Appendix 2-1: Annual Permit Report for the Picayune Strand Restoration Project, Phase 1 – Prairie Canal Backfill and Road Removal Component

Permit Report
Hydrology: May 1, 2007–April 30, 2010
Water Quality: May 1, 2006–April 20, 2010
Vegetation: May 1, 2008–June 30, 2009
Exotics Mapping and Control: January 1, 2008–September 30, 2010

Permit Number: 0221670-005-GL
Permit Modification: 0221670-008-EM

Kimberly Chuirazzi, Michael Duever and Wossenu Abtew

Contributors: Cheol Mo and Violeta Ciuca

SUMMARY

Based on Florida Department of Environmental Protection (FDEP) permit reporting guidelines, **Table 1** shows cross-references for permit-specific conditions in the permit and the specific reference pages. **Table 2** lists key permit-related information. **Table 3** lists the attachments included with this report. **Attachment A**, Table A-1, shows specific pages, tables, and graphs where project status and annual reporting requirements are addressed.

Table 1. Permit-specific conditions and references in the permit.

Permit Conditions	Permit Reference 0221670-007-GL	Permit Reference 0221670-008-EM
Annual Monitoring Reports	Specific Condition 17, page 9	Specific Condition 17, page 2

Table 2. Key permit-related information.

Project Name	**Prairie Canal Backfill and Road Removal Project**
Permit Number	0221670-005-GL
Issue and Expiration Date	Issue: October 28, 2005 Expiration: October 28, 2010
Permit Number	0221670-008-EM
Issue and Expiration Date	Issue: June 11, 2010 Expiration: June 10, 2015
Project Phase	Post-Construction
Relevant Period of Record	May 1, 2007–April 30, 2010
Report Generator	Kimberly Chuirazzi kchuiraz@sfwmd.gov 561-682-2425
Permit Coordinator	Ronald Bearzotti rbearzot@sfwmd.gov 561-681-2563 x3703
Date	December 17, 2010

Table 3. Attachments included with this report.

Attachment	Title
A	Specific Conditions and Cross-References
B	Data Used for Hydrologic Analyses
C	Data Used for Water Quality Analyses
D	2 Year Post-Restoration Vegetation Monitoring of Prairie Canal and Control Transects: Picayune Strand Restoration Project, PSRP Vegetation Monitoring 2009
E	Picayune Strand Restoration Project – Restored Footprint Exotics Mapping and Control Coordination, Final Report – September 2009
F	Picayune Strand Restoration Project – Restored Footprint Exotics Mapping and Control Coordination, Final Report – September 2010

The Prairie Canal Backfill and Road Removal component, which was Phase 1 of the Picayune Strand Restoration Project, was completed in 2007 and post-construction monitoring is being conducted. Results from hydrologic and water quality monitoring are provided in this report for post-construction water years (2008 through 2010). In addition, water quality data are reported for Water Year (WY) 2007, since they were incompletely reported in previous annual reports submitted for the entire restoration project. Vegetation monitoring for WY2008 was already reported in the 2010 South Florida Environmental Report (Chuirazzi and Duever, 2010). The vegetation report for WY2010 monitoring is not yet available so only the vegetation monitoring for WY2009 is covered in this appendix. WY2010 will be discussed in next year's annual report.

Hydrology has improved within the Phase 1 footprint and to the east of the canal in Fakahatchee Strand Preserve State Park as a result of the canal backfilling and road degradation. Groundwater levels adjacent to the backfilled canal have risen by 2 feet in the summer wet season and 5 feet in the dry season. As groundwater rose in this area, drawdowns of groundwater in the neighboring Fakahatchee Strand Preserve State Park decreased. These effects extend 1 to 3 miles into the park.

In general, it is too early to quantify restoration of vegetation, especially because of drought. Some subtle increases were observed in ground cover in wet prairie and cypress transects at the restored sites.

BACKGROUND

PROJECT DESCRIPTION

The Prairie Canal Backfill and Road Removal Project was the first phase of the Picayune Strand Restoration Project. The Picayune Strand Restoration Project is a Comprehensive Everglades Restoration Plan (CERP) project with the objective to restore hydrological and ecological function of the region by establishing pre-development sheetflows and hydroperiods. The first phase of this larger restoration effort consisted of the elimination of channelized flow in the Prairie Canal. To accomplish this, a number of earthen plugs were constructed in the canal. Also, all roads east of Merritt Canal were demolished and degraded or filled to ground level. Source material for the canal plugs and swale blocks consisted of spoils from the original canal and swale excavations and the demolition and degradation of the berms and roads.

PROJECT LOCATION

The project is located in the eastern portion of the Picayune Strand Restoration Project area (**Figure 1**), which is in an area previously known as Southern Golden Gate Estates. The Prairie Canal and roads to be removed are located in Section 1, 2, 11, 12, 13, 14, 23, 24, 25, 26, 35, and 36 of Township 50 South Range 28 East; and Sections 1, 2, 11, 12, 13, 14, 23, 24, 25, 26, and 35 of Township 51 South Range 28 East. All roads to the east of Merritt Canal were degraded (**Figure 2**). The area is located directly to the west of Fakahatchee Strand Preserve State Park. The canal used to divide the two areas.

PROJECT OBJECTIVE

The objectives of the project are (1) the restoration of the historic hydrologic regime, including overland sheetflow, and historic water levels and durations (hydroperiods) through the backfilling of the canal and degradation of the roads; (2) recolonization of the construction footprint by native vegetation by controlling exotic and nuisance vegetation; and (3) the restoration of historic plant and animal communities.

PROJECT HISTORY

The first phase of this larger restoration effort consisted of the elimination of channelized flow in the Prairie Canal. To accomplish this, a number of earthen plugs were constructed along the 7 miles of the canal. Also, all 65 miles of roads east of Merritt Canal were demolished and degraded or filled to ground level (**Figure 2**). Excess materials from the road degradation were used as fill for the canals. More fill was available in the northern portion of the canal so more of the canal was filled in this area while plugs were used to fill the southern portion of the canal.

The plugging of the canal and demolition of the roads were completed on March 4, 2007. Work began in 2004 on the portion of the canal and the roads north of 79th Street, and hydrologic effects were apparent in this area beginning in the 2005 rainy season. Effects began to be seen in 2007 in the area south of 79th Street. The effects are discussed in more detail in the Hydrologic Improvements section of this report.

PERMIT HISTORY

Permit number 0221670-001-GL was issued for the Prairie Canal Backfill and Road Removal Project on October 28, 2005. Specific condition 8 on page 6 of the permit requires water level and water quality monitoring be conducted in accordance with the Prairie Canal Restoration Fish and Wildlife Resource Monitoring Vegetation Monitoring and Construction Protocol Plan dated

October 14, 2002, and amended based on a letter from Kenneth Ammon, South Florida Water Management District (SFWMD), dated September 14, 2005. Specific condition 16 on page 8 requires the submittal of an annual report detailing the progress of the project for five years after the completion of construction. The annual report must include a discussion of results obtained from the monitoring plan mentioned earlier in the paragraph.

Modification number 0221670-008-EM was issued on June 11, 2010, to modify the post-construction monitoring protocol for this project. At this time, the Modified Prairie Canal Monitoring Plan (Version 2) replaced the previous plan.

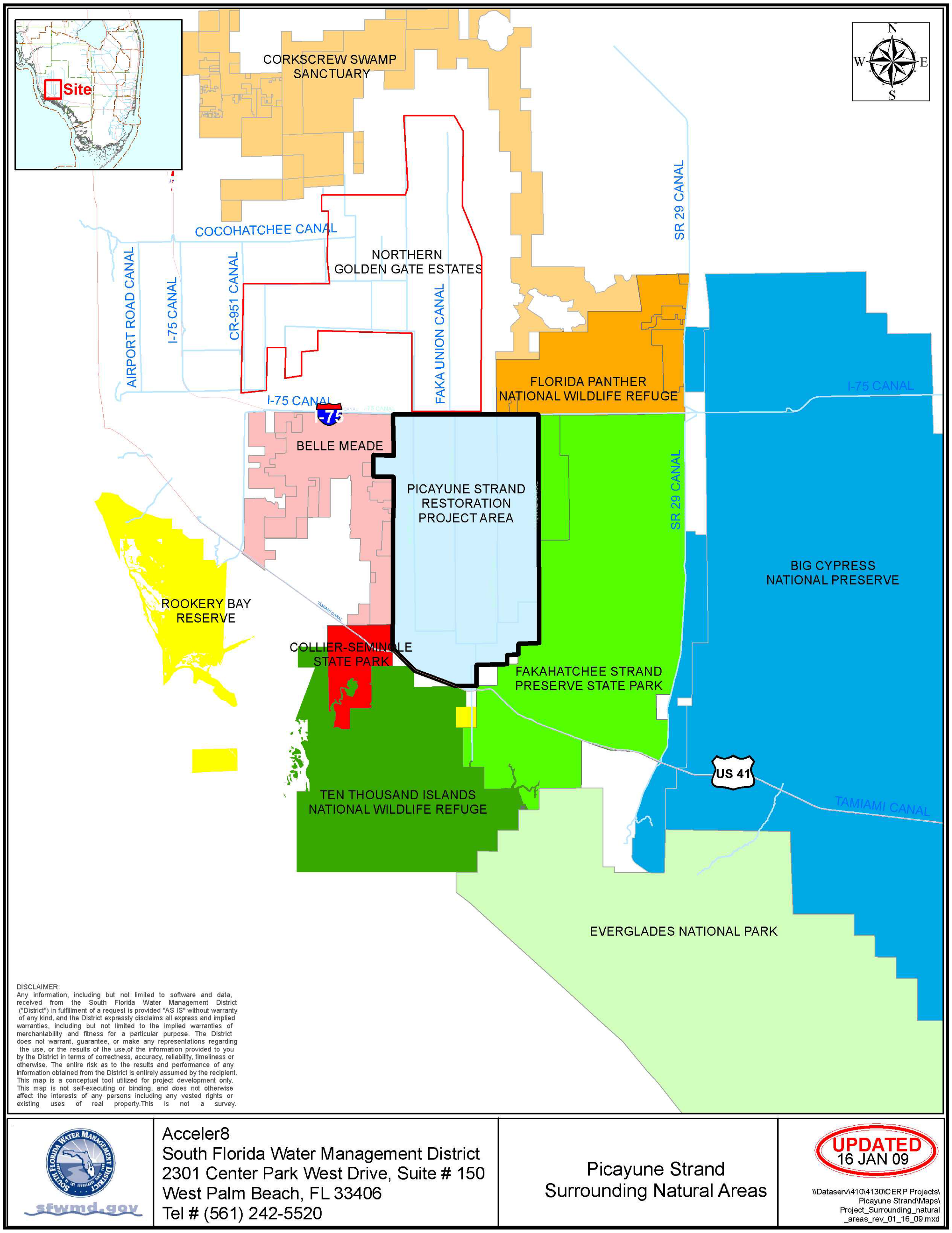

Figure 1. Picayune Strand Restoration Project area and surrounding areas.

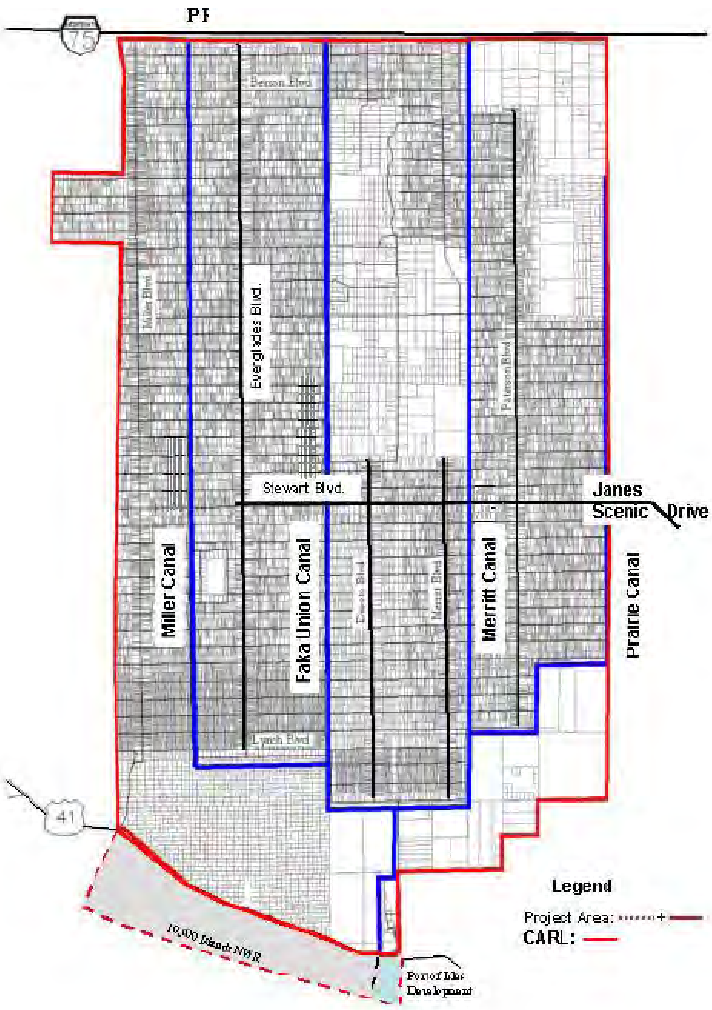

Figure 2. Picayune Strand Restoration Project area showing subdivision infrastructure.

MONITORING AND REPORTING HISTORY

Past reporting for this project has been included within the Picayune Strand Restoration Project reports (Chuirazzi and Duever, 2008, 2010; Chuirazzi et al., 2009). In these reports, the post-construction water quality reporting for this phase of the project was incomplete. As a result, water quality monitoring from WY2007–WY2010 is reported in this document.

PROJECT STATUS

Monitoring will continue for Phase 1 per the requirements in Permit Modification 0221670-008-EM dated June 11, 2010. Groundwater levels will continue to be measured and reported at the seven stations listed in **Table 6** through the year 2050. Water quality will no longer be monitored within the Phase 1 footprint as the plugging of Prairie Canal has eliminated surface water for water quality sampling. Vegetation will be monitored annually for three more years and then every three years for six more years (years 1, 2, 4, 7, and 10) at the end of the growing season. Assessment and treatment of exotic vegetation will continue. Once a species has been completely eradicated (has 0.0 percent coverage for three consecutive years), it will be removed from the list of exotics to be monitored by the SFWMD. Exotic vegetation management will continue throughout the Picayune Strand Restoration Project area through the Division of Forestry Land Management Program but it will not be reported in annual reports. Wildlife monitoring will be conducted the first wet season following the first full year after filling the Merritt Canal for Florida panther (*Felis concolor*), wading birds, manatee (*Trichechus manatus*), and aquatic fauna. These monitoring events are not scheduled until after the Merritt Canal is filled because no detectable results are expected to be realized until after canal filling is completed. For other parameters, monitoring will commence after all three pumps being constructed are operational, the entire Picayune Strand Restoration Project is complete, and one full wet season has passed.

HYDROLOGIC MONITORING

WEATHER

Daily rainfall and evapotranspiration (ET) data were retrieved from the SFWMD's DBHYDRO database for a weather station (SGGEWX) in the project area (**Table 4**). Daily rainfall is depicted in **Figure 3** and daily ET for WY2010 is shown in **Figure 4**. The annual average rainfall in the Southwest Rain Area is 54.12 inches (Abtew et al., 2010). WY2010 received 63.37 inches indicating this was a wet year. The annual ET for WY2010 was 52.67 inches. Monthly rainfall and ET for WY2010 are shown in **Table 5**.

Most months, ET was higher than rainfall (**Table 5** and **Figure 5**). However, December, January, March, and April rainfall was higher than the historical average (**Table 5**). This was an El Niño year and during these events, dry season rainfall is above the historical average in South Florida. September and August were the wettest months. October and November were dry with ET far higher than rainfall. Data used for these analyses are provided in **Attachment B**.

Table 4. Hydrologic monitoring stations and database Dbkeys.

Site Name	Dbkey	Parameter
SGGEWX	OR084	Rainfall
SGGEWX	OR083	Evapotranspiration

Table 5. WY2010 and historical average monthly rainfall and WY2010 evapotranspiration (ET) (May 1, 2009–April 30, 2010)

Month	Rainfall		ET (inches)	Month	Rainfall		ET (inches)
	WY2010	Historical Average			WY2010	Historical Average	
May	3.99	4.03	5.36	November	1.43	1.55	3.66
June	7.6	9.13	4.96	December	3.65	1.43	2.86
July	7.39	8.73	5.04	January	2.47	1.92	3.23
August	10.97	8.26	5.1	February	1.83	2.15	3.57
September	12.52	8.20	4.31	March	6.63	2.46	4.88
October	1.15	4.05	4.48	April	3.74	2.21	5.22
				TOTAL	**63.37**	**54.12**	**52.67**

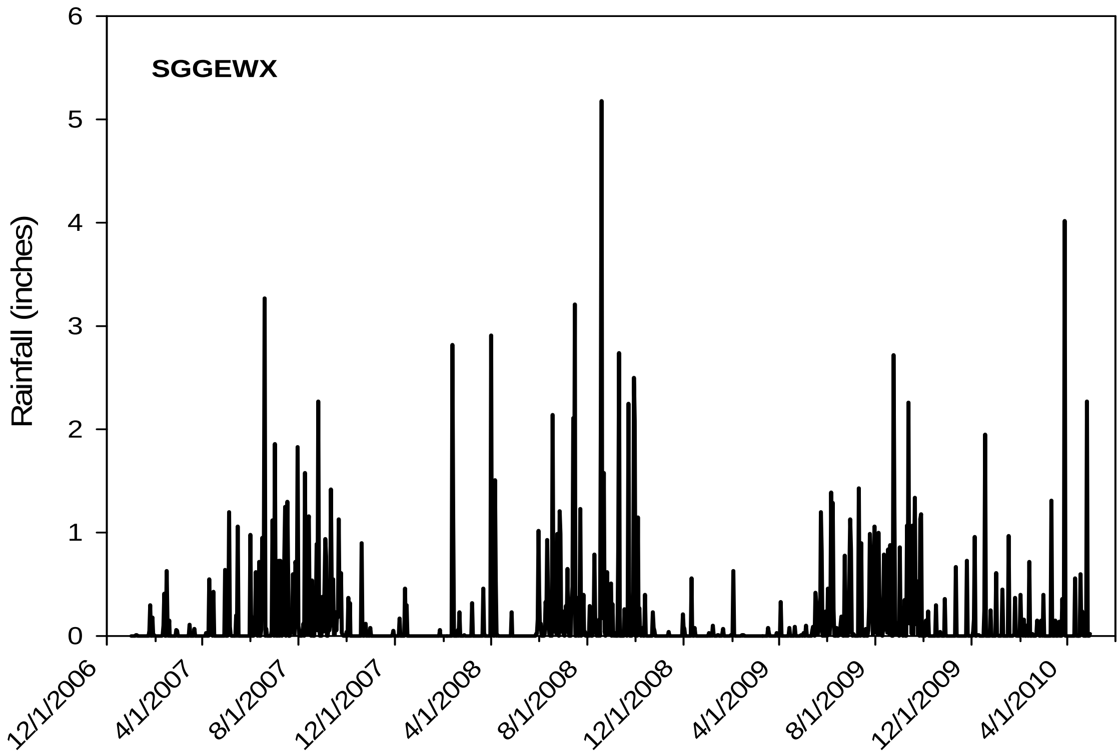

Figure 3. Daily rainfall at the Picayune Strand Restoration Project area.

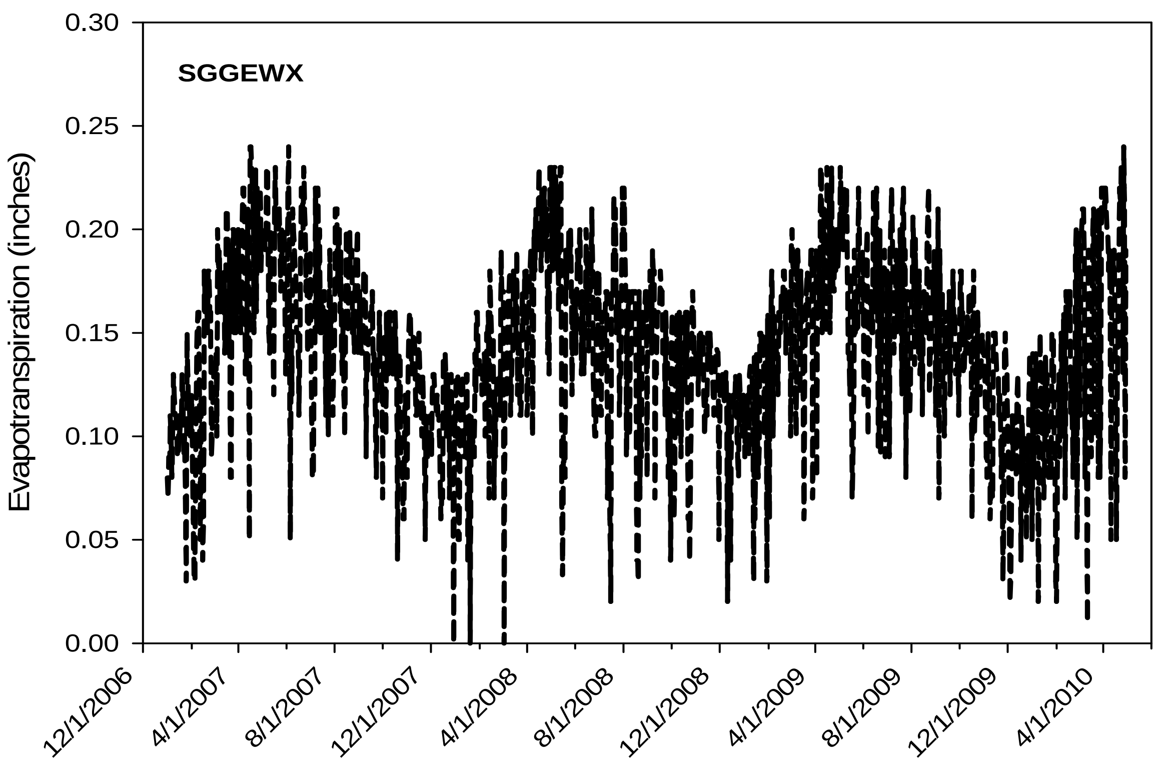

Figure 4. Daily ET at the Picayune Strand Restoration Project area.

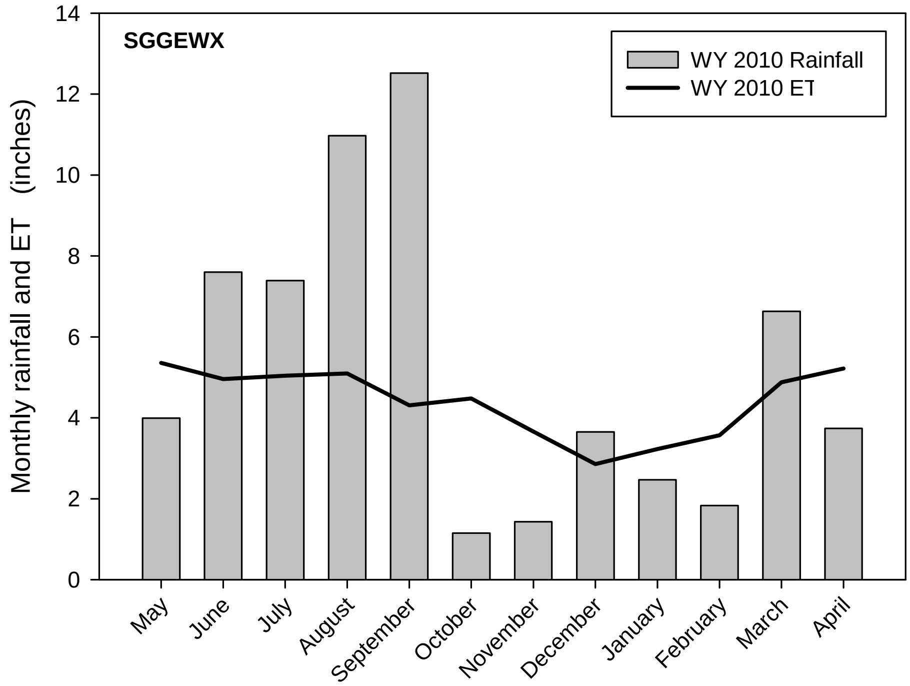

Figure 5. Monthly rainfall and ET at the Picayune Strand Restoration Project.

GROUNDWATER LEVELS

For the Prairie Canal Backfilling and Road Removal phase of the project, water level is monitored at seven stations to the east of Merritt Canal, which are shown in **Figure 6** along with the rest of the Picayune Strand Restoration Project stations. The stations sampled are SGT1W5, SGT2W5, SGT2W6, SGT3W5, SGT3W6, SGT3W7, and SGT4W6. Information about these seven sites is presented in **Table 6**. These stations have been renamed since the permit was issued and the former names are provided in the table. **Figure 7** through **Figure 13** show water levels and depths at each of the seven stations for the period of record. Data used for these analyses are provided as **Attachment B**.

Table 6. Groundwater level and water quality monitoring stations coordinates and database Dbkeys.

Latitude	Longitude	Status	DBHYDRO Station Name	Former Station Name	DBHYDRO Dbkey
260835.68	812811.048	Existing	SGT1W5	SGGE5SW	PT049
260635.995	812834.49	Existing	SGT2W5	SGGE10SW	PT059
260535.218	812739.212	Existing	SGT2W6	SGGE11SW	PT061
260319.78	812956.813	Existing	SGT3W5	SGGE16SW	PT069
260227.5	812747.2	Existing	SGT3W6	SGGE23SW	PT071
260252.501	812628.314	Existing	SGT3W7	SGGE17SW	PT073
260138.427	812842.013	Existing	SGT4W6	SGGE22SW	PT087

Picayune Strand Restoration Project
Hydrologic and Meteorologic Monitoring Sites

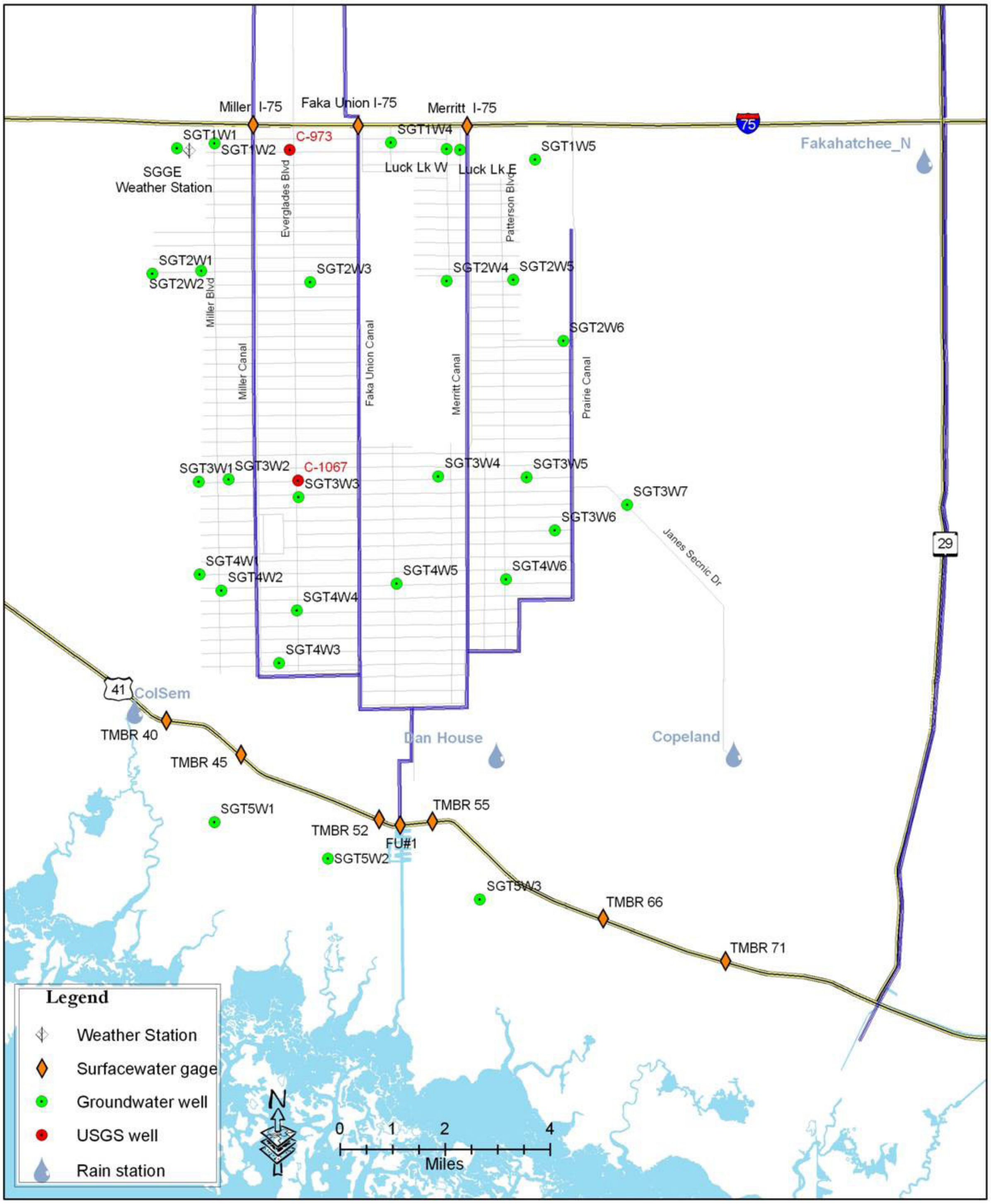

Figure 6. Map showing all hydrologic and water quality sampling stations for the Picayune Strand Restoration Project. Data from the seven stations to the east of Merritt Canal are reported for this phase of the project.

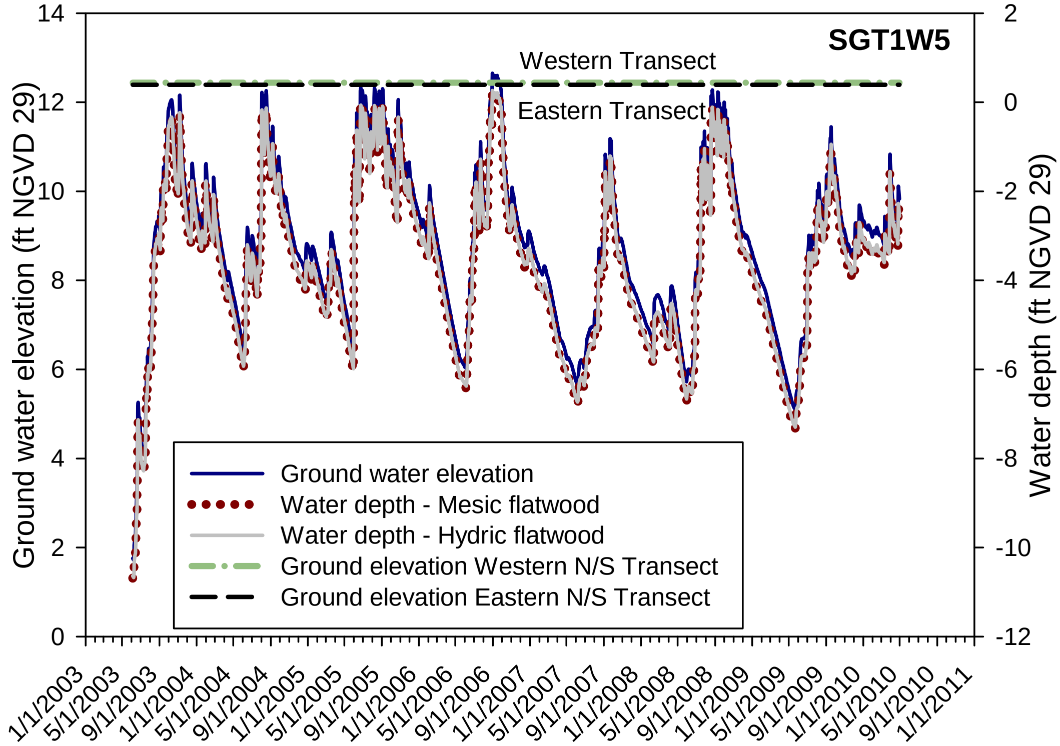

Figure 7. Ground elevation, groundwater elevation, and water depth for well SGT1W5.

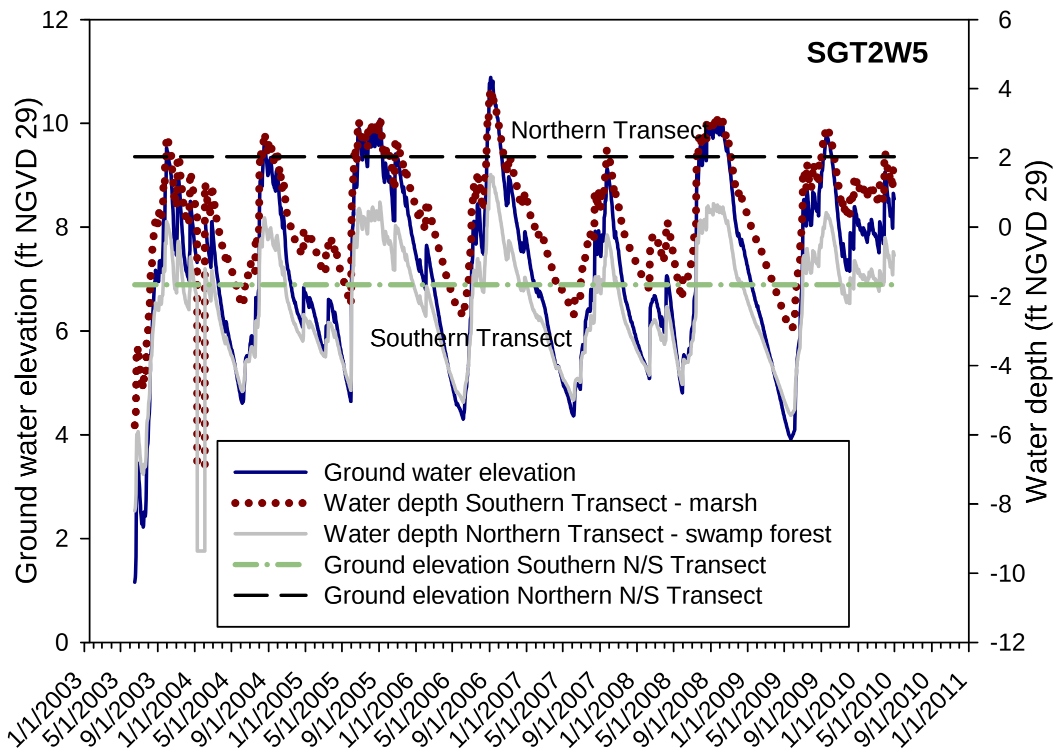

Figure 8. Ground elevation, groundwater elevation, and water depth for well SGT2W5.

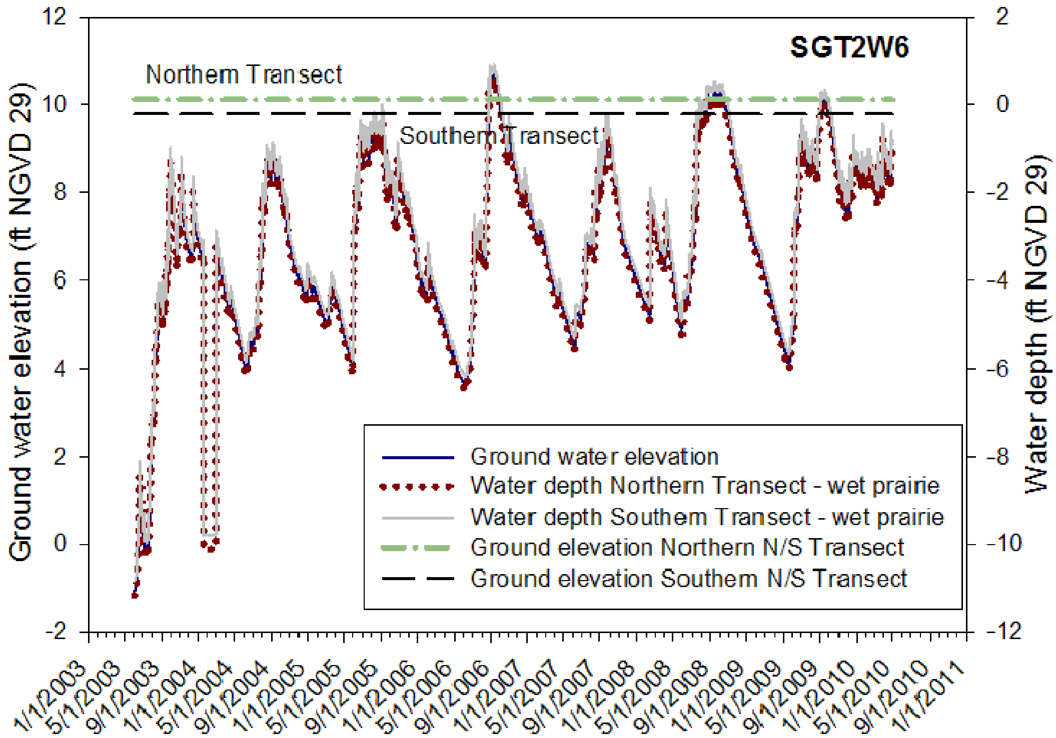

Figure 9. Ground elevation, groundwater elevation, and water depth for well SGT2W6.

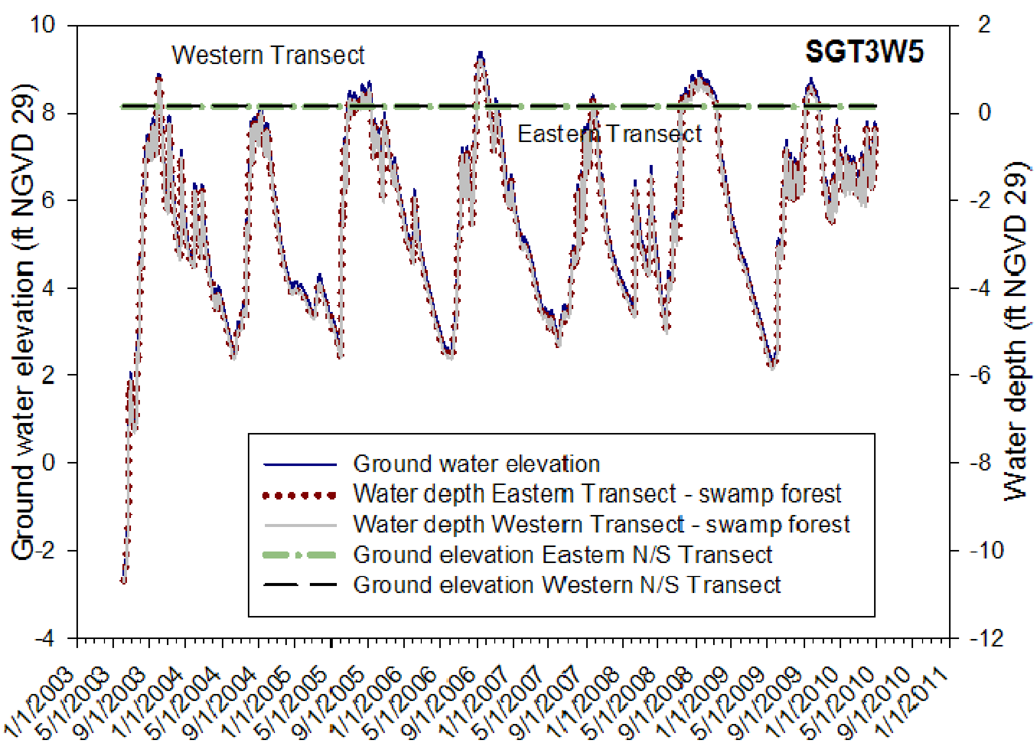

Figure 10. Ground elevation, groundwater elevation, and water depth for well SGT3W5.

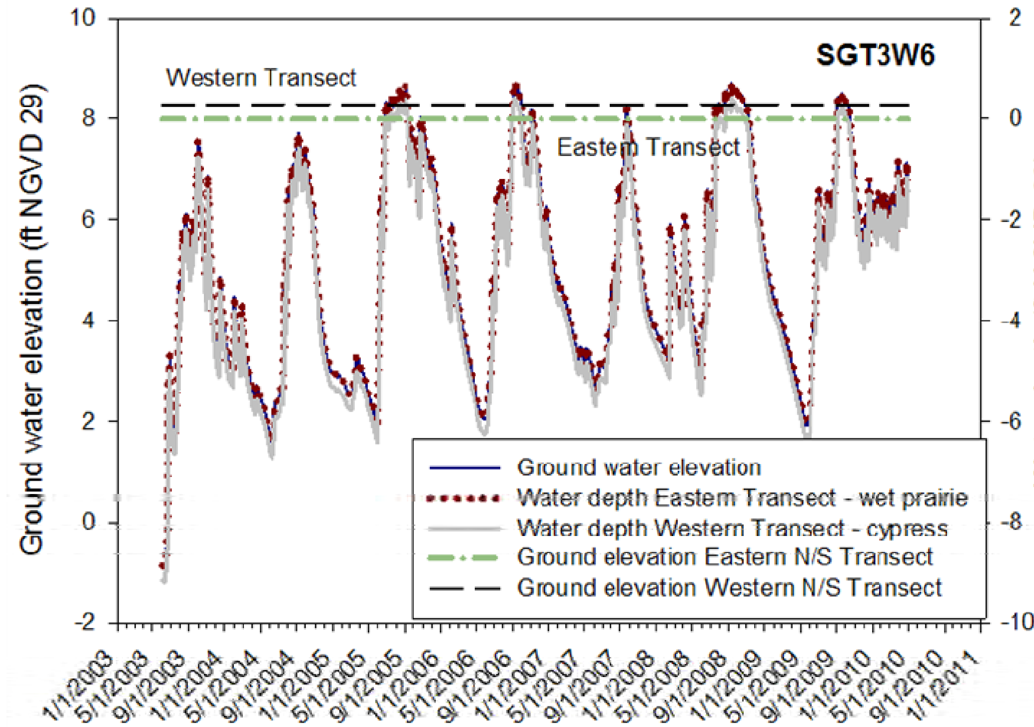

Figure 11. Ground elevation, groundwater elevation, and water depth for well SGT3W6.

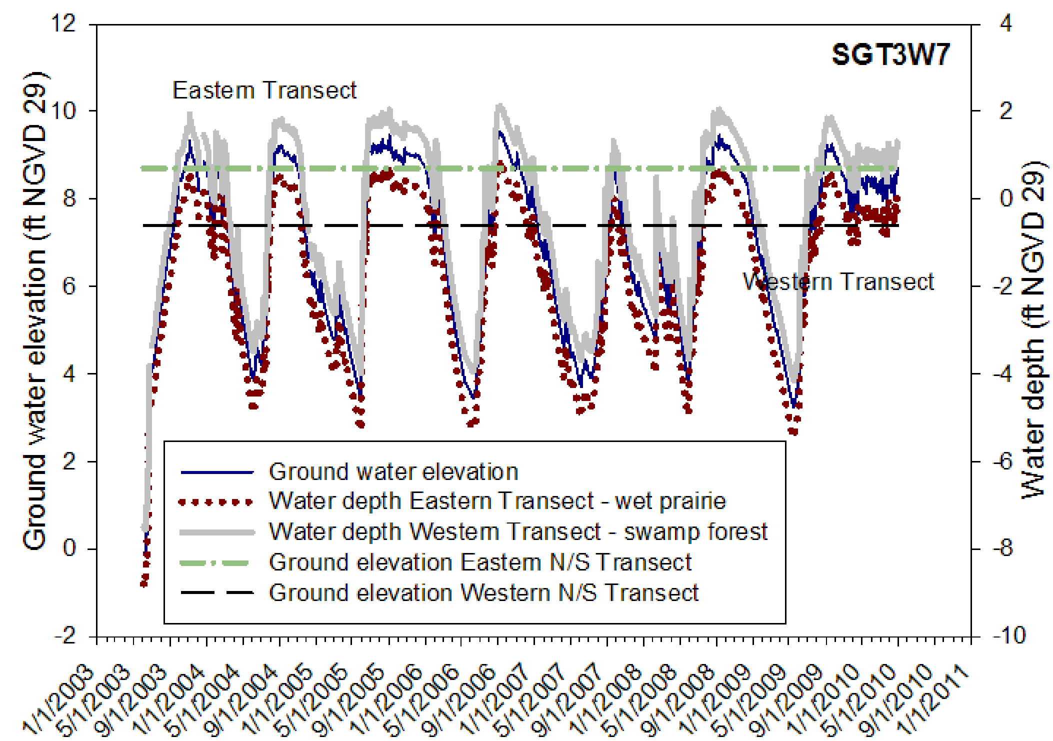

Figure 12. Ground elevation, groundwater elevation, and water depth for well SGT3W7.

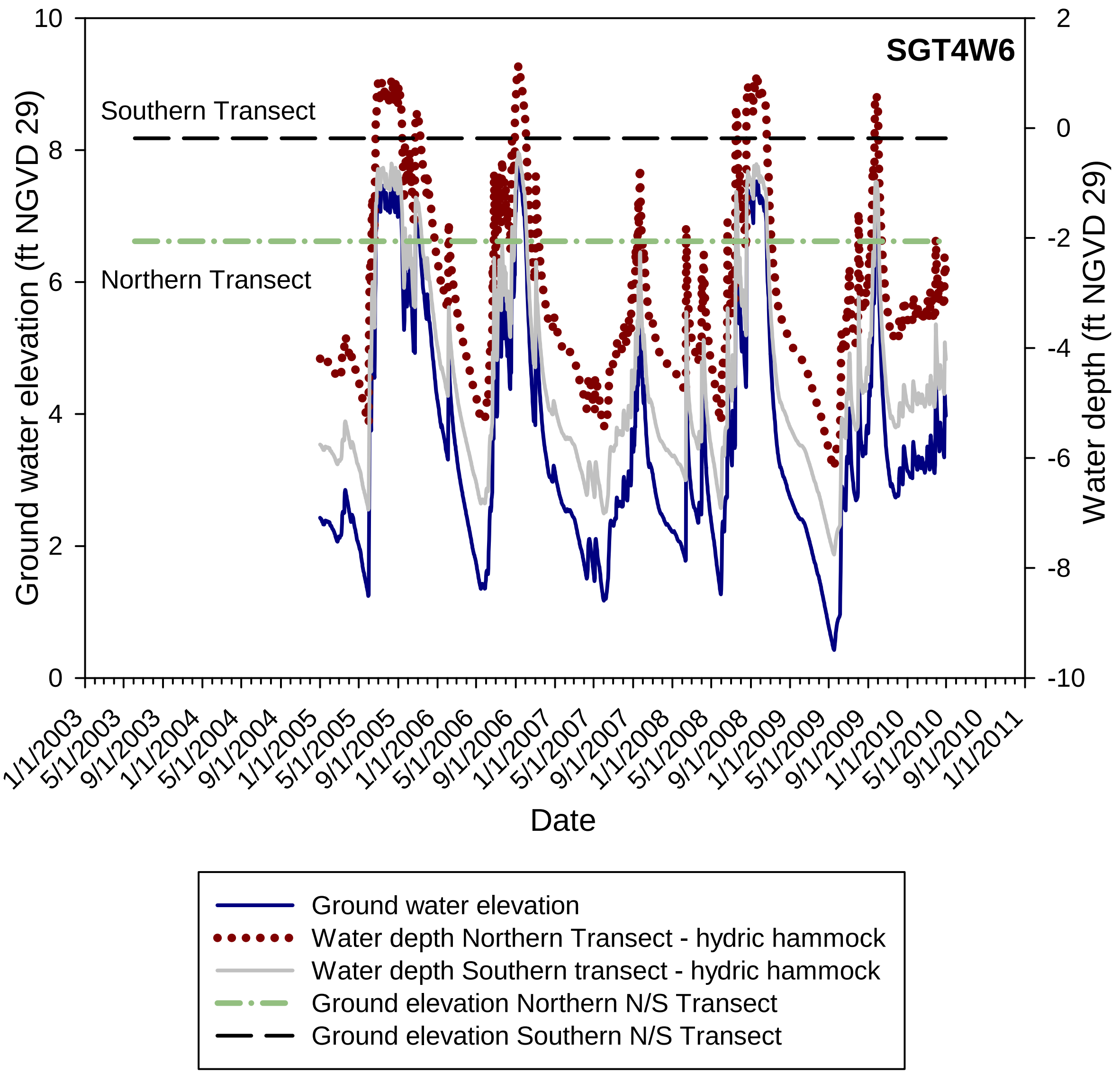

Figure 13. Ground elevation, groundwater elevation, and water depth for well SGT4W6.

WY2010 was an unusually wet dry season, which maintained relatively high water levels through the dry season compared to previous years. This fact coincides with improvements provided by filling drainage canals. A reference on natural systems hydrologic regime (hydroperiods and water depths) for the various plant communities of Picayune Strand is shown in **Table 7** (Duever, 2008).

Table 7. Hydrologic regimes of major southwest Florida plant communities.

Southwest Florida Plant Communities	Hydroperiod (months)	Seasonal Water Level (inches)	
		Wet	Dry (1,10)*
Xeric Flatwood	0	≤-24	-60, -90
Mesic Flatwood Mesic Hammock	≤1	≤2	-46, -76
Hydric Flatwood Hydric Hammock	1 - 2	2 - 6	-30, -60
Wet Prairie Dwarf Cypress	2 - 6	6 - 12	-24, -54
Marsh	6 - 10	12 - 24	-6, -46
Cypress	6 - 8	12 - 18	-16, -46
Swamp Forest	8 - 10	18 - 24	-6, -36
Open Water	>10	≥24	< 24, -6
Tidal Marsh Mangrove Beach	Tidal	Tidal	Tidal

* 1 = average year low water
10 = 1-in-10 year drought

HYDROLOGIC IMPROVEMENT

Figure 14 compares water levels between a well located next to Prairie Canal and a well located 2.5 miles to the east of Prairie Canal in Fakahatchee Strand Preserve State Park. Prior to the backfilling, Prairie Canal lowered adjacent water levels by up to 2 feet in the wet season (summer) and up to 5 feet in the dry season (spring). These canal drainage effects extended 1 to 3 miles into Fakahatchee Strand Preserve State Park. Hydrologic restoration from filling the Prairie Canal began in winter 2006-2007.

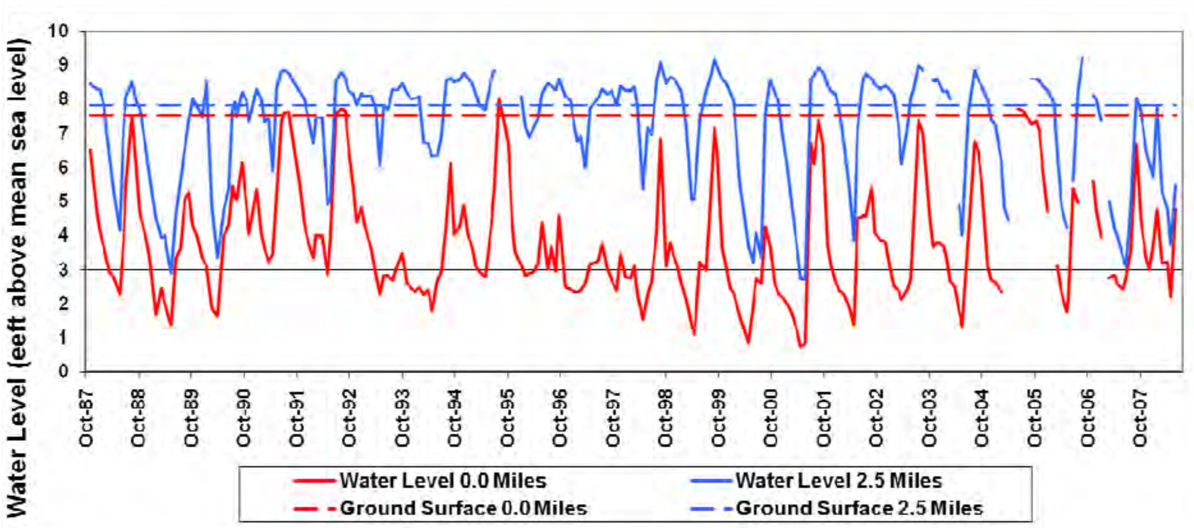

Figure 14. Shows water level and ground surface elevations over time at one well located next to Prairie Canal and one located 2.5 miles from Prairie Canal.

The effects of plugging Prairie Canal, road degradation, and management changes are apparent in **Figure 15**. The figure shows the difference in the water levels between the wells. The difference between the water levels decreased substantially once Prairie Canal was filled and roads were removed.

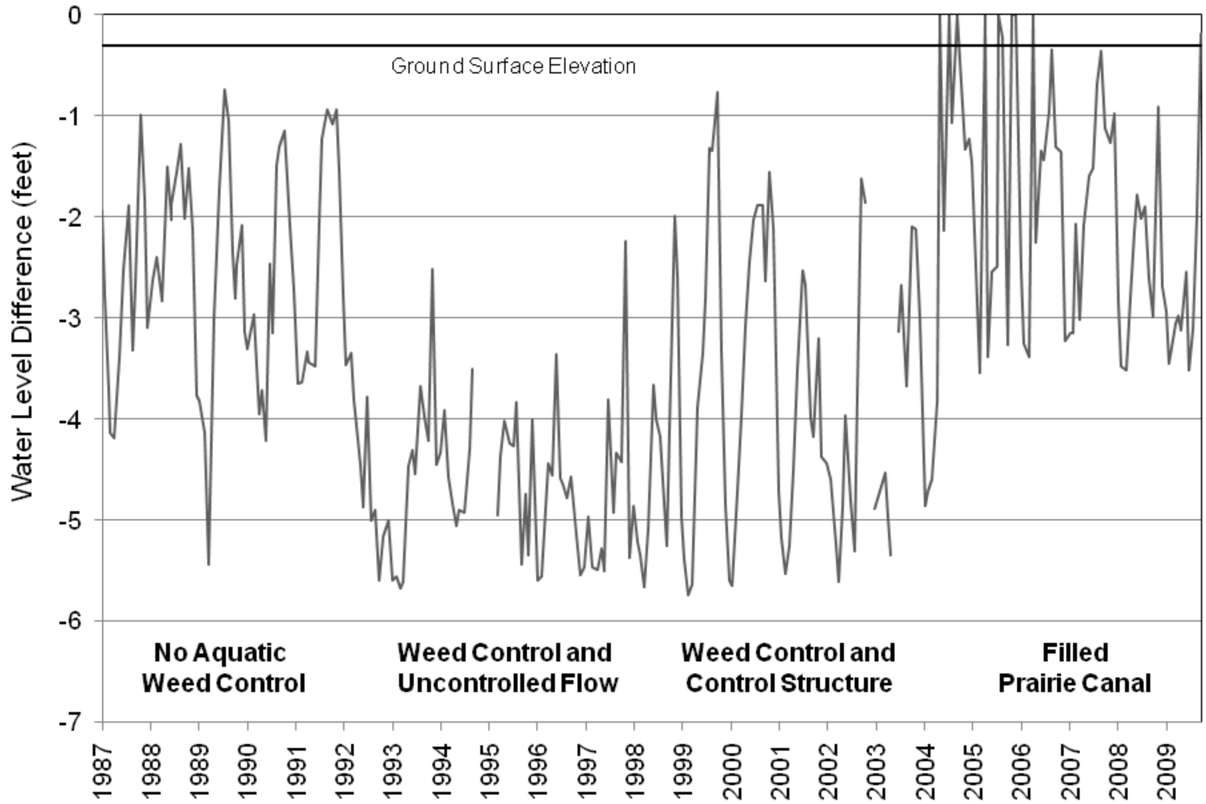

Figure 15. The differences in water levels and ground surface elevations between a well next to the Prairie Canal and another well 2.5 miles from the canal. The relationship to management and project changes are indicated.

Plugging the Prairie Canal and degradation of the roads to the west of the canal is only the first phase of the overall Picayune Strand Restoration Project. Completion of the next phase, which involves plugging Merritt Canal, is currently under way. Until this canal is plugged, the Phase 1 restored areas will continue to be drained. Plugging Merritt Canal will allow for the full hydrologic restoration of the Phase I area. These benefits are expected to be seen in future groundwater data once the Merritt Canal phase of the project is complete. Data for the Transect 2 graph (**Figure 16**), which is north of Transect 3, is from wells at the same latitude as those beginning with SGT2 in **Figure 6**. Data for the Transect 3 graph (**Figure 17**) is from wells at the same latitude as those beginning with SGT3 in **Figure 6**. These plots show reduced water level drawdowns in the Prairie Canal vicinity since it was filled compared to those near the Merritt Canal, which has not been filled, and halfway between the two canals.

The backfilling of Prairie Canal has decreased drawdowns in Fakahatchee Strand Preserve State Park as well. This can be seen by comparing water levels measured at 24 wells placed along two transects within the park (**Figure 18**) and comparing the drawdowns experienced in 2003 for the North (**Figure 19**) and South (**Figure 20**) Transects to those in 2008 (**Figure 21** and **Figure 22**) and 2009 (**Figure 23** and **Figure 24**). Prior to the filling and plugging of the canal, water levels of those closest to the canal were lower than those more than 5 miles from the canal. This is especially true during the dry season. The difference in water levels between the west and east end of each transect should lessen even more once Merritt Canal is filled.

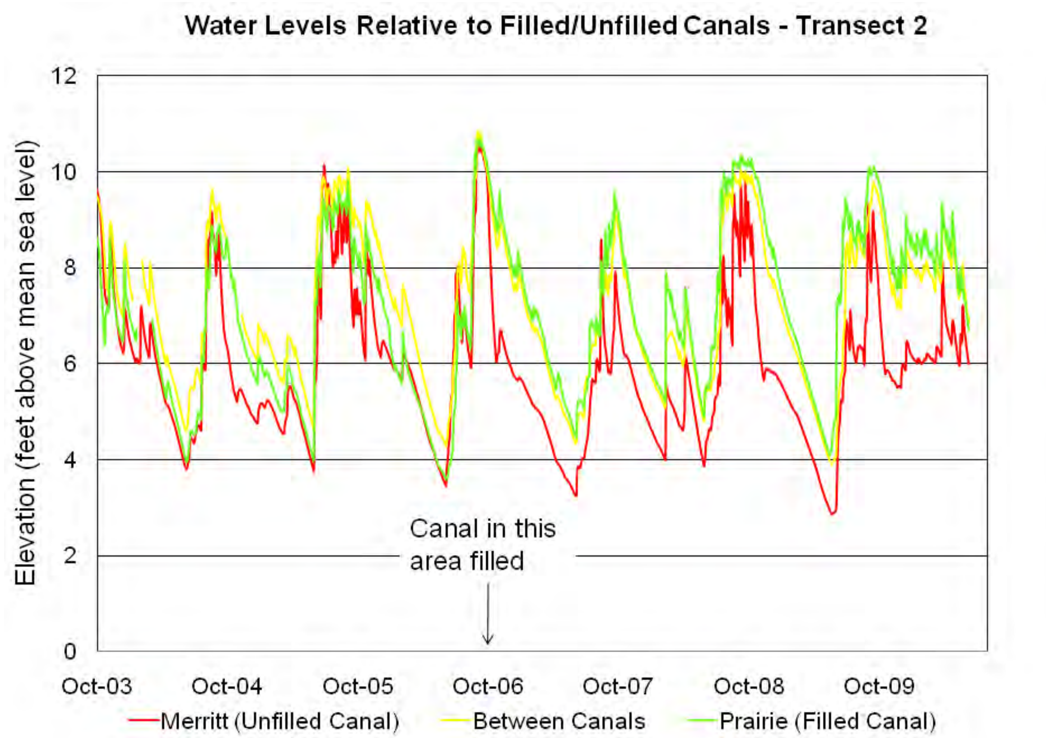

Figure 16. Transect 2 water levels relative to filled and unfilled canals.

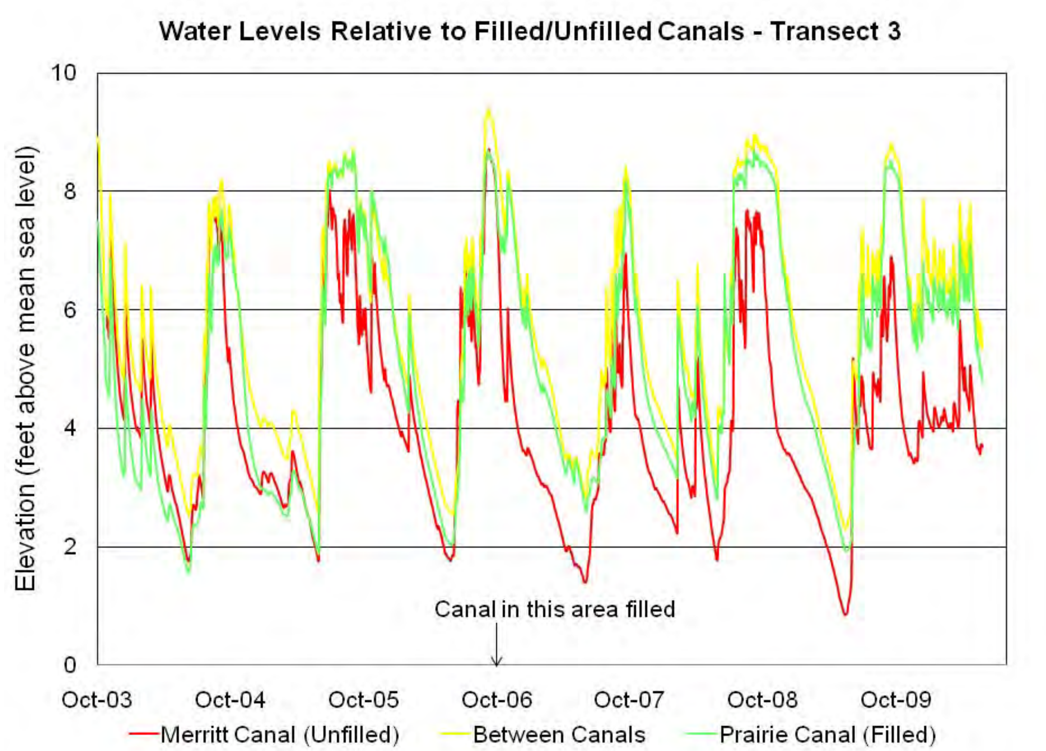

Figure 17. Transect 3 water levels relative to filled and unfilled canals.

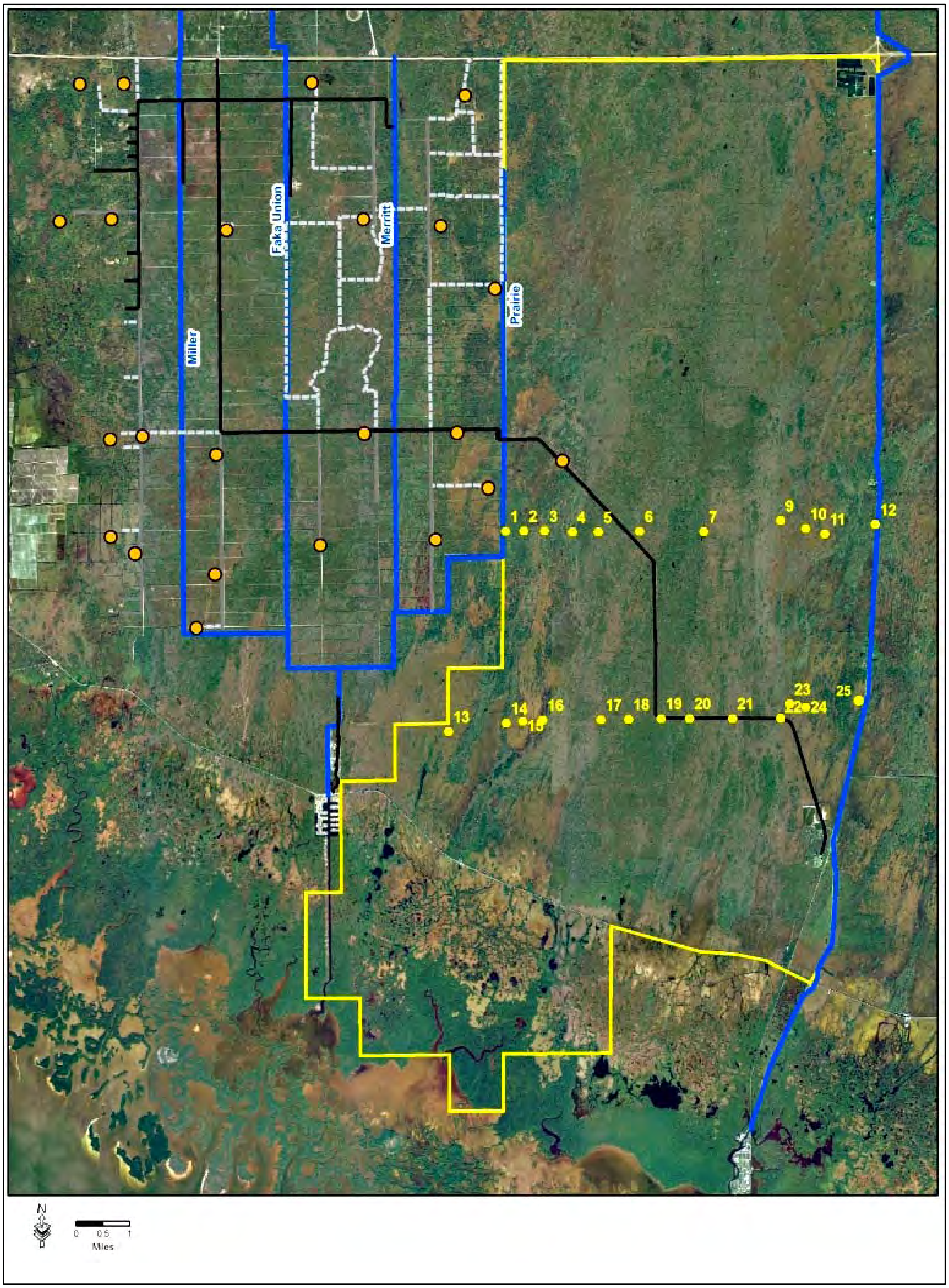

Figure 18. Yellow dots indicate groundwater wells within Fakahatchee Strand Preserve State Park. Orange dots indicate the wells shown in **Figure 6.**

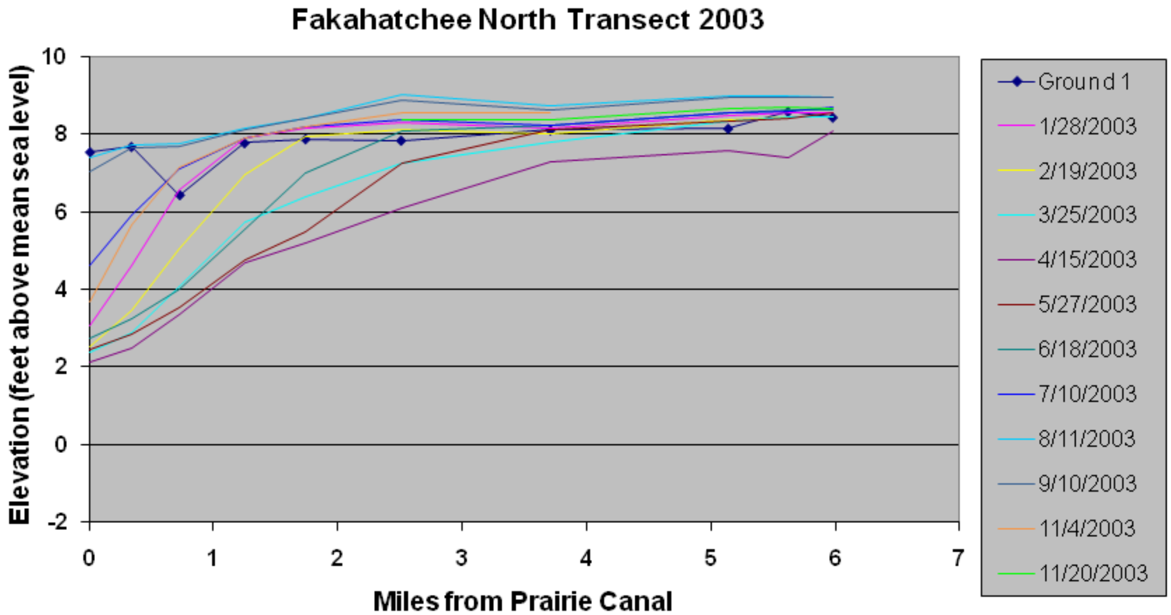

Figure 19. 2003 monthly water profiles (January–December) for Fakahatchee Strand Preserve State Park North Transect.

