

**CROCODILE  
SPECIALIST  
GROUP  
NEWSLETTER**

VOLUME 23 No. 3 • JULY 2004 – SEPTEMBER 2004



IUCN - World Conservation Union • Species Survival Commission

# CROCODILE

# SPECIALIST

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Species Survival Commission

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COVER PHOTO. 17 day-old *T. schlegelii*, PT. Ekanindya Karsa Crocodile Farm, Java. Taken with permission of Mr. Rachmat Wiradinata, following completion of TTF-PRCF surveys in West Kalimantan (see page 4). Photo: Mark Bezuijen.

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## Editorial

As most of you know, at the 17th Working Meeting of the CSG in Darwin Australia (May 2004), the CSG Chairman Professor Messel, confirmed that he would be retiring from the Chairman's position at the next IUCN World Congress (November 2004). The CSG Executive Officer, Dr. Perran Ross also confirmed that he would be taking up a new position in July 2004, which he subsequently did, and Deputy Chairman Prof. Wayne King announced his decision to stand down. Although these are of course significant changes within the CSG, I'm glad to report that there is no significant loss of institutional memory: all remain active CSG members.

As CSG Chairman-elect, let me firstly confirm that the other Deputy Chairman, Dr. Dietrich Jelden, will remain in his position, as will many people on the current Steering Committee! All CSG membership comes up for renewal in November 2004, and changes to the Steering Committee will be announced in December. I am keen to see the CSG consolidate "core" business and then become more active at assisting our members at the frontline of crocodilian conservation: where species and their habitats are threatened and need help.

One of the logistic changes I will be making after November is the relocation of the main executive office from Florida to Australia. Since Perran Ross stood down as the Executive Officer, I have been operating the CSG office from Darwin with the help of Charlie Manolis, Adam Britton, Tom Dacey and of course Perran. We're gradually coming to grips with the scope of CSG work obligations and the type of executive office, facilities, staffing and budget that are required in the future. This is our first

attempt at producing a CSG Newsletter, which we all consider one of the crucial CSG activities that binds CSG members together.

During this transition period we also had to deal with CITES COP13 in Bangkok, Thailand (October 2004). There was a good representation of CSG members at COP13, where three crocodilian proposals (Cuba, Namibia, Zambia) and a number of other resolutions and decisions in which the CSG has an interest (personal effects, synergy with the CBD, adoption of the Addis Ababa Principles and guidelines on sustainable use) were debated. The Parties voted to support Cuba and Namibia, in accordance with CSG views, and Zambia withdrew its proposal (it was not actually required), but in accordance with CSG advice, reduced its quota from 548 to 300 crocodiles per year. The other issues all advanced in directions consistent with CSG views, which is heartening - we seem to be on the right boat heading in the right direction!

CITES meetings afford CSG members a good opportunity to "talk in the hallways" and COP13 was no exception. We had discussions with many national delegates about crocodilians (Bolivia, Cambodia, Colombia, Ecuador, Madagascar, Mozambique, Namibia, Paraguay, Zambia), and were able to talk to the Chairs and Executive Officers of a number of different IUCN-SSC specialist groups about just how they organise their office and staff - all are very different from each other! We were also able to talk with colleagues in the IUCN and TRAFFIC.

Many COP13 delegates visited the famous Samutprakarn Crocodile Farm on their "field day", and were impressed by the experience and hospitality. Others visited the crocodile production farm at Sriracha, where over 36,000 hatchlings per year are produced and raised. Yosapong Temsiripong reported that 20 *Crocodylus siamensis*, all DNA screened, had been released in Pang Sida National Park - a site where a few wild individuals still exist in Thailand. This extremely important project, under Yosapong's direction, was supported by Royal Forestry Department and CMAT, one of Thailand's crocodile industry associations. Uthen Younprapakorn reported that their captive *Tomistoma schlegelii* were now producing large numbers of hatchlings each year - something that has taken decades of investment and patience to achieve. With help from the Tomistoma Task Force, we hope this is the first step towards the Thai crocodile industry playing a role in getting Tomistoma back into the wild in southern Thailand, where they have long been extinct. This is clearly a high CSG priority.

I'm personally looking forward to assisting the CSG and its members to improve the conservation and management of crocodilians, thereby assisting the IUCN to fulfill its mission with regard to crocodilians.

Grahame Webb, CSG Chairman-Elect

## Task Force Updates

### Tomistoma Task Force

TOMISTOMA SURVEYS IN WEST KALIMANTAN, INDONESIA. From August-September 2004 the CSG Tomistoma Task Force (TTF) and the People, Resources, and Conservation Foundation (PRCF) conducted a joint survey to assess the status of Tomistoma in West Kalimantan Province, Indonesia. The survey was funded by the TTF, PRCF, and National Geographic. This is the first fieldwork to be supported by the TTF since its inception in 2003. West Kalimantan was selected for surveys due to previous reports indicating the province holds important Tomistoma populations. The objectives of the survey were to: document the current status of Tomistoma in selected sites; raise awareness of the species among regulatory agencies; and, identify potential Tomistoma conservation priorities in the province. Field surveys were conducted with the provincial Department of Nature Conservation and local conservation NGOs. Logistical support and project facilitation was provided by the PRCF-Indonesia office in West Kalimantan.

Surveys were conducted in sections of nine protected and unprotected rivers in the south and northeast of the province, including the Danau Sentarum, Betung Kerihun and Gunung Palung National Parks. A total of 21 spotlight nights, covering 227 km, were conducted by canoe and speedboat (over a total of 28 field days). These were the first crocodile surveys to be conducted in all sites except Danau Sentarum National Park.

A surprisingly low number of Tomistoma were recorded (8 individuals and one “eyeshine”), in four of nine rivers surveyed. Seven of eight observed individuals were small (2-4 ft; 0.6-1.2 m). A rare daytime sighting of a large Tomistoma (15-16 ft; 4.6-4.9 m) basking on a river bank was made. Morphometric measurements of two captive Tomistoma, a skull, skins and eggs were obtained from specimens held by local communities. No active Tomistoma nests were found during surveys, although two old nest sites were observed in Gunung Palung National Park, and four eggs were shown to the team in Danau Sentarum National Park. It is unclear why so few Tomistoma (or other crocodile species) were sighted during surveys, despite good survey conditions and reports by local people at most sites that the species is “common”. This is comparable with spotlight survey results in similar river systems in swamp forest in eastern Sumatra, when the species is often not seen during surveys despite its confirmed presence.

Based on local reports and current and previous surveys, it appears that Tomistoma continues to be relatively widely distributed throughout freshwater river systems in the south, central and northeast of the province. Surveys

confirmed that the species occurs in two previously undocumented protected areas (Gunung Palung and Betung Kerihun National Parks) and appears to remain widespread in a third, Danau Sentarum National Park. These results indicate that Tomistoma may be relatively well represented in the protected area system of West Kalimantan. However, in all sites visited, threats to Tomistoma and its nesting/foraging habitats were apparent, including large-scale loss of nesting habitat due to forest fire and illegal logging, and occasional collection of Tomistoma eggs for local consumption. The paucity of sightings during surveys may indicate the species remains widespread, but at low densities, in many areas.

Training in crocodile survey techniques was provided to local agencies that accompanied surveys. Much interest and support for surveys was given by provincial forestry and national park personnel, who requested the provision of more information about the species and advice with site-specific follow-up activities. Perhaps the most important result of the project has been to establish awareness, interest, and a “foundation” for future Tomistoma conservation activities among provincial agencies. Current follow-up activities by the project include translation of survey forms into Indonesian and provision of Tomistoma literature to provincial agencies, and continued liaison with provincial/national agencies (Directorates for Biodiversity Conservation and National Parks, Indonesian Ministry of Forestry, and the Indonesian Institute of Sciences) to maintain support and interest for conservation of the species.

Finally, field surveys in Danau Sentarum National Park were coordinated with a brief field visit by a National Geographic (NG) film team, led by Dr. Brady Barr. The NG team spent two days/nights with the project survey team during the final stages of surveying, with the main objective of catching and filming a Tomistoma. Locations with Tomistoma were shown to the NG team, who managed to catch and film a Tomistoma. Considerable assistance for facilitation of NG filming and field logistics was given by PRCF-Indonesia and counterparts from the provincial Department of Nature Conservation.

A survey report is under preparation and will be circulated to sponsors, the CSG and other key agencies by November 2004. The project team extends its sincerest thanks to the TTF, PRCF and NG personnel whose generous fund-raising efforts enabled the implementation of this project.

Mark R. Bezuijen, *Project Coordinator, TTF-PRCF Tomistoma Project*

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LOCAL CONSERVATION OF TOMISTOMA IN EASTERN SUMATRA. During recent Tomistoma surveys in Kalimantan (see previous article), the opportunity was taken to obtain information on the status of Tomistoma

conservation at important sites in eastern Sumatra, previously surveyed by Wildlife Management International in 1995-96, and by WMI/Wetlands International-Indonesia Program (WI-IP) in 2001-02 [Bezuijen *et al.* False Gharial surveys in southeast Sumatra, Indonesia (1995-2002). WMI, Darwin].

In the Merang River (South Sumatra Province), WI-IP and regional government agencies have developed a management program to address conservation and natural resource use of peat swamp forest [CSG Newsletter Vol. 23(2): 20-21]. This program was initiated after a WMI/WI-IP workshop on Tomistoma/Merang River in 2002, and includes conservation of bankside nesting habitat for Tomistoma. Local government is actively engaged in this program and now uses Tomistoma as a "flagship species" for activities (Yus Rusila Noor, WI-IP, pers.comm.).

