



National parks of India and their role in in-situ conservation

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Abstract

India's national parks play a vital role in conserving the country's rich biodiversity and safeguarding endangered species. This research paper explores the significance of national parks in India and their role in in-situ conservation efforts. It examines the challenges faced by these protected areas and explores various strategies employed to mitigate threats and enhance conservation outcomes.

The paper begins by providing an overview of India's national park system, highlighting their diverse ecosystems, species richness, and ecological importance. It emphasizes the critical role played by national parks in preserving genetic diversity, protecting endangered species, and maintaining ecological balance.

The research paper identifies key challenges confronting national parks, including human-wildlife conflicts, habitat fragmentation, poaching, and the impacts of climate change. It delves into the complexities of managing these issues and explores the implications for in-situ conservation efforts.

Addressing human-wildlife conflicts emerges as a critical priority, necessitating the implementation of effective mitigation measures and the engagement of local communities. Strategies such as sustainable agriculture practices, alternative livelihood options, and community participation in decision-making processes are highlighted as essential components for minimizing conflicts and fostering support for conservation.

Habitat fragmentation and degradation are identified as significant threats to in-situ conservation. The paper emphasizes the importance of establishing ecological corridors, reforestation, and sustainable land-use practices in mitigating these challenges. Collaboration between park authorities, local communities, and stakeholders is essential for ensuring ecological connectivity and the survival of species. Poaching and illegal wildlife trade remain persistent threats to national parks. The paper emphasizes the importance of robust law enforcement, international collaborations, and awareness-raising efforts to combat these activities. It highlights the need for strengthening anti-poaching measures and providing alternative livelihood options for local communities.

Climate change poses significant challenges to in-situ conservation efforts. The paper underscores the importance of adaptive management strategies, such as identifying climate refugia, implementing habitat restoration measures, and integrating climate change considerations into conservation planning.

Keywords: National parks, in-situ conservation, biodiversity, conservation challenges, community engagement

Introduction

National parks play a vital role in the preservation of biodiversity and the promotion of in-situ conservation efforts. In India, a country renowned for its rich natural heritage, national parks serve as crucial habitats for a diverse range of flora and fauna. These protected areas are designated to conserve the ecological integrity of specific regions and provide a sanctuary for endangered species.

Biodiversity, the variety of life on Earth, is a precious asset that provides numerous ecological, economic, and cultural benefits. However, increasing human activities, habitat destruction, and climate change pose significant threats to biodiversity worldwide. In-situ conservation, the preservation of species and ecosystems within their natural habitats, has emerged as a key approach to safeguarding biodiversity.

The primary objective of this research paper is to explore the role of national parks in India in promoting in-situ conservation. By analyzing the significance, biodiversity, and conservation efforts in these protected areas, we can gain insights into their contributions and identify potential strategies to enhance their effectiveness.

Overview of National Parks in India

A. Definition and Significance of National Parks

National parks are designated areas that are legally protected and managed to preserve natural ecosystems, habitats, and biodiversity. They serve as living laboratories for scientists, naturalists, and conservationists to study and understand the intricacies of nature. National parks are crucial for maintaining ecological balance, protecting endangered species, and ensuring the sustainability of ecosystems.

B. Total Number of National Parks in India

India boasts an extensive network of national parks, reflecting its commitment to environmental conservation. As of 2023, there are 106 national parks in India, covering a combined area of 44378 sq. km. These parks are spread across different states, representing the diverse geographical and ecological landscapes of the country.

C. Distribution of National Parks across Different States

National parks in India are distributed across various states, each with its unique ecological features and biodiversity. Some states, such as Madhya Pradesh, Assam, Uttarakhand, West Bengal are home to several prominent national parks.

For instance, Uttarakhand hosts renowned parks like Jim Corbett National Park, Nanda Devi National Park, and Valley of Flowers National Park. Similarly, Madhya Pradesh is known for Kanha National Park, Bandhavgarh National Park, and Pench National Park. Such distribution ensures the protection of diverse ecosystems and species throughout the country.

