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Provocative Idea:

Landscape Loopholes: Moments for Change

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Abstract

Social-ecological systems are breaking down at local, regional, and global scales, and sustainability seems an increasingly distant aspiration. Social harmony and economic systems are connected to ecological systems and climate, in multiple complex ways, at many scales. Adapting research practice to match integration opportunities within social-ecological systems could contribute foresight capabilities emerging from landscape change studies, which can be coupled with emerging policy transformation opportunities. The shaping of landscapes by human imagination and physical action creates meaningful contexts for building sustainability. However, the policy landscape is often dominated by circularity and "lock-in" to unsustainable pathways that are hard to escape. Moments for change emerge through timely convergence of circumstances, within a landscape context, that provide a window of opportunity—a "landscape loophole"—through which the transformation to more sustainable social-ecological relationships might be achieved. Creating future options redundancy (FOR) plans, a variety of possible pathways and alternative landscape futures within the characteristics and capacity of a region, could facilitate policy shifts and adaptive capacity, and reduce risk through reflexive future options. The convergence of circumstances providing loophole opportunities to escape existing lock-in might be understood, and even predicted, by closely coupling landscape sciences and policy research.

Index Terms: transdisciplinary policy research; social-ecological systems; landscape context; landscape futures; policy lock-in; policy landscape; sustainability transformation

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1. Interaction Within Social-Ecological Systems & Opportunities for Transformation

The urgency for societal shifts towards sustainability is growing. Across local to global interactions of social-ecological systems, humanity faces rapidly accelerating pressures from faltering ecosystem functions, environmental degradation, climate change, and social breakdown. Articles in scientific and public media are increasingly bringing attention to the urgency of sustainability challenges. They highlight the urgent need for policy relevant, interdisciplinary research, advocacy, and application, and the requirement to go beyond incremental change to serious transformation (Rockström, 2015). The sustainability challenges of coupled human-nature relationships (Liu et al., 2015) require holistic, integrated research and policy responses to develop robust options in adaptive capacity for transformations into the future (Costanza, Fioramonti, & Kubiszewski, 2016; Dittrich, Wreford, & Moran, 2016). Few authors however, propose forward looking suggestions for real action, or insights into the kinds of strategic agency required to facilitate sustainability transformations; that is, a change of direction away from unsustainable trajectories (Brunckhorst, 2010, 2015; Diamond, 2005). Perhaps this is due to the complexity of context, in that action and strategic agency must occur in contexts that make sense for the social-ecological systems (Ban et al., 2013). This is where the multi-scale term *landscape* can be a valuable integration tool when discussing transformation of unsustainable trajectories in social-ecological systems.

Landscapes internalise many of the interactions within ecosystem and social elements. Environmental history reflects human-nature interactions in the coevolution of human institutions and landscapes over time. Change is constant along with newly emerging social-ecological conditions. Emergent conditions of interaction within social-ecological systems are often at the heart of sustainability issues and may involve interactions of fast and slow moving variables, feedback, threshold effects, and re-organising transformations (Liu et al., 2015; Suding, Gross, & Houseman, 2004; Westley et al., 2011).

Understanding both the characteristics and the circumstances of change in social-ecological systems will help identify *leverage points* where transformations in social-ecological systems might more easily allow shifts towards sustainable futures. The concept of anticipatory landscape governance refocuses multi-level policy and decision making on spatial contexts that reflect present to future scales of internalisation of interdependencies and social-ecological relations; that is, between socially constructed spaces and the ecosystem function and the changing conditions of places (Brunckhorst, 2005, 2015; Morley & Brunckhorst, 2010; Shearer et al., 2006; Steinitz et al., 2003). Social and ecological research needs to become more seamlessly integrated with policy development in order to design and evaluate the range of alternative sustainable futures.

