

GHARIAL ECOLOGY PROJECT

ANNUAL REPORT 2018

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OVERVIEW

The Gharial Ecology Project (GEP) has finished its 11th field season, since its initiation in 2008, immediately following the mass die-off in the winter of 2007-08. To date, our research approach has been productive, and has been sustained by strong support from the international zoo community, and concerned NGOs. In particular, little was known about gharial reproductive behaviors, and the species is one of the most desired for exhibit, because of its unusual appearance and unique position as the only living member of its crocodilian subgroup. Gharials in captivity have the reputation of being very difficult to breed, and only recently has a North American zoo facility, Saint Augustine Alligator Farm, been able to successfully breed and produce a hatchling. Within India, gharial have been bred since the 1980s, but seldom have other captive facilities been successful with captive reproduction. International zoos have taken the lead in providing range country conservation funds. And there is sustained interest among crocodilian conservationists to foster field research and conservation efforts on the remaining extant populations.

The GEP has as its ultimate goals 1) to develop a comprehensive assessment of gharials in the National Chambal Sanctuary (NCS), 2) to identify and protect the species' critical riverine habitats, and 3) to reduce threats and challenges to the species' continued survival. Gharials are Critically Endangered (=CR) with an estimated 650-700 mature adults globally; 500+ are resident in the NCS. Project activities are conducted by a small core staff (3-4) of Indian biologists / naturalists, under the banner of the Madras Crocodile Bank Trust (in south India, near Chennai, Tamil Nadu) and with inputs from the Senior Scientific Advisor, Professor Jeff Lang. Over the last decade (2008-2018), the GEP has produced a detailed description of gharial behavioral ecology in the bottom third of the 625km NCS. Adult gharials make seasonal migratory movements of 200+ km and exhibit complex social interactions at large crèches of hatchlings (Lang & Kumar 2013, 2016; summarized in Lenin 2018, and in Sohn 2018).

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 crocodilian biology, reptile conservation, and riverine ecology.

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

The major activities for this component in 2018 were: 1) tracking gharial tagged in 2018 and previously (photos 21-24), 2) population estimates of adults and nests within the entire NCS (tables 1-3), 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 (photos 17-20, 27-32) , 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 (photos 25-26), 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 (Figs 3-10), and 11) necessary actions for gharial in Nepal (photos 43-44). International zoos and NGOs have funded major support for many components of these related conservation activities relevant to the Chambal gharial population. Government of India and the respective state Forest Departments have provided necessary approvals and permissions for this work, but provide no funding for this project.

Training Component: Program Coordinator, Training Workshops, Education Programs

In 2018, 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 2018, the major focus of the capacity and community programs was in presenting environmental awareness programs in the lower Chambal riverside communities by visiting local and regional colleges (photos 49-85). Wildlife Week celebrations were also hosted with presentations (photos 73-85). He conducted one capacity building workshop in Uttar Pradesh (photos 86-89), plus a Teacher Training Course (photos 90-91), as well as making visits to village schools and conducting community programs in 12+ rural riverside villages (photos 92-104). In addition to the Uttar Pradesh programs, Ashutosh Tripathi was able to spend considerable time developing new program approaches and new program materials (Fig. 13).

ECOLOGY COMPONENT OF GHARIAL ECOLOGY PROJECT

BACKGROUND

The Gharial Ecology Project, also known as the Gharial Telemetry Project, 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). The following narrative summarizes ecological studies underway during 2018, and includes images showing some of these activities. Detailed supporting materials, including reports and publications are provided as supplementary documentation (links to separate folder provided). In 2018, the Gharial Ecology Project (GEP) continued in two major phases:

a) monitoring radioed animals from late 2017, as well as small numbers from previous taggings (2016 and earlier). Surveys, tracking and behavioral observations were carried out throughout the entire year, from January thru December. Furthermore, additional animals were radio tagged for monitoring and observation during 2018-2019, primarily as part of studies to determine the efficacy of releasing additional head-started individuals, raised in captivity for 2+ years from hatched eggs removed from wild Chambal nests. In 2019, an upstream initiative is underway to understand the dynamics of gharial in the entire NCS.

LONG DISTANCE, SEASONAL MOVEMENTS and COMPLEX SOCIAL INTERACTIONS

The most exceptional result to date are the extraordinary distances, >200 kms each way in seasonal return trips up and down the river, primarily related to breeding and nesting. 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 from year to year. Social interactions, from hatchling to adult, are complex, and appear to be mediated by an elaborate communication system of visual/acoustic signals.

TRACKING RADIO-TAGGED GHARIAL in 2018

International zoos and NGOs supported the year long monitoring for the gharial tagged in November 2017. A total of 12 gharial were tagged in late 2017, and as of end of 2018, 11 of these had been successfully followed throughout the entire annual cycle. For the other animals tagged previously in 2016 and earlier, a total of 21 individuals were trackable, including 9 still trackable at the end of 2018, and 12 which were tracked for the early part of 2018, prior to the annual monsoon. All of these individual records are being mapped to determine the individual spatial patterns of various aged gharial, and quantitative data will be presented in future reports and publications.

For the 2017 tagged animals, a total of 510 geolocations, which include the individual's identity, the location, date, and time it was tracked, were observed for the 12 tagged gharial, including 2 fully mature adult females which nested in 2018, and 2 "near adult" females that resided with nesting females near nest sites, but have not yet nested for the first time. One young gharial was tracked for only the period prior to the monsoon, whereas the other 11 animals were still being tracked at the end of 2018. The number of locations per individual ranged from 26 to 84 records, from Dec 2017 to through Dec 2018, averaging a mean of 44 records per individual, totaling 489 for 11 gharial. Observations were spread evenly across the entire year, but were most frequent just before and just after the monsoon rains in June, July, and August.

For the 2016 and earlier tagged animals, a total of 404 geolocations were recorded in the same period (Dec 2017-Dec 2018), that included 133 locations for 12 animals tracked only prior to the monsoon, and 261 locations for the other 9 gharial tracked for most of 2018. For these individuals, the average number of relocations was 29, ranging from 9 to 57 records per individual.

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

During January---March 2018, 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. These surveys were conducted to make additional actual counts of gharial in the National Chambal Sanctuary (NCS), as noted above, in a manner similar to those conducted in 2017 (GEP 2017). Using a boat in the upper stretches in late January and early February, the GEP team was able to make stationary counts of gharial present, and established counts to extend the annual early season survey to estimate the total number of gharial present, based on repeated encounter rates at regular basking areas where gharial congregated during the winter months. Upstream habitats and survey methodologies are shown in photos 1-10.

An earlier field report (GEP 2017) established on a 425 km stretch of the National Chambal Sanctuary (NCS) from Pali to the Yamuna confluence, based on actual counts, the adult gharial population was 72 males with gharas (>4.5m), and at least 411 were reproductive females, based nest counts in 2017, immediately after hatching (GEP 2017). At that time, we estimated very conservatively a total of 483 mature adult gharial inhabit the NCS. Furthermore, these data firmly established that this minimum estimated population (revised upward by 20+ to 500+ adults, and by 4+ to 415+ nests, with the addition of the Parvati tributary population; Khandel et al. 2017) inhabits ALL of the 425 km of NCS surveyed where they reside most of the year, and also nest from Pali (near Ranthambore) to the Yamuna confluence (Bareh), at approximately 30 riverside locations identified in nest surveys. These recent counts provided the bases for highlighting the Chambal gharial population in the recently updated Red List assessment, as the single most important extant gharial population, by a factor of ten (10x larger than the next largest of 5 remaining breeding populations), and the only open-river, self- sustaining remnant of this CR species alive today (Lang et al. 2018).

In the upper Chambal, prior to the boat survey, the static survey in late January 2018 counted 393 gharial, specifically 19 males, 183 females, 120 subadults, 56 juveniles, and 15 yearlings. The boat survey tallied 456 gharial in the same upper stretch. In the lower Chambal, immediately prior to the boat survey, 1330 gharial were directly observed and tallied by the static survey. These consisted of 53 males, 391 females, 370 subadults, 318 juveniles, and 198 yearlings. On the same stretch of lower Chambal, the boat survey counted 1225 gharial. Thus, the overall number of gharial living on the 425 km of Chambal River counted by boat survey was 1681, and by static survey was 1676, based on Jan-Feb direct counts of observed animals. Adjusted for accuracy in size categories, these counts included 75 mature males (with ghara), 464 reproductive females plus 52 "near reproductive" females, 462 subadults, 366 juveniles, and 208 yearlings. In 2017, in the NCS, we tallied 417 nests at 28 sites, of which 358 hatched and 59 were lost. In 2018, a total of 443 nests at 37 sites were observed, of which 318 hatched and 115 were lost. The 2018 report, in its entirety, is available in a linked folder cited in references at end of this report, and is also downloadable at Academia.edu

TRACKING HEAD-STARTS: SURVIVAL AND RESIDENCY OF RELEASED CAPTIVES

The successful conservation and management of gharial in the National Chambal Sanctuary will require additional detailed information about the species' ecology, not yet determined on the bases of studies to date. Although the rear and release program has been conducted for many years by the MPFD & UPFD, there is still no information on what happens to these animals once they are released. It is critical to learn how many of these survive, and particularly to find out how many become residents near the release sites. Most head start programs have tended to hold gharial until they are at least 2m in total length, and 3-5 years of age, before releasing them back into wild. No follow up studies are available.

A major limitation has been the lack of information on juvenile gharial, from yearlings to those <1.5m length. There is a widespread belief that juveniles are vagile, and tend to be washed downstream when monsoon flooding occurs. Alternately, they may move laterally into side channels, and may not necessarily end up shifting long distances downriver, either actively or passively. Identifying whether juveniles move upstream or downstream seasonally is important for their management, and that of the riverine habitats juveniles depend upon.

The on-going studies of the Gharial Ecology Project, tagging and tracking wild caught, resident gharial to determine their seasonal movements, activities, and behaviors have established that young juvenile gharial have a very restricted residential area where they live as juveniles and subadults. Only when they begin to reach maturity, do they range farther and farther from their respective "home" areas, particularly during the seasonal monsoon and resultant high water period. Older animals, such as large subadults, begin to move away from residential river segments and move over longer distances, approximating 50+ kms seasonally.

The GEP proposed to initiate telemetry studies on released head-started juveniles, in order to determine the movements, behaviors, and activities of these young gharial, and compare their survival with that of their wild counterparts. Previously, we have tagged and tracked the movements, behaviors, and activities of wild caught gharial ranging in size from 0.7 to 1.8m, inhabiting relatively small activity centers and home ranges of 2-10 km of river, on the lower 100 km of the Chambal River (from above the Yamuna confluence).

The specific objectives of the proposed study are: 1) to study the movements, activities, and behaviors of released, head-started gharial, 2) to develop suitable release strategies aimed at ensuring that head started individuals become residents in the vicinity of release sites, and 3) to make recommendations for continuance of the head start and release program for gharial in NCS.

Conservation benefits from this project include the enhancement of self-sustaining, wild gharial populations by targeting the release of head started gharial for maximum survival as resident members of the population. Challenges include reducing the likelihood that released gharial will not survive, and/or that the released animals will not become established as resident animals.

In mid February 2018, we radio tagged 9 juvenile gharial at the Deori EcoCentre, and released these in the Chambal between Ater (Naangoan) and Chilonga (Garhaita). These gharial were tracked as long as signals were detected, from release to the point at which it was determined that the animal had disappeared or dead or no longer trackable. In short, none of the gharial were evident after the first week in September, and most were lost during the first several months following release. Three radios were retrieved. Two were recovered on land, with tooth marks suggestive of scavenging by jackals. One was eventually recovered in shallow water, after it was relocated inside a subadult mugger crocodile (*Crocodylus palustris*) resident near where the released gharial was observed earlier (photos 11-16).

Five of these head starts were no longer trackable by the end of March, about six weeks post release. Of the other four, two were tracked into early May, one til the end of June, and the longest individual tracked through most of the monsoon, until it disappeared in early September. The tracking results are summarized in a progress report prepared for MPFD.

