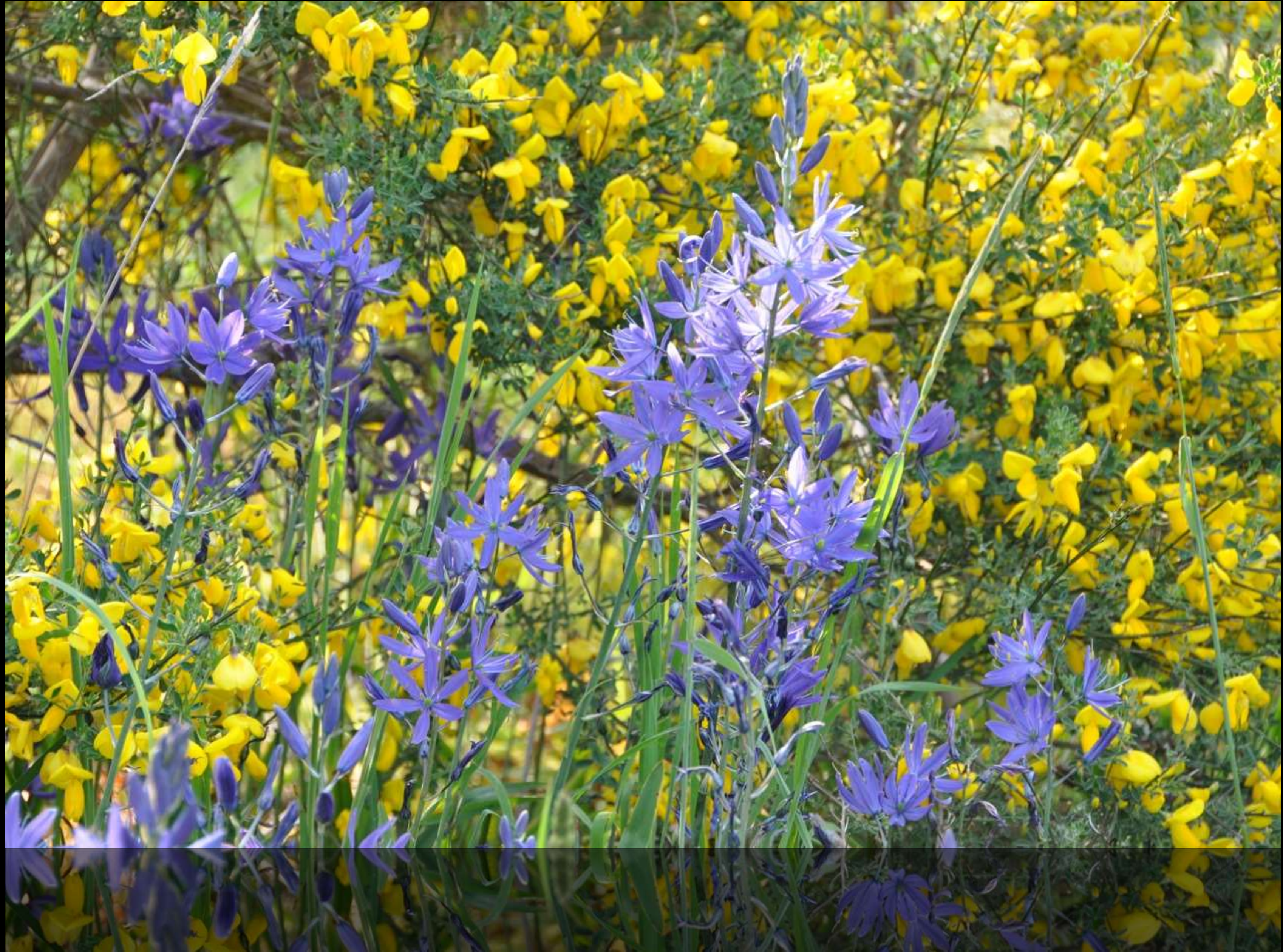


# Causes of novelty

- disconnection from historical ecosystems
- connectivity to hybrid/novel ecosystems
- altered disturbance rates and extent
- altered trophic interactions
- subsidized predators/invaders
- propagule pressure
- climate change....



Regional threatened Garry oak (*Quercus garryana*) ecosystems





# Abandoned plantations



(Photo: flickr / glennhurowitz)



