International Principles and Standards for the Practice of Ecological Restoration: An Overview

Florida International University
March 5, 2020

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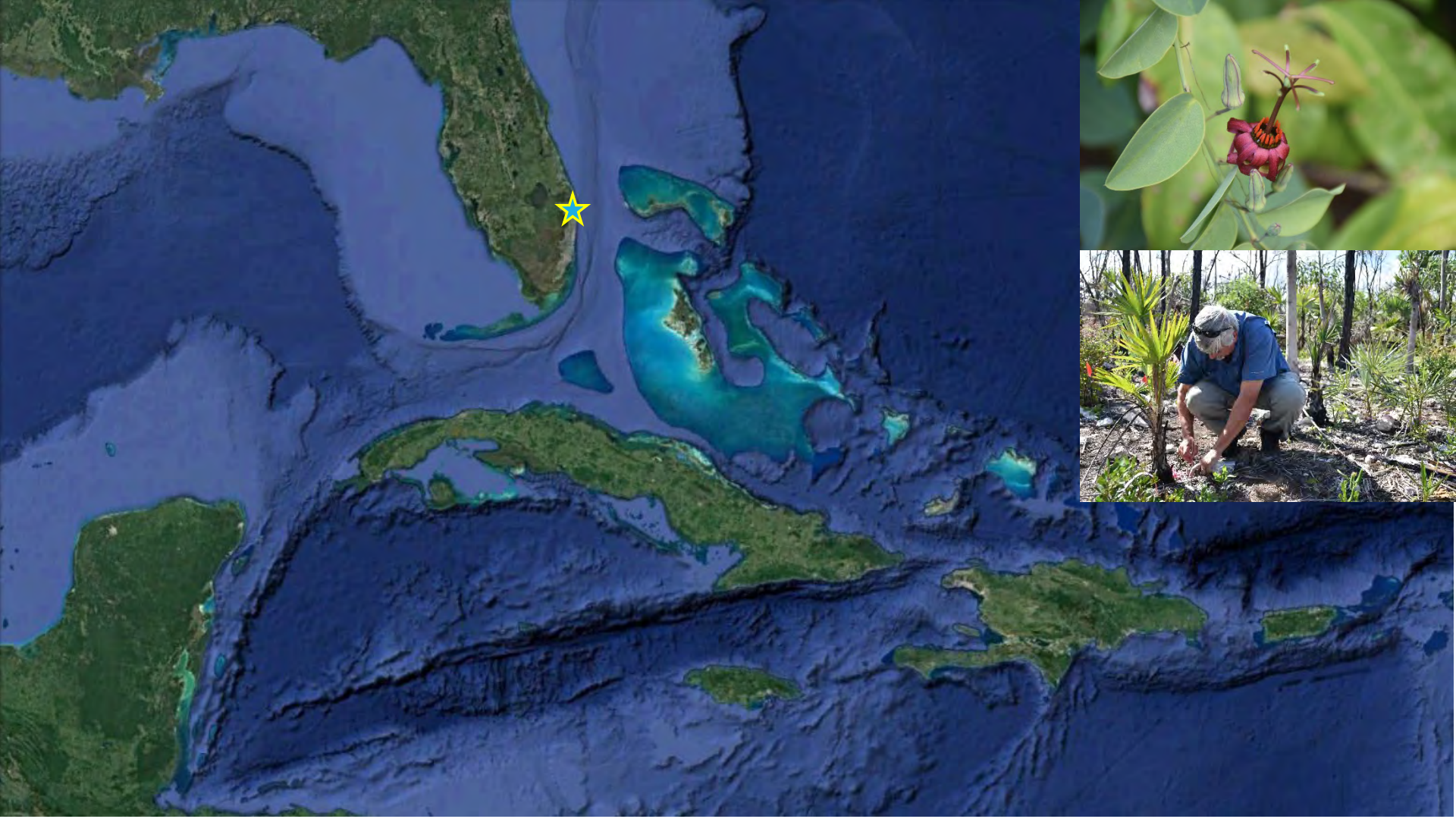


My Neighborhood

George and Bethanie Walder, SER ED, Washington D.C., 2018

Global and Local Perspectives

SER SOCIETY FOR ECOLOGICAL RESTORATION

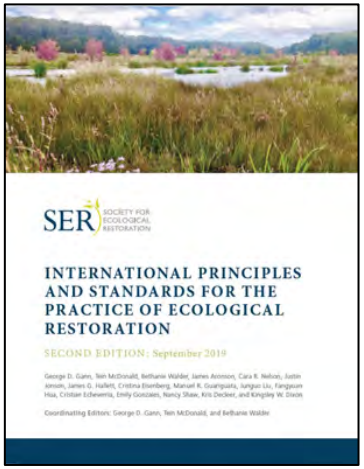
The Institute for Regional Conservation

World Conference on Ecological Restoration
Cape Town, South Africa 2019

Restoration site, No Name Key
National Key Deer Refuge, FL, USA

Outline

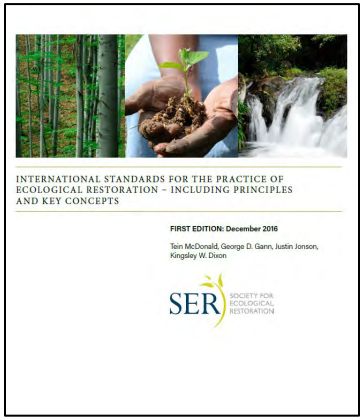
1. Brief History of the SER Standards Process
2. 2nd Edition Launch and Introduction
3. Eight Principles
4. Additional Tools
5. Questions and Discussion

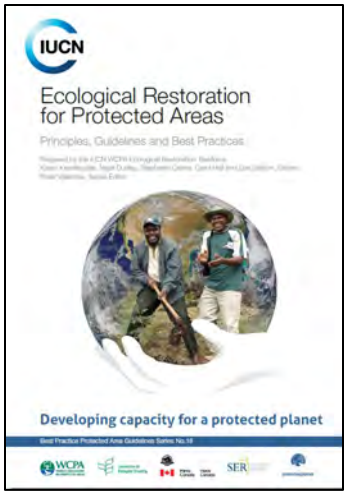


1. Brief History

International Standards for the Practice of Ecological Restoration

- 1st published in 2016
- Built on Australian template
- Adapted for consistency with SER foundation documents, including Ecological Restoration for Protected Areas
- Reviewed by two dozen external reviewers from around the world
- Designed to be a living document
- Four authors from Australia + United States





Goal

The standards are applicable in all types of ecosystems and across all sectors

Slide courtesy Tein McDonald

Main Questions

Is all restoration ecological restoration?

What is the minimum standard for a project to be called an ecological restoration project?

Slide courtesy Tein McDonald

Decades of discussion regarding:

- ***Which*** *target?*
- ***What degree*** *of recovery?*
- ***Direct*** *or* ***indirect*** *activity?*

Camp 1:

'Inclusive at all costs'

Concerned the movement will lose relevance if all related efforts are not encouraged

Camp 2:

'Raise the bar at all costs'

Concerned full inclusion will devalue the term "ecological restoration"

Dual needs for Ecological Restoration

"…global society must secure a **net gain** in the extent and functioning of **native ecosystems** by investing not only in environmental protection, but also in environmental repair including ecological restoration."

