

STATUS AND CONSERVATION OF THE ASIAN CROCODYLIANS

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Madras Crocodile Bank
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INTRODUCTION

The eight species of Asian crocodylians have declined drastically in numbers, especially in the past 25 years. The story of their extermination is now into what could be the final chapter. Of the eight only the New Guinea crocodile is still fairly common in the wild. Intensive hide hunting managed to shift the focus from Africa to Asia and then South America as each area dried up (Fig. 1). Often there has been a second or third round of mopping up where a second, "inferior grade" species was available or when remote areas were opened up. Areas such as the island of Borneo, now split between Malaysia, Indonesia and tiny Brunei, which still contain large tracts of unsettled land, have only fragments of once substantial *Crocodylus porosus* and inland *Tomistoma* populations.

There is little accurate documentation of skin harvests of Asian crocodylians but what recent statistics are available are given in Table 1 to put into perspective what a profitable industry crocodiles could be for many indigenous peoples if used as a properly managed resource. Ross (1982b) asks a key question: "How do we integrate a policy dealing with an animal which is potentially dangerous, disliked and lives in areas suitable for fish ponds and rice paddy without completely eradicating it"?

For the purpose of this chapter, "Asia" is defined as ranging from the mugger habitat of Iran eastward to the Indonesian border with Papua New Guinea.

THE ASIAN CROCODYLIANS

Crocodylus palustris -- Mugger, marsh crocodile

The mugger has the widest range of any of Asian freshwater species. It is highly adaptable and occupies a variety of habitats including hill streams and saltwater lagoons. In Iran, Pakistan, Nepal and Bangladesh there are very few left and with the exception of those in the few protected areas there is little future for the mugger in these countries. If considerable effort was made to rehabilitate the mugger, combined with stringent habitat protection and perhaps a commercial motive in these four countries, the mugger would have the chance of making a limited comeback.

In India the mugger has been fully protected under the Wildlife Protection Act to 1972 and is the subject of a conservation program that began in 1975. Nearly every state had at least a few

