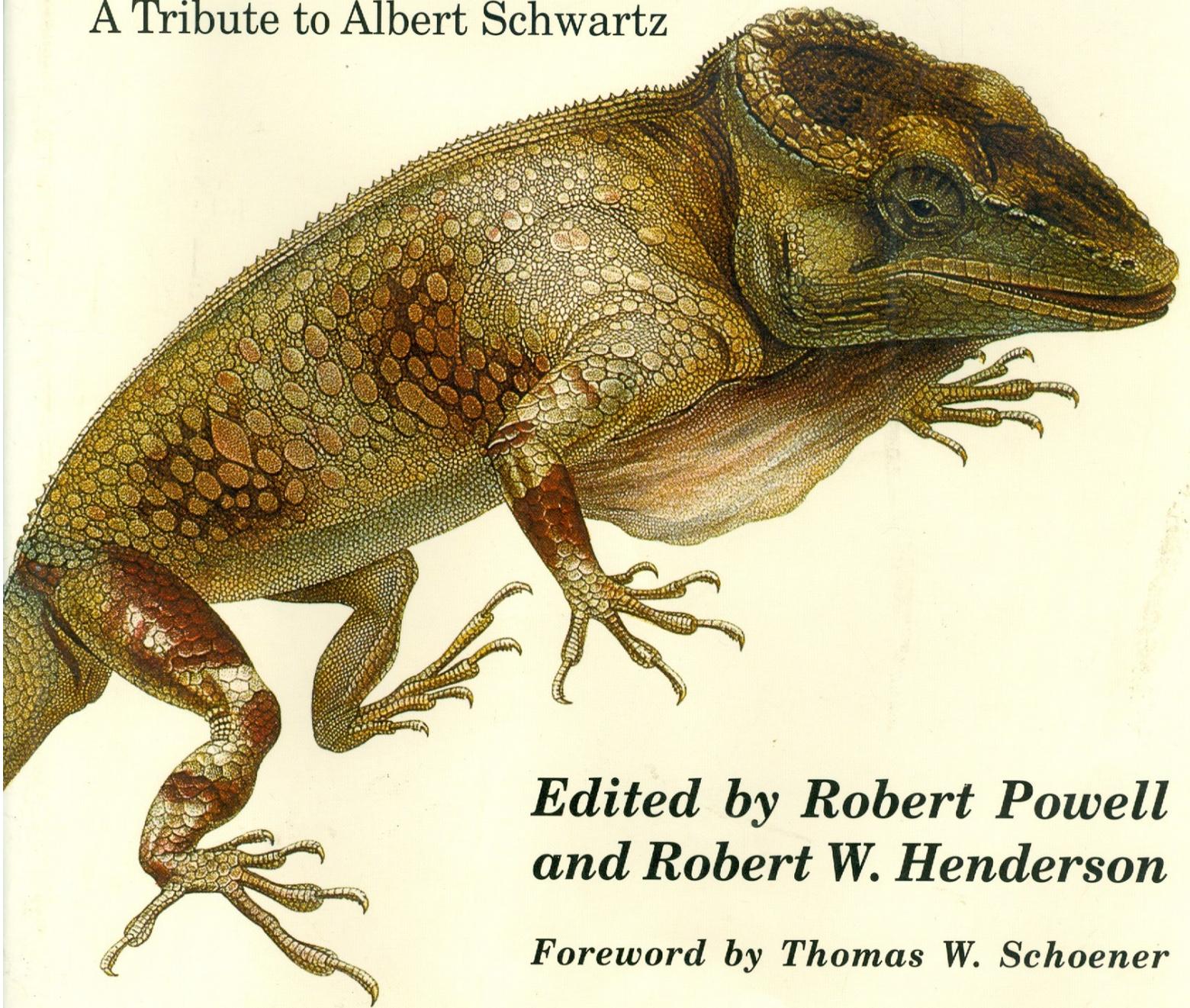


Contributions to
*West Indian
Herpetology*

A Tribute to Albert Schwartz



*Edited by Robert Powell
and Robert W. Henderson*

Foreword by Thomas W. Schoener

Published by the Society for the Study of Amphibians and Reptiles



CONSERVATION OF THE AMERICAN CROCODILE (*CROCODYLUS ACUTUS*) IN THE DOMINICAN REPUBLIC

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Abstract.—The American Crocodile (*Crocodylus acutus*), once widespread on Hispaniola, now survives only in Lago Enriquillo, a hyper-saline inland lake in the Dominican Republic, and Etang Saumatre in Haiti. In the late 1980s and early 1990s, the population size and reproduction rate of the Dominican population declined by about two thirds compared to former levels, mainly due to human impact. As a result of a study carried out by the Dominican Wildlife Department, an Action Plan for the conservation of the species was established and presently is implemented. The results to date include: (1) frequent patrols of the lake shore by park rangers and wildlife inspectors have minimized human disturbances; (2) since 1992, the adult/subadult population seems to have increased slightly and today numbers about 200 individuals; (3) since May 1993, a “genetic reserve” of some 130 juvenile crocodiles is maintained in the Santo Domingo Zoo (headstart program); and (4) Lago Enriquillo soon will have protected status as a National Park.

INTRODUCTION

THE AMERICAN CROCODILE (*CROCODYLUS ACUTUS*) ranges from coastal regions of central Mexico south through Central America to northern Peru on the Pacific and to Venezuela on the Caribbean coast. The species is also present in extreme southern Florida and in the Greater Antilles (Cuba, Jamaica, and Hispaniola) (Groombridge 1987). Once widespread and very abundant, most populations today are severely depleted, mainly due to hunting for skins and habitat destruction (Thorbjarnarson 1992).

On Hispaniola, American crocodiles historically were very abundant along much of the coastline (Descourtilz 1809; Moreau de St. Mery 1797–1798). More recently, in Haiti, small populations of *Crocodylus acutus* could be found in four areas along the coast (Thorbjarnarson 1988). However, subsequently in the Río Massacre area, on the border between the Dominican Republic and Haiti in northern Hispaniola, no crocodiles or signs of their pres-

ence were found, despite intensive searches (SEA/DVS 1993). Most of the mangrove habitat in this area is heavily degraded.

