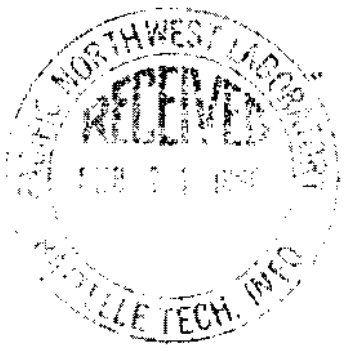
PNNL-10953
UC-702



Monitoring and Mapping Selected Riparian Habitat Along the Lower Snake River

J. L. Downs
B. L. Tiller
M. Witter
R. Mazaika

January 1996

Prepared for
the U.S. Army Corps of Engineers
Walla Walla District
under a Related Services Agreement
with the U.S. Department of Energy
Contract DE-AC06-76RLO 1830

Pacific Northwest National Laboratory
Operated for the U.S. Department of Energy
by Battelle

Battelle

PNNL-10953

PACIFIC NORTHWEST NATIONAL LABORATORY
operated by
BATTELLE
for the
UNITED STATES DEPARTMENT OF ENERGY
under Contract DE-AC06-76RLO 1830

Printed in the United States of America

Available to DOE and DOE contractors from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831; prices available from (615) 576-8401.

Available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161

PNNL-10953
UC-702

Monitoring and Mapping Selected Riparian Habitat Along the Lower Snake River

J. L. Downs
B. L. Tiller
M. Witter[a]
R. Mazaika[b]

January 1996

Prepared for the
U.S. Army Corp of Engineers, Walla Walla District
under a Related Services Agreement
with the U.S. Department of Energy
Contract DE-AC06-76RLO 1830

Pacific Northwest National Laboratory
Richland, Washington 99352

(a) Shannon and Wilson, Inc. Geotechnical and Environmental Consultants, Seattle, Washington.
(b) U.S. Army Corp of Engineers, Portland, Oregon.

Executive Summary

In support of the System Operating Review (SOR) for the Columbia River system, Pacific Northwest National Laboratory (PNNL) is assisting the U.S. Army Corps of Engineers (ACOE) to gather and analyze information concerning potential changes in riparian habitat resulting from river regulation and subsequent impacts to wildlife. Implementing alternative operating strategies --such as partial drawdown, flow augmentation, and lowering operating pool levels--along the lower Snake River may alter shoreline conditions and impact the riparian habitat available to wildlife. Evaluation and identification of the effects of fluctuating water levels on riparian habitats is prerequisite to assessing short- and long-term impacts to wildlife species using these habitats. The work described in this report documents current riparian habitat conditions and identifies how available habitat has changed at selected sites over the past 8 years.

Twenty-eight sites along the lower Snake River (from the reservoir behind Lower Granite Dam to Ice Harbor Dam) were surveyed during 1995 to evaluate the amount, composition, and extent of riparian habitat along the shoreline using two approaches: 1) documenting the composition of existing riparian habitat along wetland and upland transects at 14 of the 28 areas at three periods during the growing season, and 2) conducting field surveys and mapping vegetation to assess whether the amount and type of available riparian habitat had changed over the past 8 years at all 28 areas. For each site survey, the resulting maps and delineation of babitat areas were incorporated into a Geographic Information System (GIS) and compared with habitat maps generated from 1987 aerial photography (ACOE 1991).

The 28 sites surveyed for this report represent diverse riparian babitats. A number of plant communities documented appear to have established during the past 3 to 4 years, and are still developing floristically and structurally. Data from transects through wetland areas indicated that community species composition varied significantly over the growing season, and appeared to depend on a complex interaction of substrate and water level changes.

In general, the amounts of palustrine emergent and palustrine shrub-scrub habitat along the lower Snake River appeared to be increasing. Our observations indicated that significant increases in palustrine emergent vegetation occurred at the confluence of tributaries with the main river. Palustrine shrub-scrub vegetation appeared most likely to increase along bars that are somewhat protected from wind and wave erosion. Several depositional bars included in this study had young, fringing, emergent scrub-willow communities developing along the shoreline. Some study areas also exhibited increases in the amounts of palustrine forest habitat, usually at the expense of shrub-scrub habitat area. These increases in habitat extent may be a result of current operating strategies that maintain operating pools behind the four dams at minimum levels, thus increasing the area of shoreline available for vegetation establishment.

Predicting riparian community response to fluctuating water levels will require further analyses to determine whether these data or similar data on seasonal and long-term community composition can be correlated with information on water regulation (i.e., flooding and dewatering) at each site. New areas of habitat mapped in these surveys should be overlaid on bathymetric information for the reservoirs and considered with respect to the area of shoreline that lies between the ordinary high water level and the minimum operating pool level. This approach would provide insight into the potential extent of further riparian habitat development along the reservoir shorelines.

Acknowledgments

This work was initiated by Ms. Rosemary Mazaika, through funding provided by the U.S. Army Corp of Engineers, Walla Walla District, and performed under the direction of Mr. Lonnie Mettler. Mr Mettler provided valuable technical guidance and insight. We would also like to thank Dr. Duane Neitzel for his support and technical advice and Dr. Dennis Dauble for his review and valuable technical contributions on this task.

Contents

Contents (cont'd)

Figures

Tables

1.0 Introduction

The fate and distribution of riparian habitat along the Snake and Columbia rivers has become an issue of increasing concern during the past decade. Operating strategies are being developed for the Columbia River system that attempt to balance the needs for hydroelectric production, irrigation, recreation, wildlife, and endangered species (Northwest Power Planning Council 1994, BPA 1994).

Pacific Northwest National Laboratory (PNNL) provided assistance to the U.S. Army Corp of Engineers (ACOE), Walla Walla District, in analyzing the impacts to terrestrial wildlife that could result from such changes in operation. In particular, studies described in this report are intended to support the System Operating Review (SOR) for the Columbia River system, and document the amounts and types of riparian/wetland habitat at selected sites along the lower Snake River.

Currently, the ACOE is considering alternative operating strategies for the Columbia River system. Strategies for the lower Snake River include partial drawdowns, flow augmentation, and maintaining lakes behind the dams at the minimum operating pool level. Drawdowns and lowering operating pools to provide augmented flows may expose unvegetated substrate and potential habitat for pioneering vegetation. Augmenting river flows to provide additional flow for important fisheries species may cause fluctuations in water levels and thus periodically inundate or dewater shoreline vegetation. Such changes in shoreline conditions will likely impact the establishment and development of riparian/wetland vegetation.

The studies reported in this document were initiated to establish baseline information on riparian and wetland habitat conditions at the areas studied under the current reservoir operations on the lower Snake River. Two approaches were used to assess habitat at 28 study sites selected on the four pools on the lower Snake River. These areas all contribute significant riparian habitat along the river, and several of these areas are designated habitat management units (HMUs), operated by the ACOE (ACOE 1991) to maximize habitat available for wildlife. At 14 of the 28 sites, we monitored riparian habitat on three dates during the growing season to quantify vegetation abundance and composition along three transects: soil nutrients, moisture, and pH and water level and pH. A second approach involved identifying any differences in the extent and amount of riparian/wetland habitat currently found at the study areas from that previously documented (ACOE 1991). We used both ground and boat surveys to map and classify (Cowardin et al. 1979) the changes in vegetative cover along the shoreline at the 14 monitoring sites and at 14 additional sites along the lower Snake selected to represent various riparian/ wetland habitat conditions. Results of these mapping efforts are compared with maps of cover types previously generated using aerial photography taken in 1987 (ACOE 1991).

The methods used in surveying and mapping these 28 sites and locations of each of the sites are documented in Section 2 of this report. Section 3 provides detailed descriptions of site topography and vegetation and discusses vegetation survey results for each of the four pools on the lower Snake River. Section 4 presents concluding information and recommendations. Appendix A describes monitoring protocols in detail. Appendix B includes the results of soils and water analyses for samples from 14 sites. Appendix C contains summarized data for wetland and upland vegetation transects.

2.0 Survey Methods

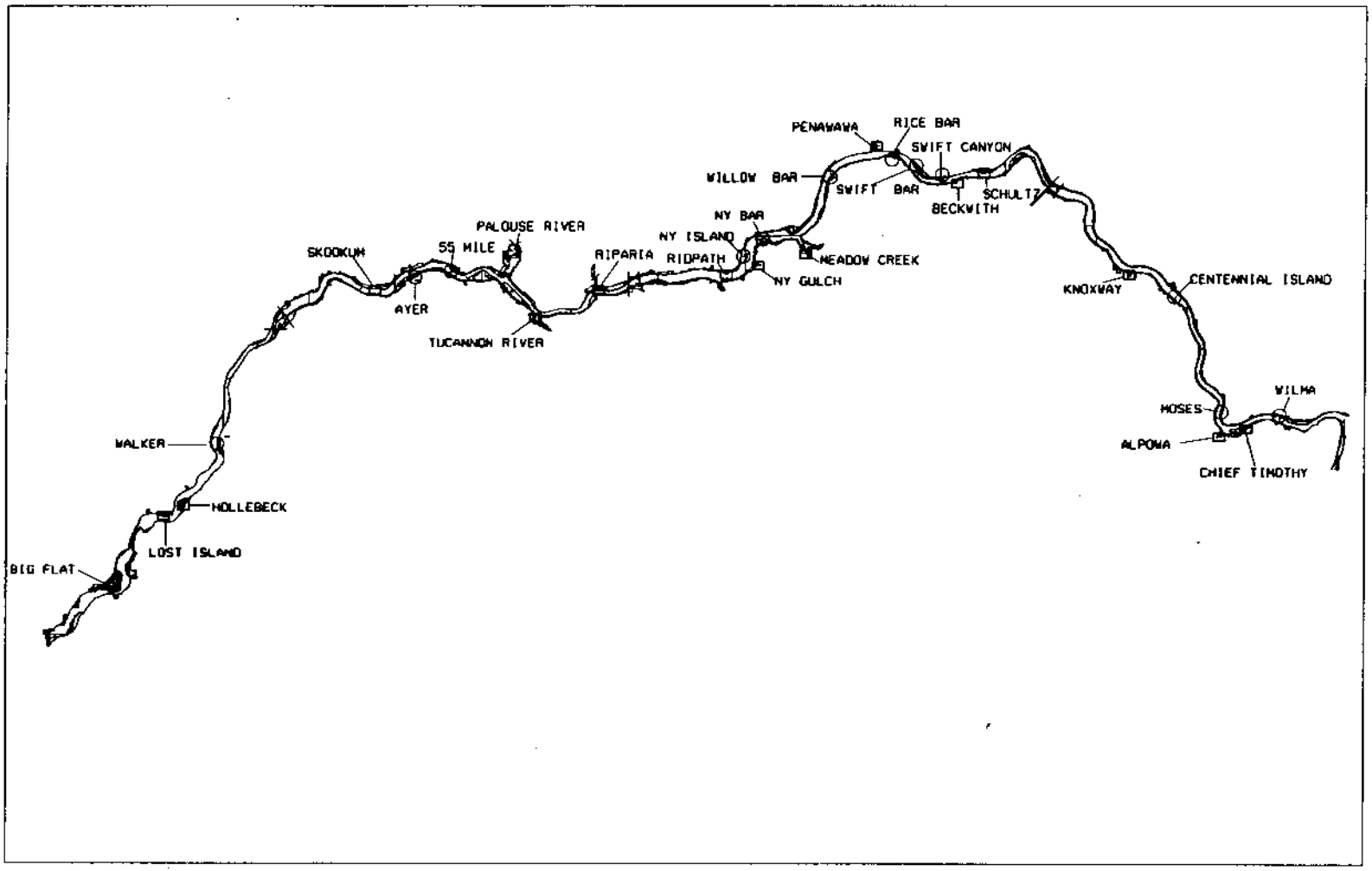
This survey included 28 habitat areas on the four lower pools of the Snake River--Ice Harbor Dam, Lake Sacajawea; Lower Monumental Dam, Lake Herbert G. West; Little Goose Dam, Lake Bryan; and Lower Granite Dam, Lower Granite Lake (Table 2.1 and Figure 2.1). All 28 areas were surveyed to evaluate whether the amount and extent of riparian/wetland habitat at the site changed from that mapped from 1987 aerial photography. Fourteen of these sites were monitored intensively to determine seasonal changes in riparian/wetland vegetation composition and abundance, substrate, and soils. Shannon & Wilson, Inc., personnel implemented field sampling under contract to PNNL. Appendix A contains a full description of monitoring protocols used for this study.

Table 2.1 Areas Surveyed Along Four Pools on the Lower Snake River. Numbers in parentheses indicate approximate river mile location.

Ice Harbor	**Lower Monumental**	**Little Goose**	**Lower Granite**
Lake Sacajawea	Lake Herbert G. West	Lake Bryan	Lower Granite Lake
Big Flat HMU (14.7)	Skookum (47.2)	Ridpath HMU (77)	Knoxway HMU (115.9)
Lost Island HMU (24.3)	Ayer HMU (50.9)	New York Gulch HMU (78.2)	Centennial Island (120)
Hollebeck HMU (24.7)	55-mile HMU (55)	New York Island (78.2)	Moses HMU (130)
Walker HMU (30)	Palouse River (59.4)	New York Bar HMU (80.7)	Alpowa Creek HMU (130.5)
	Tucannon River (62.4)	Meadow Creek HMU (83)	Chief Timothy HMU (131.7)
	Riparia HMU (67.3)	Willow Bar HMU (88)	Wilma HMU (134.5)
		Penawawa HMU (91.6)	
		Rice Bar HMU (93)	
		Swift Bar and Island HMU (95)	
		Swift Canyon (97.2)	
		Beckwith Bar HMU (97.6)	
		Schultz Bar HMU (100.7)	

2.1 Vegetation Monitoring

We monitored species composition and abundance of vegetation at 14 of the 28 sites along transects three times during the 1995 growing season: May 15-20, July 20-25, and September 26-30. Plant species' occurrence and general abundance were documented for land surrounding the transect locations. This effort included an assessment of the study area by walking the 300-m plot to catalog plant species not documented within the study plots or along the transects, and to provide a general overview of existing habitat conditions.



c:/prj/hep/dgn/new-hep/map2.dgn Jan. 26, 1996 10:38:17

Figure 2.1 Locations of Areas on the Lower Snake River

2.1.1 Transects

At each of the 14 sites surveyed for this study, three wetland transects and three upland transects were established and permanently marked in the field. Rebar stakes with polyvinyl chloride (PVC) pipe casings were used to mark transect ends. The transition between the upland portion of the transect and the wetland portion was generally defined by locating the ordinary high-water mark (OHWM). The OHWM was typically defined by a beach, a wrack of driftwood, or a noticeable bench or break in vegetation type. Wetland transects varied in length from 4.5 to 100 m in length, depending on the extent or width of the vegetation zone between the OHWM and open water. Upland transects were an extension of the wetland transects and were 30 m long.

Five plot locations were defined along each wetland transect, and three upland plot locations were established. Wetland plot locations were determined by establishing the length of the transect and then dividing that length by four. Plot locations were then located at the beginning of the transect and at four intervals along the transect. Plot 1 was located at the start of the transect, and Plot 5 coincided with the far end of the wetland portion of the transect. Plot 1 was generally located at the deep-water edge of the plant community, and Plot 5 was generally at the OHWM. Some of the sites differed from this general pattern as a result of physical or topographic constraints, and these differences are reflected in the data collected.

2.1.2 Line Intercept

Line-intercept data for shrub species were collected along each upland and wetland transect established for this project. Sampling for line intercept was completed only during the May visit to each of the 14 monitoring sites. All shrubs or trees intersecting the transect line were recorded. Height and length of intercept were recorded for each individual plant or group of plants along the transect.

2.1.3 Plots

At each of the wetland plot locations, a 0.5-m^2, rectangular quadrant plot frame was placed on the ground. Percent vegetative canopy cover was estimated visually according to Daubenmire (1959). Data were collected for each species encountered, and values were recorded for vegetative cover, leaf color, desiccation, senescence, vigor, colonization, recruitment, and herbivory. Leaf color was measured directly by comparing the dominant leaf color of a particular plant to an appropriate Munsell Color Chart for Plant Tissue. Desiccation, senescence, and vigor were noted for each overall plant, or group of plants at a particular plot. Herbivory was noted if recent evidence of herbivory was observed on the plants measured within the plot.

Data collected in plots along the wetland transects were summarized by vegetation type to best represent the riparian habitat available. Plant species were assigned to one of the following categories according to growth habit: herbaceous, emergent, shrubs, or trees. Trees and shrubs

are obvious classifications according to size and structure. The emergent class includes all rushes, sedges, and aquatic forbs and grasses (e.g., cattail species, bulrush, duckweed, and reed canary grass). The herbaceous class includes all other forbs and grasses.

2.2 Soils and Water Sampling

Soil parameters important for plant species establishment and growth were measured in the field and analyzed by the University of Idaho soils laboratory. In May 1995, soil samples were obtained and sent to the laboratory for pH, nutrient content, moisture content, particle size distribution, texture, and field moisture capacity analysis. Field measurements completed once during the May 1995 field visit include soil pH, texture, color, and horizonation. Soil pH and moisture content were measured at the field sites on each survey date. Results of the soils analysis are presented in Appendix B. When surface or ground water was recoverable from a soil plot location, water level, pH, and temperature measurements were recorded.

2.3 Habitat Survey and Mapping

Differences in the extent and amount of riparian/wetland vegetation from that mapped for 1987 conditions (ACOE 1991) at each of the 28 sites were determined from ground and boat surveys. At each site, the coverage depicted on the 1987 habitat evaluation process maps was compared visually with existing vegetation, and field site maps were drawn as needed. Where feasible, Global Positioning Systems (GPS) were used to augment mapping efforts and delineate the extent of new vegetation, locations of invasive plant species, or locations of important species assemblages. The GPS data for each site were post-processed with base station information to correct coordinates for selective availability of satellite data. Post-processed coordinates should reflect the actual ground coordinates ±15 ft. These data were transferred to the INTERGRAPH® Geographical Information System (GIS) for mapping and visualization.

Using the GIS, the acreage of new vegetation in each cover class was calculated. Data from the GPS systems did not overlay and align correctly on the 1987 cover maps for all sites. We believe that the source of error may be in the original interpretation and digitizing of uncorrected aerial photography. Tests of the GPS systems against known benchmarks were within ±10 ft. Thus, our calculations of number of acres of change in cover class or new vegetation are based on our best field interpretation of the locations of the new vegetation. The GPS and mapping data shown in this report are overlaid on the 1987 coverage without any adjustment.

3.0 Results and Discussion

This section presents the findings of the monitoring and survey efforts for each of the 28 sites along with descriptive information concerning the relative size, location, and topography for each HMU. The study sites selected for this project represent a diverse set of riparian habitats. A number of the plant communities documented appeared to have established relatively recently, and are still developing floristically and structurally. Recently established plant communities exhibit low species diversity, high numbers of pioneer species, and often a large percentage of very young shrubs. Although no one factor can be identified as a causal agent for development of these communities, such characteristics could result from normal water management activities along the river.

Analysis of plot data from the wetland transects indicated, in general, that canopy cover of persistent emergent vegetation and shrub-scrub vegetation increased from May through September at most of the sites monitored. Shrub cover data gathered during May using the line-intercept method are compared with values estimated from the plot data to estimate shrub canopy coverage and provide information on seasonal change in canopy cover (Table 3.1).

Table 3.1 Percent Canopy Cover of Shrubs and Trees Measured Using Line-Intercept Methods

Site	Shrub Canopy Cover (%)	Tree Canopy Cover (%)	False Indigo Cover (%)
Lost Island	43.6	0	38.5
Hollebeck	12.9	9.6	11.2
Skookum	72.2	11.8	42.4
Tucannon	10.2	0	0.3
Riparia	24.7	0	14.4
Ridpath	105.3	3.0	29.2
New York Gulch	9.4	0	8.1
Meadow Creek	50.7	0	50.7
Penawawa	0	40.4	0
Beckwith	23.7	0	0
Schultz	49.0	0	0
Knoxway	4.0	0.7	0
Alpowa	6.2	0	0
Chief Timothy	51.6	0	0

Mapping changes in vegetation types at the 28 sites revealed that palustrine emergent and palustrine shrub-scrub habitat generally have increased along the lower Snake River since 1987. Total palustrine emergent habitat increased by 134 acres, palustrine shrub-scrub habitat increased by 88 acres (this includes mapped acres dominated by false indigo), and palustrine forest increased by 34 acres. These differences may be a result of lowering operating pools behind the dams and providing additional substrate for vegetation establishment. Siltation and soil deposition occurring along side tributaries to the main river also appear to have created additional areas suitable for establishment of emergent and shrub-scrub vegetation.

All the study sites are depositional environments and have formed relatively recently (since construction of the dams). Soil textures ranged from a fine sand to silt loam (Appendix B), and soil water contents ranged from 16 to 46% (g/g). As expected, finer-grained soils displayed a higher moisture content and moisture-holding capacity than coarser grained materials, but all the soils initially measured were within the saturated zone of the river. The organic content of all soils collected was low, and all soils appear to be of recent origin. Measurements of pH and temperature of the water at each site did not reflect significant differences between plots, between sites, or between pools.

Qualitative observations of plant stress indicated no change in plant vigor throughout the study period. We did not observe wilted plants of any species at any site investigated. Plant senescence appeared to follow normal seasonal cycles and did not appear unusual at any of the sites investigated. Changes in operating pool levels did not appear to significantly decrease soil water availability and, thus, negatively impact plant growth. These data, however, are qualitative, and quantitative measures of plant and soil water potentials, plant hydraulic conductance, and transpiration rates along with measurements of growth over the season would be necessary to reach any conclusions concerning plant response to water availability and water level changes on the lower Snake River.

Plant vigor was notably variable among species known to have invasive growth tendencies. Cattail (*Typha spp.*), for instance, grew taller and with a higher stem density in areas where it was the only species present. Reed canarygrass (*Phalaris arundinacea*) also was more robust in areas where it dominated. Herbivory did not seem to affect cover estimates to a significant degree.

Information on incidental wildlife sightings is included with a discussion of vegetation information for each of the 28 areas investigated. Wildlife sightings and observations are provided only as ancillary information and do not constitute a comprehensive survey of wildlife at any of these sites.

3.1 Lake Sacajawea

Four study areas were located along Lake Sacajawea, which lies behind Ice Harbor Dam and is downstream from the other three pools surveyed during this study. Two of the 14 sites where vegetation was monitored, Lost Island and Hollebeck, occur within this reservoir. The other two HMUs, Big Flat and Walker were surveyed and mapped to document changes in vegetation.

The extent of palustrine emergent habitat increased significantly at the Lost Island and Big Flat HMUs (Figure 3.1). Palustrine forest habitat increased significantly at the Big Flat HMU as did palustrine shrub-scrub habitat. Palustrine forest vegetation increased slightly at Walker HMU. The changes in areal extent of habitat on the Lake Sacajawea pool all appear to be increases in total area of habitat available, rather than replacement of one vegetation type with another.

Water levels observed at the sites on this pool were near bank-full during the May site visit, lowered approximately 2.5 m during July, and were high again in September.

3.1.1 Lost Island

The Lost Island site is located at a small, upstream-facing cove. Forest vegetation dominated by Russian olive (*Elaeagnus angustifolia*) occurs as a small patch within the center of the site, and emergent vegetation dominates the wetland. Wetland vegetation is composed of species known to be invasive, yet no one invasive species currently appears to dominate the community. False indigo (*Amorpha fruticosa*) is well established along the rockier shorelines at the site, and coyote willow (*Salix exigua*) is common throughout the wetland shoreline. Transect A was very short because of the steep bathymetry of that side of the site. Uplands at the site appear to be dominated by cheatgrass (*Bromus tectorum*). Transects were established from the outer edge of the vegetation (deep-water edge) to the OHWM.

Analysis of the plot data on the wetland transects indicated that the percent canopy cover of persistent emergent plants (sedges, rushes, cattails) increased through the growing season as did the percent canopy cover of shrubs measured in the plots (Figure 3.2). Other herbaceous forbs and grasses were a smaller component of the plant community along the transects at this site. The total canopy cover measured in plots along the wetland transect increased from 47% in May to 102% in September. Canopy cover estimated for false indigo, represented between 35 and 45% of the total cover on the three survey dates, increasing from 18% in May to 47% in September. False indigo is an invasive alien shrub species that occurs along the shoreline and in tributary drainages on the lower three pools (see Appendix C). Shrub canopy cover (Table 3.1) measured using the line-intercept technique was similar to values estimated in plots along the transect.

ICE HARBOR SITES

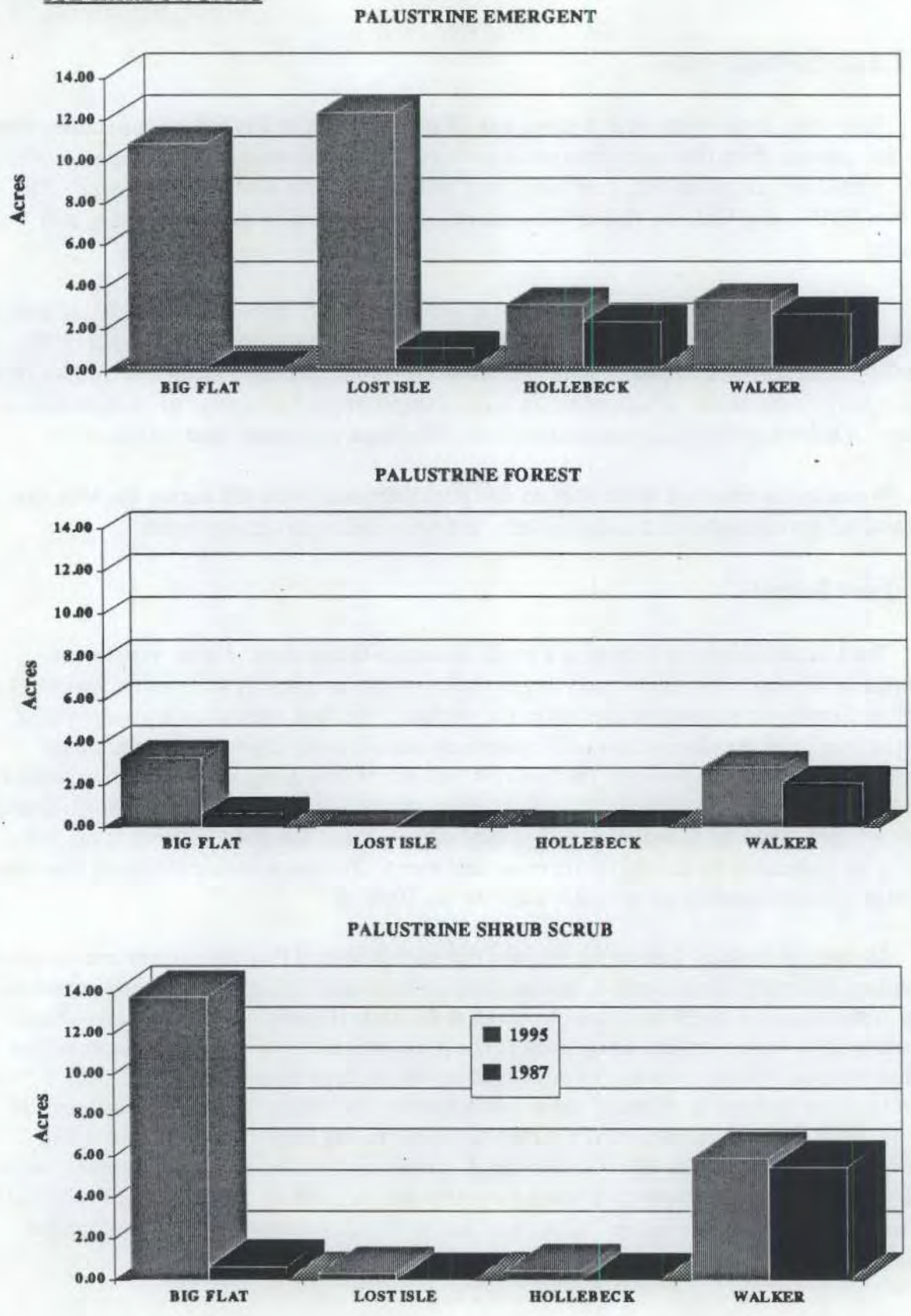


Figure 3.1 Change in Acres of Riparian Habitat at Four HMUs on Lake Sacajawea

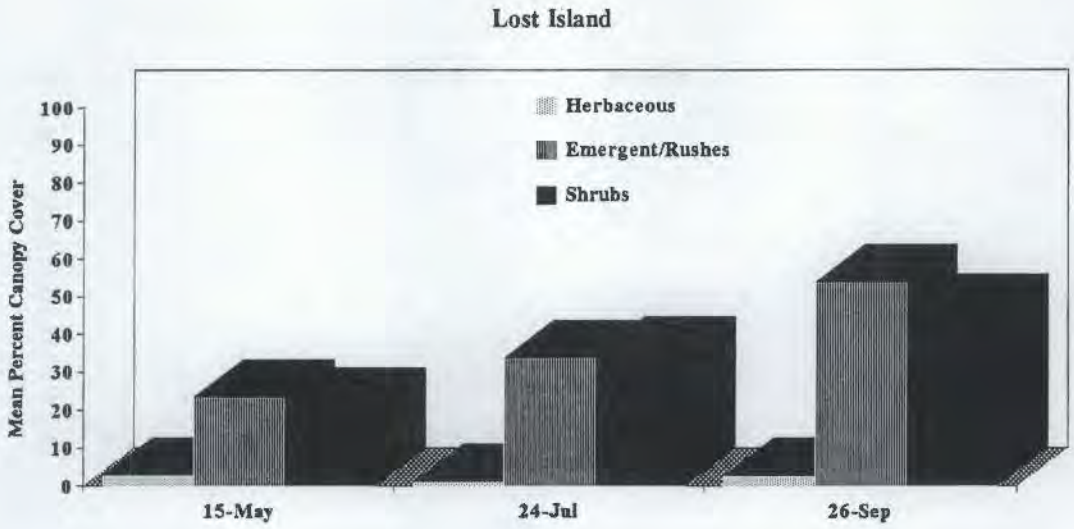


Figure 3.2 Mean Percent Canopy Cover of Vegetation Types at Lost Island HMU

Survey of the Lost Island HMU shoreline downstream from the transects revealed a significant amount of palustrine emergent cover (11.25 acres) that was not previously mapped (Figure 3.3). Smaller acreage increases in palustrine scrub-shrub (0.31) and palustrine forest (0.03) also were mapped. The mapped area covered with false indigo was less than 0.1 acre.

We saw one coyote (*Canis latrans*) at Lost Island during our May site visit. Observations of wildlife during the July site visit included a stream-side beaver burrow and a large turtle (species undetermined). Overall, wildlife abundance did not appear to be high at this site.

3.1.2 Hollebeck HMU

The Hollebeck HMU is upstream and across the river from Lost Island on the south shore of the river. Sampling transects were located across a wetland area within a sheltered cove, and ran west to east into the inlet, and eastward to the upland on the opposite shore of the cove. The western edge of the transects was actually the western shoreline of the cove, not the deep-water edge. Forest vegetation dominated by Russian olive occupied most of the shoreline of the cove, and emergent vegetation dominated the wetland. Shrub cover and tree cover was dense and nearly impenetrable in areas along the shoreline of the Hollebeck HMU with grasslands/pastures lying upland away from the shoreline.

Wetland emergent vegetation is fairly diverse at this site, and no single species appeared dominant within the wetland. Analysis of the plot data taken along wetland transects spanning the cove shows that persistent emergent vegetation has the highest canopy cover and increases through the growing season (Figure 3.4). Shrub cover measured at Hollebeck transects was dominated by false indigo, which had about 11% canopy cover at the site and represented more than 50% of the total shrub cover measured in transect plots.

Figure 3.3 Changes in Vegetation Cover at Lost Island HMU (PE=Palustrine emergent, PF=Palustrine forest AMORPHA=flase indigo, PSS=Palustrine shrub scrub, G=grassland, F=forbs, MS=Mesic shrub)

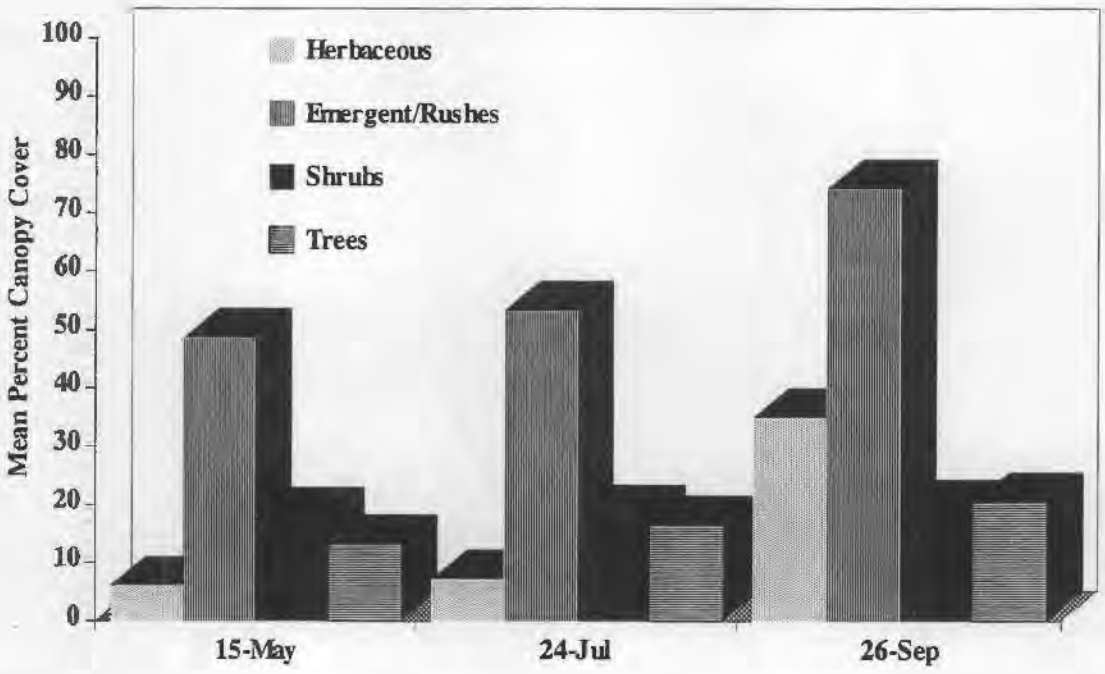


Figure 3.4 Mean Percent Canopy Cover of Vegetation Types at Hollebeck HMU

Survey and mapping of the Hollebeck shoreline (Figure 3.5) delineated a small increase in the acreage of palustrine emergent vegetation (0.83 acre) in the study area where transects were established and documented 0.46 acre of false indigo along the shoreline.

We did not see a beaver lodge at the site, but recent beaver activity was apparent in the vicinity. Several species of shorebirds were seen along the outer edge of the cove as we approached the site, and bird species abundance was generally high at this site.

3.1.3 Big Flat HMU

The Big Flat HMU, located across the river and downstream from Fishhook Park, is one of the larger HMUs on the lower Snake River. Substrates noted at the area appeared to be mostly silty clays with little or no gravel/cobble exposures. Forest vegetation, dominated by Russian olive occurred throughout much of the upland portion of the site. Trees scattered along the shoreline of the HMU were primarily white alder (*Alnus rhombifolia*) and black locust (*Robinia pseudo-acacia*).

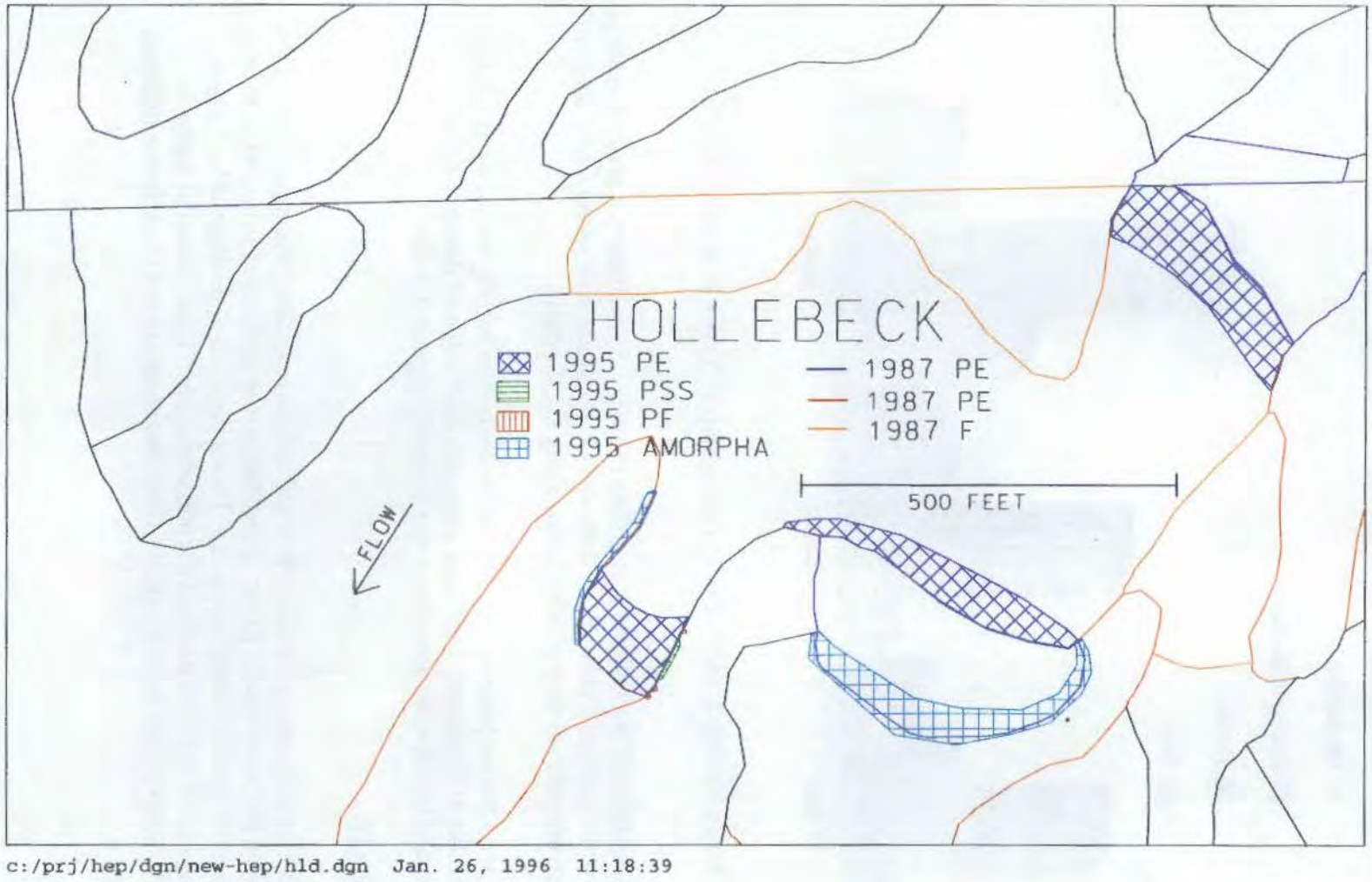


Figure 3.5 Changes in Vegetation Cover at Hollebeck HMU (PE=Palustrine emergent, PF=Palustrine forest, AMORPHA=false indigo, PSS=Palustrine shrub scrub, F=forbs)

Persistent emergent vegetation, dominated by American great bulrush (*Scirpus validus*) was established along the upstream half of the shoreline of the HMU. The shoreline of the downstream half of the Big Flat HMU was quite steep and less amenable to establishment of palustrine emergent vegetation.

Vegetation along this portion of the shoreline consisted primarily of shrub-scrub species, dominated by coyote willow intermixed with approximately 30% false indigo. Mapping cover types on this HMU (Figure 3.6) indicated an increase of palustrine emergent acreage of approximately 10.7 acres and an increase of 12.8 acres in palustrine shrub-scrub cover. An additional 2.6 acres of palustrine forest vegetation also was mapped. False indigo was not mapped as a cover class for this site, because it was interspersed homogeneously throughout the shrub-scrub vegetation and could not be distinguished as a separate mapping unit.

Wildlife incidentally observed or heard at Big Flat HMU included white-crowned sparrows (*Zonotrichia leucophrys*), tree sparrows (*Spizella arborea*), ring-necked pheasants (*Phasianus colchicus*), California quail (*Callipepla californica*), northern harrier (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), muskrat (*Ondatra zibethica*), and beaver (*Castor canadensis*). Bank swallow (*Riparia riparia*) nest cavities were commonly observed along the bluffs at this site.

3.1.4 Walker HMU

The Walker HMU, located upriver from Fishhook Park on Ice Harbor pool, exists as a small flood plain. Most of the dryland habitat is shrub-steppe. Shoreline areas of the Walker HMU slope gently to the water, and the substrate is gravelly with fine sediment overlay. A small inlet at the downriver end of this HMU is now covered by palustrine emergent vegetation. Figure 3.7 indicates that palustrine emergent habitat has increased by 0.7 acres since 1987. Cattail is the predominant emergent species occurring there.

With the exception of a small area of shrub-steppe, the downriver end of Walker HMU was covered with palustrine shrub-scrub habitat, composed of a mix of Russian olive and willow species. Shorelines along the upriver half of Walker HMU were covered with a 50/50 mix of willow and false indigo. A small forested area (white alder and small false indigo) now exists on a peninsula located at the upriver end of Walker. Palustrine shrub-scrub habitat has increased in the area by about 0.5 acres, and palustrine forest area has increased by 0.7 acres. Although false indigo occurs in mixed stands at this HMU, it could not be delineated as a separate mapping unit.

Figure 3.6 Changes in Vegetation Cover at Big Flat HMU (PE=Palustrine emergent, PF=Palustrine forest, AMORPHA=flase indigo, PSS=Palustrine shrub scrub, F=forbs, MS=Mesic shrub)

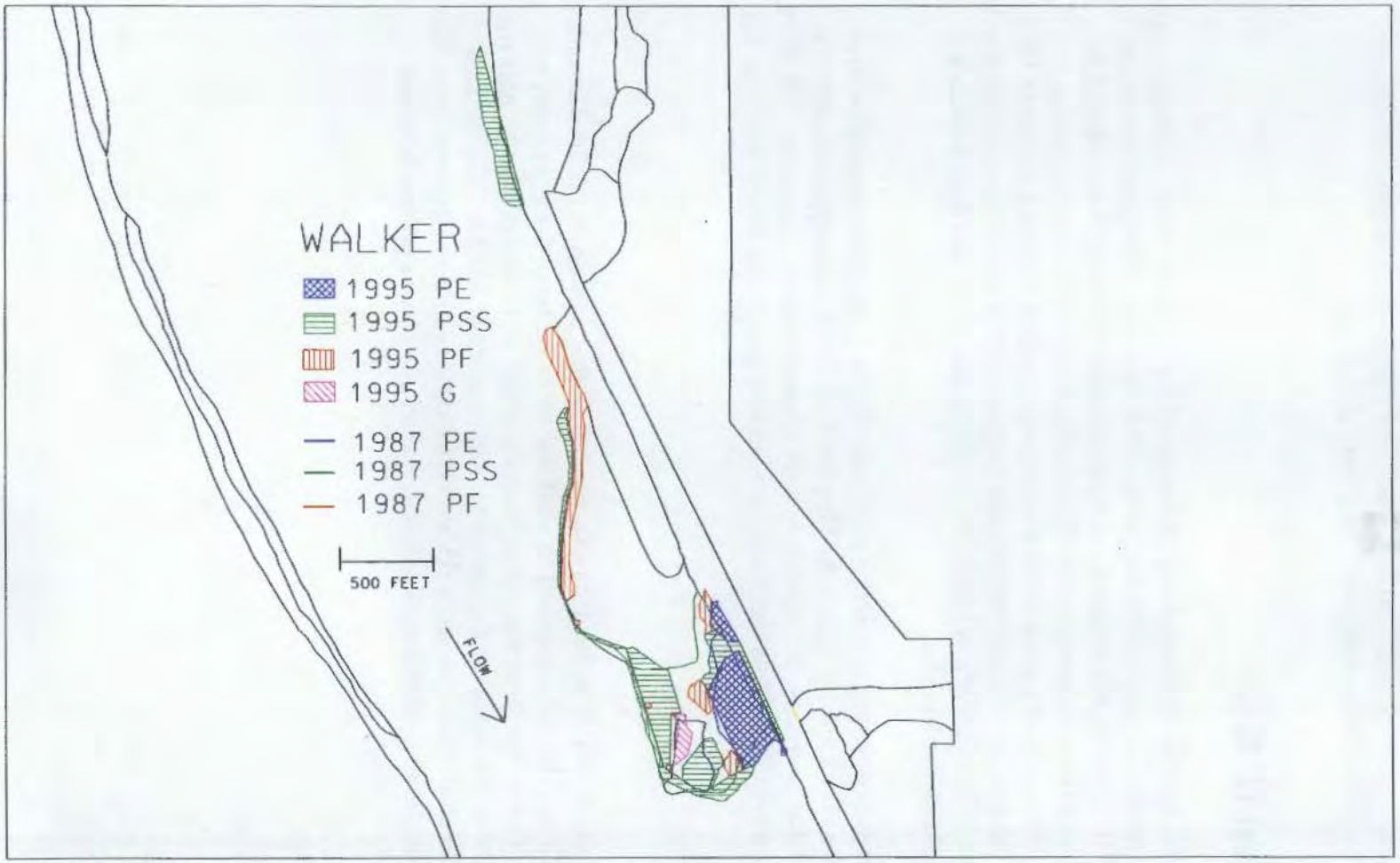


Figure 3.7 Changes in Vegetation Cover at Walker HMU (PE=Palustrine emergent, PF=Palustrine forest, PSS=Palustrine shrub scrub, G=grassland)

In general, wildlife abundance observed during the mapping activities at Walker HMU in November was low. Beaver cuttings were frequently observed within the palustrine shrub-scrub regions. White-crowned sparrows, tree sparrows, quail, and a sharp-shinned hawk (*Accipiter striatus*) were incidentally observed while conducting work at this site.

