

INDIAN GHARIAL CONSERVATION

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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, and teaches frontline staff about river ecology.

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

The major activities for this component in 2017 were: 1) tracking gharial tagged in 2016 and previously, 2) recovering GPS loggers from gharial, tagged previously, 3) making detailed observations on breeding behaviours, from courtship through hatching 4) studying gharial communication, primarily acoustic signaling by adult breeding males, as well as interactions of guardians at the crèches and hatchling communications, 5) crèche related behaviors at colonial nest sites, 6) genetic studies of relatedness of the Chambal population and amongst individuals at crèches, from siblings to guardians, 7) population estimates of adults and nests, 8) nesting success, relative to previous years, 9) importance of Chambal gharial relative to other extant populations worldwide, 10) current conservation status of gharial globally, and 11) necessary actions for gharial in Nepal. City of Prague / Prague Zoo funding provided major support for all of these related conservation activities relevant to the Chambal gharial population. Additional support was provided by international zoos & NGOs

Training Component: Program Coordinator, Training Workshops, Education Programs

In 2017, 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, from 2009-2015. In 2017, the major focus of the capacity and community programs was in Rajasthan, a 1-2 day trip by vehicle from our base near Etawah in UP. He conducted two capacity building workshops in Rajasthan, plus a Teacher Training Course, as well as making visits to village schools and conducting community programs in 15+ rural riverside villages. In addition to the Rajasthan programs, local programs were conducted in the lower Chambal, including several wetland and wildlife week celebrations, a capacity building workshop for two ranges along the lower Chambal, as well as a Teacher Training Course near the confluence, and visits to village schools and village communities for river ecology presentations.

ECOLOGY COMPONENT

BACKGROUND

The Gharial Ecology Project, also known as the Gharial Telemetry Project, and summarized in Lang & Kumar (2013, 2016), was designed to investigate the mass die-off of gharials in the 2-4m size class, totaling 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 50-210+ 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 small residencies of 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. Initially, this was a three year permission, through 2016. The project work and permissions from the Gov't of India have been extended through 2017 to 2019.

Support from the City of Prague / Prague Zoo partially funded previous tagging and monitoring of radioed animals in 2013 through 2016. This report briefly outlines various activities conducted for the Gharial Ecology Project in 2017, funded in part with City of Prague / Prague Zoo funding. These activities include an ecological component, for which an earlier update was provided (Lang and Kumar, 2016) included 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 following narrative indicates the ecological studies underway during 2017, and includes images showing some of these activities. Detailed supporting materials, including reports and publications are provided as supplementary documentation (Appendices provided in separate folder). In 2017, the Gharial Ecology Project continued in two major phases: a) monitoring radioed animals from late 2016, as well as small numbers from previous taggings (2014 and 2015). Tracking and behavioral observations were carried out throughout the entire year, from January thru December. Furthermore, b) gharial of different size/sex/age were recaptured to remove radios in late 2017, and selected additional animals were radiotagged for monitoring and observation during 2018-2019.

LONG DISTANCE, SEASONAL MOVEMENTS

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. 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 2013-2016 have routinely moved upriver and downriver over distances >200 km every season. These seasonal movement patterns are specific to individuals and are typically repeated year after year, primarily by multiple adult females for nesting. Subadults, both males and females are known to make similar seasonal movements upstream and downstream, but usually are much more restricted to small residencies that change little annually.

TRACKING RADIO-TAGGED GHARIAL

The City of Prague/Prague Zoo grant in 2017 supported the year long monitoring for the gharial tagged in November 2016. A total of 28 gharial were tagged in late 2016, and as of end of 2017, 22 of these had been successfully followed throughout the entire annual cycle. For the other 4 animals, half year records were obtained, before they were no longer found during routine tracking. The major focus in tagging the 2016 group of individuals was to radiotag smaller gharial, from 6 months of age through the first 5-6 years, in an effort to understand the spatial ecology of these smaller, younger animals.

The catching / tagging operation was conducted primarily in the lower Chambal, from its confluence with the Yamuna at Bareh, to a point approximately 50 km upstream, near the Udi bridge crossing, above Khera Ajab Singh. A total of 3 yearlings (~6 months of age, hatched in late May-early June 2016) were tagged, along with 2 two year olds, 6 three to five year olds, and 11 juveniles, aged 4-6 yrs old. Of these 22 younger gharial, all but 4 were tracked throughout the entire year, from Jan thru Dec 2017. The other 4 were followed for at least half a year, and several of these for 9+ months, before disappearing from the routine tracking logs.

As hypothesized, these smaller individuals all had very well defined and generally small activity areas and restricted movement patterns, remaining within a 5-10 km section of river shoreline. A few juveniles made major shifts soon after release, but then remained in the areas that they moved to for the remaining months. Nearly all of these small gharial did not shift appreciably during the high water, monsoonal months of July through September, but rather stayed in place in section of river which each inhabited during long dry season, from October thru June.

The relatively high rate of recovery and ability to track continuously throughout 2017 in its entirety suggests that the survivorship of the smaller age classes is high, and that mortality is much lower for gharial of >0.7-1.0m+ in total length, than for smaller, younger ones, presumably subject to higher predation rates during the immediate post hatch, pre-monsoon, as well as during the monsoon months of high water.

The older gharial tagged in late 2016 consisted of 4 subadults (2 males; 2 females). They all showed very restricted residence patterns that varied little with seasonal water levels. All were tracked successfully throughout most of 2017. The two larger near adult sized females, which were 3.0-3.2m total length, did not join breeding or nesting groups of females as was typical of reproductively active females, but these did visit breeding and nesting areas in 2017. Both remained close to where they were tagged, and showed restricted movement patterns.

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.

We are presently doing detailed analyses of the movement patterns of the GPS equipped gharial, tagged in 2014 and in 2015, and continue to track a few of the 2015 individuals during 2017, as well as the majority of GPS equipped (9 in total) gharial tagged in late 2016. Another subadult female, F43 with a damaged, shortened snout (as a result of injury related to illegal fishing) 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. This individual was targeted for recapture to recover the GPS, in order to diagnose some malfunctions, and she was caught and the GPS radio removed and downloaded, to provide a detailed, daily location record spanning a two year period, from November 2015 through November 2017.

