

The Alligator Revealed

by Leslie D. Garrick and Jeffrey W. Lang

All an alligator wants is to bellow and head slap, engage in leisurely sex, and have a protective mother

Two crocodylians live within the continental United States. The American crocodile (*Crocodylus acutus*), a widespread tropical New World species, has been reduced to about 200 individuals that inhabit some of the Florida Keys, Florida Bay, and areas in Everglades National Park. This species is threatened by the continuing loss of its coastal mangrove habitat and by human-caused mortality from automobiles on local roads and destruction of nests. The other species, the American alligator (*Alligator mississippiensis*), is endemic to ten southern states from Texas to

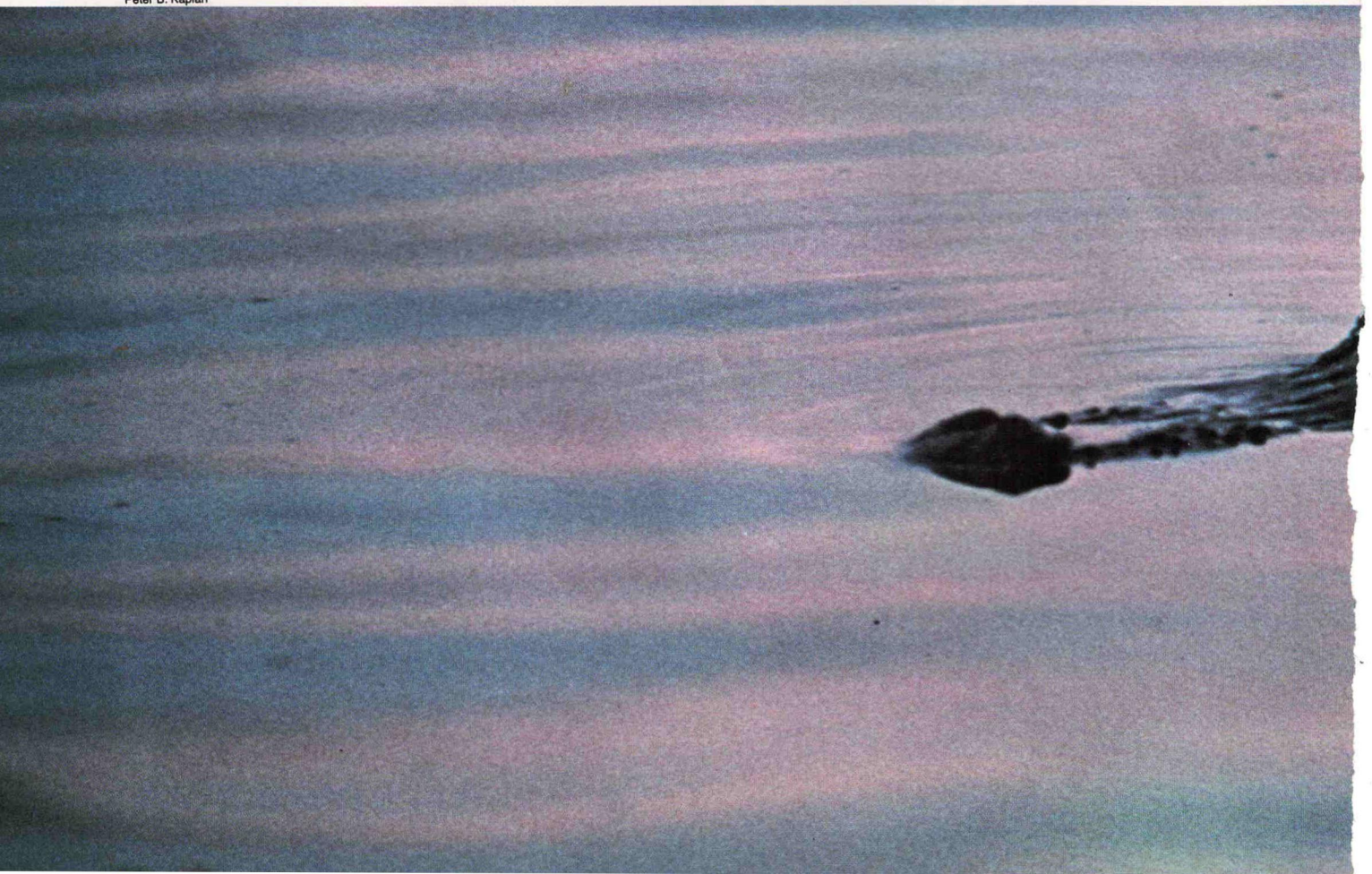
North Carolina. Its fortunes have fluctuated in the last 200 years.