Aside from the small populations around the coast of Haiti, the largest viable crocodile populations on Hispaniola live in the inland lakes Etang Saumatre in Haiti and Lago Enriquillo in the Dominican Republic (Figure 1). The Etang Saumatre population was studied in 1983 by Thorbjarnarson (1988). This brackish lake with a salinity of 8–10 ppt has a size of 113 km² and is situated at 15 m above sea level. The total crocodile population was estimated at 450 animals, including all size classes; the adult population was estimated to number about 70 individuals. More recently, efforts have been focused on the conservation of the populations in Lago Enriquillo.

CHARACTERISTICS OF THE LAGO ENRIQUILLO AREA

Physical Conditions

Lago Enriquillo is situated in the Neiba Valley in the southwestern part of the Dominican Republic.

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The lake is a remnant of a marine channel that once separated the two Hispaniolan paleoislands (Mann et al. 1984). The valley is bordered by two mountain ranges with peaks exceeding 2000 m (Araguás et al. 1993), the Sierra de Neiba to the north and the Sierra de Bahoruco to the south. The climate is arid to semi-arid, with annual precipitation ranging between 470 and 780 mm. Evaporation is estimated to exceed 2000 mm. Generally, two rainy seasons can be distinguished: a moderate April–May period and a usually more prominent September–October season. The lake lies at an elevation of 40 m below sea level, has a water surface of about 200 km², a length of 35 km, a width of 11 km, a maximum depth of 22 m, and a salinity of about 70 ppt. Mean air and lake water temperatures are about 30°C. Heavy easterly winds cause considerable wave action, especially in the afternoon. Lago Enriquillo contains one large island (Isla Cabritos) and two small islands (La Islita and La Barbarita). Due to the low lake level at the present time, the latter constitute a peninsular extension from the lake shore.

Water level, lake surface, and salinity vary substantially from year to year. In early 1979, after a prolonged drought, the lake was divided almost in half by a peninsula formed by the emergent islands. However, later that year, Hurricane David initiated a three-month period of heavy rainfall; the water

level rose in excess of 5 m and the salinity dropped from more than 90 ppt to about 35 ppt (Margalef 1985).

