

Review Article

The Role of Biodiversity Conservation and Management in Maintaining Balance of Natural Ecosystem: Review Article

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Abstract

Biodiversity and the ecological environment are two interconnected elements of nature that help sustain the balance of life on Earth through various complex interactions. They are important parts of the natural world and offer many advantages to both people and the environment. Management and conservation of biodiversity involves protecting and maintaining biodiversity to ensure sustainable benefits for both current and future generations. Biodiversity is declining, and there are significant environmental changes occurring due to various human and natural influences. As a result, various significant economic, ethical, and aesthetic benefits have decreased. The primary goal of this review was to comprehend the importance of biodiversity conservation and management in preserving ecosystem balance by examining various research materials. Recent publications were gathered from Google Scholar and the Web of Science, and a systematic review was conducted to explore the topic. Discussions with colleagues and friends were also key methods used in addition to the systematic review. In the next few years, research articles are likely to show a significant increase in the number of threatened species and the seriousness of their extinction risks. Additionally, the connections between sustainability, management, and biodiversity conservation are not yet clearly defined from a research standpoint. It is important for professionals in Ecology, Biodiversity and Conservation, as well as Environmental specialists, to communicate effectively.

Keywords

Biodiversity Management, Ecosystem Balance, Ecosystem Service

1. Introduction

Biodiversity refers to the range of different life forms on Earth, which includes various plants, animals, microorganisms, their genetic material, and the ecosystems they create. It pertains to differences in genetics, ecosystems, the number of species, and cultural aspects within a specific area, biome, or planet. Biodiversity is important for various reasons, including enhancing the beauty of the natural environment, in relation to the variety of habitats, living communities, and ecological processes found in the biosphere. In the context of global en-

vironmental changes, the resilience of ecosystems is essential for the long-term survival of species and the steady provision of ecosystem services. There are concerns about whether managing ecosystems for resilience will effectively contribute to the conservation of biodiversity. Biodiversity, which refers to the variety of living organisms on Earth, is essential for the health and stability of our planet. There is a need to maintain ecosystem services due to the significant environmental changes caused by human activities and various recent shifts in

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ecological systems. In 2009, ecosystem resilience (ER) emerged as a significant topic of discussion in ecological science, conservation management, and policymaking.

Conserving biodiversity is important for preserving ecological balance and securing the long-term survival of different species on the planet. Preserving plant biodiversity is essential for maintaining ecological balance, supporting human livelihoods, and protecting the planet's ability to adapt to environmental changes. The ongoing climate crisis is affecting ecosystems and threatening the balance of biodiversity on the planet. As temperatures increase, severe weather events become more frequent, and ecosystems encounter significant threats, it is essential to prioritize the preservation of biodiversity. Biodiversity is continually changing because of the shifting climate. The planet undergoes different rates of change, resulting in alterations in biological connections and interactions. The balance of life on Earth is closely connected to two important processes: the carbon cycle and the water cycle. Both of these processes are closely linked to the variety of life at genetic, species, and ecosystem levels. The citation refers to a work by [25].

A strong reason for preserving biodiversity is that it is essential for the functioning of ecosystems and the services they provide, which are connected to both biodiversity and sustainability. Ecosystem services are often categorized into different types. Provisioning services are the tangible resources or energy that individuals acquire from ecosystems, including food, water, medicines, and other materials that can generate income. Supporting services are those that contribute to the upkeep and operation of ecosystems, benefiting both natural processes and human requirements. These encompass activities like pollination, helpful insects that eat plant pests, and the improvement of soil quality. Regulating services are the functions of ecosystems that manage or sustain environmental conditions. These include controlling erosion through plants, regulating the climate, managing floods, and purifying air and water. Cultural services offer opportunities for cultural, recreational, and educational activities. The scientific evidence showing increasing rates of extinction, mainly caused by habitat loss, has made the conservation of biodiversity a global priority. This focus on conservation began with the founding of the International Union for Conservation of Nature (IUCN) in 1948.

