

The Green Dilemma: Conservation Challenges in the Western Ghats

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The Western Ghats, a UNESCO World Heritage Site and one of the world's most biologically diverse regions, face an array of conservation challenges stemming from anthropogenic activities and climate change. This chapter delves into the multifaceted nature of these challenges, encompassing habitat loss, livestock grazing, human-animal conflict, extraction of forest products, mining, deforestation, hunting, climate change impacts, and the complexities of effective management. Drawing from a synthesis of current research, reports, and on-the-ground observations, this chapter provides a comprehensive analysis of the conservation challenges confronting the Western Ghats. It explores the intricate interplay between human activities and ecological dynamics, shedding light on the urgent need for collaborative and adaptive conservation strategies to safeguard the ecological integrity and biodiversity of this globally significant landscape. Through a detailed examination of each challenge, this chapter aims to inform policymakers, conservation practitioners, and stakeholders about the critical issues at hand, ultimately advocating for proactive measures to address these challenges and ensure the long-term resilience of the Western Ghats' ecosystems.

Keywords: Western Ghats, Conservation, Biodiversity, Habitat loss, Deforestation, Mining.

1. Introduction

The Western Ghats, often referred to as the Sahyadri Mountains, form a majestic and ecologically vital range that spans the western coast of India (Viju, 2019). This expansive

geographical feature encompasses a diverse mosaic of ecosystems, ranging from lush tropical forests and wetlands to high-altitude grasslands and montane forests (Chakraborty et al., 2023). Renowned for its exceptional biodiversity, the Western Ghats is internationally recognized as one of the planet's eight hottest biodiversity hotspots, teeming with a remarkable variety of plant and animal life found nowhere else on Earth. The biodiversity of the Western Ghats is unrivalled, boasting an extraordinary array of endemic species uniquely adapted to its diverse habitats. This region serves as a refuge for numerous plant and animal species, many of which are found in highly localized pockets within the Ghats' rugged terrain (Gunawardene et al., 2007). From the iconic Bengal tiger and Indian elephant to the elusive lion-tailed macaque and the vibrant Malabar trogon, the Western Ghats harbour an astounding richness of life that underscores its global significance in terms of biodiversity conservation (Das et al., 2006). Despite its ecological importance and protected status as a UNESCO World Heritage Site, the Western Ghats face formidable conservation challenges driven primarily by human activities (Sharma et al., 2022). Rampant deforestation, driven by agricultural expansion, urbanization, and infrastructure development, has resulted in extensive habitat loss and fragmentation, threatening the survival of countless species reliant on intact ecosystems (Bralower and Millet, 2021). Additionally, the introduction and proliferation of invasive species further exacerbate ecological imbalances, outcompeting native flora and fauna and disrupting natural ecosystems (Omondi and Merceline, 2023). Moreover, pollution from various sources, including industrial effluents, agricultural runoff, and domestic waste, poses a

significant threat to the Western Ghats' delicate ecosystems. Water bodies are contaminated, air quality is compromised, and crucial habitats are degraded, jeopardizing the health of both wildlife and human communities inhabiting the region (Dinakaran and Anbalagan, 2007). In the face of these mounting challenges, urgent action is needed to address the conservation issues plaguing the Western Ghats. Effective management strategies, informed by scientific research and supported by robust policy frameworks, are essential to mitigate the impacts of human activities and preserve the rich biodiversity and ecological integrity of this invaluable natural treasure.

2. Biodiversity and its richness

The Western Ghats, also known as Sahyadri, stands as a majestic mountain range spanning six Indian states, from Goa to Kanyakumari, and is renowned for its rich biodiversity (Varak, 2023). Originating from Maharashtra and Gujarat, these mountains stretch approximately 1600 km, covering an area of 1,29,037 sq km with an average elevation of 1200 meters according to the Madhav Gadgil report. Hosting an array of flora and fauna, the Western Ghats boasts 7402 species of flowering plants, 1814 species of non-flowering plants, and a diverse range of animal species, including 139 mammals, 508 birds, and 179 amphibians, among others. Notably, it shelters 325 globally threatened species and serves as vital wildlife corridors for flagship conservation projects like Project Elephant and Project Tiger (Amasiddha et al., 2012). With its ecological significance recognized globally, the Western Ghats was declared one of the eight 'hottest hotspots' of biodiversity by UNESCO, leading to the

