

## **Discovery of a Population of Orinoco Crocodile *Crocodylus intermedius* in Southern Venezuela**

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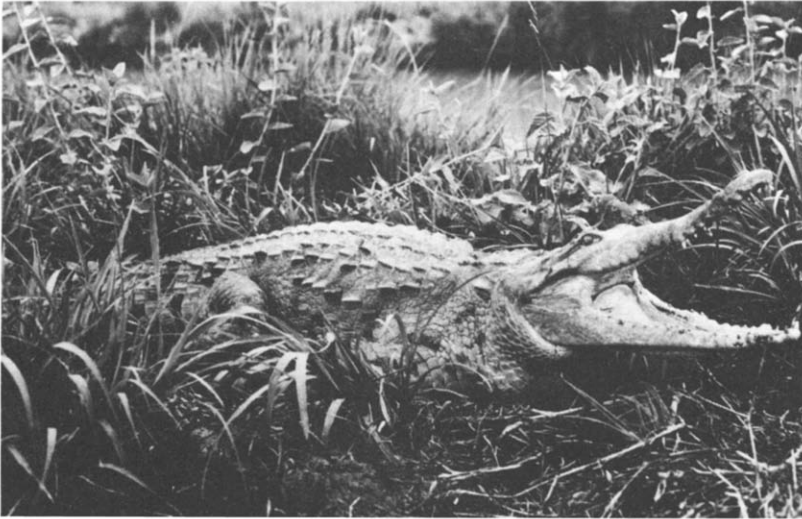
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### *ABSTRACT*

*A viable population of the Orinoco crocodile *Crocodylus intermedius* was located on the Rio Caura, State of Bolivar, Venezuela. Prior to this discovery, the species was considered to be nearly extinct in the wild. The history of this discovery, and the population's distribution and future are discussed.*

### INTRODUCTION

The Orinoco crocodile *Crocodylus intermedius* Graves is endemic to the Orinoco River basin of Venezuela and Colombia (Fig. 1). Recent surveys have shown this species to be nearly extinct over most of its natural range, a condition which resulted from excessive hide hunting and indiscriminate killing (Godshalk, 1982; Medem, 1974, 1976). Only isolated individuals, and occasionally small groups, continue to be discovered at widely scattered localities in both countries. Therefore, it is noteworthy when



