

# NESTING ECOLOGY OF ALLIGATORS ON THE OKEFENOKEE NATIONAL WILDLIFE REFUGE

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*Abstract:* Nesting ecology of the American alligator (*Alligator mississippiensis*) was investigated on the Okefenokee National Wildlife Refuge between 1972 and 1976. Nesting occurred during late June and early July. Egg counts were taken in 55 nests. Average clutch size was 30 eggs  $\pm$  12-44. Of 110 nests studied, 90 percent were destroyed before hatching. Predation accounted for 96 percent of the nest loss with black bear (*Ursus americanus*) being the major nest predator. Hatching success of eggs in successful nests was estimated to be 70 percent.

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In order to learn more about the ecology and life processes of the alligator in the Okefenokee Swamp in Georgia, a study was designed to evaluate its nesting ecology and the factors which limit its productivity. In meeting the objectives of the study, alligator nests were located and their success monitored each year between 1972 and 1976. This report discusses the findings of the study.

## STUDY AREA

The Okefenokee Swamp is a huge peat bog of over 1,500 km<sup>2</sup> located primarily in southern Georgia but extending slightly into northern Florida. About 90 percent of this swamp is included in the Okefenokee National Wildlife Refuge, and 94 percent of the refuge is included in the National Wilderness Preservation System.

The floor of the swamp, except for the true islands, is covered with a bed of peat which ranges in depth from a few cm at the edge of the swamp to about 4.5 m in some places in the interior. The surface of this peat bed is usually at the average water level.

The Okefenokee is not a swamp in the classic sense but is better described as a swamp-marsh complex. About 85 percent of the swamp is covered by forest of variable density dominated by either pond cypress (*Taxodium distichum* var. *nutans*) or by a mixed forest of swamp black gum (*Nyssa sylvatica* var. *biflora*), white bay (*Magnolia virginiana*), loblolly bay (*Gordonia lasianthus*), red bay (*Persea borbonia*) and red maple (*Acer rubrum*) with an understory of shrubs, vines and smaller trees. The marshes, known locally as "prairies", make up the remainder of the swamp. These areas are usually shallowly flooded and are the preferred habitat of the Okefenokee Swamp alligator. The prairies are dominated by the white water lily (*Nymphaea odorata*) bladderworts (*Utricularia* spp.), maidencane (*Panicum hemitomon*), and sedge (*Carex hyalinolepis*). Water levels in the prairies are unstable and fluctuate seasonally. The more permanent water areas in the prairies are limited to "gator" holes, small lakes, and maintained boat trails. The water in these areas is mostly under 1.5 m in depth (Cypert, 1972).

Scattered throughout the prairies are small clumps of trees and shrubs called "houses". The houses exist in various stages of development from the embryonic "battery" to the fully developed tree house. Batteries are formed when patches of peat break away from the rest of the peat deposit and float up to the surface (Cypert, 1972). The floating batteries are a few centimeters higher than the surrounding water level and become drier habitats upon which herbaceous plants may grow. As the batteries develop successionaly, they become vegetated with shrubs and trees and are referred to as tree houses.

Alligators occur throughout the Okefenokee Swamp. The true population of alligators in Okefenokee is impossible to determine accurately, but it is estimated at 6,000-10,000 animals. Alligators are considered more abundant in the marshland habitat than in the forested swamp.

## METHODS

Chesser and Grand Prairies were searched more intensively for alligator nests than other regions of the swamp. These two marshland prairies comprise about 1,538 ha and are located along the eastern edge of Okefenokee. The large numbers of breeding alligators and the relative ease of access make these two swamp prairies ideal for study purposes. Locating alligator nests was begun in late June at the onset of nesting and continued until mid-July. During this period the study area was checked 3 to 4 times a week for nests. An airboat was used for transportation to locate alligator nests in the

marshland prairies. A systematic meandering search through the prairie regions proved to be the best method of locating nest sites. Nests in the open marsh were observed easily while nests in the tree houses were difficult to find. An alligator trail leading into a tree house was used as an indicator of a possible nest site in these densely vegetated shrub areas. Tree houses with well defined "gator" trails were searched on foot for nests.

