

**VEGETATION MONITORING FOR THE JESSE CREEK RESTORATION PROJECT
AT THE NATURE CONSERVANCY'S FLAT RANCH PRESERVE**

By

Michael Mancuso
Conservation Data Center

February 1998



Idaho Department of Fish and Game
600 South Walnut St., P.O. Box 25
Boise, ID 83707
Stephen P. Mealey, Director

Prepared for:
The Nature Conservancy
Idaho Field Office

ABSTRACT

Since the late 1940's, all of the surface water flowing into lower Jesse Creek has been diverted from its historic channel for agricultural purposes. The Jesse Creek restoration project involves returning water to the channel within The Nature Conservancy's Flat Ranch Preserve. This report outlines a monitoring program established in 1997 to evaluate the effects of restoration on the vegetation along the Jesse Creek channel within the Preserve. This information will be used to evaluate the degree to which riparian vegetation restoration goals and objectives are met over the long-term. Vegetation monitoring for the restoration project is designed to collect trend data, and focuses on plant species composition and forage production trends. Monitoring protocol includes the nested plot frequency, line intercept, greenline, and the comparative yield methods. In addition, photo points were established to provide a visual record of the vegetation. Data collected in 1997 represents baseline conditions of selected vegetation attributes for the monitoring program.

Presently, the vegetation of most of the restoration area is characterized by either a mix of native graminoids and introduced pasture grasses, or simply dominated by the pasture grasses. However, some segments are dominated by native sedge, rush, and grass species. Silver sagebrush (*Artemisia cana*) is the only shrub present, occurring in a few small patches. There are no willows or other riparian shrubs in the restoration area. By comparison, willows do occur in places upstream of the point where Jesse Creek is diverted. The Jesse Creek restoration project is unique because it represents a first attempt to restore part of a stream that has had all of its flow diverted for approximately 50 years.

ACKNOWLEDGMENTS

I extend a large thank you to TNC intern Lisa Brennan for help with sampling and recording field data. I used scales and an oven belonging to the US Forest Service Intermountain Research Station in Boise to weigh and dry field samples. I thank Nancy Shaw and Mering Herd for letting me use their equipment. I also appreciate the help and support of Trent Stump and Louise Kellogg with this project.

TABLE OF CONTENTS

ABSTRACT.....	i
ACKNOWLEDGMENTS	i
TABLE OF CONTENTS.....	ii
LIST OF FIGURES	iii
LIST OF TABLES.....	iii
LIST OF APPENDICES.....	iii
INTRODUCTION	1
METHODS	
Plot selection.....	2
Nested plot frequency method	4
Shrub line intercept method	4
Greenline method.....	5
Photo points	5
Comparative yield method.....	6
RESULTS	
Nested plot frequency	7
Line intercept canopy.....	7
Greenline.....	8
Comparative yield.....	10
RECOMMENDATIONS	13
REFERENCES	14

LIST OF FIGURES

Figure 1. Map locations of permanent vegetation monitoring plots for the Jesse Creek restoration project
Figure 2. Comparative yield productivity graph 12

LIST OF TABLES

Table 1. Photo points for Jesse Creek vegetation monitoring plots 6
Table 2. Summary of 1997 shrub line intercept canopy data 8
Table 3. Summary of Greenline transects for plots 97FR014 - 016 10
Table 4. Summary of Greenline transect for plot 97FR017 11
Table 5. Dry weight averages for clipped reference quadrats 12
Table 6. Forage production estimates based on the Comparative yield method 13

LIST OF APPENDICES

Appendix 1. Plot information for plots 97FR014 - 97FR017.
Appendix 2. Copies of the 1997 Community Survey Form (WHTF Form II).
Appendix 3. Copies of the 1997 Ocular Plant Species Data (WHTF Form III) forms.
Appendix 4. Copies of the 1997 Nested Frequency Data forms.
Appendix 5. Data file summary for 1997 nested frequency plot data.
Appendix 6. Copies of the 1997 Shrub Line Intercept Data forms.
Appendix 7. Copies of the 1997 Greenline Transect Data forms.
Appendix 8. Notes for Comparative yield sampling at Jesse Creek.
Appendix 9. Vegetation description for the Comparative yield sampling stations.
Appendix 10. Copies of the 1997 Comparative yield data forms.

INTRODUCTION

Jesse Creek is a tributary of the Henrys Fork that formerly meandered through The Nature Conservancy's (TNC) Flat Ranch Preserve (Preserve). The Preserve is located about four miles southeast of Henrys Lake, in Fremont County, Idaho. Since the late 1940's, the surface water flowing into lower Jesse Creek has been diverted from its original channel for irrigation and stock water purposes. The ditch carrying the shunted water now forms much of the Preserve's eastern boundary. TNC's Jesse Creek restoration project will return water back into the creek's natural low gradient channel along a segment located entirely within the Preserve boundaries. The project area encompasses approximately 5,300 ft (1615 m) of meandering stream length through the Preserve, terminating at the confluence of Jesse Creek with Jones Creek. This equates to a linear length of roughly 2,000 feet (610 m) of Preserve property. An earlier management assessment of the Preserve noted that without implementation of the Jesse Creek restoration project, there would be limited potential to decrease erosion of the irrigation ditch causing sediment deposition into Jones Creek (Ypsilantis 1995). Additional background information regarding the project has been summarized (Robinson n.d.).

The Jesse Creek wetland restoration project has several conservation objectives:

- 1) to restore wetland hydrology;
- 2) to enhance fisheries and wildlife habitat;
- 3) to improve water quality, especially sediment control;
- 4) to restore native wetland plant communities.

Another objective is to use the project as a demonstration for other land owners and managers in the Henrys Fork region. To one degree or another, water in many other streams is diverted into ditch systems for agricultural purposes. This usually affects natural stream hydrology and associated functions such as water quality and fish and wildlife habitat. The Jesse Creek restoration project is an experiment to demonstrate that leaving water in the original stream channel does not necessarily result in reduced forage productivity. If returning more water to the streams can be shown to maintain or improve the amount of forage produced, the premiss is that other ranchers in the area will consider restoration efforts. This will benefit other stream systems and wetland conservation functions while maintaining the area's agricultural base.

There are a number of western streams and rivers whose historic hydrology was intentionally altered to serve human needs, but are now subject to active management efforts to restore original hydrological processes. These restoration efforts are largely due to increasing awareness that functions such as water quality, flood control, and fish and wildlife habitat are better served by an intact hydrological system. One example of a recent restoration effort in Idaho is along part of the Red River in north-central Idaho (Pocket Water Inc. 1997). However, the Jesse Creek restoration project is unique because it represents a first attempt to restore part of a stream that has had all of its flow diverted for so many years (approximately 50 years).

This report outlines a monitoring program established in 1997 to evaluate the effects of restoration on the vegetation along the historic Jesse Creek channel within the Preserve. This information will be used to assess the degree to which riparian vegetation restoration goals and objectives are met over the long-term. Field sampling was conducted July 28 - Aug 4, 1997. Data collected in 1997 represents baseline conditions of selected vegetation attributes and will be used to monitor changes to the vegetation over time. Vegetation monitoring supplements hydrological and other monitoring programs for Jesse Creek.

