Palynological Census Data from Surface Samples in South Florida

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INTRODUCTION

Understanding the distribution and abundance of pollen of various plants in modern sediments and their relationship to source plant distribution and abundance is critical for accurate interpretation of past vegetational patterns reconstructed from down-core sediments. Such evidence is particularly important for work supporting restoration efforts, in which palynological and paleobotanical analyses are used to reconstruct vegetational response to environmental changes and to guide restoration goals for a sustainable ecosystem. Such work is ongoing in south Florida, and this report summarizes the preliminary results from the first 28 of 80 surface samples collected throughout the historic Everglades, from the Water Conservation Areas south to Florida Bay. These data form a regional database of pollen distribution and abundance in surface sediments in the major vegetational types over most of the historic Everglades and supplements earlier work by Riegel (1965), covering an area from the Shark River Slough into Whitewater Bay. Such data have been used in other studies to identify modern analogs for down-core assemblages, improving the accuracy of vegetational interpretation from the pollen record (Overpeck, and others, 1985, 1992). Ultimately, this complete dataset will be used for statistical comparison with down-core pollen assemblages from the historic Everglades to determine which, if any, modern samples are close modern analogs to those deposited over the last few thousand years. This report presents assemblage data generated to date and describes the relationship between taxonomic abundance in the pollen record and standing vegetation based on this initial dataset.

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METHODS OF INVESTIGATION

Two types of surface samples were acquired: samples from short push cores collected solely for analysis of the surface centimeter of peat and samples from the tops of piston cores collected as parts of other studies. The sample sites were selected to cover a maximum area and number of vegetational types (Figure 1, Table 1). Short peat cores were collected by moving

Figure 1: Location of Surface Sample Sites in Southern Florida. Squares Indicate Sites Analyzed in this Report. Numbers Correspond to Localities described in Table 1.

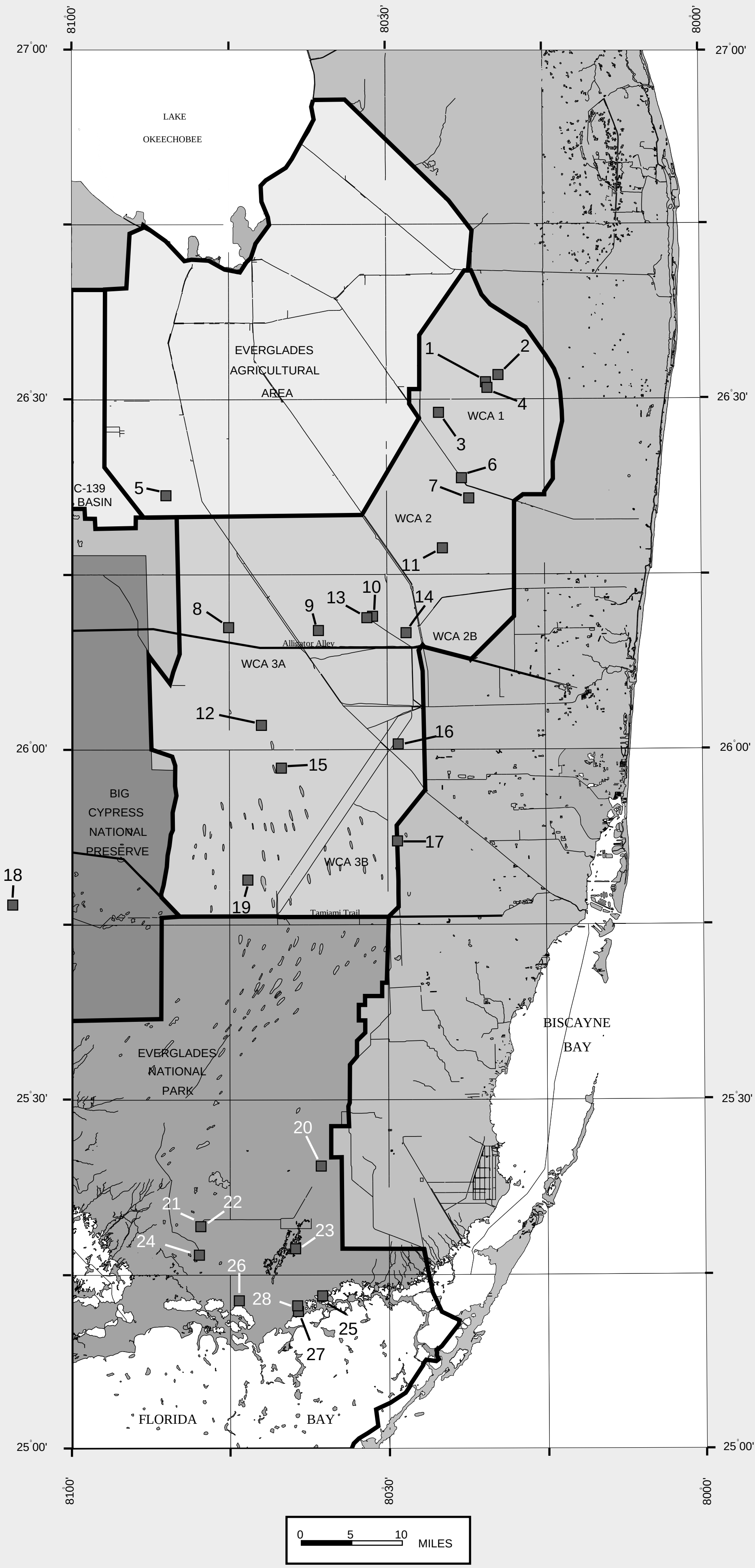

Table 1. Sample localities in southern Florida and vegetation present at each site.