We must deliver BOTH

- Biodiversity Conservation
- Ecosystem Services

Why Now?

Global Initiatives & Targets

2016

- Reducing emissions from deforestation and forest degradation (REDD+, UNFCCC)
- UN Convention on Biological Diversity Aichi Biodiversity Targets/post-2020 Targets
- UN Convention to Combat Desertification, Land Degradation Neutrality (LDN) program
- Bonn Challenge/New York Declaration on Forests, expansion of Forest Landscape Restoration (FLR) concept
- UN 2030 Sustainable Development Goals

2019

- Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)
- UN Decade on Ecosystem Restoration from 2021-2030

CBD STAPER – 4 GROUPS, 24 STEPS

Distr.
GENERAL

CBD/COP/DEC/XIII/5
10 December 2016

ORIGINAL: ENGLISH

CONFERENCE OF THE PARTIES TO THE
CONVENTION ON BIOLOGICAL DIVERSITY
Thirteenth meeting
Cancun, Mexico, 4-17 December 2016
Agenda item 10

DECISION ADOPTED BY THE CONFERENCE OF THE PARTIES TO THE CONVENTION ON BIOLOGICAL DIVERSITY

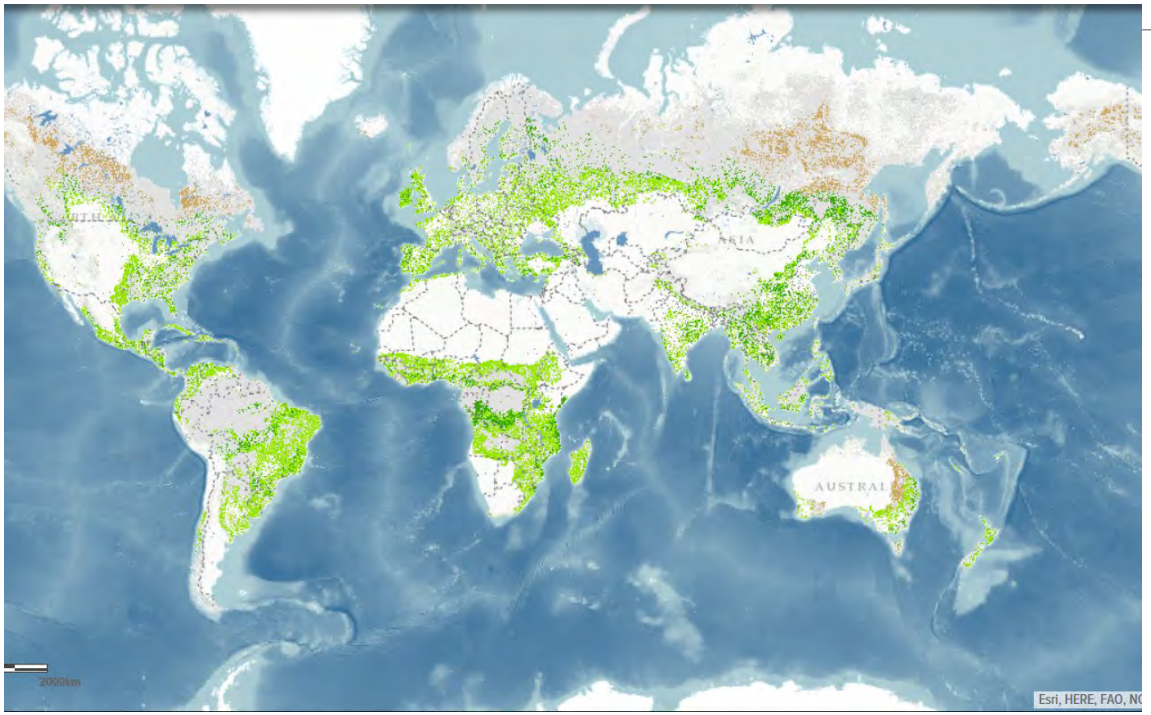
XIII/5. Ecosystem restoration: short-term action plan

The Conference of the Parties,

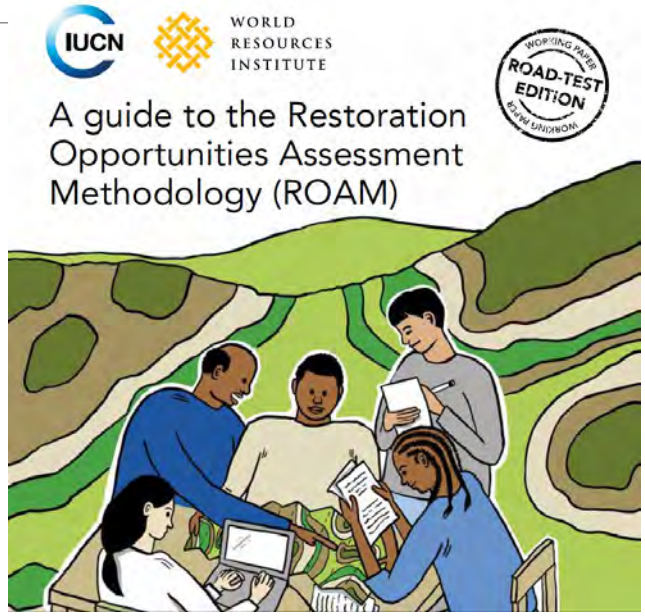
Recalling Article 8(f) and decisions XI/16 and XII/19,

Collaborations
CBD STAPER Companion

FLR Tools and Partnerships



World Resources Institute, IUCN, University of Maryland, 2009



2018

"There has never been a better time to **invest in land restoration**."

"Restoring degraded land has the potential to become **big business**."

"Some entrepreneurs are betting that a **huge new business opportunity** for natural carbon capture and sequestration will emerge as more governments charge a fee for emissions that drive climate change."

1st Edition Standards Launch December 2016

INTERNATIONAL STANDARDS FOR THE PRACTICE OF ECOLOGICAL RESTORATION – INCLUDING PRINCIPLES AND KEY CONCEPTS

FIRST EDITION: December 2016

Tein McDonald, George D. Gann, Justin Jonson, Kingsley W. Dixon

SER SOCIETY FOR ECOLOGICAL RESTORATION

SER AUSTRALASIA SOCIETY FOR ECOLOGICAL RESTORATION

Institute for Regional Conservation

George Gann (IRC, SER)

Tein McDonald (Society for Ecological Restoration Australasia, Australia)

UN BIODIVERSITY CONFERENCE

COP13-COPMOP8-COPMOP2 CANCUN, MEXICO 2016

MAINSTREAMING BIODIVERSITY FOR WELL-BEING

Standards Review

- After publication of the Standards, SER underwent nearly three years of extensive internal and external review, including, e.g., listening sessions, web surveys, knowledge cafés, and published critiques and responses. Four key topics were identified for improvement in the 2nd Edition:
  - strengthen the discussion of cultural-social elements including traditional cultural ecosystems
  - clarify and expand the text related to restoration targets so that readers better understand the need to allow for temporal change
  - improve the restorative continuum with respect to the ecosystem-landscape nexus
  - consider provenance issues for seeds and other propagules


