



Government of India



Guidelines for Mitigating Human–Crocodile Conflict

Taking a Harmonious–Coexistence Approach



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Ministry of Environment, Forest and Climate Change



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Abbreviations

BMZ	German Federal Ministry for Economic Cooperation and Development	IUCN	International Union for Conservation of Nature
CWLW	Chief Wildlife Warden	JFM	Joint forest management
CZA	Central Zoo Authority	MoEF&CC	Ministry of Environment, Forest and Climate Change, Government of India
DBT	Direct Benefit Transfer	NDRF	National Disaster Response Force
DFO	Divisional Forest Officer	NGO	Non-governmental organization
DLCC	District-Level Coordination Committee	NTCA	National Tiger Conservation Authority
DNA	Deoxyribonucleic acid	NTG	National Technical Group
EIA	Environmental impact assessment	NWAP	National Wildlife Action Plan
EWRR	Early Warning and Rapid Response	OPs	Operating procedures
GIS	Geographical information system	PA	Protected area
GIZ	<i>Deutsche Gesellschaft für Internationale Zusammenarbeit</i>	PCCF	Principal Chief Conservator of Forest
Gol	Government of India	PPE	Personal protective equipment
HCC	Human–Crocodile conflict	PRT	Primary Response Team
HOFF	Head of Forest Force (in a state)	RFID	Radio frequency identification
HWC	Human–wildlife conflict	RRT	Rapid Response Team
HWC-MAP	Human–Wildlife Conflict Management Action Plan	SDRF	State Disaster Response Force
HWC-NAP	National Human–Wildlife Conflict Mitigation Strategy and Action Plan	SFD	State forest department
HWC-SAP	State-Level HWC Mitigation Strategy and Action Plan	SHG	Self-help group
IFS	Indian Forest Service	SLCC	State-Level Coordination Committee
		SOPs	Standard operating procedures
		WII	Wildlife Institute of India
		WLPA	Wild Life (Protection) Act, 1972

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1. ABOUT THE GUIDELINES

1.1 THE OVERALL CONTEXT

- These guidelines on human–crocodile conflict (HCC) mitigation get the overall context from the Wild Life (Protection) Act, 1972 (WLPA), the National Wildlife Action Plan (2017-31)¹, the Advisory to Deal with Human–Wildlife Conflicts (MoEF&CC 2021) and the National Human–Wildlife Conflict Mitigation Strategy and Action Plan of India (2021–26) (HWC-NAP)² provides the overall conceptual and institutional framework for implementing these guidelines.
- These guidelines take into consideration the existing guidelines, advisories and good practice documents issued by various state governments and build on them to bring about a more holistic approach to HCC mitigation.
- In addition to HCC mitigation, the following species-specific guidelines are being developed: guidelines for mitigating human–Elephant, –Gaur, –Snake, –Rhesus Macaque, –Wild Pig, –Bear, –Blue Bull, –Leopard and –Blackbuck conflicts.
- The following guidelines on cross-cutting issues are to provide guidance on selected issues: Guidelines for Cooperation between the Forest and Media sector in India: Towards effective communication on Human-Wildlife Conflict Mitigation; Occupational Health and Safety in the Context of Human–Wildlife Conflict Mitigation; Crowd Management in Human-Wildlife Conflict Related Situations; and Addressing Health Emergencies and Potential Health Risks Arising Out of Human–Wildlife Conflict Situations: Taking a One Health Approach.

1.2 PURPOSE AND SCOPE

- The guidelines aim to facilitate a common understanding among key stakeholders on what constitutes effective and efficient mitigation of HCC in India, leading to co-existence, and to ensure standardisation in performing mitigation operations in the most effective and efficient manner, with minimum damage to humans and crocodiles.
- The guidelines provide advice on mitigation measures to be used to address HCC in the long term as well as facilitate the development, assessment, customisation and evaluation of site-specific HCC mitigation measures that are effective and wildlife-friendly.
- The guidelines serve as a basis for overall long-term planning and coordination of HCC mitigation measures at the national, state and division levels.
- In general, the guidelines apply to all stakeholders relevant to HCC mitigation and are not limited to state forest departments (SFDs).
- The guidelines will be able to bring in more effectiveness and efficiency when they are fully integrated into the division-level HWC Management Action Plans (HWC-MAP) and state-level HWC Mitigation Strategy and Action Plans (HWC-SAP).

1.3 APPROACH

- The development of these guidelines is driven by a harmonious-coexistence approach³ to ensure that both humans and crocodiles are protected from negative impacts of HCC.
- The guidelines adopt a holistic approach in addressing the issue of HCC. The holistic approach of the guidelines entails addressing not only the emergency situations arising due to immediate conflict situations but also the drivers and pressures that lead to HCC; providing guidance on establishing and managing prevention methods; and reducing the impact of conflict on both humans and crocodiles.
- The development of these guidelines and their intended implementation are driven by a participatory approach. These guidelines are intended to facilitate participatory planning, development and implementation of HCC mitigation measures with key sectors and stakeholders at the national, state and local levels.
- The guidelines reflect on the need for a landscape approach while formulating solutions for mitigating HCC to ensure sustainable solutions as unless comprehensive and integrated HCC mitigation measures are implemented across the landscape, the problem is likely to only shift from one place to another.
- Efforts have been made to forge linkages with plans and guidelines of key relevant sectors for enhancing synergies and eliminating trade-offs at the field level.
- Taking a capacity development approach, the guidelines facilitate the implementation through provision of *Implementer's Toolkit*, which includes Operating Procedures (OPs), formats, checklists, and other field implementation aids..

