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# Developing a restoration narrative: A pathway towards system-wide healing and a restorative culture

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ABSTRACT

The current generation of Homo sapiens is paying the bill for the foolishness of, among other things, the *Ceteris paribus* assumption which postulates that natural capital is infinite and the quality thereof constant. The outcome is an unprecedented ecological overshoot as well as rapid and widespread degradation and fragmentation of both ecological and social systems. Despite their international commitments, few nations currently pay more than lip-service to invest in the widely acknowledged need ö from economic as well as ecological perspectives ö to invest more heavily to assist the restoration and recovery of degraded ecosystems almost everywhere. There is good evidence from eight recently published meta-analyses of ecological restoration work done at over 1 400 sites, that show that human societies clearly benefit economically from ecological restoration and allied activities. Perversely ö or predictably ö global society's indifference to or denial of this reality is short-sighted in the extreme, and flagrantly neglectful of future generations of all life on earth.

We argue that the disjunction between the required and actual investment in restoration is attributable, in part, to both the dysfunction of our political economies and the fact that essentially all human and ecological systems are 'wicked systems' (i.e. complex and complicated, simultaneously). This in turn leads to 'wicked problems' for anyone concerned with making ecological restoration a part of daily life for the next generation.

While rational, science-based observations, pilot studies, and modelling can help diagnose a wicked problem, and prescribe ways to launch and sustain large-scale and lasting ecological restoration and recovery of degraded ecosystems, this is patently not sufficient. Invariably people have varying beliefs about, and understanding of, the past, present, and future. This leads to ontological uncertainty when groups of disparate people try to work together on wicked problems, thanks to past conflict and trauma, and differing readings of what *has* happened, is happening, and *may* happen in the increasingly unknowable and unpredictable future. This uncertainty introduces risk in all human impacted systems. Scientists, especially those involved in ecological economics and ecological restoration, could help society cross this bridge of uncertainty towards a shared vision and action plan. Working together with people from varying inter-connected fields and disciplines, we call for greater use of structured dialogue, embedded within a restoration narrative, to nurture and promote a 'restorative culture'.

## 1. Introduction

Despite numerous wake-up calls in the past, such as the Club of Rome report (Meadows et al., 1972), the Millennium Ecosystem Assessment (2005), the Stern Report (2006), and TEEB (The Economics of Ecosystems and Biodiversity) (2010), among many others, society has not yet learned to recognise and adapt to the fact that the earth's intertwined resources are finite. As well-informed as we are about the ongoing ecocide we have launched, global society has not yet come to its senses. It seems clear enough that we must radically change direction, and adopt the system-wide changes that will reverse the trend of degradation and depletion that threaten our wellbeing and survival. Instead, we can and should help usher in an era of more resilience, more investment in restoration, and active societal transition to a more equitable, ecologically and economically sound and sustainable world economy and culture. This paper is offered in the hope that it will contribute to the efforts many institutions and organisations are making to change the way societies, corporations, and nations transform and

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exploit natural capital despite enormous inertia and resistance to be overcome.

As suggested above, our crowded world is now experiencing radical changes in the earth's ecosystems and climate, including ongoing degradation of lands (United Nations, 2019a, 2019b), and the oceans (United Nations, 2015) and generalised ecocide of enormous proportions (IPBES, 2019a, 2019b). The drivers and multiplier effects of ecological overshoot (McBain et al., 2017; cf. Global Footprint Network, 2019; IPBES, 2019a, 2019b) means that we are rapidly depleting the stocks of natural capital from which ecosystem goods and services flow. In other words, we are sawing off the metaphorical branch on which we are perched. By doing so we are *not* enhancing our welfare (World Bank, 2017); instead we are depleting the natural and cultural heritage we should be maintaining and stewarding for future generations.

Fortunately, there does seem to be a growing awareness of the enormity of the problems we face, and of the promise that investment in the ecological restoration of degraded systems can make a big difference in relatively short periods of time. As a result, the large-scale application of a "family" of restorative activities at landscape and larger spatial scales, has become increasingly possible (Aronson et al., 2017). Advances in conceptualisation, accounting, engineering, labwork (e.g. DNA metabarcoding from e-DNA and mass samples), and progress in policy arenas have helped, as has a string of highly significant UN treaties and conventions over the past decade and a half (see below).

However, here we speak to the system-wide tension between the current spiral of degradation we are living with and perpetuating it through inaction. Despite our growing population size and per capita consumption of resources, a transition to a restoration-inspired culture is possible in our lifetimes. We aim to outline what will be required to quickly scale up locally relevant restoration work to larger landscape and catchment scales, help sites and projects communicate among themselves and collaborate, and to make sure that the efforts last and grow over the long-term. We will do so by drawing from science and the best available restoration theories, models and practices on the one hand, and sound economics on the other. Moreover, we will discuss underlying paradigms and mind sets that need to be addressed if we are serious about redressing the ills of ecosystems and human systems simultaneously.

