 | 0.05 | 0.00 | 0.17 | 0.02 | 0.01 |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 95.00 | 100.00 | 5.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.16 | 0.10 | 1.15 | 0.97 | 0.11 | 0.20 | 1.04 | 0.77 | 0.00 | 0.15 | 0.00 | 0.01 | 0.19 | 0.11 | 0.00 |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 93.33 | 95.00 | 4.17 | 5.00 | 0.83 | 0.00 | 1.67 | 0.00 | 0.25 | 0.29 | 0.82 | 0.50 | 0.69 | 0.50 | 0.13 | 0.00 | 0.25 | 0.21 | 0.01 | 0.01 | 0.13 | 0.04 | 0.03 |
| 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 96.25 | 96.25 | 3.75 | 3.75 | 0.00 | 0.00 | 0.00 | 0.00 | 0.15 | 0.21 | 1.17 | 0.74 | 0.82 | 0.71 | 0.35 | 0.03 | 0.08 | 0.07 | 0.10 | 0.00 | 0.07 | 0.00 | 0.08 |
| 9 | 0.03 | 0.10 | 0.00 | 0.00 | 0.03 | 0.10 | 93.89 | 97.78 | 6.11 | 2.22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.29 | 0.23 | 1.13 | 0.59 | 0.66 | 0.54 | 0.47 | 0.04 | 0.04 | 0.25 | 0.05 | 0.04 | 0.21 | 0.04 | 0.09 |
| 3 | ND | 0.32 | ND | 0.29 | ND | 0.61 | ND | 95.77 | ND | 3.08 | ND | 0.00 | ND | 1.15 | ND | 0.32 | ND | 0.53 | ND | 0.36 | ND | 0.17 | ND | 0.19 | ND | 0.04 | ND | 0.12 | ND |
| 6 | ND | 0.48 | ND | 0.00 | ND | 0.48 | ND | 97.50 | ND | 0.00 | ND | 0.00 | ND | 2.50 | ND | 0.33 | ND | 0.75 | ND | 0.45 | ND | 0.30 | ND | 0.17 | ND | 0.13 | ND | 0.22 | ND |
| 3 | 0.32 | 0.63 | 0.50 | 1.35 | 0.82 | 1.99 | 98.29 | 94.38 | 0.29 | 5.63 | 0.00 | 0.00 | 1.43 | 0.00 | 0.27 | 0.26 | 0.81 | 0.64 | 0.29 | 0.22 | 0.52 | 0.43 | 0.27 | 0.23 | 0.16 | 0.06 | 0.42 | 0.17 | 0.12 |
| 1 | 0.79 | 0.37 | 0.20 | 0.29 | 1.00 | 0.66 | 96.64 | 98.18 | 2.14 | 1.36 | 0.00 | 0.00 | 1.21 | 0.45 | 0.16 | 0.46 | 0.79 | 0.42 | 0.33 | 0.05 | 0.46 | 0.36 | 0.30 | 0.26 | 0.04 | 0.25 | 0.19 | 0.20 | 0.08 |
| 4 | 0.00 | 0.64 | 0.00 | 0.08 | 0.00 | 0.72 | 100.00 | 98.75 | 0.00 | 1.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.24 | 0.39 | 0.81 | 0.63 | 0.16 | 0.33 | 0.65 | 0.30 | 0.11 | 0.20 | 0.08 | 0.16 | 0.04 | 0.09 | 0.08 |
| 9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 84.44 | 100.00 | 10.00 | 0.00 | 0.56 | 0.00 | 5.00 | 0.00 | 0.17 | 0.24 | 0.96 | 0.83 | 0.16 | 0.38 | 0.80 | 0.46 | 0.04 | 0.10 | 0.00 | 0.03 | 0.02 | 0.01 | 0.02 |
| 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 97.50 | 100.00 | 2.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.14 | 0.21 | 1.23 | 0.80 | 0.46 | 0.09 | 0.77 | 0.71 | 0.04 | 0.14 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 |
| 0 | 0.00 | 0.09 | 0.00 | 0.03 | 0.00 | 0.13 | 95.00 | 98.00 | 5.00 | 2.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.15 | 0.08 | 1.14 | 0.95 | 0.58 | 0.46 | 0.56 | 0.49 | 0.03 | 0.04 | 0.00 | 0.00 | 0.04 | 0.00 | 0.03 |
| 2 | 1.10 | 0.00 | 0.00 | 0.00 | 1.10 | 0.00 | 94.55 | 97.50 | 5.45 | 0.00 | 0.00 | 2.08 | 0.00 | 0.42 | 0.24 | 0.19 | 0.94 | 0.73 | 0.26 | 0.35 | 0.68 | 0.39 | 0.10 | 0.17 | 0.09 | 0.07 | 0.30 | 0.03 | 0.04 |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 98.33 | 100.00 | 1.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.08 | 1.02 | 0.70 | 0.12 | 0.14 | 0.90 | 0.56 | 0.04 | 0.23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 88.33 | 93.33 | 11.67 | 6.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.27 | 1.01 | 0.73 | 0.59 | 0.54 | 0.42 | 0.19 | 0.06 | 0.02 | 0.00 | 0.05 | 0.16 | 0.01 | 0.00 |
| 3 | 0.04 | 0.04 | 0.00 | 0.00 | 0.04 | 0.04 | 99.38 | 100.00 | 0.63 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.13 | 1.07 | 0.83 | 0.42 | 0.34 | 0.65 | 0.48 | 0.08 | 0.11 | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 |
| 8 | 0.00 | 0.02 | 0.00 | 0.07 | 0.00 | 0.09 | 85.80 | 95.89 | 4.60 | 0.00 | 6.20 | 3.93 | 3.40 | 0.18 | 0.51 | 0.29 | 0.39 | 0.78 | 0.29 | 0.38 | 0.10 | 0.40 | 0.24 | 0.06 | 0.39 | 0.12 | 0.06 | 0.02 | 0.37 |
| 5 | 0.04 | 0.00 | 0.06 | 0.00 | 0.10 | 0.00 | 88.46 | 91.80 | 1.54 | 4.20 | 9.04 | 3.00 | 0.96 | 1.00 | 0.28 | 0.58 | 0.96 | 0.31 | 0.46 | 0.21 | 0.50 | 0.09 | 0.03 | 0.26 | 0.06 | 0.36 | 0.07 | 0.04 | 0.21 |
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 86.82 | 96.36 | 9.09 | 3.64 | 1.82 | 0.00 | 2.27 | 0.00 | 0.23 | 0.19 | 1.10 | 0.70 | 0.47 | 0.54 | 0.63 | 0.16 | 0.12 | 0.13 | 0.06 | 0.06 | 0.33 | 0.02 | 0.09 |
| 1 | 0.06 | 0.14 | 0.38 | 0.09 | 0.45 | 0.23 | 99.50 | 99.55 | 0.00 | 0.45 | 0.50 | 0.00 | 0.00 | 0.00 | 0.44 | 0.18 | 0.71 | 0.83 | 0.27 | 0.12 | 0.44 | 0.71 | 0.18 | 0.11 | 0.19 | 0.05 | 0.33 | 0.48 | 0.25 |
| 2 | 0.75 | 1.01 | 0.95 | 0.61 | 1.70 | 1.62 | 100.00 | 95.83 | 0.00 | 2.92 | 0.00 | 0.00 | 0.00 | 1.25 | 0.31 | 0.20 | 0.70 | 0.79 | 0.12 | 0.12 | 0.58 | 0.67 | 0.39 | 0.19 | 0.15 | 0.10 | 0.19 | 0.27 | 0.26 |
| 1 | 0.00 | 0.26 | 0.00 | 0.00 | 0.00 | 0.26 | 97.00 | 96.36 | 0.50 | 1.36 | 0.00 | 0.00 | 2.50 | 2.27 | 0.29 | 0.12 | 0.94 | 0.77 | 0.23 | 0.18 | 0.71 | 0.59 | 0.24 | 0.20 | 0.10 | 0.04 | 0.18 | 0.02 | 0.09 |
| 3 | 0.10 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | 100.00 | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.28 | 1.30 | 0.90 | 0.20 | 0.13 | 1.10 | 0.77 | 0.00 | 0.00 | 0.00 | 0.07 | 0.28 | 0.30 | 0.15 |
| 6 | 0.05 | 0.05 | 0.00 | 0.00 | 0.05 | 0.05 | 85.00 | 91.67 | 5.00 | 3.33 | 3.33 | 0.00 | 6.67 | 5.00 | 0.24 | 0.08 | 0.69 | 0.59 | 0.29 | 0.44 | 0.40 | 0.15 | 0.34 | 0.34 | 0.10 | 0.06 | 0.32 | 0.10 | 0.05 |
| 9 | 0.00 | 0.07 | 0.00 | 0.00 | 0.00 | 0.07 | 87.78 | 97.22 | 3.33 | 2.78 | 0.56 | 0.00 | 8.33 | 0.00 | 0.26 | 0.21 | 0.69 | 0.63 | 0.49 | 0.44 | 0.20 | 0.19 | 0.26 | 0.19 | 0.15 | 0.21 | 0.16 | 0.00 | 0.05 |
| 3 | 0.21 | 0.00 | 1.06 | 0.00 | 1.27 | 0.00 | 96.67 | 96.67 | 1.67 | 3.33 | 0.00 | 0.00 | 1.67 | 0.00 | 0.49 | 0.23 | 0.48 | 0.39 | 0.21 | 0.17 | 0.27 | 0.21 | 0.43 | 0.44 | 0.19 | 0.02 | 0.25 | 0.23 | 0.40 |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 76.67 | 100.00 | 16.67 | 0.00 | 3.33 | 0.00 | 3.33 | 0.00 | 0.18 | 0.13 | 0.86 | 0.85 | 0.35 | 0.38 | 0.51 | 0.48 | 0.00 | 0.08 | 0.11 | 0.01 | 0.11 | 0.01 | 0.00 |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 50.83 | 78.33 | 32.50 | 6.67 | 13.33 | 10.83 | 3.33 | 4.17 | 0.23 | 0.57 | 0.69 | 0.40 | 0.43 | 0.40 | 0.26 | 0.00 | 0.02 | 0.16 | 0.00 | 0.35 | 0.07 | 0.36 | 0.02 |
| 3 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.33 | 53.33 | 64.33 | 25.00 | 33.33 | 21.67 | 0.00 | 0.00 | 0.00 | 1.13 | 0.00 | 0.08 | 0.00 | 0.08 | 0.00 | 0.00 | 0.00 | 0.08 | 0.00 | 0.71 | 0.00 | 0.27 | 0.00 |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 93.33 | 98.33 | 5.00 | 1.67 | 0.00 | 0.00 | 1.67 | 0.00 | 0.09 | 0.14 | 1.02 | 0.67 | 0.14 | 0.14 | 0.88 | 0.54 | 0.12 | 0.24 | 0.02 | 0.09 | 0.02 | 0.01 | 0.00 |

2006.

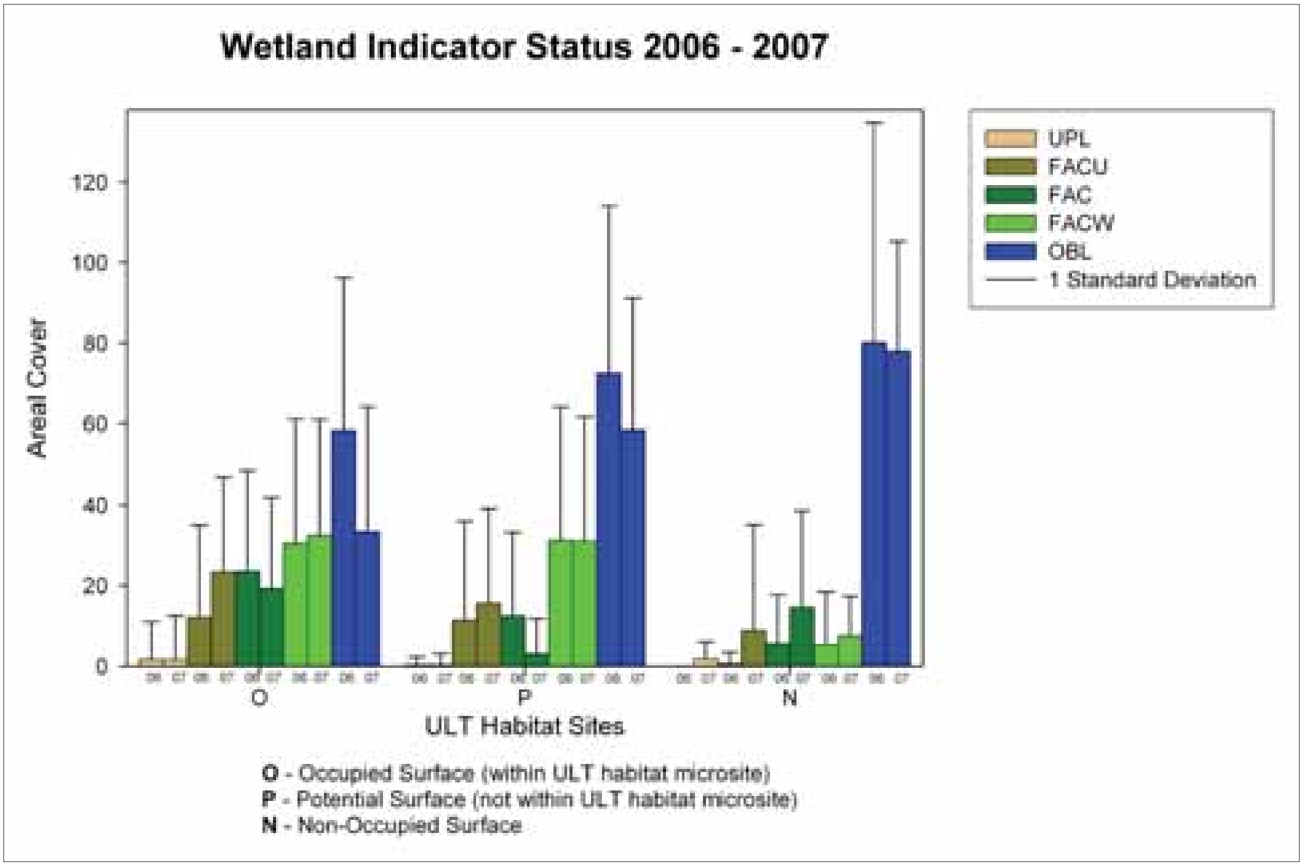



Figure 4.8. Wetland indicator status comparisons of occupied, potentially occupied and non-occupied habitat sites between 2006 and 2007.

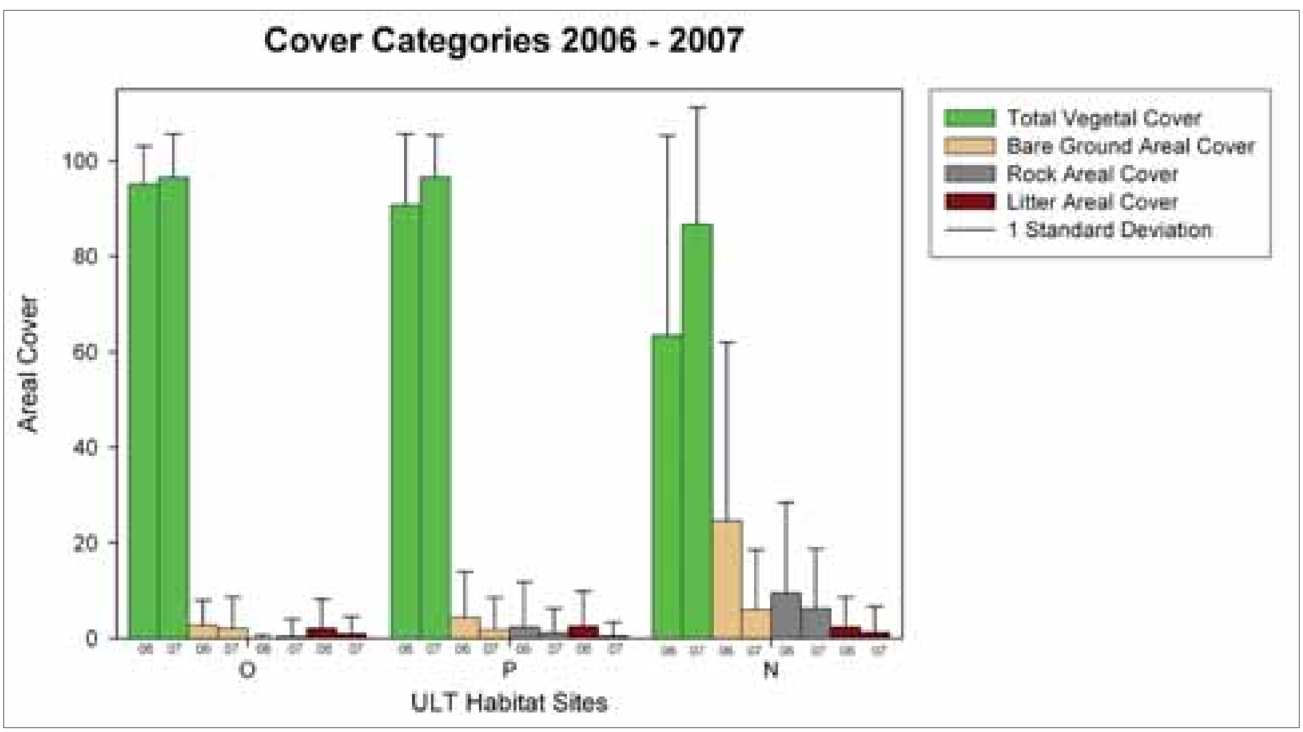



Figure 4.9 Cover category comparisons of transects between 2006 and 2007.

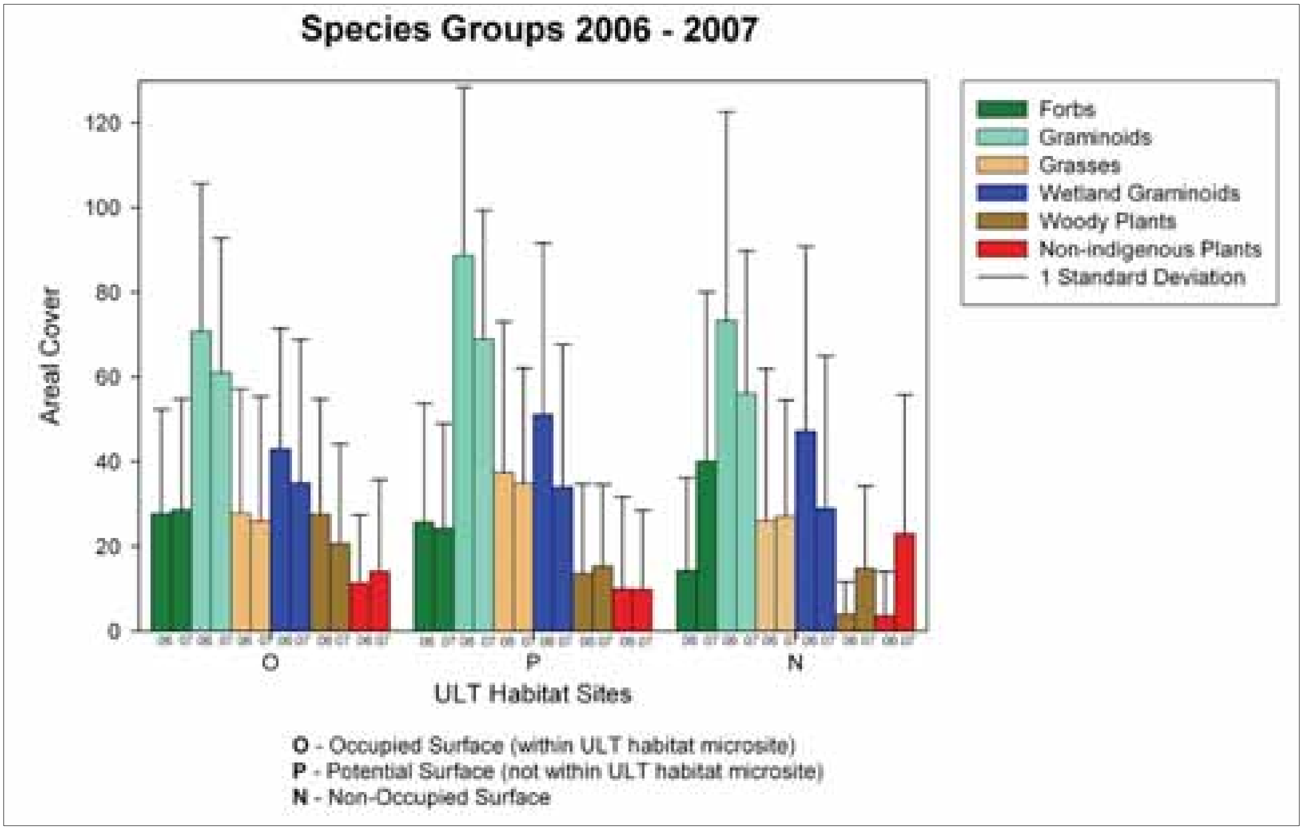



*Figure 4.10 Species groups comparisons of transects between 2006 and 2007.*

comparisons between 2006 and 2007. Graminoids in general decreased within all habitat types, for both wetland and upland species. Non-indigenous species increased between 2006 and 2007 in occupied and non-occupied sites and have not detectably changed in the potentially occupied sites, which may be a function of the wetter nature of the potentially occupied sites that are located in topographic depressions. Woody species are increasing in potentially occupied and non-occupied sites. Woody species show a decrease in occupied habitat types which may be attributed to grazing impacts that occurred during the ULT bloom period in 2007.

### 4.3.4 Non-Indigenous Plant Species

The coverage analysis of species groups found within ULT habitat indicated that there was a highly significant correlation with a P-value of <0.001 between presence of ULT individuals and the presence of non-indigenous plant species in both 2006 and 2007. Because both ULT and many non-indigenous species require and/or thrive in environmental situations caused by regular disturbance regimes and proximity to water, these species were in many cases competing for very similar resources and habitat. Since non-indigenous species are characteristically early successional species, it is understandable that a highly significant correlation exists between them.

The potential invasion of non-indigenous plant species has become as much of a concern for the persistence of ULT populations within the Diamond Fork Watershed as hydrological changes and the adaptation of the native vegetation community structure to those changes. Particular non-indigenous species of concern along Diamond Fork Creek noted in 2006 were Canada thistle (*Cirsium arvense*), bull thistle (*Cirsium vulgare*), perennial pepperweed (*Lepidium latifolium*), saltcedar (*Tamarix ramosissima*), and Russian olive (*Elaegnus angustifolia*). These species are often found in habitats similar to those where ULT are found. Since many of these non-indigenous species currently occur in relatively low numbers, early detection and rapid treatment could improve the chance of persistence of ULT colonies along Diamond Fork Creek. During the 2007 monitoring period, there were an increased number of young saltcedar and Russian olive plants observed during field work. Although none were found on the habitat transects during the 2006 monitoring period, there was a notable amount of Canada thistle found on most surfaces that contained ULT. During the 2007 surveys, surveyors noted a decrease in Canada thistle, which appeared to be displaced by yellow sweetclover, another non-indigenous species, likely in response to the lower annual precipitation received in 2007. Additionally, musk thistle (*Carduus nutans*), a non-indigenous species more typically found in upland habitats, was observed on surfaces that contain or previously contained ULT. Surfaces that appear to be transitioning to drier vegetation communities are being populated by a variety of non-indigenous species, many of which are listed as noxious weeds in Utah (UDAF 2008).

### 4.3.4 Piezometer Measurements

Peak flows from snowmelt and natural spring runoff were virtually nonexistent in 2007 due to extremely low snowpack throughout the watershed. The natural spring peak in the hydrograph (generally occurring around May 1) could barely be detected above the high base flows of water imported from Strawberry and Syar Tunnels upstream of the Diamond Fork gage (Figure 4.11). Additional water was imported at the beginning of July to create an artificial peak flow in 2007 to facilitate geomorphic functions in the channel such as cleaning gravels and flushing silt from the lower portions of Diamond Fork (Figure 4.11). This peak flow and subsequent data collection on sedimentation rates in lower Diamond Fork are discussed in a separate report (BIO-WEST 2008 in press). Fortunately, the peak flow schedule was ideal in 2007 to measure and correlate stream discharge with ground water elevations on known ULT-occupied surfaces using the existing piezometers (HDR 2005, BIO-WEST 2006).

Ten water surface measurements were taken at each piezometer (three piezometers each on three ULT surfaces [Colony 10A, 25, and 35]) including measurements of the water surface elevation in the stream channel at a location near each piezometer perpendicular to flow. The findings in 2007 were consistent with results found in 2006 (BIO-WEST 2006), showing very little correlation between ground water elevations and streamflow at all piezometers during the summer growing season when flow ranged between 60 and 100 cfs (Figures 4.12, 4.13, and 4.14). In fact, there seems to be a larger influence on depth to ground water from evapotranspiration than streamflow in this discharge range as the depth to ground water generally decreases in November (i.e., ground water rises slightly) when streamflow drops from approximately 80 cfs to approximately 60 cfs.

There was no appreciable response in the piezometer measurements to snowmelt and generally “wet” conditions occurred in May and June; however, depth to ground water at the monitored ULT-occupied surfaces was highly influenced by the artificial peak flows in 2007 (Figures 4.12, 4.13, and 4.14). Ground water elevations responded almost immediately to the high flows (i.e., flows exceeding 250 cfs). The elevational differences between surface water and ground water generally decreased during the peak flows. There were no measurable differences in ground water elevations

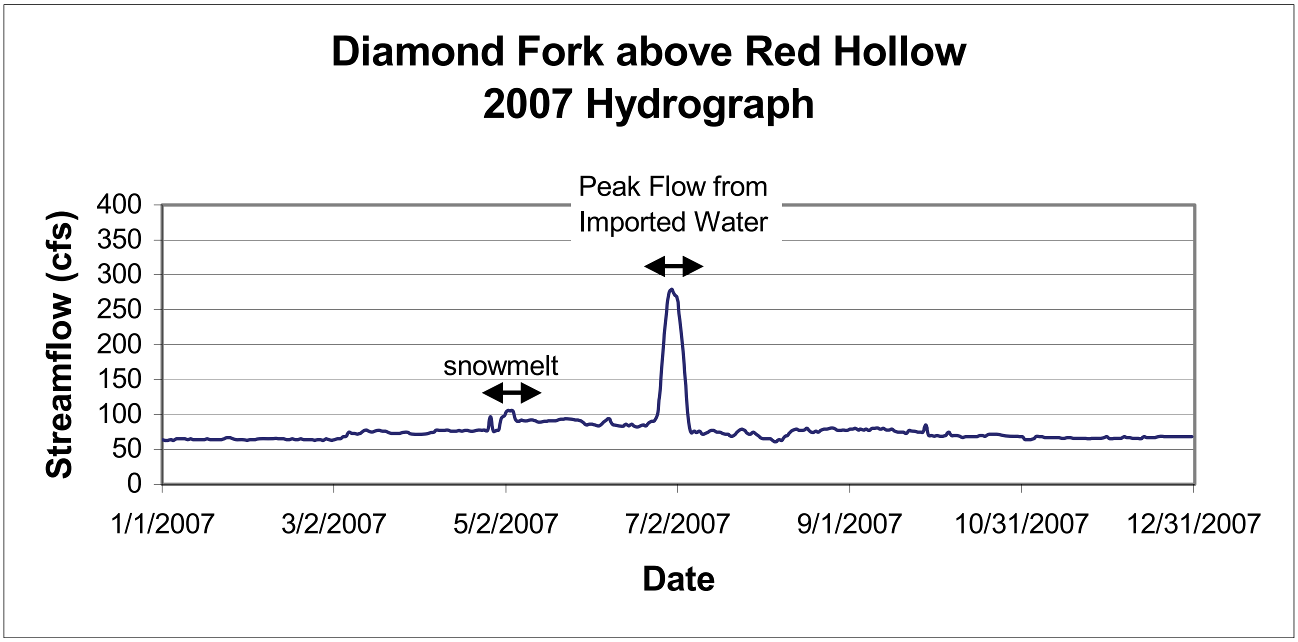



Figure 4.11. The 2007 hydrograph for lower Diamond Fork Creek (USGS 10149400 Diamond Fork above Red Hollow near Thistle, Utah).

during the "natural" runoff period (prior to the artificial peak flow), indicating that streamflow has a greater influence on depth to ground water in the shallow wells at the ULT-occupied surfaces than sidehill/tributary sources. The near-surface alluvial aquifer recharge presumably comes from upgradient bank infiltration and activation of side channels (and probably gravel lenses associated with inactive channels), given that flows generally remained in bank immediately adjacent to the piezometers at 265 cfs and ground water elevations generally increased more and remained higher farther away from the channel during high flow than adjacent to the channel as shown at the MO site (Figure 4.15).

There were no measurements between 100 cfs and 265 cfs on the ascending limb of the hydrograph between June 25-July 1, but the measurement on July 1 during the peak indicated that the near-surface alluvial aquifers began recharging as stage increased and depth to ground water decreased significantly while flows remained high. There was no way to tell whether the ground water elevations would have continued to rise if the flows had been sustained longer at this stage or if the stage had been increased beyond 265 cfs. Ground water elevations were approximately 0.8, 1.2, and 0.6 feet higher during peak flows (265 cfs) than during base flows (60-100 cfs) at DFC (Colony 10A), MO (Colony 25), and OX (Colony 35), respectively. Ground water elevations continued to be affected by peak flows more at MO than the other two occupied sites, similar to the 2006 results. However, ground water elevations at all sites—including MO—responded immediately to reduced flows on the receding limb of the hydrograph and leveled off for the rest of the summer/fall when flows dropped below 100 cfs to near their pre-runoff elevations (Figure 4.12, 4.13, and 4.14), except at the two piezometers closest to the stream at MO. These two piezometers leveled off in 2007 slightly higher (2-3 inches) following high flows than they were prior to high flows (Figure 4.14), and higher than the measurements taken in 2006. Furthermore, the piezometers at MO did not dry out in 2007, whereas they became dry in 2006, which potentially indicates aggradation of the channel upstream and/or downstream of this location during the 2007 peak flow or other processes

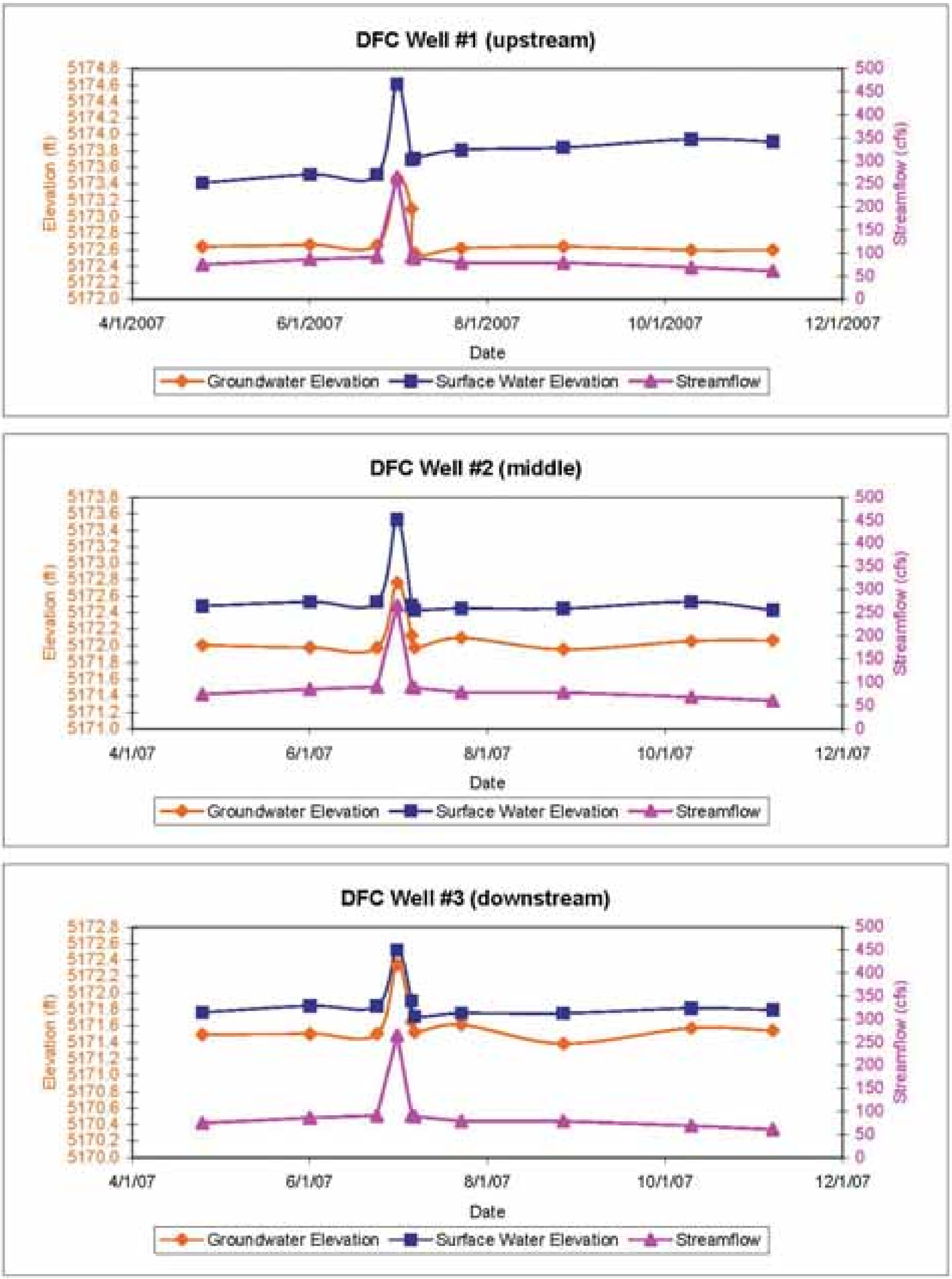



Figure 4.12. Water elevations and streamflow in 2007 at the DFC piezometer monitoring site (ULT Colony 10A).

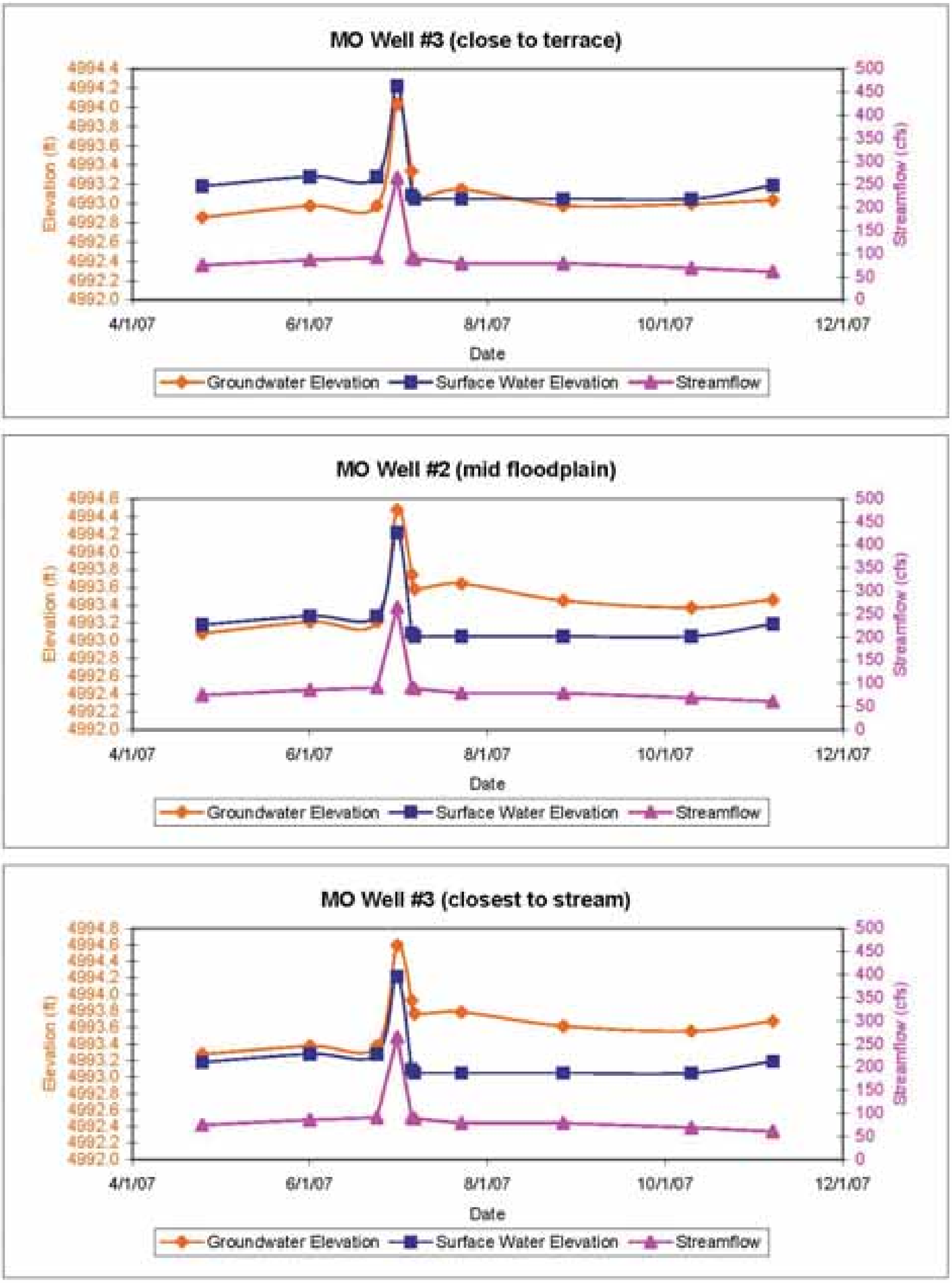



Figure 4.13. Water elevations and streamflow in 2007 at the MO piezometer monitoring site (ULT Colony 25).

