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PONDS AND LAKES OF THE LOUISIANA COASTAL MARSHES AND THEIR VALUE TO FISH AND WILDLIFE

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ABSTRACT

A survey of the Louisiana Coastal Area disclosed that ponds and lakes made up one-fourth of the area. The ponds and lakes ranged from less than 0.01 acre to over 400,000 acres and numbered 5.3 million. The study shows that the fresh, brackish and intermediate marshes were of high value to waterfowl because of high pond density and plant growth. Ponds and lakes in the saline marshes were of low value to most waterfowl, but of extreme importance to marine organisms.

INTRODUCTION

The broad, flat coastal region of Louisiana is one of the unique areas of the world. The vast marshes, interlaced with bayous, ponds and lakes, combine to make the area extremely productive for fish and wildlife. Ponds and lakes add tremendous diversity to the region and serve as concentration areas for the energy flow from adjacent marshes.

Tidal ponds and lakes are important nursery and feeding grounds for many marine organisms. Ponds and lakes are extremely important for ducks and coots (*Fulica americana*), and the wintering populations using such areas number several million. Alligators (*Alligator mississippiensis*) plus valuable fur-bearing animals, such as mink (*Mustella vison*) and otter (*Lutra canadensis*) depend on ponds and lakes for a livelihood. Also, nutria (*Myocastor coypus*) are closely associated with water areas, and often use ponds and lakes for escape and travel lanes, and aquatic vegetation for food. Wading birds and shore birds along the Louisiana coast depend heavily on ponds and lakes for a source of food.

In spite of the value of ponds and lakes to fish and wildlife along the Louisiana Coast, no detailed sampling has been done to determine their distribution and characteristics.

A survey was made of the Louisiana Coast in August 1968, to determine surface features, vegetation, and soil and water conditions. A study of ponds and lakes was included as a part of the survey, and this report presents the results of that segment. The number of ponds and lakes is presented by size classes for each hydrologic unit and vegetative type along the coast, and vegetation is described for ponds of different areas.

Ponds and lakes may be defined as bodies of water nearly or entirely surrounded by land. For the purposes of this study the terms ponds and lakes were used synonymously in many instances. Generally ponds are considered to be small bodies of water and lakes large bodies, but in this report no attempt was made to differentiate between the two. Kniffen (1968) described seven types of lakes in the Louisiana Coastal Marshes separated on the basis of origin. Bays are large bodies of water adjacent to the Gulf of Mexico, very often appearing as a part

of the Gulf extending into the marsh, but are not considered in detail in this report.

The area included by the study was all of the Louisiana coast south of a line from the mouth of Pearl River, westward along the northern edge of Lake Pontchartrain and Lake Maurepas, and following the northern edge of the coastal marshes to the Sabine River (Figure 1). The region includes coastal marshes, swamps, beaches, ridges, and agricultural, industrial and residential areas, plus numerous bodies of water of varying sizes.

Methods and Materials

Sampling stations were located at 0.25 mile intervals along 39 north-south transect lines spaced at 7.5 minutes of Longitude along the coast. Stations were classified, on the basis of surface features, as marsh, ponds, or lakes, bays, bayous, canals, swamp or dry land while hovering above them in a helicopter. Sizes of ponds and lakes were estimated and later corrected by reference to aerial photographs.

Vegetation was sampled at each station using a modification of the line-intercept method described by Canfield (1941). A more detailed description of the sampling procedure is described in an earlier report (Chabreck 1970a).

Number of Ponds and Lakes

During the study 7,127 stations were checked and classified as to surface feature. The percentage frequency of stations occupied by ponds and lakes was multiplied by the total acreage of the area sampled to calculate the total acreage of ponds and lakes. The size of the area sampled was 7,823,386 acres (Chabreck, 1970b).

The acreage of ponds and lakes in the coastal area was also calculated by size classes. This was done by first determining the percentage frequency of ponds in each size class and multiplying the percentage value by the total acreage in ponds and lakes. The values obtained were the total acreages in ponds and lakes of different size classes.

The number of ponds and lakes in each size class was computed from the total acreage. In doing this the acreage of each size class was divided by the mid-point value of the size class.

