

GHARIAL ECOLOGY PROJECT of the Madras Crocodile Bank Trust Uttar Pradesh, Madhya Pradesh, and Rajasthan Forest Departments

Environment, Forests, and Climate Change, Government of India

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OVERVIEW

Gharial (*Gavialis gangeticus*) is a critically endangered crocodilian living in South Asian rivers. The only viable, self-sustaining population inhabits the Chambal River where a mass die-off occurred in 2007-2008. With international zoo support, ecological studies (2008-2016) of these gharials have been conducted in the National Chambal Sanctuary (NCS), utilizing telemetry to record their movements, activities, and behaviours relevant to the die-off, and critical to their conservation. To date, the results reveal new information about gharial spatial habitat use and seasonal movement patterns, as well as social structure and breeding biology. For the first time worldwide, this project provides the biological basis for science-based conservation actions to protect the remaining wild gharials in their natural river habitats. A training/education component develops an awareness of this magnificent species among the river folk it lives with.

Telemetry Component: Monitoring, Tagging of Additional Small Gharial & Nesting Surveys

The major activities for this component in 2016 were: 1) tracking gharial tagged in 2014 and in 2015, 2) downloading GPS loggers from gharial, tagged in Nov 2014 and 2015, 3) making detailed observations on crèche attendance and hatchling guardians, 4) monitoring nesting success on the lower Chambal, and 5) tagging additional gharial with GPS loggers, primarily juveniles. International zoo support provided major funding for tracking, downloading, observing nest behaviors, and monitoring nest success in the NCS. Long distance seasonal movements of 200+ km are now well documented in this Chambal population of wild, free-living gharial, indicating the importance of an open, dynamic river ecosystem, free of dams and sand mining. The exceptional care behaviors shown by guardian adults, both male and female are documented in detail. A nesting survey, conducted yearly since 2010, was extended another 50+ km upriver to include a major site utilized by many tagged females for nesting upstream, where sandmining was extensive.

Training Component: Program Coordinator, Training Workshops, Education Programs

In 2016, the training/education component supported a part time, but very experienced Program Coordinator, Ashutosh Tripathi. Previously, Ashutosh has conducted innovative training and education programs, in his capacity with TSA-India. One workshop was conducted by GEP staff for UPFD staff. A Teacher Training Program was conducted for elementary school teachers in riverside villages, including those proximate to gharial habitats. In addition, week-long environmental awareness programs and educational activities were conducted at the Garhaita base education centre and in the local schools with support, provided by the international zoo support. More than 20 environmental education programs were conducted during 2016-17.

ECOLOGY COMPONENT OF PRAGUE ZOO GRANT

BACKGROUND

The Gharial Ecology Project, also known as the Gharial Telemetry Project, and summarized in Lang & Kumar (2013), was designed to investigate the mass die-off of gharials in the 2-4m size class, totalling 110+ individuals in the lower Chambal River, National Chambal Sanctuary (NCS).

Previously, 20 radio-tagged gharials have been tracked successfully through the annual monsoon and dry periods, for an average of 2+ years/animal, since June 2008 through August 2013. Individual gharials show different patterns of seasonal movement and residency, dependent on size/age. Adult females move as far as 80-120 km each to join dry season basking-breeding aggregations (>60 adults), and to locate suitable nesting areas. In contrast, sub-adult gharials moved little, only 10-30 km seasonally, and occupy residencies only 5-15 km. Most sub-adults are sedentary, virtually not moving, either upstream or downstream any time.

In July 2013, project continuation was approved to provide a comprehensive picture of the spatial and reproductive ecology of gharial and mugger living in the NCS. Permission was granted for 25 gharial and 5 mugger to be tagged and monitored. Support from the Prague Zoo funded previous tagging and monitoring of radioed animals in 2013 through 2015. This report briefly outlines activities conducted with international zoo support for 2016. These activities include an ecological component, for which an update has recently been provided (Lang and Kumar, 2016) and published in the Crocodilian Specialist Group Working Meeting Proceedings, based on an oral presentation at the conference held at Kruger Park, South Africa in late May, 2016.

The overall study demonstrates that individual gharials utilize the entire river for specific habitats as well as corridors, and aims to provide baseline information on the status of gharial populations within the NCS. In 2016, the Gharial Ecology Project continued in two phases: a) monitoring radioed animals throughout the year, and b) capture and tag in November 2016.

LONG DISTANCE, SEASONAL MOVEMENTS

The most exceptional result to date are the extraordinary distances some of the tagged gharial are moving each season, up and down the river, in seasonal patterns related to nesting. Several of the gharial tagged in 2013-2015 have routinely moved >210 km downriver to the confluence where they have remained during the monsoon, before traveling back upstream post monsoon. This seasonal movement pattern is repeated year after year, by multiple adult females for nesting. Subadults, both males and females made similar seasonal movements upstream and downstream.

TRACKING RADIO-TAGGED GHARIAL

International zoos in 2016 supported the year long monitoring for the gharial tagged in November 2014 and 2015. A summary of their movements and activities is presented in detail in Lang and Kumar (2016). In general, both adults and subadults generally may show variable movement patterns, presumably related to differences in their sizes/sexes/ages and reproductive status. In brief, nearly all of the tagged gharial exhibited restricted, seasonal movements, similar to the sedentary subadults that were monitored earlier in the 2010 radio-tagged group.

GHARIAL WITH GPS LOGGERS

In 2014, for the first time, radio transmitters equipped with GPS loggers which could be remotely downloaded periodically, while still attached to free-ranging, wild resident gharial were utilized. These tags have been successful in producing very fine scale data on daily locations, resulting in 2-10 records per day, on an almost daily basis, for each tagged gharial. A total of seven GPS tagged gharial were monitored during 2015, and a summary table of results to date is presented in Lang and Kumar (2016).

In 2016, three gharial (28, 30, & 32) were successfully tracked until mid-year, until just before, during, and/or after the monsoon and the GPS data downloaded for the previous 15-20 months since tags were affixed. These three gharial have been monitored for more than a year (=Nov2014 to Apr-Sep 2016), and daily records were obtained for about 50-80% of total days with the radios attached. In general, the least successful months for obtaining daily locations are the monsoon months (July through September) and the most successful months are the winter months (November through February) when gharial are basking on land on sunny, warmer days.

One of these individuals, subadult male 28, was not detected for 9 months, despite the fact that he resided within the regularly monitored stretch of river. Only the GPS locations revealed that this individual ranged over 116 km of river, and made an undetected upstream visit over several months, with multiple daily stopovers along the way upstream and downstream. The extensive use of a much larger section of river was only revealed when the GPS locations were downloaded and plotted, but otherwise, using the conventional manual tracking techniques, he was undetected.

In mid November 2015, another capture-tag operation was conducted to extend the number of gharial outfitted with GPS loggers and/or VHF radios for tracking. The timing of this capture-tagging coincided with the termination of many of the VHF radios, affixed to gharial in Nov-Dec 2014. A number of issues related to the programming of the GPS loggers were resolved with this second deployment, and a wider range of individuals including smaller gharial were included in this 2015 tagged group.

Throughout 2016, all of these animals are presently being tracked manually, and periodically downloaded for GPS locations. One young adult female, tagged at Barchauli (G15D; river distance=33 km from confluence), moved upstream to Purieni, at a distance of 189 kms from the Yamuna-Chambal confluence, from its previous location at Barchauli in late December. This long distance movement totalled 156 kms within a 6 week period; eventually, the GPS locations for this individual will be downloaded, and its locations and activities revealed in detail for this long distance shift upstream. In late 2016, this individual returned to the same location upstream, after moving downstream during the 2016 monsoon, to a downriver location near her initial capture site (Figs 49-51).

