Preliminary Paleontologic Report on Core 37, from Pass Key, Everglades National Park, Florida Bay

by

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ABSTRACT

Sediments from Pass Key core 37, in eastern Florida Bay (N 25.1478°, W 80.5745°) record a history of rapid sedimentation during this century. The lowest portion of the core contains benthic fauna indicative of relatively low salinities and sparse seagrass coverage. This period is followed by an increase in salinity and seagrass. In the middle portion of the core, a slight decrease in salinity and an increase in seagrass occur. These shifts in the benthic fauna correspond to a period when the terrestrial flora change, and an increase in dinocyst absolute abundance occurs, indicating changes in factors affecting the entire South Florida ecosystem. These changes may represent a period of increased terrestrial flushing, due to rainfall, water management practices or a combination of both. The benthic faunas in the upper portion of the core indicate an increase in salinity and seagrass density.

INTRODUCTION

Substantial scientific efforts have been focused on the ecosystems of southern Florida in recent years, in response to environmental, economic, and political concerns. These concerns are focused on returning the terrestrial Everglades, Florida Bay, and Biscayne Bay to their “natural state” as mandated by the Everglades Forever Act (passed in 1994). At the same time, the conflicting interests and water-use needs of the ever-growing population of southern Florida, the environmentalists, the farmers, and the tourist industry must be addressed. A number of decisions must be made by agencies of the Federal, State, and local governments related to the ecosystem restoration goals, mediation of conflicting interests, and monitoring of change.

An essential part of the decision-making process is to understand the history of the ecosystem prior to significant human alteration and to separate natural variability in the ecosystem from human-induced change. The role played by large-scale climatic effects, such as hurricanes or El Niño, must be understood and separated from the overprint of significant human activities in the region, such as land management practices, alteration of natural hydro-flow, and construction of the Flagler Railroad. The U.S. Geological Survey (USGS), in cooperation with the National Oceanic and Atmospheric Administration (NOAA), the South Florida Water Management District (SFWMD), the National Park Service (NPS), the Army Corps of Engineers (ACOE), the Florida Geological Survey (FGS), and other Federal, State, and local agencies, is conducting research to provide information on the history of the Everglades ecosystem over the last 150-200 years. The distribution of fauna and flora in a series of sediment cores taken throughout the south Florida ecosystem provides information on the biological, physical, and chemical parameters of the system over time.

Sediment piston cores were collected in May of 1996 by researchers from the USGS (St. Petersburg, FL), in cooperation with the SFWMD and the Everglades National Park (ENP), for use by USGS investigators conducting research in Florida Bay. Two cores were collected from Pass Key mud bank (N 25.1478°, W 80.5745°) in eastern Florida Bay (Figure 1). Pass Key core 37, described herein, penetrated 74 cm of sediment and was collected from a non-grassy substrate on the top of the bank in 6" of water.

This report is produced by the "Ecosystem History of Florida Bay and the Southwest Coast" component of the U.S. Geological Survey's Ecosystem Program, and is one of a series of USGS Open-File Reports on the distribution of biogenic components in sediments sampled from the southern Florida region. The data presented in these reports can be used to estimate changes in salinity, substrate, and other critical components of the ecosystem over time.

ACKNOWLEDGMENTS

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Samples were processed by Jill D'Ambrosio, Patrick Buchanan, Nancy Carlin, Ian Graham, Ellen Seefelt, Steve Wandrei, and Lisa Weimer of the USGS, Reston, VA. Rob Stamm, Jeffery Stone, and Patrick Buchanan, USGS, Reston, VA, assisted in the preparation of illustrations for this report.

METHODS OF INVESTIGATION

Benthic Foraminifers and Molluscs

Sediments from Pass Key core 37 were collected at 2-cm intervals. The samples were washed through a 63 µm sieve and dried at <50°C. All samples were picked from 0-6 cm for benthic foraminifers and from 0-10 cm for molluscs; from 6 cm and 10 cm respectively, every other 2 cm-sample was analyzed (Table 1 and 2 show distribution of samples). A total of 21 samples were analyzed for molluscan faunal content, and 20 samples for benthic foraminiferal content. When possible, a minimum of 300 benthic

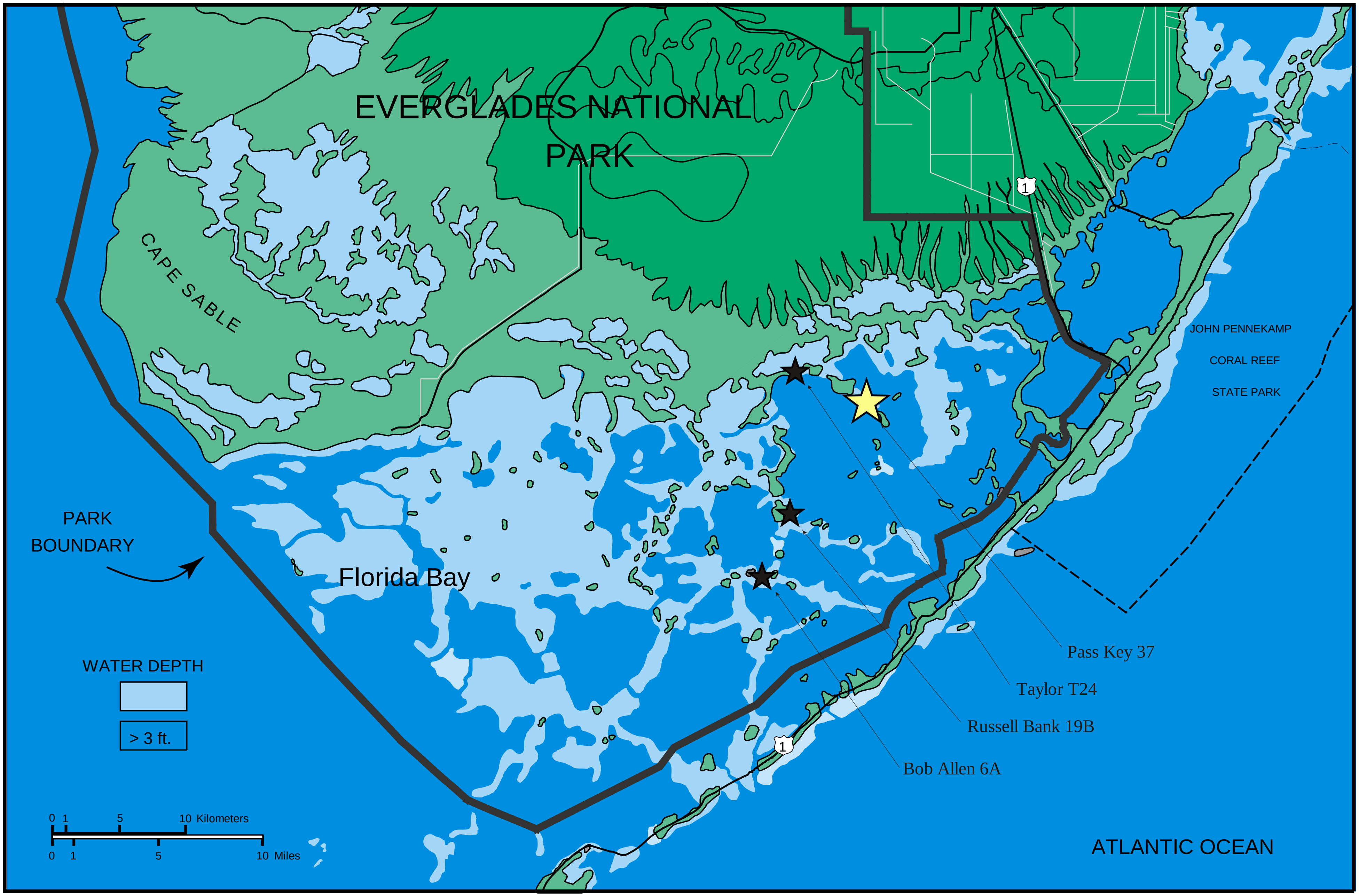


Figure 1: Map of Florida Bay showing the location of Pass Key core 37 (N 25.1478°, W 80.5745°) in eastern Florida Bay. Other cores examined to date are indicated.

