LOUISIANA'S ALLIGATOR RESEARCH PROGRAM

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The Louisiana Wildlife and Fisheries Commission initiated an intensive research program centered around the alligator (Alligator mississippiensis) as early as 1958. During that period the alligator population was at its all time low and concern for the survival of this species arose. It became quite apparent a harvestable surplus of alligators no longer existed. The alligator take in Louisiana dropped from 35,796 hides in 1948-49 to 1,091 in 1960-61. The only viable populations remained on state and federal refuges and large private land holdings which were impenetrable to man.

Very little was known about the life history of this ancient reptile and management was limited to regulating the harvest. In 1958, additional laws were passed in Louisiana regulating the taking of alligators within certain size limits and time periods. The total take continued to decline and in 1964 the season was closed statewide and a concentrated effort was made to reestablish this population.

The alligator is found throughout Louisiana's river systems, lakes, swamps, bayous, and coastal marshes. However, the greatest population is located within the four million acres of the coastal marshes of southern Louisiana. As a result of this, the majority of the research has been centered around the coastal marsh population.

The objectives of the research program centered at Rockefeller

Refuge were:

1. To investigate the life history and basic ecology of the alligator in Louisiana, specifically as observed on Rockefeller Refuge and surrounding areas.

2. To gather information on the distribution, abundance, and status of the species in Louisiana.

3. To determine the various factors affecting an alligator population.

4. To conduct experimental management programs as an aid in developing methods and recommendations for improving indefinitely, and maintaining Louisiana's alligator resource.

5. To develop propagation techniques for the American alligator in captivity.

This report deals with the findings of the various studies from the period of 1958 to the present.

Methods of Capturing, Marking, and Sexing Alligators.

The initial study conducted by Louisiana was to initiate a growth and movement study on alligators. To do this, it was necessary to develop a practical field method for capturing alligators. Chabreck (1963) described the results of an early study using a snare capture devise mounted on a pole. This method has proven successful and since 1958 over 5,000 alligators have been captured. As alligators have no external sex characters, cloacal examination was the sole method used to determine sex.

Clipping certain toes and notching the dorsal tail scutes along with insertion of self-piercing metal tags were methods used to identify individual alligators recaptured in the wild.

Studies conducted on Rockefeller Refuge from 1969 to 1970 involved the use of electrical current to immobilize alligators. Both AC and DC electrical current were tested. It was found that alligators were only slightly affected by AC electrical current. The DC electrical current tested gave varied results. Best results were obtained with 240 volts DC and applying the prod pole to the neck region with the ground approximately 5-10 feet away from the animal. Alligators were immobilized for 15-25 minutes with no apparent injury. Only limited field tests were conducted, as this method was found to be useful only during periods of low water (Joanen and Perry, 1971).

The Movement of Alligators in Louisiana.

From 1959 through 1965, approximately 2,000 alligators were captured, marked, and released in southwest Louisiana. The results of this study showed tagged alligators captured and released at the same site moved farther and farther from the site as time progressed. Of those recaptured after three years, 67 percent dispersed over one mile from the release site. Tagged alligators transported elsewhere for release moved three to four times greater than normal and showed strong homing instinct. Of those recaptured two years or more after release, 83 percent had dispersed eight

miles or more from the release site (Chabreck, 1965).

Telemetric Studies.

A considerable amount of time, effort, and money has been expended by the Refuge Division of the Louisiana Wildlife and Fisheries Commission monitoring alligators with radio telemetry tracking gear (Joanen and McNease, 1970 and 1972; McNease and Joanen, 1974). These studies have added valuable base line biological information that may be applied to the management of Louisiana's coastal alligator population.

The most striking point brought to light in these studies was the wide diversification in habitat requirements and habits between sexes of adult alligators. The minimum home range (spring, summer, fall combined) for the males under study varied from 452 acres to 12,560 acres and averaged 3,162 acres; while that for the females varied from 6.4 acres to 41 acres and averaged 21 acres. The minimum daily distance traveled averaged 2,411 feet for males and 79 feet for females.

Movement and activity data indicated that canals and deep water bayous are extremely important in all phases of the life history of the adult male alligator. A highly significant difference existed statistically between canal (large open water bodies) and marsh (predominately wiregrass, Spartina patens) usage. Over 73 percent of the 569 fixes plotted during the male telemetry study were in

either ponds, potholes, or dens in the marsh.

The largest seasonal range size for male alligators was recorded during the summer followed in decreasing order of size by the autumn and spring. Winter movement was confined to the general area around the den site.

During the course of a year all of the adult female alligators monitored used two distinct marsh types. During the spring (early May through May 31) the females were found to use open water bodies on 79 percent of the fixes recorded. This period covered the majority of the breeding season. For the remainder of their active period (June 1 - November 10), the females were closely associated with the marsh proper, spending the majority (90 percent of fixes plotted) of their time in isolated dens. The movement from open water bodies to marsh dens took place in early June or just at the onset of nest construction. Once nesting was initiated, range sizes decreased dramatically.

Immature alligators were found to be consistently more active over a wider range of environmental conditions than were adult alligators (McNease and Joanen, 1974). A comparison of daily movement data revealed that immature males and females exhibited the same trends in seasonal movements but that female movement was slightly greater than males for each season.

Minimum home range size varied from 29.7 acres to 1,523.5 acres and averaged 438.6 acres for 15 immature female alligators.

Immature males ranged from 60.6 acres to 1,493.8 acres and averaged 564.9 acres.