3.2 Lake Herbert G. West

Lake Herbert G. West lies behind Lower Monumental Dam. Three of the 14 study areas where vegetation was quantified occur along the shore of this reservoir: Skookum, Tucannon HMU, and Riparia HMU. Survey and mapping were conducted at three additional sites: Ayer HMU, 55-mile HMU, and along the mouth of the Palouse River where it enters the Snake. The amount of palustrine emergent vegetation and the extent of palustrine forest appear to have increased at all six of the sites investigated on this pool (Figure 3.8). Some of the increase seen in area of palustrine forest reflects growth of shrub-sized willows into trees, and thus, reflects a decrease in palustrine shrub-scrub habitat.

Water level changes observed within this pool were similar to the trends seen downriver. Near bank-full conditions were present during the May site visit; levels were approximately 2 m lower during July, and then near bank-full conditions were observed during September. All three sites where vegetation was monitored on this reservoir represent distinct landscape positions and habitat conditions.

3.2.1 Skookum

The Skookum site is located at the delta of a small draw that contains no defined stream channel or noticeable flow. The site is exposed to wind and wave action of the main river, and was very windy during two of our three site visits. Because of the small size of the site, only two transects were established. Wetlands are dominated by American great bulrush. The wetland edge is dominated by shrub and tree species, including white alder and black locust trees and false indigo and coyote willow shrubs. Skunkbrush sumac (*Rhus trilobata*) was present in upland portions of the draw.

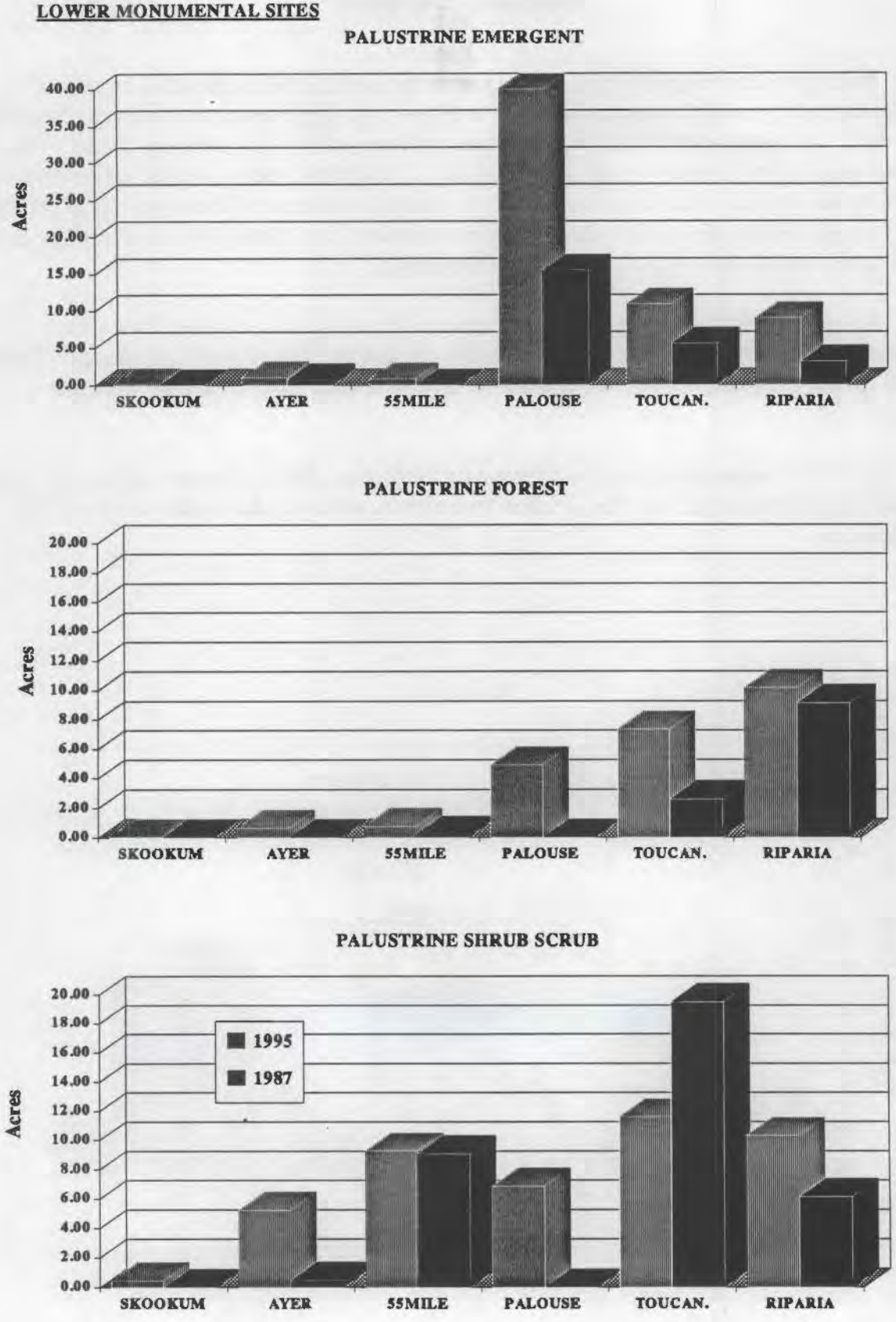


Figure 3.8 Change in Acres of Available Habitat at Six Areas on Lake Herbert G. West (note difference in scale)

Mean percent canopy cover of shrubs and persistent emergent vegetation increased through the 1995 growing season as indicated in Figure 3.9. The persistent emergent vegetation, which included bulrush and cattail species, dominated the wetland vegetation by the end of the growing season, but shrub cover was greater in May. False indigo canopy cover varied from 12 to 20% in the plots, and accounted for 35 to 50% of total shrub cover (35 to 43% mean percent canopy cover). Shrub canopy calculated from line-intercept data resulted in a total canopy cover of 72% and a mean canopy cover of 42% for false indigo.

Survey and mapping of the Skookum area was limited to the delta and draw where transects were established. Using GPS at this site, the new vegetation mapped included 0.2 acres of false indigo, 0.25 acres of palustrine shrub-scrub, and 0.13 acres of palustrine emergent (Figure 3.10).

A beaver lodge was located near the center of the site. Perhaps because of this site's small size and exposed character, very few wildlife species were observed during the course of field investigations.

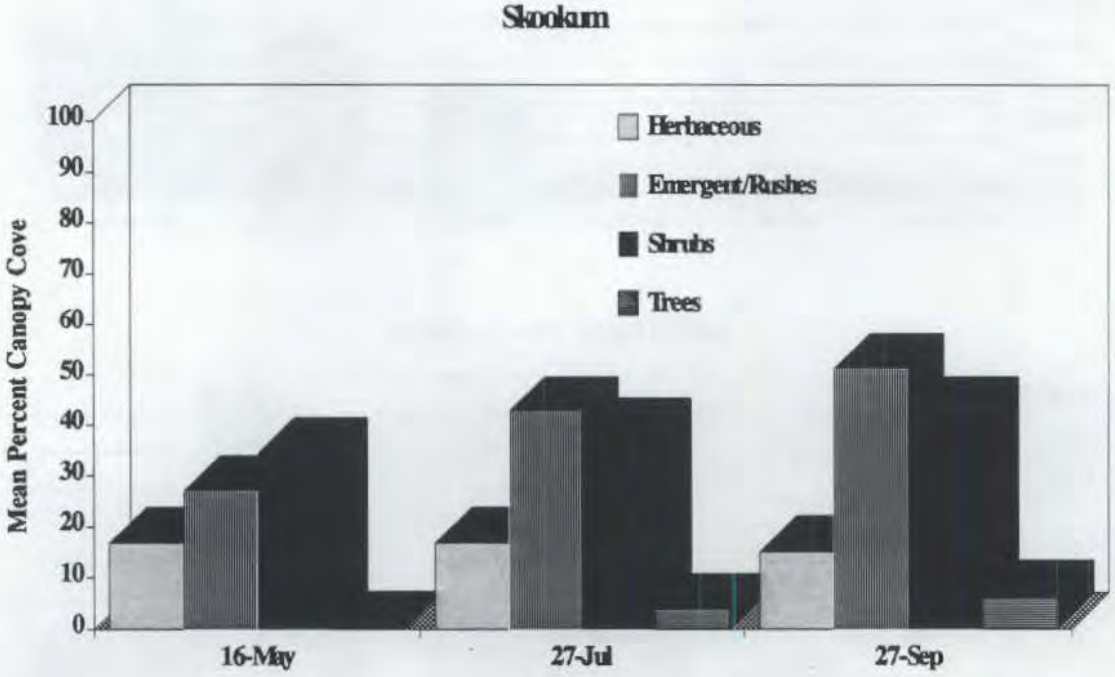


Figure 3.9 Mean Percent Canopy Cover of Vegetation Types at Skookum

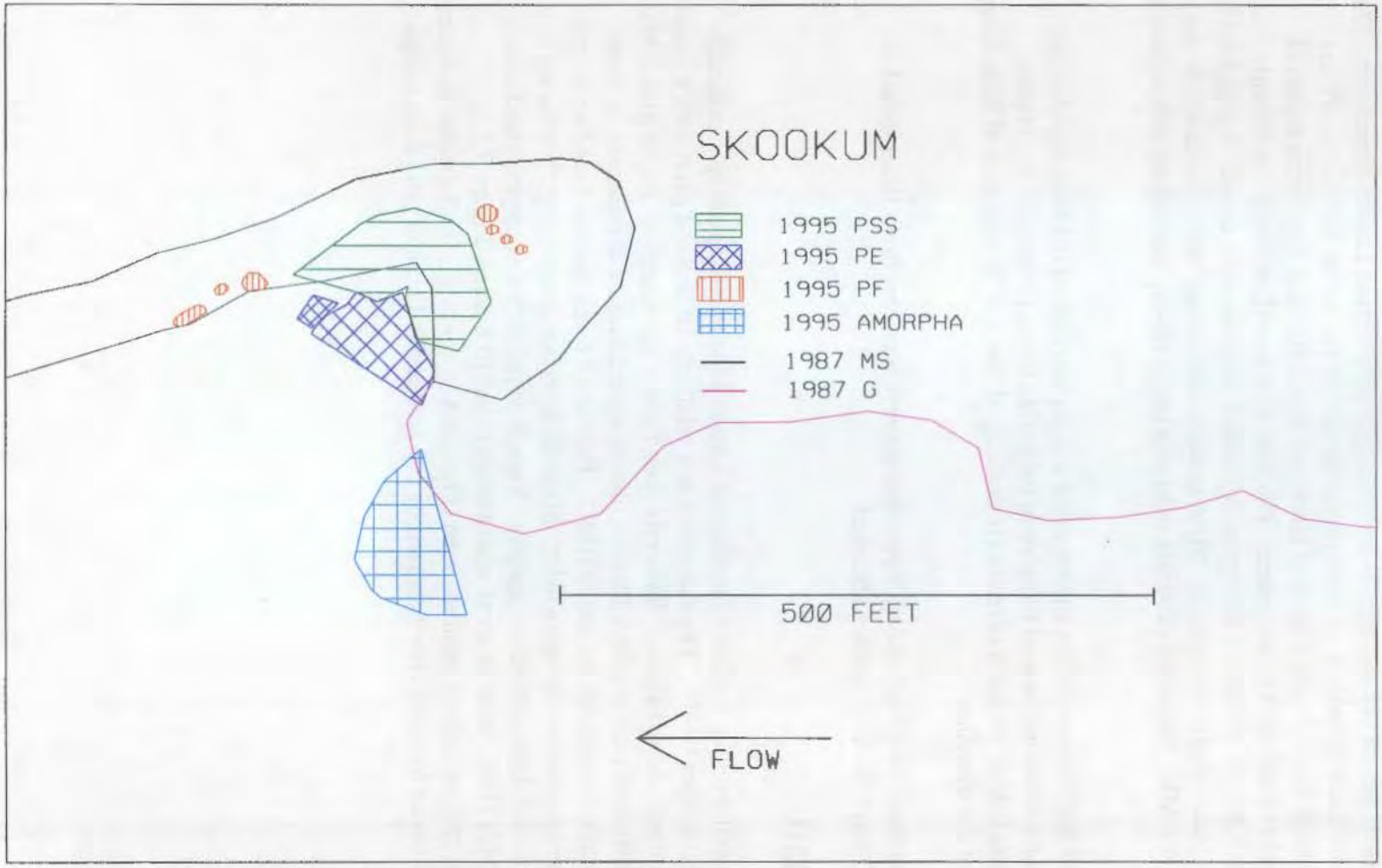


Figure 3.10 Changes in Vegetation Cover at Skookum (PE=Palustrine emergent, PF=Palustrine forest, AMORPHA=false indigo, PSS=Palustrine shrub scrub, G=grassland, MS=Mesic shrub)

3.2.2 Ayer HMU

The Ayer HMU lies on the southern shoreline of the pool behind Lower Monumental Dam only 3 miles upstream from Skookum. A boat launching area at the lower end of the site has created a relatively large inlet. Small groves of black locust and Russian olive were scattered along the inlet shorelines and upriver shorelines. The inlet area shorelines were consistently bordered with a small strip of palustrine emergent vegetation dominated by cattail. Upland habitat is largely low-cover shrub-steppe vegetation. Most notably, false indigo occurred along the entire shoreline of the Ayer HMU. Shoreline substrate is largely basalt rip-rap associated with adjacent railroad tracks.

Mapping and field surveys of the site revealed a slight increase of 0.3 acre of palustrine emergent habitat, and a small increase of 0.6 acre of palustrine forest (Figure 3.11). Native palustrine shrub-scrub habitat extent was relatively unchanged, but a 4.78-acre area of false indigo was delineated along the shoreline.

Wildlife abundance observed during November surveys was very low. Black-billed magpies (*Pica pica*) were the only species observed.

3.2.3 55-Mile HMU

This HMU occurs on the northern shoreline of Lower Monumental pool approximately 4 miles upstream of the Ayer HMU . The site exists as a relatively large flood plain with a mosaic of shrub-steppe and mesic shrub habitats. Substrate found along the shores of the 55-Mile HMU is generally cobble with sediment overlay. Russian olive is a predominate shrub-scrub or forest class species that occurs throughout the entire HMU. Two small forest groves found occurring along the shoreline are dominated by white alder. Most all shoreline areas along 55-Mile are occupied by mix of false indigo and willow species. Very little palustrine emergent vegetation exists along the 55-Mile HMU, even in areas where inlets occur (0.8 acres, Figure 3.12). Emergent vegetation species include common reed (*Phragmites*) species, cattail species and some bulrush species. Palustrine forested area increased by 0.5 acre and 0.4 acre of pure false indigo was also mapped.

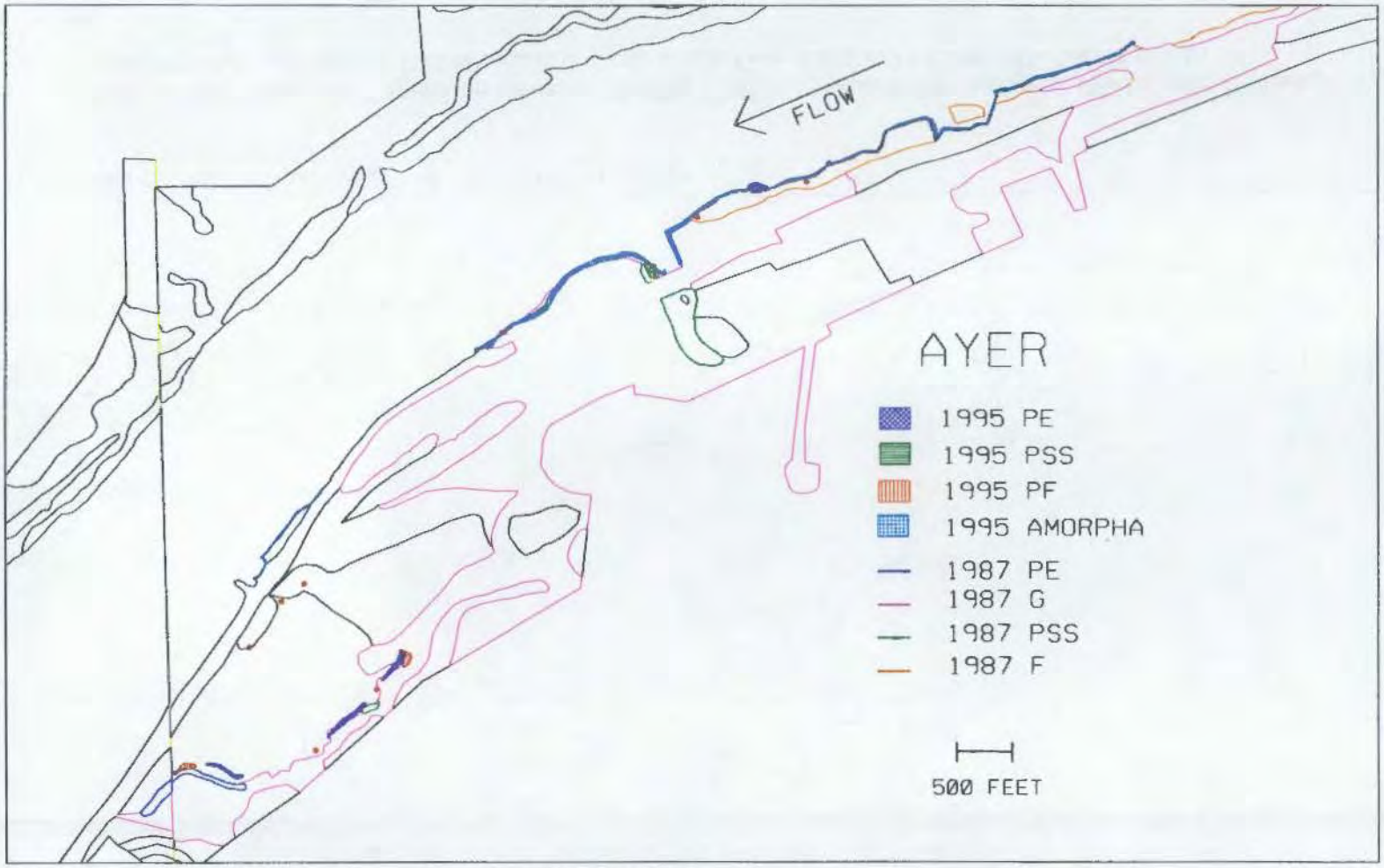


Figure 3.11 Changes in Vegetation Cover at Ayer HMU (PE=Palustrine emergent, PF=Palustrine forest, AMORPHA=flase indigo, PSS=Palustrine shrub scrub, G=grassland, F=forbs)

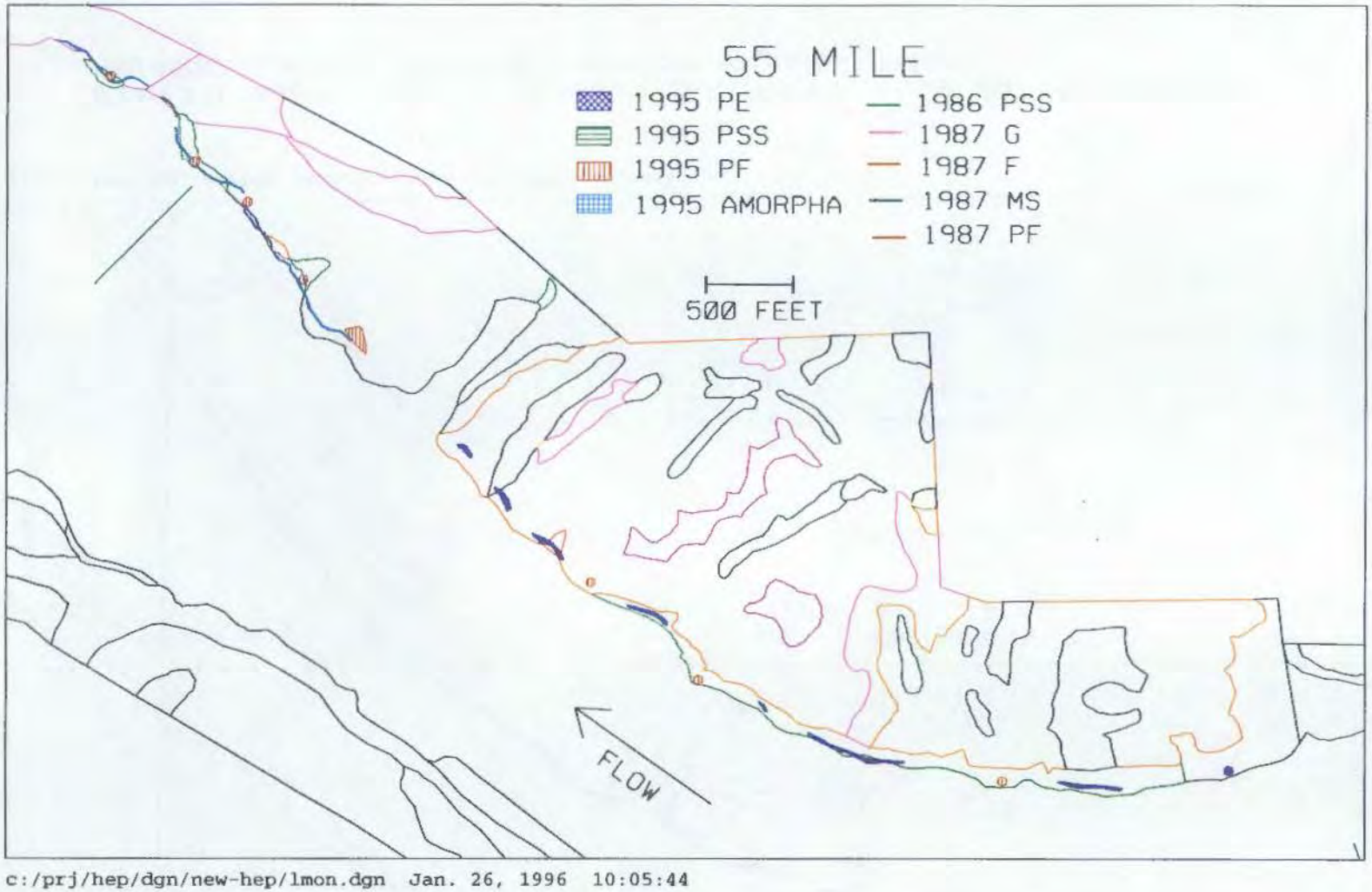


Figure 3.12 Changes in Vegetation Cover at 55-Mile HMU (PE=Palustrine emergent, PF=Palustrine forest, AMORPHA= false indigo, PSS=Palustrine shrub scrub, G=grassland, F=forbs, MS=Mesic shrub)

Wildlife abundance observed at 55-Mile HMU during October was relatively high. Species noted during mapping activities included pheasant, quail, northern harrier, unidentified owl, white-crowned sparrows, song sparrows (*Melospiza melodia*), tree sparrows, magpies, and beaver.

3.2.4 Palouse River

The Palouse River outlet is located immediately upstream from Lyons Ferry State Park, and much of the habitat associated with the river outlet resides within the park boundaries. This survey included two separate areas that exist along the Palouse River outlet. One area is located immediately adjacent to the Snake River system and includes the boat launch access area (Figure 3.13), which is composed largely of forested patches with peninsulas of emergent vegetation. White alder and black locust were the predominant trees found there. Cattail and rushes were predominant palustrine emergent vegetation found. False indigo was a common shrub-scrub class species observed along the shoreline, unlike the second area located farther up the Palouse River outlet.

The second area surveyed at this HMU included two large peninsulas located farther up the Palouse River outlet. No false indigo was found at this site. One peninsula was entirely covered with cattail and likely reflected the gentle sloping bathymetry found there. The other peninsula primarily was dominated by cattails; however, small patches of willow also were surveyed. Adjacent dryland sites consisted of shrub-steppe low cover. Sediment throughout the Palouse River site was predominantly silty clay.

The Palouse River area that was mapped showed a dramatic increase in extent and area of palustrine emergent vegetation--25.0 acres--from 1987 conditions (Figure 3.13). Palustrine forest habitat and palustrine shrub-scrub habitat also increased significantly, 4.9 and 6.7 acres, respectively. A relatively small acreage, 0.2 acres, was delineated as false indigo cover.

Wildlife abundance at the Palouse River site was relatively high. Ring-necked pheasant, chukar (*Alectoris chukar*), and quail were frequently seen or heard during the November surveys. Other wildlife observations included northern harrier, red-tailed hawk, bald eagle (*Hailaeetus leucace phalus*), unidentified falcon (likely prairie falcon), white-crowned sparrows, tree sparrows, magpie, ravens (*Corvus corax*), mallards (*Anas platyrhynchus*), Canadian geese (*Branta canadensis*), beaver, and muskrat.

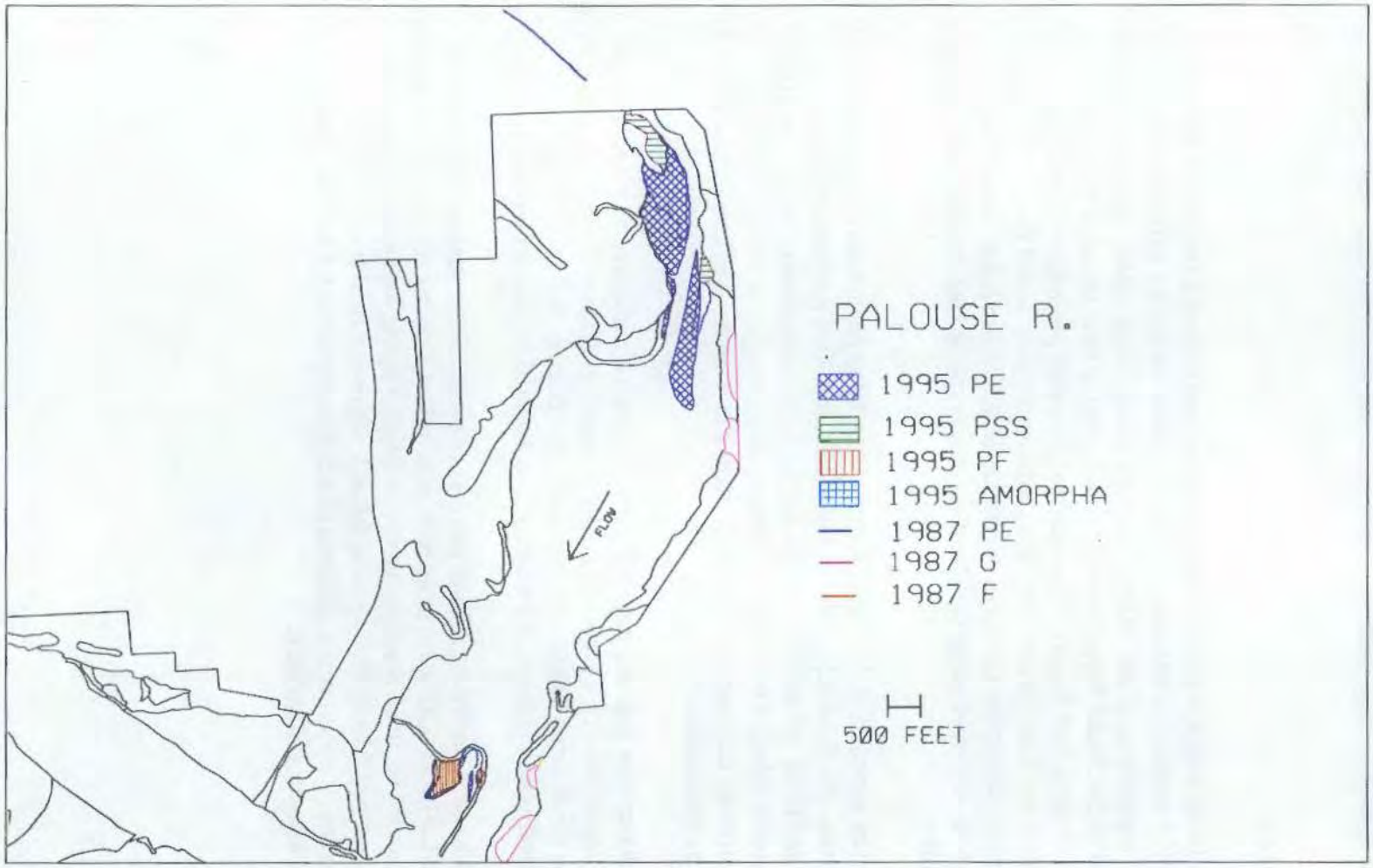


Figure 3.13 Changes in Vegetation Cover at Palouse River (PE=Palustrine emergent, PF=Palustrine forest, AMORPHA=flase indigo, PSS=Palustrine shrub scrub, G=grassland, F=forbs)

3.2.5 Tucannon River

The Tucannon River site is located within the large delta formed by the Tucannon River. To accommodate the flat topography of the delta, wetland transects were established within an emergent zone of the wetland, and upland transects were established within the shrub-dominated area of the wetland. The upland transect data at this HMU thus reflect a different wetland plant community. The plant communities examined were not particularly diverse in species composition or complexity, possibly because the communities recently formed in new habitat areas created by siltation of the mouth of the river. Reed canarygrass and cattail dominate the emergent areas of the site, and coyote willow and reed canarygrass dominate the shrub wetland. Upstream from the transects, an open-canopy forested wetland comprises larger willows.

Wetland transect plot data indicated 80% and greater canopy cover of persistent emergent vegetation during the spring and summer, which decreased to less than 20% canopy cover of emergent vegetation in September (Figure 3.14). Herbaceous canopy cover was insignificant along the wetland transects at the site, and shrub cover was 10% or less through the growing season. False indigo was a minor component of the shrub canopy measured along transects (<1% of line intercept), but occurred along the shoreline of the delta, which was not part of the area covered by transects.

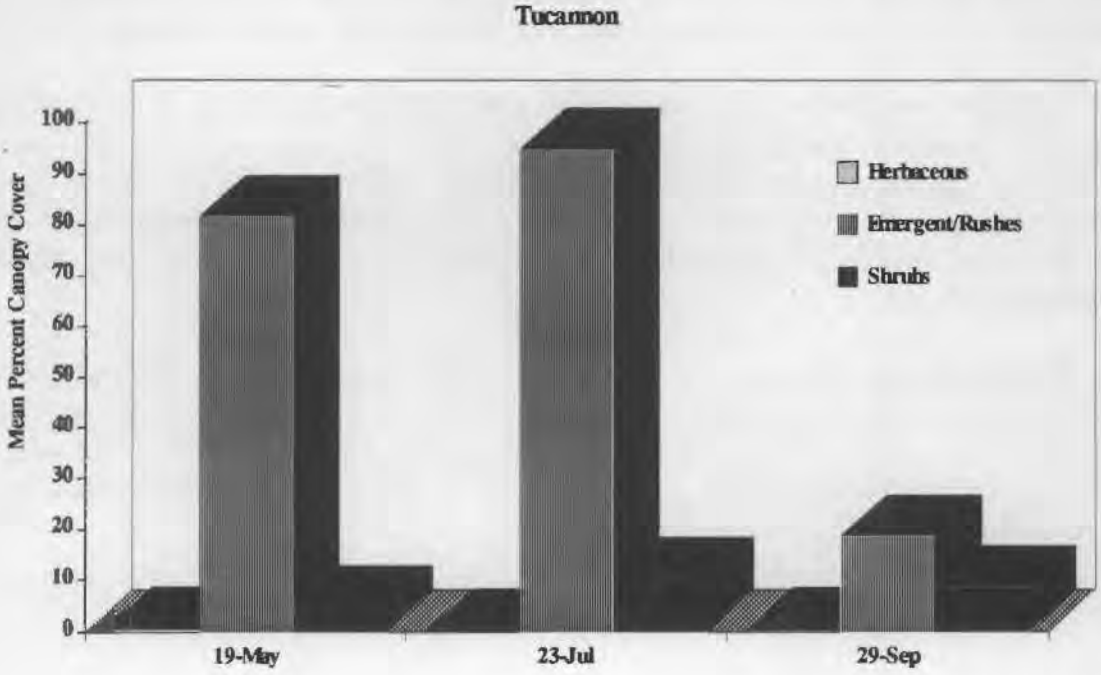


Figure 3.14 Mean Percent Canopy Cover of Vegetation Types at Tucannon River

Our mapping results indicated an increase of 5.4 acres in palustrine emergent cover, an increase of 4.75 acres in palustrine forest, and a decrease of 7.92 acres of palustrine shrub scrub cover (Figure 3.15). The increase in forested area and decrease in shrub-scrub area were probably related to growth of willow species over the past 8 years. Plant groupings previously classed as palustrine shrub-scrub have grown and are now classified as forested areas.

Sloughs were encountered during the course of field investigations, but no beaver were seen. White-tailed deer (*Odocoileus virginianus*) sign and evidence of deer bedding areas were prevalent in the forested portions of the area. The large size and relatively sheltered nature of this site may be important attributes.

3.2.6 Riparia HMU

The Riparia HMU is located within a sheltered backwater channel east of Alkali Flat Creek. A shallow slough, separating the main part of the wetland from the existing roadbed, may have been created by excavation. Transects were established from the roadway berm to the OHWM on the south side of the backwater area. Upland transects then traversed the narrow berm that separates the backwater area from the main river. This entire site appears to have been constructed, and the plant communities present reflect this recent establishment.

Cattail dominated the wetland, and shrub and tree species occurred about the fringes. Upland areas were dominated by false indigo and coyote willow. An interesting assemblage of native and non-native annual plant species occurred along the sandy beach area near the opening of the slough. Many of the species seen in this area were not seen at any of the other 13 HMUs.

At this site, we observed that the wetlands contained a uniform cover of 3-year-old false indigo plants, an unusual occurrence. Three plants outside of the study area were cut down to determine shrub age based on growth rings, and each plant sampled appeared to be 3 years old. Explanations for an even-aged invasion such as this could include previous water management of this pool or other disturbance regimes that would facilitate germination or vegetative spreading of false indigo at that time.

Measures of shrub canopy cover at the Riparia HMU reflect the large amount of false indigo at the site. Total shrub canopy cover increased from 34 to 60% through the growing season, and canopy cover of false indigo increased from 26 to 47% (67 to 80% of the total shrub cover). Line-intercept data for shrub cover (Table 3.1) in May indicated a total shrub canopy cover of 25%, of which 14% was false indigo.

Figure 3.15 Changes in Vegetation Cover at Tucannon River (PE=Palustrine emergent, PF=Palustrine forest, PSS=Palustrine shrub scrub, G=grassland, F=forbs, MS=Mesic shrub, ISLE=island shoreline)

Persistent emergent vegetation also increased from May to September from 14 to 49%; whereas, canopy cover of other forbs and grasses was quite low in May and July (<5%), but increased to 36% in September (Figure 3.16). The herbaceous canopy cover in September was composed of heartweed (*Polygonum*) species and cocklebur (*Xanthium strumarium*) that was not noted on the transects on previous sampling dates.

Survey and GPS mapping of the area indicate an increase in the acreage of palustrine emergent (+5.9 acres), palustrine shrub-scrub (+2.35 acres), and palustrine forest (+1.0 acre) (Figure 3.17). We also delineated 1.8 acres of false indigo at the Riparia HMU.

Muskrat were observed within the slough, and a gopher snake (*Pituophis melanoleucus*) was seen swimming within the wetland. Bird assemblages were diverse at this site.

3.3 Lake Bryan

The Lake Bryan pool lies behind Little Goose Dam. Thirteen of the 28 study areas were located along the shorelines of this reservoir. Seven of these sites were evaluated for changes in vegetative cover types only through field surveys and GPS mapping: New York Island, New York Bar, Willow Bar, Swift Bar/Swift Island, Swift Canyon, and Rice Bar. Six of the 14 vegetation monitoring sites--Ridpath, New York Gulch, Meadow Creek, Penawawa, Beckwitb, and Shultz--occur within this reservoir. Ridpath, Beckwith, and Shultz occur at sandy depositional areas along the main river. New York Gulch, Meadow Creek, and Penawawa occur within side drainage deltas. Penawawa is unique within the 14 sites investigated because it is the only site monitored that is dominated by forest vegetation.

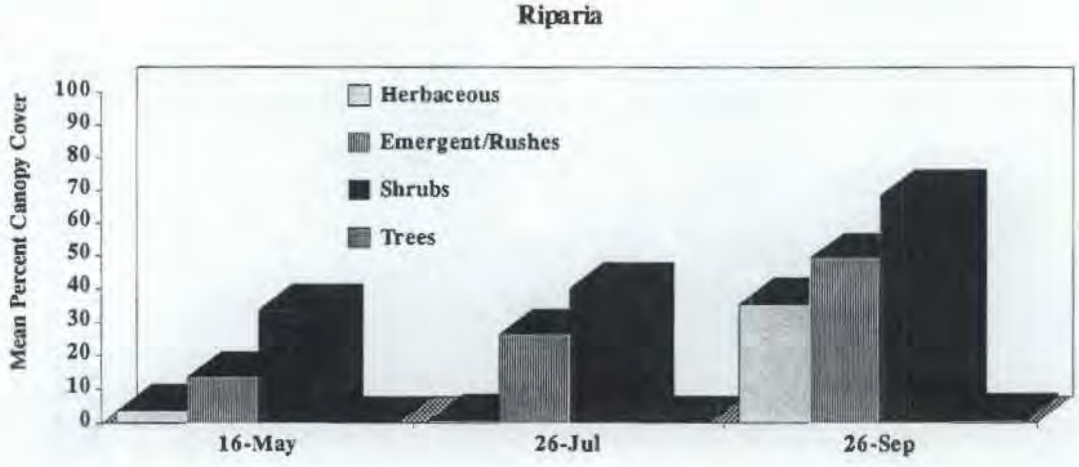


Figure 3.16 Mean Percent Canopy Cover of Vegetation Types at Riparia HMU

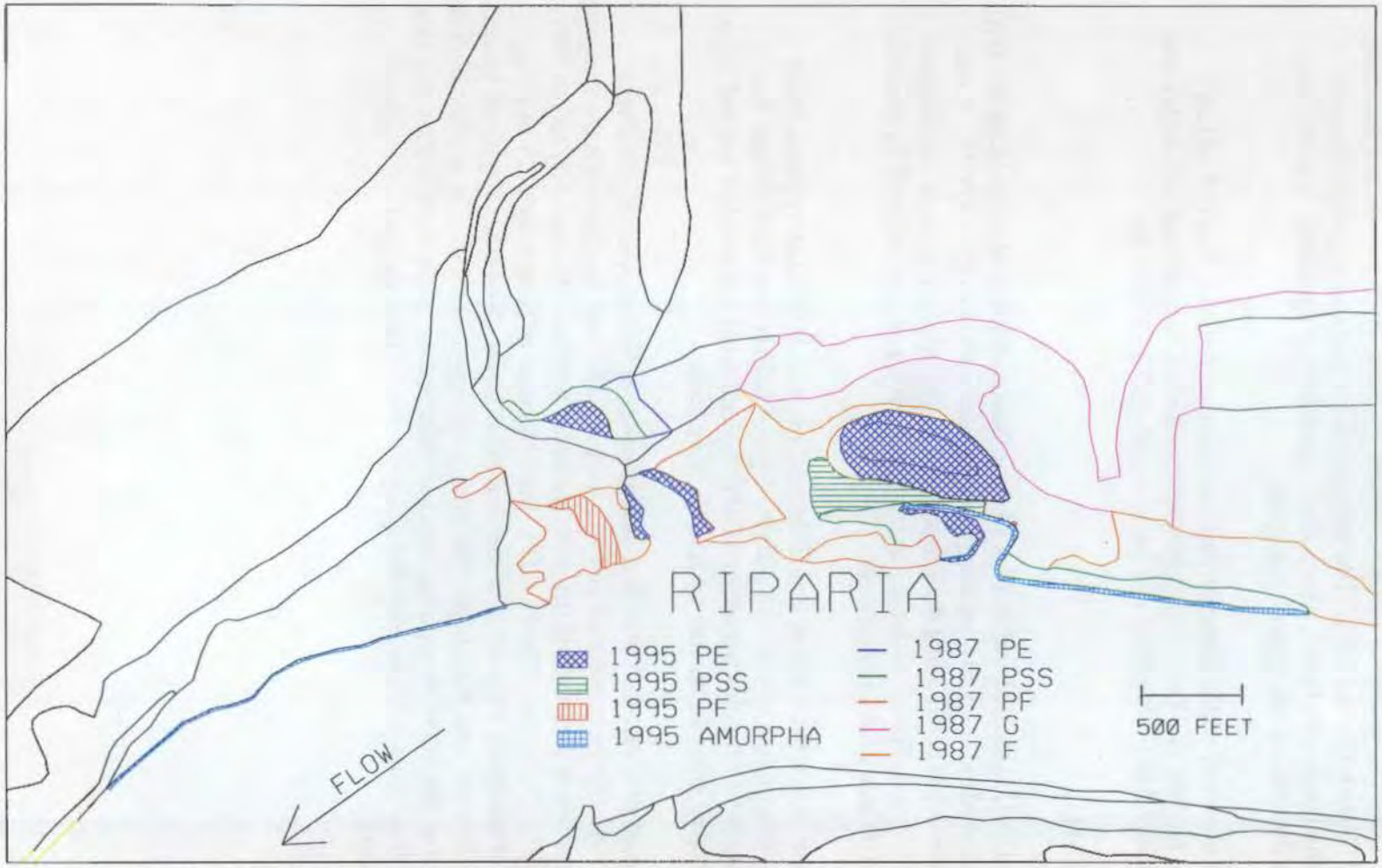


Figure 3.17 Changes in Vegetation Cover at Riparia HMU (PE=Palustrine emergent, PF=Palustrine forest, AMORPHA=false indigo, PSS=Palustrine shrub scrub, G=grassland, F=forbs)

In general, the amount of palustrine emergent vegetation and palustrine shrub-scrub habitat appears to have increased along the shorelines of Lake Bryan. Because so many sites were studied on this pool, the change in available habitat is shown for the lower and the upper portions of the pool (Figure 18a and 18b). The only significant increase in palustrine forest habitat occurred at the Penawawa HMU, where shrub-scrub habitat apparently matured into forest and along the shoreline at the Willow Bar HMU.

Water levels observed within this reservoir were similar to those observed on Lake Sacajawea and Lake Herbert G. West. The reservoir appeared to be near bank-full during our May site visit, dropped 2.5 m by July, and was back to bank-full by September.