1.4 LEGAL AND POLICY FRAMEWORK FOR IMPLEMENTING THE GUIDELINES

- These guidelines should be read in conjunction with the existing relevant legal and regulatory frameworks, especially the Wild Life (Protection) Act, 1972.
- The following laws are considered directly relevant for conservation when dealing with HCC:
 - Wild Life (Protection) Act, 1972
 - Prevention of Cruelty to Animals Act, 1960
- Other important legislations that facilitate conservation when dealing with HCC include the Environment Protection Act, 1986; Indian Penal Code, 1860; Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006; the Indian Forest Act, 1927; the Forest (Conservation) Act, 1980; the Biological Diversity Act, 2002, the Environment (Protection) Act, 1986; and Disaster Management Act, 2005.
- Sections 9, 11(1)(a) (2) (3), 12(bb), 29, 35(6) and 39(1)(a) of the WLPA 1972 are especially relevant when dealing with HCC.
- The *Supplementary Framework to HWC-NAP on Legislative Framework for HWC Mitigation in India*⁴ is to be referred to for more details on the specific legal provisions relating to HWC mitigation.

1.5 INSTITUTIONAL MECHANISM FOR IMPLEMENTING THESE GUIDELINES

- The institutional mechanism outlined in the HWC-NAP will be followed in implementing these guidelines.

1 MoEFCC (2017). National Wildlife Action Plan (2017-35)

2 National HWC Mitigation Strategy and Action Plan of India (2021–26), available from <https://moef.gov.in/wp-content/uploads/2022/01/National-Human-Wildlife-Conflict-Mitigation-Strategy-and-Action-Plan-of-India-2.pdf>

3 'Harmonious coexistence' is defined as a dynamic but sustainable state in which humans and wildlife adapt to living in shared landscapes, with minimum negative impacts of human–wildlife interactions on humans or on their resources and on the wildlife or on habitats. The mitigation measures designed using this approach maintain a balance between the welfare of animals and humans in which both are given equal importance. Overlap in space and resource use is managed in a manner that minimises conflict.

4 Supplementary frameworks to the HWC-NAP: <https://moef.gov.in/wp-content/uploads/2022/01/National-Human-Wildlife-Conflict-Mitigation-Strategy-and-Action-Plan-of-India-2.pdf>

2. CONTEXT AND SITUATION

- Crocodiles are aquatic species inhabiting freshwater, brackish water and marine ecosystems. There are about 23 species of crocodile in the world. Of these, three species, namely, the Gharial (*Gavialis gangeticus*), Saltwater Crocodile (*Crocodylus porosus*) and Mugger (*Crocodylus palustris*), occur in India.
- Though aquatic, they also require the adjoining terrestrial areas (shores and banks) of water bodies for meeting their regular basking (thermoregulatory) and seasonal breeding requirements, for example, for making a nest in the ground by the Mugger and Gharial, and a vegetation mound by Saltwater Crocodile.
- Crocodiles play a key role in aquatic ecosystems as top predators and maintain the aquatic ecology and healthy balanced ecosystems. Because of their specialized habitat needs in terms of habitat characteristics and water chemistry, they are also excellent indicators of aquatic biodiversity.
- ‘Human–crocodile conflict’ (HCC) refers to negative interactions between people and crocodiles, leading to negative impacts on people or their resources, such as human death and injury, loss of livelihoods and impacts on the emotional well-being of humans, and on the crocodiles or their habitats
- People and crocodiles have co-existed and have shared a long history of living together, in some cases for millennia, without much conflict. However, with increased human activities in crocodile habitats as well as the spillover of crocodile populations, as a result of conservation efforts, HCC has been escalating in many areas. There has been an increase in the number of human fatalities over the last few years in India due to HCC.
- HCC involves two species of crocodile, viz., saltwater crocodile and Mugger, with key impacts on humans in the form of human injury and death, livestock injury and death. HCC is a serious issues in rural and semi-rural environment.
- Human–crocodile conflict is reported from seven states (Odisha, West Bengal, Andaman and Nicobar Islands, Gujarat, Maharashtra, Karnataka and Tamil Nadu).
- The drivers of HCC include an increase in the human population close to crocodile habitats, changing lifestyles and economic aspirations; reduced appreciation of wildlife; land-use changes; tourism policies; aquaculture; fishing; and wetland habitat fragmentation, loss and degradation.

3. ADDRESSING THE DRIVERS AND PRESSURES OF HCC

The HWC-NAP recommends a holistic approach to HWC mitigation in which the thematic triangle of drivers–prevention–damage mitigation is considered and addressed. These guidelines have been prepared in line with the recommended holistic approach to bridge the current gap.

A major gap involves effective problem analysis to identify drivers and pressures of conflict. Such analysis allows selection of mitigation measures appropriately.

- An assessment of long-term outcomes and implications of all mitigation methods is needed to identify effective and wildlife-friendly mitigation measures to address HCC. For this, a systematic analysis of HCC mitigation methods may be performed to assess their effectiveness and wildlife-friendliness in different types of conflict situations. This will facilitate the customisation and adoption of mitigation measures necessary to achieve the best possible impacts in the field.
- Cross-sectoral cooperation is critical for addressing drivers of conflict through improved land-use planning and other measures and to customise the mitigation measures.

3.1 ZONATION

- The crocodile habitat should be differentiated into two management zones for achieving the varied objectives of the species management required by various HCC mitigation measures. Zonation is a management tool for implementing a science-based and pragmatic approach to landscape-level planning for conservation and HCC mitigation.

1. Crocodile Conservation Zone (CCZ)

- Crocodile Conservation Zones are protected habitats where conservation takes priority over any other management objectives and mainly include protected areas (PAs) and other critical crocodile habitats. These zones are free of human disturbance (fishing, aquaculture, cultivation, washing and bathing, removal of biomass from forests). If some human dependency exists at the interface, it is to be resolved as per the provisions of the Wild Life (Protection) Act, 1972 and the Indian Forest Act, 1927.

2. Human–Crocodile Interface Zone (HCIZ)

- This zone includes the multiple-use areas in which a crocodile habitat has an interface with a human-use area where resource extraction by the communities is permitted and there is a likelihood of chance encounters of humans and crocodiles. The cardinal principles of HWC pertaining to mutual coexistence, participatory conflict management and holistic approach should prevail. This zone also comprises areas that are important for the livelihoods of local communities and activities such as fishing, aquaculture and tourism, which are the main sources of the local economy. Therefore, this zone may be kept relatively free of crocodiles so that the local economy or livelihoods are not affected. The crocodiles in these areas may be captured and translocated to other suitable habitats or to rescue centres if required.
- The state forest department may identify and classify the above-mentioned zones on the basis of crocodile occupancy, proximity to human habitations, frequency and intensity of conflicts, fishing rights and possible inclusion in tourism zones.

