CROCODILES

Compilation of Documents from the 4th Working Meeting of the Crocodile Specialist Group of the International Union for the Conservation of Nature

Madras, India, 6- 10 February 1978

(compiled January 2012)

Foreword

No Proceedings of the 4th Working Meeting of the IUCN-SSC Crocodile Specialist Group (Madras, India, 6-10 February 1978) were produced, as most of the original documents submitted to IUCN were unable to be located. In late 2011 efforts were made to locate any documentation that may have been held by some participants of that meeting, and this publication represents a compilation of the documents that were available. We thank F. Wayne King, Ruth Elsey, John Lever and Rom Whitaker, who provided documents, photographs and other information.

Tom Dacey, CSG Executive Officer (January 2012)

Literature citations should read as follows:

For papers:

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Cover photographs (taken at meeting) courtesy of John Lever.

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NEW YORK ZOOLOGICAL SOCIETY

MEMORANDUM 26 July 1977

TO: IUCN/SSC Crocodile Specialist Group Members

FROM: W. King, Chairman

SUBJECT: Draft Agenda for 4th Working Meeting

Enclosed is the first draft agenda for the 4th Working Meeting to be held in India in February 1977. I would appreciate hearing from each of you concerning any topics we might have overlooked, or ones you feel should be modified or dropped. Please also let me know if you can speak on the subject I have tentatively indicated for you.

When your responses are in hand, I will send out the final agenda.

Wayne King

13-Feb IC-539 Madras Hyderabad
13-Feb IC-1220 Hyderabad - Bombay.

4th WORKING MEETING OF THE IUCN/SSC CROCODILE SPECIALIST GROUP

6-12 February 1977 - Girwa Gharial Sanctuary, India

6-7-8-9-10-11-12

* *

D R A F T A G E N D A

1) Status Reports

✓ North America -- T. Joanen (alligator) & H. Campbell (crocodile)

✓ West Indies and Central America -- W. King

✓ South America -- F. Medem (northern & central) & F. Achaval (southern)

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Africa -- A. C. Pooley

✓ Asia -- J. C. Daniel & R. Whitaker

✓ Australia -- H. Messel

✓ Papua New Guinea -- J. Lever

Review of Appendices of Convention on International Trade in Endangered Species of Wild Fauna and Flora -- Croc. Sp. Gp.

2) Survey Techniques

✓ River population surveys -- H. Messel

✓ Asia -- R. Whitaker

NB Papua New Guinea -- J. Lever

✓ Inventory methods and future needs -- R. Chabreck

3) Advances in capture and handling techniques

✓ Drug immobilization -- H. Messel
Handling & transport.
Radio telemetry -- H. Messel

4) Biology of crocodilians

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Factors influencing American alligator nesting -- T. Joanen

Growth in the American alligator -- R. Chabreck

Growth in the estuarine crocodile -- H. Messel

4) Biology of crocodilians (continued)

Morphometrics of the estuarine crocodile -- H. Messel

Behavior -- A.C. Pooley

Saltglands and sodium loading -- H. Campbell

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Papua New Guinea -- J. Lever

Louisiana -- T. Joanen

El Salvador -- T. Joanen

Africa -- A. C. Pooley

Zoos -- R. Honegger

Chinese alligators -- T. Joanen

Egg collection and incubation -- R. Chabreck

6) International hide trade, marketing, and tanning

International marketing survey -- J. Lever

Impact of Convention on International Trade in Endangered Species -- R. Honegger & W. King

Review of the trade from the buyers view -- Karlheinz Fuchs*

7) Publicity and Public Education -- H. Campbell & R. Honegger

8) Conservation Action Programme for Crocodiles

Review marine and coastal species programme -- W. King & Croc. Sp. Gp

Production of a freshwater species programme -- Croc. Sp. Gp.

Training counterpart staff in crocodile conservation -- R. Chabreck

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*Karlheinz Fuchs will attend the meeting as an observer from the international leather industry.

From left, Miro Laufa (Papua New Guinea), Karlheinz Fuchs (Germany), John Lever (Australia), Frederico Medem (Colombia), Rom Whitaker (India), F. Wayne King (USA), Federico Achaval (Uruguay), Harry Messel (Australia), Robert Chabreck (USA), Patrick Aia (Papua New Guinea), Ted Joanen (USA), J.C. Daniel (India).

From left, J.C. Daniel (India), Ted Joanen (USA), Zai Whitaker (sitting, background), Harry Messel (Australia), Robert Chabreck (USA), Satish Bhaskar (doorway), John Lever (Australia), Frederico Medem (Colombia), F. Wayne King (USA), Allen Vaughan (India), Federico Achaval (Uruguay), Karlheinz Fuchs (Germany), Patrick Aia or Miro Laufa (Papua New Guinea; foreground). Photograph: Rom Whitaker (India).