Historically, alligators were either treated as vermin or exploited for their economic value. Young alligators were killed, stuffed, and sold as tourist curios, while shoes and handbags were manufactured in large quantities from the hides of adults. Sharp downturns in alligator numbers were noted by the turn of the century. During the next five decades the American alligator population decreased so dramatically that, in the late 1950s and early 1960s, some states passed protective legislation. In 1967 the American alligator was listed as an endangered species. Under state and federal protection the alligator began a slow but noticeable recovery in some areas. By 1972 the state of Louisiana, a front-runner in

alligator research, management, and commerce, decided that the species had recovered its numbers sufficiently in three parishes (counties) to permit annual controlled hunting in early fall of several thousand alligators for their hides.

As of February 1977, the alligator was reclassified as "threatened" throughout most of its range. This legalizes both the killing of alligators "in defense of human life" and the sale of hides obtained in this manner. The changes in federal regulations have been justified by census data collected by game commissioners in the affected states. Although attempts have been made to standardize censusing among states, the danger is that the loosely collected figures may be overestimates. Florida, for example, claims to be overrun with a

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half-million alligators and is swamped with complaints from residents. In order to alleviate the pressure on harried Game and Fresh Water Fish Commission officers in the northern part of the state, Florida, with federal approval, will license hunters to shoot these "nuisance" alligators and to sell their hides with state cooperation. The problem is that humans have moved into alligator habitat, resulting in greater alligator-human contact.

Fortunately, the alligator's plight stimulated a serious research effort during the last two decades. Initially, management goals, directed primarily toward understanding alligator movements, feeding patterns, and reproduction, predominated. In contrast, our studies deal with alligator social life, and we have concentrated

on systematically describing their social behaviors and organization. Most of our research took place at an alligator farm in south-central Florida where thirty-five adult alligators inhabit a medium-sized lake.

Biological studies of wild alligators in the Louisiana coastal marshes have determined what parts of a water body alligators use and when. By following adult alligators fitted with radio transmitters, biologists of the Louisiana Wildlife and Fisheries Commission found that adult males prefer artificial canals and other deepwater open channels year-round, and that females prefer open water during April and May, the courtship-mating period. After that, they stay near their nests and den sites. The most significant finding to come out of this work is that alligators form

small breeding groups in open water during the spring.

Bellowing, usually an early-morning activity, is the most obvious signal of courtship and mating. We heard these booming roars in chorus nearly every morning until the middle of June. Apparently, bellowing attracts both sexes to a breeding group by advertising the location of potential mates. Only males were thought to bellow, but we found that females also do so, their roars often attracting courting males. However, when males approach other males, fights frequently result.

Head slapping is another display that we were able to study. In this display, an alligator slams its head into the water, creating a splash that can be heard at a distance of 200 yards above water, and probably much far-





Robert C. Hermes, Photo Researchers

ther underwater. Alligators head slap from within their territories, and responses to this signal by other individuals are very similar to those during bellowing. These two displays are the most obvious of the eighteen cataloged communication signals in the alligator repertoire (including six distinct vocalizations) that function to bind individuals into a social unit.

Now, for the first time, we can sketch the framework of alligator social structure. Upon arrival at the breeding area the males fight and the victors establish territories. We watched as the largest, most aggressive male won all of his battles and emerged socially dominant. He defended a large territory in the lake and had priority access to females for mating. Several subdominant males were excluded from his territory and occupied smaller adjacent areas. The top male also interrupted the subdominants during their courtship with females. A system of mutual advertising attracted the nonterritorial females to the dominant male and to other males. The females are polygamous and move freely from one male to another, but the dominant male

probably mates more than the subdominant males.

Once a potential mate is attracted, courtship begins with greeting behaviors: the male and female touch and rub snouts, rub heads, and emit coughing sounds. At this point, the female may refuse further attention from the male by emitting a short, throaty bellow, then swimming off.

Following the short greeting, the pair begin to circle one another, ride on each other's backs, and submerge and blow bubbles. These behaviors shift about within the courtship sequence, and the pair can break off at any time.

Copulation takes place in shallow water. The male mounts his mate's back and after intertwining his tail with the female's, he lists to one side so that her cloacal vent is accessible to his penis. The entire act lasts only a few minutes.