Tropical agrisystems: Puerto Rico, Costa Rica, Mauritius, etc



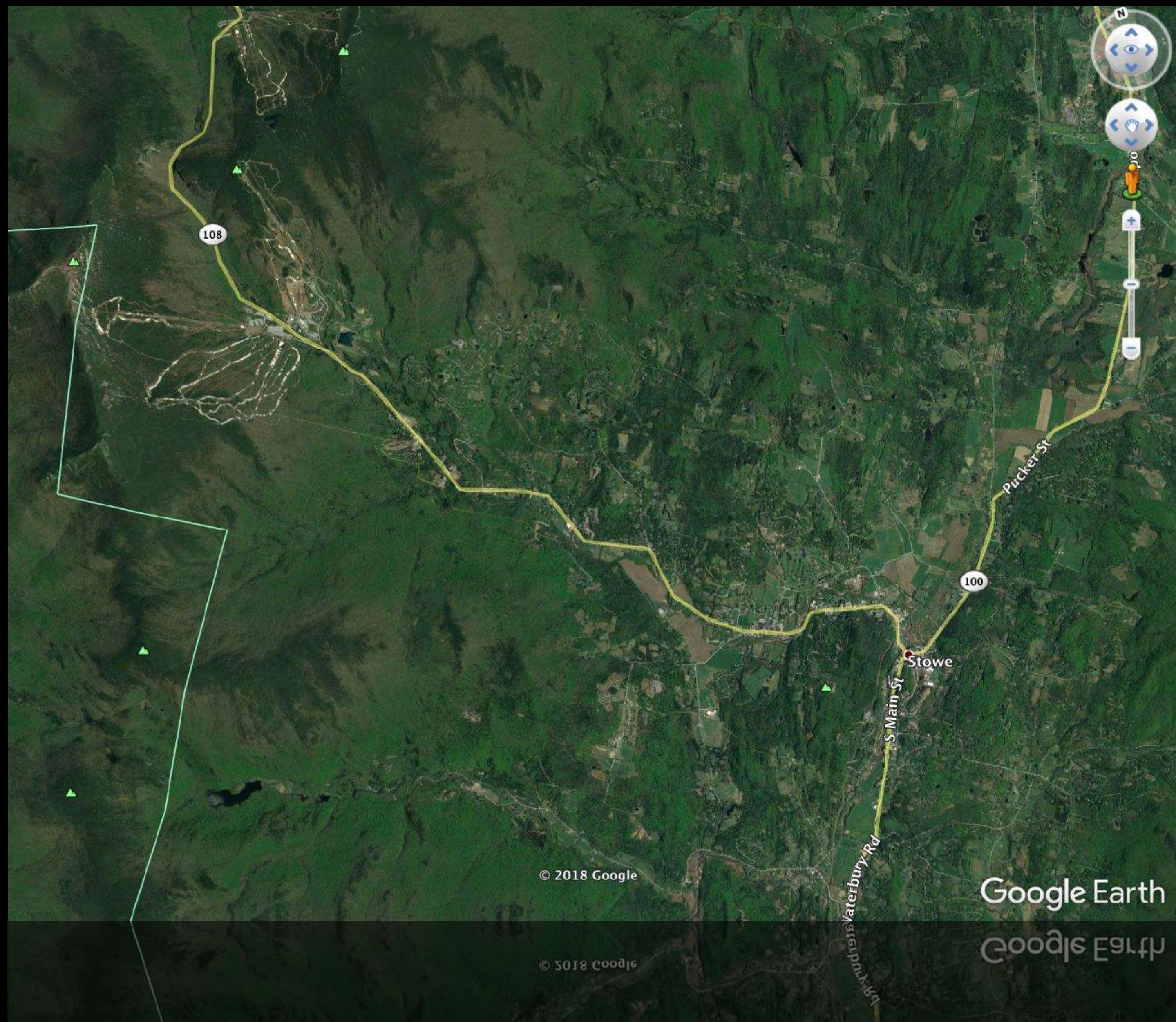


Mt. Sutro, San Francisco





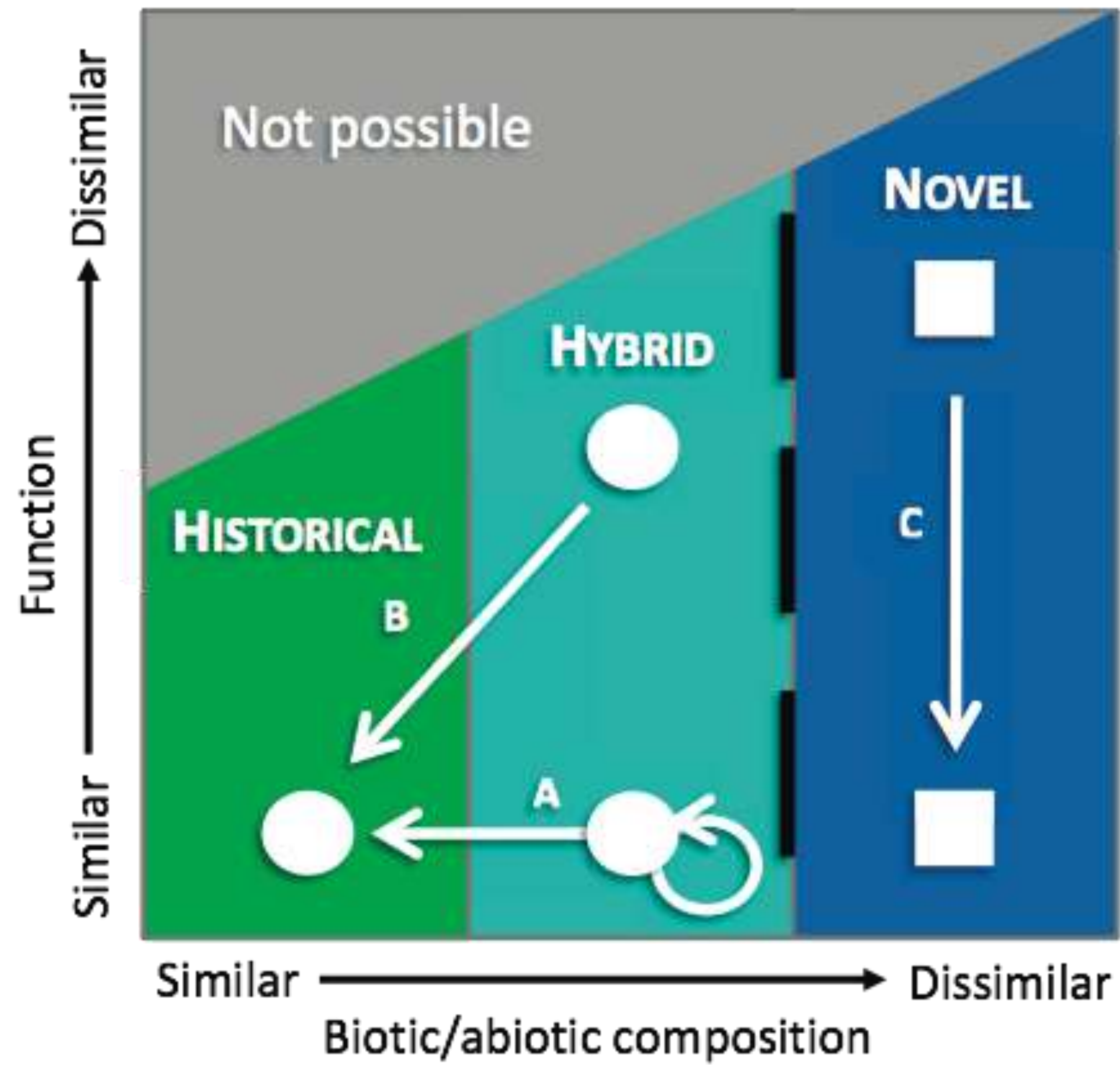
Abandoned farmlands: eastern Canada, eastern USA






