

**Crocodile Specialist Group Steering Committee Meeting**  
**Universidad Nacional del Litoral, Santa Fe, Argentina**  
(6 May 2018)

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**South Asia and Iran**

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**CSG Action Plan** accounts for Gharial, Mugger and Saltwater crocodiles are currently in preparation. These accounts contain contributions from members within this region.

**IUCN Red List** account for Gharial currently being reviewed. Account was updated by Jeff Lang and Subir Chowfin.

### **Bangladesh**

**Saltwater Crocodile:** Saltwater crocodiles occur in the Sunderbans (Ganges delta), but no population data based on systematic survey is available. The population is believed to have been reduced to less than 100 due to a variety of reasons, including an increasing human disturbance for harvesting resources, fishing activities particularly the use of monofilament nets and shorelines set throughout the forest at favorable basking sites during low tide, habitat alteration and illegal killing by people (eg fishermen believe crocodiles compete with them for fish). It was deemed necessary to ascertain the wild population of Saltwater crocodiles as no scientific survey had ever been done to estimate the population. Whatever numbers were published were just the guesstimates of the biologists visiting the Sundarban on a regular basis.

The World Bank (WB) funded a project titled “Strengthening Regional Cooperation for Wildlife Protection (SRCWP)” for the South Asian countries. The project objective is to assist the participating governments to build or enhance shared capacity, institutions, knowledge and incentives to collaborate in tackling illegal wildlife trade and other select regional conservation threats to habitats in border areas. The details of this were given in the 2016 country report for South Asia and Iran.

Under the SRCWP Project administered by the Bangladesh Forest Department (BFD), Centre for Advanced Research in Natural Resources & Management (CARINAM) was awarded a two-year sub-project titled “Population Assessment, Protection and Conservation of Saltwater Crocodiles (*Crocodylus porosus*) in the Sundarban Reserve Forest, Bangladesh”. The survey was carried out from March 2014 to May 2016. During the survey more than 2500 km of waterways were surveyed regularly. The results of the survey will be published soon.

**Mugger:** The last wild mugger was shot near Sullah, Azmiriganj in 1962 (Rashid 2003). The pair of muggers (locally known as kalapahar and dholapahar) at the shrine pond of Khan Jahan Ali that represented the original bloodline of the population that occurred in Bangladesh has been lost. Two female Muggers suspected to represent the same bloodline exist – one at the Jalalabad Cantonment Zoo, Khulna, and one in private captivity at Pashuram, Noakhali. The captive Mugger populations that Bangladesh has at different zoos (Dhaka, Chittagong, Dulahazra Safari Park and Gazipur Safari Park) are members/descendants of the 40 Muggers that were brought from Madras Crocodile Bank Trust (MCBT) in 2005.

**Gharial:** CARINAM carried out extensive surveys from August 2009 to June 2011 with support from the Mohamed bin Zayed Species Conservation Fund (MBZ) where an adult female and six young were recorded in the Padma and the Jamuna Rivers of Bangladesh in 2009-10 and seven juveniles in 2010-11. No nesting site was found during the survey, which however demanded continuation of the search for their nesting sites. It was also evident from the survey that potential habitats still exist for the Gharial to survive. Though the threats are immense there are still some secluded places that may provide refuge to the gharials.

The World Bank-funded SRCWP Project also funded a project for the survey of Gharials and to explore means for recovery and restoration of gharials in their natural habitats - the Padma and Jamuna Rivers. The project was implemented by IUCN-Bangladesh Chapter. Several zoos had captive Gharials but either the captive individuals were of the same sex (Rajshahi Zoo; two females) or there was no breeding at all (2 male, 3 females). Captive breeding initiative included transportation of an adult male gharial from Dhaka Zoo to Rajshahi Zoo. Rangpur Zoo also has two females in captivity.

Publication of IUCN report “Gharials of Bangladesh” (Hasan and Alam 2016). Only remnant Gharials were reported from questionnaires/interviews with local peoples.

**Human Crocodile Conflict:** HCC incidents were not properly recorded in the past but during the Saltwater crocodile survey in the Sundarban Reserve Forest (SRF), Bangladesh, by CARINAM it was observed that the numbers of such incidents were worth mentioning. Some HCC cases were studied and the manuscript related to Saltwater crocodile population estimation and HCC is under preparation for publication. The Government has, through the Bangladesh Wildlife Act 2012, started giving compensation to the victims of human-wildlife conflict, which includes crocodile, elephant and tiger.

