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COASTAL MARSH IMPOUNDMENTS FOR DUCKS IN LOUISIANA

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INTRODUCTION

The Gulf Coast is a major waterfowl wintering area. The Louisiana coast alone winters over 4,000,000 ducks annually (Smith, 1959). However, industry and agriculture are gradually reducing the acreage of the Gulf Coast waterfowl habitat, and as a result of man's activity the quality of much of this habitat is diminishing. As more canals are dug and stream channels enlarged each year for navigation, pipelines, and drainage, problems of tidal action and salt water intrusion become more and more severe. Only with carefully planned management will this wetland habitat be preserved.

Realizing the need for intensive waterfowl management, the Louisiana Wild Life and Fisheries Commission in 1954 began constructing marsh impoundments on refuge areas. Since that time a total of 26,200 acres have been impounded with waterfowl management the primary objective. Of this total 18,200 acres are on the 84,000-acre Rockefeller Wildlife Refuge in Cameron and Vermilion Parishes, Louisiana. On Rockefeller Refuge nine impoundments have been constructed with sizes ranging from 480 acres to 5,680 acres. A contract was let in August, 1960, for impounding an additional 4,400 acres on Rockefeller Refuge and placing a tidewater barrier around another 13,500-acre block.

DESCRIPTION OF THE AREA

Rockefeller Refuge is situated between the Gulf of Mexico and the Grand Chenier ridge complex, a stranded beach ridge located seven miles inland from the Gulf. The entire refuge consists of low marshland with an average elevation of 1.1 feet above mean sea level. Tidewater enters the refuge from the Gulf of Mexico through five separate channels then spreads to all parts of the refuge, outside the impounded areas. The average tidal fluctuation is one foot; however, high tides frequently inundate the marshes with salt water.

The impoundments were completed by 1956 and in 1957 Hurricane "Audrey" (Ensminger and Nichols, 1957) badly damaged the levees and filled the impoundments with salt water. However, the salt water was soon drained out and all levee breaks repaired.

In 1958 a study was begun to determine the effectiveness of the impoundments in waterfowl habitat management. As a part of this study the impoundments and adjacent control areas were sampled to determine the vegetative composition and vegetative coverage. Sampling was done annually to determine plant succession and measure the effects of different impoundment management techniques.

STUDY METHODS

Line transects were used in sampling. Using marsh buggies permanent markers were placed and labeled at 100-foot intervals along a line through the center of each impoundment. The line ran in a north-south direction. A five percent

sample was made of the line by using a five-foot rule for sampling at each one hundred-foot marker. Vegetative types and opening were tabulated as they occurred along each five-foot transect to the nearest one-tenth foot. The species composition of mixed types was estimated.

Lines were placed in areas south of certain impoundments as a control and sampled by the same method. The entire line, including the control areas was 74,400 feet long (13.5 miles) with 753 stations.

As another part of this study the water depth and salinity was checked monthly in all impoundments and control areas. Water salinity was determined with a conductivity bridge.

The study area included only the impoundments on Rockefeller Wildlife Refuge. They range in size from 480 acres to 5,680 acres and vary according to salinity, water depth and system of management. In general the impoundments can be classified into three groups. The first group are those permanently flooded with brackish water, second are those permanently flooded with fresh water and third are a group which are drained each spring and flooded during the fall and winter with fresh water.

WATER DEPTH AND SALINITY

Table I lists the water depths and salinities of the impoundments and control areas during the time of the study. The water depths in the permanently flooded impoundments varied considerably and were at their highest level during the late fall and winter. As a result of evaporation and transpiration water depths dropped to their lowest levels in late summer and early fall. The water depth and salinity were inversely proportional. As the water depth decreased the water salinity increased and vice versa. The study area was within 5 miles of the Gulf of Mexico and joined with a network of bayous and canals. As a result the water depth and salinity in the control areas followed no trend. Tidal action and rainfall were the limiting factors, causing frequent and drastic changes.

