

VIEWPOINT

Rewilding: A Call for Boosting Ecological Complexity in Conservation

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Biodiversity policy; land-use change; ecological cascades; megafauna; trophic downgrading.

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Abstract

Rewilding has emerged as an audacious conservation approach aiming at restoring wild species interactions and their regulation of ecosystem processes by focusing on the key role of species that have been extensively extirpated by humans. Rewilding has gained increasing attention from scientists, conservationists and the mass-media. Yet, it has raised highly divergent perspectives as to which ecological processes and species assemblages should be restored. Here we argue that a pragmatic and immediate approach to rewilding unequivocally focused on preserving and restoring the structural and functional complexity of ecosystems must become a primary component of biodiversity conservation. We propose a process-oriented formulation of the rewilding hypothesis as a general guide to assess the conservation benefits of reverting defaunation. Finally, we identify the need for a framework where the benefits, risks, and costs of rewilding can be evaluated in relation to restoration baselines and the intensity of interventions required to achieve conservation goals.

The influence of human activities on biodiversity composition and ecosystem processes is escalating, leading to a nearly ubiquitous domination of the terrestrial realm by humans. In response, conservation biologists are urged to propose innovative approaches, moving beyond the protection of well-preserved nature by also alleviating pressures and restoring biodiversity in degraded areas. Rewilding is one of these approaches that has gained both unconditional followers and contentious critics among the scientific community and the public. Soulé & Noss (1998) first referred to rewilding as the “restoration and protection of big wilderness and wide-ranging, large animals—particularly carnivores.” The proposal was based on the idea that recovering the ecological roles of large animals, which have been extensively extirpated by humans, is critical for restoring degraded ecosystems and their capacity to sustain a richer biodiversity. In recent years, evidence has been mounting that extinctions of

large-bodied animals result in major ecosystem shifts. For example, a variety of trophic cascading effects on food webs and ecosystem functions have been already documented for seven of the largest and best studied mammalian predator species, despite these effects being difficult to uncover, often requiring decades of study to become evident (Ripple *et al.* 2014). Large-bodied herbivores are similarly important to maintain the natural dynamics in ecosystems, regulating the vegetation structure and succession, the nutrient cycling, and fire regimes. Thus, it seems clear that an ambitious biodiversity conservation agenda should consider broad-scale efforts specifically targeted at restoring the ecological roles of megafauna. However, translating this idea into practice has raised divergent perspectives about what should be the subject of restoration, both in terms of ecological processes and the biodiversity components to be restored.

Rewilding implementation proposals range from passive management allowing population and community dynamics to reestablish themselves, to actions involving translocations, introductions of nonnative species as ecological replacements for extinct species, or even establishing analogues of megafauna communities that became extinct several millennia ago. Examples of these contrasting views include the advocacy for promoting natural ecological successions through precluding management actions in agricultural landscapes undergoing abandonment (e.g., in Europe, Pereira & Navarro 2015) versus the creation of novel species assemblages introducing alien megafauna to simulate the ecological conditions of the Pleistocene (e.g., in North America, Donlan *et al.* 2006). Such a diversity of perspectives has led opponents to rewilding to question its conceptual foundations as being based on a confusing concept with inconsistent conservation targets (e.g., Nogués-Bravo *et al.* 2016). Furthermore, it has been argued that rewilding can be harmful for biodiversity conservation because introducing novel species has uncertain and potentially disastrous consequences for native ecosystems. Thus, is rewilding a suitable framework for restoration planning in biodiversity conservation, or is it just a fuzzy and potentially risky idea with marginal connection to today's conservation needs?

We argue that a rewilding approach unequivocally focused on preserving and restoring the structural and functional complexity of degraded ecosystems must become a primary component of broad-scale and long-term visions for biodiversity conservation. However, we also believe that the debate on rewilding has been largely conditioned by an overemphasis on some of the most extreme propositions, while ignoring more pragmatic and immediate approaches. Rewilding pursues the goal of restoring wild species interactions and their regulation of key ecosystem processes including nutrient and energy flows, vegetation succession and disturbances, drawing specific attention to the key roles of large-bodied species that are especially sensitive to the human appropriation of landscapes. This objective is actually implicit in most formulations of rewilding, although different proposals—e.g., namely “trophic,” “translocation,” “Pleistocene,” “passive,” or “ecological” rewilding—differ in two fundamental aspects: the baseline used to decide which biodiversity components should be the subject of restoration, and the type of interventions required to achieve their objectives. Thus, the different views of rewilding can be essentially synthesized in a unifying framework defined by baselines and management intensities (Figure 1). The debate on rewilding needs to recognize that costs, ecological uncertainties, and conservation conflicts are closely linked to these two gradients, ranging from a relatively