Habitat preference for males and females differed appreciably. The immature males showed a marked preference for shallow water impoundments in the spring and for the remainder of the year, open deep water habitat types were preferred. Immature females like the males, showed a preference for shallow water impoundment areas in the spring and a dependance on deep water areas within dense marsh for the summer, fall, and winter.

A telemetric study is presently underway on immature alligators in a bottomland hardwood area of northeast Louisiana. This study was initiated to investigate the movement and habitat preference of introduced alligators from a coastal environment as compared to the movement and habitat preference of resident animals. This study will involve approximately one year of field work.

Restocking Activities.

Louisiana has taken aggressive action in the restocking of alligators into suitable habitat; areas that historically contained large numbers of alligators but in which due to varied reasons, population levels have fallen in past years. Recipient areas for the transplants included: selected marshlands in south Louisiana, and bottomland hardwoods in Louisiana, Mississippi, and Arkansas.

Three thousand eight hundred and twenty-three alligators have

been moved to new homes since 1959. Of this total, 1,709 were restocked in the marshes of south Louisiana (refuges and wildlife management area's received 37 percent and private lands 63 percent), bottomland hardwood areas and river basins received 527 alligators, and 1,481 were moved to Arkansas and Mississippi. An additional 106 were relocated for educational and research purposes.

The numbers included here as being restocked were captured specifically for this purpose. Numerous nuisance alligators were captured throughout the state and moved to other areas but these numbers were not included for purposes of this discussion.

Nesting---Reproductive Biology.

Biological and environmental factors associated with nesting have been studied at Rockefeller Refuge yearly since the mid-1960's.

Joanen (1969) reported on a five-year investigation to gather information on factors associated with nesting activities of alligators on Rockefeller Refuge. Findings from this study indicated a 68.3 percent nesting success while hatching success averaged 58.2 percent.

Nesting occurred from the first week in June and extended to the first week in July. The bulk of the nesting took place within a two-week period for any given year. Spring temperatures appear to greatly affect the time that the majority of the nesting occurs each year. Incubation averaged about nine weeks.

The average clutch size was determined to be 38.9, ranging

from 2 to 58 eggs per nest. Over half of the nests examined contained cracked eggs. Predation on the nests by raccoons was quite significant and most often occurred just after the eggs began to crack along the longitudinal axis, usually at the end of the seventh week of incubation.

The sizes of nesting females varied between 6 feet and 9 feet (hind foot measurement related to total length); however, no correlation existed between size of the female and number of eggs laid.

In order to more fully understand certain factors affecting population dynamics, a study was initiated in 1969 and continued through 1973 to investigate factors dealing with the alligator's breeding biology. Special emphasis was placed on the mechanics of reproduction.

Analysis of data collected (March through October) indicated that 67 percent of the adult female segment of the population are capable of reproducing for any given year. The onset of sexual maturity was determined to be about 72 inches.

The position of ova in the reproductive tract were as follows:

1. April through the end of May - development of eggs in ovaries.

2. First week of June - eggs moved from ovaries to upper end of oviduct.

3. Second week of June - shelled eggs first appeared in lower

end of oviduct.

4. End of second week of June through end of June - all females capable of reproducing for the year contained shelled eggs in the terminal end of the oviducts - the period from ovulation to laying occupied a 3½ week period.

All males examined in the 6-13 foot size classes were physiologically capable of reproduction. During 1969, males were found to produce semen from May 9 through June 20, a period of 42 days. Maximum gonadal development, hence semen production, was determined to include the period of the last week in May and the first week in June. Dead sperm cells were first encountered during mid-June and by June 20 roughly 90 percent of spermatogenetic activity had ceased (Joanen and McNease, 1973).

Salinity Tolerance of Hatchling Alligators.

A study was initiated in 1971 to determine growth rates and mortality factors of newly hatched alligators as influenced by water salinities.

Four identical tanks were set up with salinity being the only variable tested. Salinities maintained were 0, 5, 10, and 13 parts per thousand. Constant factors were feeding rates, food types, temperature, and stocking rates.

Mortality occurred after 60 days at the highest salinity. The alligators in the two lower salinities gained weight while the ones in the two higher salinities actually lost weight during

the first two months of the study.

Alligators inhabiting brackish marsh areas must tolerate fairly high salinities in water holes during drought periods and during storm tides; therefore, consideration should be given newly hatched alligators under such circumstances if the ultimate in production is to be achieved.

Alligator Carrying Capacity of an Intermediate Marsh Type.

The objectives of this study, begun in 1972, were (1) to determine the number of alligators that a predominately wiregrass, Spartina patens, marsh type will support, (2) to determine food availability on a seasonal basis, and (3) to determine growth rates and relate body conditions to stocking rates.

Three 16-acre pens were stocked with alligators ranging in size from three to five feet in length. Each pen was stocked with a different stocking rate; one alligator per 0.5 acre, one alligator per acre, and one alligator per two acres.

A length-weight relationship has been determined for alligators inhabiting natural marsh. This data will be used as a base line for comparing growth rates of alligators in the three pens. Aquatic and terrestrial food availability samples were made of each treatment.

The study was prematurily terminated when Hurricane Delia of 1973 struck the southwest Louisiana coast and damaged the existing pens. However, extensive repairs will be undertaken

and the project rejuvenated in the summer of 1975.

Method of Determining the Size and Composition of Alligator Populations in Louisiana.