TABLE I

WATER DEPTH (FT.) AND SALINITY*(PPT) OF IMPOUNDMENT AND CONTROL AREAS ON ROCKEFELLER REFUGE, 1959

	Impoundments		
	Permanent Brackish Water	*Permanent Fresh Water*	*Manipulated Fresh Water*
Mean Water Depth	.6	1.2	.4
Minimum Water Depths	.1	.3	–.4
Maximum Water Depths	1.1	2.0	1.1
Mean Water Salinity	5.2	1.8	2.1
Minimum Water Salinity	2.0	.8	.9
Maximum Water Salinity	12.0	3.4	5.3
		Control Areas	
Mean Water Depth	.5	.2	.3
Minimum Water Depth	0	0	.1
Maximum Water Depth	.9	.5	.7
Mean Water Salinity	5.1	5.4	4.8
Minimum Water Salinity	1.9	1.1	1.8
Maximum Water Salinity	15.1	18.2	17.5

* Water Salinity shown in parts per thousand.

IMPOUNDMENT VEGETATION

As shown in Table II the marsh vegetative coverage in the impoundments that remained permanently flooded was similar to the adjacent control areas, but slightly less. This is probably a result of the inability of certain plant species to tolerate permanent flooding. Marshhay (*Spartina patens*) cordgrass, almost the sole occupant of the control areas, was much less abundant in the impoundments flooded with brackish water and did not occur on the transects through the impoundments flooded with fresh water. The lesser abundance of this species provided greater growing space for species of far more importance to waterfowl.

In the impoundments regulated so as to remove the water during the early growing season (*manipulated fresh water*), the amount vegetated was considerably greater than the adjacent control area. This particular section is characterized by a large number of barren ponds. Consequentlly, reducing the salinity, Table I, and removing the water at the critical time permitted the germination of annual grasses. Wild millet (*Echinochloa walteri*) and sprangletop (*Leptochloa fascicularis*) made up 53.3 percent of the vegetative composition of the impoundments, Table III, but in the control area did not appear in

TABLE II

COMPARISON OF THE MARSH VEGETATIVE COVERAGE (PERCENTAGE) IN IMPOUNDMENT AND CONTROL AREAS, ROCKEFELLER REFUGE, SUMMER, 1959

	Impoundments		
	Permanent Brackish Water	*Permanent Fresh Water*	*Manipulated Fresh Water*
Vegetated	62.9	69.6	61.5
Non-Vegetated	37.1	30.4	38.5
	Control Areas		
Vegetated	72.1	77.8	28.2
Non-Vegetated	27.9	22.2	71.8

TABLE III

VEGETATIVE COMPOSITION (PERCENTAGE) OF IMPOUNDMENT AND CONTROL AREAS,* ROCKEFELLER REFUGE, SUMMER 1959

	Impoundments			*Control Areas*		
Plant Species	*Perm. Brackish Water*	*Perm. Fresh Water*	*Manip. Fresh Water*	*Perm. Brackish Water*	*Perm. Fresh Water*	*Manip. Fresh Water*
Marshay cordgrass *Spartina patens*	40.5	. .	23.3	96.9	94.5	94.5
Widgeongrass *Ruppia maratima*	55.5	8.2	8.8	. .	1.1	. .
Duckweed *Lemna minor*	. .	76.4	. .	. .	. .	. .
Wild millet *Echinochloa walteri*	. .	.5	41.5	. .	. .	. .
Nutgrass *Cyperus sp.*	.3	.3	3.4	1.3	.8	1.4
Three-cornered grass *Scirpus olneyi*	. .	. .	. .	1.8	. .	. .
Bullwhip *Scirpus californicus*	. .	8.6	. .	. .	. .	. .
Bulltongue *Sagittaria sp.*	. .	4.5	2.4	. .	. .	. .
Waterhyssops *Bacopa monnieria*	. .	1.4	4.2	. .	2.3	. .
Marsh fleabane *Pluchea purpurascens*	. .	.1	.2	. .	. .	1.3
Sprangletop *Leptochloa fascicularis*	. .	. .	11.8	. .	. .	. .
Spikerush *Eleocharis sp.*	2.0	. .	. .	. .	. .	. .
Saltmarsh bulrush *Scirpus robustus*	. .	. .	1.6	. .	.4	2.8
Roseau *Phragmites communis*	. .	. .	2.5	. .	.9	. .
Saltgrass *Distichlis spicata*	1.7	. .	. .	. .	. .	. .
Buckbrush *Baccharis halimifolia*	. .	. .	.3	. .	. .	. .