Subdivisions of the Coastal Area

The coastal area was divided into 9 hydrologic units and 4 vegetative types. The hydrologic units were based on drainage systems (Figure 1), and have been described elsewhere (Chabreck, 1970b).

Vegetative typing followed the scheme developed by Penfound and Hathaway (1938). The vegetative types (saline, brackish, intermediate and fresh) follow a general east-west direction paralleling the coast. The vegetative types referred to in this report are shown on a map prepared by Chabreck, Joanen and Palmisano (1968). Mean water salinities for the vegetative types were: saline, 18.1 ppt; brackish, 8.2 ppt; intermediate, 3.3 ppt; and fresh, 1.0 ppt; (Chabreck, 1970a).

RESULTS AND DISCUSSION

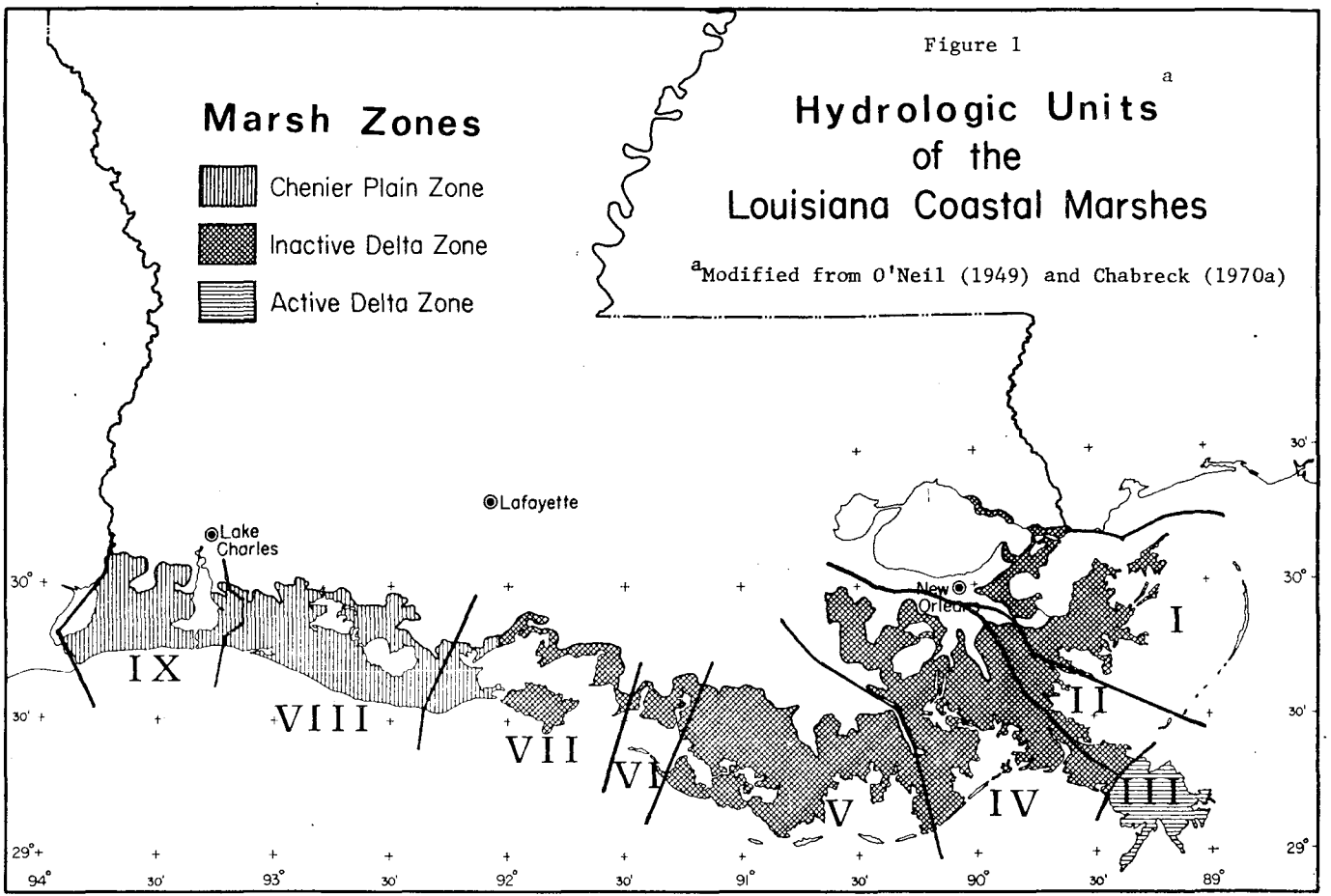
Acreage in Ponds and Lakes

Of the 7,832,386 acres sampled along the Louisiana Coast, almost one-fourth of the area consisted of ponds and lakes (Table 1). Ponds and lakes of the coastal area were classified in 10 size classes, and all size classes were well represented (Table 2). A general increase was noted in total acreage occupied with each increase in size class.

The 9 hydrologic units used varied considerably in size. Likewise, the acreage of ponds and lakes in the hydrologic units also varied (Table 3). Hydrologic Unit 1, which included Lake Pontchartrain and Lake Maurepas, had the greatest acreage in ponds and lakes.

Barrett (1970) measured the total area of the Louisiana Coast from quadrangle maps and computed the acreage in water bodies. He listed the portion in ponds, lakes and bays as 3,173,366 acres. This figure was

Figure 1


Marsh Zones
Chenier Plain Zone
Inactive Delta Zone
Active Delta Zone
Hydrologic Units
of the
Louisiana Coastal Marshes
Modified from O'Neil (1949) and Chabreck (1970a)
Lafayette
Lake Charles
New Orleans
IX
VIII
VII
VI
V
IV
III
II
I
30°
29°
94°
93°
92°
91°
90°
89°
30'

