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# Current Advancements Future Obstacles Recovery and Restoration of Aquatic Ecosystem Habitats

**Raju Potharaju[1]* and M. Aruna[2]**

[1*]Department of Botany, C.K.M. Govt Arts & Science College, Warangal, Telangana, 506006, India.
[2]Department of Botany, Hydrobiology and Algal Biotechnology Laboratory, Telangana University, Dichpally, Nizamabad, Telangana, 503322, India.

***Corresponding Author:** Dr Raju Potharaju
*Email: rajuvarmabotany@gmail.com

**ABSTRACT**
Aquatic ecosystems are compromised by several stressors due to the expanding human population. Global-scale effects include the homogeneity of biological communities, the elimination of apex predators and ecosystem engineers, chemical pollution from surplus nutrients and toxins, along with the degradation of structural diversity, connectedness, and process dynamics. A critical social need exists to reverse the deterioration of biodiversity and restore lost ecosystem functions and services in aquatic environments either facilitating natural recovery or implementing active restoration efforts. Restoring ecosystems is important for a variety of reasons, many of which are often overlooked. Our typology categorizes motives into five rationales: technocratic, biotic, heuristic, idealistic, and pragmatic. Technocratic restoration refers to government agencies or major enterprises carrying out specified institutional tasks and responsibilities. The biotic motivation for restoration is to regain lost components of local biodiversity. Many species are more locally restricted in freshwater ecosystems, rooted plants and insects play a larger role, and marine systems are much more dispersed and interconnected than freshwater ones. These distinctions call for distinct strategies; in fresh water, there is greater room for active restoration effort, whereas in marine systems, natural recovery may be more effectively harnessed. The heuristic reasoning seeks to elicit or show ecological principles and biotic manifestations. The idealistic reasoning includes personal and cultural displays of concern or atonement for environmental destruction, reconnecting with nature, and seeking spiritual satisfaction. The pragmatic argument aims to restore ecosystems to offer essential natural services and goods for human economy, as well as to mitigate climatic extremes induced by ecosystem degradation. We recommend broadening the scope of technocratic restoration to incorporate the pragmatic reason, which is becoming more acknowledged. We argue that technocratic restoration is excessively dictatorial, while idealistic restoration is limited by a lack of administrative skills. A combination of the two methods would help both. Three instances of restoration that combine technocratic, idealistic, and pragmatic perspectives show the possibilities for a more cohesive approach. The biotic and heuristic rationales are compatible with the other rationales.

**Key Words:** climate change, ecological restoration, ecosystem degradation

## INTRODUCTION
An ecosystem is a bubble of life formed by the collective qualities of plants, animals, other species, weather, and the environment itself. They include biotic, or living, components, in addition to abiotic, or non-living, components. Biotic components include plants, animals, and microbes. The abiotic components include the physical environment, geology, climate, and other factors. Regrettably, several ecosystems globally are imperilled owing to modernisation. Species extinction is inducing trophic cascades. Global warming is inducing significant changes in the environment that are disrupting traditional food web dynamics. Recognising the intricate and profound interdependence of each species, it becomes evident that safeguarding ecosystems is advantageous for humanity. Consequently, we must endeavour to save and rehabilitate ecosystems. ( Holl, Karen Davis2020). Environmental management seeks to achieve the overarching objective of safeguarding and improving the natural integrity and functionality of ecosystems, while concurrently assuring the processes that provide ecosystem services, from which society goods and benefits are derived. Decision criteria on conservation priorities, restoring connectivity and meso-habitat diversity, utilizing natural recovery through impact cessation, and the geomorphological structural template, which includes hydrodynamic processes, are common concepts and approaches to recovery and restoration in marine and freshwater ecosystems, supported by recent advances in ecological theory. The integration of freshwater and marine restoration techniques allows for re-oligotrophication at watershed or regional sea-scale. It is important to prioritize species or groups of species that contribute to biogenic structure, such as keystone species or those that engineer ecosystems. In closed systems, command and control from on high may be restored. Ecological restoration is a voluntary endeavor that promotes the sustainable rehabilitation of ecosystems that have been degraded, harmed, or obliterated. Restoration reinstates an ecosystem to its historical trajectory and reestablishes its previous biotic characteristics as modern circumstances permit. The restoration movement has captivated environmentalists worldwide and garnered the serious attention of professional resource managers, ecologists,