In early November, 6 resident gharial were radio tagged in the same area, as above, and tracked through the remainder of 2018. As of mid January 2019, all of these gharial are still trackable, and are resident very close to where each was captured and subsequently released.

Later in November, 15 head started juveniles from Deori (MPFD) were radio tagged in a separate operation, and released at three sites within the range of the capture / release localities of the resident juveniles tagged earlier in the month. Most of these made frequent daily movements during the past six weeks since release. The most typical response was for an animal to move downstream, rather than upstream. Some of these movements are substantial, >30 kms, while others are much shorter. Five released gharial remained nearby their respective release sites, whereas the others moved downstream during the initial post-release, and have remained 3-35 kms downstream. Some moved downstream, then returned upstream. To date, in early 2019, 13 of the 15 released are being tracked frequently to determine residency patterns (photos 33-40). This study will continue during 2019. The progress reports prepared to date are available in a linked folder cited in the references at end of this report.

GHARIAL COMMUNICATION: ACOUSTIC STUDIES

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 infra- sound. 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 doctoral research project is a subproject of the GEP.

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 (photos 17-20).

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 guarding 100-1000 young at nest sites.

During February and March 2018, additional acoustic recordings were made of big ghara males that were engaged in breeding activities, and these results compared to data collected previously during 2017. The results were summarized in a poster presented at the CSG meeting in Argentina in May, and also presented in an oral presentation at an international acoustics conference in New Delhi in November. These data also included additional recordings and video documentation made during the hatching and crèche periods in June-July 2018. Summaries of the acoustic presentations made in 2018 are included in a linked folder cited in references.

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 Chambal gharial. A PhD student, Ravi Singh, participated fully in the field work during the 2017 hatch and post hatch period, and again in Feb-Mar, and in May-June 2018 (photos 25-26).

Consequently, all of the eggshells from hatched and unhatched eggs collected at hatching, at each of the nine colonial sites resulted in the collection of over 5000+ samples of egg materials from more than 110 nests during 2017 and 120 nests in 2018. At present, DNA has been prepared from these egg/eggshell fragments and detailed genetic analyses are underway. During the catching and tagging procedures, carried out on resident wild gharial of various sizes/ ages/sexes, 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.

At present, Ravi Singh is characterizing the Chambal gharial population, using microsatellite markers, and plans are underway to use Next Generation Sequencing (NGS) to reveal how guardian adults at the crèches are related to hatchlings, and how the Chambal gharial population is genetically structured. One surprising result of Ravi's studies to date indicate that certain markers are specific to the Chambal population, and show little/no variation. These studies are designed to reveal the genetic relatedness among crèche participants, including large, big ghara male guardians, some of which exhibit "alloparental care" of hatchlings likely fathered by other males. Another collaboration in the same lab with Dr. Vasudevan focuses on stable isotope analyses to understand food webs in Chambal gharials, as apex predators in this river ecosystem.

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. 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 2018, as we had done in 2017, 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 event (photos 27-32).

NEST COUNTS AND ESTIMATES OF ANNUAL NESTING BY CHAMBAL GHARIAL

We have been making direct counts of nesting and nest success on the lower stretch of NCS (UP/Raj border downstream since 2010, and from Tigri-Rithora downstream since 2015). An annual boat survey conducted by the Gharial Ecology Project team immediately after the conclusion of hatching each year has provided direct counts at each nesting site. Each nesting site was identified during trial nesting and monitored weekly or biweekly throughout the two month incubation period, prior to the boat survey following hatching. Frequent foot patrols during nesting and post nesting were done to monitor these nesting sites during incubation, and count adult females present in the nesting areas.

The estimated number of nests at nesting time has closely approximated the actual number of nests tallied once the nests have hatched, and a final definitive count at each nesting site is made post hatching. By carefully tallying all of the lost nests, either through predation, disturbance, or nest failure, whether occurring early or late, we have direct counts each year for the total number of nests. We also count the number of hatched, successful nests at each site on the entire lower stretch, and follow up with frequent counts of the hatchlings in crèches at each site, until high monsoon waters make continuing this routine impractical.

By combining these data, from the MP population and nest surveys in 2017, and those conducted by the Gharial Ecology Project in 2017 and previously, it is possible to estimate with much greater accuracy than in previous years, the total nesting effort of gharial inhabiting the National Chambal Sanctuary. In 2017, a total of 411 nests at 26 sites were recorded, 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. The overall nest success was 86%, and was >90% in the upper stretch, and ~80% in the lower stretch.

In 2018, a total of 443 nests at 37 sites were recorded, of which 318 hatched, and 115 were predated and/or failed. This includes 143 nests in the upper stretch, and 290 nests in the lower stretch. The overall nest success was 72%, down 14% from the previous year, and was 80% in the upper stretch, and was 70% in the lower stretch, down by 10% relative to 2017. These data for 2017 and for 2018 are summarized in the Field Report referenced above

RED LIST REASSESSMENT

Together with coauthors S. Chowfin and J.P. Ross, and substantive inputs from many knowledgeable colleagues, a reassessment of gharial for the IUCN Red List has been completed (June 2018), and is “in press” (Lang et al. 2019). Today, gharial are limited to only 14 widely spaced, restricted localities in north India and in lowland Nepal. Only 5 subpopulations (4 in India; 1 in Nepal) exhibit recent reproduction / recruitment. In approximate rank order of importance (from high to low), these are: Chambal, Katarniaghat, Chitwan, Gandak, Corbett; a sixth locality, Babai River in Bardia National Park (BNP-Nepal) is potentially another breeding population, but recent evidence of nesting / hatching is absent.

The updated CR status of gharial is based upon a 1) 94% exponential decline in adult numbers, within 3 generations (using 25 yrs/generation, =from 1943), from >20,000 adults historically (based on 1 gharial / river km) to 650 adults today, and 2) 94% exponential decline in occupancy area from 80,000 km² historically to 4400 km² today. Continuing major threats include: dams/barrages, water extraction/irrigation, river inter-linking, fishing net mortality, sand/boulder mining, and introduced species. Conservation actions have included captive breeding and head-starting in past decades, but now require smart, site-specific programs with local river communities to reduce multiple threats *in-situ* (photos 45-48; Figs. 3-10).

GHARIAL IN NEPAL

In early 2018, an updated Nepalese Action Plan for Gharial was outlined by the Department of National Parks and Wildlife Conservation, Government of Nepal, and was reviewed upon request by the Crocodile Specialist Group. In brief, the revised plan for gharial in Nepal refocuses attention on *in-situ* vs. *ex-situ* conservation strategies, including an emphasis on an evidence-based program, informed by science. Phoebe Griffith, an Oxford U. PhD student, has initiated a comprehensive series of studies, from telemetry of wild resident gharials to “local ecological knowledge” surveys in riverside communities surrounding Chitwan National Park (CNP). To date, 5 resident wild gharial have been outfitted with VHF and / or GSM transmitters, and are being tracked successfully in CNP (photos 43-44).

The Gharial Ecology Project (GEP) has been instrumental in assisting with the Nepal telemetry study by loaning equipment and supplies, as well as sharing capture and tagging methodologies. Phoebe joined the GEP staff on the Chambal in late February and early March during the gharial breeding season. In November, she assisted with capture, tagging and tracking resident wild gharial living near our Garhaita base near Etawah, UP. Documents related to the gharial conservation initiatives mentioned here are included in the linked folder cited in the references at the end of this report.

EDGE CONSERVATION FELLOWS

In early 2019, three young conservation biologists (one in India; two in Nepal) working with gharial will begin funded projects as EDGE Fellows for 2019-2020. These are competitive, two-year awards from the Zoological Society of London (ZSL) to benefit Critically Endangered (=CR) species in their natural habitats. The EDGE Fellows working with gharial are: Jailabdeen A. (India-Chambal), Ranjana Bhatta (Nepal- Chitwan), and Ashish Bashyal (Nepal-Bardia). Ranjana will coordinate her project with Phoebe’s project in Chitwan, and Ashish will continue his research on the Babai River subpopulation (the sixth ranked “breeding” population). It is indeed fortunate to have 3 EDGE Fellows focusing on gharial, and there will be opportunities to work together and collaborate, amongst themselves and with other gharial researchers. For example, in November, Ashish joined Phoebe and Jailabdeen in the joint capture/tag operation near our Chambal base, and did some tracking (photo 41-42).

UPSTREAM INITIATIVE.

Jailabdeen A. and our expert tracker and naturalist Pankaj Kumar, are the core GEP team, together with base manager and driver Deepu. In 2019, they will extend the GEP behavioral and telemetry studies of gharial to the upstream of the NCS (Dholpur to Pali; ~205 km river stretch, including the upstream tributaries). In marked contrast to the downstream section (studied since 2008), little is known about gharial ecology upstream. Present surveys (2017& 2018) indicate a robust gharial population (>450) and 1/3 of the total nesting (143/443) in this top stretch of 200+ river kms where gharial reside.

These findings highlight two critical questions: 1) where are the upstream adults during the seasonal monsoon months, when the river is in flood, and 2) why are there so few young gharials encountered in upstream sections?

In short, by extending observations and tracking to gharial living upstream, a better understanding of how the relatively large number of resident wild gharials are using resources in the entire NCS and how best to protect and conserve this last large breeding population through appropriate actions. Our studies will concentrate initially on 1) a detailed reconnaissance of riverine habitats, and eventually, later in 2019, on 2) radio tracking of upstream residents during 2019-2021, using proven field methodologies and observational and behavioral approaches we have pioneered and refined downstream.

CAPACITY BUILDING & TRAINING COMPONENT OF GHARIAL ECOLOGY PROJECT

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 international zoos and NGOs 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. Photos 49-104 show community activities.

PROGRAM COORDINATOR

During 2018, 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 2018 on UTTAR PRADESH TRAINING AND EDUCATION in RIVERSIDE VILLAGES

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.

In 2018, Ashutosh Tripathi was involved in organizing and conducting a telemetry study of the Narrow necked river turtle, *Chitra indica*, during the first half of the year, so the programs were concentrated during August through December. In late August and early September, a total of 9 local / regional colleges were visited, and programs presented to over 1500 students, often in multiple sessions at a school, speaking to a number of classes. In early October, specific programs were arranged in conjunction with Wildlife Week, primarily in Etawah upper division 10-12 standard classes, and with site visits by several schools to the National Chambal Sanctuary. These programs involved 4 schools, and consisted of a total of 720 students who participated in them.

In late October, a capacity building workshop was organized and conducted for the frontline staff of the UPFD at the Naangoan Interpretation Centre, located within several kms of the NCS. About 30 FD staff participated in this workshop, conducted by two GEP staff, Dr. Tripathi & Jailabdeen A. In late November, a Teacher Training Program was held for 20 upper primary school teachers who had more than 400+ students. Follow up visits were made to 12 riverside village schools. Finally, in early December, community programs targeted primarily at village elders in daytime discussion groups, were organized and conducted in 5 riverside villages, located along the lower Chambal area. A total of more than 100 residents attended these meetings, led by Dr. Tripathi.

ENVIRONMENTAL AWARENESS PROGRAMS IN LOCAL / REGIONAL COLLEGES

1. Rambeti Inter collage, Chakkar Nagar, Etawah: 30 August 2018 (photos 49,50)

An awareness program was conducted in Rambeti inter collage, Chakkarnagar, Etawah. The objectives of this program were to encourage graduate student to develop a network for spreading education and awareness on aquatic wildlife of NCS among community. Presentation of wildlife rich of national Chambal sanctuary and fact of Gharials were presented to students in local language. 100+ students were appealed to conserve the River and its biodiversity and spread awareness among their family and neighborhood.

2. Harnarayan collage (HN collage), Etawah: (photos 51-52)

On 1 September, an awareness program was conducted in Gayaprasad degree collage, Debolighat Chakkar nagar, Etawah. Information on Aquatic fauna of National Chambal Sanctuary was shared with 35+ students with the help of PPT and A/V.