788,991 acres below the 3,962,357 acres calculated for ponds, lakes, bays, and sounds during this study. Much of the difference was probably accounted for by ponds which did not appear on maps, but were located during the ground surveys. Also, ponds and lakes in the upper end of the Barataria Basin were not included by Barrett. Nevertheless, for the lake sizes included and areas sampled, the results were very similar to this study.

TABLE 1. Acreages contained in various surface features of hydrologic units of the Louisiana Coastal Marshes, August, 1968.

Surface Feature	Hydrologic Unit 1	2	3	4	5
			Acres		
Marshes:					
Natural marsh	261,198	143,850	81,738	469,311	583,101
De-watered marsh	18,300	2,373	0	27,748	18,226
Water Bodies:					
Ponds and Lakes	603,306	49,517	95,391	292,056	228,390
Bays and Sounds	1,019,066	212,260	122,625	108,841	320,082
Bayous and Rivers	27,040	5,888	17,004	43,795	16,965
Canals and Ditches	9,234	7,075	12,476	5,198	9,365
Swamp	0	0	0	15,419	22,853
Dry Land *	263,835	27,108	27,234	327,428	202,172
TOTAL	2,200,979	448,071	356,071	1,289,796	1,401,154

Surface Feature	Hydrologic Unit 6	7	8	9	Total
			Acres		
Marshes:					
Natural marsh	40,554	271,087	396,353	212,362	2,459,554
De-watered marsh	0	4,511	54,773	39,858	165,789
Water Bodies:					
Ponds and Lakes	20,825	33,904	230,747	228,552	1,782,688
Bays and Sounds	64,668	332,127	0	0	2,179,669
Bayous and Rivers	3,288	4,781	4,174	3,262	125,197
Canals and Ditches	1,095	5,328	3,849	3,855	57,475
Swamp	21,920	8,256	0	0	68,448
Dry Land *	4,383	54,204	26,456	51,746	984,566
TOTAL	156,733	714,198	716,352	539,635	7,823,386

* Includes active beaches, cheniers, spoil deposits, ridges and elevated bayou and lake banks.

NUMBER OF PONDS AND LAKES

The study shows a total of 5.3 million ponds and lakes in the coastal area (Table 2). Of these, over one-half were less than 0.01 acre in size. The number of ponds and lakes decreased progressively with increases in size classes in most cases. An interesting point in this regard was that the ponds 0.01 to 0.1 acre in size out-numbered those less than 0.01 acre in size in Hydrologic Units 7, 8, and 9 (Table 4). These hydrologic units occupy the western portion of the Louisiana Coast and include the Chenier Plain.