By combining the information from several population survey methods and from kill surveys, Chabreck (1966) was able to compute the total alligator population on an area by size classes. This was accomplished by first obtaining a nest count of the area then applying the formula $P = \frac{N}{AFE}$

where P = total alligator population in the area,

N = total number of alligator nest on the area,

A = percent of alligator population over six feet long,

F = percent of females among alligators over six feet long,

E = percent of adult females nesting.

Using the method described by Chabreck, an experimental coastal alligator census was initiated in 1970 to determine the feasibility of censusing Louisiana's coastal alligator population by counting nests from a helicopter flying permanently established transect lines. A quantative measurement was made of the number of acres transected per nest for each of Louisiana's three marsh types and these figures were used to project alligator populations for the three coastal marsh zones.

Coastal Alligator Census.

Louisiana's marshes may be divided into three zones according

to geological origin; that is, chenier plain, inactive delta, and active delta. Each marsh zone may then be further sub-divided into fresh, intermediate, brackish, and salt marsh types. The nesting surveys in southern Louisiana conducted annually since 1970 indicate approximately 154,000 alligators (1973) in a little over 3¼ million acres of coastal marshlands (Joanen and McNease, 1974). No nesting was observed in the salt marsh, consequently this type was deleted from the survey.

In comparing the population distribution within the three marsh zones, the chenier plain of southwest Louisiana was found to house the greatest population as compared to either the inactive or active delta. This zone occupied only 35 percent of Louisiana's marshland; however, 57.2 percent of the total coastwide population was located within this zone. The inactive marsh zone made up 57 percent of the coastal marsh acreage and yet contained only 34.5 percent of the coastal population. The active delta marshes cover 7.9 percent of the coastal acreage and contained 8.3 percent of the population (Table 1).

In comparing the marsh types within the three marsh zones, the intermediate marsh had the highest population density as compared to the fresh and brackish marsh along the entire coast.

The fresh marsh made up 40.9 percent of the area sampled and contained 40.3 percent of the coastal alligator population. The intermediate marsh occupied 21.8 percent of the coastal

marshland and housed 30.2 percent of the alligators. The brackish marshes of 10 ppt salinity and less comprised 37.4 percent of the area sampled. This marsh type carried only 29.5 percent of the total population.

Approximately 60 percent of the coastal alligator population was determined to be on privately owned land. The remaining 40 percent inhabited publicly owned lands which included state and federal refuges and wildlife management areas. State and federal land comprise approximately 20 percent of the total coastal zone excluding the saline marsh zone (Joanen and McNease, 1972a).

Alligator Night Count Surveys.

A coordinated investigation was begun in 1970 to use standardized alligator night counts to document generalized trends in populations for the southeastern United States. Efforts were made to include the major habitat types commonly used by the American alligator.

In Louisiana, 32 survey lines were checked during 1972 covering some 281.6 miles. This survey was planned for developing an index to the alligator population in different parts of its range. Annual counts of alligators along the survey lines may be used as a means of determining population trends. The survey is not intended as a means of determining total numbers of alligators, and information must be gathered for a period of years before any trend will be evident (Chabreck, 1973).

Population Distribution of Alligators in Southeastern United States.

The status of the alligator in the southeastern United States has received much attention during recent years. This was a direct result from the publicity the alligator received through the news media, conservation groups, state and federal game departments.

Generally speaking, alligator populations today have made dramatic increases when compared to the all time low population levels of the mid-1950's and early 1960's. Several states have documented these trends in the coastal areas with nest count surveys annually since 1970. However, in areas where nest count methods were not feasible, night counts were initiated to determine population trends.

In order to obtain an estimate of total populations and available alligator habitat, a questionnaire was distributed to all state agencies within the range of the American alligator. Information requested included the estimated number of alligators by county/parish, estimated number of square miles of available alligator habitat, and the number of alligators per square mile. The results of the questionnaire showed the following alligator population: North Carolina - 1,314, South Carolina - 48,700, Florida - 407,585, Georgia - 29,954, Alabama - 12,715, Mississippi - 4,740, Oklahoma - 10, Arkansas - 1,900, Louisiana - 200,682, and Texas - 26,784. A total population estimate of 734,384 alligators were recorded in the ten states with approximately 45,000 square

miles of available alligator habitat. Excluding the 64 Florida counties, 152 counties reported stable populations, 168 counties reported increasing populations, and 25 counties reported decreasing populations (Joanen, 1974).

In order that we may get a better insight as to the types of available alligator habitat, an additional questionnaire is in the process of being prepared and distributed to the ten alligator states. Information requested on this survey will classify habitat as to type; such as, wooded swamps, seasonally flooded basins and flats, open fresh water lakes and marshes. Also, a rating will be assigned each habitat type, based on the environmental factors it possesses.

Experimental Alligator Harvest Program for Louisiana, 1972 and 1973.

The Louisiana Wildlife and Fisheries Commission acting on the recommendations made by research and administrative personnel established two experimental alligator harvest seasons in a limited area of southwestern Louisiana during September of 1972 and 1973.

The primary objectives of the programs were to evaluate a complex system of quotas, tags, and report forms which were felt necessary for a controlled harvest of surplus alligators and to measure the effects of the harvest on alligator populations. Secondary objectives were to gather biological information relative to food habits, tag recovery rates, body condition factors, aging techniques, reproductive biology, pesticides and parasite levels

of alligators.

The number of alligator tags allotted to each licensed hunter was determined by the size of the area to be hunted, the quality of the habitat, and most important, the standing crop of alligators on a particular piece of marsh.