Another subadult female, with a damaged, shortened snout, as a result of injury related to netting, showed a seasonal pattern of restricted movements, upstream during the winter months to locations 20 km above the confluence of the Chambal=Yamuna, then downstream movements just prior to and during the monsoon to a residence at the confluence (see Figs 1-8).

BREEDING, TRIAL NESTING, EGG LAYING, & INCUBATION

Prior to breeding, big ghara males contest at likely breeding sites where groups of reproductive adult females and young females nearing breeding size/age congregate. At one such location, Rhea, a resident, older male with a distinctive twisted ghara was challenged by another large ghara male (Fig. 9). These two males engaged in stereotyped assertive displays, involving parallel and head to tail, side by side swimming, sparing with lifted heads, riding of one animal upon the other,

punctuated by time-out periods when both moved onto land, near one another to bask and presumably rest (Figs. 13-16). In this instance, the older, twisted-ghara resident male remained to be the dominant breeder at this site, and then became the guardian male as the hatchlings emerged, and near the crèche post hatch for up to a month, before the monsoon flooding started (Figs.10-11). During the monsoon, he was observed in the downstream Chambal, 30 km upstream of the Yamuna confluence, and >130 km downstream from the breeding site and nesting location, where the crèche remained pre-monsoon (Fig 12).

Similar seasonal long-distance movements downstream during the monsoon months have been recorded for other big ghara males, and the presence of individually distinctive features on most of these large males facilitates positive identification of certain animals, from resident upstream locations. For instance, a large dominant male resident at Maghera Pura, just below Naangaon Temple nesting site, had a recognizable “double flaps” of skin above his right eyelid, and he was observed during the monsoon, >90 km downstream near the Yamuna confluence (17-18). Other large ghara males often had scars and scrapes on the snout and ghara that facilitated individual identification, based on distinctive head and body features, such as truncated tails, trunk injuries (Figs. 19-20).

At the Naangaon Temple site, a young male was observed to be the sole and dominant male guardian of the hatchling crèche in 2014 and again in 2015, but known to not be the dominant breeding male during courtship and mating in several nearby breeding group during those years (Figs.21-22). In 2016, this male (previously tagged with radios 44 /46, in 2013; neck radio still attached in 2016) was observed to be the main breeding male near the same nesting site used in 2014 and 2015. Subsequent to the breeding in 2016 in which he was the main breeder, he remained near the nesting site during incubation, and assumed the role of male guardian at the crèche when it formed (Figs. 23-24).

In mid March, trial nesting began at likely nesting areas, and open nest holes were evident at these communal, egg laying sites (Figs 25-26, 40). Earlier nesting in 2016 coincided with warmer, daytime temperatures and low river water levels; nest locations tended to be positioned on lower sandbank slopes, closer to water. At one upstream site, Dinnpura on MP side of river, the nesting sandbank was located within 100m of the main village “watering” site, where local residents conducted riverside activity (Fig 29,30,33). At this location, villagers often disturbed resident gharials, and one dead adult female was observed just at the time when eggs hatched and hatchlings emerged (Fig. 34). Another female, radiotracked for 4 seasons (2010-2013), and manually tracked and identified in two subsequent nesting years (2014-2015), utilized the site again in 2016, and appeared to be the dominant, resident guardian adult female associated with the crèche (Fig. 35).

Predation on freshly-laid eggs by jackals and other terrestrial mammals is high soon after egg deposition, and some early nests in colonies are disturbed by late-nesting females. During the incubation period, females remain near, but not necessarily at, nesting colonies, typically basking in adult female groups, upstream or downstream of the actual nest site. At some localities, a resident big ghara male remains in the vicinity of the nest colony; at other nest locations, big males are usually absent.

CRECHE ATTENDANCE AND HATCHLING GUARDIANS

During the nesting season in 2016, a concerted effort was made to monitor several large crèches in the lower Chambal with infrared game cameras for continuous 24 hour periods for days at a time in order to determine which adult individuals were acting as protectors and guardians at each crèche, and to characterize the patterns of attendance, care, protection and guarding exhibited by adults remaining in the vicinity of large groups of hatchlings assembled at colonial nesting (Figs 27-28, 31-32, 37-40).

The emphases during this year's hatching and post hatching period were to make detailed observations, supported with still, video, and remote game camera video clips, without interfering with the natural progression of daily activities. In other words, disturbance by human presence was minimized as much as possible. Crèches were observed at safe distances that resulted in minimal, if any disturbance, in most cases. Whenever possible, observations were confined to opposite river banks, at distances of 100+m, so direct disturbance was avoided.

Crèches at four sites were sampled with game camera video continuously during hatching, within a week to 10 days post hatching, and later at 2-3 weeks post hatching. Sets of game cameras (8-14 cameras), modified to take sequential 55 second video clips for 24+ hrs were installed, and changed daily to record complete records of activities at the crèche during the daytime and at night. Representative stills from this extensive data set are shown in Figs. 41-44.

Importantly, these crèche observations indicate two special features associated with the patterns of attendance and guarding of hatchlings. First, some nesting females, apparently among the largest at each site, appear to be dominant in protection of hatchlings. Each of these females visits the group(s) of young often, but does not remain constantly with them. At some localities, only one female seems to do the majority of the guarding, and she actively excludes other females from close approach to the hatchlings, under most circumstances. At others, several females appear to share primary guardian duties (Figs. 41-43).

At nearly every nest colony, dominant guarding female(s) is/are assisted in hatchling protection by a single, large ghara male who associates himself with the crèche of young. When major threats occur to the hatchlings, the male replaces the dominant female at the crèche, and displays his presence with acoustic jawclaps, and loud exhalations that resonate through the large, cartilaginous ghara at the tip of his snout (Fig.44).

Detailed behavioural observations during the breeding and nesting and hatching periods in 2014 and in 2015 at one site upstream, Naangoan Temple nesting colony, strongly suggest that the guardian male at this site is a junior, not yet dominant male, with a ghara that has enlarged in size over the past 3 years. Male 44/46 was tagged in Nov 2014 and so is relatively easy to locate; his river travel is very limited to a small area, e.g., within 7 kms). He has not been actively engaged in breeding in the two previous years. But in 2016, this male was the dominant breeder at the nearby breeding congregation near the nest site, and also was the persistent guardian at a relatively large crèche consisting of 15+ hatched nests again in 2016 (Fig. 21-24).

In 2016, a new phenomenon was observed at one crèche, and may have occurred at one or more other crèches. A 3m adult, presumed to be a young subadult male, was recorded in two instances on one morning, approaching a group of hatchlings at close range, and then lunging and capturing a hatchling in its jaws, and then rapidly retreating from the shoreline, pursued in one instance by the female guardian attending the group of hatchlings (Figs.45-48). "Selective cannibalism" has not been recorded in any of the previous years at any nest site, and was a surprise observation made several times in 2016. Little is known of the frequency of occurrence, which animals in the population are engaged in this behaviour, or what the significance of such behaviour is. It has only been recorded remotely via the game camera surveillance system set up at particular crèches during the post hatch period in 2016. We speculate that the cannibals are growing, subadult males.

