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U.S. GEOLOGICAL SURVEY OPEN-FILE REPORT 00-520

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LONG-TERM PATTERNS OF VEGETATION AND SALINITY CHANGE IN THE LAKE PONTCHARTRAIN REGION, LOUISIANA

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Abstract

Palynomorph, ostracode, and benthic foraminiferal assemblages from Lake Pontchartrain sediment cores were analyzed to reconstruct long-term trends in regional vegetation and salinity in the lake. Pollen assemblages from two short cores (9-7-96-7 and 9-7-96-9), mostly deposited after 1950 AD, indicate dominance of *Pinus* pollen and the common occurrence of *Pediastrum*, a colonial green alga typically indicative of eutrophication, throughout this time. A longer core (3.47 m), LP 97-1a, includes middle Holocene sediments (5.5-4.2 ka), characterized by higher salinities and greater abundance of *Quercus* pollen. Younger sediments in this core record a transition to meso-to oligohaline conditions and wetter conditions later in the Holocene. The upper 30-40 cm of LP 97-1a represents sediment deposition after 1950 AD. These sediments are characterized by oligohaline to limnic ostracode faunas and unprecedented abundance of colonial green algae indicative of eutrophication. This may represent the response of phytoplankton and benthic communities to the introduction of Mississippi River water and sediment resuspension resulting from openings of the Bonnet Carre' spillway during the last half of the 20th century.

Introduction

As part of a project documenting the impact of altered land management on Lake Pontchartrain, Louisiana, a series of cores was collected for analysis of trace metals and reconstruction of the vegetation and salinity histories of the lake and surrounding region. This report describes pollen records from three cores collected in Lake Pontchartrain and data from ostracode and benthic foraminiferal assemblages from one core to determine the feasibility of documenting both the climatic variability of the system and its response to anthropogenic changes of the last few decades and centuries.

Methodology

Palynomorph assemblages were examined from three cores from Lake Pontchartrain (Figure 1, Table 1), and ostracodes and benthic foraminifers were studied from one core,

TABLE 1. Locations of cores analyzed for palynomorphs, Lake Pontchartrain, Louisiana.

CORE ID	LATITUDE	LONGITUDE	WATER DEPTH (m)	CORE LENGTH (cm)
9-7-96-7	30.0775° N	90.0363° W	5.03	62
9-7-96-9	30.1105° N	90.1051° W	4.88	59
LP-97-1a	30.2531° N	90.1597° W	4.88	347

LP-97-1a. Sediment samples weighing from 5 to 15 grams 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 HCl to remove carbonates, neutralized with deionized water, and treated with HF to remove silicates. After neutralization, the samples were sieved through 200 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 ZnCl_2 (S.G. = 1.8) to further clean samples. The pollen residue was mixed with warm glycerine jelly and mounted on microscope slides for examination.

To calculate percent abundance of pollen, at least 300 grains were counted from each sample; these results are provided in Appendices 1 - 6. Absolute pollen concentrations were calculated using the marker-grain method described by Benninghoff (1962). The

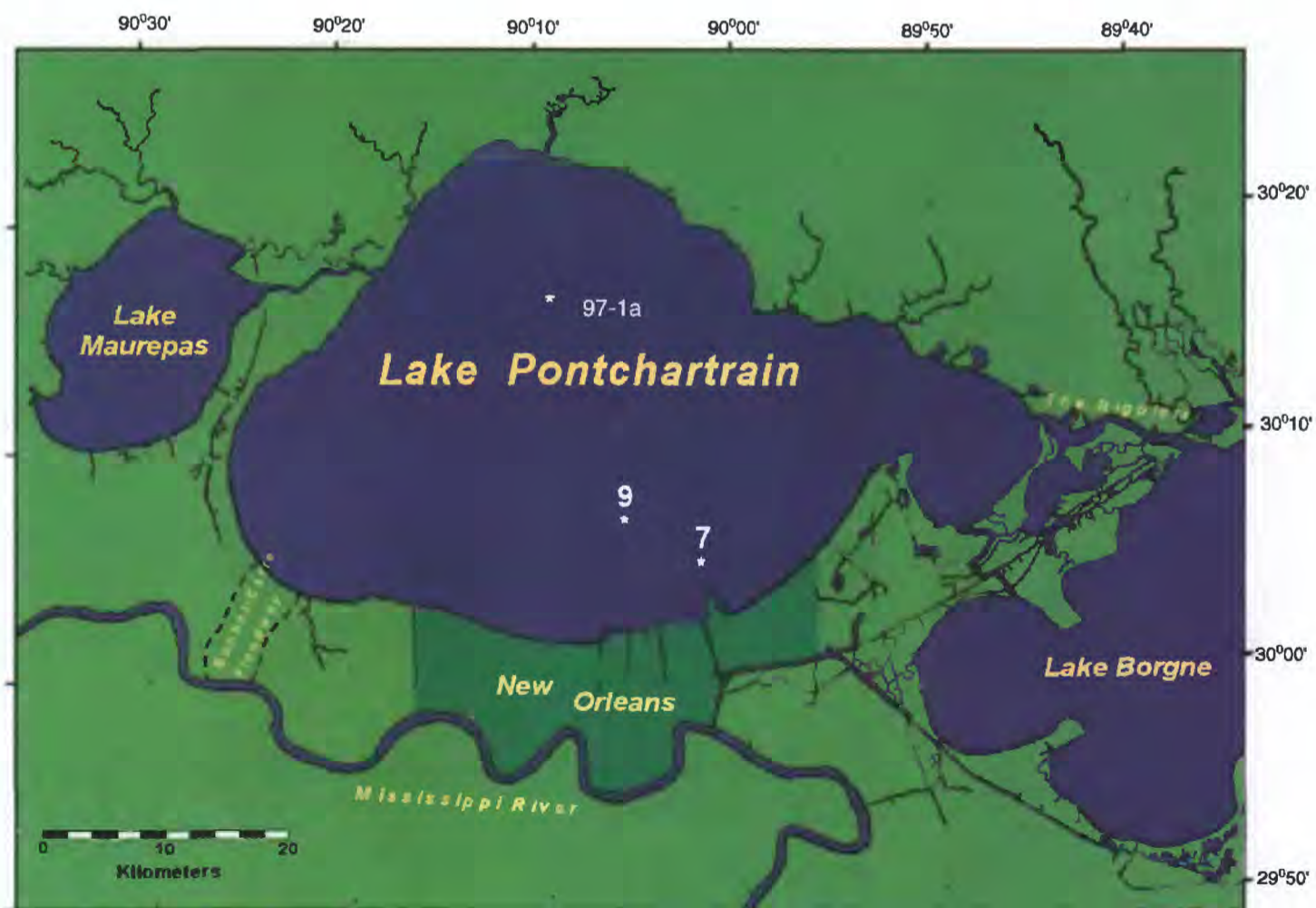


Figure 1. Location of core sites, Lake Pontchartrain, Louisiana.

quantity of *Lycopodium* spores in the marker tablets was determined by the manufacturer with a Coulter Counter following the procedures of Stockmarr (1973) to be 12,542 +/- 416. Absolute pollen concentration was calculated using the formula (Maher, 1981):

$$\text{pollen per gram dry sediment} = ((\text{pollen grains counted}/\text{markers counted}) \times 12,542) / \text{weight of sediment.}$$

Fossil pollen assemblages were compared statistically to modern assemblages from shallow marine sediments collected off the Gulf Coast of Mississippi and Alabama (Edwards and Willard, in press) and shelf assemblages collected along the east coast of North America (Litwin and Andrie, 1992; Willard, unpub. data) using the modern analog technique (MAT) (Overpeck, Webb, and Prentice, 1985).

Ostracode and foraminiferal assemblages were studied after washing sediment through a 63 µm sieve and qualitatively examining the assemblages under a binocular microscope. Ecological inferences were made based on published studies of foraminifers and ostracodes from Gulf and Atlantic coastal zones (Poag, 1978; Poag, 1981).

Three foraminifer samples for radiocarbon dating were obtained from LP 97-1a, and results are listed in Table 2. Samples from 9-7-96-7 and 9-7-96-9 were analyzed for ²¹⁰Pb and ¹³⁷Cs activity. In 9-7-96-9, ¹³⁷Cs is present throughout the core, indicating deposition of the entire core since 1950 AD (Flocks, et al, in press). In 9-7-96-7, ¹³⁷Cs is present only in the upper 40 cm (Appendix 7), indicating that the lower part of the core (40-56 cm) was deposited before 1950.

TABLE 2. Radiocarbon dates from core LP 97-1. WW indicates laboratory numbers assigned by the USGS ¹⁴C Laboratory. Samples were processed at the ¹⁴C laboratory of the U.S. Geological Survey in Reston, Virginia. ¹⁴C ages were determined at the Center for Accelerator Mass Spectrometry (CAMS), Lawrence Livermore National Laboratory, Livermore, California. δ¹³C values were estimated. ¹⁴C ages are reported with one sigma error.

WW	Depth (cm)	Material	δ ¹³ C ‰	¹⁴ C Age yr BP	+/-	Calibrated age Cal yr BP*
1891	140-144	Forams	0	4,220	50	4,426-4,152
1892	222-224	Forams	0	4,550	50	4,846-4,602
1893	320-324	Forams	0	5,070	50	5,562-5,299

Calibrated using CALIB 4.0 Radiocarbon Calibration software, after Stuiver and Reimer (1993), in conjunction with The Marine Calibration Data Set (Stuiver, and others, 1998). Calibrated age ranges are reported with a two-sigma error.

RESULTS

CORE 9-7-96-7

Palynomorph assemblages were examined from every 2-cm interval in the upper 12 cm of Core 9-7-96-7 and every 5 cm below that. *Pinus* (see Table 3 for common names

of plant taxa) pollen dominates most assemblages, typically comprising 60% to 90% of the assemblages (Fig. 2). Other tree pollen commonly present includes *Quercus*, Taxodiaceae/Cupressaceae/Taxaceae (TCT), *Carya*, and *Liquidambar*. Pollen of the herbaceous Chenopodiaceae/Amaranthaceae usually ranks second in abundance, comprising up to 40% of the assemblages, and Asteraceae pollen also is common. Above 40 cm depth, pollen concentration increases fivefold, and *Pediastrum*, a colonial green alga, is present in concentrations of up to 18,000 grains/gram dry sediment; below 40 cm, it is absent.

