

GHARIAL ECOLOGY PROJECT

Progress Report 2014

Project duration: January-December 2014

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OVERVIEW

Gharial (*Gavialis gangeticus*) is a critically endangered crocodilian living in South Asian rivers. The only viable, self-sustaining population inhabits the Chambal River where a mass die-off occurred in 2007-2008. With GCA support, ecological studies (2008-2013) of these gharials have been conducted in the National Chambal Sanctuary (NCS), utilizing telemetry to record their movements, activities, and behaviours relevant to the die-off, and critical to their conservation. To date, the results reveal new information about gharial spatial habitat use and seasonal movement patterns, as well as social structure and breeding biology. For the first time worldwide, this project provides the biological basis for science-based conservation actions to protect the remaining wild gharials in their natural river habitats. A training/education component develops an awareness of this magnificent species among the river folk it lives with.

Telemetry Component: Capture and Tagging of Additional Large Gharial in NCS

In Nov 2014, the major activity for this component was the capture and tagging of large gharial. We were able to tag a large ghara male, total length 5.3m, weighing in at an estimated 850+ kgs; a 4m male was also recaptured and outfitted with a GPS logging radio. All together, we captured an additional 20+ gharial, and successfully tagged 7 large gharial with GPS loggers. To date 5 of these 7 are being actively tracked, as well as 20+ previously tagged animals. In Nov-Dec 2013, major support from the Prague Zoo funded the capture and radio tagging of 20 gharial and 2 mugger crocodiles, with the requisite permissions of Government of India, Ministry of Environments and Forests, and permissions and collaborative cooperation from the State Forest Departments of Madhya Pradesh, Uttar Pradesh, and Rajasthan. A highlight of the capture/tag operation was a visit to the capture sites by Prague Zoo Director, Miroslav Bobek and his wife Klara, and Jaroslav Simek, Deputy Director, as well as Romulus Whitaker, Founder of Madras Crocodile Bank Trust, who joined the catch team for several days, and Kalyan Varma, journalist. UP Forest Dept officials were on hand throughout catching.

Training Component: Full-time Coordinator, Training Workshops, Education Programs

From Jan thru Dec 2014, the training/education component supported a full time Coordinator, Saniya Chaplod. A training manual was finalized for front line Forest Department staff working on the Chambal. The draft manual was used in the workshops held to inform and orient the staff about the diversity and identities of the plants and animals living along the river in a variety of habitats. Three workshops were conducted by GCA/TSA staff for FD personnel. Two of these were held in April at Garhaita village on the Chambal in UP for two groups of range officers and staff. Another was held in October at the Deori Centre, near Morena for MP Forest Department officers and staff. Local education programs were supported in Gandak and Son river communities in gharial habitats. In addition, for Wildlife Week in October, week long environmental awareness programs and educational activities were conducted at the Kukrail Centre in Lucknow and in the local schools with GCA/TSA support, in part provided by the Prague Zoo training grant, focusing on aquatic reptiles.

TELEMETRY COMPONENT OF Gharial Ecology Project

BACKGROUND

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

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

In July 2013, project continuation was approved to provide a comprehensive picture of the spatial and reproductive ecology of gharial and mugger living in the NCS. Permission was granted for 30 animals to be tagged, 25 gharial and 5 mugger. Previous support from the Prague Zoo funded the radio-tagging of 22 gharial and 2 mugger crocodiles, in Nov-Dec 2013.

The overall study will demonstrate that individual gharials utilize the entire river for specific habitats as well as corridors, and aims to provide baseline information on the status of gharial populations within the NCS. The Gharial Ecology Project continues for 3 years in two phases: a) capture and tag in November-December 2013, and b) monitoring for 3 years, until Dec 2016.

CAPTURING GHARIAL

Unlike other crocodilians, gharial cannot be trapped or caught with lines. The most effective way to capture animals without injury is to net them, with modified gear and tackle used by contract fishermen. We employed a team of six experienced fishermen from local river communities who had worked with us during two previous capture/tag operations. They employed large mesh gill nets, 2-5m depth and 50-150m in length, which were set and checked at regular intervals. Gharial and mugger were entangled in nets as they moved onto basking sites, or retreated from basking areas. Trapped animals were removed as soon as noticed, usually within 5-20 minutes of being caught, restrained with netting and ropes, and moved to the nearby shore where they were measured and tagged. The total capture to release period for each animal varied, but usually was 1-4 hours or less.

Both gharial and mugger became docile when properly restrained, with eyes/head covered to reduce disturbance, and only showed vigorous escape behaviours when they were untied and released after capture and tagging. In addition to the fishermen, two experienced crocodilian handlers from MCBT were hired as consultants to assist throughout the capture/tag operation. Also, an experienced reptile veterinarian, was on hand for the entire operation.

The general capture strategy was similar to that used in 2013, but a greater level of cooperation was required by the fisherman and experienced catchers to work together in setting longer nets in complicated patterns to entrap larger adult gharial. Most large subadults and adults are extremely wary of the nets, and used a variety of techniques to avoid getting entangled in them.

For the 2014 capture/tag operation, additional large mesh, deep, and long nets were constructed in the week prior to starting, and used along with the previous nets from 2013. Eight nets were used, in varying combinations, settings, and lengths. In most sets, nets were stretched for distances of 100-300m, and used in combinations of 2-3 net "curtains" around favoured basking sites, typically sand bars and beaches at locations where the river turned path. In addition to the two country boats used by the fishermen to set nets, a shallow draft, flat



Figure 1. Local fishermen use large mesh gill nets, set parallel along selected sand bars and beaches, and extending 50-200m in length, and 2-4m in depth to entangle gharial as they approach to emerge and bask. The larger mesh used during 2014 allowed the catch team to target large gharial, and reduced the likelihood of catching smaller gharial. Floats tied to these long nets permitted close, continuous monitoring of all nets via binoculars.



Figure 2. The catch team employed two "country" boats, shown here, and an aluminium jonboat, with a 25hp outboard motor, in their netting and capturing strategies. This year's catch team, which included two MCBT based crocodile handlers, as well as the gharial trackers, consisted of 10 people working the nets and captures. In addition, there was an experienced reptile veterinarian as well as assistants to attach radios, and measure, mark, and weigh animals.



