Coast 2050 Region 1

BAYOU SAUVAGE HYDROLOGIC RESTORATION (PO-18)
PROGRESS REPORT No. 1
PO-18-MSPR-0598-1

for the period
June 1, 1997, to June 1, 1998

Project Status

This is the first in a series of progress reports describing the Department of Natural Resources Coastal Restoration Division monitoring for the Bayou Sauvage Hydrologic Restoration project. This report, and all subsequent progress reports for this project, will identify the monitoring data being collected and will briefly discuss the preliminary results from project monitoring efforts.

Project Description

The Bayou Sauvage Hydrologic Restoration (PO-18) project is located in the Bayou Sauvage National Wildlife Refuge (NWR), 16 mi (26 km) east of New Orleans in Orleans Parish (figure 1). The project area encompasses 6,900 ac (2,792 ha) and is bounded by U.S. Interstate 10 to the north, the Lake Pontchartrain Hurricane Protection Levee to the east, U.S. Highway 90 to the south, and the Maxent Canal levee to the west. The reference area is also part of the NWR and is located north of the project area between U.S. Interstate 10 and the Hurricane Protection Levee, adjacent to Lake Pontchartrain (figure 1).

The project and reference areas are classified as impounded freshwater marsh (U.S. Fish & Wildlife Service [USFWS] 1991); however the reference area and sections of the project area nearest Lake Pontchartrain exhibit fresh/intermediate marsh plant communities. Dominant plant species in the project area include *Spartina patens* (marshhay cordgrass), *Cyperus odoratus* (fragrant flatsedge), and *Bacopa monnieri* (coastal waterhyssop). The reference area is dominated by *S. patens* and *Ipomoea sagittata* (saltmarsh morningglory).

Much of the NWR is hydrologically isolated from its surrounding estuary by the Lake Pontchartrain Hurricane Protection Levee, which was built in 1956. Thus, the project area has been effectively impounded, and precipitation is the major source of water input for the area. Water control structures in the project area are unable to remove excess rainfall in a timely fashion, and elevated water levels have caused significant deterioration of the impounded marsh over the last four decades. For example, the project area exhibited an increase in open water from 6 % in 1956 to 30% in 1988 (USFWS 1994). In addition, open-water ponds in the area contained an abundance of submerged aquatic vegetation in 1978, but most of this vegetation had disappeared by 1990. The loss of marsh and submerged vegetation has resulted in the formation of numerous open-water ponds that have depths of 1-2 ft (0.3-0.6 m) (USFWS 1994).

This project was designed to remove excess water in the project area throughout the year, and to lower water levels during the spring and summer to enhance emergent freshwater marsh habitats