Table 1: State wise List of National Parks in India (As on January, 2023)

Name of State	No. of National Parks
Andhra Pradesh	03
Arunachal Pradesh	02
Assam	07
Bihar	01
Chhattisgarh	03
Goa	01
Gujarat	04
Haryana	02
Himachal Pradesh	05
Jharkhand	01
Karnataka	05
Kerala	06
Madhya Pradesh	11
Maharashtra	06
Manipur	02
Meghalaya	02
Mizoram	02
Nagaland	01
Odisha	02
Rajasthan	05
Sikkim	01
Tamil Nadu	05
Telangana	03
Tripura	02
Uttar Pradesh	01
Uttarakhand	06
West Bengal	06
Andaman & Nicobar Islands	06
Jammu & Kashmir	04
Ladakh	01
TOTAL	106

Source: National Wildlife Database Centre, Wildlife Institute of India

D. Brief Description of Notable National Parks in India

Jim Corbett National Park

Located in Uttarakhand, Jim Corbett National Park is India's oldest national park and a haven for wildlife enthusiasts. It spans across the picturesque landscapes of the Himalayan foothills and is famous for its population of Bengal tigers. The park also shelters several endangered species, including the Asian elephant, leopard, and Himalayan black bear (Jhala *et al.* 2020) [2].

Kaziranga National Park

Situated in the northeastern state of Assam, Kaziranga National Park is a UNESCO World Heritage Site and one of the most significant habitats for the Indian one-horned rhinoceros. The park's vast grasslands, wetlands, and dense forests provide a refuge for numerous other species, including tigers, elephants, and water buffaloes (Jhala *et al.* 2020) [2].

Periyar National Park

Nestled in the Western Ghats of Kerala, Periyar National Park is renowned for its scenic beauty and rich biodiversity. The park encompasses the picturesque Periyar Lake and is known for its population of Asian elephants. It is also a critical habitat for the endangered Nilgiri langur, lion-tailed macaque, and great Indian hornbill (Menon *et al.* 2011) [4].

Objectives and Principles of In-situ Conservation

A. Definition and Importance of In-situ Conservation

In-situ conservation refers to the protection, management, and restoration of ecosystems, natural habitats, and species within their original locations. It emphasizes the preservation of biodiversity through the maintenance of functional ecosystems and the ecological processes that sustain them. In-situ conservation is vital for maintaining genetic diversity, evolutionary processes, and ecological resilience.

B. Objectives of In-situ Conservation Efforts

The primary objectives of in-situ conservation efforts in national parks are multifaceted. Firstly, these efforts aim to protect and conserve endangered and threatened species by preserving their natural habitats. By ensuring the survival of key species, in-situ conservation contributes to the overall stability and functioning of ecosystems. Secondly, in-situ conservation aims to maintain genetic diversity within populations, allowing species to adapt to changing environmental conditions and reducing the risk of inbreeding depression. Lastly, in-situ conservation contributes to the preservation of ecosystem services and the cultural heritage associated with natural landscapes.

C. Principles Guiding In-situ Conservation Strategies

Several key principles guide in-situ conservation strategies in national parks. These principles include:

Protected Area Designation: National parks provide legal protection and management frameworks to safeguard ecosystems and species.

Habitat Preservation: Ensuring the conservation of intact habitats and protecting critical ecological niches for target species.

Species-focused Approaches: Implementing species-specific conservation measures tailored to the unique requirements of endangered and threatened species.

Ecosystem-based Management: Considering the interactions and interdependencies between species and their habitats to maintain ecosystem functionality.

Community Engagement: Promoting the involvement of local communities in conservation efforts to foster sustainable livelihoods and garner support for conservation initiatives.

Scientific Research and Monitoring: Conducting systematic studies to monitor species populations, assess threats, and guide conservation actions.

International Collaboration: Collaborating with global conservation organizations and participating in international conservation agreements to address transboundary conservation challenges (Gadgil *et al.* 2020) [3].

Role of National Parks in In-situ Conservation

A. Protected Areas and Their Contribution to In-situ Conservation

National parks serve as key protected areas for in-situ conservation efforts in India. These areas are designated and managed specifically for the conservation of biodiversity, making them important strongholds for endangered species and ecosystems. National parks provide legal protection against activities that may harm or disturb the natural habitats, ensuring the long-term survival of species.

The establishment of national parks fosters a sense of stewardship and responsibility for the conservation of ecosystems. Park authorities enforce regulations and implement management strategies to safeguard habitats and control human activities within these protected areas. This proactive approach to conservation helps prevent habitat loss, poaching, and other threats to biodiversity.

B. Conservation Strategies and Initiatives in National Parks

National parks employ various conservation strategies and initiatives to protect and restore biodiversity. These include habitat restoration, anti-poaching measures, ecological research, and community-based conservation programs.

Habitat restoration efforts aim to rehabilitate degraded areas within national parks, promoting the recovery of ecosystems and the revival of threatened species. This may involve reforestation, removal of invasive species, and the creation of artificial habitats to support the ecological needs of target species.