During the 13-day season of 1972, 1,350 alligators were taken by licensed hunters. This represented 68.8 percent of the total number of tags issued. The sex ratio of animals examined in the field ran very heavy to males, 80.3 percent. The average hide length was 6'11". The average price paid per linear foot was $8.10 (Palmisano, Joanen, and McNease, 1973). During the 1973 experimental program, 107 licensed alligator hunters were issued 3,243 tags. A total of 2,821 alligators averaging slightly over 7 feet were taken during the 19-day season. This represented 86.9 percent of the total number of tags issued. Males comprised the majority of the harvested animals (66.3 percent). The average price paid per linear foot was $13.15 (Joanen, McNease, and Linscombe, 1974).

A major objective was to test the shipping procedure to assure that no illegally taken skins entered the legal traffic. Control on the shipment was accomplished through a series of shipping tags and report forms which were required of hunters, buyers, and dealers. Hunter report forms were completed at the time of validation and public auction. From these forms the buyer

of each skin was identified. Dealers, shipping their skins out-of-state, are required to complete official shipping tags. The next distination was recorded on the shipping tags.

Population levels appeared unaffected by the experimental harvest program and there was no indication of an increase in poaching activity. Population estimates for privately owned marshlands in Cameron and Vermilion Parishes exhibited significant increases in 1973 and especially 1974 when compared to previous years (Table 2). Figures for 1973 and 1974, the years following the experimental season, showed a 33.4 and 48.5 percent increase respectively over the previous four year average (Joanen and McNease, 1974a).

Enforcement efforts were used to determine the effects of the experimental alligator harvest on the rate of violations. Information on man hours expended and cases filed was tabulated for federal and state agents as well as state refuge wardens for calendar years 1971, 1972, and 1973.

Federal agents expended a total of 3,948 man hours on alligator oriented enforcement in 1971 and filed 21 alligator cases. This amounts to 188 man hours per case. In 1972, the year of the experimental season, 2,645 man hours were expended and 4 cases filed, approximately 661 man hours per case. These figures indicate that 3.5 times the effort was required to file a case in 1972 than 1971 (Table 3). In 1973, 1,640 man hours were expended

and 7 cases filed; approximately 234 man hours per case. These figures indicate that 1.2 times the effort was required to file a case in 1973 as compared to 1971. Man hour figures do not include out-of-state investigations originating in Louisiana or preparation for court and travel time to testify.

State agent enforcement effort followed a similar trend. Information compiled for District 8, a vast area of coastal marsh in southeastern Louisiana, indicated that in 1971, 1,981 man hours were spent and 25 cases filed. The enforcement effort more than doubled in 1972 and 18 cases were made. It required 2.9 times as many man hours to make a case in 1972 than in 1971. State agent enforcement effort followed a similar trend in 1973. The enforcement effort more than tripled in 1973 when 28 cases were made. It required 3.2 times as many man hours to make a case in 1973 as compared to 1971.

State refuge wardens accounted for much of the alligator enforcement effort in coastal Louisiana. Their time was not necessarily confined within the boundaries of the refuges. Only two cases were filed each year by refuge wardens. In 1971, it required 4,658 man hours to make a case and 6,766 man hours in 1972. Enforcement effort indicated that there was a significant reduction in the number of alligator violations in 1972 when compared to the previous year. Only one case was filed by refuge wardens in 1973. It required 14,500 man hours in 1973 to make

a case. Enforcement effort indicated that there was a significant reduction in the number of alligator violations in 1973 when compared to 1971.

Another good index to the degree of alligator hunting was skinned carcasses. During the open season such carcasses were apparent to even the most casual observer. It was no easy matter to dispose of an animal the size of an alligator. Other areas of the state exhibited no apparent signs of illegal hunting. It was evident that the open season did not stimulate alligator poaching anywhere in Louisiana.

Alligator Food Habits.

Various investigations have been conducted relative to the food habits of the alligator. A preliminary review of the food items contained in 202 stomachs taken from three distinct marsh types in the coastal marshes of Cameron Parish, Louisiana are included in Table 4. Collections were made in mid-September, consequently, seasonal availability of food items is not represented. All animals were in the larger size classes (5'-12').

In summary, vertebrates made up 88.8 percent by weight of the foods represented from the fresh marsh, 64.3 percent from intermediate marsh, and 58.8 percent from brackish marshes. Crustacean representation was directly proportional to marsh water salt content---brackish - 30.5 percent, intermediate - 15.5 percent, and fresh - 6.3 percent.

Valentine, et al. (1972) examined 413 alligator stomachs for food contents which were collected in 1961, 1962, and 1964 from a coastal area in Cameron Parish, Louisiana. They found that fluctuations in mammal populations were reflected in alligator food habits. Crustaceans and fishes were found to be important foods for alligators of all sizes. Reptiles and birds ranked fairly high in the diets.

Chabreck (1971) found little relation between foods eaten by young alligators and organisms available in fresh and saline water in Louisiana. Crustaceans were the principal foods in both freshwater and saline areas. Alligator stomachs from a freshwater area contained more than 6 times as much food as those from an adjacent saline area. The stomach capacity in the freshwater area was twice as great as in the saline area. The study suggested that young alligators which remain for extended periods in saline areas will have reduced growth rates as a result of reduced food intake. Chabreck found that crawfish (Procambarus clarki) were the major freshwater food item of alligators, making up 61.0 percent of the food eaten. Water bugs made up less than 10 percent of the diet of the same alligators. Invertebrates other than crawfish and water bugs made up less than 1 percent of the diet in freshwater.