In its first ten years, IUCN primarily concentrated on studying how human activities affect natural habitats. It acknowledged the harmful impacts of pesticides and other chemicals on biodiversity and encouraged the use of environmental impact assessments for different activities. In the 1960s and 1970s, a significant portion of IUCN's efforts focused on protecting species and their essential habitats. In 1964, the IUCN created the "Red List of Threatened Species," which has since developed into the most extensive database regarding the extinction risk of species worldwide and serves as a key source of information on the conservation status of animals, fungi, and plants.

1.1. Biodiversity and Human Well-being

In addition to its importance for the environment, biodiversity is essential for enhancing human well-being. Biodiverse ecosystems support food security by providing a range of species that help create stable and productive agricultural systems. Medicinal resources obtained from various plant and animal species are the basis for pharmaceuticals that support human health. Biodiversity also adds to cultural and recreational benefits, improving the quality of life for communities globally. Biodiversity supports various economic activities such as agriculture, forestry, fishing, and tourism. Healthy ecosystems offer important resources and services that help sustain livelihoods and promote economic growth.

The decline in biodiversity can lead to a series of impacts on various industries and economies. In [18] published research or findings. Biodiversity has inherent worth, and its protection is connected to moral issues. Numerous cultures and indigenous groups acknowledge the importance of biodiversity in spiritual, aesthetic, and cultural contexts. The extinction of species prompts ethical considerations regarding humanity's duty to protect the planet's biological diversity. People around the world rely on tens of thousands of species for various aspects of their survival. In [27], the authors conducted a study. Therefore, biodiversity conservation should be integrated with the economic and social aspects of sustainability. Successful biodiversity conservation is closely linked to addressing poverty, improving women's health, providing education, and promoting economic participation. According to [17], the global approach to conservation does not always consider the needs of different stakeholder groups. Instead, it views the solution to biodiversity issues as restricting development and resource use, even for those resources that provide income.

This method has been called bio-imperialism, which contrasts with sustainability goals that need bio-democracy [8]. It is important to acknowledge that the growing partnership between biodiversity conservation organizations and the private sector turns biodiversity conservation into a structured political activity, which may prioritize profit for large businesses over the interests of local communities. This may involve significant development projects that pose a risk to biodiversity and restrict income opportunities for local communities. Some people believe that conservation, human rights, and development needs can be at odds with one another. There is a significant need for additional research on effective ways to integrate conservation efforts with poverty reduction. Research priorities should concentrate on exploring how biodiversity can contribute to income generation for stakeholders while maintaining sustainability.

1.2. The Importance of Biodiversity in Ecosystems Service

One of the more convincing arguments for biodiversity preservation is that the maintenance of biodiversity is crucial

for ecosystem function and services that also link biodiversity and sustainability [15]. Ecosystem services are commonly classified into different types. Provisioning services are the useful materials or energy that people acquire from ecosystems, including food, water, medicines, and other resources that can generate income. Supporting services are those that contribute to the maintenance and functioning of ecosystems, which benefit both natural processes and human needs. These consist of activities like pollination, helpful insects that eat plant pests, and the improvement of soil quality. Regulating services are ecosystem functions that manage or sustain environmental conditions. These include actions like preventing soil erosion through plants, regulating climate, controlling floods, and purifying air and water. Cultural services offer opportunities for cultural activities, recreation, and education. These services are important. The worldwide reduction of ecosystem services resulting from land use changes is estimated to be between \$4.3 trillion and \$20.2 trillion per year. Additionally, ecosystem services provide more than twice the benefit to human well-being compared to the global GDP [20].

In agricultural production, the estimated annual value of pollinators is \$400 billion, the value of natural predators in pest management ranges from \$100 to \$200 billion, and nitrogen fixation is valued at \$50 billion [3]. Although the connection between biodiversity and these services is acknowledged, there is still a pressing need for a more detailed examination of how they are related. There is a significant need for scientifically validated information regarding the status, trends, and services of biodiversity, as well as for identifying priorities and recommendations for its protection [13]. A healthy ecosystem relies on the mutual reliance of various species. This indicates that all living organisms are interconnected within a life network and depend on one another for their survival. These links create food webs that illustrate the flow of energy within an ecosystem. Plants serve as food for herbivores such as rabbits, which are subsequently preyed upon by carnivores like foxes. The disappearance of one species could disrupt the entire food web. Biodiversity supports the functioning of ecosystems by offering essential services. It facilitates nutrient cycling, as plants, animals, and microorganisms assist in decomposing dead materials and returning nutrients to the soil, which are then utilized by plants for growth. Insects that pollinate, such as bees and butterflies, assist in the reproduction of plants, which in turn produce food items like fruits and vegetables. Wetlands and forests assist in filtering water, resulting in cleaner and safer drinking water. Ecosystems require a diverse range of species to carry out essential functions in order to offer important services. Maintaining biodiversity is important for the health of ecosystems.

