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Biology and Ecosystem Conservation: The Role of Life Sciences in Addressing the Destruction of Nature

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13 ABSTRACT

This study aims to examine the role of biology in ecosystem conservation and efforts to overcome environmental degradation through an evidence-based scientific approach. The method used is the Systematic Literature Review (SLR), which allows a comprehensive analysis of various relevant previous articles and studies. Literature was collected from leading academic databases, such as Google Scholar, PubMed, ScienceDirect, and JSTOR, with a focus on publications in the last five years that discuss ecosystem conservation, environmental restoration, and the use of biology in environmental conservation. The main keywords used in the search include "biological conservation," "ecosystem restoration," "environmental degradation," and "sustainable ecosystems." The results of the study indicate that biology has a crucial role in ecosystem conservation through a deep understanding of species, ecological interactions, and environmental dynamics. Effective conservation efforts require a holistic approach that integrates science, technology, and active community participation. Thus, to achieve environmental sustainability and reduce the impact of environmental degradation, a collaborative strategy is needed that makes biology the main pillar in ecosystem conservation and restoration efforts.

Keywords: Biology, Ecosystem Conservation, Natural Damage, Conservation

INTRODUCTION

Environmental degradation and ecosystem degradation are serious problems that affect the sustainability of life on Earth. Human activities, such as deforestation, result in the loss of habitat for many species, reduce biodiversity, and disrupt the natural cycles of carbon and water (Missleini, M. 2023). In addition, poaching threatens wildlife populations, especially those that are already endangered, accelerating the loss of important ecosystems. Pollution, whether from plastic waste, chemicals, or greenhouse gas emissions, contaminates air, water, and soil, which in turn impacts the health of humans and other living things. Meanwhile, climate change—triggered by activities such as the burning of fossil fuels and deforestation—exacerbates the frequency of natural disasters, such as floods, droughts, and storms, and damages sensitive ecosystems such as coral reefs and tropical rainforests (Humaida, N. 2024). Efforts to address these issues require global collaboration that includes the use of renewable energy, reforestation of damaged areas, the implementation of strict environmental policies, and increasing public awareness of the importance of maintaining ecosystem balance. With concrete steps and shared commitment, we still have the opportunity to repair and protect the Earth for future generations. The impact of this damage not only threatens plant and animal species, but can also affect the quality of human life, such as through the loss of important natural resources and disruption of ecological systems that support daily life. Therefore, there needs to be a more systematic and science-based approach to



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addressing this problem, especially those related to biology and ecosystem conservation (Rahmah, N. 2023).

Biology plays an important role in supporting ecosystem conservation. As a branch of science that studies life, biology provides an understanding of biodiversity, ecological processes, and the relationships between organisms in an environment (Ninasari, 2023). Through the study of biodiversity, biology helps identify species of living things, including endangered species, and understand their important role in maintaining ecosystem balance. In addition, biology is used to monitor ecosystem health, detect the impacts of human activities, and develop strategies for restoring damaged habitats. Biology-based technologies, such as biotechnology, also offer environmentally friendly solutions, from bioremediation to clean up pollution to the development of sustainable materials. No less important, biology contributes to education and increasing public awareness of the importance of maintaining ecosystems. By applying the principles of biology, humans can create innovative conservation approaches and ensure the sustainability of ecosystems for future generations (Lasaiba, I. (2023).

Through biology, we can identify various types of endangered species and understand their specific roles in the ecosystem. Biology also allows us to study patterns of interactions between species, such as predator-prey relationships, symbiosis, and competition, all of which affect the balance of the ecosystem. In addition, biology provides an understanding of how an ecosystem works as a whole, including energy flow, nutrient cycles, and ecosystem functions. This knowledge forms the basis for designing more effective conservation policies, such as protecting critical habitats and managing species populations. In addition, biology helps restore damaged ecosystems through science-based approaches, such as habitat rehabilitation and species reintroduction. With this strong foundation, mitigating the impacts of natural damage, such as climate change and pollution, can be done in a more targeted and sustainable manner (Lasaiba, I. 2023)