3.3.1 Ridpath HMU

The Ridpath HMU is located within a broad flat of shrub-dominated wetland on the north side of the river. The wetland transects ran from the deep-water edge to the OHWM. A series of beaches and backwater areas occur along the transects. The site appears to be an environment favorable for deposition and siltation through scouring and wave action because of its downward position and because no side drainage is present.

Habitat present within the wetland was fairly uniform, and dominated by dense shrub vegetation, including false indigo and coyote willow. Upland habitat was more diverse due to regular habitat management activities within the HMU. Upland areas consisted of mowed fields interspersed with forested areas dominated by Russian olive trees.

Wetland transect plot data indicated that canopy cover of herbaceous and persistent emergent vegetation was relatively constant and relatively low (11% or less) through the sampling periods. Shrub canopy cover measured in the plots increased between May and July (60 to 76%) and decreased slightly by September (Figure 3.19). Canopy cover of false indigo (14 to 26% mean canopy cover) represented 24 to 34% of the total shrub cover. Shrub canopy cover values calculated from line-intercept data were higher for total shrub cover--105%. This was the highest shrub cover measured at any of the monitoring sites and reflected the dense scrub willow thickets that occurred in this area. Line-intercept data for canopy cover of false indigo (29%) agreed fairly well with plot data.

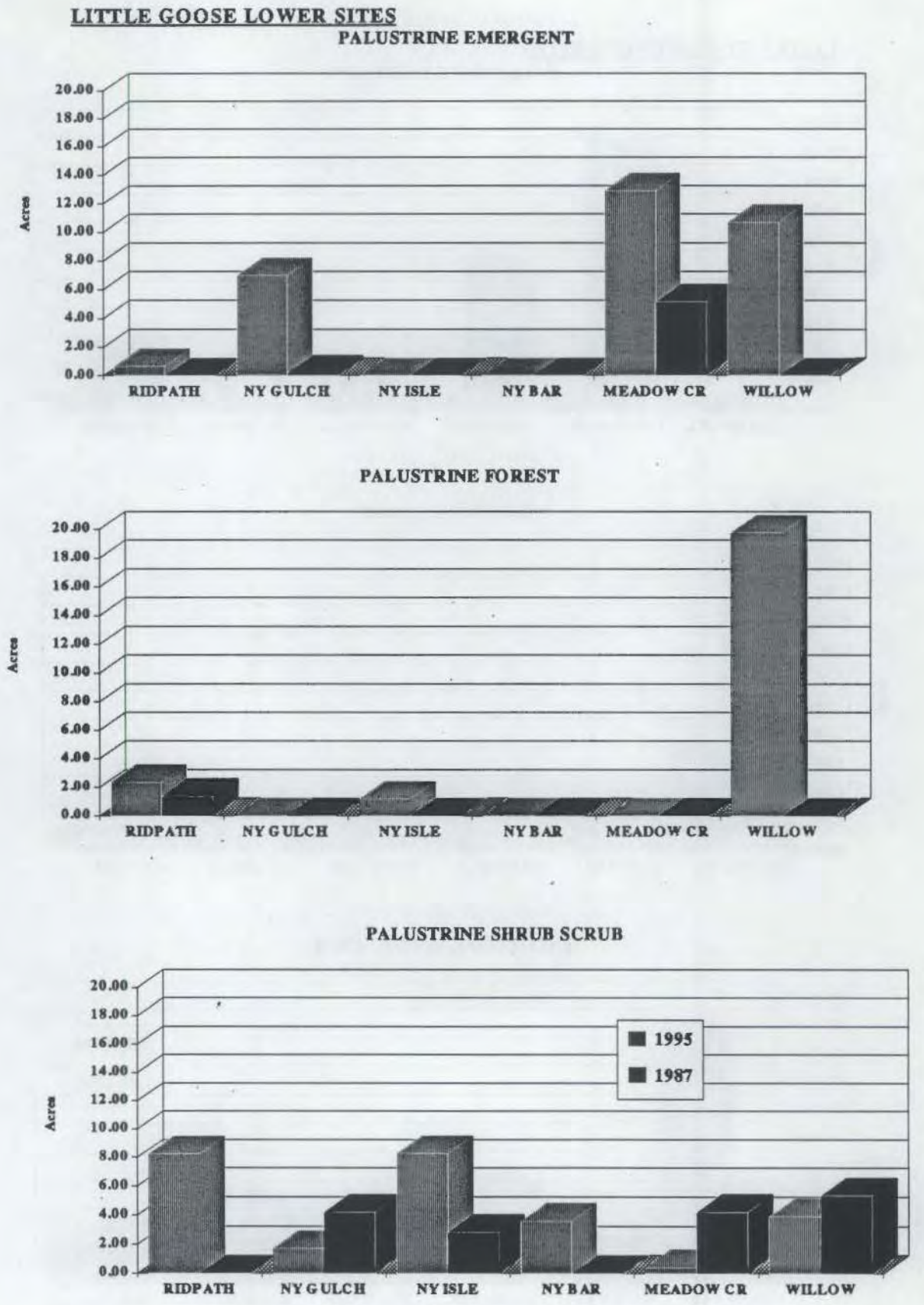


Figure 3.18a Changes in Riparian Habitat Along the Downstream Portion of Lake Bryan

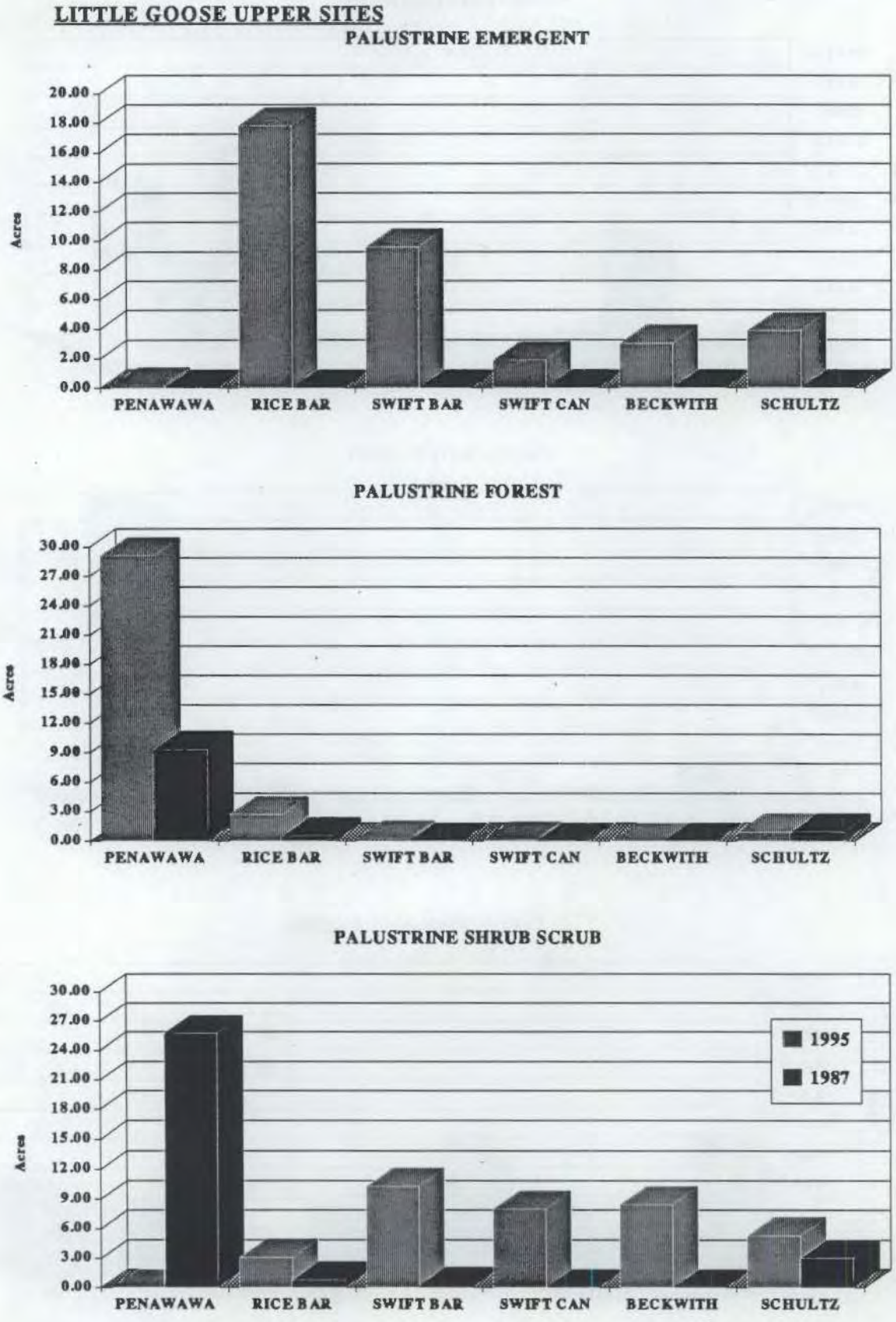


Figure 3.18b Changes in Riparian Habitat Along the Upstream Portion of Lake Bryan

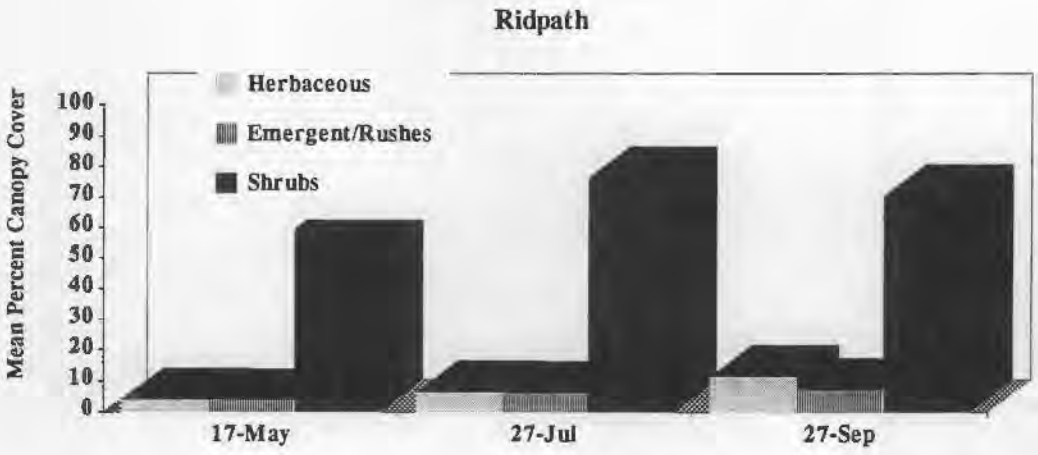


Figure 3.19 Mean Percent Canopy Cover of Vegetation Types at Ridpath HMU

The high values for shrub canopy cover along the wetland transects at the Ridpath HMU were corroborated by mapping a 7.1-acre increase in palustrine shrub-scrub cover (Figure 3.20). Survey of the cover types revealed a 42% increase in palustrine forest cover from 1.38 acres to 2.36 acres and 0.7 new acres of palustrine emergent cover.

A relatively diverse assemblage of bird species was observed at this site in the uplands, reflecting the diversity of habitat types present. A Great Basin spadefoot toad (*Scaphiopus intermontanus*) was also seen during the surveys at this area.

3.3.2 New York Gulch HMU

The wetland at this HMU lies in a delta formed at the mouth of New York Gulch. The mouth of the gulch creates a downstream-facing cove of the Snake River. Sedimentation appeared to be rapidly accreting in the gulch and increasing the area of the delta. Emergent plants, including cattail, dominated most areas. Strong westerly winds buffet the deep-water edge of the wetland and appear to have formed a series of shallow beaches further protecting emergent plants. Transects were established (running south) to cross the cove. Plot 1 occurs at the north side of the cove. Upland transects bisect a fringe of false indigo. Conditions at this HMU are emergent and shrub-scrub wetland habitats.

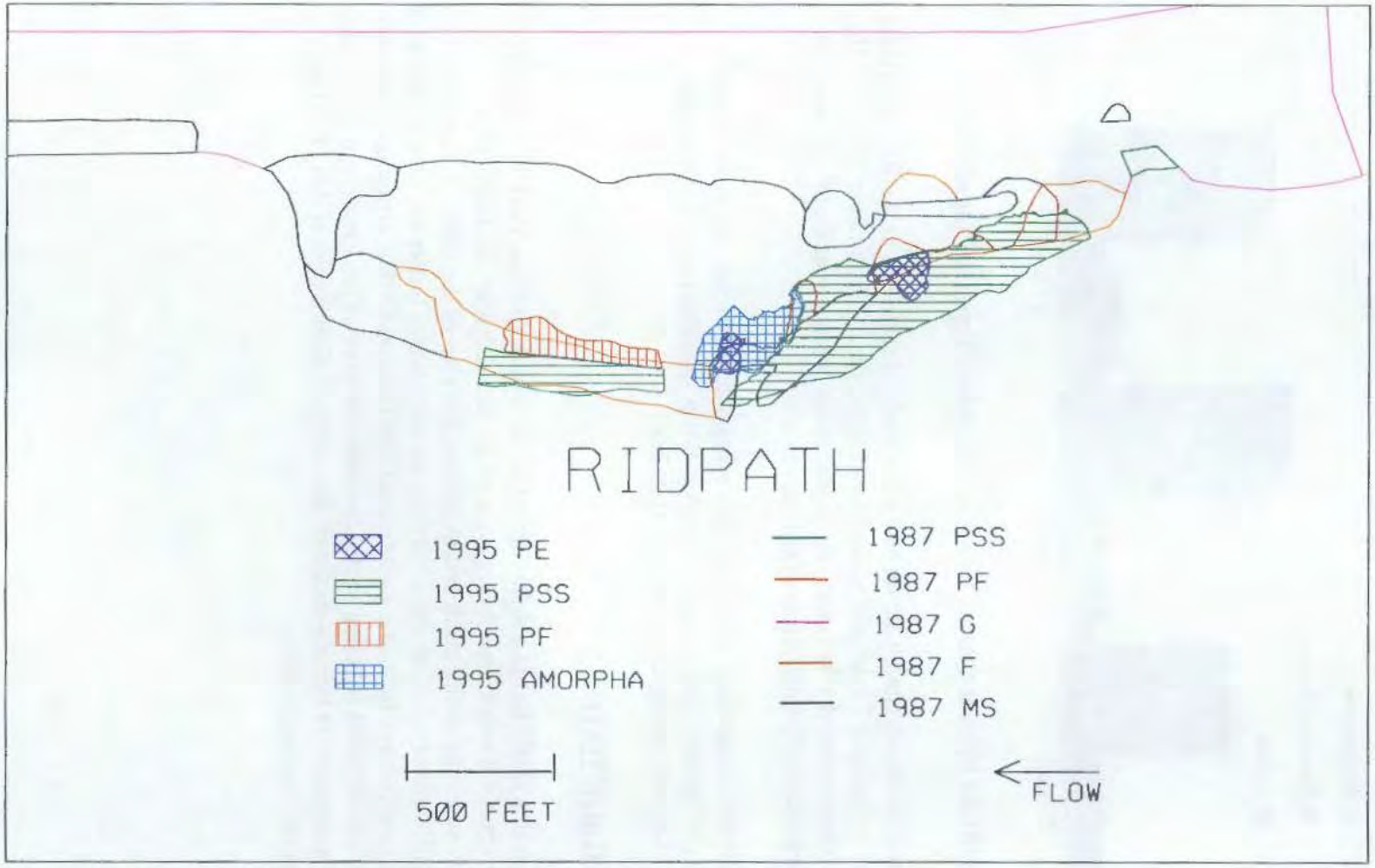


Figure 3.20 Changes in Vegetation Cover at Ridpath HMU (PE=Palustrine emergent, PF=Palustrine forest, AMORPHA=false indigo, PSS=Palustrine shrub scrub, G=grassland, F=forbs, MS=Mesic shrub)

Plot data for New York Gulch indicated that persistent emergent vegetation canopy cover remained fairly constant, about 40%, throughout the growing season, (Figure 3.21). Canopy cover of shrubs increased slightly from 14 to 18%, and other herbaceous cover increased from 3 to 9.7% by September. False indigo mean canopy cover measured from May to September ranged from 13.3 to 15.7%, which represented 77 to 93% of the total shrub cover. Line-intercept data for shrubs along the wetland transect at New York Gulch (Table 3.1) indicate a total canopy cover of 9.4%, which includes 8.1% canopy cover of false indigo.

The siltation creating the delta in the mouth of the gulch and subsequent vegetation establishment have increased the palustrine emergent cover at New York Gulch by 6.75 acres from that mapped from 1987 photos (Figure 3.22). No palustrine forest had developed at the study area, and palustrine scrub shrub cover appeared to decrease by 3.84 acres. Approximately 1.3 acres of false indigo were mapped where it occurs along the wetland edge and in small patches of the wetland intermixed with willows.

Beaver sign was common at this site, and a beaver lodge was located near plot 5 on transect A. Deer bedding areas were located up the gulch from the wetland habitat.

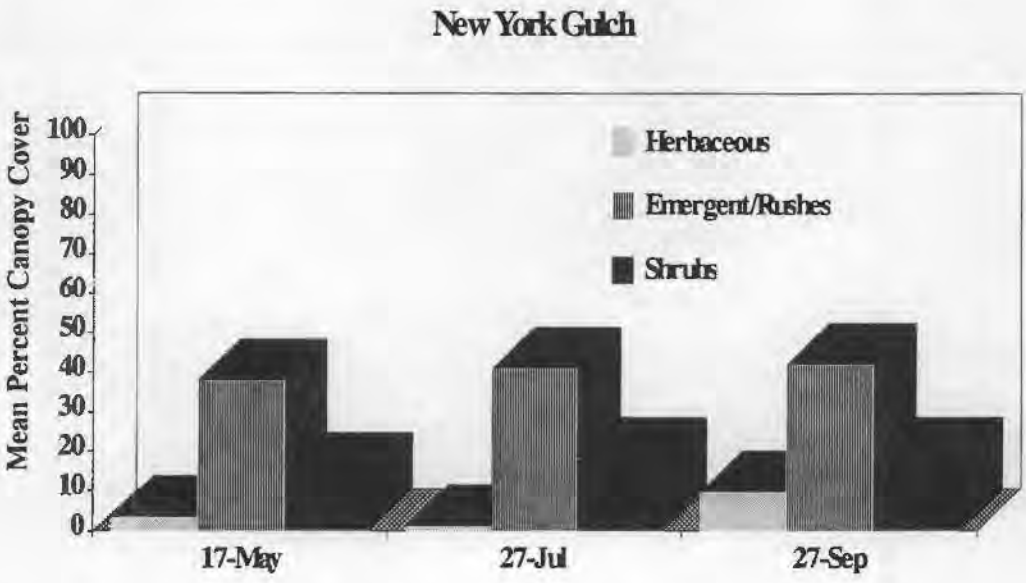


Figure 3.21 Mean Percent Canopy Cover of Vegetation Types at New York Gulch HMU

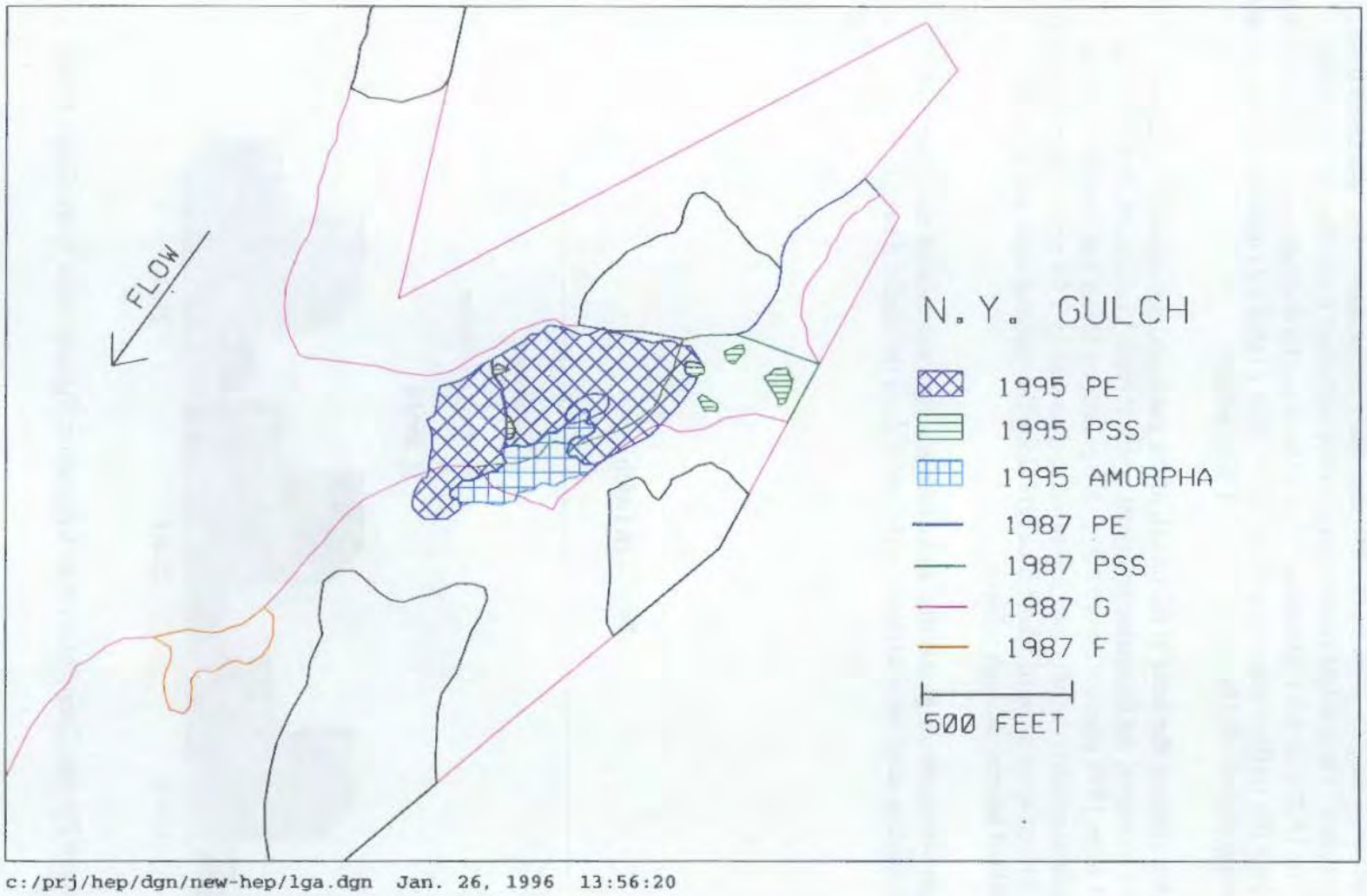


Figure 3.22 Changes in Vegetation Cover at New York Gulch HMU (PE=Palustrine emergent, AMORPHA= flase indigo, PSS=Palustrine shrub scrub, G=grassland, F=forbs)

3.3.3 New York Island

The New York Island site is located immediately adjacent to New York Gulch (river mile 78.2). The island is largely covered by shrub-steppe low cover; however, shoreline areas along the southern edge of the island contain a mixture of palustrine shrub-scrub and palustrine forest. Willow and false indigo intermixed with cattail were the predominant plant types for palustrine shrub-scrub habitat found there. Small groves of whiplash willow *(Salix lasiandra)* were scattered along the shorelines, and a few coniferous trees--ponderosa pine (*Pinus ponderosa*)--were found in the dryland areas of the island. Field survey and mapping of New York Island revealed an additional 1.2 acres of palustrine forest and an increase of 5.5 acres of palustrine shrub-scrub habitat (Figure 3.23). The remainder of island shorelines were bare with sandy silt or large cobble substrate.

Wildlife observations on this island were unique. Cottontail rabbits (*Sylvilagus nuttallii*) are the most abundant wildlife residing on New York Island. The density of this species is extremely high, and burrows and scat were encountered over the entire island. Despite the high density of rabbits, the shrub-steppe plant community appeared to be in good condition. Remains of rabbits consumed by raptorial species were found under every tree or tree grove on the island. One bald eagle was observed flying over the island during November. Other wildlife observations included white-crowned sparrows, song sparrows, and previously active nests of Canada geese.

3.3.4 New York Bar HMU

New York Bar is located on the southern shoreline of the Snake River approximately 2 miles upstream from New York Island. The dryland areas of this site were composed of a mosaic of different habitat types, primarily including palustrine forests, agricultural areas, and shrub-steppe. Russian olive was the predominant forest class species and is well established at New York Bar. Riverine shoreline vegetation consisted of a narrow (5- to 10-m) strip of palustrine shrub-scrub habitat. False indigo was the predominant species occurring in this strip. Shoreline substrate existing at this site was coarse cobble with very little sedimentation and may inhibit the establishment of extensive palustrine emergent vegetation there. Steep bluffs exist along the upriver half of New York Bar, making this HMU less amenable for establishment of riparian vegetation.

Results of field mapping at New York Bar did not indicate any increase in palustrine emergent, shrub-scrub, or forest habitat areas, but did reveal a 3.6-acre area of false indigo (Figure 3.24).

Wildlife abundance incidentally observed during field surveys in November was moderate, but reflects an area where forest cover is abundant. Species either seen or heard included great blue heron (*Ardea herodias*), tree sparrow, white-crowned sparrow, raven, magpie, American robins (*Turdus migratorius*), flickers (*Colaptes auratus*), deer, and coyote.

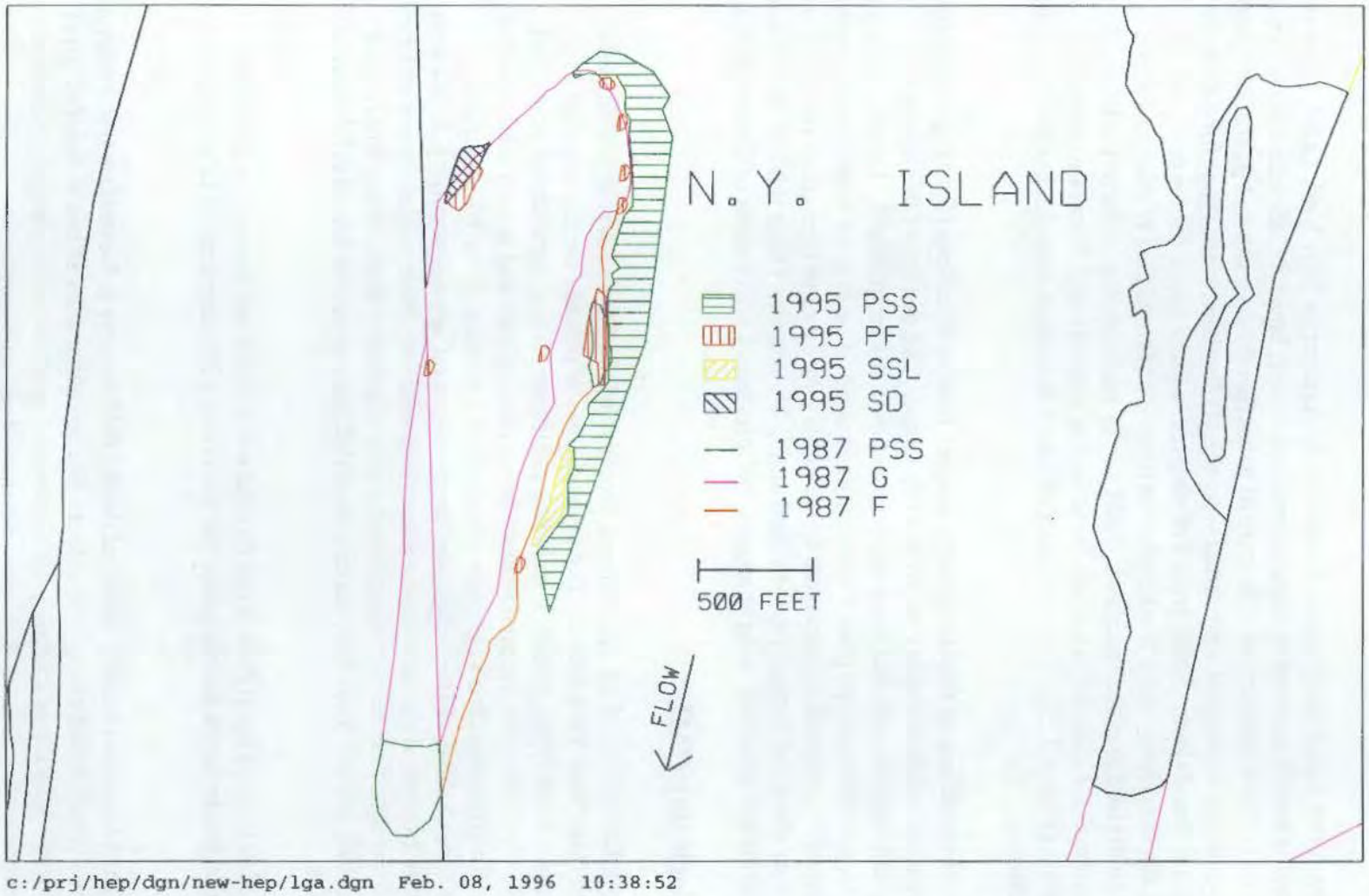


Figure 3.23 Changes in Vegetation Cover at New York Island (PF=Palustrine emergent, AMORPHA= false indigo, PSS=Palustrine shrub scrub, G=grassland, F=forbs, SSL=shrub steppe low cover, SD= sand dune)

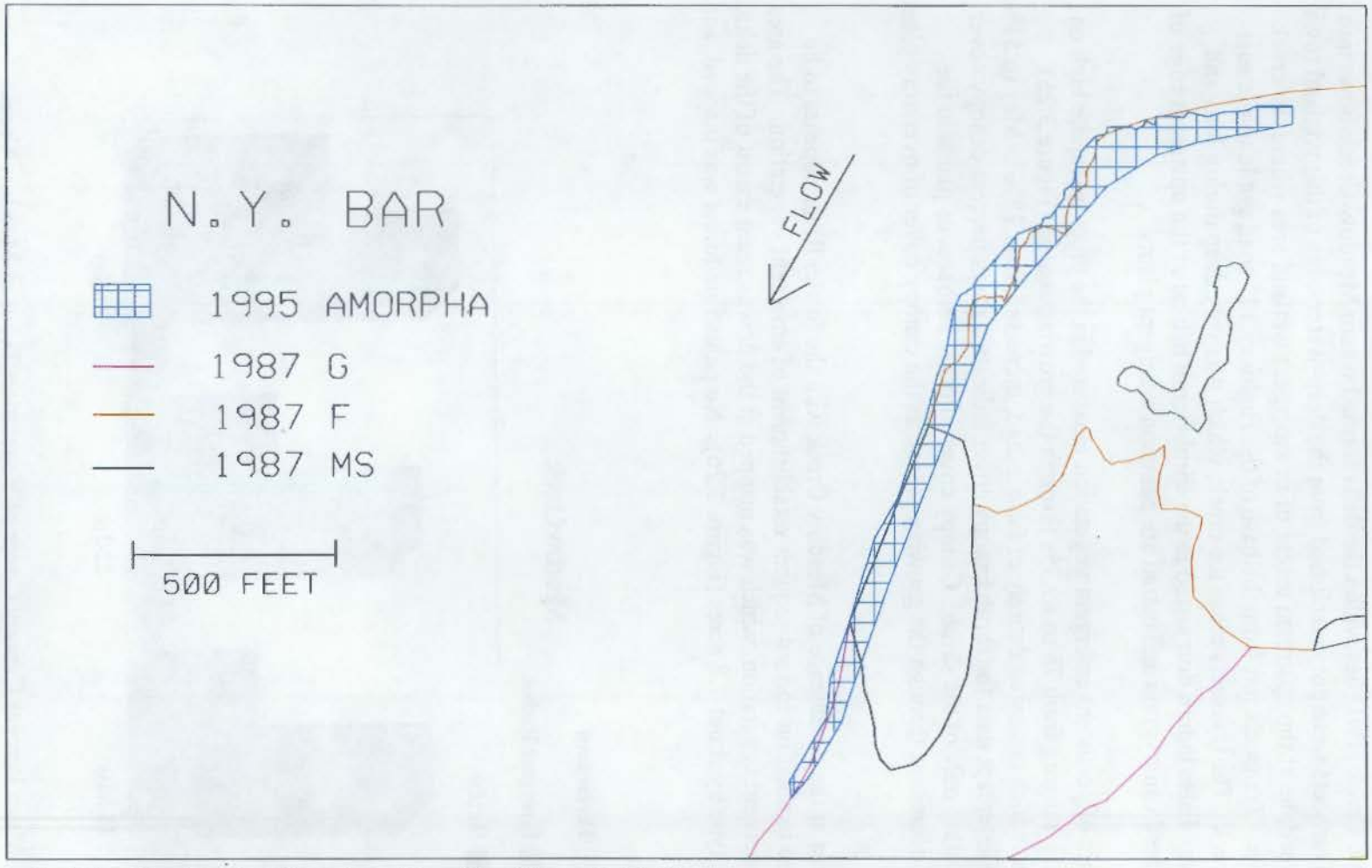


Figure 3.24 Changes in Vegetation Cover at New York Bar HMU (AMORPHA=false indigo, G=grassland, F=forbs, MS=Mesic shrub)

3.3.5 Meadow Creek HMU

The Meadow Creek HMU lies within the delta formed where Meadow Creek flows into the Snake River. Transects were not established from the deep-water edge of this wetland toward the upland, but instead, lie at the upstream extent of an emergent wetland area where the creek meanders to the river. Transects run from the base of the Highway 127 road grade to the east side of Meadow Creek. The transects cross the creek, which was very deep during May and September site visits. False indigo dominated in the shrub-scrub habitat at the upstream edge of the delta area, and reed canarygrass and cattail are common emergent plants.

Canopy cover of persistent emergent vegetation measured in the plots was quite high on the wetland transects, ranging from 78 to 89.7% through the growing season (Figure 3.25). Shrub canopy cover, which consisted entirely of false indigo, increased from 28% in May to 51% in September. Line-intercept data for shrub canopy cover indicate a mean percent canopy cover of 51%, again consisting only of the shrub. Canopy cover of other herbaceous plants in the understory (<10%) decreased through the growing season as the canopy cover of overstory plants increased.

The delta area at the confluence of Meadow Creek with the Snake River appears to be increasing in size due to siltation and subsequent establishment of emergent vegetation. The area of new palustrine emergent vegetation, which was mapped at the downstream extent of the delta, increased this cover type by about 7.8 acres (Figure 3.26). No palustrine forest was mapped, and

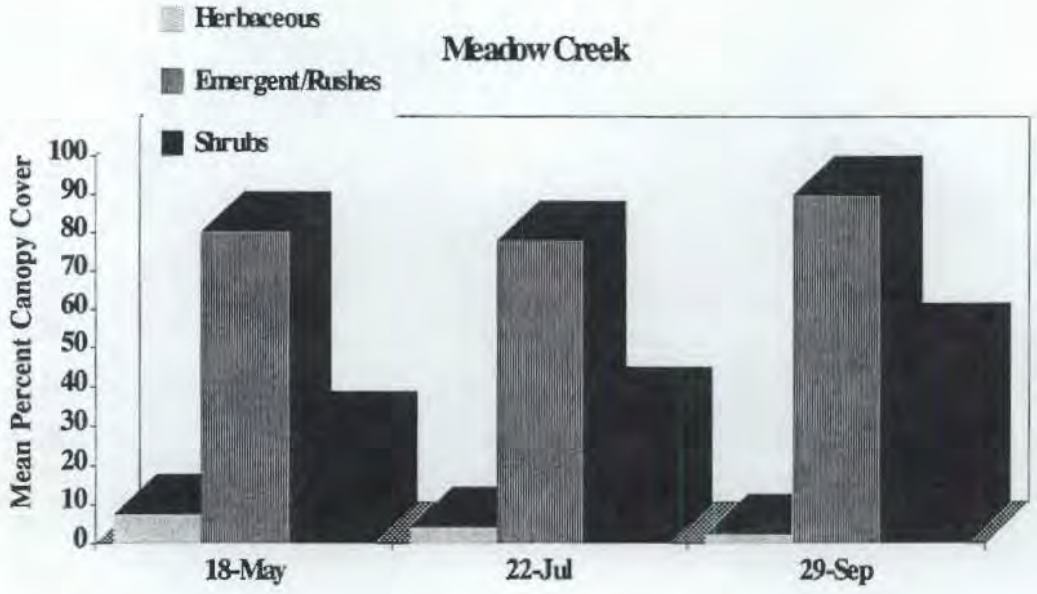


Figure 3.25 Mean Percent Canopy Cover of Vegetation Types at Meadow Creek

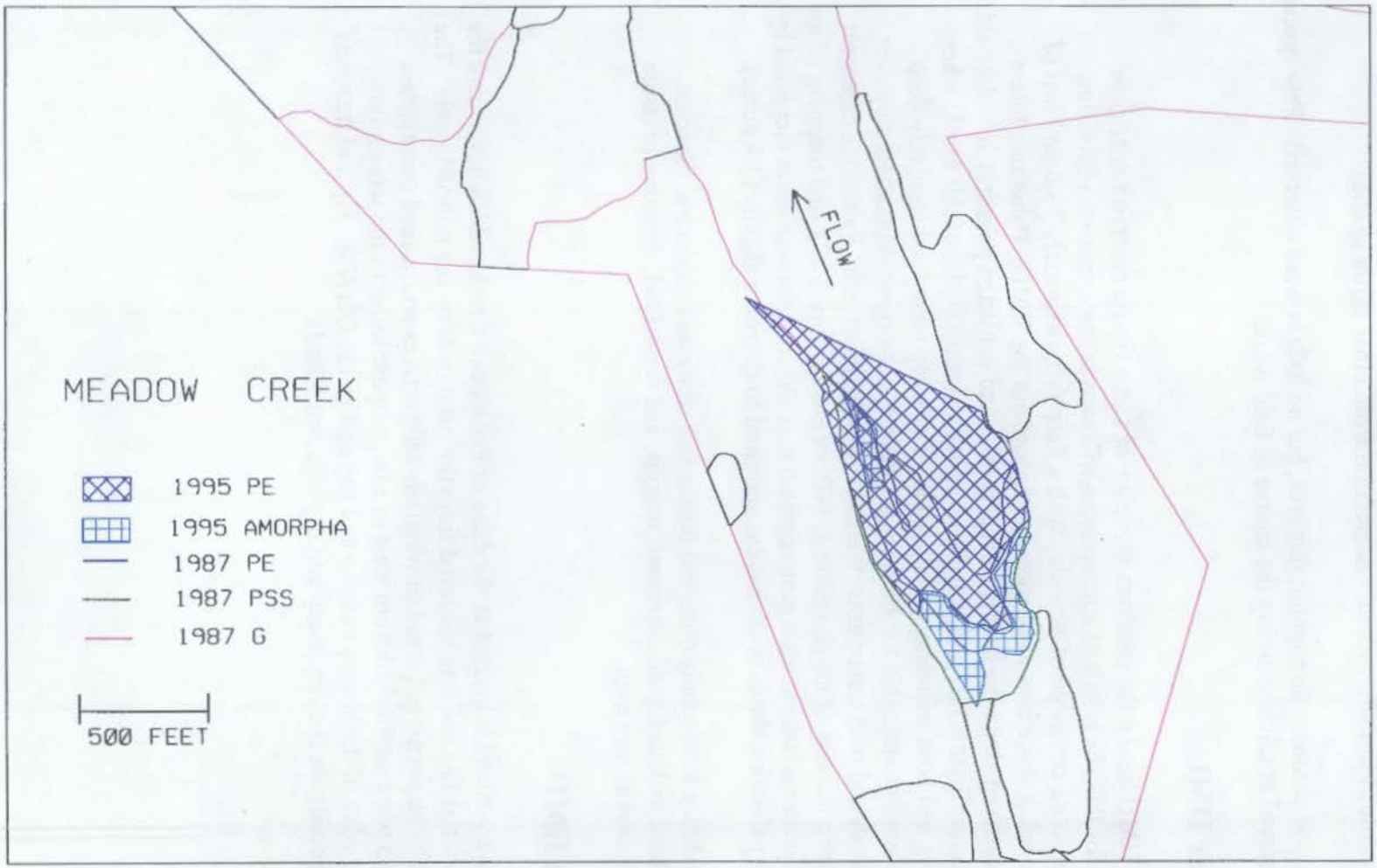


Figure 3.26 Changes in Vegetation Cover at Meadow Creek HMU (PE=Palustrine emergent, AMORPHA= flase indigo, PSS=Palustrine shrub scrub, G=grassland)

palustrine shrub-scrub canopy may actually have decreased at this site. Future vegetation succession at this site might be strongly influenced by false indigo whicb appears to play a particularly invasive role at this site without competition from other shrub species.

Beaver sign was common throughout this area, but no lodges were observed. Few species of wildlife were observed at this site during the course of field work.

3.3.6 Willow Bar HMU

Willow Bar HMU lies on the southern shoreline of Little Goose reservoir near river mile 88. The name for this site is indeed appropriate--willow was the dominant vegetation occurring there. Substrate consisted of silty clay with a deep (approximately 3 - 6 cm) bed of cobble, and gentle sloping shorelines were common throughout the HMU. Palustrine forest habitat was found scattered along the shores of Willow Bar and consisted primarily of white alder and black locust species (Figure 3.27). A small inlet exists near the middle of this HMU where public vehicle parking and boat launching are available. The steep banks and relatively deep waters of this inlet were not amenable for substantial palustrine emergent vegetation; however, small patches of bulrusb and reed canarygrass were found occurring there. Palustrine emergent habitat was found along the rest of the shoreline at Willow Bar (Figure 3.27), and mapping of the area indicates a 10.7-acre increase in emergent vegetation. Palustrine forest habitat increased by almost 20 acres, and palustrine shrub-scrub habitat appeared to decrease slightly (1.4 acres).

Wildlife abundance incidentally observed during this study was moderate. Species incidentally seen or herd included quail, pheasant, magpie, and waterfowl. Hunting pressure during the November survey was high.

3.3.7 Penawawa HMU

The Penawawa wetland is located at the delta of Penawawa Creek, which lies behind the railroad trestle. Habitat at this site was sheltered from the main river by the railroad grade. The delta was dominated by an even-aged stand of whiplash willow trees with a reed canarygrass understory. Transects were established from west to east, perpendicular to the stream flow. Transects start at the edge of the stream channel and run east to the OHWM. Upland transects include vegetation growing on the very steep and dry adjacent hillside.