Chabreck examined young alligators in saline waters and found that half of the diet was composed of blue crabs (Callinectes

sapidus) and approximately one-fourth crawfish and fiddler crabs (Uca pugnax). The remainder consisted of fish and insects.

Fogarty and Albury (1967) examined the stomach contents of small alligators from freshwater in Florida and found that the ampullarid snail (Pomacea paludosa) comprised 65.8 percent by volume of the stomach contents. Crawfish comprised 31.9 percent of the stomach contents. Invertebrates accounted for 98.0 percent by volume of the stomach contents.

Giles and Childs (1949) examined the stomachs from 318 specimens taken by hunters on the Sabine National Wildlife Refuge in southwestern Louisiana and found a definite correlation between length of the alligator and types of food taken. Alligators less than 5 feet long contained mainly crustaceans while those over 5 feet showed a preference for vertebrates. McIlhenny (1934) reported 136 herons, 27 turtles, 22 gar, 8 snakes, 1 rabbit, and 1 muskrat in the stomachs of 24 Avery Island, Louisiana specimens from 5 feet 3-1/2 inches (161.1 cm.) to 10 feet 1 inch (306.9 cm.) collected from 1927 to 1931. McIlhenny thought that the large number of herons found in the stomachs was due to the dense concentration of these birds on the island. Chamberlain (1930) reported that the stomach of one alligator taken by set-hook in North Carolina contained five young herons of two species, Hydranassa tricolor and Florida caerulea. Kellogg (1929) analyzed the contents of 149 stomachs collected from Louisiana, Georgia,

and Florida, and found that 70 percent by volume of the diet was invertebrates, 20 percent vertebrates, and 1 percent debris.

Experimental Alligator Farming.

Sixteen licensed alligator propagators; ten farmers, four municipal zoos, and two displayers, are presently responsible for 9,562 alligators in Louisiana. Of these, 665 are adults, 7,700 immatures (12"-71"), and 1,197 young of the year from the 1974 hatch (Joanen and McNease, 1974b).

An alligator farming bill was passed in 1974 by the Louisiana Legislature. This bill outlined operational procedures and established a monitoring program whereby the Louisiana Wildlife and Fisheries Commission could effectively exercise control over these enterprises.

With the decline of the wild population in the mid-1950's and early 1960's, interest turned to alligator farming as a possible source of hides which would augment the rapidly declining wild population. When the alligator season was closed in 1964, more and more people turned to the Louisiana Wildlife and Fisheries Commission for information concerning the propagation of alligators in captivity.

As a result of these inquiries, a study was initiated on Rockefeller Refuge in 1964 in order to investigate the possibilities of raising alligators in captivity. The objectives were:

1. To develop proper methods for maintaining alligators under captive conditions; such as, stocking rates, pen sizes, and feeding rates.

2. To relate propagation techniques to reproductive success.

3. To study behavior, particularly reproductive oriented activities, of alligators under penned conditions.

4. To determine problems, especially diseases and ailments, which effect the well being of the breeding stock.

Results achieved during a seven year study (Joanen and McNease, 1971), demonstrated that alligators can be propagated under captive conditions; however, careful consideration must be given to the source of the alligators (wild or pen reared), size and shape of the pens, source of water supply, size and depth of water holes, and stocking rates. A feeding rate of 7-8 percent of the body weight per alligator per week appears to be an optimum amount, provided a balanced ration is used. Feeding was done twice weekly and all unused food was removed from the feeding sites on the day following feeding. Nesting and hatching success in pens closely correlated that determined for wild alligators in previous studies.

Artificial Insemination---Hormone Evaluation.

Low reproductive rates of alligators held under captive conditions have been a problem that has plagued farmers in the southeast United States. The inability or refusal of alligators to

ovulate under confined conditions is thought to be a major factor in the failure of the alligator to reproduce in captivity. This problem may also be associated with overcrowding of adults and/or pen design. Assuming that the basic problem in the pen rearing of alligators is ovulation, then a logical solution to the problem is (1) inducing the animals into breeding readiness, especially females, by using hormones, and (2) artificial insemination of the female.

An insemination project was initiated in 1970 and continued through 1973 in cooperation with the L.S.U. Animal Science Department to develop workable methods of semen collection, semen storage and artificial insemination. Commercially prepared hormones proved ineffective when administrated in an effort to bring females into breeding readiness. Future hormone work will involve the use of crocodilian, amphibian, and avian pituitary hormones.

Semen was collected from mature males by using the electro-ejaculation method. Various extenders were used to evaluate the most effective in terms of spermatozoan motility. Attempts at freezing extended semen proved unsuccessful, although low livability was recorded for one extender.

Insemination of the female was a simple procedure, using a speculum and small bore pipette to introduce the extended semen into the terminal end of the oviduct.

No nesting or egg deposition was recorded during the three

years of this investigation. Future work will be concentrated on developing techniques to bring the female into a reproductive physiological state such that insemination will take and also, in developing a dependable extender.

Age at First Nesting in the Alligator.

Age at first nesting of captive raised alligators on Rockefeller Refuge was identical to that reported by McIlhenny (1935). Two of six captive raised female alligators first nested at 9 years 10 months of age (Joanen and McNease, 1975). Growth rates were less than optimum, with the females approaching the 72 inch size class in the spring preceeding their first breeding season. Clutch sizes of the nests were 36 and 21 eggs. Nest dimensions for these alligators were considerably smaller than that determined for wild alligators. These findings differ appreciably from that reported by Kellogg (1929) and Neil (1971).

Artificial Incubation of Alligator Eggs.