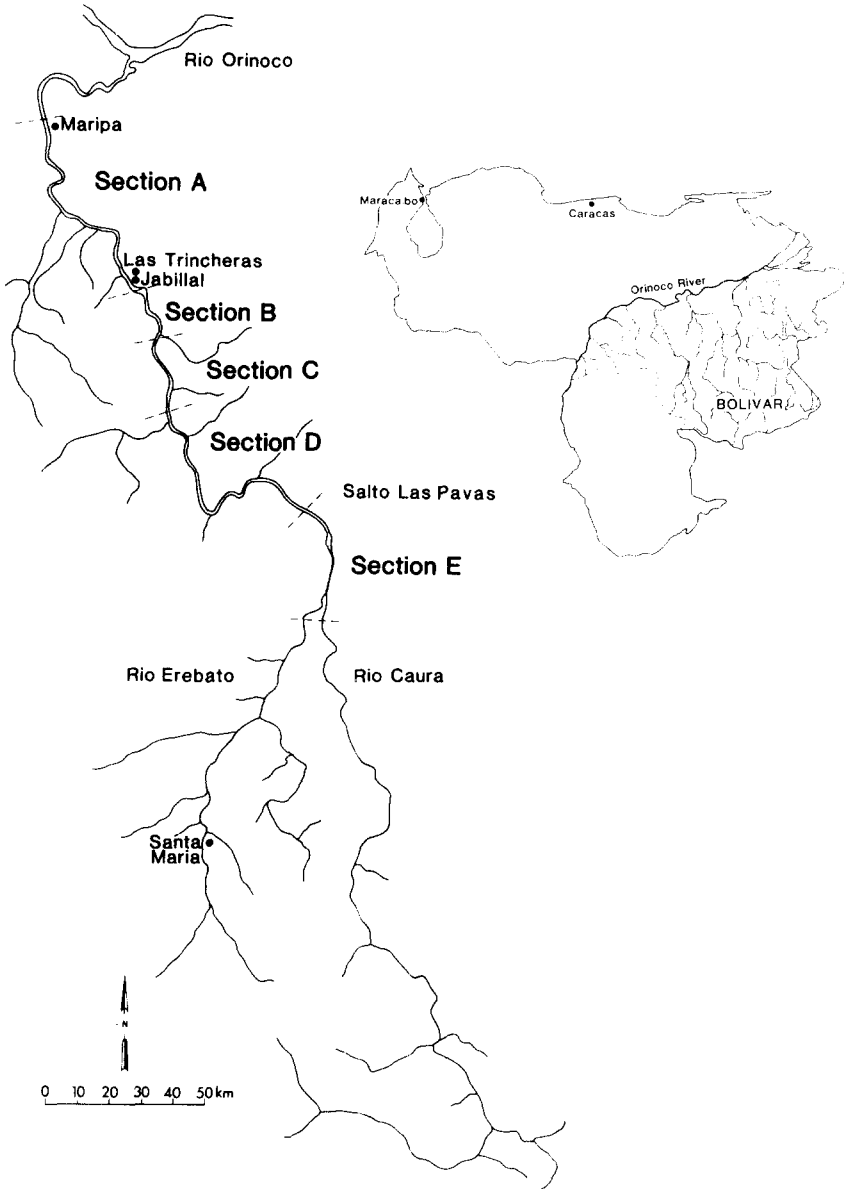
**Fig. 1.** A 2.5m female Orinoco crocodile *Crocodylus intermedius* in captivity at Universidad Nacional Experimental de los Llanos Occidentales at Guanare, Venezuela. The specimen was collected in the Rio Tucupedo.

large concentrations are found so that conservation efforts can be mounted to conserve them.

In 1981, while conducting ichthyological field work in southern Venezuela, R. Franz and S. Reid observed from an aircraft several large crocodiles in the Rio Caura, near Salto Las Pavas in the State of Bolivar. At that time we also learned from the staff at Pie del Salto Hydrological Station, located at the waterfalls, that crocodiles were common in the river below the station. In 1982, we returned with C. Puckett to the Rio Caura to establish whether individuals sighted in 1981 were part of a viable population, and if so, to determine the population's distributional limits on the river. This river lies outside those areas in Venezuela previously surveyed for *C. intermedius* (see Godshalk, 1982).

### RIO CAURA REGION

The Rio Caura originates in the Guyana Highlands, near Venezuela's border with Brazil, and flows north (Fig. 2). This blackwater river drops approximately 900 m (in elevation) over its 480 km course before entering the Rio Orinoco east of Caicara. Much of the river's tortuous path is on



**Fig. 2.** Map of the Rio Caura, showing sections A–E of the study area.

granitic rocks of the Guyana Shield; these rocks form extensive shoals, rapids, and waterfalls. At one major falls complex (Salto Las Pavas), the river drops 190 m in just a few kilometres, and forms an impassable barrier to boat traffic (Fig. 3).

The region is so remote that it is only accessible by small boat and light aircraft. No trails or roads are known to exist along the river's edge, except for an Indian path around Salto Las Pavas. The small villages of



**Fig. 3.** Upper falls at Salto Las Pavas, Rio Caura.

Maripa, Jabillal, and Las Trincheras in the lower part of the river, Indian towns of Santa Maria de Erebató on the Rio Erebató, Guana and Canaracuni on tributaries of the Upper Rio Caura, three hydrological stations operated by the Ministerio del Ambiente y de los Recursos Naturales Renovables (MARNR), and a facility operated by the national electrical utility company of Venezuela (CADAFE) above Salto Las Pavas are the only permanent settlements and installations on the river. The region is classified by the authorities as a forestry reserve, and settlement by Venezuelan nationals is prohibited beyond Jabillal. The region is sparsely populated with Makiritare and Yanomama Indians.