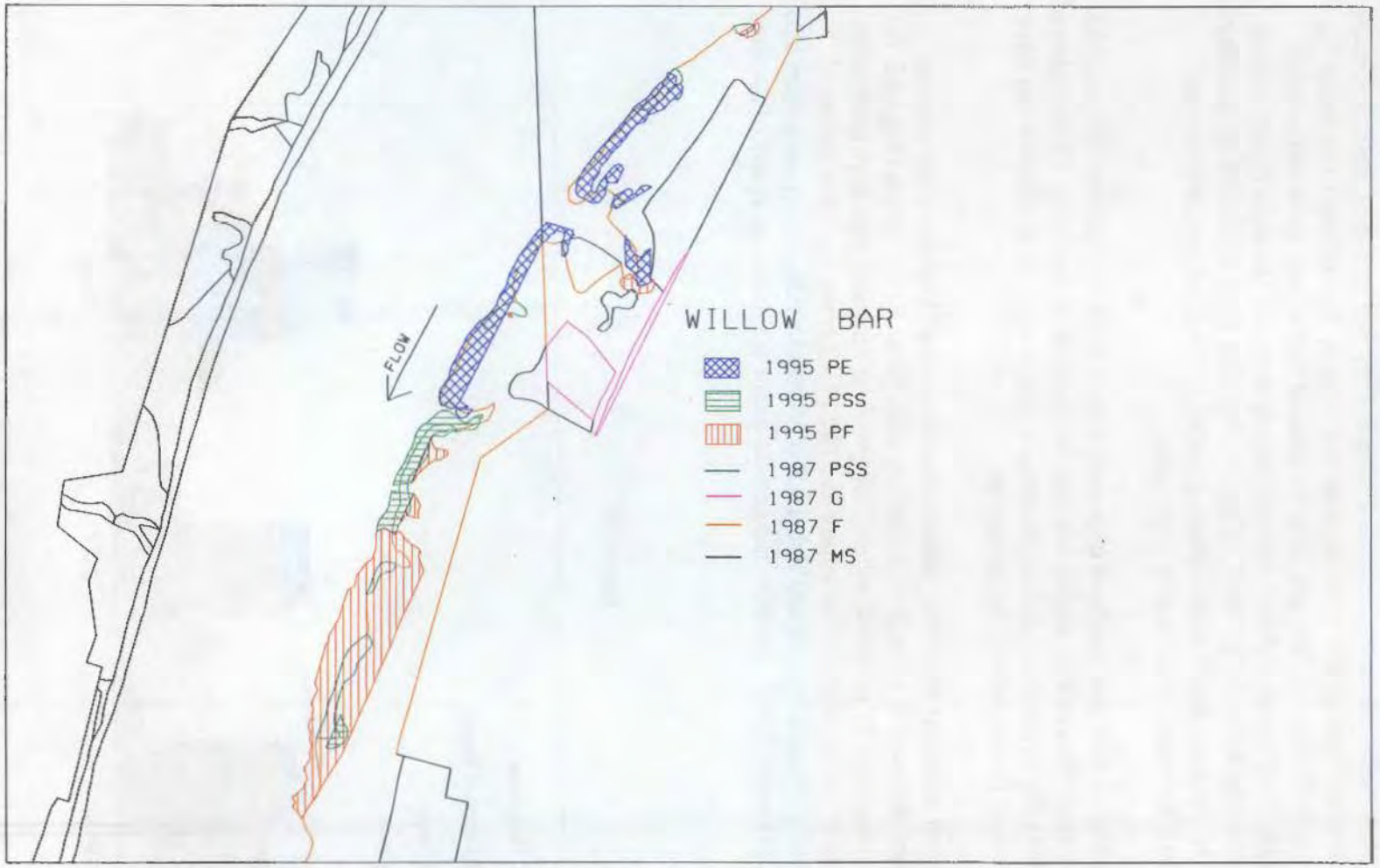


Figure 3.27 Changes in Vegetation Cover at Willow Bar HMU (PE=Palustrine emergent, PF=Palustrine forest, PSS=Palustrine shrub scrub, G=grassland, F=forbs, MS=Mesic shrub)

Canopy cover measured in plots along the wetland transect indicated that persistent emergent vegetation and shrubs co-dominate the community (Figure 3.28). Shrub cover (37%) was slightly greater than persistent emergent cover (30%) in May, but emergent wetland canopy cover continued to increase through the growing season to 52% by September, while shrub canopy cover decreased. During our July site visit, we noticed that a flash flood had recently impacted this drainage. Large piles of debris were evident upstream of the main forest, and the river obviously had filled the entire valley floor. This flooding may have influenced measurements of canopy cover of the shrubs and herbaceous plants growing in the delta, which decreased sharply in July, but had increased somewhat by September.

It was interesting to note that the flood deposited a layer of silt approximately 2 cm thick throughout the study area. Floods such as this one may he common in this basin. Observation of sediment deposits along the stream bank indicate that more than a meter of deposition may have occurred in some areas of the site within the recent past.

Mapping current habitat at this HMU indicated an increase of 19.8 acres in palustrine forest and a concurrent decrease in acreage of palustrine scrub shrub of 25.7 acres (Figure 3.29). The forested area is dominated by whiplash willow, and previous mapping may have incorrectly identified these stands as scrub-shrub, or the stature and size of the trees may have increased significantly since 1987 photography. An additional 0.2 acres of palustrine emergent habitat also was mapped at the Penawawa HMU. No false indigo was found at this site or at any of the sites visited upstream.

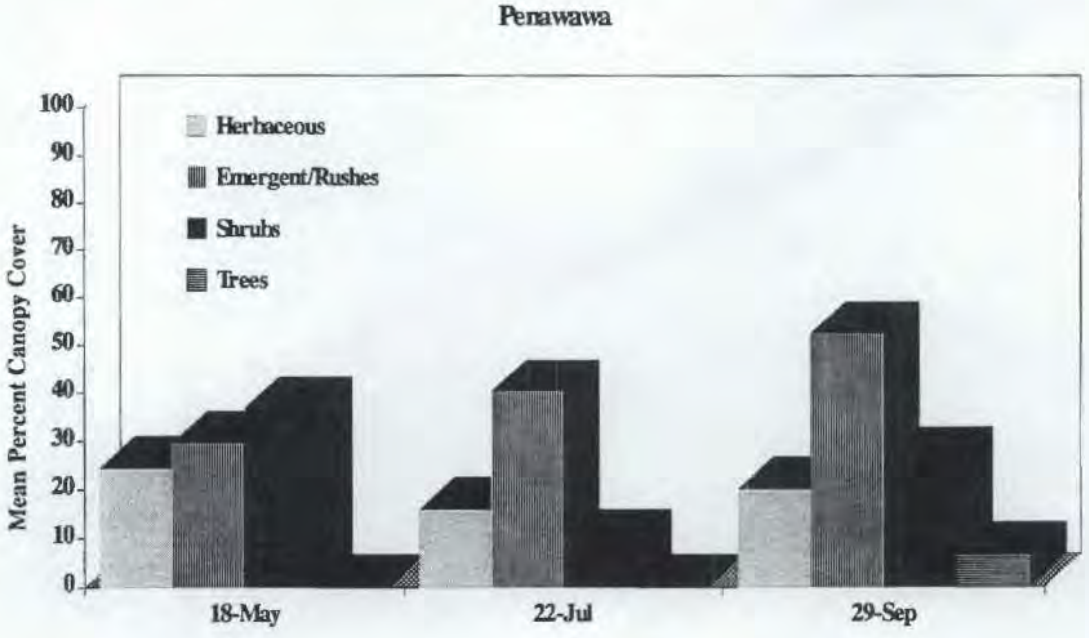


Figure 3.28 Mean Percent Canopy Cover of Vegetation Types at Penawawa HMU

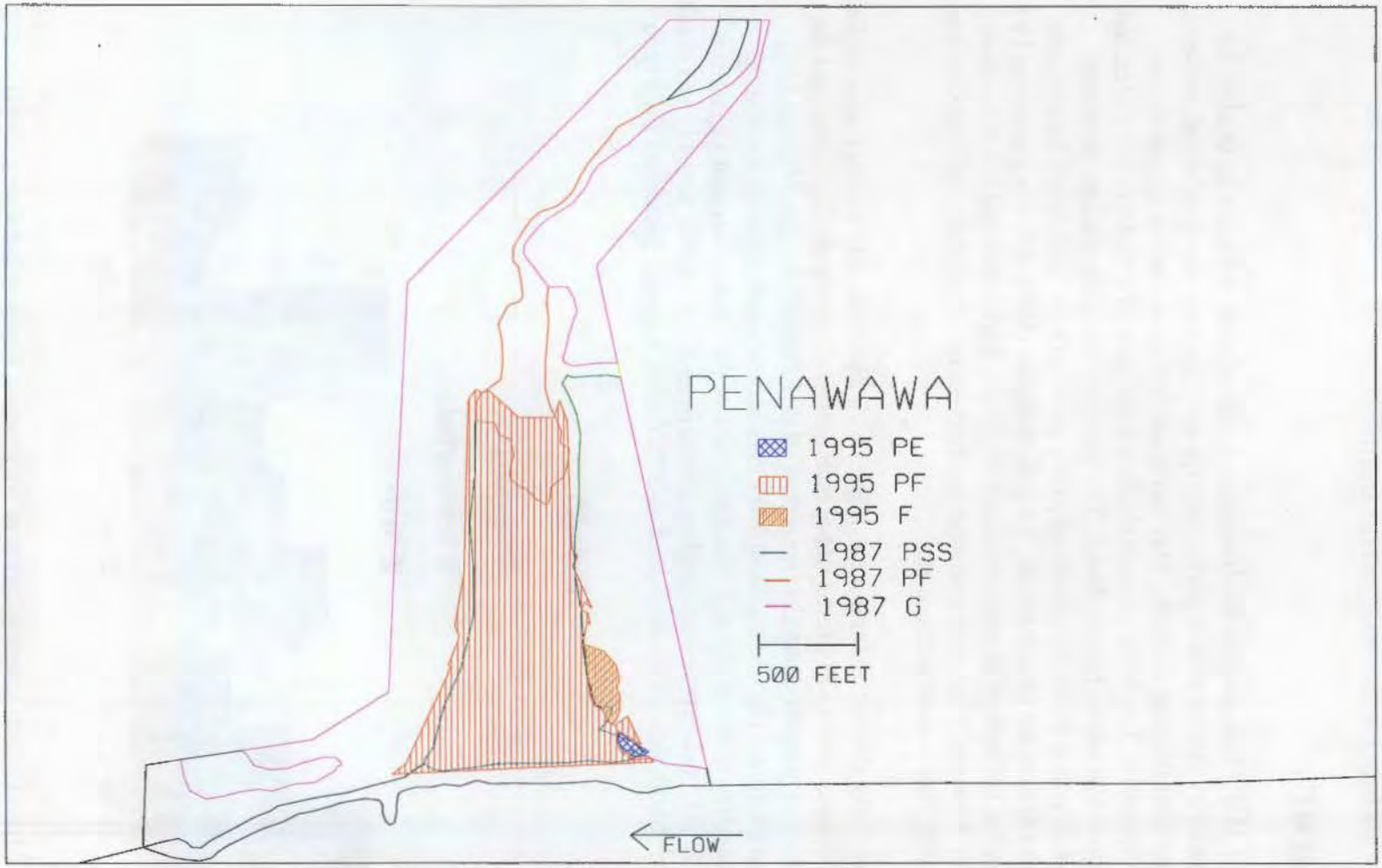


Figure 3.29 Changes in Vegetation Cover at Penawawa HMU (PE=Palustrine emergent, PF=Palustrine forest, PSS=Palustrine shrub scrub, G=grassland, F=forbs)

Beaver sloughs were common throughout the area, and evidence of recent beaver use of the willows is common. Bird species abundance was high in this forest area. This may be because similar habitats were not found in the vicinity of the HMU.

3.3.8 Beckwith HMU

The Beckwith HMU is located at the downstream side of what is known as Wade's Bar. The area was dominated by coyote willow with a very diverse, shallow emergent marsh between the shore and the emergent fringing willows. This marsh and the upland areas appear to have been heavily grazed by cattle. Transects were established from the OHWM north for 100 m, but did not reach the deep-water edge of the willows. The transects cross the shallow emergent marsh area. The upland area is primarily grassland with a grove of very large black locust trees present just east of the site on the upland bench. Like the Ridpath HMU, this site appears to be a depositional environment because of its position along the Snake River flow and not from input from a side drainage. A beaver lodge was seen near the deep-water edge of the willows very near the site, and beaver sign was evident in the area.

Canopy cover along the wetland transects at Beckwith was dissimilar to other sites studied for this report. Herbaceous grasses and forbs rather than persistent emergent vegetation had the highest mean percent canopy cover along the transect at all three sampling dates (Figure 3.30). Cocklebur and redtop bentgrass (*Agrostis stolonifera*), considered weedy species, formed the majority of the herbaceous canopy at the site. Canopy cover of persistent emergent vegetation decreased between the July and September sampling period from 33 to 10.5%, possibly as a result of grazing on the site. Shrub canopy cover peaked at 27% during July and decreased slightly to

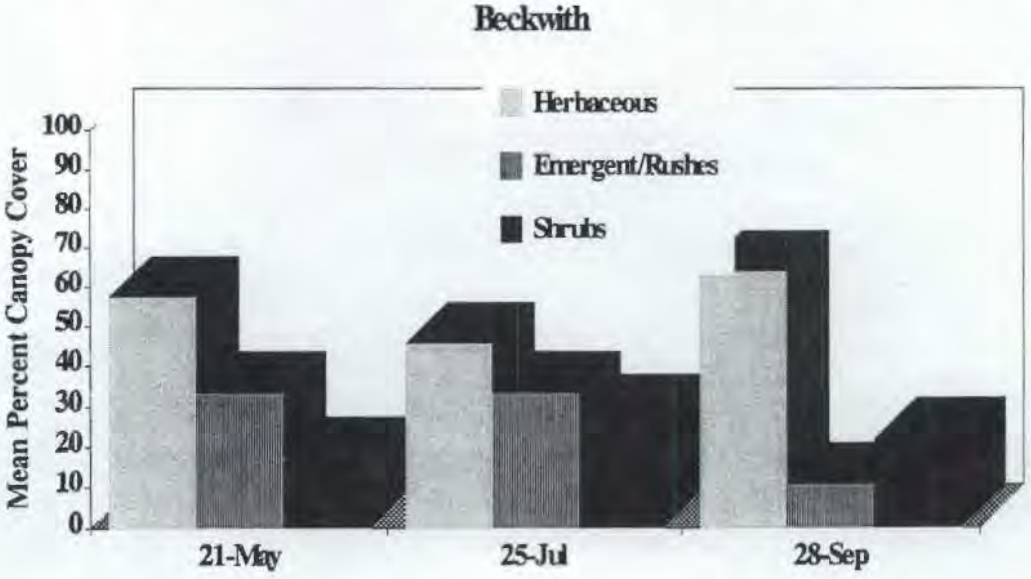


Figure 3.30 Mean Percent Canopy Cover of Vegetation Types at Beckwith HMU

22% by September, but was relatively constant through the growing season. Line-intercept data for the Beckwith HMU indicate mean canopy cover for shrubs of 23.7%, agreeing fairly well with information from wetland plots.

Acreage of palustrine shrub-scrub along the Beckwith shoreline increased significantly by 8.5 acres from 1987 to 1995 (Figure 3.31). A wide band of willows has established along shallow sandbars protecting the marshland area from wind and wave action. Palustrine emergent habitat also increased by 3 acres from that previously mapped.

3.3.9 Shultz Bar HMU

The Shultz Bar HMU is located in the center of what is known as Shultz Bar on the north side of the river. This site appeared to be a depositional area, which is a result of its topography and location along the Snake River and not a result of regular deposition from a side drainage. Coyote willow and common cattail dominated the wetland area, and patches were dominated by common reed. A large patch of smooth sumac occurred within the upland portion of this site, but much of the upland area was disturbed, and vegetation was mostly weedy species. Transects were established from the deep-water edge to the OHWM at this site. A gravel roadway bisected the upland transects.

Measurements of canopy cover on the wetland transects showed that persistent emergent vegetation was dominant at the site, but was greatest (43%) during the July sampling period (Figure 3.32). Shrub canopy cover also increased from May to July (10 to 29%) and decreased by September (23%). Line-intercept data for the shrub canopy cover at Schultz Bar HMU was 23% (Figure 3.33).

Results of field surveys and mapping indicated that palustrine emergent habitat increased at Shultz Bar by 3.87 acres from 1987 conditions (Figure 3.33). No increase was seen in palustrine forest habitat, but palustrine shrub-scrub vegetation along the shoreline increased by 8.4 acres. Much of the palustrine shrub-scrub habitat consisted of willow stands that were often inundated by the river. No beaver lodges were detected at this site, but beaver sign was common.

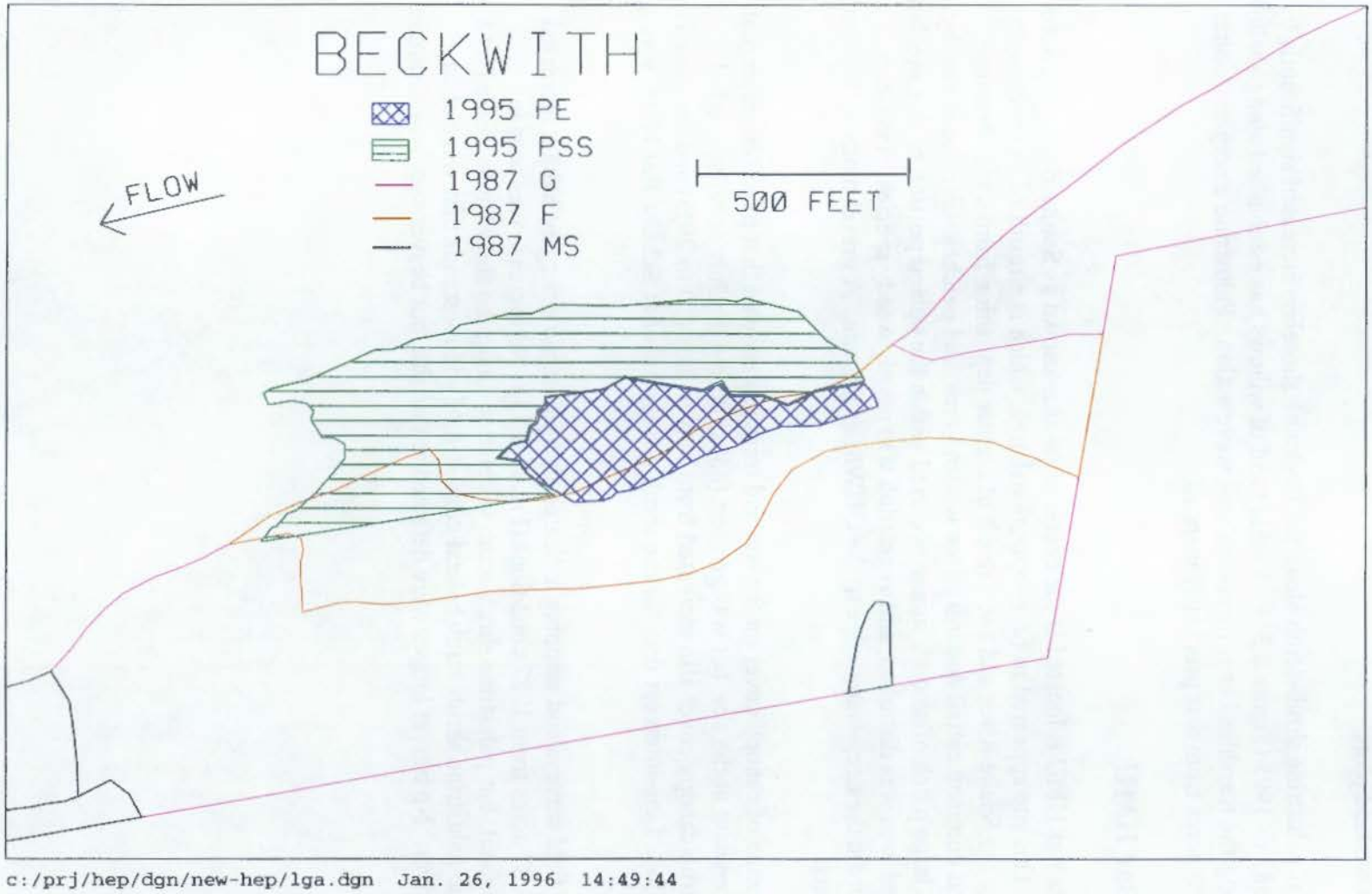


Figure 3.31 Changes in Vegetation Cover at Beckwith HMU (PE=Palustrine emergent, PSS=Palustrine shrub scrub, G=grassland, F=forbs, MS=Mesic shrub)

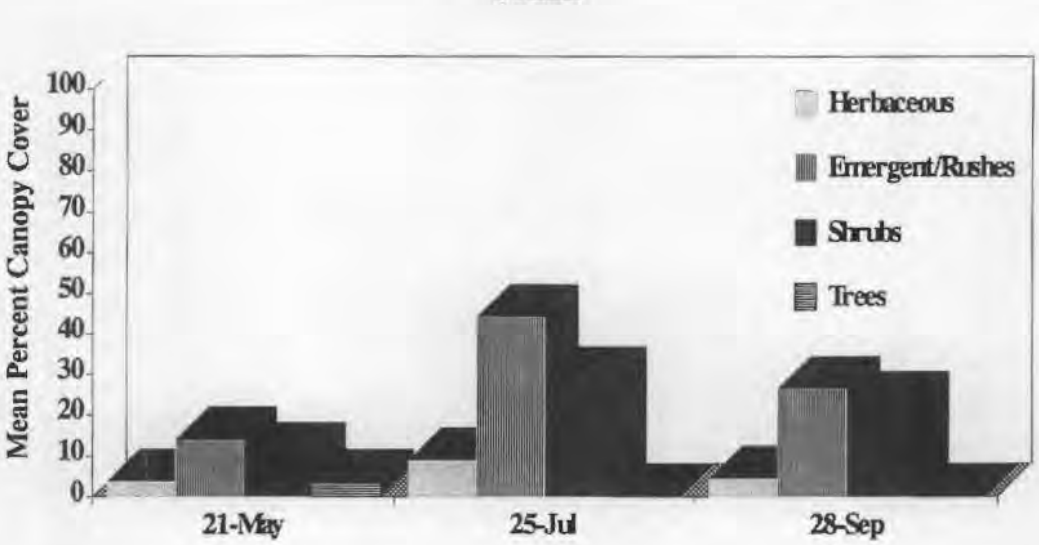


Figure 3.32 Mean Percent Canopy Cover of Vegetation Types at Schultz Bar HMU

3.3.10 Swift Bar HMU

Swift Bar HMU exists on the northern shoreline of the Snake River, approximately 2 miles upstream of Rice Bar. Swift Island also was included in this study area. The island is located near the lower end of Swift Bar HMU and is predominately low cover grasses with one white alder tree. Shorelines on the island were gravelly; however, steep slopes will not contribute to developing emergent vegetation. Dryland areas of Swift Bar were a mosaic of grasslands, mesic shrub, and shrub-steppe. Other than a few trees (white alder and Russian olive) surveyed near the down river end of Swift Bar, very little palustrine forest was present. Mapping of the site indicated only 0.26 additional acres of palustrine forest habitat (Figure 3.34a and b). Swift Bar shorelines were a continuous strip (10 m wide) of palustrine emergent and palustrine shrub-scrub habitat, which increased available habitat of these types by 9.6 and 10.1 acres, respectively. Palustrine shrub-scrub habitat was dominated by an uneven age stand of willow. No false indigo was found at this site. Palustrine emergent vegetation habitat was relatively diverse, containing a mixture of reed canarygrass, bulrush, cattail, and reeds.

No incidental wildlife observations were recorded at this site. Substrate consisted of gravel/cobble with sediment overlay along most of the HMU.

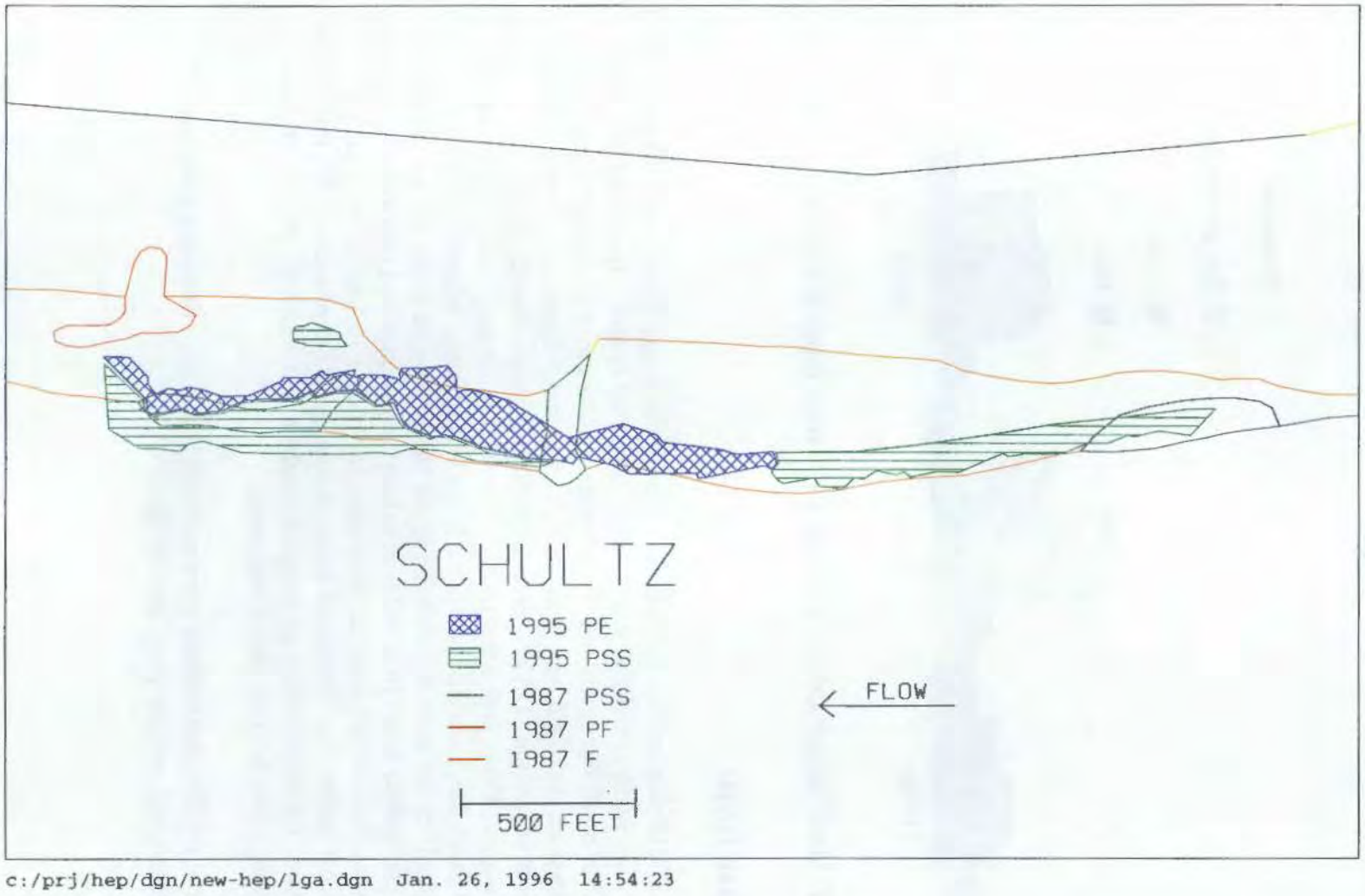


Figure 3.33 Changes in Vegetation Cover at Schultz Bar HMU (PE=Palustrine emergent, PF=Palustrine forest, PSS=Palustrine shrub scrub, F=forbs)

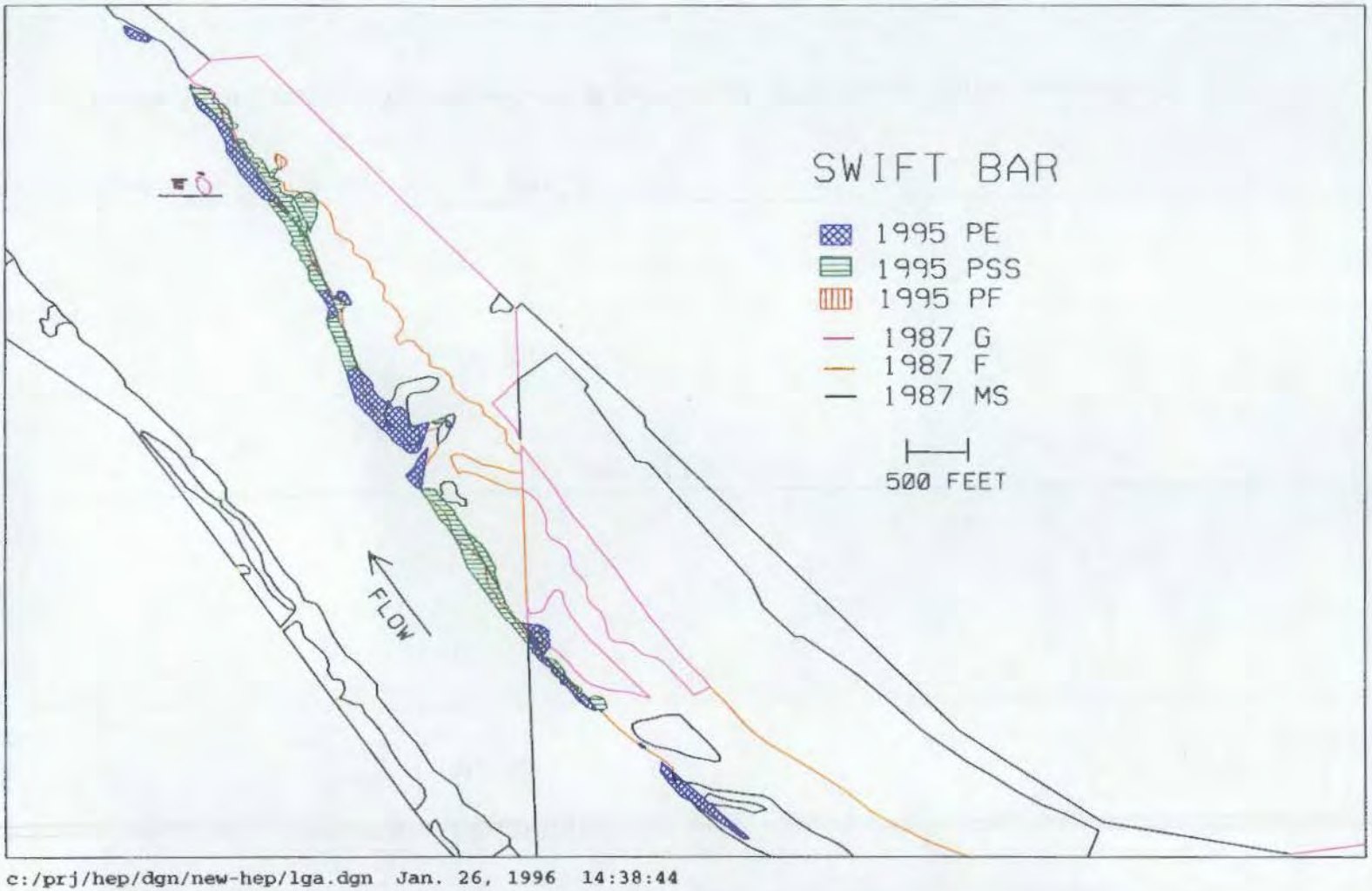


Figure 3.34a Changes in Vegetation Cover at Swift Bar HMU (PE=Palustrine emergent, PF=Palustrine forest, PSS=Palustrine shrub scrub, G=grassland, F=forbs, MS=Mesic shrub)

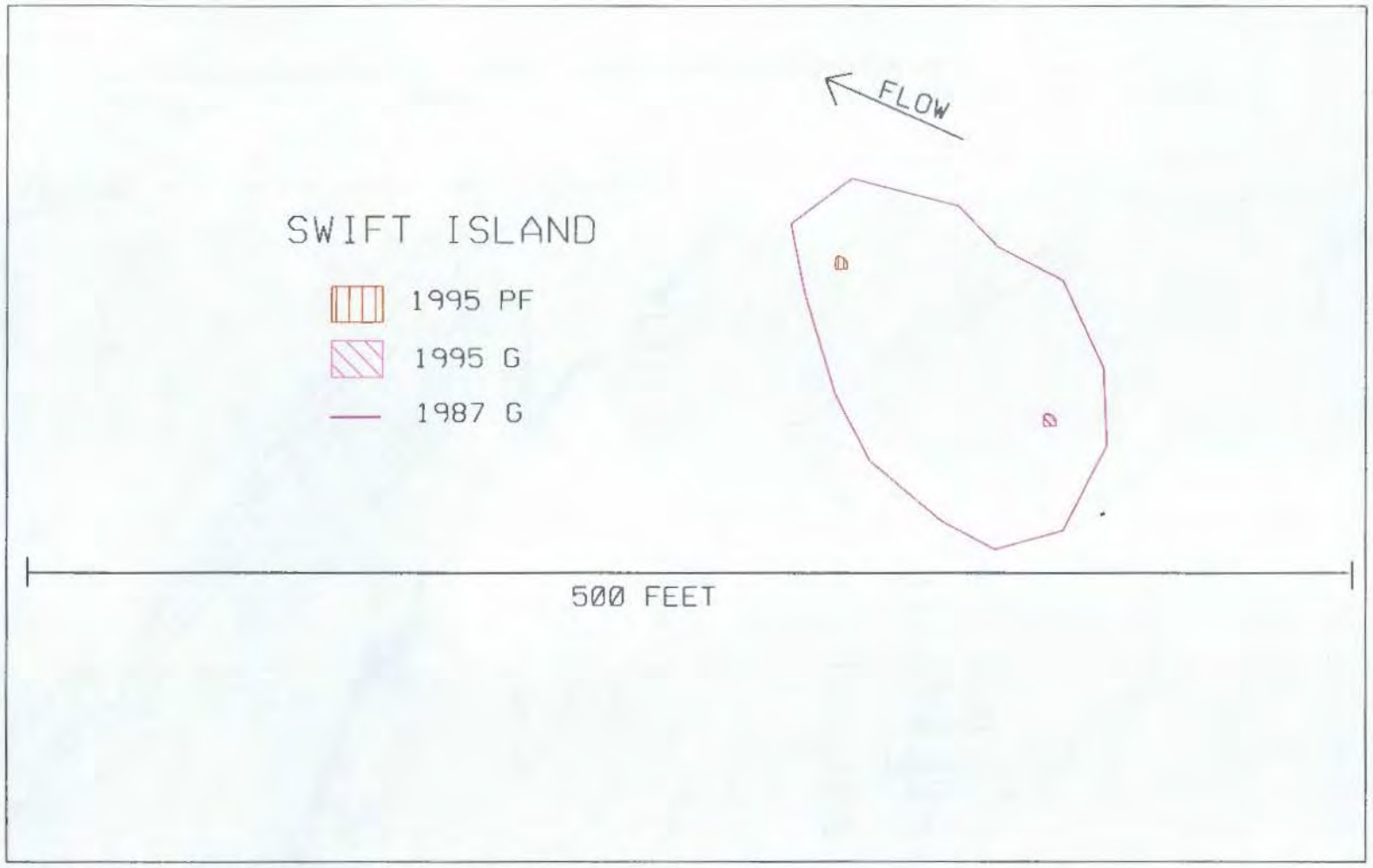


Figure 3.34b Changes in Vegetation Cover at Swift Island (PF=Palustrine forest, G=grassland)

3.3.11 Swift Canyon

The Swift Canyon site is located immediately upstream from Swift Bar and exists as an alluvial fan originating from a relatively large canyon. A shallow inlet is present near the middle section of this site where a small tree grove occurred. Cattail covered most of the inlet and were also found intermixed with willows near the upriver end of this site. Much of the shoreline area along Swift Canyon was considered palustrine shrub-scrub because developing willow stands were frequently encountered. No false indigo was found. Figure 3.35 illustrates the extent of additional shrub-scrub habitat--8.0 acres. Palustrine emergent habitat also increased by 1.9 acres. A relatively large bulrush patch was located near the lower end of this site, and reeds and scouring rush (*Equisetum sp.*) stands also were encountered . Substrate generally consisted of gravel/cobble with a thin sediment overlay. Shoreline bathymetry was rather steep along the lower end of Swift Canyon site, but progressed to gradual slopes proceeding upriver.

No wildlife observations were recorded at this site.

3.3.12 Rice Bar HMU

Rice Bar is located on the southern shore of the Snake River and immediately upstream of the Penawawa HMU. This bar appeared to be an old flood plain with much silty/clay sediment. A few small white alder and black locust groves were found at this site. With the shallow sloping bathymetry and deep sediment layer, the riverine shores were almost entirely covered with palustrine shrub-scrub and palustrine emergent vegetation (Figure 3.36). Palustrine shrub-scrub vegetation was largely even-aged stands of willow but was frequently intermixed with palustrine emergent species. Mapping of these areas revealed an additional 2.36 acres of shrub-scrub habitat from that mapped for 1987 conditions. Our field surveys also indicated a small increase (2.2 acres) in palustrine forest habitat at the site.

Relatively high species richness was found for palustrine emergent vegetation, including cattail, reeds, bulrush, and canarygrass. Palustrine emergent habitat increased significantly at Rice Bar--an additional 17.8 acres were mapped. No false indigo was found at Rice Bar. Dryland areas were primarily grassland cover class.

Wildlife abundance was moderate at Rice Bar HMU. Species encountered included quail, pheasant, numerous waterfowl, and signs of beaver activity.

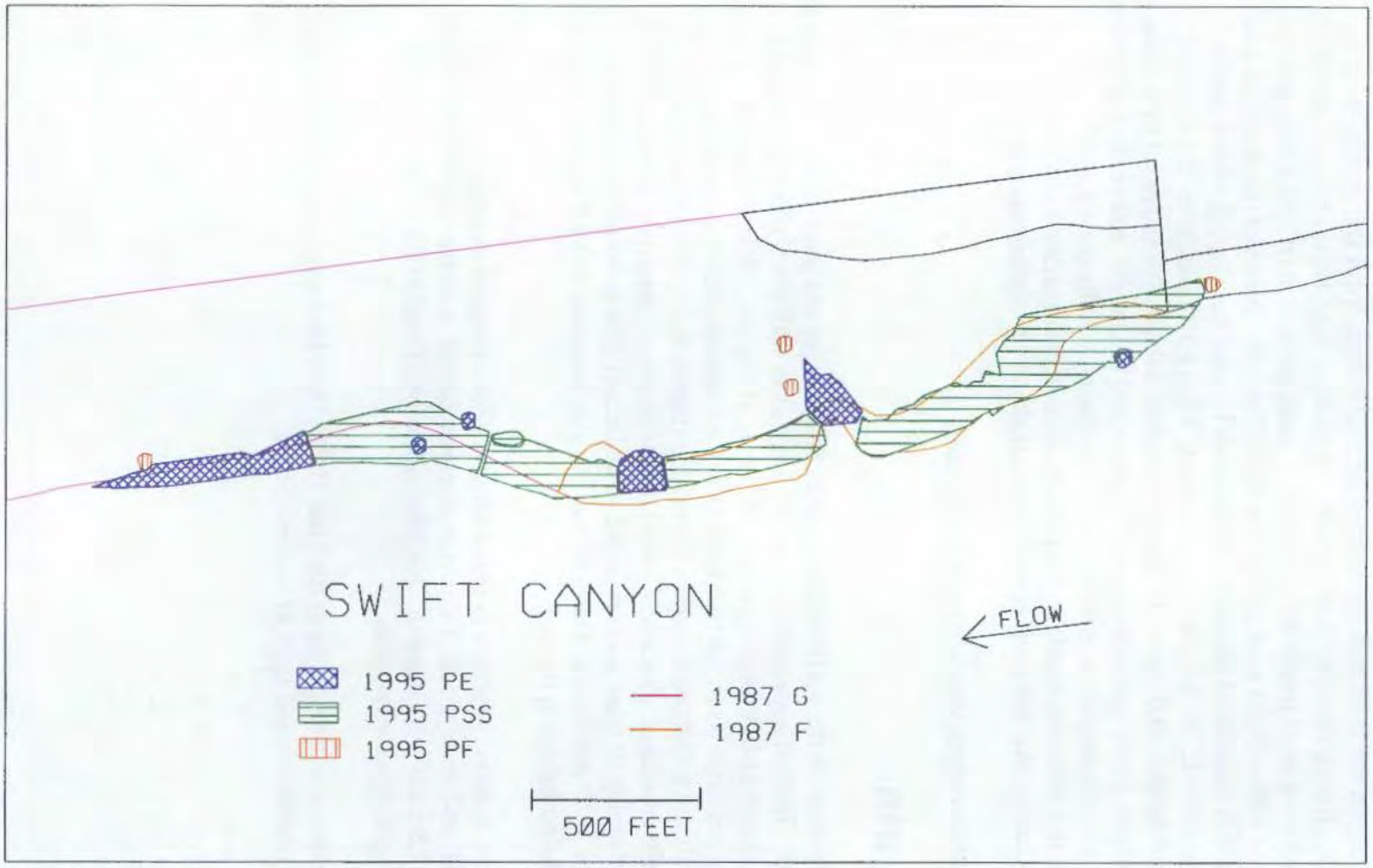


Figure 3.35 Changes in Vegetation Cover at Swift Canyon (PE=Palustrine emergent, PF=Palustrine forest, PSS=Palustrine shrub scrub, G=grassland, F=forbs)

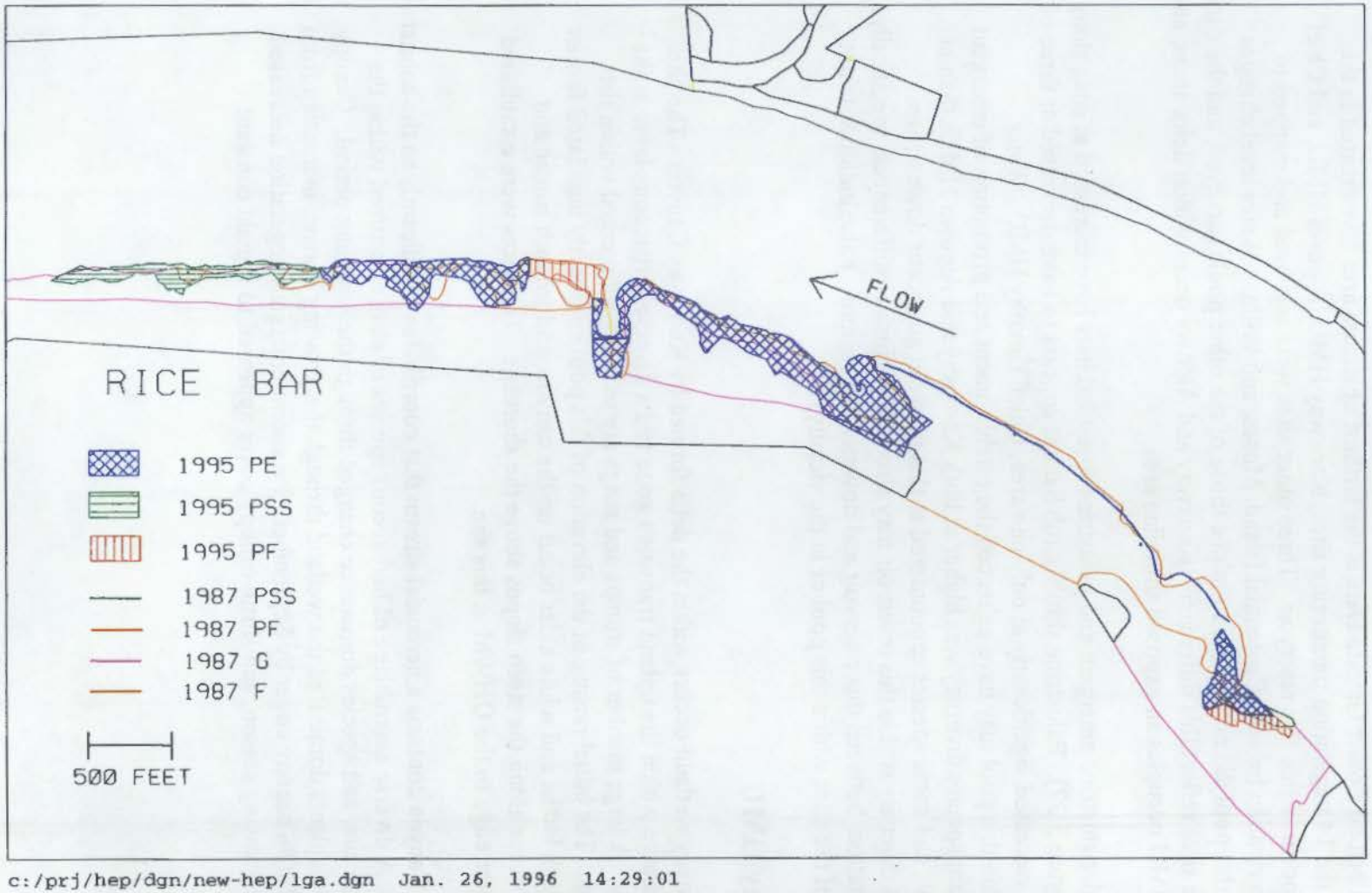


Figure 3.36 Changes in Vegetation Cover at Rice Bar HMU (PE=Palustrine emergent, PF=Palustrine forest, PSS=Palustrine shrub scrub, G=grassland, F=forbs)

3.4 Lower Granite Lake

The pool behind Lower Granite Dam is the farthest upstream area investigated in this study. Three of the 14 vegetation monitoring sites, Knoxway HMU, Alpowa HMU, and Chief Timothy HMU, occur within this reservoir. Three other sites were surveyed and mapped to detect changes in riparian habitat: Centennial Island, Moses, and Wilma. Water level changes observed within this pool did not appear to mimic those of the other pools surveyed, and the data collected at these sites reflect this difference. Knoxway and Alpowa occur within delta areas, and Chief Timothy HMU occupies an exposed shoreline area.