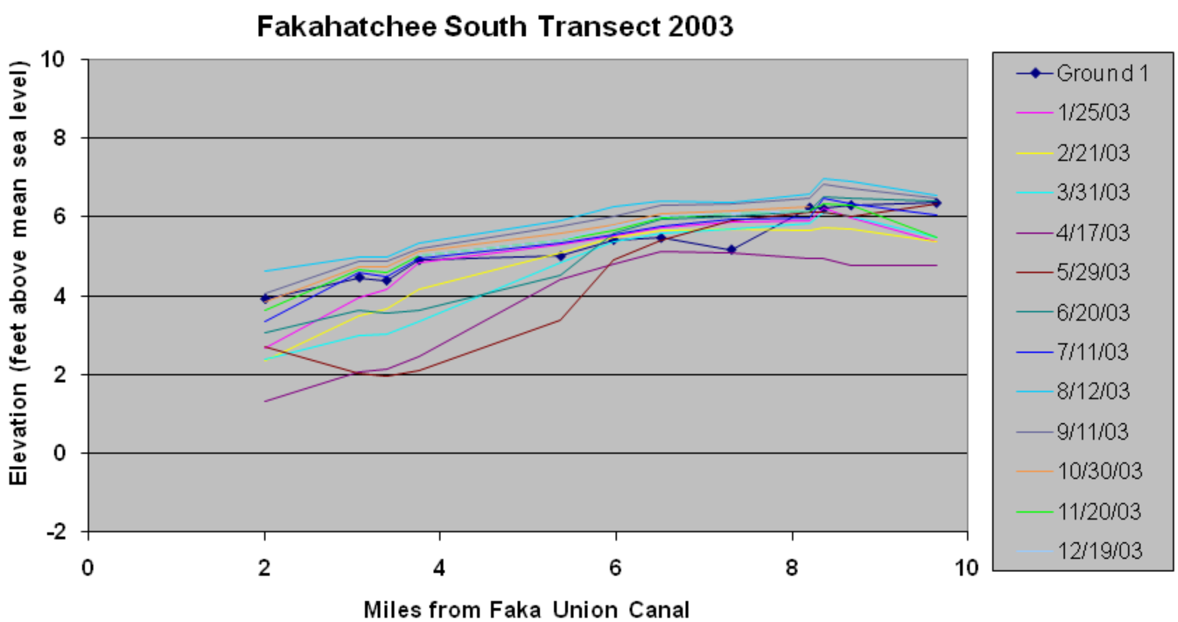

Figure 20. 2003 monthly water profiles (January–December) for Fakahatchee Strand Preserve State Park South Transect.

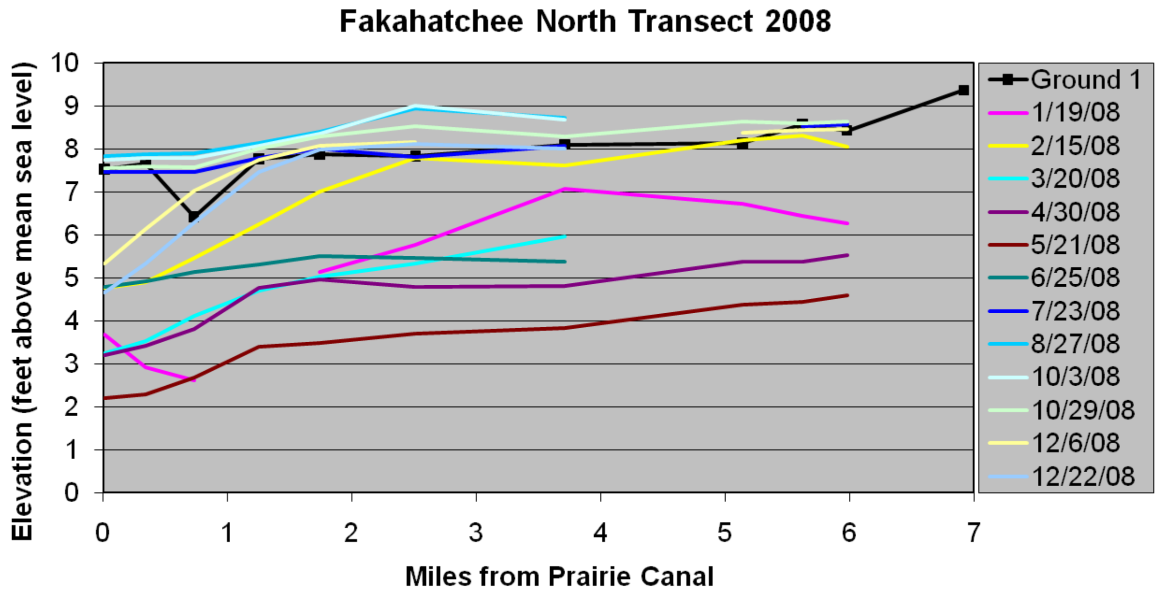

Figure 21. 2008 monthly water profiles (January–December) for Fakahatchee Strand Preserve State Park North Transect.

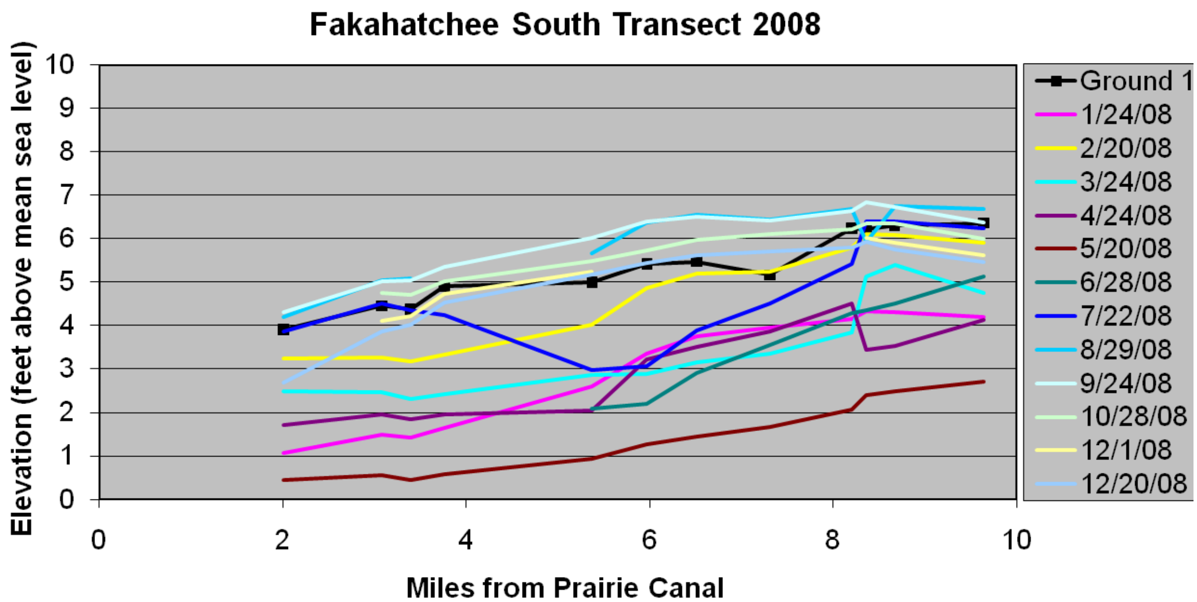

Figure 22. 2008 monthly water profiles (January–December) for Fakahatchee Strand Preserve State Park South Transect.

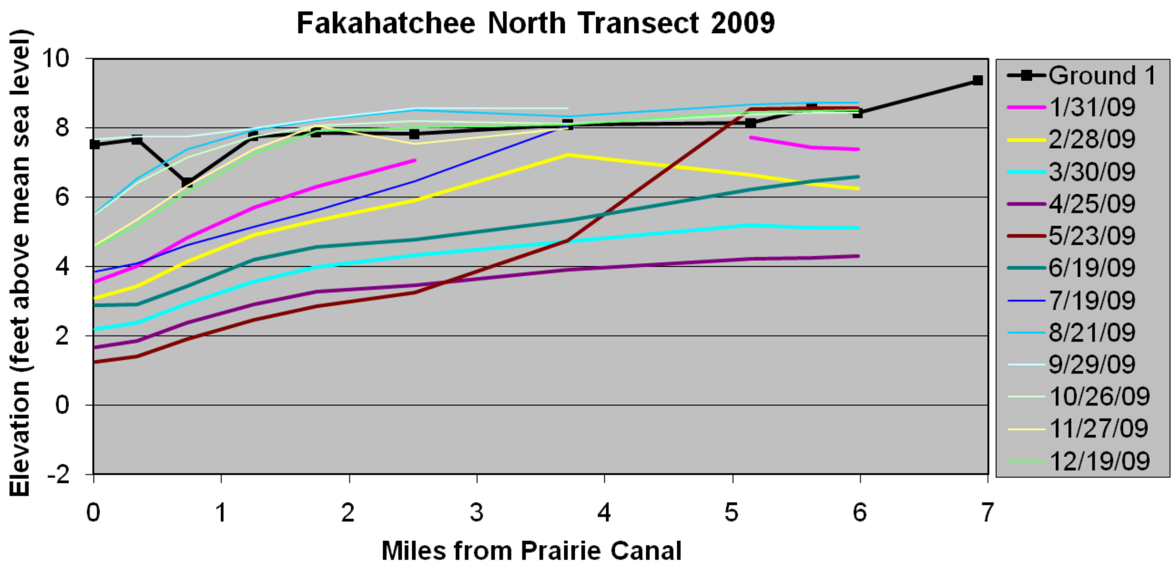

Figure 23. 2009 monthly water profiles (January–December) for Fakahatchee Strand Preserve State Park North Transect.

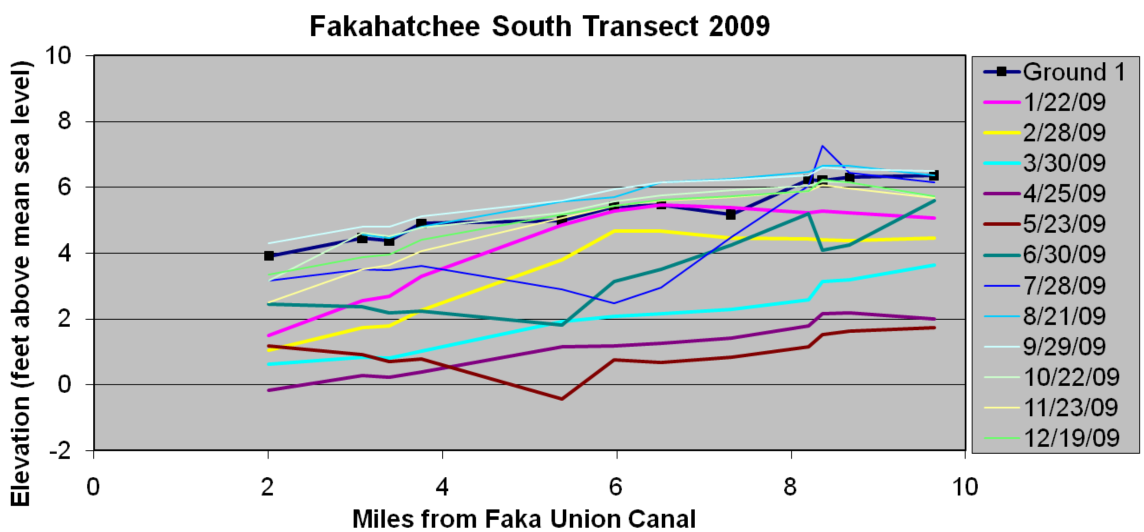

Figure 24. 2008 monthly water profiles (January–December) for Fakahatchee Strand Preserve State Park South Transect.

WATER QUALITY MONITORING

For the Prairie Canal Backfilling and Road Removal phase of the project, when water is flowing, water quality is measured at the same seven stations as water levels (**Figure 6** and **Table 6)**. In past reports, the post-construction water quality reporting for this phase of the project was incomplete. As a result, water quality monitoring data for WY2007 through WY2010 are reported in this document.

Tables 8 through **14** summarize the water quality data for each station for WY2007 through WY2010. Backfilling of the Prairie Canal began prior to these water years. As a result, water was not flowing at many of these stations during monitoring events and water quality monitoring was not conducted.

Data used in these analyses are provided as **Attachment C**. These data were compared to Florida's surface water quality standards in Chapter 62-302.530 Florida Administrative Code for Class III waters. Only dissolved oxygen and total iron had excursions from Class III standards. Dissolved oxygen was generally low, ranging from 0.7 to 6.4 milligrams per liter (mg/L) and averaging 2.3 mg/L. All but one of the 25 dissolved oxygen measurements were below 5 mg/L. **Table 15** shows the 7 total iron measurements that were above the 1.0 mg/L Class III standard.

Table 8. Water quality data summary for station SGT1W5 (WY2007–WY2010).

Parameter[1]	Units[2]	Water Year	Number of Samples	Minimum	Maximum	Average
Ammonia (as N)	mg N/L	WY2007	1			0.030
Biochemical Oxygen Demand	mg/L	WY2007	1			<0.78
Chlorophyll-*a*	µg/L	WY2007	1			<3
Dissolved Calcium	mg/L	WY2007	1			95.90
Dissolved Magnesium	mg/L	WY2007	1			2.06
Dissolved Oxygen	mg/L	WY2007	1			3.32
Dissolved Silica	mg/L	WY2007	1			3.5
Field pH	SU	WY2007	1			7.22
Specific Conductance	µS/cm	WY2007	1			483
Hardness (as $CaCO_3$)	mg $CaCO_3$/L	WY2007	1			248
Nitrate/Nitrite (as N)	mg N/L	WY2007	1			0.010
Nitrite (as N)	mg N/L	WY2007	1			<0.002
Ortho-Phosphate (as P)	mg P/L	WY2007	1			<0.004
Phaeophytin-*a*	µg/L	WY2007	1			<3
Salinity	psu	WY2007	1			0.23
Sulfate	mg/L	WY2007	1			<1
Temperature	°C	WY2007	1			28.5
Total Dissolved Solids	mg/L	WY2007	1			244
Total Kjeldahl Nitrogen	mg/L	WY2007	1			0.23
Total Manganese	µg/L	WY2007	1			12.00
Total Phosphorus	mg/L	WY2007	1			0.013
Total Suspended Solids	mg/L	WY2007	1			<2

[1]Parameter Key: $CaCo_3$ – calcium carbonate; N – nitrogen; P – phosphorus

[2]Unit Key: °C – degrees Celsius; $CaCo_3$ – calcium carbonate; cm – centimeter; L – liter; mg – milligram; N – nitrogen; P – phosphorus; psu – practical salinity units; SU – standard unit; µg – micrograms; µS - microsiemens

Table 9. Water quality data summary for station SGT2W5 (WY2007–WY2010).

Parameter	Units	Water Year	Number of Samples	Minimum	Maximum	Average
Alkalinity (as $CaCO_3$)	mg $CaCO_3$/L	WY2007	1			239
		WY2008	3	222	240	233
		WY2009	3	218	248	229
		WY2010	1			216
Ammonia (as N)	mg N/L	WY2007	3	<0.01	0.050	0.035
		WY2008	3	0.020	0.050	0.033
		WY2009	3	<0.018	0.020	0.013
		WY2010	1			0.012
Biochemical Oxygen Demand	mg/L	WY2007	2	<0.78	<0.78	<0.78
		WY2008	2	<2	5.03	3.02
		WY2009	1			4.00
		WY2010	1			4.40
Chlorophyll-*a*	µg/L	WY2007	2	3.0	6.9	5.0
		WY2008	1			11.2
Chlorophyll-*a* (corrected)	µg/L	WY2008	2	5.3	27.8	16.6
		WY2009	1			<3
		WY2010	1			6.4
Dissolved Calcium	mg/L	WY2007	3	62.20	107.70	81.67
		WY2008	3	78.00	90.00	84.30
		WY2009	3	87.00	99.70	94.03
		WY2010	1			47.30
Dissolved Magnesium	mg/L	WY2007	3	2.28	3.00	2.54
		WY2008	3	2.85	4.80	3.50
		WY2009	3	2.01	2.08	2.04
		WY2010	1			3.01
Dissolved Oxygen	mg/L	WY2007	2	2.04	3.54	2.79
		WY2008	2	1.79	2.37	2.08
		WY2009	3	0.98	2.42	1.92
		WY2010	1			1.81
Dissolved Silica	mg/L	WY2007	3	4.1	6.2	4.8
		WY2008	2	3.8	9.6	6.7
		WY2009	3	3.6	3.7	3.6
		WY2010	1			5.0
Field pH	SU	WY2007	3	7.31	7.34	7.33
		WY2008	2	7.24	7.32	7.28
		WY2009	3	6.97	7.21	7.07
		WY2010	1			7.50
Specific Conductance	µS/cm	WY2007	3	385	544	482
		WY2008	1			480
		WY2009	2	487	492	490
Hardness (as $CaCO_3$)	mg $CaCO_3$/L	WY2007	2	165	197	181
		WY2008	1			240
		WY2009	2	250	260	255
Nitrate (as N)	mg N/L	WY2009	3	<0.002	<0.002	<0.002
		WY2010	1			<0.002
Nitrate/Nitrite (as N)	mg N/L	WY2007	3	<0.01	0.010	0.007
		WY2008	3	<0.003	<0.003	0.005
		WY2009	3	<0.003	<0.003	<0.003
		WY2010	1			0.002

Table 9. Continued.

Parameter	Units	Water Year	Number of Samples	Minimum	Maximum	Average
Nitrite (as N)	mg N/L	WY2007	3	<0.002	0.004	0.002
		WY2008	3	0.002	0.005	0.003
		WY2009	3	<0.002	0.002	<0.002
		WY2010	1			0.003
Ortho-Phosphate (as P)	mg P/L	WY2007	3	<0.004	0.020	0.008
		WY2008	3	0.004	0.330	0.121
		WY2009	3	<0.004	<0.004	<0.004
		WY2010	1			0.034
Phaeophytin-*a*	µg/L	WY2007	3	<3	3.2	<3
		WY2008	3	<3	19.7	8.4
		WY2009	1			3.3
		WY2010	1			3.0
Salinity	psu	WY2007	3	0.18	0.26	0.23
		WY2008	2	0.23	0.29	0.26
		WY2009	3	0.22	0.24	0.23
		WY2010	1			0.23
Sulfate	mg/L	WY2007	3	<1	11.7	4.5
		WY2008	3	<1	40.0	17.4
		WY2009	3	<1	<1	<1
		WY2010	1			21.8
Temperature	°C	WY2007	3	20.1	26.7	24.0
		WY2008	2	25.4	27.9	26.7
		WY2009	3	17.9	26.2	22.9
		WY2010	1			26.3
Total Dissolved Solids	mg/L	WY2007	3	222	310	262
		WY2008	3	130	334	253
		WY2009	3	228	310	259
Total Kjeldahl Nitrogen	mg/L	WY2007	3	0.33	0.64	0.43
		WY2008	3	0.62	2.24	1.61
		WY2009	3	0.41	0.58	0.52
		WY2010	1			0.73
Total Manganese	µg/L	WY2007	3	9.00	26.00	15.00
		WY2008	1			21.00
		WY2009	2	8.89	15.00	11.95
		WY2010	1			39.01
Total Phosphorus	mg/L	WY2007	3	0.019	0.040	0.033
		WY2008	3	0.054	0.489	0.203
		WY2009	3	0.020	0.041	0.029
		WY2010	1			0.147
Total Suspended Solids	mg/L	WY2007	3	<2	5	3
		WY2008	3	2	17	12
		WY2009	3	<2	2	<2
		WY2010	1			3

Table 10. Water quality data summary for station SGT2W6 (WY2007–WY2010).

Parameter	Units	Water Year	Number of Samples	Minimum	Maximum	Average
Alkalinity (as $CaCO_3$)	mg $CaCO_3$/L	WY2009	2	162	198	180
Ammonia (as N)	mg N/L	WY2009	2	0.020	0.089	0.054
Biochemical Oxygen Demand	mg/L	WY2009	1			<2
Dissolved Calcium	mg/L	WY2009	2	60.80	62.20	61.50
Dissolved Magnesium	mg/L	WY2009	2	2.84	2.96	2.90
Dissolved Oxygen	mg/L	WY2009	2	1.03	1.13	1.08
Dissolved Silica	mg/L	WY2009	2	2.5	4.3	3.4
Field pH	SU	WY2009	2	7.34	7.43	7.39
Specific Conductance	µS/cm	WY2009	1			393
Hardness (as $CaCO_3$)	mg $CaCO_3$/L	WY2009	1			170
Nitrate/Nitrite (as N)	mg N/L	WY2009	2	<0.003	<0.003	<0.003
Nitrite (as N)	mg N/L	WY2009	2	<0.003	<0.003	<0.003
Ortho-Phosphate (as P)	mg P/L	WY2009	2	0.002	0.002	0.002
Phaeophytin-*a*	µg/L	WY2009	2	<0.004	<0.004	<0.004
Salinity	psu	WY2009	2	0.17	0.19	0.18
Sulfate	mg/L	WY2009	2	<1	<1	<1
Temperature	°C	WY2009	2	27.3	30.3	28.8
Total Dissolved Solids	mg/L	WY2009	2	122	204	163
Total Kjeldahl Nitrogen	mg/L	WY2009	2	0.56	0.75	0.66
Total Manganese	µg/L	WY2009	1			23.00
Total Phosphorus	mg/L	WY2009	2	0.017	0.017	0.017
Total Suspended Solids	mg/L	WY2009	2	<2	<2	<2

Table 11. Water quality data summary for station SGT3W5 (WY2007–WY2010).

Parameter	Units	Water Year	Number of Samples	Minimum	Maximum	Average
Alkalinity (as $CaCO_3$)	mg $CaCO_3$/L	WY2007	1			186
		WY2008	1			242
		WY2009	3	144	200	179
Ammonia (as N)	mg N/L	WY2007	1			0.040
		WY2008	1			0.070
		WY2009	2	0.067	0.131	0.099
Biochemical Oxygen Demand	mg/L	WY2007	1			3.00
		WY2008	1			12.60
		WY2009	1			4.10
Chlorophyll-*a*	µg/L	WY2007	1			3.2
Chlorophyll-*a* (corrected)	µg/L	WY2008	1			<3
Dissolved Calcium	mg/L	WY2007	1			72.90
		WY2008	1			80.00
		WY2009	3	57.80	78.50	70.77
Dissolved Magnesium	mg/L	WY2007	1			3.09
		WY2008	1			2.90
		WY2009	3	2.49	2.72	2.60
Dissolved Oxygen	mg/L	WY2007	1			1.46
		WY2009	3	0.70	1.28	0.91
Dissolved Silica	mg/L	WY2007	1			5.8
		WY2009	3	4.1	4.2	4.2
Field pH	SU	WY2007	1			7.05
		WY2009	3	6.77	6.95	6.89
Specific Conductance	µS/cm	WY2007	1			412
		WY2009	2	372	462	417
Hardness (as $CaCO_3$)	mg $CaCO_3$/L	WY2007	1			195
		WY2009	2	160	210	185
Nitrate (as N)	mg N/L	WY2009	3	<0.003	<0.003	<0.003
Nitrate/Nitrite (as N)	mg N/L	WY2007	1			0.020
		WY2008	1			<0.01
		WY2009	3	<0.003	0.003	<0.003

Table 11. Continued.

Parameter	Units	Water Year	Number of Samples	Minimum	Maximum	Average
Nitrite (as N)	mg N/L	WY2007	1			<0.002
		WY2008	1			0.003
		WY2009	3	0.002	0.004	0.003
Ortho-Phosphate (as P)	mg P/L	WY2007	1			0.008
		WY2008	1			0.030
		WY2009	3	<0.004	0.012	0.006
Phaeophytin-*a*	µg/L	WY2007	1			<3
		WY2008	1			<3
Salinity	psu	WY2007	1			0.20
		WY2009	3	0.18	0.22	0.21
Sulfate	mg/L	WY2007	1			<1
		WY2008	1			10.7
		WY2009	3	<1.0	1.1	<1.0
Temperature	°C	WY2007	1			26.9
		WY2009	3	25.3	27.6	26.8
Total Dissolved Solids	mg/L	WY2007	1			190
		WY2008	1			312
		WY2009	3	196	286	234
Total Kjeldahl Nitrogen	mg/L	WY2007	1			0.86
		WY2008	1			0.72
		WY2009	3	0.69	0.82	0.74
Total Manganese	µg/L	WY2007	1			47.00
		WY2009	3	29.00	41.00	34.23
Total Phosphorus	mg/L	WY2007	1			0.056
		WY2008	1			0.053
		WY2009	3	0.030	0.046	0.039
Total Suspended Solids	mg/L	WY2007	1			<2
		WY2008	1			6
		WY2009	3	<2	37	14

Table 12. Water quality data summary for station SGT3W6 (WY2007–WY2010).

Parameter	Units	Water Year	Number of Samples	Minimum	Maximum	Average
Alkalinity (as $CaCO_3$)	mg $CaCO_3$/L	WY2007	1			191
		WY2009	2	142	150	146
Ammonia (as N)	mg N/L	WY2007	1			0.050
		WY2009	2	<0.018	0.076	0.042
Biochemical Oxygen Demand	mg/L	WY2007	1			<0.78
		WY2009	1			<2
Chlorophyll-*a*	µg/L	WY2007	1			<3
Dissolved Calcium	mg/L	WY2007	1			80.10
		WY2009	2	57.40	84.20	70.80
Dissolved Magnesium	mg/L	WY2007	1			1.94
		WY2009	2	2.04	2.18	2.11
Dissolved Oxygen	mg/L	WY2007	1			3.06
		WY2009	2	2.36	6.40	4.38
Dissolved Silica	mg/L	WY2007	1			3.8
		WY2009	2	3.4	4.1	3.8
Field pH	SU	WY2007	1			7.10
		WY2009	2	7.21	7.61	7.41
Specific Conductance	µS/cm	WY2007	1			446
		WY2009	1			501
Hardness (as $CaCO_3$)	mg $CaCO_3$/L	WY2007	1			208
		WY2009	1			220
Nitrate (as N)	mg N/L	WY2009	2	<0.003	<0.003	<0.003
Nitrate/Nitrite (as N)	mg N/L	WY2009	2	<0.003	<0.003	<0.003
Nitrite (as N)	mg N/L	WY2007	1			<0.002
		WY2009	2	<0.002	0.002	<0.002
Ortho-Phosphate (as P)	mg P/L	WY2007	1			<0.004
		WY2009	2	<0.004	<0.004	<0.004

Table 12. Continued.

Parameter	Units	Water Year	Number of Samples	Minimum	Maximum	Average
Phaeophytin-*a*	µg/L	WY2007	1			<3
Salinity	psu	WY2007	1			0.21
		WY2009	2	0.16	0.24	0.20
Sulfate	mg/L	WY2007	1			10.4
		WY2009	2	<1	6.0	3.3
Temperature	°C	WY2007	1			27.3
		WY2009	2	30.6	35.5	33.1
Total Dissolved Solids	mg/L	WY2007	1			210
		WY2009	2	166	186	176
Total Kjeldahl Nitrogen	mg/L	WY2007	1			0.27
		WY2009	2	0.57	0.80	0.69
Total Manganese	µg/L	WY2007	1			47.00
		WY2009	1			7.60
Total Phosphorus	mg/L	WY2007	1			0.011
		WY2009	2	0.017	0.022	0.020
Total Suspended Solids	mg/L	WY2007	1			<2
		WY2009	2	<2	3	2

Table 13. Water quality data summary for station SGT3W7 (WY2007–WY2010).

Parameter	Units	Water Year	Number of Samples	Minimum	Maximum	Average
Alkalinity (as $CaCO_3$)	mg $CaCO_3$/L	WY2007	1			156
		WY2009	3	134	182	162
Ammonia (as N)	mg N/L	WY2007	1			0.030
		WY2009	2	0.038	0.073	0.056
Biochemical Oxygen Demand	mg/L	WY2007	1			<0.78
		WY2009	1			4.20
Chlorophyll-*a*	µg/L	WY2007	1			<3
Dissolved Calcium	mg/L	WY2007	1			71.00
		WY2009	3	52.80	80.20	67.60
Dissolved Magnesium	mg/L	WY2007	1			2.91
		WY2009	3	2.76	3.43	3.20
Dissolved Oxygen	mg/L	WY2007	1			4.68
		WY2009	3	2.04	3.74	2.63
Dissolved Silica	mg/L	WY2007	1			6.1
		WY2009	3	1.8	6.0	4.4
Field pH	SU	WY2007	1			7.38
		WY2009	3	7.14	7.39	7.28
Specific Conductance	µS/cm	WY2007	1			350
		WY2009	2	398	422	410
Hardness (as $CaCO_3$)	mg $CaCO_3$/L	WY2007	1			189
		WY2009	2	190	210	200
Nitrate (as N)	mg N/L	WY2009	3	<0.003	<0.003	<0.003
Nitrate/Nitrite (as N)	mg N/L	WY2007	1			0.020
		WY2009	3	<0.003	0.003	<0.003
Nitrite (as N)	mg N/L	WY2007	1			<0.002
		WY2009	3	0.002	0.005	0.003
Ortho-Phosphate (as P)	mg P/L	WY2007	1			<0.004
		WY2009	3	<0.004	<0.004	<0.004

Table 13. Continued.

Parameter	Units	Water Year	Number of Samples	Minimum	Maximum	Average
Phaeophytin-*a*	µg/L	WY2007	1			<3
Salinity	psu	WY2007	1			0.16
		WY2009	3	0.16	0.20	0.18
Sulfate	mg/L	WY2007	1			<1
		WY2009	3	<1	2.8	1.3
Temperature	°C	WY2007	1			29.6
		WY2009	3	26.0	31.7	28.8
Total Dissolved Solids	mg/L	WY2007	1			168
		WY2009	3	190	266	227
Total Kjeldahl Nitrogen	mg/L	WY2007	1			0.80
		WY2009	3	0.28	0.93	0.63
Total Manganese	µg/L	WY2007	1			74.00
		WY2009	3	22.00	61.98	40.99
Total Phosphorus	mg/L	WY2007	1			0.020
		WY2009	3	0.023	0.041	0.032
Total Suspended Solids	mg/L	WY2007	1			<2
		WY2009	3	12	69	48

Table 14. Water quality data summary for station SGT4W6 (WY2007–WY2010).

Parameter	Units	Water Year	Number of Samples	Minimum	Maximum	Average
Alkalinity (as $CaCO_3$)	mg $CaCO_3$/L	WY2007	1			190
		WY2009	2	148	166	157
Ammonia (as N)	mg N/L	WY2007	1			0.050
		WY2009	2	0.050	0.105	0.078
Biochemical Oxygen Demand	mg/L	WY2007	1			2.00
		WY2009	1			2.70
Chlorophyll-*a*	µg/L	WY2007	1			<3
Dissolved Calcium	mg/L	WY2007	1			80.80
		WY2009	2	55.20	66.00	60.60
Dissolved Magnesium	mg/L	WY2007	1			2.58
		WY2009	2	2.40	2.48	2.44
Dissolved Oxygen	mg/L	WY2007	1			1.48
		WY2009	2	2.28	3.17	2.73
Dissolved Silica	mg/L	WY2007	1			6.4
		WY2009	2	2.8	4.9	3.9
Field pH	SU	WY2007	1			7.25
		WY2009	2	7.46	7.56	7.51
Specific Conductance	µS/cm	WY2007	1			399
		WY2009	1			381
Hardness (as $CaCO_3$)	mg $CaCO_3$/L	WY2007	1			212
		WY2009	1			170
Nitrate (as N)	mg N/L	WY2009	2	<0.003	<0.003	<0.003
Nitrate/Nitrite (as N)	mg N/L	WY2007	1			0.010
		WY2009	2	<0.003	<0.003	<0.003
Nitrite (as N)	mg N/L	WY2007	1			<0.002
		WY2009	2	<0.002	0.002	<0.002
Ortho-Phosphate (as P)	mg P/L	WY2007	1			0.008
		WY2009	2	<0.004	<0.004	<0.004

Table 14. Continued.

Parameter	Units	Water Year	Number of Samples	Minimum	Maximum	Average
Phaeophytin-*a*	µg/L	WY2007	1			<3
Salinity	psu	WY2007	1			0.19
		WY2009	2	0.16	0.18	0.17
Sulfate	mg/L	WY2007	1			<1
		WY2009	2	<1	<1	<1
Temperature	°C	WY2007	1			25.5
		WY2009	2	28.1	31.5	29.8
Total Dissolved Solids	mg/L	WY2007	1			188
		WY2009	2	140	188	164
Total Kjeldahl Nitrogen	mg/L	WY2007	1			0.79
		WY2009	2	0.71	0.77	0.74
Total Manganese	µg/L	WY2007	1			58.00
		WY2009	1			300.00
Total Phosphorus	mg/L	WY2007	1			0.040
		WY2009	2	0.015	0.023	0.019
Total Suspended Solids	mg/L	WY2007	1			<2
		WY2009	2	<2	<2	<2

Table 15. Total iron excursions.

Sample ID	Station ID	Date Collected	Value (mg/L)
08082731-07	SGT3W5	08/27/08	1.07
08091732-02	SGT3W5	09/17/08	1.00
08101531-02	SGT3W5	10/15/08	1.47
06092731-04	SGT3W7	09/27/06	2.10
08091732-01	SGT3W7	09/17/08	1.06
08101531-01	SGT3W7	10/15/08	1.69
08092931-08	SGT3W6	09/29/08	1.11

VEGETATION TRANSECT MONITORING

Vegetation is monitored along three series of 10 transects that transverse the filled canal (**Figure 25**) with half of the sites within the Picayune Strand Restoration Area and the other half in Fakahatchee Strand Preserve State Park. These sites are considered restored sites. In addition, five control sites are located within areas of Fakahatchee Strand Preserve State Park that were not affected by Prairie Canal drawdowns. Six additional control sites are within the Florida Panther National Wildlife Refuge, which is north of the Picayune and Fakahatchee Strands (**Figure 1**).

Data collected and analyses provided include time since fire; plant identification; density and basal area of tree species with special attention to cabbage palms (*Sabal palmetto*); shrub cover with special attention to Brazilian pepper (*Schinus terebinthifolius*) and cabbage palms; cabbage palm coverage within lower strata; overall species richness, composition, structure and cover; wetland affinity index; floristic quality index; and wind damage. The wetland affinity index (Gilbert et al., 1996) is used to assist with evaluating the effects of hydrological conditions on the plant communities. The floristic quality index is based on species-specific degrees of fidelity to habitats and quality of habitats as well as tolerance to disturbance and species richness (Mortellaro et al., 2009). In addition, analyses are performed to determine the effects of management regimes and fire on the vegetation. Wind damage was primarily due to Hurricane Wilma, which passed directly over the study area on October 24, 2005.

The most recent vegetation monitoring results available are for WY2009 (May 1, 2008–April 30, 2009). In general, it is too early to quantify restoration of vegetation, especially because of drought. Some subtle increases were observed in ground cover (as measured by wetland affinity index) in wet prairie and cypress transects at restored sites. These increases were due to lengthened hydroperiod. Encouraging restoration effects on woody vegetation were confined primarily to two cypress habitat transects (PC25 and PC26) adjacent to the southern end of the filled canal. Flooding of the area killed mature Brazilian pepper and cabbage palm seedlings. The report containing the data and analyses for WY2009 vegetation transect monitoring (Barry et al., 2009) is provided as **Attachment D**.

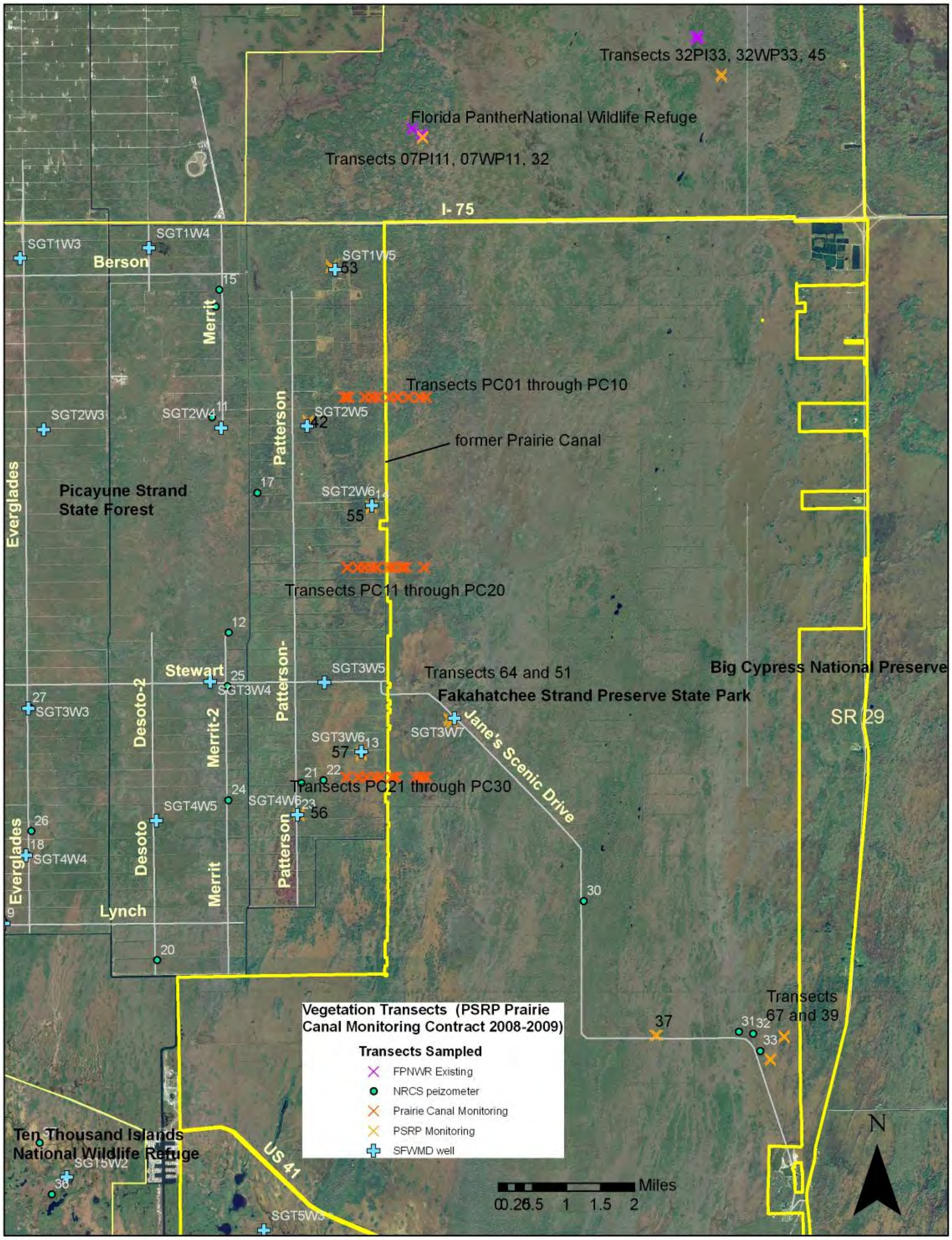

Figure 25. Location of restored and control site transects used for Picayune Strand Restoration Project vegetation monitoring.

EXOTICS MAPPING AND CONTROL

Exotic and nuisance vegetation is mapped within the footprint of the filled Prairie Canal and the cleared road and house demolition footprints east of Merritt Canal and control efforts are conducted. Two Restored Footprint Exotics Mapping and Control Coordination annual reports (Barry, 2009, 2010) are summarized in this appendix and are provided as **Attachment E** and **Attachment F**, respectively. The 2009 report covers the period from October 1, 2008–September 30, 2009. The 2010 report covers the period from October 1, 2009–September 30, 2010.

Brazilian pepper has been the top priority for treatment. For 2008 through 2009, total cover of this invasive species and treatment using Garlon IV are provided in **Figure 26** and **Figure 27**, respectively. Initial treatments for the entire footprint were nearly completed prior to October 1, 2008, except for one area totaling 61 acres along 110th Ave SE. This area of dense coverage was completed in December 2008. Because of the relatively dense coverage, actual acres treated totaled 25 acres. Following this initial treatment, approximately 90 percent of the footprint area was mapped as less than 1 percent cover by Brazilian pepper and contained scattered and usually small Brazilian pepper plants. While the re-treatment area covered was 2,568 acres, actual coverage of Brazilian pepper was estimated at only 20 acres. Despite the low coverage, there were higher densities scattered throughout and it was important to prevent the many small individuals from getting established. Re-treatment continued during 2010 (**Figure 28)**. A total of 1,370 acres had varying coverage by Brazilian pepper totaling 208 acres of actual treated pepper.

After Brazilian pepper, invasive exotic grass species were considered as priority. The fall flowering grasses were considered the next priority. Over the two-year period, 8,697 acres were covered with 165 acres actually requiring treatment.

The highest priority for next year is treatment of soil remediation sites in the fall when water recedes. Foliar treatments of the entire footprint targeting torpedograss (*Panicum repens*) and any missed fall flowering grasses and potentially natal grass (*Rhynchelytrum repens*) should be conducted in the fall or early winter before a freeze event. Re-treatment of footprint areas for Brazilian pepper can be skipped and be resumed the following year, unless especially dense areas are found. Cover by Brazilian pepper should be re-assessed in November. Foliar treatments in the spring and into the summer should again be conducted focusing on cogongrass (*Imperata cylindrical*), torpedograss, and any remaining fall flowering grasses. Foliar treatments focusing on jaraguá (*Hyparrhenia rufa*) and other priority grasses should again be conducted in September and October 2011.

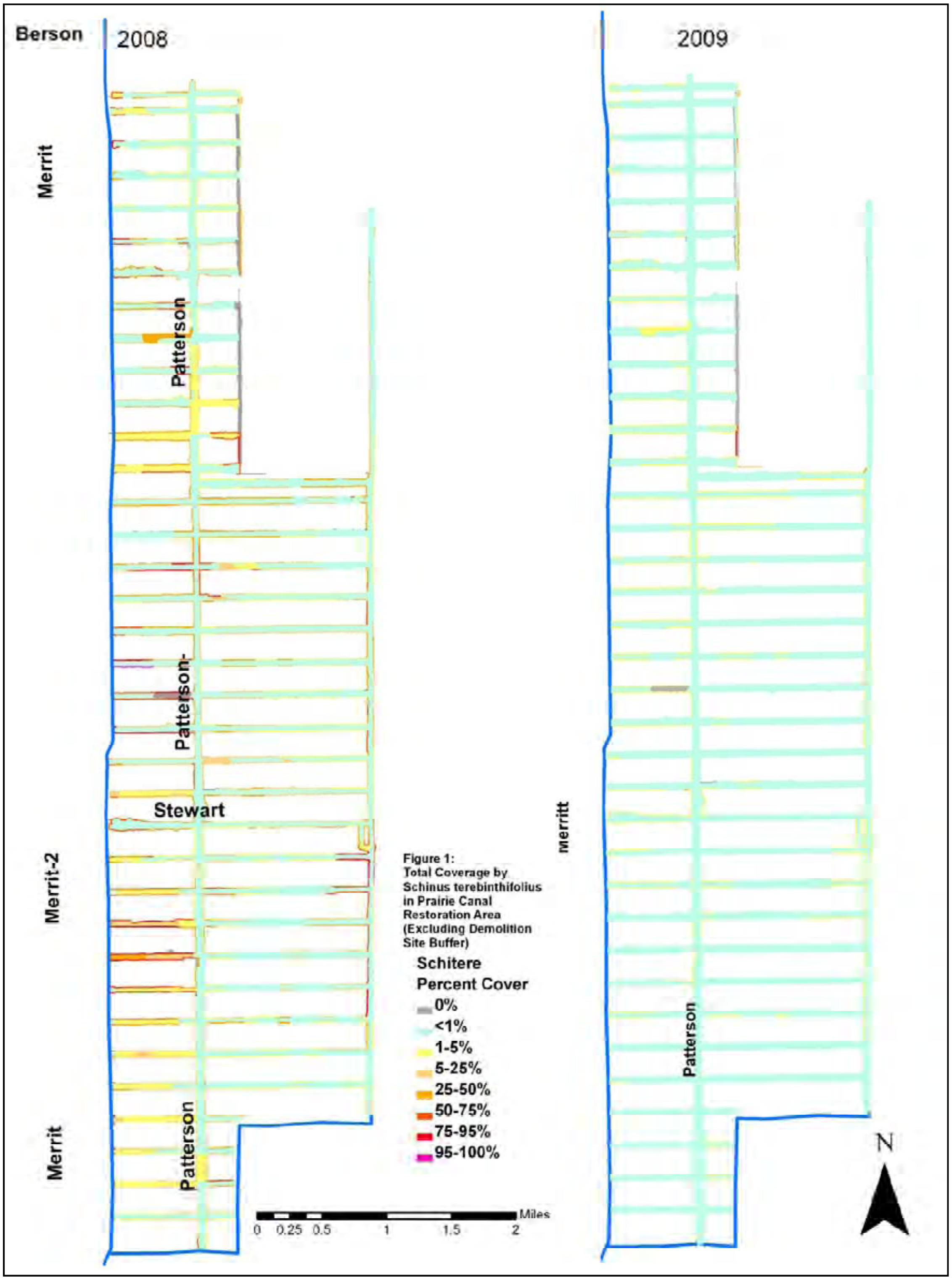

Figure 26. Pre-treatment cover of Brazilian pepper within the restoration footprint for 2008 and 2009.

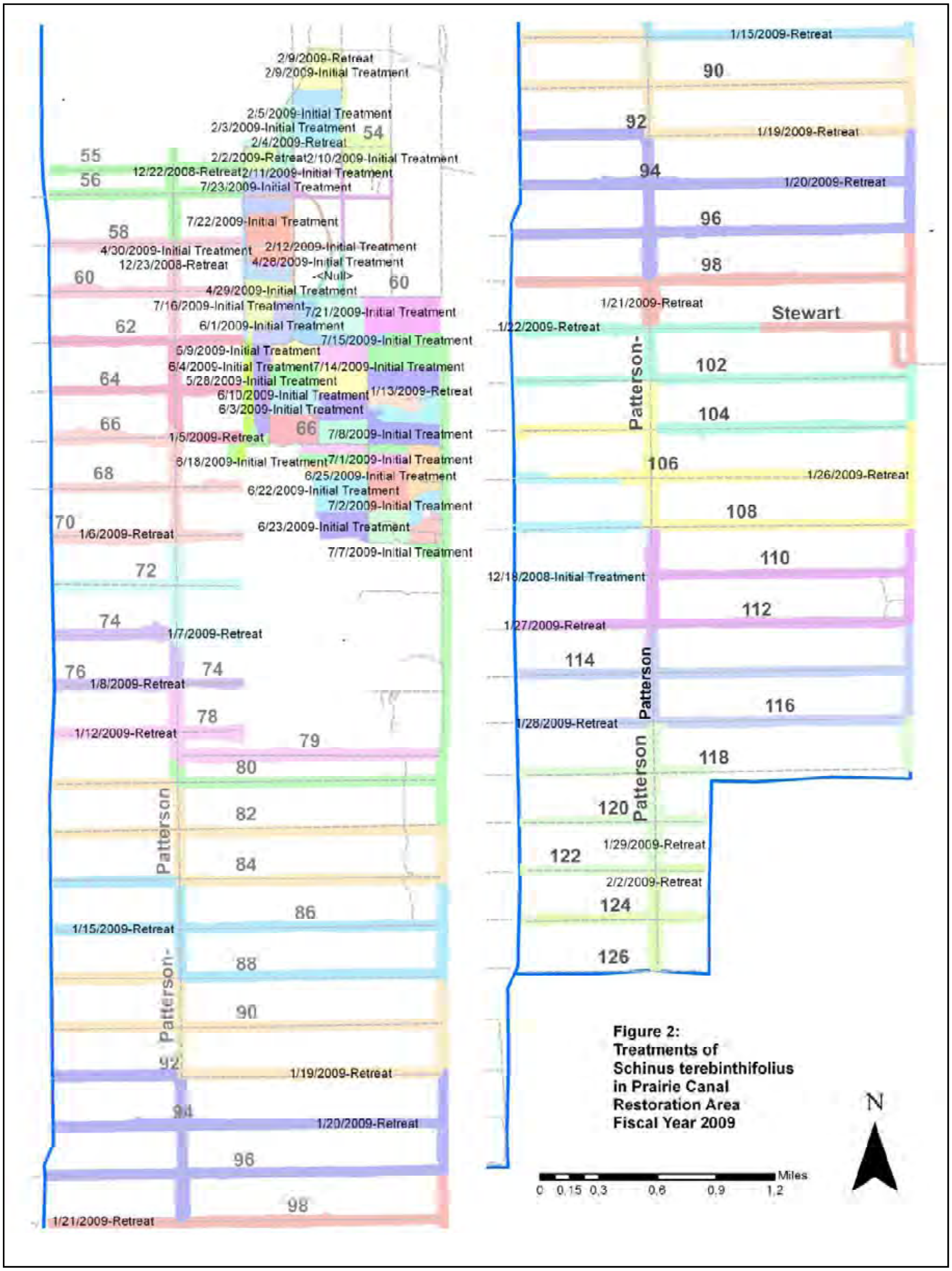

Figure 27. Treatments of Brazilian pepper with Garlon IV during 2009.

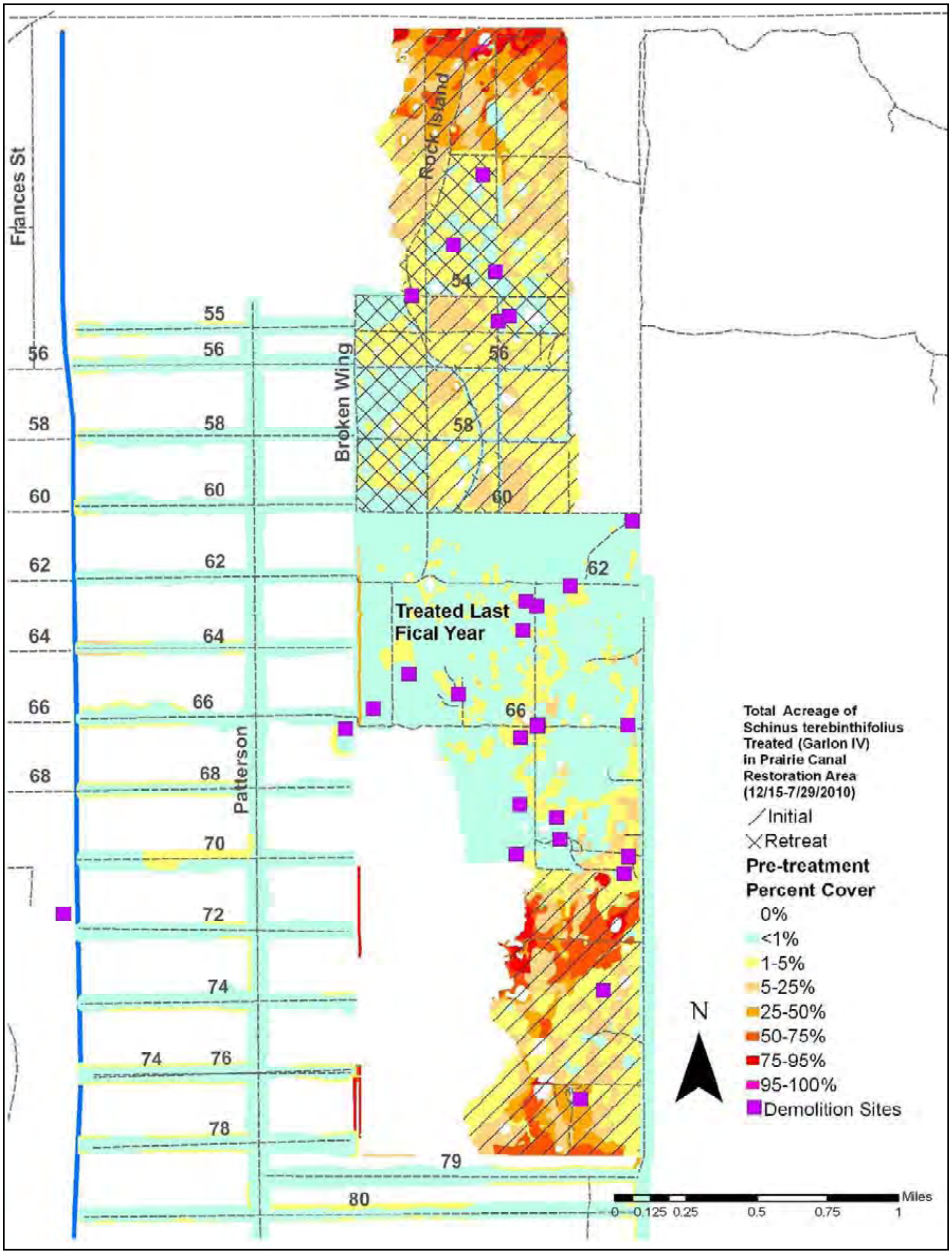

Figure 28. Pre-treatment cover and treatment of Brazilian pepper within the restoration footprint for 2010.

WILDLIFE MONITORING

Implementation of the entire Picayune Strand Restoration Project will provide more accurate wildlife data rather than monitoring prior to completion of the entire restoration project. However, in the interim, ongoing wildlife monitoring will be conducted the first wet season following the first full year after the Merritt Canal backfilling has been completed. Florida panther, wading birds, manatee, and aquatic fauna will be monitored during this interim period. The monitoring events are not scheduled until after the Merritt Canal is filled because no detectable results are expected to be realized before then.

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Attachment A: Specific Conditions and Cross-References

Table A-1. Specific conditions and cross-references presented in this report.

Condition	Table	Narrative (pages)	Figure	Attachment
Water Quality Data: *(condition 8, page 6)* ammonia, biochemical oxygen demand, hardness, nitrate, nitrite, no_x, orthophosphorus, total dissolved solids, total Kjeldahl nitrogen, total phosphorus, total suspended solids, chlorophyll-a, phaeophytin, alkalinity, manganese, magnesium, dissolved silica, sulfate, iron, pH, dissolved oxygen, specific conductance, temperature, sample depth, and total depth	---	---	---	C
Water Quality Data Summary	8–15	App. 2-1-23	---	---
Site Specific Conditions:				
Weather: *(condition 8, page 6)* Rainfall and Evapotranspiration at Station SGGEWX	4 and 5	App. 2-1-7	3–5	B
Water Levels at 7 Stations: *(condition 8, page 6)* SGT1W5 (formerly SGGE5SW) SGT2W5 (formerly SGGE10SW) SGT2W6 (formerly SGGE11SW) SGT3W5 (formerly SGGE16SW) SGT3W6 (formerly SGGE23SW) SGT3W7 (formerly SGGE17SW) SGT4W6 (formerly SGGE22SW)	6	App. 2-1-9	7–13	B
Vegetation Transects: *(condition 16, page 8)*	---	App. 2-1-36	---	D
Wildlife: macroinvertebrate, fish and amphibian, small mammals, birds, and other wildlife *(condition 16, page 8)*	---	App. 2-1-42	---	---
Project Status	---	App. 2-1-6 – 2-1-7	---	---
Improvement/Enhancement Implementation Schedules/Progress:				
Hydrologic Improvement	---	App. 2-1-16 – 2-1-17	14–24	---
Exotic Footprint Mapping and Control	---	App. 2-1-38	26–28	E and F
Pre versus Current Performance Evaluation	---	App. 2-1-16 – 2-1-17	7–13 14–17 19–24	---

Attachment B: Supporting Data for Hydrologic Analyses

Contact: Kim Chuirazzi

Note: This supporting information is available upon request.

Attachment C: Supporting Data for Water Quality Analyses

Contact: Kim Chuirazzi

Note: This supporting information is available upon request.

Attachment D: 2 Year Post-Restoration Vegetation Monitoring of Prairie Canal and Control Transects: Picayune Strand Restoration Project, PSRP Vegetation Monitoring 2009

Note: This document, dated November 2009, was provided to the South Florida Water Management District by The Institute for Regional Conservation, under Purchase Order No. 4500026581.

2 Year Post-Restoration Vegetation Monitoring of Prairie Canal and Control Transects: Picayune Strand Restoration Project

PSRP Vegetation Monitoring 2009
4500026581

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[1] Cover Photo: Transect PC23 with dead cypress trunk (on ground) and swollen base of living old-growth slash pine suggesting past flooded conditions along with more recent Brazilian pepper and abundant midstory cabbage palm. Photo by M. J. Barry 6/10/2009.

List of Tables:

List of Figures:

Background / Introduction

The Picayune Strand Restoration Project (PSRP), formerly known as Southern Golden Gate Estates (SGGE), is a large development located east of Naples in southern Collier County. It is located within the southeastern portion of Picayune Strand, and is part of a larger development, Golden Gate Estates (GGE), the northern portion of which is a developing residential community. The whole GGE area has undergone hydrologic and environmental alteration due to construction of a network of canals, levees, and roads built in the 1960s. Four major north to south canals drain the PSRP and connect at the southern end to drain together into the Ten Thousand Islands.

Prior to development, the PSRP was characterized by seasonal flooding and slow-moving overland sheet flow that supported a variety of plant and animal communities in uplands and freshwater wetlands and in its downstream brackish wetlands and estuaries. Channelization of water flows has resulted in elimination of sheet flow across the PSRP and into the estuaries, lowered water tables within the PSRP, and created a fluctuating freshwater point discharge to the estuarine ecosystem in the Ten Thousand Islands (marine ecosystems are outside of the preserve – impacts outside and downstream). Upland, wetland, and estuarine plant communities have been degraded, the abundance of native fish, wildlife, and estuarine shellfish populations has declined, recharge of the surficial aquifer has been reduced, and non-native species have increased in abundance. The drained conditions have resulted in widespread and more intense wildfires than occurred under pre-drainage conditions. These fires are accelerating the change in vegetation from wetlands to upland communities dominated by fire tolerant species such as cabbage palm (*Sabal palmetto*) and exotics such as Brazilian-pepper (*Schinus terebinthifolius*). In addition, these impacts extend a mile or more into other conservation areas, including the Fakahatchee Strand Preserve State Park.

The PSRP currently has a network of east-west roads every quarter mile that are connected by north-south roads approximately every mile. The most significant environmental impact of the road network is that it impedes natural sheet flow. However, it also provides access to all parts of the project area where there are impacts from off-road vehicles, poaching of animals and plants, vandalism, and the illegal dumping of solid waste. It has resulted in the fragmentation of an extensive block of contiguous natural lands that compromises the value of the area for a variety of wide-ranging wildlife such as the Florida panther, as well as other threatened and endangered species.

In 2007, the removal of 65 miles of road east of Merritt canal and the filling of the north-south portion of Prairie canal was completed. Construction work began in 2004 at the northernmost portion (north of 79th Ave SE) and progress of the filling of the canal continued southward until 2007.

The plugging and filling of long sections of Prairie Canal, the furthest canal to the east in the PSRP, has eliminated the rapid loss of water along most of its seven-mile length by stopping quick flows and reestablishing sheet flow in the area during high rainfall periods. It has also greatly slowed drainage after the water table falls below ground during drier periods, although slightly increased flows probably remain through the less consolidated fill material in the restored canal and adjacent substrates that were fractured during construction. Over time, these slightly higher groundwater flows should steadily diminish as organics accumulate in the pools remaining along the canal, and these organics seal the pool bottoms.

The area hydrologically benefited by the plugging and filling of Prairie Canal includes virtually all of SGGE to the east of Patterson Boulevard. Based on 20 years of monitoring water levels in the adjacent Fakahatchee Strand (a reference site), the effects from the Prairie Canal plugging have extended from one to three miles into Fakahatchee Strand during wet and dry periods. These effects are increasingly greater as one gets closer to the canal , and assuming a similar extent of impacts from the other SGGE canals, the portion of SGGE to the west of Patterson Boulevard will probably continue to be severely impacted until Merritt Canal is restored. Also, since the east-west (southern most) portion of Prairie Canal below the restored upper seven miles is still open and draining into Merritt Canal, it is likely that the water table in the lower one-to-three miles of the area between Patterson Boulevard and the north-south portion of the filled Prairie Canal is still being impacted.

An additional influence on water levels to the west of Prairie Canal is the major cypress strand that crosses I-75 and enters SGGE in the vicinity of Merritt Canal. This large strand swamp is the actual Picayune Strand and the name-sake of the entire state forest and project area. This large flow-way turns to the east and approaches Prairie Canal above Stewart Boulevard before turning back to the west and leaving SGGE in the vicinity of the Faka Union Canal at US 41. Particularly during and for some time following wetter periods, flows in this strand would have historically increased water levels along and to the west of Prairie Canal prior to the construction of the SGGE canal system. These water levels cannot be completely restored until Merritt Canal is restored. Based on the above discussion, hydrologic restoration from plugging and filling Prairie Canal should be close to complete east of the canal, but benefits should diminish as one moves west from the canal and as one approaches the unfilled east-west (southernmost) section between Merritt and Prairie Canals

Prior to plugging and filling Prairie Canal, three east-west vegetation transects were established in the upper, middle, and lower portions of the seven-mile long north-south portion of the canal in Spring 2004. These transects were sampled once to provide a baseline condition to be used to document restoration of plant communities along the canal. Vegetation monitoring was scheduled to commence along these transects after one full growing season following the completion of construction, and then annually for some additional years. Depending on the observed restoration response, less frequent sampling may occur thereafter until a trend toward pre-development conditions is established. The original baseline monitoring was conducted during spring 2004, and all post-construction monitoring began in spring of 2008. Therefore the data collected in the northernmost areas have potentially been affected by a lengthened hydroperiod during the rainy seasons of 2005, 2006, 2007 and 2008 while the southern portion would have only experienced two rainy seasons, 2007, which was a drought year, and 2008. The purpose of this report is to analyze vegetative changes observed in resampling of these transects between pre restoration and post restoration along the Prairie Canal to determine if indeed the restoration is having an impact on vegetation composition and structure, and if the vegetation is converging towards the reference composition.

Methods

Thirty permanently marked 50 m transects along three 2 km transects (PC01-PC30), which extend 1 km to the east and 1 km to the west of Prairie Canal, were located and if necessary re-established using a Global Positioning System (GPS) (Figure 1). The five 50 m transects at the original Natural Resources Conservation Service (NRCS) monitoring sites near Prairie Canal within Picayune Strand State Forest (PSSF) were also visited (42, 53, 55, 56, and 57). Additional control transects in Florida Panther National Wildlife Refuge (FPNWR) and Fakahatchee Strand Preserve State Park (FSPSP) were re- sampled as they were in 2005 and in some cases as far back as 1996 (07PI11, 07WP11, 32, 32PI33, 32WP33, 45, 37, 39, 51, 64, and 67). Each transect was marked with rebar at each end and then each rebar position was recorded in UTMs (NAD83 17N) using a sub-meter accuracy GPS device throughout the study. Trees near each rebar were flagged using orange tape. A 50 m transect tape was then strung between the two rebar at a taught/straight position. In all cases, transects were positioned North/South and East/West, with the origins occurring at the East or North. Although not required, at least one photo was taken at each rebar position in the direction of the other rebar stake for each transect.

Vegetation sampling methods similar to those utilized during the pre-construction sampling were utilized during the post-construction sampling (Barry and Woodmansee 2005). These methods were derived from those utilized at FPNWR, with some modification to include the canopy stratum (Main et al. 2000). Restoration targets for the Prairie Canal monitoring sites are a function of their new hydrologic regime, and should be comparable to the composition and structure of hydrologically similar reference sites in the FPNWR and FSPSP sampled during the baseline PSRP vegetation monitoring effort. This includes a total of 13 transects placed as control plots (Figure 1).

The vegetation along the transects are divided into four strata based on DEP 62-340.200, F.A.C. (1996) of the Florida Wetlands Delineation Manual, Delineation of the Landward Extent of Wetlands and Surface Waters. Canopy trees are defined as those woody plants with a diameter at breast height (dbh) greater than 10 cm. The sub canopy consists of tree species, excluding common woody shrubs such as wax-myrtle (*Myrica cerifera*), willow (*Salix caroliniana*), Brazilian-pepper (*Schinus terebinthifolius*), and saltbush (*Baccharis glomeruliflora*) with a dbh between 2.5 and 10 cm (1-4 in). The shrub layer consists of trees with a dbh less than 2.5 cm (1 in) and any-sized individuals of the four common shrub species mentioned above. Ground cover consists of all plants not found in the other strata and consists primarily of herbaceous species.

Cabbage palms (*Sabal palmetto*) are separated into the following strata: 1) canopy palms with apical meristems above 2.4 m (8 ft), 2) sub canopy palms with apical meristems greater than a breast height of 1.4 m (4.5 ft) but less than 2.4 m (8 ft), 3) shrub layer palms with apical meristem just above ground level to a breast height of 1.4 m (4.5 ft), 4) groundcover stratum palms include individuals with palmate leaves but apical meristem still at ground level (*i.e.* no trunk) or with at least four (or evidence of having produced four) non-palmate leaves. According to McPherson and Williams (1996), this stratum would include pre-trunk plants with palmate leaves down to plants with pinnate leaves but leaf width >8 mm. Palm seedlings were defined as individuals without palmate leaves and only two to three leaves (including remnant petioles at the base if present). McPherson and Williams (1996) defined new recruits to be the smallest plants with leaves of three segments (a segment is the characteristic plication with "V" shape), further distinguished by leaf width less than or equal to 8 mm. This stratum is intended to represent only the newest recruits. For cabbage palms with trunks (strata 1-3), the presence or absence of adventitious roots was recorded.

Additionally, presumed "old growth", or pre-disturbance overstory slash pine (*Pinus elliottii*) and cabbage palm were separated into strata 1.5 for analysis. This determination was made based on morphological characters such as slash pine crown form and whether a cabbage palm was completely bootless with adventitious roots. Detailed explanation of this strata designation can be found in Barry's 2006 FPNWR report.

Canopy and sub canopy trees (and Sabal palms in all strata) were sampled along 5 m wide belt transects (Mueller-Dombois and Ellenberg 1974). Diameters of all canopy trees were measured and they were tagged to facilitate re-sampling and to document mortality and recruitment. Sub canopy trees were counted by species to estimate density, but not measured or tagged. Sabal palms, but not other tree species, were counted in the shrub, groundcover, and seedling strata. Extra emphasis has been placed on cabbage palm densities due to the current high densities observed in the drained areas of PSRP relative to historical accounts of the area prior to drainage.