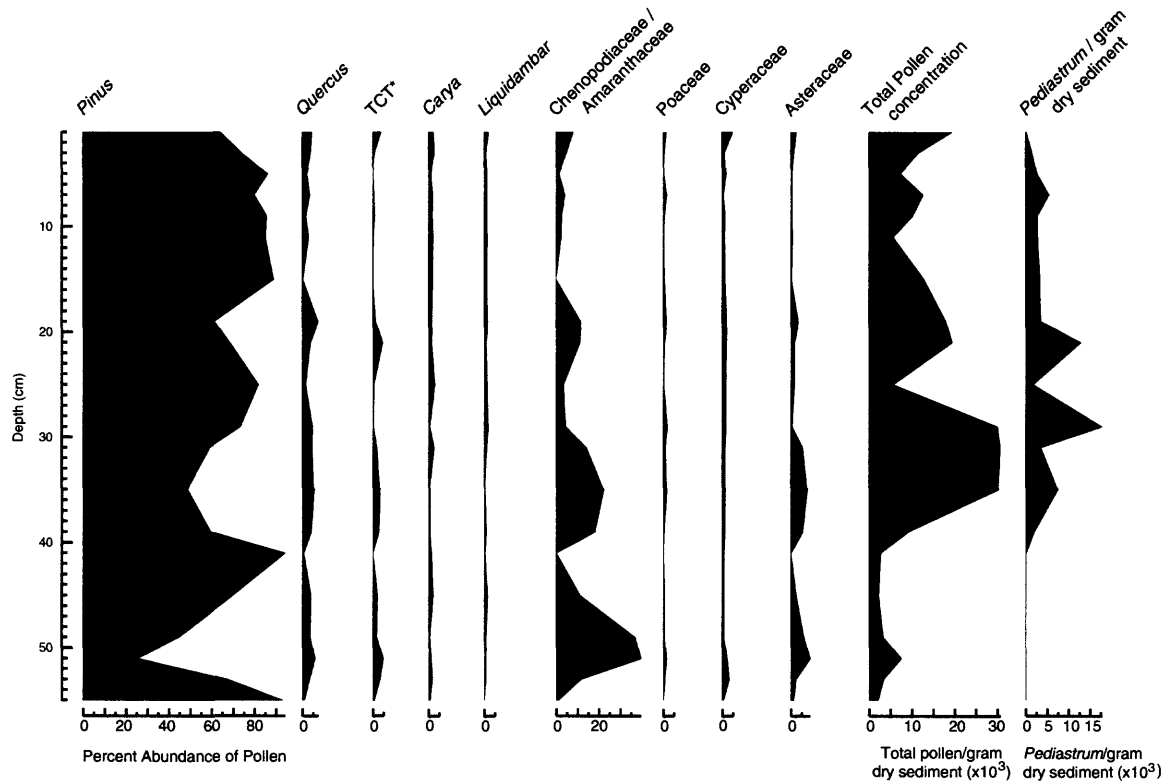


Figure 2. Percent abundance of pollen of major plant groups, core 9-7-96-7, Lake Pontchartrain, Louisiana. TCT – Taxodiaceae/Cupressaceae/Taxaceae.

CORE 9-7-96-9

Palynomorph assemblages were examined from every 2-cm interval of the 48 cm long core, and assemblages vary little. *Pinus* pollen dominates most assemblages, comprising 33-69% of the assemblages (Fig. 3). Other common pollen types include *Quercus*, TCT, and Chenopodiaceae/Amaranthaceae, each of which typically comprise about 10% of the assemblage. *Pediastrum* is common throughout the core, with peak abundances at 30-35 cm and 6-12 cm.

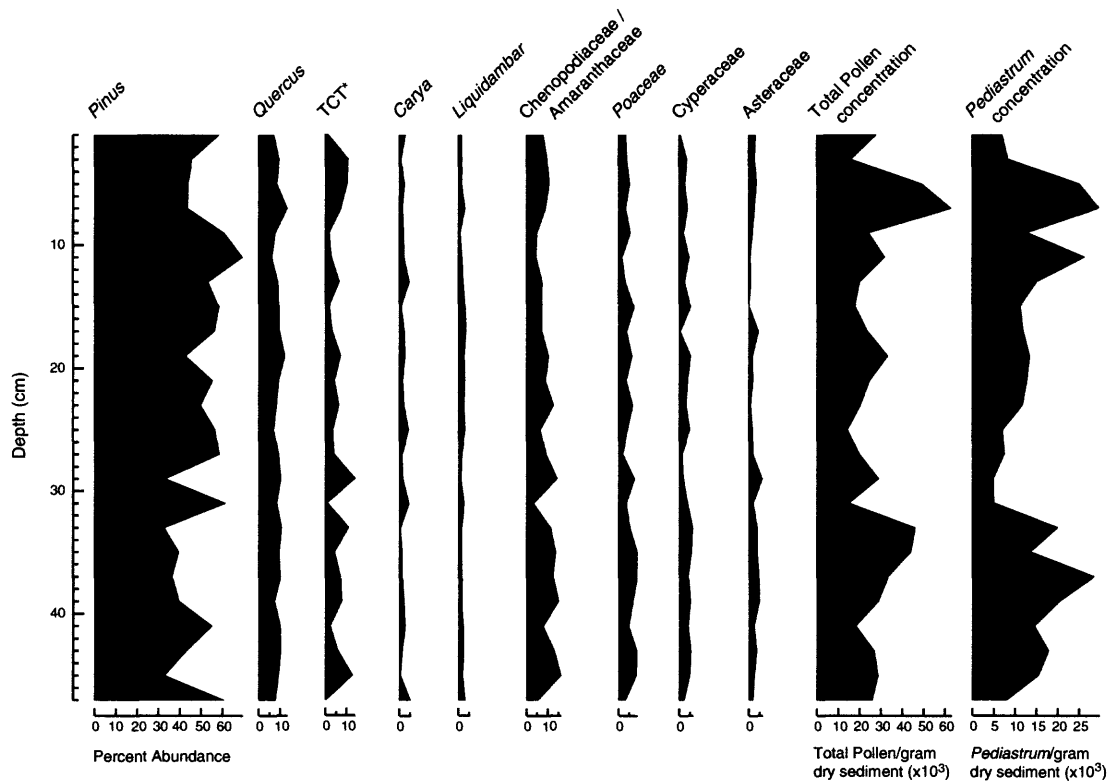


Figure 3. Percent abundance of pollen of major plant groups, core 9-7-96-9, Lake Pontchartrain, Louisiana. TCT – Taxodiaceae/Cupressaceae/Taxaceae.

CORE LP 97-1a

Palynomorphs, ostracodes, and benthic foraminifers were examined every 5 cm in the upper meter of core and every 20 cm for the lower 2.5 meters. The basal 10 cm of core consists of a burrowed, Pleistocene clay with low concentrations of pollen. The upper 337 cm of core consists of Holocene sediments and is divided into four assemblage zones based on pollen, dinocysts, green algae, ostracodes, and benthic foraminifers. Zone I, between 340 cm and 90 cm depth (Fig. 4), is characterized by dominance of *Pinus* pollen (53-81%) and the highest abundances of *Quercus* in the core (9-21%). Dinocysts are common, comprising up to 2,600 cysts per gram; the dominant species is *Polysphaeridium zoharyi*, with *Spiniferites* spp. also common (Fig. 5). Ostracode and benthic foraminifer faunas in this interval are comprised of polyhaline taxa (Fig. 6). Benthic foraminifer faunas have affinities to the *Elphidium* assemblage of Poag (1981), described from bays and lagoons of the Gulf Coast region. Common ostracodes in the assemblage include *Paratocytheroma stephensi*, *Cytherura radialirata*, *Megacythere repexa*, and *Cytheromorpha paracastanea*.

Zone II, ranging from 90 to 50 cm depth, is characterized by faunas associated with mesohaline conditions (5-18 ppt). Foraminifer assemblages are dominated by *Ammonia parkinsoniana*, with abundant *Elphidium gunteri*. Ostracode assemblages are dominated by *Perissocytheridea brachyforma*, *Candona* spp., and, in the upper part of this interval, non-marine cyprids that indicate periodic fresh-water events. Pollen assemblages in this interval are characterized by much higher abundances of Chenopodiaceae

Table 3. Scientific and common names of plant taxa preserved in the pollen record, Lake Pontchartrain, Louisiana.

TREES AND SHRUBS

Family	Genus	Common Name
Aceraceae	<i>Acer</i>	Maple
Betulaceae	<i>Alnus</i>	Alder
Betulaceae	<i>Betula</i>	Birch
Fagaceae	<i>Carya</i>	Hickory
Ulmaceae	<i>Celtis</i>	Hackberry
Rubiaceae	<i>Cephalanthus</i>	Buttonbush
Cornaceae	<i>Cornus</i>	Dogwood
Corylaceae	<i>Corylus</i>	Hazlenut
Facaceae	<i>Fagus</i>	Beech
Oleaceae	<i>Fraxinus</i>	Ash
Aquifoliaceae	<i>Ilex</i>	Holly
Juglandaceae	<i>Juglans</i>	Walnut
Hamamelidaceae	<i>Liquidambar</i>	Sweet gum
Magnoliaceae	<i>Liriodendron</i>	Tulip tree
Magnoliaceae	<i>Magnolia</i>	Magnolia
Myricaceae	<i>Myrica</i>	Wax myrtle
Nyssaceae	<i>Nyssa</i>	Tupelo/Black gum
Betulaceae	<i>Ostrya/ Carpinus</i>	Hophornbeam
Pinaceae	<i>Picea</i>	Spruce
Pinaceae	<i>Pinus</i>	Pine
Fagaceae	<i>Quercus</i>	Oak
Salicaceae	<i>Salix</i>	Willow
Taxodiaceae/Cupressaceae/		Cypress/Cedar/Yew families
Taxaceae		
Ulmaceae	<i>Ulmus</i>	Elm

HERBACEOUS TAXA

Asteraceae	<i>Ambrosia</i>	Ragweed
Apiaceae		Umbel/parsley family
Asteraceae		Aster/daisy family
Chenopodiaceae/Amaranthaceae		Pigweed/Goosefoot families
Cyperaceae	<i>Cladium</i>	Sawgrass
Cyperaceae		Sedge family
Ephedraceae	<i>Ephedra</i>	Mormon tea
Ericaceae		Heath family
Euphorbiaceae		Spurge family
Fabaceae		Bean/legume family
Celastraceae	<i>Hippocratea</i>	n/a
Lamiaceae		Mint family
Haloragidaceae	<i>Myriophyllum</i>	Water milfoil
Nymphaeaceae	<i>Nymphaea</i>	Waterlily
Plantaginaceae	<i>Plantago</i>	Plantain
Poaceae		Grass family
Polygonaceae		Knotweed family
Alismataceae	<i>Sagittaria</i>	Arrowhead
Typhaceae	<i>Typha</i>	Cattail
Lentibulariaceae	<i>Utricularia</i>	Bladderwort