Restoration Ecology

STRATEGIC ISSUES ARTICLE

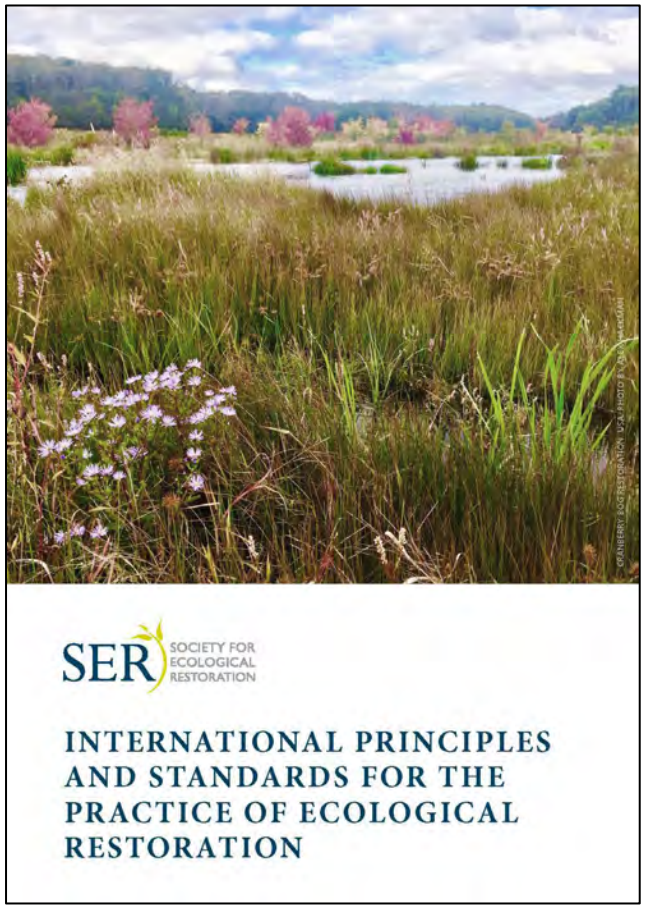
On principles and standards in ecological restoration

Restoration Ecology

RESPONSE ARTICLE

The SER Standards: a globally relevant and inclusive tool for improving restoration practice—a reply to Higgs et al.

2. Launch and Introduction of 2nd Edition



Launched at SER2019 in South Africa, simultaneously in *Restoration Ecology* and by SER.

www.ser.org/Standards

16 authors
7 countries
5 continents

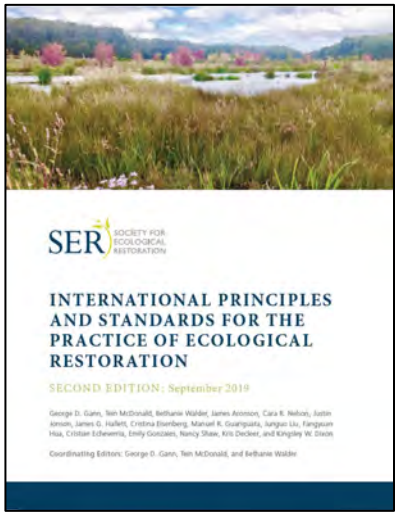
Core writing team of George Gann, Tein McDonald, and Bethanie Walder

Jim Hallet steered publication in RE in coordination with Valter Amaral

George D. Gann, Tein McDonald, Bethanie Walder, James Aronson, Cara R. Nelson, Justin Jonson, James G. Hallett, Cristina Eisenberg, Manuel R. Guariguata, Junguo Liu, Fangyuan Hua, Cristian Echeverría, Emily Gonzales, Nancy Shaw, Kris Decleer, and Kingsley W. Dixon

International Principles and Standards for the Practice of Ecological Restoration. Second Edition

- Introduction
- Eight Principles that underpin ecological restoration
- Standards of Practice for planning and implementing ecological restoration projects
- Leading practices
- Glossary
- Appendices
  - Selection of seeds and other propagules for restoration
  - Project evaluation templates



Section 1: Introduction

- Ecological restoration as a means of conserving biodiversity and improving human wellbeing and its role in broader global initiatives
- Need for principles and standards
- Background (approach)
- What's new in this edition
- Key definitions and terms
- Underpinning assumptions

Key Updates in 2nd Edition

- Title modified; Principles and Key Concepts are merged into a single section of "Eight Principles that Underpin Ecological Restoration"
- The principles are organized to highlight social-economic and cultural components, including a new "Social Benefits Wheel"
- Scaling-up ecological restoration and the relationship between ecological restoration and allied activities are expanded in the principles
- Key topics related to reference models and restoration approaches are in a new Section IV on Leading Practices, including content on:
  - Developing the reference model
  - Identifying appropriate ecological restoration approaches
  - The role of ecological restoration in global restoration initiatives
- Sourcing of seeds and other propagules are included as an appendix

Key Definitions and Terms

- **Ecological restoration (ER)** is the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed. (originally published in SER Primer in 2002)
- Ecological restoration is commonly used to describe both the process and the outcome sought for an ecosystem, but the Standards reserve the term **restoration** for the activity undertaken and **recovery** for the outcome sought or achieved.
- The Standards define ecological restoration as any **activity** with the goal of achieving substantial ecosystem recovery relative to an appropriate **reference model**, regardless of the time required to achieve recovery.
- Other key definitions include **full recovery**, **partial recovery**, **key ecosystem attributes**.

Underpinning Assumptions

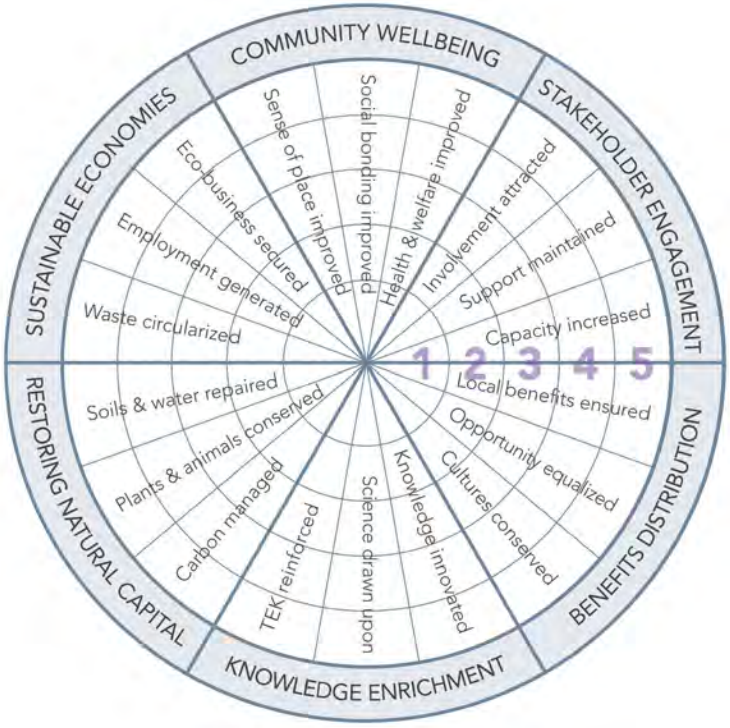
e.g., "…while compensation may be mandated as a result of ecosystem loss or degradation, **the potential for ecological restoration should never be invoked as a justification for destroying or damaging existing native ecosystems or for unsustainable use.**"

3. Eight Principles

Section 2: Eight Principles that Underpin Ecological Restoration

Principle 1

Ecological restoration engages stakeholders



Social Benefits Wheel

Table 1.