NESTING SUCCESS ON THE LOWER CHAMBAL

Nesting effort has been monitored for the past six years on the Uttar Pradesh section of the lower Chambal, in the National Chambal Sanctuary; the river distance above the confluence with the Yamuna is 163 kms. In 2015, because several of the radio-tagged females had ventured even farther upstream, to a river distance of 210 km above the Yamuna confluence, at Tighra. In 2015-2016, this entire section of river, on both banks, was surveyed from Tighra down to the confluence for evidence of nesting. Within this stretch, 153 nests were located, based on either predation signs prior to hatching and/or evidence of hatching. Of these, 124 showed evidence of successful hatching, and many groups of young were observed in the vicinity of the numerous nest sites examined within several weeks of hatching. The survey was conducted during daylight hours, from pre-dawn through evening dusk, during 17-20 June.

In 2016, the same stretch of lower Chambal, for 210+ kms, from Tighra to Sashon was monitored for nesting, and subsequently for hatching success (Figs. 49-52). A total of 203 nests were recorded, of which 174 hatched. Notably, in 2016, nesting was about 7-10 days earlier, occurring in third-fourth weeks of March primarily, and hatching began 7-10 days earlier, with the first nest hatched on night of 22-23rd May. Monsoon rains began in mid to late June, and heavy rains were frequent by the end of the first week in July. Water levels in 2016 were markedly lower than in 2015.

During the past two years, sand mining activities have dramatically increased on lower Chambal River sand banks and sand bars, primarily in Madhya Pradesh, and to a lesser extent, in Rajasthan. In Uttar Pradesh, sand mining, using tractors and trolleys to move sand up and out of the river bed, is less frequent (Figs. 53-56). At a number of localities, these activities appear to disturb gharials attempting to bask nearby, and in some instances, actually remove sand from the edge of the shoreline in prime areas typically selected as colonial nesting sites. At certain localities in Madhya Pradesh, mining is continuous, with the use of heavy equipment to load and remove sand, 24/7 for all months of the year except the monsoon months of late July, August, and early September.

CONSERVATION BENEFITS OF GHARIAL ECOLOGY PROJECT

The Gharial Telemetry Project has been recognized by the National Tri-State Committee for Coordination of the Conservation in the National Chambal Sanctuary, and the recommendations of the project solicited for incorporation into the National Plan for Gharial Conservation, under consideration for adoption and implementation. The Principal Investigator presented a paper in late May 2016 at Working Meeting of the Crocodile Specialist Group in south Africa. A summary of recent activities related to gharial conservation appeared in the Jan-Mar 2016 issue of Croc Spec Group Newsletter, IUCN (included in the supplementary materials for this report).

In April and in July, I also made two research trips to Nepal and visited the two important remaining sites where gharial occur in the wild, at Bardia National Park and at Chitwan National Park. Summaries of my Nepal visits and impressions, etc. are also included in the supplementary materials for this report. A summary article on Nepal gharial is being prepared.

There is now wide recognition of the importance and significance of the biological findings of the Gharial Ecology Project, and in particular, how these inform and are directly relevant to ongoing conservation and management efforts. This is especially important for the remaining gharial populations in the National Chambal Sanctuary, living in a protected, free ranging, wild river habitat. The success of efforts to date to continue the study attest to the interest and commitment by the state and central governments, particularly the MoEF and the Forest Departments of Madhya Pradesh, Rajasthan, and Uttar Pradesh for the shared objectives outlined for this project.

CAPACITY BUILDING & TRAINING COMPONENT OF PRAGUE ZOO GRANT

BACKGROUND

With an aim to involve members of the local communities of the Chambal region in the conservation efforts for the gharial, the Gharial Ecology Project started its education and awareness programme in the region in April 2012, and has sponsored workshops and environmental education classes in local village schools, as well as in public and private schools in nearby town, cities, and in the region. Sensitization of the local communities towards the region's biodiversity and finding more sustainable ways to extract natural resources and also to restrict their extraction were identified as the key steps in this programme, which has been on-going since it started. An informative and illustrated story book was developed in the local language Hindi for adults as well as children of the local river-side communities. This book focuses on the Chambal River, its fauna and the threats faced by this region in the form of a story to engender interest towards local biodiversity and its conservation. Along with this we also developed four posters for display in the focal villages. Through these educational materials we intend to educate the local communities about the local wildlife, especially the gharial and enable them to conserve and protect their environment and the wildlife they co-exist with. This programmatic approach will directly inform members of local communities and provide foundations for conservation efforts.

PROGRAM COORDINATOR

During 2016, a Program Coordinator, Ashutosh Tripathi has continued to work in conjunction with the Gharial Ecology Project. He has been engaged in capacity building for the Forest Departments in Uttar Pradesh, Madhya Pradesh, and Rajasthan. In particular, Ashutosh Tripathi joined the Gharial Ecology Project in July 2015, and has taken the lead in developing an active training and education program schedule for the frontline staff of all concerned Forest Departments, as well as a critical education training program for elementary school teachers in the districts along the National Chambal Sanctuary. Previously, Ashutosh conducted programs for more than five years as the main educational officer with the Turtle Survival Alliance—India Program, with a main focus on the Chambal ecosystem.

FOREST DEPARTMENT WORKSHOPS

In October 2016, a two day workshop was held at the Garhaita base and along the Chambal River nearby the village. There are two ranges in the UP stretch of the NCS, one in the lower Chambal, the Etawah Range, and one upstream, the Bah Range. The main objectives of the workshop were: 1) to provide information on species identification, 2) to train staff on basic survey techniques, 3) to outline confiscation details, and 4) to demonstrate methods of nest location, handling, protection, and translocation for turtles and crocodilians. Workshop staff were: Jailabdeen A., Ashutosh Tripathi, Pankaj Kumar, Ramraj, Deepu, and RWW Suresh Chandra Rajpoot and Rangers from Etawah and Bah Districts. The workshops included classroom sessions, hands-on identification and animal handling at the local facility, and field trips to stretches of the Chambal River nearby. A custom made Resource Packet was provided for all participants, including handouts on gharial natural history, a list of bird species, fauna and flora lists for the Chambal, snakebite information, survey datasheets, and a manual on turtle identification and protection. A draft version of the FD manual on Chambal River Ecology was distributed, and utilized for portions of the workshop training, and further refined in design. Newly recruited frontline staff were the main participants Figs. 69-76).

In early 2017, a similar workshop will be held at the Deori Eco-Centre, run by the MPFD, and this full day of activity will be attended by participants from the Morena, Bhind, and Sheopur Ranges in Madhya Pradesh, particularly those in the NCS. A similar program for Rajasthan FD staff is planned.

TEACHER TRAINING WORKSHOP

In early January (2016), a Teacher's Training Workshop was jointly organized by Gharial Conservation Alliance, Madras Crocodile Bank Trust, Uttar Pradesh Forest Department and District Primary Education Department. Initially, this workshop was to be conducted in December, but it had to be postponed because the teachers were required to do election duty in December. The main objective of this workshop was to train elementary school teachers and children of riverside schools on the need for conservation of the endangered Gharial (*Gavialis gangeticus*) through adopting an innovative (village) cluster based approach and managed to educate over 500 students, 25 teachers and several more community members from 25 riverside schools and villages. The session in the workshop was "Introduction and concept of TTP", "Our River and its Social, Cultural, Economic and Ecological importance", "A brief description about Gharial (*Gavialis Gangeticus*); its importance and threats", "About National Chambal Sanctuary" & "Role of schools & teachers in Gharial and its habitat Conservation". A number of eco-games were performed with teachers to conceptualize the play way learning methods for the teachers for the school kids (Figs.61-62).

Currently, in 2016, education and awareness programs with the focus on Chambal conservation issues were conducted in local riverside communities, as well as in regional schools at all levels. By following the teachers training workshop, village school programs were conducted in Kasaua (Fig.66), Kasonga, Kheda Ajab singh (Fig. 65), Miholipaar (Fig.101-102), Bahuri (Fig.89-90), Udi (Fig.109-110), and Bhawanidas pura (Figs.63-64). During the program, skit preparation methods were explained and executed to school kids to aware the local village people.