**Crocodile Farming:** One commercial farm (Reptiles Farm Limited - RFL), based on production through captive breeding, and acquired adult stock from Malaysia. A license for a second farm (Akij Wildlife Farm - AWF) was approved by Government in late 2008 (Sharma 2008). The Karamjal Crocodile Breeding Centre, established in 2000, has one adult male and two adult females and as of 2016 had 243 hatchlings. Of the 243 bred individuals, 50-70 individuals were one meter long and ready for release in the wild, and others less than one meter. One of the goals of the centre is to make animals available for release into the wild, when they have reached 2 m in length – 79 individuals have been released so far.

## India

The Report and Action Plan for Three Indian Crocodiles

**Estimation of Wild Gharial Population:** 1400-1600 different-sized animals survive in Chambal, Katerniaghat, Hastinapur, Gandak, Corbett NP and Ken and Son Rivers, and other population in main Ganges, Hugli and Mahanadi.

**Captive Stock:** Over 500 sub-adult and adult animals (in captive facilities, India)

**Distribution:** Across India including Chambal, Son, Ken, Ramganga and Mahanadi Rivers; Katerniaghat Sanctuary.

**Status:** Critically Endangered

Update action plan/ formulate new action plan for the critically endangered Gharials in India and the trans-boundary regions, with neighboring countries such as Nepal, Bangladesh, Bhutan and Pakistan. India may be addressed to provide and facilitate surplus stocks of gharials to be spared to the neighboring countries.

The Gharial is critically endangered in the wild and there are over 500 animals of various age classes in captive facilities. It is now being bred regularly in several zoos and other captive facilities in India. These captive-bred and -reared Gharials are being released through re-introduction programs, under the direction of Central Zoo Authority, Ministry of Environment and Forest about *ex-situ* conservation policy.

### Ongoing Activity

The tri-state National Chambal Sanctuary Management Plan has been prepared by the expert committee formed by the Ministry of Environment and Forest, Government of India which also includes two - three members who are crocodile experts.

**Gharial Survey:** The survey was carried out by Dr. Tarun Nair, in collaboration with Madhya Pradesh Forest Department, Foundation for Ecological Security (FES, Anand), and Ashoka Trust for Research in Ecology and the Environment (ATREE, Bangalore) to determine Gharials' status and habitat assessment in Son River and Son Gharial Sanctuary.

The survey and assessment of Gharial population, along with its breeding status in upstream of Chambal River has been conducted and estimated in Parvati River with help of Madhya Pradesh Forest Department and the Gharial Ecology Project, MCBT, (Khandal et al. 2018).

Main gharial project is the Gharial Ecology Project within the range states is carried out by Dr Jeff Lang through MCBT.

An assessment of Gharial population and their breeding status in the famous Corbett National Park in River Ramaganga is in further progress (Subir Chowfin).

Further, the Gharial Restocking Program is being continued and further progress has been notable. Under this program, a small number of sub-adult gharials was released in natural habitats of three states of northern India, namely Bihar, Punjab and Uttar Pradesh.

- The captive rearing small population of sub-adult Gharials introduced at Hastinapur Wildlife Sanctuary by State Forest Department of Uttar Pradesh with help of WWF-India, under the guidance of crocodile expert, Prof. Dr B.C. Choudhury.

- In a major reintroduction programme of Gharial in to the Indus River System, 25 juvenile and sub adult Gharials from the Deori Madhya Pradesh Centre were taken and released in to the Beas River in Punjab, India just upstream of the Harike RAMSAR site during December 17 and January 18 2018 by the Punjab Forest and Wildlife Department and the WWF-India with the technical guidance of CSG member Prof. B. C. Choudhury.

### **Future Action**

1. Developing management plan for other gharial supporting areas.
2. Precise plan for future of captive Gharials.
3. Evaluate the Gharial Restocking Program and monitor re-stocking/re-introduced Gharials at new sites (River Sutlaj and Beas (tributaries of Indus) and Hastinapur Wildlife Sanctuary).

### **Saltwater Crocodile (*Crocodylus porosus*)**

**Estimation of animals in wild:** 3500+ at three locations Andaman (group of islands), Sundarban (West Bengal) and Bhitarkanika (Orissa).

