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भारतीय वन्यजीव संस्थान
Wildlife Institute of India

FIELD GUIDE

BEST PRACTICES FOR NEST RESCUE OF SELECT AQUATIC REPTILES OF GANGA BASIN

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Field Guide:
Best Practices for Nest Rescue of Select Aquatic Reptiles of Ganga Basin

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INTRODUCTION

THE GANGA BASIN SUPPORTS BOTH A HIGHLY DIVERSE BIOLOGICAL ASSEMBLAGE AND AN EXTREMELY DENSE HUMAN POPULATION. THE AQUATIC MACRO FAUNA INCLUDES FIVE SPECIES OF MAMMALS (THREE SPECIES OF OTTERS AND TWO DOLPHIN SPECIES) AND A LARGE NUMBER OF REPTILE SPECIES THAT INCLUDE 14 SPECIES OF CHELONIANS AND THREE CROCODYLIANS. THESE MAMMALS AND REPTILE SPECIES DEPEND ON THE SUSTAINED RIVER FLOW IN THE BASIN FOR THEIR SURVIVAL. THE HUMAN POPULATION INHABITING THE BASIN RELIES EXTENSIVELY ON THE RIVER AND ITS TRIBUTARIES FOR RESOURCES. THE SITUATION HAS RESULTED IN CHALLENGES TO THE SURVIVAL OF THESE ANIMAL SPECIES DUE TO UNSUSTAINABLE RESOURCE EXTRACTION PRACTICES, POLLUTION, RIVERSIDE AGRICULTURE AND ALTERED RIVER FLOWS.

Particularly vulnerable are the chelonians and crocodilians utilising the river banks for nesting. The eggs are vulnerable to depredations from natural and feral predators, human egg collection, inundation from unseasonal water discharges, etc. An additional challenge is the effect of climate change on the sex ratios of hatchlings, as sex determination in these species is temperature-dependent and greatly influenced by ambient environmental conditions.

Various measures are being implemented to addressing the above concerns. These include protecting nests *in-situ*, establishing *in-situ* hatcheries, collecting eggs from susceptible nests, and incubating them in *ex-situ* hatcheries. A judicious mix of the three methods has been successfully used to restore the Gharial population in the Chambal River. This field guide aims to document various methods currently practiced for conserving freshwater chelonians and crocodilians in the Ganga Basin based on protecting their nests and eggs, and suggest the best practices that can ensure the conservation of these species.

The following sections present the steps that may be adopted to identify and protect nests, as well as various measures used to incubate and rear eggs both *in-situ* and *ex-situ*.

Table. 1

Species	Clutch size	Nesting season	Nesting substrate
Gavialis gangeticus	25-30	March-May	Sandbanks
Crocodylus palustris	40-60	Annual dry season	Sand and clay
Batagur baska	50-60	January-March	Sand banks
Batagur kachuga	11-30	March-April	Sandbanks
Batagur dhongoka	21-35	March-April	Sand banks
Geoclemys hamiltonii	20-30	December-March	Loamy soil and sandbanks
Hardella thurjii	12-26	August-September	Sandy areas with vegetation
Pangshura smithii	5-8	September-November	Sand and muddy banks
Pangshura tentoria	5-12	September-February	Sand and muddy banks
Pangshura tecta	4-11	October-April	Sand and muddy banks
Melanochelys trijuga	2-16	January-March	Muddy banks
Melanochelys tricarinata	3-6	January-April	Sand and Soil
Lissemys punctata	2-15	July-November	Loamy soil
Nilssonia gangetica	25-35	September-October	Sand and Soil
Nilssonia hurum	10-30	August-November	Sand and Soil
Chitra indica	>100	February-May	Loamy soil and sandbanks
Indotestudo elongata	6-10	November-January	The base of trees or bamboo clumps on slopes

Hatchery management *In-situ*

Locating nests

Nests safe from flooding

Fencing nesting bank for Crocodilians

Nests likely to be from flooded

Excavating eggs

Marking orientation of eggs

Nest data collection

Egg shifting in a transportation container

Transportation to riverside *in-situ* hatchery

Dig nest pit similar to natural nest

Place eggs in the same orientation and depth as collected from the natural nest

Fill up the dug nest with substrate

Monitor humidity and temperature during incubation

Hatchery management *Ex-situ*

Locating nests

- **Nests likely to be from flooded**
- **Fencing bank having reptilian nests**
- **Nests safe from flooding**
- **Excavating eggs**

Marking orientation of eggs

Nest Data collection

Shifting eggs in a transportation container

Transportation to *ex-situ* facility

Incubation

- Natural
  - Recreating nest in wooden box same as natural nest
- Artificial
  - Reptile egg Incubator

Substrate

- Natural (Sand/Soil)
- Artificial (Vermiculite)

Place eggs in the same orientation and depth as collected from the natural nest

Monitor humidity and temperature during incubation

IDENTIFICATION OF NESTING SITES

Turtles

Identifying nests of freshwater chelonians involves several vital indicators and systematic approaches and requires patience and perseverance.

