23 Forest Sustainability and Habitat Management

Sustainable. Does it mean leaving resources for the next generation that are equal to or greater than those that we enjoy? Or does it mean not losing any of Leopold's pieces (see Chapter 1)? Or using resources wisely for the greatest good in the long run as Pinchot suggested? Or restoring as much as possible to wilderness to be honored as a place of beauty and spirit as John Muir might have suggested? Clearly, sustainability, literally, is in the eye of the beholder. Equally as clear is that society is demanding more services, *ecosystem services*, from our forests than they ever have before.

I have heard some foresters say that they manage forests sustainably. They cut trees, they plant trees, the trees grow, and they cut them again. Trees are indeed a renewable resource and theoretically production of wood fiber can continue for a very long period of time using currently accepted silvicultural practices. But in the past 20 years, society has raised questions about what exactly is being sustained: 2 × 4 inches, plywood, and pulp? Water? Habitat for various wildlife species? Recreation? Aesthetics? Medicinal plants? Nontimber products? More? During the 1980s and 1990s, large areas of tropical forests were cleared for agriculture, or for planting exotic tree species for timber production, and some forests were simply cut and abandoned.

Philosopher George Santayana once stated: "Those who forget the past are doomed to repeat it." And indeed they have. This is a story that has repeated itself from the northeastern United States, through the Deep South and parts of the west, but also in New Zealand, Australia, and many countries in South America, leading to an increasing number of questions regarding forest sustainability.

In 1992, 172 governments and 2400 representatives of nongovernmental organizations (NGOs) participated in a meeting in Rio de Janeiro, Brazil, in what became known as the Earth Summit. One outcome of that meeting was the endorsement of a set of 17 nonbinding forest principles that provided guidance for management and conservation of global forests. Also during this meeting, an agreement on biodiversity conservation was reached, which stated that:

> …the signatories must develop plans for protecting habitat and species; provide funds and technology to help developing countries provide protection; ensure commercial access to biological resources for development and share revenues fairly among source countries and developers; and establish safety regulations and accept liability for risks associated with biotechnology development.

One hundred fifty-three nations endorsed this agreement. The United States did not.

The very next year, in 1993, another meeting was held in Montreal, Canada, that culminated in the Montreal Process. Participants included countries with temperate and boreal forests, including the United States. They developed a framework for measuring the progress of each country toward sustainable forest management. The framework included 7 criteria and 67 indicators, known collectively as the Montreal Process Criteria & Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests (Washburn and Block 2001). The first criterion dealt with the conservation of biodiversity. This process and the discussions that led to it represented the social expectations—if not demands—that forests be managed in a way that ensured sustainability of a variety of resources, including, and especially, biodiversity.

DEFINING THE RESOURCES TO BE SUSTAINED

Managing forests sustainably requires that those people responsible for forest management understand which resources need to be sustained. The Montreal Process provides an internationally accepted list of resources that should be considered during forest management (listed in order of criteria in the document, Washburn and Block 2001):

1. Conservation of biological diversity, including ecosystem diversity (5 indicators), species diversity (2 indicators), and genetic diversity (2 indicators).
2. Maintenance of productive capacity of forest ecosystems (5 indicators).
3. Maintenance of forest ecosystem health and vitality (3 indicators).
4. Conservation and maintenance of soil and water resources (8 indicators).
5. Maintenance of forest contribution to global carbon cycles (3 indicators).
6. Maintenance and enhancement of long-term multiple socioeconomic benefits to meet the needs of societies, including production and consumption (6 indicators), recreation and tourism (3 indicators), investment in the forest sector (4 indicators), cultural, social, and spiritual needs and values (2 indicators), and employment and community needs (4 indicators).
7. Legal, institutional, and economic framework for forest conservation and sustainable management, including a legal framework (5 indicators), institutional framework (5 indicators), economic framework (2 indicators), a means to measure and monitor changes (3 indicators), and to conduct and apply research and development (5 indicators).