Vegetation and Fauna

Extensive freshwater wetlands in the eastern and western ends of Lago Enriquillo create conditions that result in a mosaic of different vegetation types: cattail stands (*Typha domingensis*), mangrove forests (*Conocarpus erectus*), and halophyte marshes (*Batis maritima*). Other areas are totally devoid of any vegetation. The typical vegetation around Lago Enriquillo and on the islands is dry forest, composed of spinous hard woods and cacti. This dry forest harbors many species of birds and reptiles, among them the two threatened species of iguana, *Cyclura cornuta* and *C. ricordii*.

Along most of the northern lakeshore, irrigation schemes allow agriculture and pasture usage down to the shoreline. Many canals and creeks enter the lake, most of the latter arising close to the shore in so-called “borbollones.” No fresh water is found along most of the southern shore or on the islands. Two endemic species of the genus *Cyprinodon* occur in the lake. In the 1950s, *Tilapia mossambica* was introduced into Lago Enriquillo and today is the most abundant species of fish (Incháustegui et al. 1978).

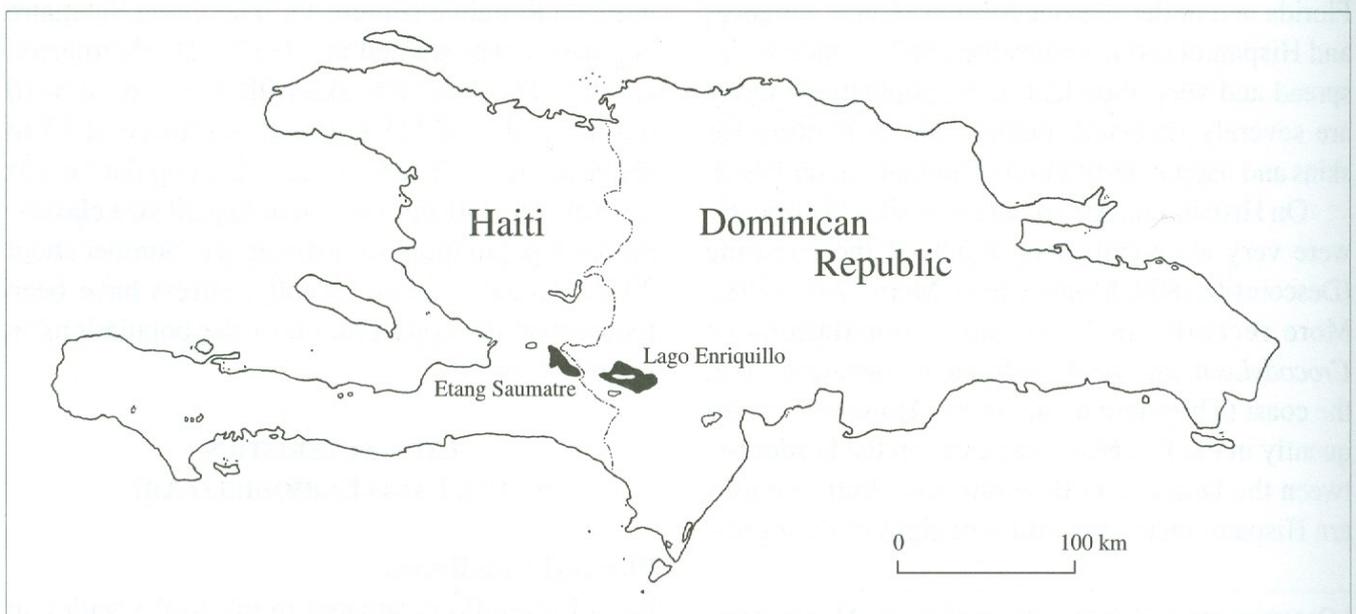


FIGURE 1. Map of Hispaniola illustrating the location of the two inland lakes supporting viable American crocodile populations.