In general, palustrine emergent and palustrine forest habitats have increased at sites along this reservoir (Figure 3.37). Palustrine shrub-scrub habitat appears to have decreased at three of the six areas and increased significantly at only one area, Chief Timothy HMU. Water management within this pool may have enhanced the establishment and promotion of emergent plant species. Plant species diversity was higher at both Knoxway and Alpowa HMUs than at downstream areas, and some species encountered at this pool did not occur downstream. Increased species diversity within this reservoir may also reflect climatic differences, specifically increased precipitation, between this reservoir and downstream regions. False indigo was not observed at any of the sites within this pool or in the vicinity.

3.4.1 Knoxway HMU

The Knoxway wetland occurs within the delta formed by Knoxway Canyon. The site contains a forest fringe within the upland transition zone and a diverse herbaceous layer in the exposed mud area. A large number of stumps and snags are partially submerged within the shallow water inlet. The initial raising of the elevation of this pool apparently inundated former forest habitat. Black locust and white alder occur up the canyon, and smooth sumac and perennial grasses occur along the steep slopes above the shoreline. Transects were established from the deep-water edge to the OHWM at this site.

Knoxway Canyon contains a perennial stream that contributes significantly to the habitat values at this site. A diverse assemblage of herbaceous species of plants occurred within the wetland area of this site, and species dominance changed through the sampling period. Canopy cover of herbaceous plants dominated the wetland through the growing season, increasing from 55% in May to >100% canopy cover by September. Persistent emergent vegetation decreased slightly during the growing season, and shrub canopy cover appeared to remain constant (Figure 3.38).

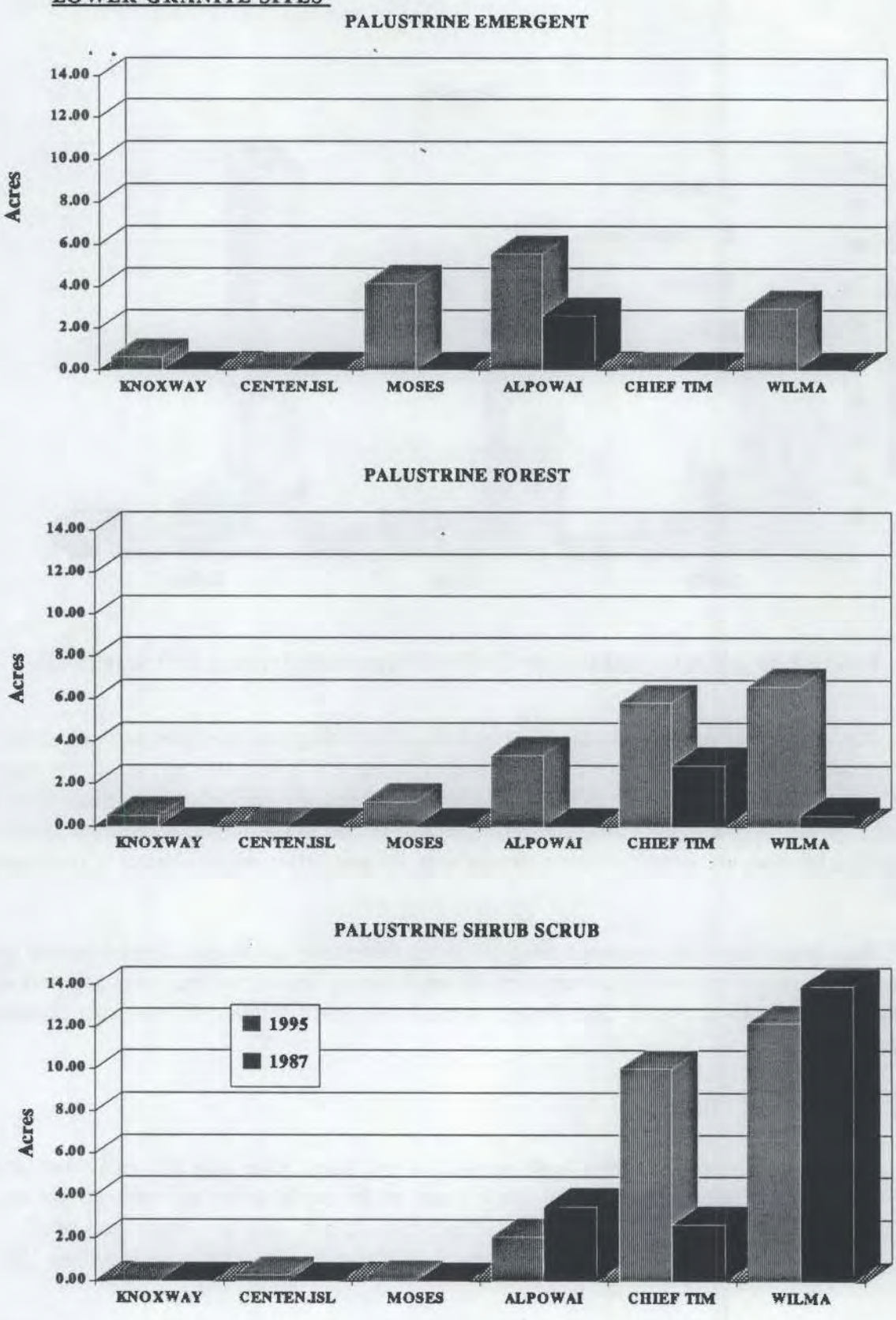


Figure 3.37 Changes in Riparian Habitat at Six Areas on Lower Granite Lake

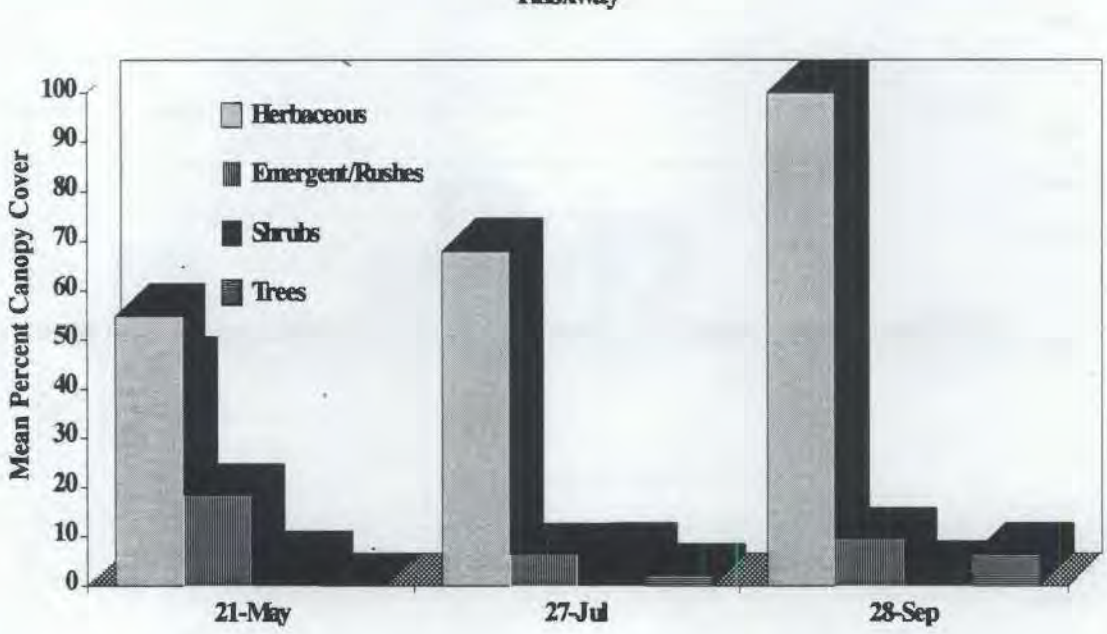


Figure 3.38 Mean Percent Canopy Cover of Vegetation Types at Knoxway HMU

Results of field surveys and mapping indicated that palustrine emergent and palustrine forest habitat areas increased by 0.65 and 0.5 acres (Figure 3.39), respectively, since previous survey and mapping efforts. This increase in emergent habitat appeared relatively small compared with other sites along the lower Snake River; however, the mouth of Knoxway Canyon is narrow, surrounding hillsides are steep, and the potential area for vegetation establishment is also much smaller.

Beaver activity was common among the forest vegetation at this site, but no beaver lodges were seen. Osprey (*Pandion haliaetus*) were noted at this site during several sampling periods as were wood ducks (*Aix sponsa*). One western screech owl (*Otus kennicottii*) was also observed during July.

3.4.2 Centennial Island

Centennial Island is a narrow sand bar located just below river mile 120 on Lower Granite Pool. Gravelly substrate and steep bathymetry found on the north-facing shoreline do not appear to be amenable for palustrine emergent vegetation establishment. The downriver end of this island contained two patches of palustrine shrub-scrub [coyote willow and pacific willow (*Salix*

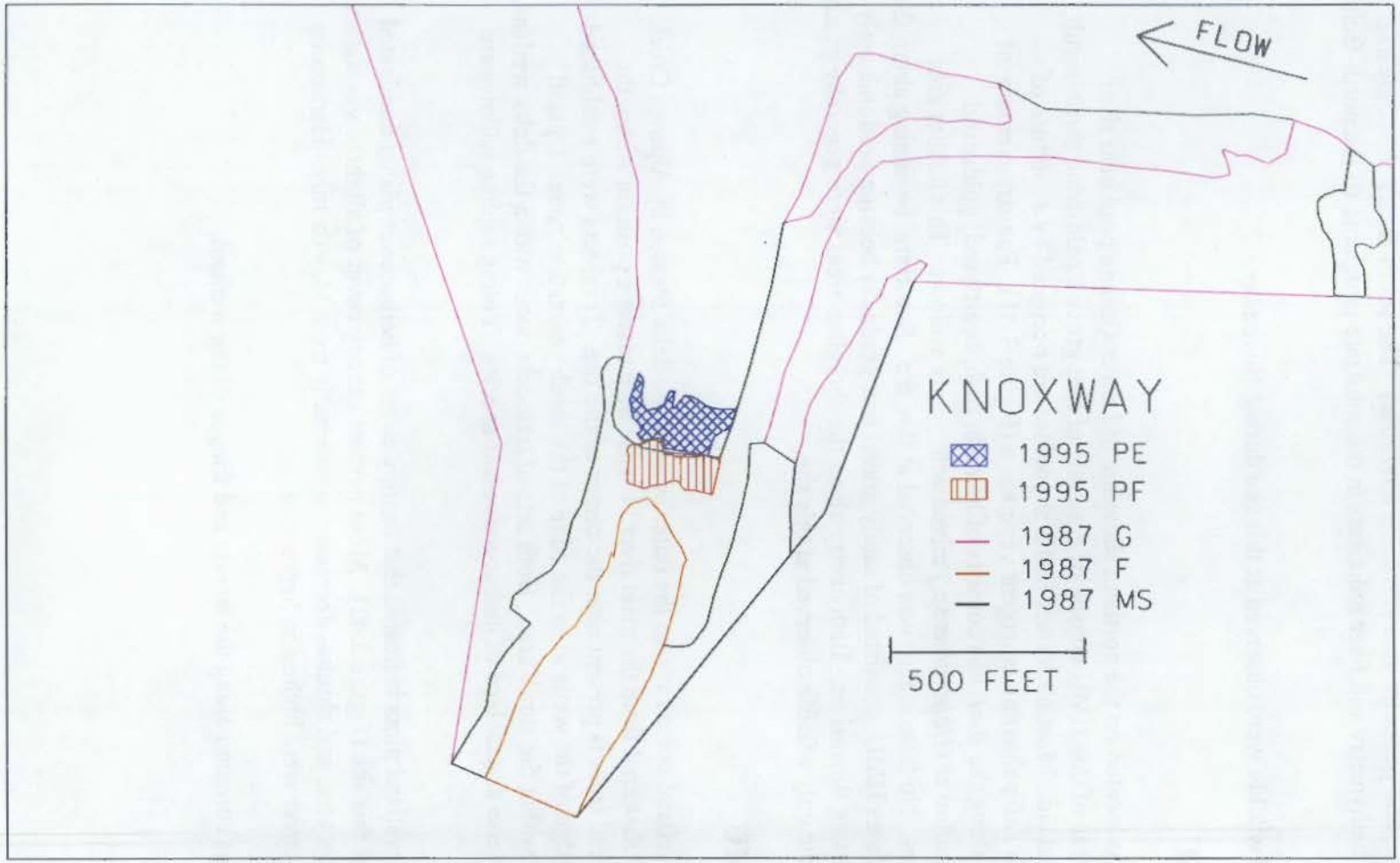


Figure 3.39 Chages in Vegetation Cover at Knoxway HMU (PE=Palustrine emergent, PF=Palustrine forest, G=grassland, F=forbs, MS=Mesic shrub)

pacifica)] vegetation, which represents an increase of 0.27 acres (Figure 3.40). Remaining portions of the island were sandy and contained riparian type forbs, heartweed (*Polygonum persicaria*), cocklebur, and puncture vine (*Tribulus terrestris*). The south-facing shoreline had rather gentle sloping bathymetry and finer sediments in the substrate compared to the north-facing shoreline.

No incidental wildlife were observed at this site during November.

3.4.3 Moses HMU

Moses HMU is located on the northern shoreline of Lower Granite pool near river mile 130. Dryland areas of this HMU consist of a mosaic of tree groves, palustrine shrub-scrub, mesic shrub, and grassland. Most all Moses HMU shorelines are occupied by a mixture of palustrine shrub-scrub and palustrine emergent vegetation (Figure 3.41). Palustrine emergent vegetation occurring along the shoreline consists of bulrush, rush, heartweed, goldenrod (*Solidago sp.*), and sunflower (*Helianthus sp.*) mixed with young willows. This habitat area increased by 4.17 acres. No false indigo was observed at this site. Substrate, beginning along the upriver portions of Moses HMU, consisted of sandy gravel that gradually became predominantly cobble/rip rap progressing downriver. Bathymetry along the shoreline areas were generally gently sloping. Quail were the only wildlife observed at this site.

3.4.4 Alpowa HMU

The Alpowa wetland occurs within the outer edge of the delta formed by Alpowa Creek. This delta is relatively sheltered from the main river because of landscape position within the canyon. A series of dead trees is present near the center of the site. Transects were established from the deep-water edge of the wetland to the edge of the shrub vegetation zone. Upland transects were placed within the shrub area. Both sets of transects occur within the delta wetland. This site displays a diverse assemblage of herbaceous plant species. Young sapling willows are also present.

Data from the wetland plots indicated that canopy cover of herbaceous plants dominated the vegetation found at this site (Figure 3.42). Mean percent canopy cover of all three vegetation types--herbaceous, emergent, and shrubs--decreased significantly from May to July. Herbacous and emergent canopy cover were highest in September.

Beaver sign was common along the stream and fringes of the wetland.

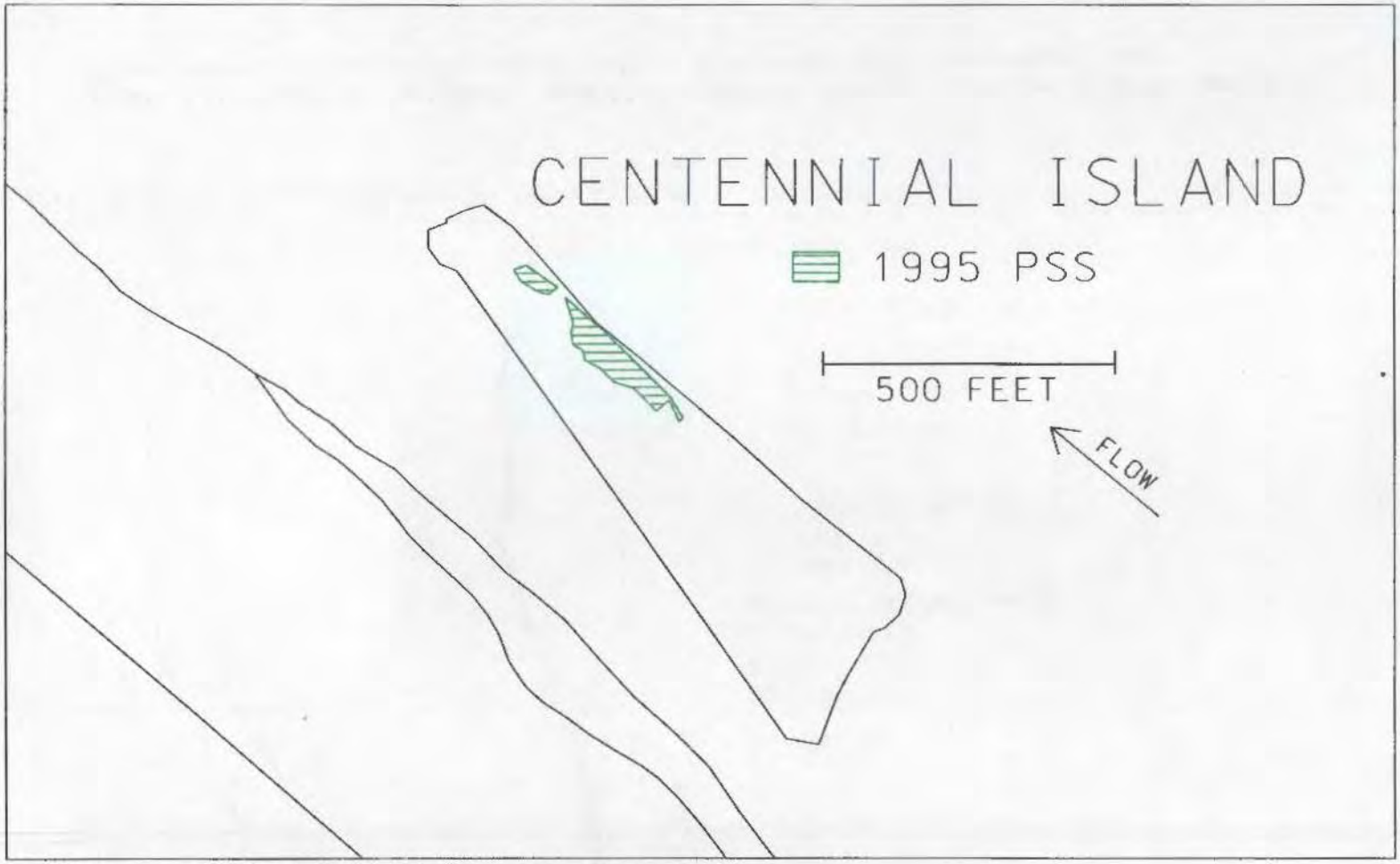


Figure 3.40 Changes in Vegetation Cover at Centennial Island (PSS=Palustrine shrub scrub)

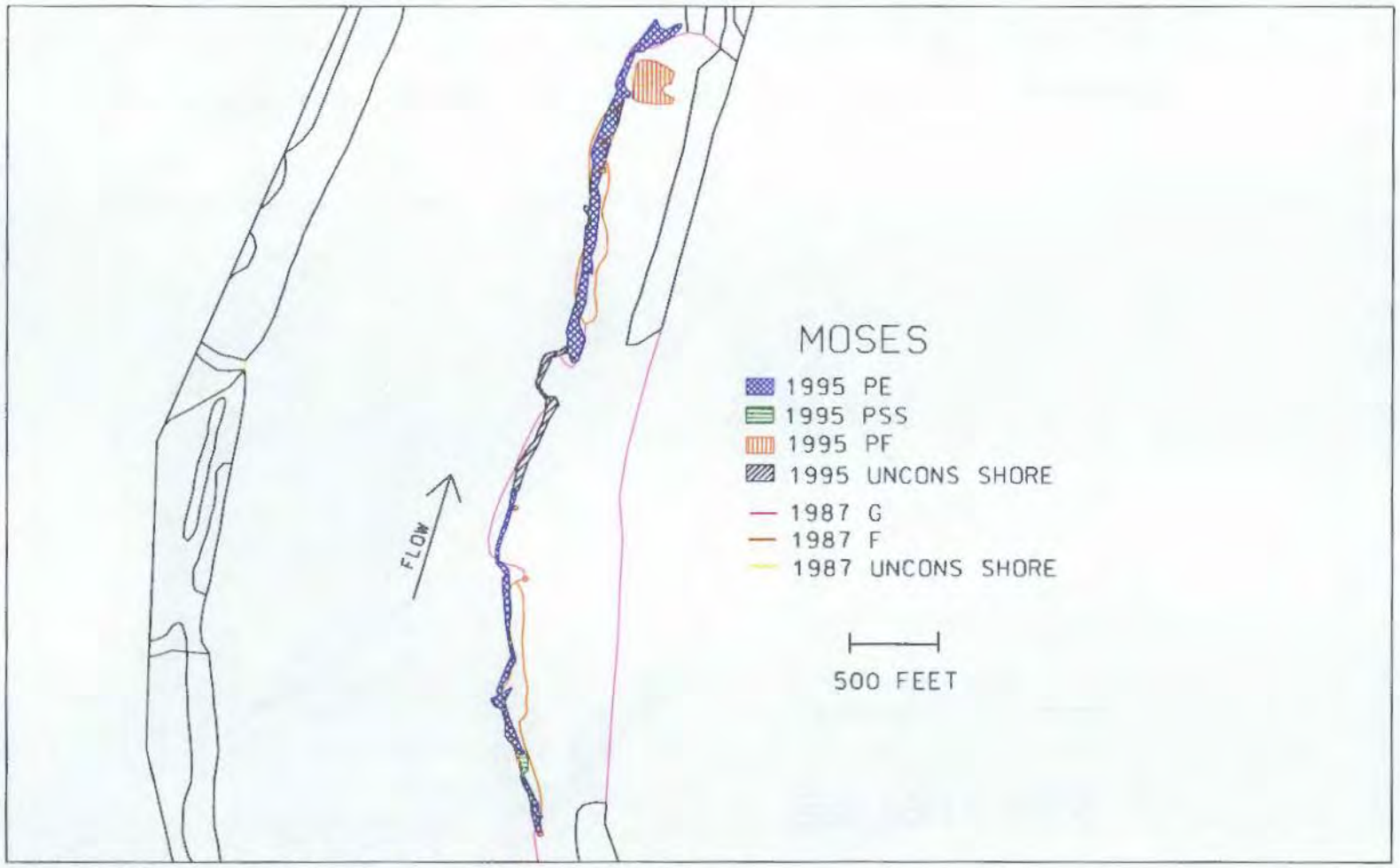


Figure 3.41 Changes in Vegetation Cover at Moses HMU (PE=Palustrine emergent, PF=Palustrine forest, PSS=Palustrine shrub scrub, G=grassland, F=forbs, UCONS SHORE=Unconsolidated shore)

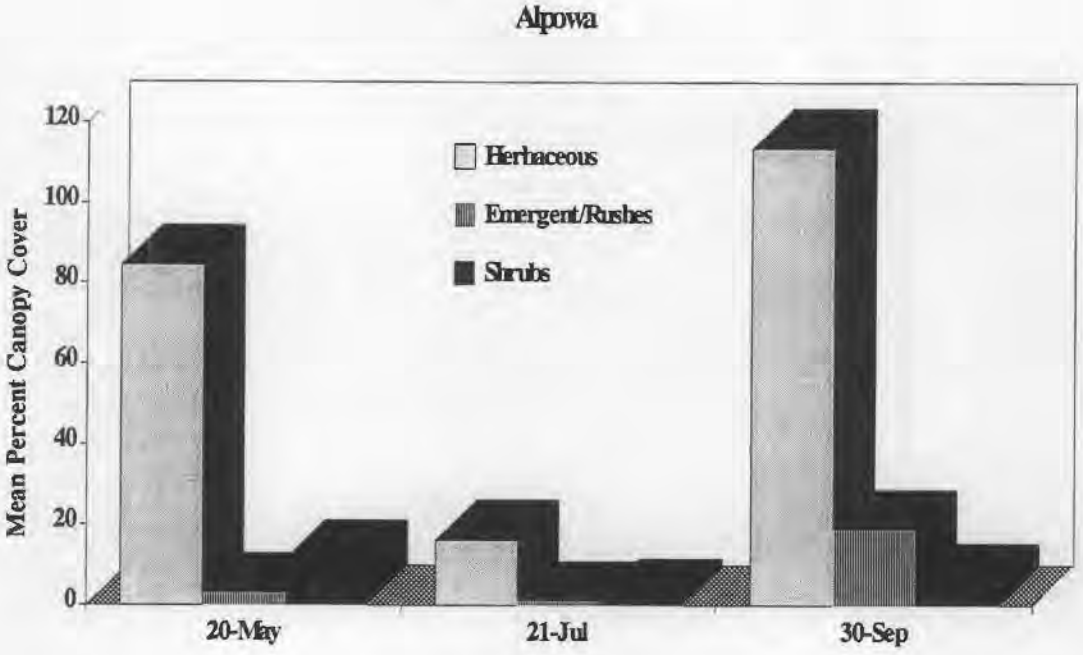


Figure 3.42 Mean Percent Canopy Cover of Vegetation Types at Alpowa HMU

Figure 3.43 shows the results of our field survey and mapping efforts. Palustrine emergent habitat increased by 3.0 acres, and palustrine forest increased by 3.35 acres. Palustrine shrub-scrub habitat actually decreased by 1.42 acres. This decrease along with the concurrent increase in palustrine forest habitat appears to reflect maturation and growth of shrub-sized vegetation into trees.

The protected position of Alpowa HMU within the mouth of the canyon and the trees and mesic shrubs occurring along the creek appear to create favorable wildlife habitat. A number of bird species were observed during our surveys, including black-headed grosbeak (*Pheucticus melanocephalus*), yellow warbler (*Dendroica petechia*), bank swallow (*Riparia riparia*), barn swallow (*Hirundo rustica*), song sparrow, northern flicker (*Colaptes auratus*), Canada goose, ring-necked pheasant, semipalmated sandpiper (*Caldris pusilla*), western sandpiper (*Caldris mauri*), spotted sandpiper (*Actitis macularia*), killdeer (*Charadrius vociferus*), merlin (*Falco columbarius*), and American kestrel (*Falco sparverius*). Deer sign and beaver sign were also observed during the surveys.

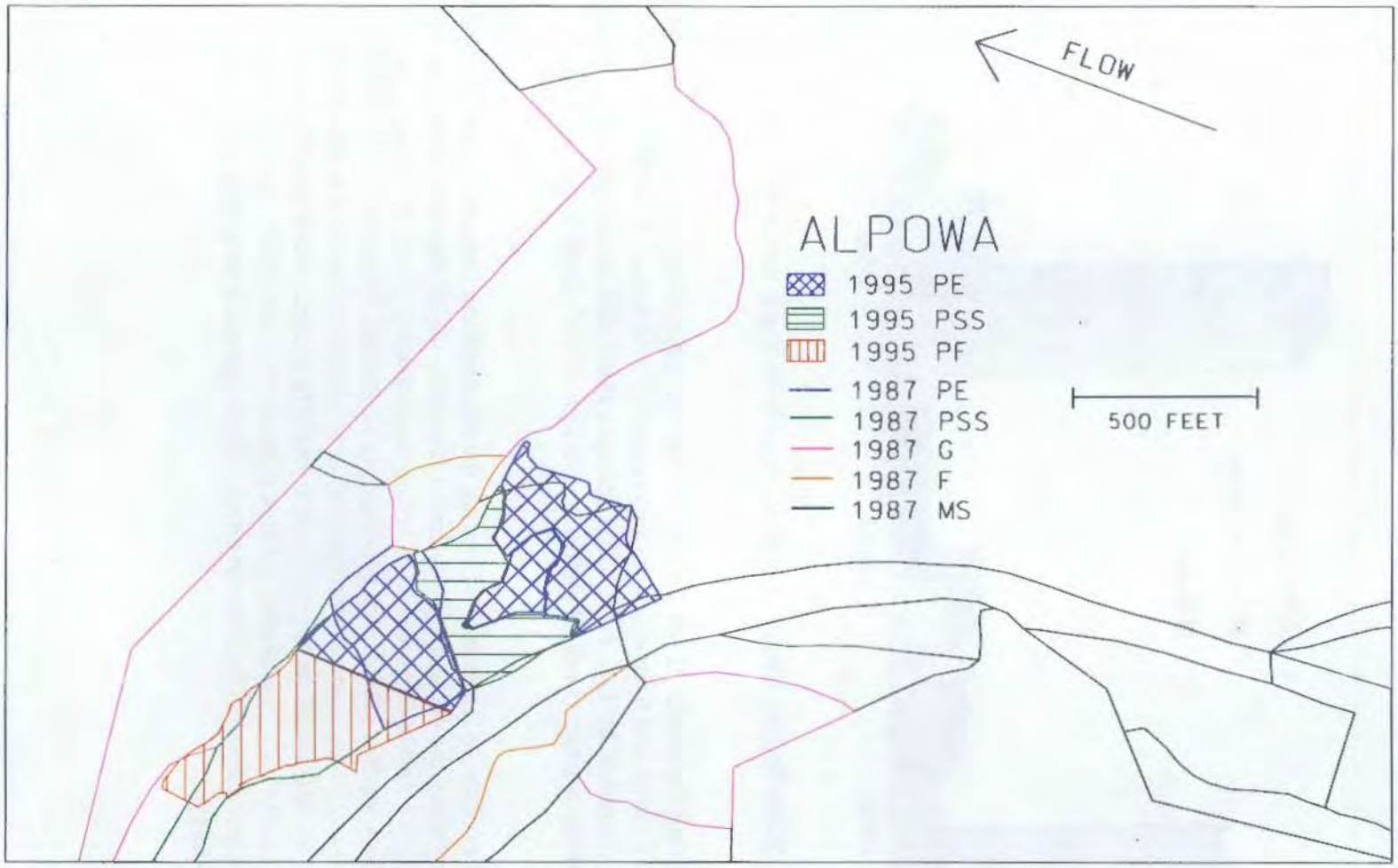


Figure 3.43 Changes in Vegetation Cover at Alpowa Creek HMU (PE=Palustrine emergent, PF=Palustrine forest, PSS=Palustrine shrub scrub, G=grassland, F=forbs, MS=Mesic shrub)

3.4.5 Chief Timothy HMU

The Chief Timothy HMU occurs within the irregularly flooded perimeter of a low island that occurs east of Chief Timothy State Park. The shore is regularly impacted by recreational boat wakes but appears to be well protected from erosion associated with changes in poor elevation. Wetland transects were established from the deep-water edge of the vegetation to the OHWM. Beach erosion from boat wakes resulted in shortening the length of Transect C on subsequent site visits. The upland/wetland interface is discontinuously vegetated with Russian olive and silver maple (*Acer saccharum*) trees. Upland transects traversed a weedy field containing very sandy soils.

Canopy cover of species dominating the wetland transects varied through the growing season (Figure 3.44). Shrubs had the highest canopy cover along the transect during May and July (35 and 23%), but herbaceous plants and emergent plants increased in canopy cover from July to September. Line-intercept data (Table 3.1) indicate a much higher value, 52%, for shrub canopy cover than do the wetland plots, and may better reflect actual shrub canopy cover for the area.

Figure 3.45 shows the extent of palustrine shrub-scrub habitat along the shoreline of Chief Timothy HMU, representing an increase in habitat of 7.4 acres. Palustrine forest also increased within this HMU by 2.95 acres.

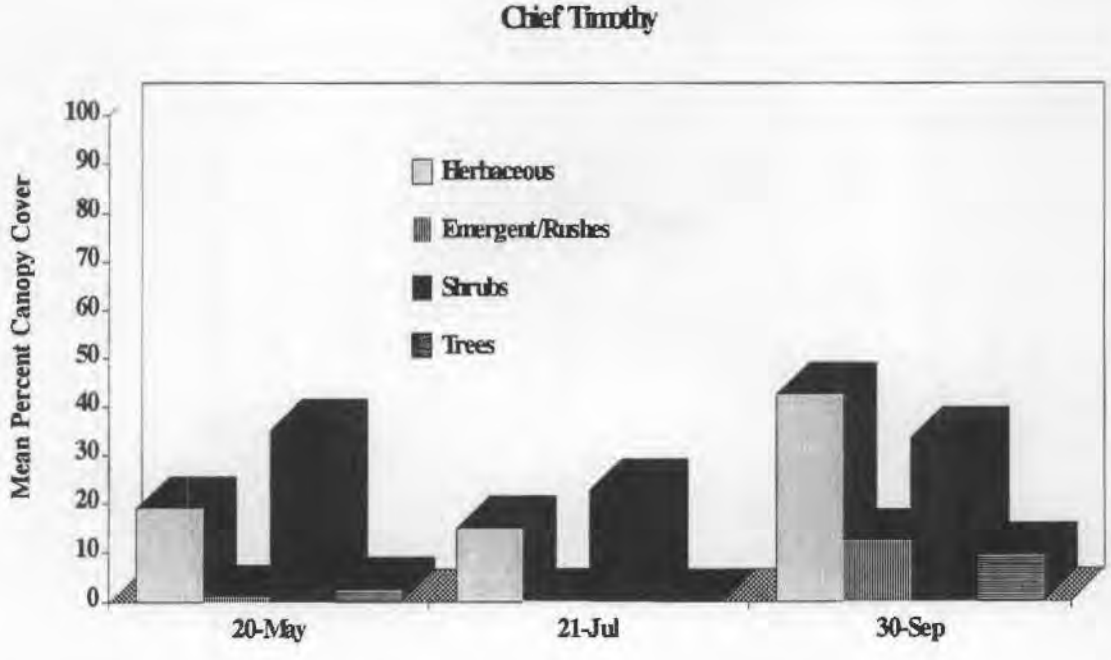


Figure 3.44 Mean Percent Canopy Cover of Vegetation Types at Chief Timothy HMU

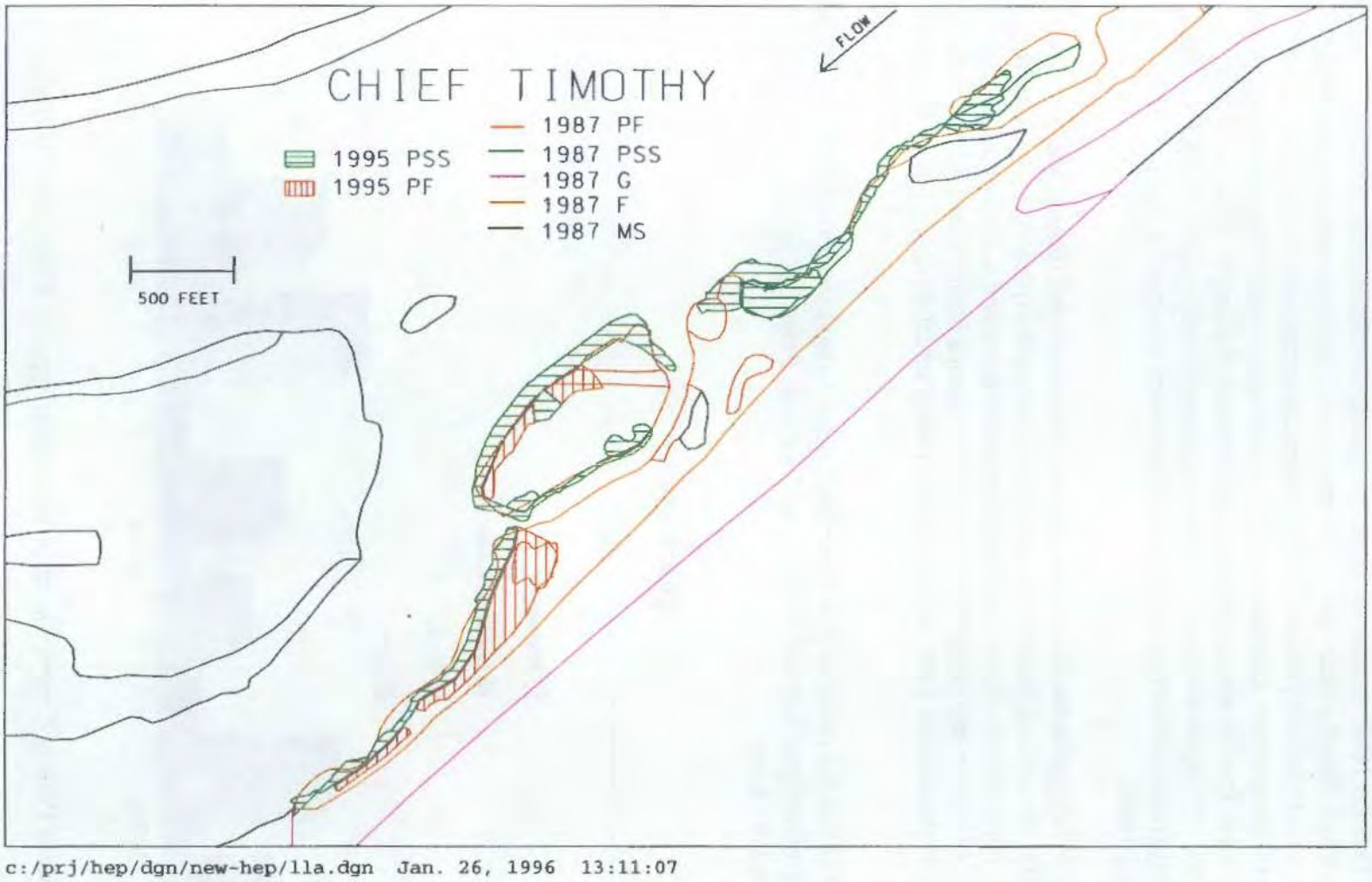


Figure 3.45 Changes in Vegetation Cover at Chief Timothy HMU (PF=Palustrine forest, PSS=Palustrine shrub scrub, G=grassland, F=forbs, MS=Mesic shrub)

Beaver use was noted for the area, but no lodges were seen at the site. A number of different birds use the forested and emergent habitat at Chief Timothy. Birds observed during our surveys included ring-necked pheasant, quail, bank swallow, robin, American goldfinch (*Carduelis tristis*), dark-eyed junco (*Junco hyemalis*), song sparrow, yellow warbler, lesser goldfinch (*Carduelis psaltria*), northern harrier, osprey, Caspian tern (*Sterna caspia*), spotted sandpiper, belted kingfisher (*Ceryle alcyon*), great blue heron, mallard, cinnamon teal (*Anas cyanoptera*), and Canada goose.

3.4.6 Wilma HMU

Wilma HMU is located on the north shoreline of the Snake River near river mile 135 and the Port of Whitman County. Dryland vegetation along Wilma HMU was composed of perennial grasses and forbs. *Kochia* sp. was a predominant weed occurring throughout the disturbed dryland areas. Several depressions, probably old dredge ponds, were observed near the middle of the Wilma HMU. One of these areas contained a mix of palustrine forest, palustrine shrub-scrub, and palustrine emergent vegetation types. Another area appeared to be a monoculture of *Kochia*.

A strip of relatively tall (5 m) palustrine shrub-scrub vegetation was found occurring along the shores of this site witb occasional patches of palustrine forests. Immediately adjacent to the water's edge, a strip of young (less than 1 m tall) willow was found along most of the Wilma HMU. Little palustrine emergent vegetation was found along the shoreline, but palustrine emergent vegetation and palustrine forest appeared to have replaced shrub-scrub vegetation within one of the depressions. Figure 3.46 reflects these findings, indicating an increase in the number of acres of palustrine emergent vegetation (+3.0) and an increase of 6.05 acres of palustrine forest. No false indigo was observed at this site. Substrate occurring along Wilma HMU consisted of fine sediment with a bed layer of cobble.

Wildlife activity observed during October included quail, mallard, kingfisher, flicker, yellow-rumped warbler (*Dendroica coronata*), dark-eyed junco, bank swallow, raccoon (*Procyon lotor*), beaver, coyote, and mink (*Mustela vison*).

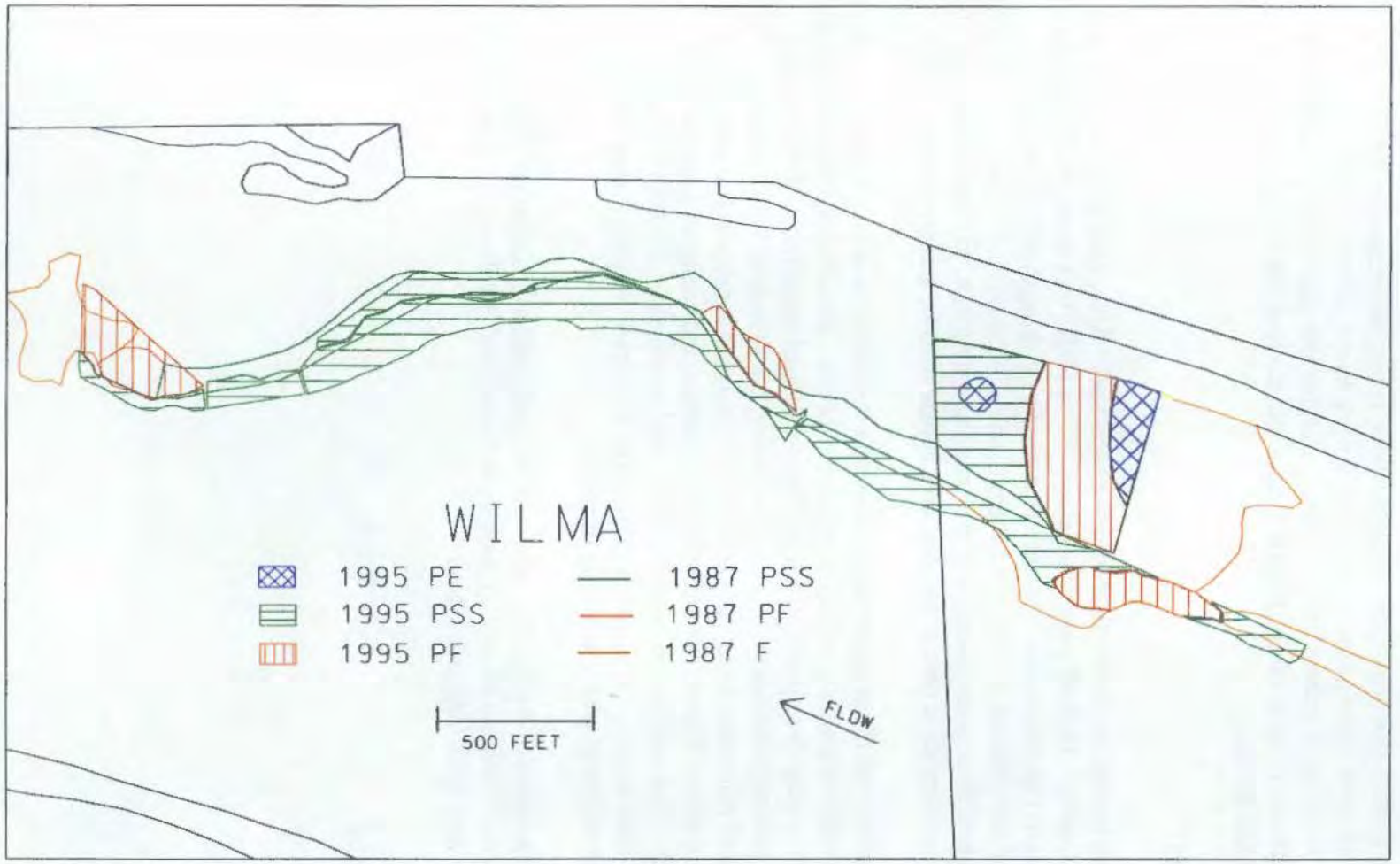


Figure 3.46 Changes in Vegetation Cover at Wilma HMU (PE=Palustrine emergent, PF=Palustrine forest, PSS=Palustrine shrub scrub, F=forbs)

4.0 Conclusions and Recommendations

During 1994 and 1995, PNNL staff assessed 28 riparian areas in the reservoirs of the lower Snake River in Washington. We conducted soil, water and vegetation surveys of 28 diverse riparian habitats. At many of the sites, the plant communities documented along wetland transects appeared to have established during the past 3 to 4 years, and are still developing floristically and structurally. Community species composition and canopy cover of different vegetation types--herbaceous, persistent emergent, shrubs, and trees--varied over the growing season, and appear to depend on a complex interaction of substrate and water level changes.