Several of these criteria specifically identify areas of forest management where habitat must be explicitly considered. Clearly, Criterion 1 identifies ecosystems, species, and genes that must be conserved. Managing forests in ways that achieve this goal is the motivation for writing this book. This indicator also ensures representation of forest types across a landscape and addresses levels of fragmentation of forests. Species richness, rare species protection, and population viability must be considered, as must species on the periphery of their geographic range. Other indicators also have implicit habitat management goals: plantations of native tree species, harvest of nontimber forest products (including berry-producing plants), management within the historical range of variability, maintaining ecological processes, providing coarse woody debris (as a carbon store), as well as socioeconomic goals such as employment and social stability. Many of the concepts addressed so far in this book relate directly to sustainable forest management as outlined in the Montreal Process. The devil is in the details, however, when trying to decide how to apply these concepts to forests at local, regional, and global scales.

SCALES OF SUSTAINABILITY

The Montreal Process framework is useful for assessing the status and trends of forest services and is designed to enhance international communication about sustainable forest management (Washburn and Block 2001). With increased information within and among nations regarding the indicators identified in the Montreal Process, policy makers and stakeholders may be better able to make informed forest management decisions locally, regionally, and globally. How do these indicators scale over space and time? Clearly, there is a temporal limit to sustainability. Societies change and so do their values. Climates change and so does the ability of ecosystems to provide services. Species go extinct, including humans. Stars die and planets grow cold. So the first step in developing a sustainable forest management plan is to define the scope of the plan. How far into the future will we strive to remain sustainable? As long as possible, recognizing that it is a continually moving target? For 100 years? 1000 years? Setting these goals may seem moot, but they do influence the actions that will be taken today to ensure that goals in the future are attainable.

We also need to define the size of the area over which we are striving to be sustainable. The Oregon Department of Forestry has used the Montreal Process criteria and indicators as a basis for developing a sustainable forest management plan for state forests. The Oregon Department of Forestry planners defined the spatial scale as one ownership. The department's ability to achieve its goals will be in part dependent on how its neighbors view forest management and how landowner decisions aggregate to contribute to regional goals, and how regional contributions aggregate to achieve global goals. Think globally, act locally. Although defining the temporal and spatial framework within which sustainable forest management will be conducted, it is equally as important to define the context within which sustainable forest management is being conducted, and how your actions on your lands contribute to some larger aggregate goal. The concept of explicitly considering the context for sustainable forest management is particularly important when addressing Criterion 1. It should be clear by now that no single landowner and no set of reserves will meet the needs for all species and sustain global biodiversity along with other ecosystem services.

HUMANS ARE PART OF THE SYSTEM

The crux of the issue regarding sustainable forest management is: How can we provide the depth and breadth of ecosystem services, that include economic products over space and time demanded by society. Humans set the agenda, humans are part of the problem, and humans are part of the solution. It's all about us. Forest managers are granted a social license to practice forestry in a way that they choose, so long as ecosystem services are provided. How does society grant that license? Unlike wildlife, which, in the United States, is a public resource that occurs on public and private lands, forests are considered private resources. This political dichotomy of ownership is a challenge when managing habitat on private lands to achieve public wildlife goals. Society benefits from forests regardless of whose land they occur on. Policies and laws (see next chapter), the Montreal Process, and certification by a third party are mechanisms used to ensure that those benefits are sustained. Occasionally, incentives, such as selling carbon credits to forest owners are also used. So, although one person or company may own forest land, what they are allowed to do on forest land is influenced by society, both in their own country, as well as in others.

Are We Making Progress?

Twenty years after the Rio Summit, how have we done in sustaining Earth's resources for future generations? Rio +20 was a conference held in Rio de Janeiro 2012 to take stock of the progress made over the previous 20 years. A 17-page document, "The Zero Document," framed the discussion by calling for greater coordination around environmental economic policies, support for developing counties, greater use of technology, and a framework for global governance (Martella and Smaczniak 2013). In essence, this document, and the resulting discussion, had at its core the philosophy of not sliding back on any progress already made. A total of 283 statements, describing the desired future condition of the planet, were provided, and signatory countries reaffirmed their commitments to achieving these sustainability goals. The general sense of an assessment of progress was that change has been modest at best. However laudable the goals of the Rio Summit may be, the task of achieving sustainability among all countries is daunting, if not impossible. It is impossible for growth to continue indefinitely, given that resources are finite (Mace 2012). Uncertainty of future climates further confounds our prediction of resource limits, since climate may change resource availability, at least geographically, on the planet. To be successful and make clear progress over the next 20 years, Martella and Smaczniak (2013) identified several obstacles that must be overcome: (1) global environmental governance must be more cohesive and synergistic; (2) organizations need to more effectively coordinate their efforts; (3) resources available to implement strategies need to be more cost-effective; (4) nongovernmental organizations (NGOs) must be given more authority; and (5) NGOs and businesses need to be equal partners in developing solutions. To date, the Rio Summit has been successful in raising awareness around issues and proposing solutions to improve the fate of future generations. Rio +20 confirmed that awareness. It will be up to participating countries, NGOs, educational institutions, and businesses to begin to work together to bring about true change that will lead to reduced population growth, a reduction in the rate of climate change, a higher quality of life for more individuals, and less disparity between the "haves" and the "have nots." This is a very tall order for politicians who view successes in 2-, 4-, or 6-year intervals, depending on their position and country's government. Sustainability can only be achieved by continued pressure and participation from the citizens of the planet, if we hope to achieve sustainability for future generations.