Map ID	Site Name	Site Location	Latitude	Longitude	Vegetation Type	Disturbance
7	Site F1	WCA 2A	26°16.892'N	80°18.407'W	Cattail marsh, monospecific stanc	Canal/levee
6	USGS Gage 15	North WCA 2A	26°23.23'N	80°22.85'W	Cattail marsh near canal, with *Eichornia,* grasses and sedges	Canal/levee
25	Mud Creek Site 1	Mud Creek, ENP	25°13.191'N	80°36.279'W	Dwarf mangrove swamp, primarily *Rhizophora*	Isolated
27	Taylor Creek Site 1A	Taylor Creek, ENP	25°11.863'N	80°38.598'W	Dwarf mangrove swamp, primarily *Rhizophora*	Isolated
28	Taylor Creek Site 2	Taylor Creek, ENP	25°12.339'N	80°38.641'W	Dwarf mangrove swamp, primarily *Rhizophora*	Isolated
19	USGS Gage 65	South WCA 3A	25°48.86'N	80°43.20'W	Sawgrass Marsh, with open water areas with *Nymphaea,*	Monitoring station
					Utricularia, and periphyton	
15	CA315 (AAS)	WCA 3A	25°58.455'N	80°40.129'W	Sawgrass marsh, with *Nymphaea* and *Sagittaria*	Monitoring station
12	WCA 3A Site 3-4-4	South WCA 3A	26°02.146'N	80°28.165'W	Sawgrass Marsh near tree island, with *Nymphaea*	Isolated
9	WCA 3A Site 3-4-3	WCA 3A	26°10.213'N	80°36.525'W	Sawgrass Marsh, with *Sagittaria* and some *Typha; Salix and bays nearby.*	Isolated
8	USGS Gage 62	West WCA 3A	26°10.46'N	80°45.09'W	Sawgrass Marsh, with *Sagittaria, Nymphaea, Typha* and *Utricularia*	Monitoring station
13	USGS Gage 63	Northeast WCA 3A	26°11.32'N	80°31.86'W	Sawgrass Marsh, with *Sagittaria* and *Nymphaea*	Monitoring station
10	WCA 3A Site 3-4-2	East WCA 3A	26°11.402'N	80°31.386'W	Broad Leaf Marsh near tree island with *Sagittaria, Utricularia, Cladium,*	Isolated
					Typha, and *Salix*	
16	USGS Gage 76	North WCA 3B	25°00.45'N	80°28.96'W	Sawgrass Marsh, with *Sagittaria* and *Nymphaea,* scattered	Monitoring station
					Typha. Periphyton present	
17	USGS Gage 34	East WCA 3B	25°52.15'N	80°29.10'W	Sawgrass marsh near Canal, with some *Nymphaea* and *Sagittaria.*	Monitoring station
					Melaleuca island nearby	
3	EPA Site 7	Loxahatchee NWR	26°28.873'N	80°24.930'W	Sawgrass marsh with *Nymphaea*	Monitoring station
23	Taylor Slough Site 7	Taylor Slough	25°17.231'N	80°38.780'W	Sawgrass marsh, with *Nymphaea,* some *Rhizophora,* and periphyton	Isolated
20	Taylor Slough Site 2	North Taylor Slough	25°24.306'N	80°38.598'W	Sawgrass Marsh, with *Sagittaria* and periphyton	Isolated
24	Loop Road Site 3	Southwest ENP	25°16.718'N	80°47.713'W	Sawgrass Marsh, with short sparse *Cladium,* dwarf *Rhizophora,*	Near road
					Myrica, Cocoplum, grasses and sedges. Periphyton abundant	
22	Loop Road Site 1	Southwest ENP	25°19.169'N	80°47.713'W	Sawgrass Marsh, *Taxodium, Sagittaria* and *Yucca* (rare)	Near road
5	Rotenberger Site 1	Rotenberger WMA	26°21.800'N	80°50.946'W	Sawgrass Marsh (short *Cladium), Smilax, Pontederia,*	Isolated
					Potamogeton and *Scirpus*	
26	Taylor Slough Site 14	Mid Taylor Slough	25°12.778'N	80°44.184'W	Sawgrass Marsh, with *Rhizophora, Sagittaria* and *Typha*	Isolated
14	WCA 3A Site 3-4-1	East WCA 3A	26°10.012'N	80°28.165'W	Mixed sawgrass-Cattail marsh near Canal, with *Sagittaria* and *Nymphaea*	Canal/levee
11	Site U3	WCA 2A	26°17.250'N	80°24.680'W	Mixed sawgrass-cattail marsh	Monitoring station
1	Loxahatchee Site [illegible]	Loxahatchee NWR	26°31.008'N	80°20.340'W	Water Lily slough. *Nymphaea* dominant with *Panicum* and	Isolated
					Cladium fringe	
2	Loxahatchee Site 4	Loxahatchee NWR	26°31.365'N	80°20.522'W	Water Lily slough near tree island. *Nymphaea* dominant	Isolated
21	Loop Road Site 2	Southwest ENP	25°19.169'N	80°47.911'W	Hardwood hammock periphery, with *Cladium, Sagittaria, Utricularia,*	Near road
					Cypress, Ferns, *Chrysobalanus* and *Myrica*	
4	Loxahatchee Site 3	Loxahatchee NWR	26°31.365'N	80°20.340'W	Tree island periphery, with Bays *Ilex, Salix, Myrica* and ferns	Isolated
18	Big Cypress Site 4-1-1	Big Cypress Preserve	25°46.769'N	81°5.43'W	Cypress strand with scrub oaks and bromeliad	Near Loop Road

aside as much surface vegetation as possible and beginning the core at the actual peat surface. The short push cores (< 1 foot long) were collected in 4-inch core barrels, capped and transported to the laboratory facilities. Sampling was accomplished by extruding the core slowly to drain off surface water and removing the surface 1 cm of peat as the surface sample. When substantial periphyton (floating algal mats consisting of green- and blue-green algae and diatoms) was present, this was sampled separately and labeled as such. For surface samples from piston cores, the top sample was used, which either was 1 cm or 2 cm thick, depending on the sampling strategy for the core. At each surface sample site, notes on surrounding vegetation, and the proximity to disturbance were made, and these are provided along with locality information in Table 1 for all sites discussed in this report.

Peat samples weighing approximately 0.5 g were used for pollen preparation. Samples were dried and weighed before being spiked with Lycopodium marker tablets for calculation of absolute pollen concentrations (Stockmarr, 1971). Samples were treated with dilute HCl to dissolve the marker tablet, neutralized with deionized water, and rinsed twice with glacial acetic acid to dry the material for acetolysis. Samples were acetolyzed in a hot water bath for 10 minutes, neutralized, and treated with 10% KOH in a hot water bath for 15 minutes. After neutralization, the samples were sieved with 149 µm and 10 µm nylon mesh to remove extraneous plant material and clay-sized particles. Some samples were run through a heavy-liquid separation with ZnCl2 (S.G. = 2.1) to remove sand and other mineral matter. The pollen residue was mixed with warm glycerine jelly and mounted on microscope slides for examination.

Absolute pollen concentrations were calculated using the marker-grain method described by Benninghoff (1962). Marker tablets of Lycopodium spores were the source of the exotic grains, and the quantity of Lycopodium spores in the marker tablets was determined by the manufacturer with a Coulter Counter following the procedures of Stockmarr (1973). The concentration of spores in these tablets is 12,542 +/- 416.