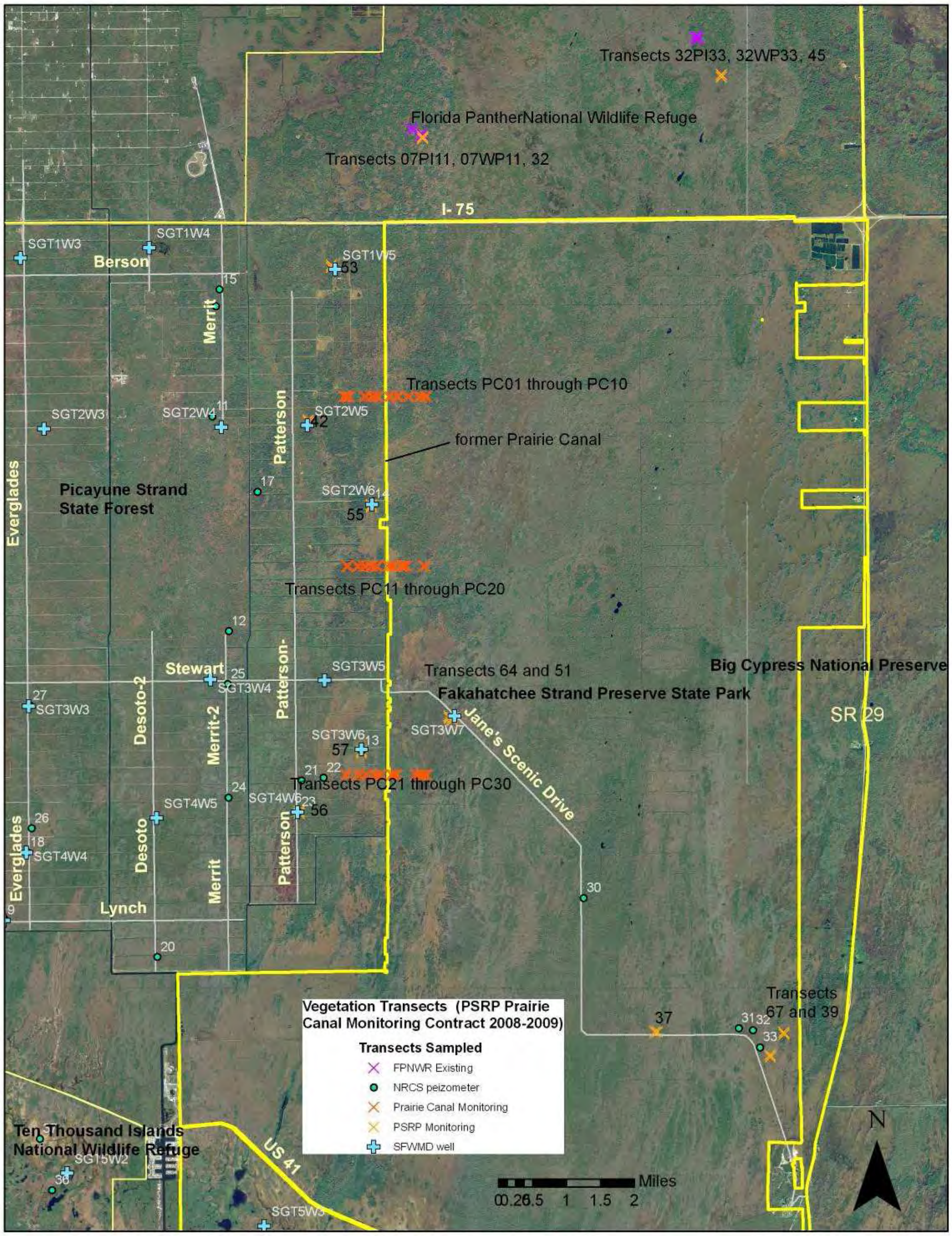
The composition and cover of shrub species, as defined above, were quantified using the line-intercept method (Mueller-Dombois and Ellenberg 1974, Canfield 1941, Lindsey 1955) along each of the transects. Intercept lengths include all overhanging or underlying shrub canopy. Saw palmetto (*Serenoa repens*) is always considered a shrub. From these data, percent coverage was estimated.

Species composition and cover of herbaceous ground cover species were quantified using 0.5 m^2 rectangular quadrats (40.5" x 20.75") placed at 10 m intervals along the transect using Daubenmire (1959) cover classes. These six cover classes are: 1) 0-5%, 2) 5-25%, 3) 25-50%, 4) 50-75%, 5) 75-95%, and 6) 95-100%.

All plant species whose stems originated from within the quadrat were assigned cover class values. Shrub species were assigned cover class values if any part of the plant overhung the quadrat regardless of where the stems originated. Sabal palm coverage was recorded separately for the shrub, groundcover, and seedling strata.

In addition to the quantitative sampling, qualitative records were kept of all plant species observed within each sampling site by habitat. These random observations were incorporated into the site species lists.

Because fire is so important to the reestablishment of natural vegetation on the PSRP, records of wildfires and prescribed burns that affect portions of the PSRP vegetation monitoring sites were requested from appropriate managing agencies in the course of sampling. For each transect, fire interval was recorded. Fire intervals were placed into three categories: 1 = <1 year, 2 = 1-7 years, and 3 = > 7 years. Intervals were determined with recorded burn history provided by managing agency staff or field observations when actual burn dates were not available.



Transects 32PI33, 32WP33, 45
Florida PantherNational Wildlife Refuge
Transects 07PI11, 07WP11, 32
I- 75
SGT1W3
SGT1W4
SGT1W5
53
Berson
15
Merrit
Transects PC01 through PC10
SGT2W3
SGT2W4
11
SGT2W5
42
Patterson
former Prairie Canal
17
Everglades
Picayune Strand
State Forest
SGT2W6
14
55
Transects PC11 through PC20
12
Stewart
25
SGT3W4
SGT3W5
Transects 64 and 51
Big Cypress National Preserve
Fakahatchee Strand Preserve State Park
27
SGT3W3
Desoto-2
Merrit-2
Patterson-
SGT3W7
Jane's Scenic Drive
SR 29
SGT3W6
13
57
21
22
Transects PC21 through PC30
24
SGT4W5
SGT4W6
23
56
26
18
SGT4W4
Desoto
Merrit
Patterson
Everglades
30
Lynch
20
Transects
67 and 39
37
31
32
33
Vegetation Transects (PSRP Prairie
Canal Monitoring Contract 2008-2009)
Transects Sampled
FPNWR Existing
NRCS peizometer
Prairie Canal Monitoring
PSRP Monitoring
SFWMD well
Ten Thousand Islands
National Wildlife Refuge
SGT5W2
36
US 41
SGT5W3
N
Miles
0 0.25 0.5 1 1.5 2

Figure 1

All plant nomenclature followed Wunderlin (2003) with certain exceptions, including any taxonomic changes generally accepted by IRC since the date of this publication. Important departures include South Florida bluestem (*Schizachyrium rhizomatum*) which in Wunderlin (2003) is lumped with Little bluestem (*S. scoparium)*. To avoid confusion, the synonyms are provided in the species list included in the database. At least 98% of vascular plants and ferns encountered in the plots were required to be identified to species, which at times required more than one trip to a sampling site. Species not identified to species level were identified to the lowest taxonomic level possible and a specimen was taken from outside the transect as a voucher if possible. The weighted (by total percent cover) percent of species not identified to species level must be less than 1% per SFWMD contract (4500026581).

Data Entry

Data was entered into a Microsoft Access database. A single table was used for each study type: belt transect data, line intercept data, and quadrat data. In addition, tables were created for descriptions of each transect, including well number, location, rebar number, transect number, fire history, habitat, former habitat, and any notes. A table was also created for sampling events containing dates, surveyors, and time since fire data. Comment fields were included in all tables. Additional tables were provided including a GPS table linking geographic coordinates of each rebar belonging to transect, an Accepted Names table (linking taxon code with genus species, higher taxonomic data, plant authority code, nativity, rare plant status, and Florida Exotic Pest Plant Council status), an Authority table (linking authority code with the appropriate literature reference), and Lookup tables for each of the data tables. After initial data entry, data was cross-checked for errors and corrected accordingly.

Previous data collection events possessing the same Field Study methods were incorporated into the Access database and were included in some of the analyses of this report. This was done in order to discuss preliminary findings, as well as to summarize pre-restoration habitats. A total of 308 transects have been established and sampled multiple times (totaling 882 samples) through multiple funding sources. These were all included in the current database. A summary of all data set events is in Table 1. For a complete discussion of these events refer to Barry (2006).

Table 1: Summary of sampling events included in database.

Location	Funding Source	Principal Investigator	Management Regime	Sampling Event #	Beginning Date	Ending Date	Number of Transects
Florida Panther National Wildlife Refuge (FPNWR)	USFWS	Dr. M. Main	Control	0	12/20/1997	1/5/1998	4
	USFWS	Dr. M. Main	Control	1	5/20/1998	6/2/1998	4
	SFWMD PC P502173	M. Barry and S. Woodmansee	Control	4	10/19/2005	12/5/2005	6
	SFWMD 4500026581	M. Barry	Control	5	6/7/2008	6/7/2008	3
	SFWMD 4500026581	M. Barry	Control	6	5/29/2009	6/11/2009	6
	USFWS	Dr. M. Main	Restored	0	4/29/1996	1/7/1998	212
	USFWS	Dr. M. Main	Restored	1	8/12/1996	6/2/1998	201
	USFWS	Dr. M. Main	Restored	2	11/14/1996	12/10/1997	153
	USFWS	Dr. M. Main	Restored	3	4/23/1997	9/20/1998	135
	Everglades Reprogram	M. Barry	Restored	4	5/13/2005	9/20/2006	72
Fakahatchee Strand Preserve State Park (FSPSP)	SFWMD PC P502173	M. Barry and S. Woodmansee	Control	4	9/30/2005	11/10/2005	7
	SFWMD 4500026581	M. Barry	Control	5	6/5/2008	7/8/2008	5
	SFWMD 4500026581	M. Barry	Control	6	6/18/2009	6/25/2009	5
	Interagency	M. Barry	Restored	0	3/11/2004	5/3/2004	15
	SFWMD 4500026581	M. Barry	Restored	5	5/8/2008	6/4/2008	15
	SFWMD 4500026581	M. Barry	Restored	6	5/21/2009	6/22/2009	15
Picayune Strand State Forest (PSSF)	Interagency	M. Barry	Restored	0	12/9/2003	5/11/2004	23
	SFWMD PC P502173	M. Barry and S. Woodmansee	Restored	4	9/6/2005	10/6/2005	46
	SFWMD 4500026581	M. Barry	Restored	5	5/20/2008	7/9/2008	20
	SFWMD 4500026581	M. Barry	Restored	6	5/19/2009	6/16/2009	20
Ten Thousand Islands National Wildlife Refuge (TTINWR)	SFWMD PC P502173	M. Barry and S. Woodmansee	Restored	4	8/10/2005	10/14/2005	4
308 permanently marked transects						**Sample Total:**	971

Data Analysis

Of the entire database described above, only a subset of transects and sampling events were utilized in analysis for this report and are presented below (Table 2). Basic statistics were calculated and presented for each of the field methods including standard forestry parameters such as density, basal area, and stand basal area for belt transect data, percent cover for line intercept data, and percent cover, percent frequency of occurrence in quadrats, and percent dominance using quadrat data. Additional analysis was carried out using wetland indicator values (Reed 1988). Wetland Affinity Index (WAI) was computed and utilized to assist with evaluating the effects of hydrological conditions on the plant communities.

Table 2: Summary of transects and sampling events analyzed in this report.

Location	Management Regime	Sampling Event #	Beginning Date	Ending Date	Transect ID	# of Transects
FPNWR	Control	4	10/19/2005	12/5/2005	07WP11, 07PI11, 32, 32PI33, 32WP33, 45	6
FPNWR	Control	5	6/7/2008	6/7/2008	07WP11, 07PI11, 32 (32PI33, 32WP33, 45 not sampled due to Rx burn)	3
FPNWR	Control	6	5/29/2009	6/11/2009	07WP11, 07PI11, 32, 32PI33, 32WP33, 45	6
FSPSP	Control	4	9/30/2005	11/9/2005	37, 39, 51, 64, 67	5
FSPSP	Control	5	6/5/2008	7/8/2008	(same as above)	5
FSPSP	Control	6	6/18/2009	6/25/2009	(same as above)	5
FSPSP	Restored	0	3/11/2004	5/3/2004	PC06, PC07, PC08, PC09, PC10, PC16, PC17, PC18, PC19, PC20, PC26, PC27, PC28, PC29, PC30	15
FSPSP	Restored	5	5/8/2008	6/4/2008	(same as above)	15
FSPSP	Restored	6	5/21/2009	6/22/2009	(same as above)	15
PSSF	Restored	0	12/9/2003	5/11/2004	PC01, PC02, PC03, PC04, PC05, PC11, PC12, PC13, PC14, PC15, PC21, PC22, PC23, PC24, PC25, 42, 53, 55, 56, 57	20
PSSF	Restored	5	5/20/2008	7/9/2008	(same as above)	20
PSSF	Restored	6	5/19/2009	6/16/2009	(same as above)	20

All analyses were conducted using SPSS 11.5 and graphs were made with Sigma Plot 10. PCORD5 was used to determine community traits such as species richness and species diversity.

We used parametric tests on either the raw data or transformed data to meet criteria of normality. Univariate ANOVA and repeated measures analyses were conducted to examine the effects of restoration on species richness, Wetland Affinity Index (WAI), and on relative diameter growth rates, using habitats (Cypress, Pinelands and Wet prairies), Management regimes (control and restored), year of data collection (2004, 2005, 2008, 2009), and species as the predictor variables.

In addition, we explore the patterns of species composition across habitats to examine the role of fire, hydroperiod and restoration in Cypress dominated habitats in distinguishing areas of similar species composition and abundances. We present means in the results section, graphs for analyses where we found significant effects of management regimes and statistical tables in appendices.

Species richness, species diversity and percent cover

Species richness (*S*) was defined as total number of all species occurring per transect. Species diversity is a non-biased measure of species composition which takes into consideration *S,* and the relative abundance (n/N) of each species in a transect. Where n is the frequency, percent cover, or count of individuals of a species and N is the total sum of occurrences of all species in a transect. For this study, frequency was utilized. Shannon Weaver's index *H'* was used to estimate diversity and was computed as

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

Where p_i is the relative abundance measured by percent frequency of a constituent species *i* in the transect.

Wetland Affinity Index

Dominance by hydrophytic species can be quantified by summarizing the data using the wetland indicator values (Reed 1988). These values were revised in 1996 but not yet published, though the list is due for publication soon (Steve Mortallero, USFWS, personal communication). We utilized the 1996 draft for our calculations. The WAI, or simply the weighted mean probability of occurrence in wetlands for all species combined in each one meter^2 quadrat, is calculated by the following formula:

$X_i = P_{USFWS}$ for indicator category i. (based on 1996 classification)
W_i = Weight = Percent Frequency by plants in indicator category i

$$WAI = \sum XiWi \Big/ \sum Wi$$

This artificial index of dominance by hydrophytic vegetation allows us to quantify degree of dominance by inundation tolerant species (0.99 = obligate wetland species, 0.50 = facultative wetland species, and <0.50 = upland species).

Floristic Quality Index

Another way of assessing quality of a site from species composition is using the *coefficient of conservatism* (C) which is based on species specific degrees of fidelity to habitats and quality of habitats as well as tolerance to disturbance (Mortellaro et al. 2009). Each plant was assigned C values (from 0 to 10) with exotic plant species having a value of 0 and species with very little tolerance to disturbance and highly restricted to high quality habitats given a value of 10. These values were determined by consensus through efforts coordinated by Steve Mortallero of USFWS Vero Beach office in cooperation with myself, staff at The Institute for Regional Conservation, and several other botanists/plant ecologists here in South Florida. The index was created based on work done by Wilhelm and Masters (1995).

The mean C values were calculated by summing the C values for all species in the transect and dividing this value by the total number of species (species richness = N):

$$Mean\ C = \frac{\sum C}{N}$$

The weighted mean C was calculated for comparison based on percent cover values (W)

$$weighted\ Mean\, C = \frac{\sum C_i W_i}{\sum W_i}$$

The Floristic quality index (FQI) is the mean C value multiplied by the square root of species richness (N) which gives a weighted estimate of species richness that can allow for comparison between areas of different size (Mortellaro et al. 2009, Swink and Wilhem 1979, 1994).

$$FQI = mean\, C\ \sqrt{N}$$

Results and Discussion

Vegetation sampling data collected in the spring (dry season) of 2008 and 2009 were compared to control sites sampled in the fall of 2005 (wet season) and restoration sites sampled in the spring (dry season) of 2004. The comparisons with the control sites sampled in the fall of 2005 (wet season) are not considered valid for groundcover analysis because the wet season sampling typically consists of greater species richness and abundance of wetland plants than the dry season in flatwoods and prairies and lower species richness in cypress wetlands, but these data are presented for discussion purposes. Assessment of woody vegetation is not influenced by seasonality of sampling. The effects of changes in hydrology, fire regime, and the effects of wind damage, primarily from Hurricane Wilma, are discussed below.

The questions we address here are fundamental to the notion of successful restoration that involves restoration of hydrological conditions. Simply put- restoration success is measured by recovery of native species abundances and richness to pre-disturbance levels. Given the ecological complexity of Fakahatchee and Picayune strands, and the plethora of problems associated with reverting hydrology to pre disturbance conditions, the scale at which the current restoration efforts are trying to operate is impressive. However, in last several decades global climate change has influenced phenomena such as recurrence of drought and or flooding in South Florida's ecosystems, adding an extra dimension that influences the restoration efforts. Here we present the results and analyses which might shed light on the role of hydrological restoration and climatic fluctuations experienced by ecosystems in Picayune strand and Fakahatchee preserve.

Hydrology

In 2007, the removal of 65 miles of road east of Merritt Canal and the filling of the north-south portion of Prairie Canal was completed. Construction work began in 2004 at the northernmost portion (north of 79^{th}) and progress of the filling of the canal continued southward until 2007. Therefore the data collected in the northernmost areas have potentially been affected by a lengthened hydroperiod during the rainy seasons of 2005, 2006 and 2007 while the southern portion would have only experienced one rainy season, 2007, which was a drought year.

Rainfall data has been recorded at SFWMD's SGGEWX weather station (located in PSSF) since its establishment in September of 2002 and is presented below (Figure 2). Rainfall data indicate patterns generally consistent with long-term averages posted by SFWMD, although two notable outlier years occurred since initial vegetation sampling was conducted in 2004 (Abtew and Huebner 2002). Total rainfall in 2005, the year that hurricanes Katrina, Rita, and Wilma passed nearby or over the study site, was 74 inches which is substantially greater than the long-term average for the Naples Area which is 52-55 inches per year. In contrast, 2007 rainfall totaled 50 inches, which was below average, though not by much, however monthly totals were especially low during July through October when inundation is expected to occur in natural wetlands but did not happen. In 2008 some early spring rains kept the dry season from being too extreme and rains in June-September were steady. Total rainfall for 2008 was slightly above average at 61 inches. Tropical Storm Fay passed just to the north of the project area in mid August, 2008, but did not significantly affect the Picayune Strand even though just to the north in Corkscrew Swamp and Immokalee heavy rains brought up water levels. The dry season started immediately in October 2008 and was below average rainfall right through to sampling in 2009. Though not reflected by rainfall totals alone, there were many weeks of drier than normal air masses associated with frequent cool fronts in the winter and then followed by warmer than normal dry air masses during the summer which acted to exacerbate water shortages to plants (pers. observation).

As mentioned in the last report, water levels were manually recorded in the PSRP area between 1997 and 2004 using peizometers installed by NRCS. Deeper monitoring wells with automated data recorders were installed by SFWMD in 2003. The locations of all of these monitoring wells can be found in Figure 1 (above).

Hydrographs were prepared for select NRCS wells by IRC while charts for SFWMD wells were provided by Dr. M. Duever of SFWMD. A hydrograph for SFWMD well SGT3W7 is presented as a control data comparison, though it is near the eastern edge of the expected zone of influence for the former Prairie Canal (Figure 3). Hydrographs for NRCS peizometer 14 and SFWMD well SGT2W6 at the same location are presented below to represent the middle to northern section of the Prairie Canal study area (Figures 4 and 5). Data for NRCS peizometer 13 and SFWMD well SGT3W6 are presented to represent the middle to southern area (Figures 6 and 7). Data for NRCS peizometer 21 and SFWMD well SGT4W6 are presented to show additional data from the southernmost area (Figures 8 and 9).

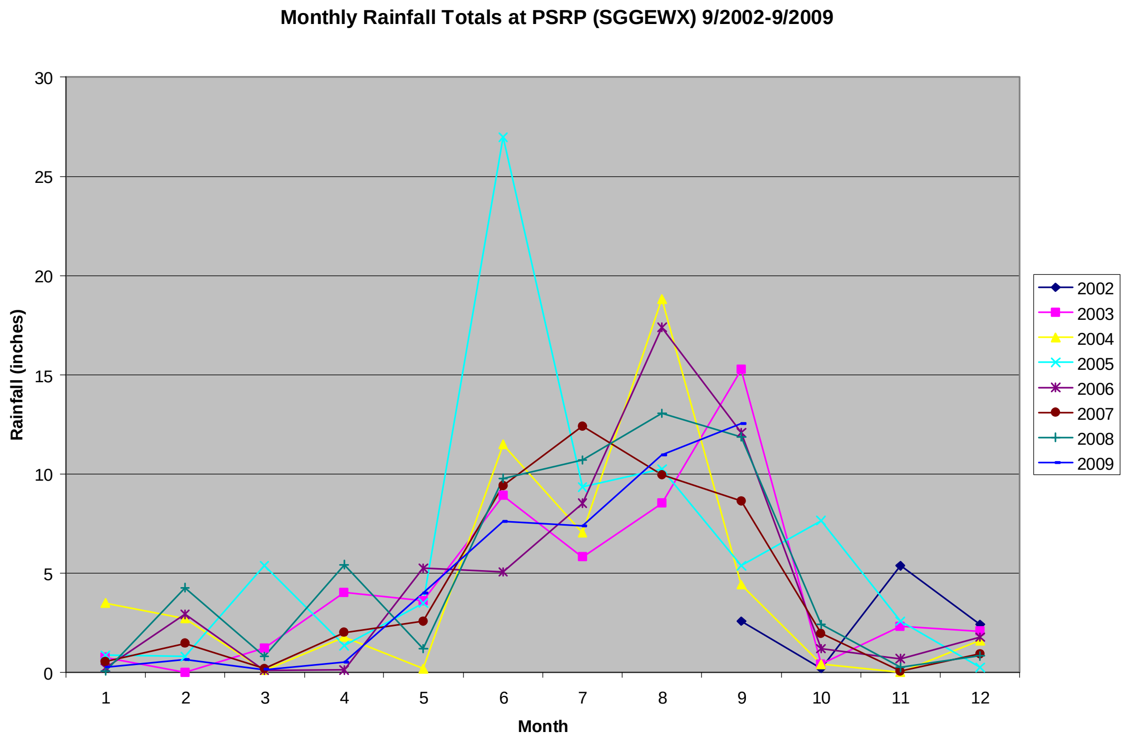


Figure 2

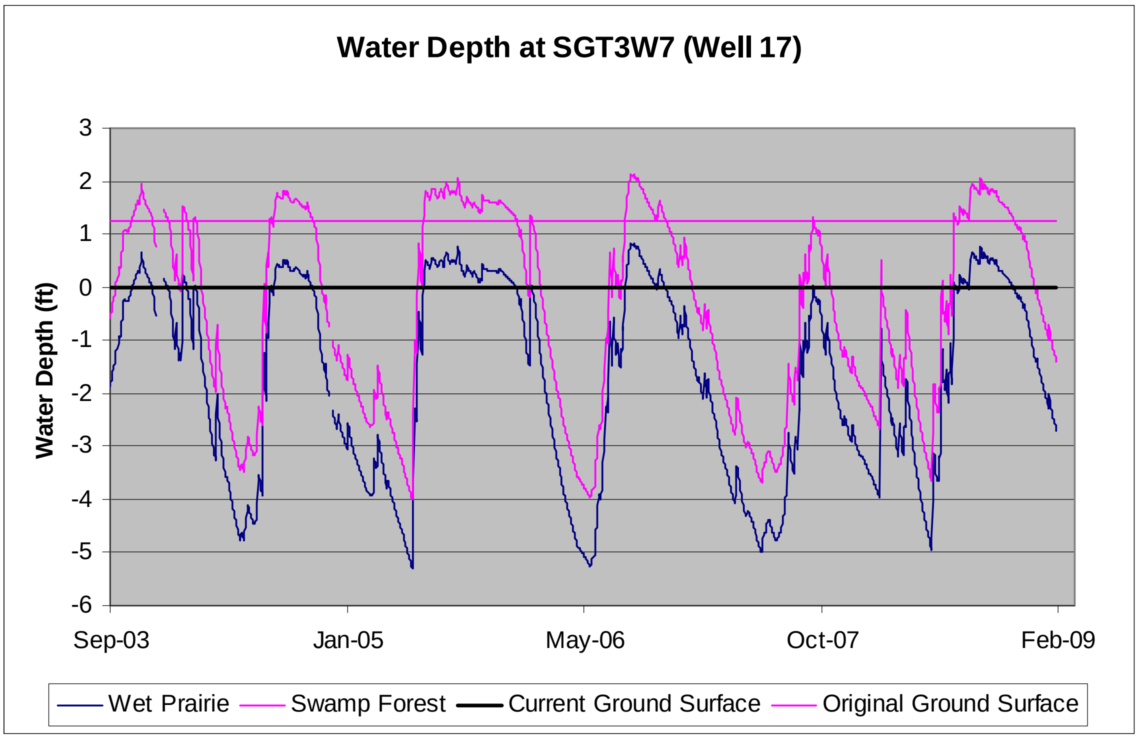


Figure 3

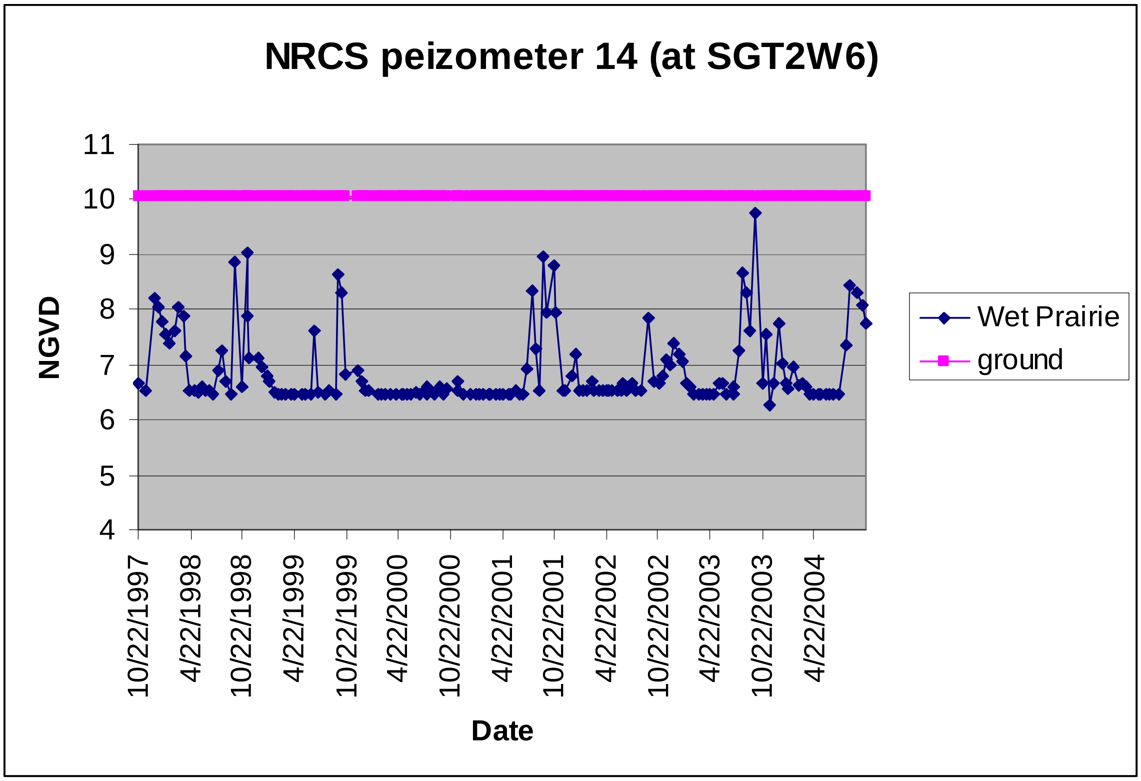


Figure 4

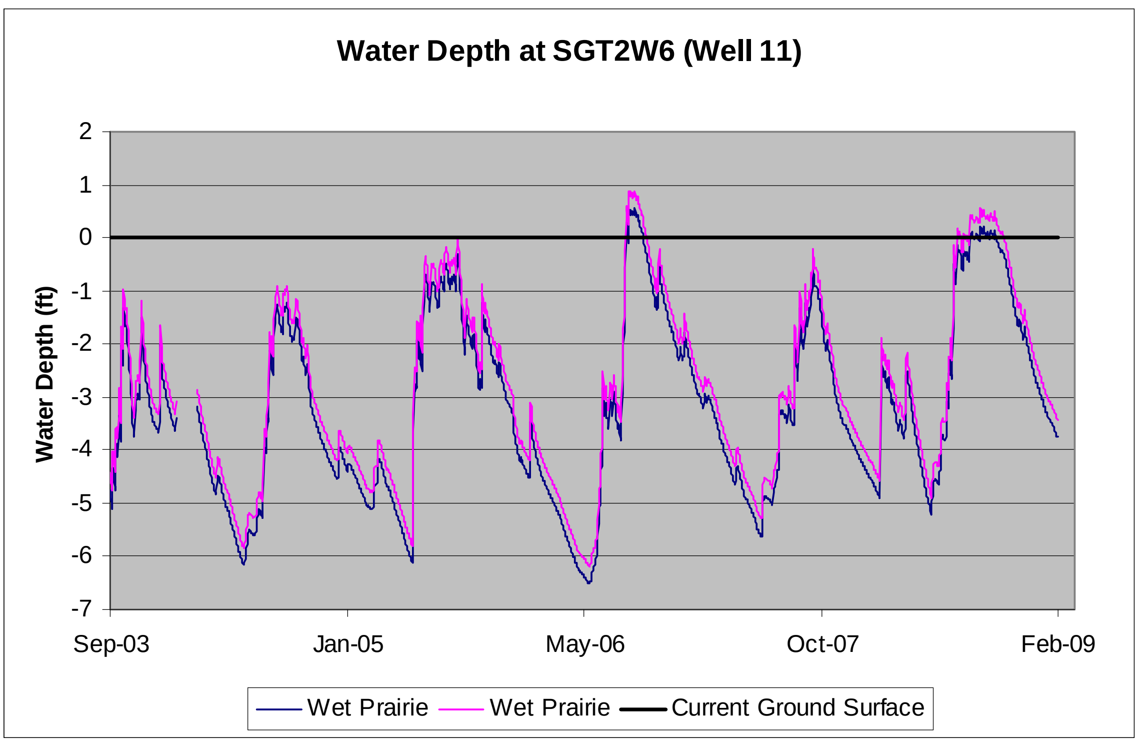


Figure 5

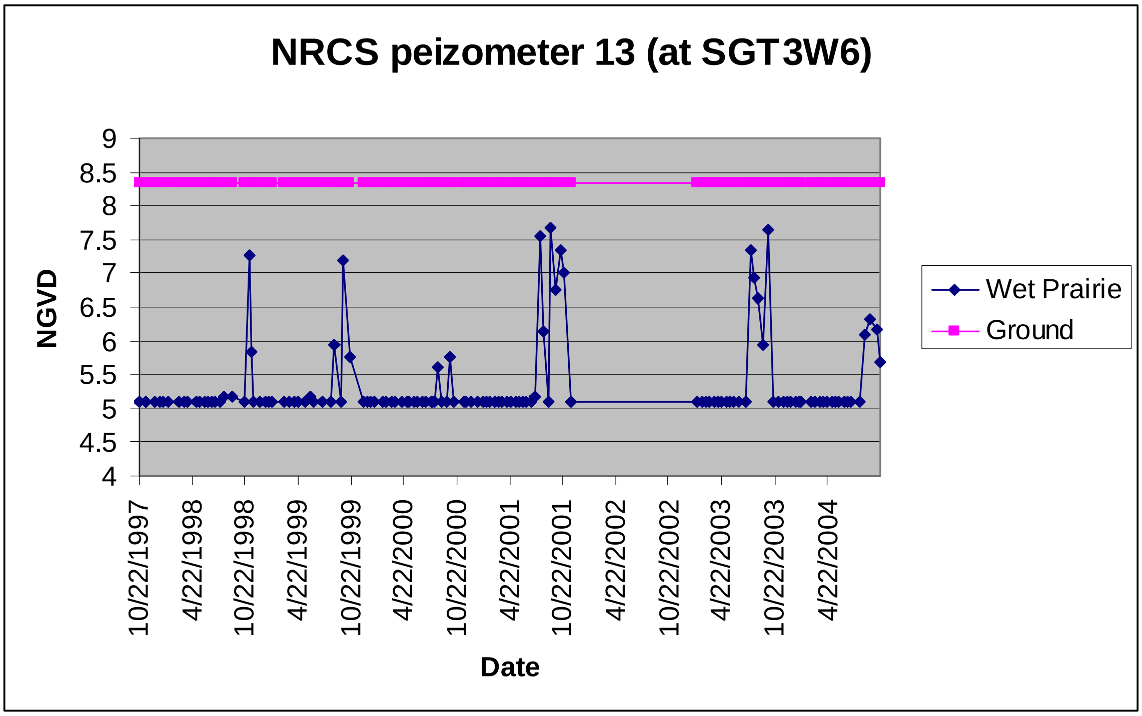


Figure 6

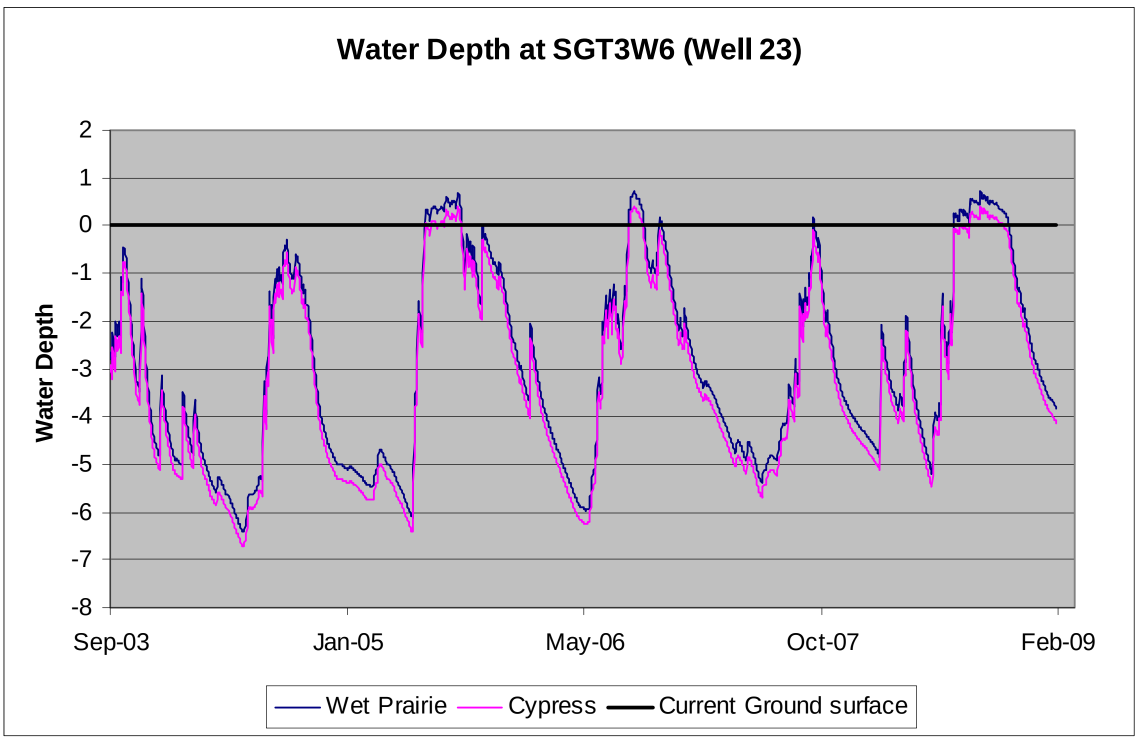


Figure 7

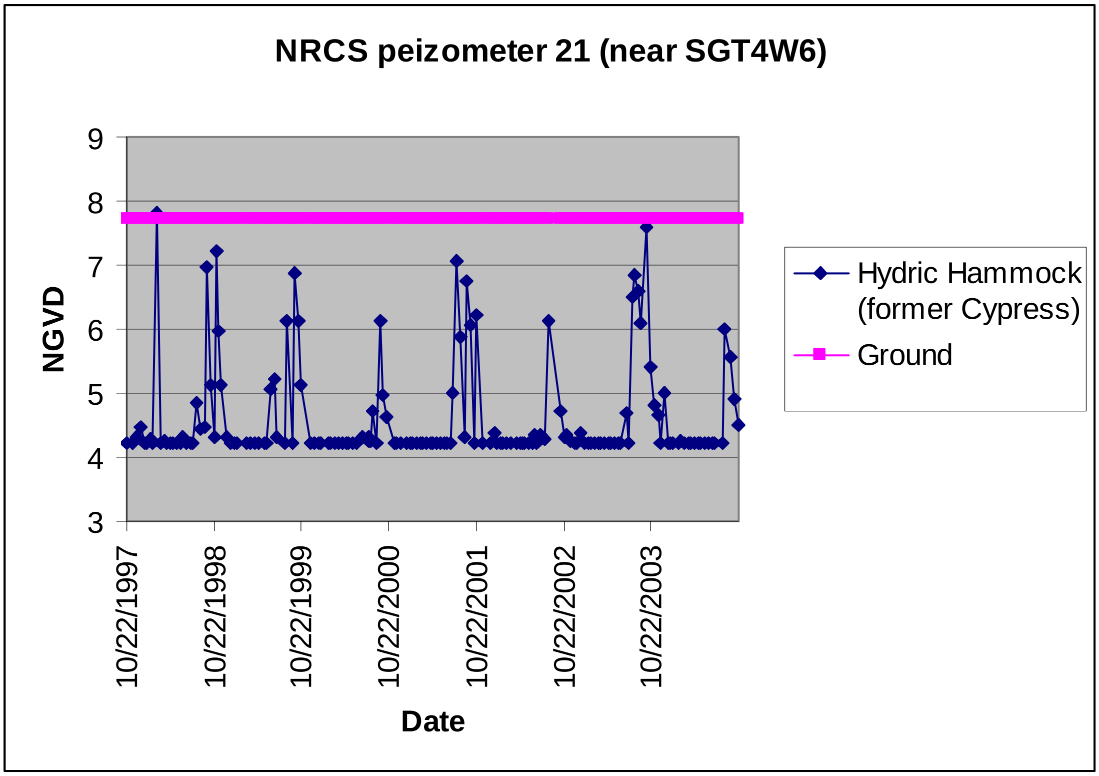


Figure 8

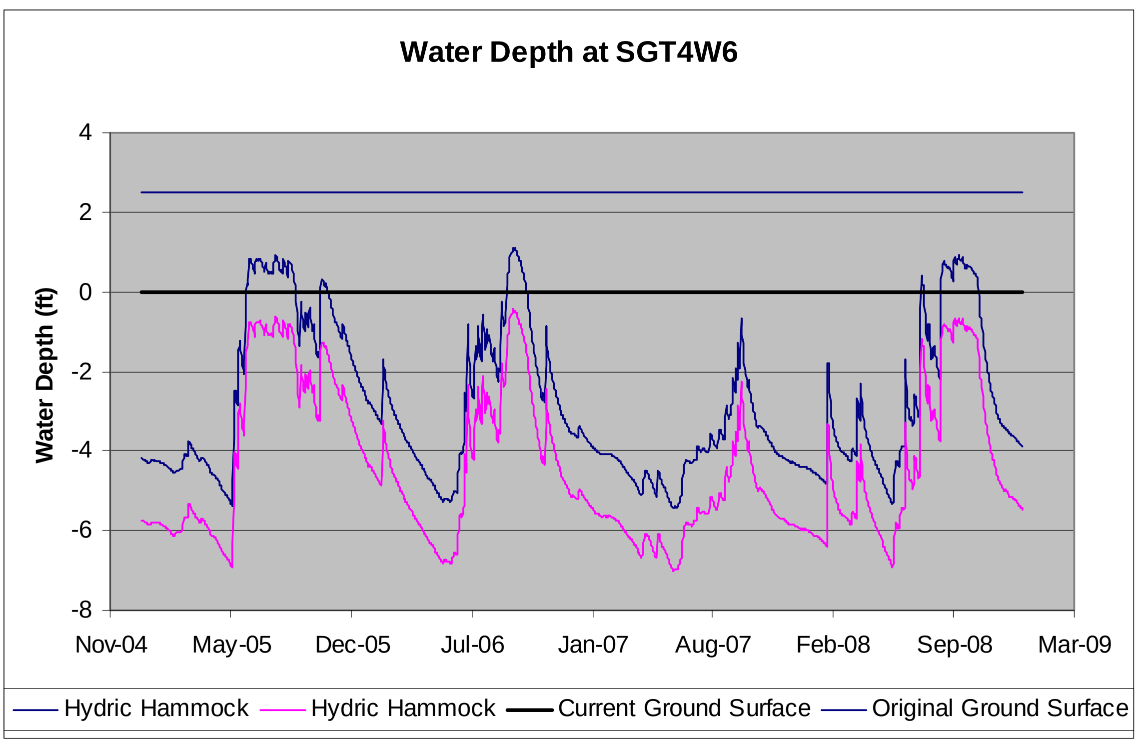


Figure 9

These hydrographs may begin to suggest the effects of restoration on lengthening the hydroperiod as water levels above ground level are recorded at the restoration sites by SFWMD wells. Water levels were rarely above ground level in the data collected in the NRCS peizometers. NRCS peizometer 13 and SFWMD well SGT3W6 most strongly suggests the effect of restoration at this early stage of restoration with the evidence of a brief period of standing water during an average year of rainfall in 2006 and again in 2008. This is significant in light of the lack of recorded standing water in the period between 1997 to 2004. Average number of days inundated pre and post treatment may be utilized in future analysis using the NRCS data primarily for pre-treatment condition (Barry and Woodmansee 2006) and SFWMD wells for a short time of pre-treatment but mostly for post-treatment condition, as more data is collected to generate averages.

Heavy rains in 2005 did result in a lengthened hydroperiod even in the control well site (SGT3W7) while, conversely, all wells show a shortened hydroperiod in 2007, which follows the rainfall patterns (Figure 2). The spring 2008 rains also appear in the hydrograph which helped ease the effects of drought and the steady rains of June through September of 2008 also resulted in a good period of high water roughly from July through September. Prior to sampling in June 2008, low rainfall resulted in a return to drought conditions, and these were made somewhat more severe due to the presence of very dry air masses over the winter.

Habitats

Habitat designations followed Jim Burch's definitions (Burch et al. 1998), with some modifications. This habitat classification system was chosen for analysis because all of the past work for PSRP, including pre and post drainage vegetation maps, have utilized these vegetation types. In the next monitoring report, we would also like to utilize for analysis the vegetation classification system for South Florida (Rutchey et al. 2006).

A total of eight distinct habitats (including altered habitat types) were studied under this project at control and reference sites (Table 3). Seven were analyzed last event but the designation of transect # PC27 was changed to cabbage palm hammock (Hp) from cypress (C) which it was erroneously called, likely because it was assumed that was the original habitat type. However, it has many old (tall and bootless) palms and no evidence of cypress although dead cypress can be found just outside the transect towards the West.

For most of the statistical analysis, we found it helpful to combine all cypress habitats (Ch, Cg, and C) to one group and both mesic and hydric pine flatwoods for comparisons between control and restoration sites to increase sample size by habitat. This results in 4 control and 12 restoration Cypress transects along with 3 control and 12 restoration pine flatwoods transects. Most analysis was done based on current conditions. However, it may be better to look at historic habitat types for analysis in future reports.

The general location of all transects at control and restoration sites were presented above in the Methods section in Figure 1. Each transect is presented below with both pre-drainage and current (baseline) habitat type in Table 4 and soil types following the mapping data (no soil analysis conducted at transects) from the Soil Survey for Collier County (Liudahl et al. 1998). The restoration sites are shown over 1940 and 2009 aerial photography separated by Northern, Middle, and Southern transects in Figures 10-15. Existing condition or baseline habitat types were designated based on general assessment of the site in the field and utilizing transect data. Historic or pre-drainage habitat types were determined using a combination of evaluation of 1940's aerial photography and evidence in the field including presence or absence of old-growth trees, dead stumps or trunks, and species composition.

Table 3: Transects by existing habitat type and management regime.

Management Regime	Habitat Name	Habitat	# transects
Control	Cypress	C	3
Control	Cypress w/ graminoid understory	Cg	1
Control	Pine flatwoods / hydric	Ph	3
Control	Wet Prairie	G	4
Restored	Cypress	C	5
Restored	Cypress w/ graminoid understory (2 historically Cg were colonized by slash pine)	Cg	5 (7)
Restored	Cypress w/ hardwoods	Ch	2
Restored	Hammock / cabbage palm	Hp	1
Restored	Hammock / hydric (historically C)	Hh (C)	1 (0)
Restored	Pine flatwoods / hydric (2 were historically Cg)	Ph	10 (8)
Restored	Pine flatwoods / mesic	Pm	2
Restored	Wet Prairie	G	9
	Total:		46

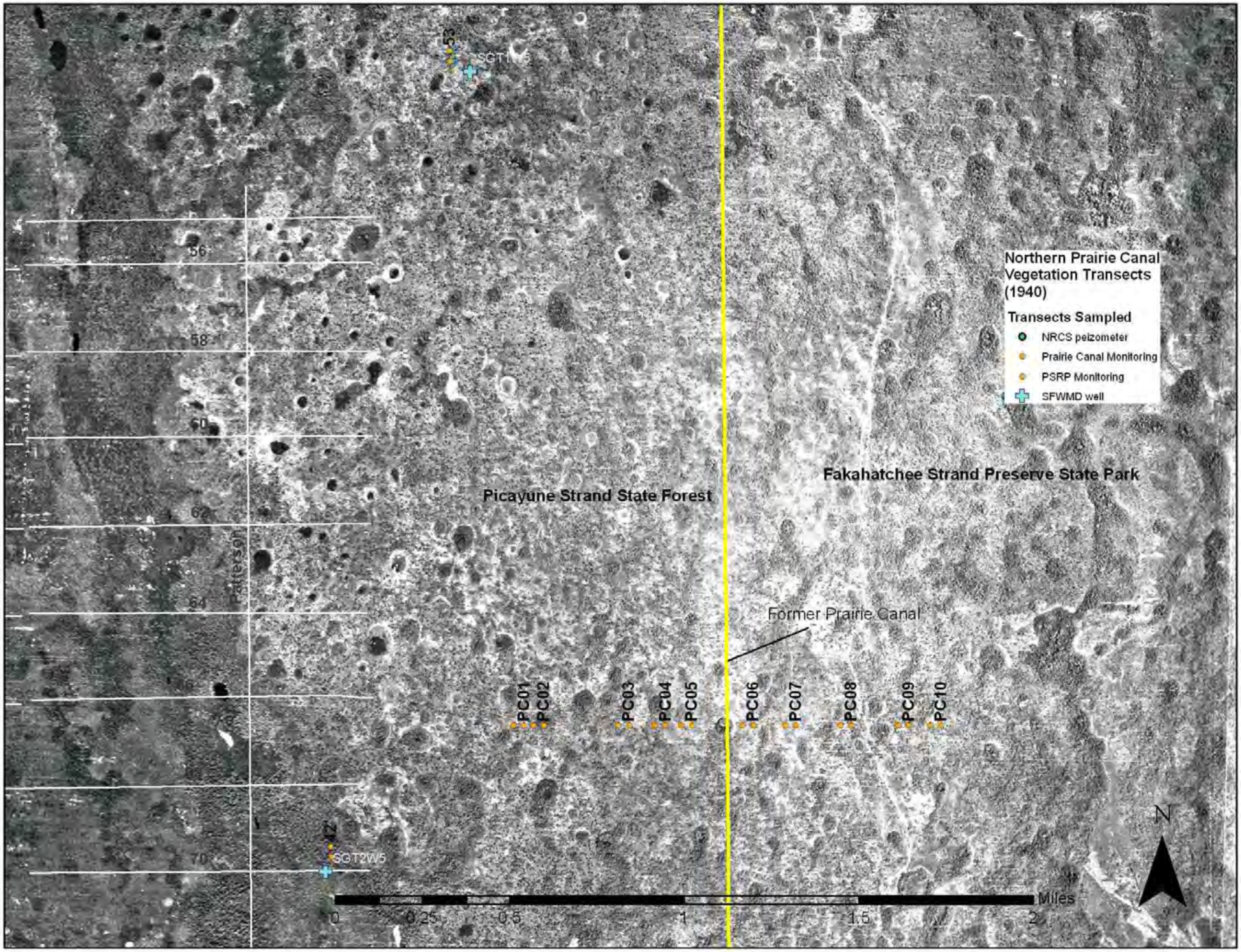
Dominant soil types generally follow habitat types. Half of the transects (23 of 46) consist of Ochopee fine sandy loam and Ochopee fine sandy loam, low and are prevalent in the wet prairies (G), graminoid dominated hydric pine flatwoods (Ph), and some of the more open cypress with graminoid (Cg) transects. Pinelands also consisted of Hallandale and Boca fine sands. Cypress areas included Boca, Riviera, limestone substratum, Copland fine sands, digressional. The wet prairie with this soil type is a narrow area around a cypress dome thus the soil type is probably different just reflecting the lack of precision in the soils mapping. To analyze effects of soils specifically it would be advisable to first have a soil scientist evaluate each transect in the field.

Historic aerial photograph interpretation was also utilized for clues to past site conditions. While in general the 1940's aerial photography is a good indication of pre-drainage conditions, when examining these photos one must bare in mind that logging of slash pine may have occurred here in the 1920's and 1930's as saw mills were operating during these years along S.R. 29 (Duever et al. 1986). This may make at least some of the canopy of the pineland areas seem even more sparse than they would have been prior to this disturbance. Several disturbed areas and trails evident in the 1940's aerial photography may have been utilized for timber extraction. Also one must be careful in examining the figures because geo-referencing of the 1940's aerials was less precise than the 2008 aerials so transect placement over the photography is less accurate.

Table 4: Transect Descriptions

Transect	Mgt. Regime	Location	Habitat Group	Pre-drainage NRCS Habitat	Baseline NRCS Habitat	SOIL #	Soil Type Name
07PI11	Control	FPNWR	Pineland	Ph	Ph	11	Hallandale Fine Sand
07WP11	Control	FPNWR	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
32	Control	FPNWR	Cypress	C	C	51	Ochopee Fine Sandy Loam
32PI33	Control	FPNWR	Pineland	Ph	Ph	49	Hallandale and Boca Fine Sands
32WP33	Control	FPNWR	Wet Prairie	G	G	25	Boca, Riviera, Limestone substratum, Copeland Fine Sands, Depressional
37	Control	FSPSP	Cypress	C	C	25	Boca, Riviera, Limestone substratum, Copeland Fine Sands, Depressional
39	Control	FSPSP	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
42	Restored	PSSF	Cypress	C	C	11	Hallandale Fine Sand
45	Control	FPNWR	Cypress	Cg	Cg	25	Boca, Riviera, Limestone substratum, Copeland Fine Sands, Depressional
51	Control	FSPSP	Cypress	C	C	25	Boca, Riviera, Limestone substratum, Copeland Fine Sands, Depressional
53	Restored	PSSF	Pineland	Pm	Pm	11	Hallandale Fine Sand
55	Restored	PSSF	Cypress	Cg	Ph	50	Ochopee Fine Sandy Loam, Low
56	Restored	PSSF	Cypress	C	Hh	25	Boca, Riviera, Limestone substratum, Copeland Fine Sands, Depressional
57	Restored	PSSF	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
64	Control	FSPSP	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
67	Control	FSPSP	Pineland	Ph	Ph	51	Ochopee Fine Sandy Loam, Low
PC01	Restored	PSSF	Pineland	Pm	Pm	11	Hallandale Fine Sand
PC02	Restored	PSSF	Cypress	Ch	Ch	11	Hallandale Fine Sand
PC03	Restored	PSSF	Pineland	Ph	Ph	11	Hallandale Fine Sand
PC04	Restored	PSSF	Cypress	Cg	Ph	51	Ochopee Fine Sandy Loam
PC05	Restored	PSSF	Pineland	Ph	Ph	51	Ochopee Fine Sandy Loam
PC06	Restored	FSPSP	Wet Prairie	G	G	51	Ochopee Fine Sandy Loam
PC07	Restored	FSPSP	Wet Prairie	G	G	51	Ochopee Fine Sandy Loam
PC08	Restored	FSPSP	Pineland	Ph	Ph	51	Ochopee Fine Sandy Loam
PC09	Restored	FSPSP	Pineland	Ph	Ph	51	Ochopee Fine Sandy Loam
PC10	Restored	FSPSP	Pineland	Ph	Ph	51	Ochopee Fine Sandy Loam
PC11	Restored	PSSF	Cypress	Cg	Cg	49	Hallandale and Boca Fine Sands

Transect	Mgt. Regime	Location	Habitat Group	Pre-drainage NRCS Habitat	Baseline NRCS Habitat	SOIL #	Soil Type Name
PC12	Restored	PSSF	Cypress	C	C	49	Hallandale and Boca Fine Sands
PC13	Restored	PSSF	Cypress	Cg	Cg	49	Hallandale and Boca Fine Sands
PC14	Restored	PSSF	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
PC15	Restored	PSSF	Cypress	C	Ch	11	Hallandale Fine Sand
PC16	Restored	FSPSP	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
PC17	Restored	FSPSP	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
PC18	Restored	FSPSP	Pineland	Ph	Ph	51	Ochopee Fine Sandy Loam, Low
PC19	Restored	FSPSP	Pineland	Ph	Ph	51	Ochopee Fine Sandy Loam, Low
PC20	Restored	FSPSP	Cypress	C	C	25	Boca, Riviera, Limestone substratum, Copeland Fine Sands, Depressional
PC21	Restored	PSSF	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
PC22	Restored	PSSF	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
PC23	Restored	PSSF	Pineland	Ph	Ph	49	Hallandale and Boca Fine Sands
PC24	Restored	PSSF	Wet Prairie	G	G	50	Ochopee Fine Sandy Loam, Low
PC25	Restored	PSSF	Cypress	Cg	Cg	49	Hallandale and Boca Fine Sands
PC26	Restored	FSPSP	Cypress	C	C	49	Hallandale and Boca Fine Sands
PC27	Restored	FSPSP	Hammoc k	Hp	Hp	49	Hallandale and Boca Fine Sands
PC28	Restored	FSPSP	Cypress	C	C	51	Ochopee Fine Sandy Loam
PC29	Restored	FSPSP	Cypress	Cg	Cg	25	Boca, Riviera, Limestone substratum, Copeland Fine Sands, Depressional
PC30	Restored	FSPSP	Cypress	Cg	Cg	25	Boca, Riviera, Limestone substratum, Copeland Fine Sands, Depressional



Northern Prairie Canal Vegetation Transects (1940)
Transects Sampled
NRCS peizometer
Prairie Canal Monitoring
PSRP Monitoring
SFWMD well
Picayune Strand State Forest
Fakahatchee Strand Preserve State Park
Former Prairie Canal
PC01
PC02
PC03
PC04
PC05
PC06
PC07
PC08
PC09
PC10
SGT2W5
Patterson
56
58
60
62
64
66
70
0
0.25
0.5
1
1.5
2
Miles
N

Figure 10

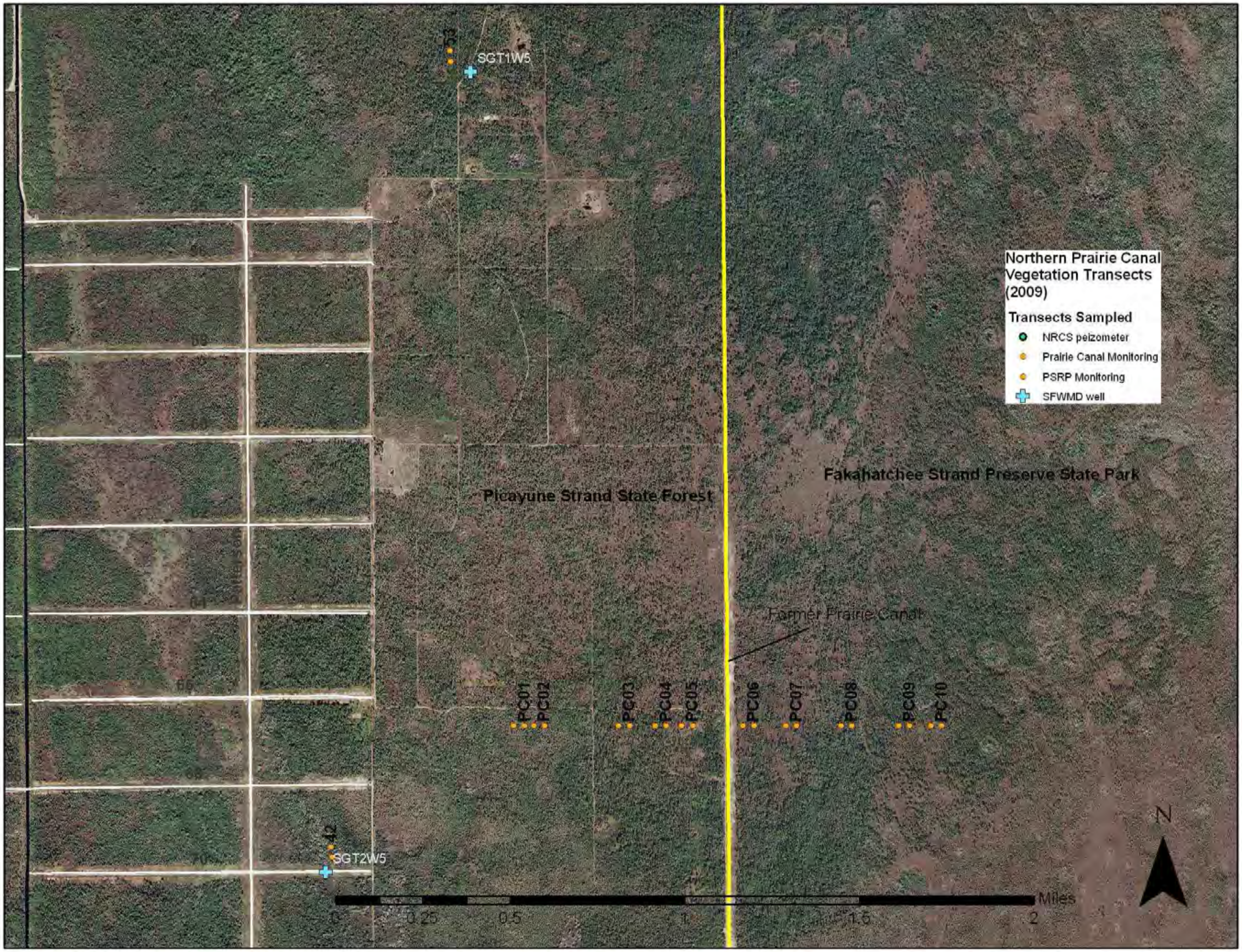

Northern Prairie Canal Vegetation Transects (2009)
Transects Sampled
NRCS peizometer
Prairie Canal Monitoring
PSRP Monitoring
SFWMD well
SGT1W5
53
42
SGT2W5
Picayune Strand State Forest
Fakahatchee Strand Preserve State Park
Former Prairie Canal
PC01
PC02
PC03
PC04
PC05
PC06
PC07
PC08
PC09
PC10
0
0.25
0.5
1
1.5
2
Miles
N

Figure 11

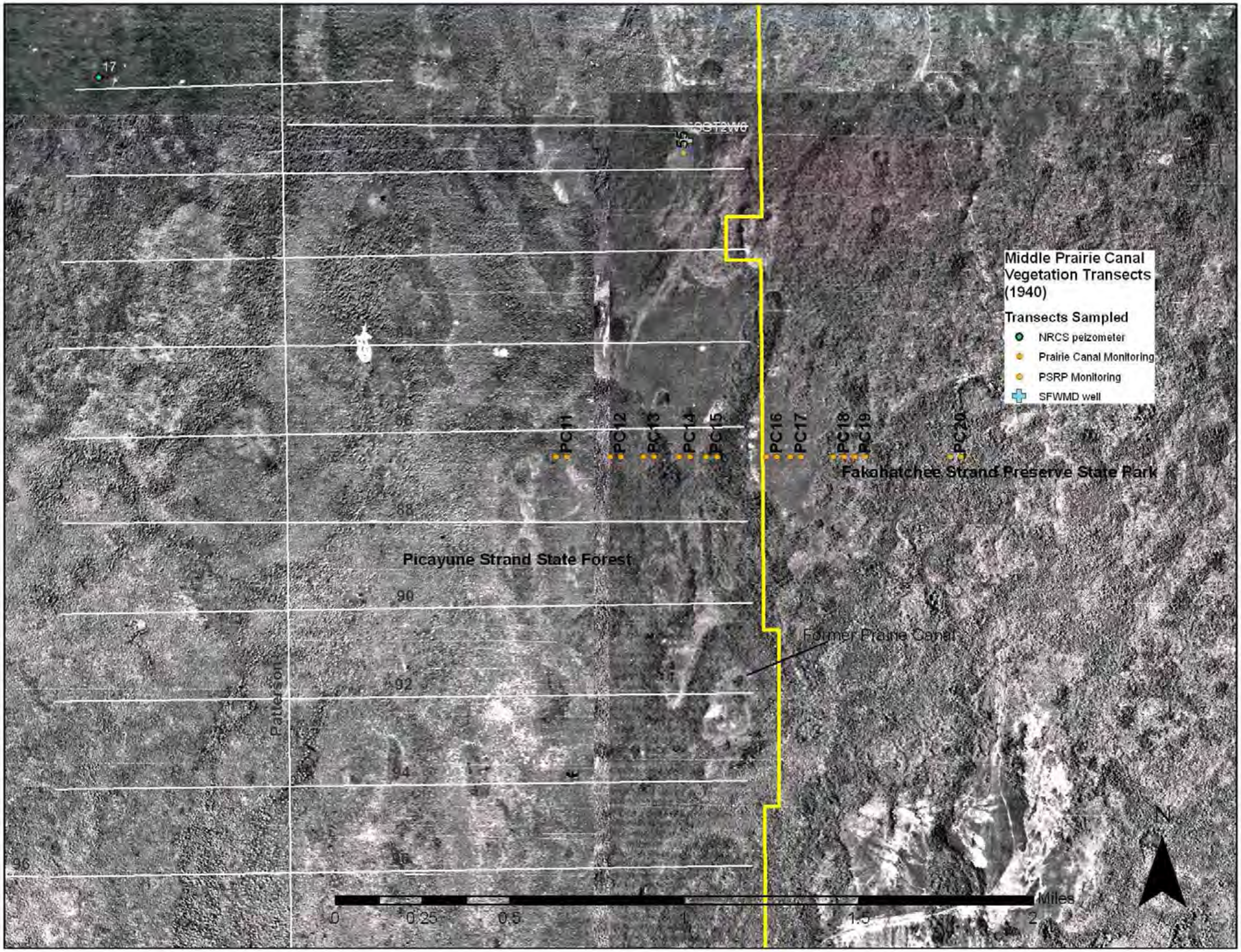

Middle Prairie Canal
Vegetation Transects
(1940)
Transects Sampled
NRCS peizometer
Prairie Canal Monitoring
PSRP Monitoring
SFWMD well
PC11
PC12
PC13
PC14
PC15
PC16
PC17
PC18
PC19
PC20
Fakahatchee Strand Preserve State Park
Picayune Strand State Forest
Former Prairie Canal
Patterson
17
84
86
88
90
92
94
96
0
0.25
0.5
1
1.5
2
Miles
N

Figure 12

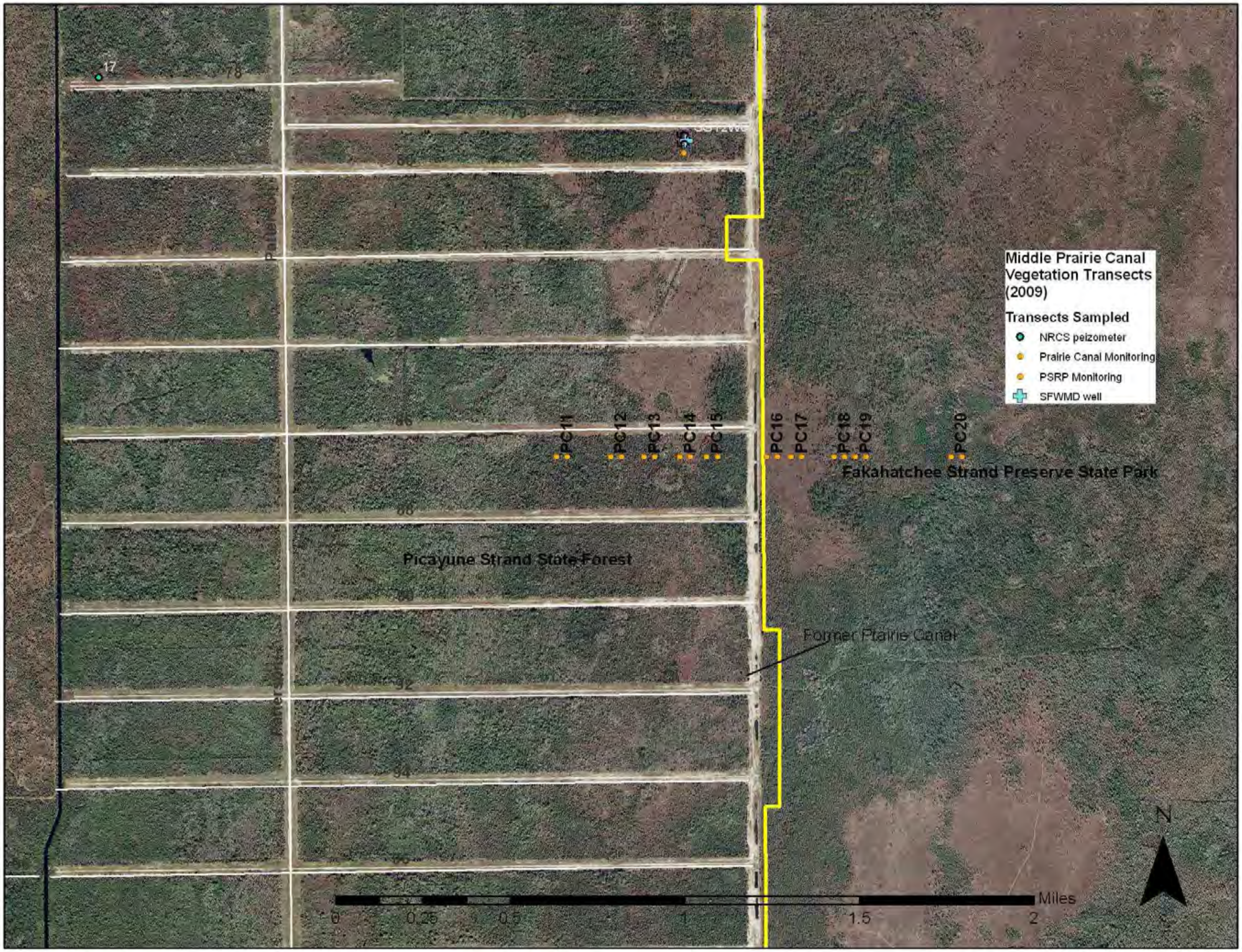

Middle Prairie Canal Vegetation Transects (2009)
Transects Sampled
NRCS peizometer
Prairie Canal Monitoring
PSRP Monitoring
SFWMD well
PC11
PC12
PC13
PC14
PC15
PC16
PC17
PC18
PC19
PC20
Fakahatchee Strand Preserve State Park
Picayune Strand State Forest
Former Prairie Canal
Miles
0
0.25
0.5
1
1.5
2
N

Figure 13

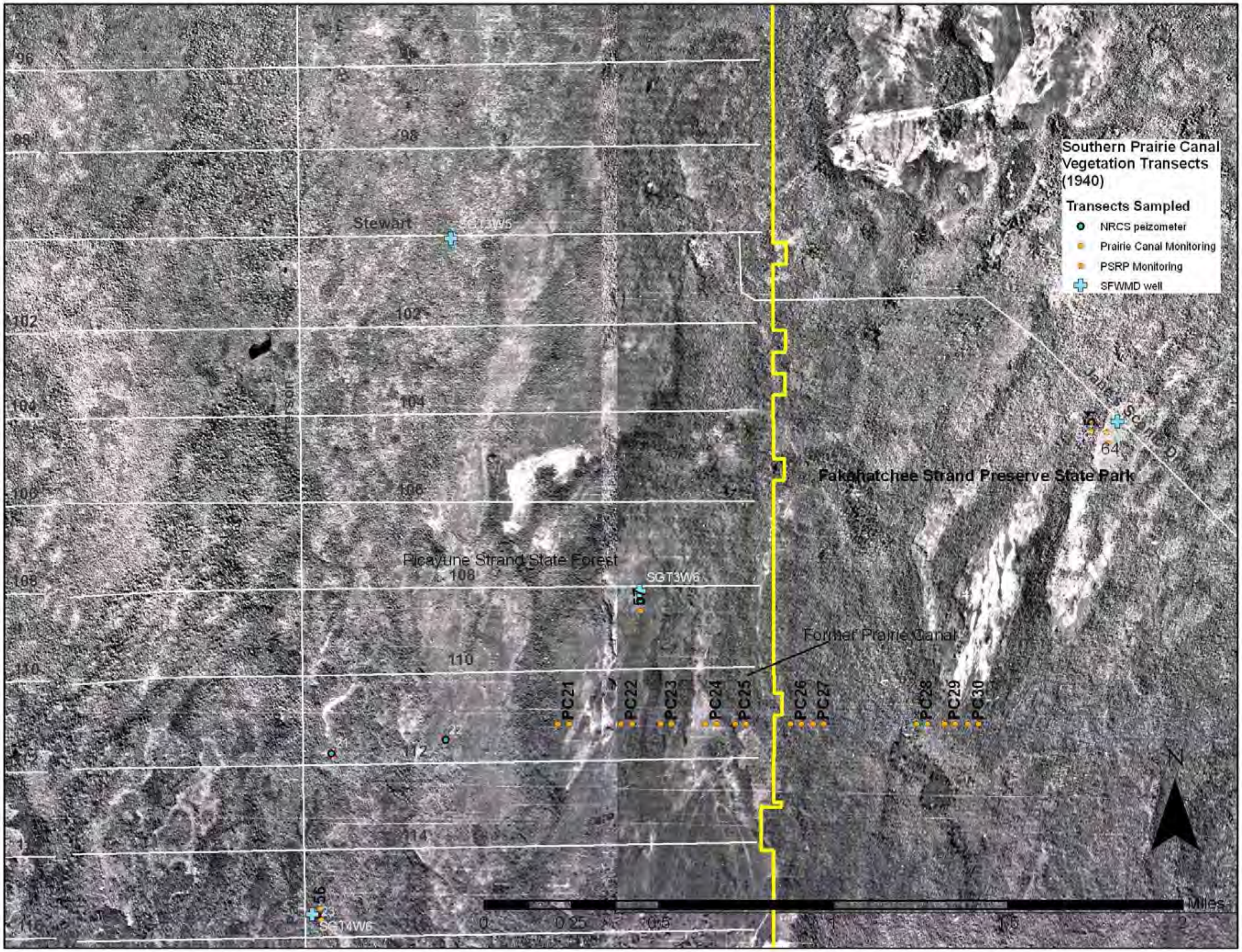

Southern Prairie Canal Vegetation Transects (1940)
Transects Sampled
NRCS peizometer
Prairie Canal Monitoring
PSRP Monitoring
SFWMD well
Stewart
Picayune Strand State Forest
Fakahatchee Strand Preserve State Park
Former Prairie Canal
SGT3W6
SGT4W6
PC21
PC22
PC23
PC24
PC25
PC26
PC27
PC28
PC29
PC30
Miles
N

Figure 14

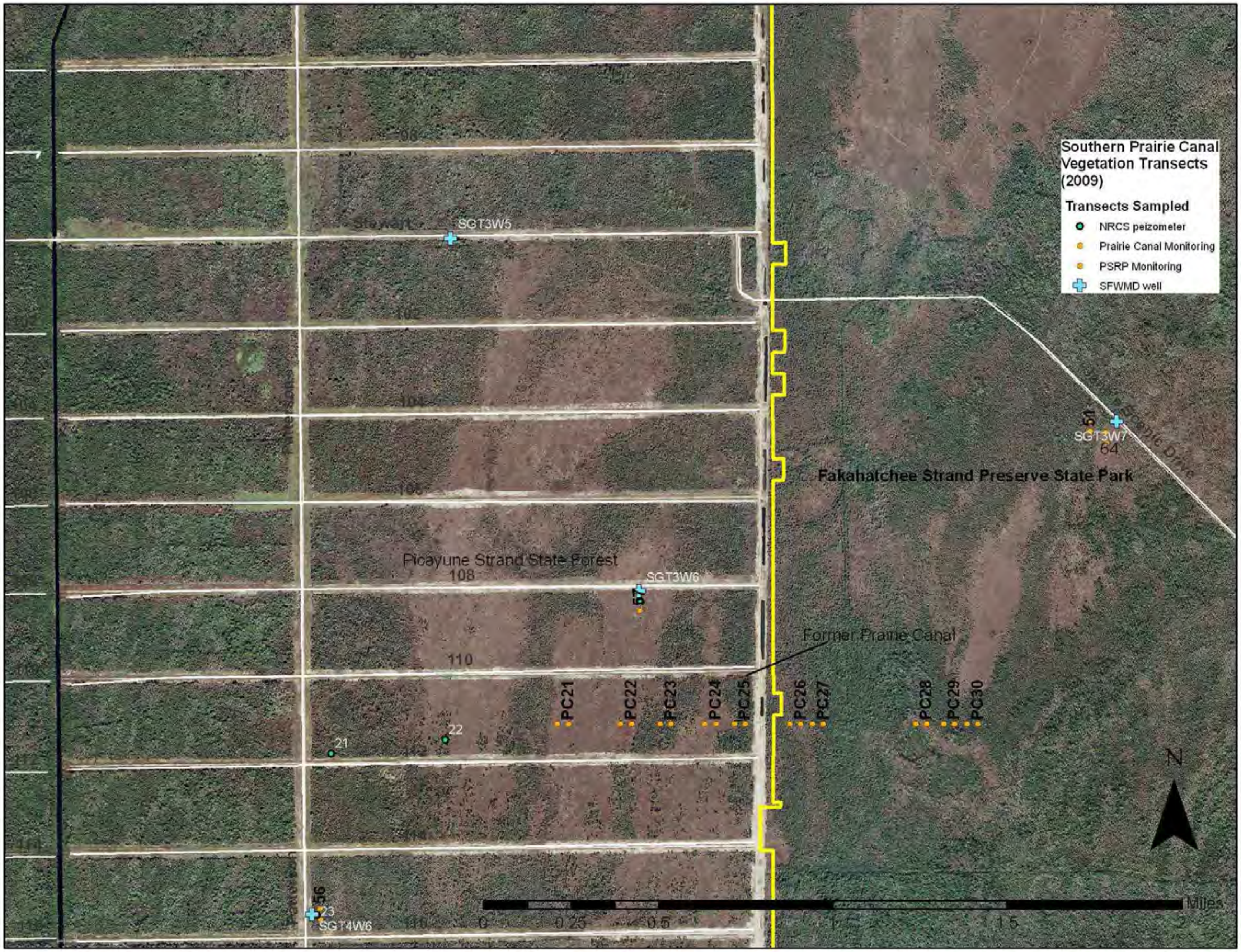

Southern Prairie Canal Vegetation Transects (2009)
Transects Sampled
NRCS peizometer
Prairie Canal Monitoring
PSRP Monitoring
SFWMD well
SGT3W5
SGT3W6
SGT3W7
SGT4W6
Picayune Strand State Forest
Fakahatchee Strand Preserve State Park
Former Prairie Canal
PC21
PC22
PC23
PC24
PC25
PC26
PC27
PC28
PC29
PC30
N
Miles
0
0.25
0.5
1
1.5
2

Figure 15

The Northern Transects include PC01-PC10 which were historically predominantly open, assumed fire-maintained habitats, with the possible exception of PC02. It is also possible that the very open canopy nature of this area evident in the 1940's aerial may be in part artificial due to logging as evidenced by the visible trail running through the middle of the most open area, but this cannot be determined simply from aerial interpretation. PC02 consists of more visible canopy (less open) in the 1940 aerial and is currently considered to be Cypress with hardwoods (Ch) because of the abundant swamp bay (*Persea palustris*) and old growth cabbage palms. The canopy seems more closed in the current aerial photography. Incidentally, PC02 changed dramatically after the "Pretty Island" Fire in June of 2004 opening the canopy quite substantially by killing much of the swamp bay and promoting growth of sawgrass (*Cladium jamaicense*) underneath. Two additional transects in the area include one pineland (53) and one cypress (42) transect which were closer to the actual Picayune Strand Swamp which runs from North to South along the western side of the study area.