Anti-poaching measures play a crucial role in curbing illegal hunting and wildlife trafficking within national parks. Park authorities, in collaboration with law enforcement agencies, implement stringent surveillance systems, patrol strategies, and intelligence networks to combat poaching activities. The involvement of local communities in anti-poaching efforts, through community-based patrolling and reporting mechanisms, has proven effective in many national parks (George *et al.* 2019)^[5]

Ecological research conducted within national parks provides valuable insights into species populations, ecological processes, and the impacts of human activities on ecosystems. Scientific studies help guide conservation actions, inform management decisions, and contribute to a better understanding of the intricate relationships within ecosystems.

Community-based conservation programs involve local communities living in and around national parks. These programs promote sustainable livelihoods, raise awareness about the importance of biodiversity, and encourage local participation in conservation activities. By involving communities as stakeholders in conservation efforts, national parks can benefit from their traditional knowledge, enhance social acceptance, and mitigate conflicts between humans and wildlife.

C. Role of National Parks in Preserving Genetic Diversity

Preserving genetic diversity is a crucial aspect of in-situ conservation, as it enables species to adapt to changing environmental conditions and ensures the long-term viability of populations. National parks play a vital role in preserving genetic diversity by providing protected habitats where populations can maintain their genetic integrity.

The geographic isolation and limited human disturbances within national parks reduce the risks of genetic erosion and hybridization with domestic or invasive species. This allows for the preservation of unique genetic lineages and the natural evolutionary processes that shape populations over time.

National parks also facilitate gene flow and genetic exchange among populations through ecological corridors and connectivity. These connections enhance genetic diversity by enabling individuals to disperse, mate, and establish new populations in different areas.

By preserving genetic diversity, national parks contribute to the overall resilience and adaptability of ecosystems, ensuring their ability to withstand environmental changes and ecological disturbances (Gadgil *et al.* 2020)^[3].

D. Success Stories of In-situ Conservation in Indian National Parks

Indian national parks have witnessed notable success stories in in-situ conservation efforts. One such example is the revival of the Indian tiger population. Through concerted efforts in tiger conservation, including strict anti-poaching measures, habitat protection, and community engagement, several national parks have witnessed an increase in tiger numbers. The success of projects like "Project Tiger" has demonstrated the positive impact of in-situ conservation strategies in safeguarding endangered species.

Another success story lies in the recovery of the Indian rhinoceros population in Kaziranga National Park. Rigorous anti-poaching measures, habitat management, and strong law enforcement have contributed to a significant increase in the rhinoceros population, reflecting the effectiveness of in-situ conservation initiatives.

These success stories highlight the importance of national parks as effective tools for in-situ conservation, demonstrating that dedicated efforts can reverse population declines and restore threatened species.

Challenges and Threats to In-situ Conservation in National Parks

Despite the critical role national parks play in in-situ conservation, they face numerous challenges and threats that hinder their effectiveness.

A. Human-Wildlife Conflicts and Their Impact on Conservation Efforts

Human-wildlife conflicts arise when there is a clash between the needs and activities of local communities and the conservation objectives of national parks. Encroachment of human settlements into the periphery of national parks can result in conflicts such as crop raiding, livestock depredation, and even attacks on humans by wildlife. These conflicts lead to negative perceptions of wildlife and can undermine support for conservation efforts.

Addressing human-wildlife conflicts requires a multi-pronged approach, including implementing effective mitigation measures, enhancing livelihood opportunities for local communities, and fostering community participation in decision-making processes. Promoting sustainable agriculture practices, providing alternative income sources, and implementing early-warning systems can help minimize conflicts and garner local support for conservation (Sekar *et al.* 2019)^[8].

B. Habitat Fragmentation and Degradation

Habitat fragmentation and degradation pose significant threats to in-situ conservation in national parks. The expansion of human activities, including infrastructure development, agriculture, and resource extraction, often results in the fragmentation of natural habitats and the loss of connectivity between populations.

Fragmentation hinders the movement of wildlife, disrupts ecological processes, and increases the vulnerability of species to genetic isolation and reduced population viability. Degradation of habitats through deforestation, pollution, and invasive species further exacerbates the challenges faced by national parks.

To highlight the magnitude of habitat fragmentation and degradation, Table 2 presents data on the extent of habitat loss and the number of fragmented habitats in selected national parks in India.

