



THE FLORIDA CROCODILE: Will It Survive?

by Jeffrey W. Lang

Finding a crocodile in Florida is not easy. Clouds of mosquitoes engulfed us whenever the boat stopped. We had searched miles of coastline without seeing a single eyeshine—the conspicuous yellow-orange reflection we knew would signal “crocodile.” As our small skiff skimmed over the calm waters of Florida Bay in Everglades National Park, a spotlight in the front of the boat created eerie figures among the tangled mangrove roots that reached into the water from shore. Suddenly a faint glimmer appeared in the distance, just offshore. As we approached, I was sure that at any moment the eye glowing in the darkness would drop out of sight. But we glided closer, and other features came into view: a light, tan-colored head and a long, tapering snout with a tooth

protruding upwards from the lower jaw several inches from the tip of the snout. A large American crocodile (*Crocodylus acutus*) swam slowly off the bow of the boat, only an arm's reach away.

Today crocodiles are rarely seen in the park, even though their presence there has been known for years. Unlike the alligator, which is widely distributed throughout the southeastern United States, the crocodile is restricted to the southeastern coast of Florida. A century ago, the species ranged from about Lake Worth on the east coast south into the Miami area and west through the Florida Keys. At present, crocodiles occur on North Key Largo and in eastern Florida Bay, with scattered records from the lower Florida Keys. Recent estimates place the entire population in the United

States at between 200 and 400 individuals; of these, only 25 or less are breeding females.

For us, getting so close to a crocodile was a pleasant surprise and an encouraging sign. On previous nights, we'd looked in vain for hours. When we did see a crocodile, it would dive out of sight before we could approach. It was

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◀ *Crocodile hatchlings with radio transmitters attached.*

late July of 1973; and I was collaborating with John Ogden, a research biologist with the park staff, on a pilot project to mark and study the crocodiles in Florida Bay. Several rangers who had handled alligators were assisting us. Because crocodiles tend to be more aggressive and dangerous than alligators, experienced helpers were welcome.

As our boat headed for shore, the crocodile unexpectedly climbed out of the water onto a high marl bank and went crashing through the brush. We scrambled after it, dropping our gear and grabbing for headlamps. After a brief chase, the crocodile was surrounded, hissing at us whenever we approached. Finally, one of the rangers pinned down its head with a long pole and held its jaws closed, while two of us gently eased onto its back and tail. Carefully, the crocodile's snout was taped. Amazingly, the crocodile didn't struggle. I'd read that, once captured, crocodiles become lethargic; in this instance, I was happy to confirm it. With two men sitting on the crocodile's back, we quickly took body measurements, marked several tail scutes in a distinctive pattern, and released the eight-foot female unharmed—our first crocodile was marked.

Investigations of the biology of the American crocodile are long overdue. Surprising as it may seem, throughout the species' range—in Florida, the Greater Antilles, and parts of Central America and northern South America—very little is known about its natural history. For instance, what do crocodiles eat? Where do they live? When are they active? Are crocodiles social? How do they breed?

Exciting answers to some of these questions are beginning to emerge from the studies conducted by John Ogden in the Everglades National Park. Starting in 1969, his first efforts involved searching for nests and patiently waiting for glimpses of the animals that made the nests. Within several years, eight nesting sites were located, but the crocodiles were almost never seen. So, at a few of

the nests, remote-control cameras were set up to monitor the crocodiles when they visited the nests. The resulting photographs document many of the behaviors associated with nest-building, nest attendance, and hatching.¹

Over a period of weeks, every April and May, female crocodiles construct their nests along the sandy beaches and marl banks of eastern Florida Bay. Some are large mounds of sand that are visible a quarter-mile away; others are mere holes in the ground that are barely distinguishable from the surrounding terrain. Each female lays about 20 to 60 eggs, and then visits her nest frequently, often at night. At the end of the 100-day incubation period, she excavates the nest, carrying newly-hatched young to the water in her mouth.

