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VEGETATION CHANGES IN THE LAKE OKEECHOBEE LITTORAL ZONE

1972 TO 1982

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By

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EXECUTIVE SUMMARY

The distribution of major plant communities within the Lake Okeechobee littoral zone, and its associated inundation characteristics, was first documented in 1972-73 along two permanently established transects. Indian Prairie Transect was located on the northwest shore of the lake and extended for 4.57 km, while Moore Haven Transect extended 13.05 km through the southwest marshes of the lake. This provided a methodology and a data base for evaluation of future changes in marsh vegetation.

The regulation schedule for Lake Okeechobee was increased from a 13.5-15.5 ft msl schedule in 1973 to a 15.5-17.5 ft msl schedule by 1978. Lake stages increased subsequently, especially during 1978 and 1979. Marsh vegetation along the Indian Prairie transect was redocumented in spring 1981, following several years of higher lakes stages, while the Moore Haven transect was redocumented in spring and summer 1982, following a drought period which caused record low lake levels.

Substantial changes in the composition and distribution of plant communities were recorded along the Indian Prairie Transect following the periods of high lake stages. The most apparent changes were elimination of the spikerush (Eleocharis cellulosa) community, expansion of the cattail (Typha domingensis) zone and domination of the mixed grass zone by torpedo grass (Panicum repens).

The results of the 1982 Moore Haven transect redocumentation indicated the distribution of major plant communities was similar to that reported in 1973. While this seems contradictory as substantial changes were observed during the previous year on Indian Prairie Transect, it appears that the subsequent drying of the marsh during the 1981-82 drought period may have reversed some of the vegetational changes associated with prolonged inundation. Specifically, drying of the marsh along the Moore Haven Transect probably rejuvenated the spikerush community and may have reversed the expansion of cattails. Evidence to support these assumptions was available from later observations along the Indian Prairie Transects in summer 1982.

Melaleuca quinquinervia, the exotic cajeput tree, was well established along the western portion of the Moore Haven marsh in 1973, primarily at elevations above 14.0 ft msl. Melaleuca has not increased into lower elevation ranges, but has increased substantially in frequency of occurrence, primarily due to an increase in the areal extent of the circular stands.

Since the majority of the 38,700 ha of Lake Okeechobee marsh lies below 15.0 ft msl, extended stages above 15.0 ft msl keep the marsh continuously inundated. Constant flooding selects for more water tolerant plant species over those which require periodic drying. Continued adherence to the 15.5-17.5 ft msl schedule for Lake Okeechobee could lead to a decline in the diversity of the littoral zone plant communities. This reduced diversity will affect not only the marsh vegetation itself, but the myriad waterfowl, wading birds, reptiles, fishes, and other species which are dependent on the variety of habitats provided by a complex marsh ecosystem.

ACKNOWLEDGEMENTS

This program was conceived by J. Walter Dineen, Director, Environmental Sciences Division, in the early 1970's. Robert Brown, Director, Geographic Sciences Division, provided valuable insight which allowed for resumption of this program nine years after the initial documentation. Mike Zaffke, Ed Terczak, Robb Startzman, and especially Robert Martens and Steve Guzman provided valuable assistance in the field aspects of this program, working at times under extremely difficult conditions. Mike Zaffke provided taxonomic identification and verification of plant species. Robb Startzman was helpful with the computer programming to facilitate data storage and manipulation.

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INTRODUCTION

Lake Okeechobee is a 1894 km^2 fresh water lake that occupies a broad, shallow depression in south central Florida. Encircled by a levee for flood control purposes, Lake Okeechobee serves as a water supply reservoir for agricultural and urban interests in south Florida.

Lake Okeechobee contains approximately 387 km^2 of emergent marshes which represent a valuable component of the south Florida ecosystem. These marshes provide feeding and nesting habitat for thousands of wading birds and migratory waterfowl (Zaffke, 1984). Fresh water sport and commercial fishing in Lake Okeechobee, both of which are at least partly dependent on the littoral habitat, represent a significant economic resource for south Florida (Game and Fish Commission, 1975). A number of endangered and threatened species, including the snail kite, wood stork, sandhill crane, and American alligator utilize the lake's marshes. These marshes may also enhance the water quality of Lake Okeechobee through nutrient uptake and cycling by aquatic vegetation.

Numerous drainage and water control activities have influenced water levels in Lake Okeechobee. Several canals for drainage and transportation to the lake were originally constructed from the 1880's to the 1920's. More recently, the Central and Southern Florida Flood Control District (now the South Florida Water Management District) was created in 1949 to operate and maintain an extensive water control system which was designed in response to severe flooding in south Florida. Lake Okeechobee is vital to the operation of much of this system.

The effects of water level manipulation and water management techniques on the Lake Okeechobee marshes have concerned several researchers. Sincock (1957) investigated relationships between water level fluctuation and littoral vegetation along the northwest shore of the lake prior to construction of the perimeter levees in that area. Ager and Kerce (1970) repeated Sincock's study after water level controls became more effective, and showed that water level stabilization had promoted more defined vegetation zones, resulted in perennial species replacing annual plants, and increased the frequency of submergent species. Pesnell and Brown (1976, 1977) mapped the plant communities within Lake Okeechobee and examined the associated inundation characeristics which promoted these communities.

Pesnell and Brown (1977) conducted their field investigations in Lake Okeechobee marshes during 1972 and 1973. The Indian Prairie transect was originally documented in July-August 1972, and the Moore Haven transect from December 1972-April 1973. For comparative purposes, initial Indian Prairie transect documentation is listed as 1972, and Moore Haven transect as 1973. In an effort to provide additional water storage capacity in the lake, the maximum regulation schedule was subsequently increased from 15.5 ft msl to 16.0 ft msl in 1974, and to 17.5 ft msl in 1978. In addition, cattle grazing leases with local ranchers were cancelled in 1977 and all cattle were removed from the marshes. This study was designed to repeat the work of Pesnell and Brown (1977) and to investigate changes in plant species composition and distribution in the ensuing 10 years.

DESCRIPTION OF THE STUDY AREA

The majority of the emergent littoral zone of Lake Okeechobee is located along the western side of the Lake, extending from the mouth of the Kissimmee River on the north to Clewiston on the south. Marshes surround three islands in the southeast part of the lake, and also occur along the northeastern shore. Emergent vegetation generally begins at the 10 ft msl contour and extends landward to the base of the encircling levee, the Herbert Hoover Dike, at approximately 15 ft msl.

Fifteen distinct plant communities identified and mapped by Pesnell and Brown (1976) are listed in Table 1. Over 80% of the emergent vegetation was

TABLE 1. PLANT COMMUNITIES OF THE LAKE OKEECHOBEE LITTORAL ZONE*

Community	Acres	Hectares	%
Cattail	24,128	9772	25.3
Spikerush	17,609	7132	18.4
Beakrush	15,120	6124	15.8
Willow	10,419	4220	10.9
Mixed Grasses	9,552	3869	10.0
Wire Cordgrass	6,907	2797	7.2
Sawgrass	4,041	1637	4.2
Bulrush	2,427	983	2.5
Mixed Forest	1,642	665	1.7
Buttonbush	1,426	578	1.5
Melaleuca	972	394	1.0
Bog	582	236	0.6
Water Lily	401	162	0.4
Water Hyacinth	202	82	0.2
Guava	34	14	0.1
TOTAL	95,482	38,665	99.8

*Data from an unpublished supplement prepared for the map "The Vegetation ofLake Okeechobee, Florida-1973" by Gary L. Pesnell and Robert T. Brown III (1976) characterized by five major communities, dominated by cattail, spikerush, beakrush, willow, and mixed grasses.

METHODS

Due to the standard practice of the South Florida Water Management District (SFWMD) to report water levels and regulation schedules in feet msl, measurements in this study referring to water and ground elevations are in English units. Otherwise, metric units have been used.

Transect Locations and Characteristics

Two permanent transects were installed across the Lake Okeechobee littoral zone in 1972 (Pesnell and Brown, 1977). These transects were reestablished in 1981 and 1982 for the present study and are depicted in Figure 1.

The Indian Prairie Transect begins lakeward of the Herbert Hoover Dike, about 1200 m southwest of the Indian Prairie Canal (C-40) on the northwest shore of Lake Okeechobee in Glades County, Florida. The origin of the transect is marked by a 3 m galvanized steel pipe, driven to bedrock, located about 125 m east of the base of the levee. The transect extends lakeward through the emergent marsh along a 135° compass heading for a distance of 4.57 km. Metal pipes, driven into the bedrock, were located at about 90 m intervals to mark the line. Ground elevations were determined by survey to the nearest 0.1 ft, referenced to mean sea level (msl) datum, at 25 ft (7.6 m) intervals along the transect line in 1972.

The Moore Haven Transect originates at a point about 300 m east of the old Moore Haven canal and about 375 m north of the rim canal along the southwest shore of Lake Okeechobee, and extends lakeward at a 63° compass heading for a distance of 13.05 km. This transect is marked by 6 m lengths of galvanized steel pipe, driven into the underlying bedrock, placed at about 600 m intervals. Ground elevations were surveyed to the nearest 0.1 ft msl at 100 ft (30.5 m) intervals along the transect in 1972. The elevation at intermediate locations were determined by interpolation.

Field Methods

Vegetation along each transect was documented by recording the presence of each species within a continuous strip of quadrats located along each line. Each quadrat measured 3.0 x 7.6 m and was offset 3 m north of the transect. The ground elevation determined for each 25 ft (7.6 m) interval was assumed to be representative of the entire quadrat. Specimens of unknown plants were collected for later identification to the extent possible, using taxonomic references (Long and Lakela, 1971; Correll and Correll, 1972; Godfrey and Wooten, 1979, 1981).

Field documentation of the 601 quadrats comprising the Indian Prairie transect was conducted between April 7 and May 6, 1981. A total of 1713 quadrats were documented along the Moore Haven transect between May 17 and July 24, 1982.

Plant communities occurring along each transect were determined in the field by observation, and were designated by an **indicator** species. An indicator is that species whose dominance, either by morphological characteristics or abundance, provides a distinct, recognizable form to the community. Community indicator species, as used herein, is comparable to the "preferential species" discussed by Braun-Blanquett (1972).

Data Tabulation and Analysis

The vegetation data collected from the transects were treated by direct gradient analysis (Whittaker, 1982). Each quadrat sample consisted of a list of species present and the corresponding ground elevation. Using a computer program (SFWMD, 1979) the samples were grouped according to each 0.1 ft msl elevation class. For each species, a frequency was calculated based on the number of times the species occurred in the total number of quadrats within each 0.1 foot elevation interval. A graphic plot was made of the frequency (y-axis) vs the elevation gradient (x-axis) for each of the community indicator species. The resulting frequency distribution curves were smoothed with a 5 point moving average. Frequency distributions were generally depicted by bell-shaped curves, with low frequencies at each end of the overall range, and relatively high frequencies in the central portion of the range.

Frequency distribution curves for all of the community indicators from each transect were plotted simultaneously. By examination of the composite graphs, the optimum elevation range for each indicator species was determined. The **optimum elevation range** for each indicator was represented by the elevations at which the frequency curve of one species intersected the frequency curve of the species above and below it (Pesnell and Brown, 1977), and where the frequency peaks were most obvious. In some instances two or more species exhibited similar frequency curves within the same range of land elevations, so optimum elevation ranges are not necessarily exclusive. Discretion was used where field

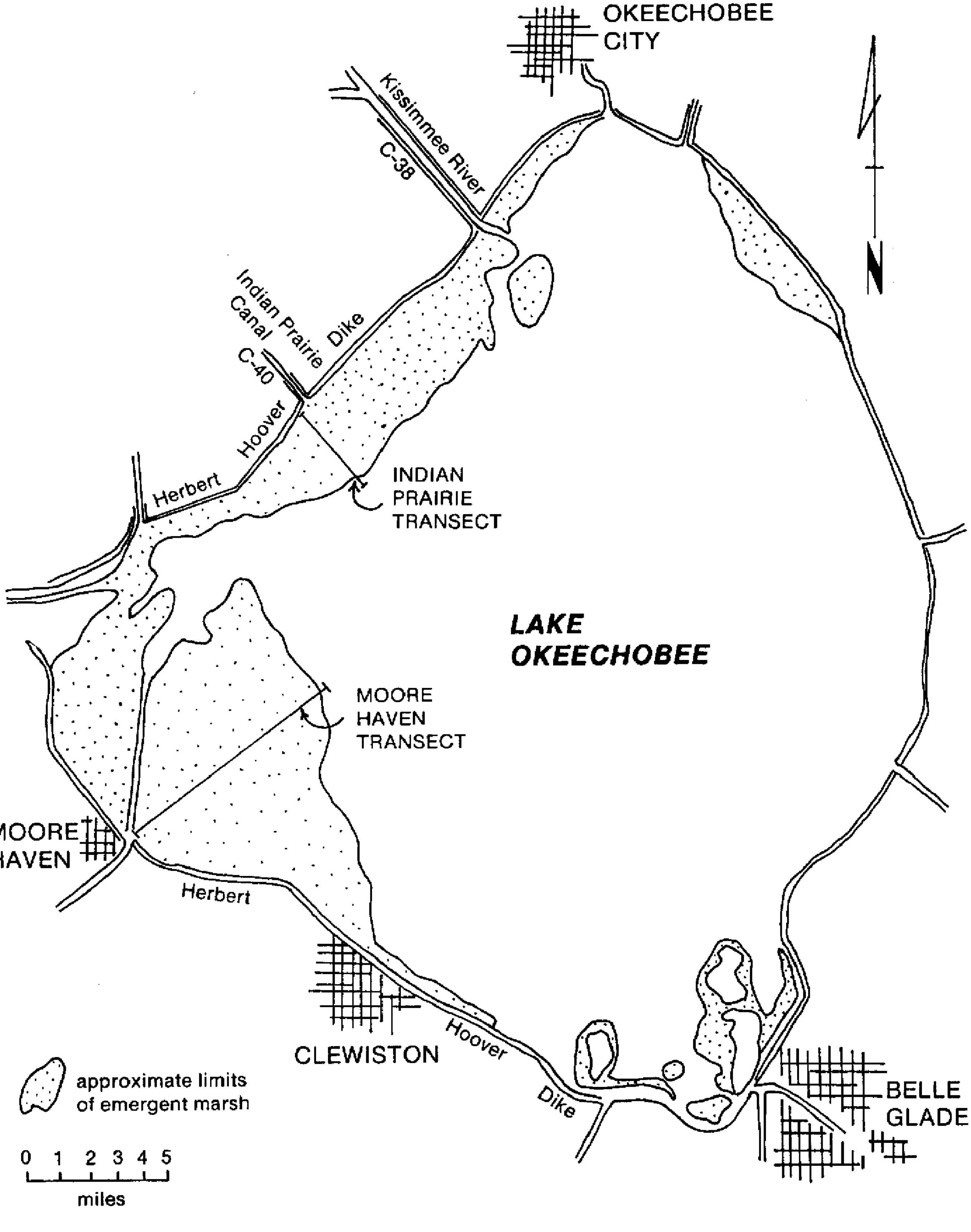

FIGURE 1. LOCATION OF INDIAN PRAIRIE AND MOORE HAVEN TRANSECTS IN THE EMERGENT MARSH OF LAKE OKEECHOBEE

observations supported that a high frequency of an indicator species occurred but the species was not present in sufficient density to represent a community.

