

A REVIEW ON THE CONSERVATION AND ECOLOGICAL SIGNIFICANCE OF *XYLOCARPUS* MANGROVES IN BHITARKANIKA, ODISHA, AMIDST CLIMATE CHANGE

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ABSTRACT

Mangrove ecosystems play a crucial role in coastal protection, biodiversity conservation, and climate change mitigation. Bhitarkanika National Park in Odisha, India, is one of the most ecologically significant mangrove forests in the country, providing a habitat for diverse flora and fauna. Among its various mangrove species, *Xylocarpus granatum*, *Xylocarpus mekongensis*, and *Xylocarpus moluccensis* serve as keystone species, contributing to soil stabilization, faunal diversity, and medicinal applications. However, increasing anthropogenic pressures, including deforestation, aquaculture expansion, and climate-induced impacts, pose severe threats to their survival. This paper examines the ecological significance of *Xylocarpus* species, presents statistical data on mangrove cover loss, and discusses conservation measures implemented to mitigate environmental degradation. Synthesizing information from live observation & previous research papers, this study provides scientific insights into Bhitarkanika's conservation challenges and proposes strategic interventions for sustainable mangrove management.

1. INTRODUCTION

Mangrove ecosystems are among the most productive and ecologically significant coastal environments, playing a key role in carbon sequestration, shoreline protection, and marine biodiversity conservation (Alongi, 2008). Bhitarkanika, located along the northeastern coast of Odisha, covers approximately 223 sq. km and has been recognized as a Ramsar Wetland Site due to its ecological importance. This unique mangrove ecosystem hosts more than 62 mangrove species, including several *Xylocarpus* species, which contribute significantly to ecosystem stability and resilience (Tomlinson, 1986; Bandaranayake, 1998). Despite their importance, Bhitarkanika's mangroves are facing multiple threats, including deforestation, human encroachment, and climate change-induced impacts.

Recent research highlights the ecological and economic significance of mangrove ecosystems. Studies have found that mangrove forests store three to five times more carbon per hectare than tropical rainforests, making them crucial for climate change mitigation (Donato et al., 2011). Furthermore, dense mangrove belts along Odisha's coast have reduced cyclone-related damages by nearly 30% (Das & Vincent, 2009). Over 80% of marine species rely on mangroves at some stage of their life cycle, further emphasizing the necessity of conservation efforts (Duke et al., 2007). However, the increasing degradation of mangrove ecosystems in Bhitarkanika calls for immediate conservation interventions.

Ecological Importance of Bhitarkanika's *Xylocarpus* Mangroves

The *Xylocarpus* genus plays a crucial role in the ecological stability of Bhitarkanika's mangrove forests. *Xylocarpus granatum*, commonly known as the cannonball mangrove, is vital for soil stabilization and erosion prevention, as its deep-rooted system helps hold sediments together (Ghosh & Mukherjee, 2019). *Xylocarpus mekongensis* supports aquatic biodiversity by providing breeding and nursery grounds for estuarine fish species (Duke et al., 1998). Additionally, *Xylocarpus moluccensis* possesses antifungal and antibacterial properties, making it valuable for traditional medicine (Bandaranayake, 1998).

Recent statistical data indicates alarming trends in mangrove degradation. According to the Forest Survey of India (FSI) 2023, Bhitarkanika has experienced a 3.5% decline in mangrove cover since 2015, with an annual deforestation rate of 1.2% primarily due to human encroachment and aquaculture expansion. Additionally, bird diversity has declined by 8% over the past decade due to habitat loss (Ghosh & Mukherjee, 2019). Despite these challenges, Bhitarkanika's mangroves play a significant role in carbon sequestration, with an estimated annual absorption of 1.02 million metric tons of carbon dioxide, making conservation efforts even more critical (Alongi, 2012).