The middle transects include PC11-PC20 which were predominantly cypress dominated communities to the west of Prairie canal (the main Picayune Strand jogs to the east just north of this location) and the far eastern transect. Wet prairie and pineland habitats are more in the center. The wet prairies occur just to the west of the former Prairie canal in transect PC14 and to the east in transects PC16 and PC17. Then to the east a slightly higher fire-maintained area of pineland occurs (PC18 and PC19) which then grades back down into another cypress dominated area (PC20) which has since burned out (2001) killing overstory cypress trees. One additional transect sampled (55) occurs about a mile to the north on the Picayune Strand side of the former Prairie canal representing a stretch of former cypress with graminoid understory (Cg) that has become colonized by slash pine and shrubs. One important change that is evident in the cypress with graminoid (Cg) transects (PC11 and PC13) in this middle area is that they have become much more closed canopy since the 1940's aerial photography. This suggests that the shrubs, palms, and vines dominating these transects may have increased since that time. Also the young pines at the east end of PC11 and to the south of this transect may be recent colonization as well since it appears there was a prairie-like open area extending from the edge of that transect.

The southern transects (PC21-PC30) are open fire-maintained wet prairie and pineland to the west of the former Prairie canal with areas around the canal (PC26) and to the east generally are cypress dominated ecosystems. Changes since 1940 are less obvious from the aerial photography then they are in the field. Most of the wet prairies have changed little in overall structure though scattered dead trunks of small cypress trees can be found indicating that perhaps cypress was more abundant though not dominant. The cypress areas appear closed canopy on both 1940 and 2009 aerial photography, however cypress logging (after 1940), drainage and fire has obviously lowered the overall canopy height in many areas as abundant large cypress stumps and logs can be found in these areas. PC28 is a good example of a logged old growth stand with large stumps and at least one very large standing dead hollow trunk that was probably left when the area was logged shortly after the 1940's aerial photography was taken.

PC27 was considered to by cabbage palm hammock (Hp) in both historic and current condition because it occurs on an isolated (by strand swamp) slightly higher, rocky area and is currently dominated by old growth (tall bootless) cabbage palms and a variety of shrubs typical of hammock areas. There are no dead cypress trunks or stumps in this area so it is doubtful cypress occurred here. The transect also appears possibly a little more open in 1940 suggesting that it was more of a woodland with scattered palms historically which is typical along the edges of less disturbed areas of the Fakahatchee Strand but the designation of hammock (Hp) is still the closest fit in the NRCS habitat classification system. Large areas of this habitat type likely occurred along the edges of the actual Picayune Strand flow way which is evidenced by persisting old palms in the field and large areas mapped by NRCS in the 1940's vegetation map called "cabbage palm flatwoods". It is important to take notice of these areas when considering control of cabbage palm as a nuisance species in other habitats where a substantial increase in palms has affected species composition and the ecology of the area negatively.

The quantitative sampling data was also briefly analyzed to examine how habitat designations fit individual transects (Figures 16 and 17). Utilizing percent cover by species from the quadrat sampling (2009) which emphasizes groundcover and shrub strata rather than overstory tree densities, the relationships between each of the transects were examined. Univariate and multivariate analyses were performed using PRIMER v6 (Clarke and Gorley 2006). Bray-Curtis similarity matrices (Bray and Curtis 1957) were employed for the hierarchical cluster analysis using the group average method. Similarity profile global significance tests (SIMPROF) were used to identify significance of groups within the cluster analysis (Clarke and Gorley 2006). Non-metric multidimensional scaling (MDS) ordinations were also based on Bray-Curtis similarity of plant communities represented by quadrat samples. Although the statistical routines used were non-parametric, all abundance data as measured by % cover per quadrat were square-root transformed prior to the analysis to down-weight the influence of extremely abundant species (Clarke and Warwick 2001).

The most important message from this preliminary analysis is that irrespective of location in control or restored sites, cypress areas are more distinct from the other habitats than pineland and wet prairie are from each other, which is expected when examining groundcover data only. However, there are two cypress with graminoid (Cg) transects which fall into the pool of wet prairie and pineland transects, and these are both well fire-maintained and therefore have more prairie components than the other cypress with graminoid areas which are long fire suppressed and dominated by shrubs and vines. It is also important to note that one of these two fire maintained cypress with graminoid transects is quite distinct from all other habitats. This is transect 45 on FPNWR and should be considered one of the few examples of a healthy system which has significant hydrology and therefore hosts species not often found in the shorter hydroperiod prairies adjacent to it and yet has had repeated fire to favor herbaceous and graminoid species thanks to the rigorous fire management on FPNWR. Transect 55, which was historically cypress with graminoid (Cg) was heavily colonized by slash pine and saltbush (*Baccharis glomeruliflora*) and more severely drained than some of the other sites due to its proximity to the Prairie Canal (Figures 4 and 5) and was found to be least similar to all other sites. Transect PC23 is also interesting in that it is surrounded by cypress with graminoid (Cg) and even has some dead cypress trunks fallen over the far western edge suggesting it was perhaps at least in part historically a different habitat. However, there are several old-growth pines along the length of the transect suggesting otherwise though these pines do have characteristic swollen bole formation typical of regularly flooded hydric flatwoods (see cover photo).

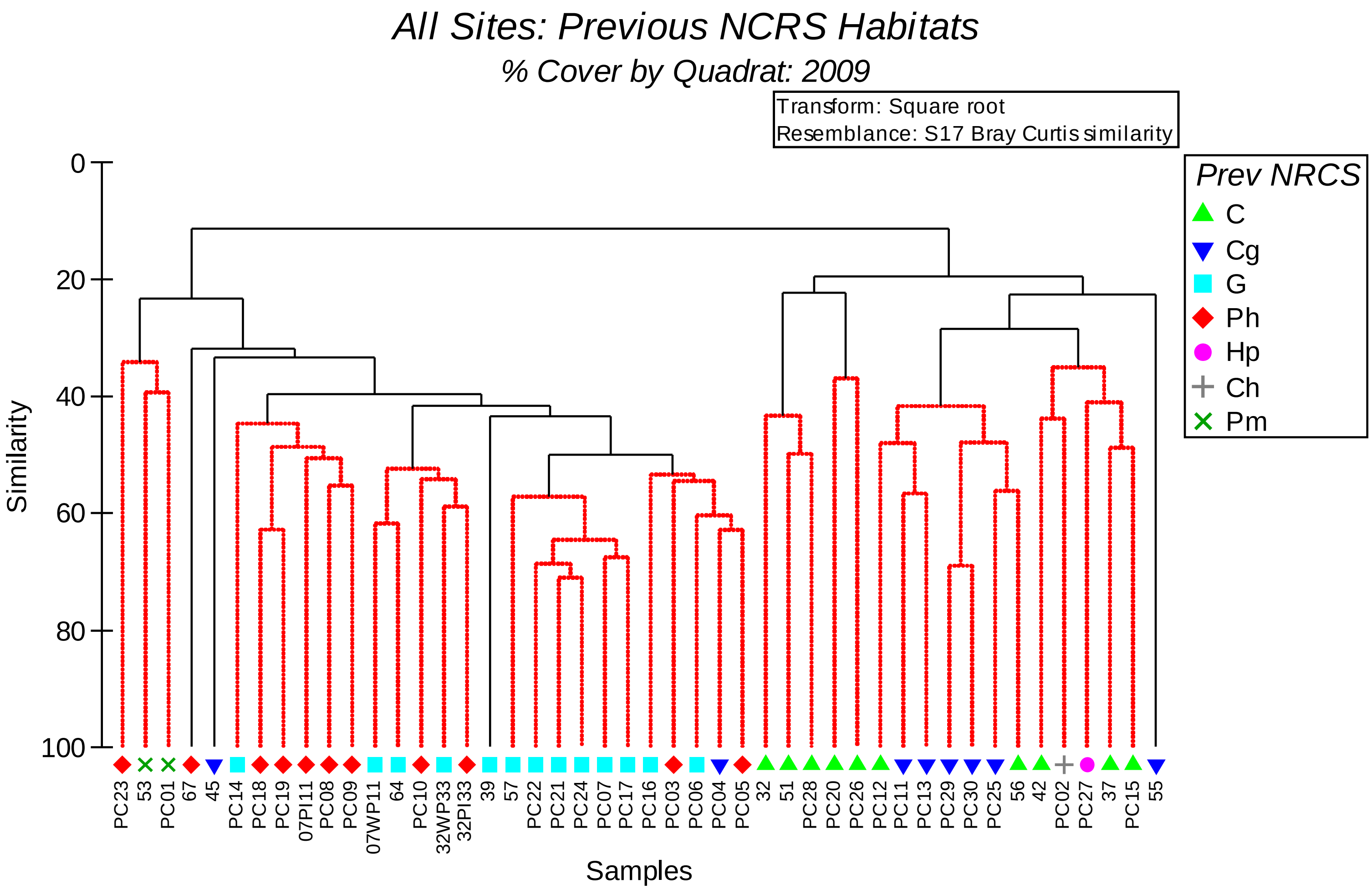

All Sites: Previous NCRS Habitats
% Cover by Quadrat: 2009
Transform: Square root
Resemblance: S17 Bray Curtis similarity
Prev NRCS
C
Cg
G
Ph
Hp
Ch
Pm
Similarity
0
20
40
60
80
100
PC23 53 PC01 67 45 PC14 PC18 PC19 07PI11 PC08 PC09 07WP11 64 PC10 32WP33 32PI33 39 57 PC22 PC21 PC24 PC07 PC17 PC16 PC03 PC06 PC04 PC05 32 51 PC28 PC20 PC26 PC12 PC11 PC13 PC29 PC30 PC25 56 42 PC02 PC27 37 PC15 55
Samples

Figure 16.

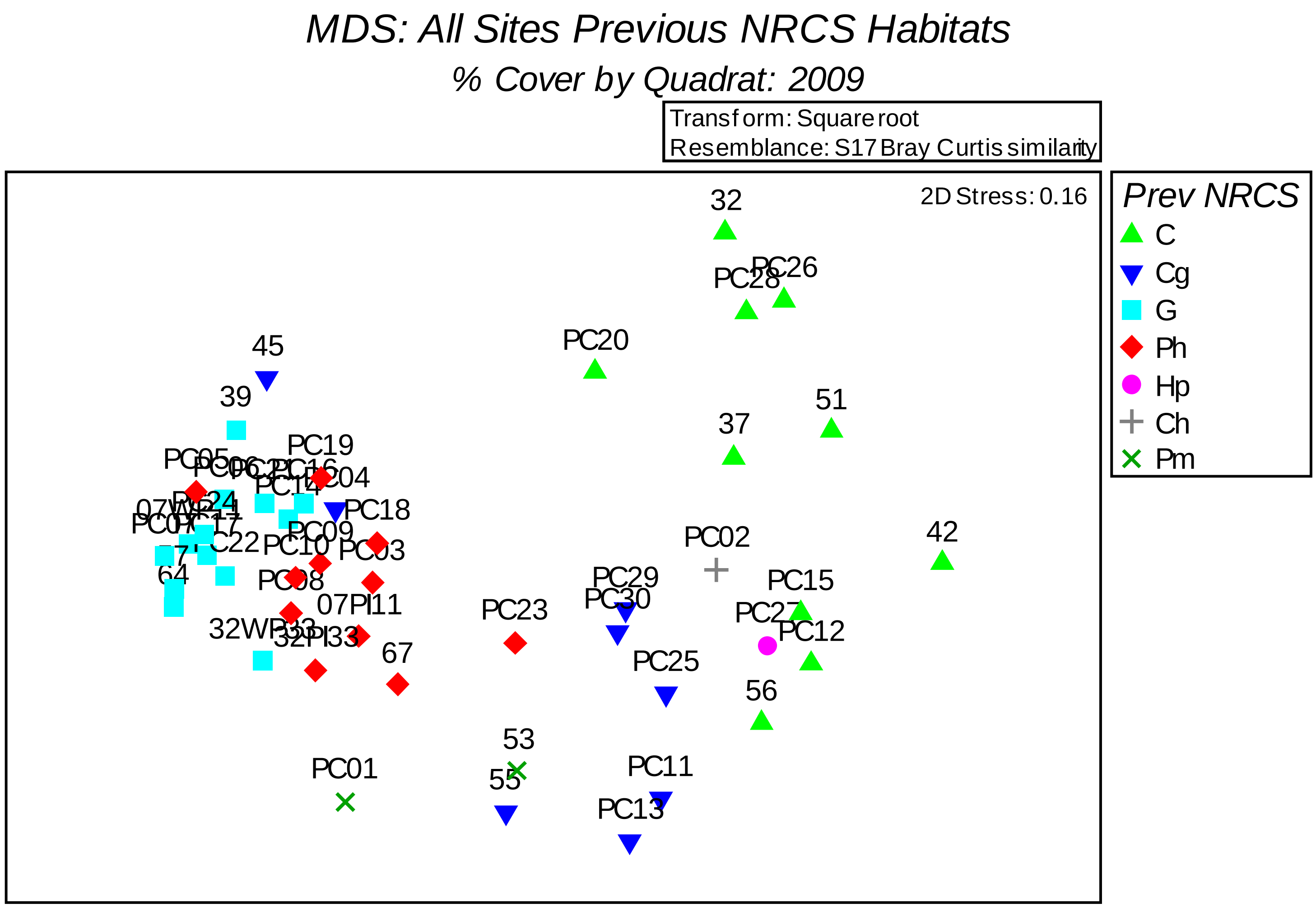

MDS: All Sites Previous NRCS Habitats
% Cover by Quadrat: 2009
Transform: Square root
Resemblance: S17 Bray Curtis similarity
2D Stress: 0.16
Prev NRCS
C
Cg
G
Ph
Hp
Ch
Pm
32
PC26
PC28
PC20
45
39
51
37
PC19
PC05
PC18
42
PC02
PC09
PC29
PC30
PC15
PC23
PC27
PC12
07PI11
32WP33
32PI33
67
PC25
56
53
55
PC01
PC11
PC13

Figure 17.

Time Since Fire

Fire may have a much more immediate and substantial effect on vegetation transect data than hydrological restoration in the short term. To address this, a geodatabase of wildfire and prescribed (Rx) burns was compiled using existing GIS data from PSSF, FSPSP, and FPNWR. These data, however, are as yet incomplete. IRC had hoped to work with cooperating agencies to fill in gaps in the data, but at the moment the three fire interval categories described in the methods were at times determined based on estimate of time of year (if only year was reported, for example) or, in a few cases, fire category was determined in the field based on professional judgment using signs of char and woody growth. In the future, actual data for number of months since fire may be utilized, and perhaps also the number of fires over an extended time period can be analyzed.

Fires occurring prior to the 2004 sampling are presented in Figure 18. Fires between sampling events are presented in Figure 19. Fires between sampling events in 2008 and 2009 are presented in Figure 20. Fires in PSSF affecting transects in the northern section (PC01-PC05) were all wildfires under drought conditions after periods of fire suppression in June of 2004, immediately following sampling. Photographs of the transects were taken immediately following this fire. The middle transects (PC11-PC15) are long fire suppressed while the southern transects (PC21-PC25, 57) in PSSF have been burned more than once in prescribed burns. Fakahatchee fires along Prairie Canal are the least well mapped, therefore the fire histories of some of the transects may be in error. These are largely wildfires prior to 2004 and more recently in June 2007 (PC08-PC10, PC18-PC20) with the exception of the wet prairie transects (PC06-PC07, PC16-PC17) which were prescribed burns in early 2007. Fakahatchee control transects in the isolated prairies and areas of Janes' scenic drive (39, 64, and 67) have been burned under both Rx burns and wildfires but the exact data have not yet been acquired. No fires along Prairie canal occurred between sampling events 2008 and 2009. The prairie transect (64) along Janes' scenic drive was burned again between the 2008 and 2009 sampling event, though the exact date is not known. Florida Panther NWR not only has the most detailed records of fire, but has implemented the highest frequency of Rx burns not only in the study area but in all of the Everglades and Big Cypress basins. Though wildfires have occurred on FPNWR, only Rx burns have affected transects and no transects occur in fire-suppressed areas though the cypress transects have not shown effects of the fires which surround them, likely due to the moisture conditions during Rx burns. Burning near last year in cypress transect 45, cypress with graminoid understory, prevented the site from being sampled and this year it had been 1 year since fire when sampled.

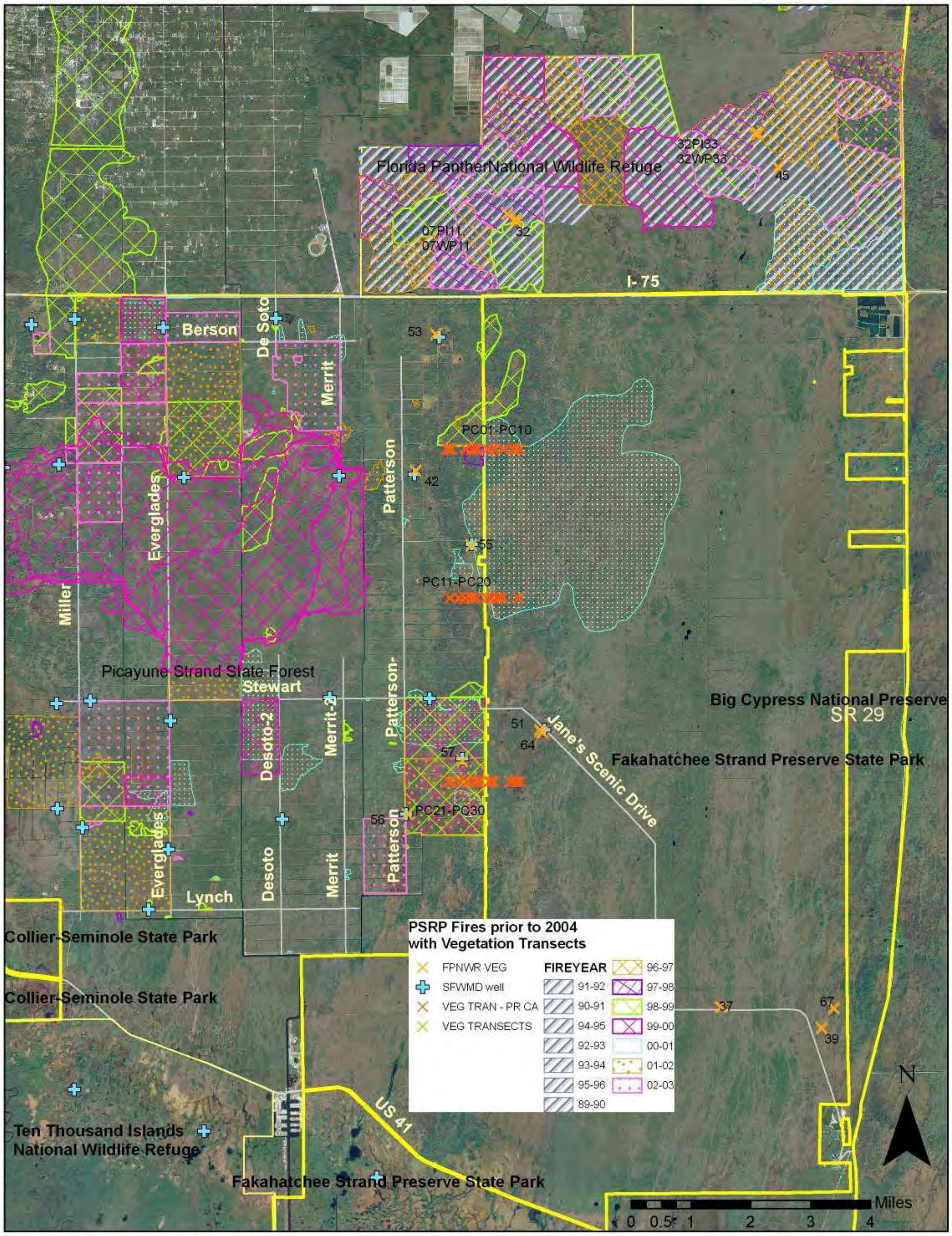


Figure 18: Fires prior to 2004 sampling

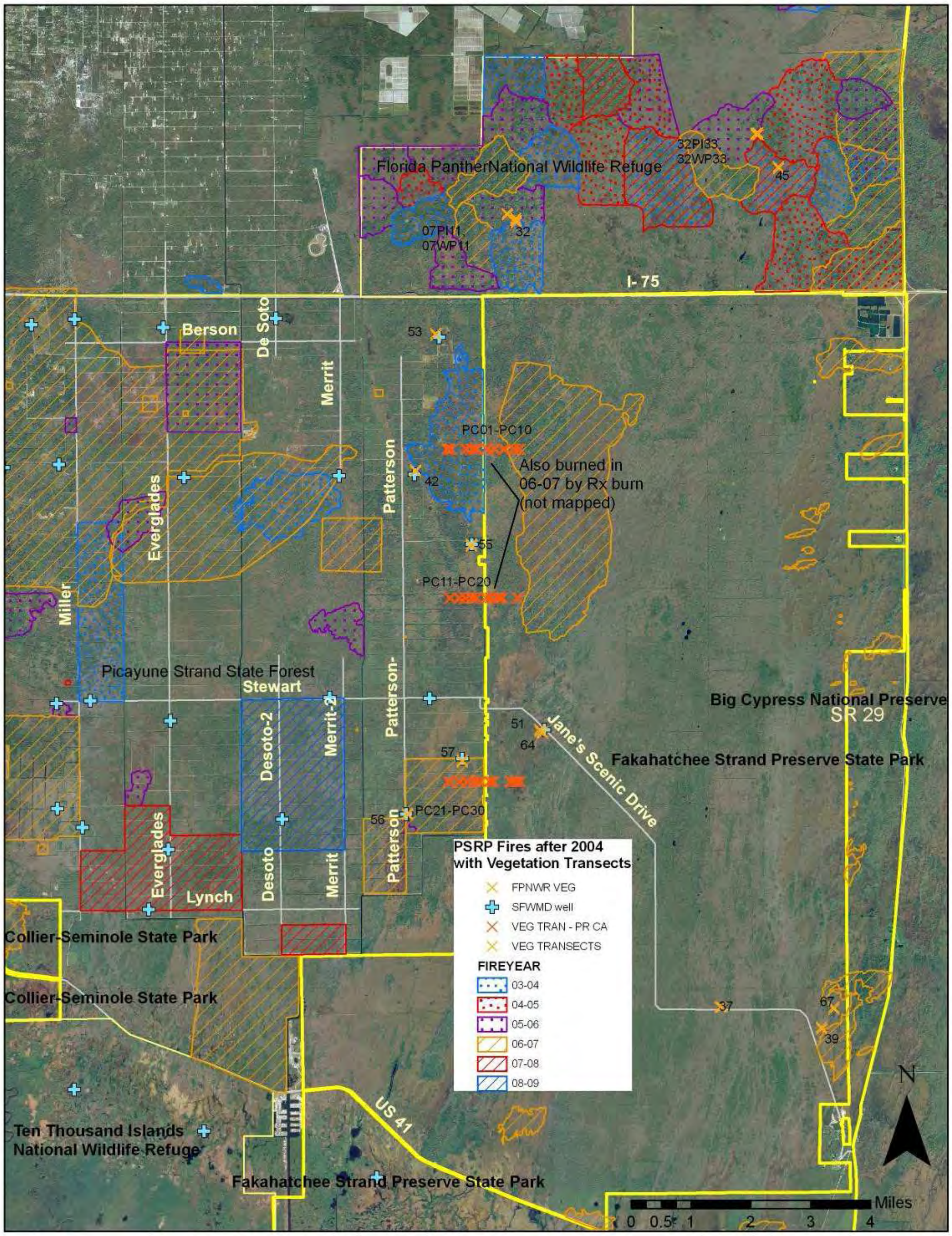


Figure 19: Fires between 2004 and 2008 sampling

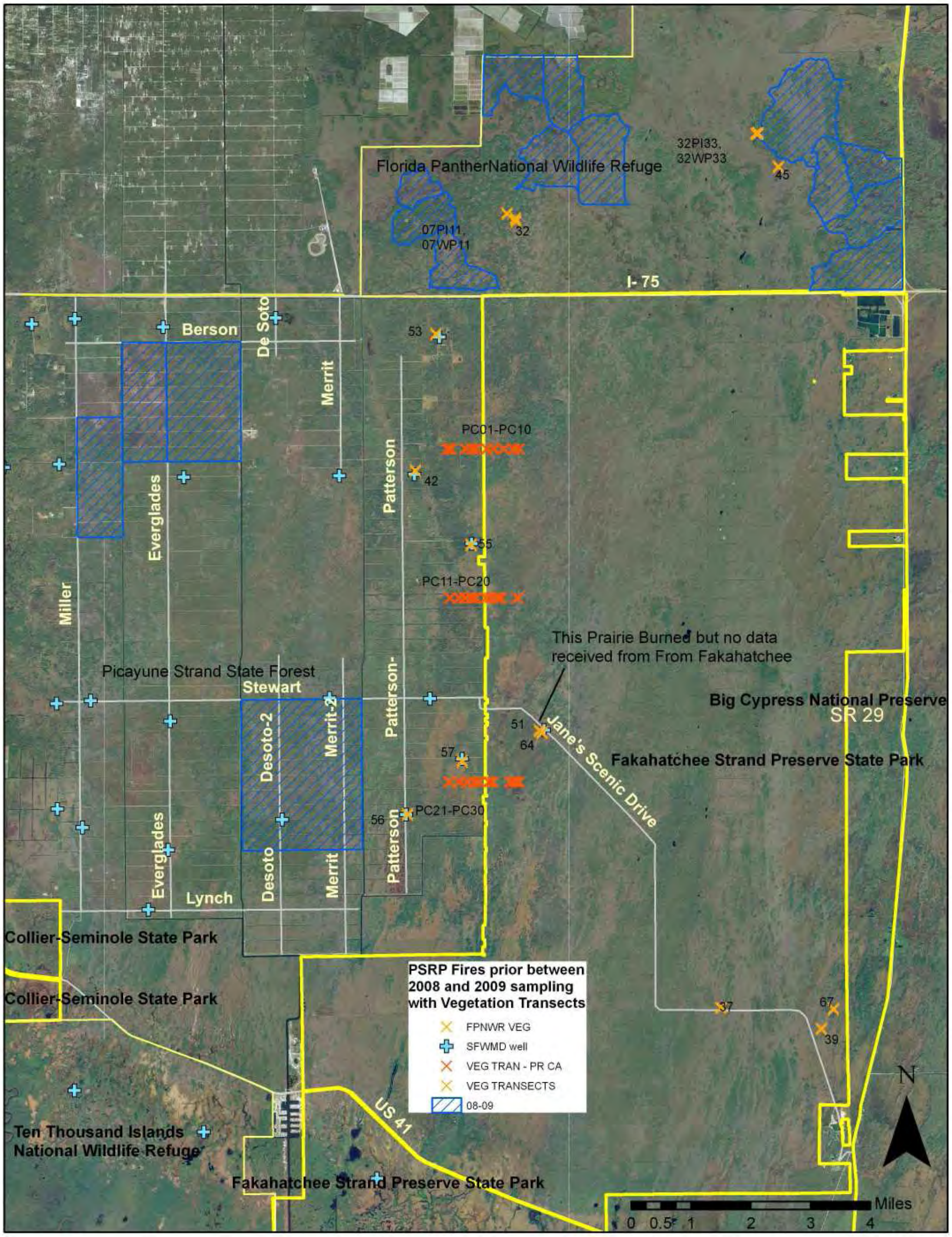


Figure 20: Fires between 2008 and 2009 Sampling (No data for FSPSP)

Within the study area, one transect in 2004 and 8 transects were sampled less than one year since fire (category 1) in hydric flatwoods (Ph), mesic flatwoods (Pm) and prairie (G) habitats (Table 5). Twenty-seven transects in 2004/5 and twenty transects in 2008 were sampled from 1-7 years since fire (category 2) in various habitats. Eighteen transects in 2004/5 and fifteen transects in 2008 were sampled greater than 7 years since fire (category 3), the majority of which were cypress or former cypress (C, Cg, Ch, Hh) habitats which rarely burn, although this did include some hydric and mesic flatwoods (Ph, Pm) and wet prairie (G) sites in PSSF are long fire-suppressed.

Only one wet prairie site (G) and one cypress with graminoid understory (Cg) transect burned since 2008 event totaling 2 transects of <1 year since fire in 2009. A total of 29 transects were from 1-7 years since fire (category 2) in 2009. A total of 15 transects were long fire suppressed (category 3) in 2009.

Table 5: Transects by habitat and time since fire.

			Time Since Fire Category:				Burned Since Last Event:	
Mgt. Regime	Habitat	Transect	2004 (Spring)	2005 (fall)	2008 (Spring)	2009 (Spring)	2008	2009
Control	C	32		3	3	3	Yes	
Control	C	37		3	3	3		
Control	C	51		3	3	3		
Control	Cg	45		2		1		Yes
Control	G	07WP11		2	2	2	Yes	
Control	G	32WP33		2		2		Yes
Control	G	39		2	2	2		
Control	G	64		3	2	1	Yes	Yes
Control	Ph	07PI11		2	2	2	Yes	
Control	Ph	32PI33		2		2		Yes
Control	Ph	67		3	3	3		
Restored	C	42	3	3*	3	3		
Restored	C	PC12	3		3	3		
Restored	C	PC20	2		3	3		
Restored	C	PC26	3		3	3		
Restored	C	PC28	3		3	3		
Restored	Cg	PC11	3		3	3		
Restored	Cg	PC13	3		3	3		
Restored	Cg	PC25	2		2	2	Yes	
Restored	Cg	PC29	2		2	2		
Restored	Cg	PC30	2		2	2		
Restored	Ch	PC02	3		2	2	Yes	
Restored	Ch	PC15	3		3	3		
Restored	G	57	2	2*	2	2	Yes	
Restored	G	PC06	2		1	2	Yes	
Restored	G	PC07	2		1	2	Yes	
Restored	G	PC14	3		3	3		
Restored	G	PC16	3		2	2	Yes	
Restored	G	PC17	2		1	2	Yes	

			Time Since Fire Category:				Burned Since Last Event:	
Mgt. Regime	Habitat	Transect	2004 (Spring)	2005 (fall)	2008 (Spring)	2009 (Spring)	2008	2009
Restored	G	PC21	2		2	2	Yes	
Restored	G	PC22	2		2	2	Yes	
Restored	G	PC24	2		2	2	Yes	
Restored	Hh	56	2	3*	2	2	Yes	
Restored	Hp	PC27	3		3	3		
Restored	Ph	55	1	2*	2	2		
Restored	Ph	PC03	2		2	2	Yes	
Restored	Ph	PC04	2		2	2	Yes	
Restored	Ph	PC05	2		2	2	Yes	
Restored	Ph	PC08	2		1	2	Yes	
Restored	Ph	PC09	2		1	2	Yes	
Restored	Ph	PC10	2		1	2	Yes	
Restored	Ph	PC18	2		1	2	Yes	
Restored	Ph	PC19	2		1	2	Yes	
Restored	Ph	PC23	2		2	2	Yes	
Restored	Pm	53	3	3*	3	3		
Restored	Pm	PC01	3		2	2	Yes	

* *These data were not included in analysis*

Effects of Wind Damage and Hurricane Wilma on Belt Transects

Several Hurricanes hit the area between the 2004/2005 sampling events and the 2008/2009 sampling events with Hurricane Wilma having the most profound impact. The 75 mile wide eye of Hurricane Wilma passed directly over the study area with 120 mph sustained winds on October 24, 2005. Other storms such as hurricanes Charley, Frances, Jeanne, Katrina and Rita may also have effected some of the transects to a lesser degree since initial sampling in spring of 2004/2005. Based on sampling right after Wilma on FPNWR, the most substantial effect of the storm on pine flatwoods was a roughly 9% reduction in slash pine overstory density. Secondarily, there was a 3.5% reduction in old (tall bootless) cabbage palms and a 14% reduction in density of the fairly uncommon live oak as discussed in more detail in the 1 year monitoring report (Barry 2006). Effects on cypress habitats differed greatly with no measurable effect on pop-ash (*Fraxinus caroliniana*) and pond cypress (*Taxodium ascendens*) in control sites with up to 50% mortality observed in restoration transects (Barry and Saha 2008). No major wind storms hit the study area between the 2008 and 2009 sampling events, though tropical storm Fay passed just to the north in August 2008.

Belt Transect Evaluation

Data for density and basal area for overstory and density for understory and cabbage palm in all strata were averaged by habitat in control and restoration transects below in Tables 6 and 7, respectively. As mentioned in the last report, all trees were identified to species or variety level (Barry and Saha 2008). Some errors in identification of tagged trees occurred during initial sampling in 2004 and persisted through to 2008 and even to the 2009 sampling events in some cases. This is because in the past volunteers and less experienced people assisted with overstory data while those with more botanical knowledge focused on simultaneously collecting the ground cover data. Because of this protocol, errors in identification were carried through from one event to the next as less experienced people gave the benefit of the doubt to the existing data for tagged trees, and this persisted until the 2009 sampling event when the author Mike Barry sampled all transects, overstory to groundcover, and cleaned up these errors. This explains why some of the numbers presented in the 1 year monitoring report may differ slightly from last years report, as well as the change in habitat designation of PC27 mentioned earlier in the report.

Cypress Communities (C, Cg, and Ch)
Density of pond cypress, the dominant overstory species in both control and restoration transects in these communities, remained the same in control sites while it reduced from 2004 to 2008 in restoration and rebounded slightly in 2009 (C) or stabilized (Cg and Ch) (Tables 6 and 7). Overall densities of pond cypress were also lower at restoration sites. The higher mortality observed in restoration versus control sites might help explain the generally lower density of overstory pond cypress in non-control versus control sites during both sampling events. This lower density and higher mortality at restoration sites, if not an artifact of differing sample sizes, may be associated with higher risk of fire and wind damage in the drained communities based on observed incidences of mortality in which the cause of death was evident in the field (Barry and Saha 2008).

Pop-ash, the co-dominant in cypress communities, increased as understory trees grew into the overstory in control and restoration sites alike, despite mortality observed in the overstory due to wind damage from Wilma (Barry and Saha 2008). Understory density increased from 2005 to 2008 and 2009 in control sites as younger trees grew while understory decreased at restoration sites from 2004 to 2008 but stabilized in the 2009 event. Many of these trees are multiple stemmed individuals with trunks that may become damaged, as recorded last event, but actual tree remains alive. Other, less frequent species such as red maple (*Acer rub*rum), pond apple (*Annona glabra*), sweetbay (*Magnolia virginiana*), dahoon holly (*Ilex cassine*), and laurel oak (*Quercus laurifolia*) varied in densities from event to event, control to restoration. Swamp bay was in generally higher density in restoration vs. control, which might be expected due to hydrology as this is typically a shorter hydroperiod species than pond cypress. Also, though overstory density in control increased as the individuals in the understory grew, restoration transects showed general decrease which was explained by observed mortality by both Wilma and fire (Barry and Saha 2008). Understory densities in restoration transects did increase steadily in C and Cg habitats in restoration sites as smaller individuals recovered from Wilma and in Ch habitat where they were recovering more slowly from a fire after sampling in 2004. Densities of swamp bay must also be monitored as the laurel wilt disease associated with a fungus transmitted by the introduced ambrosia beetle may be approaching our area from North Florida (Mayfield et al. 2009, http://edis.ifas.ufl.edu/HS391).

Hydric and Cabbage Palm Hammocks (Hh and Hp)
Hydric hammock (Hh) was only sampled in the restoration transects (n=1 transect). This transect (56) was no doubt historically a cypress (C) strand and will likely be lumped in cypress with hardwoods (Ch) communities for future analysis. Substantial mortality in swamp bay and pond cypress was observed due to Hurricane Wilma in this transect. Cabbage palm showed an increase in overstory strata and associated decrease in understory

since 2004 as they have grown in height, and lower strata number vary but remain high with over 700 trees/acres in the three lower strata combined. Although a series of north to south mesic and hydric hammocks which were historically hammocks (prior to drainage) exist in the restoration area in the Prairie Canal area, none were sampled and their acreage is relatively small.

Cabbage palm hammock (Hp) was represented by only transect PC27 in the restoration transects of Fakahatchee Strand between two north to south flowing sloughs. Because no living or dead cypress trees can be found in the transect and a high density of old (tall bootless) cabbage palms along with a variety of small tree and shrub species typically associated with hammocks are present, it is likely this location was also historically cabbage palm hammock, though it may have been more open historically. No marked change since 2004 was observed in the overstory although some old growth palm reduction occurred with Wilma. In the understory some smaller live oak has increased after smaller stems grow into that strata. It also appears that there had been a fire prior to the 2004 event which may have burnt some of the oaks back to the ground and their resprouts continue to grow towards the canopy.

Wet Prairies (G)

Wet prairies by definition lack substantial tree coverage. However, where overstory pond cypress occurred in restoration sites, several were killed outright by fire (PC22) or top-killed and resprouted to increase the understory density. No substantial changes were observed in the upper two strata of cabbage palms in wet prairies of control or non-control.

Pineland communities (Ph, Pm)

Overstory slash pine densities did not change in control pineland transects (n=3 transects), although basal area did increase due to individual tree growth. These data suggest hurricane Wilma did not affect the slash pine overstory at control sites. However, as mentioned above and in the 1 year monitoring report, additional transects (n=27) sampled on FPNWR with USFWS funds in 2005 showed 9% decrease in density directly attributed to hurricane Wilma (Barry 2006). A similar decrease of 8.8% was observed in the restoration hydric pine flatwoods transects (n=10 transects) while no effect on the few mesic flatwoods sites was observed (n=2 transects). No further mortality was observed during the 2009 sampling event and some recruitment from the understory into the overstory was recorded in the mesic flatwoods transects. Of the overstory pine mortality observed due to Wilma, two were uprooted and one was snapped.

Some mortality of old (tall bootless) cabbage palms was observed in both control and restoration hydric flatwoods (Ph) transects. An increase in the overstory strata (strata 1) of cabbage palms was observed in control and restoration transects. Changes in strata 2 cabbage palms varied as it is evident several had grown out of the understory and into the overstory. A decline in hydric pine flatwoods (Ph) in restoration sites in the 2008 sampling event is from a single transect PC23 which was revisited in November 2008 because of problems with data collected in 2008 (a lack of line intercept data). No overstory mortality was observed at that time (i.e. no dead palms found) thus it is likely that the decrease is a result of sampling error. Although these data are incorporated into Table 7, these data were not included in upper strata statistical analysis due to potential surveyor error in transect placement and methodologies in 2008. In general, cabbage palms in all strata seem to be increasing in pine flatwoods across the board in control and restoration transects.

Table 6: Density and basal area of tree species by habitat (Control).

			Density (trees/acre)			Stand Basal Area (acres)		
Habitat	Strata	Scientific Name	2005	2008	2009	2005	2008	2009
C	1	Acer rubrum	10.8	10.8	10.8	0.15	0.16	0.17
C	1	Ficus aurea	5.4	5.4	10.8	0.03	0.04	0.12
C	1	Fraxinus caroliniana*	134.8	145.6	156.4	1.60	1.52	1.61
C	1	Magnolia virginiana	5.4			0.57		
C	1	Persea palustris			5.4			0.07
C	1	Sabal palmetto	5.4	5.4	5.4			
C	1	Taxodium ascendens	253.5	253.5	253.5	12.18	12.50	12.59
C	1.5	Sabal palmetto	10.8	10.8	10.8			
C	2	Acer rubrum	27.0	32.4	32.4			
C	2	Annona glabra	27.0	43.1	70.1			
C	2	Ficus aurea	16.2	27.0	27.0			
C	2	Fraxinus caroliniana	738.9	760.5	765.9			
C	2	Ilex cassine	10.8	16.2	16.2			
C	2	Magnolia virginiana	16.2	16.2	21.6			
C	2	Persea palustris	5.4	5.4				
C	2	Quercus laurifolia			5.4			
C	2	Sabal palmetto		5.4	5.4			
C	2	Taxodium ascendens	178.0	145.6	151.0			
C	3	Sabal palmetto	27.0	27.0	27.0			
C	4	Sabal palmetto	102.5	787.5	1720.6			
C	5	Sabal palmetto	10.8	2222.2	151.0			
G	1	Sabal palmetto		5.4	5.4			
G	2	Sabal palmetto	5.4					
G	4	Sabal palmetto	16.2	32.4	32.4			
Ph	1	Pinus elliottii var. densa	64.7	64.7	64.7	2.65	2.90	2.86
Ph	1	Sabal palmetto	48.5	40.5	48.5			
Ph	1.5	Sabal palmetto*	24.3	16.2	16.2			
Ph	2	Ilex cassine		48.5	56.6			
Ph	2	Persea palustris		8.1	8.1			
Ph	2	Sabal palmetto	8.1	32.4	32.4			
Ph	3	Sabal palmetto	372.2	323.6	331.7			
Ph	4	Sabal palmetto	1593.9	1359.2	1836.6			
Ph	5	Sabal palmetto	24.3	64.7	48.5			

**some reduction by hurricane Wilma observed prior to 2008 event*

Table 7: Density and basal area of tree species by habitat (Restoration).

			Density (trees/acre)			Stand Basal Area (acres)		
Habitat	Strata	Scientific Name	2004	2008	2009	2004	2008	2009
C	1	Fraxinus caroliniana	22.7	32.4	32.4	0.10	0.22	0.22
C	1	Persea palustris*	16.2	9.7	9.7	0.48	0.20	0.20
C	1	Quercus laurifolia	3.2	16.2	16.2	0.06	0.53	0.57
C	1	Sabal palmetto	25.9	25.9	25.9			
C	1	Taxodium ascendens	184.5	174.8	178.0	3.02	2.96	3.05
C	1.5	Sabal palmetto	3.2	3.2	3.2			
C	2	Acer rubrum	3.2	3.2	6.5			
C	2	Fraxinus caroliniana	203.9	184.5	184.5			
C	2	Ilex cassine	3.2	3.2	3.2			
C	2	Persea palustris	19.4	22.7	32.4			
C	2	Quercus laurifolia		3.2	3.2			
C	2	Taxodium ascendens	200.6	158.6	145.6			
C	3	Sabal palmetto	110.0	48.5	45.3			
C	4	Sabal palmetto	213.6	987.1	436.9			
C	5	Sabal palmetto	310.7	242.7	216.8			
Cg	1	Ilex cassine		3.2	3.2		0.02	0.02
Cg	1	Persea palustris	6.5	12.9	12.9	0.07	0.11	0.11
Cg	1	Pinus elliottii var. densa	9.7	9.7	9.7	0.09	0.12	0.23
Cg	1	Quercus virginiana		6.5	6.5		0.06	0.09
Cg	1	Sabal palmetto	135.9	165.0	190.9			
Cg	1	Taxodium ascendens*	51.8	35.6	35.6	0.64	0.36	0.44
Cg	1.5	Sabal palmetto	6.5	6.5	6.5			
Cg	2	Ilex cassine		3.2	9.7			
Cg	2	Persea palustris	12.9	29.1	45.3			
Cg	2	Pinus elliottii var. densa		3.2	3.2			
Cg	2	Quercus virginiana	6.5					
Cg	2	Sabal palmetto	48.5	48.5	42.1			
Cg	2	Taxodium ascendens	25.9	16.2	16.2			
Cg	3	Acoelorraphe wrightii	9.7					
Cg	3	Sabal palmetto	381.9	252.4	288.0			
Cg	4	Acoelorraphe wrightii	6.5	9.7	6.5			
Cg	4	Sabal palmetto	1171.5	1190.9	954.7			
Cg	5	Sabal palmetto	1702.3	174.8	165.0			
Ch	1	Persea palustris	80.9	64.7	64.7	0.96	0.94	1.00
Ch	1	Sabal palmetto	97.1	105.2	121.4			
Ch	1	Taxodium ascendens*	48.5	24.3	24.3	0.81	0.31	0.31
Ch	1.5	Sabal palmetto	40.5	40.5	40.5			
Ch	2	Ilex cassine	8.1	8.1	8.1			
Ch	2	Persea palustris	56.6	16.2	24.3			
Ch	2	Sabal palmetto	80.9	64.7	64.7			
Ch	2	Taxodium ascendens	24.3	16.2	16.2			

			Density (trees/acre)			Stand Basal Area (acres)		
Habitat	Strata	Scientific Name	2004	2008	2009	2004	2008	2009
Ch	3	Sabal palmetto	420.7	242.7	226.5			
Ch	4	Sabal palmetto	194.2	234.6	283.2			
Ch	5	Sabal palmetto	169.9	194.2	137.5			
G	1	Pinus elliottii var. densa	3.6	3.6	3.6	0.10	0.20	0.21
G	1	Sabal palmetto	5.4	5.4	5.4			
G	1	Taxodium ascendens	3.6	1.8	1.8	0.05	0.03	0.03
G	2	Sabal palmetto	1.8	1.8	1.8			
G	2	Taxodium ascendens	3.6	5.4	5.4			
G	3	Sabal palmetto	30.6	25.2	23.4			
G	4	Sabal palmetto	77.3	100.7	116.9			
G	5	Sabal palmetto	9.0	23.4	21.6			
Hh	1	Acer rubrum			16.2			0.09
Hh	1	Persea palustris*	16.2			0.08		
Hh	1	Quercus laurifolia	32.4	32.4	32.4	1.06	1.64	1.91
Hh	1	Sabal palmetto	97.1	113.3	129.4			
Hh	1	Taxodium ascendens*	32.4	16.2	16.2	2.52	1.21	1.38
Hh	2	Acer rubrum	48.5	64.7	16.2			
Hh	2	Fraxinus caroliniana	16.2	80.9	32.4			
Hh	2	Sabal palmetto	48.5	16.2				
Hh	3	Sabal palmetto	48.5	64.7	64.7			
Hh	4	Sabal palmetto	275.1	1262.1	453.1			
Hh	5	Sabal palmetto	647.2	48.5	194.2			
Hp	1	Quercus virginiana	16.2	16.2	16.2	0.14	0.21	0.24
Hp	1	Sabal palmetto	145.6	145.6	145.6			
Hp	1.5	Sabal palmetto	113.3	97.1	97.1			
Hp	2	Quercus laurifolia	32.4	16.2	16.2			
Hp	2	Quercus virginiana	32.4	32.4	64.7			
Hp	2	Sabal palmetto	16.2	32.4	32.4			
Hp	3	Sabal palmetto	307.4	226.5	226.5			
Hp	4	Sabal palmetto	436.9	922.3	501.6			
Hp	5	Sabal palmetto	501.6	113.3	129.4			
Ph	1	Pinus elliottii var. densa*	55.0	48.5	48.5	1.46	1.54	1.57
Ph	1	Sabal palmetto	58.3	55.0	76.1			
Ph	1	Taxodium ascendens	8.1	4.9	4.9	0.18	0.14	0.14
Ph	1.5	Pinus elliottii var. densa	4.9	4.9	4.9	0.41	0.45	0.45
Ph	1.5	Sabal palmetto*	11.3	9.7	9.7			
Ph	2	Pinus elliottii var. densa	9.7	11.3	9.7			
Ph	2	Sabal palmetto	27.5	24.3	29.1			
Ph	2	Taxodium ascendens	4.9	4.9	4.9			
Ph	3	Sabal palmetto	229.8	153.7	145.6			
Ph	4	Sabal palmetto	676.4	1012.9	983.8			
Ph	5	Sabal palmetto	64.7	71.2	126.2			
Pm	1	Pinus elliottii var.	64.7	89.0	97.1	1.67	2.14	2.34

			Density (trees/acre)			Stand Basal Area (acres)		
Habitat	Strata	Scientific Name	2004	2008	2009	2004	2008	2009
		densa						
Pm	1	Sabal palmetto	97.1	137.5	153.7			
Pm	2	Pinus elliottii var. densa	80.9	16.2	8.1			
Pm	2	Sabal palmetto	80.9	40.5	64.7			
Pm	3	Sabal palmetto	404.5	356.0	323.6			
Pm	4	Sabal palmetto	784.8	1019.4	930.4			
Pm	5	Sabal palmetto	242.7	210.4	275.1			

**some reduction by hurricane Wilma observed prior to 2008 event*

Changes in strata 3 cabbage palm densities

Changes in cabbage palms in strata 3, or palms with meristem above ground (*i.e.* trunk) and height below 4.5 feet, showed the highest variability in numbers throughout all habitat types. This should not be surprising as growth rates upwards are expected to increase as palms begin forming above ground trunks and can exceed 15 cm/year (McPherson and Williams (1996). Locals insist palms entering this stage can grow a foot per year. Moreover, error in measurement, or surveyor bias, is possible especially in determining when a "trunk" is present and the meristem is above ground so one must be careful not to over-analyze the individual strata densities.

In summary, the strata 3 densities for control sites changed very little (Table 6) while a notable decrease in this strata was observed in several restoration transects, resulting in an average decrease in all restoration habitats from 2004 to 2008 and 2009 (Table 7). Some possible causes of this reduction, based on anecdotal observations recorded in the field, include transects where palms were observed just higher than 4.5 foot (therefore likely just moved up to strata 2) in 6 transects, and predation by Florida black bear (*Ursus americanus*) in 5 transects (Barry and Saha 2008). No palm predation was recorded in control transects in suggesting it was not observed at any significant levels. Cypress (C) habitat at restoration transects showed a marginally significant decline across years 2004 to 2008, probably in part attributed to bear damage (Barry and Saha 2008).

Changes in lower strata cabbage palm densities

Changes in cabbage palms of lower strata varied. A substantial increase in pre-trunk strata (strata 4 and 5) was observed consistently in the control cypress dominated communities in 2008 (Table 6). The low water levels and short hydroperiod due to the drought in 2007 may well have allowed recruitment in these areas. A slight decrease, though not approaching 2004 levels, was observed in 2009 suggesting some mortality in seedlings (strata 5). An increase in the lower strata (pre-trunk palms) was also observed in restoration cypress dominated transects, except for PC25. PC25, which is located just outside the footprint of the former Prairie Canal, showed a substantial die-off of pre-trunk palms or strata 5 (seedlings) from 494 plants transect^{-1} to 10 plants transect^{-1} from 2004 to 2008 respectively. A decline was also observed for strata 4 plants from180 to 89 plants transect^{-1} from 2004 to 2008 respectively. In 2009 numbers were similar to 2008 with 77 and 18 plants transect^{-1} of strata 4 and 5 respectively. The die-off appears to be a result of flooding per field observations (Barry and Saha 2008). Additional reductions in strata 4 and 5 palms were observed in a few other cypress transects in 2009, though none as substantial as PC25.

Changes in cabbage palms of lower strata in hammocks (Hp, Hh) in restoration transects (only 2 transects) showed a substantial increase from 2004 to 2008 then a decrease to 2009 but not to 2004 levels (Table 6). It is interesting that both hammock transects followed this pattern which perhaps warrants closer examination in the field upon re-sampling to see if causes of mortality can be determined.

Changes at control sites in Pine flatwoods (Ph, Pm) had decreased slightly from 2005 to 2008, then increased more than 2005 levels in 2009. Because densities were so high in these habitats (between 1,000 and 2,000 trees/acre), it is not improbable that either the numbers are fluctuating or that sampling at such high densities is simply imprecise. Either way, numbers remain high at control sites. Densities for these 2 strata combined in restoration pine flatwoods transects also remained high through all sampling events changing little. Changes in both control and restoration wet prairie (G) transects increased from 2004/2005 sampling events to 2008 and remained at similar densities in 2009.

We statistically compared the density of strata 4 and 5 palmetto plants across the management regimes, years and habitats. We performed univariate ANOVA with habitat, years and management regime as categorical variables to test for variation in density.

Hydric and mesic pine flatwoods were grouped (Pm, Ph) as were all cypress habitats (C, Cg, Ch). No effects of management regimes and years were found, though habitat explained significant variation in density (Tables 8 and 9). Wet prairies had the lowest density of palmetto plants in strata 4 and 5 (5.54 ± 18.9), followed by Pinelands (82.62 ± 16.24) and Cypress habitats (86.78 ± 78). Interactions of Year, Habitat and Management regimes did not explain variation in *Sabal* densities.

Table 8 ANOVA table testing Sabal palmetto density of strata 4 and 5 plants across years, management regimes and habitats.

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	169273.0987	17	9957.241	1.837814	0.033317
Intercept	199260.4599	1	199260.5	36.77762	2.42E-08
Year	6845.344482	2	3422.672	0.631725	0.533804
Management regime	7350.404651	1	7350.405	1.356668	0.246915
Habitat	72170.15683	2	36085.08	6.660244	0.001933
Year * Management regime	7638.569352	2	3819.285	0.704928	0.496608
Year * Habitat	15972.42859	4	3993.107	0.73701	0.568909
Management regime * Habitat	4837.214022	2	2418.607	0.446404	0.641207
Year * Management regime * Habitat	27160.96054	4	6790.24	1.253279	0.293586
Error	536380.2005	99	5417.982		

Table 9: Mean *Sabal* density of strata 4 and 5 plants across management regimes, habitats and years

Mgmt. Regime	Control			Restored		
Year	2004	2008	2009	2004	2008	2009
Cypress	10.5 ± 52.05	186.0 ± 42.5	115.6 ± 42.5	88.7 ± 20.41	70.7 ± 21.35	49.2 ± 20.45
Pinelands	100.0 ± 52.05	88.0 ± 52.45	116.5± 52.05	53.2 ± 22.19	68.5 ± 21.25	69.6 ± 21.25
Wet prairies	3.2 ± 3.61	3.0 ± 2.05	3.0 ± 2.05	6.0 ± 6.02	8.6 ± 6.02	9.6 ± 6.02

Effects of management regimes on diameter growth rate

We determined diameter growth as relative growth rate measured at two points in time. The initial set of measurements varied from 2004, 2005 and 2008, though the final measurements were taken in 2009. Relative growth rate normalizes for the initial differences in size across individuals and also for the elapsed time over which the growth is assessed so that growth rates can be compared.

$$RGR_{diameter} = \frac{(\ln diameter\ t_2) - (\ln diameter\ t_1)}{t_2 - t_1}$$

For growth rates, since all species do not occur at all sites, we compared a) Cypress growth across management regimes for Cypress dominated habitats and b) growth rate of species that were common to all habitats: *Fraxinus caroliniana*, *Pinus elliottii*, and *Taxodium* between management regimes. We pooled data across habitats because of lack of species in all the possible combinations of management regime and habitat. To illustrate, *Fraxinus* was absent from control transects in wet prairies and pinelands. The table provides mean growth rate for all common species across all habitats where they occurred in control and restored sites (Table 10).

Table 10. Mean RGR across species across habitats and management regimes. Blanks indicate that no data were available for those combinations of species, management regimes and habitats.

Management regime	Habitat	Species	Mean	Std. Error
Restored	Cypress	*Fraxinus*	0.027088722	0.00855
Restored	Cypress	*Pinus*	0.092668381	0.011038
Restored	Cypress	*Taxodium*	0.003081222	0.002731
Restored	Pineland	*Fraxinus*	.	.
Restored	Pineland	*Pinus*	0.036242795	0.002986
Restored	Pineland	*Taxodium*	0.006174766	0.011038
Restored	Wet prairie	*Fraxinus*	.	.

Management regime	Habitat	Species	Mean	Std. Error
Restored	Wet prairie	*Pinus*	0.071657996	0.013519
Restored	Wet prairie	*Taxodium*	0.003324176	0.019118
Control	Cypress	*Fraxinus*	0.011663638	0.003679
Control	Cypress	*Pinus*	.	.
Control	Cypress	*Taxodium*	0.005128642	0.002086
Control	Pineland	*Fraxinus*	.	.
Control	Pineland	*Pinus*	0.008394442	0.00478
Control	Pineland	*Taxodium*	.	.
Control	Wet prairie	*Fraxinus*	.	.
Control	Wet prairie	*Pinus*	0.007216056	0.011038
Control	Wet prairie	*Taxodium*	0.005725441	0.019118

The results of common species compared across management regimes indicates that *Pinus* had the highest growth rate (0.025 ± 0.003) compared to *Fraxinus* (0.019 ± 0.005) and *Taxodium* (0.004 ± 0.002) analyzed here (Figure 21). Growth rates were higher for *Fraxinus* (0.027± 0.009) and *Pinus* (0.041 ± 0.003) in restored, than control sites (*Fraxinus* 0.012 ± 0.004; *Pinus* 0.008 ± 0.005), while the opposite was true for *Taxodium* (Control 0.005 ± 0.002; Restored 0.003 ± 0.002) (Table 10).

When only the Cypress habitats were chosen to examine how the *Taxodium* growth compared across the management regimes, we found that the growth was slightly higher in the restored sites but was statistically similar to the control sites in both Cypress (Restored 0.003 ± 0.001; Control 0.005 ± 0.002; Table 11 ANOVA table) and Prairie habitats (Restored 0.003 ± 0.001; Control 0.006 ± 0.003).

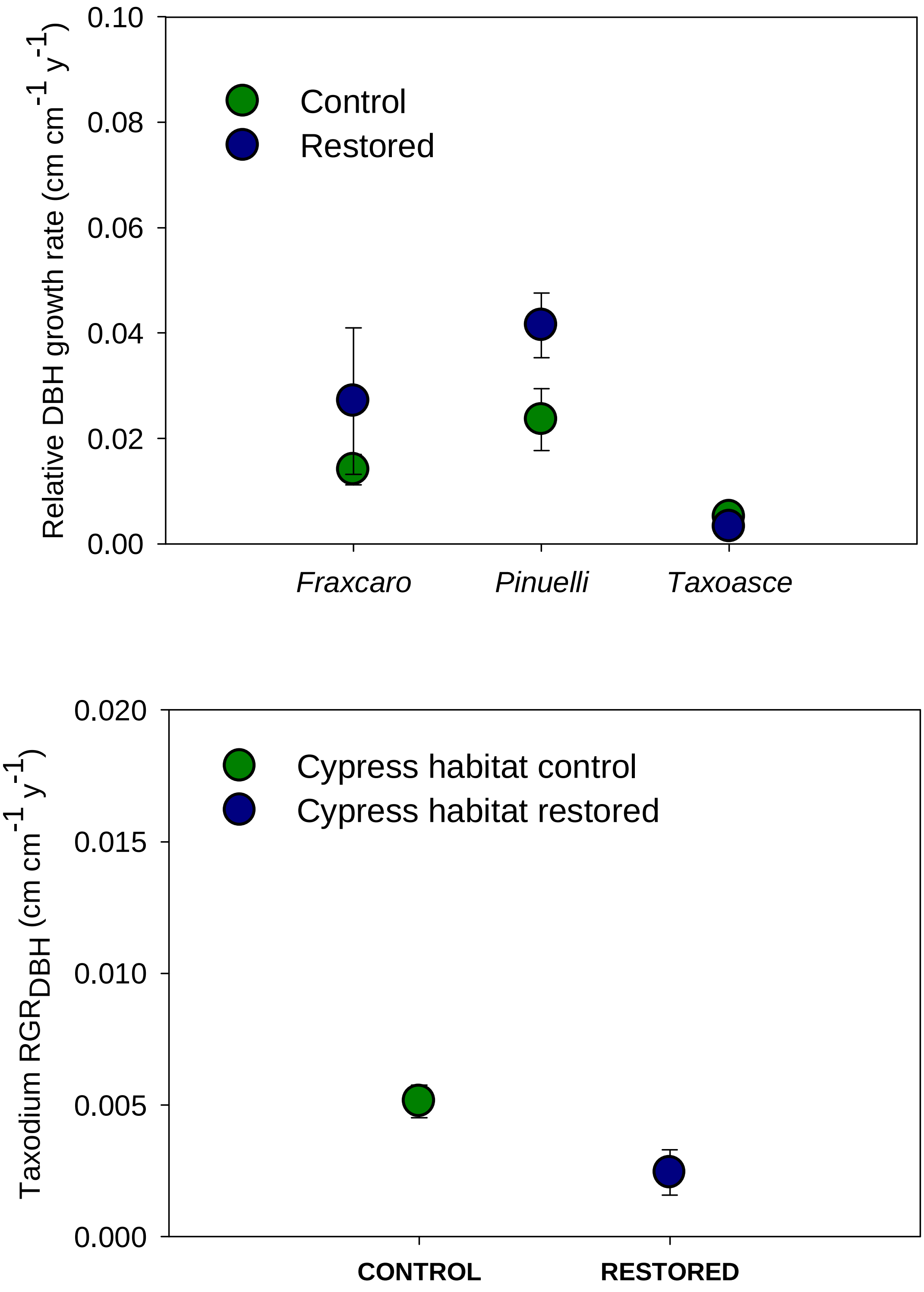


Figure 21: DBH change measured as relative growth rate between time t_2 (final measurement) and t_1 (initial measurement) varying as majority but not all transects were measured in 2005, but some measured in 2008 and 2009 only.

Table 11: ANOVA table testing for Relative Growth Rate (increase in diameter growth from 2004-2009) differences across species and management regimes.

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	0.049006645	5	0.009801329	24.30521	1.33E-19
Intercept	0.027406355	1	0.027406355	67.96193	1.3E-14
Species	0.017520399	2	0.0087602	21.72343	2.3E-09
Management regime	0.006404677	1	0.006404677	15.88224	9.06E-05
Species* Management regime	0.011944567	2	0.005972283	14.80999	8.94E-07
Error	0.092346629	229	0.00040326		

Table 12: ANOVA table testing effects of management regimes on Cypress growth across Cypress and Wet prairie habitats.