We begin with a brief discussion of the consequences of the foolishness of the *Ceteris paribus* assumption, and the inability of international treaties alone to jumpstart large scale restoration programmes. We ponder this in the light of overwhelming evidence that restoration does make economic sense in the medium- and long-terms. We conclude by offering some insights as to how scientists, restoration practitioners – both professionals and amateurs, social workers, community activists, the myriad relevant NGOs, and social health professionals could assist society to embark on a pathway of *system-wide healing*. With the aid of an example of a project underway in Rwanda, we argue that through structured dialogue around a coherent *restoration narrative* developed specifically for the area or country in question, it is possible to achieve rapid progress towards a restorative culture and to gradually resolve the wicked research problems (Rittel and Webber, 1973; Pacanowsky, 1995; Bueren et al., 2003; Andersson et al., 2014) we face (see Section 4 for further discussion of the term).

## 2. The foolishness of *Ceteris paribus*

Post-World War II economics can be called the era of *Ceteris paribus* economics. During this period scholarly economic thinking, both theoretical and applied, has been dominated by the notion of *Ceteris paribus*, a modern Latin phrase meaning "all other things being equal". In this context, "other things" refers to production factors other than labour and financial capital in the economic production function equation that is central to 20th century economics models. This powerful phrase, as commonly applied as a modelling convenience by economists, implies that *only* labour and capital have an impact on economic wellbeing and (perpetual) growth since the other factors of production are held constant through artificial means. This suggests that the recommendations made by economists using this modelling convenience to policy- and decision-makers alike are embedded within the notion of *Ceteris paribus* – that it is only capital and labour that has an impact on welfare. This reductionistic approach is highly detrimental and misleading as it reduces welfare enhancement to changes in only two factors of production.

Thanks to the *Ceteris paribus* assumption or – shall we say – artifice, which virtually all mainstream economists employ in their models, only labour and capital are studied, analysed and (through elaborate policy pirouettes) either treated *laissez-faire*, from a right-wing, free-markets worldview, or actively steered one way or another, from a more left-leaning interventionist worldview. Neither of these approaches adequately consider the impact of their policies – and their behaviour as economists – on the quality and the quantity of natural capital. What are some of the consequences of this convenient but catastrophic construct?

The *Ceteris paribus* assumption has led to a mindset of limitlessness where everything that can be imagined is possible. This blatant arrogance, or worse, combined with a liberal economics view of freedom of individual choice, has unequivocally contributed to the runaway growth of human per capita consumption, albeit unequally distributed, to levels unimagined a century ago. It is spiralling even further upward today, with no end in sight. As McBain et al. (2017: 13) argued, without the mitigation of human resource demand, our collective ecological overshoot will continue to increase in the foreseeable future, and continued global ecological overshoot in turn will intensify the risk of ecological collapse, as we fast approach at least two planetary boundaries (see Rockström et al., 2009; Steffen et al., 2015). How to transition society towards sustainability has been a recurrent theme since the 1970s, and yet we are still manifestly moving in the wrong direction. Elsewhere (Aronson et al., 2017, inter alia), we have described three kinds of divides that global society must overcome to reverse this trend; in Section 4.1 below, we provide more discussion of those obstacles as promised in the Abstract above. Rather than repeat ourselves, however, in this paper we introduce a strategy and toolset that have not been previously evoked.

The key question is: How can we change our societal trajectory before it is too late to make any meaningful difference? One way will be to proactively increase our restorative 'handprint' or handiwork on land, bodies of water, and degraded ecosystems and fragmented landscapes in general, *and* to do so on the basis of a coherent restorative narrative. As anyone who has attempted ecological restoration will know, this is only viable if an inclusive, participatory approach is adopted with as many local stakeholders as possible. Only in that way may we hope to create and maintain a value- and ethics-driven restorative culture. Globally, as described in the next section, there has been some recognition of the need for change and even some international progress towards change, through the UN, especially since 2012.

### 2.1. Recent UN actions and programmes

In 2012, the delegates at the eleventh Conference of the Parties (COP-11) of the UN Convention on Biological Diversity (CBD) adopted an historic resolution to support the Strategic Plan for Biodiversity 2011–2020 and, in conjunction with that decision, to implement the Aichi Biodiversity Targets (UNEP, 2012). Among these, Target 15 specifically named ecological restoration as a tool "contributing to climate change mitigation and adaptation and to combating desertification" (Convention on Biological Diversity, 2019). In the last seven years, several additional treaties and conventions have been concluded to help the global society move forward. However, what nations have achieved since 2012 has been disappointing (Secretariat of the Convention on Biological Diversity, 2014a, b). Yet on 1 March 2019,

the UN General Assembly ratified a decision declaring the UN Decade on Ecosystem Restoration, 2021–2030 (see United Nations, 2019a, 2019b). Both Cross et al. (2019) and Temperton et al. (2019) have provided useful commentaries on this momentous Declaration, and hopefully much more in-depth discussion and – above all, action – will follow. In addition, restoration can and likely will assist countries to achieve a variety of Sustainable Development Goals (SDGs). These include Goal 2 (To end hunger), Goal 3 (To ensure healthy lives), Goal 6 (regarding water), Goal 13 (regarding climate change), Goal 14 (regarding marine life and the oceans), and Goal 15 (regarding biodiversity and terrestrial restoration).