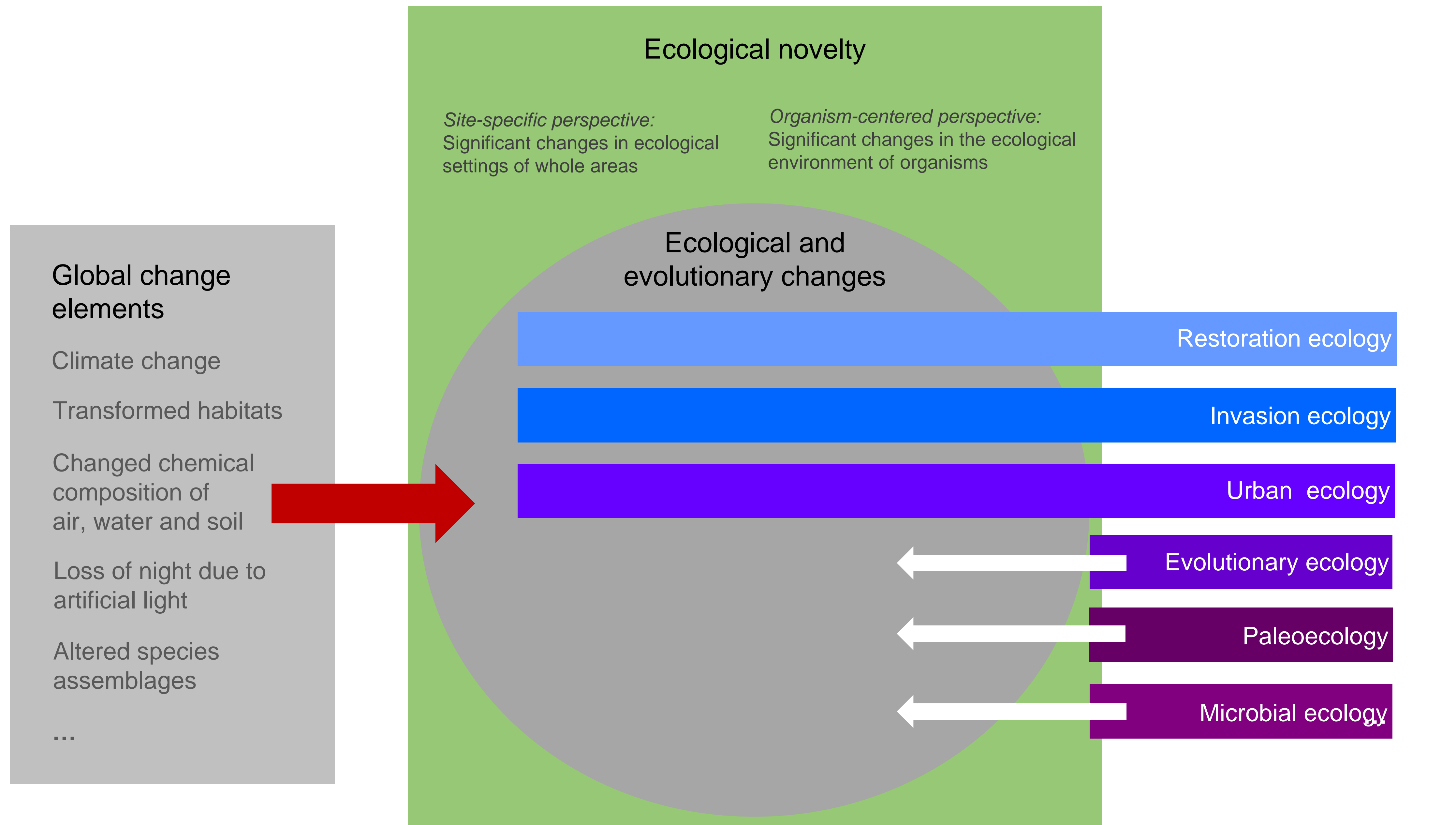




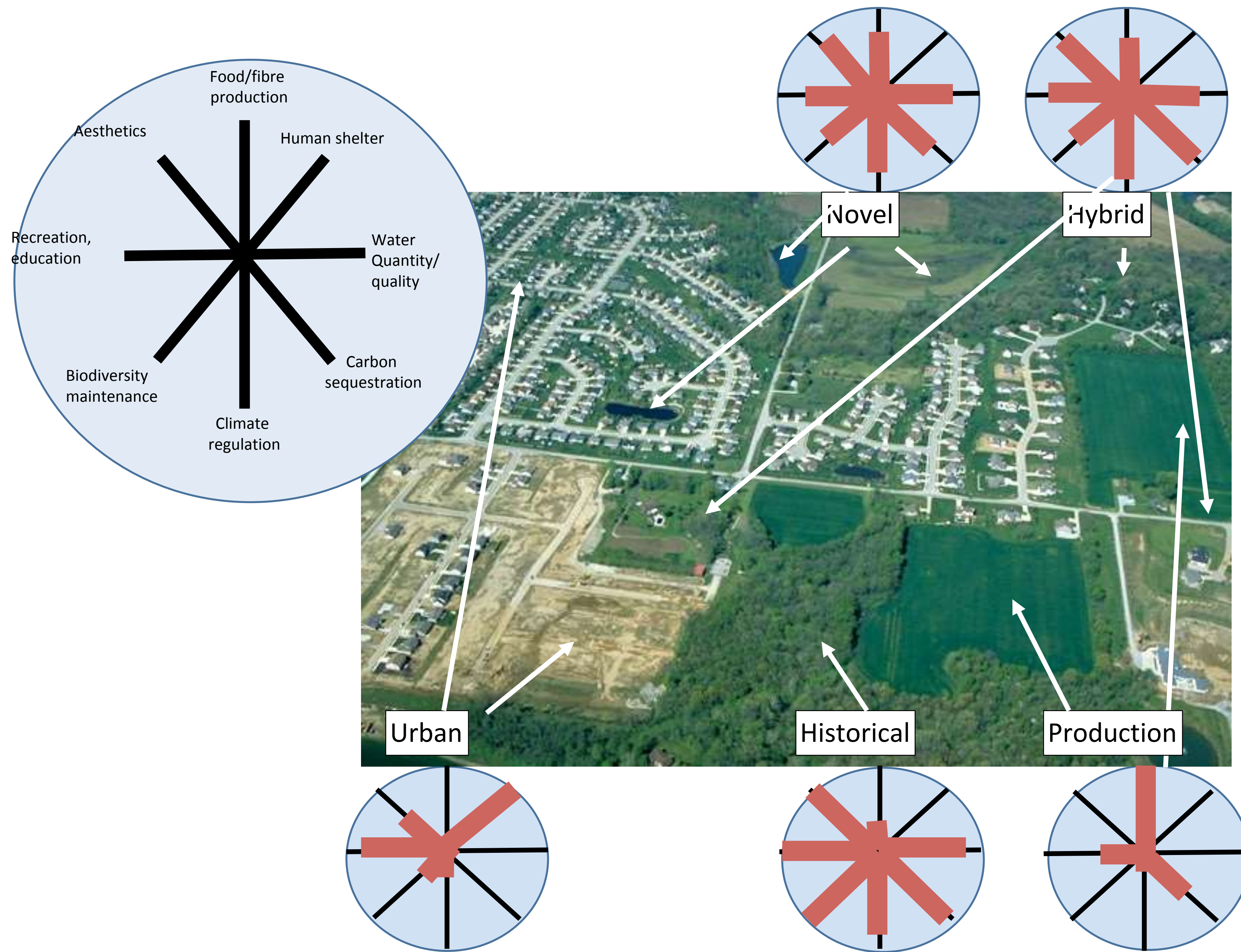


 Restoration threshold

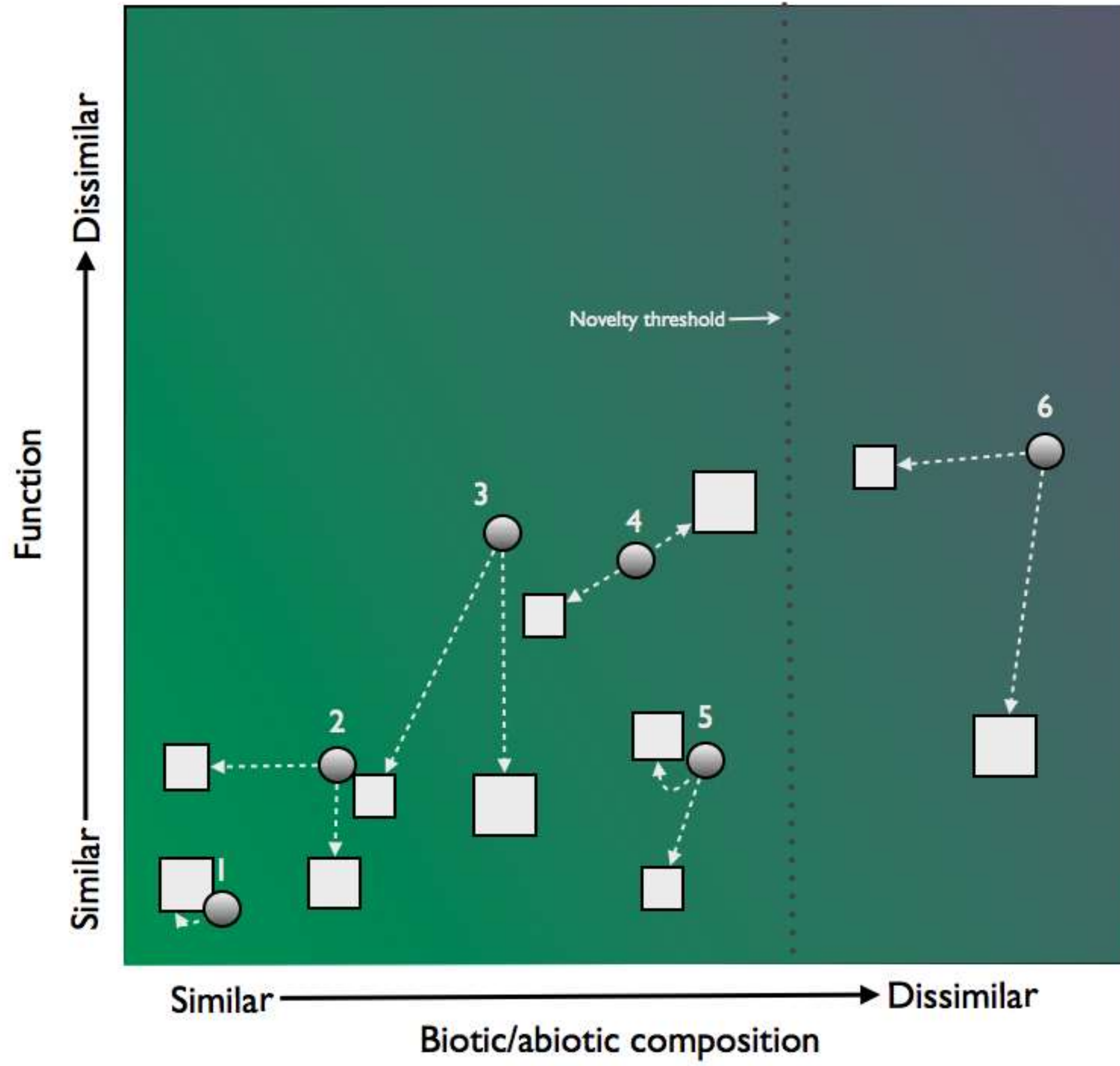












Hobbs RJ, Higgs ES, Hall CM. Expanding the Portfolio: Conserving Nature's Masterpieces in a Changing World. *BioScience*. 2017;67(6):568–75.



