bottoms. Hay served as nesting media. Incubating temperatures were tested ranging from 28-34°C. The best hatching success was obtained at 31-31.7°C. Hatching at 31°C was 18 and 60 percent superior than at 29.4°C and 33.9°C, respectively. Hatchlings were retained in their hatching trays for at least 24 hours, which allowed the alligators to separate from the egg shell and time for the umbilical cord to break off.

Hatching for an entire years compliment of eggs generally extended over a three-week period. The average hatching rate of 94 percent for 578 fertile wild eggs hatched in incubators greatly exceeded the 72 percent rate for 375 captive produced eggs.

**Pen Culture Studies**

Quality stock is a prerequisite to a productive farming program. Wild stock, especially adults, simply cannot adapt to an efficient pen-type operation. Wild captured stock were phased out when enough cultured "domesticated" alligators were available for breeding stock. About 200 "domesticated" brood animals have been incorporated into our propagation pens with reproduction expected this year or next.

Wild captured alligators need approximately 10 times more spacing requirements than cultured alligators. Under the best pen conditions, only five wild alligators were maintained per 0.4 ha. A commercial alligator farm in Louisiana maintains 45 adult domesticated alligators per 0.4 ha with nesting success ranging from 18 to 90 percent over a 13 year period.

Two pair of Chinese alligators were assigned to Rockefeller Refuge in late spring, 1976. Major emphasis was placed on attaining
reproduction. After a year of acclimatization, and a death of one male, a successful nest was produced in June, 1977. Eleven eggs were laid, all of which were artificially incubated. One hatchling died about a month after hatching, two died while pipping, three well developed embryos died within the egg, two died very early in incubation and three eggs were infertile.

Legislation

The Louisiana legislature passed an act regulating the sale of alligator parts other than hides. The act provided for licensing and regulation by the Department of Wildlife and Fisheries of the buying and selling of alligator parts and also the manufacture of products from alligator parts. Hopefully, this will light the way for eventual sale of meat and parts that would add income to the farmers program.

The Louisiana Department of Wildlife and Fisheries with the concurrence of 16 southeastern states, including all alligator states, petitioned the U. S. Fish and Wildlife Service to reclassify the American alligator from Appendix I to Appendix II on the Convention of International Trade in Endangered Species of Wild Fauna and Flora. Appendix II status could allow controlled shipment of hides. Farmers and hunters need a free market system if they are to receive fair market value for their products.

The Louisiana Department of Wildlife and Fisheries adopted supplemental guidelines governing private alligator farms in addition to that contained in Louisiana's regulatory wildlife and fisheries laws. The focal point of new regulations is that the state may furnish stock (eggs/hatchlings) to farmers provided they
meet strict requirements regulating the culture of state-donated stock.

The following regulations govern state-donated stock and operation of private alligator farms. (1) Farm must meet Department approval as mandated by Louisiana State law. Most important factors that applicants will be judged by include land availability, culture facilities, and suitability of applicants operational plans. (2) Some type of controlled environmental chamber, capable of maintaining growth throughout the winter period, must be included in operational plans to house alligators up to 1.2 m (4') in length. Our experience with environmental chambers indicates that mortality should be almost negligible and that a farmer would have animals 1.7 m in less than three years. (3) Cooperators are obliged to return to the state live alligators of a minimum size of 0.9 m (3'); representing 5 percent of the number of eggs/hatchlings taken. (4) Record keeping must comply with Department regulations. (5) Periodic inspections will be conducted by Department personnel to insure compliance with regulations. (6) The Department may revoke the lincense of farmers who violate state or federal regulations. (7) The Department has the authority to establish additional rules and regulations, as the need arises, pertaining to the culture and sale of alligators. (8) Farmers must submit an annual inventory and status report in order to renew farmer/exhibitor license.

Private Alligator Farms in Louisiana

The Department of Wildlife and Fisheries classifies alligator propagators as either farmers (breeders) or exhibitors. By definition, a farming operation is of the nature that the operator
generally stresses growth, reproduction, and eventual commercial transactions of live alligators, skins/parts. Exhibitors include zoos, roadside tourist attractions, and individuals holding alligators primarily for aesthetic purposes. Table 1 gives an overview of farm and exhibitors inventories for a three year period, 1975-1977.