It is, we argue, urgent and imperative to begin a process of what we call system-wide repair and healing to halt and mitigate some of the consequences of the foolishness of *Ceteris paribus*. To paraphrase Einstein (1946), we can't solve the problems we have created without changing the mindset that created them. In this context, we note that while timely and promising, the Declaration on a Decade of Ecosystem Restoration could turn out to be hollow and meaningless, as many global UN treaties and brokered commitments in the past have proven to be. What is meant here by "to restore"? These and other basic questions that arise from a careful reading of the recent UN Declaration need resolution (Cross et al., 2019).

In Section 3, we focus on a particularly big part of the 'solution', namely ecological restoration, as defined by the Society for Ecological Restoration (SER, 2004) and tested, developed and refined over the past three decades. Notably, the concept of ecological restoration is being redefined as the calls for scaling up multiply, and funds become available for large-scale experiments and applications.

## 3. The economics of restoration

In recent years various recommendations and strategies have been put forward with respect to the scaling up of locally relevant and effective restoration at a global scale (e.g. Holl et al., 2003; Aronson et al., 2007; Blignaut et al., 2014a, b; Blignaut, 2017; Strassburg et al., 2017; Blignaut, 2019). We will not repeat the content of those pieces; instead we will expand on the subject of the restoration 'toolbox 'needed or, better still, the 'family of restorative activities' (Aronson et al., 2017) that will need to be deployed and coordinated in efforts to scale up from existing projects.

### 3.1. The various members in a 'family of restorative activities'

Scaling-up of the current restoration activities by orders of magnitude will require appropriate planning, adequate financing, coordination, consensus building, decision-making and modes of action, based on science and evidence-based best practices at all scales (e.g. Bayraktarov and Saunders, 2016; Nevill et al., 2016; cf. Table 1 below). After initial diagnostic and planning phases, what site managers and practitioners will need is a coherent suite of inter-related and coordinated activities that make sense and interact synergistically at landscape and catchment area scales, especially in cases where agricultural systems, urbanised areas, industrial zones, and other human-centric landscape units exist and will almost certainly persist for the foreseeable future. Aronson et al. (2017) have proposed the term 'family' of restorative activities, including remediation of contaminated sites, modified management of vegetation, lakes, rivers, catchments, agriscapes, urban and suburban landscapes, etc., and the closely related activities called ecological restoration and ecological rehabilitation (SER, 2004; Clewell and Aronson, 2013; see also Fig. 1). The overall goal is to maintain and replenish natural capital stocks, make ongoing human activities and land use more ecologically sound and sustainable, and promote shifts towards a restorative culture (Cross et al., 2019).

Profound paradigm shifts are needed to make all this work. In other words, it will require more than additional science and modified technology, more than attempts to modify consumer behaviour, and more than networking among people already engaged in ecological restoration science and practice. It will require changing the "rules" – statutes, incentives, disincentives, etc. – by which governments and businesses, invest in environmental issues and ecosystem management and respond to landowners and other stakeholders.

As shown in Fig. 1, these activities include the reduction of pollution and contamination, remediation of polluted sites, reparation and recuperation of degraded areas for purposes of production or other utilitarian values, initiation and facilitation of spontaneous regeneration, ecological rehabilitation of cultural systems, and the gradual ecological restoration of degraded but still 'natural' ecological systems. As one moves through this sequence and combines the suite of restorative activities at appropriate spatial scales, biodiversity, ecological functionality and resilience, and ecosystem services to people generally increase. Likewise, the supply and the value of natural capital stocks grow (Blignaut et al., 2013). However, not all these options are readily applicable or relevant at all sites or landscape units. In addition to analysing the potential for full rehabilitation or restoration, it is critical to plan for and combine all five of the activities in a coherent and spatially explicit fashion. In this way, we shall optimise the possibility for increases that bolster the needed paradigm shift in policy to move towards long-term economic and environmental sustainability, combined with societal and social-ecological resilience.

Note: For more discussion on and illustrations of this 'family' idea to help with scaling up of restorative activities, see Aronson et al. (2017) and Gann et al. (2019).

Note that ecological restoration aims to restore ecosystem structure, content, and functioning, *to the fullest extent possible*, typically in landscape units of obvious importance to people, for example forest or woodland sites in the upper watershed of a river system (Fig. 1, top landscape segment) and/or for endangered portions of biodiversity. In contrast, ecological rehabilitation (Fig. 1, second to top landscape segment) aims to render landscape units under management for permanent production systems more ecologically sound and sustainable. As in the case of ecological restoration work, ecological rehabilitation at its best attempts to consider a historically informed and relevant reference model to set priorities and guide decision-making (see SER, 2004; Gann et al., 2019). However, it aims only at *partial* recovery of biodiversity and concentrates instead on recovery of ecosystem functioning, in the specific social-ecological system context (Gann et al., in press).

But society, and specifically policymakers and planners want to know, does the restoration of degraded ecosystems provide good return on investment not only in ecological but also in economic and social terms? Does it make sense, and if so at what scales, to attempt to restore, or is the opportunity cost (i.e. the cost of forgone economic opportunities) too high? The same question arises with regards to ecological rehabilitation, as well as assisted spontaneous recovery and the other related components of a 'family of restorative activities (Fig. 1). These questions require a cost-benefit analysis, or similar assessments that are broader in scope than simple, monetary values, and societal acknowledgement that we do not live by money alone.