PRESS RELEASE

The Crocodile Specialist Group of the International Union for the Conservation of Nature and Natural Resources (IUCN), Survival Service Commission, met from 6-10 February at the Madras Crocodile Bank in Tamil Nadu, India. The international group of ecologists and wildlife officers reviewed the conservation status of the world's wild crocodilians and discussed programmes for their protection, restoration and utilization.

The Group expressed continued concern over the endangered plight of the majority of the world's crocodile species. Particular attention was called to the critically endangered status of the estuarine crocodile (Crocodylus porosus) in Australia, Bangladesh and India. Recent surveys suggest that only the wild populations of this species in Papua New Guinea may be free from the threat of extinction. As a consequence, the Group recommends placement of the estuarine crocodile on Appendix 1 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The American Crocodile (Crocodylus acutus) amd the Argentine and Paraguay populations of Yacare caiman (Caiman crocodilus yacare) are also recommended for transfer to Appendix 1.

The Crocodile Specialist Group noted with great pleasure the significant steps the Government of India has taken to save from extinction the critically endangered gharial. The hatching, rearing and release programme developed in collaboration with the United Nations Development Programme and Food and Agriculture Organization should assure the survival of the gharial and restore its populations. It is also encouraging to see the Government of India's committment to saving its other two species of crocodiles, the mugger (Crocodylus palustris) and estuarine crocodile (C.porosus). Of special importance are the five sanctuaries India has established for the protection of crocodiles, including the porposed gharial sanctuary on the Chambal River.

Similarly, the Crocodile Specialist Group noted the successful efforts the United States of America made to restore the American alligator (Alligator mississippiensis) to former abundance. In recognition of the success of these efforts the Group is recommending transfer of the American alligator from Appendix 1 to Appendix 11 of the CITES.

During its meeting, the Crocodile Specialist Group also discussed and demonstrated the latest techniques of surveying crocodile populations; capture and handling crocodiles; the movements, growth, and other aspects of crocodile ecology, behaviour and hide marketing. Considerable time was spent reviewing the success of crocodile farms and propogation programmes in India, Papua New Guinea, the United States of America, El Salvador, Thailand,and in zoos.

Finally, a detailed strategy for the conservation of all the world's crocodilians was elaborated and will be incorporated into the World Strategy for Conservation being developed by IUUN, World Wildlife Fund, and the United Nations Environment Programme.

Participants included Federico Achaval (Uruguay), Patrick Aia (Papua New Guinea), Robert Chabreck (USA), J.C. Daniel (Bombay Natural History Society, India), Karlheinz Fuchs (West Germany), Ted Joanen (USA), Wayne King (USA), Miro Laufa (Papua New Guinea), John Lever (FAO/Papua New Guinea), Federico Medem (Colombia), Harry Messel (Australia) and Romulus Whitaker (Madras Crocodile Bank, India)

Madras meeting

NEW YORK ZOOLOGICAL SOCIETY

New York Zoological Park
New York Aquarium

Bronx Zoo
Bronx, New York 10460
Telephone: (212) 220-5100

Center for Field Biology and Conservation
Osborn Laboratories of Marine Sciences

17 February 1978

B.P. Srivastava
Inspector General of Forestry
Ministry of Agriculture
Krishi Bhavan
New Delhi

Dear Inspector General Srivastava:

The Crocodile Specialist Group of the Survival Service Commission, International Union for the Conservation of Nature and Natural Resources, in their survey of the various endangered species of crocodilians, noted with great satisfaction the efforts being made by the Government of India, in collaboration with the FAO/UNDP, in the conservation of Indian crocodilians.

The Group requested the Chairman to convey their special appreciation of the progress achieved in the conservation of the gharial and to congratulate the Government and the authorities concerned on the success achieved in the captive hatching and rearing of this species. The Crocodile Specialist Group received the information on the organization of the Chambal Gharial Sanctuary and welcomed this move as another step in the conservation of this unique species.

The Group also noted the rehabilitation programme in progress, and being organized at different levels, for the conservation of the other two species of Indian crocodiles and hoped that the momentum would be maintained.

It was noted with concern that there is a possibility of the Andaman population of the gravely endangered estuarine crocodile being seriously depleted. It is hoped that this area would also receive the urgent attention of the Government.

Again, let me congratulate the Government of India on the impressive achievements already obtained in the conservation of Indian crocodiles, and wish you even more success as the programme continues.

Sincerely,

F. Wayne King
Chairman, IUCN/SSC Crocodile
Specialist Group

/db
cc: N.D. Jayal
P. Scott
E. Baysinger
Crocodile Specialist Group

Madras Meeting

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Center for Field Biology and Conservation
Osborn Laboratories of Marine Sciences

21 February 1978

Mr. Tago
The Minister of Environment and
Conservation
P.O. Waigani
Port Moresby
PAPUA NEW GUINEA

Dear Mr. Tago:

The Crocodile Specialist Group of the Survival Service Commission, International Union for the Conservation of Nature and Natural Resources, in its Fourth Working Meeting held in Madras, India, from 6 to 10 February 1978, was delighted to hear the continued progress of the Papua New Guinea crocodile programme.