3.2 MONITORING AND MANAGING HABITAT-RELATED DRIVERS AND PRESSURES

When a crocodile habitat overlaps with human-use and -dependency areas, there are great implications for humans and crocodiles. These can be resolved through a holistic management strategy. Monitoring and understanding the factors and causes leading to the increase in human population, land-use changes, fishing, aquaculture and habitat fragmentation, loss and degradation are crucial in mitigating HCC. The following assessments are envisaged:

- Mapping of existing drivers and pressures of conflict such as land-use change by conversion of wetlands and crocodile habitats/mangroves/forest into agricultural lands, fishing, encroachment, mining, aquaculture, settlements within forests and resource use by local communities.
- Ensuring that all forest boundaries, lakes and river banks are patrolled on a regular basis for preventing encroachments and degradation of habitats.

- Managing crocodile habitats in inland and coastal lakes that fall beyond the forest boundaries requires regular assessment to generate time-series data:
 - Mapping of crocodile occupancy, distribution and numbers in habitats, especially areas of intense human use
 - Mapping land tenure and identification of key stakeholders
 - Holding consultations with local communities to facilitate crocodile conservation
 - Engaging various line departments who can facilitate the enhancement or improvement of livelihood options that reduce the extent and intensity of use of crocodile-occupancy areas
 - Facilitating capacity development of other line departments, local communities and other key stakeholders
 - Preparing and implementing long term plans such as state-level human-wildlife conflict mitigation strategy and action plans (HWC-SAPs), and division-level HWC management action plans (HWC-MAPs) for conservation and conflict management within crocodile habitats
- State forest departments, through the Multi-stakeholder Fora at the state level and the Joint Working Groups with key departments and agencies at the landscape level, may develop synergies and facilitate integrated land-use planning and effective implementation of planned measures
- Mapping the extent of pollution in and around crocodile habitats caused by discharge of wastes and effluents from industries and aquaculture to assess the degradation of the waterscape and the resultant reduction in the quality of the habitat, which may require intensive amelioration measures and coordination with line departments

3.3 REDUCE LIVELIHOOD-DEPENDENCE OF PEOPLE ON CROCODILE HABITATS

Loss and degradation of habitat due to fishing, discharge of effluents and toxic waste, unsustainable tourism, etc in aquatic environment, and conversion of aquatic habitats into agricultural lands or aquaculture wetlands or urbanization that affects the fresh water and marine aquatic species exacerbating the HCC.

A large part of the aquatic water bodies and coastal marine area and forests are used by communities living in proximity to the forest resulting in the removal of biomass

for use as food and fuel wood, unregulated fishing, dependence of livestock population on wetlands lands leading to degradation of the coastal and inland wetlands. Wetlands based resources are often an important source of cash income for the poor around.

Fishing, aquaculture, non-timber forest produce and forest rights facilitate subsistence livelihoods, and with the growing human population and deteriorating habitat quality, such livelihoods will become even more marginal and the people will be pushed further into poverty.

- The management interventions should focus on better livelihood opportunities through community participatory approaches, including various eco-development measures and livelihood improvement programmes.
- The enhancement of the quality of life of wetlands dependent communities can be assured through efficient participatory multiple-use management and equitable distribution of resources through the following mechanism and governance system:
 - integrated development and management of wetlands-based resources
 - ensuring institutional, financial and ecological sustainability
 - establishing accountability and transparency in management practices
 - creating an institutional mechanism for empowering local communities.

3.4 MEASURES TO STRENGTHEN CROSS-SECTOR COOPERATION FOR EFFECTIVE HCC MITIGATION

Cross-sectoral cooperation for HCC mitigation entails engaging multiple stakeholders from different sectors and domains at the national, state, landscape and district/forest division levels. The following measures are envisaged:

- State-Level Coordination Committees (SLCC), landscape-level multi-stakeholder fora and District-Level Coordination Committees (DLCC) may be used to strengthen the inter-agency coordination required for HCC, and a district-specific operational mechanism may be developed to address specific needs of HCC mitigation.

3.5 COMMUNITY AWARENESS AND COMMUNICATION MEASURES TO REDUCE THE RISK OF ACCIDENTAL ENCOUNTERS AND RETALIATION

To facilitate effective engagement of local communities and various stakeholders in mitigation of HCC, it is extremely important to plan and implement awareness and sensitisation measures, adopting a participatory approach.

- Appropriate community awareness and communication measures may be implemented at HCC hotspots, and their impacts may be assessed periodically to ensure that the awareness and communication measures are locally customised.
- Plan and implement training programmes and other capacity development measures and extension programmes with school and college students and engage with women's self-help groups, village forest committees (VFCs), eco-development committees (EDCs), Biodiversity Management Committees (BMCs), large area multipurpose societies (LAMPs), etc. The EDCs/VFCs formed by the state forest department in coastal areas and villages abutting the forest area in the zone of influence may be made functional and their sustainability ensured through accrual of benefits and incentives.
- Facilitate the participation of key stakeholders to ensure the integration of traditional and local knowledge and experiences into the development of division-level HWC-MAPs for crocodile conservation and developing measures for HCC mitigation.

3.6 EFFECTIVE GARBAGE MANAGEMENT AND SAFE SANITATION IN AND AROUND HCC HOTSPOTS

Garbage is known to attract crocodiles, especially organic waste from slaughterhouses/fish-processing units that is dumped near areas visited by humans, including tourist beaches and the vicinity of human habitations on coasts/creeks and banks. These dumps create a potential for accidental encounters between people and crocodiles.

The following are indicative measures to address the situation:

- Ensuring sustainable and ecologically sound waste and garbage disposal by town municipalities and village panchayats at the borders of crocodile habitats, especially at HCC hotspots.
- Tourism zones situated close to crocodile habitats should take measures to avoid conflict through proper disposal of garbage (dumped food items, particularly fish and offal), which attracts crocodiles.