### 3.2. Restoration of natural capital: yes, it makes economic sense

Despite the plethora of restoration approaches and technical options available, our ability to assist or accelerate the recovery of biodiversity and functionality in any given type of degraded ecosystem remains far from perfect (Moreno-Mateos et al., 2012, 2017). Nonetheless, in the past thirty years, major strides in ecological restoration research and development, driven by exponentially larger investments, have been made, for example the revamped Great Green Wall project in the Sahel and Sahara region (Sacande and Berrahmouni, 2016) and the long-standing and expanding Working for Water programme in South Africa (Turpie et al., 2008; Crookes and Blignaut, 2019). This dynamic situation can be glimpsed through consideration of the major meta-

**Table 1**
Summary of the results from eight meta-analyses on ecological restoration and rehabilitation projects.

| | Sources | Ecosystem types covered | Main findings |
|---|---|---|---|
| 1 | Bayraktarov and Saunders (2016) | Marine and coastal systems: 235 studies with 954 observations from restoration or rehabilitation projects of coral reefs, sea grass meadows, mangroves forests, salt marshes, and oyster reefs worldwide. | Median and average costs of restoration of marine coastal ecosystems were ca. US$80,000/ha and US$1,600,000/ha, respectively. Restoration success depended on the ecosystem type, site selection, and techniques applied, rather than the budget allocated. |
| 2 | Neßhöver et al. (2011); de Groot et al. (2013) | Coral reefs, coastal systems, coastal wetlands, inland wetlands, lakes/rivers, tropical forest, temperate forests, woodland/shrubland, grasslands/rangelands: 225 case studies on the benefits of restoration and 91 on the costs thereof. | Coral reefs and coastal systems had lowest benefit–cost ratios of all restored ecosystem types studied (range 0.7–4.1). Woodland/shrubland and grassland/rangelands had highest ratios (range 4–130). Varying the assumptions, and assuming restoration is always imperfect, and that benefits will attain only 75% of the maximum value of the reference systems over 20 years, the benefit-cost ratios ranged from ca. 0.05:1 (coral reefs and coastal systems, worst-case scenario) to as much as 35:1 (grasslands, best-case scenario). |
| 3 | Elmqvist et al. (2015) | Urban ecosystems: evidence from 25 urban areas in the USA, Canada, and China. | Benefit-cost ratios range from 1.21–6.57, depending on the scenario used. |
| 4 | Moreno-Mateos et al. (2012) | Wetlands: analysis of 621 project sites from warm temperate and cold regions around the world. | No financial assessment done, but there were indications that after approximately 30 years of restoration, biological structure and biogeochemical functioning respectively remained 26% and 23% lower than pre-selected reference sites, even decades after work began. |
| 5 | Ren et al. (2016) | Grasslands: analysis of 70 grassland restoration and rehabilitation projects in China. | Grassland restoration efforts enhanced presence of indigenous biodiversity by 32.5%, and the supply of ecosystem services by 30.43%. After a mean of 10 years, grasslands undergoing restoration failed to reach the levels observed in non-degraded reference conditions for biodiversity levels and ecosystem services. |
| 6 | Rey Benayas et al. (2009) | Various ecosystem types: analysis of 89 published restoration projects worldwide. | Ecological restoration increased biodiversity components and provision of two ecosystem services by 44% and 25%, respectively. |
| 7 | Vermaat et al. (2015) | Rivers and floodplains: analysis of eight restoration projects in Europe. | Total ecosystem service value significantly increased in restored sites (difference €1 400 ± €600/ha/yr). |
| 8 | Crookes and Blignaut (2019) | Review of 37 restoration case studies in South Africa. | The mean opportunity cost of not restoring degraded ecosystems are between $27/ha/yr and $428/ha/yr depending on the ecosystem and the type and duration of restoration efforts carried out. When capitalised, the net loss of not restoring is 16 to 50 times greater than the annual values. |

analyses undertaken to date of the progress and achievements of specific restoration programmes across a broad range of ecosystem types.

In Table 1 we provide a summary of the results of eight such analyses covering 1401 restoration studies. Since there is no standard formula or format to communicate the costs and benefits of restoration, only three of the studies provide actual benefit:cost ratios. The society-wide benefits with respect to the values of a range of ecosystem services are implied even if not explicitly quantified. Furthermore, as a general observation, the usefulness of restoration is rarely, if ever, estimated inclusive of all benefits. In other words, the difficult to measure long-term benefits of restoration are mostly ignored, under-estimated or explicitly discounted, while the easily measured costs are accounted in full. In the cases where economic values are communicated, they reflect the marginal value or benefit of specific restoration projects.