Figure 3. Handling gharial is difficult, requires careful attention to detail. Covering the head, especially the eyes, is essential to "quiet" the animal when captured. Animals in nets were first restrained on boat, with limbs tied as in Fig.2 above, then carried ashore, on the bank opposite the netting operation, to be tagged before eventual release. Here, Soham Mukherjee (front, sunglasses) & Rom Whitaker (right) & crew carry a struggling gharial for tagging above.



Figure 4. Captured gharial are restrained by securing limbs with rope, then tying the animal to a rigid, lightweight 2.5m ladder to prevent it from twisting, and possibly injuring workers. Once secured, each animal is weighed, measured, marked with visual tags, scute-clipped, and outfitted with radio transmitter(s), on neck and/or base of tail. Restrained gharial rarely struggle, tolerate procedures without incident, but require protection from overheating.



Figure 5. Each gharial selected for tagging is outfitted with VHF radio transmitters on the neck and/or base of tail (as in Fig. 6), a procedure taking 20-30 minutes per radio. During the whole process, properly restrained animals (head covered, limbs tied, to rigid platform=ladder) rarely struggle or move, remaining docile and quiet for hours.



Figure 6. View of the GPS logger radio transmitter, with VHF signal also, looking down at attachment position on base of tail. Kevlar fishing line is threaded under the skin and through surrounding scutes, attached and swaged in place. Flexible antennas (long=VHF; short=UHF) trail backwards. GPS radio wt=240gm; VHF radio wt=120gm



Figure 7. Once the animal is tagged, measured, marked, and weighed, it is released at capture site, usually within 1-2 hrs of capture. Forest Department staff were on hand for capture operations, as well as trained veterinarian and experienced crocodile handlers from Madras Croc Bank. The 2014 cap/tag operation was the fourth time this team has safely and successfully caught and tagged wild gharial.



Figure 8. Upon release, tagged gharial rapidly move to the nearest water, and swim away without incident. In order to prevent unrestrained animals from injuring themselves or the capture team, a stick positioned next to the long snout prevents the animal from making quick turns toward the team members. Bands used to secure the snout are removed, and limbs untied on release.



Figure 9. Recapture of previously radio-tagged gharial, now 4m total length, est. 350+kgs, tiny ghara on snout. This "junior" male, probably still a large subadult, was 2m in length, and 27 kg=wt when tagged 5.5 yrs earlier. He was caught on first day of catching 2014, at site where tagged previously, in area he frequented then 2010-2012.



Figure 10. Catch team struggles to move a 5.3m male, with large ghara (Fig.11), captured in late afternoon 20 Nov. After a brief struggle while entangled in multiple nets, this male was docile and quiet until it was released 2.5 hrs later, with radio tags on its neck and tail. It was on land for 2+ hrs after release, then swam away.



Figure 11. View of large ghara, on snout of 5.3m male. Ghara measured 20cmX20cmX20cm, was loosely attached at front edge of snout, with naral opening at rear base. Note rubber bands (from truck inner tube) on snout, and massive diameter of snout (upper+lower jaws) secured with rope. Foot in foreground=mens shoe size 11.



Figure 12. Capture team astride 5.3m large ghara male, just before release. This male was caught earlier the same day in a downstream net, and escaped. Later, when several smaller gharial were captured downstream, he swam upstream into multiple nets, struggled for 15-20 minutes, and was caught. Since release, he has been observed almost daily near his capture site, a preferred basking and nesting locality in the lower Chambal River, where he has resided previously.

bottomed metal boat equipped with 25hp outboard motor was used to move between capture sites, and to transport the capture/tag team to capture locations. The capture team camped out on the river, moving every 2-3 days upstream or downstream.

Gharial and mugger were basking at midday, moving to sites by 0900-1100 and back into water by late afternoon. Most days during the capture period were misty early in the morning, but cleared with abundant sunshine at midday, and occasional winds in the afternoon. Most captures occurred in mid morning and mid afternoon when animals were moving to or from basking areas. Forest Department staff was informed in detail prior to all operations, and on some days, FD staff assisted during handling and tagging, and observed animal releases. A total of 7 gharial were radio-tagged, including two recaptures, and five animals not tagged earlier. No mugger crocodiles >2m in length were caught, using this netting technique.

RADIO-TAGGING GHARIAL

Each animal was equipped with a temperature-sensitive VHF radio transmitter, thereby allowing ambient temperature to be recorded manually by listening for radio signals from strategic high points and shore locations along the river. In addition, 7 radios affixed during to the large gharial in the 2014 capture were equipped with an additional radio that records the daily GPS locations of each animal, available at intervals via a remote download option.

The radio is positioned on the dorsum, near the base of the tail, approximately above the vent, and attached to the skin surface with fishing line inserted under the skin, but above the tail muscle, and thru the base of adjacent dorsal scutes. The line is secured with knots and metal swages/sleeves, crimped in place on attachment rings on radio baseplate. Radio attachment takes about 20-30 minutes to complete, and then visual, coloured livestock tags are placed on scutes adjacent to the radio, and selective scute removal for permanent marking of individuals.

The specific sites and animals marked at each locality, along with animal details, are tabled for the largest 20+ gharial (G21-40) captured during 10-24 November 2014. We started the capture/tag operation near the Garhaita base, at Chilonga where the large male recap, 4m total length was caught and tagged on the first day (G21), then moved upstream to Ater Ghat where a female was caught and tagged (24) on 14 Nov, then further upstream at Gohera where 2 adult females were tagged (G25,G27), on 15 and 16 Nov, respectively. Then, on 17 November, the team shifted 40-50 km downstream to Chikni Tower area where the large ghara male, 5.3m total length, was tagged (G34) on 20 Nov. A final move downstream resulted in the capture and tagging of a male large subadult (G39) and female young adult (G40) at Jaktouli on 24 Nov. when capture / tagging efforts were completed and terminated.