Absolute pollen concentration was calculated using the formula (Maher, 1981):

pollen per gram dry sediment =

((pollen grains counted/marker grains counted) x 12,542)/weight of sediment.

To calculate percent abundance, at least 100 grains were counted per sample. Ideally, 300 grains were counted, but in some samples the high proportion of phytodebris compared to pollen made acceptance of lower numbers necessary. Percent abundance of each taxon is provided in Table 2.

ANALYSIS AND DISCUSSION OF SURFACE SAMPLE DATA

The Q-mode cluster analysis using the Pearson correlation coefficient and average linkage (Fig. 2) resulted in definition of two sample groupings. There are three outliers, representing single samples from distinct vegetational assemblages; in each, more than half the assemblage is comprised of a diagnostic taxon. The first outlier represents a bay-holly tree island from Loxahatchee NWR and includes 64% Ilex (holly) pollen. The second was collected in a cypress strand in Big Cypress National Preserve and has 52% TCT (Taxodiaceae/Cupressaceae/Taxaceae) pollen, and the third was collected in a broad-leaf marsh in WCA 3A and is characterized by 59% Sagittaria (arrowhead) pollen. As further samples from

Table 2. Percent abundance of pollen taxa found in surface samples of peats, southern Florida

SAMPLE SITE	**TREES AND SHRUBS**	*Acer* (maple)	*Alnus* (alder)	*Annonaceae* (pond apple)	*Avicennia* (black mangrove)	*Betula* (birch)	*Bumelia* (buckthorn)	*Bursera* (gumbo limbo)	*Carya* (hickory)	*Casuarina* (Australian pine)	*Celtis* (hackberry)	*Cephalanth* us (button bush)	cf. *Planera* (planer tree)	*Conocarpus* (buttonwood)	*Diospyros* (persimmon)	*Fraxinus* (ash)	*Ilex* (holly)	*Liquidambar* (sweetgum)
USGS Gage 15		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
USGS Gage 34		0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
USGS Gage 65		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.67	0.00	0.00	0.00	0.00	0.00	0.00
USGS Gage 63		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
USGS Gage 76		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.19	0.00	0.00	0.00	0.00	0.00	0.00
USGS Gage 62		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.93	0.00	0.00	0.00	0.48	0.00	0.00
WCA 3A Site 3-4-1		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WCA 3A Site 3-4-2		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WCA 3A Site 3-4-3		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WCA 3A Site 3-4-4		0.00	0.63	0.00	0.00	0.00	0.31	0.00	2.19	0.63	0.00	0.31	0.31	0.00	0.00	0.00	0.00	0.00
Loxahatchee Site 1		0.00	0.38	0.00	0.00	0.00	0.00	0.00	2.30	1.92	0.00	0.00	0.00	0.00	0.00	0.00	6.90	0.00
Loop Road Site 2		0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	3.33	0.00	0.00	1.11	0.00	0.37	0.00
Loxahatchee Site 3		0.00	0.67	0.00	0.00	0.00	0.00	0.00	0.34	0.67	0.34	0.00	0.00	0.00	0.00	0.00	63.76	0.00
Loxahatchee Site 4		0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.15	0.77	0.38	0.00	0.00	0.00	0.00	0.00	4.62	0.00
Loop Road Site 3		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.18	0.00	0.00	0.00	0.00	3.24	0.00
Loop Road Site 1		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.00
Taylor Creek Site 1A		0.00	0.49	0.00	1.46	0.00	0.98	2.93	1.95	0.98	0.00	0.00	0.00	1.95	0.00	0.00	1.46	0.49
Taylor Slough Site 2		0.29	0.00	0.86	0.00	0.00	0.00	0.00	0.57	0.00	0.00	2.59	0.00	0.00	0.00	0.00	0.29	0.00
Taylor Slough Site 14		0.00	0.74	0.00	0.00	0.00	1.47	0.00	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00
Rotenberger Site 1		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Taylor Slough Site 7		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.00	0.92	0.00	0.00	0.00	0.00	2.29	0.00
CA315 (AAS)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	2.10	0.00	11.68	0.00	0.00	0.00	0.00	0.00	0.00
Big Cypress Site 4-1-1		0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EPA Site 7		0.00	0.28	0.00	0.00	0.00	0.00	0.28	0.28	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00
Mud Creek Site 1		0.00	0.00	0.00	1.37	1.37	0.00	0.00	0.00	5.48	1.37	0.00	0.00	1.37	0.00	0.00	0.00	0.00
Site F1		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Site U3		0.00	0.00	0.00	0.00	0.00	0.56	0.00	1.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Taylor Creek Site 2		0.00	1.55	0.00	2.33	0.00	0.00	0.00	6.98	3.88	0.00	0.00	0.00	3.88	0.00	0.00	0.00	0.00

Table 2. Percent abundance of pollen taxa found in surface samples of peats, southern Florida