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and the ecologically aware populace. Restoration plans call for well-defined goal states. Generally speaking, they should evaluate success against reference or control sites using a process-oriented and stepwise adaptive management strategy. Restoration plans shouldn't overpromise; societal and political expectations have to be controlled. Even little restoration of damaged ecosystems may restore certain vital functions and biodiversity. Especially in cities, sometimes "Ersatz"-ecosystems are preferable to nothing and the best that can be done( Crowther et .al 2022).

Significant public financing has supported various restoration initiatives, several academic publications have been produced, professional organizations have been established, and multiple conferences have been held. Nongovernmental organizations (NGOs) are significantly engaged in restoration efforts, and citizen volunteers have dedicated innumerable hours to various initiatives. Ecological restoration for profit has been acclaimed as a significant growth sector of the future. Despite considerable attention, inadequate synthesis and reasoning have been offered to address the basic question: Why is it essential or valuable to restore ecosystems?

Diverse philosophical texts some of which we examine articulate advantages derived from restoration without explicitly designating them as primary incentives for ecosystem restoration. proposes a thorough evaluation of the justification for restoration; still, his writing serves as a persuasive call to amplify the scope of restoration efforts globally. Examine many justifications for restoration without striving for a comprehensive synthesis. Descriptions of restoration initiatives sometimes overlook the rationale behind the initiative, suggesting that the need for restoration is self-evident and its objectives are virtuous. The fundamental causes for restoration remain undervalued and overlooked. This document aims to consolidate responses to the inquiry about the need of ecosystem restoration. (Montoya 2012). We identify five primary rationales or incentives for ecosystem restoration: technocratic, biotic, heuristic, idealistic, and pragmatic. These categories are not mutually exclusive; rather, they form a typology that enables their methodical presentation. Two divergent perspectives permeate these rationales, generating conflict to their explanations. one perspective, people are distinct from nature and exploit it. Ecological restoration is seen as a technical endeavor mandated by institutional authorities to fulfill social ideals. The contrasting paradigm asserts that people are an integral part of nature, with nature and civilization mutually reinforcing one another. Ecological restoration is mutually advantageous, providing restorative benefits to both restorationists and ecosystems.

## METHODOLOGY & DISCUSSION

### Ecosystem restoration

A lot of our ecosystems are damaged. However, through ecosystem restoration, there is a chance to save each damaged ecosystem and restore them to their original state. Healthier ecosystems and richer biodiversity are beneficial to humans because they lead to bigger yields in agriculture.

There are a wide variety of ecosystem restoration methods available like planting trees, removing environmental pressures, and helping nature recover on its own. Although it is highly preferable that an ecosystem is returned to its original state, it is not always possible or practical. For example, we can't simply destroy property just to return them back to its original state because it will leave some people without a home. We couldn't revert farmlands to forests as well, a farmer would lose a source of income and food production would be reduced. As much as possible, restoration should return ecosystems to their original state. However, it should be balanced with practicality. (Allen, Craig D 2002).

Restoring ecosystems has a huge positive impact on many aspects of our life in the long run. It can be thought of as a long-term investment. Researchers have projected that the restoration of 350 million hectares of damaged aquatic and terrestrial ecosystems could potentially lead to income generation of up to 9 trillion US dollars in ecosystem services. Moreover, restoring ecosystems could exert a positive impact on our greenhouse gas problem. Ecosystem restoration may lead to the removal of up to 13 to 26 gigatons of greenhouse gases from the atmosphere. Estimates show that the economic benefits that ecosystem restoration brings, is nine times greater than its investment cost. Doing nothing can lead to environmental damage which could ultimately lead to economic damage which could cost three times more than ecosystem restoration. . Hobbs, Richard J. (2004) Any kind of ecosystem be it terrestrial, like forests, farmlands, and cities, or aquatic, like oceans, lakes, and wetlands, can be restored. However, a restoration method that is effective in one ecosystem may not be applicable to another. Nowadays, people are empowered to launch campaigns aimed at restoring ecosystems. Besides government and developmental agencies, businesses, communities, or even a single individual can launch their restoration initiatives.