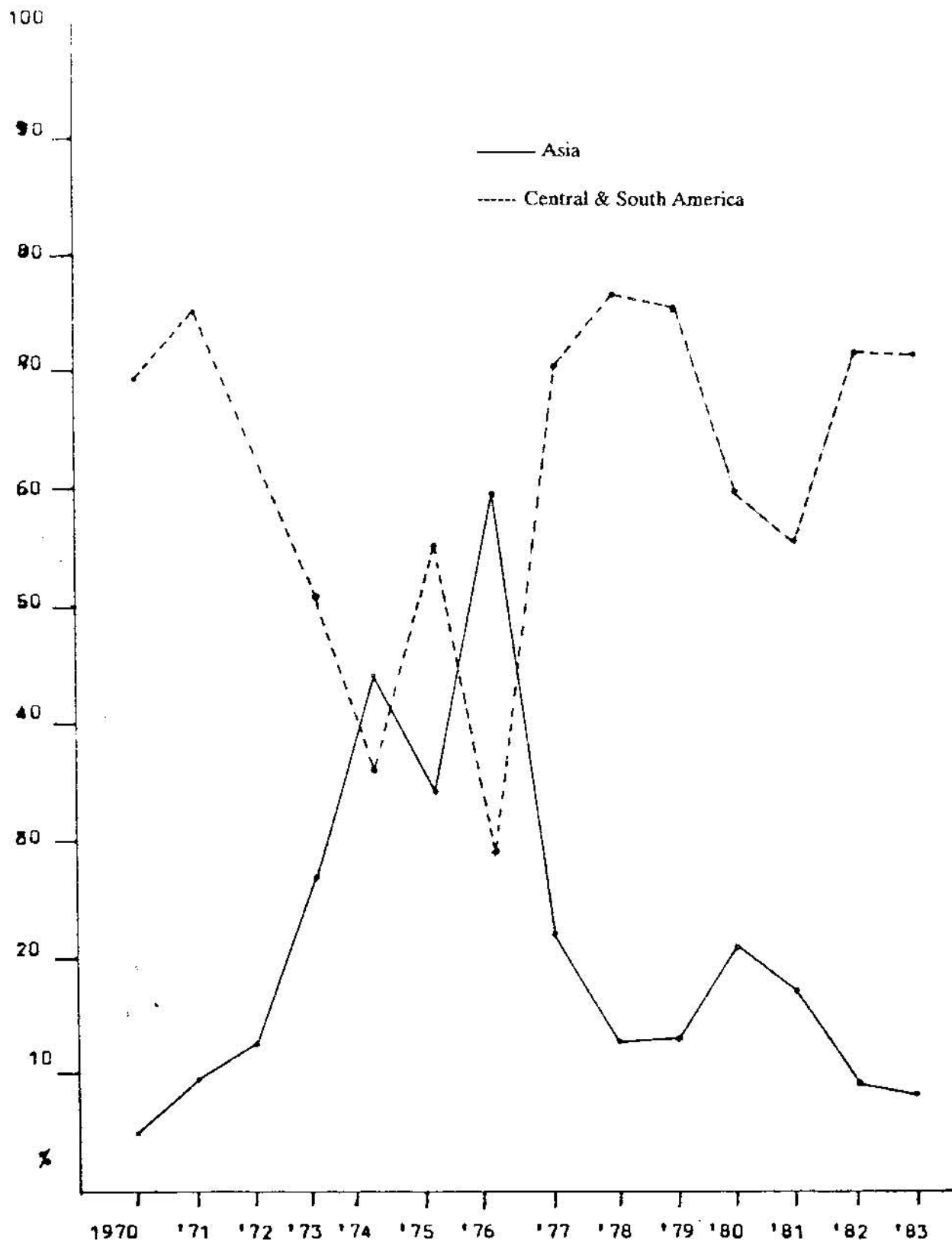


Figure 1. Rise and fall of the Asian crocodile skin trade since 1970 (courtesy of Tom Milliken, TRAFFIC/Japan).

Table 1. The Asian Crocodile Skin Trade (in Kilograms).

Country	YEARS														TOTAL
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	
Singapore	3064	2457	7930	17213	7285	10503	7619	6782	2475	4244	6552	3434	1424	91	80073
Malaysia	3292	5497	2582	1046	289	--	--	260	--	--	--	1357	1000	--	15341
Philippines	688	2568	891	809	617	104	664	353	264	1479	215	110	55	193	7950
Indonesia	770	275	1962	3162	1889	5037	5439	9373	5731	9543	7476	9554	15222	19348	94781
Thailand	--	--	20	--	--	--	2500	--	4576	6035	4008	2885	1299	--	21323
Pakistan	--	--	--	--	--	--	--	--	--	--	64	--	--	--	64
Sabah	--	28	--	--	--	--	--	--	--	--	382	621	100	--	1131
TOTAL	7814	10825	13385	22320	10080	15644	16222	16768	3046	21301	18697	17979	18100	19632	220663

Courtesy of Tom Milliken, TRAFFIC (Japan).

mugger left by the early 1970's but past hunting for skin and meat, collection of eggs for food and loss of habitat made the prognosis for mugger survival look grim.

Now, a decade later, government efforts (in some cases with FAO/UNDP assistance and private input), have secured a future for the mugger in India. At least 17 different zoos and rearing centers in the country have bred mugger in captivity and thousands of eggs have been collected from the wild for captive hatching and rearing for restocking programs. Several sanctuaries have been set up specifically for mugger and one state, Tamil Nadu, has been given Central Government approval to set up an experimental commercial crocodile farm.

In Sri Lanka mugger were common as recently as the late 1970's but were taking a battering from itinerant fishermen who netted them for the meat, discarding the skin. Large reservoir populations of mugger outside of the two large National Parks, Yala in the south-east and Wilpattu in the north-west have been decimated, particularly during drought years. Even now there are tanks (man made lakes) on the periphery of the Parks in which 100 or more mugger can be seen. Meanwhile massive development projects like the Mahaweli Ganga scheme in North Central Province take little note of the importance of the mugger as an economic resource nor of its role in the aquatic ecosystem. Mugger will survive in Sri Lanka's National Parks but it will be unfortunate if nothing is done to ensure that they remain an integral part of the island's remarkable wildlife. The Sri Lankan mugger population offers us the only chance to study an Asian freshwater crocodile in what must be close to original population densities.

