CYPRESS WETLANDS FOR WATER MANAGEMENT, RECYCLING AND CONSERVATION

Third Annual Report

to

National Science Foundation, Grant ENV 73-07823A02 (Formerly AEN 73-07823 A01), under the National Science Foundation's Program of Research Applied to National Needs (RANN)

and

The Rockefeller Foundation, Grant RF-76034

November 1, 1975
through December 15, 1976

A research project with participants from several divisions of the University of Florida, National Audubon Society, Inc., and other organizations coordinated through the Center for Wetlands with the assistance of a Steering Committee of User Agencies

Howard T. Odum, Principal Investigator
Katherine C. Ewel, Co-Principal Investigator
James W. Ordway, Site Manager
Margaret K. Johnston, Administrator of Center

Center for Wetlands
Phelps Lab
University of Florida
Gainesville, Florida 32611

December 17, 1976

THE ORGANIC SEDIMENTS OF CORKSCREW SWAMP SANCTUARY

Peter A. Stone and Patrick J. Gleason

Central and Southern Florida Flood Control District
P.O. Box V, West Palm Beach, Fla. 33402

The deposit of organic sediment, principally peats, found at Corkscrew Swamp Sanctuary is occupied by two dissimilar plant communities, an open marsh consisting of graminoid vegetation and a mature cypress swamp dominated by large bald cypress trees (Duever et al. 1974, 1975). The cypress swamp surrounds the open marsh.

A limited survey study of this organic deposit was made, mostly on personal time, and the results contrasted to more extensive studies conducted in the Everglades (Gleason, Stone, and Rosen, 1974; Gleason et al. 1975).

Methods

Four cores of the peat sediments were taken by means of a piston corer which retrieves a 3 in. (7.6 cm) diameter vertical section relatively undisturbed except for some vertical compression. The cores were taken in undisturbed sites slightly offset from Duever's "Central Marsh Transect." Only one core (CS1) penetrated and retrieved the underlying non-organic sediments. It was located in the Central Marsh at approximately the 5300 ft mark on the transect. Three other short cores were taken in the eastern big cypress tree area; two encountered

large roots at depth, while one penetrated the underlying substrate but failed to retrieve the loose, structureless, lowermost organic material.

Cores were split lengthwise and examined first macroscopically. Small peat samples were then extracted at 3 in. (7.6 cm) vertical intervals from core CS1 from the Central Marsh. These samples were treated according to the methodology of Cohen and Spackman (1972) and petrographic thin sections were mounted on slides and examined microscopically. Other peat samples were extracted at vertical intervals from CS1, 2, and 3 and were analyzed for proximate and ultimate analysis by the U.S. Bureau of Mines (BOM). Methods for these analyses are given in ASTM, standard methods for analysis of sparking coals. Analysis for phosphorus was made on peat samples laterally adjacent to the BOM samples. Weighed samples of powdered dried peat were fused in lithium metaborate, dissolved in 3% HNO_3, and the solution analyzed for phosphorus on a Technicon Autoanalyser. This method has proved effective on NBS orchard leaf standards. Phosphorus samples were taken volumetrically and dry weights measured to obtain dry weight densities. Changes in volume and vertical distances due to compression during coring were computed and corrections made. A sample of the basal peat from core CS1 was submitted for radiocarbon dating for Duever, and the results, 4720 $\pm$ 90 y.b.p., were reported by Duever et al. (1975). Using the results of the nitrogen, phosphorus, and carbon analyses, the peat densities and the age of the deposit, the net geologic rates of deposition into the sediment of these elements were calculated on a unit area basis for core CS1.

Macroscopic Analysis

Core CS1, taken in the Central Marsh, consisted of brown to dark brown fibrous peat in the uppermost 90 cm, with increasing fine material below 90 cm. Below about 110 cm the consistency was mucky and the color nearly black, but some fibrous matter was present. The lowermost portion of the organic deposit, below approximately 140 cm, was more peaty, with more fibrous structure than the material immediately above it, and the bottommost 13 cm contained a few freshwater shells. Beneath the organic sediment lay approximately 1.5 cm of sandy marl over a greyish to white marl (calcitic mud) which also included some shell material. Shells were chiefly Helisoma.