3. Gayaprasad degree collage, Debolighat, Etawah: (photos 53-56)

On 10 September 18, an awareness program was conducted in Gayaprasad degree collage, Debolighat Chakkar nagar, Etawah. In this program students were informed about global status of Gharial, its natural behaviors and importance. Program was started with an introductory speech on Gharial and its habitat with the help of Power point presentation and about Gharial ecology project, in which recent finding on gharial shared with students. During the program, students were appealed to participate in upcoming community and keep talking about gharial and spread awareness as much as possible among their circle. 50+ students participated in this program.

4. Kid valley school, Etawah: (photos 57-61; Fig 11)

On 12 September 2018, an education and awareness program was organized for students of Kids valley school, Etawah. During the program the power points presentation on Gharial and Chambal ecosystem was presented to 300+ students of schools. Videos on wildlife and animal conservation were showed to them to raise their awareness.

5. Gyanstali Academy Etawah: (photos 62-63)

On 13 September, an education and awareness program was organized for students of Gyan Sthali Academy, Etawah. During the program the information on Gharial and Chambal ecosystem was shared with 50+ students of schools. Students were appeal for the conservation of wildlife by adopting few eco-friendly habits.

6. Shivaji Shiksha Niketan: 14 Sep 2018 (photos 64-68; Fig 11)

An awareness program was conducted in Gayaprasad degree collage, Debolighat Chakkar nagar, Etawah. In this program students were informed about current situation of Gharial and its natural habitat. Program was started with an introductory speech on NCS and its biodiversity with the help of Power point presentation and facts about the gharial and crocodiles shared with students. 250+ students participated in this program.

7. Chaudahri Sughar Singh Group of Institute (CSSGI): (photos 69-72; Fig11)

On 15 September 18, an awareness program was conducted in Chaudahri Sughar Singh Group of Institute (CSSGI) in Etawah district. The objectives of this program were to share knowledge about Chambal Gharial, its natural behaviors and endangered status. Program was started with a general speech on National Chambal sanctuary and Gharial ecology project, in which recent finding on this unique creature shared with graduate students. During the program, students were appealed to participate in upcoming community and village schools program. Principal of institute agreed with the participatory theme of the program and insured participation of his institute for Gharial and Chambal River conservation. 350+ students participated in this program.

8. Mahi Group of Institute, Etawah: 27 September 2018 (Fig 11)

An awareness program was conducted in Mahi Group of Institute in Etawah district. Program was started with a general speech on Chambal River Ecosystem. Fact about crocodile and turtle were shared with the help of ppt and videos. On the request of institute's principal, a session on human-wildlife conflict- causes and solutions was conducted. During the program, students were appealed to participate in upcoming community and village schools program. Principal of institute agreed with the participatory theme of the program and insured participation of his institute for Gharial and Chambal River conservation. 100+ graduate students participated in this program.

9. Narayani Inter collage, Etawah: 28 September 2018

An awareness program was conducted in Narayani Inter collage in Etawah district. In the program, importance of wildlife animal in our life was shared with students. Presentation on fact about gharial and turtle were presented to 300+ students.

In these programs, a total of 1000+ students of intermediate level (class 11 and 12th) and 500+ graduate students were aware about the Gharial, turtles and Chambal river ecosystem. For graduate students, a whatsapp group name "Save Chambal, save our pride" developed for networking with students for participation in village community program.

WILDLIFE WEEK CELEBRATIONS (3-7 OCTOBER)

On the occasion of Wildlife week 2017, the Gharial Ecology Project education program targeted stakeholders in the local Etawah upper division schools to encourage them to organize and conduct programs on the local environments. Talks were given at four upper division schools:

Shivpal mahavidhyalaya: (photos 73-75; Fig 12))

On 3rd October, an awareness program was conducted for graduate students of science in Shivpal mahavidhyalaya, Etawah. Program was started with a documentary on "Last Chance for Gharial" by introducing the objectives and conservation efforts of Gharial ecology project. Presentation on National Chambal Gharial Sanctuary was presented to students in which they were informed about Gharial natural history and conservation status. Program was concluded with the speech on importance of Chambal River as last repository for Gharial and other vertebrate fauna. During the program collage principal requested us to start volunteer studentship program for master dissertation for students. 250+ graduate students participated in this program.

<http://www.livehindustan.com/uttar-pradesh/etawah-auraiya/story-chambal-river-and-organisms-now-exist-in-our-hands-2214578.html>

Pandit deendayal Ashram Paddhati School: (photos 76-78)

On 4 October, an awareness program for 10 to 12 standard student was conducted in Ashram Paddhati School, Etawah. Program was started with an introductory speech on National Chambal Gharial Sanctuary. In which students were shared about the importance of Chambal as a Gharial sanctuary in the world. 350+ students participated in this program.

Taigor public school: (photos 79-82; Fig 12))

6 October, on the occasion of wildlife week an awareness program was conducted at the Chambal Interpretation Centre for the students of Taigor public school. In this program, information about the aquatic fauna of NCS was shared with the students. An education tour conducted for the students, in which students were taken to the gharial basking site to see the live gharial in its natural habitat to feel the zeal. During boat riding, they were informed about the turtles, birds and other aquatic fauna. 40+ students were participated in this program.

7 Hills inter collage: (photos 83-85)

On 7 October, an awareness program was conducted in 7 Hills Inter collage, Etawah. A short speech on biodiversity and impact of human pressure on earth was presented with the help of animated video. Presentation on threats on Chambal fauna and students part of mitigation described to the participants. 80+ students participated in this program.

FOREST DEPARTMENT WORKSHOP: UTTAR PRADESH areas of Agra, Bah, and Etawah

On 27-28 October, 2018, a capacity building workshop for frontline forest department staff was jointly organized by Gharial Ecology Project with the National Chambal Sanctuary Project, UP Forest Department. The objective of the workshop was to enhance the capacity and skills of 40 participants including forest officers, foresters, and forest guards from Agra, Bah, and Etawah ranges of NCS. Setting up workshop involved preparatory day long visits in Etawah (photos 86-89).

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

TEACHER TRAINING PROGRAM in Rural Schools in Riverside Villages, CHAMBAL RIVER, UP

In late November, a regional gathering of teachers from rural villages in Etawah District, UP was jointly organized with the local District Basic Education Department. The Program Coordinator, Dr. Ashutosh Tripathi, made visits to each village school. The teachers were upper primary instructors, numbering 20 in total, with a total of 400+ students in their classes. Follow up visits were made to 12 riverside villages, focusing particularly on those villages in which community programs were also conducted (see below). Workshop (90-91) and follow up visits (92-100) photos included.

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 conveyed 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 (see photos 91-92).

The teacher training sessions focused on the need for the conservation of the gharial. The sessions consisted of the following topics: the concept of TTP, Our river and its social, cultural, economic and ecological importance, a brief description of the gharial, information about the National Chambal Sanctuary, and the role of schools and teachers in gharial and river conservation. A number of eco-games were performed with the teachers to conceptualize the playful method of learning with the students being active participants in the program activities. In the follow up programs conducted in selected schools with the teachers who participated in the TTP, the emphases were on specially designed games focusing on biodegradable materials and creative re- use and recycle of everyday consumables (see photos 92-100).

COMMUNITY DISCUSSION GROUPS IN TARGETED RIVERSIDE VILLAGES

In early December 2018, community meetings, consisting primarily of village elders engaged in agricultural activities in riverside areas of the NCS were held in 5 villages engaged in wood cutting, sand mining, and fishing. These activities are illegal within the NCS, but provide significant cash income (photos 101-104).

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. 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 2018, 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 Laboratory for the Conservation of Endangered Species (LaCONES) in Hyderabad.

In 2018, I attended the Working Meeting of the Crocodile Specialist Group in Santa Fe, Argentina, in early May and represented the Gharial Ecology Project, which presented 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 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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http://dev.earthisland.org/journal/index.php/elist/eListRead/basking_on_the_brink/

Table 1. Stationary (static) and Boat Survey Counts of Total Gharial Population in Januaryn March 2018

including adjusted estimates of total gharial population from Pali incl. Pavarti trib) to Bareh (at Yamuna-Chambal confluence)
The National Chambal Sanctuary (NCS) extends for 425 km, inhabited by gharial, plus Parvati tributary=60 km upstrm=NCS.

			BG+>4m	3-4m	2-3m	1-2m	<1m	M+F+SA+J+Y=
survey	Jan-Mar	location	males	females	subadults	juveniles	yearlings	total gharial
static	early	lower Chambal	45	389	323	228	161	1146
static	late	lower Chambal	53	391	370	318	198	1330
boat	mid	lower Chambal	50	638	70	179	288	1225
boat*	mid	lower Chambal	49	355	343	294	184	1225
static	mid	upper Chambal	19	183	120	56	15	393
boat	mid	upper Chambal	28	299	30	42	57	456
boat*	mid	upper Chambal	23	214	137	64	18	456
boat	estimate	upper & lower Chambal	78	569	480	358	202	1681
static	estimate	upper & lower Chambal	72	574	443	374	213	1676
average	estimate	NCS Chambal (425 km)	75	572	462	366	208	1679
		adjusted estimate NCS Chambal**	75+57=132	515***	462	366	208	1679
10%add	estimate	NCS Chambal (425 km)	145	567	508	403	229	1847
20%add	estimate	NCS Chambal (425 km)	158	618	554	440	250	2015

BG=big ghara males, in survey results; in estimates at bottom, includes no ghara male estimate for 3-4+m subadult males

*denotes size categories in boat surveys, adjusted to "static" proportions, separately for upstream & downstream

**total gharial (3-4m) assumed to include 10% subadult males, no ghara; adjustment=subtract from female number, add to males (<5m to 3m)

***adjusted female count includes actual number of reproductive females=proportion over 3.25m; =90% x 515=464 females, nesting annually

Table 2: Spatial distribution of gharial nest sites on lower Chambal River, referenced on distance from Yamuna confluence (=0 km), left is upstrm, right is downstrm. to 210 km upstream. At least 28 sites were used during eight nesting seasons, on the entire 210 km section.

The number of nests that produced hatchlings in each year are shown for each location in the bottom panel. Bolded, underlined entry indicates male observed guarding hatchlings at nest site, resident during hatch-post hatch. In 2018, 290 nests at 20 sites resulted in 203 hatched nests.