Understanding environmental degradation requires a deeper approach than just visual observation or data reporting. It involves a comprehensive analysis of the interactions between ecosystem components, such as the relationships between living things and their environment, energy flows, and material cycles (Ristiani, R., Ali, A., & Apriyanto, A. 2025). When one component of an ecosystem is disturbed, such as the loss of a key species or a drastic change in the physical environment, it can trigger a domino effect that affects the entire system. For example, deforestation not only reduces the population of certain species but also disrupts the water and carbon cycles, which ultimately worsens climate change. By analyzing the patterns and impacts of these interactions, we can understand the root causes of environmental degradation and develop more effective strategies to prevent or mitigate its impacts. This deep understanding also helps in predicting the long-term consequences of human activities on ecosystems. Biological processes that occur in ecosystems, such as the carbon, nitrogen, and water cycles, play an important role in maintaining the balance and stability of ecosystems. The carbon cycle, for example, regulates the level of carbon dioxide in the atmosphere through photosynthesis, respiration, and decomposition, which has a direct impact on global climate. The nitrogen cycle enables the formation of important compounds such as proteins and nucleic acids, while the water cycle supports life by regulating the distribution of water through precipitation, evapotranspiration, and water flow (Latuconsina, H. 2019).

When one element of an ecosystem, such as a particular flora or fauna, is lost, these natural processes can be disrupted. For example, the loss of forests (deforestation) not only reduces the ability of the ecosystem to absorb carbon but also disrupts the water cycle by reducing the moisture released into the atmosphere. Similarly, the loss of certain

species that play a role in organic decomposition can slow down the recycling of nutrients, thus affecting soil fertility. These disruptions not only impact the ecosystem itself but also human well-being, since many of these biological processes support basic human needs, such as clean air, clean water, and food. Therefore, maintaining the integrity of each element of the ecosystem is essential for the sustainability of life on Earth (Sitorus, IH 2024).

Although biological science plays a very important role in ecosystem conservation, the biggest challenge is how to implement this scientific knowledge into real actions in the field. One of the main obstacles is the limited resources, such as funds, technology, and manpower, needed to run conservation programs in remote areas. In addition, involving local communities in conservation efforts is also not easy, because there needs to be an integration between their scientific knowledge and traditions, as well as an understanding of the importance of such conservation (Arma, OP 2024, December). On the other hand, there is often a conflict between economic interests, such as the expansion of agricultural land or development, and environmental conservation efforts, which makes the implementation of conservation measures more complicated. Limited technology and infrastructure are also obstacles, because many areas do not yet have adequate facilities to monitor ecosystem conditions effectively. Weak supervision and law enforcement in some areas further worsen the situation, because without firm action against environmental violations, conservation efforts will not succeed. In addition, the increasingly real impacts of climate change are also worsening ecosystem conditions, requiring a more adaptive and responsive approach. Therefore, although scientific knowledge about ecosystems is very valuable, its application requires collaboration between scientists, communities, and governments to overcome these challenges (Nugraha, R., et. al. 2024).

Many countries, including Indonesia, still face various challenges in terms of environmental policies, conservation implementation, and sustainable management of natural resources. One of the main problems is the imbalance between economic development and environmental conservation. Existing policies are often not strong enough to effectively address environmental degradation, or some even conflict with conservation objectives. The implementation of conservation programs is also hampered by factors such as lack of funding, limited trained human resources, and difficulties in coordination between the various parties involved. In addition, natural resource management often does not take into account long-term sustainability, leading to over-exploitation that damages the ecosystem (Hery, M. 2024).

To address these issues, collaboration between stakeholders is essential. Governments need to develop stronger and more implementable policies to protect the environment, and provide incentives for the private sector to invest in environmentally friendly business practices. Communities, who are often the ones closest to natural resources, need to be involved in every stage of decision-making so that they understand the importance of preserving nature. Scientists and researchers also have an important role to play in providing data and evidence-based recommendations to support more effective policies. The private sector, in addition to contributing to economic development, can also be a partner in conservation initiatives by implementing sustainable business practices and environmentally friendly technologies. With holistic collaboration between governments, communities, scientists, and the private sector, it is hoped that more comprehensive solutions can be found to address environmental damage and achieve sustainable natural resource management.

In addition, the role of technology in supporting the application of biological principles is also increasing. Technologies, such as satellite monitoring, geographic

information systems (GIS), and biotechnology, have enabled scientists to monitor and map environmental damage more accurately. The use of this technology helps in making more appropriate decisions in efforts to preserve ecosystems. Thus, biology is not only the basis for understanding ecosystems, but also a tool for designing more effective and efficient conservation policies and strategies. Therefore, a comprehensive understanding of the role of biology in ecosystem conservation is essential. This study aims to explore the contribution of biology in overcoming environmental damage through an approach based on scientific principles, as well as to offer insights into how life sciences can be key to maintaining ecosystem sustainability and reducing the impact of environmental damage.