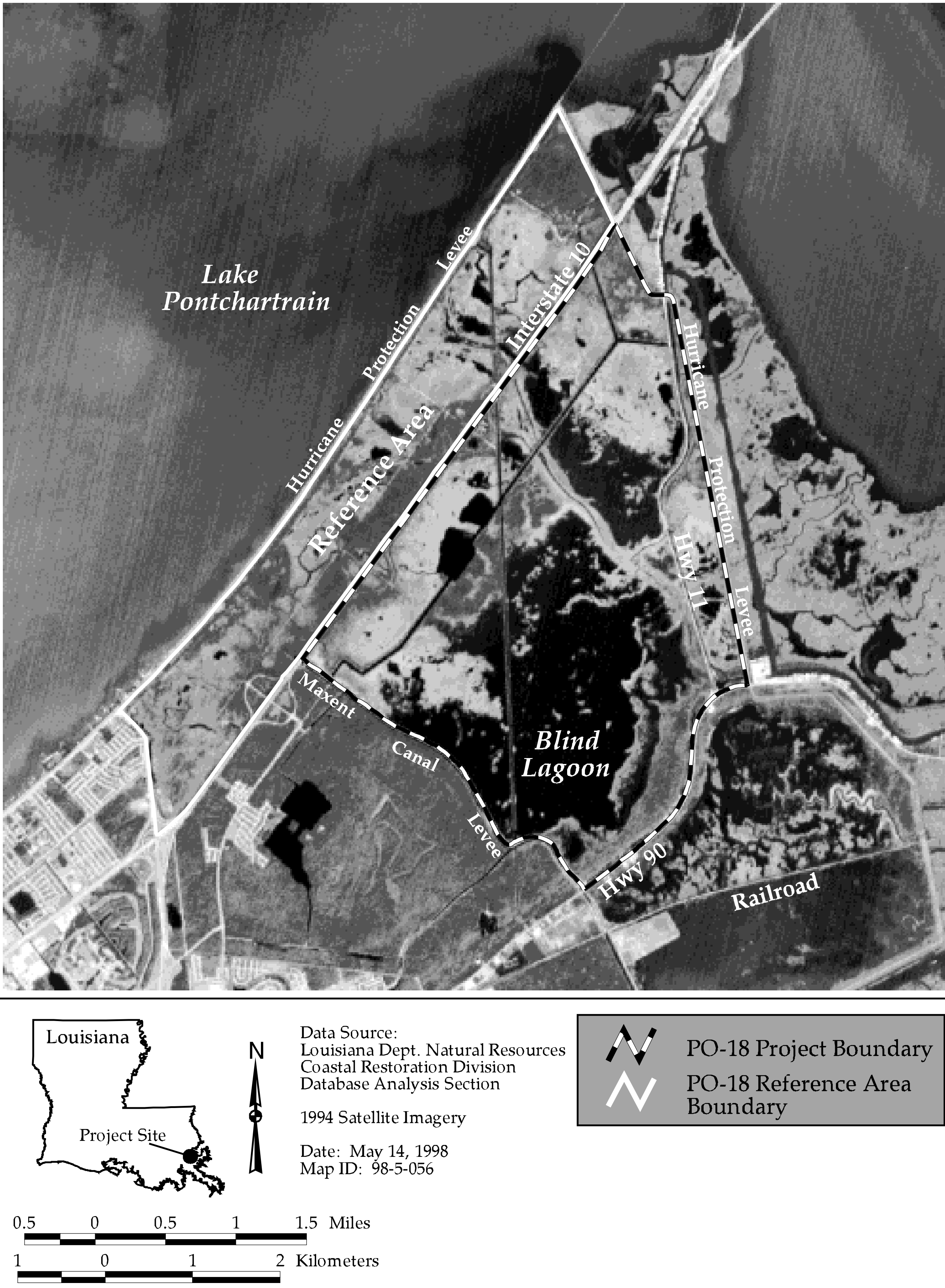


Figure 1. Project and reference area boundaries for the Bayou Sauvage Hydrologic Restoration (PO-18) project.

in the area. The specific goals are to (1) promote the reestablishment of emergent marsh vegetation, and (2) lower water levels to within the range of 0 - 0.5 ft (0 - 15 cm) below marsh elevation (ME) during the spring and summer, and to within 0 - 0.5 ft above ME during the fall and winter.

To achieve the project goals, one 48-in (1.2 m) and one 36-in (0.9 m) pump were installed at the same location in the project area, so that water level can be lowered when needed (figure 2). When run at full capacity the 48-in pump is capable of removing water at a rate of 6.9 ac-ft/hour (8,508 m^3/hr), whereas the 36-in pump can remove 5.08 ac-ft/hour (6,264 m^3/hr). To ensure that water level in the project area can be independently managed, a hydrologic connection between the project and reference area was closed with a weir.

Methods

Near-vertical, color-infrared aerial photography (1:18,000 scale) was obtained in November 1993 and December 1996, pre-construction. These data will be compared to future post-construction photos to document changes in marsh loss rates over time.

Water levels were measured weekly at five staff gauges (set to North American Vertical Datum [NAVD]) within the project area (figure 2) and two staff gauges within the reference area (figure 3) from February 20, 1997 to March 20, 1998. Water levels were also recorded hourly with a continuous recorder (YSI Model 6920 Water Quality Analyzer) at one station in the project area (figure 2) and at one station in the reference area (figure 3). The continuous recorders were installed temporarily to supplement incomplete staff gauge readings prior to the installation of all staff gauges.

In addition to water elevation, an elevation survey was conducted to determine marsh elevation in the vicinity of each staff gauge. From water and marsh elevation data, mean level of marsh inundation was calculated (PROC MEANS, SAS Institute, Inc. 1991) for the Spring/Summer (March 21 - Sept 23; [S/S]) and Fall/Winter (Sept 24 - March 20; [F/W]) time periods within the project and reference areas. Mean level of marsh inundation was then compared to the target inundation range for each time period, as outlined in the monitoring plan (Steller 1995).