The brackish vegetative type had the greatest density of ponds and lakes (Table 5). This type exceeded the others in practically all pond and lake size classes on a per unit area basis. The fresh type ranked second and the saline type had the lowest density of ponds and lakes.

TABLE 2. Number and area of ponds and lakes by size classes along the Louisiana coast, August, 1968.

Size Classes (Acres)	No. Ponds and Lakes	Total Area Included (Acres)
> .01	2,950,000	28,340
.01 - .10	1,889,000	75,230
.10 - 1.0	425,800	132,275
1.0 - 10	43,460	123,360
10 - 80	5,472	148,140
80 - 640	722	150,640
640 - 3,200	149	222,300
3,200 - 16,000	15	114,800
16,000 - 64,000	7	359,200
< 64,000	1	428,403
TOTAL	5,314,626	1,782,688

TABLE 3. Acreage of ponds and lakes in hydrologic units and vegetative types along the Louisiana coast, August, 1968.

Hydrologic Unit	Vegetative Types				
	Saline	Brackish	Intermediate	Fresh	Total
	Acres				
1	53,427	330,455	117,627	101,797	603,306
2	5,887	43,630	0	0	49,517
3	0	10,231	10,231	74,929	95,391
4	61,547	96,920	3,498	130,091	292,056
5	99,403	68,559	4,487	55,941	228,390
6	0	0	0	20,825	20,825
7	0	24,881	6,767	2,256	33,904
8	1,287	21,666	10,225	197,569	230,747
9	0	178,958	30,176	19,418	228,552
TOTAL	221,551	775,300	183,011	602,826	1,782,688

PLANT COVERAGE

Plant coverage provides information on the degree to which an area is vegetated. The non-vegetated area is considered as a potential site for plant growth.

Percent plant coverage of ponds and lakes was inversely proportional to water salinity (Table 6). Ponds and lakes of the fresh vegetative type had the greatest plant coverage, followed by the intermediate, brackish and saline types in descending order. No vegetation was found in ponds and lakes sampled in the saline vegetative type. Likewise, no vegetation was found in any lake greater than 3,200 acres in size.

PLANT SPECIES COMPOSITION

Vegetative Types

During the study, 30 species of vascular plants were found at the sampling stations in ponds and lakes. In addition the algae, *Chara vulgaris*, was included because it is frequently used as food by waterfowl. As with plant coverage, the number of species was inversely related to water salinity. Of the 31 species encountered, 29 were found in the fresh vegetative type, 10 in the intermediate, 6 in the brackish, and none in the saline (Table 7).

A brackish water species, *Ruppia maritima*, was the dominant species along the entire Louisiana coast in ponds and lakes. Other major species were *Lemna minor, Myriophyllum spicatum, Chara vulgaris, Ceratophyllum demersum* and *Eleocharis parvula* (Table 7).

Species rated from fair to excellent as waterfowl foods by Martin and Uhler (1951) made up a majority of the plants in ponds and lakes.

TABLE 4. Number of Ponds and lakes of various size classes in hydrologic units along the Louisiana coast, August, 1968

Pond Size Class (Acres)	Hydrologic Unit 1	2	3	4	5
> .01	257,000	122,000	356,000	814,000	824,000
.01 - 0.1	35,000	111,000	141,000	512,000	383,000
0.1 - 1.0	19,750	24,800	14,950	105,650	79,100
1.0 - 10	4,360	2,990	3,930	7,760	6,550
10 - 80	547	309	769	546	1,402
80 - 640	162	40	151	149	119
640 - 3,200	5	17	8	37	42
3,200 - 16,000	0	1	0	6	8
16,000 - 64,000	1	0	0	2	0
< 64,000	1	0	0	0	0

Pond Size Class (Acres)	Hydrologic Unit 6	7	8	9	Total
> .01	108,000	115,000	248,000	106,000	2,950,000
.01 - 0.1	22,000	232,000	298,000	155,000	1,889,000
0.1 - 1.0	3,100	19,400	66,450	92,600	425,800
1.0 - 01	800	1,290	9,240	6,450	43,460
10 - 80	102	321	446	1,030	5,472
80 - 640	15	28	83	38	785
640 - 3,200	8	5	12	15	149
3,200 - 16,000	0	0	0	0	15
16,000 - 64,000	0	0	2	2	7
< 64,000	0	0	0	0	1

TABLE 5. Density of ponds and lakes of various size classes in vegetative types along the Louisiana coast, August, 1968.