distance river km	210	205	201	189	176	161	133	126	118	107	103	97	91	90	89	87	85	79	74	56	54	49	46	39	38	29		
nesting location	TG	SK	BG	PR	BR	RH	KP	GA	HL	GD	GH	AT	NT	MG	HK	DM	DU	NK	CH	KF	KC	CT	KS	BA	PN	SG	total nests	nest sites
2010						11	2	-	-	4	3	-	-	-	-	-	-	3	3	4	4	-	3	-	1	-	38	10
2011						20	4	-	-	3	3	-	4	-	-	-	-	6	6	7	7	3	7	-	6	-	76	12
2012						30	-	-	-	-	-	-	-	-	12	8	-	-	20	-	3	-	-	7	-	-	80	6
2013						26	2	-	4	8	-	2	-	2	-	-	8	2	-	4	-	-	2	2	-	-	62	11
2014						20	4	3	21	-	-	3	15	-	1	7	-	-	2	13	-	-	3	-	1	1	96	14
2015	31	1	20	9	7	16	5	-	15	-	-	3	11	-	-	5	-	-	4	17	1	-	7	-	1	-	153	16
2016	26	13	14	24	13	13	2	-	19	-	5	2	10	-	-	19	-	-	2	27	-	-	14	-	-	-	203	17
2017	31	15	9	23	10	19	-	2	19	-	15	-	8	-	2	27	4	-	-	37	-	-	11	-	-	-	232	15
2018	43	15	28	38	9	30	7	-	20	-	-	7	8	-	2	25	2	-	2	41	-	-	11	-	2	-	290	20
nesting location						RH	KP	GA	HL	GD	GH	AT	NT	MG	HK	DM	DU	NK	CH	KF	KC	CT	KS	BA	PN	SG	nests hatch	hatch sites
2010						<u>11</u>	pd	-	-	4	3	-	-	-	-	-	-	2	<u>3</u>	<u>4</u>	<u>3</u>	-	pd	-	1	-	31	8
2011						<u>19</u>	pd	-	-	pd	pd	-	pd	-	-	-	-	<u>6</u>	<u>6</u>	<u>3</u>	pd	<u>3</u>	<u>5</u>	-	<u>6</u>	-	48	7
2012						<u>28</u>	-	-	-	-	-	-	-	-	-	<u>11</u>	<u>8</u>	-	-	<u>17</u>	-	pd	-	-	<u>5</u>	-	69	5
2013						<u>24</u>	2	-	4	<u>8</u>	-	2	-	2	-	-	<u>8</u>	pd	-	<u>2</u>	-	-	pd	1	-	-	53	9
2014						<u>18</u>	4	<u>2</u>	21	-	-	<u>3</u>	<u>13</u>	-	1	<u>7</u>	-	-	<u>2</u>	<u>13</u>	-	-	<u>3</u>	-	pd	1	88	12
2015	<u>27</u>	1	<u>18</u>	<u>7</u>	<u>6</u>	<u>16</u>	2	-	6	-	-	3	<u>11</u>	-	-	<u>2</u>	-	-	<u>2</u>	<u>17</u>	<u>1</u>	-	<u>7</u>	-	pd	-	126	15
2016	<u>24</u>	<u>13</u>	<u>6</u>	<u>22</u>	<u>8</u>	<u>13</u>	1	-	<u>16</u>	-	<u>5</u>	<u>1</u>	<u>8</u>	-	-	<u>16</u>	-	-	<u>2</u>	<u>25</u>	-	-	<u>14</u>	-	-	-	174	15
2017	<u>27</u>	9	5	<u>14</u>	<u>8</u>	<u>18</u>	-	-	<u>17</u>	-	<u>7</u>	-	<u>8</u>	-	<u>2</u>	<u>24</u>	<u>4</u>	-	-	<u>32</u>	-	-	<u>11</u>	-	-	-	186	14
2018	<u>38</u>	7	18	<u>23</u>	<u>7</u>	<u>25</u>	3	-	<u>0</u>	-	-	7	<u>6</u>	-	<u>0</u>	<u>23</u>	<u>2</u>	-	1	<u>32</u>	-	-	<u>11</u>	-	0	-	203	17

Chambal River locations: TG=Tighra, SK=Shankarpura, BG=Baba Singh Gir, PR=Puraini, BR=Barsala, RH=Rhea, KP=Kuerapura, GA=Gadarian, HL= Harlalpura, GD=Godha, GH=Gohera, AT=Ater, NT=Naangoan Temple, MG= Maghera ka Pura, HK=Hathkant, DM=Dinnpura MP, DU=Dinnpura UP, NK=Nauchnouli, CH=Chilonga, KF=Khera Ajab Singh, front, KC=Khera Ajab Singh, channel, CT=Chikni Tower, KS=Kasaua, BA=Barecha, PN=Pituwan ka Nagla, SG=Sashon Ghat; “pd”=nestpredation

Table 3. Nest Surveys in upper stretch NCS & NCS total nesting 2017u 2018

Upper Stretch Nest Survey

late May-early June 2017

late May-early June 2018

location	total nests	lost*	hatched
Phusod (Parvati tributary)			
Jind Baba (Pavarti tributary)	5		5
Mor Kunda (Parvati tributary)	1		1
Pali	15		15
Bagadiya	13	3	10
Baghora			
Devgir	8		8
Divyghat	20	1	19
Baroli	11		11
Nadigao	40	7	33
Dangariva			
Radi Radhain	9	2	7
Khirkan			
Palri Banwara	11		11
Loha Sarai	1		1
Bharra	20		20
Dang Basai	31		31
Kainthri			3
total nests on upper stretch (Pali to Dholpur=194 km NCS)	185	13	172

total nests	lost*	hatched
7	1	6
1	1	
20		20
12	3	9
3	3	
3		3
7		7
18		18
25	15	10
1		1
1		1
4		4
10	1	9
4		4
4		4
20	4	16
3		3
143	28	115

*lost=predated / disturbed / failed

NCS Chambal River gharial		nesting 2017		
upper stretch (210 km)	185	13	172	
lower stretch (215 km)	232	46	186	
NCS total nesting (210 km & 215 km=425 km)	417	59	358	
	total	lost	hatched	

nesting 2018			
143	28	115	
290	87	203	
443	115	318	
total	lost	hatched	

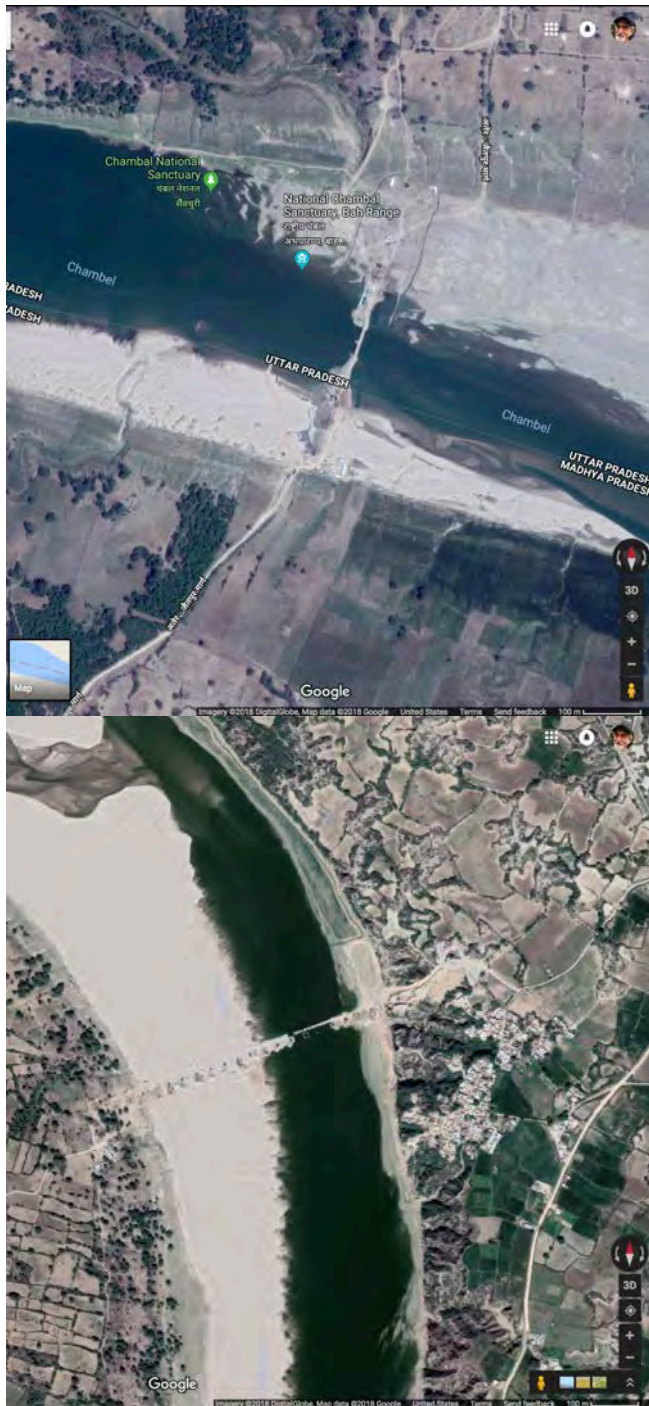


Figure 1. Two bridge construction sites on Chambal River main channel. The Ater-Naangoan site (at ~95 km from Chambal-Yamuna confluence) reduced the connectivity of the main channel to a narrow ditch over which a temporary bridge was constructed (top image; UP-Naangoan top of frame, MP-Ater bottom of frame). The Mahua Sunda-Rawani site (bottom image) spans a wider section of river (at ~25 km from Chambal-Yamuna confluence) and appears to be less problematic for gharial movements. The narrow channel at the upstream bridge site was noted as a possible problem for resident gharial in moving between the upstream and downstream areas in the vicinity of the bridge construction (MPFD 2018).

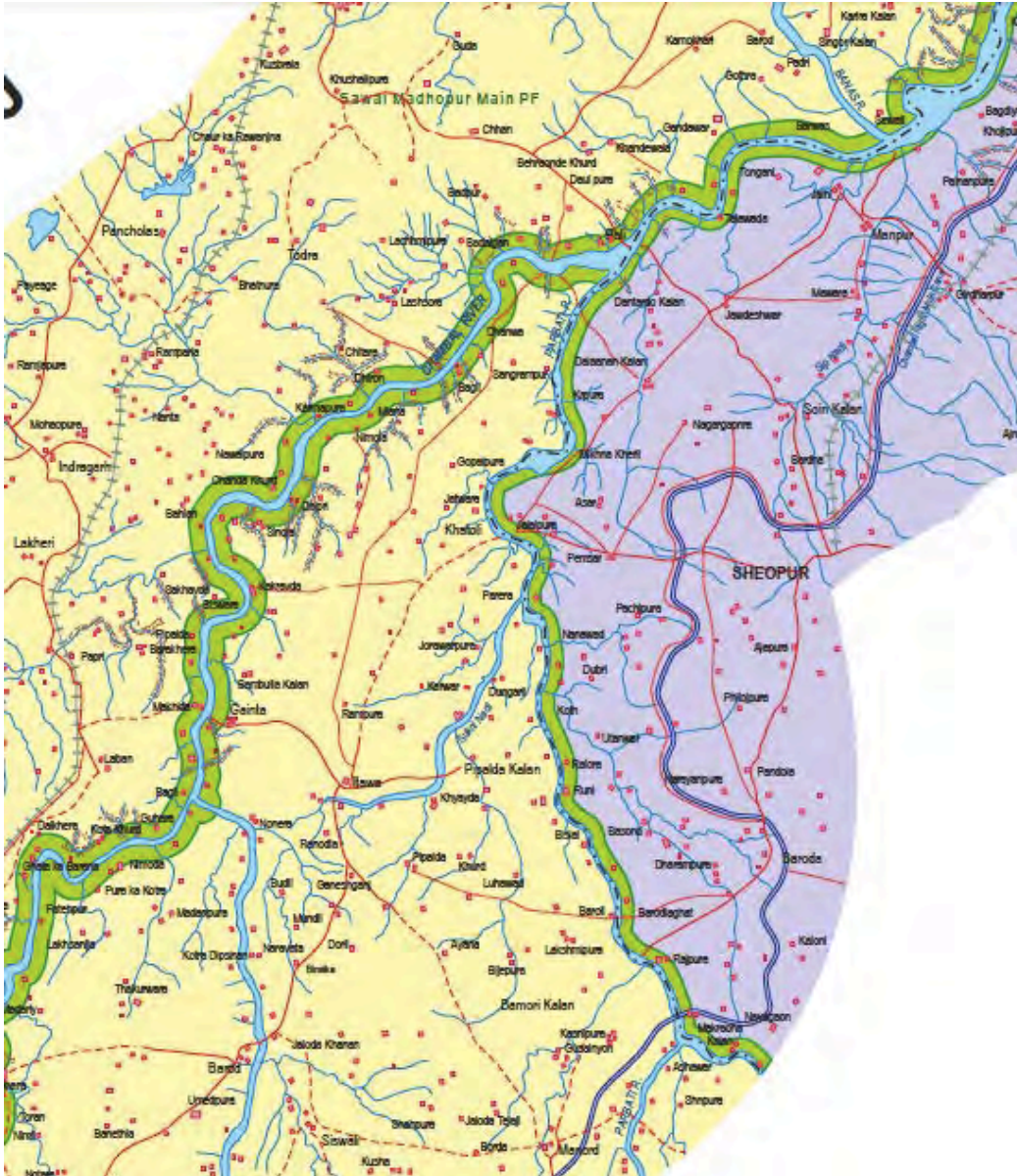


Figure 2. Parvati Tributary shown (center right) flowing north (to top of image) into Chambal main channel (running diagonally from lower left corner of image to upper right). In 2017 and 2018 surveys, adults were observed from 40 km upstream on the Parvati to the confluence, and nesting (>5 nests in 2017 and 2018) documented at 3 sites. Note that the NCS boundary (shown in green throughout image) only pertains to the Madhya Pradesh portion (right side of Parvati) of this tributary. The left side in Rajasthan (shown here in yellow) is totally unprotected from fishing, sand mining, and other anthropogenic features which have negative impacts on resident gharial.