1.3. The Significance of Biodiversity in Maintaining Environmental Balance

Biodiversity enhances the productivity of ecosystems, as every species, regardless of its size, contributes significantly.

A higher number of plant species leads to a wider range of crops. A higher variety of species supports the natural sustainability of all living things. Ecosystems and biodiversity are essential elements of the natural world that humans rely on for survival. Ecosystems and biodiversity are currently facing significant challenges. Human activities like deforestation, habitat loss, and pollution are causing significant damage to ecosystems and reducing biodiversity. Climate change is significantly affecting ecosystems and biodiversity, leading to the risk of extinction for many species because of altered environmental conditions [11].

The decline of ecosystems and biodiversity can greatly affect human well-being. The deterioration of ecosystems can result in a decrease in ecosystem services, limited access to natural resources, and adverse effects on human health and well-being. Additionally, a decline in biodiversity can decrease the resilience and adaptability of ecosystems, increasing their susceptibility to environmental changes. Biodiversity is increasingly seen as a fundamental component of healthy ecosystems [22].

The loss of biodiversity due to human action has the potential to reduce multi factor level interactions [26] and cause different cascade repercussions [25]. Legislatures and international treaties increasingly reflect need to protect biodiversity, with the convention of biological diversity [26] This treaty is the first in international law to highlight the essential role of conserving biodiversity. The European Union (EU) has recently started to highlight the significance of biodiversity, as shown in the EU Biodiversity Strategy, which is a key policy initiative. Additionally, biodiversity is included as one of the indicators of Good Environmental Status in the Marine Strategy Framework Directive [9]. The aim of environmental management is to achieve and maintain a healthy and sustainable ecosystem.

2. Threats to Biodiversity

Currently, as human populations grow and change the natural environment, they are decreasing biological diversity to its lowest point since the end of the Mesozoic era, 65 million years ago [12]. The final effects of this biological clash are unpredictable and likely to be detrimental. This is fundamentally the issue of biodiversity loss. The decline in biodiversity is a significant aspect of environmental change. This is because it is the only process that cannot be reversed. The outcomes are difficult to anticipate, as the worth of the earth's biological diversity, including both animals and plants, has not been thoroughly researched or acknowledged. Each country can be described as having three types of wealth: material, cultural, and biological. The first two have a clear understanding, as they are part of daily life. Biological wealth is not regarded with as much importance. This is a significant strategic mistake that will likely be regretted more as time goes on. The biota is an important aspect of a country's heritage, resulting from millions of years of evolution in that

region. Therefore, it should be regarded with the same level of national interest as language and culture. On the other hand, it is a potential source for immense untapped material wealth in the form of food, medicine and other commercially important substances [6].

The Millennium Ecosystem Assessment report released in [17] proposed that human activities may cause an irreversible loss to biodiversity of Earth. [1] Several reports have identified the rapid effects of climate change as risks to biodiversity, including the Millennium Ecosystem Assessment from [19] and documents from the Secretariat of the Convention on Biological Diversity. [8]; United Nation Environmental Programme, [27] and IUCN report [16]. The IUCN also proposed the classification to biodiversity threats which had been derived with the [24] intention of standardizing nomenclature for threats and facilitating comparisons and generalization of scalable data across ecosystem.

The IUCN classification was developed to identify common threats to biodiversity globally [14]. It also defines threats from non-native species based on the categories of species that have been introduced. It also categorizes introduced genetic material, such as pesticide-resistant crops and genetically modified organisms, as a threat alongside invasive species and other problematic genes. The World Conservation Union and the Conservation Measures Partnership (IUCN CMP) proposed a classification system for the factors that contribute to biodiversity loss. Stress can be described as a negative condition that arises in response to a direct threat. According to [23] and [16] report the biodiversity is facing severe threats from multiple factors that may be anthropogenic and natural.