* Descriptions apply only for the impoundment to which control areas are adjacent.

sampling. Marshhay cordgrass, practically the sole occupant of the control area, was almost as abundant in the impoundment, however its lower rank in the vegetative composition of the impoundment results from the abundance of other species.

As indicated by sampling, the impoundments produced a larger number of plant species than did the control areas (Table III). Also, species considered good duck food plants dominated the impoundments, but comprised only a small percentage of vegetative composition of the control areas. Without exception these species made up over 50 percent of the plants in the impoundments, but in the control area made up less than 5 percent.

In the impoundments permanently flooded with brackish water and the impoundments with manipulated water levels, widgeongrass (*Ruppia maratima*) and wild millet were dominants, respectively. These species are excellent duck foods along the Gulf Coast. Duckweed (*Lemna minor*) was the dominant in the permanently flooded freshwater impoundments. This species is used by ducks but it is not a preferred food along the Gulf Coast. Establishing watershield (*Brasenia schreberi*) in the flooded freshwater impoundments would greatly improve their value to certain species of ducks.

Several other plant species of fair value as duck foods occurred in the impoundments and in the control areas. However, these species made up only a small percentage of the vegetative composition of either area. Three-cornered grass (*Scirpus olneyi*) the choice food of blue geese (*Chen caerulescens*) and muskrats (*Ondatra zibethica*) along the Gulf Coast, occurred only in certain control areas; but even there, it occurred in only small isolated stands.

DUCK USAGE

Aerial inventories by Morton M. Smith, waterfowl biologist of the Louisiana Wildlife and Fisheries Commission, during the 1958-59 wintering season listed the duck population of Rockefeller Refuge at 443,000 during the peak. At the same time the coot (*Fulica americana*) population was estimated at 40,000. The principal ducks using the refuge at that time in order of abundance were pintail (*Anas acuta*), blue-winged teal (*Anas discors*), gadwall (*Anas strepera*), mallard (*Anas platyrhynchos*), shoveller (*Spatula clypeata*), green-winged teal (*Anas carolinensis*) and American widgeon (*Mareca americana*). The diving duck population numbered slightly over 10,000 birds.

The marshes surrounding Rockefeller Refuge were open to hunting; consequently ducks flocked to the refuge during shooting hours. Then, in the late afternoon many of the birds moved out to the surrounding marshes. The impoundments produced an abundance of food as well as provided an ideal resting area for ducks. Of the total number of ducks on the refuge, approximately 80 percent were using the impoundments. The remaining 20 percent were scattered throughout the refuge in ponds, lakes and flooded marshes.

Aerial inventories by Richard K. Yancey, waterfowl biologist of the Louisiana Wild Life and Fisheries Commission, revealed that Rockefeller Refuge wintered less than 75,000 ducks during 1951 and 1952, prior to the construction of the impoundments.

The system of impoundment management on the study area provided conditions favorable to practically all species of ducks. Pintail, mallard, green-winged teal and blue-winged teal used the impoundments dominated by wild millet. Gadwall, shoveller and American widgeon used those which were heavy producers of widgeongrass. Diving ducks and coots were found most often in the permanently flooded impoundments with deeper water and large open ponds.

IMPOUNDMENT MANAGEMENT

Supplying water for coastal marsh impoundments frequently becomes a problem. Brackish water can be supplied simply by permitting the water to enter on high tides. However, impoundments managed as freshwater systems usually depend on rainfall. Pumping is not economically feasible on large areas. Also canals surrounding such areas usually contain brackish water. Fresh water impoundments, which are drained during the early growing season to produce wild millet, present the greatest problem. After germination, adequate moisture is necessary for growth. Without adequate moisture plant growth and seed

production suffer. Consequently, reflooding the impoundment at the proper time is of essence. Reflooding this species with approximately 4 inches of water after it reached a height of 6 to 10 inches produced rapid growth and an abundance of seeds in the study area in 1959. However, with a severe drought in the study area during 1960 most of the wild millet germinated but died before reaching maturity.

Impoundments managed to produce widgeongrass may also dry up during severe droughts. However, the writer has observed this species invasion of brackish ponds within two weeks after reflooding. Also, many barren ponds or ponds which supported no aquatic vegetation produced dense stands of widgeongrass when reflooded, after being completely dry for several weeks. Widgeongrass growth is often limited in such ponds by turbid water, resulting from soft organic bottoms and wind action. However, when dry the bottom material cements together and hardens, thus reducing turbidity when reflooded and providing a stable base for plant growth.