In Berbak National Park (Jambi Province), no further crocodile surveys have been undertaken since WMI/WI-IP surveys in 2002. The park has been subject to further forest fires (Yus Rusila Noor, WI-IP, pers. comm. 10 September 2004), which may have resulted in further loss of Tomistoma nesting habitat (large areas of the park were destroyed by fires in 1997-98).

In Simpang Datuk Lake (Jambi Province), a small, unprotected lake near Berbak National Park, provincial forestry officials documented a Tomistoma nest in August 2004 (E. Septina, KSDA Jambi, pers. comm. 11 September 2004). The presence of Tomistoma at this site was identified by forestry officials from reports by local people in 2002, which prompted a brief visit by WMI/WI-IP in 2002, although no crocodiles were observed. In 2004, officials made a return trip to the site after discovery of the nest by local residents. The nest was located in logged peat swamp forest, and contained >16 eggs (E. Septina, KSDA Jambi, pers. comm.). The provincial forestry department is now considering conservation activities at the site to protect the species (E. Septina, pers. comm.). Discussions with these officials revealed much interest for knowledge in appropriate survey and conservation management techniques for this and other sites with Tomistoma.

The above news indicate that local government and other agencies have been independently developing Tomistoma conservation since surveys in 2001-02. Similarly, national support for Tomistoma conservation remains strong: during meetings with senior Ministry of Forestry personnel (September 2004), the need for regional training of forestry officers to raise the number of national personnel able to conduct crocodile surveys, was expressed. WMI Tomistoma surveys were initiated in Sumatra in 1995, and have included training in crocodile conservation techniques, wide distribution of project results and ongoing liaison with local agencies to raise provincial/national awareness of the species. Lobbying and technical assistance for national crocodile conservation has been provided by

the CSG and WMI since the early 1990s. These long-term relationships between the CSG, WMI and Indonesia Ministry of Forestry have undoubtedly contributed to these results, and demonstrate that international efforts to date have helped effect positive developments for Tomistoma conservation in Indonesia. A challenge now will be to maintain support for Tomistoma conservation, particularly in the capture of international funds to assist with provision of awareness materials, technical training of local personnel and continued population monitoring in selected survey sites such as the Merang River.

Mark R. Bezuijen, *TTF Regional Coordinator (Indonesia), Project Coordinator TTF-PRCF Tomistoma Project*

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## Gharial Task Force

**GHARIAL TASK FORCE.** Following the 17th CSG Working Meeting in Darwin, and stimulated by the worsening situation in the wild for remaining Gharial (*Gavialis gangeticus*) populations, the Gharial Task Force (GTF) was established to bring Gharial conservation back into the limelight. Still in its embryonic stages, the GTF's draft mission statement reads as follows:

"The Gharial Task Force (GTF), within the IUCN/SSC Crocodile Specialist Group, aims to bring together key individuals and organisations to facilitate conservation efforts on the seriously endangered Gharial (*Gavialis gangeticus*).

GTF hopes to promote continual monitoring of all surviving Gharial populations, the restoration of populations through head start programs with PAs that have the potential to support the species, initiate research on dispersal and migration to aid higher retention rates within PAs, research on environmental impacts of different biotic pressures on the Chambal River and other gharial habitats, Eco-Development to raise living standards of local residents living in Gharial habitat with the eventual elimination of their dependence on natural resources required for Gharial conservation, and sustained and adequate awareness campaigns for different stakeholders in resources required for Gharial conservation."

Regional CSG members with an interest in gharial conservation are encouraged to become part of the Task Force. A website is under construction that will help to bring gharial conservation to a wider audience and help coordinate conservation activities.

Nikhil Whitaker, *Chairman, Gharial Task Force, Chairman Gharial Task Force, Madras Crocodile Bank/Centre for Herpetology, PO Box 4, Mamallapuram, Tamil Nadu 603104, South India <kachuga21@hotmail.com>*.

## Regional Reports



### South Asia

#### India

REVIVAL OF GHARIAL REARING PROGRAMME IN THE NATIONAL CHAMBAL SANCTUARY, MORENA, MADHYA PRADESH, INDIA. Since 1975, different States have established crocodile rearing centres for rehabilitation programme under the crocodile project of the Government of India. The Government of Madhya Pradesh also recognised the need for having a centre in the best interest of the rehabilitation of crocodiles in the state. The Crocodile and Freshwater Turtle Rehabilitation Centre (CFTRC) was formally established during 1979 at Deori village, 7.23 km north of Morena (Long. 78° 04' E Lat. 26° 23' N) besides Agra-Bombay National Highway No. 3, with financial assistance from the Government of India. The centre is the headquarters of the National Chambal Sanctuary. The nearest point of the Chambal River from the CFTRC is around 15 km to the North.

By the year 1981, crocodile-rearing complex (one hatchery, one nursery pool and two hatchling pools), residential building and office building were constructed at the centre and the captive rearing of gharial was started. The centre is under the administrative fold of Madhya Pradesh Forest Department. The main objectives of the centre were to rehabilitate the captive reared gharial in different rivers and educate and make aware of the conservation programmes to the local people. While fulfilling the above objectives, the centre is providing base camps for the Wildlife Institute of India, Government of India and Jiwaji University for conducting research activities on different wildlife in National Chambal Sanctuary.

The activities of the centre were increased from gharial rearing to rearing of other reptiles. New rearing enclosures were constructed. Under this new set up the centre is entrusted with the responsibility to rear the mugger and fresh water turtles for rehabilitation purpose.

Due to paucity of funds or perhaps due to disbelief that there is no need for further releasing of gharial in the wild, the captive rearing programmes for gharial in the CFTRC were stopped from 1995 onwards. The administrative staff in the National Chambal Sanctuary has concentrated on

the protection of gharial in the Chambal River. Although the gharial PHVA workshop during 1995 recommended for continuing the gharial releasing programme for some more years, the Government has not taken any action.

The recent crocodile census in the National Chambal Sanctuary revealed low population of gharial in the wild. Looking into the decline in the wild gharial population in the Chambal River, it was strongly recommended for further releases of captive reared gharial in the wild. During the 2003 gharial nesting season, a total of 120 wild-laid gharial eggs were collected and incubated in the artificial hatchery at CFTRC. The hatched young gharial are being reared at the centre. This activity is expected to continue for some years.

Thanks to the Madhya Pradesh Forest Department for reviving the 'grow and release programme' for gharial in the National Chambal Sanctuary.

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THE MUGGER (*CROCODYLUS PALUSTRIS*) POPULATION, PROBLEMS, PANIC AND RESCUE OPERATIONS IN AND AROUND VADODARA CITY. The immense growth of urbanisation, industrialisation, agricultural practices and deforestation are the main causes of conflicts between human and wildlife. Today such conflicts are increasing day by day and they result not only in a loss of few human lives but they also negatively impact on the practice and mission of conservation of wildlife. They have even eliminated some of species. Therefore a few conservationists and animal activists are rescuing such animals from urban areas on the basis of humanitarian ground in many places, along with the help and direction of state forest department. And same practices are observed in and around Vadodara City (22° 19' N and 73° 13' E), Gujarat.

A local NGO and a few individuals are rescuing conflict animals from Vadodara City and its surroundings. The volunteers of this NGO and few individuals run and rush for rescuing the animals on the call of public and catch such problematic reptiles from human settlements. This record is of 22 species of reptiles, including 19 types of snakes, two types of turtle and a type of crocodile. During the last three years (2001-2003), such groups have rescued 47 mugger crocodiles (*Crocodylus palustris*) from the human settlements and released them in to nature, as per the direction of Forest Department, Vadodara (Table 1). Only total body lengths of rescued crocodiles were measured and natural identification marks if any present on the animals were recorded. Most of rescued crocodiles were released in Ajawa Sarover (water body is located in upper areas of the river) while few are released in Targol water tank, in Jambughoda Wildlife Sanctuary.



One of the mugger crocodiles (*C. palustris*) being removed from Vadodara.

Present data shows that during the years 2001, 2002 and 2003, 15, 15 and 17 crocodiles respectively were rescued, including 14 juveniles (<1 m), 18 sub-adults (1-2 m) and 15 adults (>2 m). Such problems are observed only from June to December every year so all the crocodiles were rescued in between these periods only. The problems start in June and reach up to 11 and 18 numbers in August and September and then they decrease (Table 2). During June all size groups of muggers are captured but higher numbers of juveniles are found in July, while higher numbers of adult muggers are found in August and September.

The crocodile problems start with month of June every year at Vadodara City and are correlated with the monsoon season (from June to September in the State). And their rescue sites are located within 100 to 500 metres of close vicinity of river and its streams only. The higher number of juvenile muggers is rescued in July because the month is peak period for incubation and hatchlings come out from the nest. The higher number of adult croc rescued in August and September because the months are peak period of rains and usually river is flooded.

All these problematic crocodiles come out from the Vishwamitri River and its tributary and enter into nearer human settlement areas during the rainy season due to flood in river and consequent enlarging of the water habitat. It shows that a small population of mugger crocodiles survives and breeds in the river system. Also it shows that the local people are very conscious about saving the mugger so they call for rescuing it. But it was noticed that in two incidences people were panicky about their presence and they badly assaulted small-sized muggers out of fear the rescuing party reached there (see Table 1; 5 and 34), finally both crocs died. It occurred only at places of dense human population especially slum areas of the city. Since they are illiterate people and they have a fear of loss of some of the livestock due to mugger in future. It was also

observed that two of earlier released sub-adult muggers in Ajawa Sarover were recaptured again from city areas in next monsoon, at the distance of 30 km from release site. Both the sub-adults are identified by external identical injury marks.