FOREST CERTIFICATION

Third-party certification is one mechanism that is an outgrowth of the Montreal Process, and it is used around the world to help ensure that forests are managed sustainably and that biodiversity conservation is considered during management. Certification that forests are managed sustainably is based on an audit by an objective organization. In this process, forest management practices are evaluated against a set of standards by an external certification organization. Certification economically benefits landowners because, at least in theory, certified forest products yield a higher return on an investment, while assuring consumers that their purchase comes from a forest whose management meets certain standards (Washburn and Block 2001). Certification also provides an opportunity to shift land management behavior to be more consistent with biodiversity conservation goals, something unlikely to happen without policies or processes such as certification (Primmer and Karppinnen 2010). Certification has two interconnected pieces: third-party certification of forest management activities that typically address some or all of the Montreal Process criteria and indicators and certification of chain of custody. Chain of custody is important, because, as wood products pass from stump to mill and mill to wholesaler and wholesaler to retailer, there is assurance to the consumer that the wood purchased did indeed come from a certified forest.

There is a variety of third-party certification organizations in the world, and over 125 million ha (>3% of the world's forests) are certified by one or more organizations (Rametsteiner and Simula 2003). Over 90% of these certified forests are in North America and Europe (Figure 23.1). The goal of conserving biodiversity in tropical forests, using sustainable forest management principles, has largely failed, but voluntary certification on private lands in temperate forests has been quite

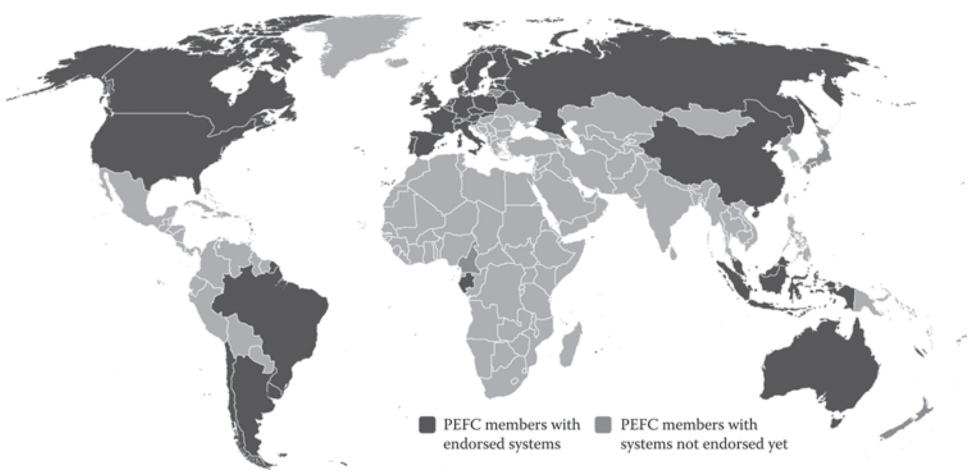

FIGURE 23.1 Map of PEFC-certified forests in the world. (Map from PEFC. With permission.)