Pond and Lake Size Classes (Acres)	Vegetative Type Saline	Brackish	Intermediate	Fresh
	Number Per Hundred Thousand Acres			
> .01	27,700.24	118,841.70	55,952.21	59,181.16
.01 - .10	16,748.98	62,162.16	45,024.04	47,637.37
.10 - 1.0	4,702.60	14,139.00	10,432.76	9,796.83
1.0 - 10	700.02	1,376.06	759.14	1,070.49
10 - 80	132.17	179.54	73.15	108.82
80 - 640	30.17	12.36	2.62	25.09
640 - 3,200	5.15	3.24	0	4.54
3,200 - 16,000	.54	.62	0	.15
16,000 - 64,000	0	.23	0	.31
< 64,000	0	.08	0	0

Brackish Type. Although the brackish type produced few species, those present were choice waterfowl foods. Major species were *Ruppia maritima* and *Eleocharis parvula* (Table 7).

Intermediate Type. Ruppia maritima and *Eleocharis parvula* were also major species in the intermediate type. However, *Chara vulgaris* was the dominant, and *Bacopa monnieri, Myriophyllum spicatum,* and *Najas quadulupensis* were very common.

Fresh Type. The fresh vegetative type contained numerous species with waterfowl values ranging from poor to excellent. The overall quality of plants in ponds and lakes of the fresh type are rated lower than that of the intermediate and brackish types. Major species in the fresh type are *Lemna minor, Ceratophyllum demersum, Myriophyllum spicatum, Eleocharis* sp., and *Chara vulgaris.*

TABLE 6. Plant coverage of ponds and lakes by vegetative types along the Louisiana coast, August, 1968.

Lake Size Class (Acres)	Vegetative Types				Entire Coast
	Saline	Brackish	Intermediate	Fresh	
			Percent		
> .01	0	8.6	11.4	53.2	20.0
.01 - .10	0	15.4	29.1	75.6	35.4
.10 - 1.0	0	8.1	37.7	71.7	31.1
1.0 - 10	0	10.7	19.5	56.4	23.9
10 - 80	0	16.3	13.1	28.4	16.0
80 - 640	0	7.1	0	29.6	15.1
640 - 3,200	0	7.9	0	4.0	3.8
3,200 - 16,000	0	0	0	0	0
16,000 - 64,000	0	0	0	0	0
< 64,000	0	0	0	0	0

TABLE 7. Plant species composition of ponds and lakes by vegetative types along the Louisiana coast, August, 1968

Plant Species	Vegetative Type *			Entire Coast
	Brackish	Intermediate	Fresh	
		Percent		
Alternanthera philoxeroides	...	...	1.29	.89
Azolla caroliniana	...	...	.59	.40
Bacopa caroliniana	...	...	.35	.24
Bacopa monnieri	4.97	11.69	.35	2.46
Bacopa rotundifolia	2.29	...	...	.49
Brasenia schreberi	...	...	2.23	1.54
Cabomba caroliniana	...	...	3.64	2.51
Centella erecta	...	...	.63	.44
Ceratophyllum demersum	...	...	11.15	7.68
Chara vulgaris	...	32.47	8.10	8.81
Eichhornia crassipes	...	...	4.53	3.12
Eleocharis parvula	23.01	10.07	1.60	6.97
Eleocharis sp.	3.98	6.82	11.27	9.28
Hydrocotyl bonariensis	...	...	.12	.08
Hydrocotyl umbellata	...	...	1.67	1.15
Hymenocallis occidentalis	...	...	.47	.32
Jussiaea alterniflora	...	...	.23	.16
Lemna minor	...	2.43	15.26	10.75
Limnobium spongia	...	...	1.13	.78
Myriophyllum spicatum	3.06	8.93	11.03	9.14
Myriophyllum heterophyllum	...	...	.47	.32
Najas quadolupensis	...	8.93	5.75	4.85
Nelumbo lutea	...	...	1.88	1.29
Nymphaea odorata	...	...	4.93	3.40
Potamogeton nodosus	...	...	.23	.16
Potamogeton pusillus	...	4.87	2.70	2.34
Ruppia maritima	62.29	12.98	.23	14.72
Sagittaria falcata	...	...	1.24	.86
Scirpus californicus	...	.81	...	.08
Spirodela polyrhiza	...	...	.94	.65
Utricularia cornuta	...	...	5.99	4.12