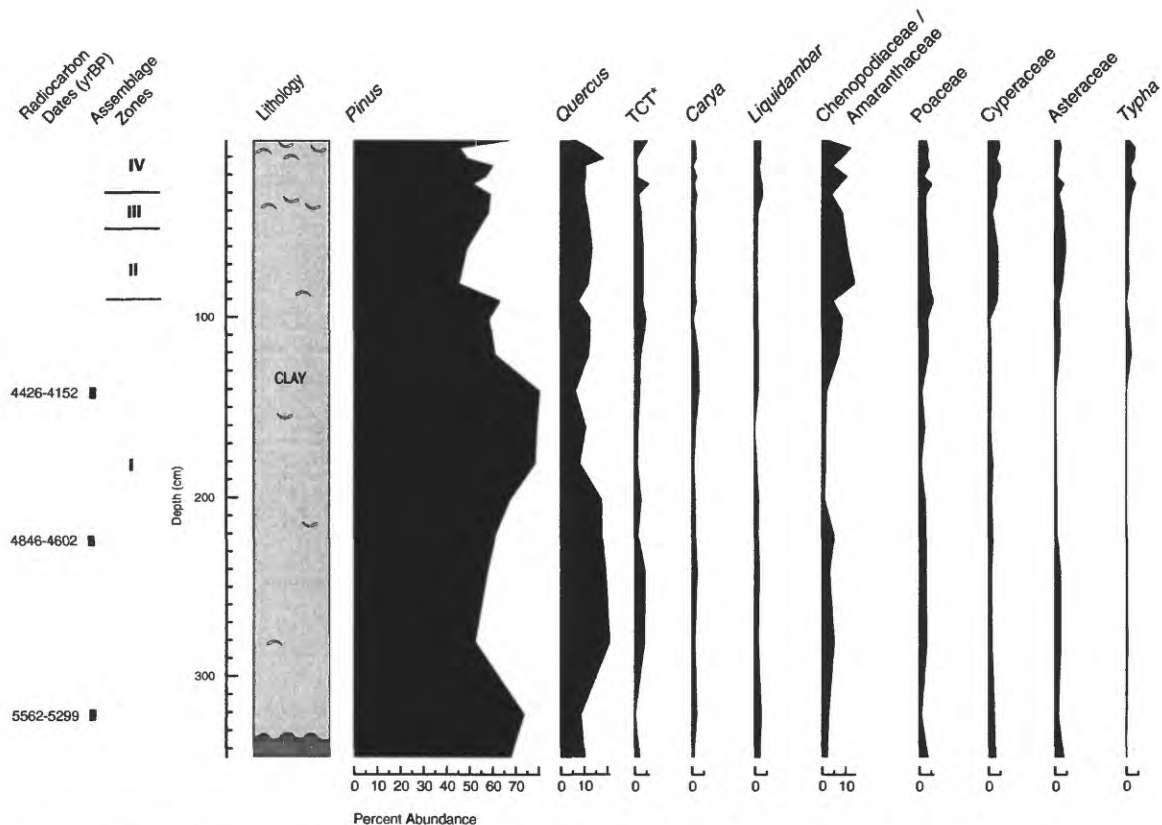


Figure 4. Percent abundance of pollen of major plant groups, core LP 97-1a, Lake Pontchartrain, Louisiana. TCT – Taxodiaceae/Cupressaceae/Taxaceae.

pollen, with increased percentages of other herbaceous taxa, including the Poaceae, Cyperaceae, Asteraceae, and *Typha* (Fig. 4). *Pediastrum* is a consistent part of the assemblage in this interval, although its concentrations are low (<300 per gram).

In zone III (50-30 cm depth), the transition from mesohaline to oligohaline (1-5 ppt) conditions is documented, with salinity maximums not exceeding 15 ppt and possibly reaching fresh-water conditions. Between 40 and 52 cm, *Ammonia parkinsoniana* and *Elphidium gunteri* are dominant components, indicating salinities as high as 10-15 ppt; *Ammotium salsum* and *Trochammina* spp. also are present. In the sample from 30-32 cm, the latter two taxa are dominant, indicating a salinity decrease to <5 ppt. Ostracodes present include cyprids, two non-marine taxa, *Candona*, and *Darwinula*, and *Perissocytheridea* (a genus characteristic of brackish water). This assemblage indicates salinities ranging from <5-10 ppt; the presence of charophytic algae and non-marine ostracodes indicates some fresh-water influence on the site. Pollen assemblages are similar to those in zone II, and an increased concentration of *Pediastrum* occurs at 30-32 cm.

In zone IV (30-0 cm depth), the agglutinated foraminifers *Ammotium salsum* and *Trochammina* spp. dominate the foraminiferal fauna. Ostracodes present include oligohaline-limnic taxa of cyprids, *Cyprideis*, and *Perissocytheridea*. These taxa commonly are associated with brackish environments with salinities usually exceeding 5 ppt, although further species-level work on ostracode assemblages is warranted. Charophytes

(fresh-water algae also referred to as stoneworts) are also present in this zone. *Pediastrum* concentration increased from <1,000 per gram to >25,000 per gram in this zone, and *Botryococcus*, another colonial green alga, also occurs for the first time (Fig. 5). Although little is known about the ecology of *Pediastrum*, increased concentrations have been documented in polluted and nutrient-enriched lakes surrounded by rich macrophyte vegetation (Digerfeldt, 1977; Fredskild, 1973; Korde, 1961; Parra Barrientos, 1979), and it has been used as an indicator of the trophic status and histories of lakes in Europe (Cronberg, 1982). Less is known about the ecology of *Botryococcus*; it typically is found in fresh-water bogs, pools, and lakes and may form thick surface scums (Baldwin and Hawker, 1915). *Botryococcus* proliferates in areas surrounded by scrub plants with nutrient enrichment from humic matter (Dulhunty, 1944). Dinocyst abundance decreased in zone IV, with *Polysphaeridium zoharyi* becoming nearly absent and *Spiniferites* sp. the primary taxon present. Pollen concentrations increased up to three-fold in this interval, but the only notable change in assemblage composition was the slight increase in *Liquidambar*.

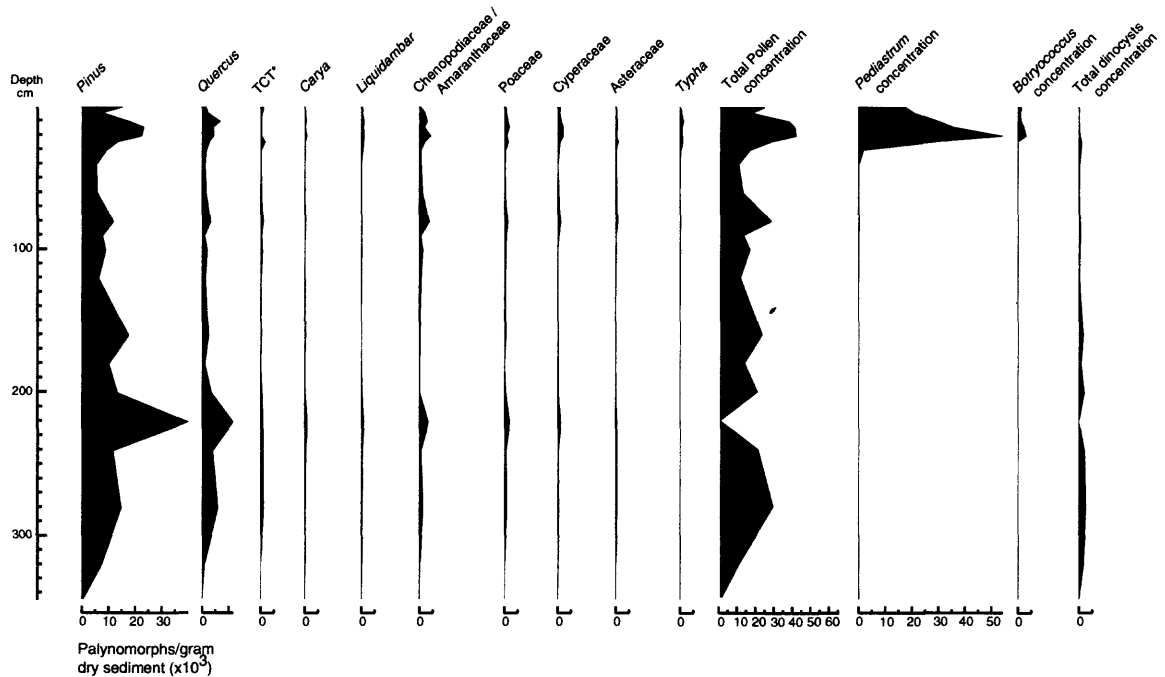


Figure 5. Concentration (pollen/gram dry sediment) of pollen of major plant groups, core LP 97-1a, Lake Pontchartrain, Louisiana. TCT – Taxodiaceae/Cupressaceae/Taxaceae.

DISCUSSION

Although mixing of the upper meter of sediment by 20th century shell mining precludes development of an age model for the past few centuries, both the past 50 years and middle Holocene sediments were identified in these cores. These correlations are based on radiocarbon dating, short-lived radioisotopes (¹³⁷Cs), and biostratigraphic correlation between cores.

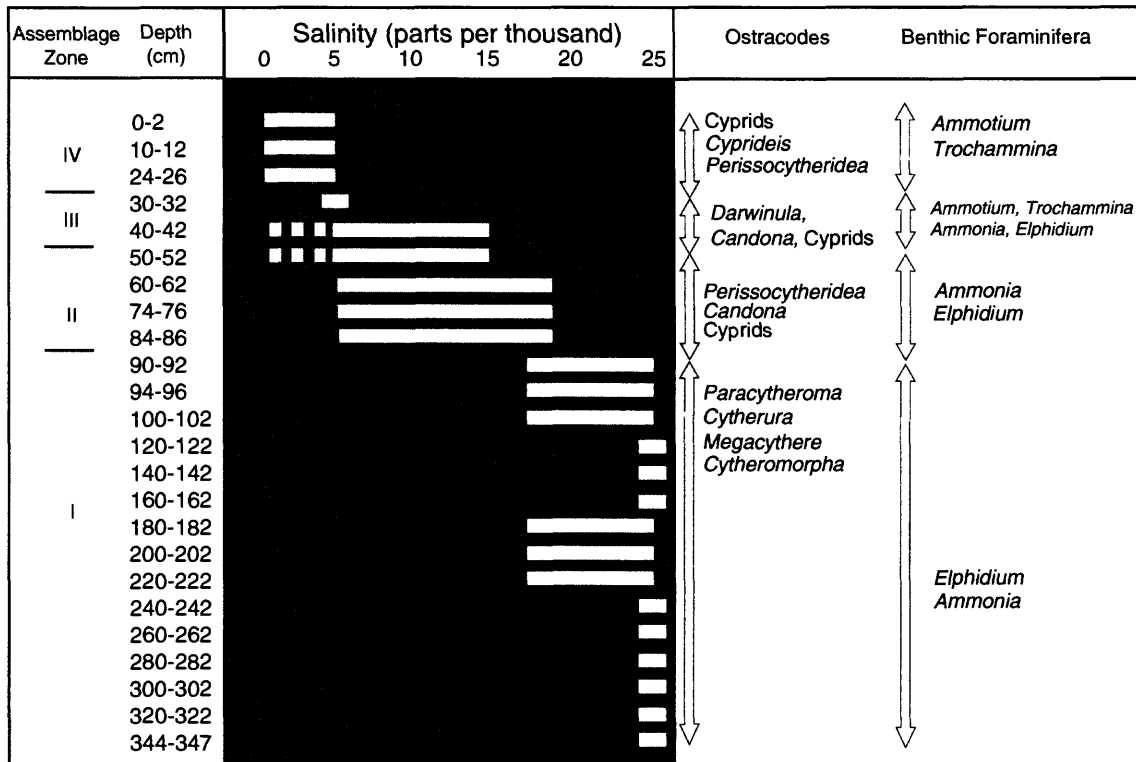


Figure 6. Salinity estimates based on benthic foraminifera and ostracode assemblages, core LP 97-1a, Lake Pontchartrain, Louisiana.