Table 1: Pass Key Core 37
Benthic Foraminiferal Abundance

Sample depth in cm	*Ammonia parkinsoniana*	*Amphistegina sp.*	*Archaias angulatus*	*Clavulina tricarinata*	*Cyclogyra planorbis*	*Elphidium delicatulum*	*Elphidium galvesonense typicum*	*Elphidium galvestonense mexicanum*	*Nubecularia lucifuga*	*Miliolinella circularis*	*Miliolinella labiosa*	*Peneroplis proteus*	*Quinqueloculina agglutinans*	*Quinqueloculina bosciana*	*Quinqueloculina seminulum*	*Quinqueloculina tenagos*	*Quinqueloculina polygona*	*Quinqueloculina poeyana*	*Rosalina floridana*	*Rosalina globularis*	*Spiroloculina antillarium*	*Triloculina lineiana*	*Triloculina rotunda*	*Triloculina triloculina*
0-2	7.44	0.00	0.00	0.00	0.00	13.92	2.27	0.00	0.32	5.50	0.00	0.00	0.00	55.99	7.77	0.00	0.65	5.18	0.00	0.65	0.00	0.00	0.00	0.32
2-4	9.53	0.00	0.00	0.00	0.00	0.00	19.07	0.00	0.00	21.16	0.00	0.00	0.23	13.95	31.40	0.00	0.00	2.79	0.00	0.00	0.00	0.00	0.00	1.86
4-6	6.67	0.00	1.03	0.00	0.00	8.97	22.82	0.00	0.00	5.64	0.00	0.00	0.26	18.21	25.38	0.00	2.05	6.92	0.00	1.03	1.03	0.00	0.00	0.00
8-10	6.02	0.00	0.00	0.00	0.00	9.70	7.69	0.00	0.00	11.37	0.00	0.00	0.00	44.82	7.36	0.00	0.67	11.04	0.00	0.00	1.34	0.00	0.00	0.00
12-14	9.81	0.32	0.00	0.00	0.00	11.08	0.00	3.80	0.00	12.66	0.00	0.00	0.00	41.77	10.13	0.00	2.22	7.91	0.00	0.00	0.00	0.00	0.32	0.00
16-18	6.15	0.00	0.00	0.00	0.00	12.31	2.15	9.23	0.00	6.46	0.00	0.00	0.00	33.54	8.00	0.00	1.85	15.69	0.00	0.00	2.15	0.00	1.54	0.92
20-22	2.58	0.00	0.65	0.00	0.00	7.10	3.55	5.81	0.00	2.58	0.00	0.00	1.94	49.35	8.39	0.00	1.94	7.10	0.65	0.00	5.16	0.00	2.26	0.97
24-26	7.58	0.00	0.61	0.00	0.00	7.88	8.48	3.64	0.00	0.30	0.30	0.00	3.94	23.33	3.33	0.30	9.09	13.94	0.30	0.00	0.91	11.82	2.73	1.52
28-30	10.12	0.00	1.49	2.08	0.00	7.14	2.98	3.27	0.00	0.89	0.00	0.00	4.17	32.74	8.63	0.00	4.46	11.31	0.30	0.00	1.49	2.68	6.25	0.00
32-34	8.56	0.31	0.00	0.31	0.00	9.79	3.67	2.14	0.00	5.50	0.00	0.00	2.14	40.06	5.81	0.00	8.56	10.09	0.00	0.31	0.61	0.92	0.61	0.61
36-38	7.56	0.00	0.00	0.00	0.29	0.00	14.83	0.00	0.00	16.57	0.00	0.00	0.29	24.13	31.69	0.00	0.58	4.07	0.00	0.00	0.00	0.00	0.00	0.00
40-42	4.84	0.00	1.61	0.65	0.00	6.77	4.84	0.00	0.00	8.71	0.65	0.00	2.90	38.71	8.06	0.65	10.00	5.16	0.00	0.00	0.00	0.00	5.81	0.65
44-46	5.18	0.30	0.00	0.30	0.61	8.54	7.01	0.00	0.91	16.77	0.61	0.00	0.61	27.74	20.43	0.30	3.96	4.88	0.00	0.00	0.00	0.00	1.52	0.30
48-50	2.17	0.00	0.00	0.62	0.31	2.48	3.72	0.00	2.79	19.50	0.00	0.31	0.00	55.42	3.10	0.31	4.33	4.33	0.00	0.00	0.00	0.00	0.62	0.00
52-54	6.73	0.00	0.00	0.32	0.00	0.00	10.26	2.24	0.00	11.22	0.00	1.28	0.00	41.99	1.28	1.28	11.22	8.33	0.00	0.32	0.64	0.64	1.92	0.32
56-58	7.00	0.00	0.00	0.00	0.67	0.00	6.33	4.33	1.33	17.00	0.00	0.00	0.33	40.33	7.33	0.00	5.00	10.33	0.00	0.00	0.00	0.00	0.00	0.00
60-62	19.52	0.00	0.00	0.00	0.00	5.48	0.00	5.48	0.00	8.56	0.00	2.05	2.40	25.34	3.77	0.00	2.74	23.97	0.00	0.00	0.68	0.00	0.00	0.00
64-66	22.11	0.00	0.99	0.00	0.33	0.00	7.26	5.28	0.66	7.26	0.00	0.99	0.33	22.11	13.86	0.00	1.98	15.84	0.00	0.00	0.99	0.00	0.00	0.00
68-70	39.06	0.00	0.00	0.34	0.00	0.00	5.39	9.09	0.00	1.35	0.00	4.38	1.35	10.77	10.44	0.00	3.70	11.78	0.00	0.00	0.67	1.68	0.00	0.00
72-74	5.36	0.00	0.00	0.63	0.00	5.68	3.15	4.73	0.00	9.15	0.00	2.21	0.00	42.90	3.79	0.63	5.68	7.26	0.00	0.32	0.00	0.00	6.94	1.58

Table 2: Pass Key Core 37
Molluscan Percent Abundance

Sample depth in cm	*Gastropoda*	*Acteocina canaliculata*	*Acteon punctostriatus*	*Amae* sp.	*Bittium varium*	*Bulla* sp.	*Caecum puchellum/floridanum*	*Cerithidea* spp.	*Cerithiopsis emersoni*	*Cerithium* ? sp. A	*Cerithium muscarum*	*Cerithium* sp.	*Crepidula* sp.	*Cyclostremiscus* sp.	*Epitonium* sp.	*Hydrobiidae*	*Marginellids*	*Modulus modulus*	*Odostomia* spp.	*Olivella* sp.	*Pyramidella* sp.	*Rissoina* sp.
0-2		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	0.00	0.00	0.00	0.00
2-4		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	0.00	0.00	0.00	0.00
4-6		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	0.00	0.00	0.00	0.00
6-8		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	11.11	0.00	0.00	0.00	0.00	0.00	0.00
8-10		9.09	0.00	0.00	18.18	0.00	0.00	0.00	0.00	9.09	0.00	9.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.09	0.00	0.00
12-14		7.69	0.00	0.00	15.38	15.38	0.00	0.00	7.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.69	0.00	0.00	0.00	0.00	0.00
16-18		0.00	0.00	0.00	13.51	0.00	0.00	0.00	0.00	16.22	5.41	0.00	5.41	0.00	0.00	0.00	0.00	2.70	0.00	2.70	0.00	0.00
20-22		3.57	0.00	0.00	17.86	7.14	0.00	0.00	0.00	3.57	0.00	0.00	0.00	0.00	0.00	0.00	7.14	7.14	0.00	3.57	0.00	0.00
24-26		3.09	0.00	1.23	6.17	5.56	1.85	0.00	0.00	5.56	4.32	2.47	1.23	0.00	0.00	1.85	0.62	4.32	0.00	0.00	0.00	1.23
28-30		1.04	0.00	0.00	5.21	4.17	0.00	0.00	0.00	6.25	5.21	5.21	3.13	1.04	0.00	3.13	3.13	4.17	0.00	0.00	0.00	1.04
32-34		3.66	0.00	0.00	3.66	0.00	1.22	0.00	1.22	0.00	4.88	0.00	6.10	3.66	0.00	3.66	0.00	2.44	0.00	0.00	0.00	1.22
36-38		1.11	0.00	0.00	1.11	3.33	0.00	0.00	0.00	0.00	7.78	0.00	4.44	8.89	0.00	0.00	1.11	5.56	0.00	0.00	2.22	3.33
40-42		0.00	0.00	0.00	5.26	0.00	1.75	0.00	0.00	0.00	1.75	3.51	7.02	1.75	0.00	1.75	3.51	5.26	0.00	0.00	0.00	1.75
44-46		0.00	0.00	0.00	5.80	0.00	1.45	0.00	0.00	0.00	0.00	1.45	4.35	1.45	0.00	0.00	1.45	4.35	0.00	0.00	2.90	2.90
48-50		0.00	0.00	0.00	9.68	3.23	0.00	0.00	0.00	0.00	0.00	0.00	12.90	0.00	0.00	0.00	3.23	6.45	0.00	0.00	0.00	9.68
52-54		0.00	0.00	0.00	6.56	1.64	0.00	0.00	0.00	0.00	0.00	14.75	6.56	0.00	0.00	0.00	1.64	3.28	3.28	0.00	0.00	18.03
56-58		0.00	0.00	0.00	7.55	0.00	0.00	0.00	0.00	0.00	0.00	3.77	5.66	1.89	0.00	0.00	0.00	7.55	0.00	0.00	0.00	1.89
60-62		0.66	0.00	0.00	5.30	0.00	0.00	0.00	0.00	6.62	0.00	2.65	16.56	0.66	0.00	0.00	1.32	4.64	0.66	0.00	0.00	0.00
64-66		3.47	0.00	0.00	11.11	0.69	0.00	0.00	0.00	0.00	1.74	5.56	4.51	0.00	0.35	0.00	0.35	1.04	0.00	0.35	0.00	0.35
68-70		0.81	0.20	0.00	8.11	0.81	0.00	0.20	0.00	2.43	0.00	1.01	4.67	0.00	0.00	0.00	0.41	0.61	0.81	0.00	0.20	1.62
72-74		0.00	0.00	0.00	5.56	0.00	0.00	0.00	0.00	0.00	0.00	1.39	5.56	2.78	0.00	0.00	4.17	4.17	0.00	0.00	0.00	2.78