The Group members discussed the joint PNG Government/ FAO paper presented at the meeting and support the need for a crocodile population survey for PNG. Your Government's request for assistance from the Group has been entered on our list of projects to be carried out during the next year.

The Group also noted your request for an Ecologist to head the more technical aspects of your crocodile programme. Shortly, we will submit nominees and other necessary details for your Ministry's consideration and possible selection.

The Crocodile Specialist Group is highly appreciative of your Government's approach in consulting the Group and keeping us informed of progress. It is encouraging to note that PNG has recognized the importance of this IUCN/SSC Specialist Group as a source of advice and assistance in your efforts to conserve and utilize your crocodilian resource.

We were delighted to have two Papua New Guineae Wildlife Officers, Patrick Aia and Miro Laufa, at the meeting. It is our hope that they gained insight into the crocodile conservation problems faced in other countries and some of the successes these other nations have achieved as these topics were discussed at the conference.

We wish you continued success in your conservation programme.

Sincerely,

F. Wayne King
Chairman, IUCN/SSC Crocodile
Specialist Group

/db
cc: P. Scott
E. Baysinger
Crocodile Specialist Group

Madras meeting

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Center for Field Biology and Conservation
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21 February 1978

Earl Baysinger
SSC, Executive Officer
IUCN
1110 Morges

Dear Earl:

Enclosed is the press release the Crocodile Specialist Group put out to the local press at the 4th Working Meeting in Madras. Would you please get Robert Allen to put the release on the wire services or whatever is appropriate.

In the release, reference is made to moving Crocodylus porosus (except for the Papua New Guinea populations), Crocodylus acutus, and the Argentina and Paraguay populations of Caiman crocodilus yacare to Appendix I of the CITES. This proposal is based on new survey information, which will be sent along to you for transmittal to the CITES Secretariat as soon as I have put the supporting material in order and duplicated it. In addition, reference is again made to moving Alligator mississippiensis to Appendix II of the CITES. This is based on the continued recovery of this species which has already led the US/FWS to reclassify the American alligator from Endangered to Threatened in most parts of its range and to delist it in others.

The freshwater component of the global strategy for crocodile conservation was outlined at the meeting, but will take several weeks to work up in final form.

I hope the SSC meeting in Faro, Portugal, went well. I am only sorry that Fred Medem and I were unable to attend both sessions.

Sincerely,

Wayne King

/db
cc: P. Scott
R. Fitter
Croc. Sp. Group

THE EL SALVADOR ALLIGATOR PROJECT

by

Ted Joanen and Allan Ensminger
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

THE EL SALVADOR ALLIGATOR PROJECT

Ted Joanen and Allan Ensminger
Louisiana Department of Wildlife and Fisheries
Grand Chenier, Louisiana 70643

Introduction

Alligators (Alligator mississippiensis) have been held in captivity in the United States for many years. Refinements in culture techniques have been developed during the past decade, however, in the United States intensive culture is relatively expensive.

In theory, culture (if biologically feasible) in a tropical climate and where labor, materials, and supplies are cheaper should result in a more cost-efficient operation. Carrying the concept one step further, positive benefits should be accrued to the local economy in countries so affected.

In 1969, a private alligator farm was established in El Salvador, San Salvador, Central America. The objectives of this farm were to: (1) test the biological feasibility of raising alligators in Central America, and (2) produce alligators in sufficient numbers for hide markets. The tropical climate of El Salvador induced year round growth, and the cost of operations were reduced when compared to United States. At the request of the owners, through the Louisiana Department of Wildlife and Fisheries, biologists with the Department were assigned to the project as technical advisors.

Description of Study Area

El Salvador, the smallest of the Central American Republics (approximately 13,671 sq. mi) is located on the Pacific side of

Honduras.

The major watershed is the Rio Limpa system which drains nearly half of the country and comprises the largest river system of Central America (Daugherty, 1973).

The alligator farm is located some 40 miles (65 km) southeast of Zacatecoluca on the coastal plain near the mouth of the Limpa River.

The climate is essentially tropical with moderately high year round temperatures (75-82° F), although temperatures are considerably moderated by elevation. Rainfall is distinctly seasonal in nature. The six-month rainy season begins in May and extends through November and accounts for about 90 percent of the total annual rainfall which ranges from 59.1-78.8 inches (150-200 cm).

