ASPECTS OF THE NESTING ECOLOGY OF AMERICAN ALLIGATORS (*ALLIGATOR MISSISSIPPIENSIS*) IN NORTH-CENTRAL FLORIDA

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ABSTRACT: Future management of American alligator populations depends upon a thorough understanding of the reproductive activities of this species. Nesting ecology was investigated during 1976 at 15 alligator nests in freshwater lakes and marshes in north-central Florida. Habitat preferences, nest sites, eggs, hatchlings, hatching success, and predation are described in this report. Alligators nest in close proximity to permanent water and use a wide variety of available plant materials and soil in constructing their dome-shaped nesting mounds. Peak egg laying activity occurred in late June or early July when an average of 30 eggs were laid in a cavity in the top center of each nest mound. Incubation was accomplished over 60–65 days. Sixty-two percent of the complete clutches of eggs produced live young. Of these nests, 31% were destroyed by mammalian predators (probably raccoons) and 8% were lost to flooding. Nesting ♀♀ were not aggressive at the nest site during our study.

THE endangered status of alligators in recent years in many areas of the southeastern United States has stimulated research into various aspects of the life history of this species. Alligator nesting has been investigated in a few habitats and locations including coastal marshes of Louisiana (McIlhenny, 1935; Joanen, 1969), South Carolina (Bara, 1972), and the Florida Everglades (Hines et al., 1968; Fogarty, 1974). Despite this attention, there is a paucity of detailed information on alligators nesting in freshwater habitats of Florida. Therefore, our primary objective was to obtain information to increase our knowledge and understanding of alligator nesting habits in this region.

STUDY AREA

Fifteen alligator nests were studied between June and September 1976 on both wet prairie and freshwater marsh habitats. All nests were within 64 km of Gainesville, Florida (29° 40′ N, 82° 25′ W); 4 were in Alachua County (Colcloughy Hill Pond and Moss Lee Lake), 1 was in Gilchrist County (McCain Lake), 5 were in Levy County (Bowen Lake and Sawgrass Springs Prairie), and 5 were on Levy's Prairie in Putnam County (Fig. 1). Typical vegetation of both habitat types includes arrowhead (*Sagittaria* sp.), buttonbush (*Cephalanthus occidentalis*), cattail (*Typha latifolia*), dollarwort (*Hydrocotyle umbellata*), maidencane (*Panicum hemitomon*), pickerelweed (*Pontederia cordata*), primrose willow (*Ludwigia peruviana*), sawgrass (*Cladium jamaicense*), spikerushes (*Eleocharis* spp.), water hyacinth (*Eichornia crassipes*), and waterlily (*Nymphaea odorata*). In addition, cordgrasses (*Spartina* spp.) were also abundant on wet prairies. All fresh marsh study areas were commonly surrounded by pond cypress (*Taxodium ascendens*). Flat terrain and fluctuating water levels due to heavy precipitation in late summer typify these study areas.

METHODS

Alligator nests were initially located in June 1976 utilizing low flying fixed-winged aircraft. Alligator nests were distinguished from the surrounding marsh by the presence of a 4–6 m diameter circular area of flattened vegetation adjacent to the nest mound. The optimum altitude for spotting and observing nests in open marshes and prairies was found to be 90–120 m above mean sea level. Most alligator nests had well developed and readily visible trails leading to the nearest permanent water.

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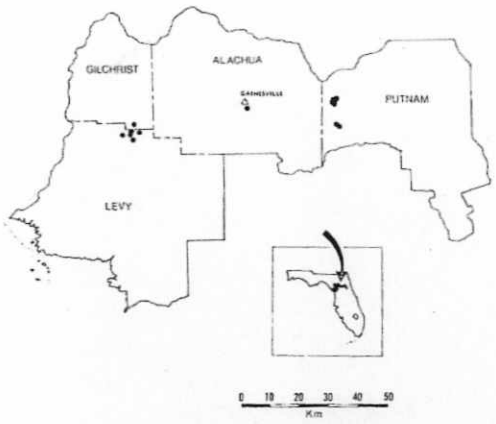

FIG. 1.—Locations of 15 alligator nests in north-central Florida, 1976.

Similar alligator trails have been observed in Louisiana (Joanen, 1969).

Accessible nests were visited by canoe, airboat, or on foot within 2–3 days of initial discovery and several times during the nesting season. Data recorded included dimensions and composition of the nest mound, distance to open water, egg cavity diameter, depth, and temperature, and weights and measurements of both eggs and hatchlings. Air and nest cavity temperatures were recorded during each visit with a hand-held laboratory thermometer. Hatchlings were marked soon after hatching with a monel tag attached to the web of the right hindfoot to facilitate further research into growth rates and movements. Additional observations were also recorded, when possible, of the estimated size and behavior of the attending female and of nesting success. The presence of a gel lubricant on eggshells was also recorded to aid in determination of the length of the incubation period.