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. In 2016, at one such location, Rhea, a resident, older male with a distinctive twisted ghara was challenged by another large ghara male. These two males engaged in stereotyped assertive displays, involving parallel and head to tail, side by side swimming, sparring 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. In 2017, a much longer prolonged contest between this same older male and possibly the same challenger lasted almost 2 hours late in the afternoon in late February. Apparently the older male prevailed, and was observed at the breeding site, and later at the nesting site nearby when the young hatched. This older male was the sole guardian at the crèche in 2017.

A similar prolonged contest between an established resident breeding male, and a challenger male was observed at Maghrapura in 2017 in late February, but soon afterward, the resident male established a breeding area, and patrolled a 500m stretch of river shoreline that contained his breeding arena. Older, larger reproductive females from this breeding group apparently nested upstream at a colonial site presided over by a younger male, and downstream at another colonial site where a guardian male resided.

In late February and early March, typically the last week in February and the first week in March, breeding behavior at all of the breeding sites intensifies markedly, and females resident within each of these areas become receptive, approaching and courting, and eventually copulating with the single, resident “big-ghara” dominant male that is the exclusive breeding male at each location. Other males, on occasion, challenge the resident breeding male, but usually a chase ensues, and the challenger is ushered out of the area, sometimes with assertive tail wagging and body surfing displays by the dominant male. The actual day to day courtship and mating seems to be sequential, such that a receptive female spends 1-2 days in close proximity of the breeding male, courting and mating frequently, then another female takes her place. It is possible that individual females court and mate with more than one male each season, but to do this, the female would have to visit one male, and then move to another breeding area where another breeding male was resident.

In mid March, trial nesting began at likely nesting areas, and open nest holes were evident at these communal, egg laying sites. 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.

GHARIAL COMMUNICATION: ACOUSTIC STUDIES

The City of Prague / Prague Zoo support provided a Project Coordinator position filled by a PhD student whose research has focused on acoustic communication in gharial. Living crocodilians communicate using visual, acoustic, chemical, and/or tactile signals. As adults, gharials vocalize only rarely, sometimes when handled or caught in a net, and also reportedly do not produce infrasound. Jailabdeen A. has been studying communication in wild, free-living gharial living in an open river habitat on the Chambal River in north India. His project is a subproject of the Gharial Ecology Project.

Male gharial produce an explosive, concussive “pop” sound underwater, in 1-3 short, loud audible bursts, referred to hereafter as syllables. A “pop” is always sudden and high volume, resembling a stoppered bottle being opened rapidly, like a wine bottle being uncorked. In this study, the acoustic “pop” is described for the first time, its signal parameters are identified, and the behavioral contexts in which the “pop” is produced are outlined in detail. The mechanism of sound production is unknown, but may involve the large, bulbous and cartilaginous “ghara”, a sexually dimorphism only on the snout-tip of adult males, possibly functioning as a sound resonator. Infrasound is produced immediately before a single or multiple pops are performed underwater.

Using hydrophones and aerial mics, the “pop” signals of 15+ adult male gharial were recorded, and resulted in 328+ examples of “pops” obtained during peak breeding in Feb-Mar 2017.

Spontaneous recordings were obtained as gharials behaved normally under natural conditions. Males performed pops in response to external disturbances, in communication exchanges with other males, and during courtship with females. During crèche formation, pops performed by a guardian male, alerted and recruited hatchlings, and presumably communicated his presence and location to nearby females participating in attending and guarding 100-1000 young at nest sites.

Each male displayed a characteristic repertoire of “pop,” performed in a consistent and stereotypical manner, unique to each individual male. The “pop” or syllable duration ranged from 0.013 to 0.023 seconds, and the time interval between syllables ranged from 0.103 to 0.555 seconds. The pattern of “pops” consisted of 1, 2, or 3 pops. Distinctive low and high frequencies were characteristic of each pop, ranging from >100-2400 Hz to >10,000-22,000 Hz. Signal parameters are being analyzed using various acoustic software packages, as detailed in literature.

A poster was presented in October 2017 at an International BioAcoustics Conference in India, and another updated poster is being presented at the 2018 CSG Mtg in early May in Santa Fe, Argentina,

CRECHE ATTENDANCE AND HATCHLING GUARDIANS

During the nesting season in 2017, a concerted effort was made to monitor nine large creches in the lower Chambal for daily evidence of nest emergence, and the resultant crèche formation at each site. Three to four selected large colonial nesting sites were monitored 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 creche, 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. 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. Creches 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.

Importantly, these creche observations in 2017 confirmed 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.

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 creche of young. When major threats occur to the hatchlings, the male replaces the dominant female at the creche, and displays his presence with acoustic jawclaps, and loud exhalations that resonate through the large, cartilaginous ghara at the tip of his snout.

In 2017, a number of observation teams fanned out during the hatch-post hatch period, and daily observations were made at nine colonial nest sites within 1-2 hours by motorcycle or jeep, from our base on the lower Chambal. Detailed location maps were recorded every day, and notes were taken on the number of nests hatched at each site, as well as a daily census of the number of hatchlings, and how they were assembled in groups, usually with adult guardians, at each location.

As part of the on-going acoustic studies, we made nightly and sometimes daytime continuous recordings, underwater and above water, at selected sites, and combined these acoustic observations with visual, video recordings to relate the various behaviors of the hatchlings and adults to the acoustic signals that were being produced. Action cameras were modified to take 12-24 continuous video recordings, so that predation attempts by diurnal wading birds can be documented, and detailed responses of multiple guardians related to suspected predation events.

GENETIC STUDIES ON CHAMBAL GHARIAL: POPULATION & INDIVIDUAL RELATEDNESS

In 2017, the Gharial Ecology Project partnered with Dr. Karthikeyan Vasudevan, Director at the Laboratory for Conservation of Endangered Species, at the Centre for Cellular and Molecular Biology, CSIR, Hyderabad to conduct detailed genetic analyses of the lower Chambal gharial population which is the subject of the detailed ecological and behavioral studies as the major project focus. A site visit by Dr. Vasudevan and a prospective PhD student, Ravi Singh in 2016 resulted in a full fledged effort by the student to participate fully in the field work during the 2017 hatch and post hatch period.