- Periodic inspection of the forest–water interface area near villages/towns by SFDs and other government departments/organisations to ensure that poor disposal of organic garbage from fishing activities and slaughterhouses/fish-processing units is detected and brought to the notice of the local authorities. Volunteers can be engaged for this.
- Community awareness programmes and signage to facilitate effective participation by local communities in garbage management. Appropriate signage about garbage management and crocodile presence may be installed along roads and at the water–land interface. Periodic inspection of forest boundaries, lakes, river banks and estuaries may be carried out by SFDs and line departments.
- SFDs may also coordinate with municipalities/panchayats about garbage management and explore the possibility of building toilets under the Swachh Bharat Mission to prevent accidental encounters at HCC hotspots.

3.7 SYSTEMATIC RESEARCH AND MONITORING ADDRESSING HCC

Crocodiles are very shy, well-camouflaged and mobile, which makes them a challenge to study. Knowledge of the ecology, biology and behaviour of crocodiles helps us develop tools and strategies to conduct safe and efficient research on crocodiles.

State forest departments, research institutions, NGOs and experts involved in crocodile conservation are encouraged to carry out result-oriented research on the HCC status and mitigation measures. While some research and monitoring topics require specialised technology, knowledge and skills, much of the research and monitoring required for effective understanding of HCC should be conducted by the forest department staff themselves.

The following are some research priorities:

- Understanding the population density, distribution and spatio-temporal changes in the distribution and occupancy of the crocodiles in the habitat
- Studying communication in crocodiles will provide knowledge about deterrents that can be used to mitigate HCC.
- Studying movement ecology through telemetry and mapping and predicting the conflict probability within a habitat
- Studies on spatio-temporal movements towards organic waste will help devise crocodile separation barriers.

- Using innovative multi-beam sonar technology and image recognition software in zones with high levels of crocodile conflict to detect crocodiles and alert authorities to their presence. This technology can help deploy a Clever Buoy system for recording environmental data (temperature, wind, humidity) to determine when and why crocodiles move into areas frequented by people.
- State-level coordination committees (SLCC), landscape-level multi-stakeholder fora and district-level coordination committees (DLCC), may be used to strengthen the inter-agency coordination required for HCC, and a district-specific operational mechanism may be developed to address the specific needs of HCC mitigation.

3.8 MEASURES TO STRENGTHEN THE SYSTEM OF KNOWLEDGE MANAGEMENT IN HCC MITIGATION

To ensure effective and sustainable HCC mitigation measures, it is essential that field experiences, learnings, field-evidence and conceptual advances be not only shared with stakeholders across landscapes but also documented to be utilised in future strategies and plans related to HCC mitigation.

- A strong knowledge base on the territorial behaviour of crocodiles should be developed at each HCC hotspot.
- The National HWC Mitigation Forum, landscape-level multi-stakeholder fora and appropriate working groups should be used to share field experiences, learnings, evidence and conceptual advances within the forest department, with stakeholders and across landscapes.
- Measures are to be put in place to systematically document field experiences, learnings, field-evidence and conceptual advances in HCC mitigation to inform the future strategies and plans with regard to HCC mitigation.

3.9 MEASURES TO STRENGTHEN THE ROLE OF KEY STAKEHOLDERS AND CROSS-SECTOR AND INTER-AGENCY COOPERATION FOR HCC MITIGATION

Cross-sectoral cooperation for HCC mitigation entails multiple stakeholders from different sectors and domains being engaged at the national, state, landscape and district/forest division levels. Key stakeholders for HCC mitigation may include the state forest department and other line departments, viz., Fisheries, Agriculture, Revenue, Animal Husbandry, Police, Public Works, Health and Family Welfare the Indian Coast Guard, Indian Navy, Marine Police and Education departments and electricity boards. The private sector the railways and the National Highway Authority of India, wildlife conservation and development NGOs, farmers' cooperatives and agricultural research institutions are relevant when dealing with conflict and conflict mitigation. The following measures are envisaged:

- Safety audits may be conducted each year, if feasible, to ensure that all members of the community act responsibly in the case of HCC and to facilitate inter-agency cooperation.
- Data relating to HCC cases (with reference to the developments in the area that may have a bearing on conflict cases) may be maintained for use in discussions in the DLCC.

3.10 FACILITATING CAPACITY DEVELOPMENT MEASURES TO DEVELOP THE REQUIRED COMPETENCIES FOR ADDRESSING HCC IN THE MOST EFFECTIVE AND EFFICIENT MANNER

Developing the capacities of SFDs, other line departments and agencies, including the Indian Coast Guard, the Fisheries Department, local communities and all key stakeholders may be facilitated to ensure that a holistic approach can be adopted:

- The SFDs may ensure that all the response teams from the Forest Department and other line departments and agencies are involved in a systematic approach to capacity development, in line with the *Supplementary Framework to HWC-NAP on Establishment and Capacity Development of HWC Mitigation Response Teams*.⁵
- The arrangements may be made for deployment of taking personnel and quick action on noticing conflict cases are to be strengthened in each forest division, and a system of resource sharing (e.g., specialised experts from response teams, other staff members and experts, and equipment across forest divisions) is to be developed.

5 Supplementary framework to HWC-NAP on establishment and capacity development of HWC mitigation response teams: <https://moef.gov.in/wp-content/uploads/2022/01/National-Human-Wildlife-Conflict-Mitigation-Strategy-and-Action-Plan-of-India-2.pdf>

4. ADOPTING MEASURES TO PREVENT HUMAN–CROCODILE CONFLICTS

The type of conflict and the mitigation depend on where the conflict is occurring and what its impact is on humans and crocodiles. HCC locations can be broadly grouped into two categories, which require different mitigation methods, with some overlap:

Crocodile Conservation Zone (conflict occurs here when humans enter for economic and recreational activities and daily rituals)

- Minimising the use of aquatic and forest habitats
- Capacity development

Crocodile–Human Interface Zone (the interface between crocodile breeding areas and cattle grazing grounds, village ponds, aquaculture farms and organic waste disposal sites/fish-processing units, etc.)