RESULTS AND DISCUSSION

Twenty nests were located via aircraft; of these, 15 were accessible, 13 contained complete clutches, 1 contained a single egg, and 1 was inactive. Nests were not in close proximity to one another, particularly in freshwater marsh habitats. Nests were located in each area and the closest adjacent nests were ≈ 160 m apart. All nests were located adjacent to permanent water ($\bar{x}$ distance = 3.4 m, range = 1–14 m). Mean daily rainfall during the study period was 7.1 mm and some alligator nests were subjected to rising water levels in late summer. Of 3 nest cavities affected by rising water, 1 was completely inundated and destroyed, whereas lower portions of 2 were partially flooded. The latter 2 nests produced 2 and 12 young from 34 and 38 eggs, respectively. All flooded eggs were destroyed in these nests.

Nests were variable in size, but all were dome-shaped mounds. Average nest height was 47.8 cm (range 112–238 cm) and the mean dimensions of these slightly oblong nests were 149.6 cm × 161.6 cm (range 112–232 and 117–238, respectively). There were no specific nest site or nesting material preferences. Alligators apparently knock down and pile up available adjacent vegetation and soil in building their nests (Table 1). Gross estimation of nesting

TABLE 1.—Locations and principal nesting materials of 15 alligator nests in north-central Florida, 1976.

Location	N	Nesting materials
Colcloughly Hill[1] Pond (Alachua County)	1	Soil, leaf litter
Moss Lee Lake[1] (Alachua County)	3	Sawgrass
Bowen Lake[2] (Levy County)	2	Cattail, maidencane, buttonbush
Sawgrass Springs[2] Prairie (Levy County)	3	Sawgrass, cattail, pickerelweed, buttonbush
McCain Lake[2] (Gilchrist County)	1	Maidencane, dollarwort
Levy's Prairie[3] (Putnam County)	5	Sawgrass, arrowhead, primrose willow
Total	15	

[1] Fresh marsh.
[2] Fresh marsh-floating island.
[3] Wet prairie.

TABLE 2.—Measurements of alligator nests, eggs, and hatchlings in north-central Florida, 1976.

Parameter	N	X ± SD	Range
Distance of nest from water (m)	15	3.4 ± 4.0	1.0–14.0
Height of nest (cm)	15	47.8 ± 12.3	33.0–82.0
Horizontal base measurements (cm)	15		
Length (longest axis)		161.6 ± 36.7	117.0–238.0
Width (shortest axis)		149.6 ± 36.0	112.0–232.0
Egg cavity diameter (cm)	13	24.9 ± 3.7	20.3–30.5
Depth to egg cavity (cm)	14	20.9 ± 7.3	7.6–33.0
Egg cavity temperature (°C)	14	31.1 ± 2.0	28.0–35.0
Clutch size	14	30.3 ± 9.7	1–39
Egg weight (g)	235	84.6 ± 12.4	61.0–108.0
Egg width (mm)	235	42.8 ± 3.4	3 13–4 66
Egg length (mm)	235	73.7 ± 6.6	6 19–8 47
Hatchling weight (g)	78	67.6 ± 4.6	58.0–77.0
Hatchling total length (cm)	78	26.4 ± 1.4	25.1–28.5
Hatchling snout-vent length (cm)	78	12.4 ± 1.5	11.4–13.7

materials and availability indicated that nests were composed primarily of adjacent vegetation. Previous reports have also indicated that alligator nests are constructed of adjacent vegetation (Joanen, 1969; Bara, 1972), and soil (McIlhenny, 1935). The female either bites off the vegetation and deposits it loosely in a pile or shovels the litter and debris into a mound with her snout. An egg cavity is formed in the top of the mound prior to nest completion. This normally occurs about 2 days before egg laying (Joanen, 1969). In nearly all cases, this cavity is located in the top center of the nest mound; in one instance, the cavity was off center and low in the nest mound resulting in flooding by water. In the 14 typical nests, the cavity (24.9 cm mean diameter) averaged 26.9 cm above the substrate and about 21 cm of vegetative materials covered the eggs.

Peak nest building was observed between mid-June and the 1st week of July. The majority of the nests contained eggs by the end of this period; the latest date eggs were deposited in any of these nests was 18 July 1976. This nesting schedule is similar to those reported for alligators in Louisiana (Joanen, 1969) and South Carolina (Bara, 1972).