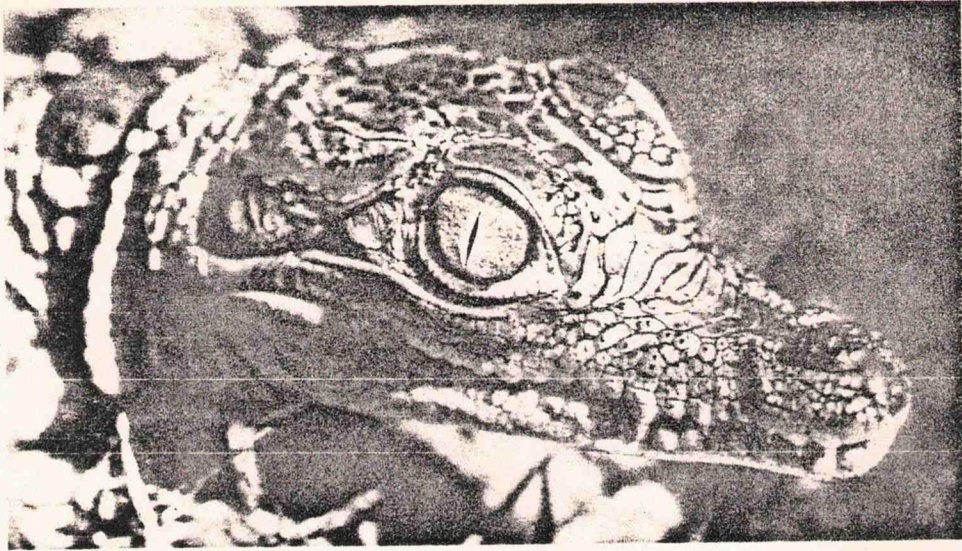
Such attentive care of the young may be typical of birds and mammals,

but it is a rare trait among reptiles. Compared to the other reptilian groups, crocodylians show exceptional care for their eggs and young. Females even guard their hatchlings against predators, according to one report on another species. We were anxious to learn how long a female crocodile stays with her young. Marking a family of American crocodiles at nesting time looked like a good way to find out.

We hoped to capture a female near her nest, equip her with a miniature radio transmitter, and then tag the young when they hatched. In this way, we could follow the mother and her young with a portable radio receiver, document their behavior, and identify the habitats they preferred. Importantly, the study would also give us a chance to develop and evaluate techniques for learning more about these shy and unusual reptiles.