successful. The degree to which certification is effective in conserving biodiversity is unknown, but assumed to be significant in temperate regions, though perhaps dependent on the certifying body (National Wildlife Federation et al. 2001). In the United States, there are two primary certification organizations: The Forest Stewardship Council (FSC) and Sustainable Forestry Initiative (SFI). Canada (e.g., Canadian Standards Association), Europe (e.g., Pan European Forest Certification, PEFC), and other countries and regions (e.g., the Keurhout Foundation in Holland, and National Timber Certification Council in Malaysia) have additional certifying bodies (Rametsteiner and Simula 2003). The FSC originated in Europe and is active in 57 countries around the world, including the United States (Perera and Vlosky 2006). FSC is a nonprofit organization that evolved from the Earth Summit agreements. SFI was established by the American Forest and Paper Association (AF&PA). It is founded in a comprehensive system of principles, objectives, and performance measures developed to integrate both responsible environmental practices and sound business practices (Perera and Vlosky 2006; Sustainable Forestry Initiative 2006). SFI certification includes first- (self) and second- (SFI board) party audits, as well as independent third-party audits of conformance to standards (Perera and Vlosky 2006). Since its establishment, over 124 million acres of forestland in North America have undergone third-party SFI certification (SFI 2006).

Consumers seem willing to support green certified products in North America and Europe, so certification of forest lands in those countries continues to grow (Rametsteiner and Simula 2003). The cost to the landowner (of being audited to receive certification) is high, and cost-prohibitive for owners of small parcels. Since most forest land in eastern United States is in small parcels, most is not certified, except where innovative mechanisms such as woodland cooperatives are used to create an economy of scale (Barten et al. 2001, Figure 23.2).

When a landowner wishes to have her (or his) property certified, she (or he) makes a request to the certification body. The application for certification usually entails an application fee (or membership in an organization, e.g., American Forest and Paper Association). Auditors then visit the property and compare what they see in owner records and on the ground with the standards for certification set by the certifying body. For third-party certification, the auditors are independent of the company or organization being certified to avoid conflict of interest. Certification is given when the auditors' report indicates that there are no noncompliances. If there are instances of noncompliance, then the landowner is given a fixed amount of time to address the issues before certification would then be granted. Periodic or annual audits are required by the certifying body. The landowner must

FIGURE 23.2 Owners of small forest tracts in Massachusetts have developed an economy of scale through development of the Massachusetts Woodlands Cooperative. The cooperative is certified by the Forest Stewardship Council. (Photo by Susan Campbell. With permission.)

not only pay the application fee but also the costs associated with the audit; hence, for small owners, the cost per certified forest acre can be prohibitively high.

Certification schemes can be broadly categorized into two groups: performance-based and process-based (Layton et al. 2002; Perera and Vlosky 2006). Performance-based standards define specific performance levels for various aspects of forest management; it is the framework used by FSC. Process-based schemes provide a systematic approach to developing, implementing, monitoring, and evaluating environmental policies, but they do not stipulate performance standards; it is the framework used by SFI (Layton et al. 2002; Perera and Vlosky 2006). The two certification processes differ in the ways that they consider the approach to ensure that biodiversity conservation and management of habitat for various wildlife species (Table 23.1). In both approaches, the metrics used to define compliance or noncompliance may be areas of concern for landowners contemplating certification; however, competition between FSC and SFI has led to changes that are bringing the two certification schemes closer together (Overdevest 2010).

Layton et al. (2002) reviewed the metrics that are used and approaches taken to certification, specifically those dealing with wildlife and biodiversity evaluations. They concluded that auditors often indicate that professional judgment is used as the basis for determining if a criterion or indicator is met. Since audit teams vary from owner to owner, the consistency of evaluation is

TABLE 23.1
Comparison of FSC and SFI Certification Approaches Dealing with Protection of Biological Diversity and Management of Habitat for Various Wildlife Species

Indicator	FSC	SFI
The status of forest-dependent species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment.	Safeguards shall exist, which protect rare, threatened, and endangered species, and their habitats. Conservation zones and protection areas shall be established… Ecological functions and values shall be maintained intact, enhanced, or restored, including … genetic, species, and ecosystem diversity…	Program participants shall apply knowledge gained through research, science, technology, and field experience, to manage wildlife habitat, and contribute to the conservation of biological diversity.
Biological diversity	Landowners are required to maintain, enhance, or restore the long-term integrity of natural habitats, ecological processes, soil, water, and stand development.	Each company develops its own policies, programs, and plans to contribute to the conservation of biological diversity and manage sites of ecological significance.
Stand age–class distribution	Forest owners and managers maintain or restore portions of the forest to the range and distribution of age classes of trees that result from processes that would naturally occur on the site.	Program participants shall have policies, programs and plans to promote habitat diversity at the stand and landscape-level.
Habitat diversity	A diversity of habitats for native species is protected, maintained, and/or enhanced.	Program participants shall apply knowledge gained through research, science, technology, and field experience, to manage wildlife habitat and contribute to the conservation of biological diversity.