Table 2: Pass Key Core 37
Molluscan Percent Abundance

Sample depth in cm	*Turbonilla* sp.	*Urosalpinx* ? sp.	Vitrinellid	Juveniles	Unknowns	Unidentified Fragments	Pelecypoda	*Anomalocardia cuneimeris*	*Arcopsis adamsi*	*Brachiodontes* sp.	*Chione cancellata*	*Cumingia tellinoidea*	*Laevecardium* spp.	*Lima* sp.	Pectinid	*Pinctada radiata*	*Semele bellastriata*	*Tellina* spp.	*Transennella* spp.	Unidentified Fragments.	Total Absolute Abundance	Species Richness
0-2	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	0.00	0.00	0	0
2-4	0.00	0.00	0.00	14.29	0.00	0.00		0.00	0.00	85.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7	2
4-6	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	50.00	50.00	2	2
6-8	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	88.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9	2
8-10	0.00	0.00	0.00	0.00	0.00	9.09		9.09	0.00	18.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.09	0.00	11	9
12-14	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	7.69	0.00	0.00	7.69	0.00	0.00	7.69	0.00	7.69	15.38	0.00	13	10
16-18	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	45.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.11	0.00	37	8
20-22	0.00	0.00	0.00	3.57	0.00	0.00		7.14	0.00	25.00	0.00	0.00	3.57	0.00	0.00	0.00	0.00	7.14	3.57	0.00	28	13
24-26	0.00	0.00	0.00	0.00	0.00	0.00		1.23	0.00	50.62	0.00	1.23	3.70	0.62	0.00	3.09	0.00	0.00	0.00	0.00	162	19
28-30	0.00	0.00	0.00	0.00	1.04	0.00		1.04	1.04	40.63	0.00	0.00	4.17	1.04	0.00	6.25	0.00	0.00	2.08	0.00	96	20
32-34	0.00	1.22	0.00	0.00	1.22	1.22		0.00	0.00	56.10	0.00	0.00	3.66	0.00	0.00	2.44	0.00	0.00	2.44	0.00	82	17
36-38	0.00	0.00	0.00	0.00	1.11	0.00		0.00	0.00	40.00	0.00	0.00	3.33	2.22	0.00	8.89	0.00	0.00	4.44	1.11	90	17
40-42	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	42.11	3.51	0.00	1.75	1.75	0.00	15.79	0.00	1.75	0.00	0.00	57	16
44-46	0.00	0.00	0.00	2.90	0.00	1.45		0.00	0.00	57.97	0.00	1.45	0.00	0.00	0.00	2.90	0.00	2.90	4.35	0.00	69	16
48-50	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	45.16	0.00	0.00	0.00	0.00	0.00	3.23	0.00	0.00	6.45	0.00	31	9
52-54	1.64	0.00	0.00	1.64	0.00	0.00		3.28	1.64	26.23	0.00	0.00	3.28	1.64	1.64	3.28	0.00	0.00	0.00	0.00	61	17
56-58	0.00	0.00	0.00	0.00	0.00	0.00		0.00	3.77	45.28	0.00	7.55	0.00	1.89	0.00	7.55	0.00	3.77	1.89	0.00	53	13
60-62	0.00	0.00	0.66	0.00	0.00	0.00		5.30	0.00	39.74	1.32	0.00	2.65	0.66	0.00	3.31	0.00	3.31	3.97	0.00	151	18
64-66	0.00	0.00	0.00	0.00	0.00	0.35		6.25	0.00	50.00	0.35	0.35	2.78	0.35	0.00	2.78	0.00	3.13	4.17	0.00	288	21
68-70	0.00	0.00	0.00	0.00	0.00	0.00		10.55	0.20	57.40	0.20	0.61	1.62	0.41	0.00	3.04	0.20	3.85	0.00	0.00	493	23
72-74	0.00	0.00	0.00	2.78	0.00	0.00		0.00	1.39	50.00	0.00	2.78	0.00	4.17	0.00	6.94	0.00	1.39	4.17	0.00	72	15

foraminifer specimens were picked from the 63-850 µm size fraction and mounted on gridded micropaleontologic slides. Large samples were put through a sample splitter to reduce randomly the number of specimens. For samples containing fewer than 300 benthic foraminifer individuals, all of the specimens present were picked. Molluscs were picked from the ≥850 µm size fraction. All molluscs, and fragments of molluscs recognizable to the generic level, present in each interval were picked. Species abundances for the benthic fauna were standardized by calculating relative abundances (percent).

Pollen and Dinocysts

Material for palynological analysis was extracted from 2-cm sections of Pass Key core 37. For each palynological sample, 25-50 g of material (dry weight) was treated in hydrochloric and hydrofluoric acids. A tablet of *Lycopodium* marker grains was added to each sample. All samples were acetolyzed, treated with 10 % KOH in a water bath for 15 minutes and then given ultrasonic pulse treatment for 5 seconds. The samples between 8-200 µm then were sieved. For most samples, at least 300 pollen grains were counted for calculation of percent abundances and absolute pollen concentration. To calculate absolute concentration of palynomorphs, the marker-grain method was used (Benninghoff, 1962; Maker, 1981; Stockmarr, 1971). For two samples, pollen was sparse and fewer than 300 grains were counted. For nine samples, one slide was completely examined for dinocysts, and all dinocyst taxa were tabulated. For two samples (0-2 cm and 80-82 cm), two slides were examined completely for dinocysts.

Diatoms

Diatoms were extracted from 15 samples (2-cm sampling interval) using a modification of the method by Funkhauser and Evitt (1959). Specimens were mounted on slides with Naphrax for viewing with a light microscope. Three hundred to five hundred diatom valves were identified and counted from each sample. Results of the diatom analysis will be included in a separate report.

Isotopic Analyses and Age Model

Samples were collected every 2 cm from Pass Key core 37 and analyzed for ^{210}Pb. For details of the method see Robbins and others (in press). The ^{210}Pb age model indicates extremely rapid sedimentation in the area, on the order of 2.06 cm/year ± 0.2. The ^{210}Pb age model is consistent with aerial photo evidence and evidence from pollen data. Aerial photo evidence indicates that the opening south of Pass Key has been closing in progressively since the 1950's (Figure 2). *Casuarina* (Australian pine) pollen is present throughout the core, indicating that sediments have been deposited since the late 1800's or early 1900's when *Casuarina* was introduced in south Florida (Craighead, 1971; Langeland, 1990).