- Early warning system
- Deployment of RRT/PRT
- Barriers and deterrents
- Capture and translocation
- Release and rehabilitation
- Capacity development

4.1 IDENTIFICATION OF HOTSPOTS OF HCC

Identifying conflict hotspots⁶ that could also provide a direction towards the drivers of conflict is critical to providing site-specific solutions to mitigate HCC. Conflict hotspots of HCC can be mapped through geo-spatial assessments, by using both primary data and secondary data, including time-series data. The hotspots can be identified and mapped as follows.

- **Incident hotspot:** Frequency of occurrence of incidences over a specific period in the past, such as 5 or 10 years, mapped in the target area. The data include the number of incidences of injury and death and the number of attacks/killings of domestic animals.

- **Vulnerability hotspot:** Cumulative index determined by overlaying past incidents, the vulnerability of the local community and the potential risk of the area.

- The hotspot data can be overlaid on a GIS platform to generate a map of the ranging pattern of the animal-in-conflict to delineate its residence and movements in the core zone, interface zone and forest fringe area (agriculture–forest matrix) a PA.
- The use of predictive modelling based on geo-spatial data for hotspot mapping and robust spatial analyses and modelling tools, including scenario building, may be explored.

4.2 EFFECTIVE USE OF EARLY WARNING AND RAPID RESPONSE SYSTEMS AT HCC HOTSPOTS

A key requirement for addressing HCC effectively is deployment of an EWRR⁷ system at strategic locations in identified hotspots. This may enhance the overall efficiency of mitigation efforts in the field. The EWRR system should be in line with the *Supplementary Framework to HWC-NAP on Establishment and Capacity Development of HWC Mitigation Response Teams*.⁸

- The EWRR system may be used to detect early conflict cases with crocodiles and to ensure appropriate responses in cases of HCC.
- The response teams may be placed on high alert at conflict hotspots during the rainy season (June to November), when aquatic bodies overflow, at high tide and during the breeding season.
- Further tools for establishing and implementing the EWRR system may be elaborated.

6 'HWC hotspots' are areas with actual or predicted repeated occurrences of HWC incidents that result in crop-loss, livestock death, human death and injury, and wildlife death and injury over temporal and spatial scales. The HWC can be static (repeated in the same place or time) or dynamic (shift in space and time over years). In addition to count statistics, the magnitude of the incidents is subjected to interpolation or extrapolation techniques to define the hotspots in space and time.

7 EWRR is a set of tools, processes and personnel competencies needed for the timely and meaningful generation and dissemination of alert information to individuals, communities and establishments at risk for optimal preparedness and response at the appropriate time to reduce the likelihood of injury, death or crop damage. EWRR will structurally include an HWC Mitigation Hub/Control Room and a system of three-tiered response teams, viz., division-level Rapid Response teams (Division RRTs), range-level Rapid Response Teams (Range RRTs) and village-/ward-level Primary Response Teams of the local community (Community PRTs).

8 Supplementary frameworks to the HWC-NAP: <https://moef.gov.in/wp-content/uploads/2022/01/National-Human-Wildlife-Conflict-Mitigation-Strategy-and-Action-Plan-of-India-2.pdf>

4.3 MONITOR AND DOCUMENT 'POTENTIAL CROCODILES-IN-CONFLICT' IN THE LANDSCAPE

A potential crocodile-in-conflict is an individual that is likely to enter a HCC situation owing to its movement pattern or other behaviour.

Monitoring potential crocodiles-in-conflict at the land–water interface area may be carried out, as a preparedness and prevention measure, to ensure that their movements in the human-dominated landscape and seascape do not lead to an emergency situation.

The following are some examples of monitoring methods:

- Studying the population dynamics and spatio-temporal distribution using spotlight surveys and mark–recapture assessment, which can provide information for planning conflict mitigation measures
- Studies on the behavioural ecology of crocodiles to get good baseline data on animals-in-conflict and their attraction towards organic waste from aquaculture farms/fish-processing units.
- Monitoring individuals using satellite transmitters to get information on the movements of marked individuals
- Building (by SFDs) identification profiles of conflict/non-conflict crocodiles for identifying and differentiating individuals who get involved in conflicts and understanding their ranging patterns.

4.4 SUPPORT LOCAL POPULATION IN PREVENTING ACCIDENTAL ENCOUNTERS WITH CROCODILES

People living in HCC areas may be engaged to avoid accidental encounters, in the following ways:

- SFDs may facilitate, encourage and seek support from local NGOs, volunteers and other stakeholders to implement safety measures aimed at preventing human–crocodile encounters. These measures may include guiding humans to avoid the following activities, which exacerbate HCC:
 - Humans or livestock entering the aquatic habitats of crocodiles (wading or, swimming in an unprotected manner for daily rituals or economic or recreational purposes). Aquaculture farms near crocodile habitats attract crocodiles to the food and result in accidental encounters.
 - Using water bodies for rituals such as bathing and washing clothes and other items

- Entering water bodies for fishing, collection of crabs, snails and other molluscs and prawn seed, unauthorised fishing using makeshift canoes, etc.
 - Grazing of livestock along the water's edge.
 - Sudden encounters with nest-guarding crocodiles during the breeding season (nest-guarding muggers remaining close to their nests in the water and nest-guarding female saltwater crocodile in the wallows close to mound nests in the mangrove habitat).
 - Venturing into village ponds during floods and the dry season.
- Briefing of vulnerable groups, including fish workers and divers, may be done about the crocodile risk and safety issues.
 - Regular training programmes may be organised at local schools and colleges, and possibly during village meetings, at HCC hotspots to train humans in safety measures.
 - Safety audits may be conducted each year, if feasible, to ensure that all members of the community act responsibly in case there is HCC and to facilitate inter-agency cooperation.