Associated species are those plant species which occur with the community indicator species within each of the sampled quadrats. A **conditional frequency** was calculated (SFWMD, 1979) for each of the associated plant species. Conditional frequency is the percentage of quadrats in which each associated species occurs along with the indicator species, within the previously determined optimum elevation range. For example, if coinwort (Centella asiatica) occurred in 47 of the 136 quadrats which contained the indicator species beakrush (Rhynchospora tracyi), then the conditional frequency for Centella asiatica would be 0.35 (47/136 = 0.35). Thus, the **community composition** is expressed as a list of associated species and their conditional frequency. Community composition lists were culled at the 0.10 conditional frequency level to represent the most prevalent associated species.

Comparisons of community composition between 1972-73 and 1981-82 were made by examining the lists of associated species, and by use of a similarity index: (Krebs, 1978)

$$I = \frac{2c}{a+b}$$

where
a = no. of prevalent associated species in 1972-73
b = no. of prevalent associated species in 1981-82
c = no. of prevalent species common to both communities (Krebs, 1978)

Hydrology

Daily lake stage records were obtained from the United States Geological Survey and U.S. Army Corps of Engineers for the period of record. **Stage duration curves** (the percentage of time that lake stage equalled or exceeded a given elevation) were prepared with a computer program (Startzman et. al., 1983) for selected time periods to demonstrate relative hydrologic differences. The **inundation frequency**, which represents the proportional amount of time that a selected ground elevation was covered with water, can be extracted from stage duration curves.

RESULTS

1. Hydrology

The water level fluctuation regime of a lake is an important factor influencing the distribution of aquatic vegetation. Plant communities within a marsh are dependent on a water level regime that (1) provides conditions suitable for the initial establishment of species within each community and (2) provides conditions appropriate for the prolonged maintenance of the plant community. The distribution of plant species at different elevations in a marsh reflects the influence of the preceding water level conditions.

Verified daily stage records exist for Lake Okeechobee from 1931 to present (U.S. Geological Survey, 1980). Figure 2 compares stage duration curves for the pre-flood project conditions (1931-1950) with the initial 20 year flood control project period (1951-1970). Lake stages ranged from 11.30 to 18.77 ft msl during 1931-1950, with a median stage of about 15.3 ft msl (i.e., 50% of the time lake stages equalled or exceeded 15.3 ft msl). In contrast, lake stages during the project period 1951-1970 were about 1.0 to 1.5 feet lower. The overall range was 10.14 to 17.69 ft msl, with a median stage of about 14.0 ft msl.

A stage duration curve was computed for the six year period (1967-72) prior to the initial documentation of the transects (Figure 2). The similarity of the 1967-72 stage duration curve with the 1951-70 curve indicates that water conditions of both periods were comparable. Consequently, both periods depict the lake stage regime which influenced the vegetation communities documented in 1972-73. In previous investigations of Lake Okeechobee marshes, Sincock and Powell (1957) suggest that stage duration during the past five year period is adequate to determine distribution of perennial vegetation.

In 1974, a series of increases in the regulation schedule for Lake Okeechobee began which ultimately resulted in a 15.5-17.5 ft msl schedule in 1978. Figure 3 shows the regulation schedule changes, and the stage hydrograph for the period 1973-1982. Lake Okeechobee reached a high of 17.62 ft msl on October 7, 1979 approaching a level which had not been previously reached since 1953 (Appendix 1). The stage duration curve for the six year period (1975-80) prior to redocumentation of the Indian Prairie Transect (Figure 2) shows water levels generally about 0.5 foot higher than conditions depicted for both the 1951-70 and 1967-72 periods.

Figure 4 shows Lake Okeechobee stages for 1980-82 which includes the recent transect documentation periods. Indian Prairie transect was documented in spring 1981 as water levels receded to a point where shallow water or dry conditions allowed access on foot. Below average rainfall during summer 1981 caused Lake Okeechobee to reach a record low of 9.78 ft msl.

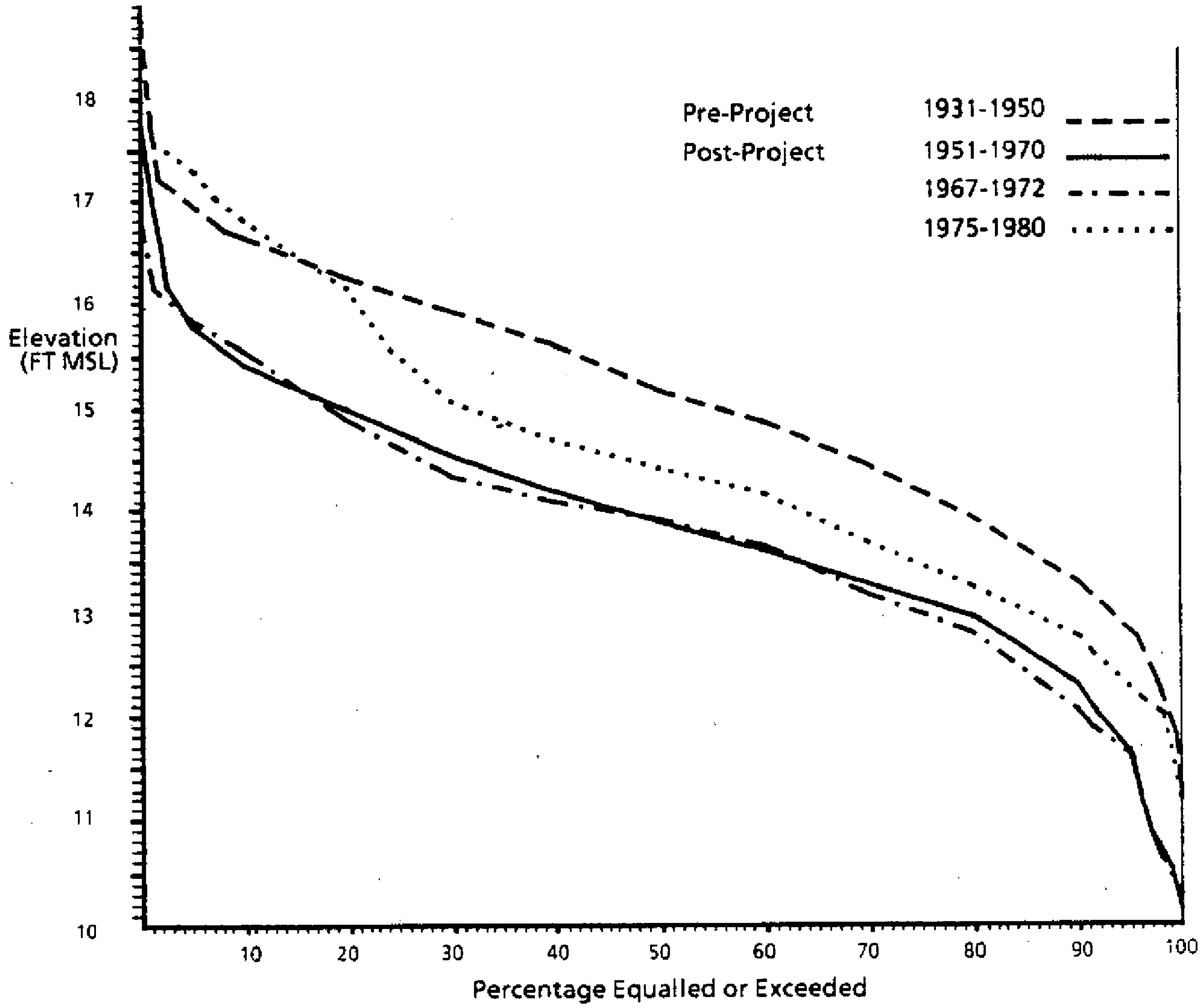

FIGURE 2. LAKE OKEECHOBEE STAGE DURATION CURVES FOR SELECTED TIME PERIODS

Moore Haven transect was documentated from May 19 to July 14, 1982, after which the lake stage rose rapidly to 17 ft msl by October 1982. Prolonged low water levels during 1981 and 1982 exposed portions of Lake Okeechobee marshes which had been continuously inundated for ten years or more.

2. Vegetation Documentation - Indian Prairie Transect

Ground elevations along the Indian Prairie transect range from 15.1 to 10.1 ft msl and exhibit a relatively uniform gradient after an initial drop of about one foot along the beginning of the line (Appendix 2).

A total of 50 species of plants were identified from the Indian Prairie transect in 1981. This compares with 39 species reported in 1972 (Pesnell and Brown, 1977). Unidentifiable plants were listed as unknown grasses, sedges, or broadleafs. The increase in the number of species was primarily due to improved identification of grasses. Spartina bakeri was the only grass identified in 1972; all others were grouped as unknown grass. However, in 1981 seven other species of grasses (Panicum hemitomon, Paspalidium paludivagum, Panicum repens, Hydrochloa caroliniensis, Leersia hexandra, Paspalum distichum and Sacciolepis striata) were identified. Appendix 3 summarizes the species recorded during both surveys, the total number of