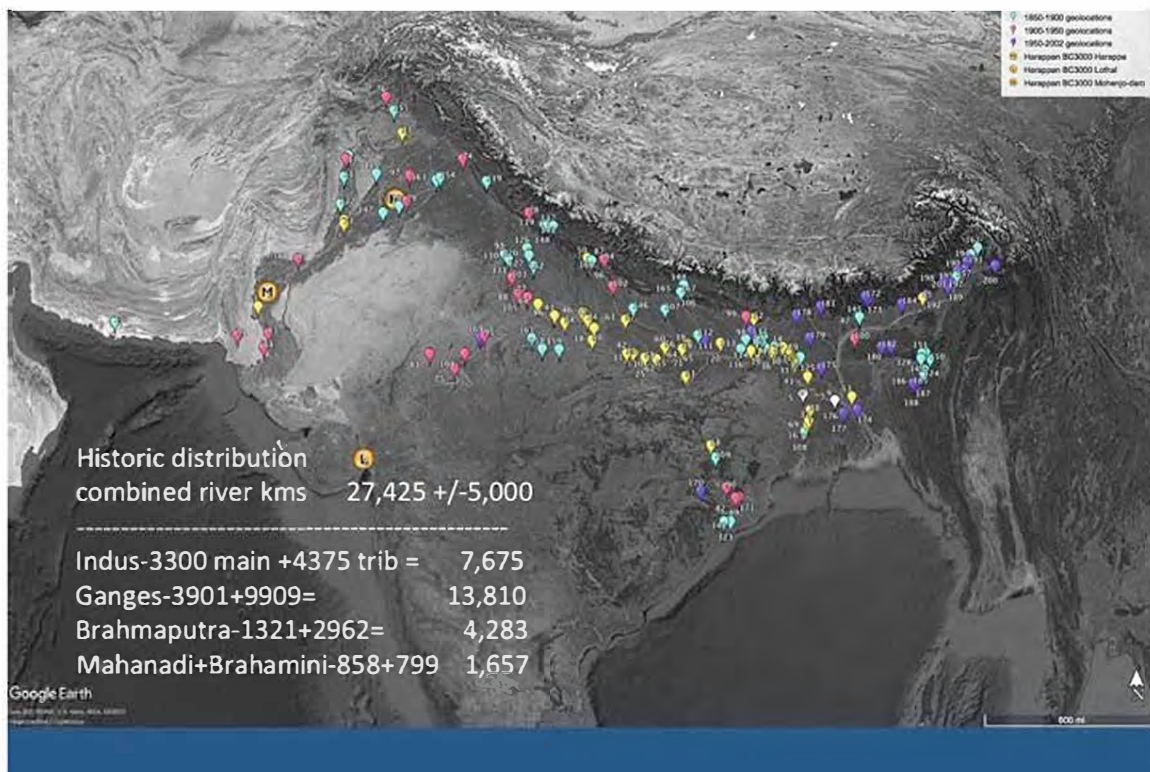


Figure 3. Historic distribution of *Gavialis gangeticus*, based on 200+ documented geolocations

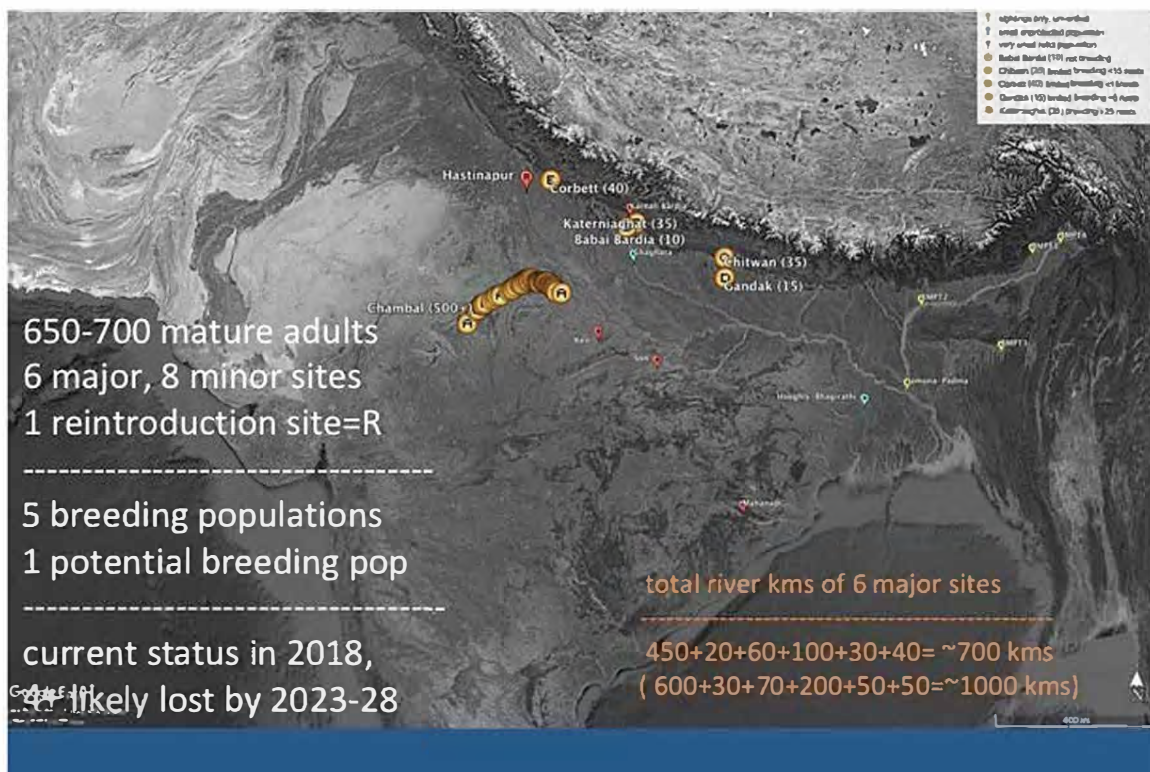


Figure 4. Current distribution of *Gavialis gangeticus*, based on a detailed review of recent reports

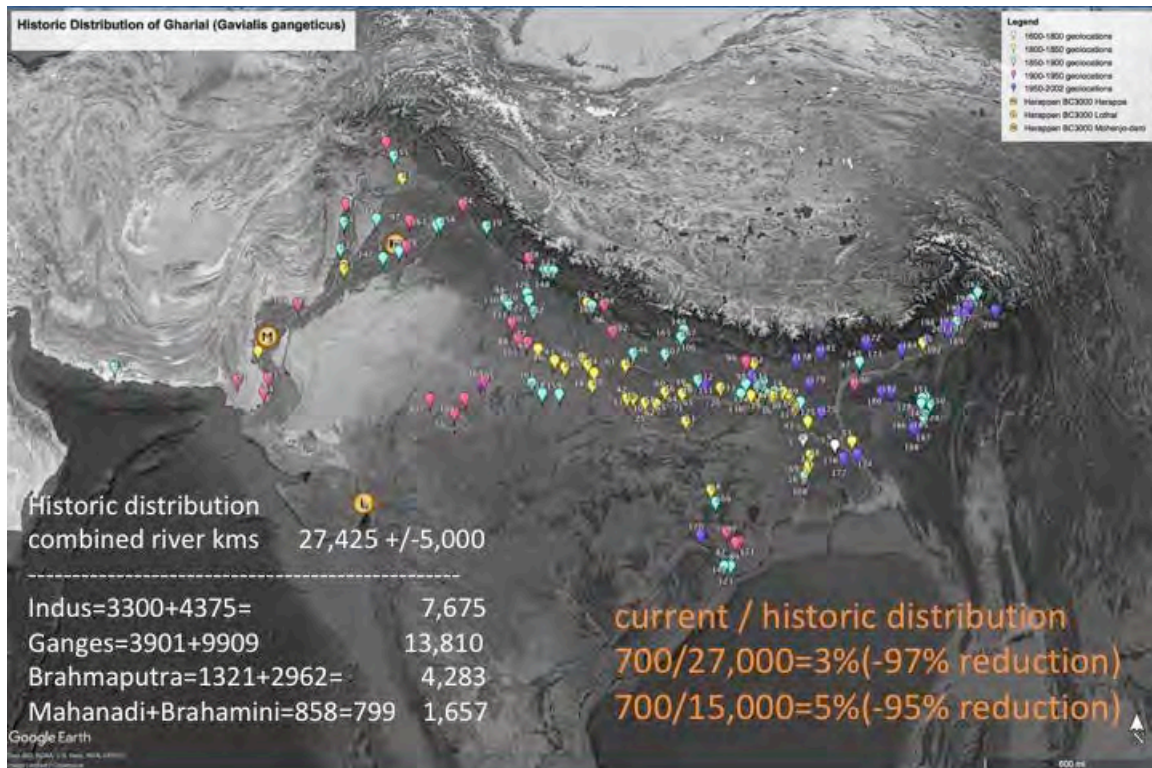


Fig 5. Reduction in historic range of *Gavialis gangeticus*, on 27,425 river kms, at 200+ locations

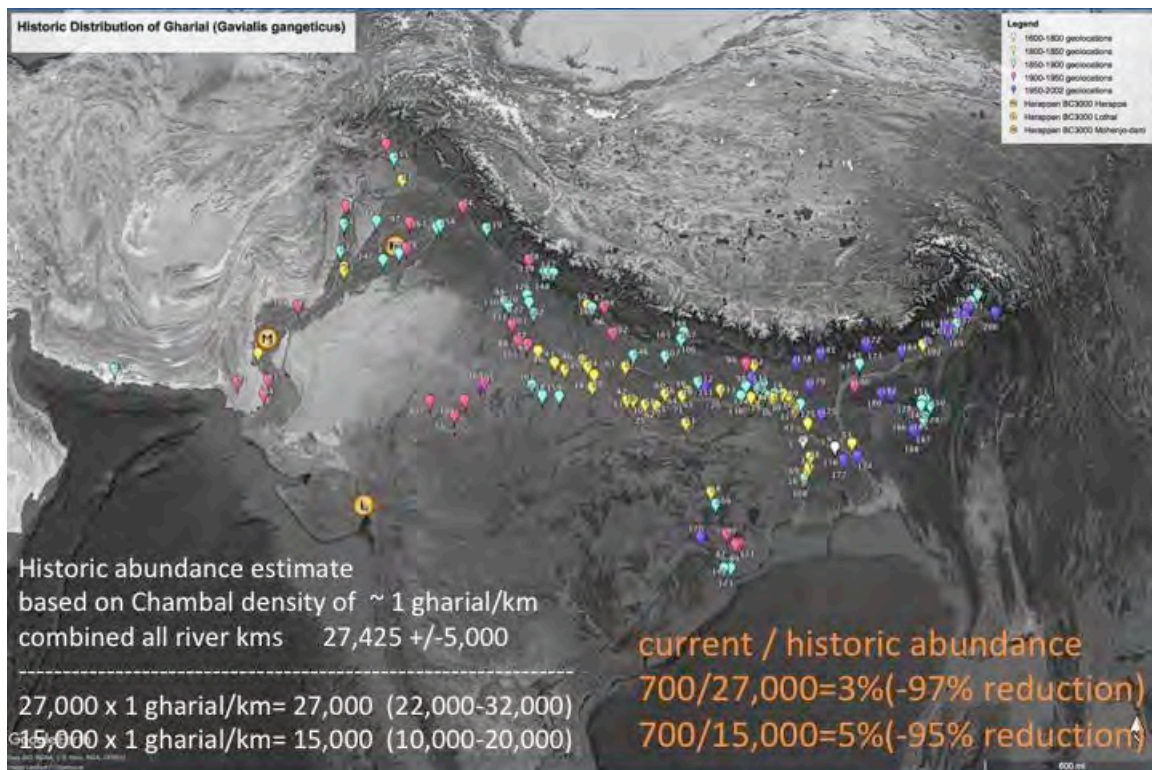


Fig 6: Reduction in historic abundance, based on 1 gharial/km over 27,000+ river kms, occupied

Abundance statements
Taylor 1840 alligators are numerous in all the rivers of the district (Dacca), and especially the garial, which is often of a very large size
Hornaday 1877 six hours, counted 24 gharial, multiple reports of groups 5-10 at sandbars
Braddon 1895 stood on boat bridge and fired at 20-30 ghurials within an hour
Delhi Gazatteer 1912 entire river (Yamuna) is infested with crocodiles both the gharial (or fish eating variety) and the magar (a blunt nosed variety: the former are the more common
Webber 1902 near the Indo-Nepal border, groups of 20 or more basking
Champion 1933 in late 20's, on the Mohana, 45 gharial lying on the banks gharial are extremely common in Oudh (UP today)
Maskey 1989 In the early 1950s about 235 gharial were observed on the lower Narayani prior to the construction of the border dam in 1964 .