2.1. Conservation and Management of Biodiversity

Biodiversity refers to the variety of different organisms within a specific ecological setting, such as a habitat, community, landscape, or ecosystem. This refers to both the total number of species and the variety within a species, such as genetic differences or variations between populations. The size of the area is important when assessing biodiversity [4]. One can examine diversity at a specific location, known as alpha diversity, the variations in species composition between different locations, referred to as beta diversity, or the overall diversity of a larger area, which includes the regional species pool and reflects the changes in species from one site to another, termed gamma diversity. Early research on biodiversity primarily focused on taxonomy, which involves discovering, cataloging, classifying, and naming organisms. It also included systematic studies that aim to determine the evolutionary relationships among organisms. The area of systematics has grown quickly due to advancements in molecular genetics methods.

Conservation biology and sustainability have been evolving separately for an extended period. Research indicates that

biodiversity is essential for the functioning of ecosystems and the services they provide to humans. It is also directly related to the economic, social, and environmental aspects of sustainability. The encroachment and fragmentation of habitats are significant causes of biodiversity loss. Human activities, including agricultural expansion, urban development, logging, and the construction of infrastructure, are the main causes of habitat encroachment and fragmentation. These activities alter, fragment, and diminish natural habitats, resulting in a notable reduction in the living space available for different species [23].

This fragmentation separates populations, restricting their capacity to reproduce, find food, and move. The decrease in genetic diversity and resources can result in a decline in species populations, which can further worsen the loss of biodiversity. In addition, fragmented habitats typically cannot sustain species that need large areas or particular conditions to thrive, which further leads to a decrease in biodiversity.

2.2. Basic Principles and Policy Issues in Biodiversity Conservation and Management

The global community is in the midst of a mass extinction event, with human actions to blame [10]. Human activities contribute to major threats of extinction, such as deforestation and habitat destruction, pollution, the introduction of non-native species, and the impacts of climate change, which includes more frequent natural disasters [5]. Law is a key tool for restricting these human behaviors that lead to biodiversity decline and extinction [10], National and local governments worldwide have sought to reduce increasing extinction rates by implementing laws and policies to tackle these issues. Effective biodiversity conservation requires essential principles and management systems within its legal framework.

The main principles are: 1) creating laws that respond to threats, 2) establishing laws that include conservation goals, 3) incorporating transparency and options for independent decision-making and review, 4) developing inclusive laws and legal systems, and 5) ensuring there are effective evaluation and review processes. The management strategies may include: 1) integrating biodiversity and climate change, 2) working with indigenous groups and forming partnerships, 3) establishing protected areas, 4) creating listings and recovery plans, 5) implementing stewardship and private protected areas (PPAs), 6) restoring land, 7) using offsets and no net loss programs, and 8) recognizing the legal rights of nature. Ethiopia has a diverse range of forest biodiversity, including various trees, plants, animals, and many other organisms. The Ethiopian government has issued various proclamations, regulations, directives, policies, strategies, and development frameworks to guide the conservation and sustainable use of biodiversity.

To enhance current efforts, it is important to incorporate biodiversity considerations into forest management. This

ensures that conservation and sustainability are integrated into all levels of decision-making and policy execution. The review of various research studies indicates that a significant portion of the policy framework needed to integrate biodiversity into forest management in Ethiopia is already established. The implementation is still inadequate, showing issues with compliance and alignment [21].