designation of thirty-nine spots as World Heritage Sites in 2012 (Miltenberger et al., 2018). However, rapid human migration and unsustainable developmental activities have posed grave threats to its delicate ecosystem, resulting in a governmental dilemma (Redford and Fearn, 2007). Two significant reports, led by environmentalists Madhav Gadgil and Dr. Kasturirangan, offered contrasting recommendations to address conservation and developmental concerns. While the Gadgil report proposed stringent measures to protect the region, including declaring it as an Ecologically Sensitive Area and imposing restrictions on dam constructions and mining activities, the Kasturirangan report suggested dilutions to accommodate developmental aspirations. Both reports faced criticism for neglecting the human aspect of the region, sparking public outrage and political opposition. As the government grapples with the complex task of balancing environmental preservation with socioeconomic development, the fate of the Western Ghats hangs in the balance, highlighting the intricate interplay between environmental, social, and political dynamics in decision-making processes (Sheela and James, 2013).

Biodiversity, the diversity of life forms within an ecosystem, encompasses various species of organisms, including plants, animals, and microorganisms, as well as the genes they possess and the ecosystems they form. According to Heywood and Baste (1995), biodiversity is defined as the number, variety, and variability of living organisms in a given ecosystem. However, biodiversity cannot be solely expressed in numbers; it also depends on the ecological structure of an area. Whittaker (1972) identified three types of diversity: alpha, beta, and gamma diversity. Alpha diversity represents

diversity within each geographical group, while beta diversity reflects the proportion of diversity due to differences among geographical populations, and gamma diversity represents the total diversity within plants. Biodiversity can be further categorized into genetic, species, and ecosystem diversity. Genetic diversity refers to the variability in the individuals of a species, characterized by numerous genes that result in differences in genetic makeup among individuals (Mukhopadhyay and Bhattacharjee, 2016). Genetic variability is crucial for a healthy breeding population as it contributes to resistance to disease and parasites and enables flexibility in coping with environmental challenges, ultimately preventing species extinction (Naskar et al., 2012).

Species diversity, on the other hand, pertains to the number of plant and animal species present in a region, known as species richness (Whittaker et al., 2001). Tropical rainforests, for example, support higher species diversity compared to desert ecosystems. Hotspots of biodiversity are areas abundant in species diversity, endemic species, and rare or threatened species (Marchese, 2015). Species diversity is essential for ecosystem functioning as it influences productivity and stability. Ecosystem diversity focuses on the diversity within and between ecosystems, which are the result of various biological, climatic, geological, and chemical factors. Ecosystems such as forests, grasslands, deserts, mountains, and aquatic ecosystems play a crucial role in supporting biodiversity. However, the exploitation or overuse of species within ecosystems can lead to productivity loss and deterioration (Chu, 2020).

The consequences of biodiversity loss are difficult to analyze based solely on genetic or species diversity. Various conservation strategies are necessary to address threats to biodiversity and ensure present and future human well-being. These strategies include habitat preservation, species protection, sustainable resource management, and raising awareness about the importance of biodiversity conservation. Conservation strategies must be implemented on a large scale to address threats and mitigate the impacts of biodiversity loss on ecosystems and human well-being (Rawat and Agarwal, 2015). The biodiversity is facing many threats due to the human encroachment and their activities as well as few natural factors which can be enumerated below