METHOD

This study uses a Systematic Literature Review (SLR) approach to review various previous articles and studies that are relevant to the topic of the role of biology in ecosystem conservation and efforts to overcome environmental degradation. This approach was chosen because SLR allows the collection and analysis of data from various studies that have been conducted previously, providing a comprehensive overview of the findings in this field (Rachman, TA, et al. 2024). The first step in this study was to conduct a literature search through various leading academic databases, such as Google Scholar, PubMed, ScienceDirect, and JSTOR. This literature search focused on articles published in the last five years that discussed topics such as ecosystem conservation, environmental restoration, and the use of biology in environmental conservation. The keywords used in the search included "biological conservation," "ecosystem restoration," "environmental degradation," and "sustainable ecosystems."

After obtaining a number of relevant articles, the next step is to conduct a selection based on the inclusion criteria that have been set, such as the relevance of the topic to the research focus, the quality of the research methodology, and the validity and reliability of the research results. The articles cover a variety of approaches and methods used in addressing ecosystem damage, with a focus on the contribution of biology to ecosystem maintenance and restoration. (Karya, D., et al. 2024). Takaza Innovatix Labs. Then, the analysis was carried out by examining the main findings of each selected article. Researchers assessed how biology is used in ecosystem conservation efforts, either through species conservation, habitat restoration, or the application of ecological principles to improve ecosystem sustainability. This process also includes identifying key trends emerging in research and evaluating the effectiveness of various strategies proposed in the literature. The results of this analysis were then synthesized to provide insights into the role of biology in ecosystem conservation as well as recommendations for more effective steps in overcoming environmental degradation. This study aims to provide a clearer picture of the contribution of life sciences in overcoming environmental degradation problems and as a basis for science-based conservation policies.

RESULTS AND DISCUSSION

Based on the results of the literature analysis conducted, it can be concluded that biology has a very large role in ecosystem conservation. A deep understanding of ecosystems and interactions between species provides a strong basis for scientists and policy makers in designing effective conservation strategies. One of the most prominent results is the finding that the success of species conservation is highly dependent on a good understanding of their natural habitats and how their interactions with other species can affect their survival. In addition, research shows that ecosystem restoration, which involves the reconstruction of damaged habitats, also utilizes biological principles

to determine the right species to be replanted or reintroduced into disturbed ecosystems. This is important because not all species can survive in damaged habitats without human adjustment or intervention. In many cases, ecosystem restoration requires active human involvement to restore the ecological balance lost due to destructive activities.

The study also found that one effective approach to addressing environmental degradation is through education and outreach on the importance of biodiversity and nature conservation. Many studies have shown that people who are more aware of the importance of healthy ecosystems tend to be more involved in conservation activities, such as reducing plastic waste, planting trees, and protecting endangered species. Therefore, biology education that focuses on ecological understanding can play an important role in addressing environmental degradation. The use of technology in biology also plays an important role in ecosystem conservation efforts. Satellite monitoring technology, for example, allows scientists to track ecosystem changes in real time, identify areas of degradation, and plan appropriate restoration actions. Research using satellite data shows that this technology can help monitor tropical forests, prevent forest fires, and protect the habitats of endangered species. However, the biggest challenge in applying biology to ecosystem conservation is the need for cross-disciplinary collaboration. Environmental degradation cannot be solved with a purely scientific approach, but requires collaboration between scientists, governments, communities, and the private sector. Much literature reveals that effective policies in ecosystem conservation require a strong scientific basis, but must also be supported by appropriate regulations and real actions in the field.

The Role of Biology in Understanding Ecosystems

Biology plays an important role in understanding ecosystems, as it provides a scientific framework for studying the interactions between living things and their environment. Through biology, scientists can identify the relationships between species in food chains, food webs, and energy cycles in ecosystems. Biology also helps understand the adaptation of organisms to certain environmental conditions, such as changes in temperature, water availability, and soil quality. In addition, biology plays a role in analyzing the impact of human activities, such as deforestation, pollution, and climate change, on the balance of ecosystems. With this knowledge, biology provides a basis for designing conservation strategies, habitat restoration, and sustainable management of natural resources for the sake of environmental sustainability and life on earth (Lasaiba, I. 2023).

Biology also enables us to understand the biodiversity that is an integral part of the ecosystem. Biological research helps to identify species, understand their ecological roles, and evaluate how environmental changes affect their populations and distribution. Through branches such as ecology, genetics, and biotechnology, biology supports the understanding of complex interactions in ecosystems, including symbiosis, competition, and predation. Biology also plays a role in the development of environmentally friendly technologies, such as bioremediation to overcome pollution or the use of certain organisms to improve soil fertility. In addition, biology provides insight into the importance of ecosystems in providing ecological services, such as pollination, water filtration, and natural disaster control. All of this makes biology an essential science in maintaining the balance of ecosystems and the sustainability of life on this planet. (Setyanto, A. 2021).