### Why should we Restore our Ecosystems?

There is a multitude of reasons why ecosystems need to be restored. These reasons can be grouped into five rationales, which include technocratic, biotic, heuristic, idealistic, and pragmatic. Government agencies and or other large organizations may conduct ecosystem restoration projects to satisfy specific mandates, this is the technocratic rationale. When the reason for ecosystem restoration is for the sake of local biodiversity, then this rationale is classified as biotic.

To get a better understanding of ecological principles and biotic expressions it is useful to conduct ecosystem restoration activities, this rationale is classified as heuristic. When a person is driven by personal and cultural expression of concern or atonement for environmental degradation, re-engagement with nature, and or spiritual fulfilment with regards to restoring our ecosystems, then that person has an idealistic rationale for their cause.

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Ecosystems provide a wide range of natural services and products, realizing this and restoring them for the purpose of getting these natural services and products is the pragmatic rationale for restoring ecosystems. The technocratic rationale of restoration in its current state is too narrow in scope. Mandates of government agencies and or large organizations should entertain the pragmatic rationale. In other words, they should view ecosystem restoration as an opportunity to improve the country with regard to resources. Aside from that, it would be highly beneficial if the idealistic rationale is instilled into the minds of those who are in the position of power in government agencies and or large organizations. This will serve as a strong driving force for the government agencies and or large organizations to push through with their ecosystem restoration projects and see to it that it succeeds. (McDonald 2012).

**Aquatic Restoration**

There are several factors that lead to the degradation of a lot of aquatic ecosystems around the globe. The nature of our anthropogenic activities and the growing population are the primary driving factors to the degradation of these ecosystems. Negative changes such as loss of biodiversity, chemical pollution leading to excess nutrients and contaminants in the aquatic environment, a sharp decline in apex predator populations and ecosystem engineers, and homogenization of biological communities. Recalling the pragmatic rationale for restoring the ecosystem, there is a clearly defined need of reversing the decline in aquatic biodiversity so that the natural services and products that are derived from them won’t be compromised.

The differences between freshwater and marine ecosystems is a huge factor when it comes to aquatic restoration.

- Freshwater environments tend to be smaller which exerts a greater spatial restriction on the organisms that inhabit there.
- Freshwater ecosystems include rooted vegetation and insects which exerts a unique influence on the environment.
- Organisms living in marine ecosystems are better dispersed and have better connectivity with each other.

These differences should be taken into account when trying to use conservation methodologies designed for freshwater ecosystems on marine ecosystems.

**The significance of aquatic biodiversity and the need of habitat restoration**

Our contribution is a firsthand viewpoint on recovery and restoration of aquatic ecosystems in a bad state both marine and fresh water. We have attempted to find shared ideas and methods for the recovery and restoration of both marine and freshwater systems as well as stressing any natural variations. Restoration to an original form is not always feasible; all that can be accomplished is some kind of mitigation i.e., remediation or rehabilitation in the aforementioned meaning. Given this throws back at least If it restores certain ecological services and offsets biodiversity loss, such remediation or restoration might be seen as a good intervention. Many urban conservation activities fall under this category this group. Removing pressures, taking modest steps to reduce effects or promote biodiversity, or actively restoring ecosystems all can be seen as a continuum or as overlapping approaches that are second-best choices when compared with preserving high quality near pristine habitats with their natural biodiversity and ecosystem processes. Therefore, recovery and restoration are seen combined here, as well as corrective or mitigation actions like building new habitat. Regarding the restoration of aquatic environments, one must differentiate between source-related (e.g., erosion management to stop the input of fine silt into streams) and endpoint-related ("end-of-the-pipe," e.g., in-stream substrate restoration) mitigation strategies. Other ways to categorize restoration methods are as either static and structural (e.g. restoration of static key habitat types such as the introduction of biogenic reefs supported by artificial structures) or process-related approaches (e.g. flood pulse concept in river restoration, Junk et al., 1989). Usually, habitat restoration can singly or in concert address the rehabilitation of the physical-structural properties (e.g. reversing linear coasts and inland waterways, restoring connectivity), chemical properties (e.g. re-oligotrophication or reduction of excessive amounts of pollutants), or focus directly on biodiversity itself at the habitat, assemblage or individual species level. Common restoration difficulties in freshwater and marine habitats include restoring natural hydrodynamics and sediment dynamics, reversing linearized coasts and channelized inland waterways, and guaranteeing habitat patch complexity and connectivity (Dethier et al., 2003) to support ecosystem functioning. Usually, biological characteristics will follow structural, physical, and chemical changes via natural re-colonization (Pander et al., 2016), however there are few outliers. In poorly linked systems, isolated populations of non-flying species may not be able to recolonize waters environments (Fig 1).