Middle Holocene sediments (~5,100 to 4,200 yrBP) are preserved in the interval between 340 and 90 cm in core LP 97-1a; these were deposited in a polyhaline (18-25 ppt) bay environment, similar to many bays and lagoons of the modern Gulf coast. During that interval, pollen assemblages indicate few changes in terrestrial vegetation; close modern analogs for down-core assemblages occur along the Mississippi and Alabama portions of the Gulf Coast and along the east coast of the U.S. between northern North Carolina and Key Largo. Summer (July) temperatures in these regions have ranged from 27.1-29.4° C between 1989 and 1998, winter (January) temperatures ranged from 10.0-22° C, and mean annual precipitation ranges from 98-203 cm (NOAA, 1989-1997a; NOAA, 1989-1997b; NOAA, 1989-1997c; NOAA, 1989-1997d; NOAA, 1989-1997e).

Faunal changes between 86 cm and 90 cm depth indicate a salinity shift to mesohaline conditions, and herbaceous taxa were more abundant in the pollen flora. In the interval above 120 cm, close modern analogs for pollen assemblages are found only along the Gulf Coast of Mississippi and Alabama and the east coast of southern Florida. Summer temperatures in these areas range from 26.9-28.7° F, winter temperatures range from 10.1 – 22.0° C, similar to those indicated for earlier assemblages. Mean annual precipitation, however, was higher, ranging from 153-203 cm. This is suggestive of greater precipitation during this interval of reduced salinity and is consistent with onset of wetter conditions beginning in the middle Holocene.

The high concentrations of pollen and *Pediastrum* in the upper 30 cm of LP 97-1a are mirrored in core 9-7-96-7; in the latter core, sediments above that interval were deposited

Table 4. Openings of the Bonnet Carre' spillway (modified from U.S. Army Corps of Engineers, 2001).

Date	Duration	Max. Flow (cfs)
1937	(1/30 - 3/7)	211,000
1945	(3/23 - 5/18)	318,000
1950	(2/10 - 3/19)	223,000
1973	(4/8 - 6/21)	195,000
1975	(4/14 - 4/26)	110,000
1979	(4/18 - 5/21)	191,000
1983	(5/20 - 6/23)	268,000
1997	(3/17 - 4/18)	243,000

after 1950, and we suggest that these events are correlative with those in LP 97-1a. The increased abundance of both *Pediastrum* and *Botryococcus* is consistent with greater influx of fresh water and may indicate increased eutrophication during this interval. This may reflect phytoplankton response to numerous openings of the Bonnet Carre' spillway after 1950 (Table 4). Such openings occurred during flood events of a great enough magnitude that Mississippi River water levels threatened the stability of the main levees in New Orleans and other downstream communities (U.S. Army Corps of Engineers, 2001). Our data indicate that the impacts of spillway opening, including increased sediment and nutrient load, had an impact on phytoplankton assemblages that was unprecedented during the last 5,500 years. More detailed study of benthic faunas would determine their response to such abrupt changes and the length of time needed to recover to their previous state.

CONCLUSIONS

Phytoplankton assemblages and benthic faunas from three cores collected in Lake Pontchartrain indicate lower salinity and, possibly, increased eutrophication after 1950 AD. During this time, the Bonnet Carre' spillway was opened six times, releasing Mississippi River flood waters into the lake, and the floral and faunal changes appear to reflect the biotic response to changes in circulation, sedimentation, nutrient load associated with these releases. These recent assemblages contrast with those from middle to late Holocene sediments, preserved in core LP 97-1a. Older benthic faunas document a gradual change from a polyhaline bay environment to a mesohaline environment. Pollen assemblages indicate a concomitant shift to greater precipitation. It is possible that analysis of faunas and phytoplankton assemblages from less-disturbed nearshore sites or marshes fringing the lake may clarify both how spillway openings affected these communities and their subsequent recovery from such events.

ACKNOWLEDGEMENTS

We thank Patrick Buchanan, Andrew Fagenholz, Neil Waibel, and Lisa Weimer for

technical support to process samples for analysis of pollen and dinocysts. Neil Waibel also assisted in pollen counts. Sampling assistance was provided by Mike Brown, Jim Flocks, and Phil McCarty. We are grateful to Julie Damon for editorial assistance in assembling the report. We thank Jack Kindinger, Shea Penland, and Paul Conner for assistance in selection of cores for analysis. Jack McGeehin provided sample preparation for AMS dating of samples and calibration of radiocarbon dates. The research was supported by U.S. Geological Survey Coastal and Marine Geology Program.

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Appendix 1. Percent abundance of pollen in samples from core 9-6-96-7, Lake Pontchartrain, Louisiana.
(TCT=Taxodiaceae/Cupressaceae/Taxaceae)

Depth	Alnus	Betula	Carya	Corylus	Fraxinus	Ilex	Juglans	Liquidambar	Myrica	Nyssa	Pinus	Quercus	Salix	TCT
0-2 cm	0.00	0.00	2.37	0.00	0.59	0.00	0.00	2.08	1.19	0.89	64.09	4.45	0.30	3.86
2-4 cm	0.00	0.30	2.74	0.30	0.30	0.00	0.00	0.91	0.30	0.30	74.09	3.96	0.00	0.91
4-6 cm	0.00	0.27	1.07	0.00	0.54	0.00	0.00	1.34	0.27	0.54	86.06	2.14	0.00	0.00
6-8 cm	0.00	0.00	1.86	0.00	0.31	0.00	0.00	1.24	0.62	0.31	79.81	3.42	0.00	0.62
8-10 cm	0.00	0.28	1.69	0.00	0.00	0.00	0.00	1.12	0.56	0.00	85.67	1.69	0.00	0.84
10-12 cm	0.00	0.00	2.05	0.29	0.00	0.00	0.00	1.47	0.00	0.29	85.04	2.93	0.00	0.29
14-16 cm	0.00	0.00	1.85	0.00	0.00	0.00	0.00	1.23	1.85	0.62	88.92	0.31	0.00	0.00
18-20 cm	0.00	0.00	1.65	0.27	0.00	0.00	0.00	1.65	1.10	0.00	61.26	7.42	0.00	1.37
20-22 cm	0.00	0.00	1.41	0.00	0.00	0.00	0.28	0.85	0.28	0.00	68.36	3.67	0.00	4.52
24-26 cm	0.00	0.00	2.86	0.00	0.00	0.00	0.00	1.30	0.26	0.00	81.77	1.56	0.00	0.52
28-30 cm	0.00	0.32	0.63	0.00	0.00	0.00	0.00	1.90	1.27	0.32	73.42	4.75	0.00	0.32
30-32 cm	0.00	0.48	2.64	0.00	0.00	0.00	0.00	1.20	0.48	0.00	58.99	4.56	0.48	1.92
34-36 cm	0.00	0.00	0.54	0.27	0.54	0.00	0.00	0.27	0.27	0.54	48.65	5.41	0.54	3.24
38-40 cm	0.00	0.00	0.63	0.00	0.95	0.00	0.00	0.95	0.63	0.63	59.49	4.11	0.00	2.85
40-42 cm	0.00	0.00	1.29	0.00	0.00	0.00	0.00	0.32	0.32	0.00	94.21	0.64	0.00	0.00
44-46 cm	0.00	0.92	2.15	0.00	0.00	0.00	0.00	1.53	0.31	0.00	69.94	3.99	0.31	2.15
48-50 cm	0.31	0.00	0.61	0.00	0.00	0.00	0.00	0.92	0.00	0.00	44.65	3.67	0.00	1.83
50-52 cm	0.28	0.55	1.11	0.00	2.49	0.28	0.55	0.55	0.55	0.28	25.21	5.82	0.00	4.71
52-54 cm	0.33	0.98	1.63	0.00	0.65	0.00	0.00	0.65	0.65	0.00	67.10	3.26	0.00	3.26
54-56 cm	0.00	0.00	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	93.10	0.94	0.00	0.63

Appendix 1. Continued

Depth	<i>Tilia</i>	<i>Ulmus</i>	<i>Ambrosia</i>	Asteraceae	Chenopodiaceae	<i>Cladium</i>	Cyperaceae	Labiales	Poaceae	Polygonaceae	<i>Sagittaria</i>	<i>Typha</i>
0-2 cm	0.59	0.59	0.89	2.67	8.01	2.67	2.37	1.19	1.48	0.30	0.30	1.48
2-4 cm	0.00	1.22	0.30	1.52	4.88	0.30	0.91	0.00	0.61	0.61	0.00	4.27
4-6 cm	0.00	0.54	0.27	0.54	1.34	0.54	1.34	0.00	0.27	0.80	0.27	1.34
6-8 cm	0.00	0.62	0.31	0.62	4.04	0.00	0.62	0.00	1.55	0.31	0.31	2.80
8-10 cm	0.00	0.28	0.00	0.56	2.53	0.28	1.12	0.00	0.56	0.28	0.00	1.69
10-12 cm	0.00	0.29	0.29	0.88	2.35	0.00	1.17	0.00	0.29	0.29	0.59	1.17
14-16 cm	0.00	0.00	0.00	0.31	0.00	0.00	1.54	0.00	0.62	0.31	0.00	0.31
18-20 cm	0.00	0.27	1.37	3.57	11.54	0.00	2.20	0.00	1.65	0.27	1.10	2.47
20-22 cm	0.00	0.00	0.28	1.69	11.02	0.28	1.69	0.00	0.56	0.85	0.28	2.26
24-26 cm	0.00	0.00	0.00	1.56	3.39	0.00	1.82	0.00	0.26	0.52	0.00	2.08
28-30 cm	0.00	0.95	0.32	0.63	4.43	0.00	1.90	0.00	1.90	0.63	1.27	3.48
30-32 cm	0.00	0.24	2.16	5.52	14.15	0.00	1.44	0.00	0.96	0.48	0.72	4.56
34-36 cm	0.00	0.27	1.62	7.57	22.16	0.00	1.35	0.00	1.62	0.27	0.54	4.05
38-40 cm	0.00	0.00	0.32	5.38	18.04	0.00	1.27	0.00	0.32	0.32	0.32	2.85
40-42 cm	0.00	0.00	0.00	0.00	0.00	0.00	0.96	0.00	0.00	0.64	0.64	0.32
44-46 cm	0.00	0.61	0.31	2.45	11.04	0.00	0.92	0.00	0.61	0.00	0.00	0.61
48-50 cm	0.00	0.00	0.00	6.12	37.00	0.00	0.92	0.00	0.61	0.31	0.00	1.22
50-52 cm	0.28	0.28	0.83	8.86	39.61	0.83	1.39	0.00	1.39	0.00	0.28	1.39
52-54 cm	0.33	0.00	0.33	2.28	11.40	0.00	3.26	0.00	0.65	0.33	0.33	0.65
54-56 cm	0.00	0.00	0.00	1.25	0.94	0.00	0.63	0.00	0.00	1.25	0.31	0.00

Appendix 2. Concentration (palynomorphs/gram dry sediment) of pollen and algal taxa present in core 9-6-96-7, Lake Pontchartrain, Louisiana.
(TCT=Taxodiaceae/Cupressaceae/Taxaceae)