Figure 7. Abundance estimates extracted from historical documents describing gharial distribution and abundance at various localities throughout the historical range of the species. References and details in updated Red List Assessment (2019)

Historic Reasons for population decline
1. Dams and barrages
2. Unregulated hunting
3. Mortality in fishing nets / gear
Recent Threats to extant populations
1. Sand mining and boulder removal
2. Water extraction / irrigation
3. Dams and river inter-linking
4. Water quality / pollution
5. Introduced species

Figure 8. Summary of major causes of historical decline of gharial throughout the range of species, based on historical evidence reviewed for updated Red List Assessment (2019)

Action Plan Update
Place ranking Chambal (1), Chitwan (2), Gandak (3), Babai (4), Katerniaghat (5), Corbett (6)
Site-specific needs , requirements, desired actions
1. Chambal: stationary surveys; nest monitoring; detailed upstream study Restrict sand mining, control illegal fishing, limit water extraction Reinforcement not necessary; no nest / egg / hatchling head starting
2. Chitwan: local community engagement, shift ex-situ focus to in-situ Reinforcement desirable, combined with telemetry studies in wild Release "science" and in-situ management strategies needed
3. Gandak: monitor reproduction, establish protected areas; trans-border Reinforcement desirable, coordinated with upstream actions in Nepal

Figure 9 . Outline of Action Plan 2019 for six extant gharial populations, in which there is documented breeding / potential breeding, in rank order from highest (1) to lowest (6) priority. Conservation actions needed at each site are specifically listed.

Action Plan Update
Place ranking Chambal (1), Chitwan (2), Gandak (3), Babai (4), Katerniaghat (5), Corbett (6)
Site-specific needs , requirements, desired actions
4. Babai-Bardia: baseline studies, reproduction: older head-start releases Reinforcement desirable, combined with telemetry studies in wild Document active breeding, based on previous record of nesting there
5. Katerniaghat: assurance site for breeding; juvenile retention in reservoir Detailed ecological and behavioral studies of reservoir adaptations, etc. No reinforcement presently, but active management and in-situ studies
6. Corbett: studies of reproduction aimed at augmenting breeding as needed Reinforcement may be desirable, pending analyses of present nesting, etc Comparative studies of Corbett & K'Ghat gharials inhabiting reservoirs, etc

Figure 10 . Outline of Action Plan 2019 for six extant gharial populations, in which there is documented breeding / potential breeding, in rank order from highest (1) to lowest (6) priority. Conservation actions needed at each site are specifically listed.

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वन्य जीव संरक्षण को लेकर छात्रों को किया जागरूक

शहर के कटरा शमशेर खाँ स्थित शिवाजी शिक्षा निकेतन इंटर कॉलेज में मंगलवार को एक कार्यक्रम आयोजित की गई। इस कार्यक्रम में छात्र-छात्राओं को जानकारी दी। परिवर्तन शिक्षाई प्रोजेक्ट, मद्रास को कोडाल वैक व इन विभाग के संयुक्त तत्वाधान में यह कार्यक्रम लगाई गई थी।

परिवर्तन समन्वयक धर्मादित्य हुकालीजी परिचयना डा. आशातोष चिप्राटी ने विद्यार्थियों को चम्बल सैन्चुरी के जीवों के प्रथम समग्र स्थिति पर



बच्चों को वन्यजीव संरक्षण की जानकारी देते हैं। अमिताभ रिपटी •

विद्यार्थियों को वन्य जीव संरक्षण को किया प्रेरित

बाह/पिनाहट | हिन्दुस्तान संवाद

नंदगवा में शनिवार को वन्यजीव सप्ताह के अवसर पर वन विभाग ने कार्यक्रम आयोजित किया। वन विभाग के परियोजना समन्वयक (घड़ियाल इकोलॉजी प्रोजेक्ट) ने छात्र छात्राओं को वन्य व जलीय जीवों की जानकारी दी। बोट से छात्र छात्राओं को चम्बल की सैर कराई। उनको जलीय जीवों की भी जानकारी दी गई।

शनिवार को वन विभाग ने टैगोर पब्लिक स्कूल (बाह) के विद्यार्थियों के साथ प्रकृति शिक्षण केंद्र नंदगवा (जैतपुर) में वन्य जीव सप्ताह मनाया। मुख्य अतिथि डॉ. आशुतोष त्रिपाठी परियोजना समन्वयक घड़ियाल इकोलॉजी प्रोजेक्ट ने विद्यार्थियों को पर्यावरण तथा वन्य जीव संरक्षण के



नंदगवा में शनिवार को वन्य जीव सप्ताह के तहत विद्यार्थियों को बोट से चम्बल की सैर कराई। • हिन्दुस्तान

संरक्षित करना न केवल हमारा दायित्व है बल्कि हमारे अस्तित्व के लिए भी जरूरी है। पर्यावरण से ही प्रकृति का

विद्यार्थियों से वन्यजीव पर संकटों के बारे में चर्चा की। टैगोर पब्लिक स्कूल के छात्र-छात्राओं को बोट से चम्बल

इस मौके पर प्रधानाध्यपक रविदत्त शर्मा ने भी विद्यार्थियों को संबोधित किया। राहुल, नंदराम, विनोद, महेंद्र

Figure 12. News clippings for Awareness Programs at Shivpal Singh Degree College (below) and Taigor School boat tour of gharial habitat on Chambal River, Naangoan (above). Both programs were conducted during Wildlife Week in early October 2018.

फछुआ फा 29 प्रजातया सफटग्रस्त



वन्य जीव प्राणी सप्ताह के अंतर्गत आयोजित कार्यक्रम में महाविद्यालय के छात्र-छात्राएं शिक्षकों के साथ • जागरण

संवाद सहयोगी, जसवंतनगर : घड़ियाल इकोलॉजी प्रोजेक्ट मद्रास क्रोकोडाइल बैंक तथा वन विभाग के संयुक्त तत्वावधान में वन्य जीव सप्ताह के उपलक्ष्य में शिवपाल सिंह महाविद्यालय में जलीय जीव एवं नदी संरक्षण जागरूकता कार्यक्रम का आयोजन किया गया।

प्रोजेक्ट के समन्वयक डा. आशुतोष त्रिपाठी तथा कॉलेज के प्रबंधक विश्वनाथ प्रताप सिंह, सोनू यादव ने छात्रों को घड़ियाल इकोलॉजी प्रोजेक्ट के बारे में जानकारी दी।

327 प्रजातियां पाई जाती हैं जिसमें से 59 प्रजातियां संकटग्रस्त हैं। भारत में इनकी 29 प्रजातियां पाई जाती हैं, जिसमें से 12 प्रजातियां गंगा नदी में पाई जाती हैं और उत्तर प्रदेश में इनकी कुल 15 प्रजातियां हैं। चम्बल नदी में इनकी 8 प्रजातियां हैं, जिसमें से 5 प्रजातियां घोर संकट में हैं। वर्तमान में चम्बल नदी में कछुओं के संरक्षण हेतु कई परियोजनाएं क्रियान्वित हैं लेकिन बिना स्थानीय लोगों के सहयोग के इनका पूर्ण संरक्षण संभव नहीं है।



कार्यक्रम में भाग लेती विद्यालय की छात्राएं • जागरण

विलुप्त प्रजातियों के संरक्षण के उपाय बताए

संवाद सहयोगी, चकरनगर : क्षेत्र के दो विद्यालयों की छात्राओं को चम्बल सैक्चुररी टीम ने वन्य प्राणी सप्ताह के तहत प्रतियोगिता का आयोजन कर छात्राओं को वन्य प्राणियों के बारे में जानकारी दी। इस मौके पर सैक्चुररी टीम के अधिकारियों सहित शिक्षक मौजूद रहे।

गर्देन सिंह स्कूल महाविद्यालय

को विलुप्त होते जानवरों की प्रजातियों और उनके संरक्षण के बारे में जानकारी दी। कुछ खूंखार जंगली जानवरों से बचने के उपाय तथा सर्पों में जहरीले सर्पों की जानकारी दी।

इस मौके पर रेंजर सहित विभाग से वन दारोगा वीरेन्द्र सिंह, चंद्रभान सिंह, प्रमोद कुमार तिवारी, मोनित सिंह

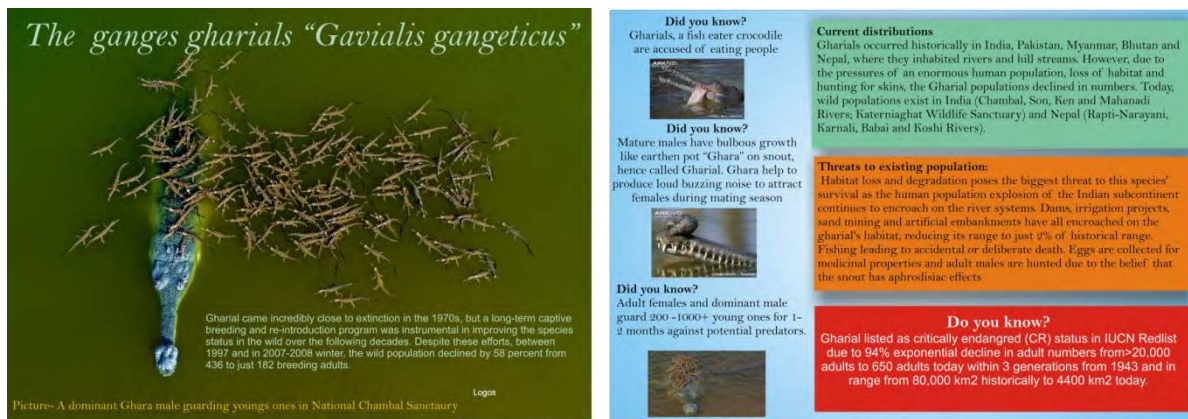
Education materials designed for riparian communities:**1. Leaflet****2. Education through game:****3. Pocket gharial diary:**



Photo 1. Upstream congregation of adult gharials on bank at Pali used in previous years as a nesting site just upstream on the Parvati River, from its confluence with the Chambal. This area is within the National Chambal Sanctuary (NCS) January 2018



Photo 2. Rocky areas are common throughout main river channel of Chambal, particularly in the top stretch from Pali near Parvati confluence to the high falls at JuJu. The Gharial Ecology Project (GEP) is initiating detailed behavioral studies of gharial in the NCS on the Chambal River between Pali & Dholpur



Photo 3. Pankaj Kumar helps guide the inflatable used by the Gharial Ecology Project to conduct an upstream population count in late January-early February 2018. About one third of the total adult population and about ~150 nests are located in the 200 km of stretch of NCS inhabited by gharial, above Dholpur to the Parvati confluence and in the Parvati.



Photo 4. Rapids associated with rocky sections are common throughout main river channel of Chambal, particularly in the top stretch from Pali near Parvati confluence to the high falls at JuJu, about 100 kms downstream from the Parvati confluence.