A study was initiated in 1970 and continued annually through 1974 to develop efficient methods of tending to and artificial hatching of alligator eggs. Reasons for this study are obvious---to reduce effects of the ravages of nature, such as predation, flooding, severe weather, etc.

Uncracked eggs from 11 alligator nests were picked up in late July, 1974 and maintained in a controlled environmental chamber until they hatched. The temperature averaged 84.02° F. for the

incubation period of July-mid-September and relative humidity was maintained near 100 percent.

Various treatments of the eggs were tried and evaluated as to hatching success. These included washed vs. unwashed, over water vs. over dry concrete, and covered (native vegetation) vs. uncovered. A comparison of the first years data revealed no major differences in hatchability according to treatment. Perhaps future research efforts of a more detailed nature will shed more light on the subject.

Hatching success averaged 50.28 percent for all nests, 25.15 percent of the eggs contained dead embryos, and 24.58 percent of the eggs were infertile. This hatching success was slightly below the 58 percent (4 year period) reported by Joanen (1969) for wild nests. However, the small sample size of artificially incubated eggs probably was a factor and may account for the slight variance.

Joanen (1969) reported that 68 percent of 266 wild nests followed over a four-year period produced young. All clutches represented in this study were successful in producing young. The hatch ranged from 1 to 36 and averaged 16.4 young per clutch.

Dr. Robert Chabreck studied artificial nesting over five seasons. Preliminary results indicated that, "Whenever moisture levels (50, 60, 70, 80 percent) were considered alone the 80 percent moisture level produced the highest hatching rate. Whenever temperature (80, 85, 90, 95° F.) levels were considered alone,

the 90° level produced the highest hatching rate. However, the interactions of temperature and moisture was highly significant and the interaction of the 90° temperature and 70 percent moisture produced the highest hatching rate" (14th Biennial Report, La. Wildlife and Fisheries Commission, 1970-71). A comparison study by Chabreck investigated hatching rates of eggs incubated under various types of materials. Grass hay, leaf litter, and sawdust were found to be best when compared to original nest material, sand, sphagnum peat, vermiculite, and Spanish moss.

Propagation of Immature Alligators in Controlled Environmental Chambers.

Nine controlled environmental chambers have been constructed on Rockefeller Refuge and used for propagation and research purposes since 1972 (Joanen and McNease, 1974c). These chambers are essentially insulated concrete vats, three being 16' x 7' and six being 16' x 10'. Heat (84°-86° F.) is furnished by thermostatically controlled electrical thermal conductors and well water through a system of underground plastic pipes. One half of each chamber contained water while half remained dry. Water capacity equalled 140 gallons for the small chambers and 300 gallons for the larger.

Presently, 500 immature alligators are being studied, 78 from the 1972 hatch, 120 from 1973 and 302 from 1974. Factors being investigated most thoroughly are: growth rates and food

conversion, diets, diseases, temperature preferences, and economics. Future investigations, once these animals outgrow their chambers, will center on pen propagation and biological parameters.

No mortality or serious disease problems have been encountered with the 78 alligators originally stocked in 1972 (8.5" long at that time). These animals, nearing their third anniversary under optimum conditions, are approaching 6 feet in length and 60 pounds. The 1973 hatch are in the 3½' to 4' size class and 12 to 14 pounds. The 1974 hatch are roughly 20 inches long.

Various foods have been tested but fresh frozen fish and red meat (nutria) have proven best. Fish is probably better suited for a large scale operation due to its year round availability, low cost, and acceptance. Vitamin, trace elements, and concentrated protein addatives may offer certain advantages that offset their costs. Diets with heavy vegetable base proteins proved entirely unacceptable.

Food conversion rates for animals fed fish and nutria were excellent, requiring about two pounds of feed to produce one pound of alligator.

Gout, produced by overfeeding with fish, and a suspected occasional viral or bacterial infection were the only disease problems encountered during three years of study and oddly enough, these conditions were easily overcome and no mortality was experienced from either. Fighting can be a problem, especially

with high stocking rates (1 alligator less than 6 months old: 0.9 square feet).

In summary, artificial propagation of alligators in environmental chambers is definitely biologically feasible. Their ability to domesticate is remarkable, diseases do not appear to pose any serious threats even at extremely high stocking densities, and type of diets (high quality animal proteins) and environmental controls can be altered to fit a particular set of circumstances.

Summary

Although Louisiana has accumulated a vast wealth of information concerning the life history of the alligator, much still needs to be done. Methods of inventory need to be refined in parts of the state other than the coastal marsh zone. Information is needed with reference to total population, carrying capacity, natural mortality factors, population distribution, habitat requirements, and habitat tolerances. Every effort should be made to encourage research on alligator farming.

One of the biggest threats facing Louisiana today is the unmanaged "development" of out wetland habitat (Jahn, 1967). Frequently these wetlands are altered for agricultural, industrial, or residental purposes. It is essential that a close working relationship be established with private land managers and all available information be disseminated to them using every available media as new research findings become known.

We should recognize the fact that the alligator has many values and therefore, several methods of approach may be used. The main method of approach used in Louisiana since the inception of the program is that the animal can be managed as a renewable resource by a sustained yield harvest. Using this approach, private marshland managers have derived added incentive to manage their wetlands, thus insuring the future of all wildlife forms using that ecological nitch. Our program is devised to provide information necessary to enhance management needs and practices required to maintain, restore, and increase the population of alligators within the state. It is the intention of the Louisiana Wildlife and Fisheries Commission to see that these goals are reached.