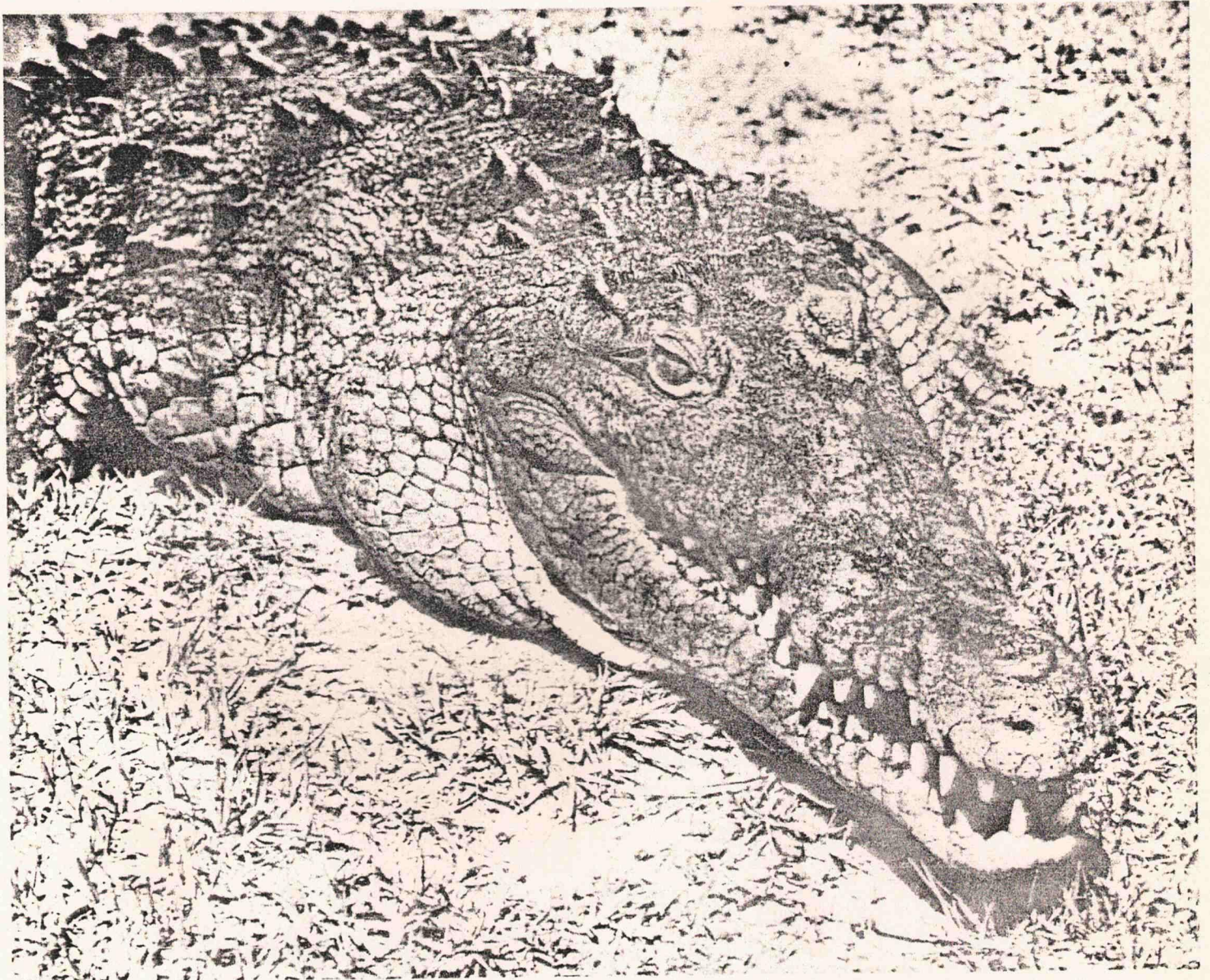


► *Baby crocodile emerges from egg after three-month incubation. An egg tooth at tip of upper jaw serves to puncture the inner leathery shell. The brittle outer shell cracks away at hatching.*



Day-old crocodile hatchling. Weight: about 3 ounces; length: 11 inches.

The business end of an adult American crocodile. Its narrow, tapering snout and light coloration distinguish it from the American alligator. Adults sometimes reach 15 feet in length and may weigh half a ton.



Apparently, our first marked crocodile did not have a nest in the vicinity, so we looked for another candidate for attaching the telemetry equipment. A few days later, a second female was trapped near her nest and outfitted with a transmitter. But "Black Betsy," named for the key where she nested, wasn't very cooperative. After weeks of searching, we were still never able to relocate her. The radio may have malfunctioned, or perhaps the disturbance so close to the time of hatching scared her away.

Fortunately, her young were more willing. Altogether, we tracked 28 hatchlings for periods of 2 to 15 days. At first the young clustered within several feet of each other on the shoreline near the nest. But after several weeks, they had dispersed, some as far as 200 yards from the nest. The baby crocodiles spent most of the daytime hiding among mangrove roots and under leaves and debris near the water. At night, particularly between dusk and midnight, they were more active.

Contrary to predictions, the hatchlings seemed to tolerate salt water quite well; some workers have suggested that they move into fresh water soon after hatching. In general, the young preferred shallow, protected areas on the inland side of the key. As we expected, predation was very high, at least for these young without a mother around. Various tracks and signs near the radios we recovered suggested that raccoons were the villains. Ironically, raccoons have become abundant in south Florida since many of their predators, including crocodiles, have been reduced in numbers or eliminated by man.

Following crocodiles in the wild is not the only way to study their behavior. At a unique alligator farm, known as "Gatorama," in south central Florida, I have been observing and filming the behavior of captive American crocodiles. Within the large, spacious enclosure, adult crocodiles cruised around a three-acre lake and went about their daily business of feeding, basking, and socializing. Actually, a casual first glance didn't reveal the complex social structure that really existed. But as I watched day after day, I saw frequent encounters between animals and subtle behaviors that I hadn't noticed initially. Many of the crocodiles had distinctive markings,

and I marked certain others. In this way, I was able to identify individuals and watch their behavior for several months at a time.