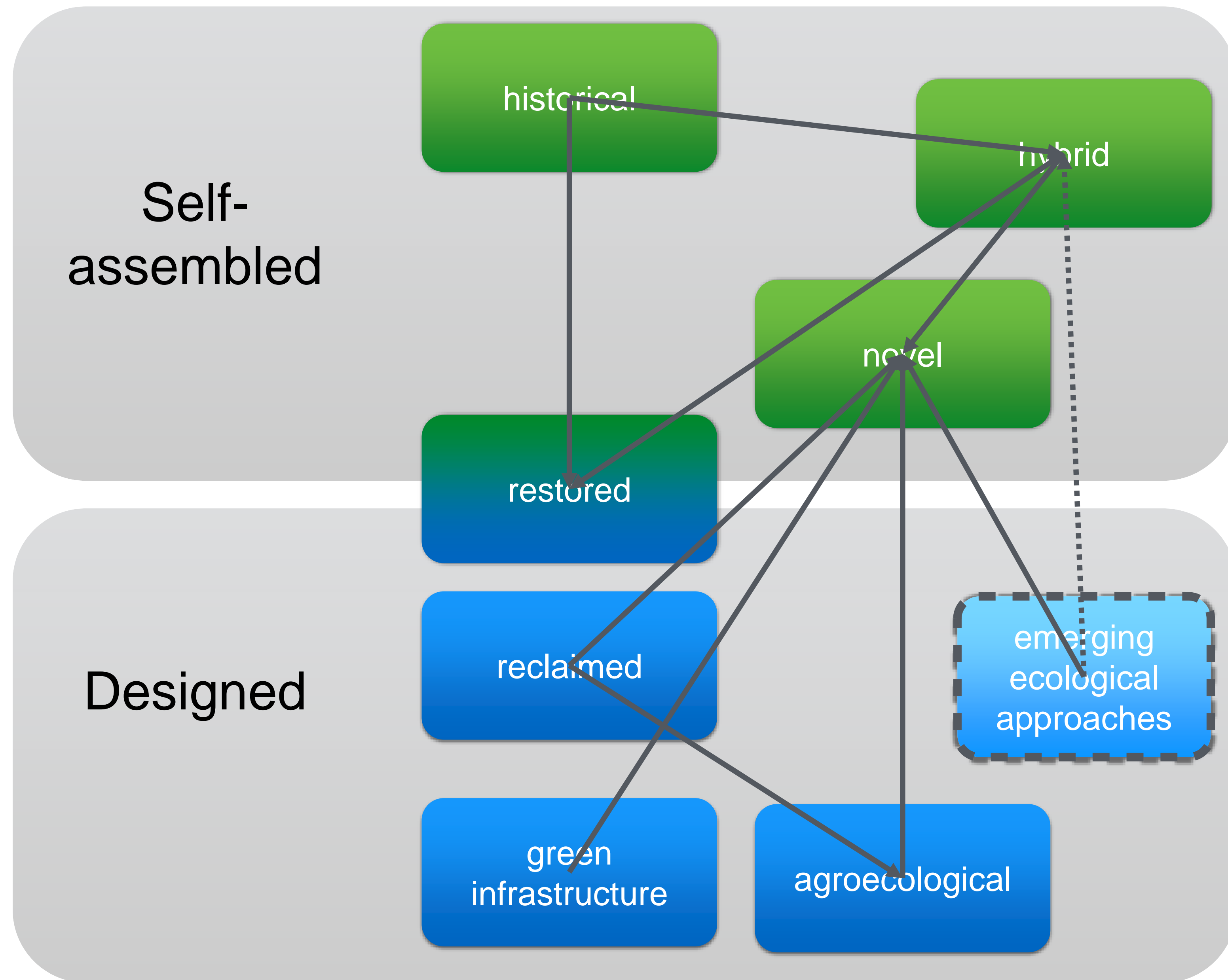
Can we engage novel ecosystems without ambition and hubris taking over?

How can biodiversity and ecological autonomy be respected?

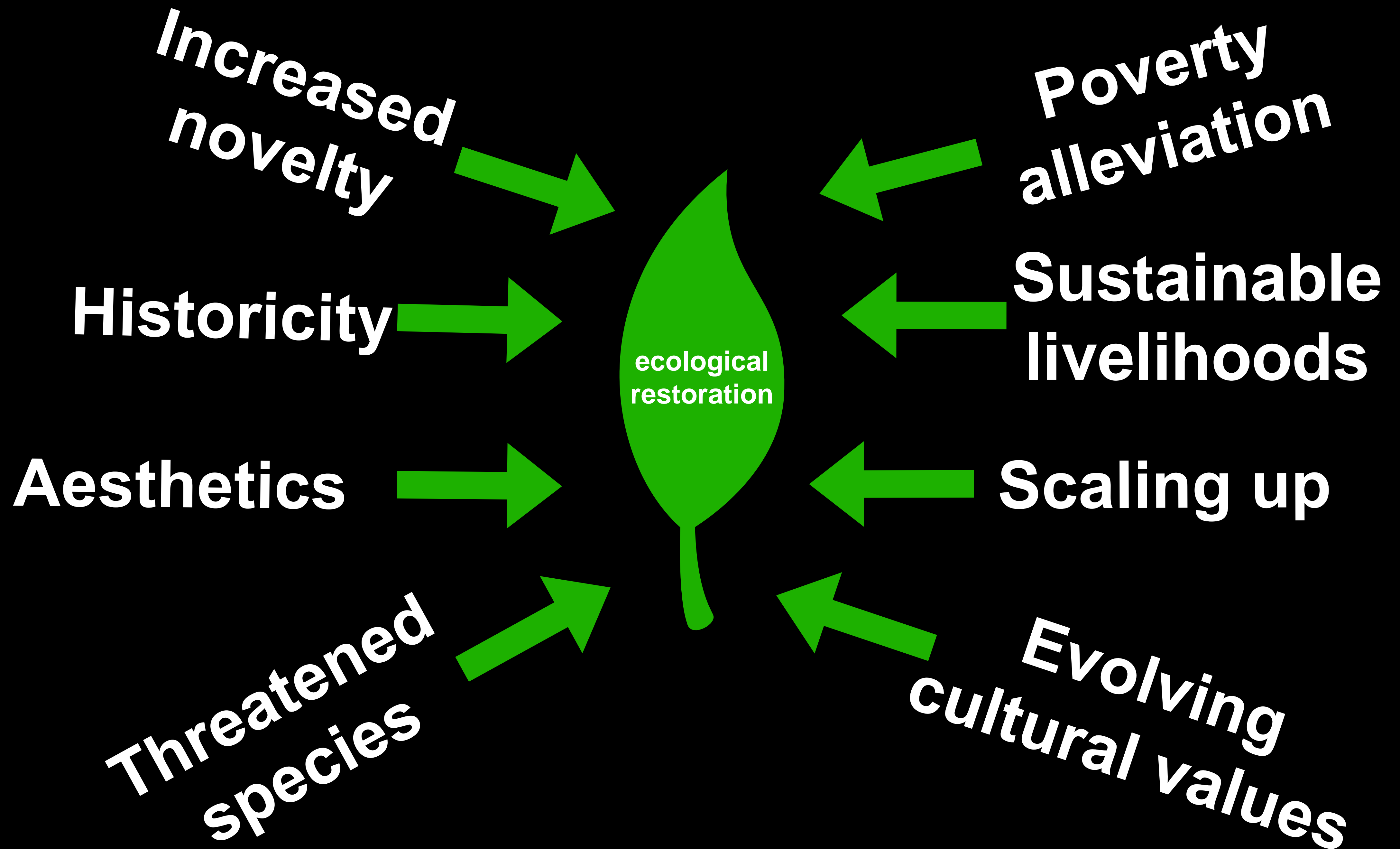
How do we act responsibly in ecosystems lacking historical continuity?