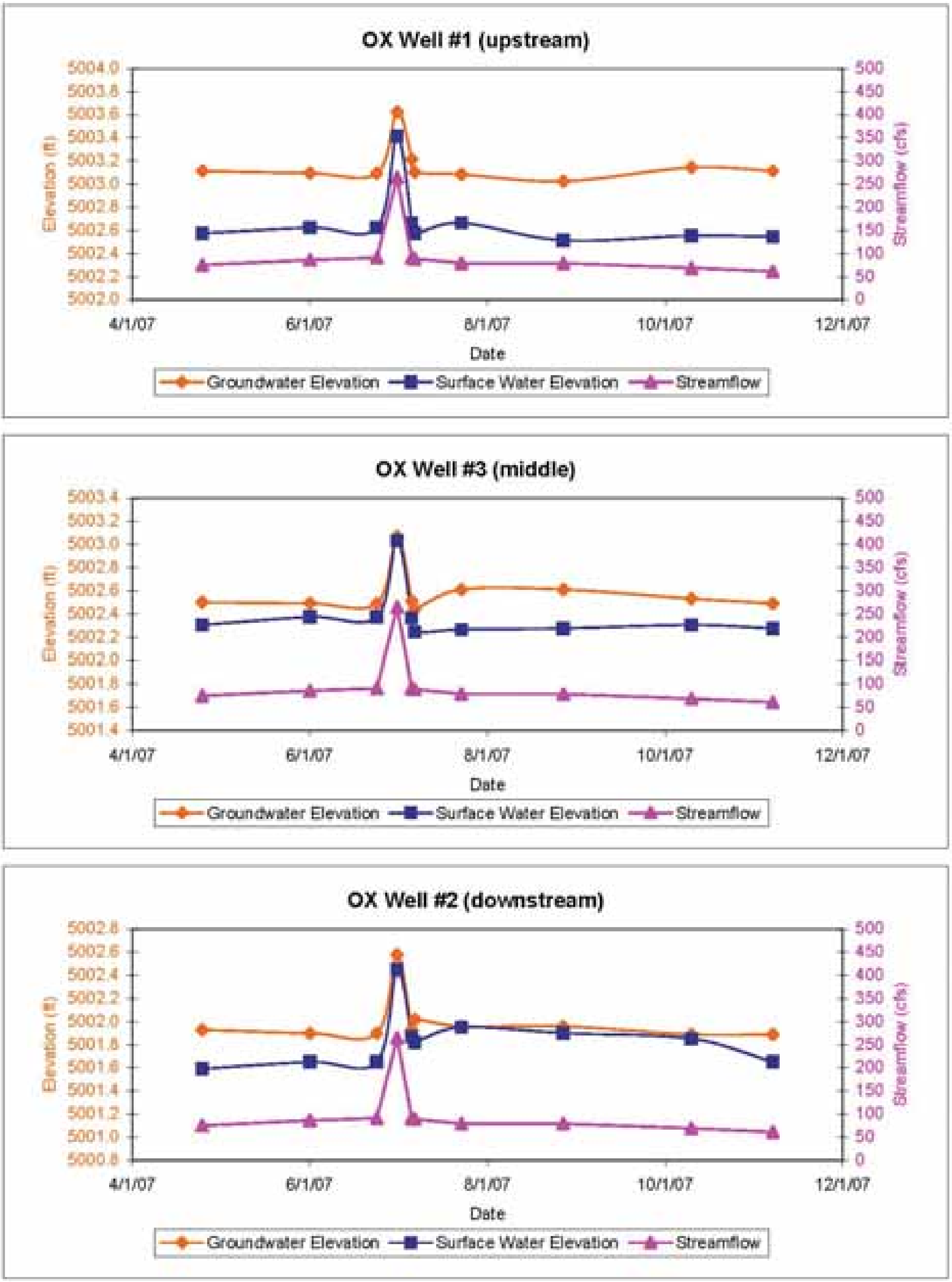
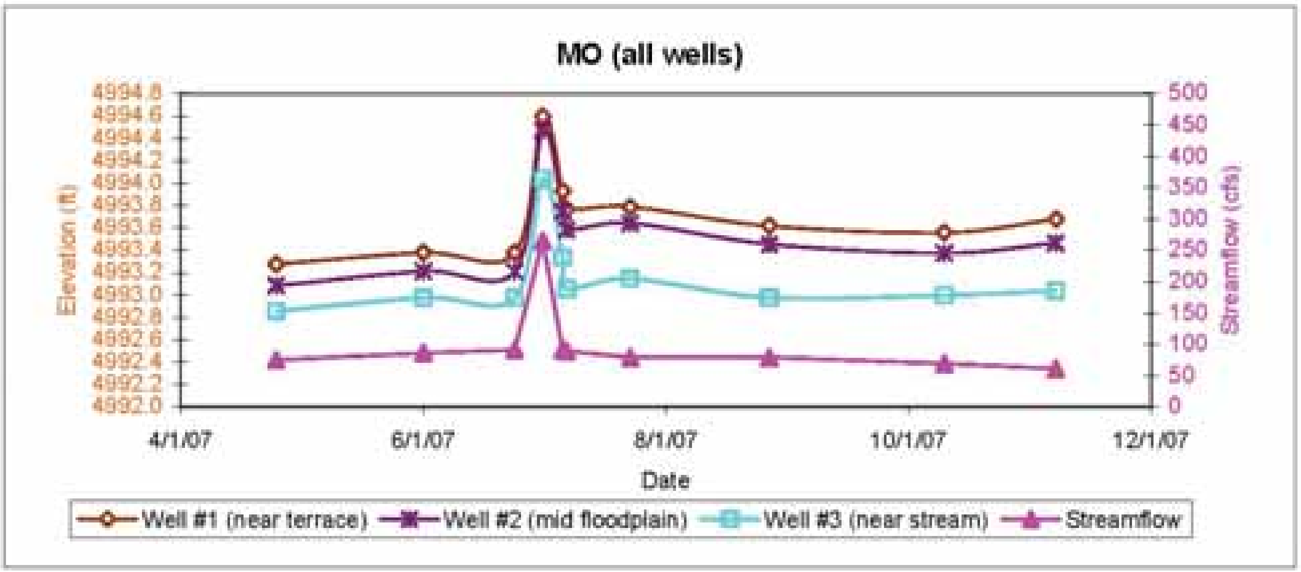



Figure 4.14. Water elevations and streamflow in 2007 at the OX piezometer monitoring site (ULT Colony 35).



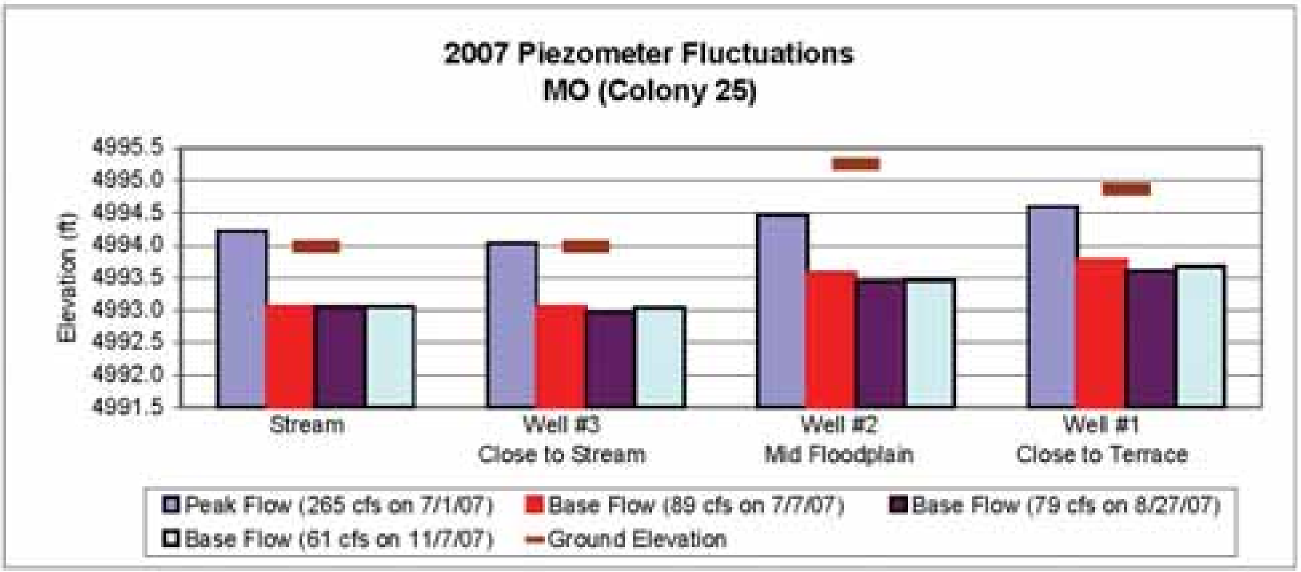




Figure 4.15. Ground water fluctuations relative to the ground surface at the three wells at the MO piezometer monitoring site during peak and base flows at different times of the summer and late fall in 2007.

that would set a new base for ground water elevations near the channel. The piezometer farthest away from the channel returned closer to its pre-runoff elevation.

The DFC site still appears to be a “losing reach” (losing surface water to the nearby alluvial aquifer) at all flow levels, whereas the MO and OX sites still appear to be “gaining reaches” (water flows from the near-surface alluvial aquifer to the stream). The separation between ground water and surface water elevations at DFC and OX were greatest at the upstream piezometers (DFC #1 and OX #1) and least at the downstream piezometer (DFC #3 and OX #2) during all flows, indicating that the water table under these ULT occupied surfaces has a more gentle slope than the channel. The ground water elevation remained relatively stable in each piezometer from July 7 (post flood) through November when our last measurements were made (Figure 4.12).

Major ground water fluctuations followed the same seasonal pattern as surface water fluctuations during peak flows; however, the response in ground water to reductions in flow (80 cfs to 60 cfs) in October and November was similar to 2006. The alluvial water table (presumably being supported at least partially by streamflow) seemed to stay at the same elevation throughout the summer and rise slightly later in the fall when flows were decreased during October and November (compared with July and August flows). Since the flows decreased during this period, a drop in evapotranspiration rates is still the most logical cause for the slight increase in ground water elevations during late fall.

The alignment of the three piezometers at MO was set perpendicular to flow (across the floodplain), whereas piezometers at DFC and OX were aligned more parallel to flow. Therefore, there was only one surface water measurement site for all three piezometers at the MO site. Further complicating surface water measurements at this site was the fact that the stream was relatively steep and uneven (i.e., in a riffle) directly perpendicular to the piezometers. Although a rebar was originally placed along the bank at a set elevation above the water, it was tampered with in 2006 and simple measurements to the horizontal portion of the bank were made in 2007. Therefore, the surface water measurements at the MO site are less precise than the other sites and are assumed static throughout the base flow period.

## 4.4 DISCUSSION

Both bare ground and total vegetal cover may be influenced by specific transect locations as portions of some of the potentially occupied and unoccupied transects bisected active segments of the streambed. The transects were originally located within the different sites based on very narrow corridors of micro-topography (surfaces) that were either occupied (i.e., transects located at the right elevation for previous ULT colonization), potentially occupied (i.e., transects located on occupied surfaces but at slightly lower and wetter elevations on the same surface), or unoccupied (transects located on unoccupied surfaces that are also slightly lower and wetter than the occupied sites). The question posed in 2006 was: How will these habitats and associated ULT colonies change over time with a more natural hydrologic regime? Comparisons between data collected in quadrats in 2006 and 2007 show that there are changes occurring on occupied, potentially occupied, and non-occupied habitat sites. There was higher vegetal cover in 2007 and less bare ground, rock, and litter on all habitat types than observed in 2006. This may be a function of maturing vegetation communities and less disturbance of surface areas adjacent to Diamond Fork Creek because of reduced peak/irrigation flows. Although there was a higher amount of overall vegetal cover found in 2007, the changes are subtle and there were no statistically significant differences of vegetal cover observed between any of the habitat types.

In 2006 and 2007, the number of woody plant individuals and non-indigenous species was significantly higher at occupied sites. However, the differences found in 2007 were not as drastic between the occupied and non-occupied sites. This homogenization of habitat types may be caused by dry, hot conditions in 2007 and reduced dynamics and disturbance caused by Diamond Fork Creek. The majority of species that were highly significant or significant when compared between habitat types in 2006 were given the Wetland Indicator Status of either FACW or OBL. In 2007 the majority of species that showed a high correlation of P values between habitat types recorded within quadrats were classified with either a UPL, FACU, or FAC Wetland Indicator Status. Further, and suggesting a drying trend on all habitat types, was an overall decrease of OBL species occurring in all habitat sites in 2007 when comparisons were made between 2006 and 2007 transects. The increased occurrence of species classified as either FACU or FAC suggests that the riparian corridor may be transitioning to a more moderate environment conducive to species with more intermediate water requirements. These trends also coincide with the cooler wetter conditions in 2006 compared with the hot, dry conditions in 2007.

Non-indigenous species were recorded both in quadrats and on sites containing ULT colonies. As previously discussed, particular species may compete directly with ULT for similar soil, moisture, light, and pollinator requirements. An effort to map and treat weeds within the Diamond Fork Watershed may be important in the preservation of existing and establishment of future ULT colonies. There was a highly significant correlation between the presence of ULT individuals and the presence of non-indigenous plant species observed in 2006 and 2007.

One impact to habitat analysis during 2007 surveys was unexpected cattle-grazing impacts within the riparian corridor. Habitat analysis may have been skewed by their preferential herbivory, trampling of species, and the difficulty of species identification as a result of grazing. This may impact ULT habitat in many ways including spreading non-indigenous plant species and/or reducing canopy cover of young willows that potentially shade ULT.

Ground water, and its association with the instream flows of Diamond Fork Creek, was inconsistent at the three piezometer monitoring sites. The 2006 and 2007 measurements strongly indicated that two of the sites (OX and MO) were gaining reaches and one site (DFC) was a losing reach. While depth to ground water (distance from the bare ground to the water table) decreased significantly when flows exceeded 250 cfs, there seemed to be no correlation between streamflow and ground water elevations during base flow (60 to 100 cfs) at the three sites. The implications that instream flows (flows ranging from 60 to 80 cfs) control ground water elevations via lateral exchanges were not supported by any of the data collected in 2006 and 2007. Furthermore, ground water elevations were not affected by hillside drainage during snowmelt as suspected. Given the fact that streamflow remained primarily in-channel in 2007, the most logical explanation was that the high flows caused a combination of upstream bank infiltration and/or flooding at specific locations (most likely along old channels and side channels where the bank is lower), and the near surface alluvial aquifer became recharged during the artificial peak flow from upgradient connections with the current channel. The upgradient connections did not seem to be active when flows dropped below 100 cfs.

The immediate response in ground water elevations to peak flows was surprising as the alluvial aquifer drained as quickly as it filled. There may be significance between the apparent correlation between peak flows exceeding 400 cfs and higher ULT counts since 2002 (Figure 3.4) given the streamflow/ground water connections observed at the piezometers in 2007. The higher-magnitude and longer-duration peak flows in 2002, 2003, and 2006 would have more effectively filled the near-surface alluvial aquifer (from upgradient sources) and decreased the depth to ground water at the ULT-occupied surfaces than the lower magnitude peak flows in 2004, 2005, and 2007. However, all years since 2002 have experienced some level of flooding and ground water recharge.

# CHAPTER 5: SUMMARY AND DISCUSSIONS

# 5.0 SUMMARY AND DISCUSSION

Diamond Fork Creek and its tributary, Sixth Water Creek, have conveyed water imported from Strawberry Reservoir to the Wasatch Front as an important component of the Strawberry Valley Project. The artificially high flows ceased with the completion of the Diamond Fork System, which is part of the Bonneville Unit of the Central Utah Project (CUP). Today, the Diamond Fork System transports imported water through a series of tunnels and pipes directly to Spanish Fork River and can largely bypass Diamond Fork and Sixth Water Creeks. The only flows sent through Sixth Water and Diamond Fork Creeks are waters imported to satisfy instream flow requirements (USFWS 1999) and water in excess of the system's capacity.

Mitigation of impacts that were caused by the Diamond Fork System is required under Central Utah Project Completion Act (CUPCA) (1992). In order to fulfill these commitments, the Utah Reclamation Mitigation and Conservation Commission established a long-term monitoring program to evaluate the geomorphic and ecological changes related to the new flow regime set by instream flow requirements. Long-term monitoring will allow analysis of change over time in order to set and prioritize restoration efforts and adaptively maintain the riverine and riparian ecosystem in a desirable and functional condition. The main study objectives discussed in this report include riparian vegetation mapping, plant community classification, Ute Ladies'-tresses (ULT) counts and relative abundance estimates to assess population trends, ULT habitat assessment, and ground water elevation, surface water elevation, and instream flow monitoring. This report documents findings from the 2007 monitoring effort and makes comparisons when appropriate to findings from the 2006 monitoring effort. Because vegetation communities can take several growing seasons to adjust to changes in hydrology, riparian vegetation mapping was not conducted during the 2007 monitoring period; however, it is recommended that this mapping be conducted during the 2008 monitoring period. Cross-sectional transect data and findings for 2007 will be used as the baseline for subsequent monitoring sessions based on adjusted data collection methodology implemented in 2007.

## 5.1 Riparian Vegetation Transects

When the riparian vegetation transect study was designed in 2006, vegetation along each transect was to be categorized for future comparisons. Areas that contained no single dominant species (>20%) were considered either mixed upland or mixed wetland and, therefore, no species information was gathered for those segments along the transects. A limitation of the survey methods used in 2006 was that data describing percent cover by species were not collected. Upon closer examination of the data and after consultation with other vegetation experts (Coles-Richie 2006), it became apparent that this method would result in the loss of important information that would allow for analysis of finer-scaled changes.

Based on adjustments to the 2006 methodology, data gathered in 2007 are intended to serve as the baseline with which subsequent monitoring periods are compared. Overall, reaches surveyed are dominated by obligate (OBL) and co-dominated by facultative wetland (FACW) species. In general, reaches are dominated by an over-story of woody species, except for Mother and Diamond Fork Creek. It was thought during the first year of vegetation sampling along the riparian corridor that communities were dominated by early successional and disturbance-adapted species. This may be the case; however, as disturbance regimes remain relatively mild and infrequent compared to pre-Diamond Fork System conditions, communities comprised of willow and cottonwood species will continue to develop, thereby increasing canopy cover and possible reduced species diversity. Another potential consequence of reduced flows in Sixth Water and Diamond Fork Creeks is the lateral reduction of riparian vegetation communities adjacent to the channel and potential reduction in potential ULT habitat. During the 2007 monitoring period, a detailed baseline was established. Because compositional changes within the vegetation community, as well as the lateral extent of the riparian corridor, is not likely to change drastically annually, we recommend repeating transect monitoring every 5 years until the area stabilizes enough that a 10-year monitoring cycle is appropriate.

## 5.2 Ute Ladies'-Tresses Surveys

The year-to-year variability of ULT counts has made it difficult to identify patterns and extrapolate trends for flowering individuals. The actual counts of ULT individuals showed a significant decrease of flowering individuals. The counts were more similar to those observed by HDR in 2002, 2003, 2004, and 2005 (Black and Gruwell 2005). Counts were compared with peak discharge measurements from 2002 to 2007 and there appears to be a relationship between years where peak flow is high, possibly resulting in an increase of flowering ULT. This is an interesting correlation, which further indicates that peak flows within Diamond Fork Creek may impact ULT counts. Abundance estimates were also lower for nearly all occupies surfaces surveyed. The low counts may be a result of lower peak flows, drier-than-normal climatic conditions, grazing impacts, or a combination of those and other variables. During the 2007 field season, observations of multiple peaks in flowering individuals further indicate that ULT counts conducted once annually may be inadequate for the assessment of the ULT population status along Sixth Water and Diamond Fork Creeks. Observed actual counts, as well as abundance estimates, may be as much a function of annual variability as they are variability of flowering within the bloom period that occurs from late July through early September. One surprising consistency observed between 2006 and 2007 was the flowering and non-flowering rates. The ratio of flowering to non-flowering ULT individuals during 2006 was 1 to 1.119, and in 2007 the ratio of flowering to non-flowering individuals was 1 to 1.055, suggesting that the variability in counts from year to year may not be a result of variation of flowering rates within a population.

Impacts to ULT populations in the Diamond Fork Watershed may be attributed to changes in vegetation rather than changes in water levels. Mechanisms changing vegetation composition include: competition from non-indigenous plant species, changes in disturbance regimes, vegetation structure (transition from young willows to mature stands), and establishment of late successional species. Another element affecting ULT counts that was not expected during the 2007 ULT counts was the extensive grazing on occupied surfaces which occurred during the bloom period, likely affecting the counts on a number of occupied surfaces. Annual ULT counts still provide valuable data for general status of ULT populations and overall condition of occupied and potentially occupied surfaces along Diamond Fork Creek. Because there are so many potential threats to ULT and ULT habitat (i.e., grazing pressures and inappropriate recreational use), the fragile nature of the species warrants a presence and awareness of land managers for continual assessment of habitat and population health. We therefore recommend that annual monitoring of ULT counts continue.

## 5.3 Ute Ladies'-Tresses Habitat Analysis

Transects established to assess ULT habitat were originally located within the different sites based on very narrow corridors of micro-topography (surfaces). The question posed in 2006 was: How will these habitats and associated ULT colonies change over time with a more natural hydrologic regime? Comparisons between data collected in quadrats in 2006 and 2007 show that there are changes occurring on occupied, potentially occupied, and non-occupied habitat sites. There was higher vegetal cover in 2007 and less bare ground, rock, and litter on all habitat types than observed in 2006. This may be a function of maturing vegetation communities and less disturbance of surface areas adjacent to Diamond Fork Creek because of reduced peak/irrigation flows.

Data collected in 2007 suggest a drying trend on all habitat types resulted in an overall decrease of OBL species occurring in all habitat sites when comparisons were made between 2006 and 2007 transect data. The increased occurrence of species classified as either facultative upland (FACU) or FAC suggests that the riparian corridor may be transitioning to a more moderate environment conducive to species with more intermediate water requirements. These trends also coincide with the cooler, wetter conditions in 2006 compared with the hot, dry conditions in 2007. As surfaces along Sixth Water and Diamond Fork Creeks adjust to restored hydrology, it is likely that compositional changes within vegetation communities will continue. As these changes occur, it is likely that the transitioning ecosystems will be more vulnerable to infestation of non-indigenous plant species. An effort to map and treat weeds within the Diamond Fork Watershed may be important for the preservation of existing and establishment of future ULT colonies. There was a highly significant correlation between the presence of ULT individuals and the presence of non-indigenous plant species observed in 2006 and 2007, suggesting that ULT habitats are susceptible to infestation. Some differences in habitat may be the result of two extremely different years climatically. We recommend repeating th habitat monitoring in 2008 to determine whether the changes are trends or simply responses to hot, dry climatic conditions in 2007.

Ground water is highly influenced by peak flows (flows reaching 265 cubic feet per second and higher) and follows a rising and falling elevational change similar to surface water. Stream flow has less influence on groundwater elevations during base flows (60 to 80 cfs) than evapotranspiration. Channel aggradation may be influencing ground water elevations at the MO site as the water table is 2 to 3 inches higher following 2007 peak flows than it was in 2006 and spring 2007. Sidehill and/or tributary flow has an insignificant affect on groundwater elevations in the near surface alluvial aquifers compared to peak flows in Diamond Fork Creek. Future peizometer monitoring can be reduced to a single pre-peak, peak, and two post peak samples; one immediately following the peak and one in the late summer or early fall.

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# 6.0 LITERATURE CITED


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# APPENDIX 2.1 ENDPOINT COORDINATES

| Easting | Northing | Elevation | Comment | Point_ID | SITE |
|---|---|---|---|---|---|
| 476057.7 | 4445801.13 | 2118.88 | rep1 | 1 | SXW 2006 |
| 476020.79 | 4445787.82 | 2118.14 | rep2 | 2 | SXW 2006 |
| 475995.48 | 4445756.59 | 2108.01 | rep3 | 3 | SXW 2006 |
| 475922.93 | 4445731.04 | 2111.75 | rep456 | 4 | SXW 2006 |
| 476084.76 | 4445764.73 | 2111 | lep1 | 5 | SXW 2006 |
| 476046.11 | 4445742.51 | 2110.2 | lep2-3 | 6 | SXW 2006 |
| 476041.6 | 4445717.89 | 2109.62 | lep4 | 7 | SXW 2006 |
| 475994.53 | 4445684.05 | 2107.29 | lep5 | 8 | SXW 2006 |
| 475973.5988 | 4445652.311 | 2109.283969 | lep6 | 9 | SXW 2006 |

| Easting | Northing | Elevation | Comment | Point_ID | SITE |
|---|---|---|---|---|---|
| 474710.07 | 4444911.43 | 2035.83 | lep1 | 1 | RC (veg only) |
| 474654.7403 | 4444851.436 | 2033.12 | lep2 | 2 | RC (veg only) |
| 474642.51 | 4444833.98 | 2032.44 | lep3 | 3 | RC (veg only) |
| 474641.6 | 4444769.34 | 2035.47 | lep4 | 4 | RC (veg only) |
| 474605.1649 | 4444709.958 | 2035.73 | lep5-6 | 5 | RC (veg only) |
| 474660.5826 | 4444965.739 | 2043.28 | rep1 | 6 | RC (veg only) |
| 474590.2435 | 4444910.162 | 2046.02 | rep2 | 7 | RC (veg only) |
| 474582.0645 | 4444880.456 | 2040.4 | rep3 | 8 | RC (veg only) |
| 474547.3861 | 4444841.56 | 2037.56 | rep4 | 9 | RC (veg only) |
| 474539.8123 | 4444813.557 | 2036.66 | rep5 | 10 | RC (veg only) |
| 474509.1567 | 4444786.04 | 2034.99 | rep6 | 11 | RC (veg only) |

| Easting | Northing | Elevation | Comment | Point_ID | site |
|---|---|---|---|---|---|
| 462855.080 | 4435557.767 | 1582.130 | DFC-REP-1 | 1 | DFC |
| 462746.593 | 4435553.853 | 1583.162 | DFC-REP-2 | 2 | DFC |
| 462656.147 | 4435484.219 | 1578.176 | DFC-REP-3 | 3 | DFC |
| 462612.837 | 4435445.240 | 1580.406 | DFC-REP-4 | 4 | DFC |
| 462586.015 | 4435385.243 | 1579.860 | DFC-REP-5-6-7 | 5 | DFC |
| 462587.462 | 4435310.518 | 1585.932 | DFC-LEP-7 | 6 | DFC |
| 462647.073 | 4435332.725 | 1586.842 | DFC-LEP-6 | 7 | DFC |
| 462672.331 | 4435357.397 | 1586.970 | DFC-LEP-3-4-5 | 8 | DFC |
| 462709.623 | 4435363.029 | 1587.179 | DFC-LEP-2 | 9 | DFC |
| 462869.865 | 4435372.647 | 1584.037 | DFC-LEP-1 | 10 | DFC |

| Easting | Northing | Elevation | Comment | Point_ID | SITE |
|---|---|---|---|---|---|
| 460101.282 | 4432997.957 | 1546.183 | MO-REP-1 | 1 | MO |
| 460015.578 | 4433013.975 | 1547.047 | MO-REP-2 | 2 | MO |
| 459892.216 | 4432982.203 | 1545.042 | MO-REP-3 | 3 | MO |
| 459850.802 | 4432895.619 | 1543.816 | MO-REP-4 | 4 | MO |
| 459818.580 | 4432847.995 | 1542.713 | MO-REP-5-6 | 5 | MO |
| 459856.049 | 4432761.330 | 1546.340 | MO-LEP-6 | 6 | MO |
| 459933.745 | 4432807.721 | 1549.076 | MO-LEP-2-3-4-5 | 7 | MO |
| 460149.020 | 4432949.666 | 1548.723 | MO-LEP-1 | 8 | MO |

| Easting | Northing | Elevation | Comment | Point_ID | SITE |
|---|---|---|---|---|---|
| 458756.916 | 4432364.023 | 1533.385 | OX-REP-1 | 1 | OX |
| 458693.331 | 4432308.607 | 1532.500 | OX-REP-2-3-4 | 2 | OX |
| 458585.881 | 4432244.073 | 1530.627 | OX-REP-5 | 3 | OX |
| 458495.212 | 4432232.762 | 1533.659 | OX-REP-6-7 | 4 | OX |
| 458374.451 | 4432122.365 | 1529.140 | OX-LEP-7-8 | 5 | OX |
| 458288.554 | 4432123.248 | 1526.165 | OX-REP-8 | 6 | OX |
| 458500.762 | 4432047.812 | 1529.836 | OX-LEP-6 | 7 | OX |
| 458621.931 | 4432054.016 | 1530.133 | OX-LEP-5 | 8 | OX |
| 458737.358 | 4432102.144 | 1531.664 | OX-LEP-4 | 9 | OX |
| 458802.239 | 4432169.137 | 1531.300 | OX-LEP-3 | 10 | OX |
| 458850.937 | 4432250.128 | 1531.909 | OX-LEP-1-2 | 11 | OX |

# APPENDIX 2.2A COMPREHENSIVE LIST OF NATIVE SPECIES

| | | | |
|---|---|---|---|
| ARLU | *Artemisia ludoviciana* | white sagebrush | |
| ARTR2 | *Artemisia tridentata* | big sagebrush | |
| ASSP | *Asclepias speciosa* | showy milkweed | |
| BEOC2 | *Betula occidentalis* | water birch | |
| CAAU3 | *Carex aurea* | golden sedge | |
| CACA11 | *Carex canescens* | silvery sedge | |
| CALU7 | *Carex luzulina* | woodrush sedge | |
| CANE2 | *Carex nebrascensis* | Nebraska sedge | |
| CAPE42 | *Carex pellita* | woolly sedge | |
| CAREX | *Carex species* | sedge | |
| CAMIM6 | *Castilleja minor ssp. minor* | lesser Indian paintbrush | |
| CAAQ3 | *Catabrosa aquatica* | water brookgrass | |
| CHVI8 | *Chrysothamnus viscidiflorus* | yellow rabbitbrush | |
| CIDO | *Cicuta douglasii* | western water hemlock | |
| COCA5 | *Conyza canadensis* | Canadian horseweed | |
| COSE16 | *Cornus sericea* | redosier dogwood | |
| CRDO2 | *Crataegus douglasii* | black hawthorn | |
| ELPA3 | *Eleocharis palustris* | common spikerush | |
| EPBR3 | *Epilobium brachycarpum* | tall annual willowherb | |
| EPCI | *Epilobium ciliatum* | fringed willowherb | |
| EPILO | *Epilobium species* | willowherb | |
| EQAR | *Equisetum arvense* | field horsetail | |
| EUOC4 | *Euthamia occidentalis* | western goldentop | |
| FRVE | *Fragaria vesca* | woodland strawberry | |
| GEMA4 | *Geum macrophyllum* | largeleaf avens | |
| GRSQ | *Grindelia squarrosa* | curlycup gumweed | |
| GUMI | *Gutierrezia microcephala* | threadleaf snakeweed | |
| HEAN3 | *Helianthus annuus* | common sunflower | |
| HOJU | *Hordeum jubatum* | foxtail barley | |
| JUAC2 | *Juncus acutus* | spiny rush | |
| JUARL | *Juncus arcticus ssp. littoralis* | mountain rush | |
| JUCO2 | *Juncus confusus* | Colorado rush | |
| JUEN | *Juncus ensifolius* | swordleaf rush | |
| JUTO | *Juncus torreyi* | Torrey's rush | |
| JUSC2 | *Juniperus scopulorum* | Rocky Mountain juniper | |
| LECI4 | *Leymus cinereus* | basin wildrye | |
| LILE3 | *Linum lewisii* | Lewis flax | * |
| MARE11 | *Mahonia repens* | creeping barberry | |
| MEAR4 | *Mentha arvensis* | wild mint | |
| MIGU | *Mimulus guttatus* | seep monkeyflower | |
| PHPR2 | *Phacelia procera* | tall phacelia | |
| PHAR3 | *Phalaris arundinacea* | reed canarygrass | * |
| PHAU7 | *Phragmites australis* | common reed | * |
| PITHOP | *Pithophora* | horsehair algae | |
| POMO5 | *Polypogon monspeliensis* | annual rabbitsfoot grass | |
| POAN3 | *Populus angustifolia* | narrowleaf cottonwood | |
| PRVU | *Prunella vulgaris* | common selfheal | |
| PSSP6 | *Pseudoroegneria spicata* | bluebunch wheatgrass | |
| PUTR2 | *Purshia tridentata* | antelope bitterbrush | |
| QUGA | *Quercus gambelii* | Gambel oak | |
| RACY | *Ranunculus cymbalaria* | alkali buttercup | |
| RHTR | *Rhus trilobata* | skunkbush sumac | |
| ROWO | *Rosa woodsii* | Woods' rose | |
| SABO2 | *Salix boothii* | Booth's willow | |
| SAEX | *Salix exigua* | coyote willow | |
| SALU | *Salix lucida* | shining willow | |
| SARA2 | *Sambucus racemosa* | red elderberry | |
| SCAM6 | *Schoenoplectus americanus* | Olney's threesquare | |
| SOCA6 | *Solidago canadensis* | Canada goldenrod | |
| SPDI6 | *Spiranthes diluvialis* | Ute lady's tresses | |
| SYOR2 | *Symphoricarpos oreophilus* | mountain snowberry | |
| SYEA2 | *Symphyotrichum eatonii* | Eaton's aster | |
| SYMPH4 | *Symphyotrichum species* | aster | |
| TRPR2 | *Trifolium pratense* | red clover | * |

# APPENDIX 2.2B COMPREHENSIVE LIST OF NON-INDIGENOUS SPECIES

**Non-indigenous Plant Species**

| | | |
|---|---|---|
| AGCR | Agropyron cristatum | crested wheatgrass |
| BRIN2 | Bromus inermis | smooth brome |
| BRTE | Bromus tectorum | cheatgrass |
| CABU2 | Capsella bursa-pastoris | shepherd's purse |
| CANU4 | Carduus nutans | musk thistle |
| CIAR4 | Cirsium arvense | Canada thistle |
| CIVU | Cirsium vulgare | bull thistle |
| COAR4 | Convolvulus arvensis | field bindweed |
| CYOF | Cynoglossum officinale | hound's tongue |
| ELAN | Elaeagnus angustifolia | Russian olive |
| LELA2 | Lepidium latifolium | broadleaved pepperweed |
| LIDAD | Linaria dalmatica | Dalmatian toadflax |
| MELU | Medicago lupulina | black medick |
| MESA | Medicago sativa | alfalfa |
| MEOF | Melilotus officinalis | sweetclover |
| NAOF | Nasturtium officinale | watercress |
| PLLA | Plantago lanceolata | narrowleaf plantain |
| PLMA2 | Plantago major | common plantain |
| RUCR | Rumex crispus | curly dock |
| SCPR4 | Schedonorus pratensis | meadow fescue |
| SOAR2 | Sonchus arvensis | field sowthistle |
| TAOF | Taraxacum officinale | common dandelion |
| TARA | Tamarix ramosissima | saltcedar |
| THIN6 | Thinopyrum intermedium | intermediate wheatgrass |
| TRDU | Tragopogon dubius | yellow salsify |
| VETH | Verbascum thapsus | common mullein |

1. Bare ground was not recorded as a 'species' component in 2007, only as part of total aerial cover.
2. Systematic changes have now separated *Carex lanuginosa* into separate taxa, ours is *C. pellita*.
3. Systematic changes have now separated *Castilleja minor* from other species and into subspecies and may
4. This species used to be called Baltic rush, and since the newly separated species does not occur in the Baltic, mountain rush is a more appropriate common name.
5. Professor-weed/goatsrue (Galega officinalis) possibly found on surface 37D, should be monitored.