Consequently, all of the eggshells from hatched and unhatched eggs collected at each nest as it hatched, at each of the nine colonial sites resulted in the collection of over 3000+ samples of egg materials from more than 110 nests during the 2017 hatching period. These samples were air dried, and bagged individually, so that nest assemblages, as well as individual eggs within each nest could be examined, treated to isolate DNA from each egg/eggshell, etc. In addition, it was possible to selectively sample some of the adults at each site, so that representative male and female guardians can be genotyped. At present, the DNA that is recoverable from the egg/eggshell fragments is abundant, and will provide adequate samples for detailed genetic analyses to be done.

During the catching and tagging procedures, carried out on resident wild gharial of various sizes/ages/sizes, the tail scutes which are routinely removed for permanent marking of individuals were recovered and labeled, and air dried, and catalogued to be used to establish the average relatedness of random, individual animals within the resident population to each other. This procedure will allow us to establish a baseline of "relatedness" among seemingly unrelated individuals, and also by genotyping the younger, juvenile segment of the population, it will be possible to relate these surviving individuals, amongst the hundreds and thousands of hatchlings produced along the lower Chambal each season, to be distinguished and possibly related to possible parents among the established breeding population of reproductive adults, both male and female.

A poster is being prepared by the PhD student for presentation at the 2018 CSG Meeting in early May in Santa Fe, Argentina.

FIELD REPORT: POPULATION SIZE & NUMER OF NESTS, NATIONAL CHAMBAL SANCTUARY

During January---March 2017, various surveys were conducted to make actual counts of gharial in the National Chambal Sanctuary (NCS), between Pali, 425 km upstream from the Yamuna---Chambal confluence and Bareh at the confluence. In the lower Chambal, immediately prior to the boat survey, 861 gharial were directly observed and tallied by the static survey. These consisted of 47 males, 345 females, 232 subadults, 158 juveniles, and 79 yearlings. On the exact same stretch of lower Chambal, the boat survey counted 541 gharial, consisting of 38 males, 376 females, 41 subadults, 59 juveniles, and 27 yearlings. Thus, the overall number of gharial living on the 414 km of Chambal River surveyed is 1316 in late January, and 1216 in late February. This includes 72 mature males (with ghara), 545 "females," 365 subadults, 217 juveniles, and 117 yearlings. In 2016, we counted 203 nests at 17 sites, of which 174 nests hatched at 15 sites on the 210 km stretch from Tigri--- Rithora to Kasaua (Sankri in MP). In 2017, on this same stretch, we tallied a total of 232 nests at 15 sites, at which 186 hatched at 14 sites. In 2017, a total of 411 nests at 26 sites were recorded in 414 km of NCS, of which 352 nests hatched and 59 nests were lost. This includes 179 nests at 11 sites from the upper stretch, and 232 nests from 15 sites in the lower stretch. Our best estimate of the number of reproductive females in the 414 km of NCS surveyed in 2017 is 442, based on direct counts, adjusted to account for males in the 3---4m category, and the number further adjusted to account for non---reproductive females in this size/age category

This report establishes that on a 414km stretch of the NCS from Pali to the Yamuna confluence, the most conservative estimate of the adult gharial population is 72 males with gharas (>4.5m) based on direct actual counts, and at least 411 reproductive females, based on the number of nests counted in 2017, immediately after hatching. Thus, we estimate very conservatively a total of 483 mature adults. Furthermore, these data firmly establish that this minimum estimated population inhabits ALL of the 414 km of NCS surveyed where they reside most of the year, and also nest from Pali to Kasaua, at a minimum of 26 sites identified in nest surveys.

NESTING SUCCESS ON THE LOWER CHAMBAL

Nesting effort has been monitored for the past seven 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. 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.

In 2017, on the same stretch of lower Chambal (as noted above), a total of 232 nests were recorded from 15 sites, of which 186 hatched at 14 sites (Table 4, Field Report, cited above). As in 2016, hatching began about a week earlier than in most previous years in which it was monitored, and this related to an earlier overall nesting period in primarily in late March, rather than early April. Notably, in 2017, the total number of nests estimated to be in the upper stretch, not closely monitored in previous years, was 179 nests at 11 additional sites, of which 166 hatched at 11 sites. Our best estimate of the total nests on the mainstem Chambal, spanning 414 km from Pali to Bareh, was 411 nests at 26 sites in 2017.

During the past three 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.

IMPORTANCE OF CHAMBAL POPULATION, RELATIVE TO EXTANT GHARIAL ELSEWHERE

In 2017, in addition, above Pali to the Kota Barrage on the mainstream Chambal, 11 adults were tallied in the top 143 km of the NCS (H. Meena, pers. comm. 2017), we estimate an additional 10-15 mature adults inhabit the stretches of the Parvati and Banas in the areas surveyed in this study. Thus, the total population in the Chambal likely exceeds 1300 non-hatchling Gharial of all sizes, adding an additional 20+ mature adults to those already counted in the Chambal mainstream.

Importantly, our observations in the Parvati add 4-6 nests to the estimated nest tally in 2017 on the Chambal, based on combined surveys on the upstream (WII 2017) and downstream (GEP 2017) main channel of the Chambal. The nesting observed in 2017 was 411 nests along the 415 km stretch of Chambal from Pali (upstream) to Kasaua (downstream) plus 4-6 nests on the Parvati, resulting in a total of ~415+ nests overall, all of these lying within the NCS boundaries.

Not only does our study highlight the importance of the upstream segments of the NCS, as suitable Gharial habitats and important water sources, but the Gharial counts of breeding adults and nests from the Parvati surveys add to the emerging picture of how many Gharial actually live in the Chambal River, largely within the confines of the NCS.