**Captive Stock:** Over 500+ animals of various sizes at few captive facilities, including West Bengal, Orissa, Andhra Pradesh, MCBT –Tamil Nadu and Andaman & Nicobar.

**Distribution:** East coast of India from Orissa to Sundarban, West Bengal and Andaman Nicobar.

**Status:** Endangered

Andaman and Nicobar Forest Department and Orissa Forest department have initiated fresh surveys of saltwater crocodile population, habitat assessments, and training programs for field forests staffs.

Human crocodile conflict reports involving the species are being reported increasingly from coastal areas of Andaman & Nicobar and Orissa.

### **Ongoing Activity**

Andaman and Nicobar Forest Department has initiated surveys and sought professional advice from the CSG members in India and elsewhere to contain the HCC problem, particularly nearer to the beach tourism destinations in the Islands. The IUCN, India, Wildlife Institute of India and ATREE have been asked to advise on this HCC containment program.

The Annual SW Croc population count in the Bhitarkanika Wildlife Sanctuary is being conducted regularly under the expert advice of CSG member Dr Sudhakar Kar.

### **Future Action**

1. Joint trans-boundary salt water crocodile population assessment in Sunderbans (large mangrove habitat forest), involving CSG members from India and Bangladesh.
2. An awareness campaign and tourist education program for beach visitors of Andaman Islands.

### **Mugger Crocodile (*Crocodylus palustris*)**

**Estimation of Wild Population:** 8500 to 9000+ animals of various sizes in most Indian States.

**Captive Stock:** 500+ (in various captive facilities, India, CZA 2017)

**Distribution:** Gujarat, Maharashtra, Rajasthan, Uttar Pradesh, Kerala, Orissa, Karnataka, Uttarakhand, Tamil Nadu, Goa, Haryana, Madhya Pradesh, Rajasthan and Andhra Pradesh.

**Status:** Vulnerable

Gujarat, Orissa, Maharashtra and Goa Forest Department along with local NGOs have initiated fresh surveys of mugger population, along with habitat assessment, awareness and training programs.

Human-crocodile conflict reports involving the species are being increasingly reported from various states of India, led by Gujarat, Tamil Nadu, Maharashtra and a few other states.

Gujarat, Maharashtra, Rajasthan, Orissa, Uttar Pradesh, Uttarakhand, Karnataka, West Bengal and Tamil Nadu are reporting Human-crocodile conflicts as a specific area of concern to be immediately addressed. An action plan to address this issue is urgent.

The Principal Chief Conservator of Forest, Gujarat Forest Department developed an initiative towards 'man and mugger conflict', by preparing a detailed manual (in regional Gujarati language) for circulation across the state.

Gujarat Forest Department and Vadodara Municipal Corporation have taken up a joint initiative for further development of a 'Refuge Park' for large and culprit muggers in Vadodara, especially from Vishwamitri-Dhadhar River.

### **Ongoing Activity**

Gujarat Forest Department and Junagadh Forest Division initiated first ever 'mugger survey' for entire Greater Gir area with the help of various NGOs and members of CSG, India. The result and final report is in progress for finalizing.

As part of 'Mugger Conservation and Awareness Program' a booklet 'Muggers of Vadodara' was published by Raju Vyas and new poster was designed by Dr. Simon Pooley and Anirudh Vasava with financial supports from Mr. Dhaval Patel (Voluntary Nature Conservancy, Gujarat).

Ongoing project 'Survey of Habitat Assessment of Crocodiles and steps to Mitigate Man Animal Conflict' is being conducted by Mr. Dhaval Patel and Soham Mukherjee (Voluntary Nature Conservancy, Gujarat) with the help and funding from Rufford Foundation and State Forest Department of Gujarat to find out positive solutions to human-crocodile conflicts in Gujarat State. The project is in its final stage.

Ongoing study on the ecology, dynamic population and status of muggers of Cauvery River delta region is in progress as Ph.D. program by Nikhil Whitaker.

Two new research projects initiated by MCBT; Organamorphometry and study of food and food habits of mugger crocodile population of Cauvery River on the basis of scat analysis.

### **Future Action**

1. Design and develop proper protocols for 'Rescue and Release of Muggers'; and strict adherence to it, by the State Forest Department.
2. Proper guideline and direction for 'capture and translocation of large and problematic (nuisance) mugger crocodiles.
3. Awareness programs for locals around mugger-infested water bodies.
4. Produce educational material in various local languages for explaining Muggers role in our ecosystem and its importance to layman, with help of MCBT staff and local NGOs.