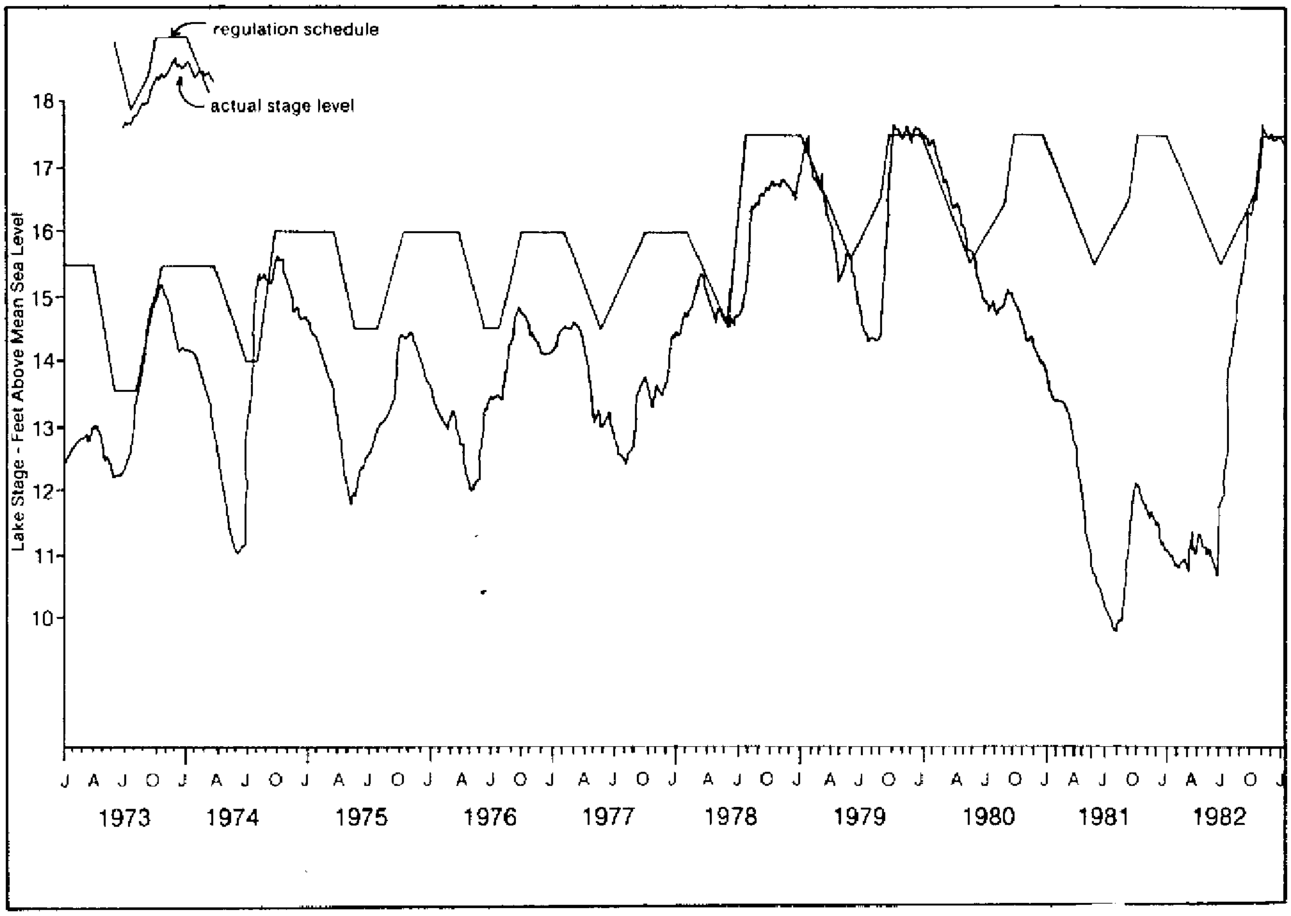

FIGURE 3. HYDROGRAPH AND REGULATION SCHEDULES FOR LAKE OKEECHOBEE, 1973-1982

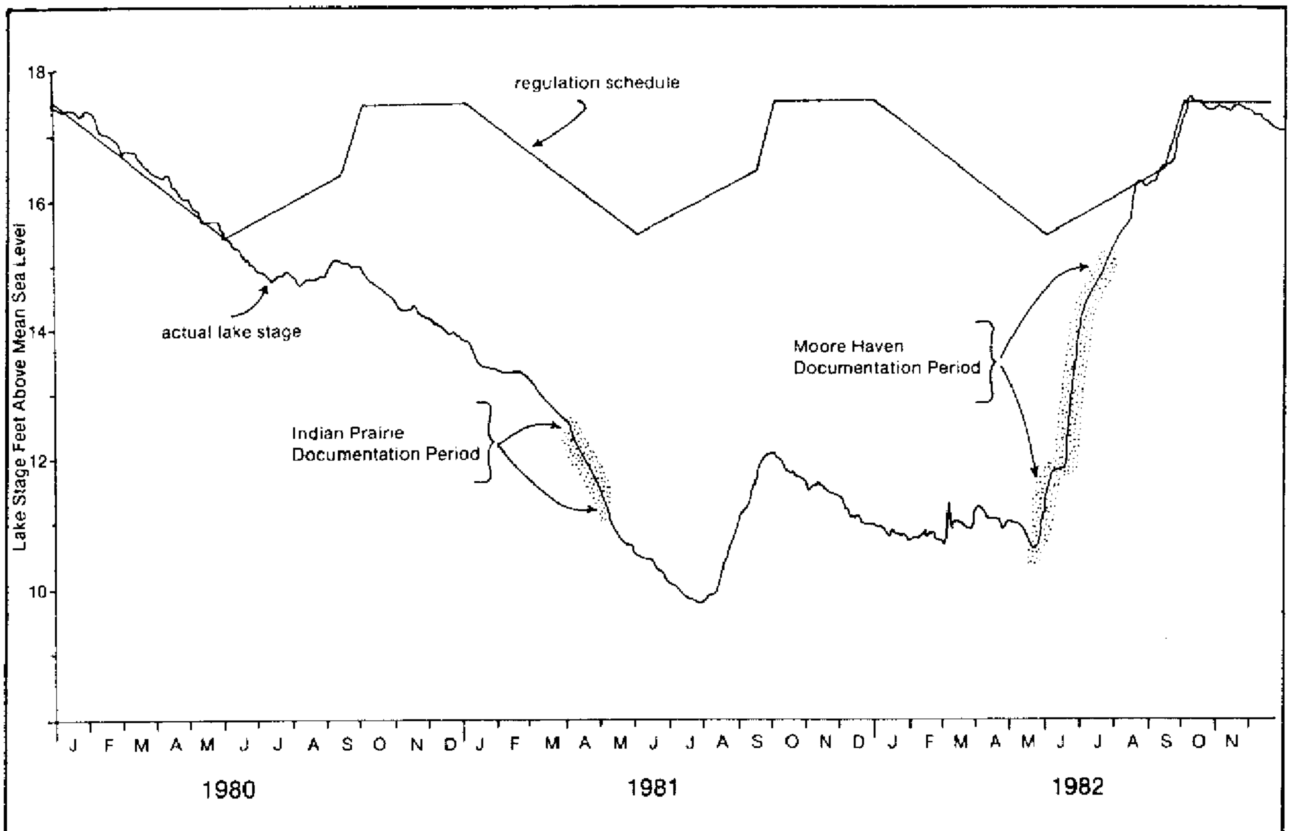

FIGURE 4. LAKE OKEECHOBEE HYDROGRAPH AND TRANSECT DOCUMENTATION PERIODS: 1980-1982

occurrences, and the overall elevation range of each species.

In 1981, the marsh along the Indian Prairie transect was composed of four plant communities, characterized by the indicator species, Panicum repens, Spartina bakeri, Typha domingensis, and Scirpus californicus. This differs from the four communities reported in 1972, represented by Spartina bakeri, Typha domingensis, Eleocharis cellulosa, and Scirpus californicus.

Figure 5 compares distribution of the 1972 indicator species with the distribution and frequency of occurrence of the indicator species in 1981. This comparison shows the increased frequency of Typha domingensis in the lower elevations of its range, and the elimination of Eleocharis cellulosa at the lower end of its former range.

The community indicator species in the higher elevations of the Indian Prairie Transect have shown marked changes since 1972. In 1981, torpedo grass (Panicum repens) represented the dominant emergent in the upper marsh. Since 1972, Panicum repens has increased in both size and density, thereby overshadowing the formerly robust Spartina bakeri, and is consequently considered a community indicator. The distribution and frequency of Eleocharis cellulosa and Spartina bakeri showed little change since 1972. Although Eleocharis cellulosa exhibited a frequency peak near 14 ft msl, it was not sufficiently dense to be considered a community indicator at this location. Likewise, Spartina bakeri has exhibited a decline in stature since 1972.

Table 2 compares optimum elevation ranges of the indicator species in 1972 and 1981. Pesnell and Brown (1977) did not include any aquatic grasses as indicator species, yet their accompanying vegetation map (Pesnell and Brown, 1976) shows an aquatic grass zone along the upper 1000 meters of the transect, and describes it as containing Panicum repens, Cynodon dactylon, Eleusine indica, and Paspalum notatum.

A comparison of the associated species within the three plant communities common to both survey periods (bulrush, Scirpus californicus; cattail, Typha domingensis; and switchgrass, Spartina bakeri) is presented in Table 3. Only those associated species with a conditional frequency of 0.10 or higher are listed and compared.

Scirpus californicus: There were 10 prevalent associated species within the bulrush community in 1972 and nine in 1981. Four of these species were common to both sampling periods. Three of the species eliminated since 1972 were emergents, Eleocharis cellulosa, Fuirena scirpordea, and Sagittaria lancifolia, while another species was Utricularia sp., a floating submergent. New species present in 1981 included Panicum hemitomon, Nymphaea odorata, Najas quadalupensis, and Chara sp. The addition of cattail (Typha domingensis) to the list of associated species in the bulrush community is due to the increased range of the community in 1982. A similarity index of 0.32 was calculated in comparing the two associated species lists.

TABLE 2. OPTIMUM ELEVATION RANGE OF COMMUNITY INDICATOR SPECIES ALONG INDIAN PRAIRIE TRANSECT, 1972 AND 1981

Indicator Species	1972 Range (ft msl)*	1981 Range (ft msl)**
Scirpus californicus	10.1-10.7	10.1-11.1
Eleocharis cellulosa	10.7-12.0	---
Typha domingensis	12.0-13.0	11.1-13.0
Spartina bakeri	13.0-14.5	13.0-13.5
Panicum repens***	---	13.5-15.0

* From Pesnell and Brown (1977).

** From curves depicting 1981 redocumentation - See Figure 3.

*** Grasses were unidentified in earlier analyses (Pesnell and Brown 1977)but an aquatic grass zone is shown on the vegetation map (Pesnell andBrown 1976).

Typha domingensis: The cattail community consisted of nine prevalent associated species in 1972 and 12 prevalent associated species in 1981. The increase in associated species reflected the cattail community's lakeward expansion into the 11.1-12.0 ft msl contour interval which included several deep water tolerant species. The most significant changes occuring within the cattail community between 1972-1981 were the reduction of smartweed (Polygonum) and the increase of bulrush and white water lily (Nymphaea odorata). A similarity index of 0.48 was calculated for the cattail community.

Spartina bakeri: The switchgrass community showed a reduction in number of prevalent associated species between 1972 and 1981. This may be due to the reduction in the optimum range of the community from a landward limit of 14.5 ft msl to 13.5 ft msl. The major associated species, Pontederia lanceolata, Nymphaea odorata, Eleocharis cellulosa, and Polygonum sp. were still present a high percentage of

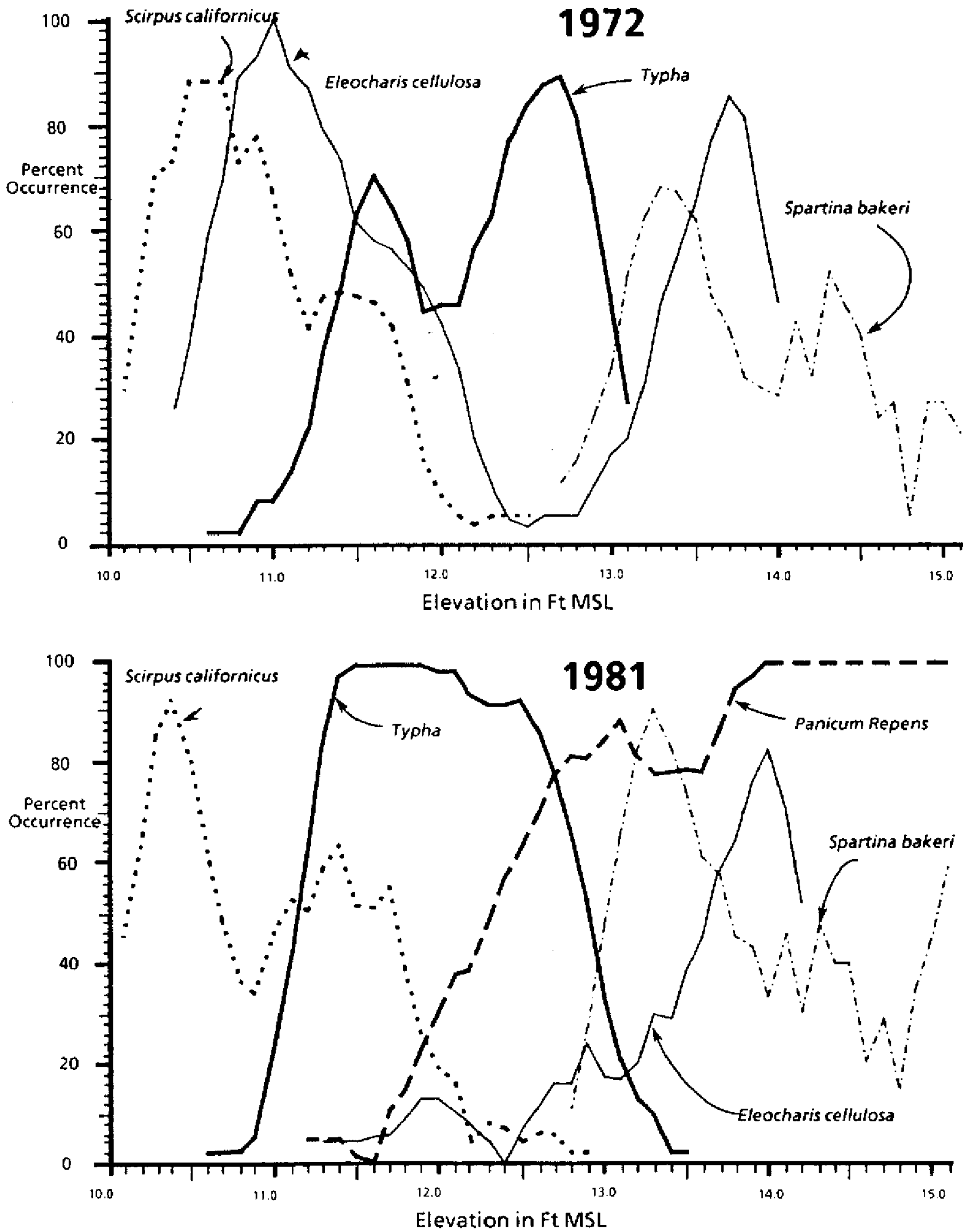

FIGURE 5. DISTRIBUTION OF PLANT COMMUNITY INDICATOR SPECIES ALONG INDIAN PRAIRIE TRANSECT, 1972 AND 1981.

TABLE 3. COMMUNITY COMPOSITION OF THREE PLANT COMMUNITIES ON INDIAN PRAIRIE TRANSECT -1972 AND 1981.