In 2017, independent surveys by the Madhya Pradesh Forest Department and the Gharial Ecology Project, using different methodologies (boat counts vs. stationary counts, respectively), estimated that the mainstream Chambal River, from Pali upstream in Rajasthan to the Yamuna confluence (a river length distance of 415 km), contains a Gharial population >1250 individuals, with conservative counts of 617-761 mature adults (ie 65-121 males and 491-696 females; MPFD 2017; GEP 2017). Further information on the importance of the upstream tributaries of the Chambal to the National Chambal Sanctuary is discussed in Khandal et al. 2017 appended to this report.

GLOBAL STATUS OF GHARIAL: CRITICALLY ENDANGERED in 2018

In 2007, the IUCN Red List assessment for gharial determined that there were estimated to be less than 200 mature reproductive adults worldwide, and on this basis, the criterion for being listed as CRITICALLY ENDANGERED was met, and the species status was thereby determined. Shortly after the 2007 uplisting to “CE”, the mass die off occurred in the Chambal population, and the situation became even more dire. Fortunately, despite the loss of an estimated 110+ gharial in the die-off, the vast majority of these were subadults, not old enough to be reproductively active at the time of death, so the overall impact of the late 2007-early 2008 mortality event did not appear to affect successful recruitment in the years immediately after the die-off.

Careful and systematic monitoring of the Chambal population now indicates that a conservative estimate of mature, reproductive adults is 500+ individuals, a number which no longer automatically qualifies the species to be classified as “CE” strictly on the basis of numbers alone. Rather, the basis now for maintaining gharial as “CE” on the IUCN Red List is the extent to which the historical numbers worldwide have been reduced, and/or the extent to which the historical range worldwide has been reduced, relative to the present range and/or numbers extant today.

Using the current encounter rate of approximately 1 gharial per river km as a realistic estimate of former abundance of gharial in large, open river habitat, the calculated estimate of river kms inhabited by gharial historically was >20,000 km in the Indus-Ganges-Brahmaputra systems, plus several other regional drainages (Mahanadi-Brahmini; Irrawaddy systems). Thus, historical numbers may have been in the range of 20,000 mature, reproductive gharial. Worldwide, the extant gharial populations number 6 populations, which show some indication of reproduction, now and/or in the recent past. Taken together, the total number of gharial is estimated at 650-750, of which at least 500 are presently residing in the Chambal River. All of the other populations number about 50 mature adults, or less., in 5 locations, other than the Chambal.

The relative importance of the Chambal gharial population cannot be overstated. With more realistic estimates of the sizes of the other subpopulations, totaling approximately 650-750 total adults globally, then the Chambal population comprises ~85% of the global total. Likewise, the Chambal population probably represents >90% of the known nesting globally. Importantly, the Chambal gharial population is the ONLY population living in an open river, protected habitat. Threats to the Chambal population are presently, in order of importance, a) major disruptions to natural river flow, such as dams and/or river linking sand mining, b) water extraction, c) sand mining, and d) net fishing. The full Red List Assessment for gharial status in 2018 is appended.

NEPAL GHARIAL CONSERVATION: DOING THE NEEDFUL=SCIENCE + IN-SITU ACTIONS

In recent months, in addition to preparing the 2018 Red List Assessment, I have been involved in reviewing the gharial situation in Nepal, and making recommendations about how the gharial conservation efforts there need to be refocused on the last remaining, breeding wild population at Chitwan National Park, before it is too late. In 2016, I made two research trips to Nepal to learn about gharial studies there, and meet with principal personnel in govt and NGOs. In 2017, I reviewed the situation, and made suggestions on what needed to be done, moving forward. I have just participated in a CSG review of the Nepal Gharial Action Plan, 2018-2022, and also hosted a young investigator proposing to do a study modeled on our work on the Gharial Ecology Project, on the Chitwan wild gharial population, and also study possible release strategies to determine the most effective way to conduct releases of the overload of head started captive gharial now in Nepal at the Kasara Gharial Conservation and Breeding Center, supported by taking eggs from wild nests.

For more information on gharial conservation in Nepal, see the appended article on Nepal gharial.

CAPACITY BUILDING & TRAINING COMPONENT

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 program in 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, in each and every year through 2017. The major support of the City of Prague / Prague Zoo for this capacity building, school, and community work has been critical to sustaining and expanding these programs. A large share of this dedicated support is to provide consultancy fees for the planning and execution of this component.

PROGRAM COORDINATOR

During 2017, the Program Coordinator, Ashutosh Tripathi has continued to work in conjunction with the Gharial Ecology Project. He has been engaged in capacity building workshops and training sessions for frontline guards 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 concerned Forest Departments, as well as a critical education training program for elementary school teachers in the districts along the National Chambal Sanctuary. The teacher training workshops provide rural village teachers with the knowledge and resources to develop and teach environmental education, particularly about the Chambal River and the important role of the National Chambal Sanctuary (NCS) for the conservation of native wildlife. These teacher workshops are then followed up with class room visits to each of the rural schools in the local villages along the river. When visiting each village, local community programs, involving video and graphic presentations are held in the afternoons and evenings in village common areas, and snacks are provided, and discussion and conversation encouraged about the important role of the river in the lives those who live and work along its banks. 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 Chambal ecosystem.

FOCUS in 2017 on RAJASTHAN TRAINING AND EDUCATION in RIVERSIDE VILLAGES

In previous years, most of the work with local staff, schools, and communities was centered in the two riverside states of Madhya Pradesh and Uttar Pradesh, with many of the venues relatively close, within several hours travel, of the regional towns of Etawah and Bhind, and close to our base of operations for the Gharial Ecology Project, located in a riverside village, about 40 kms away.

In 2017, with the recent initiatives from the Rajasthan Forest Department for enforcement and wildlife protection within the National Chambal Sanctuary, a special effort was made to develop and conduct programs for this component at some distance, within 1-2 days travel by vehicle, bus, motorbike from our base near Etawah, in Uttar Pradesh. This focus has meant considerably more time in planning and travel preparatory to conducting the various programs, and then when the work underway, living arrangements to stay in the local areas for days, weeks to conduct these visits. The two regional centers were at Sawai Madhopur, near the Ranthambore National Park, close to the top end of the NCS, two days from the Etawah base, and at Dholpur, about half way up the NCS, a full day's trip from the base. Work in both areas involved long travel times and over-nights, in order to allow sufficient time for rural school and community visits in riverside villages.