3. Livestock Grazing

Livestock grazing within and bordering protected areas, particularly in the biodiverse ecosystem of the Western Ghats, presents a significant environmental challenge due to its detrimental impact on habitat integrity (Ramachandran et al., 2018). The region's lush forests and diverse wildlife face threats from high densities of cattle and goats, which degrade habitats through overgrazing, soil compaction, and trampling of vegetation (Rawat and Adhikari, 2015). As human populations in the surrounding areas grow, so does the demand for livestock, exacerbating the issue. This increase in livestock densities intensifies the pressure on already fragile ecosystems, leading to a vicious cycle of habitat degradation and biodiversity loss (Wassie, 2020). Furthermore, the rising demand for grazing land often encroaches upon protected areas, sparking conflicts between local villagers, who rely on livestock for their livelihoods, and forest department officials

tasked with conservation efforts. These conflicts arise from competing interests, with villagers seeking to sustain their livelihoods through traditional practices while conservationists strive to protect the fragile ecosystems and biodiversity hotspots of the Western Ghats (Bijoy, 2019). The clash between these interests often results in tense standoffs, hindering effective conservation measures and exacerbating habitat degradation. Such conflicts underscore the urgent need for holistic management strategies that balance the needs of local communities with the imperative of conserving the invaluable ecological resources of the Western Ghats. Collaborative efforts involving stakeholders from government agencies, local communities, and conservation organizations are essential to address this complex issue, ensuring the long-term sustainability of both livelihoods and biodiversity in the region (Jamal and Stronza, 2009).

One of the primary drivers of the conflict is the close relationship between livestock densities and human population growth. As human populations expand in the vicinity of protected areas, the demand for livestock increases to meet the growing needs of communities for food, income, and other resources. This, in turn, leads to a rise in livestock densities, exacerbating the pressure on natural habitats within and around protected areas. Consequently, conflicts between villagers and forest department officials escalate as villagers compete for limited grazing resources and resist efforts to regulate or restrict livestock grazing in protected areas (Herrero et al., 2013). The consequences of unchecked livestock grazing are severe and far-reaching. Habitat degradation not only threatens the survival of numerous plant and animal species but also undermines the ecosystem

services provided by protected areas. Degraded habitats are less resilient to environmental stressors such as climate change, making them more susceptible to further deterioration and loss of biodiversity. Moreover, the conflicts arising from livestock grazing hinder conservation efforts and strain relationships between communities and conservation authorities, complicating the implementation of effective management strategies (Mori et al., 2013).

To address these challenges, it is crucial to adopt a collaborative and participatory approach that engages all stakeholders in finding sustainable solutions. This approach should involve the implementation of community-based conservation initiatives, promotion of alternative livelihood options that reduce dependence on livestock grazing, establishment of clear regulations and enforcement mechanisms, and provision of incentives for sustainable land management practices. By fostering cooperation and mutual understanding among stakeholders, it is possible to mitigate the adverse effects of livestock grazing and ensure the long-term protection of the Western Ghats' unique biodiversity and ecosystems (Dyani et al., 2022).

4. Human- animal Conflict

Human-animal conflicts in the Western Ghats of India present a multifaceted challenge, characterized by the coexistence of diverse wildlife and human populations (Oommen, 2021). The region's rich biodiversity, including species such as elephants and tigers, contributes to a complex dynamic where conflicts arise due to crop and livestock losses. These conflicts arise due to various factors, including the proximity of human

settlements to wildlife reserves, land-use patterns, and agricultural practices prevalent in the region (Thomassen et al., 2011). The unique ecological landscape of the Western Ghats, characterized by its diverse vegetation cover and topographical variations, further complicates the dynamics of human-wildlife conflicts. The dense forests and fragmented habitats provide suitable habitats for wildlife, bringing them into close proximity to human settlements and agricultural lands. This spatial overlap increases the likelihood of conflicts, as wildlife venture into farmlands in search of food or water, resulting in crop depredation and damage to property (Choudhury et al., 2023).

Additionally, socio-economic factors also play a significant role in shaping the vulnerability of communities to wildlife-related losses in the Western Ghats. Household resources, such as land size and economic assets, influence the ability of communities to cope with and recover from conflict incidents. Furthermore, the adoption of mitigation measures, such as installing fencing, guarding livestock, or using deterrents like lighting, can mitigate the risk of conflicts and minimize losses (Rajvanshi et al., 2001). However, the implementation of these measures often depends on the financial resources and awareness levels of local communities. Access to compensation for losses incurred due to wildlife conflicts further adds complexity to the situation, with variations based on factors such as the species involved, the type of conflict, and the ability of households to report incidents. Despite the availability of compensation schemes, challenges associated with timely and equitable distribution often lead to

dissatisfaction among affected communities (Barua et al., 2013).