TRACKING AND MONITORING GHARIAL AND MUGGER

During December 2014 and January 2015, these individuals have been monitored using the well established tracking techniques used previously (Tables 3-5). By mid February, at the time of this report writing, 17+ (15+ gharial and 2 mugger) tagged in 2013 are still under regular surveillance, and 5 of the 7 larger gharial tagged in 2014. The whereabouts of the remaining animals is still to be determined, but the large males are routinely being tracked. In early 2014, particularly difficult weather conditions with little sunshine and frequent rainy, overcast, and/or foggy days, has meant less than ideal tracking conditions. It is likely that during the next 1-2 months, as favourable weather for tracking resumes, the rest of the tagged individuals will be relocated and tracked, especially during the nesting season in April-May. In addition to foot patrols, boat surveys will assist radio tracking, directed to upstream stretches.

During the next several months, as basking activities intensify, the GPS logger on each of the 7 most recent tagged gharial will be periodically downloaded when favourable conditions persist, and the resulting data set will be compared to manually determined locations of each individual.

GHARIAL ECOLOGY PROJECT --CONTINUATION OF TELEMETRY STUDY 2013-2016, MADRAS CROCODILE BANK, CHENNAI

SUMMARY OF CAPTURE/TAGGING OF GHARIAL IN NATIONAL CHAMBAL SANCTUARY, 10-24 NOVEMBER 2014
(MINISTRY OF ENVIRONMENT AND FORESTS, & UTTAR PRADESH / MADHYA PRADESH FOREST DEPARTMENTS)

animal #	date	location		state permit	species	size/age	sex	total length (m)	weight (kg)	radio freq	tags
		MP village	UP village								
G21	10.11.14	Chilonga	Garhaita	UP	Gharial	subadult	M	4.07	>350	.202,,705	Yf,Rb
G22	11.11.14	Chilonga	Garhaita	UP	Gharial	subadult	F	2.8	88	no radio	Rf,Yb
G23	12.11.14	Nachnouli	Kumoni	UP	Gharial	subadult	M	2.21	37	no radio	no tags
G24	14.11.14	Ater Ghat	Mahua	UP	Gharial	subadult	F	2.9	77	.223,,81	Rf,Yb
G25	15.11.14	Mukutpura	Gohera	UP	Gharial	adult	F	2.9*	[125]	.244,,745	Yf,Rb+Yb
G26	15.11.14	Mukutpura	Gohera	UP	Gharial	subadult	M	2.57	47	no radio	Yf, Wb
G27	16.11.14	Mukutpura	Gohera	UP	Gharial	adult	F	3.23*	[98]	.263,,865	Yf, Rb+Pb
G28	18.11.14	Thona	Khera Ab Sg	UP	Gharial	subadult	M	2.65	64	no radio	Yf,
G29	18.11.14	Thona	Khera Ab Sg	UP	Gharial	subadult	F	2.72	68	no radio	Rf,
G30	20.11.14	Sankri	Kasua	UP	Gharial	subadult	F	2.47	58	no radio	Yf, Rf
G31	20.11.14	Sankri	Kasua	UP	Gharial	subadult	M	2.43	50	no radio	Rf,Rf
G32	20.11.14	Sankri	Kasua	UP	Gharial	subadult	M	2.19	29	no radio	Rf,Rf
G33	20.11.14	Sankri	Kasua	UP	Gharial	subadult	F	2.62	60	no radio	Yf,Yf
G33	20.11.14	Sankri	Kasua	UP	Gharial	subadult	F	2.42	48	no radio	Yf,Yf
G34	20.11.14	Sankri	Kasua	UP	Gharial	adult/ghara	M	5.33	>850	.302,,783	Rf, Bb
G35	21.11.14	Bindwakalan	Pituwan	UP	Gharial	subadult	M	2.63	57	no radio	Of,Of
G36	22.11.14	Sirsa	Barchouli	UP	Gharial	subadult	M	2.04	25	no radio	Yf,Yf
G37	22.11.14	Sirsa	Barchouli	UP	Gharial	subadult	M	2.03	25	no radio	Of,Of
G38	23.11.14	Titaoli	Jagtauli	UP	Gharial	subadult	F	3.01	106	no radio	Gf,Gf
G38	23.11.14	Titaoli	Jagtauli	UP	Gharial	subadult	M	2.91	79	no radio	Yf,Yf
G39	24.11.14	Titaoli	Jagtauli	UP	Gharial	subadult	M	3.10	90	.280	Yf,Rb+Wb
G40	24.11.14	Titaoli	Jagtauli	UP	Gharial	adult	F	3.20*	[109]	.323	Of,Yf

Total caught (>2m TL) =20 gharial, =0 muggers ; 7 tagged with radios (5 new individuals + 2 recaptures of previously radioed gharial).

Approximately 10 additional gharial >1.5m were also caught in nets and immediately released; no gharial were injured or died.

All captured individuals were measured, weighed, and marked with visible tags, and also scute clipped for permanent identification.

Visual livestock tags attached to single caudal scutes (flags) and to double scutes at base of tail (buttons) in various color combinations (red=R, yellow=Y, blue=B, purple=P, green=G, white=W, orange=O)

* indicates significant portion of tail missing, therefore total length is not accurate estimate of animal size/age; weight is preferable indicator of size

Table 3. Summary of Capture/Tagging of Gharial & Mugger in National Chambal Sanctuary, 2013

GHARIAL ECOLOGY PROJECT --CONTINUATION OF TELEMETRY STUDY 2013-2016, MADRAS CROCODILE BANK, CHENNAI

SUMMARY OF CAPTURE/TAGGING OF GHARIAL AND MUGGER IN NATIONAL CHAMBAL SANCTUARY, NOV-DEC 2013
(MINISTRY OF ENVIRONMENT AND FORESTS, & UTTAR PRADESH / MADHYA PRADESH FOREST DEPARTMENTS)