Emergent vegetation was surveyed with the line-intercept method (Chabreck 1972;Fletcher 1983) in 1989 (pre-construction) by the USFWS (Harris 1989). Seven transects were established in the project area (figure 2), and four transects were established in the reference area (figure 3). Transects were chosen to intersect dominant habitat types found in each area, which included fresh marsh, *S. patens* marshes, *Salix nigra* (black willow) stands, and open water. The first post-construction vegetation survey was conducted in September 1997 by Department of Natural Resources (DNR) personnel. For this survey a modified Braun-Blanquet method was employed (Steyer et al. 1995). Species composition and percent cover of emergent vegetation were determined at five randomly selected plots (2-m^2) along each of the previously established (by USFWS) transects. The pre- and post-construction surveys were not compared to one another, because different survey methods were used. Also, it was difficult to relocate the exact stations that were sampled in 1989. For the 1997

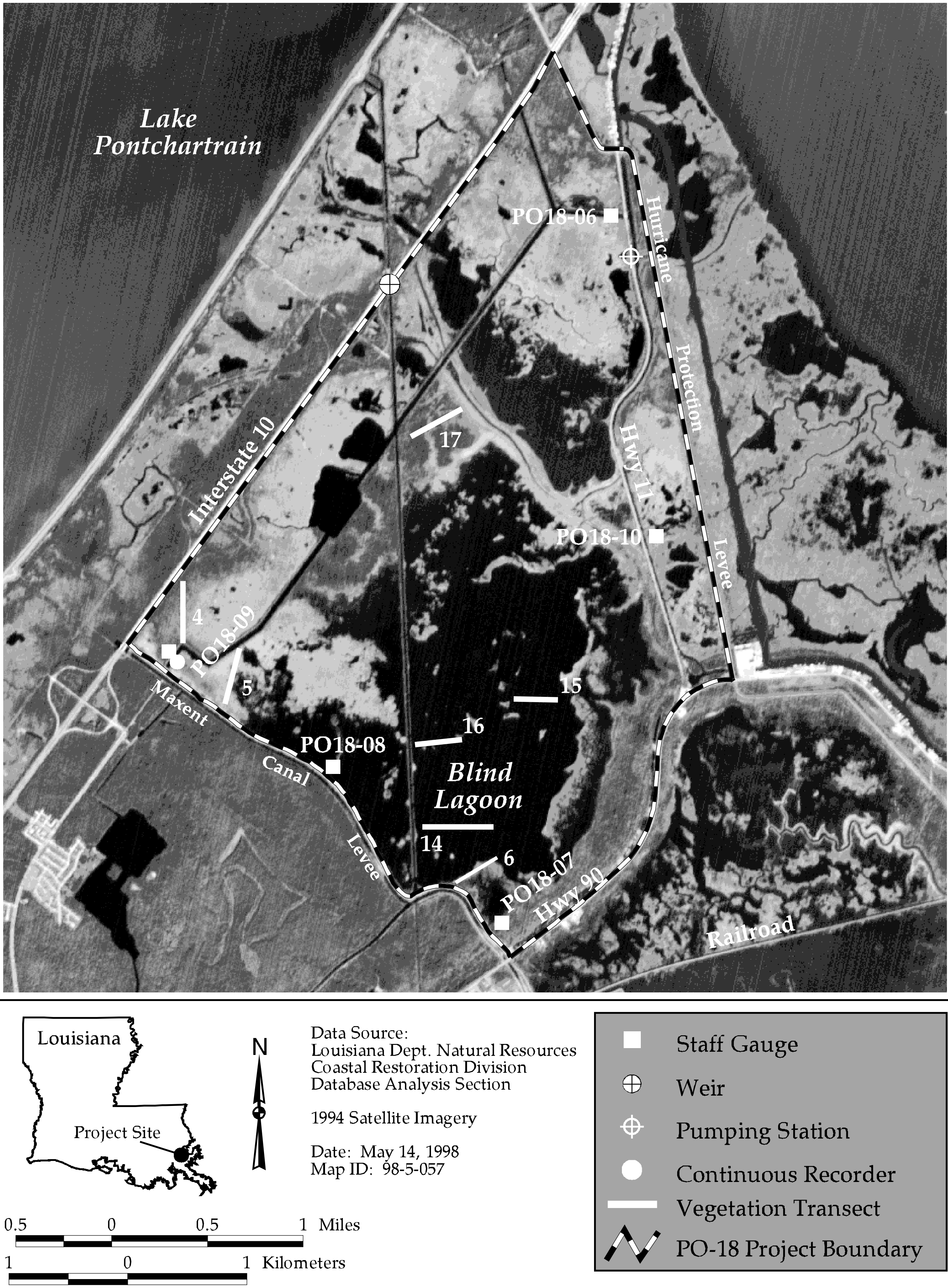


Figure 2. Bayou Sauvage Hydrologic Restoration (PO-18) project features.