Like many animals, crocodiles are territorial during the breeding season. Three large males divided up the enclosure early in the spring; and each resident male patrolled his territory often, excluding other males. Territorial boundaries served as neutral zones where the nonterritorial males sought refuge, but the females moved from one territory to the next with impunity. A crocodile's whereabouts was circumscribed largely by his relative position in the "pecking order." Consequently, every crocodile that I could identify had a predictable pattern of basking, feeding, and moving within the enclosure. I had a feeling as I watched that each individual noticed and distinguished among its neighbors and acted accordingly.

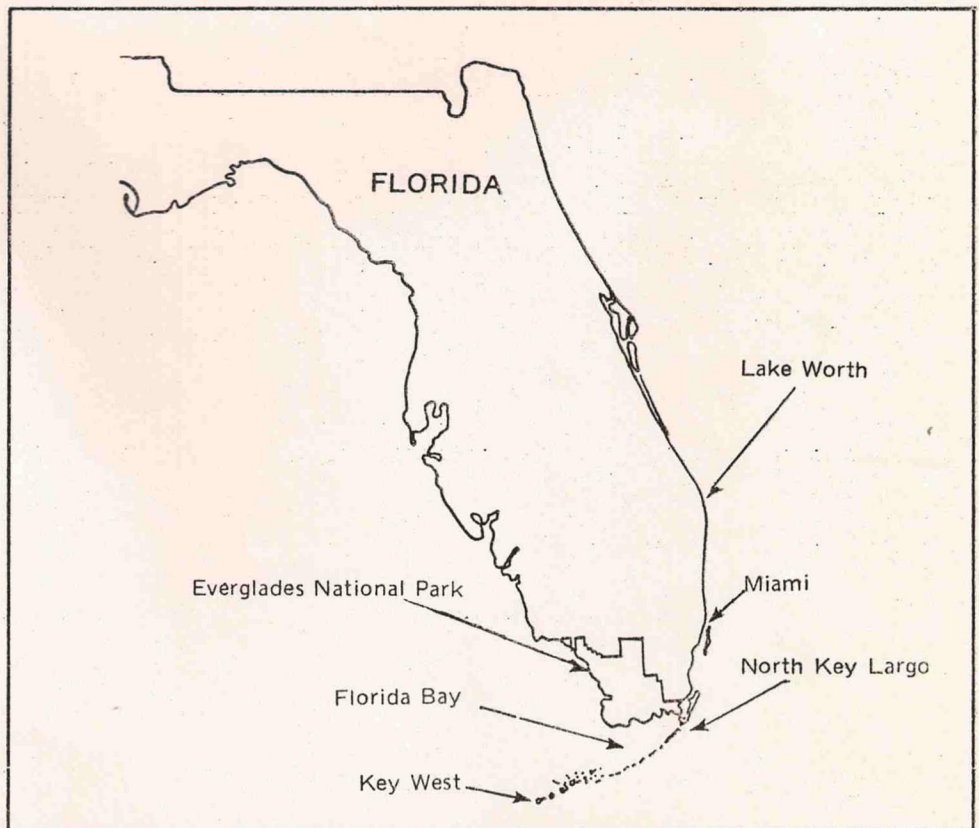
Resident males advertised their presence by "headslapping." In this display, the head is lifted up and then slapped suddenly onto the surface of the water. Simultaneously, the jaws are opened and closed quickly as the head hits the water. The cumulative effect is a popping sound audible some 200 yards away and loud

enough to wake a sound sleeper. The resident males I watched headslapped one to three times in rapid succession, usually in response to a neighbor's headslap or when an intruder entered a resident's territory.

Social interactions occurred more frequently during the breeding season, but fighting was observed only rarely among these American crocodiles.

On one occasion, two males of similar size squared off, lunged at each other with opened jaws, grappled briefly, and then separated. Each displayed the "arched-back" posture in which the back is arched and the body inflated. The purpose of this display seems to be intimidation of the opponent. Another display, tail wagging, was performed by the dominant male just prior to his attack. But usually, subordinate males were chased hastily out of an occupied territory by the resident male. Biting, when it did occur, was stereotyped: the attacker would grasp its opponent by the base of the tail with its jaws, then quickly release its hold. Only minor damage was inflicted during these skirmishes, but the message seemed to be clear.