Sample social five-star system for evaluating progress toward social goals in a restoration project or program. Social goals will be many and varied. Not all elements in this table will be relevant to all projects. The Social Benefits Wheel can be applied to small- or large-scale projects, with scale used as a multiplier of outcomes, rather than being itself an attribute.

ATTRIBUTE	★	★★	★★★	★★★★	★★★★★
Stakeholder engagement	Stakeholders identified and made aware of project and its rationale. Ongoing communication strategy prepared.	Key stakeholders supportive and involved in project planning phase.	Number of stakeholders, support, and involvement increasing at start of implementation phase.	Number of stakeholders, support, and involvement consolidating throughout implementation phase.	Number of stakeholders, support, and involvement optimal, and self-management and succession arrangements are in place.
Benefits distribution	Benefits to local communities negotiated, ensuring equitable opportunities and reinforcement of traditional cultural relationships to the site.	Benefits to local communities starting and equitable opportunities maintained. Traditional cultural elements integrated, as appropriate, into project planning.	Benefits to locals at an intermediate level and equitable opportunities maintained. Any traditional cultural elements well secured within project implementation.	Benefits to locals at a high level and equitable opportunities maintained. Substantial integration of any traditional cultural elements, increasing reconciliation prospects.	Benefits to locals and equitable opportunities very high, with optimal integration of any traditional cultural elements, substantially contributing to reconciliation and social justice.

Building a Coalition for Restoring the Gold Coast

Official Collaboration

Atlantic Community High School
Boca Raton Community High School
City of Boynton Beach
City of Delray Beach
Fairchild Tropical Botanic Garden
Keep Palm Beach County Beautiful
Gulf Stream School
Milagro Center
Ocean Ridge Garden Club
Sea Turtle Adventures
And more

Funding Committed

Impact 100 Palm Beach County
New York Life Community Impact Grant
City of Boca Raton
Beach Property Owners' Association
Town of Ocean Ridge
New York Life Foundation (Green Delray)
Erin L. Deady Law (Green Delray)
Surfrider Foundation, Palm Beach County
Individual Donors

Principle 2

Ecological restoration draws on many types of knowledge

The practice of ecological restoration requires a high degree of ecological knowledge that can be drawn from **practitioner** experience, **Traditional Ecological Knowledge, Local Ecological Knowledge**, and **scientific discovery**.

Recognition of Local Knowledge is Crucial

Rob Barron, November 2019

Principle 3

Ecological restoration practice is informed by native reference ecosystems, while considering environmental change

Reference ecosystem – a native ecosystem able to act as a **model** for ecological restoration (**as distinct from a reference site**). A reference ecosystem usually represents a nondegraded version of the ecosystem—adjusted to accommodate changed or predicted environmental conditions. Can include **traditional cultural ecosystems**.

Key Ecosystem Attributes

Table 2.

Description of the key ecosystem attributes used to characterize the reference ecosystem, as well as to evaluate baseline condition, set project goals, and monitor degree of recovery at a restoration site. These attributes are suited to monitoring in Principle 5 and the Five-star System discussed in Principle 6.

ATTRIBUTE	DESCRIPTION
Absence of threats	Direct threats to the ecosystem such as overutilization, contamination, or invasive species are absent.
Physical conditions	Environmental conditions (including the physical and chemical conditions of soil and water, and topography) required to sustain the target ecosystem are present.
Species composition	Native species characteristic of the appropriate reference ecosystem are present, whereas undesirable species are absent.
Structural diversity	Appropriate diversity of key structural components, including demographic stages, trophic levels, vegetation strata and spatial habitat diversity are present.
Ecosystem function	Appropriate levels of growth and productivity, nutrient cycling, decomposition, species interactions, and rates of disturbance.
External exchanges	The ecosystem is appropriately integrated into its larger landscape or aquatic context through abiotic and biotic flows and exchanges.

Climate Change and Insurmountable Environmental Change

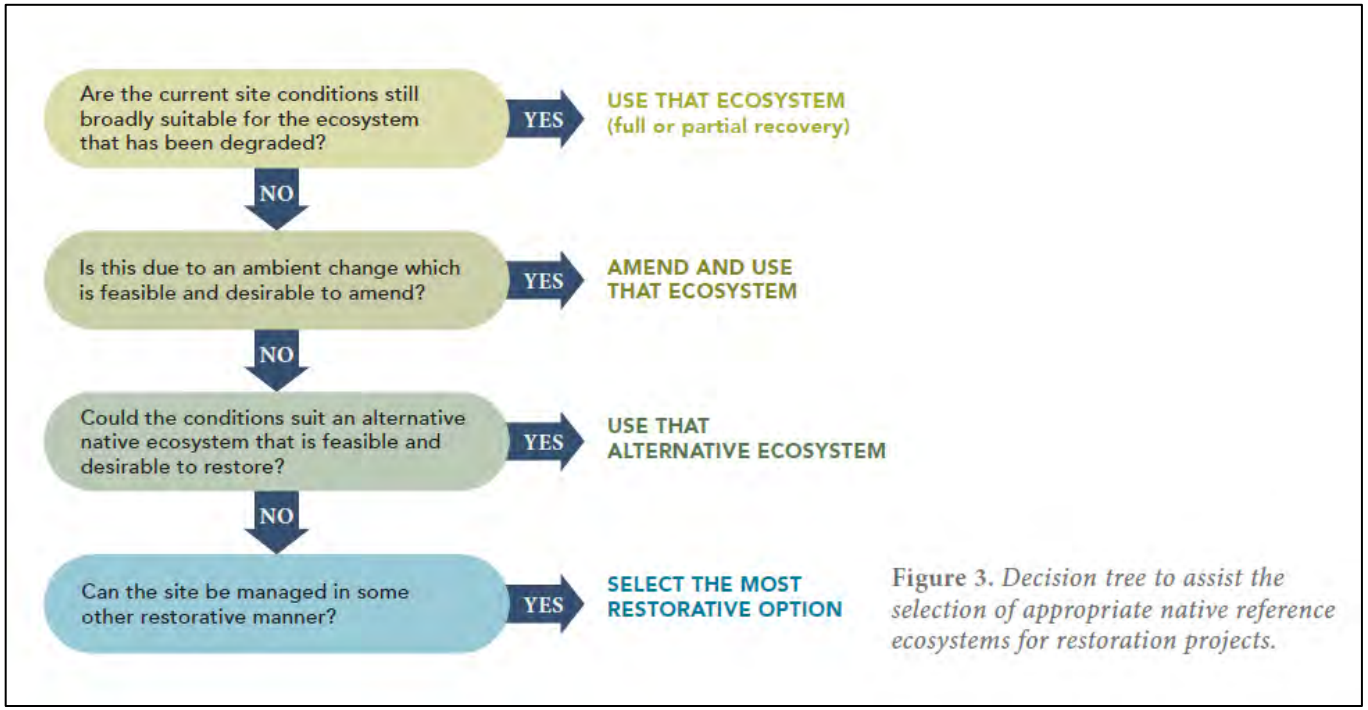


Figure 3. *Decision tree to assist the selection of appropriate native reference ecosystems for restoration projects.*