Fresh tracks of crocodilians and turtles and shoreline crawl marks (Fig. 1A & B) in sandy or soft soil substrates close to water bodies are primary indicators of recent nesting activity during the nesting season. Foot patrols along potential and earlier documented nesting sites can reveal these signs. During peak nesting season, their direct sighting (Fig. 1C) can be used for monitored nest site identification, especially in the early morning or late evening when turtles are most active.

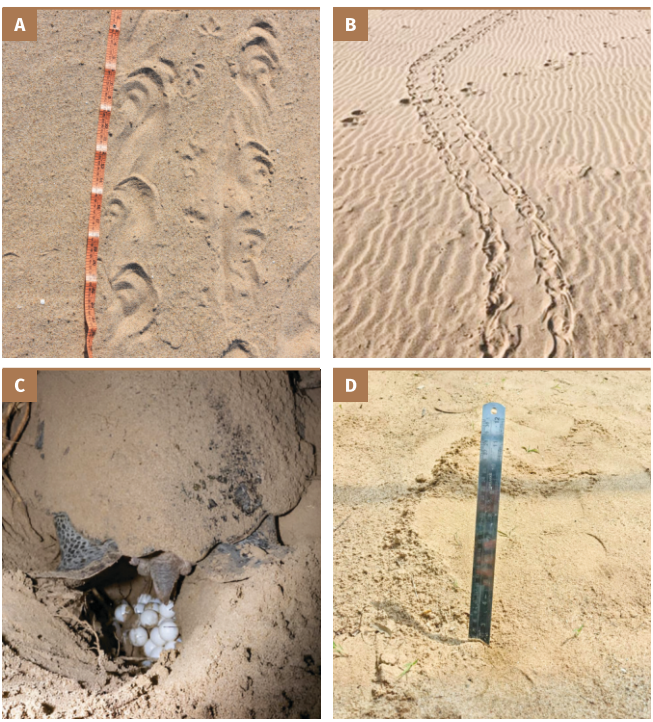

Figure 1. (A & B) Turtle tracks, (C) Turtle laying eggs, (D) Searching for nests using a probe.

If the nest crawls are not visible, the nests may be identified by carefully probing the possible nesting area with a small stick or scale (Fig. 1D) to locate the egg chamber without damaging the eggs. The nest substrate feels more porous than the rest of the substrate. Observing vegetation disturbance and soil displacement can also help pinpoint the nest locations.

Species identification of nests/eggs

The species of turtle eggs can be differentiated by their shape, size, colour and texture. Knowledge of the species found in the habitat and their nesting times is helpful for identification. The eggs of hardshell turtles found in the Ganga basin are elliptical (Fig. 2A), while those of softshell turtles are spherical (Fig. 2B).

Figure 2. A & B Eggs of select turtle species of Ganga Basin

Nest Identification of crocodylians: Mugger

Their nests are often found in sandy or muddy banks near freshwater bodies like rivers, lakes, and reservoirs (Fig. 3B). The mugger is a hole-nesting species, laying eggs during the annual dry season. Tracks or slide marks leading from the water (Fig. 3C) to the nest site can also indicate the presence of mugger crocodyle eggs. The eggs are typically oval-shaped with a hard, calcareous shell (Fig. 3A). They are usually white or off-white; a single clutch can contain 25-30 eggs.