# APPENDIX 2.3A VEGETATION TRANSECT DATA

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DFC | 1 | EUOC4 | *Euthamia occidentalis* | western goldentop | 32.23234728 | Forb | OBL | FALSE |
| DFC | 1 | JUARL | *Juncus arcticus* ssp. *littoralis* | mountain rush | 142.2096312 | Graminoid | FACW | FALSE |
| DFC | 1 | OW | Open Water | Open Water | 38.73657226 | Open Water | | FALSE |
| DFC | 1 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 8.873489772 | Grass | OBL | FALSE |
| DFC | 1 | PLMA2 | *Plantago major* | common plantain | 1.150805228 | Forb | FAC | TRUE |
| DFC | 1 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 35.62367625 | Woody | FAC* | FALSE |
| DFC | 1 | RHTR | *Rhus trilobata* | skunkbush sumac | 11.43870445 | Woody | NI | FALSE |
| DFC | 1 | SABO2 | *Salix boothii* | Booth's willow | 18.63143843 | Woody | OBL* | FALSE |
| DFC | 1 | SAEX | *Salix exigua* | coyote willow | 123.2216393 | Woody | OBL | FALSE |
| DFC | 1 | SALU | *Salix lucida* | shining willow | 49.35483572 | Woody | OBL | FALSE |
| DFC | 1 | SCPR4 | *Schedonorus pratensis* | meadow fescue | 0.885663774 | Grass | FACU | TRUE |
| DFC | 1 | SYEA2 | *Symphyotrichum eatonii* | Eaton's aster | 28.68457897 | Forb | FAC | FALSE |
| DFC | 1 | VETH | *Verbascum thapsus* | common mullein | 1.495431743 | Forb | UPL | TRUE |
| DFC | 2 | AGGI2 | *Agrostis gigantea* | redtop | 78.74685595 | Grass | FACW | FALSE |
| DFC | 2 | ARTR2 | *Artemisia tridentata* | big sagebrush | 0.066803738 | Woody | UPL | FALSE |
| DFC | 2 | BEOC2 | *Betula occidentalis* | water birch | 3.936076199 | Woody | FACW | FALSE |
| DFC | 2 | BRIN2 | *Bromus inermis* | smooth brome | 69.1850034 | Grass | UPL | TRUE |
| DFC | 2 | BRTE | *Bromus tectorum* | cheatgrass | 2.195244642 | Graminoid | UPL | TRUE |
| DFC | 2 | CANU4 | *Carduus nutans* | musk thistle | 0.548811161 | Forb | UPL | TRUE |
| DFC | 2 | CIAR4 | *Cirsium arvense* | Canada thistle | 9.073016306 | Forb | FACU | TRUE |
| DFC | 2 | CIVU | *Cirsium vulgare* | bull thistle | 1.911836427 | Forb | FAC | TRUE |
| DFC | 2 | CRDO2 | *Crataegus douglasii* | black hawthorn | 12.06485703 | Woody | FAC | FALSE |
| DFC | 2 | EQAR | *Equisetum arvense* | field horsetail | 4.931423308 | Graminoid | FAC+ | FALSE |
| DFC | 2 | EUOC4 | *Euthamia occidentalis* | western goldentop | 15.66347821 | Forb | OBL | FALSE |
| DFC | 2 | GRSQ | *Grindelia squarrosa* | curlycup gumweed | 137.2036334 | Forb | FACU | FALSE |
| DFC | 2 | JUARL | *Juncus arcticus ssp. littoralis* | mountain rush | 19.42202875 | Graminoid | FACW | FALSE |
| DFC | 2 | JUSC2 | *Juniperus scopulorum* | Rocky Mountain juniper | 3.45932241 | Woody | UPL | FALSE |
| DFC | 2 | LECI4 | *Leymus cinereus* | basin wildrye | 1.646433482 | Graminoid | FACU | FALSE |
| DFC | 2 | MEOF | *Melilotus officinalis* | sweetclover | 137.2036334 | Forb | FACU | TRUE |
| DFC | 2 | OW | Open Water | Open Water | 9.428505733 | Open Water | | FALSE |
| DFC | 2 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 38.72992568 | Grass | OBL | FALSE |
| DFC | 2 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 6.142243329 | Woody | FAC* | FALSE |
| DFC | 2 | PSSP6 | *Pseudoroegneria spicata* | bluebunch wheatgrass | 2.195244642 | Grass | UPL | FALSE |
| DFC | 2 | RHTR | *Rhus trilobata* | skunkbush sumac | 11.39236183 | Woody | NI | FALSE |
| DFC | 2 | SAEX | *Salix exigua* | coyote willow | 53.59080697 | Woody | OBL | FALSE |
| DFC | 2 | SALU | *Salix lucida* | shining willow | 84.88299935 | Woody | OBL | FALSE |
| DFC | 2 | SCPR4 | *Schedonorus pratensis* | meadow fescue | 5.735509282 | Grass | FACU | TRUE |
| DFC | 2 | THIN6 | *Thinopyrum intermedium* | intermediate wheatgrass | 1.646433482 | Graminoid | UPL | TRUE |
| DFC | 2 | VETH | *Verbascum thapsus* | common mullein | 0.5622966 | Forb | UPL | TRUE |
| DFC | 3 | AGGI2 | *Agrostis gigantea* | redtop | 49.23213038 | Grass | FACW | FALSE |
| DFC | 3 | BG | Bare Ground | Bare Ground | 14.16355753 | Bare ground | | FALSE |
| DFC | 3 | BEOC2 | *Betula occidentalis* | water birch | 2.267674032 | Woody | FACW | FALSE |
| DFC | 3 | BRIN2 | *Bromus inermis* | smooth brome | 86.06483471 | Grass | UPL | TRUE |
| DFC | 3 | CIAR4 | *Cirsium arvense* | Canada thistle | 0.201274913 | Forb | FACU | TRUE |
| DFC | 3 | EQAR | *Equisetum arvense* | field horsetail | 12.25963866 | Graminoid | FAC+ | FALSE |
| DFC | 3 | EUOC4 | *Euthamia occidentalis* | western goldentop | 13.33910852 | Forb | OBL | FALSE |
| DFC | 3 | JUARL | *Juncus arcticus ssp. littoralis* | mountain rush | 31.42000657 | Graminoid | FACW | FALSE |
| DFC | 3 | MARE11 | *Mahonia repens* | creeping barberry | 0.005364008 | Woody | UPL | FALSE |
| DFC | 3 | MEOF | *Melilotus officinalis* | sweetclover | 5.882616473 | Forb | FACU | TRUE |
| DFC | 3 | OW | Open Water | Open Water | 48.10125632 | Open Water | | FALSE |
| DFC | 3 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 33.78057693 | Grass | OBL | FALSE |
| DFC | 3 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 6.174970098 | Woody | FAC* | FALSE |
| DFC | 3 | RHTR | *Rhus trilobata* | skunkbush sumac | 18.26818989 | Woody | NI | FALSE |
| DFC | 3 | ROCK | Rock | Rock | 9.244509458 | Rock | | FALSE |
| DFC | 3 | RUCR | *Rumex crispus* | curly dock | 1.292538371 | Forb | FACW | TRUE |
| DFC | 3 | SABO2 | *Salix boothii* | Booth's willow | 37.4582504 | Woody | OBL* | FALSE |
| DFC | 3 | SAEX | *Salix exigua* | coyote willow | 60.85173591 | Woody | OBL | FALSE |
| DFC | 3 | SALU | *Salix lucida* | shining willow | 17.10446871 | Woody | OBL | FALSE |
| DFC | 3 | SCPR4 | *Schedonorus pratensis* | meadow fescue | 4.496702023 | Grass | FACU | TRUE |
| DFC | 3 | THIN6 | *Thinopyrum intermedium* | intermediate wheatgrass | 0.505785019 | Graminoid | UPL | TRUE |
| DFC | 3 | TYLA | *Typha latifolia* | broadleaf cattail | 2.049575578 | Graminoid | OBL | FALSE |
| DFC | 4 | ACMI2 | *Achillea millefolium* | common yarrow | 6.607536597 | Forb | FACU | FALSE |
| DFC | 4 | AGGI2 | *Agrostis gigantea* | redtop | 21.41590679 | Grass | FACW | FALSE |
| DFC | 4 | ARTR2 | *Artemisia tridentata* | big sagebrush | 1.887867599 | Woody | UPL | FALSE |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DFC | 4 | SCPR4 | *Schedonorus pratensis* | meadow fescue | 38.33734792 | Grass | FACU | TRUE |
| DFC | 5 | ACMI2 | *Achillea millefolium* | common yarrow | 6.984372477 | Forb | FACU | FALSE |
| DFC | 5 | AGGI2 | *Agrostis gigantea* | redtop | 39.68107389 | Grass | FACW | FALSE |
| DFC | 5 | ARTR2 | *Artemisia tridentata* | big sagebrush | 4.418584313 | Woody | UPL | FALSE |
| DFC | 5 | BG | Bare Ground | Bare Ground | 4.927390235 | Bare ground | | FALSE |
| DFC | 5 | BRIN2 | *Bromus inermis* | smooth brome | 34.45875842 | Grass | UPL | TRUE |
| DFC | 5 | BRTE | *Bromus tectorum* | cheatgrass | 6.984372477 | Graminoid | UPL | TRUE |
| DFC | 5 | CANU4 | *Carduus nutans* | musk thistle | 1.746093119 | Forb | UPL | TRUE |
| DFC | 5 | CIDO | *Cicuta douglasii* | western water hemlock | 3.408841909 | Forb | OBL | FALSE |
| DFC | 5 | CIAR4 | *Cirsium arvense* | Canada thistle | 1.430480157 | Forb | FACU | TRUE |
| DFC | 5 | CYOF | *Cynoglossum officinale* | hound's tongue | 5.238279358 | Forb | UPL | TRUE |
| DFC | 5 | EQAR | *Equisetum arvense* | field horsetail | 1.430480157 | Graminoid | FAC+ | FALSE |
| DFC | 5 | EUOC4 | *Euthamia occidentalis* | western goldentop | 20.01157824 | Forb | OBL | FALSE |
| DFC | 5 | GRSQ | *Grindelia squarrosa* | curlycup gumweed | 3.492186239 | Forb | FACU | FALSE |
| DFC | 5 | JUARL | *Juncus arcticus ssp. littoralis* | mountain rush | 8.950478786 | Graminoid | FACW | FALSE |
| DFC | 5 | JUTO | *Juncus torreyi* | Torrey's rush | 0.701208317 | Graminoid | FACW+ | FALSE |
| DFC | 5 | MARE11 | *Mahonia repens* | creeping barberry | 0.138881692 | Woody | UPL | FALSE |
| DFC | 5 | MEOF | *Melilotus officinalis* | sweetclover | 13.76095046 | Forb | FACU | TRUE |
| DFC | 5 | OW | Open Water | Open Water | 9.879420086 | Open Water | | FALSE |
| DFC | 5 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 54.59382628 | Grass | OBL | FALSE |
| DFC | 5 | PLMA2 | *Plantago major* | common plantain | 0.754737778 | Forb | FAC | TRUE |
| DFC | 5 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 1.746093119 | Woody | FAC* | FALSE |
| DFC | 5 | PSSP6 | *Pseudoroegneria spicata* | bluebunch wheatgrass | 5.238279358 | Grass | UPL | FALSE |
| DFC | 5 | RHTR | *Rhus trilobata* | skunkbush sumac | 6.62787647 | Woody | NI | FALSE |
| DFC | 5 | SABO2 | *Salix boothii* | Booth's willow | 24.60773415 | Woody | OBL* | FALSE |
| DFC | 5 | SAEX | *Salix exigua* | coyote willow | 20.68985222 | Woody | OBL | FALSE |
| DFC | 5 | SALU | *Salix lucida* | shining willow | 0.882598562 | Woody | OBL | FALSE |
| DFC | 5 | VETH | *Verbascum thapsus* | common mullein | 0.101204498 | Forb | UPL | TRUE |
| DFC | 6 | ACMI2 | *Achillea millefolium* | common yarrow | 8.106705886 | Forb | FACU | FALSE |
| DFC | 6 | AGGI2 | *Agrostis gigantea* | redtop | 38.87783526 | Grass | FACW | FALSE |
| DFC | 6 | ARLU | *Artemisia ludoviciana* | white sagebrush | 4.053352943 | Forb | FACU | FALSE |
| DFC | 6 | BG | Bare Ground | Bare Ground | 28.38587413 | Bare ground | | FALSE |
| DFC | 6 | BRIN2 | *Bromus inermis* | smooth brome | 43.88298286 | Grass | UPL | TRUE |
| DFC | 6 | BRTE | *Bromus tectorum* | cheatgrass | 10.13338236 | Graminoid | UPL | TRUE |
| DFC | 6 | CANU4 | *Carduus nutans* | musk thistle | 2.026676472 | Forb | UPL | TRUE |
| DFC | 6 | CIAR4 | *Cirsium arvense* | Canada thistle | 0 | Forb | FACU | TRUE |
| DFC | 6 | EQAR | *Equisetum arvense* | field horsetail | 2.102904256 | Graminoid | FAC+ | FALSE |
| DFC | 6 | EUOC4 | *Euthamia occidentalis* | western goldentop | 4.205808512 | Forb | OBL | FALSE |
| DFC | 6 | JUARL | *Juncus arcticus* ssp. *littoralis* | mountain rush | 10.27070176 | Graminoid | FACW | FALSE |
| DFC | 6 | LILE3 | *Linum lewisii* | Lewis flax | 2.026676472 | Forb | UPL | FALSE |
| DFC | 6 | MEOF | *Melilotus officinalis* | sweetclover | 8.430087897 | Forb | FACU | TRUE |
| DFC | 6 | OW | Open Water | Open Water | 14.38879975 | Open Water | | FALSE |
| DFC | 6 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 14.99900598 | Grass | OBL | FALSE |
| DFC | 6 | PSSP6 | *Pseudoroegneria spicata* | bluebunch wheatgrass | 0 | Grass | UPL | FALSE |
| DFC | 6 | RHTR | *Rhus trilobata* | skunkbush sumac | 2.276333198 | Woody | NI | FALSE |
| DFC | 6 | SABO2 | *Salix boothii* | Booth's willow | 8.411617023 | Woody | OBL* | FALSE |
| DFC | 6 | SAEX | *Salix exigua* | coyote willow | 8.411617023 | Woody | OBL | FALSE |
| DFC | 6 | SALU | *Salix lucida* | shining willow | 36.86039422 | Woody | OBL | FALSE |
| DFC | 6 | VEAM2 | *Veronica americana* | American speedwell | 7.165832476 | Forb | OBL | FALSE |
| DFC | 7 | ACMI2 | *Achillea millefolium* | common yarrow | 3.871503492 | Forb | FACU | FALSE |
| DFC | 7 | AGGI2 | *Agrostis gigantea* | redtop | 7.871721874 | Grass | FACW | FALSE |
| DFC | 7 | ARLU | *Artemisia ludoviciana* | white sagebrush | 11.61451048 | Forb | FACU | FALSE |
| DFC | 7 | BG | Bare Ground | Bare Ground | 14.15981499 | Bare ground | | FALSE |
| DFC | 7 | BRIN2 | *Bromus inermis* | smooth brome | 41.46871326 | Grass | UPL | TRUE |
| DFC | 7 | BRTE | *Bromus tectorum* | cheatgrass | 5.035045058 | Graminoid | UPL | TRUE |
| DFC | 7 | CANE2 | *Carex nebrascensis* | Nebraska sedge | 20.88597871 | Graminoid | OBL | FALSE |
| DFC | 7 | CIAR4 | *Cirsium arvense* | Canada thistle | 0.462371055 | Forb | FACU | TRUE |
| DFC | 7 | EQAR | *Equisetum arvense* | field horsetail | 5.162004656 | Graminoid | FAC+ | FALSE |
| DFC | 7 | EUOC4 | *Euthamia occidentalis* | western goldentop | 2.396998422 | Forb | OBL | FALSE |
| DFC | 7 | JUARL | *Juncus arcticus ssp. littoralis* | mountain rush | 1.171693246 | Graminoid | FACW | FALSE |
| DFC | 7 | MEOF | *Melilotus officinalis* | sweetclover | 11.70137021 | Forb | FACU | TRUE |
| DFC | 7 | OW | Open Water | Open Water | 12.16354276 | Open Water | | FALSE |
| DFC | 7 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 27.49425086 | Grass | OBL | FALSE |
| DFC | 7 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 7.872383667 | Woody | FAC* | FALSE |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| MO | 1 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 74.12422909 | Grass | OBL | FALSE |
| MO | 1 | ROWO | *Rosa woodsii* | Woods' rose | 0.606253984 | Woody | FAC- | FALSE |
| MO | 1 | SABO2 | *Salix boothii* | Booth's willow | 3.241373644 | Woody | OBL* | FALSE |
| MO | 1 | SAEX | *Salix exigua* | coyote willow | 61.81488075 | Woody | OBL | FALSE |
| MO | 1 | SALU | *Salix lucida* | shining willow | 4.253938615 | Woody | OBL | FALSE |
| MO | 1 | SYOR2 | *Symphoricarpos oreophilus* | mountain snowberry | 0.425567647 | Woody | FACU | FALSE |
| MO | 1 | THIN6 | *Thinopyrum intermedium* | intermediate wheatgrass | 0.057481437 | Graminoid | UPL | TRUE |
| MO | 2 | AGGI2 | *Agrostis gigantea* | redtop | 132.7660624 | Grass | FACW | FALSE |
| MO | 2 | ARTR2 | *Artemisia tridentata* | big sagebrush | 4.673189061 | Woody | UPL | FALSE |
| MO | 2 | BEOC2 | *Betula occidentalis* | water birch | 6.649481761 | Woody | FACW | FALSE |
| MO | 2 | BRIN2 | *Bromus inermis* | smooth brome | 79.307056 | Grass | UPL | TRUE |
| MO | 2 | CIAR4 | *Cirsium arvense* | Canada thistle | 37.72968269 | Forb | FACU | TRUE |
| MO | 2 | ELPA3 | *Eleocharis palustris* | common spikerush | 3.657391176 | Graminoid | OBL | FALSE |
| MO | 2 | EQAR | *Equisetum arvense* | field horsetail | 3.419831917 | Graminoid | FAC+ | FALSE |
| MO | 2 | EUOC4 | *Euthamia occidentalis* | western goldentop | 16.94423395 | Forb | OBL | FALSE |
| MO | 2 | JUARL | *Juncus arcticus* ssp. *littoralis* | mountain rush | 65.98468646 | Graminoid | FACW | FALSE |
| MO | 2 | JUCO2 | *Juncus confusus* | Colorado rush | 0.328669979 | Graminoid | FAC+ | FALSE |
| MO | 2 | LITTER | Litter | Litter | 4.687216361 | Litter | | FALSE |
| MO | 2 | MEOF | *Melilotus officinalis* | sweetclover | 0.24089546 | Forb | FACU | TRUE |
| MO | 2 | OW | Open Water | Open Water | 50.1926102 | Open Water | | FALSE |
| MO | 2 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 174.8673515 | Grass | OBL | FALSE |
| MO | 2 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 5.485001375 | Woody | FAC* | FALSE |
| MO | 2 | RUCR | *Rumex crispus* | curly dock | 0.328669979 | Forb | FACW | TRUE |
| MO | 2 | SABO2 | *Salix boothii* | Booth's willow | 6.848441315 | Woody | OBL* | FALSE |
| MO | 2 | SAEX | *Salix exigua* | coyote willow | 198.0504753 | Woody | OBL | FALSE |
| MO | 2 | SALU | *Salix lucida* | shining willow | 59.72169775 | Woody | OBL | FALSE |
| MO | 2 | SOCA6 | *Solidago canadensis* | Canada goldenrod | 11.52705335 | Forb | FACU | FALSE |
| MO | 2 | VEAM2 | *Veronica americana* | American speedwell | 0.645404418 | Forb | OBL | FALSE |
| MO | 3 | AGGI2 | *Agrostis gigantea* | redtop | 79.9384573 | Grass | FACW | FALSE |
| MO | 3 | ARTR2 | *Artemisia tridentata* | big sagebrush | 1.658779963 | Woody | UPL | FALSE |
| MO | 3 | BG | Bare Ground | Bare Ground | 18.97470192 | Bare ground | | FALSE |
| MO | 3 | BRIN2 | *Bromus inermis* | smooth brome | 70.95757025 | Grass | UPL | TRUE |
| MO | 3 | CANU4 | *Carduus nutans* | musk thistle | 2.626289964 | Forb | UPL | TRUE |
| MO | 3 | CIAR4 | *Cirsium arvense* | Canada thistle | 2.212352482 | Forb | FACU | TRUE |
| MO | 3 | ELPA3 | *Eleocharis palustris* | common spikerush | 12.9763431 | Graminoid | OBL | FALSE |
| MO | 3 | EUOC4 | *Euthamia occidentalis* | western goldentop | 14.94226987 | Forb | OBL | FALSE |
| MO | 3 | GRSQ | *Grindelia squarrosa* | curlycup gumweed | 5.156857758 | Forb | FACU | FALSE |
| MO | 3 | JUARL | *Juncus arcticus* ssp. *littoralis* | mountain rush | 9.829146852 | Graminoid | FACW | FALSE |
| MO | 3 | LITTER | Litter | Litter | 2.796393474 | Litter | | FALSE |
| MO | 3 | MEOF | *Melilotus officinalis* | sweetclover | 1.236266709 | Forb | FACU | TRUE |
| MO | 3 | OW | Open Water | Open Water | 57.04191638 | Open Water | | FALSE |
| MO | 3 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 142.5409493 | Grass | OBL | FALSE |
| MO | 3 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 36.79998838 | Woody | FAC* | FALSE |
| MO | 3 | ROCK | Rock | Rock | 23.63660968 | Rock | | FALSE |
| MO | 3 | SABO2 | *Salix boothii* | Booth's willow | 21.3684026 | Woody | OBL* | FALSE |
| MO | 3 | SAEX | *Salix exigua* | coyote willow | 96.72913019 | Woody | OBL | FALSE |
| MO | 3 | SCPR4 | *Schedonorus pratensis* | meadow fescue | 57.53595282 | Grass | FACU | TRUE |
| MO | 3 | SOCA6 | *Solidago canadensis* | Canada goldenrod | 10.06195793 | Forb | FACU | FALSE |
| MO | 3 | SYEA2 | *Symphyotrichum eatonii* | Eaton's aster | 0.170869547 | Forb | FAC | FALSE |
| MO | 3 | VETH | *Verbascum thapsus* | common mullein | 5.958949101 | Forb | UPL | TRUE |
| MO | 4 | AGGI2 | *Agrostis gigantea* | redtop | 46.75855459 | Grass | FACW | FALSE |
| MO | 4 | ARTR2 | *Artemisia tridentata* | big sagebrush | 2.413304792 | Woody | UPL | FALSE |
| MO | 4 | BG | Bare Ground | Bare Ground | 6.004942414 | Bare ground | | FALSE |
| MO | 4 | BRIN2 | *Bromus inermis* | smooth brome | 55.17246609 | Grass | UPL | TRUE |
| MO | 4 | CIAR4 | *Cirsium arvense* | Canada thistle | 16.36209073 | Forb | FACU | TRUE |
| MO | 4 | COCA5 | *Conyza canadensis* | Canadian horseweed | 0.766814957 | Forb | UPL | FALSE |
| MO | 4 | CYOF | *Cynoglossum officinale* | hound's tongue | 0.588610223 | Forb | UPL | TRUE |
| MO | 4 | EQAR | *Equisetum arvense* | field horsetail | 11.95534258 | Graminoid | FAC+ | FALSE |
| MO | 4 | EUOC4 | *Euthamia occidentalis* | western goldentop | 6.484069707 | Forb | OBL | FALSE |
| MO | 4 | HOJU | *Hordeum jubatum* | foxtail barley | 0 | Grass | FAC* | FALSE |
| MO | 4 | JUARL | *Juncus arcticus* ssp. *littoralis* | mountain rush | 15.71017213 | Graminoid | FACW | FALSE |
| MO | 4 | MEOF | *Melilotus officinalis* | sweetclover | 5.306071299 | Forb | FACU | TRUE |
| MO | 4 | OW | Open Water | Open Water | 80.11101812 | Open Water | | FALSE |
| MO | 4 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 111.0804522 | Grass | OBL | FALSE |

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|---|---|---|---|---|---|---|---|---|
| MO | 5 | LITTER | Litter | Litter | 1.98918833 | Litter | | FALSE |
| MO | 5 | MEOF | *Melilotus officinalis* | sweetclover | 1.437918904 | Forb | FACU | TRUE |
| MO | 5 | OW | Open Water | Open Water | 34.43694915 | Open Water | | FALSE |
| MO | 5 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 75.06041612 | Grass | OBL | FALSE |
| MO | 5 | ROCK | Rock | Rock | 3.59479726 | Rock | | FALSE |
| MO | 5 | RUCR | *Rumex crispus* | curly dock | 1.030018678 | Forb | FACW | TRUE |
| MO | 5 | SABO2 | *Salix boothii* | Booth's willow | 6.061485142 | Woody | OBL* | FALSE |
| MO | 5 | SAEX | *Salix exigua* | coyote willow | 60.68082253 | Woody | OBL | FALSE |
| MO | 5 | SALU | *Salix lucida* | shining willow | 12.573964 | Woody | OBL | FALSE |
| MO | 5 | SCPR4 | *Schedonorus pratensis* | meadow fescue | 6.283208295 | Grass | FACU | TRUE |
| MO | 5 | SOCA6 | *Solidago canadensis* | Canada goldenrod | 15.65136512 | Forb | FACU | FALSE |
| MO | 5 | VEAM2 | *Veronica americana* | American speedwell | 2.040790008 | Forb | OBL | FALSE |
| MO | 6 | AGGI2 | *Agrostis gigantea* | redtop | 4.897166976 | Grass | FACW | FALSE |
| MO | 6 | ARTR2 | *Artemisia tridentata* | big sagebrush | 1.043950208 | Woody | UPL | FALSE |
| MO | 6 | BG | Bare Ground | Bare Ground | 4.616536036 | Bare ground | | FALSE |
| MO | 6 | BRIN2 | *Bromus inermis* | smooth brome | 14.95085121 | Grass | UPL | TRUE |
| MO | 6 | CABU2 | *Capsella bursa-pastoris* | shepherd's purse | 3.330107714 | Forb | FACU | TRUE |
| MO | 6 | CIAR4 | *Cirsium arvense* | Canada thistle | 5.023439476 | Forb | FACU | TRUE |
| MO | 6 | CIVU | *Cirsium vulgare* | bull thistle | 2.373263278 | Forb | FAC | TRUE |
| MO | 6 | EQAR | *Equisetum arvense* | field horsetail | 8.306421472 | Graminoid | FAC+ | FALSE |
| MO | 6 | EUOC4 | *Euthamia occidentalis* | western goldentop | 14.80118325 | Forb | OBL | FALSE |
| MO | 6 | HOJU | *Hordeum jubatum* | foxtail barley | 2.180928833 | Grass | FAC* | FALSE |
| MO | 6 | MEOF | *Melilotus officinalis* | sweetclover | 4.396249691 | Forb | FACU | TRUE |
| MO | 6 | OW | Open Water | Open Water | 30.84045291 | Open Water | | FALSE |
| MO | 6 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 75.67481933 | Grass | OBL | FALSE |
| MO | 6 | ROCK | Rock | Rock | 23.2576298 | Rock | | FALSE |
| MO | 6 | SABO2 | *Salix boothii* | Booth's willow | 3.899614479 | Woody | OBL* | FALSE |
| MO | 6 | SAEX | *Salix exigua* | coyote willow | 40.60108847 | Woody | OBL | FALSE |
| MO | 6 | SALU | *Salix lucida* | shining willow | 8.707821215 | Woody | OBL | FALSE |
| MO | 6 | SCPR4 | *Schedonorus pratensis* | meadow fescue | 8.173594446 | Grass | FACU | TRUE |
| MO | 6 | SOCA6 | *Solidago canadensis* | Canada goldenrod | 12.38259386 | Forb | FACU | FALSE |
| OX | 1 | AGGI2 | *Agrostis gigantea* | redtop | 10.08772077 | Grass | FACW | FALSE |
| OX | 1 | ALIN2 | *Alnus incana* | gray alder | 2.882205933 | Woody | FACW | FALSE |
| OX | 1 | BG | Bare Ground | Bare Ground | 10.43474836 | Bare ground | | FALSE |
| OX | 1 | BRIN2 | *Bromus inermis* | smooth brome | 72.59738 | Grass | UPL | TRUE |
| OX | 1 | EQAR | *Equisetum arvense* | field horsetail | 18.09252092 | Graminoid | FAC+ | FALSE |
| OX | 1 | EUOC4 | *Euthamia occidentalis* | western goldentop | 6.780483855 | Forb | OBL | FALSE |
| OX | 1 | LIDAD | *Linaria dalmatica* | Dalmatian toadflax | 0.544057197 | Forb | UPL | TRUE |
| OX | 1 | MEOF | *Melilotus officinalis* | sweetclover | 9.022845331 | Forb | FACU | TRUE |
| OX | 1 | OW | Open Water | Open Water | 8.988320725 | Open Water | | FALSE |
| OX | 1 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 13.62337023 | Grass | OBL | FALSE |
| OX | 1 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 159.0841995 | Woody | FAC* | FALSE |
| OX | 1 | ROCK | Rock | Rock | 81.9509789 | Rock | | FALSE |
| OX | 1 | SAEX | *Salix exigua* | coyote willow | 121.5595062 | Woody | OBL | FALSE |
| OX | 1 | SALU | *Salix lucida* | shining willow | 4.855678343 | Woody | OBL | FALSE |
| OX | 1 | SYEA2 | *Symphyotrichum eatonii* | Eaton's aster | 0.345519991 | Forb | FAC | FALSE |
| OX | 1 | THIN6 | *Thinopyrum intermedium* | intermediate wheatgrass | 2.017694966 | Graminoid | UPL | TRUE |
| OX | 1 | VETH | *Verbascum thapsus* | common mullein | 1.088114395 | Forb | UPL | TRUE |
| OX | 2 | AGGI2 | *Agrostis gigantea* | redtop | 5.189337135 | Grass | FACW | FALSE |
| OX | 2 | ARTR2 | *Artemisia tridentata* | big sagebrush | 0.605734719 | Woody | UPL | FALSE |
| OX | 2 | BG | Bare Ground | Bare Ground | 10.60837672 | Bare ground | | FALSE |
| OX | 2 | BRIN2 | *Bromus inermis* | smooth brome | 113.3697001 | Grass | UPL | TRUE |
| OX | 2 | BRTE | *Bromus tectorum* | cheatgrass | 6.783149378 | Graminoid | UPL | TRUE |
| OX | 2 | CANU4 | *Carduus nutans* | musk thistle | 3.564058874 | Forb | UPL | TRUE |
| OX | 2 | LELA2 | *Lepidium latifolium* | broadleaved pepperweed | 66.94052776 | Forb | FAC | TRUE |
| OX | 2 | LITTER | Litter | Litter | 9.753954915 | Litter | | FALSE |
| OX | 2 | MEOF | *Melilotus officinalis* | sweetclover | 8.24612381 | Forb | FACU | TRUE |
| OX | 2 | OW | Open Water | Open Water | 8.660822658 | Open Water | | FALSE |
| OX | 2 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 31.26037634 | Grass | OBL | FALSE |
| OX | 2 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 104.4984249 | Woody | FAC* | FALSE |
| OX | 2 | ROCK | Rock | Rock | 29.26186475 | Rock | | FALSE |
| OX | 2 | RUCR | *Rumex crispus* | curly dock | 1.356629876 | Forb | FACW | TRUE |
| OX | 2 | SAEX | *Salix exigua* | coyote willow | 124.7474749 | Woody | OBL | FALSE |
| OX | 2 | SOCA6 | *Solidago canadensis* | Canada goldenrod | 2.851247099 | Forb | FACU | FALSE |

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|---|---|---|---|---|---|---|---|---|
| OX | 3 | SYEA2 | *Symphyotrichum eatonii* | Eaton's aster | 1.631091182 | Forb | FAC | FALSE |
| OX | 3 | VETH | *Verbascum thapsus* | common mullein | 0.340729013 | Forb | UPL | TRUE |
| OX | 4 | ACGR3 | *Acer grandidentatum* | bigtooth maple | 0.063913046 | Woody | UPL | FALSE |
| OX | 4 | AGGI2 | *Agrostis gigantea* | redtop | 24.34854909 | Grass | FACW | FALSE |
| OX | 4 | ARLU | *Artemisia ludoviciana* | white sagebrush | 3.341592023 | Forb | FACU | FALSE |
| OX | 4 | ARTR2 | *Artemisia tridentata* | big sagebrush | 10.90312454 | Woody | UPL | FALSE |
| OX | 4 | ASSP | *Asclepias speciosa* | showy milkweed | 4.133226869 | Forb | FACW | FALSE |
| OX | 4 | BG | Bare Ground | Bare Ground | 34.02761318 | Bare ground | | FALSE |
| OX | 4 | BRIN2 | *Bromus inermis* | smooth brome | 145.4634633 | Grass | UPL | TRUE |
| OX | 4 | CHVI8 | *Chrysothamnus viscidiflorus* | yellow rabbitbrush | 0.031956523 | Woody | UPL | FALSE |
| OX | 4 | CIAR4 | *Cirsium arvense* | Canada thistle | 6.602393465 | Forb | FACU | TRUE |
| OX | 4 | CIVU | *Cirsium vulgare* | bull thistle | 6.72469156 | Forb | FAC | TRUE |
| OX | 4 | COCA5 | *Conyza canadensis* | Canadian horseweed | 2.066429341 | Forb | UPL | FALSE |
| OX | 4 | EQAR | *Equisetum arvense* | field horsetail | 20.39997023 | Graminoid | FAC+ | FALSE |
| OX | 4 | EUOC4 | *Euthamia occidentalis* | western goldentop | 45.05115696 | Forb | OBL | FALSE |
| OX | 4 | JUARL | *Juncus arcticus* ssp. *littoralis* | mountain rush | 11.58648124 | Graminoid | FACW | FALSE |
| OX | 4 | JUSC2 | *Juniperus scopulorum* | Rocky Mountain juniper | 0.063913046 | Woody | UPL | FALSE |
| OX | 4 | LIDAD | *Linaria dalmatica* | Dalmatian toadflax | 3.341592023 | Forb | UPL | TRUE |
| OX | 4 | MEOF | *Melilotus officinalis* | sweetclover | 41.71368616 | Forb | FACU | TRUE |
| OX | 4 | OW | Open Water | Open Water | 11.35937747 | Open Water | | FALSE |
| OX | 4 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 34.42640446 | Grass | OBL | FALSE |
| OX | 4 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 129.7264083 | Woody | FAC* | FALSE |
| OX | 4 | ROCK | Rock | Rock | 57.775954 | Rock | | FALSE |
| OX | 4 | ROWO | *Rosa woodsii* | Woods' rose | 0.09586957 | Woody | FAC- | FALSE |
| OX | 4 | SABO2 | *Salix boothii* | Booth's willow | 5.85498887 | Woody | OBL* | FALSE |
| OX | 4 | SAEX | *Salix exigua* | coyote willow | 69.03419299 | Woody | OBL | FALSE |
| OX | 4 | SALU | *Salix lucida* | shining willow | 12.17909651 | Woody | OBL | FALSE |
| OX | 4 | SCPR4 | *Schedonorus pratensis* | meadow fescue | 17.32411289 | Grass | FACU | TRUE |
| OX | 4 | SOCA6 | *Solidago canadensis* | Canada goldenrod | 12.36967411 | Forb | FACU | FALSE |
| OX | 4 | SYEA2 | *Symphyotrichum eatonii* | Eaton's aster | 2.755484579 | Forb | FAC | FALSE |
| OX | 4 | VETH | *Verbascum thapsus* | common mullein | 1.065171194 | Forb | UPL | TRUE |
| OX | 4 | VEAM2 | *Veronica americana* | American speedwell | 1.378232409 | Forb | OBL | FALSE |
| OX | 5 | AGGI2 | *Agrostis gigantea* | redtop | 73.56898866 | Grass | FACW | FALSE |
| OX | 5 | BG | Bare Ground | Bare Ground | 12.74074415 | Bare ground | | FALSE |
| OX | 5 | BRIN2 | *Bromus inermis* | smooth brome | 23.07671577 | Grass | UPL | TRUE |
| OX | 5 | BRTE | *Bromus tectorum* | cheatgrass | 0.809744685 | Graminoid | UPL | TRUE |
| OX | 5 | CIAR4 | *Cirsium arvense* | Canada thistle | 5.237752646 | Forb | FACU | TRUE |
| OX | 5 | CIVU | *Cirsium vulgare* | bull thistle | 1.408581963 | Forb | FAC | TRUE |
| OX | 5 | COSE16 | *Cornus sericea* | redosier dogwood | 1.73170127 | Woody | FACW | FALSE |
| OX | 5 | ELPA3 | *Eleocharis palustris* | common spikerush | 78.85042376 | Graminoid | OBL | FALSE |
| OX | 5 | EQAR | *Equisetum arvense* | field horsetail | 31.71949234 | Graminoid | FAC+ | FALSE |
| OX | 5 | EUOC4 | *Euthamia occidentalis* | western goldentop | 10.09662133 | Forb | OBL | FALSE |
| OX | 5 | GRSQ | *Grindelia squarrosa* | curlycup gumweed | 2.817163926 | Forb | FACU | FALSE |
| OX | 5 | JUARL | *Juncus arcticus* ssp. *littoralis* | mountain rush | 20.29657653 | Graminoid | FACW | FALSE |
| OX | 5 | MEOF | *Melilotus officinalis* | sweetclover | 15.88396065 | Forb | FACU | TRUE |
| OX | 5 | OW | Open Water | Open Water | 61.56732951 | Open Water | | FALSE |
| OX | 5 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 13.01806769 | Grass | OBL | FALSE |
| OX | 5 | PLMA2 | *Plantago major* | common plantain | 1.684120809 | Forb | FAC | TRUE |
| OX | 5 | POMO5 | *Polypogon monspeliensis* | annual rabbitsfoot grass | 0.161866363 | Graminoid | FACW+ | FALSE |
| OX | 5 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 21.98445114 | Woody | FAC* | FALSE |
| OX | 5 | RACY | *Ranunculus cymbalaria* | alkali buttercup | 3.02552422 | Forb | OBL | FALSE |
| OX | 5 | ROCK | Rock | Rock | 9.391131564 | Rock | | FALSE |
| OX | 5 | SABO2 | *Salix boothii* | Booth's willow | 30.74993348 | Woody | OBL* | FALSE |
| OX | 5 | SAEX | *Salix exigua* | coyote willow | 152.5390427 | Woody | OBL | FALSE |
| OX | 5 | SALU | *Salix lucida* | shining willow | 51.94009635 | Woody | OBL | FALSE |
| OX | 5 | SCPR4 | *Schedonorus pratensis* | meadow fescue | 12.077339 | Grass | FACU | TRUE |
| OX | 5 | SOCA6 | *Solidago canadensis* | Canada goldenrod | 28.56605003 | Forb | FACU | FALSE |
| OX | 5 | SYEA2 | *Symphyotrichum eatonii* | Eaton's aster | 6.37231351 | Forb | FAC | FALSE |
| OX | 5 | TYLA | *Typha latifolia* | broadleaf cattail | 1.511900942 | Graminoid | OBL | FALSE |
| OX | 5 | VETH | *Verbascum thapsus* | common mullein | 3.487968353 | Forb | UPL | TRUE |
| OX | 5 | VEAM2 | *Veronica americana* | American speedwell | 0.72360738 | Forb | OBL | FALSE |
| OX | 6 | AGGI2 | *Agrostis gigantea* | redtop | 84.23034178 | Grass | FACW | FALSE |
| OX | 6 | BG | Bare Ground | Bare Ground | 18.86349402 | Bare ground | | FALSE |
| OX | 6 | BRIN2 | *Bromus inermis* | smooth brome | 87.34825486 | Grass | UPL | TRUE |