Lowland tropical forests cover the basin, and the canopy is continuous except for a few breaks along the river, around larger tributaries, and near human habitations. Jaguar *panthera onca*, tapir *Tapirus terrestris*, monkeys *Alouatta seniculus*, *Cebus olivaceus*, parrots *Amazonas* sp., macaws *Ara* sp., freshwater dolphins *Inia geoffrensis*, turtles *Podocnemis expansa*, *P. unifilis*, and other wildlife species declining elsewhere are still common in this area. Prior to this investigation, the smooth-snouted caiman *Paleosuchus trigonatus* was the only crocodylian reported from this drainage (Medem, 1981). Preliminary ichthyological data indicate that the fish fauna above Salto Las Pavas is typical of the Guyana Shield, whereas, below the falls, the fauna is Orinocan in its affinities (S. Ried. unpublished data). The falls act also as an effective barrier to upstream movements of dolphins and crocodiles.

### CROCODYLIAN SURVEYS

The Rio Caura was surveyed by aircraft and boat during 19-30 March and 5-9 April 1982. Aerial surveys were done in a single-engine Cessna 170-B aircraft at altitudes of 250-300 m above the river and airspeeds of 85-95 knots. The aircraft allowed for easy approach to basking or swimming crocodiles, as well as the detection of individuals submerged in shallow water. Usually the crocodile's narrow snout, obvious even under water, readily distinguished it from the more round-snouted sympatric caimans *Caiman crocodilus* and *Paleosuchus trigonatus*.

Sightings were plotted on primitive maps constructed by us in flight using compass bearings, landmarks, and airspeed. The parts of the river between the waterfalls and Maripa were the most intensely surveyed.

Unfortunately, during the study period the region was experiencing an early start of the rainy season. The accompanying inclement weather and very hazardous river conditions limited our mobility, particularly at night. Night surveys, out of necessity, had to be confined to the calmer portions of the river. Daytime surveys from motorized boats and dugouts were ineffectual, because the sounds of the motor caused crocodiles to abandon basking sites or to submerge. Strong currents precluded the use of non-motorized crafts. Steep river banks, high water, and dense jungle growths prevented most foot travel. Thus, the use of the aircraft was indispensable in surveying a larger range and providing more efficient use of survey time, particularly since weather and river conditions changed so

rapidly (e.g. it was not uncommon for the river levels to fluctuate several metres on any given day).

One three-day river (round-) trip between Salto Las Pavas and Maripa by motorized dugout with a group of Makiritare Indians was useful in identifying nesting sites and obtaining anecdotal information about crocodile behaviour and crocodile-Indian interactions.

Table 1 shows the results of 16 aerial surveys. Sightings included 68 positively identified *Crocodylus intermedius*, 3 *Caiman crocodilus*, and 4 unidentified crocodilians. The number of crocodilian sightings per aerial

**TABLE 1**

Combined Numbers of Crocodilian Sightings from Aerial and Surface Surveys on the Rio Caura, State of Bolivar, Venezuela, between 19 March and 8 April 1982 (Maximum number of crocodilian sightings in each section during one survey is shown in parentheses. Sections correspond to those shown on Fig. 2.)

	Sections				
	A	B	C	D	E
Estimated length of river section (km)	78	20	25	70	40
Aerial surveys (n = 16)					
Crocodiles	0	7(3)	0	61(9)	0
Caimans	0	0	0	3(2)	0
Unidentified crocodilians	2(1)	2(1)	0	0	0
Surface surveys (n = 2 for sections A-D)					
Crocodiles	0	4(3)	0	7(4)	0
Caimans	2(2)	0	0	3(2)	0
Unidentified crocodilians and signs (eyeshine, body drags, etc.)	2(2)	2(1)	1(1)	8(4)	0
Total	6	15	1	82	0

survey ranged from 0 to 9 (mean = 4.9). In addition, night and daytime surveys by boat on the river produced another 11 sightings and 13 signs (eyeshines and body drags) of crocodilians. Indians identified three nesting beaches; however, we were able only to investigate one and found a recently hatched nest and evidence of three others (Fig. 4). This indicates that nest opening occurs in late March-early April and agrees well with Medem's (1981) report of *C. intermedius* nests hatching during the same period in Colombia.