SAMPLE SITE	*Liriodendr* on (tulip tree)	*Magnolia* (magnolia)	*Melaleuca* (Melaleuca)	*Myrica* (wax myrtle)	*Nyssa* (tupelo)	Palmae (palm family)	*Pinus* (pine)	*Quercus* (oak)	*Rhizophora* (red mangrove)	*Salix* (willow)	*Schinus* (pepper tree)	Taxodiaceae/Cupressaceae/Taxac (cypress, juniper, yew)	*Ulmus* (elm)	**HERBACEOUS PLANTS**	Asteraceae (Low-spined Type)	Asteraceae (high-spined type)	Asteraceae indet. (aster family)
USGS Gage 15	0.00	0.00	0.00	1.42	0.00	0.00	3.56	1.07	0.00	3.91	0.00	0.00	0.00		1.78	0.36	0.00
USGS Gage 34	0.00	0.56	0.00	0.56	0.00	0.00	27.53	2.81	0.00	0.00	0.00	0.00	0.00		1.12	0.00	1.12
USGS Gage 65	0.00	0.00	0.00	5.00	0.00	0.00	55.00	1.67	0.00	1.67	0.00	0.00	0.00		5.00	0.00	0.00
USGS Gage 63	0.00	0.00	0.00	0.66	0.00	0.00	5.28	0.33	0.00	0.00	0.00	0.00	0.00		1.65	0.66	1.65
USGS Gage 76	0.00	0.00	0.00	0.88	0.00	0.00	28.32	2.21	0.00	1.33	0.00	0.00	0.00		1.33	0.00	0.44
USGS Gage 62	0.00	0.00	0.00	3.38	0.00	0.00	21.26	0.48	0.00	0.00	0.00	0.00	0.00		8.21	1.45	4.83
WCA 3A Site 3-4-1	0.00	0.00	0.00	2.37	0.00	0.00	5.62	1.18	0.00	0.00	0.00	0.00	0.00		1.48	0.59	0.00
WCA 3A Site 3-4-2	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00
WCA 3A Site 3-4-3	0.00	0.00	0.00	2.28	0.00	0.00	4.11	1.83	0.00	0.00	0.00	0.00	1.37		0.91	0.00	0.91
WCA 3A Site 3-4-4	0.00	0.00	0.00	27.90	0.00	0.00	35.42	4.70	0.00	0.00	0.00	0.00	0.63		2.82	0.31	0.31
Loxahatchee Site 1	0.38	0.00	0.00	24.14	0.00	0.38	22.22	3.83	0.00	0.77	0.00	0.00	0.00		5.75	0.00	0.00
Loop Road Site 2	0.00	0.00	0.00	35.93	0.00	0.00	8.52	1.11	0.00	0.74	0.00	0.00	0.00		2.59	21.85	12.22
Loxahatchee Site 3	0.00	0.00	0.00	23.83	0.00	0.00	1.68	1.34	0.00	0.00	0.00	0.00	0.00		1.68	0.00	1.01
Loxahatchee Site 4	0.00	0.00	0.00	17.31	0.00	0.00	25.00	1.92	0.00	0.00	0.00	0.38	0.00		9.62	0.38	0.38
Loop Road Site 3	0.00	0.00	0.00	34.41	0.29	0.00	39.12	2.06	0.29	0.29	0.00	0.29	0.00		4.12	0.59	0.00
Loop Road Site 1	0.00	0.00	0.00	18.54	0.00	0.00	60.93	3.31	1.99	0.00	0.00	0.00	0.00		5.30	2.65	0.00
Taylor Creek Site 1A	0.00	0.00	0.00	34.63	0.00	0.00	13.17	2.93	7.80	0.00	0.00	0.00	0.00		1.95	4.39	0.00
Taylor Slough Site 2	0.00	0.00	0.29	6.90	0.00	0.00	18.10	4.60	1.15	0.57	0.00	0.29	0.29		13.22	10.34	0.86
Taylor Slough Site 14	0.00	0.00	0.00	56.25	0.00	0.00	5.15	3.31	4.04	0.00	0.00	0.00	0.00		3.31	1.10	0.00
Rotenberger Site 1	0.00	0.00	0.00	0.66	0.00	0.00	21.05	0.33	0.00	0.00	0.00	0.00	0.00		0.99	1.64	0.33
Taylor Slough Site 7	0.00	0.00	0.00	11.00	0.00	0.00	50.50	5.96	0.00	0.00	0.00	0.92	0.00		12.39	0.46	0.46
CA315 (AAS)	0.00	0.00	0.00	8.68	0.00	0.00	9.28	3.29	0.00	0.60	0.00	0.00	0.00		5.99	3.29	0.30
Big Cypress Site 4-1-1	0.00	0.00	0.00	3.45	0.00	0.00	25.86	5.17	0.00	1.72	0.00	####	0.00		1.72	1.72	5.17
EPA Site 7	0.00	0.00	0.00	7.54	0.00	0.00	17.60	1.12	0.00	0.00	0.00	0.00	0.00		8.94	2.51	0.56
Mud Creek Site 1	0.00	0.00	0.00	5.48	0.00	0.00	32.88	12.33	5.48	1.37	0.00	0.00	0.00		1.37	0.00	4.11
Site F1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.00		0.28	0.83	0.28
Site U3	0.00	0.00	0.00	2.22	0.00	0.00	18.33	6.11	0.00	0.00	0.00	0.00	0.00		15.56	1.67	1.11
Taylor Creek Site 2	0.00	0.00	0.00	8.53	0.00	0.00	21.71	8.53	11.63	0.00	0.78	0.00	0.00		0.00	0.00	6.20

Table 2. Percent abundance of pollen taxa found in surface samples of peats, southern Florida

SAMPLE SITE	Chenopodiaceae/Amaranthaceae (pigweed family)	*Cladium* (sawgrass)	Cyperaceae (non-*Cladium*) (sedge	*Cyrilla* (Cyrilla)	*Decodon* (swamp loosetrife)	Ericaceae (heath family)	Euphorbiaceae (spurge family)	*Hippocratea*	Leguminosae (bean family)	*Myriophyll* um (water milfoil)	*Nuphar* (spatter dock)	*Nymphaea* (water lily)	Onagraceae (primrose family)	Poaceae (grass family)	Polygalaceae (polygala family)	Polygonaceae (knotweed family)	*Sagittaria* (arrowhead)
USGS Gage 15	78.65	0.00	1.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.78	0.00	1.42	0.00	1.07	0.36
USGS Gage 34	50.56	0.00	2.81	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	5.06	0.00	0.56	0.00	0.00	3.93
USGS Gage 65	3.33	0.00	3.33	0.00	0.00	0.00	0.00	0.00	3.33	0.00	0.00	13.33	0.00	0.00	0.00	0.00	0.00
USGS Gage 63	83.17	0.00	0.99	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.66	0.00	0.33	1.98
USGS Gage 76	38.94	0.00	2.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.33	0.00	0.44	0.00	0.88	6.19
USGS Gage 62	37.68	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.97	0.00	0.00	0.00	2.42	8.21
WCA 3A Site 3-4-1	43.20	19.53	0.59	0.00	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	0.00	2.07	0.00	11.24	5.33
WCA 3A Site 3-4-2	90.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.37	0.00	3.02	1.37
WCA 3A Site 3-4-3	8.68	3.20	1.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.37	0.00	0.00	58.90
WCA 3A Site 3-4-4	8.78	2.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.39	0.00	3.13	0.00	1.25	0.00	0.00	0.63
Loxahatchee Site 1	18.77	2.30	1.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.07	0.00	1.53	0.00	0.00	0.00
Loop Road Site 2	1.48	1.85	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	3.33	0.00	0.00	1.48
Loxahatchee Site 3	0.34	0.34	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.01	0.00	0.67	0.00	0.00	0.00
Loxahatchee Site 4	28.08	1.92	1.54	0.00	0.00	0.38	0.00	0.00	0.38	0.00	0.00	3.08	0.00	0.38	0.00	0.38	0.38
Loop Road Site 3	3.53	0.00	2.94	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	5.59	0.00	0.00	0.59
Loop Road Site 1	3.31	0.66	1.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66
Taylor Creek Site 1A	2.44	0.49	0.00	0.00	0.49	0.00	4.39	0.00	6.83	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00
Taylor Slough Site 2	8.05	2.30	2.87	0.00	0.00	0.00	0.29	0.00	1.72	0.00	0.00	0.00	0.00	6.03	0.00	0.29	7.76
Taylor Slough Site 14	2.21	4.41	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	0.00	0.00	0.37
Rotenberger Site 1	15.13	3.29	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.00	13.16	0.00	2.63	0.00	1.32	6.91
Taylor Slough Site 7	4.13	1.38	3.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92	0.00	0.00	3.67
CA315 (AAS)	13.47	0.60	11.40	0.00	0.00	0.00	0.00	0.30	1.80	0.00	0.30	2.99	0.00	3.89	0.00	0.60	5.09
Big Cypress Site 4-1-1	3.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.72	0.00	0.00	0.00
EPA Site 7	32.12	8.38	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84	0.00	0.00	0.84
Mud Creek Site 1	4.11	5.48	0.00	0.00	2.74	0.00	0.00	0.00	1.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Site F1	79.61	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Site U3	33.33	12.78	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	0.56	0.00	0.00	0.00	0.00	1.11
Taylor Creek Site 2	7.75	0.78	0.00	0.78	0.00	0.00	3.88	0.00	4.65	0.00	0.00	0.78	0.00	0.78	0.00	0.00	0.00