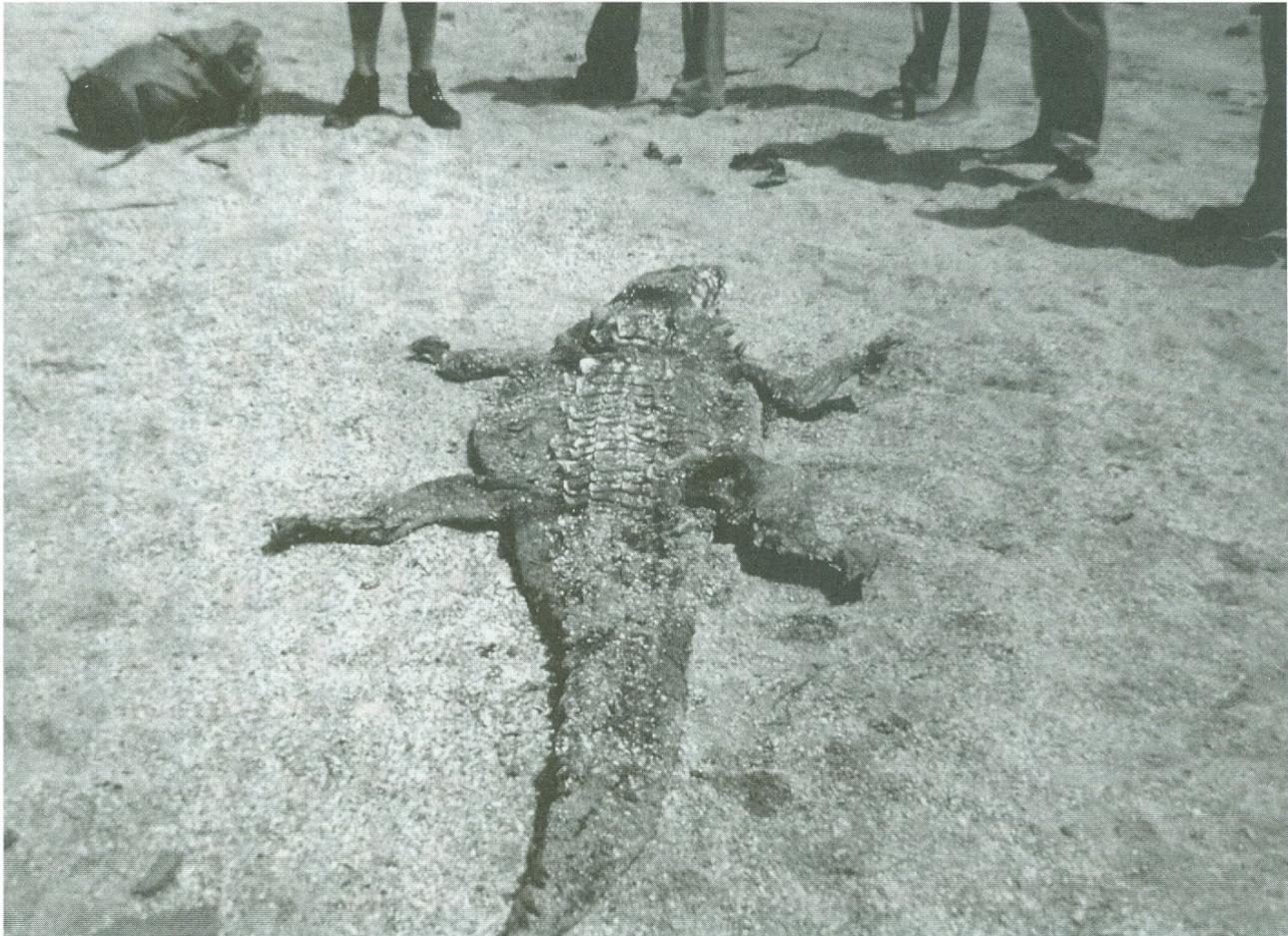


FIGURE 2. Carcass of a crocodile killed in 1991.

HUMAN IMPACT ON THE CROCODYLE POPULATION

Before the Isla Cabritos National Park was established in 1974, the impact of human activities on the crocodile population was very severe (SEA/DVS 1993). Sometimes up to 20 crocodiles were killed in a single event. Generally the motive behind this killing was to obtain meat for food, fat for the local pharmaceutical industry, and penises (which are assumed to have aphrodisiac properties), rather than hides.

However, as recently as the early 1980s, the crocodile population of Lago Enriquillo was considered to be the largest and densest throughout the entire range of the species. During the late 1970s and early 1980s different Dominican institutions (CIBIMA, Museo de Historia Natural, and Departamento de Vida Silvestre) studied this population.

