The Missing Component

Incorporating Biodiversity into Natural Resource Remediation and Restoration

Jen Lyndall, Kegan Brown, and Thomas Pearce

Ecosystems with high biodiversity are more resilient to climate change, habitat degradation, and other potential stressors. However, the existing regulatory frameworks for contaminated sites, such as the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. §§ 9601 *et seq.*, and similar state analogs, often fail to prioritize biodiversity and instead favor a prescribed stepwise approach to investigation, remediation (cleanup), and natural resource damage assessment (NRDA) to provide compensation for ecosystem service losses over time. As a result, the current combined remediation and NRDA process is slow, typically taking a decade or more, and often delays restoration until after the cleanup phase is completed. This approach misses a critical opportunity to engage in early ecosystem restoration, which could help reduce the potential long-term harm to affected ecosystems by increasing near-term resilience through biodiversity. A more flexible and streamlined approach, promoted potentially through amendment to existing NRDA regulations, e.g., 43 C.F.R. Part 11, can provide mechanisms for biodiversity-focused early restoration approaches. As an added bonus for the responsible parties, these early restoration efforts could also reduce and even potentially resolve their liability for natural resource damages (NRDs).

The Importance of Biodiversity

A stable ecosystem is characterized by many, diverse species that interact to provide a functional system. This diversity of living organisms (e.g., plants, animals, bacteria, fungi) is referred to as biodiversity and plays a critical role in the function of ecosystems.

Unfortunately, activities such as pollution, habitat degradation, and climate change have already led to a significant decline in biodiversity around the world and have brought into focus the importance of biodiversity to combat potential future issues. Climate change is one of the most pressing environmental challenges of our time, and it has significant implications for biodiversity and ecosystem health. As the climate changes, ecosystems will face increasing stressors like more frequent extreme weather events, changes in precipitation patterns and temperature, and rising sea levels. These stressors can adversely impact ecosystems by altering habitat conditions, disrupting species interactions, and increasing the vulnerability of species to disease and predation. Intergovernmental Panel on Climate Change, Climate Change 2023: Synthesis Report. A Report of the Intergovernmental Panel on Climate Change. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (2023). However, ecosystems with high biodiversity are more resilient to stressors like habitat degradation or climate change because more diversity means that the ecosystem can resist and/or adapt to stressors. *Id.*

Resilience means that the system can tolerate more stress and can bounce back from adverse events. Biodiversity promotes resilience because systems with greater biodiversity often have multiple species that are providing overlapping functions (e.g., breeding habitat, food sources, carbon cycling). If one species is impacted by a stressor, another species can provide the same functions, allowing the ecosystem to resist ecosystem-wide impacts. Christopher R. Biggs et al., Does Functional Redundancy Affect Ecological Stability and Resilience? A Review and Meta-analysis, Ecosphere (July 2020). For example, drought or pests might severely impact a forest with only one or two species but would have a much lesser impact on forests with diverse tree species because some species should be able to tolerate the impacts and continue growing.

In addition to resisting impacts, ecosystems with greater biodiversity can also adapt to stressors. Adaptation in response to adverse events is possible because the variety of species in the ecosystem have differing tolerances and sensitivities, allowing some species to tolerate challenging conditions and other species to thrive in novel or changing conditions. Michael Begon & Colin R. Townsend, Ecology: From Individuals to Ecosystems (5th ed. 2021). Greater species diversity can allow a system to fill niches opened by the loss of some species to adapt to changing conditions. In a diverse system, some species may be able to capitalize on the changing conditions and thrive, while other species may not. This shifting of functions between sensitive and resilient species allows the ecosystem and its associated functions to remain intact even if the species or communities that are providing the functions change.

The NRDA process provides a great opportunity to increase biodiversity through ecological restoration. NRDA includes injury determination, injury quantification, and then the development and scaling of restoration to compensate the public for lost natural resources and natural resource services resulting from the release of a hazardous substance(s). Ecological restoration projects under the NRDA framework can be targeted to increase biodiversity and overall ecological function.