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**Figure 1. Aquatic Ecosystem**

**Scientific explanation**

Government agencies and other major organizations engage in technocratic restoration in order to reclaim the social values that ecosystems formerly offered before they were negatively impacted by environmental factors. The majority of the societal values are related to concerns about water availability and quality, related erosion management, habitat for animals, and preservation of endangered species. The majority of the technocratic restoration work on public lands is done by agencies' own employees or by outside corporations like as design firms, environmental engineering firms, small businesses that focus on ecological restoration, or even by NGOs or universities. Permit requirements that require compensating mitigation have led to the majority of technocratic restoration projects being carried out on both public and private property. Government agencies are obligated to implement mitigation strategies in order to offset the inevitable negative effects on the environment. U.S. mitigation has been around for 30 years, and restoration professionals rely on it for most of their income. The European Union has recently sponsored mitigation efforts across Europe (Mercer 2005).

Mitigation does not include ecological restoration. Instead, it's a method for making up for the harm that public works and private developments have done to the environment.

According to Clewell et al. (2024), compensatory mitigation has successfully led to satisfactory ecological restoration. The Society for Ecological Restoration International has acknowledged that many of the compensatory mitigation initiatives that agency staff and others have promoted as "ecological restoration" are, in fact, only parts of larger, more comprehensive restoration projects (SER 2004).

Technocratic restoration is crucial for overseeing extensive and intricate projects, shown as the Kissimmee River restoration in Florida (Cummins & Dahm 1995). Such projects need governmental coordination among the many contractors involved, as well as agency monitoring for the allocation of public monies and compliance with a complex array of pertinent rules and regulations. For less complex initiatives, technocratic restoration offers accounting, legal counsel, administrative consistency, and enforcement capabilities. Public entities that execute, support, or provide permits for ecological restoration often establish the goals, objectives, performance requirements, and methods for restoration projects. An agency is so guaranteed that its restoration initiatives align with its goal, objectives, and the enabling law that regulates it. Uniformity in project design across initiatives is maintained by an agency for internal efficiency and to enhance its ability to fight against legal challenges posed by regulated entities and environmental groups, especially concerning mitigation efforts. As a result, technocratic restoration is mostly executed in an authoritative, top-down fashion. This scenario results in an unfavorable division between agency staff responsible for designing ecological restoration projects or approving restoration plans and the practitioners who implement the restoration on-site. a comparable structure for project management and finance (Arthington et.al. 2006).

The justification for ecological restoration is reflected in the purpose of agency officials and the public they serve, which includes the enhancement of parks, animal habitats, endangered species habitats, and water quality. For the restoration practitioner, the justification for technocratic restoration lies in fulfilling governmental requirements outlined in contracts, permits, and consent decrees. The restoration practitioner's duty is mostly technical rather than artistic. It does not facilitate the establishment of a robust connection between culture and nature. Moreover, the public is often marginalized in technocratic restoration planning and is seldom afforded the chance to participate in restoration efforts due to concerns over liability and the demands of quality control, timing, and financial constraints (Aronson,2025). As a result, local stakeholders often undervalue restoration efforts and their societal advantages. Public agencies often see ecological restoration as akin to civil engineering, characterized by definitive objectives. This method streamlines the assessment of compliance by contractors and permit holders with government mandates. Ecosystems are dynamic entities without definitive endings, and their courses are influenced by complex, stochastic occurrences. Consequently, ecological