Date: 1972 / 1981

A. Bulrush Community (Scirpus californicus)

Optimum elevation range: 1972: 10.1-10.7 ft msl*; 1981: 10.1-11.1 ft msl

Associated Species (1972)	Conditional Frequency	Associated Species (1981)	Conditional Frequency
Vallisneria neotropicalis	0.94	Vallisneria neotropicalis	0.93
Pontederia lanceolata	0.63	Potamogeton illinoensis	0.67
Sagittaria lancifolia	0.50	Chara sp.	0.37
Eleocharis cellulosa	0.31	Nymphaea odorata	0.19
Potamogeton illinoensis	0.31	Eichhornia crassipes	0.19
Unidentified grass	0.25	Panicum hemitomon	0.19
Utricularia sp.	0.25	Najas guadalupensis	0.15
Eichhornia crassipes	0.25	Typha domigensis	0.11
Fuirena scirpoidea	0.19	Pontederia lanceolata	0.11
Pistia stratoites	0.19		

Similarity Index I = 0.32

B. Cattail Community (Typha domingensis)

Optimum elevation range: 1972: 12.0-13.0 ft msl; 1981: 11.1-13.0 ft msl

Associated Species (1972)	Conditional Frequency	Associated Species (1981)	Conditional Frequency
Polygonum sp.	0.74	Nymphaea odorata	0.72
Pontederia lanceolata	0.71	Utricularia biflora	0.53
Unidentified grass	0.68	Pontederia lanceolata	0.50
Sagittaria lancifolia	0.49	Scirpus californicus	0.40
Nymphaea odorata	0.33	Unidentified grass	0.37
Utricularia spp.	0.26	Paspalidium paludivagum	0.28
Alternanthera philoxeroides	0.22	Sagittaria lancifolia	0.25
Salvinia rotundifolia	0.20	Leersia hexandra	0.19
Vigna luteola	0.13	Ceratophyllum demersum	0.18
		Panicum repens	0.15
		Nymphaea mexicana	0.14
		Eleocharis equistoides	0.12

Similarity Index I = 0.48

C. Switchgrass Community (Spartina bakeri)

Optimum elevationrange: 1972: 13.0-14.5 ft msl; 1981: 13.0-13.5 ft msl

Associated Species (1972)	Conditional Frequency	Associated Species (1981)	Conditional Frequency
Unidentifiable grasses	100	Pontederia lanceolata	0.85
Pontederia lanceolata	0.84	Leersia hexandra	0.76
Nymphaea odorata	0.71	Panicum repens	0.74
Unidentifiable sedges	0.68	Nymphaea odorata	0.65
Polygonum sp.	0.63	Hydrochloa caroliniensis	0.56
Eleocharis cellulosa	0.63	Paspalidium paludivagum	0.53
Bacopa monnieri	0.62	Eleocharis cellulosa	0.35
Sesuvium portulacastrum	0.50	Utricularia biflora	0.32
Pluchea sp.	0.39	Cephalanthus occidentalis	0.29
Hydrocotyle umbellata	0.38	Polygonum sp.	0.26
Centella asiatica	0.33	Diodia virginica	0.26
Eupatorium sp.	0.33	Eleocharis equistoides	0.24
Ludwigia sp.	0.26	Unidentifiable grasses	0.12
Baccharis halimifolia	0.20		
Hibiscus grandiflorus	0.17		
Scirpus americanus	0.16		
Lippia nodiflora	0.13		
Cephalanthus occidentalis	0.11		

Similarity Index I = 0.40

* = refers to the optimum elevation range of the community indicator species.

time. However, a low similarity index of 0.40 was calculated for this community.

3. Vegetation Documentation - Moore Haven Transect

Ground elevations along the Moore Haven transect ranged from a high of 14.6 ft msl at the western origin of the transect to 9.9 ft msl in Cochran's Pass. Two ridges, occupied by willow (Salix caroliniana) are prominent features in this portion of the marsh. Elevation at the lakeward edge of the transect is 10.6 ft msl (Appendix 2).

During the 1982 survey of the Moore Haven transect, a total of 109 species of plants were identified. This compares with 82 species of plants recorded in 1973. The increase in the number of species identified in 1982 was partly due to improved taxonomic capability (21 grass species were identified in 1982 compared to 14 in 1973; 24 sedge species in 1982 compared to 17 in 1973; and 4 Polygonum species in 1982 compared to one in 1973), and partly from recruitment of species due to drying conditions during the previous year. Sixty-six species were common to both sampling periods. Appendix 4 summarizes the species recorded during both studies, the total number of occurrences and the elevation range for each species.

Pesnell and Brown (1977) reported six major plant communities along the Moore Haven transect during 1973, represented by the indicator species, Spartina bakeri, Rhynchospora tracyi, Typha domingensis, Salix caroliniana, Eleocharis cellulosa, and Scirpus californicus. These same six communities were present during the 1982 sampling period, and no other marsh plant communities were evident along the transect.

Figure 6 shows the distribution and frequency of occurrence of the six indicator species along the Moore Haven transect in 1973 and 1982. There is considerable overlapping in the distribution curves of several indicator species (R. tracyi, S. bakeri, and S. caroliniana) in the 13.0-14.5 ft msl elevation range. Consequently, optimum elevation ranges for these species are not exclusive.

Table 4 summarizes the optimum elevation ranges of the indicator species as determined in 1973 (Pesnell and Brown, 1977) and in 1982. As an aid in interpreting the graphs, a separate comparison of the distributions for each community indicator species is provided in Figure 7.

TABLE 4. OPTIMUM ELEVATION RANGE OF COMMUNITY INDICATOR SPECIES ALONG MOORE HAVEN TRANSECT, 1973 AND 1982.

Indicator Species	1973 Range (ft msl)[1]	1982 Range (ft msl)
Eleocharis cellulosa	10.6-12.4	10.7-12.4
Scirpus californicus	11.1-12.3	11.0-11.8
Typha domingensis	12.4-13.1	12.4-13.0
Salix caroliniana	13.2-14.3	12.9-14.4
Rhynchospora trayci	13.1-14.3	13.0-14.4
Spartina bakeri	13.1-14.6	12.9-14.5

[1] from Pesnell and Brown (1977)

Eleocharis cellulosa: Spikerush exhibited a similar distribution pattern at the low end of its range in 1982 and 1973. Within the optimum elevation range of 10.6-12.4 ft msl, two peaks were evident at 11.5 and 12.2 ft msl. A third peak at 13.5 ft msl in 1973 has expanded to a much broader peak, extending to 14.2 ft msl, with the upper limit of spikerush increasing from 14.2 ft msl in 1973 to 14.6 ft msl in 1982. Spikerush is a common component of the beakrush and switchgrass communities at the higher elevations.

Scirpus californicus: Bulrush was reduced in frequency and distribution in 1982 compared with 1973, occurring only between 11.0 and 11.8 ft msl. Bulrush occurred only in the lakeward most plant community in 1982, whereas scattered individuals were associated with other plant communities in 1973.

Typha domingensis: Cattail distribution in 1982 was similar to 1973, exhibiting bimodal peaks between 10 and 11 ft msl and between 12 and 13 ft msl. The optimum elevation range for cattail in 1973 was determined as the landward peak (12.4-13.1 ft msl). Cattails that occupied the lower land elevations occurred as floating mats, which rooted in the flocculent organic substrate during low water and floated free as the lake stage rose (Pesnell and Brown, 1977). This floating phenomenon enabled cattail to occur at these low ground elevations, yet precluded them from representing a plant community dependent on inundation characteristics. The cattails documented at elevations below about 11.0 ft msl in 1982 exhibited these same floating characteristics, and therefore were not considered as a community indicator. Overall, in 1982 the frequency of occurrence of cattail had increased slightly along the lower portion of its range, and decreased along the higher portion of its range.

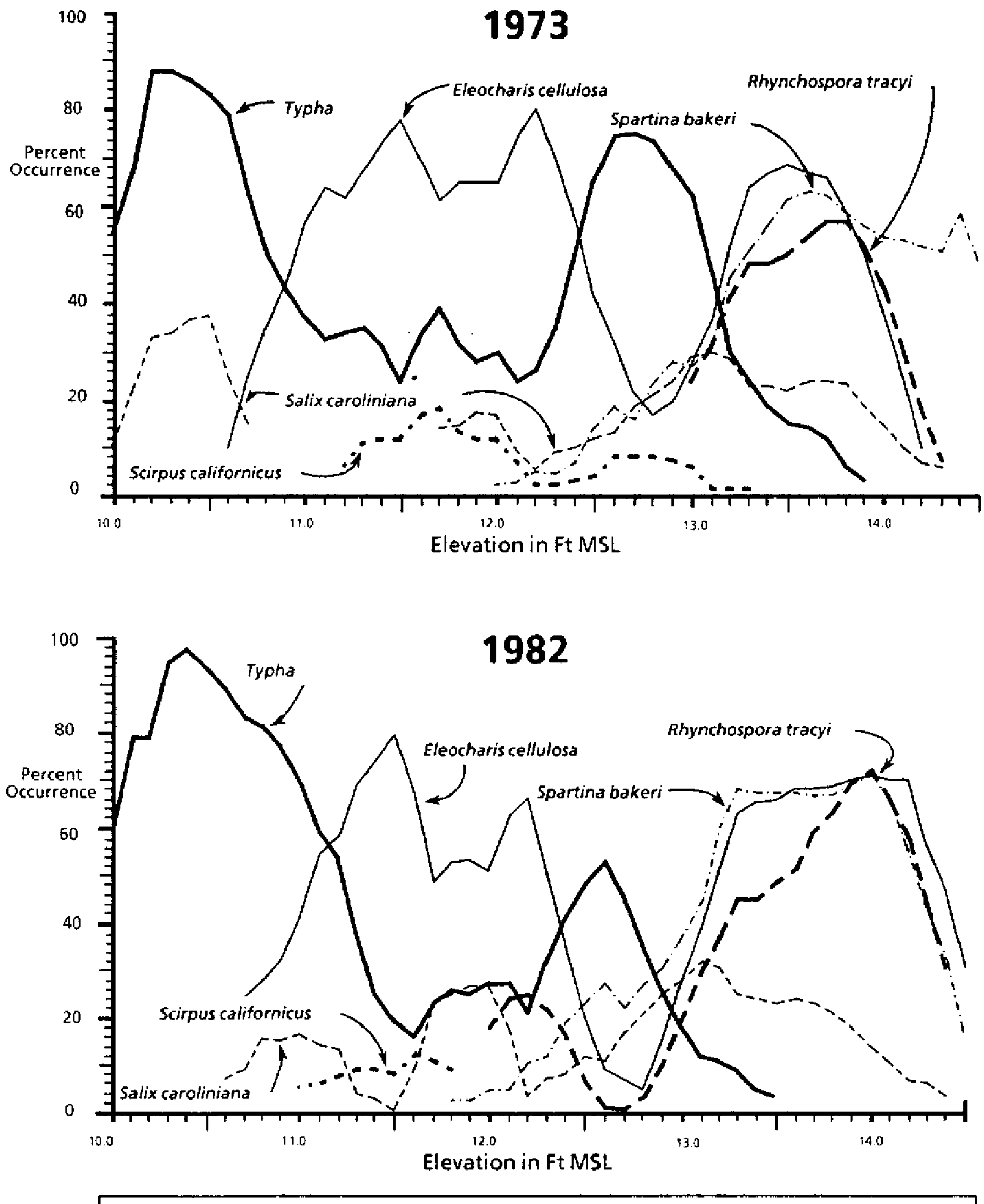

FIGURE 6. DISTRIBUTION OF PLANT COMMUNITY INDICATOR SPECIES ALONG MOORE HAVEN TRANSECT, 1973 AND 1982.

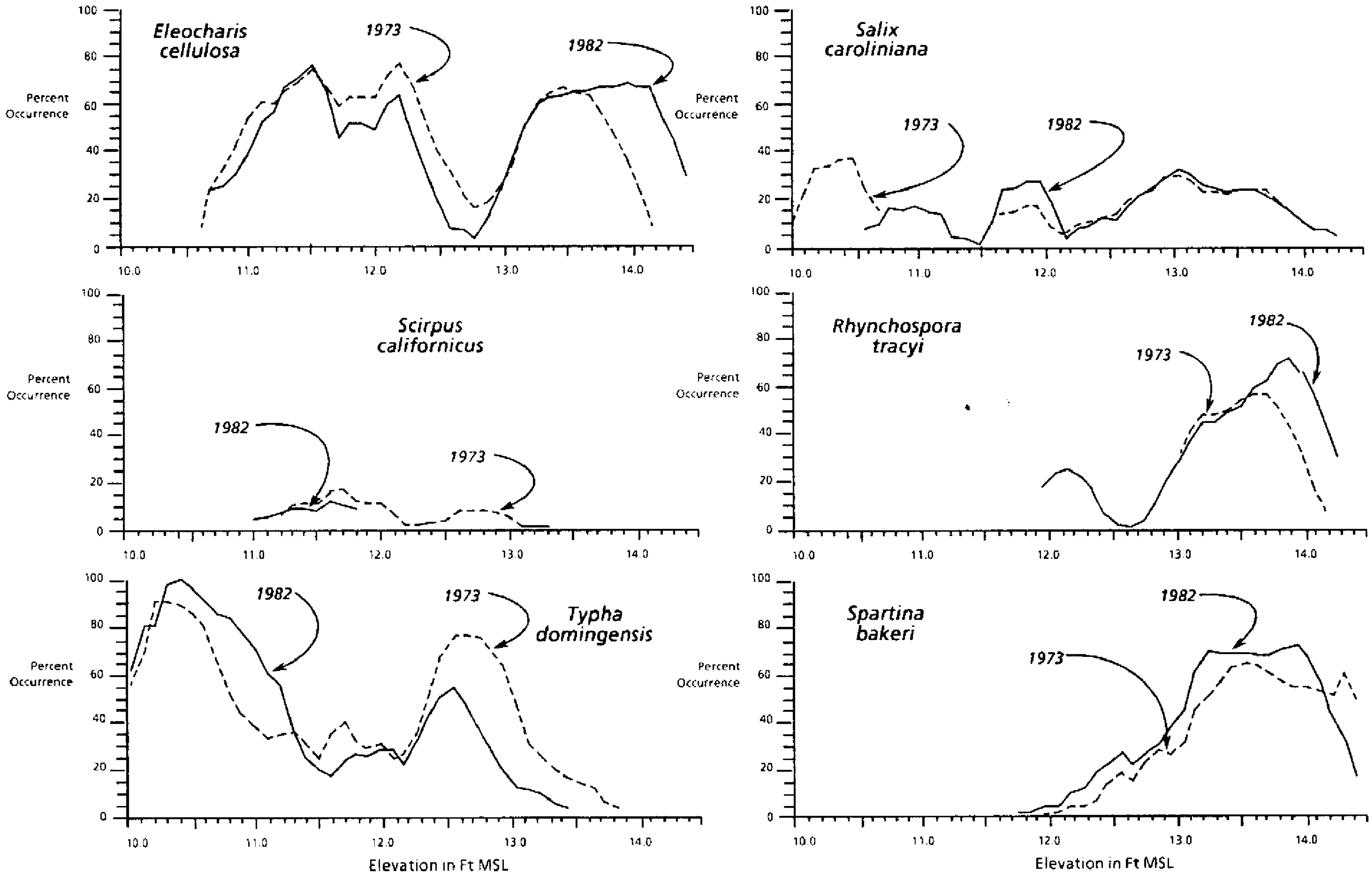

FIGURE 7. COMPARISONS OF FREQUENCY DISTRIBUTION FOR SIX INDICATOR SPECIES ON MOORE HAVEN TRANSECT, 1973 AND. 1982.