The Western Ghats of India provide an ideal setting to study the intricate interplay of ecological, social, and economic factors driving human-animal conflicts. Effective management of these conflicts requires a holistic approach that addresses both ecological conservation and socio-economic development goals. By understanding the underlying drivers of conflicts and implementing targeted mitigation strategies, it is possible to promote harmonious coexistence between humans and wildlife while safeguarding livelihoods and biodiversity in the region (Redpath et al., 2013).

5. Deforestation

Deforestation in the Western Ghats, a UNESCO World Heritage Site and one of the world's eight "hottest hotspots" of biological diversity, poses a grave threat to both the environment and human populations reliant on its resources (Kumar, 2019). The Western Ghats, spanning six states in India, harbour a unique and rich biodiversity, encompassing dense forests, diverse flora and fauna, and critical watersheds. However, rampant deforestation driven by various factors including agricultural expansion, logging, infrastructure development, and illegal encroachments is rapidly depleting this invaluable ecosystem (Raman et al., 2009). The conversion of forested lands for agriculture, particularly for cash crops like tea, coffee, and spices, has led to widespread habitat loss and fragmentation, disrupting ecological

processes and threatening numerous endemic species found nowhere else on Earth (Sodhi et al., 2013).

The consequences of deforestation in the Western Ghats are multifaceted and far-reaching. Loss of forest cover not only diminishes the region's biodiversity but also exacerbates climate change by reducing carbon sequestration capacity and altering local weather patterns. Moreover, the disruption of natural habitats increases human-wildlife conflicts as animals are forced to venture into human settlements in search of food and shelter. This poses risks to both wildlife and local communities, leading to conflicts and loss of lives on both sides (Kumar and Srivastava, 2018). The Western Ghats are also crucial for providing ecosystem services such as regulating water flow, soil conservation, and supporting agricultural productivity in the surrounding areas. Deforestation disrupts these services, leading to soil erosion, reduced water availability, and decreased agricultural yields, thereby impacting the livelihoods of millions of people who depend on these resources for their sustenance (Kumar et al., 2022). Efforts to mitigate deforestation in the Western Ghats have been met with various challenges, including inadequate enforcement of environmental regulations, weak governance, and competing interests for land use. Despite the existence of protected areas and conservation initiatives, illegal logging and encroachments continue to persist due to limited resources for monitoring and enforcement (Garcia et al., 2010).

Addressing deforestation in the Western Ghats requires a multifaceted approach that integrates conservation efforts with sustainable development strategies. This entails strengthening

environmental governance, enhancing law enforcement, promoting community-based conservation initiatives, and incentivizing sustainable land management practices among local communities and stakeholders (Kothari et al., 2013). Furthermore, raising awareness about the ecological significance of the Western Ghats and fostering a sense of stewardship among the public is crucial for ensuring the long-term conservation of this unique and irreplaceable ecosystem. Only through concerted efforts and collaboration between governments, civil society, and local communities can we hope to safeguard the Western Ghats for future generations and preserve its invaluable biodiversity and ecosystem services (Naruka and Reddy, 2023).

6. Habitat loss

The Western Ghats, a UNESCO World Heritage Site and one of the world's biodiversity hotspots, faces significant challenges regarding habitat loss, posing a threat to its rich and unique ecosystems (Sharma et al., 2022). Spanning six states along the western coast of India, the Western Ghats are home to a diverse array of flora and fauna, including numerous endemic species found nowhere else on Earth. However, rampant human activities such as deforestation, urbanization, agricultural expansion, and infrastructure development have led to substantial habitat loss and fragmentation within this ecologically sensitive region. Deforestation stands out as one of the primary drivers of habitat loss in the Western Ghats. Historically, large swathes of forest cover have been cleared for timber extraction, agriculture, and settlement expansion, leading to the destruction of critical habitats for numerous plant and animal