RIVERSIDE COMMUNITY PROGRAMS

General Comments on Community Programs in lower section Chambal National Sanctuary:

The lower section of NCS is highly populated as compare to the upstream, and due to which the dependency level is higher. The village mostly belongs to fishermen community and wood cutters and situated on the river bank at the closest point of accessibility. During the monsoon, this section is home to different aquatic fauna including Gharial as a halting place where animal spent the whole monsoon and late summer. Due to lack of awareness and education, tremendous anthropogenic activities in this section disturbed the annual cycle of these endangered animals and sometime prove fatal to them. GEP has taken a step to spread awareness and education for these communities to sensitize and inspire them for animal conservation. For execution of these programs, we used A/V tools and education materials in field of education and awareness.

Dhakra village:- This village situated at the junction of road network along the river, where people is highly involved in wood cutting. A themed program on value of trees and reforestation methods was show to the people with the help of ppt. Short documentaries were played to sensitize them and plantation schemes recently launched by government was introduced in the program to >200 participants/villagers (Figs. 67-68).

Gopiyakhar village:- Gopiyakhar is a small village, situated at the confluence of five river streams which has a history of huge fishing and poaching of aquatic animal. The village people are highly skilled in fishing and depend on for their subsistence. A sensitizing conservation orientation program was prepared and executed with the A/V mode for > 150 people/participants.

Sahson village:-A big village situated at the Chambal river bank. The main mode of subsistence is agriculture here which is doing by the flattening the Chambal ravines which is home of different threatened species of birds and terrestrial reptiles. On the other hand, wood cutting is secondary occupation which is devastating the indigenous plant species in this area. A themed program was conducted in this village through hosting 100+ participants.

Bihar village:-A small village situated on riverbank. The main subsistence of the village here is agriculture, animal husbandry and few incidents crocodile attacks on cattle reported in this village which is the main reason of crocodile-man conflict. A themed program on crocodile-man conflict was conducted with A/V mode of education and awareness. Education material on term and conditions of crocodile attack and on precaution measures were distributed among the villagers to cure the further incidents.

Gohra village is situated at the bank of River Chambal and belongs to milkman caste (aheer) community. They are mainly depending upon agriculture/farming and animal husbandry for their subsistence. But the life change entirely here during the monsoon. In monsoon, this village surround by flooded river and river animal (Muggers and Gharials) which remains in farmland throughout the early winter, till the water set back into the river terrain. Under these circumstances, not only they face the great chances of crocodile attack, but due to water logging they only able to do single crop annually. During monsoon, the road conveyance also interrupted and villagers bear lot of trouble to reach the nearest town for purchasing goods/needs. Under these circumstances, people doing job in big cities and evacuating village. A themed program was conducted through interaction with the help of audio/visual presentation. During the program, precautionary information was given to the villager to cope with the human-crocodile attacks and cell number given to villagers to help in crocodile rescue from the village as and when required. In this program, about 50+ people were participated in this program (Figs. 105-106).

Gudha village is situated at the edge of Chambal River and belongs to fisherman community. The main occupation of villagers here is farming, though often they do fishing and sand mining. A themed program was conducted through interaction with the help of audio/visual presentation. During the program, about 100+ people were participated in this program (Figs. 107-108).

Amdapur is fisherman community village, where farming is a primary livelihood option for villagers. However, few people are heavily dependent on fishing and sand mining. A Chambal River conservation and awareness program was conducted in this village to sensitize the people River conservation. A themed program was conducted through interaction with the help of audio/visual presentation. About 70+ people were participated in this program (Figs. 91-92).

Nimadanda is typical/traditional fishermen village, situated near the Chambal-Yamuna confluence. Although, most of the people have adopted farming and animal husbandry, but still they involved in fishing/poaching. A themed program was conducted through interaction with the help of audio/visual presentation. About 150+ people were participated in this program Figs. 103-104).

Pachhaygaon ki madaiyan: An awareness program was organized in Pachhaygaon ki Madaiyan village by Gharial Ecology Project under the aegis of Madras Crocodile Bank Trust in collaboration with Uttar Pradesh Forest Department. The main objective of the program was to spread awareness on conservation of Aquatic fauna of Chambal River with focus on Gharial conservation. The program was started with introductory speech in which local folk were explained about the objective of this program. A skit was presented by kids of Garhaita village themed “impact of human activities on animals”. During the program, the people were interacted and informed about the conservation status of Gharial and importance of protection given to aquatic fauna by declaring Chambal River as Sanctuary with the help of documentaries and power point presentation. They were requested to contribute in Gharial and Chambal River conservation. At the end of the program, all the participant (>250 villagers) were hosted with high tea (Figs.121-124).

Baroli Paar village community program: An awareness program was organized in Barolipaar village by Gharial Ecology Project under the aegis of Madras Crocodile Bank Trust in collaboration with Uttar Pradesh Forest Department. The program was started with introductory speech in which local folk were explained about the objective of this program. A skit was presented by kids of Garhaita village themed “impact of human activities on animals”. During the program, the people were interacted and informed about the conservation status of Gharial and importance of protection given to aquatic fauna by declaring Chambal River as Sanctuary with the help of documentaries and power point presentation. At the end of the program they were requested to contribute in Gharial and Chambal River conservation. All the participant (>75 villagers) were hosted with snacks (Figs.117-120).

Education and awareness in Saint Vivekanand Public school

An education and awareness program was organized in Sant Vivekanand Public Schools on 28 November 2016, to share the life history of Gharials and Turtle, radio telemetry exercise and facts about the behavior and movement of Gharial in National Chambal Sanctuary. Myths and facts about the snakes and precaution during snake bite. During session “Meet the scientist”, Prof. J. W. Lang hosted school students to explain about their curiosity on Gharial ecology and natural history. Short documentaries “Last chance for Gharial”, “National Chambal Sanctauryg pristine river” was played for a total of 63 students’ of the program (Figs. 77-80).

Bird Festival 2-4 DEC 2016:-Gharial Ecology Project (GEP) actively participated in Annual Bird festival conducted by Uttar Pradesh Forest Department at Chambal Safari Lodge. For this, a booth was assembled with standees, radio telemetry equipments and A/V tools and education materials and reports to share about GEP and finding of the project with the participants. Bird festival was an event platform which brings the birders, naturalists, wildlifers, researchers, students from all over world and local folk all together for bird watching, sharing information and spreading conservation and awareness about the NCS. During this event festival, we could spread words towards the gharial conservation and research to 500+ participants including birders, naturalists, wildlifers, researchers and could aware and educate 2000+ students and local people (Figs. 81-84).

Bird watching at Bhareh Confluence:- On Dec 2 2016, bird watching trip was organized for the student of class 12th of Seven Hill college at Bhareh Chambal-Yamuna confluence. This trip was purely an awareness and education trip where student earned an experience on techniques of watching birds and bird counting. During the program, a total of 32 species of birds were seen including large wetlands birds (Pelicans, Storks, Cranes) on the island to small waders (Sand pipers, Red shanks, curlews), aquatic reptiles including Gharial and Mugger and aquatic mammals Gangetic dolphin in natural habitat along the river bank. During the session “Meet the scientist”, students met to Prof. J. W. Lang and satisfy their curiosity about the Gharial and Radio telemetry project. This trip was executed by Mr. Khem Bahadur Singh and participated by 50 students (Figs. 85-88).