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	0.000142147	4	3.55367E-05	0.834961	0.505256
Intercept	0.000259454	1	0.000259454	6.096069	0.014816
Management regime	9.73807E-06	1	9.73807E-06	0.228803	0.633198
Habitat	2.17698E-05	2	1.08849E-05	0.255749	0.774716
Management regime * Habitat	6.16075E-08	1	6.16075E-08	0.001448	0.969708
Error	0.005660596	133	4.25609E-05		

Line Intercept Data

Data for total shrub cover (all species combined), and with cabbage palm and Brazilian-pepper values, is presented in Tables 13 and 14. Data for each species separated can be analyzed in the database, but total combined species does provide a good measure of the amount of shade (or conversely the amount of light) influencing the ground cover species. Also, many of these woody shrub species are similarly effected by fire thus by lumping the effects of fire can be more easily observed in the data. Cabbage palm cover is important to analyze separately both because we are interested in verifying trends observed with density data specific to this species which has increased substantially compared to pre-development conditions (as discussed above in Belt Transect data) and because cabbage palm is typically not influenced by fire in the way other species are influenced (McPherson 1997 and 1998).

Combined Shrub Species Cover

These data suggest only subtle changes with respect to combined shrub cover at control sites (Table 13). Cover in the cypress habitats for the control sites can not readily be analyzed for fire because of the lack of shrub cover in the burned transects, but in general fire has had a minor influence these habitats. This is because when they do burn, especially under prescribed fire, the intensity and severity is low. Fire has had an effect of maintaining shrub cover in burned transects of the hydric pine flatwoods while lack of fire showed a steady increase in shrub cover. Most of the fires in the control transects were prescribed burns and the transects in the FPNWR have been burned regularly every 3-5 years since the area became a refuge. Increasing shrub cover can have a negative effect on the ground cover species by increasing shade, thus fire becomes extremely important for maintenance of plant species composition and dominance.

Table 13: Shrub cover measured by line intercept (Control)

		Combined (excluding palms) Species (%):			Sabal palmetto (%):			Schinus terebinthifolius (%):		
Habitat	Burned since 2005	2005	2008	2009	2005	2008	2009	2005	2008	2009
C	Yes									
C	No	18.2	13.2	22.6	2.9	0.9	2.8	8.9	5.3	8.8
Cg	Yes									
G	Yes									
G	No									
Ph	Yes	75.2	71.0	73.6	20.8	20.4	25.0			
Ph	No	89.4	97.4	102.8	24.4	26.6	24.4		0.2	4.0

Table 14: Shrub cover measured by line intercept (Restoration)

		Combined (excluding palms) Species:			Sabal palmetto:			Schinus terebinthifolius:		
Habitat	Burned since 2004	2004	2008	2009	2004	2008	2009	2004	2008	2009
C	No	51.0	48.9	54.2	3.2	2.4	3.7	35.8	23.4	20.8
Cg	Yes	97.4	63.6	113.6	9.4	1.2	2.0	44.0	26.0	40.8
Cg	No	77.4	86.7	95.2	24.3	17.0	18.3	5.4	11.2	7.7
Ch	Yes	93.8	81.4	75.4	28.8	7.6	12.4	39.8	34.2	23.0
Ch	No	74.4	75.6	69.6	61.6	28.0	31.8	4.0	40.6	32.8
G	Yes	5.5	3.9	2.7	3.0	3.6	2.6	1.2	0.2	0.1
G	No	5.2	2.6	3.0						
Hh	Yes	81.2	88.6	100.0	14.4	5.0	9.0			
Hp	No	99.6	66.6	92.4	30.6	11.8	14.8	31.2	35.8	43.8
Ph	Yes	26.9	15.3	18.4	15.9	10.5	9.4	8.1	3.3	6.3
Ph	No	55.6	44.6	61.6					3.2	6.8
Pm	Yes	60.0	36.8	36.0	24.4	20.8	20.0	9.4	3.2	2.8
Pm	No	49.2	48.8	55.4	38.0	31.0	38.0	1.2	7.0	8.6

Changes in total shrub coverage seemed to vary more substantially amongst restoration transects (Table 14). Total combined species cover in cypress habitats varied and seemed less influenced by fire, as mentioned above due to low intensity and severity of fire in these habitats. This is likely also the case for the hammock (Hh, Hp) transects as well which have shown an increase in shrub cover. Only on transect PC02 (Ch), which had burned in an intense wildfire in June 2004 (Pretty Island Fire), showed a marked decrease.

These data suggest fire played an important role in restoration pine flatwoods (Ph, Pm) transects. In fact, instead of the maintenance effect observed in control transects, a marked decrease was observed in the burned transects and an increase in the fire suppressed transects. Most of the fires at the restoration transects were wildfires under drought conditions such as the wildfire of June 2004 (which occurred shortly after sampling was completed) which affected transects PC01-PC05 and the June 2007 wildfire which affected transects PC09 and PC10 in FSPSP. These fires were typically more intense and severe than the prescribed fire at the control sites. This reduction in shrub cover in burned transects would be expected to affect groundcover by increasing available light.

We statistically analyzed the percent cover of all shrubs excluding palms to examine if the fires between sampling events of 2004/2005 and 2008/2009 impacted shrub cover differentially across habitats and management regimes. We used only Pinelands and Cypress habitats for the analyses as wet prairie sites were inadequately represented. Univariate ANOVA was used to test the effects of fire, management regime and habitat, while Wilcoxon Rank Test was used to compare the percent cover of *Schinus* between transects burnt and unburnt between 2005 and 2008/2009.

No differences were observed in percent cover across habitats, fire and management regimes suggesting that the percent cover did not increase or decrease in response to fire and management regimes in Pinelands and Cypress (Table 15). However we did observe that fires made a stronger negative impact on shrub cover in restored sites, especially the pinelands which showed dramatic increase in shrub cover if the fire was excluded (Table 16). In control sites the effects of fire were less dramatic.

Table 15: ANOVA results showing that management regime and fire between 2004/2005 and 2009 did not have a significant effect on percent cover of shrubs in Pinelands and Cypress habitats.

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	679.7253793	7	97.10363	1.427599	0.246638
Intercept	137.4843404	1	137.4843	2.021268	0.169792
Management regime	57.36519149	1	57.36519	0.843372	0.368862
Habitat	28.53114894	1	28.53115	0.419459	0.524225
Fire	103.1660426	1	103.166	1.516727	0.231729
Management regime * Habitat	8.126042553	1	8.126043	0.119467	0.733051
Management regime * Fire	36.06817021	1	36.06817	0.530267	0.474537
Habitat * Fire	145.8281702	1	145.8282	2.143937	0.157944
Management regime * Habitat * Fire	65.75668085	1	65.75668	0.966742	0.336687
Error	1428.396	21	68.01886		

Table 16: Restored pineland sites showed a reduction in shrub cover after fire compared to when they were not burnt. In control sites the fire did not have dramatic effects on percent cover in pinelands. In cypress habitats, where fire intensity and severity are low, fire led to an increase in shrub cover in restored transects.

Management regime	Habitat	Fire	Mean	Std. Error
Control	Cypress	Fire	0.4	8.247355
Control	Cypress	No fire	0.5	5.83176
Control	Pineland	Fire	-0.4	8.247355
Control	Pineland	No fire	4	8.247355
Restored	Cypress	Fire	4.1	5.83176
Restored	Cypress	No fire	1.92	2.608043
Restored	Pineland	Fire	-2.4	2.608043
Restored	Pineland	No fire	17.3	5.83176

We also analyzed the role of time since fire category on shrub cover (all species except palms) across the Cypress and Pineland habitats. We did not find a significant change in shrub cover between years (Table 17). Shrub cover increased in 2009 compared to 2004 though the increase was substantially lower in Cypress habitats bunt recently (0.001 $\pm$ 8.63; huge variation!), compared to the fire category of 2 (1.05 $\pm$ 4.5) and 3 (2.27 $\pm$ 2.75) (Table 18). The increase in shrub cover across years was lower in transects under burn category 2 in Pinelands (0.24 $\pm$ 2.53) compared to transects that were long unburnt (1.4 $\pm$ 6.4).

Table17: ANOVA results testing for effects of fire on change in percent cover of shrubs excluding palms (estimated with line intercept method) across habitats.

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	25.08484187	3	8.361614	0.103699	0.957192
Intercept	26.09600144	1	26.096	0.323637	0.574132
Fire	7.709281056	1	7.709281	0.095609	0.759538
Habitat	2.478402732	1	2.478403	0.030737	0.862137
Fire * Habitat	0.089619493	1	0.089619	0.001111	0.97365
Error	2177.106126	27	80.63356		

Table 18: Mean change in shrub cover from 2004 to 2009 across habitats and fire regimes. Blanks indicate absence of shrubs in the particular habitat and fire combination.

FIRE	HABITAT	Mean	Std. Error
1	Cypress	8.88E-16	9.148821
1	Pineland	.	.
2	Cypress	1.05	4.574411
2	Pineland	0.246154	2.537426
3	Cypress	2.272727	2.758473
3	Pineland	1.4	6.469193

Brazilian Pepper Cover

Brazilian pepper at the control sites follows a similar pattern to the combined shrub species data, with an increase observed in the fire suppressed pine flatwoods highlighting the importance of fire in management of this species (Table 13). Also, cover varied in cypress habitats with a reduction observed in 2005 which was a very wet year with a lengthened hydroperiod which may have reduced the cover. This is supported by anecdotal evidence recorded in field notes for transect 51 (in FSPSP) reporting what appeared to be "flood-killed" individuals with survivors higher up on hummocks. Cover in 2009 shows that Brazilian pepper has rebounded from this flood event.

Brazilian-pepper decreased more substantially in burned restoration transects (Table 14), similar to data for combined shrub species data. In fact, the converse was observed with an increase in cover observed in fire-suppressed pineland transects. Data would suggest that fire is an effective control tool in both hydric and mesic flatwoods.

Schinus cover was statistically compared between transects that were burnt between 2004 and 2009 sampling to examine if recent fires curbed the increase in cover of this exotic weedy tree. Only restored Pineland and wet prairie transects were amalgamated for this analysis because, only selected transects were impacted by combination of Schinus and fires.

A significant effect of recent fires was observed on difference in *Schinus* cover between 2009 and 2004. Transects burnt recently, exhibited a significant decline in percent cover than the transects that did not burn. Difference in percent cover between years was -4% in plots recently burnt while the *Schinus* cover increased by 6.5 % in transects that were not burnt between sampling years of 2004 and 2009.

Mean difference in Schinus cover between years 2004 and 2009 in transects pooled across Wet prairies and Pinelands that were burnt between sampling years or were left unburnt. A significant effect of fire was detected with Wilcoxon sign rank test with cover declining significantly in transects recently burnt compared to transects long unburnt (Table 19).

Table 19: Wilcoxon sign rank test for Brazilian pepper cover between years 2004 and 2009

Mann-Whitney U	0
Wilcoxon W	36
Z	-2.08893
Asymp. Sig. (2-tailed)	0.036
Exact Sig. [2*(1-tailed Sig.)]	0.044

Perhaps more exciting was the Brazilian-pepper decline in the cypress transects that had not burned, though this was actually the result of a dramatic decline in only one transect, PC26. Coverage in this transect was 88% Brazilian-pepper cover in 2004 mixed with swamp dogwood (*Cornus foemina*), but was reduced to less than 1% cover of Brazilian-pepper in 2008 with all swamp dogwood surviving and no evidence of fire, suggesting flood-caused mortality. Further evidence to support this was encountered near the PC26 in the same north-south swamp dogwood dominated slough in November 2008 during a hike when both recently killed Brazilian-pepper (with brown leaves still persisting) and highly stressed individuals were encountered in areas where standing water still persisted. It appears that this area, on both sides of the former canal (PC25 also showed dramatic reduction in cabbage palm seedlings) is substantially affected by restoration.

Cabbage Palm Cover

Percent coverage of cabbage palm in middle and lower strata combined (line intercept method lumps all palms <4.5 ft height) differs from measurements of other shrub species in that once a cabbage palm exceeds 4.5 feet it is no longer measured. This is because this method was used on FPNWR in the original transects aimed at assessing deer forage quality (Main et al. 2000) in the database and we wanted to keep the methods similar to allow comparisons. However, this makes analysis of change more difficult since a reduction in this measure may simply reflect recruitment into the overstory.

Fire influences cabbage palm cover differently from other shrub species as well. While fire top kills most woody vegetation reducing cover, it has little effect on cabbage palm cover which puts out new leaves and achieves pre-burn cover in 3-6 months (Main et al. 2000). Fire does not typically reduce palm coverage or cause substantial mortality in seedlings (McPherson 1997).

Cover of cabbage palm (<4.5 feet in height) changed little in control sites across all habitats from 2005 to 2009 (Table 13). Cover in restoration transects seems much more variable, especially in cypress and hammock transects (Table 14). Most of these transects showed some reduction in cover which could be explained by any of the following causes: individuals have grown just higher than 4.5 ft (presumed to have grown out of strata 3 into strata 2), predation by Florida black bear documented in several transects (Barry and Saha 2008), or simply sampling error from placement of the tape in the field. This reduction correlates best to strata 3 palm densities (see Belt Transect data) which would be the most significant contribution to line intercept cover, as strata 4 and 5 palms, though higher densities, are very small in terms of cover.

We statistically analyzed the effects of management regimes on percent cover of *Sabal palmetto* across Pinelands (Pm, Ph combined) and Cypress habitats (C, Cg, Ch combined) . Palm cover decline in restored sites while increased in the control sites, though the differences were non-significant because wet prairies did not show a dramatic difference between control and restored transects (Table 20). Both Cypress and Pinelands exhibited comparable trend across management regimes. Decline in *Sabal* cover was -6.4% and -5.2% in Cypress and Pinelands respectively in restores sites (Table 21). On the other hand, the increase in cover was 1.4% and 1.33% respectively in Cypress and Pinelands in control sites.

Table 20: ANOVA table testing for effects of management regime and habitat on difference in percent cover between 2004 and 2009 of *Sabal palmetto* estimated with line intercept method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	245.137	3	81.71232	0.719083	0.55
Intercept	95.19255	1	95.19255	0.837712	0.369
Management regime	**230.5048**	**1**	**230.5048**	**2.028484**	**0.086**
Habitat	1.146413	1	1.146413	0.010089	0.92
Management regime * Habitat	1.447309	1	1.447309	0.012737	0.911
Error	2613.583	23	113.634		

Table 21: Mean difference across years in *Sabal palmetto* percent cover across habitats and management regimes.

Management regime	Habitat	Mean	Std. Error
Restored	Cypress	-6.85	2.866211403
Restored	Wet prairie	-0.08	4.251278534
Restored	Pineland	-5.70	2.866211403
Control	Cypress	1.57	4.753073897
Control	Wet prairie	2.80	9.506147794
Control	Pineland	1.33	5.488376988

Quadrat Data Evaluation

All data collected using the 0.5 meter quadrats is maintained in the now 54,789 record 'QUAD_DA' table in the PLANT_RAWDATA.mdb database file provided to SFWMD by IRC. Not only does this table include the data summarized and discussed below, but it also includes many fields not analyzed thus far for PSRP such as phenology and evidence of browsing by white-tailed deer (*Odocoileus virginianus*), a major prey item of the Florida Panther, as well as data from PSSF and FPNWR from up to 12 years ago. Summaries by species and transects, habitat, and time since fire are available in the QUAD_ANALYSIS.mdb, also provided to SFWMD, but many of the tables are too large to present in this report. Below are summaries IRC felt would contribute to the establishment of successional trends in the restored ecosystems of PSRP. The groundcover trends are expected to most quickly respond to changes in hydrology thus warrants close analysis.

Plant Identification

Plant species were identified to the lowest possible taxonomic level during all sampling events. In sampling in 2004 of non-control transects, 97.6% of the records were identified to species or variety level. This was after various transects were revisited in the fall of 2004 to verify some of the partially identified taxa. During sampling of control transects in 2005, over 98% of the ground cover species were identified to the species or infra-specific taxon or 99% when weighted by percent cover. Sampling in the fall of 2005 allowed for greater ability of identification and transects did not have to be revisited due to phenology of many of the taxa. Partial identification problems in 2004 and 2005 primarily included immature members of Poaceae, Cyperaceae, and Asteraceae. During sampling in 2008 and 2009 for this contract, similar levels of identification were achieved with 99% of the records identified to species or variety level when weighted by percent cover values (Table 22). The same identification problems arose in 2009 as 2008 and include many common species identified to the genus level but are not readily identifiable during the spring (Barry and Saha 2008).

Table 22: Level of plant identification in quadrat sampling data in 2008 and 2009

	2008				2009			
Level of ID:	total cover	total # records	% total cover	% total records	total cover	total # records	% total cover	% total records
completely unknown	7.5	15	0.03%	0.6%	13	16	0.05%	0.7%
ID to family	32.5	16	0.1%	0.7%	7	9	0.02%	0.4%
ID to Genus	98.5	40	0.4%	1.6%	116.5	46	0.4%	1.9%
Total Partial ID	138.5	71	0.5%	2.9%	136	70	0.5%	2.9%
Full ID	27659	2312	99.0%	94.2%	28045	2384	99.5%	97.1%
Total Species	27936	2454	100.0%	100.0%	28181	2454	100.0%	100.0%

Overall Species Richness, Composition, Structure and Cover

Percent cover for each species measured in quadrat data summarized by transect can be found in the 'quad_mean_cover_frequency_bytransect' table in the quad_analysis.mdb database file provided to the SFWMD by IRC. These data are too large to present in tabular format in this report. Instead, summaries of species richness and cover for grouped native, exotic, native ruderal, and partially identified plant species are presented below in Tables 23 and 24 (control) and Tables 25 and 26 (restoration). Caesarweed (*Urena lobata*) which is sometimes considered native, was included as native ruderal in the last report but was treated as an exotic this event based on Wunderlin and Hansen website. Fire history is not accounted for in these general tables, though in general the cypress areas are not affected by fire while most of the transects of the pine flatwoods and wet prairie have been burned in intense wildfires or prescribed burns between sampling events (Table 5 above).

Table 23: mean # of species (S) per transect for control transects

	# of transects			2005			2008			2009		
HABITAT	2005	2008	2009	Exotic	Native	Uncertain	Exotic	Native	Uncertain	Exotic	Native	Uncertain
C	3	3	3	0.33	8.67	0.33	0.67	19.67	2.00	1.00	17.33	1.67
Cg	1		1		25.00						27.00	3.00
G	4	3	4		30.00	0.25		26.00	1.00		26.75	1.25
Ph	3	2	3	0.67	41.67	1.00	1.00	33.00	1.50	1.00	39.00	0.67

Table 24: mean cover (%) per transect for control transects

	# of transects			2005			2008			2009		
HABITAT	2005	2008	2009	Exotic	Native	Uncertain	Exotic	Native	Uncertain	Exotic	Native	Uncertain
C	3	3	3	0.83	35.83	0.14	4.86	64.72	2.92	10.56	50.83	1.25
Cg	1		1		46.67						94.17	4.58
G	4	3	4		109.38	0.21		137.08	0.42		100.94	1.04
Ph	3	2	3	0.97	127.50	0.42	0.63	125.42	0.63	1.11	115.33	0.28

Table 25: mean # of species (S) per transect for restoration transects

	# of transects			2004				2008				2009			
HABITAT	2004	2008	2009	Exotic	Native	Ruderal	Uncertain	Exotic	Native	Ruderal	Uncertain	Exotic	Native	Ruderal	Uncertain
C	5	5	5	0.80	15.40	0.40	0.20	1.20	22.00		1.00	1.00	17.60	0.20	0.40
Cg	5	5	5	0.80	27.40		1.60	1.60	29.40	0.60	1.80	1.00	24.60	0.20	0.80
Ch	2	2	2	2.00	13.00			1.50	23.50		1.50	1.50	16.00		1.50
G	9	9	9	0.33	22.11	0.11	0.78	0.22	23.22	0.11	0.67	0.78	23.22	0.22	1.00
Hh	1	1	1	1.00	21.00			1.00	23.00		1.00		18.00		
Hp	1	1	1	3.00	21.00	1.00		4.00	30.00		2.00	3.00	31.00		2.00
Ph	10	10	10	0.80	25.00	0.10	1.20	0.90	25.80	0.30	1.30	1.10	24.90		0.90
Pm	2	2	2	1.00	19.50		0.50	1.50	21.00	0.50	2.00	2.00	20.50	0.50	

Table 26: mean cover (%) per transect for restoration transects

	# of transects			2004				2008				2009			
HABITAT	2004	2008	2009	Exotic	Native	Ruderal	Uncertain	Exotic	Native	Ruderal	Uncertain	Exotic	Native	Ruderal	Uncertain
C	5	5	5	22.08	105.58	1.50	0.08	20.00	111.00		0.58	19.17	96.67	0.08	0.17
Cg	5	5	5	7.67	131.42		0.75	12.75	131.50	0.67	0.92	10.08	116.75	0.08	0.33
Ch	2	2	2	21.04	116.04			17.29	100.42		1.04	16.25	120.21		0.63
G	9	9	9	1.34	114.38	0.09	0.65	0.09	104.09	0.05	0.28	1.62	106.02	0.09	1.06
Hh	1	1	1	7.08	140.42			0.42	98.75		0.42		104.17		
Hp	1	1	1	41.67	100.42	0.42		40.42	111.25		1.25	46.67	99.17		0.83
Ph	10	10	10	9.08	100.13	0.04	0.88	3.29	93.92	0.33	0.75	4.04	93.21		0.58
Pm	2	2	2	6.25	75.00		0.21	12.29	69.58	0.83	2.71	2.50	55.63	0.63	

Vegetative structural changes can be important to understanding ecological shifts due to environmental change such as fire, hurricanes, and hydrological restoration. Species richness and cover by growth form and habitat are presented below for all control transects (Table 27) and restoration transects (Table 28). Fire history was not incorporated into these tables, but again the important consideration is that most of the cypress transects remained unaffected by fire while the majority of the pine flatwoods and wet prairie transects burned in intense wildfires or prescribed burns since sampling in 2004 (Table 5).

Table 27: Species richness and cover by growth form for control transects

		# of transects			Species Richness			Cover (%)		
Habitat	Growth Form	2005	2008	2009	2005	2008	2009	2005	2008	2009
C	EPIPHYTE	3	3	3	2.7	3.0	2.3	4.4	3.5	2.4
C	FERN	3	3	3	0.7	1.3	1.3	16.3	22.1	12.5
C	FORB	3	3	3	2.0	6.7	6.0	6.0	16.3	8.8
C	GRAMINOID	3	3	3	0.3	1.0	0.3	0.1	3.1	0.3
C	SABAL	3	3	3	0.7	0.7	0.7	3.9	7.6	9.7
C	SHRUB	3	3	3	1.7	6.3	5.7	4.9	16.5	22.6
C	UNKNOWN	3	3	3			0.7			0.7
C	VINE	3	3	3	1.3	3.3	2.3	1.3	3.5	5.4
Cg	FORB	1		1	13.0		13.0	15.8		36.3
Cg	GRAMINOID	1		1	11.0		13.0	27.9		56.7
Cg	SHRUB	1		1	1.0		1.0	2.9		2.5
Cg	UNKNOWN	1		1			1.0			1.7
Cg	VINE	1		1			2.0			1.7
G	FORB	4	3	4	13.3	11.7	11.0	17.5	10.0	11.4
G	GRAMINOID	4	3	4	13.8	12.0	13.3	84.8	120.8	82.7
G	SABAL	4	3	4	0.3		0.3	0.7		2.2
G	SHRUB	4	3	4	1.0	0.3	1.0	0.6	0.1	1.8
G	UNKNOWN	4	3	4		0.7	0.3		0.3	0.1
G	VINE	4	3	4	2.0	2.3	2.0	5.9	6.3	3.8
Ph	FERN	3	2	3	0.3	1.0	0.7	2.1	0.4	0.3
Ph	FORB	3	2	3	17.3	14.5	16.3	25.0	17.9	14.9
Ph	GRAMINOID	3	2	3	16.0	9.5	12.7	41.3	40.0	41.5
Ph	SABAL	3	2	3	1.0	1.0	1.0	25.1	26.5	20.8
Ph	SERENOA	3	2	3	0.7	1.0	0.7	14.0	25.2	20.6
Ph	SHRUB	3	2	3	4.0	4.0	4.0	15.0	11.9	13.0
Ph	UNKNOWN	3	2	3		0.5			0.2	
Ph	VINE	3	2	3	4.0	4.0	4.7	6.4	4.6	5.3

Greatest diversity in control hydric pine flatwoods and wet prairie transects is not surprisingly made up of graminoid and forb species. Cypress habitats are generally lower diversity and cover of graminoid and forb species. However, Cypress with graminoid understory is exceptionally diverse and showed a dramatic increase in forb and graminoid diversity in 2009 compared to 2005 following a prescribed burn in 2008 which caused us to miss sampling in 2008 (transect 45 on FPNWR). Shrub cover and diversity has increased in cypress habitat at control transects since initial sampling in 2005. Also there was lower cover of Forbs in 2005 likely due to seasonal effect of high water levels. Structure of wet prairies and pine flatwoods at control sites has changed less dramatically. Generally wet prairies were similar in all 3 sampling events with perhaps less shrub but more vines in the 2009 sampling event. Hydric pine flatwoods was roughly the same except for higher forb cover in 2005 which may reflect effects of seasonality of sampling.

As in the control transects, the greatest diversity was found amongst graminoids and forbs in the pine flatwoods and wet prairies of the restoration transects. Similar diversity was also found in the cypress with graminoid understory which is typically more fire-dependant and shorter hydroperiod than other cypress habitats. Shrub cover did increase in cypress (C) and was accompanied with a slight increase in fern cover. Cypress with graminoid (Cg) habitats, which in general have not burned since 2004, did show a marked increase accompanied with a decrease in ferns, forbs, and graminoids, essentially showing the opposite trend as the recently burned control cypress with graminoid (Cg) transects. This re-iterates the importance of fire in these transitional areas. In contrast, cover changed little in cypress with hardwoods (Ch) which reflects data from two transects, one of which burned in an intense wildfire since initial sampling, thus countering each other in the mean presented in the table. Wet prairie (G) habitat in restoration sites has changed little in terms of structure, though the already low coverage by shrubs was further reduced, presumably because most of the prairies have burned either in wildfires or prescribed burns since initial sampling in 2004.

Pine flatwoods communities exhibited changes in species composition, however the change was not consistent across the hydric and mesic pine flatwoods, which is more likely a result of fire and other factors. Hydric pine flatwoods (Ph) seems to have changed little, though there is a suggestion that the slight reduction in shrub and cabbage palm cover may correspond to the increase in forb and graminoid diversity. The reduction in shrub cover is likely due to fire since the majority of these transects burned after 2004 (Table 5 above). Cabbage palm cover is measured in quadrats only for individuals less than 4.5 feet (strata 3, 4, and 5), and, like the line intercept data, a decrease was observed. As discussed above in the line intercept and belt transect sections, a possible cause of the decrease is predation by Florida black bear which was observed in several restoration transects. Mesic pine flatwoods (Pm) showed an increase in shrub cover which is likely due to fire suppression as one of the two transects burned while the other remained long fire suppressed (time since fire category 3) thus the mean reflects two opposite trends.

Table 28: Species richness and cover by growth form for restoration transects

		# of transects			Species Richness			Cover (%)		
Habitat	Growth Form	2004	2008	2009	2004	2008	2009	2004	2008	2009
C	EPIPHYTE	5	5	5		1.2			0.8	
C	FERN	5	5	5	1.2	1.2	1.0	18.0	13.3	14.1
C	FORB	5	5	5	5.8	6.2	6.4	35.2	36.6	30.8
C	GRAMINOID	5	5	5	1.8	3.6	1.4	4.4	8.3	5.6
C	SABAL	5	5	5	0.6	0.8	0.8	2.8	3.5	2.6
C	SHRUB	5	5	5	3.6	5.4	4.6	33.2	41.0	43.3

		# of transects			Species Richness			Cover (%)		
Habitat	Growth Form	2004	2008	2009	2004	2008	2009	2004	2008	2009
C	UNKNOWN	5	5	5		0.4			0.3	
C	VINE	5	5	5	3.8	5.4	4.6	35.8	27.8	19.6
Cg	FERN	5	5	5	0.4	1.4	1.2	1.4	3.8	1.6
Cg	FORB	5	5	5	11.2	11.8	7.6	34.9	22.5	16.6
Cg	GRAMINOID	5	5	5	6.8	7.4	6.2	14.3	17.0	7.8
Cg	SABAL	5	5	5	1.0	1.0	1.0	15.9	15.6	13.1
Cg	SHRUB	5	5	5	4.4	4.8	4.4	37.5	60.3	56.4
Cg	UNK	5	5	5		0.2			0.2	
Cg	UNKNOWN	5	5	5	0.2	0.2		0.1	0.1	
Cg	VINE	5	5	5	5.8	6.6	5.8	35.8	26.4	31.6
Ch	EPIPHYTE	2	2	2		1.0	0.5		0.8	0.2
Ch	FERN	2	2	2	1.5	1.0	1.0	24.6	17.5	16.5
Ch	FORB	2	2	2	1.5	8.5	4.0	3.5	9.8	4.0
Ch	GRAMINOID	2	2	2	0.5	3.5	3.0	0.2	1.9	1.3
Ch	ORCHID	2	2	2	0.5			0.2		
Ch	SABAL	2	2	2	1.0	1.0	1.0	41.5	5.2	27.1
Ch	SHRUB	2	2	2	4.5	4.5	3.5	44.4	39.4	41.3
Ch	UNK	2	2	2			0.5			0.2
Ch	VINE	2	2	2	5.5	7.0	5.5	22.7	44.2	46.7
G	FERN	9	9	9	0.1	0.1		0.05	0.3	
G	FORB	9	9	9	11.2	11.4	12.0	17.6	17.1	14.1
G	GRAMINOID	9	9	9	9.4	9.3	10.0	93.4	82.8	90.6
G	SABAL	9	9	9	0.6	0.6	0.7	2.0	1.9	1.1
G	SHRUB	9	9	9	0.6	0.7	0.3	2.1	0.3	0.8
G	UNKNOWN	9	9	9	0.4	0.4	0.3	0.5	0.2	0.1
G	VINE	9	9	9	1.0	1.7	1.7	0.9	2.1	2.0
Hh	FERN	1	1	1	1.0	2.0	1.0	8.3	17.1	8.3
Hh	FORB	1	1	1	6.0	8.0	5.0	54.2	27.9	41.3
Hh	GRAMINOID	1	1	1	1.0	2.0	1.0	2.9	7.5	0.4
Hh	SABAL	1	1	1	1.0	1.0	1.0	10.8	16.7	11.3
Hh	SHRUB	1	1	1	4.0	4.0	3.0	14.2	17.9	27.1
Hh	VINE	1	1	1	9.0	8.0	7.0	57.1	12.5	15.8
Hp	FERN	1	1	1	1.0	2.0	1.0	15.4	22.5	15.8
Hp	FORB	1	1	1	4.0	9.0	9.0	2.5	4.6	5.0
Hp	GRAMINOID	1	1	1	6.0	8.0	6.0	13.8	21.3	15.4
Hp	SABAL	1	1	1	1.0	1.0	1.0	9.2	10.0	17.9
Hp	SHRUB	1	1	1	7.0	8.0	8.0	73.3	74.6	61.7
Hp	VINE	1	1	1	6.0	8.0	11.0	28.3	20.0	30.8
Ph	FERN	10	10	10	0.6	0.4	0.3	5.9	0.9	1.0
Ph	FORB	10	10	10	11.0	13.4	12.5	20.0	20.0	13.8
Ph	GRAMINOID	10	10	10	8.6	9.5	8.5	53.7	55.4	58.3
Ph	SABAL	10	10	10	0.8	0.9	1.0	10.3	7.3	7.4
Ph	SERENOA	10	10	10	0.3	0.3	0.3	3.7	2.3	2.7
Ph	SHRUB	10	10	10	1.7	1.2	1.6	9.3	8.0	9.9
Ph	UNKNOWN	10	10	10	0.6	0.1	0.2	0.6	0.1	0.1
Ph	VINE	10	10	10	3.5	2.5	2.5	6.6	4.3	4.5

		# of transects			Species Richness			Cover (%)		
Habitat	Growth Form	2004	2008	2009	2004	2008	2009	2004	2008	2009
Pm	FERN	2	2	2	1.0			1.5		
Pm	FORB	2	2	2	5.0	9.5	8.5	4.4	12.5	4.6
Pm	GRAMINOID	2	2	2	7.0	8.5	8.0	16.5	19.2	10.4
Pm	SABAL	2	2	2	1.0	1.0	1.0	34.8	28.5	23.5
Pm	SERENOA	2	2	2	1.0	1.0	1.0	12.5	8.3	8.5
Pm	SHRUB	2	2	2	3.0	2.0	2.5	8.8	13.8	6.0
Pm	VINE	2	2	2	3.0	3.0	2.0	3.1	3.1	5.6

Effects of management regimes on species richness (Statistical Analysis)

In last years report, we classified restoration transects into two groups for analysis based on their fire histories in 2004, 2005 and 2008 (Barry and Saha 2008). Transects with comparable fire histories across years (*i.e.* the same time since fire category) were separated from transects that experienced a change in time since fire category. Species composition at restoration transects across years was compared using paired sample *t* tests for data pooled across all habitat categories, and for each category separately (Barry and Saha 2008). Analyses across pooled data suggested a marginally significant effect of drought/restoration on species richness (t = -2.45, df = 21, P = 0.05), and no effect on *H'*. However, when separate habitat categories were analyzed, no significant effect of restoration was observed. The means for 2008 sampling remained higher though. Species composition at control sites across years was compared using paired sample *t* tests for data pooled across all habitat categories. Species richness across transects increased significantly in 2008 as compared to 2005 (t = -6.15, df =7, P < 0.05). Individual habitats were not tested separately due to small sample size per habitat category. Species diversity did not show a significant effect of time. Even though the species richness was significantly higher in the 2008 sampling than 2005 sampling, the Species richness of 6 and 7 observed in Transects 32 and 51 is a result of excessive flooding due to Hurricane Wilma. Species richness was 10 ± 2.32, 33 ± 3.17, and 24 ± 3.68 for Cypress, Hydric Pine Flatwoods and Wet Prairies respectively in 2005, while in 2008 the richness was substantially higher only for Cypress transects (22 ± 4.31) and similar for Hydric Pine flatwoods (35 ± 2.64) and Wet Prairie respectively (27 ± 2.45). The drought from 2006 to 2007 allowed additional species in cypress transects to become established.

In this report, we combine all cypress habitats (Ch, Cg, and C) to one group and both mesic and hydric pine flatwoods for comparisons between control and restoration sites to increase sample size by habitat. This results in 4 control and 12 restoration Cypress transects along with 3 control and 12 restoration pine flatwoods transects. We do not separate by comparable fire histories due to the smaller sample size and the results last year, though we may return to this analysis type in the future depending on sample size issues when or if the rest of Picayune Strand Restoration is monitored together with these transects. Instead of addressing time since fire together with control vs. restoration, we look at the effects of time since fire by habitat, specifically pine flatwoods transects due to sample size and higher diversity below.

We examine the effects of management regimes on species richness across time (2008 and 2009) and habitats. We do include 2004 data for restored sites in the graph to provide a benchmark for a visual comparison of the trend across years at least for restored sites to the readers. Because of seasonality effects on species richness, we do not include the 2005 (control) data which was sampled in the fall, differing from all other events sampled in the spring. Since we pooled the sub-habitats together we gained more power to perform an ANOVA. Restoration if as expected leads towards substantial lengthening of hydroperiod (at least in cypress habitats and assuming fire effects equal), then the species richness will decrease with time for restored sites in each of the three habitats until equilibrium is reached. Control sites will reflect the effects of rainfall and fire, factors extraneous to hydrological restoration. The earlier analyses had implicated a strong effect of droughts in 2006 and 2007 on species richness (Barry and Saha 2008).

Species richness was significantly influenced by habitat, year did not play a significant role, suggesting that richness in 2008 and 2009 was not significantly different (Table 29, Figure 22); not very surprising given the monitoring spanned a short time frame. Pinelands had significantly higher species richness than other habitats (31.04 ± 1.5, compared to Cypress 23.12 ± 1.5 and wet prairies 25.19 ± 1.5; Table 30). Habitat interacted significantly with the effects of management regime. Pinelands plots had significantly higher richness in control than restored sites (35 ± 3.3 in control, 27 ± 1.3 in restored), Cypress dominated plots had significantly higher richness in restored (25 ± 1.3) than control sites (21.67 ± 2.7), a result which can be attributed to restoration to some extent, while the wet prairie plots did not show a significant difference in species richness between management regimes (25 ± 2.7 in control, and 24.80 ± 1.5 in restored). Other variable such as year, and other interactions were not significant). The drought effects appear to influence the patterns in species richness, by counteracting the restoration efforts and leading to peaks in species richness resulting from drying.

Role of fire on species richness in pinelands

Fire had a significant impact on species richness in pineland habitats (Figure 23, 31). Control transects had significantly higher mean species richness (35.4 ± 5.67) than restored transects (25.73 ± 6.46), but transects recently burnt had significantly higher species richness in both control (40 ± and restored sites (29 ± 1.1) than in transects long unburnt (26 ± 4.3 in control, and 18 ± 3.0 in restored)(Table 32). The figure also includes results from 2004 to give readers the interpretation of how restored sites have changed in time, though the data were not included in analyses as no sampling was conducted in control sites.

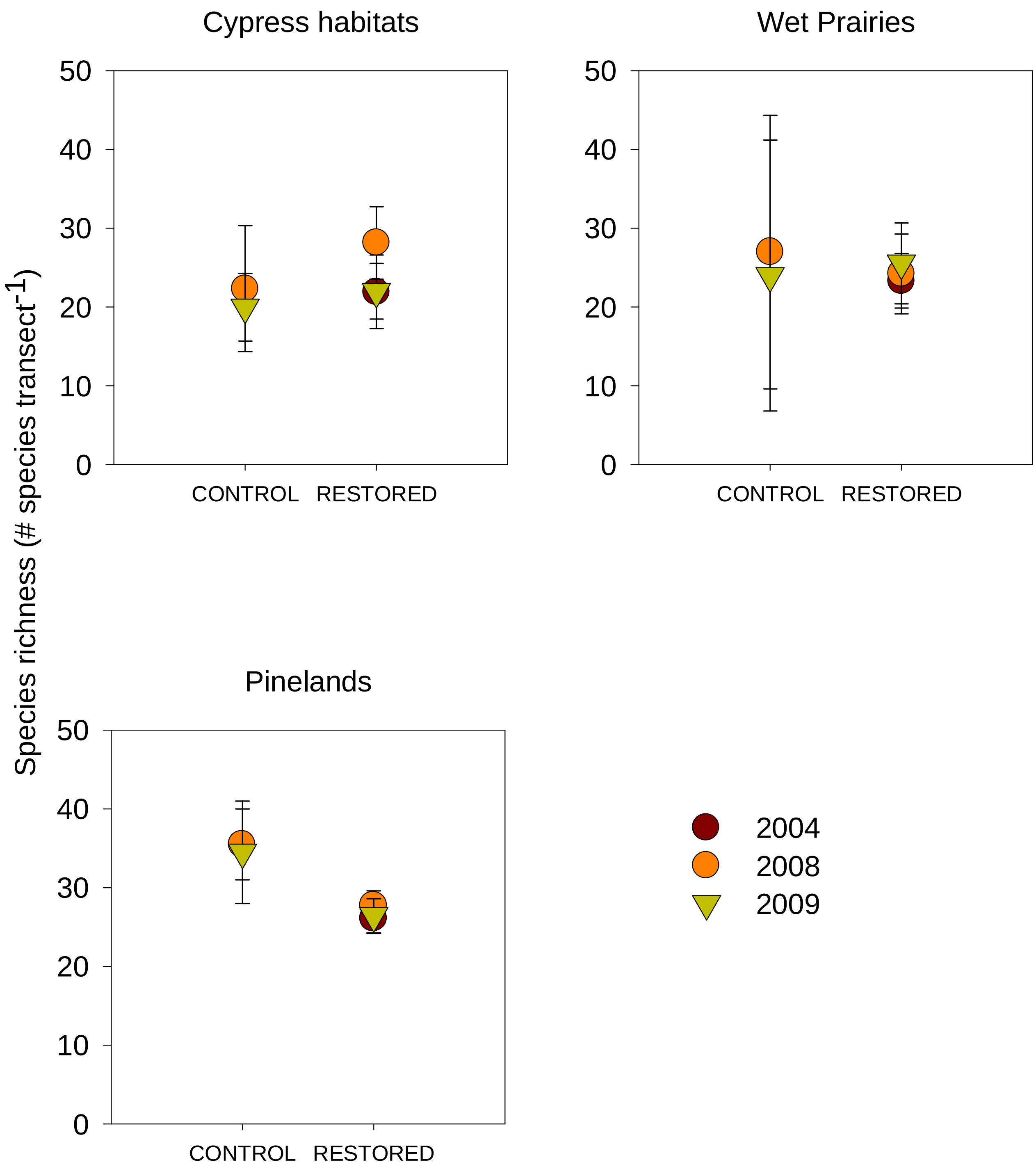


Figure 22: **Mean species richness across years and management regimes**

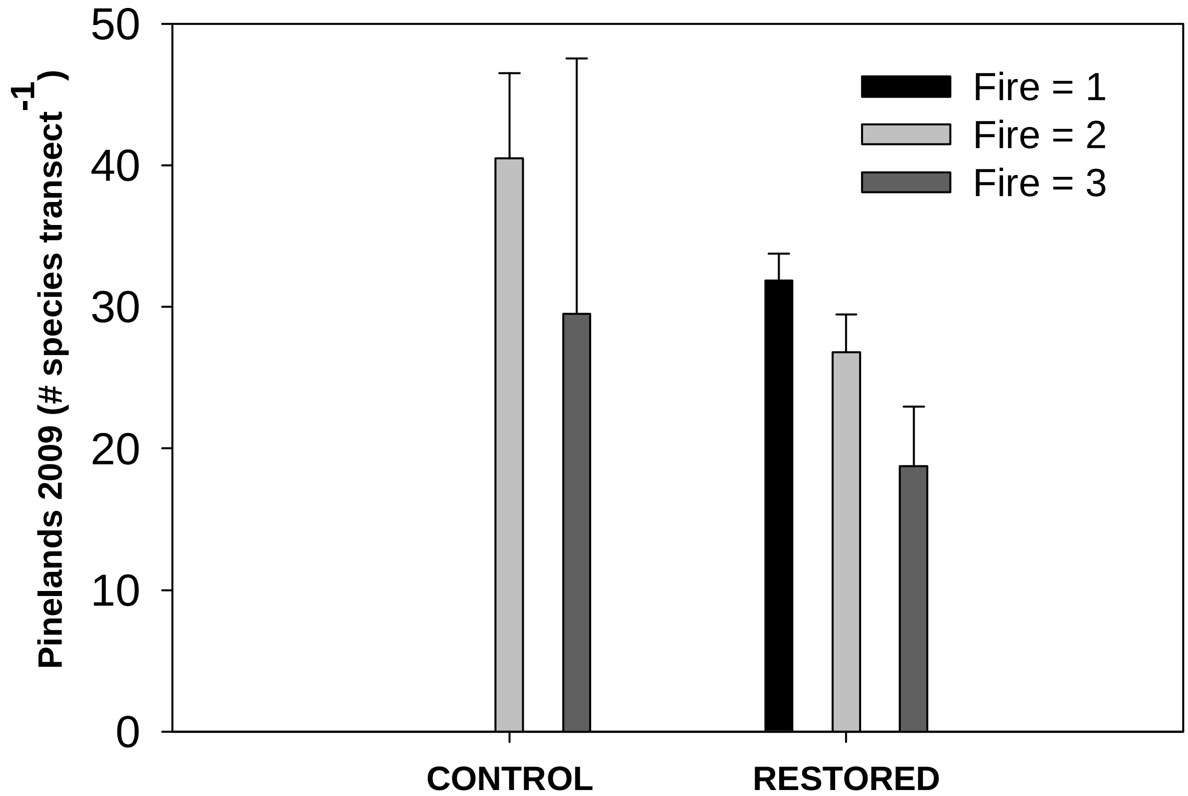


Figure 23: Species richness in pineland transects across burn categories and management regimes. Category 1 suggests recent fires and category 3 sites are long unburnt.

Table 29: ANOVA table presenting the results of species richness across habitats, years and management regimes. Significant effects are in bold.

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1037.213	14	74.08663	1.674865	0.072271
Intercept	39993.7	1	39993.7	904.1312	8.31E-53
Habitat	622.9907	2	311.4954	7.041926	0.00136
Year	134.2977	2	67.14887	1.518024	0.224006
Management regimes	29.65368	1	29.65368	0.670376	0.414811
Habitat * Year	53.12358	4	13.28089	0.300239	0.877187
Habitat * Management regime	281.9395	2	140.9698	3.186881	0.045404
Year* Management regime	0.011201	1	0.011201	0.000253	0.987335
Habitat * Year* Management regime	39.0081	2	19.50405	0.440925	0.64465
Error	4556.143	103	44.2344		

Table 30: **Mean species richness across habitats, years and management regimes**.

Management Regime	Control		Restored	
Year	2008	2009	2008	2009
Cypress	22.3 ± 3.87	20.0 ± 3.87	28.1 ± 1.86	22.0 ± 1.86
Pinelands	35.5 ± 4.74	34.5 ± 4.74	27.7 ± 1.94	26.4 ± 1.94
Wet prairies	27.0 ± 3.87	24.0 ± 3.87	24.2 ± 2.24	25.5 ± 2.24

Table 31: Species richness in pineland transects across fire categories.

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	649.15271	3	216.3842383	5.786766	0.003024
Intercept	10363.973	1	10363.97273	277.1638	1.06E-16
Management regime	463.67423	1	463.674225	12.40004	0.001395
Fire	281.88318	1	281.8831803	7.538405	0.010107
Management regime * Fire	6.7190011	1	6.719001148	0.179686	0.674667
Error	1121.7885	30	37.39294872		

Table 32: Mean species richness in pinelands across fire categories. Fire category 1 was excluded from the analysis due to inadequate representation in control sites.

Management regime	Fire	Mean	Std. Error
Control	2	40.5	4.323942
Control	3	29.5	4.323942
Restored	2	26.80769	1.199246
Restored	3	18.75	3.057489

Changes in frequency and percent cover of common/dominant species

To assess the changes in species composition, it is imperative to examine common and dominant species in conjunction with rare, uncommon and indicator species. Last year we used Fisher's Exact Test to examine differences in percent frequency per habitat (Barry and Saha 2008). The common species did not exhibit a unidirectional change, and both their frequency of occurrence and percent cover increased or decreased based on the species and habitat (Barry and Saha 2008).

In this years analysis, only subtle differences in overall cover of dominant species were observed. However, to attempt to assess the issues of species composition and dominance as a whole in restoration vs. control sites and all related factors effecting them, gradient analysis was conducted using percent cover data by species and transect. Below we discuss the results using the cypress habitats which are less influenced by fire than pineland and wet prairie habitats and potentially more influenced by hydrology, thus most valuable to determine success of rehydration.

Detrended Correspondence Analysis (DCA) was performed to visualize vegetation composition in Cypress habitats using data from 2004, 2005, 2009 sampling. The DCA is an indirect method of understanding the role of environmental factors that might be impacting species composition. All transects belonging to control and restored sites were pooled to examine if differences among sites translated into a gradient in hydrology which might influence the underlying species composition of Cypress habitats. The distance between plots along the DCA axes signifies differences between plots based on species turnover. The length of the gradient and the DCA axis is proportional to beta diversity. Thus for example, if samples are distributed along a strong gradient in hydrology, one end of the axis will have wetter sites (control) while the impacted sites that are drier will constitute the other extreme end of the axis. However if the impacted sites undergoing restoration are hydrologically similar to the control sites we will expect the gradient to be less sharp and the distance between control and restored sites to be narrow.

Analyses separated inherently wetter sites (transects to the far right are in the Fakahatchee Strand) irrespective of management regimes from the drier sites (transects on the far left are more severely drained) suggesting axis 1 is related to hydrology (Figure 24). The gradient analyses also captured differences in fire regimes. Higher fire frequencies are expected in Cg habitats than C and even less in Ch, thus suggesting axis 2 is related to fire. The plant species presented (Figures 25 and 26) also support this hypothesis with more Obligate wetland species to the right and upland weeds like dog fennel (*Eupatorium capilifolium*) to the left. Also trees, shrubs and vines are found lower on axis 2 (indicative of lower fire frequency) and fire dependant graminoids and forbs are found higher on the axis. Interestingly the same sites sampled over 2004 to 2009, showed different coordinates and thus the spatial location on the graph, however the direction of movement did not always correspond to increase in hydroperiod, as expected of restoration. Transects went from being wet to dry (PC20 for e.g.), and vice versa (PC26), depending on the habitat type, location, severity of drought and to certain extent the role of restoration. Thus from the species composition perspective the major habitat differences were governing transect locations while the restoration effects were not strong enough yet to stand out and positively correlate with hydrological axis (drought of 2006-2007 definitely played a role).

In addition, we tested if significant clustering of transects occurred into groups representing NRCS habitats using 2009 sampling, and to examine if control and restored transects cluster together, or have differences in species composition which will have to be scaled in order for restoration to be successful. Bray-Curtis similarity matrices (Bray and Curtis 1957) were employed for the hierarchical cluster analysis using the group average method. Although the statistical routines used were non-parametric, all abundance data as measured by % cover per quadrat were square-root transformed prior to the analysis to down-weight the influence of extremely abundant species (Clarke and Warwick 2001).

Four major groups were identified with Cluster Analysis (Figure 27), and site 56 was identified as an outlier ($P < 0.05$; black lines) from all other groups based on SIMPROF test. Clear-cut clustering of transects did not occur either based on the sub-habitat types, or on the management regimes (control vs. restored). Interestingly the results of cluster analysis and non-metric multidimensional scaling (MDS) were similar to DCA ordination results which suggested that spatial differences did not correspond with the differences resulting from management regimes, that is the restored and control sites did not show strong segregation.

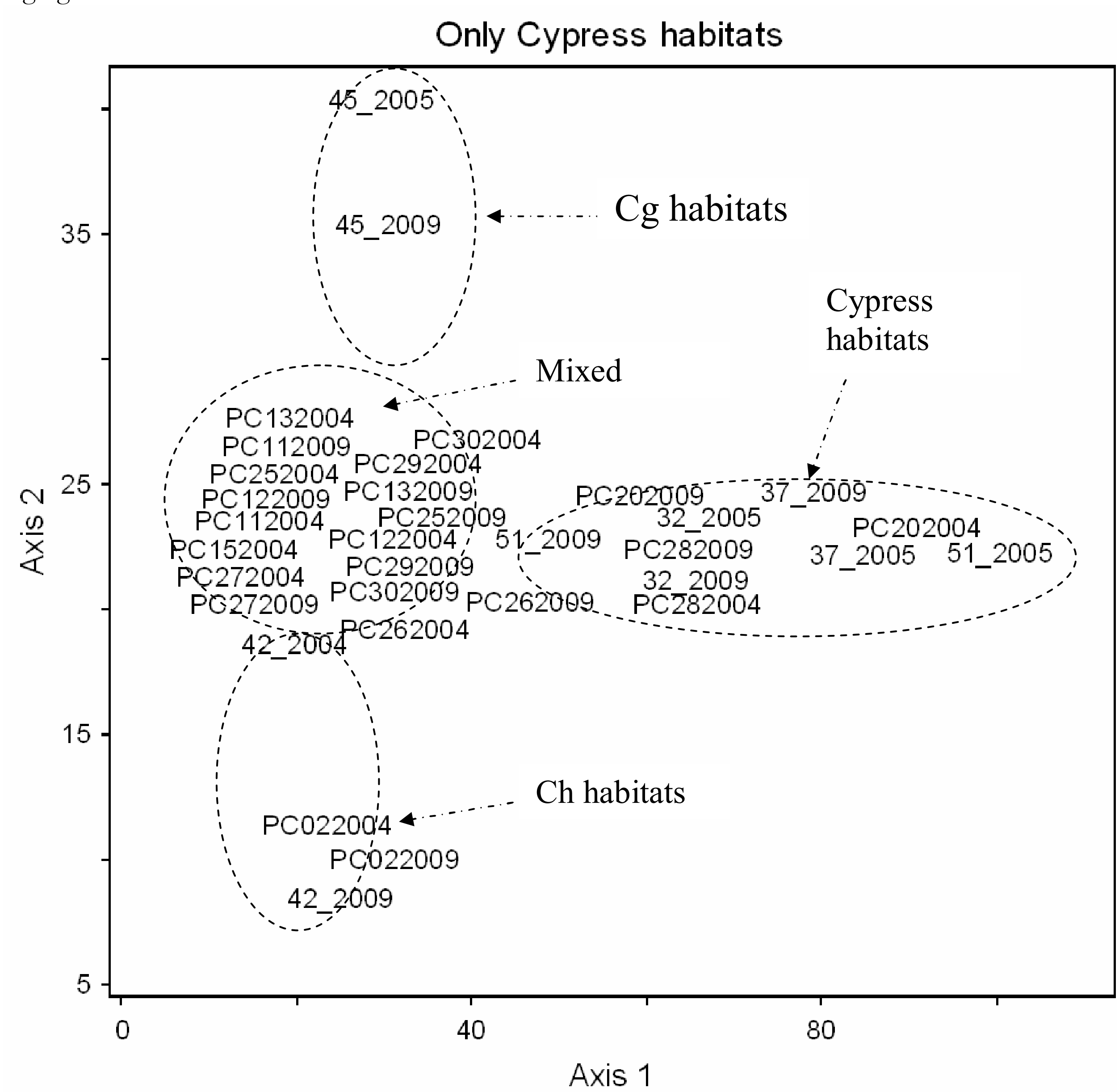


Figure 24: DCA analysis of cypress habitats

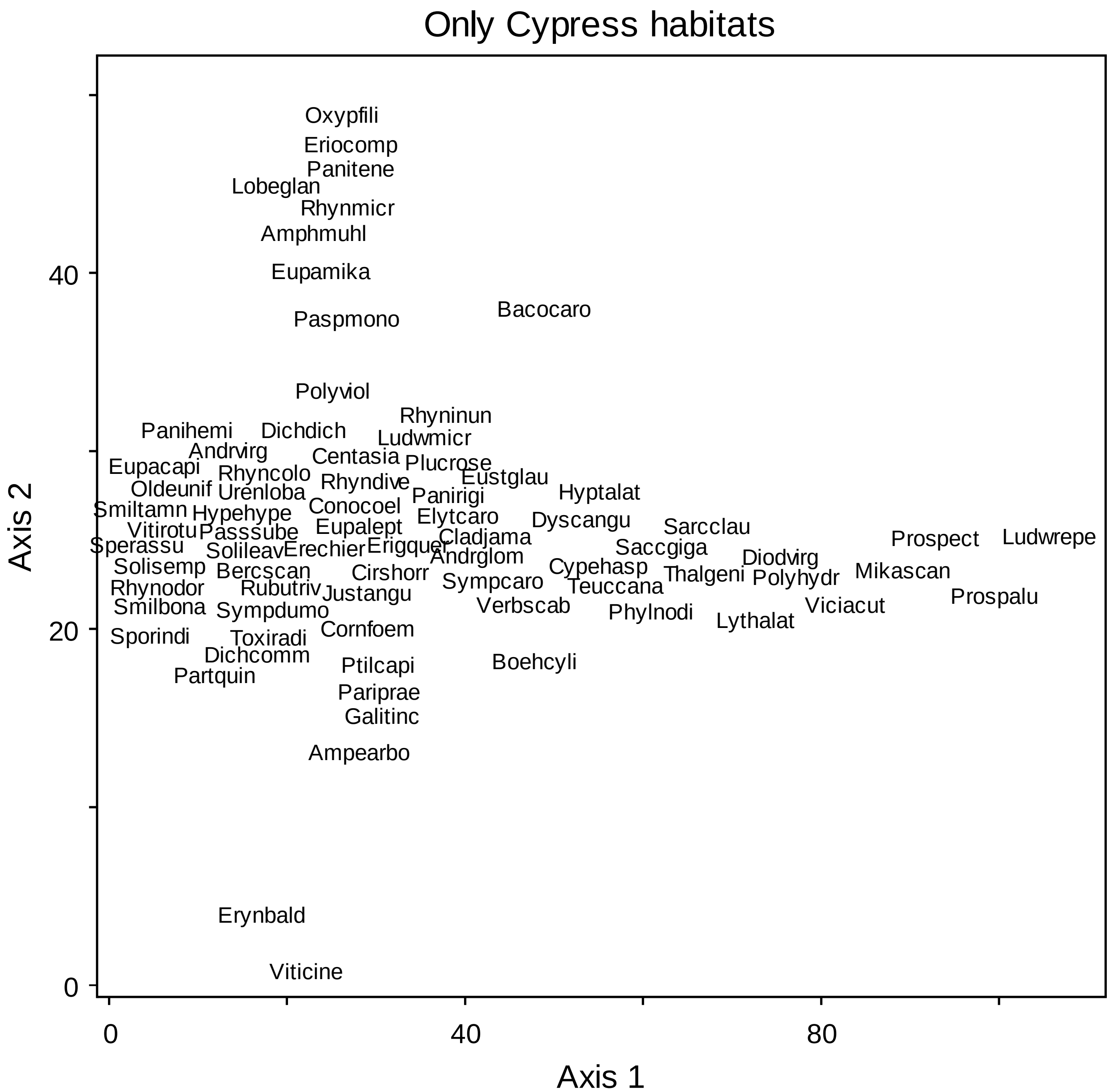


Figure 25: DCA analysis – species and cover in cypress habitats

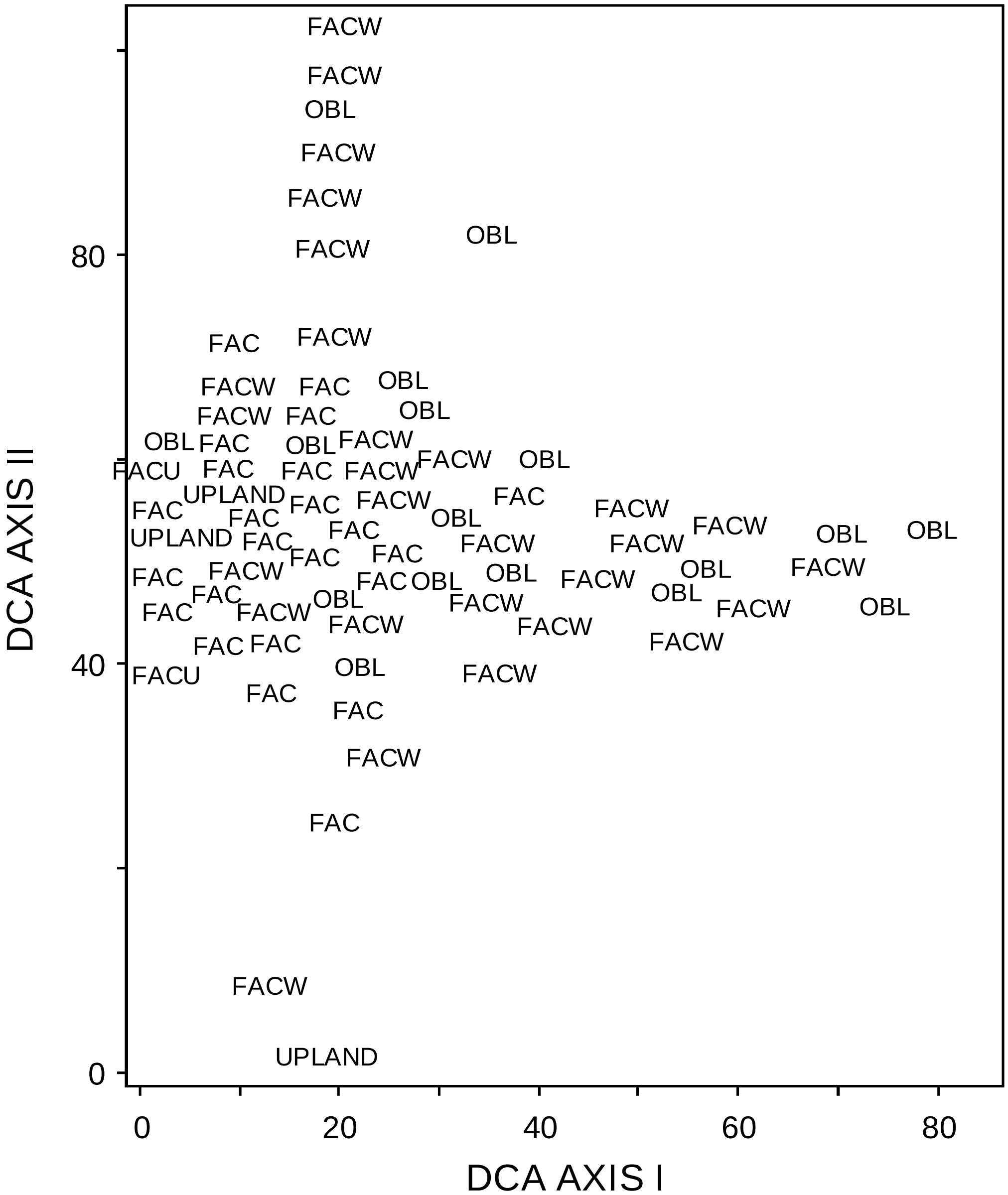
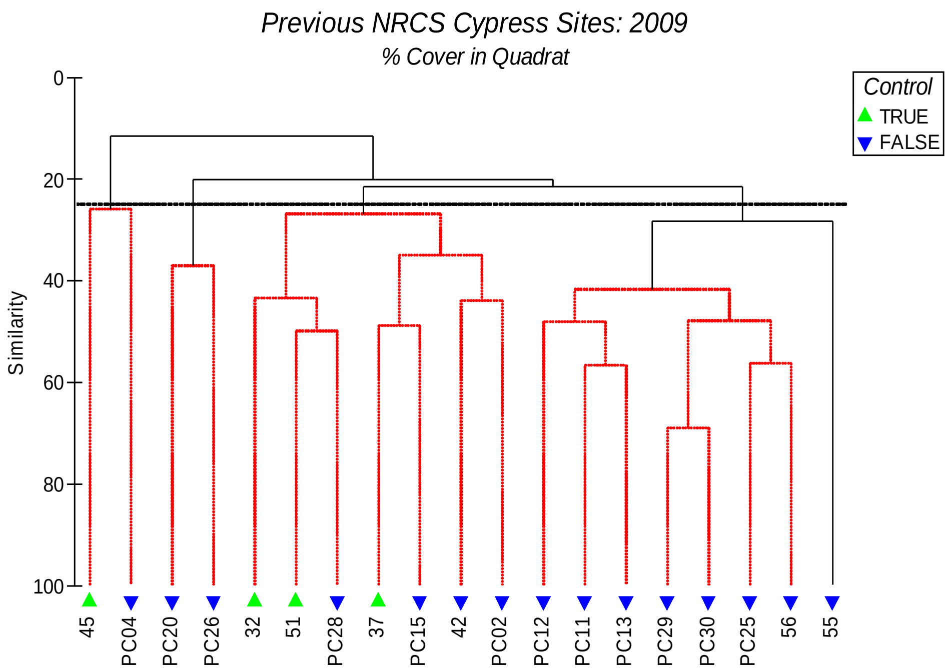


Figure 26: **DCA analysis species cover with wetland indicator values in cypress habitats**



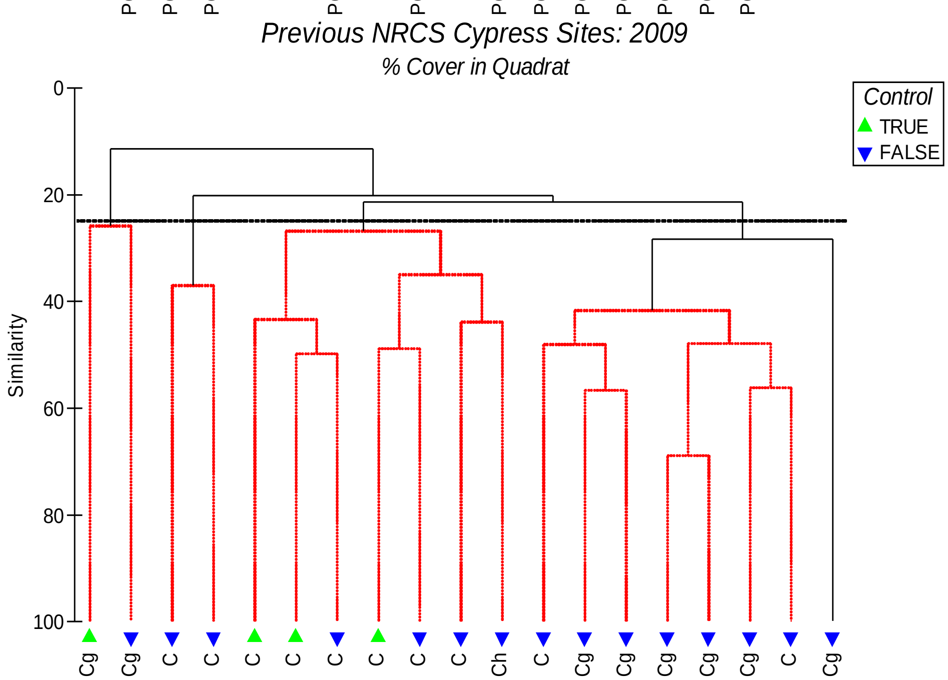


Figure 27: **Hierarchical clustering of previous NRCS "Cypress" sites labeled as control (True) and restore (False) and showing transect ids (above) and habitat (below).** There were four major groups and site 56 as outlier identified as significant (P<0.05) (black lines) from all other groups based on SIMPROF test. site The outliers previously (pre-drainage) classified as C and Cg are now classified as Hh and Ph respectively.

Changes in Frequency of Indicator Species

While conducting sampling in 2004 and 2005, especially in the wet prairies, we began to notice the lack of certain low coverage, high frequency diminutive forb species typical of the prairies of FPNWR (Barry and Woodmansee 2006). In last years report, we focused on changes in mean percent frequency of occurrence across years in both control and restoration sites (Barry and Saha 2008). No test of significance was done for control transects due to limited sample size per habitat category. Thus, most of the changes observed suggest influence of drought except for the increase in smallfruit primrosewillow (*Ludwigia microcarpa*) in hydric pine flatwoods. At restoration transects, smallfruit primrosewillow significantly decreased in percent frequency across years from 2004 to 2008 in Cypress with graminoid understory, while a non-significant decrease was noticed in hydric pine flatwoods habitat. An increase was actually observed in wet prairie and cypress with hardwoods. As mentioned above, the increase in these indicator species in the deeper cypress habitats may suggest influence of drought. However, because these sites are so drained, the hydroperiod may actually just now be suitable for these species with an increased hydroperiod. The decrease of these indicators in the other habitats suggests influence of drought. Also it is possible that the varied frequency of these species is explained by variables other than hydrology and they simply to not function well as stand alone indicators.

Based on the varied results in 2008 summarized above and examining new data from 2009, we decided that it was not necessary to evaluate these indicators again this event. Instead, we believe that the analysis of all wetland indicators using the Wetland Affinity Index is a more powerful tool which already incorporates these individual species. We will continue to keep our eye on the frequency and cover of these species in the future sampling events.

Effects of management regimes on Wetland Affinity Index

Wetland indicator values (Reed 1988) were utilized to calculate Wetland Affinity Index (WAI) to assist with evaluating the effects of hydrological conditions on plant communities across management regimes. As described above in discussion of species richness, we combine all cypress habitats (Ch, Cg, and C) to one group and both mesic and hydric pine flatwoods for comparisons between control and restoration sites to increase sample size by habitat. We do include 2004 data for restored sites in the graph to provide a benchmark or baseline, but due to the effects of seasonality on species composition, we do not include the 2005 (control) data which was sampled in the fall, differing from all other events sampled in the spring.

The WAI showed a significant difference between management regimes (Figure 28, Table 33). Transects had significantly higher WAI in control (0.729 ± 0.02) than the restored sites (0.644 ± 0.01) for each habitat (Table 34). As per expectations, Cypress (0.726 ± 0.02) and wet prairies transects (0.72 ± 0.02) had significantly higher WAI than the pinelands (0.614 ± 0.02). There was a trend but no significant interaction of year and management regime. Control sites across all habitats had higher WAI in 2008 (0.737 ± 0.03) than 2009 (0.722 ± 0.01), while in the restored sites the effect was the opposite, the 2009 WAI (0.658 ± 0.03) is higher than in the 2008 sampling (0.631 ± 0.01). The results driven in part by trends exhibited by Cypress and Pineland habitats. The results of WAI suggest that the effects of 2006- 2007 drought on the WAI are probably wearing off as the restored sites get wetter, though further sampling over time would be required to determine if these are concrete effects or year to year variation resulting from drought.