species (Viju, 2019). The loss of forest cover not only reduces biodiversity but also disrupts ecological processes, leading to imbalances in local ecosystems. Urbanization and agricultural expansion further exacerbate habitat loss in the Western Ghats. As human populations grow and urban centres expand, natural habitats are converted into residential and commercial areas, resulting in the fragmentation and isolation of remaining forest patches. Similarly, agricultural activities such as plantation farming and monoculture practices lead to the conversion of natural habitats into agricultural landscapes, displacing native flora and fauna and reducing overall biodiversity (Liu et al., 2019).

Infrastructure development, including road construction, dam building, and mining activities, also contributes significantly to habitat loss in the Western Ghats (Mohit and Samant, 2013). The construction of roads and highways through forested areas not only results in direct habitat destruction but also creates barriers that hinder the movement of wildlife and disrupt ecological connectivity (Seiler, 2001). Similarly, the building of dams for hydroelectric projects and mining activities for mineral extraction led to the destruction of natural habitats and the fragmentation of landscapes, further threatening biodiversity in the region (Hughes, 2017).

The cumulative impact of these human activities has led to a severe decline in habitat quality and quantity across the Western Ghats. Fragmentation of habitats, loss of biodiversity, and disruption of ecological processes are some of the adverse effects observed due to habitat loss in this region (Fahrig, 2003). Additionally, habitat loss in the Western Ghats has broader implications for ecosystem services, including water

regulation, soil conservation, and climate regulation, affecting the well-being of both local communities and the broader region (Srivastha et al., 2023).

Addressing habitat loss in the Western Ghats requires concerted efforts aimed at conservation and sustainable land management practices. Strategies such as protected area establishment, habitat restoration, community-based conservation initiatives, and sustainable development planning are essential to mitigate the adverse effects of habitat loss and preserve the unique biodiversity of this ecologically significant region. Moreover, collaborative efforts involving government agencies, conservation organizations, local communities, and other stakeholders are crucial for effective conservation action in the Western Ghats, ensuring the long-term survival of its diverse ecosystems and the species they support (Ghats and Hotspot, 2013).

7. Climate change

Climate change poses a formidable challenge to conservation efforts in the Western Ghats, a UNESCO World Heritage site renowned for its rich biodiversity and unique ecosystems (Kandekar and Srivastava, 2014). The region, characterized by diverse habitats ranging from dense tropical forests to montane grasslands, faces escalating threats from changing climatic conditions. One of the most significant impacts of climate change is the alteration of precipitation patterns, which can lead to shifts in vegetation distribution and changes in ecosystem composition (Grim et al., 2013). This, coupled with rising temperatures, threatens the survival of many endemic species that are adapted to specific climatic

conditions. Habitat fragmentation is another critical issue exacerbated by climate change in the Western Ghats (Bhatt et al., 2018). As temperatures rise and precipitation patterns become erratic, habitats become fragmented, isolating populations and reducing genetic connectivity among species. This fragmentation not only disrupts ecological processes but also increases the vulnerability of species to extinction. Moreover, the Western Ghats are home to numerous endemic species with narrow geographic ranges, making them particularly susceptible to the impacts of habitat fragmentation (Opdam and Wascher, 2004).

Invasive species also pose a significant threat to the biodiversity of the Western Ghats in the context of climate change. As temperatures increase, invasive species from lower altitudes or latitudes may expand their ranges into higher elevations or latitudes, outcompeting native species and disrupting fragile ecosystems. This can lead to the loss of biodiversity and ecosystem services essential for the well-being of local communities dependent on these ecosystems for their livelihoods (Dukes, 2011).

Addressing the impacts of climate change on conservation in the Western Ghats requires a multifaceted approach. Ecosystem-based adaptation strategies, such as habitat restoration and conservation corridors, can enhance the resilience of ecosystems to climate change impacts. Engaging local communities in conservation efforts, promoting sustainable land-use practices, and building community resilience are also crucial components of effective conservation strategies (Naumann et al., 2011). Furthermore, integrating climate change considerations into conservation

policies and management plans is essential to ensure the long-term viability of conservation efforts in the face of changing climatic conditions.