Vegetation monitoring of meadow habitats throughout the Preserve were established in 1995 as a

cooperative project between TNC and the Idaho Department of Fish and Games's Conservation Data Center. Monitoring at Jesse Creek builds upon this initial monitoring base and extends the working relationship between TNC and the Department.

METHODS

Vegetation monitoring for the Jesse Creek Restoration Project is designed to collect trend data. Trend data quantifies direction of change, if any, away from or towards specific management objectives (Bureau of Land Management 1985). The monitoring focuses on two aspects of vegetation trend - plant species composition and forage production. The nested plot frequency (for herbaceous species), line intercept (for shrub species), and greenline methods are used to monitor trends in composition, while the comparative yield method was chosen to monitor trends in forage production. In addition, photo points were established to provide a visual record of the vegetation at each permanent monitoring site. The original 1997 field data sheets are being archived at the Conservation Data Center office in Boise.

Plot selection

During a reconnaissance of the project area on July 28, I found the meadow vegetation along the original Jesse Creek channel could be classified into one of three broad categories: (1) vegetation dominated by native graminoids; (2) vegetation dominated by introduced pasture grasses, especially timothy (*Phleum pratense*); and (3) vegetation supporting a mix of native and pasture graminoid species. I decided to establish one permanent monitoring plot in each of these three general vegetation categories. The channel segment which was chosen to monitor vegetation supporting native graminoids is the most extensive and highest quality representative of this type within the project area. Of the several channel segments where the vegetation is dominated by pasture grasses, the deciding selection factor was the co-occurrence of silver sagebrush (*Artemisia cana*). Preserve Manager Trent Stump expressed interest in the response of silver sagebrush to the restoration effort. The area chosen was the only place with more than just occasional silver sagebrush plants. The permanent monitoring plot for vegetation containing a mix of native and pasture graminoids is located approximately halfway between the other two plot sites. This ensures the plots are fairly evenly distributed in the project area.

A fourth monitoring plot was established along a stream segment located outside the Preserve just upstream of the point where the water is shunted from the Jesse Creek channel. This reference plot was established with the permission of the adjacent landowner. It may provide insight into future riparian plant community characteristics within the project area. Because no segments of the channel in the project area will be denied water, I was unable to establish a control plot to help validate that changes in the vegetation along the channel are solely in response to the reintroduction of water into the system.

The 13 vegetation monitoring plots established in 1995 were coded 95FR001 to 95FR013 (the first two digits represent the year of establishment, the two letters stand for 'Flat Ranch', and the last three digits are the plot identifiers). Continuing with this convention, the four permanent plots established in 1997 are coded 97FR014 through 97FR017. Plot 97FR014 is dominated by native graminoids, 97FR015 is dominated by pasture grasses with interspersed silver sagebrush shrubs, and 97FR016 contains a mix of native and pasture graminoids. Plot 97FR017 is the riparian reference site located outside the Preserve on nearby private land and supports a willow community on one side of the channel and pasture on the other. Locations for the four monitoring plots are mapped (Figure 1). Each plot is monumented by a metal fencepost with the plot identification number etched on the post. In addition, a nearby Preserve boundary fencepost is marked with the same identification number to assist in relocating the plots. Diagrammatic sketches and other information that will help relocate the permanent plots are contained in Appendix 1.

Figure 1.

Nested plot frequency method

Nested plot frequency sampling and plot metrics use the same protocols as vegetation monitoring plots established in 1995 for the Preserve (Mancuso 1995). This method is best suited for herbaceous-dominated vegetation such as the meadows typifying much of the Preserve. Frequency is the indicator of trend with this method. By comparing the frequency of plants in the same location at two different time periods it is possible to calculate whether a change has occurred.

Plot establishment

Vegetation changes in response to rewatering the channel may be different (in degree and temporally) on opposite sides of the channel, as well as at different distances away from the channel. To monitor these potential differences I established transects at three different distances away from the channel. Plots contains six transects, three on either side of the stream. The transects are 12 m long and run parallel to the channel bearing. They begin (0,0 point) in the middle of the channel, with foot markers located at the 3 m, 10 m, and 25 m points along a baseline. The baselines run perpendicular to the channel and are 25 m in length. A stout plastic stake permanently marks the 3 m foot marker and serves as the reference point for the entire transect. Transects #1 and #4 begin at the 3 m mark, #2 and #5 at the 10 m mark, and #3 and #6 at the 25 m mark.

Plot metrics

Nested frequency sampling was conducted at plots 97FR014, 97FR015, and 97FR016. Plot characteristics and other general information, as well as compositional and structural vegetation data were collected at each plot to supplement the nested frequency data. This was done using methods developed by the Western Heritage Task Force (Bourgeron et al. 1992). Monitoring site characteristics and description were recorded using the WHTF Form II - Community Survey Form. Copies of the 1997 forms are in Appendix 2. A vascular plant species list and corresponding cover value estimates were compiled for each plot area using WHTF Form III - Ocular Plant Species Data. Copies of the 1997 forms are in Appendix 3. Sampling for the plant species data was accomplished using a 0.1 acre circular plot centered around the 0,0 point of the baseline. No voucher specimens were collected, but I was able to identify most plants to species.

Nested frequency data were collected for four quadrat sizes - 5 x 5 cm, 10 x 10 cm, 25 x 25 cm, and 25 x 50 cm. Frequency data were collected for all vascular plant species, litter, bare ground, moss, and soil lichens. Special field forms were prepared to record frequency data. Copies of the 1997 data forms are found in Appendix 4. These data have also been tabulated into a spreadsheet format (Appendix 5).

Two wide-angle (28 mm lens) color slide photographs were taken along each transect using Kodax 100 ASA slide film. I took the photos from a height of approximately 1 meter while positioned one meter behind the start of the transect. One photo is a close-up focused at the 2-meter mark on the transect tape, and the other is set at infinity focus. The complete and labeled 1997 photo record is being submitted to TNC with this report.

Shrub line intercept method

In 1997, the only shrub species present along Jesse Creek were small silver sagebrush plants. However, other shrub species may become established in the future in response to stream restoration efforts. For instance, several willow species (*Salix* spp.) grow along Jesse Creek just upstream of the channel

diversion. Monitoring needs to take this potential change into account. Methods other than nested plot frequency are better for monitoring shrubs. For this reason, monitoring protocol uses the shrub line intercept method to sample shrub species. Methods follow those outlined in the Bureau of Land Management (BLM) manual (Bureau of Land Management 1996).

Shrub line intercept data were collected along the same transects established for frequency sampling in plots 97FR014, 015, and 016. In addition, data were collected along three transects established in reference plot 97FR017. The transects in plot 97FR017 are 20 m in length. Diagrams of the transects are found in Appendix 1. Copies of the 1997 shrub line intercept data forms are contained in Appendix 6.

Greenline method

Another part of the monitoring protocol uses the greenline method. It is a method used extensively by the BLM in Idaho. It was added to the protocol because it is a relatively quick and easy riparian vegetation trend monitoring method. For this reason it may be more appealing to repeat at regular intervals than nested plot frequency sampling, which is more labor and time intensive, as well as requiring more plant identification experience. Greenline vegetation data can complement soil, hydrological, fisheries, or other data collected along a stream. The greenline method is meant to supplement not replace other components of the vegetation monitoring plan.