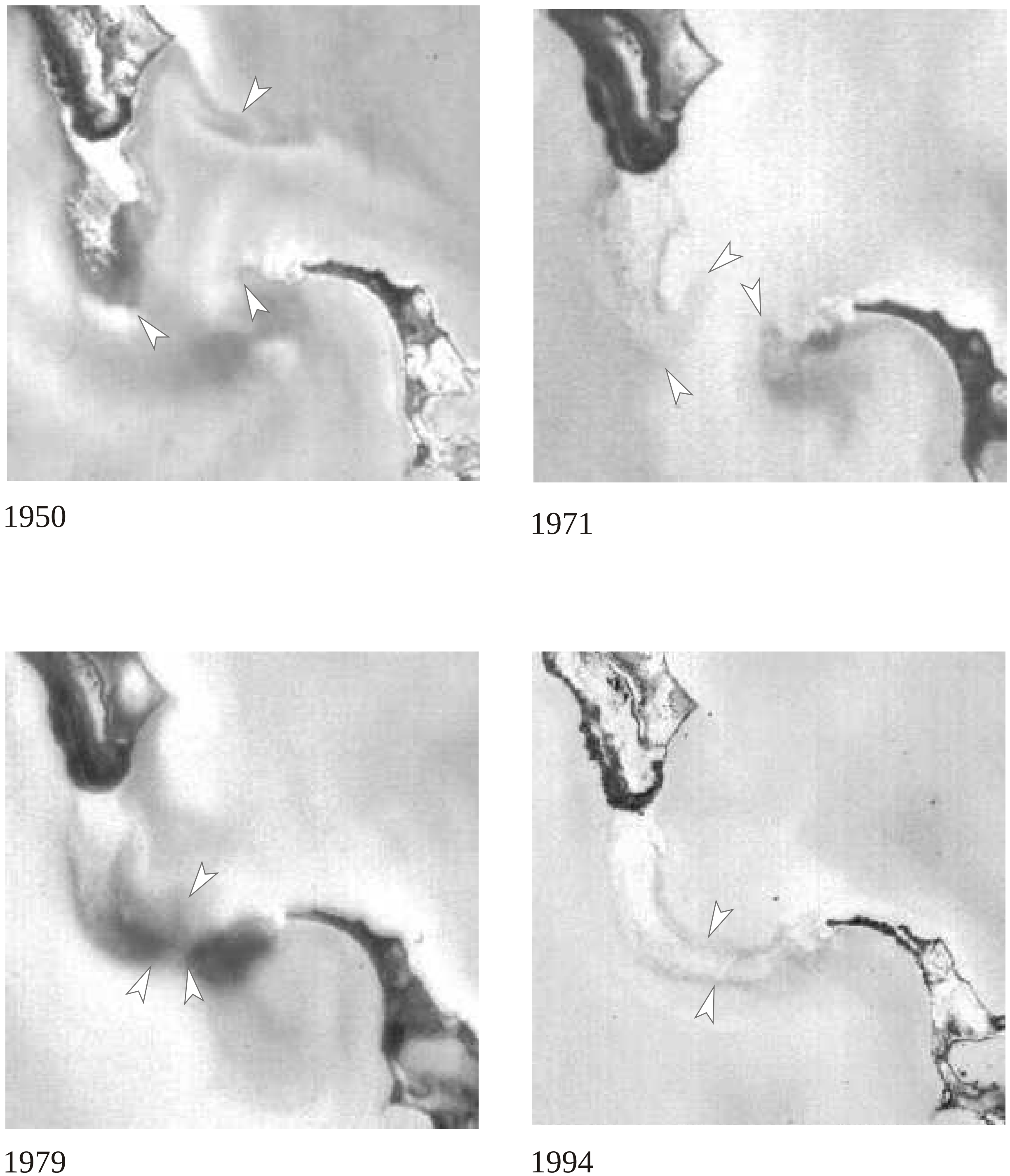


Figure 2: Aerial photographs of the region between Pass and Lake Key between 1950 and 1994. Note progressive filling of Lake Key Pass, completely closing off by 1994. (Arrows denote approximate positions of bank margins.)

ANALYSIS AND DISCUSSION OF THE BENTHIC FAUNA IN PASS KEY CORE 37

Benthic Foraminifers

Twenty-four species of benthic foraminifera were identified in Pass Key core 37 (Table 1). Three faunal units can be identified within the core. The lower part of core 37 (74-64 cm) is dominated by *Ammonia parkinsoniana* and *Quinqueloculina bosciana*, with relative abundances up to 40 and 42% respectively (Figure 3). At 64 cm, *A. parkinsoniana* is greatly reduced, and miliolids become the dominant taxonomic group. Of the miliolids, *Miliolinella circularis* becomes a major component of the assemblage, indicating a significant increase in seagrass density (Brasier, 1975). At 38 cm, another faunal shift occurs that is marked by a reduction in *M. circularis* and an increase in other miliolids such as *Q. bosciana*. *Quinqueloculina poeyana* increases in abundance at 16 cm and remains a signficant component of the assemblage to the top of the core. *Quinqueloculina bosciana* is ubiquitous throughout the core, ranging from 11-56% abundance.

Molluscs

Thirty-seven molluscan taxonomic categories were identified in Pass Key core 37 (Table 2), but overall molluscan absolute abundance is low. Values for species richness in individual samples ranged from 2-22, with the higher numbers corresponding to the samples with greater abundances (Figure 4). The majority of the taxa, however, are rare. Sixteen of the taxa account for less than 5 percent of the fauna in the samples in which they occur, and nine of these taxa occur in only one sample. *Brachiodontes* sp. and *Bittium varium* are nearly ubiquitous (Figure 5), occurring in all but a few samples from the upper 10 cm of the core, but 79% of the *Brachiodontes* sp. occur as fragments, indicating that they may have been transported.

The lower portion of the core from 70-60 cm is characterized by higher molluscan abundance (72-493 individuals/sample), the occurrence of *Anomalocardia cuneimeris* and *Crepidula* sp., and a mixture of grass and sediment dwelling species (Figure 5). From 60-38 cm, abundance is moderate (31-69 individuals/sample), and a number of grass dwelling species are present, including *Modulus modulus*, *Rissoina* sp., and *Pinctada radiata*. The segment of the core from 38-24 cm shows increased abundance (82-162 individuals/sample), the continued presence of *M. modulus*, *Rissoina* sp., and *P. radiata*, and the addition of *Cerithium muscarum* and *Laevicardium* spp. Above 22 cm, the number of molluscs present drops dramatically to virtually nothing in the upper 14 cm, so any patterns above 22 cm are meaningless.

Figure 3: Percent abundance of selected benthic foraminifers from Pass Key Core 37.

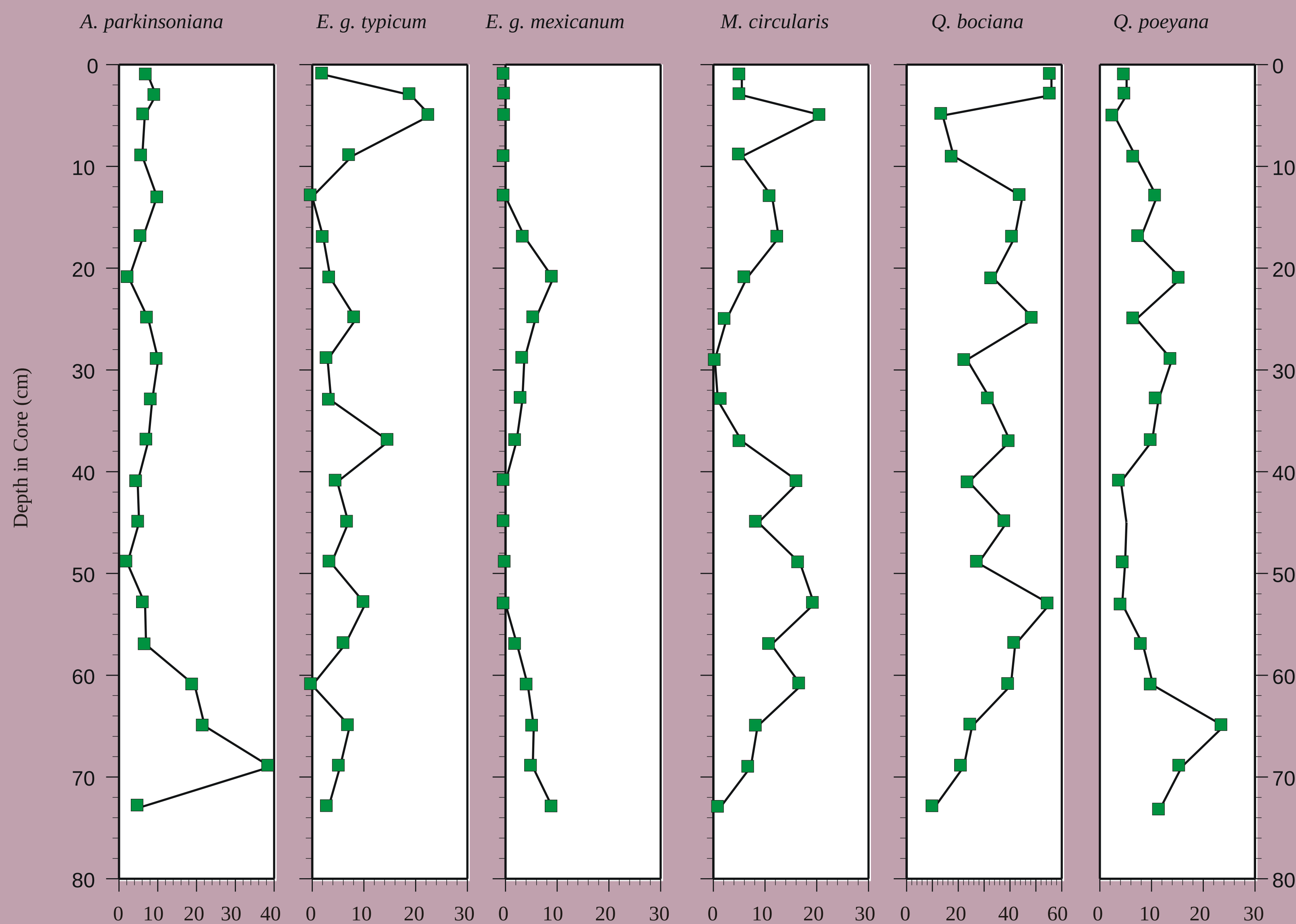
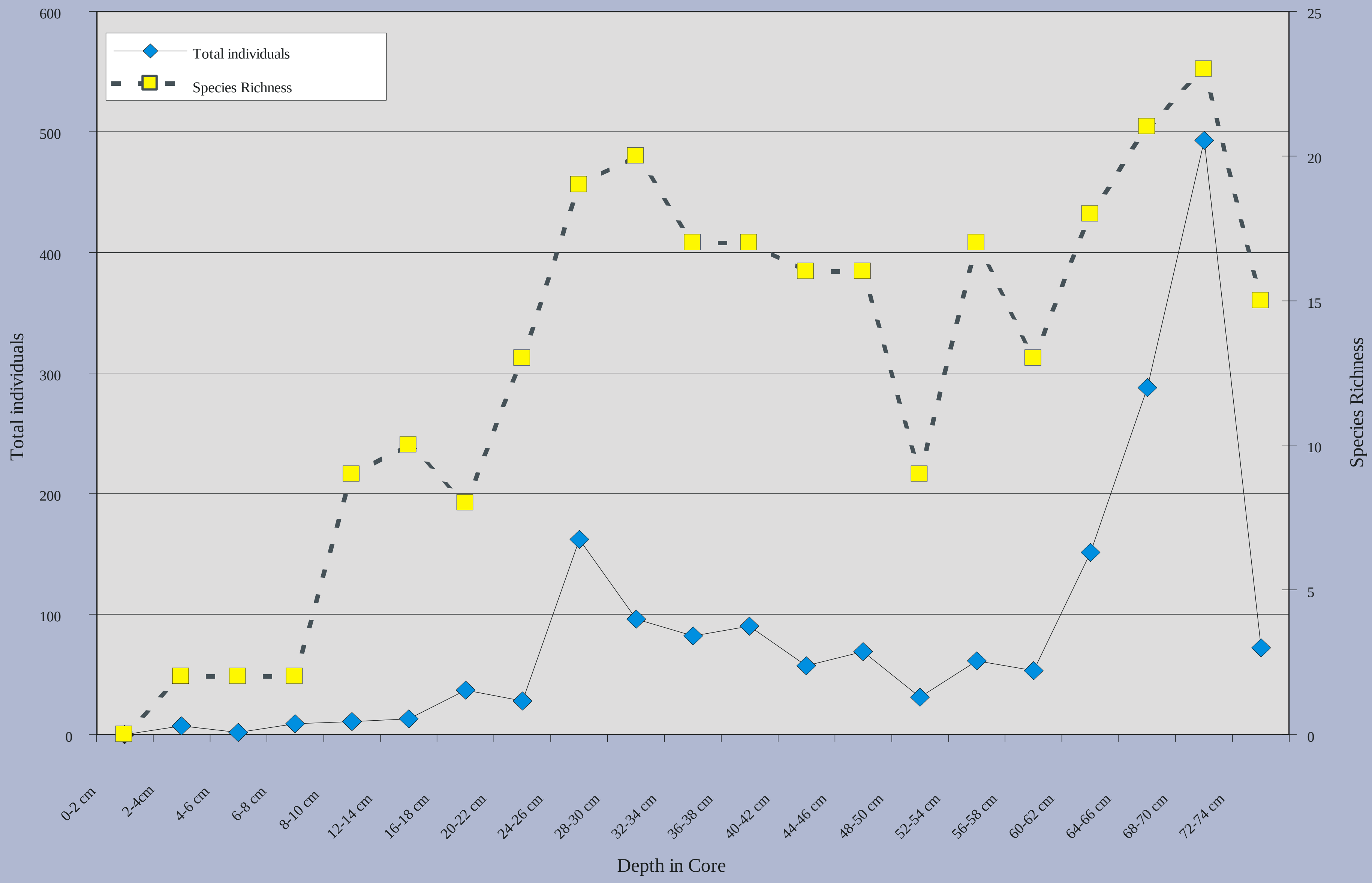