This Vishwamitri River is one of the seasonal rivers in the state and it flows east to west in between two large perennial rivers Mahi and Narmada. Vishwamitri river originates from Pavagadh hills, flows to west through Vadodara city and further it joins with two other small tributaries (Dhadhar and Jambuva near Kothawada village) and finally reaches the Gulf of Khambhat near Khanpur village. Two water reservoirs are constructed on the river systems, Sayaji Sarovar on Vishwamitri river near Ajawa village and Dev Dam on Dhadhar branch, for the drinking and irrigation purposes.

Since a long time a small breeding population of mugger crocodiles flourished in the rivers system. An unpublished earlier record of the Gaikwad State indicates that this small population of the mugger is inhabiting in Ajawa Sarovar since late eighteenth century. A report of Oza (1975) indicates that there were about 50 muggers in Ajawa Sarovar, when entire mugger population depleted in India. Vijayakumar *et al.* (1999) and Vyas and Vyas (2002) counted 27 and 70 muggers during the survey of 1995 and 2001 respectively.

Recent and previous data of rescuing muggers (Vyas 1994; Bhatt 2000) from Vadodara City suggests that such a small population of muggers survives in these areas with ups and downs phases. But mugger like reptilian species cannot survive in such condition without positive efforts of conservation and consciousness of the local people along with legal protection of Indian Wildlife Protection Act - 1972.

I am thankful to all volunteers of GSPCA, Vadodara for providing the information of rescued animals, especially reptilian species. Thanks to Conservator of Forest, Vadodara for help and suggestions.

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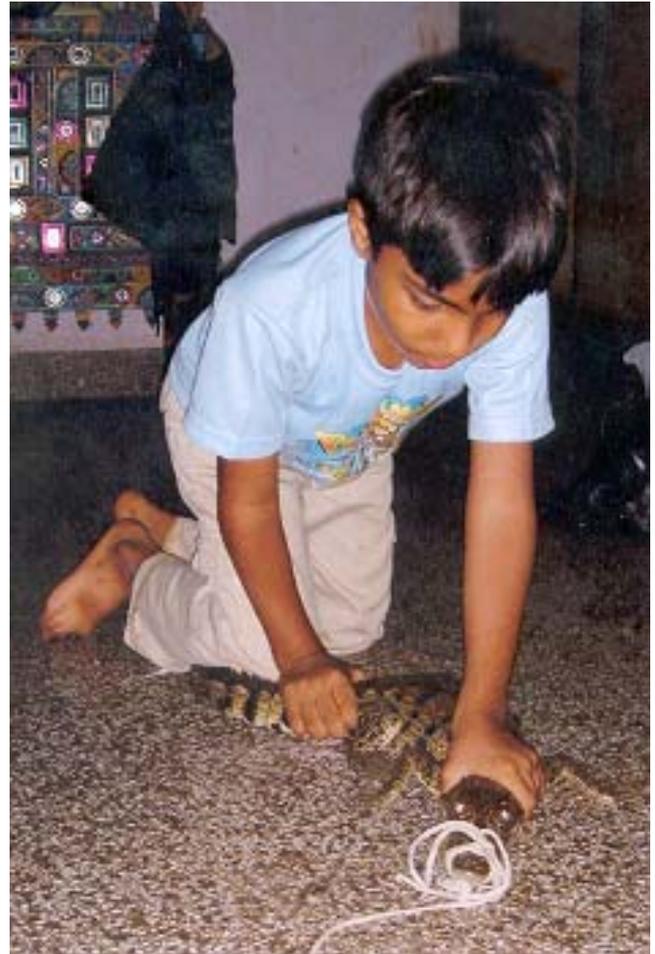
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Adult mugger crocodile (*C. palustris*) in a trap.



A higher proportion of juveniles are caught in July.

Table 2. Monthly analysis of rescued mugger in and around Vadodara City, Gujarat (2001-2003).

Month	Juvenile	Sub-adult	Adult	Total
June	0 + 1 + 1	1 + 0 + 1	2 + 0 + 0	<b>3 + 1 + 2 = 6</b>
July	2 + 1 + 3	3 + 1 + 1	0 + 1 + 0	<b>5 + 3 + 4 = 12</b>
August	1 + 0 + 1	0 + 2 + 2	0 + 2 + 3	<b>1 + 4 + 6 = 11</b>
September	0 + 0 + 3	3 + 1 + 1	1 + 4 + 0	<b>4 + 5 + 4 = 13</b>
October	0 + 0 + 0	0 + 1 + 0	0 + 1 + 1	<b>0 + 2 + 1 = 3</b>
November	1 + 0 + 0	0 + 0 + 0	0 + 0 + 0	<b>1 + 0 + 0 = 1</b>
December	0 + 0 + 0	1 + 0 + 0	0 + 0 + 0	<b>1 + 0 + 0 = 1</b>
<b>Totals</b>	<b>4 + 2 + 8</b>	<b>8 + 5 + 5</b>	<b>3 + 8 + 4</b>	<b>15 + 15 + 17 = 47</b>

Table 1. Details of mugger (*Crocodylus palustris*) are rescued from in around Vadodara City, Gujarat, by local NGO and some individuals, from 2001 to 2003. Mugger rescued by Gujarat Society for the Prevention of Cruelty to Animals. except where marked with \*. VC = Vadodara City, VD = Vadodara District.

No.	Date	Area from which crocodile rescued	Age group
1 (2001)	15 June	Varasiya RTO, Dhobitalaw, VC	Adult
2	21 June	Manjalpur, Bhathuji Temple, VC	Sub-adult
3	21 June	Venpura, Nr. Sankariya	Adult
4	3 July	Vishva Jayoti Ashram, VC	Sub-adult
5	4 July	Transpach Inst., Makarpura, VC	Young killed
6	7 July	Parshuram Bhaththa, VC	Juvenile
7	12 July	Akota, Police line, VC	Sub-adult
8	27 July	Navapura, VC	Sub-adult
9	6 August	Sama village, VC	Juvenile
10	4 September	Harni, Ne. Mayo Hospital, VC	Sub-adult
11	11 September	Sarda School, Padara Town	Adult
12	20 September	Central Jaill, VC	Sub-adult
13	23 September	Akota, Ne. Muni School, VC	Sub-adult
14	11 November	Akota, VC	Juvenile
15	15 December	Dumad Village, Vadodara District	Sub-sdult
16 (2002)	27 June	Kamatibaug, Narhari Hospital, VC	Juvenile
17	1 July	Gujarat Tector Factory, VC	Juvenile
18	6 July	VIP Road, Khodiyar Nagar, VC	Adult
19	13 July	Nimeta, Sankariya village, VD	Sub-adult
20	18 August	Navalakhi, GEB Compound, VC	Adult
21	22 August	Manjalpur, Sontekari, VC	Sub-adult
22	26 August	Navalakhi, GEB Co., VC	Sub-adult
23	27 August	Nimeta village, VD	Adult
24	1 September	Lalabaug, VC	Adult
25	6 September	Goladan Chokadi, Harni village, VD	Sub-adult
26	9 September	Manjalpur, VC	Adult
27	12 September	Vemali village, VD	Adult
28	20 September	Motibaug, Rajmehal, VC	Adult *
29	26 October	Jambusar Town, VD	Sub-adult
30	27 October	Vaghodiya Town, VD	Adult
31 (2003)	16 June	Navalakhi, GEB Co., VC	Sub-adult
32	16 June	Akota, VC	Juvenile
33	13 July	Chapad village, VD	Juvenile
34	14 July	Bhutnath, Sama, VC	Young killed
35	25 July	Munj-mahuda, VC	Juvenile
36	26 July	Navalkhi, GEB Co., VC	Sub-adult
37	12 August	Navalkhi, GEB Co., VC	Sub-adult
38	19 August	Goladan Chokadi, Harni, VD	Adult
39	20 August	Ambaliya Village, Padara, VD	Adult
40	26 August	Sadhi Village, Padara, VD	Sub-adult
41	28 August	Vadasar Village, VD	Adult
42	31 August	Dandiya bajar, VC	Juvenile
43	4 September	Manjalpur, VC	Juvenile
44	21 September	GSFC Nagar, VC	Sub-adult
45	26 September	Sashtribridge, VC	Juvenile
46	26 September	Manjalpur GIDC, VC	Juvenile
47	10 October	Ratanpur, canal, CD	Adult

## Sri Lanka

**DISCOVERY OF CROCODILES ON MANNAR ISLAND, SRI LANKA.** Serendipity is a word coined by Horace Walpole in 1754 to denote the faculty of making lucky and unexpected 'finds' by accident. Walpole in a letter to Sir Horace Mann wrote that he formed it on the title of a fairy story, The Three Princes of Serendip, because the princes "were always making discoveries, by accidents and sagacity, of things they were not in quest of." There is no better word than serendipity to describe how we stumbled on two adult crocodiles basking on a spit of land in one of the seasonal water holes in Mannar. This happened on Sunday 1 February 2004, when we travelled with students from the University of Peradeniya (Sri Lanka) on a field trip across the island of Mannar.