Salix caroliniana: Willow distribution was consistent in 1973 and 1982 within its optimum elevation range, from about 12.9 to 14.4 ft msl. An anomalous peak in willow (10.0 to 10.7 ft msl), recorded in 1973, was described by Pesnell and Brown (1977) as willows growing on floating Typha mats. They also reported that these willows had died prior to 1977. Willows occupying the 10.6 to 11.6 ft msl range in 1982 represent new growth since 1973.

Rhynchospora tracyi: The major difference in beakrush distribution between 1973 and 1982 was the peak in occurrence at 12.0-12.5 ft msl which represented new growth since 1973. Additionally, Rhynchospora tracyi occurred in quadrats more frequently at higher elevations, from 13.7 to 14.4 ft msl.

Spartina bakeri: Switchgrass exhibited a similar distribution pattern in 1982 and 1973. A slight shift toward lower elevations was noted in 1982, and overall, Spartina became more abundant (674 occurrences in 1982 vs 557 in 1973). However, personal observations indicated that individual plants were generally less robust than before.

In summary, the distribution and frequency of occurrence patterns observed for the six major community indicator species along the Moore Haven transect were similar in 1973 and 1982. Eleocharis cellulosa and Rhynchospora tracyi expanded into higher elevation ranges along the transect, probably a result of higher lake stages in the late 1970's and early 1980. Typha domingensis, Salix caroliniana, and Rhynchospora tracyi, which expanded into the lower elevation of their ranges, may represent new growth during the drought period 1981-82. Scirpus californicus apparently did not survive continued drying of the marsh above 12 ft msl, and remained only as a lake edge plant community in 1982. Spartina bakeri was slightly more abundant throughout its range.

A comparison of the community composition of the six major plant communities along the Moore Haven transect from 1973 and 1982 documentation periods is presented in Table 5. Only the species present in 10% or more of the quadrats are listed. Additionally, species which are considered annuals or recently germinated terrestrials have been listed separately. Similarity indices are calculated.

Eleocharis cellulosa: The spikerush community is characterized as a uniform stand of Eleocharis cellulosa, with only scattered associated grasses and sedges. This is evident by the low frequency occurrence of associated species. Nymphaea odorata, white water lily, is a common component of the spikerush community, but is not conspicuous among the emergent stems. In addition to Nymphaea odorata, three other species, Sagittaria lancifolia, Paspalidium paludivagum, and Typha domingensis were frequently associated with spikerush in 1973 and 1982. Utricularia sp. did not occur abundantly in 1982 due to the preceding drought which thoroughly dried this zone.

Scirpus californicus: The bulrush community on the Moore Haven transect is limited to a narrow band at the lakeward edge of the marsh. Five of the seven most prevalent associated species from 1973 (Eleocharis cellulosa, Panicum hemitomon, Pontederia lanceolata, Scirpus americanus, and Paspalidium paludivagum) were also prominent in 1982. Utricularia sp. and Salvinia rotundifolia (a submergent and a floating species) were absent in 1982.

Typha domingensis: In contrast with spikerush, the cattail community is characterized by a more diverse community composition. Sagittaria lancifolia was consistently present in cattail quadrats (91% in 1973; 96% in 1982). Three other commonly associated species in both sampling periods were Polygonum sp., Paspalidium paludivagum, and Panicum repens (probably unidentified grass in 1973). Overall, nine of the most abundant associated species were common to both sample periods. Two vines often associated with cattail, Sarcostemma clausa and Mikania scandens, were absent in 1982.

Salix caroliniana: Associated plant species in 1973 and 1982 were similar in rank order, and included Hibiscus grandiflorus, Cephalanthus occidentalis, Phragmites communis, Kosteletzkya virginica, Sagittaria lancifolia, and Polygonum hydropiperoides. Three species of vines which were abundant in 1973 (Sarcostemma clausa, Mikania scandens, and Ipomea sagittata) were absent in 1982. Two species generally indicative of deep water habitats, Utricularia sp. and Nymphaea odorata, were additions in 1982.

Rhynchospora tracyi: The three most abundant associated species in 1973, Eleocharis cellulosa, Spartina bakeri, and Panicum tenerum, occurred in a similar rank order during 1982, while other common associated species during both sampling periods included Centella asiatica, Panicum paludivagum, and Cephalanthus occidentalis. Two of the Panicum species (P. repens and P. dichotomiflorum) common in 1982 may have been grouped with unidentified grasses in the initial survey. Panicum hemitomon and Sagittaria lancifolia have both expanded into the range of Rhynchsopora tracyi.

TABLE 5. COMMUNITY COMPOSITION OF SIX PLANT COMMUNITIES ON MOORE HAVEN

TRANSECT - 1973 and 1982.

Date: 1973 — 1982

A. Spikerush Community (Eleocharis cellulosa)

Optimum elevation range: 1973: 10.6-12.4 ft msl; 1982: 10.7-12.4 ft msl

Associated Species (1973)	Conditional Frequency	Associated Species (1982)	Conditional Frequency
Utricularia sp.	0.61	Nymphaea odorata	0.35
Sagittaria lancifolia	0.44	Sagittaria lancifolia	0.32
Fuirena scipoidea	0.36	Panicum repens	0.29
Nymphaea odorata	0.32	Paspalidium paludivagum	0.27
Paspalidium paludivagum	0.27	Paspalum dissectum	0.25
Panicum hemitomon	0.17	Rhynchospora tracyi	0.24
Pontederia lanceolata	0.14	Typha sp.	0.13
Typha angustifolia	0.11		
Annual/terrestrial species			
		Echinochloa walteri	0.79
		Eupatorium capillifolum	0.19
		Cyperus odoratus	0.13

Similarity Index I = 0.53

B. Bulrush community (Scirpus californicus)

Date: 1973 — 1982

Optimum elevation range: 1973: 11.1-12.3 ft msl; 1982: 11.0-11.7 ft msl

Associated Species (1973)	Conditional Frequency	Associated Species (1982)	Conditional Frequency
Utricularia sp.	0.52	Mikania scandens	0.62
Eleocharis cellulosa	0.48	Panicum repens	0.38
Salvinia rotundifolia	0.39	Eleocharis cellulosa	0.31
Panicum hemitomon	0.30	Panicum hemitomon	0.31
Pontederia lanceolata	0.30	Eragrostis spectabilis	0.23
Sagittaria lancifolia	0.26	Panicum tenerum	0.23
Scirpus americanus	0.22	Polygonum hydropiperoides	0.23
Paspalidium paludivagum	0.17	Bohmeria cylindrica	0.15
Furiena scirpoidea	0.13	Nymphoides aquatica	0.15
Nymphaea odorata	0.13	Paspalidium paludivagum	0.15
Vallisneria americana	0.13	Pontederia lanceolata	0.15
		Salix caroliniana	0.15
		Scirpus americanus	0.15
Annual/terrestrial species			
		Echinochloa walteri	0.62
		Eupatorium capillifolium	0.62
		Unid. composite	0.46
		Pluchea rosea	0.38
		Baccharis sp.	0.31
		Cyperus polystachyos	0.31
		Amaranthus cannabilis	0.23

Table 5 (Continued)

		Associated Species	Conditional Frequency
		Cyperus sp.	0.23
		Sesbania exaltata	0.23
		Setaria geniculata	0.23
		Setaria magna	0.23

Similarity Index I = 0.42

C. Cattail Community (Typha domingensis)

Date: **1973** / **1982**

Optimum elevation range: 12.4-13.1 ft msl (1973); 12.4-13.0 ft msl (1982)

Associated Species (1973)	Conditional Frequency	Associated Species (1982)	Conditional Frequency
Sagittaria lancifolia	0.91	Sagittaria lancifolia	0.96
Polygonum sp.	0.69	Panicum repens	0.78
Unid. grass	0.66	Paspalidium paludivagum	0.44
Paspalidium paludivagum	0.45	Polygonum hydropiperoides	0.38
Pontederia lanceolata	0.43	Alternanthera philoxeroides	0.35
Sarcostemma clausa	0.39	Paspalum dissectum	0.34
Spartina bakeri	0.29	Spartina bakeri	0.33
Alternanathera philoxeroides	0.17	Nymphaea odorata	0.31
Eleocharis cellulosa	0.15	Phragmites communis	0.19
Nymphaea odorata	0.14	Panicum hemitomon	0.15
Mikania scandens	0.11	Pontederia lanceolata	0.14
Phragmites communis	0.11		
Salix caroliniana	0.11		
Annual/terrestrial species			
		Echinochloa walteri	0.90
		Cyperus odoratus	0.29
		Hibiscus grandiflorus	0.15
		Eupatorium capillifolium	0.13

Similarity Index I = 0.75

D. Willow Community (Salix caroliniana)

Date: **1973** / **1982**

Optimum elevation range: 13.2-14.3 ft msl (1973); 12.9-14.4 ft msl (1982)

Associated Species (1973)	Conditional Frequency	Associated Species (1982)	Conditional Frequency
Sarcostemma clausa	0.97	Hibiscus grandiflorus	0.76
Hibiscus grandiflorus	0.64	Cephalanthus occidentalis	0.69
Mikania scandens	0.58	Phragmites communis	0.48
Cephalanthus occidentalis	0.48	Utricularia sp.	0.33
Polygonum sp.	0.38	Kosteletzkya virginica	0.29
Phragmites communis	0.32	Sagittaria lancifolia	0.23
Sagittaria lancifolia	0.28	Cladium jamaicense	0.15
Unid. grass	0.25	Polygonum sp.	0.14
Hydrocotyle sp.	0.21	Nymphea odorata	0.13
Kosteletzkya virginica	0.21	Teucrium canadense	0.13
Spartina bakeri	0.21		

Table 5 (Continued)

Cirsium sp.	0.19
Cladium jamiacense	0.13
Ipomea sagittata	0.13
Sacciolepis striata	0.12

Similarity Index I = 0.64

E. Beakrush Community (Rhynchospora tracyi)

Date: 1973		1982	
Optimum elevation range:	13.1-14.3 ft msl		13.0-14.4 ft msl
Associated Species	Conditional Frequency	Associated Species	Conditional Frequency
Eleocharis cellulosa	0.82	Eleocharis cellulosa	0.95
Spartina bakeri	0.65	Spartina bakeri	0.88
Panicum tenerum	0.62	Pluchea rosea	0.58
Pluchea rosea	0.59	Panicum tenerum	0.46
Centella asiatica	0.41	Panicum repens	0.39
Unid. grass	0.39	Cephalanthus occidentalis	0.36
Eragrostis elliotti	0.31	Centella asiatica	0.26
Rhynchospora globularis	0.13	Panicum hemitomon	0.26
Lythrum lanceolata	0.11	Panicum dichotomiflorum	0.21
Paspalidium paludivagum	0.11	Sagittaria lancifolia	0.19
Cephalanthus occidentalis	0.10	Diodia virginica	0.18
		Lachnanthes caroliniana	0.18
		Paspalidium paludivagumm	0.17
		Rhynchospora inundata	0.17
Annual/terrestrial species			
		Heliotropium polyphyllum	0.17

Similarity Index I = 0.64

F. Switchgrass (Spartina bakeri)

Date: 1973		1982	
Optimum elevation range:	13.1-14.3 ft msl		12.9-14.5 ft msl
Associated Species	Conditional Frequency	Associated Species	Conditional Frequency
Panicum tenerum	0.58	Eleocharis cellulosa	0.87
Eleocharis cellulosa	0.57	Rhynchospora tracyi	0.78
Centella asiatica	0.51	Pluchea rosea	0.49
Pluchea rosea	0.50	Alternanthera philoxeroides	0.46
Rhynchospora tracyi	0.48	Cephalanthus occidentalis	0.42
Eragrostis elliottii	0.32	Panicum repens	0.41
Unid. grass	0.32	Panicum tenerum	0.39
Cephalanthus occidentalis	0.28	Sagittaria lancifolia	0.32
Sagittaria lancifolia	0.23	Unid. grass	0.31
Rhynchospora globularis	0.20	Panicum hemitomon	0.24
Andropogan sp.	0.17	Centella asiatica	0.23
Rhynchospora sp.	0.17	Diodia virginica	0.21

Table 5 (Continued)

Melaleuca quinquenervia	0.14	Panicum dichotomiflorum	0.18
Cladium jamaicense	0.13	Rhynchospora inundata	0.18
Myrica cerifera	0.13	Lachnanthes caroliniana	0.18
Sarcostemma clausa	0.13	Paspalidium paludivagum	0.16
		Cladium jamaicense	0.15
		Polygonum hydropiperoides	0.15
		Melaleuca quinquerina	0.12
		Utricularia sp.	0.11
		Ludwigia curtissi	0.10
		Psilocarya nitens	0.10
Annual/terrestrial species			
		Eupatorium capillifolium	0.12
		Heliotroplum polyphyllum	0.11

Similarity Index I = 0.58

Spartina bakeri: In 1973 and 1982, the Spartina bakeri community was richest in numbers of species. A total of 63 species were associated with Spartina within its optimum range in 1973, compared to 80 species in 1982. Sixteen of these associated species occurred in 10 percent or more of the quadrats in 1973, while 24 species met this criteria in 1982. Although the rank order differed between sample periods, the most abundant species included Eleocharis cellulosa, Rhynchospora tracyi, Cephalanthus occidentalis, Panicum tenerum, Sagittaria lancifolia, Centella asiatica, and unidentified grasses.