Figure 4: Molluscan absolute abundance and species richness for Pass Key core 37.



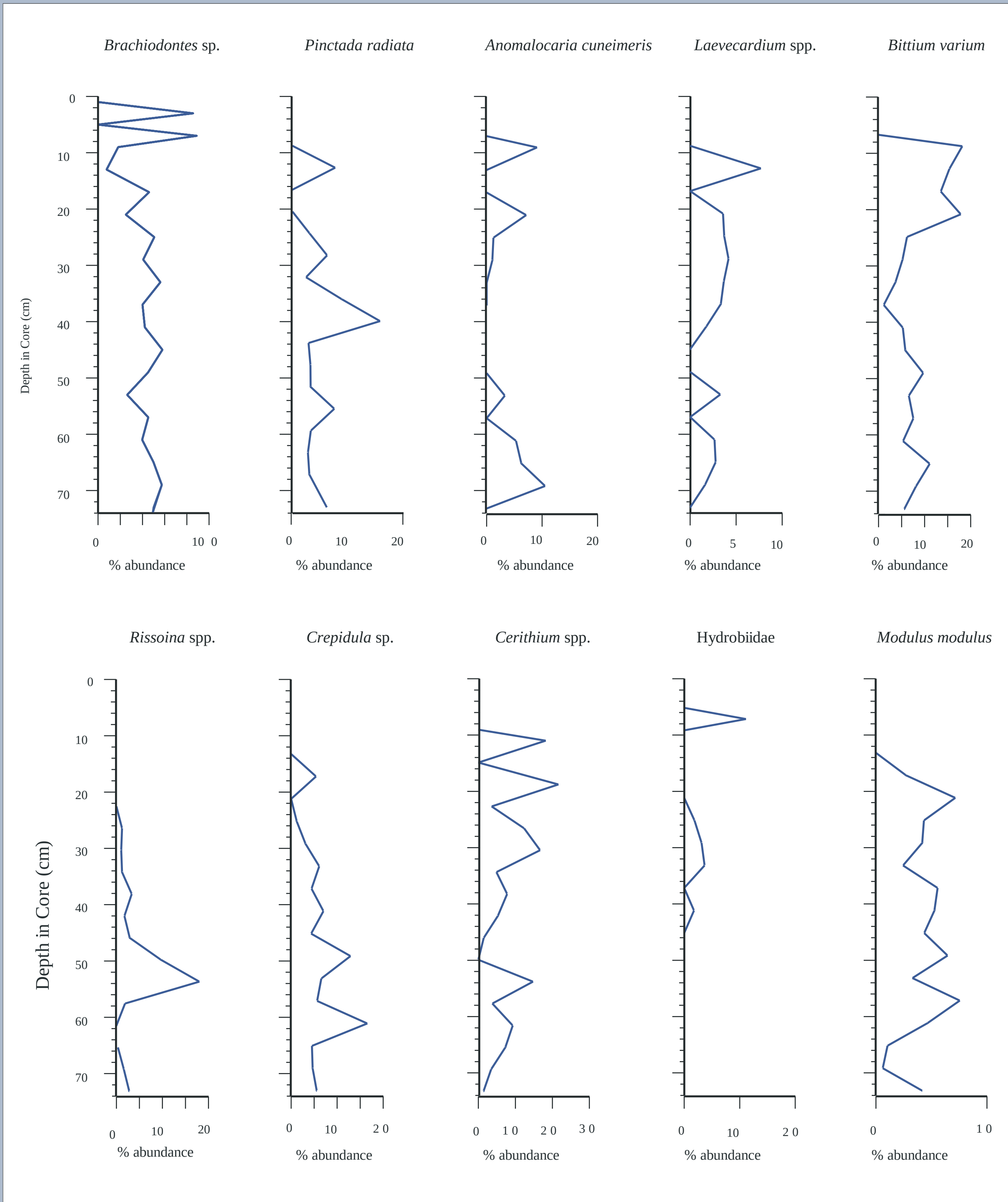


Figure 5: Percent abundance of selected molluscan taxa for Pass Key Core 37.

Benthic Faunal Patterns

The foraminiferal faunal record indicates mesohaline to polyhaline (25 ppt) conditions in the lower part of the core from 74-64 cm (Figure 6). An increase in salinity occurs at 64 cm, reaching euhaline conditions. A slight decrease in salinity occurs at 38 cm, with a shift back to higher salinities from 14 cm to the top of the core. The molluscan faunal data are consistent with the salinity patterns indicated by the benthic foraminifers. The presence of minute freshwater hydrobiid gastropods in the core (42-40 cm, 34-24 cm, 8-6 cm) may indicate periods of terrestrial flushing.

The benthic foraminfers and molluscs indicate that seagrass was relatively sparse in the area during deposition of the lowest portion of the core. An increase in seagrass in the area is indicated at 64 cm by both faunal groups, which corresponds to the shift towards increased salinity. Benthic foraminifers indicate that conditions revert to lower seagrass density in the area at about 38 cm. The molluscs show a decrease in sea grass density at 34 cm, but not as low as the 74-64 cm segment of the core. The benthic foraminifers show a relative increase in seagrass density in the area from 14 cm to the top of the core, again corresponding to a shift towards higher salinity.