Courtship activity lasts for six weeks, suggesting that sustained reciprocal stimulation is necessary for coordinated mating. The most intense courting and mating precedes nesting by about one month and probably coincides with ovulation. Here may be

Males and females take turns riding on each other's backs as part of their precopulatory ritual. Blowing bubbles and geysers of water through their nostrils is also a part of a courtship that may last for hours. The larger males establish breeding territories and mate with numerous females.

an example of how behavior and physiology are integrated over a long courtship season to determine the timing of fertilization. In any event, a courtship period lasting that long, even though it does involve a shifting of partners, can be described as leisurely. From our vantage point it also was noticeably playful.

An alligator nest is composed of locally available vegetation and earth. In early June we saw females crawl out of the water at night and begin to shape, rework, and condition the nesting material into a mound about three feet in height and five to six feet across at the base, a process that took a week. For most of the construction they use both hind limbs and forelimbs. The last detail prior to egg laying is the formation of a conical egg chamber, extending about a foot or more below the apex.

A female lays between 20 and 55 eggs, one every 45 seconds. As each egg leaves her body, she meets it with the underside of her hind limb, first breaking the egg's fall and then positioning it in the nest. After the last egg is deposited, she covers the clutch; with amazing control she grasps nesting material with the claws of her hind limbs and drops it on top of the eggs. Once the eggs are covered, the female reshapes the nest and packs it by crawling across it.

Nests usually are built in places above the high-water mark that summer rains will bring. Even so, some nests are flooded during severe storms. Release of water from canals into former parts of the Everglades of southern Florida during the rainy season regularly inundates and destroys many alligator nests.

Hatching success is determined by proper temperature and humidity





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Defending her vegetation- and earth-packed nest, left, a female will charge potential egg predators, such as black bears and raccoons, and humans who venture too close. Having worked its way out of an egg with the use of an egg tooth, a hatchling, below, will be assisted to nearby water by its mother. Another hatchling, facing page, rests on its mother's back, basking and snapping at insects.

conditions in the nest, maternal protection against nest predators, and parental assistance at hatching. Temperatures within the egg chamber vary between 79° and 92° F during the sixty- to seventy-day incubation period. Moisture content in the nest is affected by rainfall and groundwater.

Raccoons and black bears are major predators of alligator eggs. Other studies have demonstrated that female alligators do guard and defend their nests against predators. From radio tracking studies and other observations, we know that females remain near the nest after laying. We often sighted females resting quietly at the edge of the lake near their nests; as we approached they lifted their heads and tails slightly out of the water. If we approached too close to a female, she swiftly charged toward us, driving us away from the nest.

Just prior to hatching, the outer shell of the egg cracks and falls away, and the tiny alligator slits the tough inner membrane with its egg tooth. Even before it takes its first breath of air outside of the egg, the hatchling is capable of vocalizing a high-pitched "erk" sound. By playing the tape-recorded grunts of a day-old alligator through remote audio speakers, we demonstrated that female alligators actually respond to the vocalizations of the young. A recently completed study by Gene Meyer and



Robert H. Potts, Jr., Photo Researchers

Myrna Watanabe, in the Okefenokee National Wildlife Refuge in Georgia, has produced conclusive evidence that female alligators excavate the nest, carry some hatchlings to water in their jaws, and lure the remaining offspring out of their natal tombs by vocalizations. But it is also known that in areas of heavy poaching or human disturbance females do not defend nests after laying and do not liberate the young at hatching. Given the heavy mortality on hatchling alligators, such disturbance can cause a significant drain on alligator populations. Other crocodylians also defend

their nests and liberate the hatchlings from the nest, emphasizing the importance of maternal care.

Hatchling alligators, probably from the same nest, live in groups, or "pods," near their mother's den site. They often crawl about on the mother's head and back where they bask and snap at insects. When we approached a brood the mother opened her mouth and hissed, then lunged and chased us from the area. When we grasped a hatchling it emitted a loud, repetitive "distress" yelp that attracted adults to the sound. An experiment by Everglades National

Park biologist James Kushlan demonstrated a female's response to the distress calls. Kushlan elicited such calls by holding a newly hatched alligator ten feet from its mother, which then rapidly crawled out of the water toward him. He then released the young one. The female picked up the hatchling with the side of her mouth, retreated to the water, and released it. Transporting of the young in the mouth by females also has been documented in American, Morelet's, and Nile crocodiles, and in the spectacled caiman.