Methods and Materials

Approximately 325 alligators were purchased from Louisiana farmers of which 250 were shipped air freight to El Salvador in two shipments (Table 1). The first shipment, made on October 15, 1970, consisted of fifty 10 inch (25 cm) alligators and 50 animals ranging from 15 inches to 8 feet (0.4 m to 2.5 m) in length. The second shipment was made on April 29, 1971 and consisted of 150 alligators ranging in size from 4 feet to 8 feet (1.2 m to 2.5 m). The remainder were housed in a pen at Lake Judge Perez, Plaquemines Parish, Louisiana and were eventually sold to a Louisiana farmer.

Pen Design

Pen design and fencing were similar to that as described by Joanen and McNease (1975) and consisted of one pen approximately 5 acres (2 ha) in size. The pen was further sub-divided into two

compartments separating adult alligators from the sub-adults. Alligators less than one year of age were held in concrete vats approximately 10 x 10 x 2 feet deep (3 m x 3 m x 0.6 m) and sloped on one end. A roof of corrugated asbestos covered half the vats.

During the dry season, fresh water was pumped from the Limpa River through an aqueduct system in order to maintain pool stage and for cleaning and maintaining the concrete vats.

Salt water intrusion was a problem at the original pen location. Consequently the pens were relocated adjacent to the Limpa River in an area unaffected by salt water.

Feeding and Rations

Feeding schedules were accomplished as described by Joanen and McNease (1971 and 1976). Several feeding sites were established in each pen. These sites were usually situated near a sunning area on a path adjacent to the water edge used by the alligators. A feeding rate of 7-8 percent body weight per week was adhered to on an annual basis. Young alligators were fed at a much higher rate.

The most common sources of foods were horses, mules, and trawl remnant fish and crustaceans. Horses and mules were purchased locally and the trawl remnants were obtained at dock side from a nearby seaport town.

Nesting and Artificial Incubation

Nests were constructed on the levee system and made of natural vegetation available in the pen. After nesting was completed in 1977, eggs were collected and handled as reported by Joanen and McNease (1977) except that controlled environmental chambers were not used for incubation. Eggs were set in styrofoam boxes, by

clutch, in a building maintained at 82-88° F (28-31° C). Nesting material was used as incubating media. One inch holes were made in the bottom of each box to allow the runoff of excess water.

Growth Rates

Hatching year alligators were weighed and measured periodically during the first 15 months of the study. Notes on general body condition and morphology were taken on all alligators. These data were correlated with feeding rates to compare the results of the feeding program in terms of general health, food conversion, and reproductive productivity.

Discussion of Results

Growth Rates

Length and weights were determined from hatching size to 15 months of age. After 12 months of feeding, alligators averaged 2'5" (73.7 cm) total length and 2 lbs. 5 oz. (1049 g) body weight. In comparison, alligators held in environmental chambers in Louisiana for a one year period averaged 2'6" (76.2 cm) total length and 3.37 lbs. (1530 g). After 14 months of feeding the El Salvador alligators averaged 2'11" (88.9 cm) total length and 4 lbs. 5 oz. (1958 g). Louisiana alligators after 14 months averaged 3' 1/4" (92.1 cm) total length and 4 lbs. 5 oz. (1958 g) in weight (Joanen and McNease, 1976).

Nesting in Captivity

Nesting occurred in El Salvador in 1972, 1976, and 1977. One nest was constructed in 1972, 12 in 1976, and 17 in 1977. The rather graphic rise in nesting is attributable to acclimization and recruitment into sexually mature size classes. The 1972 nest hatched in

July and produced 12 young. The 1976 nesting effort began in late April and extended through May 24. Four nests were completed by May 16. Eight nests were constructed between May 5 and May 24. A total of 225 eggs were examined in the 12 nests, averaging 18.7 eggs per nest. Two false nesting attempts were located.

In early June 1976, the Limpa River overflowed its banks and flooded the alligator pen and nests with 2-3 feet (1 m) of water for approximately 4 days; addling all eggs.

Fertility rates were determined for the addled eggs shortly after flooding. Of the 225 eggs examined, 32.4 percent were infertile, higher than the 24.6 percent found in captive breeding programs at Rockefeller Refuge (Joanen and McNease, 1975). All embryos were in the same state of decomposition, and obviously died as a result of the flood.

The 1977 nesting effort was initiated 2-3 weeks earlier than the 1976 effort. Seventeen nests, five more than in 1976, contained 369 eggs. The average number of eggs per nest was 21.7, 3.6 eggs per nest more than in 1976.

The alligators acclimated to their warm tropical setting and seemed to adjust their reproductive rhythm to coincide with the rain-season. Alligators nested in El Salvador in late April and May, about 1-1/2 months earlier than they had nested in Louisiana. Temperatures in El Salvador did not exhibit drastic seasonal fluctuations as in Louisiana.