* No vegetation in saline vegetative type.

Pond and Lake Size

The plant species composition of ponds and lakes of different size classes is shown in Table 8. A comparison of the number of plant species to pond size shows that the 1 to 10-acre size class contained the greatest number of species. The number of species decline progressively both below and above this class.

TABLE 8. Plant species composition of ponds and lakes of various size classes along the Louisiana coast, August, 1968.

Plant Species	Pond Size Classes *				
	.01	.01-.10	.10-1.0	1.0-10	10-80
	Percent				
Alternanthera philoxeroides	...	...	...	...	1.01
Azolla caroliniana	...	.52	...	1.69	...
Bacopa caroliniana	...	...	...	1.26	...
Bacopa monnieri	...	12.67	...	.85	2.02
Bacopa rotundifolia	...	...	...	2.53	...
Brasenia schreberi	...	...	1.92	5.49	...
Cabomba caroliniana	...	1.04	.32	5.07	8.06
Centella erecta	8.33	...	...	.85	...
Ceratophyllum demersum	...	3.63	2.88	4.22	2.02
Chara vulgaris	...	1.04	20.50	9.71	10.08
Eichhornia crassipes	24.51	...	6.28	2.11	...
Eleocharis parvula	40.20	10.70	4.68	5.32	3.53
Eleocharis sp.	22.06	26.17	14.41	2.95	.20
Hydrocotyl bonariensis	...	.52	...	...	...
Hydrocotyl umbellata	...	4.46	1.15	.85	...
Hymenocallis occidentalis	...	2.08	...	...	...
Jussiaea alterniflora	...	...	.64	...	...
Lemna minor	...	9.35	11.34	12.92	5.54
Limnobium spongia	...	4.67	...	.25	...
Myriophyllum spicatum	...	...	3.20	...	26.21
Myriophyllum heterophyllum	...	...	...	1.69	...
Najas quadolupensis	...	1.04	5.13	15.20	3.02
Nelumbo lutea	...	...	1.28	...	1.01
Nymphaea odorata	...	1.04	5.13	5.07	4.03
Potamogeton nodosus	...	...	...	.85	...
Potamogeton pusillus	...	...	1.60	5.49	1.01
Ruppia maritima	...	6.75	10.89	11.40	32.26
Sagittaria falcata	...	3.42	.64	...	...
Scirpus californicus	...	...	.32	...	...
Spirodela polyrhiza	...	2.59	...	.85	...
Utricularia cornuta	4.90	8.31	7.69	3.38	...

* Pond size in acres.

Lakes larger than one square mile in size usually contained few plants. The greater water depth or increased turbidity from wave action probably produced conditions unfavorable for plant growth. Several of the larger lakes, such as Lake Pontchartrain, contained aquatic plants in the shallow water around the shoreline. However, no plants occurred at the sample stations, indicating a very narrow distribution.

CONCLUSIONS AND SUMMARY

Approximately one-fourth of the Louisiana Coastal Area was composed of ponds and lakes. The ponds and lakes ranged from less than 0.01 acre to over 400,000 acres and numbered 5.3 million. Over one-half of the ponds and lakes were less than 0.01 acre in size.

The greatest density of ponds and lakes was in the brackish vegetative type, followed by the fresh type, intermediate type, and saline type in decending order of abundance.

