Short Term Action Plan on Ecosystem Restoration
Group of activities C: Planning and implementation of ecosystem restoration activities

Biodiversity considerations in the context of restoration science and practice

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The following concepts can be useful in the implementation of restoration activities:

Standards and guidelines [C1, C3, C4]

Standards and guidelines to assist with ecological and ecosystem restoration planning have been produced at the global (see SER International Standards below)[1], country[2] and ecosystem level. One example of the latter are the ITTO Guidelines for the Restoration, Management and Rehabilitation of Degraded and Secondary Tropical Forests[3], which have recently been assessed with case studies from Ghana, Indonesia and Mexico[4]. There are also published standards for river restoration[5], and many other guidelines and manuals published in local languages (e.g., Guidelines for limestone quarry restoration in Mediterranean climate, published in Spanish[6]).

Reference ecosystem or model ecosystem [C1, C3, C4]

A reference ecosystem or model can be used both to help guide planning and to assess performance (SER's International Standards for the Practice of Ecological Restoration[1] is a useful resource for more information in this regard). Reference models are assembled from diverse sources of information on native plants, animals, other biota and abiotic conditions. These sources may include multiple reference sites, surveys of the restoration site, and historical records, including human use. It is also critically important that ecological change is considered, both past and current, and what can be projected for the future[7]. The resulting reference or model helps identify and communicate a shared vision of project targets, which then provides a basis for setting goals and objectives as well as for monitoring and assessing restoration outcomes over time. Ecosystem attributes (e.g., species composition, ecosystem functionality, external exchanges) must be identified and measured before, during, and after project implementation.

Restoration approaches [C1, C2]

Many approaches can be taken to restore native ecosystems and biodiversity, and an even greater number of approaches can be used that mix ecosystem restoration with other activities, such as agroforestry. These approaches are often used in combination or mosaics across landscapes, and many approaches utilize natural successional processes and ongoing adaptive management to help drive ecosystem recovery.

Natural regeneration, which focuses on removing sources of degradation (e.g., deforestation, inappropriate grazing, over-

fishing, restriction of water flows, and inappropriate fire regimes), has enormous potential to contribute to ecosystem restoration[8-10]. However, natural regeneration alone may not be sufficient and other more active restoration approaches may be needed.

Planted forests with a high diversity of native tree species, for instance, can be used to overcome low resilience, reduced forest cover, and high fragmentation, and create biologically rich and viable forests[11]. Diverse plantings of native species also contribute to the restoration of soils and improve ecosystem resilience[12].

Agro-successional restoration is defined as the incorporation of a range of agroecology and agroforestry techniques as a transition phase early in forest restoration. This approach could be used more widely to overcome socioeconomic and ecological obstacles to restoration on former agricultural lands[13].

Planting mixed stands of native trees and commercial species, or allowing natural inclusion of native species in commercial plantations, can lower costs and increase biodiversity in forest restoration. However, co-benefits of mixed plantations may come with some environmental costs over native forests, such as lower water availability[14].

Species interactions [C5]

Animals are important seed dispersers and ecosystem engineers in restoration projects. A wide variety of animals are important for dispersal, including birds and bats[15], and even large mammals[16]. As ecosystem engineers and producers of habitat for many species, beavers, for example, are important in temperate forests[17]. Where animal populations have been depleted or locally extirpated, reversing defaunation using intensive translocation techniques may be considered[18]. Where native animals are extinct, analogue species are being evaluated as ecological surrogates[19].

Genetic diversity and supply of plants and other essential materials [C5]

For restoration to be successful, it is important to identify potential gaps in knowledge, technology or supply chains. Genetic diversity, in particular, plays a critical role in seedling survival and adaptation of forests to environmental change[20,21]. Consequently, use of native tree species over exotic species is advantageous for meeting conservation and sustainable development goals. However, genetic resources for restoration may be limited or decreasing, and efforts to conserve available genetic diversity for restoration may need to be increased[22]. Supplies of native seeds, seedlings, and plants for restoration are also often limited. Policies and supportive programs may be required to develop private nurseries and to ensure adequate supply for the emergent economy of forest restoration[23].

A policy brief on Safeguarding Investments in Forest Ecosystem Restoration recommended: (1) using adapted and genetically diverse seed; (2) allowing ample planning and implementation time - restoration can take up 20 years or more; and, (3) monitoring success at multiple stages[24].

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