Air temperatures prior to and during nesting near the alligator farm (Cruz Porullo, approximately 48 km northwest of farm) were checked for January through May in 1976. Average air temperature

for the five months was 80.5° F (27° C), ranging from 77.2° F (25.1° C) in January to 82.8° F (28.2° C) in May. Air temperatures during nest construction averaged 81.3° F (27.4° C) for April and 82.8° F (28.2° C) for May.

Ambient temperature had a highly significant correlation with time of alligator nesting activity in Louisiana (Joanen and McNease, 1978). Temperatures for the three months prior to nesting showed a progressive gradual warming trend. March averaged 63.2° F (17.3° C), April averaged 67.7° F (19.8° C), May 75.0° F (23.9° C), and June 79.9° F (26.6° C). Earlier nesting occurred with warmer temperatures.

Rainfall in El Salvador was strictly seasonal, beginning in April or May and continuing through November. Reproductive activities seemed to be keyed to the rain-season, as courtship activity each year was initiated with the advent of rain. In Louisiana, rainfall had no significant relationship with time of nesting although the relationship seemed to approach significance. Recent observations in Louisiana strongly indicate that rainfall and its related affect on surface water definitely affects the degree of nesting.

Photoperiod for El Salvador was considerably different than that experienced in Louisiana. Nesting activity took place when day period was increasing and almost at its maximum, between 12:40 and 12:52 hours of daylight. In Louisiana, egg deposition occurred when diurnal period was at its maximum, 14:06 hours of daylight.

Egg Incubation

Eggs were collected on May 31 from the 1977 nesting effort

and set in styrofoam boxes. Due to the malfunction of an electric heater, temperatures were allowed to cool in the nest boxes to 78-80° F (26° C). Water was apathetically added to the nest boxes almost daily further chilling the eggs. As a result, the majority of the embryos died. Fifteen young were produced from the 1977 nesting effort.

Mortality

Thirty-eight alligators died as a result of problems with salt water intrusion from 1970-1972, the majority during the dry season of 1971. Twenty of the animals were less than one year old and 18 were in the 2-4 foot (61-122 cm) size class. After the initial culture operation was moved, no further problems were encountered with salt water intrusion. Interestingly, no alligators died during either of the two shipments.

Summary and Conclusion

Alligators were shipped air freight from Louisiana to El Salvador, San Salvador, Central America in two separate shipments. The first shipment of 100 alligators were sent on October 15, 1970, the second shipment of 150 on April 29, 1971.

Growth for young alligators in El Salvador were comparable to alligators cultured in controlled environmental chambers in Louisiana. The most economical and readily available sources of foods in El Salvador were horses, mules, and trawl remnants, with trawl remnants being the most available year round.

Below average nesting was achieved in 1972, 1976, and 1977. Hatching success was well below the 75.4 percent attained for pen alligators in Louisiana. Fertility rates averaged 66.7 percent

during the 1976 nesting season, somewhat below the 75.5 percent determined for penned alligators in Louisiana.

Literature Cited

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TABLE 1. 1972 Captive Alligator Inventory, El Salvador, San Salvador, Central America.

	Size Class in Feet								
	1	2	3	4	5	6	7	8	TOTAL
No. Alligators	1	29	12	5	18	73	56	18	212

STATUS OF LOUISIANA ALLIGATOR FARM PROGRAM

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

STATUS OF LOUISIANA ALLIGATOR FARM PROGRAM

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

Introduction

A number of developments have taken place in regards to alligator farming since the 1976 Maningrida status report. Refinements were made in culture techniques at Rockefeller Refuge; namely, artificial egg incubation, and development of brood stock. Three farmers entered the business, two farmers liquidated their enterprises, and one farmer significantly enlarged his facilities. State guidelines were adopted to provide stock (off state-owned lands) and professional expertise to farmers. Legislation was adopted at the state level to benefit commercial farms. Attempts are underway to amend federal and international legislation so that farmers will have more latitude in commercial transactions of alligator skins/parts. A Southeastern Alligator Association, composed of trappers, farmers, land owners, tanners, and fabricators, was formed to encourage the reputable growth of the commercial alligator industry. Hopefully, the U. S. Fish and Wildlife Service, State Game Departments, and other legislative and regulatory bodies will provide input into the Association.

