CAPTIVE PROPAGATION OF ALLIGATORS IN LOUISIANA

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Abstract

The Louisiana Department of Wildlife and Fisheries conducted an alligator (Alligator mississippiensis) research and management program during the period 1959 through 1981. The research program included a field study segment investigating basic life history and a culture program based on biological facts derived from field investigations. In 1976 a Chinese alligator (Alligator sinensis) propagation program was begun. This paper addresses facility design, maintenance, feeds and feeding, growth, and reproductive success for alligators in captivity at Rockefeller Refuge, Grand Chenier, Louisiana. Biological information collected from wild alligators and nests in the wild provided a basis for comparison of reproductive success, growth, and age at maturity under captive conditions.

Introduction

In 1959 the Louisiana Department of Wildlife and Fisheries initiated an intensive alligator research and management program. Research was in two parts: a field study investigating basic life history and a culture program based on biological facts

derived from field investigations. The farming study demonstrated the feasibility of rearing alligators in captivity and reinforced the concept of culture as a viable source of animals for commercial and conservation purposes. We are able to study captive alligators and make observations on reproductive activities, stocking densities, food requirements, growth, and social order. In 1976 a Chinese alligator propagation program was begun.

The transition of the alligator from a native habitat, one literally occupied for millions of years, to an artificial environment offers tremendous challenges in terms of management. This paper describes facility design, maintenance, feeding, growth, and reproductive success for alligators reared in captivity at Rockefeller Refuge, Grand Chenier, Louisiana.

Basic Life History

Information gathered from telemetric investigations added valuable insight into habitat requirements of adult alligators (Joanen and McNease 1970, 1972). Insight was gained as to differences in habitat requirements both by sex and season. Both sexes tended to gather in courting groups in open water areas, usually 1 to 3 m in depth, during the spring. During courtship females were more social than males, but after mating the males remained in the open water while females moved to small isolated ponds surrounded by dense cover in the interior marshes to begin nest construction. Females generally remained in isolation until the following spring when courtship once again brought them into open water.

Growth rates of wild alligators provided a base for evaluating

growth under captive conditions. Males grow fairly rapidly for 20 years (until ≈3.5 m long) and reach a projected total length of 4.2 m at age 80. Growth of females declines considerably after age 10, and individuals are about 2.55 m long at age 20. The maximum projected length of females is 2.73 m at age 45 (Chabreck and Joanen 1979). Food habit investigations showed immature alligators (<1.8 m) consumed a large proportion of invertebrates whereas adults preyed heavily on vertebrates (Chabreck 1971, Valentine et al. 1972, McNease and Joanen 1977).

Culture of Adults

Enclosures for Adults

An important finding of culture study was the relationship between pen design and productivity (Joanen and McNease 1971). Though breeding occurred, the original pen layout was inadequate to achieve productivity needed for a commercial farm-type operation. The original five pens were 0.1 ha rectangles with a 2.4:1 water to land ratio. Each contained a single pond 2 m deep with a small island in the center. Spoil excavated from the water area formed a 5 m wide levee around the perimeter of the pen and served as a foundation for the fence. Natural vegetation provided cover and nesting material.

Because of the lack of habitat diversification, stocking rates were fixed at one male to one female (wild-caught) per pen. Efforts were made to stock more heavily, but social order prevailed and the dominant male and female either killed their competitors or forced them to flee. This pen design was inefficient and impractical due to the large number of animals, especially

males, that had to be maintained and the expense of housing only one pair per pen.

Using data collected from recent field studies on habitat requirements, new pens were constructed that incorporated social and environmental parameters into the design and allowed higher stocking densities (Joanen and McNease 1979a). Pen sizes varied from 0.2-0.8 ha, with a water to land ratio of 1:2.4. A number of water areas were dispersed about the pen for isolation and courtship areas. No perimeter levees were constructed and fences were set at ground level preventing animals from burrowing under the fence as had happened previously. Well water was provided to each pond.

Feeding sites were established in all pens, usually near areas frequently used, such as loafing areas near a water hole. Trails were maintained to all feeding sites by light applications of herbicides and periodic mowings.

Feeds and Feeding

Various diets were tested during the past 15 years to develop an economical and nutritionally balanced feeding regimen that would be adaptable to large scale farming operations. Factors evaluated were: cost, availability, storage quality, ease of handling, alligator acceptance and nutrition, and effects on growth rates and reproduction.

The feeding segment of the Rockefeller program evolved into three distinct phases; Phase I (age 1 day to 3 years) - intensive culture under closely controlled environmental conditions, Phase II (age 3 to 6 years) - pen grow-out program, and Phase III (over

age 6) - pen breeding program.