Limitations of Current Regulatory Framework for Prioritizing Biodiversity

The current regulatory framework for contaminated sites fails to prioritize biodiversity in remediation and NRDA efforts. Specifically, current approaches employ rigid stepwise methods with limited flexibility for addressing or focusing on biodiversity, particularly through early restoration. In addition, economic methods commonly used to determine the scale of natural resource injuries and needed restoration compound the problem because they generally do not incorporate biodiversity, climate change, or ecological functional redundancies. Furthermore, remediation and restoration processes are often slow, perhaps taking a decade or more.

CERCLA; the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. §§ 6901 *et seq.*; and the Oil Pollution Act (OPA), 33 U.S.C. §§ 2701 *et seq.*, are three of the main federal environmental laws that govern the investigation and remediation of contaminated sites. There are also numerous equivalent state statutes. These laws generally require responsible parties to remediate a contaminated site to protect human health and the environment, e.g., 42 U.S.C. § 9621, which typically means reducing contamination to levels where risks to human health and ecological risks are deemed acceptable.

CERCLA, OPA, and other statutes authorize federal, state, and tribal trustees (collectively, the trustees) to seek damages for injury to, destruction of, or loss of natural resources resulting from the release of a hazardous substance or a discharge of oil. 42 U.S.C. § 9607(f)(1); 33 U.S.C. § 2706; *see, e.g.*, N.J.S.A. § 58:10-23.11g(c)(1); N.Y. Nav. Law § 181(2)(b). In contrast to remediation, these statutes often require the restoration of natural resources to achieve pre-release levels of ecosystem services. The measure of damages is generally: (1) the cost of restoring injured natural resources to their baseline condition (i.e., the condition of the natural resource "but for" the release of hazardous substances or discharge of oil), (2) compensation for the interim loss of injured natural resources pending restoration, and (3) the reasonable cost of a damage assessment (43 C.F.R. pt. 11; 15 C.F.R. pt. 990).

These statutes provide a high-level framework for the use of NRDAs to evaluate the ecological impacts of contamination and to determine the appropriate restoration actions to restore any lost natural resource services. As required under CERCLA, 42 U.S.C. § 9651(c), the NRDA implementing regulations, promulgated by the U.S. Department of the Interior (DOI) at 43 C.F.R. Part 11, establish an optional process for assessing NRD. These detailed regulations describe how to evaluate natural resource injuries, quantify any natural resource injuries, and then restore injured natural resources.

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Consistent with statutory and regulatory requirements, all recovered NRDs are used to restore, replace, rehabilitate, or acquire the equivalent of the injured natural resources (or to cover the costs of assessments). *See, e.g.*, 42 U.S.C. § 9607(f)(1); 43 C.F.R. § 11.81(a)(1)(ii). Therefore, trustees generally seek restoration projects that are closely tied to the injured natural resource, such as by restoring the same natural resources (or services) in the same or nearby areas.

NRDs may be quantified based on the natural resource injury required to be offset or addressed by the restoration. Restoring an injured resource to its pre-discharge (or baseline) condition is known as primary restoration. *See, e.g.*, DOI, *Update of the Operating Principle for Restoration Activities*, at 3 (July 27, 2021). In addition to primary restoration, NRDs also cover interim losses. *Id.*; 43 C.F.R. § 11.83(c). Quantifying interim losses typically involves using non-monetary metrics to evaluate habitat or resource equivalencies for the purposes of determining appropriate compensatory restoration. *See, e.g.*, NOAA, *Habitat Equivalency Analysis: An Overview*, at 3 (2006). To ensure full compensation for interim losses, the trustees determine the scale of the proposed compensatory restoration actions for which the gains provided by the restoration equal the natural resource service losses resulting from the injury. *Id.* The NRDs are the cost of implementing the selected restoration projects—typically either a cash payment to the trustees or a direct implementation of the project by the responsible parties. The process for injury assessment and restoration scaling typically includes determining the appropriate metric that can measure the reduction in natural resource services at issue (for example, fish mortality); measuring the level of services provided by the injured resource and comparing it to the condition absent the injury (the baseline); determining changes in service levels over time; determining the scale of restoration that would provide services of the same type and quality as in the baseline scenario; and determining the cost of providing restoration to compensate for the identified natural resource service losses. NOAA, *Habitat Equivalency Analysis: An Overview*, at 5–6 (2006); Joan Snyder & William Desvousges, *Habitat and Resource Equivalency Analyses in Resource Compensation and Restoration Decision Making*, Nat. Res. & Env't 4(2013).