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|---|---|---|---|---|---|---|---|---|
| OX | 7 | AGGI2 | *Agrostis gigantea* | redtop | 55.75501467 | Grass | FACW | FALSE |
| OX | 7 | ARTR2 | *Artemisia tridentata* | big sagebrush | 1.209477793 | Woody | UPL | FALSE |
| OX | 7 | BG | Bare Ground | Bare Ground | 9.071083447 | Bare ground | | FALSE |
| OX | 7 | BRIN2 | *Bromus inermis* | smooth brome | 18.42183661 | Grass | UPL | TRUE |
| OX | 7 | BRTE | *Bromus tectorum* | cheatgrass | 7.813400025 | Graminoid | UPL | TRUE |
| OX | 7 | CIAR4 | *Cirsium arvense* | Canada thistle | 91.99236538 | Forb | FACU | TRUE |
| OX | 7 | EQAR | *Equisetum arvense* | field horsetail | 7.813400025 | Graminoid | FAC+ | FALSE |
| OX | 7 | EUOC4 | *Euthamia occidentalis* | western goldentop | 128.0799016 | Forb | OBL | FALSE |
| OX | 7 | HOJU | *Hordeum jubatum* | foxtail barley | 0.59283736 | Grass | FAC* | FALSE |
| OX | 7 | JUARL | *Juncus arcticus* ssp. *littoralis* | mountain rush | 0.996166813 | Graminoid | FACW | FALSE |
| OX | 7 | MEOF | *Melilotus officinalis* | sweetclover | 11.13681919 | Forb | FACU | TRUE |
| OX | 7 | OW | Open Water | Open Water | 63.98373117 | Open Water | | FALSE |
| OX | 7 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 33.09260468 | Grass | OBL | FALSE |
| OX | 7 | POMO5 | *Polypogon monspeliensis* | annual rabbitsfoot grass | 2.291737992 | Graminoid | FACW+ | FALSE |
| OX | 7 | SABO2 | *Salix boothii* | Booth's willow | 99.65576764 | Woody | OBL* | FALSE |
| OX | 7 | SAEX | *Salix exigua* | coyote willow | 30.92474685 | Woody | OBL | FALSE |
| OX | 7 | SALU | *Salix lucida* | shining willow | 76.61974833 | Woody | OBL | FALSE |
| OX | 7 | SCPR4 | *Schedonorus pratensis* | meadow fescue | 17.04823521 | Grass | FACU | TRUE |
| OX | 7 | SOCA6 | *Solidago canadensis* | Canada goldenrod | 37.41251139 | Forb | FACU | FALSE |
| OX | 7 | SYEA2 | *Symphyotrichum eatonii* | Eaton's aster | 2.227363838 | Forb | FAC | FALSE |
| OX | 7 | THIN6 | *Thinopyrum intermedium* | intermediate wheatgrass | 4.381056111 | Graminoid | UPL | TRUE |
| OX | 8 | AGGI2 | *Agrostis gigantea* | redtop | 22.78747942 | Grass | FACW | FALSE |
| OX | 8 | BRIN2 | *Bromus inermis* | smooth brome | 20.4084695 | Grass | UPL | TRUE |
| OX | 8 | CANU4 | *Carduus nutans* | musk thistle | 0.036094747 | Forb | UPL | TRUE |
| OX | 8 | CANE2 | *Carex nebrascensis* | Nebraska sedge | 5.964960807 | Graminoid | OBL | FALSE |
| OX | 8 | CIAR4 | *Cirsium arvense* | Canada thistle | 4.605970297 | Forb | FACU | TRUE |
| OX | 8 | ELPA3 | *Eleocharis palustris* | common spikerush | 19.49189887 | Graminoid | OBL | FALSE |
| OX | 8 | EQAR | *Equisetum arvense* | field horsetail | 13.2601761 | Graminoid | FAC+ | FALSE |
| OX | 8 | EUOC4 | *Euthamia occidentalis* | western goldentop | 0.632101121 | Forb | OBL | FALSE |
| OX | 8 | GRSQ | *Grindelia squarrosa* | curlycup gumweed | 1.44286383 | Forb | FACU | FALSE |
| OX | 8 | JUARL | *Juncus arcticus* ssp. *littoralis* | mountain rush | 11.4129744 | Graminoid | FACW | FALSE |
| OX | 8 | JUCO2 | *Juncus confusus* | Colorado rush | 0.210700374 | Graminoid | FAC+ | FALSE |
| OX | 8 | JUTO | *Juncus torreyi* | Torrey's rush | 0.901107518 | Graminoid | FACW+ | FALSE |
| OX | 8 | MEOF | *Melilotus officinalis* | sweetclover | 7.496725233 | Forb | FACU | TRUE |
| OX | 8 | OW | Open Water | Open Water | 19.96627801 | Open Water | | FALSE |
| OX | 8 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 47.12006027 | Grass | OBL | FALSE |
| OX | 8 | SABO2 | *Salix boothii* | Booth's willow | 0.210700374 | Woody | OBL* | FALSE |
| OX | 8 | SAEX | *Salix exigua* | coyote willow | 81.13870511 | Woody | OBL | FALSE |
| OX | 8 | SALU | *Salix lucida* | shining willow | 25.74763399 | Woody | OBL | FALSE |
| OX | 8 | SCPR4 | *Schedonorus pratensis* | meadow fescue | 0.210700374 | Grass | FACU | TRUE |
| OX | 8 | SOCA6 | *Solidago canadensis* | Canada goldenrod | 1.867938217 | Forb | FACU | FALSE |
| OX | 8 | TYLA | *Typha latifolia* | broadleaf cattail | 24.72898821 | Graminoid | OBL | FALSE |
| OX | 8 | TYLA | *Typha latifolia* | broadleaf cattail | 0 | Graminoid | OBL | FALSE |
| RC | 1 | AGGI2 | *Agrostis gigantea* | redtop | 41.65885228 | Grass | FACW | FALSE |
| RC | 1 | ARLU | *Artemisia ludoviciana* | white sagebrush | 2.399920878 | Forb | FACU | FALSE |
| RC | 1 | ARTR2 | *Artemisia tridentata* | big sagebrush | 4.588954495 | Woody | UPL | FALSE |
| RC | 1 | BG | Bare Ground | Bare Ground | 10.81988621 | Bare ground | | FALSE |
| RC | 1 | BEOC2 | *Betula occidentalis* | water birch | 52.52702186 | Woody | FACW | FALSE |
| RC | 1 | CHVI8 | *Chrysothamnus viscidiflorus* | yellow rabbitbrush | 7.965353084 | Woody | UPL | FALSE |
| RC | 1 | EUOC4 | *Euthamia occidentalis* | western goldentop | 2.820149953 | Forb | OBL | FALSE |
| RC | 1 | LITTER | Litter | Litter | 2.928690874 | Litter | | FALSE |
| RC | 1 | MEOF | *Melilotus officinalis* | sweetclover | 29.7637368 | Forb | FACU | TRUE |
| RC | 1 | OW | Open Water | Open Water | 34.56618477 | Open Water | | FALSE |
| RC | 1 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 8.889193648 | Woody | FAC* | FALSE |
| RC | 1 | PUTR2 | *Purshia tridentata* | antelope bitterbrush | 12.04173544 | Woody | UPL | FALSE |
| RC | 1 | QUGA | *Quercus gambelii* | Gambel oak | 4.588954495 | Woody | UPL | FALSE |
| RC | 1 | ROWO | *Rosa woodsii* | Woods' rose | 9.51824534 | Woody | FAC- | FALSE |
| RC | 1 | SABO2 | *Salix boothii* | Booth's willow | 7.675215953 | Woody | OBL* | FALSE |
| RC | 1 | SAEX | *Salix exigua* | coyote willow | 44.65877867 | Woody | OBL | FALSE |
| RC | 1 | SALU | *Salix lucida* | shining willow | 11.87053828 | Woody | OBL | FALSE |
| RC | 1 | SYOR2 | *Symphoricarpos oreophilus* | mountain snowberry | 8.961022219 | Woody | FACU | FALSE |
| RC | 1 | VETH | *Verbascum thapsus* | common mullein | 0.995669135 | Forb | UPL | TRUE |
| RC | 2 | AGGI2 | *Agrostis gigantea* | redtop | 70.11481941 | Grass | FACW | FALSE |
| RC | 2 | ARLU | *Artemisia ludoviciana* | white sagebrush | 4.533578502 | Forb | FACU | FALSE |

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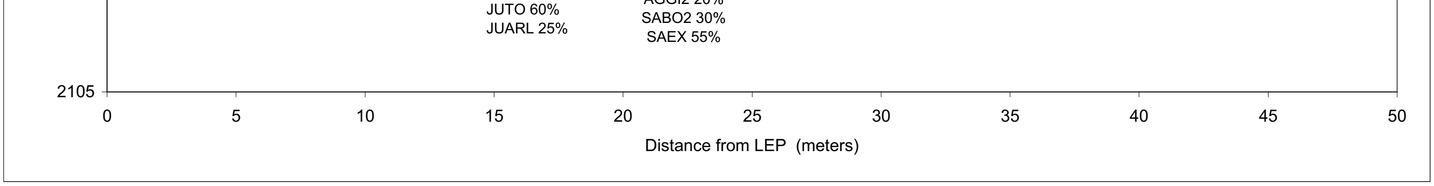
|---|---|---|---|---|---|---|---|---|
| RC | 3 | MARE11 | *Mahonia repens* | creeping barberry | 2.580560012 | Woody | UPL | FALSE |
| RC | 3 | MEOF | *Melilotus officinalis* | sweetclover | 2.031467136 | Forb | FACU | TRUE |
| RC | 3 | OW | Open Water | Open Water | 24.00650818 | Open Water | | FALSE |
| RC | 3 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 60.21238294 | Woody | FAC* | FALSE |
| RC | 3 | PUTR2 | *Purshia tridentata* | antelope bitterbrush | 1.032224005 | Woody | UPL | FALSE |
| RC | 3 | QUGA | *Quercus gambelii* | Gambel oak | 8.477501599 | Woody | UPL | FALSE |
| RC | 3 | SABO2 | *Salix boothii* | Booth's willow | 13.52207075 | Woody | OBL* | FALSE |
| RC | 3 | SAEX | *Salix exigua* | coyote willow | 77.88868232 | Woody | OBL | FALSE |
| RC | 3 | SALU | *Salix lucida* | shining willow | 1.625173708 | Woody | OBL | FALSE |
| RC | 3 | SYOR2 | *Symphoricarpos oreophilus* | mountain snowberry | 0 | Woody | FACU | FALSE |
| RC | 4 | ACMI2 | *Achillea millefolium* | common yarrow | 17.70425959 | Forb | FACU | FALSE |
| RC | 4 | AGGI2 | *Agrostis gigantea* | redtop | 70.67703426 | Grass | FACW | FALSE |
| RC | 4 | ARTR2 | *Artemisia tridentata* | big sagebrush | 9.395347294 | Woody | UPL | FALSE |
| RC | 4 | BG | Bare Ground | Bare Ground | 23.2855851 | Bare ground | | FALSE |
| RC | 4 | BEOC2 | *Betula occidentalis* | water birch | 88.57015388 | Woody | FACW | FALSE |
| RC | 4 | COSE16 | *Cornus sericea* | redosier dogwood | 18.74741009 | Woody | FACW | FALSE |
| RC | 4 | JUARL | *Juncus arcticus* ssp. *littoralis* | mountain rush | 2.318108538 | Graminoid | FACW | FALSE |
| RC | 4 | MEOF | *Melilotus officinalis* | sweetclover | 18.26529458 | Forb | FACU | TRUE |
| RC | 4 | OW | Open Water | Open Water | 20.60861715 | Open Water | | FALSE |
| RC | 4 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 21.18889147 | Woody | FAC* | FALSE |
| RC | 4 | QUGA | *Quercus gambelii* | Gambel oak | 12.02336037 | Woody | UPL | FALSE |
| RC | 4 | RHTR | *Rhus trilobata* | skunkbush sumac | 34.58171055 | Woody | NI | FALSE |
| RC | 4 | ROCK | Rock | Rock | 13.65732656 | Rock | | FALSE |
| RC | 4 | ROWO | *Rosa woodsii* | Woods' rose | 5.68902433 | Woody | FAC- | FALSE |
| RC | 4 | SABO2 | *Salix boothii* | Booth's willow | 6.141605472 | Woody | OBL* | FALSE |
| RC | 4 | SAEX | *Salix exigua* | coyote willow | 34.07988352 | Woody | OBL | FALSE |
| RC | 4 | SALU | *Salix lucida* | shining willow | 37.67502901 | Woody | OBL | FALSE |
| RC | 4 | SYOR2 | *Symphoricarpos oreophilus* | mountain snowberry | 18.79069459 | Woody | FACU | FALSE |
| RC | 4 | SYMPH4 | *Symphyotrichum species* | aster | 1.279133735 | Forb | | FALSE |
| RC | 5 | AGGI2 | *Agrostis gigantea* | redtop | 36.08767392 | Grass | FACW | FALSE |
| RC | 5 | ARTR2 | *Artemisia tridentata* | big sagebrush | 24.15407252 | Woody | UPL | FALSE |
| RC | 5 | BEOC2 | *Betula occidentalis* | water birch | 57.73566727 | Woody | FACW | FALSE |
| RC | 5 | CIAR4 | *Cirsium arvense* | Canada thistle | 1.80001554 | Forb | FACU | TRUE |
| RC | 5 | EUOC4 | *Euthamia occidentalis* | western goldentop | 1.802562824 | Forb | OBL | FALSE |
| RC | 5 | JUARL | *Juncus arcticus* ssp. *littoralis* | mountain rush | 16.3527798 | Graminoid | FACW | FALSE |
| RC | 5 | MEOF | *Melilotus officinalis* | sweetclover | 32.07537071 | Forb | FACU | TRUE |
| RC | 5 | OW | Open Water | Open Water | 27.07611357 | Open Water | | FALSE |
| RC | 5 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 44.90551899 | Woody | FAC* | FALSE |
| RC | 5 | QUGA | *Quercus gambelii* | Gambel oak | 12.10001185 | Woody | UPL | FALSE |
| RC | 5 | RHTR | *Rhus trilobata* | skunkbush sumac | 7.970891782 | Woody | NI | FALSE |
| RC | 5 | SABO2 | *Salix boothii* | Booth's willow | 20.87587982 | Woody | OBL* | FALSE |
| RC | 5 | SAEX | *Salix exigua* | coyote willow | 123.0761997 | Woody | OBL | FALSE |
| RC | 5 | SALU | *Salix lucida* | shining willow | 30.06059937 | Woody | OBL | FALSE |
| RC | 5 | SYOR2 | *Symphoricarpos oreophilus* | mountain snowberry | 19.54697292 | Woody | FACU | FALSE |
| RC | 5 | SYMPH4 | *Symphyotrichum species* | aster | 7.211178637 | Forb | | FALSE |
| RC | 6 | AGGI2 | *Agrostis gigantea* | redtop | 67.27703147 | Grass | FACW | FALSE |
| RC | 6 | ARTR2 | *Artemisia tridentata* | big sagebrush | 7.833132713 | Woody | UPL | FALSE |
| RC | 6 | BG | Bare Ground | Bare Ground | 6.579583246 | Bare ground | | FALSE |
| RC | 6 | BEOC2 | *Betula occidentalis* | water birch | 91.09030032 | Woody | FACW | FALSE |
| RC | 6 | CALU7 | *Carex luzulina* | woodrush sedge | 0.451982712 | Graminoid | OBL | FALSE |
| RC | 6 | CIAR4 | *Cirsium arvense* | Canada thistle | 0 | Forb | FACU | TRUE |
| RC | 6 | CYOF | *Cynoglossum officinale* | hound's tongue | 2.193194415 | Forb | UPL | TRUE |
| RC | 6 | ELPA3 | *Eleocharis palustris* | common spikerush | 0.139071604 | Graminoid | OBL | FALSE |
| RC | 6 | OW | Open Water | Open Water | 46.93674087 | Open Water | | FALSE |
| RC | 6 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 70.84801136 | Woody | FAC* | FALSE |
| RC | 6 | SAEX | *Salix exigua* | coyote willow | 111.7210292 | Woody | OBL | FALSE |
| RC | 6 | SALU | *Salix lucida* | shining willow | 36.94301669 | Woody | OBL | FALSE |
| RC | 6 | SYOR2 | *Symphoricarpos oreophilus* | mountain snowberry | 21.76804324 | Woody | FACU | FALSE |
| SXW | 1 | AGGI2 | *Agrostis gigantea* | redtop | 31.95083043 | Grass | FACW | FALSE |
| SXW | 1 | BG | Bare Ground | Bare Ground | 10.7340331 | Bare ground | | FALSE |
| SXW | 1 | CANE2 | *Carex nebrascensis* | Nebraska sedge | 1.8854414 | Graminoid | OBL | FALSE |
| SXW | 1 | CIAR4 | *Cirsium arvense* | Canada thistle | 0.0815906 | Forb | FACU | TRUE |
| SXW | 1 | CYOF | *Cynoglossum officinale* | hound's tongue | 3.058177726 | Forb | UPL | TRUE |
| SXW | 1 | GEMA4 | *Geum macrophyllum* | largeleaf avens | 0.0407953 | Forb | OBL | FALSE |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SXW | 2 | SABO2 | *Salix boothii* | Booth's willow | 0.51767087 | Woody | OBL* | FALSE |
| SXW | 2 | SAEX | *Salix exigua* | coyote willow | 26.29084493 | Woody | OBL | FALSE |
| SXW | 2 | SARA2 | *Sambucus racemosa* | red elderberry | 0.279627284 | Woody | FACU | FALSE |
| SXW | 2 | SYOR2 | *Symphoricarpos oreophilus* | mountain snowberry | 0.928872312 | Woody | FACU | FALSE |
| SXW | 2 | URDI | *Urtica dioica* | stinging nettle | 0.776506306 | Forb | FAC | FALSE |
| SXW | 2 | VEAM2 | *Veronica americana* | American speedwell | 1.553012611 | Forb | OBL | FALSE |
| SXW | 3 | AGGI2 | *Agrostis gigantea* | redtop | 20.27179138 | Grass | FACW | FALSE |
| SXW | 3 | BG | Bare Ground | Bare Ground | 16.50899164 | Bare ground | | FALSE |
| SXW | 3 | CANU4 | *Carduus nutans* | musk thistle | 0.334894101 | Forb | UPL | TRUE |
| SXW | 3 | CANE2 | *Carex nebrascensis* | Nebraska sedge | 6.567668848 | Graminoid | OBL | FALSE |
| SXW | 3 | CAAQ3 | *Catabrosa aquatica* | water brookgrass | 11.79576129 | Graminoid | OBL | FALSE |
| SXW | 3 | CIAR4 | *Cirsium arvense* | Canada thistle | 0.334894101 | Forb | FACU | TRUE |
| SXW | 3 | MEOF | *Melilotus officinalis* | sweetclover | 1.328932318 | Forb | FACU | TRUE |
| SXW | 3 | OW | Open Water | Open Water | 26.14780129 | Open Water | | FALSE |
| SXW | 3 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 3.336918427 | Woody | FAC* | FALSE |
| SXW | 3 | ROWO | *Rosa woodsii* | Woods' rose | 0.669788201 | Woody | FAC- | FALSE |
| SXW | 3 | SABO2 | *Salix boothii* | Booth's willow | 5.003204253 | Woody | OBL* | FALSE |
| SXW | 3 | SAEX | *Salix exigua* | coyote willow | 73.03122443 | Woody | OBL | FALSE |
| SXW | 3 | VEAM2 | *Veronica americana* | American speedwell | 5.897880647 | Forb | OBL | FALSE |
| SXW | 4 | AGGI2 | *Agrostis gigantea* | redtop | 32.35256339 | Grass | FACW | FALSE |
| SXW | 4 | ARLU | *Artemisia ludoviciana* | white sagebrush | 49.97380307 | Forb | FACU | FALSE |
| SXW | 4 | ARTR2 | *Artemisia tridentata* | big sagebrush | 75.61098957 | Woody | UPL | FALSE |
| SXW | 4 | BG | Bare Ground | Bare Ground | 1.159399561 | Bare ground | | FALSE |
| SXW | 4 | BRTE | *Bromus tectorum* | cheatgrass | 129.931888 | Graminoid | UPL | TRUE |
| SXW | 4 | CANU4 | *Carduus nutans* | musk thistle | 0.783903355 | Forb | UPL | TRUE |
| SXW | 4 | CIDO | *Cicuta douglasii* | western water hemlock | 2.928798232 | Forb | OBL | FALSE |
| SXW | 4 | CIAR4 | *Cirsium arvense* | Canada thistle | 2.0819565 | Forb | FACU | TRUE |
| SXW | 4 | CRDO2 | *Crataegus douglasii* | black hawthorn | 9.744998131 | Woody | FAC | FALSE |
| SXW | 4 | CYOF | *Cynoglossum officinale* | hound's tongue | 0.783903355 | Forb | UPL | TRUE |
| SXW | 4 | FRVE | *Fragaria vesca* | woodland strawberry | 3.662455215 | Forb | UPL | FALSE |
| SXW | 4 | OW | Open Water | Open Water | 10.44030992 | Open Water | | FALSE |
| SXW | 4 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 0.13943976 | Woody | FAC* | FALSE |
| SXW | 4 | ROCK | Rock | Rock | 29.75038482 | Rock | | FALSE |
| SXW | 4 | SAEX | *Salix exigua* | coyote willow | 66.18479382 | Woody | OBL | FALSE |
| SXW | 4 | SOCA6 | *Solidago canadensis* | Canada goldenrod | 1.028299579 | Forb | FACU | FALSE |
| SXW | 4 | SYOR2 | *Symphoricarpos oreophilus* | mountain snowberry | 20.77342458 | Woody | FACU | FALSE |
| SXW | 4 | SYEA2 | *Symphyotrichum eatonii* | Eaton's aster | 4.393197348 | Forb | FAC | FALSE |
| SXW | 4 | VETH | *Verbascum thapsus* | common mullein | 12.60989158 | Forb | UPL | TRUE |
| SXW | 5 | AGGI2 | *Agrostis gigantea* | redtop | 20.42090383 | Grass | FACW | FALSE |
| SXW | 5 | BG | Bare Ground | Bare Ground | 2.678264546 | Bare ground | | FALSE |
| SXW | 5 | BRTE | *Bromus tectorum* | cheatgrass | 139.4676367 | Graminoid | UPL | TRUE |
| SXW | 5 | CIAR4 | *Cirsium arvense* | Canada thistle | 3.934423272 | Forb | FACU | TRUE |
| SXW | 5 | CYOF | *Cynoglossum officinale* | hound's tongue | 1.967211636 | Forb | UPL | TRUE |
| SXW | 5 | GEMA4 | *Geum macrophyllum* | largeleaf avens | 0.014680193 | Forb | OBL | FALSE |
| SXW | 5 | OW | Open Water | Open Water | 7.897157517 | Open Water | | FALSE |
| SXW | 5 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 1.914960553 | Grass | OBL | FALSE |
| SXW | 5 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 1.597662081 | Woody | FAC* | FALSE |
| SXW | 5 | ROCK | Rock | Rock | 2.139446698 | Rock | | FALSE |
| SXW | 5 | ROWO | *Rosa woodsii* | Woods' rose | 1.999869842 | Woody | FAC- | FALSE |
| SXW | 5 | SABO2 | *Salix boothii* | Booth's willow | 0.602881804 | Woody | OBL* | FALSE |
| SXW | 5 | SAEX | *Salix exigua* | coyote willow | 38.18559012 | Woody | OBL | FALSE |
| SXW | 5 | SYOR2 | *Symphoricarpos oreophilus* | mountain snowberry | 17.43345458 | Woody | FACU | FALSE |
| SXW | 5 | URDI | *Urtica dioica* | stinging nettle | 4.802081574 | Forb | FAC | FALSE |
| SXW | 5 | VETH | *Verbascum thapsus* | common mullein | 11.28682073 | Forb | UPL | TRUE |
| SXW | 6 | AGGI2 | *Agrostis gigantea* | redtop | 28.22485279 | Grass | FACW | FALSE |
| SXW | 6 | BG | Bare Ground | Bare Ground | 0.011478812 | Bare ground | | FALSE |
| SXW | 6 | BRTE | *Bromus tectorum* | cheatgrass | 10.84174133 | Graminoid | UPL | TRUE |
| SXW | 6 | CANE2 | *Carex nebrascensis* | Nebraska sedge | 6.52731102 | Graminoid | OBL | FALSE |
| SXW | 6 | CIAR4 | *Cirsium arvense* | Canada thistle | 0.586980761 | Forb | FACU | TRUE |
| SXW | 6 | GEMA4 | *Geum macrophyllum* | largeleaf avens | 0.650957633 | Forb | OBL | FALSE |
| SXW | 6 | LITTER | Litter | Litter | 1.785939696 | Litter | | FALSE |
| SXW | 6 | OW | Open Water | Open Water | 35.4400736 | Open Water | | FALSE |
| SXW | 6 | PHAR3 | *Phalaris arundinacea* | reed canarygrass | 99.0950127 | Grass | OBL | FALSE |
| SXW | 6 | POAN3 | *Populus angustifolia* | narrowleaf cottonwood | 7.924110113 | Woody | FAC* | FALSE |

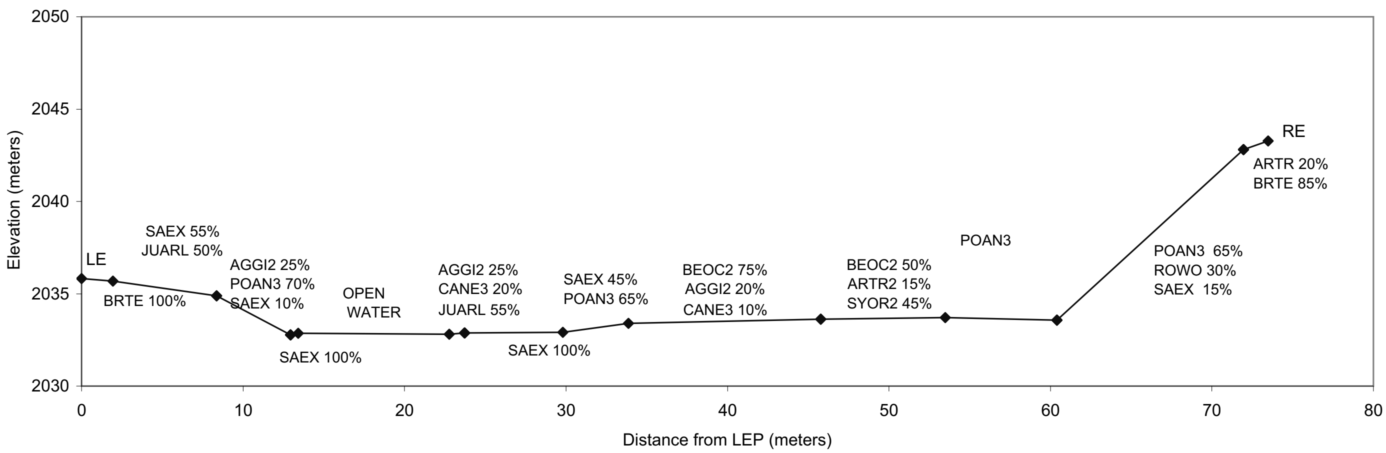
# APPENDIX 2.3B VEGETATION TRANSECT DATA

| | FACU | FAC | FACW | OBL | FORB | GRAMINOID | GRASS | WETLAND GRAMINOID | WOODY | NON-INDICATOR | TOTA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4588929 | 21.0522737 | 133.1858603 | 257.9794019 | 232.3137505 | 91.27777034 | 331.1667891 | 161.5630304 | 169.6037586 | 313.5713208 | 142.5816407 | |
| 5916008 | 290.8622259 | 25.0503601 | 102.1049609 | 192.8672102 | 302.1667055 | 224.4341026 | 194.592539 | 29.84156367 | 175.5354709 | 228.0617847 | |
| 7598374 | 10.58059341 | 18.43460876 | 84.21234936 | 164.5837161 | 20.71553828 | 219.8092499 | 173.574244 | 46.23500583 | 142.1306531 | 98.44375151 | |
| 3633719 | 49.92350733 | 7.60906264 | 27.33427058 | 95.69504821 | 22.19356375 | 216.5873048 | 204.6788192 | 11.90848567 | 35.72070497 | 111.2528579 | |
| 2445323 | 25.66798933 | 3.931311054 | 49.33276099 | 124.1944314 | 56.92872424 | 152.0384777 | 133.9719379 | 18.06653974 | 59.11162053 | 64.47487627 | |
| 6971816 | 20.59014673 | 2.102904256 | 49.14853701 | 80.05427523 | 36.01514066 | 120.2668125 | 97.75982409 | 22.50698837 | 55.95996147 | 64.47312959 | |
| 7260784 | 27.64975523 | 20.42138908 | 11.66577382 | 90.32263302 | 41.8266896 | 116.5163745 | 78.51303435 | 38.00334013 | 45.18997507 | 62.58035944 | |
| 4341495 | 446.3264916 | 210.7354962 | 581.7780545 | 980.0310646 | 571.1241324 | 1380.819111 | 1044.653429 | 336.165682 | 827.2197067 | 771.8684001 | |
| 6743811 | 3.101194399 | 0.606253984 | 64.66379803 | 149.4101087 | 12.27949797 | 164.8609206 | 126.4504839 | 38.41043671 | 70.70837466 | 32.37670485 | |
| 3024506 | 49.49763149 | 9.233503271 | 205.7289006 | 460.7349953 | 67.41593984 | 460.3310494 | 386.9404699 | 73.39057954 | 281.4282865 | 117.6063041 | |
| 0158928 | 76.2033877 | 36.97085793 | 89.76760415 | 288.5570951 | 42.36581336 | 373.7784197 | 350.9729297 | 22.80548995 | 156.5563011 | 140.5273813 | |
| 4119606 | 30.27934395 | 11.95534258 | 62.97716657 | 240.5979413 | 37.009594 | 242.2946723 | 214.6291576 | 27.66551471 | 125.4467241 | 79.55536288 | |
| 9769202 | 51.32141016 | 5.431238987 | 90.03558947 | 208.1173946 | 73.64972446 | 218.193975 | 156.64901 | 61.54496503 | 79.45962584 | 53.36230179 | |
| 9480142 | 33.30598518 | 12.86061358 | 4.897166976 | 143.6845267 | 42.30683726 | 114.1837823 | 105.8773608 | 8.306421472 | 54.25247437 | 38.24750581 | |
| 5829619 | 243.7089529 | 77.05781033 | 518.0702258 | 1491.102062 | 275.0274069 | 1573.642819 | 1341.519412 | 232.1234074 | 767.8517867 | 461.6755608 | |
| 4724656 | 9.022845331 | 177.5222404 | 12.9699267 | 146.8190386 | 17.78102077 | 116.4186869 | 96.30847099 | 20.11021588 | 288.38159 | 85.27009189 | |
| 0354548 | 11.09737091 | 171.4389527 | 6.54596701 | 156.0078512 | 83.67139919 | 156.6025629 | 149.8194136 | 6.783149378 | 229.8516345 | 200.9730016 | |
| 9275475 | 38.89425042 | 155.8614379 | 50.85466886 | 150.3568476 | 49.21603052 | 226.1615949 | 189.1802128 | 36.98138208 | 259.5171268 | 158.8172993 | |
| .999563 | 81.35145864 | 159.7024242 | 40.0682572 | 167.9240722 | 130.5433307 | 253.5489812 | 221.5625298 | 31.98645147 | 227.9534634 | 222.2351106 | |
| 7442881 | 64.58226625 | 63.16895976 | 95.75913283 | 342.4552179 | 79.30366481 | 255.0911157 | 121.7411111 | 133.3500046 | 258.945225 | 63.66618388 | |
| 2114631 | 89.97170654 | 171.1390447 | 85.76750905 | 264.4110799 | 127.0186011 | 295.7839541 | 242.4409565 | 53.34299751 | 283.9079314 | 165.7763033 | |
| 2577054 | 157.5899312 | 10.63360122 | 59.04291948 | 368.3727691 | 270.8489614 | 148.2062895 | 124.9105285 | 23.29576097 | 208.4097406 | 150.7937125 | |
| 4456425 | 15.62419795 | 13.47087647 | 35.10156133 | 205.0350488 | 16.08169344 | 166.4975158 | 90.52670956 | 75.97080627 | 107.0970395 | 32.75796015 | |
| 2757218 | 468.1340272 | 922.9375374 | 386.1099425 | 1801.381925 | 774.4647019 | 1618.310701 | 1236.489933 | 381.8207682 | 1864.063751 | 1080.289663 | |
| 3066665 | 41.12467989 | 18.40743899 | 94.18587414 | 67.02468286 | 35.97947676 | 41.65885228 | 41.65885228 | 0 | 173.2850135 | 30.75940593 | |
| 3737179 | 28.3227142 | 35.55095842 | 106.4961107 | 92.08648832 | 34.29105069 | 70.11481941 | 70.11481941 | 0 | 209.1061098 | 23.78913569 | |
| 9028562 | 2.953872565 | 60.21238294 | 59.31208628 | 93.03592677 | 2.953872565 | 44.16575072 | 44.16575072 | 0 | 180.4849309 | 2.437760563 | |
| 1870766 | 54.76024876 | 26.8779158 | 180.3127068 | 77.89651801 | 37.24868791 | 72.9951428 | 70.67703426 | 2.318108538 | 286.8831106 | 18.26529458 | |
| 5408437 | 53.42235916 | 44.90551899 | 110.176121 | 175.8152417 | 42.88912771 | 52.44045372 | 36.08767392 | 16.3527798 | 340.4258142 | 33.87538625 | |
| 2632713 | 21.76804324 | 70.84801136 | 158.3673318 | 149.2551002 | 2.193194415 | 67.86808578 | 67.27703147 | 0.591054316 | 340.2035335 | 2.193194415 | |
| 0574432 | 202.3519178 | 256.8022265 | 708.8502307 | 655.1139578 | 155.55541 | 349.2431047 | 329.981162 | 19.26194265 | 1530.388512 | 111.3201774 | |
| 4894101 | 1.663826419 | 4.006706629 | 20.27179138 | 102.2957395 | 7.896601167 | 38.63522152 | 20.27179138 | 18.36343014 | 82.04113531 | 1.99872052 | |
| 4584496 | 0.0815906 | 29.68030123 | 31.95083043 | 65.39030977 | 18.36619071 | 36.66443393 | 34.77899253 | 1.8854414 | 78.92699189 | 6.936175097 | |
| 3840687 | 1.208499596 | 35.28421417 | 21.4136791 | 32.88331632 | 2.793955073 | 25.93546702 | 21.4136791 | 4.521787913 | 70.52912779 | 0.464436156 | |
| .383031 | 73.85748373 | 14.27763524 | 32.35256339 | 69.11359205 | 78.24620823 | 162.2844514 | 32.35256339 | 129.931888 | 172.4536459 | 146.1915428 | |
| .721669 | 21.36787785 | 8.399613497 | 20.42090383 | 40.71811267 | 22.00521741 | 161.803501 | 22.33586439 | 139.4676367 | 59.81945843 | 156.6560923 | |
| 6647158 | 1.86247974 | 8.591138082 | 28.22485279 | 208.4386584 | 6.843518288 | 144.6889178 | 127.3198655 | 17.36905235 | 107.6511644 | 12.65345234 | |
| 3294909 | 100.0417579 | 100.2396089 | 154.6346209 | 518.8397287 | 136.1516909 | 570.0119927 | 258.4727563 | 311.5392364 | 571.4215237 | 324.9004192 | |