Wastewater Treatment Area at Green Cay Wetland,
Palm Beach County, Florida

Principle 4

Ecological restoration supports ecosystem recovery processes

All restoration interventions are designed to **assist natural processes** of recovery that ultimately are carried out by the effects of time on physical processes and the responses and interactions of the biota as they go through their life cycles.

Area without restoration

National Key Deer Refuge, Big Pine Key, Florida

Area burned, April 2018, following 1-year restoration activities

Principle 5

Ecological restoration is assessed against clear goals and objectives using measurable indicators

Both ecological and social attributes of the project should be included in the planning phase. **Indicators** can then be used to monitor progress over time, applying adaptive management approaches. **Resources** for appropriate monitoring must to be allocated during the planning phase.

Uncoupling the reference ecosystem from the target

The reference model should describe the native ecosystem as if full recovery were the target.

In projects in which **full recovery** is possible and desirable, the ecological target will align with the reference model.

In projects aiming for **partial recovery**, the target and reference model will not fully align. For example, the target ecosystem may lack some species or include non-native surrogates, or the ecological targets may be modified to meet social targets.


Delray Beach, Florida

Principle 6

Ecological restoration seeks the highest level of recovery possible

Ecological restoration aims for the highest practicable level of recovery appropriate to the circumstances. Recovery can be assessed using the “5-Star Recovery Scale” and the “Ecological Recovery Wheel”

Principle 6

5-Star Scale

(examples from 3 of 6 key attributes)

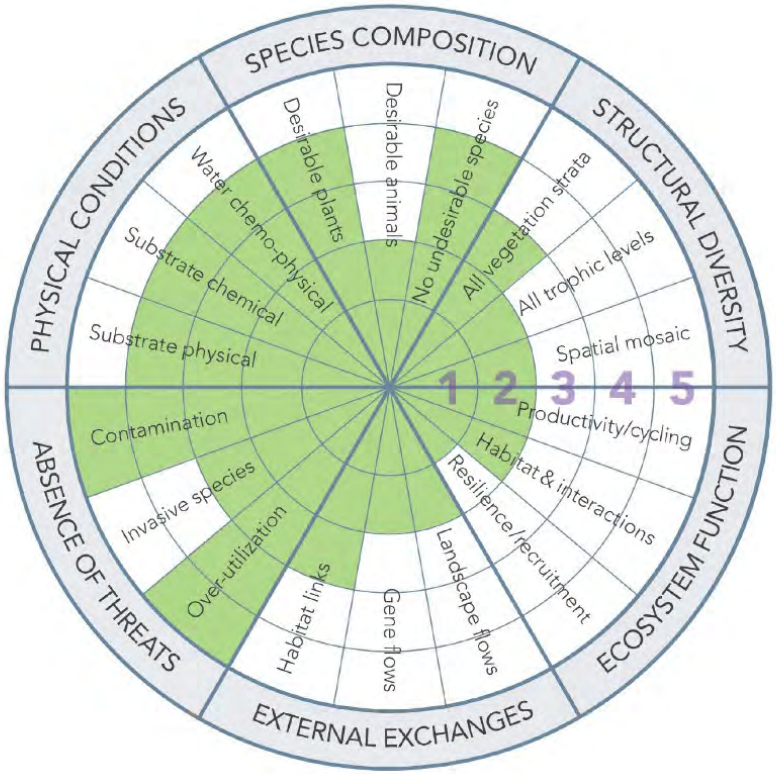
Table 4.

Sample 1-5 star recovery scale interpreted in the context of the six key ecosystem attributes used to measure progress along a trajectory of recovery. This 5-star scale represents a gradient from very low to very high similarity to the reference model. As a generic framework, users must develop indicators and monitoring metrics specific to the ecosystem and sub-attributes they identify.

ATTRIBUTE	★	★★	★★★	★★★★	★★★★★
Absence of threats	Further deterioration discontinued, and site has tenure and management secured.	Threats from adjacent areas beginning to be managed or mitigated.	All adjacent threats managed or mitigated to a low extent.	All adjacent threats managed or mitigated to an intermediate extent.	All threats managed or mitigated to high extent.
Physical conditions	Gross physical and chemical problems remediated (e.g., excess nitrogen, altered pH, high salinity, contamination or other damage to soil or water).	Substrate chemical and physical properties on track	Substrate stabilized within natural range and supporting growth of characteristic native biota.	Substrate securely maintaining conditions suitable for ongoing growth and recruitment of characteristic native biota.	Substrate exhibiting physical and chemical characteristics highly similar to that of the reference ecosystem with evidence they can indefinitely sustain species and processes.
Species composition	Some colonizing native species present (e.g., ~2% of species in the reference ecosystem). Moderate onsite threat from nonnative invasive or undesirable species. Regeneration niches available.	A small subset of characteristic native species establishing (e.g., ~10% of reference). Low to moderate onsite threat from nonnative invasive or undesirable species.	A subset of key native species (e.g., ~25% of reference) establishing over substantial proportions of the site. Very low onsite threat from nonnative invasive or undesirable species.	Substantial diversity of characteristic native biota (e.g., ~60% of reference) present across the site and representing a wide diversity of species groups. Very low onsite threat from nonnative invasive or undesirable species.	High diversity of characteristic native species present (e.g., >80% of reference), with high similarity to the reference ecosystem; improved potential for colonization of more native species over time. No known onsite threat from undesir-