Estimates of total crocodile length were based on previous experiences

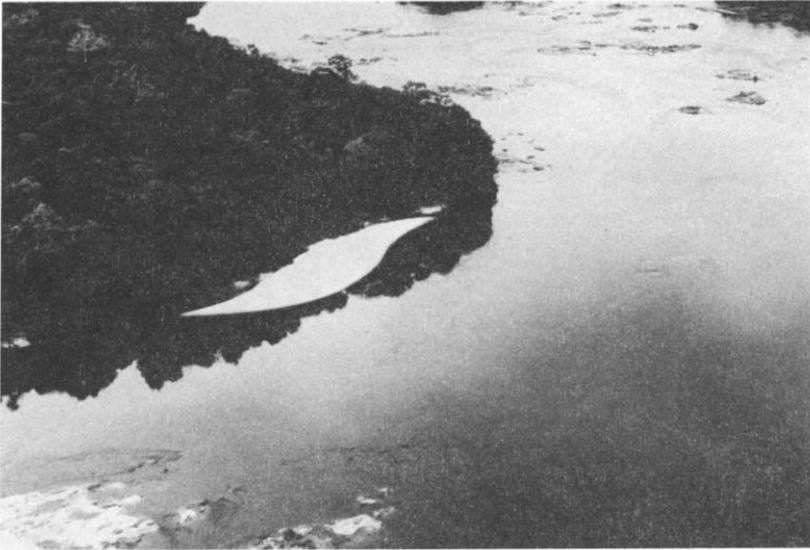


Fig. 4. Crocodile nesting beach in section D, Rio Caura.

with Orinoco crocodiles of known sizes at Hato El Frio, Fundo Pecuario Masaguaral, Caicara, and Guanare. Crocodiles under 1 m were probably not visible from the air (Parker & Watson, 1970). Of the crocodiles we observed, approximately 45% were out of the water, and others were either swimming or submerged in shallow water. Of all sightings, 70% were of individuals 2–3 m in total length; on 12 occasions, specimens were estimated to be larger than 3 m.

#### DISTRIBUTION OF CROCODILE SIGHTINGS

The surveyed portions of the river were divided into Sections A–E (Fig. 2). Section boundaries were established at points where the river's features changed. Sections B, D, and E are regions of extensive shoals, islands, and beaches (Fig. 5), while in Sections A and C the river is slower and deeper. The greatest number of sightings occurred in Sections B and D, and it is believed that these sections are the most densely populated (Table 1). The lack of sightings in Section E supports information supplied by both Venezuelan and Indian informants that no *C. intermedius* occur above Salto Las Pavas. Crocodiles in Sections B and D were associated (1) with lagoon areas on the back sides of large islands, (2) on sand bars either on



**Fig. 5.** Extensive shoals, islands, and beaches are exposed in section D of the Rio Caura during low water periods.

the upstream side of the islands or along the river banks, and (3) in shallow water along sand bars and other beaches. Crocodiles were rarely observed in midriver. Tributaries in Section D were surveyed by airplane on four occasions for distances in excess of 25 km from the main river. Two *C. crocodilus* were the only crocodylians observed. According to the Indians, crocodiles only ascend tributaries during the summer rainy season when the main river floods. A similar pattern of seasonal movements has been reported by Medem (1981) for Colombian crocodiles.

Table 1 shows that 87% of the combined aerial and surface sightings of crocodiles occurred in Section D. We believe that the reason for their apparent abundance in this Section is related to the availability of basking and nesting sites, and to little or no hunting pressure. Many of the sightings in Section D are clustered near active nesting sites.