The greenline method relies on identification of plant community types along a line transect. It generates baseline data describing existing conditions. Trend is monitored by resampling the greenline over time and comparing to previous results. One limitation is that statistical analysis is not possible because the data collection process involves only a single line intercept transect. The data are descriptive, but not a statistical population sample.

The greenline is defined as the area where a more or less continuous cover of vegetation is encountered when moving away from the center of an observable channel (Cagney 1993). Identifying the greenline along Jesse Creek was problematic because the dewatered channel supports a dense sward of herbaceous vegetation. For sampling purposes, I defined the greenline as the top of the channel bank, thereby discounting the vegetation within the channel. This point averages about 0.5 m above the channel bottom in most places. Greenline sampling and ground rules follows the methods outlined in the BLM manual (Cagney 1993).

The greenline was sampled at all permanent plot locations. Greenline transects are 726 ft. (221 m) long. This length is used due to its easy conversion to acreage - 726 ft., six feet wide equates to 0.1 acre. The first 363 feet (111 m) of the transect are read in a downstream direction on the right side of the channel (facing downstream). At this point the channel is crossed to the left side, and the second 363 feet are read in the upstream direction backs towards the starting point. The starting point for the greenline transect is not permanently marked. It is determined by following the baseline bearing (a bearing perpendicular to the channel bearing and determined earlier for the nested frequency sampling) from the permanent plot marker post to the channel. Where this bearing intersects the channel is the greenline starting point. Greenline community types along Jesse Creek are described in a later section of this report. Copies of the 1997 data sheets are in Appendix 7.

Photo Points

I established photo points at all the permanent plots along Jesse Creek as part of the monitoring record. Photo points provide a visual record of the landscape at the monitoring plots. Comparing photographs of

the same site taken over a period of years gives visual evidence of changes to landscape features such as the vegetation, and helps interpret other long-term monitoring information (Bureau of Land Management 1996).

Photographs were taken from three places at each plot that correspond to points along the baseline transect established for nested frequency sampling. These are the 0,0 point (the middle of the channel), and the two permanently marked 3 m footmarks on either sides of the channel. To provide a reference for distance and height, a 6 foot (2 m) rod was placed in the middle of the channel 10 m and then 20 m from the 0,0 point noted above. The base of the rod is positioned in the approximate center of the photo. Photographs were taken while standing upright facing downstream and then upstream. This results in twelve photographs for each plot. Table 1 summarizes the photos taken at each photo point. Photographs were taken using Kodak 100 ASA slide film, with a wide angle (28 mm) lens set at infinity focus. The labeled 1997 photo point record is being submitted to TNC with this report.

Table 1. Photo points for the Jesse Creek vegetation monitoring plots.

Plot #	Direction	middle of channel		right side of channel (3 m stake)		left side of channel (3 m stake)	
		10 m	20 m	10 m	20 m	10 m	20 m
97FR014	downstream	1	2	3	4	5	6
	upstream	7	8	9	10	11	12
97FR015	downstream	13	14	15	16	17	18
	upstream	19	20	21	22	23	24
97FR016	downstream	25	26	27	28	29	30
	upstream	31	32	33	34	35	36
97FR017	downstream	37	38	39	40	41	42
	upstream	43	44	45	46	47	48

Comparative yield method

In addition to collecting plant composition trend information, one of the main goals of the Jesse Creek monitoring plan is to monitor forage production. To estimate forage production I chose the comparative yield method. This method evaluates total forage production, but does not determine the relative contribution of individual forage species. Details regarding the sampling process, data collection, and analysis follows the BLM (1996).

For sampling purposes, the target area for estimating forage was defined as 25 m (83 ft) on either side of the Jesse Creek channel. The target area was stratified into ten separate 500 foot (152 m) segments to distribute sample stations throughout the approximately 5,000 feet of channel length. Forage estimates are based on data collected at ten randomly chosen sampling stations along the creek, one within each 500 foot channel segment. Appendix 8 outlines the sampling specifics used for Jesse Creek.

RESULTS

The potential natural vegetation for the project area is probably a mosaic of sedge (*Carex* spp.), willow (*Salix*)/sedge, and perhaps tufted hairgrass (*Deschampsia cespitosa*) wetland types. Based on observations from other riparian sites in the Henrys Fork area, the main sedge types are likely bladder sedge (*Carex utriculata*), short-beaked sedge (*C. simulata*), and possibly water sedge (*C. aquatilis*) and thickheaded sedge (*Carex pachystachya*). The primary willow types are likely part of the Booth's willow (*Salix boothii*) and/or Geyer's willow (*S. geyeriana*) series.

Nested plot frequency

Baseline frequency data collected during 1997 will be used to monitor vegetation trend in the project area. In addition, plot 95FR001 near (a little west) the Jesse Creek channel was established in 1995 (Mancuso 1995) and will provide additional trend data for the project area. Frequency data were collected at 95FR001 in 1995 and 1996 (Mancuso 1996).

No trend analysis of the nested frequency data can be made with only one year of data. After two years of data collection it will be possible to test the null hypothesis that no change has occurred over time. This can be done based on a paired *t* statistic computed from the change in plot frequencies. Another option is to use CALCFREQ, a statistical software program designed to calculate percent frequency and test for significant differences in frequency between two different time periods (Patton and Nyren 1992). When more than two years of data are available, more sophisticated methods will be necessary, such as repeated measures ANOVA.

Plot 97FR014 is dominated by native mesic graminoids. Awned sedge (*Carex atherodes*) has the highest frequency, while meadow barley (*Hordeum brachyantherum*) and Baltic rush (*Juncus balticus*) also have relatively high frequency values throughout the plot. Awned sedge is probably the most obligate wetland indicator species found in any of the nested frequency plots. Tufted hairgrass and thickheaded sedge have higher frequency values along transects further away from the channel. Frequency for litter is high, but very low for bare ground. No introduced species were sampled.

The highest frequency values throughout plot 97FR015 are for the introduced pasture grasses timothy and Kentucky bluegrass (*Poa pratensis*). The most frequently sampled native graminoid was thickheaded sedge. Other native mesic graminoids were infrequently sampled. Unlike plot 97FR014, the frequency of bare ground was high. These results indicate that the vegetation characterizing 97FR015 is the most altered of the three nested frequency plots.

Plot 97FR016 contains a more even mix of native and introduced graminoids. The frequency values for introduced grasses increases for transects located further from the channel. Thickheaded sedge was the most commonly sampled native graminoid throughout the plot, with Nebraska sedge more or less restricted to one side of the channel. Awned sedge was sampled only along a transect closest to the channel. No consistent pattern was discerned for the other native graminoids.

Shrub line intercept

Plots 97FR014, 015, and 016 contain six transects, each 12 m long. This equates to a total transect length of 72 m (7,200 cm) for each plot. Plot 97FR017 has three 20 m long transects, for a total of 60 m (6,000 cm).

Silver sagebrush was the only shrub species I observed in the project area during 1997. It was present at low densities (3% canopy cover) in plot 97FR015, but absent from the other plots. Willows occur in a local, but pretty dense band along Jesse Creek just upstream of the creek diversion. Reference plot 97FR017 encompasses part of this willow band. Booth's willow (*Salix boothii*), Geyer's willow (*Geyer's willow*), and planeleaf willow (*Salix planifolia*) had a combined 71% canopy cover for this plot. Table 2 summarizes the 1997 shrub line intercept data.