Photo 5. A large basking group of adult gharials, including several big ghara males, and 30+ females assembles on the Baroli sandbank along the main Chambal River channel. From December onward, adults concentrate in an area known to be a regular breeding and nesting site, for many years previous. A small falls, JuJu Falls, lies above Baroli sandbank.



Photo 6. In the upstream area, aquatic vegetation, such as the reed beds, visible in the image above, commonly occur, whereas these are seldom seen in the lower Chambal, from Dholpur to the Yamuna confluence. Overall, gharial are regular residents in the bottom 400 km of the 600 km NCS. The bottom 300 km stretch below Rahu Falls (see below left) is similar in aspect and terrain, and differs from the top 100 km above the falls to Pali, at the Parvati mouth.



Photo 7. Rahu Falls, seen here looking upstream, presents major logistic and operational challenges to boat traffic. The GEP orange inflatable boat proved to be a poor match for the upstream rocky stretch, sustaining many rips and tears to bottom and sides, and requiring frequent repairs and stops.



Photo 8. Sand mining on both sides of the banks of the Chambal (in MP and in Rajasthan) was often observed. In some areas, sand was bagged and ferried across the river from one state to the other, and then transported from the riverbank by tractor to off-river sites where it was loaded for sale/transit.



Photo 9. The inflatable boat took quite a beating on the upstream survey in early 2018. Jailabdeen A. (GEP Project Coordinator) and Ravi Singh (who is PhD student at LaCONES, CCMB, Hyderabad) make temporary repairs, at a Tighra-Rithora stop while the GEP survey team is enroute to our downstream base near Garhaita. The boat survey during the winter months facilitates accurate counts of adult gharial at basking sites near breeding areas.



Photo 10. Adult gharials bask on a sunny day in early February at riverside while JCBs and tractors with trolleys remove sand on a large sandbar at the Tighra-Rithora bend in Chambal River. Large numbers of adults and large sub-adults congregate at this site every year during the winter months. Group numbers often exceed 70+ gharial. Some of these are seasonal residents, marked in previous years by the GEP at locales >100 km downriver.



Photo 11. In mid February, the GEP partnered with the MPFD staff at the Deori EcoCentre to radiotag juvenile gharial, reared at the facility from hatchlings. These individuals are referred to as "head-starts" and are typically raised in captivity for ~2 years to sizes of 1-2m in total length, for eventual release.



Photo 12. Jailabdeen A. (left, foreground) readies a young gharial for restraint with duct tape, applied by Pankaj Kumar (the main tracker on the GEP; right foreground). Jyoti, MPFD staff, looks on (center).



Photo 13. The VHF radio transmitters, temporarily turned OFF with a magnet on each, secured with yellow tape, are readied for attachment. Each radio has a battery life of ~2 years, and range of 1-4 kms. The weight is 50-60 gms, and a radio is attached to the dorsal tail by securing it with kevlar line thru the skin of each gharial. Each animal has a separate signal that identifies it, and is tracked 2-4X a week post release, depending on its location.



Photo 14. Jailabdeen A. (left, foreground) finishes attaching a radio transmitter to a young gharial prior to releasing it into the wild. The whole procedure takes about 15-30 minutes per animal while the animal is restrained by tying its limbs to prevent movement, and taping the body to a rigid frame. The tagged animals are measured, weighed and scute clipped with permanent marks, and restrained in burlap bags kept moist, released same/next day.



Photo 15. In mid February, the GEP partnered with the MPFD staff at the Deori EcoCentre to radiotag juvenile gharial, reared at the facility from hatchlings. Nine radiotagged gharial were released at three sites upstream from the GEP base at Garhaita, and were tracked for 1-6 months post release



Photo 16. Nine radio tagged juvenile gharial, reared in captivity, were released at 2 years, 1.2-1.6m in size, at three sites between Naangoan and our base at Garhaita in the NCS. Within 5 months, none of these animals were trackable, and 3 radios were recovered indicating the releases were dead.



Photo 17. Ravi Singh, PhD student at LaCONES, studying the genetics of how creche participants are related in the Chambal gharial population, assists in an acoustic investigation of how large male gharial communicate. Here he installs a hydrophone (underwater mic) for recording the sounds produced by breeding males as they communicate with mates and potential rivals. Jailabdeen A. is doing the acoustic study, underway for second field season in 2018.



Photo 18. The hydrophone (circular disc adjacent to red tape), weighted with lead, is submerged in shallow water, and attached by cable to a digital recorder. Typically, a dual array is installed each monitoring period, for hours of observation recorded. In some settings, these arrays are left for 24-48 hrs so that remote continuous recordings can be made near breeding / nesting sites. This arrangement allows the GEP team to detect specific individuals.



Photo 19. Jailabdeen A. checks an acoustic array near our Garhaita base, where multiple hydrophones, as described above, are installed for monitoring of big ghara males present at the breeding site. Each male produces a distinct "pop" signal that varies depending on the context, e.g., external disturbance, female-male interaction, male-male challenges, etc.

Male gharial underwater popping signal – Maghera male

Hydrophone audio record – Frequency view



Photo 20. In gharial, acoustic signals are produced but few vocalizations are evident. Each large male has a distinctive "signature" sound it makes, which depends on the social context, and the behaviors in which the male is engaging. The "popping" sound differs in different contexts, e.g., mating vs. contests.



Photo 21. Pankaj Kumar, the main principal tracker working for more than a decade on the Gharial Ecology Project, takes aim with a point and shoot camera to document gharial social interactions and behaviors. He makes daily observations of gharial that are residents of the NCS, and makes detailed records of the seasonal activities of individuals.



Photo 22. Observations are frequent and prolonged during the breeding, nesting, and hatching seasons at multiple sites known to be used year after year by individual gharial that have been marked and tagged with radio transmitters to identify each animal and allow the GEP team to keep track of its movements up and down the NCS. Jailabdeen A. (left) and J. Lang (right) focus on gharial basking at Chilonga.



Photo 23. Jailabdeen A., Project Coordinator GEP, is engaged in the fine art of tracking gharial using radiotelemetry gear from Advanced Telemetry Systems (ATS), Isanti Minnesota. Here he is using a 5 element YAGI antenna, explaining details to Phoebe Griffith, Oxford U., studying gharial in Nepal.



Photo 24. Deepu Mishra, base manager for GEP, works with Jailabdeen A., to detect the radio signals from a GPS transmitter, which is being remotely downloaded at close range, from a basking gharial across the river. Multiple GPS locations allow the team to detect fine-scale movement patterns.



Photo 25. In mid to late June, depending on how early nesting / hatching occurs each year, the GEP team surveys the nesting areas, and determines the number of hatched and / or predated nests, to add to the seasonal total for each colonial nest site. At this site near the Rajasthan-Uttar Pradesh border in the NCS, eggshells are collected from nests that just hatched for genetic analyses of hatchlings at site.



Photo 26. Ravi Singh (center, right) looks over an opened, hatched nest as an assistant collects eggshells. Eggshells from hatched eggs are retrieved and air dried before being returned to the lab for extraction of DNA representing each hatchling. With samples from a number of nests at the same site, it is possible to determine the relationships of hatchlings to one another, as well as parentage.



Photo 27. Documenting anomalies observed in hatchlings is useful in determining the health and relative fitness of various nests. In this image, the individual in the center displays a shortened snout (relative to the individual, right side of image) and a slightly shorter top jaw, which may correlate with other asymmetries related to incubation conditions.



Photo 28. An aerial view of shoreline inhabited by a creche of hatchlings. In the lower left corner, just offshore, is an action camera mounted close to water level, on a PVC pipe about .5m offshore. This setup facilitates continuous monitoring of creche behaviors by hatchlings and guardian adults when these creche residents are not disturbed by people. An example is included below (photo 29).



Photo 29. Action camera imagery, taken at water level, just offshore at a creche site (see previous figure for aerial view), using an inexpensive camera powered by a small battery pack, and allowed to run throughout the day and night. In this image, hatchlings are evident in the water and onshore, and big ghara male and guardian female are seen at water surface (center, distant and to right).



Photo 30. Infra-red imagery, taken with a modified action camera (IR filter removed) at a nest site, opened by a female (visible here facing the shore, lower right corner). In this sequence, newly hatched young were clearly seen to exit the nest and walk to the water, unaided by the attendant female.



Photo 31. Aerial image showing a creche of young with the guardian female, attendant at the nest in the water at the shoreline where the young remain. At this site, two hydrophones were installed nearby to monitor possible communications in the water. An aerial mic nearby recorded vocalizations.



Photo 32. Aerial imagery of a big ghara, guardian male at the Kasaua nest site. The 30cm scale (upper right, yellow) and 100cm scale (white, to left of snout) allow relatively accurate estimates of the sizes of creche participants, adults and hatchlings.



Photo 33. Local fishermen skilled in designing ways of catching gharials in modified nets have been with the Gharial Ecology Project, for the past eight captures. These experienced river folk work closely with Pankaj Kumar and other trackers to develop effective strategies for restraining gharial while they are fitted with radio transmitters.



Photo 34. Gharial struggle little when captured in nets, and must be removed quickly to avoid any injuries. Once the snout is tied shut, and the limbs are restrained, a burlap bag over the head to cover the eyes results in minimal stress during capture and handling in boats and on land. Once released, these gharial become alert and bound for the water.



Photo 35. Processing each individual, by taking its measurements and then clipping an distinctive series of tail scutes, requires careful handling by multiple people. The animals are typically tied to rigid frames, such as lightweight ladders, to aid in safely restraining them for the radio attachment.



Photo 36. Lack of skill in handling gharial results in local fishermen damaging gharial caught in their fishing nets, by chopping off the tips of the jaws. Here, a juvenile with the front portion of both jaws amputated is shown. Care must be taken to prop open the jaws of such damaged animals, so that the animal can breathe effectively, without a nares.



Photo 37. In mid November 2018, another 15 head-started, captive reared gharial resident at the Deori EcoCentre, Madhya Pradesh Forest Department, were radiotagged by the Gharial Ecology Project team and in a joint operation with the MPFD, were released at multiple localities in the lower Chambal. Here, Hari Meena (left) and Jailabdeen A. (right) contemplate how these four gharial will be tagged.



Photo 38. The captive-reared gharial, with radios attached, await transport from the Deori EcoCentre to the field sites, riverside on the Chambal River between Naangoan (Ater) and Garhaita (Chilonga) where they will be released. The GEP team will be tracking these individuals to determine their survival and residency as they acclimate to the wild conditions and become established in the NCS.



Photo 39. Front line MPFD staff assist Jailabdeen A. in the release of one of the 15 radiotagged gharial from the Deori EcoCentre into the Chambal River. Earlier in November 2018, 8 resident juvenile gharial living wild in the NCS were radiotagged to provide a comparison of survival and residency, relative to the released head-starts, matched for size and sex.



Photo 40. Jyoti, staff at the Deori EcoCentre, looks on as a head-started juvenile is released into the Chambal River in November 2018. This animal is one of the 15 captive reared gharial released for follow up studies of their survival and residency.



Photo 41. Young conservationists work together to measure and radio tag a wild resident juvenile gharial near the Garhaita base on Chambal River. Ashish Bashyal (left), Phoebe Griffith (center), and Jailabdeen A. (right) are conducting separate studies at two localities in Nepal (Ashish at Bardia, and Phoebe at Chitwan) and on the Chambal (Jai).



Photo 42. The Gharial Ecology Project team on site during capture and radiotagging of juvenile gharial. Ashish and Jailabdeen are EDGE Fellows for 2019-2020, and Phoebe G. is a PhD student, Oxford U. Other staff shown here are: (from left to center) Anil, ShivSingh, Ravi Singh (LaCONES), Jeff Lang.



Photo 43. In late November and early December, Phoebe Griffith (Oxford U.) captured and tagged 5 gharial resident in Chitwan National Park (CNP) for her PhD project, designed to learn how wild gharial at Chitwan utilize riverine habitats in CNP. She is shown here with a 3.1m adult female with tags.