Crocodylus siamensis -- Siamese crocodile

Once reportedly common in parts of Thailand, the Siamese crocodile's range extended to the Indochinese region and parts of Indonesia (Kalimantan, Sumatra, Java). Today the only known wild individuals survive at Bung Boraphet Reservoir in Nakhon Sawan province, Thailand where there may be 50 left.

The Siamese crocodile breeds readily in captivity and the Samut Prakan Crocodile Farm near Bangkok has over 20,00. Here they have been encouraged to hybridize with *C. porosus* though the owner assures us that pure stock is being separately maintained. It has also been bred in at least two zoos in the United States and at this time captivity seems to be where the species will remain.

Crocodylus porosus -- Saltwater crocodile, estuarine crocodile

The saltwater crocodile has the widest present day range of any crocodilian. Its ability to swim long distances in the open sea allowed it to colonize almost the whole of tropical coastal Asia besides many inland areas. The female produces large clutches of eggs and can be a formidable defender of her nest. But the large size and occasional man-killing tendency of big saltwater crocodiles have worked against the species. In addition, the skin industry prefers the smaller scales and larger surface area of saltwater crocodile skins to any other. More accessible to hunters than the inland freshwater species, saltwater crocodile populations were quickly reduced to remnants by the mid 1960's.

In the extreme east of its range the saltwater crocodile exists in safer numbers than most of the Asian crocodiles. Australia and Papua New Guinea have both spent considerable money and effort on managing their crocodiles and it is paying off, particularly in Papua New Guinea where the million dollar skin industry brings money to the poorest districts with few or no other exportable resources.

Just over the border from Papua New Guinea is the Irian Jaya Province of Indonesia where adult saltwater crocodiles are being rapidly wiped out for skins. In a few locations, important populations such as at the large, peninsular island of Pulau Kimaam near Merauke in the southeast are receiving some protection. From here westwards to India, the situation gets progressively worse. Probably the only significant populations in the entire remaining area of Asia are in some of the more remote inland areas of northern Sumatra (for example Sungai Kuba, Rian Province), the well managed breeding populations at Bhitarkanika Sanctuary in Orissa (India) and in parts of the Andamans and Nicobars (India).

Areas like Sabah and Sarawak on the island of Borneo would seem to be likely repositories of some of the old saltwater crocodile population densities but unfortunately it is not so. World Wildlife Fund sponsored surveys carried out in 1983 by Rom Whitaker and in 1985 by Jack Cox have turned up low density figures of about 0.05 crocodiles per kilometer of river surveyed by night. Much of the area surveyed was uninhabited and still forested and contained habitat capable of supporting much higher densities of crocodiles. Hunting for skins is obviously the most important recent factor for the continued decline of crocodiles here, but as early as 1881 the British Government had been paying rewards for killing crocodiles "to encourage destruction of a pest".

Recommendations for the rehabilitation and management of the saltwater crocodile have been officially made to the governments of Sabah and Sarawak (East Malaysia) and Indonesia. Project proposals based on crocodile ranching and farming have been made in the hopes that aid agencies such as FAO/UNDP and USAID will provide funding and expertise. Major elements in the proposals include detailed surveys, establishment of reserves, crocodile farming, research, and population monitoring programmes. In specific cases, such as Sarawak, any hope of bringing crocodiles back to areas in which they have long been extinct is linked to public relations and the forming of an effective crocodile control team to deal with the occasional nuisance crocodile.

Crocodylus mindorensis -- Philippine crocodile

Recent surveys and studies by C.A. Ross and A.O. Alcala demonstrate the extremely depleted status of the Philippine crocodile. Hide hiding and now loss of habitat to agricultural development are the main reasons for the decline. It is still found scattered in small numbers in remaining suitable inland habitats, mainly on Mindanao and the Sulu Archipelago. It is estimated, perhaps optimistically, that there are 500 to 1000 left in the world.