Soils sampled along transects at sites where tributaries flowed into the river were finer grained--loam and silt-loam soils. Soils at vegetation monitoring sites that were located along bars were sands or sandy loams. No significant differences in water pH were found between sites. Observations of plant vigor and senesence did not reveal any evidence of plant water stress at any of the monitoring sites. These observations agree with those of Phillips (1992), who found no evidence of plant water stress even during summer months.

No specific trends were identified in canopy cover of vegetation types along this reach of the Snake River. Previous studies (Tabor et al. 1980, Meeks 1969, and Rorslett 1989) either predicted or observed increases in weedy annual species or a change in species composition from perennial aquatic plants to drought-tolerant herbs and grasses. We found that herbaceous canopy cover of wetland areas on the Lower Granite pool was greater than the canopy cover of herbaceous forbs and grasses at other monitoring sites downstream. However, few of the herbaceous species found at these sites were considered weedy species. Wetland plots at sites along the Lower Granite pool were not flooded during any of the sampling periods of our study.

Shrub canopy cover measurements varied from site to site and were influenced by topography and placement of the transects. No invasions of false indigo occurred along the river above Meadow Creek HMU where false indigo was the only shrub species encountered. Other studies (Schmidt 1951, Moyle and Nielsen 1953, Dirschl et al. 1974, Kantrud et al. 1989) reported a successional pathway where fluctuations in water level ultimately led to communities dominated by woody species where shrubs and trees were dominant lifeforms. The invasion and domination of shrub-scrub communities by false indigo shrubs at some of the sites may be a result of river regulation. At the Riparia HMU, an even-aged false indigo stand may have established following the 1992 drawdown tests on the Snake River.

In general, the amounts of palustrine emergent and palustrine shrub-scrub habitat along the lower Snake River appeared to be increasing. Our observations indicated that significant increases in palustrine emergent vegetation occurred at the confluence of tributaries with the main river. Palustrine shrub-scrub vegetation appears most likely to increase along bars that are somewhat protected from wind and wave erosion. Several depositional bars included in this study had young, fringing, emergent scrub-willow communities developing along the shoreline. Some

study areas also exhibited increased palustrine forest habitat, usually at the expense of shrub-scrub habitat. These increases in habitat extent may be a result of current operating strategies that maintain operating pools behind the four dams at minimum levels, thus increasing the area of shoreline available for vegetation establishment.

Mapping changes in vegetation types at the 28 sites revealed that palustrine emergent and palustrine shrub-scrub habitat generally have increased along the lower Snake River since 1987. Total palustrine emergent habitat increased by 134 acres, palustrine shrub-scrub habitat increased by 88 acres, and palustrine forest increased by 34 acres at the 28 sites surveyed. These acreage estimates are based on limited mapping of the sites and may not include all the new habitat along the shoreline of these areas; however, these estimates indicate that the types and amount of available habitat along the lower Snake River are changing. These differences may be a result of lowering operating pools behind the dams and providing additional substrate for vegetation establishment. Siltation and soil deposition occurring alongside tributaries to the main river also appeared to have created additional areas suitable for establishment of emergent and shrub-scrub vegetation.

Predicting changes in community composition and structure at these diverse riparian sites will require a more complex analysis of vegetation information in concert with substrate information and data on the periodicity of flooding and dewatering at each site. We recommend that the ACOE use existing GIS information concerning bathymetry and shoreline elevations to determine the extent of the zone between the OHWM and minimum operating pool along the shoreline of each of the four reservoirs. This information should be reviewed in concert with the information for each survey site concerning the acreage and types of habitat occurring within this zone. This analysis would provide insight into the potential extent of habitat development along the shores of each pool. We also suggest that the ACOE incorporate existing information concerning the topography, substrate, and vegetation information from each of the monitoring sites to model potential habitat composition.

5.0 References

Bonneville Power Administration (BPA) 1994. *Columbia River System Operation Review Draft EIS.* DOE/EIS-0170. Published for the Columbia River System Operation Review, a joint project of the U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, and Bonneville Power Administration, Portland, Oregon.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States.* U.S. Fish and Wildlife Service, FWS/OBS-79-31, Washington, D.C.

Daubenmire, R. 1959. "A Canopy-Coverage Method of Vegetational Analysis." *Northwest Science* 33:43-64.

Dirschl, H.J., D.L. Dabbs, and G.C. Gentle. 1974. *Landscape Classification and Plant Successional Trends in the Peace-Athabasca Delta.* Canadian Wildlife Service, Environment Canada. Ontario Re. Ser. No. 30, Ottawa, Canada.

Kantrud, H.A., J.B. Millar, and A.G. van der Valk. 1989. "Vegetation of the Prairie Pothole Region." *In: Northern Prairie Wetlands.* A.G. van der Valk, ed. Iowa State University, Ames, Iowa.

Meeks, R.L. 1969. "The Effect of Drawdown Date on Wetland Plant Succession." *J. Wildlife Manage.* 33(4): 817-321.

Moyle, J.B., and E.L. Nielson. 1953. "Further Observations on Forest Invasion and Succession on Basins of Drained Lakes in Northern Minnesota." *Am. Mid. Nat.* 50:480-487.

Northwest Power Planning Council. 1994. *Columbia River Basin Fish and Wildlife Program Overview.* Northwest Power Planning Council, Portland, Oregon.

Phillips, R. 1992. Columbia River Salmon Mitigation Analysis, 1992 Reservoir Drawdown: Wildlife Monitoring Program, Shoreline Monitoring, and Vegetation Evaluations. Battelle Pacific Northwest Laboratory. Prepared for U.S. Army Corps of Engineers, Walla Walla District, Walla Walla, Washington.

Rørslett, B. 1989. "An Integrated Approach to Hydropower Impact Assessment." *Hydrobiologia* 175:65-82.

Schmidt, F.V. 1951. *Planned Waterlevel Control and the Resultant Effect on Vegetation.* New Jersey Division of Fish and Game, Trenton, New Jersey.

Tabor, J., B. Thompson, C. Turner, R. Stocker, C. Detrick, and J. Howerton. 1980. *Study of Impacts of Project Modification and River Regulation on Riparian Habitats and Associated Wildlife Along the Columbia River*. U.S. Army Corps of Engineers, Seattle District, Seattle, Washington.

Tabor, J., B. Thompson, C. Turner, R. Stocker, C. Detrick, and J. Howerton. 1980. *Study of Impacts of Project Modification and River Regulation on Riparian Habitats and Associated Wildlife along the Columbia River*, Washington Department of Game, Olympia, Washington.

U.S. Army Corps of Engineers (ACOE). 1991. *Lower Snake River Fish and Wildlife Compensation Plan: Wildlife Habitat Compensation Evaluation for the Lower Snake River Project*, ACOE Walla Walla District, Walla Walla, Washington.

Appendix A

Monitoring Protocols

Vegetation Measurement

Individual Quadrant Data

Qualitative measurements as described below were done within the 0.5 square meter plots along the wetland\riparian transects.

LEAF COLOR: Leaf colors were determined and recorded by species, using a Munsell Plant Tissue Color Chart.

DESICCATION:
1. turgid: no observed desiccation
2. slightly wilted: one or more branches or leaves drooping
3. wilted: leaves or branches obviously drooping
4. dessicated: leaves dry

SENESCENCE:
1. seedling: plant grown from seed this year
2. plant (not flowering): plant well developed, no flowers visible
3. plant (flowering): plant well developed, flowers present
4. seed dispersal: mature seeds actively dehiscent
5. scenescent: fall die back or dormant
6. dead: annual or perennial plant dead

VIGOR:
1. very feeble: plant dying back, no new growth, very stressed
2. feeble: plant has minimal new growth, stressed
3. normal: plant healthy, some new growth visible, no obvious stress
4. vigorous: new growth obvious, plant thriving
5. exceptionally vigorous: abundant new growth, plant flourishing

COVER: Cover estimates within the Daubenmire plots were visually determined to the nearest 5 percent and overall dominance of native/non-natives and invasives species will be estimated using the following cover classes:

1. 0-5 % coverage
2. 5-25 % coverage
3. 25-50 % coverage
4. 50-75 % coverage
5. 75-95 % coverage
6. 95-100 % coverage

Colonization and recruitment were recorded for each species within each plot by distinguishing seedling growth versus vegetative or perennial growth forms.

COLONIZATION: Individuals or clonal patches observed spreading from existing rooted plants.

RECRUITMENT: Individual plants observed growing from seeds originating from the existing seed banks or from outside of the immediate vicinity of the plot, measured by percent cover of new seedlings. Plants rhizomatously spreading were not included.

300-Meter Radius Plot Data

Density and vigor within the 300 meter plots were measured using qualitative measures as follows:

DENSITY:
1. individual plant: one plant seen in entire 300 meter radius plot
2. rare occurrence: a few plants found in particular microhabitats
3. occasional: species seen throughout area, but rare
4. common: species seen regularly throughout area
5. abundant: species seen in most microhabitats and common
6. very abundant: species ubiquitous and dominant

VIGOR:
1. thriving: new growth obvious
2. normal: limited new growth, some signs of senescence
3. stressed: obvious signs of stress including die back, senescence, wilting, or death

30-Meter Upland Transect Quadrant Data

Shrub and tree height were measured using a rod measured in meters.

Diameter Breast Height were measured for each tree using a DBH tape measure.

COVER: Cover estimates within the Daubenmire plots were visually determined to the nearest 5 percent and overall dominance of native\non-natives and invasives species were estimated using the following cover classes:

1. 0-5 % coverage
2. 5-25 % coverage
3. 25-50 % coverage
4. 50-75 % coverage
5. 75-95 % coverage
6. 95-100 % coverage

Water Test Methods

TEMPERATURE: Water temperature was measured in the field using an Orion model 250A pH\temperature meter.

pH: Water pH was measured when present in the field using an Orion model 250A pH\temperature meter.

DO: Dissolved oxygen was measured when present in the field using a YSI model 50B DO meter.

Soil Test Methods

pH: soil pH was measured in the field using a LaMotte Model AM-31 soil test kit.

MOISTURE CONTENT: An approved soils labs completed the analysis of water content in the soil by measuring the mass of a soil sample and then remeasuring the mass after the sample has been dried to a constant weight. Method: ASTM D 2216-92.

FIELD MOISTURE CAPACITY: Field moisture capacity was measured using ASTM standard test methods or equivalent to obtain water holding capacity, tests were run by the University of Idaho Soils Laboratory.

PERCENT ORGANIC MATTER: Percent organic matter was determined using a calorimetric procedure as outlined in Soil Science journal volume 112. This procedure was conducted by the University of Idaho Soils Laboratory.

NUTRIENT CONTENT: Nutrient content analysis was completed for macronutrients at the University of Idaho Soils Laboratory.

Soil Particle Size: The University of Idaho Soils Laboratory conducted a sieve analysis and a standard hydrometer test for particle size distribution. Methods: ASTM D 422-63 (reapproved 1990) and ASTM 1140-92.

Soil Texture Class: Hand texturing was done in the field using the basic soil textural classes per the Soil Survey Manual Agricultural Handbook Number 18.

Oxidation: Redoximorphic features, as identified in Technical Bulletin 301 from the North Carolina Agricultural Research Service (North Carolina State University) were identified in the field.

Appendix B

Soil and Water Analyses

Table B.1

Soil Moisture Content (%)

Site	Date	B-1	B-3	B-5
Lost Island	15-May 24-Jul	25.7 27.9	33.8 42.6	25.2 16.2
Hollebeck	15-May 24-Jul	20.5 38.5	36.9 35.5	23.3 19.5
Skookum	16-May 27-Jul	25.1 28.3	26.1 42.2	28.5 88.7
Tucannon	19-May 23-Jul	33.8 35.7	39.6 41.8	50.9 47.7
Riparia	16-May 26-Jul	21.7 32.2	29.5 33.8	27.2 31.8
Ridpath	17-May 27-Jul	23.2 23.1	26.6 32.9	25.9 32.8
New York Gulch	17-May 27-Jul	29.7 39.8	37.7 33.2	20.2 22.6
Meadow Creek	18-May 22-Jul	36.3 47.5	24.7 28.7	55.9 55.0
Penawawa	18-May 22-Jul	25.5 46.4	36.5 40.2	33.6 40.2
Beckwith	21-May 25-Jul	30.5 37.2	33.7 35.5	28.2 34.0
Schultz	21-May 25-Jul	30.0 31.1	39.0 38.5	22.7 04.4
Knoxway	21-May 27-Jul	38.2 45.8	37.2 44.8	35.7 37.9
Alpowa	20-May 21-Jul	38.2 45.8	37.2 44.8	35.7 37.9
Chief Timothy	20-May 21-Jul	25.9 25.7	22.6 29.1	16.9 20.8

11-7-95/TBL-2/V1033-tbdfeet

Table B.2

Water Depths Measured in May 1995 (cm)

Site	B-1	B-3	B-5
Lost Island	90	37	1
Hollebeck	6	48	-15
Skookum	50	25	-10
Tucannon	30	20	-1
Riparia	50	45	20
Ridpath	70	55	-20
New York Gulch	75	45	-60
Meadow Creek	10	-30	-20
Penawawa	10	5	-57
Beckwith	785	20	-20
Schultz	85	80	1
Knoxway	-30	?	?
Alpowa	-40	-35	-70
Chief Timothy	-3	-80	-80

Note: 0 = ground surface

11-7-95/TBL-3/V1033-lkd/eet

FROM: ANALYTICAL SCIENCES LABORATORY
UNIVERSITY OF IDAHO
HOLM RESEARCH CENTER
MOSCOW, ID 83844-2203

Date Received:MAY 23, 1995 Fee: $3024.00 Budget #:V-1033-01 File:SMA9538
PRELIMINARY REPORT

Analyst/QC: Date: 7-21-95

Group Leader: Date: 7-24-95

SAMPLE ID	LAB # SMA95-38	SAT. PASTE pH	NaOAC P µg/g	NaOAC K µg/g	O.M. %	NO3-N µg/g	NH4-N µg/g	MOISTURE %	MOISTURE in/ft	PARTICLE SIZE DISTRIBUTION SAND %	CLAY %	SILT %	TEXTURE USDA1950	MOISTURE RETENTION 1/3 bar	15 bar
LOST ISLAND B-1	1261	6.7	3.0	94	0.60	<0.4	20.1	25.7	1.6	72.0	2.0	26.0	SANDY LOAM	9.6	3.8
LOST ISLAND B-3	1262	5.1	1.6	62	0.66	<0.4	3.0	33.8	3.0	92.0	2.0	6.0	SAND	6.7	2.4
LOST ISLAND B-5	1263	5.9	2.1	62	0.53	<0.4	2.6	25.2	1.5	90.0	2.0	8.0	SAND	6.1	2.4
HOLLEBECK B-1	1264	6.1	1.9	117	0.44	<0.4	2.1	20.5	0.8	64.0	6.0	30.0	SANDY LOAM	13.6	4.5
HOLLEBECK B-3	1265	5.3	1.6	84	1.03	<0.4	4.3	36.9	3.5	64.4	2.0	33.6	SANDY LOAM	11.8	4.1
HOLLEBECK B-5	1266	8.4	4.1	87	0.56	0.4	2.1	23.3	1.2	84.8	0.0	15.2	LOAMY SAND	6.1	2.8
SKOOKUM B-1	1267	7.8	3.5	121	0.44	<0.4	3.6	25.1	1.5	54.8	4.0	41.2	SANDY LOAM	13.8	5.2
SKOOKUM B-3	1268	7.8	3.1	117	0.48	<0.4	1.4	26.1	1.7	46.8	4.0	49.2	SANDY LOAM	18.2	5.7
SKOOKUM B-5	1269	7.6	2.9	139	0.69	<0.4	1.2	28.5	2.1	42.8	6.0	51.2	SILT LOAM	24.9	7.0
NEW YORK GULCH B-1	1270	7.7	3.6	122	0.68	0.4	2.5	29.7	2.3	40.8	4.0	55.2	SILT LOAM	15.2	4.8
NEW YORK GULCH B-3	1271	7.9	3.3	135	0.94	<0.4	1.8	37.7	3.6	46.8	2.0	51.2	SILT LOAM	17.3	5.7
NEW YORK GULCH B-5	1272	8.0	7.7	108	0.35	<0.4	0.6	20.2	0.7	76.8	4.0	19.2	LOAMY SAND	12.8	4.2
TUCANNON B-1	1273	7.5	4.4	172	1.52	<0.4	2.1	33.8	3.0	24.8	6.0	69.2	SILT LOAM	33.1	8.1
TUCANNON B-3	1274	6.6	2.4	111	1.65	<0.4	1.1	39.6	4.0	20.8	6.0	73.2	SILT LOAM	37.5	9.5
TUCANNON B-5	1275	8.0	2.8	80	2.61	<0.4	1.2	50.9	5.9	18.8	8.0	73.2	SILT LOAM	46.4	12.2
RIPARIA B-1	1276	8.4	16.8	298	0.97	<0.4	2.6	21.7	1.0	61.0	5.0	34.0	SANDY LOAM	17.7	5.9
RIPARIA B-3	1277	7.5	7.4	164	1.35	<0.4	2.1	29.5	2.3	78.8	2.0	19.2	LOAMY SAND	12.0	4.4
RIPARIA B-5	1278	6.8	5.5	109	1.64	<0.4	2.1	27.2	1.9	76.4	4.4	19.1	LOAMY SAND	15.1	5.8
RIDPATH B-1	1279	7.2	2.3	63	0.33	<0.4	3.3	23.2	1.2	95.2	0.8	4.0	SAND	6.1	3.0
RIDPATH B-3	1280	7.1	1.5	141	0.81	<0.4	2.2	26.6	1.8	45.2	4.8	50.0	SANDY LOAM	26.9	7.7
RIDPATH B-5	1281	8.2	5.9	138	0.25	<0.4	0.4	25.9	1.7	57.2	4.8	38.0	SANDY LOAM	23.3	6.7

FROM: ANALYTICAL SCIENCES LABORATORY
UNIVERSITY OF IDAHO
HOLM RESEARCH CENTER
MOSCOW, ID 83844-2203

Date Received:MAY 23, 1995 Fee: $3024.00 Budget #:V-1033-01 File:SMA0536
PRELIMINARY REPORT

Analyst/OC: Eleanor Elser Date: 7-21-95

Group Leader: Ken A. Nelson Date: 7-24-95

SAMPLE ID	LAB # SMA95-36	SAT. PASTE pH	NaOAC P µg/g	NaOAC K µg/g	O.M. %	NO3-N µg/g	NH4-N µg/g	MOISTURE %	MOISTURE in/ft	PARTICLE SIZE DISTRIBUTION SAND %	CLAY %	SILT %	TEXTURE USDA1950	MOISTURE RETENTION 1/3 bar	MOISTURE RETENTION 15 bar
PENAWAWA B-1	1282	8.0	5.3	132	0.99	<0.4	1.7	25.5	1.6	33.2	2.8	64.0	SILT LOAM	24.4	6.6
PENAWAWA B-3	1283	6.8	7.0	168	2.65	0.6	1.5	36.5	3.4	29.2	8.8	62.0	SILT LOAM	43.8	12.6
PENAWAWA B-5	1284	8.1	6.3	179	1.25	0.7	1.0	33.6	3.0	43.2	4.8	52.0	SILT LOAM	36.2	11.0
MEADOW CREEK B-1	1285	7.4	4.4	141	1.62	<0.4	1.3	36.3	3.4	37.2	6.8	56.0	SILT LOAM	31.0	9.0
MEADOW CREEK B-3	1286	8.4	12.4	199	1.32	0.5	0.9	24.7	1.5	49.2	4.8	46.0	SANDY LOAM	23.1	7.6
MEADOW CREEK B-5	1287	7.1	5.4	161	2.14	0.7	1.7	55.9	6.7	41.2	2.8	56.0	SILT LOAM	29.4	9.3
BECKWITH B-1	1288	6.9	2.9	131	0.74	<0.4	1.2	30.5	2.4	63.2	0.8	36.0	SANDY LOAM	17.3	6.2
BECKWITH B-3	1289	7.4	3.1	122	0.72	<0.4	10.9	33.7	3.0	65.2	0.8	34.0	SANDY LOAM	13.9	5.5
BECKWITH B-5	1290	7.6	11.8	157	0.44	<0.4	0.5	28.2	2.0	43.2	4.8	52.0	SILT LOAM	25.5	9.1
SCHULTZ B-1	1291	7.6	5.2	90	0.60	0.9	1.1	30.0	2.4	87.2	0.8	12.0	SAND	6.9	3.4
SCHULTZ B-3	1292	6.9	3.3	95	0.92	<0.4	0.9	39.0	3.9	77.2	0.8	22.0	LOAMY SAND	13.3	4.8
SCHULTZ B-5	1293	7.7	3.8	94	0.24	<0.4	1.4	22.7	1.1	99.2	0.8	0.0	SAND	5.3	2.3
ALPOWA B-1	1294	7.2	6.3	151	1.88	0.6	44.4	38.2	3.7	31.2	2.8	66.0	SILT LOAM	26.9	8.4
ALPOWA B-3	1295	5.9	6.4	178	2.13	<0.4	42.4	37.2	3.6	21.2	4.8	74.0	SILT LOAM	38.4	9.1
ALPOWA B-5	1296	7.0	5.6	153	1.69	<0.4	46.4	35.7	3.3	35.2	2.8	62.0	SILT LOAM	28.4	7.4
KNOXWAY B-1	1297	6.5	5.1	151	1.84	<0.4	50.5	37.7	3.6	31.2	2.8	66.0	SILT LOAM	23.4	6.7
KNOXWAY B-3	1298	5.6	3.4	146	3.27	<0.4	21.2	50.6	5.8	25.2	2.8	72.0	SILT LOAM	33.1	8.9
KNOXWAY B-5	1299	6.4	4.6	60	3.72	1.0	1.9	36.7	3.5	41.2	2.8	56.0	SILT LOAM	25.4	9.1
CHIEF TIMOTHY B-1	1300	6.9	4.1	101	0.51	<0.4	7.0	25.9	1.7	81.2	0.8	18.0	LOAMY SAND	8.8	3.5
CHIEF TIMOTHY B-3	1301	7.8	2.9	78	0.33	<0.4	0.5	22.6	1.1	91.2	0.8	8.0	SAND	6.8	2.9
CHIEF TIMOTHY B-5	1302	7.3	2.4	70	0.33	<0.4	0.5	16.9	0.2	91.2	0.8	8.0	SAND	6.8	3.1

Table C.1
Wetland Transect: Line Intercept Data (%)

Site	T	T Length	Shrub #1	Shrub #2	Shrub #3	Shrub #4	Shrub #5	Total Shrub Cover
Lost Island			AMFR	SAEX				
	A	4.5	82.2	0.0				82.2
	B	13	15.3	13.8				29.1
	C	20	18.0	1.5				19.5
Hollebeck			SAEX	AMFR	ELAN			
	A	45	1.1	1.5	4.2			6.8
	B	40	4.2	32.0	2.7			38.9
	C	20	0.0	0.0	22.0			22
Skookum			SAEX	AMFR	SAAM	ALRH	RUDI	
	A	28	13.4	42.7	0.3	23.6	13.0	93
	B	30	33.0	42.0	0.0	0.0	0.0	75
Tucannon			SAEX	AMFR				
	A	81	6.8	0.0				6.8
	B	100	1.8	0.8				2.6
	C	100	21.1	0.1				21.2
Riparia			SAEX	AMFR				
	A	40	4.7	20.0				24.7
	B	48	13.1	17.5				30.6
	C	43	21.3	5.6				26.9
Ridpath			SAEX	AMFR	SAAM	ELAN	SABA	
	A	88	90.7	17.0	0.1	2.2	6.8	116.8
	B	92	79.7	30.4	3.6	0.0	0.0	113.7
	C	95	54.0	40.3	0.2	0.0	0.0	94.5
New York Gulch			AMFR	SAEX				
	A	100	16.2	0.0				16.2
	B	100	7.9	3.8				11.7
	C	96	0.1	0.0				0.1
Meadow Creek			AMFR					
	B	42	45.7					45.7
	C	40	55.7					55.7

Table C.1 (Cont'd)
Wetland Transect: Line Intercept Data (%)

Site	T	T Length	Shrub #1	Shrub #2	Shrub #3	Shrub #4	Shrub #5	Total Shrub Cover
Penawawa			SALA	ACSA				
	A	40	24.5	0.0				24.5
	B	58	34.1	6.2				40.3
	C	75	56.4	0.0				56.4
Beckwith			SAEX	SAAM				
	A	100	8.5	1.2				9.7
	B	100	17.9	8.7				26.6
	C	100	28.1	6.5				34.6
Schultz			SAEX	SAAM				
	A	52	34.5	13.8				48.3
	B	60	28.5	10.5				39
	C	61	38.3	21.4				59.7
Knoxway			SAAM	ALRH	SAEX			
	A	46	3.9	0.0	0.0			3.9
	B	51	0.0	2.1	0.0			2.1
	C	36	0.0	0.0	8.0			8
Alpowa			SAAM	SAEX				
	A	86	5.3	0.0				5.3
	B	89	3.3	3.9				7.2
	C	84	4.5	2.2				6.7
Chief Timothy			SAAM	SAEX				
	A	17	10.0	59.4				69.4
	B	18	6.1	47.7				53.8
	C	24	0.0	31.6				31.6

Notes: ACSA = *Acer saccarum*
ALRH = *Alnus rhombifolia*
AMFR = *Amorpha frutwosa*
ELAN = *Elaeagnus angustifolia*
RUDI = *Rubus discolor*
SAAM = *Salix amygdaloides*
SABA = *Salix babylonica*
SAEX = *Salix exigua*
SALA = *Salix lasiandra*

11-7-95/TBL-4.WET/V1033-lkd/ect

Table C.2
Upland Line Transect: Line Intercept Data (%)

Site	T	Shrub #1	Shrub #2	Shrub #3	Shrub #4	Shrub #5	Shrub #6	Shrub #7	Shrub #8	Total Shrub Cover
Lost Island		SAEX	ELAN	AMFR	ROW D					
	A	0.0	0.0	0.0	0.0					0.0
	B	4.0	11.6	5.0	1.3					11.6
	C	26.0	0.0	0.0	0.0					26.0
Hollebeck		SAEX	ELAN							
	A	8.3	10.0							18.0
	B	30.0	10.0							40.0
	C	40.0	40.0							40.0
Skookum		RUDI	ROPS	AMFR	JUCC	CHNA	RHTR			
	A	13.3	26.6	0.0	0.0	0.0	0.0			26.6
	B	0.0	0.0	2.3	4.6	15.3	4.6			
Tucannon		SAEX	AMFR							
	A	59.6	0.0							59.6
	B	38.0	0.0							38.0
	C	62.3	11.3							73.6
Riparia		SAEX	AMFR							
	A	33.3	100.0							100.0
	B	50.0	74.2							76.4
	C	37.0	41.0							49.3
Ridpath		RUDI	ELAN	CERE	MOAL	LOMB	AMFR	SAEX		
	A	66.0	100.0	10.0	13.3	36.6				100.0
	B		67.3				5.0	2.6		71.6
	C		6.6	1.6				16.6		16.6
New York Gulch		SAEX	AMFR							
	A	1.3	68.3							68.3
	B	3.0	94.3							94.3
	C	0.0	64.3							64.3
Meadow Creek		AMFR	Shrub							
	A	69.3								69.3

Table C.2 (Cont'd)
Upland Line Transect; Line Intercept Data (%)

Site	T	Shrub #1	Shrub #2	Shrub #3	Shrub #4	Shrub #5	Shrub #6	Shrub #7	Shrub #8	Total Shrub Cover
	B	47.0	14.0							58.6
	C	7.3	5.3							12.6
Penawawa		LERE	ALSA							
	A	22.0								22.0
	B	18.3	13.3							21.6
	C	23.3								23.3
Beckwith		RULA	RUDI							
	A	12.3								12.3
	B		0.3							0.3
	C		19.3							19.3
Schultz		RHGL	SAEX	RODU						
	A		28.3	0.0						28.3
	B	2.6	0.0	15.0						17.6
	C	27.6	0.0	0.0						27.6
Knoxway		ALRH	RIAU	PRVI	ROSP	MOAL	PHLE	ROPS	SAEX	
	A	44.6	6.6	38.3	0.6	33.3	10.3	24.6	0.0	100.0
	B	49.0	9.3	0.0	0.0	2.6	0.0	0.0	0.0	49.3
	C	39.0	0.0	7.6	12.3	21.6	0.0	0.0	4.6	74.6
Alpowa		SAAM	ACSA	SAEX						
	A	16.3	0.0	0.0						16.3
	B	3.6	1.0	0.0						4.6
	C	17.0	0.0	2.6						19.0
Chief Timothy		ALSA	ELAN	RUDI	SAEX					
	A	3.6	37.0	22.3	0.0					38.6
	B	11.6	25.0	0.0	13.6					37.0
	C	0.0	0.0	0.0	0.0					0.0

Table C.2 (Cont'd)
Upland Line Transect; Line Intercept Data (%)

ACSA = *Acer saccharum* (Sugar maple)
ALRH = *Alnus rhombifolia*
AMFR = *Amorpha fruticosa* (False indigo)
CERE = *Celtix reticulatus* (Hackberry)
CHNA = *Chrysothamnus nauseosus* (Gray rabbitbrush)
ELAN = *Elaeagnus angustifolia* (Russian olive)
JUOC = *Juniperus occidentalis* (Western juniper)
LOMB = *Lombary poplar* (Lombardy poplar)
MOAL = *Morus alba* (Mulberry)
PHLE = *Philadelphia lewisii* (Mock orange)
RHGL = *Rhus glabra* (Smooth sumac)
RHTR = Rhus trilobata (Poison oak)
RIAV = Ribes aureum (Currant)
ROPS = Robinia pseudo-acacia (Black locust)
ROSP = Rosa sp. (Rose species)
ROWD = Rosa woodsii (Wood rose)
RPVI = Prunus virginiana (Choke cherry)
RUDI = *Rubus discolor* (Himalayan blackberry)
RULA = Rubus lacineatus (Evergreen blackberry)
SAAM = *Salix amigdaloides* (Peachleaf willow)
SABA = *Salix babylonica*
SAEX = *Salix exigua* (Coyote willow)
SALA = *Salix lasiandra*

Table C.3 Calculated Change in Acreage of Habitat Types Along the Shoreline

LOCATION	CLASS	1995 ACRES	1987 ACRES	NET CHANGE
55MILE	AMORFA	0.39	0.00	0.39
55MILE	PE	0.83	0.00	0.83
55MILE	PF	0.77	0.23	0.54
55MILE	PSS	8.89	9.09	-0.20
ALPOWA	AMORFA	0.00	0.00	0.00
ALPOWA	PE	5.57	2.61	2.96
ALPOWA	PF	3.35	0.00	3.35
ALPOWA	PSS	2.07	3.49	-1.42
AYER	AMORFA	4.78	0.00	4.78
AYER	PE	1.04	0.74	0.29
AYER	PF	0.63	0.00	0.63
AYER	PSS	0.45	0.48	-0.03
BECKWITH	AMORFA	0.00	0.00	0.00
BECKWITH	PE	3.03	0.00	3.03
BECKWITH	PF	0.00	0.00	0.00
BECKWITH	PSS	8.49	0.00	8.49
BIG FLAT	AMORFA	0.39	0.00	0.39
BIG FLAT	PE	10.68	0.00	10.68
BIG FLAT	PF	3.31	0.66	2.64
BIG FLAT	PSS	13.41	0.65	12.76
CENTEN.ISL	AMORFA	0.00	0.00	0.00
CENTEN.ISL	PE	0.00	0.00	0.00
CENTEN.ISL	PF	0.00	0.00	0.00
CENTEN.ISL	PSS	0.27	0.00	0.27
CHIEF TIM	AMORFA	0.00	0.00	0.00
CHIEF TIM	PE	0.00	0.00	0.00
CHIEF TIM	PF	5.82	2.88	2.95
CHIEF TIM	PSS	10.02	2.66	7.36
HOLLEBECK	AMORFA	0.46	0.00	0.46
HOLLEBECK	PE	2.97	2.15	0.83
HOLLEBECK	PF	0.00	0.00	0.00
HOLLEBECK	PSS	0.01	0.00	0.01
KNOXWAY	AMORFA	0.00	0.00	0.00
KNOXWAY	PE	0.65	0.00	0.65
KNOXWAY	PF	0.51	0.00	0.51
KNOXWAY	PSS	0.00	0.00	0.00
LOST ISLE	AMORFA	0.09	0.00	0.09
LOST ISLE	PE	12.17	0.91	11.26
LOST ISLE	PF	0.03	0.00	0.03
LOST ISLE	PSS	0.22	0.00	0.22
MEADOW CR	AMORFA	0.42	0.00	0.42
MEADOW CR	PE	12.92	5.16	7.76
MEADOW CR	PF	0.00	0.00	0.00
MEADOW CR	PSS	0.42	4.23	-3.81
MOSES	AMORFA	0.00	0.00	0.00

MOSES	PE	4.17	0.00	4.17
MOSES	PF	1.16	0.00	1.16
MOSES	PSS	0.10	0.00	0.10
NY BAR	AMORFA	3.61	0.00	3.61
NY BAR	PE	0.00	0.00	0.00
NY BAR	PF	0.00	0.00	0.00
NY BAR	PSS	0.00	0.00	0.00
NY GULCH	AMORFA	1.34	0.00	1.34
NY GULCH	PE	6.97	0.22	6.75
NY GULCH	PF	0.00	0.00	0.00
NY GULCH	PSS	0.38	4.22	-3.84
NY ISLE	AMORFA	0*	0.00	0.00
NY ISLE	PE	0.00	0.00	0.00
NY ISLE	PF	1.20	0.00	1.20
NY ISLE	PSS	8.31	2.85	5.45
PALOUSE R.	AMORFA	0.18	0.00	0.18
PALOUSE R.	PE	40.55	15.55	25.00
PALOUSE R.	PF	4.91	0.00	4.91
PALOUSE R.	PSS	6.68	0.00	6.68
PENAWAWA	AMORFA	0.00	0.00	0.00
PENAWAWA	PE	0.19	0.00	0.19
PENAWAWA	PF	29.17	9.35	19.82
PENAWAWA	PSS	0.00	25.76	-25.76
RICE BAR	AMORFA	0.00	0.00	0.00
RICE BAR	PE	17.85	0.00	17.85
RICE BAR	PF	2.74	0.56	2.18
RICE BAR	PSS	3.13	0.83	2.30
RIDPATH	AMORFA	1.14	0.00	1.14
RIDPATH	PE	0.67	0.00	0.67
RIDPATH	PF	2.36	1.38	0.98
RIDPATH	PSS	7.13	0.00	7.13
RIPARIA	AMORFA	1.81	0.00	1.81
RIPARIA	PE	9.05	3.16	5.89
RIPARIA	PF	10.16	9.14	1.02
RIPARIA	PSS	8.50	6.14	2.35
SCHULTZ	AMORFA	0.00	0.00	0.00
SCHULTZ	PE	3.87	0.00	3.87
SCHULTZ	PF	0.97	0.97	0.00
SCHULTZ	PSS	5.33	3.04	8.37
SKOOKUM	AMORFA	0.19	0.00	0.19
SKOOKUM	PE	0.13	0.00	0.13
SKOOKUM	PF	0.02	0.00	0.00
SKOOKUM	PSS	0.25	0.00	0.25
SWIFT BAR	AMORFA	0.00	0.00	0.00
SWIFT BAR	PE	9.58	0.00	9.58
SWIFT BAR	PF	0.26	0.00	0.26
SWIFT BAR	PSS	10.32	0.25	10.07
SWIFT CAN	AMORFA	0.00	0.00	0.00

SWIFT CAN	PE	1.89	0.00	1.89
SWIFT CAN	PF	0.15	0.00	0.15
SWIFT CAN	PSS	8.02	0.00	8.02
SWIFT ISLE	AMORFA	0.00	0.00	0.00
SWIFT ISLE	PE	0.00	0.00	0.00
SWIFT ISLE	PF	0.00	0.00	0.00
SWIFT ISLE	PSS	0.00	0.00	0.00
TOUCANNON	AMORFA	0.00	0.00	0.00
TOUCANNON	PE	10.93	5.58	5.36
TOUCANNON	PF	7.35	2.60	4.75
TOUCANNON	PSS	11.60	19.52	-7.92
WALKER	AMORFA	0.00	0.00	0.00
WALKER	PE	3.16	2.53	0.64
WALKER	PF	2.84	2.13	0.71
WALKER	PSS	5.91	5.48	0.43
WILLOW	AMORFA	0.00	0.00	0.00
WILLOW	PE	10.70	0.00	10.70
WILLOW	PF	19.79	0.00	19.79
WILLOW	PSS	3.95	5.36	-1.41
WILMA	AMORFA	0.00	0.00	0.00
WILMA	PE	2.97	0.00	2.97
WILMA	PF	6.59	0.53	6.05
WILMA	PSS	12.21	13.96	-1.75

Table C.4 Mean Percent Canopy Cover on Wetland Transects at Alpowa

Plant Species	Date	(A) Mean	(B) Mean	(C) Mean	(A,B,C) Mean
Digitaria sp.	20-May	0.00	0.00	0.00	0.00
Veronica americana	20-May	0.00	0.00	0.00	0.00
Veronica biloba	20-May	0.00	0.00	0.00	0.00
Polygonum hydropiper	20-May	13.50	9.00	8.50	10.33
Polygonum persicaria	20-May	3.50	0.00	0.00	1.17
Ranunculus sceleratus	20-May	6.00	0.50	0.50	2.33
Solidago occidentalis *	20-May	3.00	0.00	9.00	4.00
Epilobium sp.	20-May	41.50	37.00	21.00	33.17
Xanthium strumarium	20-May	23.00	20.00	40.50	27.83
Lycopus sp.	20-May	0.50	0.00	0.00	0.17
Stellaria sp.	20-May	0.00	0.00	0.00	0.00
Impatiens noli-tangere	20-May	0.50	0.00	0.00	0.17
Gnaphalium palustre	20-May	1.00	0.00	0.00	0.33
Polygonum lapathifolium	20-May	3.00	1.00	10.50	4.83
Bidens cernua	20-May	0.00	0.00	0.00	0.00
Rumex crispus	20-May	0.00	0.00	0.00	0.00
Lythrum sp.	20-May	0.00	0.00	0.00	0.00
Plantago major	20-May	0.00	0.00	0.00	0.00
Cyperus strigosus	20-May	8.00	0.00	0.50	2.83
Cyperus rivularis	20-May	0.00	0.00	0.00	0.00
Eleocharis palustris	20-May	0.50	0.00	0.00	0.17
Cyperus erythrorhyzos	20-May	0.00	0.00	0.00	0.00
Typha sp.	20-May	0.00	0.00	0.00	0.00
Salix amygdaloides*	20-May	7.50	16.50	6.50	10.17
Salix exigua	20-May	0.50	0.00	3.00	1.17
Digitaria sp.	21-Jul	0.00	0.00	0.00	0.00
Veronica americana	21-Jul	0.00	0.00	0.00	0.00
Veronica biloba	21-Jul	0.00	0.00	0.00	0.00
Polygonum hydropiper	21-Jul	9.50	6.00	6.00	7.17
Polygonum persicaria	21-Jul	0.00	0.00	0.00	0.00
Ranunculus sceleratus	21-Jul	0.00	0.00	0.00	0.00
Solidago occidentalis *	21-Jul	0.00	0.50	3.50	1.33
Epilobium sp.	21-Jul	0.00	0.00	0.00	0.00
Xanthium strumarium	21-Jul	3.50	7.50	3.50	4.83
Lycopus sp.	21-Jul	0.00	0.00	0.00	0.00
Stellaria sp.	21-Jul	0.00	0.00	0.00	0.00
Impatiens noli-tangere	21-Jul	0.00	0.00	0.00	0.00
Gnaphalium palustre	21-Jul	0.00	0.00	0.00	0.00
Polygonum lapathifolium	21-Jul	7.50	0.50	0.50	2.83
Bidens cernua	21-Jul	0.00	0.00	0.00	0.00
Rumex crispus	21-Jul	0.00	0.00	0.00	0.00
Lythrum sp.	21-Jul	0.00	0.00	0.00	0.00
Plantago major	21-Jul	0.00	0.00	0.00	0.00
Cyperus strigosus	21-Jul	3.00	0.00	0.00	1.00
Cyperus rivularis	21-Jul	0.00	0.00	0.00	0.00

Eleocharis palustris	21-Jul	0.00	0.00	0.00	0.00
Cyperus erythrorhyzos	21-Jul	0.00	0.00	0.00	0.00
Typha sp.	21-Jul	0.00	0.00	0.00	0.00
Salix amygdaloides*	21-Jul	1.00	1.00	3.00	1.67
Salix exigua	21-Jul	0.00	0.00	0.00	0.00
Digitaria sp.	30-Sep	0.00	0.00	0.50	0.17
Veronica americana	30-Sep	3.00	6.00	0.00	3.00
Veronica biloba	30-Sep	3.00	0.00	0.00	1.00
Polygonum hydropiper	30-Sep	25.50	38.00	13.50	25.67
Polygonum persicaria	30-Sep	0.00	0.00	0.00	0.00
Ranunculus sceleratus	30-Sep	0.00	0.00	0.00	0.00
Solidago occidentalis *	30-Sep	12.50	0.00	23.00	11.83
Epilobium sp.	30-Sep	15.00	21.00	3.00	13.00
Xanthium strumarium	30-Sep	12.50	20.00	42.00	24.83
Lycopus sp.	30-Sep	0.00	0.00	0.00	0.00
Stellaria sp.	30-Sep	27.50	6.00	40.00	24.50
Impatiens noli-tangere	30-Sep	0.00	0.00	0.00	0.00
Gnaphalium palustre	30-Sep	0.50	0.00	3.00	1.17
Polygonum lapathifolium	30-Sep	7.50	7.00	4.00	6.17
Bidens cernua	30-Sep	0.00	3.00	0.00	1.00
Rumex crispus	30-Sep	0.00	0.50	0.00	0.17
Lythrum sp.	30-Sep	0.00	3.00	0.00	1.00
Plantago major	30-Sep	0.00	0.00	0.50	0.17
Cyperus strigosus	30-Sep	9.50	16.50	14.00	13.33
Cyperus rivularis	30-Sep	8.00	0.50	3.00	3.83
Eleocharis palustris	30-Sep	0.50	3.50	0.00	1.33
Cyperus erythrorhyzos	30-Sep	0.00	0.50	0.00	0.17
Typha sp.	30-Sep	0.00	0.50	0.00	0.17
Salix amygdaloides*	30-Sep	10.50	0.00	3.00	4.50
Salix exigua	30-Sep	0.00	3.00	0.50	1.17