We were traveling down the A14 highway that goes all the way to Talaimannar on the western end of the island on Sunday when at 1055 h we stopped at a waterhole known as Kora kulam situated between the 89 and 90 km posts (Fig. 1) to observe the diversity of birds, especially the waders, when we spotted two "log-like" structures on a spit of land. Closer examination through binoculars revealed that these were two fairly large (about 2 m long) crocodiles. It is not known for certain to what species they belong, for as they were about to be photographed, a gunshot nearby drove them into water. It was an incredible find for there had been no recent account of crocodiles from Mannar, although according to Deraniyagala (1953), the freshwater ('freshy') or marsh crocodile (*Crocodylus palustris*) "inhabits some of the islands to the north-west and north of Ceylon which it has reached either by crossing the sea during heavy rainy weather or by being isolated when these islands separated off the mainland." However, the list of areas from where Deraniyagala examined specimens of this species does not include the island of Mannar. According to Deraniyagala (1939), the salty (*C.*

*porosus*) is most common in the estuaries of large rivers and appears to prefer water that is only slightly brackish. It thus avoids the sea but is known to travel short distances by sea from one river mouth to another close by, when swept there by floods. There is no mention of Mannar in the list of localities from where Deraniyagala (1939) had recorded the salty. According to Dr. Rom Whitaker (pers. comm.) the two animals that were seen in Mannar might have been freshwater crocodiles (*C. palustris*). This view is supported by the fact that subsequent to our finding the two animals at Kora Kulam, a fisherman brought a young (30 cm long) freshwater crocodile captured in Mannar Island, which was later released into a river known to have freshwater crocodiles.

Crocodiles have been poorly studied in Sri Lanka. During the British Colonial period, Mr. W.J.S. Boake (1888) published a Monograph on Mannar in which he refers to the presence of both species of crocodile in the Mannar District (400 sq. miles) but not specifically in Mannar Island. According to Boake (1888), the two species are known by their local names Chemmukkan (salty) and Chanakam (freshy) in Mannar District. After the pioneering work by Deraniyagala on crocodiles, the next remarkable piece of work was the survey carried out in 1977 by Rom and Zahida Whitaker of the Madras Snake Park Trust, on behalf of the Wildlife and Nature Protection Society of Sri Lanka. The Whitakers arrived by ferry from South India and landed at Talaimannar and travelled some 1600 miles across much of the island of Sri Lanka on their Jawa Motorcycle examining 'hundreds of ponds, reservoirs, streams and rivers' and interviewing local residents and fishermen for information on crocodiles. They were able to gather detailed information on crocodiles from 40 representative tanks. Their survey was, and remains to this date, the most comprehensive study of the distribution of crocodiles in Sri Lanka. This was followed by a re-assessment of the status of the two species of crocodiles by Santiapillai and de Silva (2001). In both studies, there was no specific mention of crocodiles being present in the island of Mannar, and it was thought that they were either absent or extinct. Herein lies the significance of our observation in Mannar. Subsequent to our discovery of the crocodiles, we found out from a fisherman that both species occur in ponds and seasonal water holes in Mannar, but this needs to be confirmed through more detailed surveys. We were also told that crocodiles were routinely killed as people are fearful of their presence in their neighborhood, especially in view of the fact that women and children bathe in such seasonal ponds.

The island of Mannar lies between 8°30' N latitude and 80°30' East longitude off the west coast of Sri Lanka (Fig. 1). With an annual rainfall between 762 and 1016 mm, it is one of the driest places in Sri Lanka. The north-east monsoon brings rain during the short period from December to February. High daytime temperatures of over 30°C have been recorded in the island between April and

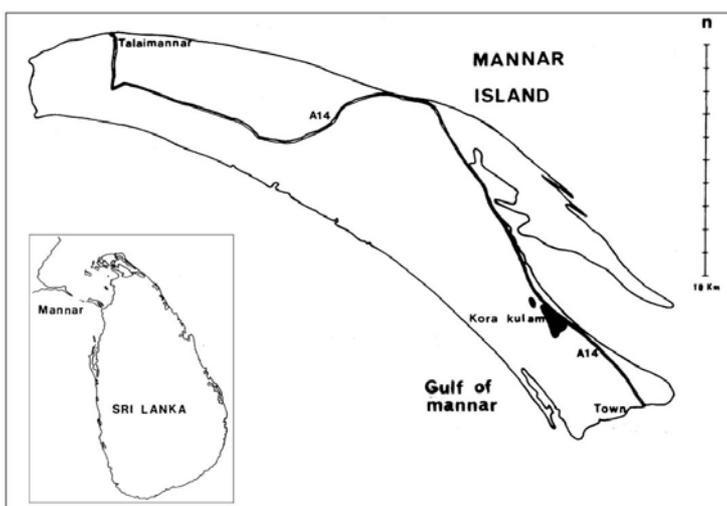


Figure 1. Map of the Island of Mannar showing the location of Kora Kulam where crocodiles were observed.

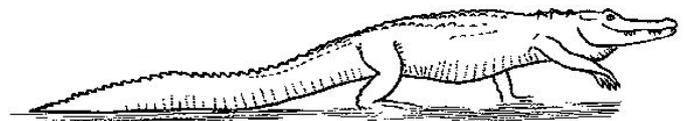
May. The central part of Mannar Island is blown sand overlying Miocene limestone and inter-bedded coral (Eriyagama 1961). The fine clay soil becomes bone dry and stony hard during the drought and makes it extremely impervious to water. But during the brief rainy season, the island of Mannar undergoes a remarkable transformation and becomes a Mecca for the millions of migratory birds that arrive annually to escape the northern winter. It is during such time that crocodiles too benefit from the rich source of food available in the seasonal ponds and water holes. As Boake (1888) points out during the rainy season every tank and swampy ground is full of fish, which in the dry season “bury themselves into the mud like the saurians”.

The discovery of crocodiles in the island of Mannar underlines the need for surveys across much of the north and east of Sri Lanka. As Sale (1985) points out, long-term research on any particular system should be planned on the basis of a logical progression through a series of phases, involving the processes of discovery, assessment and prediction. In Sri Lanka, there is still much to be done in discovering the island’s rich biological diversity. Ross (1998) accords a high priority for surveys of crocodiles to be carried out in hitherto unsurveyed areas in countries where the species occur. Crocodiles have been recognized as “keystone species” that maintain ecosystem structure and function by such activities as selective predation on fish species, recycling nutrients, and maintenance of wet refugia in droughts (King 1988). It is remarkable that despite intensive hunting pressure in the past, crocodiles have managed to retain a toehold on the island of Mannar to date, proving that they are indeed tenacious survivors. Although many crocodile populations have been reduced in size, as a result of hunting for skin and meat, no species of crocodile has yet been driven to extinction. A potential threat for the future of the crocodiles may come from a rapid rise in the human population (through resettlement of refugees), the spread of settled agriculture, and the development of ill considered and over ambitious tourism facilities. Already, large tracts of land hitherto left in a state of wilderness have been cleared of vegetation to make way for the construction of buildings along the A14 highway in Mannar, close to where the crocodiles were observed. The human footprint will soon be felt across much of the island of Mannar given its strategic importance as the gateway to India. The Kora kulam must be saved from the bulldozer, given its conservation importance as a habitat for crocodiles and migrant birds. Conserving crocodiles will not be easy since they have a poor image in Sri Lanka. Many rural people loathe them as noxious animals and would not regret their disappearance from their neighborhood. If people are to be persuaded to tolerate such potentially dangerous animals in their midst, they need to gain more direct benefits from crocodiles through their non-consumptive use in a carefully controlled wildlife-based tourism. But the reality is that In Sri Lanka, the island of serendipity, where the probable never happens and the

impossible always does, we usually attempt one thing but accomplish another.

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## Pakistan

**MANGHOPIR, KARACHI, PAKISTAN, AND CROCODILES.** Manghopir, original name of which was Sufi Sakhi Sultan. His history is about 700 years old! Legend says that Mango (later known as Sufi Sakhi Sultan) was formerly a Hindu dacoit, notorious for looting caravans, but impressed by the righteous personality and teachings of Saint Baba Farid (Ganj-e-Shakar, a well-known saint of Punjab), he converted to Islam and turned to live a noble life. He also became one of the disciples of Baba Farid, who was so pleased with Mangho due to his devotion and meditation, that he and titled him with 'Pir'. Thus Mangho became a saint equally respected by both Hindus and Muslims. Apart from crocodile's festival, the Urs of Manghopir is celebrated in the Islamic month of Zilhej.

The crocodiles are an integral part of the shrine, chronicle of the saint, and are so tightly interwoven that it is almost impossible to judge between fact and fiction. There are many traditions about myth of crocodiles, as if it is believed that Baba Farid gifted the reptiles to Manghopir. Second myth is quite factual, ie during a visit of Lal Shahbaz Qalandar (the celebrated Saint of Sindh), who in order to make the barren valley more inhabitable caused a hot spring to issue forth from the rock and a grove of date palms to spring up from the ground, and the crocodiles were originally lice of the saint, which he gifted to Pir Mango, to put them into the pond and then each turned into a crocodile!

When according to third rational explanation, the crocodiles were introduced in Manghopir by Mor Mubarak (also a saint), who brought them from a cave in Korangi, as a result, after the name of saint, the chief of crocodiles (the eldest one) came to be known as 'Mor Sahib'.

According to scientific explanations, these crocodiles were carried through some heavy floods, during ancient times and later gathered/collected at this pond. Archaeological investigations have also suggested the existence of a bronze age settlement (2500-1700 BC) near Manghopir, who worshipped crocodiles and before the advent of Islam crocodiles were also thought sacred for Hindus. More to the point, certain signs of crocodile-myth in form of animal magic and witchcraft are also seen in the African countries like Guinea and Zaire. Certainly, these trends are because of the unique nature of the reptile, which is always quick and ruthless and one who maintains a cool behaviour at the surface of water, while paddling like a devil underneath.

