



ex-situ

Quarterly Edition

October, 2025 to December 2025 Volume 6 Issue 4



Central Zoo Authority
केन्द्रीय चिड़ियाघर प्राधिकरण



Ministry of Environment Forest
and Climate Change



"Securing Species: Ex-Situ Actions for Conservation"

Securing Species: Ex-Situ Actions for Conservation

Dr. Brij Kishor Gupta, Director and Dr. Prudhvi Raj Gunturu, Compliance Officer

GZRRC-VANTARA, Jamnagar

Ex-situ conservation encompasses the scientific management of species outside their natural habitats with the objective of preventing extinction, maintaining genetic diversity, and supporting population recovery. In India, zoological institutions are regulated by the Central Zoo Authority, which over the years have transitioned from traditional display facilities to integrated conservation centres that actively contribute to biodiversity preservation. These institutions operate with national and global conservation frameworks established by organisations such as the Ministry of Environment, Forest and Climate Change, Government of India, International Union for Conservation of Nature, CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora), etc. ensuring that ex-situ interventions are aligned with international standards and complement in-situ conservation strategies.

Contemporary ex-situ approaches in India are multifaceted and include conservation breeding programmes, rescue and rehabilitation of displaced wildlife, genetic resource banking, and reintroduction initiatives. Collectively, these interventions function as a critical safety net for species threatened by habitat loss, illegal wildlife trade, and human-wildlife conflict, while also generating scientific knowledge that supports long-term conservation planning. Zoological institutions across India play a central role in maintaining assurance populations of threatened species through coordinated breeding and management programmes. Notable examples include the conservation of the Asiatic lion at Sakkarbaug Zoological Garden, Red panda breeding initiatives at Padmaja Naidu Himalayan Zoological Park, Indian spotted chevrotain breeding programme at Nehru Zoological Park, Red-crowned Roofed Turtle and Northern River Terrapin at Madras Crocodile Bank Trust, Breeding of various species of South Asian Vultures at Jatayu Conservation and Breeding Centre, Pygmy hog breeding at the Pygmy Hog Breeding Centre in Basistha, Guwahati, Pangolins and Gharials at Nandankanan Zoological Park, Bhubaneswar, One-horned rhinoceros at Sanjay Gandhi Biological Park, Patna etc. These programmes are supported by structured genetic management systems, including studbooks and species management plans, which ensure demographic stability and minimize inbreeding across institutions.

Ex-situ conservation efforts are further strengthened by advances in genetic and reproductive sciences. Institutions such as the Laboratory for the Conservation of Endangered Species, Centre for Cellular and Molecular Biology play a pivotal role in supporting

conservation breeding through molecular genetics, assisted reproductive technologies, and biobanking. The development of “frozen zoo” facilities such as those at Padmaja Naidu Himalayan Zoological Park in collaboration with CCMB enables long-term preservation of genetic material, including DNA, gametes, and tissues, thereby safeguarding evolutionary potential and facilitating future species recovery efforts.

Within this national framework, the Greens Zoological Rescue and Rehabilitation Centre (GZRRC) represents a distinctive model of ex-situ conservation, characterized by its strong emphasis on rescue-driven intake, large-scale rehabilitation, and long-term management of confiscated and displaced wildlife. Unlike conventional zoos, such rescue-oriented facilities contribute not only to population management but also to addressing the immediate impacts of anthropogenic pressures on wildlife. Building on this national momentum, GZRRC is well-positioned to contribute to emerging genetic conservation initiatives through its extensive and taxonomically diverse rescued populations. Such facilities have the potential to integrate rehabilitation, genetic resource banking, and conservation breeding into a unified framework, enhancing their role in long-term species security.

Rescue and Rehabilitation: Foundation of Ex-Situ Conservation

A defining component of ex-situ conservation in India is the structured rescue and rehabilitation of wildlife affected by anthropogenic pressures. Animals admitted into zoological facilities typically originate from illegal wildlife trade, human-wildlife conflict situations, habitat degradation, or institutional transfers arising from resource constraints. Upon intake, individuals undergo systematic evaluation protocols, including legal documentation, quarantine, disease screening, and clinical assessment, ensuring both individual welfare and population-level biosecurity. Rehabilitation strategies are tailored to species-specific ecological and behavioural requirements and include veterinary care, nutritional stabilization, environmental enrichment, and behavioural conditioning aimed at reducing stress and minimizing human imprinting.

In this context, GZRRC functions as a major wild animal rescue facility, equipped to handle large-scale intake and complex cases involving multiple taxa. Its integrated approach combining critical care, behavioural recovery, and long-term welfare management illustrates the

evolving role of rescue centres as essential components of conservation infrastructure rather than merely holding facilities. Consequently, ex-situ institutions must adopt dual management pathways, wherein animals are either prepared for reintroduction or incorporated into lifetime care and conservation breeding programmes. This approach ensures optimal utilization of rescued individuals within broader conservation objectives.