Research and monitoring programs play a vital role in understanding the impacts of climate change on biodiversity and ecosystems in the Western Ghats. By collecting data on species distributions, habitat dynamics, and ecosystem processes, researchers can inform evidence-based conservation decision-making and adaptive management strategies (Gillson et al., 2019). Ultimately, a collaborative approach involving policymakers, scientists, local communities, and civil society organizations is necessary to address the complex challenges posed by climate change and safeguard the biodiversity and ecosystems of the Western Ghats for future generations.

8. Mining

Mining activities in the Western Ghats have had a profound impact on biodiversity conservation in this ecologically sensitive region (Ramachandra et al., 2018). The expansion of mining operations has led to significant habitat destruction, fragmentation, and ecosystem degradation, posing serious threats to the survival of numerous species. One of the primary concerns regarding mining in the Western Ghats is the destruction of natural habitats. Mining activities often involve the clearing of large areas of vegetation, including forests and grasslands, to access mineral deposits (Sonder et al., 2014). This deforestation not only directly eliminates crucial habitat for many species but also disrupts important ecological processes such as nutrient cycling and water

regulation. Additionally, the fragmentation of habitats caused by mining infrastructure further exacerbates the isolation of wildlife populations, leading to reduced genetic diversity and increased vulnerability to extinction (Thatte et al., 2018).

Furthermore, mining operations in the Western Ghats have detrimental effects on freshwater ecosystems. The extraction of minerals often requires the diversion and contamination of water sources, leading to the pollution of rivers, streams, and wetlands. This pollution not only affects aquatic organisms directly but also has cascading impacts on terrestrial species that depend on freshwater resources for survival. Moreover, the disturbance of river systems and sedimentation resulting from mining activities can alter the hydrological regimes of entire watersheds, further disrupting the balance of ecosystems and threatening the survival of aquatic biodiversity (Wolkersdorfer and Mugova, 2021).

The influx of human populations associated with mining activities also poses additional pressures on biodiversity conservation in the Western Ghats (Nagarajan et al., 2015). Rapid urbanization, infrastructure development, and associated activities such as logging and agriculture further encroach upon natural habitats and exacerbate the fragmentation of ecosystems. This human-wildlife interface often leads to conflicts between humans and wildlife, resulting in retaliatory killings, habitat degradation, and disruption of ecological processes (Kumar et al., 2022).

Despite these significant impacts, the regulation and enforcement of environmental laws in the context of mining activities in the Western Ghats have often been inadequate.

Weak governance, corruption, and lack of transparency in decision-making processes have facilitated the unchecked expansion of mining operations, exacerbating environmental degradation and biodiversity loss. Additionally, the socio-economic benefits derived from mining activities often overshadow environmental concerns, leading to a prioritization of short-term economic gains over long-term sustainability (Asuamah, 2023).

The mining activities in the Western Ghats have emerged as a major threat to biodiversity conservation in this globally significant region. The destruction of natural habitats, pollution of freshwater ecosystems, and associated human pressures have led to a decline in species populations and ecological integrity. Urgent measures are needed to address the root causes of environmental degradation, strengthen regulatory mechanisms, and promote sustainable development practices that prioritize biodiversity conservation in the Western Ghats.

9. Extraction of forest products

The Western Ghats, sustains a diverse array of flora and fauna crucial for ecological balance and human well-being. However, the extraction of forest products in this region has raised concerns regarding its adverse effects on biodiversity (Bawa and Seidler, 1998). This report aims to delve into the intricate relationship between forest product extraction and biodiversity loss in the Western Ghats, drawing upon authentic literature. Forests in the Western Ghats harbor a rich diversity of plant species, many of which serve as sources of livelihood for local communities through extraction for timber,

non-timber forest products (NTFPs), and medicinal plants (Alex and Vidyasgaran, 2014). However, indiscriminate and unsustainable extraction practices pose a significant threat to the region's biodiversity. Studies have shown that overexploitation of commercially valuable species such as teak, rosewood, and sandalwood has led to the depletion of these species, disrupting the intricate ecological balance within the forests.