Due to near and far coupling of cause and effect interdependencies of social-ecological systems, progressive failures in policy and governance systems are increasingly reflected in crashes of natural resource stocks and essential services that ecosystems provide, such as clean air and fresh water (Liu et al., 2015). Social-ecological system collapses occur even when there are symptoms giving prior warning (Diamond, 2005). Nevertheless, learning and change often appear to be very hard in human dominated systems. Policy arenas inclusive of science and government are often locked into policies "going no-where" (Gismondi & Cannon, 2012; Perry, 2015), while narrow partisan approaches, single command-control decrees, and policy circularity lead to no action (Gunderson, Holling, & Light, 1995; Kingdon, 2003; Quiggin, 2012). Such fixed policy landscapes are like inescapable and inflexible legal contracts. Loopholes in these systems need to be identified to escape the "lock-in" headed for unsustainable futures. While system breakdown and crisis points are increasing, there are nevertheless, examples of successful and timely transformation, especially within well-defined landscapes. Retrospective scrutiny often reveals the circumstances that arose at a point in history permitting the advance of a technological, social, or policy "breakthrough" (Brunckhorst 2005; Diamond, 2005; Meckling, Kelsey, Biber, & Zysman, 2015; Shannon, 2004). We need to develop *foresight capabilities* to identify, in advance, the gathering circumstances creating forthcoming opportunities for transformation in social-ecological systems towards sustainable futures (Brunckhorst & Trammell, 2016). Transdisciplinary science is fundamental to wise intervention, while socio-environmental sciences are important for informing action. Landscape concepts and sciences contribute both medium and method for synthesis (Brunckhorst, 2005; Nassauer, 2012, 2015).

2. Social and Ecological Landscapes

Landscapes are co-constructed by society and the biophysical environment. Not surprisingly, landscapes are valued through human perceptions, and evolve through closely interdependent human-nature relationships. Landscape change reflects the evolving coupled responses of environment and institutions (Brunckhorst, 2010; Liu et al., 2015; Nassauer, 2012). These social-ecological system interactions and responses to feedback create a "sense of place" attachment and sustenance to local communities at one level, and environmental degradation and global climate change at multiple other levels. The theatre of social-ecological system interactions often plays out via relationships of human actors with ecosystems and governance at landscape scales (Brunckhorst & Trammell 2016). Our use of landscape refers particularly to the geographical meaning of social-ecologically defined contexts in space, time, and organisational configuration (e.g., cultural landscape, bioregion, eco-civic region: Brunckhorst, Coop, & Reeve, 2006), including "spaces" with a sense of place, identity, or attachment conferred and experienced by local residents (Brunckhorst, 2010; Williams, 2014). Such spatial contexts often possess other institutional meanings as well, such as policy landscape, political landscape, and economic landscape (Ascher, 2007; Brunckhorst, 2015; Kingdon, 2003; Schindler & Hilborn, 2015; Shannon, 2004). There are also emerging examples of socio-political landscape change, such as green industry coalitions building influence, together with changing circumstances of economics and citizens, to provide plausible loopholes through which to escape the present carbon lock-in of many nations (Foxton & Pearson, 2008; Meckling et al. 2015).

Head and Xiang (2016) highlight the need for policy responses to *wicked problems* that are well grounded in understanding context-dependence, including the context produced by social-ecological interactions. Emergent properties and self-organising capacities of human-nature interactions generate both a particular "setting," the human-environment landscape context, and the circumstances permitting adaptive change (Ahearn, 2011; Brunckhorst, 2010, 2015; Nassauer, 2012; Nassauer & Corry, 2004). Reflecting the context and characteristics of social-ecological systems, transformations are non-linear, complexly linked, and flexible to information and monitoring across space, time and (re)organisation (Lui et al., 2015; Westley et al., 2011). Management scientists now identify organisational change and leadership as complex-adaptive processes from which, in the right circumstances and despite uncertainty, positive transformation can emerge (Dittrich, Wreford, & Moran, 2016; Gismondi & Cannon, 2012; Lichtenstein & Plowman, 2009).

Social-ecological systems possess recombinant and self-organising capacities. Through the timely confluence of the context and circumstances of the social-ecological systems, an unfolding backdrop of conditions and plausible pathways amenable to, and capable of, transformation are created (Westley et al., 2011). This social-institutional "space" primed for re-organisation, has been called a *fitness landscape* (Osborn & Hunt, 2007). The moment of emergence of the transformational opportunity is what we consider a "landscape loophole."