animal #	date	location		state permit	species	size/age	sex	total leng	weight	radio freq	tags
		MP village	UP village								
G1	24.11.13	Bijora	Murong	MP	Gharial	juvenile	F	1.34	6	151.92	Rf, Rb
G2	24.11.13	Kosar	Kumoni	MP	Gharial	subadult	F	1.86	20	151.94	Yf,Yb
G3	25.11.13	Chilonga	Garhaita	MP	Gharial	juvenile	M	1.41	6	151.90	Rf,Bb
G4	25.11.13	Chilonga	Garhaita	MP	Gharial	subadult	M	2.12	23	151.40	Rf,Gb
G5	26.11.13	Magherapura	Hatkant	MP	Gharial	juvenile	M	1.83	15	151.42	Of only
G6	27.11.13	Magherapura	Bithauna	MP	Gharial	adult	M	4.34	>500	151.44	Ygf, Gb (nk)
G7	27.11.13	Magherapura	Bithauna	MP	Gharial	juvenile	F	1.72	12	151.96	Rf, Gb
G8	28.11.13	Maghaerapura	Bithauna	MP	Gharial	subadult	M	2.61	59	151.48	Yf,Bb
G9	30.11.13	Ater Ghat	Mahua	MP	Gharial	adult	F	3.33	89	151.54	Yf, Ob
G10	30.11.13	Ater Ghat	Mahua	MP	Gharial	adult	F	3.25	79	151.50	Yf, Bb
G11	1.12.13	Mukutpura	Gohera	MP	Gharial	subadult	M	2.52	41	151.52	Yf, Yb
G12	1.12.13	Mukutpura	Gohera	MP	Gharial	juvenile	F	1.79	8	151.98	Yf, Rf
G13	3.12.13	Bareri	Baroli	UP	Gharial	subadult	F	2.57	71	151.58	Rf ,Rb
G14	4.12.13	Gyanpura	Gatikolan	UP	Gharial	subadult	M	2.53	54	151.60	Rf, Bb
G15	4.12.13	Gyanpura	Gatikolan	UP	Gharial	subadult	F	2.34	46	151.66	Rf, Bb
G16	4.12.13	Gyanpura	Gatikolan	UP	Gharial	subadult	M	2.75	78	151.62	Rf, Yb
G17	5.12.13	Bindwakalan	Pituwan	UP	Gharial	subadult	M	2.71	63	151.64	Rf, Gb
G18	5.12.13	Bindwakalan	Pituwan	UP	Gharial	subadult	M	2.61	57	151.68	Rf, Bb
G19	6.12.13	Titaoli	Jagtauli	UP	Gharial	subadult	F	2.44	50	151.80	Rf, Wb
G20	6.12.13	Bindwakalan	Pituwan	UP	Gharial	subadult	M	2.03	28	151.76	Rf, Pb
M1	1.12.13	Mukutpura	Gohera	MP	Mugger	juvenile	F	1.87	39	151.56	Yf, Rb
M2	6.12.13	Bindwakalan	Pituwan	UP	Mugger	juvenile	M	1.66	17	151.82	Yf, Rf

Total tagged=22, consisting of 20 gharial and 2 mugger; 12 gharial in MP (2 juv, 5 males, 5 females); 8 gharial in UP (5 males, 3 females);
1 mugger in MP (female) and 1 mugger in UP (male)

Visual livestock tags attached to single caudal scutes (flags) and to double scutes at base of tail (buttons) in various color combinations
(red=R, yellow=Y, blue=B, purple=P, green=G, white=W, orange=O)

Table 4. Tracking summary for 20 resident wild Gharial (*Gavialis gangeticus*) in National Chambal Sanctuary, 2013-2014

Movements are summarized for 20 gharial tagged in Nov-Dec 2013. Most were tracked biweekly; as of end October 2014, all gharial are being monitored intermittently. Animal-specific locations from Dec 2013 thru mid-September 2014 totaled 576; transmitter temperatures were recorded in 555 instances (external transmitters mounted on tail). Records are across all months, monsoon=Jun,Jul,Aug,Sept; rest=dry

ID	sex	tl	cp	mn	locs	kms	river loc	village locations	body temp	monsoon	D	home	shift
98	jF	1.8	GH	10	12	8	97 to 105	Ater to Ranipura	26 to 35 C	no move		Gohera	none
52	saM	2.5	GH	10	29	10	93 to 103	Naan to Gohera	15 to 32 C	no move		Gohera	none
50	aF	3.3	AT	10	19	64	97 to 161	Ater to Rhea	25 to 40 C	no move	+50	Gohera	up, +50
54	aF	3.3	AT	10	42	24	79 to 103	Nachnouli to Gohera	15 to 45 C	upstrm	+14	NK, DN, GH	Dwn, -18
96	jF	1.7	MG	10	10	12	93 to 105	Naan to Ranipura	26 to 32 C	no move	+13	Gohera	up, +10
42	saM	1.8	MG	10	26	3	88 to 91	Hathkant to NaanTpl	20 to 37 C	no move		Magerapura	none
48	saM	2.6	MG	10	40	2	89 to 91	Magerapura to NTpl	15 to 37 C	no move		Magerapura	none
44	aM	4.3	MG	10	39	7	90 to 97	Magerapura to Ater	15 to 46 C	upstrm	+5	Naan Tpl	none
94	jF	1.9	KM	10	33	2	73 to 75	Chilonga to Murong	23 to 36 C	no move		Murong	none
92	jF	1.3	MU	10	20	4	64 to 68	Udi Bdge to Baroli	15 to 35 C	dwnstrm	-4	Baroli	dwn, -12
90	jM	1.4	CH	10	44	4	72 to 76	Lakan to Murong	18 to 36 C	no move		Chilonga	none
40	saM	1.8	CH	10	18	15	103 to 118	Gohera to Harlalpura	19 to 40 C	upstrm	+15	Gohera	up, +24
58	saF	2.6	BR	10	19	5	65 to 70	Baroli to Ranepura	15 to 32 C	no move		Baroli	Dwn, -10
60	saM	2.5	GY	10	27	5	49 to 54	Gyanapura to Khera C	20 to 34 C	no move		Gyanapura	none
62	saM	2.8	GY	10	39	10	44 to 54	Kasaua to Khera C	16 to 38 C	no move		Chickni	none
66	saF	2.3	GY	10	29	4	34 to 38	Titaoli to Barecha	15 to 39 C	dwnstrm	-8	Barecha	none
64	saM	2.7	PN	10	28	8	30 to 38	Sashon to Barecha	21 to 37 C	no move		Pituwan	none
68	saM	2.6	PN	10	31	5	33 to 38	Barchauli to Barecha	17 to 36 C	no move		Pituwan	none
76	saM	2.0	PN	10	42	4	34 to 38	Titaoli to Barecha	15 to 36 C	dwnstrm	-6	Pituwan	none
80	saF	2.5	JG	10	29	6	38 to 44	Barecha to Kasaua	18 to 32 C	dwnstrm	-36	Barecha	up, +4