Habitat equivalency analysis (HEA) is one such scaling methodology. *See* 43 C.F.R. § 11.83(c)(2). HEA is based on the premise that the public can be compensated for past losses of natural resource services through restoration project(s) that would provide additional natural resource services of the same type—in this case, habitat. The natural resource service losses are sometimes referred to as "debits," and the replacement natural resource services are sometimes referred to as "credits." In a HEA, the most frequently used unit of measurement is a discounted-service-acre-year (DSAY). A DSAY represents the value of ecosystem services provided by one acre of habitat in one year, discounted to present value. Once the trustees or responsible parties calculate DSAYs based on acres of injured habitat, they then select restoration projects that will offset these lost DSAYs in the form of acres of restored habitat.

Resource equivalency analysis (REA) is another scaling method trustees may use. *See id*. Conceptually, a REA is similar to a HEA, but service losses and gains are calculated using a biological metric (e.g., number of fish killed) instead of acres of habitat.

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HEA and REA are limited in their abilities to incorporate biodiversity. Most importantly, they tend to focus on individual habitats or specific resources rather than holistic ecosystem functions. For instance, REA typically only focuses on one biological metric for a specific resource, such as the number of fish, owls, or endangered plants. This approach does not expressly acknowledge biodiversity or address ecological functional redundancies, such as the fact that other species might be compensating for the loss of the focus species (or not). HEA and REA also both rely on static baseline conditions, making it difficult to incorporate ecosystem-wide effects such as climate change, biodiversity, or other future conditions. As a result, the NRDA process usually does not consider either comprehensive biodiversity evaluations or climate change when calculating NRDs.

The current approach to NRDA thus misses a critical opportunity for early restoration that could help reduce potential long-term harm to ecosystems by increasing near-term resilience through biodiversity. The delays built into the NRDA and restoration process can also disincentivize both regulatory agencies and responsible parties from incorporating biodiversity considerations into the remediation and restoration process. Simply put, the NRDA regulations and most NRDA tools do not easily incorporate biodiversity in calculating credits and debits in a manner that incentivizes early restoration focused on biodiversity.

Restoring Hope: Possible Solutions for the Future

Despite the challenges to incorporating biodiversity into natural resource remediation and restoration, there are several potential solutions. These include implementing a more flexible and streamlined approach, focusing on incorporating biodiversity into project goals, prioritizing conservation, and incentivizing early restoration.

A more flexible and streamlined approach to NRDA would potentially allow for earlier, and greater, incorporation of biodiversity into the remediation and restoration process. One potential approach is through broader use of the DOI Type A NRDA regulations. *See* 43 C.F.R. §§ 11.40–11.44. The Type A regulations provide simplified NRDA procedures in cases where limited fieldwork is necessary to complete an assessment. *Id*. § 11.33(a). DOI is currently evaluating amendments to the Type A NRDA regulations, and such amendments could facilitate a renewed focus on biodiversity. *See* 88 Fed. Reg. 3373 (Jan. 19, 2023).

Trustees and responsible parties can also incorporate flexibility into the credit side of NRDA to prioritize biodiversity. For instance, early restoration projects that target biodiversity provide synergistic benefits that can pay long-term ecological dividends. For example, the diversification of a wetland plant community in a degraded wetland may increase the short-term services, but more importantly it avoids a tipping point where further habitat degradation may make the system more vulnerable to habitat loss. To capture the multiplicative effects of biodiversity-focused early restoration projects, the trustees might multiply the restoration credits such projects generate in the overall assessment. Credit multipliers would be a logical outcome given the wide-ranging benefits of projects focusing on biodiversity and would incentivize such projects. By prioritizing early restoration and incentivizing responsible parties to incorporate biodiversity considerations into the restoration process, the NRDA process could help to improve the efficiency, effectiveness, and sustainability of restoration efforts.