3. Emergence of Future Options and Loopholes

Recognising the nested scales of organisational interactions within social-ecological systems, particularly diversity, complexity, connectivity, and redundancy, is critically important in actually realising adaptive capabilities and subsequently, the emergent conditions for transformations towards sustainability (Osborn & Hunt, 2007; Ostrom & Cox, 2010). Numerous studies of ecosystems and landscapes have shown that the greater the diversity of system elements and their connections, the greater will be the number of possible options and paths for reorganisation (Ahern, 2011; Lui et al., 2015; Seidl, 2014). This is also true of policy in terms of consideration of a diversity of options and interconnectivity of multiple policy and management pathways, as opposed to single focus and policy lock-in (Kingdon, 2003; Lichtenstein & Plowman, 2009; Sabatier & Weible, 2014). Portfolio concepts for managing risk through diversification can also be applied to responses to change in social-ecological systems (Schindler et al., 2015); for example, having multiple flexible policy options and pathways on-hand. Having a diversity of potential responses increases the likelihood of sustaining social and ecological processes under new or changing environmental conditions (Ahern, 2011; Schindler, Armstrong, & Reed, 2015). Additionally, a diversity of available social-ecological system responses can allow for redundancy, with multiple pathways to alternative sustainable futures and therefore adaptive capacity. Over time, the connectivity and network attributes of social-ecological systems facilitate a higher level of transformation redundancy, providing multiple credible directions and pathways towards future sustainability. We refer to this capability as "future options redundancy" (FOR)—a key element for timely, reflexive adaptation (Brunckhorst & Trammell, 2016). In practice, FOR planning identifies a variety of possible pathways and alternative

landscape futures within the characteristics and capacity of a particular regional social-ecological system.

A further type of redundancy of a complex and diverse social-ecological system portfolio might be regarded as the capacity and wisdom (through understanding feedback and residuals) of the social-institutional system to enumerate ideas for facilitating transitions across thresholds, towards preferred near and far futures (Figure 1). Transformation risks can be minimised by integrating "future options redundancy knowledge" (FORK) with anticipatory action (Brunckhorst & Trammell, 2016). Such pro-active responses maximise the use of interdisciplinary data integration and "learning by doing" through monitoring, feedback, redundancy, connectivity and policy flexibility (Ascher, 2007; Schindler & Hilborn, 2015; Seidl, 2014). Even when the benefits of an anticipatory pathway and action are clear, it is often difficult to push through a threshold of economic or social-political resistance (Kingdon, 2003; Quiggin, 2012; Sabatier & Weible, 2014). Novel approaches will be required that anticipate facilitation and flexibility, so having (previously deliberated) procedures and future options ready for implementation when context and circumstances shift to a "window of opportunity" can make the shift in social-ecological systems achievable (Brunckhorst, 2005, 2015; Seidl, 2014; Westley et al., 2011).

Public policy focused interdisciplinary sustainability sciences can inform society of the preferred options, directions, and pathways towards sustainable adaptable futures (Costanza et al., 2016; Ostrom & Cox, 2010; Schindler & Hilborn, 2015). Change is a continuous process. An integrated, interdisciplinary approach assumes change and manages for uncertainty and adaptive potential (Perry, 2015; Schindler, Armstrong, & Reed, 2015). Such integration, cognisant of inevitable change and uncertainty, directs policy makers to what they have previously failed to learn from the complex interdependencies within social-ecological systems and facilitate a move towards adaptive action. Schindler and Hilborn (2015) observed that environmental management will always operate with uncertainty and recommended that policy should embrace flexibility, being informed by examination of models using a wide range of information to develop and compare plausible alternative future scenarios. They concluded, "The best management and conservation plans will likely be those that can harness unexpected opportunities" (Schindler & Hilborn 2015, p. 954). Transformation risks and uncertainty can be minimised by anticipatory action that maximises the use of interdisciplinary knowledge and "learning by doing" through monitoring, feedback, redundancy, connectivity, and policy flexibility (Head & Xiang, 2016; Seidl, 2014; Westley et al., 2011).