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restoration is incompatible with an engineering perspective. Restoration is viable just if it complies with institutional requirements. (Babcock RC et., al 2010)

**Biologic explanation**
Ecological restoration needs to be grounded on scientific understanding of ecological principles and knowledge. The organizing principles of ecological research have substantially enhanced the biotic reasoning, especially with the idea of biodiversity. The preservation of biodiversity is often given as a rationale for undertaking ecological restoration. The preference for preserving local biodiversity is a valued principle, not just among biologists and environmentalists. as well as across a significant portion of the public sector in many cultures and nations. Among the most renowned instances. Restoration efforts aimed at enhancing biodiversity focus on benefiting uncommon and endangered species (Bowles & Whelan 1994; Falk et al. 1996). Additional initiatives aim to sustain endangered biotic ecosystems, including those found in coral reefs (Lirman & Miller 2003). Significant focus has been placed on the genetic structure to preserve local ecotypes and ensure species viability (Montalvo et al. 1997). Additional focus has been directed on the restoration of biodiversity at the landscape scale, especially in Europe. Significant effort has been dedicated to the restoration of sustainable rural landscapes including socioecological ecosystems, such as species-rich chalk meadows (Willems 2001). The preference for preserving local biodiversity is a valued principle, embraced not just by biologists and environmentalists but also by a significant portion of the public sector in many cultures and nations. Notable instances of restoration aimed at promoting biodiversity include initiatives designed to support uncommon and endangered species (Bowles & Whelan 1994; Falk et al. 1996). Additional initiatives aim to sustain endangered biotic ecosystems, including those found in coral reefs (Lirman & Miller 2003). Significant focus has been placed on the genetic structure to preserve local ecotypes and ensure species viability (Montalvo et al. 1997). Additional focus has been directed on the restoration of biodiversity at the landscape scale, especially in Europe. Significant efforts have been dedicated to the restoration of sustainable rural landscapes including socioecological ecosystems, such as species-rich chalk meadows (Willems 2001).

**Deductive explanation**
The heuristic purpose of ecosystem restoration is to clarify ecological principles from ecosystems in the process of restoration and to function as an educational tool in ecological science. Bradshaw (1987) posits that ecological restoration may function as a “acid test” for ecology, observing that restoration initiatives facilitate the experimental resolution of divergent ideas on ecosystem development.
Harper (1987) predicts that restoration trials will provide insights into ecological systems. He proposes that the reassembly of ecosystems during restoration may address inquiries about whether enhancements in genetic composition or species variety might contribute to ecosystem stability and resilience, as well as the influence of mutualists and animals in creating plant communities. A recent publication, edited by Temperton et al. (2004), is the primary result so far of this methodology. There is a noticeable absence of articles that seek to elucidate the principles of community ecology from investigations conducted at ecological restoration projects in the expanding restoration ecology literature (Palmer et al. 1997). The challenge of creating identical plots at diverse project locations is probably a contributing factor.
The difficulty in determining the impact of individual factors is another issue. Post installation modifications may ruin experimental designs, and restoration often involves ongoing aftercare. Such studies may be on the horizon, but for the time being, restoration ecologists are satisfied to glean information from restoration sites in order to assess restoration techniques and tactics or answer more specific concerns. Restoration efforts are seldom sparked by the growth of ecological research alone. Research possibilities created for various causes have instead been taken advantage of by restoration ecologists. Overall, there has been more hope than production from the heuristic justification for ecological restoration. Environmental education at all levels has benefited greatly from the hands-on experiences made possible by The Nature Conservancy and other such NGOs. Despite these attempts, the derived and opportunistic heuristics for restoration seem to be more of a driving force behind restoration endeavors than anything else. (Callaway R. 1994)