As Ross (1982a) noted, "conservation of non-essential wildlife resources is not given high priority in the Philippines; any conservation program which offers some possibility of ultimate utilization is more likely to win support from the government." At present the Philippine program for *C. mindorensis* consists of a World Wildlife Fund aided project of the Silliman University where a small captive group at Dumaguete City are being bred to provide young for release in protected areas.

Crocodylus novaeguineae -- New Guinea crocodile

A four month survey of the New Guinea crocodile was carried out (October 1984 to February 1985) and over 1500 kilometers covered by boat in the interior of Irian Jaya by Rom Whitaker and his assistants, Paul Sukran of Indonesian Environmental Forum (WALHI) and Chadiz Hartono of Directorate of Forest Protection (PHPA).

During the day villages were visited to interview the people about crocodile natural history, status and the skin industry. At night spotlight surveys were carried out to assess relative numbers of crocodiles and capture of a sample for measuring, marking and release. Visits were made to mission stations and discussions were held with people responsible for rural development in Irian Jaya. Visits were made to the main crocodile rearing farms and skins exporters. A survey of the trash fish resources was also carried out to determine feed availability for crocodile farms. The main crocodile habitats that were visited and surveyed were:

- a) Bian Lakes, Merauke District
- b) Asmat Area, Merauke District
- c) Rouffaer River (Upper Mamberamo), Paniai District
- d) Bintuni Bay, Manokwari District

In addition, the main towns and other areas visited were:

- a) Jayapura
- b) Merakue
- c) Fak Fak
- d) Kaimana
- e) Manokwari
- f) Nabire
- g) Sorong

It was found that crocodile populations have been heavily reduced in the accessible river areas due to overhunting for skins. However, deep inland crocodile populations are more stable.

Some illegal killing of crocodiles and export of their skins continues. In general it was found that the local hunters will respect laws but are induced by the skin traders to organize periodic crocodile hunts. Most of the crocodile farms seen were of a mediocre standard and only one (Skyline in Jayapura) had significant numbers (1500-2000). So far very few skins of farmed animals are being exported.

Village hunters and rural developers all expressed a keen interest in participating in a proposed crocodile project. It was found that there is no other viable long-term alternative to help swamp-dwelling people (about 100,000 of them) to earn a living with cash income. For example, the small-scale timber industry in the Asmat area provides only a small remuneration (Rp. 5000 (US \$5) per cubic meter or about Rp. 10,000 for a large tree) for the hard work of felling and hauling logs along the river. The necessity of extracting timber near the river (in the absence of hauling machines) is causing rapid degradation to the riverbanks. A managed crocodile industry could provide the Asmat villagers with Rp. 10,000 for one baby crocodile, a wiser use of the forest than removal of its timber!

It was found that there are sufficient trash fish resources (the by-catch of the shrimp trawlers) to feed 20,000 crocodiles or more in the towns of Sorong, Jayapura and Merauke.

It was recommended that a project proposal be drafted to initiate a crocodile project in Irian Jaya consisting of three basic components:

- a) large commercial farms at Sorong, Jayapura and Merauke
- b) a network of village collection farms and appropriate rural extension work and
- c) a crocodile population monitoring and research program to assure the sustainability of the industry and conservation of the species.

It was recommended that aid agencies be approached for technical and financial assistance in implementing this project. It was also recommended that the protection of wild adult crocodiles in

Irian Jaya be given priority. The New Guinea crocodile will have a safe future in Irian Jaya if it can become a managed resource upon which a large number of economically depressed people are dependent.

Tomistoma schlegelii -- Malayan (or false) gharial

One of the least known of all the crocodylians, *Tomistoma* is rarely seen in the wild anymore and has only bred in captivity at the Samut Prakan Crocodile Farm, Thailand. *Tomistoma* ranges from southern Thailand across to Borneo and down into Sumatra.