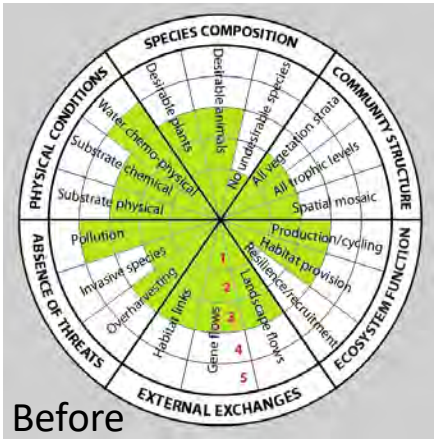
Principle 6

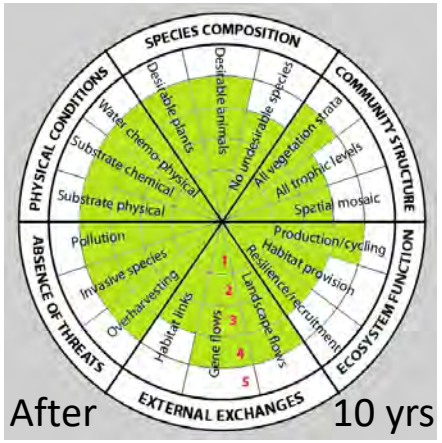
Ecological Recovery Wheel



Principle 6

Case Study: New South Wales, Australia



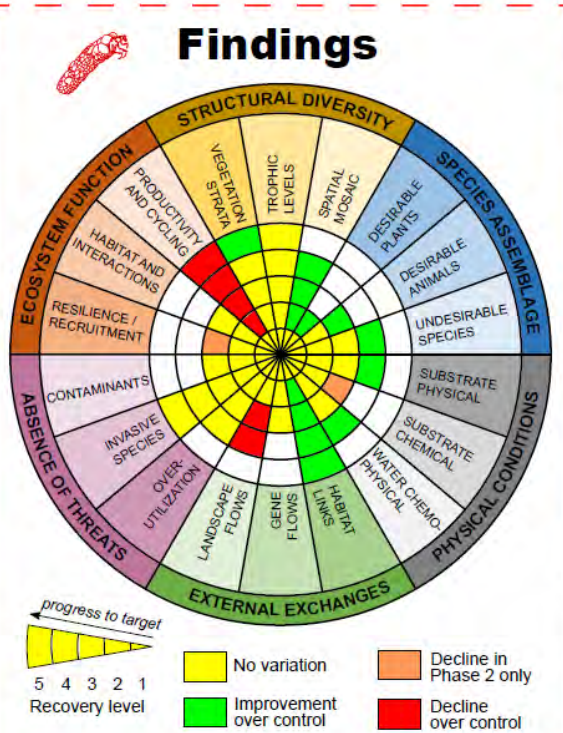


Slide courtesy Tein McDonald

Principle 6

Calibrating the recovery wheel

ECOSYSTEM FUNCTION		
Attribute	***Survey***	***Base index***
Productivity and cycling	Macrophytes	Vegetation cover within river banks
Habitat and interactions	Macro-invertebrates	Count of feeding functional groups (guilds)
Resilience/ recruitment	Macro-invertebrates	Number of taxa recorded for each functional group
ABSENCE OF THREATS		
Attribute	***Survey***	***Base index***
Contam.	Diatoms	Target-adjusted Diatom Trophic Index (TDI)
Invasive-species	Macro-invertebrates, diatoms, macrophytes	Invasivity-adjusted ratio of taxa designated as invasive
Over-utilization	Macro-invertebrates,	Ratio of taxa without resistance form
EXTERNAL EXCHANGES		
Attribute	***Survey***	***Base index***
Landscape flows	Landscape	dPc, distance-and probability-adjusted connectivity index of priority habitats
Gene flows	Macro-invertebrates	Ratio of aerial active and aquatic active taxa
Habitat links	Walkover	Circuit theory model simulation of river substrate and flow distribution

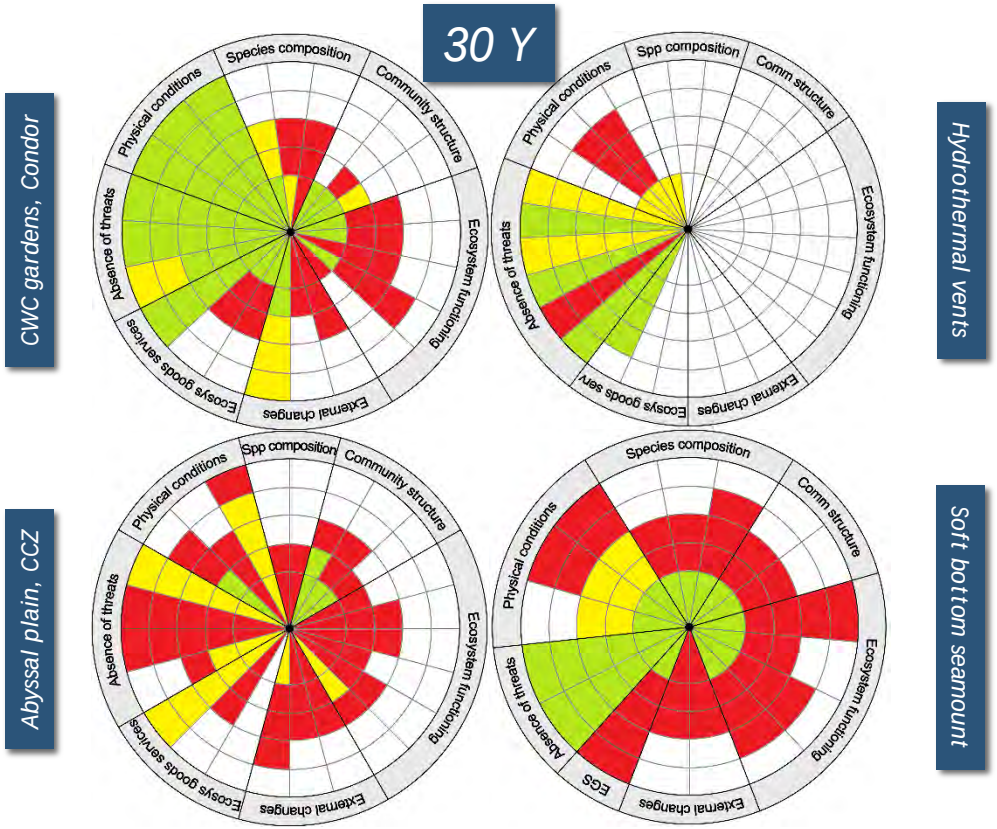


STRUCTURAL DIVERSITY		
Attribute	***Survey***	***Base index***
Vegetation strata	Landscape, macrophytes	Ratio of aquatic and terrestrial habitat layers to target level
Trophic levels	Macro-invertebrates, vertebrates	Count of levels in the trophic web
Spatial mosaic	Landscape	Ratio of seral to climax successional stages
SPECIES ASSEMBLAGE		
Attribute	***Survey***	***Base index***
Desirable plants	Macrophytes	Ratio of recorded taxa to assemblage mentioned in designation
Desirable animals	Macro-invertebrates	Number of recorded Ephemeroptera, Plecoptera and Trichoptera taxa
Undesirable species	Macro-invertebrates	Ratio of eutrophilic and polysabrobic taxa
PHYSICAL CONDITIONS		
Attribute	***Survey***	***Base index***
Substrate chemical	Macrophytes	Target-adjusted RMNI (River Macrophyte Nutrient Index).
Substrate physical	Macro-invertebrates	PSI (Proportion of sediment-sensitive invertebrates)
Water chemo-physical	Macro-invertebrates	WHPT (Whalley, Hawkes, Paisley & Trigg) taxon score average

Fioratti, Marco. 2017. Powering the Recovery Wheel: The development of a framework of quantitative tools to assess the ecological response of a river to restoration. MSc Thesis. Cranfield University.