When a nest was found, it was opened to determine if it was a completed nest containing eggs. Other information recorded at the nest site included the nest location, nest material, nest dimensions, water depth, and behavior of female. Frequent follow-up checks of the study nests were made throughout the nesting period to record nest predation and nesting success. The follow-up checks usually were made at a 20-30 m distance from the nest to minimize nest disturbance.

## RESULTS

A total of 110 alligator nests was located for study during the 5 nesting seasons from 1972 through 1976. Of these, 90 percent were located in the wet prairie and 10 percent in the swamp forest. The understory in the swamp forest is characterized by a dense growth of shrubs and vines which makes it virtually impossible to traverse on foot and locate alligator nests in this habitat. The nests found in the swamp forest were located by cautiously searching along the well used alligator trails that led from the prairie edge into the forested area.

Alligator nests found in the wet prairie were situated on peat batteries and on tree houses. These regions are normally a few centimeters higher than the surrounding marshland providing a drier elevated area for nest construction. Of the 99 nests found in the wet prairie, 68.7 percent were located on peat batteries and 31.3 percent on the tree houses. Nests located on the tree houses were well concealed by a dense understory of shrubs. These nests were difficult to find; and as in the swamp forest, a well used alligator trail leading into a tree house was an indication of a possible nesting site. The peat batteries used for nesting were generally dominated vegetatively by maidencane. Nests in these areas were observed easily from the elevated seat of an airboat.

The alligator nests examined were constructed from the most readily available material in the immediate vicinity of the site. Nests on the peat batteries were constructed from herbaceous vegetation of which over 90 percent was maidencane grass and peat. Nests on the tree houses were constructed mostly from surface litter, loose peat, twigs and sphagnum moss (*Sphagnum sp.*). In the construction of the nest, a circular area approximately 3 m in diameter was cleared of vegetation. This vegetative material was shaped into a conical nesting mound in the center of the cleared area. As reported by Joanen (1969) in his nesting studies of alligators in Louisiana, incomplete nests often were found in close proximity to a completed nest. These additional nests were referred to as dummy nests. It was suggested that the dummy nests might serve to lure predators and increase the survival rate of the nests containing eggs. This, however, was not demonstrated during this study.

The size of the nests varied considerably with those on the peat batteries tending to be larger than those located on the tree houses. The nest size differences between these areas may have been due to relative availability of nesting material. The largest nest examined measured 274 cm in diameter and 86 cm in height from the peat surface. The average nest was 187 cm in diameter and 52 cm high. No correlation was noted between the size of the female and the nest size.

The egg cavity was located in the top center of the nest. The average depth from the top of the nest to the top of the clutch of eggs was 18 cm. The average diameter of the inside of the egg cavity was 29 cm.

Egg laying was closely synchronized within a 3-5 day period each year with very few nests containing eggs located before or after this period. The bulk of nest construction and egg laying during the 5-year study occurred between June 20 and July 5.

Eggs were counted in 55 of the total nests studied. Of the remaining nests, 35 had been destroyed before being located, 14 were attended by aggressive alligators, and six were designated as control nests. The average number of eggs found in the 55 nests was 30, ranging from 12-44. The eggs were arranged in a neatly compact circular pattern two to four rows in depth. Only a few cracked eggs were noted in the nests that were examined. Joanen (1969) reported that of the nests he studied in Louisiana 52.5 percent contained cracked eggs.

During nest checks, the female alligator usually was at or in the near vicinity of the nest site. When the nest site was approached, the female alligator usually would dive into a nearby alligator hole and remain submerged during the nest check. Of the

110 nests examined, only 14 female alligators demonstrated any type of aggressive behavior towards researchers. Aggressiveness varied from a reluctance of the female to leave the nest site to the more aggressive threat displays of hissing and charging towards researchers during nest checks.