Photo 44. Phoebe Griffith visited the Gharial Ecology Project in February 2018, and again in November 2018 to assist in capture and tagging wild resident gharial. She is deploying GSM radios that communicate with cell towers to upload GPS fixes at regular intervals to an internet mapping site.



Photo 45. One side of a clay tablet from the Indus Valley Civilization, ~2000 to 3000 BC era, showing a long snouted crocodilian, with a fish in its jaws. Other imagery on seals, stamps, and coins appear to illustrate gharial which were living in Indus River. Gharial bone has been found at three Harappan sites, in midden remains, including one in Gujarat.

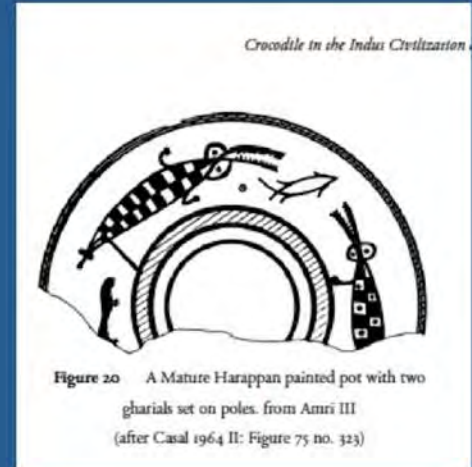


Photo 46. Two gharials figured on a painted pot from the Indus Valley Civilization, with elongated snouts and a fish. The presumed pole mounted figures shown here closely resemble similar figures found in some localities in western India today. Gharials inhabited the Indus River until the turn of the 21st century. Now the species is extinct in Pakistan, and found nowhere wild in the Indus.



Photo 47. The British Raj produced many records of trophy hunting by officers stationed throughout south Asia. Here, a photograph archived in a south Asian library in London clearly shows a gharial, with the dead animal referred to as a "mugga" taken in February 1931 at an upriver site on Indus.



Photo 48. Early photographs of wildlife in India, taken by F.W. Champion included shots of gharial at a site on the Ramganga River before it was converted into a reservoir at Corbett National Park. These images provide accurate geodata on the historic distribution of gharial across south Asia.



Photo 49. Awareness Program presented by Dr. Ashutosh Tripathi, Community Coordinator, for the Gharial Ecology Project to a rural college in a town, Chakkar Nagar, located close the National Chambal Sanctuary (NCS). The program consisted of videos, and power point presentations on the biodiversity of the NCS, with emphases on gharial.



Photo 50. Looking toward 100+ students at the Rambeti Inter College, Chakkar Nagar, Etawah District, during presentation (as in Photo 49) on 30 August 2018. Conservation of the Chambal River ecosystem, and its fauna and flora were featured, especially the aquatic fauna, including turtles, and freshwater dolphins, as well as wading birds.



Photo 51. Presentation on 1 September, at nearby rural college, Harnarayan College, located along the Yamuna River, at the top end of the protected NCS. This college and the one shown in Photos 49-50 are private schools with tuition paid by families of students for enrollment, as alternative to the government-run rural village schools.



Photo 52. Another view of students at Harnarayan College, as shown in image to left. A total of 35+ students viewed this presentation and took part in question and answer session at its conclusion.



Photo 53. Presentation on gharial and the relative importance of the National Chambal Sanctuary (NCS) in the species' conservation was heard by more than 50 students on 10 September at the Gayaprasad Degree College, Debholighat, near the top boundary of NCS on the Yamuna River.



Photo 54. Another view of presentation described in Photo 53. The presentation included a series of videos in the local language, Hindi, explaining the Gharial Ecology Project, and the biodiversity of the Chambal and Yamuna Rivers as an aquatic ecosystem deserving local protection.



Photo 55. Another view of students at Gayaprasad Degree College, Debholighat, Etawah District, UP



Photo 56. Another view of students at Gayaprasad Degree College, Debholighat, Etawah District, UP



Photo 57. Kids Valley School, Etawah, where GEP Community Coordinator, Dr. Ashutosh Tripathi made multiple presentations to over 300 students on 12 September 2018.



Photo 58. Another view of one of the several talks presented to the entire student body at Kids Valley School, on the topic of environmental awareness, featuring the work of Gharial Ecology Project on gharial conservation.



Photo 59. Another view of one of the several talks presented to the entire student body at Kids Valley School, on the topic of environmental awareness, featuring the work of Gharial Ecology Project on gharial conservation.



Photo 60. Another view of one of the several talks presented to the entire student body at Kids Valley School on the topic of environmental awareness, featuring the work of Gharial Ecology Project on gharial conservation.



Photo 64. Presentation at Shivaji Shiksha Niketan, on 14 September, to a total of 250+ students in several groups on environmental awareness.



Photo 61. View of teachers participating in the discussions following the presentations at Kids Valley School, as in Photos 57-60 above.



Photo 62. On 13 September, 2018, presentation on environmental awareness, featuring topics related to the National Chambal Sanctuary and the Gharial Ecology Project was made to 50+ students, followed by question and answers and discussion by students.



Photo 63. Another view of the presentation to the Gyanstali Academy, Etawah by Dr. Ashutosh Tripathi, Community Program Coordinator for the Gharial Ecology Project.



Photo 65. Presentation at Shivaji Shiksha Niketan, on 14 September, to a total of 250+ students in several groups on environmental awareness.



Photo 66. Presentation at Shivaji Shiksha Niketan, on 14 September, to a total of 250+ students in several groups on environmental awareness.



Photo 67. Presentation at Shivaji Shiksha Niketan, on 14 September, to a total of 250+ students in several groups on environmental awareness.



Photo 68. Presentation at Shivaji Shiksha Niketan, on 14 September, to a total of 250+ students in several groups on environmental awareness.



Photo 69. Presentation to the Chaudahri Sughar Singh Group Institute (CSSGI) on 15 September to a total of 350+ students who participated in the program, with assurances from the Principal that his institution would fully engage in conservation of river and in particular gharial.



Photo 70. The program at CSSGI (as in Photo 69) consisted of multiple short videos with Hindi narration, explaining the natural history of gharial, and the importance of the National Chambal Sanctuary (NCS) for its continued survival.



Photo 71. Other views of the programs underway at the CSSGI, conducted by the Gharial Ecology Project (GEP), to a series of classes at institute on 15 September. Here, teachers participate in the discussions with students, with Dr. A. Tripathi, Community Programs Coordinator for the GEP



Photo 72. View of interior courtyard at CSSGI, where presentations were conducted by the Gharial Ecology Project (GEP), to a series of classes, totaling 350+ students in all classes.



Photo 73. During Wildlife Week (3-7 October, 2018) a number of Environmental Awareness Programs were presented to higher level students, in 10-12 grades, at four institutions in Etawah, Uttar Pradesh.



Photo 74. These students at Shivpal Mahavidhyalaya are concentrating on science, and some go on to do master projects on specific topics. A total of 250+ students participated in programs presented by Dr. A. Tripathi, for Gharial Ecology Project.



Photo 75. A group photo of participants in the programs described above (photos 73-74). At this venue, the Principal requested the GEP to start a student volunteer program for environmental education in riverside villages within the NCS.



Photo 76. On 4 October, in Wildlife Week, program was presented at the Ashram Paddhati School, Etawah. Ten teachers participated in the program.



Photo 77. Another view of Ashram Paddhati with presentation by Dr. A. Tripathi for the Gharial Ecology Project.



Photo 78. Student body looks on, while videos are presented during Wildlife Week presentations at Ashram Paddhati School, 4 October, for 350+ students.



Photo 79. On 6 October, at the Naangoan Nature Interpretation Centre in the National Chambal Sanctuary (NCS) during Wildlife Week, a total of 40+ students participated in awareness programs.



Photo 80. Another view of students from Taigor Public School, as in Photo 79, participating with games and skits dealing with the environment.



Photo 81. Taigor Public School group on a boat ride on the Chambal River, near Naangoan, to visit nearby areas frequented by wild resident gharial. These students also met at the interpretation centre which is part of Uttar Pradesh Forest Department facility for NCS visitors (photos 79-80 above).



Photo 83. Seven Hills Inter College students at an environmental awareness program during Wildlife Week. This presentation, on 7 October, was viewed by 80+ students, and included a discussion of snake bite and snake rescue practices.



Photo 84. Seven Hills Inter College students at an environmental awareness program during Wildlife Week. This presentation, on 7 October, was viewed by 80+ students, and included a discussion of snake bite and snake rescue practices.



Photo 82. Taigor Public School group on a boat ride on the Chambal River, near Naangoan, to visit nearby areas frequented by wild resident gharial.



Photo 85. Seven Hills Inter College students at an environmental awareness program during Wildlife Week. This presentation, on 7 October, was viewed by 80+ students, and included a discussion of snake bite and snake rescue practices.



Photo 86. On 27 October, a Capacity Building Workshop was conducted by two GEP staff for the new recruits to the frontline staff of the Bah and Etawah and Agra districts, UP Forest Department.



Photo 87. Dr. Ashutosh Tripathi presents details on human-crocodile conflict, and capture and handling techniques for large reptiles, including crocodiles and snakes to the frontline staff at the Naangoan Interpretation Centre, UPFD.



Photo 88. Jailabdeen A., Program Coordinator for the Gharial Ecology Project, outlines the common and dangerous snakes of the region, and also tells about the Gharial Ecology Project activities to frontline staff of the UPFD at a capacity building workshop held in the training facility, in the NCS.



Photo 89. The new recruits as well as experienced guards and foresters in the UPFD, assigned to the Chambal River beat, review workshop materials prepared and presented by members of the GEP at the October 2018 Capacity Building Workshop.



Photo 92. Students at the local school in Kasaua, a riverside village near a prime gharial nesting site, sort through rubbish, and separate out the bio-degradable material from that which is not. A prize was awarded to those students which were able to do learn quickly how to accomplish these tasks.



Photo 90. A Teacher Training Program was held in late November in Etawah for rural upper primary school teachers, 20 participants, responsible for the classroom activities of 400+ students in many of the riverside village schools.



Photo 91. Dr. Ashutosh Tripathi, Community lead for the Gharial Ecology Project, was the principal guest and leader of an environmental unit that was presented as part of the Teacher Training Program. A follow up in 12 schools was also conducted.



Photo 94. A student at the village school in Jaitpura reads to his classmates about the lifestyles of both gharial and mugger crocodiles, native species in the NCS. Most of these kids play and work near places inhabited by these protected crocodylians.



Photo 95. Creative activities such as sketching gharial activities and behaviors on Chambal River were included in the TTP follow up visits by GEP staff. Here, a student draws a fisherman netting a gharial while trying to catch fish illegally in NCS.



Photo 96. Students in an upper primary school in Kasaua, a riverside village with a lot of gharial in the nearby Chambal River, participating in games led by Dr. A. Tripathi during the follow up visits.



Photo 93. Ashutosh reviews how to tell a gharial from a crocodile for an audience of upper primary students in Gaati village school follow up visit.



Photo 99. One of the older students in Kasaua draws a big male gharial with a bump on its nose, as part of a drawing competition among students.



Photo 98. Teacher with students, looking at their drawings of gharial and crocodiles, and asking for them to explain what each drawing illustrates.



Photo 97. Coloring drawings provided by the Prague Zoo in gharial story books was part of a competition.



Photo 100. Ashutosh teaches students how to play a large version of a modified "snakes and ladders" with questions about environmental awareness.



Photo 101. A discussion group organized around tea time in Kasaua village to discuss issues that concern village elders about the management of the National Chambal Sanctuary (NCS) where the lands these villagers farm is located.



Photo 102. Villagers in Piproligadhiya listen to the points about conservation of the river fauna and flora in the NCS where they farm and graze stock. Gharials are threatened by illegal sand mining, and also by net fishing which is not sanctioned in NCS.



Photo 103. Villagers at Bareh gather for a teatime meeting that focused on the biodiversity of the protected river habitats and animals, and offer advice on what their major concerns are in NCS.



Photo 104. Villagers at Badhpura, located close to the Chambal River, watch an instructive video on the protected animals, including the gharial, within the NCS. Issues of concern with the way the NCS is managed are often a favored topic at meetings.