Based on the summary provided in Table 1, we conclude that:

- Full recovery of native biodiversity and ecosystem functioning following restoration efforts in all ecosystem types studied thus far still eludes us and probably always will. Moreno-Mateos et al. (2017) call this discrepancy the 'recovery debt'. We would add – to make the point more compelling for the general audience – that there is no "ctrl-z" function, as in Windows, that allows us to immediately undo regretted actions. Thus, the transformation – and above all, the short-sighted degradation – of ecosystems and landscapes should be approached far more prudently and evaluated by policy-makers in very different ways than they have been in the past.
- There is a large and rapidly growing evidence base demonstrating that ecological restoration and ecological rehabilitation interventions often make positive and lasting contributions towards societal wellbeing and sustainability. In addition to their obvious ecological benefits, the social benefits include jobs, livelihood opportunities, and public health benefits, e.g. in southwestern Australia (Bradby et al., 2016), coastal Peru (Whaley et al., 2010) and South Africa

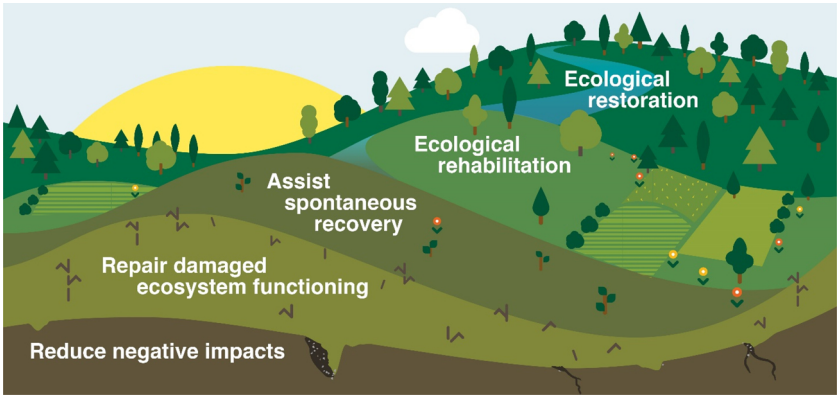


**Fig. 1.** A simplified representation of the possible spatial deployment of a family of restorative activities applied at a generic or schematic terrestrial landscape.

(Crookes and Blignaut, 2019).

- Restorative efforts are economically highly beneficial, giving positive benefit-cost ratios rarely seen in other investments. This is because of the multiple benefit streams derived from investments in maintaining biodiversity and ecosystem services through protection and restoration of natural capital (de Groot et al., 2013; Elmqvist et al., 2015).

Based on the evidence above, society benefits greatly from restoration, but restoration is a slow process and in general only leads to partial recovery. While essential, it thus cannot serve and must not be allowed to serve, as a 'get-out-of-jail-card' permitting ongoing degradation at the current scale and rate. Consequently, we must also restore our economic thinking and change societal paradigms. How can this be achieved? We turn to these interrelated goals next.

## 4. The restoration of economics

### 4.1. Wicked research problems

Economics deals primarily with the subject of scarcity and how to navigate between unlimited wants and limited means. One option would be to augment the supply of ecosystem goods and services given its obvious advantages to society – as indicated above, through restoration. Why, however, do we not see a rapid upscaling in restoration? Does the way we think of and engage with economics require some restoration of itself? Aronson et al. (2010) asked this question and they argued that this is because of a disconnect between our epistemological knowledge base – whatever specific ways of knowing we employ (see discussion of Episteme and epistemology *sensu* Goddard et al., 2019) – and our actions, as was highlighted in Section 2 above. They developed this idea further, arguing that three great divides must be bridged for this disconnect to be addressed. These divides are i) an ideological divide between economists and ecologists; ii) an economic development divide between the rich and the poor; and iii) an information divide, which obstructs communications among scientists, the general public, and policymakers. These authors also argued that the concept of restoration of natural capital can act as an important strategy to bridge these three divides since ecological restoration by definition and on a real-world evidence basis, must be conceived with cognisance of biophysical and ecological aspects of ecological and social-ecological systems, and everything that involves information, the economy, and policy in general.

Bridging these divides implies the successful handling of what are called wicked problems (Rittel and Webber, 1973; Pacanowsky, 1995; Bueren et al., 2003). Wicked problems (see Box 1) arise as a result of the simultaneous co-existence of both complexity and complicatedness in a system (Andersson et al., 2014). Complex systems comprise many spatially and temporally dynamic phenomena and their associated innate processes, such as a migrating school of fish, a herd of grazing cattle, pedestrian or automobile traffic in an urban setting, etc. They are globally characterised by innumerable elements of surprise, and non-linearity, with multiple feedback loops affecting the system's functioning and development. In contrast, complicated systems (*sensu* Andersson et al., 2014) are characterised by the high number of interconnected structural parts they have, often in fractal dimensions of intricacy. Astrophysics, microbiology, population genetics, and other aspects of the internal and interactive organisation of organisms and human cultural organisations qualify as "complicated".

It follows that when there is system-wide failure or major malfunctioning within a wicked system, we will find various kinds of system-wide messes such as global overshoot of carrying capacity, and ecosystem degradation in relation to structure, composition, and functioning. In human systems, social fragmentation, segregation, and revolution can be among the outcomes. In their seminal paper on wicked problems viewed from policy planners' perspectives, Rittel and Webber (1973:160) stated boldly that planning problems are wicked problems: "*A great many barriers keep us from perfecting such a planning/governing system* [as most planners desire]*: theory is inadequate for decent forecasting; our intelligence is insufficient to our tasks; plurality of objectives held by pluralities of politics makes it impossible to pursue unitary aims; and so on.*"

Wicked systems are therefore the breeding place for what we might call 'wicked research problems'. Research problems related to restoration often fall into this category because the restoration of natural capital deals with the undesirable side-effects, or externalities, of both human and ecological systems (Goodwin, 2019). Wicked problems are also particularly difficult to quantify, involve incommensurable values, and are characterised by extreme uncertainty. This might explain why:

- despite the overwhelming evidence of the benefits of restoration (Table 1),
- the growing proficiency of practitioners,
- much improved benefit-cost analyses – at least for some ecosystem types, and
- despite numerous international treaties and conventions calling for rapid upscaling of restoration to a global and international imperative for collective action, the real work being done in most countries is still entirely inadequate. Sadly, in many places it appears not even to be present on the policy-makers' radar screens (see Section 2).