Table 2: Extent of Habitat Fragmentation and Degradation in Selected National Parks

National Park	Total Area (sq. km)	Habitat Loss (%)	Fragmented Habitats
Ranthambore	392	21.8	9
Bandipur	874	15.2	12
Sundarbans	1,330	31.5	7
Kaziranga	858	12.6	5

(Gadgil, M., & Meher-Homji, V. M. 2020) [3]

The data in Table 2 reveals the varying degrees of habitat loss and fragmentation in different national parks. Ranthambore, for instance, has experienced a habitat loss of 21.8%, resulting in the fragmentation of nine habitats within the park. Similarly, Bandipur has encountered a habitat loss of 15.2% and exhibits 12 fragmented habitats.

These numbers emphasize the urgent need to address habitat fragmentation and degradation in national parks. Establishing ecological corridors, reforesting degraded areas, and implementing sustainable land-use practices are essential steps to mitigate the impacts of fragmentation and ensure the ecological connectivity necessary for species survival.

C. Poaching and Illegal Wildlife Trade

Poaching and illegal wildlife trade pose significant threats to the conservation of endangered species in national parks. These activities not only impact the targeted species but also disrupt ecological balance and undermine conservation efforts.

To illustrate the scale of poaching and illegal wildlife trade, Table 3 presents data on wildlife crime incidents and seizures in selected national parks in India

Table 3: Wildlife Crime Incidents and Seizures in Selected National Parks

National Park	Wildlife Crime Incidents (Yearly Average)	Seizures
Kaziranga	57	82
Jim Corbett	34	49
Bandhavgarh	21	39
Periyar	15	27

(Sekar, A., Sukumar, R., & Cowlshaw, G. 2019) [8]

The data in Table 3 highlights the frequency of wildlife crime incidents and the number of seizures in different

national parks. Kaziranga, for example, witnesses an average of 57 wildlife crime incidents per year, leading to 82 seizures. Jim Corbett National Park and Bandhavgarh National Park also face a substantial number of incidents and seizures. These numbers underscore the need for enhanced anti-poaching measures, robust law enforcement, and international collaborations to combat poaching and illegal wildlife trade. It is crucial to strengthen the monitoring and surveillance systems in national parks and implement strict penalties for wildlife crimes.

D. Climate Change and Its Impacts on National Parks

Climate change poses significant challenges to in-situ conservation efforts in national parks. Rising temperatures, changing rainfall patterns, and extreme weather events can disrupt ecosystems, alter species' distributions, and affect the availability of critical resources.

To mitigate the impacts of climate change, national parks need to implement adaptive management strategies. This may include the identification of climate refugia within parks, implementing habitat restoration measures that enhance resilience, and incorporating climate change considerations into conservation planning.

Furthermore, national parks can contribute to climate change mitigation by preserving carbon-rich habitats, promoting sustainable tourism practices, and engaging in ecosystem restoration projects (Kushwaha *et al.* 2017) [6]

Measures to Enhance In-situ Conservation Efforts in National Parks

A. Strengthening Protected Area Management

Enhancing the management of national parks is crucial for improving in-situ conservation efforts. This can be achieved through the following measures:

Capacity Building: Providing training and capacity-building programs for park staff and local communities to enhance their skills in conservation, monitoring, and law enforcement. This includes training in wildlife management, ecological research techniques, community engagement, and sustainable tourism practices.

Adequate Resources and Infrastructure: Allocating sufficient financial resources and infrastructure to national parks to support effective management. This includes funding for equipment, facilities, research initiatives, and the recruitment and training of additional park staff.

Integrated Management Plans: Developing comprehensive management plans for national parks that integrate conservation objectives with sustainable development goals. These plans should consider ecological requirements, human-wildlife interactions, and the needs of local communities.

Collaborative Partnerships: Fostering collaborations between national park authorities, scientific institutions, local communities, NGOs, and international organizations. These partnerships can leverage expertise, resources, and knowledge sharing to enhance conservation initiatives.

B. Community Engagement and Sustainable Livelihoods

Involving local communities in conservation efforts is crucial for the success of in-situ conservation in national parks. The following measures can promote community engagement and sustainable livelihoods:

Community-based Conservation Programs: Establishing community-based conservation programs that empower

local communities to actively participate in decision-making processes and benefit from conservation initiatives. This can include providing alternative income-generating opportunities, such as eco-tourism, handicrafts, and sustainable agriculture practices (Singh *et al.* 2016)^[9].

Education and Awareness: Conducting educational programs to raise awareness among local communities about the importance of biodiversity conservation and the role they can play in protecting their natural heritage. This can be achieved through school outreach programs, workshops, and campaigns that promote environmental education and sustainable lifestyles.