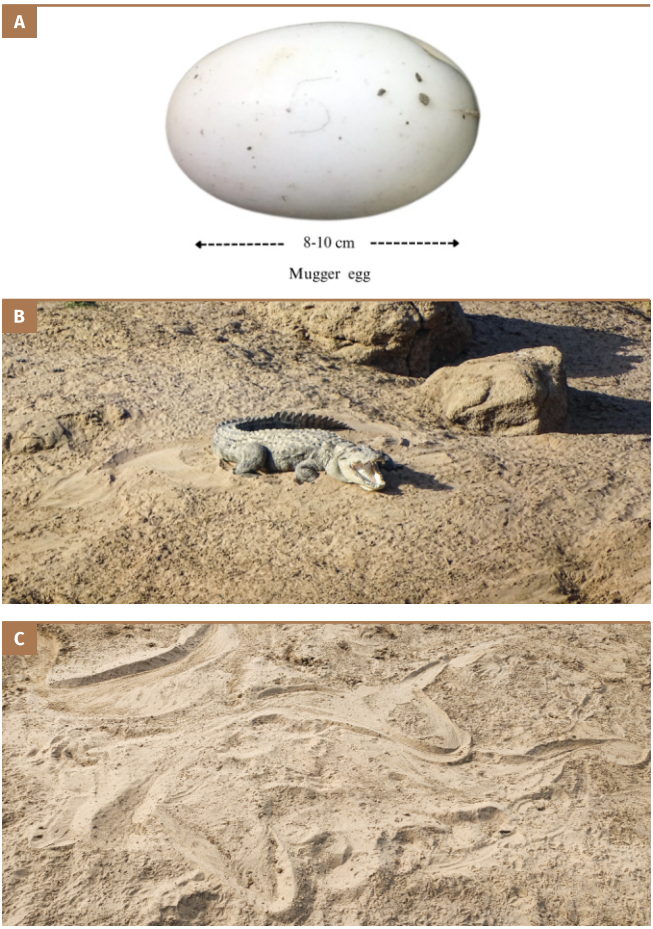

Figure 3. (A) Mugger egg, (B) Nesting habitat, (C) Mugger track and slide marks

Nest Identification crocodylians: Gharial

Gharial nests are found on steep sand banks with fine sand along river bends and junctions (Fig. 4A & B). They prefer sandy banks for digging pitcher-shaped nest burrows on steep, sandy riverbanks at night. The nesting season for Gharials is more defined, typically in March and April, and the nests are dug into fine sand, preferred over coarse sand banks. The mother maintains an active posture near the nest and aggressively guards the nest. Gharial eggs are oval-shaped, more elongated than mugger eggs, and have a hard, calcareous shell (Fig. 4D). They are typically white or cream-coloured, containing around 20-60 eggs per clutch.

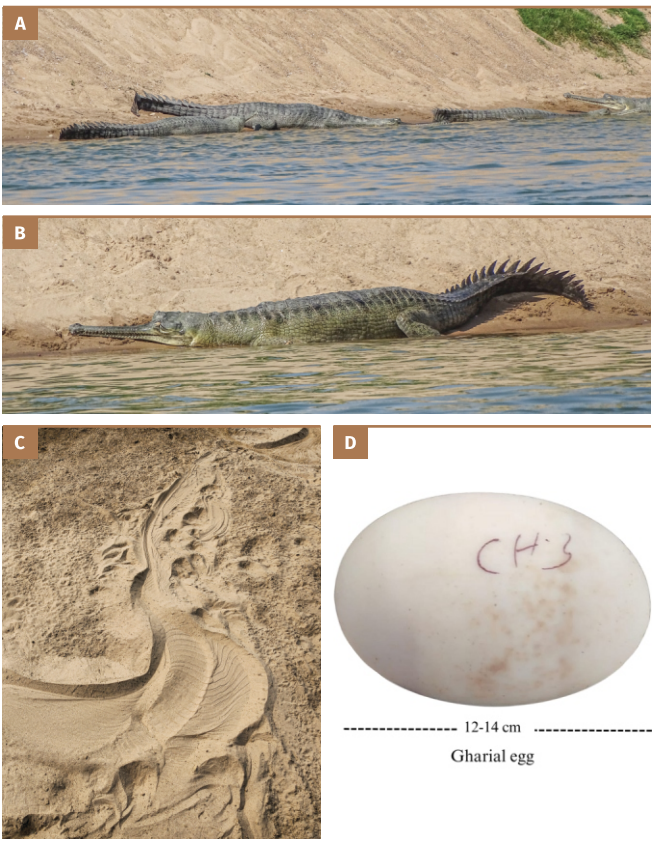

Figure 4. **(A&B)** Gharial nesting habitat, **(C)** Gharial track and slide marks, **(D)** Gharial egg

ESTABLISHMENT OF *IN-SITU* HATCHERY TURTLE AND CROCODYLIANS

Riverside hatchery

In-situ hatcheries are conservation facilities where eggs are protected and hatched in their natural environment. This approach allows hatchlings to imprint on their native habitat, which is crucial for their future navigation and breeding. It also ensures that they are adapted to the local environmental conditions from the start.

Hatchery setup steps

Hatchery Site Selection: Choose an elevated sandbar or mud bank, depending on the species for which the hatchery is being established, for natural protection against flooding and predators (Fig. 5A). The site should have minimal disturbance and be away from human habitation while being accessible to ensure the safety of the eggs. The local communities inhabiting the area should be supportive and aware of the conservation actions being undertaken. To protect the eggs from predation, a chain-link fence reinforced with thorny brushwood around the hatchery will ensure the nests' safety (Fig. 5B).