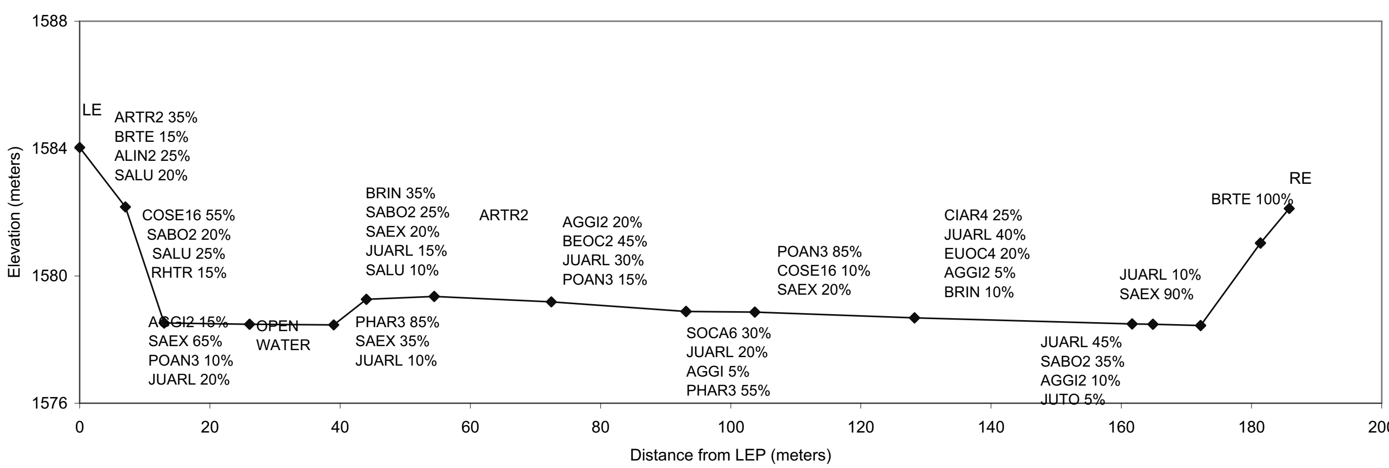
# APPENDIX 2.4 VEGETATION TRANSECT EXAMPLES



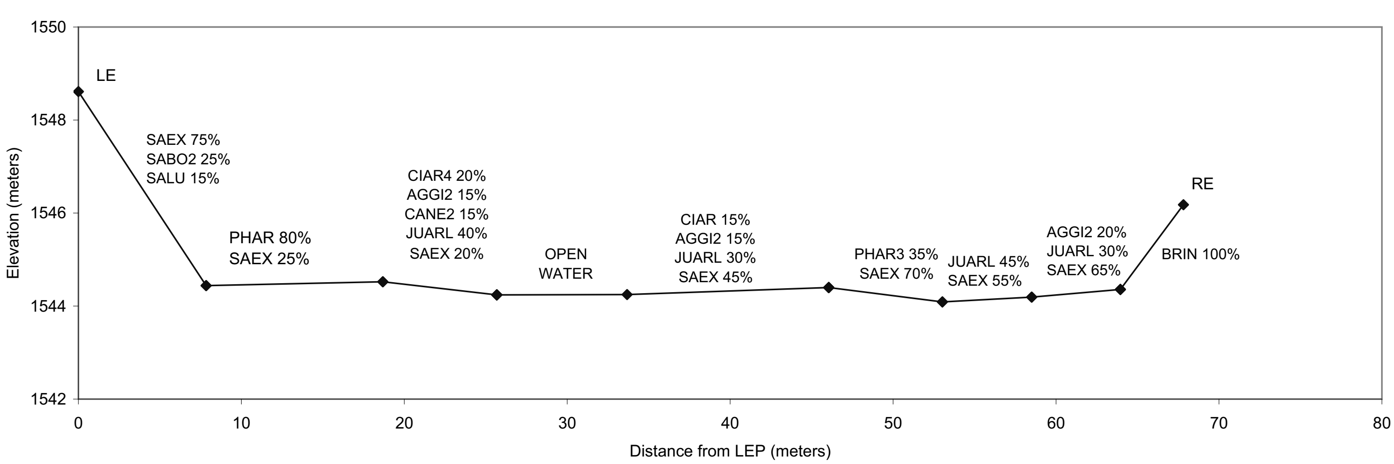

Rays 1 Vegetation



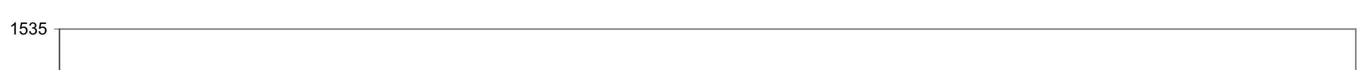

DFC 1 Vegetation




MO 1 Vegetation




OX 1 Vegetation



# APPENDIX 3.1 UTE LADIES'-TRESSES MONITORING SITE CHARACTERISTICS

Proposed ULT Total Count Sites

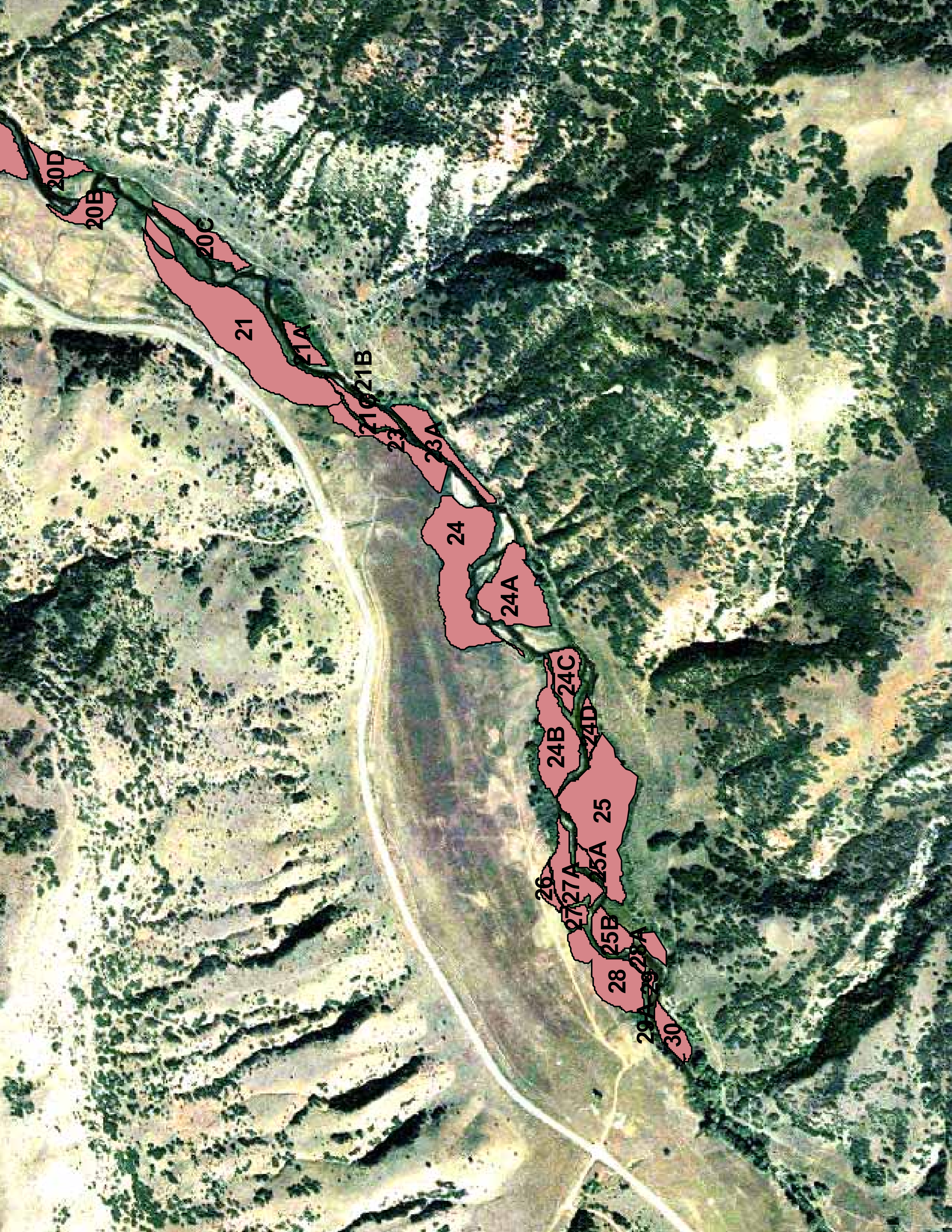
| Colony # | R-sq | Max | Median | Min |
|---|---|---|---|---|
| Upper | | | | |
| 2A | 0.62 | 63 | 3 | 0 |
| 2B | 0.56 | 432 | 37 | 0 |
| Midddle | | | | |
| 10A | 0.69 | 523 | 61 | 0 |
| 13 | 0.56 | 83 | 27 | 0 |
| 14 | 0.36 | 958 | 104 | 18 |
| 17A | 0.70 | 53 | 30 | 0 |
| Lower | | | | |
| 20 | 0.73 | 1888 | 253 | 17 |
| 24B | 0.58 | 1409 | 250 | 8 |
| 30 | 0.37 | 474 | 49 | 0 |
| 36 | 0.36 | 382 | 43 | 2 |
| Total # Colonies | 0.61 | 89 | 76 | 54 |

| | |
|---|---|
| 2A, 14 | Similar trend pattern as total # flowering plants |
| 10A, 30, 36 | Same trend pattern as total # flowering plants |

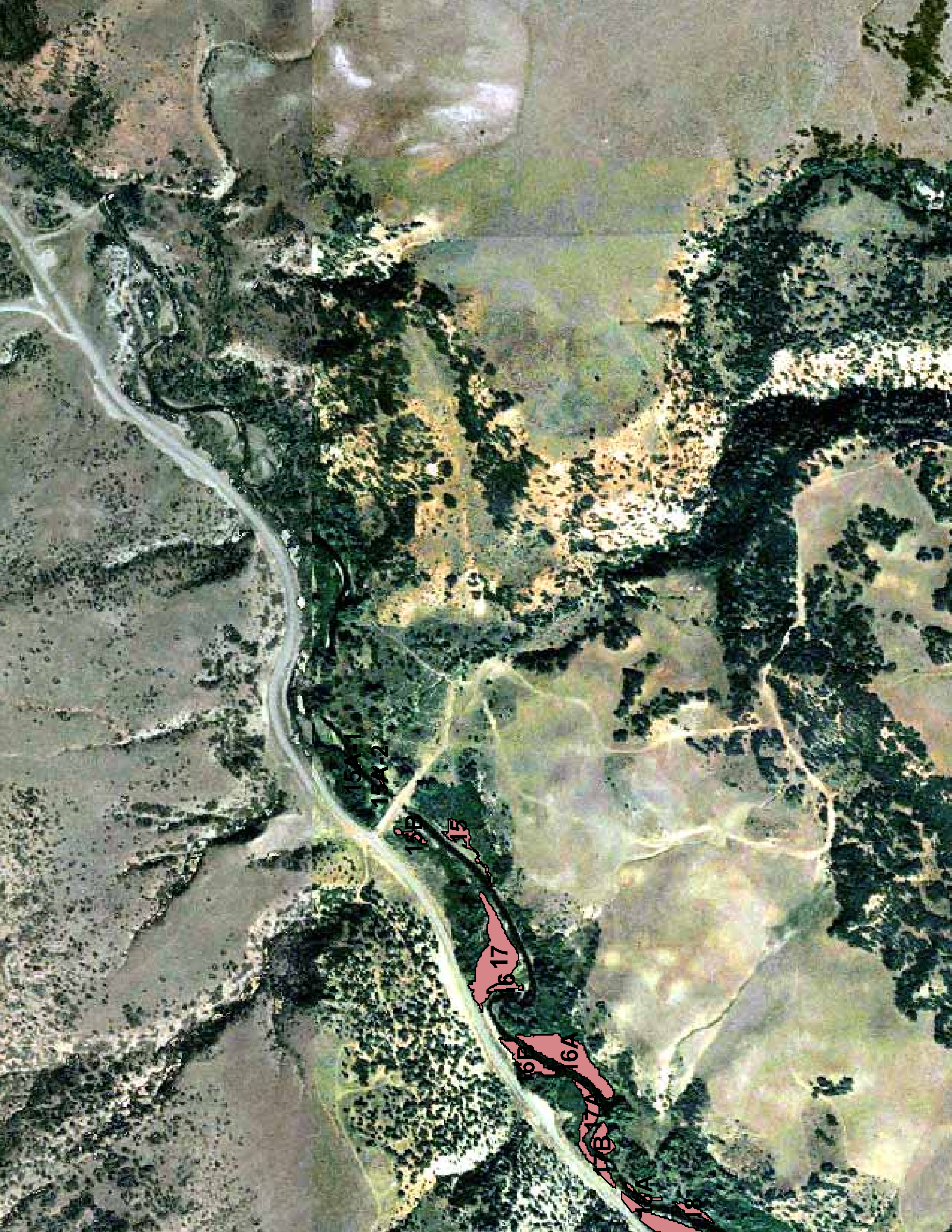
# Sites with Correlation >50% = 10
Of these, 3 had a median <1
Substituted for these sites the three sites with the greatest correlation that had the same or similar trend pattern as the total count.

# APPENDIX 3.2 UTE LADIES'-TRESSES SURFACE NUMBERS MAPS


33A
33
34A
34
35
35A
36
35B
36A
36B
37A



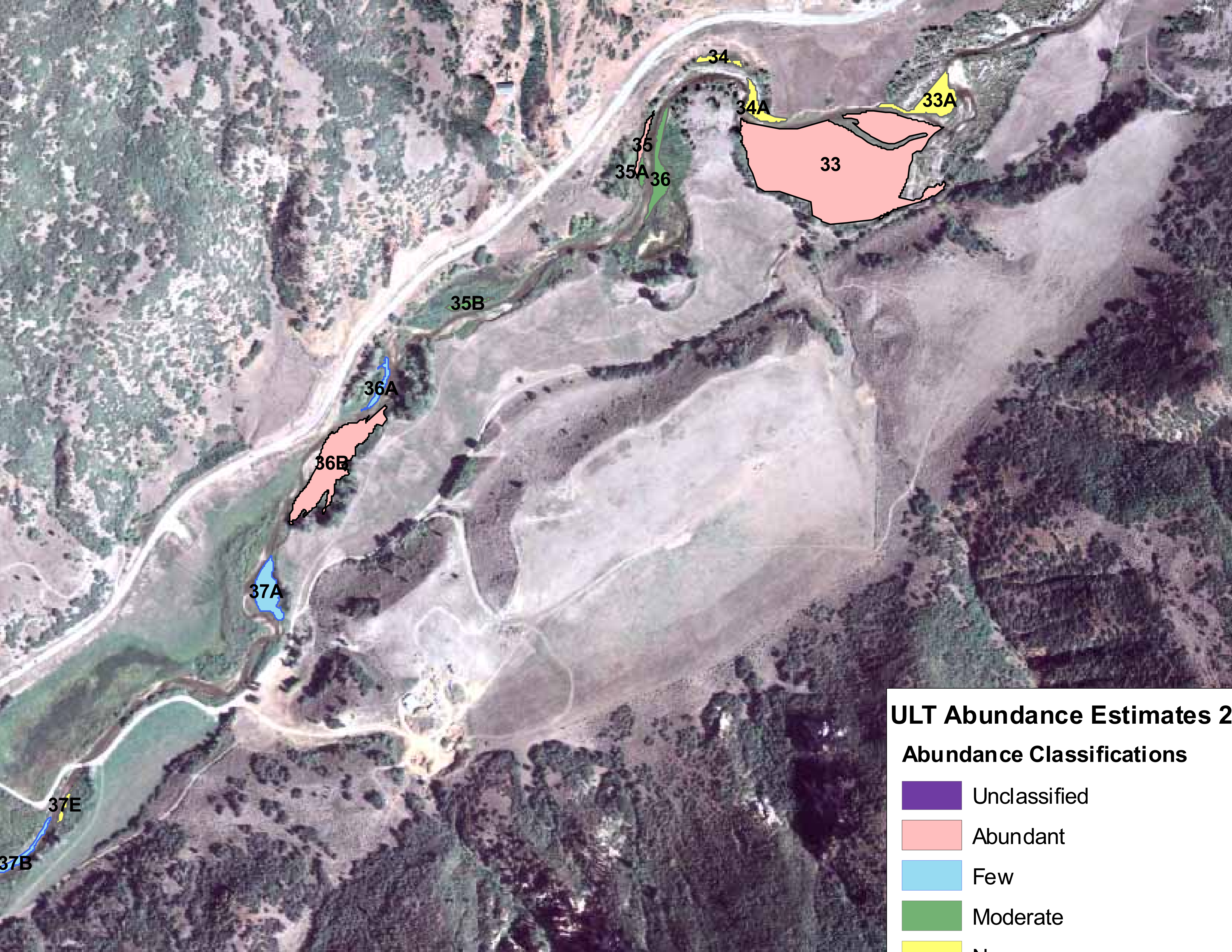
20D
20B
20C
21
21B
23
24
24A
24C
24B
25
26
27A
25B
28
30



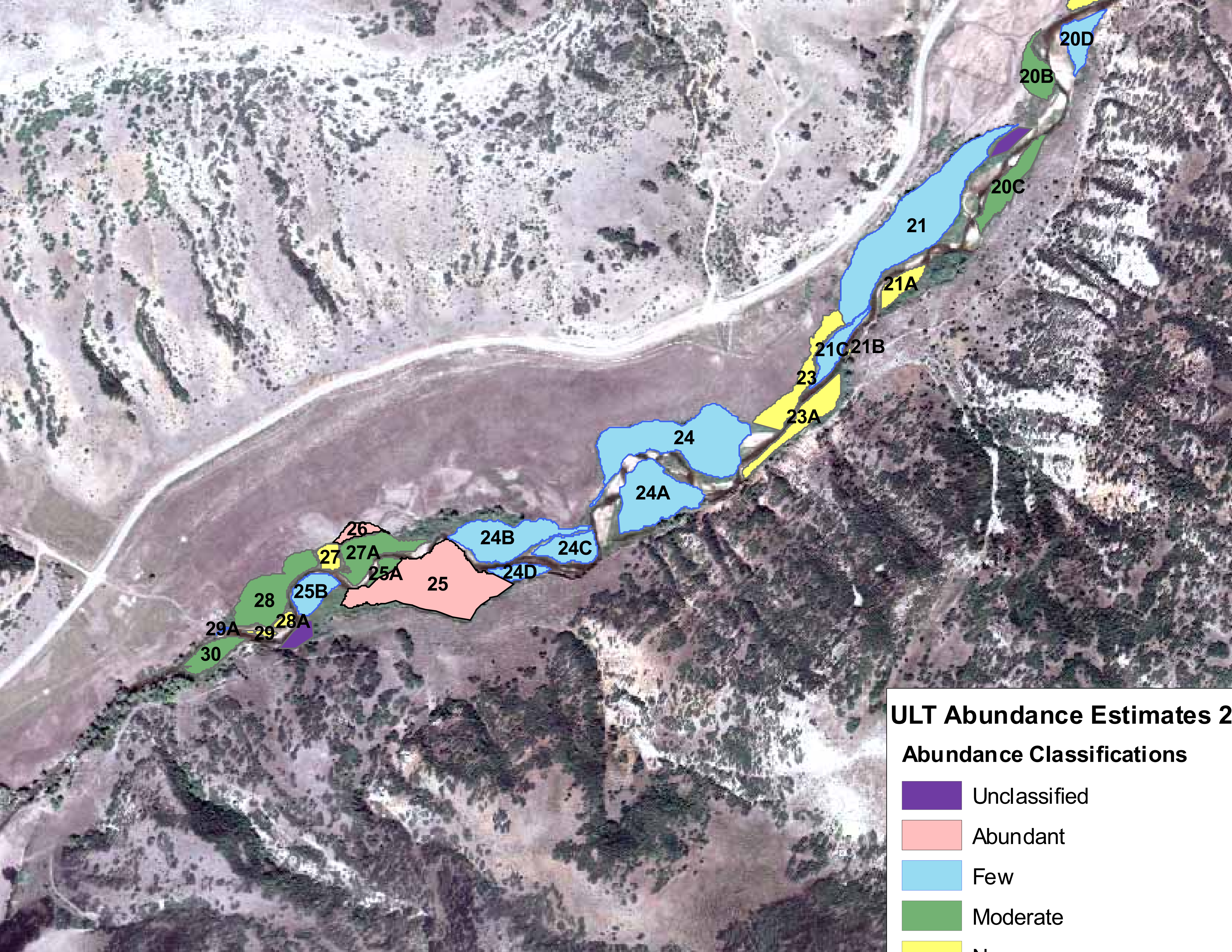
15A-1
15A-2
15B
15
17
16
16A
16B
17A
17B
18A
18


1B
1
2-1
2-2
2-3
1A

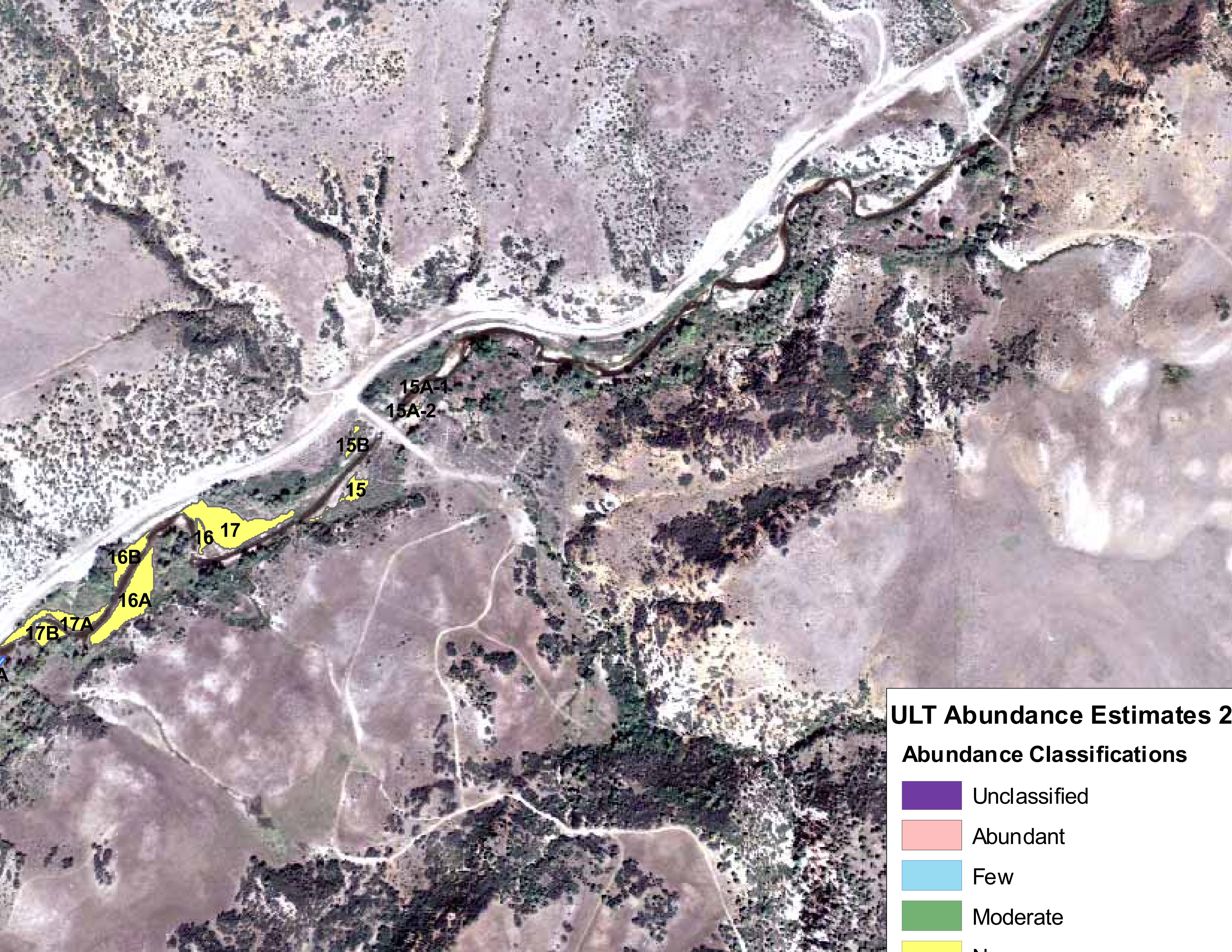
# APPENDIX 3.3 UTE LADIES'-TRESSES ABUNDANCE ESTIMATES



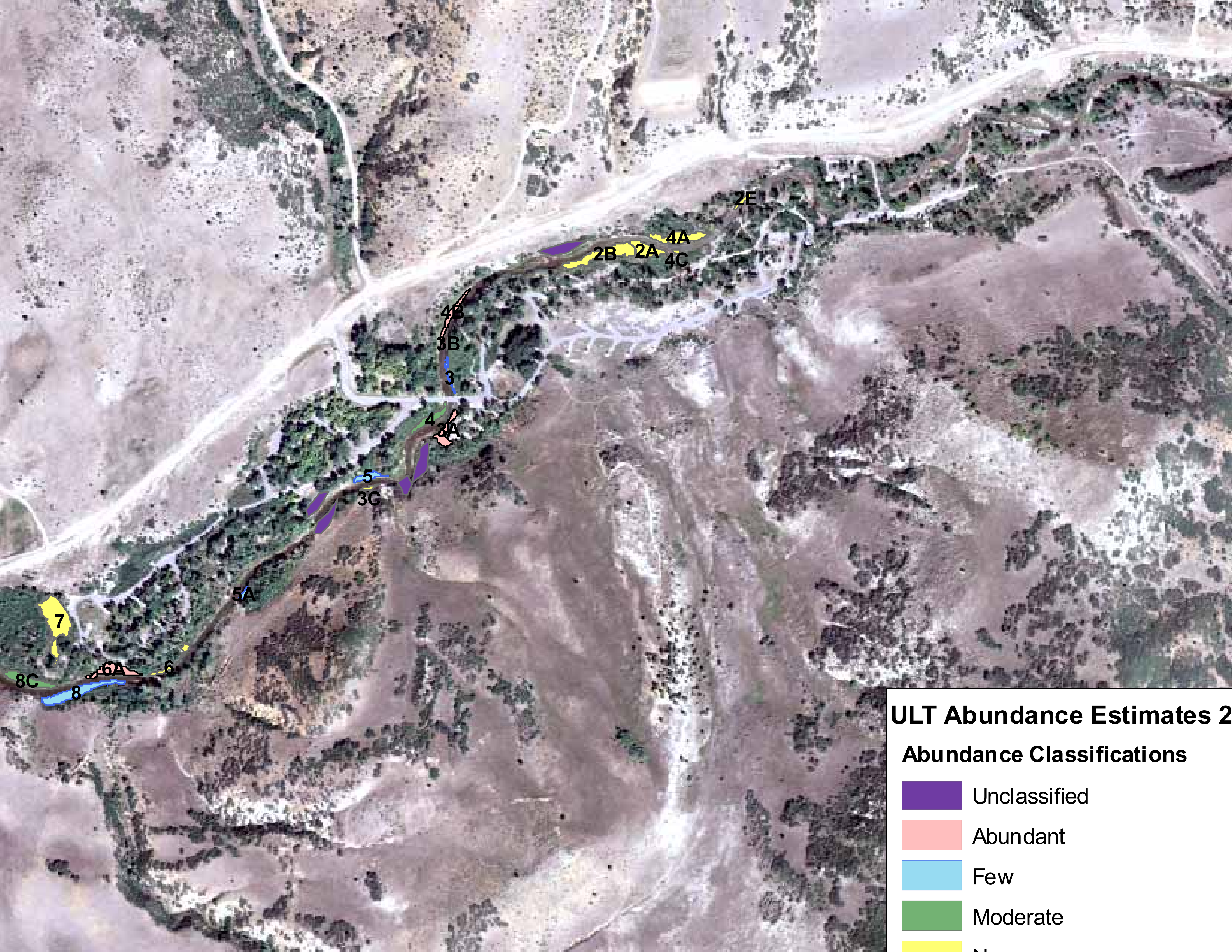
ULT Abundance Estimates 2
Abundance Classifications
Unclassified
Abundant
Few
Moderate
33
33A
34
34A
35
35A
36
35B
36A
36B
37A
37E
37B



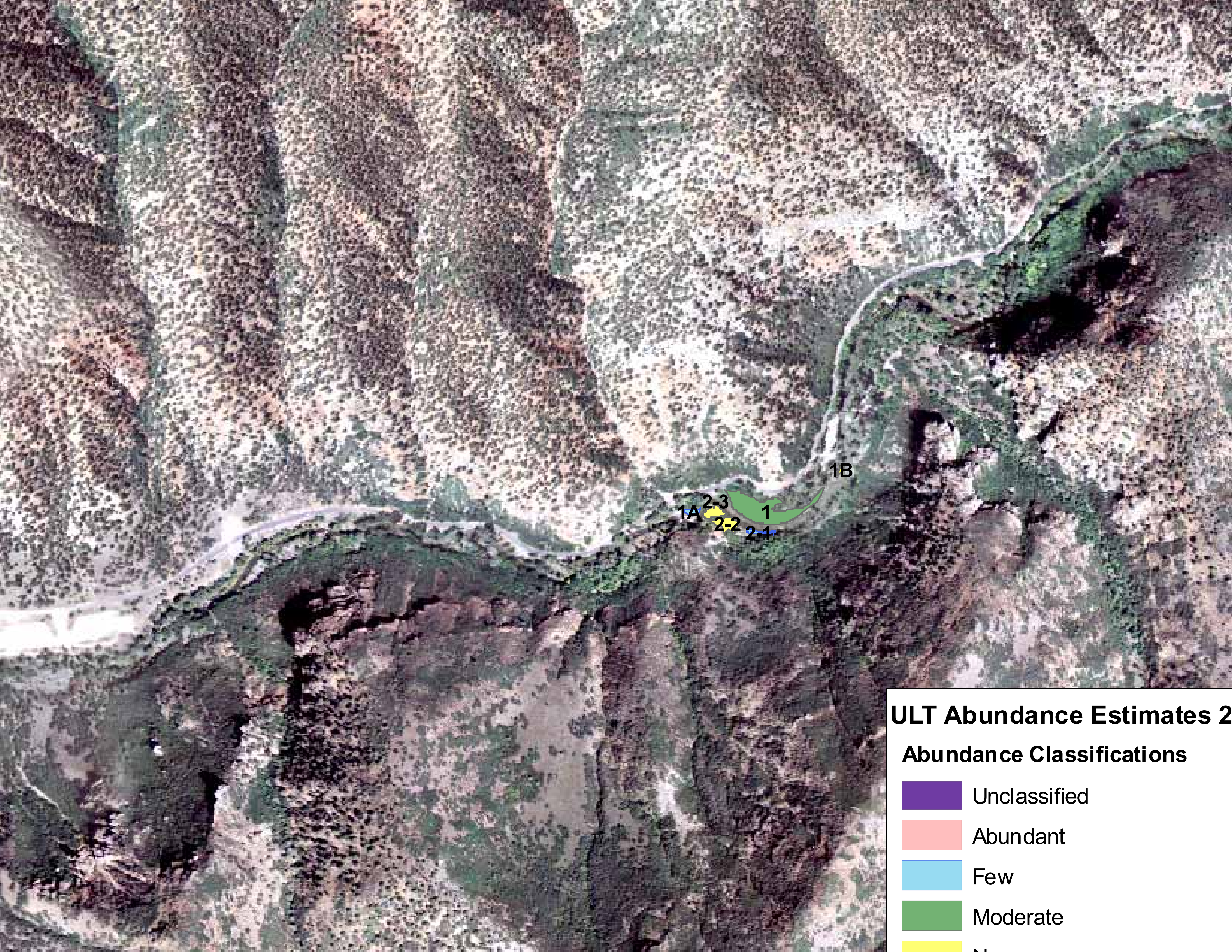
20D
20B
20C
21
21A
21C
21B
23
23A
24
24A
24B
24C
24D
25
25A
26
27
27A
25B
28
28A
29A
29
30
ULT Abundance Estimates 2
Abundance Classifications
Unclassified
Abundant
Few
Moderate



15A-1
15A-2
15B
15
17
16
16B
16A
17A
17B
ULT Abundance Estimates 2
Abundance Classifications
Unclassified
Abundant
Few
Moderate



2E
4A
2A
4C
2B
4B
3B
3
4
3A
5
3C
5A
7
6
6A
8C
8
ULT Abundance Estimates 2
Abundance Classifications
Unclassified
Abundant
Few
Moderate


1B
2-3
1A
1
2-2
2-1
ULT Abundance Estimates 2
Abundance Classifications
Unclassified
Abundant
Few
Moderate

# APPENDIX 3.4 TRANSECT LOCATION MAPS


t37-sp
t37-ep
Transect Location Map 2007
Transect
End Points

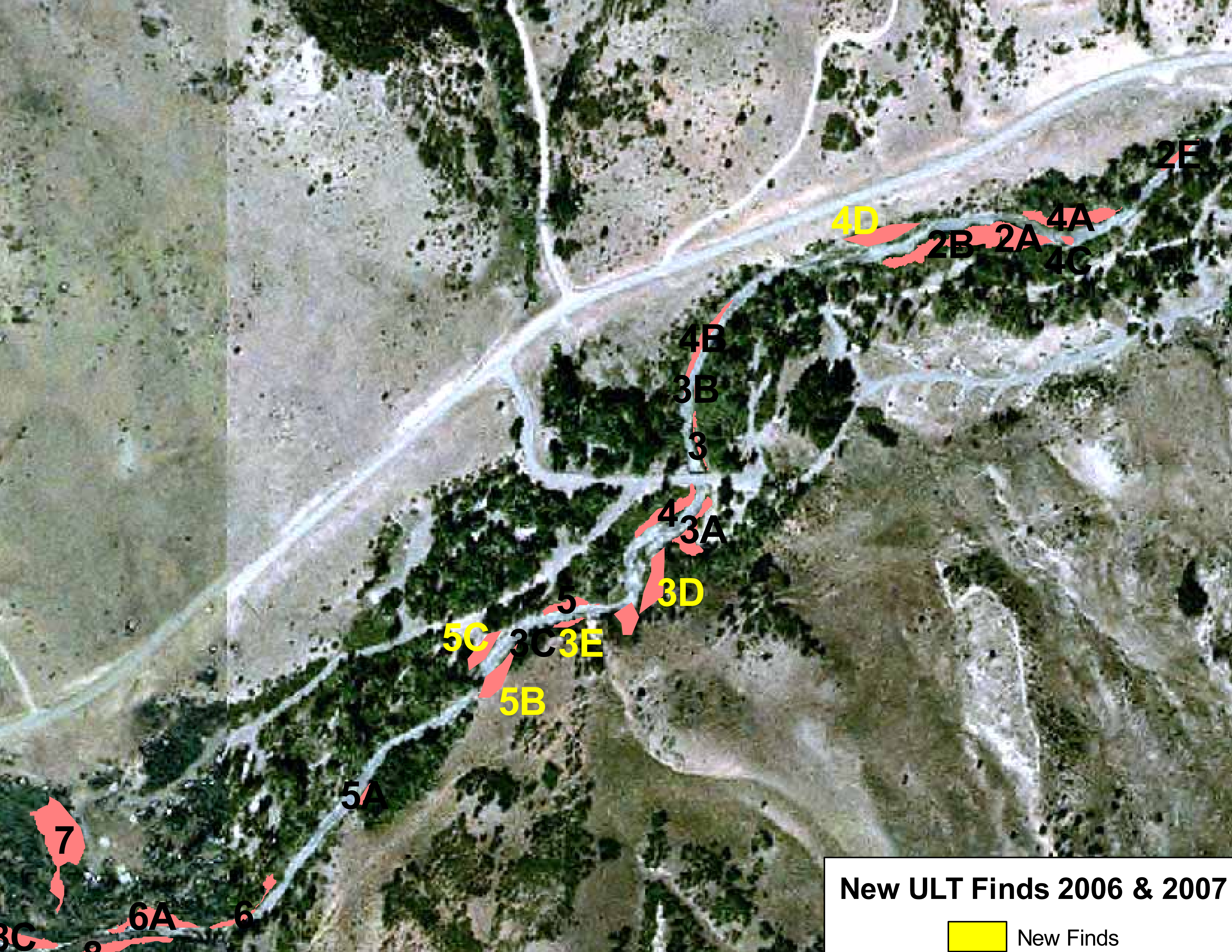

Transect Location Map 2007
Transect
End Points
t32-ep
t32-tp1
t32-sp
t31-ep
t30-ep
t31-tp5
t31-sp
t31-tp2
t31-tp1
t30-sp
t31-tp4
t30-tp1
t30-tp3
t30-tp2
t-34 sp
t-33 sp
t-36 sp
t-36 ep
t-35 ep