Cores CS2 and CS4, taken in the eastern big cypress tree area, retrieved only the upper layers of the organic deposit. CS2 was examined in only a cursory manner, but it graded from a fibrous peat in the upper portion to a mucky consistency in the lower portion. Core CS4 retrieved the upper 94 cm of the deposit. It consisted of relatively firm, brown fibrous peat with wood fragments in the upper 46 cm. At 46 cm a fairly distinct boundary occurred with black, muddy or mucky consistency material below, which also contained some wood fragments.

Microscopic Analysis

Microscopic examination of the marsh core (CS1) peats in thin section failed to determine the parent plant communities. Compared to Everglades peats, Corkscrew Swamp peats are more degraded with less plant material retaining identifiable tissue structure. Many samples from CS1 showed a coarsely granular appearance under 200X with much

material in the 10 - 50 μm size range. There was some tissue structure present in most samples from CS1, but most from the upper levels appeared modern (due to high birefringence under crossed Nicols). No samples exhibited any significant amount of sawgrass, Sagittaria, or water lily tissue, indicative of present marsh or possibly pondlike conditions. Given the relatively degraded condition of the peat, the absence of such tissue is likewise non-conclusive. The degraded condition, relative to Everglades peats, is indicative of a poorer preserving environment, possibly a shorter hydroperiod or deeper zone of aeration.

Fusinite, charred fragments indicative of local fire, occurred at all levels sampled in the core and varied from a very minor component in some samples to common in others. No clear vertical trends were apparent.

Chemical Analyses of Peats

Table 1 gives the results of proximate and ultimate analyses of peats from cores CS1, 2, and 3. These analyses are designed for organic rich sediments - peats, lignites and coals - and characterize the organic matter present as well as measure ash content. Table 2 gives phosphorus concentrations for core CS1. Core CS1 exhibited several obvious vertical trends, some of which also occur in other south Florida peats such as those from the Everglades (Gleason et al., 1975; Gleason and Stone, unpublished data). Ash increases generally with depth. This may occur from two causes: incorporation of inorganic material in the original sediment and concentration of plant ash due to decomposition of organic matter. On a moisture free basis, nitrogen decreases with depth, probably also from partial decomposition. Oxygen decreases and sulfur increases

TABLE 1. ANALYSIS OF CORKSCREW SWAMP SANCTUARY PEATS.

PROXIMATE ANALYSIS					ULTIMATE ANALYSIS									
% MOISTURE FREE					% MOISTURE FREE					% MOISTURE + ASH FREE				
SAMPLE	CORRECTED DEPTH (cm)	VOLATILE MATTER	FIXED CARBON	ASH	H	C	N	O	S	H	C	N	O	S
CS1(1) 0-6	0-18	62.4	27.9	9.7	5.0	51.3	3.7	29.7	0.4	5.6	56.8	4.1	33.0	0.5
17-23	52-70	52.7	26.5	20.8	4.4	48.1	3.0	23.2	0.5	5.5	60.8	3.8	29.2	0.7
35-41	106-124	47.7	27.7	14.6	4.7	53.6	2.8	22.8	1.5	5.5	62.7	3.3	26.8	1.7
CS1(2) 4.5-10.5	133-150	50.4	28.4	21.2	4.3	52.6	2.3	15.8	3.8	5.5	66.7	2.9	20.1	4.8
10.5-16.5	150-168	52.2	17.3	30.5	4.5	42.2	2.3	17.0	3.5	6.5	60.7	3.3	24.4	5.1
CS2: 1	top of core	65.0	26.8	8.2	4.8	52.4	3.4	30.5	0.7	5.2	57.0	3.7	33.4	0.7
2	mid-core	58.8	27.8	13.4	4.8	50.4	2.8	28.0	0.6	5.5	58.2	3.2	32.4	0.7
3	bottom of core	46.0	20.9	33.1	4.0	41.6	2.2	18.6	0.5	5.9	62.2	3.3	27.8	0.8
CS3: 0-10	top of core	65.6	27.0	7.4	5.1	52.8	3.5	30.5	0.7	5.5	57.0	3.8	33.0	0.7

TABLE 2 . PHOSPHORUS, NITROGEN, AND CARBON CONCENTRATION PROFILES AN NET GEOLOGICAL RATE OF DEPOSITION, CORE CS1, CORKSCREW SWAMP SANCTUA