An appropriate step in program planning, and one that is often times overlooked, should be the consolidated support by all affected governmental and conservation agencies. Extreme caution should be exercised to insure that programs remain flexible in order to incorporate research findings and to adjust guidelines as new knowledge becomes available.

Likewise, conservation organizations need to push forward with a tremendous unified effort into the public relations---education fields. A governing agency in a democratic society should be especially sympathetic to the feelings of the populace. Only through a free exchange of management concepts and long range

management goals can we as wildlife managers expect public support.

Literature Review

Chabreck, R. H. 1963. Methods of capturing, marking and sexing alligators. Proc. 17th Annu. Conf. Southeastern Assoc. Game and Fish Comm. 17:47-50.

Chabreck, R. H. 1965. The movement of alligators in Louisiana. Proc. 19th Annu. Conf. Southeastern Assoc. Game and Fish Comm. 19:102-110.

Chabreck, R. H. 1966. Methods of determining the size and composition of alligator populations in Louisiana. Proc. 20th Annu. Conf. Southeastern Assoc. Game and Fish Comm. 20:105-112.

Chabreck, R. H. 1971. The foods and feeding habits of alligators from fresh and saline environments in Louisiana. Proc. 25th Annu. Conf. Southeastern Assoc. Game and Fish Comm. 25:117-124.

Chabreck, R. H. 1973. Population status surveys of the American alligator in the southeastern United States in 1972. IUCN Crocodile Specialist Group 1973. Zululand, South Africa. 12 pp. Mimeograph.

Chamberlain, E. B. 1930. Notes on the stomach contents of an alligator. Copeia 3:83-84.

Fogarty, M. J. and J. D. Albury. 1967. Late summer foods of young alligators. Proc. 21st Annu. Conf. Southeastern Assoc. Game and Fish Comm. 21:220-222.

Giles, L. W., and V. L. Childs. 1949. Alligator management of the Sabine National Wildlife Refuge. Journal of Wildlife Management 13(1):16-28.

Jahn, L. R. 1967. Symposium summary, p. 243-250. In John D. Newsom (Ed.) Proc. of the Marsh and Estuary Management Symposium. La. State Univ., Div. Continuing Educ., Baton Rouge. 250 p.

Joanen, T. 1969. Nesting ecology of the alligator in Louisiana. Proc. 24th Annu. Conf. Southeastern Assoc. Game and Fish Comm. 23:141-151.

Joanen, T. 1974. Population status and distribution of alligators in the southeastern United States. Southeastern Regional Endangered Species Workshop, Tallahassee, Florida. 5 pp. Mimeograph.

Joanen, T., and L. L. McNease. 1970. A telemetric study of nesting female alligators on Rockefeller Wildlife Refuge, Louisiana. Proc. 24th Annu. Conf. Southeastern Assoc. Game and Fish Comm. 24:175-193.

Joanen, T., and L. L. McNease. 1970a. Coastal alligator census progress report. Louisiana Wildlife and Fisheries Comm. New Orleans, Louisiana. 7 pp. Mimeograph.

Joanen, T., and L. L. McNease. 1971. Propagation of the American alligator in captivity. Proc. 25th Annu. Conf. Southeastern Assoc. Game and Fish Comm. 25:106-116.

Joanen, T., and L. L. McNease. 1972. A telemetric study of adult male alligators on Rockefeller Wildlife Refuge, Louisiana. Proc. 26th Annu. Conf. Southeastern Assoc. Game and Fish Comm. 26:252-275.

Joanen, T., and L. L. McNease. 1972a. Population distribution of alligators with special reference to the Louisiana coastal marsh zones. 1972 American Alligator Council Symposium, Lake Charles, Louisiana. 12 pp. Mimeograph.

Joanen, T., and L. L. McNease. 1973. Developments in alligator research in Louisiana since 1958. 1973 American Alligator Council Symposium, Winter Park, Florida. 20 pp. Mimeograph.

Joanen, T., and L. L. McNease. 1974. Coastal alligator census progress report. Louisiana Wildlife and Fisheries Comm., New Orleans, Louisiana. Mimeograph.

Joanen, T., and L. L. McNease. 1974a. A summary of population surveys of the American alligator in the Louisiana coastal marshes 1970-1974. Louisiana Wildlife and Fisheries Comm., (Administrative Report), New Orleans, Louisiana. 5 pp. Mimeograph.

Joanen, T., and L. L. McNease. 1974b. Results of alligator farming questionnaire. Louisiana Wildlife and Fisheries Comm., New Orleans, Louisiana. 4 pp. Mimeograph.

Joanen, T., and L. L. McNease. 1974c. Propagation of immature American alligators in controlled environmental chambers. Southern Zoo Workshop, Monroe, Louisiana. 11 pp. Mimeograph.

Joanen, T., and L. L. McNease. (In preparation). Age at first nesting of the American alligator. Louisiana Wildlife and Fisheries Comm., New Orleans, Louisiana. 4 pp. Mimeograph.

Joanen, T., L. L. McNease, and Greg Linscomb. 1974. An analysis of Louisiana's 1973 experimental alligator harvest program. Louisiana Wildlife and Fisheries Commission, New Orleans, Louisiana. 20 pp. Mimeograph.

Joanen, T., and W. G. Perry, Jr. 1971. A new method for capturing alligators using electricity. Proc. 25th Annu. Conf. Southeastern Assoc. Game and Fish Comm. 25:124-130.