To summarize, a relatively high degree of similarity occurred among the associated plant species within each of the six plant communities examined in 1973 and 1982 along the Moore Haven Transect. Within each community, the group of prevalent associated plant species in 1973 remained the same in 1982, although some changes in rank order did occur within the groups. Similarity indices for the Moore Haven Transect communities were generally higher than calculated for the Indian Prairie communities. These indices showed that the cattail community retained the greatest portion of associated species between 1973 and 1982 (I=0.75) while the bulrush community was least similar (I=0.42).

Notable changes in community composition between 1973 and 1982 included: (1) loss of common vines (Sarcostemma clausa and Mikania scandens) from the cattail and willow communities; (2) loss of submergent and floating species (Utricularia sp. and Salvinia rotundifolia) from bulrush and spikerush communities; and (3) an increase in occurrence of Sagittaria lancifolia and Panicum hemitomon in the higher elevation beakrush and switchgrass communities.

Melaleuca quinquenervia, the cajeput or punk tree, has become a prominent feature of the upper portions of the southwest marsh of Lake Okeechobee. Melaleuca grows in dense, circular stands which have increased in size and density along the higher portions of the transect since 1973. Distribution curves for Melaleuca are very similar for 1973 and 1982, (Figure 8) and depict identical ranges (13.4-14.6 ft msl). However, the curves do not adequately show the 46% increase in number of occurrences of Melaleuca (107 in 1973 vs 156 in 1982), due partly to the large number of stations (752) which fall within that elevation range.

Melaleuca is still confined primarily to the landward 1500 meters of the transect. It was present in 99 of 201 quadrats in 1973 and 137 of 201 quadrats in 1982. During both periods, scattered Melaleuca saplings occurred as far as 3521 meters lakeward on the transect. Additionally, due to the prominent growth form of Melaleuca, in dense, circular stands, a large increase in area of a stand causes only a small increase in frequency occurrence.

The actual distribution of Melaleuca, by quadrat, along the first 5000 feet (1500 meters) of the transect is presented in Appendix 5. The Melaleuca encountered between 600 and 1300 feet (183 and 396 meters) during 1973 were mainly small saplings, about 50 cm in height (Brown, pers. comm.). Their absence in 1982 may have resulted from fires during the mid-1970's which were capable of destroying young Melaleuca. Mature Melaleuca trees are especially fire resistant (Meskimen, 1962) and will release seeds upon disturbance, such as cutting or

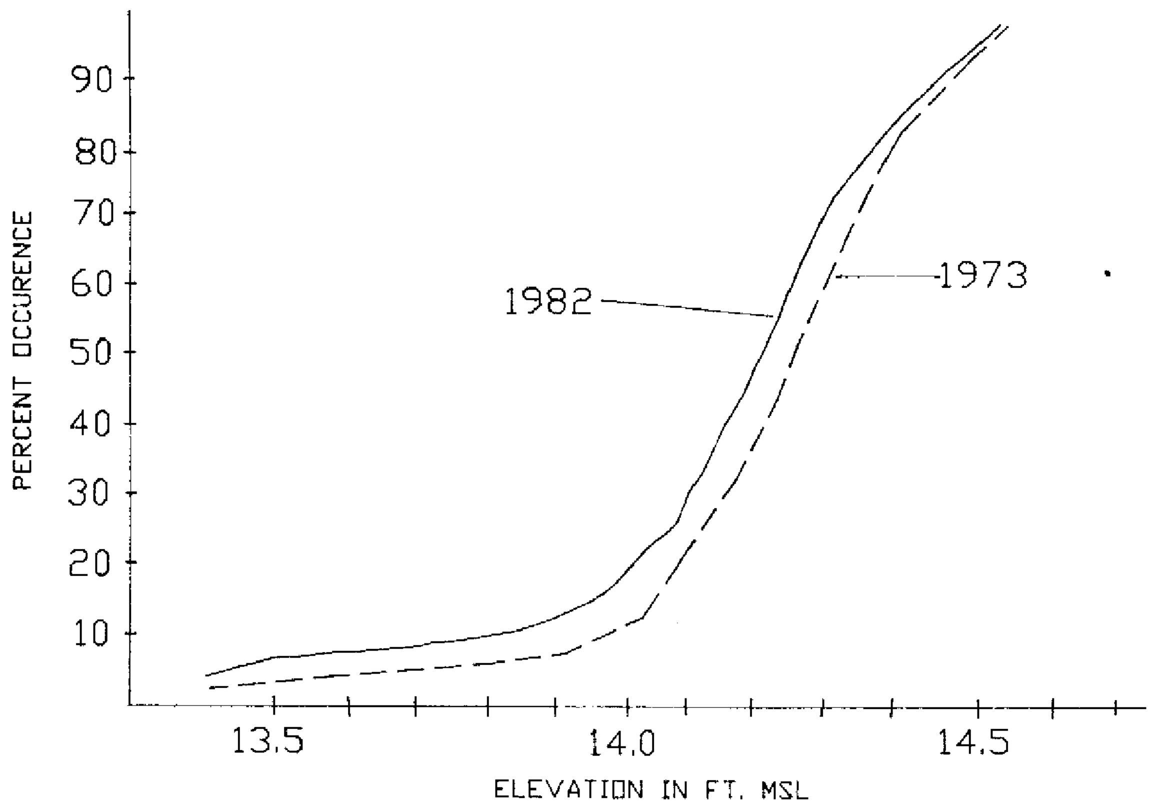

FIGURE 8. DISTRIBUTION OF MELALEUCA ALONG MOORE HAVEN TRANSECT 1973 AND 1982

burning (Wade, 1981; Woodall, 1978). With the exception of Melaleuca in the 600-1300 foot interval on the transect, a comparison of the two sample periods shows an increase in the occurrence of this species through the area.

DISCUSSION

Pesnell and Brown (1977) reported that the distribution of plant communities in Lake Okeechobee littoral zone was influenced by lake stages and fluctuations of the post-drainage period (basically 1951-1970). During the mid-1970's, the lake regulation schedule was increased incrementally to the current 15.5-17.5 ft msl, and lake stages increased accordingly in years of adequate rainfall. Prior to redocumentation of Indian Prairie Transect in 1981, lake stages had exceeded 14 ft msl since December 1977, (37 consecutive months), and were above 15 ft msl for the majority of this period. Changes in vegetation along Indian Prairie transect were influenced by this high water period.

The Moore Haven transect was redocumented in 1982, after a severe drought which caused record low lake stages. Prior to the Moore Haven documentation, Lake Okeechobee stages had been below 14 ft msl for 17 months. Consequently, vegetation changes along the Indian Prairie transect and the Moore Haven transect will be considered separately due to the vastly different hydrologic conditions preceding data collections.

Indian Prairie Transect

Bulrush Community: The bulrush community demonstrated some changes between 1972 and 1981. Whereas bulrush plants occupied the same range of elevations, with the same peak in frequency, and were present in approximately the same number of quadrats, the community expanded in elevation range due to the loss of the spikerush community. Scirpus californicus is very tolerant of prolonged inundation, and plant growth occurs readily under flooded conditions by vegetative propagation from rhizomes (Pesnell and Brown, 1977).

High water levels did not appear to adversely affect bulrush, since this species is capable of growing to 4m or more in height, allowing it to extend well above the water, even at stages exceeding 17+ ft msl. Prolonged hydroperiod and deeper water levels did influence the associated species, eliminating three emergent species, and recruiting three new species tolerant to deep water conditions.

Spikerush Community: In 1972, spikerush exhibited two frequency peaks along the Indian Prairie transect. The lakeward peak occurred at 11.0 ft msl, and a second peak occurred at 13.7 ft msl. Eleocharis cellulosa was the indicator of a plant community occurring landward of the bulrushes, and lakeward of cattails. Common associated species included Utricularia spp., Sagittaria lancifolia, Scirpus californicus, Potamogeton illinoensis, and unidentified grasses.

By 1981, Eleocharis cellulosa was absent below 11.3 ft msl, and was present only infrequently up to about 13.5 feet msl. Although Eleocharis cellulosa exhibited a peak in 1981 similar to that in 1972 along the upper portion of the transect, its density was low, and it was just a component of the Panicum repens community.

Eleocharis cellulosa is a common wet prairie indicator in south Florida, which requires occassional drying for seed germination. I have observed that Eleocharis cellulosa can withstand moderate water depths for extended periods of time. During the 6 year period prior to the 1972 documentation, the inundation frequency ranged from 92 to 98% within the spikerush community, and the average water depth ranged from 1.8 to 3.1 ft (13.8 ft msl average stage). In the 6 years prior to the 1981 documentation, the inundation frequency was 98% to 100%, and average water depths ranged from 2.6 to 3.9 ft (14.6 ft msl average lake stage). It is suggested that the greater water depths, especially in 1978-79, exceeded the tolerance of spikerush in this area, and led to its elimination.

Cattail Community: The overall elevation range of cattail along the Indian Prairie transect did not change appreciably from 1972 to 1981. Individual cattail occurrence ranged from 10.6 ft msl to 13.1 ft msl in 1972 and extended to 13.5 ft msl in 1981. However, the cattail community increased lakeward from a low elevation of 12.0 ft msl in 1972 to 11.1 ft msl in 1981. This community expansion was due to a greater frequency of cattail and to the loss of the spikerush community. The most obvious feature of the cattail distribution was the consistent presence of this plant throughout a large portion of the transect. Typha domingensis was present in over 90% of the quadrats located between elevations 11.4 and 12.5 ft msl in 1981.

Pesnell and Brown (1977) documented a lakeward expansion of cattail between 1960 and 1968 in the vicinity of the Indian Prairie transect, and related this expansion to low lake stages in 1962. This expansion was probably due to germination of cattail seeds on exposed lake bottom. The increased frequency of cattail within its existing elevation range between 1972 and 1981, probably resulted from both vegetative reproduction and growth from seed. Davis and Harris (1978) have demonstrated that higher water levels are one factor which tends to favor the growth of cattail over other species occupying the same area. Once established, cattail seems to have a competitive edge under high water conditions.

Throughout much of its present range, cattail forms almost impenetrable stands, with plants ranging 3-4 m in height. The community composition analysis indicated 12 prevalent plant species associated with cattail in 1981. However, this figure is misleading and does not adequately describe the community, since cattail comprises the vast majority of the total biomass within this zone. Additionally, cattail detritus accumulates at the base of the plants, building up a deep thatch which further reduces understory vegetation.

A comparison of associated species in the cattail community between 1972 and 1981 also shows the expansion of this zone into deeper waters. Several deep water tolerant species, Nymphaea odorata (white water lily), Utricularia spp. (bladderwort), and Scirpus californicus (bulrush) substantially increased in conditional percentage occurrence from 1972 to 1981.

Switchgrass Community: Spartina bakeri, a large, robust tufted grass, is the indicator species for a plant community that receives frequent drying. In 1972, Spartina bakeri occupied land contours which had been subjected to 27-75% inundation during the previous six year period. A comparison of graphs depicting distribution and frequency of occurrence of Spartina in 1972 and 1981 indicates very little difference; the ranges of elevations and the frequency peaks are similar. These similarities are probably more reflective of the capability of Spartina to withstand periods of prolonged inundation, than of its preference for the 75-85% inundation frequency to which it was subjected during the six year period prior to 1981.

In 1972, Spartina tufts were the dominant feature of this plant community, rising well above the low ground cover of grasses, sedges, and herbs. By 1981, most of the Spartina plants were small and barely recognizable among the more vigorous Panicum repens.

The decline of Spartina bakeri was a consequence of the increases in water depths and flooding duration in the late 1970's. The increased hydroperiod stressed S. bakeri, while Panicum repens responded more favorably to the deeper water conditions. Additionally, the elimination of cattle leases in Lake Okeechobee marshes reduced the grazing pressure on Panicum repens. Consequently, torpedo grass has grown to heights of about 1 meter, accumulated a considerable thatch of dead plant material, and outcompeted most other species in the upper portions of the marsh.

Moore Haven Transect

The distribution and frequencies of occurrence of the six major community indicator species along the Moore Haven transect were quite similar in 1973 and 1982. The frequency distribution curves for each of the species exhibited similar characteristics within the optimum elevation ranges, although some changes were evident along the upper and lower extremes. In fact, optimum elevation ranges for each of the species in 1982 did not differ substantially from the ranges reported in 1973 (See Table 4).