Depth	Betula	Carya	Corylus	Fraxinus	Ilex	Juglans	Liquidambar	Myrica	Nyssa	Pinus	Quercus	Salix	TCT
0-2 cm	0	447	0	112	0	0	391	224	168	12,073	838	56	727
2-4 cm	34	309	34	34	0	0	103	34	34	8,338	446	0	103
4-6 cm	19	77	0	38	0	0	96	19	38	6,167	154	0	0
6-8 cm	0	232	0	39	0	0	155	77	39	9,948	426	0	77
8-10 cm	28	168	0	0	0	0	112	56	0	8,535	168	0	84
10-12 cm	0	110	16	0	0	0	79	0	16	4,572	158	0	16
14-16 cm	0	235	0	0	0	0	157	235	78	11,313	39	0	0
18-20 cm	0	287	48	0	0	0	287	192	0	10,683	1,293	0	240
20-22 cm	0	263	0	0	0	53	158	53	0	12,715	683	0	841
24-26 cm	0	156	0	0	0	0	71	14	0	4,448	85	0	28
28-30 cm	94	188	0	0	0	0	563	376	94	21,780	1,408	0	94
30-32 cm	143	784	0	0	0	0	356	143	0	17,530	1,354	143	570
34-36 cm	0	160	80	160	0	0	80	80	160	14,416	1,602	160	961
38-40 cm	0	57	0	85	0	0	85	57	57	5,335	369	0	255
40-42 cm	0	34	0	0	0	0	9	9	0	2,511	17	0	0
44-46 cm	20	46	0	0	0	0	33	7	0	1,499	85	7	46
48-50 cm	0	20	0	0	0	0	29	0	0	1,434	118	0	59
50-52 cm	40	79	0	178	20	40	40	40	20	1,801	416	0	337
52-54 cm	31	52	0	21	0	0	21	21	0	2,136	104	0	104
54-56 cm	0	13	0	0	0	0	0	0	0	1,929	19	0	13

Appendix 2. Continued

Depth	<i>Tilia</i>	<i>Ulmus</i>	<i>Ambrosia</i>	Asteraceae	Chenopodiaceae	<i>Cladium</i>	Cyperaceae	Poaceae	Polygonaceae	<i>Sagittaria</i>	<i>Typha</i>	Total Pollen	<i>Pediastrum</i>
0-2 cm	112	112	168	503	1,509	447	279	279	56	56	224	19,394	168
2-4 cm	0	137	34	172	549	34	103	69	69	0	480	11,564	1,510
4-6 cm	0	38	19	38	96	38	96	19	58	19	96	7,301	2,613
6-8 cm	0	77	39	77	503	0	77	194	39	39	348	12,581	5,381
8-10 cm	0	28	0	56	252	28	112	56	28	0	168	10,158	2,686
10-12 cm	0	16	16	47	126	0	63	16	16	32	63	5,597	2,759
14-16 cm	0	0	0	39	0	0	196	78	39	0	39	12,879	3,288
18-20 cm	0	48	240	623	2,012	0	383	287	48	192	431	17,965	3,545
20-22 cm	0	0	53	315	2,049	53	315	105	158	53	420	19,336	12,820
24-26 cm	0	0	0	85	184	0	99	14	28	0	113	5,582	1,686
28-30 cm	0	282	94	188	1,314	0	563	563	188	376	1,033	30,041	17,743
30-32 cm	0	71	641	1,639	4,204	0	428	285	143	214	1,354	30,714	3,492
34-36 cm	0	80	481	2,243	6,567	0	400	481	80	160	1,201	30,194	7,448
38-40 cm	0	0	28	482	1,617	0	114	28	28	28	255	9,080	1,930
40-42 cm	0	0	0	0	0	0	26	0	17	17	9	2,683	86
44-46 cm	0	13	7	53	237	0	20	13	0	0	13	2,215	53
48-50 cm	0	0	0	196	1,189	0	29	20	10	0	39	3,310	0
50-52 cm	20	20	59	633	2,831	59	99	99	0	20	99	7,502	20
52-54 cm	10	0	10	73	363	0	104	21	10	10	21	3,370	21
54-56 cm	0	0	0	26	19	0	13	0	26	6	0	2,098	19

Appendix 3. Percent abundance of pollen in samples from core 9-6-96-9, Lake Pontchartrain, Louisiana. (TCT=Taxodiaceae/Cupressaceae/Taxaceae)

Depth	Acer	Alnus	Betula	Carya	Castanea	Cephalanthus	Cornus	Corylus	Fagus	Fraxinus	Ilex	Juglans	Liquidambar	Magnolia	Myrica
0-2 cm	0.00	0.28	0.84	3.08	0.00	0.00	0.00	0.56	0.00	0.28	0.00	0.56	1.68	0.00	0.84
2-4	0.00	0.26	0.26	1.02	0.00	0.00	0.00	0.51	0.00	0.51	0.00	0.00	1.79	0.00	0.77
4-6	0.00	0.61	0.00	2.43	0.00	0.00	0.00	0.30	0.00	0.91	0.00	0.61	1.52	0.00	0.30
6-8	0.00	0.31	0.31	1.56	0.00	0.00	0.00	0.62	0.00	0.62	0.31	0.00	3.12	0.00	0.93
8-10	0.31	0.31	0.00	2.19	0.00	0.00	0.00	0.31	0.00	0.63	0.00	0.00	0.94	0.00	0.63
10-12	0.00	0.59	0.00	2.37	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.30	1.78	0.00	0.00
12-14	0.00	0.30	0.30	4.85	0.00	0.00	0.30	0.30	0.00	0.30	0.00	0.30	2.42	0.00	0.91
14-16	0.00	0.32	0.00	0.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.21	0.00	0.64
16-18	0.00	0.27	0.00	2.43	0.00	0.00	0.00	0.00	0.27	0.27	0.00	0.27	3.51	0.00	0.54
18-20	0.00	0.30	0.00	2.70	0.00	0.00	0.00	0.30	0.00	0.30	0.00	0.00	2.70	0.00	0.60
20-22	0.00	0.00	0.34	1.68	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.34	3.02	0.34	1.01
22-24	0.00	0.00	0.00	2.36	0.00	0.00	0.00	0.34	0.34	0.34	0.00	0.00	2.69	0.00	1.01
24-26	0.00	0.53	0.00	4.50	0.00	0.00	0.00	0.53	0.00	0.00	0.00	0.00	3.17	0.00	0.53
26-28	0.00	0.33	0.33	1.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.66	0.00	0.00
28-30	0.00	0.29	0.29	1.72	0.00	0.00	0.00	0.29	0.00	0.57	0.00	0.00	1.15	0.00	0.29
30-32	0.30	0.30	0.30	4.56	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00	2.74	0.00	0.91
32-34	0.00	0.00	0.00	0.67	0.00	0.00	0.00	1.68	0.00	1.35	0.67	0.34	1.68	0.00	1.68
34-36	0.28	0.55	0.00	1.38	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	1.66	0.00	0.00
36-38	0.77	0.00	0.00	1.54	0.00	0.26	0.00	0.77	0.00	1.03	0.00	0.51	1.79	0.00	0.26
38-40	0.31	0.61	0.00	2.15	0.00	0.31	0.00	0.00	0.00	0.61	0.00	0.31	1.53	0.00	0.31
40-42	0.00	0.56	0.00	2.81	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	2.25	0.00	1.12
42-44	0.00	0.34	0.34	1.38	0.00	0.00	0.00	0.69	0.00	0.69	0.00	0.00	2.41	0.00	0.34
44-46	0.33	0.33	0.00	0.66	0.33	0.00	0.00	1.32	0.00	0.66	0.00	0.00	1.99	0.00	0.00
46-48	0.00	0.00	0.00	5.23	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	3.20	0.00	2.33

Appendix 3. Continued

Depth	<i>Nymphaea</i>	<i>Nyssa</i>	<i>Ostrya/Carpinus</i>	<i>Pinus</i>	<i>Quercus</i>	<i>Salix</i>	TCT	<i>Tilia</i>	<i>Ulmus</i>	<i>Ambrosia</i>	<i>Asteraceae</i>	<i>Chenopodiaceae</i>	<i>Cyperaceae</i>	<i>Ephedra</i>	<i>Ericaceae</i>
0-2 cm	0.00	0.56	0.00	58.54	7.28	0.00	1.40	0.00	1.96	1.12	3.36	8.12	0.84	0.00	0.00
2-4	0.00	0.26	0.00	45.78	9.72	2.30	11.00	0.00	0.26	1.79	3.07	9.97	3.84	0.00	0.00
4-6	0.00	1.82	0.00	43.77	8.51	0.00	10.33	0.00	2.13	0.61	3.65	10.64	2.74	0.00	0.00
6-8	0.62	0.62	0.00	43.61	13.40	1.25	7.48	0.00	1.25	0.93	2.80	9.03	4.05	0.00	0.00
8-10	0.00	1.57	0.00	60.82	7.84	0.00	1.88	0.00	0.63	0.63	1.88	5.02	2.19	0.00	0.00
10-12	0.30	0.89	0.00	69.44	6.23	0.00	2.97	0.00	0.30	0.30	0.89	4.75	4.75	0.00	0.00
12-14	0.00	0.61	0.00	53.33	9.09	0.30	6.67	0.91	0.00	0.00	1.21	7.58	2.73	0.00	0.00
14-16	0.32	1.60	0.00	58.33	9.62	0.00	1.92	0.00	0.32	0.00	0.32	7.37	5.45	0.00	0.00
16-18	0.00	0.81	0.00	56.22	9.73	0.81	3.24	0.00	0.54	2.43	4.59	7.30	0.54	0.00	0.00
18-20	0.00	0.60	0.30	42.64	12.31	0.30	7.21	0.00	0.90	0.00	1.80	10.51	5.41	0.00	0.00
20-22	0.00	1.01	0.00	55.37	9.40	0.34	4.36	0.00	0.34	1.34	2.01	9.06	4.03	0.00	0.00
22-24	0.00	1.01	0.00	49.83	8.42	0.34	6.40	0.00	0.67	0.34	1.01	12.79	3.37	0.00	0.00
24-26	0.00	0.79	0.26	56.61	7.14	0.53	3.70	0.00	0.53	1.06	1.85	6.61	5.03	0.00	0.00
26-28	0.00	1.33	0.00	58.47	9.30	1.00	3.99	0.00	1.00	0.33	1.99	9.30	1.33	0.00	0.00
28-30	0.00	0.57	0.00	33.05	10.34	1.44	14.08	0.00	0.29	0.57	6.32	14.37	2.01	0.00	0.00
30-32	0.00	0.61	0.00	61.40	8.51	0.00	0.91	0.00	1.22	1.52	2.13	3.34	3.95	0.00	0.00
32-34	0.34	1.01	0.00	32.66	10.77	2.36	11.11	0.00	0.67	0.00	4.04	11.45	6.40	0.00	0.00
34-36	0.00	0.28	0.00	39.50	9.67	1.38	4.42	0.00	0.55	1.66	4.14	13.81	5.80	0.00	0.00
36-38	0.26	0.26	0.00	36.41	10.26	1.79	7.18	0.00	0.77	0.00	4.87	12.56	4.36	0.00	0.00
38-40	0.31	0.92	0.00	39.57	7.36	1.23	7.67	0.31	0.61	0.00	4.91	15.03	5.21	0.00	0.00
40-42	0.00	1.12	0.00	55.06	10.11	0.56	2.25	0.00	0.84	0.56	2.53	7.87	4.21	0.00	0.00
42-44	0.00	1.03	0.00	43.10	10.34	0.34	5.86	0.00	1.03	0.00	3.79	13.10	5.52	0.00	0.00
44-46	0.00	0.99	0.00	32.78	9.27	3.64	12.91	0.00	0.66	0.00	2.65	16.23	4.97	0.00	0.00
46-48	0.29	1.16	0.00	60.76	7.85	0.00	0.29	0.00	0.87	0.58	2.03	5.23	2.33	0.29	0.29