With the present data, it is not possible accurately to estimate the current crocodile population on the Rio Caura. Other investigators incorporating aerial survey techniques to estimate crocodylian populations were concerned with the inability to see smaller, or more cryptically-coloured animals, and missing submerged ones. We believe that these and other factors contributed to inconsistencies in our data, and probably the



most significant factor affecting our counts was changes in water levels. During periods of low water, our counts averaged 8.0 crocodiles per aerial survey, while during periods of high water they dropped to only 2.3 crocodiles. Similar reductions were noted by Montague (1983) in *Crocodylus novaeguineae* on the Fly River in Papua, New Guinea. According to the Indians, when water begins to rise at the onset of the rainy season, crocodiles avoid stronger currents by moving under overhanging vegetation or amongst fallen trees or other debris near the river banks. During high water, this makes them difficult to locate from the air. Parker & Watson (1970) and Watson *et al.* (1971) tried various types of aircraft, as well as photography, to increase the reliability of the aerial census. Graham (1968) applied correction factors derived from comparing aerial and night counts to estimate actual numbers of *Crocodylus niloticus* at Lake Rudolf, Kenya. Although we lack on-ground comparisons, we believe that the preliminary data collected by us indicate the presence of a sizeable *Crocodylus intermedius* population on the Rio Caura. This is in part based on the presence of a broad range of size classes, including very large individuals, and the location of three nesting areas.

#### CONSERVATION OF THE RIO CAURA POPULATION

Our discovery of the Rio Caura population of crocodiles is especially timely, since the river's future is uncertain. Currently, CADAPE is conducting a study on the river to determine the feasibility of constructing a hydroelectric facility in the vicinity of Salto Las Pavas. We believe that construction of a dam would adversely affect the crocodile population, because all the proposed dam sites are upstream from the major concentrations of crocodiles in Section D. The most obvious impacts will be those associated with changes in the river's character below the dam site from the initial construction activities. Along with construction, there would also be a surge in deforestation and accompanying erosion. In addition, there would be an increase in agricultural activities with the influx of construction workers, support personnel, and later, as the area becomes accessible, settlers into a region which today is only lightly populated with indigenous people. With additional people, and the area opened to development, there will be more crocodile-human encounters, and as has happened in other parts of this species' range, it will succumb to these pressures.

The Rio Caura region is a vital natural resource for Venezuela. It has not only many unique and endangered species inhabiting it, but also it represents one of the largest pristine tropical wildernesses left in the world. Ideally, the best way to conserve this region is to let it alone, and to designate it a national treasure and preserve it as a park or sanctuary. This would not only conserve the crocodile and the area's unique fauna and flora, but also the traditions of the region's indigenous peoples. As the world's pristine wildernesses shrink, this region becomes even more worthy of protection—tropical rainforests are among the world's most endangered ecosystems.

If the dam should become a reality, then we recommend a thorough survey of the region's fauna and flora be initiated prior to construction, with an emphasis on the crocodile and other rare species. We further recommend that the river Sections B–D, as well as adjacent tributaries and floodplain forests, be declared a national wildlife sanctuary, with all the wildlife within the area being protected from hunting and other types of exploitation; that sufficient numbers of wildlife wardens be on site to prevent poaching or molesting of wildlife; that severe penalties be imposed on individuals engaging in such activities; that access to these sections be limited; and that settlement along the river and heavy boat traffic be prohibited. Sections B–D must be kept in their natural condition as much as possible so that water quality and quantity remain close to their present state. Development of an educational programme to provide public awareness concerning the importance of the crocodile and other natural resources to the region would be a necessary parallel undertaking. We also believe that it is imperative to continue yearly surveys of the population in order to assess changes that may require action by the authorities.

We believe that the establishment of a national sanctuary in this region, or a crocodile reserve between Jabillal and Salto Las Pavas, would be not only an example to other nations, but it would also gain international attention as a unique experiment in conserving one of the world's most endangered ecosystems, as well as one of its most spectacular crocodilians.

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