Submission was signalled by the "head-up" gesture. In this display, the



head is lifted out of the water, and the snout pointed upward at an acute angle to the water. Often, the jaws are held open, exposing the bright yellow interior of the mouth. Females and possibly subordinate males lifted their snouts when they were approached by a large male, particularly a resident. If the initial gesture failed to halt an advance, the snout was lifted higher, and lowered, and

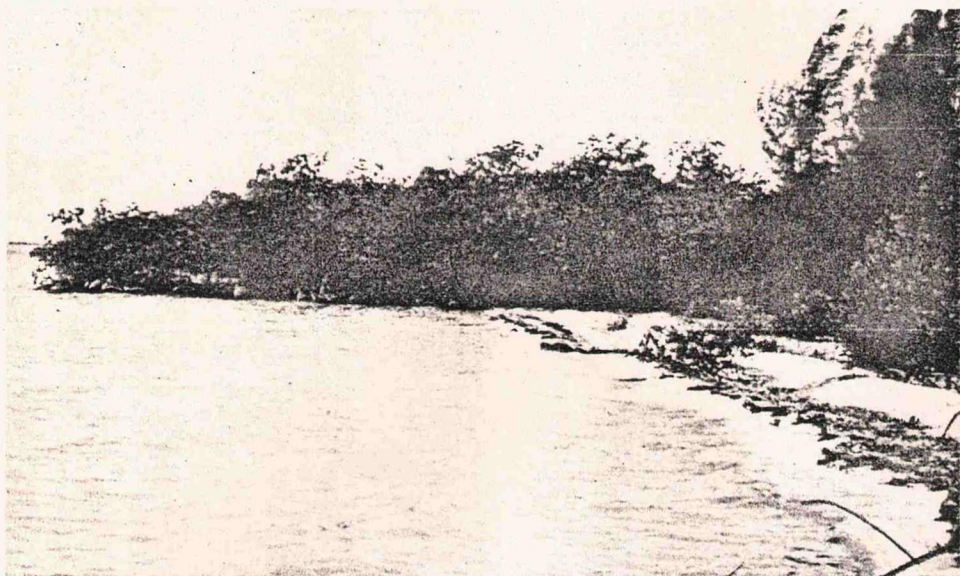
lifted again. Paradoxically, a crocodile's open jaw in this context signaled appeasement rather than aggression.

Courtship was a relaxed, yet complex activity. The sequence of events was quite variable and often continued intermittently for days. Typically, the female approached a potential suitor, usually one of the resident males, with her snout lifted upward in the "head-up"

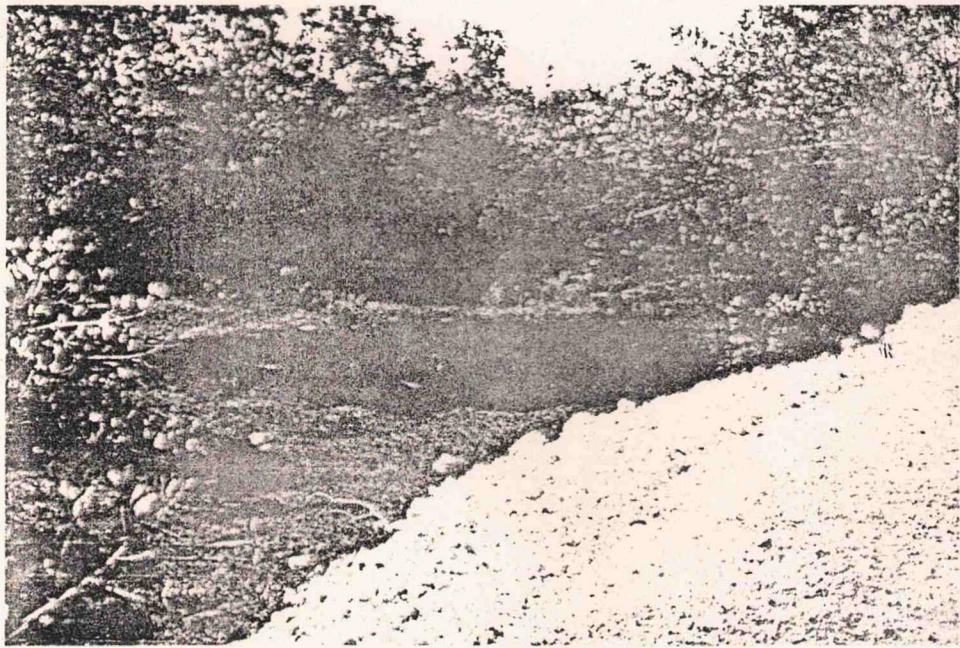
posture. If the male remained stationary, the female lifted her head onto his neck and back, circled behind him, and then repeated the performance on his other side. Eventually, the male assumed a characteristic posture with his head and tail out of the water. A period of elaborate circling by both partners followed; their heads were lifted and in contact. Circling continued until the male swung around on top of the female's back; with the female almost completely submerged, copulation took place underwater.