4.5 SUPPORT THE LOCAL COMMUNITY IN USING BARRIERS AND OTHER EXCLUSIONARY MEASURES, ADOPTING A HARMONIOUS-COEXISTENCE APPROACH

Crocodiles in wetland habitats are elusive and can move fast into human-use areas. They enter low-lying forests and agricultural lands adjoining their habitats during the high tide, when nallas and creeks are flooded, and gain access to houses, tourist beaches and creeks. People using submerged areas for commuting, grazing cattle, fishing, washing, bathing and cleaning utensils are vulnerable to attacks. The use of the following barriers is envisaged for preventing chance encounters:

- Setting up an exclusion barrier (frill gate, net, bamboo fence, vegetative barrier, exclusion enclosure of wood and iron) is one of the most effective safety measures. Segregation of the crocodile habitat from the human habitation may be done by setting up moveable grill gates, crocodile-proof nets and bamboo fences
- Installing crocodile exclusion enclosures (CEE) to protect human habitation at conflict hotspots
- Segregation of footpaths from creeks/rivers/streams by erecting log bridges/culverts to facilitate crossing

- Setting up vegetative and semi-vegetative check dams in the upstream sections of freshwater streams as barriers to prevent crocodiles from gaining access
- Engagement of community-based institutions by SFDs along with wildlife experts/organisations to motivate, train and hand-hold the community in the use of exclusionary measures
- Awareness building and training related to the proper usage and maintenance of these barriers
- Supporting farmers through incentive mechanisms and subsidised funding for creating awareness and for using and maintaining barriers under district schemes (such as MGNREGS)
- Developing a compendium on good practices in setting up exclusion barriers for the use of the community

4.6 ADDRESSING HIGH-CONFLICT CROCODILE INDIVIDUALS

Male adult crocodiles occupying large territories and home ranges are more aggressive and have, therefore, higher potential to enter into a conflict situation when moving out into the lowlands during the high tide and rains. Some crocodiles are attracted towards organic waste dumped along the shore. The female crocodiles display antagonism when defending nests. The following measures are envisaged:

- SFDs may identify the high-conflict individuals from the conflict database.
- SFDs may test aversion conditioning to train habituated males who have the ability to breach barriers to reach organic waste dumps (waste from fish-processing units) close to their habitats. Satellite transmitters can be used to monitor the movements of high-conflict individuals.
- Capture and translocation (if required) or rehabilitation be carried out as per the guidelines and OPs, with the related monitoring protocols.

5. ADDRESSING THE EMERGENCY SITUATIONS ARISING DUE TO HCC

This is an indicative list of potential emergency⁹ situations, in order of decreasing priority:

- I. A crocodile has killed/injured a person.
- II. A crocodile has attacked livestock.
- III. A crocodile has entered human-use areas (village ponds/paddy fields/canals/other settlement areas)
- IV. An injured crocodile is to be rescued.
- V. A crocodile has died due to retaliatory action.

Key response procedures should be established, and actions promptly implemented/undertaken, to address emergency situations. Detailed step-by-step guidance is to be developed in the form of 'Operating Procedures for Addressing Emergency Response Situations'.

The key emergency response procedures are to be elaborated in the *Implementer's Toolkit*, and these should include the procedures listed in the following sections.

5.1 ESTABLISHING AN EMERGENCY RESPONSE MECHANISM

A strong institutional mechanism is required to respond to an emergency situation arising due to HCC. The response starts with detection of the incident, communication to the control room and dissemination of information to the officials and staff in the command-and-control hierarchy, including the forest and civil administration, for initiation of appropriate response actions. The Divisional Forest Office coordinates the action by deploying the RRTs to the incident site. The field support operations may be structured around the following key operational stages for synchronisation of activities to meet the emergency:

- Monitoring and creating situational awareness
- Mitigation hubs/control room/helplines to receiving and disseminating information
- RRT/PRT personnel, a veterinary team, equipment, and mobility and communication facilities are needed to address the emergency situation effectively and efficiently.

5.2 INTRA- AND INTER-AGENCY COORDINATION AND COOPERATION

- Operating procedures may be laid down in each forest division/district in line with these guidelines and in line with the institutional framework suggested under the HWC-NAP to ensure timely coordination amongst the various response teams from the Forest Department and other agencies, under the DLCC, consisting of the District Magistrate/District Collector, the police, the fire services, the Animal Husbandry Department, the Health Department, SDRF, NDRF, fisheries department, the Indian Coast Guard, Marine Police, paramilitary forces, etc. and the local community, especially local panchayat leaders and village community PRTs.

5.3 PREPAREDNESS OF RESPONSE TEAMS

- Operating procedures may be laid down in detail to ensure that the capacities and capabilities of the various response teams (community PRTs, RRTs) are established and their capacities developed through training sessions and other measures, including training in relation to occupational health and safety.
- Operating procedures may be laid down with specifications to ensure that each response team is sensitised and equipped with appropriate and adequate response equipment and personal protective equipment (PPE kits), in view of the need to prevent, manage and control zoonotic diseases and pandemics effectively.

⁹ An emergency or crisis situation can be defined as a situation that is sudden, unexpected and has the potential to be serious/ is serious in nature and therefore requires immediate intervention in time and space from concerned stakeholders to minimise the loss of lives and assets. The response to such emergencies involves prompt handling of situations and ensuring that the vulnerabilities of humans and crocodiles are reduced.

5.4 ACTION AT THE ONSET OF EMERGENCIES OR SPECIFIC SITUATIONS

5.4.1 Identification of Crocodiles-in-Conflict

- The CWLW can permit the hunting of a crocodile if she or he is satisfied that such an animal has become dangerous to human life or is disabled or diseased beyond recovery. However, she or he may record the reasons in writing after being satisfied after studying a report from field officers that the animal has been identified and could not be captured, tranquilised or translocated, but its presence is dangerous to human life
- Crocodiles are shy and camouflaged and hide in aquatic and muddy habitats. This elusive nature prevents immediate identification. The following steps may be taken to identify a crocodile that is involved in conflict:
 - Follow the track marks and other distinct signs to confirm and track the movements of the crocodile, and demarcate and map them.
 - Investigate an area within a 50 m radius of the incident site, focusing on trails, kills, carcasses, organic waste dumps, etc.
 - Deploy a number of cameras at strategic locations, depending on the predicted movements.
 - Investigate the existing camera trap database, if available, and identify the individual on the basis of distinct morphological features.

