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CRAWFISH-WATERFOWL, A MULTIPLE USE CONCEPT FOR IMPOUNDED MARSHES

by

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ABSTRACT

A study was initiated in order to evaluate crawfish *(Procambarus clarki)* production in several impoundments managed for waterfowl on Rockefeller Refuge, Grand Chenier, Louisiana. Impoundments have been intensively managed for waterfowl on the refuge for the past 16 years, however, this has been through a gravity flow system. Pumping units were installed in three of the impoundments in 1968, bringing under water control some 6,000 acres of marshland. Certain management techniques employed in these impoundments, particularly in the areas controlled by pumping units, have significantly increased the production of crawfish as well as desirable waterfowl food plants. It is hoped that programs of this nature will stimulate the owners of large tracts of marshes to manage their holdings for wildlife.

It is probable that more wetlands would be created and preserved if land owners could get some assurance of added profits from multiple land usage programs such as the production of crawfish in waterfowl impoundments. This potential exists in Louisiana and bordering states where crawfish are a commercially important human food item.

INTRODUCTION

It is apparent that little by little the marshlands of Louisiana are being altered into areas not conducive to wildlife dependent upon wetlands. The quantity and quality of nursery grounds for sport and commercial fisheries are gradually declining, and each year the vast wetlands that are so very important to our furbearers and wintering waterfowl decrease in size.

Landowners trying to get maximum yield from their lands have gradually drained and channelized many acres of prime coastal marshland. Oil exploration, agriculture and navigation are probably three of the major interests involved. Oil exploration began in 1920 in the Louisiana marshes and has resulted in the alteration of waterfowl wintering habitat due to drainage, pollution and saltwater intrusion. Marsh drainage for agriculture also greatly reduces the value for wildlife. The construction of navigation channels have led to the rapid drainage of thousands of acres of one time prime waterfowl habitat.

Since land-use practices have a direct influence on wildlife, the development of practices which result in financial gain to the landowner and at the same time benefit wildlife are essential.

Multiple use practices offer the greatest solution for capitol gain from a particular marsh area. However, the development of practices which are compatable is essential.

A multiple use program which may offer a solution to the problem is waterfowl management and crawfish production. This paper relates certain aspects of impoundment management for waterfowl and the relationship of these practices to the production of a recreational crop of crawfish.

STUDY AREA

Information for this paper was gathered through research conducted at the Rockefeller Wildlife Refuge. The state-owned and operated refuge is located in the Chenier Plain marshes of Southwestern Louisiana. The refuge borders the Gulf of Mexico for 26.5 miles and extends six miles northward to the stranded beach ridge complex of Grand Chenier. The Rockefeller marsh has an average elevation of 1.1 feet above sea level and an average tidal fluctuation of approximately 18 inches between mean low and high tides. The salinities of the refuge waters range from 0.1 ppt (parts per thousand) to 30 ppt. The typical marsh flora of wiregrass *(Spartina patens)* and saltmarsh grass *(Distichlis spicata)* is dominant in the non-impounded areas of the refuge.

DISCUSSION

Crawfish Culture

The red swamp crawfish *(Procambarus clarki)* is considered a valued delicacy not only to Louisianans, but to citizens of the bordering states of Texas, Arkansas and Mississippi and indications are that the market will expand.

Since the supply of crawfish is seasonal and largely depends upon an erratic natural crop, mainly from the Atchafalaya Basin of Louisiana, they are often in short supply. The recently established business of crawfish farming has proven successful to most persons involved (Figure 1). These farmers are able to control water levels and produce satisfactory crops with less annual variation than that experienced in natural areas.

Crawfish farming is a relatively new industry. It was reported in 1959-60 that there were approximately 2,000 acres devoted to crawfish farming in Louisiana (Viosca, 1961). The acreage increased to 6,000 acres by 1966 (LaCaze, 1966), and to 12,000 by 1969 (Perry and LaCaze, 1969). In 1970 there are reports of 18,000 acres being in production and the supply still can not meet the demand (C. LaCaze, Personal Communication). The acreage devoted to crawfish farming suggest the importance of this industry to the recreation and economy of the state (Figure 2). Rice lands have also been used for crawfish production as a rotation with rice, using procedures as described by Thomas (1963).

Waterfowl Impoundments

In the early 1950's saltwater intrusion and tidal action, resulting in drastic salinity changes and extensive flooding and draining were greatly reducing the quality of the waterfowl habitat in the Rockefeller marshes. Realizing that this would jeopardize the habitat for migratory waterfowl, the Louisiana Wild Life and Fisheries Commission in 1954 began constructing brackish and freshwater impoundments.