Toward the middle of their first year the young begin to swim alone. Several in a group we watched appeared to be leaders because they were followed by other individuals during their wanderings. While swimming, these leaders emit frequent grunts that probably help to maintain contact among all the members of the group and to alert others to the presence of food or predators.

In spite of maternal care, young alligators are preyed upon heavily by raccoons, otters, turtles, fish, and several species of heron. The toll taken by predators, when added to that taken by disease and other sources, probably reduces the original clutch by half within one year and by 80 to 90 percent within three years. The remaining small alligators very likely disperse away from the mother by the second or third year, but this may be dependent upon the habitat. For example, in the Everglades, where alligators are restricted to "gator holes" during the dry season, young of three successive years have been seen near a female's den.

Crocodylians grow very rapidly, but mature late. Ranging from eight to ten inches at hatching, alligators grow roughly one foot during each of their first six years, eventually reaching an adult length of six to eight feet for females and ten to fourteen feet for males.

A diet of insects, snails, crabs, small fish, frogs, and small mammals supports such rapid growth. Larger prey such as gar and other fish, snakes, birds, raccoons, muskrats, and an occasional dog are also eaten as the alligator grows larger. Alligators are by no means finicky eaters—they will take live prey or scavenge their meals—but they feed less fre-

quently than might be assumed for so large an animal. Nonfood items called gastroliths (stomach stones) are sought out, ingested, and retained in the stomach. Some biologists argue that these stones function as ballast, while others are of the opinion that they aid digestion.

Retention of gastroliths enabled us to feed adult alligators a small pseudogastrolith containing a radio transmitter that encoded stomach temperature. We wanted to know

how the internal body temperature of this large ectotherm (ectotherms derive body heat from the environment, rather than from internal metabolism, as do birds and mammals) fluctuated in response to daily and seasonal changes in the environment and how an alligator's behavior affected its body temperature. By simultaneously recording temperature and observing behavior, we demonstrated that an alligator can maintain its body temperature at about 89°F for



hours each day by basking in the sunlight on land or in the water. During the warmer months, when alligators bask infrequently and remain submerged for hours at a time, their body temperatures fluctuate by only a few degrees throughout the day.

In order to regulate their body temperatures alligators require a source of water deep enough to provide a temperature gradient and shelter from the sun, adequate vegetation on land and near the water for shade and shelter, and access to suitable land areas for basking.

Water, therefore, is the key to the alligator's survival. Within a broader wetland mosaic, this semiaquatic reptile must locate suitable water for its food, social behavior, reproduction, and heat balance. However, wetland ecosystems are disappearing so rapidly that the American alligator's survival cannot be guaranteed. For example, in 1972 biologist Jim Schortemeyer of the Florida Game and Fresh Water Fish Commission estimated that 23 percent of good alligator habitat was lost in the development of six south Florida counties.

A new life-history portrait of the

American alligator is emerging, one that could save its existence. Alligators can be characterized as lacking predators (except humans) as adults, as suffering their major mortality prior to three or four years of age, as investing much time and energy in maternal care, as seasonal breeders possessing an intricate social organization and sophisticated communicatory behaviors, and as being long-lived in the wild. This is a very stable life-history pattern, one in which the alligator exploits a particular set of predictable environmental resources. For example, some female alligators show fidelity to nest sites year after year.

We have suggested how human alteration of the environment can disturb the alligator's reproductive behavior and ecology. Such human disturbance as the flooding of nests is obviously detrimental. A less obvious but equally important human impact may also soon occur. Killing of large males in the Louisiana and Florida hunting programs should be avoided because removal of such individuals might disrupt the alligators' male-dominated social structure dur-

ing breeding and deprive the population of a potentially important genetic contribution.

Many important questions about the relationship between alligator behavior and ecology remain to be answered. One of these is whether habitat differences generate differences in social structure; that is, do alligators living in lakes or rivers have a different social structure from those living in marshes. Despite gaps in our knowledge, we now have enough information to enable us to formulate a coherent, habitat-centered survival plan for this ancient reptile. □

Hatchling alligators float in a bed of swamp lettuce, below. At this stage of their lives, they feed mainly on insects, snails, frogs, and small fish. Raccoons are major predators on the young reptiles. When an alligator reaches the size of the one at right, however, the tables are turned and raccoons become the prey.



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