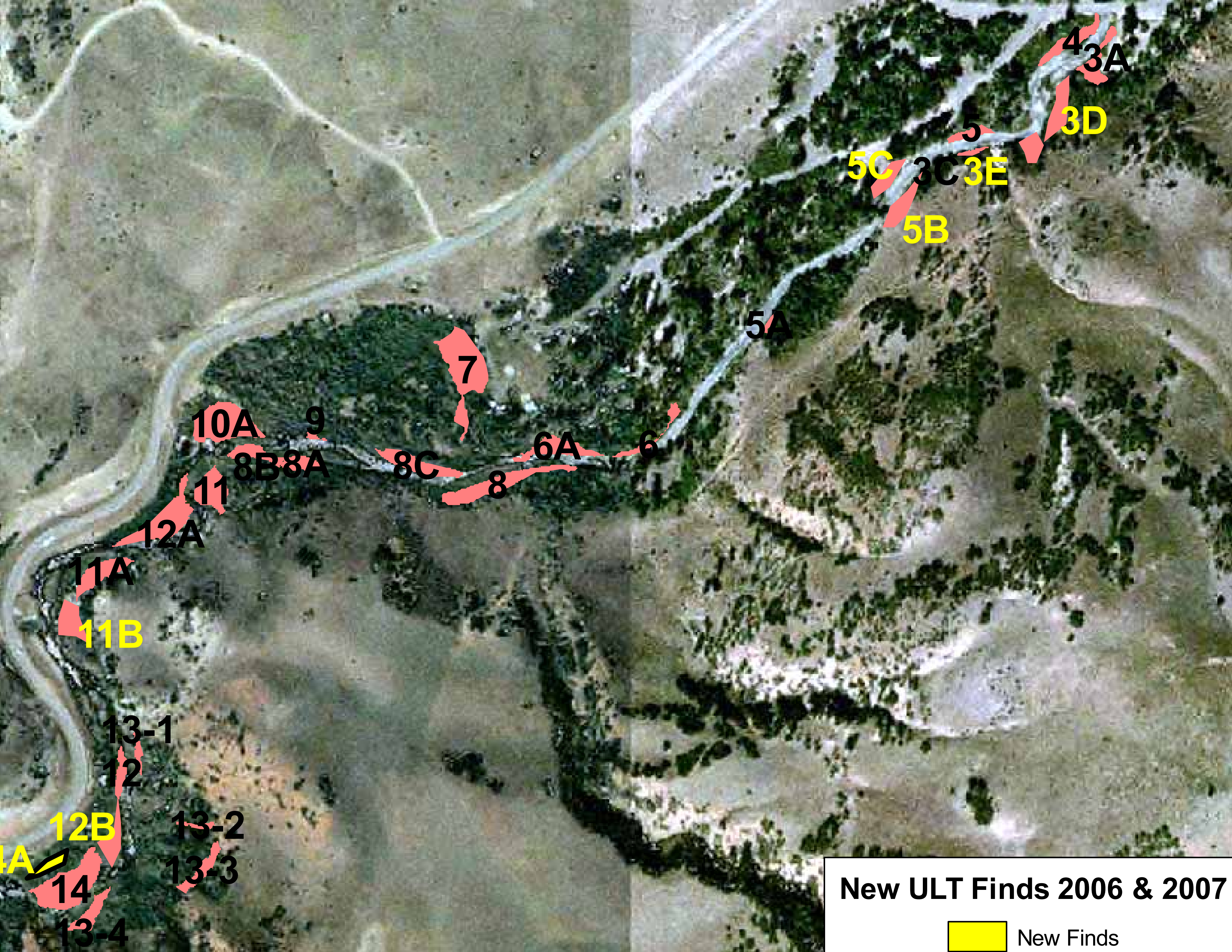

Transect Location Map 2007
Transect
End Points
t-16 ep
t-16 sp
t-17 sp
t-17 ep
t-18 ep
t-18 tp
t-18 ep
t-19 ep
t-19 sp
t-20 sp
t-20 tp1
t-20 ep
t-21 ep
t-22 sp
t-23 sp
t-23 ep
t-24 sp
t-24 tp1
t-24 ep
t-25 sp
t-25 ep
t-26 ep
t-26 sp
t-27 sp
t-27 tp
t-27 ep
t-28 sp
t-28 ep
t-29 sp
t-29 ep


Transect Location Map 2007
Transect
End Points
t-10 sp
t-10 ep
t-11 sp
t-13 sp
t-14 sp
t-14 ep
t-15 sp
t-15 ep
t-15 ep

Transect Location Map 2007
Transect
End Points
t-5 ep
t-4 ep
t-3 ep
t-3 sp
t-3 sp
t-2 ep
t-2 sp
t-2 sp
t-1 ep
t-1 sp

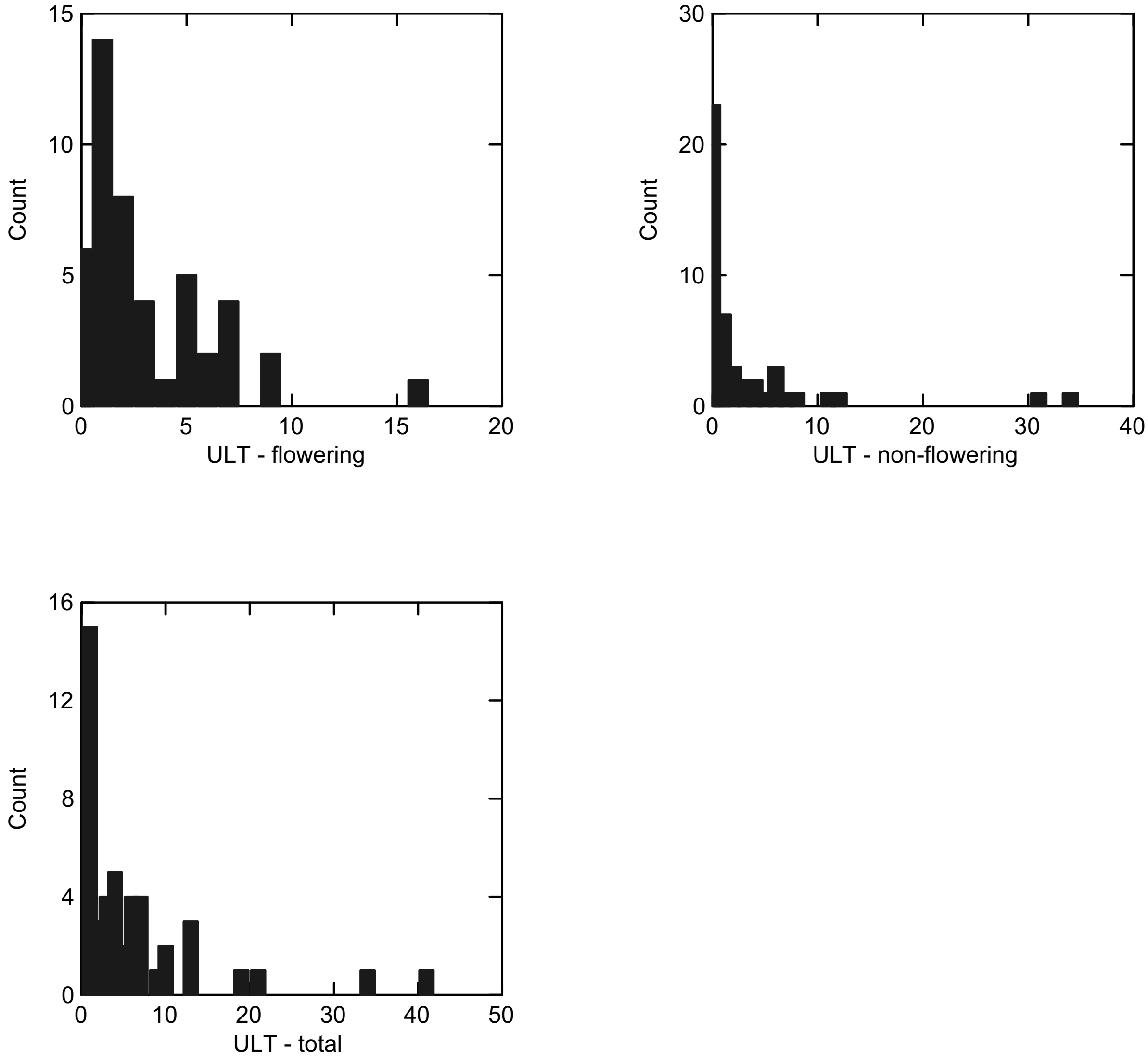
# APPENDIX 3.5 NEW UTE LADIES'-TRESSES COLONIES LOCATION MAPS


2E
4A
4D
2B
2A
4C
4B
3B
3
4
3A
3D
5
5C
3C
3E
5B
5A
7
6A
6
New ULT Finds 2006 & 2007
New Finds


4
3A
3D
5
5C
3C
3E
5B
5A
7
10A
9
6A
6
8B
8A
8C
8
11
12A
11A
11B
13-1
12
12B
13-2
4A
13-3
14
13-4
New ULT Finds 2006 & 2007
New Finds

# APPENDIX 3.6 HISTOGRAMS OF UTE LADIES'-TRESSES NUMBERS PER HOOP

# Histograms of ULT Numbers per Hoop




Histograms of ULT numbers per hoop - A normal distribution is not apparent.

# APPENDIX 3.7 UTE LADIES'-TRESSES COLONY SURFACE CHARACTERISTICS AND CONDITIONS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 68 | SAEX | *Salix exigua* | Narrowleaf willow | CIAR4 | *Cirsium arvense* | Canada thistle | Counts seem to be much than last years c |
| | SABO2 | *Salix boothii* | Booth's willow | VETH | *Verbascum thapsus* | Common mullien | |
| | JUARL | *Juncus arcticus* ssp. *littortalis* | Baltic rush | | | | |
| 128 | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| | EUOC4 | *Euthamia occidentalis* | Western golden-rod | | | | |
| 5 | SAEX | *Salix exigua* | Narrowleaf willow | | | | Site seems to be slightly dryer. |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | LIDAD | *Linaria genistifolia* | Dalmation toadflax | Site beginning to be colonized by Artemisi |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | CANU4 | *Carduus nutans* | Musk thistle | |
| | POAN3 | *Populus angustifolia* | Narroleaf cottonwood | | | | |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | CIVU | *Cirsium vulgare* | Bull thistle | Site Dry, lots of bare ground. |
| | SALU | *Salix lucida* | Shining willow | CANU4 | *Carduus nutans* | Musk thistle | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | TAOF | *Taraxacum officale* | Common dandelion | |
| | | | | MEOF | *Melilotus officianalis* | Yellow sweetclover | |
| 57 | SAEX | *Salix exigua* | Narrowleaf willow | VETH | *Verbascum thapsus* | Common mullien | Cow pies, trails and grazed within the last |
| | SABO2 | *Salix boothii* | Booth's willow | CIAR4 | *Cirsium arvense* | Canada thistle | |
| | SALU | *Salix lucida* | Shining willow | ELAN | *Elaeagnus angustifolia* | Russian olive | |
| 0 | ELPA3 | *Eleocharis palustris* | Creeping spikerush | | | | |
| | EUOC4 | *Euthamia occidentalis* | Western golden-rod | | | | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| 114 | SAEX | *Salix exigua* | Narrowleaf willow | | | | Site heavily grazed, very few ULT found c |
| | SALU | *Salix lucida* | Shining willow | | | | |
| | SABO2 | *Salix boothii* | Booth's willow | | | | |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | CIAR4 | *Cirsium arvense* | Canada thistle | Lots of Canada thistle and dense coyote w |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | | | | Unidentified vetch/astragalus |

| | Dominant Native Vegetation | | | Nonindigenous Plant Species | | | |
|---|---|---|---|---|---|---|---|
| ted | Code | Scientific Name | Common Name | Code | Scientific Name | Common Name | Unique Site Characteristic |
| 0 | EUOC4 | *Euthamia occidentalis* | Western golden-rod | CIAR4 | *Cirsium arvense* | Canada thistle | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| | SABO2 | *Salix boothii* | Booth's willow | | | | |
| 0 | SALU | *Salix lucida* | Shining willow | | | | Site drying |
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| | SOCA6 | *Solidago canadensis* | Canada golden-rod | | | | |
| | EQAR | *Equisetum arvense* | Field horsetail | | | | |
| 0 | SALU | *Salix lucida* | Shining willow | | | | |
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| 290 | SALU | *Salix lucida* | Shining willow | CIAR4 | *Cirsium arvense* | Canada thistle | |
| | SOCA6 | *Solidago canadensis* | Canada golden-rod | | | | |
| | EQAR | *Equisetum arvense* | Field horsetail | | | | |
| | JUAR | *Juncus articus* | Arctic rush | | | | |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| | SALU | *Salix lucida* | Shining willow | | | | |
| 1 | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| | SALU | *Salix lucida* | Shining willow | | | | |
| 10 | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | MEOF | *Melilotus officianalis* | Yellow sweetclover | Much of site dominated by yellow sweetcl |
| 100 | SAEX | *Salix exigua* | Narrowleaf willow | ELAN | *Elaeagnus angustifolia* | Russian olive | |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| | EQAR | *Equisetum arvense* | Field horsetail | | | | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| | SALU | *Salix lucida* | Shining willow | | | | |
| | SABO2 | *Salix boothii* | Booth's willow | | | | |
| 35 | SAEX | *Salix exigua* | Narrowleaf willow | ELAN | *Elaeagnus angustifolia* | Russian olive | Russian olive mature |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | SALU | *Salix lucida* | Shining willow | | | | |
| | EQAR | *Equisetum arvense* | Field horsetail | | | | |
| 0 | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| 1 | EQAR | *Equisetum arvense* | Field horsetail | ELAN | *Elaeagnus angustifolia* | Russian olive | Young Russian olive |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| | SOCA6 | *Solidago canadensis* | Canada golden-rod | | | | |
| 7 | EQAR | *Equisetum arvense* | Field horsetail | CIVU | *Cirsium vulgare* | Bull thistle | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| | SALU | *Salix lucida* | Shining willow | | | | |
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| 118 | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| | SALU | *Salix lucida* | Shining willow | | | | |
| | unknown vetch | | | | | | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| 76 | SAEX | *Salix exigua* | Narrowleaf willow | ELAN | *Elaeagnus angustifolia* | Russian olive | |
| 2 | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| | JUTO | *Juncus torreyi* | Torry's rush | | | | |
| | SALU | *Salix lucida* | Shining willow | | | | |
| | ELPA3 | *Eleocharis palustris* | Common spikerush | | | | |
| 25 | SABO2 | *Salix boothii* | Booth's willow | ELAN | *Elaeagnus angustifolia* | Russian olive | Mature willows beginning to dominate the |
| | SALU | *Salix lucida* | Shining willow | GAOF | *Galega officinalis* | Professor-weed | |
| 3 | SABO2 | *Salix boothii* | Booth's willow | | | | |
| | CAMIM6 | *Castilleja minor ssp. Minor* | Lesser Indian paintbrush | | | | |
| 0 | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | Site dry, few willows |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| 5 | SALU | *Salix lucida* | Shining willow | CIAR4 | *Cirsium arvense* | Canada thistle | |
| | SABO2 | *Salix boothii* | Booth's willow | | | | |
| 135 | EUOC4 | *Euthamia occidentalis* | Western golden-rod | CIVU | *Cirsium vulgare* | Bull thistle | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | MEOF | *Melilotus officianalis* | Yellow sweetclover | |
| 8 | AGGI2 | *Agrostis gigantea* | Black bentgrass | CIVU | *Cirsium vulgare* | Bull thistle | |
| | ELPA3 | *Eleocharis palustris* | Common spikerush | | | | |
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| 0 | SALU | *Salix lucida* | Shining willow | MEOF | *Melilotus officianalis* | Yellow sweetclover | |
| | ELPA3 | *Eleocharis palustris* | Common spikerush | | | | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| 55 | EQAR | *Equisetum arvense* | Field horsetail | | | | |
| | SABO2 | *Salix boothii* | Booth's willow | | | | |
| | SALU | *Salix lucida* | Shining willow | | | | |
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| 362 | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| | SABO2 | *Salix boothii* | Booth's willow | | | | |
| 0 | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | Site appears to be drying |
| | EUOC4 | *Euthamia occidentalis* | Western golden-rod | | | | |
| 0 | EUOC4 | *Euthamia occidentalis* | Western golden-rod | CANU4 | *Carduus nutans* | Nodding plumeless thistle | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | CIVU | *Cirsium vulgare* | Bull thistle | |
| | | | | VETH | *Verbascum thapsus* | Common Mullein | |
| 122 | EUOC4 | *Euthamia occidentalis* | Western golden-rod | MEOF | *Melilotus officianalis* | Yellow sweetclover | |
| | SOCA6 | *Solidago canadensis* | Canada golden-rod | CIVU | *Cirsium vulgare* | Bull thistle | |
| | | | | CIAR4 | *Cirsium arvense* | Canada thistle | |
| 0 | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | MEOF | *Melilotus officianalis* | Yellow sweetclover | Surface dynamics changed, split into 3 se |
| | SAEX | *Salix exigua* | Shining willow | | | | |
| 2 | ELPA3 | *Eleocharis palustris* | Common spikerush | | | | |
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| | EUOC4 | *Euthamia occidentalis* | Western golden-rod | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | EUOC4 | *Euthamia occidentalis* | Western golden-rod | | | | |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| 55 | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| 485 | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| | CAMIM6 | *Castilleja minor* ssp. *Minor* | Lesser Indian paintbrush | | | | |
| 1 | EUOC4 | *Euthamia occidentalis* | Western golden-rod | MEOF | *Melilotus officianalis* | Yellow sweetclover | |
| | ELPA3 | *Eleocharis palustris* | Common spikerush | CIVU | *Cirsium vulgare* | Bull thistle | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | pollinators observed |
| | SALU | *Salix lucida* | Shining willow | | | | |
| | EUOC4 | *Euthamia occidentalis* | Western golden-rod | | | | |
| 73 | EUOC4 | *Euthamia occidentalis* | Western golden-rod | | | | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| 7 | EUOC4 | *Euthamia occidentalis* | Western golden-rod | | | | |
| | SABO2 | *Salix boothii* | Booth's willow | | | | |
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| 2 | SAEX | *Salix exigua* | Narrowleaf willow | | | | Carex species drying and bare ground pre |
| | SABO2 | *Salix boothii* | Booth's willow | | | | |
| | SALU | *Salix lucida* | Shining willow | | | | |
| 1 | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | CIAR4 | *Cirsium arvense* | Canada thistle | |
| | SAEX | *Salix exigua* | Narrowleaf willow | MEOF | *Melilotus officianalis* | Yellow sweetclover | |
| | EUOC4 | *Euthamia occidentalis* | Western golden-rod | VETH | *Verbascum thapsus* | Common Mullein | |
| | JUAR | *Juncus articus* | Arctic rush | CANU4 | *Carduus nutans* | Nodding plumeless thistle | |
| 2 | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | minimal habitat, mature willows |
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| 0 | EUOC4 | *Euthamia occidentalis* | Western golden-rod | VETH | *Verbascum thapsus* | Common Mullein | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| | POMO3 | *Polypogon monspeliensis* | Annual rabbitsfoot grass | | | | |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | CIAR4 | *Cirsium arvense* | Canada thistle | Lots of Canada thistle present |
| | JUAR | *Juncus articus* | Arctic rush | | | | |
| | SALU | *Salix lucida* | Shining willow | | | | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| 1 | SAEX | *Salix exigua* | Narrowleaf willow | CIAR4 | *Cirsium arvense* | Canada thistle | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| | JUAR | *Juncus articus* | Arctic rush | | | | |
| 2 | SAEX | *Salix exigua* | Narrowleaf willow | CIAR4 | *Cirsium arvense* | Canada thistle | Lots of Canada thistle present |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| 25 | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | MEOF | *Melilotus officianalis* | Yellow sweetclover | Site dominated by bare ground and dry |
| | GUSA2 | *Gutierrezia sarothrae* | Broom snakeweed | CANU4 | *Carduus nutans* | Nodding plumeless thistle | |
| | GRSQ | *Grindelia squarrosa* | Curlycup gumweed | | | | |
| 21 | SALU | *Salix lucida* | Shining willow | CIAR4 | *Cirsium arvense* | Canada thistle | |
| | SAEX | *Salix exigua* | Narrowleaf willow | CIVU | *Cirsium vulgare* | Bull thistle | |
| | EUOC4 | *Euthamia occidentalis* | Western golden-rod | | | | |
| | CAMIM6 | *Castilleja minor ssp. Minor* | Lesser Indian paintbrush | | | | |
| | EQAR | *Equisetum arvense* | Field horsetail | | | | |
| 12 | SAEX | *Salix exigua* | Narrowleaf willow | CIAR4 | *Cirsium arvense* | Canada thistle | |
| | SALU | *Salix lucida* | Shining willow | | | | |
| | SABO2 | *Salix boothii* | Booth's willow | | | | |
| 0 | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | CIAR4 | *Cirsium arvense* | Canada thistle | Dominated by PHAR3, rattlesnake by cre |
| | SAEX | *Salix exigua* | Narrowleaf willow | CYOF | *Cynoglossum officinale* | Gypsyflower | |
| | | | | CIVU | *Cirsium vulgare* | Bull thistle | |
| | | | | VETH | *Verbascum thapsus* | Common Mullein | |
| | | | | CANU4 | *Carduus nutans* | Nodding plumeless thistle | |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | CIAR4 | *Cirsium arvense* | Canada thistle | Site dry, |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| 3 | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| 0 | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | VETH | *Verbascum thapsus* | Common Mullein | |
| | SABO2 | *Salix boothii* | Booth's willow | MEOF | *Melilotus officianalis* | Yellow sweetclover | |
| | EUOC4 | *Euthamia occidentalis* | Western golden-rod | | | | |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | TARA | *Tamarix ramosissima* | Saltcedar | Upland plant species moving in |
| | SABO2 | *Salix boothii* | Booth's willow | | | | |
| 0 | JUAR | *Juncus articus* | Arctic rush | CIAR4 | *Cirsium arvense* | Canada thistle | |
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| 0 | JUAR | *Juncus articus* | Arctic rush | POBU | *Poa bulbosa* | Bulbous bluegrass | Site dry |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | | | | Dry |
| | ARTR2 | *Artemisia tridentata* | Big sagebrush | | | | |
| 0 | JUAR | *Juncus articus* | Arctic rush | | | | Dry |
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | CANU4 | *Carduus nutans* | Nodding plumeless t | bareground due to erosion, moist soil |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| 0 | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| 55 | SALU | *Salix lucida* | Shining willow | CIAR4 | *Cirsium arvense* | Canada thistle | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| 55 | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| | JUAR | *Juncus articus* | Arctic rush | | | | |
| | EUOC4 | *Euthamia occidentalis* | Western golden-rod | | | | |
| | SALU | *Salix lucida* | Shining willow | | | | |
| 0 | SALU | *Salix lucida* | Shining willow | | | | Dry |
| | POAN3 | *Populus angustifolia* | Narrowleaf cottonwood | | | | |
| 27 | SALU | *Salix lucida* | Shining willow | | | | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| 0 | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | Site has been washed out, gravel and sar |
| | EUOC4 | *Euthamia occidentalis* | Western golden-rod | | | | |
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| 0 | SABO2 | *Salix boothii* | Booth's willow | | | | Dry |
| | POAN2 | *Populus angustifolia* | Narrowleaf cottonwood | | | | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| | BRIN2 | *Bromus inermis* | Smooth brome | | | | |
| 35 | SALU | *Salix lucida* | Shining willow | MEOF | *Melilotus officianalis* | Yellow sweetclover | Grazed |
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| | EUOC4 | *Euthamia occidentalis* | Western golden-rod | | | | |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | | | | Grazed |
| | SALU | *Salix lucida* | Shining willow | | | | |
| | BRIN2 | *Bromus inermis* | Smooth brome | | | | |
| 30 | SAEX | *Salix exigua* | Narrowleaf willow | | | | next to 14 by adjacent to road |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| | SALU | *Salix lucida* | shining willow | | | | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| | BRIN2 | *Bromus inermis* | Smooth brome | | | | |
| | POAN3 | *Populus angustifolia* | Narrowleaf cottonwood | | | | |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | | | | Possibly washed out |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | | | | Willows mature, ULT habitat reduced |
| | EUOC4 | *Euthamia occidentalis* | Western golden-rod | | | | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | POAN3 | *Populus angustifolia* | Narrowleaf cottonwood | | | | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| | BRIN2 | *Bromus inermis* | Smooth brome | | | | |
| | EQAR | *Equisetum arvense* | Field horsetail | | | | |
| 0 | SCPR4 | *Schedonorus pratensis* | Meadow fescue | | | | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| | BRIN2 | *Bromus inermis* | Smooth brome | | | | |
| | SAEX | *Salix exigua* | Narrowleaf willow | | | | |
| 38 | SAEX | *Salix exigua* | Narrowleaf willow | MEOF | *Melilotus officianalis* | Yellow sweetclover | |
| | POAN3 | *Populus angustifolia* | Narrowleaf cottonwood | | | | |
| | SCPR4 | *Schedonorus pratensis* | Meadow fescue | | | | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| | SCPR4 | *Schedonorus pratensis* | Meadow fescue | MEOF | *Melilotus officianalis* | Yellow sweetclover | |
| | POAN3 | *Populus angustifolia* | Narrowleaf cottonwood | | | | |
| | AGGI2 | *Agrostis gigantea* | Black bentgrass | | | | |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | | | | Grazed. |
| | POAN3 | *Populus angustifolia* | Narrowleaf cottonwood | | | | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |
| 0 | SAEX | *Salix exigua* | Narrowleaf willow | | | | Grazed |
| | POAN3 | *Populus angustifolia* | Narrowleaf cottonwood | | | | |
| | PHAR3 | *Phalaris arundinacea* | Reed canarygrass | | | | |

# APPENDIX 4.1 QUADRAT DATA

# Quadrat Data

## Colony 10A Transect 4 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| CIVU | 5 |
| MEOF | 65 |
| SOCA6 | 10 |

## Colony 10A Transect 4 Quadrat: 2

**Vegetal Cover:** 90 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 5 **Litter Areal Cover:** 5

| species | cover |
|---|---|
| CIVU | 30 |
| MEOF | 35 |
| SALU | 25 |

## Colony 10A Transect 4 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| MEOF | 100 |

## Colony 10A Transect 4 Quadrat: 4

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 30 |
| EQAR | 5 |
| JUARL | 25 |
| MEOF | 35 |
| SAEX | 5 |

## Colony 10A Transect 4 Quadrat: 5

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| JUARL | 10 |
| MEOF | 95 |
| SALU | 5 |

## Colony 10A Transect 4 Quadrat: 6

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| EQAR | 5 |
| SABO2 | 80 |

## Colony 10A Transect 4 Quadrat: 7

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| EQAR | 25 |
| JUARL | 40 |
| MEOF | 5 |
| SABO2 | 5 |
| SAEX | 30 |

## Colony 10A Transect 4 Quadrat: 8

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| EQAR | 25 |
| JUARL | 10 |
| SAEX | 10 |
| SOAR2 | 50 |

## Colony 10A Transect 5 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| CIVU | 5 |
| MELU | 25 |
| MEOF | 25 |
| SALU | 30 |
| TRRE3 | 5 |

## Colony 10A Transect 5 Quadrat: 2

**Vegetal Cover:** 70 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 15 **Litter Areal Cover:** 15

| species | cover |
|---|---|
| AGGI2 | 20 |
| EQAR | 35 |
| MEOF | 5 |
| SOAR2 | 10 |

## Colony 10A Transect 5 Quadrat: 3

**Vegetal Cover:** 85 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 15 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| EQAR | 30 |
| SALU | 25 |
| SOAR2 | 10 |
| SOCA6 | 5 |

## Colony 10A Transect 5 Quadrat: 4

**Vegetal Cover:** 75 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 5 **Litter Areal Cover:** 20

| species | cover |
|---|---|
| AGGI2 | 15 |
| EQAR | 10 |
| MEOF | 30 |
| PRVU | 5 |
| SAEX | 15 |

## Colony 10A Transect 5 Quadrat: 5

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| EQAR | 10 |
| FORB | 10 |
| MEOF | 65 |
| PRVU | 5 |
| SALU | 20 |

## Colony 10A Transect 5 Quadrat: 6

**Vegetal Cover:** 65 **Rock Areal Cover:** 35 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| EQAR | 15 |
| JUEN | 5 |
| SAEX | 10 |
| SOAR2 | 10 |

## Colony 10A Transect 5 Quadrat: 7

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EQAR | 5 |
| JUARL | 95 |
| MEOF | 5 |
| SAEX | 10 |

## Colony 10A Transect 5 Quadrat: 8

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| GEMA4 | 5 |
| JUARL | 70 |
| SABO2 | 30 |

## Colony 10A Transect 5 Quadrat: 9

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| JUARL | 75 |
| SABO2 | 10 |
| SAEX | 5 |

## Colony 10A Transect 6 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| SAEX | 15 |
| SCPR4 | 75 |

## Colony 10A Transect 6 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| SAEX | 20 |
| SCPR4 | 60 |

## Colony 10A Transect 6 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 60 |
| PHAR3 | 10 |
| SAEX | 15 |
| SCPR4 | 15 |

## Colony 10A Transect 6 Quadrat: 4

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| MEOF | 10 |
| PHAR3 | 10 |
| SAEX | 65 |

## Colony 10A Transect 6 Quadrat: 5

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| CIVU | 5 |
| EUOC4 | 10 |
| PHAR3 | 60 |
| SOAR2 | 5 |

## Colony 10A Transect 6 Quadrat: 6

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| PHAR3 | 90 |
| SAEX | 10 |

## Colony 10A Transect 6 Quadrat: 7

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| PHAR3 | 20 |
| SAEX | 95 |

## Colony 11 Transect 7 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ACMI2 | 10 |
| AGGI2 | 15 |
| EUOC4 | 10 |
| MEOF | 20 |
| SAEX | 5 |
| SALU | 50 |

## Colony 11 Transect 7 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| CIDO | 5 |
| ELPA3 | 5 |
| JUARL | 5 |
| MEOF | 5 |
| SABO2 | 5 |
| SALU | 10 |
| SCPR4 | 50 |

## Colony 11 Transect 7 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ACMI2 | 15 |
| ELPA3 | 55 |
| JUARL | 5 |
| PHAR3 | 10 |
| SOAR2 | 5 |

## Colony 11 Transect 7 Quadrat: 4

**Vegetal Cover:** 80 **Rock Areal Cover:** 10 **Bare Ground Areal Cover:** 10 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| ELPA3 | 15 |
| JUEN | 10 |
| RACY | 15 |
| SALU | 15 |
| SCPR4 | 15 |

## Colony 11 Transect 7 Quadrat: 5

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| JUARL | 95 |

## Colony 11 Transect 8 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 75 |
| JUTO | 5 |
| PHAR3 | 15 |
| SALU | 10 |

**Colony 11 Transect 8 Quadrat: 2**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 85 |
| EUOC4 | 10 |
| PHAR3 | 5 |
| SABO2 | 5 |

**Colony 11 Transect 8 Quadrat: 3**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 50 |
| JUEN | 10 |
| JUTO | 10 |
| PHAR3 | 20 |
| SABO2 | 10 |
| SAEX | 15 |

**Colony 11 Transect 8 Quadrat: 4**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIAR4 | 5 |
| ELPA3 | 65 |
| JUEN | 15 |
| PHAR3 | 15 |

**Colony 11 Transect 8 Quadrat: 5**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 35 |
| EUOC4 | 10 |
| PHAR3 | 20 |

**Colony 11 Transect 9 Quadrat: 1**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 65 |
| PHAR3 | 30 |
| SAEX | 10 |

**Colony 11 Transect 9 Quadrat: 2**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 25 |
| MEOF | 10 |
| PHAR3 | 40 |
| SABO2 | 25 |

**Colony 11 Transect 9 Quadrat: 3**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIDO | 20 |
| ELPA3 | 35 |
| JUEN | 10 |
| PHAR3 | 35 |

**Colony 11 Transect 9 Quadrat: 4**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| COCA5 | 5 |
| ELPA3 | 50 |
| PHAR3 | 30 |
| SABO2 | 15 |

## Colony 11 Transect 9 Quadrat: 5

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 35 |
| MEOF | 10 |
| PHAR3 | 45 |
| SABO2 | 10 |

## Colony 11A Transect 10 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| CIDO | 20 |
| EQAR | 10 |
| PHAR3 | 65 |

## Colony 11A Transect 10 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| PHAR3 | 100 |

## Colony 11A Transect 10 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EUOC4 | 10 |
| SALU | 90 |

## Colony 11A Transect 10 Quadrat: 4

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| CIDO | 10 |
| PHAR3 | 55 |
| TRPR2 | 15 |

## Colony 11A Transect 10 Quadrat: 5

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CANE2 | 15 |
| EUOC4 | 20 |
| PHAR3 | 65 |
| SAEX | 10 |

## Colony 11A Transect 10 Quadrat: 6

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| CIDO | 15 |
| PHAR3 | 55 |
| SAEX | 20 |

## Colony 11A Transect 11 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| ELPA3 | 90 |
| EUOC4 | 10 |

## Colony 11A Transect 11 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| ELPA3 | 45 |
| JUEN | 40 |
| SABO2 | 5 |
| SALU | 15 |

## Colony 11A Transect 11 Quadrat: 3
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIDO | 35 |
| ELPA3 | 65 |
| EQAR | 20 |

## Colony 11A Transect 11 Quadrat: 4
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 35 |
| ELPA3 | 40 |
| EQAR | 35 |
| SAEX | 20 |

## Colony 11A Transect 11 Quadrat: 5
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| JUARL | 10 |
| JUEN | 40 |
| MEOF | 5 |
| PHAR3 | 30 |
| SALU | 35 |

## Colony 13-4 Transect 15 Quadrat: 1
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| EUOC4 | 5 |
| PHAR3 | 75 |
| SAEX | 5 |
| SYEA2 | 5 |

## Colony 13-4 Transect 15 Quadrat: 2
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| EUOC4 | 5 |
| PHAR3 | 20 |
| SAEX | 65 |

## Colony 13-4 Transect 15 Quadrat: 3
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| EUOC4 | 25 |
| PHAR3 | 5 |
| SAEX | 15 |
| SCPR4 | 45 |

## Colony 13-4 Transect 15 Quadrat: 4
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| EUOC4 | 20 |
| MEOF | 5 |
| SAEX | 20 |
| SCPR4 | 50 |

## Colony 13-4 Transect 15 Quadrat: 5
**Vegetal Cover:** 85 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 15 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIDO | 5 |
| EUOC4 | 40 |
| PHAR3 | 10 |
| SOCA6 | 30 |

## Colony 13-4 Transect 15 Quadrat: 6

**Vegetal Cover:** 85 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 15 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| SAEX | 15 |
| SCPR4 | 45 |
| SYEA2 | 15 |

## Colony 24B Transect 16 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| EUOC4 | 10 |
| PHAR3 | 70 |

## Colony 24B Transect 16 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| EUOC4 | 20 |
| PHAR3 | 10 |
| SCPR4 | 70 |

## Colony 24B Transect 16 Quadrat: 3

**Vegetal Cover:** 95 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 5 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| EUOC4 | 35 |
| SALU | 25 |
| SCPR4 | 10 |

## Colony 24B Transect 16 Quadrat: 4

**Vegetal Cover:** 90 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 10 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| EUOC4 | 15 |
| JUEN | 10 |
| PHAR3 | 45 |

## Colony 25 Transect 17 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| EUOC4 | 5 |
| PHAR3 | 10 |
| SABO2 | 20 |
| SALU | 15 |
| SCPR4 | 40 |

## Colony 25 Transect 17 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 55 |
| EUOC4 | 5 |
| EUOC4 | 20 |
| PHAR3 | 5 |
| SCPR4 | 20 |

## Colony 25 Transect 17 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| JUCO2 | 5 |
| JUEN | 15 |
| MEOF | 5 |
| PHAR3 | 10 |
| SALU | 55 |
| SYEA2 | 10 |

**Colony 25 Transect 17 Quadrat: 4**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| CIDO | 15 |
| JUCO2 | 10 |
| PHAR3 | 25 |
| SAEX | 10 |
| SCPR4 | 35 |

**Colony 25 Transect 17 Quadrat: 5**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| CIAR4 | 4 |
| EUOC4 | 10 |
| PHAR3 | 80 |
| SOAR2 | 15 |