Natural resource remediation and restoration efforts could adopt a holistic approach that considers the entire ecosystem, rather than solely focusing on the contaminated site. An ecosystem-based approach would consider not only the local ecological context but also potential impacts of climate change and social-economic factors that may influence the success of restoration efforts. For example, a restoration project that is slightly farther away from the injured resource itself may nevertheless allow one project to provide multiple benefits, such as by connecting fragmented habitats, providing floodwater storage, or providing park access to lower-income communities. By adopting this comprehensive perspective, managers of remediation projects or trustees could incorporate factors such as biodiversity, regional climate vulnerability, and environmental justice when evaluating potential remedial alternatives and restoration goals. In short, the NRDA process should incentivize managers of remediation and restoration projects to use available funds to maximize natural resource services—on an ecosystem basis—in the most cost-effective manner possible.

Although the NRDA regulations require responsible parties to "restore, replace, or acquire the equivalent of" the injured habitat, the trustees strongly prioritize restoration over conservation to resolve NRD claims. 43 C.F.R. § 11.83(c). Rather than restoring an injured resource, conservation generally maintains an equivalent resource in its current condition, such as by acquiring property to prevent future development. This preference is partially based on the limitations of HEA, which may undervalue conservation because it is harder to quantify service gains from a conservation project than from a restoration project. The trustee preference for restoration projects is reasonable in certain cases where stakeholders place more importance on improving a degraded natural resource. However, conservation projects should also be prioritized (along with restoration) to help regional resilience and adaptation to the impacts of climate change and other stressors.

Conservation of land and aquatic resources can provide a number of benefits simply by protecting the area. For example, preservation of terrestrial areas maintains acreage of permeable surface, facilitating surface water infiltration, and groundwater recharge. These ecosystem functions become particularly important in areas near brackish and marine systems where saltwater intrusion into groundwater is becoming more problematic. Conserving land helps maintain freshwater inputs to groundwater aquifers, which in turn serves as a buffer against saltwater intrusion. Conserved land may also provide refuge habitats for species displaced by climate change, establish critical connections between fragmented habitats for species with larger home ranges or migratory pathways, and offer niche habitats that enhance biodiversity and associated resilience. As habitat is lost or degraded because of development or climate change acceleration, these moderate- to high-quality parcels will play an increasingly critical role in regional resilience and adaptation. These types of conservation projects should be promoted, along with the restoration projects that are already being used, to resolve NRDs.

Numerous federal and state agencies have recently launched or are developing extensive conservation and preservation initiatives, which can also be used to identify priority conservation opportunities. Trustees and responsible parties can incorporate conservation projects into the existing NRDA framework by introducing a factor that accounts for the vulnerability of the parcel and region to climate change. Considering climate change vulnerability would enable practitioners to incorporate resilience into the NRDA valuation process and more accurately assess the value of restoration projects based on their contributions to ecosystem resilience.

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Similar to conservation efforts in NRDA, practitioners have frequently discussed early restoration, but they implement it only infrequently because of the complexities involved in reaching NRD settlements. At most contaminated sites, remediation is the initial focus, with ecological restoration occurring toward the end of that cleanup process. However, restoration that occurs much earlier in this extended remediation process can significantly increase the opportunity to address future stressors. Early restoration can offer greater value than traditional end-of-project restoration for several reasons. First, early restoration reduces potential long-term harm to ecosystems by increasing near-term resilience through biodiversity. Restoring biodiversity in degraded ecosystems can enhance those systems' ability to withstand the impacts of climate change. For example, wetland restoration can improve water storage and filtration, thereby reducing the impacts of flooding and drought. Restoring forest ecosystems can enhance carbon storage and sequestration, contributing to climate change mitigation. Coastal ecosystem restoration can mitigate impacts of storm surges and sea level rise. Restored ecosystems can also facilitate species migration as habitats shift due to changing climate conditions. Second, early restoration can increase the chances that degraded or damaged ecosystems are addressed before they reach a tipping point beyond which they can no longer recover. For instance, the restoration of certain wetland areas may focus on wetland elevations to restore stressed wetlands before they are no longer viable as a result of flooding caused by sea level rise.