Chambal River loc: GH=Gohera; AT=Ater; MG= Maghera ka Pura; DN=Dinnpura; NK=Nauchnouli; KM=Kumoni; MU=Murong;; CH=Chilonga; BR=Baroli; GY=Gyanapura; PN= Pituwan ka Nagla (Philmunnagara); JG=Jagtouli

legends: ID=radio frequency at 151 MHz; sex/size: j=juvenile, sa=subadults, a=adult, F=female, M=male; tl-m=total length, metres; cap=capture location; mn=months tracked; locs=locations recorded; kms= maximum movement distance, in kms, exclusive of monsoonal migration; river loc=distance in km, from Chambal-Yamuna confluence. Village locations=downstream to upstream; body temp=range from lowest to highest recorded; monsoon movement, direction and distance (in km; up=+, dwn=-) D= seasonal movement, in kms; home=most frequent category; shift=upstream or downstream shift in home location, following tagging, and/or spontaneous.

The locations noted above and the legend key applies to Table 2 (above) and Table 3 (below)

Table 5. Tracking summary for 2 resident wild Mugger crocodiles (*Crocodylus palustris*) in National Chambal Sanctuary, 2013-2014

Movements are summarized for 2 mugger tagged in Nov-Dec 2013. These were tracked biweekly; as of end October 2014, muggers are being monitored intermittently. Animal-specific locations from Dec 2013 thru mid-September 2014 totaled 65; transmitter temperatures were recorded in 62 instances (external transmitters mounted on tail). Records are across all months, monsoon=Jun,Jul,Aug,Sept; rest=dry

ID	sex	tl	cp	mn	locs	kms	river loc	village locations	body temp	monsoon	D	home	shift
56	jF	1.9	MK	10	35	12	93 to 105	Naan to Ranipura	15 to 38 C	no move		Gohera	none
82	jM	1.7	MK	10	30	11	15 to 44	Mahua to Kasaua	16 to 37 C	dwn,	-29	Pituwan	none

CONSERVATION BENEFITS OF GHARIAL ECOLOGY PROJECT

The Gharial Telemetry Project has been recognized by the National Tri-State Committee for Coordination of the Conservation in the National Chambal Sanctuary, and the recommendations of the project solicited for incorporation into the National Plan for Gharial Conservation, under consideration for adoption and implementation (copy of relevant findings and recommendations in Supplementary Materials, available from Jaroslav Simek, Prague Zoo via DROPBOX or directly from jeff.w.lang@gmail.com). The Principal Investigator presented a plenary paper in January 2015 at the Society for Integrative and Comparative Biology (SICB) meeting in Florida, and delivered talks at the U. Florida in Gainesville, St. Augustine Alligator Farm, and in late January, at the Wildlife Conservation Society head office in New York City, based at Bronx Zoo. In September 2014, I visited the Bergen Aquarium in Norway, the Prague Zoo in the Czech Republic, the Leipzig Zoo and the Berlin Zoo, and did presentations at all of these venues. Publication in peer-reviewed journals is in preparation, as are popular articles.

With the recent efforts to publicize the work and disseminate the findings to the various Indian and international agencies, including the funding sources, about the Gharial Telemetry Project, 2008-2013, there is now wide recognition of the importance and significance of the biological findings, and in particular, how these inform and are directly relevant to ongoing conservation and management efforts. This is especially important for the remaining gharial populations in the National Chambal Sanctuary, living in a protected, free-ranging, wild river habitat. The success of efforts to date to continue the study attest to the interest and commitment by the state and central governments, particularly the MoEF and the Forest Departments of Madhya Pradesh, Rajasthan, and Uttar Pradesh for the shared objectives outlined for this project.

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, GCA started its education and awareness programme in the region in April 2012. Sensitization of the local communities towards the region's biodiversity and finding more sustainable ways to extract natural resources and also to restrict their extraction were identified as the key steps in this programme. Preliminary surveys were conducted in April 2012 in 29 villages across Rajasthan, Madhya Pradesh (MP) and Uttar Pradesh (UP) to assess the socio-economic status of human populations living along the River and to understand their attitudes towards the gharial and National Chambal Sanctuary (NCS). Based on their proximity to critical gharial nesting sites eight villages in Rajasthan were shortlisted as focal villages. During May thru December 2013, two events were conducted in the focal villages and educational materials on the Chambal region were prepared.

As proposed, an informative and illustrated story book was developed in the local language Hindi for adults as well as children of the local river-side communities. This book focuses on the Chambal River, its fauna and the threats faced by this region in the form of a story to engender interest towards local biodiversity and its conservation. Along with this we also developed four posters which will be displayed in the focal villages. Through these educational materials we intend to clear the misconceptions held by the local communities about the local wildlife, especially the gharial and enable them to understand their environment properly which will help change their existing perceptions and foster positive attitudes towards the wildlife they co-exist with. This will indirectly lead to sensitization among the local communities and strengthen the foundation for future conservation activities. Work on developing a manual for training forest department staff is well under progress. Drafts of this manual will be printed and used in the forest department workshops in next phase of the project.

EDUCATIONAL PROGRAM COORDINATOR

During 2014, the full-time Program Coordinator in conjunction with Dr. Gowri Mallapur, MCBT was engaged in the following activities: 1) (Jan-Mar) design and development of the Forest Department handbook, aimed at providing front-line FD staff with a basic understanding of the ecology of Chambal flora and fauna, and the detailed field information to assist with identification of the important biological features of the region, with special reference to the National Chambal Sanctuary (NCS) and Forest Department activities, 2) (Apr-May) organized and conducted two workshops for Forest Department staff on duty in the NCS and prepared reports on these activities, 3) (Jun-Aug) conducted village programs along the Gandak River in Bihar, and along the Son River in Madhya Pradesh, including preparation of materials to be used and also conducted local programs for Forest Department staff in these two regions, 4) (Sep-Dec) continued to develop materials and make preparations for educational programs and the Deori workshop (MP), as well as organized final details for FD manual final printing.