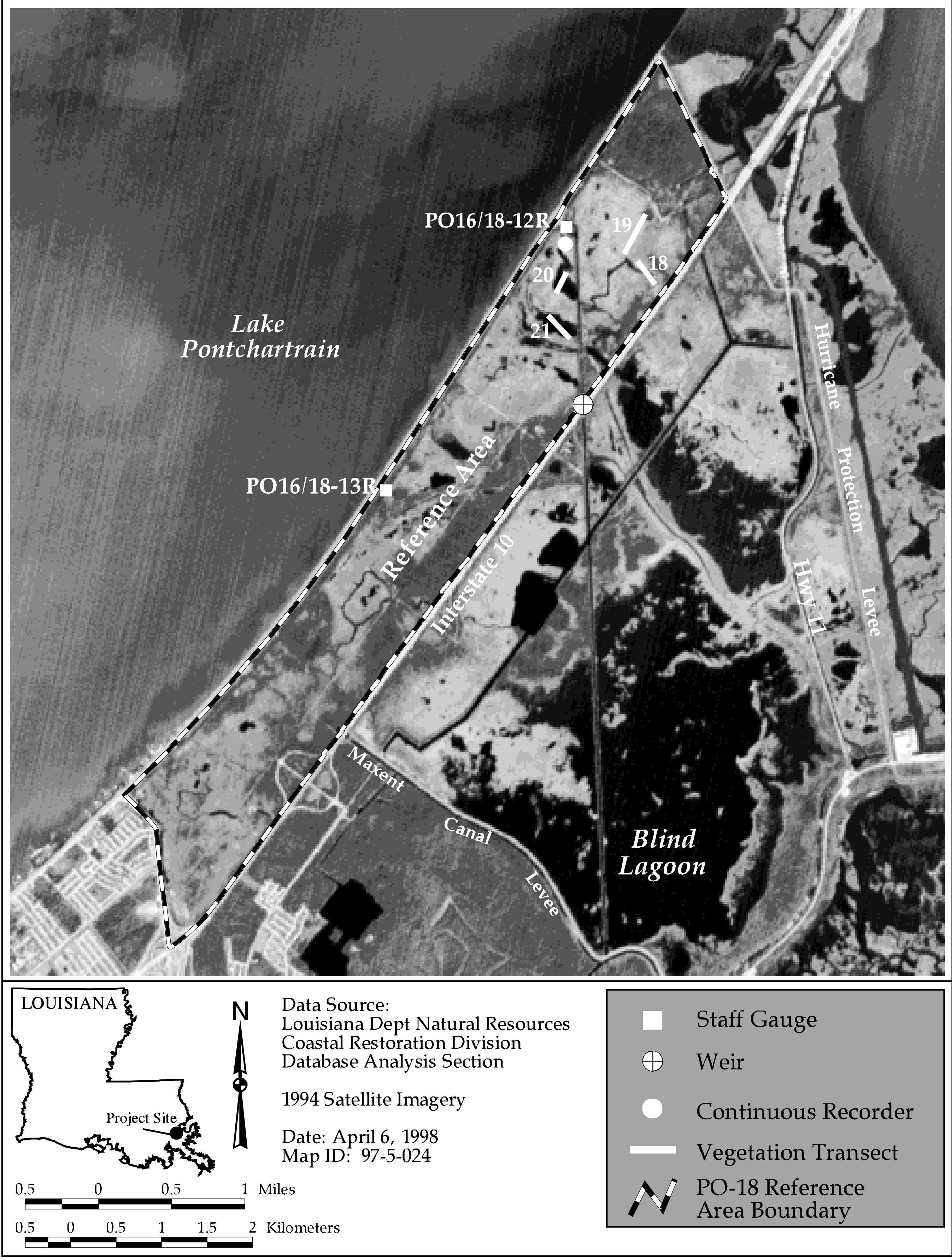


Figure 3. Bayou Sauvage Hydrologic Restoration (PO-18) reference area features.

survey data, a two-way analysis of variance (ANOVA) was used to test for differences in mean species richness (number of species) between the project and reference areas (α =0.05) and among transects within each area (PROC GLM, SAS Institute, Inc. 1991). Least squared means were used to compare factor levels when ANOVA indicated significant differences were present. In addition, frequency of each vegetation species was reported for the project and reference areas.

Results

Comparison of water level data taken by the continuous recorders and those data recorded from the staff gauges indicated that both devices generated similar measurements (figure 4). Thus, the continuous recorders were removed from the project and reference areas in March 1998, and only the staff gauges will be used to measure water levels for the duration of the project. The continuous recorders were not required by the monitoring plan and were only used temporarily as a source of supplementary data in the absence of complete staff gauge data. Therefore, evaluation of project effectiveness will not be compromised by their removal.