ANALYSIS AND DISCUSSION OF THE FLORA IN PASS KEY CORE 37

Pollen

Pollen is preserved abundantly in the samples, and assemblages throughout the core are dominated by *Pinus* (pine) pollen (48-78%) (Table 3; Figure 7). The core may be divided into two assemblage zones. The lower zone (70-35 cm) has the highest abundances of *Pinus* (>70%) and lowest abundances of *Quercus* (oak) and *Myrica* (wax myrtle), which comprise <10% and <5% of the assemblages, respectively. The preservation below 48 cm is poorer than in the upper zone. In the upper zone (35-0 cm), *Pinus* pollen is less abundant (<60%), whereas higher abundances of *Quercus* and *Myrica* pollen are present (>15% and >5%, respectively). *Casuarina* (Australian pine) pollen is present throughout the core; this species was introduced in south Florida during the late 1800's or early 1900's (Craighead, 1971; Langeland, 1990), so its presence restricts the age of the sediments at the bottom of the core to deposition in the last 100 years. *Rhizophora* (red mangrove) and *Conocarpus* (buttonwood) pollen also are present throughout the core, which is consistent with their presence on nearby shores.

Dinocysts

Dinocyst recovery in nearly all samples in Pass Key core 37 was low; only one sample was counted to 300 specimens. Most microscope slides are heavily dominated by phytoclasts. Absolute abundance ranged from 100-800 cysts/g. These values are one to two orders of magnitude below those reported by Wall and others (1977) for samples from the Middle Atlantic Bight and western South Africa and are consistent with high sedimentation rates. They are far below "bloom" concentrations.

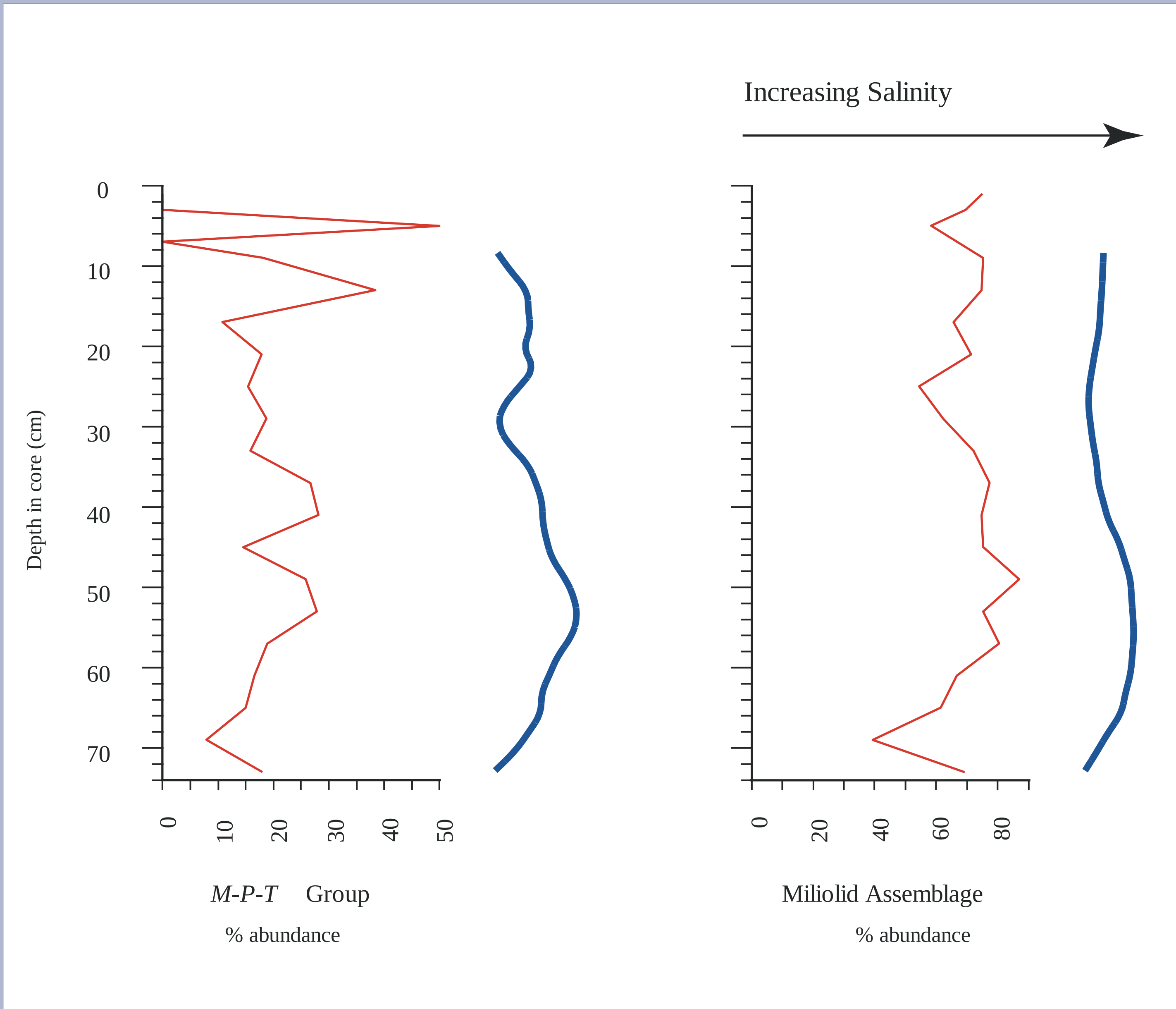


Figure 6: Percent abundance of benthic foraminiferal and molluscan assemblages indicative of increased salinities at Pass Key. The percent abundance of the benthic foraminiferal miliolid assemblage increases above 25 ppt. The molluscan *M-P-T* group (*Modulus-Pinctada-Transennella*) can tolerate a broad range of salinities (18-35 ppt), but generally increase in abundance as salinity increases. Curves show the smoothed trend for each plot.

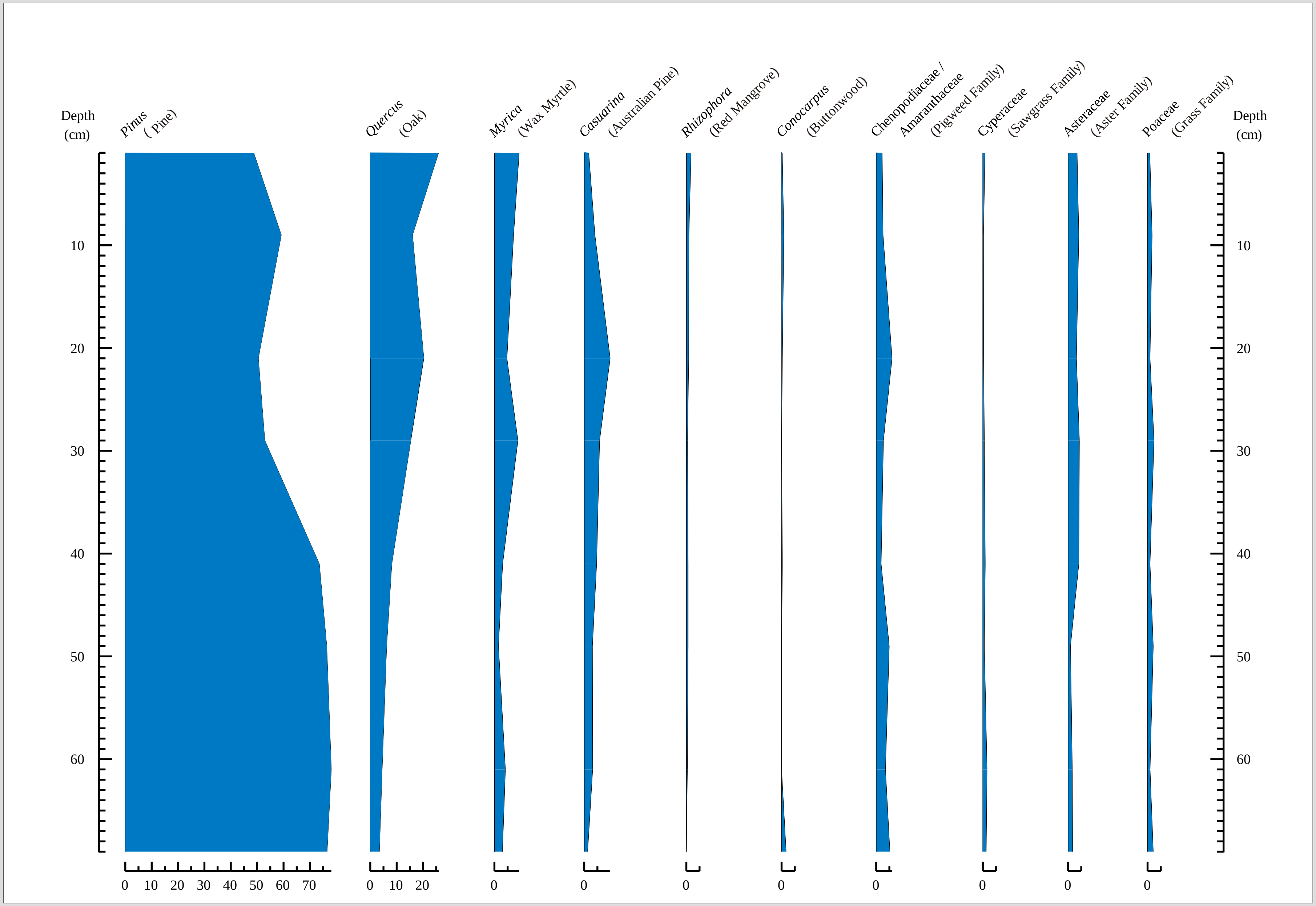


Figure 7: Percent abundance of selected pollen groups in Pass Key core 37.