Table 2. Percent abundance of pollen taxa found in surface samples of peats, southern Florida

SAMPLE SITE	*Typha* (cattail)	*Umbelliferae (parsley family)*	*Utricularia* (bladderwort)	Total pollen counted	Pollen concentration (pollen/gram dry sediment)
USGS Gage 15	3.20	0.00	0.00	285	44,681
USGS Gage 34	0.00	0.56	0.56	181	113,505
USGS Gage 65	0.00	0.00	0.00	61	6,349
USGS Gage 63	0.66	0.33	0.00	306	142,143
USGS Gage 76	8.85	0.44	0.00	226	77,657
USGS Gage 62	8.21	0.00	0.00	207	77,498
WCA 3A Site 3-4-1	4.73	0.00	0.30	345	131,121
WCA 3A Site 3-4-2	0.27	0.00	0.00	364	#######
WCA 3A Site 3-4-3	12.79	0.00	0.91	224	114,204
WCA 3A Site 3-4-4	0.94	0.63	0.31	331	399,173
Loxahatchee Site 1	0.77	0.00	0.77	269	108,135
Loop Road Site 2	0.74	0.00	0.00	290	40,413
Loxahatchee Site 3	0.00	0.00	0.00	304	433,269
Loxahatchee Site 4	0.77	0.00	0.38	278	290,556
Loop Road Site 3	1.18	0.00	0.00	343	22,129
Loop Road Site 1	0.66	0.00	0.00	173	3,241
Taylor Creek Site 1A	0.00	0.00	0.49	221	42,774
Taylor Slough Site 2	0.29	1.72	0.57	375	17,681
Taylor Slough Site 14	14.34	0.00	0.00	212	12,619
Rotenberger Site 1	29.61	0.00	0.66	314	76,470
Taylor Slough Site 7	0.92	0.00	0.00	218	6,004
CA315 (AAS)	0.30	0.30	0.30	334	119,667
Big Cypress Site 4-1-1	0.00	0.00	0.00	---------	---------------
EPA Site 7	0.56	0.00	0.00	358	374,170
Mud Creek Site 1	0.00	0.00	0.00	75	11,471
Site F1	14.60	0.00	0.00	365	653,976
Site U3	1.11	0.00	0.00	188	88,977
Taylor Creek Site 2	3.10	0.00	0.00	137	11,780