Mean level of marsh inundation was higher in the reference area than in the project area for both the S/S and F/W time periods (table 1 and 2). For both areas, mean water level during the F/W was higher than during the S/S, although, for the reference area, the difference in water level between these two periods is minimal (0.02 ft [0.006 m]). In the project area, mean inundation was within the target range for the F/W, but was slightly above the target range for the S/S.

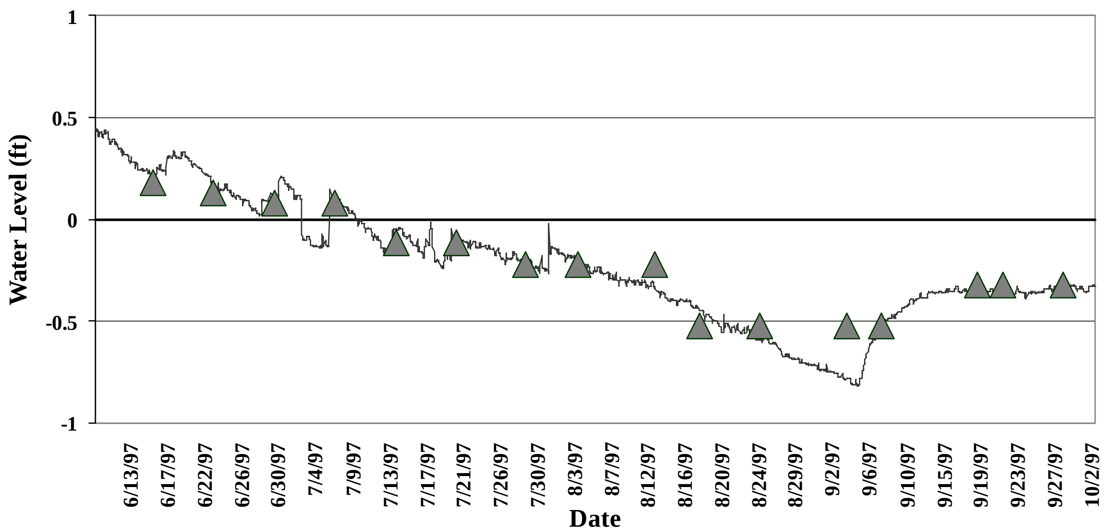
Although the pre- and post-construction vegetation surveys could not be directly compared, a cursory comparison indicated few changes in the dominant species of each area. For the 1989 survey, the dominant species in the project area included *S. patens*, *B. monnieri*, *Panicum* spp., and *Leptochloa* spp. The most noted difference between the two surveys was the occurrence of *C. odoratus*, which was the most frequently encountered species within the project area during the 1997 survey (table 3). Other species frequently encountered in 1997 included *B. monnieri*, *S. patens*, *Echinochloa walteri* (walter's millet), and *Alternanthera philoxeroides* (alligator weed). Dominant species in the reference area included *S. patens* and *I. sagittata* (table 4).

Mean species richness (per plot) in the project area (4.36 ± 0.42 SE) was not significantly different ($F_{(1)}$ = 3.41, p = 0.0741) from species richness in the reference area (2.80 ± 0.73 SE). However, a total of 27 species was found in the project area, whereas only nine species were encountered in the reference area. Within the project area, species richness was significantly different ($F_{(6)}$ = 4.38, p = 0.0025) among transects (table 5). Transect six was the most diverse, whereas transect 16 had the fewest number of species.

Discussion

Mean level of marsh inundation in the project area during the S/S time period was slightly above the target range (goal) of 0 - 0.5 ft below ME. However, it must be noted that installation of the pumps

(A)