CHAMBAL RIVER ECOLOGY MANUAL

During 2014, a major focus of the educational program was the final development and design of the Chambal River Ecology manual for Forest Department staff, and related wildlife managers, ecologists, naturalists, and educators. The manual provides a short introduction to rivers, and details the specifics related to the Chambal River. It also includes an historical narrative about the religious and cultural significance of the Chambal region, in the context of the history of north India. The ecological focus of the manual is on the development of the National Chambal Sanctuary, the longest river sanctuary in the country and the only tri-state protected area.

Within the NCS, the total species of fish is 147, of reptiles is 56, of birds is 308, and of mammals is 60; these include 6 that are critically endangered, 12 endangered, and 18 vulnerable species. The NCS has the largest population of gharial and red-crowned roof turtle in the world, and it is one of the most important habitats for the Gangetic dolphin, narrow headed soft shelled turtle, three-striped roofed turtle, and the Indian skimmer, Saurus crane, and mahaseer. The manual goes on to list the important threats to this unique riverine habitats, including power plants and water extraction, sand mining, fishing and poaching, riverside cultivation, and grazing. It concludes with sections on basic methods for monitoring resident crocodilians, and on overall protection strategies and ways to value and conserve wildlife and natural habitats.

FOREST DEPARTMENT WORKSHOPS

During 2014, the major focus of the training component were the workshops held for local Forest Department staff in Uttar Pradesh, at the Garhaita base for GCA/TSA on the Chambal, and in Madhya Pradesh, at the Deori Eco-Centre run by the MPFD and located near the Chambal outside Morena. These workshops were joint programs with the Turtle Survival Alliance-India Office in Lucknow, and both Gharial Ecology Project staff and TSA staff organized and participated in all of the 2014 workshops.

In April 2014, a two day workshop was held at the Chambal Conservation Centre, Garhaita and along the Chambal River nearby the village. There are two ranges in the UP stretch of the NCS, one in the lower Chambal, the Etawah Range, and one upstream, the Bah Range. The main objectives of the workshop were: 1) to provide information on species identification, 2) to train staff on basic survey techniques, 3) to outline confiscation details, and 4) to demonstrate methods of nest location, handling, protection, and translocation for turtles and crocodilians. Workshop staff included: Dr. Gowri Mallapur, Dr. Disha Sharma, Saniya Chaplod, Ashutosh Tripathi, Pankaj Kumar, Dhiraj Gopinath and other MCBT/GCA/TSA local staff. All together, the workshops on 15 and 16 April were attended by 16 and 14 FD staff, respectively and included classroom sessions, hands-on identification and handling at the TSA turtle facility, and field trips to stretches of the Chambal River nearby. A custom made Resource Packet was provided for all

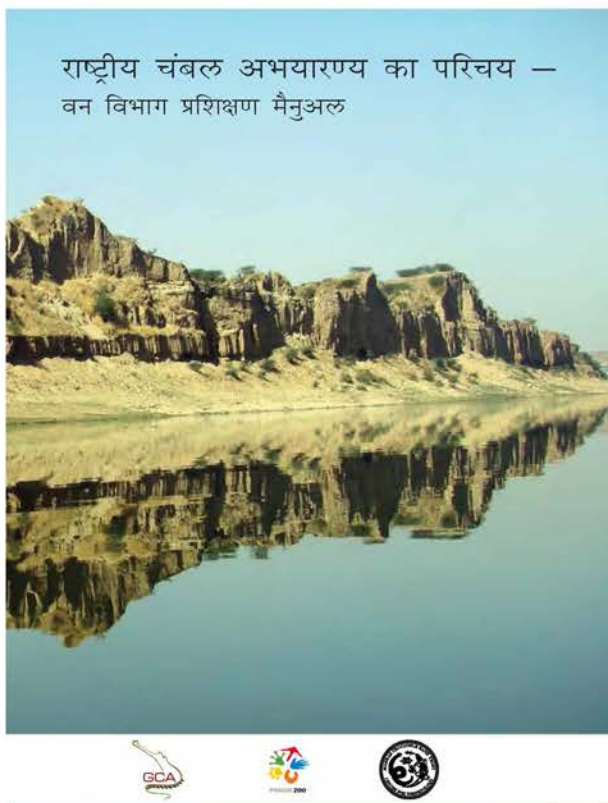


Figure 13. Title page of Chambal River Ecology, the FD manual developed by GCA for training / workshops for front line staff of state Forest Departments in NCS.

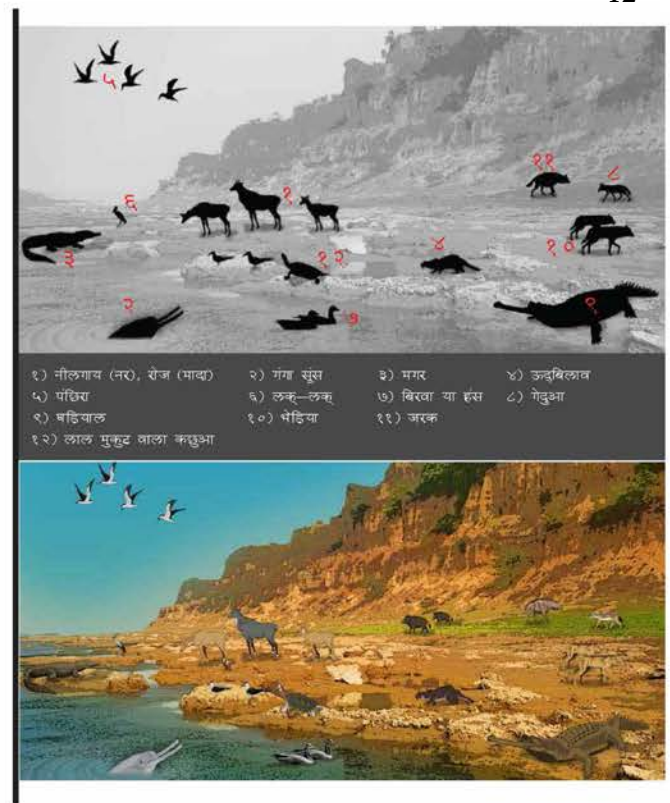


Figure 14. Illustration of Chambal bankside, with local fauna identified and shown in typical habitats, page from Chambal River Ecology, a manual for Forest Departments.