### **Future Research Incentives:**

1. A nationwide Data Base (detailed one which includes financial compensation for non-fatal croc bite victims received, percentage of impact of on victim and loss of body parts, etc.) should be created/maintained regarding HCC by two species, namely Mugger and Saltwater crocodile, this will be in addition to data given in CrocBITE database.
2. An urgent need to formulate conservation action plan for Gharial in consultations Indian Government and solutions for problematic crocodilian species of mugger and Salty.
3. Formulate a protocol for rescue and release of mugger crocodiles, especially for HCC identified Indian states, and strict adherence to it, by the State Forest Department.
4. Seeking national level uniform guidelines and compensation in every Indian state, especially for HCC victims/family members and for loss of livestock of villagers.
5. Formulate a protocol for autopsy & postmortem procedures for the sudden and suspicious deaths of Mugger, and salty. Already available for Gharial on CSG website on veterinary section.
6. A national level courses and workshops designed to refresh and update professionals practicing veterinary medicine and animal husbandry.????
7. Invite a national level meet of Indian Crocodilian Researchers & Biologists for discussion, debates and further advocacy with following agenda:
  - (1) Research issues & permission related problems.
  - (2) Ex-situ conservation policy and sustainable uses (farms animals), its Outcome products.
  - (3) Protocols: Nuisance & culprit muggers, with emphasis on rapidly escalating numbers of HCC.
8. Prof. Dr. R.J. Rao Pro Vice chancellor of Jiwaji University, Gwalior, India, after consulting with the CSG members in India has submitted a proposal to host the next CSG working meeting in India, in 2020.

## Iran

The captive rearing center in Riko Kash is developing, currently maintaining more than 70 crocodiles in different life stages, planning to have more public awareness role in the region. The center uses some local people to create crocodile-friendly incentives to them.

Based on the Mugger Crocodile Conservation and Management plan, all future works are supposed to be based on that. Using of private sector, especially local bodies, would play important role in public awareness and sustainable uses.

Some public awareness activities and local people participate in activities conducted by local offices of DOE in the region with support provided from private sectors and central office of DOE, such as water supply to local villages. .

A book titled “Gandou, Iranian Crocodile” compiled by Asghar Mobaraki and Elham Abtin (2017) provides details about Mugger crocodile in Iran.

Drought and lack of rain remains the most critical point at the moment in the region. The crocodile habitats seem to be under climate change effects. Some studies are underway in this regard.

## Nepal

Report for Nepal not received as of 1<sup>st</sup> April 2018

**Gharial Conservation Action Plan for Nepal (2018-2022)** prepared by the Department of National Parks and Wildlife Conservation. This report is currently under CSG review.

## Pakistan

Pakistan is home to two crocodile species:

- i. The gharial, *Gavialis gangeticus*, once a common sight in the rivers in the Indus Plains, is now considered to be extinct from within Pakistan (last seen in 1978).
- ii. The mugger or marsh crocodile *Crocodylus palustris* still exists in different areas of Sindh and Balochistan. Some efforts have also been made to breed them in captivity in the Public sector in Sindh and Punjab, where the progress has been somewhat slow.

### Distribution and Status

Wild *mugger* populations exist in the provinces of Sindh and Balochistan whereas in the Punjab province it is considered extinct.

Wild *mugger* populations in Sindh exist in DehAkro, Nara canal, Nara desert, Chhotiari reservoir complex and Halejilake. Bakar and Paksiri, Pakseri, Makhi, Dangewarilake and Nadiaser Lake are important wetlands in Chhotiari and DehAkro Complex areas. Estimated population in Sindh province is around 430.

The mugger remains widely distributed in Balochistan with confirmed locations on the Nari, Hab, Titiani, Spin Tangi in Harnai, Sibi, Hingol rivers; and Dasht river along Pakistan Iran Border and its tributaries Nahang (District Gwadar) and KeichKuar (Kech district). A sizeable mugger population was reported in at least 21 seepage water pools around Dasht River until 2012. Estimated population in Balochistan province is around 210.

Wild crocodile populations have been wiped out from within Punjab. The only captive crocodile facility in the public sector is located at Punjab Wildlife Breeding Centre Faisalabad.