Moreover, the extraction of NTFPs like rattan, bamboo, and medicinal plants has also been identified as a major driver of biodiversity loss. Research indicates that overharvesting of these species not only diminishes their populations but also impacts associated flora and fauna dependent on them for survival (Razal and Guerrero, 2014). For instance, the depletion of bamboo forests affects the habitat of various endemic species like the Malabar giant squirrel and the Nilgiri langur, leading to a decline in their populations. Furthermore, the extraction of medicinal plants, which are integral to traditional healthcare practices in local communities, has raised concerns regarding the loss of genetic diversity and potential extinction of certain species. This is particularly alarming given the role of medicinal plants in providing novel compounds for pharmaceutical research and drug development (Hamilton, 2004).

The consequences of forest product extraction extend beyond direct impacts on plant species to affect the entire ecosystem. Deforestation and habitat degradation resulting from extraction activities fragment habitats, disrupt ecological processes, and escalate the vulnerability of species to extinction. This fragmentation restricts the movement of

wildlife, reduces genetic connectivity, and diminishes species resilience to environmental stressors such as climate change.

The extraction of forest products in the Western Ghats poses a significant threat to biodiversity conservation efforts in the region. Unsustainable extraction practices driven by commercial interests not only deplete valuable plant species but also disrupt entire ecosystems, endangering the survival of numerous endemic species. Addressing this issue necessitates a holistic approach that integrates sustainable forest management practices, community involvement, and stringent conservation policies to safeguard the unique biodiversity of the Western Ghats for future generations.

10. Hydropower projects

The Western Ghats, a biodiversity hotspot in India, is under significant pressure due to various anthropogenic activities, including the development of hydropower projects (Jumani et al., 2013). These projects have been a subject of debate concerning their environmental impact, particularly on the region's rich and diverse flora and fauna. Hydropower projects in the Western Ghats region have led to the alteration of natural water flow patterns, which in turn disrupts the habitat of numerous species. Fragmentation of river systems due to dam construction isolates populations, affecting genetic diversity and potentially leading to the decline of endemic species. For instance, the construction of dams can obstruct fish migration routes, impacting fish populations and the livelihoods of communities dependent on fishing (Naniwadekar and Vasudevan, 2014). Moreover, the flooding of large areas for reservoir creation results in the submergence

of terrestrial ecosystems, leading to habitat loss for various species, including amphibians, reptiles, and mammals. This loss of habitat exacerbates the threat of species extinction, particularly for those with specialized habitat requirements or limited dispersal abilities (Alho and Silha, 2012).

The altered flow regimes downstream of dams also affect riparian vegetation, which plays a crucial role in providing habitat, food, and shelter for diverse aquatic and terrestrial species. Changes in water flow can lead to the loss of riparian vegetation, impacting biodiversity both directly and indirectly through altered ecological processes. Additionally, the construction phase of hydropower projects involves extensive land clearing, which further contributes to habitat destruction and fragmentation. This can lead to increased human-wildlife conflict as displaced wildlife may encroach upon human settlements in search of alternative habitats and resources (Pandit and Grumbine, 2012).

To mitigate the adverse effects of hydropower projects on biodiversity in the Western Ghats, several measures have been proposed. These include the implementation of comprehensive Environmental Impact Assessments (EIAs) to evaluate potential impacts and identify mitigation measures before project approval. Additionally, the adoption of environmentally sustainable practices such as fish ladders and bypass channels can facilitate fish migration and mitigate the impacts of dam construction on aquatic biodiversity.

Furthermore, the conservation and restoration of riparian vegetation through afforestation and restoration initiatives can help maintain ecological connectivity and support biodiversity

conservation in the region. Engaging local communities and stakeholders in conservation efforts and ensuring their participation in decision-making processes regarding hydropower projects can also enhance the effectiveness of biodiversity conservation measures. Hydropower projects in the Western Ghats region have significant implications for biodiversity, leading to habitat loss, fragmentation, and altered ecological processes. However, by implementing rigorous environmental assessments and adopting sustainable practices, it is possible to mitigate these impacts and promote the conservation of biodiversity in this critical ecological hotspot.