This similarity is unusual, in light of the prominent changes noted along the Indian Prairie transect. However, it appears that the marsh drying which preceded the Moore Haven documentation, had the effect of reversing some of the trends noted on Indian Prairie. Specifically, rejuvenation of the spikerush community may have resulted from seed germination during the preceding dry conditions. Further, prolonged drying of cattail stands in the 12.4 to 13.0 ft msl range for over 12 months may have led to the reduced frequency observed in this part of the marsh, which contrasted with the increased cattail frequency noted on Indian Prairie.

Expansion of the range and frequency of Eleocharis cellulosa and Rhynchospora tracyi into higher elevation ranges along the transect may have been a response to higher lake stages since 1973. Conversely, expansion of Typha domingensis, Salix caroliniana, and Rhynchospora tracyi into lower elevations along the transect may represent growth in newly available habitat as lake stages receded in 1981 and 1982 and rendered these areas suitable for seed germination. Spartina bakeri distribution changed little, and only Scirpus californicus was eliminated from the upper part of its former range in a portion of the marsh which had been dry for over a year.

Comparison of community structure within the six plant communities along Moore Haven transect showed higher similarity among the prevalent associated species, than was evident on the Indian Prairie transect.

It should be noted that observations were made of the Indian Prairie transect area in 1982 following the documentation of Moore Haven transect and the return of flooded conditions in the marshes. Prominent among these observations were (1) a resurgence of the Eleocharis cellulosa community just landward of the bulrushes, and (2) evidence of a stressed cattail community, with considerable areas void of living cattail, but occupied by cattail litter.

Melaleuca quinquenervia, an exotic tree, has spread rapidly throughout many parts of south Florida in the recent past. Melaleuca was planted along parts of the base of the Herbert Hoover dike, and along the interior rim canal to serve as a breakwater. Spread of Melaleuca into the marshes of Lake Okeechobee has been most apparent in the upper elevations of the marsh in the vicinity of Moore Haven. Seed germination occurs readily on exposed saturated soils, and once a seedling becomes established, it is tolerant of prolonged flooding.

Continuous flooding of the marshes will prevent further spread of Melaleuca, but would be detrimental to the remainder of the marsh. Perhaps the most desirable way to keep Melaleuca in check is to maintain a healthy marsh community through seasonal water level fluctuations which periodically dry the marsh substrates. The U.S. Army Corps of Engineers currently have plans to selectively treat Melaleuca infestations in Lake Okeechobee with herbicides.

The marshes of Lake Okeechobee are dynamic ecosystems which change in response to environmental conditions, of which hydroperiod and depth are only two components. Through this redocumentation, a snapshot of the marsh at one point in time has been taken in an attempt to assess changes, and more importantly, long term trends.

SUMMARY

The marshes of Lake Okeechobee represent a significant resource for the ecology of the lake, and also provide critical seasonal habitat for south Florida wading birds as well as migratory birds and waterfowl (Zaffke, 1984). The original documentation of Lake Okeechobee marshes in 1972-73 (Pesnell and Brown, 1977) was designed to provide a base line of information for future comparisons and to provide a methodology for assessing changes. Redocumentation of the Indian Prairie transect in 1981 and the Moore Haven transect in 1982 provided the opportunity to assess vegetation changes in relation to lake regulation schedule changes and natural drought conditions.

Substantial changes in marsh vegetation which occurred as a result of high water years preceding redocumentation of the Indian Prairie transect included elimination of the spikerush community, expansion of the cattail community, and increased dominance of torpedo grass in the mixed grass zone. Reductions in the diversity of plant community types and composition can affect the resources dependent on those marshes for habitat. Subsequent record low water conditions which prevailed in the lake during 1981 and 1982 probably reversed some of these changes so that documentation of the Moore Haven transect in spring 1982 indicated little overall change from 1973. Specifically, drying of the marshes probably stimulated regrowth of spikerush into a viable community in the lower elevations of the marsh. These changes were also observed during 1982 in the vicinity of the Indian Prairie transect.

The current regulation schedule of 15.5-17.5 ft msl has the potential to significantly affect the distribution and composition of Lake Okeechobee marsh communities if it is adhered to for a considerable length of time. Since the base of the Herbert Hoover dike generally lies between the land contours of 15.0 and 15.5 ft msl, and most of the lake's marshes lie below 15.0 ft msl, adherence to the 15.5-17.5 ft schedule will continuously inundate all of the marshes. As demonstrated, prolonged inundation can reduce or eliminate species which require occasional drying, such as <u>Eleocharis</u> <u>cellulosa</u>, and encourage more flood tolerant species, such as <u>Typha domingensis</u>.

The District will continue to monitor and evaluate the effects of long term water level trends in Lake Okeechobee in response to ever changing water inflows, climatic conditions, and regulation schedules, as well as increasing and changing water supply needs and demands.

CONCLUSIONS

1. Two permanent transects should be maintained for future periodic in-depth examination of plant community and community composition changes in relation to Lake Okeechobee water level regimes.

2. Efforts should be made to re-assess the lake wide distribution and extent of the major plant communities for comparisons with the previous mapping efforts of Pesnell and Brown (1976). Those plant communities exhibiting the greatest changes in coverage, either increases or decreases, should be targeted for additional research.

3. Submergent plant communities lakeward of the emergent littoral marsh should be thoroughly mapped and characterized in terms of species composition, distribution, and responses to water level changes.

4. Information generated pertinent to the response of Lake Okeechobee marshes in relation to past changes in water levels should be used for evaluation of proposed lake regulation schedule changes.

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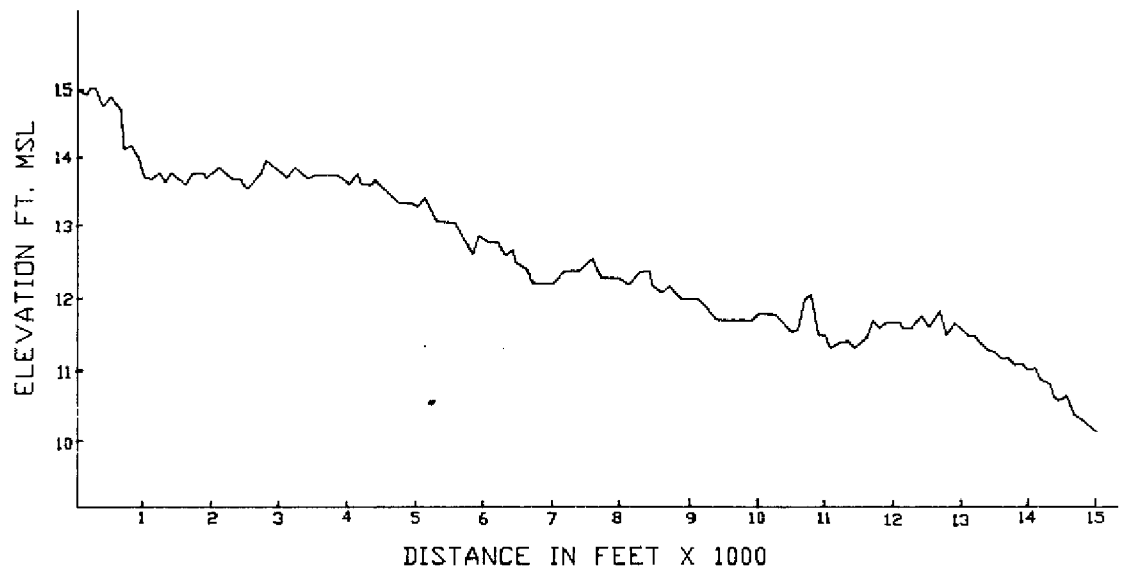
APPENDIX 1

ANNUAL WATER LEVEL FLUCTUATIONS FOR LAKE OKEECHOBEE 1932-1982

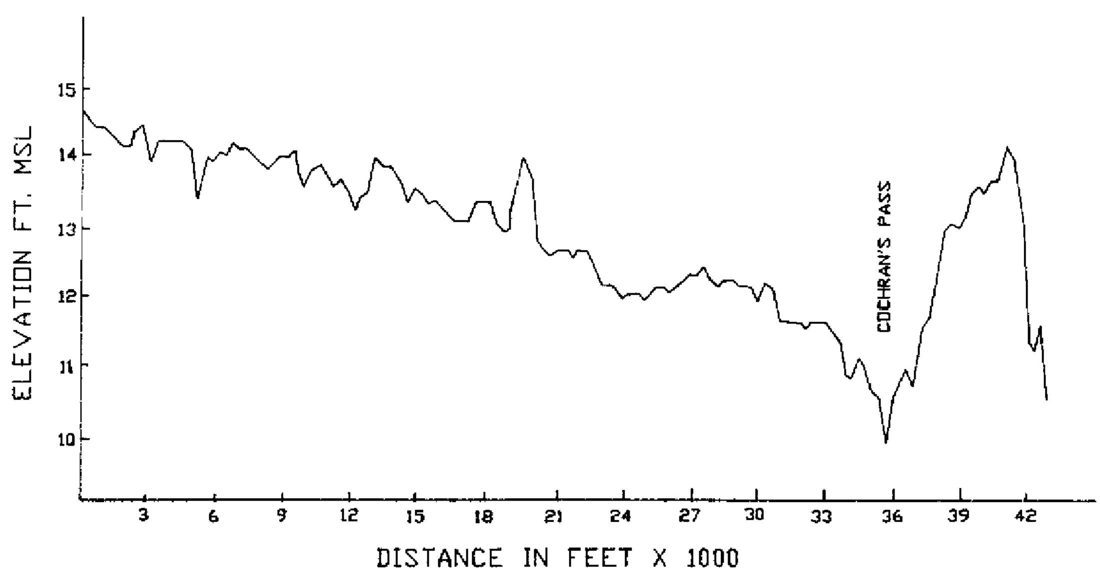
YEAR	MIN. FEET MSL	MAX. FEET MSL	RANGE (ft)
1932	11.30	14.60	3.30
1933	13.10	17.05*	3.95
1934	15.65	16.85	1.20
1935	14.10	16.75	2.65
1936	14.65	16.85	2.20
1937	15.10	17.30	2.20
1938	14.10	16.55	2.45
1939	13.50	17.34	3.84
1940	15.00	17.22	2.22
1941	14.70	16.65	1.95
1942	14.71	16.64	1.93
1943	13.07	15.36	2.29
1944	13.62	15.19	1.57
1945	12.72	17.22	4.50
1946	14.65	16.90	2.25
1947	14.25	18.77	4.52
1948	13.04	17.77	4.73
1949	12.47	15.53	3.06
1950	12.84	15.16	2.36
1951	12.65	15.97	3.32
1952	12.76	15.81	3.05
1953	12.89	17.66	4.77
1954	13.28	16.01	2.73
1955	12.74	14.39	1.65
1956	10.14	12.85	2.71

YEAR	MIN. FEET MSL	MAX. FEET MSL	RANGE
1957	12.36	15.45	3.09
1958	12.99	16.18	3.19
1959	13.30	15.93	2.63
1960	12.97	17.69	4.72
1961	11.66	15.30	3.64
1962	10.22	15.15	4.93
1963	11.84	14.72	2.88
1964	12.39	14.63	2.24
1965	12.28	15.13	2.85
1966	13.60	15.94	2.34
1967	11.75	14.90	3.15
1968	11.70	15.80	4.10
1969	13.61	16.80	3.19
1970	13.00	16.77	3.77
1971	10.29	14.44	4.15
1972	12.48	14.07	1.59
1973	12.16	15.17	3.01
1974	10.98	15.60	4.62
1975	11.71	14.63	2.92
1976	11.90	14.81	2.91
1977	12.35	14.58	2.23
1978	14.32	16.81	2.49
1979	14.24	17.62	3.38
1980	13.82	17.47	3.65
1981	9.76	13.84	4.08
1982	10.55	17.64	7.09

*Actual recorded high was 21.1 ft msl on September 4 from wind tide



INDIAN PRAIRIE TRANSECT ELEVATION PROFILE



MOORE HAVEN TRANSECT ELEVATION PROFILE

APPENDIX 2 - TRANSECT ELEVATION PROFILES

APPENDIX 3. A COMPARISON OF PLANT SPECIES IDENTIFIED ALONG INDIAN PRAIRIE TRANSECT AND THEIR RANGE OF ELEVATION, 1972 and 1981.

	1972		1981	
	# Occur[1]	Elev.[2]	# Occur[1]	Elev.[2]
Charophyceae				
Chara sp.	72	10.7-13.9	14	10.1-10.8
Salviniaceae				
Salvinia rotundifolia	27	11.7-12.4	4	12.3-12.4
Typhacea				
Typha domingensis	216	10.6-13.1	309	10.6-13.5
Potamogetonaceae				
Potaogeton illinoensis	99	10.1-13.8	36	10.1-11.2
Najadaceae				
Najas quadalupensis	38	11.0-12.2	12	10.4-11.2
Alismataceae				
Sagittaria lancifolia	187	10.3-14.8	157	11.1-14.0
Hydrocharitaceae				
Hydrilla verticillata	20	11.6-12.2	13	10.7-11.2
Vallisneria neotropicalis	59	10.1-13.7	55	10.1-11.2
Poaceae				
Hydrochloa caroliniensis			43	12.0-13.8
Leersia hexandra			157	11.7-14.0
Panicum hemitomon			6	10.5-10.7
Panicum repens			296	11.2-15.1
Paspalidium paludivagum			114	10.5-13.8
Paspalum distichum			3	13.5-14.8
Sacciolepis striata			5	11.4-12.8
Spartina bakeri	88	12.7-15.1	116	12.8-15.1
Unidentified grass	524	10.6-15.1	107	10.6-13.7
Cyperaceae				
Dichromena latifolia	16	14.7-15.0		
Eleocharis cellulosa	300	10.4-14.0	124	11.3-14.2
Eleocharis equistoides	8	12.8-13.6	84	12.1-13.9
Eleocharis flavescens	21	10.7-12.8	6	11.4-12.9
Fuirena scirpoidea	33	10.6-11.2		
Rhynchospora sp			22	14.1-15.0
Scirpus americanus	28	11.8-13.9	22	11.2-13.8
Scirpus californicus	109	10.1-12.5	128	10.1-12.9
Scirpus cubensis			1	11.3-11.3
Unidentified sedge	94	11.0-15.1	15	11.1-13.1
Araceae				
Pistia stratiotes	3	10.4-10.5	17	10.5-11.3
Pontederiaceae				
Eichhornia crassipes	30	10.4-11.9	26	10.5-11.4
Pontederia lanceolata	351	10.4-14.0	290	10.6-14.0
Orchidaceae				
Habaneria repens			1	12.9
Salicaceae				
Salix caroliniana	5	11.5-13.1	10	11.7-13.1

APPENDIX 3 (Con't).