Today *Tomistoma* is apparently absent from southern Thailand and only a few live on peninsular Malaysia. On Borneo the situation may be little better. On a recent crocodile survey in Sarawak for WWF-Malaysia, consultant Jack Cox saw three *Tomistoma* at only one location, the Ensengai swamp system near Kuching. Rom Whitaker found no evidence that *Tomistoma* ever existed in Sabah; *Tomistoma* habitats in Kalimantan and Sarawak are cut off from Sabah by fairly high hill and mountain ranges. It is probable that there are viable populations of *Tomistoma* in Kalimantan (Indonesia) but no surveys have yet been made.

Small numbers of juvenile live *Tomistoma* still appear at Singapore crocodile "farms" and it is likely that their origin is nearby Sumatra which has never been surveyed.

Gavialis gangeticus -- Gharial

The gharial is one crocodylian that people acknowledge as harmless to humans. But being a fisheater it is treated as a competitor. In 1974 the world gharial population, captive and wild, was estimated to be under 250. Now, in 1986 it is over 2500 due mainly to the efforts of several State Forest Departments (see Table 2). The Government crocodylian rehabilitation program, initially aided by FAO/UNDP, initially concentrated its efforts on saving the gharial which looked like it was on its way out. Even today there are apparently fewer than twenty adult male gharial both captive and wild.

The only large area of protected habitat for the gharial in India is the National Chambal Sanctuary, covering 600 river kilometers and running through three states, Uttar Pradesh, Madhya Pradesh and Rajasthan. The other gharial areas in India such as Katarniaghat in Uttar Pradesh, Sathkoshia Gorge in Orissa and bits of the Son, Ken (Madhya Pradesh) and other rivers are very small and in the long run, very vulnerable. There is a small population in Corbett National Park (Uttar Pradesh). Besides the Chambal in India, the other major gharial population that is reasonably secure is that of about 20 adults in Chitwan National Park (Rapti-Narayani River) in Nepal.

Although it has been so far bred at only one center, (in 1985 six nests were laid at Nandankanan Biological Park, Orissa) the gharial responds well to captive rearing and growth rates make it acceptable for commercial farming or ranching. Considering the large quantities of fish gharial consume, it is critical that the ecological/economic advantages of having gharial back in the river ecosystems outweigh the disadvantages.

Table 2. Juvenile Gharial Released for Restocking Protected Habitat (1977-1984).

Place	State/Country	Number released
National Chambal Sanctuary	Madhya Pradesh, Uttar Pradesh, Rajasthan	912
Sathkoshia Gorge Sanctuary	Orissa	150
Katerniaghat Sanctuary	Uttar Pradesh	83
Chitawan National Park	Nepal	50
Ken Sanctuary	Madhya Pradesh	3
Son Sanctuary	Madhya Pradesh	2

Alligator sinensis – Chinese alligator

This small (under 2 m) alligator was once widespread throughout the eastern portion of the Yangzi River basin. There is now little or no wild habitat left for the Chinese alligator and it survives precariously in the midst of human agriculture. Concentrated in the Xuancheng region, the center of the alligator's current range, smaller populations are found in Zhejiang and Jiangau Province. Watanabe and Chu-chien (1984) estimate that there are about 300-500 wild alligators in the Xuancheng region and a total of 1500-2000 (both on farms and in the wild) in the country.

Chinese alligators depend on being able to dig extensive dens to hide in and to hibernate in over winter months. Being docile and fairly small they are frequently disturbed and nests destroyed by children and farmers.

The Chinese alligator is the subject of several ongoing studies and captive breeding has been achieved at the Chinese Alligator Breeding Center, Anhui Province (where 300 hatchlings were produced in 1983), Shanghai Zoo and Rockefeller Wildlife Refuge in the U.S. Emphasis on captive breeding is important to ensure the survival of adequate genetic stocks of the species. The establishment and maintenance of wild reserves for the Chinese alligator has very limited scope, but unless these efforts are made this interesting reptile will no longer be able to survive in the wild.

SUMMARY

The outlook for the Asian crocodylians is bleak indeed. Table 3, which is made up in many cases of very approximate data, dramatizes their plight. The Chinese alligator, gharial and Siamese crocodile are all more numerous in captivity than in the wild. The New Guinea crocodile is the only species that still exists in anything resembling "safe" numbers and only because of its original swamp habitat remains difficult of access and unaltered.