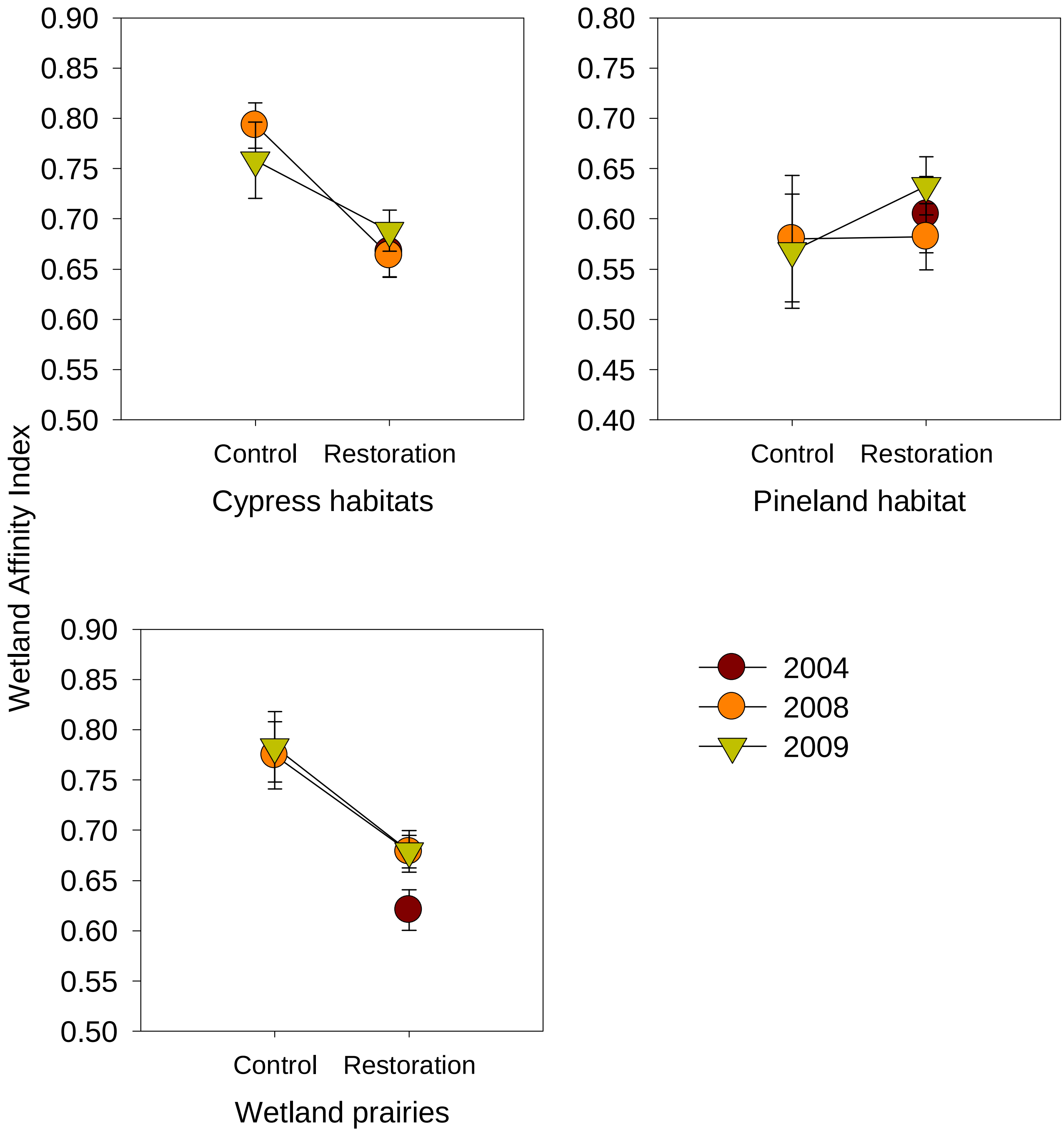


Figure 28. Wetland Affinity Index graphed across management regimes and years. To aid the understanding we present the means for habitats separately, and present 2004 values as benchmark to evaluate how the restoration has progressed in time.

Table 33: ANOVA table testing for the role of year, management regimes and habitats on WAI

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	0.1982017	11	0.018018334	2.417641	0.012535
Intercept	23.920928	1	23.92092766	3209.632	1.06E-62
Year	0.0013457	1	0.000023	0	1
Management regime	0.0513092	1	0.051309198	6.8845	0.010554
Habitat	0.1022623	2	0.051131168	6.860612	0.001848
Year * Control * Habitat	0.0018343	1	0.000063	0	1
Year * Habitat	0.0000046	2	0	0	1
Management regime * Habitat	0.0255293	2	0.012764632	1.712716	0.187447
Year * Management regime * Habitat	4.365E-06	2	0	0	1
Error	0.5515115	74	0.007452858		

Table 34: **Mean WAI across , management regimes and habitats**

Management Regime	Control		Restored	
Year	2008	2009	2008	2009
Cypress	0.793 ± 0.05	0.758 ± 0.05	0.664 ± 0.023	0.688 ± 0.023
Pinelands	0.642 ± 0.061	0.624 ± 0.061	0.570 ± 0.025	0.621 ± 0.025
Wet prairies	0.774 ± 0.05	0.783 ± 0.05	0.659 ± 0.029	0.665 ± 0.029

Effects of transect location on Wetland Affinity Index

We evaluated the location of transects on restoration success and analyzed changes in WAI over time for restored transects only (Figure 29). If increase in WAI is a parameter indicating restoration success, the data did not show a significant change in WAI over time (Table 35). There was an increasing trend in WAI for cypress and wet prairie habitats over time indicating WAI was on a gradual rise. The results were impacted by the patterns in Pineland. Barring transects located in south, pinelands showed a substantial reduction in WAI from 2004 to 2008 (0.60 to 0.53 in north transects and from 0.81 to 0.75 among transects located in the middle).

Whether transects were located in Picayune or in Fakahatchee strand, did not make an impact on restoration success (Figure 30). Effects of changes in hydrology especially in the western (Picayune) areas are being reflected in the results (Table 36).

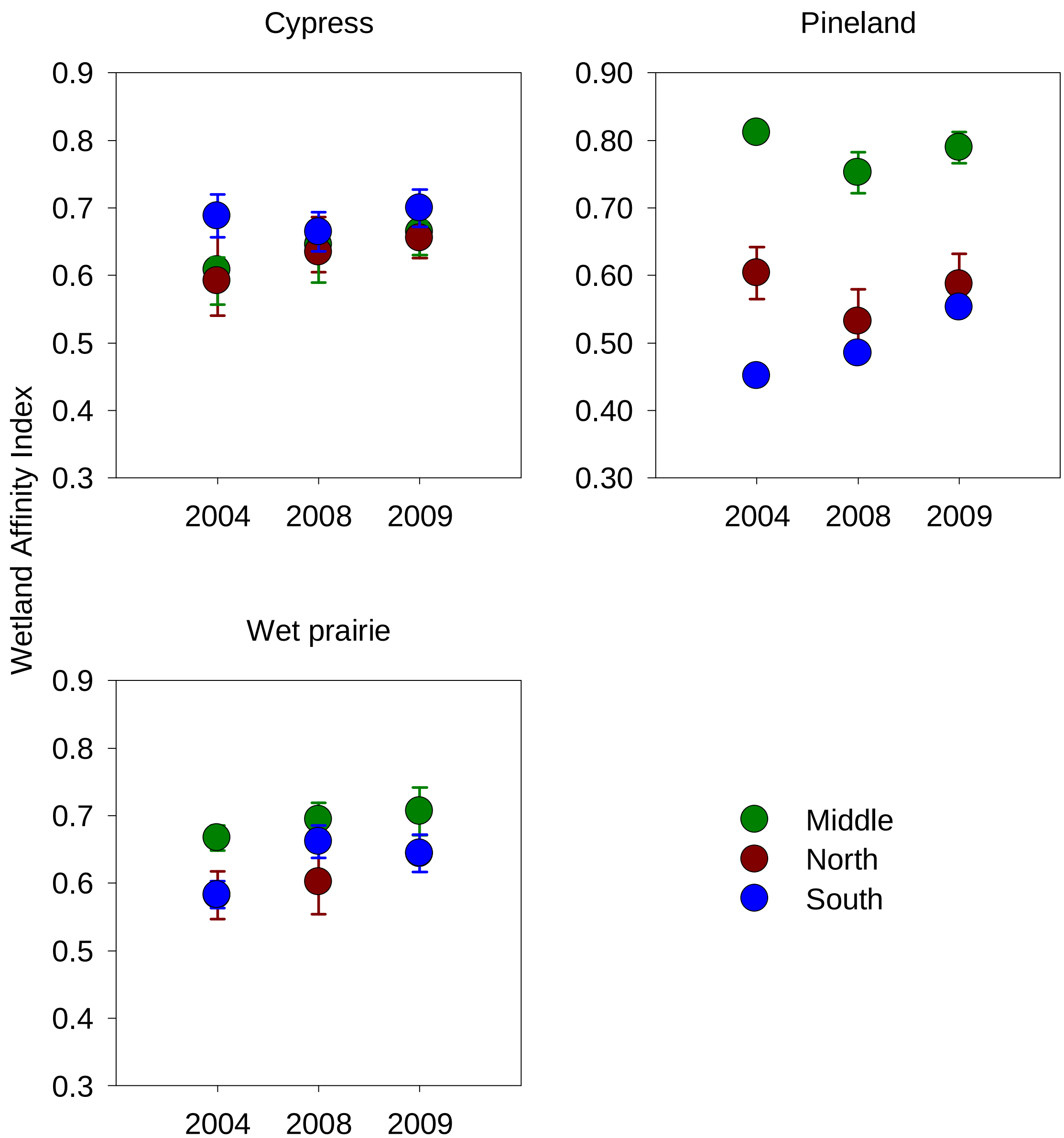


Figure 29. Changes in WAI with time in restored transects partitioned across locations for each habitat separately.

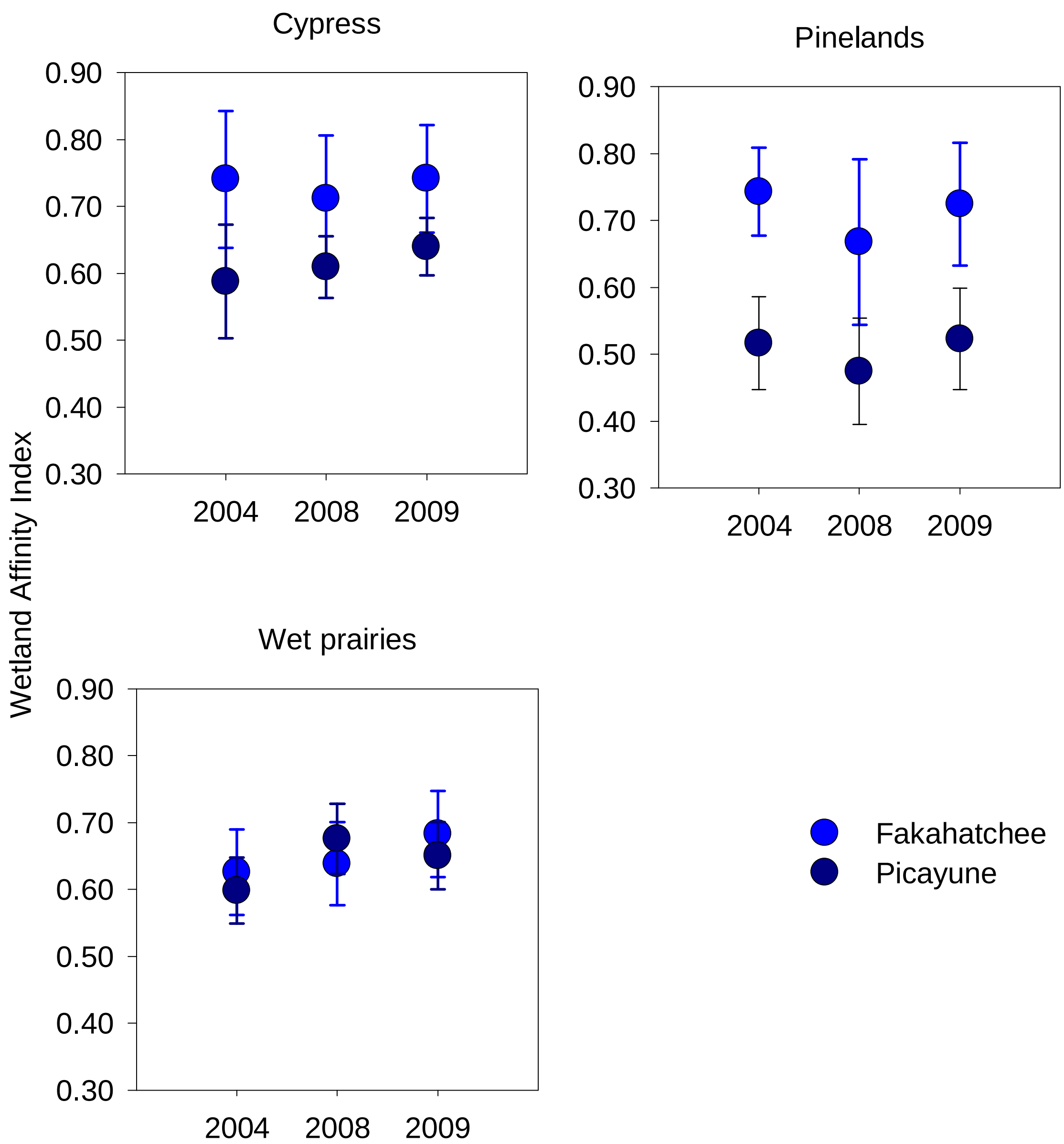


Figure 30. Changes in WAI with time in restored transects east (Fakahatchee) and west (Picayune) of Prairie Canal for each habitat separately

Table 35. Mean WAI across transect locations, time and habitats

Habitat	Location	2004	2008	2009
Cypress	North	0.592 ± 0.053	0.634 ± 0.053	0.655 ± 0.053
	Middle	0.608 ± 0.037	0.645 ± 0.037	0.664 ± 0.037
	South	0.688 ± 0.035	0.664 ± 0.035	0.700 ± 0.035
Pineland	North	0.603 ± 0.035	0.532 ± 0.035	0.587 ± 0.035
	Middle	0.811 ± 0.065	0.752 ± 0.065	0.789 ± 0.065
	South	0.451 ± 0.091	0.485 ± 0.091	0.553 ± 0.091
Wet Prairie	North	0.582 ± 0.065	0.602 ± 0.065	0.643 ± 0.065
	Middle	0.667 ± 0.053	0.694 ± 0.053	0.706 ± 0.053
	South	0.583 ± 0.046	0.662 ± 0.046	0.644 ± 0.046

Table 36. Mean WAI across transect locations east or west of Prairie Canal, time and habitats

Location	Fakahatchee (East)			Picayune (West)		
Year	2004	2008	2009	2004	2008	2009
Cypress	0.740 ± 0.032	0.712 ± 0.032	0.741 ± 0.027	0.579 ± 0.025	0.614 ± 0.024	0.639 ± 0.021
Pineland	0.742 ± 0.035	0.667 ± 0.035	0.724 ± 0.030	0.516 ± 0.035	0.474 ± 0.035	0.522 ± 0.030
Wet Prairies	0.625 ± 0.039	0.638 ± 0.039	0.682 ± 0.033	0.598 ± 0.039	0.675 ± 0.035	0.650 ± 0.030

Floristic Quality Index

Analysis of the relative quality of species composition of sites was done relative to hydrology in specific habitats using the wetland affinity index as described above. Species richness can also be used as a relative quality measure of a site based on comparable habitats. Another way of assessing quality of a site from species composition is using the *coefficient of conservatism* (C) to calculate the Floristic quality index (FQI) which is based on species specific degrees of fidelity to habitats and quality of habitats as well as tolerance to disturbance and species richness (Mortellaro et al. 2009). See the analysis section above for more details on calculations. Preliminary analysis of groundcover data utilizing the C values was conducted in a previous report to SFWMD (Barry and Woodmansee 2006). However, those data utilized the list in draft (2006) form therefore not directly comparable.

Habitats for statistical analysis were combined as above in species richness and wetland affinity indices. Habitat had a significant impact on FQI. Cypress had a FQI of 19.25 ± 0.774 while FQI of Wet Prairie and Pinelands was 26.92 ± 0.87, and 27.62 ± 0.59 respectively (Figure 31, Tables 37 and 38). Interaction of habitats and years and management regime and habitats was significant as well. Habitat and year interaction though indicated that the taxonomic quality of Cypress habitats has increasingly improved since 2004, while the quality of Pinelands and Wet prairies has remained unchanged. The changes in taxonomic quality of habitats did not reflect the effects of hydrological restoration, as they were driven mainly due to improved quality of control sites. Cypress and Prairie habitats showed marginal differences in FQI across management regimes. The strong interaction of management regime and habitat was driven by significantly greater FQI in control Pineland transects (30.98 ± 1.5) compared to restored transects (24.27 ± 0.7).

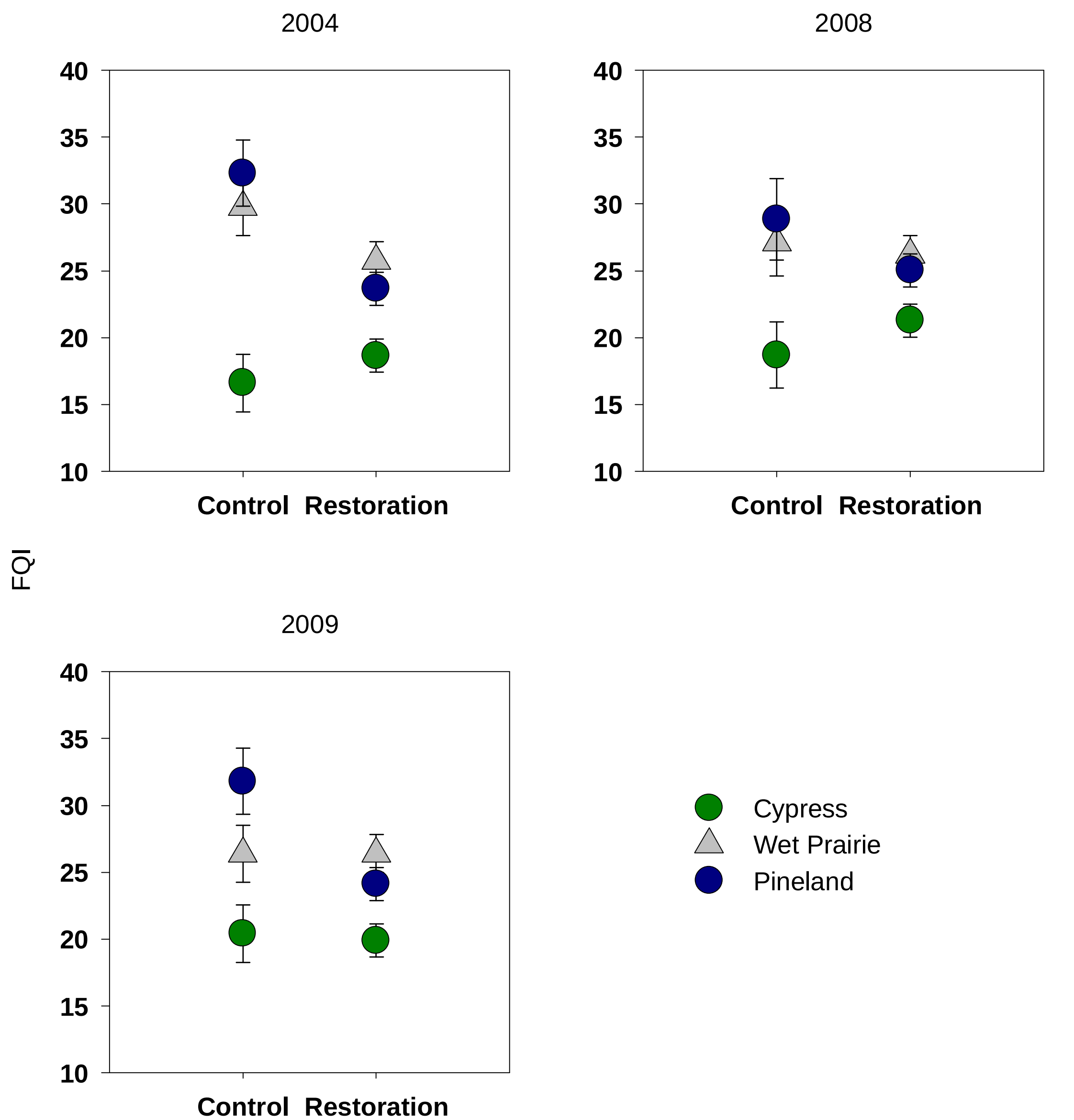


Figure 31: FQI across management regimes, and habitats depicted here separately for all three sampling events. The results reflect inherent quality of habitats rather than the effects of restoration.

Table 37: Effects of management regime, habitat and fire on Floristic Quality Index.

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1734.487389	17	102.0287	5.545498	7.79E-09
Intercept	53489.76219	1	53489.76	2907.294	1.88E-81
Management regime	119.519192	1	119.5192	6.496149	0.012177
Habitat * Year	1340.062663	2	670.0313	36.41778	6.91E-13
Year	2.644371387	2	1.322186	0.071864	0.930701
Management regime * Habitat	236.2154253	2	118.1077	6.419432	0.002301
Management regime * Year	29.09340323	2	14.5467	0.790647	0.456088
Habitat * Year	59.64422579	4	14.91106	0.810451	0.52107
Management regime * Habitat*Year	39.45273826	4	9.863185	0.536087	0.709492
Error	2042.229882	111	18.39847		

Table 38: Mean FQI across management regimes, habitats and sampling years

Management regime	Control			Restored		
Year	2005	2008	2009	2004	2008	2009
Cypress	16.61 ± 2.14	18.7 ± 2.48	20.41 ± 2.14	18.65 ± 1.24	21.28 ± 1.24	19.9 ± 1.24
Pinelands	32.29 ± 2.48	28.85 ± 3.03	31.81 ± 2.48	23.67 ± 1.24	25.04 ± 1.24	24.11 ± 1.24
Wet Prairies	29.76 ± 2.14	27.09 ± 2.48	26.38 ± 2.14	25.73 ± 1.43	26.2 ± 1.43	26.4 ± 1.46

When the values of mean C were compared across habitats, years and management regimes, the significant effect of habitat was observed while no other effects and interactions were significant. Mean C values were greatest for wet prairies (5.38 ± 0.09) compared to Cypress (4.18 ± 0.09) and pineland (4.83 ± 0.1) habitats.

The mean C, weighted mean (by percent cover) C, and FQI are presented below by specific habitat type (not the combined habitats used in analysis above) for control and restorations sites in Tables 39-42. The combined average for mean C was 4.93 at the control sites and 4.35 at the restoration, and weighted mean C values were 5.42 at control and 4.49 at the restoration sites, which could perhaps suggest a lower quality flora at the restored sites (as mentioned above for grouped habitats).

The values for specific habitats reiterates the necessity to compare like habitats in all assessments of species composition (above). The hydric hammock (Hh), cabbage palm hammock (Hp), and cypress with hardwoods (Ch) had the lowest C values and are only represented by one transect each (Hh, Hp) and 2 transects (Ch) at the restoration sites. This is not surprising because they are dominated by fairly widespread woody species and cabbage palm which have broad tolerance to disturbance. Cypress habitats had the next lowest C and FQI for similar reasons, but it is interesting to note that overall FQI for is higher for this habitat at restoration sites compared to the lower weighted mean C value. This is likely due to the slightly higher species richness at the restoration sites which is influenced by the fall 2005 sampling event at high water when dry season species are gone and underwater. All of these habitats are typically lower species richness and have lower FQI (16.31 – 19.90) as compared to more fire maintained habitats Pine flatwoods (Ph, Pm) wet prairie (G), and cypress with graminoid understory (Cg) with a higher FQI (22.16 – 30.98).

Table 39: Coefficient of Conservatism (C) by habitat for Control Transects

	Mean C:				Weighted Mean C:				# of transects:		
Habitat	2005	2008	2009	Average	2005	2008	2009	Average	2005	2008	2009
C	3.95	3.96	4.05	3.99	4.87	4.72	4.15	4.58	3	3	3
Cg	6.04		4.97	5.50	5.34		5.27	5.31	1		1
G	5.51	5.22	5.04	5.26	6.44	6.88	6.61	6.64	4	3	4
Ph	5.00	4.86	5.03	4.96	4.98	5.19	5.23	5.13	3	2	3
			Combined:	4.93			Combined:	5.42			

Table 40: Coefficient of Conservatism (C) by habitat for Restoration Transects

	Mean C:				Weighted Mean C:				# of transects:		
Habitat	2004	2008	2009	Average	2004	2008	2009	Average	2004	2008	2009
C	4.02	3.90	4.07	4.00	3.81	3.53	3.79	3.71	5	5	5
Cg	4.12	4.10	4.57	4.26	4.17	4.27	4.58	4.34	5	5	5
Ch	3.78	4.21	3.82	3.94	3.38	3.77	3.51	3.55	2	2	2
G	5.37	5.41	5.30	5.36	6.66	7.01	7.01	6.89	9	9	9
Hh	3.86	4.20	4.83	4.30	4.61	4.71	5.04	4.79	1	1	1
Hp	3.44	3.39	3.69	3.51	3.09	3.37	2.91	3.12	1	1	1
Ph	4.64	4.81	4.81	4.75	5.33	5.94	6.04	5.77	10	10	10
Pm	4.71	4.74	4.57	4.67	3.74	3.93	3.56	3.75	2	2	2
			Combined:	4.35			Combined:	4.49			

Table 41: Floristic Quality Index by habitat for Control Transects

	FQI:			
Habitat	2005	2008	2009	Average
C	12.07	18.70	18.15	16.31
Cg	30.20		27.20	28.70
G	29.76	27.09	26.38	27.75
Ph	32.29	28.85	31.81	30.98
			Combined:	25.93

Table 42: Floristic Quality Index by habitat for Restoration Transects

	FQI:			
Habitat	2004	2008	2009	Average
C	16.51	18.90	17.51	17.64
Cg	22.40	23.67	23.56	23.21
Ch	14.60	21.23	16.70	17.51
G	25.73	26.20	26.40	26.11
Hh	18.12	21.00	20.51	19.88
Hp	17.20	20.33	22.17	19.90
Ph	24.08	25.44	24.57	24.70
Pm	21.60	23.03	21.84	22.16
			Combined:	21.39

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Attachment E: Picayune Strand Restoration Project – Restored Footprint Exotics Mapping and Control Coordination, Final Report – September 2009

Note: This document, dated September 2009, was provided to the South Florida Water Management District by The Institute for Regional Conservation, under Purchase Order No. 4500034492.

Picayune Strand Restoration Project – Restored Footprint Exotics Mapping and Control Coordination Final Report – September 2009

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Introduction

The Institute for Regional Conservation (IRC) was contracted (purchase order #4500034492) by South Florida Water Management District (SFWMD) to map exotic and nuisance vegetation within the footprint of the filled Prairie Canal and the cleared road and house demolition footprints east of Merritt Canal and to coordinate exotic control efforts conducted by SFWMD contractors. Contract start date was February 17, 2009. The primary goals were to identify and prioritize areas of significant exotic and nuisance plant infestations, facilitate control efforts by providing maps of these areas, provide technical assistance including plant identification, and conduct follow-up surveys to map areas treated, identify areas missed, and generally evaluate success of control methods. This report marks the completion of this contract.

Scope of Work

The Contractor shall be the onsite coordinator for nuisance and exotic control efforts conducted by exotic control contractors employed by SFWMD Initially, exotic and nuisance vegetation shall be mapped according to methods outlined by the Florida Natural Areas Inventory (FNAI) Florida Invasive Plants Geodatabase project (http://fnai.org/invasivespecies.cfm). These surveys shall include the construction footprints and adjacent areas out to 50 ft from the cleared areas along Prairie Canal and the road and demolition sites east of Merritt Canal. Subsequently, the onsite coordinator shall identify and prioritize areas of significant exotic and nuisance plant infestation, facilitate control efforts by providing maps of the areas and being available for technical assistance, especially with plant identification. They shall conduct follow-up surveys to map areas treated, identify areas missed, and generally evaluate success of control methods. They shall provide monthly reports summarizing status of exotic control efforts to SFWMD.

While it is important to eliminate nuisance species, it is equally important that non-nuisance native species are minimally affected by the treatments. One of the most effective mechanisms for combating nuisance species over the long term is competition from desirable species, including early successional native species that may be abundant during the first few years following restoration. Personnel conducting the surveys and treatments shall be able to distinguish nuisance/exotic species from non-nuisance native species and shall exert sufficient care to not adversely affect non-nuisance native species.

Methods

The geodatabase established between February and October 2008 was utilized and updated for post treatment and rainy season exotic species cover values to coordinate new control efforts based on spot field assessments of the contract area. The geodatabase (ArcView 9.2 geodatabase format) incorporates points, lines and polygons of exotic and nuisance vegetation recorded during initial survey efforts with updated values for this fiscal year on density and/or percent cover. Mapping utilized an existing geodatabase and methodology based on FNAI Florida Invasive Plants Geodatabase project (http://fnai.org/invasivespecies.cfm), with modifications. Modifications included expansion of scope of species mapped as well as to incorporate survey track log with percent cover of dominant exotic species along the track route to strengthen the data set for production of polygon maps. All Florida Exotic Pest Plant Council (FLEPPC) category I and II species were recorded in the field, as with FNAI methods, however, additional exotic species proven to exhibit invasive behavior in Collier County but not yet listed by FLEPPC such as West Indian Pennisetum (*Pennisetum polystachion*), jaragua (*Hyparrhenia rufa*) and signal grass (*Urochloa arrecta*) were included. Moreover, two native species with potential for nuisance behavior were also mapped: cattail (*Typha domingensis*) and common reed (*Phragmites australis).* Fixed point photographs were occasionally taken with GPS points recorded and photos taken at the point starting towards the north and continuing clockwise in order to document significant infestations.

IRC was available for onsite orientation of the exotic control contractor upon initiating control efforts. IRC was also available as needed for interpretation of maps, plant identification, discussion of priorities, or adjustment of control methodologies during treatments. A more basic survey of the entire footprint shall is conducted as the contractor completes each section, with field work timed with other needs of the contractor whenever possible, reporting any missed areas to the contractor, preferably prior to de-mobilization.

Spot assessments were conducted from 1-3 months following treatments to generally evaluate control methods on target species. Field work by IRC included taking GPS track logs into the 50 foot buffer areas around the cleared areas to verify the distance into the buffer area that was treated, and to get an idea of how much was missed or re-sprouting. Emphasis was on identifying problems and successes in order to better strategize for future control efforts. Efforts were made to return to as many fixed-point photograph locations as possible to take post-treatment photographs.

Monthly letter reports like this one including status maps of exotic and nuisance vegetation treated were provided to SFWMD. Problems encountered during treatments were discussed as well as justifications for priorities or actions taken in the field. A list of all exotic and nuisance vascular plant species observed within the footprints was recorded with taxonomy following Wunderlin & Hansen (2003) and provided to the SFWMD.

Results and Recommendations

This report summarizes work completed by IRC (purchase order #4500034492) and Applied Aquatic Management, Inc. (exotic control contractor to SFWMD) for fiscal year 2008-2009. IRC coordinated with the contractor onsite and conducted field surveys of exotic treatment areas throughout the fiscal year in order to increase efficiency of control efforts and attempt to minimize recovery time for the restored footprints of the removed roads, ditches, and Prairie canal.

Foliar treatments began the fiscal year as Applied Aquatic Management, Inc. finished treatment of fall flowering grasses they began in September (last fiscal year). This fall treatment lasted from 10/20/2008 to 12/16/2008. On 12/18/2008 the contractor finished the remaining initial treatment of Brazilian pepper with Garlon IV on 110th Ave SE to the West of Patterson, once water levels dropped. Re-treatment of Brazilian pepper over the entire footprint then followed from 12/22/2008 to 2/2/2009. Initial Brazilian pepper control by the contractor at the demolition sites began 2/3/2009 and continued until 2/12/2009 at which point work was discontinued due to freeze damage, drought conditions, and scheduling conflicts. The contractor began again 4/28/2009 and continued until 7/23/2009 at which time the portion of the budget planned for Brazilian pepper had been utilized. Foliar treatments were also in progress 6/12/2009 to 8/28/2009 targeting primarily cogongrass and torpedograss, but opportunistically treating others. A test treatment of cabbage palm using Garlon IV was also conducted 8/3/2009 to 8/6/2009. The remaining budget was then utilized conducting foliar treatments with special emphasis on spraying jaraguá (Hyparrhenia rufa) from 9/14/2009 to 9/24/2009.

This report also discusses overall success of exotic control efforts. Percent cover of exotic and nuisance vegetation is assessed during the year and compared to past conditions. Since March of 2008 there has been a dramatic reduction of primary target species, especially Brazilian pepper and Burma reed, while other non-targeted species such as natalgrass (Melinis repens) and smutgrass (Sporobolus indicus var. pyramidalis) have actually increased at least in higher, drier areas. Weedy native species dominate overall where exotic species do not. The highest quality and quantity of native species assemblages were found in the wetter areas and the lowest coverage by native species was found in the driest areas north of 79th Ave SE. Based on these results, this fiscal year additional species such as natalgrass will be treated at least in the areas north of 79th Ave SE.

<u>Basal-Bark treatments with Garlon IV of Brazilian Pepper</u>
Brazilian pepper was the top priority for treatments in fiscal years 2008 and 2009. Total coverage of Brazilian pepper in the footprint and 50' buffer areas is depicted in Figure 1. Treatments are shown in Figure 2. Initial treatments for the entire footprint were nearly completed in fiscal year 2008 except for one area totaling **61 acres** along 110th Ave SE. This area of dense coverage was completed on 12/18/2008 (Table 1). Because of the relatively dense coverage, actual acres treated totaled 25 acres (Table 2).

Re-treatment of the entire footprint for fiscal year 2009 and 50' buffer areas began in the late afternoon 12/18/2008 in the northernmost portion of the contract area by 56th Ave SE and Patterson. Re-treatment continued in the footprint and 50' Buffer areas to 2/2/2009 totaling **2568 acres** (Table 3). Approximately 90% of the footprint area was mapped as less than 1% cover by Brazilian pepper and contained scattered and usually small Brazilian pepper plants. Because of this, actual coverage of Brazilian pepper was estimated at only 20 acres (Table 4). Despite the low cover, there were higher densities scattered throughout and it was important to prevent the many small individuals from getting established. Based on the results of this re-treatment, however, it appears that it will be unnecessary to treat the footprints in fiscal year 2010 but will likely be necessary to retreat the entire area again in fiscal year 2011.

Initial treatments of the Brazilian pepper around the demolition sites and the re-treatment of the core demolition sites, in the northern portion of the Broken Wing Ranch area, started 2/2/2009. These areas were labeled as 'Demolition Site Buffer' areas in the database as they include the areas around the old home sites which were often heavily infested due to the activities associated with the home sites as well as less disturbed areas which were treated in order to utilize existing roads as boundaries for treatments and crew management. A total of **996 acres** of Brazilian pepper has been treated (initial treatment) at demolition sites this fiscal year since February 2, 2009 (Table 5).

A map of coverage of Brazilian pepper in the demolition site buffer areas is provided based on survey work conducted by IRC this dry season and existing data collected in 2005 by Pete Stelzer and others with DOF (Figure 3). However, more post-treatment ground-truthing will be conducted this dry season and the coverage map and acreage numbers will be further edited.

Actual coverage of Brazilian pepper treated was calculated for all the initial treatment areas completed since February 3, 2009 totaling 145 acres total (Table 6). Highest density areas were definitely found around the disturbed areas (associated with old home sites) in the interior of the un-blocked sections though dense areas of pepper were found around nearly all of the transitional cypress and cabbage palm (with dead cypress) depressions (Cp/Hp). The deeper centers of the former cypress dominated wetlands lacked significant coverage by pepper, presumably due to the longer hydroperiods.

Because so much pepper is found in the lower elevation areas formerly dominated by cypress, except the lowest center areas, work was to be discontinued soon as water levels rose into the wetland areas. Despite the early onset of the rainy season, water levels did not rise above the deepest centers of cypress domes (which lacked Brazilian pepper) due to the extreme low levels caused by the drought this year and spotty rainfall this June and July. Brazilian pepper treatments had already been discontinued to save the budget for fall flowering grass treatments before water levels rose above that level in late August.

Table 1: Completion (December 18, 2008) of Initial Treatments of Brazilian Pepper (*Schinus terebinthifolius*) in Road Footprints and 50' Buffer Areas at PSRP (Fiscal Year 2009)										
Treatment	**Location**	**0**	**0-<1%**	**1-5%**	**5-25%**	**25-50%**	**50-75%**	**75-95%**	**>95%**	**Total Acres**
Initial Treatment	50' outside footprint		0.01	3.28	6.46	0.68	1.76	8.77		21.0
	Inside Footprint		7.91	1.29	4.64	11.00	2.54	9.93		37.3
	Outside Contract Area	3.16								3.2
	Total:	3.2	7.9	4.6	11.1	11.7	4.3	18.7	0.0	61.4

Table 2: Completion (December 18, 2008) of Initial Treatments of Brazilian Pepper (*Schinus terebinthifolius*) in Road Footprints and 50' Buffer Areas actual acreage covered* at PSRP (Fiscal Year 2009)										
Treatment	**Location**	**0**	**0-<1%**	**1-5%**	**5-25%**	**25-50%**	**50-75%**	**75-95%**	**>95%**	**Total Acres**
	Combined		10.7	7.3	5.6	3.8	1.5	1.0	0.0	30.0
Initial Treatment	50' outside footprint		0.00	0.10	0.97	0.25	1.10	7.45		9.9
	Inside Footprint		0.04	0.04	0.70	4.12	1.59	8.44		14.9
	Outside Contract Area	0								0.0
	Total:		0.0	0.1	1.7	4.4	2.7	15.9	0.0	24.8

Table 3: Re-treatment (December 22 - February 2, 2009) of Brazilian Pepper (Schinus terebinthifolius) at PSRP										
Treatment	**Location**	**0**	**0-<1%**	**1-5%**	**5-25%**	**25-50%**	**50-75%**	**75-95%**	**>95%**	**Total Acres**
Re-treatment	50' outside footprint	1.7	603.3	215.0	4.4	0.5	0.1	0.0		825.0
	Inside Footprint	7.7	1713.2	8.6						1729.5
	Demolition Site		1.3	11.7						13.0
	Total:	9.4	2317.8	235.3	4.4	0.5	0.1	0.0	0.0	2567.6

Table 4: Re-treatment (December 22 - February 2, 2009) of Brazilian Pepper (Schinus terebinthifolius) at PSRP Actual Treatment Acres (Acres by cover)										
Treatment	**Location**	**0**	**0-<1%**	**1-5%**	**5-25%**	**25-50%**	**50-75%**	**75-95%**	**>95%**	**Total Acres**
Re-treatment	50' outside footprint	0.0	3.0	6.4	0.7	0.2	0.1	0.0		10.4
	Inside Footprint	0.0	8.6	0.3						8.8
	Demolition Site	0.0	0.0	0.4						0.4
	Total:	0.0	11.6	7.1	0.7	0.2	0.1	0.0	0.0	19.6

Table 5: Treatment of Brazilian Pepper (Schinus terebinthifolius) at PSRP Demolition Sites*											
	Includes Buffer Areas Surrounding Demolition Sites and Abandoned Roads										
Treatment	**Location**	**Dates**	**0**	**0-<1%**	**1-5%**	**5-25%**	**25-50%**	**50-75%**	**75-95%**	**>95%**	**Total Acres**
Initial Treatment	Demolition Sites	2/3/2009-6/30/2009	3.3	35.2	272.5	223.5	80.1	22.9	8.0	0.0	645.5
Initial Treatment	Demolition Sites	7/1/2009-7/23/2009	5.3	9.4	184.0	83.5	44.6	11.5	12.3	0.0	350.5
										TOTAL TREATED:	996.0

Table 6: Actual Treatment Acres (Acres by Cover) of Brazilian Pepper (Schinus terebinthifolius) at PSRP Demolition Sites (February 3 – June 30, 2009)*											
	Includes Buffer Areas Surrounding Demolition Sites and Abandoned Roads										
Treatment	**Location**		**0**	**0-<1%**	**1-5%**	**5-25%**	**25-50%**	**50-75%**	**75-95%**	**>95%**	**Total Acres**
Initial Treatment	Demolition Sites	2/3/2009-6/30/2009	0.0	0.2	8.2	33.5	30.0	14.3	6.8	0.00	93.0
Initial Treatment	Demolition Sites	7/1/2009-7/23/2009	0.0	0.05	5.5	12.5	16.7	7.2	10.4	0.00	52.4
										TOTAL TREATED:	145.5

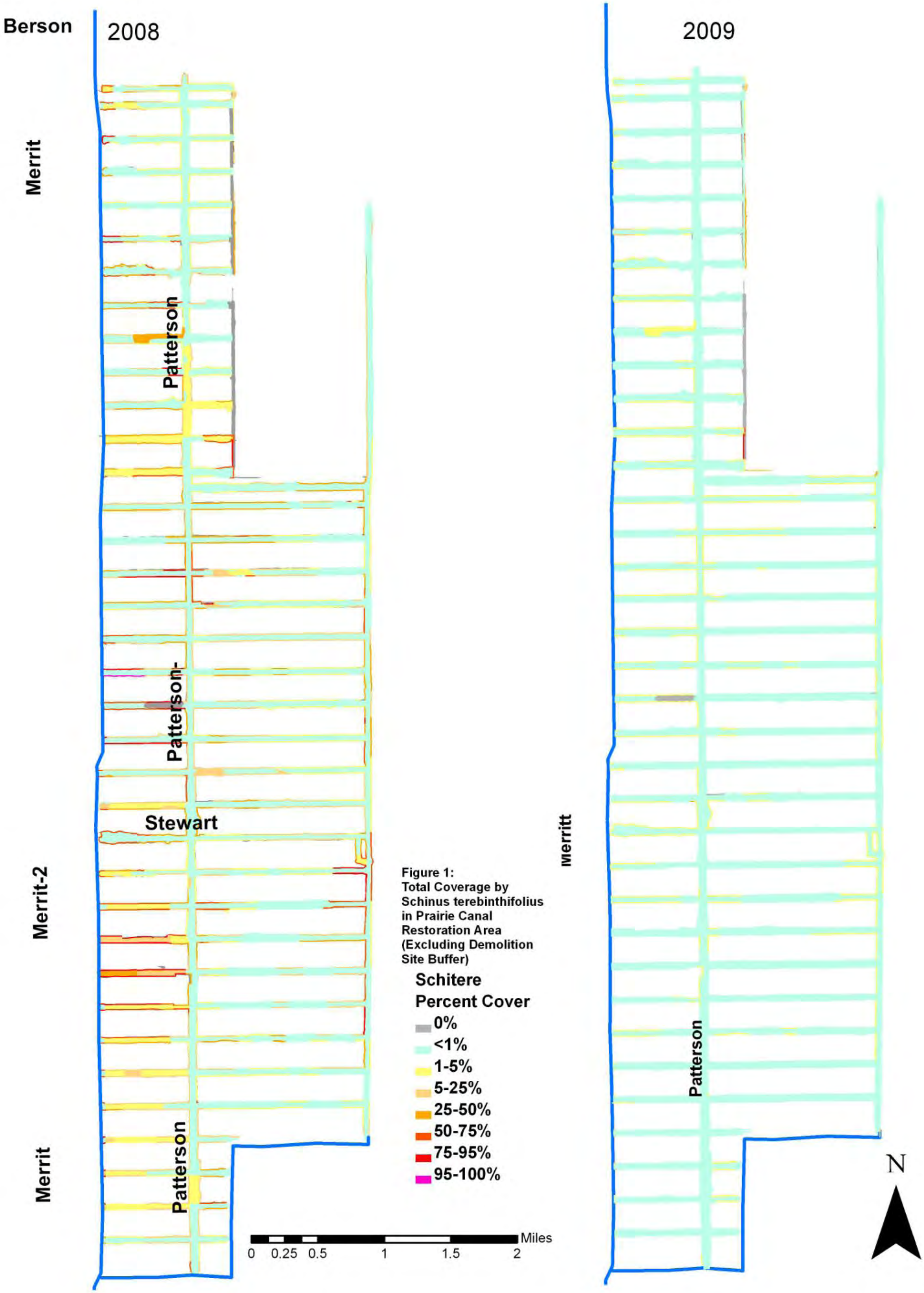


Figure 1:
Total Coverage by Schinus terebinthifolius in Prairie Canal Restoration Area (Excluding Demolition Site Buffer)

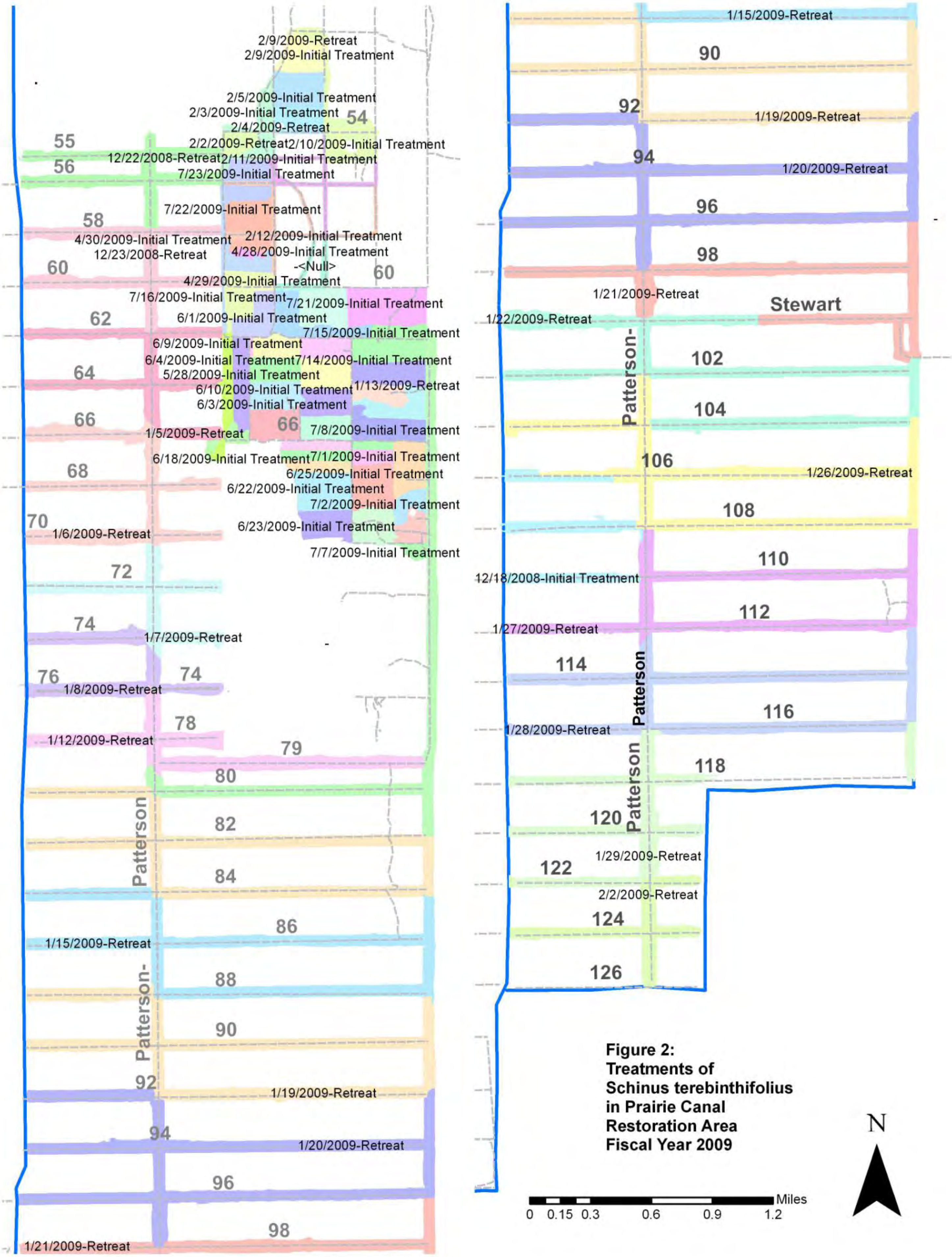


Figure 2: Treatments of Schinus terebinthifolius in Prairie Canal Restoration Area Fiscal Year 2009


Figure 3:
Percent Cover of
Schinus terebinthifolius
in Treated Areas
of Prairie Canal
Restoration Area
Demolition Sites
Fiscal Year 2009
Schitere
Percent Cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Demolition Sites
Rock Island
Broken Wing
Patterson
54
55
56
58
60
62
64
66
68
70
Miles
0
0.125
0.25
0.5
0.75
1
N

Other Exotic Species Treated with Garlon IV

While conducting the initial treatments around the old home sites in the "Demolition Site Buffer" areas, the ground contractor made special effort to re-visit a majority of the demolition sites which included a wide variety of invasive species escaped or non-invasive species persisting from cultivation which were treated last year. Any surviving individuals were re-treated.

Air potato (*Dioscorea bulbifera*) was also re-treated at known points using maps and coordinates we provided to the contractor. Air potato locations were treated with Garlon IV. The largest patch is located where Stewart meets Prairie Canal and Janes' scenic drive at the site of the demolished hunting camp had abundant new recruits this summer. The other significant patch is located at the end of 66th east of Patterson at an old home site. A few of the other reported locations could not be found for the second year so it is hoped that previous control efforts were effective.

Foliar Treatments with Glyphosate and Imazapyr

After Brazilian pepper, certain invasive exotic grass species were considered as priority including cogongrass and torpedograss as the highest priority for foliar treatments (Barry 2008). The fall flowering grasses including Burma reed (*Neyraudia reynaudiana*), elephantgrass (*Pennisetum purpureum*), jaragua (*Hyparrhenia rufa*), and vaseygrass (*Paspalum urvillei*) were considered the next priority. Other species were either sporadically treated or not treated at all in order to insure that there was enough time and money to treat the priority species completely.

Three time periods of foliar treatments were conducted this fiscal year. First in October 2008 the entire footprint was covered to treat fall flowering grasses, especially jaragua (*Hyparrhenia rufa*) which is difficult to recognize at other times of the year. Because of freeze and drought, no foliar treatments were conducted during the winter and spring but some additional treatments were conducted during the summer especially targeting cogongrass and torpedograss. Finally, fall grass treatments were again conducted at the end of this fiscal year in September.

Originally it was planned to only utilize Imazapyr in the mix when targeting cogongrass and torpedograss due to the added expense and the potential for non-target damage. However, because cogongrass is scattered throughout the area and it requires constant re-treatments, and because the footprints are dominated primarily by other exotics or weedy native species which are not much concern for non-target damage, Imazapyr was almost always included in the mix. With Imazapyr, the occasional Brazilian pepper sapling can also be included in the foliar treatment.

The majority of the activity at the beginning of this fiscal year was centered around fall flowering grasses. Treatments last fiscal year were conducted in September 2008 while this fiscal year treatments began 10/20/2008 and ended 12/16/2008 totaling **2698 acres** (Table 7). A map showing the location and cover of all species included in the treatments (including caesarweed and lantana which were only sporadically treated) is presented as Figure 4. Total combined coverage of the target grasses only is presented in Figure 5.

The primary goal was to reduce coverage of these species prior to fruit set thereby reducing the seed bank and potential increase in coverage for next year. Herbicide treatments using glyphosate of fall flowering grasses included primarily Burma reed, elephantgrass, jaragua, and vaseygrass. In addition tanglehead (*Heteropogon contortus*), which primarily formed dense patches north of 68th Ave SE was also treated. Common reed (*Phragmites australis*) was also treated and cattail (*Typha domingensis*) treatments were started in the north of 92 Ave SE. Applied aquatics completed treatment of fall flowering grasses from 10/20/2008 to 12/16/2008. Burma reed was the most extensive of the fall flowering grasses treated during that treatment event. This was the first time the contactor had treated jaragua so it took some time before they were confident with its identification. The contractor also treated Caesarweed (*Urena lobata*) and lantana (*Lantana camara*) opportunistically.

Actual combined coverage of treated primary target grasses, including Burma reed, jaraguá, elephant grass, common reed, vaseygrass, and tanglehead is presented in Table **8.** Other species which were only partially treated were included in the combined coverage calculations, thus these calculations may overestimate actual treatment.

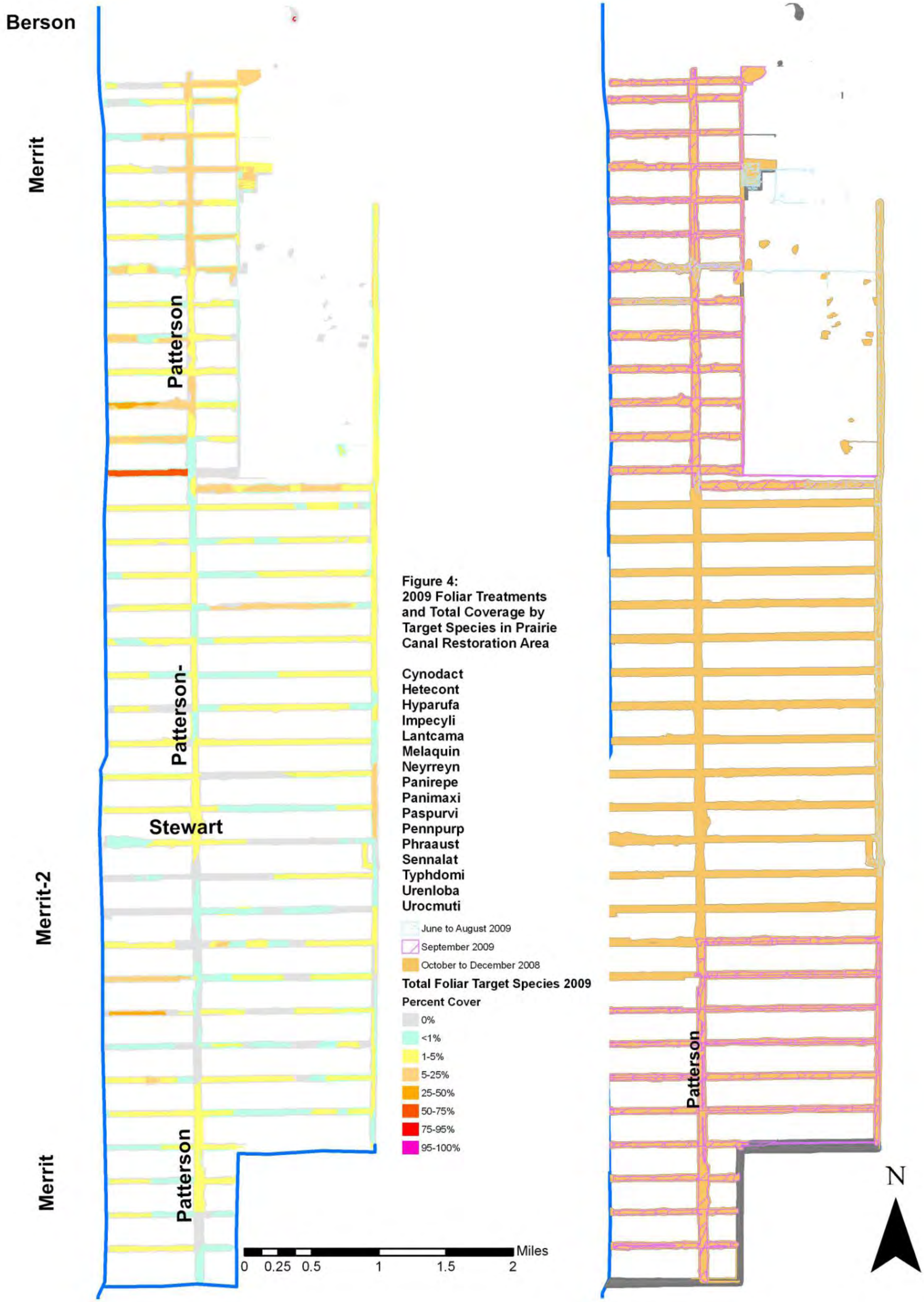
Foliar treatments of herbaceous plants were also conducted 6/12/2009 through 8/28/2009, usually only 1 or 2 days at a time during a normal week, often on Fridays. A total of **183 acres** was treated during this time (Table 7). All areas north of Stewart on the former Prairie canal were treated in June, while July 3rd areas along 66th Ave SE from Prairie canal to just west of Patterson were treated and 68th Ave SE west of Patterson were treated. Torpedograss (*Panicum repens*) was the primary target along the former Prairie canal with all known areas retreated north of Stewart thus far. Also treated were significant amounts of vaseygrass (Paspalum urvillei), lantana (Lantana camara), Cogongrass (*Imperata cylindrica*), and cattail (*Typha domingensis*). Also, because torpedograss has been found mixed in patches of similar looking Bermudagrass (*Cynodon dactylon*), some areas were treated along 79th Ave SE. Foliar treatments on 7/27 and 7/28/2009 focused on re-treatment of the field formerly dominated by elephantgrass (*Pennisetum purpureum*) initial and re-treatments of known cogongrass patches in the Sabal palm test treatment area to the east of Patterson in the unblocked sections between 60th and 62nd Ave SE.

Most recently fall flowering grasses were again targeted from 9/14/2009 to 9/24/2009, with emphasis on jaraguá, especially in the northern portion of the contract area totaling **905 acres** (Table 7). It quickly became apparent that because we had not treated much of this grass before it had flowered in the fall of 2008, there were many new recruits in September 2009 and very little reduction in coverage overall. However, this event the contractor was already familiar with the grass and was able to readily identify jaraguá long before it flowered.

Table 7: Acreage Covered for Foliar Treatments (Fiscal Year 2009)											
Treatment	**Location**	**Dates**	**0**	**0-<1%**	**1-5%**	**5-25%**	**25-50%**	**50-75%**	**75-95%**	**>95%**	**Total Acres**
Fall 2008	Entire Footprint	10/20/2008 to 12/16/2008	972.2	474.9	980.0	270.5	13.7	17.3			2697.7
Spring 2009	Canal Footprint N of Stewart and Misc. Areas N of 79th, Al's deer farm	6/12/2009 to 8/28/2009	5.3	24.5	118.3	35.0					183.1
Fall 2009	79th to N and 106th to S	9/14/2009 to 9/24/2009	118.0	169.9	404.4	212.9	13.6	17.3	0.3		905.2
		Total:	1095.6	669.3	1502.6	518.5	27.4	34.6	0.3	0.0	3785.9

Table 8: Actual Acreage Treated* for Foliar Treatments (Fiscal Year 2009)										
Treatment	**Location**	**Dates**	**0-<1%**	**1-5%**	**5-25%**	**25-50%**	**50-75%**	**75-95%**	**>95%**	**Total Acres**
Fall 2008	Entire Footprint	10/20/2008 to 12/16/2008	2.4	29.4	40.6	5.1	10.8			31.774
Spring 2009	Canal Footprint N of Stewart and Misc. Areas N of 79th, Al's deer farm	6/12/2009 to 8/28/2009	0.1	3.5	5.3					3.6705
Fall 2009	79th to N and 106th to S	9/14/2009 to 9/24/2009	0.8	12.1	31.9	5.1	10.8	0.3		44.92
		Total:	2.4	29.4	40.6	5.1	10.8		0.0	80.4

*Acreage based on combined coverage of Cynodact, Hetecont, Hyparufa, Impecyli, Lantcama, Melaquin, Neyrreyn, Panirepe, Panimaxi, Paspurvi, Pennpurp, Phraaust, Sennalat, Typhdomi, Urenloba, Urocmuti but some of the lower priority species were not always treated.


Berson
Merrit
Patterson
Patterson-
Stewart
Merrit-2
Merrit
Patterson
Patterson
Figure 4:
2009 Foliar Treatments
and Total Coverage by
Target Species in Prairie
Canal Restoration Area
Cynodact
Hetecont
Hyparufa
Impecyli
Lantcama
Melaquin
Neyrreyn
Panirepe
Panimaxi
Paspurvi
Pennpurp
Phraaust
Sennalat
Typhdomi
Urenloba
Urocmuti
June to August 2009
September 2009
October to December 2008
Total Foliar Target Species 2009
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Miles
0 0.25 0.5 1 1.5 2
N

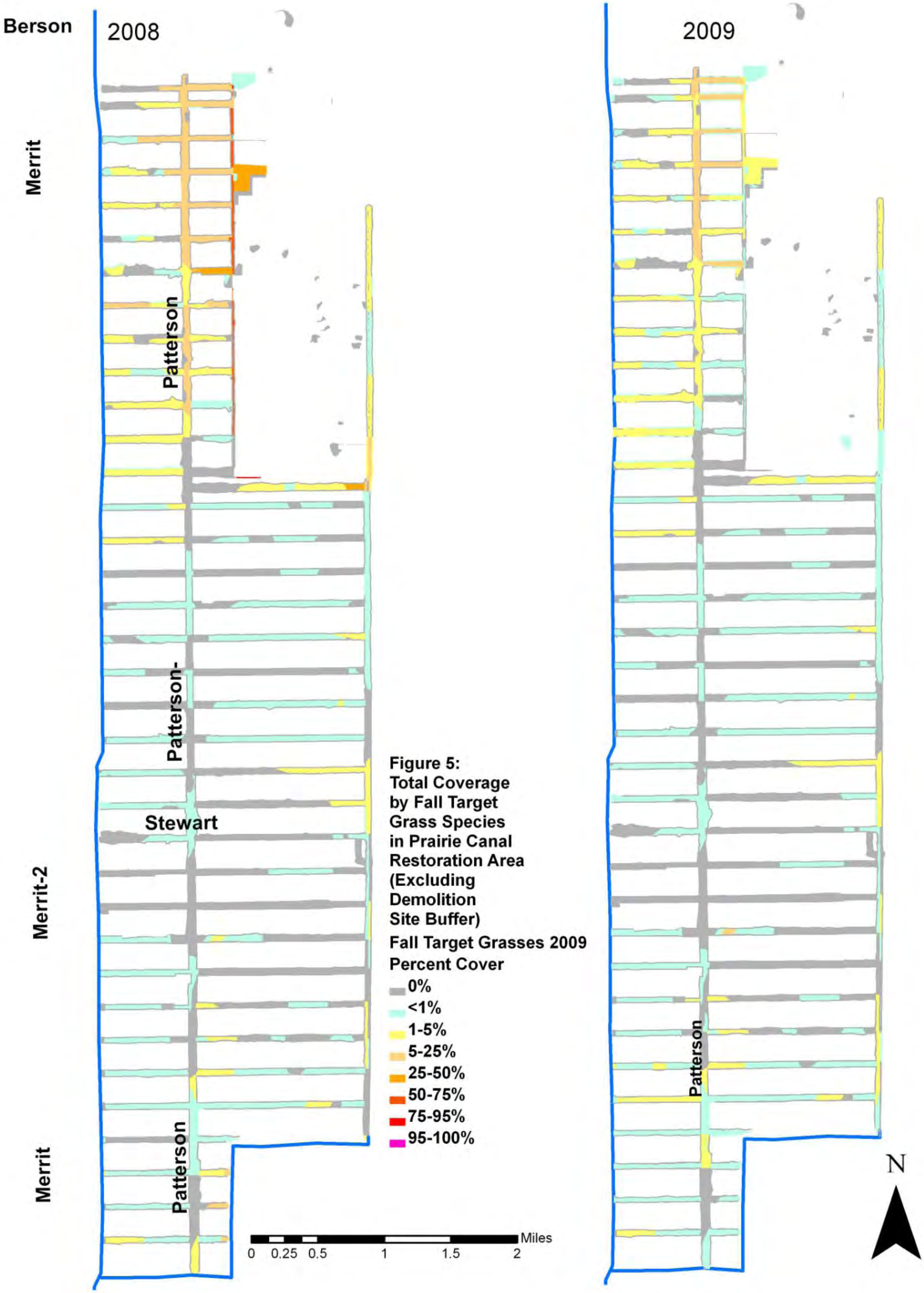


Figure 5: Total Coverage by Fall Target Grass Species in Prairie Canal Restoration Area (Excluding Demolition Site Buffer)

Cabbage palm

A test plot of cabbage palm (*Sabal palmetto*) control was conducted August 3 through 6, 2009 in the unblocked section between 60th and 62nd Ave SE to the east of the elephantgrass field and toward the northern tip of the former Prairie canal (Figure 4). The palms were treated with Garlon IV sprayed onto the apical meristem of all plants reachable with a typical back-pack sprayer by the crews as they retreated the Brazilian pepper which was originally treated July 17, 20, and 21, 2009. Two backpack sprayers were fitted with longer wands to reach a little higher to see if it would be worth the extra expense in the future. Also a 18% mix of Garlon IV was used instead of the 10% mix used with Brazilian pepper so that less mix is needed on each plant and refill time by crew members would be less. This mix was chosen because in 2004 and 2005 test applications in Picayune by then DOF biologist (2004) and FPNWR technician (2005) Mike Barry found that the 10% mix did not always kill the larger palms. Brad Smith of Sanibel-Captiva Conservation Foundation also found this to be true after test treatments on Sanibel (personal communication).

The site was chosen primarily because the area was generally in good shape in terms of exotic infestations and had abundant old growth slash pines in the overstory and therefore has potential for future re-establishment of the red-cockaded woodpecker. The palm coverage overall was primarily 5-25% with patchy areas of higher density, and the western quarter as well was 25-50%. Brazilian pepper had been treated a few weeks prior and the known patches of cogongrass were treated (actually all but 1 were re-treatments from last year and/or year before). Brazilian pepper was retreated (any that were still green) at the time of the palm treatments and 1 new cogongrass patch was located and GPS coordinates recorded for treatment later this fall. It is especially important to control these exotic species prior to killing palms due to the potential increase in light.

A total of **86.9 acres** were treated in 3.5 days (Table 9). High temperatures hindered efficiency of the crew, much as the Brazilian pepper treatments the past 2 months, and evening rain showers may have washed some chemical out of the palm meristems. So future cost estimates made from this test plot could be over-estimates. Rough estimate of the cost was about $25,000 making the ball-park cost per acre less than $290, although WEEDAR data has not been entered so the number is not exact. However, it is roughly the same as initial Brazilian pepper treatments. Initial assesments made in September, 2008, showed good mortality on the smaller palms while the tallest ones treated (8-12′ apical meristem) showed mixed results. It may still be too early to tell for the taller palms. The area will be assessed for effectiveness during the next fiscal year.