Chabreck (1960) revealed three types impoundments; permanently flooded brackish water, permanently flooded freshwater, and manipulated freshwater. He stated that impoundments permanently flooded with brackish water usually produced an abundance of widgeongrass *(Ruppia maritima)*. These impoundments are very attractive to all ducks; especially gadwalls, widgeon, mottled ducks, pintail and shovellers and require some manipulation of water levels. He reported that the permanently flooded freshwater type usually produces a lower quality food and is generally used by diving ducks and coots. His data indicated that the manipulated freshwater type was best, producing stands of high quality annual grasses and sedges; such as wild millet *(Echinochloa walteri),* sprangletop *(Leptochloa fascicularis),* spike rush *(Eleocharis sp.),* foxtail *(Setaria magna),* and nutgrass *(Cyperus sp.)* (Figure 3).

Water levels on Rockefeller Refuge were regulated by gravity drainage, rainfall and evaporation for a number of years. This system was very inefficient and often the desired water level could not be obtained. In order to gain better control of water levels, pumping units were installed on three impoundments in 1968. These pumps were constructed so that the same unit could be used to drain or fill the impoundments. With the installation of these units, water levels could be maintained on approximately 6,000 acres of marshland.

Water control structures first installed in the Rockefeller impoundments consisted of 48 inch corrugated metal culverts equipped with radial screw lift gates and flap gates. The lift gate and an overflow structure were placed on the impoundment side and the flap gate was on the canal side to prevent high water flowing into the impoundments. These structures were found to be very short-lived due to the corrosive nature of coastal waters. Presently, pumping units are being used for freshwater impoundment systems and concrete and timber stop log (gravity flow) systems are being used for water control in brackish water impoundments.

Ensminger (1963) in an excellent discussion of impoundment construction reported that the life expectancy of impoundment systems depends on a sound levee system. He states that marsh soil varies as to its moisture content and careful consideration had to be given to levee subsidence and shrinkage. Also, the initial levee height depends upon the foundation upon which the levee is placed. A finished grade of at least four feet, a slope of 2:1, and a crown width of 18 feet is suggested. Also, a berm of at least 12 feet should be left on the canal side to prevent the levee from sluffing. New levees may experience as much as 60 percent shrinkage due to the semi-fluid nature of the soil. Maximum shrinkage is during the first two years.

Multiple Use Concept

The management techniques for raising crawfish and production of choice waterfowl foods appear to be synonymous. This indicates that the two may be successfully incorporated, thus resulting in greater production of both resources and a high margin of monetary profit to land holders. After a close review of existing crawfish farming practices and a careful check on the methods of waterfowl management the following procedures were formulated:

Time	Method Recommended
Early spring*	Levees built, pumping units installed.
March 1st*	Pond dried, cover established, fish eradication.
May 1st-June 1st*	Pond flooded, and stocked with crawfish.
June 1st*	Pond slowly dewatered and remain dry.
Late September	Pond reflooded. 4-8 Inches of water by Oct. 15th.
December-May 15th	Crawfish harvested.
May 15th-June 1st	Pond slowly dewatered. (Cycle repeated)

*New ponds not containing a natural stock of crawfish.

FIGURE 1. There are approximately 18,000 acres devoted to crawfish culture in Louisiana and the commercial catch is taken in traps constructed of ¾ inch poultry wire baited with fish or meat of some type.

FIGURE 2. The recreational value of crawfishing is inestimable. Pictured above, two families try their luck at night with baited lift nets.

FIGURE 3. Annual summer drawdowns encourage the germination of valuable species such as wild millet and foxtail. This type management will produce an abundance of food which is heavily used by puddle ducks.

Preparation of Pond. The land should be flat and capable of maintaining water depths of 4 to approximately 8 inches. However, the levee should be high enough to prevent nearby streams from overflowing into the impoundments during periods of high water. The slope of the bed should be such that the impoundment may be completely dewatered. A natural stream may be used as a water supply, but this should be screened to avoid the entrance of fish. Dense stands of water hyacinth, cattail, and other large, tough plants are undesirable since they do not furnish a significant amount of food for ducks or crawfsh. However, with the proper water manipulation many of the more succulent annual grasses will thrive.

In the absence of a natural stock of crawfish, potential ponds should be dewatered by March or earlier if possible and prepared for stocking. If there are low places where water persist, rotenone should be added to eradicate any fish present. By May 1st, a natural stand of vegetation should be present and the field should be flooded to approximately 6 inches for stocking. The flooding and drying operations must be accomplished to coincide with the natural needs of the crawfish and annual grasses.