**Standish, Thompson, Higgs & Murphy, 2013. Concerns about novel ecosystems.**



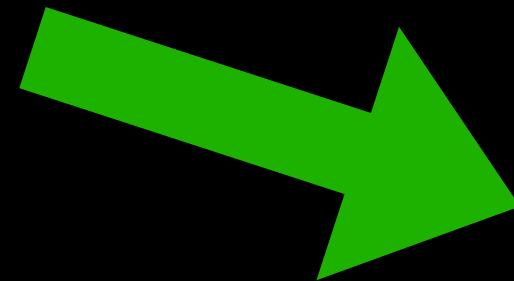




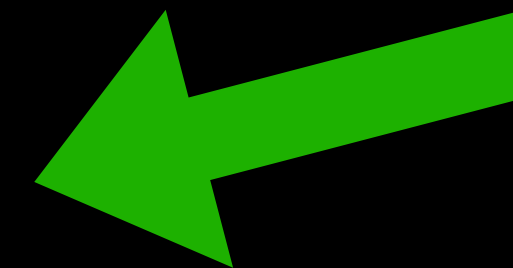




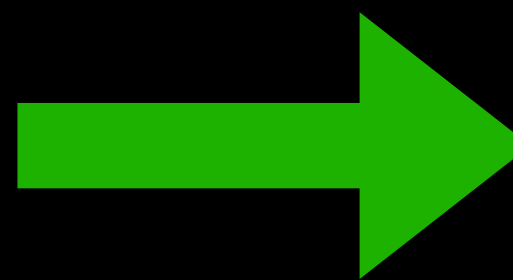
**Species re-  
introductions**



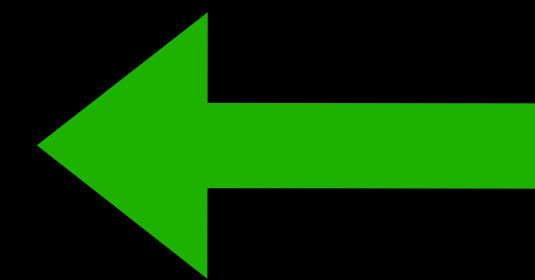
**Bio-novelty**



**Rewilding**

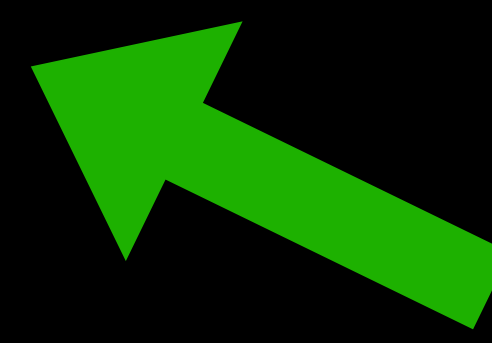
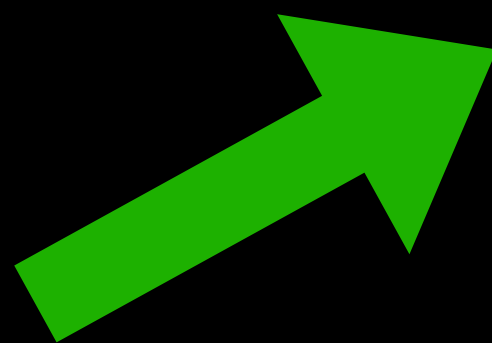


**ecological  
restoration**



**Forest  
Landscape  
restoration**

**Reclamation**



**Ecological  
design**



# Keep ecological restoration open and flexible

To the Editor — The stakes are high as investment commitments to ecological restoration intensify<sup>1</sup>. The ‘international standards’ published by the Society for Ecological Restoration (SER)<sup>2</sup> and the adoption of a narrow definition of restoration by the United Nations Convention to Combat Desertification (UNCCD)<sup>3</sup> are indications that restoration is moving away from the open and flexible approach that we believe is needed to address responsible intervention in times of rapid change.

Restoration science originated in the idea that ecosystems could be returned to a defined pre-disturbance condition. This served as a proxy for improving biodiversity, structural attributes and functional traits, as well as for eliminating degradation. Now, three types of change are forcing restoration as a science and practice to reassess appropriate interventions in ecosystems. First, rapid environmental, ecological and cultural changes — ranging from climate change, to species invasions, to the rise of ecosystem-services valuation — are shifting the scope of traditional restoration. Second, innovation at the intersection of ecology, design and engineering is producing new types of ecosystem, such as green infrastructure, agroecosystems and naturalized landscapes. Third, investment in restoration has increased dramatically through major international agreements and conventions.

Restoration is positioned to become a go-to approach for addressing future environmental challenges by embracing a wide array of practices. This status must bring with it a signature commitment to ecosystem integrity, a disciplined approach to understanding the legacies and probable trajectories of ecosystems, and an appreciation of food security and human well-being. This may falter, however,

if an overly narrow version of restoration is adopted.