Number of Alligators in Captivity

A 1977 survey indicated that approximately 9,300 alligators are being cultured by farmers/exhibitors. An additional 400 are being held at Rockefeller Refuge and 100 for medical research at the Louisiana State University Medical School. Seven percent were classed as adults (total length > 183 cm).

Number of Nest and Young Produced

The number of nests produced by year were: 1977 - 59 on farms, 3 in zoos; 1976 - 42 on farms, 2 in zoos; 1975 - 26 on farms, 1 in zoo. Hatchling production totaled 2,095 over three years, 889 in 1977, 713 in 1976, and 493 in 1975. One farm produced 63 percent of total nest output. This farm also is the only one to artificially incubate eggs.

Hatchlings, Egg Donated by Louisiana Department of Wildlife and Fisheries

One hundred hatchlings were given annually to Louisiana State University Medical School for research. Three hundred eggs were given to one farmer and 50 hatchlings to one farm. One farm will receive hatchlings, pending completion of controlled environmental chamber and culture facilities.

Farm Improvements, New Farms

Louisiana's oldest established farm has converted to controlled
environmental chambers for brooder facilities. This operation was converted from outside grow-out enclosures to controlled environmental brooder chambers. Three farms are in a fledgling state of construction. In summary, six farms have been in operation in Louisiana since 1954, three new farms are entering business, and two farmers liquidated their stock.
<table>
<thead>
<tr>
<th>Category</th>
<th>1977</th>
<th>1976</th>
<th>1975</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Licensed Farmers (Breeders)</td>
<td>9</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Total No. Alligators</td>
<td>9,162</td>
<td>8,261</td>
<td>8,357</td>
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<tr>
<td>No. New Farms</td>
<td>2</td>
<td>1</td>
<td>0</td>
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<tr>
<td>No. Farms Liquidated</td>
<td>0</td>
<td>1</td>
<td>1</td>
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<tr>
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<td>11</td>
<td>9</td>
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<tr>
<td>No. Zoos</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>No. Tourist Attractions</td>
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<td>3</td>
<td>3</td>
</tr>
<tr>
<td>No. Individuals (Private Home-type Operation)</td>
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<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Total No. Alligators</td>
<td>136</td>
<td>122</td>
<td>122</td>
</tr>
</tbody>
</table>
Figure 1. Diagram for construction of small alligator environmental chamber.
POPULATION AND CLASSIFICATION STATUS OF THE AMERICAN ALLIGATOR

By

Ted Joanen and Larry McNease
Louisiana Department of Wildlife and Fisheries
Grand Chenier, Louisiana 70643

Presented at
I.U.C.N., Survival Service Commission
Crocodile Specialist Group
Madras, India
February, 1978
POPULATION AND CLASSIFICATION STATUS OF THE AMERICAN ALLIGATOR

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Biological Classification Status

Since the IUCN meeting in Maningrida, the U. S. Fish and Wildlife Service (Jan. 10, 1977) reclassified the biological status of the alligator (Alligator mississippiensis) in all of Florida and in portions of 4 states; Louisiana, Texas, Georgia, and South Carolina (Table 1). The remainder of the range remained classified as endangered.

All 64 counties in Florida were delisted from endangered to threatened status, allowing a limited experimental harvest in 1977.

Three Louisiana parishes were delisted to threatened S/A in 1974. All or part of 27 coastal parishes were delisted from endangered to threatened in 1977. Thirty-three parishes retained endangered status.

Texas delisted 14 of 74 counties reporting alligator populations. Five counties in South Carolina were delisted while 23 remained classified as endangered.

Alligators in 21 Georgia counties were delisted to threatened status; 74 counties retained their endangered status.

Southeastern United States Population Status

A comparison of Tables 1 and 2 points out the relative abundance of alligators in reference to classification status. Almost 78 percent (570,009) of the total number of alligators in the United States inhabit the 131 counties classed as threatened, which comprise
only 30 percent of the total range. Thirteen percent of the estimated Southeastern United States population inhabit three parishes in Louisiana classified as threatened S/A which comprise less than 1 percent of the total range (by county). Nine percent, occupying a disproportionate 69 percent of the total range (by county), are protected under endangered status.