### 4.2. Developing a restoration narrative and the restoration of economics

System-wide messes, such as the consequences of ecological overshoot and degradation in the pursuit of narrowly defined, *Ceteris paribus*-inflicted economic gains, can neither be solved as biophysical nor as economic problems alone. Instead, they must be faced and addressed as wicked research problems through processes that facilitate and celebrate dialogue within the respective social, economic and ecological contexts.

In other words, ecological restoration should be aligned and integrated with other efforts to overcome social injustice, to alleviate environmental damages, and in general to undo ecological and social harm done in the past to the greatest possible extent. Ecological restoration cannot be treated as a purely biophysical intervention (i.e. it is

**Box 1**
Wicked research problems: An overview

(modified from Batie, 2008: 1176).

Wicked research problem requires systems analysis to probe what are sometimes called social messes. These research problems are dynamically complex, ill-structured (devoid of a fixed and well-determined structure), and public in nature. Their causes and effects are difficult to identify and model. They are influenced by many volatile and unpredictable social and political factors along with innate biophysical complexities. Also, most wicked research problems are connected to, or are symptoms of, other problems. Indeed, a wicked research problem is generally not well understood until after formulation of a potential solution. Furthermore, because of their complex interdependences, wicked research problems are never fully solved. The conditions can, however, become better or worse as a result of interventions. Focus should thus be on ecosystem trajectories and not just states and transitions.


**Fig. 2.** The combined use of Western science, epistemological knowledge (of all relevant knowledge systems), past experiences (good and bad) and cultural values, as well as structured dialoguing using narrative logic and storytelling to reduce the stress and trauma associated with ontological uncertainty and risk while courageously and collectively fostering system-wide healing within a new restorative culture.

not a single *event* such as tree planting or the transplanting of coral reef fragments). Indeed, the dynamical complexity of the process is too great for that. Nor can it be treated as a simple problem for economic modelling; it is too complicated for that. Instead, it should be treated as a *process* of social, economic and ecological system-wide repair, and indeed healing, in which the people most concerned and affected must be able to engage with the process, and actively participate in a 'self-healing' process, at the population or community level. It is this process of active engagement in seeking and initiating system-wide repair that we refer to as developing a *restoration narrative*. This process will be very time and site-specific, as a function of the characteristics of the unique contextual circumstances. It serves to replace acrimony and despair with cooperation and hope. It tells the story that however bad the past was, we can effectively work together to repair, heal, and restore.

Inspired by the work of Andersson et al. (2014), we therefore propose that the development of opportunities for structured dialogue by promoting a narrative discourse with respect to restoration will help close the gaps in our understanding of the underlying problems. Moreover, it will help nurture and promote more appropriate means of remediation as well. Promoting the narrative discourse is founded upon the idea that the narrative is a basic and natural human process whereby humans, individually and collectively, seek to make meaning of their experiences, perceptions, problems and, presumably, the actions they take to address problems (Pam, 2013).

Research into wicked problems requires investigation of actors and objects, and the relationships among them. This is taking place in an increasingly fragmented world and it introduces more confusion about the future, our identity as to who we are as individuals, communities, and society at all scales, as well as trajectories for future development (economic and otherwise). Given the fact that wicked research problems originate from disfunction or malfunctioning *within* 'wicked systems', they cannot be managed – let alone solved – purely with epistemological knowledge, or any single way of knowing. This concept allows us to discuss the nature and difficulties of knowing in the contemporary world without being limited to one form (e.g. deductive reasoning)" (Goddard et al., this edition).

Indeed, even within a given culture or discipline, people are driven and inspired by collective beliefs and shared knowledge (doxa) – and individual or collective ways of knowing (epideme) *sensu* Goddard et al. (this edition). In cases of wicked research problems like ecological restoration problems in human-dominated landscapes and regions, where complicatedness and complexity can introduce huge uncertainty and controversy, it is crucial that different ways of knowing be clearly enunciated among people trying to address the problem together. This is necessary to help identify and resolve conflicts of interest that add to the difficulty when there is collective ontological uncertainty, not to say trauma, about the past, present and the future.

Because of these uncertainties the academic scientific, empirical, and deductive research techniques and mainstream Western epistemological knowledge may be inadequate to motivate even the most Westernised of human societies towards a robust plan of restorative action that everyone will willingly adhere to. This also helps explain why, despite the overwhelming evidence from mainstream, Western science and research of the need for and the benefits of restoration (as well as the suite of restoration options available), bold action and investment are still so woefully limited. What's more, confusion about what constitutes ecological restoration and what does not, is still prominent in most parts of the world. Furthermore, there are a myriad of knowledge systems to include in these discussions, a.k.a., epistemologies, arising from different civilizations. All these obstacles suggest that the use of alternative techniques of communication and mutual exploration of problems and potential responses are needed, such as structured dialoguing (Lane and Maxfield, 2005; Leach et al., 2010; James and Morel, 2018).