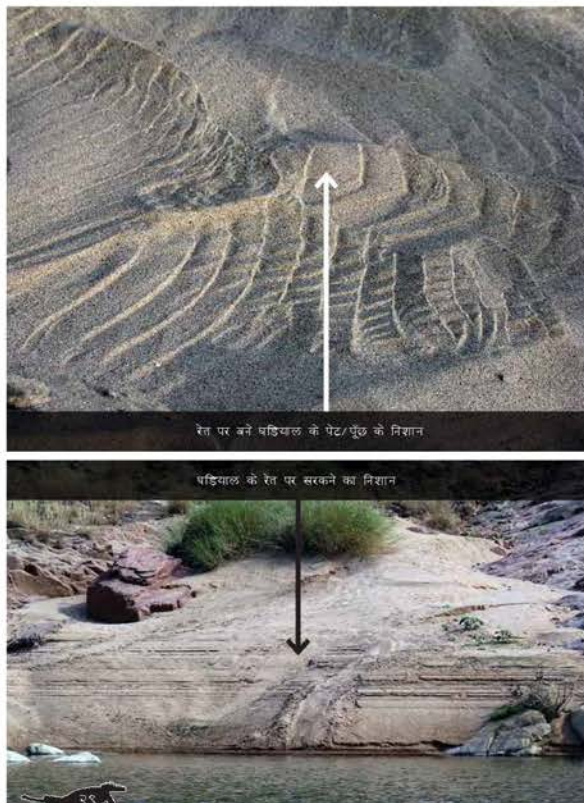


Figure 15. Composite graphic of gharial belly print (above) and bank slide (below), from FD manual. Other illustrations compare mugger vs. gharial tracks

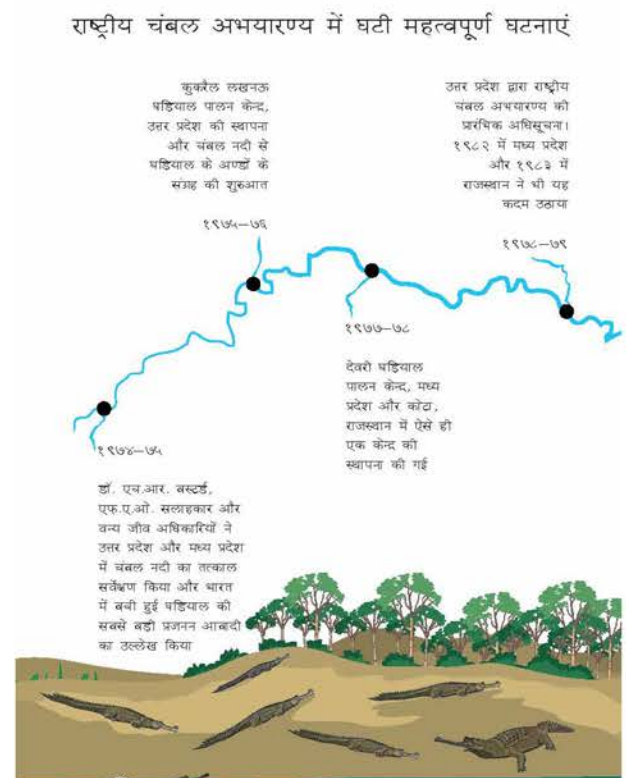


Figure 16. Illustration of gharial resting ashore, near nesting sites, located at major localities in NCS, from FD manual, on natural history of gharial on Chambal.



Figure 17. Dr. Disha Sharma, veterinarian with TSA-India, explains to Forest Department front-line staff in NCS, details of handling & confiscation at the Chambal Conservation Centre, Garhaita village, as part of April UPFD Workshop program, with Prague Zoo funds.



Figure 18. Group photo of Bah Range personnel, UPFD, assembled at Garhaita village, near TSA turtle hatchery on sandbar on Chambal River. As part of April workshop, participants were able to handle incubating turtle eggs, and learn more about nest protection details.



Figure 19. Saniya Chaplod, Training Coordinator for Gharial Ecology Project, salaried with Prague Zoo funds in 2014, briefs participants on some fundamentals about crocodilian and turtle surveys as well as monitoring. Saniya used the Chambal River Ecology manual for FD.



Figure 20. Participants took advantage of the proximity of the river habitats near Garhaita village, to observe local fauna, and search for tell-tale signs of specific species of turtles, gharials, and muggers, as well as learning to identify distinctive features of eggs and nests.



Figure 21. Pankaj Kumar, main researcher and tracker on the Gharial Ecology Project, explains the distinctive signs of gharial, and how to identify the size of the animal from a belly print on basking spot. It is important to be able to distinguish gharial from mugger tracks & signs, and scats & eggs.



Figure 22. Ashutosh Tripathi, Chambal coordinator for TSA-India, explains how to identify and distinguish the turtle species living in the NCS, and also provides participants with important details about the natural histories of the species, and how to enhance protections.



Figure 23. Dr. Gowri Mallapur, reptile veterinarian for GCA and Madras Crocodile Bank Trust, explains how to handle and transport turtles and crocodilians during rescue and/or confiscation. Aquatic reptiles are subject to getting caught in illegal nets and fishing gear.



Figure 24. April Training Workshop participants gather together outside the Chambal Conservation Centre, a large modern facility at TSA-India turtle nursery base in Garhaita village, Etawah Range where the two days of UPFD workshops were held, 15-16 April 2014.



Figure 25. Front-line Madhya Pradesh Forest Department staff, tasked with protecting river habitats and wildlife in the National Chambal Sanctuary, assemble at Deori Eco-Centre to participate in training workshop sponsored by GCA/TSA, supported by MCBT.