Stocking. On new ponds, crawfish should be stocked in late May when they are easily obtained and the price is relatively low (LaCaze, 1966). Stocking rates may range from 15 pounds per acre in areas containing a small natural stock of crawfish to 95 pounds per acre in areas completely void of crawfish.

Dewatering. The gradual dewatering of the impoundment should begin approximately three weeks after stocking, around the first of June, and should be drawn out over a period of two to four weeks. The crawfish will begin to burrow in the soft mud as the pond is slowly dewatered. Quick draining will expose many crawfish to predators. The crawfish which mate during April, May or June remain dormant until the pond is reflooded in early fall.

The annual summer drying of freshwater impoundments is necessary so that lake beds are allowed to solidify and oxydize, increasing available nutrient levels many fold. The seeds of the annual grasses must also be on exposed soil to germinate. Thus, water is also drained from waterfowl impoundments by mid-May or early June and the bottoms kept dry.

Beginning in September, eggs are laid and simultaneously fertilized by the sperm held in the receptacle of the female crawfish. The eggs (about 400) are deposited on the underside of the female's tail. Approximately 14 to 21 days later, hatching occurs and it takes another two weeks before the young are able to make it on their own.

Reflooding. If the ponds are not reflooded by this time the females are believed to remain in the burrows and may become canibalistic. Also, crowding and shortage of food in the burrows will retard growth, causing a late harvest. Early crawfish bring the highest prices; therefore, flooding should be done as early as possible. Reflooding at this time is especially attractive to the early waterfowl migrants such as teal and pintail (Figure 4).

The ponds are slowly dewatered beginning in mid-May-early June. They remain dry until the next September flooding. The cycle is repeated.

Harvest. Crawfish harvesting may begin in early December in some instances, catching adults or late hatches from the year before. Crawfish are harvested by means of lift or drop nets and by round funnel type traps. The most common baits used are beef melts, fish heads, and shad. A well managed and harvested crawfish pond will yield between 400 and 1,000 pounds per acre annually. The harvest of waterfowl will naturally depend upon hunting seasons, number of days hunted and bag limits.

Sample Data. Vegetative sampling has been conducted on impoundment 10 on Rockefeller during the early fall of each year since its construction. This was by line transects and quadrats as described by Chabreck (1960). A summer dry up was not achieved for the years of 1959, 1960, 1961, 1964, 1966, 1967, and 1968 (Table 1). The excellent or choice freshwater waterfowl foods of nutgrass, wild millet, sprangletop and foxtail were poorly represented if at all during these lean years (Table 2). An analyses of the percent vegetative coverage showed that these years experienced varied results. However, upon a closer check it is seen that the vegetation was of poorer quality.

Waterfowl inventory records reveal that before the impoundment work was started at the Rockefeller Wildlife Refuge, there were fewer than 75,000 ducks utilizing the 84,000 acre refuge. Now, our records show that duck usage has increased and reaches a peak of approximately 400,000 birds.

Impoundment 10 has produced two crops of crawfish since 1965. During these years with heavy crawfish production it was possible to dry and flood the impoundment at the proper time. This 480 acre impoundment was opened to the public for sport fishing and a good harvest resulted.

A study evaluating the potential of Louisiana brackish coastal acres for crawfish culture gave additional support to this multiple land use program (Perry and LaCaze, 1969). This study disclosed a plant succession of choice duck foods in the experimental pond. The dominant vegetation present in the study pond prior to renovation was oyster grass *(Spartina alterniflora)* indicating a highly brackish area. Shortly after the management of this brackish-freshwater pond began for crawfish, choice annual waterfowl foods began to appear. In fact, sprangletop made up 80 percent of the vegetation and wild millet made up 10 percent after the first 14 months of crawfish management. The study ponds were very attractive to wintering waterfowl as well as producing good yields of crawfish.

SUMMARY

Considering the continuing decline in natural marsh habitat, a need for intensified waterfowl management will increase. Where water levels and quality control can be manipulated, waterfowl use can be increased through the improvement of food supplies.

The Louisiana Wild Life and Fisheries Commission began constructing marsh impoundments in 1958 as a part of a waterfowl management program. Studies over the past 12 years revealed that choice duck foods made up a good percentage of the manipulated freshwater impoundments when managed correctly. This resulted in a greatly increased carrying capacity of the impoundments for waterfowl. Annual waterfowl censuses revealed that duck usage has increased on the refuge approximately 400 percent.

Crawfish production was another benefit derived from such management. In fact, enough could be gained from this to make it attractive to landowners interested in getting the most from their holdings.