State Sponsored Research Activities

Artificial Egg Incubation

The most efficient method of hatching eggs appears to be in controlled environmental chambers (Figure 1). Eggs were set in trays measuring 61 x 61 x 15 cm with hardware fabric tops and

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 Wildlie 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 negligable 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 licnese 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 1. Status of Louisiana Captive Alligators

	1977	1976	1975
No. Licensed Farmers (Breeders)	9	7	8
Total No. Alligators	9,162	8,261	8,357
No. New Farms	2	1	0
No. Farms Liquidated	0	1	1
No. Licensed Exhibitors	11	11	9
No. Zoos	4	4	4
No. Tourist Attractions	3	3	3
No. Individuals (Private Home-type Operation)	4	4	2
Total No. Alligators	136	122	122

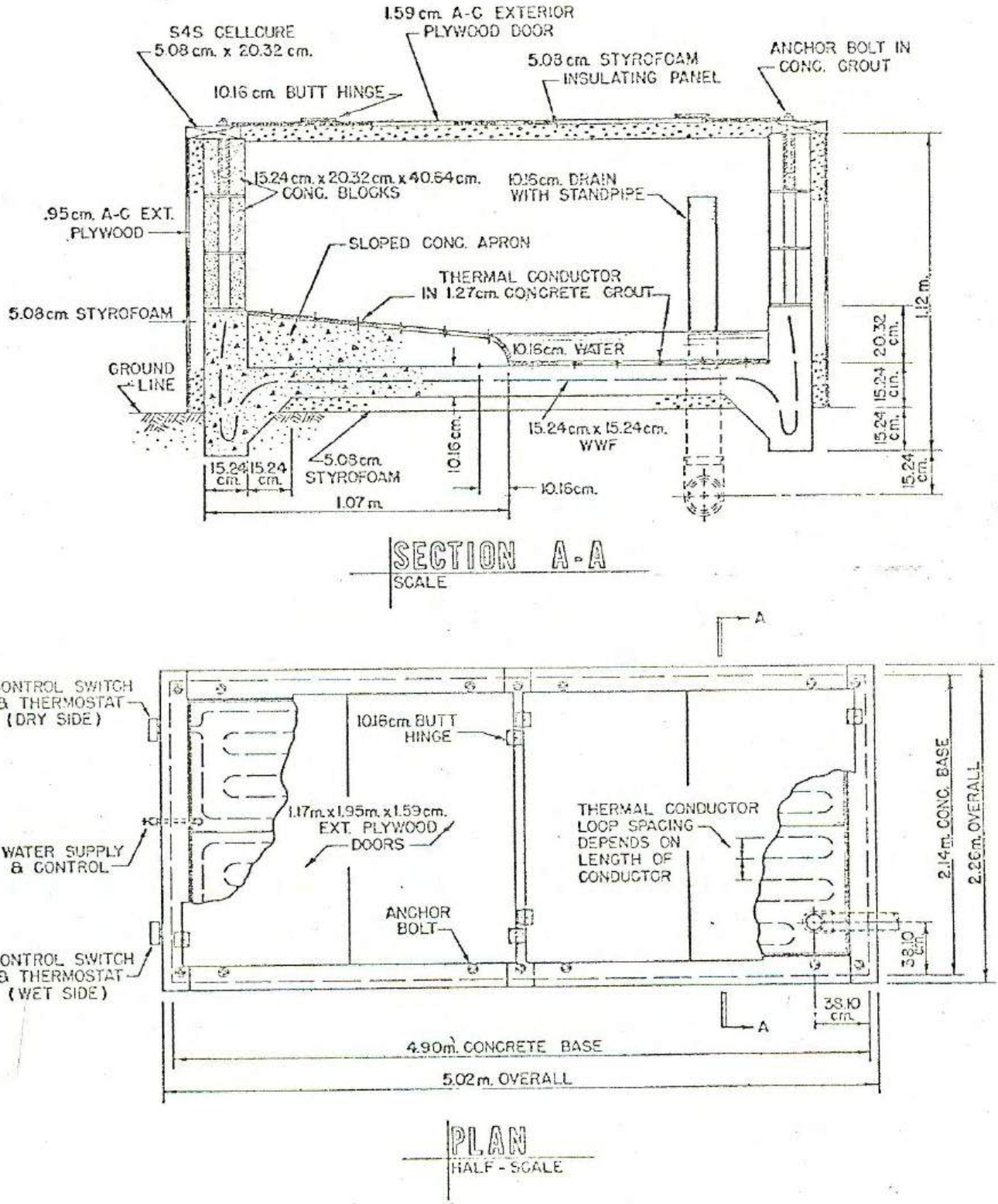

Figure 1. Diagram for construction of small alligator environmental chamber.

POPULATION AND CLASSIFICATION STATUS OF THE AMERICAN ALLIGATOR

By

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Presented at

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Crocodile Specialist Group
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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 mississipiensis) 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

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 equaled 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.