FOREST DEPARTMENT WORKSHOPS: SAWAI MADHOPUR & DHOLPUR in RAJASTHAN

On May 3, 2017, a capacity building workshop for frontline forest department staff was jointly organized by Gharial Ecology Project with the National Chambal Sanctuary Project, Sawaimadhupur Division, Rajasthan. The objective of the workshop was to enhance the capacity and skills of 42 participants including forest officers, foresters, and forest guards from Keshori Patan, Itawa, and Palighat range of NCS. Setting up this workshop involved two visits to Sawai.

List of the selected sections of the workshop: 1. Survey techniques for river reptiles including crocodilians and river turtles, wetland birds and aquatic mammals (river dolphin), 2. Rescue and release of wild crocodiles from human settlements, 3. Indian Wildlife Protection Act 1972, 4. facilitation briefing (attitude when dealing with the community, 5. Community dealing (for conservation/issues and solution) in NCS.

On 22 August, a capacity building workshop for Forest Department frontline staff, Dholpur, Rajasthan was jointly organized with the Gharial Ecology Project and Rajasthan Forest Department. The goal of this workshop to enhance the skills of frontline staff of forest department on researcher and conservation of aquatic reptiles and Chambal River ecosystem. The sessions on 1. Snake handling and rescue, 2. Crocodile monitoring, 3. Crocodile handling and rescue, 4. Community dealing in NCS and 5. Identification and nest protection of freshwater turtles were organized for 17 participants. Setting up this program involved several visits to Dholpur.

FOREST DEPT WORKSHOP in UTTAR PRADESH: NAANGOAN INTERPRETATIVE CENTRE

On 9 November 2017, a capacity building program was conducted by the Gharial Ecology Project with UPFD in Chambal Interpretation Center at Nandgaon village, Agra district, Uttar Pradesh. The main objective of this workshop was to provide hand on training to the UPFD frontline staff for conducting research and wildlife conservation. The session covered in this workshop were 1) Comparative analysis and conclusion on Gharial Die-off in NCS, Case study – 2007 -2008 Gharial Die-off, 2) survey techniques for chelonians and crocodilians, 3) rescue and handling of crocodilians, 4) wildlife rescue and release, 5) snake rescue and release 5) community dealing on conservation issues and solutions in the NCS, and 6) review of Indian Wildlife Protection Act 1972.

The program was started with the Pray of Goddess Chambal River by lighting up the lamp and an inaugural speech by Mr. S. N Shukla (Wildlife Warden, NCS). Sessions on topics listed above taken up by Dr. Ashutosh Tripathi and Mr. Jailabdeen A. A total of 30 participants participated this workshop from Etawah range (Etawah), Bah Range (Agra), Saman Range (Mainpuri), Keetham Range (Agra). Education material, including turtle identification pamphlet, River reptiles monitoring guidelines, and booklet on “Introduction of National Chambal Sanctuary and training manual for Forest department” was provided to every participant of the workshop. In addition, LED flashlights were provided to each participant, to be included in each information packet.

TEACHER TRAINING PROGRAMS in EASTERN RAJASTHAN & on CHAMBAL RIVER, UP

In August, 2017, a regional gathering of teachers from rural villages on the Rajasthan border of the NCS, from Dholpur to Reha, at the UP / Rajasthan border along the NCS was scheduled for Dholpur, but logistics during the monsoon months of July and August did not allow such a regional meet. Instead, the Program Coordinator, Dr. Ashutosh Tripathi, made visits to each village school.

On 1 October, an awareness program was organized for a student group who was studying for Bachelor of Education (B.Ed) degree in Pinahat, With the help of power point presentation on bio-diversity richness of NCS and threats on residing fauna were communicated to the students group. As they will be primary or secondary teachers in near future, so they were encouraged for their active participation for saving wildlife and environment, and requested to make sure to engage their pupil in environmental conservation activities. 32 students of B.Ed participated in program.

On December 28, 2017, a Teachers Training workshop was conducted by the Gharial Ecology Project team in collaboration with UPFD at Chakkar Nagar block, Etawah district, Uttar Pradesh. The main objective of this workshop was to train teachers to include Chambal River conservation in their routine curricular activity and educate and encourage children towards Chambal River conservation. With the help of audio/visual and power point presentation on “Gharial – The living legend”, “A historical river Chambal- bagging its existence” and “People, we are on the river!! For the river??” were conveys to them to sensitize them and to enhance their capability. Teachers were also provided the booklet on Introduction of National Chambal Sanctuary for their class work activities. A total of 21 teachers from the upper primary schools, Chakkar nagar block and 5 administrators of education department were participated in this workshop

FOLLOW UP VISITS TO RURAL SCHOOL CLASSROOMS, WITH EDUCATIONAL ACTIVITIES

Dholpur-Rajakherra region, eastern Rajasthan

Sahanpur school program: On 16 August, a schools program was conducted for the students of secondary school (6-8 class) for encourage them for Gharial and Chambal River Conservation. The program was initiated with the description of the gharial and its natural behavior which was conveyed to school kids with the help of diagram on black board. At the end of the session, play way learning through a game was organized for the kids to understand the right way of commencing their duties as a schools kids towards gharial and river conservation. This program was attended by 25+ students with 3 school teachers.

Tigra school program: On 17 August, a similar school program was conducted for the students of secondary school (6-8 class). Attended by 20+ students with 2 school teachers.

Bamroli school program: On 17 August, a similar school program was conducted for the students of secondary school (6-8 class). Attended by 15+ students with 1 school teachers.

Gadrai school program: On 19 August, a similar program for the schools kids was conducted and participated by 70+ students with 5 teachers.

Chakar Nagar-Lower Chambal region, southern Uttar Pradesh

So far, awareness and education program on conservation of National Chambal Sanctuary and biodiversity have been done in 17 upper primary schools in Chakkar Nagar block under the teachers training program follow up. The objectives of the follow up programs were to scrutinize that the teachers are educating students about the Gharial and Chambal river conservation, and to show them (teachers) to enhance learning capacity of students and engaging them by using various methods like eco-games, quiz/competitions and through encouraging story telling etc.