**Current Population Status by State, 1977**

In general, the population trend is increasing throughout the range of the alligator (Table 3). Some areas on the fringes of the range are near stable and can not biologically harbor high density populations.

**Louisiana**

The statewide population is estimated at 322,000, a 60 percent increase since 1973. The largest increases were noted in coastal parishes where nest count indexes were used to compute population levels. Current data indicate an annual increment of approximately 15 percent. Thirty-five Louisiana parishes showed increases, 27 stable, and 1 decreasing (decrease due to habitat alteration).

**Florida**

Population increases are occurring throughout Florida (Hines, letter of 23 December, 1977 and Memo Report September 14, 1977). Florida has expanded their night count transect lines in 21 counties covering a total of 285 miles. Summarization of night count data by year demonstrated an average of 5.0 alligators per mile in 1974, 4.6 per mile in 1975, 6.3 per mile in 1976, and 9.4 per mile in 1977. Hines (1977) reported 16.64 alligators per mile of lake

- 2 -
shoreline, 7.57 alligators per mile on canal, 4.58 alligator per mile of river, and 2.92 per mile of marsh.

South Carolina

The statewide population of alligators is stable to slightly increasing, with increases estimated at less than 5 percent per year on a local basis. Southern coastal areas have better populations than mid and northern coastal areas. Impounded marshes possess good populations (Murphy, letter of December 16, 1977). Population data by county showed 8 with increases and 8 as stable, while population information was not available for 12 counties.

Mississippi

The statewide population is estimated at 7,000, a 48 percent increase since 1973. Twenty-eight counties were listed as having increasing populations, while 27 were stable. The 1977 estimates were higher in 52 counties as compared to the 1973 survey. A large scale restocking program has been carried out in Mississippi.

Alabama

No up to date population estimates are available for Alabama. However, 1977 population trend information revealed that 16 counties were increasing and 12 were stable. In comparison, 1973 data indicated 11 counties contained stable populations, 15 increasing, and two decreasing. Population information is incomplete for five additional counties.

Arkansas

Alligator range is limited in Arkansas. The population is expanding and in excess of 1,900. Restocking efforts plus evidence of nesting indicates a brighter future for Arkansas alligators.
Oklahoma

Ten alligators were listed in one county for both 1973 and 1977.

Georgia

A 1978 alligator population survey indicated population increases are occurring in most of Georgia. An analysis of population trends by county showed that 73 (76%) were increasing, 12 (13%) were stable and 11 (11%) were decreasing. The statewide population was estimated as 83,456 over a 96 county area. Alligator habitat available equalled 9117 square miles. The statewide average density was estimated as 9.15 alligators per square mile.

North Carolina and Texas

Current population data not yet available.
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<thead>
<tr>
<th></th>
<th>Number of Counties</th>
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<td></td>
<td>Threatened S/A</td>
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<td>55</td>
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<tr>
<td>Alabama</td>
<td>33</td>
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<tr>
<td>North Carolina</td>
<td>21</td>
</tr>
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<td>Texas</td>
<td>60</td>
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<td>Arkansas</td>
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<tr>
<td>Oklahoma</td>
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</tr>
<tr>
<td>Georgia</td>
<td>74</td>
</tr>
<tr>
<td>Louisiana</td>
<td>33</td>
</tr>
<tr>
<td>Florida</td>
<td></td>
</tr>
<tr>
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<td>23</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
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</tr>
<tr>
<td><strong>Percent</strong></td>
<td><strong>0.7%</strong></td>
</tr>
<tr>
<td></td>
<td>Estimated Populations</td>
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<tr>
<td>----------------</td>
<td>--------------------------------</td>
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<tr>
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<td>Endangered Status</td>
</tr>
<tr>
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<td>4,740</td>
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<td>Alabama</td>
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<td>North Carolina</td>
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<td>Arkansas</td>
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<td>Oklahoma</td>
<td>10</td>
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<tr>
<td>South Carolina</td>
<td>16,200</td>
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<td>66,004</td>
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<tr>
<td>Percent</td>
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<td>----------------------</td>
<td>-------------------------</td>
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<tr>
<td>South Carolina</td>
<td>48,700</td>
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<td>Florida</td>
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<td>Georgia</td>
<td>83,456</td>
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<td>10</td>
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<td>Arkansas</td>
<td>1,706</td>
</tr>
<tr>
<td>Texas</td>
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<tr>
<td>North Carolina</td>
<td>12,715</td>
</tr>
<tr>
<td>Alabama</td>
<td>7,000</td>
</tr>
</tbody>
</table>