### Natural Hot and Cold Water Resort

There are also hot and cold springs at a distance of about a kilometre from the shrine. Warm water passing through the sulphur rocks contains some medicinal qualities and many people from long distances, with skin diseases

regularly visit there to have a bath to cure them. There are separate swimming pools/shower rooms for men and women. Scientific analysis also shows that this warm water is naturally saturated with carbon dioxide, besides containing some sulphur and other skin friendly nourishments, which are no doubt suitable for many skin-diseased patients.

### Requirement of Croc Pool

Near about 100+ crocodile in the pool, because lack of budget it is not possible to extend the area of pool, and there is no proper seating arrangement for people to watch the crocs' activities. About \$4500 is required for all civil work such as building of boundary wall, walls, mini-pool for newly-born crocodiles and one storeroom for croc feed, one refrigerator for croc meat, grills for boundary wall, and benches for sitting. Its cost near about \$5000 we contribute near about \$1000 in our locality we need further \$4500 for all expenses.



Saint Tomb



Local name of this crocodile is Morsawab. Age is not less than 65 years old.



Waseem Baloch interacting with the crocodiles.



Crocodiles relaxing near Pool.



Sajjad Baloch, caretaker of the Croc pool, also feeds the crocodiles. His salary is Pak Rupees 3000 (\$US60-65) per month, paid by the Government of Sindh.

Waseem Baloch, *Manghopir, Karachi, Pakistan.*

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## North America

### USA

LOUISIANA 2004 ALLIGATOR SEASON STATISTICS. The coastal nesting survey this year was the second highest nest count on record. Water levels in June were good, and thus nesting effort was higher than in the recent drought years (1996, 1998, 2000). Tag quotas are based on the average of the five most recent years' nesting surveys and number of acres and habitat types (fresh, intermediate, brackish) for each property submitted for possible harvest.

The number of tags issued this year was: 31,533 regular and 3659 bonus (total 35,192). Last year Louisiana issued: 30,533 regular and 3270 bonus (total 33,803). Total number of licensed Louisiana trappers in 2004 was 2041.

“Bonus” tags are an additional 10% of a trapper’s quota, and are extra tags to be used on alligators six feet long or smaller, to allow take of more of the smaller alligators, which are more numerous.

Low water levels at present have made trapping relatively easy with alligators concentrated in deep water canals; most trappers successfully tagged all/most of their quota.

Prices were higher this year than last year. Most dealers were buying 7 foot alligators (whole carcass) at \$US20-22 per foot. This is comparable to prices in 2001 (prices were about \$US16/foot in 2002, and \$13/foot in 2003). Value of hides and meat last year was over \$US6 million.

Ruth M. Elsey, *Louisiana Dept. of Wildlife and Fisheries, Rockefeller Wildlife Refuge, 5476 Grand Chenier Highway, Grand Chenier, Louisiana 70643, USA.* <relsey@wlf.louisiana.gov>



Full view of Croc Pool.



Near the area of Croc Pool.

# South America

## El Salvador

NOTES ON CROCODILES IN EL SALVADOR. For good management, and to help to preserve natural populations, information about distribution, etology, population density, population size and population structure is needed (Bailey 1984).

During October and November 2002, we conducted the first census of crocodile populations. Ten night surveys were carried out in different areas where information existed on occurrence of crocodiles (personal communications and confirmed records), or which hadn't been published.

All observations were located in El Salvador's administrative division map, to use the system of geographical information facilitated for Ministerio de Medio Ambiente y Recursos Naturales of El Salvador (MARN). We estimated relative density of crocodiles (individuals per kilometre; Table 1), and on the basis of individual size (estimate of head length), crocodiles were grouped in three categories: a) juvenile <90 cm; b) sub-adults between 90 and 180 cm; and, c) adults >180 cm (Thorbjarnarson 1989).

In Guija's Lake, the people say crocodiles existed in the past (10 to 40 years ago), and were mainly hunted for their skins.

All individuals were observed in the littoral zone. Most crocodiles sighted were juveniles, followed by sub-adults and then adults (Fig. 1).

Cattle activities, expansion of agricultural land and illegal activities such as wood extraction and hunting of fauna, result in more people living permanently in coastal habitats.

The growth of the human population generates a great pressure to develop crocodile habitats, and to displace the crocodiles and all other fauna and flora.

This evaluation of the crocodile population in different areas of the country does not constitute a population census due to the low number of surveys. On the contrary, it indicates of minimum number of *Crocodylus acutus* and *Caiman crocodilus* in the zones.

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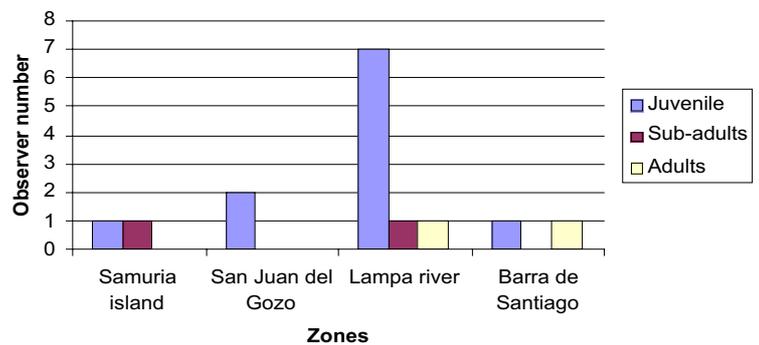


Figure 1. Size distribution of *Crocodylus acutus*.

Table 1. Distance, density and number of *Crocodylus acutus* and *Caiman crocodilus* in the different areas of El Salvador.

Locality	Observed Species	Observed Number	Distance (km)	Density (ind/km)
Jiquilisco's Bay (Samuria Island)	<i>C. acutus</i>	9	30.5	0.33
Jiquilisco's Bay	-	0	20	0
Jiquilisco's Bay (Escondido)	<i>C. crocodilus</i>	4	3	1.33
El Jocotal's Lake	-	0	10	0
Jiquilisco's Bay (San Juan del Gozo)	<i>C. acutus</i>	1	3	0.33
Jiquilisco's Bay (San Juan del Gozo)	-	0	7	0
Lempa River	<i>C. acutus</i>	13	10	1.33
Barra de Santiago	<i>C. acutus</i>	5	7	0.71
Guija's Lake (Ostua River)	-	0	35	0
Guija's Lake (Angue River)	-	0	32	0
Total		32	157.5	0.2

# Eastern Asia, Australia and Oceania

## Hong Kong

WILY CROC FINALLY MEETS ITS MATCH. A crocodile in Hong Kong that for months eluded some of the world's top crocodile hunters has finally been caught. The reptile, thought to have been brought in illegally as a pet and later released in a river in the city's rural New Territories area, swam into a trap after a seven-month hunt.

"Yes, we've got it," a spokesman for the Agriculture and Fisheries Department said on Thursday. The 1.5 metre (5 foot) animal, named "Croc Croc Chan" after the family that first spotted it in October, became a media star in a city better known for its gleaming skyscrapers than its wildlife.

Its fame soared when it managed to give hunters from Australia and mainland China the slip, and it attracted hundreds of tourists a day after newspapers splashed its picture on their front pages.

Experts said Croc Croc Chan, a Saltwater Crocodile, could grow to a length of 8 metres (26 feet). Its species has the worst record for attacks on people. It was not immediately clear what the government planned to do with Croc Croc Chan. "We will have to decide later," said the spokesman.

Reuters, Friday, June 11, 2004

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## Australia

It was a sad day when the Australian Wildlife Park, a component of Wonderland Sydney, the largest theme park in the Southern Hemisphere, closed its gates on 26 April 2004. Over 650 animals needed to be placed amongst them "Maniac" a 15 foot plus Saltwater Crocodile *Crocodylus porosus*.

Maniac was originally brought down to The Australian Reptile Park by Neville Burns, approximately 16 years ago, from Edward River Crocodile Farm. He was one of the first animals in the park and was a major attraction. Neville had remained his keeper for most of this period.

Finding a home for Maniac proved to be relatively easy. There was a bit of interest from within Australia for starters. Liz Romer the Zoological Consultant, who was relocating the animals, was at the time also coordinating a reptile import and export for some of the ARAZPA Zoos and was dealing with Terry Phillips the Curator at Black Hills Reptile Gardens in South Dakota. When she mentioned

the availability of Maniac they jumped at the chance to acquire him.

The first step was contacting Environment Australia to check if this was a feasible transaction. As a Zoo-to-Zoo export for Educational Exhibition, provided they were able to prove they could satisfactorily care for the animal, it would be achievable. Also the Saltwater Crocodile is only CITES II and not threatened in Australia.

An Application for a permit to export or import wildlife or wildlife products was completed. This involved a number of sections including Supplementary form G where the facilities and expertise at Black Hills had to be detailed. These forms are then assessed by the sending institution. Generally the receiving institution must show it meets the Exhibited Animals Protection Act (NSW) Minimum Standards for Keeping Animals for Display purposes.

The initial paperwork received showed that the enclosure was too small. However Black Hills were able to knock out a wall to an adjoining area which then gave the animal the space needed. The application was then processed and a permit issued.

Then the organisation of the transfer began. We firstly stopped feeding him 3 weeks prior to transport as the weather was cooling and we wanted to make sure there was no regurgitation during capture and transport.

Because of the size and weight of the animal it was realised that a crane would be needed to get him out when in his transport box. Trees beside the exhibit were cleared to allow access on the date. Black Hills transport agent working with Dogtainers coordinated the flights through to Denver from Sydney as well as the long list of associated paperwork such as customs declarations!