### Population estimates

During the period 2017-18, official crocodile surveys have not been undertaken. After Rapid Population Estimates compiled with the help of local people and Wildlife Department staff the following picture emerges:

#### Crocodile population in Pakistan, March 2018

S. No.	Area/Crocodile habitat	Estimated population
<b>Sindh</b>		
1	Chhotiari reservoir complex and adjoining seepage ponds	140
2	DehAkro complex and adjoining seepage areas (some lakes in the Sanctuary have dried up)	80-100
3	Nara canal and adjoining seepage pools	90
4	Nara desert (some lakes in the Sanctuary have dried up)	30
5	Haleji lake	35-40
6	Stragglers in irrigation canals and the fish farms	30

<b>Total</b>		<b>405 to 430</b>
7	Khar Breeding Centre, Khirthar National Park (captive)	54
8	Manghopir(captive)	120
<b>Balochistan</b>		
1	Hingol River, Hingol National Park	25-30
2	Hub River	30
3	Dasht River along Pak-Iran border and adjoining seepage ponds (176 reported in 2007)	90
4	Spin Tangi in Harnai	30
5	Mirani Dam and adjoining seepage ponds	25-30
<b>Total</b>		<b>200-210</b>
<b>Punjab</b>		
1	Punjab Wildlife Breeding Centre, Gatwala, Faisalabad (captive)	One breeding pair, 3 sub-adults
2	Lahore Zoo, Lahore(captive)	2 breeding pairs

### Captive Crocodiles in the Private Sector

Crocodile farming is gaining popularity in the Private sector; more than 40 breeding centers have been established in suburbs of Karachi and interior Sindh and more than 20 in Punjab. Captive Breeding Farms have mostly been established in association with Fish Farms. Captive Breeding Farms are registered with the Government. Because of lack of veterinary cover, survival percentage of hatchlings is however very low. The commercial activities have not yet started in earnest; the only commercial activity is the sale of hatchlings to other crocodile breeding farms for building up their stock. No estimates of number of individuals are available. Sporadic information trickling down is that one farm in Karachi has 45 breeding individuals and another farm in Noshehro Feroze has about 70 breeding individuals. The total number could be anybody's guess. These breeding farms are however open to public and the owners earn handsome amounts through gate money. Commercial activities at the captive breeding farms may start now as the sizeable crocodile populations are now available.

### Human Crocodile Conflict

Human Crocodile Conflict (HCC) in Pakistan stems from the fear of damage to property and life of both livestock and human beings. Fish eating habit of crocodiles also annoys fishermen who try to entangle crocodiles in fishing nets and subsequently kill them. The fear has also been transmitted into tribal customs and traditions to an extent that not killing a crocodile on sight leads to social taboos.

The conflict mainly arises from the economic losses that the crocodiles are believed to inflict on the fish, as well as livestock that may fall prey to crocodile while visiting the wetlands to drink water or graze near the banks of water bodies. Direct attacks on human beings have recently been reported: *A woman while washing clothes along the bank of Spin Tangi in Harnai was reported to have been dragged into water and consumed in 2017; recently a female teenager was attacked by a crocodile that came out of a canal and into the village. The people however forced the crocodile to retreat and then chased it to the canal. An instance of a woman being dragged into river Dasht was reported a few years back. It seems not improbable that many cases might have gone unreported. Two cases of the death of a woman and a child at Halejilake have also been reported in the past.* The fear, therefore, remains.

Crocodiles have also been reported to be hunted / killed for their hides but presently there have been few reports of such a trade perhaps due to government vigilance. The fact that in recent years dead crocodiles have been found in water bodies with skins intact thus gives credence to the belief that the crocodile was killed in retaliation for damage to fish, livestock or human beings, and not for its skin.

Because of the fear for life and property, the tribal (especially in Balochistan---Hingol National Park) customs required that the crocodile be killed at the site otherwise it would be *zantalaq* i.e. the wife of the person would stand divorced. The custom however is redundant now with the increasing awareness.

The crocodiles are distributed in areas which do not normally come under surveillance of government wildlife departments hence the occasional killings go unreported. Lack of funds and facilities at the part of government wildlife departments is another reason of slackness in vigil.