Coastal Louisiana produces an abundant supply of high quality, reasonably priced fish and nutria (Myocastor coypus). Whole fish and nutria carcasses are available as by-products of commercial operations and cost less than $ .44 per kilogram packaged and frozen. Nutria is available 3 months necessitating long periods of freezing. Fish is available year round requiring short-term freezing.

Nutritional analyses revealed that nutria contained 14.9% crude protein, 2.1% crude fat, 0.5% crude fiber, and 45% moisture; whereas mixed fish contained 9.9% protein, 4.0% fat, 1.0% fiber, and 60.6% moisture. Atlantic croaker (Micropogon undulatus) comprised 80% by occurrance of the fish mixture diet. Sciaenidae (croaker) made up 90% of the mix, Polynemidae (threadfin) 7% and Stromateidae (butterfish) 2%.

A special vitamin premix was added to all diets at a maximum rate of 1% by weight for all age classes of cultured alligators (Joanen and McNease 1976). The concentration of vitamins A and D_3 were doubled during the last 3 years of feeding in an attempt to increase reproductive productivity. The specifications for the premix presently in use are (manufactured by Dawe's Laboratories Ltd., Chicago Heights, Illinois 60411):

SPECIFICATIONS	PER 1 LB.
VITAMIN A	1,800,000.00 USP U
VITAMIN D_3	200,000.00 IC U
VITAMIN E	5,000.00 IU
RIBOFLAVIN	1,000.00 MG.
d-PANTOTHENIC ACID	2,760.00 MG.
NIACIN	4.50 GM.

CHOLINE CHLORIDE	86.43 GM.
VITAMIN B_{12}	1.35 MG.
FOLIC ACID	90.00 MG.
BIOTIN	20.00 MG.
PYRIDOXINE HYDROCHLORIDE	1,000.00 MG.
MENODIONE SODIUM BISULFITE	4,283.00 MG.
THIAMINE MONONITRATE	1,000.00 MG.
INOSITOL	5,000.00 MG.
PARA-AMINO BENZOIC ACID	5,000.00 MG.
ASCORBIC ACID	45,000.00 MG.
ETHOXYQUIN	5.00 GM.

Joanen and McNease (1971, 1975, 1979a) described feeding methods and rations for wild caught captive alligators. Feeding began in March and terminated in October, corresponding to the 8 warmer months of the year. A feeding rate corresponding to about 7% body weight was fed weekly. Various types of food were fed; trawl remnant marine fish, mammals, and beef by-products. Fish was the basic dietary component because of availability and minimal cost. Nutria meat was substituted for fish in some of the pens during 1980. The Chinese alligators were fed nutria in 1980 and 1981, and a mixture of nutria-fish in 1979.

Cultured alligators on a fish monodiet exhibited suspected dietary problems that were not observed with wild caught stock. Growth rates were excellent but poor egg fertility and hatchability appeared to be caused by inadequate nutrition. Problems with reproduction deserve further study.

Most alligator farms in the United States rely heavily upon fish as their primary food source. We strongly recommend that farmers take a close look at their feeding programs, especially for brood stock animals. Culture of our artificially incubated and hand-reared stock has raised serious questions about the effectiveness of traditional feeding programs with respect to

an efficient, self-sustaining program.

Stocking Rates

As in any farming operation, quality stock is a prerequisite to a productive program. In early Rockefeller Refuge farming endeavours wild-captured adults were the only stock available and were used until they were replaced with alligators which had been raised entirely in captivity.

Wild-captured alligators need approximately ten times more space than captive-bred alligators. Under the best pen conditions we were able to maintain five wild alligators per 0.4 ha. A commercial alligator farm in Louisiana is reported to have maintained 45 adult domesticated alligators per 0.4 ha with a nesting success ranging from 18-90% over a 13 year period (Joanen and McNease 1979a).

Present experimental stocking rates for cultured American alligators vary from a low of 12 adults per 0.4 ha to a high of 46 per 0.4 ha. Because of their rarity and the fact that we only have three Chinese alligators, they are stocked at the rate of 1 to 0.2 ha.

Culture of Juveniles

Housing of Juveniles

Environmental chambers were used as brooders for alligators up to three years of age (Joanen and McNease 1974, 1977, 1979a). These chambers were heated by thermostatically controlled electrical thermal conductors. Water was supplied through a network of plastic and galvanized pipes from a 5 cm water well. Temperatures were maintained at 29-32° C. Chambers were 'climb proofed'

because hatchlings were especially agile and could readily climb out.