Appendix 3. Continued

Depth	Euphorbs	Labiatae	Leguminosae	Myrtophyllum	Plantago	Poaceae	Polygonaceae	Pontederia	Sagittaria	Typha	Utricularia
0-2 cm	0.28	0.00	0.00	0.00	0.00	3.64	0.28	0.28	0.56	2.24	0.00
2-4	0.00	0.00	0.51	0.00	0.26	4.09	0.00	0.00	0.77	2.05	0.00
4-6	0.00	0.00	0.00	0.00	0.00	5.17	0.30	0.00	0.00	3.34	0.00
6-8	0.00	0.00	0.31	0.00	0.00	3.43	0.00	0.00	0.62	3.43	0.00
8-10	0.00	0.00	0.31	0.00	0.00	5.64	0.31	0.00	0.31	5.64	0.00
10-12	0.00	0.30	0.00	0.00	0.00	1.78	0.00	0.00	0.00	1.78	0.00
12-14	0.30	0.00	0.00	0.30	0.00	3.33	0.00	0.00	0.61	1.82	0.00
14-16	0.00	0.00	0.00	0.00	0.00	7.37	0.00	0.00	0.32	1.60	0.00
16-18	0.00	0.00	0.27	0.00	0.00	3.78	0.27	0.00	0.00	3.51	0.00
18-20	0.00	0.00	0.00	0.00	0.00	6.31	0.60	0.00	0.00	3.30	0.00
20-22	0.00	0.00	0.34	0.00	0.00	3.69	0.67	0.00	0.34	1.01	0.00
22-24	0.00	0.00	0.00	0.34	0.00	6.73	0.00	0.00	0.00	1.35	0.34
24-26	0.00	0.00	0.00	0.00	0.00	4.23	0.26	0.00	0.53	2.38	0.00
26-28	0.00	0.00	0.00	0.00	0.00	1.99	0.66	0.00	0.33	4.32	0.00
28-30	0.00	0.00	0.00	0.00	0.00	7.47	0.00	0.00	0.00	4.89	0.00
30-32	0.00	0.00	0.30	0.00	0.00	3.65	0.00	0.00	0.00	2.74	0.00
32-34	0.00	0.00	0.67	0.00	0.00	5.39	0.34	0.00	0.00	1.01	0.00
34-36	0.00	0.00	0.28	0.00	0.00	8.84	0.55	0.00	0.28	5.25	0.00
36-38	0.00	0.26	0.26	0.00	0.00	8.72	0.26	0.00	0.00	3.85	0.00
38-40	0.00	0.00	0.00	0.00	0.00	6.75	0.00	0.00	0.61	2.45	0.00
40-42	0.00	0.00	0.56	0.00	0.00	4.78	0.00	0.00	0.00	2.53	0.00
42-44	0.00	0.00	0.00	0.34	0.00	8.62	0.00	0.00	0.69	2.76	0.00
44-46	0.33	0.00	0.33	0.00	0.00	8.28	0.00	0.00	0.33	4.30	0.00
46-48	0.00	0.00	0.00	0.00	0.00	3.20	0.00	0.00	0.29	2.62	0.00

Appendix 4. Concentration (palynomorphs/gram dry sediment) of pollen and algal taxa present in core 9-6-96-9, Lake Pontchartrain, Louisiana.
(TCT=Taxodiaceae/Cupressaceae/Taxaceae)

Depth	Acer	Alnus	Betula	Carya	Castanea	Cephalanthus	Conocarpus	Cornus	Corylus	Fagus	Fraxinus	Ilex	Juglans
0-2 cm	0	76	227	831	0	0	0	0	151	0	76	0	151
2-4	0	39	39	158	0	0	0	0	79	0	79	0	0
4-6	0	281	0	1,122	0	0	0	0	140	0	421	0	281
6-8	0	189	189	944	0	0	0	0	378	0	378	189	0
8-10	73	73	0	512	0	0	0	0	73	0	146	0	0
10-12	0	180	0	721	0	0	0	0	90	0	0	0	90
12-14	0	57	57	914	0	0	0	57	57	0	57	0	57
14-16	0	56	0	169	0	0	56	0	0	0	0	0	0
16-18	0	62	0	560	0	0	0	0	0	62	62	0	62
18-20	0	97	0	871	0	0	0	0	97	0	97	0	0
20-22	0	0	79	394	0	0	0	0	79	0	0	0	79
22-24	0	0	0	472	0	0	0	0	67	67	67	0	0
24-26	0	74	0	631	0	0	0	0	74	0	0	0	0
26-28	0	64	64	257	0	0	0	0	0	0	0	0	0
28-30	0	83	83	495	0	0	0	0	83	0	165	0	0
30-32	44	44	44	653	0	0	0	0	87	0	0	0	0
32-34	0	0	0	297	0	0	0	0	742	0	594	297	148
34-36	118	236	0	589	0	0	0	0	0	0	118	0	0
36-38	243	0	0	485	0	81	0	0	243	0	324	0	162
38-40	87	174	0	610	0	87	0	0	0	0	174	0	87
40-42	0	102	0	512	0	0	0	0	0	0	51	0	0
42-44	0	89	89	357	0	0	0	0	179	0	179	0	0
44-46	92	92	0	183	92	0	0	0	367	0	183	0	0
46-48	0	0	0	1,294	0	0	0	0	72	0	0	0	0

Appendix 4. Continued

Depth	<i>Liquidambar</i>	<i>Magnolia</i>	<i>Myrica</i>	<i>Nyssa</i>	<i>Ostrya/Carpinus</i>	<i>Pinus</i>	<i>Quercus</i>	<i>Salix</i>	TCT	<i>Tilia</i>	<i>Ulmus</i>	<i>Ambrosia</i>	Aster
0-2 cm	453	0	227	151	0	15,781	1,963	0	378	0	529	302	604
2-4	276	0	118	39	0	7,064	1,500	355	1,697	0	39	276	79
4-6	701	0	140	842	0	20,202	3,928	0	4,770	0	982	281	421
6-8	1,889	0	567	378	0	26,444	8,122	756	4,533	0	756	567	378
8-10	219	0	146	365	0	14,179	1,827	0	439	0	146	146	146
10-12	541	0	0	270	0	21,084	1,892	0	901	0	90	90	0
12-14	457	0	171	114	0	10,052	1,713	57	1,256	171	0	0	0
14-16	564	0	113	282	0	10,264	1,692	0	338	0	56	0	0
16-18	809	0	124	187	0	12,940	2,240	187	747	0	124	560	0
18-20	871	0	194	194	97	13,742	3,968	97	2,323	0	290	0	97
20-22	709	79	236	236	0	12,991	2,204	79	1,024	0	79	315	0
22-24	540	0	202	202	0	9,985	1,687	67	1,282	0	135	67	135
24-26	445	0	74	111	37	7,941	1,002	74	519	0	74	148	37
26-28	322	0	0	257	0	11,320	1,801	193	772	0	193	64	0
28-30	330	0	83	165	0	9,489	2,970	413	4,043	0	83	165	0
30-32	392	0	131	87	0	8,797	1,219	0	131	0	174	218	87
32-34	742	0	742	445	0	14,397	4,750	1,039	4,898	0	297	0	0
34-36	707	0	0	118	0	16,856	4,126	589	1,886	0	236	707	118
36-38	566	0	81	81	0	11,490	3,237	566	2,266	0	243	0	162
38-40	435	0	87	261	0	11,236	2,090	348	2,177	87	174	0	0
40-42	410	0	205	205	0	10,042	1,844	102	410	0	154	102	102
42-44	625	0	89	268	0	11,166	2,680	89	1,519	0	268	0	0
44-46	550	0	0	275	0	9,076	2,567	1,008	3,576	0	183	0	183
46-48	791	0	575	288	0	15,030	1,942	0	72	0	216	144	216

Appendix 4. Continued

Depth	Asteraceae indet.	Chenopodiaceae	Cyperaceae	Ephedra	Ericaceae	Euphorbiaceae	Labiatae	Leguminosae	Myrtophyllum	Nymphaea	Plantago	Poaceae	Polygonaceae
0-2 cm	0	2,190	227	0	0	76	0	0	0	0	0	982	76
2-4	118	1,539	592	0	0	0	0	79	0	0	39	631	0
4-6	982	4,910	1,263	0	0	0	0	0	0	0	0	2,385	140
6-8	756	5,478	2,456	0	0	0	0	189	0	378	0	2,078	0
8-10	146	1,169	512	0	0	0	0	73	0	0	0	1,316	73
10-12	180	1,442	1,442	0	0	0	90	0	0	90	0	541	0
12-14	228	1,428	514	0	0	57	0	0	57	0	0	628	0
14-16	56	1,297	959	0	0	0	0	0	0	56	0	1,297	0
16-18	498	1,680	124	0	0	0	0	62	0	0	0	871	62
18-20	484	3,387	1,742	0	0	0	0	0	0	0	0	2,032	194
20-22	157	2,126	945	0	0	0	0	79	0	0	0	866	157
22-24	0	2,564	675	0	0	0	0	0	67	0	0	1,349	0
24-26	74	928	705	0	0	0	0	0	0	0	0	594	37
26-28	322	1,801	257	0	0	0	0	0	0	0	0	386	129
28-30	1,650	4,126	578	0	0	0	0	0	0	0	0	2,145	0
30-32	0	479	566	0	0	0	0	44	0	0	0	523	0
32-34	1,781	5,046	2,820	0	0	0	0	297	0	148	0	2,375	148
34-36	943	5,894	2,475	0	0	0	0	118	0	0	0	3,772	236
36-38	1,376	3,965	1,376	0	0	0	81	81	0	81	0	2,751	81
38-40	1,394	4,268	1,481	0	0	0	0	0	0	87	0	1,916	0
40-42	256	1,435	769	0	0	0	0	102	0	0	0	871	0
42-44	983	3,395	1,429	0	0	0	0	0	89	0	0	2,233	0
44-46	550	4,492	1,375	0	0	92	0	92	0	0	0	2,292	0
46-48	144	1,294	575	72	72	0	0	0	0	72	0	791	0

Appendix 4. Continued

Depth	<i>Pontederia</i>	<i>Sagittaria</i>	<i>Typha</i>	<i>Utricularia</i>	<i>Pedicularis</i>
0-2 cm	76	151	604	0	7,098
2-4	0	118	316	0	8,524
4-6	0	0	1,543	0	25,112
6-8	0	378	2,078	0	29,844
8-10	0	73	1,316	0	12,864
10-12	0	0	541	0	26,399
12-14	0	114	343	0	15,192
14-16	0	56	282	0	11,222
16-18	0	0	809	0	11,945
18-20	0	0	1,065	0	13,452
20-22	0	79	236	0	12,833
22-24	0	0	270	67	11,807
24-26	0	74	334	0	7,199
26-28	0	64	836	0	7,461
28-30	0	0	1,403	0	4,868
30-32	0	0	392	0	5,095
32-34	0	0	445	0	20,038
34-36	0	118	2,240	0	13,674
36-38	0	0	1,214	0	28,644
38-40	0	174	697	0	20,468
40-42	0	0	461	0	14,550
42-44	0	179	715	0	17,866
44-46	0	92	1,192	0	15,494
46-48	0	72	647	0	8,054