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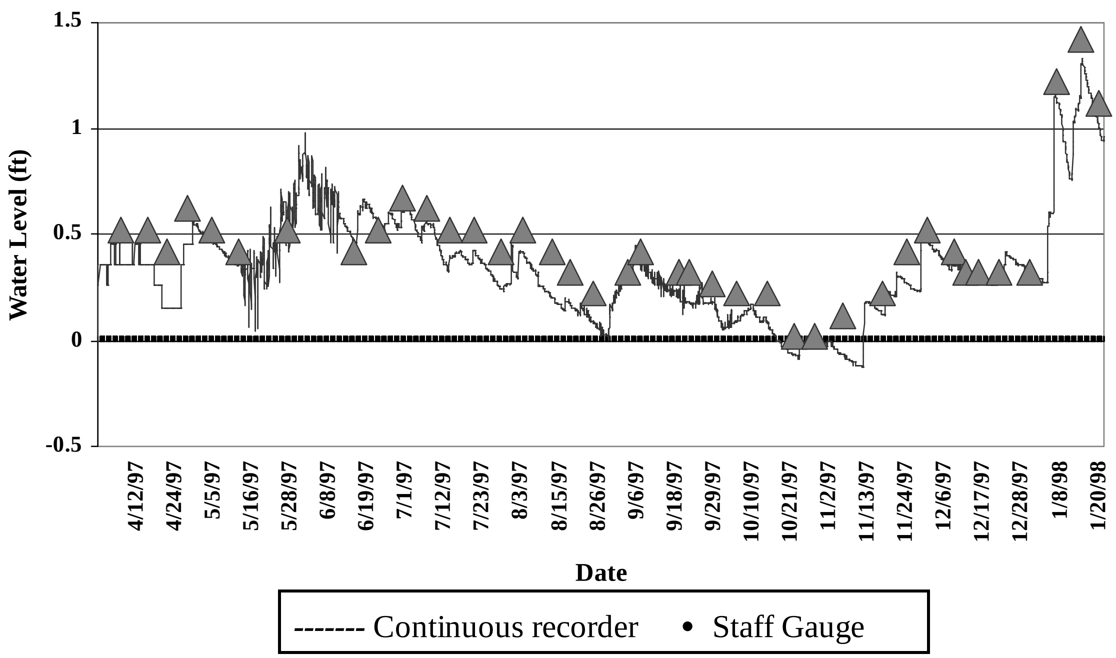


Figure 4. Comparison of continuous recorder water level data and staff gauge readings for the Bayou Sauvage Phase II (PO-18) project area (A) and reference area (B). Water level is given relative to the marsh surface (0.0 ft).

Table 1. Mean (standard error) for water elevation, marsh elevation, and marsh inundation for the Bayou Sauvage Hydrologic Restoration (PO-18) project for March 21, 1997 through September 23, 1997 (Spring / Summer).

Spring / Summer			
	water elevation (w) (NAVD)	marsh elevation (m) (NAVD)	marsh inundation (w-m) (Target -0.5#x#0 ft)
Project Area	0.01 (± 0.06)	-0.01 (± 0.10)	0.02 (± 0.06)
Reference Area	0.63 (± 0.02)	0.28 (0)	0.35 (± 0.02)

Table 2. Mean (standard error) for water elevation, marsh elevation, and inundation for the Bayou Sauvage Hydrologic Restoration (PO-18) project for September 24, 1997 through March 20, 1998 (Fall / Winter).

Fall / Winter			
	water elevation (w) (NAVD)	marsh elevation (m) (NAVD)	marsh inundation (w-m) (Target 0#x#0.5 ft)
Project Area	0.14 (± 0.11)	-0.01 (± 0.10)	0.15 (± 0.11)
Reference Area	0.65 (± 0.02)	0.28 (0)	0.37 (± 0.06)

Table 3. Frequency of vegetation species at survey sites in the Bayou Sauvage project area for September 1997.

Species	**Frequency**
Cyperus odoratus	16/30
Bacopa monnieri	14/30
Spartina patens	12/30
Echinochloa walteri	12/30
Alternanthera philoxeroides	12/30
Pluchea camphorata	6/30
Sesbania spp.	6/30
Phyla nodiflora	5/30
Aeschynomene indica	5/30
Salix nigra	5/30
Ipomoea sagittata	4/30
Scirpus americanus	3/30
Eleocharis parvula	3/30
Paspalum distichum	3/30
Ammania latifolia	2/30
Vigna luteola	2/30
Sacciolepis striata	2/30
Sapium sebiferum	2/30
Leptochloa fascicularis	2/30
Hydrocotyle spp.	2/30
Panicum virgatum	2/30
Ludwigia leptocarpa	1/30
Panicum dichotomiflorum	1/30
Sagittaria lancifolia	1/30
Kosteletzkya virginica	1/30
Typha latifolia	1/30
Lemna minor	1/30

Table 4. Frequency of vegetation species at survey sites in the Bayou Sauvage reference area for September 1997.

Species	Frequency
Spartina patens	10/10
Ipomoea sagittata	8/10
Juncus roemerianus	3/10
Scirpus americanus	2/10
Salix nigra	1/10
Bacopa monnieri	1/10
Eleocharis parvula	1/10
Cyperus odoratus	1/10
Sacciolepis striata	1/10

Table 5. Least squared means grouping for Bayou Sauvage (PO-18) vegetation transects. Means with the same letter are not significantly different (α =0.05).