Principle 6

Calibrating the recovery wheel



6 SEEKS THE HIGHEST LEVEL OF RECOVERY POSSIBLE

MERCES

Principle 7

Ecological restoration gains cumulative value when applied at large scales

Some ecosystem **processes** (such as gene flow, colonization, predation and ecological disturbances) function at larger scales (larger aquatic environment, landscape, watershed, etc.), as do degradation processes.

Some species may have large **minimum habitat areas** (or greater trophic complexity) than is provided by small scale projects unless these are linked within a larger program or to protected areas.

Substantially increasing the scale of **carbon sequestration** through extensive additional plants and animal biomass (including biomass in soils) is also urgently needed.

Thus, ecological restoration needs to be at scales (these may be at the hundreds to the thousands, to millions of hectares) that provide needed environmental and ecological benefits.

Principle 8

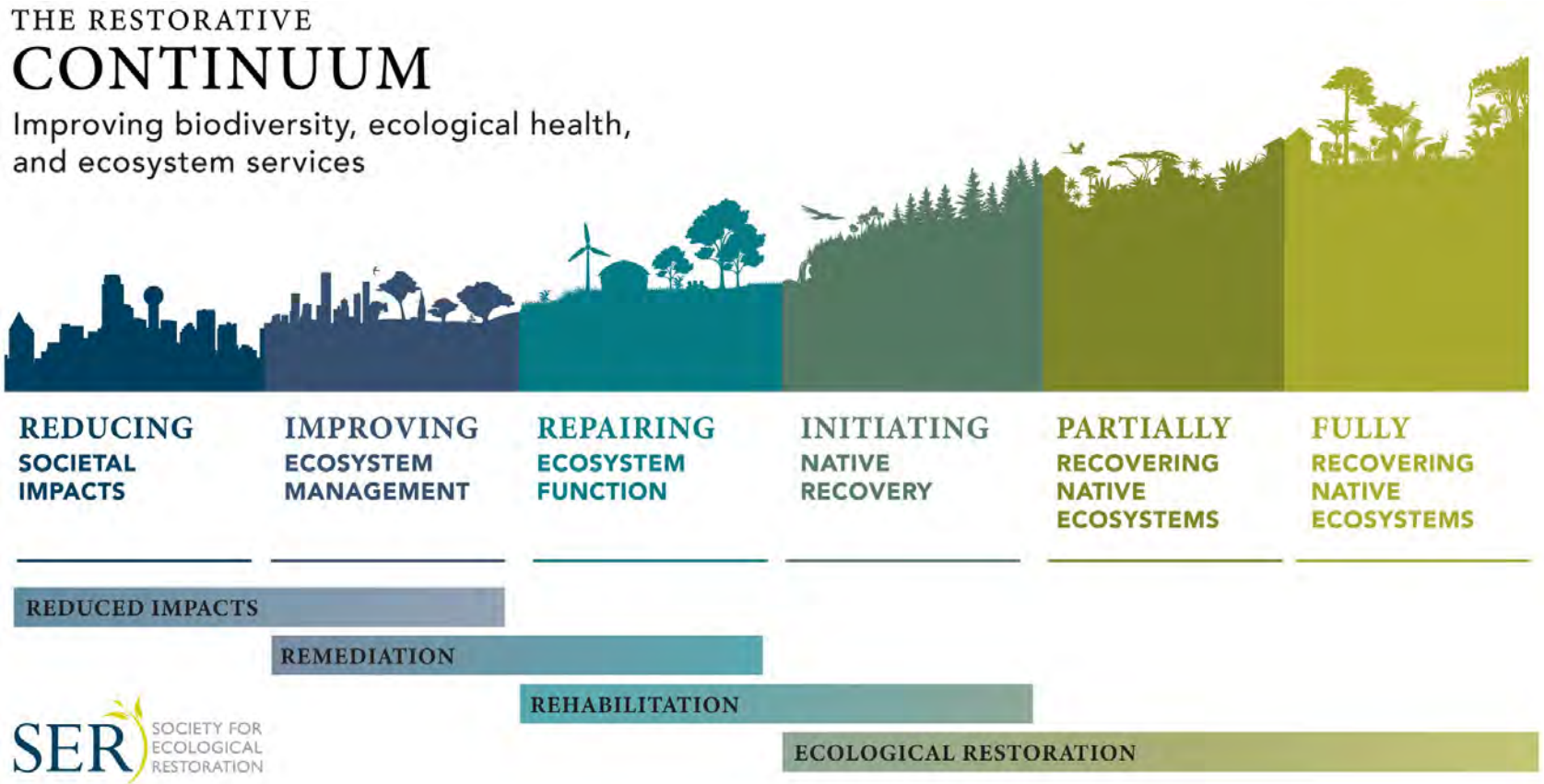
Ecological restoration is part of a continuum of restorative activities

Ecological restoration is **one part** of a range or family of restorative activities that can be conceived as occurring along a continuum. The concept of a restorative continuum ensures a holistic approach to repairing the world's ecosystems.

Restorative activities reduce degradation or improve conditions for the partial or full recovery of ecosystems.

All activities that are restorative, no matter the scale, are important and are valued.

Principle 8


THE RESTORATIVE
CONTINUUM
Improving biodiversity, ecological health, and ecosystem services
REDUCING SOCIETAL IMPACTS
IMPROVING ECOSYSTEM MANAGEMENT
REPAIRING ECOSYSTEM FUNCTION
INITIATING NATIVE RECOVERY
PARTIALLY RECOVERING NATIVE ECOSYSTEMS
FULLY RECOVERING NATIVE ECOSYSTEMS
REDUCED IMPACTS
REMEDIATION
REHABILITATION
ECOLOGICAL RESTORATION
SER SOCIETY FOR ECOLOGICAL RESTORATION

4. Additional Tools

Section 3: Standards of Practice for Planning & Implementation

I. Planning and Design

II. Implementation

III. Monitoring, documentation, evaluation, and reporting

IV. Post-implementation maintenance

Section 4: Leading Practices

- Developing the reference model
- Identifying appropriate ecological restoration approaches
- The role of ecological restoration in global restoration initiatives

Developing the reference model

The reference model should account for multiple ecosystem attributes and their variation within the target ecosystem, as well as overall ecosystem complexity and dynamics (i.e., changes over time).

Best practices include:

- Utilizing a broad set of ecosystem attributes
- Recognizing complexity
- Incorporating change
- Using multiple reference sites
- Using multiple reference models when appropriate

Identifying Appropriate Ecological Restoration Approaches

Three **approaches** may be used singly or in combination if appropriate. All of them utilize natural recovery processes and require ongoing adaptive management until recovery is attained.

