

Novel ecosystems: concept or inconvenient reality? A response to Murcia *et al.*

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We are concerned by mischaracterizations, misrepresentations, and selective uses of evidence in a recent critical opinion of ‘the novel ecosystems concept’ [1]. Murcia *et al.* contend that the concept is poorly developed, has no evidence base, and has little management application and potential negative policy impacts. However, it is more accurate to observe that conceptual development is ongoing (as would be expected in a relatively new area of endeavor), empirical evidence is mounting, many managers find the ideas useful for framing what they observe on the ground, and negative policy impacts are feared rather than observed, despite the growing attention that novel ecosystems are receiving.

Murcia *et al.*'s mischaracterizations risk entrenching objections that fail to address urgent conservation and restoration needs in an era of rapid environmental, ecological, and cultural change. The concept of novel ecosystems, in its various formulations, is based on the fact of novel ecosystems: there is indisputable evidence that some ecosystems have departed entirely and irreversibly from their historical analogs (e.g., the recent examples in [2–4]). This (unfortunate) reality has led us, and other researchers and practitioners, to consider how traditional practices in conservation and restoration might adapt and whether new practices are required [5]. In particular, attention needs to be focused on intransigent ecosystems that are unresponsive to restorative measures because of directional changes in environmental conditions or have persistent assemblages of alien species for which removal is practically impossible. Some of these new ecosystems clearly have ecological and cultural value (e.g., [6]). These constitute increasingly difficult conservation and restoration conundrums for which new thinking is required. As noted elsewhere, recognizing the need to address these conundrums does not constitute a willingness to give up entirely on conventional methods [7,8].

Examples of hybrid and novel ecosystems are mounting rapidly in the ecological literature, and there are ongoing discussions regarding how to modify current management and policy to deal with the rapid changes being observed on the ground. The concept of novel ecosystems is finding traction with practitioners who wrestle with altered ecosystems on a daily basis. Decisions are almost always made

in the context of finances, human capacities, and other resources that are nowhere near sufficient to cope with the totality of the tasks at hand [9]. Everyone can agree that the ultimate solutions are to stop ongoing environmental change and degradation and to enable resource management and reparative action at a level concomitant with the task. We sincerely hope that the day will come when this happens. Meanwhile, practitioners need guidance to make difficult decisions on priorities and action in the face of ongoing change.

Murcia *et al.* misrepresent the intentions of those working with the novel ecosystem concept. That community neither advocates for novel ecosystems nor claims that novel ecosystems are the only targets worth contemplating for future action. This same community advocates dialog aimed at a principled, evidence-based exploration of science, practice, and policy to support responsible intervention in ecosystems undergoing relatively rapid change. The dialog arose from decades of enquiry and active engagement at all levels in ecological restoration, which offers much guidance on responsible intervention. For many ecosystems restoration remains a viable model and critical practice. This is why the concept of novel ecosystems embeds a dynamic interplay between historically continuous, hybrid, and novel ecosystems that allows a mix of traditional and emerging practices. Opinions differ on the relative representation of novel, hybrid, and historically continuous systems. However, choosing to deny the existence of any of these categories appears unwise. While novel ecosystems have received considerable attention, much action is to be found in hybrid ecosystems that form at the confluence of historical and novel forces.

Murcia *et al.* point out the problems of identifying thresholds, particularly those that might be ‘irreversible’. This question is not restricted to discussions on novel ecosystems but is a topic of ongoing empirical and theoretical research. Their point that barriers to restoration are frequently social and economic rather than strictly ecological is well made. However, these factors are rarely separable in practice. In some ecosystems, abiotic factors in particular are so altered that a return to a previous system is impossible (for instance, mining excavations and waste dumps, salinized wetlands, urban infrastructure). While it may be theoretically possible to intervene in virtually any other ecological situation, the sheer scale and amount of effort required is what constitutes the main barrier: the ecological condition is what drives the social and economic barriers to attempting restoration in some situations – especially where such actions have to be

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weighed against less costly interventions in other systems that have greater chances of success [10].

The significant ramifications of engaging with novel ecosystems – as fact and concept – have been clearly articulated elsewhere. Has identification and discussion of novel ecosystems inadvertently opened the floodgates to heedless human meddling, as Murcia *et al.* imply? We think not. Those who would transform ecosystems for human benefit have not been shy about doing so and certainly do not need a concept such as novel ecosystems to justify their actions. Indeed, continued retention of unrealistic restoration goals may feed into the ongoing destruction of good-condition ecosystems by allowing unachievable offset and mitigation targets to be traded for development [11].

Recalling earlier fears that restoration would dilute preservation and conservation efforts, history, it would seem, is repeating itself. Careful management of hybrid and novel ecosystems can add capacity and innovation to environmental management in the same way that restoration has. It can also open up a wider range of ecosystems for consideration, providing many opportunities for both ecological and social gains in urban and other developed areas where novel ecosystems are perhaps most prominent [12].

The question is thus not whether we should continue to discuss and research novel ecosystems, but whether the developing concepts and frameworks can assist with the process of better understanding, managing, and restoring ecosystems in a rapidly changing world. Murcia *et al.* highlight ([1], see Box 2) the ongoing empirical research needed on nonlinear dynamics and thresholds, resilience, and new paradigms to manage highly disturbed ecosystems – all features of the emerging body of work on novel ecosystems. While this research is continuing, the need for difficult management decisions remains. Embracing the

increasing prevalence of altered ecosystems (whether these are called hybrid, novel, emerging, or something else) does not involve throwing away all current efforts in conservation and restoration. Rather, it should allow more reasonable discussion of the options available, the likelihood of success of different degrees of intervention, and the priorities for action.

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