Conservation Breeding and Genetic Management

Conservation breeding programmes in Indian zoos are designed to maintain genetically viable populations of threatened species through scientifically coordinated management. These programmes rely on studbooks, demographic analyses, and inter-institutional transfers guided by the Central Zoo Authority, ensuring long-term population sustainability and minimizing inbreeding. Advances in conservation genetics have significantly strengthened these efforts through the integration of molecular tools, genome resource banking, and assisted reproductive technologies. Institutions such as the Laboratory for the Conservation of Endangered Species and the Centre for Cellular and Molecular Biology play a pivotal role in this domain, supporting species recovery through genetic characterization, biobanking, and reproductive interventions.

A key development within ex-situ conservation is the establishment of “frozen zoo” facilities, which enable the long-term preservation of genetic material including DNA, gametes, embryos, and somatic tissues under ultra-low temperature conditions. In India, such initiatives have already been operationalized at Padmaja Naidu Himalayan Zoological Park in collaboration with CCMB, representing a significant advancement in safeguarding genetic diversity beyond living populations.

Building upon this national framework, the Greens Zoological Rescue and Rehabilitation Centre (GZRRC) is uniquely positioned to develop one of the most comprehensive integrated frozen zoo and genetic resource banking facilities in the country. Given its access to a large and taxonomically diverse pool of rescued and confiscated wildlife often representing multiple geographic lineages GZRRC offers a rare opportunity to capture and preserve genetic diversity that may otherwise be irretrievably lost from wild populations.

The establishment of a frozen zoo at GZRRC would enable:

- Long-term genetic archiving of threatened and confiscated species
- Support for assisted reproductive technologies, including artificial insemination and in vitro fertilization

- Genetic rescue of small or fragmented populations through future reintroduction of genetic material
- Integration with national and global biobanking networks, strengthening collaborative conservation efforts

Importantly, the integration of genetic resource banking with ongoing rescue, rehabilitation, and conservation breeding programmes at GZRRC represents a holistic conservation model, where immediate animal welfare interventions are directly linked to long-term species survival strategies. Such an approach not only enhances the conservation value of rescued individuals but also positions GZRRC as a potential national hub for genetic conservation, complementing existing institutional capacities and contributing to the development of a coordinated, forward-looking ex-situ conservation framework in India.

Reintroduction and Release: Bridging Ex-Situ and In-Situ Conservation

Reintroduction and release programmes represent a critical interface between ex-situ and in-situ conservation. These initiatives aim to restore viable populations in natural habitats through the strategic release of rehabilitated or captive-bred individuals.

Successful reintroduction requires a rigorous, science-based approach involving:

- Habitat suitability assessments
- Identification and mitigation of threats such as poaching and habitat degradation
- Disease risk analysis
- Behavioural evaluation of candidate individuals
- Post-release monitoring using telemetry and field-based surveys

Zoological institutions contribute to this process through pre-release conditioning, health certification, and fitness assessments. Facilities such as GZRRC play an important role in preparing animals for release by ensuring that individuals exhibit appropriate behavioural competencies and physiological readiness. However, reintroduction is inherently selective and context dependent. Many rescued animals—particularly those that are habituated to humans or have sustained irreversible injuries—may not be suitable for release. In such cases, their continued care within ex-situ systems contributes to conservation through education, research, and genetic management.

Research, Education, and Institutional Contributions

Beyond direct conservation interventions, zoological institutions serve as important centres for scientific research, education, and capacity building. Zoological

facilities in India and globally contribute significantly to advancements in animal health, husbandry practices, and conservation awareness. By generating data on species biology, disease dynamics, nutrition, and behaviour, these institutions provide critical inputs for species recovery programmes and adaptive management strategies. GZRRC, by virtue of managing a high diversity and volume of rescued wildlife, offers valuable insights into real-world conservation challenges, particularly those arising from wildlife trade and human–wildlife interactions.

Challenges and Future Directions

Despite their expanding role, ex-situ conservation programmes face several inherent challenges. Genetic bottlenecks and the risk of inbreeding remain significant concerns, particularly in small or isolated populations. Behavioural modifications associated with captivity may reduce the success of reintroduction efforts, while the long-term maintenance of high-standard facilities requires substantial financial, technical, and human resources. Additionally, the effectiveness of ex-situ interventions is ultimately dependent on conditions in the wild. Persistent threats such as habitat loss, climate change, and illegal wildlife trade can limit the success of

reintroduction programmes and necessitate sustained conservation efforts beyond institutional boundaries. Addressing these challenges requires stronger integration between ex-situ and in-situ strategies, enhanced genetic and ecological planning, and continued collaboration among regulatory bodies and research institutions.

Conclusion

Ex-situ conservation has emerged as a critical component of modern biodiversity conservation, functioning as both a safeguard against species loss and a platform for scientific intervention. Through integrated approaches encompassing rescue, rehabilitation, conservation breeding, and reintroduction, zoological institutions contribute significantly to species recovery and ecosystem resilience.

Facilities such as GZRRC exemplify the evolving paradigm of ex-situ conservation, where large-scale rescue operations are seamlessly integrated with long-term conservation objectives. Moving forward, the continued success of these efforts will depend on their ability to remain scientifically robust, policy-aligned, and closely linked with in-situ conservation initiatives, ensuring a holistic and sustainable approach to securing species for the future.