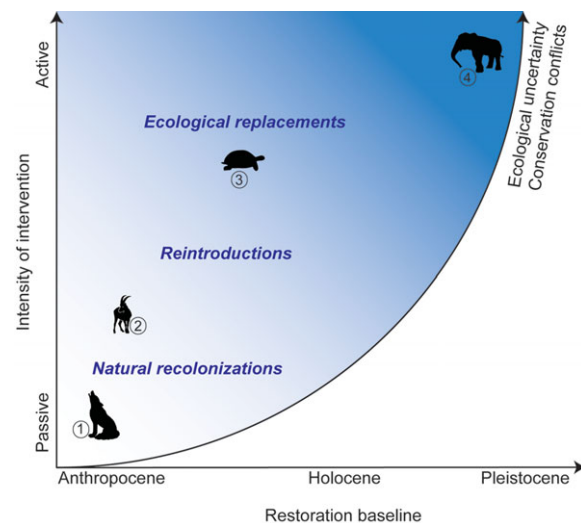


Figure 1 The different views of rewilding can be essentially synthesized in a unifying framework defined by restoration baselines and management intensity gradients. The examples are not exhaustive but meant to illustrate different cases of rewilding. (A) Natural recolonizations of large carnivores in Europe following conservation programs, legislations, and new availability of land. (B) Combinations of natural range expansion, translocations, and land abandonment that led to increases in the geographical distribution and abundance of the Iberian ibex (*Capra pyrenaica*) since the 1960s. (C) Restoring seed dispersal on islands with Aldabra tortoises (*Aldabrachelys gigantea*) in Mauritius to replace the giant *Cylindraspis* tortoise, a seed disperser gone extinct some 300 years ago. (D) Taxon substitution and introductions of alien megafauna for “Pleistocene rewilding.”

safer “proximate” area for self-reestablishment of recently degraded communities, to the high uncertainties and a large amount of resources required to create communities resembling those that went extinct millennia ago.

A pragmatic impulse of broad-scale rewilding should seize the many opportunities provided by policies, management strategies, and societal changes that can revert defaunation processes, and consider the following recommendations.

First, scientists must strengthen efforts to improve our understanding of the response of ecosystems to rewilding. We propose an unequivocally process-oriented formulation of the “rewilding hypothesis” as a general guidance: that the large-scale restoration of apex consumers and large herbivores promotes self-regulation in community assemblages, and increases the complexity of ecological processes in ecosystems. Despite the fact that many evidences have been collected showing the negative consequences of large-bodied species defaunation, the reverse (i.e., the restoration of ecosystem functions after these species return) has been less often assessed.

Second, natural rewilding processes should be promoted through proactive policies and management

measures aimed at reducing the interference of humans with natural recolonization processes. For instance, a wildlife comeback is currently being observed in Europe as a result of the implementation of legislation protecting biodiversity, reduced direct persecution, and land abandonment, which have favored the natural expansion of apex predators and large herbivores after centuries of regression including the brown bear, gray wolf, Eurasian lynx, European bison, and the Eurasian elk (Deinet *et al.* 2013). Millions of hectares of agricultural land are expected to continue to be abandoned in low-productive and sparsely populated areas within the next decades, providing opportunities to target extensive landscapes for promoting rewilding (Pereira & Navarro 2015). Furthermore, policies and practices should be developed in order to enforce the idea that rewilding is about reducing the human control on ecosystem processes. It must begin to include varied objectives to alleviate pressures on wildlife populations such as a full legal protection of large predators based on their unique ecological roles and not just depending on their conservation status; the eradication of predator control programs; or the elimination of game management practices such as wildlife fencing, introduction of alien game populations, supplementary feeding and others that profoundly alter the natural regulation and the genetic structure of large herbivore populations.

Third, it is important to recognize that rewilding is not a synonym of stunning introductions: translocations in rewilding need to be considered as a supporting tool rather than as a final goal, and should be primarily guided by the ecological roles of species in communities and ecosystems—i.e., being endangered or charismatic is just one of the several factors to be considered.

Rewilding is founded on solid ecological theory and stimulates an ambitious agenda for the recovery of more integral ecosystem processes. Furthermore, rewilding initiatives receive increasing mass-media coverage, elicit strong emotional values, and provide new opportunities for reconnecting people with nature. However, the future contribution of rewilding to biodiversity conservation will require refocusing discussions on which are the most cost-effective ways to extensively restore the ecological roles of megafauna while minimizing potential conservation conflicts and uncertainties.

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