Public awareness campaigns and community empowerment projects undertaken by WWF Pakistan in the River Dasht and its watershed areas in the past (2007-14) were helpful in reducing the conflict and making local communities aware of the role of crocodiles in the ecosystem but with the project coming to an end, the awareness campaign was stopped, and the impact of the project vanished. Now only occasional reports of crocodile sightings are made whereas hardly any conflicts are reported. There could only be two possibilities i.e. either there have been no conflicts, or the crocodiles are discreetly removed. Because of low government capacity such incidences remain obscure.

In Sindh specifically because of the presence of WWF teams, awareness education is imparted to the people hence hardly any conflicts are reported.

Another form of damage to wild crocodile populations recently coming into light is the illegal capture of young crocodiles from the wild for local use for captive breeding. These young ones are used to stock the captive breeding farms in the private sector.

### **Threats to crocodile population and conservation actions**

Threats to crocodile population include habitat alteration due to human and natural factors, habitat destruction like construction of Dams/Reservoirs, drought periods, predation of eggs by feral dogs, shooting by local people (retaliatory killings of nuisance crocodiles), frequent tropical cyclones/high floods in the area, and illegal smuggling of Crocodile juveniles/hatchlings.

Based on survey findings, the WWF Pakistan under a World Bank / GEF Funded program started a Conservation Program in Metang and ZarinBaig villages located along Dasht River that continued from 2007 to 2014. Wetland Conservation Committees were formed. The local community-initiated advocacy and awareness raising program on the conservation of Crocodiles. The Program also introduced demonstrations on freshwater conservation initiatives such as efficient irrigation techniques like drip irrigation systems for freshwater conservation, alternate energy models (Solar and Wind) and other Natural Resource Management initiatives with Women Communities to improve their livelihood. This initiative proved to be a step towards building the confidence of communities and they started adopting conservation initiatives. The impact continued even after the end of the project however it has slackened now because of lack of interest on the part of Government. Similar initiatives have also been taken in Hingol National Park where Village Conservation Committees have been formed with similar objectives.

### **Research and Awareness**

- Pakistan Zoological Survey Department has recently been tasked to conduct population surveys throughout Sindh and Balochistan. Hopefully surveys shall be completed by May 2018;
- Sindh University Jamshoro has taken the initiative and planned to undertake two research projects financed by Higher Education Commission Pakistan and WWF-Pakistan. The studies are:
  - Temperature-dependent sex determination in Marsh Crocodiles (*Crocodylus palustris*) population in Sindh, Pakistan;
  - Population genetics implications for the conservation of Marsh Crocodiles *Crocodylus palustris* (Crocodylia: Crocodylidae) in Sindh, Pakistan.
- Awareness campaigns are being carried out in areas where crocodiles occur;
- Community participation programs have been started in areas where crocodiles occur.

## **Sri Lanka**

Following activities were conducted during 2017.

### **Location Surveys & Research**

#### **Bolgoda River**

As a part of the preliminary study in this river system day time boat surveys were done to assess the bank environment and to identify the possible crocodile habitats. Night surveys were done from land using the eye shine count method during June & July 2017 and recorded 01 adult, 03 sub adults.

We rescued one sub adult female, 8 juveniles, and 18 hatchlings of Saltwater Crocodiles from fishing nets, and released back to close safe habitats.

#### **Udawalawe National Park**

A pilot survey was conducted in September 2017 around Walawe River. Recorded a total 185 adults and 34 sub adults Mugger Crocodiles. At an area of 10,000 m<sup>2</sup> (100 m x 100 m), 74 adults and 12 sub adults were recorded.

Two male Mugger crocodiles were rescued from human habitats and released in to the Udawalawe National Park.

#### **Yala National Park**

A water hole survey was done in January to February 2017 around Block III. A total of 257 adult, 89 sub adult, and 26 juvenile of Mugger Crocodiles were recorded. In "Kaluwara Bokkuwa" in an area of 2,500 m<sup>2</sup> (50 m x 50 m), 32 adults and 15 sub adults were recorded.

#### **Wilpattu National Park**

A water hole survey was done in August 2017 around Kudiramale. A total of 116 adults, 39 sub adults, and 7 juveniles of Mugger Crocodiles were recorded. In "Madavillu" at an area of 2,400 m<sup>2</sup> (40 m x 60 m) adults and 14 sub adults were recorded.

#### **Nilwala River**

As a part of an ongoing research the biological aspect of the human-crocodile conflict was studied.