TABLE 1. Alligator Classification Status by State - January 10, 1977

	Number of Counties			
	Threatened S/A	Endangered	Threatened	Total
Mississippi		55		55
Alabama		33		33
North Carolina		21		21
Texas		60	14	74
Arkansas		3		3
Oklahoma		1		1
Georgia		74	21	95
Louisiana	+ 3 12	33	27	63
Florida			64	64
South Carolina		23	5	28
TOTAL	3	303	131	437
Percent	0.7	69.3	30.0	

TABLE 2. Population Levels by State (Federal Register, Vol. 42, No. 6 - January 10, 1977)

	Estimated Populations		
	Endangered Status	Threatened Status	Threatened S/A Status
Mississippi	4,740		
Alabama	12,715		
North Carolina	1,314		
Texas	7,492	19,292	
Arkansas	1,900		
Oklahoma	10		
Georgia	14,101	15,853	
Louisiana	7,532	94,770	98,151
Florida		407,585	
South Carolina	16,200	32,500	
TOTAL	66,004	570,009	98,151
Percent	9.0	77.6	13.4

TABLE 3. Alligator Population Survey by State, 1977

State	Number Alligators		Percent Change in Population Since 1973 Survey	Population Trend; No. Counties Showing:			
	1977	1973		Increase	Stable	Decrease	Undetermined
Mississippi	7,000	4,740	+48	28	27	0	0
Alabama	N/A	12,715	Stable to slight increase	16	12	0	5
North Carolina	*	1,314	*	*	*	*	*
Texas	*	26,784	*	*	*	*	*
Arkansas	1,900+	1,900	Increasing	3	0	0	0
Oklahoma	10	10	Stable	0	1	0	0
Georgia	83,456	-	Increasing over 75% of Range	73	12	11	0
Louisiana	322,000	200,682	+60	35	27	1	0
Florida	N/A	407,585	General statewide increase	N/A	N/A	N/A	N/A
South Carolina	N/A	48,700	Stable to slight increase	8	8	0	12

* No response
N/A - Not available

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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 effect 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.