ACKNOWLEDGMENTS

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FIGURE 4. Prior to the construction of the impoundments, waterfowl inventories listed the duck usage of the 85,000 acre refuge at 75,000 birds, but since the completion of the impoundments, duck usage has increased to 400,000. Although impoundments comprise less than one-fourth the total area, 80 percent of the ducks on the refuge are found in the impoundments.

TABLE 1
WATER DEPTHS (FT.) IN LAKE 10, ROCKEFELLER WILDLIFE REFUGE

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
January	*	1.7	1.78	1.74	0.68	1.14	1.42	0.76	0.86	1.36	1.24
February	*	1.8	1.74	1.76	0.80	1.18	1.40	1.00	0.98	0.70	0.20
March	2.0	1.76	1.72	1.46	0.80	1.16	1.44	1.60	0.80	0.66	1.42
April	1.7	1.60	1.40	1.30	0.50	1.01	1.38	1.00	0.70	0.60	1.00
May	1.5	1.52	1.26	1.00	dry	0.80	0.02	1.30	1.10	0.52	1.98
June	1.2	1.40	1.06	0.56	0.01	0.36	0.10	0.60	0.75	0.46	1.30
July	1.1	0.52	1.22	0.40	dry	1.52	dry	0.36	0.10	0.70	dry
August	1.5	0.58	1.66	dry	dry	1.45	dry	0.70	0.60	0.64	0.10
September	1.4	1.10	1.70	0.42	0.90	1.44	dry	0.42	1.56	0.60	0.40
October	1.4	0.96	1.70	0.25	0.70	1.50	0.36	0.62	0.60	1.02	0.30
November	1.8	1.20	1.42	*	0.82	1.28	0.20	0.58	1.18	0.20	0.10
December	1.6	1.20	1.66	0.10	0.70	1.44	0.30	0.66	0.50	1.42	0.05

*Sample not obtained

TABLE 2

PERCENT VEGETATIVE COMPOSITION OF LAKE 10, ROCKEFELLER WILDLIFE REFUGE

Species	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Spartina patens	1.9	-	-	-	-	-	-	2.0	2.6	7.2	6.0	3.6
Bacopa monnieri	-	-	-	-	0.4	7.3	4.7	5.9	2.6	tr.	-	0.9
Cyperus sp.	-	-	-	-	6.7	70.0	-	36.7	tr.	tr.	1.0	9.5
Echinochla walteri	-	-	-	-	-	9.5	-	26.5	0.7	tr.	6.0	31.1
Scirpus californicus	12.8	13.5	11.1	13.3	1.1	-	tr.	2.0	13.8	-	tr	tr.
Baccharis halimifolia	-	-	-	-	-	-	-	-	-	tr.	tr.	tr.
Pluchea purpurascens	-	-	-	-	-	2.2	-	4.7	-	-	6.0	1.8
Leptochloa fascicularis	-	-	-	-	-	-	-	tr.	-	-	-	0.9
Vicia ludoviciana	-	-	-	-	-	-	-	-	tr.	-	-	
Setaria magna	-	-	-	-	-	-	tr.	11.7	-	tr.	-	tr.
Acnida alabamensis	-	-	-	-	-	-	-	0.4	-	-	-	tr.
Eleocharis sp.	-	-	-	-	3.7	6.6	-	-	tr.	-	-	38.7
Sagittaria latifolia	19.4	10.0	21.0	24.9	30.0	4.4	93.1	tr.	26.3	29.6	42.0	13.5
Lemna minor	31.6	70.9	27.9	32.9	-	-	2.2	-	46.1	17.6	36.0	tr.
Daubentonia sp.	-	-	-	-	-	-	-	-	-	-	-	tr.
Iva frutescens	-	-	-	-	-	-	-	-	-	-	-	tr.
Phragmites communis	-	-	-	-	-	-	-	-	-	1.6	tr.	-
Ruppia maritima	34.3	5.6	28.9	28.9	58.1	-	-	-	6.6	-	-	-
Chara vulgaris	-	-	-	-	-	-	-	-	-	-	1.0	-
Potamogeton sp	-	-	-	-	-	-	-	-	-	30.4	-	-
Najas sp.	-	-	-	-	-	-	-	-	tr.	11.2	2.0	-
Wolffia sp.	-	-	-	-	-	-	-	-	-	-	tr.	-
Lippia sp.	-	-	-	-	-	-	-	-	-	-	tr.	-
Zizaniopsis miliacea	-	-	-	-	-	-	-	-	tr.	tr.	-	-