Biology Seminar at Jiwaji University, Gwalior, Madhya Pradesh: On 5 December, J. W. Lang gave a seminar to the Biology majors (Junior and Senior PostGrads) and MSc students at Jiwaji U., Gwalior entitled “Crocodilian Superdads: Gharial on the Chambal River, north India”. The talk was a 1 hr presentation of Gharial Ecology Project research and activities, and then students discussed the talk for half an hour afterward. The attendance was approximately 100 students, plus Biology Dept. faculty (Figs.97-100)..

Education and Awareness Program for Garhaita School (river village where GEP has staff residence): On 20 Jan 2017, an education and awareness program was conducted in Garhaita schools for secondary and primary school kids. The main objective of this program was to educate the kids about the conservation of Chambal river and its aquatic fauna. In the program, a skit on "Impact of activities of riparian people on endangered aquatic fauna of Chambal River" was presented by village children in the presence of Ms. Zahida Whitaker (Director, MCBT) and Ms. Yamini (Chief guest). The Director interacted with the kids and shared about MCBT and GEP project and encouraged them for the Gharial conservation. At the end of the program Master Shivam nominated as Junior Environment Ambassador for this school (Figs.111-116).

CONSERVATION BENEFITS FROM TRAINING

Regular events like these will leave a strong influence among the locals especially children and also give them an interesting platform to learn as well as express themselves. These training activities have the potential to engage and motivate members of the local communities as well as the field staff of the forest departments and promote conservation efforts for Chambal River and its associated biodiversity, particularly for the resident gharial in the NCS and elsewhere.



Figure 1. F43, a short snouted subadult female, basks upstream in March 2016. This female moved 10 km upstream from her capture site during Feb and Mar, then shifted downstream in April to locations near the Yamuna confluence (Figs. 5-8).



Figure 2. Downloading GPS logging radio attached to F43 (Fig. 1). in late March 2016. Data downloads were accomplished with UHF antenna and ATS Fixes software at intervals of 1-4 months during the 2 year period of logger operation.



Figure 3. Another short-snouted subadult female, similar in size and age to F43, at Yamuna confluence. Observations during the monsoon indicate that numerous "damaged" females congregated near the Yamuna confluence where abundant fishes, sometimes injured by other animals, were plentiful.



Figure 4. "Short-snouted" subadult and adult gharial result from intentional wounding by fishermen who cut the snouts of gharial entangled in their nets. Despite suggestions that these animals are then doomed to starvation and death, many of these injured gharial continue to feed and grow, and eventually nest as adults.





Figure 9. A large, mature, big-ghara male, known from previous years, from his frequent location at Rhea, 160 km upstream from the Yamuna confluence, basks on land at his established breeding site near a known nesting location. In background, another male rests on land. He challenged the resident male (foreground) before (see Fig. 15-16) and after (Fig. 13-14) resting on land, by both individuals in the encounter, as shown here.



Figure 10. Resident Rhea male (foreground in Fig. 9) with creche of hatchlings in early June 2016 at nest site (shown in Fig. 11), adjacent to breeding area (the location shown in Fig. 9). Young are shown as tiny heads in the water behind the male's head, and a cluster of young are visible at the base of the male's tail. Note the scars on the male's snout are identical in Figs. 9 & 10.



Figure 11. Creche of hatchlings at shoreline (center of image) at Rhea nesting site. Tractor tracks, evidence of sand mining at this site, are clearly visible in the foreground, running along shore.



Figure 12. Rhea resident male, same individual shown in Fig. 9 and Fig. 10, observed in August 2016, at Sashon Bridge during the monsoon high water. He moved 130 km downstream, and likely moved from this location even further downriver to the Yamuna confluence, 30 km below the bridge. In late 2016, this male returned back to Rhea, his post monsoon residency, >160 km upstream of the Yamuna confluence.



Figure 13. Male-male combat, parallel swimming, head to tail. Earlier in this encounter, both males (resident and challenger) as shown in Fig. 9, swam together, aligned parallel, with heads and tails, side by side, heads together.



Figure 14. Later encounter, on the same day (26 Feb 2016), between two large, big-ghara males at Rhea. Older, resident male (scarred snout) rides on top of challenger, before challenger moves away, and leaves the vicinity, after a prolonged 3-4 hour interaction, shown in Figs. 9, 13-16.



Figure 15. After "parallel swim," males aligned heads, and circled each other, eventually lifting heads and duelling with snouts raised in air, as shown.



Figure 16. Following the initial "snout-dual" interaction, the challenger male moved on top of the resident male (whitened snout visible to left in this figure) and rode on the resident male's back. Then, there was a "time-out" on land, as shown in Fig. 9.



Figure 17. Individual large, big-male ghara males are the dominant breeders during the courtship and mating period. Each individual typically has distinctive markings that facilitate identification, based on naturally-occurring differences in head, body, and tail markings. Shown here is the dominant male at Magherapura, with two fleshy-lobes on his right eyelid, evident in this figure, at the breeding site, February 2016.



Figure 18. Same male shown in Fig. 17, photographed at Yamuna confluence, 80 km downstream, during the monsoon high water, later in August 2016.



Figure 19. Another large, big-ghara male, the guardian male at Khera Ajab Singh nesting site, had a distinctive, asymmetrical shaped ghara, and scarring marks on his snout, evident in these two figures (Fig. 19-20).



Figure 20. Same male shown in Fig. 19, from a different camera angle, showing same asymmetrical ghara, and distinctive scarring on the snout, Khera Ajab Singh nesting site guardian.



Figure 21. Panoramic view of Magherapura "turning" just below the Naangaon Temple nesting site. At this location, male 44/46 was captured and tagged as a young, maturing adult male with a small, knob like ghara in November 2013.



Figure 22. Male 44/46, now in 2016, with large, well-developed ghara, is the resident, breeding male at Naangaon Temple site, is shown here basking on an opposite bank. Large ghara is evident and the neck radio attached in November 2013 is clearly visible, attached to neck scutes, as small black rectangle.



Figure 23. Low-lying nesting site, on bank behind the game cameras on tripods at the shoreline, right side of image here. Temple on hilltop, opposite bank, in distance, is white tower (left bank, in distance). In distance on spit of sand jutting from right bank into midriver, a cremation is underway by local villagers when this photo was taken in late afternoon.



Figure 24. Adult female "tracks" at shoreline, and "hatchling" crawl marks from nest site to the water, evident in foreground, at Naangaon Temple nesting site, early June 2016.



Figure 25. Trial nesting at Khera Ajab Singh. In late March, nesting females congregate at colonial nesting sites, characterized by high sand banks adjacent to deep water at their bases. Initially, "test" nest holes are excavated and left open, as shown in this figure. Freshly excavated sand and "belly" prints mark these sites.



Figure 26. Evidence of trial nesting on sand bank adjacent to that shown in Fig. 25. Here, interbedded mud and sand have been disturbed by digging, but no test holes were excavated. Tail and belly marks reveal digging attempts by reproductive female gharials.



Figure 27. Following egg deposition and a two month period of incubation, nesting females visit nest sites just prior to egg excavation. Here, freshly disturbed sand tracks indicate a female has crawled over the nest, but not attempted to excavate it. Presumably, the sound of hatchlings calling from within the nest is a primary signal to the female that the hatchlings are emerging.



Figure 28. Evidence of a freshly-excavated nest with eggshells visible on the surface of excavated sand below the nest hole, located at top of sand disturbance. Location of nest on high sand bank is clearly visible, 10m+ above water line. Khera Ajab Singh, nest site, late May 2016.



Figure 29. Panoramic view from Dinnpura nest site, MP side, 80 km upstream from Yamuna confluence. Village riverside gardens are evident on right side of photo in distance. Extensive village activities were commonplace, within 100m of nesting site.