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

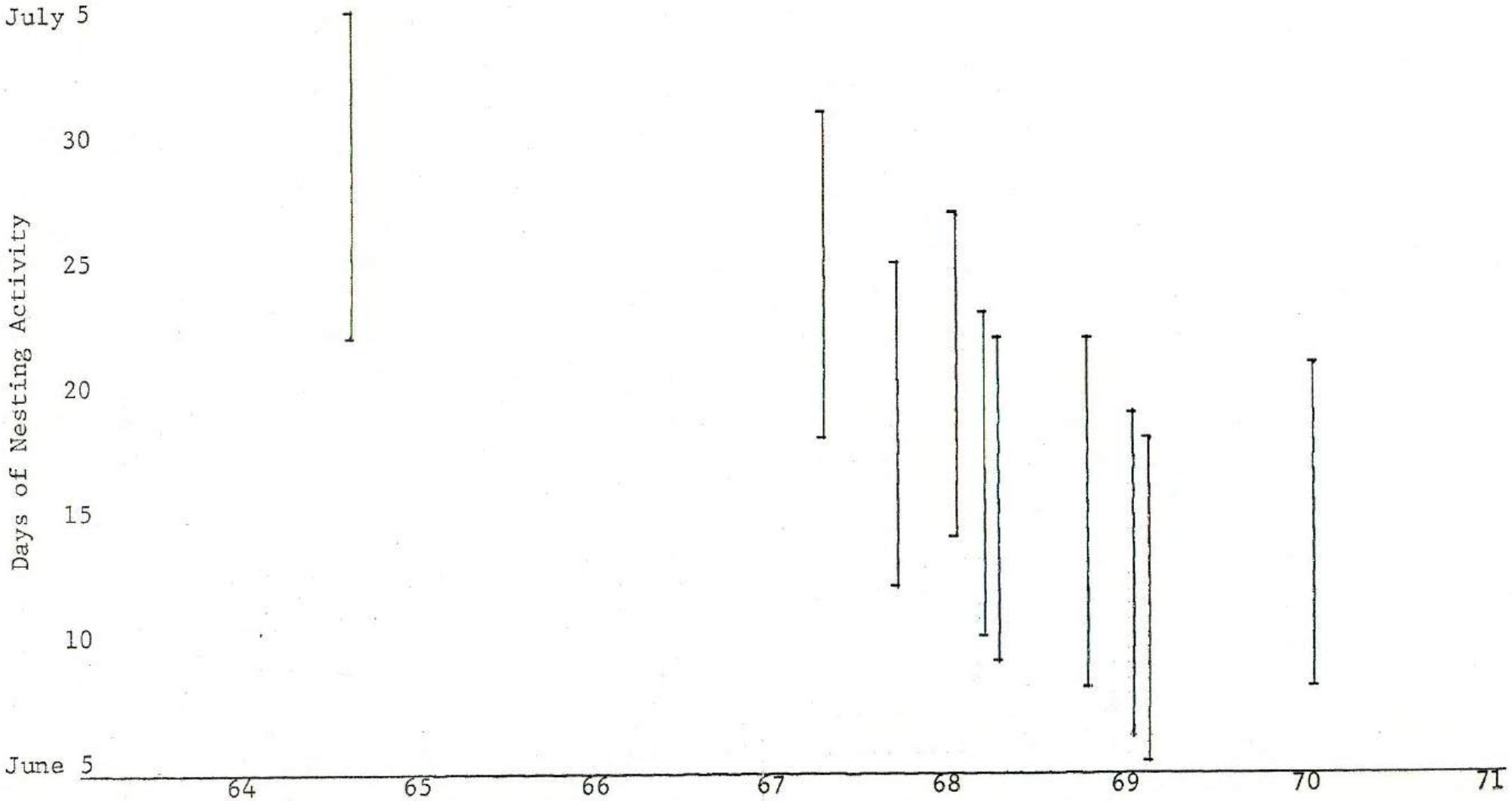

TABLE 2. Nesting periods related to average air temperatures for March, April and May, Savannah, Georgia

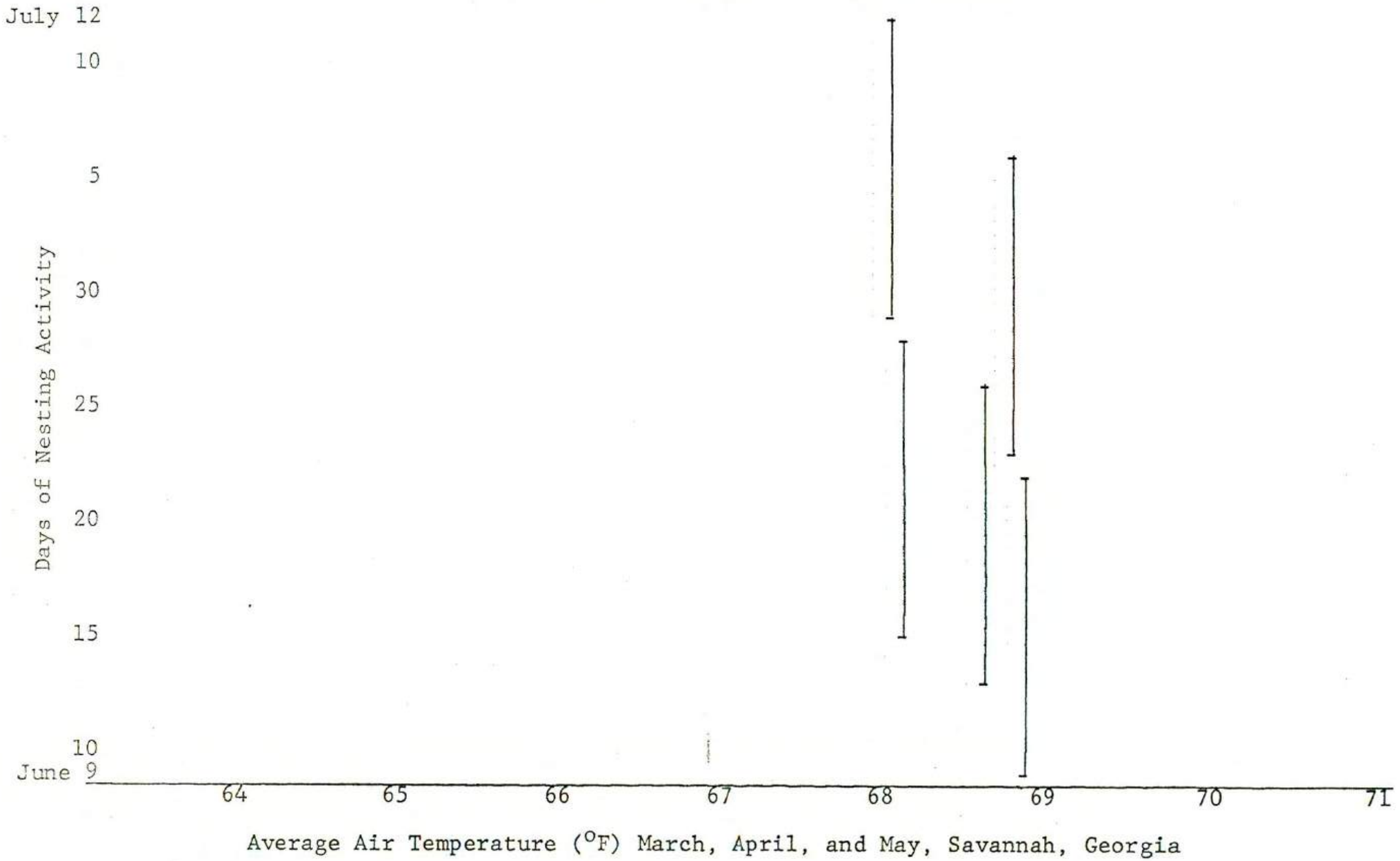

TABLE 3. Nesting periods related to average air temperatures for March, April, and May, West Palm Beach, Florida