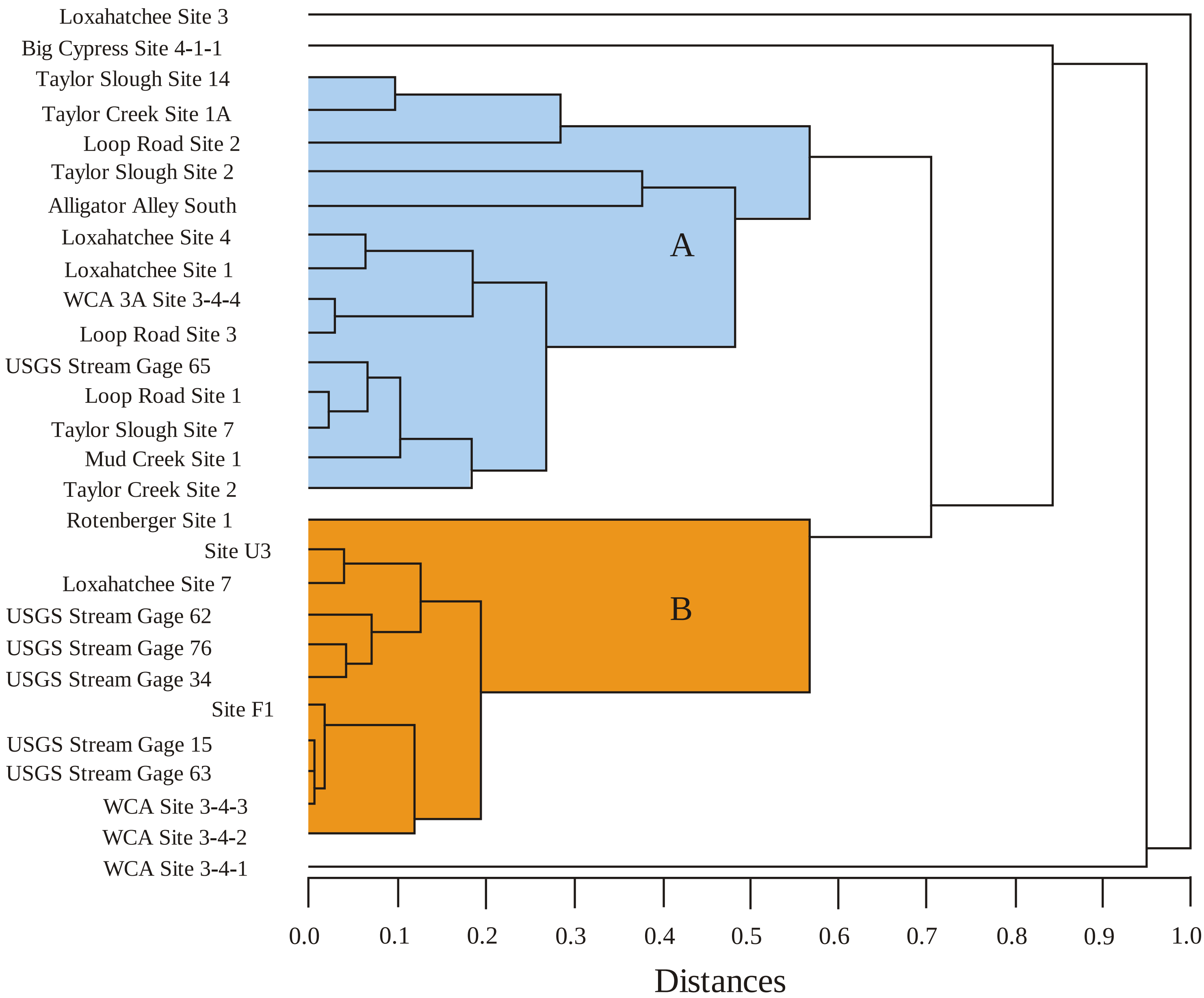

Figure 2: Cluster diagram from Q-mode cluster analysis of 28 surface samples, southern Florida.

these vegetation types are analyzed, the robustness of these assemblages will be determined.

The two clusters can be broadly characterized as those from the Water Conservation Areas north of Alligator Alley, which primarily consist of "disturbed" sites at monitoring stations and near canals, levees, and airboat trails (Cluster B) and those collected in relatively undisturbed, "pristine" localities, primarily south of Alligator Alley (Cluster A). Sample sites in Cluster B represent both sawgrass and cattail marsh vegetation; these samples are characterized by high percentages (30-90%) of Chenopodiaceae/ Amaranthaceae (pigweed) pollen with varying proportions of Cladium (sawgrass) and Asteraceae (aster) pollen. Sample sites in Cluster A include sawgrass marsh, mixed sawgrass marsh/slough, and dwarf mangrove vegetation, and this cluster is characterized by high percentages (usually 10%) of Myrica (wax myrtle) pollen and low percentages (<10%) of pigweed pollen. The higher proportion of Myrica in Cluster A is due to sample proximity to either tree islands (both the bay/holly islands of Loxahatchee NWR and those found in the southern part of the region), the Buttonwood Embankment along Florida Bay, or roads, which frequently are lined by wax myrtle.

The R-mode cluster analysis (Fig. 3) shows two broad groupings of taxa. Cluster A includes relatively mesic taxa that are characteristic of tree islands, mangrove fringe environments, or wet prairies. Cluster B includes marsh and slough taxa, typical of environments with moderate to long hydroperiods. Within Cluster A, there are three groupings that correlate with vegetation type. Group A1 includes Myrica, Bumelia (buckthorn), and Bursera (gumbo limbo), which are most common in hardwood hammocks and maritime forests (Snyder et al, 1994; Johnson and Barbour, 1994). Group A2 consists of mangrove taxa [Rhizophora (red mangrove), Avicennia (black mangrove), and Conocarpus (buttonwood)], which are the dominant vegetation in the saline-influenced mangrove fringe along Florida Bay (Odum and

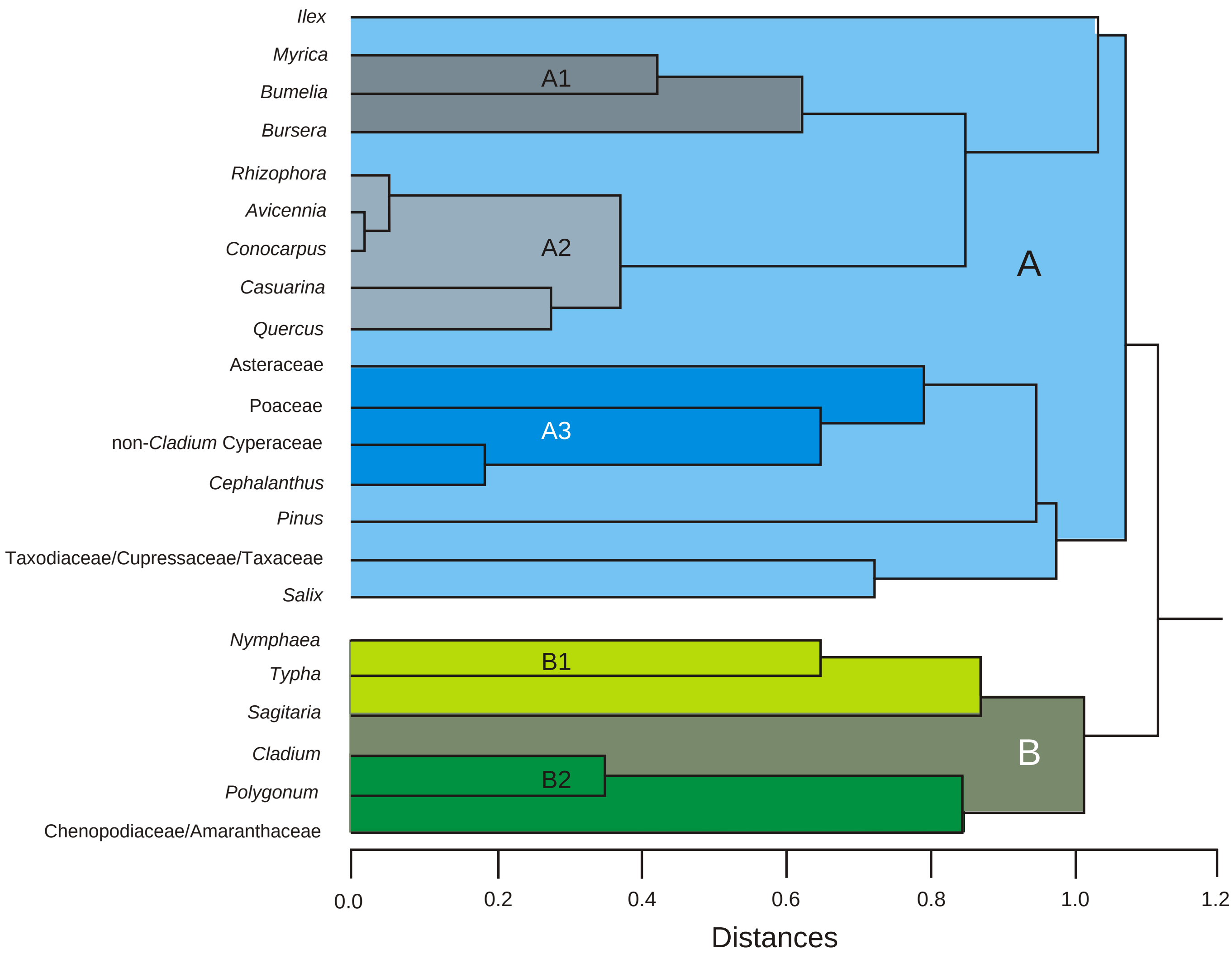

Figure 3: Cluster diagram from R-mode cluster analysis of 22 taxa from 28 samples, southern Florida.