Table 9: Summary of Test Treatment of Cabbage Palm (Sabal palmetto) at PSRP Demolition Sites

Treatment	Location	Dates	0	0-<1%	1-5%	5-25%	25-50%	50-75%	75-95%	>95%	Total Acres
18% Garlon on buds	Between 60th and 62nd Ave SE East of the former Elephantgrass Field (Al's Deer Farm) and West of the former Prairie Canal	03-Aug-09	0.2	0.1	3.4	2.7	12.9	0.2		0.0	19.5
		04-Aug-09			0.1	7.7	13.1	0.9			21.7
		05-Aug-09			4.0	12.9	5.3	1.1			23.2
		06-Aug-09 (not full day)			4.7	11.9	5.8		2.0	0.0	22.4
										TOTAL TREATED:	86.9

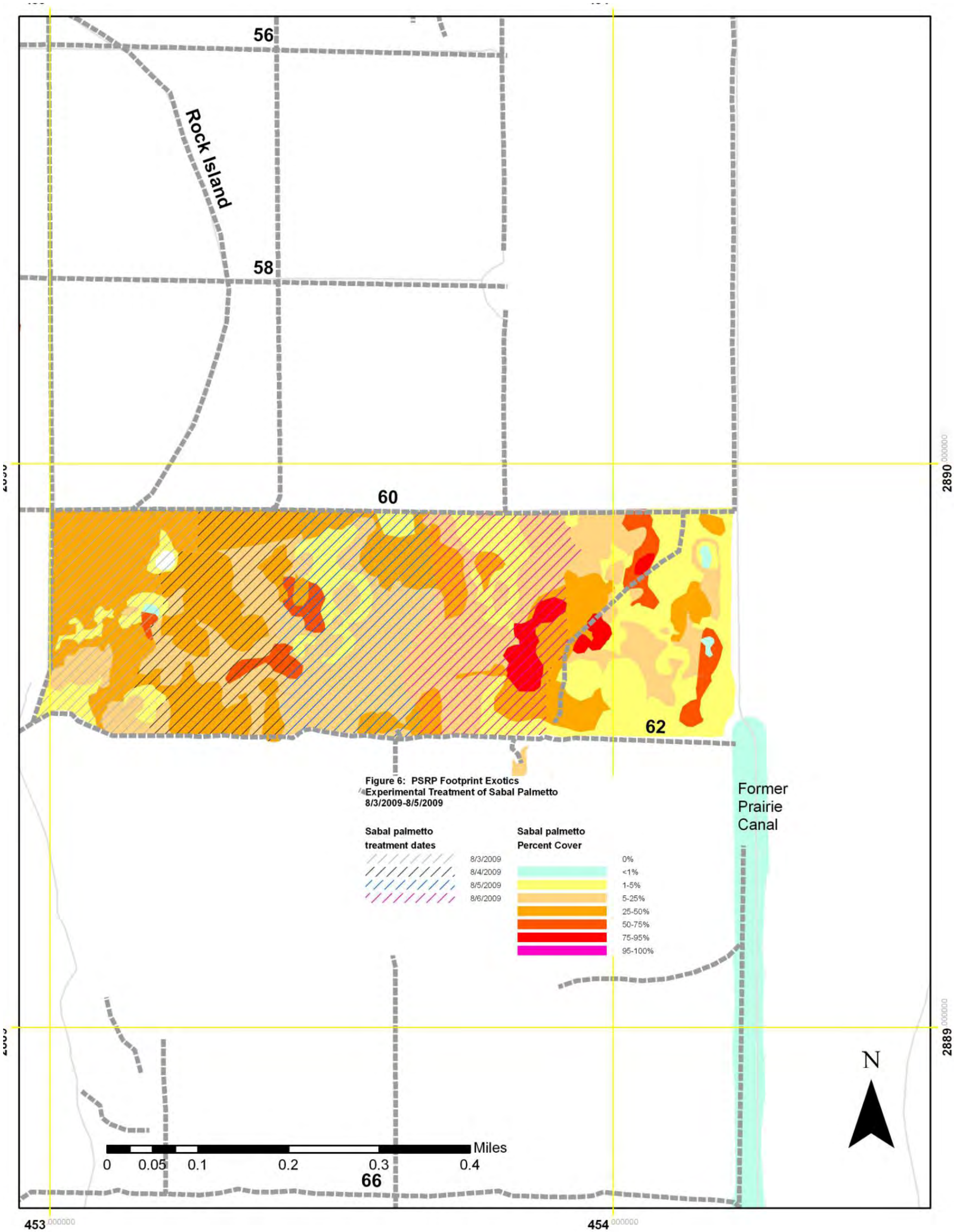


Figure 6: PSRP Footprint Exotics
Experimental Treatment of Sabal Palmetto
8/3/2009-8/5/2009

Overall Exotic and Nuisance Species Coverage

Initial mapping efforts began in February of 2008 with ground-truthing continuing until the summer rains brought water levels up and limited access to much of the area to swamp buggy only. Once water levels receded in the fall of 2008, IRC began re-assessing exotic species coverage. However, once again mother nature made it difficult with a series of freezes in February and March of 2009 and severe drought conditions which followed making evaluation of coverage difficult. Originally IRC had hoped to update coverage layers twice a year, making coverage estimates for rainy and dry season. However, due to these logistics, assessing and updating the GIS layers once a year is more realistic, with much of the field work to be done during the dry season when the entire site is easily accessible. Moreover, it takes considerable time to re-visit the entire area so coverage must be updated little by little. At this time we will be presenting data for each year which will be based largely on dry season assessments but are presented as "pre-treatment" for that year. Thus 2009 coverage is considered post 2008 control efforts and pre 2009 control, with some exceptions. Once a new year has begun, the cover values for the previous year are archived in new fields in the geodatabase for comparison.

In the field, cover by each invasive exotic and nuisance species was recorded by cover class and these data were entered for each polygon in the contract area. To look at overall invasive species cover, the sum of the mid points of the cover class for each invasive species found in a polygon were calculated using Microsoft Access in a linked table which later could be incorporated into ArcGIS. Using the sum of cover of invasive species cover could inherently over estimate total cover if species are growing under other species while in other cases if cover barely makes it in to the next higher cover class it could be an underestimate. In general, the more invasive species found in a polygon the more chances that it is an over estimate, especially if both woody and herbaceous species are present which can occupy different strata of the same patch of ground.

A total of 50 invasive exotic species and 2 native nuisance species were mapped using points, lines and polygons (Barry 2008). However, only 26 species with multiple locations of signficant infestations were incorporated into the polygon map in order to track acreage (Table 10). These species were grouped by priority for the Picayune Strand Restoration Area last year and to date only priority 1 species have been treated whenever they were encountered. Other species have been treated opportunistically but next year we will begin treating priority 2 species more systimatically as we start to 'peel back the layers of the onion'. Also one change from last year is that both jaragua and crowfoot grass have been added to the FLEPPC list as a category II species on the 2009 list (http://www.fleppc.org/list/List-WW-F09-final.pdf).

Table 10: Invasive Exotic and Nuisance Species Tracked in polygons by Priority						
EPPC	Priority	Scientific Name	Common Names	# of Pts	Treatment Type	Alt. Treatment Type
II	1	*Hyparrhenia rufa*	Jaragua	45	4	2
I	1	*Imperata cylindrica*	Congongrass, Cogongrass	68	2	4
I	1	*Melaleuca quinquenervia*	Punktree	7	6	
I	1	*Neyraudia reynaudiana*	Burmareed, Silkreed	161	4	
II	1	*Panicum maximum*	Guineagrass	2	4	
I	1	*Panicum repens*	Torpedo grass	47	2	
I	1	*Pennisetum purpureum*	Napier grass, Elephantgrass	21	4	
I	1	*Schinus terebinthifolius*	Brazilian-pepper	4	1	2
I	1	*Urochloa mutica*	Paragrass	2	4	
I	2	*Lantana camara*	Shrubverbena	26	1	4
	2	*Ludwigia peruviana*	Peruvian primrosewillow	2	5	
I	2	*Nephrolepis cordifolia*	Tuberous sword fern	1	4	
I	2	*Nephrolepis multiflora*	Asian sword fern	18	4	
	2	*Paspalum urvillei*	Vasey grass	16	4	
I	2	*Melinis repens*	Rose Natalgrass	55	2	
	3	*Phragmites australis*	Common reed	24	3	
	3	*Typha domingensis*	Southern cat-tail	59	3	
	4	*Cynodon dactylon*	Bermuda grass	10	2	4
	4	*Eragrostis atrovirens*	Thalia love grass	9	4	
	4	*Heteropogon contortus*	Tanglehead	9	4	
	4	*Senna alata*	Candlestick plant	2	1	4
II	4	*Urena lobata*	Caesarweed	15*	7	
	5	*Bothriochloa pertusa*	Pitted bluestem, Pitted beardgrass	1*		0
II	5	*Dactyloctenium aegyptium*	Crow's-foot grass, Durban crowfootgrass	3*	4	
	5	*Dioscorea alata*	White yam	1		
	5	*Sporobolus indicus var. pyramidalis*	West Indian dropseed	9*	4	

Total acreage by cover class of total combined species, FLEPPC I, II, and non listed, and highest priority species tracked inside the footprints (excluding the 50′ buffers, demolition sites, and demolition site buffers) are presented below in Table 11. Combined cover values for these groupings of FLEPPC I and II, other non-listed species, and foliar targeted species are also mapped below figures 7-10.

Though total infested acres of all tracked species combined changed little, it is important to note that combined infested acres in polygons with 50% or greater cover were reduced substantially. This is true also for FLEPPC category I species, but not for category II species or non-FLEPPC listed species illustrating our strategy for prioritizing the worst invasive species and working our way down the list. Brazilian pepper treatments account for a lot of the reduction in category I species. The densest areas of total combined coverage by targeted fall grasses including Burma reed, elephantgrass, jaragua, tanglehead, Guineagrass, and vasey grass, also was reduced substantially. However, the total infested acreage of fall grasses did increase slightly as some species were noticed in new locations but primarily as individuals falling into the category of less than 1%, most of which were vasey grass which seems to now be scattered throughout the area at low density, even in wet areas. Elephantgrass was the biggest success story due in part to the aerial treatment of the largest patch at a demolition site but primarily to the continued and relentless re-treatment at that demolition site by the contractor basically eliminating the seed source to the surrounding areas where only sporadic occurrences were found. Burma reed was also reduced significantly by repeated treatments and in a few lower areas by flooding observed last year as well (Barry 2008).

Cogongrass and torpedograss have received a lot of attention by the contractor but have not been reduced in total infested acreage inside the footprints. This is not surprising due to the difficulty in control of these species. The densest areas of cogongrass were reduced in cover and very few areas actually increased. One exception outside the footprint in the field in the former Broken Wing Ranch area where coverage did increase since last year, probably the result of some small individuals that were missed and the early onset to the rainy season this year. Coverage by torpedograss in the footprint changed little. This year was not a good year for control due to the freezes, but we are lucky it has not actually increased at this time. The ditch outflow near 79th Ave SE and the former prairie canal (not reflected in Table 11 because it is outside the footprint) which was a monoculture of torpedograss is now devoid of torpedograss completely with native wetland species present. This was a significant gain (and was targeted heavily by the contractor) because of the seeds flowing out of the partially filled (upstream) ditch onto the former Prairie canal footprint during the wet season. The same is true for several large patches of cogongrass outside but adjacent to the footprint. However, both species pop up as new patches all around treated areas and will continue to give the contractor a challenge in years to come.

Finally one lower priority grass was included in the table to illustrate the challenge that lies ahead to return these footprints to native vegetation. Natalgrass cover increased in cover, especially in areas where Burmareed and other fall grasses were reduced. The acreage of the cover classes greater than 5% did increase suggesting we need to begin treating this species and some others we have not previously targeted. Overall infested acres did not increase substantially, however, presumably because the non-infested areas are too wet for this species. Again, it is the drier areas at this time that will be the biggest challenge.

Table 11: Acreage by Percent Cover Category of Nuisance and Exotic Species inside the Cleared Footprints

Taxa	FLEPPC	Year	0	Total Infested Acres:	<1%	1-5%	5-25%	25-50%	50-75%	75-95%	95-100%
Total Combined:		2008	2.0	1785.2	7.7	568.6	922.9	205.5	74.5	5.3	0.7
		2009	2.1	1785.1	13.1	667.3	870.7	178.9	51.5	3.5	
FLEPPC I		2008	2.0	1785.2	462.9	1082.9	169.4	50.2	17.2	1.8	0.7
		2009	2.1	1785.1	538.0	1079.7	138.2	28.8	0.3		
FLEPPC II		2008	136.6	1650.6	717.5	705.8	203.3	6.7	17.3	0.0	0.0
		2009	135.6	1651.5	693.8	749.0	184.8	6.7	17.3		
Non FLEPPC		2008	33.0	1754.2	6.3	1277.8	433.5	36.6			
		2009	33.0	1754.2	41.9	1306.7	344.2	61.4			
Fall Grasses		2008	663.5	1123.7	628.7	307.6	157.2	11.5	17.5	1.3	
		2009	642.3	1144.8	688.8	373.2	82.8				
Schinus terebinthifolius	I	2008	28.3	1758.8	1498.1	202.7	41.1	16.0	0.9		
		2009	14.7	1772.5	1761.9	9.2	1.1		0.3		
Imperata cylindrica	I	2008	1504.5	282.7	227.3	51.6	3.6		0.1		
		2009	1504.1	283.1	272.6	10.4	0.1				
Panicum repens	I	2008	1628.9	158.3	141.5	16.7	0.0				
		2009	1628.9	158.3	141.5	16.7	0.0				
Neyraudia reynaudiana	I	2008	947.9	839.3	681.5	105.6	29.4	3.9	17.5	1.3	
		2009	949.4	837.7	789.3	48.4					
Pennisetum purpureum	I	2008	1667.9	119.3	110.3	9.0					
		2009	1725.3	61.8	59.5	0.0	2.4				
Hyparrhenia rufa	II	2008	1576.8	210.4	107.6	102.8					
		2009	1526.0	261.1	192.7	65.8	2.6				
Melinis repens	I	2008	1061.5	725.6	530.5	119.4	52.9	22.9			
		2009	1043.7	743.4	482.4	133.1	99.1	28.8			

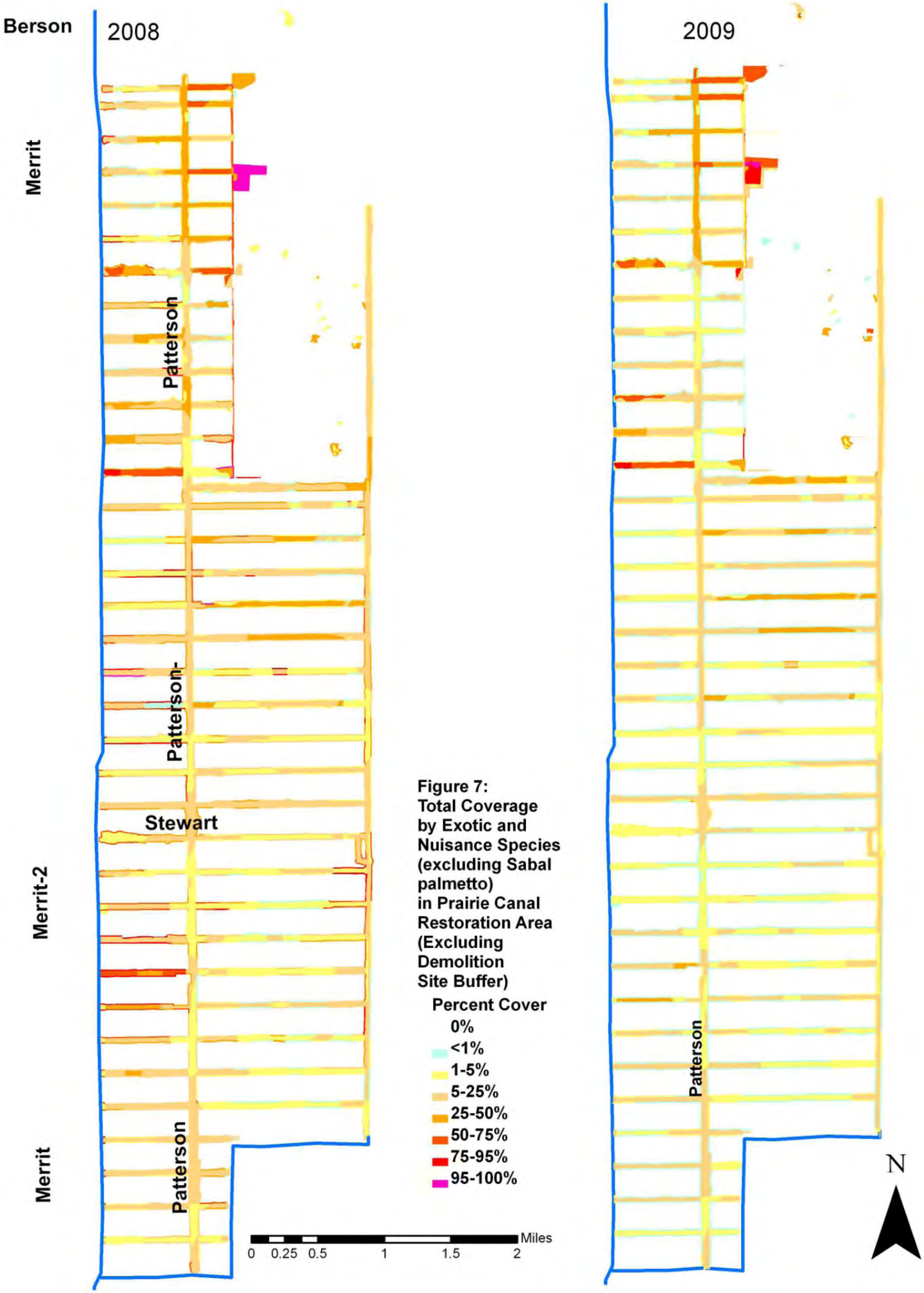


Figure 7: Total Coverage by Exotic and Nuisance Species (excluding Sabal palmetto) in Prairie Canal Restoration Area (Excluding Demolition Site Buffer)

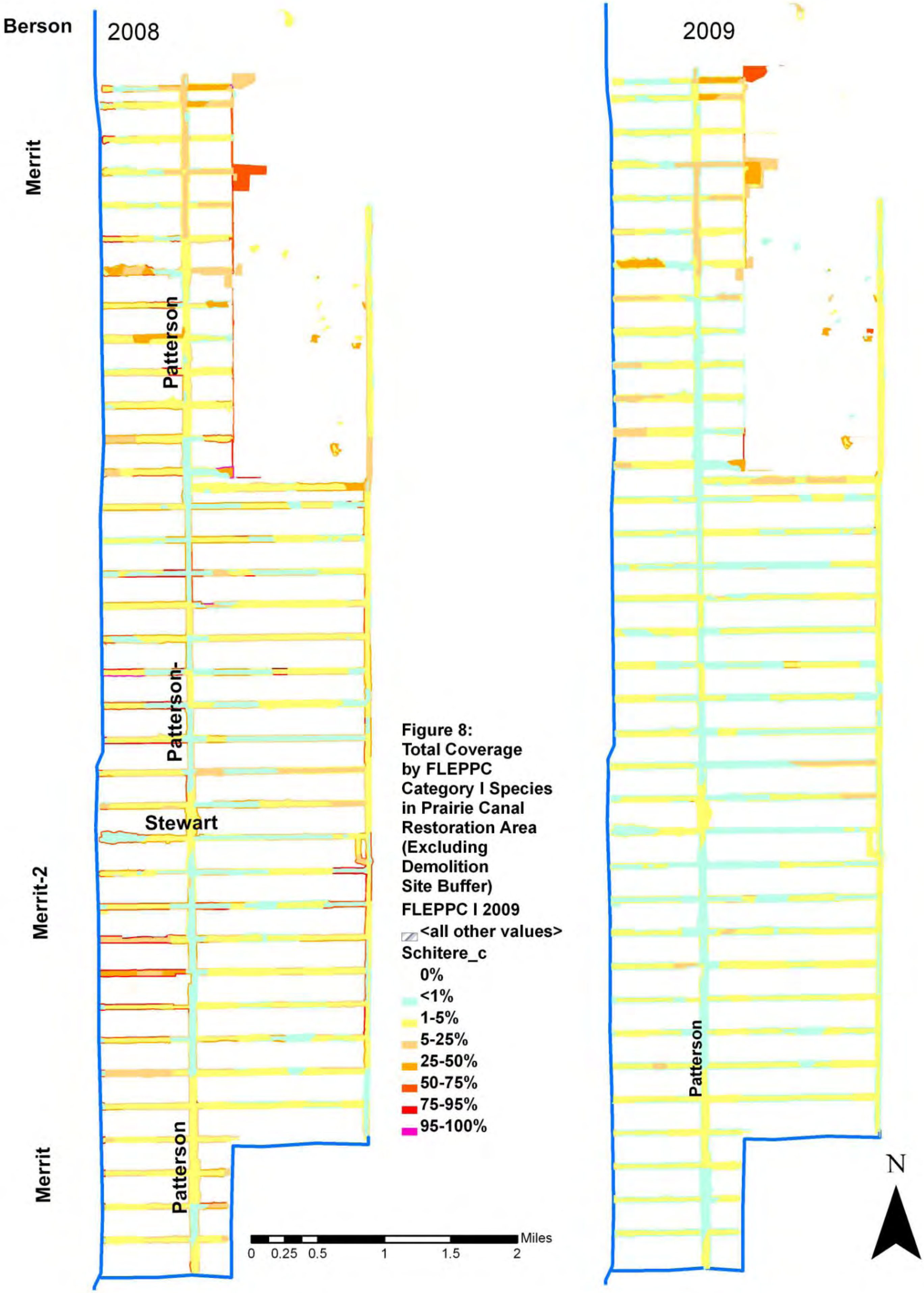


Figure 8: Total Coverage by FLEPPC Category I Species in Prairie Canal Restoration Area (Excluding Demolition Site Buffer)

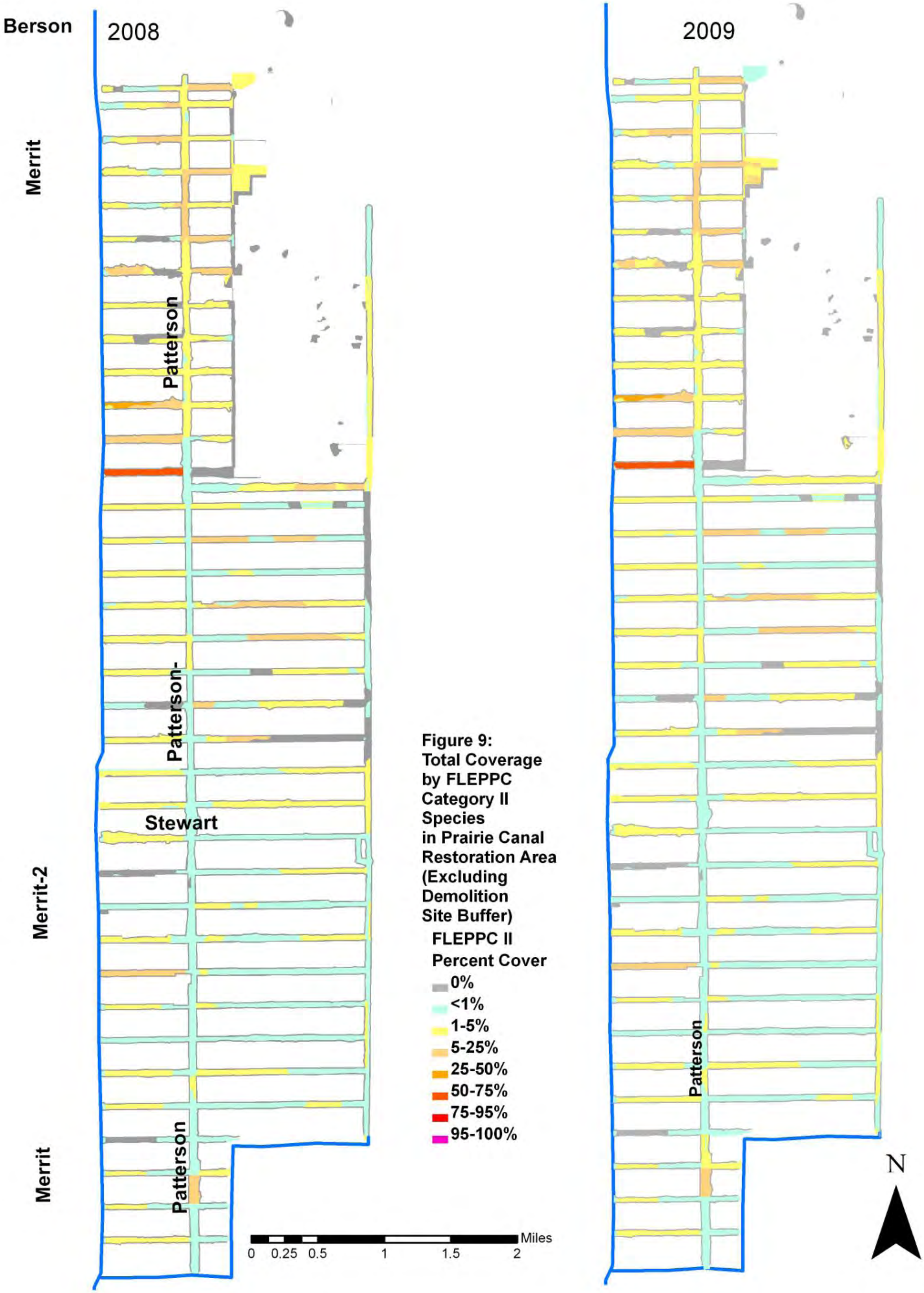


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Figure 9:
Total Coverage
by FLEPPC
Category II
Species
in Prairie Canal
Restoration Area
(Excluding
Demolition
Site Buffer)
FLEPPC II
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Miles
0 0.25 0.5 1 1.5 2
N

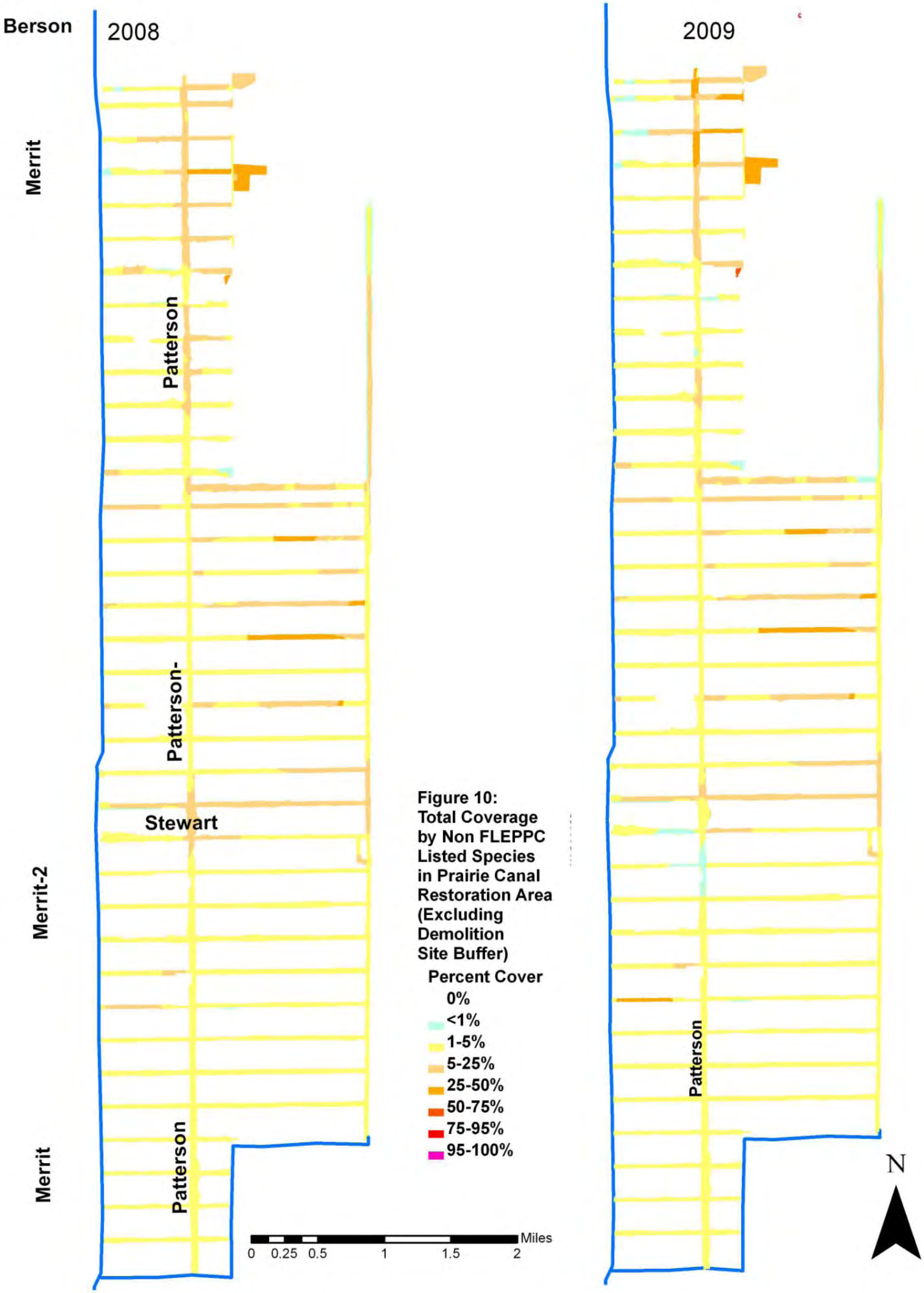

Figure 10: Total Coverage by Non FLEPPC Listed Species in Prairie Canal Restoration Area (Excluding Demolition Site Buffer)

Recommendations

Based on the results of treatment efforts discussed above, the following suggestions for treatments next fiscal year are presented below:

1. Foliar treatments of the entire footprint targeting fall flowering grasses and natal grass should be conducted again this fall before a freeze event.
2. Re-treatment of footprint areas for Brazilian pepper can be skipped this fiscal year and be resumed the following year, unless especially dense areas are found.
3. Continue initial treatment of Brazilian pepper in the areas associated with the demolition sites between 79th Ave SE and the former Prairie canal up through the former Broken Wing Ranch area.
4. Foliar treatments in the spring should again be conducted focusing on cogongrass, torpedograss and any of the remaining fall flowering grasses. Natalgrass should also be targeted at that time.
5. Foliar treatments focusing on jaragua and other priority grasses should again be conducted in September 2010.

References

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Attachment F: Picayune Strand Restoration Project – Restored Footprint Exotics Mapping and Control Coordination, Final Report – September 2010

Note: This document, dated September 2010, was provided to the South Florida Water Management District by The Institute for Regional Conservation, under Purchase Order No. 4500046172.

Picayune Strand Restoration Project – Restored Footprint Exotics Mapping and Control Coordination Final Report – September 2010

September 23, 2010

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Introduction

The Institute for Regional Conservation (IRC) was contracted (purchase order #4500046172) by South Florida Water Management District (SFWMD) to map exotic and nuisance vegetation within the footprint of the filled Prairie Canal and the cleared road and house demolition footprints east of Merritt Canal and to coordinate exotic control efforts conducted by SFWMD contractors. Contract start date was January 27, 2010. The primary goals were to identify and prioritize areas of significant exotic and nuisance plant infestations, facilitate control efforts by providing maps of these areas, provide technical assistance including plant identification, and conduct follow-up surveys to map areas treated, identify areas missed, and generally evaluate success of control methods. This report marks the completion of this contract.

Scope of Work

The Contractor shall be the onsite coordinator for nuisance and exotic control efforts conducted by exotic control contractors employed by SFWMD Initially, exotic and nuisance vegetation shall be mapped according to methods outlined by the Florida Natural Areas Inventory (FNAI) Florida Invasive Plants Geodatabase project (http://fnai.org/invasivespecies.cfm). These surveys shall include the construction footprints and adjacent areas out to 50 ft from the cleared areas along Prairie Canal and the road and demolition sites east of Merritt Canal. Subsequently, the onsite coordinator shall identify and prioritize areas of significant exotic and nuisance plant infestation, facilitate control efforts by providing maps of the areas and being available for technical assistance, especially with plant identification. They shall conduct follow-up surveys to map areas treated, identify areas missed, and generally evaluate success of control methods. They shall provide monthly reports summarizing status of exotic control efforts to SFWMD.

While it is important to eliminate nuisance species, it is equally important that non-nuisance native species are minimally affected by the treatments. One of the most effective mechanisms for combating nuisance species over the long term is competition from desirable species, including early successional native species that may be abundant during the first few years following restoration. Personnel conducting the surveys and treatments shall be able to distinguish nuisance/exotic species from non-nuisance native species and shall exert sufficient care to not adversely affect non-nuisance native species.

Methods

The geodatabase established between February and October 2008 was utilized and updated for post treatment and rainy season exotic species cover values to coordinate new control efforts based on spot field assessments of the contract area. The geodatabase (ArcView 9.2 geodatabase format) incorporates points, lines and polygons of exotic and nuisance vegetation recorded during initial survey efforts with updated values for this fiscal year on density and/or percent cover. Mapping utilized an existing geodatabase and methodology based on FNAI Florida Invasive Plants Geodatabase project (http://fnai.org/invasivespecies.cfm), with modifications. Modifications included expansion of scope of species mapped as well as to incorporate survey track log with percent cover of dominant exotic species along the track route to strengthen the data set for production of polygon maps. All Florida Exotic Pest Plant Council (FLEPPC) category I and II species were recorded in the field, as with FNAI methods, however, additional exotic species proven to exhibit invasive behavior in Collier County but not yet listed by FLEPPC such as West Indian Pennisetum (*Pennisetum polystachion*) and signal grass (*Urochloa arrecta*) were included. Moreover, two native species with potential for nuisance behavior were also mapped: cattail (*Typha domingensis*) and common reed (*Phragmites australis).* Fixed point photographs were occasionally taken with GPS points recorded and photos taken at the point starting towards the north and continuing clockwise in order to document significant infestations.

IRC was available for onsite orientation of the exotic control contractor upon initiating control efforts. IRC was also available as needed for interpretation of maps, plant identification, discussion of priorities, or adjustment of control methodologies during treatments. A more basic survey of the entire footprint was conducted as the contractor completes each section, with field work timed with other needs of the contractor whenever possible, reporting any missed areas to the contractor, preferably prior to de-mobilization.

Spot assessments were conducted from 1-3 months following treatments to generally evaluate control methods on target species. Field work by IRC included taking GPS track logs into the 50 foot buffer areas around the cleared areas to verify the distance into the buffer area that was treated, and to get an idea of how much was missed or re-sprouting. Emphasis was on identifying problems and successes in order to better strategize for future control efforts. Efforts were made to return to as many fixed-point photograph locations as possible to take post-treatment photographs.

Monthly letter including status maps of exotic and nuisance vegetation treated were provided to SFWMD. Problems encountered during treatments were discussed as well as justifications for priorities or actions taken in the field. A list of all exotic and nuisance vascular plant species observed within the footprints was recorded with taxonomy following Wunderlin & Hansen (2003) and provided to the SFWMD.

Results and Recommendations

This report summarizes work completed by IRC (purchase order #4500046172) and Applied Aquatic Management, Inc. (exotic control contractor to SFWMD) for fiscal year 2009-2010. IRC coordinated with the contractor onsite and conducted field surveys of exotic treatment areas throughout the fiscal year in order to increase efficiency of control efforts and attempt to minimize recovery time for the restored footprints of the removed roads, ditches, and Prairie canal. Field work was largely conducted while the contractor was on site to increase efficiency and to be available to assist with map interpretation and plant identification.

Exotic control treatments were primarily scheduled for the winter and dry season but due to weather conditions extended through the summer months. Brazilian pepper (*Schinus terebinthifolius*) treatments began the fiscal year as Applied Aquatic Management, Inc. continued initial treatments in the Demolition Site buffer areas (known as the Broken Wing Ranch) starting in December and January until freeze damage prevented further progress then resuming in May continuing into the summer. Foliar treatments by a new 2 person crew began in April and continued to present date which is a significant departure in strategy for foliar treatments by covering the areas repeatedly and continuously rather than sporadic treatments in past years. We also expanded the area of foliar treatments to include the demolition site buffers and soil remediation sites. As water levels rose in the Prairie Canal phase (restored), we received approval to allocate budget to begin treatments of the still drained demolition sites in the Merritt Phase of PSRP including treatments with Garlon IV of Brazilian pepper and misc. species as well as foliar grass treatments. The remaining budget was then utilized conducting foliar treatments in the Prairie Canal phase with special emphasis on spraying jaraguá (*Hyparrhenia rufa*) in September to continue into October.

This report also discusses overall success of exotic control efforts. Percent cover of exotic and nuisance vegetation is assessed during the year and compared to past conditions. As mentioned last year, since March of 2008 there has been a dramatic reduction of targeted FLEPPC I species, especially Brazilian pepper and Burma reed, while other lower priority exotics have remained un-treated or in some cases increased. Priority invasive grass species such as cogongrass (Imperata cylindrica) and torpedograss (*Panicum repens*) have been maintained or increased despite treatments through last year, thus significantly more effort was placed on these species this year and their treatment was expanded to include the demolition site buffers to eliminate seed s.

Weather and Water Levels

Weather played an important role this year with extremes in temperature and departure from typical rainfall and resulting hydrological patterns as illustrated by Figures 1 and 2 from Big Cypress National preserve provided by Bob Sobczak from The South Florida Watershed Journal website (http://www.gohydrology.org). Most of the work was scheduled for completion in the winter and dry season but was delayed primarily by the freeze events in January. Higher than average water levels during the dry season also significantly hindered progress in April and finally receded in June not to rise again until mid July on site which is a bit late. Fortunately the later than average low water levels allowed us to partially recover (but not completely) from the time lost from the freeze. The final blow to progress was the higher than average temperatures beginning the end of April continuing through the summer resulting in much lower productivity especially by hand crews and frequent occurrence of heat exhaustion by crew members.

Foliar treatments were also affected by weather significantly. First windy conditions, especially in April but also sporadically throughout the year, cut many days short. Also, because work continued into the summer months instead of being completed prior to the onset of the rainy season as planned, afternoon thunderstorms shortened many days as well and may have reduced effectiveness in some cases depending on the amount and timing of the rain following treatments.

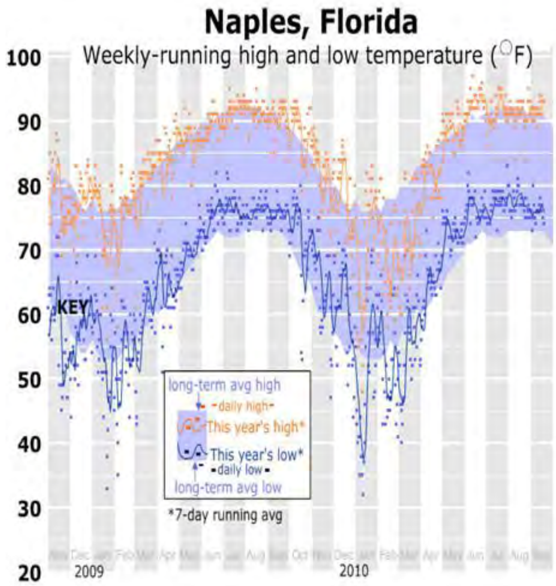


Figure 1

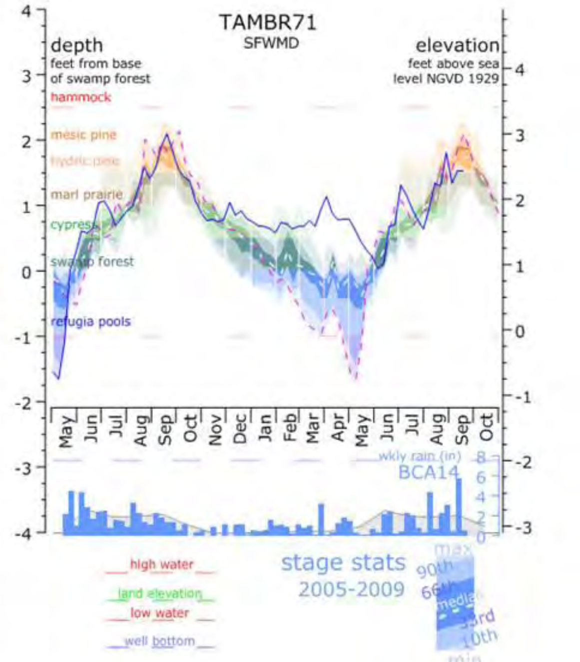


Figure 2

<u>Basal-Bark / cut stump treatments with Garlon IV</u>

Brazilian pepper in the cleared footprints was the top priority for treatments in fiscal years 2008 and 2009 (Barry 2009). Total coverage of Brazilian pepper (*Schinus terebinthifolius*) in the footprint and 50′ buffer areas remains less than 5% and in most areas less than 1% and thus re-treatments were not conducted this year. Instead focus was on completing the demolition site buffer areas started last summer.

Brazilian pepper treatments began the fiscal year as Applied Aquatic Management, Inc. continued initial treatments in the Demolition Site buffer areas (known as the Broken Wing Ranch) starting 12/15/2009. Work was discontinued due to freeze damage, much like last year, after 1/14/2010. Brazilian pepper treatments resumed 5/28/2010 and continued through 7/29/2010 in the Broken Wing Ranch including initial treatments and retreatment between I-75 and 79th Ave SE in the unblocked sections. As water levels (finally) rose in these areas preventing the planned retreatment of the rest of the Broken Wing Ranch area treated last year, we received approval to begin treatments of the still drained demolition sites in the Merritt Phase of PSRP including treatments with Garlon IV of Brazilian pepper and misc. species from 8/2/2010-9/2/2010.

Treatments using Garlon IV are summarized in tables 1-2 and shown in Figures 3 and 4. A total of 1370 acres were covered totaling 752 acres of initial treatment and 281 acres of retreatment in the demolition site buffer areas of the Broken wing Ranch and an additional 336 acres at the demolition sites in the Merritt phase. Treatments in the Broken Wing Ranch areas including almost entirely Brazilian pepper while treatments in the Merritt phase also included a variety of other exotic hardwood species and air potato (*Dioscorea bulbifera*).

Initial treatment areas in the Broken Wing Ranch resulted in an estimated 147 actual treatment acres by using the midpoints of the percent cover class values for the polygons treated while retreatment areas were typically low coverage. There were three main concentrations of heavy coverage (>50%) of Brazilian pepper including the first areas treated in a disturbed cypress slough with a borrow pit excavated in the middle of it in the unblocked area due east of 72nd Ave SE (Figure 3). The second area is the continuation of that slough to the south especially where it reaches the east-west ditch separating the Broken Wing Ranch area from 79th Ave SE. These areas were treated first to complete them before rainy season because most of the pepper was in low lying areas, though the deepest centers of the cypress slough was devoid of pepper presumably due to longer hydroperiods. The third area of heavy pepper coverage lies in the northernmost portion of the Broken Wing Ranch area along I-75 especially near Rock Island roads and other secondary abandoned north-south roads where they meet I-75. Presumably the borrow canal along I-75 drains the immediately adjacent areas to some degree, at least during the dry season, because it was the cypress areas that were most affected while the pop-ash (*Fraxinus caroliniana*) dominated ponds were devoid of pepper even near I-75.

Re-treatment areas, shown in crosshatch, show Brazilian pepper cover reflecting conditions at the time of re-treatment (i.e. post initial treatment) in Figure 3. These areas are not specifically separable by treatment dates in WEEDAR because last year crews completed 50 feet in from most of the roads and this year that first 50′ was retreated while finishing the blocks in Broken Wing Ranch. Other entire blocks that were treated last year were also re-treated and because these blocks often went very quickly new blocks of initial treatment were often recorded under the same WEEDAR dates as well. In general though, it is quite clear retreatment was significantly quicker and cheaper with generally <5% coverage (mostly <1%) still a year later except for a few areas which were >50% upon initial treatment.

Garlon t~~T~~reatments in the Merritt phase were conducted for three primary reasons. First, these sites contained an extremely high diversity and concentration of invasive exotics which could potentially invade road footprints soon to be cleared. Secondly we had significant budget for retreatment of Brazilian pepper in the Broken Wing Ranch area that we were unable to use due to high water in those locations with a contractor already on site ready to work. Thirdly, DOF conducted a very large controlled burn earlier this winter improving access to much of the pepper. As it turned out we were a little late to benefit from the burn in the home sites with misc. exotic hardwood species (which grew back relatively quickly) but the burn did significantly improve efficiency in the surrounding pinelands. Extensive dense stands of Brazilian pepper monocultures which did not burn were avoided since there was no advantage for treatments at this time but these areas were mapped.

Table 1: Total Acres Covered by Treatments of Brazilian Pepper (*Schinus terebinthifolius*) and Misc. Exotic Hardwoods with Garlon IV (Fiscal Year 2010)

Treatment	Location	0	0-<1%	1-5%	5-25%	25-50%	50-75%	75-95%	>95%	Total Acres
Retreatment (1/6/2010, 1/13/2010, 7/6-7/26/2010)	Prairie Canal Demolition Sites	0.9	136.4	142.1	1.6	0	0	0	0	280.9
Initial (12/15/2009-7/29/2010)	Prairie Canal Demolition Sites	22.7	15.0	296.3	223.1	88.0	85.8	20.7	0.7	752.3
Initial (8/2/2010-9/2/2010)	Merritt Demolition Sites	1.5	19.7	134.0	110.0	39.8	30.3	1.0	0	336.3
	Total:	25.1	171.0	572.4	334.8	127.8	116.0	21.8	0.7	1369.5

Table 2: Actual Treated Acres of Brazilian Pepper (*Schinus terebinthifolius*) and Misc. Exotic Hardwoods with Garlon IV (Fiscal Year 2010)

Treatment	Location	0	0-<1%	1-5%	5-25%	25-50%	50-75%	75-95%	>95%	Total Acres
Retreatment (1/6/2010, 1/13/2010, 7/6-7/26/2010)	Prairie Canal Demolition Sites	0.0	0.7	4.3	0.2	0	0	0	0	5.2
Initial (12/15/2009-7/29/2010)	Prairie Canal Demolition Sites	0.0	0.1	8.9	33.5	33.0	53.6	17.6	0.7	147.3
Initial (8/2/2010-9/2/2010)	Merritt Demolition Sites	0.0	0.1	4.0	16.5	14.9	18.9	0.9	0	55.3
	Total:	0.0	0.9	17.2	50.2	47.9	72.5	18.5	0.7	207.8

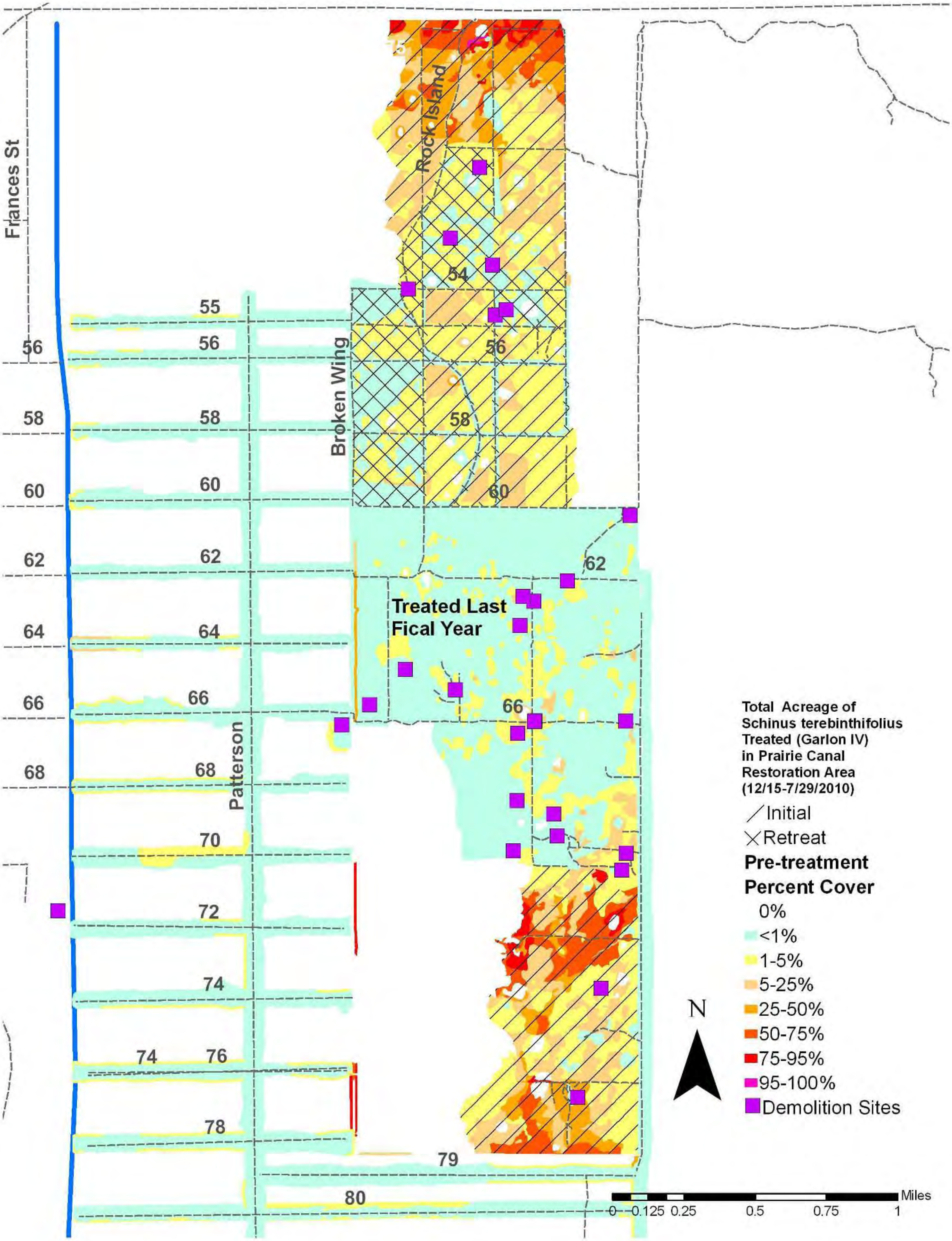
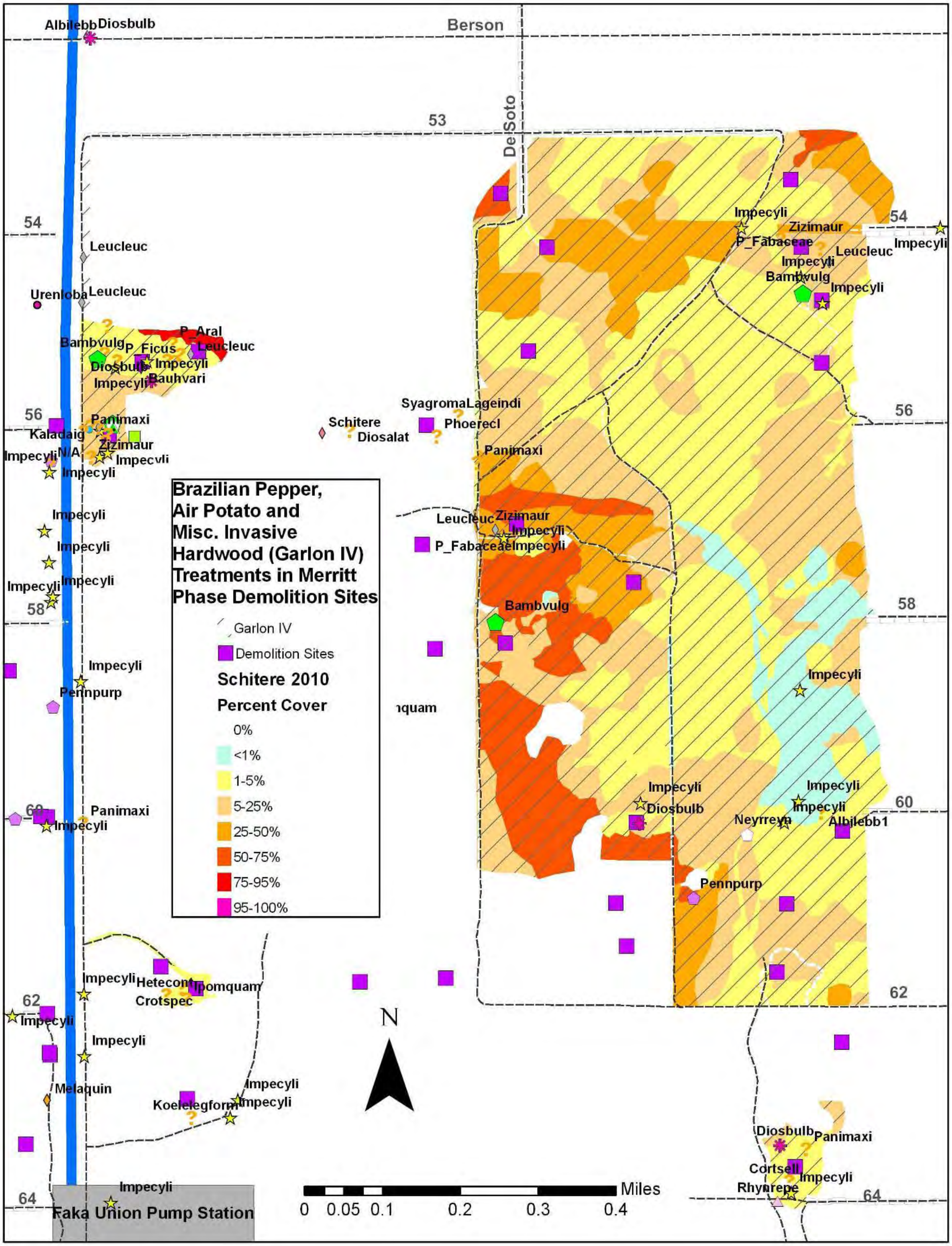

Frances St
Rock Island
Broken Wing
Patterson
Treated Last
Fical Year
55
56
58
60
62
64
66
68
70
72
74
76
78
79
80
54
Total Acreage of
Schinus terebinthifolius
Treated (Garlon IV)
in Prairie Canal
Restoration Area
(12/15-7/29/2010)
Initial
Retreat
Pre-treatment
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Demolition Sites
N
Miles
0 0.125 0.25 0.5 0.75 1

Figure 3


Brazilian Pepper, Air Potato and Misc. Invasive Hardwood (Garlon IV) Treatments in Merritt Phase Demolition Sites
Garlon IV
Demolition Sites
Schitere 2010
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Berson
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N
0 0.05 0.1 0.2 0.3 0.4 Miles

Figure 4

A total of 336 acres were covered between 8/2/2010 and 9/2/2010 with varying cover of Brazilian pepper totaling 55 acres of actual treated pepper (Tables 1 and 2). The actual treated acreage does not include the miscellaneous other species treated. Miscellaneous hardwoods were treated along with pepper on 8/2-8/5/2010 and 8/11-8/12/2010 though they are not specifically separable in the WEEDAR data. Air potato was treated on 8/11/2010 and 8/30/2010 along with pepper and again will be lumped with pepper in the WEEDAR data as both were treated at the same time.

The miscellaneous species treated at the Merritt demolition sites included most importantly large stands of lead tree (*Leucaena leucocephala*) which have visibly spread significantly both by comparison of past aerial photography (2000) and my own personal observations. Because this tree is resistant to typical basal bark treatments, on days when this species was present crew members carried a more concentrated mix of Garlon IV (30%) and all lead tree were killed with cut-stump treatments.

Other species also treated are listed below in Table 3. Most are persisting from small farms formerly inhabited by Vietnamese Americans and a wide variety of edible plants were historically grown at these sites and only the hardy or invasive species have survived without irrigation and fire protection and thus warrant a closer look (personal observations). Nearly all of the species were present at 4 farm locations as well as several of the home sites in Broken Wing Ranch, suggesting they shared plants. Because the largest specimens of many of these, including large diameter Indian jujube (Ziziphus mauritiana), were found at the sites in the Merritt phase, it appears that these farms were the origin with the Picayune. Indian Jujube has definitely naturalized around these sites and in Broken Wing Ranch area and individual recruits can be found on Merritt and other side roads still as they were found and treated on roads near the demolition sites in the Broken Wing Ranch. One of the plants was a small spiny Mimosoid tree with yellow flowers and aromatic pinnately compound leaves which to date we have not identified but were calling the "spiny lead tree" in the field. This may turn out to be invasive based on what seemed to be a naturalized or expanding population around persistent planted specimens. It is important to note they have survived for over 6 years without irrigation, several freeze events, major hurricanes, and Rx burns. Specimens were taken to determine this species just in case it shows up elsewhere. Jícama (Pachyrhizus erosus) persisted at all of the farm sites though it does not appear to be spreading out from these locations. It is also unclear whether or not Chùm Ruột *(Phyllanthus acidus)* was naturalized or persisting from cultivation. The same exotic fig (Ficus sp.) with 3 prominent veins on the leaf was found at a couple of sites in Merritt as it was at one similar site in Broken Wing Ranch. It does not seem to be invasive. A Polygonaceous tree (*Triplaris melaenodendronsp.*) was also found at one of the sites and it appears to only be persisting from cultivation at that location. This tree was found to be naturalized, or at least reproducing, off C.R. 858 (collected by Keith Bradley), though this population was destroyed by road widening. This may be a species to watch for more carefully as well. Finally, some bamboo (*Bambusa vulgaris*) was treated where it had been top-killed back from fire. Due to their size they should eventually be treated. None of the other non-FLEPPC listed species appear to be invasive, though it is impressive they have survived at these sites without the TLC the former landowners gave them.

Table 3: Other Exotic Plant Species Treated at Merritt Demolition Sites

TXCODE	Scientific Name	FLEPPC	Common Names
P_Fabaceae	?	I	Unknown spiny Mimosoid small tree with aromatic pinnate compound leaves
Albilebb1	*Albizia lebbeck*	II	Woman's tongue
Allacath	*Allamanda cathartica*		Yellow allamanda, Golden trumpet
Alpizeru	*Alpinia zerumbet*		Shellflower, Shell ginger
P_Aralia	*Aralia sp.*		Ornamental Aralia
Bambvulg	*Bambusa vulgaris*		Common bamboo
Bauhvari	*Bauhinia variegata*	I	Mountain ebony, orchidtree
Biscjava	*Bischofia javanica*	I	Javanese bishopwood
Dalbsiss	*Dalbergia sissoo*	II	Indian rosewood
P_Ficus	*Ficus sp.*		Unknown Fig – same as in Broken Wing Ranch with 3 prominent mid-veins
Kaladaig	*Kalanchoe daigremontiana*		Devil's-backbone
Lageindi	*Lagerstroemia indica*		Crapemyrtle
Leucleuc	*Leucaena leucocephala*	II	White leadtree
Litcchin	*Litchi chinensis*		Litchee
Musaacum	*Musa acuminataе*		Banana
Pacheros	*Pachyrhizus erosus*		Jícama (edible tuber cultivated by Mayans)
Phylacid	*Phyllanthus acidus*		*Chùm Ruột, kemangor, mayom, iba, groselha* (native to Madagascar and cultivated extensively in Asia for edible fruits and leaves)
Psidguaj	*Psidium guajava*	I	Guava
Syzycumi	*Syzygium cumini*	I	Jambolan-plum, Java-plum
Termcata	*Terminalia catappa*	II	Tropical-almond, West Indian-almond
Tradspat	*Tradescantia spathacea*	I	Oysterplant, Moses-in-the-cradle, Boatlily
Trip	*Triplaris melaenodendron.*		~~Triplaris~~ Long John
Zizimaur	*Ziziphus mauritiana*		Indian jujube

Because IRC had planned only to coordinate areas in the Broken Wing Ranch area already heavily ground-truthed and nothing in the Merritt phase, IRC did not have sufficient budget to ground-truth exotics coverage except for the bare minimum. As a result the pepper cover presented in this report (Figure 4) should be considered preliminary. Additional ground-truthing will be conducted when the area is re-treated and as more progress is made on demolition sites in the Merritt un-blocked areas.

Foliar Treatments with Glyphosate and Imazapyr

Foliar treatments by a new 2 person crew began 4/16/2010 starting with torpedograss in the upper 2 miles of the former Prairie Canal footprint and continued until 8/6/2010 which is a significant departure in strategy for foliar treatments by covering the areas repeatedly and continuously rather than the sporadic treatments in past years. We also expanded foliar treatments to include the areas of demolition site buffers where the treated pepper was increasing coverage of invasive grasses by allowing more light to reach the groundcover in the disturbed areas around the old home sites. Also one week of foliar treatment budget with this crew was spent on the Phase I soil remediation site off 108th Ave SE west of Miller. Foliar grass treatments were also conducted in the Merritt Phase from 9/7/2010-9/21/2010 following Garlon IV treatments. The remaining budget was then utilized conducting foliar treatments in the Prairie Canal phase with special emphasis on spraying jaraguá (*Hyparrhenia rufa*) in the road footprints and any missed Burma reed and cogongrass in the Broken Wing Ranch area from 9/22/2009 to present. A grand total of 4911 acres were covered this year with estimated 85 actual treatment acres (Tables 4 and 5).

The first annual retreat was conducted from 4/16/2010-5/28/2010 totaling 2078 acres covered mostly in the cleared road and canal footprints (Table 4, Figure 5). Foliar targets were limited primarily to torpedograss and cogongrass at first while IRC worked with the new crew to improve plant identification skills including native species which might be confused with exotics in order to avoid non-target damage. Torpedograss along the Prairie canal footprint was treated at this time but due to unusually high water (see Figure 2 above) this treatment was incomplete and would warrant re-treatment as soon as water levels dropped. All known cogongrass locations were also loaded into the crew's Garmin GPS unit to facilitate re treatments. This quick "one pass" treatment also allowed the new crew to become more familiar to the site.

The second re-treatment (re-visiting recently treated areas) of the fiscal year started 5/28/2010 and continued to 8/10/2010 totaling 2064 of the just treated 2078 acres. This pass started again with the Prairie Canal footprint but this time water levels had dropped allowing for successful treatments of torpedograss except in the ponds left along the canal. Because it is nearly impossible to control torpedograss in these deeper water refugia, torpedograss will continue to be a threat to the former canal footprint. This is an argument to completely fill the canals whenever it is possible. The crew treated torpedograss, cogongrass, vaseygrass (*Paspalum urvillei*), guineagrass (*Panicum maximum*), B~~u~~ermudagrass (*Cynodon dactylon*), ~~E~~elephantgrass (*Pennisetum purpureum*), paragrass (*Urochloa mutica*), cattail (*Typha dominguensis*), common reed (*Phragmites australis*) and some Burma reed (*Neyraudia reynaudiana*). Actual treated acreage based on combined cover of these species totaled 30 acres (Table 5) and is shown in Figure 6.

During this "second retreat" (7/9/2010-8/6/2010), some areas were treated for the first time this fiscal year (in the cleared footprints and demolition sites) while other areas were treated for the first time ever (demolition site buffers). This treatment is portrayed by the crosshatch over grey background in Figure 5. A total of 654 acres were covered while 13 acres were treated (Tables 4 and 5). This acreage includes 304 acres of road footprints and 149 acres of 50' buffer (scanned from the road) which were skipped during the first retreat such as 92^{nd}-98^{th} Ave SE east of Patterson and 102^{nd}-118^{th} west of Patterson because there was no known cogongrass or torpedograss. Primary targets included cattail on 92^{nd}-98^{th} and vaseygrass and widely scattered Burma reed on all of the roads covered. Roads at the south end including 120^{th}-126^{th} (except a known cogongrass patch) were not treated because they were found to only have widely scattered Burma reed (low cover) which is associated with the Merritt canal and southern end of the Prairie canal where restoration is incomplete. Much of the spoil is dominated by Burma reed and is inaccessible to treat at this time so it will remain a lower priority until the restoration work is completed.

Initial treatments were also conducted at demolition sites and buffers where Brazilian pepper had been treated this year and last year increasing available light to the groundcover giving room for expansion of cogongrass in the disturbed areas. These areas had to be addressed because cogongrass kept recruiting into the adjacent footprints and the patches themselves were increasing in size rapidly. These areas are depicted by the crosshatch over grey in the un-blocked areas of in the Broken Wing Ranch area totaling 200 acres covered and 9 acres treated (Figure 5, Tables 4 and 5). All of the roads and trails connecting the sites were also covered. A roughly 1 acre patch of St. Augustine grass (*Stenotaphrum secundatum*) was also treated but is not included in the acreage in Tables 4 and 5.

Some patches of cogongrass in the Broken Wing Ranch area were treated concurrently as a part of the Invasive Plant Management Section of Florida Fish and Wildlife Conservation (project #SW-112). This contract covered only the re-treat of patches treated beginning in 2007 and was done by SE Chemtreat, Inc this year and in the past years, some areas dating back to 2004. Primarily low coverage patches off 66th and up to 62nd were treated with the exception of a very large patch (around 5 acres) between 66th and 64th with coverage in the 5-25% range. This contract significantly helped towards eliminating cogongrass from the Broken Wing Ranch area especially by allowing us to concentrate on initial treatments of the newly located patches farther off the main roads. Applied Aquatic Management Inc. re-visited all of these locations a few weeks later to catch what few patches that were missed or had not died completely.

Because of the experience in the Broken Wing Ranch area, after treating hardwoods with Garlon IV in the Merritt demolition sites Applied Aquatics, Inc. immediately began (9/7/2010-9/14/2010) treating cogongrass, guineagrass and a suite of other exotics. Smutgrass (*Sprobolus indicus* var. *pyramidale*) is rampant in these areas but has not yet been treated and will have to be addressed over the long term. A total of 55 acres were covered with more than 4 acres actually treated (Tables 4 and 5, Figure 7). Not reflected in these acreages are all the roads and trails covered between sites and the miscellaneous other exotic species which were treated opportunistically such as hairy indigo (*Indigofera hirsuta*) and bladderpod (*Crotalaria spectabilis*).

Approximately 59 acres of recruiting torpedograss were treated at the Phase I Soil remediation sites off 108th and Miller between 4/27/2010 and 4/30/2010 (Table 4, Figure 8). Actual percent cover of torpedograss was given as 1-5% over most of the treated area totaling only 1.2 actual treated acres. However, this is misleading because the torpedograss was just emerging from predominately bare ground over nearly the entire site so in reality almost the entire 59 acres was actually sprayed (and would be reflected in WEEDAR) in order to treat all the emerging shoots of torpedograss. Phase II sites were not sprayed at that time since they were still bare ground. We had hoped to retreat phase I and conduct initial treatment of Phase II prior to this date but the site has had too much standing water after finishing treatments at Prairie Canal phase.

Much more work is needed on this site with torpedograss being the highest priority but also other invasives such as Caesarweed (*Urena lobata*) and lovegrass (*Eragrostis bahiensis*). As soon as water recedes this will be the highest priority of the next fiscal year. Per an onsite meeting in May of 2010, we will be evaluating the condition of the site this winter to assess options for potentially replanting once invasive exotics are under control. This site should be considered our biggest failure this fiscal year.

Table 4: Acreage Covered for Foliar Treatments with Glyphosate and Imazapyr (Fiscal Year 2010)

Treatment	Dates	Location	0	0-<1%	1-5%	5-25%	25-50%	50-75%	75-95%	>95 %	Sub-total	Total Acres
First Annual Retreat	4/16/2010-5/28/2010	50' outside footprint	502.4	117.5	43.0	1.8					664.7	
		Inside Footprint	206.7	418.9	716.8	55.8	7.0				1405.1	
		Demolition Sites and Buffers	0.9	0.3	6.0	0.1			0.6		8.0	2077.9
Second Annual Retreat	5/28/2010-8/10/2010	50' outside footprint	501.6	125.8	29.6	1.5					658.5	
		Inside Footprint	206.2	431.0	737.4	23.5					1398.0	
		Demolition Sites and Buffers	0.9	5.7	1.0						7.6	2064.1
Continued First Retreat and Initial on Demolition Sites	7/9/2010-8/6/2010	50' outside footprint	138.0	3.9	6.8						148.6	
		Inside Footprint	81.1	121.4	101.1	0.4					304.0	
		Demolition Sites and Buffers	23.6	81.0	65.4	27.7	0.8	1.8	1.4		201.7	654.4
Merritt Initial	9/7/2010-9/14/2010	Demolition Sites and Buffers	28.1	4.8	11.5	8.6		0.8	2.0		55.7	55.7
Soil Remediation	4/27/2010-4/30/2010	Phase I	19.5	1.4	38.3						59.1	59.1
Fall Grass Treatments (not done yet)	9/22/2010 - 10/20/2010????	50' outside footprint										
		Inside Footprint										
		Demolition Sites and Buffers										
		Total:	1708.9	1311.6	1756.8	119.5	7.8	2.5	4.0			4911.2

Table 5: Estimated Treated Acreage for Foliar Treatments with Glyphosate and Imazapyr (Fiscal Year 2010)*												
Treatment	**Dates**	**Location**	**0**	**0-<1%**	**1-5%**	**5-25%**	**25-50%**	**50-75%**	**75-95%**	**>95%**	**Sub-total**	**Total Acres**
First Annual Retreat	4/16/2010-5/28/2010	50' outside footprint	0.0	0.6	1.3	0.3					2.2	
		Inside Footprint	0.0	2.1	21.5	8.4	2.6				34.6	
		Demolition Sites and Buffers		0.0	0.2	0.0			0.5		0.7	37.5
Second Annual Retreat	5/28/2010-8/10/2010	50' outside footprint	0.0	0.6	0.9	0.2					1.7	
		Inside Footprint	0.0	2.2	22.1	3.5					27.8	
		Demolition Sites and Buffers	0.00	0.03	0.03						0.1	29.6
Continued First Retreat and Initial on Demolition Sites	7/9/2010-8/6/2010	50' outside footprint	0	0.02	0.2						0.2	
		Inside Footprint	0	0.6	3.0	0.1					3.7	
		Demolition Sites and Buffers	0	0.4	2.0	4.2	0.3	1.1	1.2		9.1	13.1
Merritt Initial	9/7/2010-9/21/2010	Demolition Sites and Buffers	0.0	0.02	0.3	1.3		0.5	1.7		3.8	3.8
Soil Remediation	4/27/2010-4/30/2010	Phase I	0.0	0.01	1.1						1.2	1.2
Fall Grass Treatments (not done yet)	9/22/2010 - 10/20/2010????	50' outside footprint										
		Inside Footprint										
		Demolition Sites and Buffers										
		Total:	0.0	6.6	52.7	17.9	2.9	1.6	3.4			85.1

*Acreage based on combined coverage of Cynodact, Hyparufa, Impecyli, Neyrreyn, Panirepe, Panimaxi, Paspurvi, Pennpurp, Phraaust, Typhdomi, Urocmuti although some other lower priority species were also sometimes treated.