Note: transects 14, 20, 21 were all open-water and did not contain emergent vegetation.

Species Richness	Transect #	Least Squared Means Grouping				
7.00	6	A				
6.44	15	A	B			
5.20	17	A	B	C		
4.00	5		B	C	D	
3.60	19		B	C	D	E
2.80	4			C	D	E
2.00	18				D	E
0.80	16					E

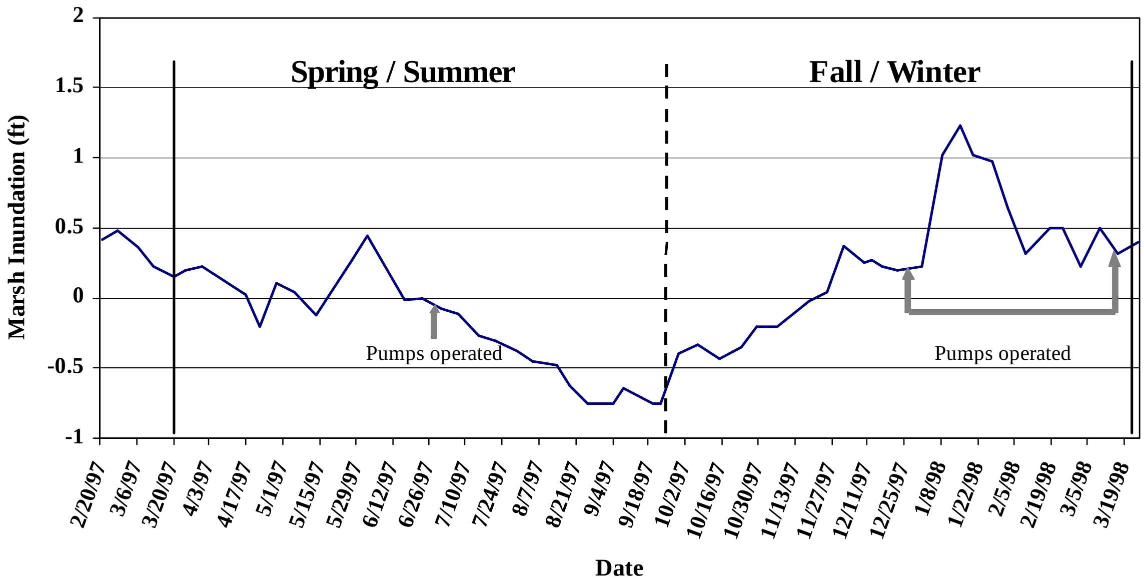
in the project area was not completed until June 1, 1997, and as a result, water levels could not be manipulated during March, April or May of the S/S time period. If the pumps had been installed before March, it is likely that mean water levels could have been drawn down to within the target range during these months. Nonetheless, water level was naturally low during the summer months, and the pumps were only needed once in July 1997.

Although mean inundation was within the target range for the F/W in the project area, water level exceeded 0.5 ft above ME during this time period (figure 5). A significant increase in water level occurred in January 1988 due to the substantial amount of rainfall during the month. Whereas the average amount of rainfall for January is 4.97 in (12.6 cm), a total of 19.28 (49.0 cm) in of rainfall was recorded at the New Orleans International Airport in January 1998, which was the wettest January recorded in state history (Louisiana Office of State Climatology [LOSC] 1998). Both pumps were operated continuously at full capacity for the entire month of January and intermittently through February and March to lower water level to within the target range.

Hydrographs of the project and reference areas were examined to determine the effects of pumping on water level within the project area. In theory, water levels in both areas should mirror one another, except for decreases in water level in the project area that are due to pump operations. Nevertheless, when the hydrographs were compared, it was difficult to determine if water level in the project area was affected by pumping. During the S/S, water level did not exhibit a decrease in the reference area as it did in the project area (figure 5), and this would suggest that pumping reduced water level in the project area. However, pumping was not necessary during the S/S, except for July 1st when the pumps were only operated for eight hours. Thus, much of the decline in water levels in the project area was likely the result of evaporative losses due to the lower than normal rainfall that was received in the area during July (avg = 6.12 in [15.54 cm]; received = 3.94 in [10.00 cm]), August (avg = 6.17 in [15.67 cm]; received = 2.25 in [5.72 cm]), September (avg = 5.51 in [14.00 cm]; received = 0.81 in [2.06 cm]), and October (avg = 3.05 in [7.75 cm]; received = 1.36 in [3.45]) of 1997 (LOSC 1998). In addition, if water level in the project area was affected by natural causes (and not pumping), then the same trend in water level should have occurred in the reference area. This was not the case, and therefore it was hard to decipher between the effects of pumping and the natural decrease in water levels in the project area, when compared to the reference area.

