Scaling up ecological restoration (ER) & related restorative activities.

*Getting serious about biodiversity & sustainability.*

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1. Basic concepts, definitions & challenges
2. Networks; what’s happening in the Mediterranean?
3. Scientific & conceptual gaps in the Mediterranean
4. Selected challenges in the Mediterranean region
5. Need ER that is scalable, transferable and measurable.
Ecological restoration:

“The process of assisting the recovery of ecosystems that have been degraded, damaged or destroyed.” (www.ser.org/Primer, 2004)

SER Mission statement: … to promote ecological restoration as a means of sustaining the diversity of life on Earth and reestablishing an ecologically healthy relationship between nature and culture.
* Ecological Restoration is a process, not a single event.

* Ecological Rehabilitation is a closely related activity which addresses economic as well as ecological concerns.

* Both are part of a Family of Restorative Activities to be applied at landscape and larger spatial scales.
Walk like the chameleon: with one eye looking forward, & the other one looking back. Malagasy proverb.

**Learning from the past** as we chart a way forward.

**HRH Princess Basma of Jordan.**
**Ecol. Rehabilitation** focuses on functions & services; productivity.

**Ecological Restoration** also aims to recover full ecosystem content & structure.

Cf. historic continuity, processes & pattern; biodiversity, Ecosystem services; ability of restored ecosystem to adapt to changing conditions.
Southern French Alps, 1876. RTM*

* *Restauration de Terres de Montagne*

(Photo: French Gov’t archives; see Vallauri et al. 2002)
How to choose the reference?
Table 1. Types of reference information used to document and infer change in composition (including invasions and extirpations), structure, dynamics, and physical factors.

<table>
<thead>
<tr>
<th>Current Conditions</th>
<th>Historic Records</th>
<th>Legacy and Latency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate variables</td>
<td>Data on composition and structure</td>
<td>Fire scars</td>
</tr>
<tr>
<td>Topography and hydrology</td>
<td>Written and oral history</td>
<td>Snags and coarse woody debris</td>
</tr>
<tr>
<td>Soil and substrate</td>
<td>Historic photos</td>
<td>Dendrochronologies and age structure</td>
</tr>
<tr>
<td>Spatial context</td>
<td>Land survey records</td>
<td>Pollen, spores, and microfossils</td>
</tr>
<tr>
<td>Composition, structure, and dynamics</td>
<td>Management and land use records</td>
<td>Macrofossils and subfossils</td>
</tr>
<tr>
<td>Successional trends</td>
<td>Fire records</td>
<td>Geomorphological features (e.g., meander bends)</td>
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<tr>
<td></td>
<td>Hydrologic records</td>
<td>Relict distributions</td>
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<td></td>
<td>Weather records</td>
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</table>
Reference models


What distinguishes ecological restoration (ER) from ecological engineering (EE)?


<table>
<thead>
<tr>
<th>Attribute</th>
<th>Ecological restoration</th>
<th>Ecological engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predictability</td>
<td>Once ecosystems recover their historical trajectory, the final outcome is not entirely predictable</td>
<td>The final outcome is set by the services desired from the ecosystem</td>
</tr>
<tr>
<td>Complexity</td>
<td>Complexity builds over time as a consequence of constant species turnover</td>
<td>Given the low number of species required for most intended services, the amount of interactions generated, and thus, complexity is low</td>
</tr>
<tr>
<td>Long-term cost</td>
<td>Although restoration will likely need of a series of interventions to recovery the historical trajectory, it should have not maintenance costs other than normal land management costs</td>
<td>To keep a high delivery of services, engineered ecosystems require regular maintenance costs. These costs will likely be orders of magnitude larger than standard land management costs</td>
</tr>
</tbody>
</table>
2. Relevant networks

- Society of Ecological Restoration
- SIACRE
- Restoring Natural Capital Alliance
- Ecosystem Services Partnership
- Global Partnership of FLR
- Ecological Restoration Alliance of Botanic Gardens
HIGHLIGHTS:

3. Key scientific & conceptual gaps in the Mediterranean
   * trees past, present & future
   * soils & soil-borne biota
   * genetic issues (ethics 1)

4. Selected challenges: focus on Mediterranean region
   * selecting or constructing a landscape-scale reference
   * ecology, hydrology, geomorphology
   * cultural, economic, political (ethics 2)
SER Primer attributes of a restored ecosystem.

• **State Attributes (including composition, structure, functions).** Restored ecosystems exhibit 3-D structure, function, dynamics.

• **Temporal attributes (including dynamics and resilience).** Restored ecosystems develop complex ecological structures that facilitate niche differentiation and habitat diversity.

• **Connectivity Attributes (relationship to the rest of the world).** Good governance and sound legal structures required.
Choosing attributes of the restored ecosystem IN A GIVEN LANDSCAPE will help in planning, and monitoring & evaluation at landscape scale.

- Structure, composition & functioning (ecological). PLUS
- Cost-effectiveness of the investments.
- Integration of each ecosystem and people in larger spatial and temporal contexts.

HIGHLIGHTS:
5. Need ER that is scalable, transferable and measurable.
6. Add concepts and tools of Restoring Natural Capital, and Families of Restorative Activities to help bridge all the gaps.
Nature conservation (or climate change mitigation) vs. economic development??

These are false dichotomies...
Institutions & human judgments determining (the use of) services

Management & restoration for sustained use

Renewable Natural Capital

Biophysical Structure & processes
(e.g. vegetation cover or Net Primary Productivity)

Functions
(e.g. slow water passage, biomass)

Services
(Flood control, Crop pollination, etc.)

Benefits
(contribution to health, safety, etc.)

Total economic Value

Feedback between value perception and use of ecosystem services

Human Society

Restoring Natural Capital (RNC) includes:

a) restoration of degraded ecosystems,
b) ecological & economic rehabilitation of production systems farms, tree farms, etc.)
c) ecological improvements in extraction, urbanization, transport, etc.) &
d) incorporation of awareness of the value of natural capital into daily activities, schools, etc.
Family of restorative actions: site or ecosystem level (Aronson et al. in press).

- **Ecological restoration** – Full recovery of ecosystem structure, composition, function and services. Generally applied to ‘natural’ systems.
- **Ecological rehabilitation** – Partial or full recovery of ecosystem processes, functions, and services. Mostly applied to semi-cultural systems.
- **Reparation & recuperation** – Partial recovery of ecosystem-based productivity and services, incl. reforestation & soil health.
- **Environmental remediation** – Clean-up, decontamination and recovery of e.g. polluted ground water, mine tails, oil spills.

Increased supply and value of the stock of natural capital.
(Aronson et al. in press; Annals Missouri Botanical Garden).
Global-scale
Landscape-scale

Project-scale

Climate amelioration
Socio-economic and institutional context

Fight against desertification

Biodiversity conservation

RNC

Thanks for your interest in ecological restoration and restoring natural capital!

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and

www.ser.org
www.bgci.org/ERA
www.rncalliance.org