There is evidence of this narrow approach emerging. For example, the Land Degradation Neutrality (LDN) framework of the UNCCD has adopted a relatively restrictive definition of restoration, emphasizing “pre-existing biotic integrity, in terms of species composition and community structure...”. We argue that this characterization cedes too much to large-scale plantation forestry, revegetation, reclamation and rehabilitation approaches, which include little ambition for securing the ability of an ecosystem to support and maintain ecological processes and a diversity of organisms. Although these practices are useful in certain settings, they usually prioritize the realization of defined human expectations over ecological function and legacies. The restoration component of the LDN framework is based on SER’s international standards<sup>2</sup>, which focus on ‘substantial recovery’ of ‘appropriate local native reference ecosystems’. Under conditions of significant change, this stipulation will increasingly narrow the scope of restoration.

We urge professional organizations and governmental agencies, at all levels, to adopt restoration advice that embeds the capacity for practitioners and scientists to respond to ongoing and future change. Policy and operational guidance based on principles, guidelines and best practices suggest a path forward<sup>4</sup>. Broadly agreed principles would allow many more practices to be conducted within a restoration envelope, and still be anchored by strong ecological commitments and clear operational effectiveness<sup>5</sup>. We appreciate that the development of standards<sup>2</sup> — comparative measures, norms or prescriptions — can be a useful element of restoration advice in ecosystems that are well-known or smaller in scale. But

the fundamental changes described above contravene a one-size-fits-all approach. For standards to function well at any level there needs to be a much better-resolved scientific understanding of ecosystems, their natural dynamics and how they respond to change. As international and national organizations refine their policy advice, we encourage an open, flexible approach. □

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## Competing interests

The authors declare no competing financial interests.

## STRATEGIC ISSUES ARTICLE

# On principles and standards in ecological restoration

Eric Higgs<sup>1,2</sup> , Jim Harris<sup>3</sup>, Stephen Murphy<sup>4</sup>, Keith Bowers<sup>5</sup>, Richard Hobbs<sup>6</sup>, Willis Jenkins<sup>7</sup>, Jeremy Kidwell<sup>8</sup>, Nikita Lopoukhine<sup>9</sup>, Bethany Sollereder<sup>10</sup>, Katherine Suding<sup>11</sup>, Allen Thompson<sup>12</sup>, Steven Whisenant<sup>13</sup>

The Society for Ecological Restoration (SER) has long debated how to define best practices. We argue that a principles-first approach offers more flexibility for restoration practitioners than a standards-based approach, is consistent with the developmental stage of restoration, and functions more effectively at a global level. However, the solution is not as simple as arguing that one approach to professional practice is sufficient. Principles and standards can and do operate effectively together, but only if they are coordinated in a transparent and systematic way. Effective professional guidance results when standards anchored by principles function in a way that is contextual and evolving. Without that clear relation to principles, the tendency to promote performance standards may lead to a narrowing of restoration practice and reduction in the potential to resolve very difficult and diverse ecological and environmental challenges. We offer recommendations on how the evolving project of restoration policy by SER and other agencies and organizations can remain open and flexible.

**Key words:** codes of ethics, principles, professional practice, scope of restoration, standards

## Implications for Practice

- A flexible, open approach to restoration practice is required to address a rapid scaling up of restoration investment, climate change, human needs, scientific uncertainties, and locally appropriate innovations in practice.
- A principles-first approach exemplified in the Society for Ecological Restoration’s “Code of ethics” and “Ecological restoration in protected areas” offers flexible and adaptable models for professional practice in a wider variety of settings.
- An approach to professional practice based on performance standards may limit innovation and the reach of ecological restoration.
- Principles and standards can operate effectively together, but only if carefully coordinated and, generally, principles should precede standards.
- Performance standards can provide valuable advice for restoration practitioners, if underlain by clear principles and scientific evidence.

## Introduction

The long-held promise of ecological restoration becoming widespread and adopted by organizations at all levels is upon us (Aronson & Alexander 2013; Perring et al. 2015). In the last half-decade, international organizations have adopted restoration within their policies (Alexander et al. 2011) and international agreements have set ambitious restoration targets (Suding et al. 2015; Cowie et al. 2017). Of course, there is heightened activity in restoration at all levels and across all biomes; it is

truly a remarkable time for the often urgent tasks of helping recover damaged, degraded, or destroyed communities, ecosystems, and landscapes.

The Society for Ecological Restoration (SER) has introduced a succession of policies to guide practice. From discussions in the 1980s and 1990s about the definition of restoration through the *SER International Primer on Ecological Restoration* (SER 2004) and subsequent guidance including the *Code of ethics* (SER 2012), the joint World Commission on Protected

Author contributions: All contributors wrote and edited the article.