	1972		1981	
	# Occur[1]	Elev.[2]	# Occur[1]	Elev.[2]
Polygonaceae				
Polygonum sp.	141	11.7-13.8	31	11.3-13.8
Amaranthaceae				
Alternanthera philoxeroides	72	11.4-13.1	13	11.3-11.8
Aizoaceae				
Sesuvium portulacastum	43	13.3-13.8		
Nymphaeaceae				
Nelumbo lutea	19	11.3-12.2	3	11.3
Nymphaea mexicana			42	11.5-12.2
Nymphaea odorata	216	11.4-14.0	281	10.6-13.9
Ceratophyllaceae				
Ceratophyllum demersum			44	10.7-11.7
Fabaceae				
Vigna luteola	14	12.0-13.6	2	11.4-14.0
Malvaceae				
Hibiscus grandiflorus	13	13.5-13.8		
Lythraceae				
Lythrum lanceolatum	1	13.7-13.7		
Onagraceae				
Ludwigia repens			1	13.7
Ludwigia sp.	44	13.1-15.1		
Haloragaceae				
Myriophyllum brasiliense			9	11.2-11.4
Apiaceae				
Centella asiatica	36	11.5-13.8	18	14.2-15.0
Hydrocotyle umbellata	83	13.4-15.1	13	11.2-11.4
Asclepiadaceae				
Sarcostemma clausa			3	12.1-15.0
Convolulaceae				
Ipomea sagittata			1	15.0
Verbenaceae				
Lippia nodiflora	35	13.6-15.1	2	14.8-15.0
Scrophulariaceae				
Bacopa monnieri	53	13.1-14.9		
Lentibulariaceae				
Utricularia spp.	277	10.6-13.9	203	11.3-13.9
Rubiaceae				
Cephalanthus occidentalis	16	12.3-14.0	19	12.4-15.0
Diodia teres			3	12.3
Diodia virginica			35	11.2-15.0
Asteraceae				
Baccharis halimifolia	15	13.4-13.8		
Cirsium sp.			5	12.3-15.1
Eupatorium sp.	33	12.8-15.1	26	11.6-15.0
Mikania scandens	1	13.6		
Pluchea sp.	33	13.4-13.8	1	11.4
Unidentified broadleaf			51	11.3-15.0

[1] 601 Total Number of Plots
[2] ft. msl

APPENDIX 4. A COMPARISON OF PLANT SPECIES IDENTIFIED ALONG MOORE HAVEN TRANSECT AND THEIR RANGE OF ELEVATION, 1973 and 1982.

	1973		1982	
	# Occur	Elev.	# Occur	Elev.
Charophyceae				
Chara sp.	3	11.2-12.2	20	13.2-13.9
Polypodiaceae				
Acrostichm sp.			1	11.2
Aspidiaceae				
Thelypteris sp.			2	11.0-11.1
Salviniaceae				
Azolla caroliniana			17	10.2-12.7
Salvinia rotundifolia	28	10.2-12.6	43	floating
Typhacea				
Typha sp.			273	9.9-13.5
Typha domingensis	357	10.0-13.8		
Potamogetonaceae				
Potamogeton illinoensis	37	10.6-12.7	3	10.6-11.6
Najadaceae				
Najas guadalupensis	7	11.2-11.6		
Alismataceae				
Sagittaria sp.	1	12.7		
Sagittaria lancifolia	552	10.7-14.4	621	9.9-14.6
Hydrocharitaceae				
Vallisneria neotropicalis	15	10.6-12.3	3	12.7-12.8
Poaceae				
Andropogan sp.	141	13.5-14.6		
Axonopus furcatus			48	11.6-14.5
Echinochloa crusgalli	12	10.3-14.0	14	13.4-14.3
Echinochloa paludigena			1	11.5
Echinochloa walteri	37	11.9-13.5	597	9.9-13.8
Eragrostis elliottii	303	13.3-14.6		
Eragrostis spectabilis			56	11.0-14.6
Hydrochloa caroliniensis			19	12.6-14.4
Leersia hexandra	13	10.3-13.8	3	13.2-13.6
Panicum sp.			1	14.1
Panicum dichotomiflorum			142	11.4-14.4
Panicum dichotomum			7	13.6-14.1
Panicum hemitomon	109	11.0-13.8	256	11.0-14.6
Panicum lancearium	5	14.1-14.4		
Panicum repens	28	12.1-14.2	565	11.1-14.6
Panicum tenerum	488	13.2-14.6	329	10.9-14.6
Paspalidium paludivagum	277	10.9-14.1	342	10.9-14.4
Paspalum dissectum			172	12.0-13.0
Paspalum urvillei			1	14.0
Phragmites communis	90	12.4-14.3	182	11.2-14.3
Sacciolepis striata	40	12.1-14.3	58	10.0-14.3
Seteria geniculata	43	13.4-14.6	10	11.2-14.4
Seteria magna			35	10.8-14.3
Spartina bakeri	557	12.0-14.6	674	11.8-14.5
Unidentified grass	365	12.1-14.4	30	12.6-14.2

APPENDIX 4. (Cont'd) A COMPARISON OF PLANT SPECIES IDENTIFIED ALONG MOORE HAVEN TRANSECT AND THEIR RANGE OF ELEVATION, 1973 and 1982

	1973		1982	
	# Occur	Elev.	# Occur	Elev.
Cyperaceae				
Cladium jamaicensis	124	12.7-14.6	150	12.7-14.6
Cyperus sp.			16	11.2-11.5
Cyperus haspan	5	12.8-14.6	2	12.7
Cyperus odoratus			149	9.9-14.6
Cyperus polystachyos			16	11.2-14.3
Dichronema colorata	1	14.2		
Dichronema latifolia	4	14.3-14.4	1	14.4
Eleocharis baldwinii	4	12.6-12.7	1	13.7
Eleocharis caribaea	4	12.1-13.3	15	11.2-14.4
Eleocharis cellulosa	910	10.6-14.2	1024	10.6-14.5
Eleocharis equisetoides	6	12.9-13.4	4	12.8-13.0
Eleocharis flavescens	5	11.2-13.8	2	14.0
Fimbristylis castanea			62	11.7-14.4
Furiena scirpoidea	210	11.0-14.4	84	10.6-14.6
Psilocarya nitens	28	12.2-14.2	89	11.6-14.4
Rhynchospora sp.	146	13.7-14.6	52	13.1-14.6
Rhynchospora globularis	137	13.3-14.6	9	14.0-14.5
Rhynchospora inundata	49	13.3-14.2	146	10.8-14.6
Rhynchospora schoenoides			1	13.0
Rhynchospora tracyi	393	12.1-14.3	627	12.0-14.4
Scirpus americanus	58	11.2-14.4	120	11.1-14.4
Scirpus californicus	35	11.2-13.4	17	11.5
Scirpus cubensis			1	11.5
Scirpus validus			16	9.9-13.7
Scleria reticularis			27	13.8-14.3
Unidentified sedge	14	10.5-14.4	15	12.2-14.4
Araceae				
Colocasia esculentum	6	12.7-14.1		
Peltandra virginica	8	12.1-14.1	8	12.7-14.0
Pistia stratoites	4	11.2-11.5	4	floating
Lemnaceae				
Lemna sp.			13	floating
Xyridaceae				
Xyris sp.	61	13.5-14.6		
Pontederiaceae				
Eichhornia crassipes	5	10.6-12.6	2	floating
Pontederia lanceolata	199	10.0-13.9	121	10.2-14.6
Juncaceae				
Juncus megacephalus			4	14.0-14.4
Juncus scirpoides	2	14.2-14.4		
Haemodoraceae				
Lachanthes caroliniana	57	13.6-14.5	145	13.4-14.6
Salicaceae				
Salix caroliniana	225	11.0-14.3	239	10.6-14.4
Myricaceae				
Myrica cerifera	97	13.9-14.6	51	13.5-14.3
Urticaceae				
Bohmeria cylindrica			3	11.0-11.5

APPENDIX 4. (Cont'd) A COMPARISON OF PLANT SPECIES IDENTIFIED ALONG MOORE HAVEN TRANSECT AND THEIR RANGE OF ELEVATION, 1973 and 1982

	1973		1982	
	# Occur	Elev.	# Occur	Elev.
Polygonaceae				
Polygonum sp.	232	11.2-14.3	5	13.8-14.1
Polygonum densiflorum			9	11.1-13.3
Polygonum hydropiperoides			301	9.9-14.6
Polygonum punctatum			5	12.2-14.2
Amaranthaceae				
Alternanthera philoxeroides	32	12.3-13.8	112	10.7-14.1
Amaranthus cannabinus			42	10.2-12.9
Phytolaccaceae				
Phytolacca sp.			1	14.4
Rivina humilis			1	13.2
Aizoaceae				
Sesuvium portulacastum	44	10.0-14.5	62	13.2-14.5
Portulacaceae				
Portulaca sp.	4	10.3-14.4		
Nymphaeaceae				
Nelumbo lutea	1	13.6		
Nuphar advena			7	10.8-11.1
Nymphaea mexicana			7	13.3-13.5
Nymphaea odorata	198	10.1-12.8	507	10.4-14.2
Fabaceae				
Sesbania sp.			4	12.2-12.7
Sesbania exalata			32	11.1-13.4
Vigna luteola	12	10.3-14.3	20	12.6-14.2
Malvaceae				
Hibiscus grandiflorus	129	11.7-14.3	270	11.0-14.6
Kosteletzkya virginica	63	12.3-14.4	99	10.3-14.3
Lythraceae				
Lythrum lanceolatum	79	13.5-14.5		
Myrtaceae				
Melaleuca quinquenervia	107	13.4-14.6	156	13.4-14.6
Onagraceae				
Ludwigia sp.	61	10.0-14.6		
Ludwigia bonariensis	17	10.5-14.1		
Ludwigia curtissii			63	13.6-14.2
Ludwigia peruviana			68	9.9-14.3
Ludwigia repens			42	10.7-14.3
Haloragaceae				
Proserpinaca palustris			36	13.4-14.3
Apiaceae				
Centella asiatica	416	12.3-14.6	215	13.3-14.6
Hydrocotyle sp.	69	10.0-14.3	37	9.9-14.5
Loganiaceae				
Cynoctonum mitreola			9	14.0-14.4
Gentianaceae				
Nymphoides aquatica			14	11.1-11.4
Asclepiadaceae				
Sarcostema clausa	322	10.0-14.3	8	10.9-13.5

APPENDIX 4. (Cont'd) A COMPARISON OF PLANT SPECIES IDENTIFIED ALONG MOORE HAVEN TRANSECT AND THEIR RANGE OF ELEVATION, 1973 and 1982

	1973		1982	
	# Occur	Elev.	# Occur	Elev.
Convolvulaceae				
Convolvulus sp.	1	13.5		
Ipomea alba	25	10.3-14.2	1	12.9
Ipomea sagitata			18	9.9-14.2
Boraginaceae				
Heliotropium polyphyllum	42	13.8-14.4	93	13.6-14.5
Verbenaceae				
Lippia nodiflora	3	12.7-13.9	5	12.9-14.0
Lamiaceae				
Teucrium canadense	65	12.7-14.4	33	13.1-14.2
Scrophulariaceae				
Bacopa caroliniana	50	13.5-14.4	55	13.8-14.4
Bacopa monnieri	9	13.6-14.2	8	10.1-14.2
Buchnera floridana	41	14.3-14.6		
Lentibulariaceae				
Utricularia sp.	372	10.0-13.2	148	10.9-14.0
Acanthaceae				
Justicia ovata			4	11.4-13.3
Rubiaceae				
Cephalanthus occidentalis	249	10.0-14.6	462	11.7-14.6
Diodia virginica			195	12.7-14.6
Asteraceae				
Aster sp.			17	11.7-14.4
Baccharis sp.	48	13.3-14.3	50	11.2-14.2
Bidens sp.	16	14.3-14.6		
Boltona diffusa	14	13.3-14.0		
Cirsium sp.	31	13.3-14.3	2	14.3-14.4
Eupatorium capillifolium	36	12.1-14.3	252	10.2-14.4
Eupatorium coelestinum			15	11.2-13.3
Mikania scandens	195	10.0-14.4	99	10.4-14.3
Pluchea rosea	432	10.2-14.6	486	9.9-14.6
Unidentified composite			11	11.0-14.4
Unidentified broadleaf			152	12.7-14.4

APPENDIX 5. DISTRIBUTION OF MELALEUCA ALONG MOORE HAVEN TRANSECT, 1973 AND 1982