TABLE 2 Continued

TABLE 2
PERCENT VEGETATIVE COMPOSITION OF LAKE 10, ROCKEFELLER WILDLIFE REFUGE

Species	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Spartina patens	1.9	-	-	-	-	-	-	2.0	2.6	7.2	6.0	3.6
Bacopa monnieri	-	-	-	-	0.4	7.3	4.7	5.9	2.6	tr.	-	0.9
Cyperus sp.	-	-	-	-	6.7	70.0	-	36.7	tr.	tr.	1.0	9.5
Echinochla walteri	-	-	-	-	-	9.5	-	26.5	0.7	tr.	6.0	31.1
Scirpus californicus	12.8	13.5	11.1	13.3	1.1	-	tr.	2.0	13.8	-	tr	tr.
Baccharis halimifolia	-	-	-	-	-	-	-	-	-	tr.	tr.	tr.
Pluchea purpurascens	-	-	-	-	-	2.2	-	4.7	-	-	6.0	1.8
Leptochloa fascicularis	-	-	-	-	-	-	-	tr.	-	-	-	0.9
Vicia ludoviciana	-	-	-	-	-	-	-	-	tr.	-	-	
Setaria magna	-	-	-	-	-	-	tr.	11.7	-	tr.	-	tr.
Acnida alabamensis	-	-	-	-	-	-	-	0.4	-	-	-	tr.
Eleocharis sp.	-	-	-	-	3.7	6.6	-	-	tr.	-	-	38.7
Sagittaria latifolia	19.4	10.0	21.0	24.9	30.0	4.4	93.1	tr.	26.3	29.6	42.0	13.5
Lemna minor	31.6	70.9	27.9	32.9	-	-	2.2	-	46.1	17.6	36.0	tr.
Daubentonia sp.	-	-	-	-	-	-	-	-	-	-	-	tr.
Iva frutescens	-	-	-	-	-	-	-	-	-	-	-	tr.
Phragmites communis	-	-	-	-	-	-	-	-	-	1.6	tr.	-
Ruppia maritima	34.3	5.6	28.9	58.1	-	-	-	6.6	-	-	-	
Chara vulgaris	-	-	-	-	-	-	-	-	-	-	1.0	-
Potamogeton sp	-	-	-	-	-	-	-	-	-	30.4	-	-
Najas sp.	-	-	-	-	-	-	-	-	tr.	11.2	2.0	-
Wolffia sp.	-	-	-	-	-	-	-	-	-	-	tr.	-
Lippia sp.	-	-	-	-	-	-	-	-	-	-	tr.	-
Zizaniopsis miliacea	-	-	-	-	-	-	-	-	tr.	tr.	-	-

TABLE 2 Continued

Species	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
Ceratophyllum demersum	-	-	-	-	-	-	-	-	-	2.4	-	-
Scirpus robustus	-	-	-	-	-	-	tr.	tr.	-	-	-	-
Paspalum distichum	-	-	-	-	-	-	tr.	tr.	1.3	-	-	-
Sesuvium portulacastrum	-	-	-	-	-	-	-	tr.	-	-	-	-
Aster sp.	-	-	-	-	-	-	-	tr.	-	-	-	-
Panicum dichotomiflorum	-	-	-	-	-	-	-	10.1	-	-	-	-
Vegetative	77.8	76.1	68.9	11.5	57.9	48.9	15.2	88.3	52.4	44.6	35.7	78.2
Non-Vegetative	22.2	23.9	31.1	88.5	42.1	51.1	84.8	11.7	47.6	55.4	64.3	21.8

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INFLUENCE OF TEMPERATURE AND PHOTO-PERIOD ON GROWTH, FOOD CONSUMPTION AND FOOD CONVERSION EFFICIENCY OF CHANNEL CATFISH

by

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ABSTRACT

A total of 275 channel catfish, measuring on the average of 21.4 mm in total length were raised in the laboratory for 120 days under controlled temperatures of 26, 28, and 32 C with 10-hr and 14-hr photoperiods. Data on growth, food consumption, food conversion efficiency, and water quality were collected at 15-day intervals.

Analysis of length-weight relationship showed that the experimental conditions had no effect on body shape. The fish under 28C-10L had slow growth in length throughout the study period. Variations in food consumption and food conversion efficiency in 15-day intervals were discussed. Average food consumption and food conversion efficiency for the entire study period were discussed in relation to temperature-photoperiod combinations. The fish at 28 and 32 C consumed more food under 10-hr than under 14-hr light conditions. There was a direct relationship between photoperiod and food conversion efficiency for the fish at all the three temperatures. Based on overall evaluation of growth, food consumption, food conversion efficiency, water quality, and mortalities, it was concluded that the optimum condition for raising channel catfish was at 32 C under a 14-hr photoperiod.