Table 2. Summary of the 1997 shrub line intercept data.

	Shrub canopy intercept (cm)				Shrub canopy intercept (% cover)			
	Plot 014	Plot 015	Plot 016	Plot 017	Plot 014	Plot 015	Plot 016	Plot 017
Silver sagebrush	0	186	0	0	0	3	0	0
Booth's willow	0	0	0	2690	0	0	0	36
Geyer's willow	0	0	0	700	0	0	0	9
Planeleaf willow	0	0	0	1940	0	0	0	26
Total	0	186	0	5330	0	3	0	71

Greenline

Prior to sampling, I compiled a list of eight greenline plant community variations occurring along Jesse Creek within the Preserve and three additional variations present further upstream in the vicinity of plot 97FR017. The variations are based on observable species composition and ratio differences. Even though the variations occur along a common gradient it was easy to differentiate and chose one of the types in most cases. The greenline type names are meant to be descriptive and do not follow any formal classification scheme.

Greenline types for greenline transects:

1. Sedge spp. - dominated by a dense cover of sedge species, most notably awned sedge. Other native graminoids, especially meadow barley and to a lesser extent tufted hairgrass and Baltic rush may be present, but at relatively low cover. Forbs usually occur at low cover. Introduced species are absent or rare.
2. Thickheaded sedge/forb - characterized by a relatively open coverage of mesic native graminoids dominated by thickheaded sedge. Meadow barley is usually common, while tufted hairgrass may or may not be prominent. Baltic rush generally occurs at low cover. Forb cover is often high (30% or greater). The forb component is dominated by native species that are relatively tolerant of, or tend to increase with livestock grazing, such as, long-stalked clover (*Trifolium longipes*), cinquefoil (*Potentilla gracilis*), Fendler's meadowrue (*Thalictrum fendleri*), meadow arnica (*Arnica chamissonis*), and common yarrow (*Achillea millefolium*). Exotic forbs are rare along the greenline, although they may be common nearby. This is the case for all the greenline types within the project area. Introduced pasture grasses are absent or

rare.

3. Tufted hairgrass - tufted hairgrass is the dominant species, although other native graminoids such as thickheaded sedge, meadow barley, and Baltic rush are often well represented. Forb cover tends to be low. Introduced pasture grasses are absent or rare.

4. Baltic rush - dominated by Baltic rush with low cover of other graminoids if they are present. Forb cover is variable, but can be high. Introduced pasture grasses are absent or rare.

5. Native graminoid-pasture grass mix - supports a mix of mesic native graminoid and pasture grass species. Tufted hairgrass, meadow barley and Baltic rush are the most likely native species, with timothy, and sometimes also meadow foxtail (*Alopecurus pratensis*) being the common pasture species. Either the combined native or pasture species can have greater overall cover. Forbs tend to be common within this mix.

6. Timothy/forb - strongly dominated by timothy, an introduced pasture grass. Native grasses may occur, but are clearly subordinate (less than 20% cover). Forbs tend to be common.

7. Silver sagebrush/timothy - similar to #6 except silver sagebrush is intermixed.

8. Forb spp. - forb-dominated vegetation with interspersed graminoids. Forb cover is over 50%, and approaches 90% in many situations. Long-stalked clover, cinquefoil, Fendler's meadowrue, and meadow arnica are the most abundant species. Other forb species occur at much lower cover.

9. Booth's willow/sedge spp. - dominated by a mix of willow species including Booth's willow, Geyer's willow, Wolf's willow (*Salix wolfii*), and planeleaf willow. The understory contains a diverse mix of graminoids and forbs. Introduced species are rare or absent.

10. Kentucky bluegrass - characterized by a Kentucky bluegrass turf. This is an introduced species.

11. Canada thistle - dominated by the weed Canada thistle (*Cirsium arvense*).

Note: types 9 -11 were present only in the vicinity of plot 97FR017 in 1997. It should also be noted that tiny sections of bare ground (1 ft. in plot 97FR014 and 3 ft. in plot 97FR017) were noted along the greenline in two of the plots.

Overall, sedges are more common along the greenline than in other portions of the associated plots. Even after decades of dewatering there are remnant indications of wetter conditions along the channel compared to just a few meters away. Along one of the banks in reference plot 97FR017 there is a willow and sedge community. The other side of the channel contains pasture grass-dominated vegetation. The greenline data for this plot incorporates both of these contrasting vegetations. Greenline data for the four plots are summarized in Tables 3 and 4.

Of the eight greenline types observed within the Preserve, probably only two of them represent "native" wetland types for Jesse Creek - the sedge species and tufted hairgrass types. These two types accounted for 36% of the greenline measured at the three Preserve plots. Although the thickheaded sedge and Baltic rush types are comprised of native species, their characterization and occurrence is likely due to anthropogenic influences. They account for 30% and <1%, respectively of the greenline for the three plots. The native graminoid-pasture grass mix, timothy/forb, silver sagebrush/timothy, and forb spp. types

are more clearly related to anthropogenic causes and account for a combined 33% of the greenline at the three plots.

The sedge species greenline type is common along transects both within and outside the Preserve. The Table 3. Summary of Greenline transects for plots 97FR014 - 016.

Greenline type name	Greenline type length (ft)			Greenline type length (%)			Combined greenline type length (%)
	Plot 014	Plot 015	Plot 016	Plot 014	Plot 015	Plot 016	
Sedge spp.	383	255	12	53	35	2	30
Thickhead sedge/forb	218	117	316	30	16	44	30
Tufted hairgrass	0	0	132	0	0	18	6
Baltic rush	0	0	8	0	0	1	<1
Native-pasture mix	34	37	0	5	5	0	3.3
Timothy/forb	0	290	103	0	40	14	18
Silver sage/timothy	0	20	0	0	3	0	1
Forb spp.	89	0	154	12	0	21	11
Booth's willow/sedge	0	0	0	0	0	0	0
Kentucky bluegrass	0	0	0	0	0	0	0
Canada thistle	0	0	0	0	0	0	0

thickheaded sedge type is common (30%) along the Preserve's greenline, but absent from the reference plot transect. The forb type is also fairly common (11%) within the Preserve, but absent from the reference plot. On the other hand, the Booth's willow/sedge type accounts for 15% of the reference plot greenline, but is absent from the Preserve.

Depending on management objectives it is possible to identify desirable and undesirable greenline types based on criteria such as watershed stability, biodiversity value, ability to form overhanging banks, and forage value. The baseline greenline data can help Preserve managers formulate site specific and measurable vegetation objectives for Jesse Creek. For example, one restoration objective may be to increase the amount of sedge type and decrease the amount of timothy/forb type by 10% within five years. A number of similar greenline objectives can be adapted from recommendations made by Ypsilantis (1995). The greenline provides monitoring trend information for such objectives.

Comparative yield

The forage base in the project area is dominated by graminoid species, the same as most other parts of the Preserve. Common graminoid species in the project area include thickheaded sedge, tufted hairgrass, meadow barley, timothy, and Kentucky bluegrass. Forbs contribute varying amounts of forage. In some areas they are sparse, but in other places abundant. Common forb species include cinquefoil, long-stalked clover, and

Table 4. Summary of Greenline transect for plot 97FR017.