They estimated an adult crocodile population between 300 and 600 individuals (S. J. Incháustegui and E. A. Bautista, personal communication). Between 70 and 112 nests were found in the years 1977 through 1984 (estimates of the total number of nests vary between 100 and 150 for these years; Incháustegui, *in* SEA/DVS 1993).

In 1990 and 1991 the Dominican Wildlife Department surveyed nesting activities and found alarmingly low numbers of nests, about 30 in 1990 and only 10 in 1991. Very few crocodiles of any age class were seen during these surveys. In one nocturnal count at the end of May 1992, for example, only six crocodiles were seen — and most of them were very thin, as is evident in a series of video recordings from 1992.

At the same time, reports of crocodile killings became more and more frequent (Figure 2). In June 1991, six crocodiles were killed by local inhabit-

ants at one time — apparently just for fun. In February 1992, a crocodile was killed by four fishermen and the meat was sold in a local discotheque.

The Wildlife Department purchased a boat with an outboard motor and a canoe, and initiated field studies in March 1992. The surveys during the first months showed that the status of the crocodile population was even worse than expected. Few adults were seen along the coast and, despite intense searching, only three nests were located. Crocodile bones, including smashed skulls, were found in most of the important basking and nesting areas. Long wooden poles used to capture crocodiles were found and destroyed. The next morning a new pole was seen at the same site. Human tracks were found even on the most remote beaches. At the end of May 1992 we even found bones with flesh and blood still on them. Evidence was common of another way to kill crocodiles, traps built out of sticks in the ground with a snare and bait at the end.

The evaluation of 1992 crocodile monitoring led to an estimate of 160 adult and subadult animals

(larger than 1.5 m) for the entire lake (SEA/DVS 1993), indicating that the population had dropped to half or even one-third of its size in the early 1980s. A similar decline was observed for nesting success. In 1993 some 36 nests were found, while in the 1980s between 70 and 112 nests were counted. The cause of the decline is still not totally clear. The Departamento de Vida Silvestre (SEA/DVS 1993) suggested that the main reason for the decline was that crocodiles were killed for their hides. However, no evidence exists to support this supposition.

A more probable reason why male crocodiles were killed was to obtain their penises, which are believed to have aphrodisiac powers. One dried penis 28 cm in length was purchased in a Santo Domingo market, where it was sold secretly and only on request. However, many crocodiles were killed for their meat and fat. The fat was used in the local pharmaceutical industries to produce an anti-rheumatic treatment, and meat was sold in area markets. Lamentably, many crocodiles also were killed indiscriminately, and the corpses were left



FIGURE 3. A local fisherman paddling his small raft in the western part of the lake in 1991.

without being used for any purpose. Mainly young men, but occasionally even children, walked the lakeshore and engaged in these killings. In interviews, several of these young men stated that, once they found a crocodile, some instinct to kill it arose, and they started to beat it or stab it with their machetes. Most of the crocodiles killed in this fashion were smaller individuals.

Another factor affecting the crocodile population was poaching of nests. That only three nests were found in 1992 can be explained by the assumption that the majority of the nests that year were poached. Egg robbers use a narrow stick to probe into the sand. A nest site is identified when the stick comes out with yolk on it. Even with good surveillance installed at all nesting beaches, three of 36 nests were robbed in 1993.

Fishermen in Lago Enriquillo (Figure 3) consider the crocodiles to be potential competitors and even a threat. Fishing in the lake does not have a long tradition. In the early 1960s people used only lines and hooks for fishing. Then, in 1980, after Hurricane David raised the lake level and dropped salinities, populations of *Tilapia* increased, and fishermen began using nets. Crocodiles, apparently attracted by the confined fishes, entangled themselves in the nets, and drowned or were killed by the fishermen. The use of nets had a dramatically negative impact on fish populations, which led, in 1992, to a cessation of all fishing activities in the lake.