* N/A - Not Applicable
* No Response

Note: The table shows the number of aliens from 1977 and the percentage change in population since the 1973 survey. The population trends are either increase, decrease, or stable.
TIME OF NESTING FOR THE AMERICAN ALLIGATOR

by

Ted Joanen and Larry McNease
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TIME OF NESTING FOR THE AMERICAN ALLIGATOR

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Introduction

An important part of any wildlife management plan involves understanding basic life history information. One of the more important aspects of any life history study involves reproduction. Therefore, a determination of time of nesting in relation to environmental parameters can be used to refine management schemes involving the alligator.

Recent investigators report that egg deposition occurs from the first week of June into the second week of July, varying from year to year (Joanen, 1969; Metzen, 1977; Edwin Froehlich, 1978, personal communication). Detailed information is lacking as to what causes annual fluctuations. An understanding of factors influencing time of nesting will allow conservationists to better manage alligators, especially if peak nesting data can be predetermined through analyses of environmental parameters. The purpose of this study was to relate time of nesting to effects caused by air temperatures, rainfall, and photoperiod.

Three study areas were selected based on the available data throughout the range of the alligator. Rockefeller Refuge is located in the coastal marsh zone of southwest Louisiana near Grand Chenier, latitude 29° 40' and longitude 92° 50'. Okefenokee National Wildlife Refuge, predominately a swamp area, is located in southern Georgia near Waycross, latitude 31° 10' and longitude 82° 20'. The
third area was an alligator farm at West Palm Beach, Florida, latitude 26° 45' and longitude 80° 10'.

The authors are grateful for the assistance of Wendell Metzen, Okefenokee National Wildlife Refuge and Ed Froehlich, West Palm Beach, Florida, for assistance in the collection of field data. W. G. Perry and Brad Robicheaux are acknowledged for their assistance in analysis of data.

Study Methods

Field observations of freshly deposited eggs were made annually for two wild alligator populations in Louisiana and Georgia and for captive alligators in Florida. Most observations were tabulated within a two week period each year and time of peak nesting was determined from these observations. Rockefeller Refuge data provided coverage for 10 years; 1964-68, 1973-77. Nest observations on Okefenokee National Wildlife Refuge covered five consecutive years, 1973-77 (W. Metzen, 1978, personal communication). Nest observations on a farm in West Palm Beach, Florida covered six years, 1972-77 (Ed Froehlich, 1978, personal communication).

Average ambient temperatures and rainfall were determined for the three months prior to egg deposition (U. S. Weather Bureau, 1964-68, 1972-77). These data were analysed for correlations with time of nesting. Photoperiod for March through July for the three study areas were analysed (Nautical Almanac Office, 1965).

Results and Discussion

The number of nest observations fluctuated annually, varying from 16 to 42 at the West Palm Beach farm and 20 to 50 at Rockefeller and Okefenokee Refuges.
Egg deposition at Rockefeller Refuge occurred from 5 June to 5 July (Table 1) during 10 years of study. Most nesting activity (egg laying) occurred between 11 June and 28 June. Egg deposition in Georgia occurred from 8 June to 12 July over a five year period with most nesting activity occurring between 20 June and 5 July (Table 2) (Metzen, 1977). Peak nesting activity over 6 years occurred between June 15-24 on the Florida farm (Table 3).

Average quarterly temperatures, March-May, are plotted as related to annual fluctuations in time of nesting (Tables 1-3).

Data analysis indicated that ambient temperature had a highly significant correlation with time of nesting activity in Louisiana ($r = -0.904$, $df = 8$, $P < .01$). Temperatures for the three months prior to nesting showed a progressive gradual warming trend; March averaged 63.2° F, April averaged 67.7° F, May 75.0° F, and June 79.9° F. Late June-early July egg deposition occurred on the coolest year when temperatures averaged slightly less than 65.0° F. Conversely, the earliest nesting recorded, early to mid-June, was for the warmest year when temperatures averaged 70.0° F.