Benefit-sharing Mechanisms: Developing benefit-sharing mechanisms that ensure local communities receive equitable benefits from conservation efforts. This can involve revenue-sharing arrangements, employment opportunities, and capacity-building initiatives that enable communities to actively participate in eco-tourism and other sustainable practices (Singh *et al.* 2016)^[9].

Traditional Knowledge Integration: Recognizing and integrating traditional knowledge and practices of local communities into conservation strategies. Traditional ecological knowledge can provide valuable insights into local biodiversity, sustainable resource management, and ecosystem dynamics.

C. Conservation-oriented Research and Monitoring

Scientific research and monitoring play a crucial role in informing conservation actions and measuring the effectiveness of in-situ conservation efforts. The following measures can enhance research and monitoring initiatives:

Long-term Ecological Research: Conducting long-term ecological research within national parks to understand species dynamics, population trends, and ecosystem processes. This can involve studies on habitat requirements, breeding behavior, species interactions, and the impacts of environmental changes.

Biodiversity Monitoring: Implementing systematic biodiversity monitoring programs to assess species populations, identify threats, and track conservation outcomes. This can include the use of remote sensing, camera traps, acoustic monitoring, and DNA analysis to gather data on species distributions, abundance, and genetic diversity (Menon *et al.* 1998)^[7]

Conservation Genetics: Incorporating genetic analyses into conservation efforts to assess population connectivity, identify genetically distinct populations, and inform translocation and reintroduction programs. Genetic studies can help identify key conservation units and develop effective strategies for maintaining genetic diversity.

Data Sharing and Collaboration: Encouraging data sharing and collaboration among researchers, park authorities, and other stakeholders to facilitate knowledge exchange and enhance conservation efforts. This can involve establishing data repositories, fostering partnerships, and promoting open-access publications to ensure that research findings are widely available for conservation planning and decision-making.

Successes and Case Studies in In-situ Conservation

Several national parks in India have achieved remarkable successes in in-situ conservation. Here are a few notable case studies:

A. Periyar National Park

Periyar National Park in Kerala is renowned for its successful conservation efforts, particularly in protecting the endangered species of the Western Ghats. The park is home to the Nilgiri langur and lion-tailed macaque, both of which have shown significant population recoveries due to effective anti-poaching measures and habitat conservation initiatives. Periyar National Park also engages local communities through eco-development programs, providing alternative livelihood options and creating a sense of ownership and responsibility towards conservation.

B. Corbett Tiger Reserve

Corbett Tiger Reserve in Uttarakhand has been instrumental in the conservation of the Bengal tiger. Through dedicated anti-poaching efforts, habitat protection, and community involvement, the reserve has witnessed a consistent increase in tiger populations. Corbett Tiger Reserve has also implemented innovative technologies such as camera traps and satellite tracking to monitor tiger movements and gain insights into their behavior and conservation needs.

C. Kanha National Park

Kanha National Park in Madhya Pradesh has made significant strides in conserving the iconic Royal Bengal tiger and the vulnerable barasingha (swamp deer). By implementing stringent anti-poaching measures, restoring critical habitats, and involving local communities in conservation activities, the park has witnessed a substantial increase in tiger and barasingha populations. Kanha National Park has also been at the forefront of research and monitoring, contributing valuable data on species ecology and management strategies.

These success stories highlight the importance of a holistic approach that combines effective management, community engagement, and scientific research to achieve positive conservation outcomes.

Conclusion

Indian national parks play a pivotal role in in-situ conservation by protecting diverse ecosystems, harboring endangered species, and preserving genetic diversity. Through effective management strategies, community engagement, and scientific research, national parks can enhance their conservation efforts and mitigate the challenges they face, such as human-wildlife conflicts, habitat degradation, poaching, and climate change. No bird or mammal is known to have been lost from India since the cheetah (*Acinonyx jubatus*) was extirpated in the mid-20th century (Divyabhanusinh, 1999)^[1]. Protected areas have clearly played a significant role in conservation of wild animals.

To ensure the long-term success of in-situ conservation in national parks, it is essential to strengthen protected area management, engage local communities as active stakeholders, and promote sustainable livelihoods. Conservation-oriented research and monitoring efforts provide valuable insights that inform decision-making and enable adaptive management practices.

With concerted efforts and collaborations among various stakeholders, national parks in India can continue to serve as invaluable repositories of biodiversity, contributing to the preservation of India's natural heritage for future generations.

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