2.3. Strategies for Biodiversity Conservation

Biodiversity conservation strategies include various actions designed to protect and maintain the variety of life on Earth. These strategies are important for protecting ecosystems, species, and genetic diversity, all of which play a role in maintaining the stability and resilience of the planet's natural systems [2]. Here are some approaches related to green initiatives and biodiversity management:

Protected areas are designated locations, including national parks, wildlife reserves, and marine protected areas, that aim to preserve important habitats and offer secure environments for endangered species. *Habitat Restoration* involves repairing and restoring damaged habitats to their original states in order to promote the recovery of biodiversity and improve ecosystem functions. *Sustainable Land Use* involves encouraging agricultural methods that are environmentally friendly, responsible management of forests, and urban planning that takes into account the preservation of biodiversity during development. *Connectivity conservation* involves establishing wildlife corridors and ecological networks to support species movement and preserve genetic diversity, particularly in areas where habitats are fragmented. *Species Conservation*: Implementing targeted efforts to conserve endangered species through captive breeding programs, habitat restoration, and protection from threats like poaching and illegal trade. *Adapting to Climate Change* Incorporating climate change factors into conservation plans to assist ecosystems and species in adjusting to altered climate conditions. *Community Engagement* involving local communities, indigenous peoples, and stakeholders in conservation initiatives to promote their active involvement and backing in safeguarding biodiversity.

Global Cooperation encouraging collaboration among governments, organizations, and individuals to tackle conservation issues that cross national borders. *Sustainable Resource Management* promoting the responsible use of natural resources, such as fisheries and forests, to avoid overuse and preserve ecological balance. *Invasive Species control* involves managing and reducing the effects of non-native species to safeguard local biodiversity and avoid ecological disturbances. Conservation finance involves gathering resources and funding methods to aid projects and initiatives aimed at preserving biodiversity.

The IUCN threat categories classify 'Critically Endangered', 'Endangered', and 'Vulnerable' species as Threatened species. These species are important for humans in various aspects of

life, so it is essential to conserve them. Biodiversity conservation involves using our natural resources wisely to satisfy the needs of the current generation while ensuring that nature remains balanced and these resources are not exhausted for future generations. Conserving biodiversity is important for slowing down the loss of genetic variety within species, protecting ecosystems from damage and deterioration, and preserving our natural resources for the long term. It represents the preservation of ecosystem processes such as biogeochemical cycling and energy flow. Conservation strategies can be divided into two main categories: in-situ conservation and ex-situ conservation, both of which are important [7] It was suggested that both conservation practices be implemented together to protect biodiversity and ensure their availability for future use.

3. Conclusion and Recommendation

Life is the key characteristic of Earth, and the variety of life forms is its most noticeable element. The worry regarding the decline of Earth's biological diversity led to twenty years of extensive research that was highly engaging and important to society. The high level of complexity in ecosystems significantly hinders the foundation of the ecological sustainability model. The limited definitions of ecological sustainability, like ecosystem health, rely on an outdated concept of ecosystems as super organisms, which assumes that all ecosystems are in a state of balance. Recent human-centered approaches, such as the concept of ecosystem integrity, suggest that ecosystems are dynamic and not strictly defined collections of species, requiring flexible management strategies. The significance of a particular species can vary and is influenced by its surroundings, even for species that are considered keystone. Biodiversity helps to protect against changes in environmental conditions and can be viewed as a form of insurance.

4. Recommendation

The following recommendations have been suggested for critical consideration in line of literature review and as an individual perception:

Earth has entered an era of rapidly escalating environmental changes that are being driven by increases in the human population. Many of species are already threatened with extinction worldwide. In the next few years, the number of threatened species and the severity of their extinction risks will rise greatly. Therefore, the policies maker and all the stakeholders should take an instrumental and adaptive action to ensure the survival of biodiversity for future era of environmental change.

The connection between sustainability and the conservation of biodiversity has been slowly growing and until recently has not been well established, particularly from a research per-

spective. In some cases, sustainability objectives have been viewed as incompatible with the priority of conserving of biodiversity. However, there is now a growing body of evidence that the diversity of life is critical for ecosystem function and services on which humans depend, and is directly linked to the economic, social, and environmental spheres of sustainability. For this reason, the more concrete efforts to link biodiversity, conservation, and sustainability should be required, and research on integrating them must be accelerated.

Abbreviations

IUCN	International Union for Conservation of Nature
IPBES	International Panel for Biodiversity and Ecosystem Service
UNEP	United Nation Environmental Protection

Author Contributions

Tekilil Wolde is the sole author. The author read and approved the final manuscript.

Conflicts of Interest

The author declares no conflicts of interest.

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