By understanding population and community dynamics, biology helps predict and prevent ecosystem disruptions that can have far-reaching impacts on human life, such as habitat destruction or species extinction. In addition, biology supports sustainable

natural resource management through science-based approaches, such as calculating environmental carrying capacity and conserving endemic species. Branches of biology such as biogeography also provide insight into the distribution of organisms across regions, helping to understand the influence of geographic and climatic factors on ecosystem diversity. Furthermore, biology contributes to environmental education and awareness, by providing scientific evidence on the importance of maintaining ecosystem balance for the sustainability of human life and all living things on earth.

Biological Approaches to Ecosystem Conservation

The biological approach to ecosystem conservation involves a variety of scientific methods aimed at understanding, protecting, and restoring environmental balance. One approach is through biodiversity conservation, which focuses on protecting species, habitats, and genetics. This approach involves identifying endangered species, establishing protected areas, and restoring habitats to support natural regeneration. Biology also uses an ecological approach to study the interactions between organisms and the environment to ensure that ecosystems can function optimally (Hatchi, SP, et al. 2024). Another approach is through biotechnology, such as the use of artificial breeding methods to conserve species whose populations are declining or the development of stress-resistant crops to prevent land degradation. Data-based ecosystem analysis, such as monitoring water, air, and soil quality, is also used to detect environmental threats as early as possible. In addition, population genetics research helps understand genetic variability within a particular species, which is important for increasing the ability to adapt to environmental changes. Biology-based education and outreach are also important parts of this approach. By disseminating information about ecosystem functions and the impacts of human activities, this approach aims to raise public awareness to protect the environment. The biological approach to ecosystem conservation involves not only science but also integration with environmental policies and community participation to achieve sustainable results (Jumiono, A., et al. 2024).

Biological approaches to ecosystem conservation also include sustainable ecosystem management, which involves the application of ecological principles to maintain and restore ecosystem functions. One example is ecosystem-based natural resource management, which aims to manage human activities, such as agriculture, fisheries, and forestry, by considering their impacts on all components of the ecosystem. This requires us to understand energy flows, nutrient cycles, and interactions between organisms, so that natural resource use can be carried out without disrupting the balance of the ecosystem. In addition, ecosystem restoration is also an important biological approach. Restoration aims to restore the condition of an ecosystem that has been damaged or disturbed by human activities, such as deforestation or pollution. This process involves vegetation restoration techniques, soil improvement, and water management to recreate habitats that can support native species. Ecosystem restoration focuses not only on improving physical conditions, but also seeks to restore lost ecological interactions, such as the relationship between pollinator species and the plants they help reproduce (Sehol, M., et al. 2023).

Biological approaches also involve the use of advanced monitoring technologies, such as satellite imagery and environmental sensors, to monitor ecosystem conditions in real time. These technologies allow scientists to map environmental changes, such as deforestation or water degradation, and take preventive action before the impacts become greater. In addition, community-based conservation approaches are gaining importance, where local communities are directly involved in conserving their ecosystems, using traditional knowledge and integrating ecologically based solutions.

With all these approaches, biology provides a strong scientific foundation for holistic ecosystem conservation, taking into account the interconnected ecological, social and economic factors, creating effective and sustainable solutions for the survival of humans and nature.

The Role of Life Sciences in Society

Life sciences play a very important role in society because they provide a scientific basis for understanding life and all aspects related to living things, be it humans, animals, plants, or microorganisms. Knowledge from life sciences not only contributes to the fields of health and biotechnology, but also provides solutions to various environmental, social, and economic challenges. In the field of health, life sciences enable society to understand the mechanisms of the human body, the causes of disease, and methods of prevention and treatment. For example, research in molecular biology and genetics has led to advances in the treatment of genetic diseases and cancer therapy (Harefa, D., & Sarumaha, M. 2020). Knowledge of microorganisms and epidemiology also helps in overcoming disease outbreaks and improving the quality of life of people through vaccination and evidence-based public health policies. On the other hand, life sciences play a role in increasing food security and the sustainability of natural resources. Research in agriculture, such as genetic engineering of plants, helps increase agricultural yields and reduce dependence on chemical pesticides that damage the environment. In addition, life sciences also support biodiversity conservation by understanding how species and ecosystems function, and how threats to them, such as deforestation and climate change, can be addressed. (Judijanto, L., et al. 2024).