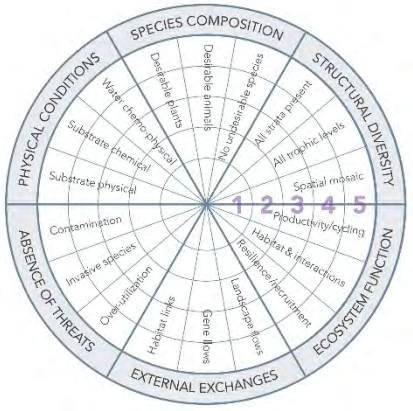
- Natural (or spontaneous) regeneration
- Assisted regeneration
- Reconstruction

The Role of Ecological Restoration in Global Initiatives

- Ecological restoration plays a critical role in a host of global restoration initiatives
- Ecological restoration is being scaled up
- Large scale initiatives often utilize landscape restoration approaches, including:
  - Landscape restoration
  - Forest landscape restoration
  - Ecological restoration
- For ecological restoration to be included in landscape restoration the restoration targets and goals must meet human needs (though they are not limited to meeting human needs)
- When delivered at the landscape level, integrated approaches that incorporate multiple types of restorative activities along the continuum are most likely to be successful

Glossary and Appendices

- Section 5: Glossary
- Appendix 1: Selection of seeds and other propagules for restoration
- Appendix 2: Blank social benefits and ecological recovery wheel templates
- Supplement 1 (online): Generic principles that underpin ecological restoration and allied activities

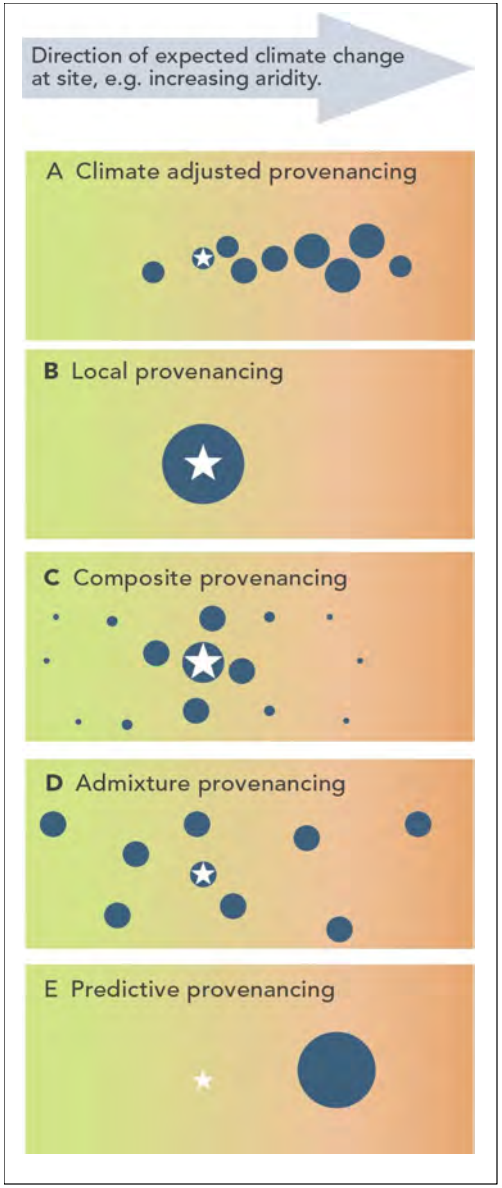


Selecting Seeds & Other Propagules

- Genetic considerations for sourcing seeds and other propagules
  - the degree of local adaptation varies by species, population, and habitat
- Climate change and propagule sourcing
  - Addressing changes in the climate “envelope” or “niche”
- Tools and future directions
- Restoring connectivity and facilitating species migration
- Includes considerations for animals

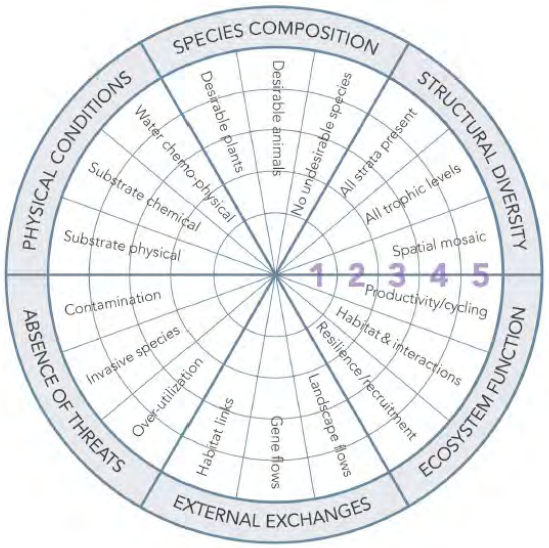
Provenancing strategies for revegetation (reprinted from Prober et al. 2015). The star indicates the site to be revegetated and the circles represent native populations used as germplasm sources. The circle size indicates the relative quantities of germplasm included from each population at the revegetation site.

These strategies can also be applied to animals and soil biota.



Appendix 2

APPENDIX 2: BLANK PROJECT EVALUATION TEMPLATES (for practitioner use)



Recovery wheel template

WWW.SER.ORG/STANDARDS

Recovery Wheel

You can access the recovery wheel through several resources.

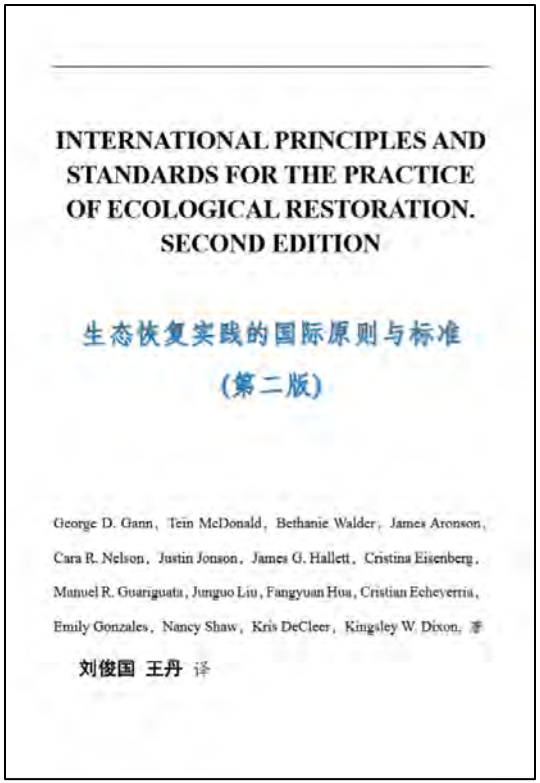
- Download a PDF of the blank recovery wheel and data sheet here.
- An interactive version of the recovery wheel is available online.
- An Excel version of the recovery wheel is available here.
- An interactive wheel is available as an app for Android, iPhone, and iPad.

E-learning Course

SER also developed a free e-learning course to introduce practitioners and professionals to the core components of restoration and how to implement the Standards on the ground. This course is currently being adapted to reflect updates from the second edition of the Standards.

This course is **free** and available online here.

Available in Chinese
More Languages Coming Soon



INTERNATIONAL PRINCIPLES AND STANDARDS FOR THE PRACTICE OF ECOLOGICAL RESTORATION. SECOND EDITION

生态恢复实践的国际原则与标准

(第二版)

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