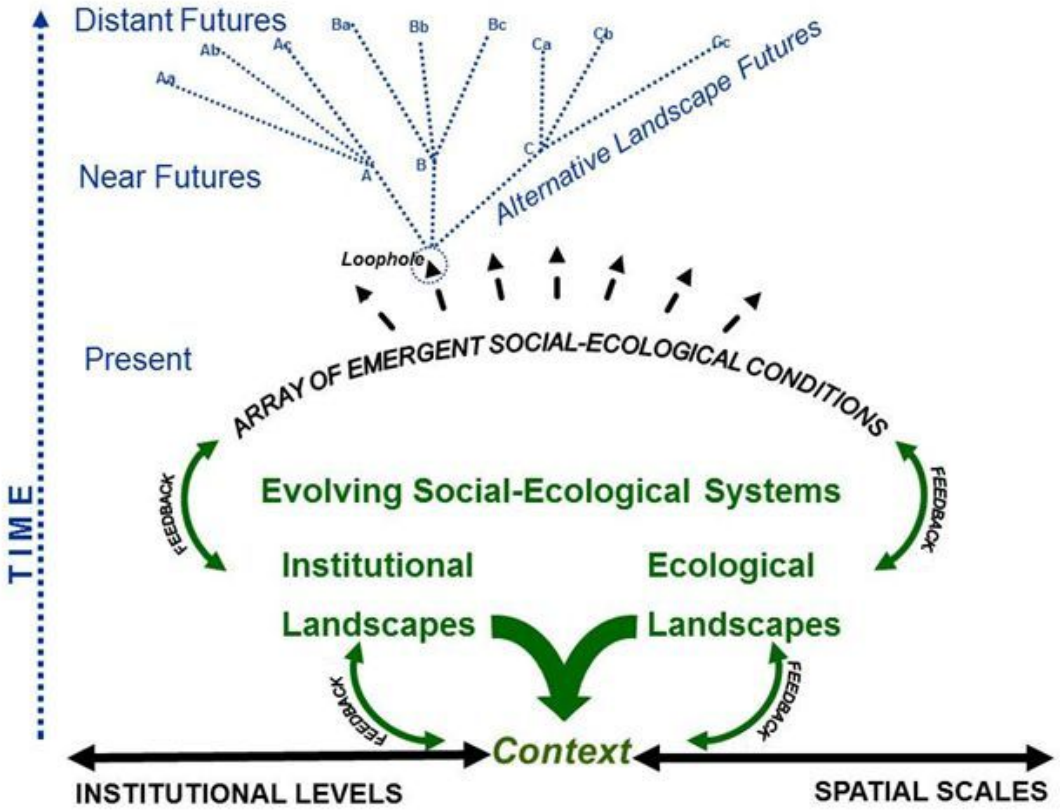

Figure 1. Emerging conditions and future options for social-ecological systems. Interactions within social-ecological systems provide re-organising potential for present and future conditions, and possibilities. Feedback and residuals of co-evolving social, institutional, and ecosystem elements create meaningful spaces (i.e., "context") and circumstances through which sustainability transformations might be anticipated and facilitated. Understanding "alternative landscape futures" (ALF) can help comprehension of adaptive policy options and pathways to implementation through emergent opportunities. The moments for change will emerge through context, circumstances, and timing that provide a "window of opportunity"—a landscape loophole, through which transformations to more sustainable futures might be achieved.

Using a wide range of social, economic and environmental information in spatial format provides for more explicit and meaningful scenario planning of regional landscapes (Nassauer & Corry, 2004; Steiner & Shearer, 2016). Such geographically based, multi-scale landscape approaches provide clearer tracking of the change pathways in social-ecological systems. These are valuable tools for understanding unexpected opportunities emerging from current trajectories of change. Such approaches provide capacity to design and test where alternative novel designs, pathways, and policies might lead in the future (Figure 1). Landscape design and scenario analysis collectively considered as "Geodesign" continues to grow in power, relevance, and application potential (Steiner & Shearer, 2016). Alternative landscape futures (ALF) scenario analysis techniques provide potent integration, synthesis, and analysis methods to assess and visualise opportunities and impacts of policy and community preferences influencing linked social and