Ken Earnest the Senior Curator from Black Hills, who had experience in moving a number of 15-17 foot crocodiles (including Gomek from Green Island) firstly sent the box design and then arrived on site a few days prior to organise final details with the Wonderland staff.

The box (see Fig 1) itself was only 10 foot long! But at 5 foot wide allowed the animal once pulled in to have his body wedged in with his snout in a corner and his tail to wrap around into the other compartment making it comfortable enough without allowing room for thrashing and hurting himself. It also had to meet the IATA requirements or it would not be allowed on the flight! The Wonderland maintenance crew, who proudly labelled it with their names and an Australian made sign, then built the box!

In order to quieten the animal for the journey the temperature of the pool was lowered slightly prior to the transport to 25°C. It was also a nice crisp May morning

when the transport day arrived. Ken and Neville entered the compound around 6.30 am alone and tried to noose his jaw. Unfortunately this didn't work first time and Maniac sunk to the bottom. A pump was then brought in which was arranged previously and the water pumped out. They then were able to noose him and then secured him with a rope around his body behind his front legs.

A number of men then helped to drag him onto the land where his jaws were carefully taped up by Ken and Neville. The box was designed with a door at each end so they could then pull Maniac through the box and the partition was then placed securely against his body so he couldn't thrash too much. His tail then fitted in snugly into the other compartment and the box was sealed and lifted onto the truck for the airport.

The whole exercise was a very calm - almost boring movement! Things were taken slowly and the animal remained relatively calm. Only a few minor scrapes on his side were sustained by the animal when he rolled a couple

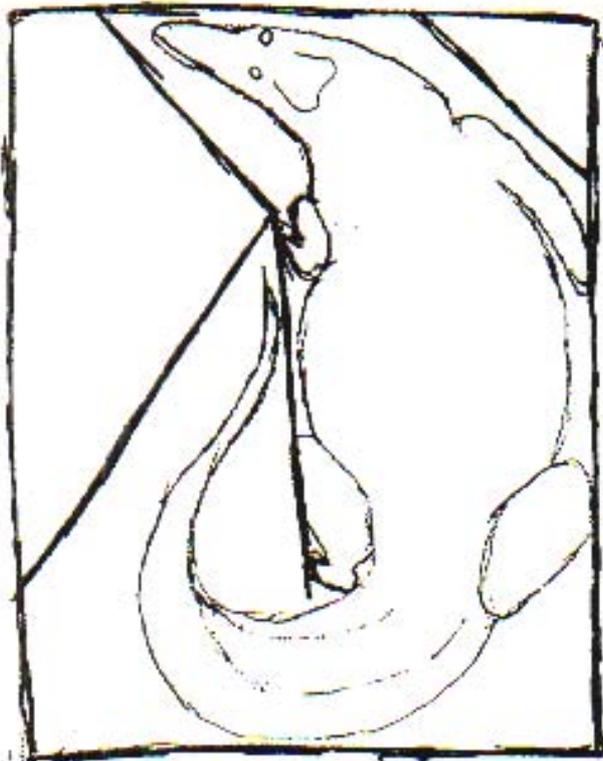


Figure 1. Crocodile transport box design.

of times after being roped. Although the vet - Mike Cannon was on hand to sedate the crocodile if necessary - this proved not to be needed.

Maniac arrived safely and in good condition approximately 20 hours later. He has settled in well and started feeding fairly shortly after arrival. To follow on from John Brueggen's article regarding the transfer of the crocodile



The front of the empty transport box.



Maniac being secured in his compound

to St Augustine Alligator Farm - this now brings the number of legal exports of this species for exhibition to 5.

Neville Burns, (*Senior Reptile Keeper*) and Liz Romer (*Zoological Consultant, slromer@bigpond.com*), *Australian Wildlife Park*.

CROCODILE ATTACKS PAIR SLEEPING IN TENT. A 34 year-old man and a 60 year-old woman were seriously injured recently (11 October 2004) when a 4.2 metre (14 ft) long Saltwater Crocodile (*Crocodylus porosus*) attacked them as they slept in a tent on a beach (Cape Melville) in far north Queensland.

Queensland Parks and Wildlife Service (QPWS) said the pair were inside their tent early in the morning when the crocodile entered the tent grabbed the man. The woman immediately went to the man's assistance, but the crocodile grabbed her and attempted to drag her towards the water. Another person subsequently shot and killed the crocodile.

The group managed to set off a rescue beacon, capturing the attention of QPWS personnel who were in the area eradicating wild pigs. The attack victims were flown by a QPWS helicopter to the ranger station at Lakefield National Park, and later taken by rescue helicopter to Cairns.

The man suffered injuries to his legs and body and was believed to be in a serious condition. The woman had injuries to her arm and upper body.

This attack represents only the second time that a Saltwater Crocodile has come out of the water and grabbed someone sleeping in a tent. In each case, the actions of others have saved the people who were grabbed. A similar attack occurred in October 1990, when a 4 m long crocodile grabbed Lena Pan Quee as she slept in a tent on the banks of the Little Moyle River in the Northern Territory. In this latter case, the tent was located closer to the water, but the river bank was very steep and it was thought that crocodiles would not be able to climb up it. Wildlife Rangers believe that the crying of a 3 month-old baby in the tent may have attracted the crocodile in this latest Queensland attack.

On 30 October 2004, a 17 year-old youth was attacked and bitten on the leg by a 2.6 m long Saltwater Crocodile, as he hunted Magpie Geese in Arnhem Land. There have now been 61 confirmed, unprovoked attacks by Saltwater Crocodiles in northern Australia, involving 63 people being either injured (73%) or killed (27%). In addition, there have been four Saltwater Crocodile attacks on people during the course of their work with wild Saltwater Crocodiles (2 rangers, 1 researcher, 1 crocodile farmer), resulting in injury.

There has been a general increase in the incidence of Saltwater Crocodile attacks in Australia over time (1971-1980, 0.50/year; 1981-1990, 2.0/year; 1991-2000, 2.20/year; 2001-2004, 3.7/year). In both Sarawak and Sabah (Malaysia), increasing numbers of attacks in recent years has coincided with increasing populations of Saltwater Crocodiles. Proposals from Zambia and Namibia submitted to COP13 (Thailand, October 2004; see Editorial) both cited increasing human-crocodile conflicts.

Charlie Manolis. *Information relating to this story was gathered from the "Sunday Territorian" (17 October 2004), AAP (11 October 2004) and Wildlife Management International's own files.*

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## **Africa**

### **Tanzania**

ONE COMMUNITY IN TANZANIA HARVESTS PROBLEM CROCODILES. When Tanzania's quota for Nile Crocodiles from the wild was increased from 1100 to 1600 animals (including 100 for sport hunting) per year by the CITES Meeting of Parties in 2000, this was granted under the condition that rural communities should be more involved and also have a greater share of the benefits. Normally the Ministry divides the quota into small portions and allocates it to companies or individual citizens who have applied. They must meet some requirements, such as owning a minimum of a 0.22 calibre rifle or a shotgun as required by the present Wildlife Act. This has not been changed since then.

The only exception so far is a community-run Wildlife Management Area (700 square kilometres) called JUKUMU, formed by 22 villages with the aim to conserve and use wildlife on their land. It is located in the northern buffer zone of the Selous Game Reserve (50,000 square kilometres) between the Ruvu and Mgeta Rivers. Like in many other areas in the country with crocodiles, people pay a heavy toll. Records show that from 1999 to February 2004, crocodiles have killed a minimum of 28 people and injured 57 others in the Jukumu area. Furthermore, they killed 53 livestock and injured 41 according to official, incomplete statistics. In one village alone 11 people were taken within a year.

Jukumu applied for quotas and was allocated 40 crocodiles in 2001 and 2002, for which they had to pay the usual upfront non-refundable licence fee of \$US50 per animal. The hunting was done mainly at daytime by the village game scouts under the guidance and supervision of the Government's Community Wildlife Officer. Thirty-five (35) were actually hunted. The average size was around 3.2 m, with several over 3.6 m and the largest measuring 4.6 m. After receiving training, the village games scouts prepared and cured the skins themselves. The skins could be sold locally for export and earned on an average \$US150-200 per skin. The money went to the Jukumu society and was used for the conservation of the area and for local community projects.

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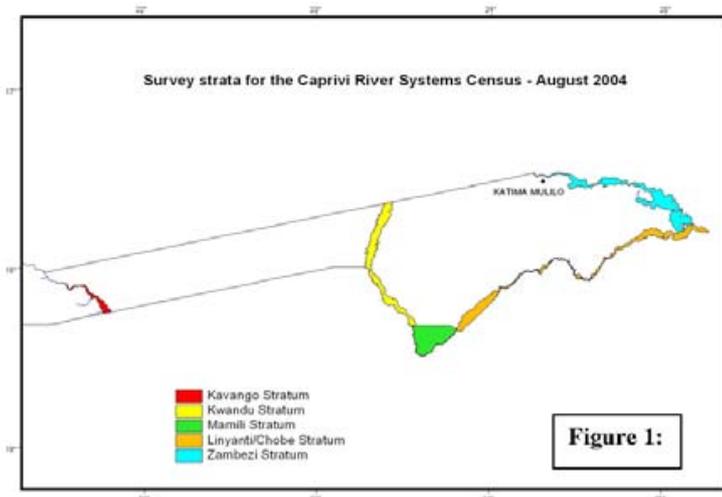
# Africa

## Namibia

RESULTS OF A CROCODILE CROCODYLUS NILOTICUS SURVEY IN THE RIVER SYSTEMS OF NORTH-EAST NAMIBIA DURING AUGUST 2004.