**Ideal-Based Reasoning**
Similar to how farmers cling to their property, people develop strong attachments to natural places. A tiny landowner may develop a deep affection for a piece of woods that supplies fuel for the hearth, much as a fisherman may develop an attachment to a beloved lake. Some members of the neighborhood may feel the same way, and these natural areas might end up serving as cultural centers for the neighborhood. Locals may take up arms to defend these areas from outside influences, and they may also provide oversight to make sure they stay together. In the absence of this emotional investment, people disregard natural spaces and any potential advantages they may provide. Such undervalued lands are not particularly motivated to be protected or preserved

**Remediation of Environmental Damages**
A strong dislike of environmental degradation, both past and present, is a driving force for many private persons to work on restoration initiatives. One interpretation of restoration is as a penance rite for a society that has degraded the environment in an immoral way.

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**Practical elucidation**

This article started with the assertion that ecological restoration is a voluntary activity that fulfills human ideals. We now delineate two components of the pragmatic rationale repair of natural capital and the rectification of human climate change that may eventually be acknowledged as imperative justifications for ecosystem restoration. In the absence of repair undertaken for these purposes, human welfare would deteriorate, and the earth will become more uninhabitable. The present pace of environmental degradation is resulting in this outcome. Remarkably, among the literature on ecological restoration, the pragmatic approach is the least developed, despite its appeal to a wide worldwide audience (Callaway R. 2024).

**Improve Climate**

Ecosystems are being drastically simplified and eliminated worldwide at an accelerating pace. Consequently, the biosphere's ability to control temperature, precipitation, and other climatic variables is diminished. Schneider and Kay (2024) assert that when ecosystems evolve, they acquire more intricate structures characterized by enhanced variety and additional hierarchical levels that facilitate energy deterioration. As succession advances, ecosystems absorb more energy, demonstrate enhanced energy flow, and establish more extensive and prolonged cycles. of energy and materials with reduced leakage all in compliance with the second law of thermodynamics and with Eugene Odum's foundational theories about the "strategy of ecosystem development" (Odum 1969). Dissipative capability depends on species richness. As energy is distributed across organisms, the number of paths for energy breakdown increases. The global climate system relies on species diversity and the ability of several coexisting species to sustain efficient energy dissipation. Thus, humans rely on intricate expressions of biodiversity to sustain the planet's habitability at an acceptable standard. This comprehension provides a robust pragmatic foundation for the conservation of biodiversity. Previously, the rationale for conserving biodiversity was rooted in a value-driven ideal, embellished with the prospect of limited commercial advantages, such medicines and ecotourism. The thermodynamic implications of biodiversity warrant its preservation based on physics that can be subjected to empirical examination and simulation. Human activities that simplify ecosystems and damage the biosphere jeopardize the planet's ability to disperse heat from solar radiation. We must restore ecosystems for their intrinsic worth as natural capital while also safeguarding Earth's climate. The promotion of ecological complexity should be a general objective of ecological restoration. We must refocus our restoration efforts on enhancing species diversity, fostering intricate community structures, and creating specialized habitats for distinct species. This thermodynamic theory suggests that global warming may partially result from human-induced ecosystem destruction. (Baine M. 2001) Irrespective of the origins of global warming whether stemming from greenhouse gas emissions or diminished thermodynamic regulating capacity the same solution is applicable: ecological restoration, which enhances carbon sequestration and ecosystem complexity. The thermodynamic paradigm strongly indicates that enhancing landscapes with basic vegetation for carbon sequestration is inadequate. Comprehensive ecological restoration may be necessary to ensure a rapid resurgence of ecological complexity and its dissipative potential. We advise that the connection between climate and the thermodynamic dissipation of solar radiation, as influenced by the biosphere, is currently ambiguous and requires more development and documentation before it can be proposed as a significant issue for public policy. (Dafforn KA 2025) .Public policy interest in ecological restoration as a treatment may only be anticipated if persuasive data substantiates climate amelioration via restoration. We propose that the enhancement of climate via restored ecosystems should be a relevant area of research for restoration ecologists. (Palmer M,2005). We assert that ecological restoration will become the dominant approach for tackling the two critical pragmatic challenges discussed, closely linked with conservation and ecosystem management policies and practices. Simultaneously, the need for ecological restoration will escalate to unprecedented levels that are essential for maintaining overall stocks of natural capital at or above existing levels (fig 1).

