CHAPTER 37

Alligator Ranching Research in Florida, USA

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THE removal of crocodilian eggs and young from the wild to use as stock for captive rearing operations, is normally referred to as ranching. It has become an increasingly popular management initiative, in both developed and underdeveloped countries where attempts are being made to utilize crocodilian resources on a sustainable basis.

Papua New Guinea began its commercial ranching programme in 1972 and they are currently removing juvenile *Crocodylus porosus* and *C. novaeguineae* from the wild for rearing within crocodile farms (Rose 1984; National Resource Council 1983; see Hollands Chapter 8). In Zimbabwe, *C. niloticus* eggs are collected from wild nests, incubated under controlled conditions, and the resulting hatchlings are then raised for skin production in crocodile ranches (Anon 1982). In Louisiana, *Alligator mississippiensis* eggs are collected and incubated by the Louisiana Department of Wildlife and Fisheries, and the resulting young are distributed to qualified alligator farms (T. Joanen, pers. comm.). A similar programme is being initiated with both *C. porosus* and *C. johnstoni* in Australia (see Webb *et al.* Chapter 11) and has been considered with *Caiman crocodilus* in Venezuela (see Gorzula Chapter 9). The Governments of other countries in Africa, Asia, Central America and South America are currently investigating the feasibility of ranching their wild populations of crocodilians.

Harvesting crocodilian eggs and young puts additional pressures on wild populations, with largely unknown consequences. Inherent within the concept of ranching is the premise that not all natural production is necessary to maintain increasing or stable populations. Density-dependent and density-independent mechanisms are assumed to be functioning in the wild populations from the egg stage through to at least the first few years of life. For example, the collection of eggs early in a nesting season may be designed to take advantage of mortality due to both flooding and predation. However, in most cases not all clutches collected would have been destroyed — therefore collections add to natural losses. Likewise, collections of juveniles temporarily reduce the numbers of animals in particular age or size classes. To overcome these losses, compensatory mechanisms would need to be operating within the populations at some level; otherwise, the populations would experience permanent long-term declines. In fact the rate at which eggs and juveniles can be harvested from wild populations will depend largely upon the degree to which compensatory mechanisms function. This concept is fundamental to understanding the impact that ranching is likely to have on wild populations, and the Florida Game and Fresh Water Fish Commission (GFC) considered it an essential area to explore before initiating any ranching programme.

In 1979, the GFC was approached by the Florida Alligator Farmers Association (FAFA) with a proposal for a farm supplement programme. The programme was aimed at supplementing captive production of *A. mississippiensis* hatchlings on the farms, with hatchlings from the wild. It was envisaged as operating until such times as the farms could produce an economically viable number of hatchlings from their own breeding stock.

Although philosophically supportive of the ranching concept, the GFC established that:

1. The long-term impact of such a harvest on alligator populations would need to be examined;
2. The resource had to be equitably distributed among potential users; and,
3. It would be essential that ranching provide some positive economic feedback to the wetlands which supported the wild populations.

Within the framework of these policy concerns, two major investigations were initiated in 1981; a hatchling removal study and a study aimed at quantifying the optimum time to collect eggs from wild nests. The objectives of the hatchling removal study were to:

1. Determine the degree, if any, to which removal of wild alligator hatchlings would be compensated for within the population (or would it simply add to natural mortality?);

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2. Determine if density-dependent mechanisms were acting upon the growth and survival of immature alligators;
3. Determine the optimum sustained harvest rate for immature alligators;
4. Examine the cost-benefit ratio of supplementing alligator farms with wild hatchlings; and,
5. Determine the relationship between habitat type and nest success.

The objective of the egg collection study was to quantify the time at which egg collections could best be carried out in Florida, with regard to maximizing the collection of eggs that could be reasonably expected to be lost to natural causes if left in the field (see below).

BACKGROUND INFORMATION

Alligator mississippiensis nests are commonly lost to flooding in southern Florida (Hines *et al.* 1968), coastal Louisiana (Joanen 1969) and the Okefenokee Swamp in Georgia (Metzen 1977). Significant flooding also occurs on the lakes and marshes of north-central Florida (Goodwin and Marion 1978; Deitz and Hines 1980) and South Carolina (Wilkinson 1983). Joanen *et al.* (1977) found that submerging eggs in water for more than 48 hours resulted in 100% mortality of all embryos, and that embryos older than 42 days were more susceptible to flood-induced mortality than were younger ones.

Predation of *A. mississippiensis* nests has been documented in Louisiana (Joanen 1969), Florida (Hines *et al.* 1968; Goodwin and Marion 1978; Deitz and Hines 1980), South Carolina (Wilkinson 1983) and Georgia (Metzen 1977; Ruckel and Steele 1984). Although it may occur throughout incubation, most reports indicate something of a peak in predation losses during the few weeks preceding hatching (Joanen 1969; Goodwin and Marion 1978; Wilkinson 1983). Metzen (1977), on the other hand, found predation by black bears (*Ursus americanus*) to occur shortly after egg laying.