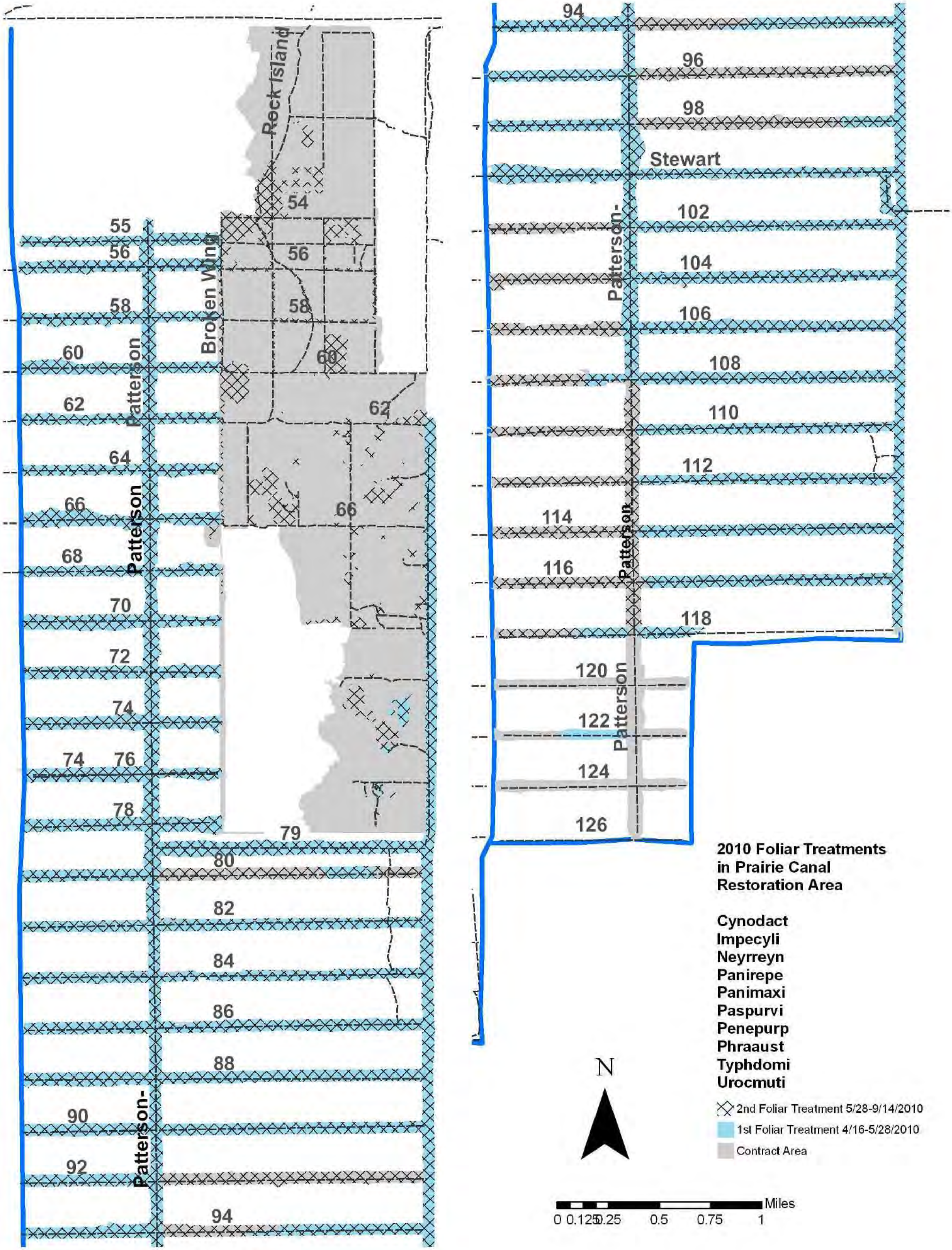

2010 Foliar Treatments in Prairie Canal Restoration Area
Cynodact
Impecyli
Neyrreyn
Panirepe
Panimaxi
Paspurvi
Penepurp
Phraaust
Typhdomi
Urocmuti
2nd Foliar Treatment 5/28-9/14/2010
1st Foliar Treatment 4/16-5/28/2010
Contract Area
N
Miles
0 0.125 0.25 0.5 0.75 1
Rock Island
Broken Wing
Patterson
Patterson-
Stewart

Figure 5

I- 75
Berson
2010
2010 post treatment
Merrit
Patterson
Patterson-
Stewart
Merrit-2
Merrit
Patterson
Patterson
Total Coverage by 2010 Foliar Treatment Target Exotic and Nuisance Species (Panirepe, Impecyli, Paspurvi, Phraaust, Neyrreyn, Panimaxi, Cynodact, Penepurp, Urocmuti, Typhdomi) in Prairie Canal Restoration Area Footprints and Demolition Sites
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Miles
0
0.25
0.5
1
1.5
2
N

Figure 6

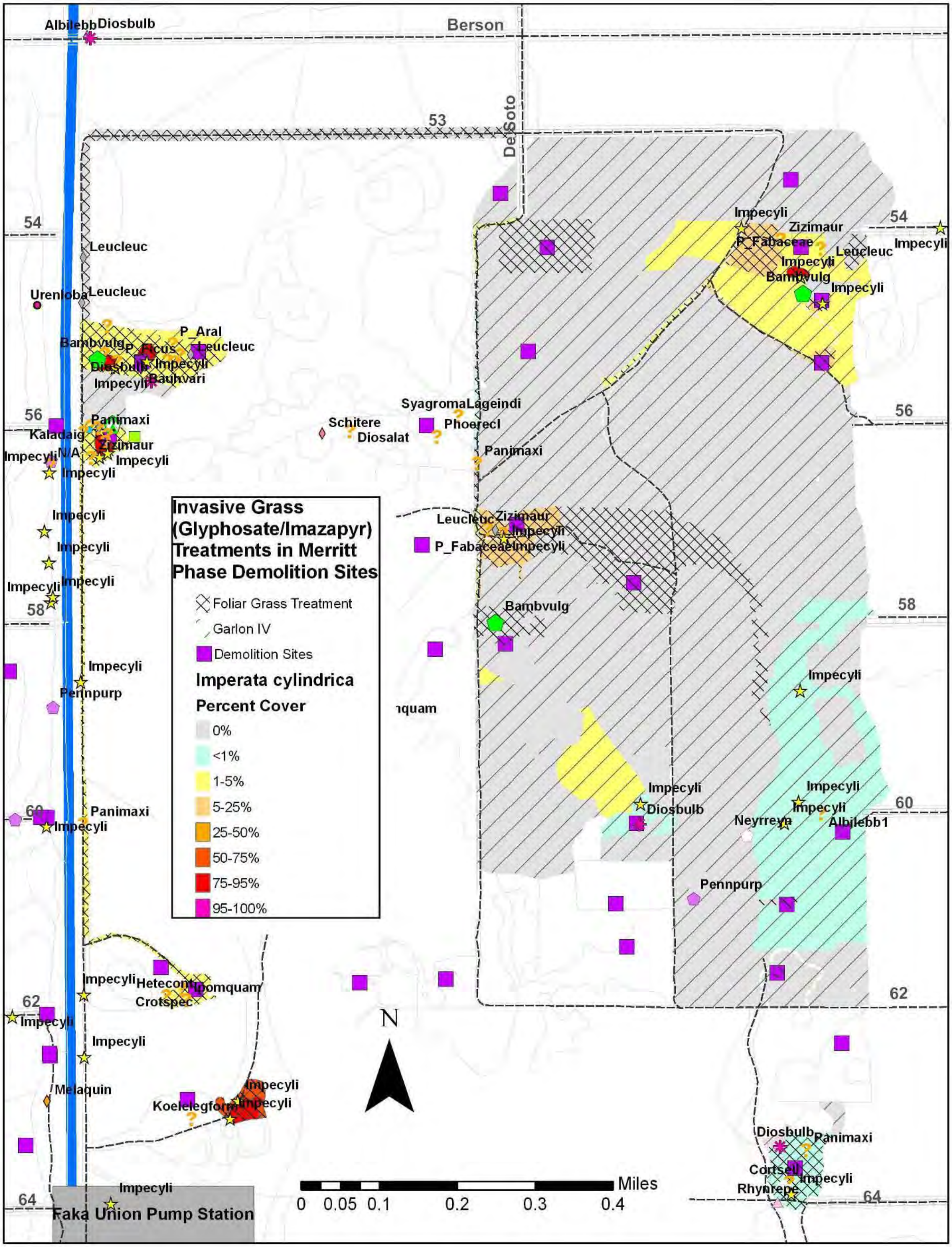

Invasive Grass
(Glyphosate/Imazapyr)
Treatments in Merritt
Phase Demolition Sites
Foliar Grass Treatment
Garlon IV
Demolition Sites
Imperata cylindrica
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Berson
De Soto
53
54
56
58
60
62
64
Faka Union Pump Station
Miles
0 0.05 0.1 0.2 0.3 0.4
N

Figure 7

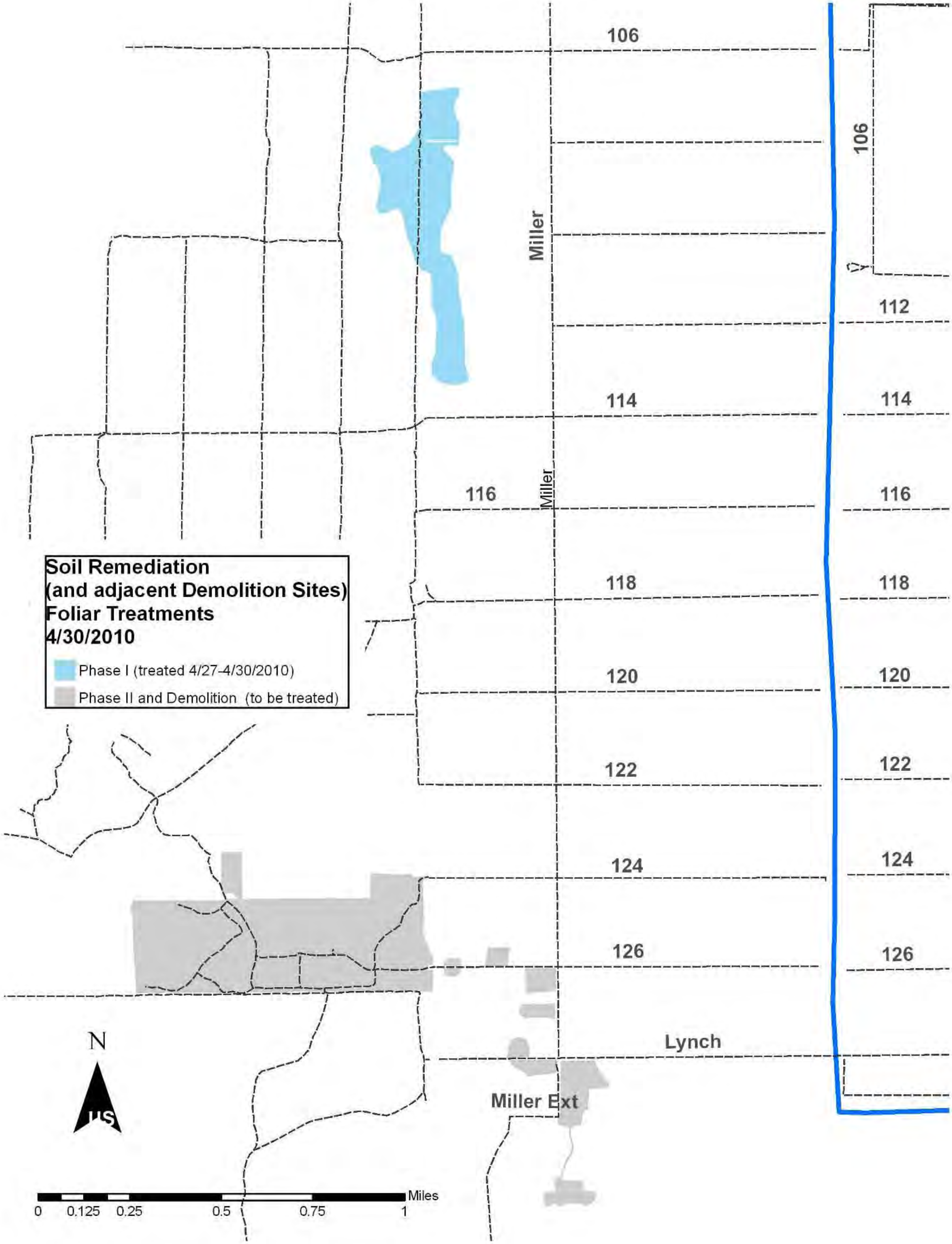

106
106
Miller
112
114
114
116
Miller
116
118
118
120
120
122
122
124
124
126
126
Lynch
Miller Ext
Soil Remediation
(and adjacent Demolition Sites)
Foliar Treatments
4/30/2010
Phase I (treated 4/27-4/30/2010)
Phase II and Demolition (to be treated)
N
US
Miles
0
0.125
0.25
0.5
0.75
1

Figure 8

Fall grass treatments began 9/22/2010 in the Broken Wing Ranch area first targeting scattered Burma reed missed during earlier treatment which targeted primarily cogongrass. Also this will be the first re-treat of some of those patches of cogongrass. The primary target will be jaraguá (*Hyparrhenia rufa*) which is scattered in the higher areas mostly from 79th Ave SE northward but it has only just begun sending up inflorescences so this treatment may be discontinued until early to mid October to insure all targets are visible. In past years treatments in September left too many missed patches because without the inflorescence this grass is inconspicuous amongst the tall weedy native plants in the footprints.

THE ACREAGE IN THE TABLES AND FIGURES ABOVE WILL BE UPDATED IN THE END OF OCTOBER AND ADDITIONAL DISCUSSION ADDED HERE

Overall Exotic and Nuisance Species Coverage

An important part of IRC's work is tracking percent cover of invasive exotic species from year to year to assess effectiveness of exotic control efforts. As discussed in the methodology, we utilize GPS units with ArcPAD software to collect data on invasive species cover in the field and then utilize these data along with aerial photograph interpretation, hand written notes on hard copy aerials, and direct communication with the contractors actually treating the exotics as well as data from their Garmin GPS units to populate a polygon map of percent cover by invasive exotic species. This fiscal year a total of 180 km were surveyed by IRC using ArcPAD with 34 km on foot away from roads and trails (Table 6). These field data are stored in the IRC_Master_GDB.mdb file. Many more additional miles were actually covered between times when only notes on hardcopy maps were taken (especially when visiting previously surveyed areas post-treatment) or when GPS unit malfunctions in the field (which happens far too often). Data collected using ArcPAD includes the most detail but other data, including daily to weekly face to face discussions with the contractor using maps with notes should not be underestimated.

Table 6: Total Distance Surveyed using GPS using ArcPAD fiscal year 2010

method	m	km
BICYCLE	34198.6	34.2
FOOT	33800.9	33.8
SWAMP BUGGY	2202.6	2.2
VEHICLE	109918.5	109.9
	180120.5	180.1

As mentioned in last year's report (Barry 2009), originally IRC had hoped to utilize these field data to update coverage layers in the geodatabase twice a year, making coverage estimates for rainy and dry season. However, we have found that updating the GIS layers once a year is more realistic, at least for long term archives. Although assessing cover in the summer and fall is typical in vegetation monitoring when dealing with a much higher diversity of species, much of the field work needs to be done during the dry season when the entire site is easily accessible and more importantly to be on site as much as possible while exotic contractors are working to be available for questions and to make sure the correct areas are being treated. Moreover, it takes considerable time to re-visit the entire area so coverage must be updated little by little so some of the areas were assessed immediately post treatment but cover values updated as "pre-treatment" at that time as well since the cover of dead material was evident, thus killing two birds with one stone. So in short, data on cover archived by each year will be considered dry season "pre-treatment" cover with the next years data pre-populated in the database based on "current" or post-treatment to indicate successes or failures immediately post treatment. Those data would then be updated the following dry season to reflect re-growth without archiving the immediate post treatment values. These polygon data are found in the PSRP_vegetation_GDB.mdb geodatabase.

In the field, cover by each invasive exotic and nuisance species was recorded by cover class and these data were entered for each polygon in the contract area. To look at overall invasive species cover, the sum of the mid points of the cover class for each invasive species found in a polygon were calculated using Microsoft Access in a linked table which later could be incorporated into ArcGIS. These summed data are then put into the cover classes for analysis.

Using the summed data in this way can result in misrepresentations, thus individual species data should always be consulted when there are questions. Total cover of invasive species cover would be overestimated, for example, if species are growing under other species. Also, if only one or two individuals (<1%) of multiple species are found in a large polygon it would jump to the next one or two cover classes (1-5% or 5-25%) and be an overestimate. In general, the more invasive species found in a polygon the more chances that it is an over estimate, especially if both woody and herbaceous species are present which can occupy different strata of the same patch of ground.

A total of 50 invasive exotic species and 2 native nuisance species were mapped using points, lines and polygons in the Prairie Canal phase of PSRP (Barry 2008, 2009). Now that we have combined data from the Soil and Water Conservation surveys of the entire State Forest and surveyed some of the high diversity sites in the Merritt phase, we have 96 exotic and nuisance species in the geodatabase with a total of 6543 points. As we enter work in coming years in the other phases we will begin to re-evaluate forest wide priorities.

Still only 26 species -with multiple locations of significant infestations were incorporated into the polygon map in order to track acreage (Barry 2009). These species were grouped by priority for the Picayune Strand Restoration Area (Barry 2008, Barry 2009). Prior to this year, only priority 1 species were treated whenever they were encountered while some of the other species were treated opportunistically. This year vaseygrass (priority 2), cattail and common reed (priority 3), and Bermudagrass (priority 4) were always treated when encountered. Bermudagrass was considered higher priority because many patches harbored torpedograss which also looks similar, but still this would not necessarily be a high priority elsewhere. We had hoped to begin treatments of smutgrass and natalgrass (*Melinus repens*) in at least the drier portions north of 79th

Ave SE, but this was not possible given increases in treatments of torpedograss and cogongrass. We hope to continue little by little to 'peel back the layers of the onion'.

Total acreage and percent of total acreage (1794 acres) actually covered by combined exotic and nuisance species, FLEPPC I, II, and non listed, and highest priority species tracked inside the footprints (excluding the 50' buffers, demolition sites, and demolition site buffers) are presented below in Table 7. These estimates are derived summing the acreage in all polygons in each cover class for each taxon or group of taxa, then multiplying it by the midpoint of the cover class that they fall in. The same calculations are presented in Table 8 for the demolition sites and their buffers, though mapping of FLEPPC II and non-listed species is somewhat incomplete for the demolition sites.

When we look at total coverage by all exotic and nuisance species combined in the cleared footprints, we see little change since 2008. However, FLEPPC I species do drop substantially from 93 acres (5.2%) down to 61 acres (3.4%). Most of this reduction is from treatment of Brazilian pepper and its remaining acreage consists largely of large areas of <1% cover. Cogongrass is also trending downward indicating success of treatments. Torpedograss on the other hand, had actually increased since 2008, especially following this wet winter, and as discussed earlier in the report we have stepped up treatments with a strategy of more treatments through the year. Total FLEPPC II species have changed little reflecting largely that we have not targeted these species (yet) but also as mentioned in last year's report, treatments of jaraguá so far have not reduced coverage substantially. Non-listed Species have increased from 113 acres (6%) to 144 acres (8%) in spring of 2010. Because this group includes several of target species such as vaseygrass, Bermudagrass, common reed and cattail, this year we stepped up treatment of these and coverage does decrease post treatment, at least in the short run. Smutgrass, buttonweed (*Spermacoce verticillata*), pitted bluestem (*Bothriochloa pertusa)* and a handful of other species also fall into this group and have remain unchanged except in the wetter areas where they have disappeared. These data indicate that though we are having some success with FLEPPC I species, we need to continue to step up torpedograss treatments and eventually start hitting more of the lesser exotics eventually.

Table 7: Estimated Coverage* by Invasive Exotic and Nuisance Species by Year Inside Restoration Footprints

	Spring 2008		Spring 2009		Spring 2010		Fall 2010	
Taxa	Acres	%	Acres	%	Acres	%	Acres	%
Total Exotics	271.8	15.2%	251.3	14.0%	277.5	15.5%	271.7	15.1%
Total FLEPPC I	93.4	5.2%	81.5	4.5%	64.0	3.6%	61.0	3.4%
Total FLEPPC II	67.8	3.8%	66.1	3.7%	65.9	3.7%	65.9	3.7%
Non-Listed	113.4	6.3%	109.6	6.1%	144.2	8.0%	140.6	7.8%
FY 2010 foliar targets	46.3	2.6%	32.4	1.8%	38.7	2.2%	32.0	1.8%
Fall Grasses	42.0	2.3%	27.0	1.5%	28.9	1.6%	N/A	N/A
Schitere	39.8	2.2%	25.0	1.4%	9.9	0.6%	9.9	0.6%
Impecyli	3.8	0.2%	3.7	0.2%	2.0	0.1%	1.7	0.1%
Panirepe	1.1	0.1%	1.1	0.1%	5.3	0.3%	1.3	0.1%

**sum of infested acres for each cover class multiplied by the midpoint of the percent cover category*

Data collected for Demolition Sites and buffer areas is somewhat incomplete at this time except for the two primary target species listed below in Table 8. However, in general there is far less coverage of FLEPPC II and other non-listed species in the demolition site buffer areas than the cleared footprints (personal observations). Without over analyzing these data, it will suffice to say that FLEPPC I species are trending downward quite nicely, and hopefully re-treatments will continue to be funded to maintain this trend. Also, though there is significant acreage dominated by smutgrass (only partially surveyed and entered at this time), most areas where Brazilian pepper has been treated is filling in with native species where not amongst cogongrass (direct observations).

Table 8: Estimated Coverage* by Invasive Exotic and Nuisance Species by Year at Demolition Sites and Their Buffers

	Spring 2008		Spring 2009		Spring 2010		Fall 2010	
	Acres	%	Acres	%	Acres	%	Acres	%
Total Exotics	330.7	19.0%	329.0	18.9%	197.3	11.3%	56.4	3.2%
Schitere	294.9	16.9%	294.4	16.9%	161.7	9.3%	27.3	1.6%
Impecyli	8.5	0.5%	10.1	0.6%	9.9	0.6%	1.6	0.1%

Total acreage by cover class for each year for total combined species, FLEPPC I, II, and non listed, and highest priority species tracked inside the footprints -(excluding the 50' buffers) and for demolition sites and demolition site buffers are presented below in Tables 9 and 10. Combined cover values for these groupings of FLEPPC I and II, other non-listed species, and foliar targeted species are also mapped below figures 9-18. These tables and subsequent figures illustrate the details utilized to come up with the overall trends just discussed above.

Though total infested acres of all tracked species combined changed little, it is important to note that combined infested acres in polygons with 50% or greater cover were reduced substantially especially for FLEPPC category I species. This is true also for FLEPPC category I species, but not for category II species or non-FLEPPC listed species illustrating our strategy for prioritizing the worst invasive species and working our way down the list as mentioned above. Figures 9-11, 16, and 18, which include many of these non-targeted species, show how coverage is concentrated more in the northern sections and towards the west near the Merritt canal where they are still drained.

We had hoped to include natalgrass (*Melinis repens*), which had shown an increase since 2008, into treatments this year and perhaps smutgrass as well, at least for the footprints north of and including 79th Ave SE. However, because we had our hands full between torpedograss and cogongrass, we did not treat these this year. Though we have not yet peeled very deeply into the 'layers of the onion', it is encouraging that FLEPPC I species overall are in decline. After all, it is our highest priority to protect and restore the areas *between* the road footprints and it is the FLEPPC I species which have the most potential to continue their spread into these areas. Hopefully by reducing coverage in the footprints we will at least slow the down invasion into these areas whether or not we eventually have a budget to treat those areas.

Table 9: Total Acres of Exotic and Nuisance Species by Percent Cover Category in Road and Canal Footprints

Taxa	Year	0	Infested Acres:	<1%	1-5%	5-25%	25-50%	50-75%	75-95%	95-100%
Total Exotics	Spring 2008	0.6	1793.2	10.0	697.1	805.3	198.5	68.0	7.5	6.8
	Spring 2009	0.8	1793.0	12.6	812.3	718.0	169.7	60.2	14.1	6.1
	Spring 2010	0.8	1793.0	5.7	624.6	899.7	179.8	67.4	9.1	6.7
	Fall 2010	0.8	1793.0	5.5	660.6	870.9	172.7	67.4	9.1	6.7
Total FLEPPC I	Spring 2008	0.6	1793.2	475.2	1088.7	152.4	60.1	5.9	10.2	0.7
	Spring 2009	0.8	1793.0	539.4	1057.3	141.8	41.7	2.9	9.9	
	Spring 2010	0.8	1793.0	599.3	1049.5	109.4	34.4	0.3		
	Fall 2010	0.8	1793.0	598.7	1075.6	84.0	34.4	0.3		
Total FLEPPC II	Spring 2008	168.7	1625.1	704.9	695.6	200.5	6.7	17.3		
	Spring 2009	167.7	1626.1	681.3	739.5	181.4	6.7	17.3		
	Spring 2010	178.3	1615.5	677.2	732.8	181.4	6.7	17.3		
	Fall 2010	178.3	1615.5	677.2	732.8	181.4	6.7	17.3		
Non-Listed Exotic and Nuisance Species (excluding *Sabal palmetto*)	Spring 2008	29.9	1763.9	6.3	1318.7	403.3	35.6			
	Spring 2009	29.9	1763.9	32.0	1366.5	305.0	60.4			
	Spring 2010	14.6	1779.2	28.3	1103.3	586.3	61.3			
	Fall 2010	14.4	1779.5	28.3	1133.6	556.2	61.3			
FY 2010 Foliar Treatment Targets	Spring 2008	381.1	1412.7	476.8	823.0	106.1	4.2	2.5		0.1
	Spring 2009	354.7	1439.1	543.7	872.1	23.4				
	Spring 2010	311.7	1482.1	597.2	821.8	56.2	7.0			
	Fall 2010	311.7	1482.1	610.4	848.2	23.5				
Fall Grasses	Spring 2008	662.8	1131.0	654.8	304.9	157.2	11.5	2.5	0.1	
	Spring 2009	629.5	1164.3	715.8	365.7	82.8				
	Spring 2010	625.4	1168.4	678.3	399.8	90.3				
	Fall 2010	N/A	N/A							
Schinus terebinthifolius	Spring 2008	9.1	1784.7	1517.5	188.3	39.4	25.5	3.9	10.2	
	Spring 2009	9.1	1784.7	1730.7	21.3	9.0	11.0	2.9	9.9	
	Spring 2010	9.1	1784.7	1752.1	32.4			0.3		
	Fall 2010	8.9	1785.0	1752.3	32.4			0.3		
Imperata cylindrica	Spring 2008	1437.1	356.7	295.5	57.5	3.6		0.1		
	Spring 2009	1437.1	356.7	295.5	57.7	3.6				
	Spring 2010	1451.0	342.8	333.3	9.4	0.1				
	Fall 2010	1451.0	342.8	342.8						
Panicum repens	Spring 2008	1652.4	141.4	125.6	15.8	0.02				

Taxa	Year	0	Infested Acres:	<1%	1-5%	5-25%	25-50%	50-75%	75-95%	95-100%
	Spring 2009	1646.9	146.9	131.1	15.8	0.02				
	Spring 2010	1575.3	218.5	169.3	24.2	25.0				
	Fall 2010	1575.1	218.8	211.3	7.4	0.02				

Table 10: Total Acres of Exotic and Nuisance Species by Percent Cover Category at Demolition Sites and Their Buffers

Taxa	Year	0	Infested Acres:	<1%	1-5%	5-25%	25-50%	50-75%	75-95%	95-100%
Total Exotics	Spring 2008	27.2	1717.4	26.7	707.8	554.3	236.7	126.1	44.1	21.6
	Spring 2009	27.2	1717.4	31.3	705.7	551.8	225.0	145.0	57.4	1.2
	Spring 2010	25.8	1718.8	546.8	675.3	250.1	102.2	108.3	35.1	1.0
	Fall 2010	27.1	1717.5	936.7	705.3	40.7	0.7	21.2	12.9	0.0
Schinus terebinthifolius	Spring 2008	28.2	1716.4	31.9	781.3	525.8	211.9	123.8	41.0	0.7
	Spring 2009	27.7	1716.8	50.3	763.6	525.6	211.9	123.8	41.0	0.7
	Spring 2010	27.5	1717.1	723.6	554.9	243.4	88.0	85.8	20.7	0.7
	Fall 2010	27.5	1717.1	1161.3	515.5	40.3				
Imperata cylindrica	Spring 2008	1473.2	271.4	188.7	61.1	17.0	0.8	1.4	2.4	
	Spring 2009	1472.5	272.0	179.6	59.8	28.0	0.8	1.4	2.4	
	Spring 2010	1472.5	272.0	179.0	60.7	28.0	0.8	1.4	2.2	
	Fall 2010	1472.5	272.0	267.8	3.7	0.1	0.5			

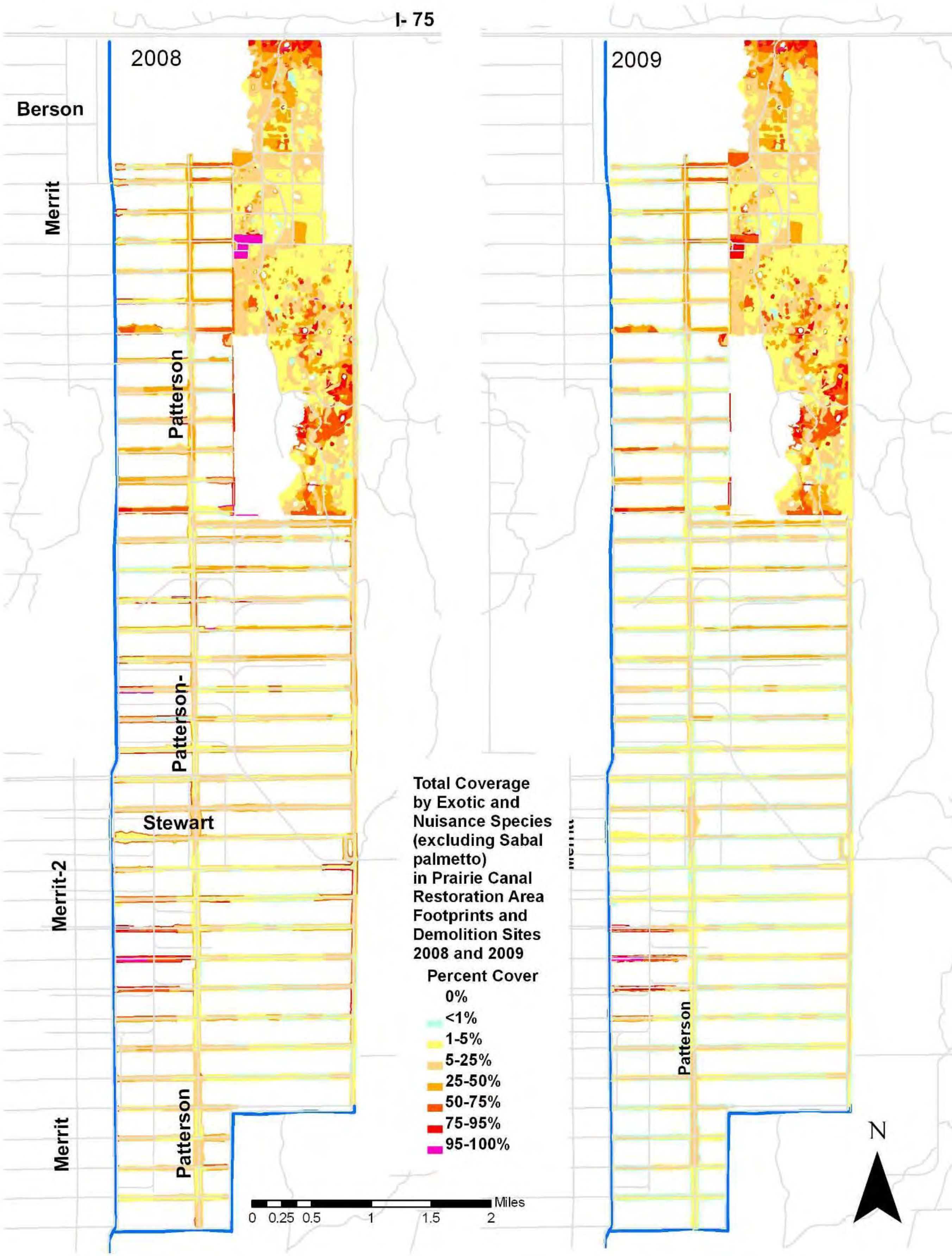
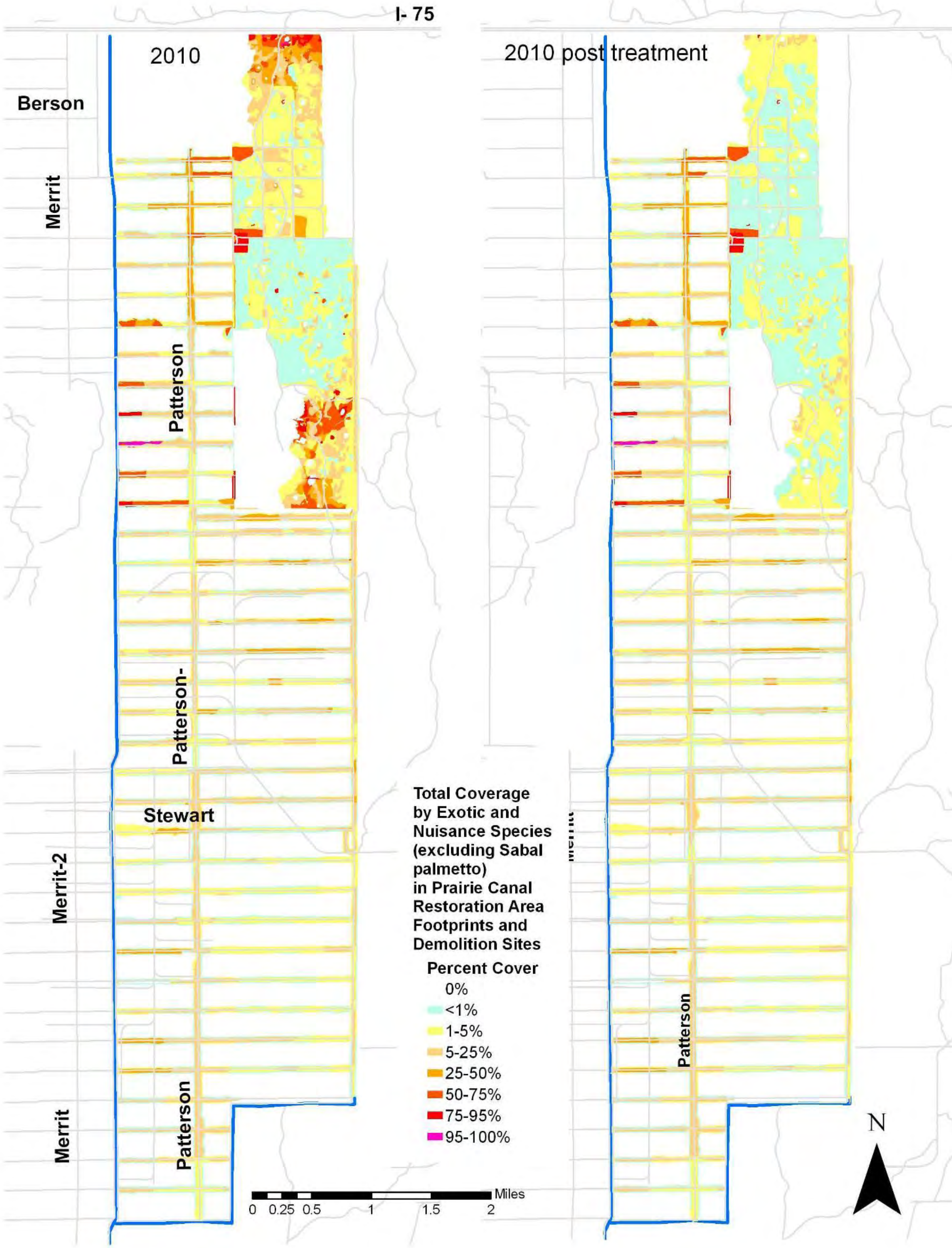

I- 75
2008
2009
Berson
Merrit
Patterson
Patterson-
Stewart
Merrit-2
Merrit
Patterson
Patterson
Total Coverage by Exotic and Nuisance Species (excluding Sabal palmetto) in Prairie Canal Restoration Area Footprints and Demolition Sites 2008 and 2009
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Miles
0 0.25 0.5 1 1.5 2
N

Figure 9



I- 75
2010
2010 post treatment
Berson
Merrit
Patterson
Patterson-
Patterson
Stewart
Merrit-2
Merrit
Patterson
Patterson
Total Coverage by Exotic and Nuisance Species (excluding Sabal palmetto) in Prairie Canal Restoration Area Footprints and Demolition Sites
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
0 0.25 0.5 1 1.5 2 Miles
N

Figure 10

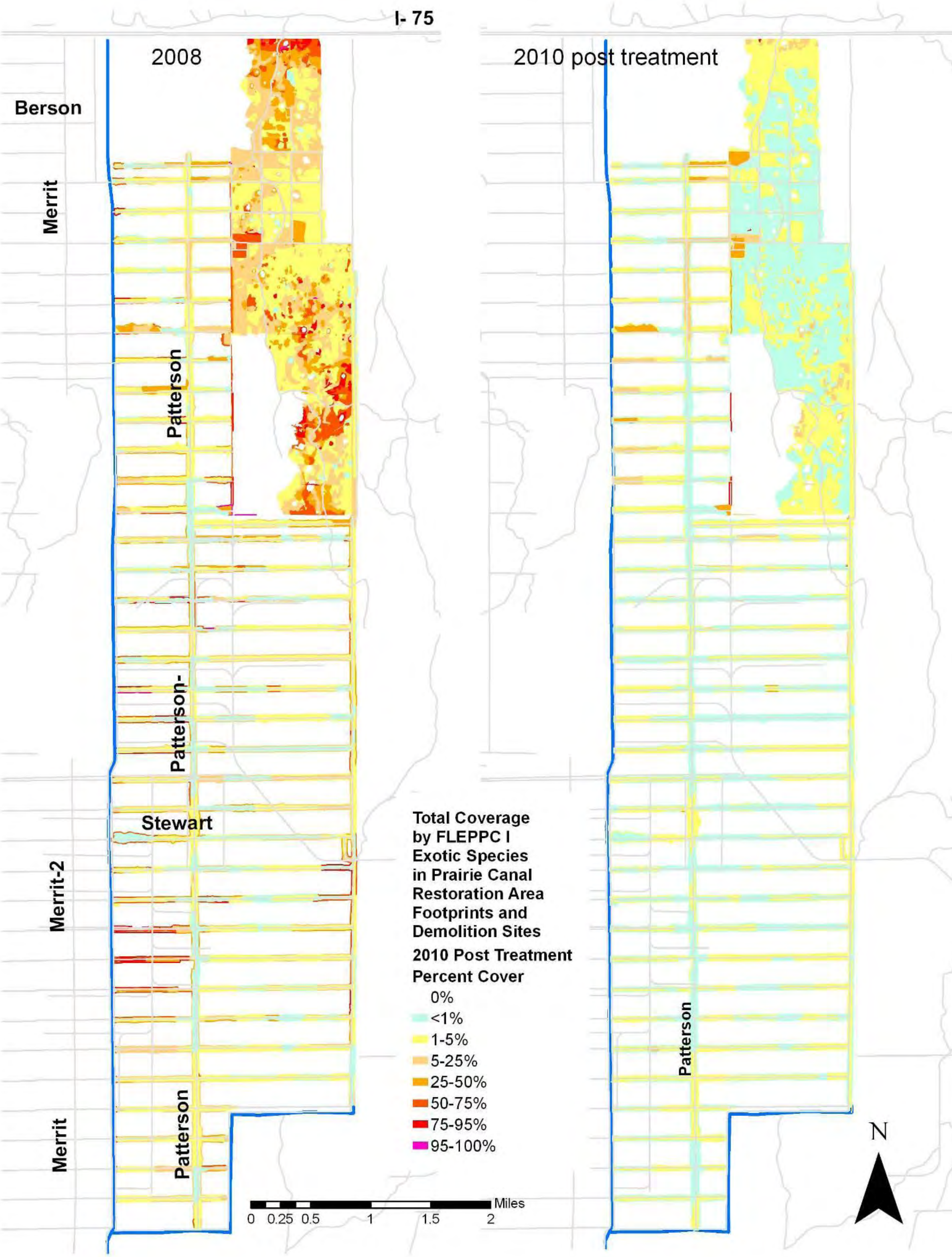

I- 75
2008
2010 post treatment
Berson
Merrit
Patterson
Patterson-
Stewart
Merrit-2
Merrit
Patterson
Patterson
Total Coverage
by FLEPPC I
Exotic Species
in Prairie Canal
Restoration Area
Footprints and
Demolition Sites
2010 Post Treatment
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Miles
0 0.25 0.5 1 1.5 2
N

Figure 11

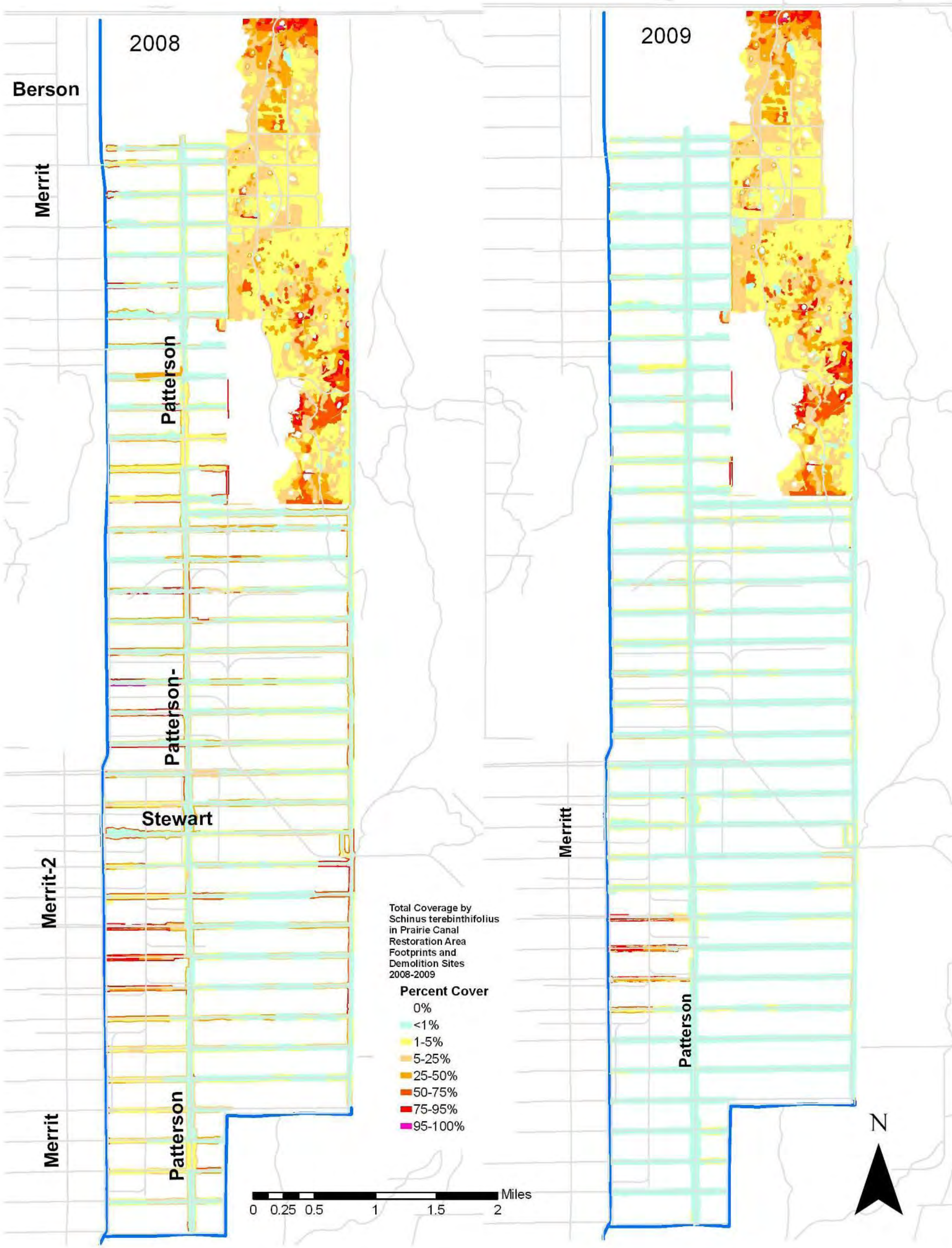

2008
2009
Berson
Merrit
Patterson
Patterson-
Patterson-
Stewart
Merrit-2
Merrit
Patterson
Merrit
Patterson
Total Coverage by Schinus terebinthifolius in Prairie Canal Restoration Area Footprints and Demolition Sites 2008-2009
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Miles
0 0.25 0.5 1 1.5 2
N

Figure 12


2010
Berson
Merrit
Patterson
Patterson-
Stewart
Merrit-2
Merrit
Patterson
Total Coverage by Schinus terebinthifolius in Prairie Canal Restoration Area Footprints and Demolition Sites 2010
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
0 0.25 0.5 1 1.5 2 Miles
2010 post treatment
Merrit
Patterson
N

Figure 13

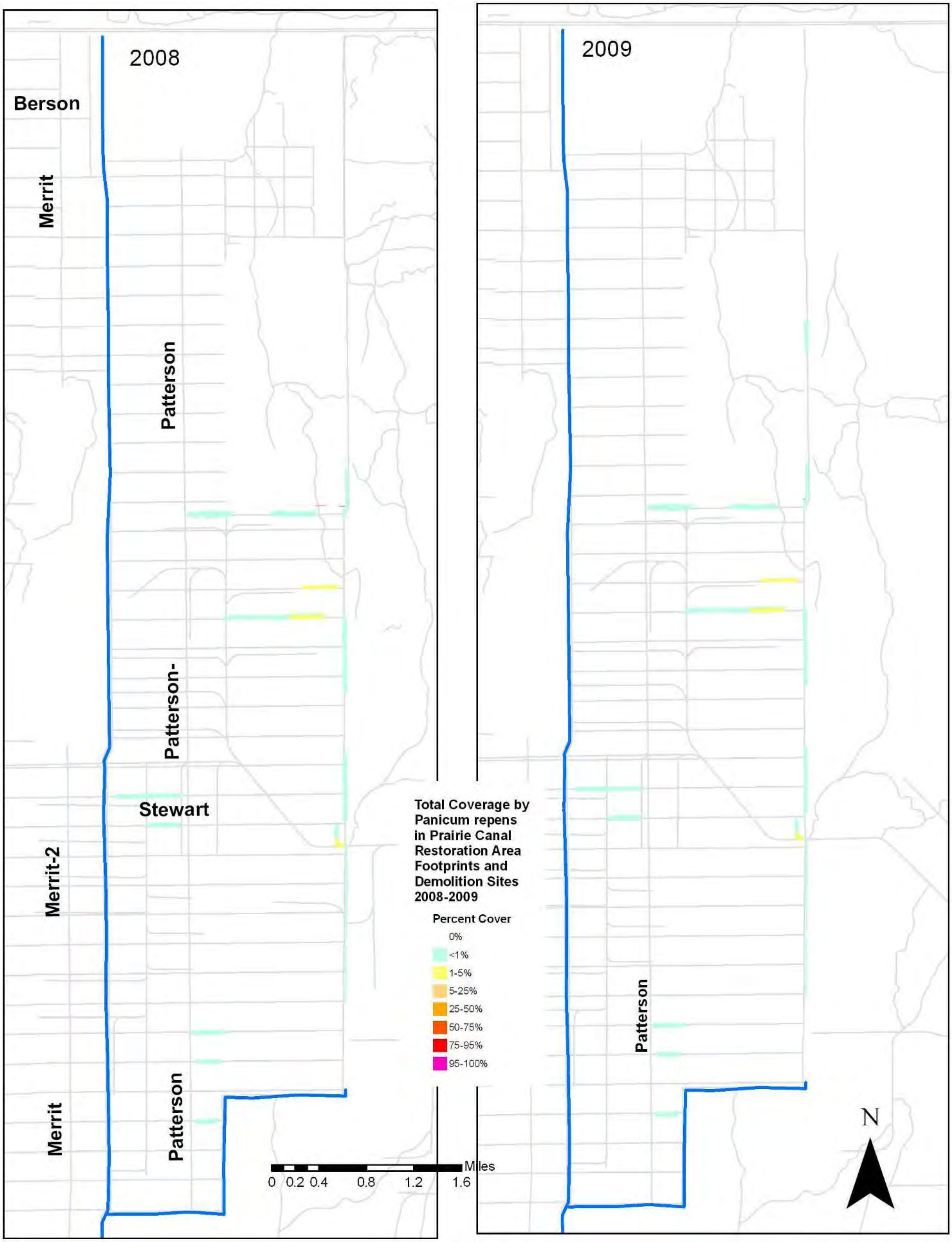

2008
Berson
Merrit
Patterson
Patterson-
Stewart
Merrit-2
Merrit
Patterson
2009
Patterson
Total Coverage by Panicum repens in Prairie Canal Restoration Area Footprints and Demolition Sites 2008-2009
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Miles
0 0.2 0.4 0.8 1.2 1.6
N

Figure 14

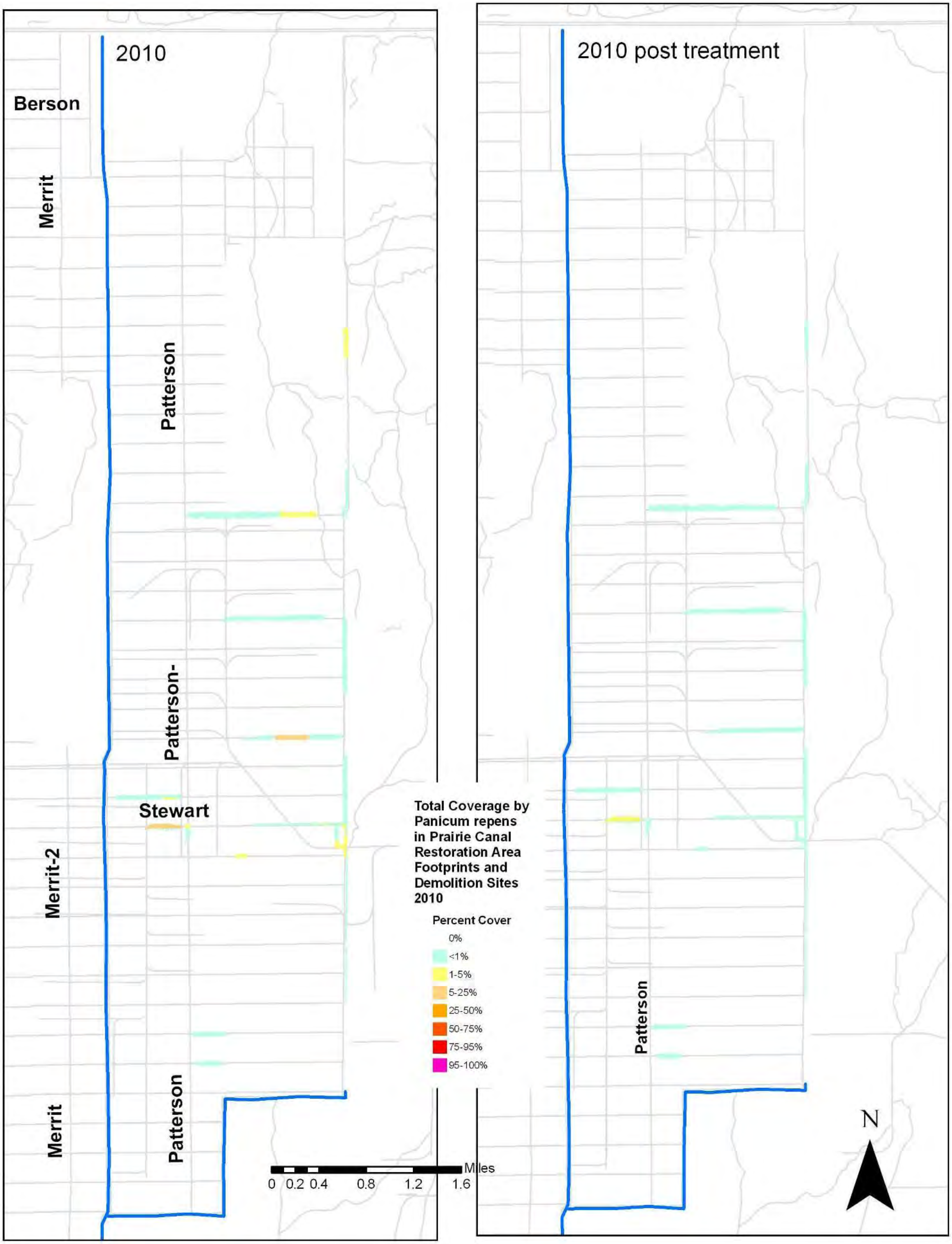

2010
Berson
Merrit
Patterson
Patterson-
Stewart
Merrit-2
Merrit
Patterson
2010 post treatment
Patterson
Total Coverage by Panicum repens in Prairie Canal Restoration Area Footprints and Demolition Sites 2010
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Miles
0 0.2 0.4 0.8 1.2 1.6
N

Figure 15

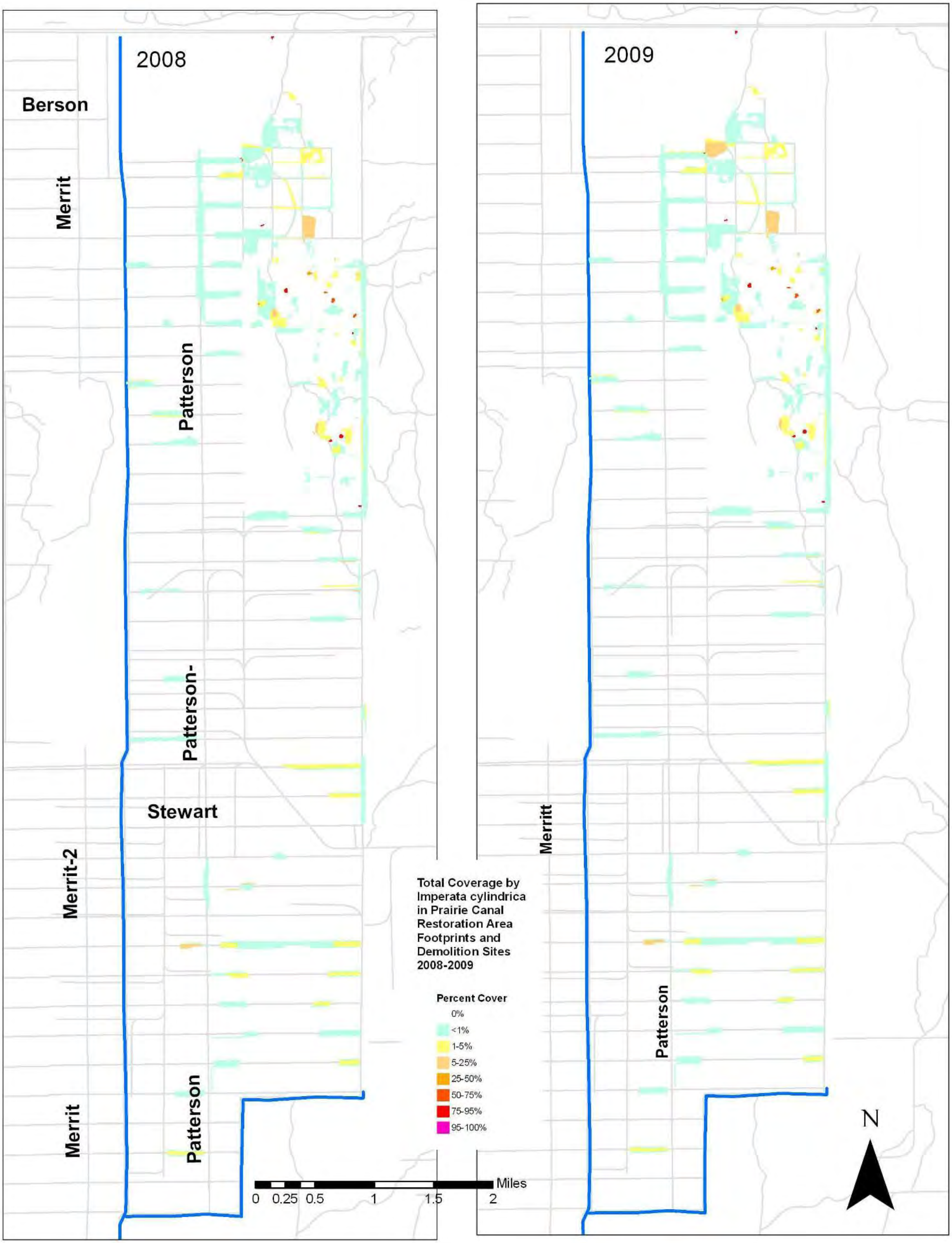

2008
Berson
Merrit
Patterson
Patterson-
Stewart
Merrit-2
Merrit
Patterson
2009
Merritt
Patterson
Total Coverage by Imperata cylindrica in Prairie Canal Restoration Area Footprints and Demolition Sites 2008-2009
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
0 0.25 0.5 1 1.5 2 Miles
N

Figure 16

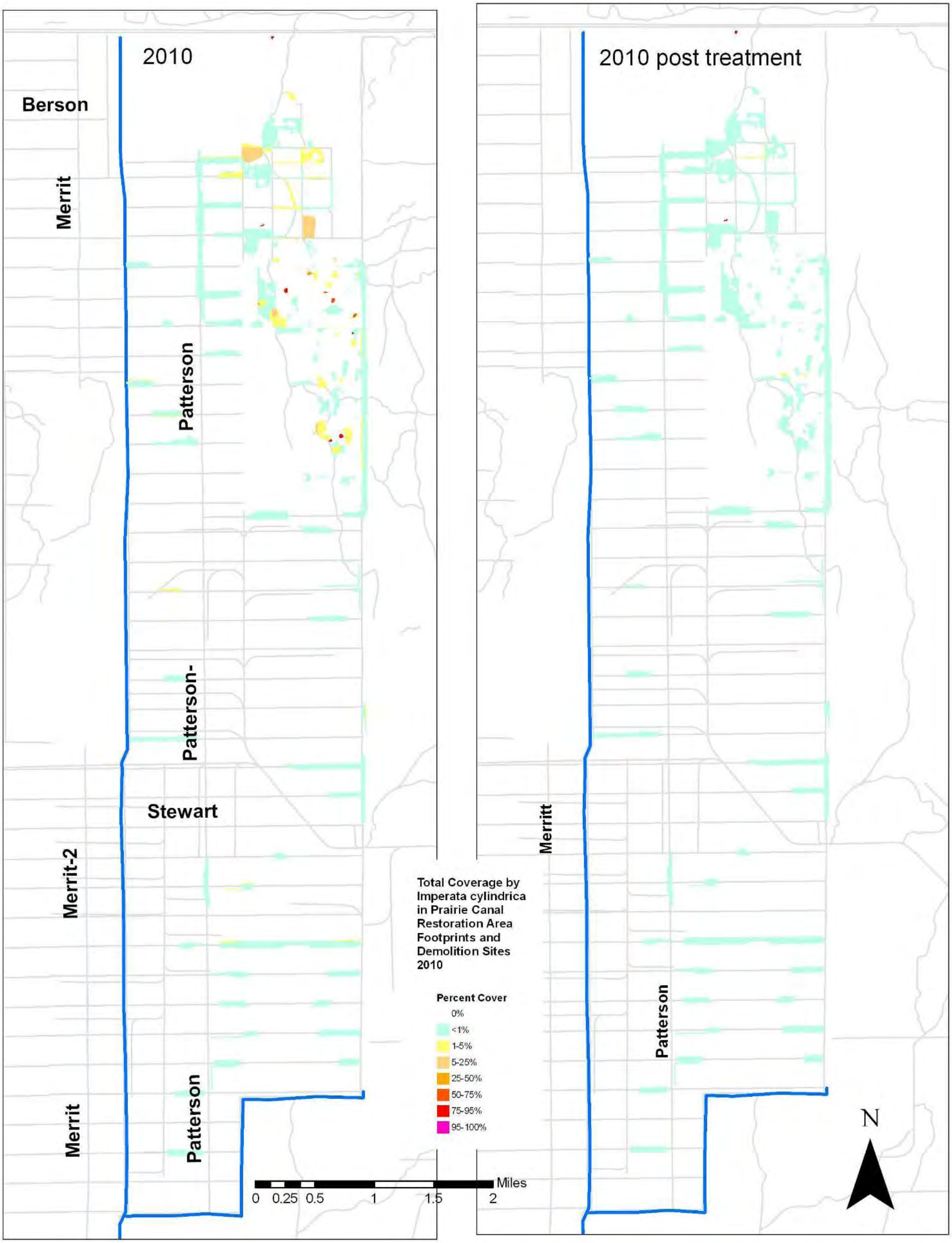

2010
Berson
Merrit
Patterson
Patterson-
Stewart
Merrit-2
Merrit
Patterson
2010 post treatment
Merritt
Patterson
Total Coverage by Imperata cylindrica in Prairie Canal Restoration Area Footprints and Demolition Sites 2010
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
0 0.25 0.5 1 1.5 2 Miles
N

Figure 17


I- 75
2008
2010 post treatment
Berson
Merrit
Patterson
Patterson-
Patterson-
Stewart
Merrit-2
Merrit
Patterson
Merritt
Patterson
Total Coverage by FLEPPC II Exotic Species in Prairie Canal Restoration Area Footprints and Selected Demolition Sites
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
0 0.25 0.5 1 1.5 2 Miles
N

Figure 18


I- 75
2008
2010 pre treatment
Berson
Merrit
Patterson
Patterson-
Stewart
Merrit-2
Merrit
Patterson
Patterson
Total Coverage by Fall Flowering Grass Species (Neyrreyn, Hyparufa, Penepurp, Paspurvi, Hetecont, Phraaust) in Prairie Canal Restoration Area Footprints and Selected Demolition Sites
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Miles
0 0.25 0.5 1 1.5 2
N

Figure 19

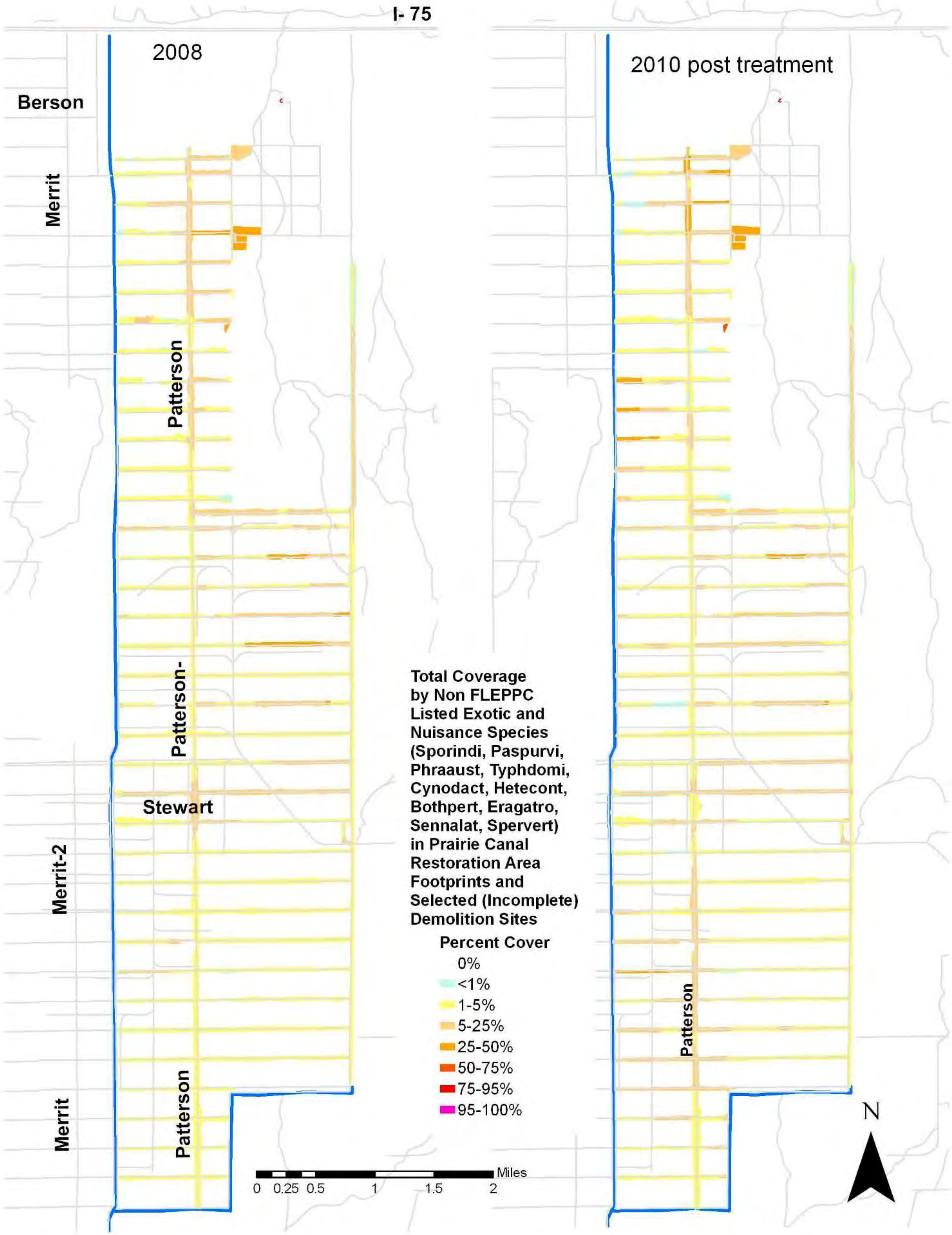

I- 75
2008
2010 post treatment
Berson
Merrit
Patterson
Patterson-
Stewart
Merrit-2
Merrit
Patterson
Patterson
Total Coverage by Non FLEPPC Listed Exotic and Nuisance Species (Sporindi, Paspurvi, Phraaust, Typhdomi, Cynodact, Hetecont, Bothpert, Eragatro, Sennalat, Spervert) in Prairie Canal Restoration Area Footprints and Selected (Incomplete) Demolition Sites
Percent Cover
0%
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Miles
0 0.25 0.5 1 1.5 2
N

Figure 20

Recommendations
Based on the results of treatment efforts discussed above, the following suggestions for treatments next fiscal year are presented below:

1. Soil remediation sites should be highest priority for treatment this fall when water recedes
2. Foliar treatments of the entire footprint targeting torpedograss and any missed fall flowering grasses and potentially natal grass should be conducted again this fall or early winter before a freeze event.
3. Re-treatment of footprint areas for Brazilian pepper can be skipped this fiscal year and be resumed the following year, unless especially dense areas are found. Cover by Brazilian pepper should be re-assessed in November by IRC.
4. The re-treatment of Brazilian pepper in the remaining roughly 600 acres the Broken Wing Ranch area which was not retreated during high water should be treated this dry season.
5. Cogongrass should be re-treated as a part of the entire footprint re-treatments for the areas in the demolition sites and buffers.
6. Foliar treatments in the spring and into the summer should again be conducted focusing on cogongrass, torpedograss and any of the remaining fall flowering grasses. It would be good to treat and do a relatively quick and immediate retreat as we did this year.
7. Foliar treatments focusing on jaraguá and other priority grasses should again be conducted in September-October 2011.
8. Finally, if at all possible, re-treatment of at least the worst hardwoods (such as lead tree) and cogongrass should be conducted next fiscal year at the treated sites of the Merritt demolition sites. If at all possible, it would be good to continue treating some of the other highly infested demolition sites as well.

References

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