Table C.5 Mean Percent Canopy Cover on Wetland Transects at Beckwith

Plant Species	Date	(A) Mean	(B) Mean	(C) Mean	(A,B,C) Mean
Poa pratensis	21-May	0.00	3.00	3.00	2.00
Alopecuris geniculatus	21-May	0.00	0.00	0.00	0.00
Festuca rubra	21-May	0.00	0.00	7.50	2.50
Xanthium strumarium	21-May	0.00	0.00	0.50	0.17
Agrostis stolonifera	21-May	41.50	44.50	35.00	40.33
Veronica americana	21-May	0.00	0.50	0.00	0.17
Echinochloa crusgalli	21-May	0.00	0.00	0.00	0.00
Solidago occidentalis	21-May	0.50	3.00	0.00	1.17
Polygonum hydropiper	21-May	0.00	0.00	0.00	0.00
Polygonum persicaria	21-May	0.00	0.00	0.00	0.00
Sporobolis cryptandrus	21-May	0.00	0.00	0.00	0.00
Mentha spp.	21-May	17.00	7.50	7.50	10.67
Ranunculus sceleratus	21-May	0.00	0.50	0.00	0.17
Taraxacum officinale	21-May	0.00	0.50	0.00	0.17
Eleocharis palustris	21-May	23.00	23.00	8.00	18.00
Juncus effusus	21-May	7.50	0.00	0.00	2.50
Scirpus validus	21-May	0.00	0.00	0.00	0.00
Phalaris arundinacea	21-May	0.00	8.00	0.00	2.67
Equisetum arvense	21-May	7.50	0.50	1.00	3.00
Juncus acuminatus	21-May	3.50	11.00	3.50	6.00
Equisetum laevigatum	21-May	0.00	0.00	0.00	0.00
Typha latifolia	21-May	0.00	3.00	0.00	1.00
Salix exigua	21-May	0.50	25.00	7.50	11.00
Salix amygdaloides	21-May	3.00	15.00	0.00	6.00
Poa pratensis	25-Jul	0.00	0.00	0.00	0.00
Alopecuris geniculatus	25-Jul	0.00	12.50	0.00	4.17
Festuca rubra	25-Jul	0.00	0.00	0.50	0.17
Xanthium strumarium	25-Jul	14.00	7.00	9.50	10.17
Agrostis stolonifera	25-Jul	3.00	35.50	20.00	19.50
Veronica americana	25-Jul	0.00	0.00	0.00	0.00
Echinochloa crusgalli	25-Jul	0.00	0.00	0.00	0.00
Solidago occidentalis	25-Jul	0.50	1.00	0.00	0.50
Polygonum hydropiper	25-Jul	0.00	0.00	0.00	0.00
Polygonum persicaria	25-Jul	0.00	0.00	3.00	1.00
Sporobolis cryptandrus	25-Jul	0.00	0.00	0.00	0.00
Mentha spp.	25-Jul	19.50	7.50	3.00	10.00
Ranunculus sceleratus	25-Jul	0.00	0.50	0.00	0.17
Taraxacum officinale	25-Jul	0.00	0.00	0.00	0.00
Eleocharis palustris	25-Jul	8.00	7.00	7.50	7.50
Juncus effusus	25-Jul	0.00	0.00	0.00	0.00
Scirpus validus	25-Jul	3.00	0.50	0.00	1.17
Phalaris arundinacea	25-Jul	0.50	0.50	13.00	4.67
Equisetum arvense	25-Jul	1.50	0.50	0.50	0.83
Juncus acuminatus	25-Jul	34.00	22.50	0.50	19.00
Equisetum laevigatum	25-Jul	0.00	0.00	0.00	0.00

Typha latifolia	25-Jul	0.00	0.00	0.00	0.00
Salix exigua	25-Jul	7.50	29.50	23.00	20.00
Salix amygdaloides	25-Jul	0.00	22.50	0.00	7.50
Poa pratensis	28-Sep	0.00	0.00	0.00	0.00
Alopecuris geniculatus	28-Sep	0.00	0.00	0.00	0.00
Festuca rubra	28-Sep	0.00	0.00	0.00	0.00
Xanthium strumarium	28-Sep	27.50	11.00	20.00	19.50
Agrostis stolonifera	28-Sep	20.00	27.50	29.50	25.67
Veronica americana	28-Sep	0.00	0.00	0.00	0.00
Echinochloa crusgalli	28-Sep	1.00	0.00	3.50	1.50
Solidago occidentalis	28-Sep	0.00	1.00	0.00	0.33
Polygonum hydropiper	28-Sep	0.50	0.50	6.00	2.33
Polygonum persicaria	28-Sep	0.50	0.00	3.00	1.17
Sporobolis cryptandrus	28-Sep	3.00	0.00	0.00	1.00
Mentha spp.	28-Sep	17.00	12.50	7.50	12.33
Ranunculus sceleratus	28-Sep	0.00	0.00	0.00	0.00
Taraxacum officinale	28-Sep	0.00	0.00	0.00	0.00
Eleocharis palustris	28-Sep	0.00	0.00	0.00	0.00
Juncus effusus	28-Sep	0.00	0.00	0.00	0.00
Scirpus validus	28-Sep	3.00	0.00	0.00	1.00
Phalaris arundinacea	28-Sep	7.50	0.00	12.50	6.67
Equisetum arvense	28-Sep	0.00	0.00	0.00	0.00
Juncus acuminatus	28-Sep	7.50	0.50	0.00	2.67
Equisetum laevigatum	28-Sep	0.50	0.00	0.00	0.17
Typha latifolia	28-Sep	0.00	0.00	0.00	0.00
Salix exigua	28-Sep	0.00	25.00	15.50	13.50
Salix amygdaloides	28-Sep	0.00	24.50	0.00	8.17

Table C.6 Mean Percent Canopy Cover on Wetland Transects at Chief Timothy

Plant Species	Date	(A) Mean	(B) Mean	(C) Mean	(A,B,C) Mean
Bromus tectorum	20-May	0.00	0.00	0.50	0.17
Agropyron cristatum	20-May	0.00	0.00	0.00	0.00
Solidago occidentalis*	20-May	13.50	6.50	0.50	6.83
Epilobium sp.	20-May	9.50	4.50	4.00	6.00
Stellaria sp.	20-May	0.00	0.00	0.00	0.00
Polygonum hydropiper	20-May	0.00	1.50	4.00	1.83
Apocynum cannabinum	20-May	3.00	3.00	0.00	2.00
Lycopus sp.	20-May	3.00	0.00	0.00	1.00
Anthemus cotula	20-May	0.50	0.00	0.50	0.33
Rumex acetocella	20-May	0.50	0.00	0.00	0.17
Veronica biloba	20-May	0.00	0.00	0.00	0.00
Polygonum lapathifolium	20-May	0.00	0.00	0.50	0.17
Bidens cernua	20-May	0.00	0.00	0.00	0.00
Plantago lanceolata	20-May	0.00	0.00	0.50	0.17
Hypericum perforatum	20-May	0.00	0.00	0.50	0.17
Melilotus alba	20-May	0.00	0.00	0.50	0.17
Evening primrose	20-May	0.00	0.00	0.00	0.00
Cyperus rivularis	20-May	3.00	0.00	0.00	1.00
Cyperus strigosus	20-May	0.00	0.00	0.00	0.00
Salix amygdaloides*	20-May	18.00	3.00	0.00	7.00
Salix exigua	20-May	26.00	33.50	14.50	24.67
Rubus discolor	20-May	3.00	7.50	0.00	3.50
Acer saccharum	20-May	0.00	7.50	0.00	2.50
Elaeagnus angustifolia	20-May	0.00	0.00	0.00	0.00
Bromus tectorum	21-Jul	0.00	0.00	0.00	0.00
Agropyron cristatum	21-Jul	0.00	0.00	0.50	0.17
Solidago occidentalis*	21-Jul	9.00	10.00	0.50	6.50
Epilobium sp.	21-Jul	0.00	0.00	0.00	0.00
Stellaria sp.	21-Jul	0.00	0.00	0.00	0.00
Polygonum hydropiper	21-Jul	7.50	0.00	8.00	5.17
Apocynum cannabinum	21-Jul	3.00	3.00	0.00	2.00
Lycopus sp.	21-Jul	0.00	0.00	0.00	0.00
Anthemus cotula	21-Jul	0.00	0.00	0.00	0.00
Rumex acetocella	21-Jul	0.00	0.00	0.00	0.00
Veronica biloba	21-Jul	0.00	1.00	0.50	0.50
Polygonum lapathifolium	21-Jul	0.00	0.00	0.00	0.00
Bidens cernua	21-Jul	0.00	0.00	0.00	0.00
Plantago lanceolata	21-Jul	0.00	0.00	0.50	0.17
Hypericum perforatum	21-Jul	0.00	0.00	0.50	0.17
Melilotus alba	21-Jul	0.00	0.00	0.50	0.17
Evening primrose	21-Jul	0.00	0.00	0.50	0.17
Cyperus rivularis	21-Jul	0.50	0.00	0.00	0.17
Cyperus strigosus	21-Jul	0.00	0.00	0.00	0.00
Salix amygdaloides*	21-Jul	6.50	3.00	0.50	3.33
Salix exigua	21-Jul	17.00	24.00	13.50	18.17

Rubus discolor	21-Jul	0.50	3.00	0.00	1.17
Acer saccharum	21-Jul	0.00	0.00	0.00	0.00
Elaeagnus angustifolia	21-Jul	0.00	0.00	0.00	0.00
Bromus tectorum	30-Sep	0.00	0.00	0.00	0.00
Agropyron cristatum	30-Sep	0.00	0.00	0.00	0.00
Solidago occidentalis*	30-Sep	21.00	38.00	13.50	24.17
Epilobium sp.	30-Sep	0.00	0.00	1.00	0.33
Stellaria sp.	30-Sep	0.50	6.00	11.00	5.83
Polygonum hydropiper	30-Sep	13.00	0.00	3.50	5.50
Apocynum cannabinum	30-Sep	3.00	0.00	0.00	1.00
Lycopus sp.	30-Sep	3.00	0.00	0.50	1.17
Anthemus cotula	30-Sep	0.00	0.00	0.00	0.00
Rumex acetocella	30-Sep	0.00	0.00	0.00	0.00
Veronica biloba	30-Sep	0.00	0.00	0.00	0.00
Polygonum lapathifolium	30-Sep	0.00	0.00	0.00	0.00
Bidens cernua	30-Sep	0.00	0.00	0.50	0.17
Plantago lanceolata	30-Sep	0.00	0.00	0.00	0.00
Hypericum perforatum	30-Sep	0.00	0.00	0.50	0.17
Melilotus alba	30-Sep	0.00	0.00	12.50	4.17
Evening primrose	30-Sep	0.00	0.00	0.50	0.17
Cyperus rivularis	30-Sep	12.50	0.50	0.00	4.33
Cyperus strigosus	30-Sep	0.50	0.50	23.00	8.00
Salix amygdaloides*	30-Sep	6.00	3.00	0.00	3.00
Salix exigua	30-Sep	45.50	29.00	11.00	28.50
Rubus discolor	30-Sep	3.00	3.00	0.00	2.00
Acer saccharum	30-Sep	12.50	3.00	0.00	5.17
Elaeagnus angustifolia	30-Sep	0.00	12.50	0.00	4.17

Table C.7 Mean Percent Canopy Cover on Wetland Transects at Hollebeck

Plant Species	Date	(A) Mean	(B) Mean	(C) Mean	(A,B,C) Mean
Echinocloa crusgalli	15-May	0	0	0	0.00
Rumex crispus	15-May	7.5	3	0.5	3.67
Bidens frondosa	15-May	0	0	0	0.00
Polygonum persicaria	15-May	0	0	0	0.00
Impatiens noli-tangere	15-May	0.5	0	3	1.17
Solidago occidentalis *	15-May	0	3.5	0	1.17
Polygonum hydropiper	15-May	0	0	0	0.00
Solanum dulcamara	15-May	0	0	0	0.00
Xanthium strumarium	15-May	0	0	0	0.00
Carex vesicaria	15-May	29.5	15.5	20.5	21.83
Phalaris arundinacea	15-May	1	0	3	1.33
Equisetum arvense	15-May	7.5	13	3	7.83
Scirpus pallidus	15-May	0	7.5	0	2.50
Phragmites communis	15-May	0	0	0	0.00
Typha latifolia	15-May	3	0.5	0	1.17
Typha angustifolia	15-May	3	3	0	2.00
Juncus acuminatus	15-May	3.5	12.5	0	5.33
Eleocharis palustris	15-May	3	0	0.5	1.17
Juncus effusus	15-May	0	3	6	3.00
Scirpus validus	15-May	0	7.5	0	2.50
Cyperus strigosus	15-May	0	0	0	0.00
Carex vulpinoidea	15-May	0	0	0	0.00
Amorpha fruticosa	15-May	3	32	0	11.67
Salix exigua	15-May	3	12.5	3.5	6.33
Elaeagnus angustifolia	15-May	17	0	22.5	13.17
Echinocloa crusgalli	24-Jul	0	0	0	0.00
Rumex crispus	24-Jul	3	0	0	1.00
Bidens frondosa	24-Jul	0.5	0	0	0.17
Polygonum persicaria	24-Jul	0	0	0	0.00
Impatiens noli-tangere	24-Jul	3	0	7.5	3.50
Solidago occidentalis *	24-Jul	0	7.5	0	2.50
Polygonum hydropiper	24-Jul	0	0	0	0.00
Solanum dulcamara	24-Jul	0	0	0	0.00
Xanthium strumarium	24-Jul	0	0	0	0.00
Carex vesicaria	24-Jul	29.5	13	20	20.83
Phalaris arundinacea	24-Jul	8	0	27.5	11.83
Equisetum arvense	24-Jul	3	3	1	2.33
Scirpus pallidus	24-Jul	0.5	3	0	1.17
Phragmites communis	24-Jul	0	0	0	0.00
Typha latifolia	24-Jul	0	3.5	0	1.17
Typha angustifolia	24-Jul	7.5	0	0	2.50
Juncus acuminatus	24-Jul	0	0	0	0.00
Eleocharis palustris	24-Jul	7.5	0	0	2.50
Juncus effusus	24-Jul	0	16	10.5	8.83
Scirpus validus	24-Jul	0	3	0	1.00

Cyperus strigosus	24-Jul	0	0	0.5	0.17
Carex vulpinoidea	24-Jul	0	0	3	1.00
Amorpha fruticosa	24-Jul	0	29.5	0	9.83
Salix exigua	24-Jul	0	15.5	10.5	8.67
Elaeagnus angustifolia	24-Jul	22.5	0	27	16.50
Echinocloa crusgalli	26-Sep	0	3.5	3	2.17
Rumex crispus	26-Sep	7.5	3	0.5	3.67
Bidens frondosa	26-Sep	3	10.5	0	4.50
Polygonum persicaria	26-Sep	7.5	20	10.5	12.67
Impatiens noli-tangere	26-Sep	7.5	0	3	3.50
Solidago occidentalis *	26-Sep	0	0	0	0.00
Polygonum hydropiper	26-Sep	0	7.5	7.5	5.00
Solanum dulcamara	26-Sep	0	0	3	1.00
Xanthium strumarium	26-Sep	0	0	7.5	2.50
Carex vesicaria	26-Sep	24.5	15.5	19.5	19.83
Phalaris arundinacea	26-Sep	19.5	7.5	35	20.67
Equisetum arvense	26-Sep	3	7.5	0.5	3.67
Scirpus pallidus	26-Sep	0	3	3	2.00
Phragmites communis	26-Sep	0.5	0	0	0.17
Typha latifolia	26-Sep	0	3	0	1.00
Typha angustifolia	26-Sep	7.5	7.5	0	5.00
Juncus acuminatus	26-Sep	0	0	0	0.00
Eleocharis palustris	26-Sep	0	0	0	0.00
Juncus effusus	26-Sep	0	20	10.5	10.17
Scirpus validus	26-Sep	0	0.5	0	0.17
Cyperus strigosus	26-Sep	0	0	34	11.33
Carex vulpinoidea	26-Sep	0	0	0.5	0.17
Amorpha fruticosa	26-Sep	0	32	3	11.67
Salix exigua	26-Sep	0	12.5	10.5	7.67
Elaeagnus angustifolia	26-Sep	27	7.5	27	20.50

Table C.8 Mean Percent Canopy Cover on Wetland Transects at Knoxway

Plant Species	Date	(A) Mean	(B) Mean	(C) Mean	(A,B,C) Mean
Echinochloa crusgalli	21-May	0.00	0.00	0.00	0.00
Agrostis stolonifera	21-May	32.50	20.00	20.50	24.33
Festuca arundinacea	21-May	0.00	3.00	15.50	6.17
Poa pratensis	21-May	0.00	7.50	12.50	6.67
Epilobium sp.	21-May	18.00	13.50	4.00	11.83
Polygonum hydropiper	21-May	0.50	18.00	4.00	7.50
Polygonum lapathifolium	21-May	7.50	0.00	0.00	2.50
Polygonum persicaria	21-May	7.50	0.50	0.00	2.67
Veronica biloba	21-May	0.50	0.50	0.00	0.33
Bidens cernua	21-May	0.00	0.00	0.00	0.00
Ranunculus sceleratus	21-May	0.50	9.00	6.00	5.17
Xanthium strumarium	21-May	25.00	1.50	3.50	10.00
Anthemis cotula	21-May	1.00	0.00	0.50	0.50
Rumex crispus	21-May	0.00	7.50	0.50	2.67
Gnaphalium palustre	21-May	1.00	0.00	10.50	3.83
Mimulus guttatus	21-May	0.50	0.00	0.00	0.17
Trifolium sp.	21-May	0.50	0.00	0.00	0.17
Dipsacus sylvestris	21-May	3.00	0.00	0.50	1.17
Ranunculus repens	21-May	3.00	0.00	0.00	1.00
Mentha spicata	21-May	0.00	3.00	6.00	3.00
Solidago occidentalis*	21-May	0.00	0.00	3.50	1.17
Lycopus sp.	21-May	0.00	0.00	0.50	0.17
Stellaria sp.	21-May	0.00	0.00	3.00	1.00
Cirsium arvense	21-May	0.00	0.00	0.00	0.00
Cyperus stigosus	21-May	0.00	0.00	0.00	0.00
Eleocharis palustris	21-May	0.50	0.00	0.00	0.17
Carex vulpinoidea	21-May	11.00	6.00	0.50	5.83
Juncus effusus	21-May	3.50	0.00	0.00	1.17
Equisetum arvense	21-May	15.50	7.50	0.00	7.67
Juncus bufonius	21-May	7.50	3.00	0.00	3.50
Phalaris arundinacea	21-May	0.00	0.00	0.00	0.00
Salix amygdaloides*	21-May	3.00	0.00	3.00	2.00
Salix exigua	21-May	0.00	0.50	7.50	2.67
Alnus rhombifolia	21-May	0.00	0.00	0.00	0.00
Morus alba	21-May	0.00	0.00	0.00	0.00
Echinochloa crusgalli	27-Jul	0.00	0.00	0.50	0.17
Agrostis stolonifera	27-Jul	23.00	36.50	17.50	25.67
Festuca arundinacea	27-Jul	0.00	0.00	12.50	4.17
Poa pratensis	27-Jul	0.00	0.00	7.50	2.50
Epilobium sp.	27-Jul	0.00	0.00	0.00	0.00
Polygonum hydropiper	27-Jul	3.00	27.50	28.00	19.50
Polygonum lapathifolium	27-Jul	0.50	3.00	0.00	1.17
Polygonum persicaria	27-Jul	0.00	0.00	0.00	0.00
Veronica biloba	27-Jul	0.00	0.50	0.00	0.17
Bidens cernua	27-Jul	0.00	0.00	0.00	0.00

Ranunculus sceleratus	27-Jul	0.00	0.00	0.00	0.00
Xanthium strumarium	27-Jul	13.50	0.50	6.00	6.67
Anthemis cotula	27-Jul	0.00	0.00	0.00	0.00
Rumex crispus	27-Jul	1.00	0.00	0.00	0.33
Gnaphalium palustre	27-Jul	0.00	0.00	0.00	0.00
Mimulus guttatus	27-Jul	0.00	0.00	0.00	0.00
Trifolium sp.	27-Jul	0.00	0.00	0.00	0.00
Dipsacus sylvestris	27-Jul	0.00	0.00	3.00	1.00
Ranunculus repens	27-Jul	3.00	0.00	0.00	1.00
Mentha spicata	27-Jul	3.00	3.00	0.50	2.17
Solidago occidentalis*	27-Jul	0.00	0.00	7.50	2.50
Lycopus sp.	27-Jul	0.00	0.00	0.00	0.00
Stellaria sp.	27-Jul	0.00	0.00	0.00	0.00
Cirsium arvense	27-Jul	0.00	0.00	3.00	1.00
Cyperus stigosus	27-Jul	0.00	0.00	0.00	0.00
Eleocharis palustris	27-Jul	0.00	0.00	0.00	0.00
Carex vulpinoidea	27-Jul	8.00	3.00	0.00	3.67
Juncus effusus	27-Jul	7.50	0.00	0.00	2.50
Equisetum arvense	27-Jul	0.00	0.00	0.00	0.00
Juncus bufonius	27-Jul	0.00	0.00	0.00	0.00
Phalaris arundinacea	27-Jul	0.00	0.00	0.00	0.00
Salix amygdaloides*	27-Jul	3.00	0.00	0.00	1.00
Salix exigua	27-Jul	0.00	0.00	16.00	5.33
Alnus rhombifolia	27-Jul	0.00	3.00	0.00	1.00
Morus alba	27-Jul	0.00	3.00	0.00	1.00
Echinochloa crusgalli	28-Sep	0.50	0.00	0.50	0.33
Agrostis stolonifera	28-Sep	15.00	29.50	17.00	20.50
Festuca arundinacea	28-Sep	7.50	3.00	12.50	7.67
Poa pratensis	28-Sep	0.00	0.00	7.50	2.50
Epilobium sp.	28-Sep	0.00	0.00	0.50	0.17
Polygonum hydropiper	28-Sep	10.50	59.00	42.00	37.17
Polygonum lapathifolium	28-Sep	15.50	3.50	3.00	7.33
Polygonum persicaria	28-Sep	0.00	0.00	0.00	0.00
Veronica biloba	28-Sep	28.00	12.50	3.50	14.67
Bidens cernua	28-Sep	3.00	0.00	3.00	2.00
Ranunculus sceleratus	28-Sep	3.00	3.00	0.00	2.00
Xanthium strumarium	28-Sep	0.50	3.00	3.50	2.33
Anthemis cotula	28-Sep	0.00	0.00	0.50	0.17
Rumex crispus	28-Sep	0.50	0.00	0.00	0.17
Gnaphalium palustre	28-Sep	3.00	0.00	0.50	1.17
Mimulus guttatus	28-Sep	0.50	0.00	0.00	0.17
Trifolium sp.	28-Sep	0.00	0.00	0.00	0.00
Dipsacus sylvestris	28-Sep	0.00	0.00	3.00	1.00
Ranunculus repens	28-Sep	0.50	0.00	0.00	0.17
Mentha spicata	28-Sep	3.00	3.00	0.50	2.17
Solidago occidentalis*	28-Sep	0.00	0.00	3.50	1.17
Lycopus sp.	28-Sep	0.00	0.00	0.00	0.00
Stellaria sp.	28-Sep	0.00	0.00	0.00	0.00

Cirsium arvense	28-Sep	0.00	0.00	0.00	0.00
Cyperus stigosus	28-Sep	6.50	0.00	0.50	2.33
Eleocharis palustris	28-Sep	3.00	0.00	0.00	1.00
Carex vulpinoidea	28-Sep	6.50	3.00	0.00	3.17
Juncus effusus	28-Sep	7.50	0.00	0.00	2.50
Equisetum arvense	28-Sep	0.50	0.00	0.00	0.17
Juncus bufonius	28-Sep	0.00	0.00	0.00	0.00
Phalaris arundinacea	28-Sep	0.00	0.00	0.50	0.17
Salix amygdaloides*	28-Sep	0.00	0.00	0.00	0.00
Salix exigua	28-Sep	0.00	0.50	7.50	2.67
Alnus rhombifolia	28-Sep	12.50	3.00	0.00	5.17
Morus alba	28-Sep	0.00	3.00	0.00	1.00

Table C.9 Mean Percent Canopy Cover on Wetland Transects at Lost Island

Plant Species	Date	(A) Mean	(B) Mean	(C) Mean	(A,B,C) Mean
Bromus tectorum	15-May	0	0	7.5	2.5
Conyza sp.	15-May	0	0	0	0
Solidago occidentalis*	15-May	0	0.5	0.5	0.333333333
Equisetum laevigatum	15-May	7.5	0	17	8.166666667
Typha latifolia	15-May	0	1.5	0	0.5
Typha angustifolia	15-May	0	3.5	4	2.5
Phragmites communis	15-May	0	23	0	7.666666667
Scirpus validus	15-May	0	3.5	1	1.5
Carex vesicaria	15-May	0	0.5	0	0.166666667
Lemna minor	15-May	0	0.5	0	0.166666667
Juncus effusus	15-May	0	0	0.5	0.166666667
Phalaris arundinacea	15-May	0	0	7.5	2.5
Amorpha fruticosa	15-May	53	3	0.5	18.83333333
Salix exigua	15-May	0	3.5	3.5	2.333333333
Bromus tectorum	24-Jul	0	0	3	1
Conyza sp.	24-Jul	0	0	0	0
Solidago occidentalis*	24-Jul	0	0	0.5	0.166666667
Equisetum laevigatum	24-Jul	8	0	7.5	5.166666667
Typha latifolia	24-Jul	0	3	0	1
Typha angustifolia	24-Jul	4	0	35.5	13.16666667
Phragmites communis	24-Jul	0	14	0	4.666666667
Scirpus validus	24-Jul	0	10.5	7.5	6
Carex vesicaria	24-Jul	0	0	0	0
Lemna minor	24-Jul	0	0	0	0
Juncus effusus	24-Jul	0	0	3	1
Phalaris arundinacea	24-Jul	0.5	0	7.5	2.666666667
Amorpha fruticosa	24-Jul	59	17.5	13	29.83333333
Salix exigua	24-Jul	0	8	6.5	4.833333333
Bromus tectorum	26-Sep	0	0	0	0
Conyza sp.	26-Sep	0	0	7.5	2.5
Solidago occidentalis*	26-Sep	0	0	0.5	0.166666667
Equisetum laevigatum	26-Sep	7.5	0	7.5	5
Typha latifolia	26-Sep	0	18	0	6
Typha angustifolia	26-Sep	10.5	13	38	20.5
Phragmites communis	26-Sep	0	25	0	8.333333333
Scirpus validus	26-Sep	0	6	12.5	6.166666667
Carex vesicaria	26-Sep	0	0	0	0
Lemna minor	26-Sep	0	0	3	1
Juncus effusus	26-Sep	0	0	7.5	2.5
Phalaris arundinacea	26-Sep	0	0.5	12.5	4.333333333
Amorpha fruticosa	26-Sep	69.5	17	25	37.16666667
Salix exigua	26-Sep	0	10.5	16	8.833333333

Table C.10 Mean Percent Canopy Cover on Wetland Transects at Meadow Creek

Plant Species	Date	(A) Mean	(B) Mean	(C) Mean	(A,B,C) Mean
Asperugo procumbens	18-May	0.00	0.00	19.50	6.50
Cirsium arvense	18-May	0.00	0.00	3.00	1.00
Solidago canadensis	18-May	0.00	0.00	0.00	0.00
Conyza spp.	18-May	0.00	0.00	0.00	0.00
Xanthium strumarium	18-May	0.00	0.00	0.00	0.00
Phalaris arundinacea	18-May	85.50	57.00	59.00	67.17
Equisetum arvense	18-May	15.00	10.50	0.00	8.50
Typha latifolia	18-May	0.00	10.50	0.00	3.50
Typha angustifolia	18-May	3.00	0.00	0.00	1.00
Amorpha fruticosa	18-May	23.00	29.50	32.50	28.33
Asperugo procumbens	22-Jul	0.00	0.00	0.00	0.00
Cirsium arvense	22-Jul	0.00	0.00	3.00	1.00
Solidago canadensis	22-Jul	0.00	0.00	3.00	1.00
Conyza spp.	22-Jul	0.00	0.00	3.00	1.00
Xanthium strumarium	22-Jul	0.00	0.00	3.00	1.00
Phalaris arundinacea	22-Jul	70.50	75.50	78.00	74.67
Equisetum arvense	22-Jul	3.00	0.00	0.00	1.00
Typha latifolia	22-Jul	0.00	3.00	0.00	1.00
Typha angustifolia	22-Jul	0.50	3.00	0.00	1.17
Amorpha fruticosa	22-Jul	39.50	32.50	32.00	34.67
Asperugo procumbens	29-Sep	0.00	0.00	0.00	0.00
Cirsium arvense	29-Sep	0.00	0.00	0.50	0.17
Solidago canadensis	29-Sep	0.00	0.00	3.00	1.00
Conyza spp.	29-Sep	0.00	0.00	3.00	1.00
Xanthium strumarium	29-Sep	0.00	0.00	0.00	0.00
Phalaris arundinacea	29-Sep	90.00	95.00	75.50	86.83
Equisetum arvense	29-Sep	0.50	0.50	0.00	0.33
Typha latifolia	29-Sep	3.00	3.00	0.00	2.00
Typha angustifolia	29-Sep	1.00	0.50	0.00	0.50
Amorpha fruticosa	29-Sep	32.50	54.50	66.50	51.17

Table C.11 Mean Percent Canopy Cover on Wetland Transects at New York Gulch

Plant Species	Date	(A) Mean	(B) Mean	(C) Mean	(A,B,C) Mean
Agrostis stolonifera	17-May	0.50	0.00	0.00	0.17
Echinochloa crusgalli	17-May	0.00	0.00	0.00	0.00
Lemna minor	17-May	0.00	0.00	0.00	0.00
Rumex crispus	17-May	0.00	3.00	0.00	1.00
Cirsium arvense	17-May	3.00	0.00	0.00	1.00
Polygonum hydropiper	17-May	0.00	0.00	0.00	0.00
Polygonum persicaria	17-May	0.00	0.00	0.00	0.00
Solidago occidentalis*	17-May	3.00	0.00	0.00	1.00
Xanthium strumarium	17-May	0.00	0.00	0.00	0.00
Chenopodium album	17-May	0.00	0.50	0.00	0.17
Sisymbrium altissimum	17-May	0.00	0.00	0.00	0.00
Bidens frondosa	17-May	0.00	0.00	0.00	0.00
Veronica biloba	17-May	0.00	0.00	0.00	0.00
Typha latifolia	17-May	35.50	32.50	16.00	28.00
Scirpus validus	17-May	3.00	12.50	6.50	7.33
Equisetum laevigatum	17-May	0.00	0.50	0.00	0.17
Scirpus acutus	17-May	0.00	0.00	7.50	2.50
Amorpha fruticosa	17-May	24.50	15.50	0.00	13.33
Salix exigua	17-May	0.00	3.00	0.00	1.00
Agrostis stolonifera	27-Jul	0.00	0.00	0.00	0.00
Echinochloa crusgalli	27-Jul	0.00	0.00	1.00	0.33
Lemna minor	27-Jul	0.00	0.00	0.00	0.00
Rumex crispus	27-Jul	0.50	0.00	0.00	0.17
Cirsium arvense	27-Jul	0.00	0.00	0.00	0.00
Polygonum hydropiper	27-Jul	0.00	0.00	0.00	0.00
Polygonum persicaria	27-Jul	0.00	0.00	0.00	0.00
Solidago occidentalis*	27-Jul	0.00	0.00	0.00	0.00
Xanthium strumarium	27-Jul	0.00	0.50	1.00	0.50
Chenopodium album	27-Jul	0.00	0.00	0.00	0.00
Sisymbrium altissimum	27-Jul	0.00	0.00	0.00	0.00
Bidens frondosa	27-Jul	0.00	0.00	0.00	0.00
Veronica biloba	27-Jul	0.00	0.00	0.00	0.00
Equisetum laevigatum	27-Jul	0.00	0.00	0.00	0.00
Typha latifolia	27-Jul	56.00	46.50	0.00	34.17
Scirpus validus	27-Jul	0.00	17.00	0.50	5.83
Scirpus acutus	27-Jul	0.00	0.00	3.00	1.00
Amorpha fruticosa	27-Jul	22.50	19.50	0.00	14.00
Salix exigua	27-Jul	0.00	12.50	0.00	4.17
Agrostis stolonifera	27-Sep	0.00	0.00	0.00	0.00
Echinochloa crusgalli	27-Sep	0.00	0.00	5.00	1.67
Lemna minor	27-Sep	3.00	0.50	0.00	1.17
Rumex crispus	27-Sep	0.50	0.00	0.00	0.17
Cirsium arvense	27-Sep	0.00	0.00	0.00	0.00
Polygonum hydropiper	27-Sep	3.00	0.50	0.00	1.17
Polygonum persicaria	27-Sep	3.00	0.00	3.00	2.00

Solidago occidentalis*	27-Sep	0.00	0.00	0.00	0.00
Xanthium strumarium	27-Sep	0.00	3.00	6.00	3.00
Chenopodium album	27-Sep	0.00	0.00	0.00	0.00
Sisymbrium altissimum	27-Sep	0.00	0.00	0.50	0.17
Bidens frondosa	27-Sep	0.00	0.00	0.50	0.17
Veronica biloba	27-Sep	0.00	0.00	0.50	0.17
Typha latifolia	27-Sep	52.00	46.50	0.00	32.83
Scirpus validus	27-Sep	0.00	3.50	3.00	2.17
Equisetum laevigatum	27-Sep	7.50	3.00	7.50	6.00
Scirpus acutus	27-Sep	0.00	0.00	3.00	1.00
Amorpha fruticosa	27-Sep	27.00	20.00	0.00	15.67
Salix exigua	27-Sep	0.00	7.50	0.00	2.50

Table C.12 Mean Percent Canopy Cover on Wetland Transects at Penawawa

Plant Species	Date	(A) Mean	(B) Mean	(C) Mean	(A,B,C) Mean
Agrostis stolonifera	18-May	12.50	0.50	3.00	5.33
Festuca rubra	18-May	10.50	0.00	0.00	3.50
Bromus tectorum	18-May	12.50	0.00	0.00	4.17
Hordeum glauca	18-May	0.50	0.00	0.00	0.17
Poa bulbosa	18-May	0.50	0.00	0.00	0.17
Echinochloa crusgalli	18-May	0.00	0.00	0.00	0.00
Bidens frondosa	18-May	6.00	0.50	0.50	2.33
Skunk weed	18-May	0.50	0.00	0.00	0.17
Dipsacus sylvestris	18-May	3.00	0.00	3.00	2.00
Xanthium strumarium	18-May	0.00	0.00	0.00	0.00
Rumex crispus	18-May	0.00	0.00	3.00	1.00
Draba verna	18-May	0.50	0.00	0.00	0.17
Melilotus alba	18-May	0.50	0.00	0.00	0.17
Lactuca serriola	18-May	0.50	0.00	0.00	0.17
Hypericum perforatum	18-May	0.00	0.00	0.00	0.00
Polygonum lapathifolium	18-May	0.00	0.50	0.00	0.17
Ranunculus sceleratus	18-May	0.00	3.00	0.50	1.17
Chenopodium album	18-May	0.00	7.50	3.00	3.50
Veronica americana	18-May	0.00	0.00	0.50	0.17
Polygonum hydropiper	18-May	0.00	0.00	0.00	0.00
Phalaris arundinacea	18-May	13.50	32.00	20.50	22.00
Carex spp.	18-May	3.00	6.00	0.00	3.00
Scirpus microcarpus	18-May	0.00	0.00	0.00	0.00
Typha latifolia	18-May	0.00	0.00	0.00	0.00
Typha angustifolia	18-May	0.00	0.00	6.00	2.00
Cyperis strigosus	18-May	0.00	0.00	7.50	2.50
Salix lasiandra	18-May	53.50	17.00	39.50	36.67
Acer saccharum	18-May	0.00	0.00	0.00	0.00
Agrostis stolonifera	22-Jul	0.00	7.50	0.50	2.67
Festuca rubra	22-Jul	15.00	0.50	0.00	5.17
Bromus tectorum	22-Jul	3.00	0.00	0.00	1.00
Hordeum glauca	22-Jul	0.50	0.00	0.00	0.17
Poa bulbosa	22-Jul	0.00	0.00	0.00	0.00
Echinochloa crusgalli	22-Jul	0.00	0.00	0.00	0.00
Bidens frondosa	22-Jul	3.00	1.00	0.50	1.50
Skunk weed	22-Jul	0.00	0.00	0.00	0.00
Dipsacus sylvestris	22-Jul	0.00	0.00	3.00	1.00
Xanthium strumarium	22-Jul	3.50	0.50	0.00	1.33
Rumex crispus	22-Jul	0.00	0.00	0.00	0.00
Draba verna	22-Jul	0.00	0.00	0.00	0.00
Melilotus alba	22-Jul	0.00	0.00	0.00	0.00
Lactuca serriola	22-Jul	0.00	0.00	0.00	0.00
Hypericum perforatum	22-Jul	0.50	0.00	0.00	0.17
Polygonum lapathifolium	22-Jul	0.00	0.00	0.00	0.00
Ranunculus sceleratus	22-Jul	0.00	0.00	0.00	0.00

Chenopodium album	22-Jul	0.00	7.50	0.50	2.67
Veronica americana	22-Jul	0.00	0.00	0.00	0.00
Polygonum hydropiper	22-Jul	0.00	0.00	0.50	0.17
Phalaris arundinacea	22-Jul	30.00	24.00	49.50	34.50
Carex spp.	22-Jul	0.00	0.00	0.00	0.00
Scirpus microcarpus	22-Jul	0.00	7.50	0.00	2.50
Typha latifolia	22-Jul	0.00	0.50	0.00	0.17
Typha angustifolia	22-Jul	0.00	0.00	6.00	2.00
Cyperis strigosus	22-Jul	0.00	0.00	3.00	1.00
Salix lasiandra	22-Jul	0.50	3.00	24.50	9.33
Acer saccharum	22-Jul	0.00	0.00	0.00	0.00
Agrostis stolonifera	29-Sep	0.00	7.50	0.00	2.50
Festuca rubra	29-Sep	3.00	0.00	0.00	1.00
Bromus tectorum	29-Sep	12.50	0.00	0.00	4.17
Hordeum glauca	29-Sep	0.00	0.00	0.00	0.00
Poa bulbosa	29-Sep	0.00	0.00	0.00	0.00
Echinochloa crusgalli	29-Sep	0.00	0.00	0.50	0.17
Bidens frondosa	29-Sep	9.50	0.50	3.00	4.33
Skunk weed	29-Sep	0.00	0.00	0.00	0.00
Dipsacus sylvestris	29-Sep	3.00	0.00	0.00	1.00
Xanthium strumarium	29-Sep	0.00	0.00	0.00	0.00
Rumex crispus	29-Sep	0.50	0.00	0.00	0.17
Draba verna	29-Sep	0.00	0.00	0.00	0.00
Melilotus alba	29-Sep	0.00	0.00	0.00	0.00
Lactuca serriola	29-Sep	0.00	0.00	0.00	0.00
Hypericum perforatum	29-Sep	0.00	0.00	0.00	0.00
Polygonum lapathifolium	29-Sep	0.00	6.00	8.00	4.67
Ranunculus sceleratus	29-Sep	0.00	0.00	0.00	0.00
Chenopodium album	29-Sep	0.00	3.00	0.00	1.00
Veronica americana	29-Sep	0.00	0.00	0.00	0.00
Polygonum hydropiper	29-Sep	0.00	0.00	3.00	1.00
Phalaris arundinacea	29-Sep	40.00	40.50	67.00	49.17
Carex spp.	29-Sep	0.00	0.00	0.00	0.00
Scirpus microcarpus	29-Sep	0.00	3.00	0.00	1.00
Typha latifolia	29-Sep	0.00	0.00	0.00	0.00
Typha angustifolia	29-Sep	0.00	0.00	3.50	1.17
Cyperis strigosus	29-Sep	0.00	0.00	3.00	1.00
Salix lasiandra	29-Sep	32.50	18.50	27.50	26.17
Acer saccharum	29-Sep	0.00	19.50	0.00	6.50

Table C.13 Mean Percent Canopy Cover on Wetland Transects at Ridpath

Plant Species	Date	(A)Mean	(B)Mean	(C)Mean	(A,B,C) Mean
Echinocloa crusgalli	17-May	0.00	0.00	0.00	0.00
Xanthium strumarium	17-May	0.00	0.00	0.00	0.00
Anthriscus scandicina	17-May	0.50	0.00	0.00	0.17
Mentha spp.	17-May	0.00	0.50	0.00	0.17
Verbascum thapsis	17-May	0.00	7.50	0.00	2.50
Galium spp.	17-May	0.00	3.00	0.00	1.00
Solidago occidentalis*	17-May	0.00	0.00	0.00	0.00
Rhus radicans	17-May	0.00	0.00	0.00	0.00
Scirpus validus	17-May	0.00	0.00	0.50	0.17
Phalaris arundinacea	17-May	3.00	0.00	0.00	1.00
Typha angustifolia	17-May	0.00	0.00	0.00	0.00
Equisetum arvense	17-May	0.00	0.00	0.00	0.00
Carex vulpinoidea	17-May	0.00	7.50	0.00	2.50
Salix exigua	17-May	49.50	27.50	38.50	38.50
Salix amygdaloides*	17-May	0.00	7.50	0.00	2.50
Amorpha fruticosa	17-May	15.50	27.50	0.00	14.33
Rubus discolor	17-May	12.50	0.00	0.00	4.17
Echinocloa crusgalli	24-Jul	0.00	0.00	0.50	0.17
Xanthium strumarium	27-Jul	3.00	0.00	8.50	3.83
Anthriscus scandicina	27-Jul	0.00	0.00	0.00	0.00
Mentha spp.	27-Jul	0.00	3.00	0.00	1.00
Verbascum thapsis	27-Jul	0.00	3.00	0.00	1.00
Galium spp.	27-Jul	0.00	0.00	0.00	0.00
Solidago occidentalis*	27-Jul	0.00	0.50	0.00	0.17
Rhus radicans	27-Jul	0.00	0.00	0.50	0.17
Scirpus validus	27-Jul	0.00	0.00	0.00	0.00
Phalaris arundinacea	27-Jul	7.50	0.00	0.00	2.50
Typha angustifolia	27-Jul	0.00	0.50	0.00	0.17
Equisetum arvense	27-Jul	0.00	7.50	0.00	2.50
Carex vulpinoidea	27-Jul	0.00	3.00	0.00	1.00
Salix exigua	27-Jul	47.00	48.00	24.00	39.67
Salix amygdaloides*	27-Jul	0.00	10.50	3.50	4.67
Amorpha fruticosa	27-Jul	36.50	42.00	0.50	26.33
Rubus discolor	27-Jul	17.00	0.00	0.00	5.67
Echinocloa crusgalli	27-Sep	0.00	3.00	3.00	2.00
Xanthium strumarium	27-Sep	7.50	0.00	17.00	8.17
Anthriscus scandicina	27-Sep	0.00	0.00	0.00	0.00
Mentha spp.	27-Sep	0.00	0.00	0.00	0.00
Verbascum thapsis	27-Sep	0.00	3.00	0.00	1.00
Galium spp.	27-Sep	0.00	0.00	0.00	0.00
Solidago occidentalis*	27-Sep	0.00	0.00	0.00	0.00
Rhus radicans	27-Sep	0.00	0.00	0.50	0.17
Scirpus validus	27-Sep	3.00	7.50	3.00	4.50
Phalaris arundinacea	27-Sep	7.50	0.00	0.00	2.50
Typha angustifolia	27-Sep	0.00	0.50	0.00	0.17

Equisetum arvense	27-Sep	0.00	0.00	0.00	0.00
Carex vulpinoidea	27-Sep	0.00	0.00	0.00	0.00
Salix exigua	27-Sep	27.50	45.00	33.50	35.33
Salix amygdaloides*	27-Sep	20.00	6.00	0.00	8.67
Amorpha fruticosa	27-Sep	24.50	42.00	0.00	22.17
Rubus discolor	27-Sep	12.50	0.00	0.00	4.17