ecological processes and change (Nassauer, 2012; Nassauer & Corry, 2004; Shearer, 2005; Trammell, Thomas, Mouat, Korbulic, & Bassett, 2017). ALF scenarios can be designed, and potential impacts of a variety of policies examined together (Hulse, Branscomb, & Payne, 2004; Kempenaar, Westerink, van Lierop, Brinkhuijsen, & van den Brink, 2016; Shearer et al., 2006; Steinitz et al., 2003). When examined within a geographical information system, social, economic, and ecological information can be integrated and scaled to social-ecological landscape contexts of relevance to communities, ecosystem services, and policy and planning (Bryan, Crossman, King, & Meyer, 2011; Hulse et al., 2004; Morley & Brunckhorst, 2010; Nassauer 2012). Landscape futures research examines context-relevant, data-rich, and spatially-explicit change pressures of likely "trend" (often related to policy lock-in) and alternative landscape future scenarios directly applicable to policy and planning at multiple scales of space and time (Bryan et al., 2011; Morley et al., 2012; Shearer, 2005). ALF scenario studies incorporate analysis of *knowable uncertainties* and impacts in space and time. Coupled with knowledge of an emerging political and organisational *fitness landscape* (Osborn & Hunt, 2007), ALF research is a valuable tool to navigate sustainability transitions towards preferred futures (Morley et al., 2012; Nassauer, 2015; Schindler & Hilborn, 2015; Steinitz et al., 2003).

These policy pertinent methods will be increasingly important for society to develop scaled, contextually relevant, adaptation tools that advance the acquisition of reflexive capabilities to anticipate, facilitate, and implement transformative action. Optimal transformation moments will occur when social-ecological context and circumstances merge, providing the "landscape loophole" through which transformation might begin (Figure 1). Understanding various alternative options for multiple futures can provide the redundancy required for flexible adaptation, and policy adjustments, over longer periods of time and change—what we call future options redundancy (FOR). Knowledge (i.e., future options redundancy knowledge [FORK]) of trending circumstances and future adaptive options is essential for successful transformation. It is a worthy challenge for transdisciplinary policy research and integration. In summary, we propose five key ideas:

1. Inflexibility of policy processes to change, limits shifts towards sustainable futures.
2. Integration of landscape sciences and policy research provides transformative capacity.
3. Context and circumstances emerge from the interactions within social-ecological systems.
4. Merging of context and circumstances create "windows of opportunity" or "moments for change" (i.e., when change can be achieved).
5. Understanding landscape loopholes and examination of multiple future landscape options can provide the foresight capabilities to achieve adaptive change across different scales of space and time.

4. Conclusions

Enduring ecological, social, and economic sustainability requires an integrated understanding of not just the complex interactions within social-ecological systems, but of emerging properties to use in adapting to change pressures—the essence of resilience. Landscapes internalise and reflect complex human-nature processes and interdependencies through emerging and evolving patterns in space and time that, in turn, reflect background processes of adaptive re-organisation. In hindsight, we can often see the various circumstances that arose at a point in time that allowed the advance of a technological, social, or policy "breakthrough." Alternative landscape futures (ALF) research can design, identify, and assess multiple plausible options for context-relevant social-ecological landscapes. We need to develop foresight capabilities to identify, in advance, the directional signposts along with accumulating circumstances that will create future opportunities for social-ecological systems (re)organisation towards sustainable futures and away from "locked-in" trajectories headed for unsustainable, fragile futures. Understanding multiple future options provides future options redundancy (FOR) and therefore adaptive policy options that build reflexive capacity. Flexible, previously deliberated pathways and future options, ready for implementation, would be a valuable transformation tool when context and circumstances shift to make the social-ecological shift achievable. The moments for change will emerge through context, circumstances, and timing that provide a "window of opportunity"—a landscape loophole—through which transformations to more sustainable social-ecological relationships might be achieved. Closely unified policy research is required to develop foresight capabilities to understand in advance, the converging circumstances and context producing the moment for change.

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