As I watched the crocodiles court, I was reminded of the elaborate courtship patterns of many species of birds. In some respects, the behavior of birds and crocodilians is remarkably similar. For instance, both groups vocalize. Alligators engage in a variety of bellows, growls, purrs, hisses, and grunts, all of which appear in certain contexts and probably convey specific messages. Other species, like the American crocodiles I watched, only growl occasionally as adults. But in all species studied so far, vocalizations are important in the mother-young relationship. When a baby crocodile grunts, adults as well as other young respond. Some observers have likened a "pod" of grunting, hatchling crocodiles to a brood of quacking ducklings. Care of the young, as noted earlier, is another behavioral characteristic that crocodilians share with birds. Although at this point we are not sure just what kind of parents crocodiles make, the degree of parental care they show is impressive, at least for reptilians. Possibly, the behavioral affinities between birds and crocodilians reflect the past evolutionary history of the two groups. Crocodilians share their archosaurian ancestry, dating back some 200 million years ago, with the birds and the dinosaurs. Perhaps the extinct dinosaurs also cared for their grunting young as the crocodilians do today.

But, in order to generalize about crocodilian behavior, we need to know much more than we do now. Of the twenty-one species of crocodiles, alligators, and gavia living today, only a few species have been studied in any detail. Already we know that certain displays, such as the "headslap" seen in the American crocodile, are performed by the Nile crocodile and the American



Typical Florida Bay shoreline of a Florida key, where mangrove prevails. Baby crocodiles sometimes conceal themselves in seaweed washed up onto the shore.



Crocodile nest (dark area at center) on North Key Largo. In 1973 this nest produced hatchlings despite nearby construction project. In 1974 the road at lower right was constructed and the nest was abandoned.

alligator as well.² Future comparisons between species should prove interesting. Studies on captive animals are a valuable first step in understanding behavior; but, ultimately, field studies such as the one we initiated in Florida Bay will be necessary in order to appreciate the role of behavior in natural populations. As a matter of immediate concern, information of this sort is essential for making wise decisions about the management and preservation of the species.

We will have to act soon. Habitat destruction threatens the continued existence of the American crocodile in Florida. Today, crocodiles occupy only a fraction of their former range. Unfortunately, this narrow strip of land is within an area that is being modified intensively by man. Crocodiles once lived on the shores of Key Largo and throughout the Miami area, but these localities have been altered so extensively that there are simply no longer any habitats or crocodiles left. Suitable habitat is protected within the Everglades National Park. Even so, we don't know enough about the habitat requirements of crocodiles to say with certainty that the area within the park is large enough to support a stable population.

Outside the park, crocodiles still occur in the North Key Largo area. In the spring of 1973, I found crocodile nests from previous years at two localities there. By the middle of the summer, a

dredge-and-fill project was underway at one site. As I searched for a nest I'd seen in the spring, I realized that it was buried beneath the road I was standing on. Somehow, a few crocodiles were able to nest. In early August, I discovered fifteen hatchlings in the water near a recently hatched nest. Less than 100 yards away, a diesel dragline was scooping up the mangroves, apparently paving the way for another seaside trailer court. The fate of these young crocodiles certainly looked bleak.