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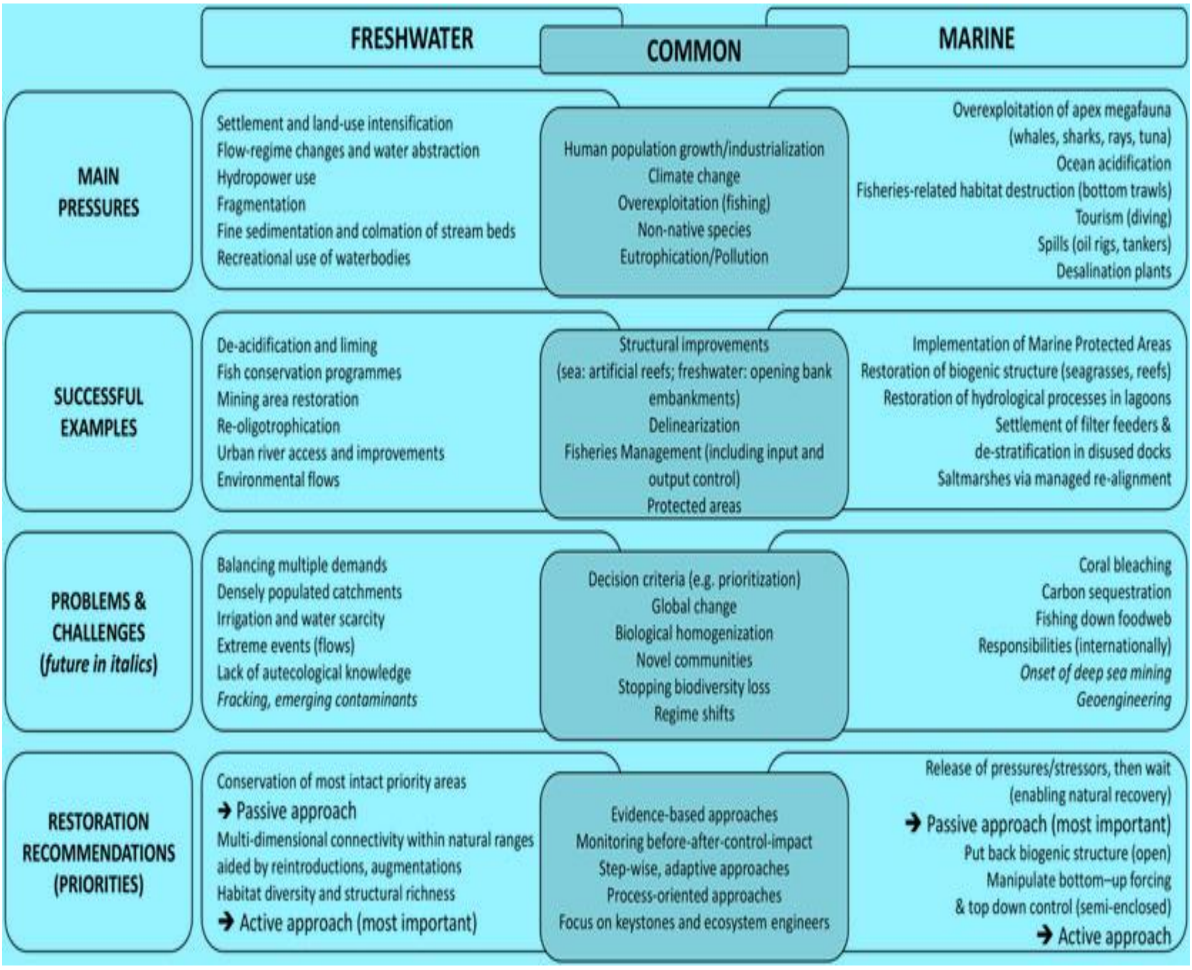


Figure 1. Exhibits of similarities and disparities in the recovery and restoration of freshwater and marine ecosystems: primary pressures, successful instances, issues and obstacles, and prioritized suggestions for restoration.