Source: Based on Washburn, M., and N. Block. 2001. *Comparing Forest Management Certification Systems and the Montreal Process Criteria and Indicators*. Pinchot Institute, Washington, DC; the National Wildlife Federation, Natural Resources Council of Maine, and Environmental Advocates. 2001. *A Comparison of the American Forest & Paper Association's Sustainable Forestry Initiative and the Forest Stewardship Council's Certification System*. National Wildlife Federation, Washington, DC.

brought into question. Certification bodies have struggled with objective measures of performance, especially when evaluating indicators of biodiversity. Lindenmayer et al. (2000) proposed the use of structure-based indicators, such as structural complexity of stands and composition of plant species, connectivity, and heterogeneity in biodiversity conservation, and these may have utility in certification audits as well.

Effectiveness of Certification

Internationally, certification is likely to be more successful where governments enforce forestry laws, provide financial incentives for certified forestry, provide land tenure security, and where forestry is profitable (Ebeling and Yasué 2009). Consequently, there are few developing countries where forest certification is likely to achieve widespread success (Ebeling and Yasué 2009). In the United States, Moore et al. (2012) found that forest certification was successful in causing change in forestry, environmental, social, and economic/system practices. Firms certified by FSC made more environmental/forest management changes, and firms certified by SFI made more economic/system changes (Moore et al. 2012).

How effective has certification been in conserving biodiversity? Apparently much depends on how certification is implemented. Elbakidze et al. (2011) compared indicators of biodiversity conservation between FSC-certified lands in Sweden and Russia and found that indicators of conservation spanned multiple spatial scales in Russia but were limited largely to stands in Sweden. So, although the standards for certification were the same between countries, implementation differed—and, hence, the potential for conserving biodiversity. Further, standards in certification, as well as in policies, set thresholds that land managers attempt to meet, thereby homogenizing the landscape, and stand elements, to threshold levels, rather than encouraging variability in representation of habitat elements (Johansson et al. 2013). For instance, if the threshold for snag retention was 10 snags per hectare, then falling below that threshold could risk noncompliance, but going above that threshold by very much may risk economic loss. Allowing variability in habitat elements over large areas may be more representative of the way in which natural systems function.

There are indications that independent audits provide an incentive for improving forest management consistent with the intent of the Montreal Process (Ramesteiner and Simula 2003). Gullison (2003) concluded that landowners that undergo FSC-certification are more likely to improve management with respect to the value of managed forests to biodiversity conservation. But the incentives associated with certification are not sufficient to attract most producers to seek certification, particularly in tropical countries where the costs of improving management to meet FSC guidelines are significantly greater than any market benefits they may receive (Gullison 2003). If FSC certification is to make greater inroads, particularly in tropical countries, significant investments will be needed, both to increase the benefits and reduce the costs of certification (Gullison 2003). Conservation investors will need to carefully consider the biodiversity benefits that will be generated from such investments versus the benefits generated from investing in more traditional approaches to biodiversity conservation (Gullison 2003); but a clear quantification of the impacts of green certification on conservation of biodiversity has not been completed. Nussbaum and Simula (2004) provided a series of case studies indicating potential benefits of certification to biodiversity conservation. They concluded that improved conservation of biodiversity appears to be a consistent benefit of certification, as evidenced by increased protection of representative ecosystems and rare, threatened or endangered species, but few data are available on which to base rigorous assessment. Loehle et al. (2005) evaluated associations between a set of landscape structure metrics that could be used in certification programs and bird species richness. Their work suggested that indicators addressing aspects of landscape structure may be useful in evaluating potential contributions to biodiversity conservation. Nonetheless, the extent to which certification has led to improved ecosystem functions, reduced risk to loss of biodiversity, or greater probability of persistence of endangered species is still unclear (Nussbaum and Simula 2004). Nonetheless, certification represents a pragmatic international system of private governance that could lead to increased levels of biodiversity conservation. We should anticipate that the processes and standards will evolve and improve over time, and the disparate approaches currently used among certifying organizations will likely coalesce into a common framework. What is needed, however, is a monitoring system that clearly documents the gains and losses of biodiversity and ecosystem processes from certified and uncertified forests.