Greenline type name	Greenline type length (ft)	Greenline type length (%)
	Plot 017	Plot 017
Sedge spp.	384	53
Thickhead sedge/forb	0	0
Tufted hairgrass	0	0
Baltic rush	0	0
Native-pasture mix	0	0
Timothy/forb	209	29
Silver sage/timothy	0	0
Forb spp.	0	0
Booth's willow/sedge	112	15
Kentucky bluegrass	10	1
Canada thistle	8	1

common dandelion (*Taraxacum officinale*). Although gross vegetation characteristics appear homogeneous throughout the project area, at a finer scale there is actually quite a bit of variability in the amount of vegetation cover, species dominance, and the size of plants. As a result, the amount of biomass and associated forage is also variable. Areas that appeared to be the driest tended to have the least biomass and the most bare ground cover.

Dry weights of comparative yield method reference quadrats are presented in Table 5. A graph (Figure 2) generated by the reference series was used to estimate yield data in kg/ha and lb/acre of forage for each transect station using the ratio estimate technique. The least-squares regression technique is recommended for more precise analysis.

Forage estimates are based on data collected at ten sampling stations. Yields calculated for the transect stations ranged from 1970 kg/ha (1758 lb/acre) to 2700 kg/ha (2409 lb/acre) (Table 6). Averaging the ten stations resulted in an estimated yield of 2402 kg/ha (2144 lb/acre) for the project area in 1997. No forage estimate sampling was conducted at reference plot 97FR017. A brief description of each transect station is

provided in Appendix 9. Copies of the 1997 data forms are in Appendix 10.

The soils around Jesse Creek have been mapped as the Sawtelpeak unit (Soil Conservation Service 1993). Rangeland productivity for this soil unit is listed as 3,000 lb/acre during favorable years, 2,250 lb/acre during normal years, and 1,600 lb/acre during unfavorable years. The type of year is largely dependent on precipitation amounts and patterns. The 1997 data are slightly below productivity yields expected for a normal year. I expected yields to be somewhat higher at a few transects, but was not surprised by the

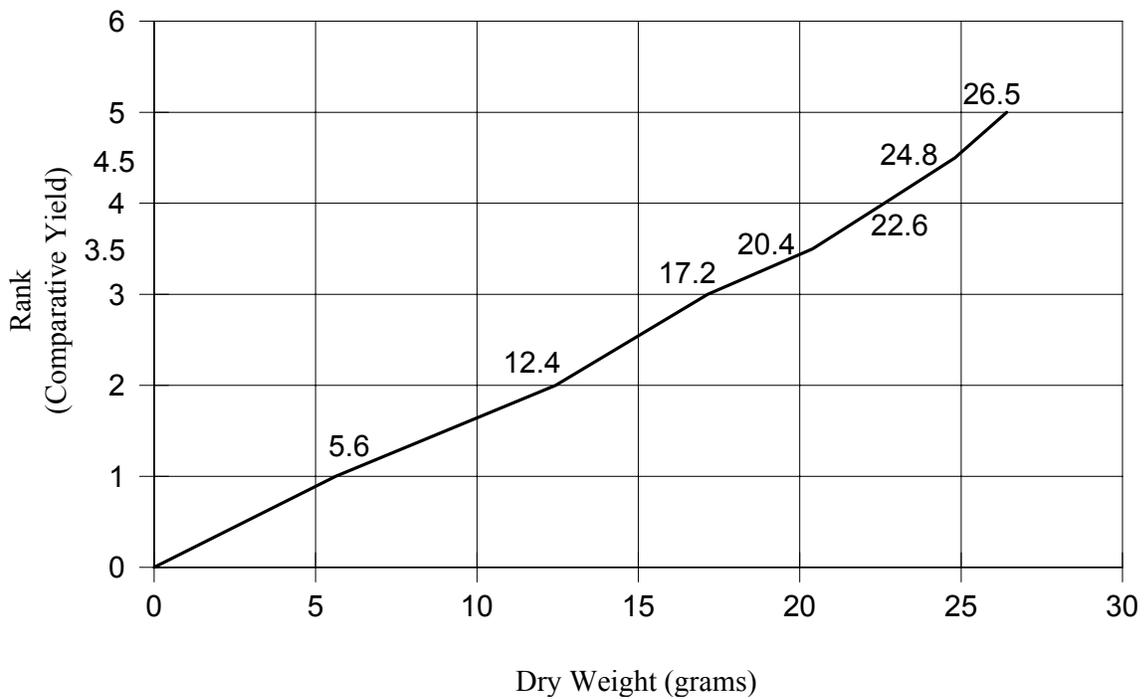
Table 5. Dry weight averages for clipped reference quadrats.

Reference No.	Dry Weight (grams)
1	5.62
2	12.52
3	18.35
4	22.62
5	26.41

Table 6. Forage production estimates based on the Comparative yield method.

Transect Station No.	Dry weight yield (kg/ha)	Dry weight yield (lb/acre)
1	2,608	2,328

Figure 2. Comparative yield productivity graph



2	2,481	2,214
3	2,171	1,937
4	2,280	2,035

5	2,298	2,051
6	1,970	1,758
7	2,317	2,068
8	2,700	2,409
9	2,627	2,345
10	2,517	2,246
Average yield	2,402	2,144

relatively low yields generated at other transects. The baseline productivity estimates suggest less than optimum yields under the current management system. Future sampling and analysis will reveal if productivity improves in the restoration area.

RECOMMENDATIONS

1. GPS coordinates need to be obtained for the four permanent monitoring plots (97FR014, 015, 016, and 017) established in 1997. This will help document their location and assist relocating them in the future. If at some point in the future the plot monument posts get destroyed, the plots can be more accurately reestablished if GPS information is available. Any other future permanent monitoring stations should also receive GPS coordinates.
2. Forage production transect stations should probably be made permanent to facilitate trend data analysis. Although trend analysis is possible using variable plots like those used in 1997, permanent sampling units are suggested (Bureau of Land Management 1996). The transect stations I sampled in 1997 can be remeasured and permanently marked in the future. The approximate location of each transect station can be found by using the distances noted in Appendix 8. The riparian exclosure fence that will be built along Jesse Creek can be used to help reference and relocate these stations in the future.
3. I recommend all plots be resampled the same year. The first round of resampling should take place within two or three years. After the second round of sampling we should have a better idea of how often future resampling needs to occur. It will likely be in the three to five year range.
4. Repeatability and comparing data sets from different years will be substantially enhanced if sampling is conducted at the same phenological stage as the baseline data. Sampling in 1997 occurred when all the major graminoid and most forb species were in flower. Exceptions include common dandelion, white mule's ears (*Wyethia helianthoides*), bistort (*Polygonum bistortoides*), and yampah (*Perideridia gairdneri*), which were largely done flowering. Standing biomass was close to its annual peak for most species. The end of July to early August would be a suitable time most years.
5. In retrospect, it was not necessary to take as many photographs at each photo point as I did in 1997. Using two reference rods simultaneously, one each for the 10 m and 20 m reference marks, would result in half as many photos. Also, using one of the reference stakes (either left or right side of channel) instead of both of them seems sufficient for photo-documentation purposes. Furthermore, it may be more convenient to use print film in the future.