Table 3: Percent abundance of pollen of major plant taxa, Pass Key Core 37, Florida Bay.

Depth (cm)	TREE AND SHRUB TAXA	*Acer* (Maple)	*Alnus* (Alder)	*Carya* (Hickory)	*Casuarina* (Australian Pine)	*Conocarpus* (Buttonwood)	*Fraxinus* (Ash)	*Juglans* (Walnut)	*Liquidambar* (Sweet Gum)	*Myrica* (Wax Myrtle)	*Nyssa* (Black Gum)	*Ostrya/ Carpinus* (Hophornbeam)	*Pinus* (Pine)	*Quercus* (Oak)	*Rhizophora* (Red Mangrove)	*Salix* (Willow)	*Sophora* (Sophora)	*Ulmus* (Elm)	HERBACEOUS TAXA	Asteraceae (Aster Family)	Chenopodiaceae (Pigweed Family)	Cyperaceae (Sawgrass Family)	*Nymphaea* (Waterlily)	Poaceae (Grass Family)	*Sagittaria* (Arrowhead)	TCT (Cypress Family)*	*Typha* (Cattail)
0-2		0.00	0.28	0.57	1.71	0.28	0.28	0.28	0.00	9.40	0.00	0.28	48.72	25.93	1.80	0.00	0.00	0.00		3.42	2.28	0.85	0.28	0.85	0.00	0.00	1.14
8-10		0.00	0.87	0.29	4.08	0.87	0.00	0.00	0.00	7.29	0.00	0.00	59.18	16.03	1.00	0.00	0.00	0.00		4.08	2.62	0.29	0.00	1.75	0.87	0.00	0.29
20-22		0.00	0.00	0.32	9.84	0.32	0.00	0.00	0.32	4.76	0.00	0.00	50.48	20.32	0.90	0.00	0.00	0.95		3.17	6.03	0.32	0.32	0.95	0.32	0.32	0.32
28-30		0.31	0.31	0.00	5.85	0.00	0.00	0.00	0.31	8.92	0.31	0.00	52.92	15.38	0.50	0.00	0.92	0.31		4.31	2.77	0.62	0.00	2.46	0.00	0.00	1.85
40-42		0.00	0.63	0.00	4.72	0.31	0.00	0.00	0.00	3.14	0.00	0.00	73.58	8.18	0.70	0.00	0.00	0.31		4.09	1.89	0.94	0.00	0.94	0.00	0.00	0.00
48-50		0.00	0.00	0.00	3.11	0.00	0.00	0.00	0.31	1.55	0.00	0.00	76.40	6.21	0.70	0.31	0.00	0.31		0.93	4.97	0.62	0.00	2.17	0.00	0.00	0.62
60-62		0.00	0.00	0.00	3.22	0.00	0.00	0.00	0.00	4.18	0.00	0.00	78.14	4.50	0.40	0.00	0.00	0.00		1.61	3.54	1.61	0.00	0.96	0.00	0.32	1.29
68-70		0.00	0.43	0.00	1.30	1.74	0.00	0.00	0.00	3.04	0.00	0.00	76.52	3.48	0.00	0.00	0.43	0.00		1.74	5.22	1.30	0.00	2.17	0.00	1.30	0.00

* Taxodiaceae/Cypressaceae/Taxaceae

The dinocyst assemblages in Pass Key core 37 consist of a small number of taxa (Table 4). Various species of the genus *Spiniferite*s Mantell dominate all samples (48-74 %). Due to poor preservation and taxonomic difficulties, the individual species of this genus were not differentiated; *S. mirabilis* (Rossignol) Sarjeant, *S. ramosus* (Ehrenberg) Mantell, *S. scabratus* (Wall) Sarjeant, and other forms are present. *Operculodinium* Wall spp. (*O. israelianum* (Rossignol) Wall or *Operculodinium* species undifferentiated) are present in all samples in amounts of 10-15 percent. *Polyspaeridium zoharyi* (Rossignol) Bujak et al. is present in all samples and comprises up to 26 percent of the assemblages. *Tectatodinium pellitum* Wall is present in all samples and comprises 4 to 14 percent. Samples included low numbers of *Lingulodinium machaerophorum* (Deflandre & Cookson) Wall and *Nematospaeropsis rigida* Wrenn. No samples contained preserved members of the family Congruentidiaceae.

Dinocyst assemblages are very similar from sample to sample (Figure 8). *Polysphaeridium zoharyi* is present in relatively low percentages throughout the core; this pattern is similar to Russell Banks core 19A (Brewster-Wingard, and others, 1996), but different from Bob Allen core 6A (Wingard, and others, 1995) and Taylor core T24 (Ishman, and others, 1996)(see Figure 1 for location). The abundance of *Tectatodinium pellitum* is noticeably higher than in other Florida Bay cores examined to date. In general, absolute abundances of *Spiniferites* spp. and *P. zoharyi* covary (Figure 9); this relationship suggests that absolute abundances are a function of sediment supply rather than cyst production. The sample at 34-32 cm is anomalous; the high absolute abundance is accompanied by conspicuously greater amounts of amorphous debris. This may be an increase in cyst production and a decrease in sediment supply. The lowest samples (74-48 cm) show low absolute abundances and low percentages of dinocysts relative to plant debris.

Floral Patterns

A comparison of the dinocyst data from Pass Key core 37 and the Florida Bay cores examined previously (Bob Allen 6A, Russell Bank 19A, and Taylor T24) suggests that the base of Pass Key core 37 is relatively young. This is consistent with the ^{210}Pb and aerial photo evidence. The presence of the pollen of *Casuarina* throughout the core is further evidence of the relatively young age for the sediments at the base of Pass Key core 37.

The pollen and dinocyst assemblages both shift between 40 and 30 cm. The dinocyst absolute abundance more than doubles in this middle segment of the core, but the upper and lower portions of the core are similar. The pollen assemblages record a decrease in pine and an increase in oak and wax myrtle, indicating that a change occurred in factors affecting terrestrial vegetation. The corresponding shifts in marine and terrestrial indicators suggest that changes occurred in factors that affect the entire South Florida ecosystem.