INITIAL STEPS TO PROTECT THE CROCODYLE POPULATION

Awareness of the severity of the problems facing the crocodiles caused the Dominican Wildlife Department, which is charged with the protection of wild plants and animals as well as their habitats, to initiate the project entitled "Estudio y Protección del Cocodrilo Americano (*Crocodylus acutus*) en la República Dominicana." Additional technical and financial support was provided by the German Service for Social and Technical Cooperation (DED). Several important steps were taken to save the population from extirpation. In July 1992, a workshop was held in the Santo Domingo Zoo (ZODOM). A

number of different government agencies and non-governmental organizations participated. As an immediate result of this workshop, a "Surveillance Plan" was established for the whole lake, utilizing park rangers under the National Park Directorate and wildlife inspectors from the Departamento de Vida Silvestre. This continues, and currently, regular patrols are scheduled by some 20 men along the lake shore on foot or by boat. Every month a meeting is held to evaluate the patrols and to plan new activities. While patrolling the lake, rangers and inspectors also collect data on crocodiles and other important species. Another important step was the provision of additional technical support by the United States Peace Corps. Since June 1992, a Peace Corps volunteer has been working on the project with a local counterpart from La Descubierta, one of the villages in the vicinity of the lake.

ACTION PLAN FOR CONSERVATION

In addition to immediate conservation activities, studies on the crocodile population, socio-economic conditions in the lake area, and impact on the crocodiles were initiated. The results of these studies were published in June 1993 (SEA/DVS 1993) with an "Action Plan for the Conservation of the American Crocodile." The action plan provides for a multi-institutional "Executive Council" to coordinate and supervise the activities of the plan. Activities are carried out by five working teams, each responsible for one facet of the five-part program: (1) surveillance, (2) investigation, (3) reproduction, (4) public relations, and (5) resource management. All teams to date have been quite successful in addressing their goals.

Surveillance

The impact of human disturbances on the crocodiles and on other species has been reduced substantially. Very few incidents (e.g., construction of traps or killing of crocodiles) have been reported since 1992. In 1994, apparently no nests were robbed. Positive side effects of the surveillance are reductions in the frequency of illegal hunting of birds (especially migratory waterfowl and doves) and the capture and

the illegal trade of Hispaniolan parrots from the nearby mountains.

Investigation

The year-round monitoring of the lake has yielded important data on abundance and distribution of the crocodiles. According to nocturnal counts, a maximum of 166 adults and subadults was counted. Based on these numbers, we, along with D. Birdsall and H. Mendez, estimated that in 1995 at least 200 individuals larger than 1.5 m live in the lake. The principal habitats for neonates and yearlings have been identified, and more than 20 yearlings were found in April 1995 among cattail stands in the northwestern part of the lake.

Reproduction

In April 1993, a total of 178 eggs from eight nests was taken to ZOODOM to be artificially incubated in a headstart program. From these eggs, 92 neonates hatched (Figure 4). In May another 53 hatchlings were taken to the zoo, for a total of 145 small crocodiles in captivity. More than 130 are still alive and

await their liberation in Lago Enriquillo within the next two years.

As 36 nests were identified and monitored in 1993, no eggs or hatchlings were taken to the zoo in 1994. A total of 48 nests was registered in 1994, half of them located on the islands where no freshwater habitat is available (SEA/DVS 1994). Because neonates must move from nesting beaches to freshwater, the decision was made to catch many of the neonates and transport them to recently-identified areas along the northern and northwestern shores.

Before release, each hatchling was measured, weighed, sexed, and individually marked by means of notches in their tail scutes. Two hundred and thirty neonates marked in this manner will enable us to monitor growth, migration patterns, and survival rates of these small crocodiles.

Public Relations

An educational television show was prepared and is being transmitted by different channels throughout the nation. Slide shows on the crocodiles and on Lago Enriquillo have been created and are pre-



FIGURE 4. A newly hatched *Crocodylus acutus* from the headstart program at ZOODOM.