6. Locating a high quality riparian reference plot would be helpful to interpret vegetation changes associated with the restoration project. Plot 97FR017 is a small reference area that probably does not encompass the range of variability expected for the project area. Beside the willow community, there is a small patch of bladder sedge adjacent to the plot that was not sampled in 1997. A portion of another similar-sized spring-fed creek in the area (such as Stephens, Jones, or Meadow creeks) may provide a more complete reference series. This may prove difficult because nearby comparable low-gradient stretches have all likely been impacted by years of livestock grazing.

REFERENCES

- Bourgeron, P.S., R.L. DeVelice, L.D. Engelking, G. Jones, and E. Muldavin. 1992. WHTF site and community survey manual. Version 92B. Western Heritage Task Force, Boulder, CO. 24 p.
- Bureau of Land Management. 1985. Rangeland monitoring trend studies. Technical Reference 4400-4. Bureau of Land Management, Denver Service Center, Denver, CO. 130 p.
- Bureau of Land Management. 1996. Sampling vegetation attributes. Interagency Technical Reference, BLM/RS/ST-96/002+1730. Bureau of Land Management's National Applied Resource Sciences Center. 163 p.
- Cagney, J. 1993. Riparian area management. Greenline riparian-wetland monitoring. Technical Reference 1737-8. Bureau of Land Management Service Center, Denver, CO. 45 p.
- Mancuso, M. 1995. Establishment of vegetation monitoring at The Nature Conservancy's Flat Ranch Preserve, Fremont County, Idaho. Unpublished report prepared for The Nature Conservancy, Idaho Field Office, Ketchum, ID. 26 p., plus appendices.
- Mancuso, M. 1996. Vegetation monitoring at The Nature Conservancy's Flat Ranch Preserve: 1996 results. Unpublished report prepared for The Nature Conservancy, Idaho Field Office, Ketchum, ID. 8 p., plus appendices.
- Patton, B.D., and A.C. Nyren. 1992. CALCFREQ. North Dakota State University, Central Grasslands Research Center, Streeter, N.D.
- Pocket Water Inc. 1997. Lower Red River meadow restoration project: 1997 monitoring plan. Unpublished report prepared by Pocket Waster Inc., Boise, ID. 20 p., plus appendices.
- Robinson, S. no date. Jesse Creek wetland demonstration project. Unpublished report prepared by the Idaho Falls Office of the State of Idaho Division of Environmental Quality, for The Nature Conservancy, Idaho Field Office, Ketchum, ID. 5 p.
- Soil Conservation Service. 1993. Soil survey of Fremont County, Idaho, western part. USDA Soil Conservation Service.
- Ypsilantis, B. 1995. The Nature Conservancy's Flat Ranch Project. Idaho Riparian Cooperative report to The Nature Conservancy: recommended management objectives and monitoring techniques. Unpublished report prepared for The Nature Conservancy, Idaho Field Office, Ketchum, ID. not paged.

Appendix 1

Plot information for plots 97FR014 - 97FR017.

This appendix provides information concerning the description, layout, and location of the four permanent monitoring plots established in 1997. Baselines and transects were established for the nested plot frequency and line intercept canopy monitoring methods. However, both the greenline method and photo point establishment utilize markers within the permanent plots. All bearings are referenced with compass declination set at 0° . The three plots within the Preserve are monumented by a metal fencepost with the plot identification number etched on the post. Plot 97FR017 on nearby private land is monumented by a stout orange stake hammered into the ground. All plots have a witness marker to help relocate them. These are red-painted squares of metal with a plot identification number, and nailed to a nearby Preserve boundary fencepost. They are called “marked fencepost” in the plot sketches. Sketches of the plots are not to scale.

Plot 97FR014

Plot 97FR014 is located along Jesse Creek roughly 120 m (400 ft.) as the crow flies downstream of the head of the diversion ditch. This is closer to the channel and about 60 m (200 ft.) north of plot 95FR001. Bladder sedge dominates segments of the channel bottom with shallow (<2 cm) standing water, while short-beaked sedge occurs where the bottom substrate is only saturated. The area near the channel is subirrigated and dominated by native graminoid species, especially awned sedge or other sedge species. Tufted hairgrass is rare close to the channel. It becomes more abundant further away and is the dominant grass in places outside the plot zone. Meadow barley is common throughout the plot. The native graminoids are joined by pasture grasses outside the plot area. Several forb species are present in varying amounts.

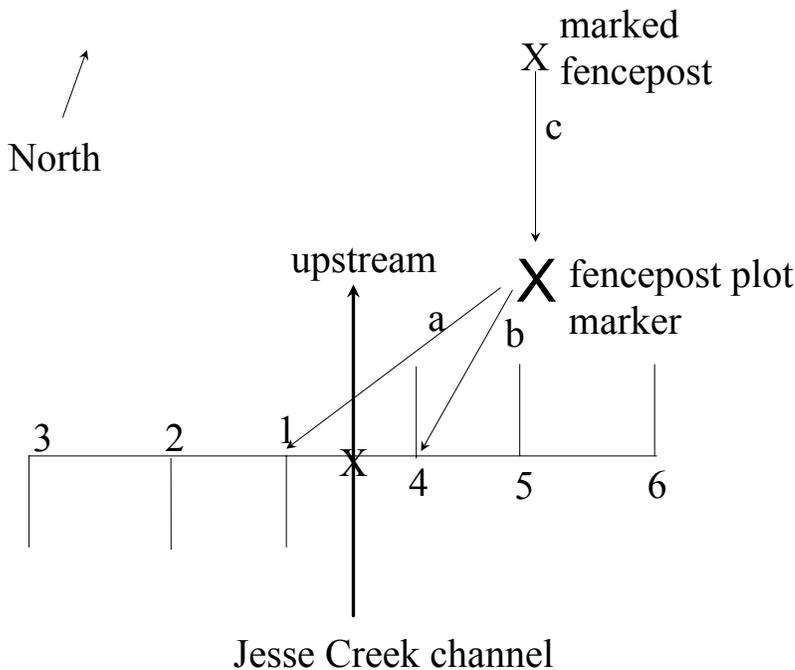
Baseline bearing for transects 1-3 = 245°
Bearing for transects 1-3 = 155°
Baseline bearing for transects 4-6 = 65°
Bearing for transects 4-6 = 335°

Transects 1-3 run in a downstream direction
Transects 4-6 run in an upstream direction
Left side of transect tape = transects 1, 2, 3, 5
Right side of transect tape = transects 4, 6

a - transect #1 footmark stake located 17.3 m
at 190 degree bearing from fencepost

b - transect #4 footmark stake located 14.6 m
at 170 degree bearing from fencepost

c - plot marker post located 162 paces at a
165 degree bearing from marked fencepost