The UPS schools are listed here: Chakkar nagar, Palighar, Dhakra, Titawali, Mahua suda, Anetha, Bachheri, Debholi, Jagtauli, Kundol, Nagla Kadhori, Vihar, Pattharra, Kachehari, Bhareh, Harauli, Bahadurpur, Emylia.

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.

2017 Community Programs in Riverside Villages in eastern Rajasthan

1. Gawan pator village community program: On 13 August 2017, team of GEP visited village to conduct the awarness program. During the program villagers, including man and woman were educated with the intractive speech on conservation of River Chambal. We observed that during such advancement in and around the town, there was no electricity in this village, makes them backward to update themselves about the occurring news in society and due to this major lacuna they spend there most of the time along the river doing legal and illegal activities. This program was supported by 37 people from the villages and interacted well to understand the situation and to follow the instruction for conservation.

2. Rajghat village program: On 13 August 2017, a similar program was conducted. A total of 50+ man and woman participated in this program.

- 3. Gawan village program:** On 14 August 2017, a similar program had 40+ participants.
- 4. Sahanpur village program:** On 16 August, a similar program was attended by 60 + villagers.
- 5. Bamroli village program:** On 19 August, a similar program was attended by 25 + villagers.
- 6. Gadrai village program:** On 19 August, a similar program was attended by 80+ villagers.

2018 Community Programs in Riverside Villages in Chakar Nagar region, lower Chambal

In January-February 2018, brief village programs were conducted in conjunction with rural school visits in the following riverside communities: Chakkar nagar, Palighar, Dhakra, Titawali, Mahua suda, Anetha, Bachheri, Deholi, Jagtauli, Kundol, Nagla Kadhori, Vihar, Pattharra, Kachehari, Bhareh, Harauli, Bahadurpur, Emylia. These were villages not visited previously in 2016 and 2017, and these community visits in early 2018 completed a region wide schedule to do environmental education activities and community programs in all of the riverside villages in the lower Chambal.

These villages are inhabited by many families that frequent the river banks, and are engaged in various riverside endeavors, such as shepherding goats, sheep, cattle, and buffaloes, washing clothes at the riverside, bathing and religious activities along the shoreline, water collection and irrigation of riverside garden plots, wood cutting along the shorelines, and illegal activities such as sand mining, hunting, and fishing within the boundaries of the protected areas within the NCS.

Wildlife week Celebration: (1 Oct 2017)

On the occasion of Wildlife week 2017, the Gharial Ecology Project community program targeted stakeholders (Village chief, and village Panchayat members) to encourage them toward the eco-development of village and engage villagers in eco-friendly activities. The program was started with an introductory speech on ecosystem, bio-diversity and occurring threats of Chambal Gharial Sanctuary, and requirement of local people intervention to mitigate the situation. An open discussion on “current situation and improvement in NCS” projected among the stakeholders. Program was concluded with the suggestion; to stop illegal land farming and practices of organic farming for stream bank cultivation on legally occupied land. This program was organized in Chambal interpretation center, Nandgaon and participated by 25+ stakeholders.

World Wetland Days in 2017 and in 2018

On the occasion of World Wetland Day, February 2 2017, a community program was organized by Gharial Ecology Project in collaboration of Saman Bird Sanctuary Range, NCSP, UP at Eco-park of Saman Bird Sanctuary, Maipuri Uttar Pradesh. The objective of this program was to awareness people about the importance of wetlands and its services for human Kind. The theme based program was conducted through interactive speeches, stories and videos documentaries on wetland protection and Gharial conservation efforts being taken in National Chambal Sanctuary. Mr. Suresh Chandra Rajpoot (Wildlife warden, NCS, UP) delivered his talk on the Saman Sanctuary and its biodiversity to aware the participants of the program. > 150 people participated in this program. Participants were hosted with snacks.

On February 2, 2018, a program was conducted at the interpretation center of Saman Bird Sanctuary govern by National Chambal Sanctuary project, Agra. The aim of this program was to educate schools kids about the importance of wetland and birds diversity. With the help of stories and poem kids were informed about the liability of human to preserve wetlands and birds for the future generations. Later we visited a village named Hindupura, where community belongs to *Bahelia* tribe and their main skill is to hunt migratory birds, what they do for their subsistence. An open discussion focused on adopting alternate livelihoods other than the hunting. The people informed us that due to lack of education among them, the next generation is also adopting the traditional skills of hunting of birds, but parents do not want their kids to do bird hunting. At the end of program, village chief promised progress in education and advancement. At the end of the meeting, pamphlet on importance of wetlands was distributed among the villagers.

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 and community programs have the potential to engage and motivate members of the local communities as well as the frontline staff of the forest departments and promote conservation efforts for Chambal River and its associated biodiversity, particularly the gharial in the NCS.

CONSERVATION BENEFITS OF GHARIAL ECOLOGY PROJECT

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.

During 2017, the Senior Scientific Advisor made three 4-6 week visits to the Garhaita base, about 40 km from Etawah, in Uttar Pradesh, and situated about 15 minutes from riverside of the NCS. In addition, I made a visit to the HERP TAG meeting of the USA based zoos, held last April in Albuquerque, New Mexico, and also made trips to the Madras Crocodile Bank Trust, the Laboratory for the Conservation of Endangered Species (LaCONES) in Hyderabad, to visit with media persons and colleagues in Bangalore, National College of Biological Sciences, and to Jiwaji University during the two week short course, taught by Dr. Perran Ross, of U. Florida, on crocodilian biology and conservation in March, 2017.

In 2018, I will attend the Working Meeting of the Crocodile Specialist Group in Santa Fe, Argentina, in early May and represent the Gharial Ecology Project, which will present three papers, on the recent Red List status of gharial globally, on the acoustic studies of Jailabdeen A., and on the genetic studies of Ravi Singh and Director Karthik Vasudevan at LaCONES. I will also present a talk on gharial global status at the HERP TAG meeting in Seattle, Washington state, in late April. I also participated in the recent CSG review of the Nepal Gharial Action Plan, and am advising on the Nepal Gharial Conservation initiatives, including the proposed PhD studies of Phoebe Griffith, UK.