Figure 30. View from village gardens, looking upstream at nesting bank, containing 19 nests (of which 16 hatched) in 2016. This nesting bank was located within 100m of extensive village riverside activities, including gardening, bathing, clothes washing, and water gathering activities by local villagers.



Figure 31. Freshly-excavated nest located on nesting bank shown in Figs. 29-30. Excavated sand, eggshells, and belly print of attending female evident in foreground, lower left. Dinnpura nest site, late May 2016.



Figure 32. View from below, of nest shown in Fig. 31, showing extensive area of freshly-excavated sand below nest opening, eggshells, belly print of adult female, and multiple tracks of hatchlings, moving on land between the nest opening to the water, at shoreline below nest, bottom of photo.



Figure 33. Pankaj Kumar, main tracker, captures a hatchling in shallow water below the nest site, shown in Figs. 31-32 at Dinnpura nesting site. Village gardens visible in distance at shoreline, upper right in this image



Figure 34. Dead adult female gharial, observed at the Dinnpura nesting site, late May 2016. Local villagers at this site often harassed and threw mud clods at gharial nearby. The cause of death for this female was not determined, but may be related to hostile attitudes toward resident crocodilians by villagers here. In 2015, at nesting time, a large mugger crocodile killed a young boy swimming near a deep pool in this vicinity.



Figure 35. A marked, tagged adult nesting female at the Dinnpura nest site, early June 2016. Several females marked in 2009 and 2010 were observed to nest at this nesting location in subsequent years. Some females shift nest sites from year to year, and others consistently nest at traditional sites repeatedly.



Figure 36. A trial nesting site located 1 km downstream from the Dinnpura nest site. Although digging was evident at this site in 2016, no nests were laid at this location but the site was used in some years previously.



Figure 37. Large, big-ghara male gharial, in shallow water near the Kasaua nest site, prior to hatching in 2016. This male was the guardian male at this nest site, and is shown with hatchlings on his back in Fig. 40. This particular male was very aggressive, and vigorously defended hatchlings whenever they were disturbed.



Figure 38. A small-ghara male was resident near the Kasaua nest site in 2016, but did not venture close to the actual nest site, nor near the creche of hatchlings on the shoreline.



Figure 39. View of excavated nest (foreground) and creche of hatchlings (background, at shoreline) at Kasaua nesting site. In 2016, 14 nests were laid at this site, and all 14 hatched successfully in late May and early June. Guardian females and a single guardian male remained with the hatchling creche for 4-6 weeks until high water resulted in the absence of guarding adults and the creche dispersing. Numbers of young gradually dropped by 25-50% during active defense by adult guardians.



Figure 40. Guardian big-ghara male at Kasaua nest site, with one week old hatchlings covering his back, while he was positioned at the shoreline, in defensive posture. This male remained at this nesting site for 5 weeks following the initial nest hatching on 22 May 2016, the earliest hatch date recorded to date in this study.



Figure 41. Game camera infrared photo of guardian female on shore, at Khera Ajab Singh nesting site. Several hatchlings are evident on the female's back, and others are visible at the shorelines, in front of the female, as well as behind her. Their eyeshines are visible as bright dots in this photo, reflected in the infrared camera flash.



Figure 42. Game camera daylight photo of hatchlings at the shoreline, many with jaws agape. Young gharial hold their heads at 45 degree angle to horizontal, as well as older individuals. This posture may facilitate viewing their surroundings, without interference from their protruding, elongate snouts which may obscure peripheral vision.



Figure 43. Game camera infrared photo of hatchlings at the shoreline, many with jaws agape. Most hatchlings are in shallow water, while others remain on shore, in the distance (eyeshines visible, upper right, this photo)



Figure 44. Game camera infrared photo of guardian male at shoreline, a hatchling climbing on his snout while others swim nearby, or rest at the shoreline. The eyeshines of gharial reflect brightly in the camera's infrared light



Figure 45. Game camera daylight video, still image, showing 3m gharial (dark head emergent, left side of photo) at shoreline, while guardian female (light head emergent, in distance, upper center of photo) remains offshore from the creche at shoreline.



Figure 46. Same video clip, as in Fig. 45, still image, showing 3m gharial snatching hatchling in its jaws, after lunging into center of creche, after stalking hatchling at shoreline. The guardian female (visible upper right of photo, light colored head) immediately chased the intruder away from the creche.



Figure 47. Game camera daylight video, still image, showing 3m gharial (possibly same individual as in Figs. 45-46 above) closely approaching a large yolked hatchling at shoreline, which is immediately in front of intruder's snout.



Figure 48. Same video clip, as in Fig. 47, still image, showing 3m gharial snatching hatchling in its jaws, after lunging into center of creche, after stalking hatchling at shoreline (Fig. 47). The guardian female (visible upper right of photo, light colored head) immediately chased the intruder away from the creche. Soon afterward, the guardian male approached creche and displayed with audible, loud breathing that resonated thru its ghara.



Figure 49. An adult female, outfitted with GPS logging radio (visible on tail, dorsal surface), ashore basking with other nesting females at Baba Singh Gir nesting site in May, 2016. At this site, 14 nests were laid in 2016, but only 6 hatched.



Figure 50. Nest predation by village dogs (visible top nest bank, center of photo) on multiple occasions at Baba Singh Gir nesting site in 2016.



Figure 51. At hatching, adult female approaches village dogs (visible at top of sand bank, upper right of photo). Village dogs preyed on eggs and hatchlings at this site when eggs began hatching in late May 2016. Earlier, at egg-laying, predation by dogs was also recorded. This nesting site was also frequently disturbed by local villagers.



Figure 52. Trackers examine gharial nests located on this mid-river island just upstream from Barsala village (Rajasthan). Nests were positioned on the downstream tip of the island, and successfully hatched in early June 2016.



Figure 53. Sand mining by multiple tractors with trolleys on sandbank on Rajasthan shoreline at Purieni village, by operators from Madhya Pradesh. These trolleys were filled with sand from Rajasthan, and then the tractors driven across the riverbed to destinations in Madhya Pradesh, observed in mid May 2016.



Figure 54. Evidence of tractor activity by sand miners immediately adjacent to hatched nests of gharial at shoreline, on Madhya Pradesh side of river, at Tighra-Rithora turning, 210 km upstream from the Yamuna confluence.



Figure 55. Sand mining in September 2016, soon after water receded, immediately in the post monsoon period when water levels were still high at Tighra-Rithora turning, Madhya Pradesh side of Chambal River.



Figure 56. Sand mining at Tighra-Rithora turning, Madhya Pradesh side of Chambal River, using heavy industrial equipment for loading sand, such as "JCB" backhoes shown here. Sand is moved to high ground near the riverbank, and loaded on large lorries for long-distance transport to major construction sites. Such activity was evident at this site from Sept thru Dec 2016.



Figure 57. Captured and tagged juvenile gharial, with radios attached to identify each one as an individual to be tracked, are released in mid November 2016. A total of 20 gharial were tagged, primarily young animals ranging in size/age from <1m and 6 mons of age, to subadults as well as several adult females.



Figure 58. Jailabdeen A, Project Coordinator, Gharial Ecology Project, prepares to release a subadult gharial outfitted with GPS logger and VHF radio for tracking, November 2016.



Figure 59. Pankaj Kumar, main tracker (in background) observes as subadult gharial is released, with VHF radio for tracking, November 2016.



Figure 60. Catching and tagging camp, Barecha village, on lower Chambal River. By employing local fishermen in multiple years, from 2009 through 2016, a highly-experienced team of skilled local river inhabitants have successfully captured and tagged gharial and mugger crocodiles, from <1m to 5m+ in size, without incident for the Gharial Ecology Project.