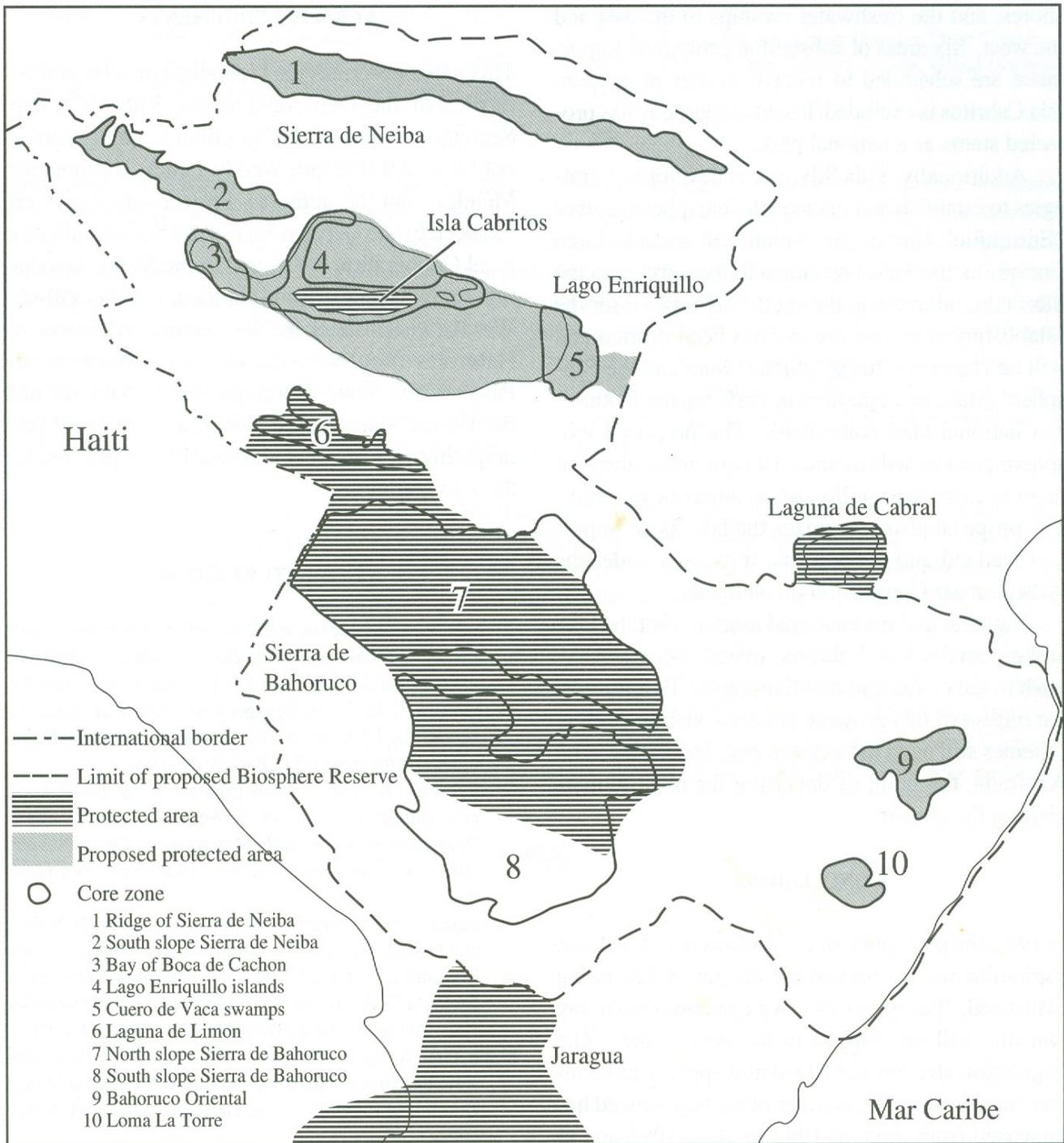


FIGURE 5. The proposed Enriquillo Biosphere Reserve, core zones, and legally protected areas.

sented in communities around the lake. Plans exist to prepare in the near future brochures and posters focusing on the lake and its species; these will be widely distributed in the lake region and throughout the county. To increase the likelihood of success of the conservation plan in the Lago Enriquillo area, the American crocodile is being used as a focal species for all public education efforts.

Resource Management

In 1993, a draft for a presidential decree establishing a new Lago Enriquillo National Park (Figure 5) was written by the staff of the Departamento de Vida Silvestre and forwarded to the president of the Dominican Republic. Undoubtedly due to the 1994 elections, the decree has yet to be signed. The proposed national park includes the entire lake, its

shores, and the freshwater swamps to the east and the west. Six areas of substantial ecological importance are scheduled to receive stricter protection. Isla Cabritos is excluded, because it already has protected status as a national park.