### Areas surveyed

The Okavango River in Namibia, from just northwest the bridge on the Trans-Caprivi highway south to the Botswana border; the entire length of the Kwandu-Linyanti-Lake Liambezi-Chobe system; and the Zambezi River for its entire length on Namibia's border (Figure 1). The Zambezi, the northern section of the Okavango and parts of the Chobe systems are fairly linear rivers. However, the lower Okavango, and in particular, the Kwandu-Linyanti system consists of a relatively small windy river in a wide floodplain with a large number of backwaters, lakes and pans.



### Methods

Two sample methods were used:

1. An aerial census of the above systems, conducted between 11 and 20 August 2004. A total count of water bodies and floodplains was carried out. The edges of the floodplains were demarcated using aerial photographs and satellite images, and the survey areas were then divided into 15 sq km blocks. GPS and mobile GIS technology was used to cover each block intensively (Fig. 2) and to plot each observation. The mean survey height above ground was between 255 and 304 ft, flying time amounted to a total of 36.5 hours (including ferry time) and the search rate ranged between 0.9 and 2.3 sq km/min.
2. A boat census of sample lengths of the Kwandu and Zambezi systems were conducted on the nights of 12-15 and 19 and 20 August 2004 respectively. The

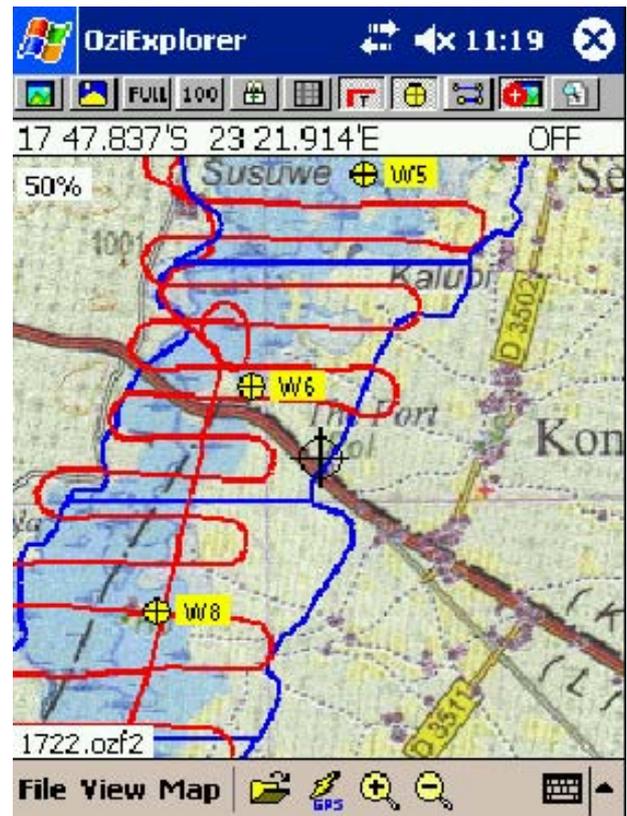


Figure 2. A handheld computer with digital mapping software, linked to a Bluetooth GPS, was used to navigate accurately within counting blocks. The live-capture image (left) depicts a 1:250,000 scanned topographic map as the background, with the counting block boundaries (blue lines), and the exact flight path of the aircraft (red lines). This high-quality and accurate moving-map image, visible to both the pilot and the survey crew during flight, enabled good coverage of the survey blocks.

following method was used on the Kwandu system: depart from one of two launching points - Lianshulu Lodge and Mazambala Lodge, and proceed downstream on the first day and upstream on the second, respectively, during the late afternoons. Wait until after nightfall, and then return to the starting point. Three spotlights of 1 million candlepower each, powered by 12-volt vehicle batteries, were used, one by the pilot to navigate and avoid hippos, the other two working from center channel to the left and right respectively, to scan the water and banks to pick up the crocodiles' reflective eyes. The average speed of the boat was about 23-26 km/h, and this was reduced upon each sighting, to approach the crocodile more slowly and estimate its size. The routes and each crocodile sighting were logged using a GPS. Crocodiles were divided into just two classes, those greater than about 2 m in length (this being the size that is visible from the air) and those less than 2 m. The survey distances were 25 and 22 km, and 15 and 19 km respectively of winding river channels, giving a total of



81 km. The counts on the Zambezi River departed from Kalizo Lodge after nightfall and covered a distance of about 12 km downstream and 13 km upstream respectively - a 25 km sample in total.

The purpose of the surveys is threefold:

1. Estimate the Numbers of crocodiles - How many?
2. Produce crocodile Distribution maps - Where are they?
3. Monitoring Population Change over time - Are crocodiles increasing or decreasing?

## Results

### Aerial survey

Table 1 summarises the results of the aerial count per survey stratum shown in Figure 1. Observations are all of crocodiles >2 m in length. The numbers per km refer to the overall length of the river system, not the length of the meandering river, side channels and lakes.

The distribution was not uniform between strata or within strata (Figs. 4 and 5). Particularly high densities were found along the lower reaches of the Zambezi River and its floodplains and on parts of the Chobe River, where

Table 1: Crocodile abundance - aerial counts	River system / Survey stratum					Total / average
	Okavango	Kwandu	Mamili	Linyanti / Chobe	Zambezi	
Number crocodiles	17	40	37	58	55	207
Crocodiles/km	0.50	0.52	0.49	0.32	0.44	0.42

Table 2: Crocodile abundance - boat counts	River systems					
	Kwandu			Zambezi		
	>2 m	<2 m	Total	>2 m	<2 m	Total
Number crocodiles	15	71	86	7	4	11
No./km meander	0.16	0.88	1.06	0.23	0.16	0.44
No./km overall	0.32	1.51	1.83	0.35	0.20	0.55

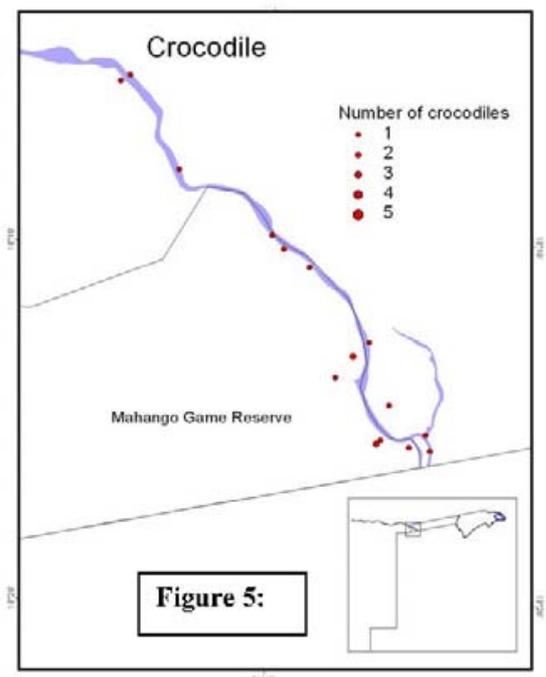
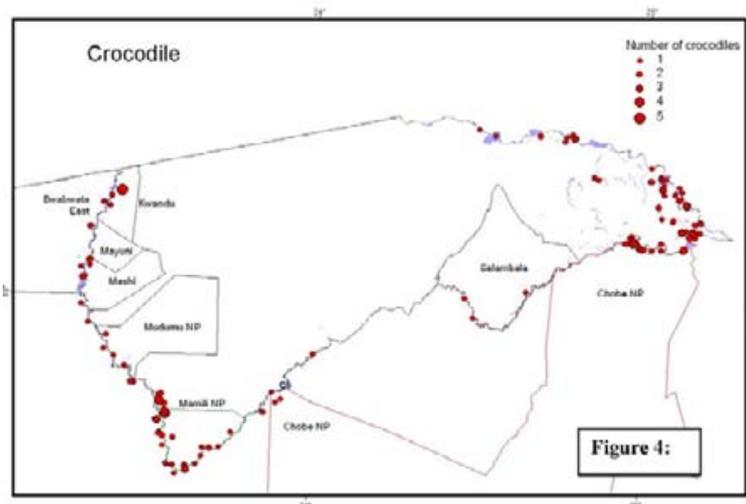
densities of 0.9 and 1.9 crocodiles/km respectively were recorded.

### Boat survey

Table 2 summarises the results of the boat counts for the Kwandu and Zambezi rivers. Observations are for all crocodiles recorded, split into two size categories of greater and less than 2 m. Two numbers per km are provided - the first refers to sightings per km of meandering river, and the second refers to sightings per overall river system (as used in Table 1). However, for the latter figure, only the main channel was travelled, and the many side channels and lakes (mostly isolated by floodplains and reed beds) were not covered. The density of crocodiles larger than 2 m in the two systems is similar, but there were many more smaller crocodiles in the Kwandu system.

### Population estimates

Both aerial and boat counts under-estimate population densities. Aerial surveys can cover large areas of wetland



that are difficult to reach from the ground. However, they severely under-estimate populations by a factor of up to 10 times. Games (1994) states that “if it is possible to do a spotlight count some estimate of bias for a given section of river can be estimated”. This estimate of bias is based on the work of Hutton and Woolhouse (1989) who used mark-recapture techniques to determine population sizes, and to assess the “submerged and concealment” factors affecting the proportion of crocodiles seen during spotlight counts. Spotlight counts under the most favourable conditions (warm weather, low water, exposed banks and dry floodplains) resulted in the highest counts of some 63% of the crocodile population being seen. Under the least favourable conditions, only some 11% of the population was seen.