Figure 61. Teacher Training Workshop, held in early January 2016, was attended by 25 teachers and additional community members from 25 riverside schools and villages. The main topic was development of education and awareness programs to be conducted in these schools by the teachers following guidelines and suggestions for environmental activities for their students.



Figure 62. Teacher Training Workshop participants engage in various games, such as this environmental version of "snakes and ladders" in preparation for using these activities with their students in village schools located along riversides in the National Chambal Sanctuary.



Figure 63. Follow up visit to Bhawanidasapura village school, by Program Coordinator Dr. Ashutosh Tripathi, as part of the Teacher Training Program conducted in early January 2016.



Figure 64. Follow up visit to Bhawanidasapura village school, by Program Coordinator Dr. Ashutosh Tripathi, as part of the Teacher Training Program conducted in early January 2016. Here, students conduct skits designed to highlight environmental issues affecting local villages within the Chambal Sanctuary.



Figure 65. Follow up visit to Khera Ajab Singh village school, by Program Coordinator Dr. Ashutosh Tripathi, as part of the Teacher Training Program conducted in early January 2016. Here, Ashu leads a discussion of local environmental issues.



Figure 66. Follow up visit to Kasaua village school, by Program Coordinator Dr. Ashutosh Tripathi, as part of the Teacher Training Program conducted in early January 2016. Here, Ashu leads students in an environmental game showing a food chain.



Figure 67. Dr. Ashutosh Tripathi, Program Coordinator, leads a video illustrated discussion in Dhakra village on the lower Chambal River, as part of the Riverside Village Community Visits. This village has a large group of workers engaged in wood cutting, and the value of trees and methods of restoration were topics covered during this early summer visit in late May 2016.



Figure 68. Another view of the community program showing video illustrated discussion in Dhakra village on the lower Chambal River, as part of the Riverside Village Community Visits.



Figure 69. Training Workshop for Uttar Pradesh Forest Department frontline staff, including local guards and rangers tasked with protecting the flora and fauna in the National Chambal Sanctuary. Participants included 14 UPFD staff, including new recruits that were in initial training for their jobs.

UPFD Training 69



Figure 70. Participants included 14 UPFD staff, including new recruits that were in initial training for their jobs. Workshop was held during Wildlife Week in early October at the Garhaita base for the Gharial Ecology Project, over two days.

UPFD Training 70



Figure 71. UPFD Workshop included sessions on identification of the local reptiles, including turtles and snakes, as well as other topics related to environmental protection in the National Chambal Sanctuary.



Figure 72. UPFD Workshop included sessions on identification of the local reptiles, including turtles and snakes. Here, Jailabdeen A., Project Coordinator for the Gharial Ecology Project, demonstrates how to capture a snake with a snake hook, and do it safely, without injuring the snake or the person catching it.



Figure 73. UPFD Workshop participants included new recruits, and field sessions included a boat trip on the Chambal River, and demonstrations of radio telemetry being used to track gharial up and down the river during the seasonal cycles of dry and wet periods. Pankaj Kumar, main tracker on the Gharial Ecology Project, explained the life history of resident gharials.



Figure 74. UPFD Workshop participants included new recruits, and field sessions question Pankaj Kumar, main tracker on the Gharial Ecology Project, about the animals and plants in the National Chambal Sanctuary.



Figure 75. UPFD Workshop participants included new recruits, and field sessions discuss with Pankaj Kumar, main tracker on the Gharial Ecology Project, how he studies gharial ecology.



Figure 76. UPFD Workshop participants included new recruits, Here, these new recruits receive their workshop credentials at the conclusion of the two day workshop by the riverside during the field trip.



Figure 77. A two hour presentation to the senior students at the Saint Vivekanand Public School, an elite secondary school in Etawah by members of the Gharial Ecology Project team. Here, Dr. J.W. Lang, Project Advisor, is welcomed by the school staff.



Figure 78. Senior students at the Saint Vivekanand Public School, an elite secondary school in Etawah listen as Dr. J.W. Lang, Project Advisor, talks about the research program he has conducted with Indian staff since 2008 in the National Chambal Sanctuary on the critically endangered resident gharials.



Figure 79. Senior students at the Saint Vivekanand Public School, an elite secondary school in Etawah listen as Dr. J.W. Lang, Project Advisor, answers questions following his talk.



Figure 80. Senior students at the Saint Vivekanand Public School, an elite secondary school in Etawah listen as Jailabdeen A., Project Coordinator for the Gharial Ecology Project discusses the identification and natural history of local snake species.



Figure 81. View of the Gharial Ecology Project booth at the International Bird Festival, held in conjunction with Chambal Safari, and the Uttar Pradesh Forest Department, Dec 1-3 in 2016, the second year of this gathering of international and regional birders and environmentalists. This festival attracted >1000 participants from all over India and the south Asian region, as well as many international birders.



Figure 82. View of the Gharial Ecology Project booth at the International Bird Festival, held in conjunction with Chambal Safari, and the Uttar Pradesh Forest Department, Dec 1-3 in 2016. Dr. Ashutosh Tripathi, Program Coordinator for the Gharial Ecology Project organized and constructed the informaton booth and staffed it for the three day festival, meeting and talking with many visitors.



Figure 83. View of the Gharial Ecology Project booth at the International Bird Festival, held in conjunction with Chambal Safari, and the Uttar Pradesh Forest Department, Dec 1-3 in 2016. The 5 min video summary of the gharial research activities were playing continuously in the booth, and school groups, such as shown here, visited and asked many questions to Dr. J.W. Lang



Figure 84. View of the Gharial Ecology Project booth at the International Bird Festival, held in conjunction with Chambal Safari, and the Uttar Pradesh Forest Department, Dec 1-3 in 2016. The booth was manned by Dr. Ashutosh Tripathi, Jailabdeen A., Hari Meena, and Dr. J.W. Lang, and local NGO staff.



Figure 85. Dr. J.W. Lang, Gharial Project Advisor, explains the life history of Chambal River gharial to senior secondary students in Seven Hill College at the confluence of the Yamuna and Chambal Rivers where the students held a field trip that included bird watching, identification of aquatic fauna, such as dolphins and turtles. The field trip included a segment called "Meet the Scientist" in which project staff demonstrated tracking methods.



Figure 86. Dr. J.W. Lang, Gharial Project Advisor, explains the life history of Chambal River gharial to senior secondary students in Seven Hill College at the confluence of the Yamuna and Chambal Rivers where the students held a field trip that included bird watching, identification of aquatic fauna, such as dolphins and turtles. The field trip included a segment called "Meet the Scientist" in which project staff demonstrated tracking methods.



Figure 87. Dr. J.W. Lang, Gharial Project Advisor, explains the life history of Chambal River gharial to senior secondary students in Seven Hill College at the confluence of the Yamuna and Chambal Rivers where the students held a field trip that included bird watching, identification of aquatic fauna, such as dolphins and turtles. The field trip included a segment called "Meet the Scientist" in which project staff demonstrated tracking methods.



Figure 88. Project staff pose with senior secondary students in Seven Hill College at the confluence of the Yamuna and Chambal Rivers where the students held a field trip that included bird watching, identification of aquatic fauna, such as dolphins and turtles. The field trip included a segment called "Meet the Scientist" in which project staff demonstrated tracking methods.



Figure 89. Follow up session at village school in Bahuri, a riverside village where one of the school teacher who attended the Teacher Training Workshop in early 2016. Students are playing an eco-themed game similar to "Snakes and Ladders."