Fighting occurred occasionally, resulting in cuts on the tail, back and limbs, but was not considered a serious problem. High stocking densities increased fighting. The best stocking density was 10 per m^2 during the first year of life. After one year a maximum of 3.3 per m^2 can be stocked (Joanen and McNease 1977).

Controlled Environmental Chamber Culture

Four diets were tested for young alligators (Joanen and McNease 1976). Two altered commercial rations, catfish and turtle feeds, proved totally ineffective and were quickly discontinued. These contained mostly vegetable based proteins which alligators are unable to synthesize (Dr. R. A. Coulson, personal communication 1974).

Ground nutria carcasses and fish were acceptable as foods. Growth of alligators fed nutria was superior to those fed fish. Nutria presented storage problems because of its seasonal availability and was more expensive than fish. Disadvantages of fish were: high percent moisture, overfeeding tended to produce gout, required freezing for storage, must be purchased in large enough quantities to make delivery economically feasible, must be ground for feeding small alligators, and was found deficient in vitamins (Joanen and McNease 1976).

After hatching, temperatures were held at 32° C in order to speed up body functions. Hatchlings began feeding by the ninth or tenth day after hatching. Feed was not offered until the eighth

for wild alligators and 75.4% for wild alligators held in pens.

Summary

Recent feed and feeding studies have resulted in more unanswered questions than answered ones. We feel that a variety of quality foods in the diet are better than a monodiet. Excellent growth was achieved with fish and nutria diets; however, fish may not be suitable for a high degree of reproductive success.

The very young age at sexual maturity further complicants comparison of data. Stocking rates, stress, artificial incubation techniques and grow-out procedure may also affect reproductive potential. These factors require long-term study.

Our pen culture program is just now reaching the point where the very basic nutritional requirements of alligators can be studied. We have only begun blood work in the past year (Dr. Valentine Lance, unpublished 1979-80 field data). Dr. Mark Ferguson's ongoing alligator egg and hatchling research should assist in answering reproductive related questions.

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TABLE 1. Growth rates for 1972 and 1973 age classes of alligators cultured in pens, Rockefeller Refuge, 1975-1981.

Date	Sex	Total Length (m) Average	Total Length (m) Range	Total Weight (kg) Average	Total Weight (kg) Range
		1972 Age Class			
6/75*	Male	1.74 (6)	1.70-1.80	25.69 (6)	22.05-28.80
6/75	Female	1.60 (65)	1.31-1.93	19.61 (65)	9.23-34.65
5/80	Female	2.13 (19)	1.97-2.43	37.51 (7)	29.48-46.27
5/80	Male	2.92 (1)		136.00 (1)	
7/81	Female	2.29 (18)	2.08-2.49	52.70 (18)	37.40-73.40
		1973 Age Class			
4/76*	Male	1.62 (37)	1.37-1.84	18.66 (37)	10.80-28.35
4/76	Female	1.56 (74)	1.29-1.76	16.42 (74)	9.00-27.00
5/80	Female	2.06 (32)	1.89-2.32	36.83 (5)	28.58-56.70
5/80	Male	2.37 (17)	2.27-2.49	52.25 (6)	42.18-61.24
5/81	Male	2.59 (4)	2.21-2.79	81.50 (4)	43.20-105.80

* Size when stocked into pens

() Sample size

TABLE 2. Reproductive success for Alligator mississippiensis, Rockefeller Refuge 1978-1981

Year of Nesting	Type of Diet	Year Class	Average Number Eggs/Clutch	Percent of Females Nesting	Percent Fertile Eggs	Percent Eggs that Hatched
1978	Fish	1972	25.8	18.2	33	12
1979*	Fish	1972	28.8	33.3	20	32
1979*	Fish	1973	25.3	25.0	29	36
1980	Fish	1972	24.2	18.2	36	37
1980	Nutria	1973	32.0	36.2	73	50
1981	Fish	1972	36.3	38.6	52	52
1981	Nutria	1973	38.3	53.7	72	57

* Began using a more 'potent' vitamin supplement

TABLE 3. *Alligator sinensis* eggs artificially incubated at Rockefeller Refuge, Grand Chenier, Louisiana, 1977-81.

Date Eggs Laid	No. Laid	No. Discarded	Percent Fertile	Young Produced	Percent Hatching
6-25-77*	11	0	81	1	11.0
6-22-78*	14	1	7	0	0
6-21-79*	24	5	77	4	26.7
6-20-80*	24	0	88	16	76.2
6-28-80**	21	1	57	8	66.7
6-27-81**	8	0	0	0	0
TOTAL	102	7		29	
AVERAGE	17.0		55.9		50.0

* New York Zoological Park - young female

** U. S. National Zoological Park - old female