Figure 26. Dr. Gowri Mallapur (left), Shashwat Sirsi, and Dhiraj Gopinath (right) prepare a presentation for the October workshop at the Deori Eco-Centre. Same topics were covered in the October meeting with MPFD staff, as were discussed in April with UPFD staff.



Figure 27. Shashwat Sirsi, TSA turtle biologist, explains how to identify and distinguish soft shell species, and also talks about threats along the Chambal and how to protect turtles and their eggs.



Figure 28. Dhiraj Gopinath, from the Madras Crocodile Bank Trust, displays some of the smaller species of turtle living in Chambal River, and explains how to identify each species, by its distinctive features. The diversity and numbers of turtles on display and in the rearing pens at the Deori facility allowed workshop participants to identify, catch and handle individual turtles of different sizes, ages, and sexes. Dr. R.K. Sharma, senior biologist, MPFD (right, foreground) points out how to distinguish this turtle species from others on Chambal.

participants, including handouts on gharial natural history, a list of bird species, fauna and flora lists for the Chambal, snakebite information, survey datasheets, and a manual on turtle identification and protection. A draft version of the FD manual on Chambal River Ecology was distributed, and utilized for portions of the workshop training, and further refined in design.

In October 2014, a one day workshop was held at the Deori Eco-Centre, run by the MPFD, and this full day of activity was attended by 40+ participants from the Morena, Bhind, and Sheopur Ranges in Madhya Pradesh, particularly those in the NCS. Dr. R.K. Sharma was present and participated in some of the presentations. The principal GCA/TSA staff included Dr. Gowri Mallapur, Pankaj Kumar, Dhiraj Gopinath, and Shashwat Sirsi, accompanied by other GCA/TSA staff. The curriculum for this workshop was similar to the earlier April program in UP. Since many of the turtle species, as well as gharial, are held in captivity at Deori, hands-on sessions in identification and handling were conducted for all participants as well. A primer on telemetry, both terrestrial (VHF) and aquatic (sonic) was also provided as it relates to on-going studies on Chambal turtles and crocodilians.

GANDAK & SON RIVER VILLAGE PROGRAMS

During July 2014, Saniya Chaplod, the training component coordinator, met with local theatre groups to develop street plays and puppetry related to the awareness programs. In Bihar, she met with FD officials to assist in the local FD training workshop, run in conjunction with the education programs in 28 villages, including 6 schools. These were conducted primarily from Bettiah to Valmikinagar areas along the Gandak River; about 3-4 villages were involved each day. Quizzes and games were organized as well as street plays and puppet shows. Handouts were provided on gharial, turtles and general river ecology.

In August, similar village programs were conducted along the Son River. These awareness programs involved approximately 43 villages, including 14 schools from Sidhi to Jogdah. A one day FD workshop was held for local staff in Jogdah, in Sidhi region, in conjunction with village programs. In addition to these programs, proposals for future education outreach in gharial areas were developed, as well as preparations of materials and activities for FD& Wildlife Week.

WILDLIFE WEEK ACTIVITIES

The Gharial Ecology Project funding via the Prague Zoo grant 2014 was used to sponsor a week of environmental awareness programs, centered at the Kukrail Nature Center near Kukrail, in conjunction with the UP Forest Department, Turtle Survival Alliance-India and the Gharial Conservation Alliance. Over 100 participants attended the inaugural event, the Kukrail Guided Nature Tour, to mark Wildlife Week, the first week in October 2014. These included school children and teachers from City Montessori School. This tour has been organized in every subsequent weekend for school children, from Oct-Mar, and takes advantage of a natural setting for urban kids learning about biodiversity, with a variety of nature/environment themed activities. The principal TSA staff involved in this program were: Dr. Shailendra Singh, Arunima Singh, Chaitra Baliga, with help from Dr. Gowri Mallapur and support from Prague Zoo.

CONSERVATION BENEFITS FROM TRAINING

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



Figure 29. Chaitra Baliga, researcher at TSA-India, in Lucknow, shows school students how to hold turtles safely, and how to identify each species, based on its distinctive features. The Kukrail Zoo-Park is being modified by the TSA-India into a major turtle holding facility.



Figure 30. As part of Wildlife Week educational activities at Kukrail in Lucknow, UP, Dr. Shailendra Singh demonstrates how to identify the common Indian species of turtles, and tells the assembled audience of school children that turtles are protected, and require healthy habitats.



Figure 31. Drs. V.B. Srivastava and Shailendra S. lead a nature tour of school children through the Kukrail woodlands near Lucknow, as part of the Inaugural Program during Wildlife Week, first week in October. The week long program was supported in part with funding from the Prague Zoo, in conjunction with TSA/GCA/Croc Bank.



Figure 32. Uttar Pradesh Forest Department officers lead the cleanup at the Kukrail Zoo-Park, outside Lucknow, as part of the inaugural activities to kick off Wildlife Week, October 2014. A varied program aimed at school groups and nature clubs was developed with funding from the Prague Zoo, as part of the training/education component.



Waste Recycling and Drawing completion organized at Kukrail

Figure 33. Wildlife Week activities, Kukrail Zoo-Park, Oct2014

AN ORIENTATION EVENT FOR FRONTLINE UP FOREST DEPARTMENT STAFF AT KUKRAIL



Arunima Singh (Education officer-TSA) briefing about turtle and crocodile species and their conservation status.

Figure 34. Wildlife Week activities, Kukrail Zoo-Park, Oct2014

VILLAGE COMMUNITY EDUCATION IN CHAMBAL NIMADANDA VILLAGE, CHAKARNAGAR BLOCK OF ETAWAH DISTRICT



Ashutosh Tripathi educating villagers' about wildlife

School children performed a skit on conservation awareness

Figure 35. Wildlife Week activities, Etawah villages, Oct 2014

AWARENESS PROGRAM AT NARORA TURTLE CENTRE, BULANDSHAHR UPPER GANGA



Raja Mandal, Project Coordinator briefing the kids about different species of turtles in Ganga near Narora and TSA/NPCIL efforts Conserving them



Figure 36. Wildlife Week activities, Upper Ganga, Oct 2014