Figure 90. Follow up session at village school in Bahuri, a riverside village where one of the school teacher who attended the Teacher Training Workshop in early 2016. Students are planning to conduct a skit showing interactions with nature.



Figure 91. Local community program in riverside village close to Chambal-Yamuna confluence. These programs were typically attended by nearly everyone in the village, from young children to elderly residents. Videos and slide presentations were followed with refreshments and discussion of the environment.



Figure 92. Local community program in riverside village of Amdapur close to Chambal-Yamuna confluence. These programs were typically attended by nearly everyone in the village, from young children to elderly residents. Videos and slide showings were followed with refreshments, discussion of the environment.



Figure 93. Regional Wildlife Warden Suresh Chandra Rajput, presenting a talk to community participants at World Earth Day Celebration.



Figure 94. A screen shot of the FACEBOOK page for the Gharial Ecology Project, showing sample video on the overall research strategy and working examples of various activities, such as catching and tagging gharial, and tracking gharial seasonally.



Figure 95. A news report based on an interview with Dr. Lang, Gharial Project Advisor, by a Times of India reporter at the Bird Festival, 1-3 December, 2016. The reporter chose to highlight the threats to Chambal gharial resulting from sand mining.



Figure 96. A news report on project research by the Gharial Ecology Project, conducted since 2009 by a Times of India reporter based on an interview with Dr. Lang at the Bird Festival, 1-3 December, 2016. The article highlights a census by the UPFD of gharial emphasizing the importance of Chambal.



Figure 96. Dr. J.W. Lang presented a seminar on "Crocodilian Superdads: Gharial on the Chambal in north India" to students and staff at Jiwaji University, Gwalior. University students were biology majors, and post grad students in ecological research. The host, Professor R.J. Rao is Rector at JU, and a long time researcher on the Chambal, on gharial and river ecology.



Figure 97. Dr. J.W. Lang presented a seminar on "Crocodilian Superdads: Gharial on the Chambal in north India" to students and staff at Jiwaji University, Gwalior. Here, in a discussion following his talk, he answers questions and discusses research.



Figure 99. Dr. J.W. Lang presented a seminar on "Crocodilian Superdads: Gharial on the Chambal in north India" to students and staff at Jiwaji University, Gwalior. Here, in a discussion following his talk, he answers questions and discusses research.



Figure 100. Dr. J.W. Lang presented a seminar on "Crocodilian Superdads: Gharial on the Chambal in north India" to students and staff at Jiwaji University, Gwalior. Here, in a discussion following his talk, he answers questions and discusses research.



Figure 101. Dr. Ashutosh Tripathi, Project Coordinator, conducts a follow up session in school classroom as part of the Teacher Training Workshop conducted earlier in January 2016. The village school is located in Miholipaar on the lower Chambal.



Figure 102. Dr. Ashutosh Tripathi, Project Coordinator, conducts a follow up session in school classroom as part of the Teacher Training Workshop conducted earlier in January 2016. The village school is located in Miholipaar on the lower Chambal.



Figure 103. Dr. Ashutosh Tripathi, Project Coordinator, conducts a community village program in Nimadanda on the middle Chambal. Videos and slide presentations are the major focus of these programs. Here, he distributes handouts on river fauna.



Figure 104. Dr. Ashutosh Tripathi, Project Coordinator, conducts a community village program in Nimadanda on the middle Chambal. Videos and slide presentations are the major focus of these programs. Here, he distributes handouts on river fauna.



Figure 105. Dr. Ashutosh Tripathi, Project Coordinator, conducts a community village program in Gohera on the middle Chambal. Videos and slide presentations are the major focus of these programs. Here, a slide show highlights the river environment.



Figure 106. Dr. Ashutosh Tripathi, Project Coordinator, conducts a community village program in Gohera on the middle Chambal. Videos and slide presentations are the major focus of these programs. Here, he discusses the local Chambal River fauna.



Figure 107. Villagers watch a 5 min video in HINDI, showing the major activities of the Gharial Ecology Project, conducted near the village of Gudha (shown here) where tagged gharial spend the winter months, at upstream locations used for nesting.



Figure 108. Villagers watch a 5 min video in HINDI, showing the major activities of the Gharial Ecology Project, conducted near the village of Gudha (shown here) where tagged gharial spend the winter months, at upstream locations used for nesting.



Figure 109. Follow up visit by Gharial Ecology Project staff to a nearby town secondary school where students are performing activities on local environmental topics, the result of their teacher attending the Teacher Training Workshop. This school is located in Udi, a regional center for the surrounding agricultural areas, many of which are in the catchment of Chambal River.



Figure 110. Follow up visit by Dr. Ashutosh Tripathi to a nearby town secondary school where students are performing activities on local environmental topics, the result of their teacher attending the Teacher Training Workshop. This school is located in Udi, a regional center for the surrounding agricultural areas, many of which are in the catchment of Chambal River.



Figure 111. Primary school students prepare to enact a skit, based on environmental themes, in village school in Garhaita, the village where the Gharial Ecology Project is based. This program was held on 21 January 2017 by Dr. Ashutosh Tripathi.



Figure 112. Primary school students participate in class discussion, based on environmental themes, in village school in Garhaita, the village where the Gharial Ecology Project is based.



Figure 113. Primary school students thank project staff for holding a learning session, in village school in Garhaita, the village where the Gharial Ecology Project is based.



Figure 114. Primary school students enact a drama with a skit, in village school in Garhaita, the village where the Gharial Ecology Project is based. The skit focuses on net fishing, wood cutting, and sand mining in the National Chambal Sanctuary, and the effects of these illegal activities on local fauna and flora.



Figure 115. Primary school students met and greet Ms. Zahida Whitaker, Director, Madras Crocodile Bank Trust in primary school in Garhaita, the village where the Gharial Ecology Project is based. The Director and Assistant Director visited the project in late January 2017.



Figure 116. Ms. Zahida Whitaker, Director, MCBT, and Assistant Director, Ms. Yamini Bhasker, discuss school programs with Dr. Ashutosh Tripathi, Project Coordinator, at Garhaita village school, near the project headquarters.



Figure 117. Riverside village program on lower Chambal River in Baroli village. School age children perform a skit based on environmental themes, and role play about various village activities that take place along the river, such as net fishing, wood cutting, sand mining that affect local fauna and flora.



Figure 118. Riverside village program on lower Chambal River in Baroli village. School age children perform a skit based on environmental themes, and role play about various village activities that take place along the river, such as net fishing, wood cutting, sand mining that affect local fauna and flora.



Figure 119. Riverside village program on lower Chambal River in Baroli village. Dr. Ashutosh Tripathi discusses the role of forests in providing habitats for Chambal birds and mammals.



Figure 120. Riverside village program on lower Chambal River in Baroli village. A video produced in HINDI shows the research about how project staff attach a radio for tracking gharial.



Figure 121. Riverside village program on lower Chambal River in Pachhagaon village. A skit is performed by school children showing the spearing of turtles, an illegal activity that threatens the continued survival of threatened and endangered species.



Figure 122. Riverside village program on lower Chambal River in Pachhagaon village. Dr. Ashutosh Tripathi discusses how the Chambal River needs protection from sand mining and fishing.



Figure 123. Riverside village program on lower Chambal River in Pachhagaon village. Video shows the research on gharial that includes catching and tagging gharial for tracking throughout the year, to record behaviors and activities during wet and dry seasons.



Figure 124. Riverside village program on lower Chambal River in Pachhagaon village. Slide presentations on environmental issues help illustrate the role of local people in Chambal conservation. Note the many school age children attending evening programs.