People, even while considering the same epistemological knowledge base, will have different mental pictures of the future due to a myriad of past experiences, trust and mistrust, understanding and confusion, abuse and misuse, as well as differing culture and value systems (see Fig. 2). This leads to widespread ontological uncertainty (uncertainty about what defines reality), metaphysically and otherwise, of our past, present, and future. Among other things, this uncertainty, with associated severe stress and anxiety – trauma even – leads to a much shorter planning horizon (thus higher discount rates) and a much narrower view of the future focussing on self-preservation. A process of dialoguing can help find the most important pressure points in the society, thus creating the possibility of system change through self-organisation and the discovery of widely held goals and values (Meadows, 1999). While the elimination of risk and uncertainty is not possible, through dialogue and improved collective understanding of what the human, economic, and ecological systems require, a jointly defined vision of the future will assist in the development of mutual trust and working together to achieve those goals.

### 4.3. Embracing the narrative: an application and new frontier

Using the narrative implies the expression of a simple yet very important story. Each agent or actor expresses their perception of the past and the need for change. The narrative articulates and ideally culminates in a collective vision for the desired future based on shared values of the local populations. One way to help people of disparate backgrounds and mindsets to arrive at such a collective vision is to engage together in the formulation of an ecosystem of reference at least partially based on historical components of cultural and natural heritage (Balaguer et al., 2014). This process can help orient restoration work, reconcile differing priorities, and mitigate the impact of possible histories of inequality and segregation among stakeholders (see Aronson et al., 2017). This vision necessitates that we embark on a course of

repairing and healing. It includes the possibility that this repair process can rebuild social capital and replace despair with hope. The system-wide healing is based on a vision for the future for a community, society, or nation, that must consider and decide on a social, economic, and ecological trajectory for the future. This implies that where there was hurt among people, healing is required. Where there was economic injustice, restitution is required. Ecological restoration outside of social and economic healing and a restorative vision for the future will be at best a project-by-project patchwork, and not durable. If not embedded in a broader process of system-wide healing, and structured dialogue, restoration will be stripped of any internal momentum. In contrast, if it is integrated in a paradigm, or culture, of system-wide healing and restoration, then the upscaling will follow naturally from the public will for betterment of local people's own conditions and a pathway towards recovery and self-repair at the systems level.

The narrative envisioned here therefore combines the epistemological and the ontological. Practically this implies the need to develop a process of dialogue whereby people can be assisted to self-organise, set goals for the ecosystem restoration and repair process, and then to take ownership of such a process and of the land-use management plan it requires. This dialogue must address all the institutional organisational and structural aspects of the restoration, and the required behavioural changes and management practices to ensure that the impact and the benefits from the restoration are durable and resilient. It also implies considering the use of financial instruments such as easements and other financial incentives to assist in fast-tracking and upscaling restoration (Blignaut, 2019). The dialogue is thus centred around the restoration package.

The central role of a restoration narrative poses a challenge for ecologist and economist alike since structured dialoguing does not sit comfortably either with complexity science or system-based theoretical discourses. Yet, that is precisely where the scientific discourse must venture over the next 30 years, including people from all the relevant disciplines and practices. The restoration of economics includes the need to embrace dialogue, specifically a narrative of restoration, to advance a culture of restoration. In the process, society's norms, values, decisions, and choices, will change favourably towards restoration and healing, to address scarcity – the root economic problem. We turn to one example where dialogue was effectively applied to spark and help nourish a culture of restoration, which, in turn, affected thoughts and actions, economic or otherwise.

A brief example can help illustrate these points. At the time of writing (April to August, 2019), the people of Rwanda are recalling the genocide that occurred exactly 25 years ago. That was a time during which approximately 1 million people were brutally slaughtered in just 100 days, mostly with machetes. Despite this horrific recent holocaust the government has sought healing and launched a new programme of landscape-scale restoration and reintegration as part of that process – which is an element of Vision 2050, the Government's long term development vision, developed through a consultative process (Government of Rwanda, 2011).

Since the genocide, Rwanda commenced actively with a process of social healing including community-based activities called *Umuganda* (http://www.rgb.rw/governance-innovations/umuganda/). Every last Saturday of the month, the country pulls together and embarks on various coordinated community and public activities. Over the years, this has garnered a cultural healing process embedded within functional relationships among all spheres of government, civil society, and communities. As a result, Rwanda has created a unique contractual and institutional model that allows the direct contracting of communities, collectively and without the need of a legal entity, to enhance community participation (Law Governing Public Procurement, N° 62/2018 of 25/08/2018, Article 27: Community Participation). The culture of seeking healing collectively and the institutional framework provided, allowed for the development of an economic and financial instrument through a Payments for Ecosystem Services (PES) pilot project (W4GR (Water for Growth Rwanda), 2018a, 2018b).