- Training sessions on identification of crocodiles-in-conflict may be organised for dedicated personnel of the Forest Department or, preferably, joint inter-agency and multi-stakeholder teams, using the training approach indicated in the *Supplementary Framework to HWC-NAP on Establishment and Capacity Development of HWC Mitigation Response Teams*¹⁰.

5.4.2 Other Key Response Actions during and after an Emergency

- Operating procedures may be laid down for step-wise key actions, for all emergency situations, media engagement and crowd management, that address health emergencies and post-response operations for the management of the animal. This includes ensuring the animal's health and safety during the capture, transport and selection of a translocation site and monitoring the animal after releasing it safely back into the wild.

10 Supplementary framework to HWC-NAP on establishment and capacity development of HWC mitigation response teams: <https://moef.gov.in/wp-content/uploads/2022/01/National-Human-Wildlife-Conflict-Mitigation-Strategy-and-Action-Plan-of-India-2.pdf>

6. REDUCING THE IMPACT OF HUMAN OR LIVESTOCK ON THE HEALTH AND OVERALL WELL-BEING OF AFFECTED PEOPLE

People living near crocodile habitats have sufficient knowledge about the habits and behaviour of the animal and the potential threats (as it is camouflaged and may attack ferociously). In spite of precautions, there is a probability of a chance encounter leading to human injury/death and retaliatory killings.

A major response to HCC has been to provide *ex gratia* for losses, but little evidence exists to support the claims that this has an impact on people's attitudes or on conservation of wildlife. Moral hazards and optimisation and leveraging of compensation schemes are a challenge.

6.1 ADDRESSING LOSS OF HUMAN LIFE AND INJURY

- Part of the *ex gratia* payment may be made immediately to the victim's family/heirs, and the balance payment may be made at the earliest.
- The payments to the victim's family should be made into their bank accounts through Direct Benefit Transfer.
- In HCC hotspots, a revolving fund may also be established, at the division-level, to ensure that funds are available for providing immediate relief to a victim/family.

- In the case of an injury as a result of an encounter with a crocodile, the victim needs to be hospitalised immediately and *ex gratia* payments made as per the norms of the state government.

- Professional counselling through qualified psychiatrists/health workers may be useful in checking the effects of such traumatic incidents. The SFDs and other government agencies/institutions may organise some counselling sessions for victims and support them as they recover from the psychological impact.

6.2 ADDRESSING LOSS OF LIVESTOCK

- Loss of livestock or aquaculture may be compensated in accordance with government norms, at the earliest.
- An app-based system can be developed to expedite the process of making an *ex gratia* payment to the owner of a dead animal.
- SFDs may coordinate with the respective resident welfare associations for the *ex gratia* payment in the event of loss of livestock.

7. REDUCING THE IMPACT OF HCC ON THE HEALTH AND WELL-BEING OF AFFECTED CROCODILES

7.1 OVERALL MEASURES

- All care should be taken to address the issues of animal welfare and animal rights as enshrined in the Constitution (Articles 48A and 51A(g)) and in the statutory provisions of the Indian Penal Code (Sections 428 and 429), Prevention of Cruelty to Animals Act of 1960 (Section 11(1)(h) and Section 11(1)(d)) and Motor Vehicles Act, 1978 (Transport of Animal) Rules, 2001) and guidelines issued by the MoEF&CC.

7.2 CAPTURE AND HANDLING OF CROCODILES

Capturing crocodiles requires special skill and training, to ensure that the animal does not get stressed during the capture process, viz. the capture operation, post-capture retention, during handling of the animal, and during transportation.

- Young and sub-adult crocodiles may be captured using scoop nets and gill nets, while the adult may be snared using a night spotlight, or by setting up traps along the water's edge. Non-lethal harpooning may serve as a quick and efficient method of capturing crocodiles-in-conflict with minimum stress to the animal.
- The time of struggling during capture must be reduced to a minimum to reduce stress, and the crocodile must be restrained as soon as possible after the initial capture effort. If possible, chemical immobilisation may be used.
- The most effective method for holding an animal for any length of time is to leave it unrestrained within a specially designed crocodile transport box or floating trap.
- Any significant deviation from normal physiological parameters should be dealt with appropriately.

Health examination after capture and critical monitoring of the crocodile

- Great care should be taken by veterinarians to ensure that crocodiles are not exposed to direct sunlight for any length of time as these animal are prone to overheating. A crocodile's skin may be kept wet using sacks that are watered regularly to prevent sunburn, which causes cracking and bleeding between the scales.

- Care should be taken to ensure that crocodiles are not attacked by ants and that moist parts of the body, such as the eyes and nostrils, or open wounds, do not get flyblown.
- The condition of restrained animals may be monitored regularly. The physiological parameters (temperature, respiration, pulse and colour of the mucous membrane) need to be monitored continuously as these are likely to be compromised during capture.
- The eyes may be covered with a wet sack (hessian bag) to reduce visual stimulation, and the limbs should be kept free; otherwise oedema (fluid accumulation) in the feet occurs, leading to severe tissue damage or loss of limbs.
- The cloaca of a crocodile, where the reproductive and excretory organs are found, is a delicate and weakly muscled sac. If large crocodiles are lifted or transported without supporting the cloaca, it is possible to cause the collapse of the muscles of the cloaca and severe injury or death.

Transportation after capture

- The method of transport used for live crocodiles will generally be determined by the size of the crocodile or crocodiles involved. The animals may be transported in specially designed ventilated boxes of a smooth material that will limit frictional damage to the skin and claws.
- A simple restraining board with webbing straps may be effective for crocodiles up to 3 m long for short-term transport.
- Transport overland across earthen, unmetalled roads may be avoided to the extent possible as pounding on hard surfaces during transportation by boats or trucks can be fatal. Suitable cushioning may be used to minimise vibrations and shocks where these are unavoidable.
- Visual stimulation may be reduced by covering the eyes or keeping the crocodile in a dark container. Captured animals are in a stressed condition, and so the noise and handling may be kept to a minimum.
- Stops *en route* may be pre-planned and identified well in advance with the aim of achieving the shortest journey-time possible and ensuring the safety and

well-being of the animal.