Mean clutch size was 30.3 eggs (range 1–39); various measurements of nests, eggs and hatchlings are included in Table 2. One nest contained no eggs; it was near extensive boat traffic and was apparently abandoned in favor of a more secluded nest (34 eggs) in dense sawgrass 18 m further inland from the lakeshore. Approximately 46% of the alligator nests observed were partially shaded by nearby vegetation during early morning or late afternoon. The mean daily external air temperature of 27°C (range 17.7°–38.3°C) was 4.1°C below the average egg cavity temperature of 31.1°C (range 28°–35°C). Heat from the decaying vegetation within the mound apparently maintains egg cavity temperatures at night which are comparable to daytime temperatures.

Twelve of a total of 425 eggs (3%) were cracked prior to our 1st visit. Several nests showed evidence that the female rested and/or moved across the top of the nest and this apparently contributed to the cracking of additional eggs. Eggs with minor cracks and an intact inner membrane developed and hatched normally, whereas, severely cracked eggs soon rotted and were destroyed by ants. Joanen (1969) also noted the presence of ants in alligator nests.

One nest had more than half of its eggs inadvertently trampled and crushed by a group of young people in the vicinity on a field trip.

Incubation periods of 2 clutches of eggs were determined to be 59 and 63 days. Definite laying dates could be determined for these 2 nests due to the presence of the gel lubricant characteristic of freshly laid reptile eggs. We related peak nest initiation dates with peak hatching dates for our study areas and estimated the normal incubation period to be 60–65 days. Other authors have reported similar incubation periods for alligators in southwestern Louisiana (McIlhenny, 1935; Joanen, 1969) and South Carolina (Bara, 1972).

Freshly laid eggs have a pure white porcelain appearance which soon becomes discolored through contact with decaying vegetation in the nest. Alligator eggs swell considerably before hatching, the outer shell cracks leaving the young alligator enclosed within the elastic inner shell membrane. The hatchling emerges from the egg after puncturing the membrane with its egg tooth at the tip of its snout. Hatching was observed at 2 nests; in both cases, the young began making their high pitched vocalizations from within the nest cavity prior to emerging from the nest. Young alligators were also observed vocalizing from within the egg membrane just prior to emergence. Lee (1968), Joanen (1969) and Campbell (1973) reported that these sounds both stimulate sibling hatchings to hatch in a synchronized manner and signal the adult female that hatching has begun. Three nests had nesting material removed from the top; this may have been done by the female to help liberate the hatchlings from the nest as suggested by Joanen (1969).

Of the 13 nests containing complete clutches of eggs, 8 (62%) produced living young, 4 (31%) were destroyed by mammalian predators (probably raccoons [*Procyon lotor*]), and 1 (8%) was lost to rising water following several days of heavy rain in early August. Fate of 1 nest containing a single egg was not determined as there was no sign of predation or of a young alligator's emergence. Hatching success was found to be 45%; 192 hatchlings were observed out of the 425 eggs.

Nest destruction was caused primarily by raccoons which usually destroyed nests late in the incubation period (6th or 7th week). Raccoon predation was evident by tracks in the mud surrounding alligator nests. Water surrounding the nest did not present a major barrier for invading raccoons; in 1 case, this predator swam approximately 80 m to reach an alligator nest on a small island. Flooding and human carelessness were additional, but minor, agents of nest destruction.

Numerous ants were observed in all nests, but they apparently caused no harm to normal eggs nor to the hatchlings as they emerged from the nest. Ants fed on the alligator eggs only when the inner membrane was broken as previously reported by Joanen (1969) and Fogarty (1974). Florida red-bellied turtles (*Chrysemys nelsoni* Carr) frequently used alligator nests as nesting sites; 7 clutches of these turtles eggs were found in 5 alligator nests under observation.

Aggressiveness by female alligators at the nest site is a poorly understood phenomenon. Adult alligators were observed at only 3 of 14 active nests and only 1 female approached the airboat as we examined her hatchlings. No adult alligator actively defended her nest against our close approach. Although it is a popular belief that nesting female alligators are among the most aggressive of all animals, our observations do not support this belief. Others have also reported that aggressiveness among nesting female alligators is a rather rare phenomenon (Joanen, 1969; Bara, 1972; Fogarty, 1974; T. C. Hines, *personal communication*). In Louisiana, McIlhenny (1935) reported female alligators actively defending nests but Joanen (1969) stated that, based on observations of 315 alligator nests,

only 9.2% were actively defended. A need exists for further research into alligator behavior and aggressiveness at the nest.

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