Conservation and management approaches range all the way from India's preservation/rehabilitation program to Papua New Guinea's managed ranching scheme. Ranching, (that is, the collection of eggs and/or young for captive rearing and culling) can be a most effective method of guaranteeing attention to habitat protection. As long as it is profitable to take crocodiles from a swamp, that swamp will be protected with everything in it.

In general, two activities are needed in each of the Asian countries where crocodiles are found: (a) public education and reassurance (which includes an effective, mobile nuisance crocodile catching squad); and (b) the setting up of management programs, if necessary with outside help. Indonesia has a special responsibility since three of the eight Asian species--Malayan gharial, saltwater crocodile, and New Guinea crocodile--are found mainly in the Indonesian archipelago and Kalimantan. India is particularly responsible for the continued survival of the gharial, China the Chinese alligator, and Thailand the Siamese crocodile.

Demonstrating that (a) crocodile farming is a logical form of land use, (b) crocodiles are needed in aquatic ecosystem, (c) crocodiles are rarely dangerous to man, and (d) crocodiles are edible and produce the most valuable and durable leather in the world will help people accept that we cannot dismiss crocodiles. These reptiles have been denizens of the earth for 100 million years. Each country and indeed each set of circumstances may demand a novel approach to the problems of accepting and living with crocodiles. But it is worth the effort. The various Asian crocodile

Table 3. Status of Asian Crocodylians.

Species	Distribution	Wild population	Captive population	Conservation management efforts	Legal Status	CITES	IUCN Red Data Book
<i>Crocodylus palustris</i>	Iran	50-100	Few	?		I	Vulnerable
	Pakistan	30-50	Few	Moderate			
	India	2-3000	3000+	Active			
	Nepal	30-50	Few	Moderate			
	Bangladesh	5	Few	Nil			
	Sri Lanka	2-3000					
<i>Crocodylus siamensis</i>	Thailand	50-100	20,000	Private farm		I	Endangered
	Vietnam	?	Few	?			
	Kampuchea	?	Few	?			
<i>Crocodylus porosus</i>	India to Irian Jaya	25-50,000	10,000**	Nil to active in various countries		I	Endangered
<i>Crocodylus mindorensis</i>	Philippines		500-1000	Moderate		I	Endangered
<i>Crocodylus novaguineae</i>	Irian Jaya	100-200,000	3000	Surveys		II	Vulnerable
<i>Tomistoma schlegelii</i>	Malaysia (Sarawak)	500-1000	100+	Surveys		I	Endangered
	Indonesia (Kalimantan, Sumatra)	1000-3000	200+	Nil		I	Endangered
<i>Gavialis gangeticus</i>	Pakistan	30	Few	Little		I	Endangered
	Nepal	30-120	100+	Active			
	India	1000+	2000+	Active			
	Bangladesh	25-35	Few	Little			
<i>Alligator sinensis</i>	China	500+	800+	Active		I	Endangered

PROTECTED BY LAW IN ALL ASIAN COUNTRIES EXCEPT VIETNAM AND KAMPUCHEA

* excluding first year hatchlings

**excluding *C. porosus* in Papua New Guinea and Australia

Table 4. Breeding results--Madras Crocodile Bank.

Year	Mugger hatchlings	Saltwater crocodile hatchlings	Caiman hatchlings
1976	30	--	--
1977	50	--	--
1978	399	--	--
1979	164	--	--
1980	236	--	--
1981	289	--	--
1982	228	--	37
1983	240	74	34
1984	252	30	60
1985	235	45	36
TOTAL	1813	92	167

are forerunners to what will hopefully become an accepted profitable form of land use. Man's first domestic reptile is the crocodile.

LITERATURE CITED

- Ross, C.A. 1982a. Philippine Crocodile Project (Smithsonian/World Wildlife Fund) Final Report, p. 1-34.
- Ross, C.A. 1982b. The crocodile must stay. *Habitat (Philippines)* 3(1):13-19.
- Watanabe, M. E., and H. Chu-chien. 1984. Status of the Chinese alligator in the People's Republic of China. Pages 216-219 in Proceedings of the 6th working meeting of the IUCN/SSC, 1982.