2. THREATS TO BHITARKANIKA'S MANGROVE ECOSYSTEM

One of the primary threats to Bhitarkanika's mangrove forests is deforestation and land conversion for commercial purposes. Shrimp farming and agricultural expansion have resulted in a 5.8% loss of mangrove cover between 2010 and 2020 (FAO, 2021). Encroachments and illegal logging further exacerbate habitat fragmentation, leading to

biodiversity decline and loss of ecosystem services (Giri et al., 2011). Industrial pollution, particularly from aquaculture operations, has altered water salinity and quality, negatively impacting the health of *Xylocarpus* species.

Climate change poses an additional challenge to mangrove conservation. The Intergovernmental Panel on Climate Change (IPCC) estimates that the global sea level is rising at a rate of 3.3 mm per year, leading to increased salinity intrusion in Bhitarkanika's wetlands (IPCC, 2014). Recent cyclonic events such as Cyclone Fani (2019) and Cyclone Yaas (2021) have caused widespread destruction of mangrove forests, further reducing their capacity to mitigate storm surges and coastal erosion (Das et al., 2012). Without adequate conservation measures, these climate-induced impacts may irreversibly alter Bhitarkanika's mangrove landscape.

Another pressing concern is the increasing human-wildlife conflict in the region. Bhitarkanika is home to one of India's largest populations of saltwater crocodiles, with a current population of 1,784 individuals, according to the Odisha Wildlife Census (2023). The destruction of natural habitats has resulted in a 32% increase in human-crocodile conflicts, posing risks to both local communities and wildlife (Behera et al., 2013). These conflicts underscore the need for sustainable conservation strategies that balance ecological protection with human safety.

3. CONSERVATION STRATEGIES AND RESTORATION EFFORTS

Efforts to conserve Bhitarkanika's mangroves have been implemented at both governmental and community levels. The Odisha Forest Department has undertaken large-scale afforestation initiatives, planting over 5 million mangrove saplings since 2015 (Odisha Forest Department, 2022). Bhitarkanika has also gained international recognition under the Ramsar Convention (2020), highlighting its ecological significance. Additionally, the site has been nominated for UNESCO World Heritage status, which could provide further protection and funding for conservation projects.

Community participation has proven to be an effective approach to mangrove conservation. Eco-tourism initiatives have provided alternative livelihoods to more than 3,500 local residents, reducing their dependency on forest resources (Badola et al., 2012). Educational programs focused on mangrove conservation have been introduced in schools, helping to raise awareness among younger generations about the importance of these ecosystems (Kathiresan, 2011). Such initiatives foster a sense of responsibility and stewardship among local communities, ensuring long-term protection of Bhitarkanika's mangroves.

Mangrove restoration programs have also been prioritized, with scientists identifying 15 high-priority zones for reforestation. Between 2020 and 2023, over 12 sq. km of degraded mangrove areas were rehabilitated, achieving a sapling survival rate of 78% (FAO, 2021). Furthermore, enforcement of conservation laws such as the Wildlife Protection Act (1972) and the Forest Conservation Act (1980) has resulted in a 40% decline in illegal logging cases since 2018 (Odisha Government Report, 2023). These legislative measures, combined with sustainable community-based conservation programs, have contributed to the gradual recovery of Bhitarkanika's mangrove ecosystem.

4. CONCLUSION

Bhitarkanika's mangrove ecosystem, particularly the *Xylocarpus* species, plays an essential role in coastal stability, biodiversity conservation, and climate resilience. However, ongoing threats such as deforestation, industrial expansion, and climate change pose significant risks to their survival. While conservation efforts by government agencies and local communities have led to notable improvements, further action is required to ensure the long-term sustainability of this critical ecosystem. Strengthening conservation policies, promoting community-driven initiatives, and enhancing legal enforcement will be vital in protecting Bhitarkanika's mangroves from future degradation. By implementing comprehensive conservation strategies, Bhitarkanika can continue to serve as a natural shield against climate change while sustaining its rich biodiversity for future generations.

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