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Fortress restoration



Flexible restoration

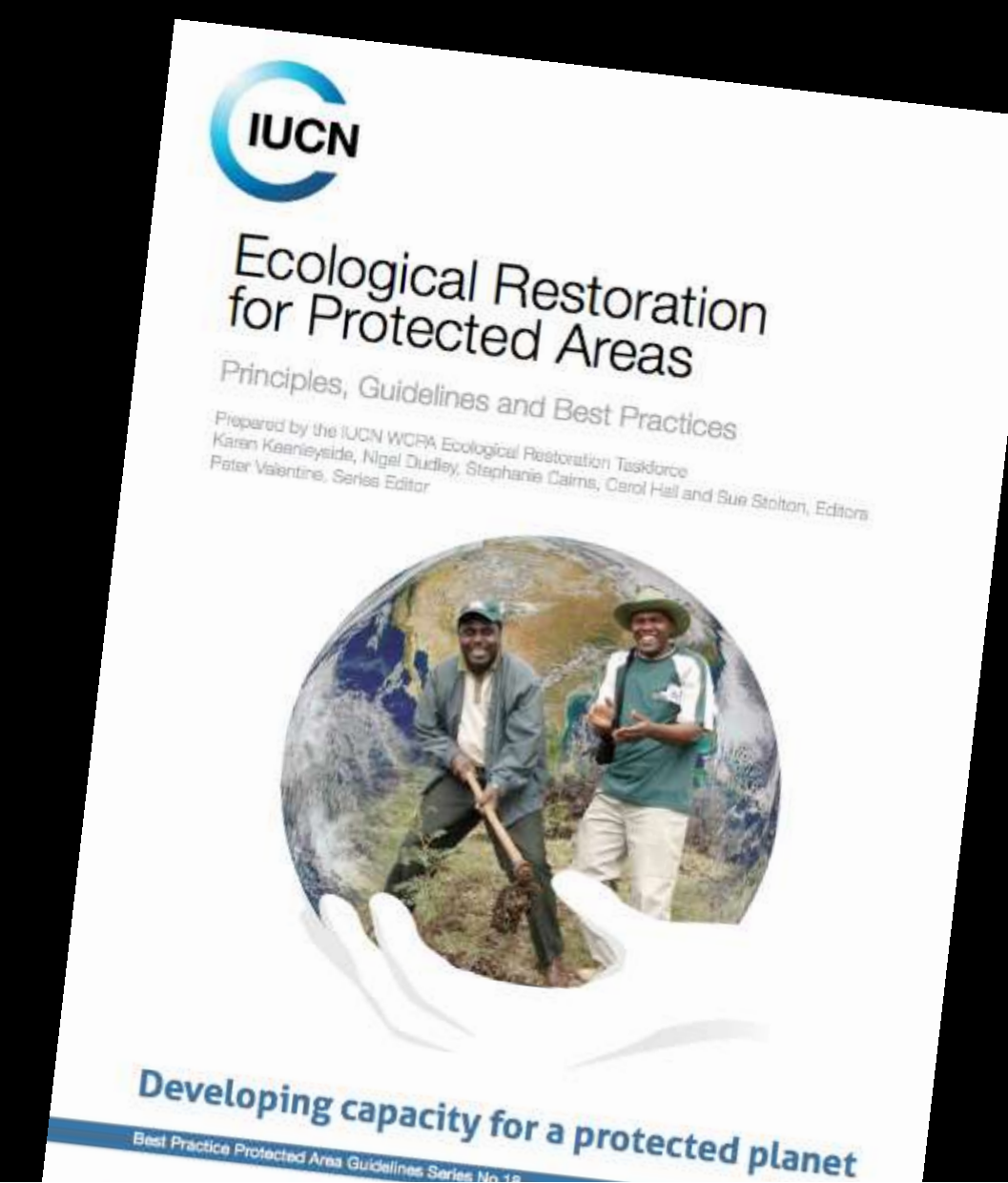




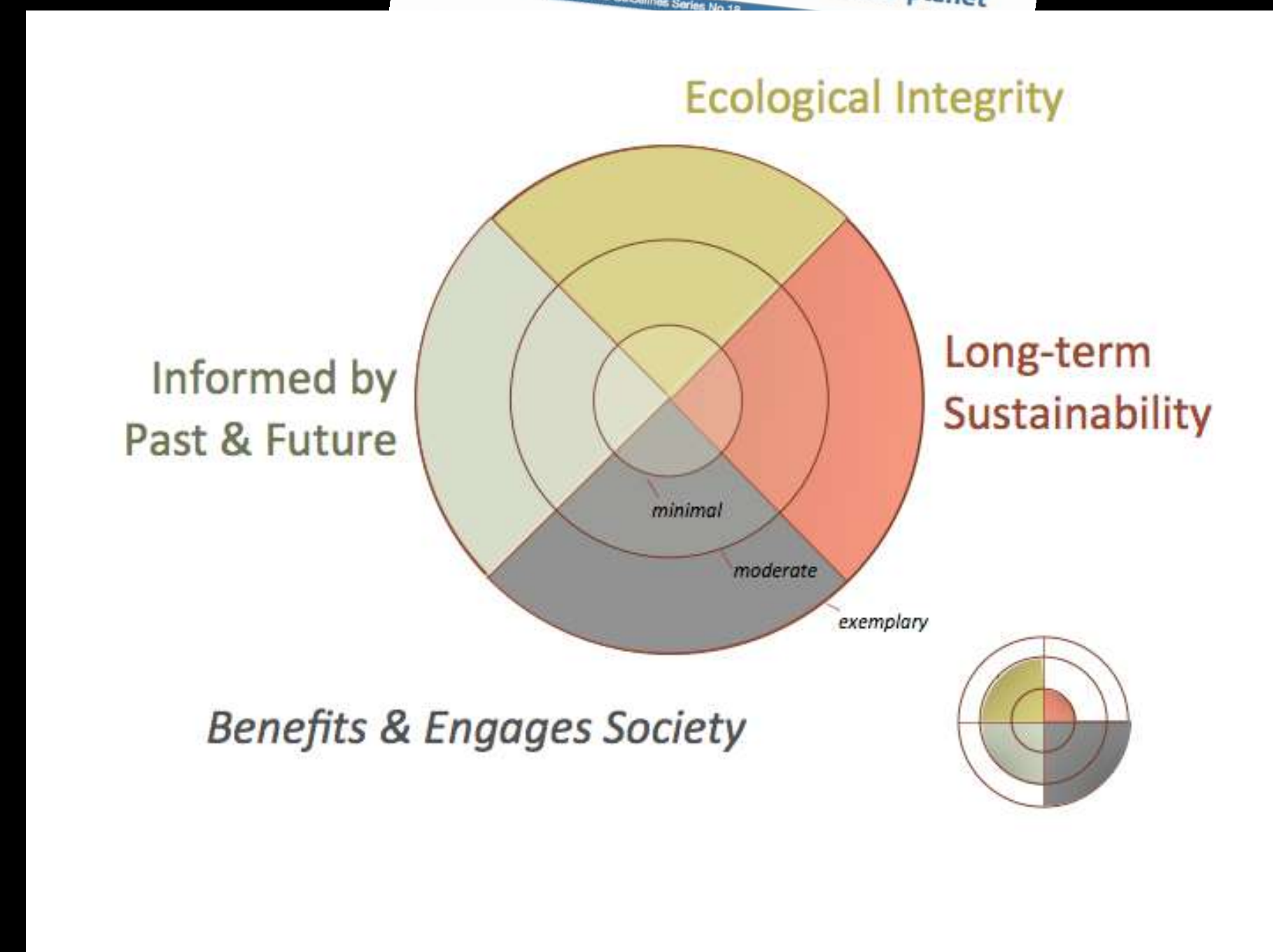
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IUCN: “effective, efficient, and engaging”



“Comprehensive ecological restoration”





WORKING TITLE:

# CHANGING NATURE

HUMAN AMBITION, BITTERSWEET LONGING, AND  
THE SEARCH FOR RECONCILIATION WITH NATURE