PHOSPHORUS SAMPLE DEPTH (cm)	PEAT DENSITY (g/cm)	P %	P mg/cm	NITROGEN AND CARBON SAMPLE DEPTHS (cm)	N %	N mg/cm	C %	C mg/cr
9-15	.071	.084	60	0-18	3.7	2.6	51.3	36
33-39	.073	.054	39					
56-62	.095	.030	29	52-70	3.0	2.9	48.1	46
83-89	.11	.020	23					
112-118	.15	.010	15	106-124	2.8	4.3	53.6	81
139-145	.14	.037	53	133-150	2.3	3.3	52.6	75
				150-168	2.3	3.3	42.2	60
$\bar{X}$	.11		36			3.3		60
TOTAL AMOUNT IN PEAT COLUMN (g/m²)		63			5648		103,638	
NET GEOLOGIC RATE OF DEPOSITION (g/m²/C¹⁴yr)		.013			1.20		22.0	

BASAL DATE : 4720 ± 90 RADIOCARBON YEARS

with depth, except for the bottom sample. The bottom sample may represent a different parent material (plant community) or differing preserving environment, for it is adjacent to calcareous sediments. On a moisture and ash free basis, which better shows the nature of the organic material (excluding natural plant ash constituents), nitrogen and oxygen decrease, while carbon increases with depth except for a reversal at the bottom sample. Sulfur increases with depth. Core CS2 which grades from fibrous peat to mucky material with depth shows similar trends except for sulfur on a moisture free basis.

Data from other vertical peat profiles appear to indicate that deoxygenation, leaching or uptake of nutrients (N and P), concentration of carbon and occasionally enrichment of sulfur (probably from low quality groundwater) often accompany the slow decomposition and reduction of peat constituents (Gleason and Stone, unpublished data).

Geologic Rate of Peat and Nutrient Deposition

The average net rate of peat deposition in core CS1 was 3.67 cm per 100 C^{14} yr. The range of values which results from radiation counting uncertainty is 3.60 to 3.74 cm per 100 C^{14} yr, (4720 + 90 to 4720 - 90 C^{14} yr). A radiocarbon year is not exactly equal to a sidereal year and it varies with indicated age. Materials with indicated ages in the region of 5000 y.b.p. tend actually to be slightly older (Ralph and Michael, 1974). Peats tend to give minimal ages due to root penetration, although this factor generally decreases in intensity with depth. These two factors tend to diminish, but probably do not cancel, one another.

Table 2 shows the calculated net geologic rates of nitrogen, phosphorus and carbon deposition using the mean peat depositional rate. These rates

apply to a deposit of a given age, in this case, approximately 4700 C^{14} y.b.p. If the decrease with depth of nitrogen and especially phosphorus concentrations in this deposit are, in fact, due to decomposition and leaching or uptake by roots, one would expect somewhat lower net uptake rates in a similar deposit of twice the age and/or thickness.

LITERATURE CITED

Cohen, A.D., and W. Spackman. 1972. Methods in peat petrology and applications to reconstruction of paleoenvironments. Geol. Soc. Amer. Bull. 83(1):129-42.

Duever, M.J., J.E. Carlson, and L.A. Riopelle. 1974. Water Budgets and comparative study of virgin Corkscrew Swamp. Pages 595-634 in Cypress Wetlands for Water Management, Recycling and Conservation. Annual Report to the Rockefeller Foundation and NSF. Center for Wetlands, Univ. of Florida.

Duever, M.J., J.E. Carlson, and L.A. Riopelle. 1974. Ecosystem analyses at Corkscrew Swamp. Pages 627-725 in Cypress Wetlands for Water Management, Recycling and Conservation. Annual Report to the Rockefeller Foundation and NSF. Center for Wetlands, Univ. of Florida.

Gleason, P.J., P.A. Stone, and M. Rosen. 1974. Nutrient uptake and rates of nutrient deposition in Conservation Area 2A. Unpublished report. Central and Southern Florida Flood Control District, West Palm Beach, Florida. 61 pp.

Gleason, P.J., P.A. Stone, R.L. Goodrick, G. Guerin, and L. Harris. 1975. The significance of paleofloral studies and ecological aspects of floating peat islands to water management in the Everglades Conservation Areas. Unpublished report. Central and Southern Florida Flood Control District, West Palm Beach, Fla. 176 pp.

Ralph, E.K. and H.N. Michael. 1974. Twenty-five years of radiocarbon dating. Amer. Scientist 62(5):553-60.