## **Education and Awareness Programs**

### **Lectures**

Public lectures were conducted in various parts of the country focusing local communities, school children, conservationists & naturalists focusing on conservation, human-crocodile conflict & crocodile ecology.

### **Group Discussions**

Group discussions were done with local communities, fisherman, farmers and a group of foreign wildlife friendly tourists from France, Japan, USA, Singapore and Germany on human-crocodile conflict & crocodile conservation.

### **Documentary Programs**

4 documentary Programs were made by Pradeep Rathnasiri with Sri Lanka Rupavahini Corporation, the state-owned television network and Swarnavahini, a privately-owned television network, on introduction to crocodiles, crocodile burrow habitat & behaviour, human-crocodile conflict and crocodile behaviour. He has also assisted for a part of a foreign production for a web series on crocodile feeding behaviour.

### **Mugger Crocodiles Survey**

Currently from grants received to Ansem de Silva from Shawn K. Heflick, Chief Executive Officer, Crocodile Conservation International, Inc. USA and Colette Adams (from Gladys Porter Zoo in Brownsville, Texas, USA), who is a co-organizer of *CrocFest* fundraisers, along with Flavio Morrissiey and Curt L. Harbsmeier, USA. Island wide survey of the status of the mugger (*Crocodylus palustris*) in Sri Lanka – this is to update the Mugger Action Plan for South Asia. To date nearly 150 water bodies were investigated. Data gathered so far indicate that we have come across several new locations with healthy mugger populations in the country. Once we complete the island-wide survey we assume that Sri Lanka may have approximately 4000 individuals, including the ones in protected National Parks (eg Wilpattu, Yala, Bundala, Udawalawe, Galoya, and many new locations in North – Jaffna district). This is more than the numbers reported by Whitaker and Whitaker in 1989. Additionally, several public awareness programs and papers were published in local and foreign journals by local CSG members.

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**Prepared by:** Ansem de Silva, CSG Regional Chair, South Asia & Iran, with inputs from S.M.A. Rashid (Bangladesh), Raju Vyas and Prof. B.C. Choudhury (India - with inputs from Tarun Nair, R.K. Sharma (Forest Department Madhya Pradesh), Nikhil Whitaker (MCBT, Chennai), Subir M. Chowfin (Wildlife Conservation Trust, Pauri), Baiju Raj MV (Wildlife SOS), Sudhakar Kar (Orissa Forest Department), Anirudh Vasava (Voluntary Nature Conservancy, Gujarat) and Prof. Dr. R. J. Rao (Jiwaji University, Gwalior), Asghar Mobaraki and Elham Abtin (Iran), Abdul Aleem Chaudhry (Pakistan) and Madhava Botheju (Sri Lanka with inputs from CSG members Suranjan Karunarathna, Anushka Kumarasinghe, Majintha Madawala, Thasun Amarasinghe, Pradeep Rathnasiri, Adrian Gabriel, Mafas Mohamed & Madhava Botejue). Finally, Colin Stevenson for his comments.

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## Appendix to the report

The following additional notes were sent by Nikhil Whitaker, Curator, Madras Crocodile Bank Trust, India. Nikhil is presently a PhD candidate "Biology of the Mugger Crocodile (*Crocodylus palustris*: Lesson, 1831) on the Cauvery River, Tamil Nadu".