Existing regulatory frameworks could be updated to prioritize early restoration and the protection and restoration of biodiversity. Federal, state, and tribal agencies should give particular attention to how they credit restoration projects toward overall NRDs and how they determine the project success criteria (e.g., some species may not thrive under current conditions but would be expected to grow well under future modeled climate and weather scenarios). Implementing adaptive (or iterative) management and flexible success criteria would allow natural resource managers to assess whether unexpected or unplanned ecosystem responses may be beneficial to long-term resilience and therefore whether the project may be a success. For example, if a project plans to plant Species X and Species Y in a 50:50 ratio, but Species X proves to be more stress-tolerant and thrives better under challenging conditions, a ratio of 75:25 may still constitute a "successful" restoration project even if it deviates from the original plan. Additionally, if replanting is needed, managers may consider planting more of Species X and adding in a new Species Z based on the changing conditions.

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Under current frameworks, incentivizing early restoration can be a challenging task because of the complex nature of the regulatory framework and liability concerns. The scope of NRD may not become apparent until the NRDA is sufficiently advanced, which makes it difficult for responsible parties and trustees to understand the benefits of early restoration, particularly because early restoration alone may not result in complete resolution of NRD liability. However, federal, state, and tribal entities can overcome such challenges through strategies that incentivize early restoration and encourage responsible parties and trustees to incorporate biodiversity considerations into the restoration process.

One potential approach is to provide greater NRD credit multipliers for responsible parties who voluntarily undertake early restoration activities, through either administrative agreements or other legal mechanisms that provide certainty and clarity to responsible parties. Such agreements can also provide clear expectations for the restoration actions required to achieve liability relief. If an early restoration action happens to overcompensate for NRDs at a specific site, settling parties should be permitted to sell excess NRD credits to other parties or use excess NRD credits at similar or related sites to resolve their potential NRD liability, even if those other sites are beyond the immediate area where the NRD credits were generated.

Another approach is to allow for flexibility in restoration success criteria to allow natural system responses that reflect biodiversity considerations. For example, a party may pursue a more "traditional" early restoration through the 1:1 replacement of a natural resource, such as a specific plant species. The party could overplant this species to achieve shorter term metrics, but also to create a future seed bank so that the restored ecosystem can respond to environmental changes such as climate change. If the success metric is based only on survival of the specific species subject to restoration, the project may not successfully meet that metric over the longer term. In contrast, if the success metric acknowledges additional enhancement through seedbank diversity (or other biodiversity metrics), then the project might still be considered successful.

Benefits to Incorporating Biodiversity into NRDA

Remediation and NRDA already involve biodiversity in the remediation goals, assessment of potential injury, and the necessary restoration for compensation, even if biodiversity is not always expressly addressed. Federal, state, and tribal agencies should consider amending remediation and NRDA regulations to increase the flexibility of how to approach remediation and restoration, to directly consider biodiversity, and to encourage biodiversity-minded early restoration projects. Actively evaluating biodiversity would often more clearly illuminate the natural resource benefits of early restoration, which in turn could lead to earlier settlements and liability resolution and reduce the delays in restoration that the traditional NRDA framework promotes. At its core, explicitly evaluating biodiversity acknowledges biodiversity's critical role in the success of restoration efforts, especially in light of the emerging and future stressors associated with climate change.

Ms. Lyndall is a senior consultant with Integral Consulting Inc., in Chagrin Falls, Ohio. Mr. Brown is a partner and Mr. Pearce is an associate at Latham & Watkins, LLP in New York, New York. They may be reached at jlyndall@integral-corp.com, kegan.brown@lw.com, and thomas.pearce@lw.com, respectively.