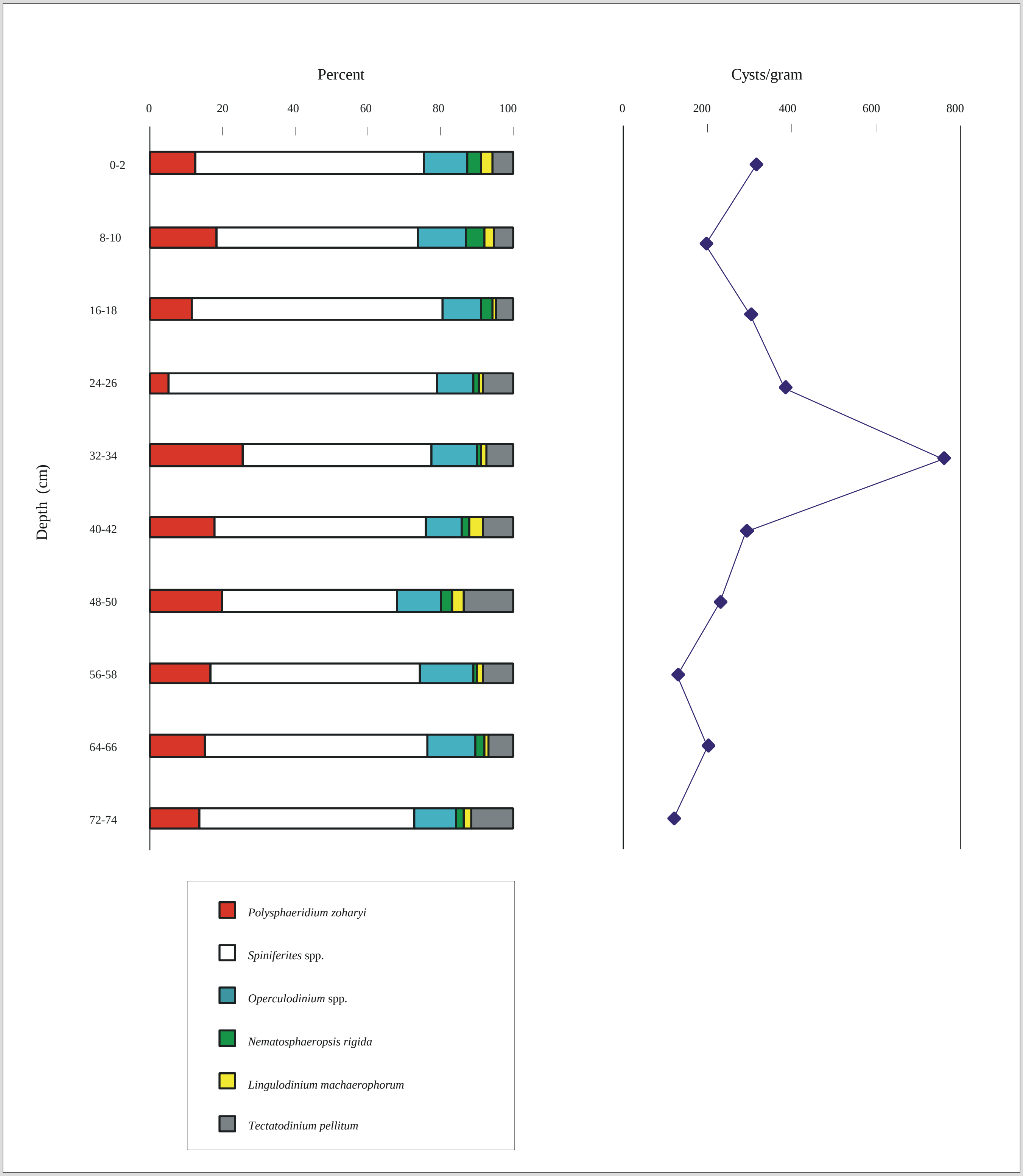


Figure 8. Percent and absolute abundances of dinocysts for Pass Key core 37.

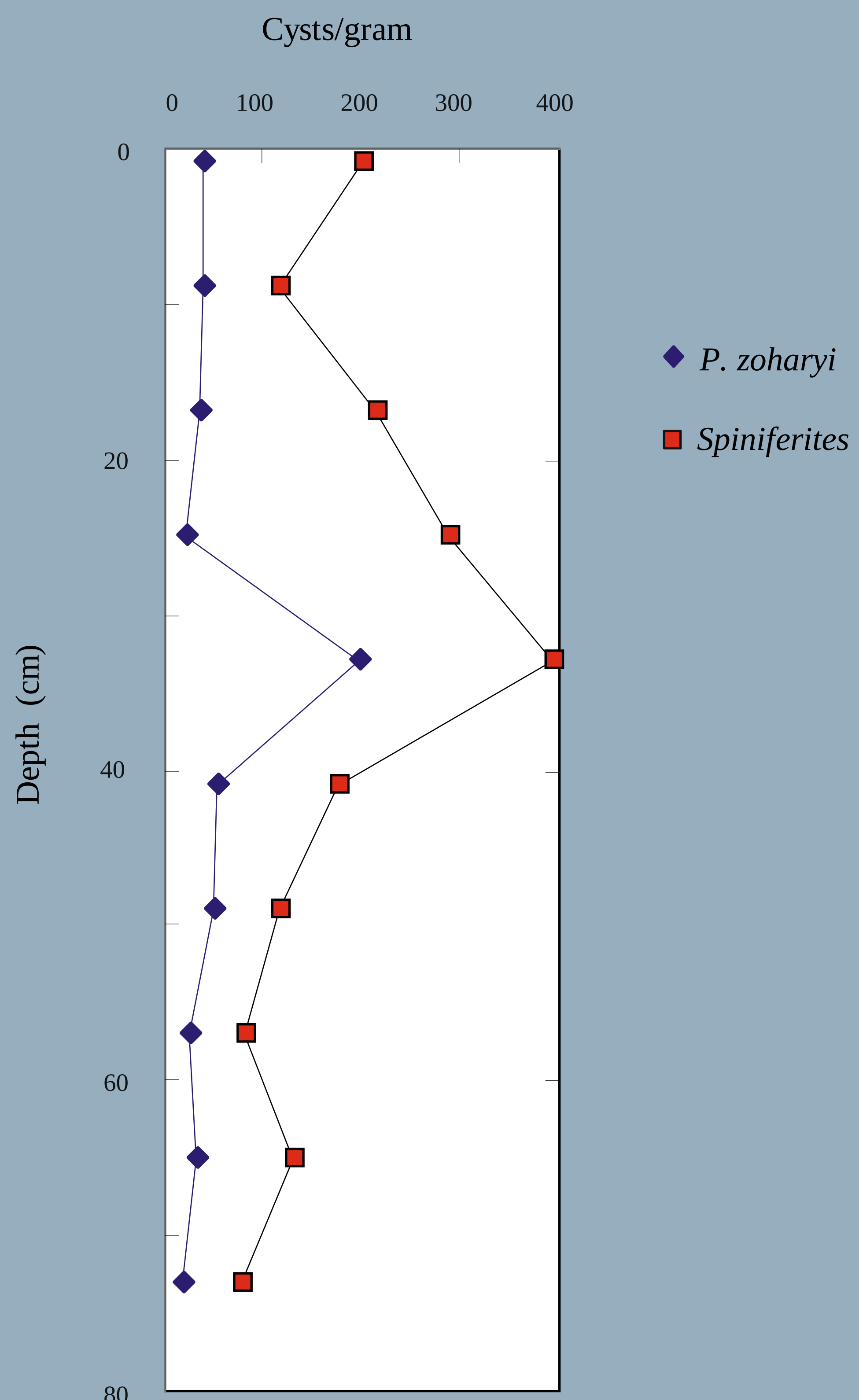


Figure 9. Absolute abundances of *Polysphaeridium zoharyi* and *Spiniferites* spp. in Pass Key core 37.

Table 4. Percent abundance of dinocysts, number of cysts per gram, and data on samples examined for Pass Key core 37.

Depth (cm)	Wt (g)	Cysts/g	Slides examined	*Polysphaeridium zoharyi*	*Spiniferites* spp.	*Operculodinium* spp.	*Nematosphaeropsis rigida*	*Lingulodinium machaerophorum*	*Tectatodinium pellitum*	Other	TOTAL DINOCYSTS COUNTED
				Percent abundance							
0-2	38.8	315	2.25	12.3	63.3	12.0	3.7	3.0	5.7	0.0	300
8-10	51.0	209	2.00	18.5	55.4	13.1	5.4	2.3	5.4	0.0	130
16-18	34.6	309	1.20	11.8	69.1	10.3	2.9	1.5	4.4	0.0	136
24-26	25.4	389	1.20	5.2	73.8	9.9	1.7	1.2	8.1	0.0	172
32-34	27.1	757	2.00	25.9	51.8	12.5	0.9	1.8	7.1	0.0	112
40-42	32.4	303	2.20	17.6	58.3	10.2	1.9	3.7	8.3	0.0	108
48-50	25.6	241	2.00	19.7	48.5	12.1	3.0	3.0	13.6	0.0	132
56-58	28.3	141	3.00	16.5	57.8	14.7	0.9	1.8	8.3	0.0	109
64-66	26.1	213	2.20	15.3	61.0	13.6	2.5	0.8	6.8	0.0	118
72-74	31.4	133	2.20	13.6	59.2	11.7	1.9	1.9	11.7	0.0	103

SUMMARY

The sediments from Pass Key core 37, taken from the mudbank on the southern end of Pass Key in eastern Florida Bay, record a history of rapid sedimentation. Aerial photos, ^{210}Pb age models, and distribution of dinocysts and *Casuarina* pollen within the core are all consistent with rapid sedimentation.

The benthic fauna record fluctuations in salinity and the distribution of seagrass during the time of deposition of the core. Salinity was relatively low, and the benthic fauna indicate seagrass was sparse during the time represented by the samples from 74-64 cm. This was followed by an increase in salinity and seagrass from 64-38 cm. At 38 cm, a slight decrease in salinity occurs, and on the basis of a decrease in epiphytal species, it appears that seagrass density decreased. These conditions continued until approximately 14 cm, where salinity and seagrass density increase.

The segment of the core from 40-30 cm records significant change in all the biotic elements examined. It is possible that this segment of the core may represent a period of increased terrestrial flushing, due to rainfall, water management practices, or a combination of both. The presence of freshwater terrestrial Hydrobiidae snails in this segment of the core and the decrease in the abundance of pine pollen is consistent with this hypothesis. In addition, the benthic fauna record a slight decrease in average salinity for this segment of the core. Investigations comparing Pass Key to other cores, and to modern surface sample samples, are continuing and will provide additional data for interpreting the fluctuations recorded in Pass Key core 37.

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