The most surprising aspect of this study was the finding of an extremely low rate of nesting success. Of the 110 alligator nests studied, 10 percent hatched successfully while 90 percent were destroyed before hatching. Predation accounted for 96 percent and flooding 4 percent of the total nest losses. Predation of nests occurred during the early stages of incubation, usually within a 48-hour period following egg laying. During this period, an odor was given off from the vegetative compost of the nest which may have been a stimulus used by predators in locating nesting sites.

The black bear was the major predator on the alligator nests that were studied. Of the 95 nests destroyed by predators, 92.6 percent were considered to have been destroyed by black bear and the remaining 7.4 percent by raccoon (*Procyon lotor*) and otter (*Lutra canadensis*). The aquatic environment surrounding the nesting sites made it difficult to determine the specific predator responsible for nest destruction. Large imprints in the peat muck at the nest site indicated the presence of a sizeable predator larger than either a raccoon or otter. The most conclusive data of black bear predation was the finding of bear hair on a camera that was set up at a nest site. This was an unsuccessful attempt to take a picture of a predator destroying a nest. Destroyed nests usually were well torn apart with egg shells remains at the nest site.

The unexpected high rate of nest predation observed during the study suggested that study disturbance to the nest sites could be influencing predation rates. In an evaluation of this, 6 of the 30 alligator nests located during 1975 were designated as controls and were not approached by researchers any closer than 30 m. Of these control nests, 100 percent were destroyed by predators during late June and within a week following their location. Of the other 24 nests studied in 1975, 10 nests had been destroyed by predators when located, 10 nests were opened for study, and 4 nests were attended by aggressive alligators preventing close nest examination. Of the 10 nests opened for study, 1 nest produced a successful hatch, and the remaining 9 nests, or 90 percent, were destroyed by predators. Predation of these nests occurred during the same time period as predation on the control nests, and it was concluded that study efforts had no effects on the predation rates.

During the nesting season, the black bear may search the tree houses and battery regions in the wet prairie for alligator nests. Numerous trails, seemingly more abundant during the nesting season, lead through and around the tree houses providing evidence of the bear's presence. Raccoons rarely are observed in the marshland habitat of the Okefenokee Swamp. Their numbers probably are controlled by the alligator population. The nests destroyed by raccoons were located along the swamp edge and not in the interior of the swamp where the majority of nesting occurs. Flooding may have accounted for a much higher rate of nest losses had they not already been destroyed by predators during the early stages of incubation. Of the 14 nests not destroyed by predators during the study, 21.4 percent were destroyed by flooding. The annual peak rainfall in Southeastern Georgia normally occurs during July and August, being associated with the tropical disturbances of the Gulf stream. During this season, water levels in Okefenokee may rise as much as 20-40 cm which often results in an inundation of nests and failure of eggs to hatch.

Of the 110 alligator nests monitored during the course of this study, the eggs in 11 nests (10 percent) hatched successfully. This success rate is much below the nesting success rate of 68.3 percent Joanen (1969) reported for alligators in the coastal marshes of Louisiana. This variance in nesting success may be attributed largely to the higher rate of nest predation occurring in the Okefenokee Swamp. Joanen (1969) reported a 16.5 percent nest loss to predation for Louisiana in comparison to our finding of 86.4 percent nest loss to predation in Okefenokee. Nest attendance by an aggressive female may be an important factor in determining nesting success in the Okefenokee Swamp. Ten, or 71.5 percent, of the 14 nests not destroyed by predators during the study were attended by aggressive female alligators.

A minimum hatching success of eggs for 1975 was estimated to be 70 percent. The hatching rate was figured indirectly by using the overall average number of 30 eggs per nest and the average number of 21 baby alligators from eight family groups that were located and captured within 60 days following hatching during 1975. The actual hatching success probably was higher than estimated since all baby alligators may not have been found and some mortality of young may have occurred between the time of hatching

and capture. Okefenokee's estimated hatching rate of around 70 percent is higher than the 58.2 percent Joanen (1969) reported for nests in Louisiana.

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