Appendix 5. Percent abundance of pollen in samples from core Pon 97-1a, Lake Pontchartrain, Louisiana. (TCT=Taxodiaceae/Cupressaceae/Taxaceae)

Depth	Acer	Alnus	Betula	Carya	Celtis	Cephalanthus	Cornus	Corylus	Fagus	Fraxinus	Ilex	Juglans	Liquidambar	Lindendron	Magnolia	Myrica	Nymphaea
0-2 cm	0.00	0.00	0.00	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.87	0.00	0.00	0.00	0.36
4-6	0.00	0.31	0.00	1.83	0.00	0.00	0.00	0.00	0.31	0.61	0.00	0.00	2.75	0.00	0.00	0.00	0.00
10-12	0.00	0.64	0.00	1.93	0.00	0.00	0.00	0.64	0.00	0.32	0.00	0.32	2.89	0.00	0.00	0.32	0.00
14-16	0.00	0.92	0.31	0.61	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	2.14	0.31	0.00	0.31	0.00
20-22	0.00	0.30	0.00	2.13	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	2.74	0.00	0.00	0.00	0.00
24-26	0.30	0.00	0.00	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.31	0.00	0.00	0.00	0.00
30-32	0.00	0.00	0.31	2.16	0.93	0.00	0.00	0.62	0.00	0.62	0.00	0.00	3.70	0.00	0.31	0.31	0.00
40-42	0.00	0.60	0.00	1.50	0.00	0.00	0.00	0.00	0.30	0.60	0.00	0.00	1.50	0.00	0.00	0.00	0.30
60-62	0.00	0.32	0.00	1.92	0.00	0.00	0.00	0.32	0.00	0.96	0.32	0.00	1.28	0.00	0.00	0.32	0.00
80-82	0.66	0.33	0.33	1.31	0.00	0.00	0.33	0.00	0.00	1.64	0.00	0.66	1.31	0.00	0.00	0.00	0.00
90-92	0.26	0.52	0.52	2.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.52	1.57	0.26	0.00	0.00	0.00
100-102	0.00	0.00	0.78	0.78	0.00	0.00	0.00	0.52	0.00	0.00	0.00	0.78	1.56	0.00	0.00	0.00	0.00
120-122	0.27	0.27	1.35	2.70	0.00	0.00	0.00	0.27	0.00	0.00	0.00	0.00	1.62	0.27	0.00	0.27	0.00
140-142	0.00	0.00	0.00	3.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.53	0.26	0.00	0.00	0.00
160-162	0.00	0.00	0.00	1.62	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00
180-182	0.00	0.32	0.00	0.96	0.00	0.00	0.00	0.32	0.32	0.96	0.32	0.00	0.96	0.32	0.00	0.32	0.00
200-202	0.00	0.30	0.00	1.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.78	0.00	0.00	0.00	0.30
220-222	0.00	0.31	0.00	1.57	0.00	0.31	0.00	0.00	0.31	0.31	0.00	0.00	1.57	0.00	0.00	0.00	0.00
240-242	0.00	0.00	0.00	2.27	0.00	0.00	0.00	0.32	0.00	0.32	0.00	0.00	1.95	0.00	0.00	0.00	0.32
280-282	0.00	0.00	0.00	1.25	0.00	0.00	0.00	0.63	0.63	0.00	0.31	0.00	1.56	0.31	0.00	0.31	0.00
320-322	0.37	0.00	0.00	2.21	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.94	0.00	0.00	0.00	0.00
344-346	0.00	0.00	0.75	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.24	0.75	0.00	0.75	0.00

Appendix 5. Continued

Depth	<i>Nyssa</i>	<i>Ostrya/Carpinus</i>	<i>Picea</i>	<i>Pinus</i>	<i>Quercus</i>	<i>Salix</i>	TCT	Tilla	<i>Ulmus</i>	<i>Ambrosia</i>	<i>Asteraceae</i>	<i>Chenopodiaceae</i>	<i>Cladium</i>	<i>Cyperaceae</i>	<i>Hippocratea</i>	<i>Labiales</i>	<i>Leguminosae</i>	<i>Plantago</i>
0-2 cm	0.36	0.00	0.00	67.38	6.81	0.36	5.73	0.00	0.00	0.00	2.15	2.87	0.00	4.66	0.00	0.00	0.00	0.00
4-6	0.61	0.00	0.00	45.87	12.54	0.31	3.67	0.00	1.53	0.61	2.75	12.54	0.00	4.89	0.00	0.00	0.00	0.00
10-12	0.32	0.00	0.00	49.20	18.65	0.96	0.96	0.00	0.64	0.64	1.93	8.36	0.00	3.54	0.00	0.00	0.00	0.00
14-16	1.53	0.00	0.00	60.24	10.70	0.31	1.22	0.00	1.22	0.92	1.83	4.89	0.31	5.20	0.00	0.00	0.00	0.00
20-22	1.22	0.00	0.00	57.14	10.94	0.30	1.22	0.00	0.00	0.30	0.91	10.94	0.00	5.17	0.00	0.00	0.30	0.00
24-26	0.30	0.00	0.00	51.51	10.54	0.60	6.33	0.00	0.00	1.51	3.92	8.13	0.00	3.61	0.00	0.00	0.00	0.00
30-32	0.31	0.00	0.31	59.26	10.49	0.00	1.85	0.00	1.85	0.93	1.85	4.32	0.00	3.70	0.00	0.00	0.00	0.31
40-42	0.00	0.30	0.00	58.38	11.98	0.30	2.99	0.00	0.00	0.90	3.59	8.98	0.30	1.80	0.00	0.00	0.30	0.00
60-62	0.00	0.00	0.32	49.04	13.78	0.32	3.85	0.00	0.64	0.64	4.81	11.22	0.00	4.17	0.00	0.00	0.32	0.00
80-82	0.00	0.00	0.00	45.57	12.13	2.30	3.93	0.00	0.66	0.98	3.28	14.43	0.00	4.26	0.00	0.00	0.00	0.00
90-92	0.26	0.00	0.00	63.52	7.87	0.26	3.67	0.00	0.00	0.26	1.84	4.99	0.00	3.94	0.00	0.00	0.00	0.00
100-102	0.00	0.00	0.00	58.70	12.99	0.26	5.19	0.00	0.26	0.00	2.34	9.09	0.00	0.78	0.26	0.00	0.00	0.00
120-122	0.27	0.00	0.00	61.19	12.13	0.00	2.70	0.00	0.00	0.00	1.89	7.28	0.00	1.08	0.00	0.27	0.00	0.00
140-142	0.51	0.00	0.00	80.56	6.39	0.00	2.30	0.26	0.00	0.26	0.26	2.05	0.00	1.28	0.00	0.00	0.00	0.00
160-162	0.40	0.00	0.00	79.35	10.93	0.00	1.62	0.00	0.00	0.00	0.40	1.62	0.00	0.81	0.00	0.00	0.00	0.00
180-182	0.00	0.00	0.00	78.66	8.28	0.00	1.27	0.00	0.00	0.64	0.64	1.59	0.00	1.91	0.00	0.32	0.00	0.00
200-202	0.00	0.00	0.00	67.75	17.75	0.00	2.96	0.00	0.00	0.00	0.89	1.18	0.00	1.48	0.00	0.00	0.00	0.00
220-222	1.26	0.00	0.00	61.32	17.92	0.31	1.57	0.00	0.31	0.00	0.94	5.35	0.00	1.89	0.00	0.00	0.00	0.31
240-242	0.97	0.00	0.00	57.79	19.48	0.00	4.55	0.00	0.65	0.00	2.27	3.25	0.00	1.30	0.00	0.00	0.00	0.00
280-282	0.31	0.31	0.00	52.50	21.25	0.31	4.38	0.00	0.94	0.63	2.50	5.31	0.00	1.56	0.00	0.00	0.00	0.00
320-322	0.37	0.00	0.00	73.90	8.82	0.00	0.37	0.00	1.10	0.00	1.47	2.94	0.00	2.57	0.37	0.00	0.00	0.00
344-346	0.00	0.00	0.00	67.91	10.45	0.00	2.24	0.00	0.75	1.49	3.73	2.24	0.00	2.99	0.00	0.00	0.00	0.00

Appendix 5. Continued

Depth	Poaceae	Polygonaceae	Sagittaria	Typha	Umbelliferae
0-2 cm	3.23	0.00	0.00	1.43	0.00
4-6	3.98	0.31	0.31	3.98	0.00
10-12	3.86	0.00	0.64	3.54	0.00
14-16	4.59	0.00	0.00	2.14	0.00
20--22	2.13	0.00	0.30	2.43	0.00
24-26	5.72	0.00	0.00	4.22	0.00
30-32	3.09	0.00	0.00	2.47	0.00
40-42	2.99	0.30	0.00	1.50	0.00
60-62	3.85	0.00	0.00	0.96	0.00
80-52	4.59	0.00	0.00	1.31	0.00
90-52	6.30	0.00	0.00	0.26	0.00
100-102	3.90	0.00	0.26	1.30	0.00
120-122	4.04	0.00	0.00	2.16	0.00
140-142	1.28	0.00	0.00	0.00	0.00
160-162	2.43	0.00	0.00	0.00	0.00
180-182	0.96	0.00	0.00	0.00	0.00
200-202	2.66	0.00	0.30	0.00	0.00
220-222	3.14	0.00	0.00	0.31	0.00
240-242	2.92	0.00	0.00	0.32	0.32
280-282	3.44	0.00	0.31	0.63	0.00
320-322	1.10	0.00	0.00	0.37	0.00
344-346	3.73	0.00	0.00	0.00	0.00

Appendix 6. Concentration (palynomorphs/gram dry sediment) of pollen and algal taxa present in core Pon 97-1a, Lake Pontchartrain, Louisiana.
(TCT=Taxodiaceae/Cupressaceae/Taxaceae)

Depth	Acer	Alnus	Betula	Carya	Celtis	Cephalanthus	Cornus	Corylus	Fagus	Fraxinus	Ilex	Juglans	Liquidambar	Liriodendron	Magnolia
0-2	0	0	0	327	0	0	0	0	0	0	0	0	653	0	0
4-6	0	50	0	303	0	0	0	0	50	101	0	0	454	0	0
10-12	0	232	0	697	0	0	0	232	0	116	0	116	1,045	0	0
14-16	0	354	118	236	0	0	0	0	118	0	0	0	825	118	0
20-22	0	119	0	836	0	0	0	119	0	0	0	0	1,075	0	0
24-26	78	0	0	314	0	0	0	0	0	0	0	0	863	0	0
30-32	0	0	48	338	145	0	0	96	0	96	0	0	579	0	48
40-42	0	56	0	141	0	0	0	0	28	56	0	0	141	0	0
60-62	0	39	0	231	0	0	0	39	0	116	39	0	154	0	0
80-82	170	85	85	341	0	0	85	0	0	426	0	170	341	0	0
90-92	32	64	64	255	0	0	0	0	0	0	0	64	191	32	0
100-102	0	0	118	118	0	0	0	79	0	0	0	118	236	0	0
120-122	28	28	140	279	0	0	0	28	0	0	0	0	168	28	0
160-162	0	0	0	358	0	0	0	0	0	0	90	0	0	0	0
180-182	0	41	0	123	0	0	0	41	41	123	41	0	123	41	0
200-202	0	58	0	292	0	0	0	0	0	0	0	0	350	0	0
220-222	0	205	0	1,025	0	205	0	0	205	205	0	0	1,025	0	0
240-242	0	0	0	459	0	0	0	66	0	66	0	0	394	0	0
280-282	0	0	0	352	0	0	0	176	176	0	88	0	440	88	0
320-322	36	0	0	219	36	0	0	0	0	0	0	0	291	0	0
344-346	0	0	6	6	0	0	0	0	0	0	0	0	17	6	0