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Fig. 1. Capacity building Workshop at SawaiMadhopur, for frontline staff of the Rajasthan Forest Department tasked with protection & management of the upper portion of National Chambal Sanctuary. Dr. Ashutosh Tripathi presented topics including survey techniques, handling procedures for reptiles, including rescue and release methods, review of the Wildlife Protection Act, and approaches for dealing with local communities. The full-day program, 3 May 2017, had 42 attendees.



Fig. 2. Capacity building Workshop at Dholpur for frontline staff of the Rajasthan Forest Department tasked with protection & management of the upper portion of National Chambal Sanctuary. Dr. Ashutosh Tripathi presented topics including handling procedures for reptiles, including rescue and release methods, monitoring techniques for river reptiles, review of the Wildlife Protection Act, and approaches for dealing with local communities. The full-day program was held on 22 August 2017, attended by 17 participants.



Fig. 3. Capacity building Workshop at Naangoan Centre, for frontline staff of the Uttar Pradesh Forest Department tasked with protection & management of the lower portion of National Chambal Sanctuary. Here, Jailabdeen A., Project Coordinator for the Gharial Ecology Project, presents handling procedures for reptiles, including rescue and release methods. 30+ participants, from Etawah and Bah ranges attended the full day program, 9 November 2017, held at riverside interpretative centre.



Fig. 4. Bah Range Officer, Amit receives LED flashlight as part of seminar packet supplied to each participant of the UP Capacity Building Workshop, held on 9 November 2017 at the Naangoan Environmental Interpretive Centre. The one day program held presentations and discussions on survey methods for river fauna, rescue, handling, and release techniques for large reptiles, how to deal with local communities, and related topics. Two staff from the Gharial Ecology Project held the workshop.



Fig. 5. Sahanpur Upper Primary School (UPS) class presentation, conducted by Dr. Ashutosh Tripathi on 16 August 2017, in which topics included description of gharials and their natural history, and the importance of protecting the Chambal River for its animals and people living in riverside villages. The program was attended by 25+ students, & 3 teachers.



Fig. 7. Bamroli Upper Primary School (UPS) students in the 6-8 grade class presentation, conducted by Dr. Ashutosh Tripathi on 17 August 2017, in which topics included description of the river food chains, and drawings of food web diagrams on the black board. An information packet was distributed to each of the program attendees, 15+ students, & 1 teacher. Active participation was awarded, and play games conducted.



Fig. 6. Tighra Upper Primary School (UPS) students in the 6-8 grade class presentation, conducted by Dr. Ashutosh Tripathi on 17 August 2017, in which topics included description of gharials and their natural history, and the importance of these top predators in the food web. Activities included drawing and completing diagrams, and doing puzzles aimed at teaching river ecology. The program was attended by 20+ students, & 2 teachers.



Fig. 8. Gadrai Upper Primary School (UPS) class activity, conducted by Dr. Ashutosh Tripathi on 19 August 2017, in which topics included description of the river food chains, and drawings of food web diagrams on the black board. Here, an interactive floor game, like snakes and ladders, helped reinforce ideas about how complex interactions are an essential part of the Chambal River ecosystem. 70+ students, 5 teachers attended sessions.



Fig. 9. Wildlife Week Celebration, held at Naangoan Environmental Interpretative Centre, UP Forest Department, on 1 October 2017. This meeting included local village chiefs and panchayat members, who discussed eco-developments and eco-friendly activities, centered on riverside areas near villages.



Fig. 10. Awareness Program for Teachers, also conducted on 1 October, as part of Wildlife Week activities. These students were in Bachelor of Education degree program in Pinahut, with 32 participants, and these graduates will become the local primary and secondary school teachers in rural riverside villages along the Chambal River, in the middle stretches of the National Chambal Sanctuary (NCS). Dr. Tripathi presented multiple river topics.



Fig. 11. Children's Day activities along the banks of the Chambal River on 14 November 2017, when 60 students and 6 teachers visited the riverside community of Sashon, near Chakar Nagar and had river boat ride.



Fig. 12. Teacher Training Program, at Chakar Nagar on 28 December 2017, attended by 21 teachers from local upper primary schools. Dr. Ashutosh Tripathi discussed the historical and current situation of the gharial, a critically endangered crocodilian, that was the target of a mass die-off in winter months of 2007-08. Teachers are provided environmental education materials for classes.



Fig. 13. Class session in Chaka Nagar Upper Primary School, outlining some of the important components of the Chambal River ecosystem, such as food webs and predator-prey interactions. This classroom session was part of an awareness and education program on the conservation of the National Chambal Sanctuary (NCS), which involved follow-up classroom visits to 17 rural riverside schools, located in villages within NCS.



Fig. 14. Playgame session in Palighar Upper Primary School, outlining some of the important components of the Chambal River ecosystem, such as food webs and predator-prey interactions. This classroom game, which plays like snakes and ladders, was part of an awareness and education program on conservation of the National Chambal Sanctuary (NCS) in local rural schools. The program included follow-up classroom visits to 17 riverside schools, in villages within NCS.



Fig. 15. Class session in Dhakra Upper Primary School, outlining some of the geographic range of gharials, and discussing details of their natural history. This class was part of an awareness and education program on the conservation of the National Chambal Sanctuary (NCS), which involved follow-up classroom visits to 17 rural riverside schools, located in villages within NCS.



Fig. 16. Class session in Titawali Upper Primary School, outlining some of the food webs and how turtles and crocodilians play important predator roles in the NCS. This class was part of an awareness and education program on the conservation of the National Chambal Sanctuary (NCS), which involved follow-up classroom visits to 17 rural riverside schools, located in villages.



Fig. 17. Student and teachers at Anetha Upper Primary School that participated in a follow up visit by Dr. Ashutosh Tripathi, after a general meeting in Chakar Nagar that focused on Teacher Training for conducting curriculum specifically focused on the Chambal River environment and the plants and animals living riverside.