Figure 5. (A) Selected hatchery site being prepared for nest relocation of hardshell turtles, (B) Completed hatchery

Egg collection: The collection process begins with carefully excavating nests from the substrate within a few days of laying eggs (Fig. 6A & B). Each nest is meticulously numbered, and its exact location is recorded. Each egg is then marked for orientation and assigned an individual number to maintain its identity (Fig. 7A & B). The eggs are carefully placed in a tray containing natal sand from the original nest site (Fig. 8) to minimise stress and maintain familiar environmental conditions. The eggs from the top layer of the nest are placed at the bottom of the transport container on a layer of sand. A layer of sand is added on top, and the second layer is placed similarly. The other layers are excavated and placed in the transport container. This results in the top layer of eggs from the nest being placed at the bottom of the transport container and the bottom layer of the nest being placed as the top layer in the transport container.

Figure 6. (A&B) Nest excavation

Figure 7. (A&B) Marking eggs for orientation

Figure 8. Transportation for *in-situ* nest relocation

Recreating Individual Nests: Use the data collected during excavation to replicate each nest. Weigh and measure each egg, then place it in the recreated nest, mimicking its original position. Label each recreated nest with the same number documented during collection to maintain consistency (Fig. 9C). The marks on the eggs help in ensuring the placement of eggs in the artificial nest similar to the natural nest (Fig. 9B). While placing the top layer of eggs from the transport container at the bottom of the relocated nest and bottom layer of eggs of the transport container at the top of the nest ensures placing the eggs in the same temperature and humidity gradient from which they were collected.

Figure 9. (A) Nest digging, (B) Placing eggs in the nest, (C) Numbering nest, (D) Individuals nests inside the hatchery

Monitoring the hatchery: Continuously monitor temperature and humidity levels in the hatchery to ensure the maintenance of optimum temperature, TSD, and egg viability. Temperatures should be kept between 28°C and 32°C, and humidity levels should be between 60% and 80% by sprinkling water or misting above the nests.

Note: The orientation of turtle and crocodilian eggs must be maintained because the embryo attaches to the inner surface of the eggshell inside the egg. The chalaza in bird eggs that maintains the orientation of the developing fetus is absent in reptile eggs. Therefore, if the egg is rotated or its orientation is changed, the embryo can detach, which may harm its development or even cause the embryo to die.

ESTABLISHMENT OF AN *EX-SITU* HATCHERY FOR TURTLES AND CROCODYLIANS

Often, incubation at *in-situ* hatcheries is not possible, and the eggs need to be shifted to *ex-situ* facilities for further processing and incubation until hatching. Nests in precarious situations are collected in the same manner as in *in-situ* egg collection. Recording the nest attributes, such as size, shape, depth, exact location and environmental conditions, is essential to replicate these conditions as closely as possible in the *ex-situ* facility.

Transportation

The vehicle used for transporting eggs must have a good shock absorption system to minimise the shaking of eggs during

transport. The vehicle should be driven slowly to avoid any jerks during the journey. The transport container should have a sand base to stabilise the eggs during transit to the *ex-situ* facility (Fig. 10). Natal sand from the original nest is added when the eggs are placed to mimic their natural environment and provide a familiar substrate. This setup allows for carrying the eggs without movement and preventing the dislodgement of the chalaza, which can cause embryonic death. Each egg is carefully marked to indicate its original orientation and given an individual number for identification. This ensures that the eggs can be monitored individually and placed in the same orientation during incubation, which is crucial for the development of the embryos.

Figure 10. Transportation container for *ex-situ* nest relocation

Incubation

Wooden boxes filled with river sand can be used to incubate chelonian and crocodilian eggs in an *ex-situ* facility (Fig. 11A). A thermo-hygrometer monitors the temperature and moisture levels inside these boxes (Fig. 11D). If the humidity drops below the optimal level, the boxes can be placed at room temperature, and moisture can be added if necessary. Maintaining consistent environmental conditions is crucial for successful incubation.

Figure 11. (A) Incubation room, (B&C) Transferring eggs and recreating nest into the incubation box, (D) Thermo-hygrometer

For artificial incubation, vermiculite, a mineral that retains moisture well, can be used as a substrate (Fig. 12A). Vermiculite provides a stable and moist environment, reducing the risk of desiccation. Artificial incubators offer precise control over temperature and humidity, which is particularly beneficial for species with specific incubation requirements (Fig. 12B). These incubators can be programmed to maintain optimal conditions, closely mimicking the natural nest environment.

Figure 12. (A) Vermiculite, (B) Reptile egg incubator

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Nest Collection Datasheet

Observer _____ Area/Site _____ Hatchery type _____

Nest No.	Date	Time	Latitude	Longitude	Species	Depth of first egg	Depth of last egg	Width of the egg chamber	Temperature on first egg	Soil humidity at first egg	Temperature on last egg	Soil humidity at last egg	Number of eggs collected

Egg Hatching Datasheet

Observer _____ Area/Site _____ Hatchery type _____

Nest No.	Date	Time	Latitude	Longitude	Species	Date of hatching	Number of hatchlings

NOTE

NOTE

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