TABLE 8. Plant species composition of ponds and lakes of various size classes along the Louisiana coast, August, 1968. (Continued)

Plant Species	Pond Size Classes * 80-640	640 to 3,200	3,200 to 16,000	16,000 to 64,000	64,000
			Percent		
Alternanthera philoxeroides	3.84	2.70	...	...	...
Azolla caroliniana	...	...	...	...	...
Bacopa caroliniana	...	...	...	...	...
Bacopa monnieri	...	...	...	...	...
Brasenia schreberi	...	...	...	...	...
Cabomba caroliniana	...	...	...	...	...
Centella erecta	...	...	...	...	...
Ceratophyllum demersum	21.43	35.14	...	...	...
Chara vulgaris	...	5.41	...	...	...
Eichhornia crassipes	...	...	...	...	...
Eleocharis parvula	8.24	...	...	...	...
Eleocharis sp.	1.65	...	...	...	...
Hydrocotyl bonariensis	...	...	...	...	...
Hydrocotyl umbellata	...	...	...	...	...
Hymenocallis occidentalis	...	...	...	...	...
Jussiaea alterniflora	...	...	...	...	...
Lemna minor	20.88	...	...	...	...
Limnobium spongia	...	...	...	...	...
Myriophyllum spicatum	26.92	2.70	...	...	...
Myriophyllum heterophyllum	...	...	...	...	...
Najas quadalupensis	...	...	...	...	...
Nelumbo lutea	5.49	...	...	...	...
Nymphaea odorata	2.20	...	...	...	...
Potamogeton nodosus	...	...	...	...	...
Potamogeton pusillus	4.95	...	...	...	...
Ruppia maritima	2.20	54.05	...	...	...
Sagittaria falcata	1.10	...	...	...	...
Scirpus californicus	...	...	...	...	...
Spirodela polyrhiza	.55	...	...	...	...
Utricularia cornuta	.55	...	...	...	...

* Pond size in acres.

The greatest plant coverage was in the fresh type. Very little vegetation was found in lakes larger than 640 acres or in the saline type.

Ponds and lakes of the fresh vegetative type produced 3 times the number of plant species of other vegetative types; 29 of the 31 species sampled occurred in this type. Ponds in the 1 to 10-acre size class produced more species than the other size classes and contained 23 of the 31 species recorded.

The results of this study show that the fresh vegetative type was of greatest value to waterfowl on a basis of pond density and plant growth. The brackish and intermediate vegetative types were of high value, but the saline vegetative type ranked low in value.

In ponds of the fresh vegetative type the high plant coverage and large number of species provided food for a tremendous number of birds and of a wide variety of species. Advantages of the brackish type were the high pond density and the high quality of the plants produced. The intermediate type ranked favorably in all categories, but the total area of this type was smaller than the others. The absence of vegetation in ponds and lakes of the saline type made this an area of low value to most species of waterfowl. Waterfowl and other birds inhabiting saline ponds and lakes feed principally on animal material.

Although ponds and lakes of the saline vegetative type are of low value to most waterfowl, this area is of extreme importance to marine

organisms (Gunter, 1967). Brackish water ponds connected with tidal channels are also widely used by marine organisms. Many species used the saline and brackish ponds and lakes as nursery areas. The adults spawn offshore and the young move to the inland waters as a part of their life cycle. Rapid growth and development taken place in the rich waters of these areas.

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THE EFFECT OF SALINITY ON THE GERMINATION AND GROWTH OF PLANTS IMPORTANT TO WILDLIFE IN THE GULF COAST MARSHES

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INTRODUCTION

Salinity, as a factor affecting plant growth, is frequently encountered in two types of environments. In arid climates, where evapotranspiration exceeds precipitation, salts may accumulate in soils and water to toxic levels. The coastal environment is also subject to high salinities as a result of inundation by sea water. Louisiana alone has more than 4,000,000 acres of coastal marshland, 65 percent of which contains sufficient soluble salts, in the soil water, to affect plant growth and distribution (Chabreck, Joanen and Palmisano, 1968; O'Neil, 1949).

Subsidence, erosion and compaction are natural processes allowing the encroachment of sea water into fresh marshes and swamps. This

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