- The animal needs to be monitored regularly for signs of discomfort or stress throughout the entire journey by veterinary professionals.

Food and water during transportation

- It is better to avoid providing feed and water during overnight transport, and efforts should be made to reach the destination (release site/rescue facility) as early as possible, taking due care of the vehicle speed and halts.

7.3 RELEASE ESSENTIALS

- The animals should be monitored for any transport injuries or any other health-related issues prior to their release.
- In case a crocodile is destined for captivity, the animal may be held in a fenced enclosure/kraal. This will provide the animal the chance to recover from anaesthetics as it gets acclimatised to its surroundings at a new location and will provide opportunities for intensive monitoring and veterinary management.
- The release site should have a proper unloading facility, and the release should be done with the least possible stress on the crocodile.
- As the effects of capture-stress may persist for many days, the animal may be closely monitored for the first few days after it is released.
- There may be a need for long-term monitoring of the health of the released individual/population.

Housing and sanitation

- In case the crocodile needs to be kept in captivity, the space provided to the crocodile should be as per the guidelines issued by the Central Zoo Authority.
- Proper sanitation and hygiene should be maintained to avoid infection.
- Adequate balanced food and water should be made available along with minerals and vitamin supplements as per the health status of the crocodile.

Health screening

- General health screening should be done periodically, and in case some serious health condition is suspected, samples may be collected and sent to institutes such as the Indian Veterinary Research Institute (IVRI) for more advanced investigations.

7.4 REHABILITATION OF CAPTURED CROCODILES

- In the case of a crocodile brought into captivity temporarily for treatment, its release after the treatment should take into consideration its past record in conflicts.
- Crocodiles that have a long record of conflicts and are injured may not be released but kept in lifetime care facilities as per CZA guidelines.

7.5 RADIO COLLARING OR TAGGING (RFID-MICROCHIP) CAPTURED CROCODILES

- Bio-logging is an important tool used for monitoring wildlife, including crocodiles. The following technologies can be utilised effectively to monitor crocodiles during relocation or translocation:
 - RFID microchips (PIT tags) may be used for tagging of all captured crocodiles brought into captivity as per CZA norms.
 - Cattle tags may be used for future identification.
 - A less conspicuous numbering system but a very useful one if crocodiles need to be re-caught for examination (e.g., weighing/measuring) is based on branding or cutting tail scutes.

8. USE OF LEARNINGS FROM THE GUIDELINES TO FURTHER STRENGTHEN THE INSTITUTIONAL AND POLICY FRAMEWORK RELATED TO HCC MITIGATION IN INDIA

These guidelines are expected to serve as a capacity development instrument, given that a robust and structured feedback mechanism will be put in place to document the feedback on their implementation.

- The feedback on the use of these guidelines should, therefore, be consolidated to form the basis for fine-tuning these mitigation measures and for understanding

the capacity needs for effectively implementing the mitigation measures.

- In the long term, the consolidated feedback should also be used to further revise/update of the capacity development strategies, HWC-MAPs, HWC-SAPs and HWC-NAP.

9. PROCESS OF DEVELOPMENT, PILOT-TESTING OF THESE GUIDELINES AND CONSULTATION PROCESS

- A dedicated framework of experts (Annexe 1) was formed, with the core team consisting of representatives from government agencies, SFDs, research institutions, civil society institutions and international organisations and independent wildlife policy experts. The experts were a mix of scientists, wildlife managers, policy experts and capacity development experts.
- A common understanding was developed on the overall purpose, scope, approach and methodology.¹¹ The experts had different roles in the drafting and editing process (Coordinating Lead Authors, Lead Authors, Contributing Authors and Review Editors). The Author Group worked on developing these guidelines between July 2019 and August 2021, during which period they consulted a larger group of experts and stakeholders via workshops, meetings and consultations. The authors reviewed the documents and guidelines available from the MoEF&CC and different states, and relevant information and recommendations were brought into the new document. The National Technical Group (NTG), consisting of experts from MoEF&CC, Wildlife Institute of India (WII) and *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ) and independent

wildlife and policy experts, was formed for the overall steering and facilitation of the process. A 'Working Group on Pilot Implementation of Guidelines and HWC-NAP' was formed to facilitate the planning and implementation of the pilot testing, consultations and final editing of the draft guidelines and HWC-NAP. Detailed terms of reference were provided for each category, and meetings and workshops of the Author Group were facilitated under the Indo-German Cooperation Project on Human–Wildlife Conflict Mitigation.

- The draft guidelines and HWC-NAP were pilot tested at selected HWC hotspots in India to receive feedback on the feasibility and acceptability of the recommendations expressed in the guidelines, using a structured process and tools. On the basis of the feedback received during fortnightly meetings and one-to-one consultations with managers, the draft of the guidelines was revised.
- A Committee was constituted by MoEFCC in December 2022, consisting of officials from MoEFCC, and the state forest departments of Bihar, Haryana, Karnataka, Tamil Nadu, Uttarakhand, Uttar Pradesh, West Bengal to review and finalize the guidelines.

10. MONITORING AND EVALUATION OF GUIDELINES

- This set of guidelines is not a static document; rather, it is a living document. It will keep abreast of the various developments in field implementation methods and wildlife research. For this, the feedback from field practitioners and other wildlife experts should be analysed to assess the specific elements and sections that need to undergo changes. The revision should take place every 5 years from 2023 onwards. However, a mid-term revision process in 2024 may be desirable. In the long term, the revision cycle of these

guidelines can be aligned with the revision cycle of HWC-NAP.

- The mechanism, templates and guidance used for collating information and feedback on the use of these guidelines are to be elaborated in the *Implementer's Toolkit*.

11 Approach paper: <https://indo-germanbiodiversity.com/pdf/publication/publication19-04-2021-1618808050.pdf>

ANNEXE 1

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