Appendix 6. Continued

Depth	Myrica	Nyssa	Ostrya/Carpinus	Picea	Pinus	Quercus	Salix	TCT	Ulmus	HERBACEOUS TAXA	Ambrosia	Asteraceae	Chenopods	Cladium	Cyperaceae	Hippocratea	Labatae
0-2	0	82	0	0	15,351	1,551	82	1,306	0		0	490	653	0	1,061	0	0
4-6	0	101	0	0	7,574	2,070	50	606	252		101	454	2,070	0	808	0	0
10-12	116	116	0	0	17,768	6,736	348	348	232		232	697	3,019	0	1,277	0	0
14-16	118	589	0	0	23,222	4,126	118	472	472		354	707	1,886	118	2,004	0	0
20-22	0	478	0	0	22,456	4,300	119	478	0		119	358	4,300	0	2,031	0	0
24-26	0	78	0	0	13,413	2,745	157	1,647	0		392	1,020	2,118	0	941	0	0
30-32	48	48	0	48	9,262	1,640	0	289	289		145	289	675	0	579	0	0
40-42	0	0	28	0	5,508	1,130	28	282	0		85	339	847	28	169	0	0
60-62	39	0	0	39	5,894	1,656	39	462	77		77	578	1,348	0	501	0	0
80-82	0	0	0	0	11,843	3,153	596	1,022	170		256	852	3,749	0	1,108	0	0
90-92	0	32	0	0	7,711	956	32	446	0		32	223	605	0	478	0	0
100-102	0	0	0	0	8,897	1,968	39	787	39		0	354	1,378	0	118	39	0
120-122	28	28	0	0	6,344	1,258	0	279	0		0	196	755	0	112	0	28
160-162	0	90	0	0	17,559	2,419	0	358	0		0	90	358	0	179	0	0
180-182	41	0	0	0	10,124	1,066	0	164	0		82	82	205	0	246	0	41
200-202	0	0	0	0	13,377	3,505	0	584	0		0	175	234	0	292	0	0
220-222	0	820	0	0	39,962	11,681	205	1,025	205		0	615	3,484	0	1,230	0	0
240-242	0	197	0	0	11,682	3,938	0	919	131		0	459	656	0	263	0	0
280-282	88	88	88	0	14,797	5,989	88	1,233	264		176	705	1,497	0	440	0	0
320-322	0	36	0	0	7,320	874	0	36	109		0	146	291	0	255	36	0
344-346	6	0	0	0	501	77	0	17	6		11	28	17	0	22	0	0

Appendix 6. Continued

Depth	Leguminosae	Nymphaea	Plantago	Poaceae	Polygonaceae	Sagittaria	Typha	Umbelliferae	Total pollen	DINOCYSTS	Lingulodinium	Spitrites	P. zoharyi	Nematosphaeropsis	Operculodinium	Misc. dinos	Reworked grains	Total Dinocysts
0-2	0	82	0	735	0	0	327	0	24,169		0	245	82	0	0	82	82	408
4-6	0	0	0	656	50	50	656	0	17,217		0	50	0	0	0	50	50	101
10-12	0	0	0	1,394	0	232	1,277	0	37,161		0	116	0	0	0	0	232	116
14-16	0	0	0	1,768	0	0	825	0	40,314		0	118	118	0	0	118	354	354
20-22	119	0	0	836	0	119	956	0	41,090		0	478	0	0	0	0	239	478
24-26	0	0	0	1,490	0	0	1,098	0	27,610		78	706	235	0	0	0	0	1,020
30-32	0	0	48	482	0	0	386	0	15,967		0	289	531	0	0	241	820	1,061
40-42	28	28	0	282	28	0	141	0	9,943		0	141	226	0	0	0	876	367
60-62	39	0	0	462	0	0	116	0	12,480		0	77	154	0	0	154	963	385
80-82	0	0	0	1,193	0	0	341	0	27,691		0	341	170	0	0	85	682	596
90-92	0	0	0	765	0	0	32	0	12,555		0	287	414	32	0	32	414	765
100-102	0	0	0	590	0	39	197	0	15,983		0	118	315	0	0	79	551	512
120-122	0	0	0	419	0	0	224	0	10,899		0	168	140	0	0	112	168	419
160-162	0	0	0	538	0	0	0	0	22,576		0	627	985	0	90	90	0	1,792
180-182	0	0	0	123	0	0	0	0	13,034		0	205	615	0	0	41	205	861
200-202	0	58	0	526	0	58	0	0	20,095		0	701	1,285	0	0	117	0	2,103
220-222	0	0	205	2,049	0	0	205	0	65,579		0	0	0	0	0	0	0	0
240-242	0	66	0	591	0	0	66	66	20,345		0	919	1,116	197	0	131	66	2,363
280-282	0	0	0	969	0	88	176	0	28,625		0	352	2,290	0	0	0	88	2,642
320-322	0	0	0	109	0	0	36	0	10,306		73	291	1,347	73	0	73	36	1,857
344-346	0	0	0	28	0	0	0	0	793		0	11	28	0	0	0	0	39

Appendix 6. Continued

Depth	GREEN ALGAE	<i>Botryococcus</i>	<i>Pediastrum</i>	<i>Pseudoschizaea</i>
0-2		1,388	17,637	0
4-6		959	20,752	0
10-12		1,161	29,961	0
14-16		2,240	35,599	0
20-22		3,066	54,229	0
24-26		0	28,708	0
30-32		0	1,785	0
40-42		0	169	0
60-62		0	116	0
80-82		0	256	0
90-92		0	64	0
100-102		0	79	0
120-122		0	0	0
160-162		0	0	0
180-182		0	0	0
200-202		0	58	0
220-222		0	0	0
240-242		0	66	0
280-282		0	0	0
320-322		0	0	0
344-346		0	99	237

Appendix 7. Lead-210 and cesium-137 activity vs. depth in core 9-7-96-7, Lake Pontchartrain, Louisiana.

Core No.	Depth (cm)	Mean Depth (cm)	Dry Bulk Density (g/cm ³)	% Water Content	Loss On Ignition (% Dry Wt.)	Total Pb-210 Activity (dpm/g)	Total Pb-210 Error +/- (dpm/g)	Ra-226 Activity (dpm/g)	Ra-226 Error +/- (dpm/g)	Excess Pb-210 Activity (dpm/g)	Excess Pb-210 Error +/- (dpm/g)	Cs-137 Activity (dpm/g)	Cs-137 Error +/- (dpm/g)
9-7-96-7	0-2	1	0.49	65.00	10.46	7.47	0.09	2.37	0.31	4.80	0.32	0.40	0.12
9-7-96-7	2-4	3	0.54	61.60	9.18	5.05	0.07	2.24	0.30	2.54	0.31	0.34	0.14
9-7-96-7	4-6	5	0.58	59.23	8.64	3.12	0.05	2.41	0.27	0.65	0.27	0.47	0.14
9-7-96-7	6-8	7	0.63	58.42	8.66	2.68	0.05	2.00	0.30	0.68	0.30	0.59	0.16
9-7-96-7	8-10	9	0.71	54.70	7.92	2.29	0.04	2.37	0.30	-0.08	0.30	0.53	0.15
9-7-96-7	10-12	11	0.65	57.85	9.16	2.99	0.05	1.95	0.14	1.04	0.15	0.47	0.05
9-7-96-7	12-14	13	0.58	59.87	9.70	3.18	0.05	1.98	0.20	1.20	0.20	0.55	0.09
9-7-96-7	14-16	15	0.54	61.89	9.40	3.31	0.04	1.93	0.17	1.38	0.17	0.58	0.06
9-7-96-7	16-18	17	0.51	63.71	10.26	3.15	0.04	1.92	0.16	1.23	0.17	0.56	0.06
9-7-96-7	18-20	19	0.53	63.20	9.54	2.97	0.04	1.90	0.18	1.07	0.18	0.55	0.06
9-7-96-7	20-22	21	0.56	60.46	8.73	2.50	0.04	2.12	0.20	0.38	0.20	0.50	0.07
9-7-96-7	22-24	23	0.59	58.81	8.53	2.62	0.04	2.05	0.17	0.57	0.17	0.54	0.06
9-7-96-7	24-26	25	0.64	57.26	8.68	2.64	0.04	1.99	0.17	0.64	0.18	0.59	0.06
9-7-96-7	26-28	27	0.58	59.84	9.52	2.90	0.04	2.14	0.22	0.77	0.22	0.66	0.11
9-7-96-7	28-30	29	0.52	64.13	11.11	3.48	0.05	1.92	0.16	1.56	0.17	0.85	0.07
9-7-96-7	30-32	31	0.55	61.55	10.43	3.19	0.04	2.06	0.18	1.11	0.18	0.79	0.07
9-7-96-7	32-34	33	0.65	56.66	8.88	2.80	0.04	2.28	0.15	0.53	0.16	0.65	0.05
9-7-96-7	34-36	35	0.70	55.60	8.27	2.58	0.03	2.19	0.18	0.39	0.18	0.63	0.06
9-7-96-7	36-38	37	0.58	59.23	9.07	2.72	0.04	2.29	0.19	0.42	0.19	0.56	0.07
9-7-96-7	38-40	39	0.77	50.74	7.92	2.08	0.03	2.20	0.18	-0.13	0.19	0.54	0.06
9-7-96-7	40-42	41	0.73	52.16	9.18	2.34	0.04	1.85	0.12	0.49	0.13	**	--
9-7-96-7	42-44	43	0.83	48.95	8.10	2.12	0.04	1.85	0.07	0.27	0.08	**	--
9-7-96-7	44-46	45	0.88	47.71	7.74	2.09	0.04	2.01	0.07	0.06	0.06	**	--
9-7-96-7	46-48	47	0.88	45.68	7.48	2.04	0.03	2.04	0.07	0.00	0.08	**	--
9-7-96-7	48-50	49	0.83	47.39	7.86	2.17	0.04	2.17	0.13	0.00	0.14	**	--
9-7-96-7	50-52	51	0.82	49.41	8.53	2.41	0.04	2.19	0.12	0.22	0.13	**	--
9-7-96-7	52-54	53	0.79	51.35	8.35	2.28	0.04	2.07	0.08	0.21	0.08	**	--
9-7-96-7	54-56	55	0.80	51.20	8.98	2.36	0.04	2.18	0.12	0.18	0.13	**	--