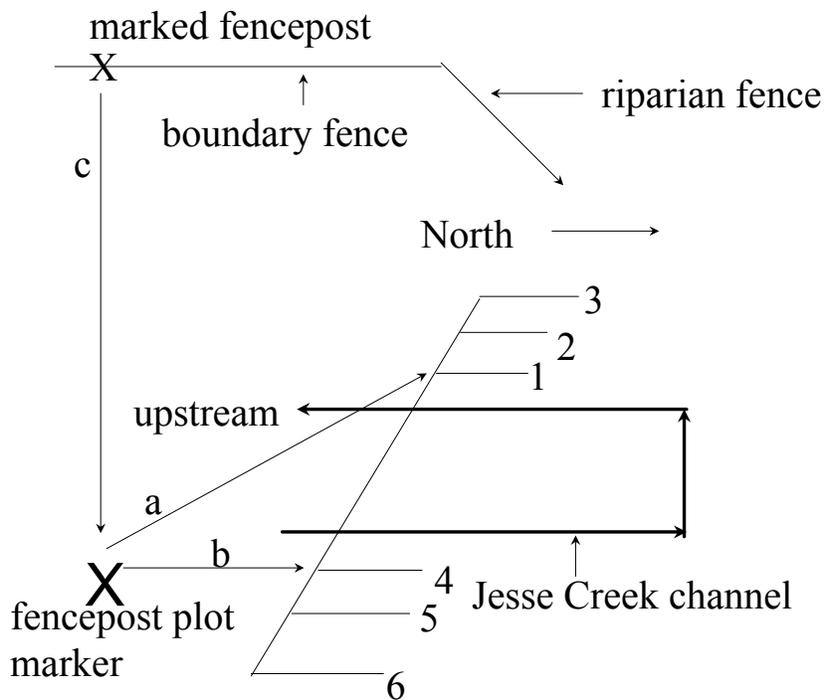


Plot 97FR015

This plot is located along the Jesse Creek channel about 120 m (400 ft.) as the crow flies, upstream of its confluence with Jones Creek. There is a large meander loop in the channel where the plot is located. Shallow standing water is present in the channel and appears to extend all the way to Jones Creek. The flat terrace is strongly dominated by timothy with interspersed silver sage. Forb and graminoid diversity is relatively high, although no other species are particularly abundant. The wedge of vegetation within the channel loop is dominated by sedge species and is obviously wetter than the nearby terraces. To sample the silver sage/timothy community, but avoid the sedge community, both transect baselines are located on the left side of the channel (facing downstream). Also note that the 3 m foot marker for transect #1 is actually 6 m from the center of the channel (not 3 m). The baseline is still 25 m long, but its beginning point is at the edge of the channel and not the middle of the channel. This was done to prevent Transect #1 from running into the meandering channel.

Baseline bearing for transects 1-3 = 343°
 Bearing for transects 1-3 = 73°
 Baseline bearing for transects 4-6 = 125°
 Bearing for transects 4-6 = 215°

All transects run in a downstream direction
 Left side of transect tape = transects 2, 5
 Right side of transect tape = transects 1, 3, 4, 6



a - transect #1 footmark stake located 28.3 m (across channel loop) at 310 degree bearing from fencepost

b - transect #4 footmark stake located 3.9 m at 350 degree bearing from fencepost

c - plot marker post located 121.5 m at a 268 degree bearing from marked fencepost. The marker post is the 8th post north of the junction between the boundary and riparian fences

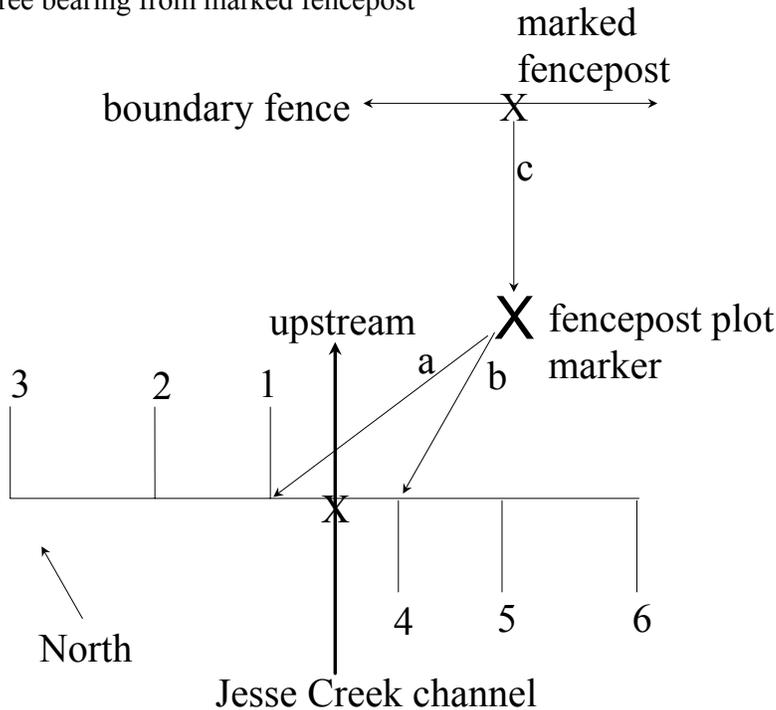
Plot 97FR016

Plot 97FR016 is situated along the Jesse Creek channel about halfway between plots 97FR014 and 015. The plot supports a mix of native and introduced graminoids. Native graminoids are more abundant on the right side (facing downstream) of the channel than the left. Overall graminoid diversity is very high. Forb diversity is also high, with a skewed abundance of several “increaser” forbs species. Further away from the channel and outside the plot the vegetation is dominated by pasture grasses.

Baseline bearing for transects 1-3 = 316° .
Bearing for transects 1-3 = 46° .
Baseline bearing for transects 4-6 = 136° .
Bearing for transects 4-6 = 226°

Transects 1-3 run in an upstream direction.
Transects 4-6 run in a downstream direction.
Left side of transect tape = transect 1
Right side of tran. tape = transects 2, 3, 4, 5, 6

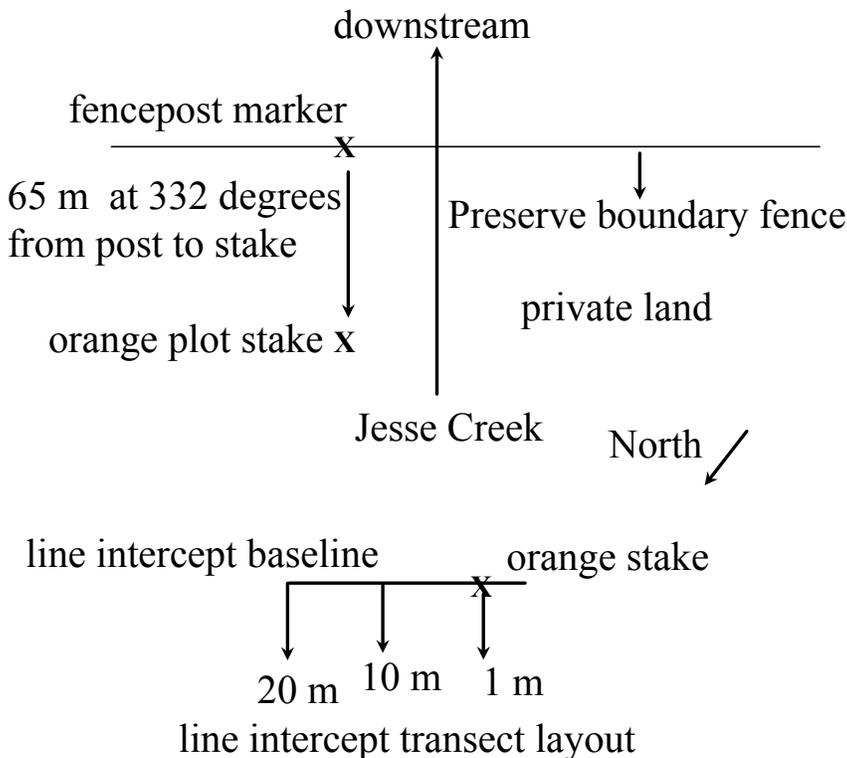
- a - transect #1 footmark stake located 11.2 m at 292 degree bearing from fencepost
- b - transect #4 footmark stake located 5.3 m at 280 degree bearing from fencepost
- c - plot marker located 128 m at 266 degree bearing from marked fencepost