11. Hunting

The Western Ghats, face a significant threat from hunting activities. This region, renowned for its rich biological diversity, is home to numerous endemic species of flora and fauna. However, the unchecked practice of hunting poses a severe risk to the delicate ecological balance of this vital ecosystem (Kuriakose and Sebastian, 2016). Hunting in the Western Ghats has a profound impact on biodiversity, affecting various species across different trophic levels. Large mammals such as tigers, leopards, and elephants are targeted for their body parts, which are often traded in illegal wildlife markets. This indiscriminate hunting disrupts the natural predator-prey dynamics, leading to imbalances in the ecosystem. As key species are eliminated or reduced in number, it cascades down the food chain, affecting vegetation and smaller animal populations (Sethi et al., 2019).

Birds, both resident and migratory, are also vulnerable to hunting activities in the Western Ghats. Species like the Great Indian Bustard and the Malabar Grey Hornbill face threats

from poaching for their feathers, meat, or as trophies. The loss of these avian species not only disrupts the intricate web of interactions within the ecosystem but also affects pollination and seed dispersal, ultimately impacting plant diversity (Saha and Mazumdar, 2017). Moreover, the practice of hunting for bushmeat, particularly of smaller mammals like deer, wild boar, and rabbits, has significant ecological ramifications. These animals play crucial roles in seed dispersal and herbivory, influencing vegetation dynamics and forest regeneration. Their decline due to hunting can lead to shifts in plant communities and affect the overall structure and composition of the forest ecosystem (Chardonnet et al., 2002).

Additionally, the use of indiscriminate hunting methods such as snares and traps not only target specific species but also results in the unintended capture of non-target species, including endangered or protected animals. This bycatch further exacerbates the pressure on already vulnerable populations and contributes to the overall decline in biodiversity (Figal et al., 2021). Furthermore, hunting disturbs wildlife behavior and distribution patterns, as animals alter their movements and habitats to avoid human disturbances. This displacement can lead to increased human-wildlife conflicts as animals encroach into human settlements in search of refuge, food, or new territories.

Hunting poses a significant threat to biodiversity in the Western Ghats, jeopardizing the survival of numerous species and disrupting the intricate ecological balance of this unique and ecologically important region. Urgent and concerted efforts are needed to address this issue through effective

enforcement of wildlife protection laws, community-based conservation initiatives, and public awareness campaigns to curb illegal hunting practices and safeguard the biodiversity of the Western Ghats for future generations.

12. Conclusion

The Western Ghats face a myriad of challenges that threaten the delicate balance of its biodiversity. From livestock grazing to mining, deforestation to the extraction of forest products, and the looming impacts of climate change and hydropower projects, these pressures collectively endanger the unique ecosystems and species that call this region home. The urgency of conserving biodiversity in the Western Ghats cannot be overstated. It is not merely a matter of preserving natural beauty or safeguarding wildlife; it is essential for the sustenance of local communities dependent on ecosystem services and for the broader goal of global biodiversity conservation.

Addressing these challenges requires a multifaceted approach that involves policymakers, local communities, conservationists, and various stakeholders. Strategies must be implemented to regulate and mitigate the adverse effects of activities such as livestock grazing and mining, while promoting sustainable practices that prioritize conservation. Furthermore, efforts to minimize human-animal conflicts and adapt to the impacts of climate change are essential for the long-term survival of the Western Ghats' biodiversity. This necessitates robust conservation policies, effective enforcement mechanisms, community engagement, and investment in research and monitoring. Ultimately, the conservation of the Western Ghats' biodiversity is not only a

moral imperative but also crucial for maintaining ecological balance and ensuring the well-being of current and future generations. By acknowledging the challenges and working collaboratively to address them, we can strive towards a future where the rich biodiversity of the Western Ghats is preserved for generations to come.

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