Kellogg, A. R. 1929. The habits and economic importance of alligators. U. S. Dept. Agri., Tech. Bull. 147. 36 pp.

McIlhenny, E. A. 1935. The alligator's life history. The Christopher Publishing House, Boston. 117 pp.

McNease, L., and T. Joanen. 1974. A study of immature alligators in Rockefeller Refuge, Louisiana. Proc. 28th Annu. Conf. Southeastern Assoc. Game and Fish Comm. (In press).

Neil, W. T. 1971. The last of the ruling reptiles. Columbia University Press, New York. 486 pp.

Palmisano, A. W., T. Joanen, and L. L. McNease. 1973. An analysis of Louisiana's 1972 experimental alligator harvest program. Proc. 27th Annu. Conf. Southeastern Assoc. Game and Fish Comm. 27:184-206.

Valentine, J. M., J. R. Walther, K. M. McCartney, and L. M. Ivy. 1972. Alligator diets on the Sabine National Wildlife Refuge, Louisiana. Journal of Wildlife Management. 36:809-815.

14th Biennial Report, State of Louisiana Wildlife and Fisheries Commission. 1970-71. p. 73-74.

TABLE 1

COASTAL ALLIGATOR POPULATION ESTIMATES IN PERCENT ACCORDING TO MARSH ZONES AND MARSH TYPES*

	MARSH ZONES							
	CHENIER PLAIN		INACTIVE DELTA		ACTIVE DELTA		Percent of Population/ Marsh Type	Per Ac Mar
sh Type	Population Estimate (%)	Acreage	Population Estimate (%)	Acreage	Population Estimate (%)	Acreage		
sh	23.66	425,100	12.86	744,900	3.81	129,340	40.33	
ermediate	20.54	354,594	5.85	230,400	3.78	106,800	30.17	
ckish**	13.05	332,466	15.74	838,786	0.70	15,747	29.49	
AL ACREAGE		1,112,160		1,814,086		251,887		
AL POPULATION	99,520		58,660		14,120			
cent Population, Per- Acreage/ sh Zone	57.25	34.99	34.46	57.08	8.29	7.93		

*Data from 1970 alligator population survey (Joanen and McNease, 1970).

**Excludes marsh acreage of 10 ppt salinity and greater.

TABLE 2

ALLIGATOR POPULATION ESTIMATES FOR PRIVATELY OWNED MARSHLANDS IN CAMERON AND VERMILION PARISHES

Year	ESTIMATED POPULATION		
	Cameron Parish[x]	Vermilion Parish	Total for Chenier-Plain
1970	36,760	17,060	53,820
1971*	18,880	13,931	32,811
1972	36,240	21,820	58,060
1973	39,734	13,503	53,237
1974	54,522	18,977	73,499

[x] Small portion of Calcasieu Parish included.

* Extremely dry nesting conditions in 1971 resulted in a low nesting effort.

TABLE 3
ALLIGATOR ENFORCEMENT EFFORT IN LOUISIANA FOR 1971-1973

Year	Federal Agents			State Agents*			State Refuge Agents		
	Man Hours	Cases Filed	Man Hours Per Case	Man Hours	Cases Filed	Man Hours Per Case	Man Hours	Cases Filed	Man Hours Per Case
1971	3,948	21	188	1,981	25	79	9,316	2	4,658
1972	2,645	4	661	4,227	18	235	14,500	1	14,500
1973	1,640	7**	234	6,400	28	228	13,532	2	6,766

* - Only District 8 - coastal parishes of southeastern Louisiana. Does not include approximately 3,000 man hours in Cameron and Vermilion Parishes during the period of the open alligator season.

** - Assisted state agents.

TABLE 4 - CONTINUED

Type Food	Fresh Marsh (72 Stomachs)		Intermediate Marsh (55 Stomachs)		Brackish Marsh (75 Sto	
	Percent Occurrence	Percent by Weight	Percent Occurrence	Percent by Weight	Percent Occurrence	Perc by We
Bull Frog	0	0	3.64	0.02	0	0
Deer (White Tail)	0	0	1.82	0.12	0	0
Snails	6.94	Trace	3.64	0.06	0	0
Shrimp	5.56	0.01	1.82	Trace	16.00	0.
Mollusk	0	0	1.82	0.02	1.33	Tra
Alligator Eggs	0	0	7.27	0.40	2.67	0.
Rats (Rice)	1.39	0.01	0	0	0	0
Plant Material	94.44	3.15	74.54	6.09	88.00	7.
Non-Foods	41.67	0.57	21.82	13.04	53.33	1.
Miscellaneous	20.83	1.58	3.64	0.58	5.33	0.

Type Food						
Nutria	63.89	65.57	41.82	25.68	22.67	20.7
Raccoon	4.17	7.61	7.27	2.40	0	0
Muskrat	6.94	1.83	0	0	0	0
Rabbit	1.39	2.76	7.27	2.01	0	0
Mink	2.78	0.24	1.82	2.52	0	0
Insects	30.56	0.02	12.73	0.01	22.67	0.1
Crab	19.44	3.50	56.36	13.03	60.00	28.4
Crawfish	51.39	2.83	32.73	2.48	30.67	2.0
Fish	25.00	4.80	36.36	12.64	58.67	33.1
Birds	44.44	3.57	50.91	9.47	14.67	4.0
Snakes	29.17	0.73	20.00	1.39	5.33	Trac
Turtles	11.11	0.08	7.27	0.13	4.00	0.1
Armadillo	1.39	1.13	1.82	7.65	0	0
Opossum	0	0	1.82	0.23	0	0