By collecting eggs soon after laying, losses due to flooding and predation can theoretically be reduced. Furthermore, by incubating eggs under optimal conditions for the whole of the incubation period, healthier, faster-growing alligators result (Ferguson 1981), and their sex (which is determined by incubation conditions during early embryogenesis) can be controlled (Ferguson 1981; Ferguson and Joanen 1982, 1983). However, both Chabreck (1978) and Ferguson (1981) found that handling and moving eggs during the first 28 days of incubation results in significantly higher embryo mortality than if they are moved later. More recently, high hatching success has been achieved with eggs collected and moved during the first six days of development or after 21 days (see Joanen and McNease Chapter 32).

These counteracting risks make time of collection a crucial variable to consider when attempting to maximize the number of hatchlings collected from the wild. However, within Florida, time of collection is important for additional reasons as well. Potential areas from which eggs could be harvested are well dispersed throughout the State and require significant amounts of travel, with a correspondingly protracted collection period. Eggs also have to be transported over long distances (200-400 km) to farms for incubation, potentially increasing the risk of mechanical damage to embryos. Webb *et al.* (1983a, reported similar problems when trying to determine the optimum time to collect eggs of both *C. porosus* and *C. johnstoni* in Australia. The programme for ranching *C. johnstoni* now involves the collection of eggs (within a week of laying) in some areas and the collection of hatchlings (within 1-2 weeks of hatching) in others (see Webb *et al.* Chapter 11).

Depending on habitat accessibility, tradition, regulatory problems and socioeconomic factors, some populations of crocodilians appear suited to an egg collection strategy of ranching, whereas others are suited to a hatchling or juvenile collection, and others may be suited to a combination of both strategies. Within Florida, the approach taken was to look at the comparative "costs" of collecting eggs and hatchlings, with a view of being able to adapt the findings into a ranching programme that would be suitable for the State.

STUDY AREAS AND DESIGN

We selected study areas that could produce at least 50 nests per year in order to satisfy sample size requirements for the experiments. Lake Griffin (6700 ha), Lake Jessup (4100 ha) and Lake Apopka (12,400 ha) were chosen as treatment lakes for the hatchling removal study. The experiment consisted of attempting to remove 50% of the annual production of hatchlings, by collecting eggs and/or hatchlings. Lake Okeechobee (181,000 ha) and Lake Jessup were selected for the study aimed at quantifying the optimum time for collecting eggs. Lake Woodruff (6870 ha) and Paynes Praire (5000 ha) were used as control areas for both studies.

RESULTS AND DISCUSSION

These studies are still in progress, and thus it is not yet possible to summarize the results. However, the approaches we have taken to the research are briefly reviewed below, along with some of the problems encountered and some of the early signs of success. These preliminary findings have been instructive to us, and may assist others contemplating similar programmes.

Funding

State funding has to be justified in terms of benefits to both wildlife conservation and to the citizens of Florida. The ranching research was justified under the following considerations:

1. The value of alligators could help create a vested interest by landowners and the general public in alligators, that would in turn encourage good wetland conservation policies;
2. Development of an alligator ranching industry could provide income for the State, create jobs and provide a means of utilizing waste animal products;
3. Because of the economic value of alligator products, a percentage of the profits could be used directly for wetland conservation.

Problems we encountered when developing the ranching study included:

1. Demands for hatchlings exceeded available supplies, and therefore it was essential to try and optimize the production of hatchlings;
2. Compared to other more pressing resource issues, alligator ranching was a moderate priority item with both the GFC and the Florida Legislature;
3. The utilization of alligator eggs and hatchlings was not a traditional use of the species and therefore the proposal created some apprehension among the general public, legislators, conservationists and GFC policy-makers; and,
4. It was difficult to "sell" a programme that used general tax, and hunting and fishing licence revenues, for the direct benefit of a small group of individuals and only potential benefits to others.

Because State funding was insufficient to support the proposed project, the GFC enlisted the aid of the U.S. Fish and Wildlife Service's Co-operative Wildlife Research Unit (CWRU), at the University of Florida, to provide equipment, extra research assistance and expertise from staff and graduate students. To complete the funding, the CWRU then entered into a contract with the FAFA to provide supplementary funding for expenses and manpower. Annual expenditure from 1981 through 1985 was approximately $60,000 per year (GFC $30,000; CWRU $15,000; FAFA $15,000).

Study Areas

Although we attempted to select areas that appeared to be similar, important components such as nutrient levels, habitat interspersion, relative percentage composition of various habitat types, latitudes (and therefore winter temperatures) and physiographic features varied considerably. In fact, the only aspect that all areas had in common was relatively high densities of *A. mississippiensis*.