One of the painful scars of the genocide and subsequent economic collapse of the country is severe and widespread ecological degradation. This has had devastating impacts on human lives, wellbeing and health, and the health of the ecosystems in which people live and on which they depend (Government of Rwanda, 2011, 2018; Lange et al., 2018). To an outsider (namely the first author of this paper), the setting of immediate resource use boundaries clearly looked like an ecological imperative, but socially and politically impossible without whole system changes. Clearly, a radical process of system change was needed whereby it would be recognised that i) restoration is an economic development concern, ii) all people and sectors, not just the land owners, are responsible for shouldering the cost of restoration, and iii) landowners are best suited for the restoration task themselves. In this view, restoration is regarded as a national security imperative (W4GR (Water for Growth Rwanda), 2018a, 2018b). To give practical meaning to this proposed system-wide change, a PES scheme was designed based on the integration of the following factors:

1 A systems-based causal-loop diagram connecting the drivers of degradation with the consequences thereof based on the principles of ecological economics;
2 In-depth development of a suite of restoration interventions at the micro-catchment level (varying between approximately 400 and 1 000 ha in size) based on the best available science;
3 A process of structured dialoguing facilitating the need for and design of the restoration plan in full conjunction with and participation of the local citizenry;
4 The development of a restoration financing scheme and institutional mechanism through which local landowners (suppliers of ecosystem goods and services) are compensated directly for land-use change and the implementation and maintenance of the restoration plan (see point 2 above); and
5 A plan to engage private, public, civil and international sectors in the process of system-wide healing through institutional change. This change allows all economic sectors to contribute to restoration and thus reduce the national security risk ecological degradation is having on the entire country.

This proposed solution is therefore a blend between i) what is required from an ecological restoration perspective, ii) a systems analysis of the ecological economic context, iii) a process of structured dialoguing and iv) the design of a financial incentive mechanism, despite its deficiencies, embedded in systemic and institutional change that will facilitate behavioural and mental change among all role players in society. It brings together people from various backgrounds, cultures and professional backgrounds, as well as the local communities and all spheres of government. Not only are they being brought together, this process necessitates a structured dialogue with respect to what is required in terms of restoration, why it is needed, and where, what, and when things should be done. Moreover, the landowners themselves, not outside contractors, have been given the necessary capacity to implement the restoration.

On 21 March 2019, the above-mentioned PES scheme was launched in pilot form in four micro-catchments. Once these pilot projects have matured, the aim is to upscale to a nation-wide programme of action. Ecological restoration is thus not seen as a stand-alone activity but as an integral part of system-wide healing, that is the healing of social relationships, of the economy and the fostering of a well-functioning set of inter-connected ecosystems at the national scale.

## 5. Conclusion

As noted at the outset of this paper, the current human generation is paying the bill for the foolishness of the *Ceteris paribus* assumption of the past decades which suggests that natural capital is infinite and the

quality thereof constant. The outcome is an unprecedented ecological overshoot, widespread degradation of ecosystems on land and at sea, and unbridled ecosystem transformation with not a care given to the long-term cost in terms of natural capital and the flow of ecosystem goods and services. Notwithstanding their international commitments, with few exceptions, governments invest little more than lip-service to the need for active interventions to assist the restoration and recovery of degraded ecosystems. But this must change in the coming 30 years. As noted above, compelling evidence from 1 401 published accounts of economic assessments of ecological restoration and rehabilitation work around the world strongly suggests that human society benefits greatly from restoration. What would it look like in, say, 2050 if a real restoration culture emerged, based on a collective will and changes to policies and rules based on the awareness of the limits to growth, and the need for a rapid transition to sustainability?

The necessary tools to accomplish this transition already exist; the challenge it is hardly a technical one. There is knowledge and know-how for the application of a large family of restorative actions that can be custom-made to suit a very wide spectrum of sites with widely varying contexts and requirements (see Gann et al., in press, and references therein). The challenge is one of willpower – and the structured channelling of that will to allow people from all walks of life to engage with the dialogue required to facilitate this transition to sustainability. A proposed way forward is that scientists, notably ecological economists, ecological engineers, and restoration ecologists who have a good fundamental understanding of systems-based processes and feedback-loops, collaborate actively so that they can effectively assist in the development of a restoration narrative and the facilitation of this process wherever communities, cities, regions, or nations are committed to taking profound change away from Business as Usual, and move instead towards a Restorative culture and a Planet in Repair (Blignaut et al., 2014a,b). The application of structured dialogue to foster a culture of restoration will, however, be case and context dependent, even though the principles are, arguably, universal.

This can be done by through a process of structured dialoguing involving public administrators, and scientists and practitioners of public health, restoration, infrastructure development/engineering, finance and ecology, to name but a few fields. How often were those studying the human dimensions of restoration other than economics ever in close collaboration and conversation with economists, ecologists or engineers? Not often enough (Blignaut et al., 2011).

The scars of ecological degradation reflect a *Ceteris paribus*-embracing mindset. To heal the land, the seas, and our biosphere unquestionably requires the healing of people as a *sine qua non*. From Aotearoa/New Zealand, to Alberta, Canada, from Patagonia to the far north of Eurasia, we are one world and we need to practice *malama honua* – a Hawaiian saying (understood Pacific Ocean-wide) meaning "Care for our Island Earth" (PVS, 2019). Over the next 30 years, ecological economics, ecological engineering, ecological restoration, and supporting disciplines and professions must work together, synergistically, to blaze the trails and build the pathways of system-wide healing, nurtured by the restoration narratives of an emerging restoration culture.

## Declaration of Competing Interest

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