In the field of education, life sciences contribute to shaping public awareness of the importance of nature conservation and sustainability. Through education and research, people can better understand the role of ecosystems and species in supporting human life, as well as the importance of maintaining the balance of nature so that future generations can enjoy the same resources. In addition, life sciences also advance technology and innovation that can improve people's quality of life. Biomedical technology, for example, has introduced sophisticated tools for diagnosis, treatment, and rehabilitation that increase life expectancy and public health. The field of biotechnology also supports various industries, such as the food industry, medicine, and renewable energy, which can drive environmentally friendly economic growth. Overall, life sciences play a vital role in shaping healthier, more sustainable, and more innovative societies, and helping to overcome the various challenges faced by the modern world (Hayunanda, V., et al. 2025).

Global Collaboration to Address Environmental Destruction

Global collaboration to address environmental degradation is a joint effort involving countries, international organizations, civil society, and the private sector to address transboundary environmental challenges such as climate change, deforestation, pollution, and biodiversity loss. Increasing environmental degradation, due to human activities such as unsustainable exploitation of natural resources, has had major impacts on the planet, including more frequent natural disasters, reduced quality of life for humans, and decreased health of ecosystems that support life. One important example of global collaboration is international agreements such as the Kyoto Protocol and the Paris Agreement on climate change mitigation (Yunus, AY, et al. 2024). Countries around the world have agreed to reduce greenhouse gas emissions that contribute to global warming, by developing renewable energy, increasing energy efficiency, and reducing dependence on fossil fuels. Although the challenges to achieve these commitments are

enormous, global collaboration in climate change mitigation and adaptation efforts has created a platform for countries to share the necessary technology, knowledge, and resources (Heppi Syofya, SE, et al. 2024).

In addition, the protection of biodiversity is also a focus of international collaboration. The Convention on Biological Diversity (CBD) is an example of an agreement that aims to protect ecosystems and species from damage caused by human activities. Countries commit to restore degraded habitats, protect endangered species, and prevent the destruction of marine and terrestrial ecosystems (Naiborhu, NSR 2021). Collaboration between governments, scientists, NGOs, and local communities plays a vital role in creating effective policies and delivering tangible results in nature conservation. International organizations such as the United Nations (UN) and the UN Environment Programme (UNEP) also support global initiatives by providing platforms for dialogue between countries and supporting programs to mitigate environmental damage. The UN has initiated various sustainable development goals (SDGs), which include goals to protect life on land and in the oceans, and reduce the damage caused by climate change.

In addition, the private sector also plays a major role in global collaboration to address environmental degradation. Large companies are increasingly recognizing the importance of sustainability and many are investing in green technologies and more sustainable business practices. For example, the use of renewable energy in their operations, reducing plastic waste, and initiatives to restore damaged ecosystems. Collaborations with non-governmental organizations and local communities are increasingly being carried out to create a broader and faster impact on environmental recovery. This global collaboration also involves civil society, which is increasingly educated about the importance of protecting nature. Environmental activism, such as that led by international organizations or global movements such as Fridays for Future, has raised public awareness and pushed for stronger policies on climate change and environmental degradation. Local communities also play a significant role in preserving their environment, through sustainable, indigenous practices.

Overall, global collaboration in overcoming environmental degradation requires joint efforts involving various parties, including governments, the private sector, international organizations, and communities. This collaboration is not only important to address current environmental problems, but also to ensure the survival and well-being of future generations, as well as the sustainability of the earth as a home for all living things. Based on this analysis, it can be concluded that biology plays a very important role in designing and implementing ecosystem conservation strategies. Life sciences provide a theoretical and practical basis for identifying the causes of environmental degradation, designing scientifically based conservation actions, and developing policies that support long-term conservation. Therefore, biology is the main tool that must be utilized in efforts to save the planet from increasingly severe damage (Wijaya, BS, et al. 2024).

CONCLUSION

Biology plays a vital role in ecosystem conservation and overcoming environmental degradation. A deep understanding of ecosystems, species, and ecological interactions provides a strong foundation for designing effective conservation policies and strategies. Ecosystem conservation requires a holistic approach, including the roles of science, technology, and active community involvement. Therefore, to achieve environmental sustainability and reduce environmental degradation, collaborative efforts are needed that integrate biology as a key pillar in ecosystem conservation and restoration efforts. Innovation and application of life sciences based on scientific data can be the key to overcoming the increasingly deep environmental degradation problem.

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