For years, crocodiles in Florida were hunted and killed for their hides. Writing about Florida Bay in 1908, A.W. Dimock said: "Before every crocodile cave, a picket fence tells of an attempt to capture its occupant."³

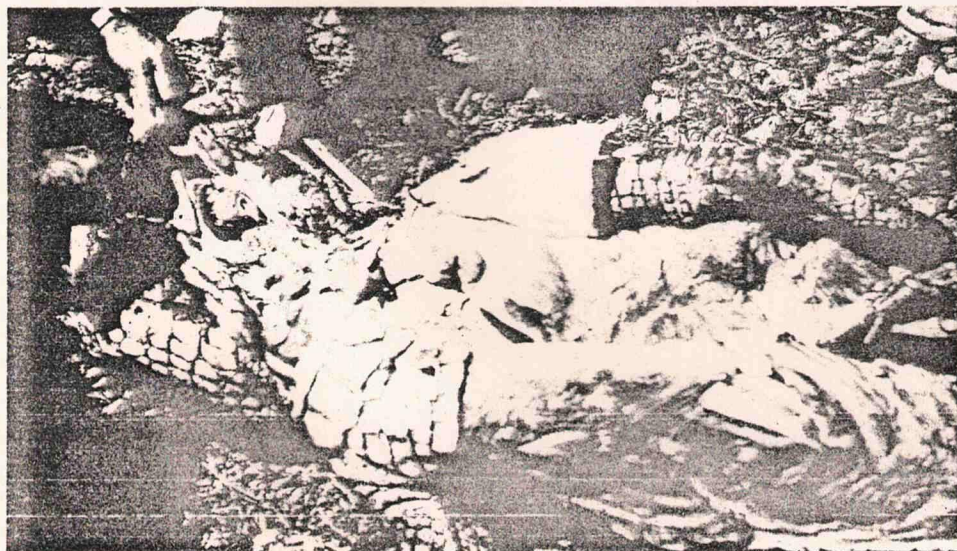
By the early 1940s; a museum curator thought it noteworthy that he took two trips through Florida Bay with an experienced crocodile hunter before finding a single adult. By the 1950s, the number of crocodiles in Florida had been reduced dramatically; finally, some respite was afforded with the creation of Everglades National Park. In the 1960s, killing a crocodile was prohibited under state law; but there was little attempt by the state to protect those that remained. presumably, by then, crocodiles were thought to be too scarce to warrant much attention.

Tragically, the killing goes on. Crocodiles are shot deliberately by construction workers as the mangroves

are cleared. Each year, others die on the busy highways. In early April of this year, local law officers captured and shot an 11'9" adult male crocodile while they were searching for evidence of a crime in a shallow lake on North Key Largo.⁴ When questioned about why the crocodile had been killed, they offered conflicting explanations about the safety of their divers, the need for an examination of the stomach contents, and the poor health of the crocodile. On subsequent examination, it was determined that the crocodile was in good health and that its stomach was empty. Simply restraining the animal (since it had been captured) would have been ample protection for the divers. This senseless shooting was clearly illegal under Florida law, but state authorities were reluctant to prosecute. To some, killing a large crocodile must seem quite heroic when, in fact, it involves little risk and takes minimal courage to shoot these shy, if powerful, animals.

Shortly after the incident on North Key Largo, the U.S. Fish and Wildlife Service announced that the American crocodile is endangered in the United States.⁵ By early fall, crocodiles will be afforded federal protection under the Endangered Species Act of 1973. Our first priority should be to identify the crocodile habitats outside the park—primarily in the North Key Largo area—and take steps to preserve these habitats and to protect our remaining crocodiles vigorously. The Endangered Species Act contains provisions for land acquisition should this prove necessary. Perhaps, with more public education and governmental cooperation, on a future visit to the Florida Keys, one might be able to see signs reading: "Caution: Crocodile Crossing Ahead." □

Mutilated carcass of 11'9" American crocodile killed illegally in April, 1975 on North Key Largo. Law officers who participated in the shooting removed the belly skin and chiseled teeth out of the skull for souvenirs.



1. "Night of the Crocodile" by J.C. Ogden, and C. Singeletary, *Audubon* 75(3):32-37 (May, 1973). An article by Ogden (*Animal Kingdom* 74:7-11, Dec., 1971) summarizes research on Florida Bay crocodiles.
2. Alligator social behavior is described by L.D. Garrick in *Animal Kingdom* 78(2):8-8 (April/May, 1975).
3. *Florida Enchantments* by A.W. and Julian A. Dimock (Outing Publ. Co. New York, 1908), p. 298.
4. *Miami Herald*, April 10, 1975.
5. *Federal Register* 40(77):17590-91 (April 21, 1975).