Table C.14 Mean Percent Canopy Cover on Wetland Transects at Riparia

Plant Species	Date	(A) Mean	(B) Mean	(C) Mean	(A,B,C) Mean
Agrostis stolonifera	16-May	0.00	3.00	3.00	2.00
Sporobolis cryptandrus	16-May	0.00	0.00	0.00	0.00
Echinocloa crusgalli	16-May	0.00	0.00	0.00	0.00
Rumex crispus	16-May	0.50	1.00	0.50	0.67
Polygonum persicaria	16-May	0.00	0.00	0.00	0.00
Xanthium strumarium	16-May	0.00	0.00	0.00	0.00
Bidens cernua	16-May	0.00	0.00	0.00	0.00
Polygonum hydropiper	16-May	0.00	0.00	0.00	0.00
Solidago canadensis	16-May	0.00	3.00	0.00	1.00
Cirsium arvense	16-May	0.00	0.00	0.00	0.00
Phalaris arundinacea	16-May	3.50	0.50	0.00	1.33
Scirpus validus	16-May	3.50	0.00	0.00	1.17
Juncus spp.	16-May	0.50	0.00	0.00	0.17
Typha latifolia	16-May	11.00	4.00	14.00	9.67
Typha angustifolia	16-May	3.00	0.50	0.00	1.17
Cyperus strigosus	16-May	0.00	0.00	0.00	0.00
Amorpha fruticosa	16-May	34.00	18.50	24.50	25.67
Salix exigua	16-May	3.50	12.50	8.00	8.00
Acer saccharum	16-May	0.00	0.00	0.00	0.00
Agrostis stolonifera	26-Jul	0.50	0.50	0.00	0.33
Sporobolis cryptandrus	26-Jul	0.00	0.00	0.00	0.00
Echinocloa crusgalli	26-Jul	0.00	0.00	0.00	0.00
Rumex crispus	26-Jul	0.00	0.00	1.00	0.33
Polygonum persicaria	26-Jul	0.00	0.00	0.00	0.00
Xanthium strumarium	26-Jul	0.00	0.00	0.00	0.00
Bidens cernua	26-Jul	0.00	0.00	0.00	0.00
Polygonum hydropiper	26-Jul	0.00	0.00	0.00	0.00
Solidago canadensis	26-Jul	0.00	0.00	0.00	0.00
Cirsium arvense	26-Jul	0.00	0.00	0.00	0.00
Phalaris arundinacea	26-Jul	10.50	7.50	0.00	6.00
Scirpus validus	26-Jul	0.00	0.00	0.00	0.00
Juncus spp.	26-Jul	0.00	0.00	0.00	0.00
Typha latifolia	26-Jul	20.00	23.00	18.00	20.33
Typha angustifolia	26-Jul	0.00	0.00	0.00	0.00
Cyperus strigosus	26-Jul	0.00	0.00	0.00	0.00
Amorpha fruticosa	26-Jul	37.00	37.50	22.50	32.33
Salix exigua	26-Jul	3.00	12.50	8.00	7.83
Acer saccharum	26-Jul	0.00	0.00	0.50	0.17
Agrostis stolonifera	26-Sep	0.00	3.00	0.00	1.00
Sporobolis cryptandrus	26-Sep	12.50	0.00	0.00	4.17
Echinocloa crusgalli	26-Sep	0.00	3.00	6.00	3.00
Rumex crispus	26-Sep	0.00	3.00	0.00	1.00
Polygonum persicaria	26-Sep	20.00	7.50	10.50	12.67
Xanthium strumarium	26-Sep	7.50	0.00	0.00	2.50
Bidens cernua	26-Sep	3.00	0.00	0.00	1.00

Polygonum hydropiper	26-Sep	7.50	17.00	0.00	8.17
Solidago canadensis	26-Sep	0.00	0.00	3.00	1.00
Cirsium arvense	26-Sep	0.00	0.00	3.00	1.00
Phalaris arundinacea	26-Sep	15.50	17.00	0.00	10.83
Scirpus validus	26-Sep	0.00	0.00	0.00	0.00
Juncus spp.	26-Sep	0.00	0.00	0.00	0.00
Typha latifolia	26-Sep	37.50	28.00	37.50	34.33
Typha angustifolia	26-Sep	0.00	0.00	0.00	0.00
Cyperus strigosus	26-Sep	0.00	12.50	0.00	4.17
Amorpha fruticosa	26-Sep	49.00	51.00	39.50	46.50
Salix exigua	26-Sep	15.50	17.00	34.00	22.17
Acer saccharum	26-Sep	0.00	0.00	3.00	1.00

Table C.15 Mean Percent Canopy Cover on Wetland Transects at Schultz

Plant Species	Date	(A) Mean	(B) Mean	(C) Mean	(A,B,C) Mean
Echinochloa crusgalli	21-May	0.00	0.00	0.00	0.00
Festuca arundinacea	21-May	0.00	0.00	3.00	1.00
Bromus tectorum	21-May	0.00	0.00	0.00	0.00
Xanthim strumarium	21-May	0.00	0.00	0.00	0.00
Helianthus annuus	21-May	0.00	0.00	0.00	0.00
Epilobium sp.	21-May	0.00	0.00	0.00	0.00
Rumex crispus	21-May	0.00	0.00	0.00	0.00
Lotus corniculatus	21-May	0.00	0.00	0.00	0.00
Solidago occidentalis*	21-May	0.00	0.00	7.50	2.50
Lactuca serriola	21-May	0.00	0.00	0.50	0.17
Typha angustifolia	21-May	0.00	0.00	0.00	0.00
Typha latifolia	21-May	10.50	3.50	4.00	6.00
Phalaris arundinacea	21-May	1.00	10.50	3.00	4.83
Equisetum arvense	21-May	0.00	0.00	0.00	0.00
Phragmites communis	21-May	0.00	3.00	0.00	1.00
Scirpus validus	21-May	0.50	0.00	0.00	0.17
Carex sp.	21-May	0.00	0.00	3.00	1.00
Juncus sp.	21-May	0.00	0.00	0.00	0.00
Equisetum laevigatum	21-May	0.00	0.00	3.00	1.00
Salix exigua	21-May	15.50	9.00	18.00	14.17
Salix amygdaloides*	21-May	0.00	3.00	17.00	6.67
Populus balsamifera	21-May	3.00	0.00	7.50	3.50
Echinochloa crusgalli	25-Jul	0.00	0.00	0.00	0.00
Festuca arundinacea	25-Jul	0.50	0.00	0.50	0.33
Bromus tectorum	25-Jul	0.00	0.50	0.00	0.17
Xanthim strumarium	25-Jul	0.00	3.50	13.00	5.50
Helianthus annuus	25-Jul	0.00	0.00	0.00	0.00
Epilobium sp.	25-Jul	0.00	0.50	0.00	0.17
Rumex crispus	25-Jul	0.00	0.50	0.00	0.17
Lotus corniculatus	25-Jul	0.00	0.50	0.00	0.17
Solidago occidentalis*	25-Jul	0.00	0.00	7.50	2.50
Lactuca serriola	25-Jul	0.00	0.00	0.00	0.00
Typha angustifolia	25-Jul	0.50	0.00	0.00	0.17
Typha latifolia	25-Jul	0.00	0.00	0.00	0.00
Phalaris arundinacea	25-Jul	42.00	15.50	20.00	25.83
Equisetum arvense	25-Jul	12.50	15.50	16.50	14.83
Phragmites communis	25-Jul	0.00	0.00	3.00	1.00
Scirpus validus	25-Jul	0.00	0.50	3.00	1.17
Carex sp.	25-Jul	0.00	0.50	0.00	0.17
Juncus sp.	25-Jul	0.00	0.50	0.00	0.17
Equisetum laevigatum	25-Jul	0.00	0.00	3.00	1.00
Salix exigua	25-Jul	37.00	12.50	17.00	22.17
Salix amygdaloides*	25-Jul	3.00	0.00	17.50	6.83
Populus balsamifera	25-Jul	0.00	0.00	0.00	0.00
Echinochloa crusgalli	28-Sep	0.50	0.50	0.00	0.33

Festuca arundinacea	28-Sep	0.00	0.00	0.50	0.17
Bromus tectorum	28-Sep	0.00	0.00	0.00	0.00
Xanthim strumarium	28-Sep	3.00	3.00	0.00	2.00
Helianthus annuus	28-Sep	3.00	0.00	0.00	1.00
Epilobium sp.	28-Sep	0.00	0.00	0.00	0.00
Rumex crispus	28-Sep	0.00	0.00	0.00	0.00
Lotus corniculatus	28-Sep	0.00	0.00	0.00	0.00
Solidago occidentalis*	28-Sep	0.00	0.00	3.00	1.00
Lactuca serriola	28-Sep	0.00	0.00	0.00	0.00
Typha angustifolia	28-Sep	0.00	0.00	0.00	0.00
Typha latifolia	28-Sep	0.00	0.50	6.00	2.17
Phalaris arundinacea	28-Sep	46.50	20.00	0.00	22.17
Equisetum arvense	28-Sep	0.00	0.00	0.00	0.00
Phragmites communis	28-Sep	3.00	3.00	0.00	2.00
Scirpus validus	28-Sep	0.00	0.00	0.00	0.00
Carex sp.	28-Sep	0.00	0.00	0.00	0.00
Juncus sp.	28-Sep	0.00	0.00	0.00	0.00
Equisetum laevigatum	28-Sep	0.00	0.00	0.50	0.17
Salix exigua	28-Sep	25.50	21.50	14.00	20.33
Salix amygdaloides*	28-Sep	0.00	0.00	7.50	2.50
Populus balsamifera	28-Sep	0.00	0.00	0.00	0.00

Table C.16 Mean Percent Canopy Cover on Wetland Transects at Skookum

Plant Species	Date	(A) Mean	(B) Mean	(A,B) Mean
Sporobolis cryptandrus	16-May	0.00	0.00	0
Bromus tectorum	16-May	0.50	0.00	0.25
Bidens cernua	16-May	0.00	0.00	0
Solidago occidentalis*	16-May	0.50	0.00	0.25
Galium spp.	16-May	7.50	0.00	3.75
Rumex crispus	16-May	0.00	0.00	0
Dipsacus sylvestris	16-May	0.50	0.00	0.25
Polygonum lapathifolium	16-May	0.00	0.00	0
Solidago canadensis	16-May	0.00	24.50	12.25
Scirpus validus	16-May	6.00	23.00	14.5
Typha latifolia	16-May	3.50	0.00	1.75
Phalaris arundinacea	16-May	0.50	0.00	0.25
Equisetum laevigatum	16-May	1.00	0.50	0.75
Typha angustifolia	16-May	0.00	3.50	1.75
Phragmites communis	16-May	0.00	12.50	6.25
Carex vesicaria	16-May	0.00	3.50	1.75
Amorpha fruticosa	16-May	11.00	13.50	12.25
Salix exigua	16-May	13.50	18.50	16
Rubus discolor	16-May	12.50	0.00	6.25
Alnus rhomhifolia	16-May	0.50	0.00	0.25
Sporobolis cryptandrus	27-Jul	0.00	0.00	0
Bromus tectorum	27-Jul	0.00	0.00	0
Bidens cernua	27-Jul	3.50	0.00	1.75
Solidago occidentalis*	27-Jul	6.00	0.00	3
Galium spp.	27-Jul	0.00	0.00	0
Rumex crispus	27-Jul	1.00	0.00	0.5
Dipsacus sylvestris	27-Jul	0.00	0.00	0
Polygonum lapathifolium	27-Jul	7.50	0.00	3.75
Solidago canadensis	27-Jul	0.00	15.50	7.75
Scirpus validus	27-Jul	8.00	44.00	26
Typha latifolia	27-Jul	1.00	0.00	0.5
Phalaris arundinacea	27-Jul	8.00	0.00	4
Equisetum laevigatum	27-Jul	6.00	0.50	3.25
Typha angustifolia	27-Jul	0.00	0.50	0.25
Phragmites communis	27-Jul	0.00	17.00	8.5
Carex vesicaria	27-Jul	0.00	0.50	0.25
Amorpha fruticosa	27-Jul	13.50	27.50	20.5
Salix exigua	27-Jul	12.00	21.00	16.5
Rubus discolor	27-Jul	3.00	0.00	1.5
Alnus rhombifolia	27-Jul	7.50	0.00	3.75
Sporobolis cryptandrus	27-Sep	0.50	0.50	0.5
Bromus tectorum	27-Sep	0.00	0.00	0
Bidens cernua	27-Sep	3.00	0.00	1.5
Solidago occidentalis*	27-Sep	7.50	0.00	3.75
Galium spp.	27-Sep	0.00	0.00	0

Rumex crispus	27-Sep	0.50	0.00	0.25
Dipsacus sylvestris	27-Sep	0.00	0.00	0
Polygonum lapathifolium	27-Sep	7.50	0.00	3.75
Solidago canadensis	27-Sep	0.00	10.50	5.25
Scirpus validus	27-Sep	20.00	35.00	27.5
Typha latifolia	27-Sep	3.00	0.00	1.5
Phalaris arundinacea	27-Sep	20.00	0.00	10
Equisetum laevigatum	27-Sep	10.50	1.00	5.75
Typha angustifolia	27-Sep	0.00	0.50	0.25
Phragmites communis	27-Sep	0.00	12.50	6.25
Carex vesicaria	27-Sep	0.00	0.00	0
Amorpha fruticosa	27-Sep	18.50	15.00	16.75
Salix exigua	27-Sep	15.00	24.50	19.75
Rubus discolor	27-Sep	12.50	0.00	6.25
Alnus rhombifolia	27-Sep	12.50	0.00	6.25

Table C.17 Mean Percent Canopy Cover on Wetland Transects at Tucannon

Plant Species	Date	(A) Mean	(B) Mean	(C) Mean	(A,B,C) Mean
Echinochloa crusgalli	19-May	0.00	0.00	0.00	0.00
Polygonum sp.	19-May	0.00	0.00	0.50	0.17
Cirsium arvense	19-May	0.00	0.00	0.50	0.17
Impatiens noli-tangere	19-May	0.00	0.00	0.50	0.17
Typha latifolia	19-May	12.00	26.00	13.00	17.00
Phalaris arundinacea	19-May	59.00	63.50	71.50	64.67
Salix amygdaloides*	19-May	0.50	0.00	0.00	0.17
Salix exigua	19-May	3.00	7.50	3.00	4.50
Echinochloa crusgalli	23-Jul	0.00	0.00	0.00	0.00
Polygonum sp.	23-Jul	0.00	0.00	0.00	0.00
Cirsium arvense	23-Jul	0.00	0.00	0.00	0.00
Impatiens noli-tangere	23-Jul	0.00	0.00	0.50	0.17
Typha latifolia	23-Jul	10.50	43.00	13.50	22.33
Phalaris arundinacea	23-Jul	75.50	63.50	78.50	72.50
Salix amygdaloides*	23-Jul	0.00	0.00	0.00	0.00
Salix exigua	23-Jul	12.50	7.50	11.00	10.33
Echinochloa crusgalli	29-Sep	0.50	0.00	0.00	0.17
Polygonum sp.	29-Sep	0.00	0.00	0.00	0.00
Cirsium arvense	29-Sep	0.00	0.00	0.00	0.00
Impatiens noli-tangere	29-Sep	0.00	0.00	0.50	0.17
Typha latifolia	29-Sep	6.50	31.00	18.00	18.50
Phalaris arundinacea	29-Sep	75.50	68.50	69.00	71.00
Salix amygdaloides*	29-Sep	0.00	0.00	0.00	0.00
Salix exigua	29-Sep	7.50	7.50	11.00	8.67

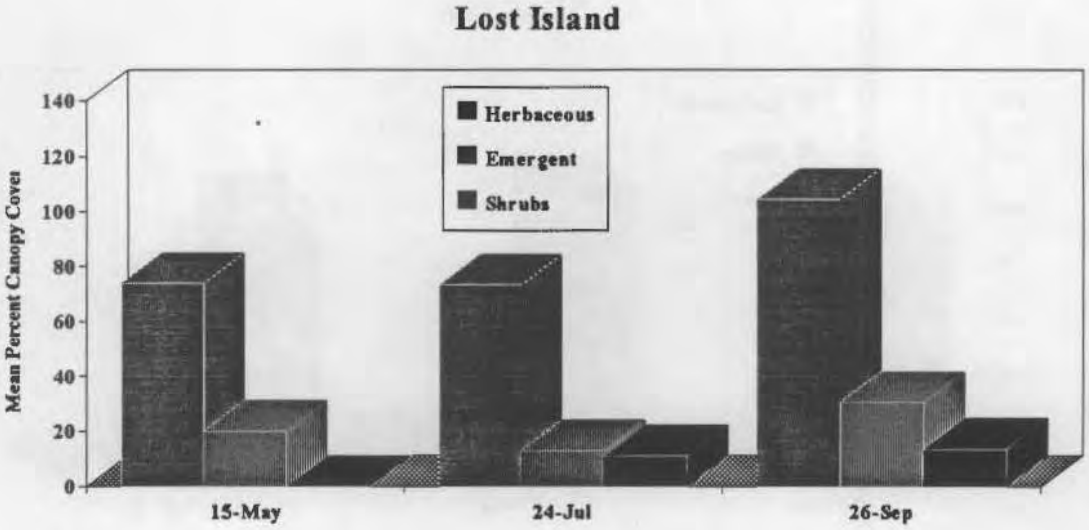


Figure C.1 Canopy Cover Measured Along Dryland Transects at Lost Island

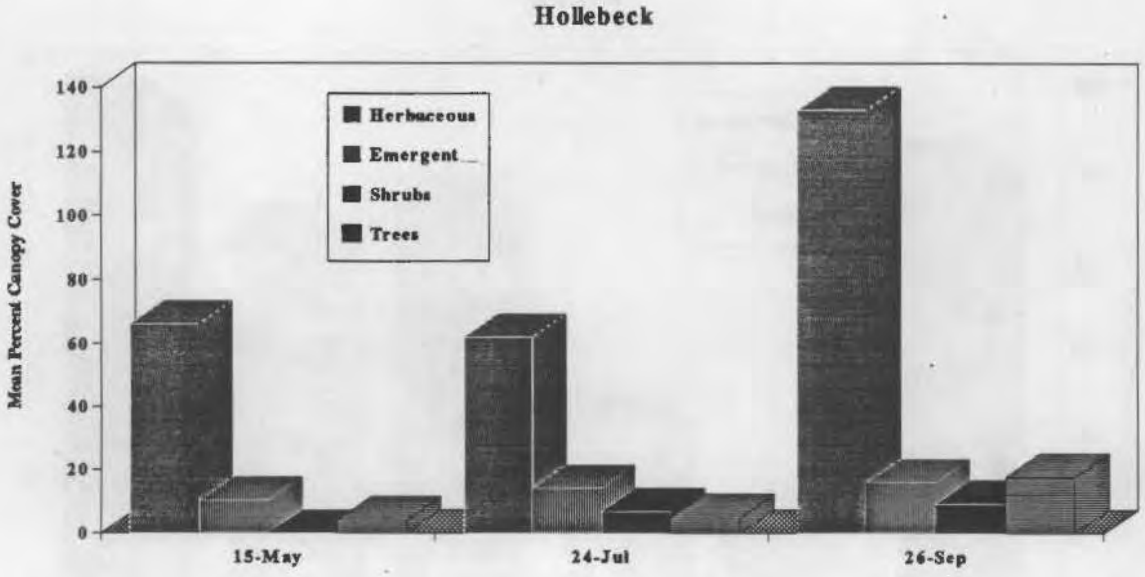


Figure C.2 Canopy Cover Measured Along Dryland Transects at Hollebeck

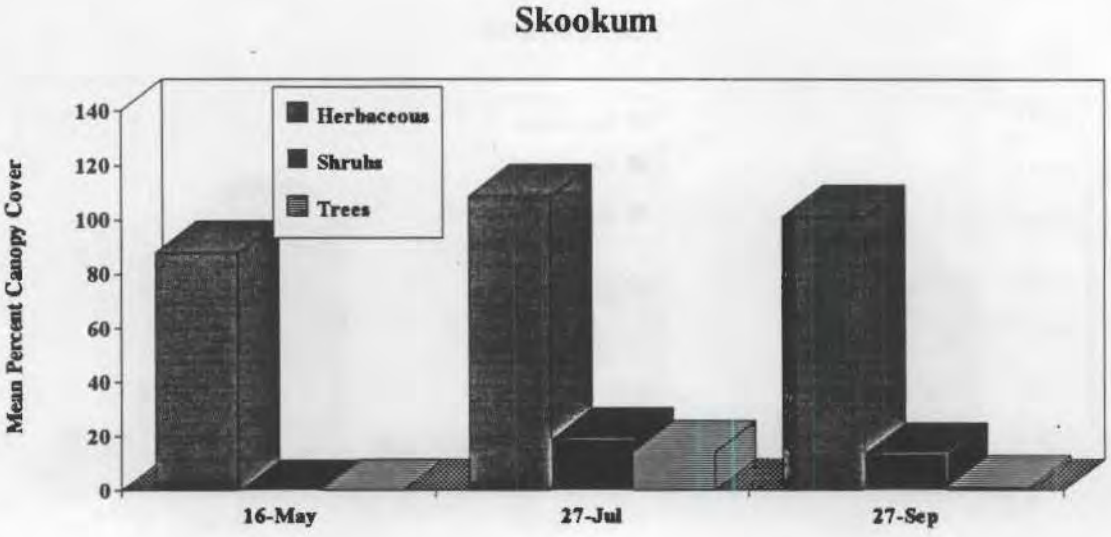


Figure C.3 Canopy Cover Measured Along Dryland Transects at Skookum

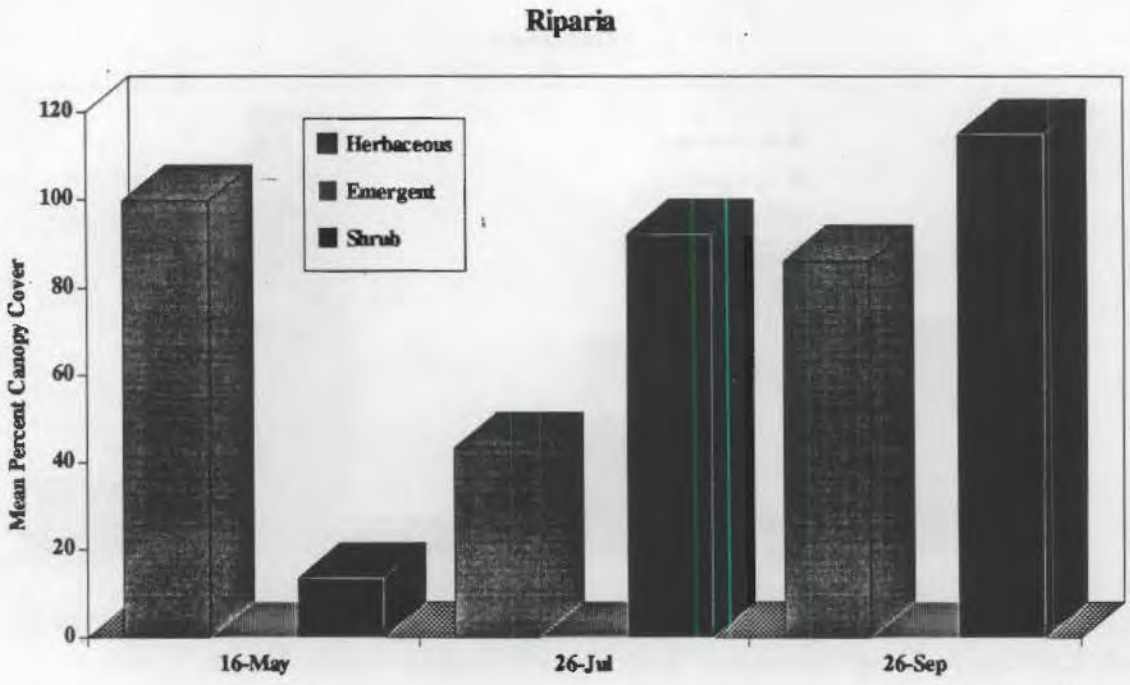


Figure C.4 Canopy Cover Measured Along Dryland Transects at Riparia

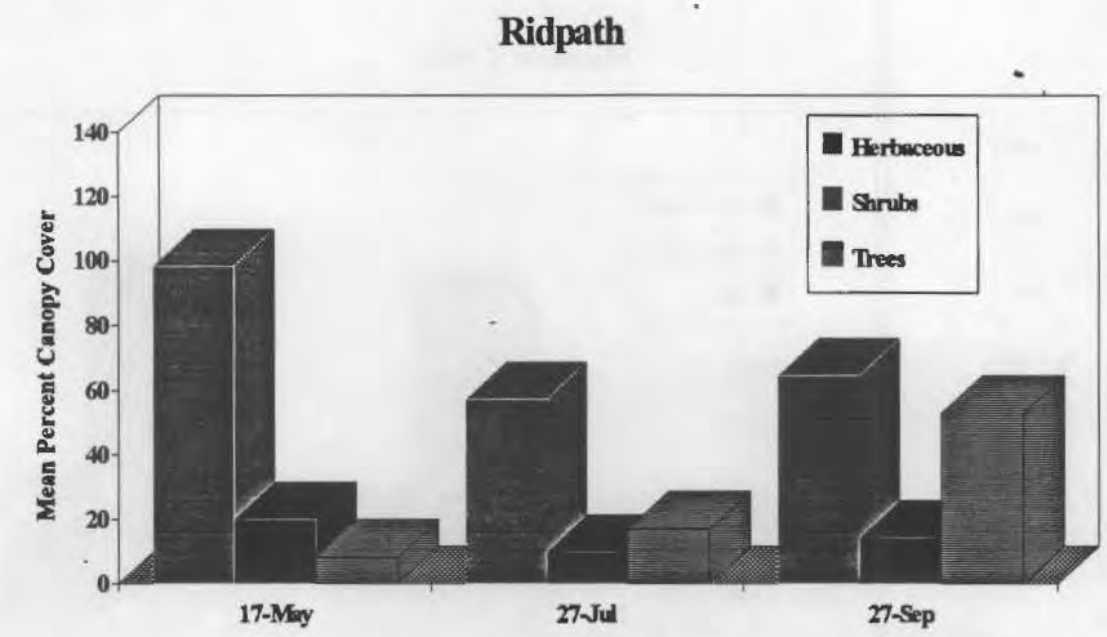


Figure C.5 Canopy Cover Measured Along Dryland Transects at Ridpath

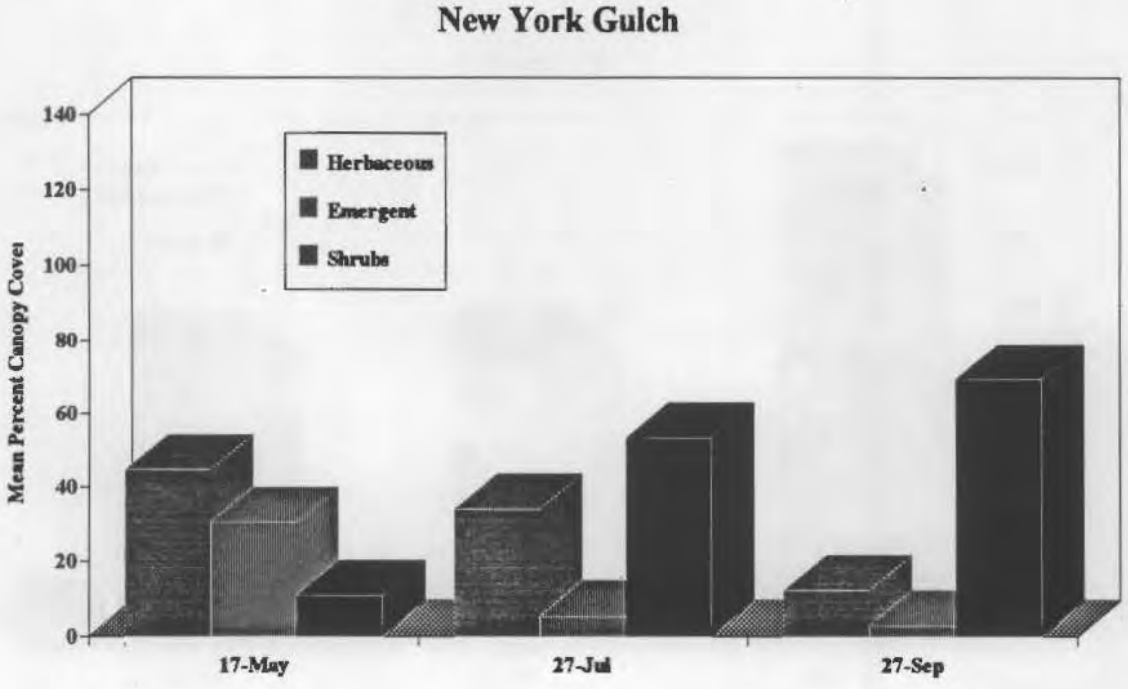


Figure C.6 Canopy Cover Measured Along Dryland Transects at New York Gulch

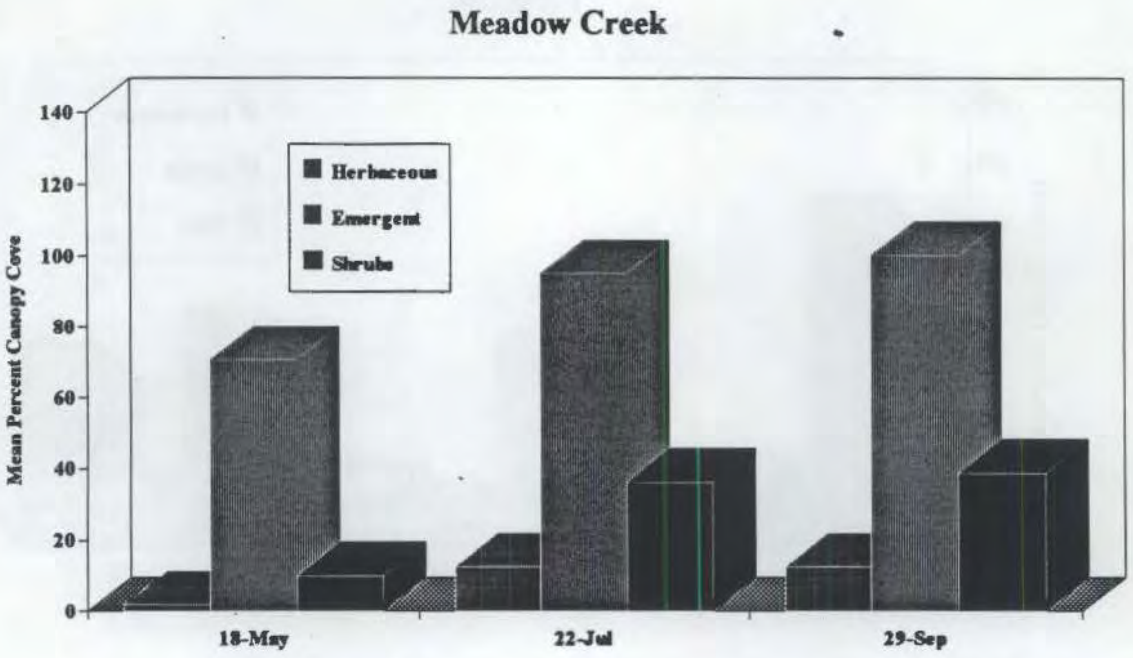


Figure C.7 Canopy Cover Along Dryland Transects at Meadow Creek

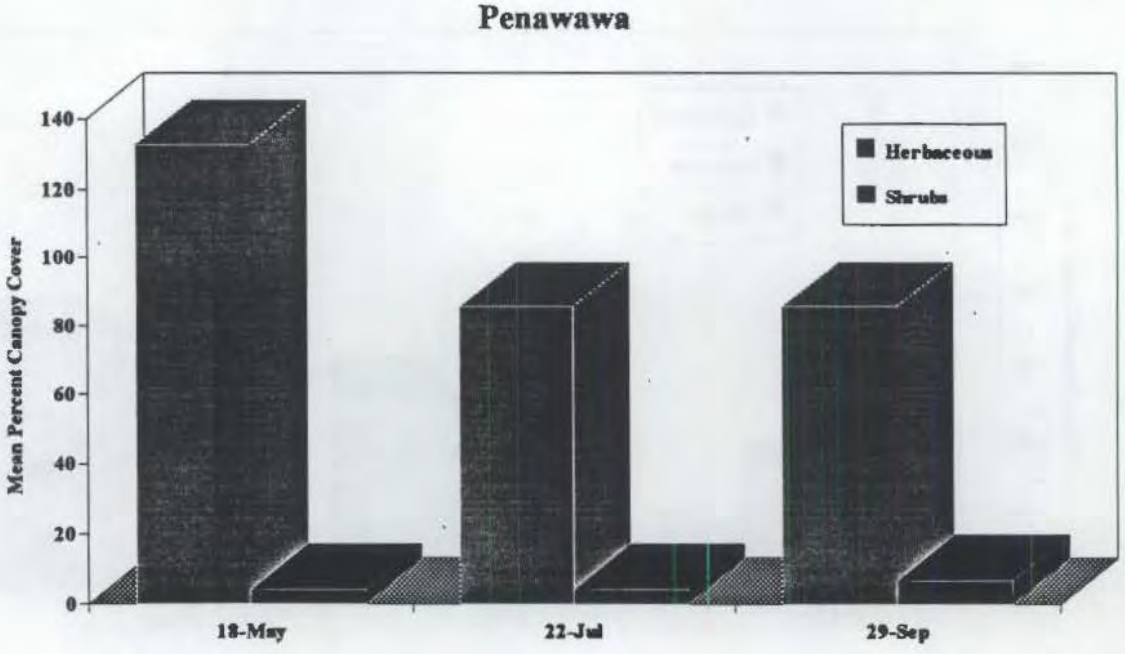


Figure C.8 Canopy Cover Measured Along Dryland Transects at Penawawa

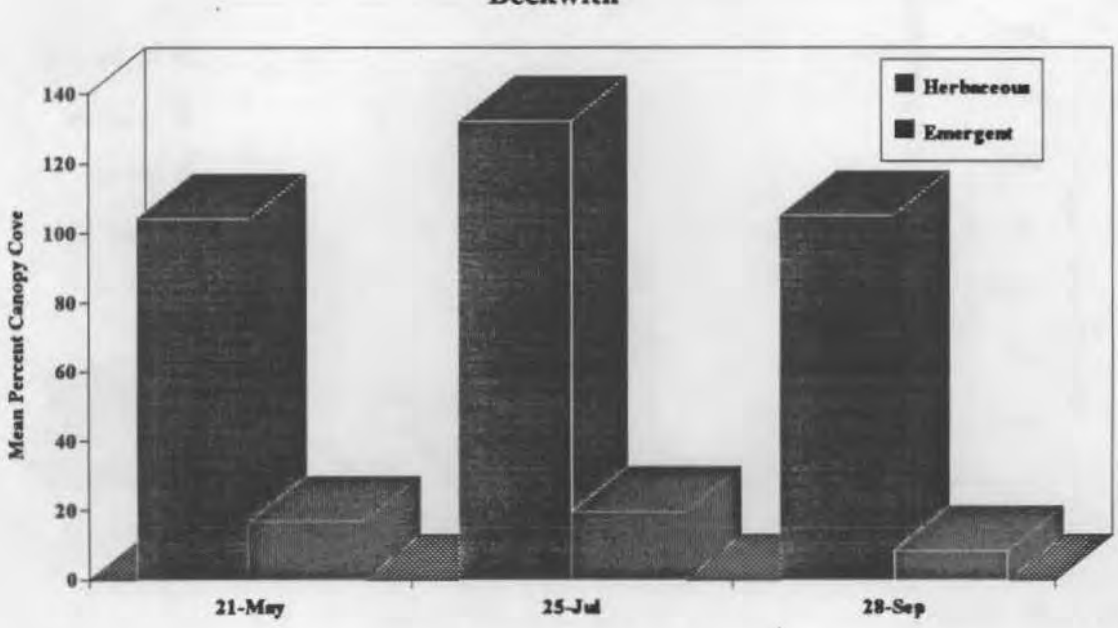


Figure C.9 Canopy Cover Measured Along Dryland Transects at Beckwith

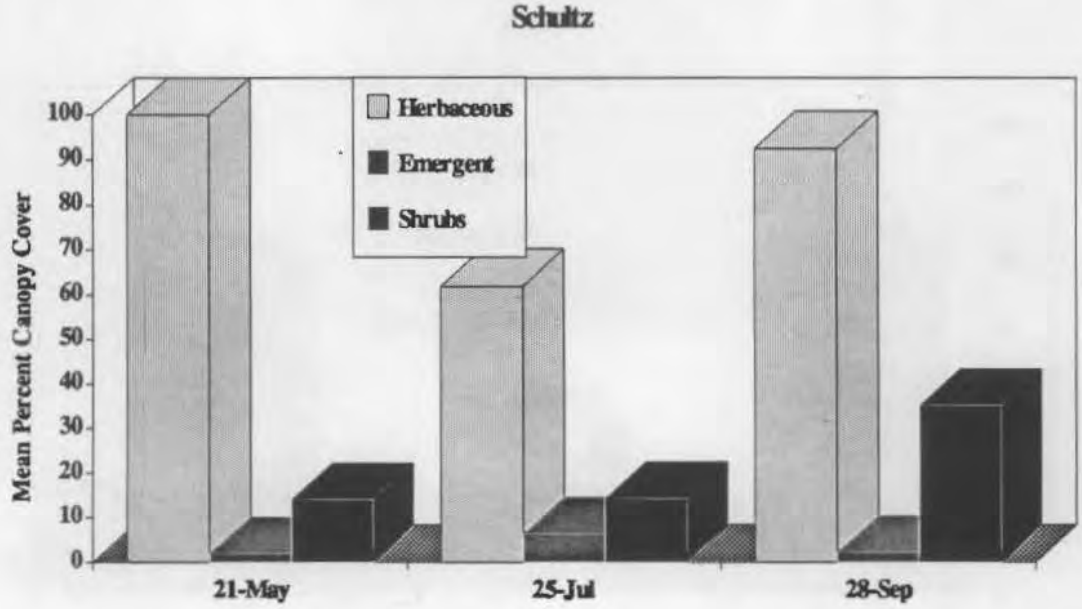


Figure C.10 Canopy Cover Measured Along Dryland Transects at Schultz Bar

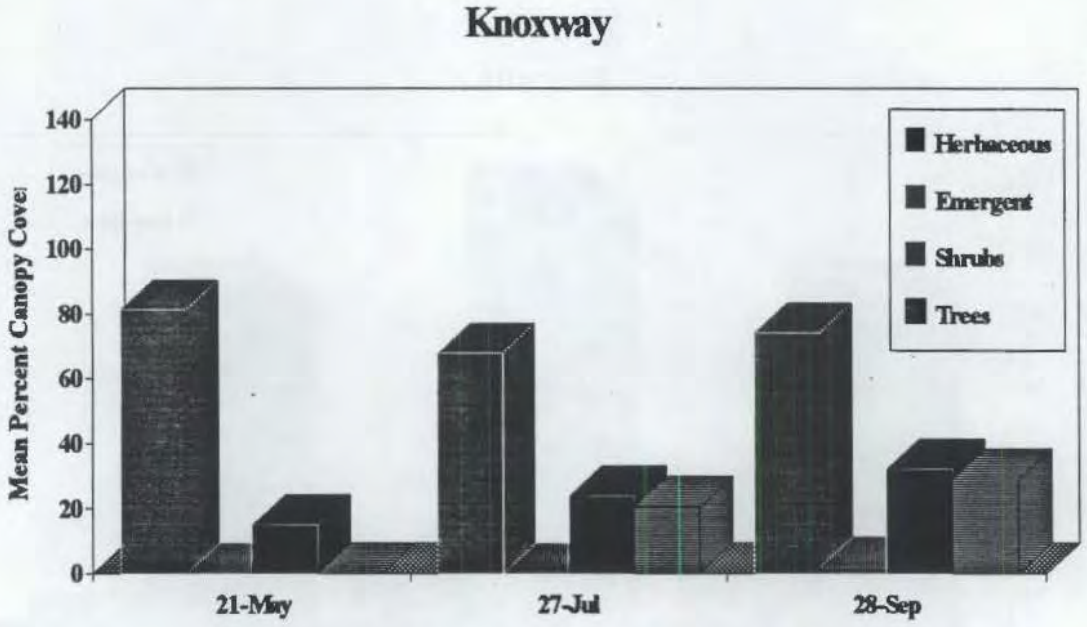


Figure C.11 Canopy Cover Measured Along Dryland Transects at Knoxway

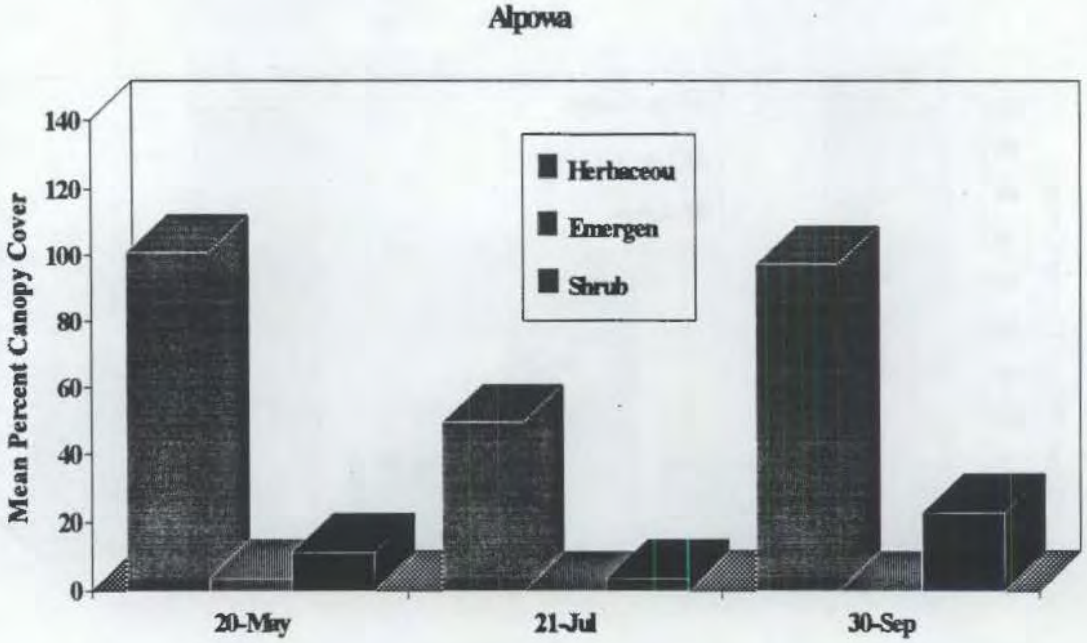


Figure C.12 Canopy Cover Measured Along Dryland Transects at Alpowa

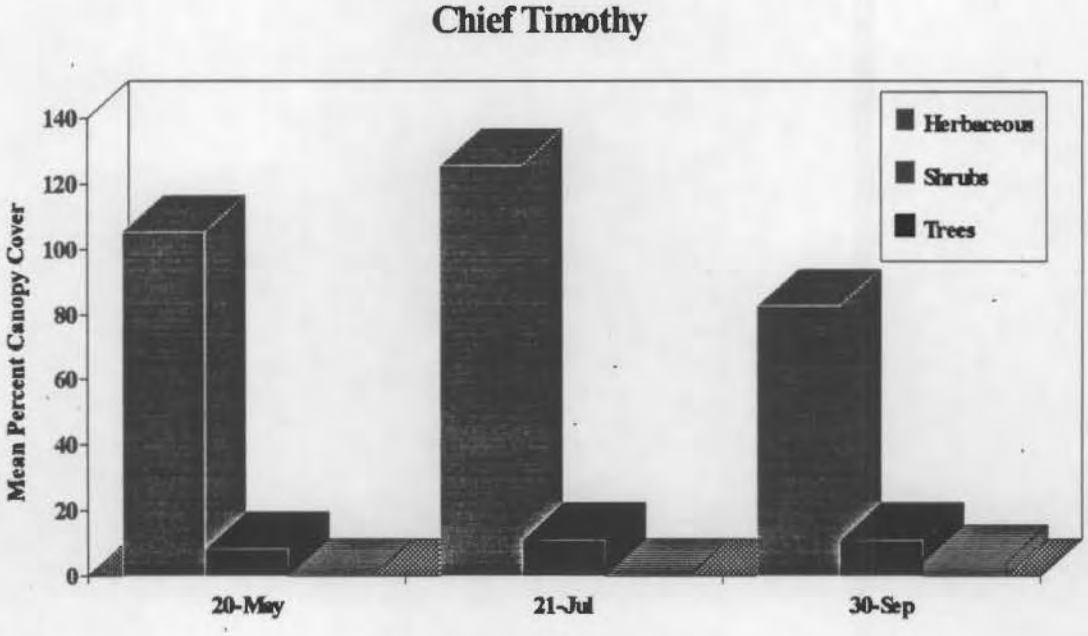


Figure C.13 Canopy Cover Measured Along Dryland Transects at Chief Timothy

PNNL-10953
UC-702

Distribution

No. of Copies

OFFSITE

5 Mr. Lonnie Mettler
Department of the Army
Walla Walla District
Corps of Engineers
201 North 3rd St.
Walla Walla, WA 99362-1876

Ms. Rosemary Mazaika
333 SW 1st Ave.
Robert Duncan Plaza
P.O. Box 2946
Portland, OR 97208-2946
Attn: CENPP-PE-E

Mr. Mike Witter
Shannon and Wilson, Inc.
400 North 34th St., Suite 100
Seattle, WA 98103

No. of Copies

ONSITE

11 Pacific Northwest National Laboratory
D.D. Dauble
J.L. Downs
D.A. Neitzel
B.L. Tiller
Information Release Office (7)