SUSTAINING AND MARKETING ECOSYSTEM SERVICES: HABITAT BANKING

Habitat banking was defined by Caldecott and Dickie (2011) as a market-based system where credits from habitat creation or set-asides (beneficial actions) can be purchased to offset the loss of habitat from development or other human uses (environmental damage). Credits can be produced, purchased, and used, when habitat loss is imminent, or stored to be used later, as needed. An assumption is that the credits and debits are associated with the gain or loss of biodiversity, which is based on habitat losses or gains (Caldecott and Dickie 2011). For rare habitat types, an overriding concern of management or development is the net loss in the area or capability of the remaining habitat to support desired species. Consequently, wetlands protection acts are in place in many states and countries to ensure that no further net loss of wetlands occurs. This approach means that wetlands in urban areas along roadsides or other highly impacted areas receive protection, even though they may not be particularly functional, depending on the landscape context in which they exist. The same could be true of old-growth stands, savannahs, meadows, or other under-represented habitat types. As humans build houses, create roads, and install similar infrastructure that remove these habitat types, they face a legal dilemma. One solution to minimizing a net loss is to mitigate any loss by setting aside or creating protected habitat elsewhere, potentially in a more functional landscape. Of course, such a measure costs money (usually), so if a developer wishes to fill in a wetland along a roadside to build a mall, he could pay a landowner in a less impacted area to set aside wetlands, or create new wetlands, which would replace the wetlands lost through development. Habitat banking is a procedure used to achieve a no-net-loss policy or objective. Given the correct topography and soils, wetlands could be created and become functional within a few years or decades. Creating old-growth forests, however, could take centuries, so this approach does have limitations (Morris et al. 2006). It is for this reason that habitat creation or habitat offsets have been brought into question as being a viable way of allowing sustainable development with no net loss of rare habitat types (Morris et al. 2006).

Not all habitat types are equal in their ability to support a species of concern (or ecosystem of concern), and not all species are equally common or rare. Consequently, Resource Equivalency Methods (REMs) or Ecological Equivalency methods are used to estimate values associated with the losses and the values associated with the banked habitat, so that comparable habitat area and value is used in the habitat offset (Ozdemiroglu et al. 2009; Quétier and Lavorel 2011). Estimating the size of the compensation area can be done by dividing the present conservation value of the site to be developed, by the predicted future conservation value of a compensation area of the same size (Moilanen et al. 2009). As noted above, it may take decades or centuries for some habitat values to be realized, and there is a risk that the future values may be delayed or not realized at all. Moilanen et al. (2009) developed a method to take into consideration the risks associated with the uncertainty of achieving future values.

There are still questions regarding the effectiveness of habitat banking efforts that monitoring will be able to address over time; the approach is one that has wide appeal because it assigns a value to habitat that can then be traded, much as carbon credits and dollars can be exchanged. In fact, depending on the context of the habitat used in offsets or created, the value of the created habitat could be greater (or less) than the habitat lost to development. Bridging approaches between economics and the ecological sciences, holds promise for a more meaningful dialog between those who promote economic development and those who promote ecological protection.

SUMMARY

Society demands increasingly more ecosystem services from forest lands, both public and private. International conferences and agreements have developed a set of principles defining sustainable forest management, and these principles have been included in certification protocols. Sustainable forest management certification is private governance of forest management, and provides the social license for managers to continue to manage forests. Enrollment in certification programs has grown dramatically since the 1990s, especially in temperate forests. The incentives to landowners for certification in tropical forests, especially in developing countries, are not apparent, especially given the high costs associated with certification. Although there appear to be benefits of certification to biodiversity conservation, based on changes in biodiversity indicators, long-term monitoring of certified and uncertified lands has yet to be conducted. Nonetheless, the generally accepted assumption is that certified forests should do more to conserve aspects of biodiversity than uncertified forests. Habitat offsets and habitat banking are approaches to help realize a no-net-loss of habitat due to development and other land uses that remove habitat for certain species. Approaches that ensure that the value of the habitat created (credits) is meaningfully exchanged for habitat lost (debits) have been developed, but monitoring is needed to assess assumptions of ecological equivalency, especially when values may take decades or centuries to be realized.

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