Alligator nesting data for Georgia indicated that the relationship with temperature only approached significance ($r = -0.527$, $df = 3$, $P > .05$). Possibly, additional data years in the sample would have been more meaningful in this comparison. Air temperatures (five years) averaged 64.1° F for March, 67.1° F in April, 73.7° F in May, and 78.4° F in June.

Air temperature for Rockefeller Wildlife Refuge was consistently more moderate and did not experience the extremes (high-low daily fluctuations) as did the temperatures of the Okefenokee National
Wildlife Refuge. When all data for Louisiana and Georgia were combined, a significant correlation existed ($r = -0.544$, df = 13, $P < .05$).

Peak periods of nesting activity over 6 years occurred between June 15-24 on a farm in West Palm Beach, Florida. The peaks were comparable to those for Louisiana's wild alligators although air temperatures in south Florida averaged six degrees higher. This data lends credibility to observations at Rockefeller Refuge which showed that captive alligators nested consistently later than their wild counterparts.

Rainfall had no significant relationship with time of nesting activity in Louisiana although it seemed to approach significance ($r = -0.500$, df = 8, $P > .05$). Alligator nesting in Georgia showed no significant correlation with amount of rainfall ($r = 0.637$, df = 3, $P > .05$), and a combination of all rainfall data experienced similar results ($r = 0.228$, df = 13, $P > .05$). While rainfall did not affect time of nesting, our observations indicate that rainfall and its related effect on surface water definitely affects the degree of nesting. Extremes in water levels, drought and floods, reduced overall nesting effort (Joanen and McNease, 1975). The artificial environment under pen conditions at the Florida farm (water levels maintained by pumping) mitigated any adverse conditions caused by low rainfall.

A look at photoperiod revealed that egg deposition occurred when diurnal period was at its maximum. Photoperiod was constant year to year; therefore, no analysis was attempted for this parameter.
Nesting activity in Louisiana usually began in early June with 14 hours of daylight. Day length was at its maximum in mid-June (14 hrs. 6 min.) and this was when egg deposition normally was at its maximum. Daylight decreased to 14 hours during the first week of July, at which time egg deposition had ceased. Nesting began in Georgia in early June with 14 hours 12 minutes of daylight and continued through early July when daylight accounted for 14 hours 10 minutes.

Physiological functions which lead to egg deposition may be keyed by increasing day length as well as temperature. A poikilothermic animal could certainly be affected by the interrelationship between maximum day length and heat budget buildup.

**Summary and Conclusion**

Average air temperature, rainfall, and photoperiod for March, April, and May were analysed for three areas to determine if a correlation existed with nesting activity. Study areas represented a wild population in Louisiana and Georgia and a domestic population in Florida.

Air temperatures affect the timing of nesting and egg laying activity. In the two wild populations, there was a significant correlation of air temperature with nesting activity. Generally in both study areas, nesting occurred in early June for the years with the highest March-May temperature. Conversely, nesting occurred in late June and in some cases the first week in July when average springtime temperatures were the lowest.

Photoperiods indicate peak nesting activity took place at 14 hours and 6 minutes for Louisiana, and 14 hours 17 minutes for
Georgia. Most nesting activity occurred in June when day period was at its maximum, allowing for maximum daytime heating.

Nesting activity for any given year extended over a two-week period, with the greatest amount of nesting activity taking place during June.

**Literature Cited**


TABLE 1. Nesting periods related to average air temperatures for March, April, and May, Rockefeller Refuge, Grand Chenier, Louisiana.

Average Air Temperature (°F) March, April, and May, Grand Chenier, Louisiana
TABLE 2. Nesting periods related to average air temperatures for March, April and May, Savannah, Georgia

Average Air Temperature (°F) March, April, and May, Savannah, Georgia
TABLE 3. Nesting periods related to average air temperatures for March, April, and May, West Palm Beach, Florida

Average Air Temperatures (°F) March, April, and May, West Palm Beach, Florida