Hatchling Removal Study

The most difficult parameter to quantify objectively in this study was the cost-benefit analysis. We had hoped to determine the liabilities of ranching in terms of "costs" to:

1. The environment;
2. The alligator population (both ecological and aesthetic);
3. The citizens of Florida;
4. The GFC (management, law enforcement and research); and,
5. The ranchers (collecting, transporting eggs and hatchlings; incubating eggs and rearing the hatchlings).

Benefits were to be evaluated in terms of:

1. The value of the harvest to the State;
2. The value of the harvest to the ranchers;
3. Positive feedback to the environment (including habitat protection and restoration);
4. Positive feedback to the alligator population; and,
5. Positive feedback to the wildlife that depend on wetlands in general.

Most of the above costs and benefits had qualitative values, but nevertheless, they were important to consider within the context of the potential ranching programme being developed.

To accomplish the other objective of the hatchling removal study, we attempted to monitor the following population parameters:

1. Nest production and success;
2. Growth rates of alligators less than 120 cm total length (TL);
3. Survival of hatchlings;
4. Relative densities;
5. Size compostion of the population; and,
6. Physical condition (length-weight relationship) of juvenile alligators.

These same parameters were monitored on the control areas and the results will be analysed for trends and tested for differences among study areas. Because we only had one treatment (50% harvest rate), it will not be possible to directly determine the optimum harvest rate for eggs and hatchlings. Instead, we plan to develop a population model based on the demographic parameters and values derived from the study and simulate various harvest

strategies. We hope these simulations will provide an indirect but improved basis for determining optimum harvest rates.

Nest Production and Success

Because it takes alligators at least 9.5 years to reach sexual maturity in the wild (Joanen and McNease 1975), compensatory responses in reproductive effort, as monitored through total nest production, should not be apparent until the 1981 cohort reaches sexual maturity (1991 at the earliest). Therefore, results from this phase of the study will only be apparent after a long-term monitoring programme.

As part of the nest success investigations, Michael Jennings, an M.Sc. candidate attending the University of Florida, is developing models for predicting the fate of nests from the characteristics of the nest site habitats. These models could allow nests with low probabilities of surviving to be targeted for removal, with minimum impact on the population.

Growth Rates

We plan to quantify growth rates using a combination of data obtained through mark-recapture efforts, and analysis of bone sections taken from samples of each population.

Survival

We attempted to tag hatchling *A. mississippiensis* whilst they were in pods during the first few months after hatching, and to recapture them at six month intervals thereafter, to obtain a minimum estimate of survival. From preliminary findings it appears that hatchling survival is largely dependent on availability of preferred habitats with protective cover. However, large fluctuations in water levels can drastically change habitat availability and therefore we suspect that differences in survival rates among the youngest alligators may be influenced more by cyclic changes in water levels than by alligator densities.

Relative Densities

Spotlight surveys have been used extensively to obtain an index of alligator abundance (Chabreck 1976). Woodward and Marion (1978) and Wood *et al.* (1985) have identified problems with such indices, yet even with these shortcomings, spotlight counts appear to be the best general means of monitoring relative population densities within the heterogeneous habitats we deal with. It is hoped that these indices will provide a general indication of long-term population trends. In addition, by evaluating the separate indices for 1′ (30 cm) size classes seen during the surveys, it should be possible to monitor the rate of change of given size classes over a number of years.

Size Distribution

The size distribution of populations as revealed by spotlight surveys could be an important indirect indicator of compensatory survival. It is obvious that the hatchling size class (< 30 cm TL) will be altered significantly in the period immediately following a harvest. However, if compensatory survival is occurring on the treatment lakes, then one would not expect the distribution of alligators over 30 cm TL to be altered signficantly from the original distribution or from that in the control areas.

Physical Condition

Few studies have been published on the relationship between physical condition and both growth and survival in crocodilians. If density-dependent factors are operating in alligator populations, then food may be a limiting factor. Because of the relatively slow growth exhibited by alligators, and the correspondingly long time it takes prey to respond to a reduction in predators, it may take five or more years before changes in physical condition can be detected.

OPTIMISING THE TIME OF EGG COLLECTION

Alligator eggs were collected during two periods on Lake Jessup and Lake Okeechobee; early incubation (5-11 July) and mid-incubation (21 July-2 August). Clutches were removed at various stages of embryonic development at each collection and the eggs were incubated under identical conditions in a commercial alligator farm. Hatching results could thus be analyzed by comparing the mean hatch rates of early and late collection, and by regressing percentage hatch against the embryo age at collection.

FUTURE PROGRAMMES

The initial 5-year research phase of the alligator ranching programme is scheduled for completion in 1986. At that time, the GFC will determine whether or not to initiate a ranching programme. If implemented, we hope that the results of these ongoing studies will provide a sound basis for selecting the best approach to meet the needs of alligator ranchers, the general public, and, most importantly, the wildlife of Florida's wetlands.

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