McIvor, 1994). Two other trees common in southernmost Florida, Quercus (oak) and Casuarina (Australian pine), also are included in this group. Group A3 consists of taxa common in wet prairies: Asteraceae, non-Cladium Cyperaceae (Eleocharis, Rhyncospora, Scirpus, and Cyperus), and Cephalanthus (buttonbush). Wet prairies have short hydroperiods with seasonal drying (Kushlan, 1994). The other taxa present in Cluster A (holly, pine, willow, cypress) are trees that are not restricted to any one vegetation type in this analysis and therefore do not cluster with any one of the three groups.

Cluster B consists of taxa common in moderate- to long-hydroperiod environments. Group B1, which includes Nymphaea (waterlily), Typha (cattail), and Sagittaria (arrowhead), represents taxa characteristic of water-lily, cattail, and broad-leaf marshes (Kushlan, 1994). Group B2 includes Cladium (sawgrass) and Polygonum (knotweed), characteristic of moderate hydroperiod sawgrass marshes, and the pigweeds that tend to be most abundant at disturbed or marginal sites such as levees or tree-island margins.

Interpretation of Vegetational Type from Pollen Evidence

The clustering of these initial samples into groupings reflecting the source vegetation types (Q-mode) indicates that the use of the modern analog technique with the complete dataset should provide statistically sound information for vegetational reconstruction based on pollen assemblages. On a more empirical level, critical abundance levels of several taxa can be defined to help differentiate vegetational types, albeit in a somewhat less quantitatively rigorous manner. Because pollen is nearly always transported some distance from its source plant, interpretation of pollen records in terms of vegetational composition is not as straightforward as for faunal data, which represent the environment in which the organisms both lived and died. Vegetational interpretation based the pollen records must take into account both the abundance of source taxa and their reproductive strategies (Davis, 1963, 1965; Janssen, 1973; Tauber, 1965). Non-local wind-pollinated plants, such as pine, wax myrtle, and pigweeds, can easily overwhelm pollen assemblages if the local vegetation is either insect-pollinated or relies primarily on vegetative reproduction (as many grasses, sedges, and sawgrass do). Thus, higher percentages of wind-pollinated plants in pollen assemblages may represent either their greater abundance in the source vegetation or greater abundances of plants that contribute minimal amounts of pollen to the pollen rain. In core samples, this problem can be addressed by determining the absolute pollen concentration of various taxa throughout the core. For example, in a core collected along Taylor Creek near Florida Bay, pine pollen comprises up to 90% of the assemblage in the lower part of the core and drops to about 10% in higher levels; its concentration, however is constant throughout the core, indicating that its abundance did not change but that either low pollen producers were dominant in the lower part of the core or vegetation at that site was very sparse (Willard and Holmes, 1997). In practice, for accurate interpretation of vegetation from pollen assemblages one must consider possible modern analogs, percentage and concentration data, and abundance of any critical taxa. In the following, assemblages from the main vegetation types analyzed to date are characterized, with primary emphasis on critical taxa that identify the vegetation.

Loxahatchee Bay-Holly Tree Island Assemblages

Samples collected on and near bay-holly tree islands are the only sites with 5% Ilex pollen (Fig. 4). These also have around 20% Myrica pollen, and 3-10% aster pollen. Pollen of Cladium, other Cyperaceae, and Nymphaea also are present consistently at these sites, reflecting