**Colony 25 Transect 17 Quadrat: 6**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| CIDO | 10 |
| MEOF | 5 |
| SABO2 | 60 |
| SAEX | 10 |
| SOCA6 | 15 |

**Colony 25 Transect 17 Quadrat: 7**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| CIAR4 | 5 |
| CIDO | 40 |
| EQAR | 10 |
| PHAR3 | 10 |
| SCPR4 | 20 |

**Colony 25 Transect 17 Quadrat: 8**

**Vegetal Cover:** 80 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 20 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIDO | 15 |
| RACY | 15 |
| SABO2 | 15 |
| SAEX | 25 |

**Colony 25 Transect 17 Quadrat: 9**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| EUOC4 | 5 |
| SAEX | 5 |
| SCPR4 | 70 |

**Colony 25 Transect 18 Quadrat: 1**

**Vegetal Cover:** 80 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 15 **Litter Areal Cover:** 5

| species | cover |
|---|---|
| AGGI2 | 25 |
| EQAR | 10 |
| SABO2 | 5 |
| SAEX | 5 |
| SOCA6 | 35 |

**Colony 25 Transect 18 Quadrat: 10**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 35 |
| EQAR | 10 |
| SALU | 45 |
| TRPR2 | 10 |

**Colony 25 Transect 18 Quadrat: 11**

**Vegetal Cover:** 90 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 10

| species | cover |
|---|---|
| AGGI2 | 25 |
| EUOC4 | 10 |
| MEOF | 10 |
| SABO2 | 40 |
| SPDI6 | 5 |

**Colony 25 Transect 18 Quadrat: 12**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| JUARL | 15 |
| PRVU | 10 |
| SALU | 65 |

**Colony 25 Transect 18 Quadrat: 13**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 45 |
| EUOC4 | 25 |
| JUARL | 20 |
| TRPR2 | 10 |

**Colony 25 Transect 18 Quadrat: 2**

**Vegetal Cover:** 90 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 10 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| EQAR | 5 |
| JUARL | 20 |
| PRVU | 5 |
| SALU | 50 |
| SOCA6 | 10 |

**Colony 25 Transect 18 Quadrat: 3**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 50 |
| EQAR | 10 |
| PHAR3 | 25 |
| SOCA6 | 15 |

**Colony 25 Transect 18 Quadrat: 4**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 55 |
| EQAR | 20 |
| EUOC4 | 20 |
| MEOF | 10 |
| SAEX | 10 |

## Colony 25 Transect 18 Quadrat: 5
**Vegetal Cover:** 90 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 10 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 35 |
| EUOC4 | 10 |
| MEOF | 10 |
| PRVU | 15 |
| SPDI6 | 5 |

## Colony 25 Transect 18 Quadrat: 6
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 55 |
| EQAR | 5 |
| EUOC4 | 15 |
| JUARL | 15 |
| MEOF | 10 |
| SAEX | 10 |

## Colony 25 Transect 18 Quadrat: 7
**Vegetal Cover:** 95 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 5 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 35 |
| JUEN | 5 |
| MEOF | 10 |
| PRVU | 20 |
| SOCA6 | 25 |

## Colony 25 Transect 18 Quadrat: 8
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| EQAR | 15 |
| SYEA2 | 65 |

## Colony 25 Transect 18 Quadrat: 9
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| EQAR | 15 |
| JUARL | 45 |
| PRVU | 25 |
| TRPR2 | 15 |

## Colony 25 Transect 19 Quadrat: 1
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 70 |
| AGGI2 | 70 |
| EQAR | 10 |
| MELU | 10 |
| SAEX | 20 |

## Colony 25 Transect 19 Quadrat: 2
**Vegetal Cover:** 85 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 15

| species | cover |
|---|---|
| AGGI2 | 60 |
| EQAR | 5 |
| MELU | 10 |
| PRVU | 15 |

**Colony 25 Transect 19 Quadrat: 3**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| EQAR | 5 |
| JUARL | 30 |
| MELU | 15 |
| MEOF | 5 |
| PRVU | 35 |

**Colony 25 Transect 19 Quadrat: 4**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| EQAR | 5 |
| JUARL | 55 |
| MELU | 20 |
| PRVU | 15 |
| SOCA6 | 20 |

**Colony 25 Transect 19 Quadrat: 5**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EQAR | 5 |
| JUARL | 20 |
| MELU | 15 |
| SABO2 | 45 |
| SALU | 35 |
| SOCA6 | 10 |

**Colony 25 Transect 19 Quadrat: 6**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 35 |
| EQAR | 30 |
| JUARL | 15 |
| PRVU | 5 |
| SOCA6 | 20 |

**Colony 25 Transect 20 Quadrat: 1**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| EQAR | 10 |
| EUOC4 | 20 |
| MEOF | 20 |
| SALU | 30 |
| SYEA2 | 15 |

**Colony 25 Transect 20 Quadrat: 2**

**Vegetal Cover:** 95 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 5 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| CAMIM6 | 5 |
| JUARL | 75 |

**Colony 25 Transect 20 Quadrat: 3**

**Vegetal Cover:** 60 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 40 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| JUARL | 35 |
| JUCO2 | 20 |

## Colony 25 Transect 20 Quadrat: 4

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| CAMIM6 | 5 |
| EQAR | 25 |
| EUOC4 | 60 |
| MEOF | 5 |
| SOCA6 | 30 |

## Colony 25 Transect 20 Quadrat: 5

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| EQAR | 20 |
| SABO2 | 85 |

## Colony 25 Transect 20 Quadrat: 6

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| EQAR | 20 |
| JUARL | 50 |
| MEOF | 10 |
| PRVU | 10 |
| SOCA6 | 10 |

## Colony 25 Transect 20 Quadrat: 7

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| EQAR | 10 |
| JUARL | 10 |
| MEOF | 10 |
| SABO2 | 10 |
| SAEX | 5 |
| SALU | 45 |

## Colony 25 Transect 20 Quadrat: 8

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 65 |
| EQAR | 5 |
| JUARL | 20 |
| SAEX | 10 |
| SOAR2 | 5 |

## Colony 25 Transect 23 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| EQAR | 20 |
| JUARL | 15 |
| MEOF | 15 |
| PRVU | 15 |
| SABO2 | 10 |
| SOCA6 | 15 |

## Colony 25 Transect 23 Quadrat: 10

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| EQAR | 10 |
| MEOF | 50 |
| SABO2 | 15 |
| SALU | 20 |
| SYEA2 | 15 |

**Colony 25 Transect 23 Quadrat: 11**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ACMI2 | 10 |
| AGGI2 | 15 |
| MEOF | 40 |
| SAEX | 25 |
| SOCA6 | 10 |

**Colony 25 Transect 23 Quadrat: 2**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| EQAR | 10 |
| JUARL | 65 |
| MEOF | 40 |

**Colony 25 Transect 23 Quadrat: 3**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| EQAR | 45 |
| JUARL | 30 |
| PRVU | 5 |
| SOAR2 | 5 |
| SYEA2 | 25 |

**Colony 25 Transect 23 Quadrat: 4**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| MEOF | 45 |
| SABO2 | 10 |
| SAEX | 35 |
| SYEA2 | 15 |

**Colony 25 Transect 23 Quadrat: 5**

**Vegetal Cover:** 95 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 5

| species | cover |
|---|---|
| MEOF | 45 |
| SABO2 | 20 |
| SAEX | 20 |
| SOCA6 | 15 |
| SPDI6 | 5 |
| SYEA2 | 20 |

**Colony 25 Transect 23 Quadrat: 6**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CAAU3 | 5 |
| EQAR | 30 |
| JUARL | 40 |
| SABO2 | 10 |
| SALU | 10 |
| SOAR2 | 5 |

**Colony 25 Transect 23 Quadrat: 7**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EQAR | 10 |
| JUARL | 65 |
| SABO2 | 35 |
| SAEX | 5 |
| SOAR2 | 10 |

## Colony 25 Transect 23 Quadrat: 8

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| JUARL | 55 |
| SABO2 | 40 |
| SAEX | 10 |
| SOAR2 | 10 |

## Colony 25 Transect 23 Quadrat: 9

**Vegetal Cover:** 85 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 15 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| SAEX | 15 |
| SOAR2 | 10 |
| SYEA2 | 20 |
| TRRE3 | 40 |

## Colony 25B Transect 28 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 35 |
| CIDO | 5 |
| EQAR | 10 |
| EUOC4 | 10 |
| PHAR3 | 20 |
| SAEX | 45 |

## Colony 25B Transect 28 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EQAR | 10 |
| JUARL | 65 |
| PHAR3 | 5 |
| SABO2 | 15 |
| SAEX | 10 |
| SOAR2 | 35 |

## Colony 25B Transect 28 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIDO | 25 |
| EUOC4 | 5 |
| JUARL | 30 |
| MEOF | 30 |
| SCPR4 | 25 |
| SYEA2 | 10 |

## Colony 25B Transect 28 Quadrat: 4

**Vegetal Cover:** 95 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 5 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CAMIM6 | 20 |
| EQAR | 5 |
| EUOC4 | 15 |
| SAEX | 10 |
| SCPR4 | 45 |

## Colony 25B Transect 29 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 35 |
| ELPA3 | 60 |
| SABO2 | 20 |
| SAEX | 10 |
| SCAM6 | 30 |

## Colony 25B Transect 29 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 50 |
| ELPA3 | 35 |
| PHAR3 | 10 |
| SALU | 15 |

## Colony 25B Transect 29 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| CIDO | 10 |
| EUOC4 | 5 |
| PHAR3 | 70 |

## Colony 25B Transect 29 Quadrat: 4

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 85 |
| EUOC4 | 10 |
| SALU | 25 |

## Colony 25B Transect 29 Quadrat: 5

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIDO | 10 |
| ELPA3 | 80 |
| PHAR3 | 15 |
| SALU | 20 |

## Colony 25B Transect 29 Quadrat: 6

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| CAMIM6 | 40 |
| ELPA3 | 30 |
| MIGU | 10 |
| RUCR | 5 |

## Colony 25B Transect 29 Quadrat: 7

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 50 |
| ELPA3 | 40 |
| NAOF | 20 |

## Colony 25B Transect 29 Quadrat: 8

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 70 |
| CIDO | 5 |
| ELPA3 | 10 |
| EUOC4 | 5 |
| MEOF | 10 |

## Colony 25B Transect 29 Quadrat: 9

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| CAMIM6 | 75 |
| CIVU | 5 |
| EQAR | 5 |
| MEOF | 10 |
| SCPR4 | 20 |

## Colony 27A Transect 21 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| CIDO | 15 |
| ELPA3 | 65 |
| EUOC4 | 5 |
| JUARL | 10 |
| JUEN | 10 |
| PRVU | 5 |

## Colony 27A Transect 21 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| CAMIM6 | 15 |
| ELPA3 | 60 |
| JUTO | 5 |
| PHAR3 | 10 |
| SAEX | 20 |

## Colony 27A Transect 21 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIDO | 10 |
| ELPA3 | 75 |
| JUEN | 15 |
| JUTO | 5 |
| SALU | 10 |

## Colony 27A Transect 21 Quadrat: 4

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CAMIM6 | 5 |
| CIDO | 30 |
| ELPA3 | 40 |
| PHAR3 | 10 |
| SAEX | 5 |
| SALU | 20 |

## Colony 27A Transect 22 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| ELPA3 | 25 |
| PHAR3 | 65 |

## Colony 27A Transect 22 Quadrat: 10

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CAREX | 45 |
| ELPA3 | 50 |
| EUOC4 | 15 |
| JUEN | 10 |

## Colony 27A Transect 22 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 65 |
| EUOC4 | 15 |
| JUEN | 10 |
| SALU | 10 |

**Colony 27A Transect 22 Quadrat: 3**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 65 |
| EUOC4 | 10 |
| JUEN | 10 |
| SALU | 15 |

**Colony 27A Transect 22 Quadrat: 4**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 45 |
| ELPA3 | 50 |
| JUEN | 10 |
| SALU | 5 |

**Colony 27A Transect 22 Quadrat: 5**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 35 |
| ELPA3 | 55 |
| EUOC4 | 5 |
| TYLA | 5 |

**Colony 27A Transect 22 Quadrat: 6**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 40 |
| CAMIM6 | 5 |
| ELPA3 | 60 |
| EUOC4 | 10 |
| JUEN | 5 |
| PHAR3 | 10 |

**Colony 27A Transect 22 Quadrat: 7**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 60 |
| JUARL | 45 |
| RUCR | 5 |

**Colony 27A Transect 22 Quadrat: 8**

**Vegetal Cover:** 80 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 20 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| PHAR3 | 50 |
| RUCR | 5 |

**Colony 27A Transect 22 Quadrat: 9**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 30 |
| ELPA3 | 45 |
| EUOC4 | 10 |
| SABO2 | 10 |

**Colony 27A Transect 24 Quadrat: 1**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| CAMIM6 | 5 |
| MEOF | 30 |
| PHAR3 | 15 |
| SAEX | 45 |
| SYEA2 | 10 |

## Colony 27A Transect 24 Quadrat: 10

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 45 |
| EUOC4 | 20 |
| JUARL | 35 |
| JUEN | 5 |
| SAEX | 5 |

## Colony 27A Transect 24 Quadrat: 11

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 55 |
| EUOC4 | 5 |
| JUEN | 10 |
| JUTO | 5 |
| PLMA2 | 10 |
| SABO2 | 15 |
| SAEX | 20 |

## Colony 27A Transect 24 Quadrat: 12

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 65 |
| EUOC4 | 20 |
| JUEN | 15 |
| JUTO | 5 |

## Colony 27A Transect 24 Quadrat: 2

**Vegetal Cover:** 95 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 5

| species | cover |
|---|---|
| ELPA3 | 60 |
| SABO2 | 10 |
| SAEX | 5 |
| SALU | 10 |
| SCPR4 | 10 |
| SYEA2 | 5 |

## Colony 27A Transect 24 Quadrat: 3

**Vegetal Cover:** 75 **Rock Areal Cover:** 25 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIDO | 5 |
| CIVU | 10 |
| MEOF | 25 |
| SABO2 | 30 |
| SCPR4 | 5 |

## Colony 27A Transect 24 Quadrat: 4

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| PHAR3 | 100 |

## Colony 27A Transect 24 Quadrat: 5

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 65 |
| ELPA3 | 35 |
| SABO2 | 20 |

## Colony 27A Transect 24 Quadrat: 6

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 60 |
| JUEN | 5 |
| PHAR3 | 25 |
| SAEX | 20 |

## Colony 27A Transect 24 Quadrat: 7

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EUOC4 | 60 |
| JUEN | 10 |
| PHAR3 | 25 |
| SAEX | 5 |

## Colony 27A Transect 24 Quadrat: 8

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 80 |
| JUEN | 20 |
| SAEX | 5 |

## Colony 27A Transect 24 Quadrat: 9

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 10 |
| EUOC4 | 5 |
| JUARL | 95 |
| JUEN | 10 |

## Colony 27A Transect 25 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| CAMIM6 | 20 |
| ELPA3 | 20 |
| JUARL | 20 |

## Colony 27A Transect 25 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 55 |
| CAMIM6 | 10 |
| ELPA3 | 15 |
| JUARL | 15 |
| SAEX | 10 |

## Colony 27A Transect 25 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 85 |
| SAEX | 20 |

## Colony 27A Transect 25 Quadrat: 4

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 40 |
| SAEX | 60 |

## Colony 27A Transect 25 Quadrat: 5

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| ELPA3 | 65 |
| RACY | 20 |
| SAEX | 20 |

## Colony 27A Transect 25 Quadrat: 6

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 60 |
| JUTO | 15 |
| SABO2 | 25 |

## Colony 27A Transect 26 Quadrat: 1

**Vegetal Cover:** 60 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 40 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EQAR | 5 |
| EUOC4 | 15 |
| MEOF | 15 |
| PHAR3 | 25 |

## Colony 27A Transect 26 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| CIAR4 | 5 |
| EUOC4 | 60 |
| PHAR3 | 20 |
| SALU | 5 |

## Colony 27A Transect 26 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 30 |
| EUOC4 | 25 |
| JUARL | 15 |
| PHAR3 | 30 |

## Colony 27A Transect 26 Quadrat: 4

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| CIDO | 20 |
| JUTO | 5 |
| PHAR3 | 65 |

## Colony 27A Transect 26 Quadrat: 5

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 55 |
| JUEN | 5 |
| PHAR3 | 35 |
| SALU | 5 |

## Colony 27A Transect 26 Quadrat: 6

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 25 |
| PHAR3 | 75 |

## Colony 27A Transect 27 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| ELPA3 | 80 |
| PHAR3 | 20 |

## Colony 27A Transect 27 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 40 |
| ELPA3 | 55 |
| EUOC4 | 10 |
| JUTO | 5 |

## Colony 27A Transect 27 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 50 |
| EUOC4 | 15 |
| SALU | 10 |

## Colony 27A Transect 27 Quadrat: 4

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| ELPA3 | 40 |
| PHAR3 | 5 |
| SALU | 35 |

## Colony 27A Transect 27 Quadrat: 5

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 45 |
| ELPA3 | 45 |
| EUOC4 | 5 |
| JUEN | 5 |
| SABO2 | 10 |
| SALU | 5 |

## Colony 27A Transect 27 Quadrat: 6

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| CIDO | 15 |
| ELPA3 | 40 |
| EUOC4 | 25 |
| JUEN | 15 |
| PHAR3 | 5 |
| SABO2 | 5 |

## Colony 27A Transect 27 Quadrat: 7

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 30 |
| ELPA3 | 40 |
| JUEN | 10 |
| PHAR3 | 5 |
| SAEX | 15 |

## Colony 27A Transect 27 Quadrat: 8

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| CIDO | 30 |
| ELPA3 | 40 |
| JUEN | 10 |
| SAEX | 10 |

## Colony 33 Transect 30 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CAMIM6 | 5 |
| EQAR | 15 |
| EUOC4 | 5 |
| MEOF | 70 |
| SOCA6 | 5 |

**Colony 33 Transect 30 Quadrat: 10**

**Vegetal Cover:** 85 **Rock Areal Cover:** 15 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 35 |
| ELPA3 | 20 |
| MEOF | 30 |
| PHAR3 | 10 |
| SABO2 | 15 |

**Colony 33 Transect 30 Quadrat: 11**

**Vegetal Cover:** 85 **Rock Areal Cover:** 10 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 5

| species | cover |
|---|---|
| AGGI2 | 25 |
| ELPA3 | 20 |
| EUOC4 | 15 |
| JUTO | 10 |
| SABO2 | 15 |

**Colony 33 Transect 30 Quadrat: 12**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 35 |
| EUOC4 | 20 |
| JUEN | 40 |
| JUTO | 15 |
| PLMA2 | 5 |

**Colony 33 Transect 30 Quadrat: 13**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| MEOF | 80 |
| SAEX | 25 |

**Colony 33 Transect 30 Quadrat: 14**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 40 |
| MEOF | 50 |
| SAEX | 10 |
| SALU | 5 |

**Colony 33 Transect 30 Quadrat: 15**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 30 |
| JUARL | 45 |
| JUEN | 20 |
| JUTO | 5 |
| SPDI6 | 5 |

**Colony 33 Transect 30 Quadrat: 16**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 75 |
| CAMIM6 | 5 |
| EUOC4 | 10 |
| JUEN | 20 |
| JUTO | 5 |

**Colony 33 Transect 30 Quadrat: 17**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| JUARL | 55 |
| JUTO | 15 |
| RACY | 30 |
| TRRE3 | 10 |

## Colony 33 Transect 30 Quadrat: 18

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| ELPA3 | 20 |
| EUOC4 | 5 |
| JUARL | 70 |

## Colony 33 Transect 30 Quadrat: 19

**Vegetal Cover:** 85 **Rock Areal Cover:** 15 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| CIDO | 25 |
| JUARL | 10 |
| MEOF | 15 |
| PHAR3 | 5 |
| SOCA6 | 25 |

## Colony 33 Transect 30 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| EUOC4 | 25 |
| JUEN | 15 |
| MEOF | 20 |
| SAEX | 5 |
| TYLA | 10 |

## Colony 33 Transect 30 Quadrat: 20

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 30 |
| EUOC4 | 10 |
| MEOF | 15 |
| PLMA2 | 5 |
| SAEX | 15 |
| SOAR2 | 50 |

## Colony 33 Transect 30 Quadrat: 21

**Vegetal Cover:** 85 **Rock Areal Cover:** 15 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| EUOC4 | 10 |
| JUARL | 45 |
| RACY | 20 |
| SAEX | 10 |
| SYEA2 | 10 |

## Colony 33 Transect 30 Quadrat: 22

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 85 |
| EUOC4 | 5 |
| JUARL | 10 |
| JUTO | 10 |
| SABO2 | 5 |

## Colony 33 Transect 30 Quadrat: 23

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 75 |
| CAMIM6 | 5 |
| SALU | 15 |
| SCPR4 | 10 |

**Colony 33 Transect 30 Quadrat: 24**
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| CAMIM6 | 15 |
| EUOC4 | 10 |
| JUARL | 60 |
| JUTO | 5 |
| RACY | 10 |

**Colony 33 Transect 30 Quadrat: 25**
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 80 |
| JUARL | 10 |
| JUTO | 5 |
| RACY | 10 |
| SALU | 5 |

**Colony 33 Transect 30 Quadrat: 26**
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 50 |
| EUOC4 | 5 |
| JUARL | 45 |
| JUTO | 5 |
| SABO2 | 5 |

**Colony 33 Transect 30 Quadrat: 27**
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| JUEN | 50 |
| JUTO | 35 |
| RACY | 45 |

**Colony 33 Transect 30 Quadrat: 28**
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| JUARL | 45 |
| RACY | 35 |

**Colony 33 Transect 30 Quadrat: 3**
**Vegetal Cover:** 65 **Rock Areal Cover:** 35 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 35 |
| EQAR | 10 |
| SALU | 10 |
| SOCA6 | 5 |

**Colony 33 Transect 30 Quadrat: 4**
**Vegetal Cover:** 80 **Rock Areal Cover:** 20 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 30 |
| EUOC4 | 15 |
| JUARL | 15 |
| SABO2 | 5 |
| SALU | 5 |
| SCPR4 | 25 |

**Colony 33 Transect 30 Quadrat: 5**
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| JUEN | 70 |
| SCPR4 | 15 |

## Colony 33 Transect 30 Quadrat: 6

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| JUARL | 40 |
| JUEN | 10 |
| NAOF | 30 |
| SCPR4 | 30 |

## Colony 33 Transect 30 Quadrat: 7

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 100 |
| TYLA | 5 |

## Colony 33 Transect 30 Quadrat: 8

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 70 |
| EUOC4 | 20 |
| PHAR3 | 25 |

## Colony 33 Transect 30 Quadrat: 9

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| ELPA3 | 35 |
| JUEN | 10 |
| PHAR3 | 10 |
| SCPR4 | 65 |

## Colony 33 Transect 31 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| MEOF | 40 |
| SAEX | 20 |
| SCPR4 | 35 |
| SOCA6 | 25 |

## Colony 33 Transect 31 Quadrat: 10

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EQAR | 20 |
| MEOF | 80 |
| SAEX | 5 |
| SALU | 5 |

## Colony 33 Transect 31 Quadrat: 11

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 35 |
| ELPA3 | 20 |
| EUOC4 | 15 |
| JUTO | 25 |
| PHAR3 | 20 |

## Colony 33 Transect 31 Quadrat: 12

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| ELPA3 | 70 |
| EUOC4 | 10 |
| JUEN | 30 |
| SABO2 | 10 |

**Colony 33 Transect 31 Quadrat: 13**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| EUOC4 | 35 |
| JUARL | 10 |
| MEOF | 70 |

**Colony 33 Transect 31 Quadrat: 14**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 30 |
| EUOC4 | 20 |
| MEOF | 45 |
| PHAR3 | 5 |
| SOCA6 | 15 |

**Colony 33 Transect 31 Quadrat: 15**

**Vegetal Cover:** 95 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 5 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIVU | 10 |
| EUOC4 | 10 |
| MEOF | 45 |
| PHAR3 | 20 |
| SOAR2 | 10 |

**Colony 33 Transect 31 Quadrat: 16**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| CAMIM6 | 40 |
| EUOC4 | 10 |
| MEOF | 10 |
| SAEX | 10 |
| SOCA6 | 10 |

**Colony 33 Transect 31 Quadrat: 17**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| MEOF | 35 |
| PHAR3 | 30 |
| PRVU | 10 |
| SAEX | 20 |

**Colony 33 Transect 31 Quadrat: 18**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| MEOF | 40 |
| PHAR3 | 5 |
| SAEX | 65 |

**Colony 33 Transect 31 Quadrat: 19**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| MEOF | 35 |
| PHAR3 | 40 |
| SAEX | 35 |
| SOCA6 | 15 |

**Colony 33 Transect 31 Quadrat: 2**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| MEOF | 35 |
| PHAR3 | 20 |
| SAEX | 45 |
| SOCA6 | 10 |

## Colony 33 Transect 31 Quadrat: 20

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CAMIM6 | 25 |
| MEOF | 30 |
| PHAR3 | 55 |
| SAEX | 10 |

## Colony 33 Transect 31 Quadrat: 21

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CAMIM6 | 35 |
| MEOF | 40 |
| PHAR3 | 10 |
| SAEX | 35 |

## Colony 33 Transect 31 Quadrat: 22

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| MEOF | 35 |
| SAEX | 95 |
| SOCA6 | 5 |

## Colony 33 Transect 31 Quadrat: 23

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CAMIM6 | 10 |
| EUOC4 | 5 |
| MEOF | 50 |
| SAEX | 40 |

## Colony 33 Transect 31 Quadrat: 24

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| CAMIM6 | 30 |
| EUOC4 | 10 |
| PHAR3 | 50 |
| SAEX | 10 |

## Colony 33 Transect 31 Quadrat: 25

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| EUOC4 | 15 |
| MEOF | 25 |
| SAEX | 60 |

## Colony 33 Transect 31 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EUOC4 | 25 |
| MEOF | 45 |
| PHAR3 | 35 |

## Colony 33 Transect 31 Quadrat: 4

**Vegetal Cover:** 40 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 60 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIVU | 10 |
| COCA5 | 15 |
| SAEX | 20 |
| SOCA6 | 10 |

## Colony 33 Transect 31 Quadrat: 5

**Vegetal Cover:** 60 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 40 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIAR4 | 30 |
| JUARL | 35 |
| MELU | 5 |

## Colony 33 Transect 31 Quadrat: 6

**Vegetal Cover:** 65 **Rock Areal Cover:** 35 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| SAEX | 45 |
| SOCA6 | 15 |
| VETH | 5 |

## Colony 33 Transect 31 Quadrat: 7

**Vegetal Cover:** 75 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 25

| species | cover |
|---|---|
| AGGI2 | 15 |
| CIAR4 | 5 |
| EUOC4 | 10 |
| MEOF | 55 |
| SAEX | 5 |

## Colony 33 Transect 31 Quadrat: 8

**Vegetal Cover:** 80 **Rock Areal Cover:** 20 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIVU | 10 |
| SAEX | 35 |
| SOCA6 | 25 |

## Colony 33 Transect 31 Quadrat: 9

**Vegetal Cover:** 80 **Rock Areal Cover:** 20 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| MEOF | 35 |
| SAEX | 20 |
| SOCA6 | 10 |
| SYEA2 | 15 |

## Colony 34A Transect 32 Quadrat: 1

**Vegetal Cover:** 80 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 20 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| CIAR4 | 5 |
| EUOC4 | 10 |
| MEOF | 25 |
| PHAR3 | 10 |

## Colony 34A Transect 32 Quadrat: 10

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 35 |
| PHAR3 | 20 |
| SALU | 35 |
| TYLA | 25 |

## Colony 34A Transect 32 Quadrat: 11

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 15 |
| PHAR3 | 65 |
| SAEX | 20 |

## Colony 34A Transect 32 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 30 |
| CIVU | 5 |
| EQAR | 15 |
| EUOC4 | 35 |
| SCPR4 | 10 |
| SOAR2 | 10 |

## Colony 34A Transect 32 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 45 |
| CIAR4 | 10 |
| CIDO | 10 |
| CIVU | 5 |
| EUOC4 | 20 |
| RUCR | 10 |

## Colony 34A Transect 32 Quadrat: 4

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| EUOC4 | 15 |
| PHAR3 | 20 |
| SALU | 15 |
| SCPR4 | 35 |

## Colony 34A Transect 32 Quadrat: 5

**Vegetal Cover:** 85 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 15 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 40 |
| EUOC4 | 20 |
| PHAR3 | 25 |

## Colony 34A Transect 32 Quadrat: 6

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| PHAR3 | 40 |
| SAEX | 15 |
| SALU | 25 |
| SCPR4 | 15 |

## Colony 34A Transect 32 Quadrat: 7

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 60 |
| PHAR3 | 20 |
| SAEX | 25 |

## Colony 34A Transect 32 Quadrat: 8

**Vegetal Cover:** 95 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 5 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 70 |
| CIDO | 10 |
| PHAR3 | 10 |
| SAEX | 5 |

## Colony 34A Transect 32 Quadrat: 9

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| ELPA3 | 75 |
| JUEN | 10 |
| SABO2 | 5 |

## Colony 35 Transect 33 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CAPE42 | 25 |
| CIDO | 15 |
| JUARL | 35 |
| MEOF | 10 |
| PHAR3 | 25 |
| SYEA2 | 10 |

## Colony 35 Transect 33 Quadrat: 10

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| EQAR | 85 |
| SABO2 | 20 |
| SOAR2 | 10 |

## Colony 35 Transect 33 Quadrat: 11

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EQAR | 90 |

## Colony 35 Transect 33 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| EQAR | 45 |
| JUARL | 35 |
| MEOF | 15 |
| PHAR3 | 30 |

## Colony 35 Transect 33 Quadrat: 3

**Vegetal Cover:** 95 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 5 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| EQAR | 60 |
| TRPR2 | 20 |

## Colony 35 Transect 33 Quadrat: 4

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| JUARL | 55 |
| SABO2 | 25 |
| SYEA2 | 5 |

## Colony 35 Transect 33 Quadrat: 5

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| JUARL | 75 |
| SAEX | 5 |
| SOCA6 | 10 |
| SYEA2 | 15 |

## Colony 35 Transect 33 Quadrat: 6

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| EQAR | 35 |
| JUARL | 25 |
| SALU | 35 |
| SOCA6 | 20 |
| SPDI6 | 10 |

**Colony 35 Transect 33 Quadrat: 7**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EQAR | 30 |
| JUARL | 25 |
| SABO2 | 30 |
| SYEA2 | 10 |
| TRPR2 | 15 |

**Colony 35 Transect 33 Quadrat: 8**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| EQAR | 65 |
| EUOC4 | 5 |
| JUARL | 20 |
| SABO2 | 10 |

**Colony 35 Transect 33 Quadrat: 9**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| EQAR | 75 |
| MEOF | 15 |
| SOCA6 | 10 |
| TRPR2 | 5 |

**Colony 35 Transect 34 Quadrat: 1**

**Vegetal Cover:** 50 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 35 **Litter Areal Cover:** 15

| species | cover |
|---|---|
| BRIN2 | 25 |
| CANU4 | 5 |
| GUMI | 5 |
| MESA | 15 |

**Colony 35 Transect 34 Quadrat: 10**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EQAR | 60 |
| SALU | 65 |
| SOCA6 | 10 |

**Colony 35 Transect 34 Quadrat: 11**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EQAR | 50 |
| JUARL | 20 |
| MEOF | 60 |
| SAEX | 5 |

**Colony 35 Transect 34 Quadrat: 12**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| CAPE42 | 25 |
| EQAR | 75 |
| SAEX | 10 |

**Colony 35 Transect 34 Quadrat: 2**

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 3 |
| BRIN2 | 75 |
| EUOC4 | 5 |
| SAEX | 10 |
| TRDU | 5 |

## Colony 35 Transect 34 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CAPE42 | 70 |
| CIAR4 | 5 |
| CIDO | 15 |
| SAEX | 10 |
| SCAM6 | 15 |

## Colony 35 Transect 34 Quadrat: 4

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CAPE42 | 70 |
| CIDO | 10 |
| PHAR3 | 10 |
| SALU | 15 |

## Colony 35 Transect 34 Quadrat: 5

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CAPE42 | 85 |
| SALU | 10 |
| TYLA | 25 |

## Colony 35 Transect 34 Quadrat: 6

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EQAR | 35 |
| JUARL | 25 |
| JUEN | 10 |
| TYLA | 45 |

## Colony 35 Transect 34 Quadrat: 7

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EQAR | 20 |
| JUARL | 70 |
| SALU | 50 |
| SOCA6 | 5 |

## Colony 35 Transect 34 Quadrat: 8

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EQAR | 20 |
| JUARL | 15 |
| SABO2 | 30 |
| SOCA6 | 50 |

## Colony 35 Transect 34 Quadrat: 9

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EQAR | 65 |
| MEOF | 10 |
| SALU | 25 |
| SOCA6 | 10 |

## Colony 35A Transect 35 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| CIDO | 35 |
| ELPA3 | 40 |
| PHAR3 | 10 |

## Colony 35A Transect 35 Quadrat: 10

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIAR4 | 5 |
| CIVU | 5 |
| JUARL | 95 |
| PHAR3 | 5 |

## Colony 35A Transect 35 Quadrat: 11

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIAR4 | 5 |
| CIVU | 5 |
| EUOC4 | 10 |
| JUARL | 65 |
| PHAR3 | 5 |
| SCAM6 | 20 |

## Colony 35A Transect 35 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 30 |
| ELPA3 | 60 |
| EQAR | 10 |
| SAEX | 10 |

## Colony 35A Transect 35 Quadrat: 3

**Vegetal Cover:** 80 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 10 **Litter Areal Cover:** 10

| species | cover |
|---|---|
| EUOC4 | 10 |
| PHAR3 | 35 |
| SABO2 | 35 |

## Colony 35A Transect 35 Quadrat: 4

**Vegetal Cover:** 85 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 15

| species | cover |
|---|---|
| CIAR4 | 5 |
| JUARL | 65 |
| PHAR3 | 10 |
| SABO2 | 5 |

## Colony 35A Transect 35 Quadrat: 5

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| JUARL | 10 |
| SALU | 80 |

## Colony 35A Transect 35 Quadrat: 6

**Vegetal Cover:** 95 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 5 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIDO | 5 |
| EUOC4 | 5 |
| JUARL | 75 |
| SOCA6 | 10 |

## Colony 35A Transect 35 Quadrat: 7

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| CIAR4 | 5 |
| CIDO | 5 |
| JUARL | 80 |
| PHAR3 | 5 |
| SOAR2 | 5 |

## Colony 35A Transect 35 Quadrat: 8

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| CIAR4 | 5 |
| JUARL | 45 |
| SABO2 | 55 |

## Colony 35A Transect 35 Quadrat: 9

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| JUARL | 70 |
| PHAR3 | 10 |
| SAEX | 25 |
| SOCA6 | 10 |

## Colony 35A Transect 36 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIAR4 | 5 |
| CIDO | 10 |
| ELPA3 | 60 |
| PHAR3 | 40 |

## Colony 35A Transect 36 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIDO | 25 |
| ELPA3 | 15 |
| EQAR | 5 |
| EUOC4 | 5 |
| SCAM6 | 65 |
| SYEA2 | 5 |

## Colony 35A Transect 36 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIAR4 | 5 |
| CIDO | 20 |
| ELPA3 | 15 |
| EQAR | 70 |
| PLMA2 | 10 |

## Colony 8 Transect 1 Quadrat: 1

**Vegetal Cover:** 75 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 25

| species | cover |
|---|---|
| AGGI2 | 30 |
| CIVU | 5 |
| EQAR | 10 |
| MESA | 5 |
| SCPR4 | 25 |

## Colony 8 Transect 1 Quadrat: 2

**Vegetal Cover:** 95 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 5

| species | cover |
|---|---|
| AGGI2 | 30 |
| EQAR | 10 |
| JUCO2 | 5 |
| MEOF | 5 |
| SAEX | 20 |
| SALU | 25 |

## Colony 8 Transect 1 Quadrat: 3
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| CIVU | 5 |
| EQAR | 20 |
| JUARL | 40 |
| SAEX | 5 |
| SALU | 20 |

## Colony 8 Transect 1 Quadrat: 4
**Vegetal Cover:** 95 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 5 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 30 |
| MEOF | 10 |
| SAEX | 10 |
| SALU | 35 |
| SCPR4 | 10 |

## Colony 8 Transect 1 Quadrat: 5
**Vegetal Cover:** 85 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 15 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| PHAR3 | 45 |
| SAEX | 20 |
| SCPR4 | 10 |

## Colony 8 Transect 1 Quadrat: 6
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| EUOC4 | 10 |
| PHAR3 | 10 |
| SALU | 60 |

## Colony 8C Transect 2 Quadrat: 1
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIAR4 | 10 |
| MEOF | 55 |
| SAEX | 15 |
| SCPR4 | 20 |

## Colony 8C Transect 2 Quadrat: 2
**Vegetal Cover:** 85 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 15 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| MEOF | 30 |
| SAEX | 5 |
| SCPR4 | 45 |
| SOCA6 | 5 |