1. Present status and scenarios of croc species; Emphasis here is largely placed with regards *C. palustris*; in captivity at MCBT there continues to be problems with high densities, with 1800 crocs of adult, and juvenile size classes, the latter being from nests not detected (usually 2nd nests, as most of you know double clutching occurs at this facility). 2,210, in 30 Zoos, with the majority (82 %) held at the Madras Crocodile Bank Trust (from the Central Zoo Authority's website, encompassing the fiscal year 2016 – 2017).
2. Approx figures and status of croc in your study area; Based on my work from my PhD, ongoing with Annamalai University, I cover the stretch of the Cauvery River between Thanjavur to the delta region (i.e. Chidambaram). My primary study site is an irrigation tank near Chidambaram, Vakaramarrai Water Works. On the Cauvery itself, at a location called Anakarai, I have observed remotely (with binoculars) at least 20- 25 adults, this was at the peak of the dry season last year. Within my primary study site, to date I have observed six scats, in January 2018; since I started monitoring this place in April of 2017, this is the first evidence of crocs here. There appears to be a dynamic interaction in movements between the main River Cauvery and this irrigation tank, confirmed by goat herders and people collecting fodder for livestock here. 4 unoccupied tunnels (with no fresh tracks) were observed in the dry season last year.
3. Any ongoing research and crocodile related programs and activities. MCBT has the below ongoing projects;
  - a. The degree of nest defence in post-ovipositing female mugger in a semi-natural enclosure.
  - b. Organomorphometry in the mugger crocodile.
  - c. Analysis of mugger scat from the Cauvery river to assess diet.
  - d. Temperature selection, enclosure utilization, and nocturnal activity in captive juvenile Gharial (*Gavialis gangeticus*).
  - e. Production of educational materials for 20 - 30 villages and towns on the mugger crocodile's role in our ecosystem.
4. If you have any crocodile related research problems; as always for most of us, the issue of funding. Though this seems to be picking up, as evidenced by the Gharial Ecology Project (under MCBT) receiving a student's grant scheme for bio-acoustic recordings on the gharial. I have been fortunate to receive funding from Rufford, for my PhD work. One problem I face is the uncertainty when applying for funding, whether or whether not I would get permits to, for example, capture and tag crocs. Vice-versa, I've been in situations where Forest Departments have given permission to carry out work, and then find that I've been turned down by funding agencies. A scary factor would appear to be the little transfer of knowledge from earlier Project Crocodile workers to current UGs/PGS/students. This has just started now, ( a prime example being the Biology of the Crocodylia: Models for Conservation Biology, March 2017 Course, held at Jiwaji University). Also, a feeling of "entitlement" for research continues to exist; this attitude needs to be publicised and trounced.
5. Also, your final word/opinion regarding mitigation of croc conflict: There are some retaliatory measures taken against mugger on the Cauvery, in the form of nest destruction, again at Anakarai, where fishermen from the area have noted hatchlings. There was also mention of a few people who collected crocodile eggs for sale, the end purpose is unknown (folk here know mugger are protected under the Wildlife Protection Act, 1972). Escalations in 'conflict have been observed at the local level, i.e. Thanjore/Tiruchipalli/Cuddalore/ districts in Tamil Nadu. Not all attacks on livestock/people are mentioned in the news, rather are instances when crocodiles are "rescued" when near areas of villages and towns. Capture techniques for rescuing crocs need to be clearly standardized for rescue teams, from pictures, you-tube links, this would appear to primarily relate to the safety and welfare of crocodiles.

Clear guidelines where victims seek compensation; in some states if attacked within a Protected Area, get compensation, other states differ; who to approach (a victim had approached Forest Department, all the way up to the District Commissioner level, but received no compensation. Prime ministers fund has sometimes been used to compensate victims/families.

Though repeatedly mentioned advocate the establishment of a farm for skin and meat in a closed cycle situation. Wild boar, nilgai, monkeys have been declared vermin in some states, allowing them to be culled. Sustainable seriously needs to be considered, particularly because of the rapidly escalating numbers of Human-Crocodile Conflict. The argument here is that crocs will not be tolerated unless they have some value.

Countrywide survey to update current mugger status; pulling in all the other people/agencies regionally available. One person/agency needs to be the nodal/coordinator. This would involve the non-enviable task of getting survey reports done by BSc and upwards students, creating a database of wildlife enthusiasts, organizations near mugger populations, (for example, the Hadoti Naturalists Society in Rajasthan), unpublished reports from Forest Departments and non CSG-members. Part of the survey effort should be to evaluate other possible relocation sites within Protected Areas. Unless

looking at a stand-alone water body with mugger within, the animals will not restrict themselves to protected areas. Census techniques have existed and need to be incorporated into a national platform for India.

It would appear only natural to making this information available to all, on an open source platform. To this end, MCBT will be uploading all survey reports done by us, inclusive of a repository of ex-situ data on the reproductive biology of the mugger, gharial, and 3 non-native species.

A worrying point is the release/translocation of mugger to Chandoli Dam (Maharashtra) and Ajawa Dam (Gujarat); crocs home back to capture sites via dam outlet canals which eventually join sections of the river allowing homing. The release/translocations of mugger need to be defined, with references to studies showing homing in crocs. Indeed, there are references from Gujarat by Raju (scute clipped crocodiles) published in the CSG newsletter".