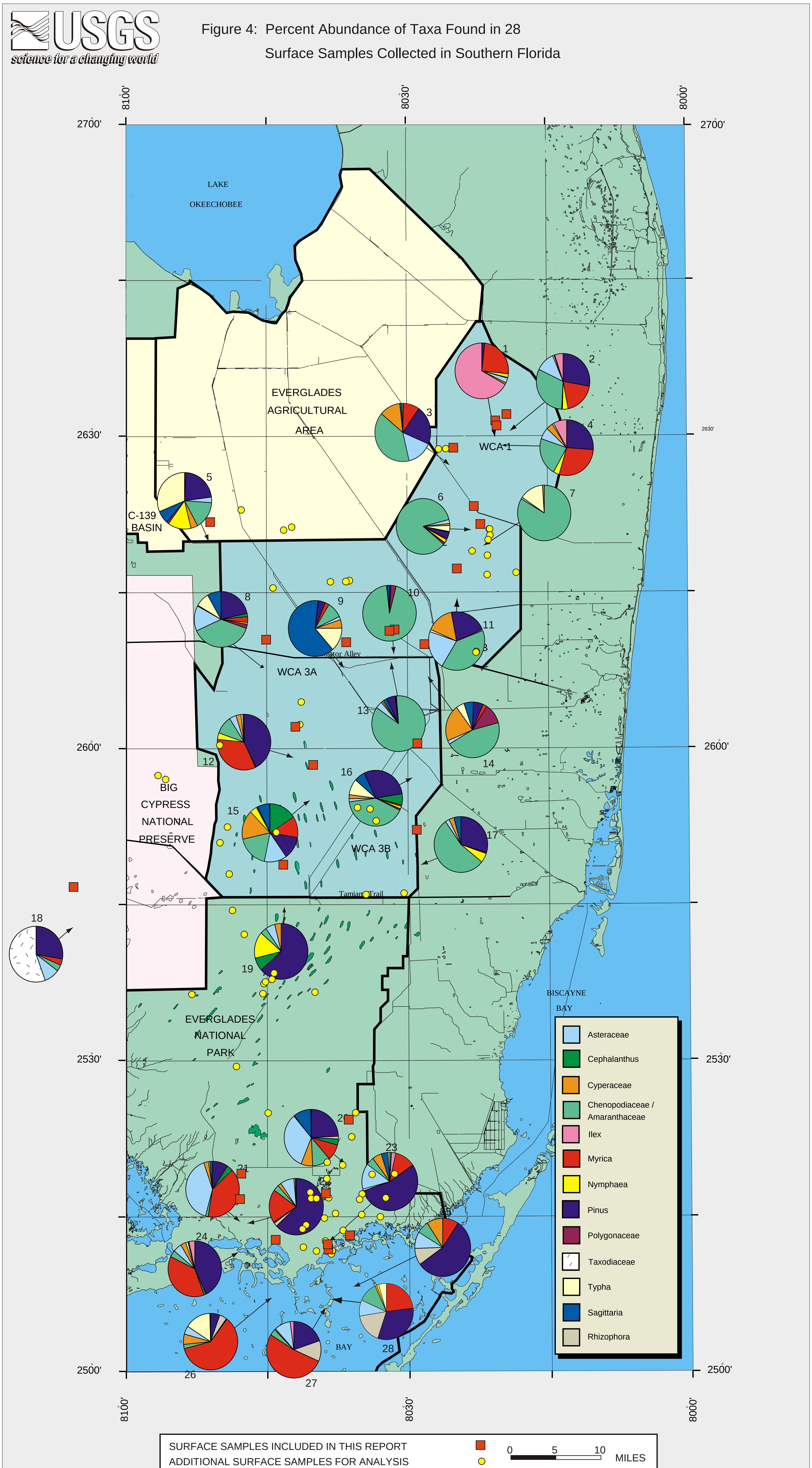

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Figure 4: Percent Abundance of Taxa Found in 28
Surface Samples Collected in Southern Florida
LAKE
OKEECHOBEE
EVERGLADES
AGRICULTURAL
AREA
WCA 1
C-139
BASIN
WCA 3A
Alligator Alley
BIG
CYPRESS
NATIONAL
PRESERVE
WCA 3B
Tamiami Trail
EVERGLADES
NATIONAL
PARK
BISCAYNE
BAY
BAY
Asteraceae
Cephalanthus
Cyperaceae
Chenopodiaceae /
Amaranthaceae
Ilex
Myrica
Nymphaea
Pinus
Polygonaceae
Taxodiaceae
Typha
Sagittaria
Rhizophora
SURFACE SAMPLES INCLUDED IN THIS REPORT
ADDITIONAL SURFACE SAMPLES FOR ANALYSIS
0 5 10 MILES
8100'
8030'
8000'
2700'
2630'
2600'
2530'
2500'

the slough vegetation surrounding the tree islands.

Cypress Strand Assemblages

The only sample examined so far from a cypress strand is dominated by cypress pollen (TCT). Pinus pollen also is common, reflecting the proximity of pinelands to the site, and aster pollen also is common.

Mangrove Fringe Assemblages

These assemblages typically have 5% Rhizophora (red mangrove) pollen and 15% Myrica pollen (Figure 4). Other taxa characteristic of this assemblage include buttonwood, black mangrove, and Australian pine.

Cattail Marsh Assemblages

Cattail pollen is most abundant (8%) in the northern part of WCA 3A, at Rotenberger Site 1, and in high-nutrient sites and those adjacent to canals in WCA 2A. Analysis of a core from Site F1 in WCA 2A indicates that cattail percentages as low as 3% may reflect its invasion of an area (Willard, 1997), and further analysis of surface samples is necessary to clarify these numbers. Typha pollen also is abundant (14%) at one site in the Taylor Slough Delta (Taylor Slough Site 14) near Seven Palms Lake, where Typha was noted in the area by field workers.

Sawgrass Marsh Assemblages

Samples yielding as little as 2% sawgrass pollen were from sites in which sawgrass is a prominent component of the vegetation. Most of the typical sawgrass marsh sites in this study, characterized by thick stands of tall sawgrass, have been altered, either through canal, levee, or road construction, establishment and visitation of monitoring stations, or through cattail invasion.

Therefore, samples from a truly representative sawgrass marsh have yet to be analyzed. Presently, the least disturbed sample from a mixed sawgrass/slough site is WCA 3A Site 3-4-1 in the eastern part of WCA 3A. Although the assemblage from this site included 43% pigweed pollen, it also included 20% Cladium, 11% Polygonum, and 5% each of Sagittaria and Typha. Rotenberger Site 1, collected in a relatively pristine area of sawgrass plain with cattail in the area, also may be fairly representative of a sawgrass or mixed sawgrass/slough community, if the 30% of Typha pollen is disregarded. This assemblage includes 3% Cladium, 13% Nymphaea, and 7% Sagittaria. Analysis of a core to be collected in the spring, 1998 should clarify how long Typha has been a dominant factor in those pollen assemblages.

Most of the samples collected in sawgrass marsh and mixed sawgrass marsh/slough in the northern part of the study area have high percentages of pigweed pollen. The wind-dispersed pollen of the pigweed family effectively masks the sawgrass component, which utilizes primarily vegetative reproduction. The much greater abundance of pigweed pollen in the northern part of the region, on initial inspection, might be attributed to the higher disturbance levels at the sample sites. All four sites with 75% pigweed pollen are adjacent to canals and levees, which tend to have higher proportions of weedy species, and most of the other sites in the cluster represent monitoring stations that are visited regularly and are not representative of pristine conditions for the region. However, when the downcore record from several cores in these regions are examined, samples collected around 2,000 BP in WCA 2A (Willard, 1997) show equally high percentages (70%) of pigweed pollen, so, clearly, modern disturbance is not the only factor controlling high abundances of this taxon.

Broad-leaf Marsh and Slough Assemblages

As was the case with sawgrass, relatively small percentages of the broad-leaved plants, such as arrowhead and waterlily, are indicative of these vegetation types. Assemblages with 2% Nymphaea pollen typically represent slough vegetation; these are found primarily in Loxahatchee NWR and in southern WCA 3A. More than 4% Sagittaria pollen reflects the presence of broad-leaf marshes; in these, the pollen of either Nymphaea (longer hydroperiods) or Sagittaria (more moderate hydroperiods) is a common component.

Disturbed Site Assemblages

Disturbed site assemblages include a number of vegetation types already discussed, but this grouping is useful for interpreting the last 150 years of record. Disturbed sites are defined as those near canals, levees, or roads and as those visited frequently by either airboat traffic or helicopter (such as monitoring stations). These typically have high percentages of weedy species, such as pigweeds and asters.

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