When considering the three impoundment management techniques on Rockefeller Refuge, it was apparent that the impoundments permanently flooded with brackish water produced an abundance of high quality duck food most consistently. The permanently flooded freshwater impoundments were dependable but the food produced was of low quality. The fluctuated freshwater impoundments produced an abundance of high quality food, but without absolute water level control, lean years were inevitable.

IMPOUNDMENT CONSTRUCTION

The impoundments were constructed with draglines by digging canals and using the spoil to form levees. In most cases the canals were placed outside the impoundments. By doing this the canals provided access to different parts of the refuge and served as a refuge boundary marker. In certain areas the canals were placed inside the impoundments.

Most impoundments on the refuges were constructed by contract at a cost ranging between fifteen and twenty cents per cubic yard for levee construction. In many instances costs were reduced by using existing levees along canals dug by oil companies for access.

Corrugated metal culverts were installed to provide drainage for the impoundments. The culverts were treated with a cold tar base preservative and placed in the levee in natural drainage systems. Most of the culverts are 30 inches in diameter and equipped with an overflow structure to keep the impoundment water below a certain level. A lift gate and flap gate were placed on opposite ends of each pipe to facilitate drainage. The flap gates permit water to flow in only one direction through the culvert, so that when the lift gate is raised water will not run into the impoundment on a high tide.

The culverts were spaced along the levees so that each structure would provide drainage for about 450 acres. The cost of each structure, including installation, was $6,000.00 complete.

The life expectancy of an impoundment depends on a sound levee system. Levees must be constructed so as to maintain a desired height for the greatest number of years. As evidenced by levees constructed on Rockefeller Refuge, Nichols (1959) reported that in any levee planning careful consideration must be given the problems of levee subsidence and shrinkage. Most coastal marsh soils are a semi-fluid material, and this material must not only be used for constructing levees but also serve as a foundation upon which the levee is placed. Also, the moisture content of the marsh soil determines the initial height that a levee may be constructed and the amount of shrinkage that will occur.

Much of the Louisiana coastal marsh is very unstable, particularly in the Southeastern section of the state, and will not support a levee. In such areas impoundments are not practical because of the maintenance problems involved.

Nichols (1959) states that most levee shrinkage takes place during the first year; however subsidence usually continues throughout the life of the levee. The subsidence rate is controlled by the nature of the marsh soil. The thickness of the surface organic layer determines the rate of immediate subsidence. This layer compresses to approximately 60 percent of its original thickness. With a

complete knowledge of marsh soil conditions, it is possible to predict levee loss, within certain limits.

One or two lifts were usually necessary to raise and reshape a marsh levee after its original construction. This was done after approximately one year and regulated by the ability of the soil to stand at the desired elevation. Under normal conditions no attempt should be made to construct a marsh levee higher than six feet.

OTHER IMPOUNDMENT VALUES

In addition to duck management marsh impoundments have other wildlife values which merit consideration. On Rockefeller Refuge the permanently flooded freshwater impoundments have proven very attractive to alligators (*Alligator mississipiensis*). Impoundments constructed with a canal inside the area offer ideal conditions for the large reptiles. Both deep and shallow water and an abundant supply of food are available, and the levees provide choice nesting sites. The alligator population of a two-mile canal inside one particular impoundment on Rockefeller Refuge in 1960 was estimated at 600, with sizes ranging from one to nine feet.

In certain coastal areas deer (*Odocoileus virginianus*) populations have benefited from impoundments. In addition to having permanent freshwater and an increased food supply, the levees provide travel lanes, escape cover and make more areas easily accessible.

SUMMARY

As a part of a waterfowl management program, the Louisiana Wild Life and Fisheries Commission began constructing marsh impoundments on certain refuges in 1954. Nine impoundments with a total area of 18,290 acres were completed in 1956 on Rockefeller Refuge.

Studies in 1959 revealed that good duck food plants made up 50 percent of the vegetative composition of the impoundments; but in adjacent control areas these plants made up less than five percent. Over 400,000 ducks wintered on the 84,000-acre refuge and of this number 80 percent were found in the impoundments.

Impoundments should be constructed only in areas which will support a suitable levee. Structures should be installed in any impoundment system to facilitate water level manipulation.

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