## Colony 8C Transect 2 Quadrat: 3
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| JUARL | 15 |
| SAEX | 10 |
| SCPR4 | 75 |

## Colony 8C Transect 2 Quadrat: 4
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| JUARL | 40 |
| PHAR3 | 25 |
| SAEX | 30 |

## Colony 8C Transect 2 Quadrat: 5

**Vegetal Cover:** 95 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 5 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| CIAR4 | 15 |
| JUARL | 45 |
| MEOF | 5 |
| SAEX | 10 |

## Colony 8C Transect 2 Quadrat: 6

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| CIAR4 | 5 |
| JUARL | 65 |
| PHAR3 | 5 |
| SALU | 15 |

## Colony 8C Transect 2 Quadrat: 7

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| CIAR4 | 10 |
| MEOF | 20 |
| PHAR3 | 40 |
| SAEX | 10 |

## Colony 8C Transect 2 Quadrat: 8

**Vegetal Cover:** 95 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 5 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 45 |
| MEOF | 5 |
| SAEX | 15 |
| SALU | 30 |

## Colony 8C Transect 2 Quadrat: 9

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 55 |
| MEOF | 25 |
| SABO2 | 5 |
| SAEX | 15 |
| SALU | 5 |

## Colony 9 Transect 3 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| ALIN2 | 55 |
| EQAR | 20 |
| SABO2 | 10 |
| SALU | 5 |

## Colony 9 Transect 3 Quadrat: 2

**Vegetal Cover:** 90 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 10 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| EQAR | 35 |
| MEOF | 5 |
| SALU | 25 |
| SOCA6 | 5 |
| SYEA2 | 5 |

## Colony 9 Transect 3 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 15 |
| EQAR | 5 |
| SALU | 35 |
| SOCA6 | 50 |

## Colony Surface 1 Transect 12 Quadrat: 1

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| ELPA3 | 80 |
| PHAR3 | 10 |
| SAEX | 5 |

## Colony Surface 1 Transect 12 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| COCA5 | 10 |
| ELPA3 | 80 |
| EUOC4 | 15 |
| PHAR3 | 15 |

## Colony Surface 1 Transect 12 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIVU | 5 |
| ELPA3 | 100 |

## Colony Surface 1 Transect 12 Quadrat: 4

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| JUARL | 10 |
| PHAR3 | 65 |
| SAEX | 10 |
| SALU | 30 |

## Colony Surface 1 Transect 12 Quadrat: 5

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| EUOC4 | 45 |
| PHAR3 | 35 |

## Colony Surface 1 Transect 12 Quadrat: 6

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| PHAR3 | 70 |
| SCAM6 | 15 |

## Colony Surface 2 Transect 13 Quadrat: 1

**Vegetal Cover:** 30 **Rock Areal Cover:** 30 **Bare Ground Areal Cover:** 15 **Litter Areal Cover:** 25

| species | cover |
|---|---|
| EUOC4 | 10 |
| MELU | 20 |
| PHAR3 | 10 |

## Colony Surface 2 Transect 13 Quadrat: 2

**Vegetal Cover:** 65 **Rock Areal Cover:** 20 **Bare Ground Areal Cover:** 15 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 5 |
| EUOC4 | 20 |
| NAOF | 5 |
| PHAR3 | 15 |
| SOAR2 | 10 |

## Colony Surface 2 Transect 13 Quadrat: 3
**Vegetal Cover:** 85 **Rock Areal Cover:** 15 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| COCA5 | 10 |
| MELU | 40 |
| PHAR3 | 25 |

## Colony Surface 2 Transect 13 Quadrat: 4
**Vegetal Cover:** 90 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 10 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 25 |
| MELU | 10 |
| SABO2 | 10 |
| SAEX | 15 |
| SALU | 10 |
| SYEA2 | 20 |

## Colony Surface 2 Transect 13 Quadrat: 5
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| MELU | 30 |
| PHAR3 | 20 |
| SABO2 | 15 |
| SAEX | 15 |
| SALU | 25 |

## Colony Surface 2 Transect 13 Quadrat: 6
**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 20 |
| MELU | 40 |
| PHAR3 | 55 |
| RACY | 25 |

## Colony Surface 2 Transect 14 Quadrat: 1
**Vegetal Cover:** 40 **Rock Areal Cover:** 45 **Bare Ground Areal Cover:** 15 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| AGGI2 | 10 |
| EUOC4 | 15 |
| MELU | 30 |
| VETH | 5 |

## Colony Surface 2 Transect 14 Quadrat: 2
**Vegetal Cover:** 95 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 5 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| COCA5 | 5 |
| EUOC4 | 80 |
| MELU | 5 |
| SAEX | 5 |

## Colony Surface 2 Transect 14 Quadrat: 3
**Vegetal Cover:** 25 **Rock Areal Cover:** 20 **Bare Ground Areal Cover:** 55 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| MEOF | 30 |
| SAEX | 5 |

## Colony Surface 4 Transect 37 Quadrat: 1
**Vegetal Cover:** 90 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 10 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 75 |
| PHAR3 | 5 |
| SAEX | 10 |

## Colony Surface4 Transect 37 Quadrat: 2

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 55 |
| MEOF | 15 |
| SABO2 | 15 |
| SALU | 10 |

## Colony Surface4 Transect 37 Quadrat: 3

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIAR4 | 5 |
| ELPA3 | 50 |
| MEOF | 10 |
| PLMA2 | 5 |
| SAEX | 15 |
| SALU | 15 |

## Colony Surface4 Transect 37 Quadrat: 4

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| CIDO | 15 |
| ELPA3 | 35 |
| SALU | 60 |

## Colony Surface4 Transect 37 Quadrat: 5

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

| species | cover |
|---|---|
| ELPA3 | 20 |
| MEOF | 20 |
| PHAR3 | 60 |

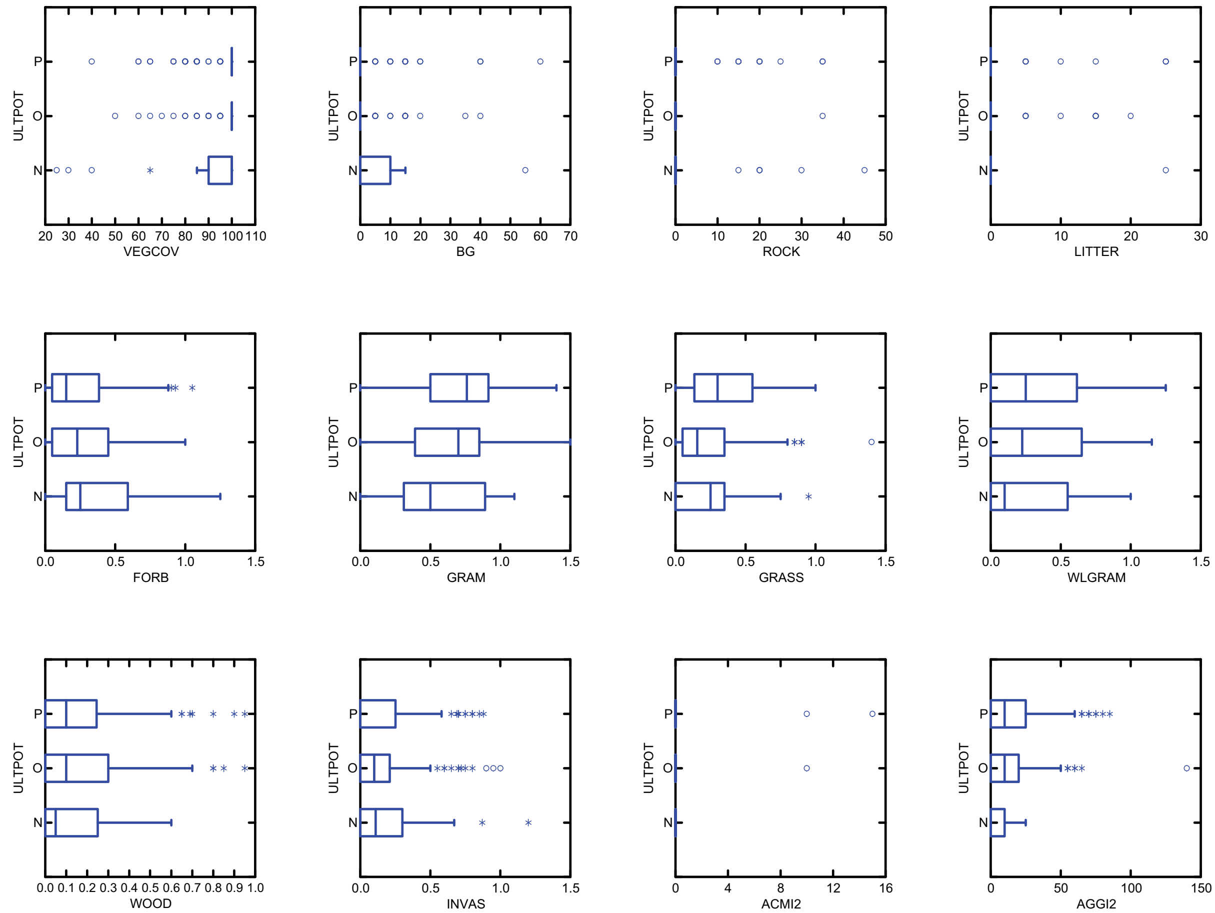
## Colony Surface4 Transect 37 Quadrat: 6

**Vegetal Cover:** 100 **Rock Areal Cover:** 0 **Bare Ground Areal Cover:** 0 **Litter Areal Cover:** 0

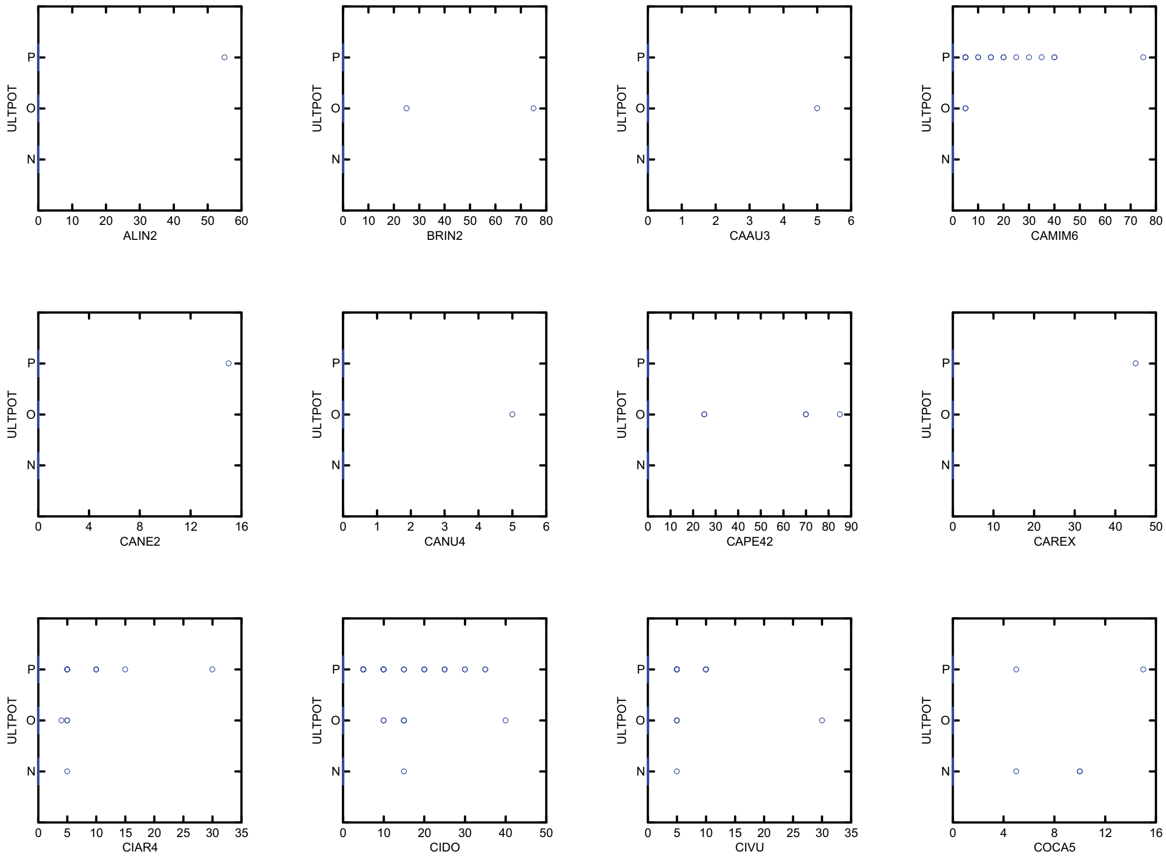
| species | cover |
|---|---|
| AGGI2 | 15 |
| ELPA3 | 55 |
| EUOC4 | 15 |
| SALU | 20 |
| SCAM6 | 25 |

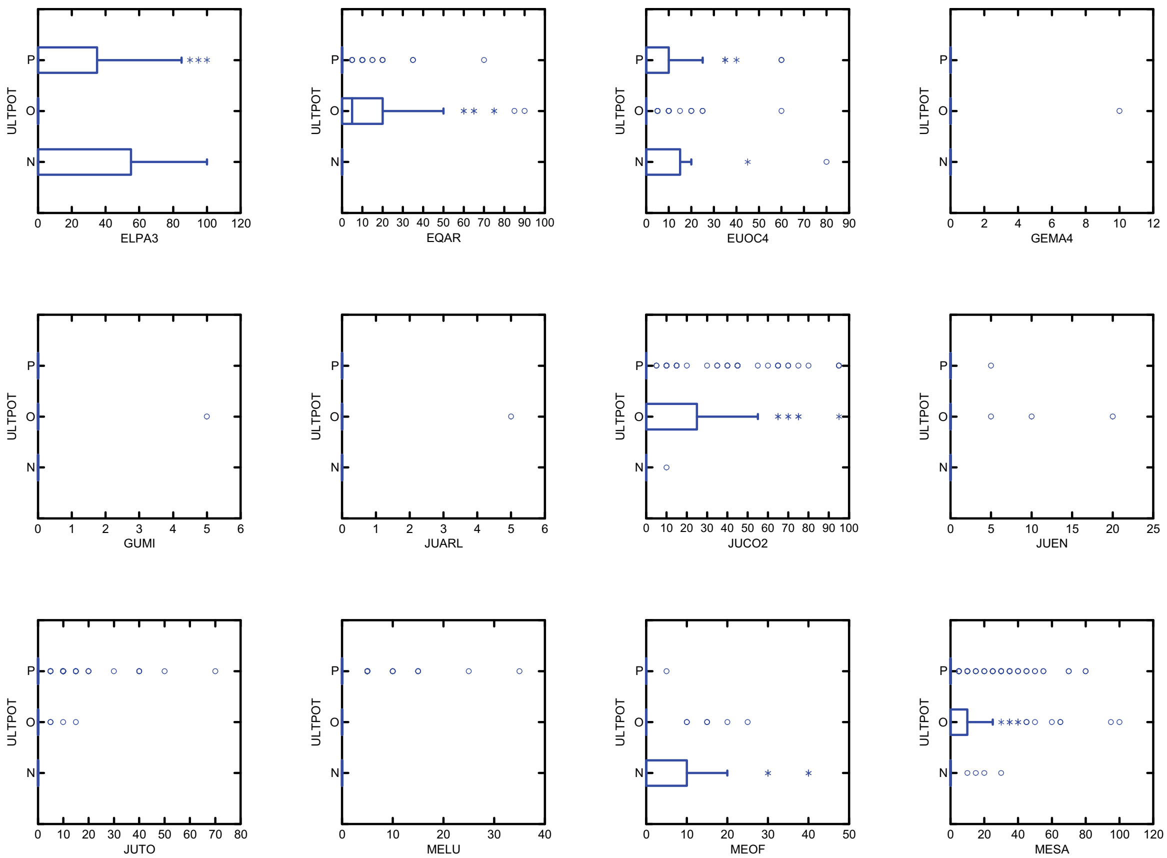
# APPENDIX 4.2 BOX PLOTS FOR UTE LADIES'-TRESSES HABITAT DATA

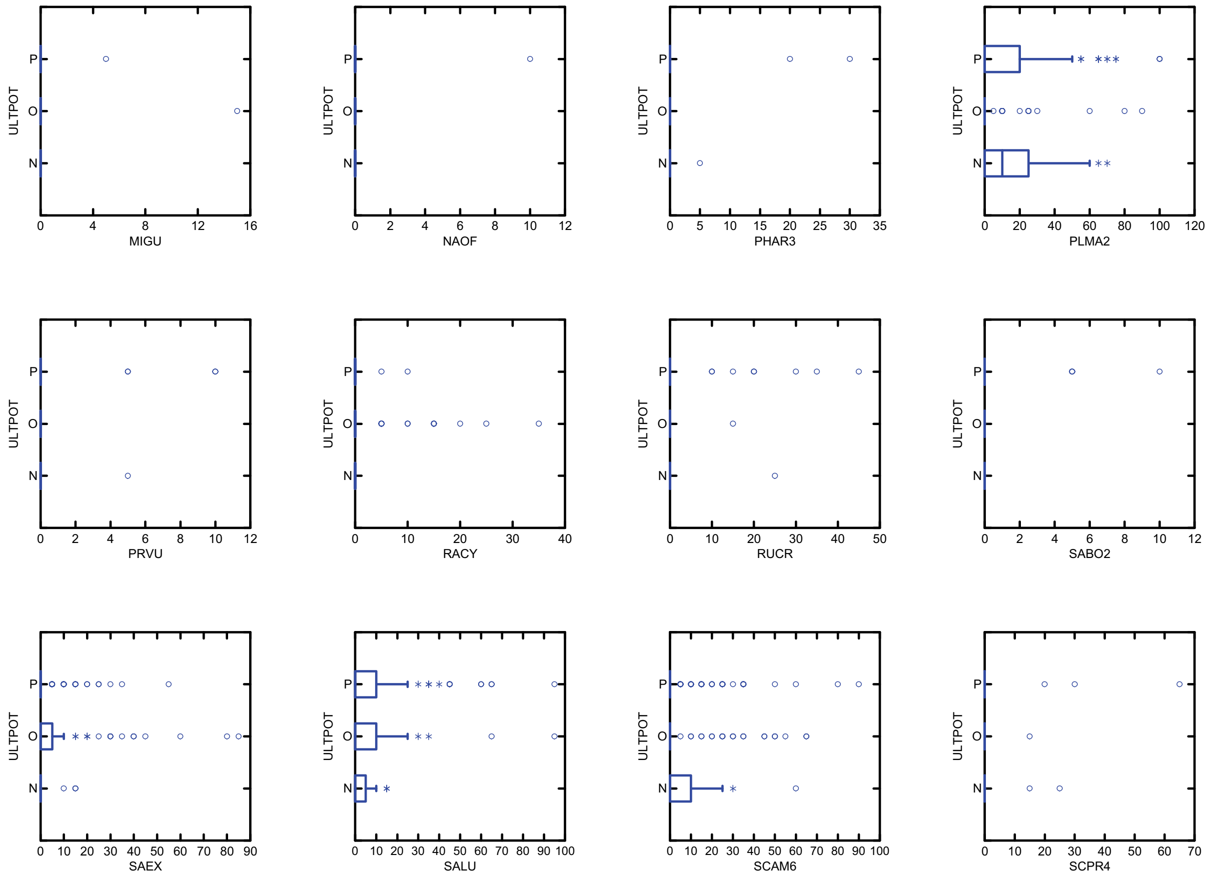
# Box Plots for ULT Habitat Data by ULT Habitat Site

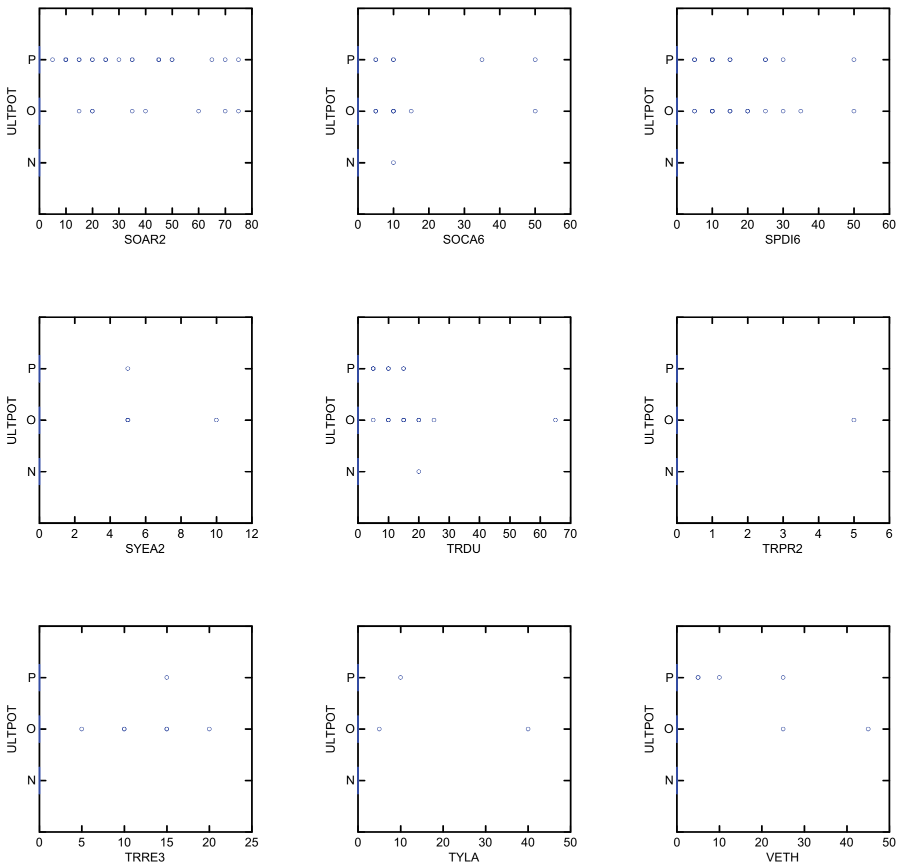



Box Plots for ULT Habitat Data by ULT Habitat Site (ULTPOT): **O** - Occupied Surface (within ULT habitat microsite) **P** - Potential Surface (not within ULT habitat microsite) **N** - Non-Occupied Surface


ULTPOT
P
O
N
0 10 20 30 40 50 60
ALIN2
0 10 20 30 40 50 60 70 80
BRIN2
0 1 2 3 4 5 6
CAAU3
0 10 20 30 40 50 60 70 80
CAMIM6
0 4 8 12 16
CANE2
0 1 2 3 4 5 6
CANU4
0 10 20 30 40 50 60 70 80 90
CAPE42
0 10 20 30 40 50
CAREX
0 5 10 15 20 25 30 35
CIAR4
0 10 20 30 40 50
CIDO
0 5 10 15 20 25 30 35
CIVU
0 4 8 12 16
COCA5


ULTPOT
P
O
N
0 20 40 60 80 100 120
ELPA3
0 10 20 30 40 50 60 70 80 90 100
EQAR
0 10 20 30 40 50 60 70 80 90
EUOC4
0 2 4 6 8 10 12
GEMA4
0 1 2 3 4 5 6
GUMI
0 1 2 3 4 5 6
JUARL
0 10 20 30 40 50 60 70 80 90 100
JUCO2
0 5 10 15 20 25
JUEN
0 10 20 30 40 50 60 70 80
JUTO
0 10 20 30 40
MELU
0 10 20 30 40 50
MEOF
0 20 40 60 80 100 120
MESA


ULTPOT
P
O
N
0 4 8 12 16
MIGU
0 2 4 6 8 10 12
NAOF
0 5 10 15 20 25 30 35
PHAR3
0 20 40 60 80 100 120
PLMA2
0 2 4 6 8 10 12
PRVU
0 10 20 30 40
RACY
0 10 20 30 40 50
RUCR
0 2 4 6 8 10 12
SABO2
0 10 20 30 40 50 60 70 80 90
SAEX
0 10 20 30 40 50 60 70 80 90 100
SALU
0 10 20 30 40 50 60 70 80 90 100
SCAM6
0 10 20 30 40 50 60 70
SCPR4


ULTPOT
P
O
N
SOAR2
SOCA6
SPDI6
SYEA2
TRDU
TRPR2
TRRE3
TYLA
VETH

# APPENDIX 4.3 UTE LADIES'-TRESSES *P* VALUES BASED ON 2006 AND 2007 QUADRAT DATA

| | | | | | |
|---|---|---|---|---|---|
| *Carex pellita* | woolly sedge | CAPE42 | < 0.001 | 0.003 | *2 |
| *Carex species* | sedge | CAREX | 0.367 | 0.740 | |
| *Castilleja minor* ssp. *minor* | lesser Indian paintbrush | CAMIM6 | 0.775 | 0.027 | *3 |
| *Cicuta douglasii* | western water hemlock | CIDO | 0.017 | 0.132 | |
| *Cirsium arvense* | Canada thistle | CIAR4 | 0.456 | 0.171 | |
| *Cirsium vulgare* | bull thistle | CIVU | 0.565 | 0.859 | |
| *Conyza canadensis* | Canadian horseweed | COCA5 | 0.462 | < 0.001 | |
| *Elaeagnus angustifolia* | Russian olive | ELAN | 0.775 | | |
| *Eleocharis palustris* | common spikerush | ELPA3 | < 0.001 | < 0.001 | |
| *Epilobium ciliatum* | fringed willowherb | EPCI | 0.599 | | |
| *Equisetum arvense* | field horsetail | EQAR | 0.005 | < 0.001 | |
| *Euthamia occidentalis* | western goldentop | EUOC4 | 0.002 | < 0.001 | |
| *Geum macrophyllum* | largeleaf avens | GEMA4 | 0.506 | | |
| *Grindelia squarrosa* | curlycup gumweed | GRSQ | 0.247 | | |
| *Gutierrezia microcephala* | threadleaf snakeweed | GUMI | | 0.324 | |
| *Hordeum jubatum* | foxtail barley | HOJU | 0.775 | | |
| *Juncus arcticus* ssp. *littoralis* | mountain rush | JUARL | < 0.001 | 0.324 | *4 |
| *Juncus confusus* | Colorado rush | JUCO2 | < 0.001 | < 0.001 | |
| *Juncus ensifolius* | swordleaf rush | JUEN | 0.037 | 0.150 | |
| *Juncus torreyi* | Torrey's rush | JUTO | 0.240 | < 0.001 | |
| *Medicago lupulina* | black medick | MELU | 0.002 | 0.002 | |
| *Medicago sativa* | alfalfa | MESA | 0.326 | 0.090 | |
| *Melilotus officinalis* | sweetclover | MEOF | 0.569 | < 0.001 | |
| *Mentha arvensis* | wild mint | MEAR4 | 0.365 | | |
| *Mimulus guttatus* | seep monkeyflower | MIGU | | 0.804 | |
| *Nasturtium officinale* | watercress | NAOF | | 0.740 | |
| *Phalaris arundinacea* | reed canarygrass | PHAR3 | 0.092 | 0.137 | |
| *Plantago lanceolata* | narrowleaf plantain | PLLA | 0.775 | | |
| *Plantago major* | common plantain | PLMA2 | 0.484 | < 0.001 | |
| *Prunella vulgaris* | common selfheal | PRVU | 0.060 | 0.217 | |
| *Pseudoroegneria spicata* | bluebunch wheatgrass | PSSP6 | 0.247 | | |
| *Ranunculus cymbalaria* | alkali buttercup | RACY | 0.532 | < 0.001 | |
| river | river | RIVER | < 0.001 | | |
| *Rosa woodsii* | Woods' rose | ROWO | 0.247 | | |
| *Rumex crispus* | curly dock | RUCR | 0.011 | 0.345 | |
| *Salix boothii* | Booth's willow | SABO2 | 0.008 | 0.296 | |
| *Salix exigua* | coyote willow | SAEX | 0.008 | 0.043 | |
| *Salix lucida* | shining willow | SALU | 0.003 | 0.807 | |
| *Schedonorus pratensis* | meadow fescue | SCPR4 | 0.054 | 0.035 | |
| *Schoenoplectus americanus* | Olney's threesquare | SCAM6 | 0.247 | 0.444 | |
| *Solidago canadensis* | Canada goldenrod | SOCA6 | 0.039 | 0.003 | |
| *Sonchus arvensis* | field sowthistle | SOAR2 | < 0.001 | 0.100 | |
| *Spiranthes diluvialis* | Ute lady's tresses | SPDI6 | < 0.001 | 0.001 | |
| *Symphyotrichum eatonii* | Eaton's aster | SYEA2 | < 0.001 | 0.054 | |
| *Taraxacum officinale* | common dandelion | TAOF | 0.775 | | |
| *Tragopogon dubius* | yellow salsify | TRDU | | 0.034 | |
| *Trifolium pratense* | red clover | TRPR2 | | 0.324 | |
| *Trifolium repens* | white clover | TRRE3 | 0.524 | 0.006 | |
| *Typha latifolia* | broadleaf cattail | TYLA | 0.599 | 0.389 | |
| *unknown species* | unknown species | UNKNOWN | 0.101 | | |
| *Verbascum thapsus* | common mullein | VETH | 0.775 | 0.451 | |
| *Veronica anagallis-aquatica* | water speedwell | VEAN2 | 0.054 | | |
| GROWTH HABIT AND NON-INDIGENOUS SPECIES | | | | | |
| Forb Species | Forb Species | FORB | 0.010 | 0.137 | |
| Graminoid Species | Graminoid Species | GRAM | 0.001 | 0.033 | |
| Grass Species | Grass Species | GRASS | 0.054 | 0.004 | |
| Non-indigenous Species | Non-indigenous Species | NONIND | < 0.001 | 0.026 | |
| Wetland Graminoid Species | Wetland Graminoid Species | WLGRAM | 0.479 | 0.570 | |

# APPENDIX 4.4 PIEZOMETER DATA

| real world el | Date 39197 | 39234 | 39257 | 39264 | 39269 | 39270 | 39286 | 39321 | 39365 | 39393 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Distance from Top of Well to Water Surface (ft) | | | | | | | | | |
| 5005.564781 | 2.45 | 2.47 | 2.47 | 1.94 | 2.35 | 2.46 | 2.48 | 2.54 | 2.42 | 2.45 |
| 5004.320915 | 1.82 | 1.83 | 1.83 | 1.25 | 1.81 | 1.88 | 1.71 | 1.71 | 1.79 | 1.83 |
| 5004.309093 | 2.38 | 2.41 | 2.41 | 1.73 | 2.38 | 2.29 | 2.35 | 2.35 | 2.42 | 2.42 |
| 5174.36667 | 1.73 | 1.71 | 1.71 | 0.9 | 1.27 | 1.81 | 1.75 | 1.73 | 1.77 | 1.77 |
| 5173.97295 | 1.97 | 2 | 2 | 1.21 | 1.85 | 2 | 1.88 | 2.02 | 1.92 | 1.91 |
| 5172.92303 | 1.43 | 1.42 | 1.42 | 0.58 | 1.27 | 1.4 | 1.31 | 1.54 | 1.35 | 1.38 |
| | | | | | | | | | | |
| 4994.43663 | 1.58 | 1.46 | 1.46 | 0.4 | 1.1 | 1.38 | 1.29 | 1.46 | 1.44 | 1.4 |
| 4995.91308 | 2.83 | 2.7 | 2.7 | 1.44 | 2.17 | 2.33 | 2.27 | 2.46 | 2.54 | 2.45 |
| 4995.61779 | 2.34 | 2.24 | 2.24 | 1.02 | 1.69 | 1.85 | 1.83 | 2 | 2.06 | 1.94 |

| real world el | Date 39197 | 39234 | 39257 | 39264 | 39269 | 39270 | 39286 | 3 |
|---|---|---|---|---|---|---|---|---|
| | Water Surface Elevation in Well (ft) | | | | | | | |
| 5005.564781 | 5003.11478 | 5003.09478 | 5003.09478 | 5003.62478 | 5003.21478 | 5003.10478 | 5003.08478 | 5003.0 |
| 5004.320915 | 5002.50091 | 5002.49091 | 5002.49091 | 5003.07091 | 5002.51091 | 5002.44091 | 5002.61091 | 5002.6 |
| 5004.309093 | 5001.92909 | 5001.89909 | 5001.89909 | 5002.57909 | 5001.92909 | 5002.01909 | 5001.95909 | 5001.9 |
| 5174.36667 | 5172.63667 | 5172.65667 | 5172.65667 | 5173.46667 | 5173.09667 | 5172.55667 | 5172.61667 | 5172.6 |
| 5173.97295 | 5172.00295 | 5171.97295 | 5171.97295 | 5172.76295 | 5172.12295 | 5171.97295 | 5172.09295 | 5171.9 |
| 5172.92303 | 5171.49303 | 5171.50303 | 5171.50303 | 5172.34303 | 5171.65303 | 5171.52303 | 5171.61303 | 5171.3 |
| | | | | 4994.2201 | | 4993.0501 | | 4993. |
| 4994.43663 | 4992.85663 | 4992.97663 | 4992.97663 | 4994.03663 | 4993.33663 | 4993.05663 | 4993.14663 | 4992.9 |
| 4995.91308 | 4993.08308 | 4993.21308 | 4993.21308 | 4994.47308 | 4993.74308 | 4993.58308 | 4993.64308 | 4993.4 |
| 4995.61779 | 4993.27779 | 4993.37779 | 4993.37779 | 4994.59779 | 4993.92779 | 4993.76779 | 4993.78779 | 4993.6 |

M

| r real world el | 39197 | 39234 | 39257 | 39264 | 39269 | 39270 | 39286 | 39321 | 39365 | 39393 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Distance from Rebar to Water Surface in Stream (ft) | | | | | | | | | |
| 5003.284486 | 0.71 | 0.66 | 0.66 | -0.13 | 0.62 | 0.71 | 0.62 | 0.77 | 0.73 | 0.74 |
| 5003.074135 | 0.77 | 0.7 | 0.7 | 0.04 | 0.71 | 0.83 | 0.81 | 0.8 | 0.77 | 0.8 |
| 5002.701403 | 1.11 | 1.05 | 1.05 | 0.25 | 0.83 | 0.88 | 0.75 | 0.8 | 0.85 | 1.05 |
| 5174.612745 | 1.2 | 1.1 | 1.1 | | 0.92 | 0.9 | 0.8 | 0.77 | 0.67 | 0.7 |
| 5173.530015 | 1.05 | 1 | 1 | 0 | 1.04 | 1.1 | 1.08 | 1.08 | 1 | 1.1 |
| 5172.69336 | 0.93 | 0.85 | 0.85 | 0.17 | 0.79 | 0.98 | 0.94 | 0.94 | 0.88 | 0.9 |
| | | | | | | | | | | |
| 4994.0101 | 0.83 | 0.73 | 0.73 | -0.21 | 0.92 | 0.96 | 0.96 | 0.96 | 0.96 | 1 |
| 4994.0101 | 0.83 | 0.73 | 0.73 | -0.21 | 0.92 | 0.96 | 0.96 | 0.96 | 0.96 | 1 |
| 4994.0101 | 0.83 | 0.73 | 0.73 | -0.21 | 0.92 | 0.96 | 0.96 | 0.96 | 0.96 | 1 |
| | 75 | 86 | 91 | 265 | 91 | 89 | 79 | 79 | 69 | 61 |

| r real world el | 39197 | 39234 | 39257 | 39264 | 39269 | 39270 | 39286 | 3 |
|---|---|---|---|---|---|---|---|---|
| | Water Surface Elevation in Stream (ft) | | | | | | | |
| 5003.284486 | 5002.57449 | 5002.62449 | 5002.62449 | 5003.41449 | 5002.66449 | 5002.57449 | 5002.66449 | 5002.5 |
| 5003.074135 | 5002.30413 | 5002.37413 | 5002.37413 | 5003.03413 | 5002.36413 | 5002.24413 | 5002.26413 | 5002.2 |
| 5002.701403 | 5001.5914 | 5001.6514 | 5001.6514 | 5002.4514 | 5001.8714 | 5001.8214 | 5001.9514 | 5001. |
| 5174.612745 | 5173.41275 | 5173.51275 | 5173.51275 | 5174.61275 | 5173.69275 | 5173.71275 | 5173.81275 | 5173.8 |
| 5173.530015 | 5172.48002 | 5172.53002 | 5172.53002 | 5173.53002 | 5172.49002 | 5172.43002 | 5172.45002 | 5172.4 |
| 5172.69336 | 5171.76336 | 5171.84336 | 5171.84336 | 5172.52336 | 5171.90336 | 5171.71336 | 5171.75336 | 5171.7 |
| | | | 0 | | | | | |
| 4994.0101 | 4993.1801 | 4993.2801 | 4993.2801 | 4994.2201 | 4993.0901 | 4993.0501 | 4993.0501 | 4993. |
| 4994.0101 | 4993.1801 | 4993.2801 | 4993.2801 | 4994.2201 | 4993.0901 | 4993.0501 | 4993.0501 | 4993. |
| 4994.0101 | 4993.1801 | 4993.2801 | 4993.2801 | 4994.2201 | 4993.0901 | 4993.0501 | 4993.0501 | 4993. |
| | 75 | 86 | 91 | 265 | 91 | 89 | 79 | |