Fig. 18. Student and teachers at Debholi Upper Primary School that participated in a follow up visit by Dr. Ashutosh Tripathi, after a general meeting in Chakar Nagar that focused on Teacher Training for conducting curriculum specifically focused on the Chambal River environment and the plants and animals living riverside.



Fig. 19. Student and teachers at Mahua Suda Upper Primary School that participated in a follow up visit by Dr. Ashutosh Tripathi, after a general meeting in Chakar Nagar that focused on Teacher Training for conducting curriculum specifically focused on the Chambal River environment and the plants and animals living riverside.



Fig. 20. Student and teachers at Bacheri Upper Primary School that participated in a follow up visit by Dr. Ashutosh Tripathi, after a general meeting in Chakar Nagar that focused on Teacher Training for conducting curriculum specifically focused on the Chambal River environment and the plants and animals living riverside.



Fig. 21. Student and teachers at Nagla Kadhori Upper Primary School that participated in a follow up visit by Dr. Ashutosh Tripathi, after a general meeting in Chakar Nagar that focused on Teacher Training for conducting curriculum specifically focused on the Chambal River environment and the plants and animals living riverside.



Fig. 22. Student and teachers at Jagtouli Upper Primary School that participated in a follow up visit by Dr. Ashutosh Tripathi, after a general meeting in Chakar Nagar that focused on Teacher Training for conducting curriculum specifically focused on the Chambal River environment and the plants and animals living riverside.



Fig. 23. Student and teachers at Kundol Upper Primary School that participated in a follow up visit by Dr. Ashutosh Tripathi, after a general meeting in Chakar Nagar that focused on Teacher Training for conducting curriculum specifically focused on the Chambal River environment and the plants and animals living riverside.



Fig. 24. Student and teachers at Vihar Upper Primary School that participated in a follow up visit by Dr. Ashutosh Tripathi, after a general meeting in Chakar Nagar that focused on Teacher Training for conducting curriculum specifically focused on the Chambal River environment and the plants and animals living riverside.



Fig. 25. Student and teachers at Kachehari Upper Primary School that participated in a follow up visit by Dr. Ashutosh Tripathi, after a general meeting in Chakar Nagar that focused on Teacher Training for conducting curriculum specifically focused on the Chambal River environment and the plants and animals living riverside.



Fig. 26. Student and teachers at Patharra Upper Primary School that participated in a follow up visit by Dr. Ashutosh Tripathi, after a general meeting in Chakar Nagar that focused on Teacher Training for conducting curriculum specifically focused on the Chambal River environment and the plants and animals living riverside.



Fig. 27. Student and teachers at Harauli Bahadurpur Upper Primary School that participated in a follow up visit by Dr. Ashutosh Tripathi, after a general meeting in Chakar Nagar that focused on Teacher Training for conducting curriculum specifically focused on the Chambal River environment and the plants and animals living riverside.



Fig. 28. Student and teachers at Bareh Upper Primary School that participated in a follow up visit by Dr. Ashutosh Tripathi, after a general meeting in Chakar Nagar that focused on Teacher Training for conducting curriculum specifically focused on the Chambal River environment and the plants and animals living riverside.



Fig. 29. Village Community Program in Gawan Pator, typically held in one of the many common areas, and usually in the evening when slide/video presentations are possible, and daily work chores are completed. 13 August 2017, 37+ attendees in eastern Rajasthan. Dr. Ashutosh Tripathi would often hold community meetings on days when he would visit village schools. The evening programs included talks about the gharial project, river ecology, and local community concerns about the sanctuary restrictions and rules.



Fig. 30. Village Community Program in Rajghat, typically held in one of the many common areas, and usually in the evening when slide/video presentations are possible, and daily work chores are completed. 13 August 2017, 50+ attendees in eastern Rajasthan. Dr. Ashutosh Tripathi would often hold community meetings on days when he would visit village schools. The evening programs included talks about the gharial project, river ecology, and local community concerns about the sanctuary restrictions and rules.



Fig. 31. Village Community Program in Gawan, 14 August 2017, 40+ attendees in eastern Rajasthan. Dr. Ashutosh Tripathi would often hold community meetings on days when he would visit village schools. The evening programs included talks about the gharial project, river ecology, and local community concerns about the sanctuary restrictions and rules.



Fig. 32. Village Community Program in Sahanpur, 16 August 2017, 60+ attendees in eastern Rajasthan. Dr. Ashutosh Tripathi would often hold community meetings on days when he would visit village schools. The evening programs included talks about the gharial project, river ecology, and local community concerns about the sanctuary restrictions and rules.



Fig. 33. World Wetland Day celebration, 2 Feb 2017, held at the Saman Bird Sanctuary, Eco-Park, Malpuri, Uttar Pradesh. This function focused on the value of wetlands and their importance for service of mankind. A varied program featured interactive speeches, and stories, plus videos and personal testimonials. The UPFD Regional Wildlife Warden presided, with >150 participants, with discussions held, snacks provided.



Fig. 34. World Wetland Day celebration, 2 Feb 2017, held at the Saman Bird Sanctuary, Eco-Park, Malpuri, Uttar Pradesh. This function focused on the value of wetlands and their importance for service of mankind. A varied program featured interactive speeches, and stories, plus videos and personal testimonials. The UPFD Regional Wildlife Warden presided, with >150 participants, with discussions held, snacks provided.



Fig. 35. World Wetland Day celebration, 2 Feb 2018, held at the Saman Bird Sanctuary, Eco-Park, Malpuri, Uttar Pradesh. This function focused on the value of wetlands and their importance for service of mankind. A varied program featured interactive speeches, and stories, plus videos and personal testimonials. The UPFD Regional Wildlife Warden presided, with >100 participants, with discussions held, snacks provided.



Fig. 36. World Wetland Day celebration, 2 Feb 2018, held at the Saman Bird Sanctuary, Eco-Park, Malpuri, Uttar Pradesh. This function focused on the value of wetlands and their importance for service of mankind. Later, a tribal village was visited where migratory birds were routinely hunted. Discussion with villagers centered on changing their practice of bird hunting, and shifting to alternate livelihoods eco-based.