Additionally, Vida Silvestre is developing strategies to establish and manage the biosphere reserve "Enriquillo" (Figure 5), which will include Lago Enriquillo, the Sierra de Neiba to the north, and the Sierra de Bahoruco to the south. A proposal for the establishment of this reserve has been drafted and will be channeled to the UNESCO Man and the Biosphere (MaB) headquarters in Paris via the Dominican national MaB committee. The proposed biosphere reserve will include 10 core areas, three of them in Lago Enriquillo and its adjacent wetlands. The proposal also recognizes the lake as an important wetland and seeks to list it as such under the IUCN Ramsar Convention on wetlands.

National and international tourists visit the lake and especially Isla Cabritos, mainly because they wish to see crocodiles and flamingos. To minimize the impact of this growing concern, visitor-guiding schemes still need to be developed, especially in La Azufrada, the point of departure for most tourists visiting the island.

CONCLUSIONS

In 1992, the population of *Crocodylus acutus* at Lago Enriquillo was in immediate danger of becoming extirpated. Two years later we can confidently say that this will not happen in the near future. The population size has stabilized and appears to be increasing slowly. The number of nests produced has increased from three in 1992 to 36 in 1993 and to 48 in 1994. More than 500 newly hatched crocodiles were recorded in 1994. If crocodile reproduction continues to increase as it has in the past two years, we may have a population recovery to pre-1980 levels within the next five to ten years. However, conservation efforts must not be relaxed. The establishment of a regional national park, that of the even larger biosphere reserve, and the elaboration and maintenance of appropriate management plans are of the greatest importance.

ACKNOWLEDGEMENTS

This paper describes the crocodile conservation activities of the Departamento de Vida Silvestre, Secretaría de Estado de Agricultura, mainly carried out by David Birdsall, Wendy James, Hermógenes Méndez, and the authors. Project activities were financed by the German Service for Social and Technical Cooperation (DED) and to the Swiss Association for Development and Cooperation (HELVETAS). We also wish to thank the Sub-secretaría de Recursos Naturales (SURENA), the Dirección Nacional de Parques, the Santo Domingo Zoo (ZODOM), and the United States Peace Corps, as well as all participating park rangers and wildlife inspectors, for their cooperation.

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Resumen.—El cocodrilo americano (*Crocodylus acutus*), una vez ampliamente distribuido en la Española, solamente sobrevive en Lago Enriquillo en la República Dominicana y en Etang Saumatre en Haití. A finales de los años 1980 y al principio de los 1990 el tamaño de la población y la tasa de reproducción bajaron a un tercio, principalmente causado por impactos humanos. Como resultado de un estudio, ejecutado por el Departamento de Vida Silvestre, un Plan de Acción para la conservación de la especie fue elaborado y actualmente está en implementación. Los resultados principales hasta ahora: (1) el frecuente patrullaje de guardaparques e inspectores de vida silvestre en las orillas del lago logró casi por completo parar las perturbaciones; (2) desde el 1992 la población de adultos y subadultos sigue aumentando lentamente y hoy en día se hay alrededor de 200 individuos; (3) desde mayo 1993 una "reserva genética" de unos 130 neonatos esta en el parque zoológico de Santo Domingo (headstart program); y (4) en un próximo futuro el Lago Enriquillo va a tener protección legal como parque nacional.

Resumé.—Le crocodile américain (*Crocodylus acutus*) qui se distribuait largement en Hispaniola, survit maintenant, seulement dans le lac Enriquillo de la République Dominicaine et dans l'Etang Saumatre en Haïti. A la fin des années 1980 et au debut des années 1990, la dimension de la population et le taux de reproduction ont baissés á un tiers, causés principalement par l'impact humain. Comme resultat d'une étude executée par le Departement de la Vie Sauvage un plan d'action pour la conservation de l'espece a été élaboré et actuellement se trouve en execution. Les resultats principaux jusqu'a maintenant: (1) le patrouillage frequent des gardes de parc et des inspecteurs de la vie sauvage au bord du lac ont arretées complètement les perturbations humaines; (2) depuis 1992 la population d'adultes et sous-adultes a augmentée et aujourd'hui il existent environ 200 individus; (3) depuis Mai 1993 une "reserve genétique" de quelques 130 jeunes crocodiles grandissent dans le parc zoologique de Santo Domingo (headstart program); et (4) dans un futur proche le lac Enriquillo aura une protection legale comme parc national.



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