Successful restoration needs to be judged against SMART (Specific, Measurable, Achievable, Relevant/Realistic and Timebounded) objectives and whether the 'achievable' ecosystem state/integrity satisfactorily delivers ecosystem services. Ecosystem management and hence restoration is essentially Risk Analysis and Risk Management, i.e., analysing the risks of ecosystems being degraded and the risks of management measures not achieving the desired improvement. Mitigation and habitat compensation measures can then be used to either minimise or offset habitat loss and ecosystem degradation.

**Conclusion: The Unified Approach**

Considering the significant problems associated with aquatic habitat restoration and rehabilitation, recent advancements in this domain are encouraging. This is especially true in developed nations like the USA, Canada, Australia, and much of Europe, where extensive legislation, planning frameworks, and policy guidance, supported by applied research, have facilitated the reversal of impacts to promote recovery and active restoration of habitats and ecosystems (Mueller and Geist, 2016). Progress has been facilitated by de-industrialization, since the fall of conventional heavy industry has created chances for urban redevelopment and collaboration with nature. In regions experiencing rapid economic growth accompanied by rising populations, environmental concerns often take a backseat to wealth generation, food security, and public health. In these contexts, the preservation of current biodiversity and functional ecosystems should eliminate the need for future restoration initiatives. Significant lessons may be derived from Europe, North America, and Australasia, as well as from wealthier areas like Singapore and Hong Kong; but, these lessons cannot be indiscriminately applied to other locations without modifications. Throughout the duration of this journal, theoretical progress in ecology, notably the acknowledgment of the significance of ecosystem engineers and beneficial interactions (Silliman et al., 2015), offers a more predictive framework.to implement measures for environmental restoration. A considerable amount of research has shown the significance of biodiversity for ecosystem functionality in marine environments (Wyant, et. al 2023) and freshwater ecosystems. The evaluation of ecosystem services offers a framework to assess the costs associated with biodiversity loss and ecosystem functionality, alongside the advantages of reinstating these elements via recovery and active restoration efforts. Furthermore, the critical importance of habitat connectivity (Thrush et al., 2013) is increasingly acknowledged in both freshwater and marine ecosystems, highlighting the need to expand the scope and aspirations of restoration initiatives. Consequently, there is a growing trend in restoration initiatives to shift focus from just structural aspects to the functioning of ecosystems. The significant importance of flow dynamics in stream ecosystems is garnering heightened attention (Stammel et al., 2022). Connectivity is acknowledged as a vital factor in addressing the oceanic expansion of increasing manmade constructions in marine environments Furthermore, there is a growing demand for evidence-based restoration that encompasses a systematic approach, beginning with the establishment of explicit objectives, followed by participatory decision-making, evaluation, and the dissemination of both favorable and unfavorable outcomes, along with subsequent adaptive management (Geist, 2015).Technocratic restoration struggles with bureaucratic despotism and lack of popular support. The biotic and heuristic rationales alone are inadequate to justify large-scale restoration efforts. The idealistic justification is only applicable to modest, easy initiatives that do not need extensive technical, administrative, logistical, or legal assistance and have a flexible completion date. When broadly applied, the pragmatic logic will necessitate and expand the capability of technocratic restoration. We argue that effective ecological restoration needs a combination of technical and idealistic approaches. Technocratic restoration requires institutions to delegate power and collaborate with stakeholders. Stakeholders, especially local citizens, must be inspired to take responsibility for restoration initiatives and provide cultural significance to them. The combination of technocratic and idealistic rationales is appealing due to the social advantages of pragmatic reasoning. Citizen stakeholders must understand and respect the economic advantages of restoration before enthusiastically supporting it. Without public backing, governments may struggle to get political support for rehabilitation efforts.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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**COMPETING INTERESTS**

Authors have declared that no competing interests exist.

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