The Namibia survey took place at the end of winter, with relatively cool water and atmospheric conditions. The Zambezi and Okavango Rivers were relatively high and falling, yet with riparian floodplains still under water. The Kwandu River was rising and pushing water into the floodplains and backwaters. The Kwandu-Linyanti-Chobe system is thickly vegetated with reeds, papyrus and floodplain grasses and sedges, and thus present poor conditions for spotlight counts. The counts would be expected to yield a relatively low proportion of the population to observation. Conservative correction factors of 35% for the Kwandu-Linyanti system was applied, and 45% for the Okavango, Chobe and Zambezi systems. These figures are supported by Bayliss *et al.* (1988) who used mark-recapture techniques to ascertain that, in winding river channels with thick vegetation, the proportion of saltwater crocodiles *C. porosus* in Northern Australia that were seen dropped to 34%.

This study then applies two correction factors to the complete aerial survey crocodile data, (a) a spotlight census correction factor, and (b) a correction factor for the submerged and concealed component of the population. The spotlight correction factor from the Kwandu is applied to also the Linyanti and Chobe systems, and the Zambezi correction factor is applied also to the Okavango systems (Table 3).

Zambezi			Kwandu				
Crocodiles >2 m			Ratio to	Crocodiles >2 m			Ratio to
Aerial	Spotlight	Correction	<2 m	Aerial	Spotlight	Correction	<2 m
4	7	1.75	0.57	3	15	5.00	4.73

The total populations of crocodiles of greater and less than 2 m in length respectively is calculated for each of the survey strata/river systems (Table 4). The total population for the north-east river systems consists of some 2208 crocodiles of greater than 2 m in length, and some 9280 crocodiles of less than 2 m, with many of the latter being small animals of less than 1 m and likely to suffer high

Okavango population			Kwandu population			Mamili		
> 2 m	< 2 m	Total	> 2 m	< 2 m	Total	> 2 m	< 2 m	Total
66	38	104	571	2,703	3,274	529	2,500	3,029

Linyanti-Chobe population			Zambezi population		
> 2 m	< 2 m	Total	> 2 m	< 2 m	Total
828	3,916	4,744	214	122	336

rates of mortality. The major component (87%) of the >2 m crocodile population occurs in the Kwandu-Linyanti-Chobe system, and this is the system that also has the largest proportion of young animals.

A significant proportion (31%) of the crocodiles seen in the Zambezi system are currently away from the river on the eastern floodplains.

### Discussion

This study has provided baseline data on crocodile numbers from aerial and spotlight counts. These data can be used with the results of future counts to determine population trends. The census has also provided information on their distribution of crocodiles in the Kavango and Caprivi regions. And third, it has resulted in the first population estimate

for crocodiles in the north-east wetlands of Namibia. While the population estimates are somewhat speculative, they have provided a basis for further research to refine the correction factors for the different river systems to more accurately calculate population estimates. The development of such refinement should be a research topic that received support and encouragement from all relevant agencies within Namibia and in her neighbouring countries, as all the river systems covered by this census form parts of shared river basins, and long sections of the rivers form international borders.

### Acknowledgements

We would like to thank the aerial and boat survey teams - L. Conradie, P. Haredoeb, M. Singwangwa, W. Cilliers, M. Griffin and Tony? A particular note of thanks goes to Lianshulu Lodge for providing logistic support, accommodation and meals, and to Mazambala Lodge for providing launch facilities and housing the boat.

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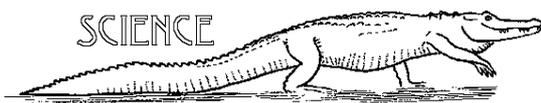
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## Science



LOW LEVELS OF NUCLEOTIDE DIVERSITY IN *CROCODYLUS MORELETII* AND EVIDENCE OF HYBRIDIZATION WITH *C. ACUTUS*.  
**Abstract:** Examinations of both population genetic structure and the processes that lead to such structure in crocodylians have been initiated in several species in response to a call by the IUCN Crocodile Specialist Group. A recent study used microsatellite markers to characterize Morelet's crocodile (*Crocodylus moreletii*) populations in north-central Belize and presented evidence for isolation by distance. To further investigate this hypothesis, we sequenced a portion of the mitochondrial control region for representative animals after including samples from additional locales in Belize, Guatemala and Mexico. While there is limited evidence of subdivision involving other locales, we found that most of the differentiation among populations of *C. moreletii* can be attributed to animals collected from a single locale in Belize, Banana Bank Lagoon. Furthermore, mitochondrial DNA sequence analysis showed that animals from this and certain other locales display a haplotype characteristic of the American crocodile, *C. acutus*, rather than *C. moreletii*. We interpret this as evidence of hybridization between the two species and comment on how these new data have influenced our interpretation of previous findings. We also found very low levels of nucleotide diversity in *C. moreletii* haplotypes and provide evidence for a low rate of substitution in the crocodylian mitochondrial control region. Finally, the conservation implications of these findings are discussed.

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THE AMERICAN ALLIGATOR AS A PREDATOR OF MOTTLED DUCKS.  
**Abstract:** Mottled ducks (*Anas fulvigula*) are widely distributed in southeastern coastal marshes, as are American Alligators (*Alligator mississippiensis*). Although the alligator has been noted to prey upon Mottled Ducks, evidence of Mottled Duck consumption is rare in numerous studies of alligator food habits. This may be due to the season and habitat from which alligators were collected for evaluation (often autumn samples from deep water habitats preferred by adult alligators). We examined stomach contents of alligators in summer (when Mottled Duck broods and molting adults are flightless) from shallow water habitats preferred by Mottled Ducks. Mottled Duck remains were found in 20.9% of 43 alligator stomachs examined, far more than the highest frequency occurrence previously reported (1.27%). Unexpectedly, three relatively small alligators (1.51-1.70 m total length) consumed Mottled Ducks and the 16 largest alligators did not. This study underscores the importance of season and location of collections when evaluating stomach content data.

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## Meeting Reports



INTERNATIONAL CONGRESS OF ZOOLOGY, SYMPOSIUM ON CROCODYLIAN CONSERVATION. The XIXth ICZ was held 23-27 August 2004 in Beijing, China. A symposium on Crocodylian Conservation was organized by Dr. Wu Xiaobing of East China Normal University and Perran Ross, University of Florida. The symposium, held on the afternoon of 25 August, opened with a general introduction to crocodylian conservation based upon comments sent by Grahame Webb, who was unfortunately unable to attend. Jiang Hongxing, coordinator of the Chinese alligator program for State Forestry Administration then presented an update on current progress implementing the national conservation plan for Chinese alligators and Professor Wang Xiaoming reported on the successful reintroduction of three alligators in Anhui. At least one of the released alligators laid a nest this spring.

Additional presentations covered conservation of the Siamese crocodile (John Thorbjarnarson), Genomic tools for crocodylian conservation (Travis Glenn), the role of international media in conservation (Brady Barr), behavior of Chinese alligators (John Zhang Fang) and alligator diets (Perran Ross). Presentations were followed by a lively discussion focusing on current progress and needs for Chinese alligator conservation.

The ICZ provided an opportunity to meet with a wide variety of international scientists and hear presentations across a very broad range of zoological topics. Approximately 400 international participants and 1000 Chinese scholars and students attended. Noteworthy plenary presentations included new discoveries of fossil bird-like dinosaurs in China that shed light on the origin of birds and flight, new applications and sophistication of genomic studies and immunology to systematic and conservation problems, and the discovery of several new extinct phyla from the early Cambrian that clarify the origins and relationships of the current phyla.

The XIX ICZ also provided the foundation for the establishment of a new International Society of Zoology that will run future Congresses and provide an international venue for zoological studies.

Perran Ross, *Department of Wildlife Ecology and Conservation, University of Florida, Gainesville, Florida 32611, USA* <rossp@wec.ufl.edu>.

PROCEEDINGS OF THE 17TH WORKING MEETING OF THE CROCODYLE SPECIALIST GROUP. The Proceedings of the 17th working meeting of the CSG, held in Darwin (May 2004), is now available. Copies have been posted to those people who participated in the meeting, and there is a limited number of copies available for. People interested in purchasing the Proceedings (1 volume, 554 pages) should contact the CSG office (PO Box 530, Sanderson, NT 0813, Australia; csg@wmi.com.au) for details.

The Proceedings include papers on: "Conservation, Management and Sustainable Use of Crocodiles in Australia" and the unique role of Aboriginal people in management; foundations of crocodylian conservation; reviews of many issues intimately linked to crocodylian conservation today (IUCN, CITES, Compliance with CITES, Article IV of CITES, Precautionary Principle, IUCN Red List); actions being taken with some of the most endangered crocodylian species (eg Tomistoma, Siamese Crocodile, Philippine Crocodile, Chinese Alligator); management case histories from different countries; trade issues and crocodile farming technology; and, research and scientific papers. The results of workshops on "CSG Core Business", "Human-Crocodile Conflicts", "Skin Quality: Farmers, Tanners and Veterinarians" and "Major Issues Affecting Sustainability of Crocodylian Trade" are also presented.

## Requests

### Looking for Cuban Crocodiles

Paul Bodnar is looking for any individuals or facilities housing pure Cuban crocodiles (*Crocodylus rhombifer*) outside the USA. Please provide any information on sex, age, size, and origin of the crocodiles (or their offspring). The goal is to locate animals and eventually incorporate new founder Cuban crocodiles into the American Zoological Association (AZA) Species Survival Program at the Louisville Zoo.

Contact: Paul Bodnar, 12204 Madison Ave., Lakewood, Ohio 44107, USA <Cubancroc@cox.net>

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