There are two factors that may obscure the relationship between water levels in these two areas. One is that the hydrology of the reference area is sometimes tidally influenced by Lake Pontchartrain during the spring (personal communication, James Harris, USFWS). This would explain the almost constant water level in the reference area throughout the S/S, as compared to the declining water level in the project area (figure 5). Another factor that affects water levels in both areas is a weir that is located along their adjoining boundary. This weir was installed to close an existing hydrologic channel between the areas. However, the weir is set at 0.8 ft (0.24 m) NAVD, and when water levels rise above this mark (0.8 ft NAVD or 0.52 ft [0.16 m] over marsh surface), the project and reference areas again become hydrologically connected. As a result, the drainage of the reference area is affected by pumping in the project area. This scenario seems to have occurred in January 1998.

(A)



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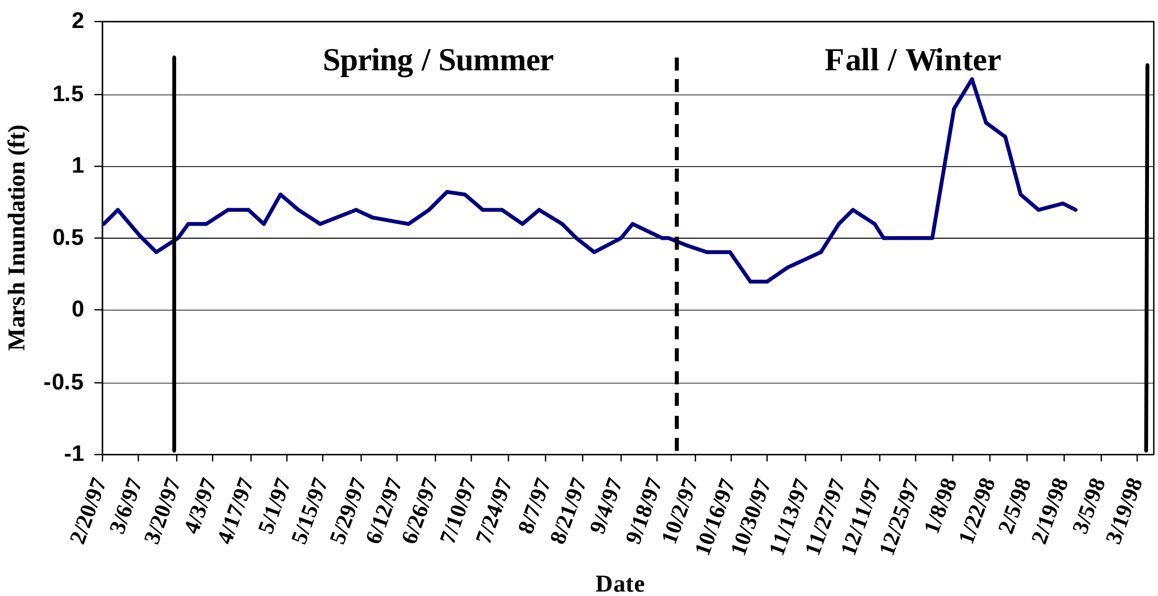

Figure 5. Level of marsh inundation in the project area (A) and reference area (B) during the Spring / Summer (March 21, 1997 - September 23, 1997) and Fall / Winter (September 24, 1997 - Mar 20, 1998) time periods.

When the pumps in the project area were operated for the entire month, water levels in both areas seemed to fluctuate identically, which seemed to be the only time during the F/W that this occurred.

Plant species composition and richness differed among transects according to location within the area. Transects that were located nearest to Lake Pontchartrain contained fewer species, whereas transects that were located further (south) from the Lake were more diverse. For example, the transects in the reference area and transect four were dominated by *S. patens* and contained relatively few other species. With the exception of transect 16, which was mostly open water, species richness among the remaining transects increased as along a north-south gradient. Changes in the dominant vegetation species due to project effects will likely not be seen in the project area for several years. Nevertheless, the *S. patens* marsh in the project area is expected to slowly convert to a fresh marsh community over time (USFWS 1991).

Conclusions

No definitive conclusions can be made at this juncture, as only one year of post-construction data has been collected. In future reports, suitability of the reference area for comparing water levels and vegetation should be reexamined after more data are compiled. Because the project and reference areas have dissimilar hydrologies and are hydrologically connected during high water events, this reference area may not be suitable for direct comparison.

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