Plot 97FR017

This plot is located just upstream of the Jesse Creek diversion ditch on private land adjacent to the Preserve. The right side (facing downstream) of the channel supports a willow community with understory composition varying along a moisture gradient. The wettest segment, with supersaturated soils is dominated by wet sedge species. The driest portions are situated furthest from the channel and support an understory dominated by timothy and Kentucky bluegrass. There is also an intermediate condition dominated by native graminoids, but these are not as dense as the wettest section. The willow species observed were Booth's willow, Geyer's willow, planeleaf willow, and Wolf's willow. In contrast, the other side of the channel is dominated by timothy and a mix of forb species, with only a few widely scattered willow plants. Water depth in Jesse Creek during the sampling period was about 40 cm (16 inches). The channel bottom is gravelly and silty. No rooted vascular plants were growing within the channel.

Because it is on private land there is no fencepost marker for this plot. Instead, a less obtrusive orange plastic stake was hammered into the ground to monument the plot. Three 20 m long transects were established for shrub line intercept sampling. The baseline bearing for the line intercept transect was 110° , while the transect bearing was 20° (same bearing as the channel). Transects were run in an upstream direction at 1 m, 10 m, and 20 m distances from the edge of the channel. The orange monument stake represents the 1 m foot mark for the baseline. Because no nested frequency sampling was conducted, the plot specifics drawn below look different than the other plots. The shrub line intercept transect is depicted in the diagram. A community survey (Form II; see Appendix 2) and associated ocular plant species plot (Form III; see Appendix 3) were completed for the wettest portion of the willow riparian mosaic.



Appendix 2

Copies of the 1997 Community Survey Form (WHTF II).

Appendix 3

Copies of the 1997 Ocular Plant Species Data (WHTF III) forms.

Appendix 4

Copies of the 1997 Nested Plot Frequency Data forms.

Appendix 5

Data file summary for 1997 nested frequency plot data.
(Lotus 1-2-3 Release 5 file)

Appendix 6

Copies of the 1997 Shrub Line Intercept Data forms.

Appendix 7

Copies of the 1997 Greenline Transect Data forms.

Appendix 8

Notes for Comparative yield sampling at Jesse Creek.

Notes for Comparative yield sampling at Jesse Creek.

Establishing the necessary references required field reconnaissance and testing. Five reference quadrats were subjectively located, clipped at ground level, and weighed. Reference 1 is representative of low-yielding situations commonly encountered in the study area, while reference 5 equates to the highest-yielding situations. References 2, 3, and 4 represent a linear series of intermediate situations.

Based on field testing, a quadrat size of 25 x 25 cm was found to work well for the Jesse Creek area. All clippings were placed in labeled paper bags. A Homs Model 100g Instrument and Laboratory scale was used to weigh reference and sample clippings in the field. Within a few days of completing field work reference and sample collections were dried for 24 hours at 100⁰F (38⁰C) in a Despatch LDB Series oven. Dried material was weighed on a Mettler PC2000 model balance.

The target sample area was defined as 25 m (83 ft) on either side of the Jesse Creek channel. Jesse Creek meanders for approximately 5,300 feet (1615 m) through the project area, and was stratified into ten separate 500 foot (152 m) segments for sampling purposes. Measurements began from the point where Jesse Creek enters the Preserve, about 0.5 mile upstream of its confluence with Jones Creek. Two transects, one on either side of the channel were established within each of the ten segments to collect comparative yield data. The transects are 25 m long, but not permanently marked. Transect stations were located by pacing (2.5 ft./step for the author) each randomly determined distance along the channel. The transects were then established at a randomly chosen bearing, with the only constraint being the bearing not cross back over the channel. The first transect was positioned along the random bearing, with the back azimuth used to establish the second transect across the channel. Transects on the left side of the channel were read on the left side of the tape, and vice versa for the right side. On both sides of the channel, the transect begins at the top of the channel bank (therefore, no quadrats are placed in the channel), with quadrats read every odd meter integer along the transect tape (e.g., 1, 3, etc.). Twenty-five quadrats were read for each transect (13 on the first transect and 12 on the other), for a total of 250 in the project area.

Transect station segments for Comparative yield sampling.

Transect station # (channel segment)	channel segment stratification ft.	distance from start of transect ft. (m)
1	0 - 500	87 (26.5)
2	501 - 1000	738 (225)
3	1001 - 1500	*969 (295)
4	1501 - 2000	1565 (477)
5	2001 - 2500	2025 (617)
6	2501 - 3000	2672 (814)
7	3001 - 3500	3067 (935)
8	3501 - 4000	3663 (1116)
9	4001 - 4500	4213 (1284)
10	4501 - 5000	4718 (1438)

* A measuring mistake was not noticed until sampling was completed.

Appendix 9

Vegetation description for the Comparative yield sampling sites.

Vegetation description for the Comparative yield sampling sites.

Transect station 1 - vegetation dominated by native mesic graminoids such as sedges, tufted hairgrass, and meadow barley, with varying amounts of forbs.

Transect station 2 - vegetation dominated by native mesic graminoids with high forb cover in places. There are also scattered patches of timothy present.

Transect station 3 - a patchwork of native graminoid-dominated and pasture grass-dominated areas, with a mixing of the two types in places. The vegetation is sparse in places. This station is located near plot 95FR001.

Transect station 4 - a mix of native and pasture graminoid species. Timothy dominates some segments, while thickheaded sedge is the primary native graminoid and is often mixed with lots of forbs.

Transect 5 - a timothy/forb combination characterizes most of the vegetation, although native mesic graminoids intermix in places. This station is located very close to plot 97FR016.

Transect 6 - timothy dominates the vegetation, varying from moderately to quite dense. Forbs are generally abundant. Inclusions with native graminoids appear dry and have minimal biomass production. The transects missed most of the timothy in the area.

Transect 7 - vegetation dominated by timothy and Kentucky bluegrass with varying forb cover.

Transect 8 - vegetation dominated by pasture grasses, especially timothy, which is dense in places. Interspersed are patches of sparse pasture grass, or thickheaded sedge. Forb cover varies from high to sparse. There is a small amount of silver sage present.

Transect 9 - mostly timothy, with some Kentucky bluegrass and patches of native graminoid species. The timothy is tall and dense in places.

Transect 10 - dominated by timothy except in the area between the split channels or depressions which contain more mesic native graminoids. Silver sagebrush is scattered in the area.

Appendix 10

Copies of the 1997 Comparative yield data forms.